

URBAN MOBILITY

INDIAN AND INTERNATIONAL ACTIVITIES



METRO NEWSLETTERS 105-108; January 2021

Gathered by Dr. F. A. Wingler

METRO NEWSLETTERS

Transport Technologies for “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN, INTERURBAN AND REGIONAL PASSENGER TRANSIT TECHNOLOGIES FOR URBAN MOBILITY AS A SERVICE WITH METRO-BUS, BUS RAPID TRANSIT, URBAN RAIL, LIGHT-RAIL, LIGHT METRO, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, COMMUTER-RAIL, MONO-RAIL, AERIAL ROPEWAY, BOTTOM CABELLINER, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER, POD CAR, SUSPENDED MONO-RAIL METRINO

THE WORLD OF TRANSPORT TECHNOLOGIES AND ECONOMICAL DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT



Low/Middle Speed M. Bögl MAGLEV Train on the Way from Munich, Germany to China

METRO 105, July 2020
METRO Newsletter by Dr. F.A. Wingler

Synopsis/Highlights:

The implementation of Data based and driven tools (Sensor- & Monitoring-Technologies, Building Information Modelling, Internet of Things, Artificial Intelligence, Digital Twins, Data Analytics and Communication Technologies) have already entered the **WORLD OF URBAN RAIL** (Metro Rail, Regional Rapid Transit Light Rail Transit) and of **RAILWAYS**, so also in India.

Bombardier acquires the contract to supply 210 Semi-High Speed Passenger Trains for India's National Capital Region Transport.

The "MAKE IN INDIA" production of Metro Rail Train-Sets has become a success story.

Hydrogen Fuel Propulsion for Transport Vehicles is worldwide on the rise.

The Max Bögle Low/Medium Speed Maglev for urban and regional public Transport will be implemented the first time in China.

The future of electric propulsion for Urban Rail could be with linear motor.

Headlines of Newsletter METRO 105:

I. Indian Activities and Initiatives

- Advancing Digital Workflows for Asset Performance Modelling of Transit Systems – Nagpur Metro Asset Information Management System.
- Metro Coaches – A Make in India Success Story.
- Larsen & Toubro wins Doha Metro Automation and Control Contract.
- Bombardier acquires Contract to supply 210 Passenger Trains for India's National Capital Region Transport Co. (NCRTC).
- Pre-Construction Activity starts on Delhi–Alwar RRTS Corridor.
- Status of Metro Rail Projects in India as on April 9th, 2020.

II. Global Activities and Initiatives

- Critical Communication Solutions for Transport.
- Get smart with Digital Twins.
- Implementation of BIM Methodology.
- Bentley Systems: OpenRail Designer - from Planning to Performance.
- Driving Rail Operational Efficiencies with Connected Ecosystem.
- Alstom and Energy Infrastructure Operator SNAM have signed an Agreement for the Development of Hydrogen Trains in Italy.
- Hyundai Rotem to enter Hydrogen Train Market with a Hydrogen powered Light Rail Vehicle.
- Max Bögl Low/Medium Speed Maglev flies from Germany to China.
- Urban Transport Industry News Round-Up I, II&III.
- Myanmar to start Yangon Sky Train Project in 2020.
- Bangkok Gold Line People-Mover Car delivered.
- Chengdu prepares to open two 140 kmph Express Metro Lines.
- Linear-Motor Subways: The Future of Urban Mass Transit.

PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

Advancing Digital Workflows for Asset Performance Modelling of Transit Systems – Nagpur Metro Asset Information Management System, India

Nagpur Metro Asset Information Management System

*Maharashtra Metro Rail Corporation Ltd.
Nagpur, Maharashtra, India*

Maharashtra Metro Rail Corporation Ltd. (Maha Metro) India, deployed a **Digital Project Management System**, developed through Bentley's OpenRail Connected Data Environment (CDE), which covers planning to performance stages of the project. The tool stores all digital models and multi-discipline data from several users in geographically distant locations.

The project is due for completion as per proposed timeline on December 2019 and has resulted in saving an estimated USD 15 million! Not just that, the clash detection utilities have been able to identify and resolve multiple concerns during design and conceptualization, resulting in saving an additional USD 60,000!

Digital Project Management for project lifecycle

Maha Metro Asset Information Management System

Sunil Mathur, Director –Rolling Stock & Systems, Maharashtra Metro Rail Corporation Limited



महाराष्ट्र मेट्रो

I work as director rolling stock and system for Maharashtra



Digital Project Management : Uniqueness @ Maha Metro

- 3D BIM
- 4D : Time
- 5D :Cost
- 6D : Asset Information for Handover
- Project Management
- Asset Management



which we call [? it ?]
asset information, which

ADVANCING DIGITAL WORKFLOWS FOR ASSET PERFORMANCE MODELING OF TRANSIT SYSTEMS

Asset Information Management System

2018 Year in Infrastructure
Special Recognition Award Winner

we have also linked all these drawings, et cetera,

INFRASTRUCTURE

Bentley Institute



ADVANCING DIGITAL WORKFLOWS FOR ASSET PERFORMANCE MODELING OF TRANSIT SYSTEMS

How Bentley tools helped

- Helped in planning and Design phases
 - Establish Common Data Environment
 - Interfacing & Clash detection
 - Progress visibility & Constructability assessment
 - All stakeholder collaboration & Co-ordination
- Virtual models / assets allow to interrogate, simulate, visualize and run the physical assets on day to day basis
- Practical way to navigate rather than traditional bundle of folders and files.
- Bentley's i-Model is our final deliverable / As built model
- Assets and documentation interrelationship help change management in O&M



as to how we approach
progressing the work.

**2018 Year in Infrastructure
Special Recognition Award Winner**

INFRASTRUCTURE



Project Summary

Project

Nagpur, the second capital of the state of Maharashtra, is experiencing a surge in economic activity and city growth, prompting a boom in infrastructure development. Increased traffic on city roads, and a public transportation system only constituting 10 percent of all travel in the city of Nagpur, has significantly impacted this financial upswing. Most commuters use motorized two-wheeled vehicles, resulting in traffic congestion, pollution, and accidents. Maharashtra Metro Rail Corporation Ltd. (Maha Metro) was hired to create a safe, dependable, commuter-friendly, and environmentally-sustainable rapid public transport system for the Nagpur metropolitan region. Expected to be completed by December 2019, Nagpur Metro is a 41.7-kilometer railway project, which includes 40 stations and two depots, divided into two corridors: North - South and East – West.

Solution

Maha Metro deployed a **Digital Project Management System**, developed through Bentley's OpenRail Connected Data Environment (CDE), which includes the combined capabilities of ProjectWise and AssetWise and covers planning to performance stages of the asset lifecycle. Maha Metro's OpenRail CDE is customized for multiple users and incorporates documents and drawings from the organization itself as well as data from external consultants and contractors within its supply chain. As part of Maha Metro's digital project management system, the organization is developing its Asset Information Management System as a synchronized arrangement for effective operations and maintenance. Combining documents, engineering and maintenance data, plus 3D models from disparate sources, the system is being used during construction to link all the project information via a tagging system for its assets. Following completion, these deliverables will be stored and maintained as source of trusted information that forms the basis upon which decisions will be made during the operation and ongoing maintenance of the railway's infrastructure.

Outcome

Using OpenRail Designer (formerly Power Rail Track) during the project delivery phase enabled the team to optimize depot design by shortening the track length by 6 kilometers and halving the bay line length to 80 meters, resulting in a savings of USD 15 million. In addition to a further anticipated savings of USD 400,000 through the avoidance of data loss throughout the process, Maha Metro used clash detection capabilities within OpenRail to identify and resolve issues during the design phase prior to construction, avoiding costly rework estimated to cost USD 60,000. During the operational phase, Maha Metro's asset management solution will help extend the useful life of its assets, enhance performance, conserve energy, ensure the safety of the traveling public, and ultimately lead to a reduction of accidents on its roads. By ensuring this trusted information remains current and accessible, the system enables strategic decision making, establishing condition-based monitoring and progressing toward predictive maintenance strategies. As a result of these benefits, reliable railway operations are estimated to save at least USD 222 million over 25 years.

Software

Bentley Software is being used to establish a connected data environment in the planning and design phases, storing the digital models and assets in a central location, and to establish an asset management system. Maha Metro's implementation of Bentley's OpenRail solution uses iModels as the final delivery model due to its ability to provide the organization with reliable, long-lasting asset models for reference. Within the OpenRail CDE, AssetWise is configured to record all data spanning every lifecycle stage, with asset tags used to link Bentley applications with other software. This interoperability allows documents and asset information to be linked to **3D Models**.

Data Acquisition for Urban Transport Solutions; India



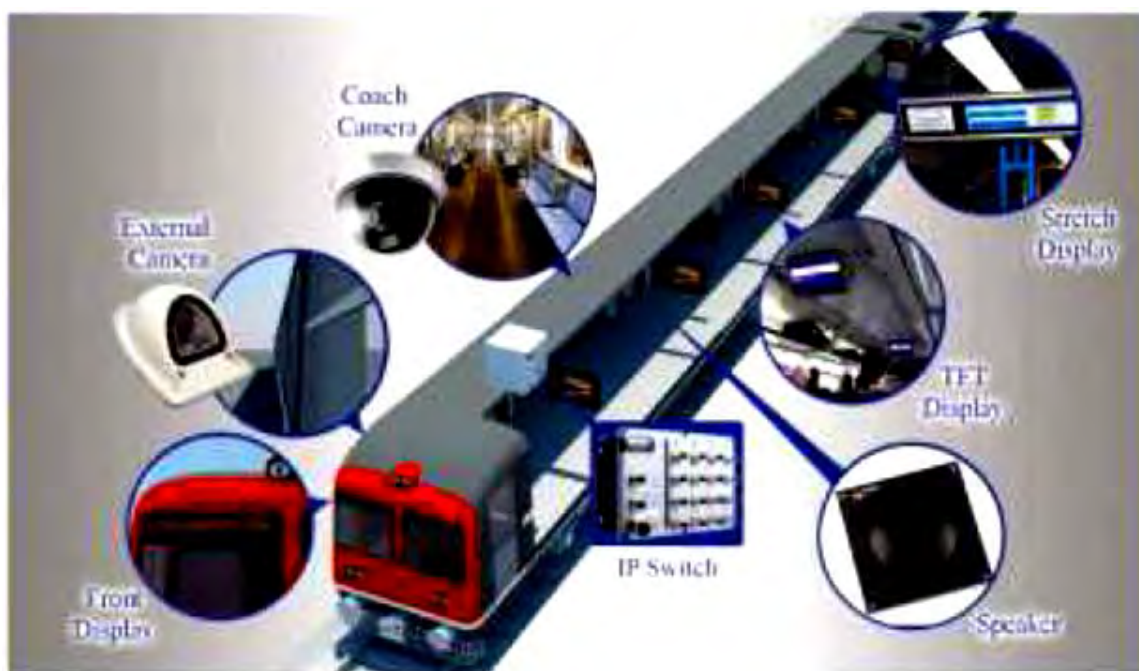
For the rapid growing mobility the country has been moving for accelerated development of urban public transport solutions in cities.

Data acquisition is the method of signals sampling, which hold physical conditions of real-world and transforming the resulting samples into digital numeric conditions, that can be manipulated via computer.

The components of data acquisition systems combine Sensors, which is used to convert physical parameters into electrical signals. Signal conditioning circuitry which is used to change sensor signals in a method that can be turned into digital values.

Analog-to-digital converters are used to change conditioned sensor signals to digital values. This Control device works as a sensor, that is basically a transducer, which is a device, that turns a physical property into a corresponding electrical signal. All the Metro's are implemented this device to take a record of their commuters. This record helps to keep pace with the rapid expansion of the metro network and growing security scenario along with enhancing the facilities at Metro Stations. With the constant development of society in recent years, metro traffic has been getting significant development and application.

Audio & Display System



The Audio and Display system provides visual and audio broadcasting of computerized route-related information and advertisements. This automated information and display system is help in providing real time route related information about the location status of inside the Metro Rail service or at the metro stations via visible, sound or other media. These are also known as Customer Information Systems. This system indicates the direction of travel, real-time dynamic area of the train, at the present Metro station, next coming station along with other relevant information such as what is the frequency of next train or the number of coaches in the train. This technology helps those people who are differently abled and want to travel by metro.

Metro Coaches – A Make in India Success Story; India

Published by: Industrial Automation, June 2020

When the first line of Delhi Metro was inaugurated in 2002, the coaches were imported as CBUs (Completely Built Units) from Germany and South Korea. 16 years later, 90% of the coaches running on the 8 lines of the over 300 km network of the country's largest and the world's 9th longest Metro network is made in India. This indigenisation of Metro coaches was facilitated by the contract conditions of DMRC, which mandated a cap on the upper limit of 25 per cent for production abroad with the balance to be manufactured in India. This in turn brought in global manufacturers like Bombardier and Alstom to form their subsidiaries and joint ventures in the country.

According to the International Association of Public Transport (UITP), a non-profit advocacy organisation for public transport authorities and operators, policy decision-makers, scientific institutes and the public transport supply and service industry, the capital costs of Metro coaches manufactured in India are substantially lower than the rest of the world. UITP estimates put the capital cost of a coach manufactured in India around INR 89.4 million (US \$ 1.35 million), which is lower than the cost in Vancouver (US \$ 2.5 million) and San Francisco (US \$ 2.30 million).

Three Metro coach manufacturing units are already in operation in India: Bombardier Transportation at Savli near Vadodara; Alstom Transport India at Sricity near Chennai (Tamil Nadu) and Bharat Earth Movers Limited (BEML), Bengaluru. There are also other players forming consortiums with one or more of these three companies with other technology partners like Hitachi, Mitsubishi, Hyundai and a couple of Chinese companies. Bombardier Transportation



BOMBARDIER MOVIA Delhi Metro Train-Set

Bombardier has been a supplier to Indian Railways for over three decades and established the Metro Coach manufacturing facility at Savli in 2008. The company is actively collaborating in the Make in India program by delivering rail vehicles, products and solutions that are developed locally, for both Indian and foreign markets. Apart from being a major supplier to Delhi Metro to which it has supplied 776 coaches till date, Bombardier

has also started exports of Metro rail coaches to Australia and components to Brazil, Australia and Saudi Arabia. Apart from the Savli facility, the company has a transportation engineering services centre at Gurgaon. Bombardier's India unit got its first export order in 2012 for supply of components for trains in Adelaide and has since supplied components and railway coaches for projects in Victoria, and Queensland in Australia, Sao Paulo in Brazil, and Riyadh in Saudi Arabia. It is also providing engineering services for its parent's projects in Germany, Switzerland, China and UK.

Bombardier has also supplied advanced rail control for the new, automated Delhi Metro Line 7, which is a major milestone as this is a fully automated line for running driverless trains in future. All four phases of Line 7, or the Pink Line, which have opened during the last 14 months, are equipped with the Bombardier Cityflo 650 communications-based train control solution to support safe and reliable automatic train operations. Cityflo 650 uses modern radio networks and moving block operation to provide centralised train supervision.



ALSTOM METROPOLIS Train build in India for Sydney Metro Australia

In December 2018 Alstom achieved a significant milestone by completing the export of the last of the 22 Metropolis trains for Sydney Metro, delivered from its Sricity facility.

In 2014, Alstom won a contract to deliver 22 six-car trainsets, as well as the CBTC signalling system, for North West Rail Link, Australia's largest public transport project and first fully-automated Metro network. Alstom's engineering hub in Bengaluru adapted the Metropolis and Urbalis solutions to the specific needs of Sydney Metro to ensure fast, safe and reliable services to the residents of Sydney.

Having begun production in 2014, Sricity has already set high standards for quality and operational safety through excellence in innovation and sustainable manufacturing practices. With an annual production capacity of 240 cars, the site has delivered coaches for the cities of Chennai, Kochi and Lucknow. It will begin work on its second export order for the light Metro project in Montreal from early 2019 while production for Mumbai Metro Line 3 will also begin next year. The on-time delivery of the trainsets for Sydney establishes Alstom's Sricity site as the one of the group's global manufacturing centres of excellence for rolling stock.

Recently, Alstom has also been awarded a contract by Mumbai Metro Rail Corporation Limited (MMRCL) to supply a CBTC signalling for Line 3 of the Mumbai Metro. The contract, which builds on rolling stock and power supply contracts won earlier for the same line, is worth over € 100 million.

Alstom will equip Line 3 with Urbalis 400, its latest generation of CBTC signalling technology. The scope of the contract includes unmanned train operation (UTO), computer-based interlocking and centralised train supervision, platform screen doors, as well as the electrical and mechanical supervisory control and data acquisition system (E&M SCADA).



Bangalore Metro Train-Set build by BEML

BEML Limited's Rail Coach Factory situated in Bangalore, India is the first all steel integrated rail coach factory established by Government of India during 1948. It was set up with the assistance and technical know-how imparted by M/s MAN of Germany to indigenously manufacture passenger rail coaches (of broad gauge) for the use of Indian Railways.

During the implementation of the first urban transit project by DMRC for its Phase-1, BEML, a public sector undertaking of the Government of India, and Rotem (now Hyundai Rotem) signed a Technical Collaboration agreement in 2002 and BEML became the first to indigenously make Metro Cars for DMRC RS1 contract, manufacturing 220 units of Metro cars. Later, in order to indigenise the manufacture and integration of Metro train sets, BEML obtained a developmental order from DMRC to develop 8 units of intermediate cars. The successful completion of this developmental order strengthened BEML as an indigenous source for Metro cars.

As on date, BEML has supplied over 1,100 Metro cars for various projects in India from its three production lines. With the experience gained in manufacture, integration and testing of Metro cars, BEML expanded its role in Metro Business and is commanding a good market share in India.

Encouraged by the successful track record in manufacturing global quality Metro coaches in India all three players have started further indigenisation process and major sub system of Metro coaches have been indigenised. Crucial parts including window glasses, battery boxes, brake blocks, bogie frames, vacuum circuit breakers, propulsion systems and signalling systems, among others are also being manufactured in India.

There are 10 cities in India with operational Metro networks, most having single lines stretching a few kilometres and six more cities have begun the construction work. In addition 18 more cities stretching from Srinagar in the north to Thiruvananthapuram in the south are working on Metro plans while dozens more are in need of one. That opens up a wide avenue for more business in the near future.

Larsen & Toubro wins Doha Metro Automation and Control Contract; India, Qatar

March 22th, 2017; Railway Pro



Artist`s Impression of Doha Metro Driver-less Train-Set

Indian Engineering and Construction Company Larsen & Toubro announced that its automation unit, L&T Electrical & Automation FZE, has won an order from Qatar Rail Company for Phase One of the Doha Metro. The scope of the order encompasses supply, installation, testing, integration, commissioning and five years' maintenance of a network-wide building automation and control systems (BACS) for 37 stations. The value of the order is QR278 million (USD 76.2 million).

The frame agreement awarded by QRail to L&T Electrical & Automation FZE is through nine contracts with design-and-build contractors for the stations and tunnels under multiple lines (Red, Green and Gold lines) and a five-year maintenance contract directly with Qatar Rail.

The main aim of BACS is to control and supervise MEP (mechanical, electrical and plumbing) systems, acquire and display MEP equipment status and alarms, provide reliable and effective third-party interfacing services, storage and offline/online analysis of MEP systems acquired data, enable testing and commissioning of the systems.

Bombardier acquires Contract to supply 210 Passenger Trains for India's National Capital Region Transport Co. (NCRTC); India



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Representative Image of BOMBARDIER *AVENTURA* Regional Semi-High Speed EMU

Bombardier Transportation has won a Letter of Award (LoA) from India's National Capital Region Transport Co. (NCRTC) to manufacture regional commuter and intracity transit trains and deliver with comprehensive maintenance assistance for the Delhi-Ghaziabad-Meerut semi-high speed rail corridor under Phase-I of the Regional Rapid Transit System.

This project includes supplying of 30 regional commuter train sets of 6 cars each and ten intercity mass transit trainsets of 3 cars each together with fifteen yrs of rolling stock maintenance. The LoA is charged at around INR 2577 cr and the customer has a provision to apply an option of an additional ninety cars along with 2 years of maintenance.

NCRTC MD Mr. Vinay Kumar Singh responded that finalization of the Rolling Stock bid process is an essential milestone in the implementation of India's 1st RRTS project. This

connection with Bombardier Transportation to supply 100% locally made trainsets for the Delhi-Ghaziabad-Meerut RRTS with above 83% local content would be a shot in the arm of the Government of India initiative for the Make in India. We believe that together we would deliver this transformational project within time to complete the purposes of the residents of the National Capital Region (NCR) willing to an enhancement in their quality of life.

He further added this project award for India's 1st and most superior semi-high speed regional trains along with sustenance services reaffirm Bombardier's pioneering status in India's rail industry.

This is the 1st project in India for regional and local transit services operating on the very network, progressively completing India's vision for the multimodal integration of transport networks.

The rolling stock would be designed at the Global Engineering and Technology Centre in Hyderabad, India and local teams would give maintenance services by 2 project and maintenance depots confirmed through our customer in Duhai & Modipuram.

Pre-Construction Activity starts on Delhi-Alwar RRTS Corridor; India



Representative Image of BOMBARDIER AVENTRA Regional Semi-High Speed EMU; Greater Anglia, UK

The Delhi residents may enjoy the ride of the much-awaited rapid rail system in the upcoming 2 years, as the National Capital Region Transport Corporation has started the pre-construction on Sarai Kale Khan- Panchgaon route under the phase-II of the Delhi-Gurugram-Shahjahanpur-Behror RRTS corridor. Delhi would be mainly covered under the phase-II, with 4 stations at Sarai Kale Khan, INA, Munirka and Aerocity being built. The rest stations at Udyog Vihar, IDPL Complex and Panchgaon are in Gurugram.

The phase-II construction under the ambitious project is supposed to be developed in 2022. The construction of phase-I of Delhi-Ghaziabad-Meerut corridor is already started.

“The main construction work tender among IDPL Complex – Rajiv Chowk has begun and under evaluation. Once the lockdown is lifted, award work would be passed through the centre and construction will start,” told a senior official of the NCRTC.

The pre-construction under the Delhi and Gurugram regions like designing, road widening, utility diversion, pile load testing, a geotechnical survey amid others has begun, Complex – Alwar would be created.

The NCRTC has floated for the project. The Sarai Kale Khan station is moving developed as the country’s 1st mega **Transit Hub**, where the 3 RRTS corridors would converge. The corridors would be interoperable for easy travelling and interchange facility so that commuters can travel easily.

For line 7 of the DMRC and Hazrat Nizamuddin Railway Station and Inter- State Bus Terminal, the Sarai Kale station would be an interchange station.

A DPR of the corridor has already been confirmed by the concerned State Government and is under active consideration of the Central Government.

The Delhi-Gurugram-SNB corridor would be executed in 3 stages. In the first stage, the Delhi-Gurugram-SNB Urban Complex would be built. In the second stage, the extension from SNB Urban Complex – Sotanala will be held, and in the third stage, SNB Urban C.

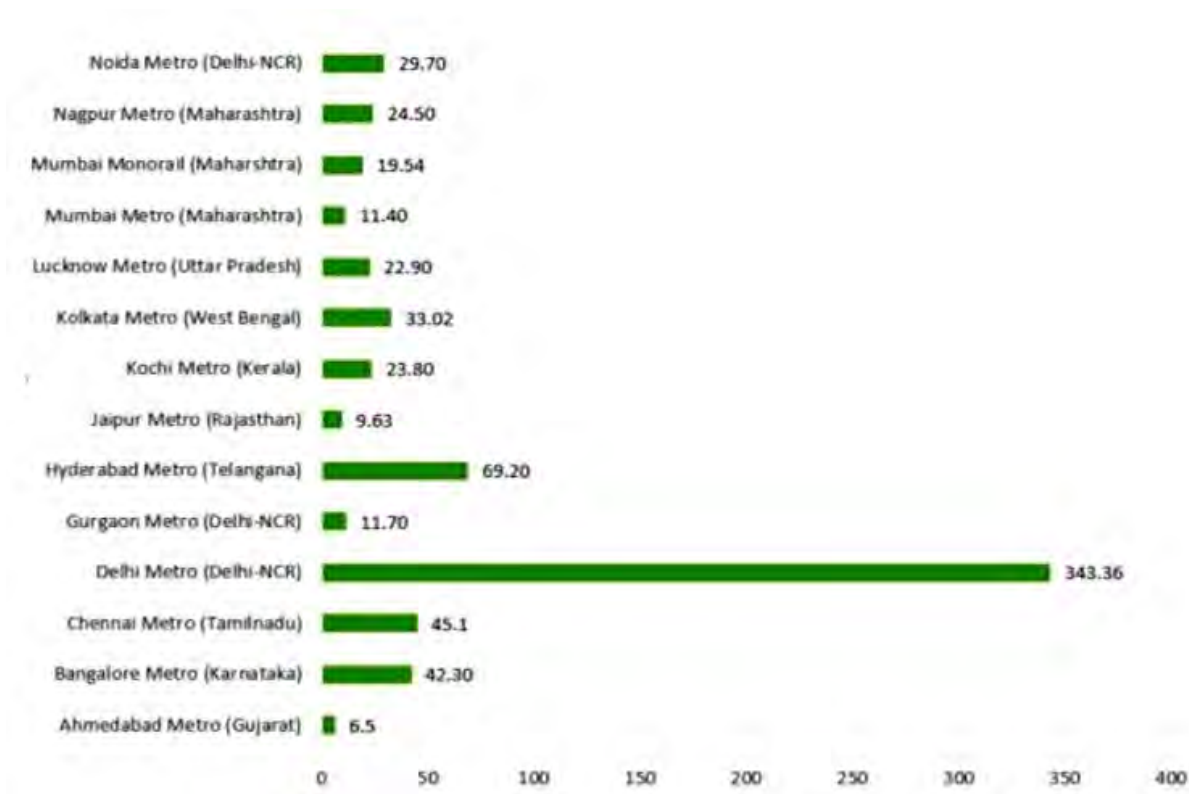
Status of Metro Rail Projects in India as on April 9th, 2020; India



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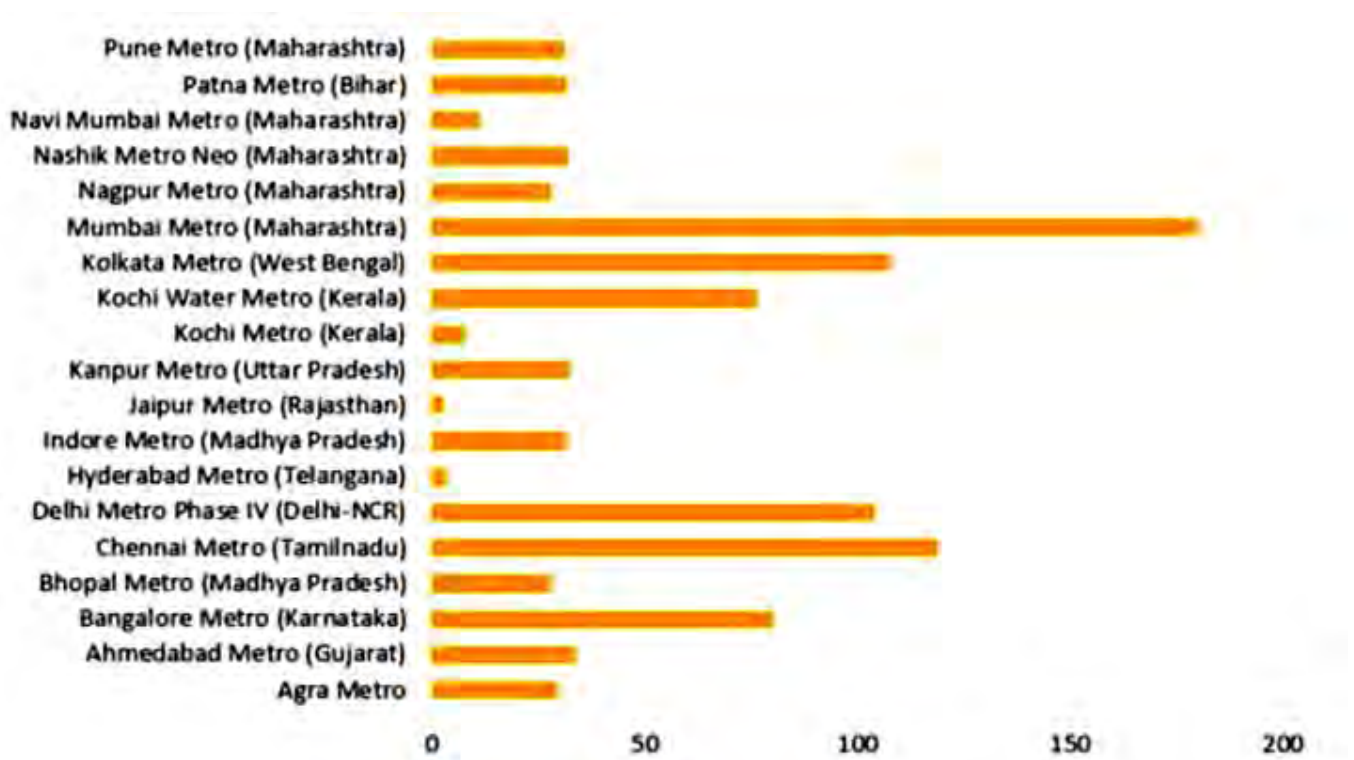
OPERATIONAL PROJECTS; total Length: 692.65 km

Length in [km]

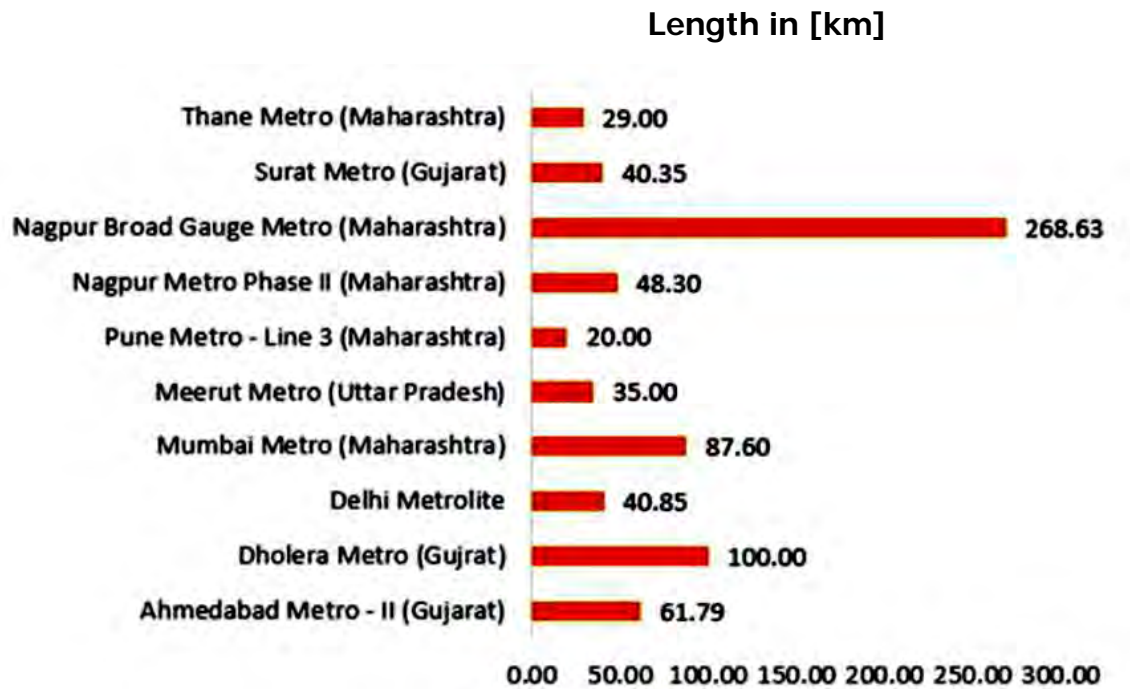


UNDER CONSTRUCTION; total Length 968.52 km:

Length in [km]



APPROVED OR EXPANSION; total Length 731.52 km:



UNDER CONSIDERATION

Under Consideration Metro Rail Project	Length in KM
Gorakhpur Metro (Uttar Pradesh)	27.41
Noida Metro (NCR-Uttar Pradesh)	
Greater Noida West metro (NCR-Uttar Pradesh)	11
Gurgaon Metro (Haryana)	
Jammu Metro (Jammu & Kashmir)	23
Srinagar Metro (Jammu & Kashmir)	25
Dehradun Metro (Uttarakhand)	
Varanasi Metro (Uttar Pradesh)	
Visakhapatnam Metro Andhra Pradesh	42.55



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PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Critical Communication Solutions for Transport; Global

Live Broadcast Tue, June 16th, 1:00 PM Eastern Standard Time; Railway Gazette

With more and more **DATA BASED AND DRIVEN MANAGEMENT AND INFORMATION EXCHANGE** Communication Technologies has become a decisive part in the world of rail transport.



Communication Technologies have become the backbone of modern railway and transit operations, as more and more systems exchange data between track and train.

As well as conventional voice communication between the controllers and drivers or passengers, data links are needed to support condition monitoring and fault diagnostics, CCTV and security alarms, and a growing range of other digital systems.

Meanwhile, communications-based train control systems and increased automation require secure channels for exchanging vital and mission-critical data.

In the latest live debate organised by Railway Gazette Events on June 16, a panel of high-level speakers have addressed the key issues:

- To what extent should different functions be supported by a single communications network?
- What level of redundancy is needed to ensure reliable operations when integrating multiple systems, and what are the implications for cybersecurity?
- What steps are needed to maintain the integrity of vital train control data?
- How should future communications architectures support interoperability, through a move to bearer-independent functionality and a more diverse mix of communications systems?
- What are the spectrum implications for rail from sharing the available bandwidth between more and more autonomous transport systems?



Main Communication Requirements

- Voice communication between drivers, control centers, depots, and passengers
- Automatic Vehicle Location (AVL)
- Remote monitoring of on-board systems
- Emergency communications
- Communication with maintenance crews
- Railway signaling



About TETRA

TETRA (Terrestrial Trunked Radio) is the leading digital radio standard worldwide for critical communications.

TETRA is a mature open standard where the focus is on meeting the critical communications needs of public safety and security agencies and an increasingly wide range of other market sectors such as mass transit and utilities.

The technology has been standardized by ETSI (European Telecommunications Standards Institute).



TETRA Benefits

- Simultaneous voice, data, and location services over a single network
- Most effective use of frequency spectrum (channel sharing)
- Private data capabilities (GPS, SCADA)
- Support large-scale capacity to meet ever increasing user needs
- Interoperability between all users at RF level
- Additional data features (SDS, AVL, Call ID, individual/group calling, etc.)
- Fewer radio sites/systems and less redundant equipment
- Integration and interoperability with First Responder networks
- Improved speech quality
- IoT over TETRA + Dual apps: PoC (MCPTT)

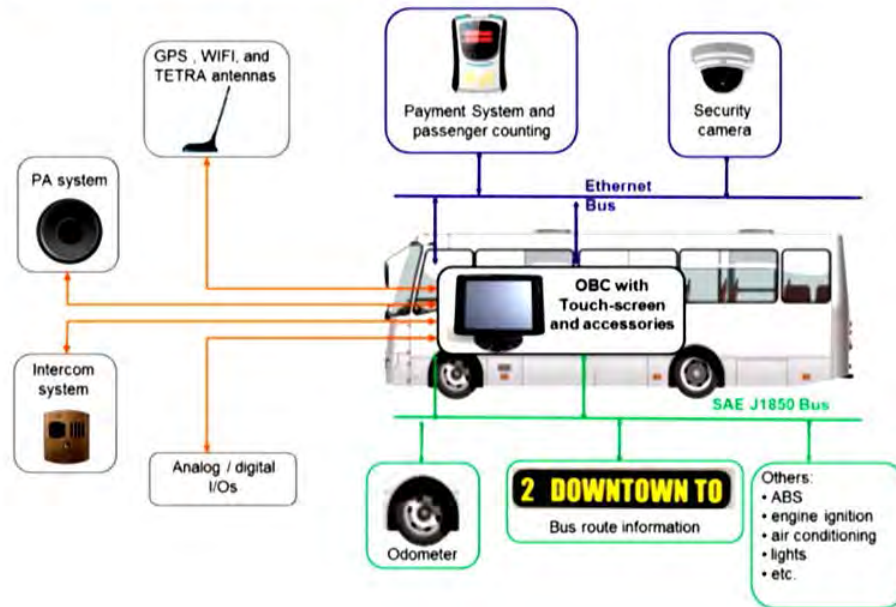


TETRA Standard Features

- The leading digital radio technology worldwide
- Open standard, multi-vendor, interoperable
- Outstanding cellular-like speech quality
- Half-duplex and full duplex calls
- Private, group, broadcast, and emergency calls
- Status and short data messaging (text, GPS, ...)
- IP packet data and circuit data modes
- Fast call setup
- Direct Mode Operation ("talk around")
- Peripheral Equipment Interface (PEI)
- Greater data capacity compared to other LMR



On-Board Systems for Transit



Conclusions

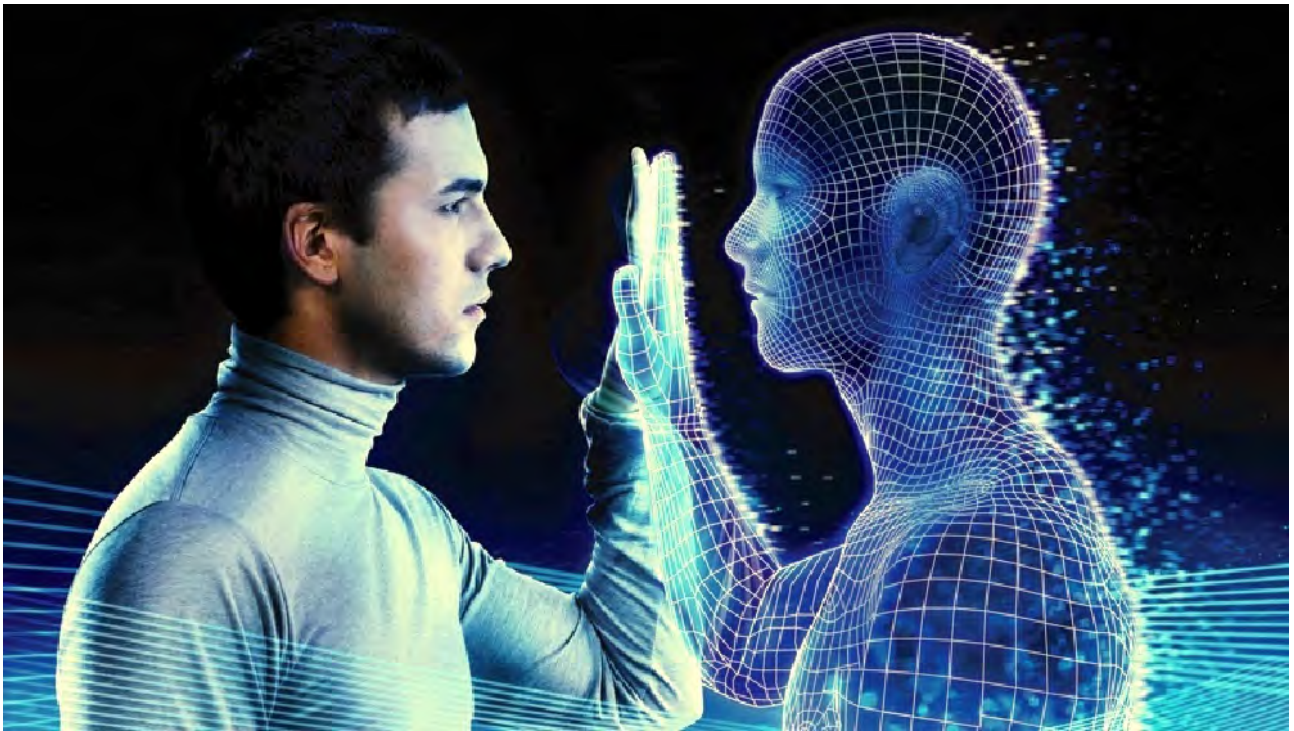


- Transportation systems have highly demanding requirements for critical voice and data communication
 - Subways, light rail, buses, etc.
 - Dispatch, vehicle tracking, monitoring
- TETRA is ideally suited to meet these needs
- Mature, proven, feature-rich, data capability
- Supports Intelligent Transportation System (ITS) applications
- Prestigious references

Get smart with Digital Twins; Global

Written by Kevin Smith, International Railway Journal, December 2019; page 46

Infrastructure Digital Twins can help railways to improve asset monitoring and performance using readily available but under-utilised data. As a leading proponent of Digital Twins across the infrastructure sector, Bentley Systems outlined an effective approach for the Rail Sector.



DEFINED simply as a digital replica of a living or non-living entity, a digital twin bridges the gap between the physical and the digital world with the seamless transfer of data from the physical enabling the digital entity to exist simultaneously.

For rail transport, digital twins offer countless opportunities, including optimizing infrastructure project planning, identify and plan maintenance actions, or test operational scenarios, and are widely touted by major infrastructure managers such as German Railway (DB) and Network Rail.



However, the challenge of developing and delivering an effective digital twin, which is not a snapshot in time, but an evolving representation of the physical asset, is significant. Railways therefore need to consider carefully how they can maximise the opportunities on offer.

Bentley Systems describes digital twins as the fourth dimension of the construction process, adding a time element to the modelling processes achieved in the previous generations: Computer-aided Design (CAD), Geographic Information System mapping (GIS) and Building Information Modelling (BIM).

The company has gradually expanded its capabilities in the field through in-house development and acquisitions in recent years. Among the most recent acquisitions is Citilabs, a mobility simulation and analytics software provider, and Orbit Geospatial Technologies, a provider of 3D and mobile mapping software.

The impressive line-up of finalists in the company's Year in Infrastructure Awards also emphasised the role, that digital twins are playing in some of the world's leading infrastructure projects.

Speaking to IRJ at the company's Year in Infrastructure conference in Singapore, Mr Andrew Smith, Bentley's rail asset performance manager, says railways considering digital twins should focus first and foremost on the low-hanging fruit. Rather than modeling their entire network in one hit, he says railways should break the process down into multiple dimensions depending on the most pressing need.

"You are not making a digital twin because you like to make digital twins," Smith says. "You are making digital twins because you have a physical asset that you need to build or maintain and you want the toolkit in place, that allows you to experiment. This means, when you do something in reality, you are doing the right thing, at the right time, in the right place using optimal resources.

"There are process changes, that need to be put in place as well as the technology aspect," Smith continues. "You can tackle it bit by bit by looking at the low hanging fruit, where the major problems are and where you have the data to populate it in the first place. You can then map those two together to find an area, where you have a data set, that is not fully utilised."

Under-utilised data, Smith says that in his view no railway on the planet is fully utilising the data, that they have available. For example, Mr. Ian Rosam, Director product management, design engineering, at Bentley, says that data capture from **Lidar Scanning** used for asset recognition and maintenance planning could also be used to build a model to help drivers learn a route. Equally, 3D modelling and visualisation of platform assets like hanging signs or wayside signaling and telecoms masts provides more enhanced information than in a typical survey.

"You can do that without having access to the track," Rosam says. "Working in a **Virtual Environment** is far safer than going on site, which you only want to do when you know what you need to do, where you need to go and how you are going to get there."

One of the major barriers to harnessing **DATA** more effectively is internal protection. Smith says too often railways are reluctant to share the data with other organisations or departments, because while suitable for the task at hand, they know their data isn't perfect.

Many of these discrepancies begin to emerge when a digital twin project gets underway. While painful in the beginning as different data sets, that previously sat in isolation are exposed, Smith says it is a worthwhile process as what was wrong to start with is

corrected to the benefit of all concerned. Rosam also hopes that standardisation of construction industry data for the rail sector, which is nearing completion through IFC Rail, will help to iron out a lot of these issues.

Ultimately the success of a digital twin project depends on getting people onboard. Rather than an IT system, that delivers information to support someone, who has been doing a job often for 20-30-40 years, it is instead a system designed by maintenance engineers based on their own experience, which could result in a stepchange in how work is carried out. "If you don't get buy in from the people - it doesn't matter what technology you have - that resistance is going to kill you," Smith says.

Equally, the use of this new technology reflects generational changes in the industry. By refusing to embrace these new methods and ways of working, the industry could be shutting itself off to the next generation of engineers, who have grown up with these types of applications.

With the data generated by railways growing exponentially, finding ways to manage this information effectively and deliver efficiency gains is one of the major challenges at the dawn of a new decade.



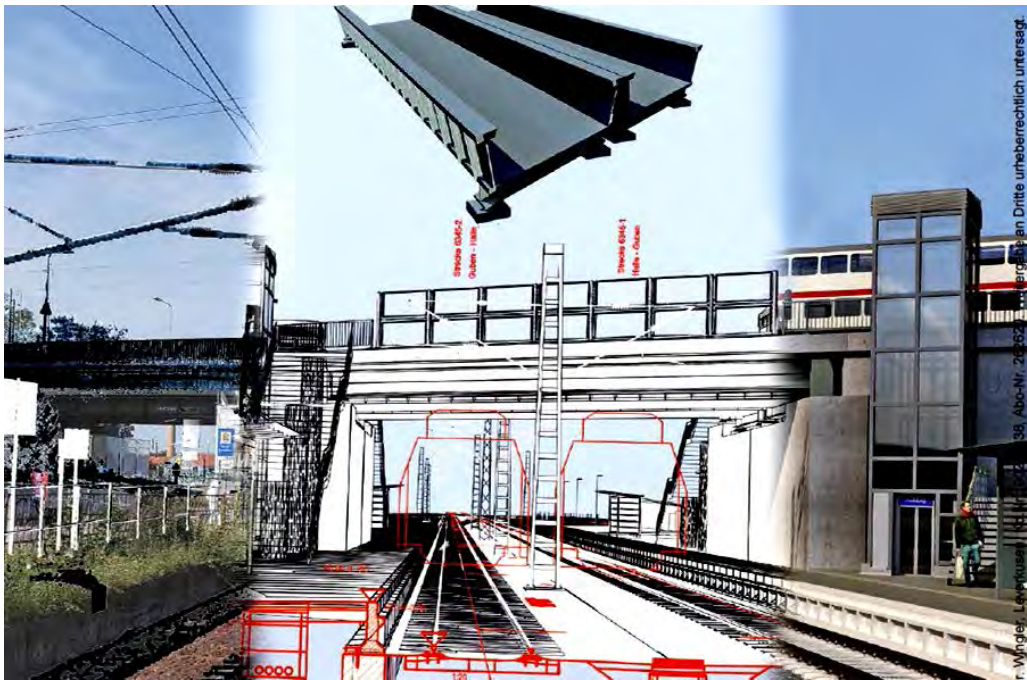
Digital Twins have played a critical Role in Sweco's Design and Development of a 9 km Light Rail Extension Project in Bergen; Norway

However, by arming themselves with digital twins, the rewards potentially on offer from this data to railways are significant. "We can't work harder and harder, we have to work smarter," Smith says. "That is fundamentally what a digital twin does for you. It is an enabler to work smarter." **IRJ**

Implementation of BIM Methodology; Germany

BIM Methodology has a strongly collaborative Approach and therefore requires the Establishment of one Cooperation-oriented Project Culture.

From ETR, Eisenbahntechnische Rundschau, May 2020, *Special Edition BIM*, ISBN 978-3-87154-674-7



Visualisation of the BIM Pilot Project „Modernisation of Railway Station Doberlug-Kirchheim“

BIM is a digital working method for the optimized planning, execution and management of buildings, assets and infrastructures. The focus of the methodology is the active networking and collaborative work of all parties involved on the basis of clear and transparent information, which is provided via a building data model enriched with schedules, cost data and other information.

BIM has a strong cooperative approach, and this inevitably has an impact on the "how" in a project/workflow over the entire life cycle.

BIM is a digital working method based on a geometric 3D model, which is successively enriched with information over the entire life cycle of a future system, so that a **DIGITAL TWIN** of the structural systems is created. This information is consolidated and coordinated in digital technical and overall models and is available via a central database, the Common Data Environment (CDE) for all project participants such as authorities, builders, specialist planners and construction companies participating on a project. The CDE forms the "single source of truth", ie. there is a single, always up-to-date data base of the models without redundant data in various intermediate states.

The evaluation options of these **DIGITAL MODELS** enable us to have the facts and figures of the project, such as costs, dates and quantities, available at all times. Visualizations, simulations and forecasts, that are derived from the models, are other important tools in the planning and implementation process.

BIM enables almost complete and coordinated planning. These always available, visualized and digital/data based networked models provide an unprecedented overview of

complex construction projects. But not only the information of the models, also everyone involved in planning, construction and operation comes much closer together:

Processes become more transparent and human action is made visible. The **BIM** method not only has an eye on the result, but also the way there. **Thus, this digital culture change also includes a culture change of working together in project execution!**

The change in the implementation of the BIM method is profound and means changes in various areas - from the use of new technologies, the establishment of new processes to a new cooperation: **The BIM method has a strongly collaborative approach and therefore requires the establishment of one cooperation-oriented project culture.**

Both, the **BIM** method and the collaborative working method are new fields of action, the establishment of which still needs to be anchored in everyday work. At the same time, they are the tools, that are necessary so that complex infrastructure projects can be implemented with higher quality and reliability. We have to learn to use these tools, and best with each other. The better we manage to work together and share knowledge, the higher the level of innovation and the more effective we are.

What are the requirements for a partnership project management with a strong "we"?

Three factors have been identified, that support collaborative work:

1. We give the "we" a room designed accordingly.
2. We create the technical conditions to use digital processes and working methods efficiently.
3. We have to give our employees the personal chance to develop a "we" from the "I". The spatial concept provides for continuous support in the BIM process across all service phases: from the creative idea, the strategic decision, the model creation to the planning coordination and high-tech visualizations.

German Railway, DB, has a clear program for the realization of digitization and data driven workflow in project management with the strategy to implement **Building Information Modeling (BIM)** in the Infrastructure Division of the Management Board. With realization of the first BIM-Labs at DB, the major Karlsruhe – Basel project has laid a solid foundation for the implementation of the BIM project in partnership with the planning team.

Bentley Systems: OpenRail Designer - from Planning to Performance; Global

White paper from Bentley Systems, June 2020

Bentley®
Advancing Infrastructure

 **CONNECT Edition**



OpenRail Designer CONNECT Edition

From Planning to Performance

OpenRail Designer CONNECT Edition is an innovative application for preliminary and detailed design of rail infrastructure of all sizes. The application is an all-in-one solution and handles a wide variety of complex tasks such as yard/station design, tunnels, corridor modeling, turnout and switch placement, overhead line electrification, site development, sanitary and stormwater network design, subsurface utilities, and production of construction staking reports.

OpenRail Designer can be configured to support a wide range of international standards providing you the flexibility and control necessary to deal with real-life design scenarios on global rail infrastructure projects. The application adapts to virtually any rail design and maintenance workflow and is suitable for light rail, metros (transit) heavy rail, high-speed rail, and MAG_LEV projects.

The CONNECT Edition

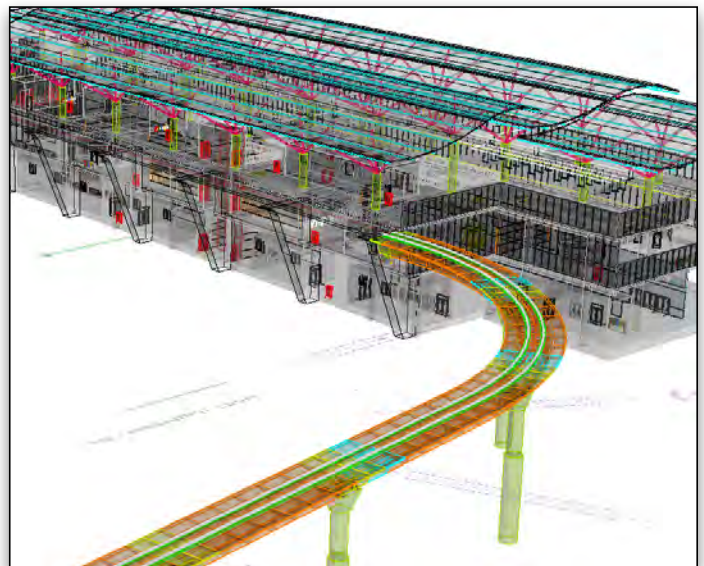
The SELECT® CONNECT Edition includes SELECT CONNECT services, new Azure-based services that provide comprehensive **learning, mobility, and collaboration** benefits to every Bentley application subscriber. *Adaptive Learning Services* helps users master use of Bentley applications through CONNECT Advisor, a new in-application service that provides contextual and personalized learning. *Personal Mobility Services* provides unlimited access to Bentley apps, ensuring users have access to the right project information when and where they need it. *ProjectWise® Connection Services* allow users to securely share application and project information, to manage and resolve issues, and to create, send, and receive transmittals, submittals, and RFIs.

Designing in Reality Context

OpenRail Designer excels at data acquisition enabling users to consume multiple data types to effectively understand site and existing conditions. From photogrammetry and total station surveys to GPS LiDAR, point clouds and reality meshes, the application can upload, analyze, and manipulate field data, while ensuring the provenance of the original data. You can rapidly capture the “as-built” condition of an existing site or asset using Bentley’s ContextCapture to quickly produce 3D models from photographs.

Rapidly Model Design Intent

OpenRail Designer’s design intent capabilities help you build associations and relationships among civil elements to ensure the design project is reflective of engineering intent to improve design efficiency. The software also delivers



Integrate data from a variety of disciplines to improve collaboration between team members, offices, and workflows to ensure the latest model is used in all phases of the design.

comprehensive mathematical and associated cant transition algorithms to accommodate the horizontal transitions required on rail projects. A check integrity report locates discontinuities and highlights potential issues, such as nontangential curves, for resolution or correction. OpenRail Designer also includes civil cells – preconfigured commonly used 2D and 3D geometric layouts, such as siding or yard layouts – while maintaining all design, constraint, and relational intelligence. Civil cells can then be used repeatedly in designs ensuring standards are implemented, while accelerating design production.

Integrate Multiple Disciplines

OpenRail Designer provides a comprehensive modeling environment for the project delivery of rail and road networks, unifying design and construction. Users can easily integrate data from different disciplines to improve collaboration and ensure the latest model is used in all phases of the design. Working in the live model reduces risk by utilizing the data interactively and working among rail, road, bridge, drainage, subsurface utilities, geotechnical and other design teams to help identify conflicts earlier in the process and eliminate construction errors and delays. Employing a comprehensive modeling environment allows users to share data that is relevant to the project and to enrich project understanding, identify potential risk, and make better engineering decisions in the design phase.

Adapt to Change

Bentley understands the demands on engineers and designers to produce models that provide information beyond documentation and construction, into operations, maintenance, and rehabilitation – and back to design if necessary. Using a model-centric approach, designs are dynamically updated throughout the model, guaranteeing that the current design is readily available for all team members. A federated modeling approach helps you make better-informed decisions earlier in the design process with more complete conceptual designs; eliminate errors and omissions in the documentation process by having fully synchronized documentation from the model; explore and analyze many options to maximize the performance of the asset in the real world; and to reuse information to improve construction and operations of the asset.

Improve Project Deliverables

OpenRail Designer automates the production of a complete array of design deliverables. To automate the drawing process, the application instantaneously synchronizes the model to produce high-quality documentation that is the result of the drawing composition process. Since all deliverables adhere to the same project standards and come from the same model, you can be confident of your deliverables. OpenRail Designer provides design, volume, and cross

section data in XML industry-standard format for data exchange and reporting. Project data can be used in multiple formats, including Excel spreadsheets, HTML or text files, PDFs, printable documents, and other output. Reporting capabilities automate the production of a variety of standard reports, including horizontal and vertical alignments, quantity takeoffs, clearance reports, stakeout, legal descriptions, surfaces, and more. The application outputs standard formats for Trimble, Topcon, and Leica for machine-controlled grading and machine guidance.

Visualizing Designs

Experience designs in real time with OpenRail Designer constraint-driven templates, context sensitive, intuitive interface, and dynamic 3D modeling. You can virtually drive through the 3D corridor model and visually inspect it for any design deficiencies or physical conflicts. In 3D QA, you can fully view rail features from all angles to identify gaps or misalignments, look for utility conflicts, and check clearances. You can also visually evaluate rail and sleeper placement, overhead line structures, signal sighting, station designs as well as try out multiple aesthetic treatments to reach the desired result. OpenRail Designer seamlessly integrates with LumenRT to create models and high-impact visuals and animations to effectively communicate the project to stakeholders for project approvals.



Incorporate real-world conditions into the design environment for better decision making.

OpenRail Designer CONNECT Edition At-A-Glance

Integrated CAD Capabilities

- Integrate data with OpenRail ConceptStation, MicroStation, ProjectWise, OpenBridge Modeler, AECOsim Building Designer, and other Bentley applications
- Support for managed workspaces
- Works across references files
- Include other engineering data (e.g. drainage) as referencing it to the DGN model
- Utilize an unlimited number of federated reference files
- Create and edit CAD elements
- Read and write to DGN and DWG files
- Supports design history
- Apply digital signatures using industry-standard encryption
- Secure digital rights definition for reviewing, printing, and editing
- Supports multiple raster formats
- Supports PostScript and HPGL2/RTL printing
- Use AccuDraw® and AccuSnap™ navigation tools
- Track annotation

Reality Modeling

- Reality mesh support
- Display of very large, photo-textured reality meshes produced using ContextCapture
- Editing of meshes (remove facets, fill holes)
- Automatic ground extraction
- Breakline extraction
- Efficient 3D modeling using sections and templates
- Mesh classification to enrich mesh with data from many sources
- Orthoimage extraction on any axis
- Generation and manipulation of cross sections
- Production of 3D PDFs and iModels
- Read/write standard data formats for:
 - » 2D/3D CAD graphics
 - » ASCII/text data
 - » LandXML
 - » LiDAR data: ASCII and LAS
 - » USGS digital elevation models
 - » Photogrammetric data
 - » Raster files

- ECW (unlimited), PDF, IMG, JPEG 2000, BIL, DOQ, FLI, SPOT CAP, and Digital Image Map
- TIFF (1-to 32-bit), GEOTIFF, iTIFF, COT, CIT, RLE, CALS, PCX,
- IMG, BUM, TG4, INT, RGB, TGA, JPEG, RLC, RS, HMR,
- BMP, and IKONOS 3 (Red), and 4 (NIR) bands from GeoEye
- Compression schemes: Deflate, Pack-Bits, CCITT3, CCITT4
 - » Contour maps
- Import and analyze point-cloud data
- Merge surfaces automatically
- Update surface data dynamically

Point-cloud Processing

- Fast display and visualization of billions of points
- Drape and snap elements
- Classification editing
- Smart Snap
- Batch tile export
- Pointools, POD, LAS, and XYZ file export
- Extraction of planar and cylindrical elements
- Linear feature extraction
- Re-color points for flexible presentation
- Class management for any type of presentation style
- Definition of custom classes
- Point-cloud colorization from orthophotos
- Clip and section manager
- Support of geographic coordinate systems

Scalable Terrain Modeling

- Creation of scalable terrain models (STMs)
- High-performance display of very large digital terrain models (DTMs)
- Display modes for smooth shading, smooth shading with shadows, aspect angle, elevation, slope, contours
- High-resolution image draping on STM
- STM update and synchronization with DGN files, civil DTMs, point-cloud data, and XYZ files
- Calculate view shed from point or path

Geotechnical Integration

- Directly interface with gINT database
- Visualize and annotate borings in 2D
- Visualize and annotate borings with separate strata in 3D
- Create subsurface terrains from boring data

Terrain Modeling

- Create intelligent, data-rich and lightweight terrain models
- No need for secondary terrain analysis to represent the terrain display. Includes context sensitive re-symbolization for triangles, contours, linear features, slope vectors, color code for slopes, elevation banding, and aspect
- Create terrain models from a variety of import sources
 - » Reality models
 - » 3D graphical data automatically using graphical filters
 - » ASCII/text data
 - » Legacy data formats of InRoads, GEOPAK, and MX
 - » Point clouds
 - » LandXML
 - » LiDAR data: ASCII and LAS
 - » USGS digital elevation model data
 - » Aerial data
 - » Raster files
- Ensure live, federated, and intelligent terrain models when stored as a DGN element
- Maintain terrain models through the preservation of relationships to source data
- Ensure correct entry with undo/redo capabilities
- Standardize displays via element templates
- Use across multiple disciplines via reference files in a

- comprehensive modeling environment
- Re-symbolization of display across multiple disciplines using a comprehensive modeling environment
- Control maximum length of triangles
- Control boundary conditions
- Create complex and clipped terrain models
- Interrogate the intelligent data rich 3D models
- Support for different features types including but not limited to boundaries, holes, voids, breaklines, inferred breaklines, and random points
- Model intelligent 3D real-world civil features (ditches, curbs, trees, and culverts)
- Context-sensitive intelligent editing of features
- Dynamic editing for
 - » Extend, trim, and intersect features
 - » Insert, move, and delete vertices
 - » Delete, partially delete, break, or join features
- Manage large LiDAR datasets
- Exclude non-DTM features from triangulation
- Control density of points on linear features for optimal surface presentation
- Display cut and fill delineation
- View and edit feature properties
- Contour smoothing
- Major, minor, and depression contours
- Automatic and manual contour labelling

Rail Modeling

Specialist Rail Geometry

- Support for rail geometry definitions: Clothoid, Cubic Parabola, Bi-quadratic Parabola, Bloss, Sinusoid, and Cosine
- Support for rail transitions defined transition length or the spiral constant

Turnouts

- Single, Double, Diamond Crossings, Single Slip, Double Slip
- Built in Libraries; Austria, Germany (heavy and light rail), Holland,
- India, Italy, Russia, South Africa, Spain, Switzerland, United
- Kingdom, United States, and Canada
- Custom libraries can be defined
- Turnout application on curves, turnout bending
- Rule based application, automatic healing of geometry and connections
- Easy design of complex connections and geometries with civil geometry

Regression

- Least squares method to calculate best-fit alignments
- Dynamic regression analysis
- Automatic sorting of point readings
- Horizontal and vertical regression
- Curvature diagram to help users identify curves, tangents, and spirals
- Convert rail readings to centreline, calculate existing vertical and cant
- Easy selection tools for regression points both on plan and curvature view
- Automatic placement of spirals

Speed Tables

- Speed tables, speed assignment for different sections of the track
- Speed transitions
- Alternative speed selection; commuter rail, freight rail, express...
- Automatic or manual creation, based on geometry and design standards

Cant

- Cant calculation; equilibrium cant, applied cant, cant deficiency, rate of change of applied cant, rate of change of cant deficiency, and cant gradient

- Cant diagram
- Automatic identification of design problems
- Virtual transitions

Rail/Sleeper Calculation

- Precise rail calculations based on curvature and cant
- Track widening application
- Rail joints
- Sleeper placement, long sleepers on turnout areas

Swept Envelope Analysis

- Custom train definitions, with articulation and bogie definitions
- Swept envelope using curvature and cant values
- 3D representation of envelope for clash detection
- 2D projection of swept envelope

Overhead Line Electrification

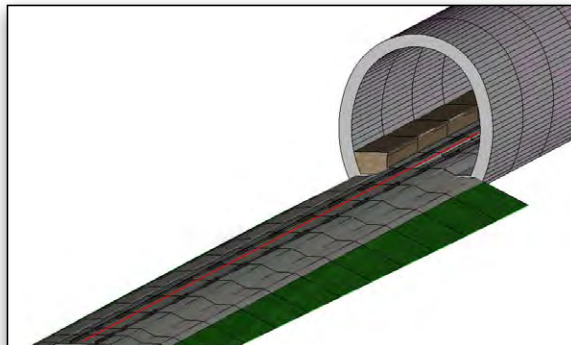
- Design rules and geometry based calculations to determine foundation locations
- Span equation and span lookup tables
- 3, 4, 5 span overlap definitions. Insulated, uninsulated overlaps and natural sections
- Simple and stitched wire runs. Precise contact, catenary and dropper wire height and length calculations
- Cant and geometry based stagger calculations
- Return and feeder wire placement
- Parametric 3D cells for structure calculations
- Moment calculations for mast and foundation selection
- Foundations, masts, single or multiple cantilever sets, and portal definitions
- Automated placement of additional OLE equipment; end wire tensioning, mid wire tensioning, jumpers, anchorage...
- Full 3D model with structures and wires
- Schematic 2D representation of OLE system
- Profile drawings and quantity reports
- Cross sections with dimension and quantity annotation for manufacturing

Rail Signals

- Rail signal library with asset tags
- 2D and 3D representation of signals
- Signal sighting analysis

Core Modeling

- Model multiple design scenarios
- Edit designs dynamically
- Automatic model updates driven by design intent
- Design time visualization with automatic material assignments
- Undo/redo capabilities
- Interactively interrogate federated 3D models with dynamic cross sections



Model with design intent using OpenRail Designer's new and innovative technology that captures, stores, and maintains design associations and relationships.

- Manage 2D/3D models and display representation
- Rule-based superelevation control of the model
- Use enhanced clipping and point controls
- Integrate and utilize CAD graphical elements in the model
- Create model reports dynamically
- Generate plan ready cross sections
- Utilize WYSIWYG features – control display of cross sections by simply turning on/off reference files
- Adheres to regional design standards

Dynamic Geometric Design

- Interactive geometry tools
- Enhanced integration with AccuDraw® and AccuSnap™ through CivilAccudraw
- Multiple vertical geometries supported per alignment
- Design time standards input and feedback with errors and warnings in Civil Message Center
- Store rules and relationships between geometric elements
- Create horizontal/vertical by PI method or by elements
- Offset tools for easy creation of complex yard layouts
- Create circular and parabolic vertical curves
- Create arc and chord horizontal curves
- Support for multiple spiral definitions including chlothoid, blossom, cosine, sinusoid, biquadratic parabola, cubic parabolas
- Support complex geometry: SCSCS, SCCS, etc.
- Support tangential and non-tangential curves
- Edit elements associatively and dynamically
- Define curves by radius, degree of curvature, and pass-through points
- Edit, delete, and join elements
- Support delta angles greater than 180°
- Annotate alignments and points with object attribution, geometric properties, stationing, dynamically and automatically
- Additional annotation tools for one-off object labeling
- Review and report geometry in variety of customizable formats
- Perform design checks dynamically or in batch processes
- Display 3D geometry

Template Libraries

- Support for surface and linear templates
- Include components, end conditions, and features
- Create components for real-world objects such as lanes, curbs, walls, ditches, and barriers
- Define parametric components graphically
- Apply constraints to components
- Place component points as free, partially constrained, or fully constrained
- Set constraints as horizontal, vertical, sloped, projected, vectors, offsets, and elevations
- Constrain end conditions partially or fully
- Set end conditions to trace existing surfaces such as rock
- Drag-and-drop assembly of templates from components and end conditions
- Perform graphical tests to verify design

Corridor Modeling

- Edit designs dynamically
- Blend horizontal and vertical geometry with 3D topography and typical sections
- Assign component control points to existing or designed features and geometry, controlling horizontal and/or vertical location
- Assign automatic overrides
- View plan, 3D model, profile, and cross section interactively
- Provides heads-up dynamic, interactive parametric design
- Level of detail user definable output
- Surface priority definable by target aliasing
- Transition among disparate templates

- Apply exceptions for bridges, voids, and special end conditions
- Clip model capability
- Edit stations dynamically
- Apply superelevation text tables, customizable calculations, or AASHTO standards
- Allows dynamic editing of superelevation
- Assists problem resolution through intelligent color coding of transitions, and super runout
- Component meshes provide direct volumetrics from the 3D model based on level of detail
- Reflect edits automatically in quantities and volumes
- Control component display via rules

Subsurface Utilities

- 3D modeling
- Create 3D utility model relative to topography and alignments
- Support interconnected network of pipes, curved pipes, channels, culverts, manholes, pumps, catch basins, and inlets
- Create associative and dynamic model-based designs
- Create storm, sanitary, or combined hydraulic networks
- Build utility models directly from survey data
- Identify graphics as utilities and drape relative to DTM
- Display all network and utility objects in sections and profiles
- Display as realistic 3D models for effective collaboration
- Identify conflicts among utility elements as well as among utilities and other 3D data
- Label all attributions in any view or include in user-defined reports
- Create user-defined attributes for any required data
- Draw 3D models of utility structures as full 3D shapes for easy clash detection
- Hydraulic design and analysis
- Analyze and design using industry-standard theorems such as Mannings, Colebrook-White, Bernouli, and continuity equations
- Analyze and design based upon HEC 22, FHWA, HDS 5, 10, 13, Rational Method, Wallingford Procedure, and regression equations
- Analyze and design using steady state gradually varied flow, and run simulations using unsteady state time-varying flow
- Compute Tc using methods such as TR-55, HEC-22, and Kinematic Wave
- Compute losses using methods such as SCS CN, Green and Ampt, Horton, Initial, and Constant Rate
- Compute runoff using methods such as Rational, Modified Rational, ILSAX, SCS, and Unit Hydrograph
- Use demand and demographic tables
- Supports infiltration, population, peaking factors, and land usage
- Compute or specify flows
- Define custom intensity-duration-frequency tables
- Generate drainage queries and customized reports
- Color code based upon queries or styles
- Calculate pond volumes
- Create input and output hydrographs
- Design inlet and outlet control structures
- Use PondMaker for inflow/ storage/outflow optimization

Reporting and Project Deliverables

- Live documentation capable
- Automate project delivery process with drafting and drawing preparation tools
- User definable annotation tools for plan, profile, and section labelling
- Extract sections, drawings, and reports directly from completed 3D model
- Automate sheet generation for plans, profiles, and cross sections
- Select from more than 550 included report formats
- Modify included reports easily in any text or XML editor
- Provide standard reports for bridges, superelevation, clearances, data collection, geometry, sections, DTM, legal descriptions, design, visibility, and more

- Compute volumes by surface to surface (triangulated surface comparison)
- Compute volumes by 3D objects

Plan, Profiles and Cross Sections

- Create/generate plan, cross sections and profiles along alignments, graphics, or between points
- Create directly from 3D model and supports federated multi-discipline models
- Include vertical alignments and existing and proposed surfaces
- Automatic user-defined annotation of points and segments
- Additional annotation tools available for one-offs
- Cut cross sections orthogonally or at skew
- Create custom cross sections
- Dynamic update for cross sections and profiles via referencing



China Rail High Speed Rail Track

Quantity Management

- Extraction of quantity take-offs for estimating
- Element pay item attribution
- Report quantities by entire project or delineate by sheets, stations, area, or phase
- Generate linear, area, and volume quantities
- Modify sample reports or create custom reports through XML style sheets
- ODBC link capable for fully customizable reporting

Visualization

- Walk/drive through interactively or along a defined path or corridor
- Visualize paths through the project relative to design control by offsets and vehicle speeds
- Predefined materials applied to components enabling realistic rendering
- Position sun for geographically defined locations to ensure realistic shadow patterns
- Animate vehicles in traffic lanes without additional software
- Populate 3D objects along linear paths and within designated areas
- Apply traffic paint striping plans to the 3D model
- Use sample vehicle library and plantings
- Image draping on DTM or 3D objects
- MicroStation®-based rendering
- Real-life textures
- Lighting effects
- Elevation and perspectives
- Creation of fly-throughs and animations
- Creation of 3D PDFs
- Support for engineering data, point cloud, reality meshes
- Seamless integration with LumenRT for real-time, immersive presentations
- Solar and shading analysis

System Requirements

Processor

Intel® Pentium®-based or AMD Athlon®-based processor 2.0 GHz or greater.

Operating System

Microsoft Windows 10, Windows 10 x64, Windows 8, Windows 8 x 64, Windows 7, Windows 7 x64, Note: Windows 7 operating system is supported only with its service pack (SP1) installed.

Memory

8 GB minimum, 16 GB recommended, (more memory typically results in better performance)

Disk Space

9 GB minimum free disk space (which includes the 5.6 GB install footprint for a complete installation)

Input Device(s):

Mouse or digitizing tablet (Digitizing tablet requires vendor-supplied WINTAB driver or Bentley's Digitizer Tablet Interface, the latter included with OpenRoads Designer installation.)

Find out about Bentley at: www.bentley.com

Contact Bentley

1-800-BENTLEY (1-800-236-8539)
Outside the US +1 610-458-5000

Global Office Listings

www.bentley.com/contact

Publishing

- Export directly to machine guidance
- Supports iModel creation (includes 2D and 3D geometry and business data)
- Support industry standards, such as LandXML
- Export alignments, surfaces, and other pertinent design information to other systems via XML
- Generate PDFs and 3D PDFs
- Direct plotting
- Integrate with Google Earth™

Integration with Bentley Content Management and Publishing Solutions

- Component-level integration with ProjectWise® for collaborative design and engineering project management
- Integration with ProjectWise® InterPlot® for automated plot set generation and web-based access to plot archives
- Integration with Bentley® Navigator for design review, construction simulation, or automated clash resolution



Use OpenRail Designer to help improve project deliverables by broadening the construction documentation and data production to meet project deliverables.

Driving Rail Operational Efficiencies with Connected Ecosystem; Global

Technical paper from  June, 2020



TECHNICAL PAPER

DRIVING RAIL OPERATIONAL EFFICIENCIES WITH A CONNECTED ECOSYSTEM



By Michael Klabunde
Vice President, Marketing, Wi-Tronix®, LLC

COMBINING EDGE AND CLOUD COMPUTING WITH AN ONBOARD IOT PLATFORM ENABLES RAILWAY OPERATORS TO CONSOLIDATE AND ANALYZE SYNCHRONIZED, FULL-FLEET DATA. MULTIPLE DATA STREAMS, INCLUDING VISUAL INTELLIGENCE AND ARTIFICIAL INTELLIGENCE, WILL BE PAVING THE WAY FOR AUTOMATED TRAIN OPERATION.

We've come a long way from when "IoT" was introduced over 20 years ago. Digitalization and advances in communications technology today are delivering massive advances in not only how we live and work but how businesses efficiently operate.

The realities of transportation are constantly changing, and to remain competitive, embracing technologies that support safe and more productive operations has become mandatory.

Leading railways are tapping into the benefits of Connected Platforms to make huge strides forward on their fleet and infrastructure operations. With real-time, full-fleet information at their fingertips, coupled with cost-effective analytics tools, rail operators are seeing great returns on technology investment. Business value is being experienced in terms of safety improvements, cost reductions and customer service in the key operating areas of Fuel, Safety & Risk Management, Transportation Operations, Mechanical Maintenance and Maintenance of Way.

Rail transportation is headed to Autonomous Train Operation (ATO) in the long term. The future of ATO will be built on the technology currently being deployed and still under development. Although there are many steps along the way, substantial incremental value can already be gleaned from putting in place the right system architecture. The long-term path will see an evolution from the current generation of Decision Support systems that simply collect and process data to advanced Decision Systems and eventually Decision Automation.

A Connected Ecosystem

A critical element on the route to railway automation is the computing architecture — or 'Ecosystem' — on which various data systems are supported. Increasingly, proprietary technologies are being replaced by common standards. The rapidly increasing amount of fleet data calls for bigger and better processing power with a lower cost of implementation demand.

In railway terms, challenging physical operating environments mean demanding technical specifications, covering aspects such as temperature, vibration, shock and electromagnetic interference, as well as the need for interoperability across multiple fleets. Nevertheless, it is now practical to apply a Connected Ecosystem across all forms of rolling stock for freight and passenger railways, including locomotives, coaches and wagons, as well as urban rail vehicles.

There are different use cases for each type of vehicle, of course, which must balance the costs of installation and use against the value derived by the operator. As well as the costs associated with the acquisition of raw data, there is the cost of creating actionable information through the correlation of multiple data sources, rules engines, Artificial Intelligence (AI), Video Analytics, and Visual Intelligence (VI).

The initial focus has been vehicle monitoring, collecting data from a multiplicity of sensors, to check the status and health of key components and inform maintenance planning decisions. Meanwhile, event recorders and digital video cameras have long been a focus to improve safety, mitigate risk, and enhance operational efficiency. Bringing all these systems together on a common Connected Platform, harnessing the latest advances in Edge and Cloud computing, AI, VI and the appropriate data analytics tools, delivers added value.

Critical Element Overview

Vehicle information, including subsystems from door controllers to traction control, is gathered through an Edge computing platform. Information is gathered using the rail-hardened onboard processing capability, as seen in Fig 1. Information and data are also off-loaded to the cloud via a communications gateway. The cloud in turn supports offline analytics, and feeds data to third-party applications. The information and action requests back to the onboard platform, triggering visual or audible messages for the train crew where necessary.

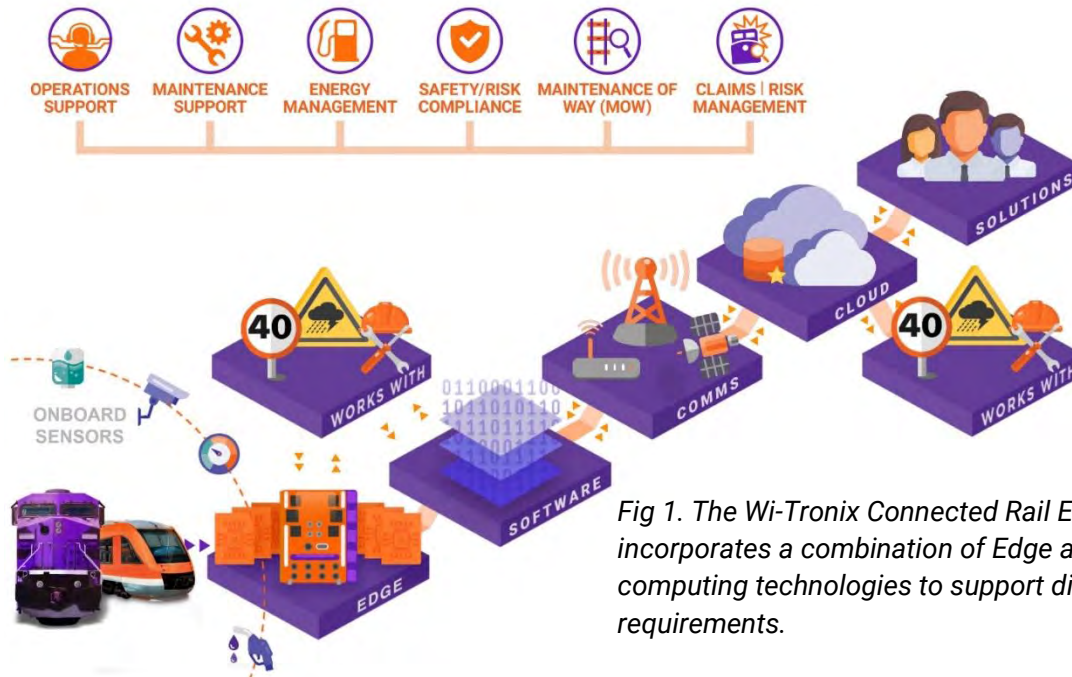


Fig 1. The Wi-Tronix Connected Rail Ecosystem incorporates a combination of Edge and Cloud computing technologies to support different operator requirements.

A critical element in the whole process is data synchronization. Data cannot simply be off boarded from individual locomotives or other vehicles in a stand-alone format. All available information (both on and off the vehicle) needs to be accurately normalized and time-synchronized in order to provide a complete picture of the overall operating environment. Data normalization is especially critical for fleets that include rail vehicles from multiple OEM or vehicles of different vintages.

A typical dataset for a diesel locomotive could include GPS location, speed, vehicle operating and systems health status, the state of operational supplies such as fuel, oil or coolant, operator commands for traction and braking, as well as weather conditions and compliance with operating rules. Combining information from multiple vehicles in the same train, where available, could potentially add further value.

Onboard Data Acquisition

A comprehensive approach for a fleet leverages the multiple data sources that already exist on board vehicles. However, diverse rail vehicle fleets include vehicles from different OEMs or different ages. This translates to a mixture of on-board data sources from the myriad of control systems. Older freight, transit, and passenger vehicles may not even have an onboard power supply suitable to support onboard data collection.

In such a complex environment, information needs to be provided in a common format regardless of the supplier, and this ideally calls for a fleet agnostic data platform.

Wi-Tronix has supplied more than 12,500 Connected Ecosystem Platforms for rail operations ranging from Class 1 freight railroads to transit and passenger railroads. Over 60 railroads leverage the power these IoT Platforms across vehicles from multiple OEMs. By supporting connections to over 100 different types of onboard systems, the IoT platforms enable great visibility into operations and maintenance. Cloud-based data playback tools, Violet View™ and Violet Live™, provide a common set of intuitive tools for users.



Fig 2. The Wi-Tronix Violet Edge 830

Modern rail operations have a wide variety of intelligent systems, with engine controls, brakes, HVAC and even sanitary systems increasingly computer-controlled. Each subsystem has its own operational status, health status, and failure condition reports which can feed data to an onboard IoT gateway.

Older locomotives typically have less data available, often just an event recorder. However, locomotives that have benefited from a mid-life refresh are often equipped with aftermarket systems focused on fuel savings, performance enhancements, or exhaust emissions reduction. In some cases specific sensors might be added to key subsystems.

The combination of video synchronized with event recorder information is immensely powerful. The fitting of cameras to locomotives and rolling stock began in the mid-2000s. Typical applications include forward-facing and cab interior cameras, while some operators include rear-facing and side-view cameras. Passenger vehicles have multiple interior and door monitoring cameras for safety and security. While the primary use case for locomotive cameras was to mitigate litigation in the event of level crossing collisions or other incidents, bringing visual analytics into the data stream adds further value for operators.

Wi-Tronix enables authorized user on-board access to signal data, video imagery data and a timeline map web-based view access to play back second-by-second data on demand remotely with Violet View™. This feature removes the delay in securing the video after an incident and saves the time needed to preserve the evidence. There is no need to locate the vehicle, drive to the location, and connect to the device physically to download the video and data.

Edge and Cloud Computing

With computing power available both onboard the vehicle and in the cloud, decisions need to be made about where and how analytic operations are best performed. The power of a fleet-wide approach combining Edge and Cloud computing cannot be minimized, but there are trade-offs between value generation and cost (Table I).

	Edge	Cloud
Time Criticality	Used for time-critical analysis. Focus is on real- time or near real-time Decision Support for operators or Decision Systems.	Used for less time-critical analysis. Focus is often on analytics or post event diagnostics. More latency introduced.
Relative Cost	Higher. The Edge processor undertakes any analytics, and this generally has a higher cost for computation due to the cost of supporting such systems, pushing software, microprocessor limits, etc.	Lower. There is a large amount of cost-effective computing power available in the cloud.

Use Case Example	Operating Rule Monitoring. Analysis of vehicle conditions and track limits for immediate alerting of driver to change operation. Examples include vehicle overspeed, excess locomotive idling, red-signal violation, and potential engine freeze. Immediate action is requested in such cases.	Fuel analytics: Fleet-wide monitoring of fuel consumption including analytics of train operation efficient, comparison reports, fuel refill tracking, and complete train reporting for all locomotives. General analytics can be completed in the cloud as they are less time-sensitive.
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Table I. Relative benefits of Edge and Cloud computing in rail applications

Data security is a key consideration. Two critical factors for data security are compliance and updates. Edge and Cloud solutions and ecosystem must adhere to recognized data security standards such as SOC2, with documented and audited testing to ensure data integrity. And the system needs to be actively managed to cope with continually evolving security threats, pushing essential updates to Edge processing platforms.

An agnostic rail Connected Ecosystem should provide remote monitoring and configuration management. Railroads have long struggled with updating software on vehicles roving across a wide area, requiring trains to be taken out of revenue service for staff to upload new versions.

Wi-Tronix keeps a record of the various software versions deployed across a locomotive fleet. Remote software updating and configuration management facilitates the automatic introduction of new functionality or updates to address security issues. Monitoring and reporting of the software versions for all connected systems is done in real-time. The pushing of updates for third-party systems through the Connected IoT Platform is already proving to be a great benefit for operators.

With Edge Computing, the onboard processing capability provides an immediate response to urgent events – allowing the use of data to take action in real-time. On a practical level, edge processing provides the ability to handle data that is too big to send off to the cloud wholesale. This means rail operators can detect and manage critical issues that need immediate intervention, such as when a train that is exceeding speed restrictions. It provides rail companies with the ability to send real-time alerts or warnings to the crew operating a train, or to management, if the train does not slow when it should.

Edge Analytics

Onboard processing capability enables an immediate response to urgent events. For example, train handling can be continuously monitored, with the driver receiving audible or visual prompts where necessary, such as a speed warning based on upcoming signal information, or advice on throttle handling, engine idling, or stretch braking of long trains on gradients.

Events such as penalty brake applications or a ‘hard coupling’ when joining trains have obvious safety implications, but analysis of the related data can also drive off board actions, including alerts and immediate data downloads. Visual analytics allow real-time monitoring of various factors including compliance with operating rules.

Cloud Computing

Using Edge computing to undertake onboard processing reduces the time needed to react to real-time train handling, and provide immediate feedback to the crew. However, broader oversight of railway operations needs to be done at a higher level. A Cloud-based approach allows data to be collected from and disseminated to many different onboard systems at the same time. Cloud computing is generally cheaper, and the larger volumes of data held off-board provide a wealth of information for analysis. This can be used to support operational recovery following an incident, as well as collating the essential data to inform any subsequent investigation.

Information processing at this level feeds into fleet management and deployment strategies, such as the analysis of asset utilization, energy consumption and crew performance. Once sufficient data is available, it becomes possible to undertake trend analysis, and move from condition-based towards predictive maintenance – with the system identifying the priorities for future interventions.

Cost is critical when considering bandwidth to support real-time data transfer. Future data communications could leverage proprietary railroad systems and networks, such as PTC. Looming larger on the horizon is 5G cellular technology, enabling many more cost-effective cloud solutions to function with less latency.

Visual Analytics and AI

Advanced analytics using tools like artificial intelligence, video analytics and visual intelligence could be either Edge or Cloud-based, depending on the cost, complexity, and latency required. This is a very fast developing field, with billions of dollars being spent on research and development every year.

It is impractical to provide a comprehensive overview of all the possibilities for advanced analytics, but some initial use cases for visual analytics include using forward-facing cameras to provide additional insight for both operations and infrastructure management.

Wayside Asset location: Cameras on passing locomotives can be used to continually identify where critical lineside assets are located along the right-of-way, either for inventory or maintenance purposes. This could allow inspection to be automated, or at the minimum increase the interval between manual inspections.

Signal Detection: Visually identifying signal aspects as viewed by the driver can be used as an additional means of oversight to ensure compliance with operating rules.

Visual analytics are starting to provide additional sources of data for rail operators, including the detection of lineside equipment (Figure 3) and trespassers (Figure 4).

Mobile device use: Distracted train crews have long been a major safety concern in the USA, and since the Chatsworth collision in 2008 there have been very specific operating rules restricting the use of mobile phones and tablets in the cab of a locomotive or driving vehicle. For example, it may be permissible for a driver to use a device when stationary, but not when moving, or maybe use is only permitted in specific geographic areas. Combined analytics would provide a holistic view of the situation –using transceivers and video monitoring to detect mobile operation, together with data on vehicle status and location to trigger an immediate alert where necessary.

Track detection: GPS typically provides sufficiently accurate information on train location for single-track lines, but it may not be cost effective to achieve the accuracy needed on double track or in yards and other complex locations. Visual analytics and GIS mapping can be combined to determine which track a locomotive is using, and its orientation. This technology can also be used where satellite signals are not available, such as in tunnels.



Fig 3. Lineside equipment detection



Fig 4. Trespasser detection

Trespasser detection: Video analytics can be used for automatic detection of trespassers or near-miss events. Creating a 'heat map' of such occurrences would enable railways to focus their capital improvements and mitigation measures on high risk areas.

The Path to Autonomous Operation

Around the world, all railways share the same fundamental objective: to move their freight or passengers as safely, efficiently, and reliably as possible. Technical innovation has driven the evolution of the rail mode, with each successive step advancing the quality of service that can be provided.

The emergence of Connected IoT Ecosystems is a genuine enabler of added value in many different areas of railway operations, permitting near real-time management of efficiency, fuel consumption, safety, and reliability, amongst other factors.

According to [Gartner](#), around 10% of enterprise-generated data is created and processed outside a traditional centralized data center or cloud. By 2025, Gartner predicts this figure will reach 75%. Given the fact that railroads have thousands of remote, mobile assets, the industry should expect an even greater percentage of enterprise data generated and processed on the edge.

As the industry continues along the path towards the long-term vision of autonomous train operation, there is much that can already be achieved, and much to learn that will help to shape the direction of travel. It is important that the industry continues to develop, as technology increases awareness of safer, more productive rail practices.

Resources

Gartner: <https://www.gartner.com/smarterwithgartner/what-edge-computing-means-for-infrastructure-and-operations-leaders/>

A Connected IoT for Rail Eco-System PDF: Combining Edge and Cloud Computing enables railway operators to consolidate and analyze multiple data streams, paving the way for automated train operation. https://www2.wi-tronix.com/wp-content/uploads/2020/05/Wi-Tronix-Ecosystem-IoT-for-Rail-Solutions_052020.pdf

Violet Edge Series PDF: Violet Edge Series Advanced IoT Platform Integrates Data From All Available Sources. <https://www2.wi-tronix.com/wp-content/uploads/2020/02/Wi-Tronix-Violet-Series-Flyer-022020.pdf>

Digital Video Recorder Packages PDF: The Violet Edge IoT platform is a connected Digital Video Recorder solution giving you secure access to view on-board data anytime, from anywhere, on any device. https://www2.wi-tronix.com/wp-content/uploads/2020/05/Wi-Tronix-Violet-Edge-DVR-Packages_052020.pdf

WI-TRONIX HAS BEEN SUPPORTING MOBILE USERS IN THE RAIL INDUSTRY FOR OVER 15 YEARS

Everywhere you go these days we are becoming more and more connected. While at your home or office, or when you are out walking, driving, or even flying, you are more connected to your friends, your work, and your entertainment. Tablets and smartphones and laptops have been the tools of our new connected life.

Wi-Tronix connects railway personnel to critical information about locomotives, from historical information for incident investigation to real-time viewing of a specific vehicle, our user portal is powerful and secure website.

We are combining edge processing with advanced systems like Visual Intelligence (VI), Artificial Intelligence (AI), and Machine Learning (ML) to detect and interpret actionable information that improves railway safety, operational efficiency and service reliability in real-time. As the preferred connected solutions provider to over one-third of all locomotives in North America, over 2,000 Wi-Tronix Violet Edge IoT platforms have been ordered and more than 12,000 rail vehicles from all types of manufacturers have Wi-Tronix systems installed.

Connect. Anytime, Anywhere, Any Device with a cohesive cloud-based IoT Platform Solution
<https://www2.wi-tronix.com/connect/>

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Alstom and Energy Infrastructure Operator SNAM have signed an Agreement for the Development of Hydrogen Trains in Italy; Italy

Josephine Cordero Sapién; published 04th June 2020; Railway News



The agreement between the two parties will run for five years. An initial phase will be devoted to feasibility studies, which are scheduled to take place in autumn 2020. Following those, the agreement aims to develop railway mobility projects, including hydrogen trains and the associated technological infrastructure, management and maintenance services. This phase is set to start in early 2021.

For its side of the agreement Alstom will manufacture and maintain newly built or converted hydrogen trains. Snam, on the other hand, will develop the infrastructure for production, transport and refuelling.



Coradia iLint Hydrogen Train at InnoTrans 2016; © a2b Global Media

Both companies have an interest in hydrogen technology, making them natural bedfellows. Alstom has developed the Coradia iLint, the world's first hydrogen train, which is currently in commercial operation in Germany. Snam has been experimenting with a 10 percent hydrogen injection into the natural gas transportation network.

Marco Alverà, CEO, Snam, said:

"This move is a further contribution to the decarbonisation of transport and to the development of hydrogen economy in Italy. Hydrogen produced from renewable will become competitive with fossil fuels in a few years and will play a key role in the energy transition, particularly in industry, heating and heavy transport. It will be a pillar of the European Green New Deal and post-Covid investments. Snam is investing and innovating to make its network compatible with hydrogen, to encourage the development of new technologies and create an Italian supply chain. Our country has the opportunity to be among the world leaders in the sector, reaping the environmental and economic benefits of this climate leadership."

Alstom managed to develop its hydrogen train in Germany thanks in part to government support. It has since also tested its operation in the Netherlands and is hoping to introduce hydrogen trains in the UK.

Michele Viale, Managing Director, Alstom Italy and Switzerland, said:

"We believe in hydrogen. This is the reason why we have signed a partnership with Snam. Coradia iLint, the first hydrogen-powered train, is already in passenger service between the towns of Cuxhaven, Bremerhaven, Bremersvörde and Buxtehude in Germany. We hope that Coradia iLint hydrogen trains will soon become a reality in Italy, too. Thanks to a partner like Snam we will be able to respond to the market by offering a full-fledged solution."

Hyundai Rotem to enters Hydrogen Train Market with a Hydrogen powered Light Rail Vehicle, LRV; Korea

Jun. 10th, 2020; written by [Kevin Smith](#); International Railway Journal

HYUNDAI Rotem has announced plans to enter the hydrogen infrastructure sector and to supply hydrogen-powered railway vehicles, with development of a hydrogen-powered LRV currently underway.



Artist`s Concept for Hyundai Rotem Hydrogen powered Light Rail Vehicle

The Korean manufacturer established a Hydrogen Energy Development team last year to begin the development of a hydrogen fuel supply division. Hyundai Rotem says it entered into a sub-license contract with Hyundai Motor in February to secure original hydrogen production technology, which together with expertise from the company's international divisions, will form the backbone of its offer.

The proposed technology can extract 640 kg of hydrogen per day from natural gas. The company hopes to reduce current costs for the on-site extraction method by 15% compared with existing methods and plans to establish a standard model for hydrogen charging stations later this year. The company will also develop a dispenser, a hydrogen charging device for vehicles, and plans to secure the additional technologies necessary to develop a hydrogen vehicle filling station for the production and storage of hydrogen, a method the company says will reduce production costs compared with extracting the fuel as a by-product of petrochemical production.

A pilot project in Changwon to establish a large mobility hydrogen mobility charging station is underway, and Hyundai Rotem says this will prove the foundation for a future fuelling station for rail vehicles.

Hyundai Rotem also revealed that it has been developing hydrogen-electric light rail vehicles in partnership with Hyundai Motor since 2019 and is planning to manufacture the first test LRVs in 2021.

The hydrogen-electric vehicles will be modular with hydrogen fuel cells, hydrogen tanks and cooling systems mounted on the roof of the vehicle. The vehicle's low-floor design will optimise space for passengers while offering additional convenience for boarding and alighting the vehicle.

Hyundai Rotem says the global hydrogen rail vehicle market is currently worth around Won 600 bn (\$ US 500 m) and it expects demand to increase as the market grows.

Max Bögl Low/Medium Speed Maglev flies from Germany to China; Germany

11th June 2020; Metro Report International



Low/Medium Speed M. Bögle MAGLEV Train-Set being loaded on Antonov Plane at Munich Airport to be shipped to China

CHINA: The first 'production' version of Max Bögl Group's urban maglev vehicle has been delivered from Munic airport to Chengdu on an Antonov Airlines 124-100 Russian aircraft.



Low/Middle Speed M. Bögl MAGLEV Train on Test Guideway, Germany

The two-car unit will be used on a 3.5 km guideway, which Max Bögl and local partner Xinzhu have built to demonstrate the Transport System Bögl concept for a low to **Medium-Speed Maglev for Urban Use.**

TSB was developed when Max Bögl revisited the ideas behind Germany's abandoned Transrapid maglev project, with the company building a short test guideway in Sengenthal near Nürnberg to refine the infrastructure, vehicle and control technology.

TSB uses track girders 1.2 m high and 23.5 m long, which is, the supplier says is, lighter than required for conventional steel wheel vehicles and is intended to reduce material costs and be more aesthetically pleasing.

Westermo has supplied a redundant ring ethernet data communication network for the Chengdu test track.

Urban Transport Industry News Round-Up I; Global

1st July 2020; Metro Report International



The first of 12 lightweight trainsets which CAF is supplying for the **Schönbuchbahn** was delivered on June 26th 2020. The 17 km branch line near Stuttgart is being rebuilt to light rail standards and electrified in a project scheduled for completion next year.



PT MRT **Jakarta** commenced construction of Phase 2 of the city's north-south metro line on June 15 after a three-month delay owing to the Covid-19 outbreak. It now expects construction of the 2.8 km underground extension from Hotel Indonesia (Bundaran HI) to the National Monument to be completed by March 2025.



Responsibility for maintenance of **Palermo's** tram fleet transferred from Bombardier Transportation to CAF on June 30. The new contract runs for four years.



Uttar Pradesh Metro Rail Corp organised a 10-day 'Business Communication Skills during Covid-19' workshop for frontline staff in collaboration with the Regional English Language Office of the US embassy. Topics included in-person, video, written and non-verbal communications, as well as professional e-mail writing.



Traktionssysteme Austria is to design and supply traction motors for the 43 driverless light metro trainsets which CAF is to build for entry into service on **London's** Docklands Light Railway from 2023.



Transport for West Midlands, **West Midlands** 5G and Vodafone have signed an MoU to work together on projects where 5G telecoms could improve transport and support reduction of congestion and emissions. This includes a connected tram trial, where WM5G is working with infotainment provider GoMedia, wireless internet specialist Icomera and the British Transport Police to connect CCTV into a 5G network so that high-resolution video footage can be monitored in real-time from the to the Regional Traffic Control Centre.

Urban Transport Industry News Round-up II, Global

24th June 2020; Metro Report International



Metrô **Rio** has awarded Alstom a two-year contract to provide post-warranty remote support services for the operational control centre which manages lines 1, 2 and 4.



On June 15 Metro de **Bilbao** finally opened Ibarbengoa station on Line 1. The station was built in 2012, but opening was delayed pending the completion of a 295-space three-level park and ride car park, on which work started in 2017 in the face of local opposition.



On June 15th 2020 MBTA and the Cubic/John Laing consortium finalised the amended contract for **Boston's** fare collection system renewal programme. The revised agreement incorporates improvements to the original AFC 2.0 contract based on feedback from customers, advocates and policy makers.



Metro de **Sevilla** has installed vending machines selling face masks and sanitising gel at all stations. Services were restored to pre-March 14 lockdown frequencies on June 12.



The US Federal Transit Administration has awarded **Dallas** Area Rapid Transit \$1m to plan for transit-oriented-development at five stops along the planned 3 km Downtown Dallas Subway light rail line from Victory Park to Deep Ellum.



VolkerRail is renewing 500 m of plain track and a crossover between **Nottingham** Express Transit's Royal Centre and Old Market Square tram stops. 'We've been operating for 16 years, and it has now become necessary to replace some of the older sections of track', said Keolis Nottingham's head of operations Mike Mabey. 'This work will take a little longer than originally planned, so VolkerRail can stick to social distancing guidance, but the timing should mean it will disrupt fewer people given much lower numbers of passengers, traffic and city visitors than normal.'



Chicago Transit Authority has been distributing free 'Travel Healthy' kits to passengers, containing a bottle of hand sanitiser, a reusable cloth mask and a healthy riding tips guide. 'As the city reopens and CTA welcomes customers back, we want to encourage everyone to continue to follow the healthy habits we've all learned since mid-March', said CTA President Dorval R Carter, Jr.



Uttar Pradesh Metro Rail Corp marked the 6th International Yoga Day on June 21 with a 1 h online yoga session which staff could join from home. Participants were introduced to posture, breathing exercises and meditation according to a protocol issued by the Ministry of Ayush which promotes indigenous alternative medicine systems. 'In these troubled times of corona pandemic, all of us need to improve our immunity and for this yoga is one of the most effective tools', said Managing Director Kumar Keshav.

Urban Transport Industry News Round-Up III; Global

17th June 2020; Metro Report International



Qatar Rail has begun taking delivery of 35 additional driverless metro trainsets, which Kinki Sharyo is supplying to increase the **Doha** Metro fleet from 75 to 110 three-car sets ahead of the 2022 FIFA World Cup.



South Korean railway signalling company DaeA-Ti has awarded Thales a contract to provide signalling equipment for the **Incheon** Line 2 depot capacity increase project. The work will accommodate six new trains that are scheduled to be delivered next year; these will be fitted with Thales' Vehicle On Board Controllers which were ordered separately by rolling stock manufacturer Wooin in 2019.



Moscow Metro passengers can apply for refund or replacement for the trips they paid for but did not make owing to the coronavirus outbreak. A ticket will be considered for refund if passengers did not make more than 22 trips made between March 30th and June 8th, 2020; they will get back the number of trips or travelling days that remained unused.



Construction contractor Çelikler Taahhut has awarded Thales a contract to supply SelTrac CBTC for the 7.5 km metro line M10 line which will serve Sabiha Gokcen International Airport on the Asian side of **Istanbul**.



Endesa Energía has been awarded a € 9.5 m one-year contract to supply electricity for FGV's train, tram and metro networks in **València** and **Alacante**, including stations, depots and other buildings.



The Thales SEC Transportation System joint venture is to supply CBTC for the 39.6 km first phase of **Nanchang** metro Line 4 from Baimashan to Yuweizhou.



On June 11, 2020 the **USA's** federal government announced that nearly 100 million cloth facial coverings would be sent to rail, urban transport and aviation sectors for passenger

use. Approximately 86.8 million coverings will be distributed to airports, and 9.6 million to 458 transport agencies and Amtrak.



Transport for **London** has begun a phased resumption of construction projects including the Bank Station Capacity Upgrade, the Northern Line Extension, Four Lines Modernisation, Barking Riverside Extension and the renovation of the Central line train fleet. Construction at around 300 sites had been brought to a halt in late March as part of coronavirus measures. Changes to ways of working which are being introduced by TfL and its contractors include staggered shifts and breaks, signage for social distancing, one-way walking routes and additional staff welfare areas.

On June 15 Vy Buss put into service in the Swedish town of Gävle a fleet of 24 Solaris Urbino 12 rigid and 16 Urbino 18 articulated buses fuelled by compressed natural gas.

Myanmar to start Yangon Sky Train Project in 2020; Myanmar

The Project, which is also called the Yangon Urban Mass Rapid Transit, will connect the eastern and western Parts of Yangon.

By Kanika Verma 06/08/2019; Metro Rail News



Suspended Sky Train System SAFE, Qingdao, China

YANGON: Myanmar planned to implement a sky train project in the commercial city of Yangon starting 2020, according to the [Ministry of Transport and Communications](#) Monday.

The over 1-billion-U.S. dollar project, which includes 13 stations, is expected to be completed by 2027.

The project, which is also called the Yangon Urban Mass Rapid Transit, will connect the eastern and western parts of Yangon.

The 18 km sky train project will start from Hlaingthaya township Station, run along the Yangon-Pathein road, cross over Hlaing River in the south of Bayinnaung Bridge and then run from Okkyin Station along the Parami Road before reaching Tokyaung Kalay Station.

The sky train is claimed to be based on standard models of Thailand and Indonesia.

Bangkok Gold Line People-Mover Car delivered; Thailand

19th June 2020; Metro Report International



THAILAND: Bangkok Mass Transit System has taken delivery of the first of three two-car Bombardier Transportation Innovia 300 automated peplemover sets for the future Gold Line



The 2.7 km first phase of the Gold Line will connect the existing BTS Green (Silom) Line Skytrain station at Krung Thon Buri with residential and commercial property developments. There will be three stations, with Charoen Nakhon serving the Iconsiam shopping and mixed-use development and Khlong San for the Taksin Hospital.

The first 1.7 km and two stations are scheduled to open in October 2020, followed by the full line in early December 2020.

Bombardier Transportation is supplying the vehicles, lineside systems and its Cityflo 650 automated control system. Design and delivery is being managed from its engineering centre in Bangkok, with the vehicles manufactured in China by the CRRC Puzhen Bombardier Transportation Systems joint venture.

ST Engineering is supplying the automatic fare collection system, and Teltronic the TETRA radio communications. AMR Asia is system integrator.

A proposed second phase would extend the line to the Phra Pok Klao and Memorial bridges.

The first Bombardier Innovia monorail 300 trainsets for Bangkok's Pink and Yellow lines are scheduled to be delivered in October.

Chengdu prepares to open two 140 kmph Express Metro Lines; China

Apr. 2., 2020; written by David Briginshaw ; International Railway Journal

THE Chinese City of Chengdu is gearing up to open lines 17 and 18 later this year. The two lines will be operated as express metro lines using trains with a maximum speed of 140 kmph.



CRRRC has completed delivery of 26 trains for Line 18, one of two express metro lines due to open in Chengdu later this year.

Line 17 will run from Venus east to Jitouqiao where it will connect with the future Line 9. It will be 26km long with nine stations, two of which will be elevated and seven underground. Line 18 will be 66.8km long with nine underground stations and only one elevated station. Line 18 will run south from Chengdu South mainline station to Tianfu Airport, where there will be two stations, one serving Terminals 3 and 4, and Terminals 1 and 2.

Civil works and track laying have been completed on Line 18, whereas civil engineering is in the final stage of completion on Line 17 and mechanical and electrical system installation is in full swing. The two lines will be electrified at 25kV ac rather than 1.5kV dc, which is used on existing metro lines.



Drivers lined up in Front of the new Trains for Chendu's new Express Metro Lines

CRRC has completed delivery of the 26 trains which it is supplying for Line 18. Type testing of the first train was officially launched in the last week of March. Eight trains have been delivered for Line 17, of which five have been commissioned.

All 54 drivers recruited to operate the two lines have passed their assessment and acceptance tests and have been officially “posted”.

Linear-Motor Subways: The Future of Urban Mass Transit; Japan

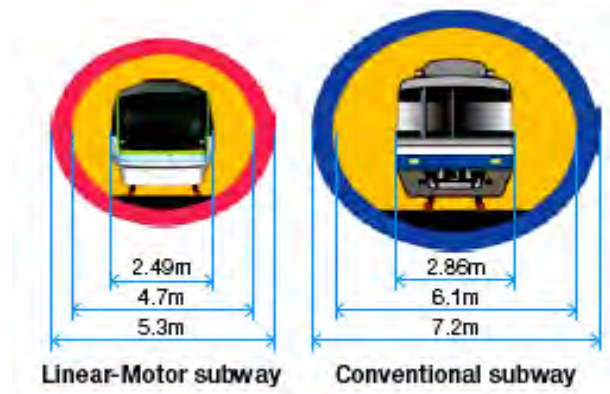
The Nanakuma Subway Line in Fukuoka, Japan, which opened in February 2005, is a **Linear-Motor Subway** developed by Hitachi, Ltd. Compact, good at handling curves and steep grades-and garnering attention as the regional mass transit system of the future.



Fukuoka Municipal Subway, Nanakuma Line with Hitachi Linear-Motor Propulsion

A linear-motor subway is driven by a linear motor where magnetic energy is generated between magnets in the train and plates in the track. This allows the chassis of the cars to be lower than conventional subway cars, and a more compact design, in turn, allows the diameter of tunnels to be reduced by almost half.

Another feature of a linear-motor subway is to allow exceptionally tight curves because of the magnetic propulsion system and to enable the rails to be laid beneath existing roadways and intersections-reducing the constraints on new routes. These characteristics of a linear-motor subway reduce the environmental impact: smaller-diameter tunnels are less costly to build and there is less excavated dirt and rocks.



Comparison of Linear-Motor and conventional Subways



Fukuoka City Subway's Nanakuma Line has a number of innovations in addition to linear-motor propulsion, focused on the goal of passengerfriendly regional public transportation. For developing the cars, the priorities were noise reduction, roomy interiors, and Universal Design. Input from a design committee, made up of the Fukuoka City Transportation Bureau, local residents and experts, was closely evaluated.

Reduced tunnel diameters can also mean increased noise, but this was minimized by soundproofed wheels, anti-vibration materials, and double-glazed windows. To produce a sense of spaciousness, and to make the best use of limited interior space, under-seat lighting and other elements were used.

Other aspects of overall system and station design include the operations control system designed by Hitachi for greater safety and reliability, elevators for easy wheelchair access, and less gap between trains and platforms. Aboveground entrances were also given an innovative design, reflecting the local cityscape.

The new line has become a convenient transportation system for local residents, linking residential areas with the city center and alleviating traffic congestion within the city. In recognition of these achievements, at the 35th Machine Industry Design Awards in 2005 (sponsored by Nikkan Kogyo Shimbun), Hitachi shared the Minister of Economy,

Trade and Industry Award with the Fukuoka City Transportation Bureau and also won the Laurel Prize given by the Japan Railfan Club.

Hitachi will continue to provide comprehensive solutions for people-friendly regional public transportation, from design and construction of the trains to the systems used to monitor and control them.

(Published in July 2007 by Hitachi)

METRO NEWSLETTERS

Transport Technologies for “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN, INTERURBAN AND REGIONAL PASSENGER TRANSIT TECHNOLOGIES FOR URBAN MOBILITY AS A SERVICE WITH METRO-BUS, BUS RAPID TRANSIT, URBAN RAIL, LIGHT-RAIL, LIGHT METRO, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, COMMUTER-RAIL, MONO-RAIL, AERIAL ROPEWAY, BOTTOM CABELLINER, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER, POD CAR, SUSPENDED MONO-RAIL METRINO

THE WORLD OF TRANSPORT TECHNOLOGIES AND ECONOMICAL DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT



Design Study for new BOMBARDIER *MOVIA* Metro Train-Sets for Agra and Kanpur

METRO 106, August 2020
METRO Newsletter by Dr. F.A. Wingler

Synopsis/Highlights

A. India

"Make in India" of Metro Coaches has become another Success Story.

The Zero-Carbon-dioxide Electricity Production by Solar Power for Delhi Metro has become a great achievement.

Bangalore will become **Light Rail Transit**.

Titagarh Wagons India will supply for Indian Metro Rail **IGBT based three phase asynchronous AC Propulsion Systems**.

Matheran Funicular Railway – an eco-unfriendly and uneconomical dream.

Uncompleted Funicular Railway Project near Kalyan, Maharashtra, is left to corrosion.

Kolkata East-West Metro Rail reaching Howrah under Hooghly River in progress. Trains are coming from BEML, India. The Tunnel Boring Machine, that hit in an in a soft alluvia strata a water-sand slurry with the disaster of crumbling houses in Bow Bazar area, will get retrieved after the ruined houses got razed to ground and the area cleared for digging a recovery shaft. India's deepest Metro Rail Ventilation and Emergency Evacuation Shaft nearly complete. Jindal Steel delivers for East West Metro first time in India indigenous milled Head Hardened Rail for a Metro Rail in India

B. Global

Tram-Trains, that run in cities on streets, at grade, on reserved lanes or underground using for regional and town-to-town public transport also governmental main railway-tracks, are becoming more and more popular in Europe.

Transport of goods, material, freight, supply- and delivery commodities/wares is in Indian Mega Cities despite the installation of Metro Rail a still unsolved problem. The German Town of Karlsruhe plans the freight transport/delivery by tram-trains.

Nokia offers solutions for Cyber Security and 5G Communication for Urban Rail.

Headlines of Newsletter METRO 106:

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- THE FUTURE OF METRO COACH INDUSTRY IN INDIA.
- "MAKE IN INDIA" of Metro Cars - another Success Story.
- Bombardier starts dispatching MOVIA Metro Coaches to Delhi Metro.
- Agra and Kanpur combined Metro Train and Communication Based Train Control, CBTC, Contract awarded to Bombardier.
- DMRC became one of the greenest Metro Services in the World.
- Bangalore, LITE Metro Rail most viable for connecting Kempegowda International Airport, KIA, with Silk Board: Bangalore Metro Rail Corporation Ltd., BMRCL.
- Nashik Metro Neo Proposal takes a Step ahead towards Approval.

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II. Global Activities and Initiatives

- Urban Transport Industry News Round-up I-IV.
- Electro-Diesel Tram-Train Order expanded to support Tram-Train Service Increase in Hungary.
- Freight Tram-Train to be tested in Karlsruhe, Germany.
- AVG Flexity Tram-Train delivered by Bombardier to Karlsruhe.
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- A new Platform for Rail Communications – adopting 5G for Railways.

PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

Mumbai – Ahmedabad High-Speed Project takes Stock; India

June 29th, 2020, International Railway Journal; written by [David Briginshaw](#)

India's first high-speed project – a 508 km new line linking Mumbai with Ahmedabad – faces major challenges to meet the December 2023 opening date.



Artist`s Concept for Vadodara High-Speed Railway Station

Services on the line are due to begin in December 2023, but it is yet to be seen whether this goal will be met.

MR. Achal Khare, managing director of India's National High-Speed Rail Corporation (NHSRCL), which is responsible for implementing the Mumbai – Ahmedabad high-speed project, has been facing uncomfortable questions recently.

These include how real are fears that the project – India's first high-speed railway – is likely to miss its December 2023 completion deadline and suffer higher costs. With execution work on the line at a standstill for the last three years, what is the justification to invite tenders to prepare Detailed Project Reports (DPRs) on six other lines? What are the reasons for the variance in figures furnished by NHSRCL and the state governments of Gujarat and Maharashtra regarding land acquisition? How will the project re-start in Maharashtra following the decision by Mr Uddhav Thackeray, the state's new chief minister, to halt execution work on a scheme he describes as a "white elephant"?

Khare faces other challenges too. In the wake of the coronavirus pandemic, the Indian government has banned all foreign nationals from entering the country, which is likely to adversely impact project implementation. Indeed, 80% of the Rs 1 trillion (\$US 14.6 bn) needed to fund the project will come from a 20-year Japan International Cooperation Agency (Jica) loan of Rs 880 bn with a 1% interest rate and a 15-year moratorium on repayment.

Another problem concerns the ever-widening gap between the Indian rupee and the Japanese yen. When the contract was signed in 2014, the value of the Jica loan component was estimated at Rs 880bn, but the fall in the value of the rupee against the yen is estimated to have increased the cost of the project by Rs 430bn. "The Memorandum of Understanding between the two countries covers depreciation costs, but not currency fluctuations," Khare admits.

If the rupee does not stabilise, the Indian government could well end up paying substantially more to repay the loan in addition to the interest payments to the Japanese

government. "The Delhi Metro had a Jica loan of approximately Rs 10bn in 2002 but ended up paying back Rs 17 bn, an increase of 70%, after the end of the 10-year moratorium in 2011-12. A similar situation cannot be ruled out in respect of the loan for the high-speed project," former Railway Board member, Mr Subodh Jain, warns.

"These are time-consuming and complex issues, but it is difficult to proceed without resolving them first."

Achal Khare, Managing Director of India's National High-Speed Rail Corporation (NHSRCL)

Additionally, the trend of spiralling project costs does not appear to have been halted. From the initial estimate of Rs 970 bn, the project cost climbed to Rs 1080bn after the Indian government opted for an almost entirely elevated line, and there have been indications lately that the project cost could rise still further.

"Some changes in project costs are likely because of certain alignment changes and engineering modifications," Khare says. "For example, instead of the earlier plan to use drilling and blasting for tunnelling, it has been decided to use 13.2 m-diameter tunnel boring machines to bore tunnels beneath Thane Creek near Mumbai where there is a flamingo sanctuary. Design changes have also been made to the construction of Vadodara's high-speed station because the height of the station and overhead wires in the original plan would have interfered with the guidelines of the Airport Restrictions Zone."

Project costs are also likely to escalate because of the growing demand from farmers for a bigger compensation package in exchange for surrendering land for the project. Farmers in Maharashtra and Gujarat have refused to part with their farmland for the project.

Growing Criticism

NHSRCL has faced growing criticism regarding the slow progress in executing the project. Early last year, the corporation floated nine civil work tenders out of the total of 14, but the opening date of the financial bids was continuously pushed back from November last year to January and then March this year. Now, the latest projections are that the bids will not be opened until November. "Unless the monetary issues are sorted out between India and Japan, it will not be possible for NHSRCL to open and award the tenders," an official earlier associated with NHSRCL says.

"Some changes in project costs are likely because of certain alignment changes and engineering modifications."

Achal Khare

Unofficial estimates are that the Japanese component of the project has nearly doubled and that NHSRCL has been under pressure to revise its financial estimates. Khare, however, maintains that the exercise to formulate the project estimates will be undertaken after the bids are opened. Regarding the decision to push back the tender opening date, he said that this had been done on account of the corporation's other preoccupations.

Nevertheless, Khare lists the achievements so far:

- tendering of civil works for 345 km out of a total length of 508km

- relocating 916 of the 1638 public utilities involving state governments
- completion of joint measurement surveys in 291 of the 297 villages identified for purchase
- acquisition of 810 hectares of the total of 1396 hectares needed for the project, and
- finalisation of a system to pay compensation to farmers for land surrender.

In addition, an agreement on moving utilities to build the high-speed station on a 76 hectare site at Sabarmati in Gujarat has also been reached, while a high-speed training institute has been constructed at Vadodara and will open in December.

“These are time-consuming and complex issues, but it is difficult to proceed without resolving them first,” Khare says.

However, major tasks remain. A joint venture for rolling stock assembly or manufacture has yet to be agreed. “Japanese companies such as Kawasaki and Hitachi have been in talks with Indian public sector undertakings, such as Bharat Heavy Electricals Limited (BHEL) and Bharat Earth Movers Limited (BEML), and an agreement is expected to be firmed up soon,” Khare says.

A bigger challenge will be resolving issues concerning project finance at upcoming meetings of the Indo-Japan Technical Committee and the Project Joint Committee, co-chaired by Mr Rajiv Kumar, vice-chairman of the Indian government policy think tank Niti Aayog.

But the biggest challenge will be meeting the December 2023 completion date, when 10-car trains each carrying 750 passengers are due to start operating on the new line. As traffic builds up, 16-car trains carrying 1250 passengers will be introduced. The line is expected to operate 35 trains per day per direction, carrying 17,900 passengers. Traffic on the new line is eventually expected to reach 92,900 passengers/day.

Mumbai – Ahmadabad High-Speed Line:

Total length – 508 km.

Elevated – 471 km.

Tunnels – 25 km.

Embankments and cuttings – 12 km.

Stations – 10.

Design-speed – 350 kmph.

Journey-time – 2h 10 min.

THE FUTURE OF METRO COACH INDUSTRY IN INDIA; India

Source: UITP India 2014

Metro is emerging as key solutions to fulfil demand for urban transportation in India. As per Ministry of Urban Development (MoUD), about 316 kilometres of Metro rail is under operation and more than 500 km of Metro Rail is under construction across the country. It is expected that 5 new systems will become operation by 2017, mainly Hyderabad,

Lucknow, Noida, Kochi and Navi Mumbai. Some of the metro lines, like Nagpur and Ahmedabad are under construction.

The emergence of metro sector in India has also benefited construction and equipment industry. Further, it has helped to commence metro coach industry in India. The country imported the CBUs (Completely Built Units) from Germany and South Korea at the launch of Delhi Metro Rail Corporation (DMRC).

Metro Coaches – ‘Make in India’

The industry has covered the long way in last 15 years from being an importer of metro coaches to become exporter of coaches to other countries. 90% of the coaches supplied to Delhi metro are manufactured in India and also maiden consignment of six metro coaches made in Bombardier facility were shipped to Queensland and Sydney Metros in Australia in January 2016. Bombardier Transportation will export a total of 450 metro coaches over a period of two-and-a-half year. Further, India will also be exporting 521 bogie frames to Brazil for Sao Paulo Monorail.



Copyright: Team-bhp

The contract conditions of DMRC mandate a cap on upper limit of 25 per cent for production abroad while the balance is to be necessarily manufactured in India either through tie-ups or a wholly-owned subsidiary. This conditions pushed international manufacturers to setup facility in India. This has helped to also boost establishment of ancillary units and helped generate employment.

To move up in value chain, the companies has started indigenisation process and major sub system of metro coaches have been indigenised. Other parts including window glasses, battery boxes, brake blocks, bogie frames, vacuum circuit breakers, propulsion among others are also being manufactured in India.

Manufacturing Units in India

The capital costs of Metro coaches in India are substantially lower than the rest of the world. The capital cost of a coach is around INR 89.4 million (US\$ 1.35 million) in India,

the cost in Vancouver is INR 160.8 million (US\$ 2.5 million) and in San Francisco is INR 151.3 million (US\$ 2.30 million). Three Metro coach manufacturing units have already been established in India:

Name of the Company	Facility at	Year of Establishment
Bombardier Transportation	Savli near Vadodara (Gujarat)	2008
Bharat Earth Movers Limited (BEML)	Bengaluru (Karnataka)	2015
Alstom Transport	Sricity near Chennai (Tamil Nadu)	2010

China Railway Rolling Stock Corp (CRRC) is planning to setup its manufacturing unit in the Multi-modal International Cargo Hub and Airport at Nagpur (MIHAN).

Metro Coaches Market

The existing numbers of coaches supplied or ordered for various metro project is as follows:

Metro Rail Project	Rolling Stock Suppliers	Coaches
Delhi Metro (Broad Gauge)	Consortium of Hyundai, Mitsubishi & MELCO / Bombardier / BEML	1232
Delhi Metro (Standard Gauge)	BEML	164
Bangalore Metro	BEML-led consortium with Mitsubishi & Hyundai	150
Mumbai Metro	CSR Nanjing (China)	64
Jaipur Metro	BEML	40
Kolkata Metro	CNR Dalian (A subsidiary of CRRC)	112
Chennai Metro	Alstom	168
Gurgaon Metro	CSR Zhuzhou (A subsidiary of CRRC)	36
Hyderabad Metro	Hyundai -Rotem	171
Lucknow Metro	Alstom Transport	80
Kochi Metro	Alstom Transport	75
Nagpur Metro	CRRC	69
Navi Mumbai Metro	CSR Zhuzhou (A subsidiary of CRRC)	12
Noida Metro	CRRC	76

(Disclaimer: Numbers released by metro operators or manufacturing agency in public domain)

Future Demand

As per industry estimates, there will be a demand of 2000 metro trains in India in the next 5 years (2015-2020). The Delhi Metro currently operates with a fleet of 227 train sets comprising of 128 six coach, 58 eight coach and 41 four coach trains across all its corridors. A total of 924 coaches have been ordered for the forthcoming phase of Delhi Metro including 504 coaches for the new Phase 3 corridors.

Further, new metro systems like Ahmedabad, Vijayawada, Kanpur etc. will release tender in coming months for the procurement of rolling stock.

“MAKE IN INDIA” of Metro Cars - another Success Story; India

Metro Rail News, Issue July 2020

When the first line of Delhi Metro was inaugurated in 2002, the coaches were imported as CBUs (Completely Built Units) from Germany and South Korea. 16 years later, 90% of the coaches running on the 8 lines of the over 300 km network of the country's largest and the world's 9th longest Metro network in Delhi is made in India. This indigenisation of Metro coaches was facilitated by the contract conditions of DMRC, which mandated a cap on the upper limit of 25 % for production abroad with the balance to be manufactured in India.

This in turn brought in global manufacturers like Bombardier, Alstom, Hyundai Rotem (with BEML) and Titagarh Firema to form their subsidiaries and joint ventures in India. In 2019 Titagarh Firema has been awarded a contract by Maharashtra Metro Rail Corporation (Maha Metro) to supply 102 aluminum-bodied metro cars for the first phase of the metro network in Pune. Alstom India rolled out the 100th 'Make-in-India' metro train-set today from its state-of-the-art rolling stock manufacturing facility in Sricity, Andhra Pradesh. The delivery of the centurion trainset to Kochi Metro Rail Corporation Limited (KMRCL) also marks completion of the Kochi Metro order for 25 trainsets by Alstom. Kochi operates a 100% 'Make in India' metro fleet entirely custom-built at the flagship manufacturing facility at Sricity. The facility was set up in 2013 as Alstom's first global manufacturing centre for rolling stock in the Asia-Pacific region.

This plant commenced operations in November 2013 and delivered its first metro train-set to Chennai Metro Rail Corporation (CMRL) in February 2014. The facility currently employs more than 600 employees and has a production capacity of 240 cars per year. The factory is currently scaling up to double production capacity and also introducing latest industrial Technologies.

Till date, Alstom's Sricity facility has made on-time deliveries of more than 420 metro cars for its Indian and international customers. This includes delivering completely indigenous trainsets to metro rail corporations of Chennai, Lucknow, Kochi and Sydney (its first international order).; see newsletter **METRO 103**, page 20 in PDF Portfolio **METRO 9**, <http://www.drwingler.com>.

In December 2018 Alstom achieved a significant milestone by completing the export of the last of the 22 Metropolis trains for Sydney Metro, Austria, delivered from its 2013 set up Sricity facility.



***"Last Polish"* on Metro Car build at ALSTOM Plant at Sricity before Shipping to Australia**

Alstom India has began from early 2019 to work on its **Success Story**.

In 2002, BEML forayed into the manufacturing of state-of-the-art Metro Coaches. Since then, more than 1600 metro coaches have been supplied to various metro rail corporations in India such as Delhi, Bangalore, Jaipur, Kolkata and Mumbai. BEML holds over 48 percent market share in Metro coach segment in India against stiff competition.

To cater for burgeoning metro orders, BEML recently set up an additional assembly line, and currently the Company has the capacity in its units to produce over 700 rail coaches per year and 300 metro cars per year. Further expansion plans would be based on market demand to augment the annual production capacity by 360 metro cars.

With the experience gained in manufacture, integration and testing of Metro cars, BEML expanded its role in Metro Business and is commanding a good market share in India; see exclusive Interview with Dr. Deepak Kumar Hota, Chairman & Managing Director, BEML, in METRO RAIL NEWS, Edition May 2020, page 24, ISSN 2582-2330 / Vol. IV / Issue 41; Symbroj Media Publication, India



BEML build Metro Train for Bangalore Metro

Metro Rail Trainset Manufacturing Units in India; source UITP India 2014

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Titagarh Firema India Ltd.	Mahametro Coach Facility Nagpur	1998

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Pune Metro	Titagarh Firema Wagons Ltd. India (a subsidiary of Titagarh Firema Italy)	102

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Source: UITP India 2014

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Bombardier starts dispatching MOVIA Metro Coaches to Delhi Metro; India

The new Coaches will join the running Fleet of the Delhi Metro once the Services resume after a long Shutdown imposed by the Pandemic and the Lockdown.

By Manoranjan Kumar; 10/08/2020; Metro Rail News



Bombardier Coaches for Delhi Metro

SALVI/NEW DELHI (Metro Rail News) – Bombardier Transportation has begun dispatching new MOVIA metro coaches to Delhi Metro Rail Corporation (DMRC). The train coaches are being supplied from its plant located in Savli, Gujarat. This delivery is part of a 40 coach order for which the firm had been awarded a tender last year in March.

DMRC had in October 2018 invited bids for supplying a fleet of 40 new broad gauge coaches compatible with its existing RS2, RS5, RS7 and RS11 type train-sets supplied by Bombardier in the past and according to the industry experts, Bombardier was naturally the only bidder for this contract even though the DMRC went for a tender. The industry

experts say that no one else other than the Bombardier transportation was able to supply the coaches demanded by the DMRC.

With an estimate of RS 562, the final contract was awarded to the Bombardier transportation for 430 crores after negotiations between the DMRC and the Bombardier transportation in March last year. Bombardier Transportation is sending these coaches from its Savi plant located in Gujarat.

It is not known yet to us about the destination of these coaches. As per the sources, it may be either the 49.31 km Yellow line's Khyber Pass Depot in North Delhi or Sultanpur Depot in South Delhi. The sources familiar with the matter told that the DMRC has not made it clear yet and we will need to wait for knowing it. Once the coaches arrive then only it will become clear as which depot, the DMRC chooses for these coaches.

"The firm had a deadline of 100 weeks to supply all 40 coaches after the letter of acceptance was issued on May 16th 2019" said one official.

Agra and Kanpur combined Metro Train and Communication Based Train Control, CBTC, Contract awarded to Bombardier; India

3th July 2020, Metro Report International



The two-line Agra Metro will serve one of the largest Cities in Uttar Pradesh, including Tourist Highlights such as the Taj Mahal and Agra Fort

INDIA: State Project Promoter Uttar Pradesh Metro Rail Corp. has awarded Bombardier Transport India a € 245 m contract to supply 67 three-car trainsets as well as Cityflo 650 communications-based train control for the metro projects in the cities of Kanpur and Agra.

Announcing the contract on July 3, 2020, UPMRC said four international bids had been submitted on February 18th 2020. Following a 'a very detailed' evaluation of the technical offers China's CRRC was disqualified. The financial offers of the three remaining bidders were then reviewed, with Bombardier's bid coming in lower than offers from Alstom and a joint venture of BEML and Hitachi.



Design Study for new BOMBARDIER MOVIA Metro Train-Sets for Agra and Kanpur

The 'state of the art' stainless steel trains from Bombardier's Movia family are to be designed at the supplier's centre in Hyderabad and manufactured at its plant at Savli in Gujrat, which UPMRC said would be 'another feather in the *"Make in India"* cap'. There is an option for a further 51 cars.

The two metros will have closely-spaced stations about 1 km apart, with the trains having a design speed of 90 kmph and operating speed of 80 kmph. Delivery of the first set is planned within 65 weeks.



Kanpur will have two lines, running 23.8 km from the Indian Institute of Technology Kanpur to Naubasta with 14 elevated and eight underground stations, and 8.6 km from Agriculture University to Barra-8 with four elevated and four underground stations.

Agra's Line 1 will run for 14.0 km from Sikandra to Taj East Gate with six elevated and seven underground stations serving destinations including the Taj Mahal, Agra Fort, Raja Ki Mandi station and the medical college. Line 2 would run 15.4 km from Agra Cant to Kalindi Vihar, with 14 elevated stations.

By combining the rolling stock and signalling contracts UPMRC hopes to replicate the rapid timescale of **Lucknow Metro** Phase 1A, which it said was the 'fastest metro project implementation in the country' having taken less than 4½ years and with the first trainset delivered in 64 weeks.

Separately, UPMRC has awarded a joint venture of Italferr of Italy and Tysa of Spain a € 43.6 m contract to provide project management services for the two metro schemes.

Civil works on for the **Kanpur Metro** are now back 'in full swing' after the coronavirus lockdown, UPMRC said, and the award of the rolling stock and signalling contract would 'not only boost the economy but will also bring the people of Kanpur and Agra closer to their dream of having their own metro'.

DMRC became one of the greenest Metro Services in the World; India

Metro Rail News, July 2020



Rewa Solar Power Park, Madhya-Pradesh, for Delhi Metro Rail

Delhi Metro Rail Corporation (DMRC) had recently announced that it is meeting 32 percent of its total energy requirement from the 750 MW **Solar Power Project** set at Rewa Solar Park in Madhya Pradesh, making it one of the greenest metro services in the world.

"PM Narendra Modi has dedicated the Rewa Solar Energy Plant to the nation. DMRC is meeting nearly 60 per cent of daytime energy requirements from Rewa and overall 32 per cent of total energy requirements from Rewa. With this, DMRC has become one of the greenest Metros in the world," a tweet by the official handle of the Delhi Metro Rail Corporation.

PM Modi while inaugurating Asia's largest 750 MW solar power project set at Rewa in Madhya Pradesh said that solar energy is the pure form of energy and would help the country towards achieving "Atmanirbharta" (self-reliance).

"Not just for the present, solar energy will be a medium of energy needs of the 21st century because solar power is sure, pure, and secure. It is sure because the Sun would shine throughout the world; it is secure because solar energy rather than polluting the environment, helps in replenishing it and it is secure because it is a testimony and inspiration towards 'atmanirbharta'," the Prime Minister said in his address, in which he dedicated the project to the nation.

The Rewa Solar Park is comprised of three solar generating units of 250 MW each located on a 500n hectare plot of land situated inside a solar park. Central financial assistance of Rs. 138 Crore has been provided to Rewa Ultra Mega Solar Limited (RUMSL) for the development of the solar park.

Lite Metro Rail most viable for connecting Kempegowda International Airport, KIA, with Silk Board: Bangalore Metro Rail Corporation Ltd., BMRCL; India

Metro Rail News, July 2020



Representative Picture of Light Metro Rail Transit at Adis Abbaba, Eritrea; Pict. by Aleksandr Prodan

Following a study conducted by Bangalore Metro Rail Corporation Ltd. (BMRCL), a six-car metro system has emerged as the most viable mass transit system to connect the Kempegowda International Airport (KIA) with Silk Board. The BMRCL conducted the analysis through iDeCK for Outer Ring Road (Silk Board to KR Puram) and KR Puram to KIA lines. The study analysed various transit systems including, Bus Rapid Transit System (BRTS), Monorail, **MetroLite** – elevated metro system (six-coach trains running at 3-minute headway) and Heavy Metro (8-coach trains at 3-minute headway). Various parameters, which were considered for the analysis includes mobility effects, conceptual engineering effect, cost of the project, environmental, and social impact were considered for evaluation.

According to the study on the Outer Ring Road Line, around 4.5 lakh employees are working in tech parks and other companies on the corridor. Moreover, as per estimations, an additional 30 million square feet would be available for occupancy, which in turn projects eight lakh working population by the coming year. Due to the growing intra-city traffic, the Outer Ring Road (ORR) is under tremendous pressure and frequently faces traffic congestions resulting in low speeds and high travel times. Hence, considering the mobility and traffic trends, the report analyses that the required travel demand for the ORR corridor is 33,709 PHPDT (Peak Hour Peak Directional Traffic) by 2041 and that the BRTS and Monorail cannot meet them.

Nashik Metro Neo Proposal takes a Step ahead towards Approval; India

Metro Rail News, July 2020



By taking a step ahead **Nashik Metro Project** proposal towards its approval as the detailed project report has been forwarded to the Union Ministry of Finance & Ministry of Railways for sanction.

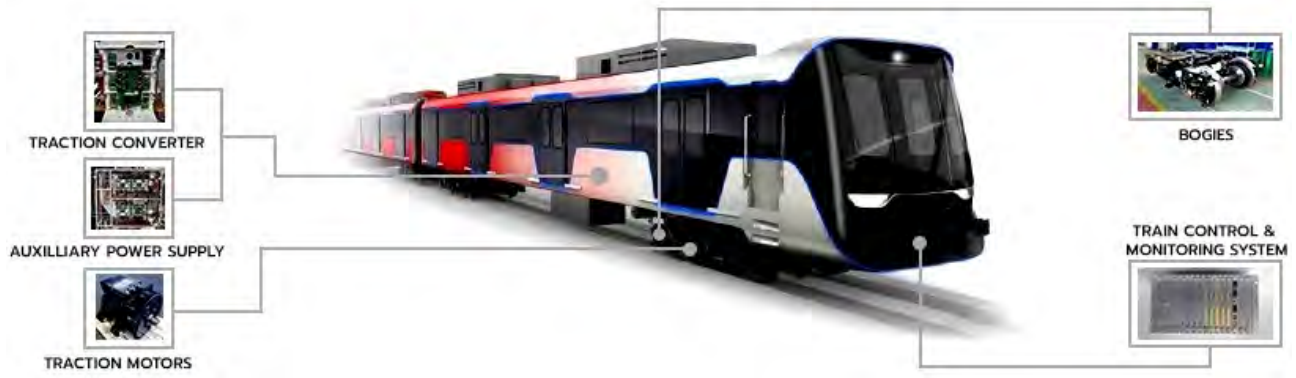
Sources officials involved with the project stated that the Union Ministry of Housing and Urban Affairs (MoHUA) has transferred the project DPR to the ministries concerned.

Metro-Neo Project with Rs. 2100 Cr project is the 1st of its kind in the country, on 2 elevated corridors **Rubber-Tyred AC Bus** coaches would run with its 32 km long distance. There will be a total 30 stations between the corridor.

The sources said by adding that it would take time for the 2 ministries to undergo the project DPR Once they check the details of the project and permit it, the proposal will be located before the Union cabinet for the final nod.

Titagarh Wagons comes up with Cooperation Agreement with ASEA Brown Boveri, ABB India, for Insulated Gate Bipolar Transistor, IGBT, based Propulsion Systems; India

Metro Rail News, July 2020



Titagarh Propulsion and Control Equipment for Metro Car

Titagarh Wagons, a wagon maker for Indian Railways and a multinational diversified engineering and fabrication group, has come up with an exclusive cooperation agreement with engineering company ABB India, to direct the expanding business of propulsion equipment for the Indian railway EMU or MEMU market.

According to the agreement, Titagarh and ABB will together design, develop and manufacture state of the art **Insulated Gate Bipolar Transistor, IGBT, based Propulsion Systems** for EMU or MEMU, that will be made in Titagarh's plant at Uttarpara in Kolkata with some parts being supplied by ABB.

This agreement goes into effect very shortly and is required to begin generating revenue in less than 2 years, the company declared in a press statement. More than 300 EMU or MEMU coaches to the Indian Railways has manufactured and supplied by Titagarh Wagons. Presently, the company is busy executing an order of 102 metro coaches for Pune Metro requisitioned through the Maharashtra Metro Rail Corporation (MMRC).

Uttarakhand Ropeway Metro Project got Approval for extensive Mobility Plan; India

Metro Rail News, July 2020



Artist`s Concept for Dehradun Ropeway Metro Project; by F.A. Wingler

The extensive Mobility Plan of the Uttarakhand Metro project got approval from Uttarakhand Government, by making the system for ropeway projects in Dehradun, Rishikesh along with Haridwar to facilitate commuters. On June 11th, 2020, in a meeting of the Unified Metropolitan Transport Authority, CM Trivendra Singh Rawat permitted for the metro project. As per the officials, a DPR for the aerial **Ropeway System** is being made with the Delhi Metro Rail Co. for Dehradun City.

Along with this the state govt also approved the Personal Rapid Transit (PRT) project for the construction in Haridwar City with the construction work of Metro Light in Haridwar to Rishikesh and Nepali Farm to Vidhan Sabha Corridor. Uttarakhand Metro Rail MD, Jitendra Tyagi gave a comprehensive presentation on Dehradun, Haridwar and Rishikesh **MetroLite** System in which he also shared a report about the route plan study for the metro project from Haridwar- Rishikesh, Dehradun-Nepali Farm.

There are two routes that have been submitted for Dehradun City, one from Forest Research Institute – Rispana Bridge by Clock Tower and the 2nd one from ISBT – Madhuban Hotel by Clock Tower. The capacity of a ropeway cabin will have to carry around ten passengers. The projects will reach around 20-25 km and supposed to cost up to Rs. 2200 Cr.

Funicular Railway for Matheran receives mixed Reactions; India

Locals are ecstatic about the Project, but Expert warns against building the Funicular-Rail Line through Forest Area and an ecologically sensitive Zone.



The Funicular Railway at Saptashrungi Hilltop in Nashik solid elevated Concrete Trajectory

The MMRDA recently approved the building of a funicular railway in Matheran, thereby presenting a challenger to the 113-year-old Matheran narrow gauge railway. While locals are happy with the decision, experts are wary about MMRDA's new plan.

Expressing happiness, Manoj Khedkar, former president of Matheran Municipal Council said, "The funicular railway will solve the connectivity issues to the hill station once and for all. It was during my tenure as the president of Matheran Municipal Council that we floated the idea and a feasibility report of the entire project had been commissioned. We are very happy to see the plan come to life finally."

However, Germany-based international railway expert Frank Wingler, who recently visited Matheran, has expressed doubts about the project. "How can an 800 m climbing rail/rope funicular on a trajectory/guideway be erected through the forest and an ecologically sensitive zone? It will require also a smooth pathway from the hill station at Malet Spring further to Matheran as a connecting transport route," he told mid-day in an email from Germany. "My transport solution for Matheran is a proper all season and monsoon resistant stable road from Neral to Dasturi with proper car park and taxis stand facilities and from Dasturi to Matheran Market a stable, smooth, monsoon proof, well-drained and easy to climb cart road resistant to hill- and mud-slides," he added.

Project Details

The project was approved at the MMRDA's 149th meeting held by video conference on July 7th 2020. It was around 2010 that a plan had been drawn up. As per the older plan made by Rail India Technical and Economic Service (RITES), it involved running a funicular rail service between Dhodani village and Malet Spring Point with two cars with each passenger coach carrying 60 commuters.

'We welcome the Plan'

The Matheran narrow gauge railway line, which has been listed in the UNESCO tentative list of Mountain Railways in India, originally came up as a private venture of the Peerbhoy family between 1901 and 1907. "We welcome the new mode of transport. The only concern and regret that we have is that the authorities need to complete the historic transactions with the Peerbhoy family about the railway line and offer adequate compensation. Our claim in the Bombay High Court is still pending," said Hussain Peerbhoy, the great-great-grandson of Sir Adamjee Peerbhoy, who built the line as a family enterprise more than a century ago.

Prominent Funiculars in India

Palani – Tamil Nadu since 1966.

At Bhira and Bhivpuri Road.

At Joginder Nagar, Himachal Pradesh.

Saptashrungi Temple, Nashik.

Maharashtra Government sanctions Rs. 5 Crore Fund for Funicular Railway Project at Haji Malang Shrine, Maharashtra; India

Pradeep Gupta /Times of India, TNN/ Jan. 24th 2020; <https://timesofindia>



Uncompleted Steel Beam elevated Trajectory for Haji Malang Shrine Rope pulled Funicular Railway near Kalyan, Maharashtra, left for Corrosion

KALYAN: The Maharashtra Government has sanctioned additional fund of Rs. 5 Crore for a long pending Funicular Railway Project at Haji Malang Gad Shrine.

The project, which started at project cost of Rs 10.42 crore in year 2008, reached up to Rs. 45.91 Crore and now the state government has sanctioned additional fund of Rs. 5 Crore for project to complete project on priority basis.

The Haji Malang Gad Hill is being cut to make way for the 1.2 km rope pulled funicular railway on an elevated trajectory/guidway. The construction of funicular will give relief to devotees especially senior citizens, who have to walk up to four kilometres to reach shrine near Kalyan.

Over the long pending project meeting was called by PWD Minister Eknath Shinde at Mantralay, where the Shinde directed MMRDA will give the fund of Rs. 5 Core to Supreme Company carrying out the work, who has stopped work for last two years as project cost was increased. Shinde directed the contractor to complete the project on time or else said his contract will be cancelled.

The contract of work was sanctioned in year 2008, and foundation stone was laid in February 2013. So far PWD has missed four deadlines.

Shrikant Shinde, MP from Kalyan, who was present in meeting said, "Around 70 percentage of work is completed and now, when additional fund is sanctioned requested, by contractor work is expected to be completed soon".

The aim of project was to develop the hills in to a tourist spot, where hundreds of devotees daily visit to take the blessings of Haji Malang Baba at Shrine.

Kolkata Metro starts building Shaft to pull out Tunnel Boring Machines, TBMs; India

by [Urban Railways](#); posted on August 7th, 2020



The Kolkata Metro Rail Corporation (KMRC) has started construction of shaft for retrieving the two giant tunnel borers for the East-West Metro corridor at Durga Pithuri Lane, off Bowbazar. It will take six months to complete the shaft.

This is where the first tunnel boring machine (TBM), Chundi, which was digging the west-bound tunnel, hit an aquifer on August 31, last year, and is now lying defunct 16 m below the ground. A 300 m radius around the spot came to be known as the cave-in zone ever since.

Several houses had collapsed when Chundi hit the sand aquifer. Water gushed into the tunnel, triggering largescale subsidence. The subsidence zone, strengthened with elaborate grouting, has now become an open space since 27 damaged houses in the area either fell or were razed for safety reasons:



Damaged and collapsed Houses razed to Ground at Bowbazar and making Space for Tunnel Boring Mashine Retrieval Shaft

The retrieval shaft is being built in this open space to pull out both the machines, which were moving from Esplanade to Sealdah for the last leg of 2.5 km East-West Metro tunnelling. Rig machines from Austria are being used to build piles for the 22 m deep retrieval shaft, 40 m in length and 15 m wide. The piles will be built for 130 piers of the retrieval shaft being dug directly on the line of the west-bound tunnel.

Cutting the damaged TBM (Chundi) into pieces will be a challenge because it its 9 m-wide front shield is covered with concrete that was poured-in to seal the water leakage. Along with the front shield, the first few metres of the concrete rings will also be pulled out of the shaft. And the wall created (in the tunnel) to prevent seepage of water will also be dismantled.

A huge crane will be used to pull out the machine parts, each machine of which weighs around 300 tonnes. The second TBM, Urvi, building the east-bound tunnel, is now burrowing towards its destination, Sealdah station, from where it will make a U-turn and dig the rest of the affected tunnel and proceed back towards Durga Pituri Lane.

Urvi should be able to reach Sealdah station by mid-September. It will be disintegrated inside a box at Sealdah station, reassembled and veered in the opposite direction, to Durga Pituri Lane and thus complete the underground link. By this time, the retrieval shaft will be ready. It would take a month to complete the retrieval of the two machines.



Kolkata Metro: Joka-Esplanade to be India's first Metro to run on indigenous Jindal Steel & Power Ltd (JSPL) Head Hardened, HH, Rails; India

By [Manoranjan Kumar](#); 13/08/2020; Metro Rail News



Jindal Steel supplies Head Hardened Rails for Kolkata Metro

Kolkata (Metro Rail News) – Joka-Esplanade Metro will be India's first Metro to run on the indigenously manufactured rail. The first lot of the rails reached Joka depot on Monday. Hitherto, all the Metros in India have been running on imported rails as Indian steel companies did not produce these head hardened (HH) rails, which are used for high-speed trains (>250 kmph), heavy traffic of varying axle loads for Freight and Metro Rail.

The 1080 grade HH rails are manufactured using an additional heat treatment. **So far, these rails were used to be imported from Japan and Europe.** Besides, supply issues from the foreign shores under the current situation, the manufacturing of HH rails is a move towards self-reliance. Now 20% of total procurement needs to be sourced indigenously, said a Railway Metro.

According to a senior Rail Vikas Nigam Limited (RVNL) official, the executing agency of Joka-Esplanade Metro, following the Railway Board's policy of indigenization and economy in purchase and procurement, RVNL became the first company to place order with **Jindal Steel & Power Ltd (JSPL)**, which was selected through a rigorous bidding process.

India's deepest Metro Vent Shaft completed in Kolkata; India

The Ventilation Shaft, which is 43.5 m deep, was completed jointly by Kolkata Metro Rail Corporation (KMRC) and Afcons, a private Engineering Company.

By [Manoranjan Kumar](#); 11/08/2020; Metro Rail



Vent and Emergency Evacuation Shaft Kolkata Metro

Kolkata (Metro Rail News) – In a major move, the Kolkata Metro has achieved a wonder. The country's deepest underground rail ventilation shaft equal to a 15 storey building and an important part of the city's East-West Metro line was completed on Monday according to sources familiar with the development.

The ventilation shaft, which is 43.5 m deep, was completed jointly by [Kolkata Metro](#) Rail Corporation (KMRC) and Afcons, a private engineering company. **Such shafts are not only used to provide ventilation to the tunnels, but also for evacuation during an emergency.** The evacuation shaft is located on Strand Road near Hooghly River, said one official.

The Metro shaft has been constructed adopting innovative engineering techniques and methodology to navigate geological challenges and overcome any impact on Kolkata's circular railway track along the [Hooghly](#), Afcons project manager Satya Narayan Kunwar aid.

The shaft is located very close to the river and abutting with the circular railway which makes its deep excavation very challenging, it said. The circular railway line runs parallel to the river in stretches which will connect Kolkata to Howrah.

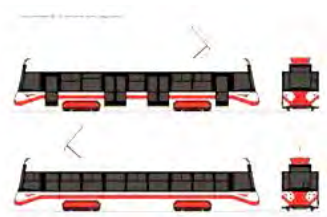
PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Urban Transport Industry News Round-up I; Global

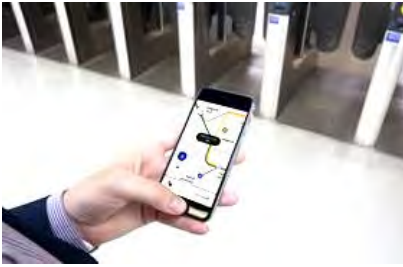
12th August 2020; Metro News International



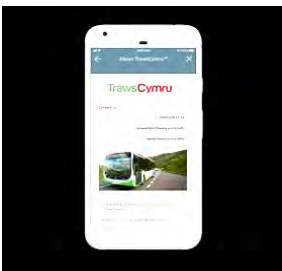
Hitachi ABB Power Grids and SNC-Lavalin company Linxon have been awarded a turnkey contract to provide the power supply systems for the extension of the **Kochi** Metro from Petta to Thripunithura, including traction substations and the 750 V DC third rail electrification. 'This project truly defines our vision of "from grid to vehicle" in the transportation segment', said the supplier's CEO Frédéric Trefois.



UVZ has been named preferred bidder for a 11.8m rouble contract to deliver three 100% low-floor four-axle trams to the Russian city of **Nizhiny Tagil**. UVZ is to supply its recently developed Type 71-415, a prototype of which is on test in Kolomna.



Transport for **London** has released an iPhone app which it has developed in-house. This provides information to encourage travel at quieter times to help maintain social distancing, suggestions for alternative routes and walking and cycling options, and accessibility information including a 'step-free' mode and easy-to-navigate views of all stations with street-to-platform accessibility. TfL intends to release an Android version later this year, with a further update to include live bus information, lift status and the location of toilets.



UrbanThings is to supply its Ticketless white-labelled software platform for three routes on the TrawsCymru multi-operator long distance bus network in **Wales**. The first covering three routes is planned for October, with a proposed second phase to extend it to the whole network next year. The system will be available in both English and Welsh, enabling passengers to purchase tickets via the website or mobile app, to reserve seats, and to see real-time travel information, including vehicle capacity in a new feature designed to help manage social distancing.

Urban Transport Industry News Round-up II; Global

05th July 2020; Metro Report International



On July 21st 2020, EBRD approved a sovereign loan of up to €10m to support a €35.3m project to acquire up to 15 new trams for **Sarajevo** operator GRAS. This is expected to improve the reliability of public transport and contribute in addressing the city's 'severe' air quality issue.



The UK government's Getting Building Fund is to provide £ 12.4 m for the **Very Light Rail Innovation** Centre in Dudley and £ 1.8 m for **Coventry's** Very Light Rail project.



San Diego Metropolitan Transit System has announced changes to its security department's use of force policy, which Chair Nathan Fletcher said were 'another step in our effort to comprehensively restructure our approach to transit safety'. Significant updates include banning carotid restraints and choke holds, including the prohibition of using knee pressure on the neck, throat or head; requiring use of force to be proportional to the seriousness of an offence; a duty to intervene if witnessing excessive force by another employee; requiring de-escalation tactics when feasible; requiring a warning prior to use of force.



A review of light rail **switch and crossing** maintenance regimes is to be funded by industry group UKTram and the Light Rail Safety & Standards Board, who will work with Huddersfield University.



On August 4th 2020, Japan International Cooperation Agency and the Government of Bangladesh signed a record of discussions for a 30-month project which would see a Japanese team provide training for future metro Line 6 operator **Dhaka** Mass Transit Corp

to support the preparation of safety related manuals and to establish a safety management system.



Transport authority Nexus has secured £ 20 m of UK government funding for **Tyne & Wear** Metro infrastructure renewal works once the current £350m Metro All Change programme ends in March 2021. 'The £20m for next year represents a down payment on what will hopefully amount to further investment, which is essential for the continuation of our capital programme through to 2025', said Director of Finance & Resources John Fenwick.



Sheel Kumar Mittal has been appointed as Director (Finance) of **Uttar Pradesh Metro Rail Corp.** with effect from July 31th 2020,, having previously been General Manager (Finance). Arvind Singh has been named as Project Director, Kanpur Metro, and Arvind Kumar Rai as Project Director, Agra Metro.



The Uber app can now be used to pay for travel on **Thames Clippers Ferry Services** in **London**, using QR ticketing technology from Masabi which has provided mobile ticketing for Thames Clippers since 2014 and is Uber's mobile ticketing partner in Ohio, Denver and Las Vegas.



The **San Francisco** Bay Area's Metropolitan Transportation Commission has launched a pilot means-based fare programme, offering discounted single fares for passengers whose household incomes are no more than twice the federal poverty level. 'MTC has a long history of serving low-income residents through community-based planning and other programs', said MTC Chair Scott Haggerty. 'Clipper START is really expanding that commitment to make transit more affordable to a wider group of people. We're excited to see how many will take advantage of this pilot.'

Urban Transport Industry News Round-up III; Global

29th July 2020; Metro Report International



Newag's Nowy Sącz factory in **Poland** has dispatched the first of 10 three-car Inspiro trainsets which the **Sofia** metro ordered from the SIMETRO consortium of Newag and Siemens Mobility in January 2019 using an option on a September 2015 contract for an initial 20 trainsets.



Uttar Pradesh Metro Rail Corp has begun erecting pre-cast concrete double T-girders for the **Kanpur** metro project, which it said was the first time these had been used for an Indian metro station concourse. 'It is our endeavor to always strive for an innovation that will not only speed up construction work but also enhance the structural beauty of the project', said Managing Director Kumar Keshav.



CAF has been awarded a five-year extension to its contract to maintain Metro de **Málaga**'s fleet of 14 Urbos 3 trams which it supplied from 2010.



China's National Development & Reform Commission has announced the completion of debugging and commissioning tests for **Lahore's** 25.6 km Orange Line. Pakistan's first metro line which is being built by NORINCO International and China State Railway Group at cost of US\$1.6bn under the China-Pakistan Economic Corridor programme. Earlier this year a consortium led by NORINCO International signed an eight-year operations and maintenance contract.



CAF has been awarded a two-year contract to overhaul 35 trainsets it had previously supplied to **Medellín** Metro.

Fairtiq check-in/check-out ticketing app went live on Regio Verkehrsverbund Lössrach services in southwest Germany on July 1st 2020,, in the city of **Aschaffenburg** on July 13th 2020, and in **Flensburg** on July 15th 2020. The **Lössrach** roll-out was handled entirely remotely, with no in-person meetings.



Traktionssysteme Austria is to supply CAF with more than 1 400 motors for the 114 Urbos low-floor trams ordered in August 2019 for **Jerusalem's** future Green Line and extended Red Line.



Kaspch TrafficCom has been awarded a € 0.5 m contract to provide monitoring systems covering ticketing, information, security and other equipment for the **Cádiz** Tram-Train project.



Next year's **UITP** Global Public Transport Summit in Melbourne has been postponed from June 6-9 until to December 14-17 2021.

Urban Transport Industry News Round-up IV; Global

15th July 2020; Metro Report International



On July 10th, 2020, the Transportation Safety Board of Canada said it was conducting an investigation after cracks were found on a total of four wheels on three **Ottawa** O-Train Line 1 LRVs during maintenance. The operator said supplier and maintenance contractor Alstom and the line's PPP concessionaire RTM were inspecting each wheel on every LRV each time it is used.



RATP has awarded Liebherr-Transportation Systems a contract to overhaul 118 saloon and 166 cab heating, ventilation & air conditioning systems on **Paris** trams by December 2021.



UK Transport Secretary Grant Shapps has approved an order under the Transport & Works Act granting legal powers for the Wednesbury to Brierley Hill extension of the **West Midlands** Metro light rail line.



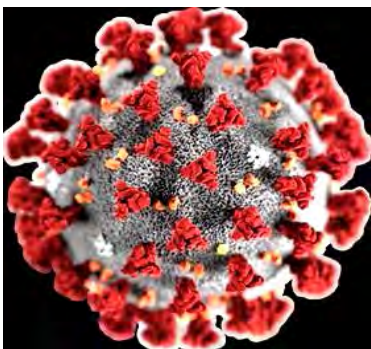
TBM 'Daria' finished boring the first tunnel for Moscow's Kommunarskaya metro line on July 10th 2020. The 826 m tunnel runs between the future stations Slavyanskiy Mir and Ulitsa Generala Tyuleneva in the southern part of the city, at a depth of 13 to 16 m below ground. The 23.2 km first phase between Ulitsa Novatorov to Kommunarka with 10 stations is planned to open in 2023-24.



Istanbul municipality has restarted construction on the 850 m Boğaziçi University/Hisarüstü-Aşiyan funicular, and the mayor has announced plans for five more routes.

Cubic Transportation Systems has published Leveraging Technology to Adapt & Thrive Post-Pandemic, a white paper discussing how technology can help make city transport networks and services safer, more efficient and more resilient. It looks at creating safe environments for staff and passengers, building trust to encourage ridership; adapting systems to be more flexible and scalable; limiting traffic congestion; and economic factors.

Plans for a 13.4 km underground metro line in the Turkish city of **Mersin** have been put on hold until the pandemic is over.



Steer has published four future scenarios – ‘cycles of lockdown, ‘adaptation’, ‘therapeutics’ and ‘vaccine’ – for what the economy, people’s activity and transport demand may look like two to three years after the shock of the Covid-19 pandemic.



Bursa municipality is planning to extend Line 2 of the city’s Bursaray light metro network by a further 5 km west from Uludag University to Görükle.

Tunnel excavation for **Istanbul**’s Atakoy – Ikitelli metro line has been completed. Opening is planned for 2022.



Solaris Bus & Coach has delivered two Urbino 12 electric buses to **Würzburg** operator NVG Omnibus, and is also providing two stationary chargers with a maximum power of 150 kW as well as a 50 kW mobile charger.

Electro-Diesel Tram-Train Order expanded to support Tram-Train Service Increase; Hungary

3th July 2020; Railway Gazette International



HUNGARY: National Passenger Operator MÁV-Start has exercised an option for Stadler's Valencia plant to supply a further four Citylink electro-diesel tram-trains for the route being developed to link Hódmezővásárhely with Szeged.

The country's first **Tram-Train Project** aims to provide a high-quality service for daily commuters between the two cities, which are 25 km apart. Both have inconveniently located railway stations, meaning the majority of public transport commuting is currently by bus. The tram-trains will use 600 V DC electric power on the street-running sections in the two cities, and will be powered by two low-emission diesel powerpacks rated at 390 kW on the main line.

MÁV-Start placed a HF17.6bn order for an initial eight Stadler tram-trains in November 2017, and these are expected to enter service in late 2021. The additional vehicles announced on July 3th 2020 will follow by the summer of 2022, enabling the service to be increased from every 20 min to every 15 min.

The low-floor vehicles will be 37.2 m long and 2 650 mm wide with a capacity of 220 passengers, including 92 seated. They will have four multi-purpose places for persons with reduced mobility including wheelchair users and people with prams.

They will be able to negotiate curves down to 22 m radius, and will have doors at different heights, as well as sliding ramps to provide easy access at stations without requiring infrastructure modifications. Other features include air-conditioning, CCTV and a passenger information system.

Freight Tram-Train to be tested in Karlsruhe; Germany

7th August 2020; Metro Report International



GERMANY: Trials with a prototype freight tram or tram-train are to start in Karlsruhe and the surrounding area in 2022. The concept is being drawn up with a view to improving urban life by reducing road traffic and the emissions it generates.

Known as 'regioKArgo', a pilot operation is proposed to demonstrate the concept, possibly on the 50 km Karlsruhe – Rastatt – Achern route, which has been studied in detail by the project's promoters.

regioKArgo brings together operators Verkehrsbetriebe Karlsruhe and Albtal-Verkehrsgesellschaft with freight shippers, logistics companies and research institutes to develop alternative forms of local goods transport to replace lorries and vans.

Increasing use of the internet in recent months to order goods has led to an increase in package delivery traffic, in turn leading to congestion and other problems such as a shortage of staff and delivery vehicles.

Freight trams or tram-trains would operate between consolidation centres, set up at locations outside Karlsruhe and surrounding towns, and 'city-hubs' in the central area of each town. From there goods would be distributed to the end customer using emission-free methods such as cargo bikes. Studies are in hand to determine where city-hubs could be located.

One option would be to use modified trams that would be dedicated for passenger duties during peak times but would carry both passengers and cargo during less-busy periods. A team of researchers and industry experts is working on the design of a demonstrator tram under the LogIKTram project, the results of which will be fed into the regioKArgo scheme.

Organisations involved in the project other than operators include DB Engineering & Consulting, the Karlsruhe Institute for Technology, the FZI IT Research Centre, Marlo Consultants and Automotive Engineering Network.

The project team is in the process of estimating the likely cost, the aim being to apply for funding under the 'Regio-Win' project which promotes Karlsruhe as a technology development centre. Research by Offenburg University suggests that users would be willing to pay for the service if it fits sustainability and environmental goals.

Freight trams would form the centrepiece of a holistic concept which will entail rethinking the existing freight transport delivery model, according to Ascan Egerer, Technical Director at AVG. Explaining that the whole process was being examined to ensure that it would function economically, this entailed looking at what happens before and after the rail leg of a consignment's journey. 'That's why we have partners from all sectors round the table', he said. 'It's not something that can be solved by a transport operator alone. And we are talking about going beyond the city limits into the region'.

Egerer suggested that the idea was to replicate for goods the tram-train concept for passengers, that was pioneered in Karlsruhe in the 1990s. 'The Karlsruhe model offers the best conditions for bringing about a switch for goods transport too', he said.

The 'father' of the Karlsruhe tram-train concept was Dr Dieter Ludwig, who believed that it was necessary to 'take the train to the people'. Dr Ludwig, who died on July 16th 2020, was CEO of AVG and VBK for 30 years, during which the Karlsruhe model became famous – the first route between Karlsruhe and Bretten opened in 1992, leading to spectacular growth in the use of public transport in the area.

AVG Flexity Tram-Train delivered by Bombardier to Karlsruhe; Germany

7th August 2020 Metro Report International



GERMANY: Bombardier Transportation has delivered the first two of 20 Flexity tram-trains which Karlsruhe area operator Albtal-Verkehrs-Gesellschaft ordered in December 2018.



The €87m order was the second option that AVG had exercised within a framework agreement signed in 2009 covering the supply of up to 75 vehicles, with an initial firm order for 30 being followed in 2016 by an order for 12 more.

‘Since the new vehicles differ only slightly in technical terms from the proven trams already in service, I expect the authorisation process to be completed quickly’, said Dirk

Wunderlich, the supplier's Head of Business Unit for German Cities, when the tram arrived from Bombardier Transportation's Wien factory on August 7th 2020.



Karlsruhe Tram-Train running on German Federal Railway Track

The 37 m long LRVs have a capacity of 244 passengers, including 93 seated, and up to three can be coupled together to increase capacity at peak times.

'With the new vehicles, we are continuing to modernise our fleet while increasing passenger capacity', said AVG Technical Director Ascan Egerer. 'In addition, the new light rail vehicles will enable us to offer our passengers the best possible comfort and high-quality standards, making public transit a more attractive option.'

Securing digital Railways against Cyber-Attacks

A growing Array of Cyber-Security Challenges

The adoption of IP-based networks and Internet of Things (IoT) technologies is enhancing safety, increasing operational efficiency and improving the passenger experience. Yet, because these networks are more interconnected than traditional railway communications systems (which tend to be more isolated), they can increase the vulnerability of railway operations to cyber-attack. Similarly, the growing use of sensors, meters, surveillance cameras and other devices to support real-time monitoring opens the possibility of IoT devices providing a back door into the network. Railways are also taking greater advantage of wireless networks from GSM-R to LTE to

5G technologies that must be engineered precisely to ensure full security. Threats arise in many ways, not just from criminals, foreign agents, or even disenchanted employees. Many breaches can be traced back to human error and even the best trained staff can be overwhelmed by the sheer volume of daily attacks. Railway operators also face increasingly stringent legal, regulatory and compliance requirements, making them directly accountable for ensuring effective information security.

A robust, end-to-end cyber-security strategy can address many of these challenges.



Defense in Depth

Nokia offers in-depth expertise on cyber-security best practices. We work with you to ascertain the underlying risks to your network. Developing an airtight, secure network would require an unrealistic level of investment. Nokia instead advocates defense in depth as a more balanced, economically feasible approach to security that mitigates the real risks.

We build cyber-defenses aligned with a network's operational objectives to achieve layered security across network, application, data, identity and access management, establishing a series of defenses that close off any attempts to exploit security gaps. Nokia end-to-end security solutions encompass business processes, regulations and security policies to keep pace with the rapid rise in attacks.

Network Element -based Security

Nokia combines expertise in both wireless and IP to achieve mission-critical security that addresses the vulnerabilities specific to these technologies. Mission-critical network solutions (IP/MPLS, optical, GSM-R, 5G) not only deliver network reliability, performance and scalability, they also defend against security threats and attacks.

SOARing to secure Operations

Nokia employs the security orchestration, automatization and response (SOAR) model, introduced by Gartner, to provide the tracking and analysis capabilities railways need. Nokia's SOAR solution, NetGuard Security Management, can interact with technologies from a variety of providers that collect data and/or trigger specific actions.

Smarter Security Systems

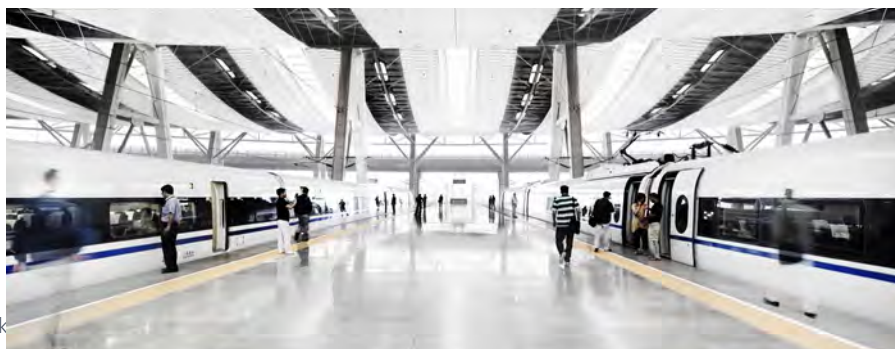
Through the application of advanced analytics and machine learning techniques, NetGuard Security Management can provide complex correlation and detection capabilities for precise security risk prediction, faster root cause analysis, faster response times through the application of pre-defined rule books and simplified (and standardized) reporting to federal and/or regional security incident response teams.

Empowering Security Teams with Automation

Customizable dashboards with powerful search and reporting capabilities can be optimized for the individual needs of security management teams. Automated workflows facilitate the investigation and mitigation of threat incidents, enabling experts to accelerate their response.

How you benefit

- Improved railway safety and operational efficiency
Effective cyber-security enables the safe adoption of new IP-based applications for train control, signal control, maintenance monitoring, video protection and passenger information systems.
- Protection against financial damage Security incidents can be costly, not just in terms of the loss of revenue from disrupted passenger services, but the recovery and restoration costs, potential lawsuits, damage to brand reputation, compensation to users and non-compliance penalties. Defense in depth can reduce these risks.
- Ensuring security compliance meet the increasingly stringent legal, regulatory and compliance requirements through more effective information security and data privacy.
- Focusing on running rail operations
end-to-end Nokia security enables you to focus on your mission-critical responsibilities without being distracted by the daily operation of a telecom business or by having to work with multiple security vendors.



Case Study

Nokia is providing an in-depth cyber-security solution as part of network modernization for large, state-owned European railway.

To counter increasingly pervasive threats from cyber attack as well as human error such as configuration problems and non-compliance with security protocols. The Railway is adopting a multi-tiered approach, built around the following products:

- The Nokia NetGuard Identity Access Manager (IAM), which secures physical and virtual network functions and resources, providing unified identify access control, single sign-on with centralized policy management and advanced access management to minimize unauthorized incursions.
- The Nokia NetGuard Virtual Firewall (VFW), which support segmentation of different applications on the network, helping to isolate and limit the impact of attacks.

Employing a comprehensive, in-depth cyber-security regime will enable the Railway to adopt new IP-based applications for a variety of critical functions (train control, signal control, maintenance monitoring, video protection and passenger information systems) safely and securely. The Railway's new cyber-security architecture will help eliminate or quickly mitigate threats, allowing it to focus on its primary operations, delivering people quickly and safely to their destinations.

For more information on Nokia cybersecurity solutions for railway operations, [click here](#).

How in-Depth Security changes the Game

- **Automation** meets the avalanche of threats Automating incident response ensures defenses are not overwhelmed by thousands of daily alerts.
- **End-to-end security** protects all network technologies End-to-end security encompasses the entire network and its security processes, such as: access management and audit compliance; network security; and security management for IoT devices.
- **Network Segmentation and Firewall** confine threats Network segmentation with IP/MPLS VPN provides traffic isolation and hampers lateral movement of hackers as they scout the network.
- **Analytics** for continuous improvement Security analytics correlates data from across the network, devices and cloud layers to spot and characterize suspicious anomalies, along with the associated business risk and recommended response; applying machine learning increases effectiveness over time.
- **Encryption** protects data Multi-layer encryption ensures that even when a perpetrator taps into the communication channels, confidentiality, integrity and authenticity are still secure.
- **High availability and operational stability Network** and transport layers enable rapid recovery from any attack, including physical shut down of communications equipment and infrastructure facilities.

Why Nokia?

- More than 30 years' experience in the rail industry.
- Expertise in working with rail operators to developing proactive security strategies.
- Leverages strong presence in the public safety segment, and as a trusted partner for public network operators around the world.
- Offers a comprehensive approach built on its in-depth experience and expertise in both security and mission-critical networks and operations.
- Mission-critical networking portfolio (IP/MPLS, optical, and wireless) features strong, built-in security mechanisms augmented by the NetGuard portfolio's end-to-end security architecture
- Provides the right balance of costs with the in-depth protection needed to defend railways against today's security threats.

Want to learn more about cyber security for railways? **Get the White Paper.**





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From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in virtual reality and digital health, we are shaping the future of technology to transform the human experience.

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Cyber Security for Railways

White paper

Digital transformation is bringing substantial benefits in railway safety, operational efficiency and reliability, as well as an enhanced passenger experience. Yet, it also inevitably increases the vulnerability of railways to cyber-threats.

This means that the continued protection of rail infrastructure will require stronger and more robust railway communications network security, with new technological and process measures being implemented.

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1. Executive summary

The consequences of a successful major cyber-attack on a nation's rail infrastructure could be catastrophic. A metro transport system brought to a standstill for even a short period would cause city wide havoc, damaging the local economy, harming the metro operator's bottom line, and making passengers doubtful about the future safety and reliability of transport services. Worse, a successful attack on a communications-based train control system could cause an accident, putting lives at risk.

Nobody in the industry wants any of that to happen. Yet, based on Nokia's experience in the industry, the risks of cyber-attacks occurring are often underestimated by rail operators.

In a July 2017 speech, Suresh Prabhu, Indian Railway Minister summed up the need for better security in railways: "When we do everything manually, the challenge is manual error and if we are shifting from manual to technology-oriented operations, then the flaws in technology, or someone who can potentially hoodwink it, is as high and sometimes even more dangerous. So cyber-security is one of the top priorities."¹

Unfortunately, some attacks have succeeded in the past, resulting in serious consequences in several countries.

Digital transformation in railway operations has ushered in new applications to monitor and control rail systems. These applications are typically based on IP technologies, generating a wide range of IP traffic flowing across the communications network. Examples of how digitization is being deployed more widely include train control, control of signaling, maintenance monitoring, video protection and passenger information systems.

Cyber-attacks are a growing threat to all types of mission-critical networks, including those used by railways. Security agencies recognize the risks. In the US, cyber-security is seen as a serious economic and national threat with the US Computer Emergency Readiness Team (US-CERT) creating a framework to support the protection of critical infrastructure. In Europe, the EU has proposed a cyber-security strategy outlining its vision, clarifying roles and responsibilities, and defining actions required to protect citizens.² In Asia, some governments have established national cyber-security policies.

Consequently, railway security must be stepped up. Railway operators should consider implementing a security life cycle strategy by applying technical solutions and enhanced security practices/processes.

To keep pace with the rapid rise in attacks, operators should consider shifting from legacy reactive security infrastructures (detection and response) into proactive automated security life cycles. Key capabilities to protect networks must include security automation that encompasses business processes, incident response plans, regulations and policies; end-to-end security that encompasses the operation of the network and its processes; security analytics to correlate security-related information from across the network, devices and cloud layers to spot suspicious anomalies and provide insight into threats; and multi-layer encryption to protect network traffic.

Such a multi-layered and active security approach provides the right balance of costs with the in-depth protection needed to defend against today's security threats, while ensuring that railway operators are prepared to meet their compliance obligations.

¹ <http://www.ehackingnews.com/2017/07/railways-to-focus-on-cyber-security.html>

² Directive (EU) 2016/1148 of the European Parliament and of the Council of 6 July 2016 <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32016L1148&from=EN>

2. Railway infrastructure is under attack

Cyber-attacks have become a global phenomenon. Several relatively recent incidents have shown how a successful cyber-attack can cause mayhem for railways. In one high-profile case in 2003, a virus infection of a train company's systems in Florida disrupted signaling, dispatching and other systems, resulting in widespread delays across the eastern US.³

In 2008, a 14-year old managed to hack systems in the city of Lodz in Poland, causing tram derailments and passenger injuries.⁴

In 2016, it was widely reported that UK railway infrastructure was the victim of at least four major cyber-attacks in the previous year.⁵

In 2017, the widely publicized Wannacry⁶ attack affected many organizations globally. Germany's Deutsche Bahn rail infrastructure suffered system failures and ransomware messages appearing on station information screens.⁷

Security incidents like these cost railway operators in many ways. Not just the loss of revenue while services are unavailable, but the recovery and restoration costs, potential lawsuits, damage to brand reputation, compensation to users and non-compliance penalties.

"Railway systems are becoming vulnerable to cyber-attack due to the move away from bespoke stand-alone systems to open-platform, standardized equipment built using Commercial Off The Shelf (COTS) components, and increasing use of networked control and automation systems that can be accessed remotely via public and private (communications) networks."

Rail Cyber Security, Guidance to Industry, Department for Transport, UK, February 2016⁸

3 <http://www.cbsnews.com/news/virus-disrupts-train-signals/>

4 <http://www.telegraph.co.uk/news/worldnews/1575293/Schoolboy-hacks-into-citys-tram-system.html>

5 <http://www.telegraph.co.uk/technology/2016/07/12/uk-rail-network-hit-by-multiple-cyber-attackslast-year/>

6 <https://www.us-cert.gov/ncas/alerts/TA17-132A>

7 <http://www.telegraph.co.uk/news/2017/05/13/cyber-attack-hits-german-train-stations-hackertarget-deutsche/>

8 <https://www.rssb.co.uk/Library/improving-industry-performance/2016-02-cyber-security-rail-cybersecurity-guidance-to-industry.pdf>

3. Rising regulatory and data privacy pressure

Railway operators face increasingly stringent legal, regulatory and compliance requirements, making them directly accountable for ensuring effective information security and data privacy.

In Europe, the EU cyber-security strategy⁹ lays out roles, responsibilities and defines actions required to protect citizens. In fact, failing to prepare adequately to address cyber-security threats is a substantial risk in and of itself.

For instance, regulations such as the European Union's Network and Information Security (NIS) directive demand that comprehensive protections be put in place, and failure to do so can result in substantial penalties. While the interpretation of NIS can vary from country to country, certain fundamental standards need to be met and maintained. It is clear that any successful plan will depend on the ability to detect risks (in advance) and mitigate threats, whether from hostile actors or simple human error. Real-time monitoring and reporting capabilities are a baseline requirement to enable security teams to track and respond to emerging events. Operators will need to monitor and report compliance to minimum security requirements, proactively assess the potential business impact of a breach and report security breaches.

Solutions are now available that follow the security orchestration, automatization and response (SOAR) model, introduced by Gartner to provide the needed tracking and analysis capabilities. These solutions can deliver a variety of benefits, notably the elimination of unauthorized access and misconfiguration, faster root cause analysis, faster response times through the application of pre-defined rule books and simplified (and standardized) reporting to federal and/or regional security incident response teams.

In addition, maintaining privacy standards and protecting citizens' data is an increasing priority in many jurisdictions. The General Data Protection Regulation (GDPR) rules in Europe, for instance, tighten data privacy requirements substantially.

Regulators are also specifying minimal compliance requirements for privacy protection that are verifiable before a communications element can be used in the telecom network of any carrier. To safeguard the privacy of their citizens, some governments are proposing legislation requiring their citizens' data be stored within the boundaries of their country and governed by their privacy laws.

4. Successful attacks on critical infrastructure provide valuable lessons for railways

Incidents in Ukraine have created some insight into how cyber-attacks unfold. In December 2015, a major attack was launched on power grids in the Ukraine, leaving 250,000 people without electricity. Almost exactly a year later, hackers struck again and parts of Kiev suffered a power outage lasting about an hour.

The 2016 attack is said to have been caused by sophisticated new malware that could automate attacks on other mission-critical networks around the world.¹⁰ The lesson is clear - cyber-attacks can disrupt mission-critical services and put lives at risk.

⁹ Directive 2006/24/EC of the European Parliament and of the Council of 15 March 2006 on the retention of data generated or processed in connection with the provision of publicly available electronic communications services or of public communications networks and amending Directive 2002/58/EC

¹⁰ <https://www.wired.com/story/crash-override-malware/>

AN AVERAGE DAY... AT AN ENTERPRISE ORGANIZATION

EVERY	4 SECONDS	53 SECONDS	81 SECONDS	4 MINUTES	32 MINUTES
	An unknown malware is downloaded	A bot communicates with its command and control center	A known malware is downloaded	A high-risk application is used	Sensitive data is sent outside the organization

Figure 1. Enterprises face constant threats from malicious software every day.¹¹

Anatomy of an attack ... and how to prevent it

Stage 1: Break-in

The Ukrainian power system attack in 2015 began in June 2014 when hackers targeted administrative and other personnel in the power company through a campaign of phishing emails with attached documents that enabled macros to install malware.

Stopping the threat: Deploying endpoint security would detect command-and-control traffic, before malware is detonated.

Stage 2: Expand and prepare

The hackers were then able to harvest credentials and gain privileges throughout the IT system. The task was made easier because passwords were hard-coded and shared passwords were not changed regularly. The hackers set up an IPSec virtual private network (VPN) connection direct into the network.

Stopping the threat: Deploying credential protection to provide a secure point of control. Implement anomaly protection to detect suspicious behavior. Using IP/MPLS VPN and a firewall to impede and restrict the hackers' lateral movement.

Stage 3: The attack

After about six months of undetected preparation, the hackers executed the attack, disconnecting circuit breakers and hindering recovery through a DDoS attack on the call center, blocking and wiping workstations, servers and endpoints. They also installed firmware to block remote commands. Recovery required physical visits to each substation to manually reset circuit breakers.

Stopping the threat: Deploy automated response solutions that can respond to threats before they become breaches.

¹¹ <http://www.internetworking.ch/files/eng-checkpoint-2015-securityreport.pdf>

5. The risks are everywhere ... and many-sided

Highly sophisticated attacks are likely to require the backing of a state, large terrorist group or sophisticated criminal organization. Such groups share similar goals: to disrupt operations or even steal information to gain a financial or strategic benefit. The motivation for groups to target rail communications networks can range from a pure demonstration of force to simply gaining publicity, venting grievances, or making a political statement.

Yet these are not the only perpetrators. Up to 70 percent of security incidents are the result of some form of insider attack or simple human error. For instance, disgruntled employees may use their privileged access rights to alter security configurations. Such failures open operators up to many different types of attack. They include data theft and tampering, eavesdropping and potentially damaging distributed denial of service (DDoS) attacks. There is also a fast-growing and potentially far more damaging category of attack known as a destruction of service (DeOS) attack that can physically damage hardware and equipment by, for example, corrupting the firmware on internet connected devices.

Fairly simple mistakes that enable IDs to be stolen through phishing attacks or more routine security breaches such as the use of weak or stale passwords can put systems at risk. Eliminating these security holes is critical and requires robust and consistent security policies coupled with automated, network-wide security measures such as password aging and complex password requirements.

Security can also be improved through the use of standardized, unified access security policies across the network infrastructure, such as the implementation of identity management systems for privileged users of critical networks, including comprehensive video/text logging to help ensure a high compliance to key security specifications. This helps address a growing need on the part of railway operators to better track who has accessed the network, and when, to enable them to identify the source of vulnerabilities and ideally who used the resulting back door. This long term forensics capability is often also required by regulators.

5.1. IP and IoT increase the risks

The evolution of railway communications networks to IP technologies and the increasing use of IP-based applications and the growing adoption of Internet of Things (IoT) technologies are widening the spectrum of vulnerability of rail infrastructure.

In the past, systems tended to be isolated, providing natural breaks that could stop the spread of a malicious infection or the reach of an attack. However, today's IP-based applications and underlying mission-critical networks are more interconnected, increasing their vulnerability.

The need to run new IP networks alongside legacy technologies, such as SCADA, adds further security complexity. A good example of how legacy vulnerabilities can carry forward into today's systems is Signaling System No. 7, or SS7, which was designed more than 40 years ago. The underlying methodologies for the SS7 signaling protocol, as used in GSM/GSM-R for example, have been incorporated into Diameter, a protocol used in standard IT-based, packet-switched/Ethernet-based solutions, including LTE wireless networks. As a result, security threats to SS7 networks may also be possible in LTE networks, requiring increased security on signaling interconnects.

Another potential security threat might arise from the forthcoming deployment of ETCS (European Train Control System) over GPRS/IP.

Meanwhile, the growing use of sensors, meters, surveillance cameras and other devices to support realtime monitoring and situational awareness, improves operational efficiency, reliability, resiliency and safety of railway infrastructure.

This evolution is bringing about the risk of cyber-attackers gaining control of IoT devices and using them to run malware to engage in attacks ranging from spam to data theft to DDoS.

Indeed, it is possible, even likely, that there are many installed devices today that have been compromised, yet their infection is undetected because they continue to perform their intended functions. A hacked sensor could be sending millions of spam messages per month over a long period of time, but this may not be obvious unless the IP address range is blacklisted. However, state-of-the-art IoT security solutions can monitor the network traffic generated by the IoT devices and alert for abnormal behaviors, which can go a long way toward helping railway operators address this challenge.

For devices that are part of a mission-critical application, such as signaling, alerts or faults must be processed in real time to ensure seamless service continuity. Just as important, corrective actions must be initiated automatically, either from or to the IoT devices, based on security policies. Finally, the data transmitted to and from IoT devices needs to be auditable to enable accuracy, governance, and regulatory compliance.

In October 2016, attackers managed to hack 145,000 IoT devices to execute the world's first terabit scale distributed denial of service (DDoS) attack¹². The attack, using a weapon called the Mirai botnet, affected a wide range of organizations from Paypal to Twitter, to Amazon to Spotify. In March 2018 and January 2019, there were even larger volumetric DDoS attacks, of 1.3 terabits per second and 580 million packets per second respectively, trying to oversaturate the network capacity as well as server processing power while denying legitimate requests and transactions. While such attacks have not yet directly target mission-critical networks it does show how IoT devices like smart sensors and cameras can be manipulated to bring operations to a complete halt.

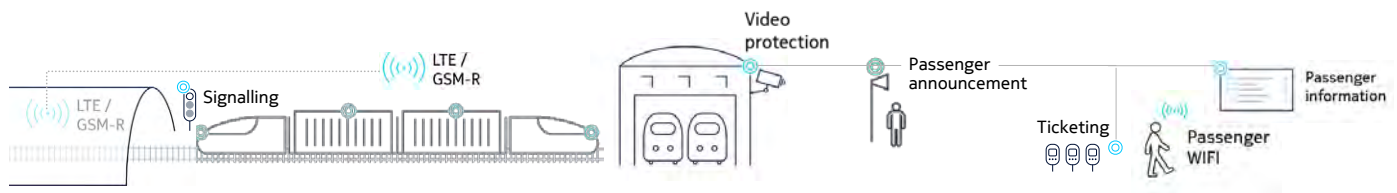


Figure 2. The evolution to interconnected IP-based systems plus the rise in the use of internet-connected devices increases the vulnerability of railway operators to cyber attack.

5.2. IP-based wireless networks need extra protection

A further development is the adoption by railways of wireless networks in the form of LTE and future 5G technologies. LTE security is based on two layers of protection instead of one-layer perimeter security as in 3G. The first layer deals with security in the radio access network, while the second layer provides security in the Evolved Packet Core (EPC) network. In practice, the implementation of this two-layer security architecture is subject to vendors' interpretation and therefore, may expose a mission-critical network to threats if not engineered properly.

The encryption of all traffic between base station and core network is also essential. LTE networks provide hop-by-hop protection that could lead to security being compromised by incorrect system configuration parameters. End-to-end encryption provides protection for situations where security is not configured properly in LTE equipment.

¹² <https://www.siliconrepublic.com/machines/internet-meltdown-mirai-botnet>

In railway networks, voice services depend on group communications in which users can simultaneously communicate, walkie-talkie style, with groups of other users. These require specific arrangements to secure group call communication and direct mode of operation, as well as ensuring the security of both device and back end control servers.

6. Defense-in-depth is vital to protect railway operations

Cost-effectively protecting railway networks from cyber-attacks first requires an understanding of the risks to the specific networks and their underlying operational processes to define the scope and appropriate level of protection required. Even if a completely airtight, secure network would be possible, it would require an unrealistic level of investment. Rather, defense in depth is a more balanced, economically feasible approach to provide the necessary security to mitigate the real risks.

The objective is to build cyber-defenses that are aligned with the network's operational objectives. Railway operators must focus on processes and technologies to implement effective layered security across network, application, data, identity and access management, laying out a series of defenses to thwart attacker's attempts to exploit security gaps.

Humans also play a predominant role in cyber-defense. Supplementing all security measures in place, rail operators need to train all employees to be prudent in electronic communications and be vigilant about reporting any anomalies, reducing security risks and protecting the rail systems.

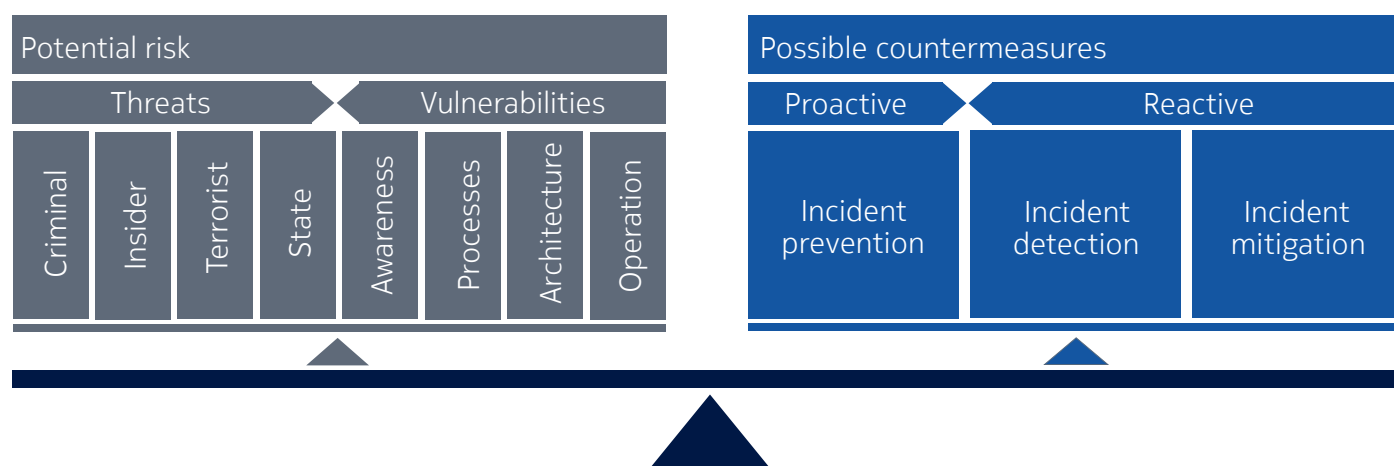


Figure 3. Security always requires a balance between the risk from threats/vulnerabilities and required investments for countermeasures.

6.1. Security is everybody's responsibility

Technical solutions that help to protect infrastructure need to be accompanied by processes and management procedures that instill a culture of security in all railway employees.

The point is made clear by the UK's Department for Transport in its publication Rail Cyber Security Guidance to Industry:⁸ "When implementing security there is a natural tendency to focus the majority of effort on the technological elements. Although important, technology is insufficient on its own to provide robust protection. It is essential that people operate best practice."

The internet carries many examples of how even the most basic of security recommendations are not being followed – such as revealing log-in details. In the UK, a 2015 TV documentary revealed how one railway operations center employee had written down username and password details on a monitor.¹³

It also reveals the use of weak passwords, as does another filmed TV interview in which a Polish organization's password information was clearly displayed on a whiteboard.¹⁴

Eliminating this security hole is critical and requires robust and consistent security policies coupled with automated, network-wide security measures such as password aging and complex password requirements.

Security can also be improved through the use of standardized, unified access security policies across the network infrastructure, such as the implementation of identity management systems for privileged users of critical networks, including comprehensive video/text logging to help ensure a high compliance to key security specifications. This helps address a growing need on the part of railway operators to better track who has accessed the network, and when, to enable them to identify the source of vulnerabilities and ideally who used the resulting back door. This long-term forensics capability is often also required by regulators.

7. Essential elements of in-depth security

There are some basic elements of effective cyber security for mission critical networks.

Automate security processes: First, today's manually intensive incident response approaches need to be automated. It's not uncommon for large critical network service providers to be bombarded with thousands of cyber-security alerts every day. Not all will be security breaches. Many will be false alerts and duplicate information. Yet, the sheer number of alerts can overwhelm a security team, leading to serious incidents not being investigated and followed up in time. They need better ways to automatically correlate, prioritize and deal with these alerts.

Furthermore, current approaches are inefficient, with up to 33 percent of incident response time is spent on manual processes, leading to delays. Combined with alert fatigue and time wasted on false calls, many security breaches can go undetected. Security automation that encompasses business processes, regulations and security policies will be essential to keep pace with the rapid rise in attacks.

End-to-end security is essential: End-to-end security is vital to protect all components of communications networks. Failing to address this will result in inadequate network protection and increase vulnerabilities to threats that are specific to one technology or another.

End-to-end security encompasses the operation of the entire network and its security processes, such as access management and audit compliance; network security, including signaling and core network security; and security management for IoT devices. Security management for devices must include three key components: secure identity management for each device, a secure communication channel between the management server and the devices, and a secure trusted software environment on each device.

An added complication is that fact that many such devices are unmanned and may not even have a conventional user interface. Also, many are meant to operate unattended for extended time periods, with no physical human interaction. The use of certificate management practices to ensure the identify and proper configuration of such devices before they are deployed in networks, is also essential.

¹³ <https://www.grahamcluley.com/train-control-centre-passwords-revealed/>

¹⁴ <https://nakedsecurity.sophos.com/2012/08/24/security-tip-when-being-interviewed-on-tv-wipe-passwords-off-whiteboard/>

Network segmentation and firewall: Network segmentation with IP/MPLS VPN based on rail applications or other policies provides traffic isolation and hampers lateral movement of hackers as they scout the network. With the frequency of DDoS attack on the rise, the network, together with network analytics platform, can also assume a critical role, acting as the first line of defense, filtering out network and transport layers attack traffic for the firewall to protect the network and infrastructure from more sophisticated application layer attacks.

Analytics for continuous improvement: Security analytics correlates data from across the network, devices and cloud layers to spot suspicious anomalies and provide insight into the nature of the threat, the associated business risk and recommended response. With machine learning, the effectiveness of security would increase continuously.

Encryption protects data: With encryption, even when a perpetrator taps into the communication channels, confidentiality, integrity and authenticity are still protected. As the network is deployed with different architecture and transport technology, it is vital to deploy multi-layer encryption that encrypts at the optical, IP, MPLS and transport layers. Encryption should also be applied to stored data, not just when it is being moved around.

High availability: Ensuring high availability and operational stability of the network and transport layers (for example on IP/MPLS, optical) is a key foundation for a secure network because it enables a rapid recovery from any attack, including physical shut down of communications equipment and infrastructure facilities.

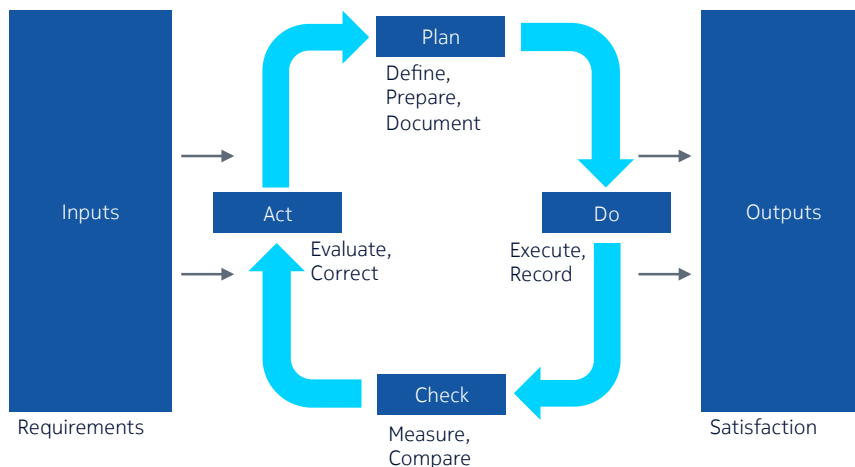
7.1 Implementing active security management

Various standards relating to security are available (see text panel “Standards for security”). There is also a wealth of best practices from mission-critical networks around the world, most of which advocate an active security management approach with automation and continuous improvement.

The traditional approach to security is largely based on manual processes without a centralized management system. This is still a reasonable approach for some organizations, but the increasing sophistication of attacks and growing regulatory complexity mean this will not be realistic in the medium term.

An expanded security management solution with analytics, automation and reporting would support workflow management and automation, analytics and reporting. This would enable security operations teams to automate and prioritize activities and report data to inform better business decision making.

Figure 4. ISO27001 is typical of the active security management approach to cyber security.



Standards for security

Examples of relevant security standards include:

ISO 2700x Information security management systems – ISO/IEC 27001 is the best-known standard in the family providing requirements for an Information Security Management System (ISMS).

ITU-T X.805 security architecture – a streamlined high-level threat model, enabling operators to assess network security and eliminate potential threats in complex environments. It can be applied across network operations, as well as in network management.

There are three layers to the architecture:

- The infrastructure layer, which comprises basic communications network building blocks such as routers, switches and transport equipment.
- The services layer, which comprises network services or circuits that deliver data generated by applications, such as supervisory control and data acquisition (SCADA), land mobile radio (LMR) or closed-circuit television (CCTV), end-to-end across the communications network.
- The application layer, which comprises the devices, simply known as endpoints, over which applications such as SCADA, video surveillance and IP telephony run. The endpoints could be a SCADA RTU, CCTV camera, SCADA server and Video Management System (VMS). An endpoint includes all associated hardware, software and firmware.

IEC 62443(-2-4) Security for industrial automation and control systems (IACS) – specifies requirements for digital security capabilities for IACS service providers during integration and maintenance of an automation solution.

EN 50126 The Specification and Demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – this is the railway sector specific application of IEC 61508.

EN 50128 Communications, signaling and processing systems – covers the software for railway control and protection systems.

EN50129 Communication, signaling and processing systems – specifies safety related electronic systems for signaling.

EN50159 Railway applications - Communication, signaling and processing systems – governs safety-related communication in transmission systems.

8. Nokia cyber security for railway communications networks

Nokia offers in-depth expertise in the development of cyber-security best practices.

The approach to mission critical cyber-security recommended by Nokia is based on a security framework that aligns an organization's different working groups and implements common best practices. The ITU-T X.805 security framework is used to help operators improve end-to-end network security and eliminate potential threats in complex, dynamic environments, and it can be applied across network operations and management.

Nokia end-to-end security solutions incorporate security products and services that address the specific challenges of rail operators. For example, the Nokia Netguard Security Management Center and Security Operations Analytics and Reporting platform enables security operations teams to automate and prioritize activities and report data to inform better business decision making.

Critical LTE network elements such as base stations, network controllers, mobile devices and application servers need to participate in their own defense. This self-defense capability is best developed during product design. The Design for Security (DFSec) approach used by Nokia deals with proactive security measures, including risk and threat analysis, secure OS configuration, access control, password policy, code review, penetration testing and other activities. Nokia also implements reactive security measures known as Security Vulnerability Monitoring (SVM) to ensure that OEM product vulnerabilities listed by computer emergency response teams (CERTs) are highlighted for further qualification and possible patches.

Nokia also applies best-in-class certificate management practices to ensure that IoT devices are properly identified and certified at the time they are deployed. Existing 4G LTE networks, and emerging 5G networks are designed with certificate management systems in place that are intended to deal with this challenge. Manufacturer-provided certificates with a unique, secure identifier can ensure that devices have not been modified or tampered with prior to deployment, and help ensure the identify of those devices once in operation. The large number of certificates and diversity of suppliers (certificate authorities) requires a significant effort to manage renewal and deployment tasks. Technologies which automate the enrollment and deployment of digital certificates can bring operational savings and prevent costly errors.

Nokia combines expertise in both LTE and IP to achieve mission-critical security that addresses the vulnerabilities specific to these technologies. Mission-critical network solutions (IP/MPLS, optical, LTE) not only deliver network reliability, performance and scalability, they are also an integral component of the security framework, defending against security threats and attacks. Nokia integrates security seamlessly with the existing operations support system (OSS), providing the relevant alarms, counters and monitoring capabilities without additional terminal applications or equipment. This enables the operator to focus on its mission-critical responsibilities without being distracted by the daily operation of a telecom business or by having to work with multiple security vendors to align on security roadmaps or incident resolution.

Nokia services provide the expert support rail operators need to secure their communications networks.

For example, the Nokia Security Risk Index (SRI) assessment framework and Managed Security Service (MSS) encompass all areas of security, including the assessment and continuous protection of multivendor networks.

With more than 30 years of experience in the rail industry, Nokia works with rail operators to develop proactive cyber-security for mission critical networks. Nokia security expertise is rooted in its strong presence in the public safety segment and as a trusted partner for public network operators around the world which impose the highest requirements for network security.

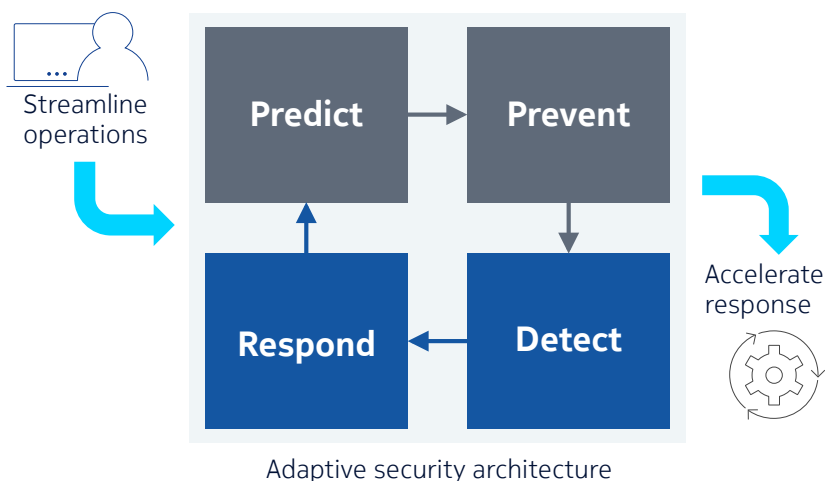


Figure 5. Security orchestration analytics and response transforms railway communications network security from manual and reactive to dynamic, Adaptive security architecture predictive and automated.

9. Conclusion

Hardly a day goes by without the media reporting a cyber-security incident or exposure of a risk somewhere in the world. Not only are attacks becoming ever-more sophisticated, but the potential damage that can result is growing, even physical damage to critical railway infrastructure such as signaling systems.

Railway infrastructure can ill afford any successful cyber-attacks. Not just financial loss is at stake; lives can be put in jeopardy.

At the same time, it is important for rail operators to evolve their communications towards new networking technologies, including LTE and IP/MPLS, to support new services and improve the efficiency of their operations. While such networks are future proof and scalable, they will introduce new vulnerabilities. With a robust network defense, these threats can be addressed.

Deploying the right level of security is a high priority. While all mission-critical networks are different, sound security typically requires a move from manual processes to automation, the application of data analytics and machine learning, end-to-end encryption and a full lifecycle evaluation of cyber-security risks.

Nokia offers an advanced and comprehensive approach built on its long experience and in-depth expertise of both security as well as mission critical networks design and operations. In line with best practices and published standards, the Nokia solution can ensure the highest levels of protection for railway communications.

Railways and the traveling public deserve nothing less.

For more information on our range of solutions and services for railways, please visit our railway page at <https://www.nokia.com/networks/industries/railways/>

10. Abbreviations

CCTV	Closed-Circuit Television
CERTS	Computer Emergency Response Teams
DDoS	Distributed Denial of Service
DeOS	Destruction of Service
DFSec	Design for Security
DWDM	Dense Wavelength Division Multiplexing
EPC	Evolved Packet Core
GDPR	General Data Protection Regulation
IoT	Internet of Things
IP	Internet Protocol
IP/MPLS	IP Multiprotocol Label Switching
ISMS	Information Security Management System
KPI	Key Performance Indicator
LMR	Land Mobile Radio
LTE	Long Term Evolution
MPLS	Multiprotocol Label Switching
OS	Operating Software
OSS	Operations Support System
SCADA	Supervisory Control and Data Acquisition
SS7	Signaling System No. 7
SVM	security vulnerability monitoring
VMS	Video Management System
VPN	Virtual Private Network

About Nokia

We create the technology to connect the world. Powered by the research and innovation of Nokia Bell Labs, we serve communications service providers, governments, large enterprises and consumers, with the industry's most complete, end-to-end portfolio of products, services and licensing.

From the enabling infrastructure for 5G and the Internet of Things, to emerging applications in digital health, we are shaping the future of technology to transform the human experience. networks.nokia.com

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A new Platform for Rail Communications – adopting 5G for Railways

White paper

5G offers a major opportunity for rail operators to transform their operations for the better. Its high speed and extreme traffic handling capacity, together with ultra-low response times, highest reliability and support for massive machine type communication (IoT), will allow rail networks to improve safety, optimize costs and make their services more attractive to passengers in many ways. Such capabilities will make the telecommunication network the cornerstone of railways' ambitions for further digitization.

With the Future Railway Mobile Communications System due to replace GSM-R and other legacy systems, rail operators can begin to plan early how they will prepare and migrate their networks to take advantage of 5G - the leading mobile technology that will serve the world far into the future.

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Executive summary: the future of railway communications will be built on 5G

The future of rail transport critically depends on taking advantage of advanced communications systems to increase safety, cut operating costs and improve the experience for rail passengers towards a digital railway.

While 4G introduced some functionality for mission-critical communications, 5G is set to go much further in meeting the demands of the Communications Service Provider (CSP) market, as well as, from day one, fully supporting the mission-critical needs of industries and enterprises, including rail operators. As well as providing efficient broadband capabilities, 5G networks will offer measures to build ultra-high reliability networks with ultra-low latency. It will also serve the need of massive Machine Type Communication (mMTC) for sensors and predictive maintenance that train operators will increasingly need in the future to improve and optimize their services. With huge performance improvements over previous generations of mobile technology, 5G delivers high speeds of up to 10 Gbps and very low latency, the time for the network to respond to requests from the mobile device. Furthermore, 5G also achieves such performance at much lower cost than other technologies.

Even more important, 5G will bring additional communications flexibility for railway operators that use dedicated networks for mission-critical services and commercial 5G network slices from CSPs for additional capacity for non-critical services.

This will bring rail operators new opportunities and applications based on mobile broadband capabilities.

Applications can be categorized into three segments:

- Critical: applications essential for train movements and safety or a legal obligation, such as emergency communications, shunting, presence, trackside maintenance, Automatic Train Operation (ATO), Automatic Train Control (ATC) and Automatic Train Protection (ATP).
- Performance: applications that help to improve the performance of the railway operation, such as train departure procedures and telemetry.
- Business: applications that support the railway business operation in general, such as wireless internet and ticketing support.

Led by ERA and UIC, the Future Railway Mobile Communications System (FRMCS) is the single global standard for railway communications. While FRMCS will be functional in nature, 3GPP technologies such as 5G will be best positioned to meet all the needs of railway operators.

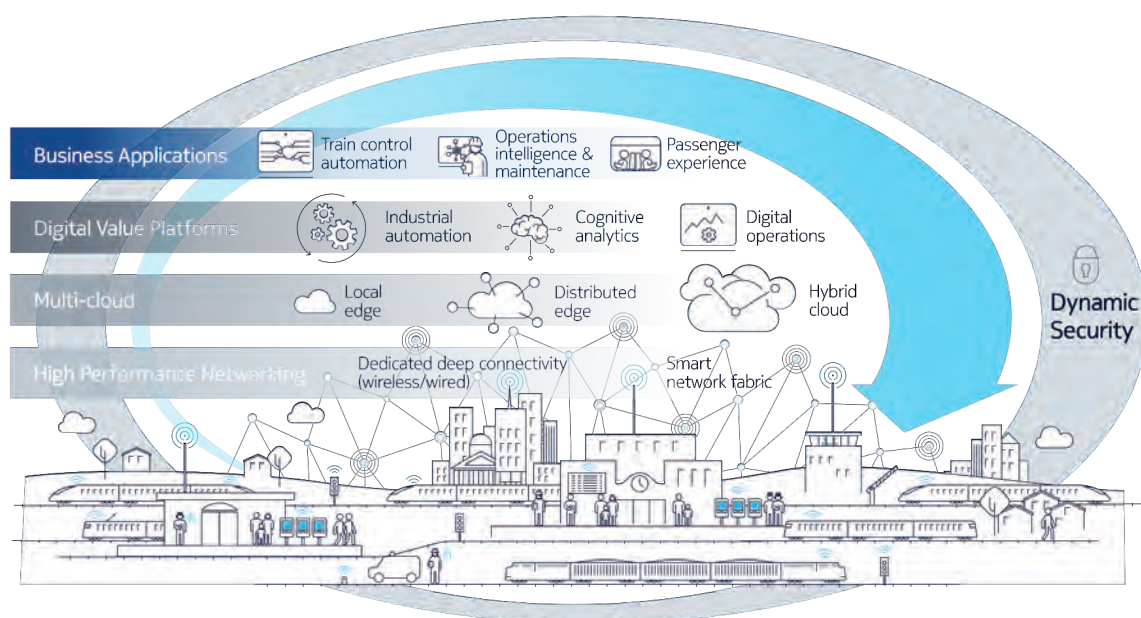
Rail operators are advised to start planning early to migrate their existing networks to the forthcoming FRMCS standard if they are to make full use of the opportunities. While it has served the rail industry well for many years, GSM is maturing, with support largely terminating by around 2030. 5G is expected to serve railways for much longer, with likely implementation in the mid-2020s to provide reliable service extending over the next few decades. However, in Europe the roadmap for ETCS extends to 2050.

This means that for several years, GSM-R and FRMCS will run in parallel during the migration period. Current GSM-R networks must be kept up to date to achieve the highest standards of quality and performance and meet the latest European Train Control System (ETCS) requirements and to free up spectrum for FRMCS. Railway organizations must upgrade trains, which is not a quick task. Additionally, overall harmonization in Europe is needed and a proper legal framework needs to be established.

Rail operators currently using GSM-R are recommended to modernize their existing GSM-R networks by introducing IP technology as in the transmission networks for FRMCS, or with ETCS over GPRS for ETCS, ensuring they are prepared for a parallel rollout of 5G for railways starting from around 2025.

As a leader in both 5G and radio communications for railways, Nokia is well equipped to provide rail operators with the expertise and advice they need to make full use of these exciting opportunities.

Figure 1. Nokia has a clear vision of the future of railway communications. The Nokia Bell Labs Future X architecture for railways provides an intelligent, dynamic communications and cloud-based platform to support all of the individual systems, processes and activities of the railway



The mobile broadband opportunity for railways

The way people live, work, play and communicate is set to be transformed by ultra-fast, reliable mobile broadband. Industries as well as consumers will benefit, and the rail industry is no exception. For rail, the benefits will be many, including enhanced safety, improved operational efficiency and innovative passenger services, helping them achieve further digitization to make the railway more competitive.

To meet its priorities, rail needs a communications technology that offers high speed, high security and high capacity to support passenger connectivity needs, as well as safety-critical operational applications such as train signaling, and safety-related applications like CCTV and on-board communications.

All this can be achieved with a single, converged and flexible network, sweeping away the complexities and inefficiencies of managing a mixture of several network technologies, including GSM-R, TETRA, DMR, Wi-Fi and even analog technologies like VHF/UHF.

FRMCS – a global standard for rail communications

The FRMCS is intended as a single global standard for railway communications. A successor to GSM-R, FRMCS conforms to European regulations while also meeting the needs and obligations of rail organizations outside Europe. As well as the mainline railways, UITP (Union Internationale des Transports Publics), the International Association of Public Transport, also supports FRMCS.

As a mobile broadband-ready technology, FRMCS will support the needs of rail in six ways:

Demand for broadband

- Automation for self-driving trains
- Increasing operational efficiency
- Improving customer experience

Optimization of networks

- Further unifying network technology towards IP
- Reduce complexity
- Increase flexibility

Long term support

- Support for ERTMS/ETCS (as examples) for the next decades
- Manage the obsolescence of GSM technology

Critical communication

- Voice, evolving to group video calls
- Train control, automated train operation
- Machine-to-Machine (M2M) and telemetry for critical elements

Performance communication

- M2M and telemetry
- Predictive maintenance
- CCTV for passenger security and train movement control, passenger Information, staff communication, lineside (fixed)

Business communication

- Wi-Fi on board

One of the main targets of FRMCS is to achieve maximum flexibility by separating the railway functions from the network and radio bearer that carries them. This makes it possible to use standard mobile radio technologies such as 4G and 5G, Wi-Fi, fixed networks or even satellites. In contrast to GSM-R, railway functionality is mainly realized on the application layer. The evolution of 3GPP technology to 5G supports multi access and application centric communications.

Although this flexibility is desirable, it is also important to harmonize network technologies across countries, for example for Europe, and avoid deploying too many different solutions. The latest thinking of the UIC and the European Railway Agency shows a clear preference towards 5G, a choice supported by many major European railway operators.

However, some railway operators see a solid business case for implementing early broadband technology for rail based on LTE. This may give them an opportunity to become familiar with 3GPP broadband technology, followed later by a smooth migration to a 5G FRMCS solution.

A compelling case for 5G

There are several reasons for choosing 5G technology as the basis for the future of rail communications. FRMCS based on 5G is expected to be introduced in Europe around 2025, by which time it is likely that the 3GPP will have ceased standardization work on 4G LTE technology. Additionally, 5G can be expected to serve railways for much longer, extending over the next 15-20 years.

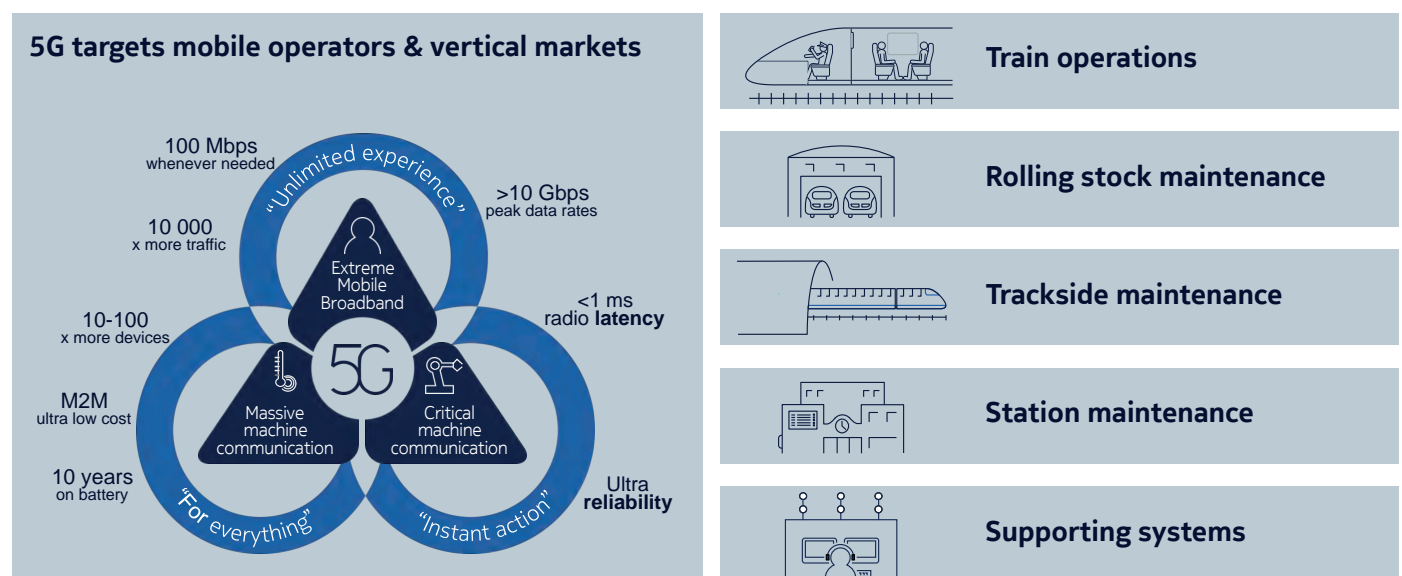
Many of the future uses for railway communications will demand minimal delay between the radio and the network, known as latency, as well as the ability to work in the Cloud. Examples include automated train operation and broadband M2M communication. Although today LTE provides a high quality of service and broadband capabilities, 5G is specifically designed for these kinds of ultra-reliable, low-latency mission-critical communications, which also include video applications. This is supported by 5G flexible deployment schemes using cloud and mobile edge computing.

There is also a huge effort to use 5G technology for the forthcoming Industry 4.0 transformation, and it is expected to become the dominant technology for vertical markets. Using 5G as a common technology will also make it easier for intermodal communication concepts, for cars and other vehicles to interwork with FRMCS to communicate with trains.

“Deutsche Bahn expects deployed 5G and Cloud technology to be 99 percent off-the-shelf and ‘mainstream’ technology but sees the need for dedicated research and innovation to optimize 5G and Cloud technology for rail scenarios.”

Dr. Patrick Marsch, DB NetzAG -DigitalisierungBahnbetrieb/ Systemarchitektur

Figure 2. 5G offers extremely high performance in many dimensions to support all the communications needs of rail operators



5G capabilities put full automation within reach

One of the major goals of many industries, not least rail operators, is to make greater use of automation, to cut costs but also to remove human error and promote greater safety. With its high speed and capacity, 5G offers the data handling abilities that extensive automation demands.

Automation has already made great inroads in rail transport, such as people movers at airports, various metro lines across the globe and in special freight applications like mining trains. Enhancing ETCS, Automated Train Operation (ATO) is being introduced to mainline rail services. Although train control as well as rolling stock solutions are commercially available today, several challenges remain. Solutions that offer precise yet affordable location of trains, obstacle detection and a sufficient and reliable communication system are yet to be developed.

When it comes to maintaining rolling stock, the first steps towards automation are complete. However, preventive maintenance is still the most common philosophy, whereas industry generally is moving more towards condition-based maintenance, where interventions are made only when issues start to occur.

Even so, this is often too late, so a newer trend is predictive maintenance. So far, few pilot projects have proven successful in this area. This is because solutions are often too siloed - even restricted to vendors of components of rolling stock. Rail operators often face the issue that these solutions are not open, and data cannot be shared.

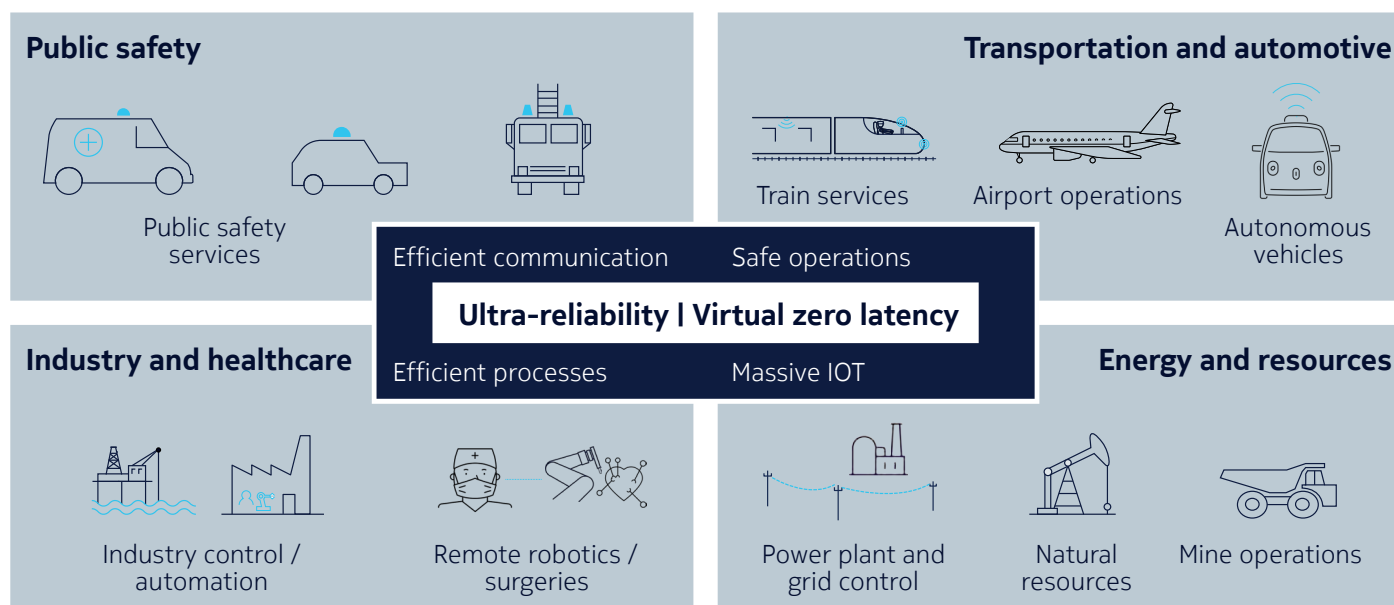
Trackside maintenance is one of the most challenging tasks to automate. However, there are some promising solutions being created by start-ups. In trackside maintenance, more than in any other case, it is important to find solutions where only minor deployments in the field are required.

Today, most automation is occurring in railway stations. Elevator and escalator maintenance is often already based on their condition. However, these solutions are siloed, as they are often provided by the elevator vendors. Another issue is that solutions are often driven by large deployments in central or major stations, but the biggest benefits can be achieved by optimizing maintenance at small, unstaffed rail stations.

What is 5G? An overview of the technology

Essentially, 5G provides radically new connectivity capabilities that are both agile and sustainable. Networks based on 5G will deliver extreme mobile broadband with unprecedented network speed and capacity, while making use of additional spectrum bands. New services and many Internet of Things (IoT) applications require ultra-low latency connectivity, coupled with ultra-reliability.

Figure 3. Introducing new radio systems and network architecture, 5G networks will be flexible and reliable, offering extreme performance in many ways, to meet a huge range of uses in many sectors



The key technologies underlying 5G

5G is a combination of several technologies, but it will not follow the static, one-size-fits-all approach of previous mobile communications generations. Instead, 5G networks will be programmable and software-driven. They will be highly scalable to meet the communication demands of consumers and enterprises.

The building blocks of 5G architecture

There are several ways to deploy 5G. The first phase of a 5G rollout can use dual connectivity, with devices connecting to both 5G and LTE networks. This is practical if the LTE network uses low band spectrum and the 5G network uses high band spectrum that offers limited coverage.

5G can be also deployed as a standalone solution without LTE.

Frequencies for all occasions

5G NR (New Radio) is a new global standard air interface for 5G networks. It is the most flexible way to benefit from all available spectrum options, currently spanning 600 MHz to 90 GHz, including licensed, shared access and unlicensed, Frequency Division Duplex (FDD) and Time Division Duplex (TDD) bands, narrowband and wideband allocations are possible, and new spectrum options are continuously introduced

- **Low bands (below 1 GHz)** are needed for wide area coverage, for ultra-high reliability and for deep indoor penetration. Extensive coverage is particularly important for Internet of Things (IoT) and critical communication.
- **Mid bands (3.5 GHz and 4.5 GHz)** will be used for 5G coverage and capacity in urban areas by reusing existing base station sites. The spectrum around 3.5 GHz is attractive for 5G because large bands of spectrum are available across the world that could support gigabit data rates.
- **High bands (mmWave spectrum above 20 GHz)** offer extreme mobile broadband capacity with data rates up to 20 Gbps.
- **Unlicensed bands** such as 5 GHz, and in the future 60 GHz, offer additional offload options for best-effort traffic and less critical applications not needing guaranteed Quality of Service (QoS).

Even higher network capacity with Massive MIMO

5G can offer increased capacity through its use of Multiple Input Multiple Output, or MIMO. This typically uses two transmit and two receive antennas to double the capacity.

Massive MIMO goes even further, using many simultaneous transmit and receive streams to create much higher network capacity. Normally, sub-6 GHz bands have smaller bandwidth, but Massive MIMO multi-stream transmission can achieve gigabit peak data rates. Massive MIMO is also an effective way to use 3-40 GHz bands to increase peak data rates through multi-stream transmission.

Research is ongoing on how these concepts support railway deployments, considering also aspects as available space on trains for complex antenna solutions.

Getting latency below one millisecond

A practical end-to-end latency in typical LTE networks is tens of milliseconds when connected and even longer when starting from idle. For many railway applications, new technologies are needed that can reduce latency by 90 percent, for example when remotely maneuvering trains as in shunting operations. 5G networks will use various techniques to reduce latency substantially, such as shorter transmission frames, flexible resource allocation and edge computing to place the processing closer to the user and thus reduce the distances that data needs to travel in the backhaul network. These technologies will help 5G networks achieve one millisecond latency or even less.

The 5G core will be cloud-native

The rise of IoT and the deployment of 5G technologies will require networks to support a much wider range of services. The one-size-fits-all architecture of networks must change and is being led by the evolution to a cloud-native core network that is both programmable and highly scalable.

A cloud-native architecture, which is built from the ground up for the cloud, allows operators to support both the scale and performance demands brought by broadband evolution and the introduction of IoT/ Machine Type Communications (MTC) and 5G. New development techniques allow operators to introduce industry specific 5G services more rapidly increasing reliability.

Evolving 5G transport technologies

With the development of the 5G radio network and the 5G core, the transport technologies that carry data traffic between them must evolve to meet their demands. A consideration for railways is the diverse locations of radios required to support new use cases, requiring flexible transport technologies to reach them.

These will include a mixture of advanced microwave, IP, Optical, Next Generation Passive Optical Network (PON), and Wireless Mesh relay technologies, all updated to transport 5G traffic securely and resiliently.

5G network slicing

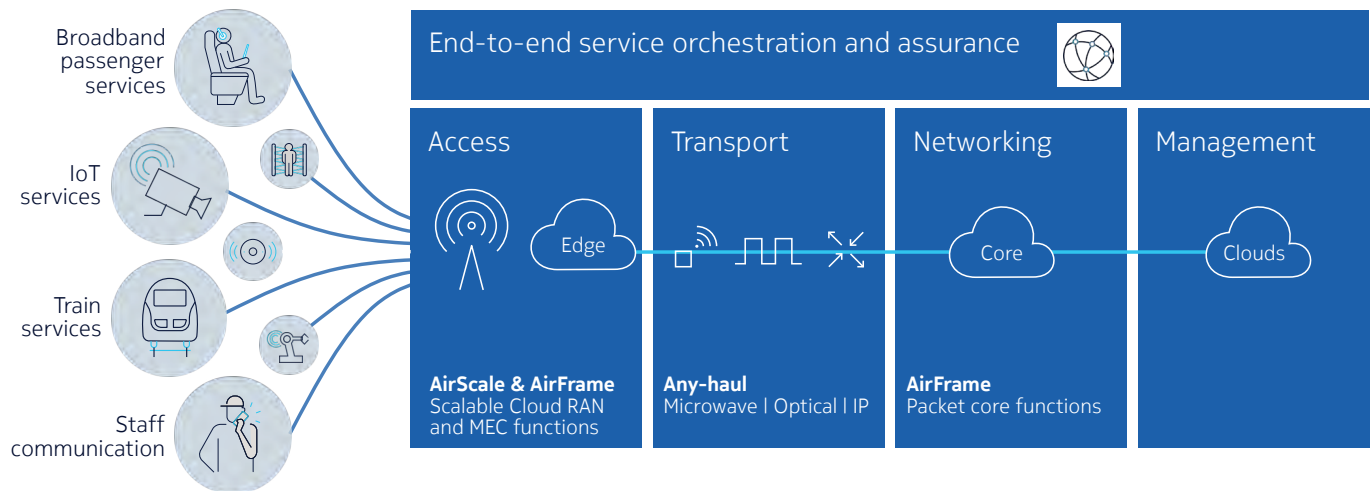
Different users will have different demands on 5G networks with sometimes very diverse and extreme requirements for latency, throughput, capacity and availability. Supporting all these different uses cost-effectively from one common infrastructure can be achieved by network slicing.

With network slicing, several different end-to-end, separate networks can be provided and operated independently for each customer, supporting, for example, smartphones, tablets and virtual reality applications.

Network slicing can provide cost-effective and flexible support for the wide range of rail applications that are likely to be implemented in the future.

Network Slicing enables separate, dedicated railway operator networks, or the use of public mobile operator slices for running non-mission-critical services.

Figure 4. 5G network slicing provides the flexibility needed for additional railway services



Uses and benefits of FRMCS and 5G

Seamless 5G connectivity, cloudified data and analytics engines will enable railway operators to partner with third parties to offer innovative applications and services.

Mission-critical applications

Mission-critical reliability is mainly required by CBTC/ETCS systems, although operational voice services also demand extreme network prioritization as they help to ensure security and provide an essential means of manually sustaining train operations should the CBTC/ETCS system fail. A CBTC/ETCS application will typically tolerate a communications loss of no more than a few seconds, while a mission-critical voice service will usually have higher tolerance of communications loss. Further Automation even increases the demand.

Predictive maintenance and operations intelligence

The maintenance and repair of rolling stock, track components, depots and stations, often across large geographies, poses challenges in planning the use of repair equipment and teams. Predictive maintenance applications, using IoT asset management and advanced data analytics promise to reduce costs, increase asset utilization, enhance safety, minimize delays and reduce revenue loss. Digital twin systems can be introduced to increase efficiency through the simulation of trains and rail infrastructure.

Video surveillance for operational security

A typical railway operation has multiple, high-quality CCTV systems generating many video streams. This requires a cost-effective and reliable high capacity communications network able to handle traffic of several Mbps per camera and thousands of video streams. Video analytics can automatically discover anomalies in people's behavior, alerting safety and security personnel so they can intervene. In fully automated mode, video is important for obstacle detection, or provide situational awareness, for example degraded train operation.

High-capacity and low latency connectivity will support applications that help improve passenger safety and security. These will include driver video for advance views of platforms and level crossings, as well as remote supervision of passengers through on-board closed CCTV.

Such CCTV systems will contain innovative features such as video analytics software to automatically detect intrusions, strange behavior or unattended baggage.

On-board CCTV services require high uplink throughput, while the platform CCTV service requires high downlink throughput. Of all types of application traffic for rail operations, CCTV traffic probably takes up the most capacity.

The digital passenger

The modern passenger expects to be connected constantly and be provided with personal, bespoke communications and services. Making sure the passenger has full broadband access in-station and on-board is only the beginning. Their smartphone and wearables, such as a watch, can provide important information such as directions, alerts and information updates.

Railway personnel can provide better services by being equipped with handheld devices that can immediately identify the passenger and provide them with key contextual information.

Enhanced passenger experience

Enhancing the passenger experience can be achieved through passenger information and multimedia entertainment applications. For instance, passenger information applications can provide route information and weather forecasts. Entertainment applications can provide video streaming.

This type of “Infotainment” traffic is typically low priority and may consume only a low to moderate amount of network capacity. It also tolerates relatively high network latency. However, passenger Internet services could eventually become the single highest consumer of network capacity.

Reducing operational costs

Lower maintenance and operational costs will be achieved through the efficient operation of rolling stock, based on real-time information and improved communication between moving trains, maintenance staff and track-side systems.

Operational costs will also be reduced by introducing new applications (for example remote diagnostics and Augmented Reality (AR) based remote maintenance) and services to simplify and automate operational processes, as well as by consolidating fragmented legacy networks with a unified 5G network capable of running multiple services.

Critical, performance and business applications

The International Union of Railways (UIC) defines three categories of application that may be enabled and supported by FRMCS:

- Critical: applications essential for train movements and safety or a legal obligation, such as emergency communications, shunting, presence, trackside maintenance, ATC, etc.
- Performance: applications that help to improve the performance of the railway operation, such as train departure, telemetry, etc.
- Business: applications that support the railway business operation in general, such as wireless internet, etc.

Source: Future Railway Mobile Communication System: User Requirements Specification https://uic.org/IMG/pdf/frmcs_user_requirements_specification_version_4.0.0.pdf

The route to FRMCS/5G for rail operators

European mainline railway operators are restricted by a legal requirement that the next-generation railway telecommunication system must be standardized. UIC, ERA (the European Union Agency for Railway), ETSI and 3GPP are defining a telecommunications system capable of replacing GSM-R from 2022 onwards, with the migration phase expected to last until 2030 at the earliest.

The first 5G trials and proofs of concept in the mobile operator market have already commenced and are seeing a fast ramp-up over the coming months. 5G-based FRMCS commercial roll out in Europe is expected from 2024/2025 onwards.

European frequency standardization and regulation is currently driven by ECC/CEPT, where different options – including the reuse of existing GSM-R spectrum – are under evaluation and expecting lower frequencies to be used for 5G in the EU. The first roll outs of 5G focus on high frequencies, but there is strong interest from all regions to deploy 5G in frequency bands below 1 GHz.

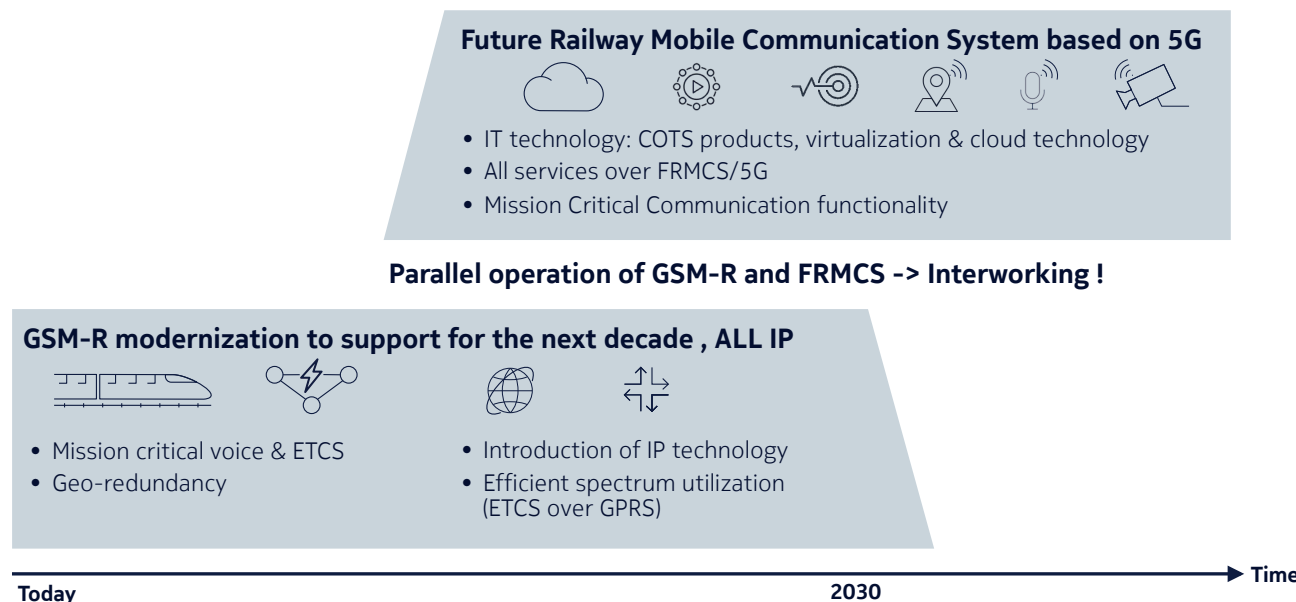
Independent of the radio technology, available spectrum remains the most important challenge facing the railway operator. Because GSM-R and FRMCS will run in parallel during migration, the efficient use of GSM-R spectrum is essential. Current GSM-R networks are not yet wholly updated to GPRS and so must be modernized to meet the latest ETCS requirements and free up spectrum for the use of FRMCS in parallel.

For existing GSM-R customers Nokia recommends modernizing existing GSM-R networks by introducing GPRS for IP services within the next two years, ensuring they are prepared for a parallel rollout of 5G for railways starting from 2025. This will also allow them to slowly convert rolling stock terminals to packet-based ETCS components in the train. Also, railway operators are advised to modernize their IP access network and start connecting GSM-R base stations via IP protocol in preparation for the FRMCS base station, which will be IP-native.

As it will be difficult to maintain basic GSM-R equipment beyond around 2030, a modernized GSM-R network will need to meet all the basic ETCS requirements by that point. This means the time slot for migrating to 5G for railways to meet ETCS would be between 2025 and about 2030 and beyond. During this period, railway operators may opt to run 5G networks for a short period to cover areas of high broadband demand, in parallel to the GSM-R network used to provide the ETCS mission-critical services.

For mainline railway operators outside Europe who currently do not run a GSM-R network and do not have to follow ERA/UIC standardization, the introduction of standard LTE for train control and rail broadband services would be technically feasible and would provide a first step to 5G for railways.

Figure 5. With the deployment of 5G starting in the mid-2020s and GSM-R reaching end of life around 2030, rail operators will need to run both technologies in parallel. Preparations for this period need to be made, principally updating existing networks including transmission and GPRS to support all-IP operation



Making a success of migration

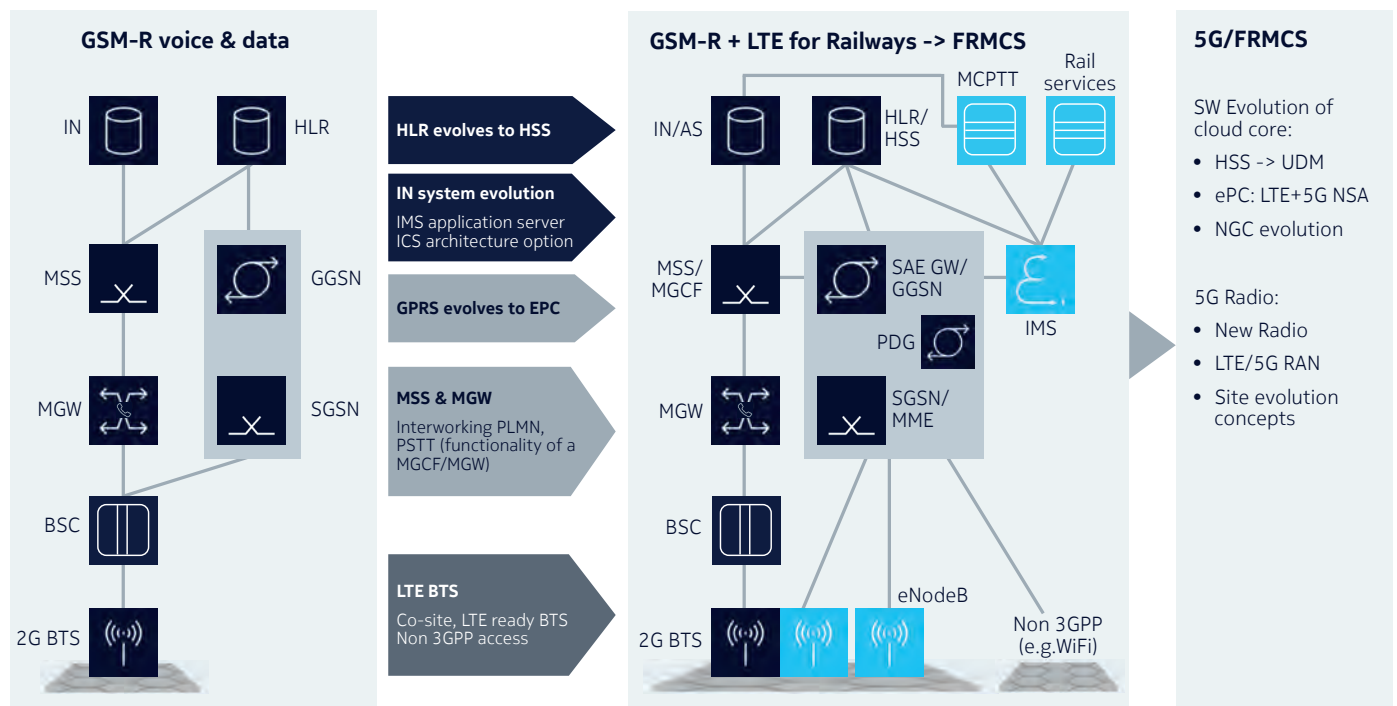
Migrating from analog legacy systems or GSM-R to FRMCS is not an overnight task. As well as updating the railway infrastructure, rolling stock must also be modernized. It is especially important that the migration of infrastructure and rolling stock are aligned to support the movement of trains across international borders, as is common in Europe.

Implementing FRMCS is also a legal requirement in Europe, requiring careful planning and allowing enough time for the migration to take place. Such issues are currently being investigated by the ERA (European Agency for Railway).

With its long experience in deploying GSM-R, Nokia is well placed to support the transition of railway infrastructure to FRMCS, helping to ensure interoperability throughout the migration period. It is vital that the introduction of FRMCS does not disrupt the running of the GSM-R network.

There are many benefits for railway operators in adopting the strategies and technologies that have underpinned the successful and smooth migration of 3GPP from 2G to 4G and 5G. For example, the latest Nokia core nodes, like Packet Core, HSS and MSS, are ready to support all access technologies through simple software updates. Distributed radio access networks with flexible deployment options support the easy transition of the radio subsystem by taking advantage of existing sites and transmission deployments.

Figure 6. From GSM-R to FRMCS – adopting a well-proven path



Nokia – leading the way to 5G

Nokia is the leading railway communications solutions provider and together with Bell Labs is developing the most innovative 5G portfolio. Its networks portfolio is field proven with the major mobile network operators worldwide and it has developed the expertise to modernize and migrate rail networks to the highest safety and efficiency standards.

Nokia is the market leader in GSM-R with 21 networks covering more than 109,000 km of GSM-R track and more than 80 mission-critical railway IP/optical networks deployed. As a principal driver of the industry's standardization work in GSM-R and the evolution to LTE/FRMCS, Nokia can support railway operators as they seek to move from their existing communications networks to ones based on IP.

As a member of UNIFE/UNITEL and with close relations to ERA, UIC, ETSI and 3GPP, Nokia is both driving the standards and ensuring that its products are fully compliant.

In addition to a full portfolio of railway solutions, Nokia also contributes its professional railway services, such as integration for predictive maintenance and station management.

It offers the highest compliancy standards in the communications industry, as well as best-in-class cyber security solutions. For any migration strategy to 5G, rail operators need to consider the evolving threat of cyber-attacks. Nokia's security portfolio helps keep networks, communications, and devices safe from cyber threats, combining a variety of security techniques to protect high-value assets and services.

With a track record of successfully supplying both GSM-R and 5G, Nokia is best prepared to handle the interworking of new 5G and existing GSM-R networks, crucial during the network migration phase.

Nokia Future X – the right track for rail 5G

The Nokia Future X 5G architecture for railways provides an intelligent, dynamic communications and cloud-based platform to support all railway systems, processes and activities. It enables better interaction between many existing systems, as well as providing a launch pad for innovative applications and services.

Future X architecture is based on dedicated, universal broadband connectivity, both wireless and wired, to connect with people, sensors, trains, video monitors and automated train control, all securely and with the highest reliability.

Conclusion

5G is set to make a major impact on all aspects of society and industry and railway communications is no different. Railway operators have an opportunity to update their legacy networks and move to a new world of supreme safety, high operational efficiency and on-train mobile broadband.

Offering high speed, high capacity and low latency, 5G can provide enormous benefits and will help rail operators move to a new era in automated operations and customer service.

The FRMCS, based on 3GPP evolution towards 5G, has been proposed as a single global standard for railway communications.

With GSM-R expected to be supported until around 2030, rail operators need to start planning early to migrate their existing networks to the new standard if they are to take full advantage of the opportunities. One example would be the introduction of IP-based transmission for today's GSM-R networks, as a first step towards FRMCS.

Experienced in both 5G and radio communications for railways, Nokia is well placed to ensure rail operators navigate the transition and help them make their communications systems fit for the broadband future.

Abbreviations

3GPP	3rd Generation Project Partnership
5G	5th Generation mobile network
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
CBTC	Communication-Based Train Control
CCTV	Closed Circuit Television
DMR	Digital Mobile Radio
ERA	European Union Agency for Railways
ERTMS	European Rail Traffic Management System
ETCS	European Train Control System
ETSI	European Telecommunications Standards Institute
FDD	Frequency Division Duplex
FRMCS	Future Railway Mobile Communications System
GPRS	General Packet Radio Service
GSM-R	GSM Railway
HSS	Home Subscriber Server
IP/MPLS	IP/Multiprotocol Label Switching
IoT	Internet of Things



LTE	Long Term Evolution
M2M	Machine-to-Machine
MBB	Mobile Broadband
MIMO	Multiple Input Multiple Output
MSS	Mobile Switching Center Server
mMTC	massive Machine Type Communications
NR	New Radio
PON	Passive Optical Network
QoS	Quality of Service
TDD	Time Division Duplex
TETRA	Terrestrial Trunked Radio
UHF	Ultra-High Frequency
UIC	European Union – Agency for Railway
VHF	Very High Frequency

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METRO NEWSLETTERS

Transport Technologies for “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN, INTERURBAN AND REGIONAL PASSENGER TRANSIT TECHNOLOGIES FOR URBAN MOBILITY AS A SERVICE WITH METRO-BUS, BUS RAPID TRANSIT, URBAN RAIL, LIGHT-RAIL, LIGHT METRO, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, COMMUTER-RAIL, MONO-RAIL, AERIAL ROPEWAY, BOTTOM CABELLINER, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER, POD CAR, SUSPENDED MONO-RAIL METRINO

THE WORLD OF TRANSPORT TECHNOLOGIES AND ECONOMICAL DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT



Kochi Water Metro Service

**METRO 107, October 2020
METRO Newsletter by Dr. F.A. Wingler**

Highlights:

A. India

India develops its indigenous Communication Base Train Control System.
India S High-Speed Train Project in has come in difficulties.
Bombardier reveals Model of RRTS Semi-High Speed EMU to be built in India.
Kochi Water Metro Project gets a push.
Metros and Manufacturers in India are going for Photo Voltaic Energy production.
Metro Lite, LET, projects in India get a push.
Jindal Steel World Class Quality Rails enter India`s rail tracks.

B. Global

Tram-Trains, the “Multi-Talent”, that run intermodal as Light Rail Transits on City Tram Networks, as well on Main-Line Railway Networks transporting Commuters from one City-Center to the other City-Center, become nowadays more and more importance in Germany, France, Spain and Hungary.

Hydrogen-Fuel-Cells for Rail and Bus Vehicles as Zero Carbon-Emission Propulsion are in Europe on increase.

Driver-less Very Light Rail Vehicle System as automated People Movers are in Development.

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- Artificial Intelligence: The Future ahead.
- Make in India indigenous CBTC under Development.
- Introducing the Third Rail System in India.
- India's First Bullet Train Project to see a Delay of five Years.
- India-Japan Logjam over Mumbai-Ahmedabad High-Speed Project.
- Tejas Express Top-and-Tail locomotives rolled out.
- Lucknow Metro conducts Emergency Exit Mock Drill.
- USD 1 Billion Loan approved for Delhi-Meerut regional Rapid Transit.
- RRTS Update: MoHUA Secretary launches the first Look of RRTS Train.
- Delhi-Meerut rapid Rail: All you need to know about Bombardier's Semi-High Speed Train Set.
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- Delhi Metro Traction Equipment ordered.
- Kochi holds Plate-Cutting Ceremony for Water Metro.
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- Kochi Metro to achieve 60% Energy Neutrality by December 2020.
- Titagarh Wagons to procure 4.8 MW Solar Energy from fourth Partner Energy.
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II. Global Activities and Initiatives

- Urban Transport Industry News Round-up, I-VIII.
- Cádiz Tram-Trains make first Main Line Test Runs.
- Regional and Tram-Train Tenders planned.
- Freight Tram-Train to be tested in Karlsruhe.
- Very Light Rail Vehicle, VLR, Prototype under Construction.

PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

Artificial Intelligence: The Future ahead; India

By [M K Rai](#); 12/09/2020; Metro Rail News

Before *moving ahead* on the matter, we must know what Artificial Intelligence is all about, what does it mean and how it works? The technology has been in the news and uses on a vast level for the last few years. As the technological advancements in all fields are growing up with time, let us assess the use of artificial intelligence in future operations of Metro systems. As I have written above, before moving ahead on the topic, let me tell you something about Artificial Intelligence.

Artificial Intelligence is also known as AI is a branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. With its introduction to the world, the technical industry has used it rigorously to grow their businesses worldwide.

From social media giants to Google, every firm is dependent on the technology of Artificial intelligence. As the use of technology is growing rapidly, we need to realise its importance in the recent future. For almost every online tech ranging from a cab app to social media platforms to scientific innovations and the making of aircraft, artificial intelligence has become a necessity, and its importance can't be neglected.

As we will further proceed towards a more digital world, the need for technology will become more and more important. In such a case, it becomes more important for us to know how does it work? We also need to know its history so that we may assess the progress made by people in this field.

In World War II, when the allied forces were able to break the code of Hitler's Enigma, which subsequently made the Allied victory a huge success, it was argued whether machines were able to think. The success of whole World War II is based mainly upon the code-breaking mechanism of USA, Russia and Britain. Indeed, it was the first such war

which showed that machines could fully replace few humans works. Mathematician Turing was later to say, "Can machines think?"

Turing's paper "Computing Machinery and Intelligence" (1950), and its subsequent Turing Test, established the fundamental goal and vision of artificial intelligence. At its core, AI is the branch of computer science that aims to answer Turing's question in the affirmative. It is the endeavour to replicate or simulate human intelligence in machines. Artificial

intelligence works with four major principles which are as follows:

1. **Thinking humanly.**
2. **Thinking rationally.**
3. **Acting humanly.**
4. **Acting rationally.**

The list of things where artificial intelligence is being used is autonomous vehicles like drones, self-driving cars, medical diagnosis, proving mathematical theorems, playing games, search engines like Google search, online assistants like Siri, image recognition in photographs, spam filtering and much more. The list is so long that one can't be able to calculate all.

Things are changing today. Everything has taken a new shape. The Coronavirus spread is playing a critical role in changing the ways which we used to live, and a lot more is expected to change in the near future as we try to adopt the New Normal.

Make in India indigenous CBTC under Development; India

5th October 2020; Metro Report International



INDIA: Delhi Metro Rail Corp. has unveiled a prototype version of I-ATS, an indigenous automatic train supervision system being developed under a programme to produce 'Make in India' communication-based train control technology.

The programme is intended to reduce significantly Indian metros' dependence on European and Japanese suppliers. Led by DMRC, it is backed by the government's

strategic planning think tank Niti Aayog, the Ministry of Housing & Urban Affairs, Bharat Electronics Ltd and the Centre for Development of Advanced Computing.

The i-ATS prototype was unveiled on September 15, during the inauguration of a laboratory for developing other CBTC subsystems by Durga Shanker Mishra, Secretary at the Ministry of Housing & Urban Affairs. 'The way we have promoted indigenisation in the development of metros in the country, I am fully confident that this Indian system will also be sold outside, and we will be the leaders in this area as well', Mishra predicted.

'This is a very important step towards the development of an indigenous CBTC system', explained DMRC's Managing Director Dr Mangu Singh. 'I am sure that we will be able to work together and scale newer heights to completely indigenise metro railway construction as well as operations.'

DMRC is intending to use i-ATS for the upgrade of the Red Line and any future metro expansion. The technology has been designed to work with train control and signalling systems from different suppliers, and is also intended to be suitable for use by Indian Railways on the national rail network.

A memorandum of understanding has also been signed for the indigenous development of a cab simulator for training metro drivers in train operation and troubleshooting.

Introducing the Third Rail System in India; India

By [M. K. Rai](#); 12/09/2020; Metro Rail News

As the Kanpur Metro has given a contract to Sterling & Wilson for electrification for Third Rail system which is going to be first of its kind in India, the scenario of Metro operations is going to change rapidly in the coming years. [Uttar Pradesh Metro Rail Corporation](#) (UPMRC) which is the nodal agency for the development of Kanpur Metro Rail Project is going to experiment with the technology of the third rail system which is very new to India. As we proceed further, we need to know something about the third rail system and its working mechanism.

Third-rail system is a means of providing electric traction power to trains, and the system uses an additional rail which is known as "conductor rail" for its work. The conductor rail is placed on the sleeper ends mostly located outside of the running rails. However, a central conductor rail is also used in some cases. In the existing system of electric traction for providing power to trains, the electrification is generally done a few feet above the upper body of metro or train coaches. The Third Rail system runs with the rails itself, making it easy to use matter for the trains. However, it is not free from cons as it may create trouble as well if it rains or there is a flood-like situation.

The Third rail system may cause trouble through electric shock because it carries a very high voltage near the ground. The electrified rail also can create a loss of lives, especially when someone falls on the tracks accidentally. As stated above, the flood like situations also may make it a dangerous thing. The overhead system on the other side may be troublesome when there is a higher wind flow or something of the same kind.

Many Countries are using this system as of now. Let us have a few examples here.

France

The new tramway in Bordeaux (France) uses a novel system with a third rail in the centre of the track. The third rail is separated into 10 m (32 ft 10 in) long conducting and 3 m (9 ft 10 in) long isolation segments. Each conducting segment is attached to an electronic circuit which will make the segment live once it lies fully beneath the tram (activated by a coded signal sent by the train) and switches it off before it becomes exposed again.

Netherlands

To mitigate investment costs, the Rotterdam Metro, basically a third-rail-powered system, has been given some outlying branches built on the surface as light rail (called Sneltram in Dutch), with numerous level crossings protected with barriers and traffic lights. These branches have overhead wires. Similarly, in Amsterdam one "Sneltram" route goes on Metro tracks and passes to the surface alignment in the suburbs, which it shares with standard trams. In most recent developments, the RandstadRail project also requires Rotterdam Metro trains to run underwires on their way along the former mainline railway to The Hague. The light rail vehicles on this line are capable of using both 600 V DC and 750 Volts DC.

London

The North London Line changes its power supply once between Richmond and Stratford at Acton Central. The route was originally the third rail throughout but several technical electrical earthing problems, plus part of the route also being covered already by overhead electric wires provided for electrical-hauled freight and Regional. Mixed services are used in many European countries to make the system more efficient and safe. If one pedestrian walks on these rails, it is for sure that he/she will be no more after getting such heavy electric shock.

Any technology has its own merits and demerits. Nothing in this world is perfect and safe remains in trend when it comes to the Third Rail system. It is the work of the authorities to ensure that proper planning like that of Netherlands is made so that chances of casualties may be reduced.

Its use on a vast scale will surely help to make metros and trains operate even during the heavy winds or similar conditions. The future indeed depends on the way of execution, and if the plans are properly executed, it is for sure that the Third Rail system will prove to be a game-changer.

India's First Bullet Train Project to see a Delay of five Years; India

The Indian Railways is now expecting the project to be commissioned fully by October 2028 with a five-year delay to its estimated time frame of December 2023.

By [M. K. Rai](#); 05/09/2020 ; Metro Rail News

New Delhi (Metro Rail News) – As low participation by Japanese companies is being seen while tenders have been cancelled because of lower rates quoted by bidders, [India's first bullet train project](#) is stuck on multiple fronts — and staring at a delay of around five years.

The Indian Railways is now expecting the project to be commissioned fully by October 2028 with a five-year delay to its estimated time frame of December 2023. The revised timeline has been decided after discussing with the concerned authorities.

The 508 km [Mumbai-Ahmedabad High-Speed Rail Corridor](#) is being constructed with an 80 per cent loan from Japan at 0.1 per cent interest and a 15-year moratorium, with the system to be built mostly with Japanese technology on the lines of the Shinkansen.

India had been keen on opening at least a portion of the project by August 2022, to coincide with 75 years of Independence. And the Railways officially maintains that the original timeline is still in place.

“As per the feasibility study, the target date for the completion of the project is December 2023,” said a spokesperson of the National High Speed Rail Corporation Limited (NHSRCL), the implementing agency, which was set up in 2016 with equity participation by the Rail Ministry and the Maharashtra and Gujarat governments.

India-Japan Logjam over Mumbai-Ahmedabad High-Speed Project; India

International Railway Journal, Issue August, 2020

A continuing stalemate between the Indian and Japanese governments over the revised cost of the Mumbai - Ahmedabad high-speed line is threatening to derail the ambitious project and push the 2023 projected completion date back by several years.

India's National High-Speed Rail Corporation (NHSRCL), which is overseeing the project, claims to have made reasonable progress despite the challenges posed by the Covid-19 pandemic in recent months.

Acquisition of about 60% of the land required for the project is complete along with relocating around 50% of public utilities. NHSRCL has also floated tenders for construction of 345 km of the 508 km alignment. But critical issues remain.

Civil tenders for nine of the 14 packages worth Rs 450 bn (\$ US 6.3 bn) floated last year remain to be finalised, largely because of requests from domestic contractors for more time to complete their bid documents.

The Indian government recently announced plans to award bigger contracts to domestic contractors to cut costs. But the strategy does not seem to be working, as **none of the**

domestic companies have the expertise or capacity to handle such large contracts.

The project was originally estimated to cost Rs 970 bn but this had risen to Rs 1.08 trillion following the government's decision to build an entirely elevated line.

"At the time the feasibility study was released in 2015, costs of **several components had been undervalued**," said a representative of JR East subsidiary Japan International Consultants for Transportation.

"Several meetings between Japanese and Indian consultants have been held, but the matter has not been settled. This issue will now require the intervention at the highest level." A Railways Ministry official said that the final cost would be worked out after a meeting between the prime ministers of India and Japan. The project cost has also risen due to the fluctuation in the Rupee-Yen conversion rate. While depreciation costs are covered under the agreement, conversion costs have not been accounted for.

Meanwhile, land acquisition hurdles have been accentuated by the NHRCL's decision to acquire a 17m-wide strip of land beneath the elevated railway. While it will take 3 m to construct a service road and 6 m to build a two-lane road below the pillars, it is unusual to acquire 17 m.

Tejas Express Top-and-Tail Locomotives rolled out; India

5th October 2020; Railway Gazette International



INDIA: Chittaranjan Locomotive Works has rolled out the first pair of WAP-5 electric locomotives designed for top-and-tail operation on *Tejas Express* privately-operated passenger services.

CLW said its existing 6 000 hp WAP-5 design was well-suited for hauling fast passenger trains running at up to 160 km/h, but a single loco was limited to a maximum of 16 coaches and a banking loco could be required on steep gradients.



A twin-unit locomotive had previously been produced to haul heavier trains, and is now operating from the Electric Loco Shed at Ghaziabad. However, this results in high coupler forces, and the locomotives still need to run around the train at termini, which takes time.

CLW's modifications to the WAP-5 design for top-and-tail operation include changes to the control systems and software to enable the locomotive at the rear of the train to be controlled from the leading loco. The driver's desk has also been modified to improve ergonomics, and the windscreen changed to improve the crew's view.



An aerodynamic front has been fitted to one end of each locomotive, to improve energy efficiency and stability when operating at higher speeds. The other end coupled to the train remains flat to minimise drag.

The locomotives can also provide hotel power for the train, eliminating the need to include a separate diesel power generator cars. This reduces noise and local emissions, and also increases capacity as the generator car can be replaced with another passenger coach within a given train length.

According to CLW, push-pull trainsets formed of locomotives and coaches are cheaper than multiple-units and easier to maintain, whilst also allowing more flexibility in train formation.

Lucknow Metro conducts Emergency Exit Mock Drill; India

The Mock Drill was conducted between Transport Nagar Metro Station to Hazratganj Metro Station to assess the UPMRC Preparedness for Safety of Commuters.

By [Manoranjan Kumar](#); 15/08/2020; Metro Rail News



Lucknow Metro conducted a special Mock Drill with Metro Train

Lucknow (Metro Rail News): [Lucknow Metro](#) conducted a special mock drill with Metro Train from Transport Nagar Metro Station to Hazratganj Metro today to assess its preparedness for checking passenger's safety in case of such emergency /exigent situations in Metro. Different scenarios were recreated in real-time to depict the scene of an emergency exit incident, monitor the casualties and mitigation efforts to be adopted to avert and control such types of major rescue situations.

All the concerned Metro staff deployed for smooth conduct of the drill included senior officer, staff from operations department, on duty Station Controller, CRA (Customer Relations Assistant), CFAs (Customer Facilitation Assistants), and the security personnel who extended their support in the drill. The mock drill commenced with maintaining social distancing and all the necessary safety measures were adhered to and complied with during the implementation of this mock drill/exercise.

UPMRC conducts such types of special mock drills regularly in close coordination with the Operations department in order to increase awareness in the system about passenger safety, security and to adopt disaster management measures at times of both unforeseen natural and manmade calamities. As a role model of the safest and most secure mode of

Mass Rapid Urban Transportation, Lucknow Metro performs and organizes such drills for its new employees to give them real-time exposure of emergency situation related to passenger evacuation and making alternate ticketing arrangements for public without obstructing their movement at the time of crisis.

Through such exercises, UPMRC is spreading the message **“Passenger Safety-UPMRC’s Utmost Priority”** thereby motivating the commuters to use Metro for commutation and daily travel to their workplace and likewise. Uttar Pradesh Metro always looks forward to create a sense of belonging with Lucknowites by providing them the safest mode of public transport and world-class facilities like clean and green alternate means of urban transportation at the same time.

USD 1 Billion Loan approved for Delhi-Meerut regional Rapid Transit; India

August 20, 2020 ; Railway Pro



Model of BOMBARDIER RRTS Semi-High Speed EMU

The Asian Development Bank (ADB) approved a USD 1 billion loan for the construction of Delhi-Meerut regional transit system (RRTS) consisting of the construction of an 82 km rail network.

The financing for the project will be implemented in four tranches between August 2020 and May 2025. USD 3.94 billion is the total value of the project, of which the Indian Government will provide USD 1.89 billion while USD 1 billion will be come from co-financing resources. A USD 3 million grant from ADB’s Japan Fund for Poverty Reduction will support various activities, including provision of visual, hearing and mobility aids, such as wheelchairs for differently abled persons.

The ADB loan will support the construction of the railway tracks, stations, maintenance facilities and traction and power supply. The RRTS will use advanced, high technology signaling systems based on latest standards and will have multimodal hubs to ensure smooth interchange with other transport modes.

The rapid transit system will have a total length of 82.15 km of which 68 km will be elevated and 14 km will be underground. 22 stations will serve the new rail network. The system, which will cross Ghaziabad, a city in Uttar Pradesh and part of the National Capital Region of Delhi, will start in Sarai Kale Khan in Delhi to Modipuram in Meerut. In Ghaziabad, the plans include the construction of 7 stations.

The design of the stations will feature and consider the needs of the elderly, women, children, and passengers with reduced mobility.

The Delhi-Meerut regional transit system [was approved](#) in February 2019 and is the first of three priority rail corridors in the country's integrated transport network under the National Capital Region (NCR) Plan 2021.

The new rail system will offer commuter transport services in the NCR, a planning region centered upon the National Capital Territory of Delhi.

The RRTS aims to streamline the urban transport system and to make a real modal shift towards sustainable transport by providing secure, reliable, fast and comfortable transport services.

In May, Bombardier was awarded a [EUR 314 million contract](#) to deliver 40 trains which will operate the new railway network.

In April 2020, the National Capital Region Transport Corporation awarded [Larsen & Toubro two contracts](#) for the construction of the first sections of the RRTS which will allow trains to run at speeds of 160 km/h providing a 1 hour-travel time across the system.

The project is expected to be completed in 2025.

RRTS Update: MoHUA Secretary launches the first Look of RRTS Train; India

By [M K Rai](#); 25/09/2020; Metro Rail News



1 in 22.5 Scale Model of RRTS Trainset, Bombardier

New Delhi (Metro Rail News): The first look of [RRTS \(Regional Rapid Transit System\) train](#) was unveiled today by Shri Durga Shanker Mishra, Secretary, Ministry of Housing & Urban Affairs (MoHUA) & Chairman, National Capital Region Transport Corporation (NCRTC) in presence of Shri Vinay Kumar Singh, Managing Director, NCRTC, all the members of Board of Directors of NCRTC and other senior officials of MoHUA, NCRTC and Bombardier India.

‘The state-of-the-art RRTS rolling stock will be first of its kind in India with a design speed of 180 kmph. With radiating stainless steel outer body, these aerodynamic [RRTS](#) trains will be lightweight and fully air-conditioned. Each car will have six automatic plug-in type wide doors, three on each side (Business Class will have four such doors, two on each side) for ease of access and exit. The RRTS trains will have transverse 2×2 seating with adequate legroom, optimized aisle width with grab handles and grab poles for a comfortable journey for standing passengers, overhead luggage rack, mobile/laptop charging sockets and onboard Wi-Fi among other computer-centric features”, a statement said.

“New Delhi’s iconic Lotus Temple is an epitome of sustainability as its design allows the flow of natural sources of light and air circulation. On similar lines, RRTS rolling stock will have lighting and temperature control systems to enhance the passenger experience with less energy consumption. Equipped with modern amenities, the RRTS rolling stock will be a unique amalgamation of new-age technology and India’s rich heritage”, it added.

Unveiling the train’s first look, [Shri Durga Shanker Mishra](#), Secretary, MoHUA said “Infrastructure is one of the five pillars of Atma Nirbhar Bharat envisioned by our Hon’ble Prime Minister, Shri Narendra Modi. It is a matter of great pride that these high-speed, high-frequency commuter trains for RRTS are entirely being manufactured under the government’s ‘Make in India’ policy. The environment friendly, energy-efficient trains will improve the quality of life in and around NCR by accelerating economic growth, creating economic opportunities and at the same time reducing air pollution, carbon footprint, congestion, and accidents.”

Deliberating on the benefits of the project, Shri Vinay Kumar Singh, Managing Director, NCRTC, said, “The rolling stock of India’s first RRTS has been designed with a vision to fulfil the aspirations of the New India. RRTS rolling stock will be energy-efficient with

about 30% regeneration during braking. NCRTC has awarded the rolling stock work with an integrated long term comprehensive maintenance by the manufacturer, thus leveraging the benefits of life cycle costing. I am confident that RRTS will prove to be the transport backbone for the people of NCR and will define a new benchmark in the transport sector enabling the overall growth of the region”.

The prototype is scheduled to roll off the production line in 2022 and will be put into public use after extensive trials. NCRTC will procure 30 train sets of 6 cars each for operating regional rail services on the entire corridor and 10 train sets of 3 cars each for operating local transit services in Meerut. The entire rolling stock for Delhi-Ghaziabad-Meerut RRTS corridor will be manufactured at Bombardier’s Savli plant in Gujarat. Features for Passengers:

- RRTS train coaches will have transverse 2×2 seats.
- Optimized aisle width with grab handles and rails for a comfortable journey for standing passengers, overhead luggage rack, mobile/laptop charging sockets, adequate leg room and onboard Wi-Fi.
- Double glazed, tempered large safety glass windows that offer passengers a panoramic view of the outside.
- Equipped with public announcement & display system, dynamic route map display, an infotainment display, along with emergency communication facilities. The train is designed for modern visual and audio announcements which orient passenger with information about the next stop, final destination, etc.
- Automatic plug-in type wide doors reducing air-friction and noise.
- CCTV, fire & smoke detector, fire extinguisher and door indicator.
- Universally accessible- Dedicated wheelchair space located near to the train doorway for easy access.
- Proven lightweight and compact propulsion system with high reliability and performance requirements.
- Innovative Train Control Monitoring System (TCMS) technology, as well as its predictive and condition-based monitoring features, which will enhance the fleet’s performance by providing extensive train-to-ground diagnostics.
- Designed keeping in mind high-acceleration and high-deceleration that the train needs to undergo given the maximum operational speed of 160kmph and stations at every 5-10 km.
- Trains would run under Automatic Train Operation (ATO) to provide smooth ride with precise stopping accuracy and will also save energy.
- These modern trains will have push buttons for selective opening of doors on need basis. This eliminates the requirement of opening all doors at every station, thus leading to energy saving.
- RRTS trains will also have business class (one coach per train) with spacious,

comfortable and reclining seats which will be accessible through a special lounge at the platform-level.

- A food automatic vending machine will be installed in the business coach.
- One coach in every train will be reserved for women passengers as well.
- Given the high-speed train operations, all RRTS stations will have Platform Screen Doors (PSDs) for safety of the passengers. The train doors will be integrated with PSDs.

Delhi-Meerut rapid Rail: All you need to know about Bombardier's Semi-High Speed Train Set; India

Delhi-Meerut RRTS corridor construction is in full swing, that will reduce and give a world-class travel facility for people commuting between the two cities

By [M K Rai](#); 01/10/2020; Metro Rail



RRTS Train Design by Bombardier

NEW DELHI (Metro Rail News): [Delhi-Meerut RRTS corridor](#) construction is in full swing that will reduce and give a world-class travel facility for people commuting between the two cities. Being the first semi-high speed Rapid Rail system, the Centre has [unveiled the first look of the Regional Rapid Transit System \(RRTS\) train](#) whose design is inspired by Delhi's iconic Lotus Temple and can attain a top speed of 180 kilometres per hour on the Delhi-Ghaziabad-Meerut corridor.

Union Housing and Urban Affairs Ministry said with a radiating stainless steel outer body, the aerodynamic RRTS trains will be lightweight and fully air-conditioned. They have been

designed in such a way that natural sources of light and energy will flow into the trains, the ministry said. Each car will have 6 automatic plug-in type wide doors, three on each side for ease of access and exit. The business class will have four such doors, two on each side.

An official of the National Capital Region Transport Corporation (NCRTC) claimed that the RRTS trains will travel at a speed three times faster than the Delhi Metro. RRTS trains will also have business class (1 coach per train) with spacious, comfortable and reclining seats which will be accessible through a special lounge at the platform-level, an official said.

The official claimed that people travelling on RRTS trains can have an 'airplane-like' experience as the coaches will have all modern facilities which are available inside a passenger aircraft. The 82-km-long [Delhi-Ghaziabad-Meerut corridor](#) is the first RRTS corridor being implemented in India. The commute time from Delhi to Meerut will be reduced to less than an hour from the current 3-4 hours by road, the official said.

The prototype is scheduled to roll off the production line in 2022 and will be put into public use after extensive trials. The 17-km priority corridor of Delhi-Meerut RRTS from Sahibabad to Duhai will be operational in 2023 and the entire corridor will be operational in 2025, the official said. "Delhi's iconic Lotus Temple is an epitome of sustainability as its design allows flow of natural sources of light and air circulation.

On similar lines, RRTS rolling stock will have lighting and temperature control systems to enhance passenger experience with less energy consumption," a statement stated. The NCRTC, which is executing India's first RRTS, will procure 30 train sets of 6 cars each for operating regional rail services on the entire corridor and ten train sets of three cars each for operating local transit services in Meerut. The entire rolling stock for Delhi-Ghaziabad-Meerut RRTS corridor will be manufactured at Bombardier's Savli plant in Gujarat, it said.

The trains have been designed while keeping in mind the high-acceleration and deceleration that they will need to undergo given the maximum operational speed of 160 kmph and stations at every 5-10 km. The RRTS trains will have transverse 2×2 seating with adequate legroom, optimised aisle width with grab handles and grab poles for a comfortable journey for standing passengers, overhead luggage rack, mobile and laptop charging sockets and onboard WiFi among other computer-centric features. Unveiling the train's first look, HUA Secretary Durga Shanker Mishra said that infrastructure is one of the 5 pillars of 'Atma Nirbhar Bharat' envisioned by Prime Minister Narendra Modi. Mishra said that it is a matter of great pride that these high-speed, high-frequency commuter trains for RRTS are [entirely being manufactured](#) under the government's 'Make in India' policy.

"The environment friendly, energy efficient trains will improve the quality of life in and around NCR by accelerating economic growth, creating economic opportunities and at the same time reducing air pollution, carbon footprint, congestion, and accidents," he said.

NCRTC's managing director Vinay Kumar said that the rolling stock of India's first RRTS has been designed with a vision to fulfil the aspirations of New India. The rolling stock will be energy-efficient with about 30 per cent regeneration during braking, Kumar said. The other two Phase-I RRTS corridors are Delhi-Gurugram-SNB and Delhi-Panipat. According to the NCRTC, pre-construction activities are in full swing for Delhi-Gurugram-SNB corridor and its detailed project report (DPR) is under active consideration of the government of India for sanction. The DPR of the Delhi to Panipat RRTS corridor is also under active consideration of the respective state governments for approval, it added.

Lotus Temple inspired Styling for Delhi – Meerut RRTS Commuter Trains; India

25th September 2020; Railway Gazette International



INDIA: The design of the trainsets ordered for the 82 km Delhi – Ghaziabad – Meerut Regional Rapid Transit System commuter line was unveiled on September 25th 2020..

Bombardier Transportation said the ‘fresh, modern and advanced’ design had been inspired by Delhi’s Lotus Temple, ‘resonating a unique amalgamation of sustainability and India’s rich heritage.’

National Capital Region Transport Corp awarded Bombardier Transportation a Rs 25.77bn contract in May covering the supply of 40 electric multiple-units of two types and the provision of 15 years of maintenance. There are options for up to 90 more cars and a further two years of maintenance.

‘These energy-efficient trains with exceptional ergonomics and low life cycle costs will contribute towards making India’s first RRTS futuristic and sustainable’, said NCRTC Managing Director Vinay Kumar Singh, when the first images of the design were released. ‘Clubbed with state-of-the-art commuter-centric features, RRTS is going to transform the way people travel in NCR and set a new benchmark for similar projects in the future.’

The order covers 30 six-car sets for longer distance regional services on the route from Delhi, and 10 three-car ‘intra-city mass transit’ sets to work local metro services through Meerut on the 21 km 13-station section between Meerut South and Modipuram Depot.

The 1.676 mm gauge EMUs are being designed at Bombardier Transportation’s Global Engineering & Technology Centre in Hyderabad, and will be manufactured at its Savli plant near Vadodara. Maintenance will be undertaken at depots in Duhai and Modipuram.

The 25 kV 50 Hz air-conditioned EMUs will offer an ‘accessible and welcoming environment’, with automatic plug doors, CCTV, 2+2 transverse seating at ‘comfortable’ pitches and space for standing passengers and luggage.

The six-car trains for regional services will have business class accommodation and a women-only car, while the three-car sets for local transit services will have a capacity of around 900 passengers.

The modular design makes provision for the EMUs to be lengthened to nine cars.

The regional trains will operate at up to 160 km/h, providing a journey time between Meerut and Delhi of less than 60 min. Ridership is estimated at 800 000 passengers/day.

Delhi – Meerut is the first phase of the RRTS project to develop a 383 km network of 'semi high speed' lines carrying high frequency commuter services connecting Delhi with cities in adjoining states to support more balanced and sustainable urban development.

Delhi Metro Traction Equipment ordered; India

18th September 2020; Metro Report International



INDIA: BEML has awarded Mitsubishi Electric Corp a contract to supply traction inverters, traction motors and train control management systems for 80 metro cars which Delhi Metro Rail Corp ordered last year.



Announcing the order on September 17th 2020, Mitsubishi Electric said it had sold propulsion equipment for more than 3 000 Indian metro cars since its first order for Delhi Metro Phase I in 2001.

Production of the traction motors and inverters has been undertaken at Mitsubishi Electric India's Bidadi factory in Bengaluru since 2015, supporting the Government's Make In India policy. The equipment is designed to be capable of enduring severe conditions, including high temperatures, high humidity and dust.

Kochi holds Plate-Cutting Ceremony for Water Metro; India

The Plate-Cutting Ceremony for Kochi Water Metro's 100 pax Hybrid Electric Passenger Boats was held at Cochin Shipyard (CSL)

By [M.K. Rai](#), 27/08/2020 , Metro Rail News



Kochi Water Metro Project

Kochi (Metro Rail News) The plate-cutting ceremony for [Kochi Water Metro](#)'s 100 pax Hybrid Electric passenger boats was held at Cochin Shipyard (CSL) on Monday, 24.08.20.

The plate-cutting for the Aluminium Hull of the boat in presence of Cochin Shipyard's Chairman & Managing Director, Madhu S Nair and Kochi Metro's Managing Director Alkesh Kumar Sharma.



Plate Cutting Work for Kochi Water Metro Boat

“This marks the beginning of construction of Water Metro’s passenger ferries. I can see the professionalism and passion at CSL. We are looking forward to the timely delivery of the boats so that Kochhites can cherish the dream of travelling in Water Metro soon.” said Alkesh Kumar Sharma.

“This is for the first time in the world a top class battery-driven passenger boat is being built. I can promise you that Cochin Shipyard will deliver state-of-the-art vessels for Kochi Metro. We all know how Kochi metro has set international benchmarks in various aspects. We will be ready with the boat by the end of the year. As a team, KMRL and CSL will work together for the success of the project.” Madhu S Nair said. Directors of KMRL and CSL attended the event organised as per the COVID protocol.

Kochi KMRL’s Water Metro gets a Push; India

By [M K Rai](#); 16/09/2020; Metro Rail News



KOCHI (Metro Rail News): [Kochi Metro Rail](#) Limited on Wednesday kicked off the construction activities at eight more terminals of Kochi Water Metro by starting the piling work at Eloor.

The eight terminals in the new package are Eloor, Cheranelloor, South Chittoor, Ferry at Cochin Port Trust, Kumbalam, Kadamakkudy, Mulavukadu North and Paliyamthuruthu. Kochi Metro Rail Limited [MD Alkesh Kumar Sharma IAS](#) attended the ground breaking ceremony at Eloor along with senior officials of KMRL. "The construction of Terminals are progressing at various locations. The new eight terminals will ensure connectivity between rural parts of Kochi and the mainland. The construction of these terminals will be completed in early 2021 in a time-bound manner", Mr. Sharma said.

Approximate size of each terminal is about 2500 sq ft. Terminals are planned with all modern facilities for the passengers. The construction of all these eight terminals is entrusted with Kool Homes Builders, Kochi after following due tender process. With this total number of terminals under construction will be 16.

Kerala to have two Solar-powered Transport Systems including Water Metro; India

By [M K Rai](#); 15/09/2020; Metro Rail News



THIRUVANANTHAPURAM (Metro Rail News): Two new solar-powered projects will be launched in a major boost to eco-friendly tourism and transport services in Kerala. On Saturday, the trial run of a mini train at the Veli tourism village in Thiruvananthapuram

was completed. The train, installed at a cost of Rs 9 crore, is entirely solar-powered and is expected to attract tourist attention to the village. "This is an initiative to improve eco-friendly tourism in the state. The Veli Tourist Village is a tourist hub and the train, which is modelled on yesteryear steam engines, will puff artificial steam and chug across the artificial lake for 1.5 km up and down," an official at the site told news channels. The artificial lake at Veli meets the Arabian Sea. The mini-train, which has a 50-person capacity (48 passengers and two staff members including the driver) will run past the lake and the beach, through a railway tunnel and a 60 m railway bridge. Most importantly, the roof of the three train coaches will have solar panels installed, which will directly power its engine. The extra solar energy generated will also be directed to the Kerala State Electricity Board grid according to an official.

The 10 feet long train will take its passengers on a 25 minute ride and will go at a maximum speed of 15 kmph. To add some old-world charm, old fashioned arm signals will also be added to the coaches. In addition to this, track changing points, turntables to turn the engines around, wood meshing, fibreglass partition and a steel frame will also be installed to ensure passenger safety.

Each coach of the train can carry 12-16 passengers and its rolling stock has been designed based on international standards. The 9-crore miniature project has been executed by the Uralungal Labour Contract Society. The village of Veli itself will see Rs 30 crore worth of development work including a swimming pool, a tourist facilitation centre and a convention centre on 20 acres of land. Another big-budget solar powered feeder service project is the Kochi Water Metro. Last week, when Chief Minister Pinarayi Vijayan announced the completion of Phase 1 of Kochi Metro, he also said that works for the **Water Metro** project will soon begin.

The **Water Metro** is essentially a fleet of aluminium ferries that will be introduced, mainly to connect passengers to Kochi metro stations. The project will be completed at a cost of Rs 747 crore and will include 78 such ferries, which will be solar-powered.

KMRL completes all major Surveys for regenerating Canals in Kochi; India

By [M K Rai](#) 11/10/2020; Metro Rail News



KOCHI (Metro Rail News): [Kochi Metro Rail Limited](#) has completed all the major surveys for the coveted IURWTS (Integrated Urban Regeneration and Water Transport System) project aimed at regenerating the canals in Kochi.

KMRL undertook the project last year on the orders of the state government and awarded the work to Antea Nederland BV (Netherlands) for the development of the concept, master planning and detailed design. KMRL is reviving six major canals in the city named Edapally Canal, Chilavanoor canal, Thevara – Perandoor canal, Thevara canal, Market canal. and Konthuruthy canal.

“KMRL has completed all major surveys within a short span of time. Detailed Project Report has been prepared and submitted for approval to the State Government. We have lined up the course of action including cleaning of canals, rehabilitation of affected persons, shore protection and canal oriented developments, thus bringing life back to the canals in Kochi ” said [Alkesh Kumar Sharma](#), MD, KMRL.

[Alkesh Kumar Sharma](#) who is also the Additional Chief Secretary for special projects in the state added that KMRL has big plans for the city. “Through this project, we will bring these canals to the erstwhile glory which shall be reminiscent of the nostalgic past where navigation was possible. KMRL is also looking to develop more lung spaces along the banks of these canals” he said.

KMRL has completed the most advanced LIDAR survey for getting the topographic details and to map the sub drains, which are falling into the canals. It has also completed the Social Impact Assessment Study, water quality studies and Bathymetric Survey. Geotechnical bore-hole investigation at 56 identified locations for understanding the soil characteristics and lithology along the canals is nearing completion. The major portion of floodplain analysis and water-balancing studies is being done in the Netherlands and the same is expected to be completed by the end of this month.

As the project area falls under the CRZ zone, KMRL had submitted an application before the Ministry of Environment, Forest and Climate Change and ministry has sanctioned the

Terms of Reference for various mandatory clearance to be obtained. Kerala State Pollution Control Board has approved the Consent to Establish (CTE) and wildlife clearance from the forest department is expected shortly. The application for Wetland clearance has been submitted by KMRL to Kochi Corporation.

Land identification and acquisition proposals are also progressing fast. As part of the social upliftments aspects of the project, persons residing along the canals banks will be resettled in a full-fledged housing complex that is being built to accommodate all those homeless. The land has been identified in kakkanad and the acquisition process is progressing fast.

As part of Urban, Regeneration KMRL has plans to implement Canal Oriented development (COD) Projects. The activities included are initial cleaning, widening, deepening to maintain the cross-section for flood mitigation and navigation, and bank protection and regular protective measures

KMRL is planning to make the canals navigable to the possible extent and it will have intermodal connectivity with the Kochi Metro Rail, [Water Metro](#) and the road network. KMRL also envisages on developing water sports facilities, sports complex etc. Special focus will be given to the development of sewerage systems and their management. Sewage management is addressed by laying primary sewer networks along the canals and the secondary networks to individual households.

Kochi Metro to achieve 60% Energy Neutrality by December 2020; India

By [M K Rai](#); 08/10/2020 Metro Rail



KOCHI (Metro Rail News): [Kochi Metro Rail Limited](#) is well on its way to achieving 60% energy neutrality by utilising solar energy and in line with its objective to achieve energy neutrality, [KMRL](#) has successfully commissioned 3 large-scale solar power generation systems in the past two years.

“The first phase of the project, which is 2.670MWP in capacity and capable of generating 36.5 Lakhs Unit/Year was implemented through RESCO (Renewable Energy Service Company) in 2018. This contributed to 60% of the total energy consumed at that point in time”, a statement said

However, the neutrality was reduced by half to 30% with the opening of new stations in the Maharajas-Thykooodam stretch.

KMRL will be commissioning an additional 5.4MWP capacity system on its buildings and tracks in 2020 to increase the output to 1.57 Crore Units/Year and maintain 60% energy neutrality.

“We are pushing for maximising the solar energy generation. We have a Solar Energy Policy in place. We are installing solar plants in all our areas, as far as possible, to gain green and clean power. The same will be replicated in the [Water Metro Project](#) also.” said Alkesh Kumar Sharma, KMRL’s Managing Director.

“KMRL has already completed the installation of solar panels at Thykooodam Metro Station. Work is progressing at Vyttila, Petta, South, Kadavanthra and Elamkulam. There are also plans to install solar panels at JLN Metro Station’s rooftop of the corporate office and Track and ramp area at Muttom Depot”, an official said. The installation of rooftop solar panels will be completed by mid of November 2020 and the rest of the work by December 2020.

This initiative has brought down carbon emissions by 13,302 Tonnes a year, which is equal to planting 5,33,033 trees.

Titagarh Wagons to procure 4.8 MW Solar Energy from fourth Partner Energy; India

By [M K Rai](#), 13/10/2020; Metro Rail News



KOLKATA (Metro Rail News): Solar power player Fourth Partner Energy has recently said that it has tied up with [Titagarh Wagons Ltd](#) to supply 4.8 megawatts (MW) solar energy to electrify the latter’s three manufacturing units in West Bengal. Passenger and freight trains maker Titagarh Wagons Ltd has signed a power purchase agreement (PPA)

with Fourth Partner Energy to procure 4.8 MW of solar power for its wagon and steel foundries at Titagarh and its passenger coach and propulsion unit at Uttarpara, to effectively replace nearly 25 per cent of its current annual electricity demand with clean energy, a statement from Fourth Partner Energy said. All three power plants are expected to be commissioned by January 2021 according to the statement. "We are excited to on-board Fourth Partner Energy to solarise our Heavy Engineering division, [Titagarh Wagons](#) and Titagarh Steel facilities across West Bengal", said one official.

India is targeting 100 per cent electrification of railways in three years, which will result in a near doubling of electricity demand by the sector, he said adding that Fourth Partner believes solar will play a crucial role in meeting this.

"We have also partnered with Indian Railways to solarise Jabalpur, Varanasi, Gorakhpur stations and the [Nagpur Metro Rail](#)," said a source related with the development. Fourth Partner Energy is a firm working for India's solar energy solutions with 400 MW operational capacity executed for marquee clients like UltraTech Cement, Walmart, Hindustan Unilever, Coca Cola, Akzo Nobel, Skoda and Schneider amongst others.

Uttarakhand Tri-City Light Metro Project approved; India

International Railway Journal, July 2020, Vol. 60 p. 12



Uttarakhand Chief Minister Trivendra Singh Rawat gave Approval for the CMP Plan in a Meeting of the Unified Metropolitan Transport Authority (UMTA) on June 11th, 2020 (File Photo Hindustan Times, Dehradun)

UNIFIED Metropolitan Transport Authority (UMTA) in the Indian state of Uttarakhand has approved construction of a 73km light metro linking Dehradun, Haridwar and Rishikesh.

The project will be completed in two phases and is expected to cost around Rs 401.5 bn (\$ US 5.2 bn). The 32 km first stage will run from Haridwar via Nepali Farm to Rishikesh with 10 stations.

The 41 km second stage will extend north from Nepali Farm to Dehradun also with 10 stations. UMTA will cooperate with Delhi Metro on the project, and work on the first stage

is expected to be completed by 2024, according to Uttarakhand cabinet minister, Mr Madan Kaushik.

The Light Metro forms part of the state's Comprehensive Mobility Plan, which will integrate the metro with planned transit systems in each of the three cities, which will incorporate cable cars (aerial ropeways) and Personal Rapid Transit (PRT) systems.



Artist`s View of Deradhun Metro Ropeway; by F.A. Wingler

Delhi Metrolite's Project gets a Push: India

Metrolite trains on this line have interchanges planned at Kirti Nagar (Green Line), Mayapuri (Pink Line), Dabri Village (Magenta Line) and Dwarka Court (Blue Line).

By [M K Rai](#): 04/09/2020; Metro Rail News



Artist`s Concept for Metro Lite

New Delhi (Metro Rail News): The new 19.15 km Kirti Nagar – Bamnoli Village (Dwarka ECC) [Metrolite](#) line in south-west Delhi with the Delhi Metro Rail Corporation (DMRC) is opening financial bids from local surveying firms for conducting geotechnical investigation, topographical survey and utility identification works along the line's alignment.

The DMRC had decided to go for inviting the bids again for this new light rail transit (LRT) system's topographical survey and utility identification contract (Package ML-01(R)) with an estimate of Rs. 65.73 lakh and completion period of 9 months. They opened technical bids on July 15 to reveal 9 bidders, opened financial bids on August 19, and then issued a letter of award to the lowest bidder, Gaveshana Geosciences Pvt Ltd., the next day with a contract value of 37.80 lakh.

DMRC in May had also invited bids for the Geotechnical investigation contract (Package ML-02) with an estimate of Rs. 83.46 lakh and completion period of 4 months. They opened technical bids on July 30 to reveal 9 bidders, rejected 3 firms in the technical round, and then opened financial bids on August 21st 2020 to reveal that TechPro Engineers Pvt. Ltd. had placed the lowest bid at Rs. 68.08 lakh. Per an industry source, an LoA for this tender will be issued this week.

Metrolite trains on this line have interchanges planned at Kirti Nagar (Green Line), Mayapuri (Pink Line), Dabri Village (Magenta Line) and Dwarka Court (Blue Line).

The Kirti Nagar – Bamnoli (Dwarka ECC) metrolite line will consist of 21 mostly at-grade stations at Kirti Nagar (elevated), Saraswati Garden, Mayapuri Bus Depot, Mayapuri, Hari Nagar, Mayapuri Industrial Area (MIA), Mayapuri Industrial Area 2 (MIA 2), Tihar Jail, Shivpuri (elevated), Dabri Village (elevated), Sitapuri (elevated), Mahavir Enclave (elevated), Dwarka Sector 2, Dwarka Sector 7, Dwarka Sector 6, Dwarka Court, Dwarka Sector 20, Dwarka Sector 23, Dhul Siras – Dwarka Sector 24, Dwarka Sector 25 – ECC Centre and Bamnoli Village.

The Detailed Project Report (DPR) for this LRT line was approved by the DMRC's board in October 2019 with an estimate of Rs. 2,673 crore and is waiting for a green signal from the Delhi Government.

JSPL produced Rails approved by Indian Railways for Main Track Usage; India

By [M K Rai](#); 30/09/2020; Metro Rail News



Rails manufactured by JSPL

RDSO approved today the supply of JSPL's rails to Indian Railways. RDSO certified UIC 60 kg, 880 Grade prime (Class- A) rails of JSPL in this move which enables JSPL to supply regularly to Indian Railways for usage in passenger track as well.

NEW DELHI (Metro Rail News): Jindal Steel & power limited (JSPL) becomes India's first private company to get approval from Indian Railways for regular rail supplier status for its upcoming and ongoing projects. Research Designs & Standards Organisation (RDSO), which works under the ambit of the Railway Board, has approved field performance of UIC 60 kg, 880 Grade prime (Class- A) rails made by JSPL at its Raigarh Plant. Railway Board has accepted the field performance test report of RDSO and considered UIC 60 kg, 880 Grade prime (Class- A) rails are suitable for use in Indian Railways.

"The approval by RDSO itself is an illustrious qualification for JSPL's Rail Mill, as their evaluation quality and safety parameters are very stringent, and not many rail producers in the world can meet ou quality norms laid by RDSO", said JSPL in a statement.

"It's a landmark development towards India's quest for AtmaNirbhar Bharat and it is a momentous occasion for our rail business. We are thankful to the Ministry of Railways and the Ministry of Steel for encouraging domestic manufacturing of Rails. We are thankful to the RDSO for field performance approval of UIC 60 kg, 880 Grade prime (Class-A) rails of JSPL" Said Mr. V R Sharma, Managing Director, JSPL.

Apart from 880 Grade main track rails, JSPL has also started supplying 1080 grade Head Hardened rails to several metro Rails projects in India which includes Rail Vikas Nigam Limited for the construction of the Kolkata Metro Rail Project and Pune Metro. Earlier RDSO had approved the 1080 grade HH rails, and JSPL has developed Special rails, Asymmetric Rails, R260, and 1175HT grades for heavy load carrying wagon units of 75 tones /wagon.

JSPL supplies special grade rail blooms to France Rail, Hayange in Europe. Rail produced from JSPL supplied Blooms by France Rail are found successful in meeting the quality & safety parameters of different European railways. JSPL also exported 2.5 Lac Tonnes of rails through Indian PSUs (IRCON & STC) to customers in Bangladesh, Sri Lanka, & Africa. About JSPL: JSPL is a leading Indian Infrastructure Conglomerate with a presence in the steel, power, and mining sectors.

With an investment of approximately 12 billion USD (90,000 Crore Rupees, the Company is continuously scaling its capacity utilization and efficiencies to contribute towards building a self-reliant India.

PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Urban Transport Industry News Round-up, I; Global

14th October 2020; Metro Report International



Siemens Mobility has delivered the last of 45 S700 light rail vehicles for **San Diego's** \$2.1bn Mid-Coast Trolley programme to extend the Blue Line by 18 km from Santa Fe Depot to UC San Diego. Opening is planned for late 2021. 'We are nearing the end of construction for the Mid-Coast Trolley project — one of the largest infrastructure developments in San Diego's history', said Nathan Fletcher, MTS Board Chair and San Diego County Supervisor. 'The California Transportation Commission helped make this day possible. It provided funding for these Trolleys and many other transit projects in San Diego that are a catalyst for economic growth and cleaner air.'



A 1.4 km extension of **Wien** tram Route O from Praterstern to Bruno-Marek-Allee opened on October 3, including 1.0 km of new track with two stops built since March at cost of € 21.5m.



A £2m project is underway to adjust tracks at 40 of the 60 **Tyne & Wear** Metro stations to accommodate the new fleet being supplied by Stadler. 'We need to adjust the height of the tracks so that the when the new trains roll into service in 2023 they interface perfectly with station platforms', said Major Projects Director Cathy Massarella. 'The new trains will have a sliding step to making boarding easy, all but eliminating the gap between train and platform edge.'



Southern California Regional Rail Authority has awarded five companies including Parsons three-year contracts to support expansion, rehabilitation and state of good repair projects on the **Los Angeles** Metrolink network.



On October 13 the Scottish government announced a further £4m of emergency funding for **Glasgow** Subway and **Edinburgh** Trams in response to the ongoing impact of the Covid-19 pandemic. This is in addition to the £ 9m announced in July and support services until the end of 2020.

Ann Arbor transport authority TheRide has joined 13 others in Michigan, Ohio and Kentucky in the EZfare app-based regional fare payment system, which uses Masabi's Justride SDK. 'While the Covid-19 pandemic continues to impact our agency, we are pleased to be able to introduce a contactless method of payment for riders', said John Metzinger, Deputy CEO, Finance & Administration, at TheRide. 'This pilot project will help reduce the risk of virus transmission while using our system, while also allowing TheRide to test community reactions and the potential for a permanent mobile ticket option in the future.'

Urban Transport Industry News Round-up, II; Global

7th October 2020 ; Metro Report International



Siemens Mobility has been selected as preferred bidder for a jointly awarded contract to supply a total of 109 high-floor light rail vehicles to **Düsseldorf** Rheinbahn (91) and **Duisburger** Verkehrsgesellschaft (18). The contract is expected to be awarded on October 12, assuming no objections are received.



Cellnex has bought Indra's 60% stake in Metrocall, which supplied and manages Metro de **Madrid**'s cellular communications network. The transaction had a total equity value of €70.8m, of which Indra has received €37.2m after deducting the interest of minority shareholders.



The Australian state of **Victoria** has launched an updated public transport app, which enables to passengers to easily search their frequent journeys, stops and stations, and save home and work locations. Future updates will allow users to manage their myki smart cards and provide real-time bus and train location information. Blind and low-vision passengers can use the VoiceOver and TalkBack capabilities. Trials have also begun with the use of predictive modelling technology and passenger counting sensors to provide real-time information about how many people are currently on board or at a station.



Ontario transport authority Metrolinx has put into service the first GO Transit buses and trains to be equipped with Icomera's centralized wi-fi connectivity network platform, which includes access to 'curated' media content. Installation has been completed on GO Transit's bus fleet, and approximately 50% of its trains.

The US Federal Transit Administration has invited applications by November 2 for a total of \$10m Public Transportation **Covid-19** Research Demonstration Grant Programme funding. This aims to support projects that demonstrate innovative approaches to cleaning and disinfecting vehicles, facilities and equipment; exposure mitigation measures; contactless payment systems; and measures to strengthen public confidence in transport services.



The Hungarian national operator's MÁV-HÉV subsidiary has called tenders for the supply of 42 light rail vehicles with a maximum speed of 100 km/h for use on **Budapest** suburban routes H5, H6 and H7, with an option for 12 more.



Over eight night shifts in August, Vossloh used a HSG-city machine to reprofile the rails on **Sofia** Metro Line 3 before it opened. Vossloh said removing the comparatively soft external decarburised layer left over from the manufacturing process provided the basis for ensuring the rail has a long service life, by reducing wear and the formation and spread of fatigue damage.

Urban Transport Industry News Round-up, III; Global



Pesa has completed deliveries of 10 Twist 2 trams ordered by MPK **Częstochowa**.



Chicago Transit Authority, Metra Rail, Pace Suburban Bus and Cubic Transportation Systems have launched an updated version of the Ventra mobile app. This has a simplified user interface, an integrated trip planner and updated transit account management, and also improved access to Metra mobile tickets. 'The Ventra app has become a valuable tool for Chicago-area transit riders', explained CTA President Dorval R Carter Jr. 'By incorporating feedback and experiences from our customers, we've re-envisioned the app to be even more convenient and flexible.'

Greater **Wellington** Regional Council is investigating the potential to roll out Snapper smart card payments to local rail services. 'We need to have safe contactless methods of payment available across the region's network sooner rather than later', explained Transport Committee chair Roger Blakeley. 'Enhancing fare collection efficiency also aligns with the future of national ticketing and the Council's longstanding vision for a world-class integrated public transport network with high levels of accessibility, quality, reliability and flexibility.'



New York MTA has updated the Metro-North Train Time app to include a real-time tracking map, a one-tap link to view and purchase tickets via MTA eTix, and the ability to bookmark favourite trips and stations. The app is also now available in English, Chinese, Italian, Portuguese, Spanish and Yiddish.

The city of **Halle** intends to purchase up to 70 new trams by 2028, Mayor Bernd Wiegand has told local media.



Contractors Kiewit and McCarthy have begun construction of **Phoenix's** 2.6 km Northwest Extension Phase II light rail project. The three-stop extension is scheduled to open in 2023.



Following initial testing at nine stations, **Hamburg's** Hochbahn has begun installing a new generation of ticket machines at 25 stops on Line U3 and four on U4. Destinations can be selected using a large-format map view, and payment made by cash, bank cards or smartphone. Thinner machines without the cash payment option are also being installed at Hauptbahnhof and Barmbek.



Brad Thomas, President of First Transit, has been named Chair of the **North American Transit Alliance** in succession to outgoing Transdev CEO Dick Alexander. He is in turn replaced as Vice-Chair by Clément Michel, CEO of Keolis North America. New Transdev

CEO Laura Hendricks and National Express COO Matthew Wood have joined the NATA board.

Urban Transport Industry News Round-up, IV; Global

23th September 2020; Metro Report International



A national 'Public Transport is OK' campaign has been launched in the **Netherlands** to encourage a return to services which saw a 90% drop in ridership after people were told to use public transport only if it was strictly necessary. Ridership is now running at 50% to 60% of pre-pandemic levels.



Transports Publics de la Région Lausannoise has called tenders for the supply of 10 light rail vehicles to operate the planned 4.7 km tramway T1 between **Lausanne-Flon** and Renens-Gare, with options for up to eight more.



Västra Götaland region has awarded Skanska a SKr847m contract to build a new tram depot at Ringön in **Göteborg**. Construction of the operations, workshop and administration buildings is due to start by the end of this year for opening in February 2024. Göteborgs Spårvägar opened a stabling facility for 30 trams on the Ringön site in June, and the second phase of the project will increase capacity to over 70 vehicles.



The UK's **Urban Transport Group** has published a report setting out how transport authorities can build back better from the Covid-19 pandemic whilst decarbonising urban transport. *Building back better on urban transport* proposes a big increase in active travel, particularly for shorter journeys; simple and affordable fares; an accessible, rapid and reliable transport network; decarbonised urban vehicle fleets; and green and smart logistics.



Japanese travel planning specialist Jorudan has used Masabi's Justride mobile ticketing SDK to provide in-app mobile ticketing for Iyotetsu, the main transport operator in the city of **Matsuyama**. Passengers can buy a range of bus and tram passes as well as Limousine Bus tickets to and from Matsuyama Airport. This will be expanded next month with the addition of Limousine Bus tickets to and from Matsuyama Tourist Port.



Mayor of **London** Sadiq Khan has called on the UK government to agree a new long-term funding settlement for Transport for London. TfL is only earning revenues of around £5.2m per day, against £13m before the pandemic, owing to continuing low levels of ridership. 'TfL's fares and other revenue fell by 90% at the height of the crisis, and ridership is still nowhere near normal levels', Khan explained on September 21. 'With TfL much more reliant on fares income than almost any other transport authority, it's clear the old model for funding public transport in London is broken.'



TransLink has launched a series of online tools designed to help people of all abilities use public transport in **Vancouver** confidently and independently, including those with a cognitive disability or people who are uncomfortable asking for help in English. The tools developed with Beckett 3D Studio and AutismBC include an interactive 360-degree virtual tour of a bus which people can use to practice boarding and eight educational videos made with support from the Wavefront Centre and social service agency SUCCESS, which are offered in English with American Sign Language, Cantonese, French, Mandarin, Punjabi, or in English with described video.



Chennai Metro Rail Ltd and Howdy Hire Bikes are now offering electric bikes for hire at Thirumangalam, Vadapalani and Alandur metro stations, with other locations expected to follow.

Urban Transport Industry News Round-Up, V; Global

16th September 2020; Metro Report International



The supervisory board of **Düsseldorf's** Rheinbahn AG has approved a € 34 0m order for 91 high floor LRVs to be delivered in 2025-27. Procurement is being undertaken jointly with **Duisburg's** transport operator, which is expected to approve the order later this month at which point the manufacturer will be named.



The exact locations for the stations on the proposed 23 km Western **Sydney** Airport driverless metro project have been confirmed. Stations are to be built at St Marys, Orchard Hills, Luddenham, the Western Sydney Aerotropolis and two sites at the Western Sydney International (Nancy-Bird Walton) airport.



Having received no objections from other potential operators, the city of **Magdeburg** has directly awarded municipal operator MVB a 22½ year contract to run local tram and bus services. 'With the direct allocation of public transport services, MVB can remain as an integrated transport company and the social standards of the employees can be secured', said MVB Chair Klaus Zimmermann. 'The city and the MVB can also jointly develop the transport offer.'

San Francisco's BART is selling personal hand straps for passengers wanting to avoid touching train car surfaces. They have loops on the ends to make it easy to tie the hand straps to poles or other surfaces in the train car without touching any surfaces.



King Mongkut's Institute of Technology Ladkrabang, BTS Group Holdings and **Bangkok** Smartcard System Co have signed a memorandum of understanding to study the feasibility of an 'electric tram-bus service' to link the institute's main campus to Lat Krabang station on the Airport Rail Link. Two routes are being studied: Hua Takhe to Lat Krabang (4 km) and a link directly from the campus to Lat Krabang.

Dallas Area Rapid Transit has approved an agreement for STAR Transit to license its GoPass mobile ticketing app and supporting systems for the next three years. GoPass is already used by DART, Trinity Railway Express, Denton County Transit Authority, Trinity Metro and Tulsa Transit.



The **Land of Nordrhein- Westfalen** is providing €3.6m to enable TH Ostwestfalen-Lippe, FH Bielefeld, the Fraunhofer Institute in Lemgo and Landeseisenbahn Lippe to study the feasibility of **MonoCabs**, proposed compact gyroscope-balanced automated monorail cars. It is envisaged that these would enable on-demand services to be provided in both directions on existing single-track railways.



Los Angeles County Metropolitan Transportation Authority's Transit Access Pass card is now available on iPhone and Apple Watch. Using the Cubic Transportation Systems technology passengers can pay for rail and bus journeys across 25 participating TAP agencies in Los Angeles County.

Urban Transport Industry News Round-up, VI; Global

9th September 2020; Metro Report International



A 1.1 km extension of the **Kochi** metro from Thykoodam to Petta opened on September 7th 2020, completing Phase 1 of the Blue Line. Civil works for the Tripunithura extension were also launched.



Dresden-based Consultancy VCDB has been awarded a €4m contract to plan the first stage of Phase 4 of the **Chemnitz** tram-train programme, covering 2.3 km of new line from the city centre to Limbach-Oberfrohna which is proposed for completion in 2025. The full route would be around 17 km long, including 10 km of new line.



Szczecin's tram operator has awarded ZUE a two-year contract worth 174.5m złoty covering the renewal of 8 track-km of its network.



Praha transport operator DPP has awarded Cegelec a €3m contract to supply electrical equipment for the rebuilding of up to 65 Tatra T3 trams as Type T3R.PLF vehicles by 2026.



A 0.7 km extension of **Poznań** tram Route 5 was opened on September 1st, 2020, extending serves from Zegrze I to the Unii Lubelskiej residential area where further housing development is planned. The extension was built by a consortium of Tormel and Terlan.



Passengers and staff on **San Francisco's** BART can now request non-emergency assistance from the metro's police department by text message. 'I want to give our riders as many ways as possible to reach us while they're on our trains and in our stations', said BART Police Chief Ed Alvarez. 'Text BART Police makes it easy for anyone to use their phone to discreetly contact us if a need should arise.'



A 0.9 km extension of **Paris** tram Route T4 from Arboretum to Hôpital de Montfermeil opened on August 31.



A 0.7 km extension of **Toulouse** tram Route T1 from Aéroconstellation to the MEETT exhibition centre opened on August 31.

Cubic Transportation Systems has won a contract for the rapid deployment of its TouchPass fare collection-as-a-service platform for MET Transit in **Billings**, Montana. 'The Covid-19 pandemic has proven the true value of a fully electronic fare collection solution for public transportation; a contactless fare payment and boarding experience is critical in order to keep travellers safe with simpler and quicker payment systems', said Mick Spiers, Vice-President and General Manager, Cubic Transportation Platforms. 'Additionally, Touch Pass allows agencies to access all the benefits of a large-scale account-based ticketing system at a fraction of the cost.'

Urban Transport Industry News Round-up, VII; Global

2cd September; Metro Report International



Strasbourg tram Route F was extended 1.7 km from Faubourg National to Comtes in Koenigshoffen with three stops on August 29th, 2020. Travel will be free on the first six Saturdays. Construction took 30 months and cost €4m, including a 330 space park-and-ride facility at Parc des Romains station, 1.5 km of cycle paths and planting of 190 trees.



On August 31st, 2020, the European Investment Bank signed a €650m loan agreement to provide to finance for the **Kanpur** metro. 'Comfortable, fast, safe, energy efficient and affordable public transport systems like metros are needed for cities to become the engines of growth in our country', said Kumar Keshav, Managing Director of Uttar Pradesh Metro Rail Corp, thanking EIB for its 'faith and wholehearted support' in funding metro projects in the state.



The use of 'innovative data and technology ideas' to improve the safety of public transport users in Greater **Sydney** is to be tested under Transport for NSW's Safety After Dark Innovation Challenge. The winners include the University of Wollongong, data sharing platform She's a Crowd, safety technology experts Guardian LifeStream and Cardno/UNSW, and the projects include using artificial intelligence and CCTV to automate the detection of threatening behaviours, using datasets and algorithms to create routing that prioritises safety, and a platform for public safety and assistance. The Innovation Challenge is part of TfNSW's commitment to a new Women's Safety Charter, co-designed with the Greater Sydney Commission and Committee for Sydney.



Kazan's orbital fast tram line has been completed with the opening of a 1.8 km section between Glazunova and Midkhata Bulatova. The line is 33 km long with 45 stops, with services 5 and 5a taking 1 h 45 min for a complete circuit.



Washington Metropolitan Area Transit Authority and Cubic Transportation Systems have expanded the SmartTrip payment system to include for iPhone and Apple Watch, enabling passengers to use contactless payment on metro and bus services. A mobile app has also been launched. 'The SmartTrip app is a game changer for metro riders, providing an integrated payment and management system when combined with Apple Wallet', said Metro General Manager & CEO Paul J Wiedefeld. 'Paying to ride Metro is now faster, safer and easier than ever before.'



Delhi **Metro Rail Corp.** has begun preliminary works for the fifth metro bridge over River Yamuna, as part of the Majlis Park – Maujpur section of Phase 4 of the network.



The **USA's** Federal Transit Administration has awarded \$ 14 m of Accelerating Innovative Mobility initiative funding for 25 projects to help transport authorities explore new models that provide more efficient and frequent service and demonstrate innovative technologies and practices to enhance the passenger experience. Nine of the projects directly address Covid-19 related issues, including contactless payment, social distancing, scheduling, real-time information to reduce crowding and contact tracing.

Urban Transport Industry News Round-up, VIII; Global

26th August 2020; Metro Report International



Delhi Metro has introduced an automatic top-up feature for its smart cards, with Rs200 loaded at ticket gates whenever the stored value falls below Rs100. The function was developed by Anduril Technologies, and requires users to download the Autope mobile app or register online to link their bank cards to a smart card. A 'nominal' convenience fee with a maximum of 1% will be charged for each transaction.



Max Bögl reports that Germany's Federal Railway Authority has given assurances that the core track and rolling stock components of its **Transport System Bögl** maglev design comply with EBA requirements for obtaining future approval. Max Bögl said it would continue co-operating with the EBA and its appointed specialists to obtain the assurance of approval for the operational control system as well as positive notices for other components, with the next step being to acquire an operating license; the manufacturer envisages that TSB could be implemented and commissioned in less than two years once a building permit has been obtained.



Cubic Transportation Systems is now providing customer contact centre services for the Regional Transportation Authority which oversees the **Chicago** Transit Authority, Metra and Pace Suburban Bus. Cubic offers trip planning services from its Western New York operations centre based in Amherst. 'With our experience developing and deploying the Ventra system for Chicago, we are thrilled with the opportunity to partner with the RTA to provide regional trip planning customer contact center services', said Sushil Rajendran, Vice-President & General Manager, Central Region, Americas for Cubic Transportation Systems.



The **USA's** Federal Transit Administration has announced new guidance designed to provide more flexibility for transport agencies to work with the developers of commercial, residential or mixed-use projects. 'We are committed to supporting transit agencies that pursue joint development projects to capture the economic value of transit', said FTA Deputy Administrator K Jane Williams. 'Innovative partnerships and funding sources can help deliver projects more quickly, and this is especially important as communities recover from the Covid-19 public health emergency.'



Hitachi Elevator (China) Co has won a contract to supply 22 lifts and 66 escalators for the five elevated and seven underground stations on the future **Wuhan** metro Line 16 Section 2, known as the Hannan Line, which is scheduled to open next year.



Carl Williams has been appointed Chief Executive of the UK's **Light Rail Safety & Standards Board**, which was established last year. Currently Director of Operations at West Midlands Metro, Williams has previously held senior positions at Keolis UK, Manchester Metrolink and Sheffield Supertram. He is due to take up the new post on a part-time basis, continuing to work for WMM until the end of the year when he will join LRSSB full time.



The US Federal Transit Administration has launched a **Covid-19 Recovery Discussion Forum** as a platform for peer-to-peer exchange of ideas and best practice.



The Romanian city of **Ploiești** has ordered 20 low-floor Solaris Trollino 12 trolleybuses for delivery within two years at a cost of 36m złoty.



The **Hungarian Government's Green Bus** programme is to provide €104m for the procurement of electric buses over the next 10 years, as part of a policy to replace half the urban fleet in the largest cities and require the use of emissions-free vehicles in places with more than 25 000 inhabitants.



Operator PKM in the Polish city of **Sosnowiec** has placed a €11m order for nine Solaris Urbino 12 electric and five articulated Urbino 18 electric buses, along with three pantograph chargers and eight plug-in chargers. Deliveries are scheduled for completion by August 2021.

Cádiz Tram-Trains make first Main Line Test Runs; Spain

8th September 2020 , Metro Report International



SPAIN: Overnight on September 2, a CAF LRV made the first runs over ADIF tracks as part of preparations for the opening of the Bahía de Cádiz tram-train route.

Initially expected to open in 2017, the tram-train project has involved the construction of 14 km of 1 668 mm gauge tramway in the towns of Chiclana de la Frontera and San Fernando, plus adaptation of 10 km of ADIF tracks on the main line into to Cádiz.

During the tests, the CAF LRV left the tram line at the Río Arillo stop in San Fernando, from where ADIF was responsible for monitoring and control of the vehicle under a complete possession of that section of the main line from Sevilla. While the three-section, 38 m long tram-trains were tested on 1 668 mm gauge tracks in northern Spain prior to acceptance by RENFE, the Río Arillo – Cádiz route will be the first main line in Spain to be used by a commercial tram-train service.

Commissioning trials are currently underway along the tramway section between Chiclana and Río Arillo; drivers, ticket inspectors and other operating staff are being provided by RENFE. It is expected that the service will be launched next year, but no formal start date has been confirmed.

Regional and Tram-Train Tenders planned; France

Railway Gazette International, September 2020, page 6



ALSTOM CITY DUALIS Tram-Train

Operations of regional rail and Tram-Train services in western France are to be competitively tendered, the Pays de la Loire regional government confirmed on July 17th 2020.

A key requirement will be to 'improve the effective quality of the service provided to passengers', in line with local expectations. Announcing the start of consultation, the region said it hopes to award one or two 10-year public service contracts in the second half of 2022 so that operations can begin from December 2023 'at the earliest'. However, the start date may be modified to respect progress with the procurement. One package covers tram-train services from Nantes to Nort-sur- Erdre, Châteaubriant and Clisson, whith totalled 800 000 train-km in 2018. This would also include management of the infrastructure on the Nantes – Châteaubriant line, 'under conditions to be defined'.

The 'Sud Loire' package covers operation of TER services on the routes from Nantes to Pornic, Saint-Gilles-Croix-de-Vie, La Roche-sur-Yon, Les Sables d'Olonne, La Rochelle and Cholet, plus the Angers – Cholet line under conditions to be defined.

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These totalled 2 million train-km in 2018, but a substantial increase to 4.2 million is envisaged by 2030. Pays de la Loire will provide the rolling stock, with the operators being responsible for maintenance.

The current fleet comprises Alstom Citadis Dualis Class U53500 Tram-Trains, and a mix of X76500 XGC diesel railcars, Z51500 electric and B84500 dual-mode Régiolis multiple-units for Sud Loire.

Freight Tram-Train to be tested in Karlsruhe; Germany

Railway Gazette International, September 2020, page 10



BOMBARDIER *FLEXITY* Tram Train for Karlsruhe

Trials with a prototype freight Tram or Tram-Trains are to start in Karlsruhe and the surrounding area in 2022, under the 'regio- cargo' project to develop alternative forms of local goods transport.

The promoters note that recent growth in online shopping has led to an increase in package delivery traffic, creating congestion and a shortage of staff and vehicles.

The project brings together operators Verkehrsbetriebe Karlsruhe, VBK, and Albtal-Verkehrs Gesellschaft, AVG, with freight shippers, logistics companies and research institutes, including DB Engineering & Consulting and the Karlsruhe Institute for Technology.

According to AVG Technical Director Ascan Egerer, the Freight Trams would form the centerpiece of a holistic concept which will entail rethinking the existing freight transport delivery model. They would operate between consolidation centres and 'city hubs', from where final distribution would use emission-free methods such as cargo bikes.

A pilot operation is proposed to demonstrate the concept, possibly on the 50 km Karlsruhe – Rastatt – Achern route.

A team of researchers is working on the design of a demonstrator vehicle under the Log IK Tram project. One option may be to use modified LRVs, that could carry passengers at peak times and freight shipments during less busy periods.

On August 7th, 2020, Bombardier Transportation delivered the first two of 20 additional Flexity Tram-Trains, which AVG ordered in December 2018 for 87 m Euro. This was the second option to be exercised within a 2009 framework agreement for up to 75 vehicles, bringing the firm orders to 62.

VBK and AVG have teamed up with four other German and Austrian tram-train operators to call tenders for up to 504 vehicles under a framework procurement coordinated by operators' association VDV. This is potentially valued at up to Euro 4b n including 32 years of maintenance.

Very Light Rail Vehicle, VLR, Prototype under Construction; UK

28th August 2020; Metro Report International



UK: A prototype battery-powered carbon fibre and metal **Very Light Rail Vehicle** is under construction at NP Aerospace's plant at Foleshill in Coventry.

The VLR project to develop low-cost technologies which would make light rail a viable option for medium sized cities is being managed by the Warwick Manufacturing Group at the University of Warwick, in partnership with Coventry City Council and Transport for West Midlands.



The prototype vehicle has been designed by WMG and Transport Design International, with a target of achieving a mass not exceeding 1 tonne per linear metre. It will have a capacity of 56 passengers.

Testing is scheduled to start early next year at the VLR National Innovation Centre which being developed in Dudley. It is envisaged that this would then be followed by passenger operation of production vehicles on a proposed line to be built in Coventry.

‘The Coventry Very Light Rail project will deliver a step change cost reduction for light rail in the UK’, said WMG Associate Professor Dr Darren Hughes on August 28. ‘We are really proud that this marks the beginning of the journey to roll out low cost, rail-based transport for medium sized cities in the UK.’

NP Aerospace CEO James Kempston said assembly of the prototype ‘utilises NP Aerospace’s capability in assembling and delivering complex defence vehicle programmes and extends this into the rail and transportation sector’.

Coventry Route

The proposed line in Coventry would run 8 km from the railway station via the city centre to Walsgrave Hospital, with around 80% of the route operating in mixed traffic. Services would be operated using a fleet of production vehicles, with consultancy WSP having forecast ridership at up to 9 million passenger-journeys a year.



Work is also underway to develop affordable trackform that could be installed quickly and cheaply, and which could also be easily removed to allow access for utility maintenance.

Engineers from the University of Warwick are working on the track design with Coventry City Council, French civil engineering company Ingerop Conseil et Ingénierie and its UK subsidiary Rendel.

‘This project will be the first of its kind in the world’, said Cllr Jim O’Boyle, Cabinet member for Jobs & Regeneration at Coventry City Council. ‘It is being led by world beating local automotive experience and is using cutting-edge materials. The proposed VLR network is key to our vision for transport here in Coventry. We want our public transport to be efficient, affordable and most importantly environmentally friendly. I believe it’s going to revolutionise how we all travel in this city.’

A separate initiative to develop a lightweight diesel rail car for operation on heavy rail lines is being undertaken by the Revolution VLR consortium of WMG, Transport Design International, Eversholt, Cummins, Prose, Transcal Engineering and RDM Group.

METRO NEWSLETTERS

Transport Technologies for “URBAN MOBILITY AS A SERVICE”

PUBLIC MULTIMODAL URBAN, SUBURBAN, INTERURBAN AND REGIONAL PASSENGER TRANSIT TECHNOLOGIES FOR URBAN MOBILITY AS A SERVICE WITH METRO-BUS, BUS RAPID TRANSIT, URBAN RAIL, LIGHT-RAIL, LIGHT METRO, TRAM-TRAIN, METRO-RAIL, METRO-TRAIN, COMMUTER-RAIL, MONO-RAIL, AERIAL ROPEWAY, BOTTOM CABELLINER, MAGLEV AND HOVERCRAFT TRANSIT/PEOPLE MOVER, WATER-METRO, AUTONOMOUS PEOPLE-MOVER, POD CAR, SUSPENDED MONO-RAIL METRINO

THE WORLD OF TRANSPORT TECHNOLOGIES AND ECONOMICAL DEVELOPMENTS IN MODERN URBAN/MEGAPOLIS ENVIROMENT



Animation for BOMBARDIER Regional Mass Rapid Transit Train

METRO 108, January 2021
METRO Newsletter by Dr. F.A. Wingler

SYNOPSIS:

India has started on the Magenta Line at Delhi with driverless automated metro train operation.

Hydrogen Fuel Cell Propulsion is worldwide on forerun, also in India, instead of CO₂ producing Diesel traction.

Long rolled rails of high steel quality and with stationary and mobile Flush-Butt Welds replacing AT-welded 13 m panel rails have become in India a milestone in reducing fatal train accidents.

Kochi Water Metro and Rubber Tired MetroNeo as a more cost effective public transport solution are in India in progress.

Combined Metro/Tram-Trains are in discussion in India to bring passengers seamless from one City Center to the next.

China introduces 100 kmph Monorail and suspended Sky Train

Headlines of Newsletter METRO 108:

I. Indian Activities and Initiatives

- Smart Trains and connected Urban Rail with improved Public Transport and inclusive Mobility.
- Prime Minister Narendra Modi inaugurates India's first Driverless Metro Train and National Common Mobility Card Services on Delhi Metro.
- Nashik Metro NEO.
- India to trial Hydrogen Fuel Cell Trainset.
- Metro Rail Projects in India.
- Exclusive Interview with Mr. V. R. Sharma, MD, JSPL: "We have Capability & Capacity to meet out entire Requirements of Rails for our Country".
- Maharashtra Government clears 120 kmph Broad Gauge Metro-Train Project.
- Metro linking Dehradun with Haridwar and Rishikesh likely by 2024.
- Cheaper Metro Neo may replace MetroLite for Delhi.
- Kochi Metro holds Keel-laying Ceremony of Water Metro's first Boat.
- JSPL becomes first Indian Firm, whose Rails get Approval by Indian Railways for Use in High-Speed Rail Corridors.
- A long Wait for the proposed Light Rail System of Jammu & Srinagar.
- In a Conversation with Mr. Steve Cockerell and Mr. Dan Vogen of Bently System

II. Global Activities and Initiatives

- Urban Transport Industry News Round-up, I- VII.
- Faster 100 kmph Monorail on Trial in China.
- Skytrain Monorail on Test in China.
- Ulaanbaatar's Yurt Settlements to be served by Cable Car in Mongolia.
- Pandrol's AutoSeal eliminates the Need for manual Sealing when welding Rails; Global.

PART I: INDIAN ACTIVITIES AND INITIATIVES FOR URBAN MOBILITY AS A SERVICE

Smart Trains and connected Urban Rail with improved Public Transport and inclusive Mobility; India

By [M. K. Raj](#), 01/12/2020; Metro Rail News

The major problem, which our developing cities are suffering from today, is the lack of efficient and effective [public transport system](#). The modern cities in India are not modern in planning in any sense. The planning lacks everywhere and can be seen in every aspect of the urban planning, designing and development. There are many problems which a new or existing city experiences today in developing nations like ours.

Enhancement of the Urban Transport System will surely result in easy access to transportation to cater to the growing needs of the residents of these cities. There are a lot more factors which may play crucial roles in the development of progressive cities for a developed India which We all have been aspiring for!

The industrial “internet of things” has had a major impact on the transportation industry, with the advent of autonomous vehicles and improved cargo management. One area that has seen less coverage is the connected railway.

“The fact that trains operate at such high speeds through tunnels and extreme weather conditions presents real challenges when it comes to deploying IoT systems. But advances in networking have made smart trains a possibility, and one that could provide significant benefits when transporting goods, providing comfort for passengers and increasing operators’ return on investments”, says one expert.

As we see today, infrastructure is gradually being replaced by train management systems in which trains become interconnected, which may be called communication hubs. They are then so interconnected that it is easy for them to transmit data among themselves, which further helps them to manage network control centres effectively and receiving instructions from control centres. Technology and Artificial Intelligence are today playing crucial roles in the enhancement of Urban Transport Systems.

As we progress further in future, we will see a whole system being developed not only in the developed nations but also in the developing countries mainly of Asia and Africa. One of the problems, which Indian Railways regularly faces, is delayed arrival of trains. The derailment of trains is another big issue pertaining to the safety and security of commuters. Systems have been developed today by Engineers, that can display train velocity for drivers and report speeds back to central control systems. These may reduce

the chances of train accidents, and it will further lead to a sharp decline in the number of average rail accidents in any country.

Furthermore, on-board monitoring systems are interconnected with outdoor signalling systems that can regulate train speeds or even remotely command trains to stop based on track conditions, the positions of switches, the presence of other trains on the track and other factors. This may help in protecting the trains from crashes and derailments once these technologies are brought into use.

The Technologies are being developed, which will not only help in the vision of running **Smart Trains**, but these will also provide the efficient, effective and best way of transportation to the cities. The governments are trying to bring more infrastructural projects for providing an efficient mode of the public transport system in the cities. India is also introducing the RRTS System. RRTS is a new, dedicated high-speed, high capacity, comfortable commuter service connecting regional nodes in NCR. According to the [NCRTC](#), which is the nodal agency for the development of Delhi-Meerut-Ghaziabad RRTS project, "RRTS is different from conventional Railway as it will provide reliable, high frequency, point to point regional travel at high speed along dedicated pathway".

[Delhi- Ghaziabad – Meerut Regional Rapid Transit System](#) is an 82.15 km long, under-construction, semi-high speed rail corridor connecting Delhi-Ghaziabad-Meerut. RRTS is different from the metro as it caters to passengers looking to travel a relatively long distance with fewer stops and at higher speed, and this will further help in the better travel facilities to the people of Urban Centres of Trade and Commerce.

The future indeed seems to be very bright for the urban transport system. Many more Metro Projects are coming up. The concept of Bullet Train is now not unknown to India. High-speed rail (HSR) is a type of rail transport, that runs significantly faster than traditional rail traffic, using an integrated system of specialized rolling stock and dedicated tracks. While there is no single standard, that applies worldwide, new lines in excess of 250 kmph (160 mph) and existing lines in excess of 200 kmph (120 mph) are widely considered to be high-speed.

In India, the upcoming Ahmedabad-Mumbai Bullet Train corridor will be 508 km long high-speed train corridor and will be India's first Bullet Train corridor. It will be based on Japan's E5 Shinkansen technology. The ambitious railway project will boast speeds of over 300 kmph. This is the first of its kind in Indian Subcontinent. What I want to say here is that things are changing today in each and every perspective. The RRTS and High-Speed Rails are two different projects, which show the progress of our country towards modernization of Urban Transport Systems.

As compared to the traditional Rail Systems, the **Smart Trains** are going to be of great help and use. When we compare the signalling systems, then we find that a lot more things are changing with the advancement in technologies. Signalling systems control the movement of a train by remotely adjusting train speed and braking.

More traditional signalling systems are based on radio-frequency identification along the train track, but wireless train to ground signalling is getting more and more common in both railroad and metro systems as of the trends now. The new European high-speed railroads are today equipped with European Train Control System Level 2, a signalling standard that requires constant radio communication between the train and the group.

These all changes are going to bring a lot of changes in the Public Transport Systems which will not only improve the things but will also help in inclusive mobility and economic growth. The time is set to change and we will see a new dawn of hopes and dreams when these all systems get fully developed and implemented in the Indian Transit System. The hopes will always be there as science is never at rest nor the scientific advancements.

I am hopeful that the Indian government work for this cause and the [Ministry of Railways](#) bring rapid transformations in the Railway Sector. Although Metro Networks are using many modern technologies, it's a time of upgrading some existing old and traditional practices. I hope we get Smart Trains and adopt these new technologies very soon in the next couple of years.

Prime Minister Narendra Modi inaugurates India's first Driverless Metro Train and National Common Mobility Card Services on Delhi Metro; India

By **M K Rai**, 28/12/2020; Metro Rail News



Prime Minister Narendra Modi inaugurats the Country's first-ever fully automated Driverless Metro, Magenta Line

NEW DELHI (Metro Rail News): Prime Minister Narendra Modi today inaugurated the country's first-ever fully automated 'Driverless Train' service by flagging off the first such train stationed at Jasola Vihar-Shaheen Bagh Metro station on Delhi Metro's 37 km long Magenta Line (Janakpuri West to Botanical Garden) and also the National Common

Mobility Card (NCMC) on the 23 km long Airport Express Line (New Delhi to Dwarka Sector 21) via video conference in the presence of the Union Minister of State (Independent Charge), Housing and Urban Affairs, Hardeep Singh Puri and the Chief Minister of Delhi, Arvind Kejriwal.

The inaugural ceremony held through video conferencing was attended by thousands of people from across the globe as history was created with the operationalisation of India's first-ever driverless train. Apart from senior dignitaries from the Central Government and the Government of the NCT of Delhi, the event was also witnessed online by HE Ambassador of Japan to India, Mr Satoshi SUZUKI. Senior dignitaries from Japan International Cooperation Agency (JICA), from Tokyo and Delhi, also witnessed the event online.

"With the launch of these fully automated Driverless Train operations (DTO), India enters into the elite league of few countries having this facility in their Metro system. The fully automated trains will reduce human intervention in operations and offer more reliability and safety for the commuters. This system also brings more flexibility in trains in operation. As a result, the number of trains in service can be regulated based on demand dynamically without any dependence on the availability of the crew. Since these trains operate on communication-based train control (signalling) system, they can be run with headway as high as 90 seconds to offer more carrying capacity", the DMRC said.

In DTO, initially, the train operator will be present on the train to instil a sense of confidence and assistance. DTO's higher level of diagnostic features will help move from conventional Time-Based Maintenance to Condition Based Maintenance. This will also reduce maintenance downtime of trains.

The NCMC service enables passengers from any part of the country travelling on the Delhi Metro's Airport Express Line to use their NCMC compliant RuPay debit card for seamless travel. The same card can also be used for shopping, banking transactions etc. across the country. DMRC's system will be able to accept transactions from 23 banks through the RuPay debit card issued by them.

"DMRC is planning to similarly upgrade its entire existing network by 2022 to facilitate the travel by this NCMC compliant Rupay Debit card. The existing Delhi Metro smart cards, tokens (currently not in use due to Covid 19 pandemic), QR Codes, etc., will also continue to remain in use. In addition, all upcoming corridors of Phase-IV will also be built with NCMC compliant Automatic Fare Collection (AFC) system at the stations", it said.

Nashik Metro NEO; India

Metro Rail News, Journal December 2020, page 22



In a recent move, the Maharashtra government has entrusted the task of implementation of an efficient Mass Rapid Transit System (MRTS) to Maha-Metro in Nashik. A Detailed Project Report (DPR) was prepared by RITES Limited and after approval from the State Government, it has been sent to Government of India for sanction.

The Report has identified a 32 km main route and 24 km feeder routes for implementation of this project. The concept of Metro-Neo was formulated after a very extensive and comprehensive technical consultations, interactions and due diligence with several stakeholders/technical experts. The system is eco-friendly, energy efficient, cost-effective and capable of providing an efficient mass public transport system which is ideally suitable for the traffic need of TIER 2/ 3 cities in India as well as similar cities abroad.

Project Highlights

- Project Name: Nashik 'Metro Neo' Light Metro Rail Project.
- Operator: Maharashtra Metro Rail Corporation Limited.
- Owner: Govt. of India, Govt. of Maharashtra & CIDCO.
- Project Type: Mass Rapid Transit System (MRTS).
- Total Network: 32.0 km.
- No. of Phases: 1 (two corridors).
- Project Cost: INR 2,100.60 Crore.
- Completion Target: 2025.

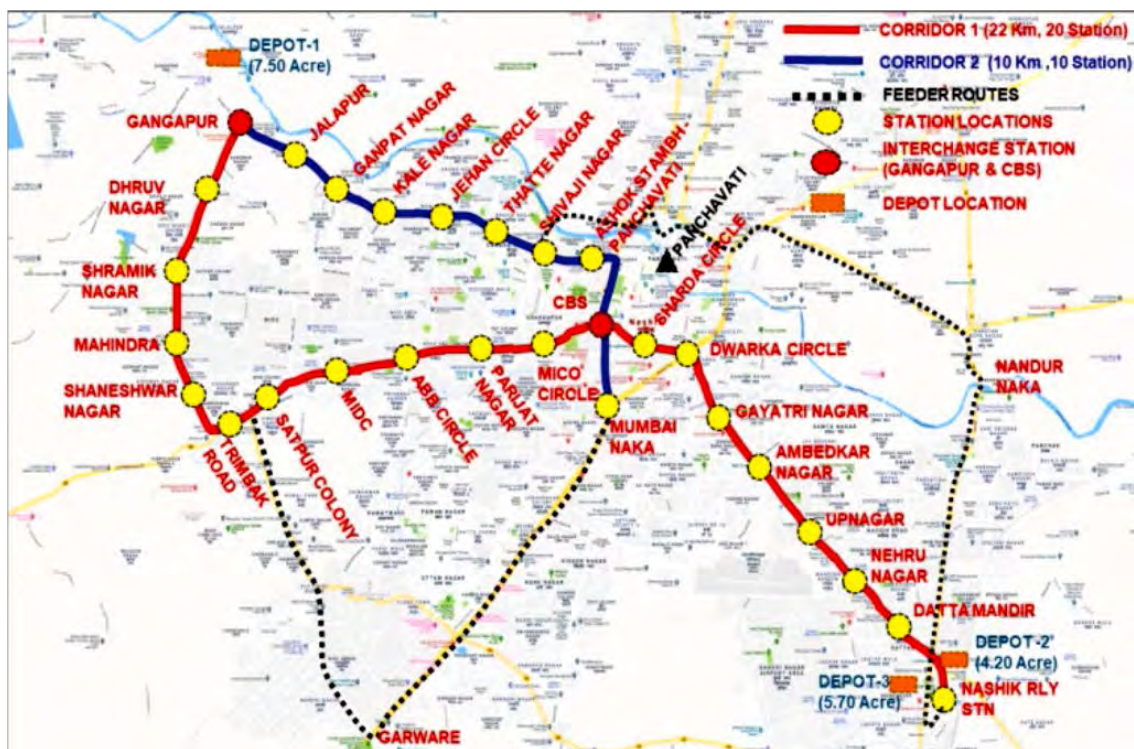
Nashik Metro NEO is a proposed rapid transit system in the Nashik metropolitan area. The system is proposed to reduce traffic congestion as well as provide direct connectivity to Nashik City from its Suburbs. The Nashik Metro NEO will connect suburbs of Nashik city like Deolali, Nashik Road, Upnagar, Nashik Airport, Sinnar, Igatpuri, Gangapur Road, Traimbakeshwar, Dindori, Bhagur, Niphad, Adagaon, Ghoti and Girnare. "Overall system capacity is estimated at 15000 PPHPD (Passengers Per Hour Per Direction). Coaches will draw power from an overhead electrical (OHE) system on the elevated portions and use battery-power while operating on the at-grade (road) sections", an official said.

"The state government hopes to receive a loan for its development from the European Investment Bank (EIB)", he added.



The project is being seen as a crucial one which will transform the whole transit system of the City of Nashik. As stated earlier, the project will be developed under the aegis of Maha Metro which is currently developing and operating Metro Services in Nagpur. The Pune Metro is also being developed by the same organization.

Proposed Nashik Metro Routes



Line-1: Gangapur – Mumbai Naka

- 1) Length: 10 km.
- 2) Type: Elevated and at-Grade.
- 3) Depot: Satpur (7.5 acre).
- 4) Number of Stations: 10.
- 5) Station Names: Gangapur, Jalapur, Ganpat Nagar, Kale Nagar, Jehan Circle, Thatte Nagar, Shivaji Nagar, Ashok Stambh Panchavati, CBS, Mumbai Naka CBS and Gangapur Stations will serve as an interchange between both lines.

Line-2: Gangapur – Nashik Road Railway Station (22 km)

- 1) Length: 10 km.
- 2) Type: Elevated and at-Grade.
- 3) Depots: 2 along Nashik Road (5.70 and 4.0 acres).
- 4) Number of Stations: 20.
- 5) Station Names: Gangapur, Dhruv Nagar, Shramik Nagar, Mahindra, Shaneshwar Nagar, Trimbak Rd, Satpur Colony, MIDC, ABB Circle, Parijat Nagar, MICO Circle, CBS, Sharda Circle, Dwarka Circle, Gayatri Nagar, Ambedkar Nagar, Upnagar, Nehru Nagar, Datta Mandir, Nashik Road Railway Station Nashik Metro Feeder Bus Lines.

Two feeder corridors have been planned to provide seamless travel and wider coverage. The feeder corridors will run between Satpur Colony via Garware to Mumbai Naka and between Nashik Road via Nandur Naka to Shivaji Nagar on the existing road network. Feeder AC electric coaches will be 12-13 meter long with a carrying capacity of 60-70 passengers.

- Line-1: Mumbai Naka via Garware to Satpur Colony (12 km).
- Line-2: Nashik Station to Shivaji-nagar via Nandur Nakka (12 km).

Other Salient Features of Project

1) Connectivity:

Two corridors are planned initially. Corridor one, Gangapur to Mumbai Naka, length 10 km and 10 stations. Corridor two, Gangapur to Nashik Road, length 22 km and 15 stations. CBS will be an interchange station where both the corridors meet.

2) Feeder Services:

There will be two feeder corridors. Feeder corridor one will run between Satpur colony – Garware – Mumbai Naka. Feeder corridor two will run between Nashik Road – Nandur.

3) Electric Bus Features:

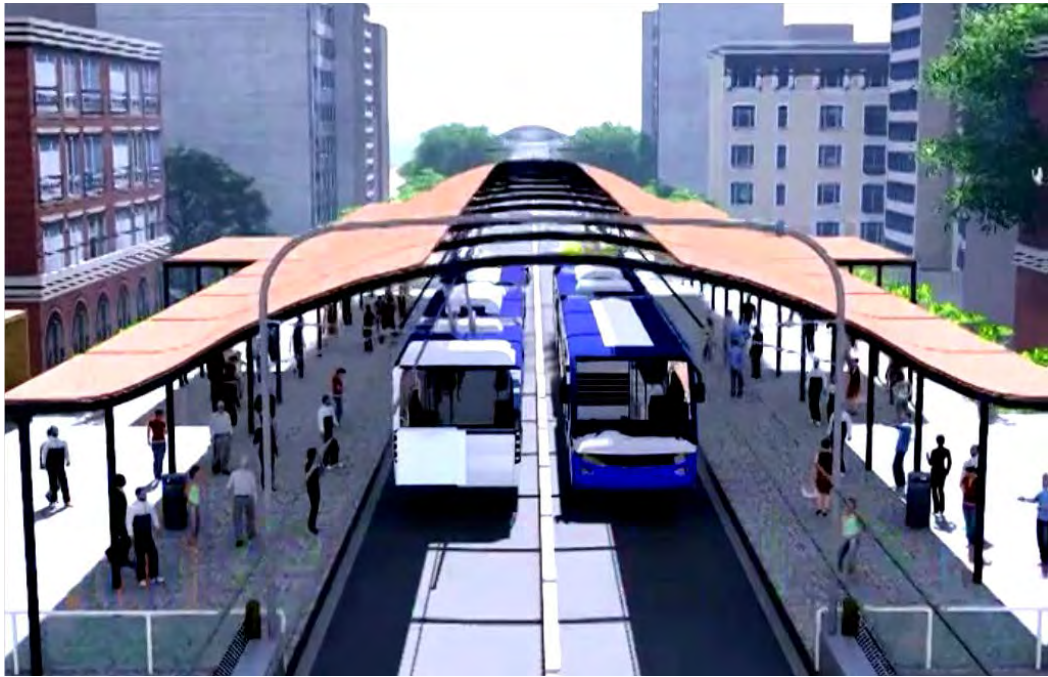
The length of Electric Bus Coaches will be 25/18 meter and carrying capacity 200/300 passengers. The buses will have rubber-tyre and draw power from the overhead electric wire having 600-750 V DC supply. The buses will take power from overhead electric wire through railway/tram like system.

4) Passenger Facility:

The buses will be air-conditioned with automatic door closing system, level boarding, comfortable seats, passenger announcement system, and passenger information system with the electronic display.

5) Stations Infrastructure:

The stations will have a staircase, lift and escalators with a passenger information display. The station entry and exit will be provided on both sides of the road to avoid road crossing by passengers.



6) Feeder Bus Routes:

Feeder Bus (12 m) battery-powered will run on the existing road on the 2 feeder routes i.e (1) Mumbai Nakka via Garware to Satpur Colony (12 km) and (2) Nashik station to Shivajinagar via Nandur Nakka (12 km). The feeder bus batteries will get charged while operating on the main corridors that will enable seamless travel with wider coverage. No separate charging facility will be required.

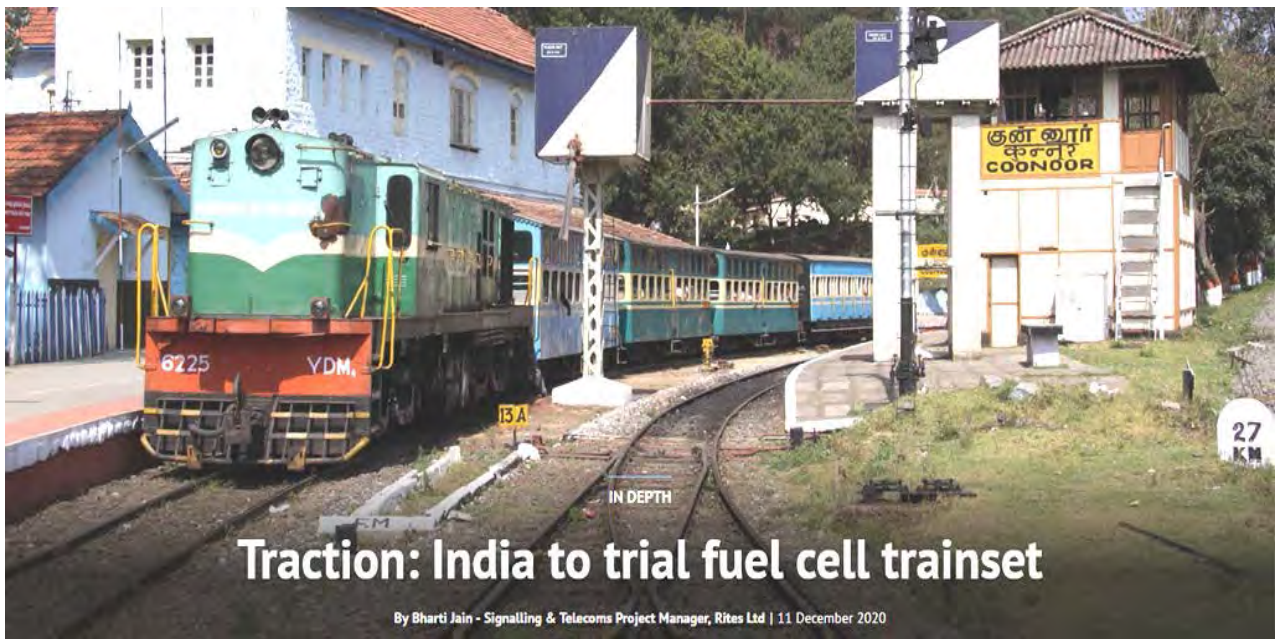
7) Energy-efficient and Environment-friendly System:

Metro-Neo is a UNIQUE concept being adopted for the 1st time in India. It is comfortable, rapid, energy efficient, less noisy (compare to diesel buses) and environment-friendly. The capacity of the main corridors will be 15000 PHPDT (Peak Hour Peak Direction Traffic). The system has been designed for headway (peak hour) 2 minute i.e. a new service after every two minutes.

8) Project Cost and Funding Pattern:

The total cost of the project is Rs 2100.6 crore. Govt. of Maharashtra, CIDCO and NMC share (Rs 552.19 crore) and Govt of India share (Rs 307.06+80.5 cr), total Government share Rs.939.3 crore and remaining Rs 1161.3 will be loan component.

India to trial Hydrogen Fuel Cell Trainset; India



Bharti Jain, Railway Gazette International December 2020; page 20



Indian Railways expects to roll-out a four-car hydrogen fuel cell multiple-unit by the end of 2021, as the country looks to alternative fuels as a way of reducing greenhouse gas emissions from the transport sector.



* Bharti Jain is an electronics and communication engineer, who began her career in the telecommunications sector before joining Rites as a project manager for signalling & telecommunication projects. She is currently working on Indian Railways' alternative energy initiatives and semi-high speed rail projects.

Next year will see the development of India's first hydrogen-powered train, with a four-car demonstrator due to be rolled out of the Diesel Loco Modernisation Works in Patiala before the end of 2021. Mirroring initiatives in other parts of the world, the fuel cell powered multiple-unit will be used to investigate the potential for decarbonising the rail sector, building on government plans to accelerate the use of hydrogen across the national economy.

India has one of the fastest growing economies in the world, with the rapid expansion of heavy industries and other production. This has resulted in a significant increase in greenhouse gas emissions from both the industrial and transport sectors, notably carbon dioxide and carbon monoxide. According to a report by the Potsdam Institute for Climate Impact Research, India's GHG emissions in 2015 stood at 3.6 million gigatonnes of CO₂ equivalent, or about 7% of global emissions. That makes it the world's third largest emitter of greenhouse gases.

Climate change due to GHG emissions has been recognised as an increasingly important issue in recent years, with CO₂ a major contributor. At present, roughly one-third of global CO₂ emissions come from industries and a quarter from the transport sector. If current trends continue, by 2050 there would be a 55% increase in transport emissions, and 38% of global CO₂ emissions would come from just seven industrial and transport sectors.

According to the International Transport Forum, global freight and passenger transport volumes are projected to grow three-fold by 2050. Demand is being driven by multiple factors such as economic globalisation, increasing population, urbanisation, tourism, rising international trade and the diversification of product value chains. More and more industries are moving away from manufacturing products at a single location, and expanding technology-specific production units which require the integration of components sourced from factories around the world.

Hence the need to move both industry and transport to more sustainable forms of energy. To this end, rapid technological development and falling costs are helping to stimulate greater use of renewable energy sources.

As part of its contribution to international efforts to limit the global temperature rise to 1.5°C, India is looking to achieve zero emissions from its heavy industry and transport sectors by around 2060. It has been working to reduce emissions from the transport sector through a range of initiatives. These include encouraging a shift from two-stroke to four-stroke internal combustion engines for road vehicles, the adoption of alternative fuels such as CNG or biofuels and the take-up of electric vehicles.

In the rail sector, there are multiple alternatives for reducing carbon emissions, including biofuels, synthetic fuels, electrification and hydrogen. India has committed significant investment to

accelerate the electrification of its national rail network, while the advent of a hydrogen-propelled train will provide a further weapon in the armoury for the fight against climate change.

Why Hydrogen?

The Covid-19 pandemic has helped to underline more than ever the need to take sustainability seriously, and this has manifested into widespread enthusiasm for hydrogen as a commercial energy source.

Between November 2019 and September 2020, India's project pipeline for green hydrogen production has grown from 3.5 GW to just over 15 GW, signalling the emergence of a growing hydrogen economy.

The Indian government is driving a number of initiatives to increase hydrogen production. The Ministry of New & Renewable Energy and major power generation players such as Indian Oil Corp Ltd and National Thermal Power Corp have committed to the establishment of hydrogen production units across the country and the implementation of fuel cell technology. Significant investment is envisaged by both public and private firms and the use of hydrogen is expected to expand between three- and 10-fold by 2050.

In keeping with this trend, Indian Railways has begun to investigate the potential for hydrogen traction, as a cleaner fuel which is both convenient and cheap to obtain.

Both battery and hydrogen trains have been considered as an alternative to diesel traction for operation on non-electrified routes. Conventional locomotives would need large and heavy batteries to operate over long distances or haul heavy payloads. Fuel cells offer a lower weight, better payload and a longer range. The consumption rate of hydrogen is less than diesel fuel, while the trains are quieter in operation.

Unlike conventional diesel engines, hydrogen-fuelled trains emit only water vapour at the point of use. This results in minimum heat and low well-to-wheel. Given the right infrastructure, hydrogen is safe to handle and vehicles can be refuelled quickly, resulting in minimal downtime.

Amongst the fuel variants, green hydrogen is considered to be the best alternative, being extracted from water using renewable energy such as solar or hydro power. This is preferable to 'grey' hydrogen produced by reforming fossil fuels or 'blue' hydrogen generated from natural gas.

Given the rapidly expanding production pipeline and investment in renewable energy generation, the cost of green hydrogen is expected to fall by up to 65% between 2030 and 2040. This would make hydrogen more economic than fossil fuels, where prices are predicted to rise as a result of restricted supply and government policies. Fuel cell manufacturing costs are also expected to fall, given that they are assembled from stacks of standard components.

Hence, IR considers that hydrogen is likely to be the most promising technology for achieving a zero-emission railway network by 2030.

Fuel Cell Basics

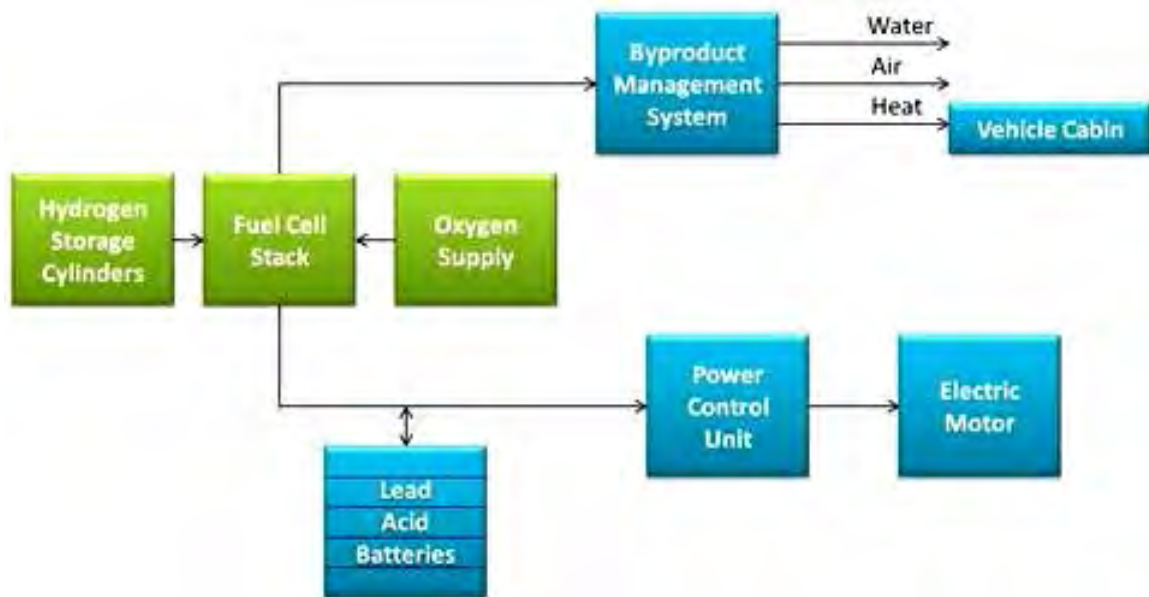
Various types of fuel cell are now available, which are typically classified by the type of electrolyte used. They include Proton Exchange Membrane, Alkaline, Phosphoric Acid, Solid Oxide and Molten Carbonate fuel cells. Indian Railways has opted to use PEM technology in its hybrid trainset, because of the low operating temperature (50 to 100°C), short starting time and the ease of using ambient air as the oxidant.

Each fuel cell transforms the chemical energy of hydrogen and oxygen to produce power. The electrodes (anode for hydrogen and cathode for oxygen) are separated by an electrolyte, which

prevents the reactants from mixing directly and controls the charged ions created during the partial cell reactions.

Hydrogen molecules enter the anode and react with a catalytic coating on the anode, releasing electrons to form a positively charged hydrogen ion. While the free electrons cannot pass through the electrolyte, the ions reach the cathode and flow into an electrical circuit, generating power. The cathode causes the hydrogen ions and free electrons to react with oxygen from the air to form water vapour.

A single fuel cell under load produces between 0.6 V and 0.8 V, so multiple cells are stacked together to produce higher voltages.



Global Development

Internationally, countries such as Germany, Netherlands, France, South Korea, Japan and the UK are investing in the development of trains powered by hydrogen fuel cells as a part of their route to a carbon-neutral future.

Attention shifted towards the evolution of hydrogen trains in 2015, when Alstom selected Hydrogenics as a key partner to develop the fuel cell technologies for its Coradia iLint project. The world's first production fuel cell train has roof-mounted power modules and hydrogen storage tanks. During operation hydrogen is combined with oxygen drawn from the ambient air, in order to charge underfloor batteries which in turn power the electric traction motors.

Unveiled at the InnoTrans 2016 trade fair in Berlin, Coradia iLint demonstrated a range of up to 1000 km between refuelling, and a similar performance to conventional diesel multiple-units, with lower noise and environmental impact. Two prototype units entered service in September 2018 for an 18 month trial on the Buxtehude – Bremervörde – Bremerhaven – Cuxhaven line in northern Germany. The units have also been demonstrated in other countries including Austria and the Netherlands, where tests were successfully conducted in March 2020.

Alstom has so far received orders for 41 Coradia iLint trainsets. The first 14 are due to enter service in Niedersachsen during 2021, and the other 27 will be used in the Rhein-Main region from the end of 2022.

In June 2019, the UK launched its HydroFlex demonstrator, developed by Porterbrook and the University of Birmingham, and this undertook its first main line trials in October 2020. HydroFlex

has been created by fitting a fuel cell power pack to an existing Class 319 EMU, enabling it to run on electrified or non-electrified routes without modifying driver's controls.

Rolling stock leasing company Eversholt Rail is working with Alstom to develop a hydrogen multiple-unit to fit the restricted UK loading gauge; again using converted EMUs, the first Breeze trainset is expected to take to the rails in 2024. And in France, SNCF hopes to have its first fuel cell train in operation by 2022, with a view to eliminating diesel traction by 2035.

Having been early in the field with its New Energy Train, East Japan Railway is looking to start testing its second hydrogen-powered trainset in 2021 at up to 100 km/h, with the first commercial version to be released by 2024. Korea Railroad Research Institute is also developing a fuel cell powered train for completion in 2022. This has been specified to achieve a range of 600 km on a single charge at a maximum speed of 110 kmph.



Photo: Kris Ward

Electrification is likely to remain the most effective strategy for reducing carbon emissions from heavy freight haulage.

India's Hydrogen Prototype

Indian Railways has completed the design for a 300 kW fuel-cell-hybrid trainset rebuilt from an existing diesel-electric suburban multiple-unit. This will be assembled by the Diesel Loco Modernisation Works at Patiala in Punjab and is expected to be completed by the end of 2021. Modification of an existing train for hybrid operation is intended to speed development and minimise the manufacturing cost.

According to IR, this will be the most powerful fuel cell trainset yet developed. As with many of the other hydrogen trains, it will have a maximum speed of 140 kmph. While the actual fuel cell power plant will be imported, the hydrogen storage system and lead acid battery packs will be supplied by Indian manufacturers.

The four-car unit will have roof mounted lightweight storage cylinders on one vehicle to carry the compressed hydrogen. The gas will be fed to the PEM fuel cells (left), which will be mounted on the roof.

To avoid any loss of energy generated by the fuel cells, the train will be fitted with lead-acid batteries to store electricity produced during non-operational periods. The batteries will also capture regenerated braking energy, and help to smooth out the power demand under real-life

driving conditions. DC-DC converters in the power vehicle will balance the voltage difference between the fuel cells and batteries.

While the long-term intention is to use green hydrogen, the current plans envisage that the hybrid demonstrator would initially be powered using hydrogen obtained from industries which generate it as a by-product.

In-House Hydrogen Production

As well as investigating the use of fuel cells to power trains, IR is looking at the scope for developing its own hydrogen production systems, using water electrolysis powered by energy from renewable sources. There are currently two areas of investigation: nano materials and metal-oxide catalysts.

The first would see nanoparticles fitted on existing solar cells, to mimic photosynthesis and separate hydrogen from water in the presence of sunlight. This approach has two key benefits. Firstly, it is a low-cost technology, and secondly it can work with seawater or wastewater, avoiding the potential wastage of clean water.

The metal oxide method combines electrolysis with low-cost catalysts such as Spinel oxides to improve performance. Electrolysis is an established way to extract from water. Electricity is passed through water in an electrolyser, triggering two chemical reactions which produce hydrogen and oxygen. These two gases are then kept separate by a membrane. However, the oxygen revolution reaction is relatively sluggish, lowering the energy efficiency of the overall conversion. Spinel oxides are typically made of cheap transition metals and have been demonstrated as a stable, low-cost catalyst that could speed up the process and overcome the energy loss.

IR is also experimenting with the production of 'blue' and 'grey' hydrogen from biogas or oil feedstock.

Other Indian conglomerates now delving into green hydrogen production include NTPC and Tata Motors. Reliance Industries Ltd recently announced its intention to become a net carbon zero firm by 2030 by getting into green hydrogen production and replacing its transport fuels with clean electricity and hydrogen. Indian companies are working to build a full-stack electrolyser and indigenous fuel cell solutions, combining the powers of digital, power electronics, advanced materials and electrochemistry.

Recently, FTI Consulting entered into an agreement with The Energy & Resources Institute to develop an India Hydrogen Economy Roadmap. This includes the deployment of grey, blue and green hydrogen, carbon capture and renewable energy technologies, as well as research programmes to test the viability of hydrogen as the sustainable fuel choice in an Indian context.

METRO RAIL PROJECTS

OPERATIONAL METRO RAIL NETWORK

Project	Network (km)
Ahmedabad Metro (Gujarat)	6.5
Bangalore Metro (Karnataka)	42.3
Chennai Metro (Tamil Nadu)	45.0
Delhi Metro (Delhi)	347.6
Gurgaon Raid Metro (Haryana)	11.7
Hyderabad Metro (Telangana)	69.2
Jaipur Metro (Rajasthan)	9.6
Kochi Metro (Kerala)	23.8
Kolkata Metro (West Bengal)	33.2
Lucknow Metro (uttar pradesh)	22.9
Mumbai Metro (Maharashtra)	11.4
Mumbai Monorail (Maharashtra)	19.5
Nagapur Metro (Maharashtra)	24.5
Noida Metro (Uttar Pradesh)	29.7
Kolkata Tram (West Bengal)	38.0
Total Network	734.9

UNDER CONSTRUCTION METRO PROJECT

Project	Network (km)
Agra Metro (uttar Pradesh)	29.4
Ahmedabad Metro (Gujarat)	95.32
Bangalore Metro (Karnataka)	80.0
Bhopal Metro (Madhya Pradesh)	28.0
Chennai Metro (Tamil Nadu)	118.9
Delhi Metro (Delhi)	103.9
Hyderabad Metro (Telangana)	3.1
Indore Metro (Madhaya Pradesh)	31.5
Jaipur Metro (Rajasthan)	2.3
Kanpur Metro (Uttar Pradesh)	32.4
Kochi Metro (Kerala)	2.0

UNDER CONSTRUCTION METRO PROJECT

Project	Network (km)
Kolkata Metro (west Bengal)	102.2
Mumbai Metro (Maharashtra)	180.0
Meerut Metro (uttar pradesh)	20.0
Nagpur Metro (Maharashtra)	76.5
Nashik Metro Neo (Maharashtra)	32.0
Navi Mumbai Metro (Maharashtra)	11.0
Patna Metro (Bihar)	31.39
Pune Metro (Maharashtra)	39.92
Surat Metro (Gujarat)	40.35
Total Network	1060.18

NEW APPROVED METRO PROJECT

Project	Network (km)
Dholera Metro (gujarat)	100.0
Delhi Metrolite (Delhi)	40.85
Mumbai Metro (Maharashtra)	87.6
Nagpur BG Metro (Maharashtra)	268.63
Thane Metro (Maharashtra)	29.0
Total Network	526.08

UNDER CONSTRUCTION METRO PROJECT

Project	Network (km)
Coimbatore Metro (Tamil Nadu)	NA
Ghaziabad Metro (Uttar Pradesh)	NA
Gorakhpur Metro (Uttar Pradesh)	NA
Gurugram Metro (Haryana)	NA
Jewar Airport Metro (Uttar Pradesh)	NA
Noida Metro (Uttar Pradesh)	NA
Jammu Metro (J&k)	NA
Srinagar Metro (J&k)	NA
Varanasi Metro (Uttar pradesh)	NA
Visakhapatnam Metro (Andhra pradesh)	80.0

Exclusive Interview with Mr. V. R. Sharma, MD, JSPL: “We have Capability & Capacity to meet out entire Requirements of Rails for our Country”; India

By [M. K. Rai](#); 23/11/2020 ; Metro Rail News



Mr. V. R. Sharma, MD, JSPL

Our Managing Editor Mr Narendra Shah and Our Senior Editor, Mr Manoranjan Kumar had a conversation with Mr V R Sharma, the Managing Director of Jindal Steel & Power Limited.

Here are some excerpts from the brief Conversation:-

Narendra Shah- JSPL has emerged as a leading manufacturer and supplier of Rails across India and the world today. What has been the strategy behind it?

V R Sharma – Delhi Metro started operation in the year 2002. They imported Head Hardened Rails from Japan and Europe. We, in JSPL, installed a Rail Mill in 1998. We were supplying Rails to Indian Railways for railway siding and yards.

The main track Rails were either imported or were supplied by SAIL, Bhilai. The consumption of Head Hardened Rails grade 1080 was increasing month after month because Delhi Metro commissioned its Phase-1, Phase-2 and declared Phase-3 expansion.

We met Metro Rails Engineers and found that the suppliers of Head Hardened 1080 grade worldwide are very few. We found an opportunity in this business. Since it was a highly technical product, we started scouting the useful and cost-effective technology so that the cost of Metro Rails Tracks can be reduced. We found a world's reputed supplier SMS-Meer, Germany who had developed the Rails Head Hardened (HH) technology. Our Rail mill is also built by SMS-Meer group, Germany.

In the year 2013, we placed the order on SMS-Meer to supply us Head Hardening facility and integrate the same in our Rail Mill. In the year 2016, we commissioned our Plant and first order we got from Iran for Head Hardened Rails for High-speed Rails tracks. Successfully we supplied 20,000 tons HH Rails to Iran Rails and the quality certification was done by international quality control agencies. This was the beginning. After having supplied to the overseas customer and after obtaining a good size of the order, we approached Indian Metro Rail projects.



Narendra Shah – How was the response from Indian Metro Rail projects and Indian Railways?

V R Sharma – Initially the response was slow but finally Metro projects started taking an interest. The basic reasons for interest were the inconveniences Metro projects were facing in most of the cases.

1) To import HH Rails, the Metro projects were required to meet the conditions of foreign rail suppliers in most of the deals such as –

- a. Minimum order quantity (approximately 3000 – 5000 tons) to be given as per the demands of foreign Rail Suppliers.
- b. Upfront opening of LC/TT Payment at least 4-6 months in advance.
- c. Waiting time was too high, that is 4-6 months from tender floating to receipt of rails.
- d. Smaller lengths – 13 meter or 26 meter long Rails because of the sea route. Hence more number of weld joints are required.
- e. The risk of currency fluctuation was on Indian buyers.

2) Buying locally from India is advantageous to the buyer.

- a. We can supply as low as 500 tons quantity per order.
- b. Our payment terms are flexible and customer friendly.
- c. We deliver Rails up to project sites damage-free as the number of handling is reduced.
- d. The delivery is done within 30-45 days or earlier if there is a specific request.
- e. No risk of currency fluctuation.
- f. Our Rails are RDSO approved and inspected by RITES (A Government of India Company).
- g. We can deliver Rails in the length up to 234/260 meter which reduces the number of weld joints and laying is easier.

Narendra Shah- RDSO has recently approved 60E1 1175 Heat Treated (HT) Rails manufactured by JSPL for use in higher axle load & high-speed trains. How will this move change the future Rail business of your firm?

V R Sharma – The grade 1175 HT is an exciting product. Indian Railways asked us to develop this grade of Rails to enable them to carry heavy load/wagon that is 75 tons instead of 64 tons/wagon as of now.

We consulted our technology partner and finally, we produced these 1175 HT grades of Rails successfully. We believe that in the next 8-10 years the entire country will have 1175 HT grade of rail tracks. Now JSPL is fully approved for Main track Rails grade 880, R260,

1080 HH and 1175 HT. JSPL has already supplied Rails for the main track of Indian Railways.

Narendra Shah – Can you please tell how JSPL started its venture in the Rail business? How do you take it today as the Managing Director of the firm?

V R Sharma – The entire country's mindset is changing after the campaign driven by Hon'ble Prime Minister, Mr Modi to go "vocal for local".

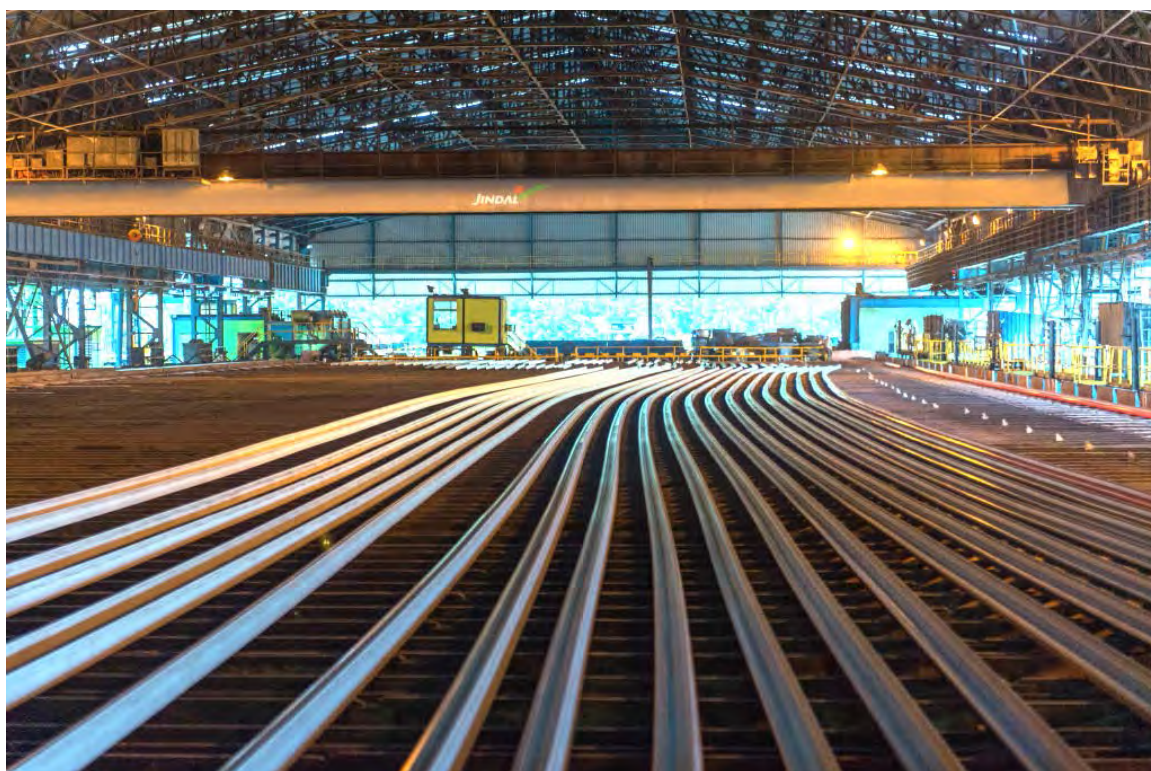
Indian Railways Engineers started utilizing the local sources as a substitute to imported Rails. Thanks to Hon'ble Prime Minister, Ministry of Steel, Ministry of Rails and Indian/Metro Railway Engineers.

Narendra Shah – What are the business prospects which you are looking for in the near future? Are you going to bring any new product for the Rail and Metro Sector?

V R Sharma – Indian Railways + Metro projects have projected 1.70 Million ton of demand of Rails per year. In addition, more than 2,00,000 tone Rails of 1080 grade are required by Metro Rails projects/Rapid Rail Projects in the country. Therefore, it is a huge market. The vocal for local will boost the sale of Rails from JSPL.

Narendra Shah – JSPL is already a key player in the Indian steel business and making good profits? How has the company performed in the last quarter?

V R Sharma – We made net profits in Q-4 of last year after a gap of more than 5 years. We are maintaining the same spirit in all subsequent months and quarter. During the Covid pandemic lockdown, we made an ever highest EBIDTA. In Q-2, we maintained the pace and earned EBIDTA more than Q-1. We have grown 19 % (YoY) in production and 30 % (YoY) in Sale and the EBIDTA margin is 31 %.



Long rolled Rails manufactured by JSPL

Manoranjan Kumar – Whom would you like to give its credit to?

V R Sharma – It is a complete teamwork and Mr Naveen Jindal is a farsighted person. Mr Jindal invested in Infrastructural steel making products rather than producing the commodities. He delegated his authority to his people so that they can work well and that is the reason the Company is doing well.

Manoranjan Kumar – The power sector is one of the most stressed sectors for the last few years. What is the status of the power business of JSPL?

V R Sharma – We are operating our power plants at 60 % capacity and the demand is picking up now. We have reached 70-75 % capacity utilization and in the next few months, we will reach to full capacity utilisation. We have requested the government of India for “One Nation One Tariff”, a policy which will enable the country to make the cost uniform across the country. The electricity prices are to be rationalized like telecom sector where its rate is uniform across the country. It will help revive the industry and create rapid industrialization across the country.

Manoranjan Kumar – The government of India had allocated a relief package of Rs 90,000 crores to the power sector. Has it brought any major change or something more is needed? Please express your views.

V R Sharma – The disbursement of Rs 90,000 Cr is definitely helping us because States are now in a position to pay on time for the electricity purchased by them.

Manoranjan Kumar- In which segment of the business, you are going to invest the most in the next financial year? What do you think about the power sector when it comes to investment?

V R Sharma – We are not going to invest in any of the businesses in the near future. We are going to make our company debt-free or lean debt company. We don't want to take further loans from banks.

Manoranjan Kumar – What do you think about the future of the Steel and Power sector? Is the route for recovery going to belong for these sectors?

V R Sharma – The future depends upon the present. The current situation is very favourable for the steel industry. Most of the major/integrated steel plants are running @ 90-95% capacity utilisation.

Manoranjan Kumar – When we come to the Rail business, there are a lot of foreign players in the market? How can the Make in India move get successful in the Rail Sector? What do you expect from the government?

V R Sharma – I would like to request the Government of India to remove restrictive clauses from Global/Local tenders that impede the domestic players. Secondly, the Government of India shall come up with a clear direction to Metro Rail projects and Indian Railways that there should be No Imports of Rails.

Once again will reiterate that the restrictive clauses in tenders to be abolished to make the dream of 'Atmanirbhar' true. Sometimes we find clauses in tender documents of Rails that the supplier should be in profit during the last 3 financial years. Such clauses are

detrimental to new suppliers. The Rails are sold on the basis of technical merits as per norms laid by RDSO and inspection by RITES (Government of India Co.).

The entry of foreign suppliers of Rails should be banned because local capacities & capabilities are available. If foreign suppliers want to avail share of Indian business then they should make an investment in India and should produce Rails in India. The concept of Atma Nirbhar Bharat should be kept in view always.

Manoranjan Kumar- Different RRTS projects are coming up in different parts of the country. The Bullet Train Project is also gaining pace. With this, the demand for rails will increase? What are your plans for the expanding Indian rail market?

V R Sharma – The Rail projects being executed on credit lines facility from different countries like Japan are very unfavourable for the steel industry in India specially for Rail manufacture. The Japanese Government is supplying Rails to Dedicated Freight Corridors and to Bullet train project. Government of India should discourage such a credit line facility where steel products or Rails are coming from the country who extends credit limit. Technology like Signalling system, Engines, Safety gadgets, control panels may be supplied by credit line countries.

Manoranjan Kumar – You have already started supplying Rails to Kolkata Metro. How has been your journey with Kolkata Metro? Do you have any ongoing deals with other Metro Corporations?

V R Sharma – Yes. We have already supplied to Kolkata Metro and we are expecting next order soon. The supplies to Pune Metro are going to be started shortly. Still, global tenders are being floated. Government of India/Ministry of Urban development must work on Hon'ble Prime Minister's vision "Vocal for Local" and should ban imports of Rails because we have capability & capacity to meet out entire requirements of Rails.

Manoranjan Kumar – Please share your views about the Atma Nirbhar Bharat plan and Make in India initiative? What are the major things which are vital for the success of these initiatives? Kindly express your opinion.

V R Sharma – This is a positive development. Thanks to Hon'ble Prime Minister, Mr Modi. I am sure, the whole country will soon start working in this direction. We must buy/prefer local products. This will boost our economy. India can be Atma Nirbhar in steel with immediate effect.

Manoranjan Kumar – Kindly share a message for our readers.

V R Sharma- It's time to localize and you will be a torchbearer in this process of localization.

Maharashtra Government Clears 120 kmph Broad Gauge Metro-Train Project; India



Intermodal Maha Metro-Rail/Railway-Train

120 kmph BG Metro-Train: First such Service gets State Cabinet Nod

NAGPUR (Metro Rail News): The Maharashtra Cabinet on Friday cleared the 120 kmph Broad Gauge (BG) Metro-Train proposal of [Maha Metro](#). The ₹ 333.60 Crore Project aims at providing semi-high speed connectivity to satellite towns in the regions of Nagpur – Narkhed, Wardha, Bhandara and Ramtek. With the state cabinet clearing the proposal, it would now be sent to Central Government for its approval.

Once implemented, **Metro-Train Rolling Stocks would run intermodal on Metro Network as well on Indian Railways' Tracks.**

One of the most ambitious projects proposed by Maha Metro, which would change the transportation pattern in Nagpur and surroundings, the proposal aims at utilising the existing infrastructure of [Indian Railways](#) by providing air-conditioned, faster, reliable and comfortable services between Nagpur and the four satellite towns mentioned above. This is the first-ever such service to be introduced in the country.

High-Quality Service: This would also act as feeder service to [Nagpur Metro](#), thereby reducing dependency on private vehicles and transportation services. Simultaneously this would reduce existing traffic congestion on the roads, subsequently accidents and pollution. The total distance covered by the project, involving all the four routes, is 265 km.

MoU Signing in July 2018: It may be recalled that the signing of Memorandum of Understanding (MoU) between Indian Railways, Government of Maharashtra and Maha Metro was held on 16th July 2018. The then Chief Minister of Maharashtra Mr Devendra Fadnis, Union Ministers Mr Nitin Gadkari and [Mr Piyush Goyal](#) was present during the MoU signing ceremony.

The journey to Wardha, for example, requires 2.25 hours' time from Nagpur. As compared to this the proposed service would require just 1.10 hours' time. Thus, the introduction of new service would not only save time but also add to the comfort levels of the commuters and prevent any accident, especially in respect of those who prefer to travel by road.

Train Speed to be 120 kmph: The Maha Metro trains would cruise at a speed of 120 kmph. Most modern coaches with all the comforts would provide transportation to the commuters between the four locations. Initially, four trains would be put to service to connect the four locations. The number would be gradually and subsequently increased to eight after a certain period of time.

KFW Ready to Finance Project: The BG Metro facility would act as Feeder Service to Nagpur Metro services and would help in increasing its present ridership. The international funding agency – KfW – which has funded [Maha Metro's Phase I project](#), has agreed to finance BG Metro project to the tune of ₹ 305.20 crores of the total project cost of ₹ 333.60 Crore.

Of the balance, the Maharashtra Government would also provide 50 % of the Strategic Debt (SD) of the Government of India (₹ 7.10 crore) and 100 % (₹ 14.20 crore) of SD incurred by the state government. Thus collectively, an amount of ₹ 21.30 crore would be sanctioned by the state government. Rest will be borne by the Central Government. The service once introduced would change the way people travel around Nagpur. This would also revolutionize the transportation concept in not just Nagpur, but across the country as a pioneering project.

Metro linking Dehradun with Haridwar and Rishikesh likely by 2024; India

By [M K Rai](#); 07/12/2020; Metro Rail



Image for Representation; Stadler WINK regional Diesel/Electric Two-Mode Express Train

DEHRADUN (Metro Rail News): The upcoming metro rail project in Uttarakhand, expected to be completed by 2024, will connect Dehradun-Rishikesh-Haridwar in its inception. The 33-km route will be the inaugural line according to sources.

"The detailed project report has been submitted to the state government, which is likely to get the nod soon", [Jitendra Tyagi](#), the Uttarakhand Metro Rail Corporation MD was stated saying.

Locals have welcomed the decision whether it be Rishikesh or Haridwar stating that this would improve connectivity and increase the footfall in these two cities which have greater religious values.

Apart from being a holy place, Haridwar is also the second-largest industrial centre of the state after Udham Singh Nagar. Many people working in [Haridwar](#) commute either by buses or other public transport.



Cheaper Metro Neo may replace MetroLite for Delhi; India

By [M K Rai](#), 18/11/2020; Metro Rail News



Image for Representation

NEW DELHI (Metro Rail News): Delhi is likely to become one of the first major cities in the country to have a “Metro Neo” corridor, which is a urban transport system with rubber-tyred electric coaches powered by an overhead electric feeding system running on elevated or at-grade sections. The light transit system, which costs about 20-25% of a

Metro and also has lower maintenance costs, is likely to come up between Kirti Nagar and Bamnoli near Dwarka, where a MetroLite corridor was proposed last year. "While MetroLite also has a lower carrying capacity compared with Delhi Metro, it is a rail-based system and costs 40% of a Metro system. Delhi Metro Rail Corporation (DMRC) had not only prepared a detailed project report (DPR) but also floated tenders for procuring MetroLite coaches", a news report said.

"For the Kirti Nagar-Bamnoli corridor, a decision was taken by [DMRC's](#) board of directors to explore the possibility of implementing the Metro Neo technology and get a DPR prepared for it," Mr [Anuj Dayal](#), executive director (corporate communications), DMRC was stated saying.

"Further modifications may be made to the technical specifications of the rolling stock as well as other allied requirements for this corridor. Therefore, the tender for procurement of 29 MetroLite trains has been cancelled. The tender may be floated again based on changes in technical specifications in the future," he was further stated saying. While the 19km Kirti Nagar-Bamnoli MetroLite project was pegged at Rs 2,673 crore, the cost of a Metro Neo corridor would be around Rs 2,000 crore. The standalone corridor would connect Kirti Nagar interchange station, where Blue (Dwarka-Noida City Centre) and Green (Inder Lok-Brig Hoshiar Singh) lines of [Delhi Metro](#) meet with the high-speed Airport Express Line, which is also being extended from Dwarka Sector 21 to Dwarka ECC near Bamnoli.

Kochi Metro holds Keel-laying Ceremony of Water Metro's first Boat; India

By [M K Rai](#), 20/10/2020; Metro Rail News



Keel-laying ceremony of Water Metro.

Keel Laying Ceremony of Kochi Water Metro Boat

KOCHI (Metro Rail News): The keel-laying ceremony of [Kochi Water Metro's](#) first boat was held at Cochin Shipyard on Tuesday. Kochi Metro is constructing a hybrid electric catamaran ferry with a capacity of 100 passengers.

The traditional keel-laying ceremony is universally recognised and one of the most important events in the construction of a vessel. It marks the beginning of a significant construction phase. Olden days, the construction happens around the keel, while in modern times, the date signifies a substantial process in the shipbuilding. Classification rules of the boat apply as on the date of Keel is laid.

"The boat is finally taking shape. We are glad about the progress. Construction of terminals as well as that of the boat is progressing well. We are looking forward to inaugurating the Water Metro's operations in early 2021." said Additional Chief Secretary (Special Projects) [Alkesh Kumar Sharma IAS, MD KMRL](#).

Thiruman Archunan, Director (Projects) [KMRL](#), Suresh Babu N V (Director-Operations) Cochin Shipyard, Shri. V J Jose (Director Finance) Cochin Shipyard and other officials attended the event.

JSPL becomes first Indian Firm whose Rails get Approval by Indian Railways for Use in High-Speed Rail Corridors; India

By [M K Rai](#); 20/10/2020; Metro Rail News



JSPL Rail Production

JSPL produced 1080 HH rails & 880 Grade rails has already been approved by RDSO for use into Indian Railways on regular basis. JSPL's 1080 Head Hardened Rails are already being supplied to the Metro Rail Corporations and High-Speed Corridors by JSPL.

NEW DELHI (Metro Rail News): [JSPL](#) is the first and only Indian manufacturer to successfully develop 60E1 1175 Heat Treated(HT) Rails suitable for High speed and High Axle Load applications. [Indian Railways](#) have projected a requirement of 1.8 Lac t per annum of this high-grade 60E1 1175 Heat Treated (HT) Rails.

JSPL produced 1080 HH rails & 880 Grade rails has already been approved by RDSO for use into Indian Railways on regular basis. JSPL's 1080 Head Hardened Rails are already being supplied to the Metro Rail Corporations and High-Speed Corridors by JSPL.

Indian Railways has embarked upon upgrading the Indian Railway Track system to carry 25 t axle-load and up to 200 kmph. Research Designs & Standards Organisation (RDSO) has approved the newly developed 60E1 1175 Heat Treated (HT) Rails of Jindal Steel and Power Limited. 60E1 1175 Heat Treated (HT) Rails is a superior grade to 1080 HH and will be used by Indian Railways for heavier loads and high-speed application.

A long Wait for the proposed Light Rail System of Jammu & Srinagar; India

By M. K. Rai, 29/10/2020; Metro Rail Report



Tramway of Nantes, France, Image for Representation.

JAMMU (Metro Rail News): Although a lot of things are being proposed, it's going to be a long route for the Union Territory of Jammu and Kashmir to get a Light Rail System. According to sources, the Light Rail System for the capital cities has yet not been sanctioned by the Union Ministry of Housing and Urban Affairs even after the [Rail India](#)

Technical and Economic Service (RITES) submitted Detailed Project Reports earlier this year.

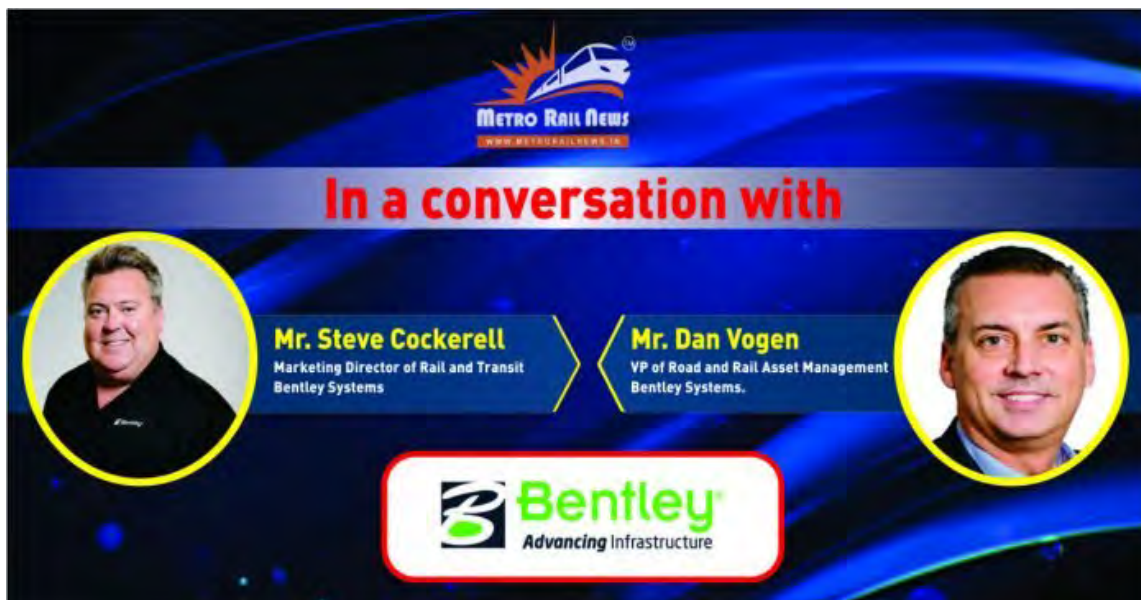
“Presently, the DPRs are laying with the Union Ministry of Housing and Urban Affairs and the same are yet to be approved. The Mass Rapid Transit System Projects including metro rail/monorail are cost-intensive which require extensive Inter-Ministerial consultations and their approval depends on the feasibility of projects and availability of resources as such no time limit can be specified for sanction of the projects for Jammu and Srinagar”, an official was quoted saying by a media agency.

As proposed, in Phase-I of the elevated Light Rail Transit System in Srinagar, two corridors will be laid from HMT junction to Indra Nagar and Osmanabad. In Phase-II, two corridors will be laid from Indra Nagar to Pampore Bus Stand and Hazuribagh to Airport. In Jammu, in Phase-I, two corridors from Bantalab to Greater Kailash and Udheywala to Exhibition Ground will be developed while as in Phase-II, corridors will be built from Greater Kailash to Bari Brahamana Railway Station and Exhibition Ground to Satwari Chowk to Airport.

In a Conversation with Mr. Steve Cockerell and Mr. Dan Vogen of Bentley Systems; India

Interaction on Bentley's Media Day during Year in Infrastructure Conference 2020

By [Narendra Shah](#); Metro Rail News 28/11/2020



In a

Conversations with Officials of Bentley Systems

Our Managing Editor Mr. Narendra Shah held a conversation with Mr. Steve Cockerell and Mr. Dan Vogen, both of whom are associated with [Bentley Systems](#).

Mr. Cockerell is Industry Marketing Director of rail and transit at Bentley Systems while Mr. Vogen is vice President of road and rail asset management at Bentley Systems.

Here are some edited excerpts from the Interview:-

Narendra Shah – Bentley Systems is a very fast-growing company with a worldwide presence. How do you feel today after contributing more than two decades to the organisation?

Steve Cockerell – I am excited, I am proud, ready for a good few more years, and stand ready to help our users realize the full potential of digital twins in rail.

Dan Vogen – I am really excited and proud of what we have accomplished. And, I am looking forward to the future. With the power of digital twins, we have more capabilities, meaning we can do things now that we could only dream of doing only a few years ago. Given the funding constraints that our users are constantly facing, I am confident that our software capabilities will help them achieve high-quality project delivery on time and under budget.

Narendra Shah – What is Bentley doing to help project owners and other stakeholders during the pandemic, especially to combat various project challenges?

Dan Vogen – Early in the pandemic we initiated a campaign called ‘Bentley Has Your Back’, and as part of this we have done a lot to make our software accessible to anyone, anywhere, and in the case of our cloud-based collaboration offering ProjectWise 365, have even waived subscription fees for a period of time. In this way, we are helping organisations to remain productive throughout the pandemic. We have worked hard to further increase our support levels, and increase the accessibility of our teams working with those users on project implementations, licensing, and deployment timeframes. We really have tried to be very flexible throughout the whole process.

Steve Cockerell – In addition to the ProjectWise 365 offering that Dan mentions, we also introduced a similar option in relation to pedestrian simulation in stations. Whereas ProjectWise 365 is really aimed at helping organisations to carry on doing what they need to do on projects, OpenBuildings Station Designer, which includes LEGION Model Builder and its pedestrian simulation capabilities, targets helping rail and transit owners return their networks, and in particular their stations, safely back into operation.

There are of course other examples, including here in the UK, with Network Rail's innovation throughout the lockdown we experienced in the first part of 2020. They used a combination of applications including ContextCapture, MicroStation, and OpenRail Designer, to pull together data from multiple sources and in the space of only a few days, create digital twins of **Exeter and London's Paddington Stations**. This really did help to ensure their work of delivering a safe and reliable railway could continue without interruption. With the help of our technology, they remained agile enough to deliver services above and beyond what was required and expected by their client and stakeholders.

Narendra Shah – The station redevelopment plan of Indian Railways is gaining rapidly. How can Bentley solutions help in this project?

Steve Cockerell – This is a really interesting question as it is not just in India that we are seeing either the expansion or redevelopment of stations, in line with – if we put COVID-19

to one side for a moment – the growing demand for rail and transit. I would like to answer the question in two parts if I may.

Firstly, in the middle of 2019 Bentley announced the general availability of OpenBuildings Station Designer, which provides our users with a multidiscipline application for the design, analysis, simulation, and visualization of rail, metro, or other transit stations. We developed the application to help owner-operators and their supply chains streamline the design and necessary collaboration between the different disciplines involved – particularly architects and engineers – when delivering new and/or upgraded stations and related facilities.

A key element of the OpenBuildings Station Designer release was the inclusion of LEGION Model Builder's industry-leading pedestrian movement modeling and simulation capabilities, which Bentley acquired in October 2018. I'd urge your readers to take a closer look at this application, which has all the capabilities of OpenBuildings Designer, plus a station-specific work set that includes functional space definitions, design components such as furniture, fixtures, and equipment, and several computational design templates.

The combination of BIM advancements OpenBuildings Station Designer delivers are, in my opinion, unrivalled in the industry. No other single solution offers a design environment capable of modeling the simplest to the most complex of stations, together with the ability to analyze their real-world performance in terms of pedestrian movement, annual energy consumption, carbon emissions, and fuel costs. The capabilities it provides means owner-operators can ensure their stations are fit for purpose not just on day one, but throughout their operational life.

Part two of my answer relates to how other open and integrated applications in Bentley's portfolio support the redevelopment of stations in the wider context. To highlight this I would like to draw your attention to an incredible project currently under construction in **Jakarta, Indonesia**.

Jakarta is expected to become the world's largest city by 2030, and its Manggarai Station will replace Gambir Station as the terminus for long-distance trains serving the city in late 2021. In a joint venture with PT. Pijar Utama, PT. WASKITA Karya (Persero) Tbk was appointed as a contractor for phase II of the railway facility from Manggarai to Jatinegara. WASKITA's work on the project includes constructing a new bridge connecting the second floor of the station's main building with the existing mainline at grade, together with new track panels above and below the bridge, as part of its revitalization.

WASKITA faced many challenges on the project. In addition to construction, their client required them to take on the design review of the existing contract drawings due to discrepancies with current standards and existing conditions. As a result of the high amount of train traffic in Manggarai Station, the team also faced constraints on the method of construction they could use, meaning they ran the risk of incurring additional time on their contract.

The project's success hinged on three main objectives: quality compliance, cost, and time efficiency. So, to ensure every decision made throughout the 720-day contract period was both timely and accurate, WASKITA decided to adopt BIM workflows and a digital twins approach using Bentley technology. WASKITA combined design information for track, civils, bridges, and structures, with a 3D reality mesh of the existing ground, in a BIM coordination model that helped team members and other stakeholders on the project make better, more informed decisions. Their BIM coordination model also allows them to clearly visualize different alternatives in terms of project scope and cost, and is proving to be a critical part of their ongoing work and negotiations with the client for project amendments.

The team's use of Bentley's OpenBridge Designer, OpenRail Designer, and ContextCapture for clash detection and resolution has meant that WASKITA has avoided issues that might not have been discovered until construction commenced. As a result of identifying potential problems earlier, WASKITA avoided additional time and cost overheads of approximately 0.3% per month. WASKITA's use of geometry control functionality in OpenBridge Designer has also helped mitigate risks and avoided any unnecessary cost and delays associated with incorrectly cast bridge spans.

Finally, in response to demands for more clarity on construction sequences, WASKITA's use of SYNCHRO has helped shorten the construction schedule by optimizing the resources available. Adoption of this digital workflow enabled right-first-time construction, as well as provided valuable insight for WASKITA and other stakeholders on the project.

Narendra Shah – Can you share some of the latest solutions for rail offered by Bentley? Can you share some of the rail or metro projects in India that are using OpenRail solutions?

Steve Cockerell – For me two submissions in our Year in Infrastructure Awards this year stand out as examples of how our rail solution is delivering different and improved outcomes on rail and metro projects in India.

The first is **Sarvada Engineering and Project Management Private Limited (SEPM)** and the work it is doing on the **Ahmedabad – Rajkot Semi High Speed Rail Project**. The elevated, 200-kilometer-per-hour railway will connect Gujarat's economic capital of Ahmedabad with one of its quickest growing cities, Rajkot, reducing transportation time by two-and-half hours.

SEPM was hired to deliver multiple design alternatives and price approximations, and produce cinematic quality videos of the project to expedite government approval. In particular, SEPM used OpenRail ConceptStation and OpenRail Designer to help them understand the terrain and structures along the proposed route, produce alignment alternatives and 3D models, saving them time and increasing accuracy.

The second is **LKT Engineering Consultants work for [Delhi Metro](#) Rail Corporation (DMRC)** who wanted to build a walkway interchange connecting the Green and Pink lines of the capital territory's metro system. To fix this connectivity issue, DMRC proposed adding platforms next to the Green Line for boarding and disembarking and attaching a 230-meter pedestrian footbridge to the Pink Line's Punjabi Bagh West station, and engaged LKT Engineering Consultants to design this unique interchange facility.

LKT Engineering decided Bentley's BIM solution offered the speed and flexibility it needed during design to produce alternative scenarios. In this project they used a combination of OpenBridge Designer (formerly RM Bridge) and STAAD, to generate 3D models, drawings, and simulations, saving significant time by creating and comparing multiple design options of the footbridge and viaduct platform next to the Green Line. Of note to me was the fact that LKT used the software to improve the structural arrangement, lowering costs and shortening the construction schedule.

Dan Vogen – My focus is in the operation and maintenance of road and rail. And, here, the focus is on big data engineering. There have been large advancements in how we understand track geometry changes and their implications. Typically, owner-operators make three to four data collections every year. Now, we have users that collect data every month, every week, and they are moving toward a daily update. The increasing frequency

of data updates allows us to provide much better insight into what is happening on the user's system.

Artificial intelligence and machine learning helps our users make real-time decisions through data analytics. We are working with data sciences, both textual and visual, that might help, for example, in a larger processing scenario, to bring enhancements in the field of transportation. We had a number of fairly large users deploying these kinds of solutions in the past, and we are working to make them accessible to small and mid-sized owner-operators. One of the finalists in the *Year in Infrastructure Awards*, which we mentioned in our press briefing, was SMRT of Singapore. They have made great advancements in the reliability of their network with the help of our analytics solutions.

Narendra Shah – The [RRTS](#) and bullet train are the two major projects the Indian government is focusing on today. Is there any plan for Bentley to participate in these projects? How can your existing products help engineers when it comes to the development and construction of the bullet train project?

Steve Cockerell – I hope my answers to other questions have demonstrated our ability, through a range of open and integrated applications in our OpenRail solution, to help the organisations who will be engaged on these and other projects across the country. A major advantage of our OpenRail solution is that it covers everything from concept through completion and onwards to operations and maintenance of the railway.

Dan Vogen – We hope to participate in everything like that. We want to be the software solution that engineering design and construction firms use for their ongoing analytics. Whether contracting directly with the owner, or through a third-party operator that is involved in the project as a consultant to the owner, we can offer them the software they require for that part of the lifecycle.

Narendra Shah – Bentley offers a product called OpenRail Designer. What are its key features? How can it help in the development of metro networks and semi-high-speed rail corridors?

Steve Cockerell – OpenRail Designer is a comprehensive modeling environment for streamlined project delivery of rail assets for all types of rail networks. It is suitable for everything from rapid transit, through metros, to standard commuter lines, freight, and high-speed rail.

The application unifies the disciplines and phases involved in the design, construction, commissioning, and completion of assets within the railway corridor including track, civils, drainage, and underground utilities, overhead line, bridges, and related infrastructure.

Largely recognised as the industry standard for track design to different international and sector specific design standards, OpenRail Designer delivers the high performance, immersive, 3D modeling environment that engineers and designers need today to plan, design, and enable right-first-time construction of new and upgraded railways.

Narendra Shah – You already have the technology for the design of overhead lines. What are the key features of this? Is there any possibility of bringing any system for designing the third rail system as it gains popularity?

Steve Cockerell – OpenRail Overhead Line Designer is, in fact, a new Bentley offering developed jointly with **Siemens Mobility**. The combination of our OpenRail Designer technology with Siemens Sicat Master functionality solves a key challenge faced by

engineers and designers – namely, ensuring that both disciplines can efficiently and effectively share the data they need.

With OpenRail Overhead Line Designer, the local standards and geometry of the underlying track can be used directly in the same modeling environment to make span calculations, locate foundation locations, and calculate height and stagger values for wire runs.

The software's parametric design capabilities enable OLE engineers to model cantilever sets, masts, portals, and wires, as well as produce schematics and 3D models of all assets within the rail corridor. Advancing traditional 2D plan-based workflows to this 3D world of digital workflows not only reduces the time and effort needed to create the required construction deliverables, it further enables downstream activities like signal sighting, stakeholder engagement, project approvals, and driver route learning.

Whether you are building brand new electrification projects or upgrading your existing networks, as we move toward a time in which digital twins in rail are commonplace, these types of digital workflows will be relied upon not just in project delivery, but through handover/handback of assets, and onwards in the operational life of railways to increase the reliability and performance of critical network assets.

Narendra Shah – What is the main rail-segment business that you intend to focus on in the next decade? Where do you see Bentley's rail business in India going?

Dan Vogen – We have shown the breadth of our solutions that we can now offer. We want to work in design, simulation, construction, and operations. We have to focus on the safe design of metro and rail station with a focus on social distancing. Bentley and its innovative software applications will play an important role in building our urban transport system infrastructure.

Narendra Shah – How does Bentley's solutions in rail asset management help owner-operators improve collaboration and project delivery? Can you share some examples?

Steve Cockerell – Rail and transit owner-operators need to manage data and information from multiple sources, often in many formats, and be able to combine it in a way that is easy to understand, visualize, and analyze. Then, with the insight gained from that information, make faster and more informed decisions.

Bentley's AssetWise Digital Twin Services does just that, providing the immersive visibility and analytical capabilities needed to ensure timely decisions about where, when, and how they should target maintenance activities to ensure the safe, reliable, and compliant operation of their networks.

A great example of an organization benefiting from the use of AssetWise Digital Twin Services is SMRT Trains Limited in Singapore, a finalist in our [Year in Infrastructure Awards](#) for road and rail asset performance this year.

To meet its 1 million-kilometers-between-failures (MKBF) target – the equivalent of travelling over the entire network more than 7,000 times between five-minute delays – SMRT has initiated numerous initiatives including the deployment of what it calls its Predictive Decision Support System (PDSS) based on Bentley's AssetWise Digital Twin Services Linear Analytics capabilities.

PDSS supports SMRT's engineers by bringing together all relevant data, analyzing it to find the optimal decision, and presenting it to the user intuitively. Simply put, AssetWise Digital Twin Services is enabling SMRT to find features in their data relating to track conditions, pinpointing where they need to act, and determining what maintenance activity is needed. Through PDSS and other SMRT reliability initiatives, this summer saw SMRT raise its MKBF figure beyond the 1 million target to reach 1.6 million MKBF, a huge increase in the reliability of their network.

Clearly, SMRT, and many other large owner-operators, are benefitting substantially from the power of AssetWise Digital Twin Services Linear Analytics. Historically though, a key challenge with the deployment of a system of this type has been the time and cost involved, due to the extensive involvement of subject matter experts, and a significant amount of configuration required.

Since we believe this type of analytics capability can benefit owner-operators with systems of all sizes and complexity, we recently announced the introduction of a pre-configured, rapidly deployable, out-of-the-box solution for linear analytics. The solution means that in a very short amount of time, any organization, including smaller metros, light rail and mass transit systems, will be able to get up to speed and recognize many of the benefits that, to date, have only been within reach of Bentley's larger rail and transit owners.

PART II: GLOBAL ACTIVITIES FOR URBAN MOBILITY AS A SERVICE

Urban Transport Industry News Round-up, I; Global

23th December 2020; Metro Report International



Dallas Area Rapid Transit and Archer Western Herzog commemorated construction of the future Silver Line Regional Rail project with a first concrete ceremony on December 16. This included a tradition from AWH parent company Walsh Group of placing 'Miraculous Medals' in a project's first concrete pour, which 'symbolises an inspiration to successfully complete the job safely and to make it as miraculous as the medal itself.'

Incheon metro Line 1 was extended 900 m underground from the International Business District station to Songdo Moonlight Festival Park on December 12, taking the line to 30.3 km.



On December 13 **Freiburg** tram Route 4 was extended 970 m from Technische Fakultät to Messe, including 635 m of grass track. The extension cost € 17.6 m, and was largely funded from federal and Land budgets.

Infrastructure Ontario and Metrolinx have appointed the 360 Transit Alliance joint venture of Jacobs and Stantec to provide program control services for the **Toronto** area's Ontario Line, Scarborough Subway Extension, Yonge Street North Subway Extension and Eglinton Crosstown West LRT extension projects. This will include scheduling, risk management and quality assurance.



Transport for **London** has awarded consulting and engineering company Wood a four-year framework contract for transport planning & impact monitoring services, including health and safety and environmental services. 'This is a significant win for Wood that reflects our breadth of expertise in delivering major transport and infrastructure projects around the world', said Joe Sczurko, CEO of Wood's Consulting business.



Lead planning and design consultant AECOM has awarded Aurecon the engineering design contract for the 2.4 km Tuen Ma Line Extension of **Hong Kong's** West Rail to Tuen Mun South. Aurecon will be responsible for detailed planning and design of the railway engineering, bridges and viaducts, noise enclosures and digital services.

Urban Transport Industry News Round-up, II; Global



The government of Crimea has awarded UVZ a contract to supply 27 four-axle partly low-floor Type 71-411 trams for the metre-gauge network in **Yevpatoria** by the end of 2021. They will operate on routes 1 and 2 which have turning loops, while the Route 3 shuttle and seasonal Route 4 will continue to be operated using cars more than 60 years old. UVZ was the sole bidder, as it is already subject to EU and US sanctions. The Russian federal government is funding modernisation of 8 km of the network.



Final designs have now been approved for the 12 Avenio trams which **Nürnberg** operator VAG ordered from Siemens Mobility in November 2019, enabling the start of manufacturing at the Kragujevac plant in Serbia. Deliveries are scheduled for mid-2022 to 2023, to support a planned increase in services, and there are options for up to 75 more to be supplied by the mid-2030s.

In early December PK TS delivered the last of a total of 390 Vityaz-M trams ordered by **Moscow**, a month ahead of schedule. The 27.5 m long, three-section, fully low-floor unidirectional Type 71-931M trams are now used on 26 of its 40 routes. PK TS is to deliver further trams under an order placed in September this year.

Systra has been commissioned to undertake studies for a proposed tramway in the Swedish city of **Uppsala**.



Planning approval is expected shortly for a €100m tram depot in the north of **Magdeburg**. It will have a capacity of 59 vehicles, and is intended to replace an existing depot which was damaged by flooding of the River Elbe in 2013.



Mumbai Metro has taken delivery of a Zephir battery powered road-rail vehicle for shunting at Charkop Depot



Following a tender, the **San Diego** Metropolitan Transit System board has approved a six-year agreement for Transdev Services to operate 52 of its 95 bus services, with two two-year options that could bring the total value to \$911m over 10 years. Transdev has provided similar services for the past 13 years. Priorities for the new contract include conversion to a zero-emissions bus fleet, with the all-electric Iris Rapid route launching in 2022.



Uraltransmash has delivered first of three Type 71-415 trams to **Nizhny Tagil**. The single section low-floor tram has a capacity of 150 people and an anticipated service life of 30 years. During the unveiling ceremony on November 24, Alexey Serkov, Commercial Director of Uraltransmash said the 71-415 trams was well received by staff and passengers because they were modern and comfortable.



Delhi Metro Rail Corp. has signed a five-year contract to act as general and project management consultant for **Noida** Metro Rail Corp's Phase II project for a 9.6 km

extension of the Aqua Line from Noida Sector 51 to Greater Noida Sector 2 with five elevated stations.

Following the normalisation of relations between **Israel** and the **UAE**, Transport Minister Miri Regev and Minister of Energy & Infrastructure Suhail Mohamed Faraj Al Mazrouei have agreed to co-operate in the development of smart transport including railways and autonomous vehicles.



SBS Transit and RATP Dev have entered into a strategic partnership 'that will set a new benchmark in delivering world-class metro services in **Singapore**'. A new jointly-owned company will be set up to seek new business prospects in the Singapore rail sector. 'We are delighted to join forces with SBST and combine our long-term vision on assets and mobility with SBST's state-of-the-art customer-centric expertise to raise the bar even higher in terms of reliability, quality and sustainability for rail', said RATP Dev's Chair Laurence Batlle.

Urban Transport Industry News Round-up, III; Global

2cd December 2020; Metro Report International



Santa Clara Valley Transportation Authority has released a Request for Industry Feedback to gather information and gauge interest from architects, engineers, contractors and subcontractors for the contract to design and build three underground stations for the BART Silicon Valley Phase II Project. This is the third of four contract packages, with RFIFs for the systems and tunnel & trackwork packages previously released. A fourth contract for the street-level Santa Clara station and Newhall Yard will be released in mid-2021.



Cable car manufacturer Bartholet Maschinenbau and Rostec Corp company RT-Razvitye Biznesa have formed the **RT-Bartholet** joint venture to produce cable cars for the Russian market.



The first deliveries of **New York** City Transit's Kawasaki R-211 subway cars have been delayed until 2021 as a result of coronavirus-related disruption to the supply chain.



EBRD and ING are providing loans totalling €87.2m to finance the acquisition of 45 trains for the extension of **Warszawa** metro Line 2 and to replace older rolling stock on Line 1. EBRD said its strategy for Poland focuses on addressing climate change and promoting sustainable development, adding that Warszawa had joined its Green Cities programme in June.



Mayor of Greater **Manchester** Andy Burnham has announced measures to boost confidence in public transport ahead of an anticipated increase in travel as England's coronavirus restrictions change. These include 'trambassadors' who will speak to light rail passengers about the latest guidance and safety measures, hand-out free face coverings

and hand sanitisers and encourage off-peak travel and contactless payment options. Cleaning of the 120 trams and 99 stops will be increased by 500 h/week, and hand-sanitiser dispensers will be installed at the busiest stops.



New York MTA and Transit Wireless have completed work to provide mobile phone voice and data connections to Verizon customers in the East River tunnels between 1st Avenue and Bedford Avenue on the L/Canarsie line. Verizon is the second carrier to offer mobile connectivity in the under-river tunnel, after AT&T in September.



HS2 Ltd and the West Midlands Combined Authority have agreed to work together to deliver the utility diversions required to enable the planned **Birmingham** Eastside tram extension to Digbeth to serve the future Curzon Street high speed rail station. The utility works will be carried out by HS2's enabling works contractor LMJV.

Urban Transport Industry News Round-up, IV; Global

25th November 2020; Metro Report

Shiraz Metro has completed trials with of GoA2 (semi-automated operation with a driver supervising) on a five-car trainset. A local engineering company plans to implement ATO on the other 12 trainsets on Line 1, with a view to increasing performance, improving service regularity and reducing energy consumption.



The 16. km **Taichung** metro Green Line opened on November 16, with a month of free trial services planned. However, operations were suspended after an intra-trainset coupling broke on November 21, and the US-made couplers on all 18 of the Kawasaki Heavy Industries trainsets are now being inspected by an independent body.

The **San Joaquin** Council of Governments and Masabi have launched of EZHub, a cashless mobile ticketing and fare payment system which has been added to the Vamos Mobility App from Kyyti. It initially covers seven rail and bus transport agencies in San Joaquin County, California, and talks are underway to expand the app's functionality and add further operators. 'Not only will people be able to buy their tickets at any time, anywhere, but that ticket will take them wherever they want to go in San Joaquin County, saving the hassle of keeping track of multiple tickets, schedules and services across different agencies', said Diane Nguyen, Deputy Director at SJCOG.



Dhaka Mass Transit Co Ltd has appointed consultancies including Nippon Koei and Systra to provide detailed design, tender assistance & construction supervision services for the Northern Route of Line 5.



Moscow public transport users can now create accounts associated with their Troika smart cards on the updated Moscow Metro app. This supports auto payment, remote ticket purchase, viewing travel history and top-ups, monitoring the status of inquiries, checking loyalty programme credits and accessing special offers.



Keolis Nottingham has become the first light rail operator in England to achieve ServiceMark accreditation from The Institute of Customer Service. 'Keolis **Nottingham** has demonstrated it understands the importance of a sustained focus on their customers' experience', said Jo Causon, CEO of The Institute of Customer Service. 'By acting on the insights gained from customer and employee feedback as part of the ServiceMark accreditation, Keolis Nottingham remains in a strong position to offer customers what they want, when they want and how they want it.'



Users of **San Francisco** BART's app can now get personalised notifications including service advisories based on preferred days of the week and specific times of travel, lift availability information, real time departures specific to a station, direction of travel, day of the week and time, and announcements of engineering works or timetable changes.

Systra acted as consultant construction manager for a **New York** MTA project to install three lifts and undertake platform and concourse works to bring Bedford Park Boulevard station on the subway's B and D lines into compliance with accessibility standards.



São Paulo operator CPTM has appointed Systra to support the planning, monitoring and control of works on suburban Line 7, the Ruby Line.

Urban Transport Industry News Round-up, V; Global

11th November 2020; Metro Report International



Stuttgart operator SSB has returned to service the first of 50 Type S-DT 8 light rail vehicles to be fitted with modernised traction inverters by Voith under a programme running to the end of 2025. The work to improve reliability and availability and reduce noise and weight includes mechanical refurbishment of the housings, switching elements, braking resistors and chokes, as well as the replacement of the power electronics.



WSP has been named prime consultant for **Toronto** Transit Commission's C\$30m, 11-year Subway Capacity Enhancement Programme for Line 1. WSP will also support the development and investigation of key elements which could impact the Line 2 CEP strategy.



Voters in **Seattle** have backed an increased sales tax to fund transport investment for another six years. Revenue is to be allocated towards maintaining the network, capital improvements and low-income fare programmes.



Pro-Tra-Building has been awarded a 81.2m złoty contract to build the 2 km second phase of a combined tram and bus route to the Nowy Dwór area of **Wrocław**.



Local voters have approved **Austin** Project Connect, a property tax with dedicated funding for Capital Metro in Austin, Texas. Plans envisaged under the investment programme include additional rail lines, express bus routes and neighbourhood circulators.



Tramwaje Śląskie has awarded Silesia Invest a 81·2m złoty contract to modernise a 1 300 m single-track segregated line along ul Frycza Modrzewskiego in **Bytom** by April 2022, and a 6·2m złoty contract to modernise the 400 m single-track route along ul Małachowskiego in Sosnowiec using prefabricated slabs and embedded rails by September 2021.

Voters in **San Antonio**, Texas, have passed a sales tax that will enable the VIA Metropolitan Transit agency to expand public transport services and passenger amenities.



Passengers in **Nottingham** can now top up their Robin Hood-branded transport smart card using an Android mobile app, rather than going an on-street machine. An iOS app is to follow, along with integration with the city's travel information app.

Ticketing technology company Masabi and Japanese trip planning company Jorudan have launched in-app mobile ticketing for Shimotsui Dentetsu in **Okayama** prefecture. Passengers can purchase Shimotsui Loop Bus Tokohai one-day tickets for travel between Kojima, Shimotsui, and Washuzan via the Japan Transit Planner and Norikae Annai apps, available in both English and Japanese. 'We are enabling people not only to plan their journeys, but also to buy their transport ticket and safely navigate the local area without the need to interact with anything but their smartphone device', said Jorudan CEO Toshikazu Sato.

The **Shift2Rail** Joint Undertaking and the **Canadian Urban Transit Research & Innovation Consortium** have signed a memorandum of understanding to promote international co-operation between railway researchers and industry to contribute to global decarbonisation. 'This MoU is very important for us because it is a key opportunity to collaborate at international scale with industry on low-carbon mobility research and innovation to enhance the leverage effect of what we do in Europe and to deliver on the European Green Deal objectives', said Carlo Borghini, Executive Director of Shift2Rail.

Berlin transport operator BVG has awarded PSI Transcom a contract to supply its PSlebus depot and charging management system to dispatch, monitor and control the vehicles the city's electric bus fleet, which is expected to reach 230 vehicles by 2022.

Urban Transport Industry News Round-up, VI; Global

28th October 2020; Metro Report International



Delhi Metro Rail Corp has taken delivery of its 800th Bombardier Transportation Movia metro car, its first having entered service in 2009. 'Delhi Metro's vast network is a classic example of self-reliant India with significantly high local content and manufacturing, delivering the Make in India programme', said SS Joshi, Director for Rolling Stock & Signalling at DMRC.



To accommodate a faster than expected increase in demand, **Frankfurt** transport operator VGF has directly awarded Alstom a contract to supply 8.5 m long intermediate modules to lengthen 22 of the 45 Type T trams it ordered in 2018 to 40 m. This will increase capacity from 191 to 248 passengers. The first Type T cars are expected to enter service in 2021, with the extended versions following in 2022.



The **Mallorca Transport Consortium** has introduced a common smartcard and contactless bank card ticketing system covering all bus, rail and metro operators on the Balearic Islands of Mallorca, Menorca, Ibiza and Formentera. This uses fare collection technology from GMV, with EMV payment provided in partnership with Redsys and Banco Santander.

Texas Department of Transportation has selected **SNC-Lavalin** as prime consultant under a \$20m five-year Indefinite Delivery Indefinite Quantity contract to provide corridor planning and development services, including analysis of existing public transport, road freight, bicycle and pedestrian routes. Tasks could include corridor feasibility analyses, relief route studies and multimodal analyses of current and future needs.



Astronics Test Systems has been awarded a \$30m contract to develop and supply automatic testing equipment which Stadler US will use to maintain metro cars ordered by Metro **Atlanta** Rapid Transit Authority for service from 2024. 'The Atlanta programme is a logical application of our skills and capabilities, leveraging our consolidated test experience for the benefit of railcar OEMs and transit authorities', said Astronics Chairman, President & CEO Peter J. Gundermann.



PPE vendor Canteen is to introduce vending machines stocked with personal protective equipment including hand sanitiser, disposable face masks, sanitising wipes and disposable gloves at six **Chicago** Transit Authority stations.



The Land of Baden-Württemberg is to provide the city of **Karlsruhe** with € 7.6 m to make eight light rail stops fully accessible, with the city contributing € 2.4 m.

Urban Transport Industry News Round-up, VII; Global

21th October2020; Metro Report International



Alstom has developed a simulator for **Barcelona** metro operator TMB, which incorporates the latest virtualisation, gamification and virtual reality technologies to train metro staff and automatic line operation technicians. The simulator reproduces real routes, conditions and obstacles to create realistic scenarios, and includes a full-scale reproduction of the cab of Metropolis trains on lines 9 and 10.



PSI Polska has won a contract to design and deploy a depot management system for the Annapol tram depot in **Warszawa**. To be built in 2021-25 at a cost of €67m, the 12 ha depot will have 14 km of track able to accommodate 150 trams. The management system is to be based on the PSIttraffic/DMS software deployed at Poznań and elsewhere, and will manage all processes, including traffic management and optimisation of tram movements.



NJ Transit is to use Ultimate Kronos Group's Dimensions cloud suite (formerly Workforce Dimensions) for real-time staff management and automated rostering. Employees, including those assigned to remote locations, will be able to clock in and out of shifts from their smartphone as well as view information pertinent to their role.



The European Investment Bank has approved €75m of financing for the €185m reconstruction and modernisation of **Sarajevo's** tram and trolleybus networks, including the purchase of new vehicles and infrastructure rehabilitation.



The European Investment Bank has approved € 44m of financing to support PKP SKM's planned €93m purchase of 10 EMUS and depot equipment for tri-city region of **Gdańsk**, Sopot and Gdynia.



Barcelona metro operator TMB has taken delivery of the first of four five-car second-generation CAF Series 6000 trainsets ordered to increase capacity on Line 1. Entry into service is planned for November 2020.



Southern **California's** Metrolink has launched the SoCal Explorer loyalty programme. Passengers earning one point for every mile (1.6 km) they travel, which they can redeem for free tickets. People signing up receive enough points for a round-trip ticket, so they can try out the service for free. Discounts are also offered at local businesses.

The Department of Transportation & Public Works of **Miami-Dade** has awarded OHL USA a \$ 368 m contract to convert the 30 km South Corridor South Dade Transitway into a bus rapid transit route. This is one of six rapid transit corridors of the Strategic Miami Area Rapid Transit Plan and the first to move to the construction phase.

Faster 100 kmph Monorail on Trial; China

20th November 2020; Metro Report International



CHINA: Test running has started with a prototype 100 kmph monorail train being developed by CRRC Qingdao Sifang.

The elevated straddle monorail concept is aimed at suburban applications in large conurbations, with a projected cost of around a third of the price of a conventional metro line.

The company initially developed an 80 kmph vehicle in 2016, which was powered by permanent-magnet motors. The latest vehicle is faster and wider, and is intended to offer a comparable capacity to a Type B metro trainset.



Equipped for driverless operation to GoA4, the streamlined new-generation trainset also uses a permanent magnet traction package, which is expected to reduce energy consumption by around 20% compared to earlier monorail designs.

Designed for a service life of up to 30 years, the vehicles have a body width of 3 098 mm, comparable to the cross-section of a Type A metro car. CRRC Sifang says a flexible configuration would allow trains to be formed of two, four, six or eight cars 'according to operational requirements', with a six car set carrying up to 1 400 passengers.

Operating on an 850 mm wide guideway beam, the vehicles are carried on two-axle bogies, providing the ability to negotiate curves as tight as 50 m radius and climb gradients of up to 6%. Moving the wheelsets to the outside of the guideway is intended to simplify replacement of the rubber tyres, reducing the whole life maintenance cost of the running gear by a third. The manufacturer suggests that the use of rubber tyres reduces running noise at maximum speed by more than 15 dB compared to steel-wheeled vehicles.

Each car has three pairs of doors to speed boarding and alighting. Internally, the passenger saloon has a wear-resistant floor covering and an anti-bacterial and anti-virus decorative coating. A 'nano-ceramic membrane' window is designed to minimise the transmission of ultraviolet and infrared radiation.

Skytrain Monorail on Test; China

16th November 2020; Metro Report International



CHINA: A driverless suspended monorail vehicle with a design speed of 80 kmph is being tested on an 800 m elevated track in Wuhan.

The Skytrain has two cars, each 11 m long and 2 400 mm wide, and could be extended to a maximum of five cars.

A 10.5 km Skytrain line in Wuhan is scheduled to open in 2021, linking Optics Valley station to Longquan Hill with six 6 stations.

Ulaanbaatar's Yurt Settlements to be served by Cable Car; Mongolia

9th November 2020, Metro Report International



MONGOLIA: A consortium of French aerial transport specialist Poma and rail consultancy Egis is to build an urban cable car route in Ulaanbaatar.

Serving three stations over a 6 km alignment, the cable car scheme is being financed by DG Trésor, a directorate of the French finance ministry which funds infrastructure projects internationally.

Poma is leading the consortium, and will supply and install the transport systems, including 122 cars, supporting towers and station equipment.

Egis will be responsible for the design and construction of the stations and their foundations under a turnkey arrangement, as well as for low and high voltage power supplies. Egis is also tasked with co-ordination of drawings during the design phase and works supervision during construction.

The ropeway is described by the project partners as a highly sustainable form of urban transport, offering 'near silent' operation and no emissions at the point of use. The technology has been selected because of the pressing need to improve local transport in the Mongolian capital; the city's population has grown from 580 000 in 1990 to 1.5 million today.

The city also has a number of significant physical features including the trans-Mongolian railway and the Tuul-Gol river, which makes aerial transport an attractive option, and the partners believe that a cableway can be delivered in a shorter timeframe than other options.

Most of the city's expansion has been driven by internal migration of nomads from the remote steppe to the edge of the capital, where they have established semi-urban settlements formed of yurts, known locally as gers. While for many years these communities were regarded as temporary, the city authorities have now decided that access to and from them must be enhanced. The cableway will link the northern ger district with the city centre.

'Our unique know-how will be harnessed to deliver this transformational project for the city of Ulaanbaatar', commented Fabien Felli, Commercial Director at Poma. 'Our cable transport solution is a perfect fit with the principle of reducing environmental impact and substantially enhancing urban mobility in Ulaanbaatar and its outskirts. This is a project, that makes sense for the development of this capital city and its suburbs, in the same way as has previously been achieved in Latin America and with our projects currently underway in France, in Toulouse and soon in Grenoble.'

Pandrol's AutoSeal eliminates the Need for manual Sealing when welding Rails; Global

18th November 2020; Railway Gazette International



WELDING: Pandrol says up to 5 min per rail weld can be saved through the use of its newly-launched AutoSeal mould, which has a built-in insulation joint that expands during pre-heating to create a tight seal and eliminate the need for manual completion.



The supplier says the process is more reliable than conventional luting, particularly when used in cold weather and tight spaces. There is a significant weight saving compared to traditional methods using 3 to 5 kg of sand, while the more ergonomic process involve less stress and kneeling for the welder.

‘Since the invention of rail aluminothermic welding at the start of the last century, the process has involved sealing the moulds to the rail ends to avoid metal leaks. This is a manual process, with paste or sand, and is particularly time-consuming and requires skill and precision’, a Pandrol spokesperson said.

‘Pandrol’s AutoSeal mould delivers considerable time, weight and cost savings, while also delivering a more reliable seal than conventional methods. In turn, it makes sealing the mould safer, quicker, more ergonomic and better for the planet.’