I-AT Seminar Weeze Airport

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Introductie Joop

Founder of The Future Mobility Network Company (2 years ago)

Learning by Doing approach now preparing for larger scale implementations in public transport

FMN has 3 lines of business: smart mobility, smart logistics, smart shipping.

Joop is currently **Knowledge Manager** of several project

The Ministry of Infrastructure and Environment and Rijkswaterstaat (RWS)

The Interreg Automated Transport project, Province of Gelderland.

The AVLM project in the MRDH region (23 Municipalities located South West in NL)

The Research lab Automated Driving TU Delft (RADD)

Joop is **'Use Case designer'** Automated Driving as a Service **empowering public** companies with partners in Fieldlabs deploying shuttles.

ESA ESTEC, Space Center Noordwijk with Arriva (DB)

Haga Hospital Shuttle with HTM

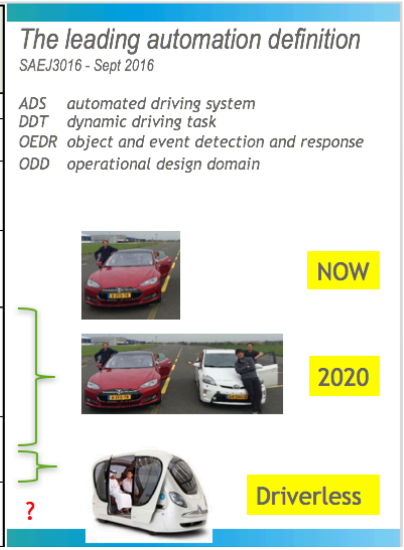
Drimmelen shuttle project with Arriva (DB)

Change……. the future of mobility! (not more but smarter)

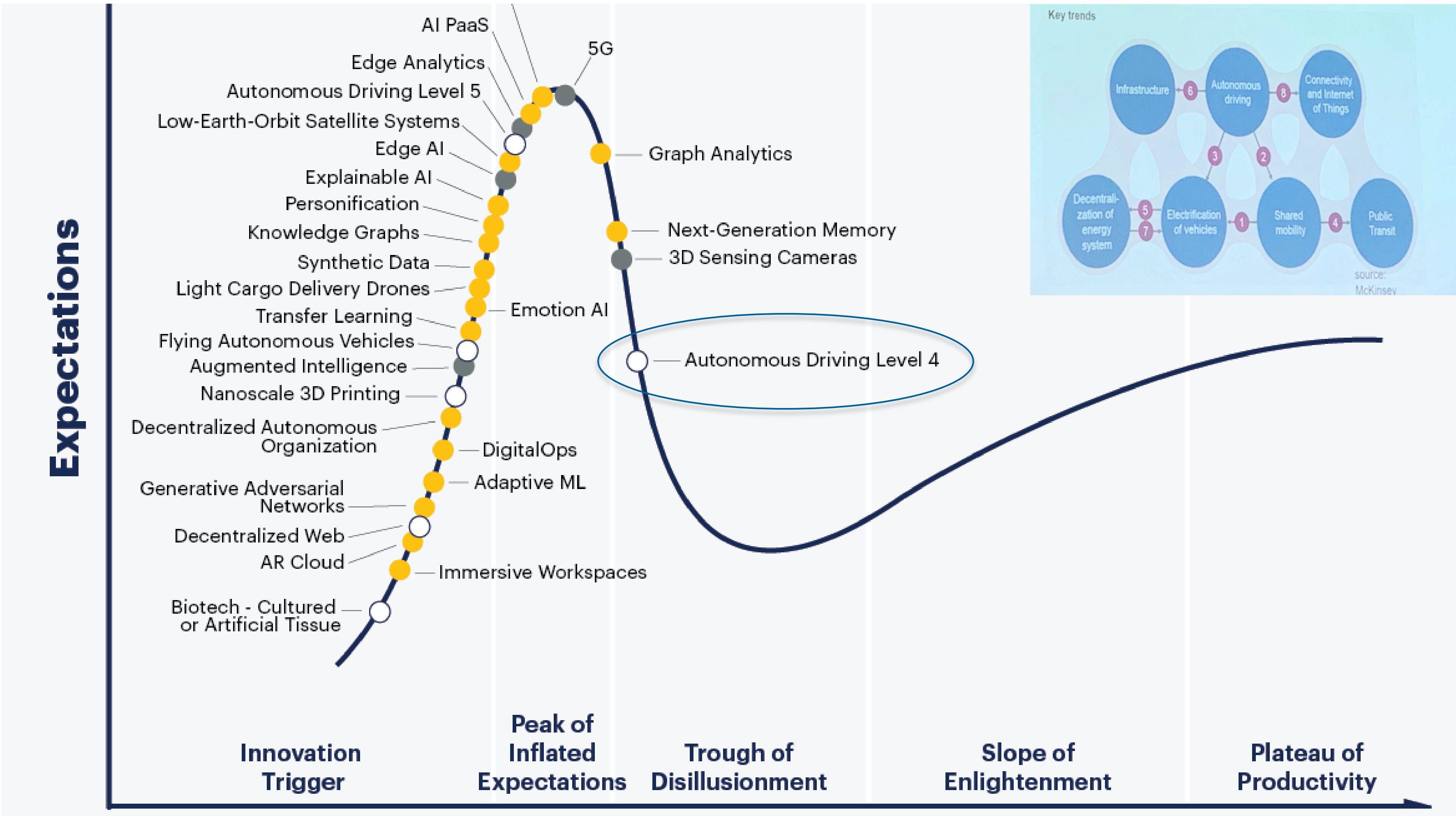
Agenda

1. Introduction.
2. The future of mobility.
3. Low speed shuttles in Public Transport: Overview of pilots (NL, DE, International).
4. Lessons Learned to share.
5. Topics:
    1. General Challenges and solutions: Vehicle technology and legal regulations
    2. Business Cases

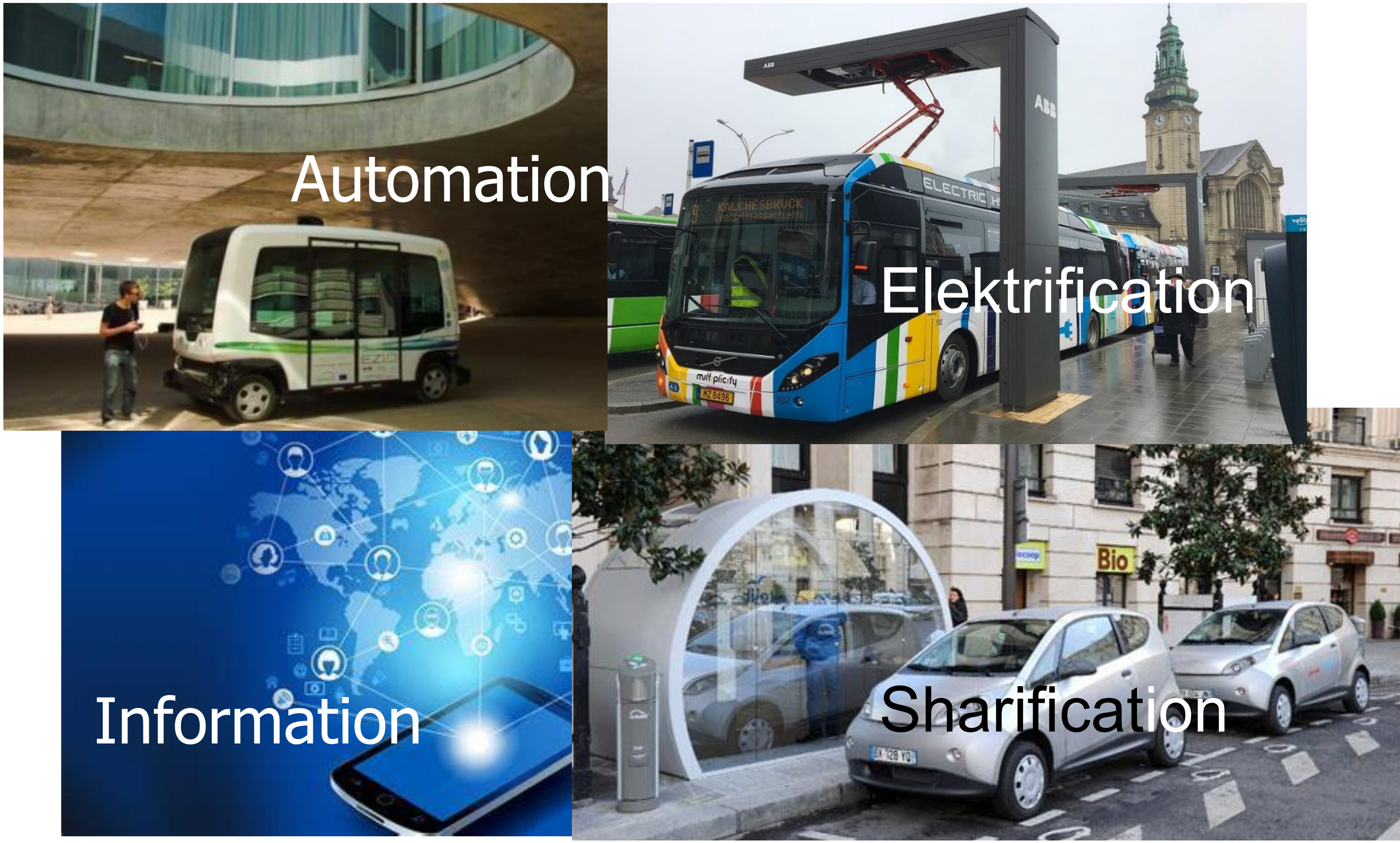
Level	Name	Narrative definition	DDT: Sustained lateral and longitudinal vehicle motion control	DDT: OEDR	DDT fallback	ODD
Driver performs part or all of the *DDT*						
0	No Driving Automation	The performance by the *driver* of the entire *DDT*, even when enhanced by *active safety systems*.	*Driver*	*Driver*	*Driver*	n/a
1	Driver Assistance	The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*.	*Driver* and *System*	*Driver*	*Driver*	Limited
2	Partial Driving Automation	The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the *driver* completes the *OEDR* subtask and *supervises* the *driving automation system*.	***System***	*Driver*	*Driver*	Limited
ADS ("*System*") performs the entire *DDT* (while engaged)						
3	Conditional Driving Automation	The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to *DDT performance-relevant system failures* in other *vehicle* systems, and will respond appropriately.	*System*	***System***	*Fallback-ready user (becomes the driver during fallback)*	Limited
4	High Driving Automation	The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	***System***	Limited
5	Full Driving Automation	The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	*System*	**Unlimited**



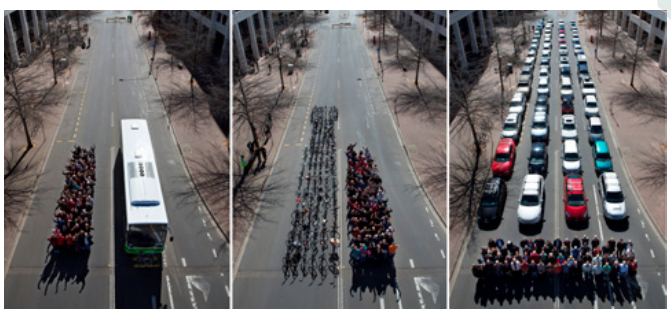
First Today..’Disillusionment’
Gartner Hype Cycle and automated shuttles at SAE level 4



Technology Trends: not 1 but at least 4 trends interacting



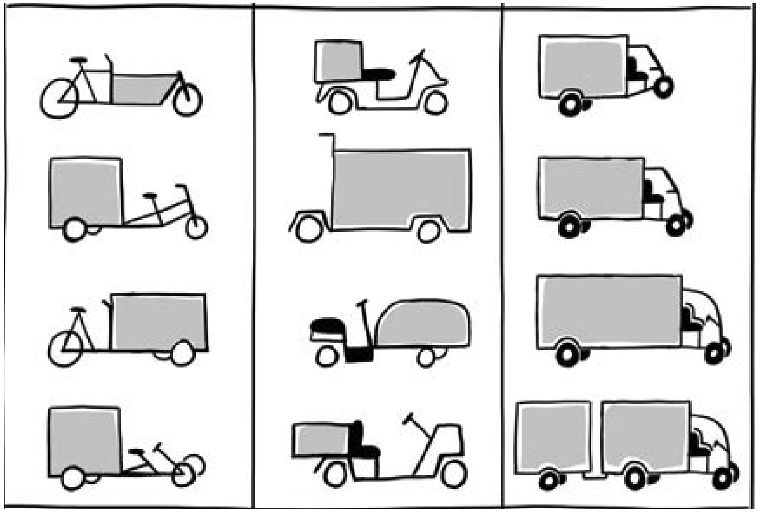
Trends could solve spatial issues (Space required for mobility)

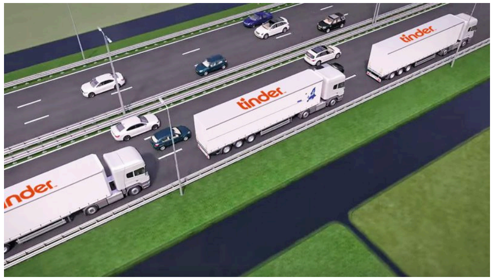


Source: © We Ride Australia.


Verkehr: Derzeit HOCH - Tendenz weiter steigend Mautgebühr: 98,- €
Nächste Ausfahrt zu Parkhaus und TuBUS in 120 m
GL
Tu 2 Degerloch
BUS
Car2go
TuBUS Station Olgaeck
Lieferanteneinfahrt
NearBy Factory
Autonomous Parking
3D

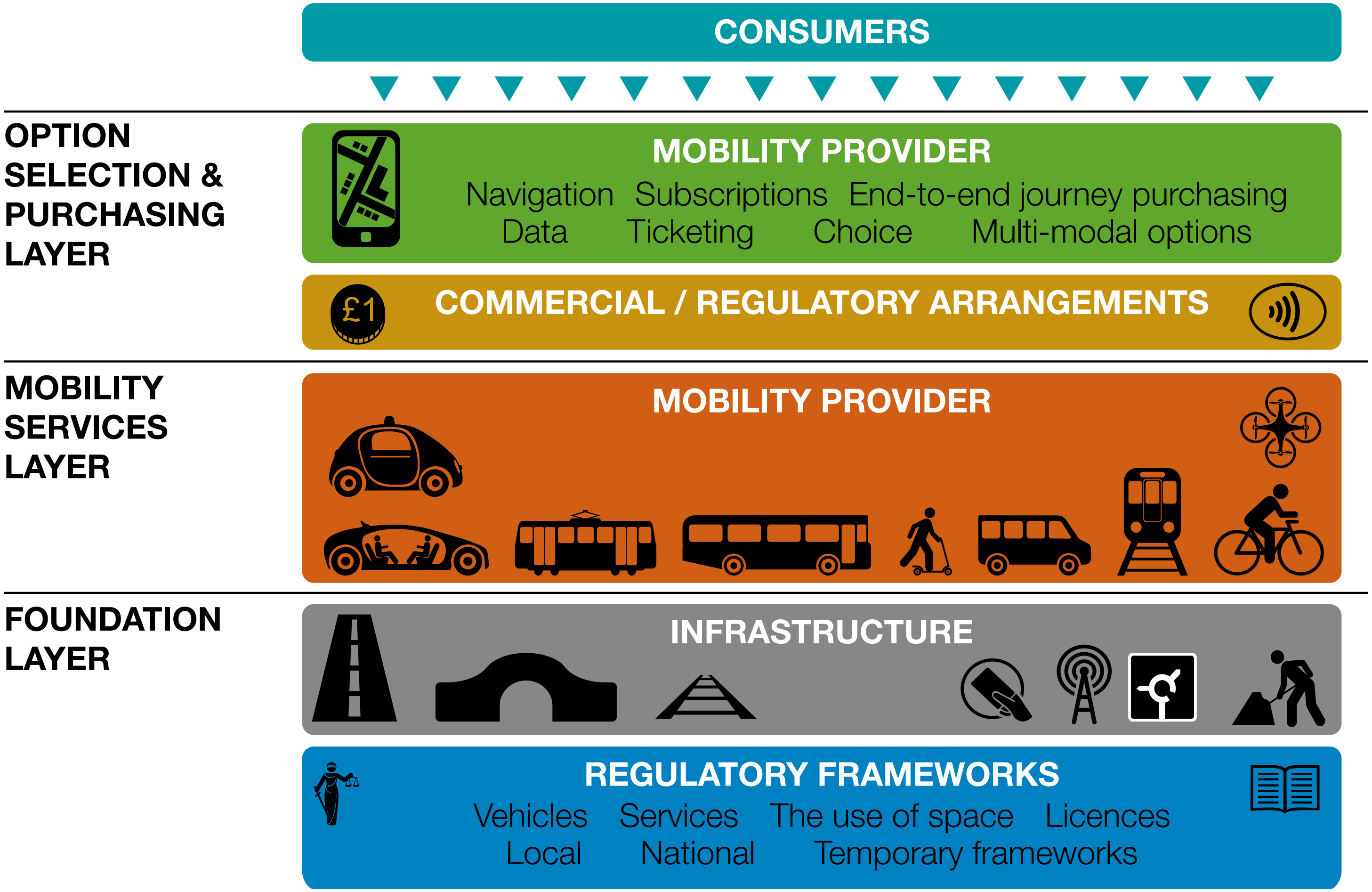
In city's space is limited and efficiency a must: To transport/deliver goods. Automation could be a solution.





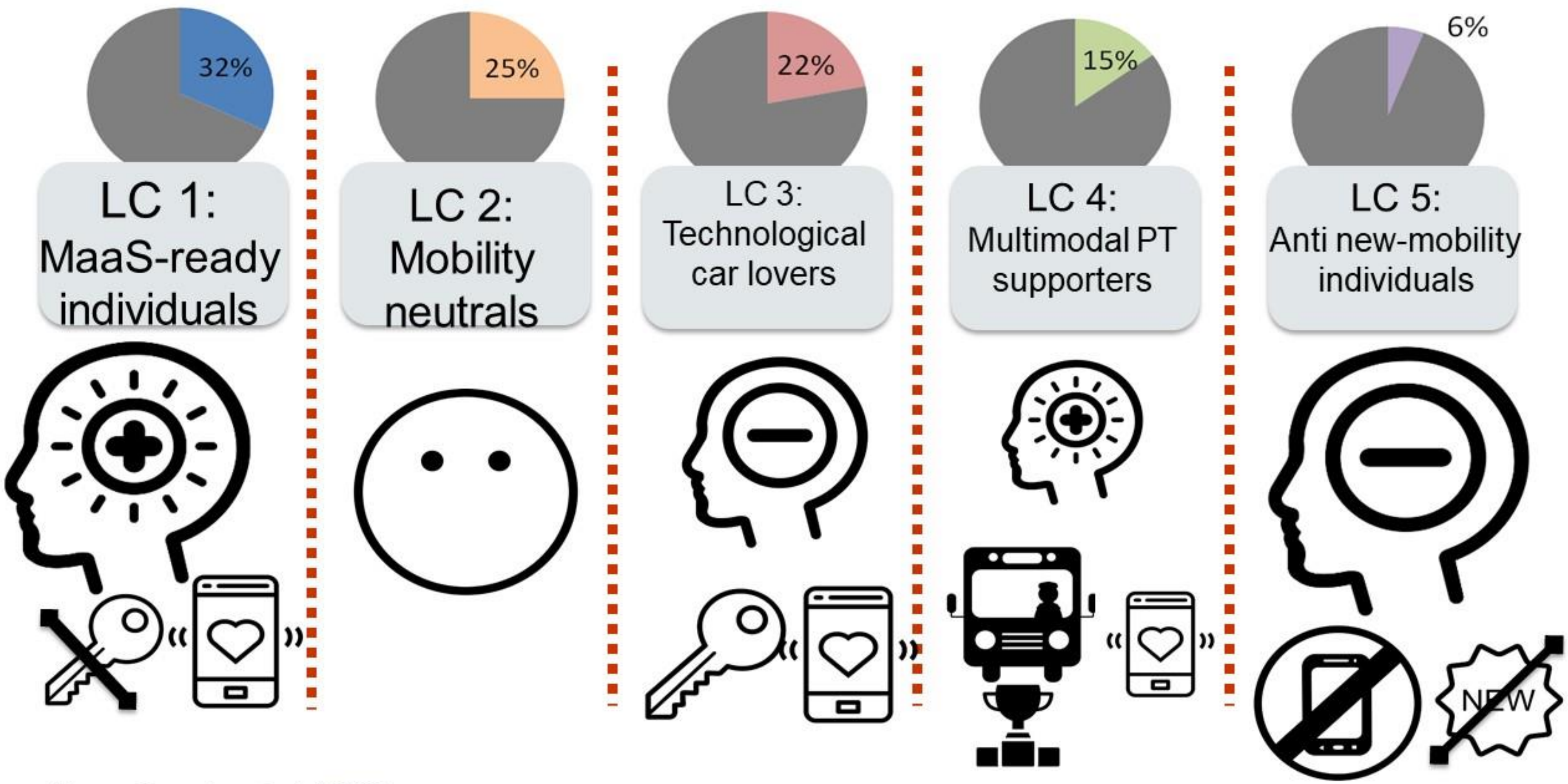
Afbeelding 3.2: Autonome LEVV. (Foto: Deutsche Post)

UITP Defined Layers of the future mobility system



Mobility options selection:
MaaS-App, PT-Hubs-Connectors and last mile (micro) mobility

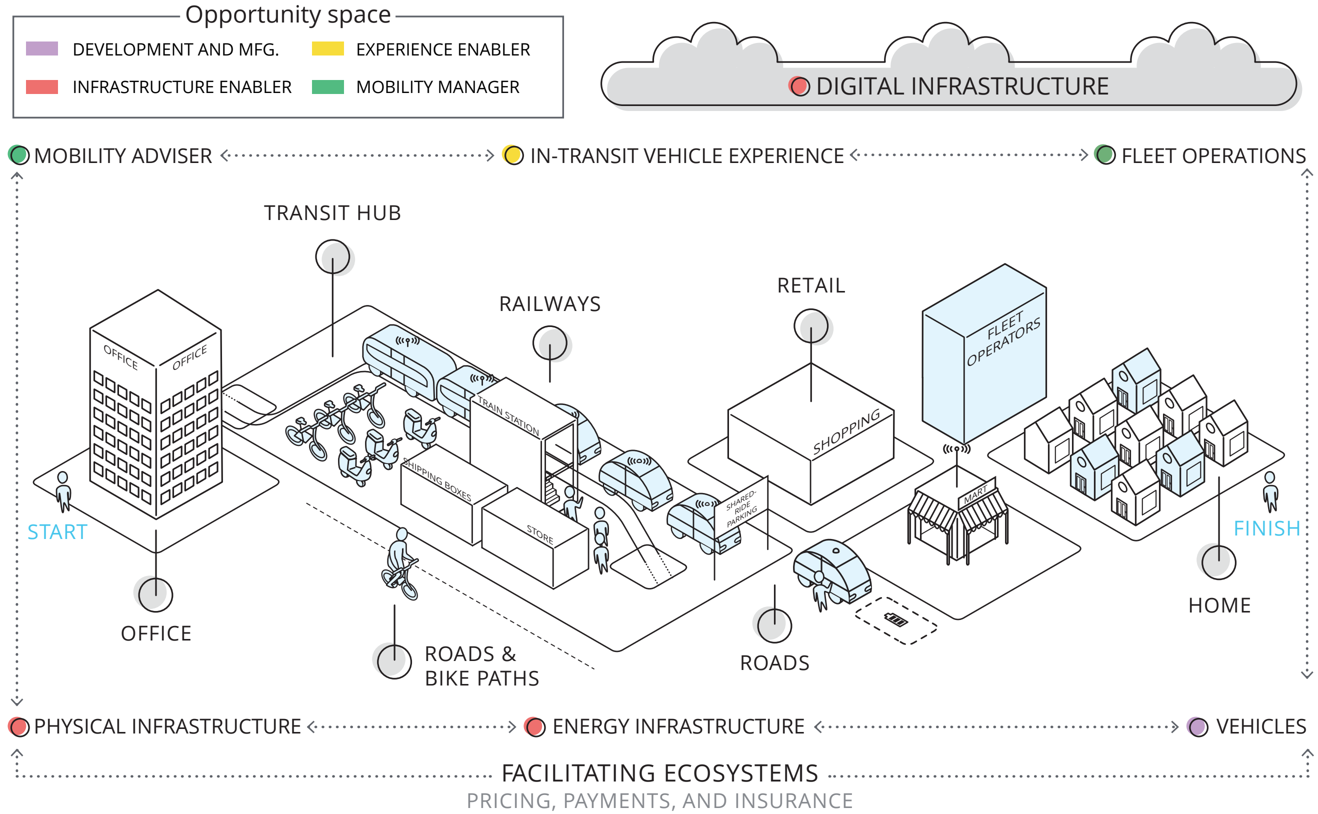
The user will make his modality choice



Alonso-Gonzalez et al. (2019)

Choices will be based on quality/reliability and pricing in the future mobility eco system.

The future mobility ecosystem



Source: Deloitte analysis.

Today: Low speed automated shuttles

Figure 1: Available examples of low-speed automated shuttles
Note: from left to right: Local Motors Olli, EasyMile EZ10, Navya Arma

- Route Infra assesment
- Infra adjustment/requirements
- Localisation
- On board attendant and remote intervention
- Accessibility

Table 1: Typical Characteristics of Low-Speed Automated Shuttles

Metric	Units	Typical Range
Passenger Capacity	pax (total)	10-15
	pax (seated)	4-8
Weight	lbs. (vehicle + pax)	6,000-7,000
Speed	mph (top)	25-35
	mph (cruising)	10-12
Range	hours	5-10
	miles	30-60

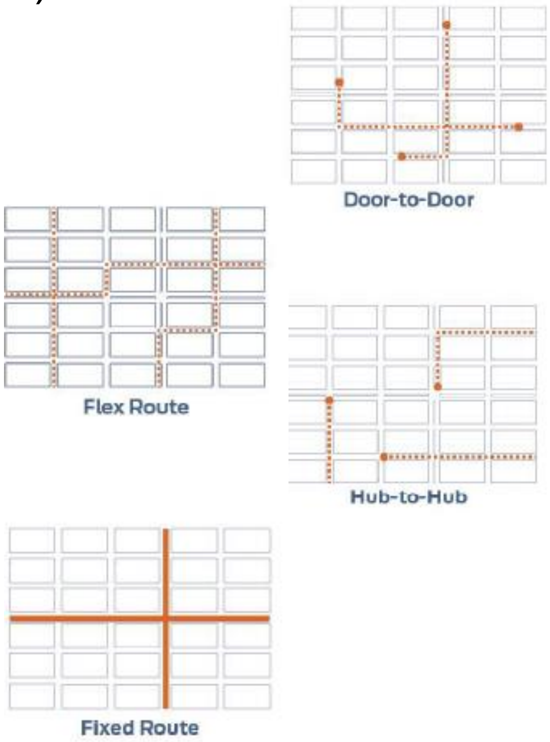
Note: Ranges are based on specifications for shuttles such as the EasyMile EZ10, Local Motors Olli, and Navya Arma. Other shuttles may vary in size, weight, speed, and range. As these shuttle vehicles are rapidly developing, specifications for any particular model may change.

Driverless Public Transport (PT) Deployment

“Driverless PT is a form of PT which can be operated without the required presence of a driver or attendant in the vehicle.”

- New routing/service options (e.g. dynamic in stead of fixed)
- A higher capacity
- Supply and demand coordination
    - Reduction of operational costs
    - Improved financial viability
- Efficient operation and fleet management
- Passenger oriented services

- Increased safety
- Reduction of costs
- Increase of flexibility/control
- Increased passenger experience

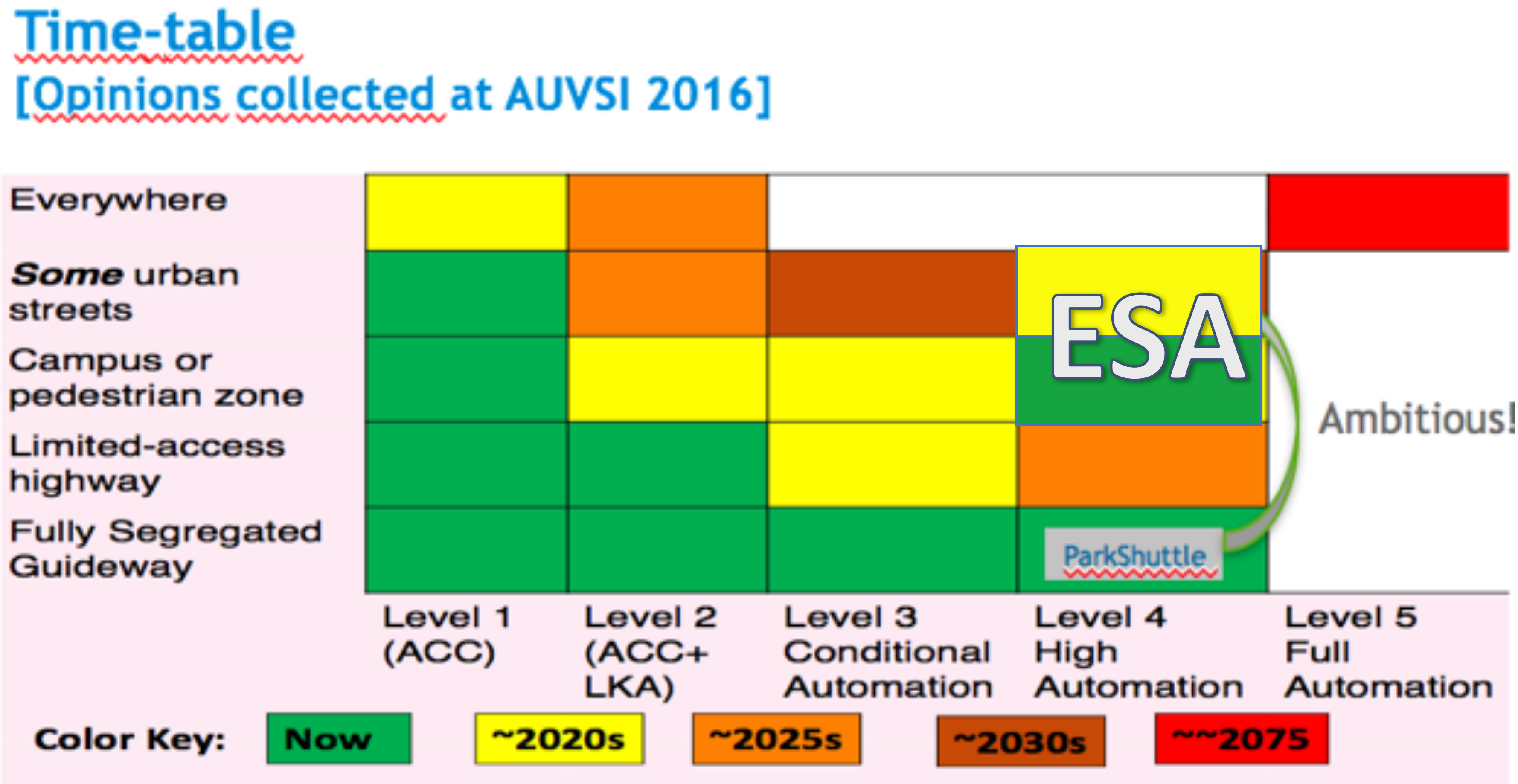


Learning by Doing (NL) / Learning by Experience (DE)

Flexible On demand Driverless (EU)	Low speed Customer focus lacking Slow development
Access rural areas First & last mile Inclusive mobility	Interaction bicycles/pedestrians Unions Social safety

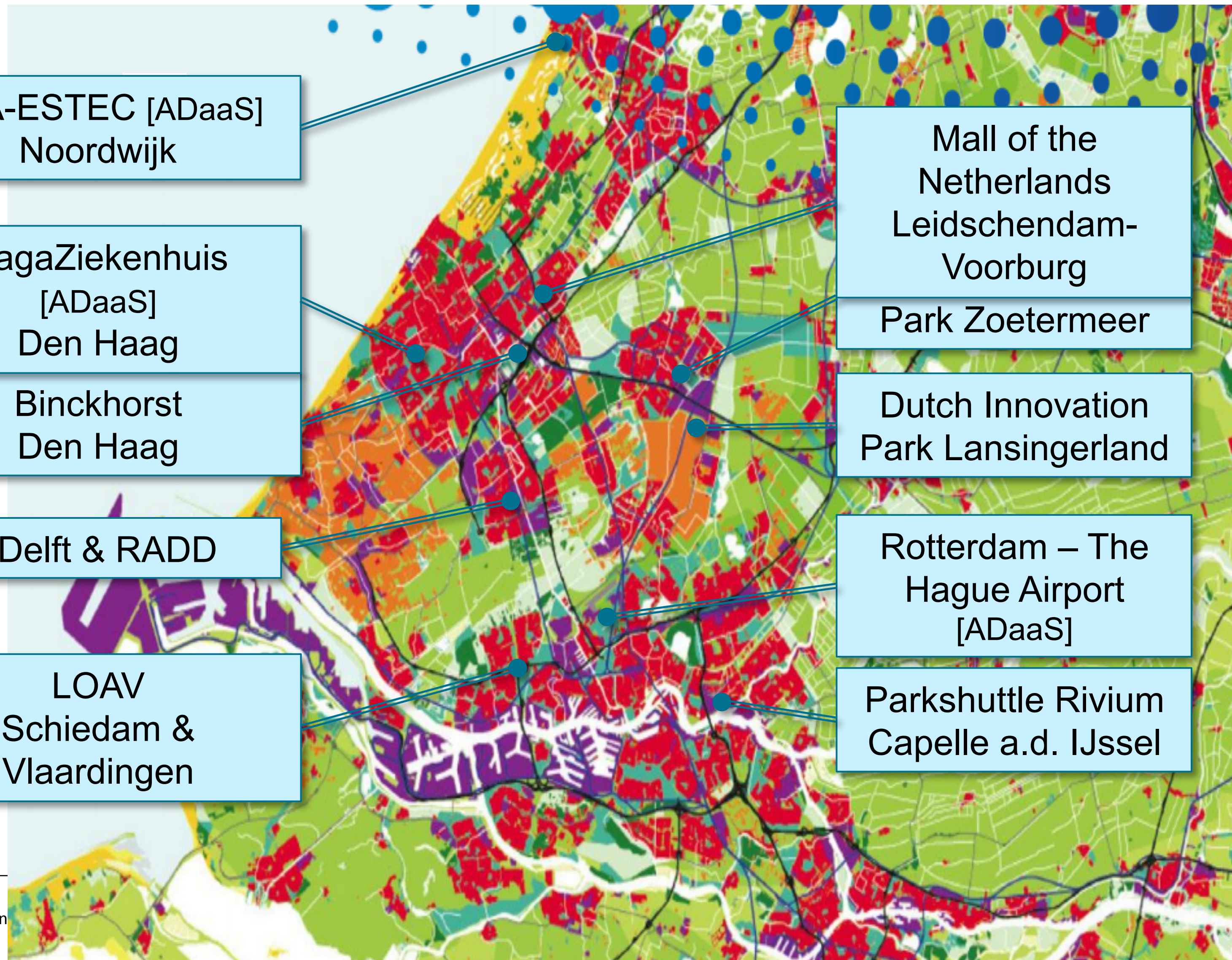
SWOT

Timing: challenge to drive without a steward



Overview Status NL Pilots

MRDH AVLM Programm



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Usecase HagaShuttle

17 januari 2019 10:08
Laatste update: 17 januari 2019 11:31

10

Aanvullend op het openbaar vervoer gaat er vanaf medio dit jaar een zelfrijdende minibus in Den Haag de weg op. Een woordvoerder van vervoermaatschappij HTM meldt dat het de eerste zelfrijdende minibus is die in een van de vier grote steden (Den Haag, Amsterdam, Utrecht en Rotterdam) in gebruik wordt genomen.

Bezoekers en patiënten van het HagaZiekenhuis kunnen met de zelfrijdende minibus gratis de laatste paar honderd meter van de halte van het openbaar vervoer naar de ingang van het ziekenhuis afleggen.

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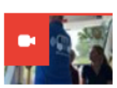
Usecase Drimmelen

Vervoerd worden in een bus zonder chauffeur? Dat kan met zelfrijdend busje door Drimmelen



DRIMMELEN - In het havengebied van Drimmelen rijdt deze zomer een shuttlebusje rond dat je van punt A naar punt B brengt. Niks geks aan zou je zeggen, maar er mist één ding: een chauffeur. Vanaf 5 augustus kun je in het havengebied tien weken lang instappen in een zelfrijdend busje.

Sachstand: Automatisierte und Autonome Test- und Pilotprojekte im ÖPNV

  Stand: 05/2019

Time line automated shuttles

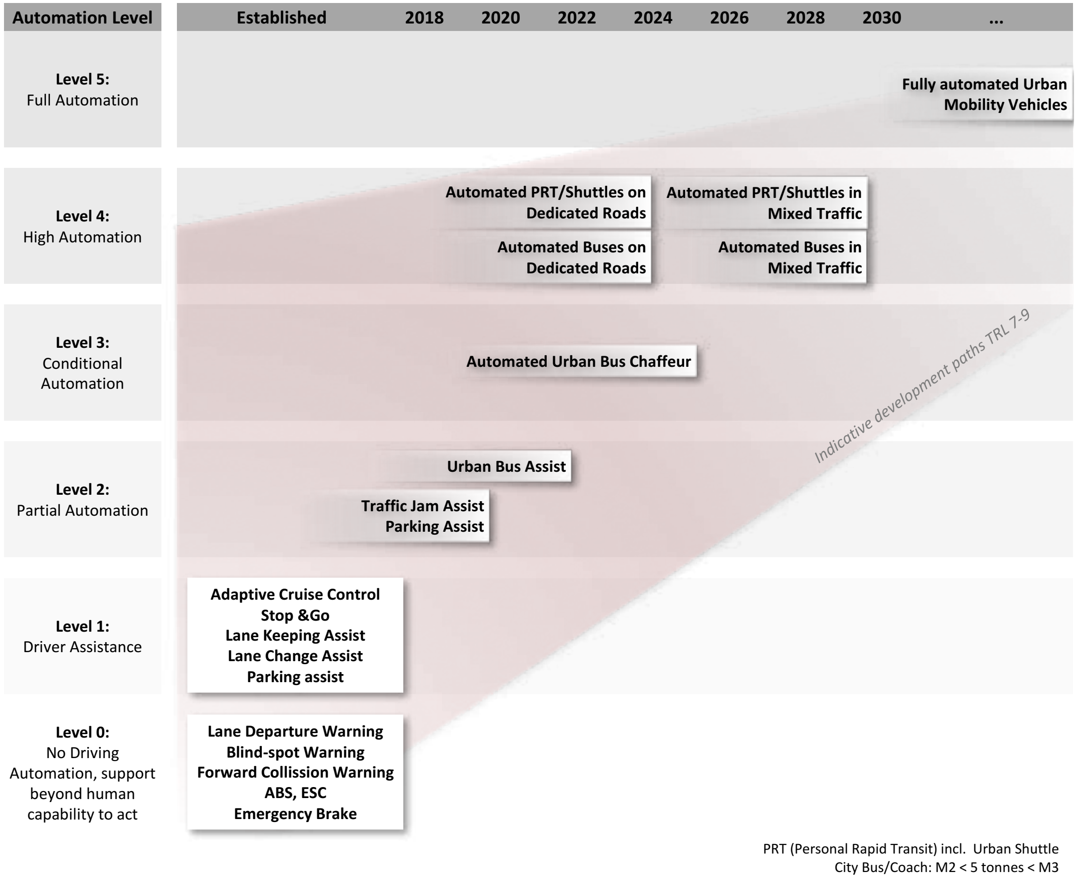
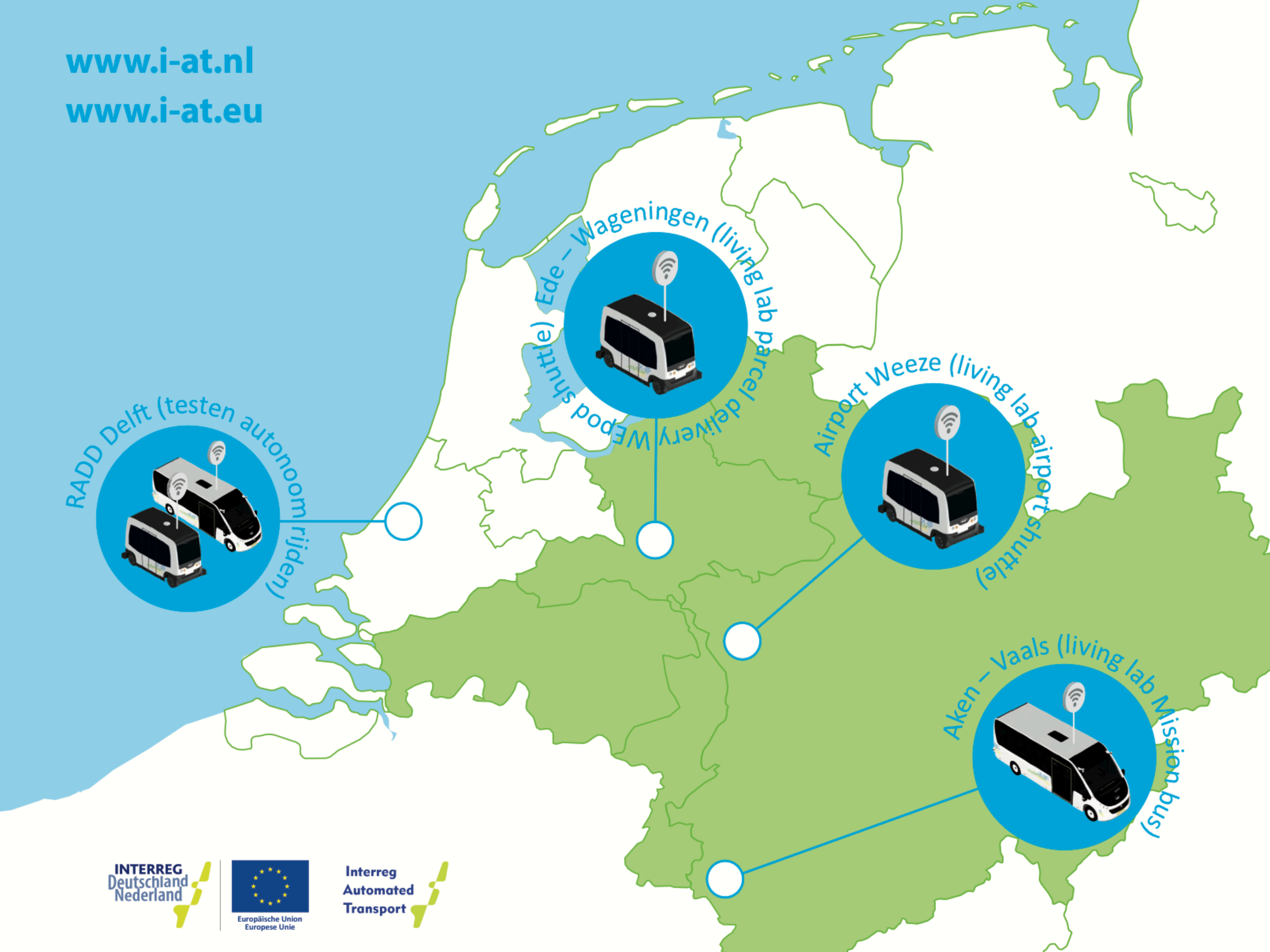


Figure 5: The Automated Driving deployment path for urban mobility vehicles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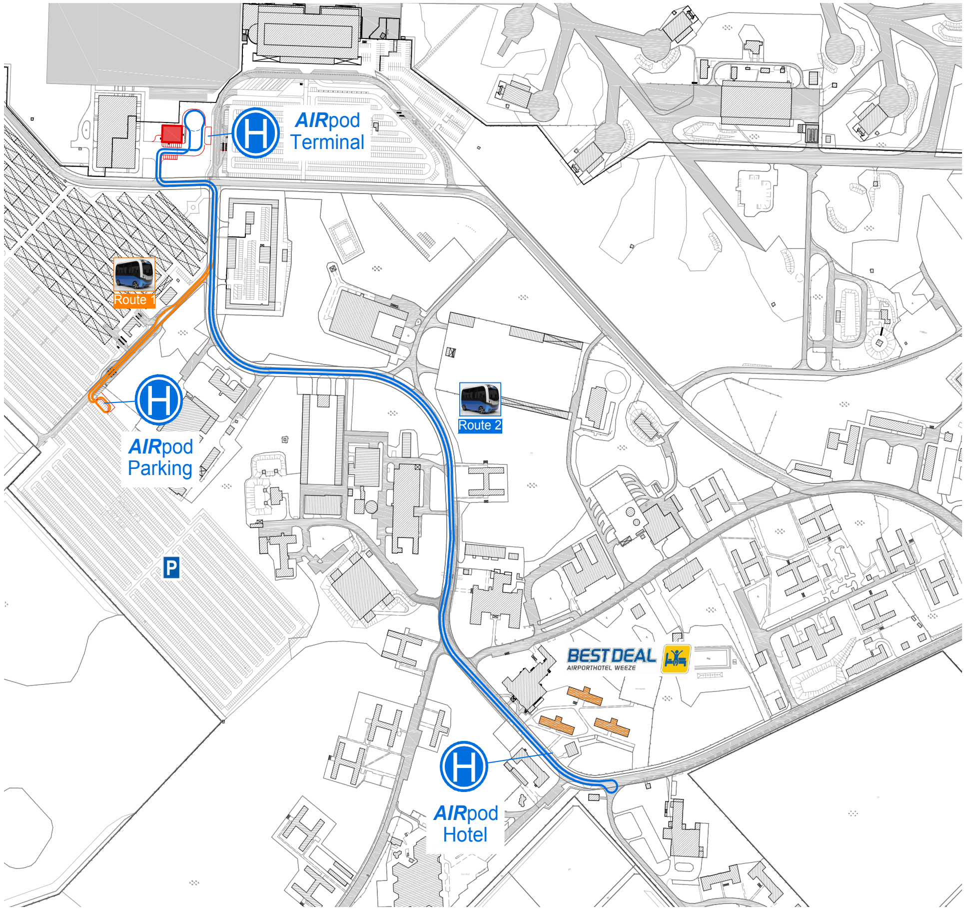
RADD Delft (testen autonoom rijden)
Ede – Wageningen (living lab parcel delivery WEpod shuttle)
Airport Weeze (living lab airport shuttle)
Aken – Vaals (living lab Mission bus)
INTERREG Deutschland Nederland
Europäische Union
Europese Unie
Interreg Automated Transport

WEPOD on the Road.

The First automated shuttle to Drive legally on public road in NL and in DE

I-AT 2018 DE: Living Lab Airport Weeze



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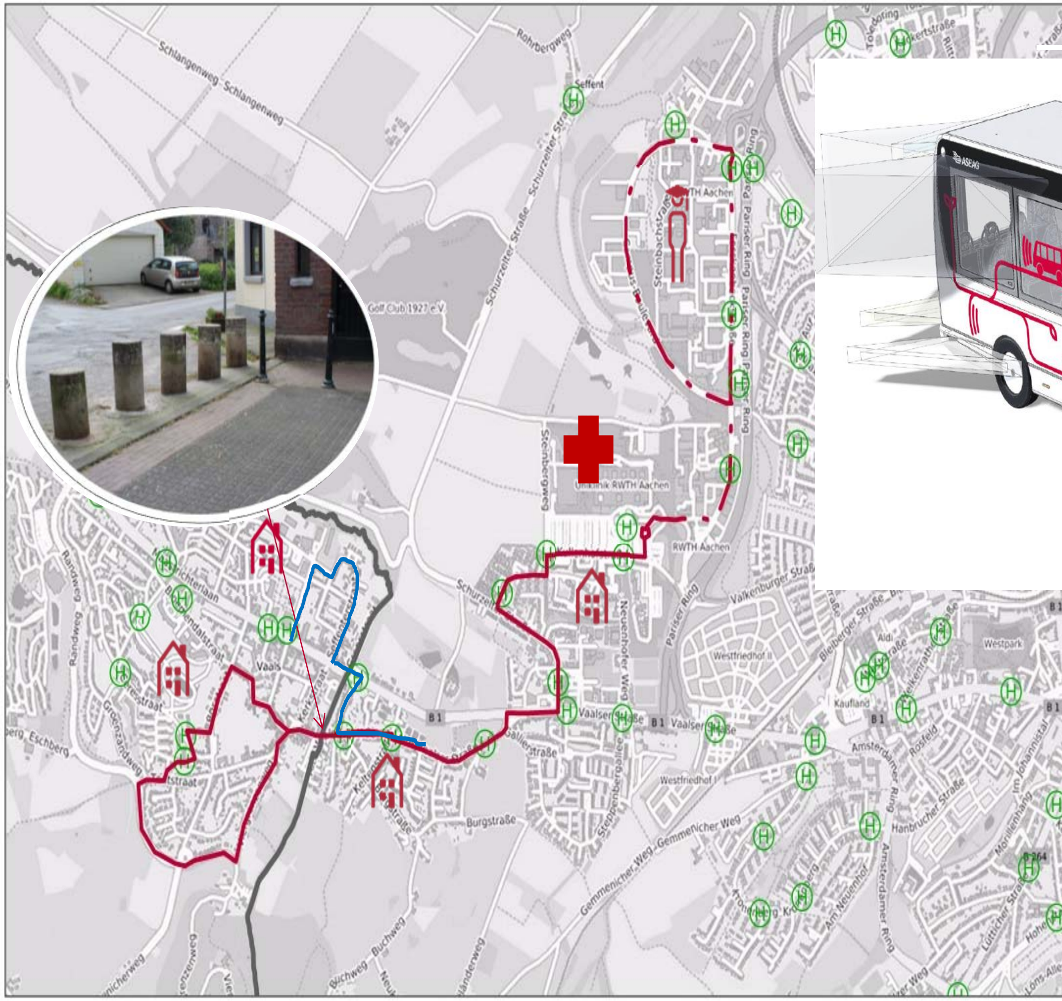
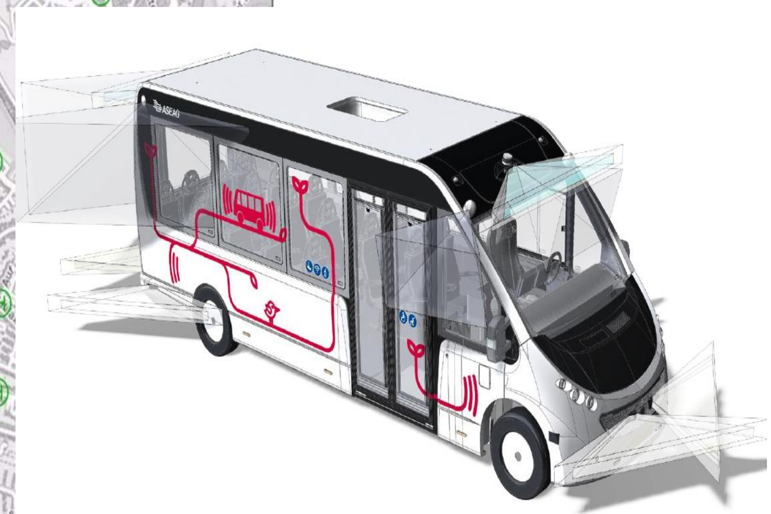
PRIOR TESTING @ SCHIPHOL ADAM

I-AT-UMS+RES Mission Bus will be tested at Aldenhoven





Slides Arbeidsgrouppe VDV: HEAT Project (started 2018)

Partners

Authority: City of Hamburg: Ministry for Economics, Transportation and Innovation.

Public Transport Company: Hamburger Hochbahn AG

Vehicles: IAV

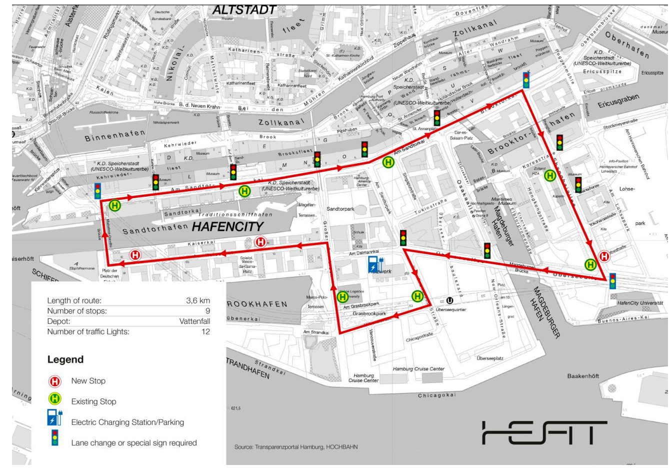
V2X: Siemens

Fleet management: Siemens

Infrastructure: Siemens

Maintenance: IAV & FFG (Hochbahn subsidiary)

Other: IKEM (accompanying research, regulation and business models) and DLR (accompanying research, user acceptance)



Technology

Lidar (installed in the infrastructure)

Radar (installed in the infrastructure)

GPS

Video camera sensors

Communication with traffic lights and back office through secured Wi-Fi

No routing

Traveller information system by Siemens

Challenge: the HD map!

LEGAL: In Germany a new regulation allows automated driving of levels 2 and 3 as long as there is a driver inside the vehicle. Further legislative changes are part of the coalition treaty, but they are not yet addressed in parliament.

Slides Arbeidsgrouppe VDV: Bad Birnbach (started 2017)

Partners:

Authority: Bad Birnbach

Public Transport Company: DB Regio bus Ostbayern

Vehicle: Easymile

Technology:

Lidar

GPS sensors

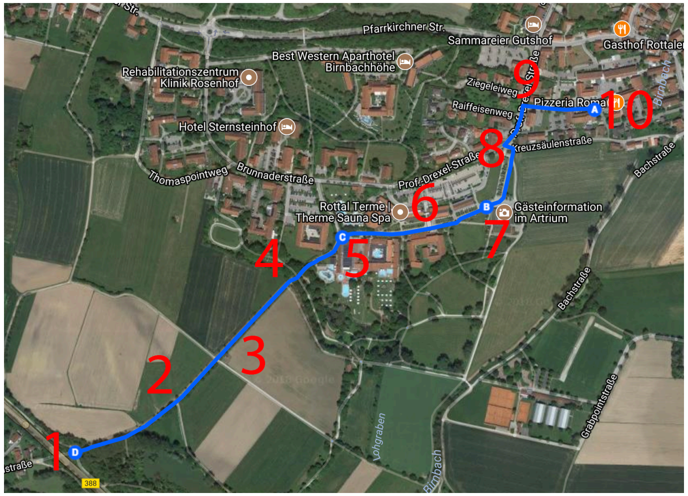
V2X communication with back-office (for central monitoring)

4G communication with in-vehicle monitor

No routing

Results & Evaluation

So far, 23,372 passengers have been transported, with an average of 65 passengers per day, 12,619km have been covered with an average distance of 30km a day and an average operational speed of 9 km/h.



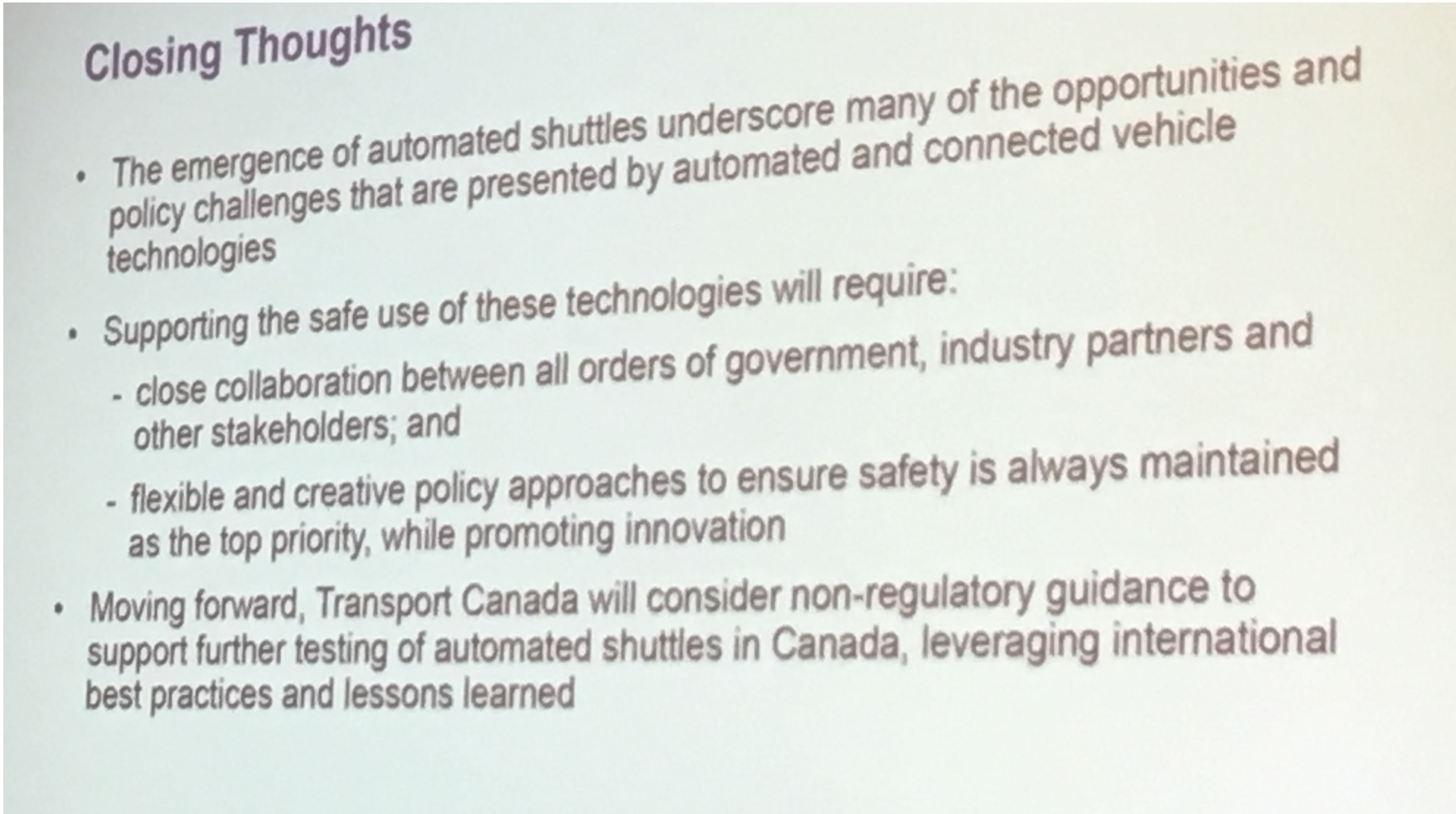
Topics introduction

1. General Challenges
   - Vehicle technology and capabilities
   - Regulations
2. Business cases

General Challenges & Early obstacles for deployment

- Vehicle capabilities
- Operating environment
- Product availability
- Planning and implementation
- Financial considerations
- Labor considerations
- Data and evaluation
- Public acceptance
- Federal, state and local regulations

We in the EU agree with lessons learned from Canada!



13 Challenges to scale up deployment

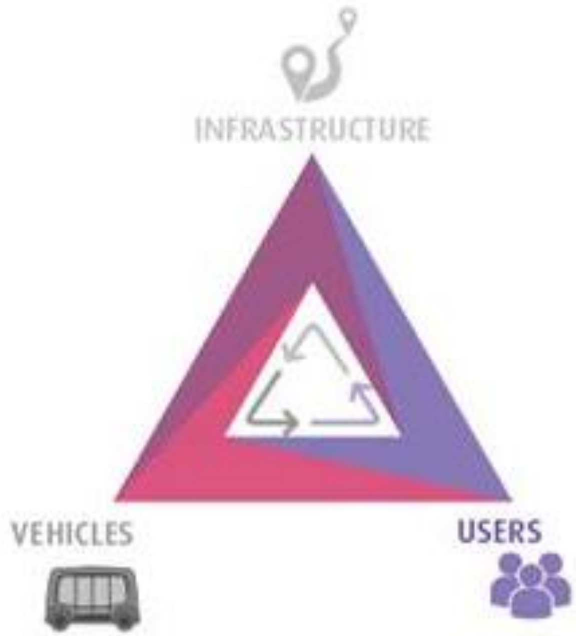
1. Increasing the vehicle's autonomy and capabilities to handle other traffic and more complex routes in mixed traffic
2. Decrease the need for a steward in the vehicle, increase training/certification
3. Decrease the need to program the vehicle's path, speed
4. Increase the vehicle's speed and capacity
5. Increase remote monitoring, operations API and datasharing options
6. Increase driving capability in bad weather
7. Decrease physical infrastructure dependancy (landmarks, maps, signs, vegatation)
8. Decreasing the price of the shuttle and increasing market availability
9. Increase the local service, maintainance and implementation options of the shuttles.
10. Increase functionality and responsibility of control room (vendor independant)
11. Increase payment options in demo's and first implementations
12. Decrease leadtime to legally operate on the public road while proving safety at the same time
13. Increase public acceptance (other road users, passengers, accessability, MaaS)

Scaling up is a challenge; requires trust and reliability

Chicken-egg problem:

Big scale application: reliable system

Developing reliable system:
big scale application



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UK


INDUSTRIAL
STRATEGY
Joint investment
in R&D
UK AUTODRIVE
GATEWAY
VENTURER
STREETWISE
HUMANDRIVE
ROBOTPILOT
DRIVEN
FLOURISH
INSIGHT
SYNERGY
CAPRI

Shuttle pilots in the US [TRB-2019]

Overview tabel first pilots in US (including # vehicels)

Table 4: Selected Domestic Low-Speed Automated Shuttle Deployments

Location	Project Partners	Vehicle Model	Shuttles	Type
Dublin, CA	Livermore Amador Valley Transit Authority, First Transit	EasyMile EZ10	1	Ongoing Pilot
San Ramon, CA	Contra Costa Transportation Authority, and Central Contra Costa Transit Authority (CCCTA), GoMentum Station, and Bishop Ranch	EasyMile EZ10	2	Ongoing Pilot
Gainesville, FL	Florida Department of Transportation, University of Florida, and City of Gainesville	EasyMile EZ10	1	Ongoing Pilot
Jacksonville, FL	Jacksonville Transportation Authority, Transdev, First Group, and Stantec	Multiple (including EasyMile EZ10, a Navya vehicle, and another shuttle TBD)	1-2 per model	Ongoing Pilot
Weymouth, MA	Optimus Ride, Lstar Ventures	Polaris GEM	5	Ongoing Piot
Ann Arbor, MI	Mcity (University of Michigan)	Navya ARMA	2	Ongoing Pilot
Detroit, MI	May Mobility, Bedrock	Polaris GEM	5	Ongoing Pilot
Las Vegas, NV	City of Las Vegas, AAA, Regional Transportation Commission of Southern Nevada, and Keolis	Navya ARMA	1	Ongoing Pilot
Greenville, SC	Greenville County, Robotic Research, and Robocist	Cushman Shuttle 6, Local Motors Olli, and possibly others TBD	2+	Ongoing Pilot
Arlington, TX	City of Arlington	EasyMile EZ10	2	Ongoing Pilot

Case Studies USA (EasyMile and Navya)

Shuttle pilots in Canada