Die Schiene als Rückgrat eines nachhaltigen Multi-modalen Transportsystems

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Setting the Scene

- Transport of people and goods is essential for society and economy

- The transport sector is faced with enormous challenges: climate change, NO_x, fine dust, ...
- Rail can become the mode of transport of the 21st century – if it provides a convincing offer

The Importance of Railways

Climate change

Congestion

Sustainability &
Economic growth

Clean energy

Capacity

Safety

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Four Generations ...

1.0
Enabler of the industrial revolution

2.0
International networks for passengers and freight - dominating surface transport

3.0
Major innovations – yet on the decline

? 4.0
Backbone of the multimodal transport chain

1800 1880 1950 2020

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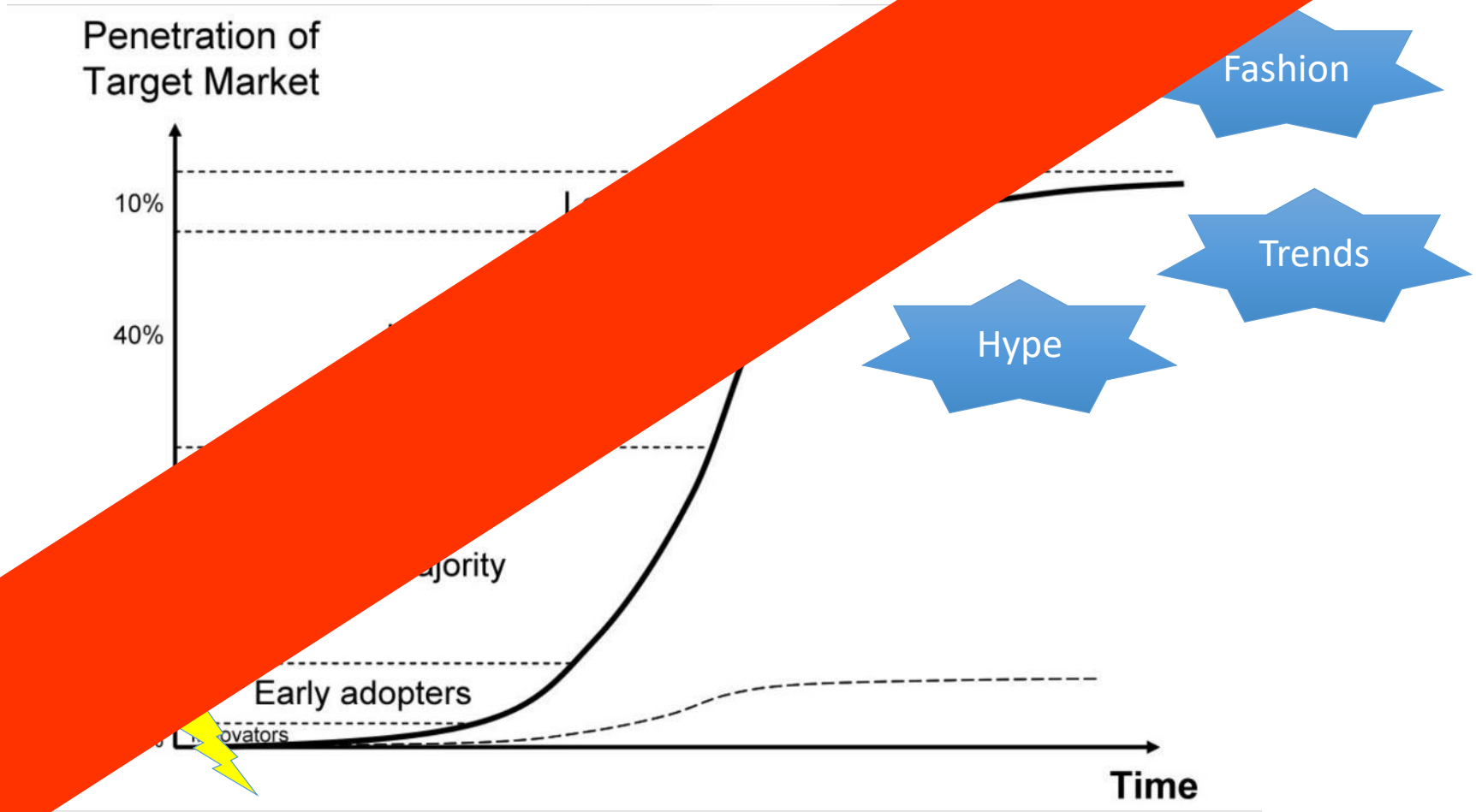
Innovation means to introduce a **new application, product, service, or proce** chain) that increases **customer value**



Fashion

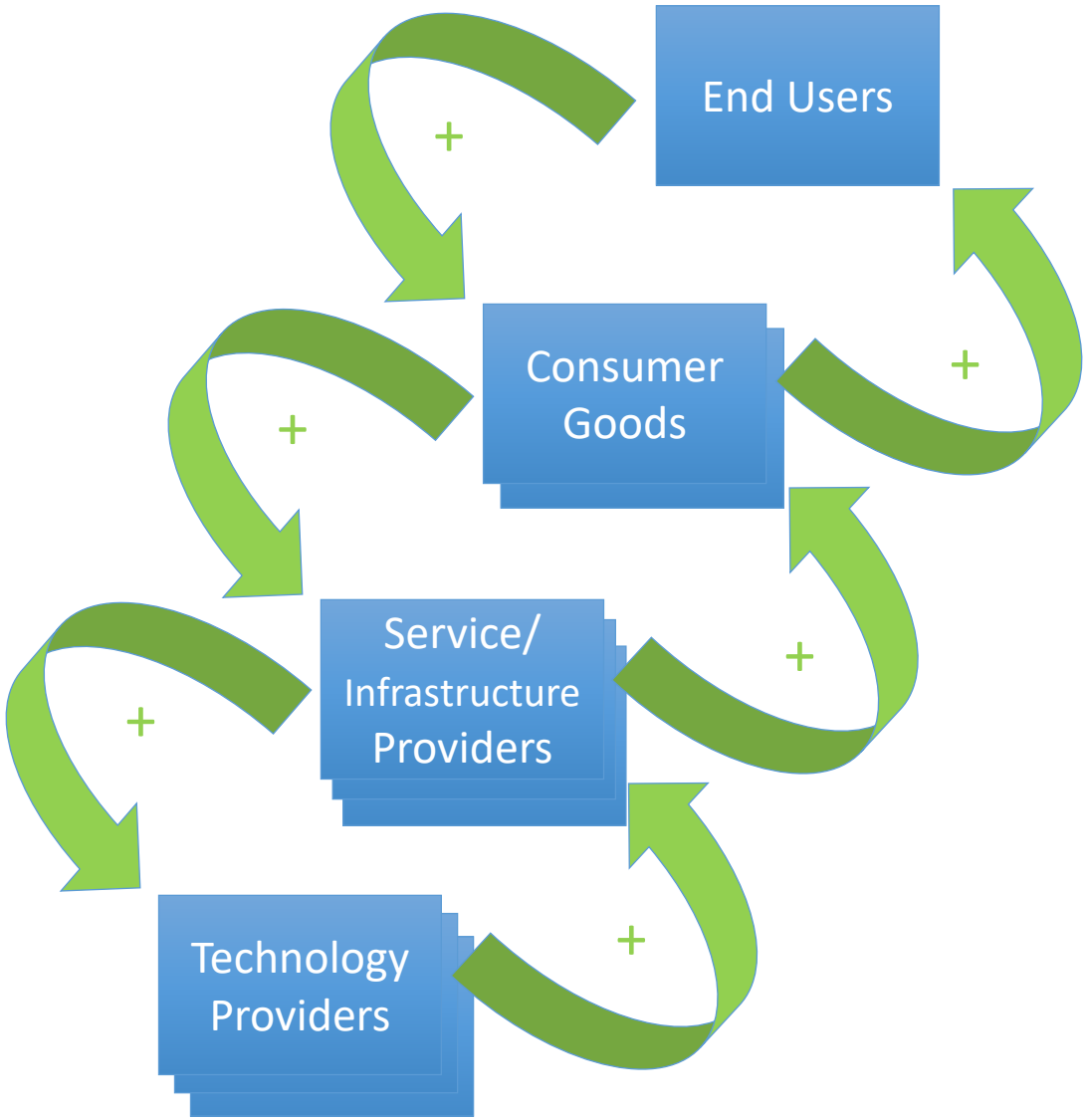
Trends

Hype


Usefull
Useless

Innovation Chains

Historic Examples:
Vegetables, Cattle,
Beer carried by rail



Current Examples:
Smart phones,
Google, Facebook,
Booking.com, ...

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The Innovation Ecosystem for Rail

Users

- Availability of service (no forced choice)
- Total travel time
- Hassle-free
- Cost/affordability
- Quality/reliability

Enablers

- Technology
- Capabilities
- Regulatory framework

Providers

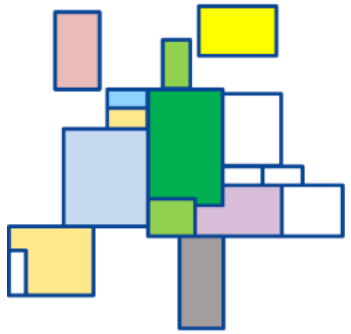
- CAPEX/OPEX (incl. energy)
- Revenue generating
- Fixed cost vs. variable cost
- Movable assets (residual value)

Policy

- Efficient transport system
- Affordable (strains on budget)
- Environment/ decarbonisation
- Public Safety

The Innovation Cycle in Rail is 25 Years

Rail has a **twofold structural innovation problem**

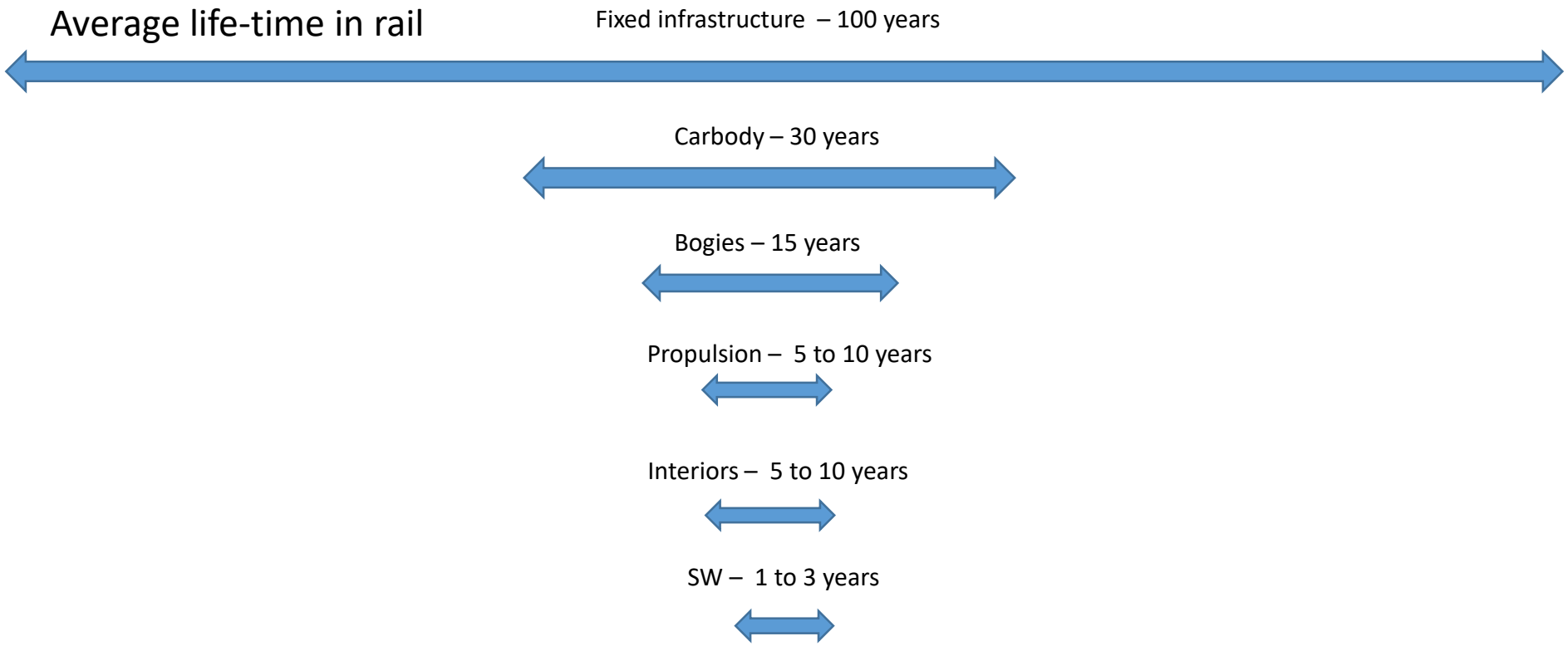


1) National fragmentation
   (N x effort, 1/N market)
2) Dynamic network
   (innovation can be local, or the elevation of the entire network to a new status)

How to get technology into rail – quickly?

We Need to Think Systems

Modularity is vital



Innovation and Interoperability are no contradiction – there is no innovation without interoperability

How did the price of Coca-Cola evolve from 1886 to 1959?

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Soft Innovation

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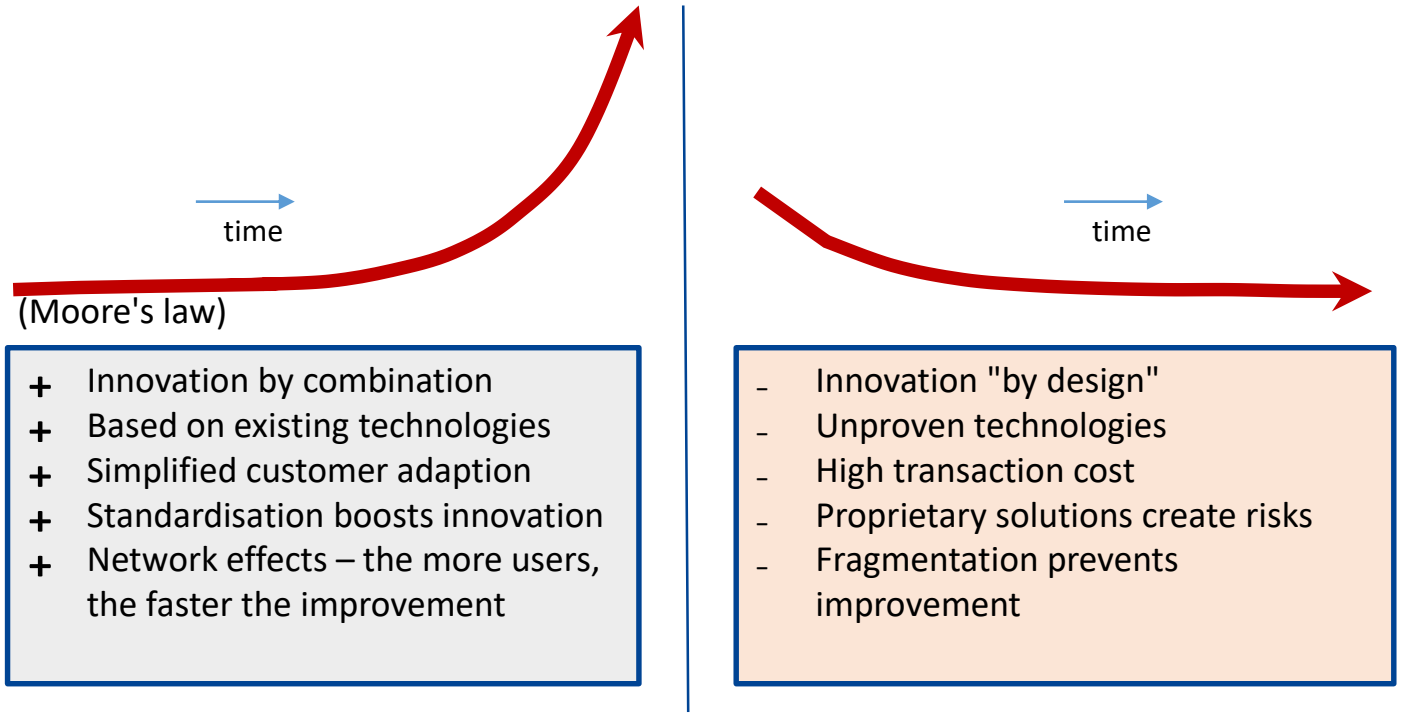
Some Rail Examples

Innovation	Locality	Soft/hard	Comment
From **steam** traction to **Diesel** traction	largely local	soft	Provided sufficient fuel is available, both steam and Diesel locomotives can run anywhere on the network
Electric traction	network	semi-soft	Diesel, steam can continue to run under catenary; unless there is batteries ("fuel on board"), electric traction depends on the provision of an adequate energy supply infrastructure
Air condition in passenger coaches	local (to coach)	soft	Practically no impact on the network (? Weight, EMC)
New materials for carbodies	local	soft	Passive safety? Fire safety?
Self-steering trains – no moving parts in switches in the infrastructure	local + network	very hard	Saves massively maintenance cost for switches in infrastructure – however, ALL trains need to be converted – a "normal" train can no longer run once the first switch is converted across the new switch!
Automated Train Operation (ATO)	largely local	semi-soft	ATO exists since quite some time in closed (urban) rail networks
Universal geographic safety logic	local + network	semi-soft	migration necessary, including regulatory framework

How to Position Rail in the Innovation Game?

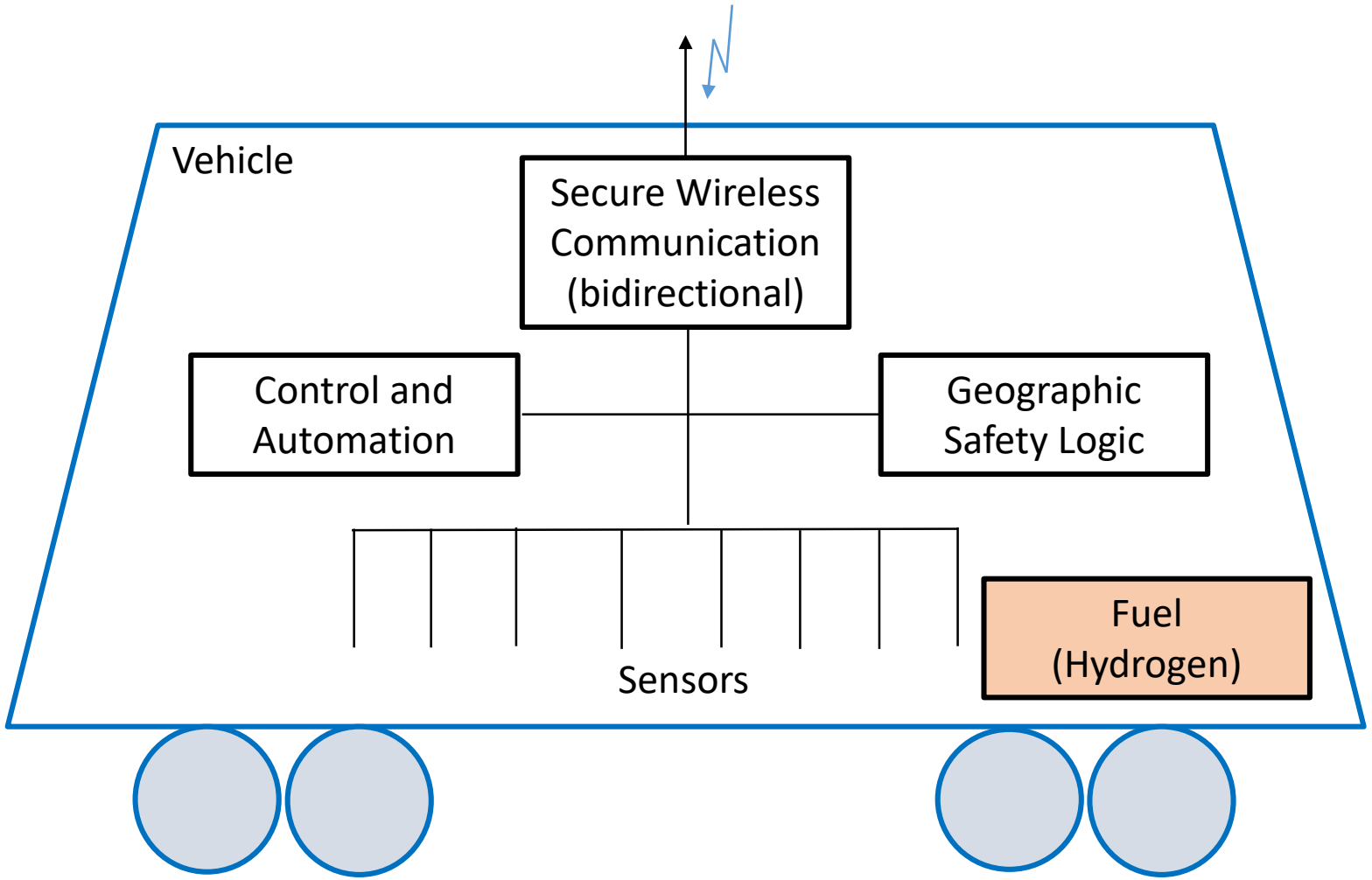


+ Innovation by combination + Based on existing technologies + Simplified customer adaption + Standardisation boosts innovation + Network effects – the more users, the faster the improvement	- Innovation "by design" - Unproven technologies - High transaction cost - Proprietary solutions create risks - Fragmentation prevents improvement

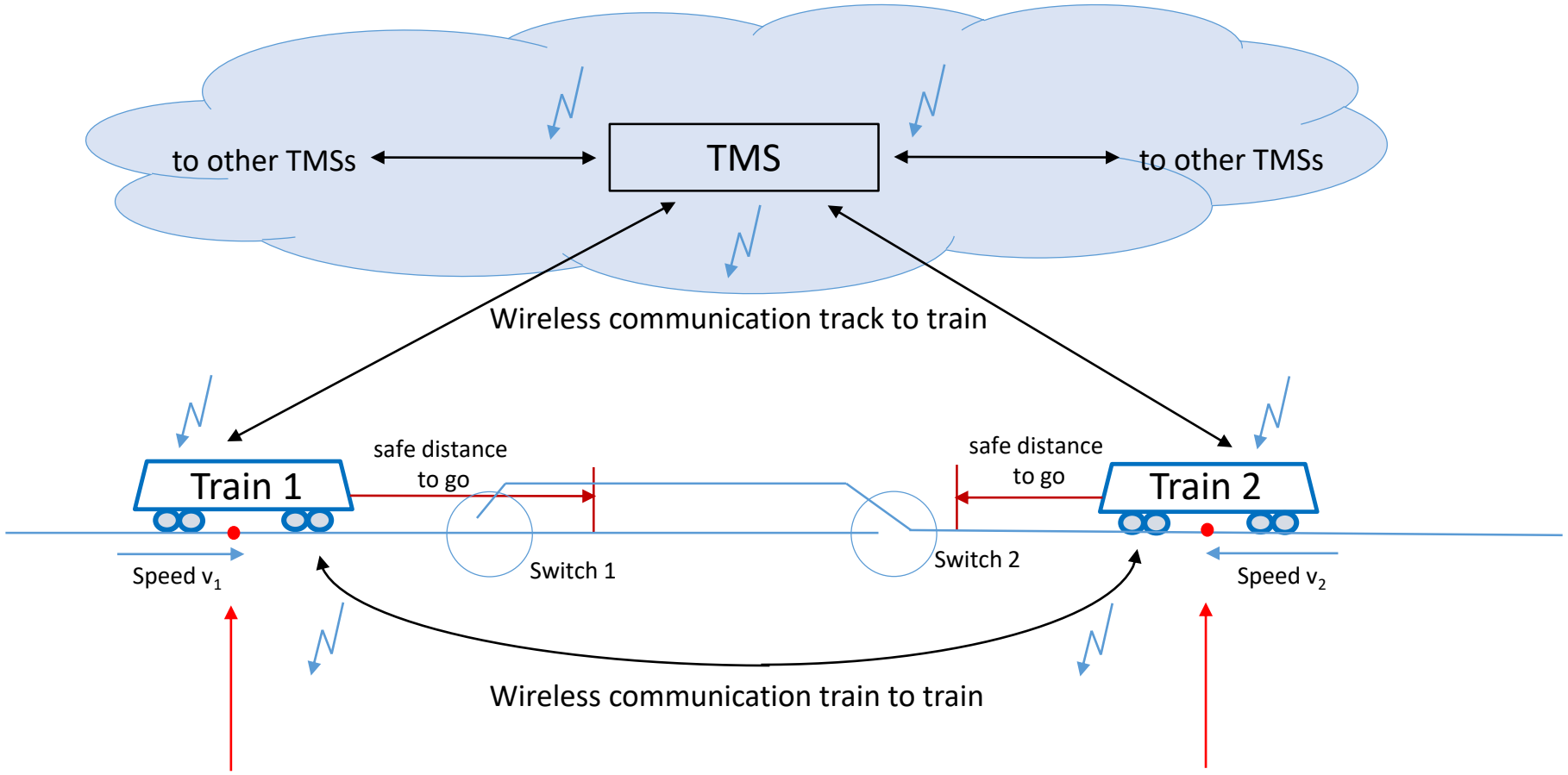
The focus has to be on **local** and **soft** innovation, and on creating the appropriate **enablers**

- Technical (comms networks, electricity on wagons, ...)
- Regulatory (authorisation scheme)
- Organisational (S2R)

From Fixed Cost to Variable Cost

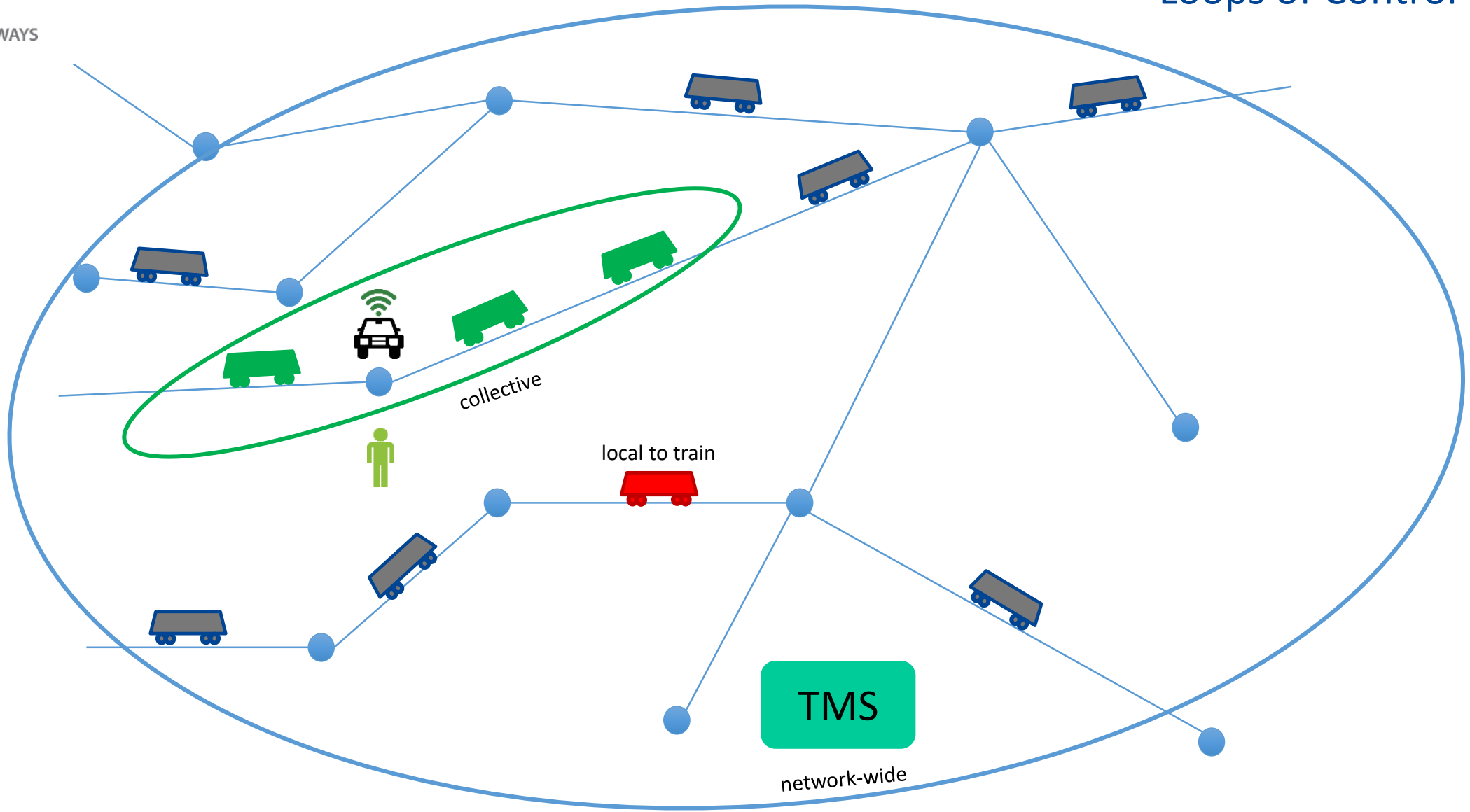


The Vision for the Future Control Loop



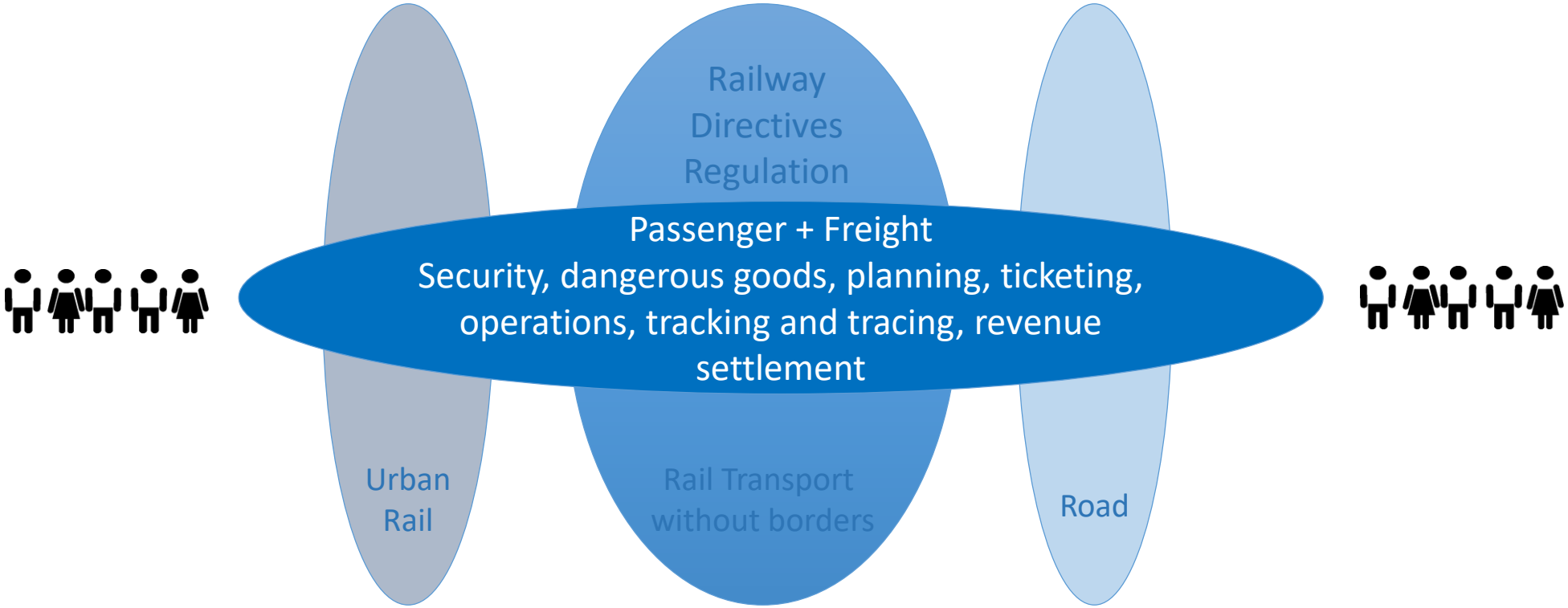
Position (train/vehicle) measured in geographic coordinates

Loops of Control



Multimodal Integration

Digital technology can be disruptive in **all aspects of the transport chain,**
also helping to integrate transport modes (seamless multi-modal transport)



Single shared transport system – journeys procured digitally using the combination that best fits customer needs - without multimodality, there is a limited future for digital rail!

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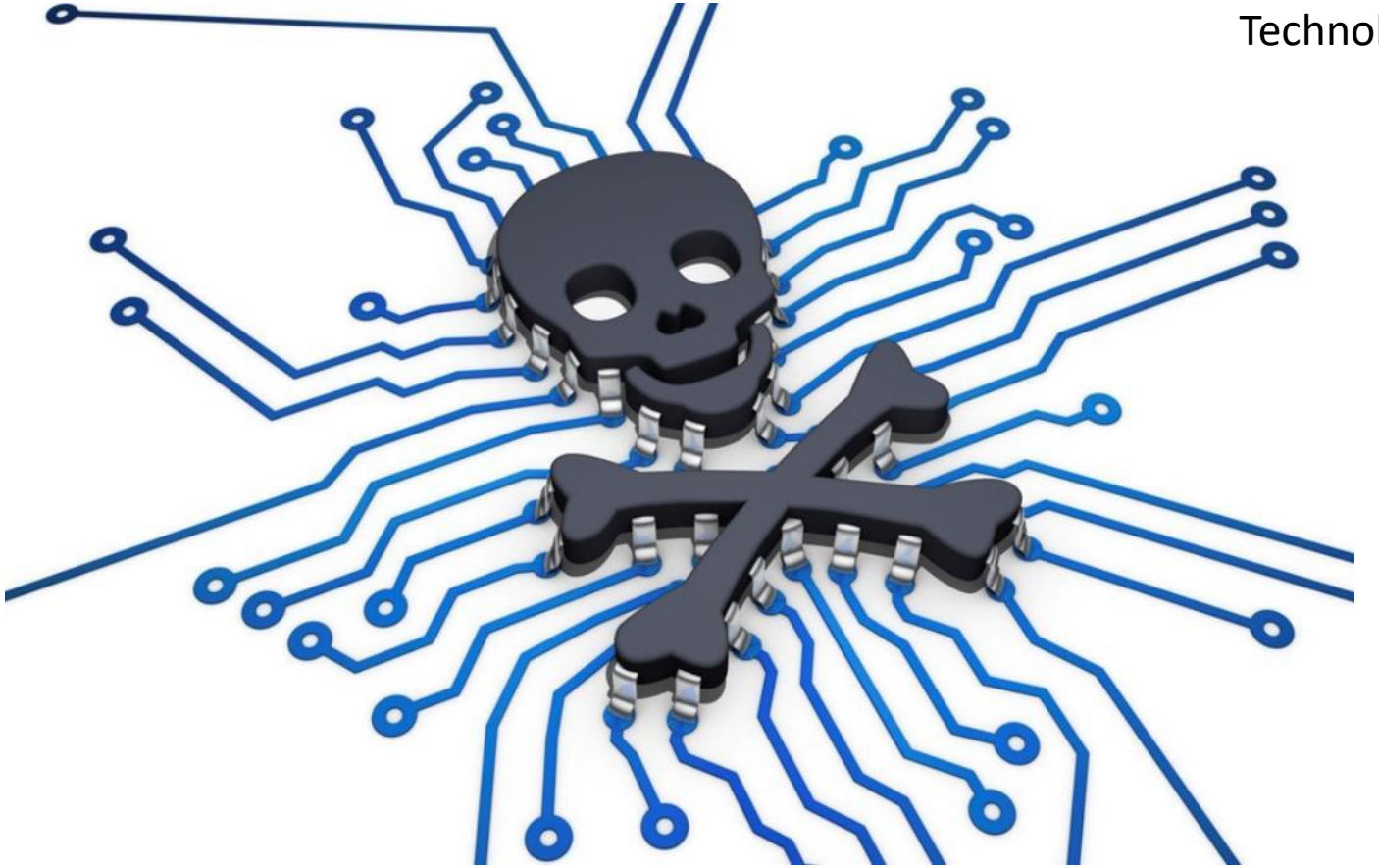
The Challenge

Technology = solution + problem



Cybersecurity will be a design requirement of the system – safe operation has to be solidly rooted in physical reality

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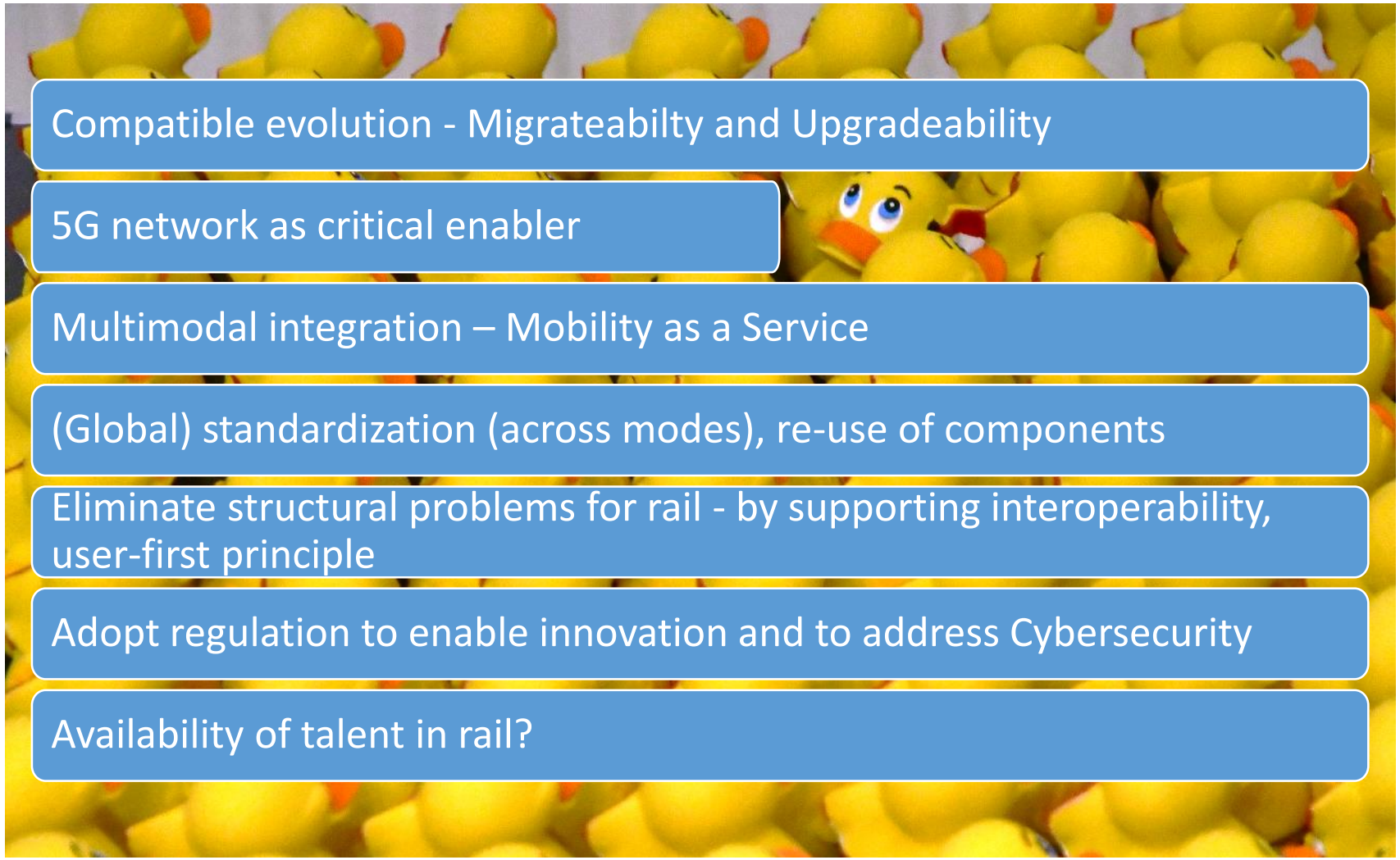
Conclusion



"Mainstreaming" rail on the technology side

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