

Nov-28-2018 第 31 屆 TWNIC OPM 暨第二屆 TWNOC 會議：

IOT in a 5G World

IoT Opportunities and Challenges, IoT Access Connectivity, IoT Application Connectivity, Cisco IOT Framework, IoT in Practice

錢小山

首席技術顧問

思科大中華區數據中心架構事業部

二〇一八年十一月

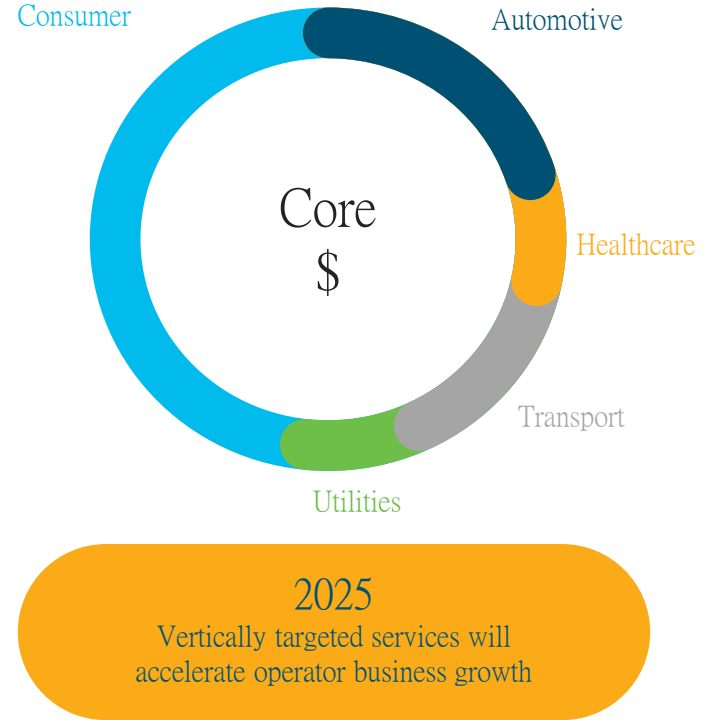
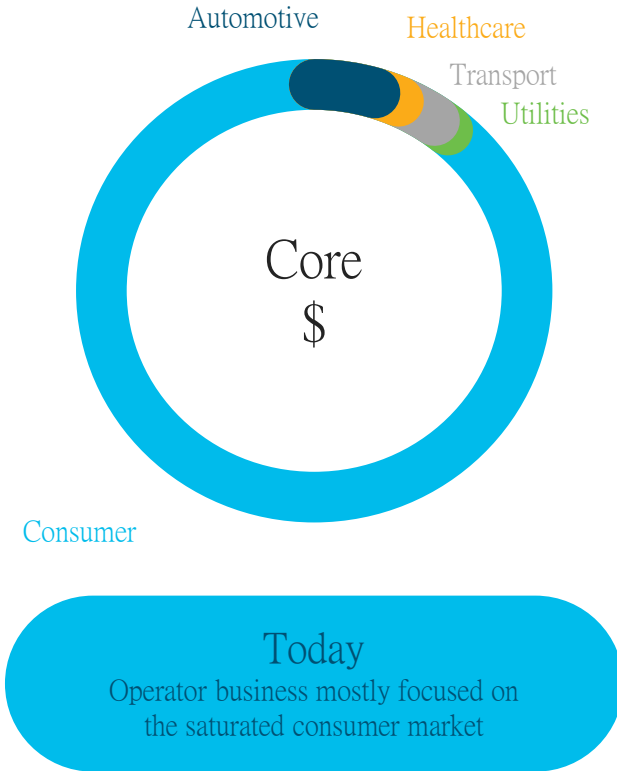


IoT Opportunities and Challenges

Nov. 2018

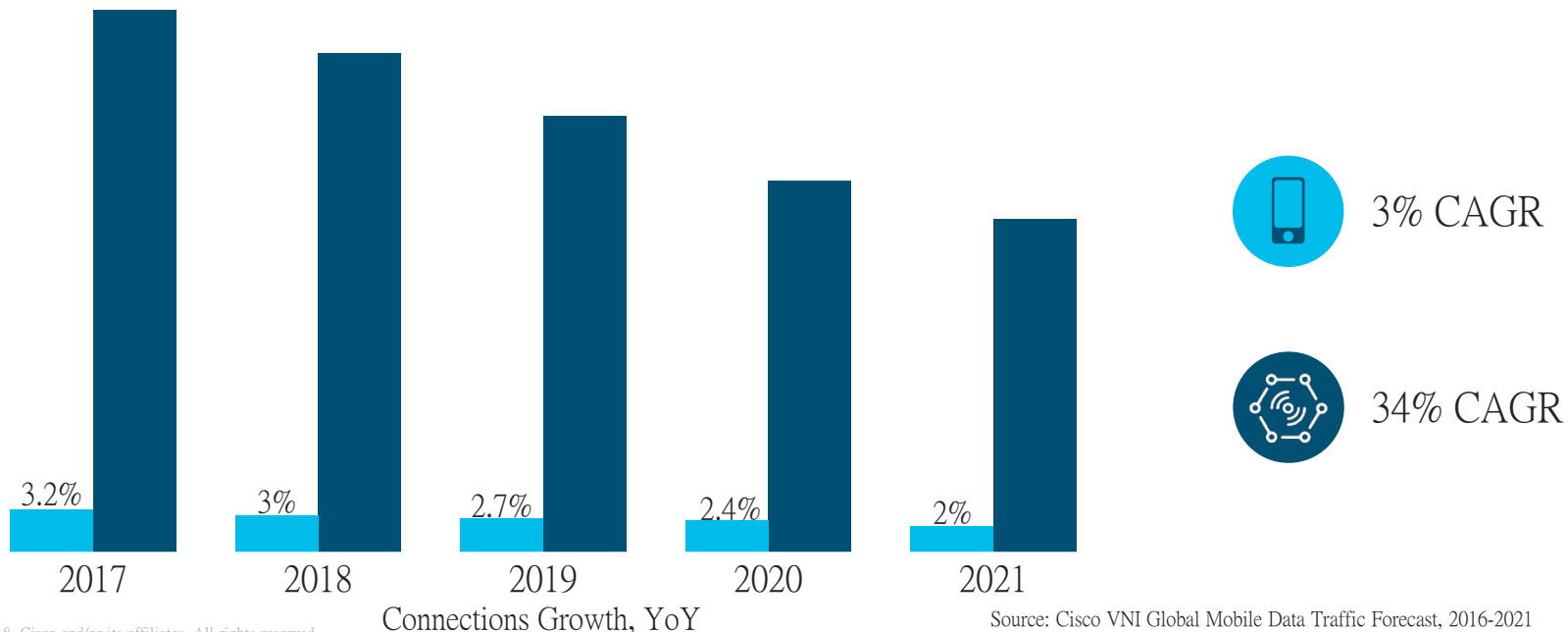


5G Revenue Growth Opportunities

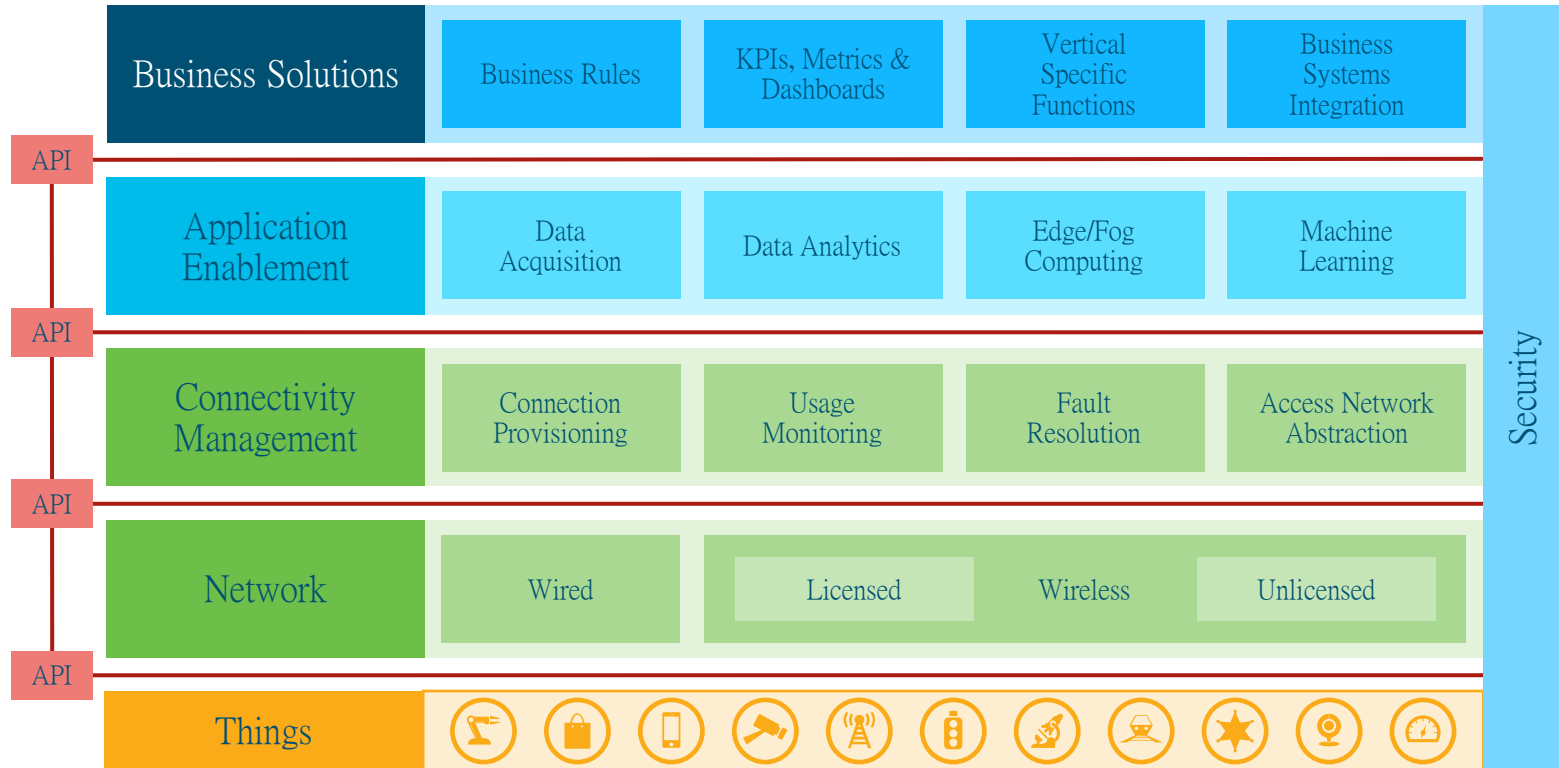


Consumer Market is Saturating Things are now Connecting

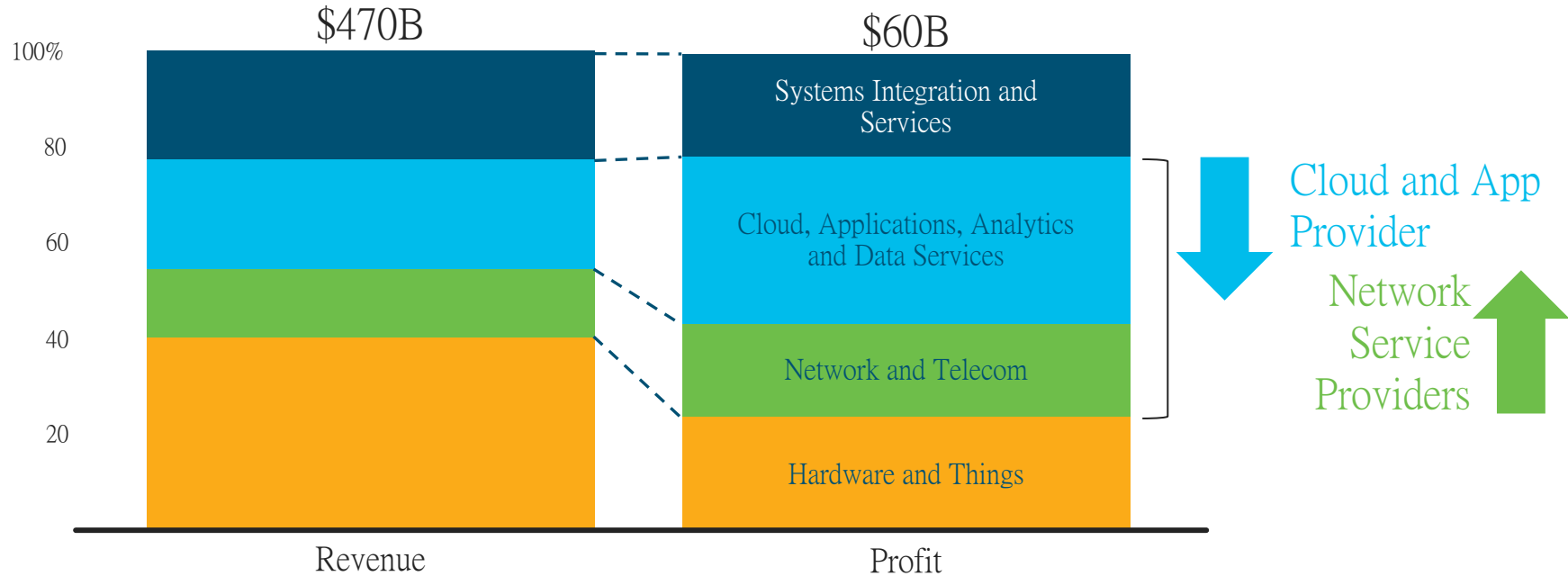
By 2021, IoT Will Account For 29% Of All Mobile Connections but 5% Of All Mobile Traffic Worldwide



An IoT Project Will Generally Have Multiple Integrated Technology Layers



What about the IoT Revenue ?



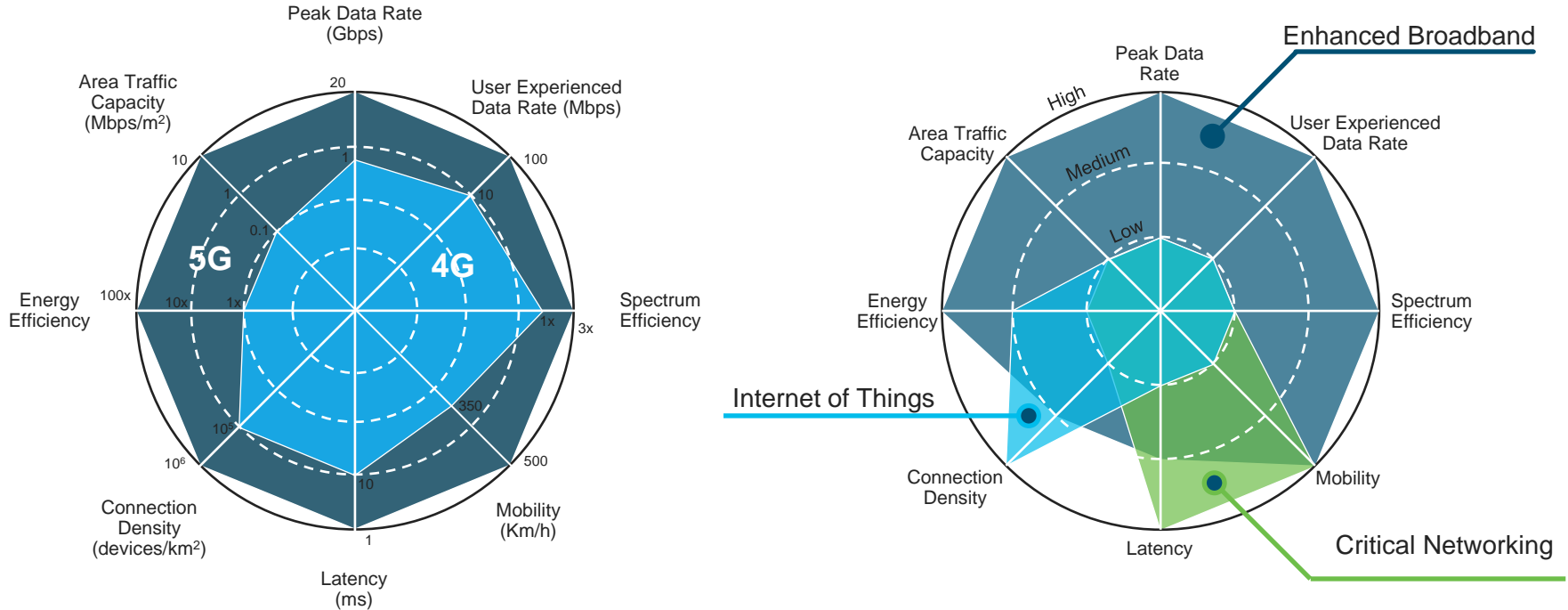


IoT Access Connectivity

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IoT is one of 5G key Use Cases








No enhanced to radio access technology planned for IOT in 3GPP R16

Many Use Cases with Many Different Requirements








Automation & Monitoring

 50 – 500kbps  High
 Fixed  10 Years








Security & Surveillance

 0.5 – 8Mbps  Low
 Fixed  Connected








Fleet Management

 100s of Kbps  Low
 10 – 150Km/h  ~3 months








Smart Cities

 50 – 500Kbps  Low
 Fixed  10 Years







Automotive / Telematics

 10s of Mbps  Low
 10 – 150Km/h  Vehicle



Wearables

 10s of Mbps  Low
 ~5Km/h  ~1 week

5G Use Case examples: V2X requirements

Use Case	V2X Mode	Latency	Reliability	Data Rate per vehicle (kbps)	Range
Cooperative Awareness	V2V/V2I	100ms-1sec	90-95%	5-96	Short to medium
Cooperative Sensing	V2V/V2I	3ms-1sec	> 95%	5-25000	Short
Autonomous Driving	V2V/V2I	<3ms-100ms	> 99%	10-5000	Short to medium
Traffic Efficiency	V2I	> 1sec	< 90%	10-2000	Long
Teleoperated Driving (Drone)	V2I	5-20ms	> 99%	> 25000	Long

Related use cases actually requiring different network capabilities

SP Wireless IoT Connectivity Options

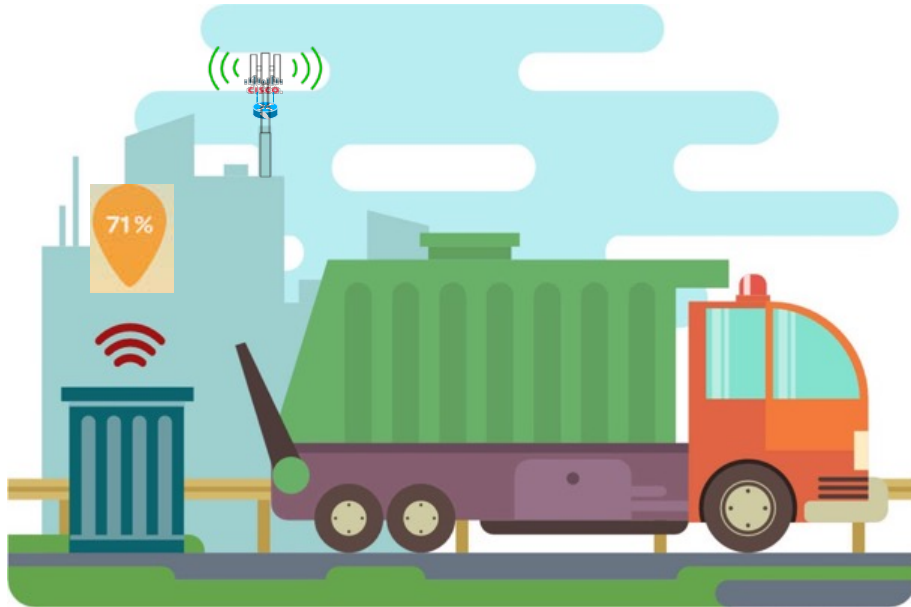
Traditional Cellular/WiFi

LPWA

Feature	2G	3G	LTE	WiFi	LTE-M (Cat M)	LPWA (LoRa)	EC-GSM	NB-IOT (Cat M2)	SIGFOX
Range	Long	Long	Long	Limited	Very Long	Long	Very Long	Very Long	Very Long
Operating Life	Hours/Day	Hours/Day	Hours/Day	Hours/Day	Days/Months	Years	Months/Years	Months/Years	Years
Spectrum	Lic.	Unlic.	Lic.	Unlic.	Lic.	Unlic.	Lic.	Lic.	Unlic.
Throughput	384kbps	40Mbps	100Mbps+	300Mbps	10Mbps	300-50kbps	<140kbps	<170kbps (DL) <250kbps (UL)	100-600bps
Module Cost (est.)	\$8-10	\$35-\$50	\$40-\$80	\$5-\$8	NC	\$5	NC	\$10-15	NC
Use Case Example	ATM	ATM	Connected Cars	Industrial	Alarm System	Metering Tracking	N/A	Smart parking Metering	Tracking
SP Offering	All	All	All	Variable	ATT, Verizon, Telus, Orange, KDDI, etc.	Orange, Swisscom, Proximus, Comcast	None	Vodafone, DT, KT	Telefonica, SFR

LPWA example

Waste management



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Key challenge :

Optimize the waste management operations

Solution :

- LoRaWAN technology enabled waste containers that monitor the filling level of the container

Key benefits :

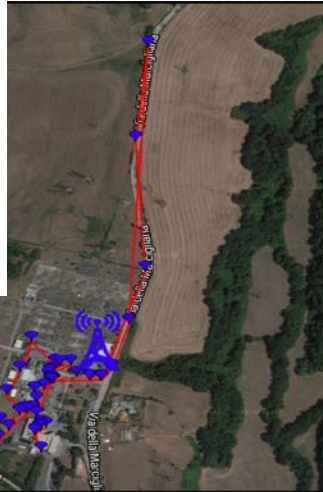
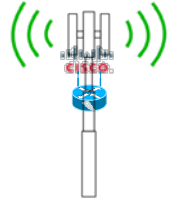
- Real-time location and monitoring of waste containers
- Containers are emptied only if detected as full
- Waste vehicle operations are adapted and directed in real-time towards 100% full waste containers

Device partners :



enevo

LPWA example: Anti-theft solution



Key challenge :

Track & monitor cable drums to avoid copper thefts

Solution :

- LoRaWAN technology enabled GPS trackers embedded in cable drums

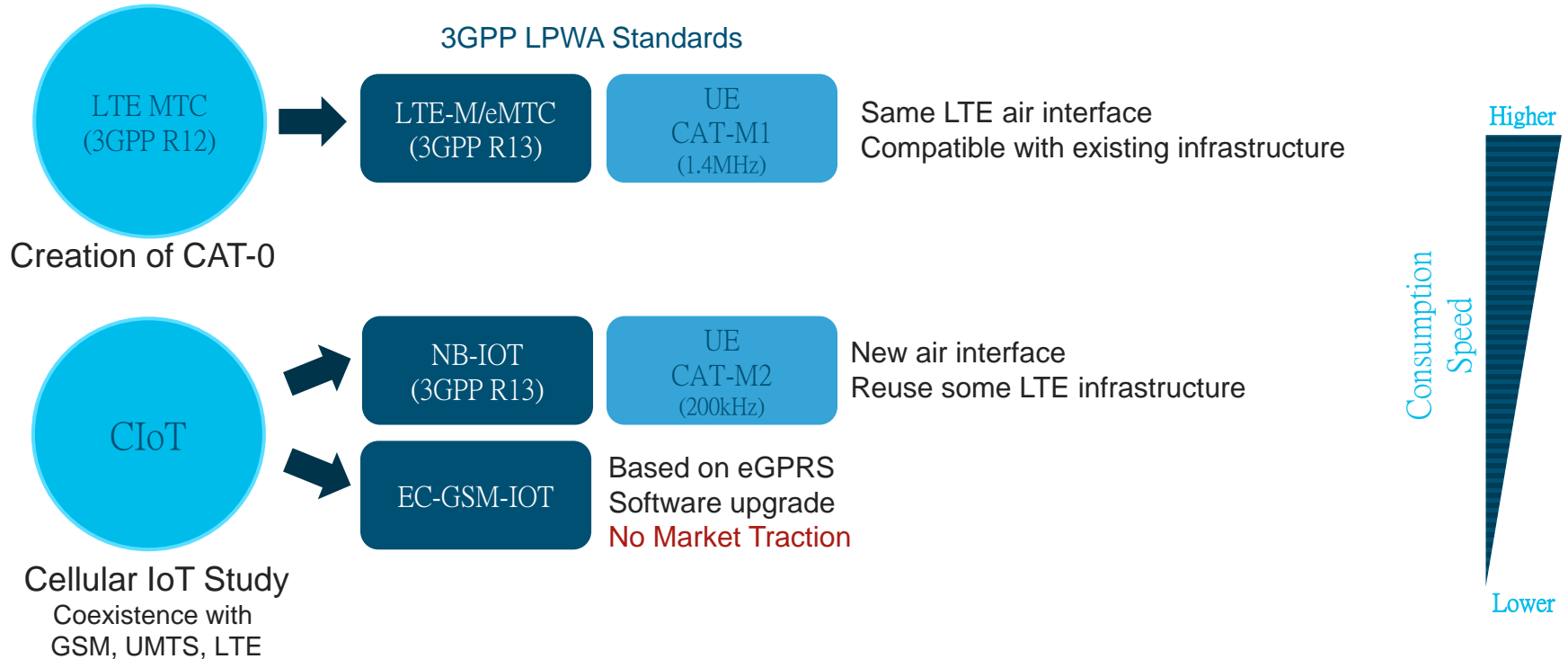
Key benefits :

- Long distance coverage up to 15 km without local gateways
- GPS low power consumption
- Utility dedicated tools to manage, operate and visualize data
- Geofencing
- Alerts in case of theft
- Ability to track the drums
- Easy to interface with application developers

Device partners :

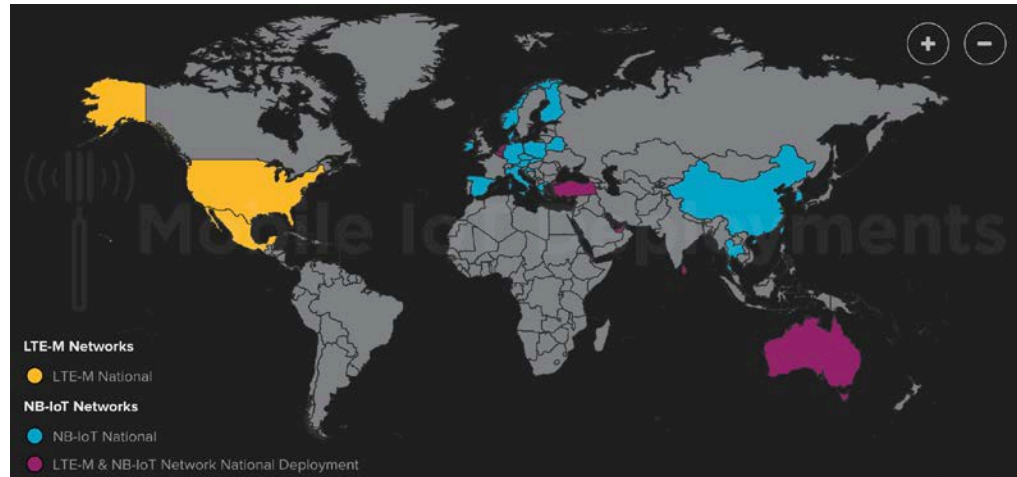


3GPP Standards – IOT on Licensed Spectrum



Cellular IOT Adoption

- Large LTE-M adoption
 - Ease of upgrade and compatibility with existing radio planning
 - Complementary with other LPWA
 - Expands existing M2M based on 2G
- Slower NB-IOT Adoption
 - Device availability
 - Interoperability
 - Impact on network (radio and core)




LoRa and NB-IOT networks will co-exist

Cases Where NB-IoT is Preferred to LoRa

- High accuracy and QoS required, even at higher costs (licensed spectrum)
- Country-wide network needed for real time data (e.g. Location tracking across states based on GPS)
- High density areas with noise interference and a 4G cellular network available
- Consumer applications in home and health as SPs have strong GTM coverage
- Electricity available (Otherwise limited battery life limits duration of usage)

SP announced dual technology Strategy

- Orange
- BT

 LoRa relevant use case

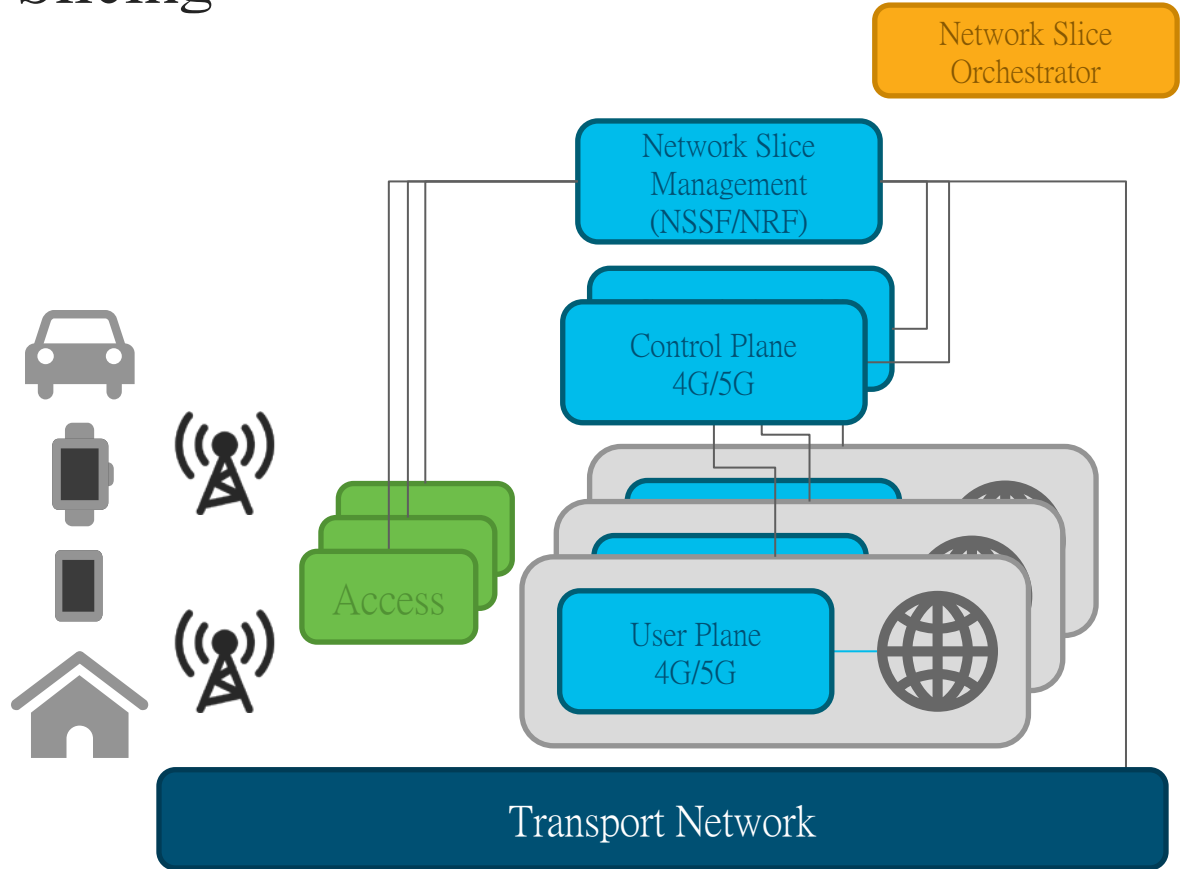
 NB-IoT relevant use case



Network Slicing is fundamentally an end-to-end **partitioning of the network resources and network functions** so that selected applications/services/connections may **run in isolation** from each other **for a specific business purpose**

4G and 5G Network Slicing

- Separate business purposes
 - Unique service assurance characteristics
 - Alternate policy and charging structure
 - Increased service security
 - Slice allocation through device identity
- Slice selection mechanisms
 - APN
 - PLMN Id (MOCN)
 - DECOR/eDECOR
 - NSSF/NRF (5G)





IoT Application Connectivity

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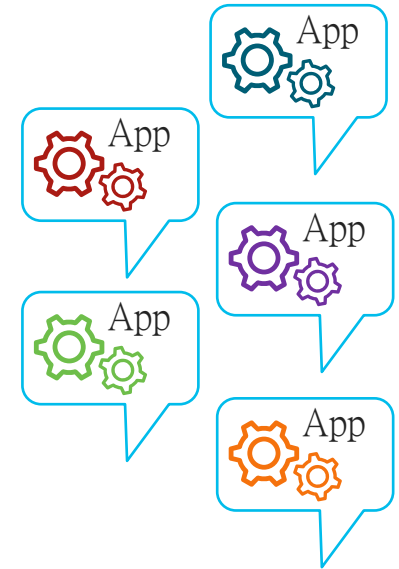
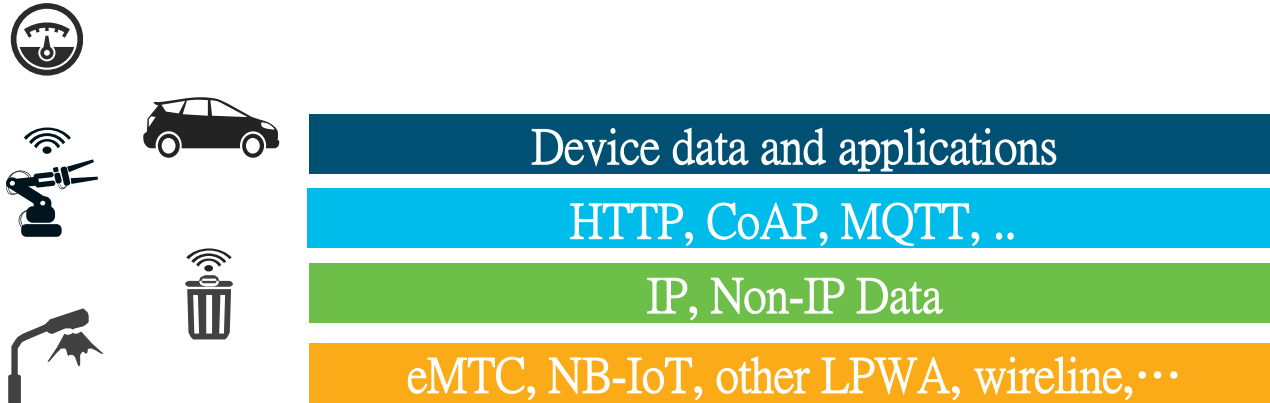
What are APIs

What are APIs

APIs transfer data as an interface



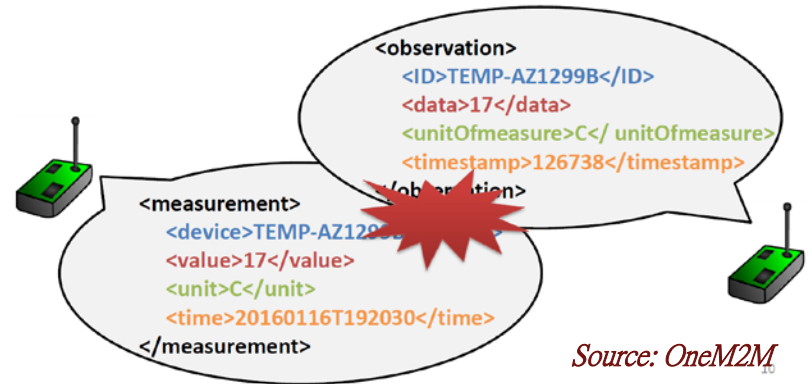
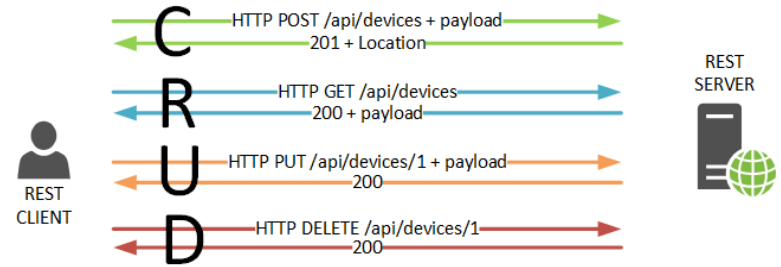
Moving Up The IoT Stack



- Many protocols and standards to choose
- How to enable and manage communication between IoT devices and apps?

Service API and Data Modeling for IoT

- REST API to manage device data
- Stateless interfaces
- No need of many functions : just read/write/change/delete
- A common vocabulary is required to define IoT data and concepts
- Need a data model and semantics to represent device data
- Built-in Security

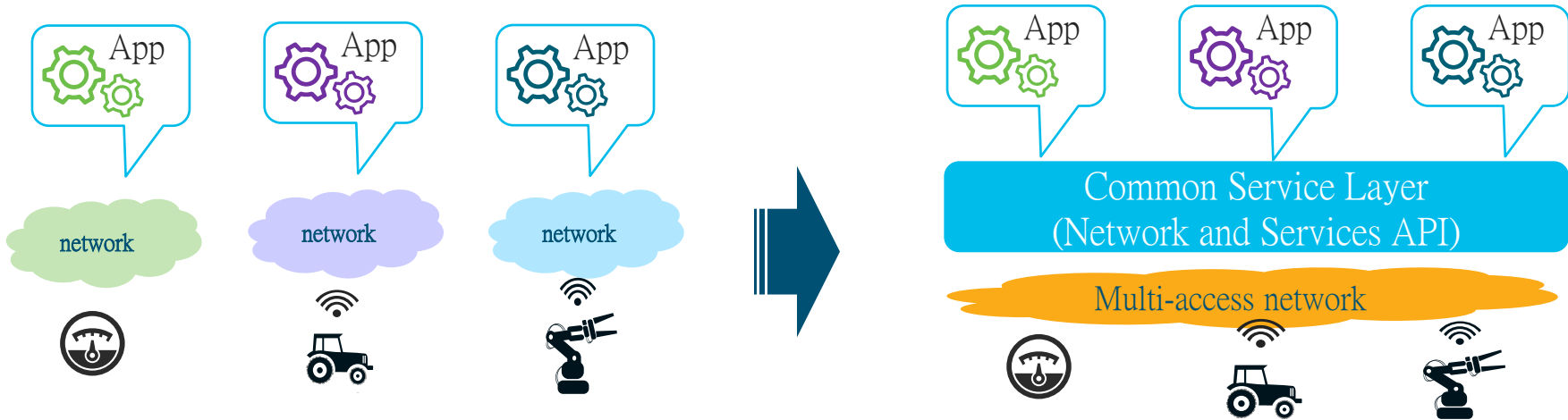


Source: OneM2M₁₀

APIs as Value Creation Elements

SECURITY	Network Monitoring and Anomaly Detection
IDENTITY	Identity Federation (e.g. with local enterprise systems)
REAL TIME EXPERIENCE	Radio Network Information APIs/ Multi-Domain SON
QUALITY OF SERVICE	Exposing Access QoS Information, delay and bandwidth experience
CONTEXT	Exposing context information, including geo-location
APPLICATION	Enabling complex business logic (e.g. triggering a notification after another events)

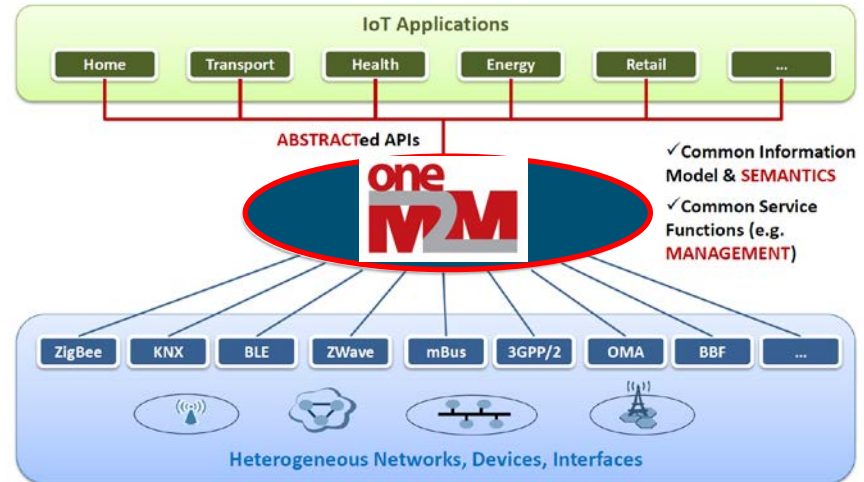
From IoT Verticals to Horizontal Platform



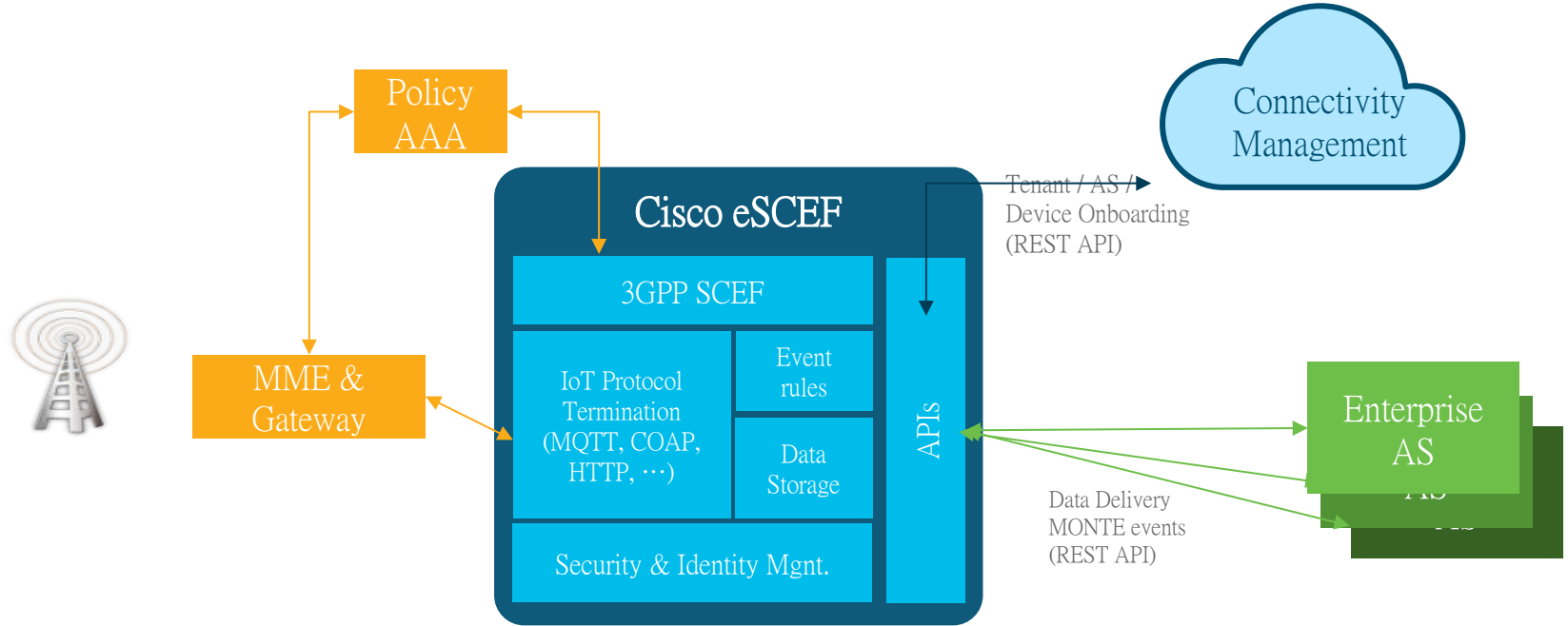
- Many “vertical” IoT deployments today each of which with their own requirements and protocols/APIs
- Requirement to harmonize to enable easier deployment of IoT services in a cost efficient way
- Exposing open Network and Services API

OneM2M

- Partnership project for a common IoT Service Layer
 - www.onem2m.org 200+ members including SPs, vendors and other standard forums
 - Enables a horizontal platform to exchange data among devices and applications
 - URI identification
 - Network independent
 - REST approach
 - Application portability
 - Device management
 - Subscription Management
 - Accounting and charging
 - HTTP/COAP/MQTT/LWM2M

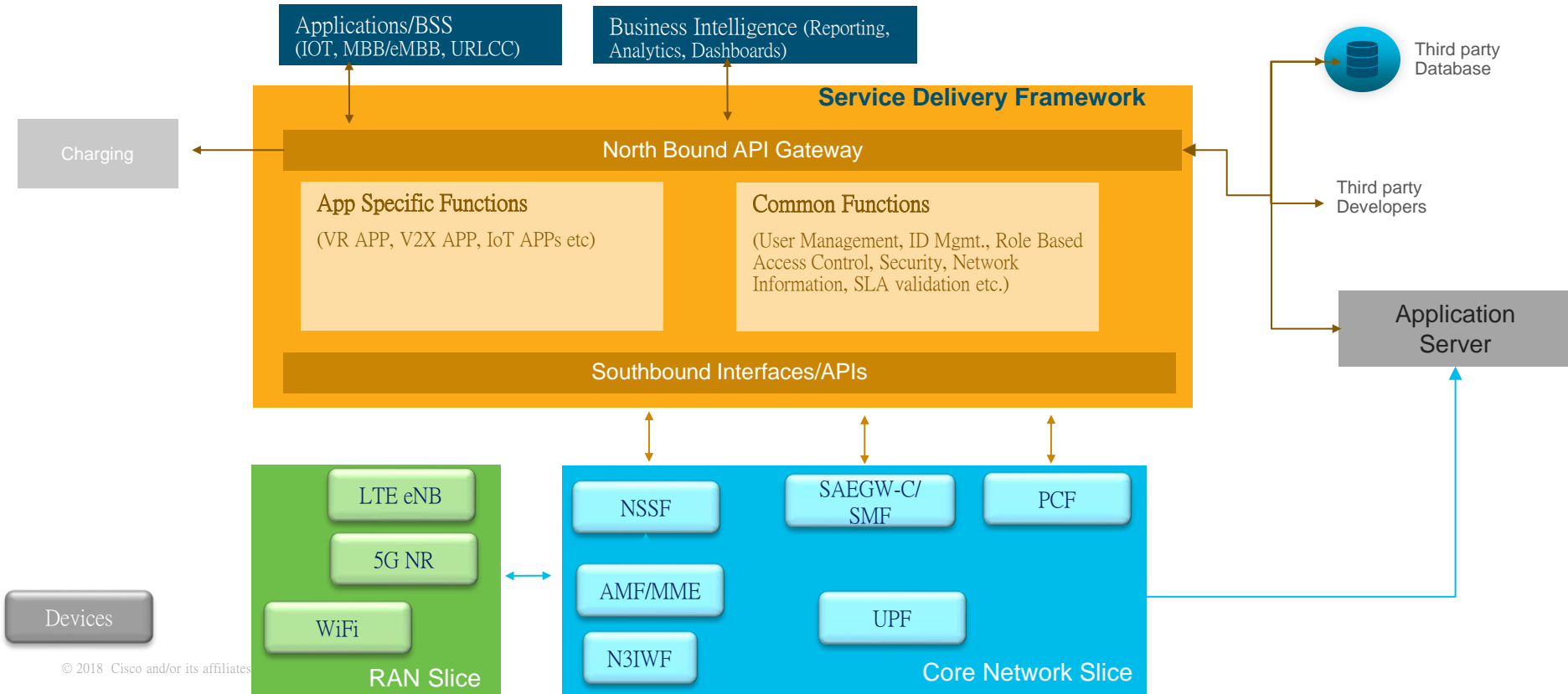


Cisco eSCEF – a Mobile IOT API Enabler

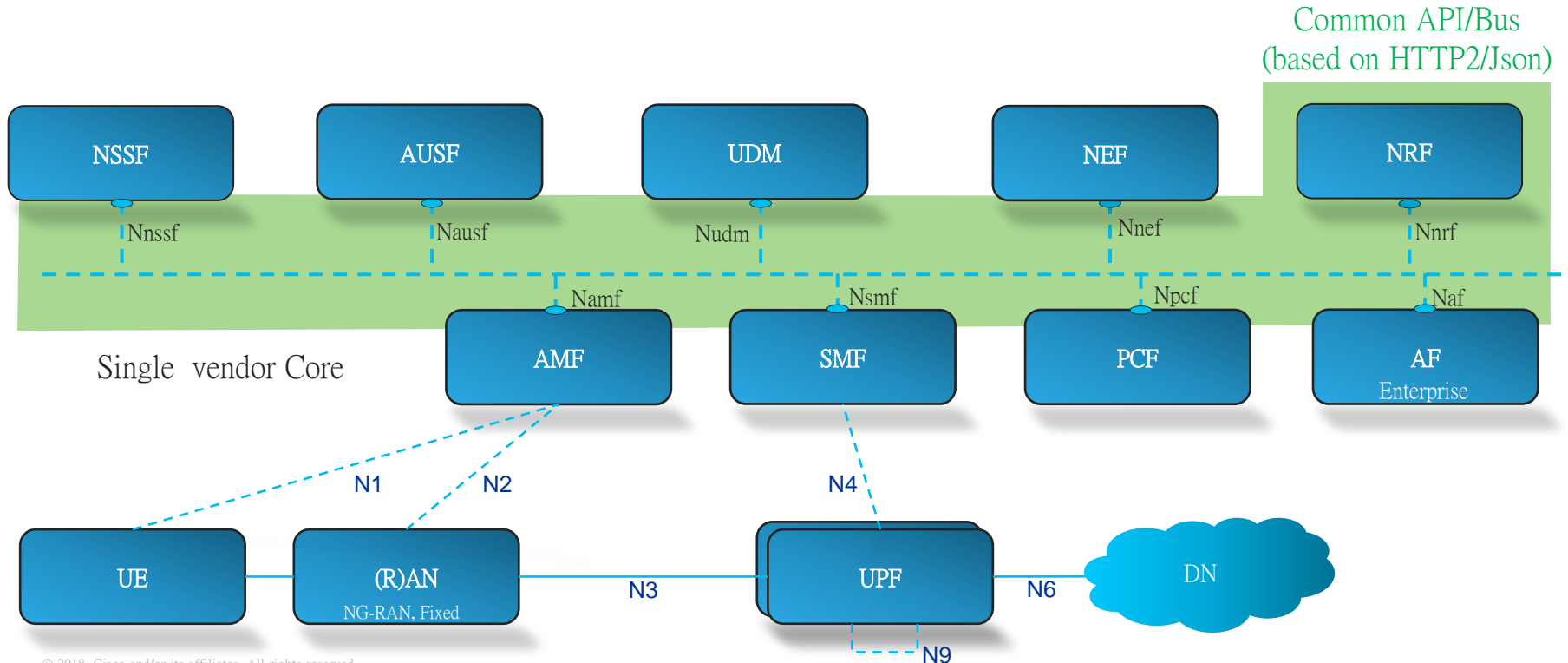


1. Terminating IOT protocol and exposing data through API
2. On-boarding Device/Application/Tenant
3. Monitoring UE events in 3GPP network and make it available to authorized external world
4. Session with on-demand QoS
5. Non IP Data Delivery

Towards a Service Delivery Framework

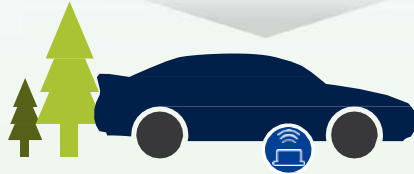


Cisco 5G Service-Based Architecture



What Do Your Customers Want from IoT?

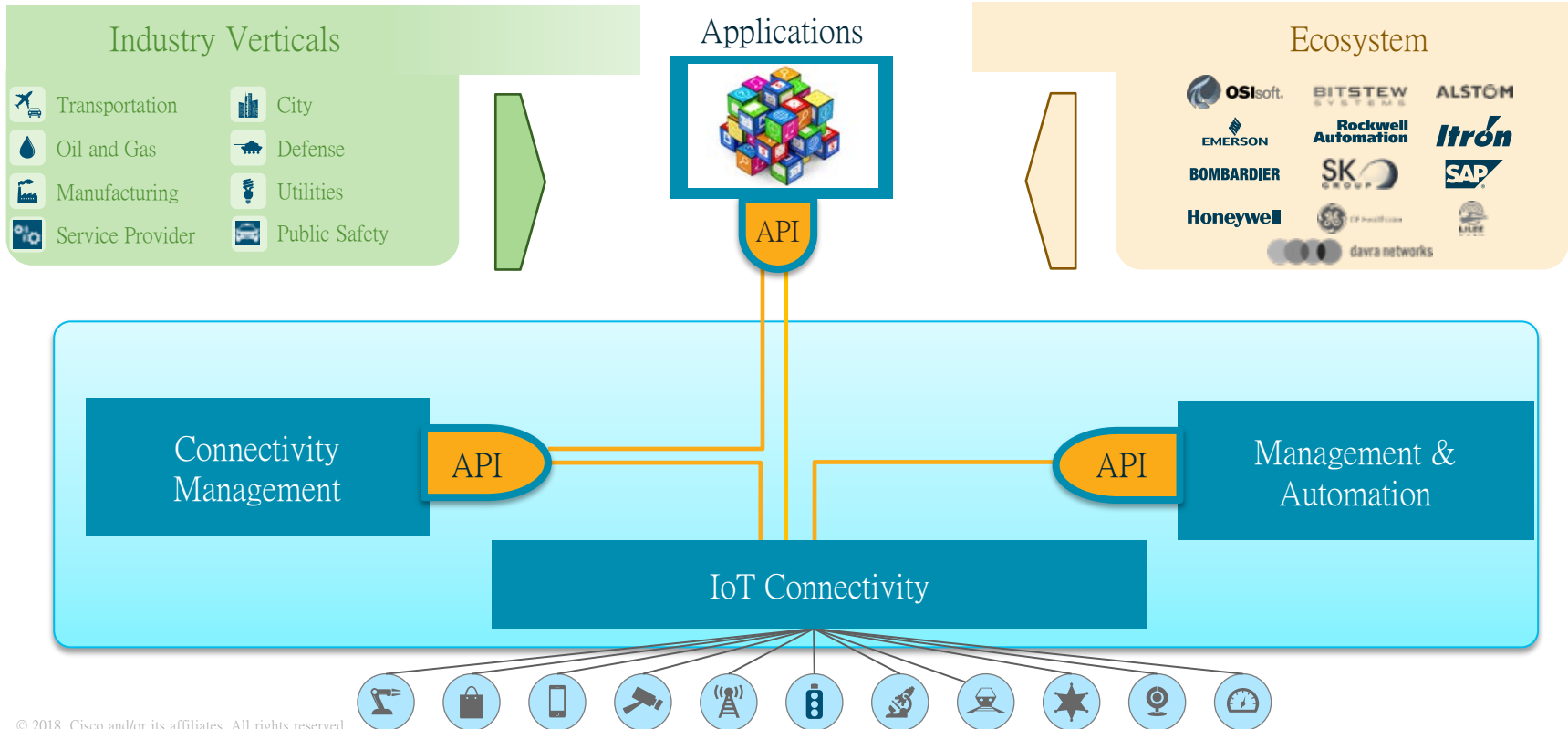
Real-time Communication



Enhanced Customer Experience



IoT Framework





Cisco IOT Framework

Nov. 2018



5G Opportunities - Enabling Digital Transformation

Business Opportunities

AR/VR Collaboration



Smart Cities



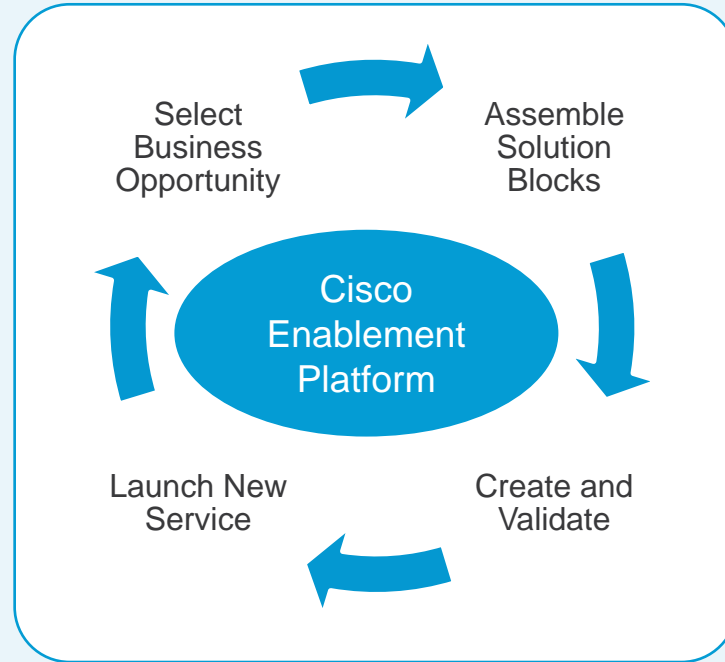
Connected Car



Mobile Gaming



Consumer Video



Services Building Blocks



Edge Computing



Low Latency



Connection Density



Massive Capacity



Network Slicing

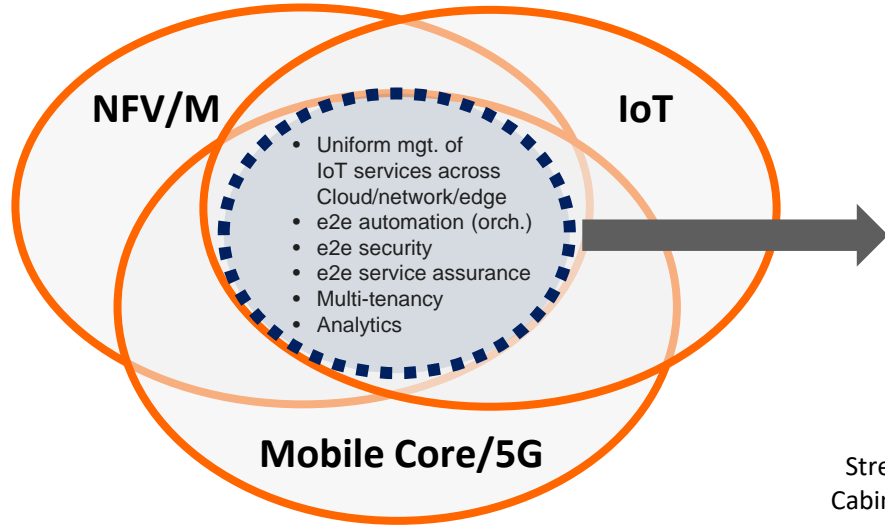


High Reliability

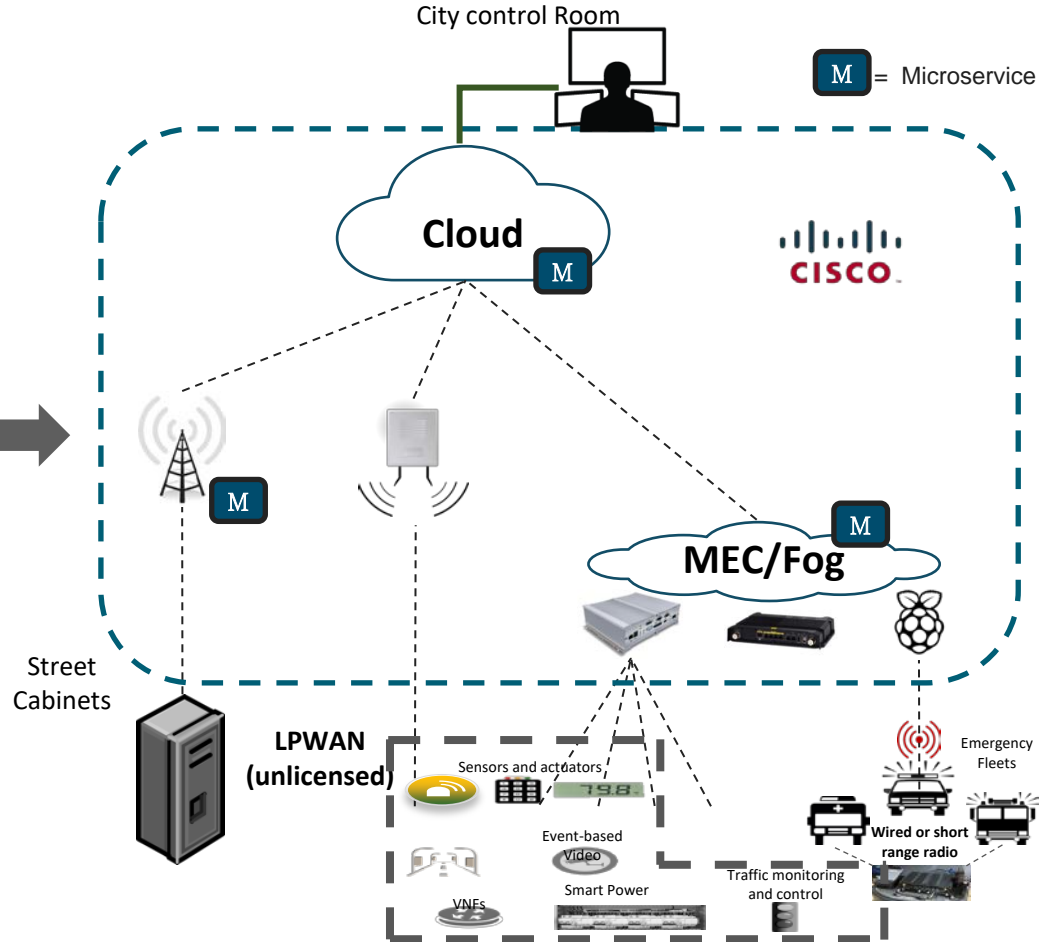


High Data Rate

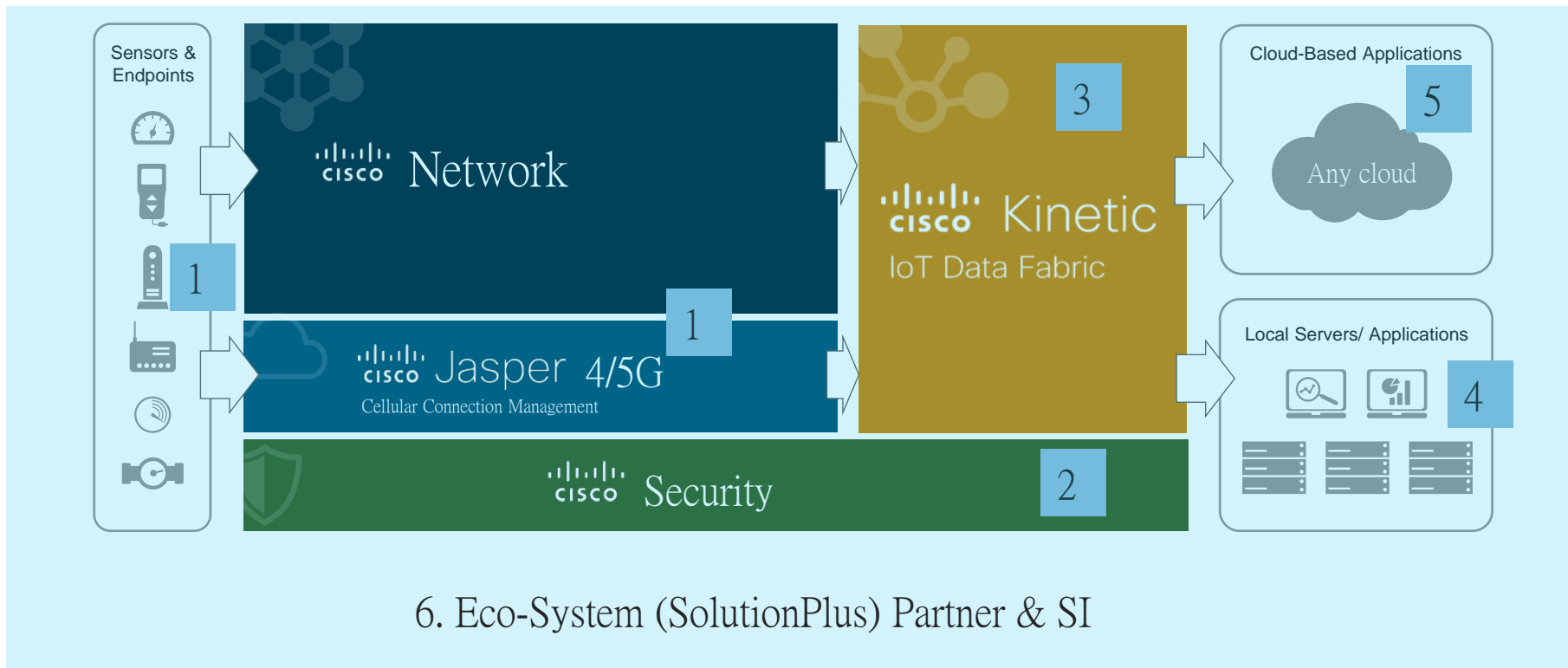
Cloud Service Model



**Same Core Components
(kill 3 birds w/1 stone)**

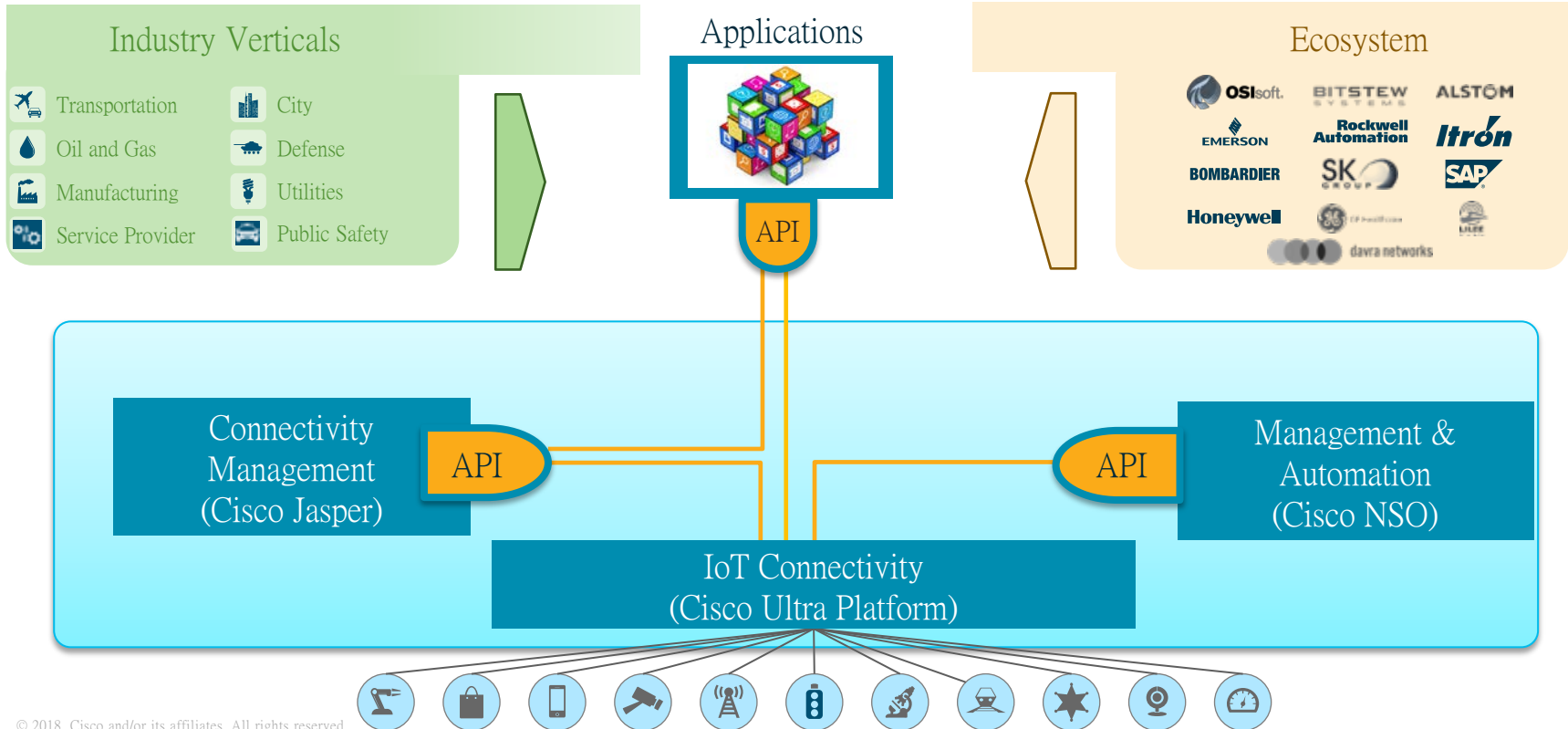


數位化的旅程與思科的定位



6. Eco-System (SolutionPlus) Partner & SI

Cisco IoT Framework



Cisco IOT Wireless Technology

WLAN

Short Range, <300 m
Unlicensed, Up to 1Gbps



- IEEE, Wi-Fi Alliance
- Use cases
 - Video surveillance
 - Manufacturing, Oil&Gas, etc.

FAN

Medium Range, <1km
Unlicensed, Up to 400kbps



- Wi-SUN, WirelessHART, ZigBee Alliance
- Use cases
 - Utility – AMI, Substation, Street Lighting, etc.
 - Industrial automation

Cellular

Long Range, > 10km
Licensed, Up to 100kbps



- 3GPP
- Use cases
 - Video surveillance, digital signage, ATM, fleet, asset vision, etc.

LPWA

Long Range, > 10km
Unlicensed, Up to 10kbps



- LoRa alliance, SigFox, 3GPP
- Use cases
 - Water/gas/heat metering, parking, pollution/environment monitoring, waste mgmt, etc.

- AW3700: 802.11ac Industrial AP

- CGR-1K: RF Mesh
- AP1552: WirelessHART

4G LTE Gateways

- IR 809/807
- IR 829

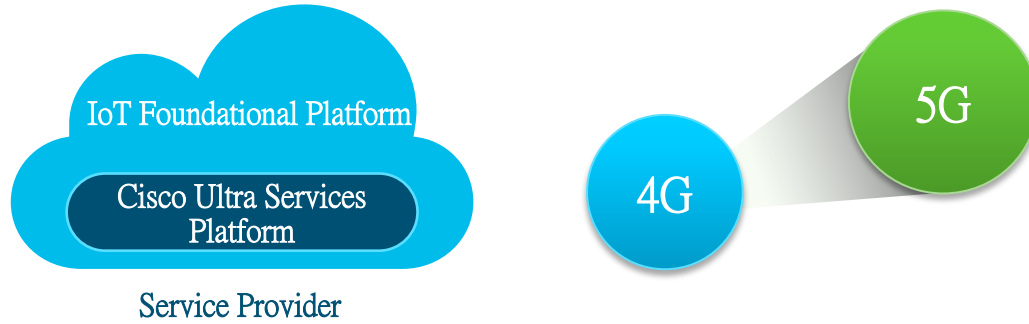
Mobile Core w/ enh.

Cisco LoRa Solution

- IR 809/829 with LoRa IXM
- Standalone LoRa IXM

Cisco Ultra Gateway

SP Opportunity in IoT: Cisco Ultra IoT



3G, LTE

NB-IoT

LTE-M

Cisco Ultra Services Platform

Scale | Distributed Architecture | Slicing

Low Latency | Gig-Speed

CSGN

eSCEF

Cisco Ultra IoT



- Terminates multiple access types
- Uniform identity, authentication, security



- Expose network capabilities and resources to applications for revenue
- Standard APIs unify access to IP and non-IP device data, easing app dev
- Roadmap for 5G IoT use cases

Cisco Ultra Services Platform

VNF Element Manager, VNFM Proxy,
Service Manager, Monitoring

Ultra Policy Platform

- Carrier-grade policy, charging, and subscriber data management solution
- Rapid service creation environment
- Multiple functions (PCRF, DRA, MOG, ANDSF, eSCEF)

Ultra Gateway Platform

- Cloud-ready VNF, fully featured packet core
- Multiple functions (EPC, ePDG, SaMOG, CSGN)
- Based on StarOS Software
- Remotely deployable user plane for ultimate elasticity and scalability

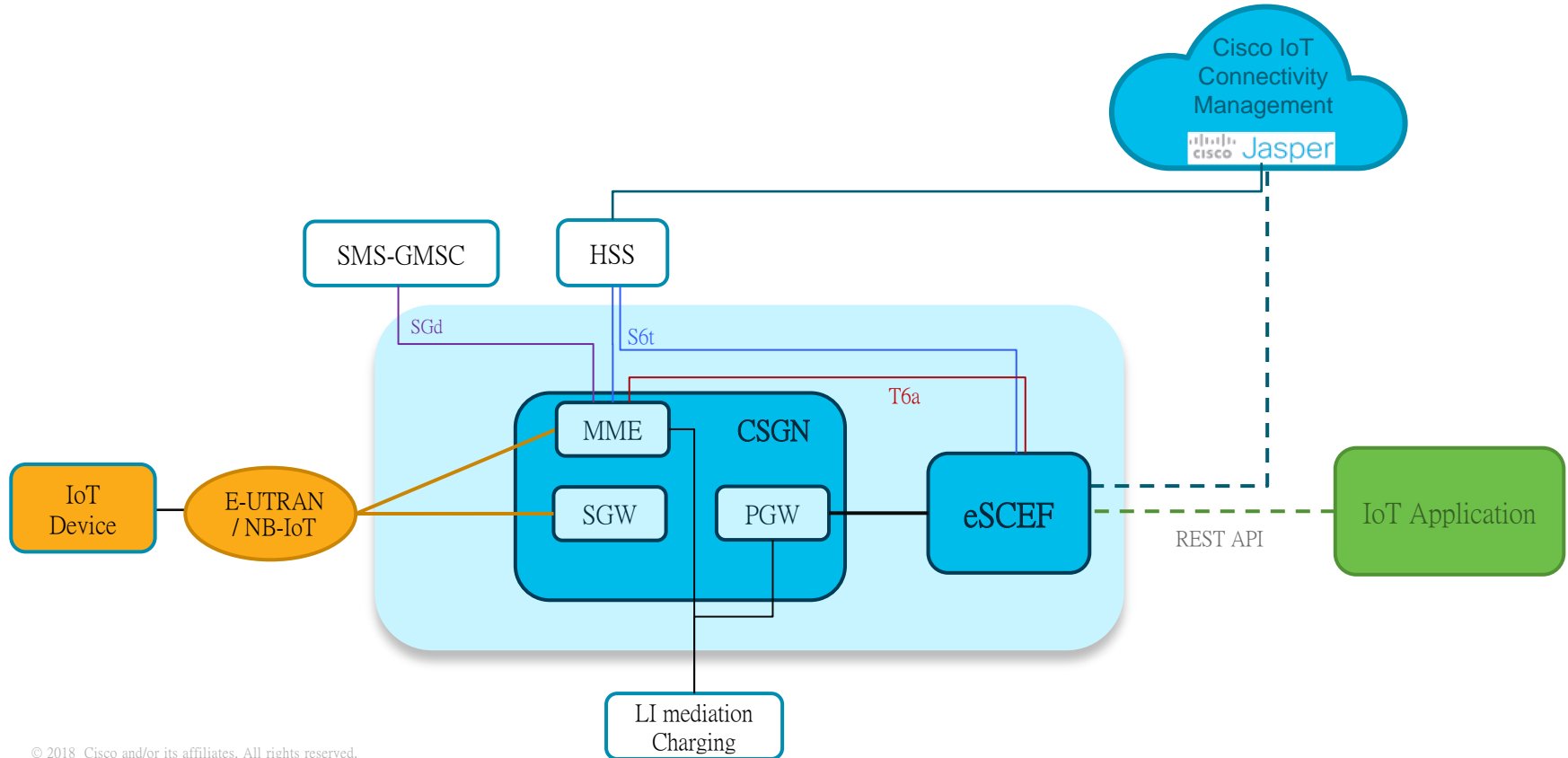
NFVI (Openstack or VMWare)
(e.g. Cisco DC infrastructure)

NFV-O
Cisco NSO

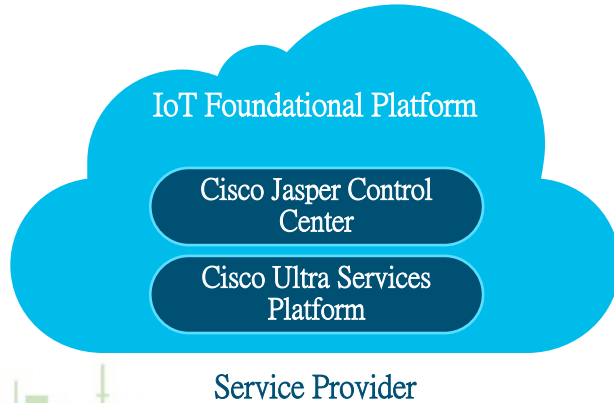
VNFM
Cisco ESC

VIM
Openstack

Cisco 3GPP IoT Architecture



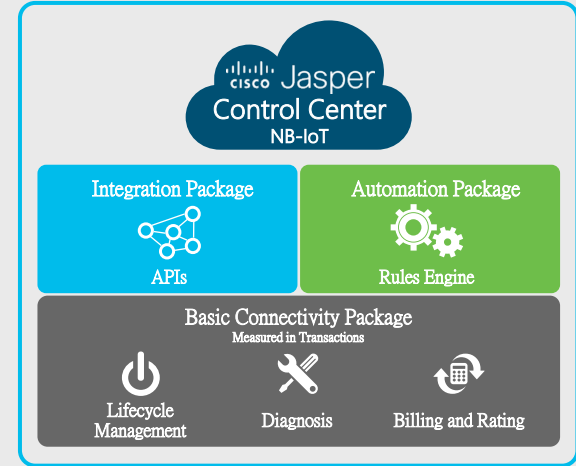
SP Opportunity in IoT: Cisco Jasper Control Center



3G, LTE

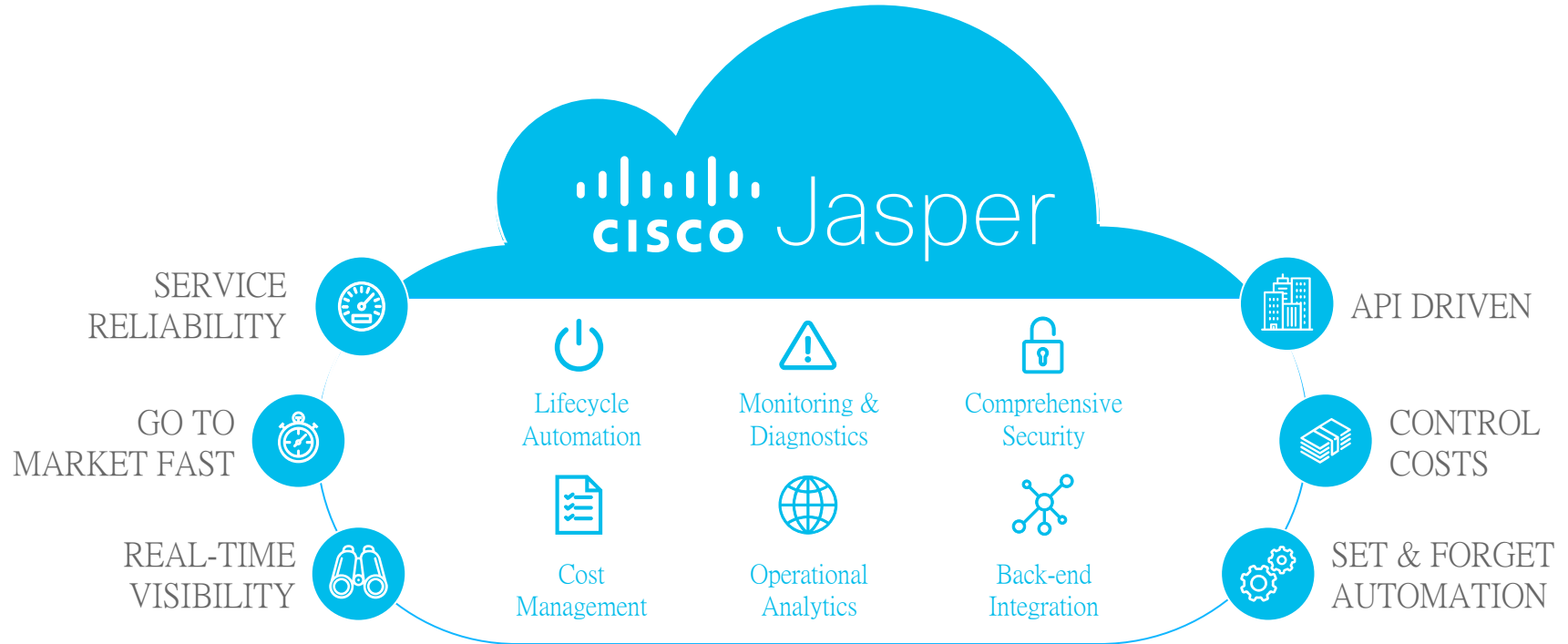
NB-IoT

LTE-M

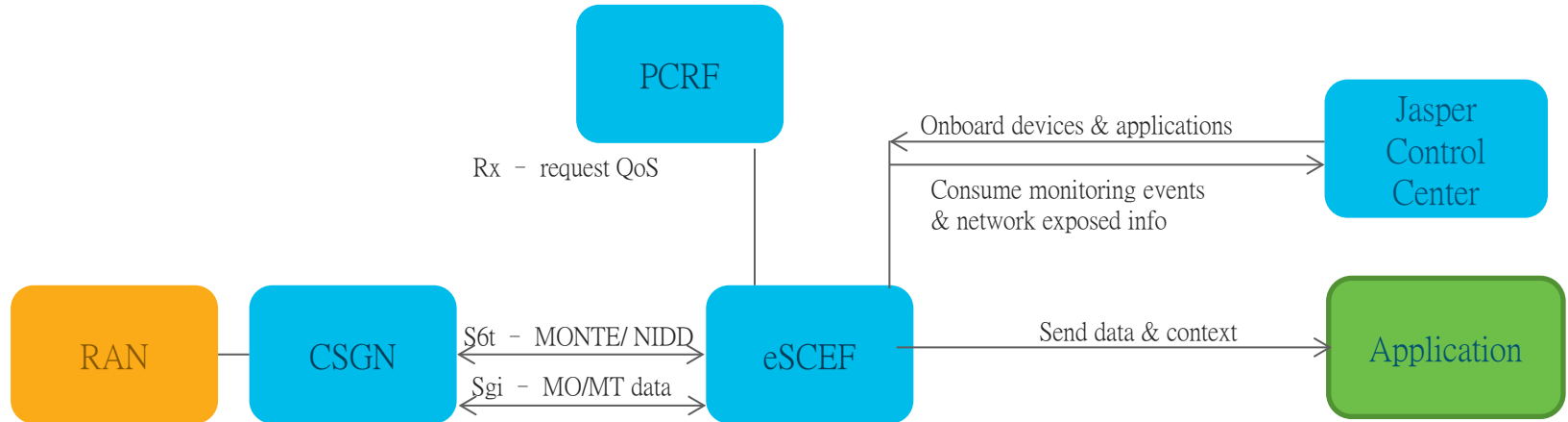


- ✓ • Tiered pricing for value delivered
- ✓ • Unified platform for cellular and NB-IoT
- ✓ • Automation for massive scale and profitability

Cisco Jasper Platform for IoT Connectivity Management



Creating Value with Cisco IoT Solutions

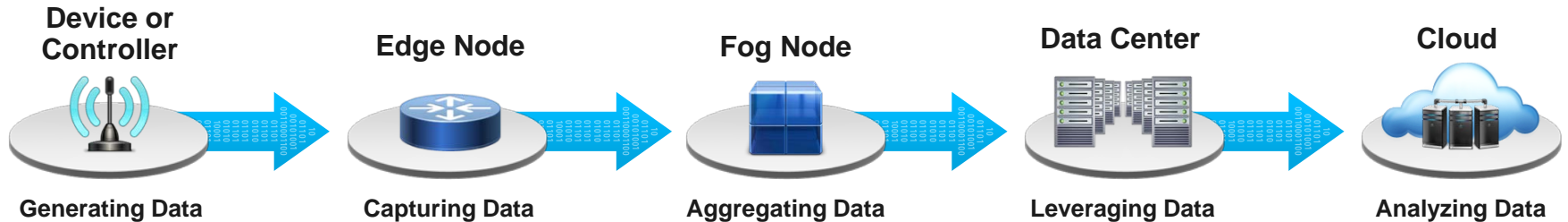
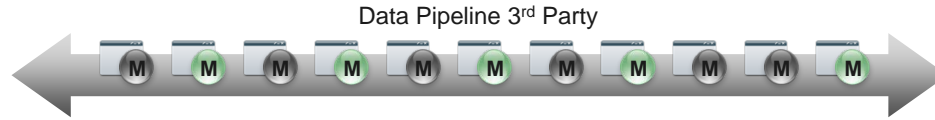


- Jasper Control Center integrates via RESTful APIs
 - Onboarding (Create Enterprise, customize profile, add Apps and Devices)
 - Event subscription/delivery (Monte, others)
 - Request Network Resources - QoS, Policies, (pass-through from AS)

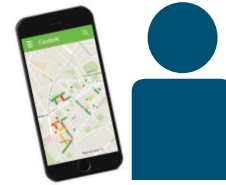
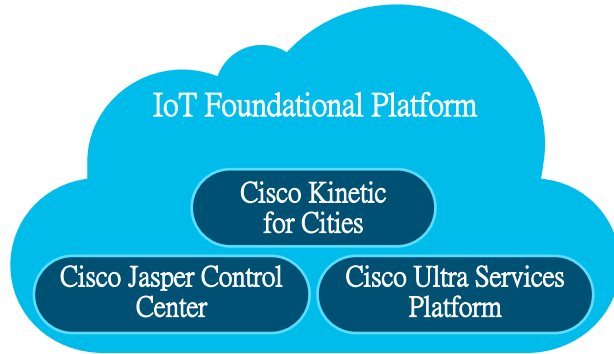
Cisco Kinetic



Microservices
(Develop or Buy)



SP Opportunity in IoT: Cisco Kinetic for Cities



Service Provider

3G, LTE

NB-IoT

CAT-M1



Data from any device



Cross-domain information



Open ecosystem



Easy for customers to adopt & deploy



- Repeatable, pre-packaged connectors/ templates
- Deployed in cities around the world

Easy to sell



- Bundles/Starter solutions
- Certified partners

New revenue through new buying centers



- Sell the network
- Sell the Kinetic for Cities platform and solutions

Cisco Kinetic for Cities

Citizen Engagement App
Parking Enforcement App



Citizen
Applications



Urban Services
Applications

Operations Center
City Dashboard

Cisco Kinetic for Cities

Lighting
Cloud

Parking Cloud

Safety and
Security Cloud

Waste Cloud

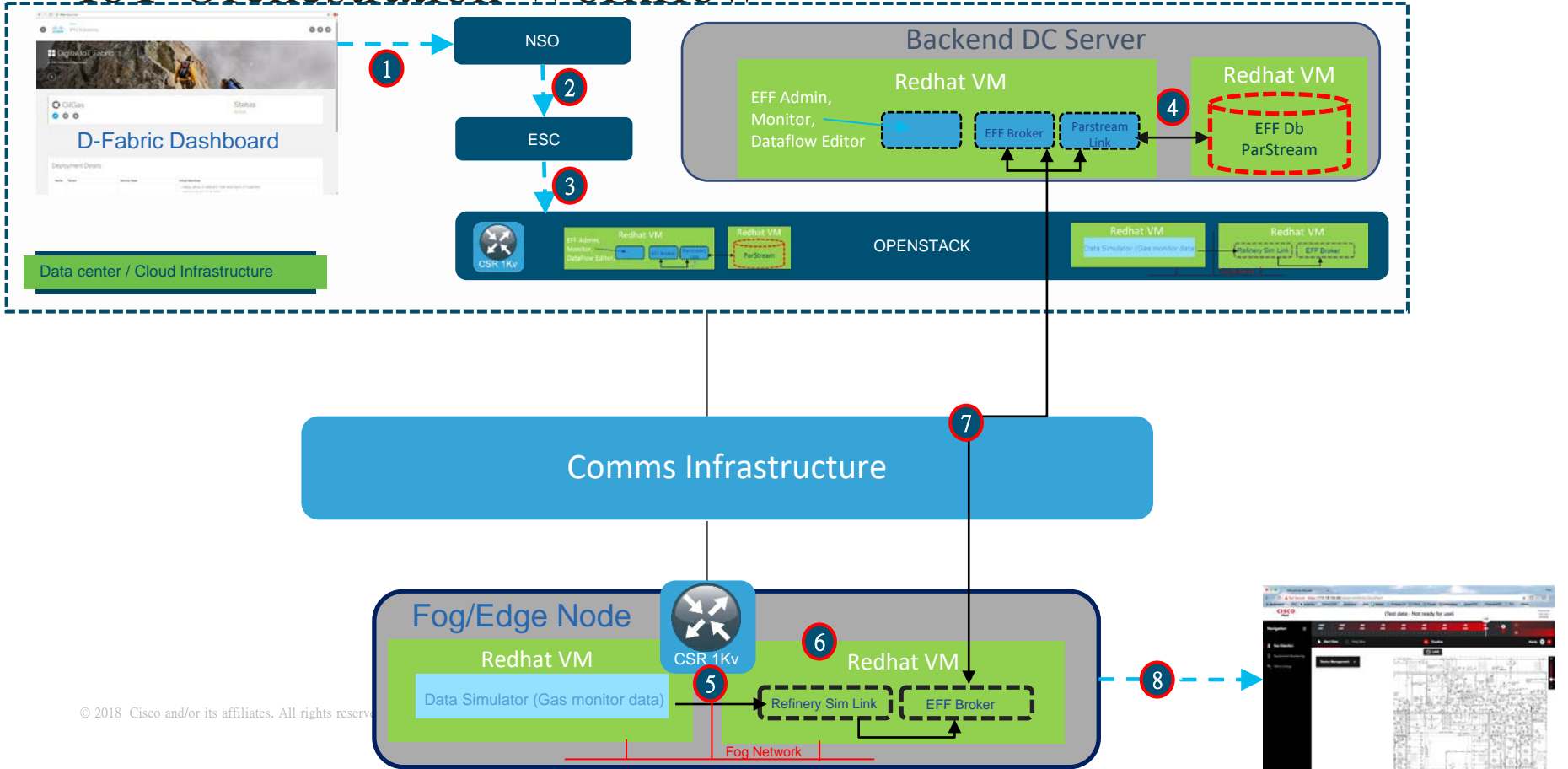
Urban Mobility
Cloud

Environmental
Cloud

Cisco Digital Network
Architecture for Cities



IoT Orchestration Workflow





IoT in Practice

Nov. 2018

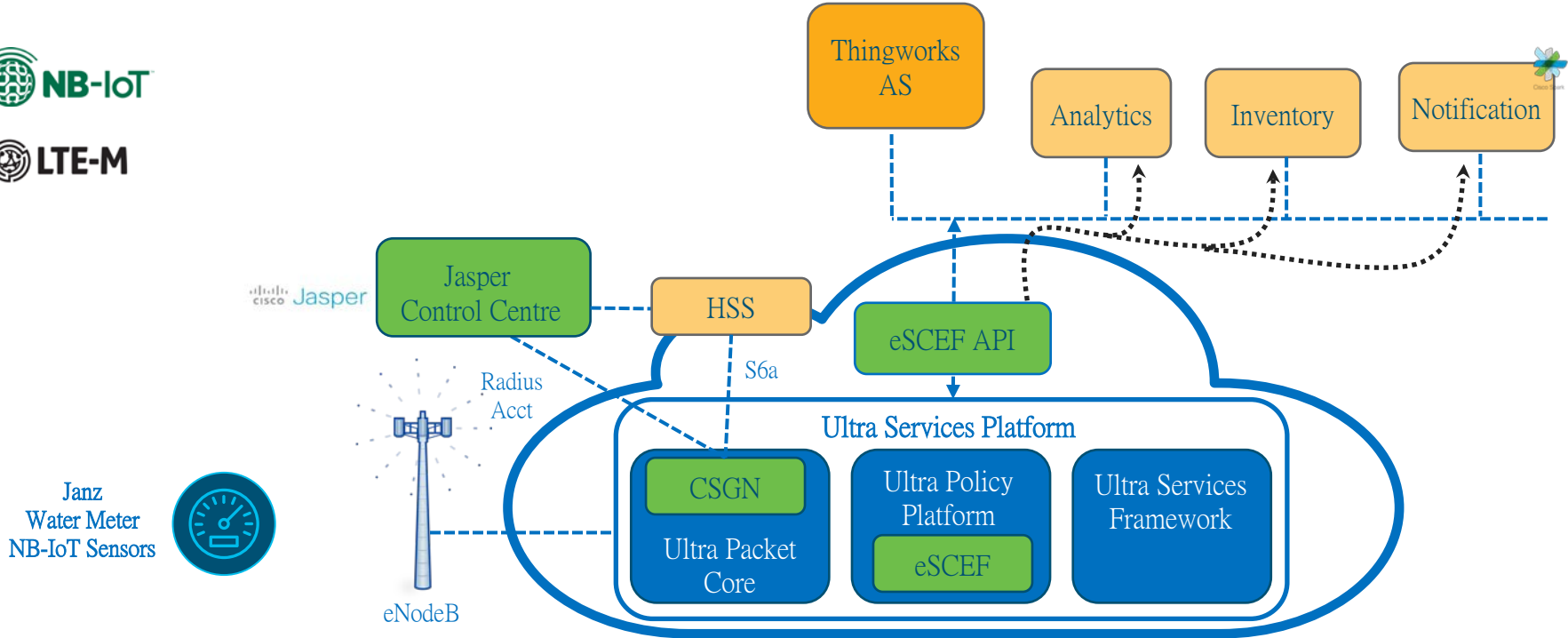


Cisco Milan Innovation Center NB-IoT environment

- End to end testing environment reproducing SP Mobile Network
 - Nokia eNodeB providing Band 20 (LTE and NB-IoT)
 - NB-IoT devices
 - Ublox SaraN chipset
 - Flashnet FRE-220NB light controller
 - Janz JV600 water meter device
 - Ublox C030 programmable board
- Virtualized Cisco Ultra IoT Core (CSGN, eSCEF) on Openstack
- Integration with Cisco Jasper Control Center and Kinetic for Cities
- <https://www.gsma.com/iot/deployment-map/#vimercate-italy>



Demo Network Diagram – Water Meter



NB-IoT IP data via SCEF to IoT Platform; Jasper managed SIMs

Step 1 – Onboard Device

- Control Center Diagnostics: provisioned, thresholds, registered to network...
- Device onboarded to Ultra/eSCEF

Step 2 – Activation

- Manage devices and rating for enterprises

Step 3 – Enable Apps

- Port unlicensed LPWA use case to licensed spectrum without impact
- Integrate with other third-party IoT platforms seamlessly
- Terminate IP data on SCEF for uniformity

Step 4 – Monetize IoT Data - #1

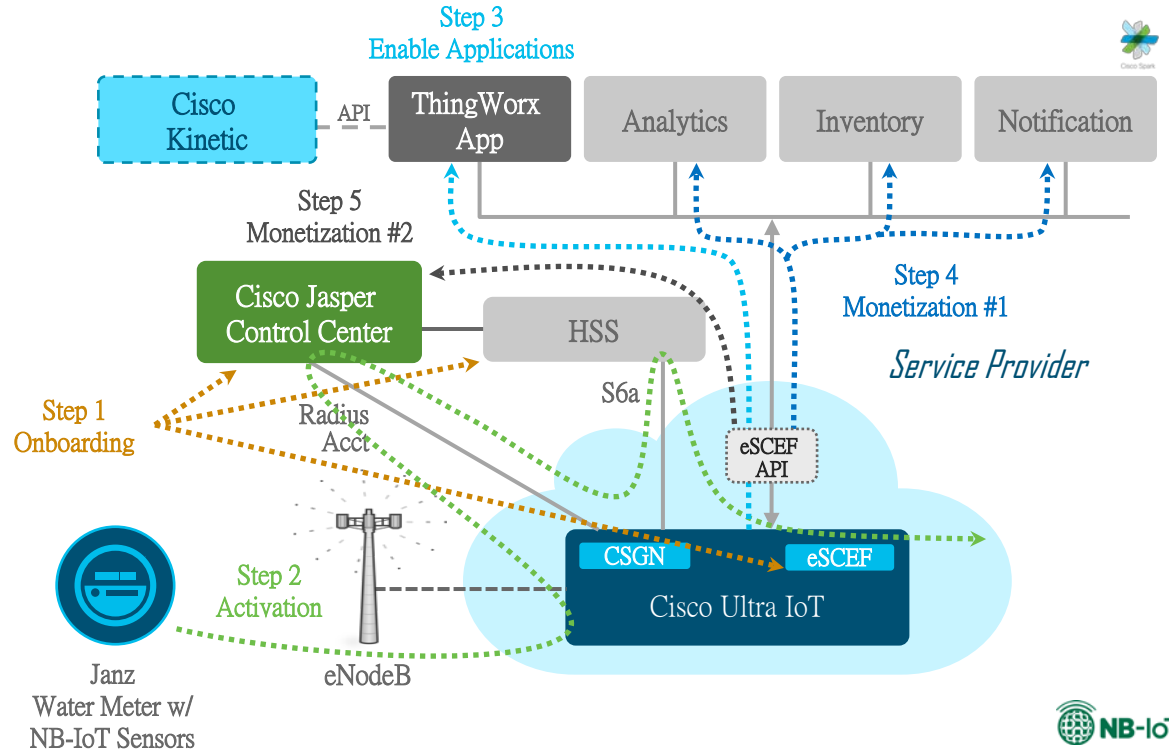
- Provide access to data and network capabilities via APIs
- Enable data from a device to be delivered securely to multiple 3rd party App Servers
- Data management service and IoT protocol termination – new opportunity for SPs
- API Caller and SLA authentication

Step 5 – Monetize IoT Data - #2

- Control Center consumes eSCEF monitoring events & network-exposed information
- Enable new billing models, e.g., transactions per device or per app, differentiated rating
- eSCEF Evolves to 5G SBA and NEF – investment protection

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IoT Platforms Demo – Water Meter





Summary

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The IoT Opportunity for Mobile SP



Connect New
Things

- Enhance access coverage to securely connect new devices (sensors, wearables, vehicles, homes, assets and more)



Enter new
markets

- Expand the customer base providing dedicated services for different vertical markets (e.g. cities, utilities, etc.)



Enable new
services

- Enrich network capabilities (device management, APIs, ..) to serve applications and develop new solutions

Thank You

