

Nebbiolo Technologies: A Fog Computing Platform for the Future of Industrial IoT and Cyber-Physical Systems

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The Pendulum Swinging Back: A Renewed Focus on the Edge of the Network, Motivated by the Network Evolution, 5G and IoT

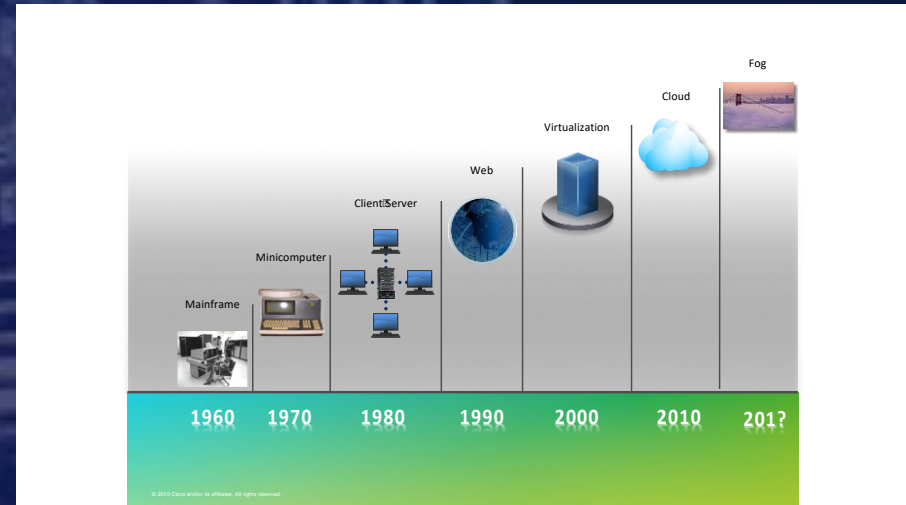
Fog Computing

Also described as:

Mobile Edge Computing

(Modern, Real-Time Capable) Edge Computing

Real-Time Edge Cloud



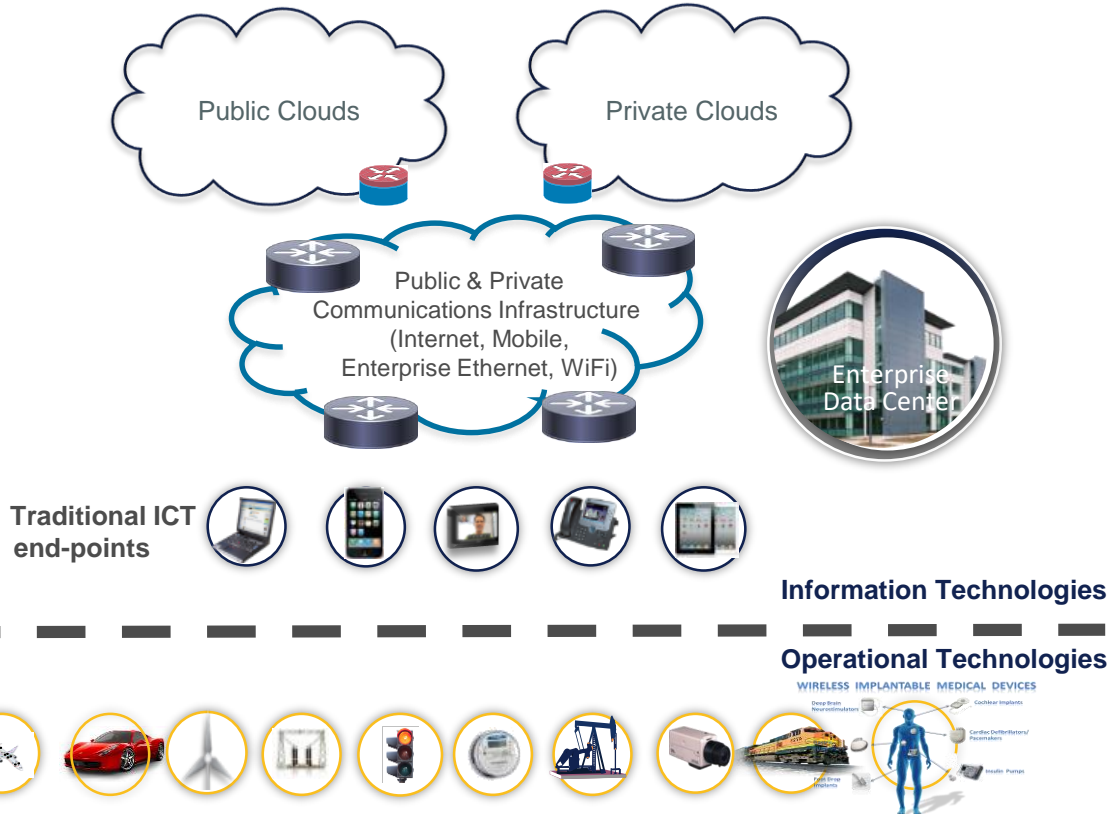
The Internet of Things: Information Technologies “Meet” Operational Technologies

Information Technologies Today:

- 1) Clouds
- 2) Enterprise Datacenters
- 3) Traditional and Embedded Endpoints
- 4) Networking

The Internet of Things Brings Together Information Domain and Operations Domain through:

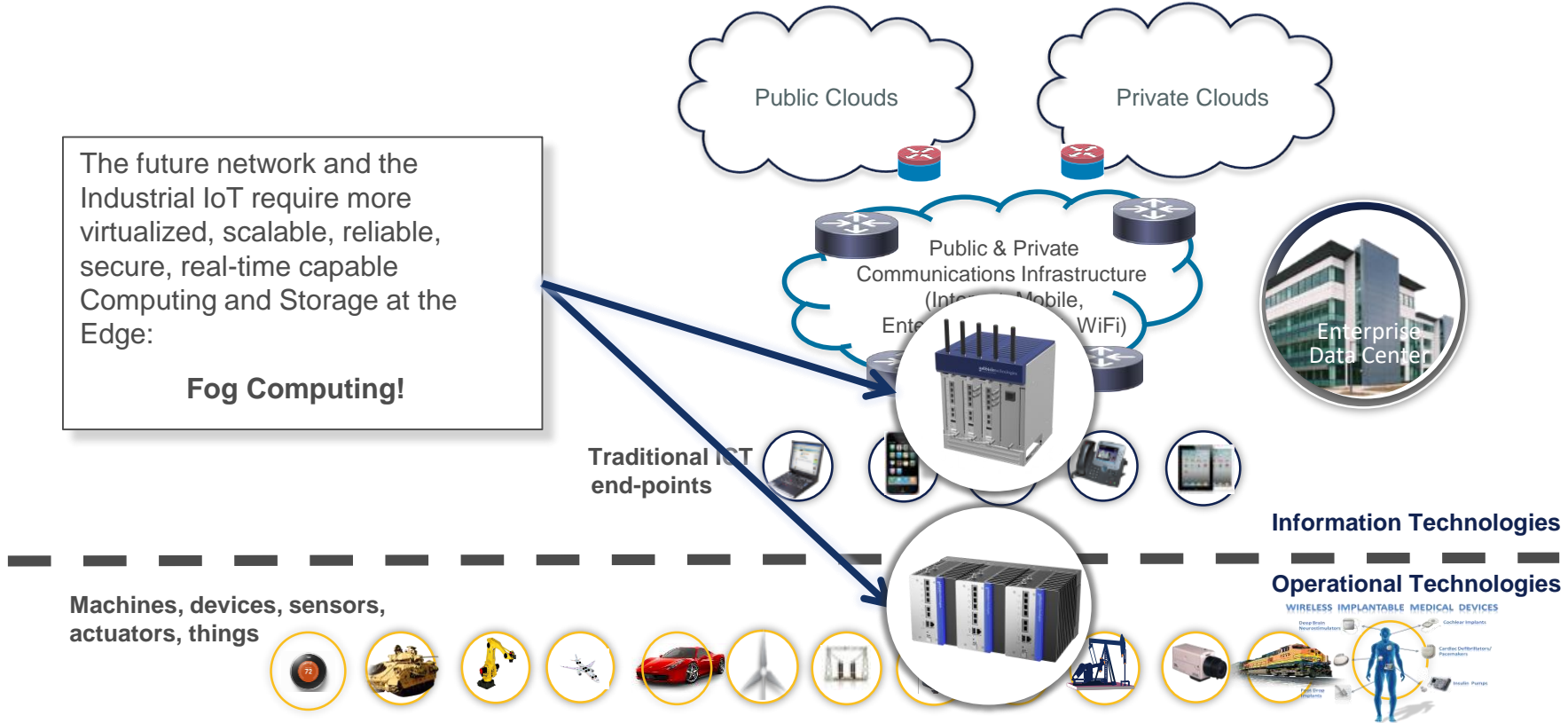
- 1) Connectivity
- 2) Data Sharing and Analysis
- 3) Technology Convergence



Industrial IoT, or Industry 4.0, Both Require More Distributed Computing

The future network and the Industrial IoT require more virtualized, scalable, reliable, secure, real-time capable Computing and Storage at the Edge:

Fog Computing!



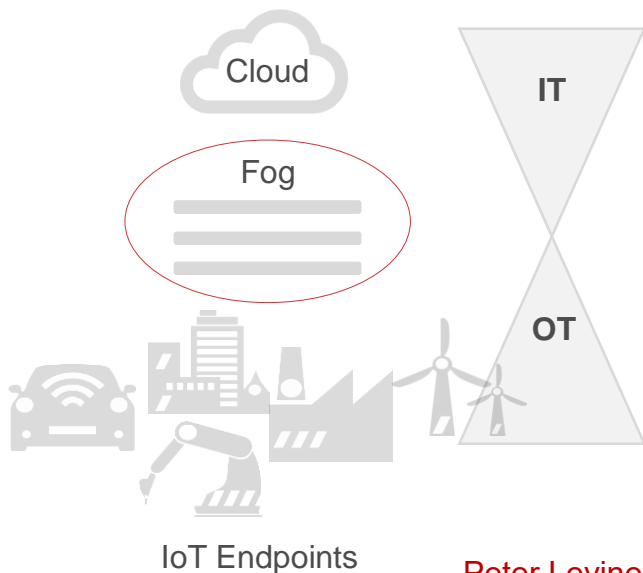
What is Fog Computing?

The Missing Link Between Clouds and End Points



Fog Computing brings:

- Cloud-inspired computing, storage, and networking functions closer to the data-producing sources...
- While integrating **real-time** and **safety** capabilities required in the OT domain



Fog Computing is the key enabler of a real **convergence** between IT and OT technology



Peter Levine on Dec '16:

“Cloud computing is dead, the intelligence is going down close to the things”

Why a Fog-based Solution Architecture ?

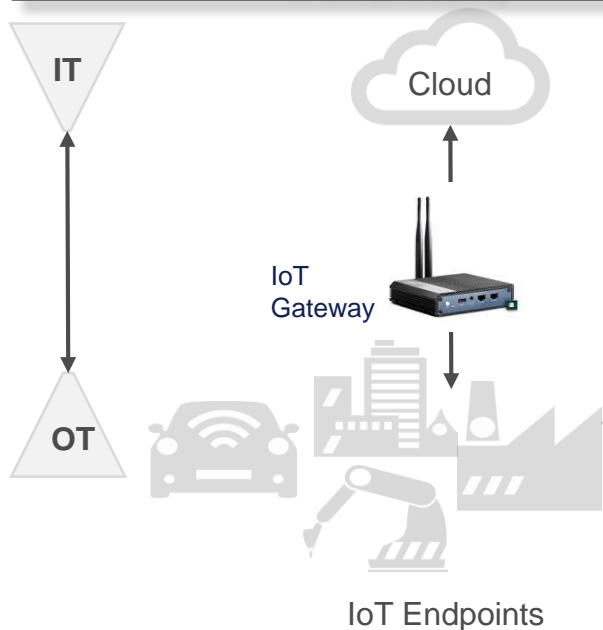
IT-OT Connectivity vs Real IT-OT Technology Convergence



IoT Gateway Solution Architecture

Data to the Cloud - Applications in the Cloud

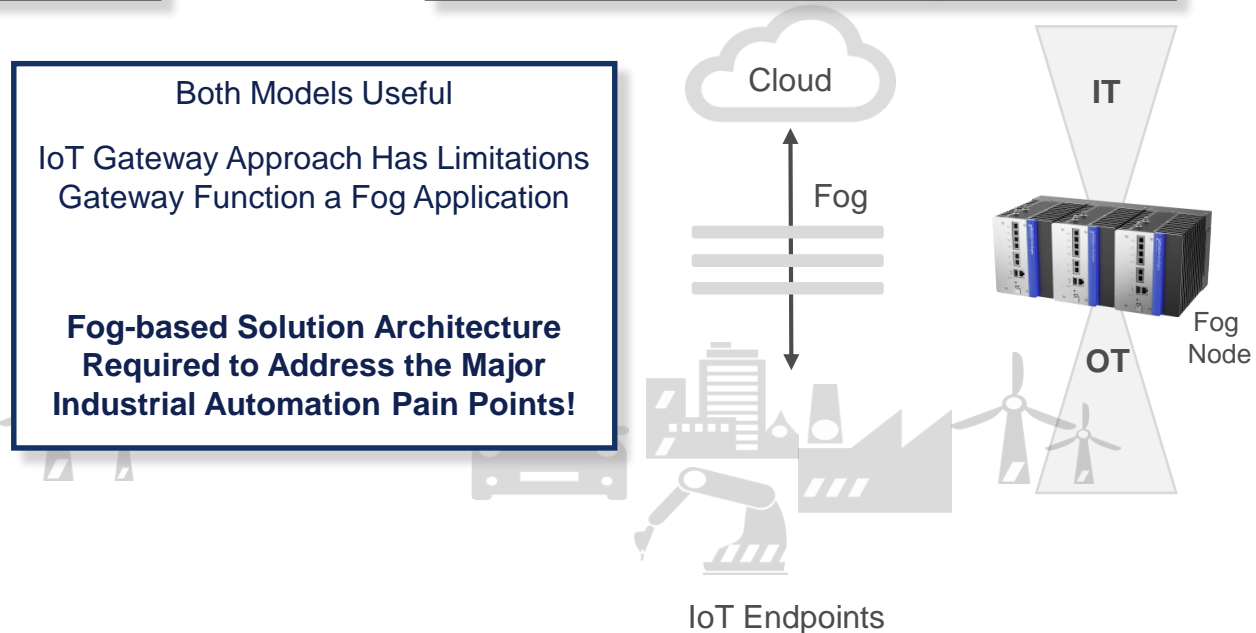
IT-OT Connectivity



Fog-based Solution Architecture

Most Data stays in the Fog – Most Applications in the Fog

IT-OT Technology Convergence



Both Models Useful

IoT Gateway Approach Has Limitations
Gateway Function a Fog Application

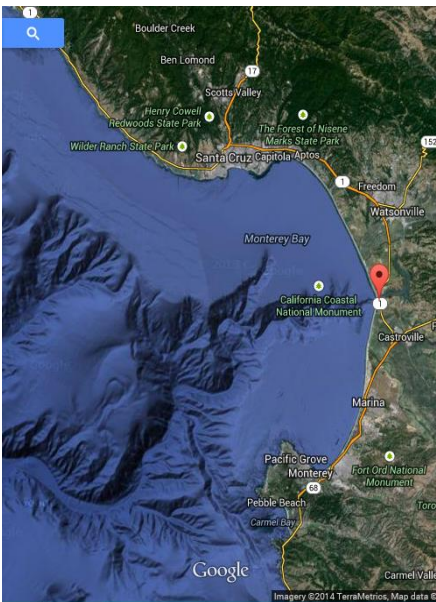
**Fog-based Solution Architecture
Required to Address the Major
Industrial Automation Pain Points!**

A Bit of “Fog” History

Where did the name “Fog Computing” come from?



- It was a day in September 2010, at the Monterey Bay Aquarium Research Institute (MBARI)



At the end of my talk,
Ginny Nichols told me:

“Flavio, why don’t you call what
you have been talking about

Fog Computing,
which is
Cloud Computing
close to the ground?”

And I adopted the idea

Nebbiolo = Grape Enjoying the Morning Fog (=Nebbia) in Northern Italy



- Producing wonderful wines: Barolo, Barbaresco, Nebbiolo, Valtellina Reds



nebbiolotechnologies
 *pioneers of fog computing*

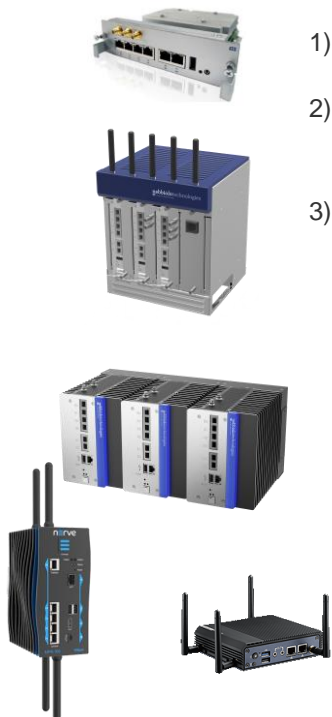
Nebbiolo Technologies:

- is architecting and building the most innovative Fog Computing Platform for IoT Solutions
- is applying it first in the Industrial Automation vertical.



- Team:
 - World-class, Cisco sourced, experienced team (20+ people)
 - Surrounded by a rich ecosystem of IoT technology partners
- Investors:
 - KUKA Robotics,
 - TTTech and
 - GiTV (Tokyo, Japan VC)
- Milestones:
 - 7 Patents pending,
 - Strong traction, production deployments and PoCs ongoing,
 - First product released December 2016

Nebbiolo Technologies Fog Computing Platform Components

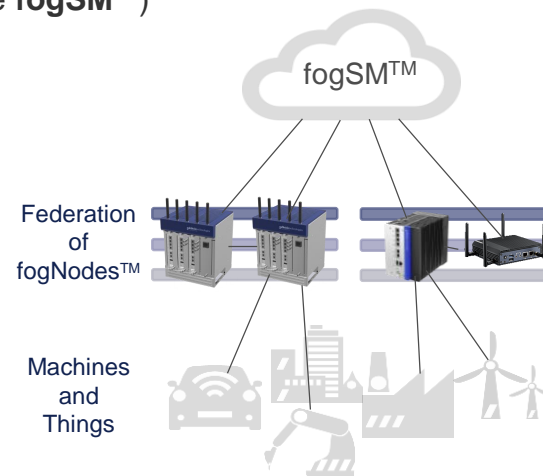


fogNodes™

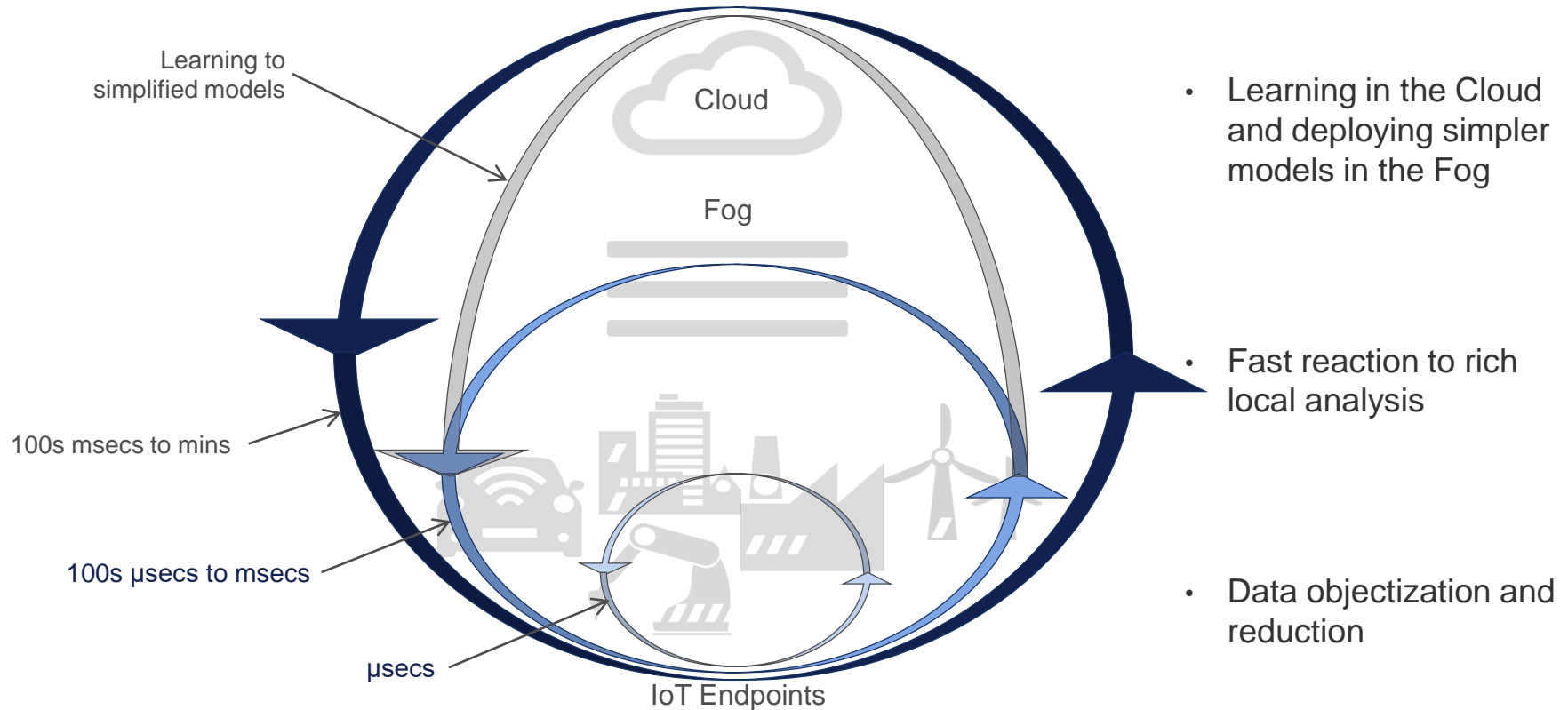
- 1) A **flexible hardware architecture** available as a family of **fogNodes™**
- 2) A rich **software distributed stack** (the **fogOS™**), enabling fast, secure, flexible communications, data management and application deployment.
- 3) An **end-to-end system management** of distributed networking and computing systems, assets, software and applications (the **fogSM™**)

Manageability	Secure Stack	Business Application
		IoT Infrastructure
		Application Hosting & Orchestration
		Middleware
		Cloud Infrastructure
	Secure Boot	Fog Infrastructure
		Admin Plane
		RTOS/Kernel
		Host OS/Hypervisor
		Hardware (X86/Arm)

fogOS™



Fog Computing: The Support for a Hierarchical Data Acquisition-Analysis-Control Cycle

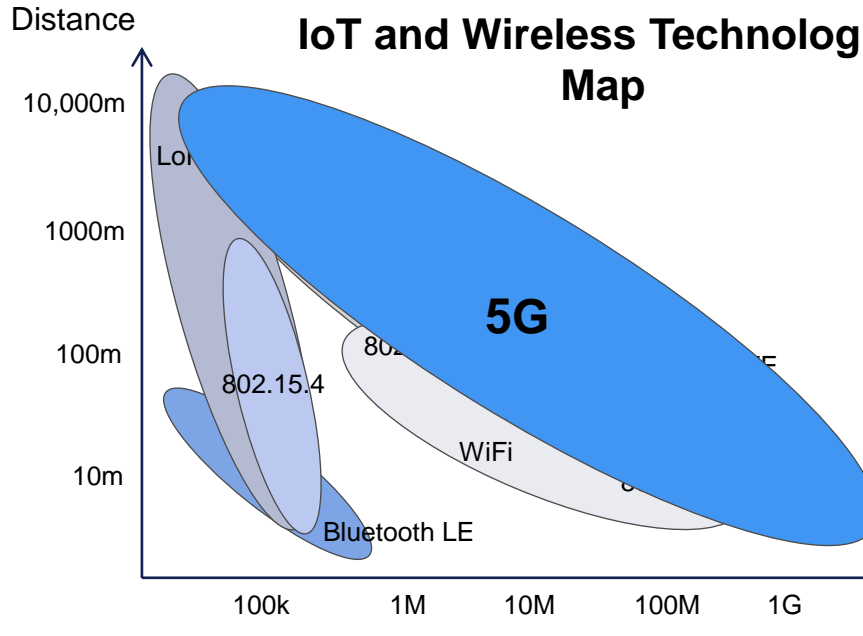


Fog Computing: At the Convergence of IT and OT Networking Technologies – Multiple Options at Play



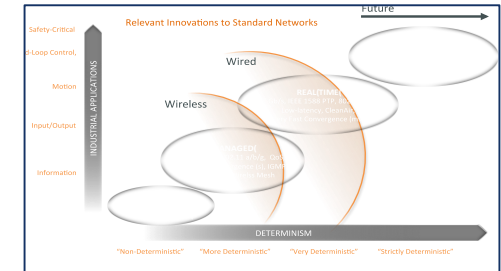
Wireless Technologies:

1. Cellular (2G/3G/4G)
2. Bluetooth Low Energy
3. LoRa (Low power wide area network)
4. IEEE 802.15.4
5. WiFi: Low Power (802.11ah) / Vehicular (802.11p)



Wired Technologies:

1. Deterministic Ethernet



2. Power Line Communications

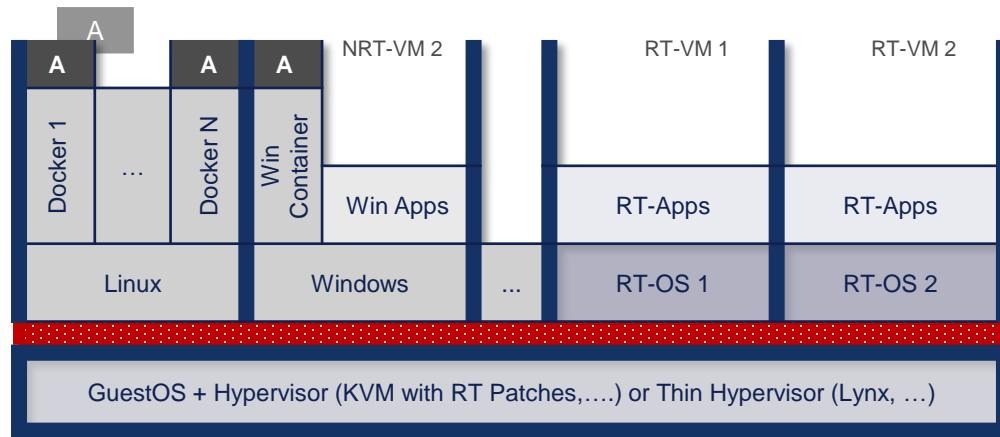
Fog Computing: Real-time Capable Virtualization to the Edge

Key enabler for the future of Industrial Automation



Virtualization:

A combination of physical separation (multicore), hard, RT-NRT Virtual Board/Machine based virtualization and more lightweight Linux/Windows Container or Docker based virtualization

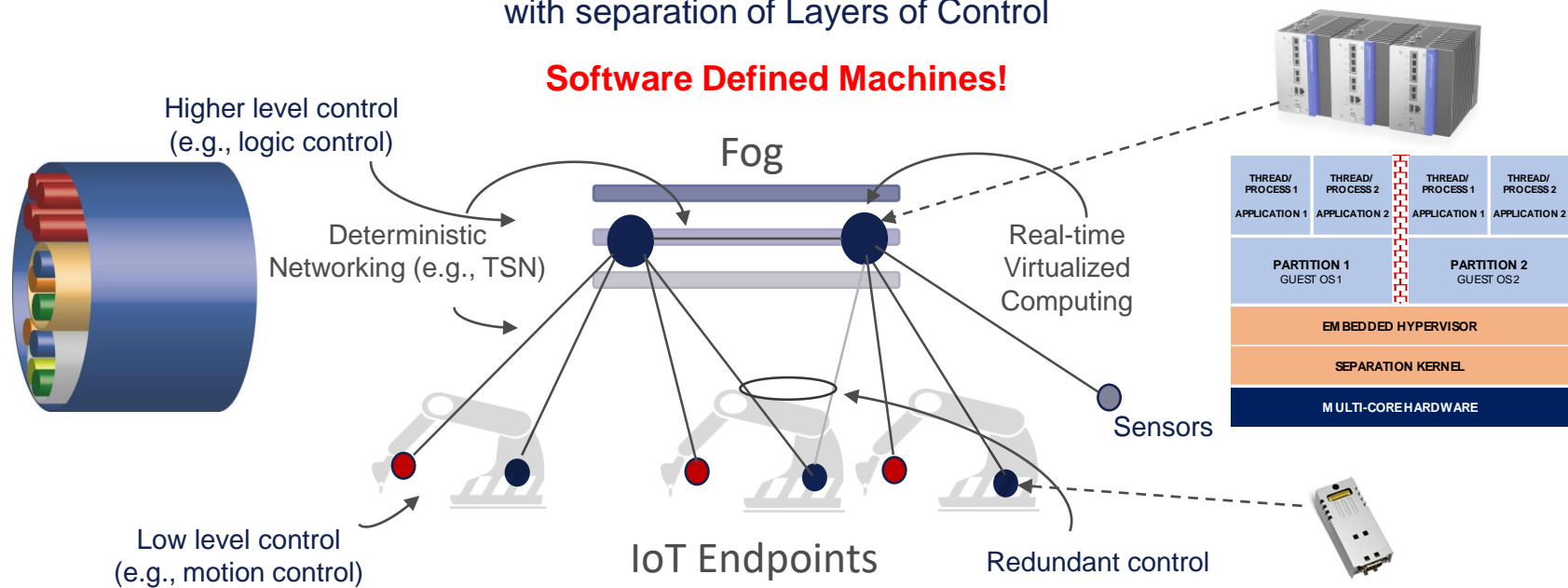


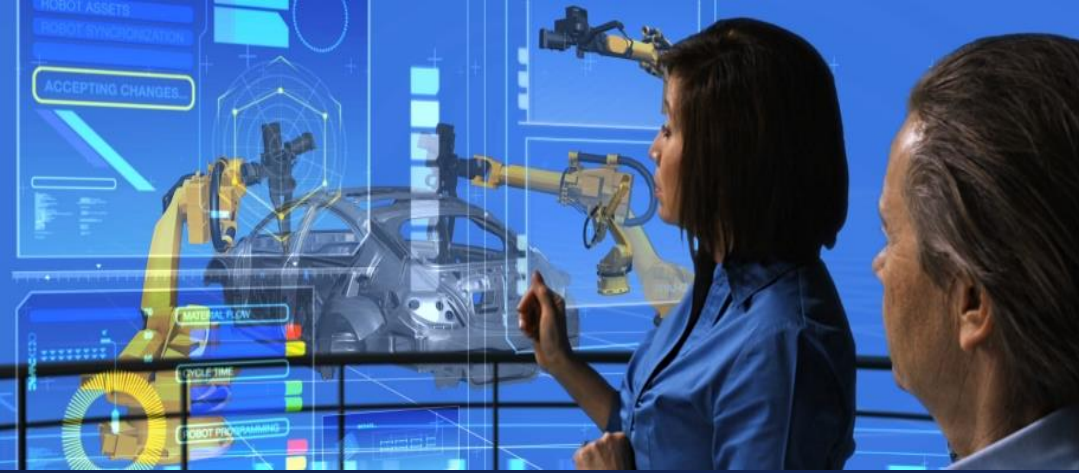
Fog Computing: Enabling the Implementation of Convergent, Hierarchical, Redundant Control



Deterministic Networking and Real-time Virtualized Computing enable the Convergence of Multiple Control Functions, one step removed from the controlled Endpoints, with separation of Layers of Control

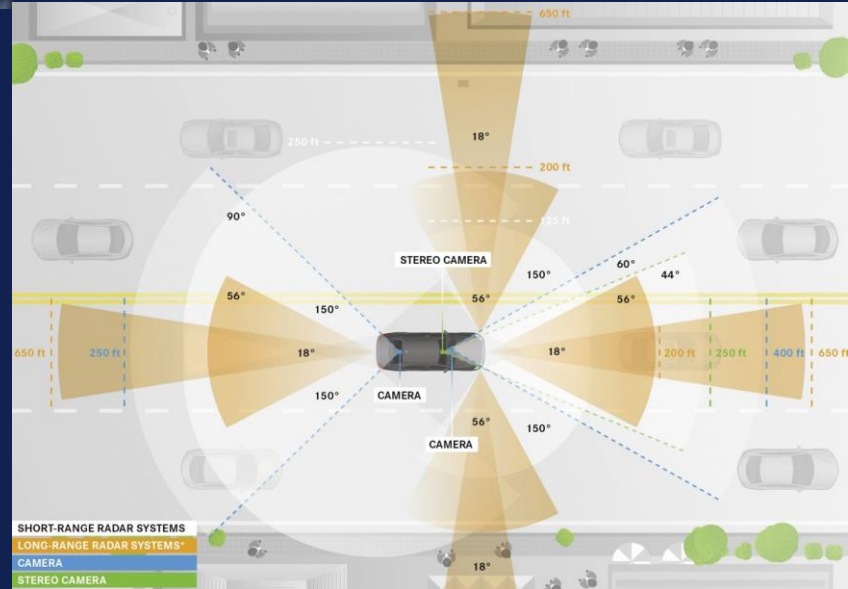
Software Defined Machines!





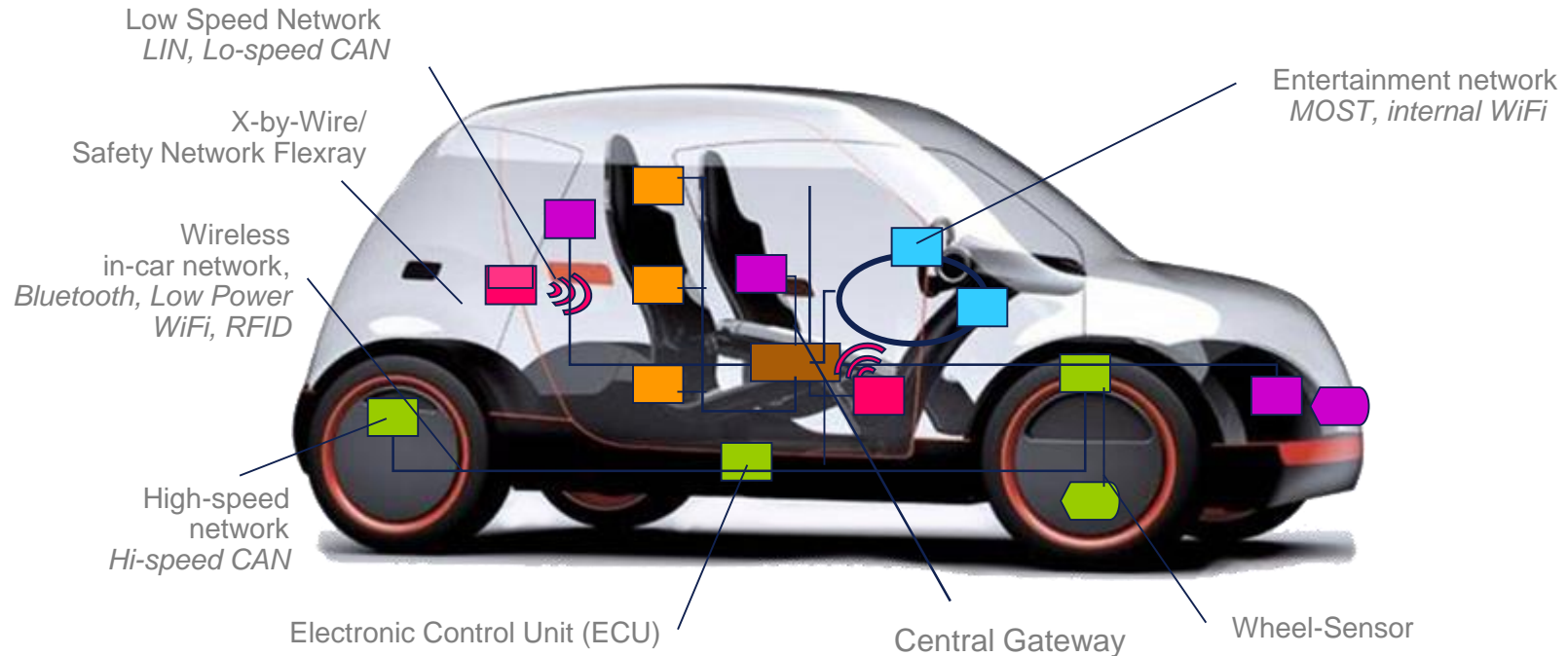
The Visions for the Future of Industrial Automation

and for the Autonomous Automobile
are Parallel and Intertwined !!!



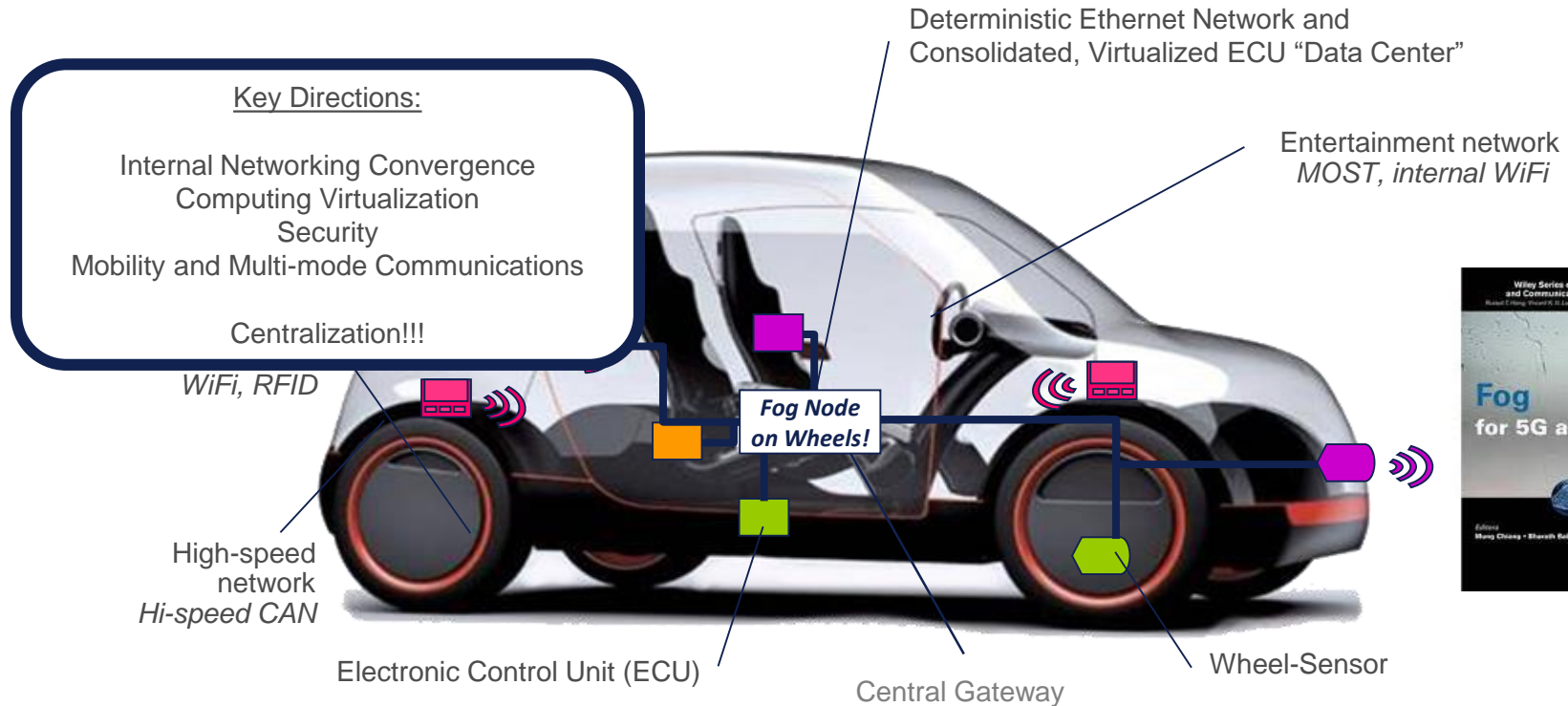
The Role of Fog Computing in the Automobile Evolution

The Fragmented Car Electronics of Today

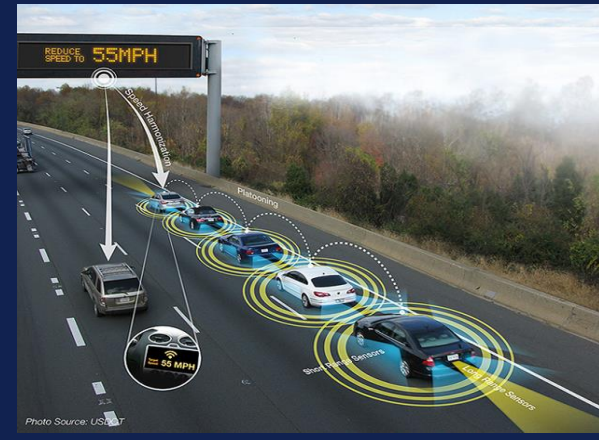
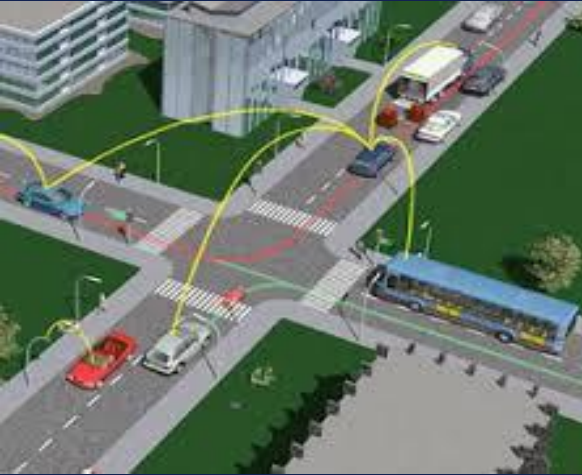


The Role of Fog Computing in the Automobile Evolution

The Future Car Domain Controller is a Fog Node! (Ricky Hudi, former Audi Head of Electronics)



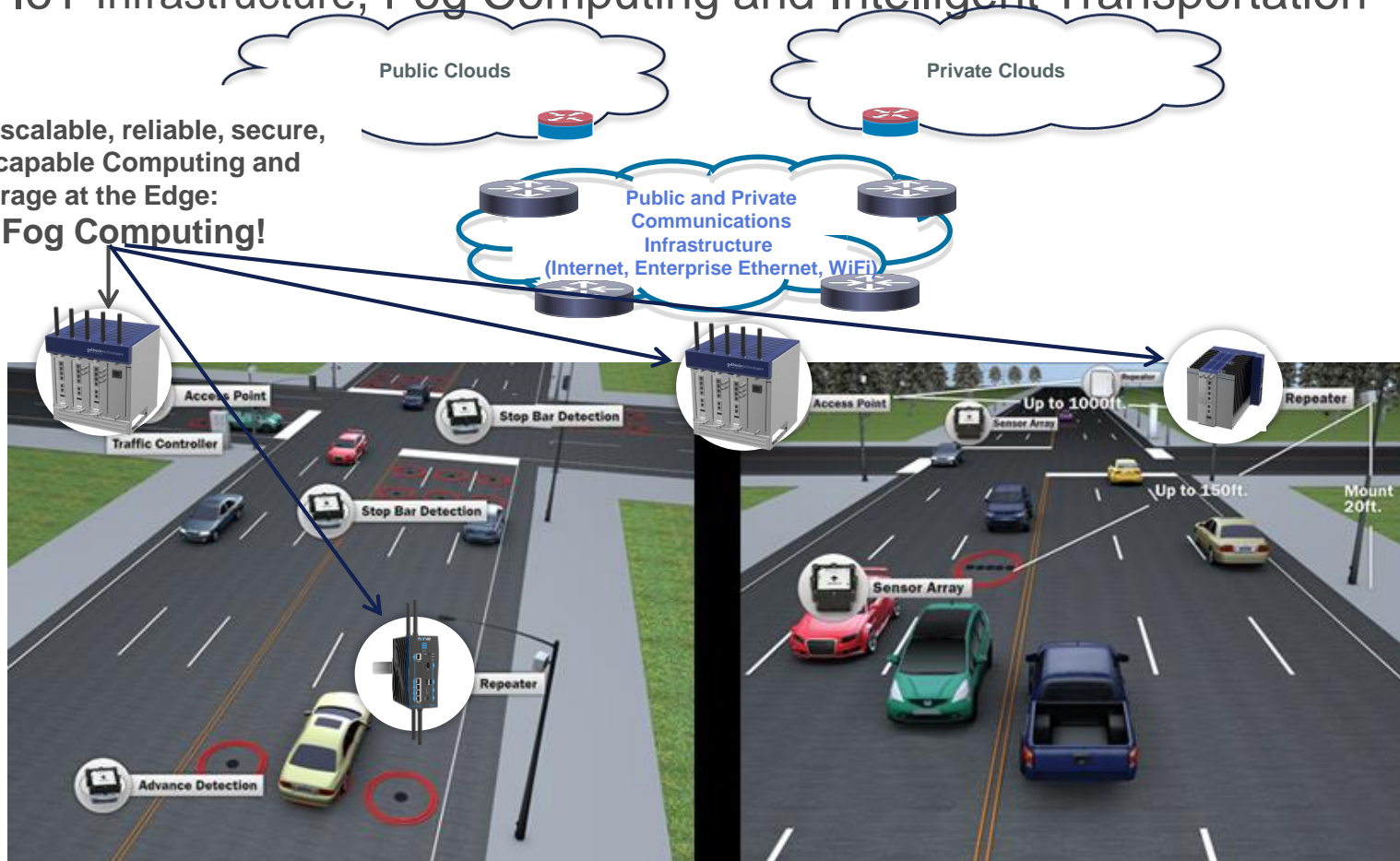
Fog Computing Based Architecture in Intelligent Transportation



The IoT Infrastructure, Fog Computing and Intelligent Transportation



Virtualized, scalable, reliable, secure,
real-time capable Computing and
Storage at the Edge:
Fog Computing!



The IoT Infrastructure, Fog Computing and Intelligent Transportation



Virtualized, scalable, reliable, secure, real-time capable Computing and Storage at the Edge:
Fog Computing!

