Linking hyperloop vision with railway infrastructure

International Conference on European Hyperloop Technology

February 23rd, 2021
Introduction
A European deep-tech company providing key components to modernize the railway industry – developing next generation of high-speed railways all the way to application of hyperloop.

Our mission
Creating a bridge between conventional railways and the hyperloop through higher efficiency & interoperability

Key strategic directions

- **Digitalization** of conventional railways infrastructure
- **Innovative technologies** for the next generation of high-speed railways – propulsion, suspension and power electronics
- **Modal shift** from road & air through restoring existing railway lines
- **Transfer** of current transportation system into a “zero-emission” one
The big picture

The guided transportation industry has widely depleted the potential of system optimization based on simple reserves and it is now at the most important crossroads in history that will define its fate.

Share in the passenger market (USA)

19th century - the era of:
• horses and carriages
• steamships
• steam locomotives

1900 Horse & carriage domination
1908 Start of Ford Model T mass production
1949 First commercial jet airliner
1965 First Boeing 737 - the beginning of mass aviation
1997 First mass-produced Hybrid car
Since 2010s intensive tests of autonomous cars
Since 2013 hyperloop development

Drivers of change:
1. environmental regulations & post-covid recovery
2. new technologies (e.g. energy & propulsion)
3. increasing mobility demand

Reinvention
• adaptation of the existing infrastructure
• digitalization
• integration with hyperloop

Marginalization
• displacement by new technologies
• further loss of share in modal split
Our solution
Technology & IP
Main focus, core products and competencies.

Market segments¹

urban maglev

P h a s e  1 :  m a g r a i l

P h a s e  2 :  h y p e r l o o p

local

Magnetic levitation monorail with unique architectural design

150 kph (93 mph)

short-medium haul

Magnetic train combined with a conventional train (interchangeable) within the existing railway corridor

300-550 kph (186-342 mph)

long haul

Vacuum train in a tube within an existing transportation corridor upgraded from magrail and/or a brand new transportation corridor

600-1200 kph (373-746 mph)

Core products²

Linear Motion

Power Electronics

Internet of Things (IoT)

Core competencies

Integration:

Electromagnetism & electrical engineering

Mechanical & civil engineering

Sensors, electronics & data analytics

¹ Other potential market segments include CRI – improving the efficiency of particular sections of conventional railway lines or applications outside the guided transportation industry.

² All core products are usable in each of the market segments.
Key features
Innovative upgrade of conventional infrastructure introducing a new mode of propulsion and interface between vehicles & infrastructure.

Infrastructure

- **Standard-gauge** ground-level track
- **Linear motor** in between the rails („third rail“)
- **Levitation and guidance „rails“** at the edges of sleepers
- **Single track** sufficient for **two-way operations** (for most local/regional lines)

Applying **railway norms** and **standards** to facilitate **homologation** process

Vehicle

- **Single car**, 2 bogies
- Possible **virtual coupling**
- **Capacity**: 10-70 passengers
- **Weight**: 5-20 tons gross
- **Speed**: up to 30-50 kph on wheels, levitation beyond

Integration of a new layer over existing infrastructure
Main advantages to conventional railways
Magrail technology provides attractive parameters for local and regional lines.

- Shorter **headway distance**
- Higher **acceleration on inclines** (up to 10%)
- Better **dynamics** at the same **geometry & curve radius**

### Operational

- Higher **frequency** (i.e. small pods every 10 minutes)
- Increased **flexibility**

### Customer-oriented

### Environmental

- Lower **energy consumption** per passenger-km at the same speed
- **Noise** reduction (key in dense urban areas)
Alternatives and competitive landscape

Magrail offers a well-balanced combination of operational, customer-oriented and OPEX advantages at a reasonable CAPEX.

<table>
<thead>
<tr>
<th>Line renewal (conventional EMUs)</th>
<th>Line renewal (magrail)</th>
<th>Electric buses on road</th>
</tr>
</thead>
<tbody>
<tr>
<td>✓ Proven and mature technology</td>
<td>✓ Increased performance and efficiency of asset use</td>
<td>✓ No infrastructure CAPEX</td>
</tr>
<tr>
<td>● Moderate CAPEX</td>
<td>✓ Low OPEX (-25-40% vs. conventional)</td>
<td>❑ Vehicle CAPEX and OPEX to be compared</td>
</tr>
<tr>
<td>✗ High OPEX</td>
<td>✗ Additional infrastructure CAPEX (EUR 3.5m; alternative configuration approx. EUR 1-1.5m)</td>
<td>✗ Dependence on road congestion</td>
</tr>
<tr>
<td>✗ Operational and customer-oriented limitations</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**LEGEND:**
- ✓ Strength
- □ Neutral
- ❑ To be evaluated
- ✗ Weakness
Technological progress
Infrastructure and vehicle development financed with EU funds.

2019: Proof of Concept (PoC)
- Aim: to prove that the pod can **accelerate**, **levitate** and **brake**
- **1:5 scale** pod, first generation of linear motor (1:1 scale)

2020: Mid-scale tests
- Aim: to verify **configuration** of second-generation **linear motor**
- Length: **50m** (to be extended to 100m to improve control), gauge: **1,000mm**

2021-2022: Full-scale test track
- Aim: full-scale tests of bogie and infrastructure (incl. levitation) at **up to 150 kph**
- Length: **700m**, gauge: **1,435mm** (standard)
- Construction: H1.2021, **tests: H2.2021-H1.2022** (to be extended in 2022: curve and switch)

2023-2024: Pilot implementation
- Test of the complete system (incl. entire vehicle)
- Certification (preliminary)
Contact:

Milan CHROMIK
Business Development Director

+420 720 043 223
m.chromik@nevomo.tech