QULSAR™

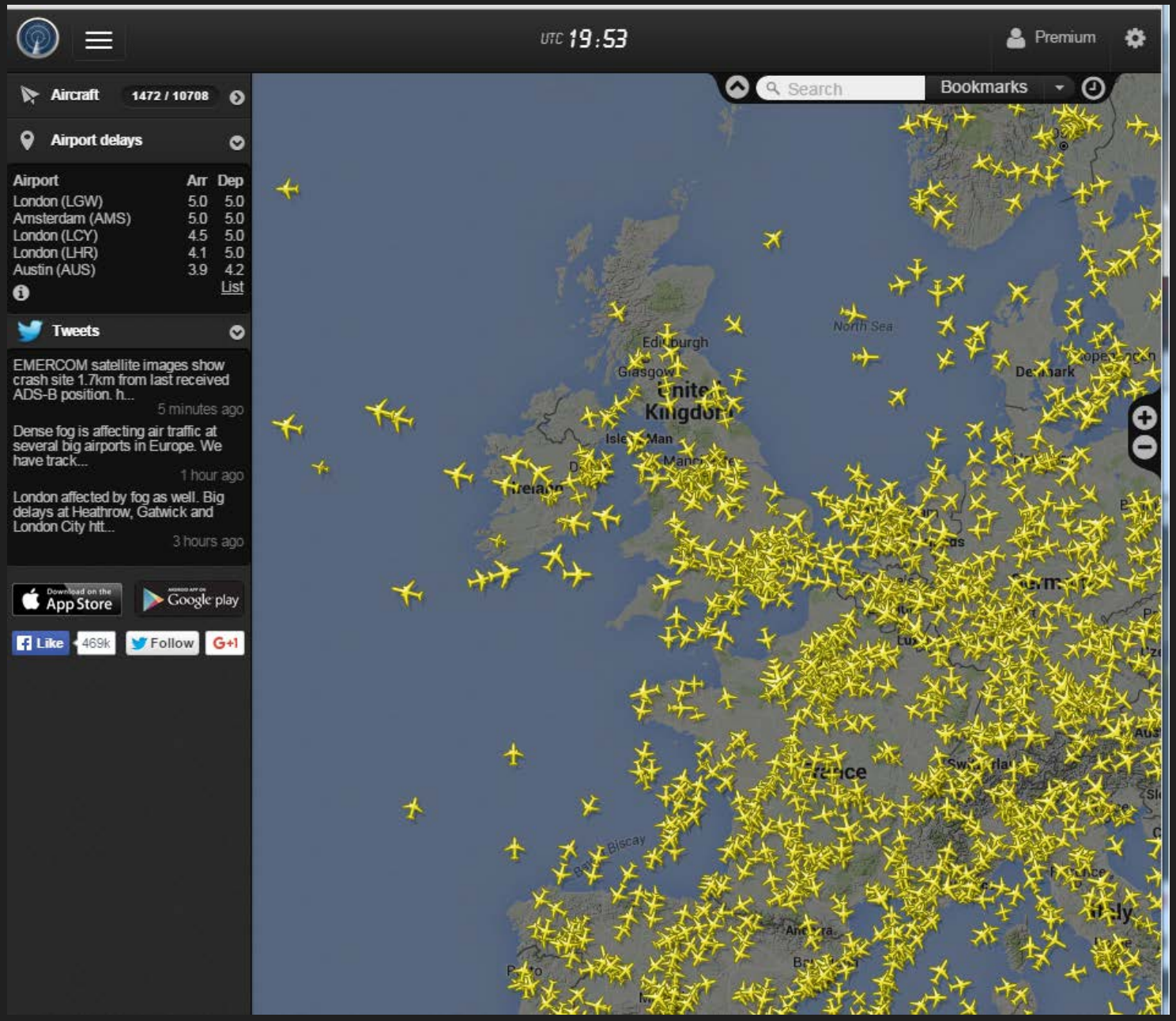
Precise time. Synchronized.

The Internet of Synchronized Things

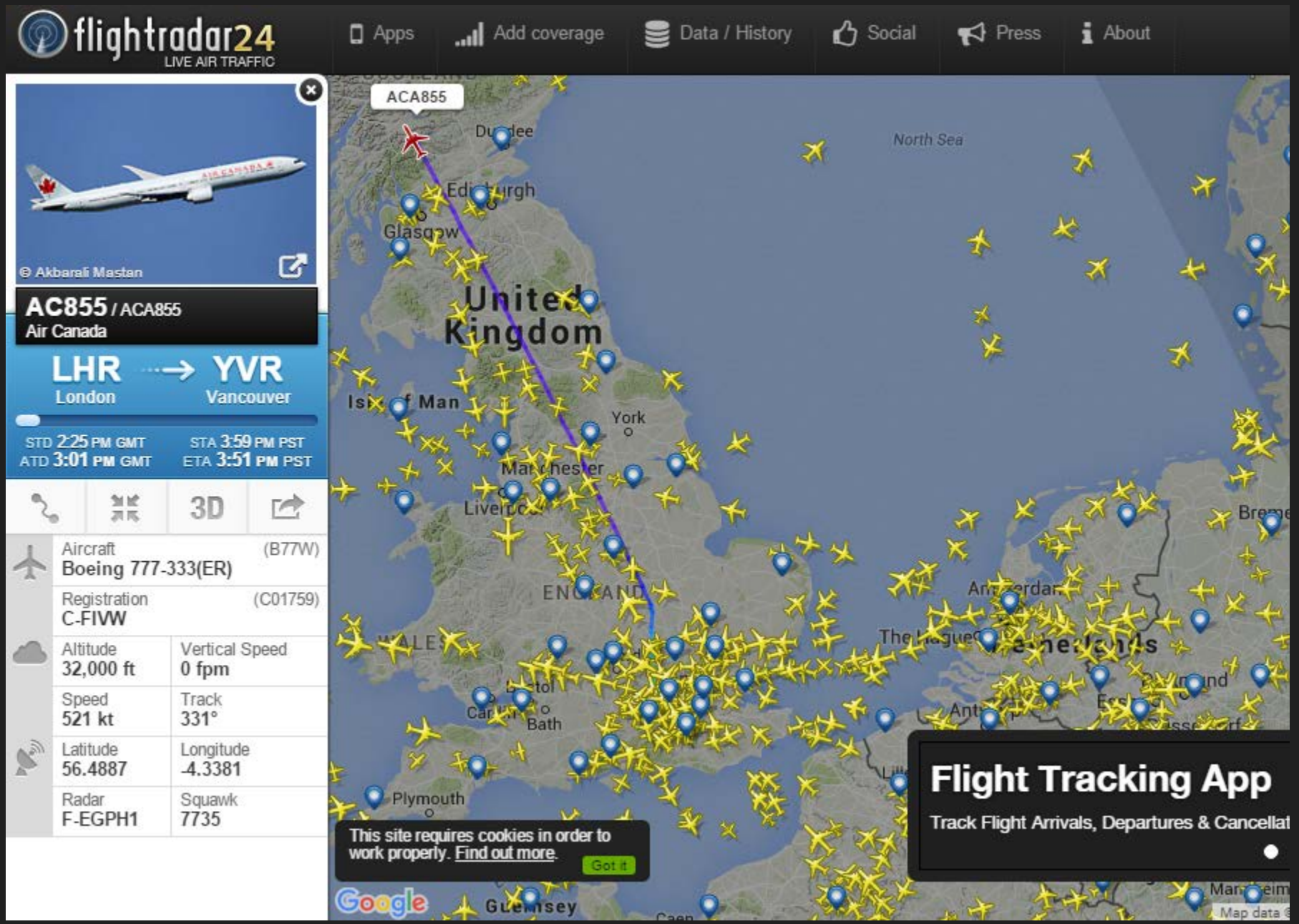
Ola Andersson

Founder & COO

ITSF, Edinburgh, Nov 2015



www.flightradar24.com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3D
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Boeing 777-333(ER)
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Vertical Speed
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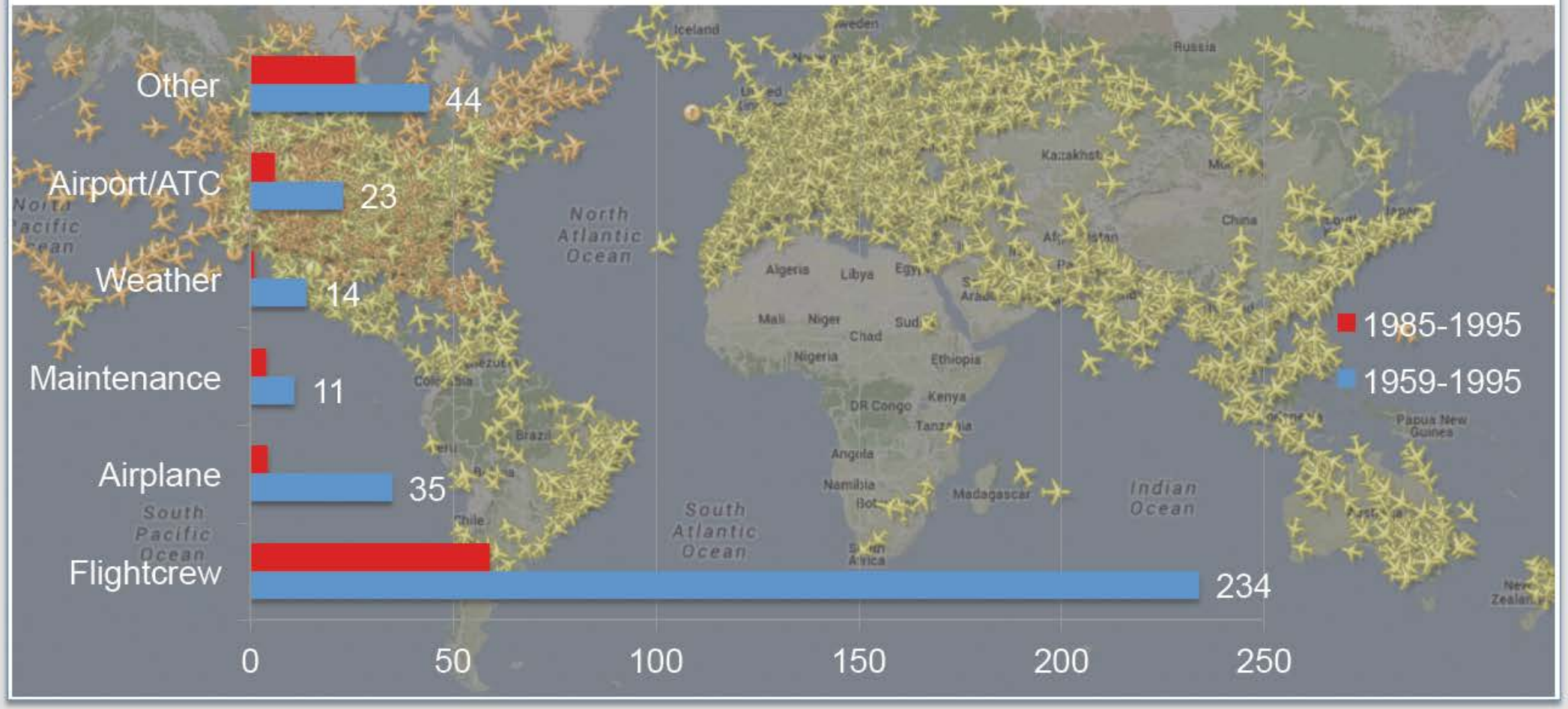
The Mobility Revolution

Source, New York Times, April 6 2015 2

Source: C2X Connectivity & Safety, Munich, Sept 2015, © Lukas Neckermann

Over 60% of fatal aircraft accidents are due to pilot error.



The Mobility Revolution

Source, Flight Radar University Bielefeld

Source: C2X Connectivity & Safety, Munich, Sept 2015, © Lukas Neckermann

Consumer IoT and Industrial IoT

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Consumer Internet of Things (CIoT)

Industrial Internet of Things (IIoT)

Cyber-Physical Systems

iTimes

Thursday, March19, 2015

IoT paused by lack of timing

Our fast-approaching future of driverless cars and "smart" electrical grids will depend on billions of linked devices making decisions and communicating with split-second precision to prevent highway collisions and power outages. But a new report* released by the National Institute of Standards and Technology (NIST) warns that this future could be stalled by our lack of effective methods to marry computers and networks with timing systems.

The authors, who include NIST's Marc Weiss and seven experts from academia and industry, are concerned about the way most modern data systems are designed to process and exchange data with one another and what that could mean for a world of discrete processors and mechanical devices linked by an information network—the "Internet of Things" (IoT). ... read more at http://www.nist.gov/pml/div688/

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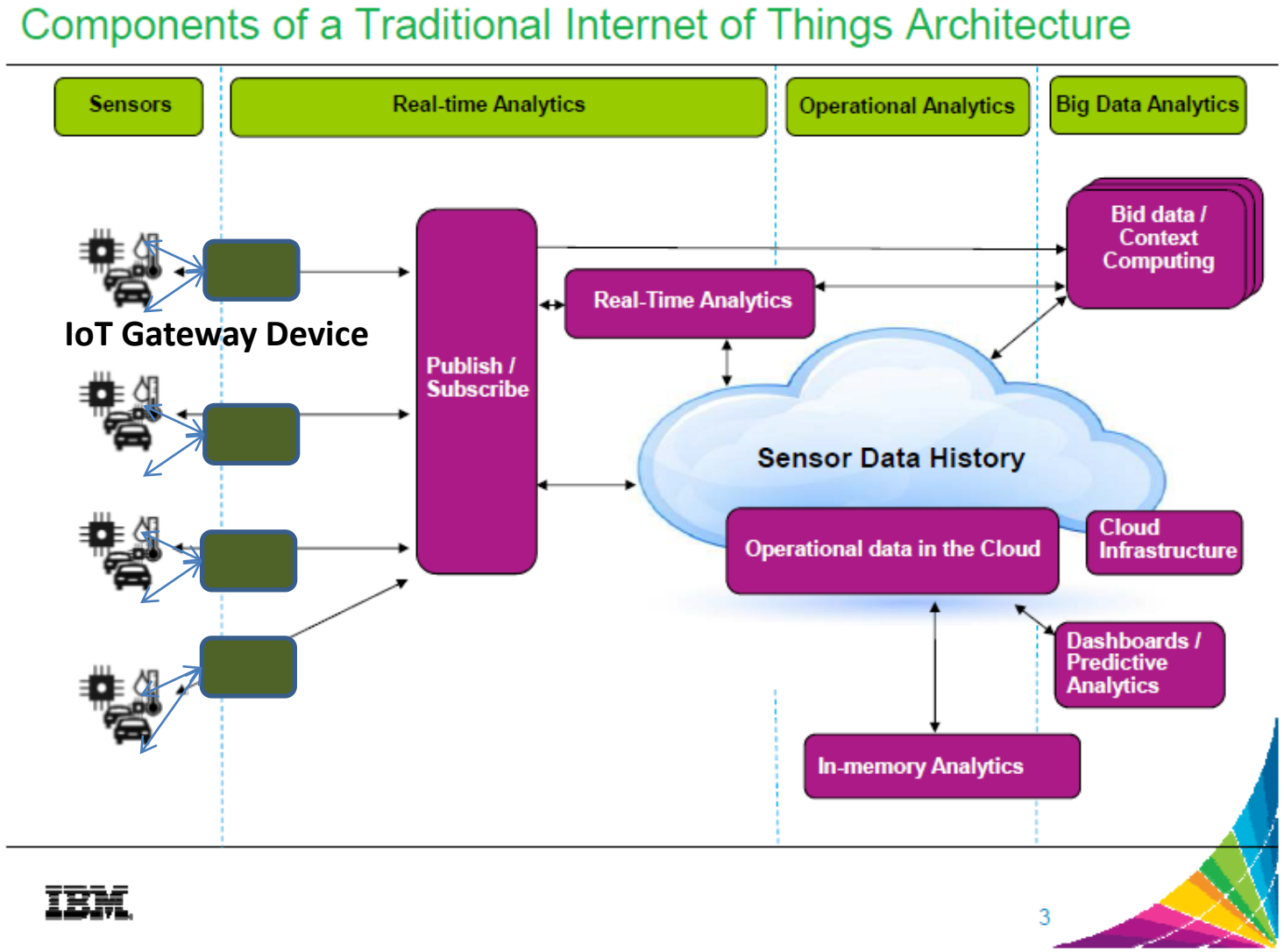
30 – 50 B connected devices!

Industrial IoT requires 'real time' data analytics

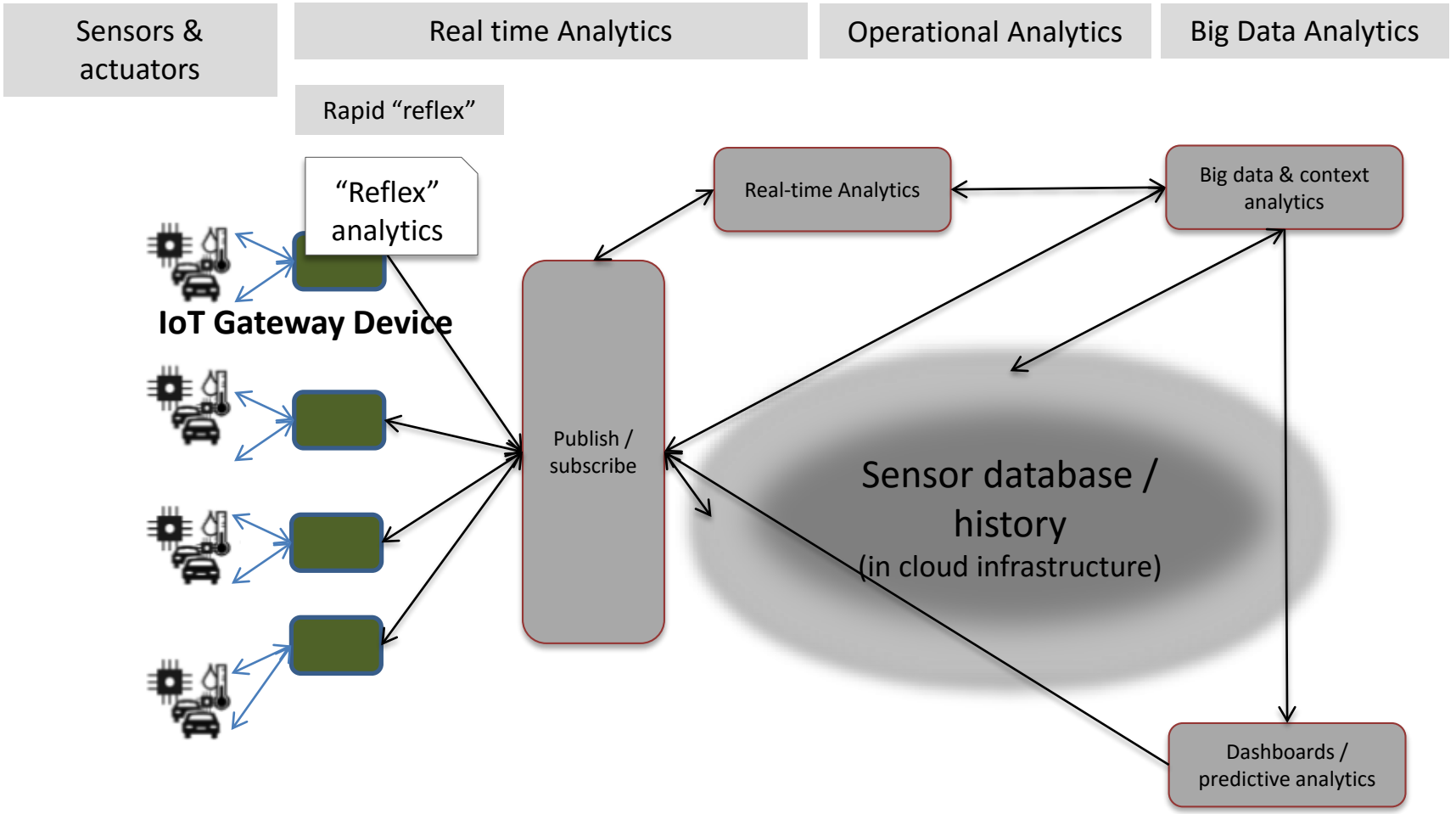
Lack of deployable precise time technology / platform for IoT

Traditional IoT Architecture

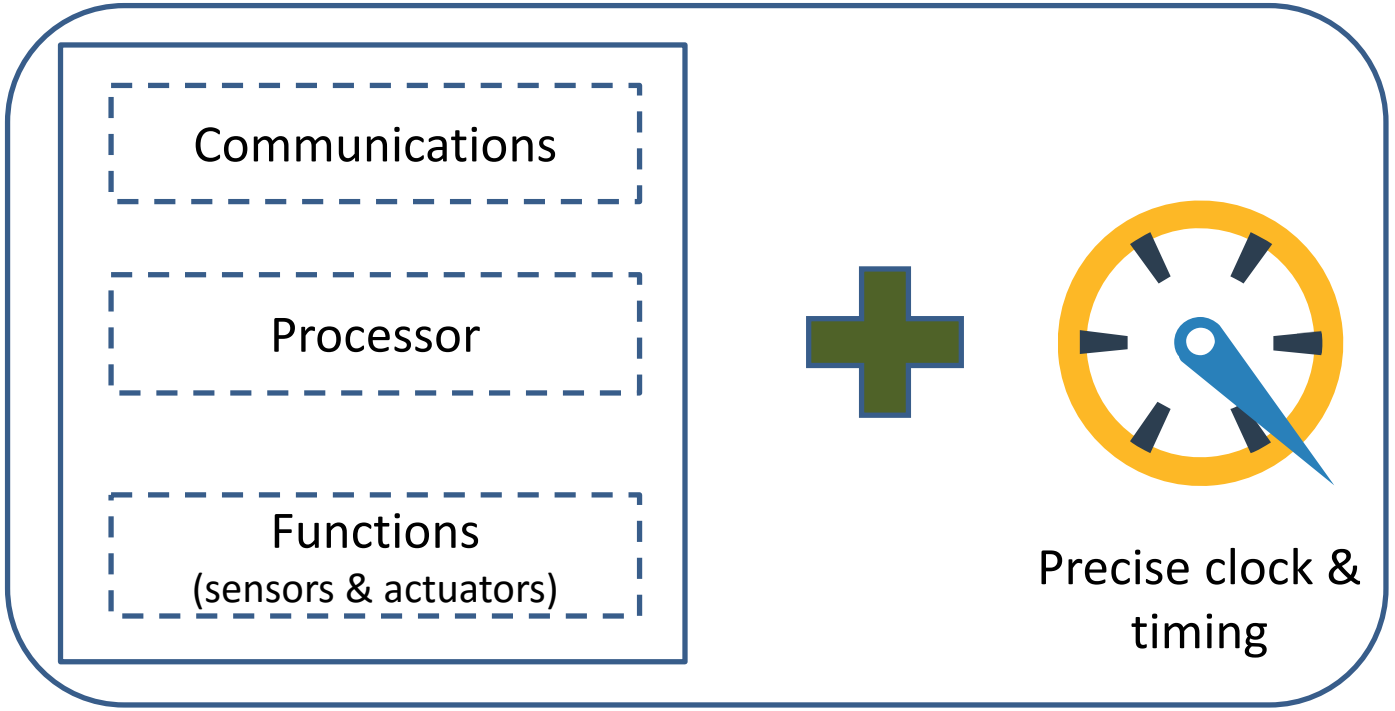


Source & © IBM 2015

Adaptation for Cyberphysical Systems



IoT Devices → *Smart* IoT Devices



Smart IoT Device

- **Smart** IoT device: precise + stable + accurate + robust + ubiquitous + cost effective **clock**
- Real Time Data → information: requires time element ; higher scale → increasing precision

Gateway Platform

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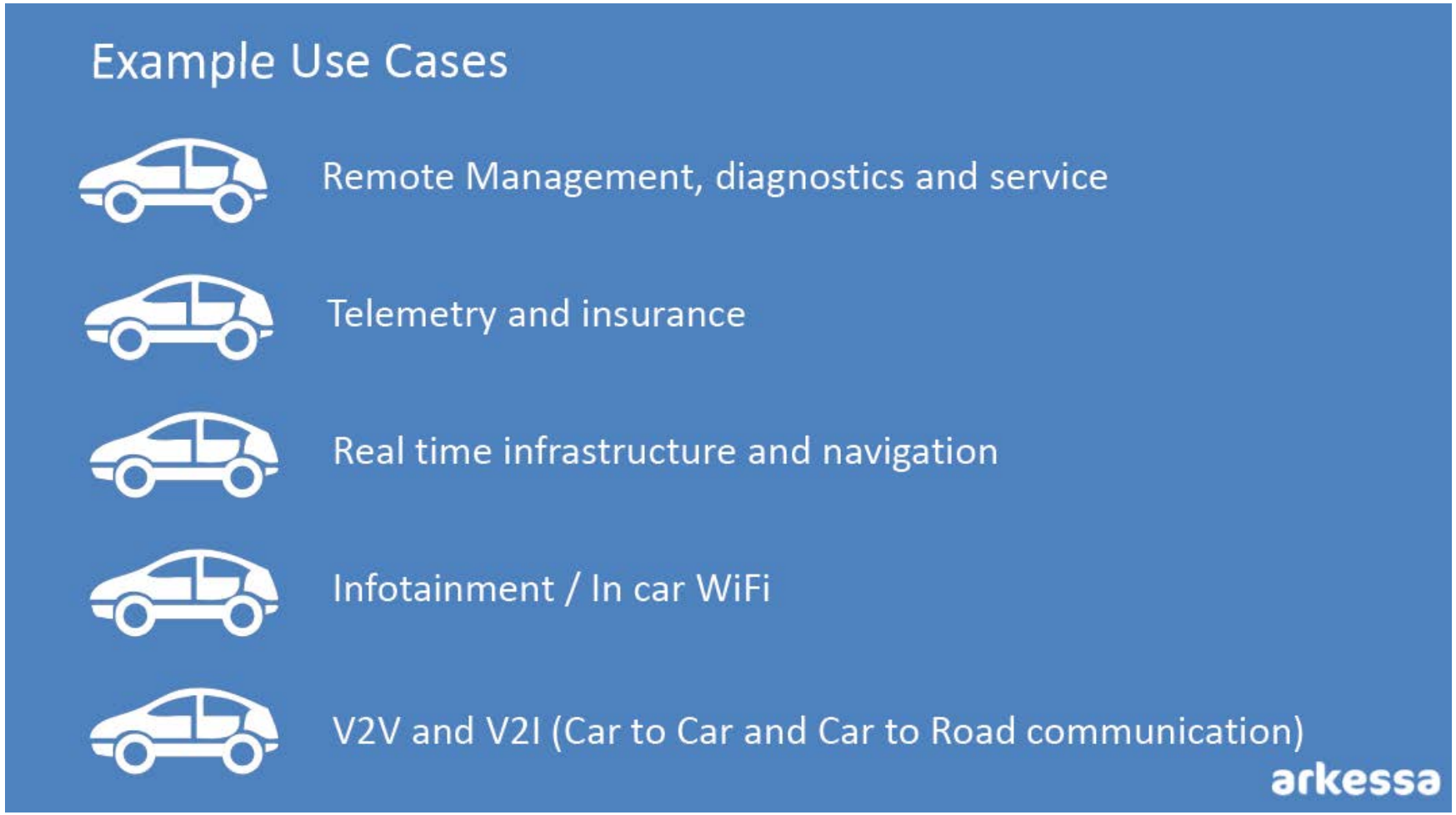
Abilities/requirements …

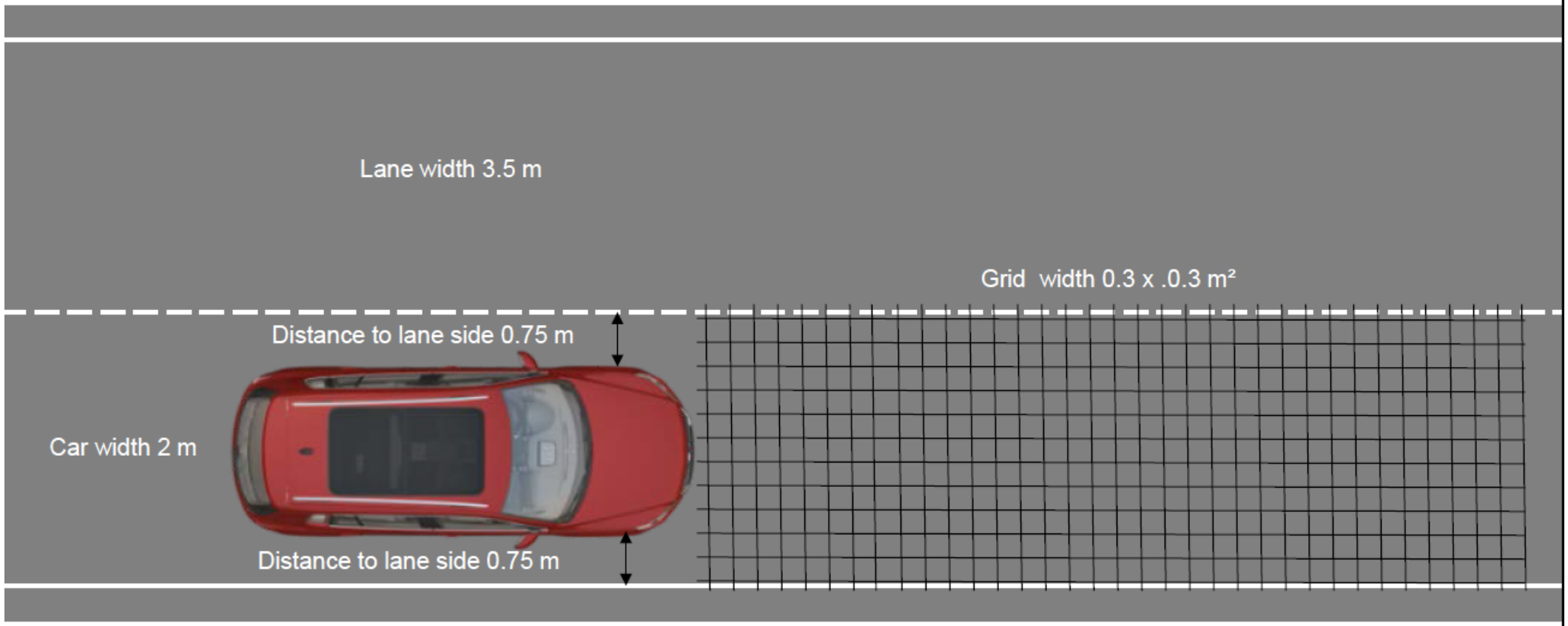
- Ubiquitously deployable
- Dynamic high scalability
- Accurate timing of sensor data + error bounds
- Accurate timed execution of actuator commands
- Precision monitoring in mission critical applications
- Support rapid response.

Connected Cars



Source: C2X Connectivity & Safety, Munich, Sept 2015, © Arkessa

Vehicle2X Communication
Automotive Requirements for Future Mobile Networks



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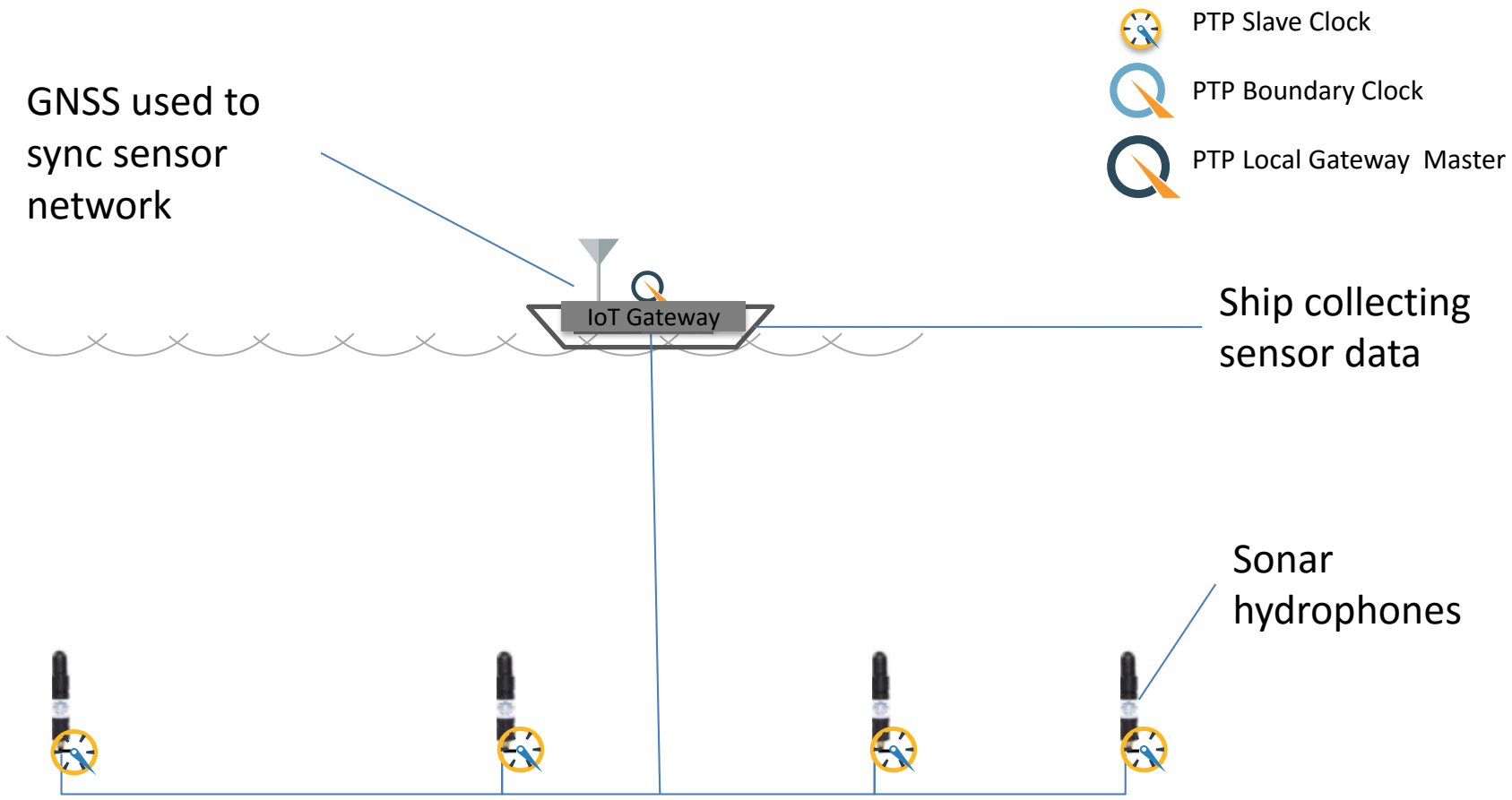
Vehicle2X Communication
Automotive Requirements for Future Mobile Networks

End-to-End Latency

- From the lane width of 3.5 m we derive a position accuracy of 0.3 m
- Trajectory planning with a grid of 0.3 x 0.3 m² to keep the vehicle in the lane
- The lateral controller has to update the output every 10 ms (5 ms)
- While we cover one grid element with 30 m/s = 108 km/h
- Within 10 ms: communication with 3 participants: sending the own trajectory, receiving the other trajectories, (compare them to the observations)
- Not possible with WLAN-based vehicle2X technology due to quasi continuous transmission during overtaking and blocking of the vehicle2X control channel.
- Managed/unmanaged D2D with approx. 3 ms per communication inclusive latency
- Massive machine type communication with small data packages

IoT: Sensor Sync



Trust in Standards

- We trust machines (to some extent)
- But we want to trust them even more (C2X)
- Machines (Things) are built on standards
- Need Standards for:
  - ensuring interoperability
  - performance expectations & conformance testing
  - customer acceptance.
- But also for
  - New reference architectures
  - Simplified command, control & management (NMS).

Thank You!

Ola Andersson
Founder & COO
oandersson@qulsar.com