The Internet of Everything(IoE) & Technology Enablement

Tony Kim / 김동오 전무

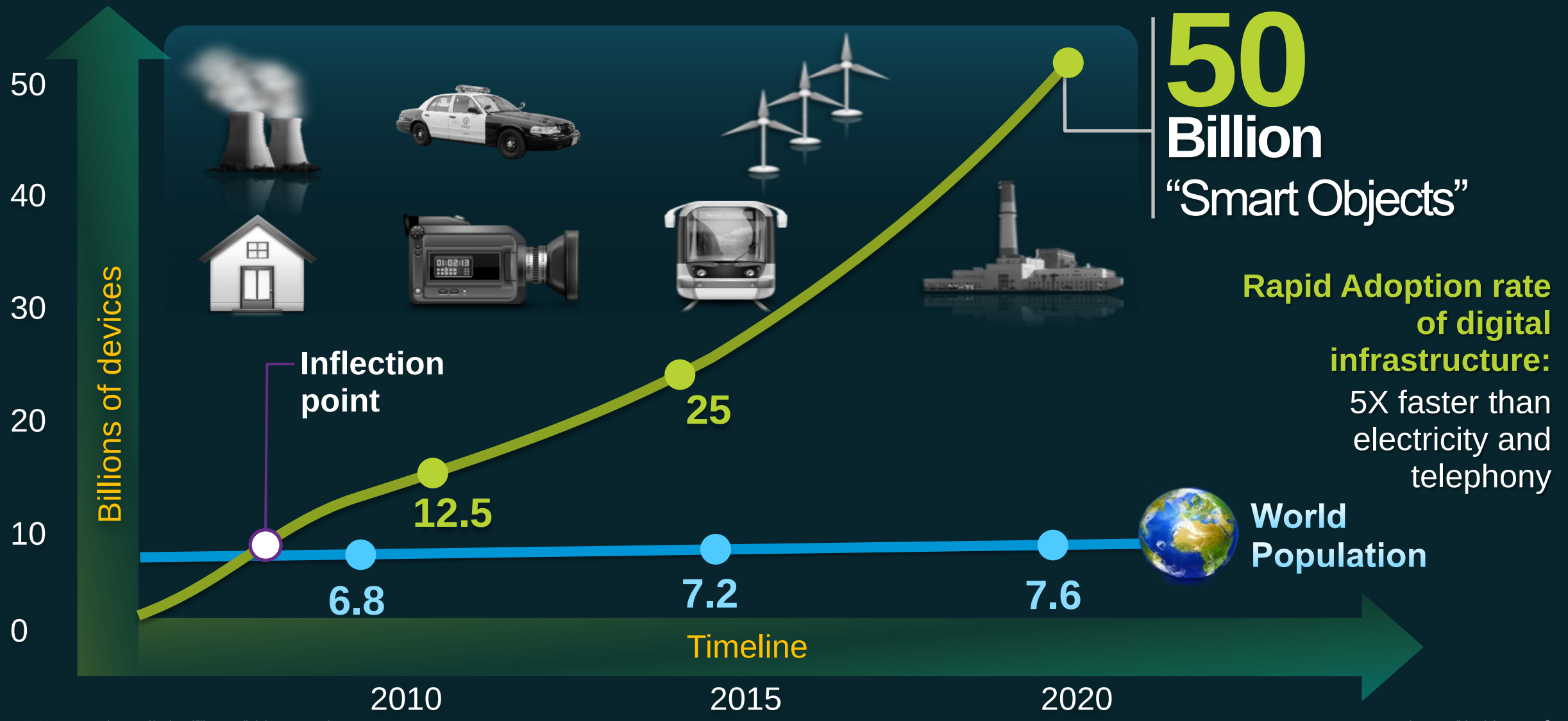
Analytics & Public Sector Lead / APJC

Cisco Consulting Services

Feb 2014

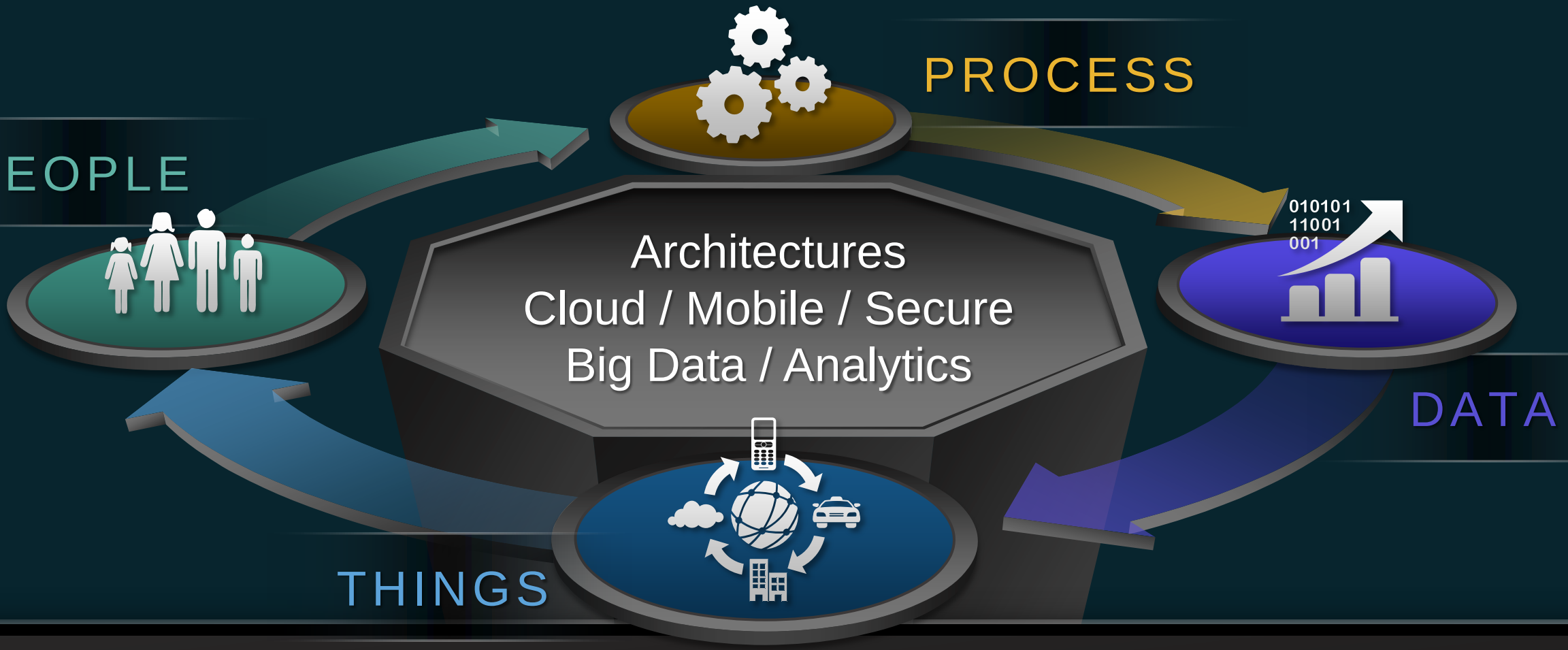
© 2013-2014 Cisco and/or its affiliates. All rights reserved.

The Internet of Things is Already Here



© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Next Disruption… IoE



Network Value = # Connections^2

200M → 10B → 50B → 500B^2 = $19T (14.4T/Private, 4.6T/Public)

What is the IoE Value at Stake?

$19 TRILLION*

Private **$14.4T**

- Asset Utilization ($2.5T)
- Employee Productivity ($2.5T)
- Supply Chain Logistics ($2.7T)
- Customer Experience ($3.7T)
- Innovation ($3.0T)

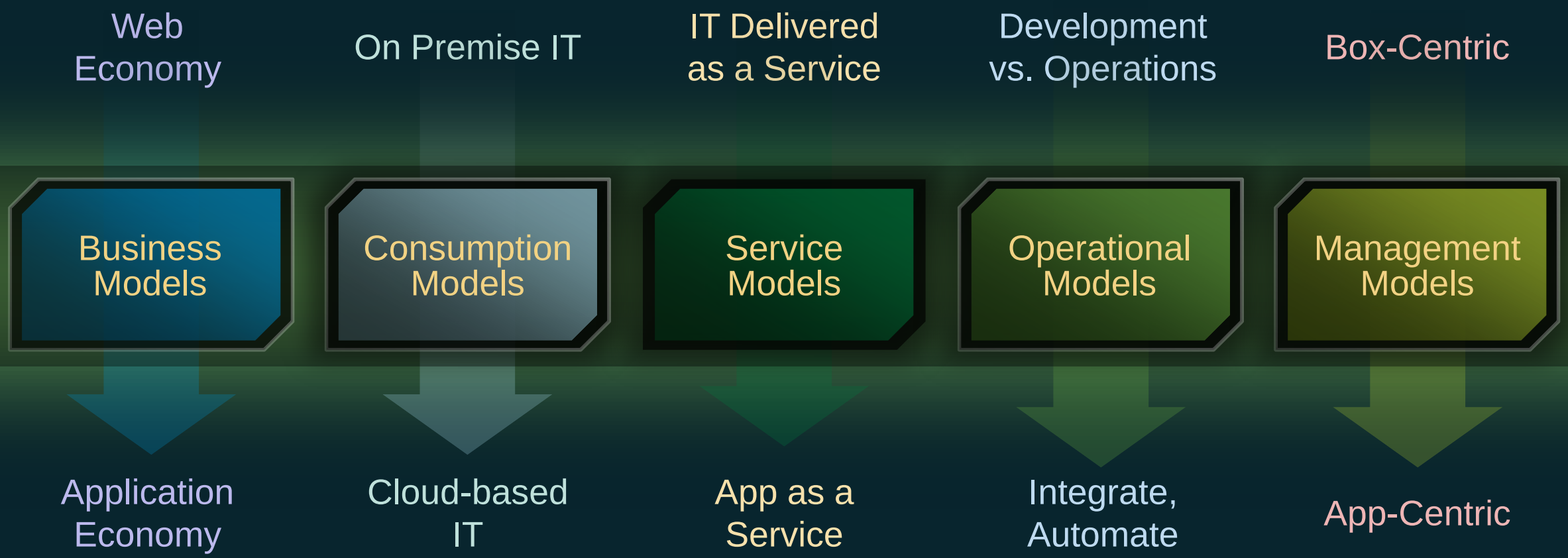
Public **$4.6T**

- Increased Revenue ($12.5B)
- Reduced Costs ($740B)
- Employee Productivity ($1.8T)
- Connected Militarized Defense ($1.5T)
- Citizen Experience ($412B)

Source: Cisco Internet Business Solutions Group, 2013, *2013-2022 - 10-year NPV

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

It’s About the Application…



© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Killer Apps Put New Demands on Your Infrastructure

MANUFACTURING

Operational Efficiency

SMART SERVICES

New Revenue

TRANSPORTATION/LOGISTICS

Regulatory Compliance

Converged, Managed Network

Resilience at Scale

Security

Distributed Intelligence

Application Enablement

IoT CONNECTIVITY

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Shift In Dominant End Points

From Consumer

Tablets, Laptops, Phones

Human Interactions

To Enterprise & Operational Technologies

Sensors, Smart Objects, Device Clustered Systems

Machine to machine interactions


Energy Saving
Smart Grid


Analytics and
Modelling


Intelligent
Buildings

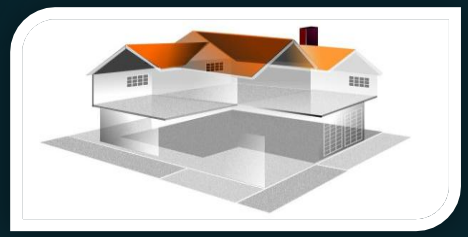
Transport and
Connected Vehicles


Improve
Productivity


Safety & Security


Precision
Agriculture


Predictive
Maintenance



Smart Home
Smart +
Connected
Communities


Healthcare

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

The Data Aggregation Challenge

1.1 Billion

Data points generated by sensors **daily**

500 Gigabytes

Data generated by an offshore oil rig **weekly**

1000 Gigabytes

Data generated by an oil refinery **daily**

10,000 Gigabytes

Data generated by a jet engine every **30 minutes**

2.5 Billion Gigabytes

Data generated worldwide **daily**

90% of the world's data

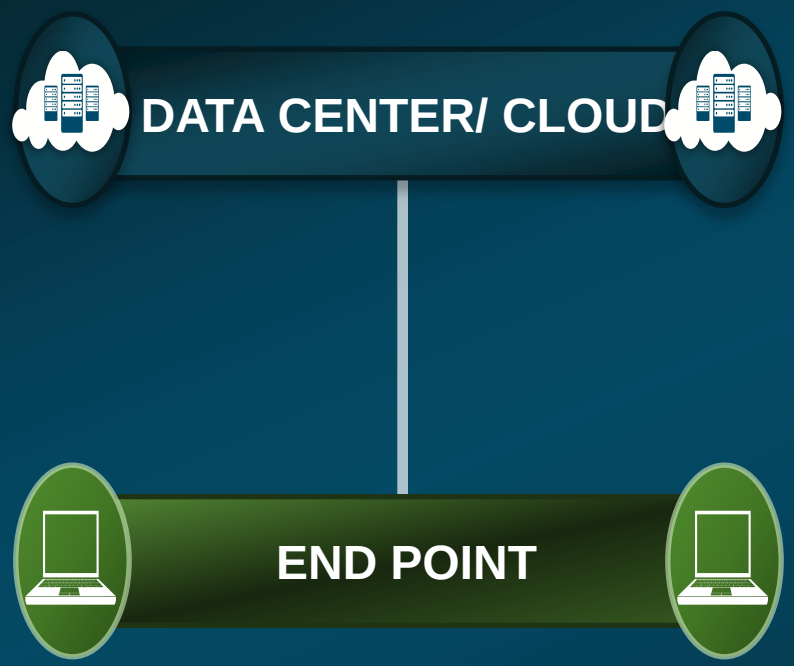
Has been created in the last **2 years!**

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

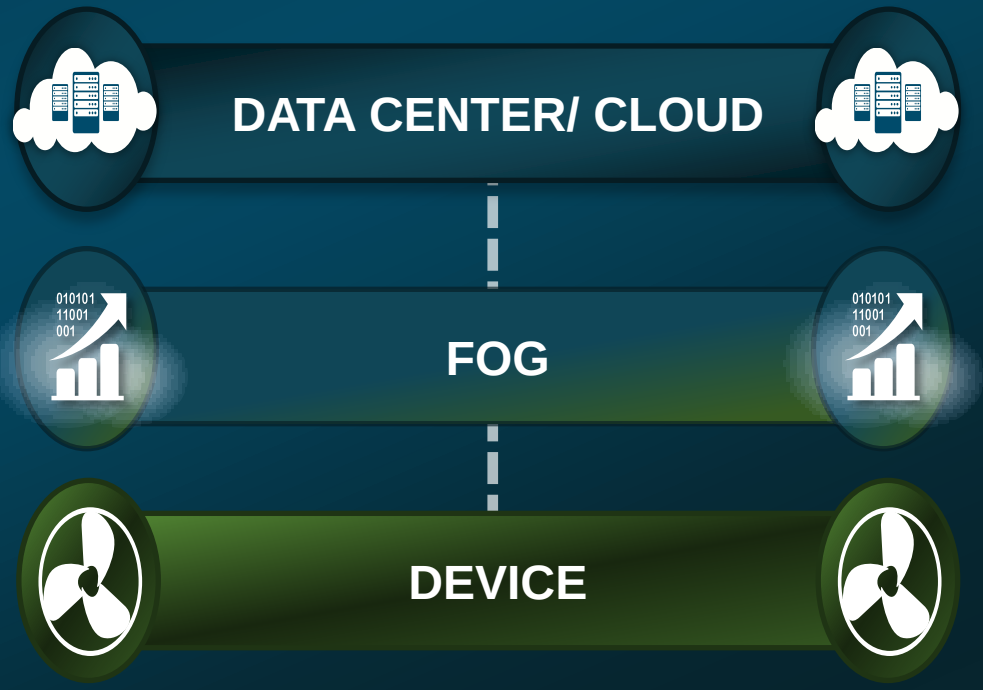
IoE Requires Distributed Computing

TRADITIONAL COMPUTING MODEL

(TERMINAL-MAINFRAME, CLIENT-SERVER, WEB)



IoE COMPUTING MODEL

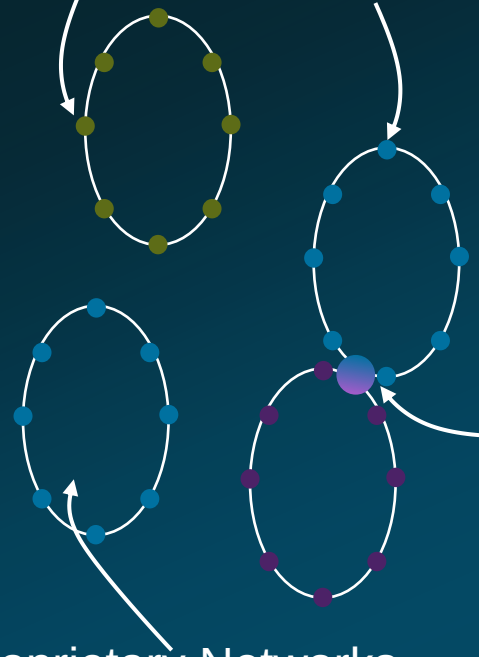


© 2013-2014 Cisco and/or its affiliates. All rights reserved.

IoE Architectural Philosophy

Closed Systems
(Little external interaction)

Various Protocols
(Modbus, SCADA, BACnet, LON, HART)

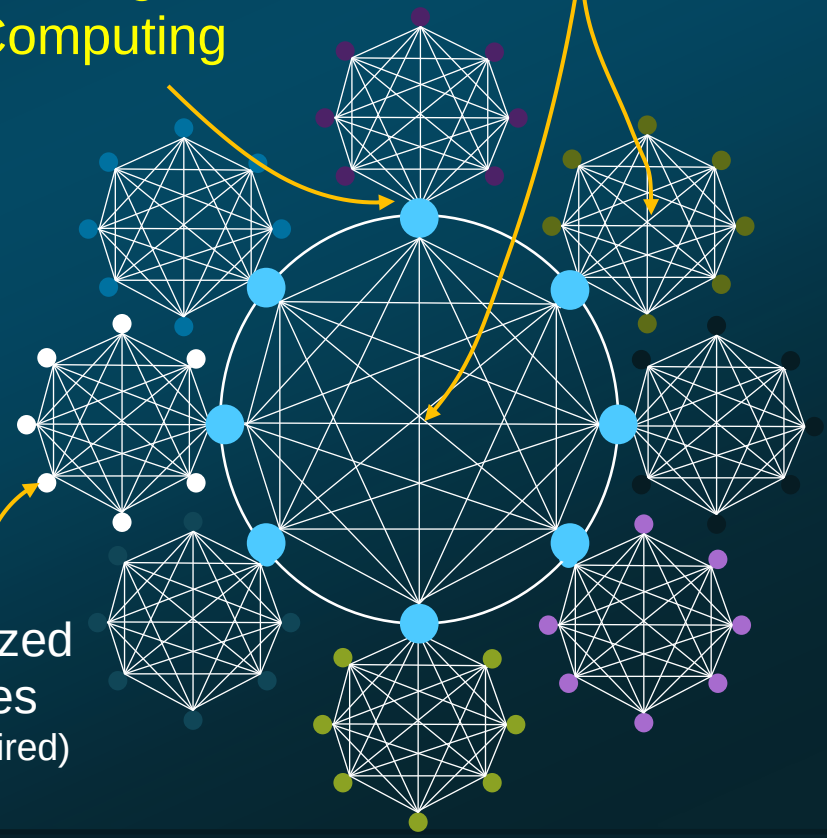


Protocol Gateways
(Inherently complex, inefficient and fragmented networks)

Proprietary Networks
(Usually layer 2 based)

Standardized Networks
(IP Based/ISO Stack)

Distributed Intelligence via Fog Computing



Standardized Interfaces
(Wireless/Wired)

Source: Jeff Apcar, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

IoE and Fog Computing Architecture

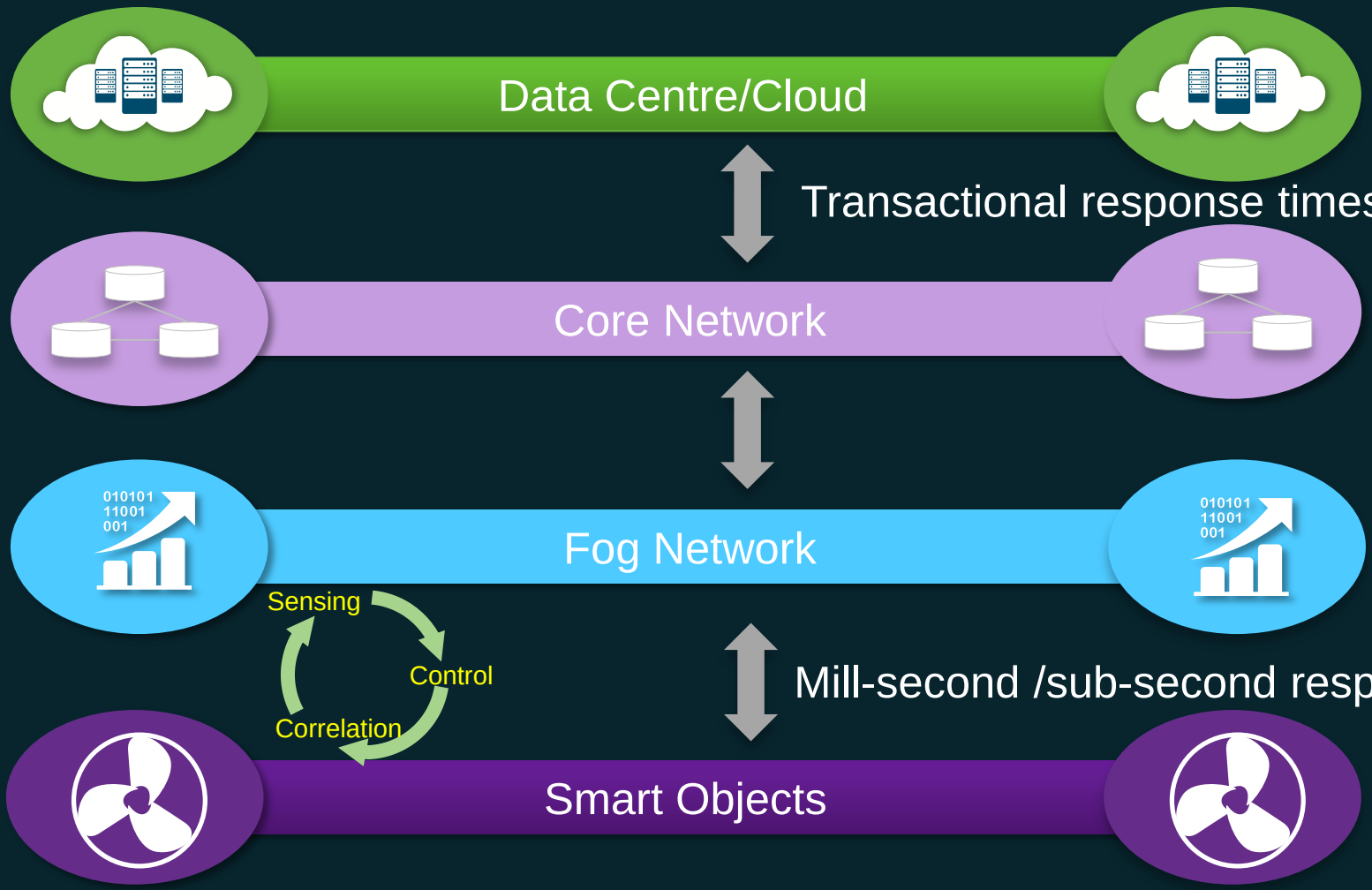
Data Volume, Variety & Velocity, Security, Resiliency, Latency

Hundreds
Data Centre/Cloud
Hosting IoT Analytics

Thousands
Backhaul
IP/MPLS, Security, QoS, Multicast

Tens of Thousands
Multi-Service Edge
3G/3G/LTE/WiFi/RF Mesh/PLC

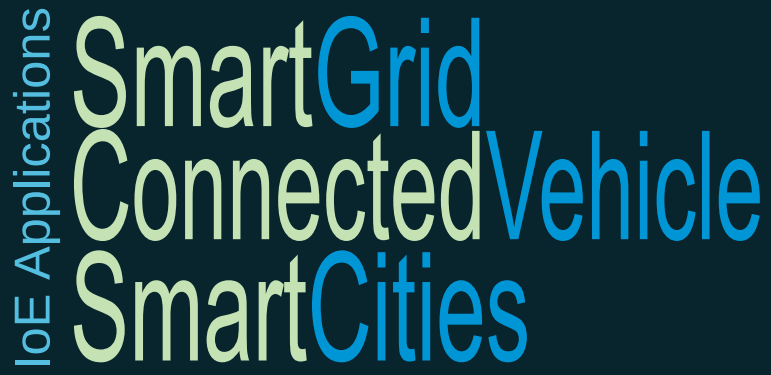
Millions
Embedded Systems & Sensors
Low power, low bandwidth



© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing Defining Characteristics

- Edge location, low latency and location & context awareness
- Wide-spread geographic distribution
- Very large number of nodes
- Predominant role of wireless access
- Real time analytics & control close to source
- Heterogeniety – different form facts, different environments

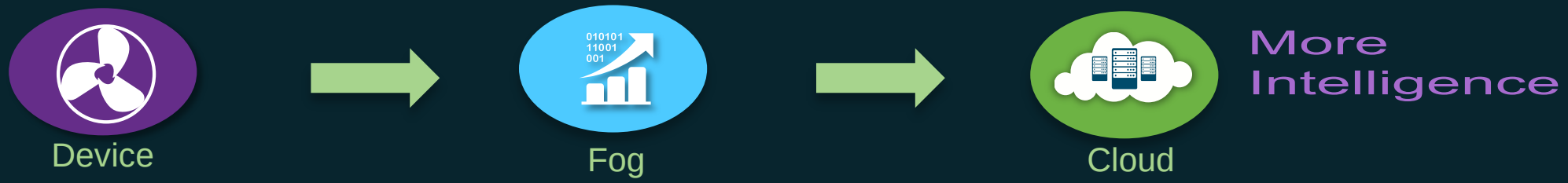


FogComputing

Extends the Cloud Computing paradigm to the network edge
Enables a new breed of applications and services
Provides distributed compute, storage and network services

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Pushing Intelligence UP To The Cloud - Challenges



Cloud Challenge	Advantages of Fog
Critical latency requirements	Few network hops, lower focused loads
Data rich mobility	Data located at optimal depth, local caching
Geographic diversity	Intelligence is localized as appropriate
Network bandwidth constraints	Local processing reduces network load
Reliability/robustness	Local resources can respond in emergency
Security/Privacy	Sensitive data can be better controlled

Source: Chuck Byers, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

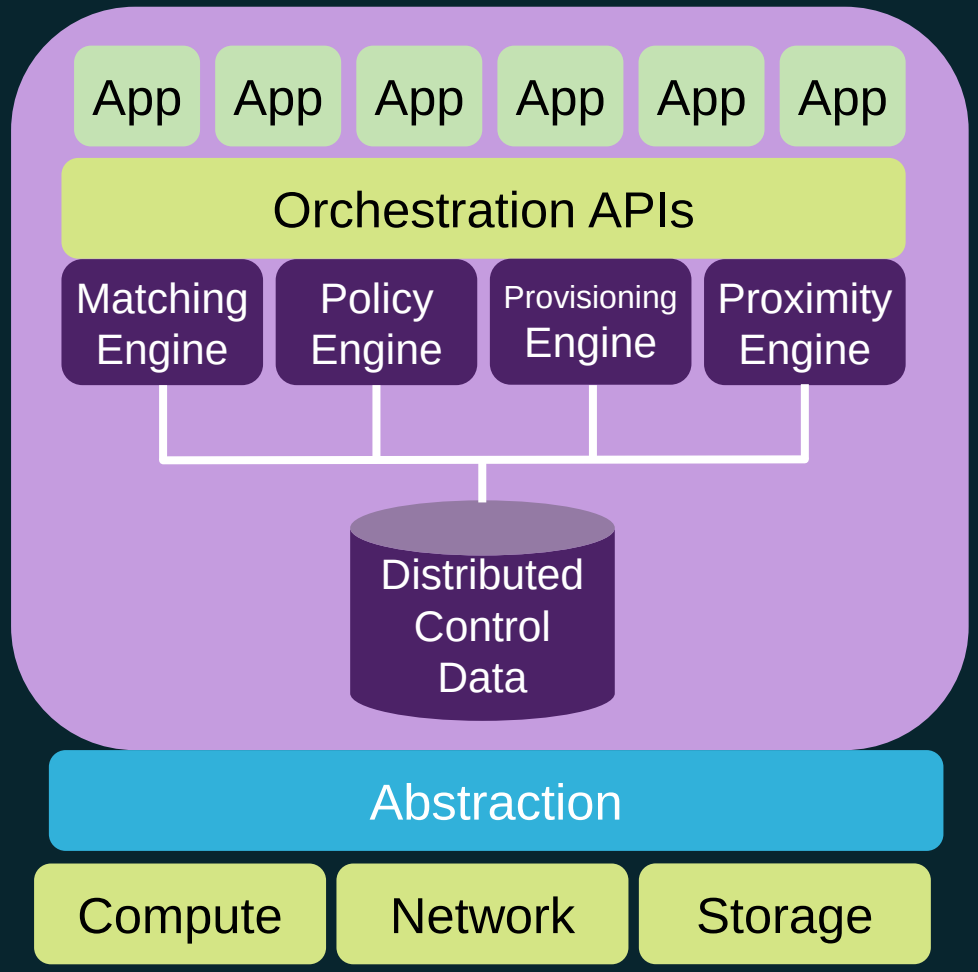
Pushing Intelligence DOWN To The Endpoints - Challenges

Device Challenge	Advantages of Fog
Power constraints	Fog nodes can use more energy
Space constraints	Fog nodes can be physically larger
Modularity/scalability	Modules can be added as needed
Environmental constraints (Heat, dust etc…)	More robust/hardened devices
Storage capacity	Terabytes→Petabytes storage capacity
Reliability/Security	Redundant nodes/highly secure

Source: Chuck Byers, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Node Architecture



Fog Applications

Various user developed apps on host O/S

Service Orchestration

Service management for subscribers, open API to apps, SDN
Proximity Engine – redirection to a closer service instance
Policy Engine - Implements tenant business policies
Matching Engine – Matches capabilities to a service instance

Heterogeneous platform

Various form factors, host O/S and service capabilities (storage, RAM….)

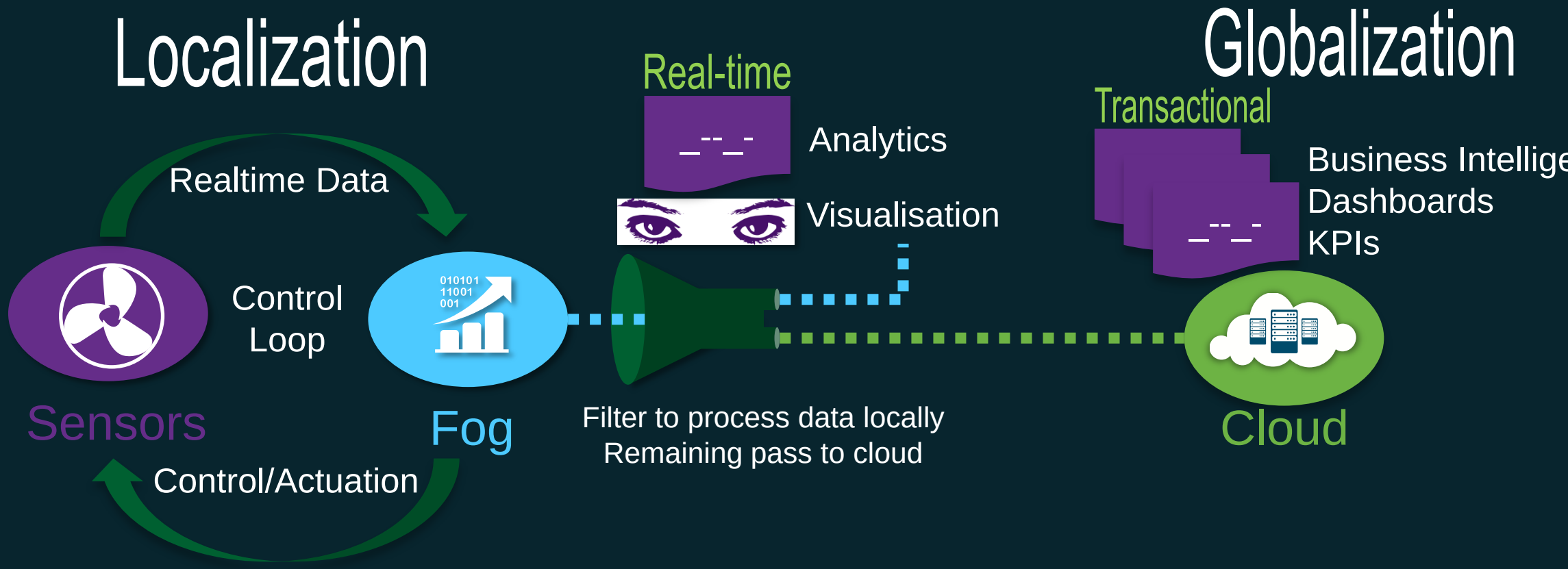
Hardware Abstraction Layer

Provides uniform interface to compute, network, storage resources
Provides resource isolation for different tenants (multi-tenancy)
Supports virtualisation (Thin Hypervisor) multiple O/S on physical machine

Source: Jeff Apcar, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Analytics Between Fog and Cloud



Storage	Transient	Semi-Permanent	Months/Years
Response	milliSec/subSec	Seconds/Minutes	Minutes/Days/Weeks

Source: Jeff Apcar, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing Example Use Cases

G L C O
Smart Traffic Lights
Real-time (RT) local control loop
Geo-distributed orchestration
Multiagency policy co-ordination
Local/Global Analytics

M G L C O
Connected Rail
Two-tier wireless AP
Fast mobility
Low latency streaming
RT actionable analytics
Global big data

M L C
SCV & Transport
RT actionable analytics
Global Big Data
(batch processing)

M G L C
Oil & Gas
RT actionable analytics
Geo-distributed Orchestration
Industrial automation, Big data

G L C
Wind Farm
RT local control loop
In-situ orchestration
Global Big Data

M G L C O
Military Apps
Real-time local control loop
Geo-distributed Orchestration
Multiagency policy co-ordination
Local/Global Analytics

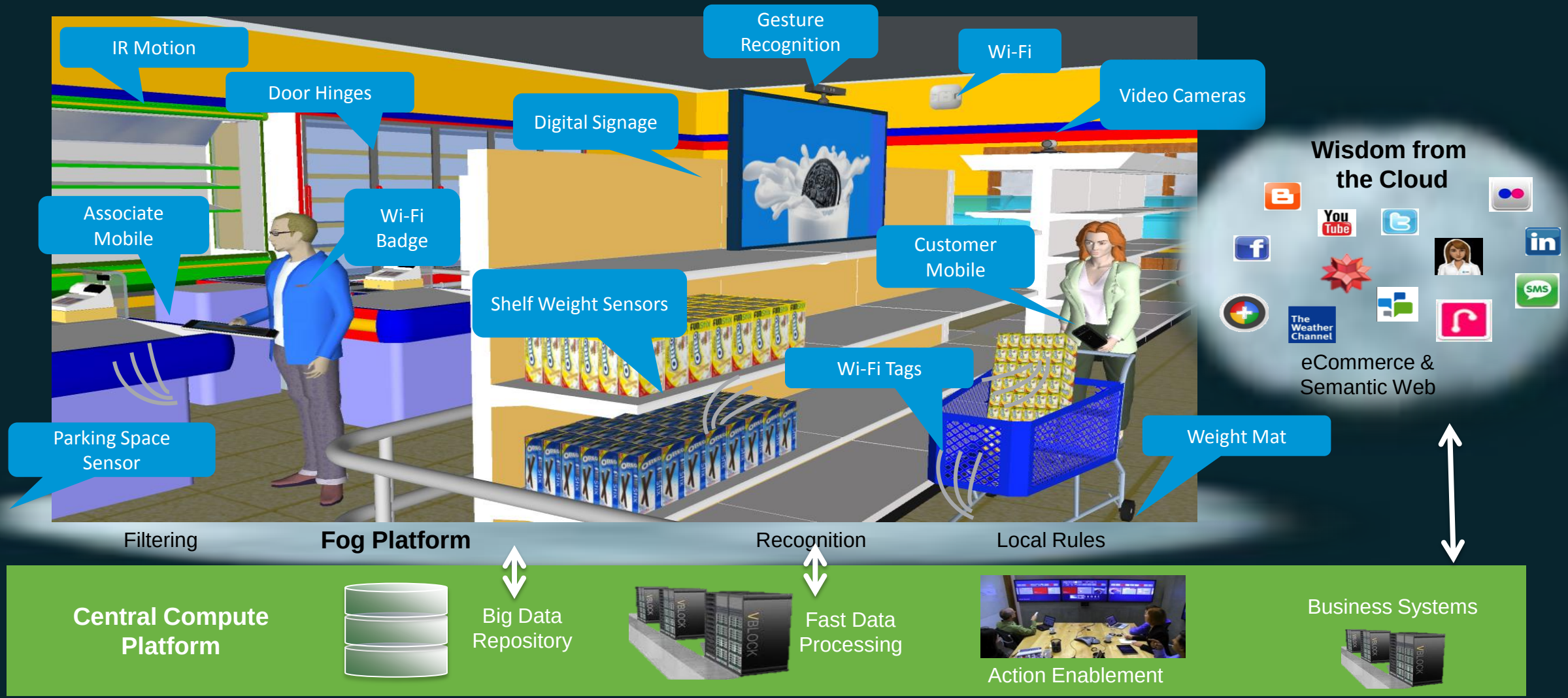
L C
Retailing
Video analytics
Interplay between local and
Globally process data

Critical attributes
M Mobility G Geo-distribution L Low/predictable latency C Cloud interaction O Multi-agent orchestration

Source: Rodolfo Milito, FogDoc-use-cases 2013

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Cisco FastRetail™ Example - Fog platform provides a foundation for in-store analytics



Source: CCS, 2013

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing Summary

- IoE requires rapid processing of significant amounts of data
- Close proximity of decision point to IoE devices is essential
- Cloud infrastructures generally not suitable due to distance
  - Introduces unacceptable processing latency
- Fog allows compute, storage and analytics at the network edge
  - Provides speed, agility and customisation

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing App Development

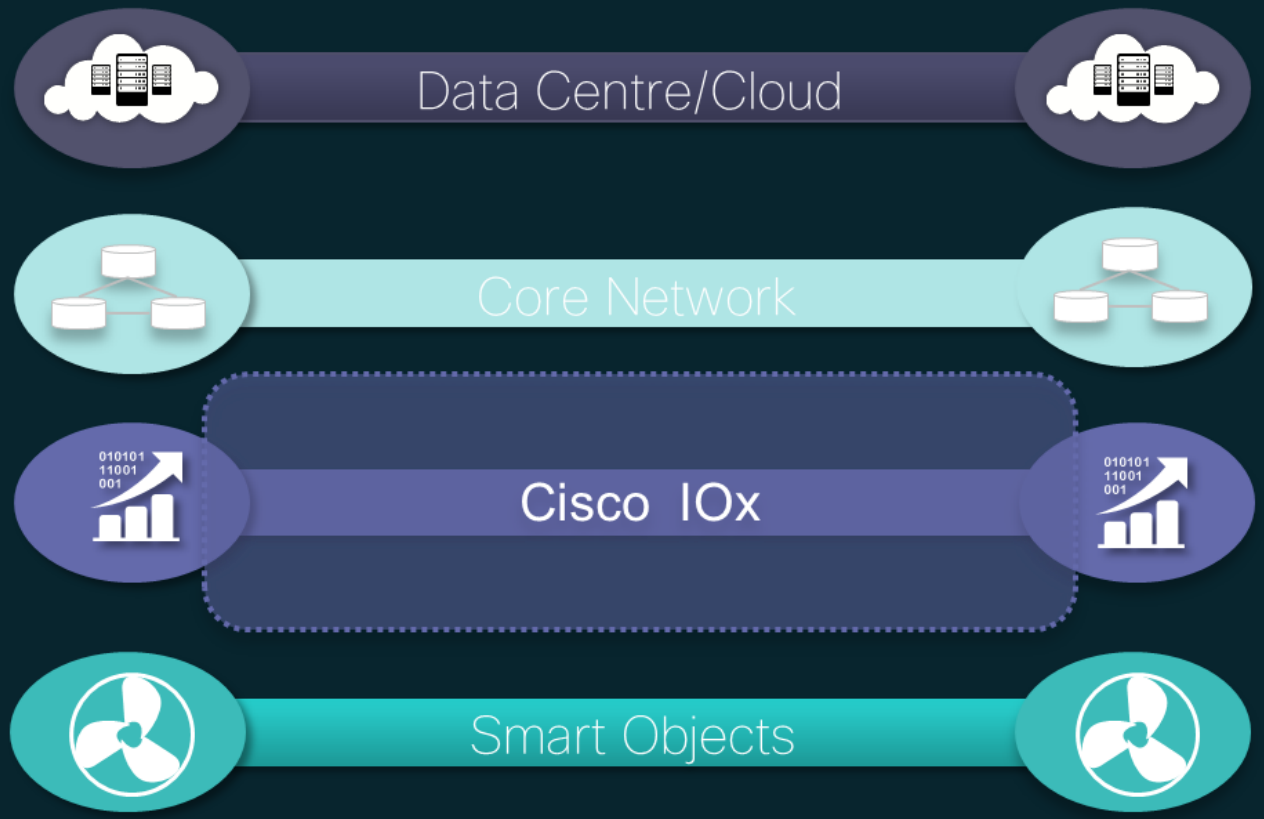
Predominantly Industrial/Enterprise focussed Fog based business model

- New eco-system development & business opportunities
  - Beyond consumer focused apps
- Developers more likely to be from key industry verticals & institutions
  - Utilities, Oil & Gas, Manufacturers, Operators, Governments, Academia…
  - Partnerships with vendors like Cisco for development
- Opportunities for the community of individual developers
  - Appropriate APIs should be developed to attract the community
- Enabled by Cisco IOx

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

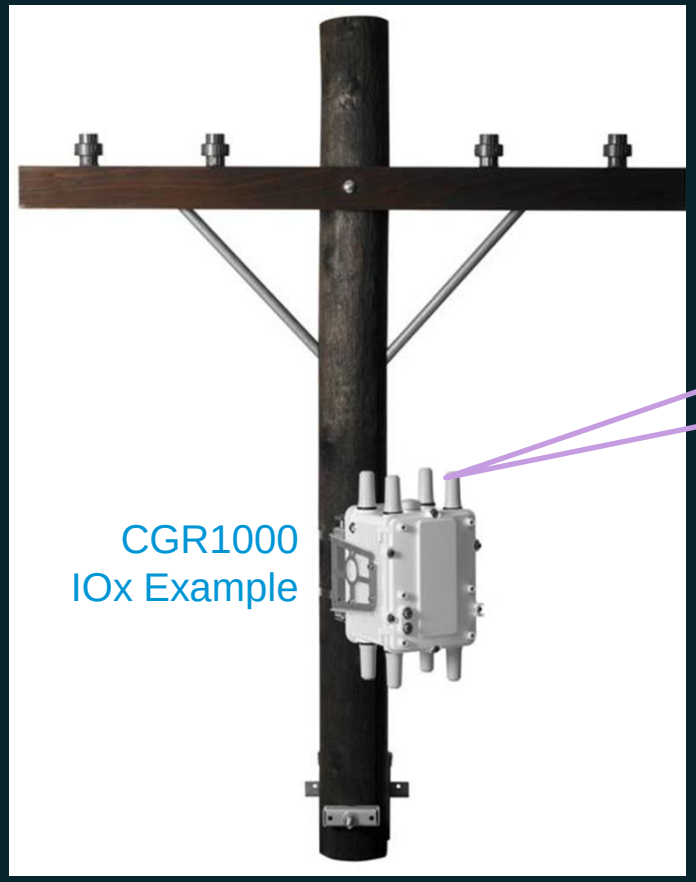
Cisco IOx

- Allows customer apps to execute on Cisco industrial network devices
  - Fosters innovation, agility and efficiency in operational technologies (OT)
- IOx integrates Cisco IoS™ with Linux (for customer apps)



© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Cisco IOS & Linux Integration (IOx)

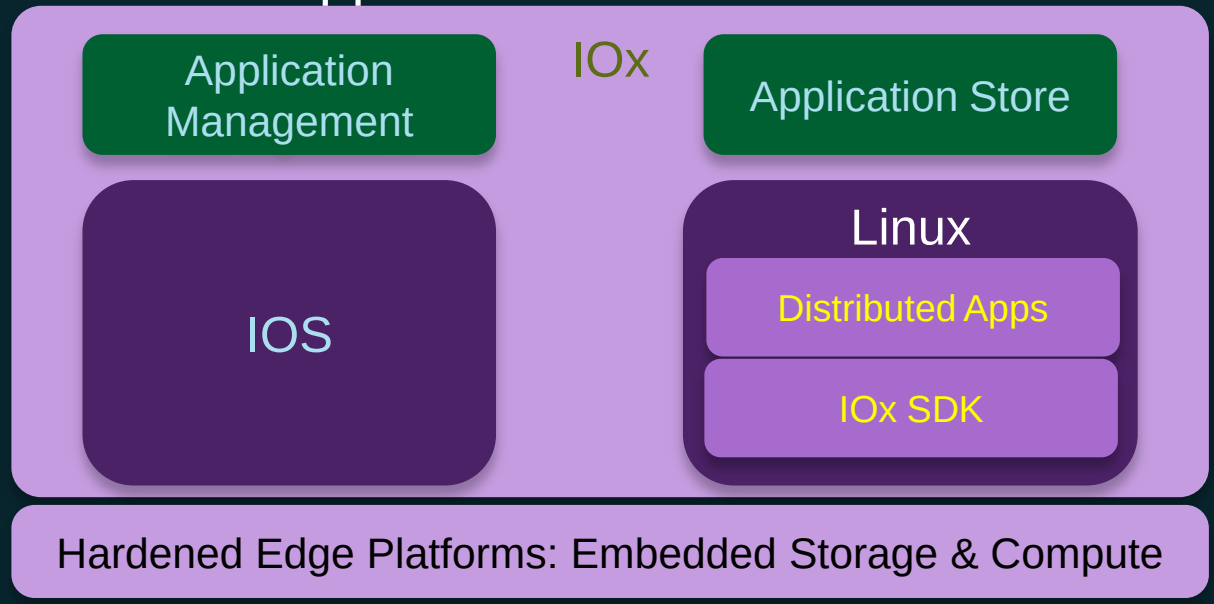


CGR1000
IOx Example

IOS + Linux = IOx

Best Internetworking Best Open Source Application Enablement

Cisco IOx Application Architecture Framework



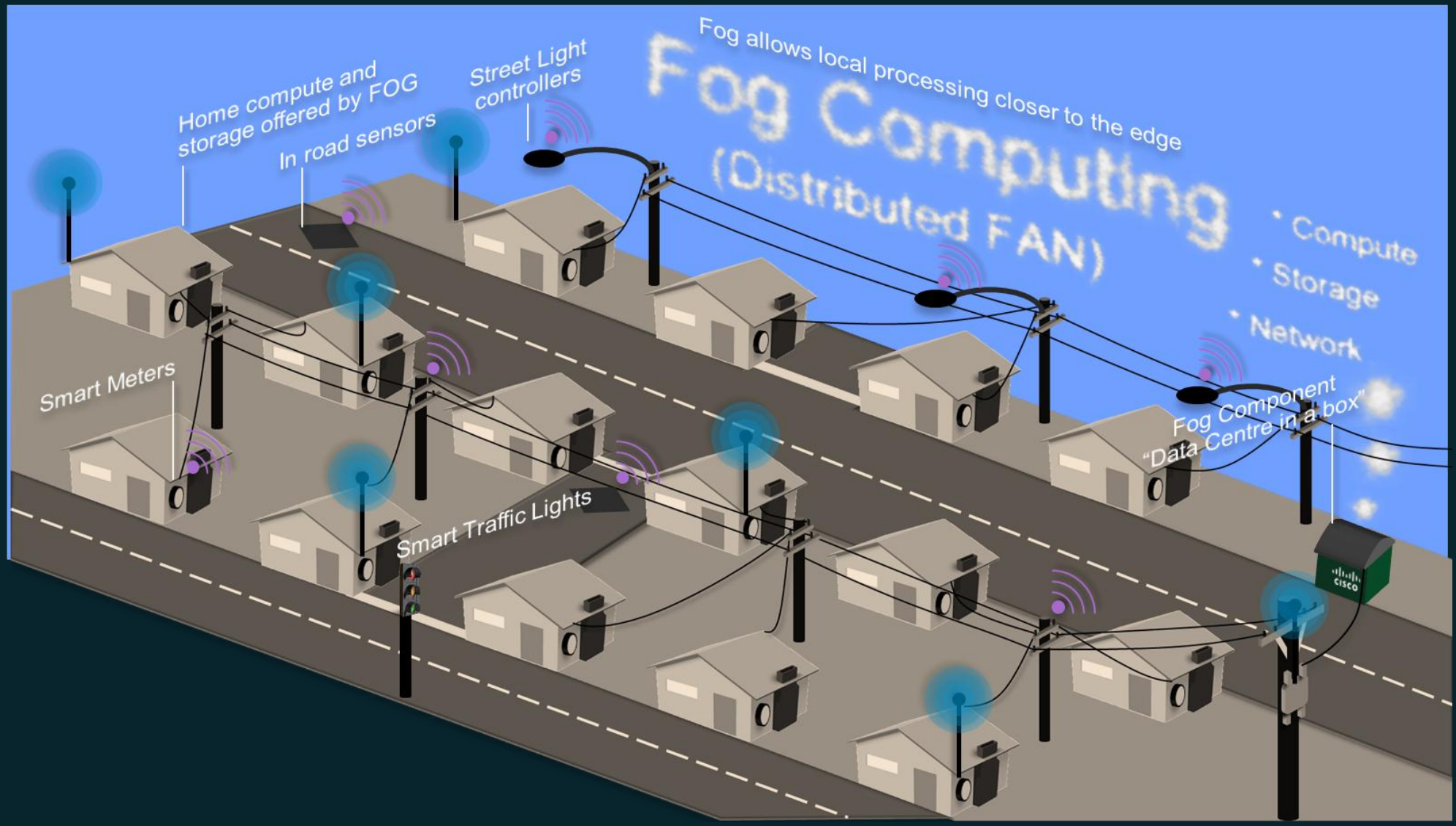
BYOI Bring your own interface

BYOA Bring your own application

Source: Jeff Apcar, Cisco Systems

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

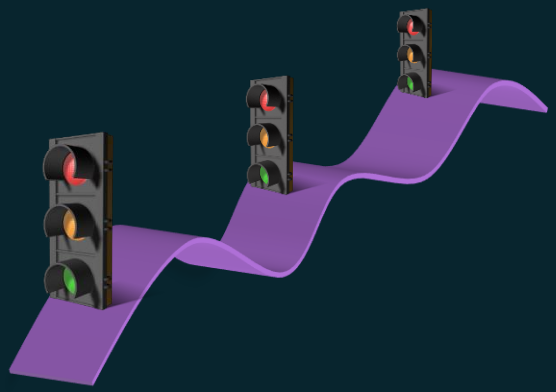
Fog Computing – Field Area Networks



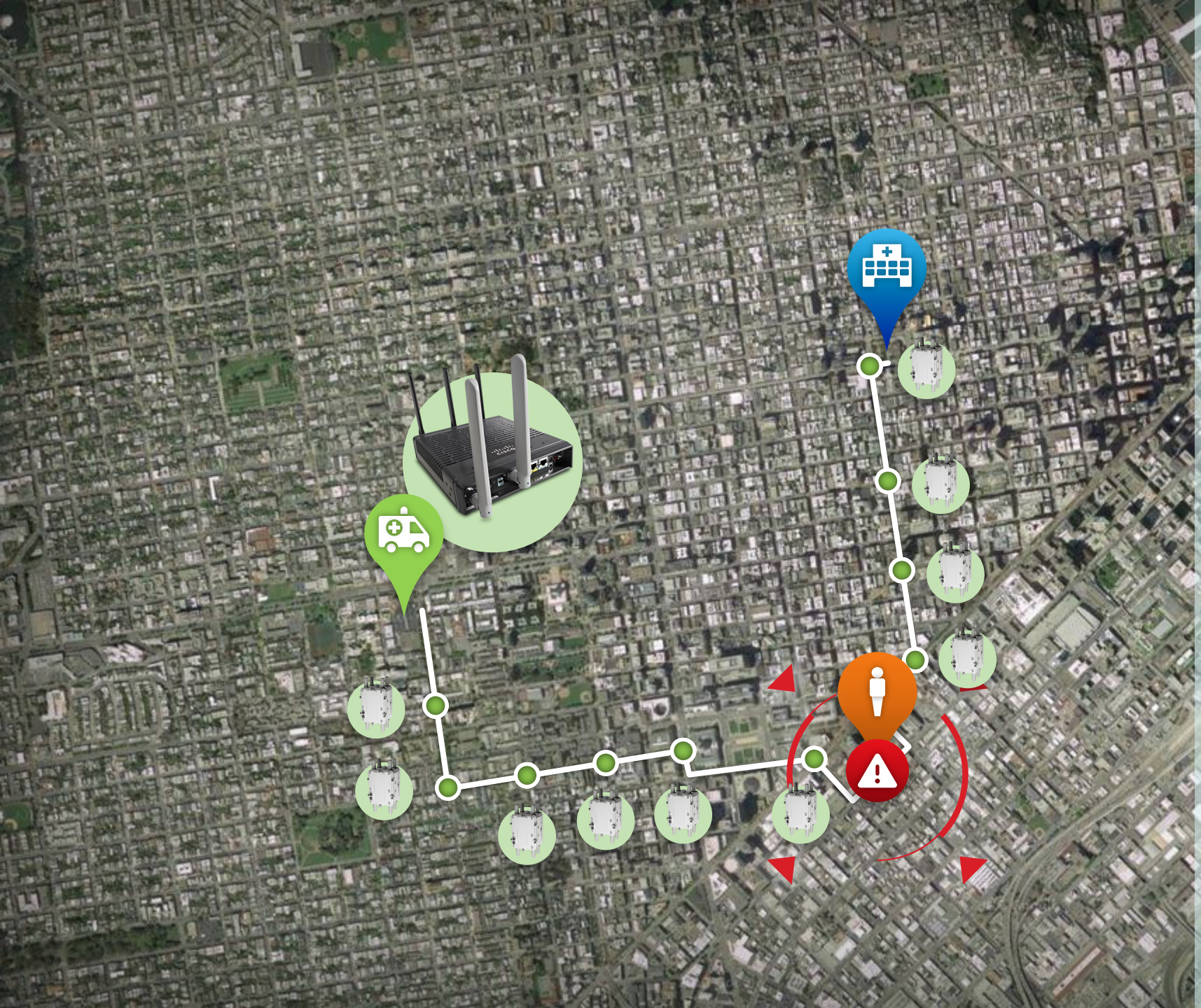
© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing – Connected Vehicle

- Cars to cars, cars to roadside units
- In-vehicle infotainment, real time local updates
- Smart traffic lights (SLT)
  - Modifies cycle based on pedestrian and vehicle traffic
  - Coordination with other lights to create green traffic wave
  - Awareness of emergency services vehicles
  - Modification of traffic cycle though FOG orchestration
  - Real-time analytics performed locally
  - Long-term analytics from SLT sent to cloud



© 2013-2014 Cisco and/or its affiliates. All rights reserved.



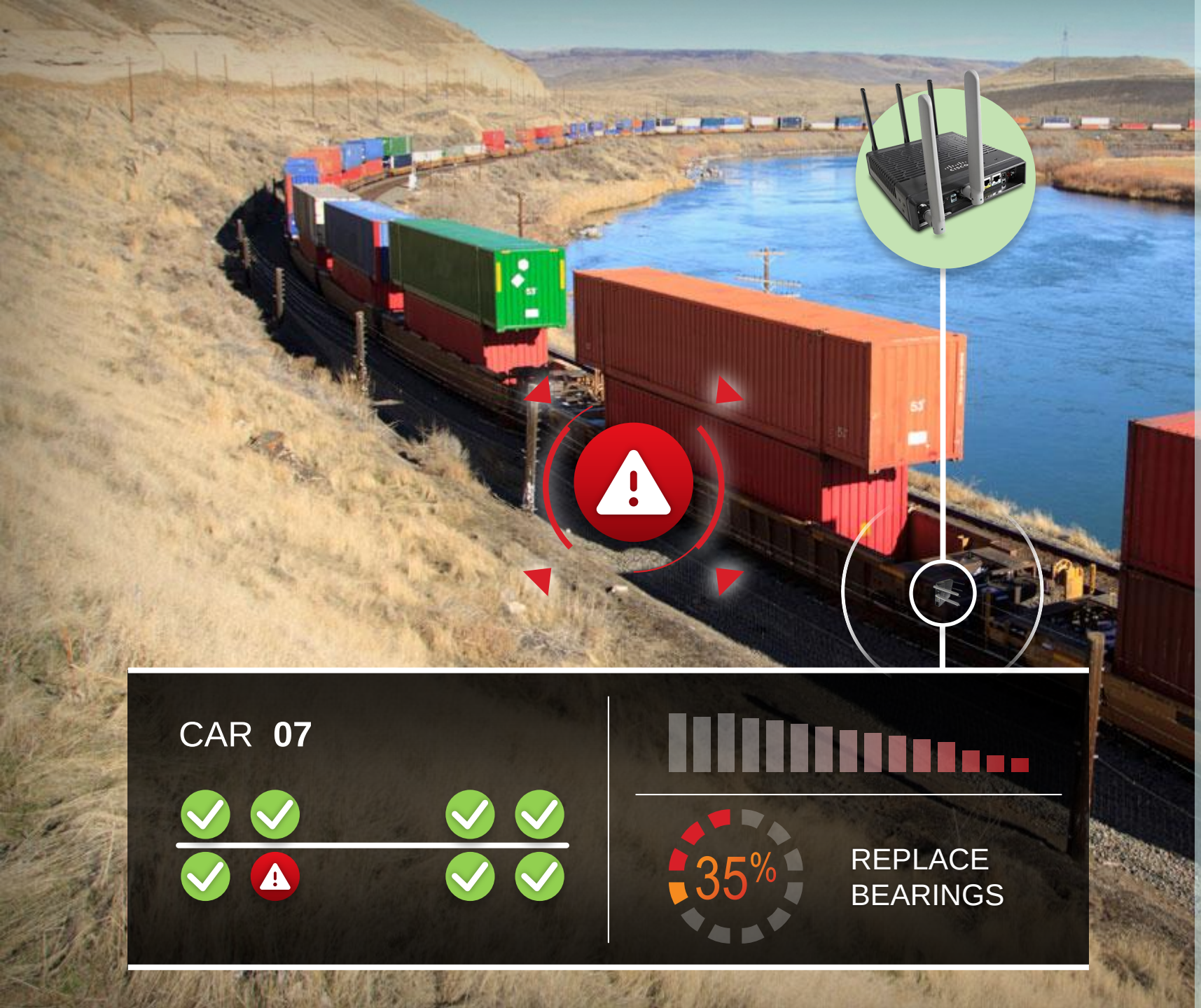
City Infrastructure

Synchronize Signals for Emergency Vehicles

Improve Congestion Management

Better Profitability

Railway Systems



Immediate Response to Equipment Failure

Real-time Health Status of Trains

New Passenger Amenities and Services

Oil Pipelines

Proactive Leak Detection

Predictive Management

Integration To Modern Operational Process

Fogrammers - A New Breed Of App Developers

Industrial Apps Vendors




Ruggedized IOx Fog Hardware




IoT Solutions

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Fog Computing: A New Paradigm

- Combines the best internetworking (IOS) and best open source (Linux)
- Accelerates and simplifies app deployment and management
- Encourages IoT innovation in OT and Enterprise predominantly
- New opportunities for sensor vendors and application developers
- Provides a platform for a new breed of applications & services

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Cisco IoE Commitment

© 2013-2014 Cisco and/or its affiliates. All rights reserved.

Thank you.

© 2013-2014 Cisco and/or its affiliates. All rights reserved.