



# IoT & Fog Computing

Bringing the Value of the Cloud Closer to the Ground

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# Agenda

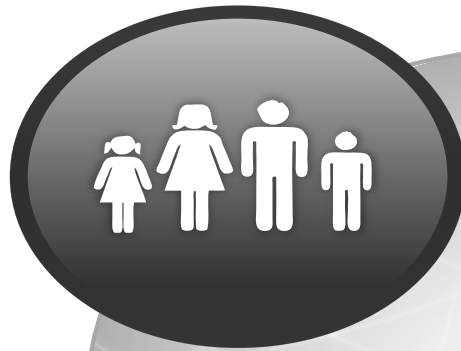
- **IoT Overview**
- **The Need for Fog Computing**
- **Fog Architecture**
- **The OpenFog Reference Architecture**

# Overview of IoE

Networked Connection of People, Process, Data,  
Things

## People

Connecting People in  
More Relevant,  
Valuable Ways



## Process

Delivering the Right Information to  
the Right Person (or Machine)  
at the Right Time



## Data

Leveraging Data into More  
Useful Information for  
Decision Making



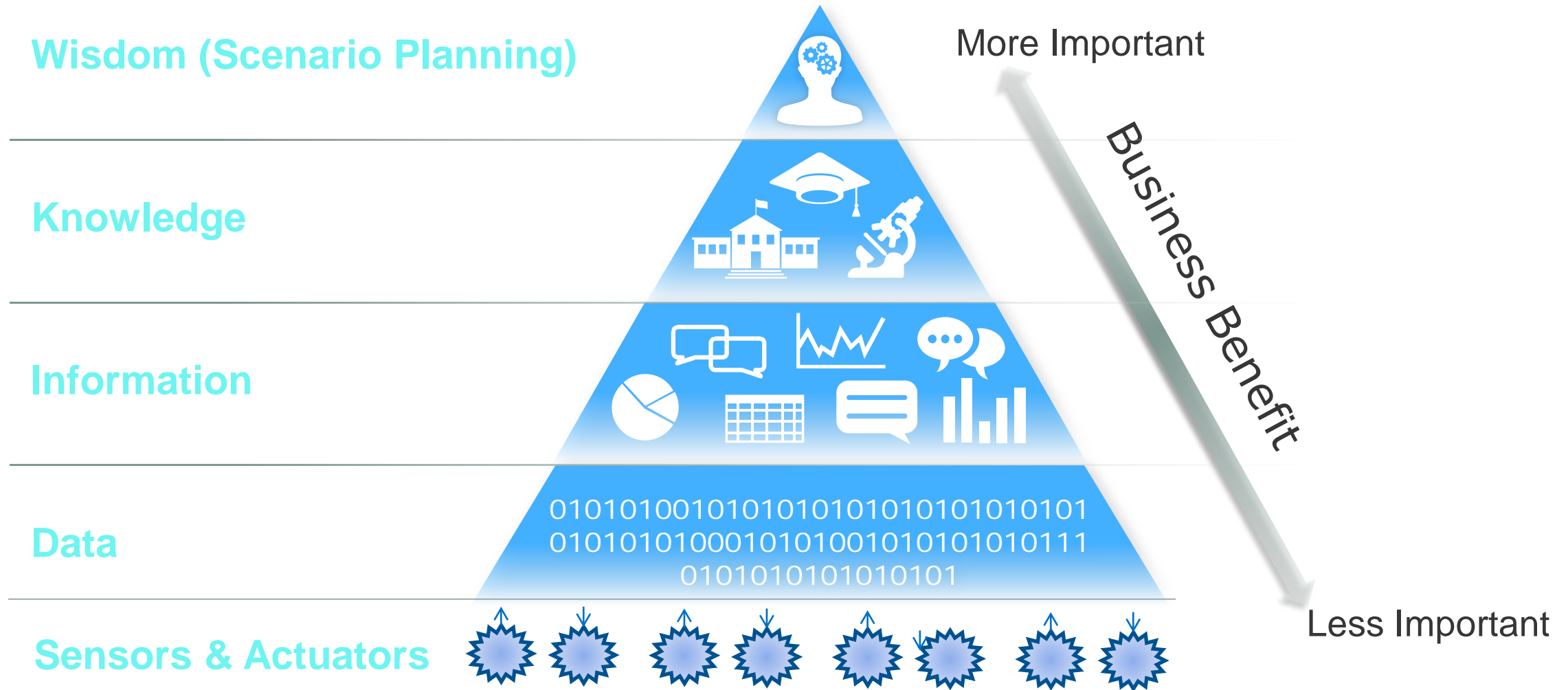
## Things

Physical Devices and Objects  
Connected to the Internet and  
Each Other for Intelligent  
Decision Making



IoE

# Transforming Data into Wisdom in IoT Networks



# Centralized vs. Distributed Compute for IoT?

## More Distributed

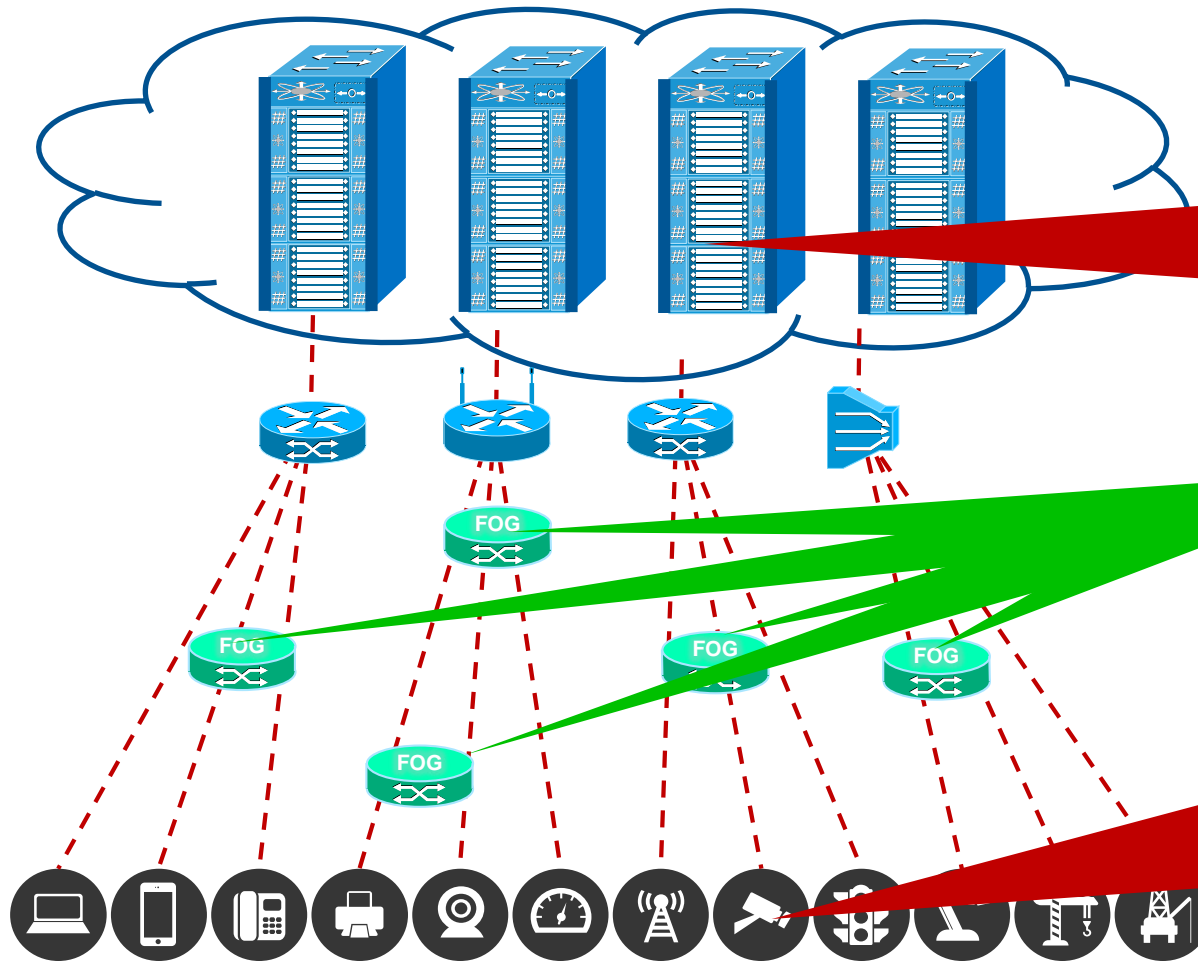
- Slide Rules & Adding Machines
- PCs and Workstations
- Smartphones & Tablets
- Fog and Edge Computing



## More Centralized

- Timeshare Computers
- Internet, WWW, Search
- Cloud Computing

# Need for Fog

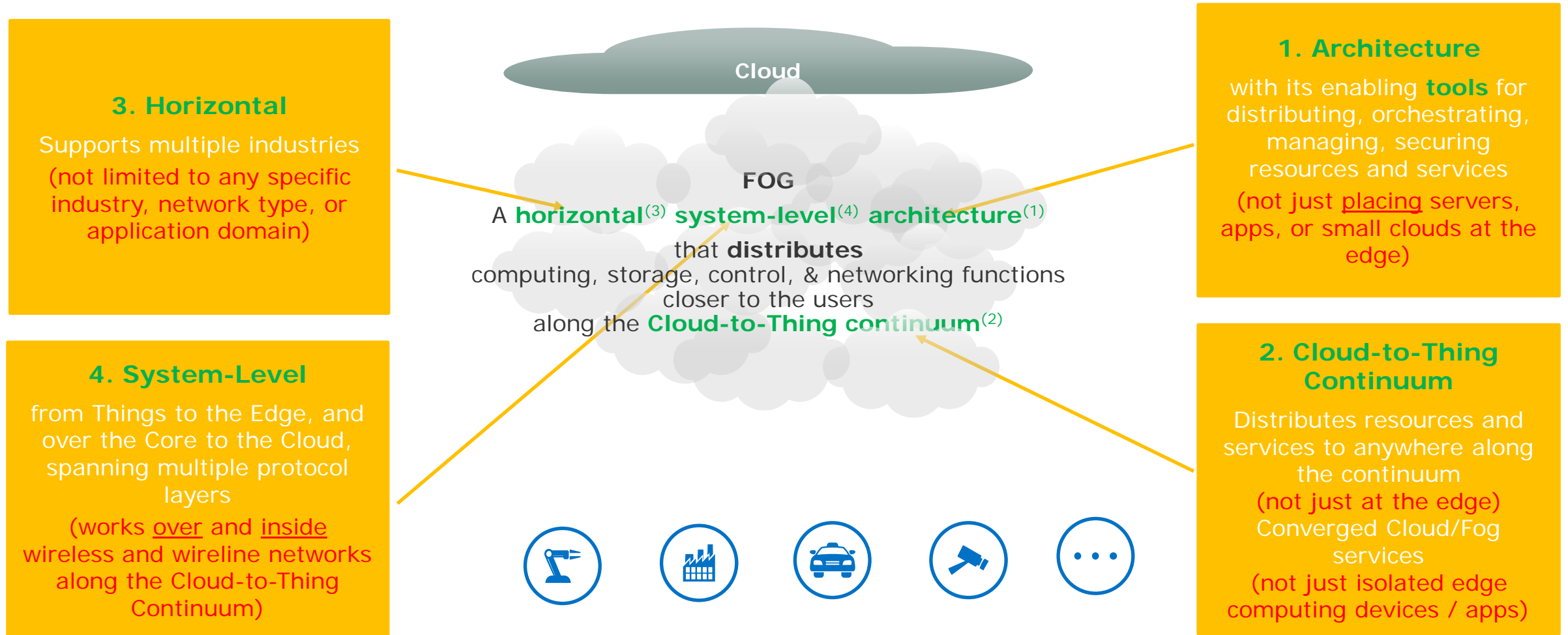


Can't run everything in the Cloud. There are latency, mobility, geographic focus, network bandwidth, reliability, security and privacy challenges

By adding layers of Fog Nodes, applications can be partitioned to run at the optimal network level.

Can't run everything in intelligent endpoints. There are energy, space, capacity, environmental, reliability, modularity, and security challenges.

# What is Fog Computing?

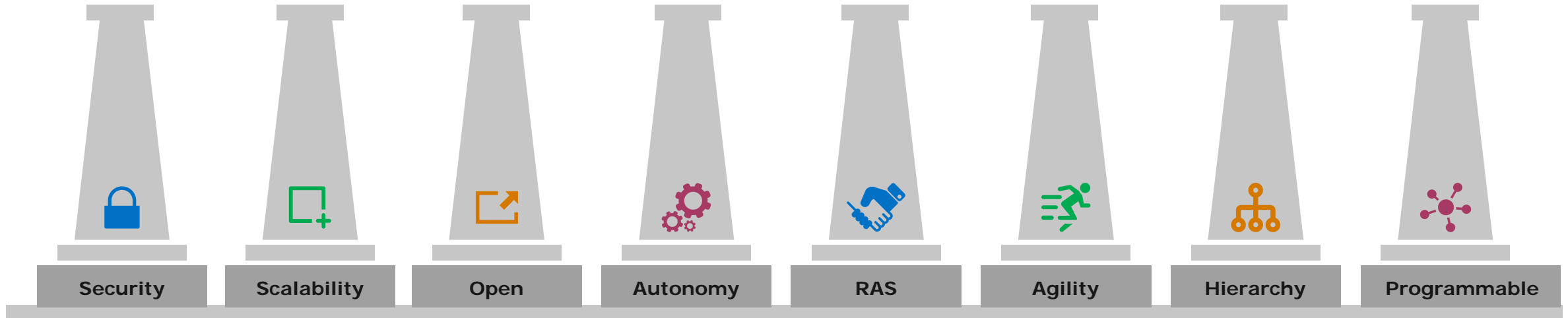


# Verticals and selected IoT Use Cases

- **Transportation:** (Smart highways, Connected / autonomous vehicles, PCT/Rail, UAV ground support, Parking)
- **Utilities:** (Smart grid, Smart meters, Water distribution, Sewer monitoring, Energy management, Renewables)
- **Manufacturing:** (Plant automation, Robotics, Analytics, Smart supply chain, QC, Distribution, Logistics)
- **Smart Cities / Smart Buildings :** (City-level Fog, Smart buildings, Lighting, Emergency services, Sanitation)
- **Retail / Enterprise:** (Smart store, Branch-in-a-box, Visual security, Asset tracking, Signage, Analytics, Thin clients)
- **Service Providers:** (Smart networks, Fog-as-a-Service, Media caching, Microcells, Resiliency, MEC)
- **Oil / Gas / Mining:** (Exploration, Rig-in-a-box, Heavy equipment, Production monitoring, Pipeline control, Refinery control)
- **Health Care:** (Continuous patient monitoring, Aging in place, Cognitive assistance, Exercise)
- **Agriculture:** (Irrigation, Crop monitoring, Yield assessment, Pest control, Autonomous equipment)
- **Government / Military:** (Homeland Security, C4ISR, Autonomous vehicles, Electronic warfare, Connected fighter)
- **Residential / Consumer:** (Home automation, Residential networking, Security, Social media, Haptics, AR, Games, Wearables)
- **Hospitality:** (Front desk, Bell robots, Entertainment, Security, Cruise ships, Campgrounds, Dormitories)
- **Data Centers:** (Installation, Management, SW upgrade, Environment monitoring, Energy management, Security, Telecom COs)
- **Logistics:** (Provenance, Cold chain monitoring, Shipment tracking, Route optimization, Ports)



# Pillars of Fog Computing



- Trust
- Attestation
- Privacy

- Localized command, control & processing
- Orchestration & Analytics
- Avoidance of network taxes

- Resource visibility & control
- White box decision making
- Interop & Data normalization

- Flexible Cognition & agility
- Value of data

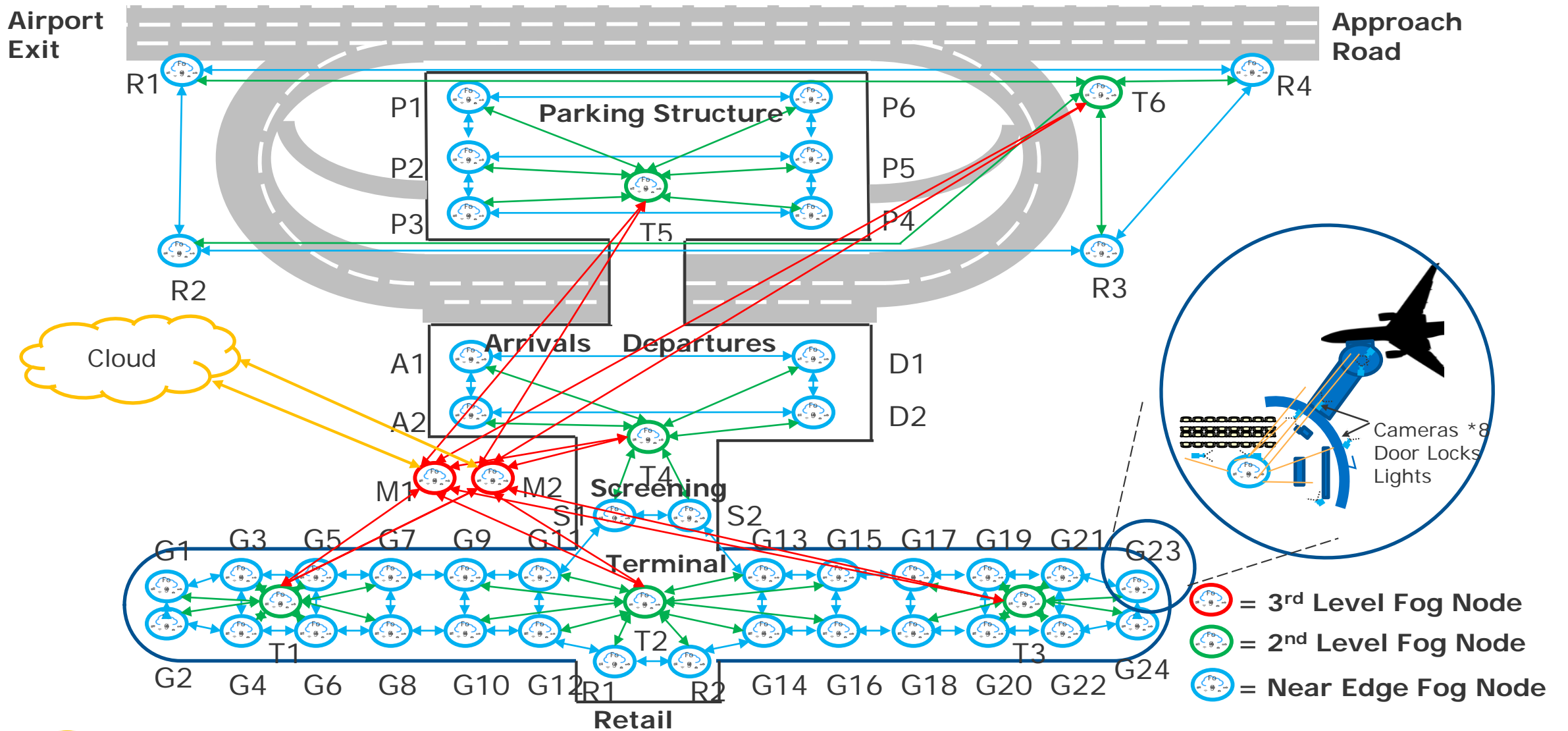
- Reliability
- Availability
- Serviceability

- Tactical & strategic decision making
- Data to wisdom

- Fully cloud enabled Computational & System
- Autonomy at all levels

- Programmable SW/HW
- Virtualization & multi-tenant
- App Fluidity

# Visual Security in Airports



# OpenFog Consortium Mission

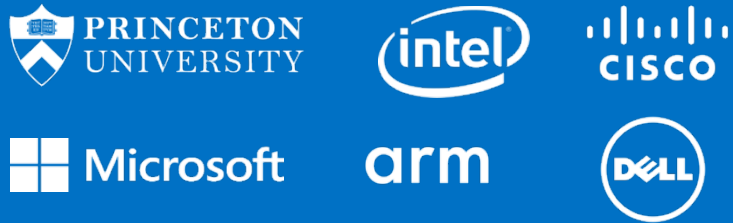


***"Drive industry and academic leadership in fog computing architecture, testbed development, and a variety of interoperability and composability deliverables that seamlessly leverage cloud and edge architectures to enable end-to-end IoT scenarios."***

# OpenFog Consortium

A Growing, Global Ecosystem of Fog Experts

## Founders



## Contributing Members

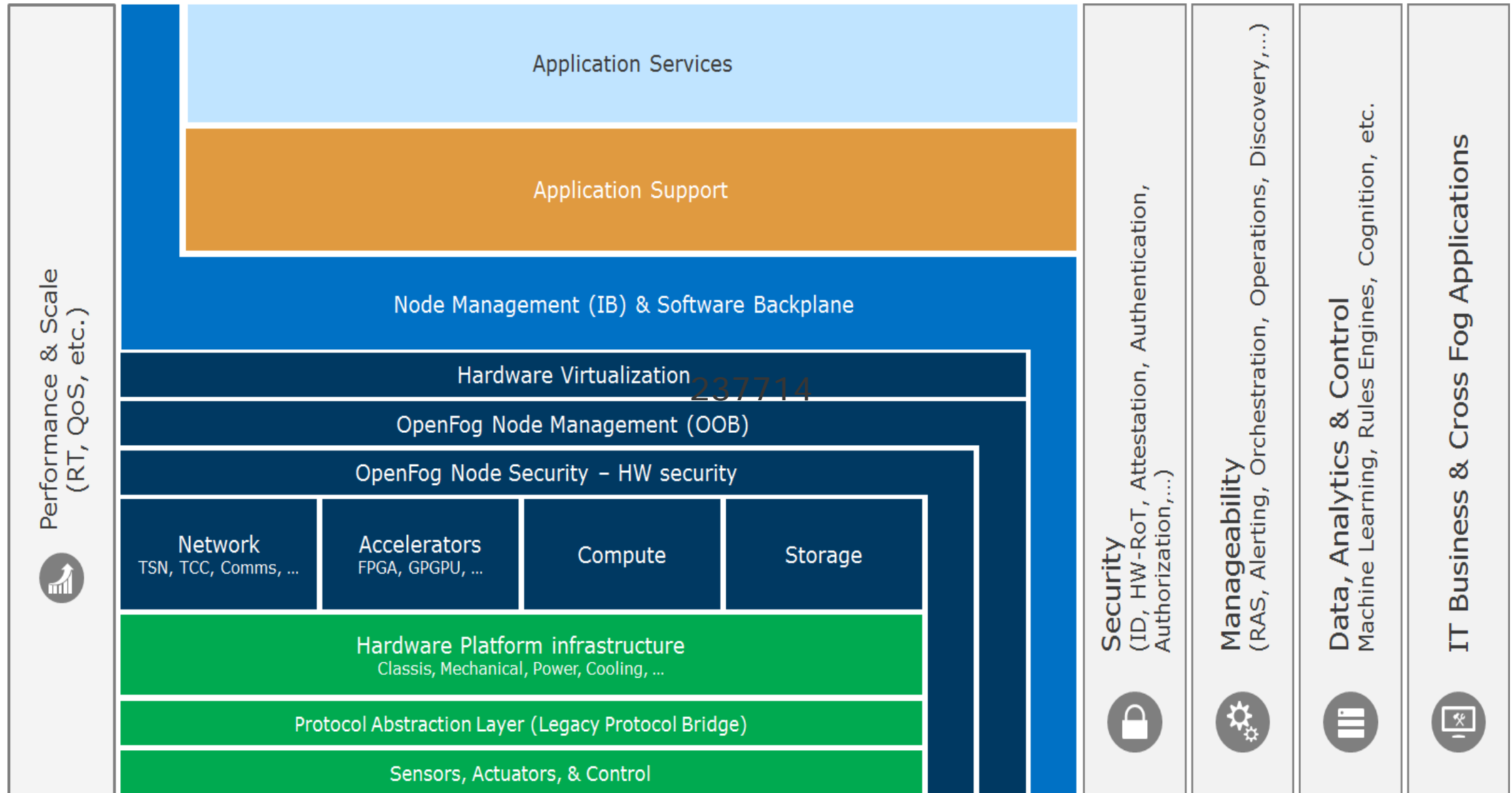


## Affiliations



62 members strong, headquartered in 18 countries as of April 2018

# OpenFog Consortium Reference Architecture

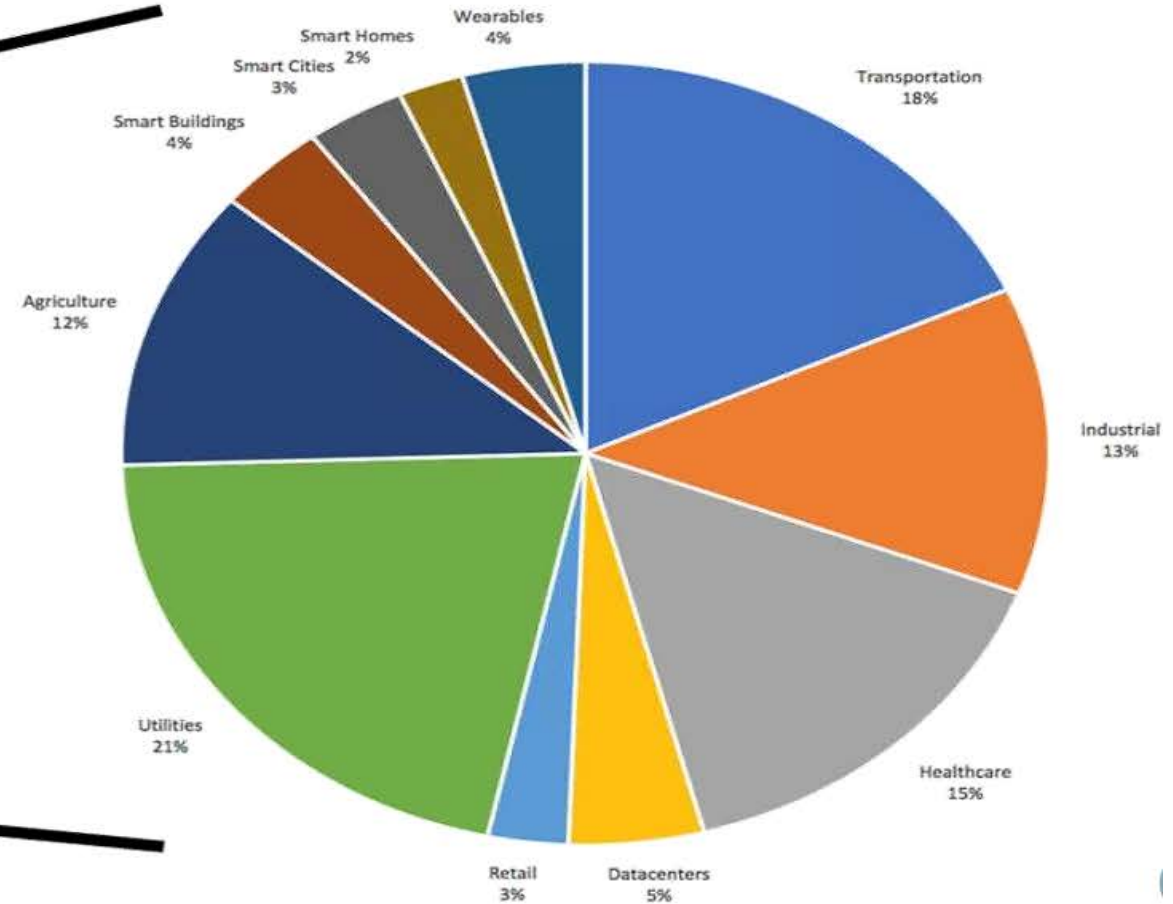
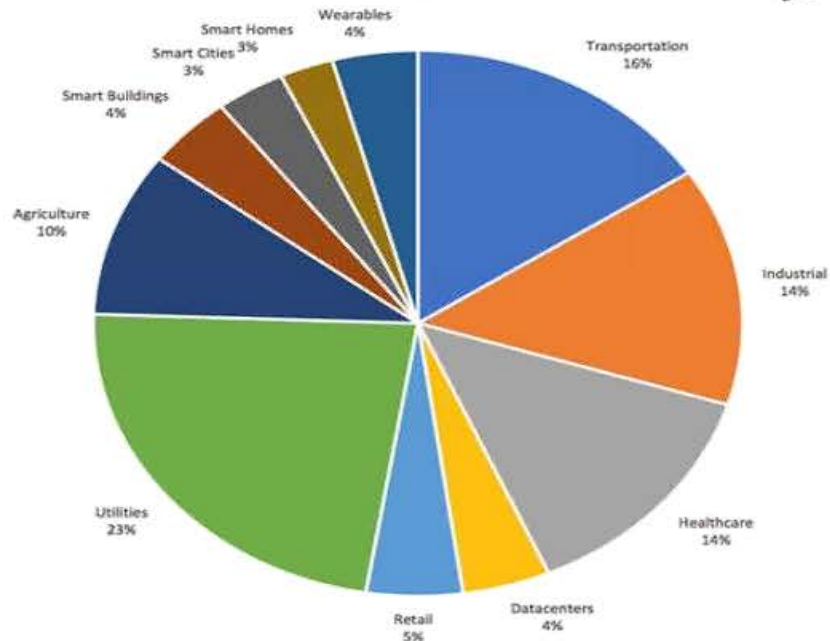


# 451 Research report – Key findings

## Fog Market

2022- \$18.2Bn

2019- \$3.9Bn



# Technical Working Groups and their Charters



# Conclusions

- Fog Computing can greatly improve the performance and efficiency of IoT, and bring value to customer networks
- In critical IoT applications, performing compute, networking and storage exclusively in the cloud or smart devices often won't work
- Fog pillar attributes, like security, scalability, openness, autonomy, manageability, agility, hierarchical approach and programmability are keys to successful IoT network deployment
- The OpenFog Consortium has charted a path for interoperable, open fog deployments. Your participation is welcome!

- More information:

[www.openfogconsortium.org](http://www.openfogconsortium.org)

<https://www.cisco.com/go/iot>