

Autonomous public transportation A comparison between Asia & Europe

Thierry MOCQUIAUX

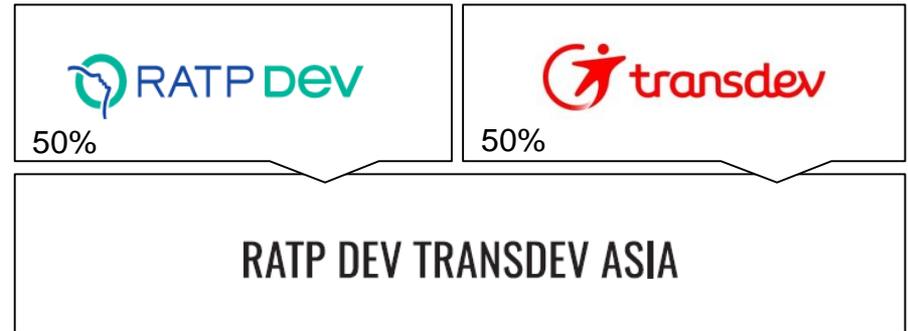
2 October 2017



Who we are

RDTA is the exclusive JV for Asia between the RATP Group (Paris Metro) and Transdev, both among the Top 5 international public transport operators.

Leveraging on more than 100 years of experience, we operate and maintain landmark systems such as the Seoul Metro Line 9, Mumbai Metro, HK Tramways, Manila LRT1, bus operations in China, and started the first Chinese modern tram in Shenyang.



Our parent companies, two international public transport operation leaders



The operator of Paris Metro developing worldwide through RATP Dev



The most global multimodal public transport operator

Paris Metro since 1900
RATP founded in 1949
RATP Dev since 2002

RATP Group key figures

€ 5.6 billion in revenue (2015)
60,000 employees
3 billion passenger journeys
15 different countries
Operate entire Paris network

- 16 metro lines
- 2 regional trains (RER A, B)



Formerly Veolia Transport
established in 1876
Renamed Transdev in 2013

Transdev key figures

€ 6.7 billion in revenue (2016)
83,000 employees
3.3 billion passenger journeys
19 different countries
All transport modes



Our expertise in Operations and Maintenance

Operations

- ⚙️ The leader in driverless operations
- ⚙️ Worldwide leading tram operator
- ⚙️ Longest and most extensive O&M track record
- ⚙️ Awarded safety management system
- ⚙️ Proprietary CRM tools

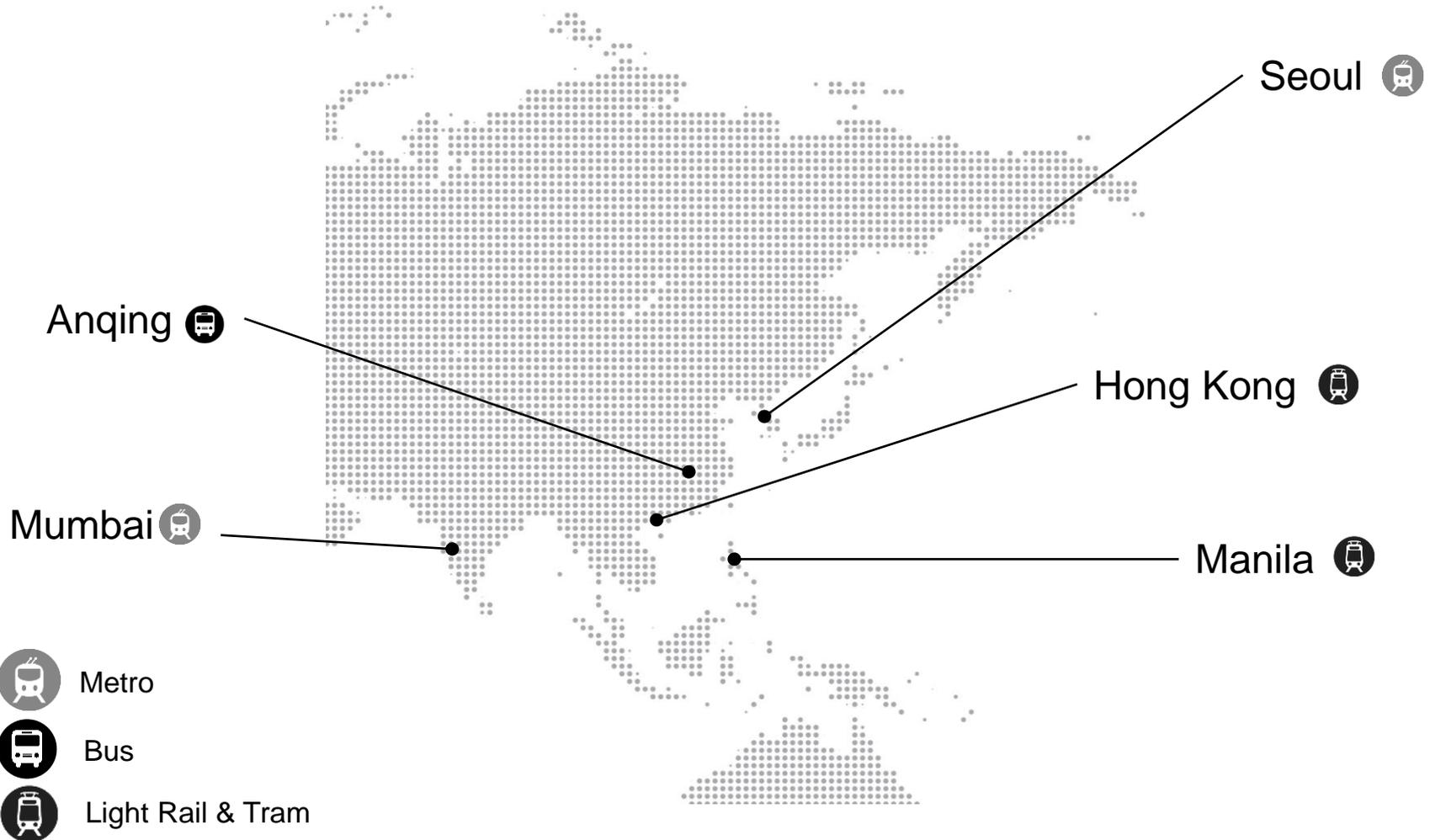
Maintenance

- ⊗ Experience with all major system suppliers
- ⊗ In-house asset and maintenance management
- ⊗ Systems obsolescence
- ⊗ Systems upgrades and refurbishment management



From Metro, Tram and Bus to Light Rail, we deploy best-in class O&M expertise from project to operation phases.

Our transport systems in Asia



Autonomous public transportation A comparison between Asia & Europe



Automation among public transport

Automated metro



Autonomous vehicles

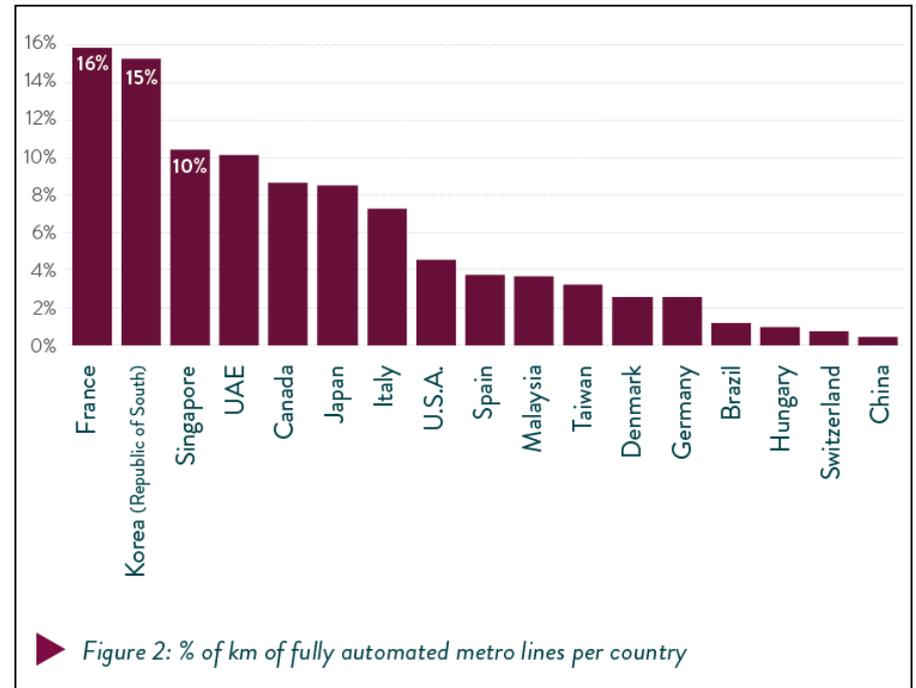
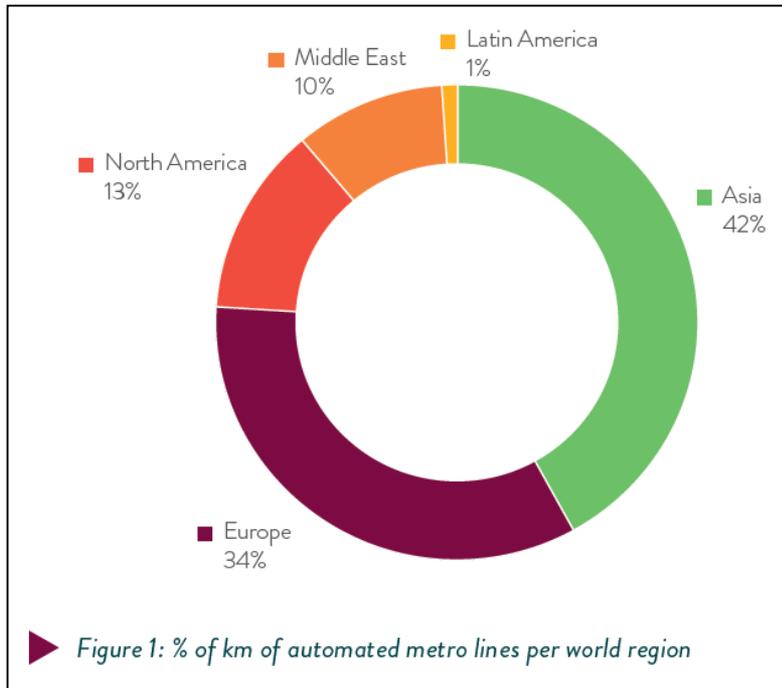


Automated tram / buses



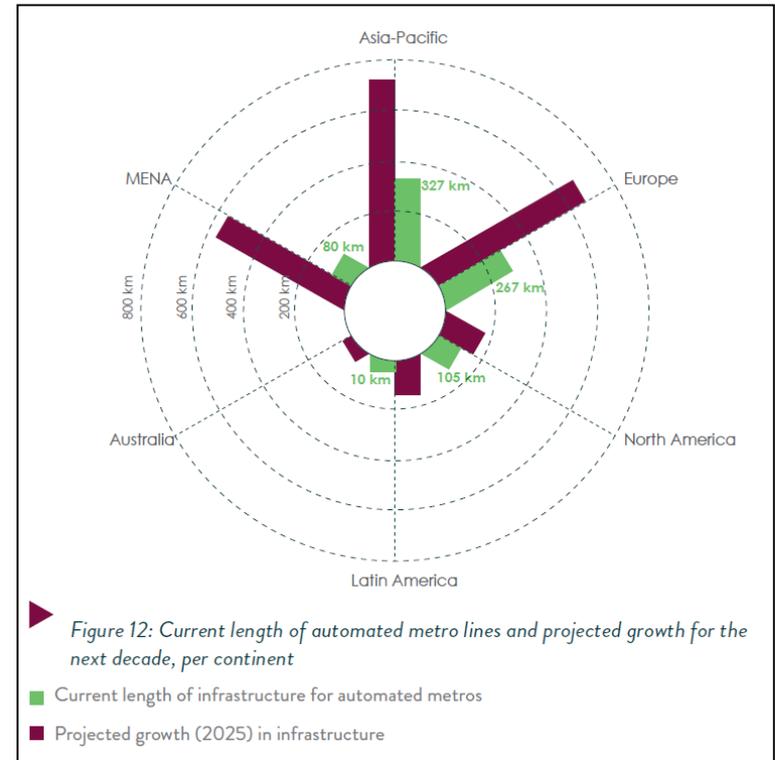
Automated metro overview

- 53 fully automated lines in 36 cities (as of July 2016).
- Automated lines represent 10% of the metro infrastructure in Europe, 5% in Asia.
- Half of the infrastructure in 4 countries.
- Asia and Europe host 75% of automated metros.



High growth expected

- Both in Europe and Asia
- 2025: Asia and Europe expected to account for 32% and 31% of the world's automated network.



Authorities still reluctant to fully unattended operations

- Cultural gap to overpass.
- Unattended operations well perceived in France by the riding public.
- Who shall cross this gap: public transport authorities or the riding public?

Grade of Automation	Type of train operation	Setting train in motion	Stopping train	Door closure	Operation in event of disruption
GoA1 	ATP* with driver	Driver	Driver	Driver	Driver
GoA2 	ATP and ATO* with driver	Automatic	Automatic	Driver	Driver
GoA3 	Driverless	Automatic	Automatic	Train attendant	Train attendant
GoA4 	UTO	Automatic	Automatic	Automatic	Automatic

*ATP - Automatic Train Protection; ATO - Automatic Train Operation

Bus / tram automation by RDTA

RDTA's approach : more intelligence in existing operations

- RATPDev and Transdev have launched several projects including Bus and Tramway parking automation projects.
- Common objectives of these experimentations:
 - Know-how of vehicles performances, reliability, limits
 - Integration in a public transport system : behavior, supervision, safety, interoperability
 - Impacts of commercial relations with customers
 - Workforce and general public acceptance



Smart stabling

Focus on bus stabling automation

- First tests in Sept. 2016: Perception and localization sensors design
- Equipped bus in a free environment : April 2017

Next steps:

- Setup in the bus depot : starting July 2017
- **Final step in March 2018**



Smart stabling

Focus on tram stabling automation

First step from December 2016 to March 2017 in T7 Tramways depot : Testing the technical feasibility.

Capabilities

- Acceleration, breaking, emergency stop
- Localization in the depot and parking at designated parking place

Next steps : Economical analysis and deployment





Other approach - bus full automation

- In the global technical race for autonomous vehicles (full autonomy)
- Mainly at concept / research stage



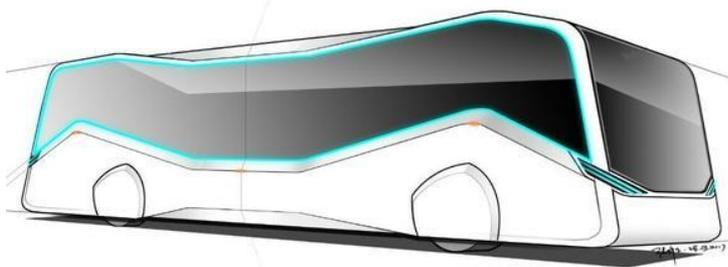
Yutong bus, China

Test in 2015, up to 40 pax, 68 kph, 20-mile drive test with 26 traffic light handled.



Proterra, US

Partnership with the university of Nevada, 3-phase plan



ST Kinetics, Singapore

Prototype stage

Autonomous vehicles

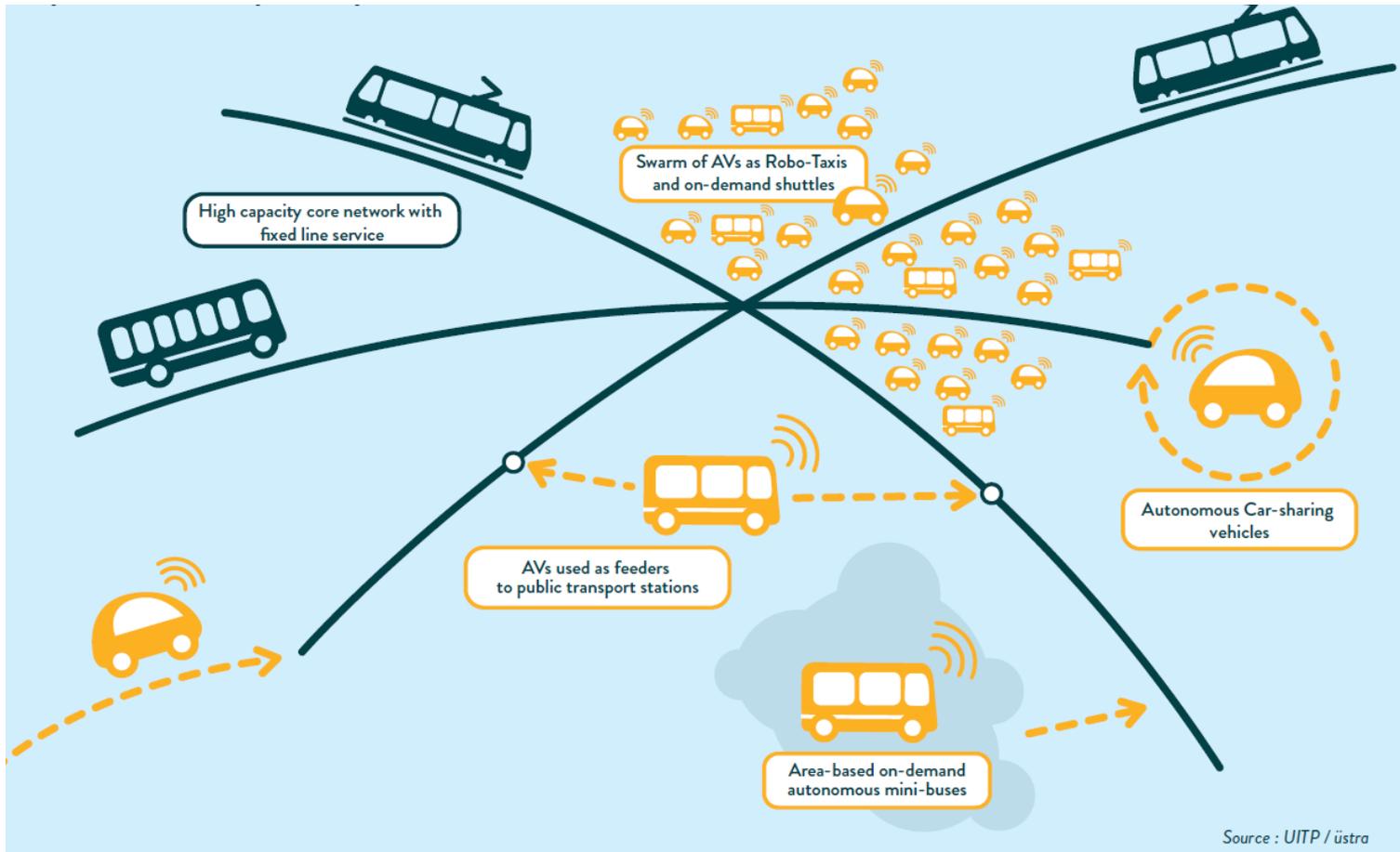
What is the right place of Public Transport operators and Authorities?



Source: COMET Labs

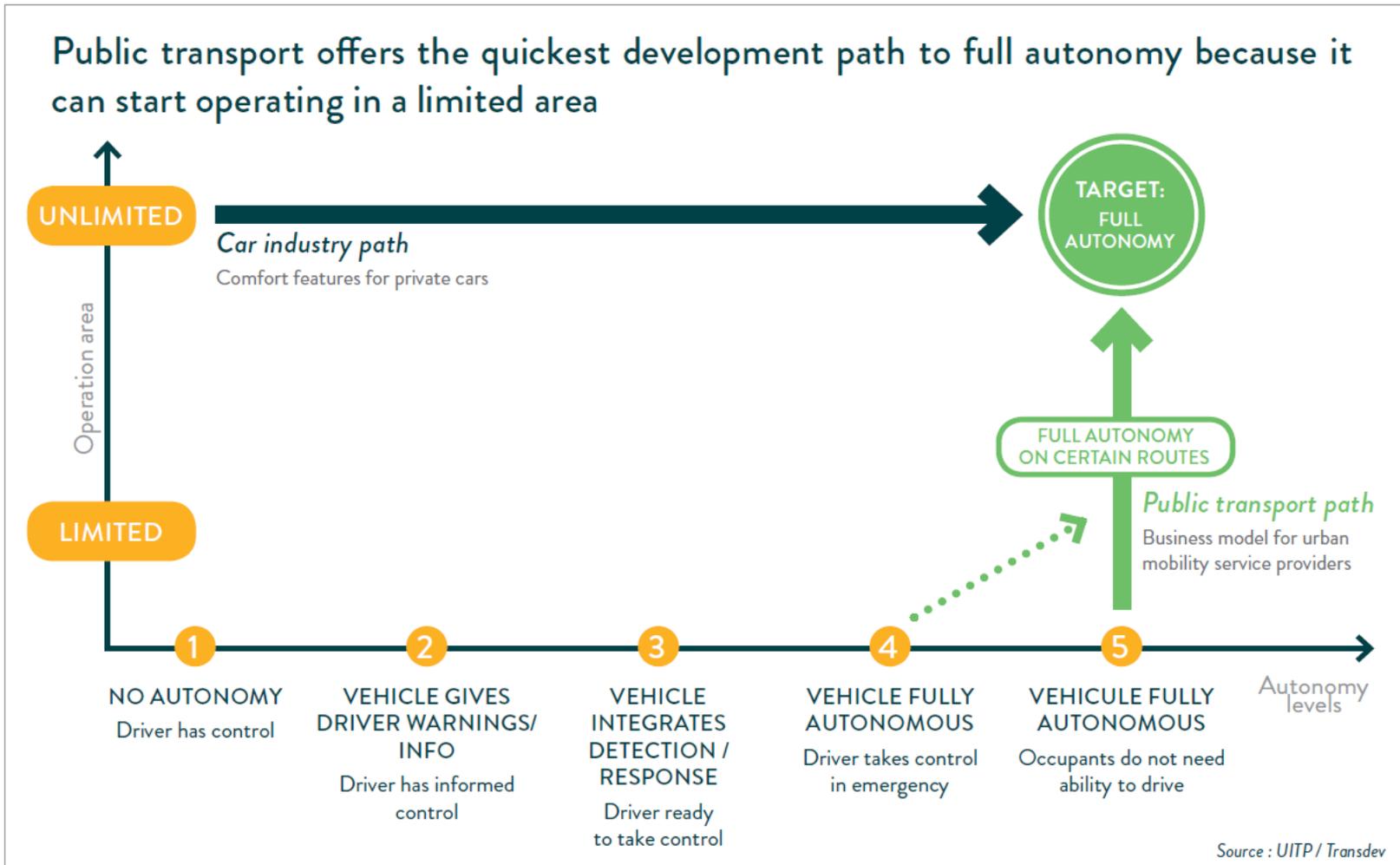
Autonomous vehicles

High opportunity for more liveable cities and increased shared mobility



Autonomous vehicles

Public Operators will arrive first – an opportunity for public authorities?



Autonomous vehicles

Operators concrete Role and Responsibilities

- Management of the fleet (Vehicles injection, headway management,..), cybersecurity.
- On site management, Degraded mode (Take-over of vehicle)
- Light Maintenance (1st Level)
- Charging, Vehicle start and transfer
- Customer service



Autonomous vehicles

Test operations examples in Europe



Civaux - EDF

- 6 vehicles
- 1st contract for operating Avs in France
- 5-year contract since April 2016
- 69 300 pax since Apr. 2016
- 12 870 km since Apr. 2016



Ladoux (May 2016)

- 1 vehicle
- 1 200 pax
- 1 056 km
- 1st deployment of Transdev app providing info on veh. geolocalisation and waiting time



La Rochelle (Dec 2014/Apr. 2015)

- 1 vehicle
- European project CityMobil2
- 1,6km in city center
- 14 660 pax carried
- 3 778 km operated



Rotterdam (since 2005)

- 6 vehicles
- 1,8 km
- 700 à 1000 pax/day
- 1,78 M. pax since 2005
- Average Km/day: 119 km
- 297 500 km since 2005

Autonomous vehicles

Test operations examples in Europe



Rouen

(Dec 2016 / Jan 2017)

- 3 000 carried pax
- 1,6km path
- 1 125 km



Perpignan

(juin 2017)

- 1 000 carried pax
- 450 m track
- 125km

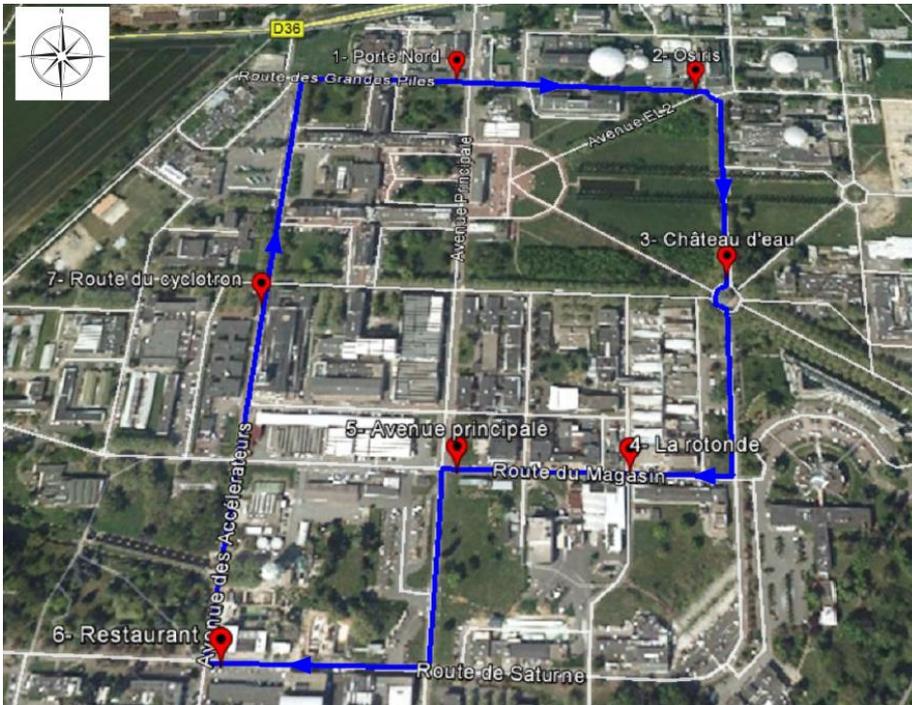


Paris (Jan to April 2017)

- 2 vehicles
- 200m, connection between two major railway stations
- 500 pax/day

Autonomous vehicles

Focus on coming Saclay's Project (France)



- 2 EZ10 vehicles (up to 8)
- Operating hours: from 10:00 to 16:00, Monday to Friday
- Duration (phase 1): 9 weeks
- Route type: private
- Traffic type: pedestrians, vehicles, buses and trucks
- Interaction with motor vehicles
- Operation mode : metro
- Number of stations: 7
- Route length: 2519m
- Open to every passengers

Autonomous vehicles

Operations examples in Asia

Garden by the bay

- 2 x EZ10 vehicles
- Operated by Garden By The Bay
- Since Dec. 2015



Tokyo – Shiba park

- First in Japan, by SB Drive (SoftBank)
- July 18th-23rd 2017, 800 passengers
- Vehicle: Navya Arma





RATP DEV TRANSDEV ASIA

Thank you

2 October 2017

