UIC HIGHSPEED Morocco 2023

HIGH-SPEED RAIL : THE RIGHT SPEED FOR OUR PLANET

Under the High Patronage of his Majesty King Mohammed VI

Session 2.4, Room Karam2
New systems

Moderator : Mr. Arthur L. Guzzetti

Vice President - Policy And Mobility,

American Public Transportation Association, United States

ONCF UIC

Session 2.4
New systems
Speaker Lists;

1

Mr.Giovanniluca De Vita

Italy

2

Mr.ZHAO Yang

China

3

Ms.LI Hongmei

China

4

Mr.Ian Rainey

United States

5

Mr.Jörg Marienhagen

Germany

6

Mr. ALPEREN KANIK

Turkey

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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

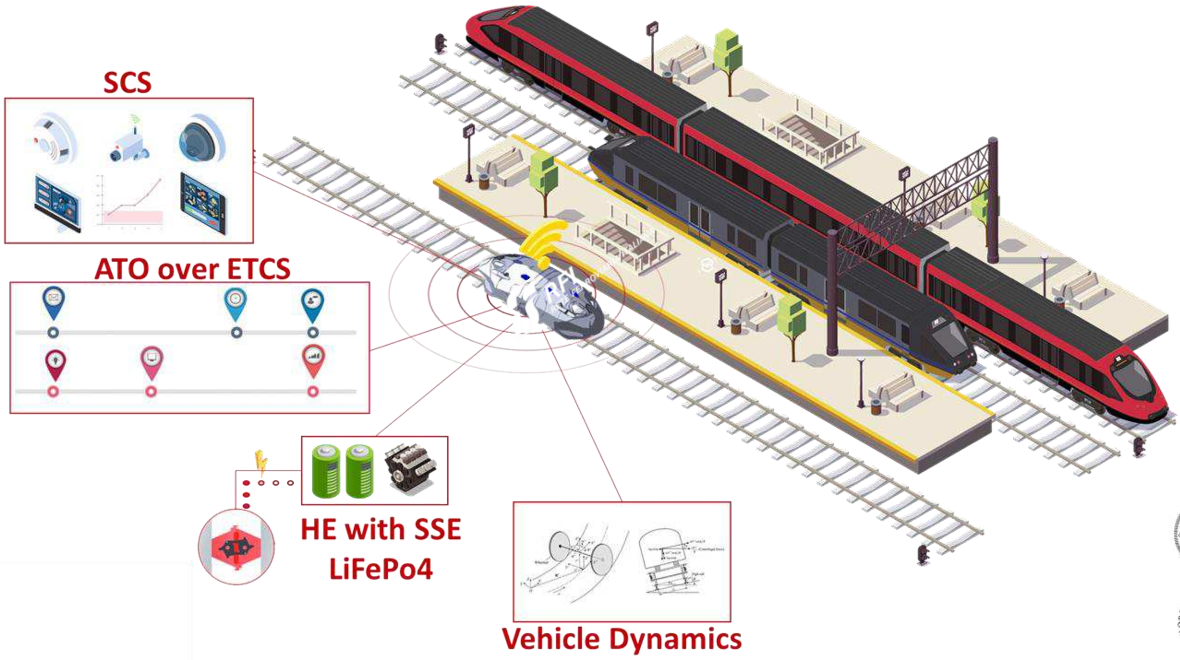
Marrakech, 7-10 MARCH 2023

RFI Unmanned Railway Vehicle Dynamic Tests on roller test bench

Giovanniluca De Vita
R&D Engineer, RFI, Italy
Session4-2.4 New systems

URV - Overview

The RFI Unmanned Railway Vehicle (URV) is an unique railway drone, designed to run autonomously on Italian HSL for inspecting and monitoring the railway infrastructure.



Individual subsystems are designed through cooperation with industrial and academic partners.

The R&D Department of RFI is in charge for system specification, development, integration and testing.

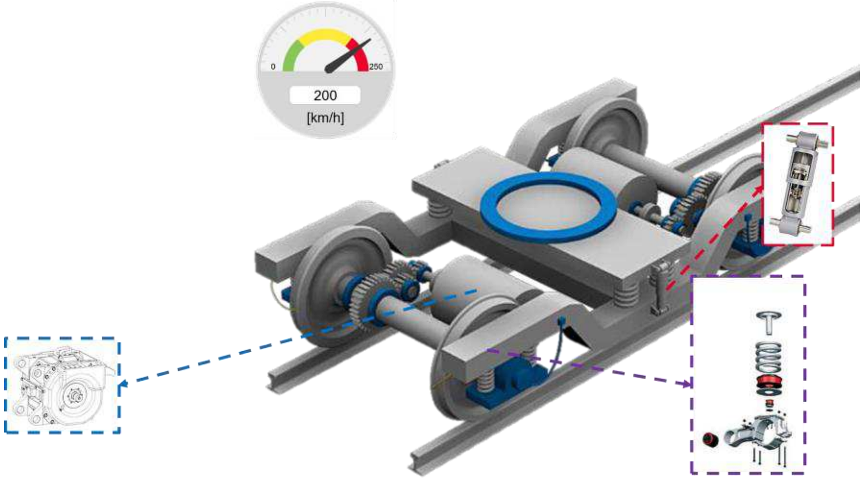
URV – Main Features and Subsystems

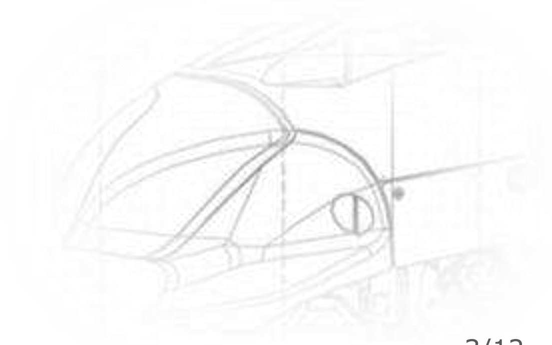
❖ Performances:

- max speed 200Km/h;
- 4 hours autonomy;

❖ Mechanical/traction design:

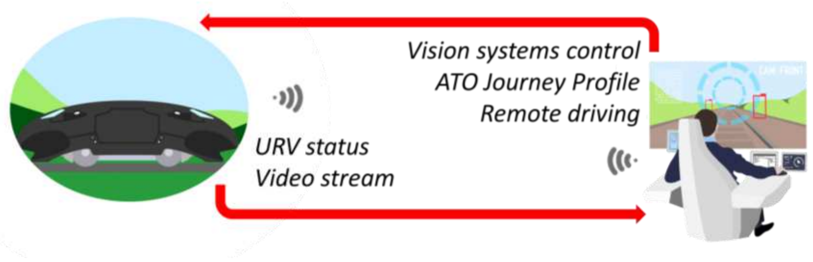
- high-speed train single boogie;
- dedicated secondary suspensions;
- purpose-designed frame mounted to host all components and instrumentation;
- hybrid powertrain;
- Plug-in charging with automatic coupler;

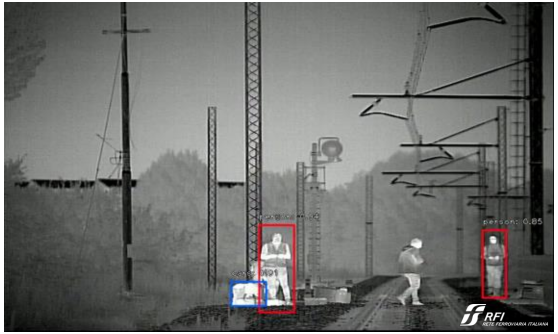




URV – Main Features and Subsystems

- Signalling and automation systems:
  - ATO with GoA 4 and remote driving functions;
  - ETCS level 2;
- Artificial vision:
  - long-distance vision and perimeter vision;
  - run-time detection and recognition of anomalies using real-time deep learning algorithms for artificial vision.





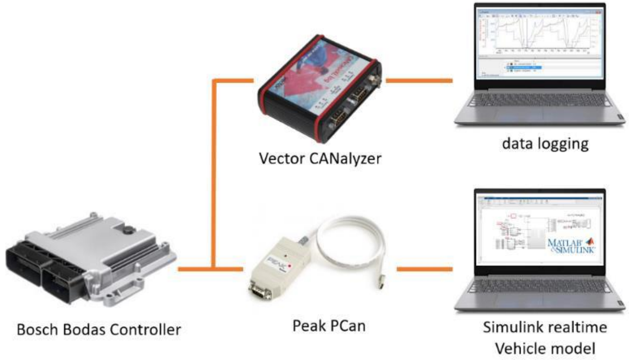
URV – Subsystems Test Environment

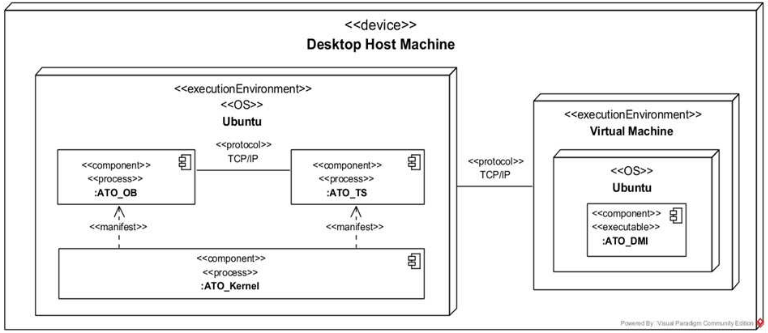
The complexity of the design in terms of architecture, functionality, safety and reliability required an incremental approach for single subsystems and systems integrations test approach.

The following types of environment have been executed:

❖ Subsystem Test Environment:

- tests the subsystem logics and emulates external systems;
- Stimulates URV software and hardware components



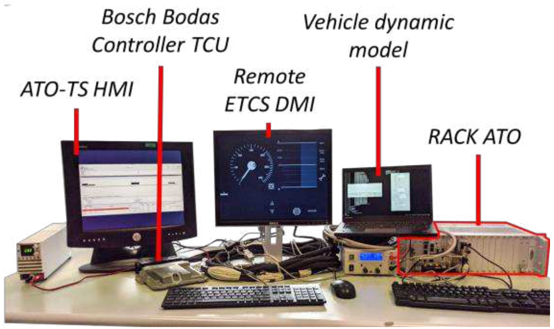


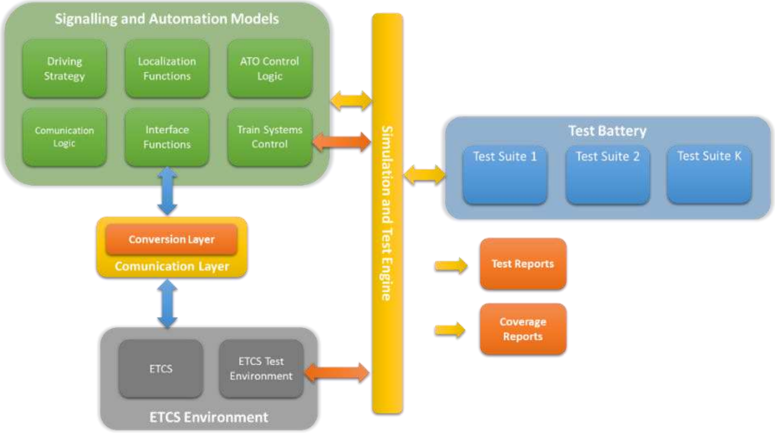
URV – Subsystems Integration Test Environment

The following types of environment have been executed:

❖ Subsystem Test Integration Environment:

- Real subsystems tested and other low-level devices are emulated;
- Integration of traction/braking systems with ETCS, ATO and vision system





URV – Firenze Osmannoro Test Bench Environment

❖ Dimensional tests carried out to determine:

- Rolling stock construction gauge;
- Body weight and centre of gravity;
- Plane curve;
- Pitching;
- Torsional rigidity
- Buckling tests for bogie and pivot pitch
- Torsional rigidity of the rolling stock;

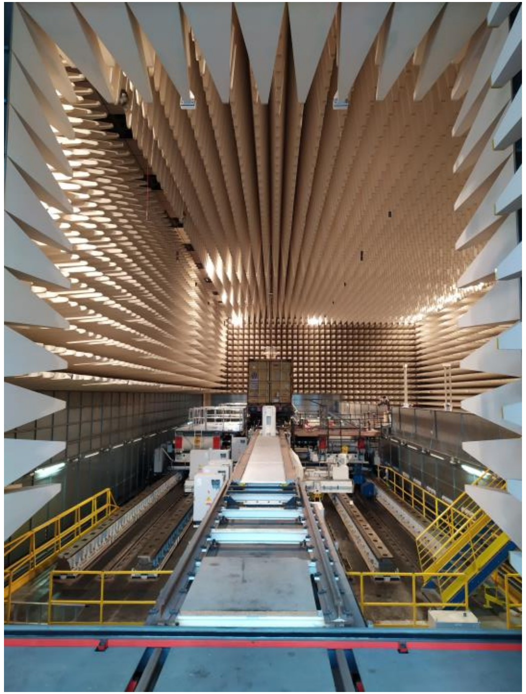
❖ Additional tests to simulate:

- Low-frequency vertical dynamics of the vehicle;
- Curve entry.

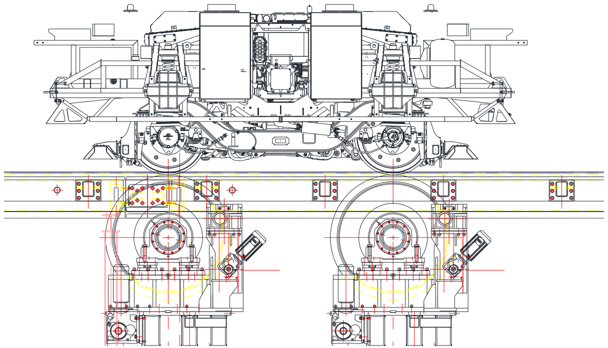
URV – Firenze Osmannoro Roller Test Bench Envirnonment

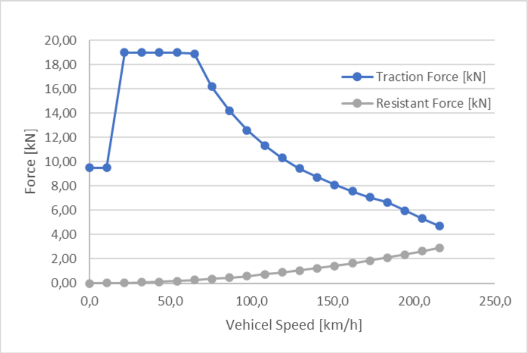
Designed to host the real vehicle to perform first acceptance tests: it emulates an endless rail with motorized rollers and is controlled to simulate resistance torques. The following tests are performed:

- Subsystem Test Integration Environment:
- Check of traction systems;
- Tests on wheel-rail sliding control systems;
- Determination of braking performances;
- Electromagnetic compatibility tests on the complete rolling stock.



URV – Firenze Osmannoro Roller Test Bench Environment





The main objective of the powertrain performance test is to evaluate the performance of the hybrid powertrain. The rig is used imposing a constant speed to each roller.

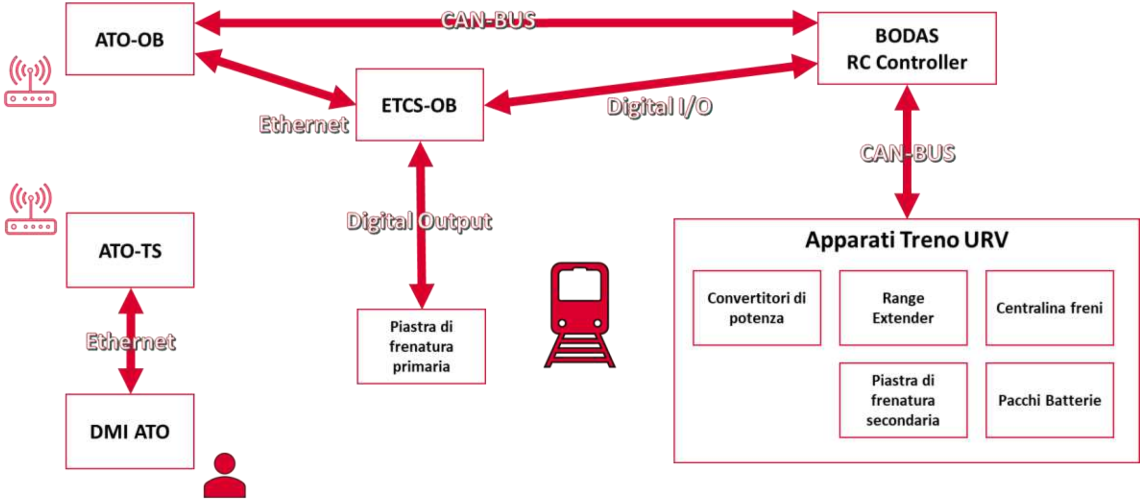
Main obejctives:

- Identification of the Force-Speed characteristics;
- Validation of the algorithms to control the on board generation system;
- Validation of the blended braking agorithms.

URV – Firenze Osmannoro Roller Test Bench Environment

The second main objective is to test the ATO system on the real vehicle running on the roller rig.

A longitudinal dynamical model of the vehicle is implemented and solved real time. The rig measure the force that the vehicle apply and apply the speed the vehicle would reach on the simulated line.



URV – Conclusion

URV vehicle is one of the most challenging projects of Rete Ferroviaria Italiana. Due to its complexity, an incremental test approach for integrations test approach have been followed.

Subsystems tests have been completed.

Subsystems integration tests have been partially completed and still in progress at Firenze Osmannoro roller test bench, specifically:
- Verification of the performance of traction and braking systems;
- Evaluation of the integration of the traction and braking systems with the ATO and Vision System.

In 2023 the URV will perform the final test phase along the Circuit of Bologna San Donato:
- The dynamic behavior of the vehicle will be tested with specific mission goals as well as integration with the infrastructure of signaling track-side/on-board.

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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

The Application of ATO for China High-speed Railway Lines

Zhao Yang
Senior Researcher ,China Academy Of Railway Sciences (CARS) ,China
Session 2.4 New systems

ONCF UIC

1. Introduction

Automatic Train Opration（ATO） can ensure safety, save energy , Increase capacity , reduce driver work intensity, and improve passenger's feeling , which are the important signs of high-speed railway intelligence.

The application of ATO in the Pearl River Delta Intercity Railway and the Beijing-Zhangjiakou High-speed Railway promote the **safety** and **automation** of train operation.

CTCS2+ATO

In 2011, began to develop

In 2015, pilot test

In 2016, put into operation

CTCS3+ATO

In 2017, began to develop

In 2018, pilot test

In 2019, put into operation

2. CTCS2+ATO for Intercity Railway

Technical features of C2 + ATO

- GoA2
- GSM-R/CSD
- Independent ATO and ATP
- Real-time Plan adjustment
- Interoperation with CTCS-2
- Control Door Automaticly

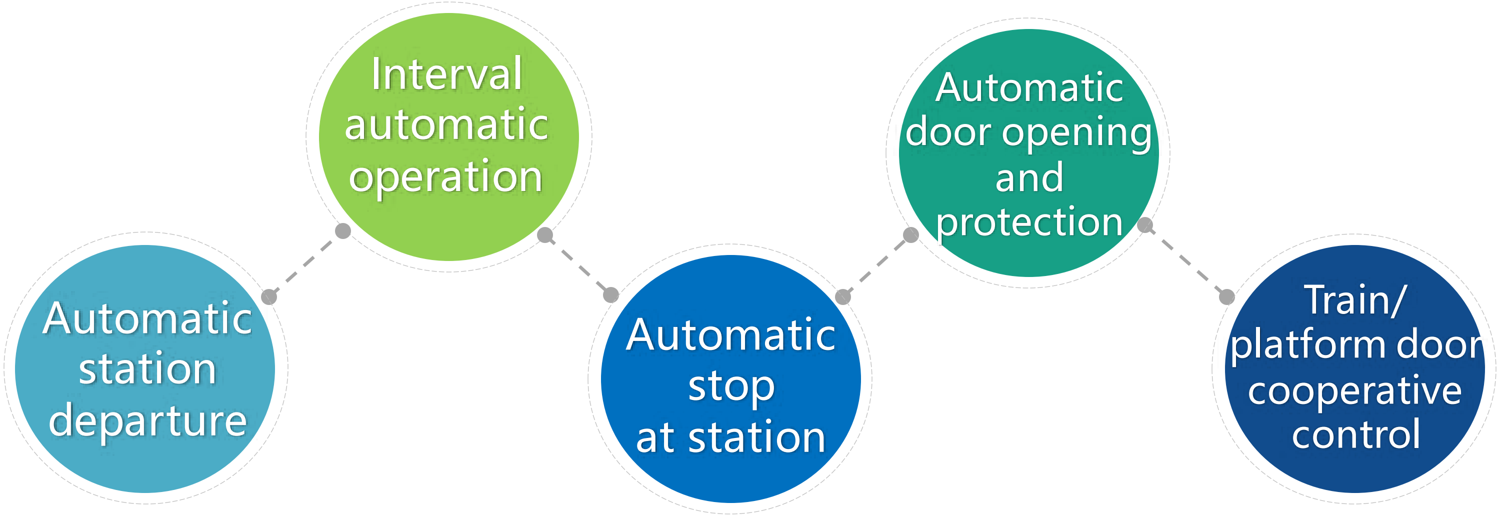
2. CTCS2+ATO for Intercity Railway

On March 30, 2016, CTCS2+ATO was successfully put into operation in the Pearl River Delta Intercity Dongguan-Huizhou Line and Guangzhou-Foshan-Zhaoqing Line.The automatic driving technology was applied to the 200km / h Railway.

Up to now, 459 km of intercity railway has been built in the Pearl River Delta, and more than 40 trains equipped with CTCS2 + ATO have been put into operation.

3.CTCS3+ATO for High-speed Railway

The functions of the automatic driving system include automatic departure, automatic interval operation, automatic stop at station, automatic door opening and protection, and train / platform door cooperative control.



3.CTCS3+ATO for High-speed Railway

Compared with the traditional manual driving, the advantages of ATO system are as follows:

- **Improve safety**
- **Enhance capacity**
- **Improve punctuality**
- **Improve passenger comfort**
- **Optimising traction energy**
- **Reduce driver's work intensity**

4. Application of Beijing-Zhangjiakou High-speed Railway

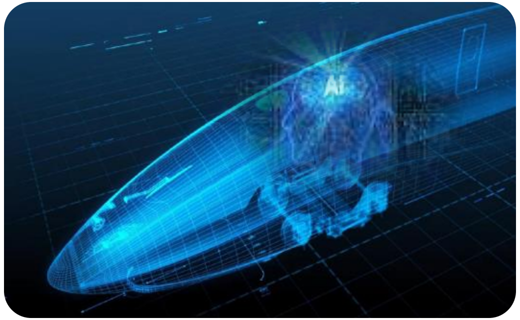
Beijing-Zhangjiakou HSR is an important part of Beijing-Tianjin-Hebei intercity HSR network. It is also a major transport infrastructure serving the Beijing Winter Olympic Games in 2022.The length of the line is 174km, and the operation speed is 350 km / h.

December 31, 2019, EMUs with CTCS3+ATO are operating on the Beijing-Zhangjiakou High-speed Railway. Until now, the ATO equipment operates stably and functions normally.

5.Future development

The goal of future railway development is to be more safe, efficient, intelligent and green, which is also the purpose of applying ATO system.

The future development directions of ATO include:



- Research on Optimized Control Strategy
- Autonomous driving of freight trains
- Fully aware and fully automatic driving (GoA3, GoA4)
- Traffic Management and operation control integration

……

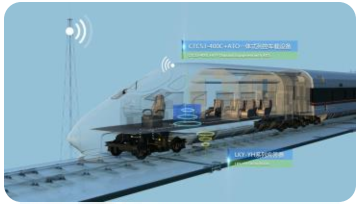
5.Future development

The main problems in the realization of GoA3 and GoA4

—— Environment perception and state detection

- Track environment perception
- Obstacle detection
- Person detection
- Vehicle status detection





5.Future development

Two viewpoints on Autonomous Rail Operation

1.Man-machine cooperation will last for a long time

2.The scenario of autonomous operation is conditional

5.Future development

In the future, China Railway will gradually realize the transformation from manual driving to automatic driving and then to intelligent driving.

- environment autonomous perception
- safety situation autonomous assessment
- equipment fault autonomous diagnosis

With the rapidly development of high-speed railway in China, the rail automation and antonomation represented by ATO will have a broad prospect in the future.

THANK YOU

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Marrakech, 7-10 MARCH 2023

Development status and significance of high-speed maglev transportation

LI, Hongmei

Beijing, China Academy of Railway Science Corporation Limited(CARS), China

2.4 New systems

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Content

1. Demand analysis

1.1 The demand trend of urban development in China

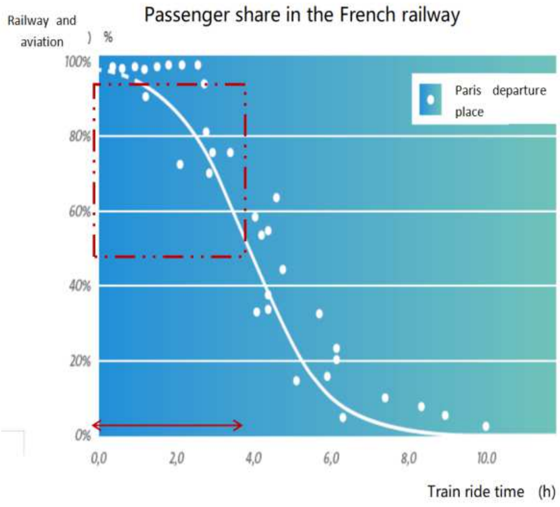
- **Economic structure:** In the later stage of industrialization, the proportion of the tertiary industry increased, bringing more efficient rapid flow demand.
- **Balanced development:** With balanced economic development in the eastern and western regions, it is necessary to plan and build high-speed transportation on the channels of the hub cities in the eastern and central and western regions.
- **Urbanization:** The integrated development of regional economy and urban agglomeration has become an important form, bringing the demand for rapid access between urban agglomeration and megacities.
- **Consumption upgrading:** With the improvement of living standards, the demand for faster, more comfortable and more diversified high-quality travel is increasing.

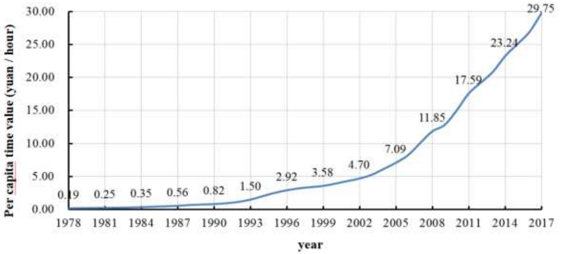
“Can run” “Can transport“ → ”Can run well” “Can transport fast”

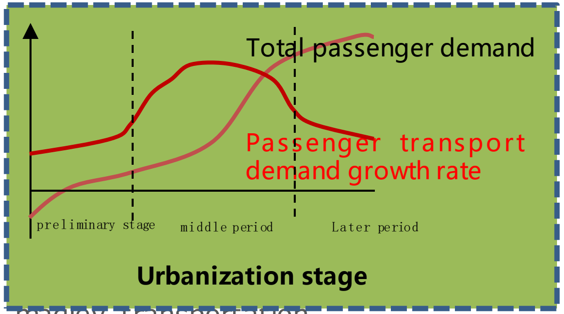
1. Demand analysis

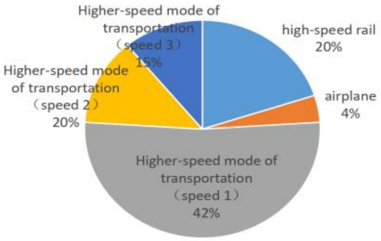
1.2 High-speed ground transport passenger demand

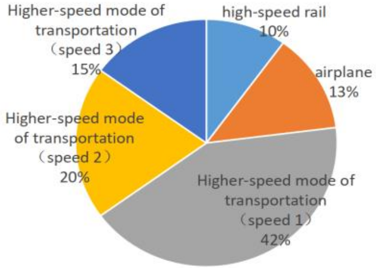
- Travel speed, travel cost, and ride comfort are the main factors affecting passenger demand.
- The passenger flow of Beijing-Shanghai, Guangzhou-Shenzhen lines continues to grow, and some sections are basically saturated, which is in urgent need of faster and more convenient passenger transport mode.
- Passengers have a prominent demand for higher speed modes of transportation.





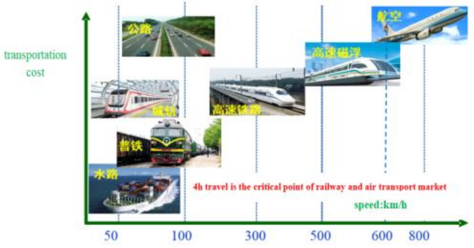




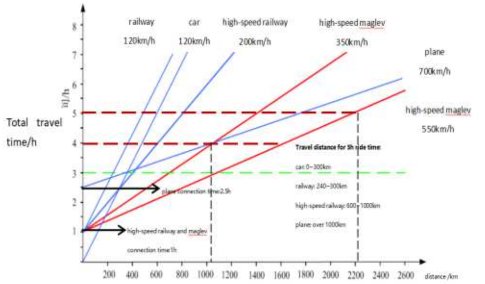


1. Demand analysis

1.3 The development of high-speed maglev train is conducive to improving the three-dimensional traffic network



Comprehensive three-dimensional transportation system

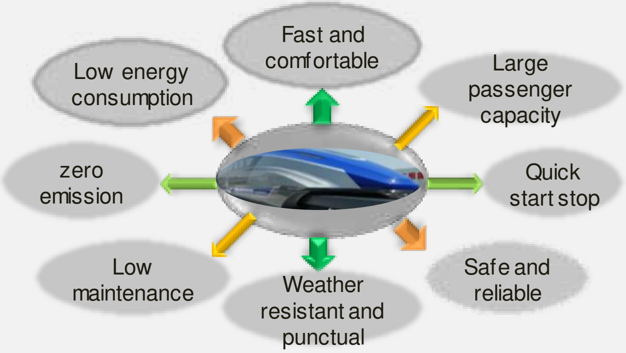


Typical total relationship between travel time and travel distance of different vehicles

1.4 Promoting technological innovation and industrial upgrading is of great significance

One of the future track development directions

- Overcome the traditional railway speed limiting factor
- In line with the future development trend of rail transit



promote technological innovation and industrial upgrading

- Develop new materials and new process technology engine to promote interdisciplinary integration
- Equipment manufacturing upgrading, technological innovation, industrial system update

Traction converter | Aluminium alloy | Railway infrastructure

- The application prospect of magnetic technology is broad

Maglev train | Maglev elevator | Maglev logistics

2. Research status

2.1 High-speed maglev development has experienced diversified technology evolution

- Since Germany proposed the theory of electric magnetic levitation in 1922, after more than 50 years of continuous research, three forms electromagnetic Suspension (EMS), low-Temperature Superconducting Electrodynamic Suspension (LTSEDS) and high-Temperature Superconducting Magnetic Levitation (HTS Maglev) have been formed.

- **Electromagnetic Suspension (EMS)**

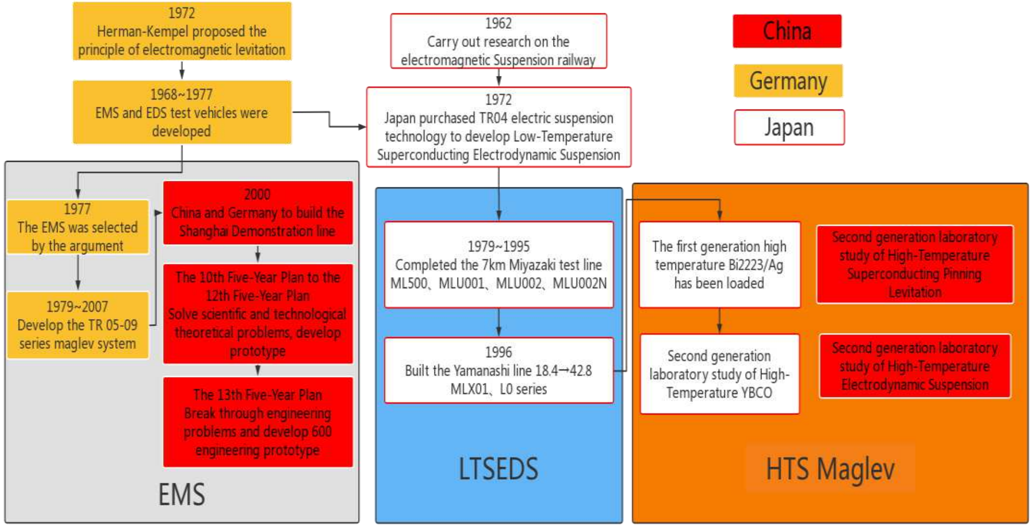
  Started in Germany and developed in China

- **low-Temperature Superconducting Electrodynamic Suspension (LTSEDS)**

  Succeed in Japan and developed in China

- **High-Temperature Superconducting Permanent Magnetic Levitation(HTS Maglev)**

  China and Japan are both trying to develop



2. Research status

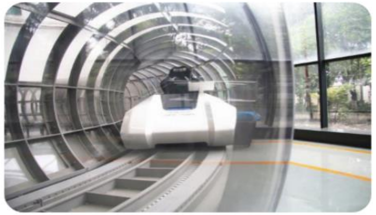
2.2 High-Temperature superconducting Pinning Levitation traffic

- Scientific research institutes in **Germany, Brazil** and other countries have carried out theoretical and experimental studies.
- Southwest Jiaotong University of **China** has built a scale prototype test platform, completed some key technology verification, and is carrying out vehicle and system program research.

2.3 Low-Temperature Superconducting Electrodynamic Suspension traffic

- **Japan** began research and development in 1972, and the L0 series car achieved 603km/h test speed in 2015.After 40 years and 7 generations of product optimization, although it has realized engineering application, it still needs operational assessment.
- The Third Academy of Aerospace Science and Industry, Naval University of Engineering and CRRC have carried out prototype research on some key components, such as superconducting magnets, and are carrying out primitive verification of key technologies.

Model car of Federal University of Rio de Janeiro, Brazil



Southwest jiaotong university maglev vehicle

Japanese L0 series maglev car

Maglev model of China Aerospace Science and Industry Corporation Limited

2. Research status

2.4 Electromagnetic Suspension traffic

- Since 1969, **Germany** has developed a series of Transrapid maglev system, and took the lead in realizing commercial application and technology output. Then, the maglev lines such as Berlin-Hamburg were successively planned, but the development was abandoned due to insufficient passenger flow demand and poor economy.
- Since the introduction of TR08 technology in the construction of Shanghai Demonstration Line in 2003, **China** has basically mastered the key technologies of high-speed maglev after continuous systematic research from the Tenth Five-Year Plan to the Thirteenth Five-Year Plan, and carried out the development and loading verification of some core components. Now, the key technology of 600 km/h maglev has formed a complete set of technical solutions.

Shanghai Demonstration Line train

"10th five-year" automatic test

"11th Five-Year" project sample vehicle

"12th five-year" mixed magnetic test model

"13th Five-Year" test sample car off the line

2. Research status

2.4 Electromagnetic Suspension traffic

- Based on the top-level index and system innovation results, taking into account long-distance transportation and regional commuting, CRRC of China proposed a complete set of technical solutions to complete the top-level - scheme - technology - construction design and review. Construction of simulation-test-trial production platform, successful development of traction power supply, transport control communication, line track, vehicle domestic complete sets of equipment.
- Controlled manufacturing in according with the high-speed railway quality system, the independently developed parts and complete equipment have excellent performance and high degree of engineering, and have batch loading conditions.
- At present, the ground test and vehicle level debugging such as suspension steering have been completed, and the low-speed line test is being carried out with good results, which is ready for design optimization and engineering prototype development.

Head car

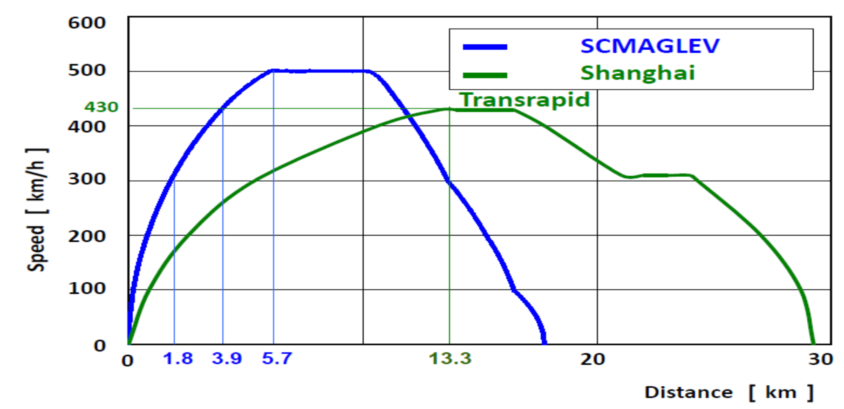
Middle car

Line test

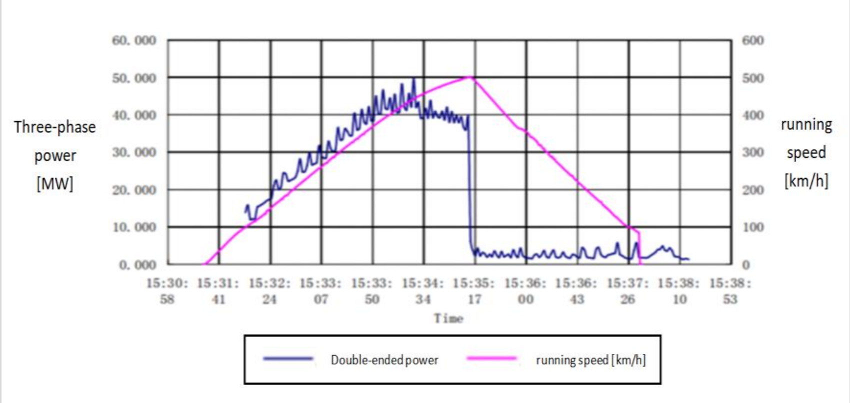
3. Development and thinking

3.1 Building high-speed maglev engineering test line, and carrying out functional and reach-speed test

- The development of high-speed maglev needs to carry out the full-speed level test verification and system optimization.The Shanghai demonstration line is 30 kilometers long, and the scene is single, so it cannot be tested at all speed levels and under full conditions.



Accelerating performance of the Shanghai demonstration line



Operating acceleration distance and speed (Power consumption speed curve -20KV input side)

0-200km/h, 0.9 m/s2 200-300km/h, 0.7m/s2
300-400km/h, 0.5m/s2 400-500km/h, 0.2m/s2

The minimum distance for acceleration to 430 km/h is 13.3 km, up to 501 km/h. Due to the short line of the demonstration line, the operation advantage of 430 km/h cannot be utilized.

3. Development and thinking

3.1 Building high-speed maglev engineering test line, and carrying out functional and reach-speed test

- It is suggested that the high-speed maglev test demonstration line should be planned and constructed, and the test line and operation line should be considered and constructed in sections. The design length should be over 60km, and the specific adjustment should be adjusted according to the field terrain.
- For the 600km/h high-speed maglev transportation system, the line length of 40km can achieve 600km/h speed, the line length of 50km can achieve 600km/h speed running about 1 minute, the line length of 60km can achieve 600km/h speed running about 2 minutes.

category	Acceleration distance (km)	Run at 600km/h		Braking distance (km)	Protective distance (km)	total distance (km)
		time (s)	distance (km)			
600km/h railway line	17.2	0	0	15.5	5	37.7
		60	10			47.7
		120	20			57.7

THANK YOU

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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

Superconducting Maglev (SCMAGLEV): A Transportation Solution for the U.S. Northeast Corridor

Ian Rainey
Senior Vice President, Northeast Maglev, USA
Session4-2.4 New systemsNew Systems

ONCF UIC

Who We Are

Northeast Maglev

- U.S.-owned company
- Project promotion & consulting

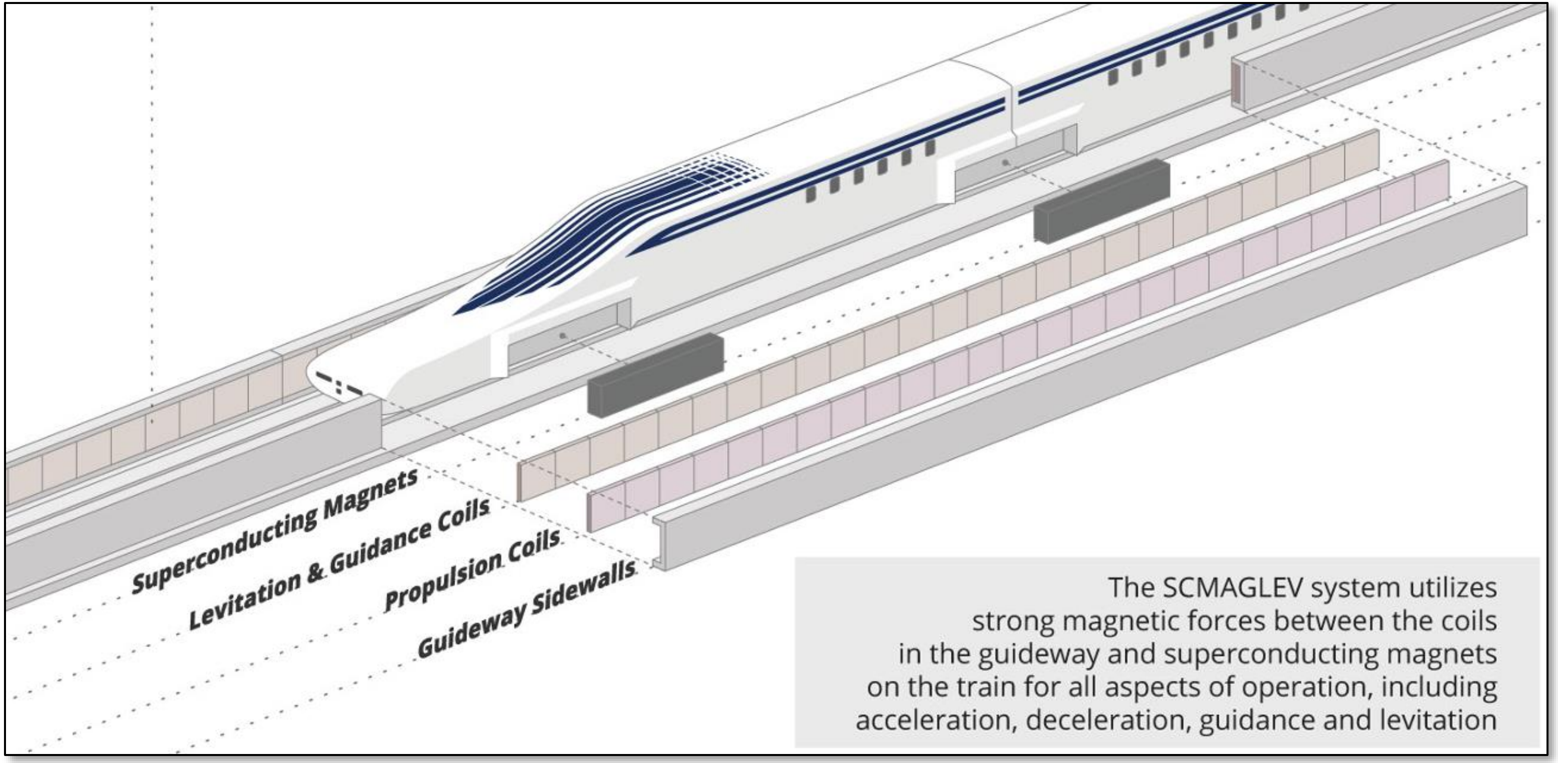
Baltimore-Washington Rapid Rail (BWRR)

- U.S.-owned company
- State franchised railroad
- Project developer

Central Japan Railway Company (JRC)

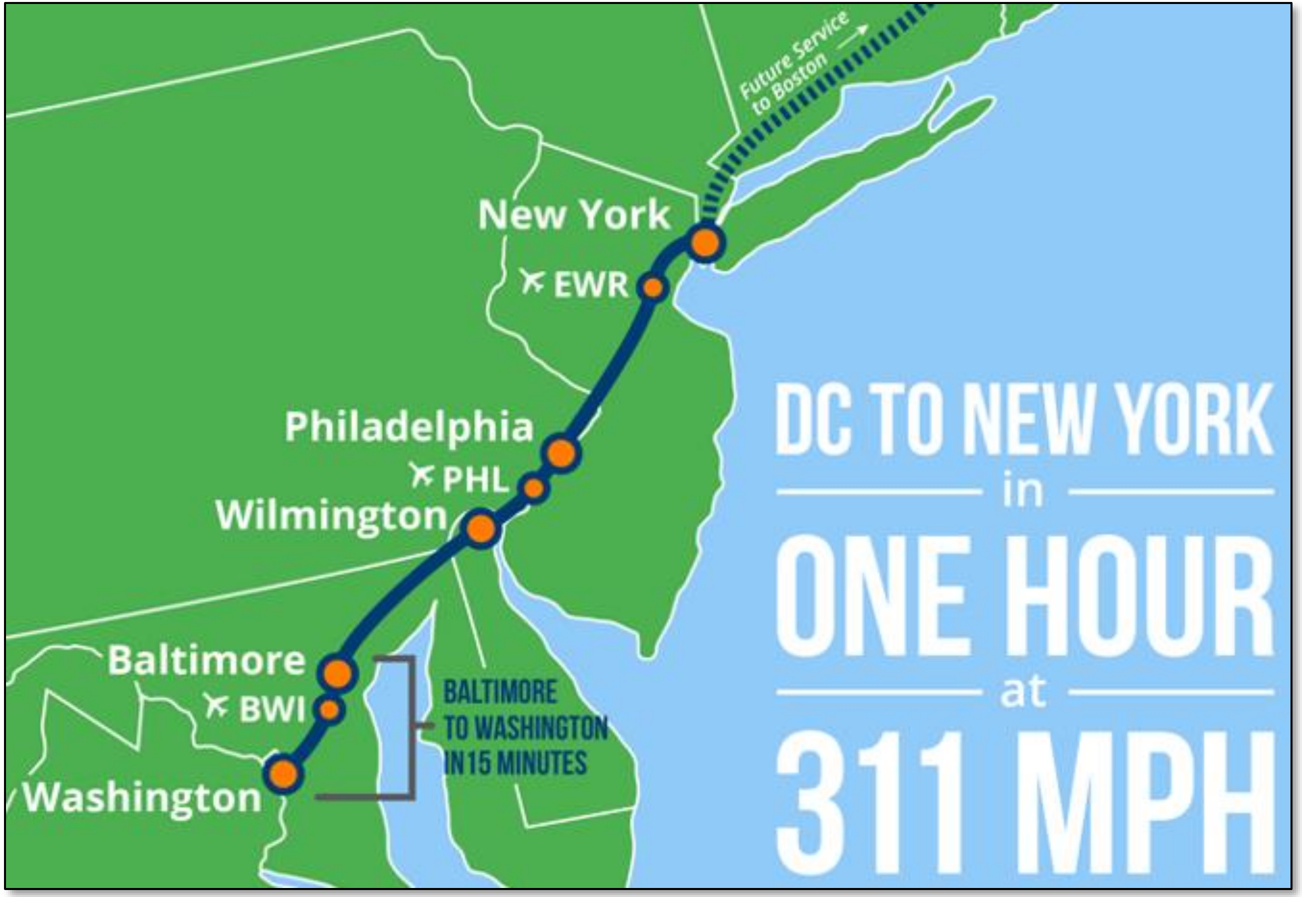
- Premier high-speed rail operator
- Tokaido-Shinkansen “Bullet Train”
- Developer/owner/operator of SCMAGLEV in Japan

About the SCMAGLEV

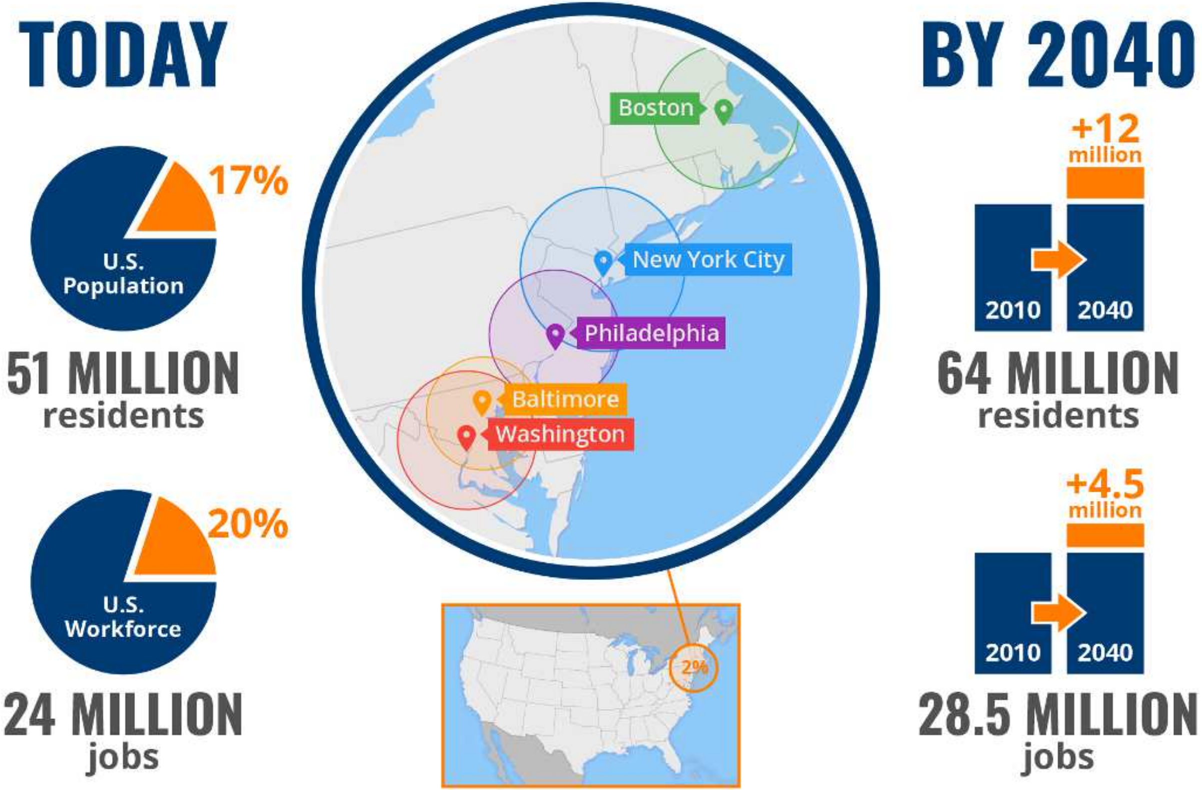


The SCMAGLEV system utilizes strong magnetic forces between the coils in the guideway and superconducting magnets on the train for all aspects of operation, including acceleration, deceleration, guidance and levitation

Our Vision


Future Service to Boston
New York
EWR
Philadelphia
PHL
Wilmington
Baltimore
BWI
Washington
BALTIMORE TO WASHINGTON IN 15 MINUTES
DC TO NEW YORK
in
ONE HOUR
at
311 MPH

Why This Project Is Needed



Project Status

The current status of the U.S. SCMAGLEV Project is as follows:

- Ten years of privately funded work
- Maryland Railroad Franchise granted
- No-cost technology transfer agreement (~$6 billion)
- Gov't of Japan has funded numerous studies in support of the Project
- Gov't of Japan has pledged to provide significant financial support for the Baltimore-Washington segment
- $50+ million in U.S. federal grants awarded to date
- EIS & Permitting is underway for first phase: Baltimore-Washington

Project Economics

Ridership

- More than 20 million Washington—Baltimore annually passengers by 2045

Revenues/Costs

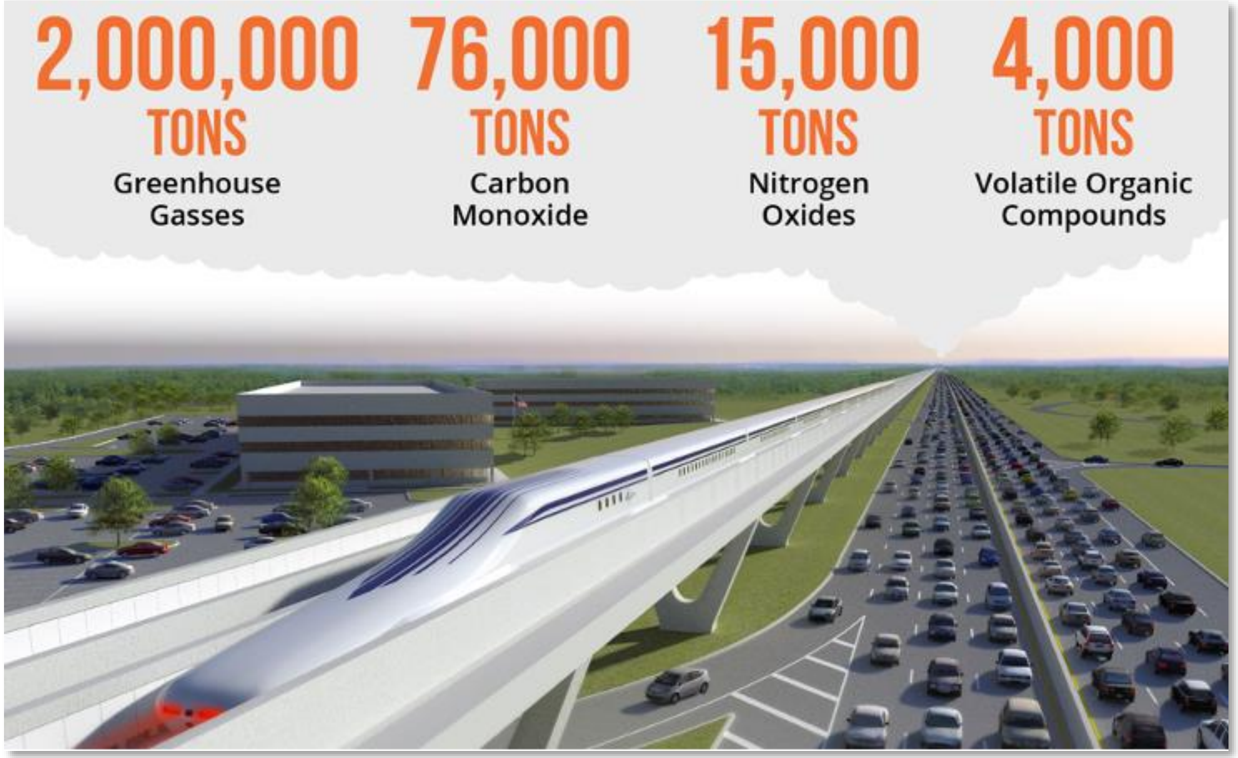
- Revenues will fully cover operations & maintenance costs

Fares

- Fares will vary based on time of day and demand
- Competitive with Amtrak and other modes

Project Economic Benefits – Job Creation & GDP Growth

Project Environmental Benefits – Emissions Reductions



For more information please visit:

https://northeastmaglev.com/

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HIGH-SPEED RAIL : THE RIGHT SPEED FOR OUR PLANET

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11TH WORLD CONGRESS OF HIGH-SPEED RAIL

Marrakech, 7-10 MARCH 2023

Hyperloop: The Fifth Mode of Transport?

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Session4-2.4 New systems

ONCF UIC

What is hyperloop and why do we need it?

Hyperloop describes a transport system of tubes with reduced air pressure in which vehicles (also called pods) can move at very high speed and accelerations with virtually no emissions thanks to contactless, electromagnetic levitation and propulsion systems and very low air resistance.

Existing transport modalities can't meet the requirements of tomorrow: Why do we have to think about new mobility and technology solutions?

Transport will **grow 2.5x by 2050**

Emits **30% of all emissions**

Consumes **28% of the all energy**



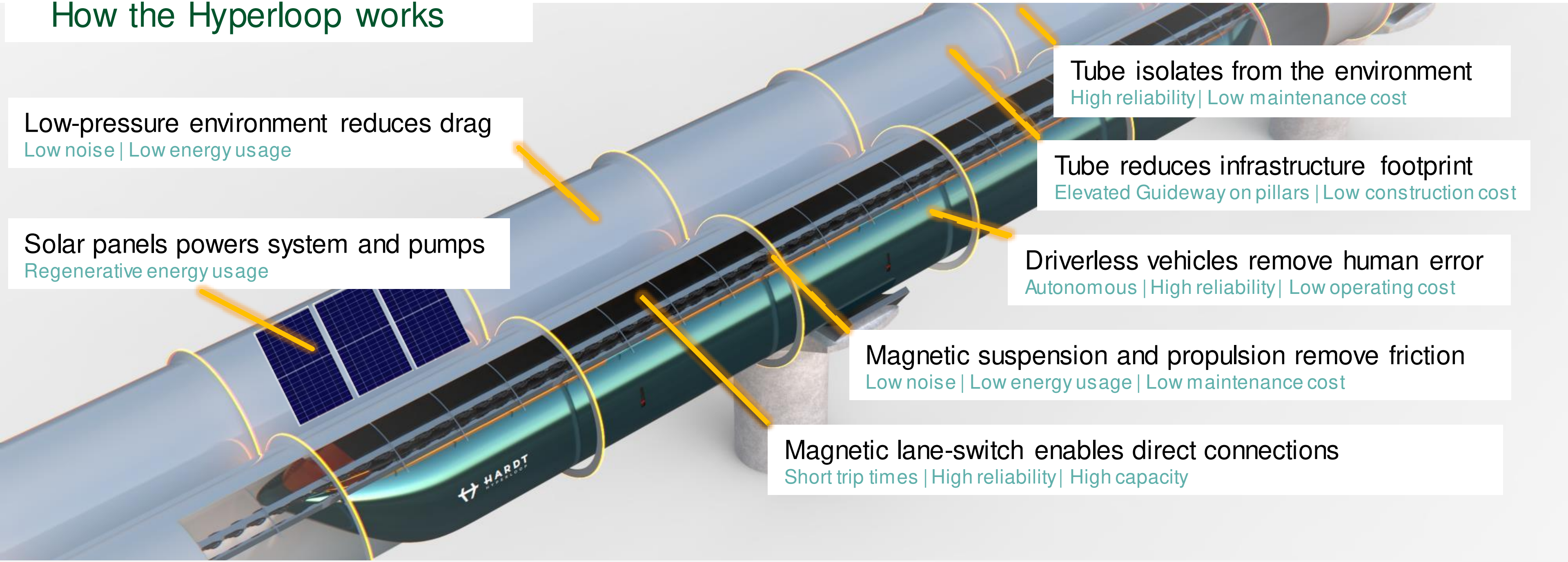
- The amount of population is rising: currently more than 8 billion people live on our earth, trend upwards
- More people, more transport capacity is necessary; freeing up of existing capacities in rail network
- In highly dense urban areas, place for new conventional transport systems is typically not available
- Resistance against external influences (theft, intrusion, weather, etc.)
- **To reach the climate goals 2030 / 2050**
  To fight against climate change we must find, develop and implement carbon neutral transport and technology solutions.

What advantages does the Hyperloop technology have?

The Hyperloop concept offers many opportunities:

- Very high speed up to 1.000 km/h
- Usable for concepts of Shared Mobility
- Operates electrified with renewable energies, which partly is produced system immanent using solar panels
- Working with a highly efficient system to prevent wasting resources
- In the future carbon neutrality can be ensured
- It can transport passenger as well as freight
- High capacities are possible, especially in passenger transport, which are on the level of high-speed rail or above
- Flexible capacity and variable optimization of operational concept

How the Hyperloop works

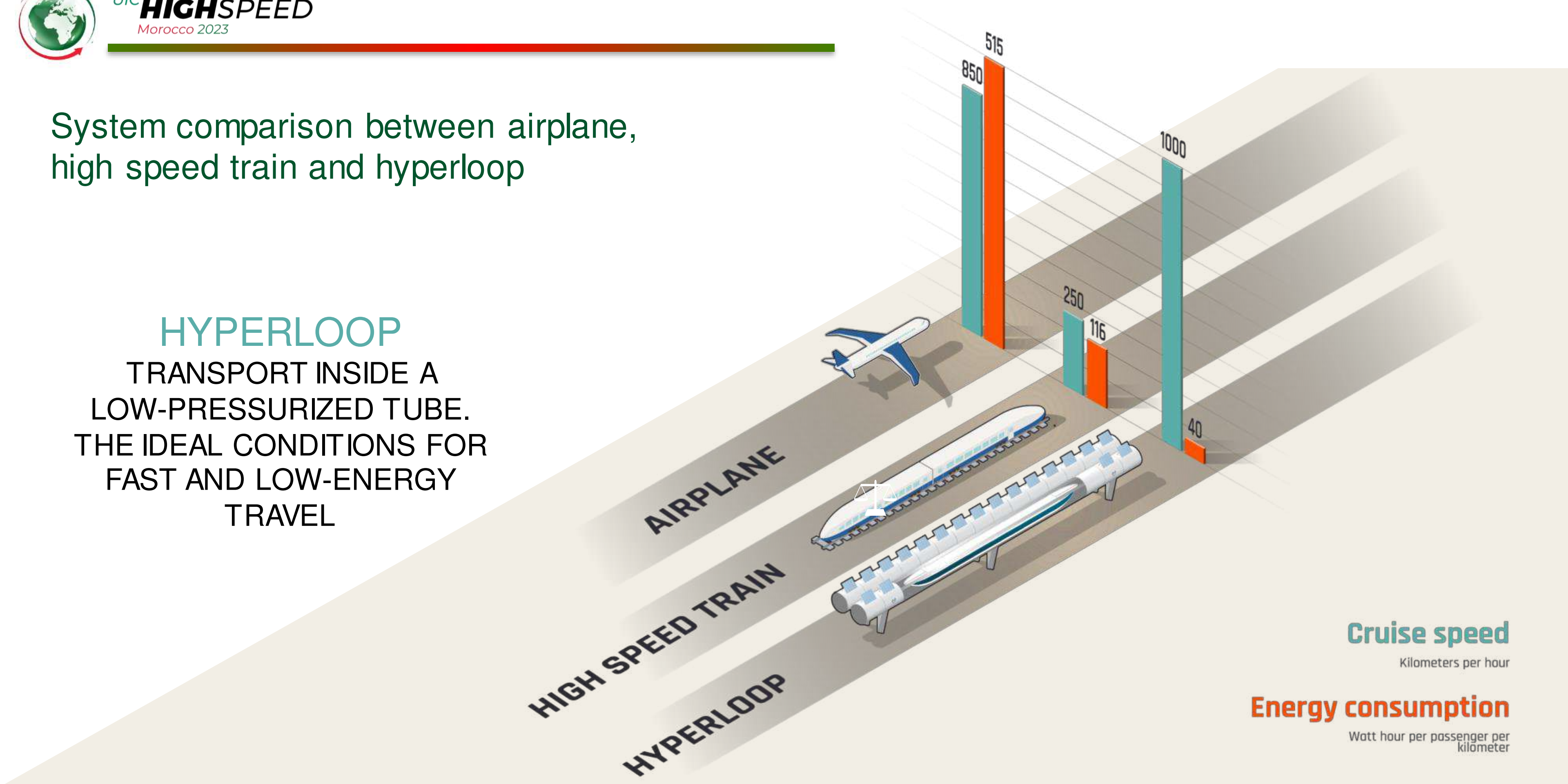


High capacity | Safe | High reliability | Autonomous | Easy implementation | Fast construction | Low noise

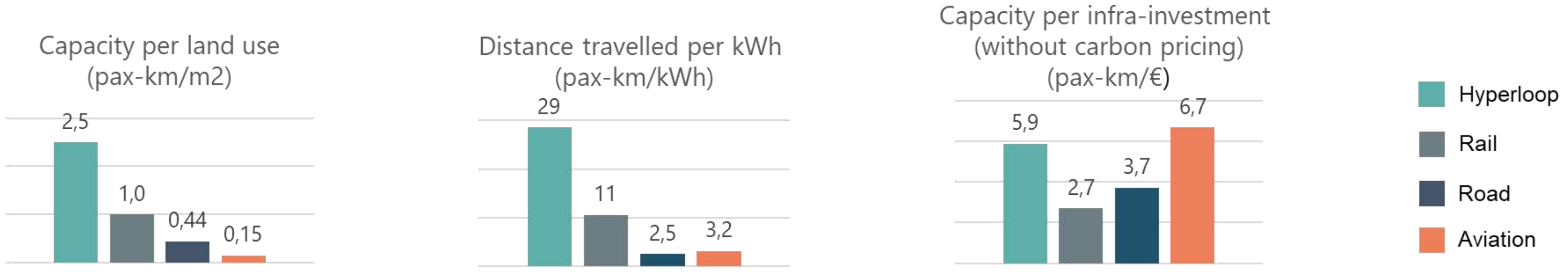
System comparison between airplane, high speed train and hyperloop

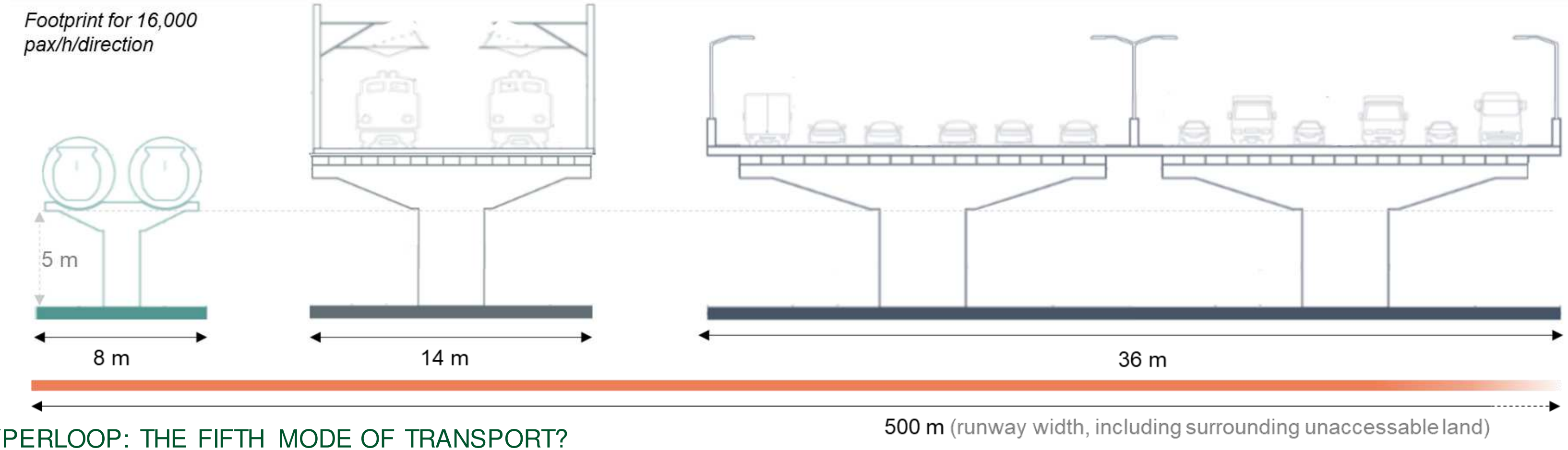
HYPERLOOP

TRANSPORT INSIDE A LOW-PRESSURIZED TUBE. THE IDEAL CONDITIONS FOR FAST AND LOW-ENERGY TRAVEL



Hyperloop provides high transport capacity with lowest land- and energy usage, at competitive infrastructure costs





Comparison of technology: technologies High-Speed-Rail, MagLev and Hyperloop differ in the main aspects of their technical data.

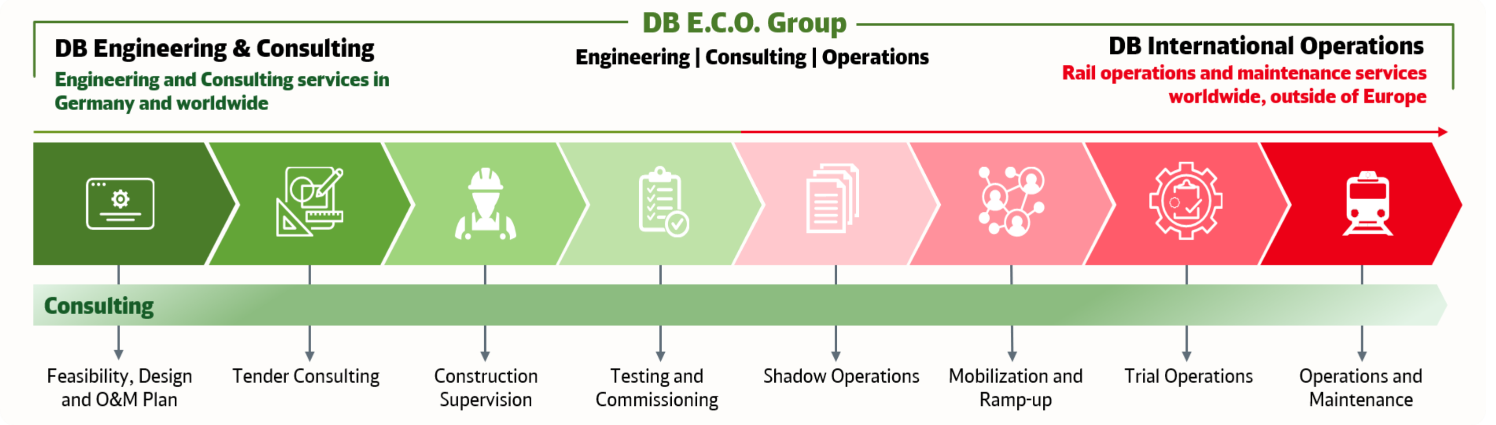
	HSR	MagLev	Hyperloop
Max. operational speed	350 km/h	600 km/h	1.200 km/h
Max. transport capacity per hour per direction	20.000 pphpd	12,000 pphpd	>20.000 pphpd
Dimension of construction	Medium	Medium	Low
Energy consumption	Medium	Medium	Low
Interoperability	High	Low	Low
Flexibility of train configuration	Medium	Low	High

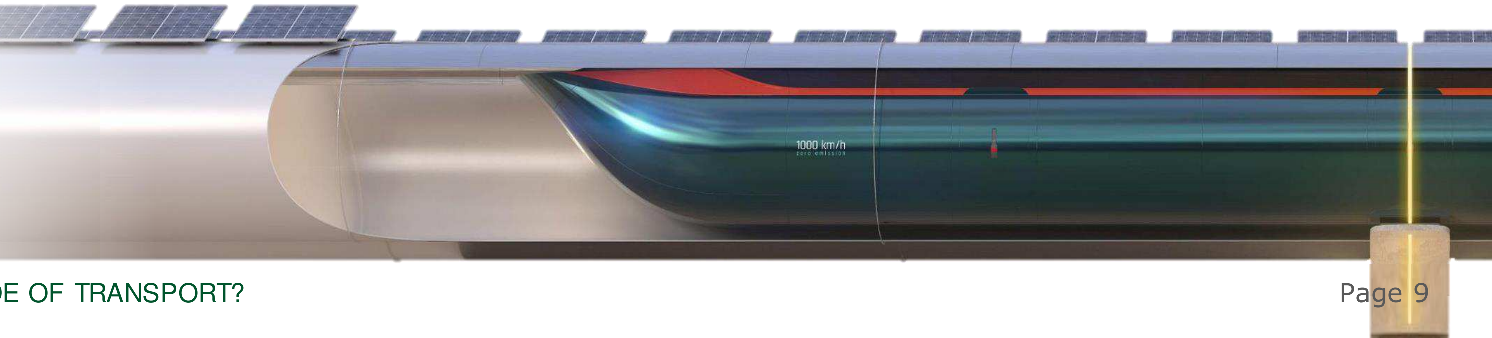
Deutsche Bahn / DB E.C.O. Group as Thought Leader

DB E.C.O. Group as a world-wide active engineering and consulting company of DB AG has established itself as a **competence center** for Hyperloop transport systems.

In this role, we maintain a **technology-open dialogue** with all **major system developers** and focus on the overall feasibility of correspond-ding projects.

Thus, we see ourselves as a **Thought Leader** for Hyperloop systems.





Operator led Hyperloop development ensuring optimal operability and project profitability

Level	Title	Lead Question / Goal
1	Operations Plan Development	What is the project aiming to achieve operationally? This sets the frame for the project.
2	Performance Specifications Development	What are the performance specifications that have to be met to deliver the operational plan?
3	Technical Solutions Design	What are technical solutions that can deliver the set performance criteria?

Today

Promoter

- Various technology developments;
- Test tracks aimed at Proof of Concepts of individual Hyperloop technology.

Proof of Technology, not operational applicability

Technical Requirements

Establishment of
- Operational Requirements;
- Standardization Requirements;
- Regulatory Requirements;

as early in the process and as far as possible without excluding technological approaches.

Proof of Operations

Goal: **Minimum Viable System**

Combines
- proof of technology; with
- proof of operational applicability; while
- meeting operational requirements; and
- standardization criteria.

Hyperloop Technology is advancing quickly. Industry and regulatory bodies need to keep track.

- Hyperloop technology has transferred **from a hype to an industry trend**.
- About hundred hyperloop projects have been proposed and there is clear public-sector and industry interest in hyperloop.
- Several Promoters are researching in this technology, focusing on Proofs of Concept and constructing Minimal Viable Systems.
- Regulatory Bodies and governmental entities showed their interest as well and are keen to drive technology.
- Notified bodies are reflecting the needs of standardization and norming.

So, what's next?

- Find **consensus of design parameters** to reach a unified technology approach for standardization and **interoperability**
- Early development of **operational, standardization and regulatory criteria at international level**.
- Check which **existing standards** and laws can be **adopted** by other means of transport (e.g., Railway, Air, MagLev, Cable Car)
- Aiming for a **Minimum Viable System** for proof of operational functionality and safety to initiate certification processes faster

THANK YOU

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SIMULATION-BASED PERFORMANCE ASSESSMENT OF PASSENGER RAIL SERVICES IN THE TRAIN VIRTUAL COUPLING SCENARIO

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Session4-2.4 New systems