

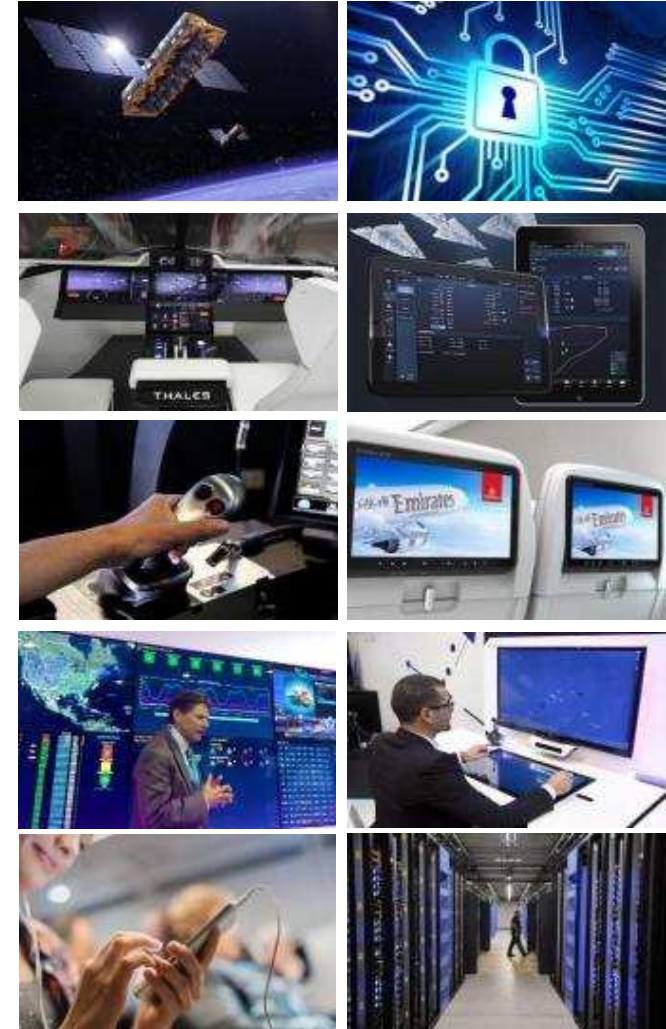
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More Autonomy for Aviation

French – Norwegian Forum
Nov 20th, 2019 – Toulouse – B612

Philippe BENQUET - VP R&T Avionics

www.thalesgroup.com



Global societal trends are pervasive within aviation



Growing demand, high customer expectations

- Consumer goods, medical care, Everything-as-a-Service

“Platforms eat the world”

- Google, Amazon, Facebook, Apple, Microsoft, Intel

Decarbonisation is environmental biggest challenge

- Political pace is faster than science & technology
- Battery power density and H₂ propulsion are good examples

Safety and security remains societal priorities

- Human Machine teaming becomes critical
- Cyber resilience, privacy, data protection for security

Digital breakthrough

- Connectivity / IoT, smart devices, cybersecurity
- Big Data, Machine Learning, Artificial Intelligence
- Virtual / Artificial Reality

Automation

- 19th Century: Blue Collar → Machines
- 21st Century: White Collar → AI



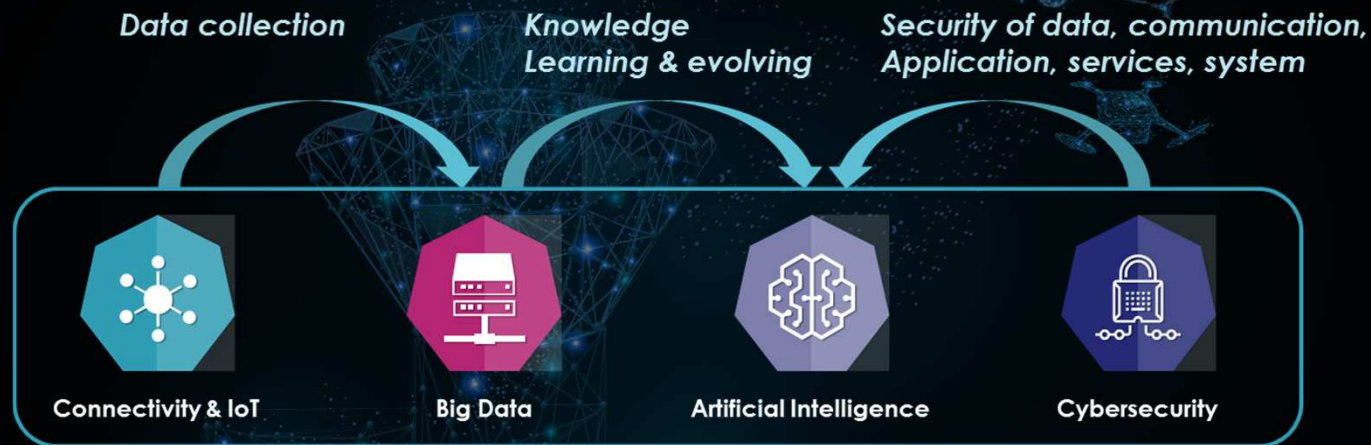
	Pax
2018	4.3 billion
2035	8 billion



Key enabling technologies

We are now at the convergence point of several new technologies:

- Materials – manufacturing
- Communication technology
- **Hybrid electrical systems, electrical propulsion**
- **Digitalization – Data Analytics – Artificial Intelligence – Cybersecurity ...**



**Since 2016, Thales has invested ~ 7 B\$
in these digital technologies**

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Mega trends in aviation



From evolution... to... disruption



The platforms and the overarching systems are becoming
connected, intelligent, safe, greener ... autonomous

The new challenges : Drones, UAM & air taxis, autonomous & greener a/c

■ The **future fleet will be more diverse** than it is today, and a growth of personal air and unmanned vehicles is be expected

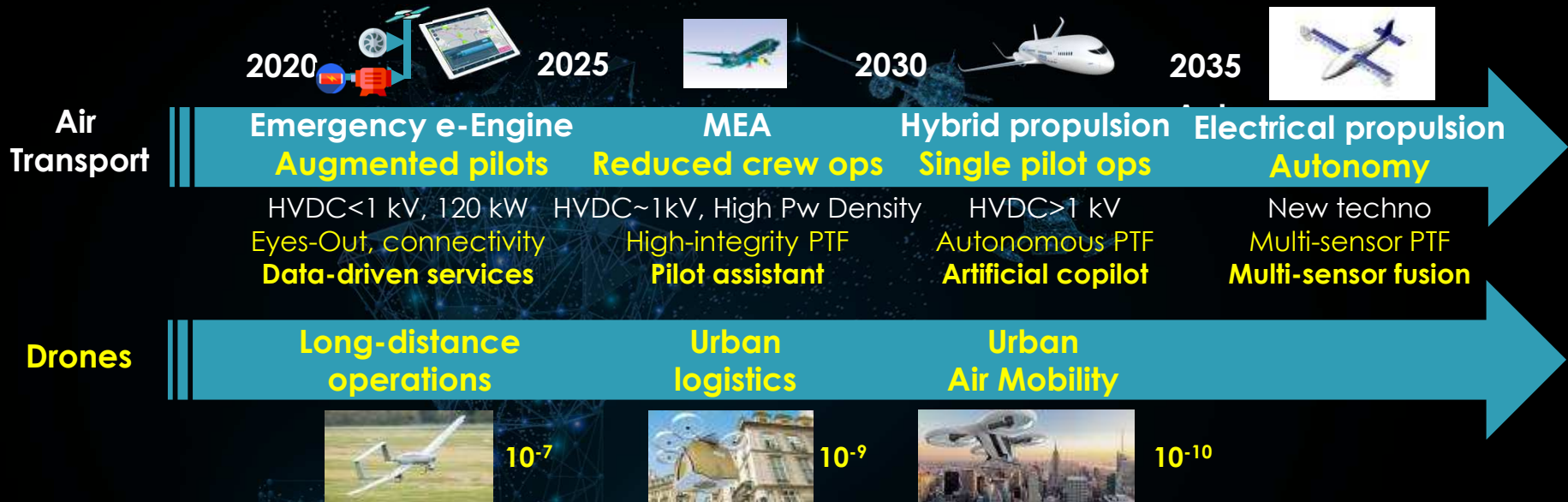
- Drones, RPAS, etc. will pave the way of increased commercial aircraft automation and ultimately to autonomous aircraft
- UTM may disrupt ATM concepts, technologies and business models
- UAM impose immediate jump to all electric or hybrid propulsion solutions

■ **Automation of aircraft and airport** will induce reduced crew / controller operations



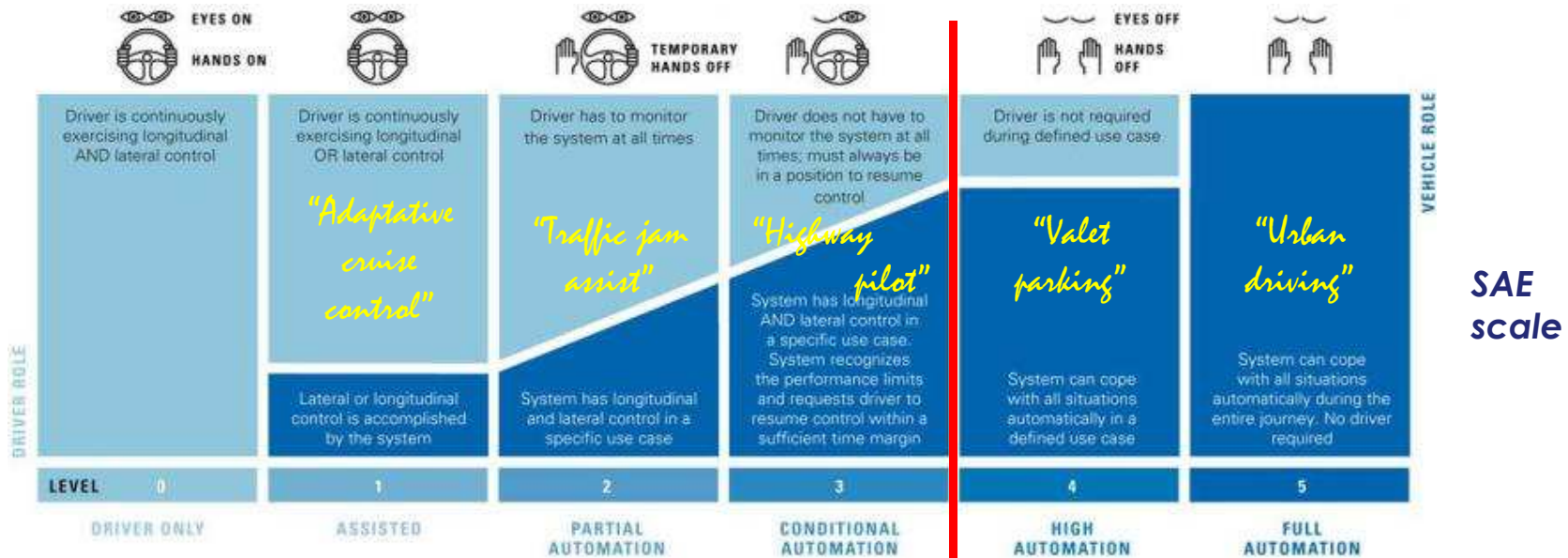
Aviation at the dawn of drastic changes – Societal Challenges

- “More electrical aircraft” (hybrid/electrical propulsion) → Decarbonisation
- “More autonomous aircraft” (Automation /Secured Connectivity/AI) → Safety, Affordability



Both roadmaps are two sides of the same coin

Two autonomy strategies – Benchmark with automotive market



Some autonomy everywhere

Full autonomy somewhere



Traditional mobility players

A roadmap of value-added driver aids to increase car value

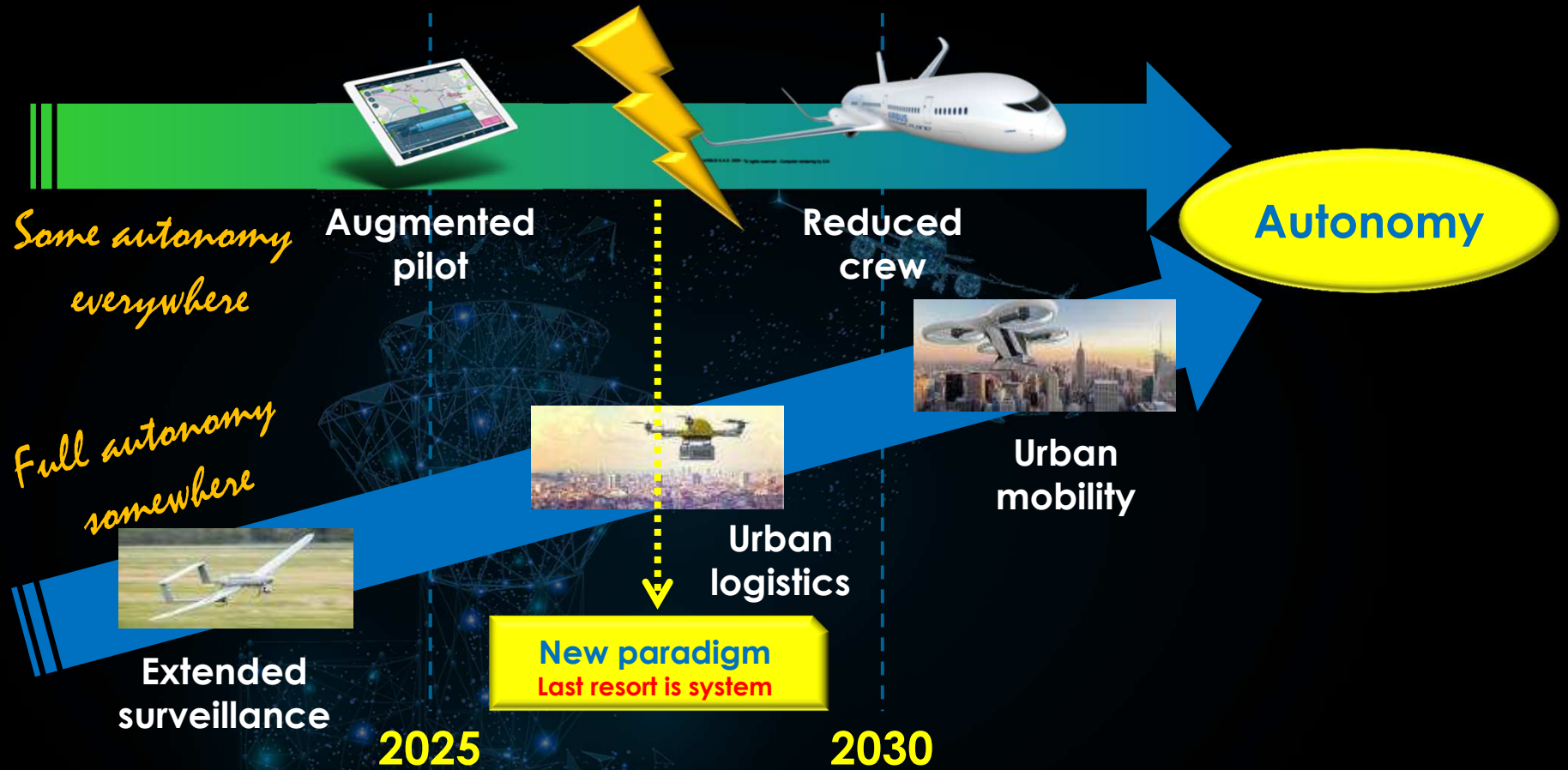


New mobility players

A fully autonomous car to disrupt urban mobility

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Roadmap to autonomy – Aviation strategy



Thales AVS/FLX Vision & Challenges

Provide SAFE, CONNECTED and SECURED avionics solutions for all our value chain, leverage DIGITAL for operations EFFICIENCY and future AUTONOMY



ENVIRONMENT

- OEM consolidation, insourcing, services
- Connectivity, Decarbonation, Autonomy
- Competitiveness, Safety & CyberSecurity

G. Faury – Sep 17th, 2019

- « Our objective is to be able to **Enter into Service in 2035** at the latest an aircraft capable to reach carbon neutrality of Air Transport by 2050. In this context, a brand new **very decarbonated** aircraft will be launch in the second half of next decade (2025-2030) including **Single Pilot Operations** technologies, latest **connectivity** technologies and produced with a very **automated industrial tool** »

Main Challenges to More Autonomy

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« Acting »

Safety Critical Autonomy Platform

- **Extended high integrity flight control platform**
- **Connected high performance service platform**
 - Distributed ground / on-board, real time
 - Small on-board footprint - Cloud platform
 - Seamless avionics / open world cooperation
 - Open World mission related data & services
 - Continuous value delivery

« Perceiving / Deciding »

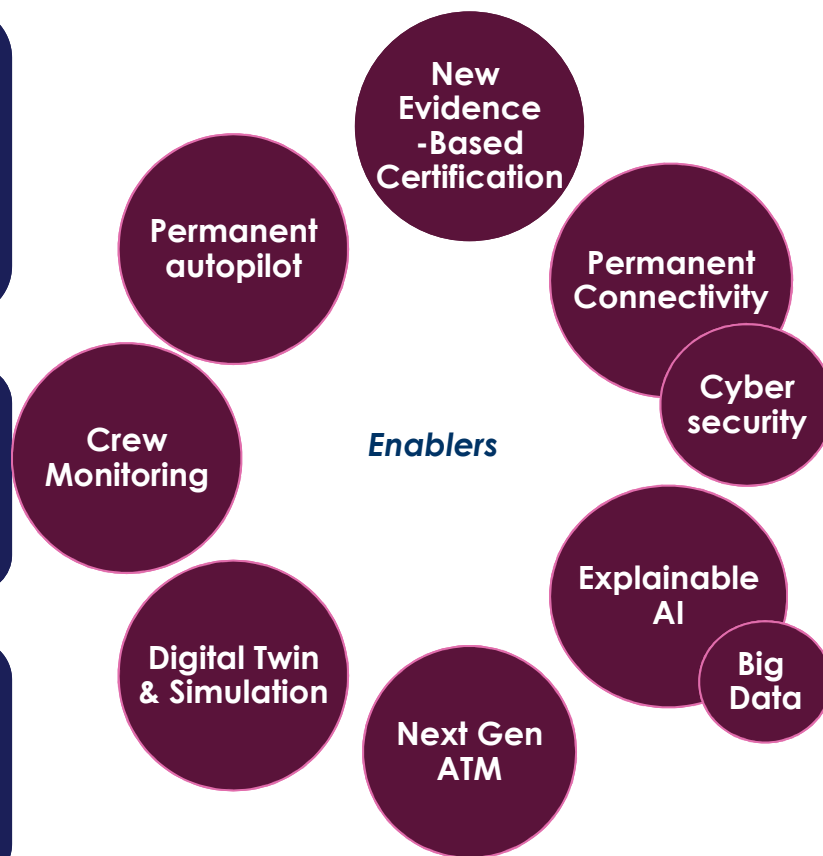
Pilot Assistant Artificial Copilot

- **Provide Suggestions / Recommendations**
- **Anticipate needs**
- **Advertise intention - Don't disrupt others actions**
- **Understand implicit**
- **Trustworthy**

« Sensing »

Multi-sensor Fusion Platform

- **Perception sensors** (camera, radar, lidar, ...)
- **Nav sensors** (IMU, GNSS, Anti-jamming, Air Data, Odometers, ...)
- **Sensor fusion** for high integrity localization, vision-based navigation, detect & avoid, trajectory management



Synthesis

Decarbonization and Safety are the highest priorities

- Decarbonization has a detrimental impact on competitiveness
- Human-Machine teaming is becoming a safety issue

More autonomy is a key contributor to:

• Systems that reduce emissions

- ✓ **Flight Management (FMS)** optimizing “green” trajectories, flying in formation, improving ground ops
- ✓ **Electrical Generation & Conversion**, modular power electronics
- ✓ **Minimizing SWaP** (Size, Weight & Power)

• Systems that reduce cost of operations, enabling expensive decarbonisation technologies w/o competitiveness impact

- ✓ **Single pilot operations** and autonomous operations

• Systems that improve safety through new automatism and new ways of operating / integrating into the air space

- ✓ New **flight controls** and **trajectory management** techniques
- ✓ **Pilot assistant and Artificial Copilot**
- ✓ New **multi-sensor platform** for vision-based navigation

on the road to
autonomy

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