

METRO



**Evolution of public Transport in
urban, suburban and interurban
metropolitan Area**

**A short History of Metro Technologies
– in Pictures**

Composed by F. A. Wingler, revised August 2019

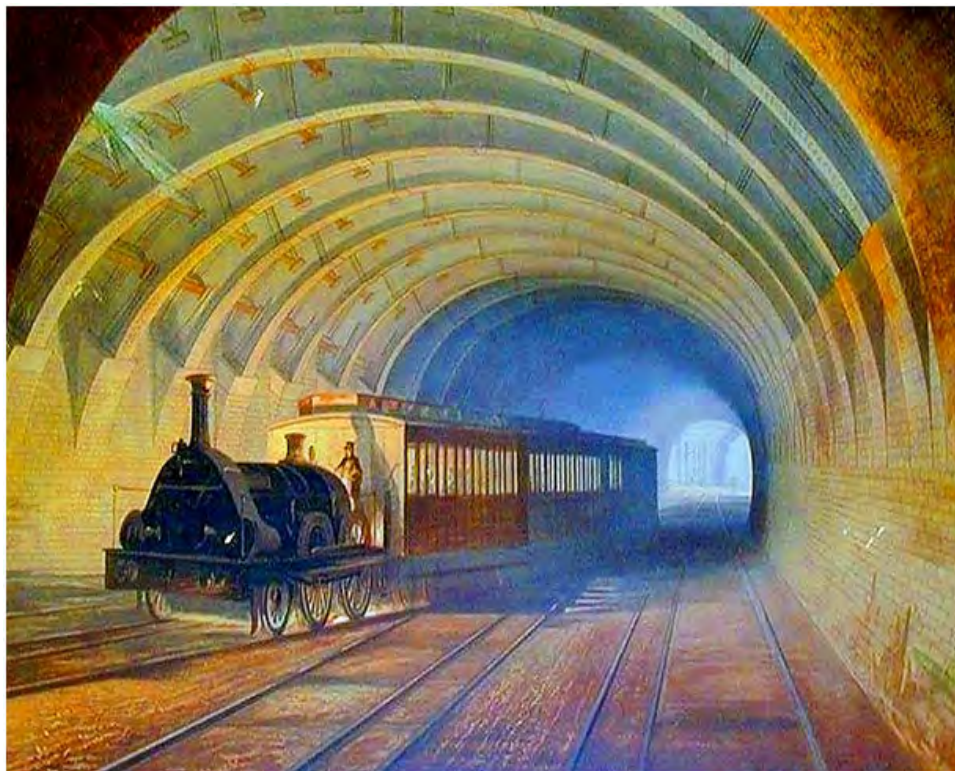
Evolution of public Transport in urban, suburban and interurban Metropolitan Area

FROM THE FIRST CITY STEAM UNDERGROUND RAILWAY TO THE MODERN CITY SKY ROPEWAY AND BOTTOM CABLELINER

A short History of World Metro Technologies for Urban Mobility in Pictures

From the world's first steam-railway subway, the London Underground, to the metropolitan ropeway in La Paz.

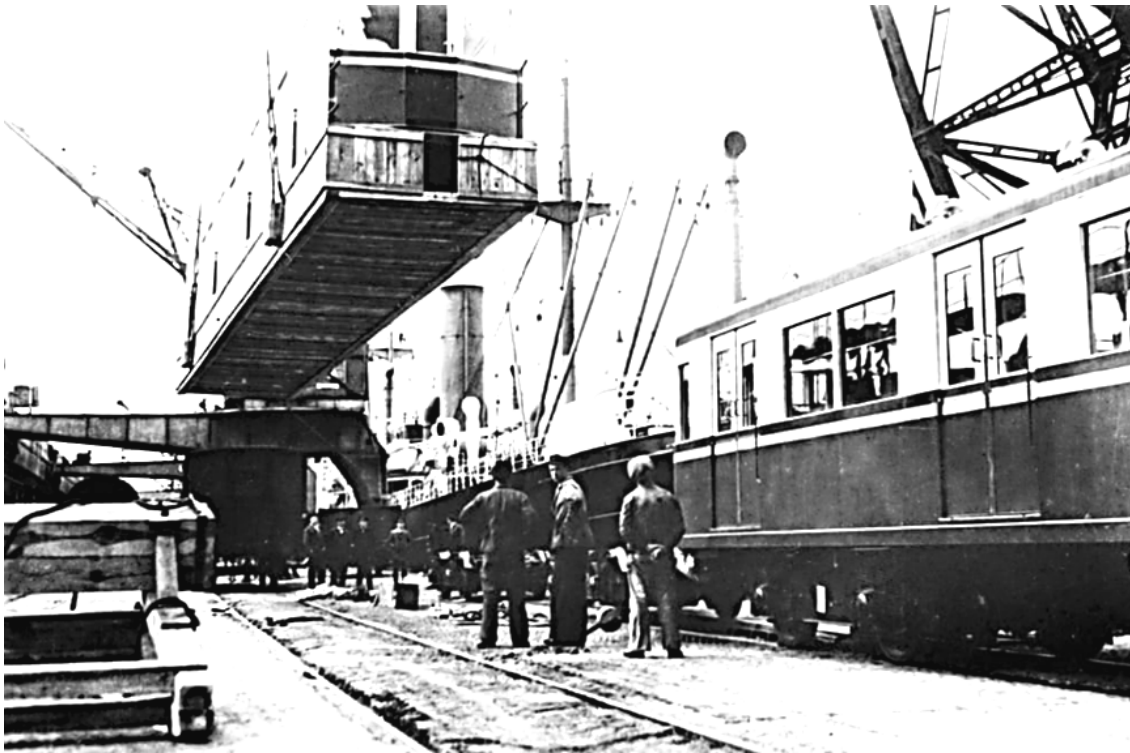
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The London Underground, which opened in 1863, was the World's first Underground Steam Railway. More than 30,000 Passengers tried out the "Tube" on the opening Day, and it was hailed by the Times as "the great engineering triumph of the day"; England; pictured: William Gladstone on an Inspection of the first Underground Line. Illustration of a Steam Train at Praed Street Junction near Paddington, 1863; from: History Today, Volume 63, Issue 1 January 2013.



The New York City Subway is now over 110 Years old; pictured: A Workman caulks Joints with Lead to make them waterproof during the Construction of the 6th Avenue Subway Tunnel in June 1939; **USA**; Photograph: NY Daily News via Getty Images



Opened in 1913, the Buenos Aires Metro **in Argentina** is the oldest in Latin America; pictured: Wooden Subway Cars are unloaded in 1934. Photograph: Keystone-France/100% Keystone



Moscow's Metro is famed for the grand Designs of its Stations, sometimes dubbed the People's Palaces; pictured: Novoslobodskaya Metro Station; **Russia**; Photograph: Linda Ny Lind for the Guardian



A Moment between Trains in Kosmonavtlar (Cosmonauts) Station, Tashkent Metro, Uzbekistan; the Stop is famous for its dreamlike Portraits of Cosmonauts

After the ban on photographing the Tashkent Metro in Uzbekistan was lifted this summer, Amos Chapple, [RFE/RL's](#) photographer went underground to reveal the art, architecture and nuclear-blast protection in Central Asia's oldest subway system.



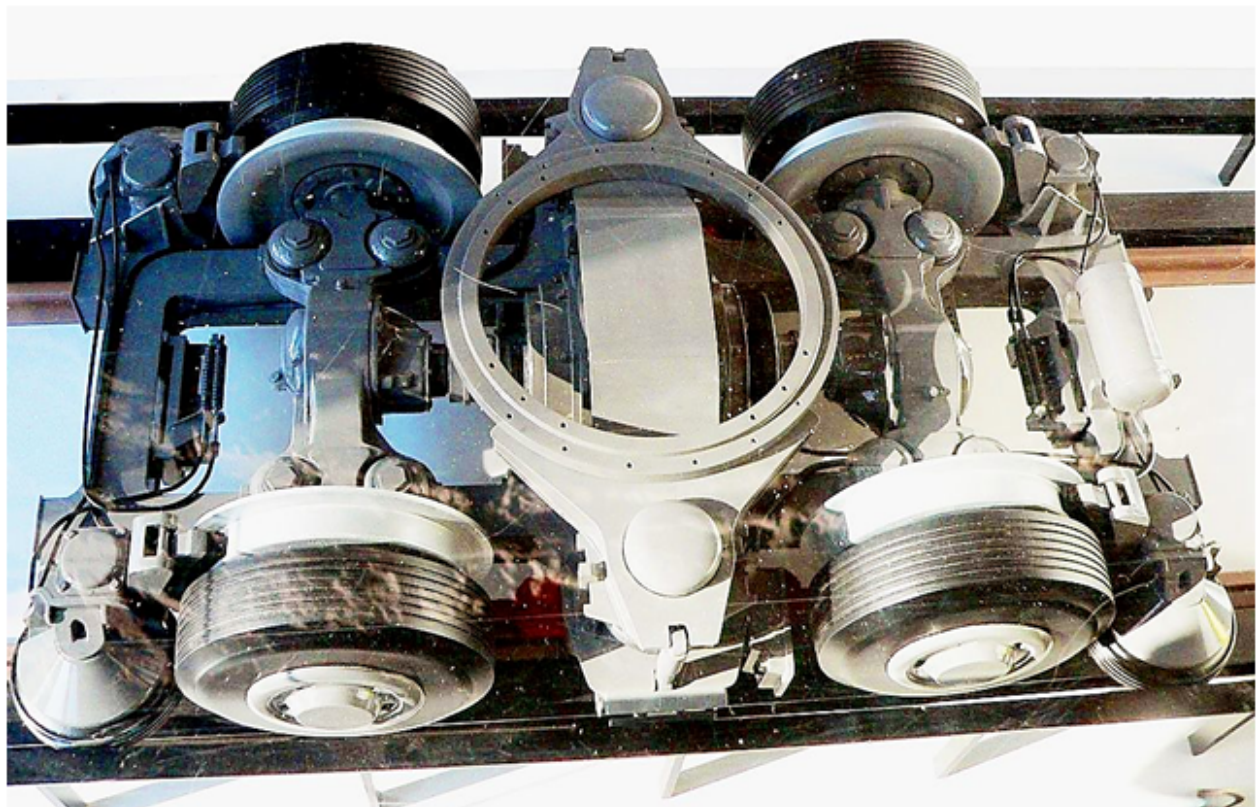
Flange guided inflated Rubber Tire Carriageway Metro Rail in Santiago de Chile - an Underground Road-Bus Urban-Rail Hybrid



Right-of-Way Mumbai Urban-Rail Metro over the Slums; India



Rubber tired Lausanne Automatic Funicular Urban-Rail Metro Train M2 on steep 12 %, 1 : 8.3, Gradient; it replaced a former Pinion Funicular; Switzerland



Guided Traction Bogie of Lausanne Metro, System Paris Metro



The World's first Experimental Mono-Rail, System ALWEG/HLB, Cologne, Germany, in the 1960-ties

ALWEG was founded by Swedish industrial magnate Dr. Axel Lennart Wenner-Gren in January 1953 as *Alweg-Forschung, GmbH* (Alweg Research Corporation), based in a suburb of Cologne, Germany. The company was an outgrowth of the *Verkehrsbahn-Studiengesellschaft* (Transit Railway Study Group), which had already presented its first monorail designs and prototypes in the previous year. The ALWEG name is an acronym of Dr. Wenner-Gren's name (Axel Lennart **W**enner-**G**ren).



Turnout System of Straddle-Beam Mono-Rail, Okinawa; Japan



**Animation: Monorail Swiss *INTAMIN* Steel-Beam LRT
GuidewayTechnology for Port Harcourt; Nigeria**



***INTAMIN* Monorail Steel-Beam LRT Guideway for Calabar Monorail;
Nigeria**



Autonomous Dubai Airport Underground People Mover running with guided inflated Rubber Tires on a **Roll-Way; Emirates**



Dubai's Catenary free Light Rail Transit Metro; ALSTOM APS Technology

Nowadays, City Trams, Light Rail Vehicles and Light Rail Transits can run in towns without a catenary. With the Alstom APS Technology (Alimentation par Aesthetic Power Supply), the vehicle takes up the electric supply from a middle third power rail (third rail feeding technology), which switches section-wise on power only by the transponder of the vehicle, when running over it



Funicular as Part of the **integrated** Metropolitan public Transport of Graz **for Urban Mobility as a Service**; Austria



Combined **Urban-Rail** City-Tram and **interurban** Railway-Train
"TRAM-TRAIN"; Karlsruhe, Germany

In some German city regions the Light Rail Transits are running in the city underground and overground as a city-tramway and outside as an interurban railway-train on the main rail-network of the national railway.



Karlsruhe LRT Tram-Train ready at Platform of German Federal Railway Main Station for an interurban run to the City Forbach in the Black Forest

German Tram-Train LRT connects seamless the Karlsruhe Main Railway Station through the City Centre with the next Town Forbach in the Black Forest, running urban as a City Tramway and sharing interurban the Mainline Rail-Track of German Federal Railway with conventional Trains. It switches automatically from the lower City DC Voltage to the higher Railway AC Voltage electric feeder.



Public Transport in Zurich with LRV City Tram Cars

Urban Mobility in the main Swiss Cities Basel, Bern, Zurich, St Gallen and Geneve is served by a dense network with City Trams Cars without the need for Underground Metro Rail. Light Rail Transits with Light Rail Vehicles can negotiate steep gradients by adhesion traction up to 1 in 12.5, or even 1 in 10 as in Austria



Suspended Sky Train in Qingdao, **System SAFEGE**, China



120 Years old suspended Sky **Mono-Rail** Transit in Wuppertal; Germany-



Autonomous **Centre Mono-Rail guided** Skyline People Mover running with inflated Rubber Tires on elevated **Roll-Way**, Frankfurt Airport; Germany



Autonomous **Cantilever** suspended Sky-Train People Mover at Dusseldorf Airport, **System Siemens/SAFEGE**, Germany



Public Transport with Maglev-Train, System Transrapid, Shanghai; China



"Low Speed" 90 kmph experimental Maglev-Train for **p**ublic urban and suburban Transport, System M. Bögl; Germany.

This system can run like a roller coaster in hilly terrain.



Lahore, Pakistan, Metro-Bus on dedicated Lanes



Istanbul, Turkey, Metro-Bus on dedicated Lanes



Rubber tired Flange guided Metro, Montreal, Canada



The Future of electric Mobility for Metro Bus and Lorry on electric Cantilever Highways; Technology Siemens, Germany



Siemens VAL (Véhicule Automatique Léger) CITYVAL Metro Car for Rubber Tired Light Metro for running on Guideway



Lyon Rubber Tired Light Metro VAL on Guideway; France



Driver-less autonomous Volvo Bus operating in Singapore



Metro-Bus on the Flange-guided O-Bahn Busway Route in Adelaide; Australia



Busan Metro Line; South Korea

The Busan Metro Line, is a rubber-tyred right-of-way metro, that connects part of Gijang-gun, Busan, and upper Haeundae-gu, Busan, into Dongnae-gu, Busan South Korea. The trains are driverless and run with pneumatic tires on a right-of-way concrete track (Roll-Way) between two Guide Bars. Source Wikipedia.



Indian Steam hauled Patiala Monorail (1907-1927) preserved in running Condition in National Rail Museum at New Delhi

The first Mono-Rail cart-road borne railway system, a good carriage system, had been the Kundala Valley Railway in India, which was built in 1902 and operated between Munnar and Top Station in the Kannan Devan Hills of Kerala. It operated with a cart-vehicle, built to transport tea and other goods. It had been the forerunner of the Indian Patial Monorail, 1907-1927.



Bombardier INNOVIA APM Centre Rail guided and Rubber tired Autonomous People Mover on Roll-Guideway, Shanghai



**"Right-of-Way" Center-Rail Guided People-Mover Bus
on elevated Roll-Guideway, Los Angeles, Airport; USA**



**"Right-of-Way" Center-Rail Guided People-Mover
Bus, Los Angeles, Airport; USA**



**Linear Induction Motor towed Light *INNOVIA* (System: Bombardier) Metro;
Rapid KL - Kelana Jaya Line; Kuala Lumpur, Malaysia**



Linear Induction Motor towed Light Metro in Guangzhou; China



Tram-Bus running without Rails on a Road-Sensor virtual Track at Zhuzhou in China

China has been leading the charge when it comes to smart rail technologies. Launched 2018 in the city of Zhuzhou, the ART - Autonomous Rail Rapid Transit, a City Tram-Bus, doesn't require a rail-track. The Tram-Bus is guided by a virtual mono-rail track with sensors in the road. Qatar is going to depoly this trackless ART in Doha.



Automated and Right-of-Way "PODCAR" On-Demand People Mover at Heathrow Airport; UK



Autonomous last Mile People-Mover Road Shuttle; Switzerland



Waterway-Metro, Kochi; India

Kochi should become in India the first city, where the entire public transport with the metro-railway, the buses, the boats, the auto-rickshaws and the taxis work together as a seamless integrated system with a common timetable, common ticketing and a centralised 'command and control'.



Metro Waterway public Transport in Istanbul; Turkey



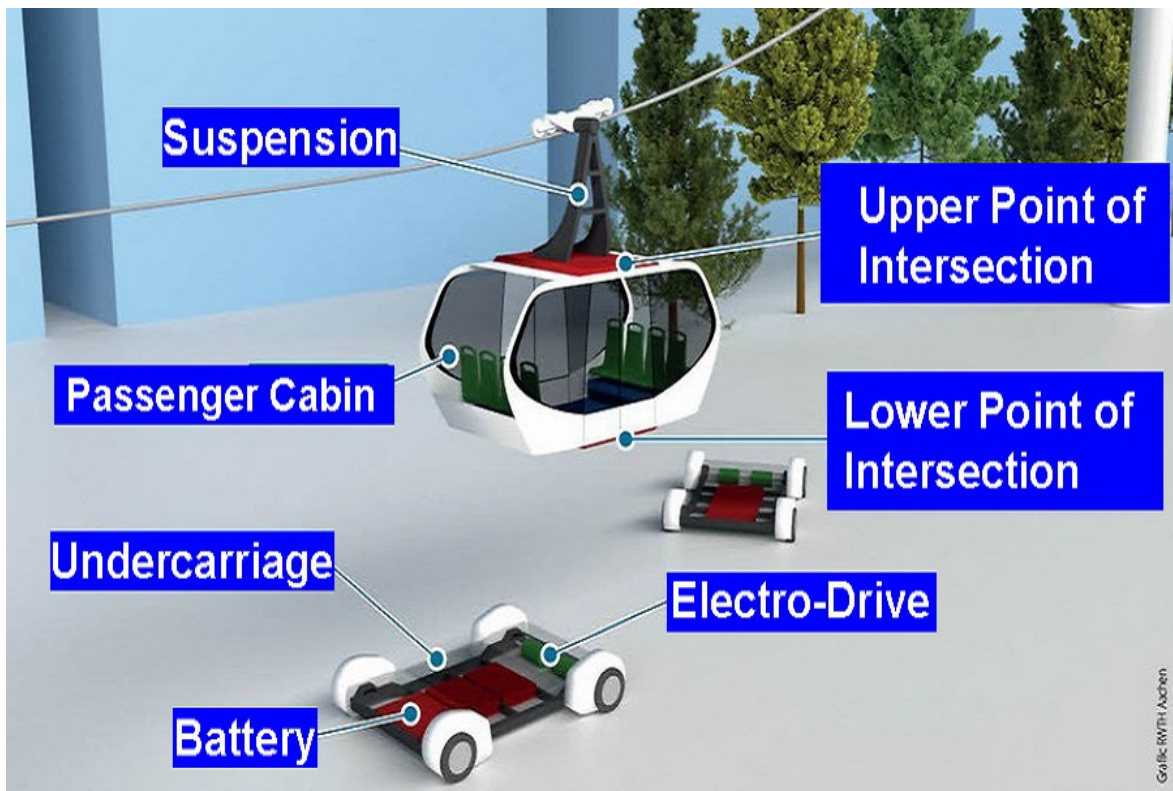
Sky Ropeway-Metro in La Paz, System Doppelmayr; Bolivia



Bottom operated Cable pulled CLS "*CABLE-LINER*" Train "Bolívariano" rolling on an elevated Guideway in Caracas; Bolivia; System Doppelmayr

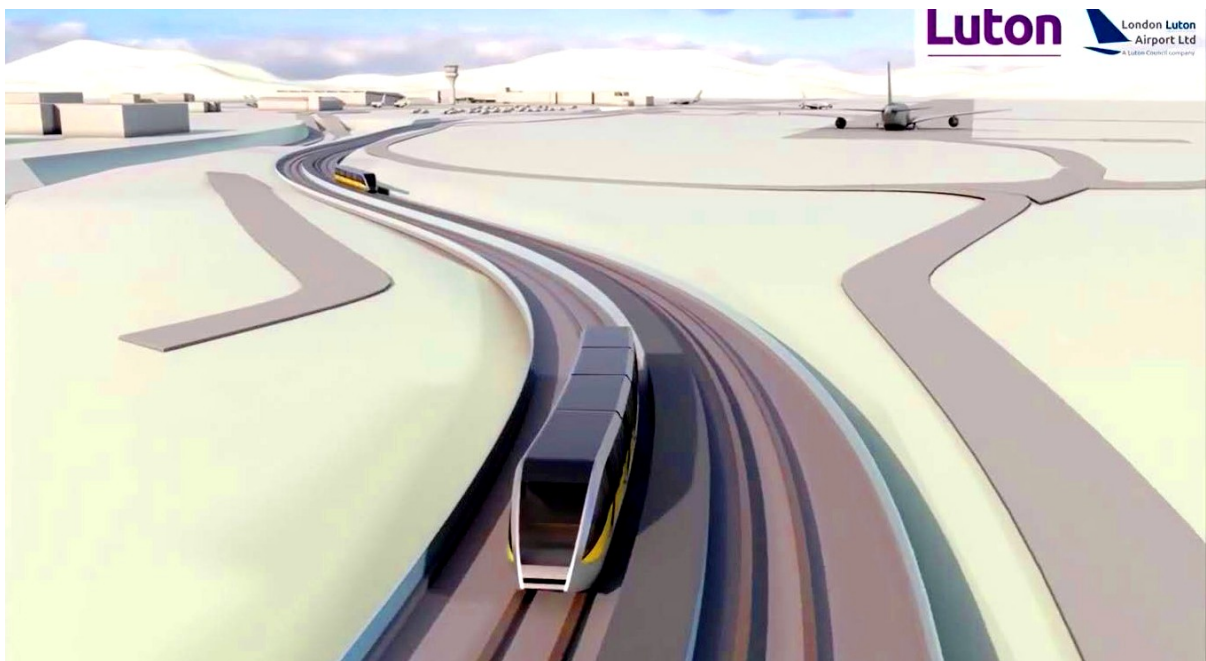


Underground "*CABLE-LINER*" on a guided Roll-Way, Sheremetyevo International Airport Moscow; Russia; System Doppelmayr



Symbiosis of automated PodCar APM and Gondola APM developed by Technical University Aachen, Germany, and Manufacturer Doppelmayr, Austria

The new symbiosis evolution can switch from automated PodCar APM running on ground to an aerial suspended Gondola Ropeway.



Animation of Rope pulled DART CABLELINER as APM on a Rollway for London Luton Airport by Ropeway Manufacturer Doppelmayr; currently under Construction

The ropeway manufacturer *DOPPELMAYER*, Austria, is building at Lodon Luton Airport a DART Cabelliner, a rope pulled automated People Mover on a rollway.



Guideway of Zurich Airport Hovercraft Type Sky Metro People Mover

The Hovercraft type People Mover vehicles run on a parallel 1138 m long guideways drawn by steel cables and floating on an approximately 0.2 mm thick air cushion generated by on board air compressors, running over a smooth concrete guideway as in other Otis *HOVAIR* installations.



ExpressTram Detroit Airport People Mover, System *OTIS-HOVAIR*

The ExpressTram is an automated rope pulled Hovercraft type people mover operating at Detroit Metropolitan Wayne County Airport, in Romulus, Michigan, USA.

The system operates 21 feet (6.4 m) above the main floor, and it consists of two cable-driven trams, that ride upon an air-cushion, similar to a hovercraft. 3-PSI of air pressure is enough to lift the tram vehicles approximately 1/2" above the guideway surface. The same "Hovair" technology is used in the Hub Tram and the Cincinnati Airport People Mover. Each tram is made up of two cars and can carry up to 208 passengers at a time. The track, referred to as a guideway in the APM industry, is over 1100 m long.



Multi-modal **Conectivity** Transport Hub at Kottawa-Makumbara, Colombo, connecting Highway-Bus, Town-Bus, Taxi and MRT-Railway **for an integrated Metropolitan Transport System (IT); Sri Lanka**



Envisaged integrated multimodal Connectivity Hub for Indore; India

FAZIT:

METRO has been understood today as a mean with integrated multi modal public transport (Integrated Transport, IT) in urban, suburban and interurban metropolitan area for **URBAN MOBILITY as a SERVICE (MaaS)**. The term **METRO** is derived from Metropolis and has nowadays become a synonym for integrated urban, suburban and interurban public transport in metropolitan area.

OUTLOOK:



Artificial Intelligence embedded in Mass Transport Technologies; source UIPT

Digitalisation, Sensor-Technology, Internet of Things, Artificial Intelligence and Big Data are rapidly penetrating urban, suburban and interurban transport and information technologies. The forth industrial revolution has already reached modern public transport, and it is reshaping urban mobility of metropolis around the globe. It offers new insight into how smart cities function and how services can be optimised to meet the everyday needs of urban dwellers.



Animation: Impression of next Generation Metro Rail/Urban Rail; Alstom