HARMONY

Rotterdam
November 7, 2019

Harmony cross-metropolitan workshop

Session 1:
Autonomous Vehicles for Passenger & Freight mobility

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www.harmony-h2020.eu

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This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 815269

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Presentation of HARMONY outputs/insights on AVs

Dr. Ioanna Pagoni

University of the Aegean

Autonomous Vehicles: The definition

- **Autonomous Vehicles (AVs)** are vehicles that are capable of operating and navigating (**driving themselves**) without the intervention of a driver.

- They are **equipped with a variety of technologies**, e.g. radars, global positioning systems, cameras and sensors which enable them to sense the road environment and detect different things such as other vehicles, people, traffic lights, and movement of other vehicles.

SAE Levels of Automation

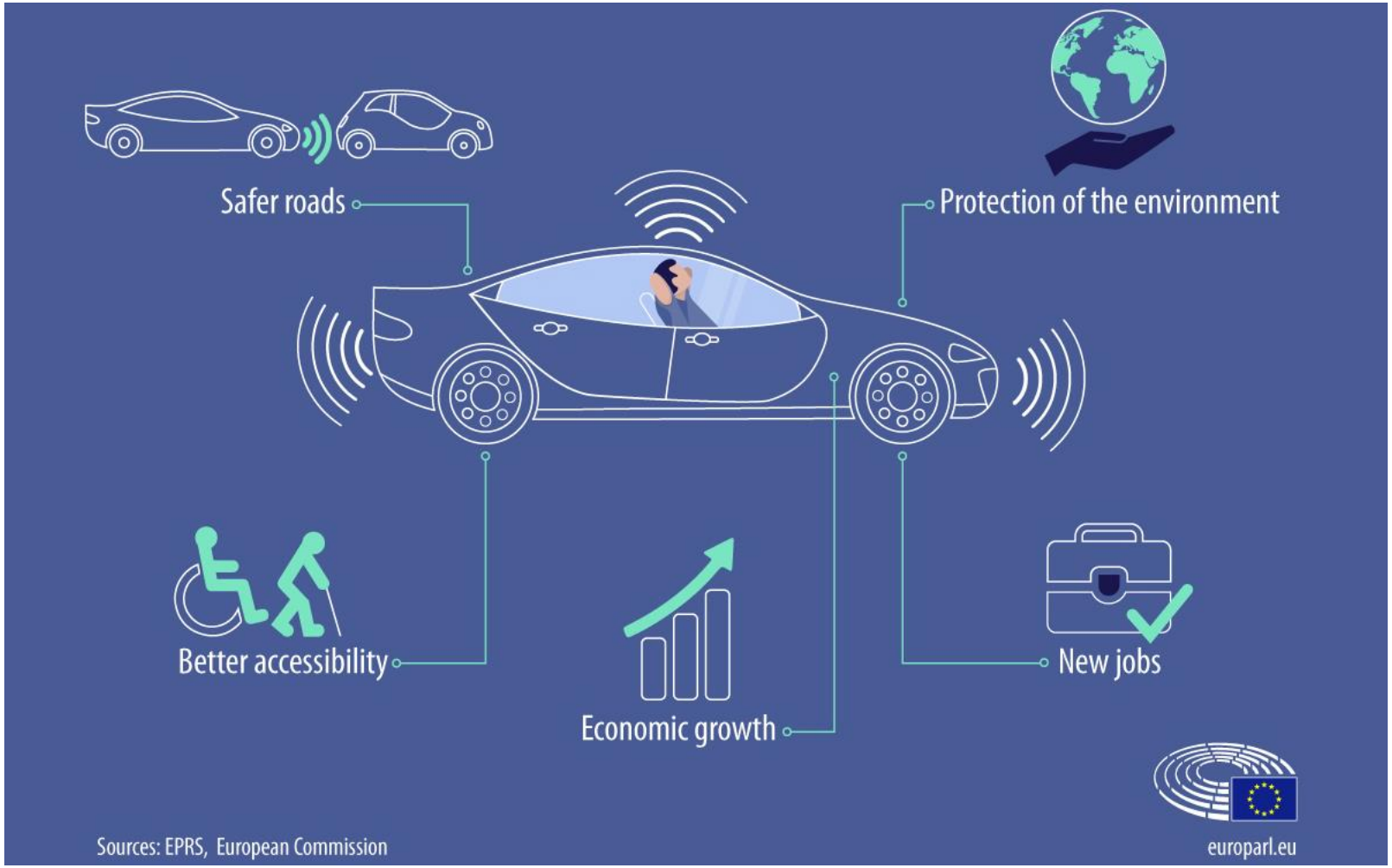
This feature can drive the vehicle under all conditions

0	1	2	3	4	5
No Automation	Driver Assistance	Partial Automation	Conditional Automation	High Automation	Full Automation
You are driving whenever these driver support features are engaged – even if your feet are off the pedals and you are not steering			You are not driving when these automated driving features are engaged – even if you are seated in "the driver's seat"		
You must constantly supervise these support features; you must steer, brake or accelerate as needed to maintain safety			When the feature requests, you must drive	These automated driving features will not require you to take over driving	

Sources: National Highway Traffic Safety Administration (https://www.nhtsa.gov/technology-innovation/automated-vehicles-safety)
Society of Automotive Engineers (https://www.sae.org/news/2019/01/sae-updates-j3016-automated-driving-graphic)

The vision of AVs…What will they bring?

Human error is involved in about 95% of all road traffic accidents in the EU **2017: 25,300 people died on the EU roads**

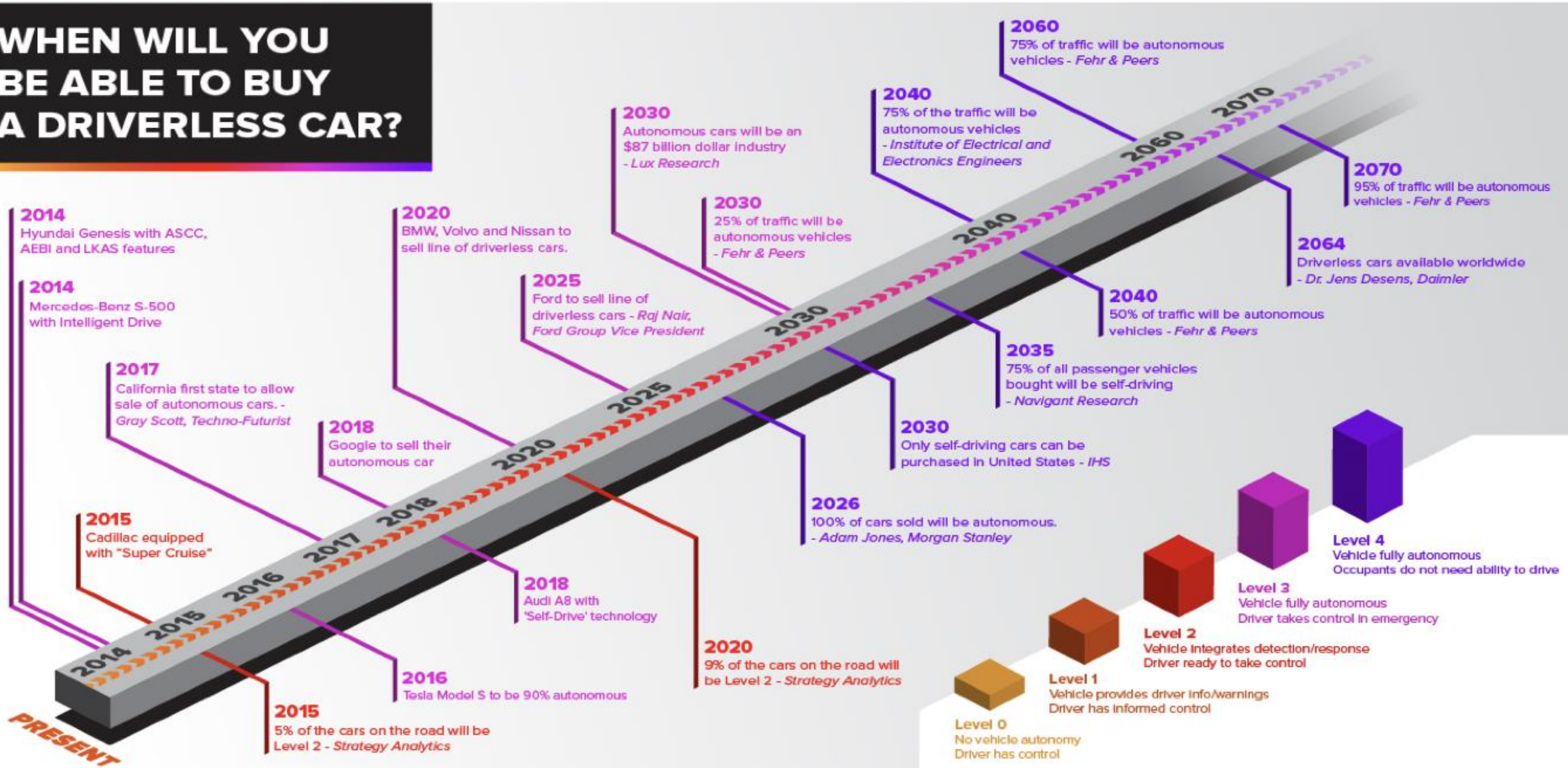


Reduction of traffic congestion and, especially since AVs are electric, **reduction of emissions of GHGs and air pollutants**

Mobility can be improved for the elderly and those with reduced mobility or disabilities.

In coming years, the AVs market is expected to grow exponentially **creating new jobs** and developing **profits of up to €620 billion by 2025 for the EU automotive industry**.

WHEN WILL YOU BE ABLE TO BUY A DRIVERLESS CAR?



Sources: Mercedes-Benz, GM News, Strategy Analytics, Automotive News, Nissan News, Navigant Research, Volvo News, Fehr & Peers, Lux Research, IHS

mojomotors

Where are we now?

Numerous companies are investing in autonomous mobility for passengers and freight

Passenger

Tesla Autopilot, semi-autonomous driver-assist technology

Self-driving software company completed 50,000+ self-driving taxi rides with Lyft (May 2019)

Baidu's Apollo: 300 AVs and 2 mil. Kms of urban driving by 07/2019

Self-driving A8 model approved for street driving in Europe

This alliance plans to create a platform for bringing self-driving cars to market, aiming to put its first vehicle, the BMW iNEXT, on the road by 2021.

Self-driving car service launched in 12/2018 (began as the Google Self-Driving Car Project in 2009)

Freight

Delivery robot "Amazon Scout"; Working on a multi-function AV with Toyota

Self-driving truck "platoons"; started testing in Oregon in 2017

Autonomous vans that have been used by UPS & UK Royal Mail to deliver mail

Vera is an electric AV controlled & monitored via a control centre

Partnership with Waymo to bring self-driving cars and trucks to Japan & France

"SameDay" robot is tested in deliveries from local & distribution centers to their consumers

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Business: How are AVs provided to the customer?

Passenger Transport

Privately-owned AVs
AVs available for private purchase

On-demand mobility service
AVs offering single or shared rides from one point to another

Public transport services
Automated passenger minibuses offering transit rides

Freight Transport

Autonomous vans
Vans which provide urban distribution services

Autonomous trucks/ Platooning
Truck platoons at dedicated lanes of specific transport corridors

Delivery bots
Autonomous bots to make last-mile deliveries (small parcels within a limited distance range)

Requirements

Data
For providing optimisation of the route, AVs require the following data:
• GPS data
• Road network data from 3D maps (road profiles, curbs and sidewalks, lane markers, crosswalks, traffic lights, stop signs)
• LIght Detection And Ranging (LIDAR) data
• Road network status data (traffic conditions, incidents, road works information)
• Weather data
• Data on location of docking and charging stations
• Especially for freight AVs (trucks, vans and delivery bots), data on the transported goods (weight, origin, destination, handling conditions) and recipient's authentication data

Infrastructure
• **Modest changes:** *Some degree of upgrade or investment in existing infrastructure*
• To make lane markings recognizable by the AVs • Signs should be standardized and designed to be 'readable' • Overall, the road infrastructure should be maintained at a high standard
• **Major investment**:
• Sensors, cameras, detectors and other infrastructure (roadside units to transmit data to the vehicles, traffic signal controllers, speed limit beacons)
• Dedicated lanes to enable platooning of vehicles
• Electric vehicle charging stations, as most AVs are likely to be electric
• Other physical infrastructure: parking areas, drop-off zones, staging areas, to allow AVs idle when picking up or discharging passengers, docking areas

The challenges we face…

- **Apart from the data and infrastructure….**
- **Road safety**: since driverless vehicles must share the road with non-automated vehicles, pedestrians and bicycles, appropriate safety requirements and the harmonisation of traffic rules at EU level are essential.
- **Liability issues**: as self-driving vehicles transfer the driving tasks from humans to autonomous technologies, existing liability laws need to evolve and clarify who is accountable in case of accidents: the driver, the software developer, the AV manufacturer?
- **Cybersecurity:** no specific measures have been taken yet to guarantee cybersecurity and protect AVs against cyberattacks.
- **Ethical questions**: self-driving vehicles have to respect human dignity and freedom of choice.

Rotterdam city presentation

Jos Streng
Transport Planner
Urban Development City of Rotterdam, Mobility Division

City of Rotterdam

Rotterdam Context

Jos Streng

Richard van der Wulp

HARMONY

Stakeholder Workshop

7 November 2019

City of Rotterdam

Challenges AVs could help solve in Rotterdam

- Accessibility – with Avs easily available, will # vehicles ↑ ?
- Urbanization – densification: urban space as scarce resource
- Modal split – policy preference: walking&cycling / public transport / shared motorized modes / individual motorized trips
- Network efficiency & performance (use of traffic space?)
- Energy and environment – implicit
- Economic growth – price of vehicle versus price of labour (drivers)

City of Rotterdam

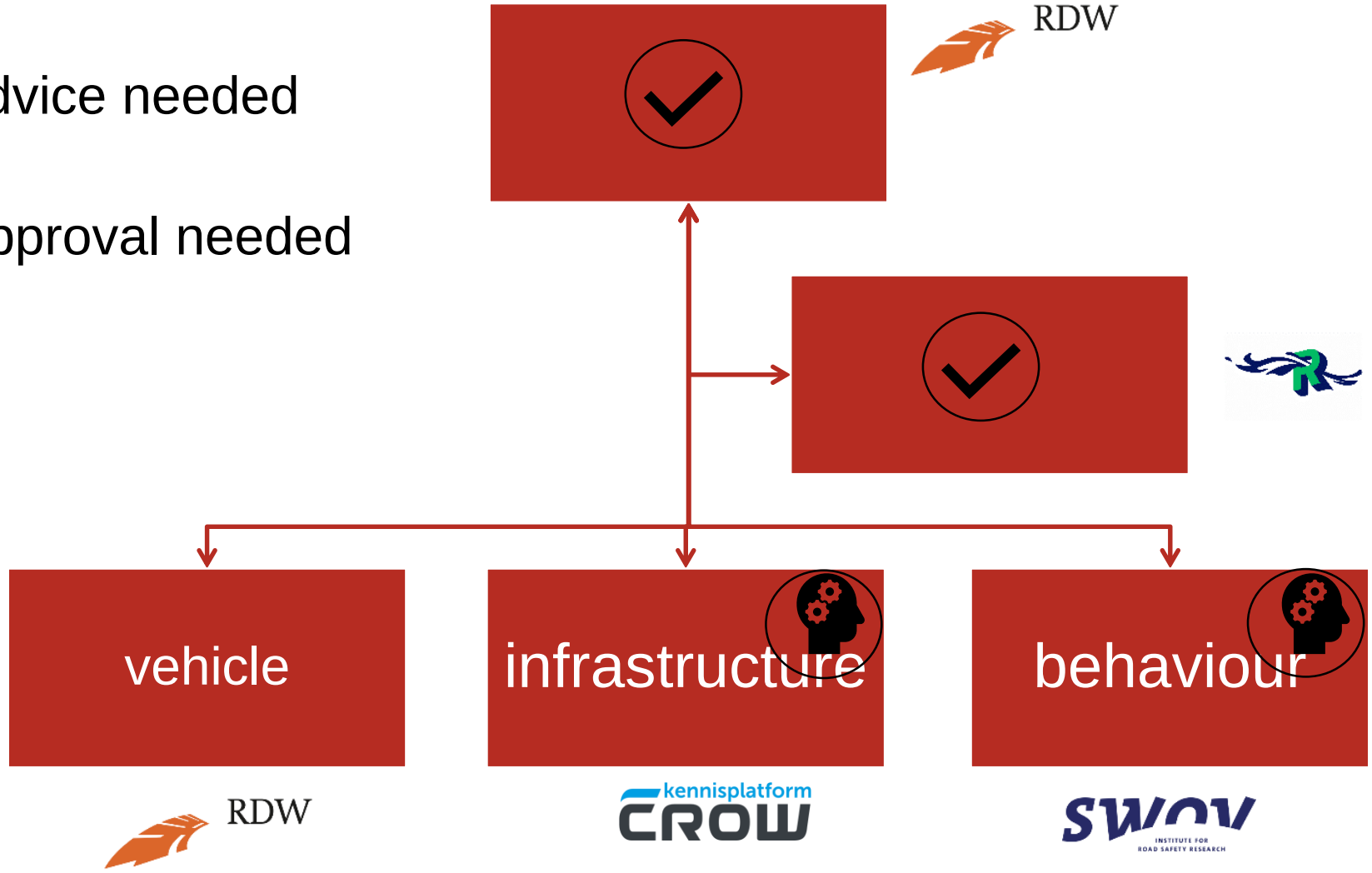
Current and foreseen obstacles for AV deployment and implementation in Rotterdam

- Regulatory
  see next slide
- Infrastructure
  assured connextedness of vehicles
  responsibility for constant position of landmarks in public space
- Investment/subsidy
  premature, pilots will shed light on economic viability
- Policy
  public acceptance
- Economic aspect/employment
  less jobs in logistics, more jobs, other jobs in transport and logistics?

Regulatory obstacles for AVs

Official advice needed

Official approval needed



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HARMONY Cross-metropolitan workshop

Drones session for passenger and freight mobility

Ioanna Kourounioti TU Delft

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 815269

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Overview of **Session 2**

- **Brief introduction,** Ioanna Kourounioti, TUDelft
- **Air Taxis,** , TU
- **Air drones**, Phillip Holand, GRIFF Aviation

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Air urban and freight mobility

Passenger

eVTOL services services for 1 or more passengers. (i.e. Airbus, Uber)

Services on **urban intercity** and **regional level.**

Electric → autonomous.

Freight

<u>Predefined</u> flight form origin to destination.

On ground flight <u>monitoring</u> by operators using GPS and cameras

Examples: Griff, Amazon and DHL air drones.

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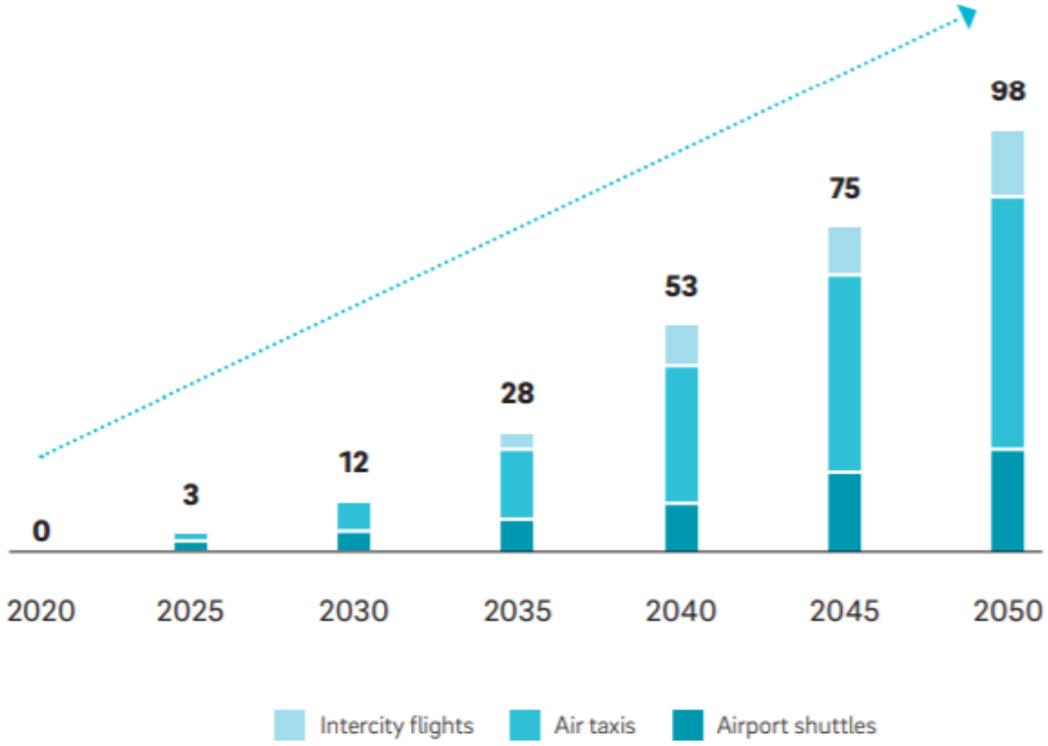
Urban Air Passenger Mobility

UAM will offer:

- ❖Lower TTs
- ❖Reasonable TCs
- ❖Safe and enjoyable trips
- ❖ Integration with land mobility services.



Prediction of UAM fleet, Source: Berger R., “Urban Air Mobility”, 2018

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Drones for Freight

Some facts and figures

- Drone Market is expected to over **1.2 billion $** by 2020
- **150.000** jobs openings in UK
- **1.000** commercial groups granted permission in UK, **42%** of US LSPs plan to use drones
- First applications for parcel, infrastructure monitoring, remote areas, emergency responses

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Needs

- Infrastructural:
  - Take-Off and Landing places will be needed;
  - Secure boarding and emergency landing (only for passenger);
  - Charging and parking areas;
  - Free line of sight, no flying areas (geofencing).
- Data:
  - Take-Off and landing area position data;
  - Routes, corridors, no fly zones data;
  - Flight route data;
  - Operating times;
  - Communication channels.

"It's still in the testing stages, but our new flying car project looks promising."Y

Challenges

1. Development of **regulatory framework**.
2. **Weather** conditions.
3. **Safety and security** issues.
4. Consumer, commuter **trust**.
5. Efficient **design** of **services** and **business models**.
   - Interaction with other air and land traffic.

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Thank you
for your kind attention!

Ioanna Kourounioti

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DEFENCE AND SPACE

Aerial Services integration into future Smart City

H2020 HARMONY

Mark Biell

05.11.2019

GRIFF

AIRBUS

DEFENCE AND SPACE

Vision 2028

UAS Traffic Management (UTM)

A modern System, to manage save low level air traffic…

..based on:

Existing ATM/ATC

..aligned to:

Aviation Standards

and

International Rules

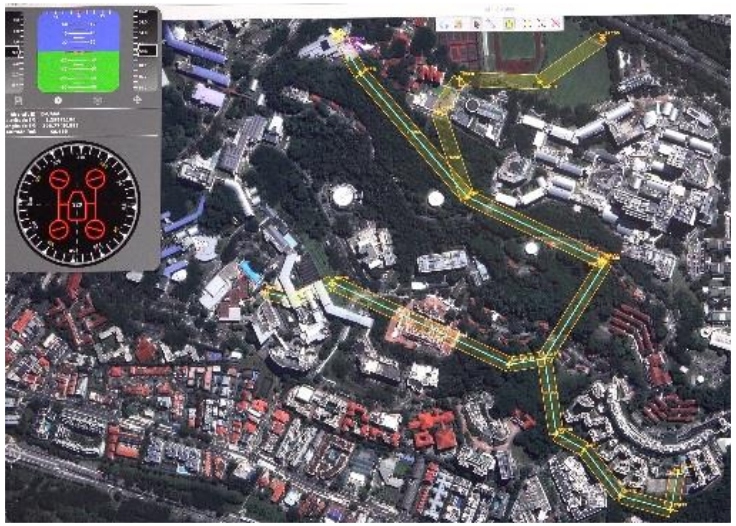
Fortion®1Sky UTM (Unmanned Aircraft System Traffic Management)

AIRBUS

Introduction: Technology & Services

Airbus is working to provide..

- UTM Concept of Operations
- Support to Standardization Groups (EUROCAE, GUTMA, JARUS)
- UTM – solution based on current ATM-system (Fortion®1Sky UTM)
- Future UTM cloud solutions
- Passenger drones
- Unmanned vehicles
- Counter UAS solutions



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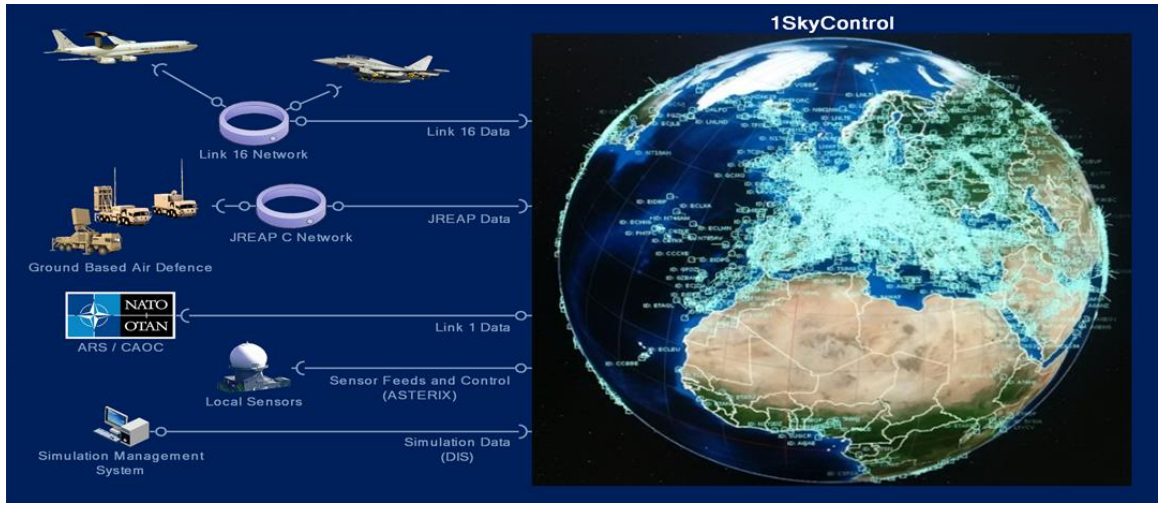
AIRBUS

Key Demonstrations 1/2

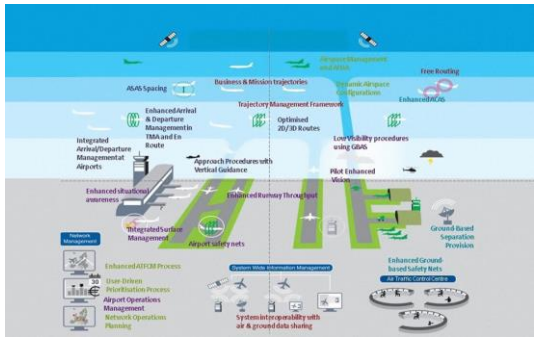
Military ATM/ATC

Airbus DS is not only demonstrating ATM/ATC capabilities, but is delivering major parts and systems for the ATM/ATC solutions of German and French Air Forces, granting state air sovereignty, since 1999.



SESAR

Integrating military flights by the Mission Trajectory Concept in a collaborative manner (CDM – Collaborative Decision Making (Process)) into the Single European Sky, maintaining highest level of safety and granting efficient access to all airspace users.



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SESAR JOINT UNDERTAKING

AIRBUS

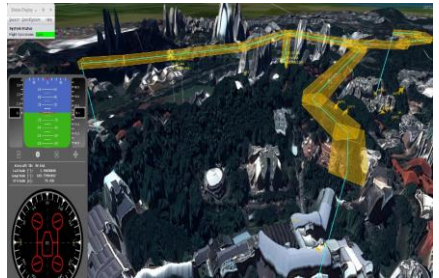
Key Demonstrations 2/2

First Drone Flight filing an ICAO Flight Plan *(16th of June`17)*

Witnessed by top managers from SJU, European Commission (DG Move, DG Growth), Eurocontrol and Airbus a first full autonomous drone flight has been demonstrated. The flight demonstrated automation capabilities and re-use of existing ATM technology and processes →

Skyways Singapore

Urban last-mile delivery project, where the **Fortion®1Sky UTM** solution from Airbus supports safe, efficient and seamless delivery of small parcels to students and facilities vll drone traffic across the NUS (National University of Singapore) campus. The SW was a core element for this project, qualified for operations with CAAS (Civil Aviation Authority of Singapore).



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Benefits vs. Challenges/Barriers

Benefits

Established UTM solution in todays ATM/ATC environment, which has been qualified with the Civil Aviation Authority of Singapore (CAAS). Providing safe airspace and flight plan handling for vll (very low level) unmanned flight operations, following current aviation standards.

- Some 630 flights were executed, 90 of which were urban (EVLOS).
- First operator permitted to fly over high-density areas of Singapore.
- Ability to conduct Shore-to-Ship transfer.
- High degree of automation.
- Radar tracking capability with track data fusion ability.

Challenges/Barriers

Concept had to be developed (started in 2015)

Right teaming had to be found (Drone Manufacturer, Logistic Company, UTM-Provider (term unknown at that time))

Export had to be managed, safety and security had to be addressed, communication/navigation/surveillance (CNS) challenges had to be solved.

Next steps:

Continuation in the dialogue with regulators and competent authorities.

Develop cloud-based services for UTM U-Space.

Learn from airspace users and drone operators needs for continuous evolvement of our solutions.

Identify partners for deployment of sustainable solutions in CNS.

Enhance the level of digitalisation and automation, whilst still fulfilling the appropriate requirements in airworthiness certification.

Continue the development of flying taxis.

Participate in research projects (e.g. HARMONY, CLASS, PODIUM, etc.) to understand how the needs of the cities and the airspace users evolve.

Steps within HARMONY – Demonstration Preparation

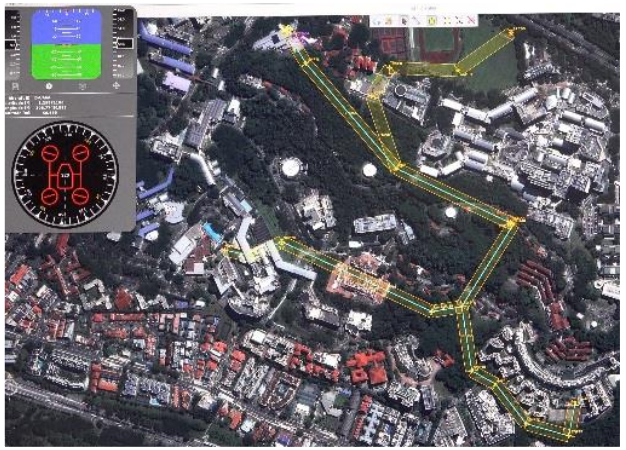
Aim of the flight operation(s): Demonstration of usage of drones in urban areas

1. Agree with OCC (Oxford City Council) on appropriate use cases

2. Define the appropriate approach to the conduct of the flight demonstration together with the competent authorities (OCC, CAA, NATS, Eurocontrol, …)
   a. Agree on the way of operation (incl. safety and security measures)
   b. Agree on the aeronautical data set
   c. Agree on the airspace usage

3. Define an interface from the UTM-system to receive transport requests out of the smart city transport system

4. Finalise the interface between the UTM-System and the drone from GRIFF



Overall:
Working to connect or partly integrate aviation (standards) with/into the smart city (model)

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AIRBUS

Thank you

AIRBUS