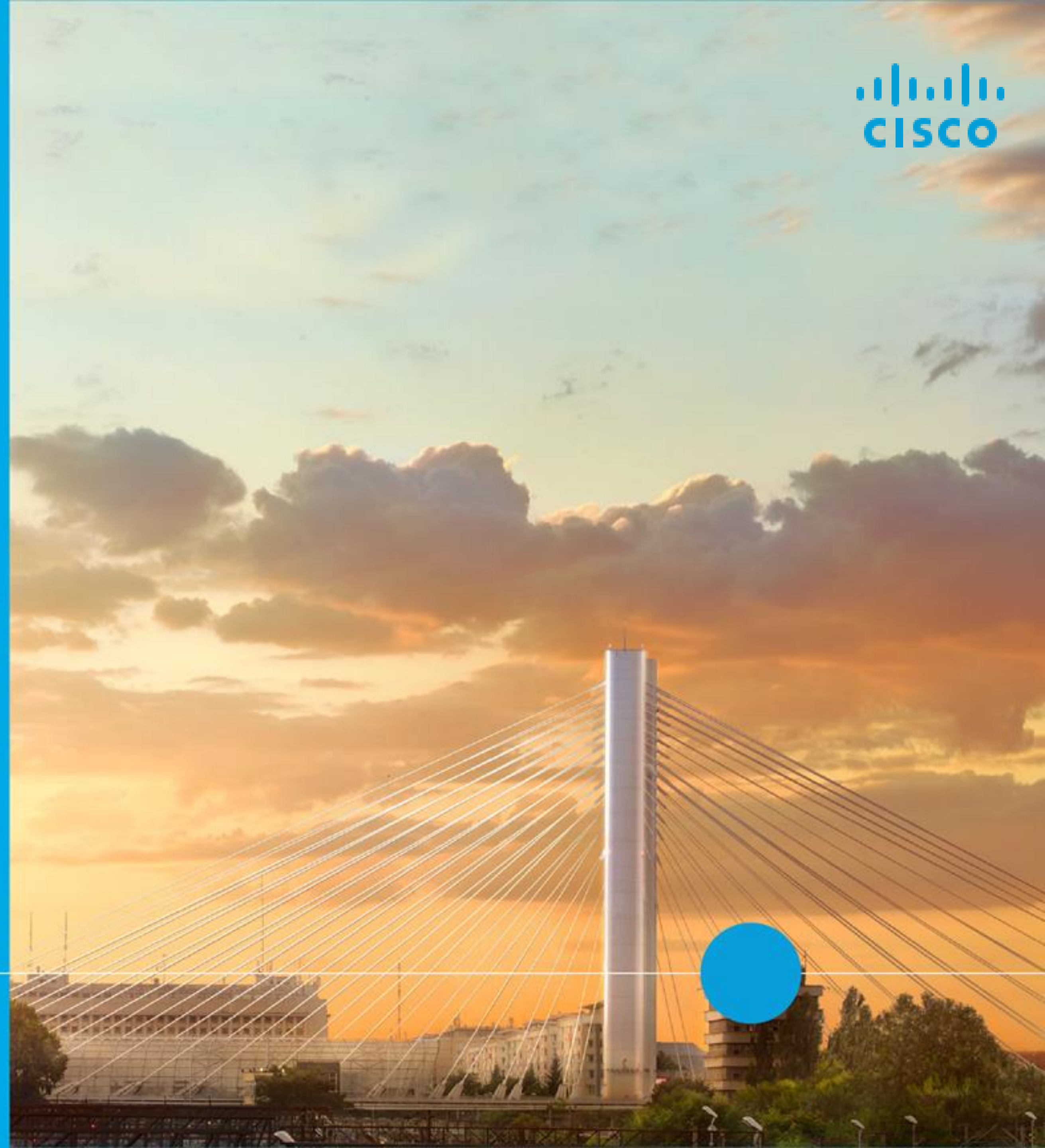


IoT Power Session

IoT Bogdan Doinea

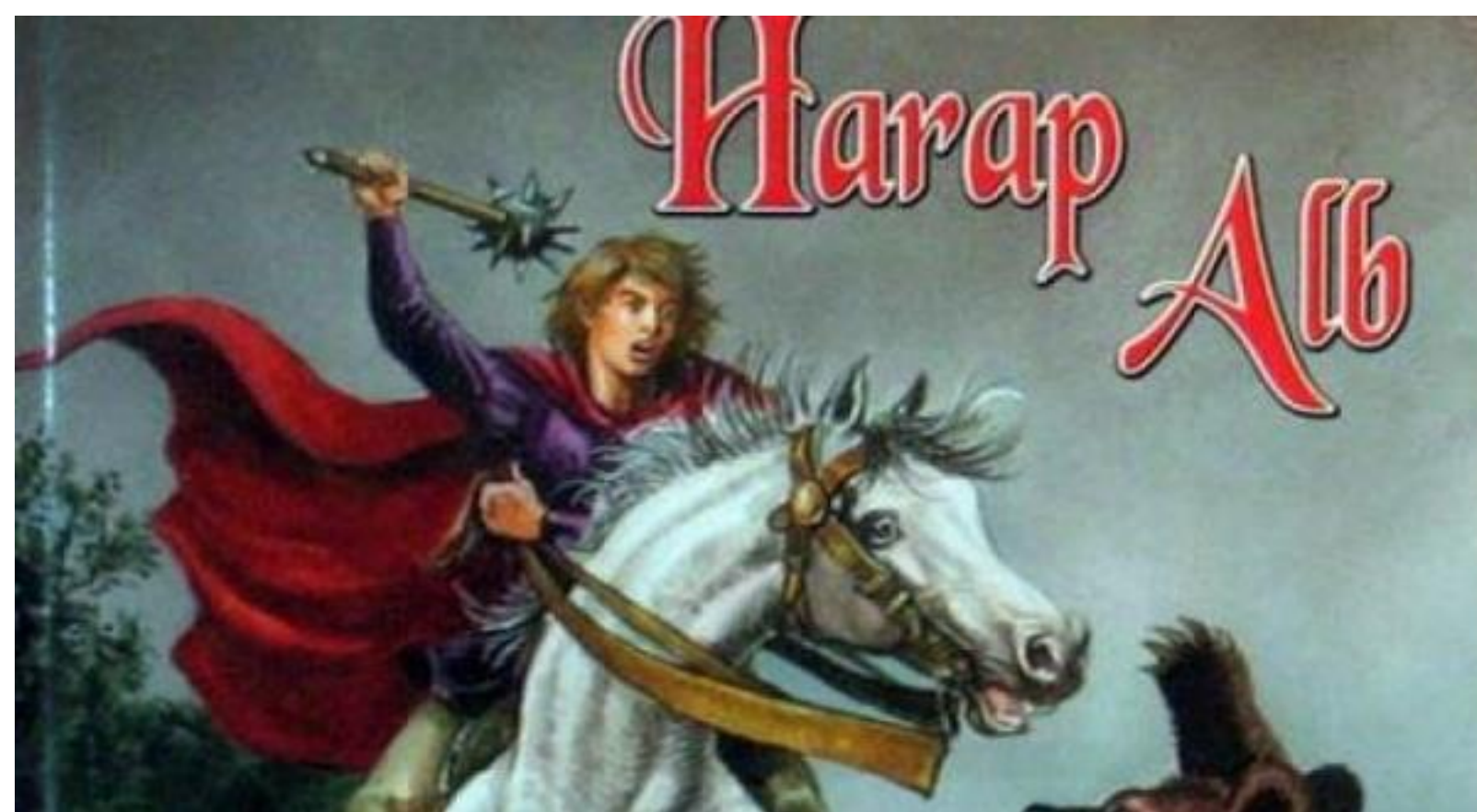
Systems
Engineer

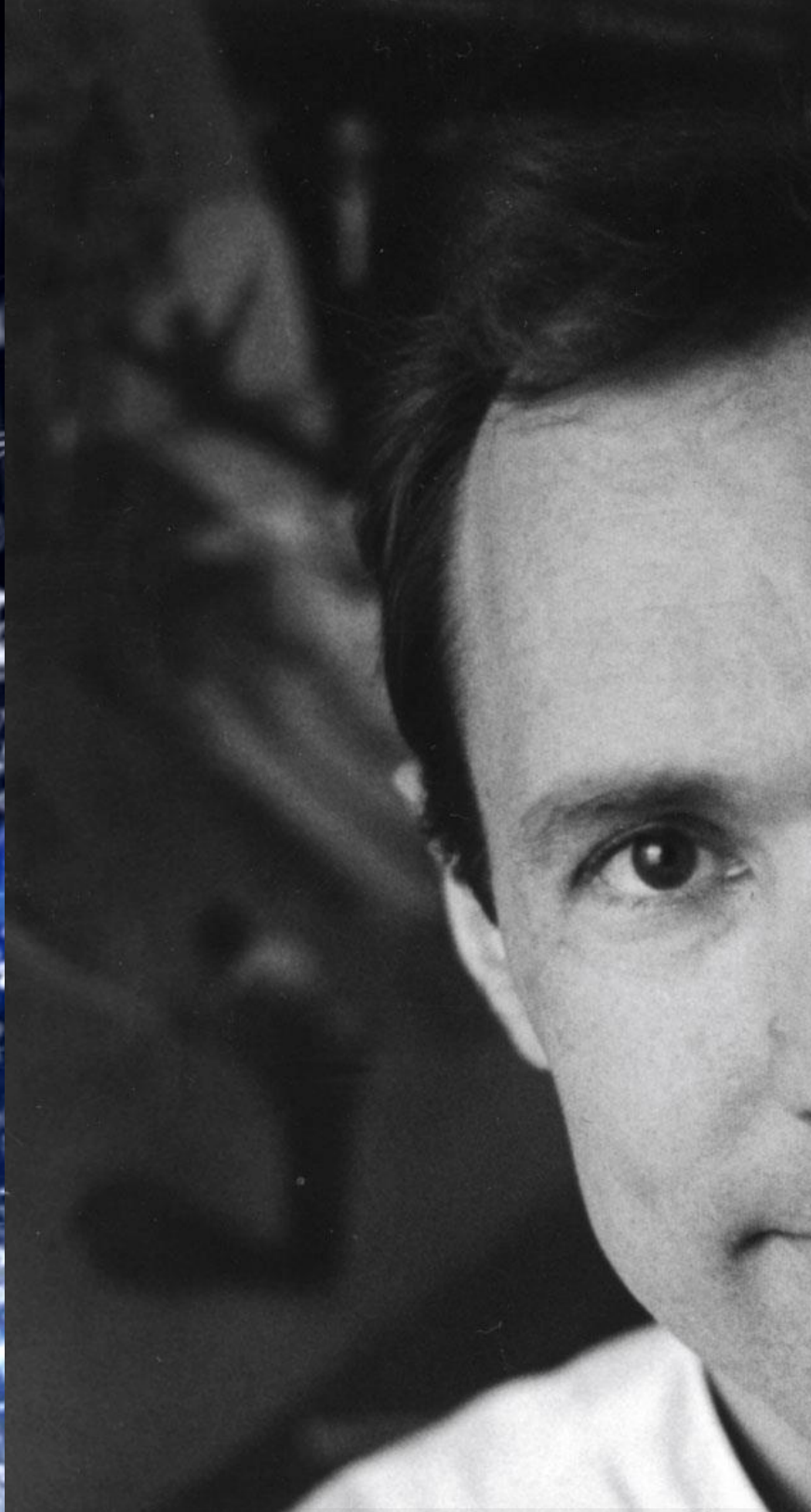
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Heroes

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Vague but exciting ...

CERN DD/OC
Information Management: A Proposal

Tim Berners-Lee, CERN/DD
March 1989

Information Management: A Proposal

Abstract

This proposal concerns the management of general information about accelerators and experiments at CERN. It discusses the problems of loss of information about complex evolving systems and derives a solution based on a distributed hypertext system.

Keywords: Hypertext, Computer conferencing, Document retrieval, Information management, Project control

Vague but exciting ...

CERN DD/OC
Information Management: A Proposal

Tim Berners-Lee, CERN/DD
March 1989

Information Management: A Proposal

Abstract

Where are we now?

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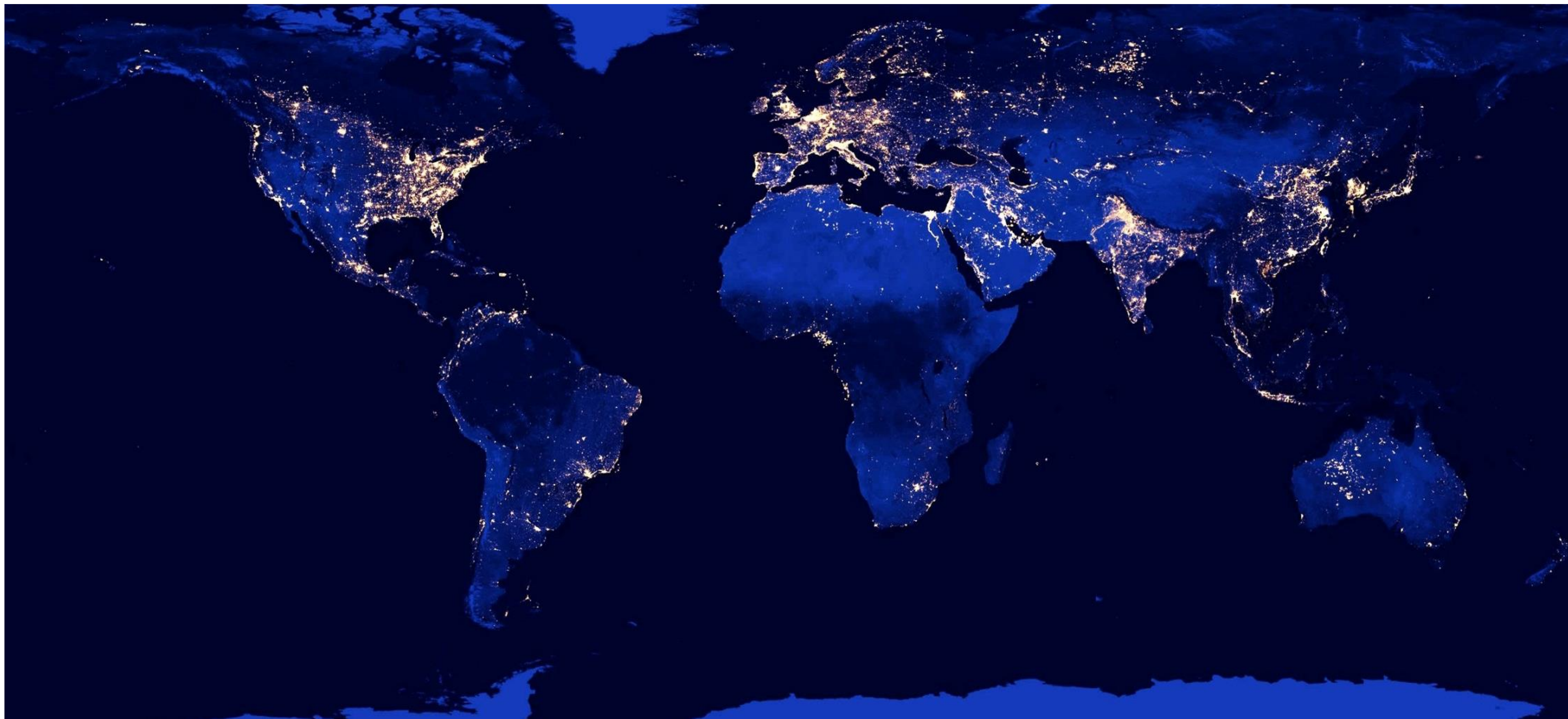


An optimized Internet for human-generated data

What can we achieve with this?

Human-generated data is changing immense paradigms

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Human-generated data is changing immense paradigms

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Machine Learning – the road to AI

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What comes next?

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3x
More Machine Data
than Human Data by
2020



The Challenge of IoT: Evolving the Internet to incorporate and integrate Machine-Generated Data

How Cisco addresses this:

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Big/Massive amount of Machine-Generated Data



Massive amount of things, each producing a small amount of Data

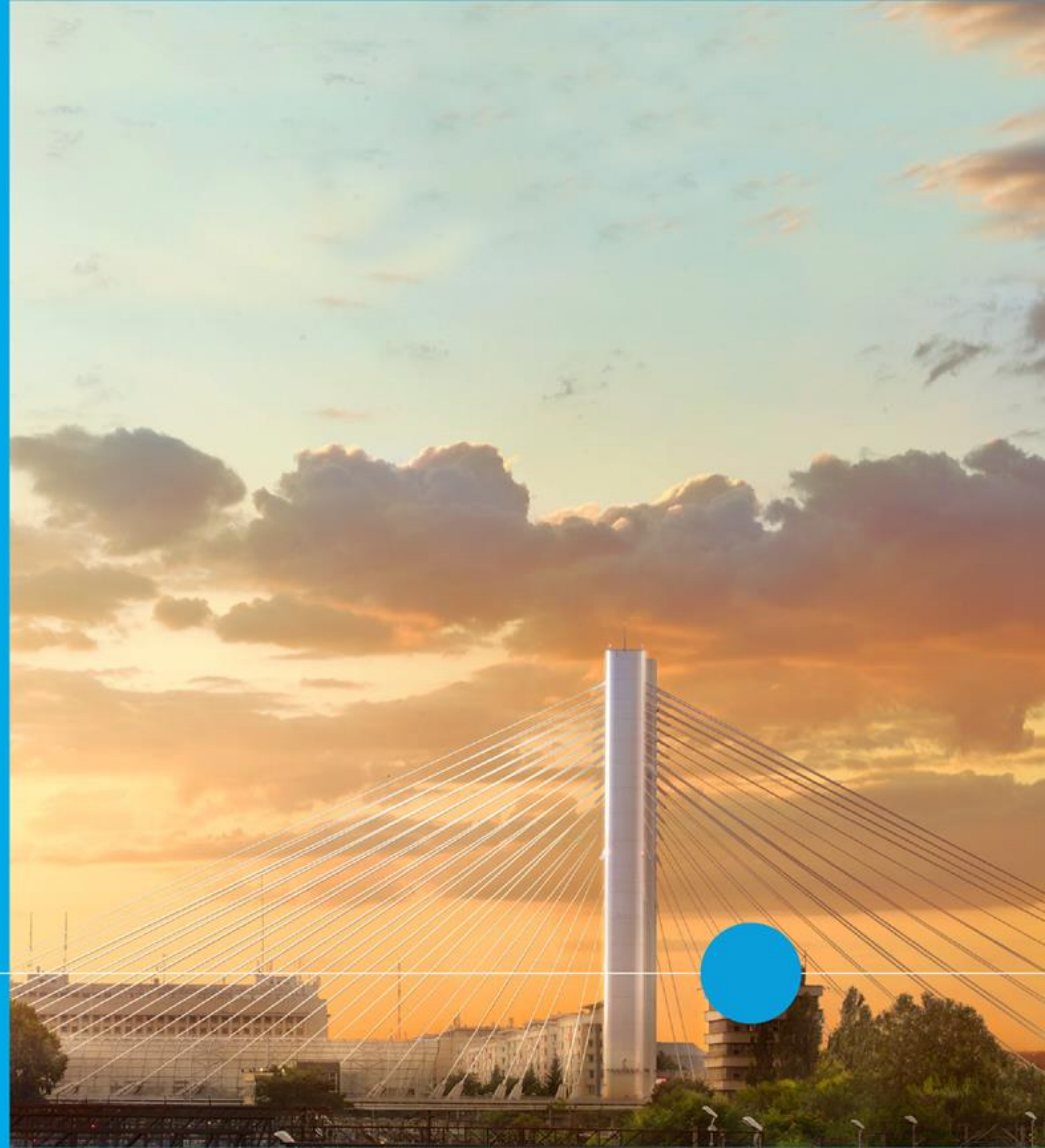


Integrating Big/Massive Machine-Generated Data on the Internet(of Things)

Bogdan Doinea

Systems
Engineer

19 Oct 2016





Insufficient
BW

Latency Too
High

Loosing Local
Automation

Critical
Connectivity
Reliability



Cloud

Levels

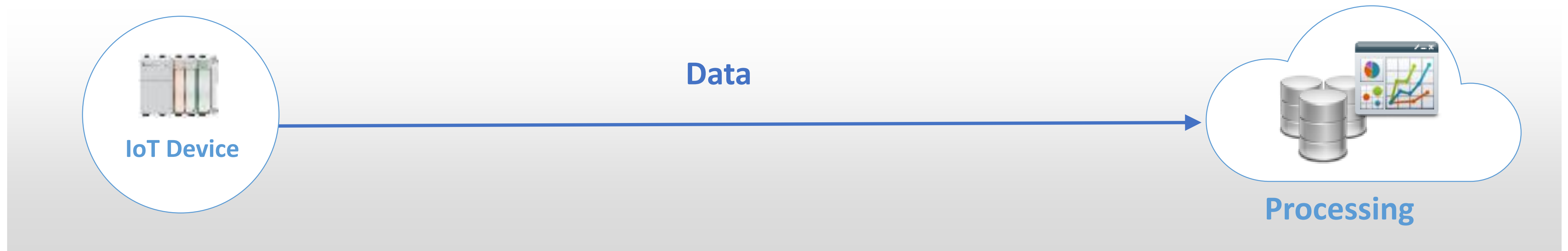
- 7 Collaboration & Processes**
(Involving People & Business Processes)
- 6 Application**
(Reporting, Analytics, Control)
- 5 Data Abstraction**
(Virtualization, Federation, Caching)
- 4 Data Accumulation**
(Storage)
- 3 Edge Computing**
(Data Element Analytics & Transformation)
- 2 Connectivity + Fog Computing**
(Communication & Processing Units)
- 1 Physical Devices & Controllers**
(The “Things” in IoT)



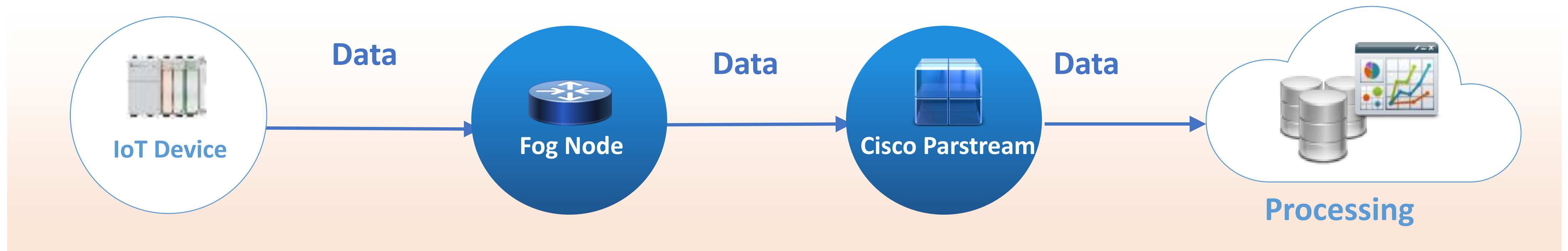
Fog Application Dev Software Model

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Traditional Approach – Take Data to the Processing



Take Processing to the Data



IoT System – Fog, App SDK, Management, Security Integrated

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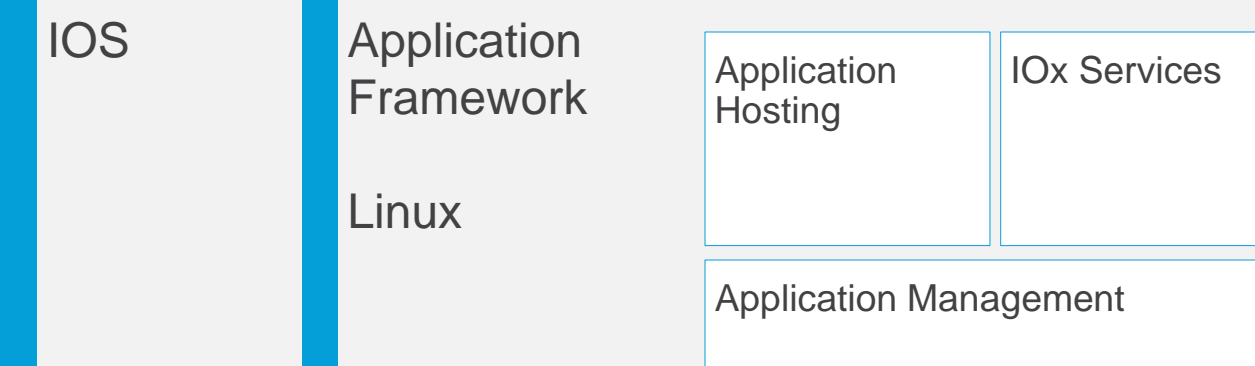
Fog-Ready Secured Network Infrastructure



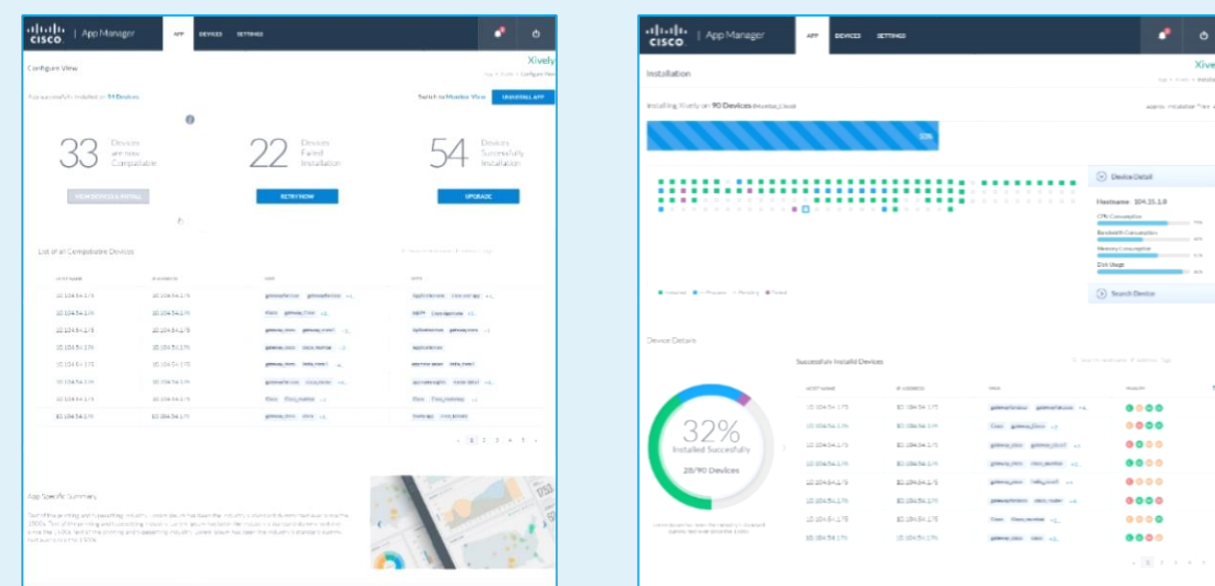
- IR 809/829, CGR 1120/1240, C819
- IE4k Concept app hosting ISR4k, etc.

Fog Application Framework

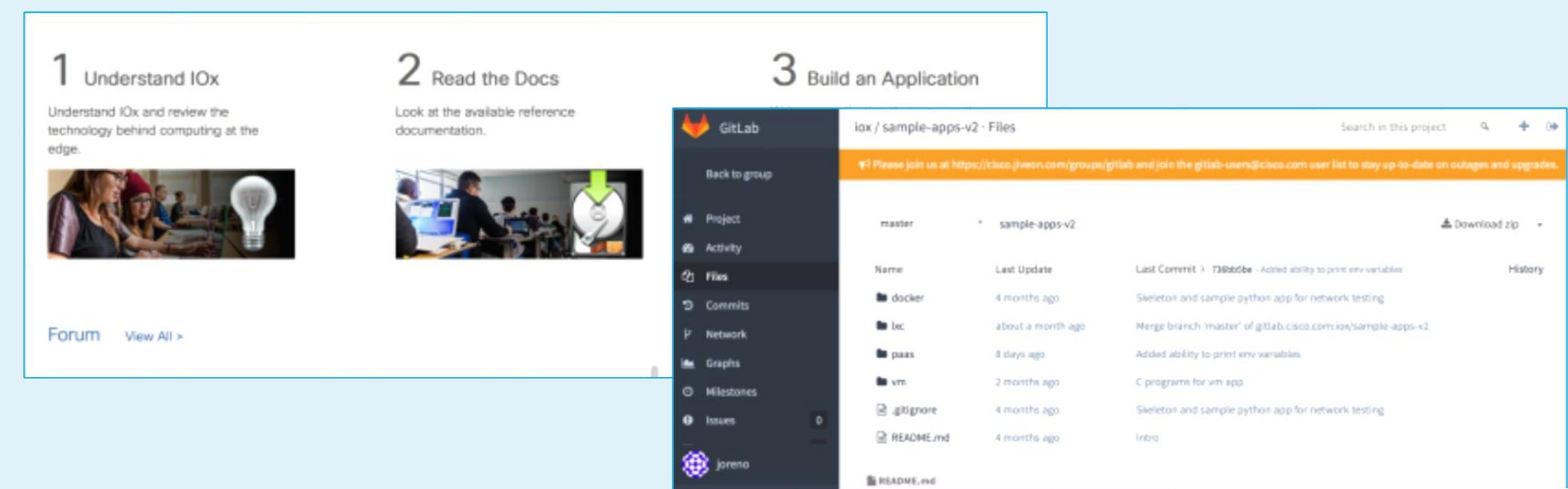
IOx



Fog Director - Fog Application Management



Developer Toolkits and SDK



IR829 – Wireless, LTE dual SIM, SFP, Ethernet Switch, RS232/RS485

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Interface Specifications

4G / LTE (w/ GPS) + 802.11 b/g/n Wi-Fi (2.4 / 5 GHz)
with Dual SIMs

Ethernet: 4 GE LAN (w/ POE) + 1 GE WAN

Serial: 2 x RJ-45

Networked USB (HW ready- future SW release)

Motion detector (HW ready- future SW release)

Power Specifications

6-30 VDC power supply options

30 W available for POE

Automotive grade power supply

Form Factor Specifications

IP-54 rating

Compact form factor

Fixed configurations- Panel / DIN rail / Door mount

Extended Temperature range



IR809 – LTE dual SIM, Ethernt Uplink, Ethernet Switch, RS232/485

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Interface Specifications

4G / LTE (w/ GPS)

Ethernet: 2 x 10/100 routed ports

Serial: 2 x RJ-45

Networked USB (HW ready- future SW release)

Motion detector (HW ready- future SW release)

Digital Alarm Input (HW ready- future SW release)

Power Specifications

9-60 VDC power supply options

Form Factor Specifications

Compact form factor: Tentative dimensions: 5" x 6.25" x 1.25"

Fixed configurations- Panel / DIN rail / Door mount

IP-30 rating

Extended Temperature range



Romania: Utilities Smart RTU Use-Case

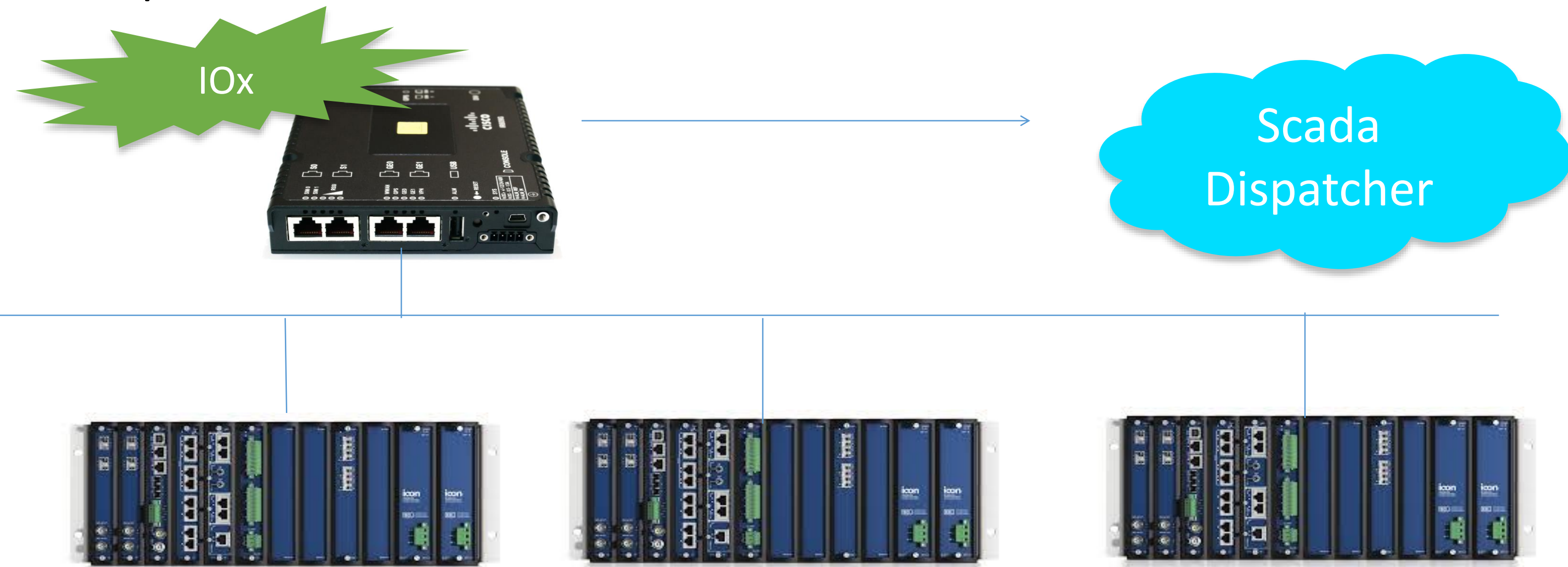
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Product: **ES200 - SCADA Visibility and Automation in sub-secondary stations.**

- Smart RTU implemented on the IR809, with Eximprod Group

ES200 – Product Highlights

- One-box solution for both RTU and Router
- Secure Connectivity with on-demand IPsec tunnels to Dispatcher
- Compatibility with any SCADA dispatcher
- SCADA Visibility



Romania: Energy Savings Use-Case

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**QUARTZ
MATRIX**[®]

Product: **ENEF** – improving energy efficiency in your Process Network by 15-25% (savings can go up to 1M\$/year)

Includes Energy Auditing, Continuous Monitoring and Efficiency/Optimization Measurable Actions

Romania(in pilot): Manufacturing Efficiency



Factory

Historian

Tool Health

Memex Merlin



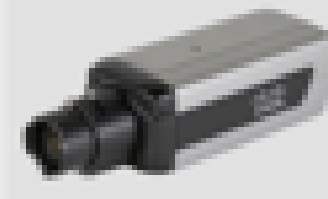
OEE & Analytics

Quality

Cisco
Maintenance

Machine / Cell Package

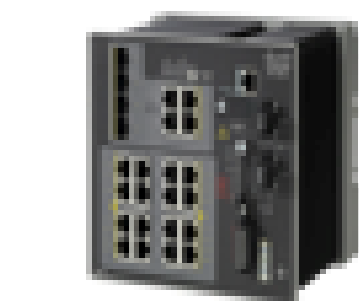
Cameras



Analytics



Sensors



IoT FOG Node
MTConnect



Cell

Oil Use-Case: Monitoring a Refinery

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ExxonMobil

Powered by **CISCO**

Navigation ☰ Offsite Line-up ⌵ Alerts **0** 🔔

Valve Status Legend

Fully Open	Partially Open	Fully Closed	Incorrect State

All Valves Unlocked
Please ensure all valves are in correct state

7 valve at outlet of tank F4307

8

9

10

11

12

13

14

15

Unit Flushing

VGO Loop

valve at pump G1502 discharge

G1602

H26423

F718

F16 intermediate front of G1611

New BFO

Blending/Circ

JMT

G1510

G1504

G1506

G1506B

F65

topping up valve to F61

6

topping up valve to F69

11

G1604A MIDW Btm to F161

JMT Return line

F61

F69



**Reduced
Downtime**

48%

Unplanned downtime
down from 11%
to 5.8%



Reduction in Defects

49%

Defect rate
down from
4.9%
to 2.5%



**New Product
Introduction**

23%

New product
introduction cycle time
reduced from 15 to 11



**OEE
Improvement**

16%

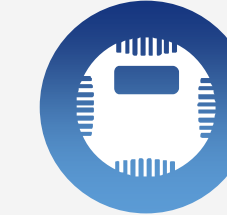
Average OEE improved
from
74% to 86%



**Improved
Inventory**

35%

Inventory
turns increased from
14 to 19



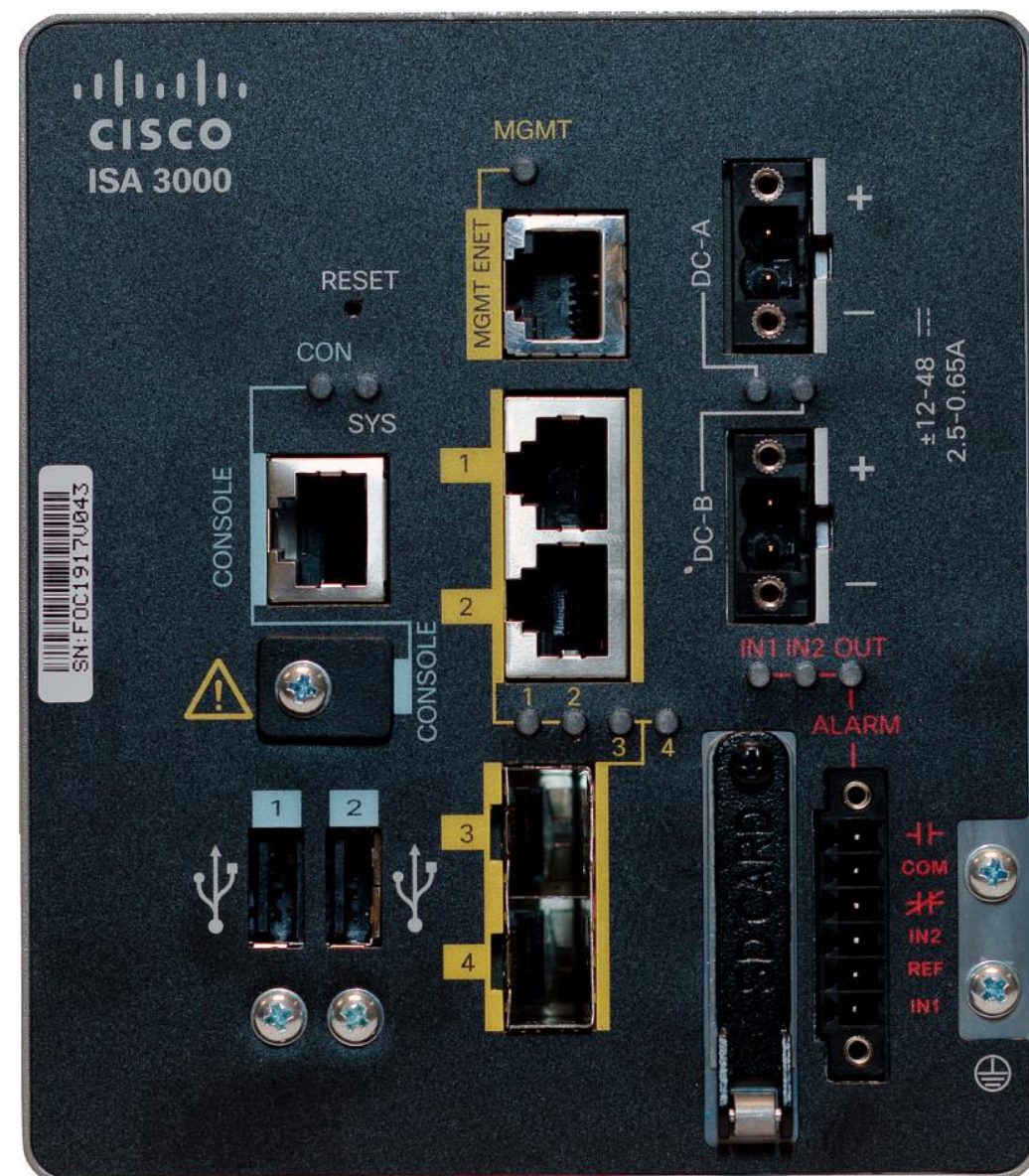
**Reduction in
Energy Use**

18%

Annual energy
cost down from
\$8.4M
to \$6.9M

The Real Economic Value is Immense

SCADA/Industrial NGFW



Rule

```
alert tcp $104_CLIENT any -> $104_SERVER $104_PORTS (flow: established; content:"|68|"; offset:0; depth:1; pcre:"/[\\S\\s]{5}(\\x2D|\\x2E|\\x2F|\\x30|\\x64|\\x65)/iAR"; content:"|06|"; offset: 8; depth: 1; msg:"17: SCADA_IDS: IEC 60870-5-104 – Suspicious Value of Transmission Cause Field"; classtype:bad-unknown; sid:6666617; rev:1; priority:2;)
```

Alert

[**] [1:6666617:1] 17: SCADA_IDS: IEC 60870-5-104 – **Suspicious Value of Transmission Cause Field** [**]

[Classification: Potentially Bad Traffic] [Priority: 2]

09/09-14:06:10.462288 10.50.50.105:40734 -> 10.50.50.75:22

TCP TTL:64 TOS:0x0 ID:60033 IpLen:20 DgmLen:60 DF

OT Application Visibility and Recognition

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Add Rule ? ×

Name Enabled Insert

Action IPS: no policies Variables: n/a Files: no inspection Logging: no logging

Zones **Networks** **Users** **Applications** **Ports** **URLs** **Inspection** **Logging** **Comments**

Application Filters **Available Applications (17)** **Selected Applications and Filters (0)**

Application Filters	Available Applications	Selected Applications and Filters
<input type="checkbox"/> Myspace 3	<input type="checkbox"/> BACnet	any
<input type="checkbox"/> not work related 146	<input type="checkbox"/> COSEM	
<input type="checkbox"/> old/obsolete 7	<input type="checkbox"/> COTP	
<input type="checkbox"/> opens port 33	<input type="checkbox"/> DNP3	
<input type="checkbox"/> OSCAR protocol 3	<input type="checkbox"/> Emission Control Protocol	
<input type="checkbox"/> QVOD related sites 2	<input type="checkbox"/> Fujitsu Device Control	
<input type="checkbox"/> recent vulnerabilities 29	<input type="checkbox"/> GOOSE	
<input checked="" type="checkbox"/> SCADA protocol 17	<input type="checkbox"/> GSE	
<input type="checkbox"/> sends mail 58	<input type="checkbox"/> Honeywell Control Station/NIF Server	
<input type="checkbox"/> share links 47	<input type="checkbox"/> Honeywell Experion DSA Server Monitor	
<input type="checkbox"/> share media 126	<input type="checkbox"/> IEC 104	
<input type="checkbox"/> share music 38	<input type="checkbox"/> ISO MMS	
<input type="checkbox"/> share photos 53	<input type="checkbox"/> Modbus	
<input type="checkbox"/> share video 79	<input type="checkbox"/> OPC-UA	
<input type="checkbox"/> Skype 9	<input type="checkbox"/> Q.931	
<input type="checkbox"/> social network apps 88	<input type="checkbox"/> SRC	
	<input type="checkbox"/> TPKT	

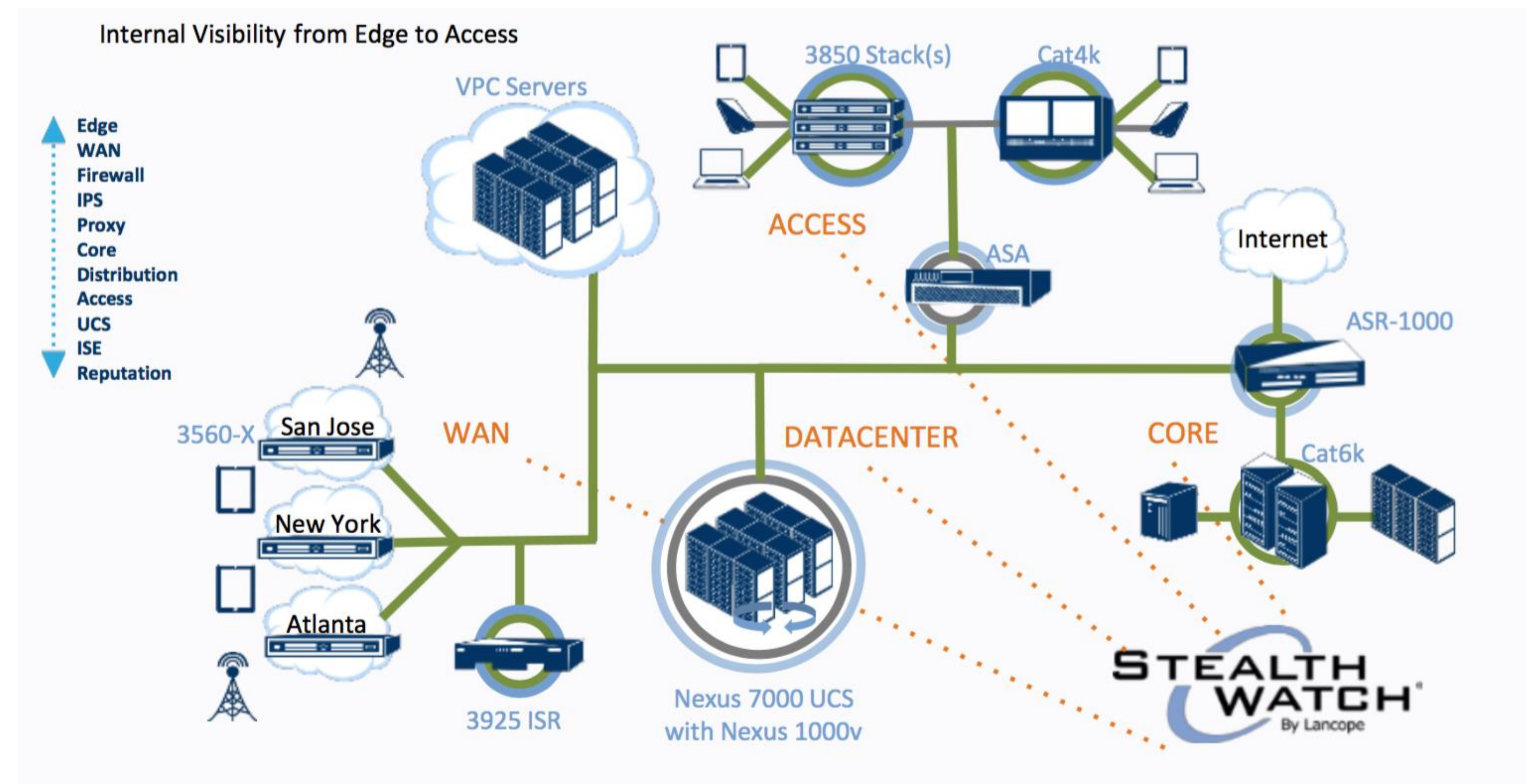
Security for Systems with Real-Time Constraints

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Cisco Stealthwatch Behavioral Analysis and Anomaly Detection

- Network Segmentation
- Incident Response
- Insider Threat
- Targeted Attack
- Zero Day Malware Propagation Internally
- Slow Network – investigation
- A Simple-Web Interface to work with

Real-Time Communications Security Architecture

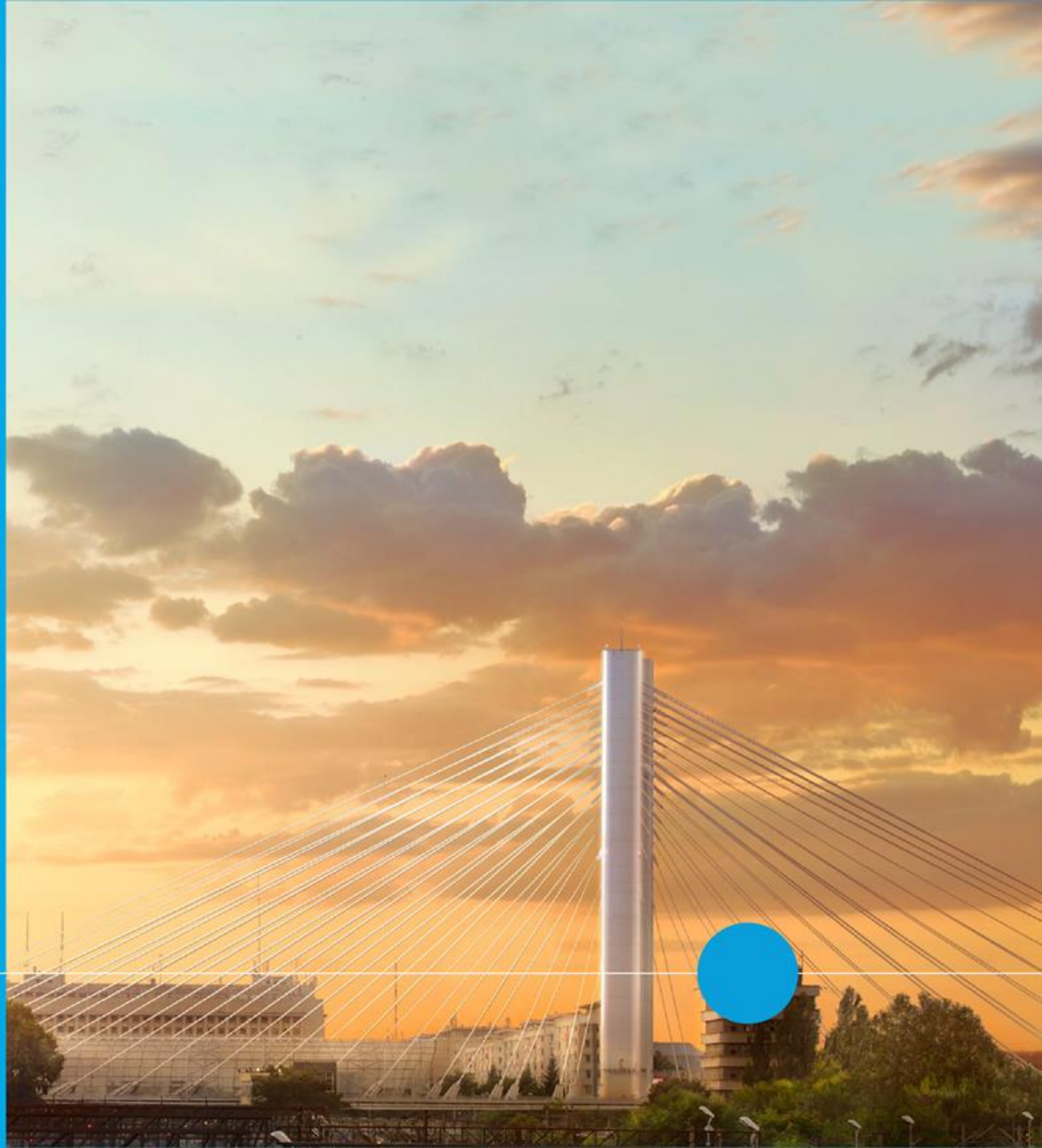


Integrating a Massive amount of things on the Internet (of Things)

Bogdan Doinea


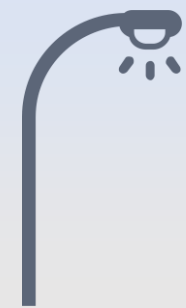



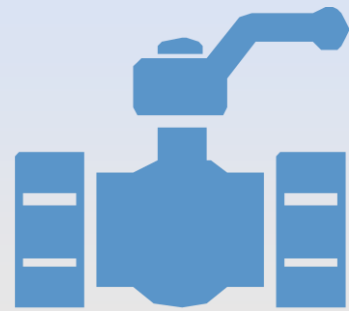
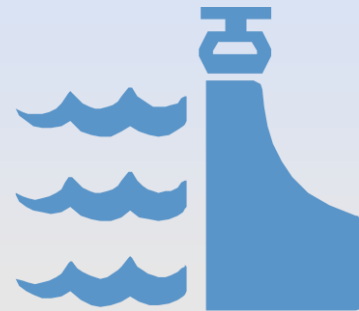





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Use-Cases that are interesting

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Smart water/ gas metering	Public lighting	Smart building	Smart parking
			
Assets Tracking	Smart Agriculture, i.e. leak detection and irrigation	Water level and flood management	Fault management
			
Security services, i.e. Smoke detectors	Smart energy and fast demand response	Waste management	Traffic management
			

LoRa Alliance – Have created the LoRaWAN Standard

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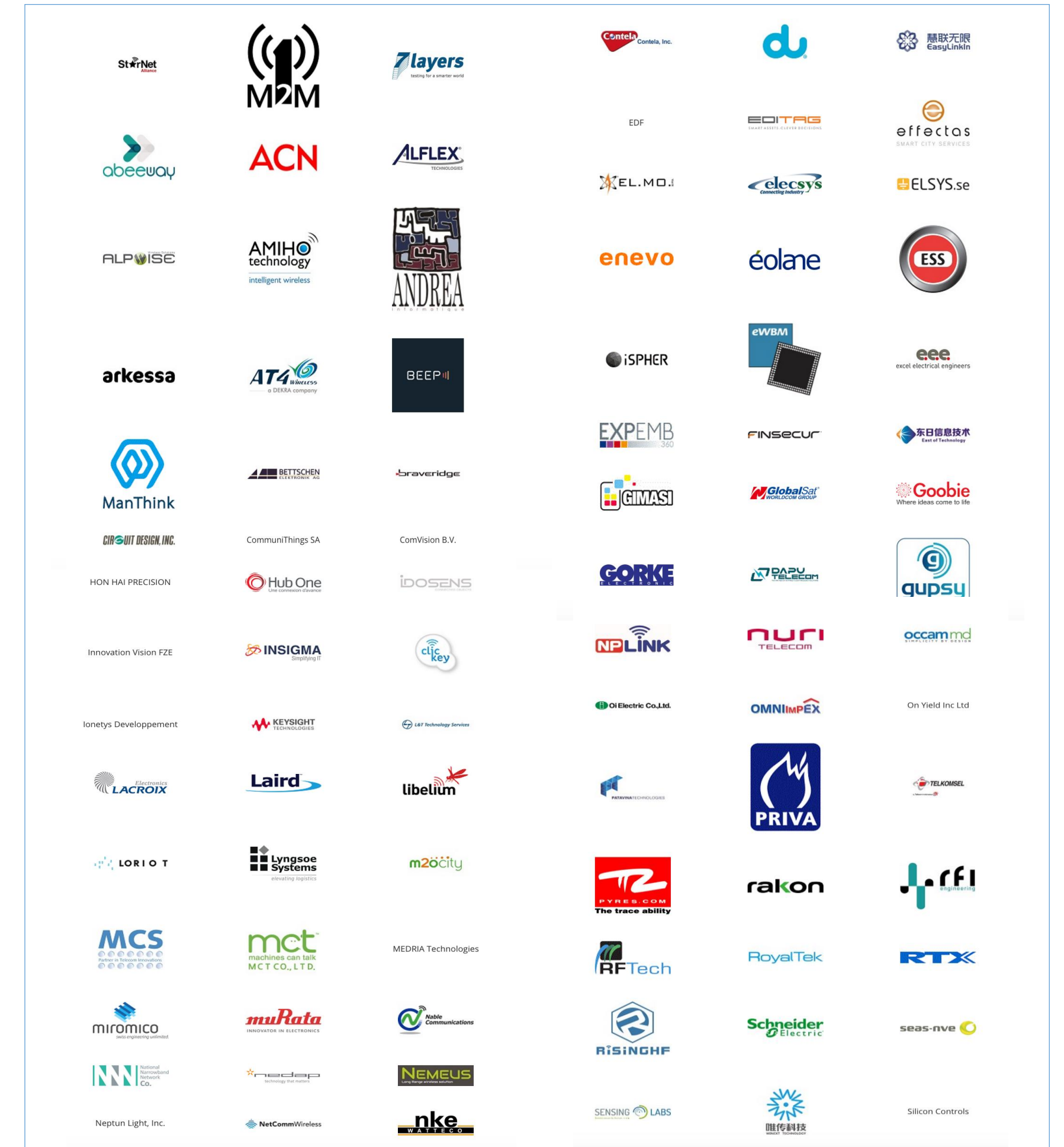
Sponsor Member



Contributor Member

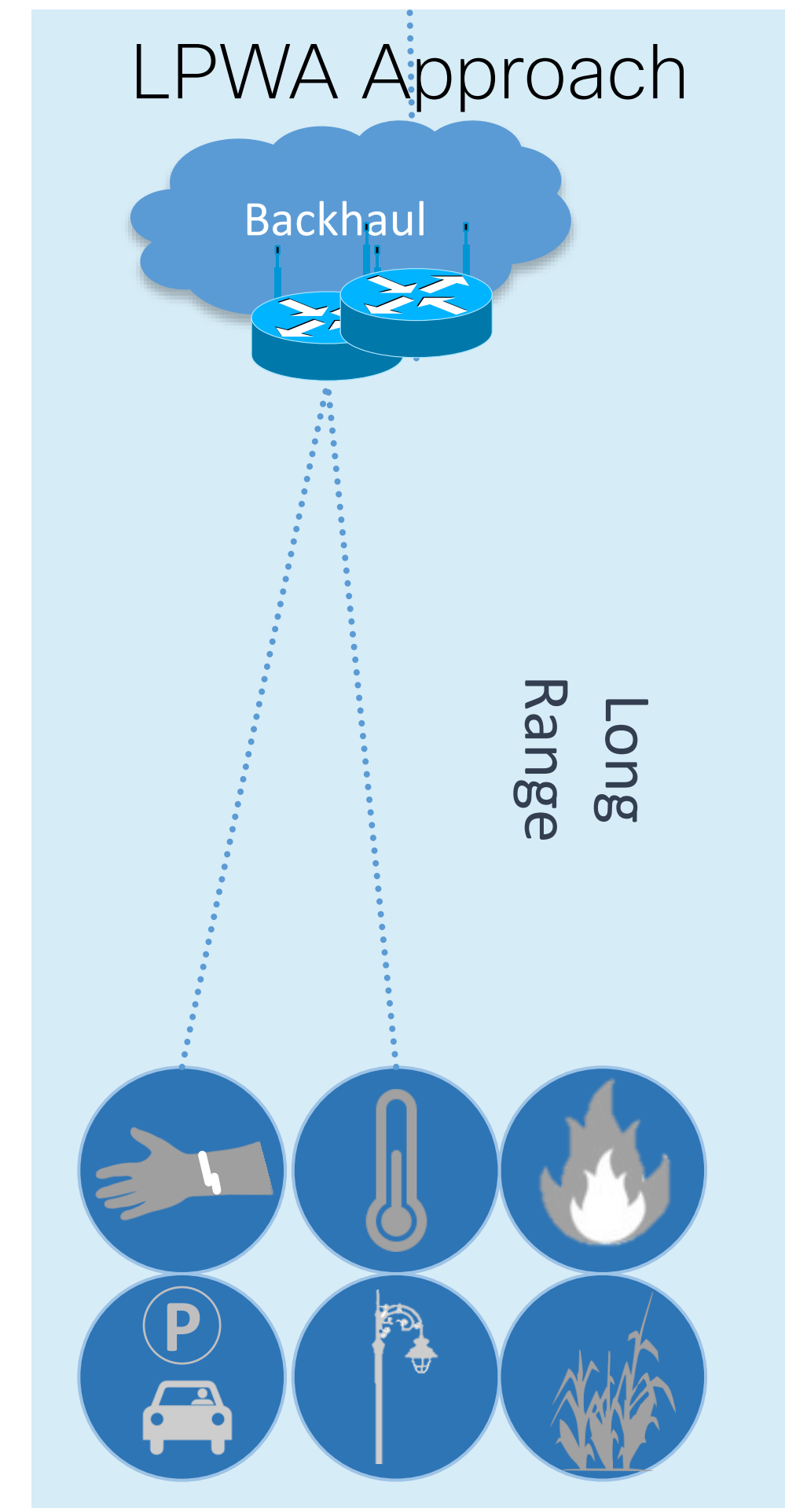
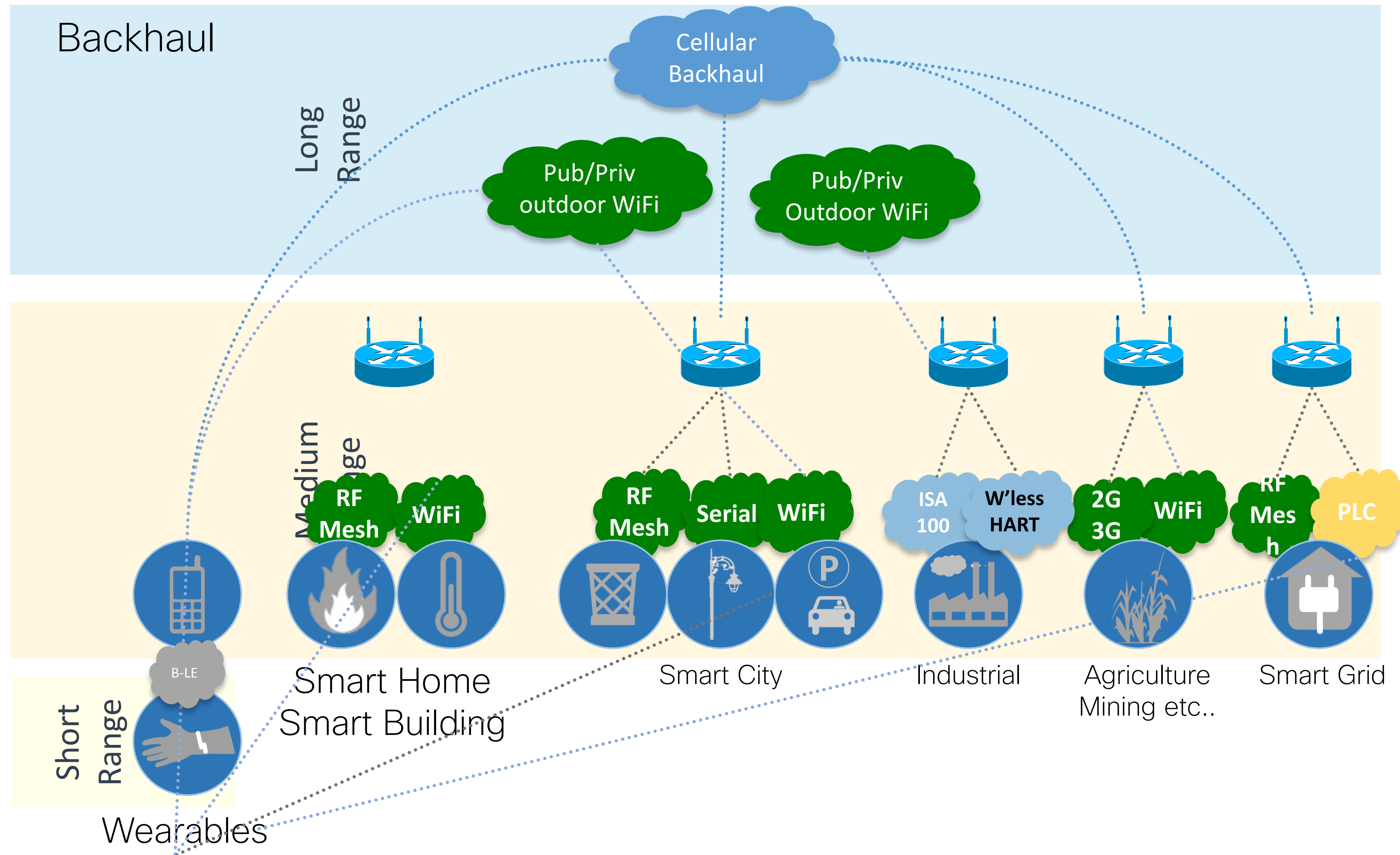


Adopter Member



LoRaWAN- for local, integrated, secure sensor networks

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Connecting the Unconnected

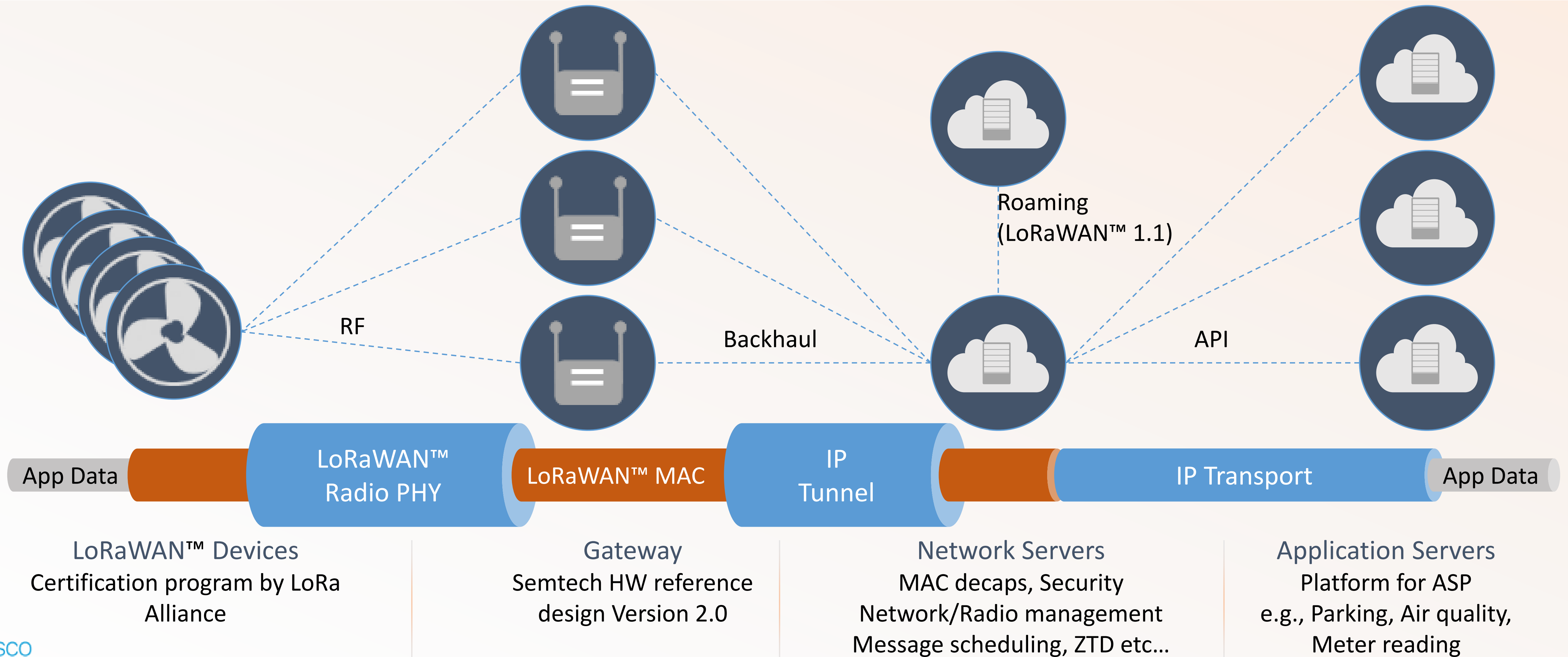
Technology Comparison Chart

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Technology	2G	3G	LTE	WIFI	Zigbee	Wireless Hart	802.15.4g	LoRaWAN
Long Range	Yes	Yes	Yes	No	No	No	Limited (1.5 Km)	Yes (10s Km)
Tx Current Consumption (3V)	30mA to 400mA	500 to 1000mA	600 to 1100 mA	19 to 400 mA	34mA	28mA	~ 35mA	20-70mA
Topology	P2P	P2P	P2P	P2P/Mesh	Mesh	Mesh	Mesh	Hub and Spoke
Standby Current Consumption (3V)	0.35 mA	1.2 to 3.5mA	1.5 to 5.5mA	1.1 mA	0.003mA	0.008mA	~.005mA	0.005mA
Operating Life on battery (2000mAh)	4-8 hours (A) 36 days (I)	2-4 hours (A) 20 days (I)	2-3 hours (A) 12 days (I)	4-8 hours (A) 50 hours (I)	60 hours (A)	8-10 years	Variable	10-20 Years
A=Active I=Idle	5 years with 1 msg/day							
Module Cost	\$12	\$35-\$50	\$40-\$80	\$5-\$8	\$6-\$12	NC	\$3	\$2-\$5
Spectrum Costs	Yes	Yes	Yes	No (Unlicensed)	No (Unlicensed)	No (Unlicensed)	No (Unlicensed)	No (Unlicensed)

LoRaWAN End-to-End Architecture

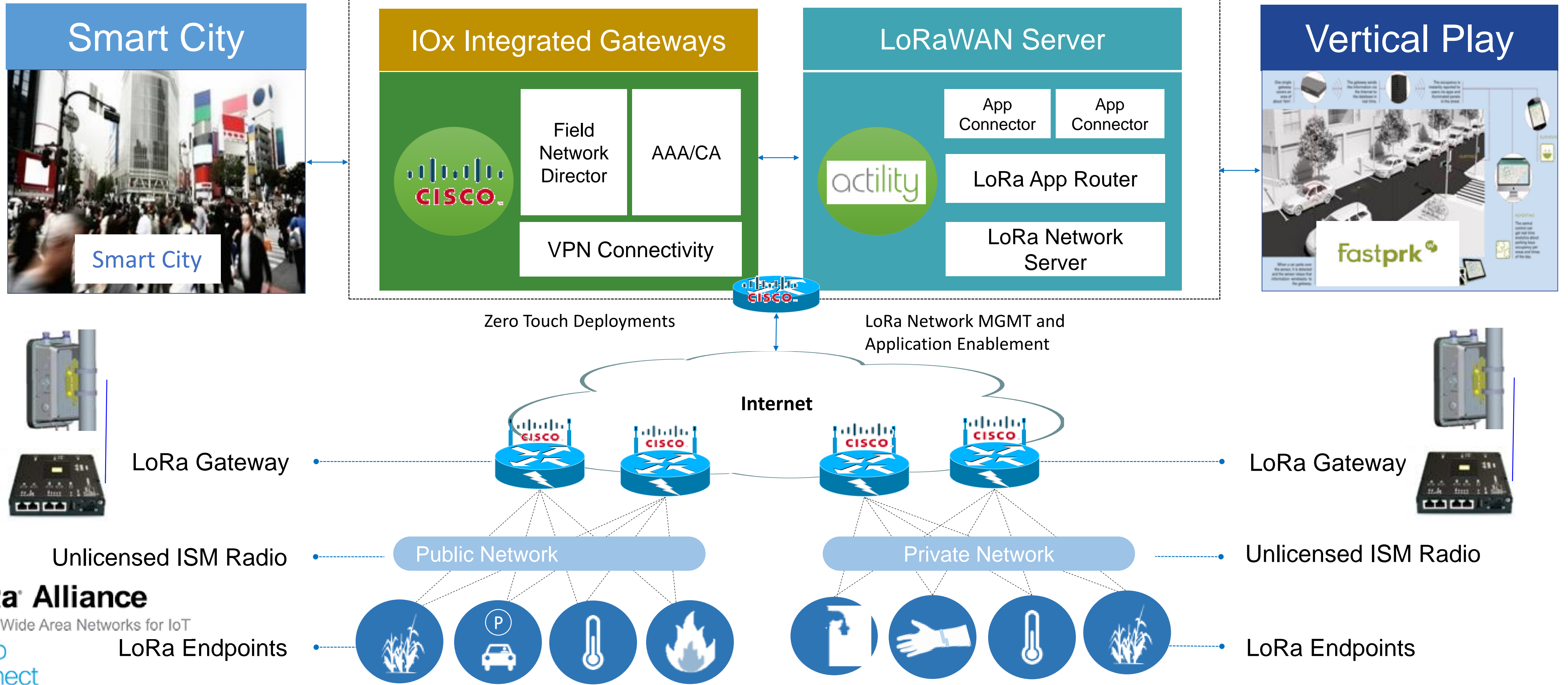
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Cisco + Actility = Strongest LoRaWAN Solution

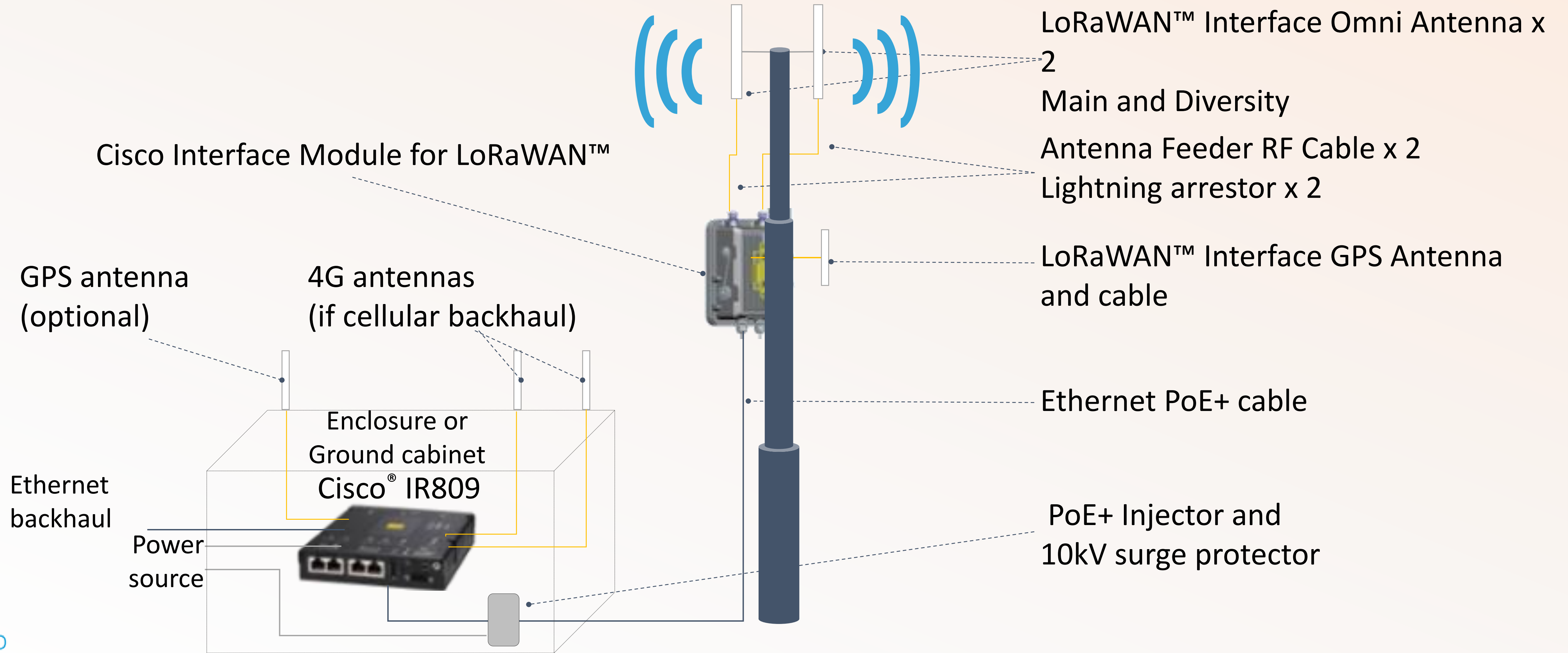
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Cisco/Actility LoRaWAN Solution



LoRaWAN Deployment Architecture

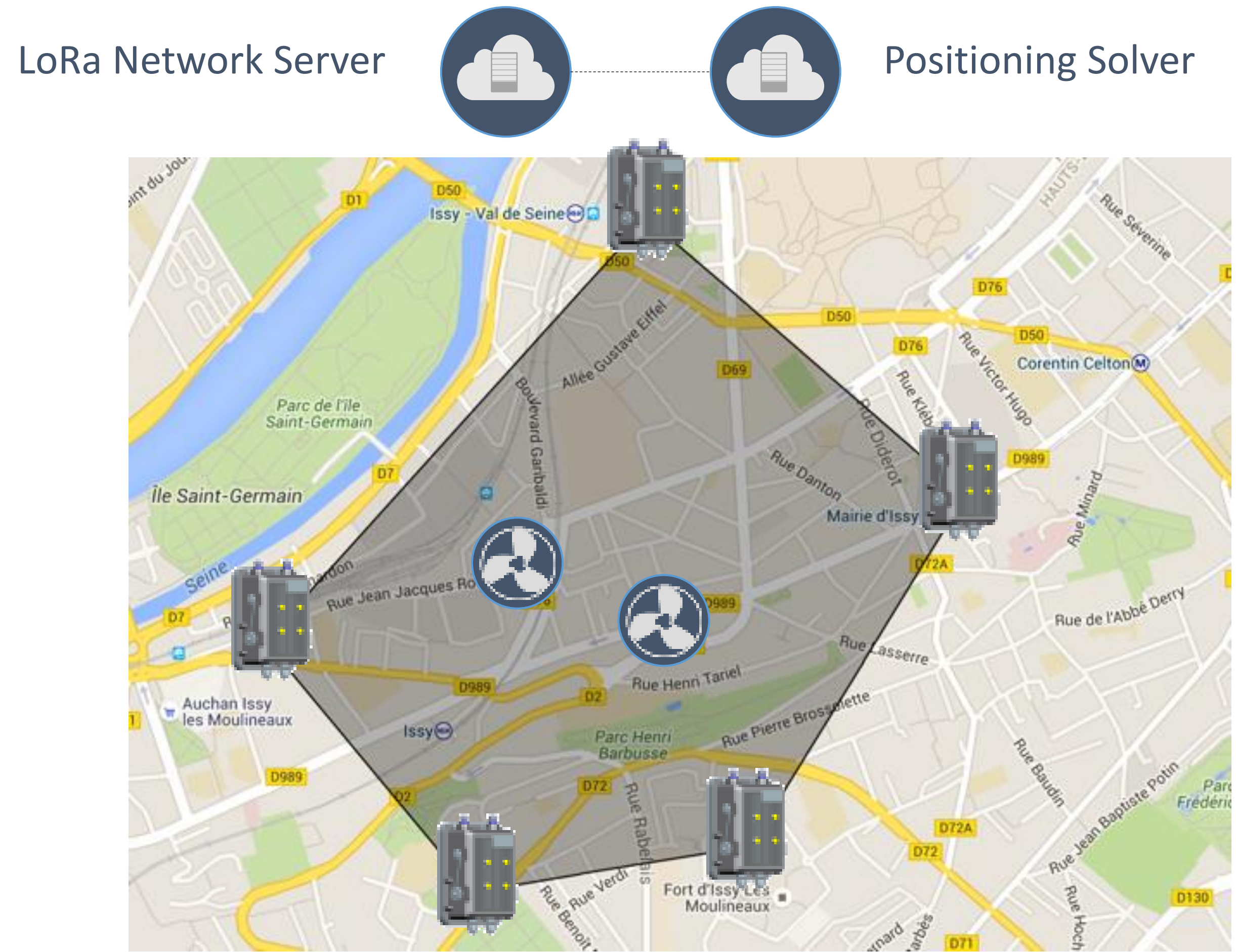
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- Cisco LoRaWAN Interface Module adds LoRaWAN Gateway services to Cisco® IoT routers
 - IR809, IR829, CGR 1000 (future)
 - Based on Semtech reference design version 2.0, ready for geo-location feature set (software upgrade in Q4 CY16)
 - Carrier and industrial grade: IP67 rating, PoE+ power, GPS, main and diversity antennas,...
- Cisco LoRaWAN Interface Module fully supports LoRaWAN 1.0.1 specifications
 - 868 MHz and 915 MHz SKUs – regional profiles through Thingpark LoRa Network Server
 - LoRaWAN devices class A, B and C
 - Full integration with Actility Thingpark LoRa Network Server
- Enables flexible topologies – one to multiple Cisco LoRaWAN Interface modules on IR800
- New Cisco IOS® Software “Virtual-LPWA” interface management and Cisco IoT FND 3.1 support
- 16 LoRaWAN Channels



- Any uplink demodulated by a gateway is time-stamped with an accuracy better than 30nsec; also adds RSSI, SNR tags.
- When an uplink is received by at least 3 gateways, the position of the transmitter can be estimated by TDOA (Time Difference of Arrival).
- No Time Of Flight measurement is required.
- Any LoRaWAN™ frame (1.0 or later) can be time-stamped, hence, located, without modification.



Creating a Community of Software Developers who Leverage Cisco Technology in Their Work

Enabling a Robust Developer Ecosystem



Engineering
Platform APIs



SDKs and
Tools



Developer
Support



Community
Management

To Build Compelling and Innovative Apps

<http://developer.cisco.com>

What's coming next

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Cisco Edge Analytics Fabric

Message Broker

IoT Database(ParStream)

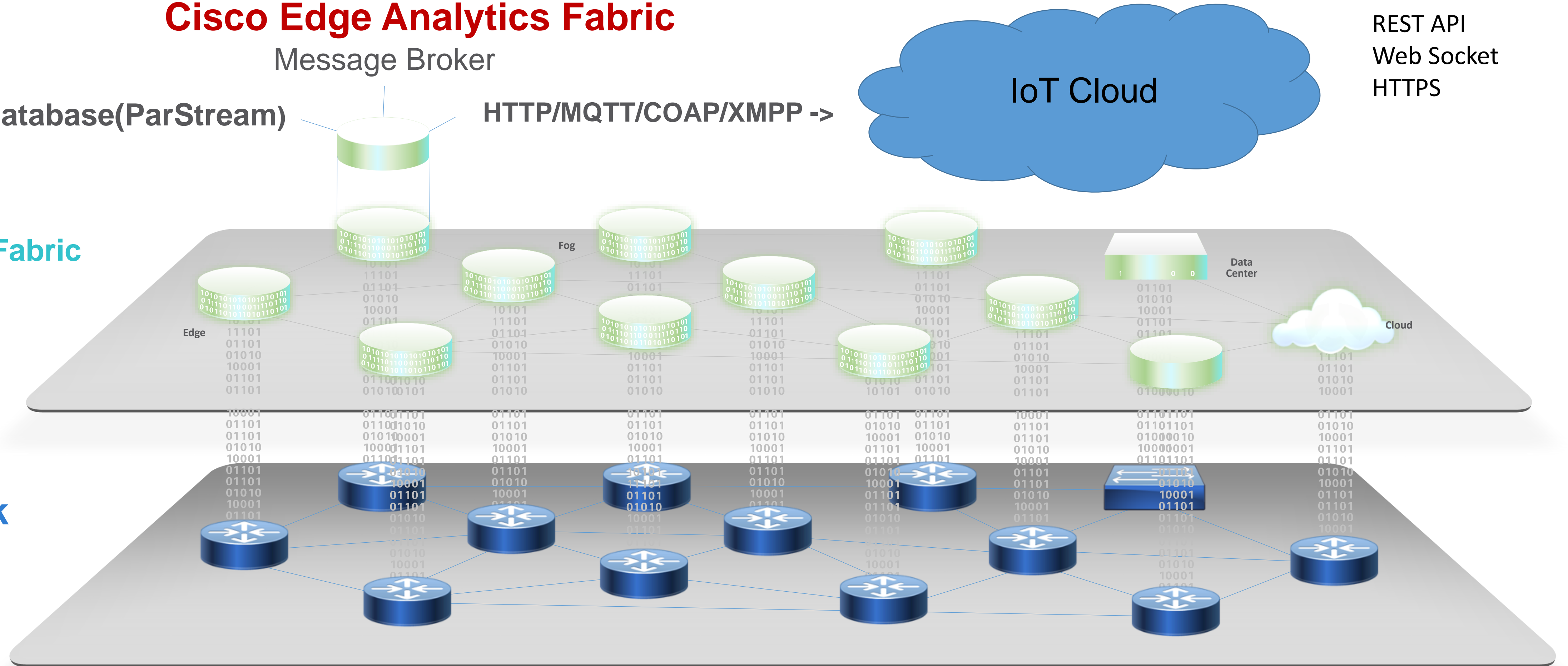
HTTP/MQTT/COAP/XMPP ->

IoT Cloud

REST API
Web Socket
HTTPS

Analytics Fabric

IP Network



- Fog Computing Model – Cisco IoX and Fog Director
- Utilities Use-Case: SCADA Visibility and Automation with Eximprod
- Energy Use-Case: Energy Efficiency with Quartz
- Other markets currently piloting: manufacturing, oil&gas
- IoT Security with ISA3000 and Cisco Stealthwatch
- LoRa = Radio IoT for Enterprise and SP
- DevNet

