RIPE NCC
RIPE NETWORK COORDINATION CENTRE

Internet of Things

Decoding the IoT Ecosystem

Jad El Cham | October 2017 | RIPE75 Tutorial

Who’s joining the game

Cisco Completes Jasper Acquisition

Simplifying IoT for Enterprises and Service Providers

Read Press Release

Jasper

Samsung snaps up SmartThings, embracing Internet of Things

The tech giant acquires the open platform for smart home devices to "improve the convenience and services in people's lives."

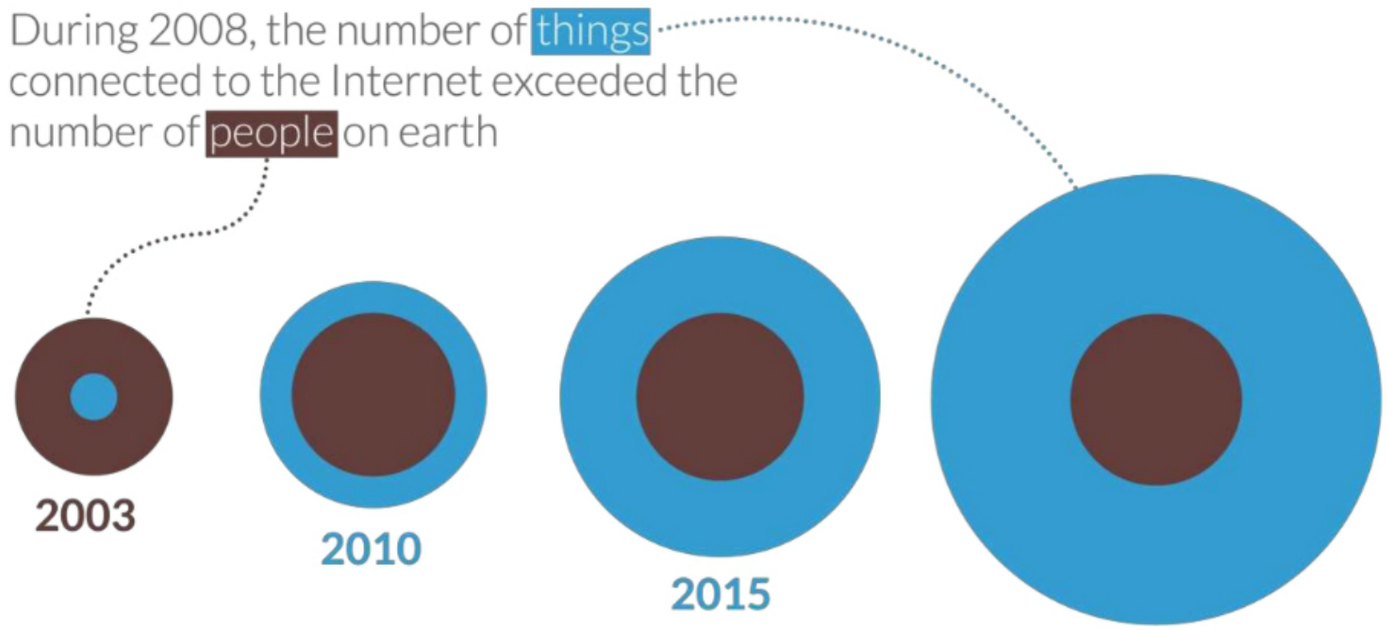
Huawei buys Cambridge Internet of Things pioneer Neul

Ericsson buys MetraTech to muscle in on IoT

SAP Announces €2 Billion Investment Plan, New Innovations, Acquisitions and Network of SAP IoT Labs to Unlock Next Wave of Value from the Internet of Things

Oracle broadens IoT cloud offering with four new solutions

The outlook for 2020



By 2020 there will be ? ? ?

- Predictions for number of connected devices
  - Gartner: 20.4 Billions
  - IHS: 30.7 Billions
  - Cisco: 50 Billions
  - Intel: 200 Billions

Value Creation

Revenue | Citizen Experience | Jobs | Productivity | Cost Control

4500 New Companies | 56000+ New Jobs | 10.5B $ Revenues / year

Overview

- The business background
- The IoT Ecosystem
- From sensor to data challenge
- The IoT Data Flow
- IoT Access Technologies
- IoT Security Challenges

Will not cover:

- Smart Device’s IoT

Use cases and Opportunities

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

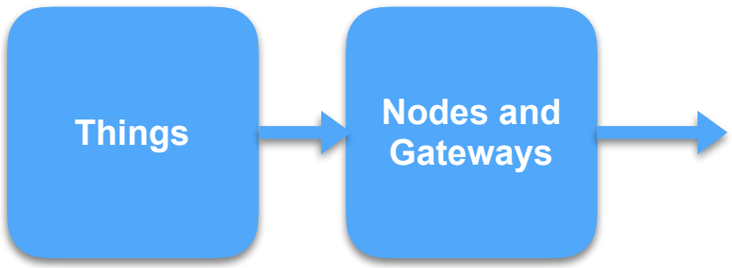
Source: Cisco

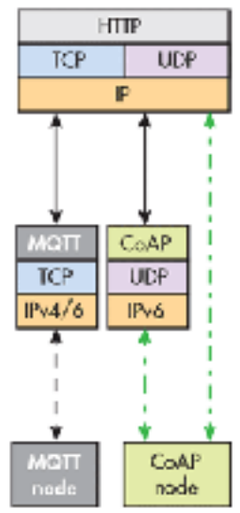
The IoT challenge

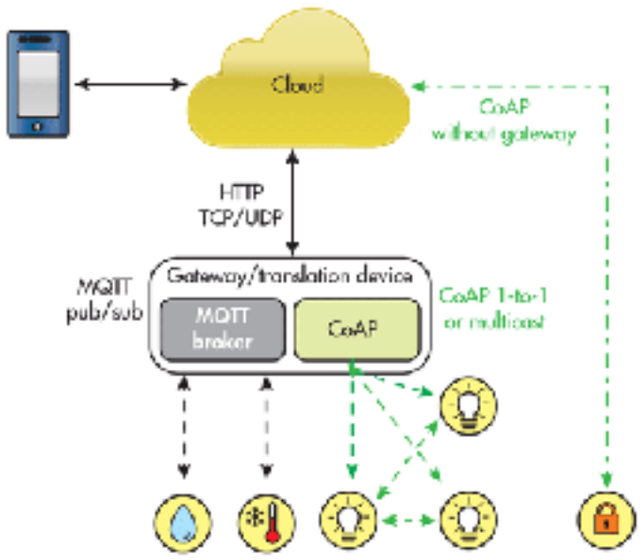
How

The IoT Data Flow

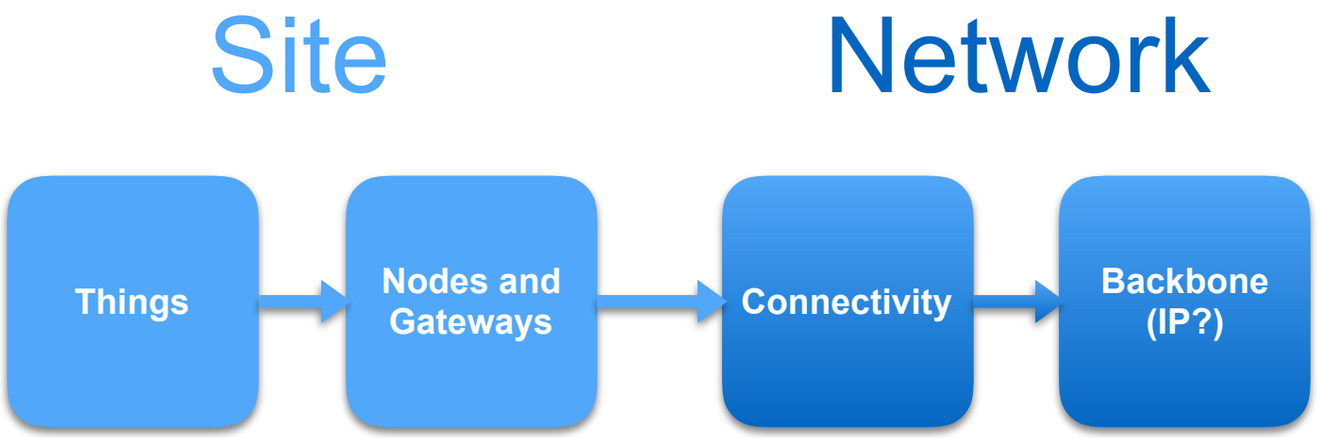
Site

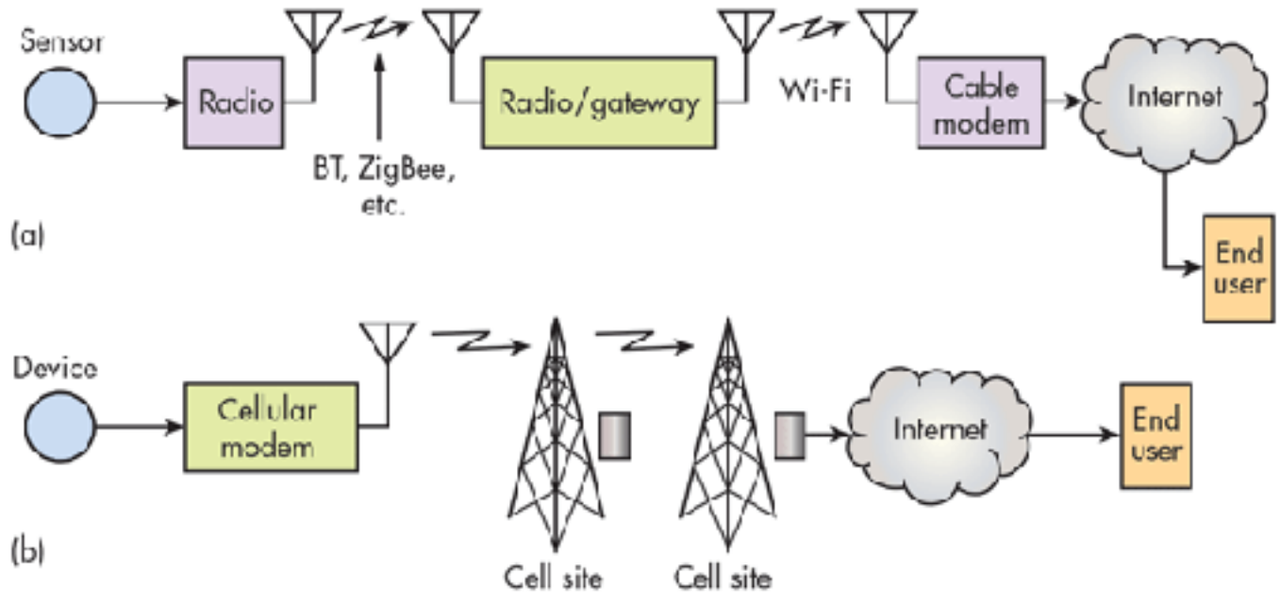




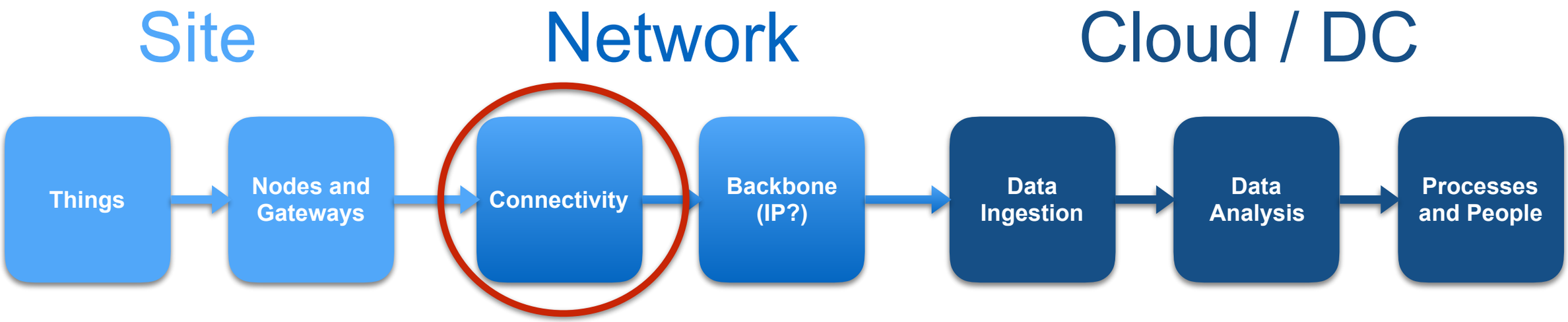


The IoT Data Flow

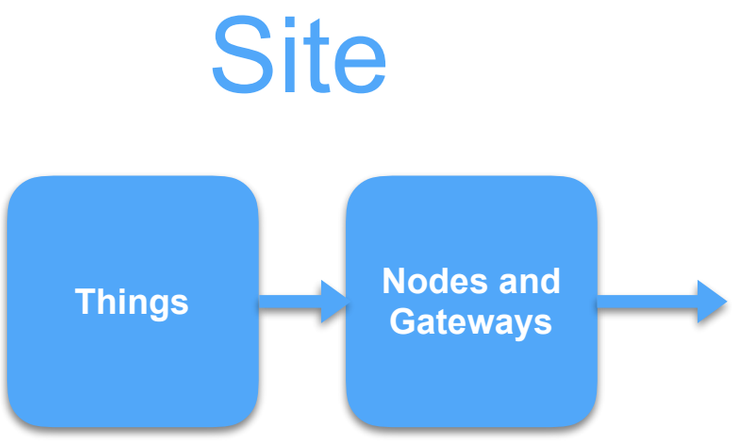




The IoT Data Flow

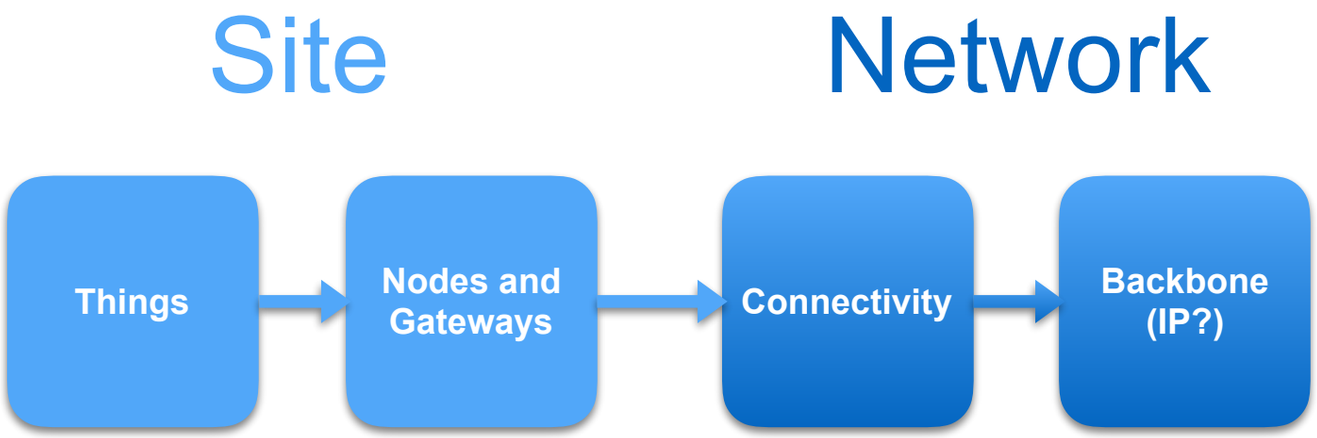


The IoT Data Flow - Site



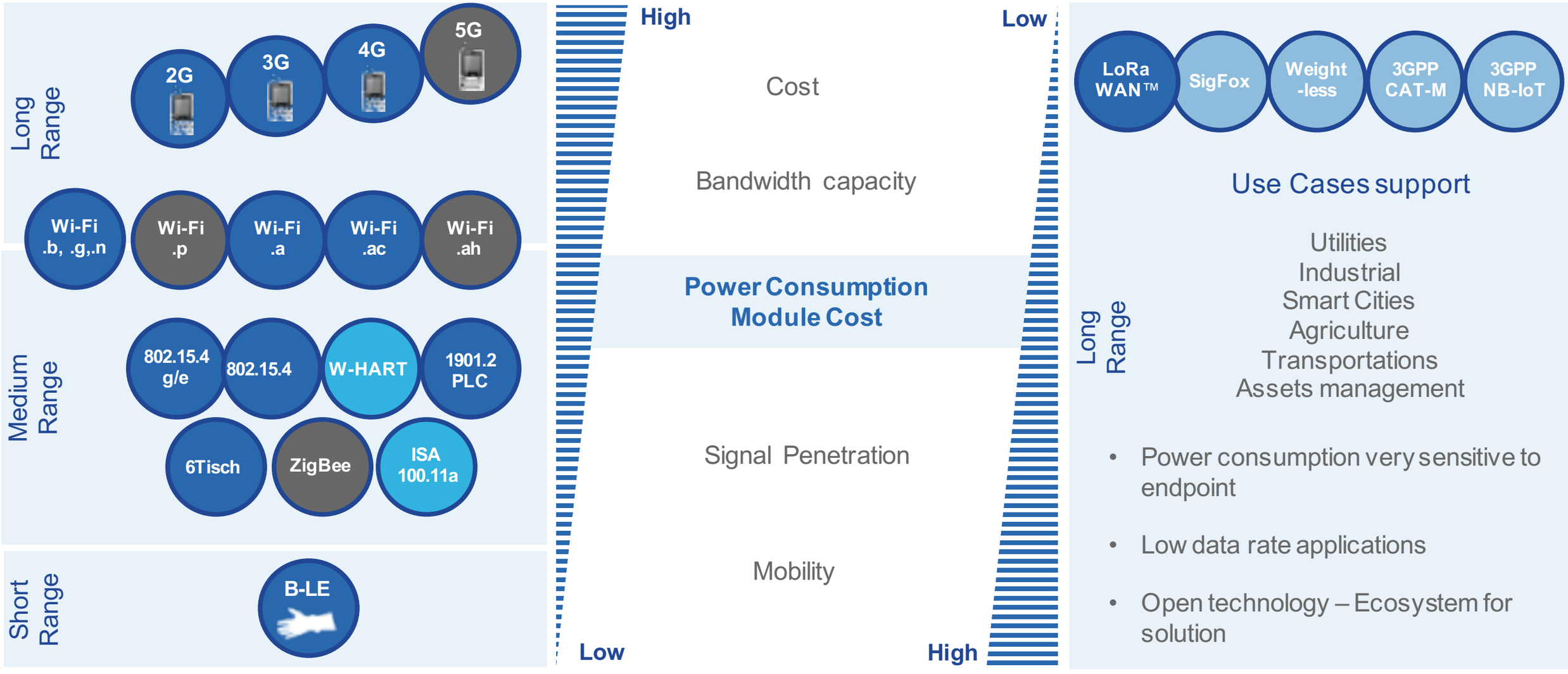
- Part of Operational Technology
- Things can be sensors with analog or digital outputs
- Sensors are powered by the IoT nodes or power sources
- Encoding can be done using MQTT, CoAP, etc.
- Many sensors (Things) can be connected to an IoT node
- Many IoT nodes can be connected to an IoT Gateway

The IoT Data Flow - Network



- Challenge of transporting the data on a massive scale
- Impact on the battery / power source of the source device
- Low Power Wide Area (LPWA) as an IoT Enabler
- Possible Deployment scenarios today:
  - Sigfox
  - LoRaWAN
  - NB-IoT, LTE-M, 5G(?)
  - WiFi + 3/4G
  - Zigbee + 3/4G

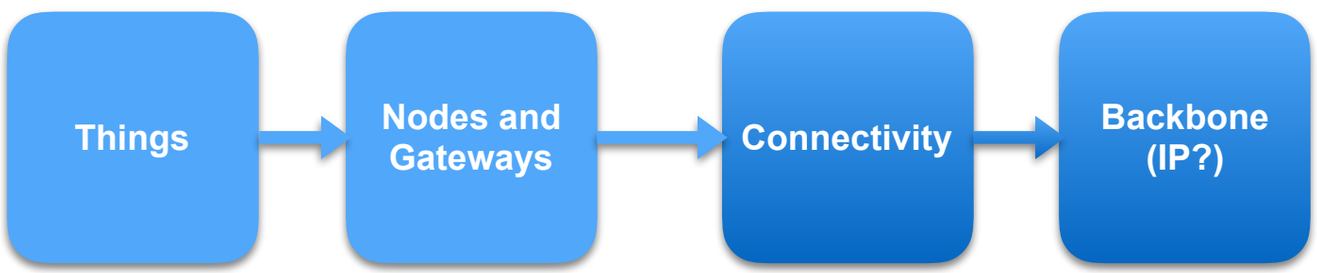
IoT Access Technologies Landscape



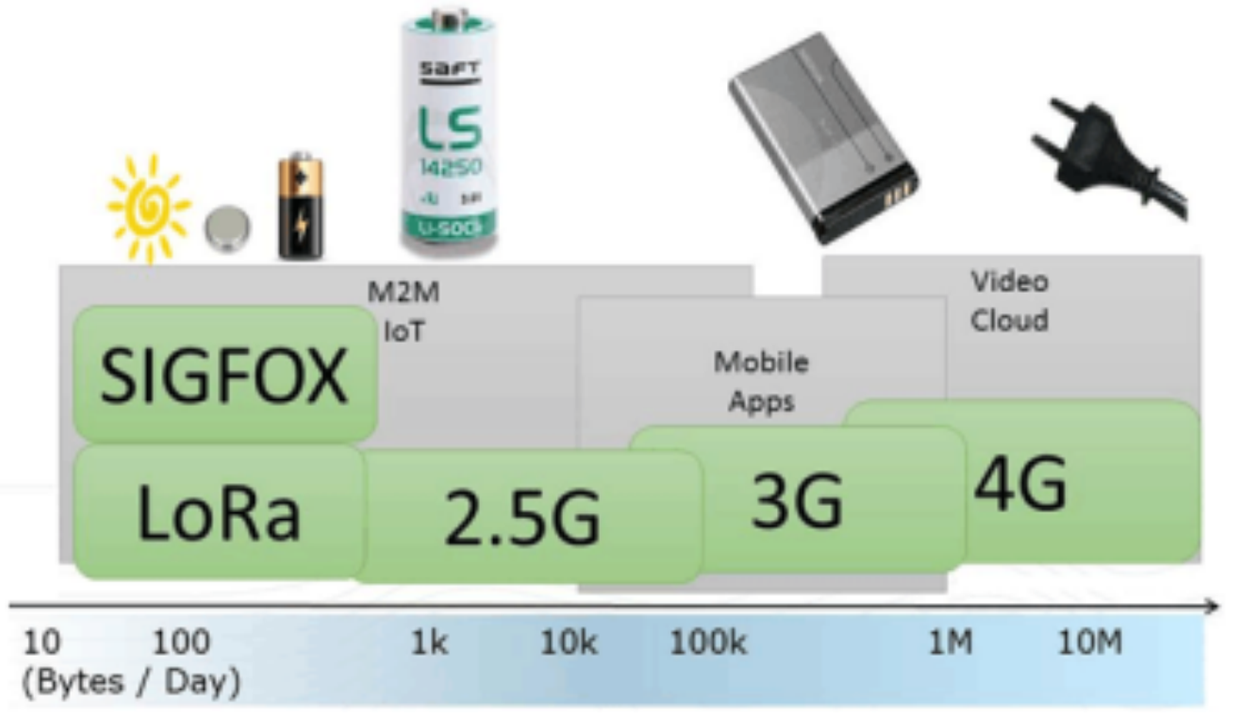
Source: Cisco / Actility

The IoT Data Flow - Network

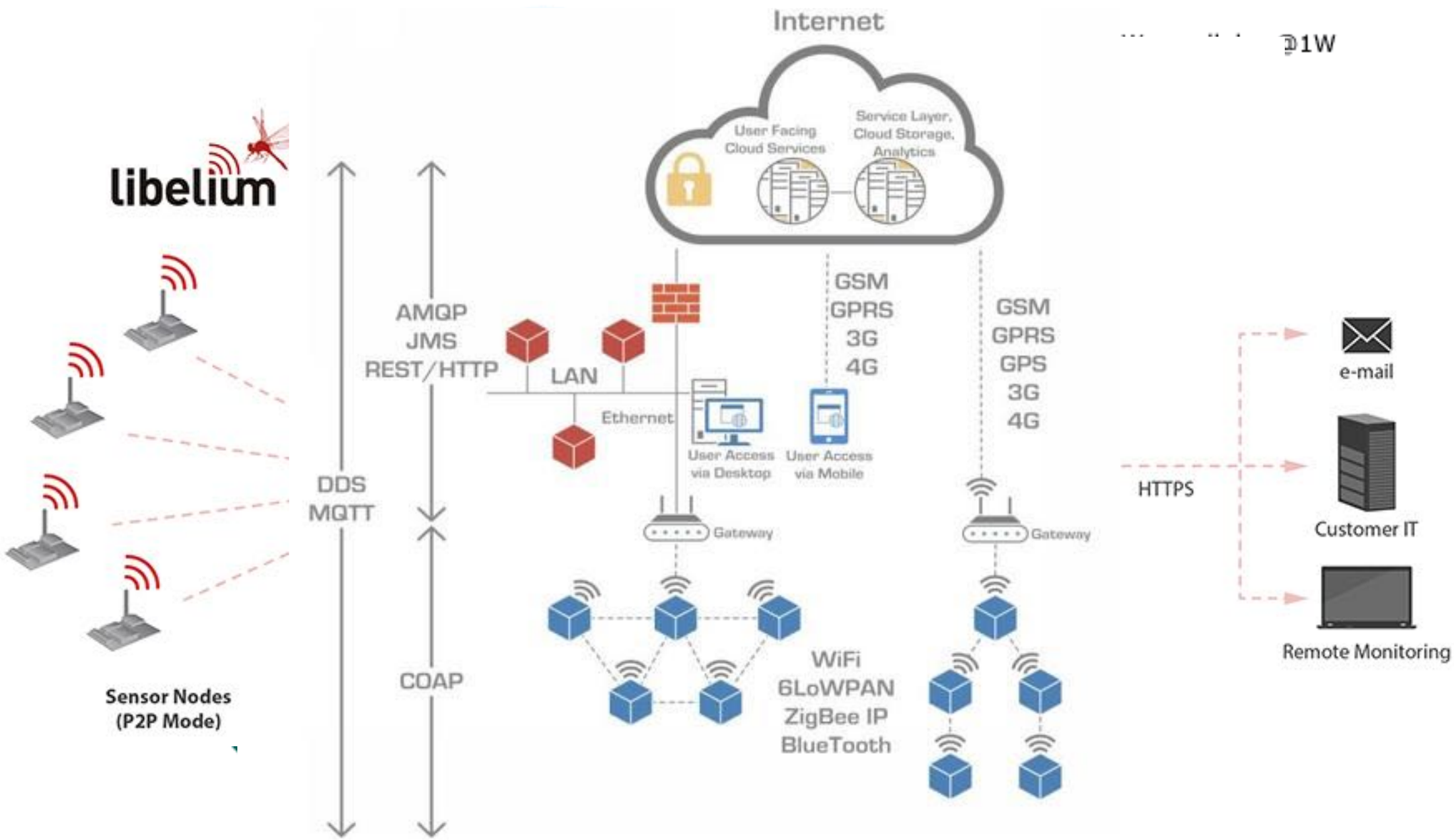
Network



Technology Decision Factor



IoT Access Scenarios



What is 5G?

	2G	3G	4G	5G
Uses Cases & Services	Voice + SMS	Voice + Small Data	Mobile Broadband	Enhanced Mobile Broadband Massive Machine Type Communications Ultra-Reliable and Low-Latency Communications
Spectrum	200 KHz Channels Below 2 GHz	5 MHz Channels Below 3.6 GHz	Up to 20 MHz Channels Below 3.8 GHz	Up to 1 GHz Channels Below 100 GHz
Radio Technology	GSM/GPRS (Single Technology)	UMTS/HSPA (Single Technology)	LTE/LTE-A (Single Technology)	Multiple Radio Access Technologies Integrated in a 5G Network 5G New Radio, 5G LTE, MultiFire, Wi-Fi…
Network Technology	Macro Cells	Macro and Small Cells	Heterogeneous Macro and Small Cells	Challenging Traditional Cell and Network Concepts: Small Cells, Mobile Edge Computing, Cloudification, Network Slicing…

Source: InterDigital

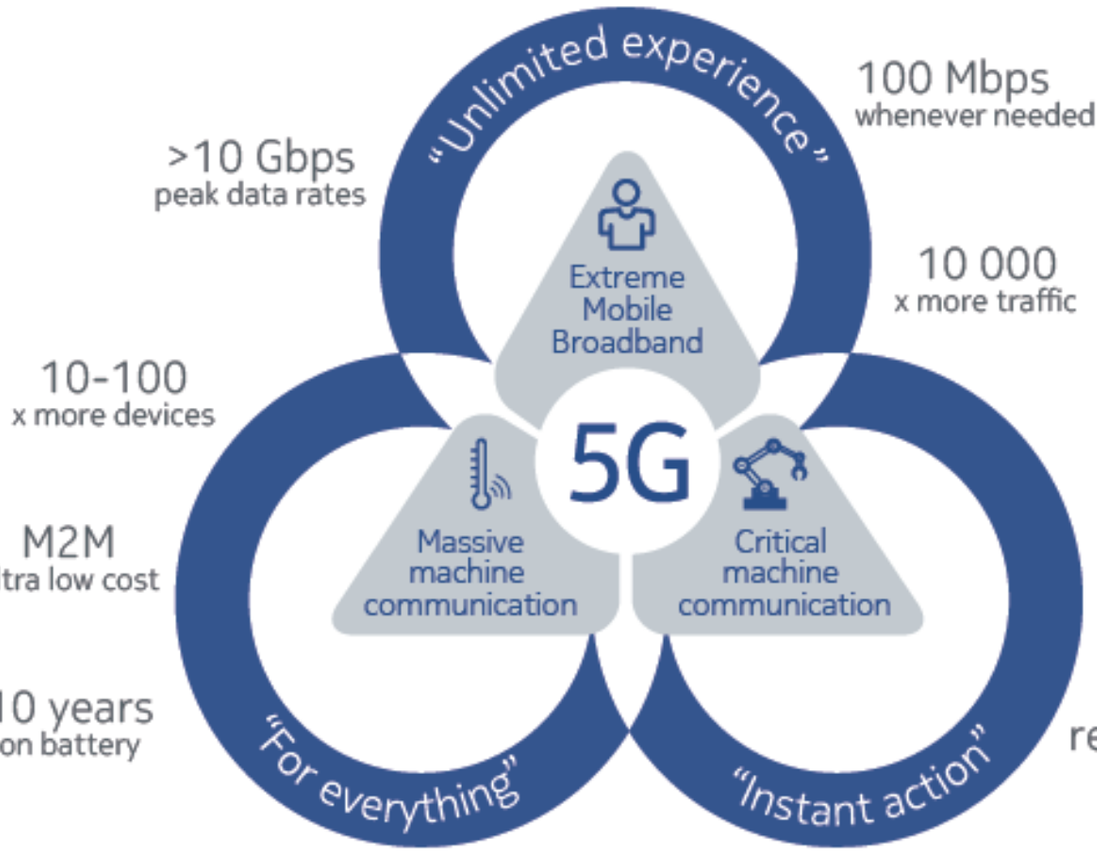
What 5G is

- The hyper-connected vision
  - Blend of pre-existing technologies (2/3/4G, WiFi, etc.) for higher coverage and availability
  - Key differentiator being greater connectivity as an enabler for M2M and IoT
  - May include a new radio technology to enable low power, low throughput field devices
- Next-generation radio access technology
  - More of a traditional ‘generation-defining’ view
  - Specific targets for data rates and latency being identified
  - Easier determination of whether a technology is 5G or not
- The two views described are regularly taken as a single set and hence views are grouped together

What 5G is

Source: Qualcomm

Technology Requirements for 5G



90% reduction in Network energy

99.999% Availability
100% Coverage

Use cases for 5G

Extreme throughput

Multi-gigabits per second

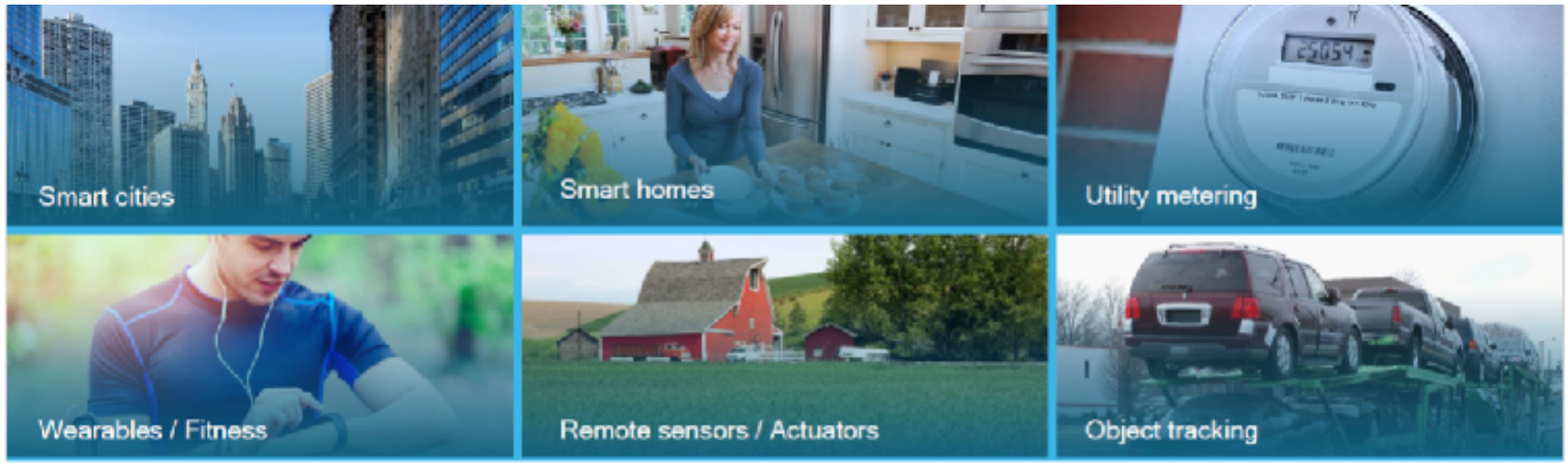
Ultra-low latency

1ms E2E latency

Uniform experience

much more capacity

Use cases for 5G



Power Efficient

Multi-year battery life

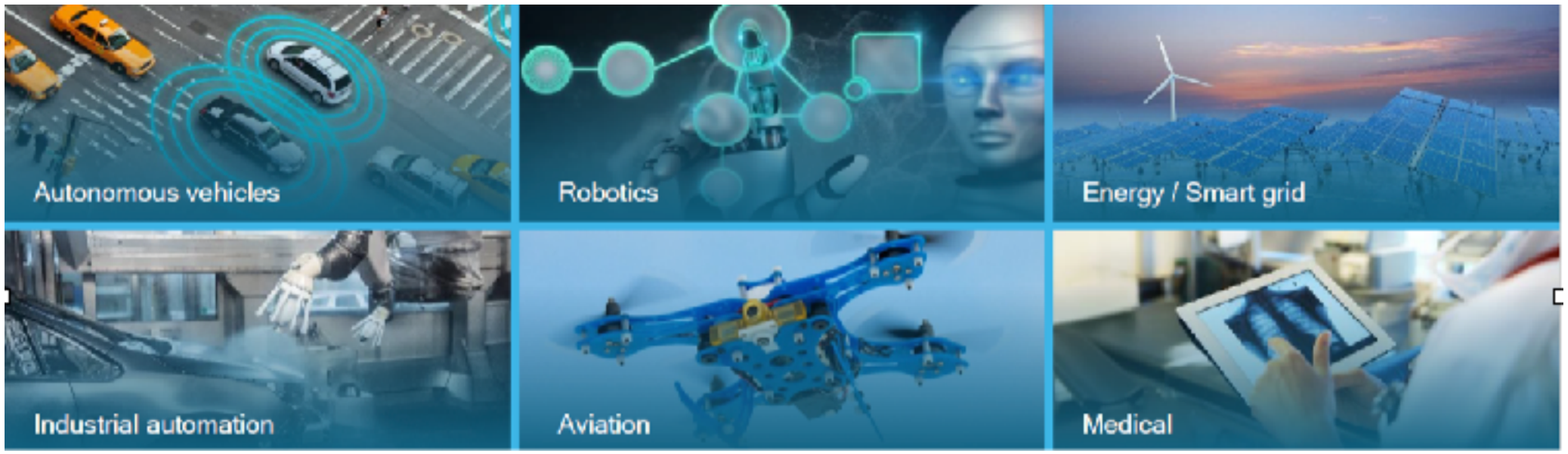
Low complexity

Low device and network cost

Long range

Deep coverage

Use cases for 5G



High reliability

Extremely low loss rate

Ultra-low latency

1ms E2E latency

High availability

Multiple links for redundancy and mobility

Implications of 5G on Operators

- Operators need to overcome a series of challenges if the 5G benefits are to be realised
- 5G spectrum and coverage implications

Below 1 GHz: longer range for massive IoT

1 GHz to 6 GHz: wider bandwidths for enhanced mobile broadband and mission control

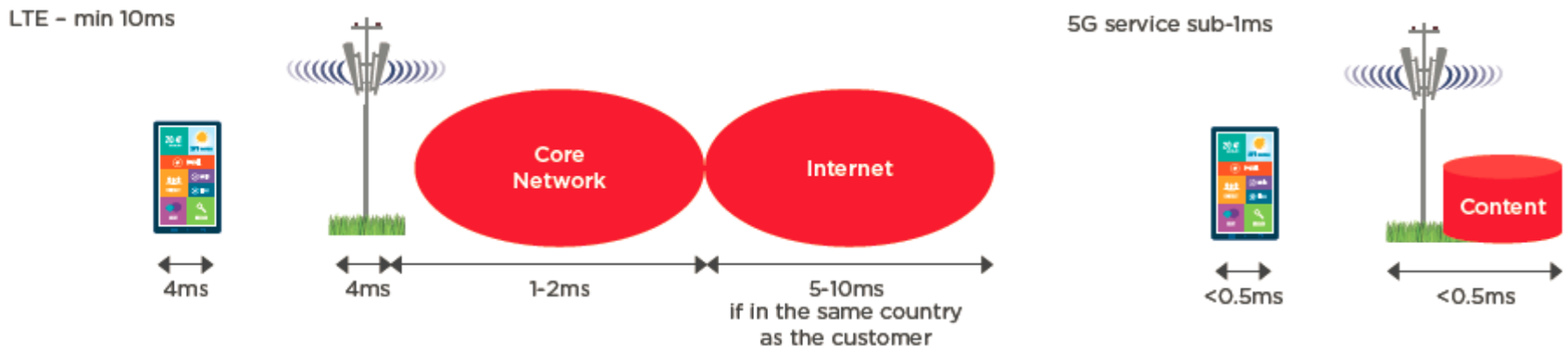
Above 6 GHz (mmWave): extreme bandwidths, shorter range for extreme mobile broadband

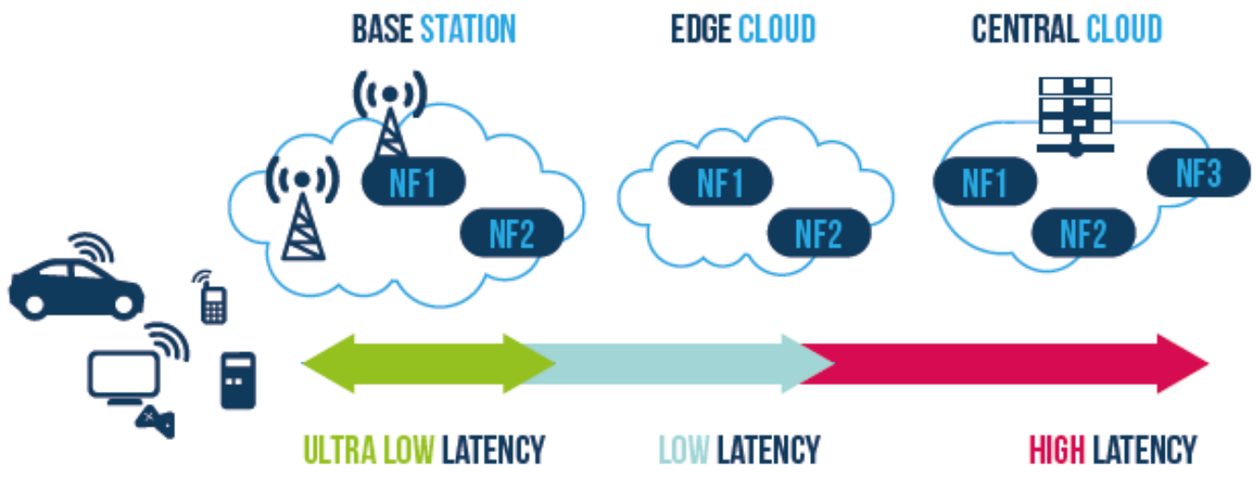
From wide area macro to local hotspot deployments

Support for diverse network topologies (D2D, Mesh,etc.)

Implications of 5G on Operators

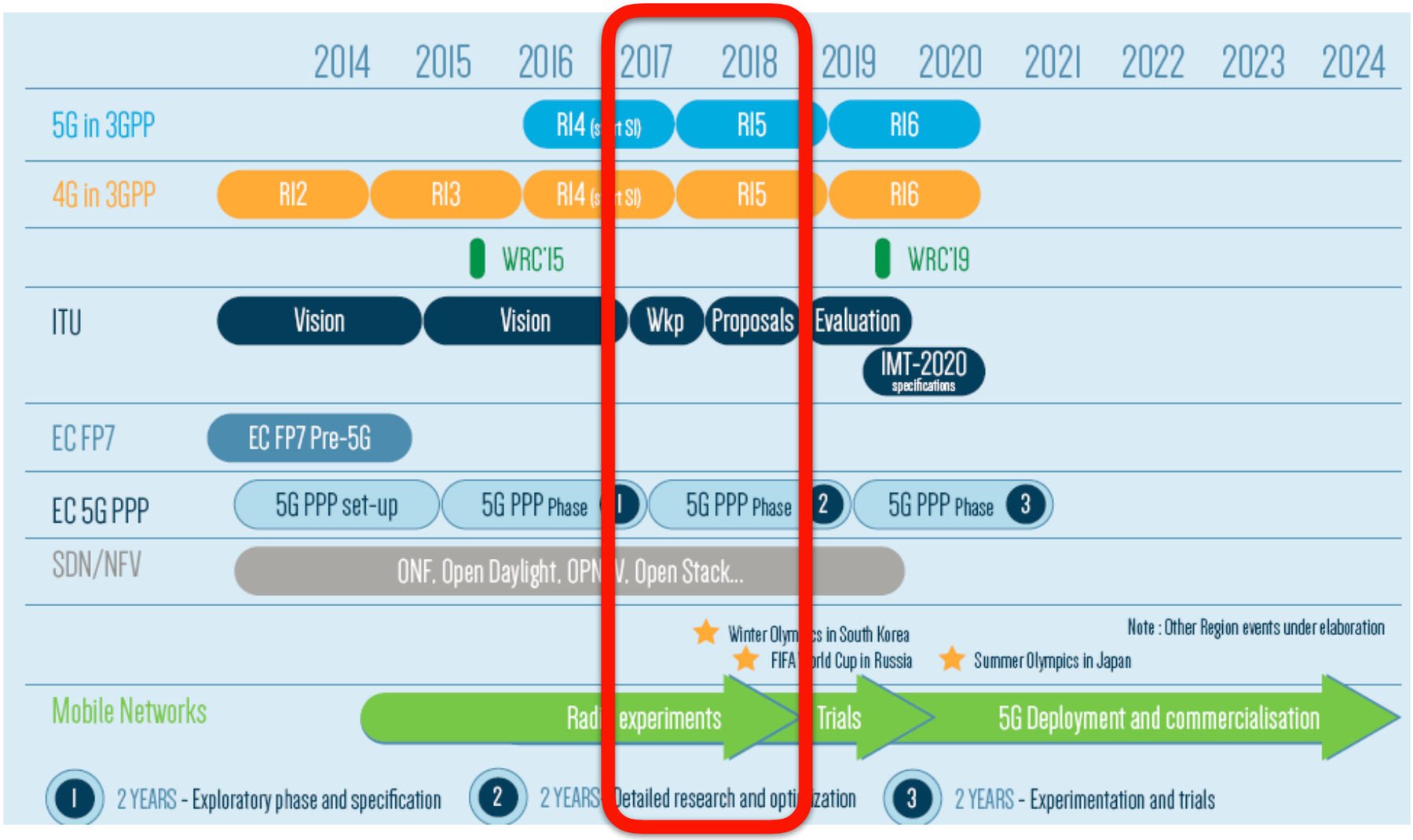
- Operators need to overcome a series of challenges if the 5G benefits are to be realised
- < 1 ms Latency





Source: GSMA Intelligence / Euro-5G

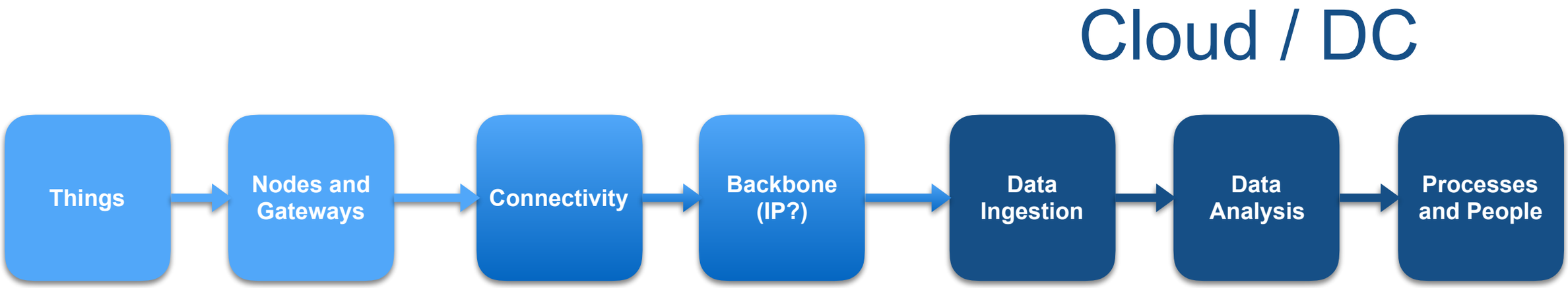
Roadmap for 5G



By the second half of 2017 the focus of our work will shift to Release 15, to deliver the first set of 5G standards - including new work as well as the maturing of the LTE-Advanced Pro specifications.

www.3gpp.org

The IoT Data Flow - Cloud / DC



- Big Data applications for IoT
- Many solutions by Cloud Software Providers
- Interface for humans to understand the data and interact with it
- Automated processes based on the input received
- Machine Learning, AI, M2M

IoT Applications Models

IoT Data Services and Apps

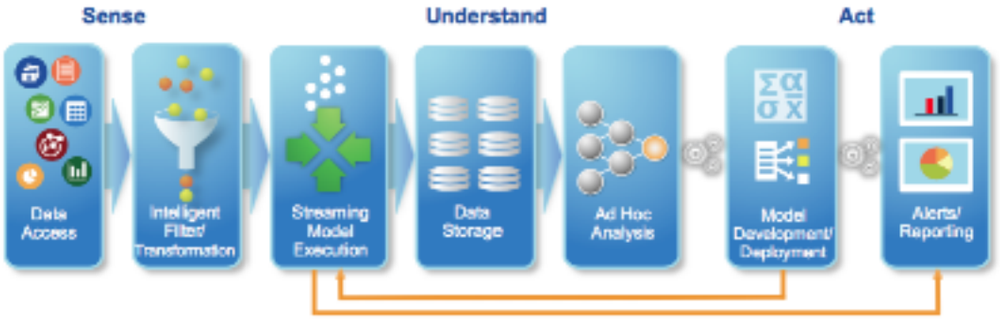
Manufacturing / Utility / Oil & Gas / Transportation / Healthcare / Cities / Retail

IoT Data Platform (IoT Cloud)

IoT Fabric

Devices / Sensors / Actuators / Silicon / Device Security

IoT Services Framework



Data Management

Device Management

Connectivity Management

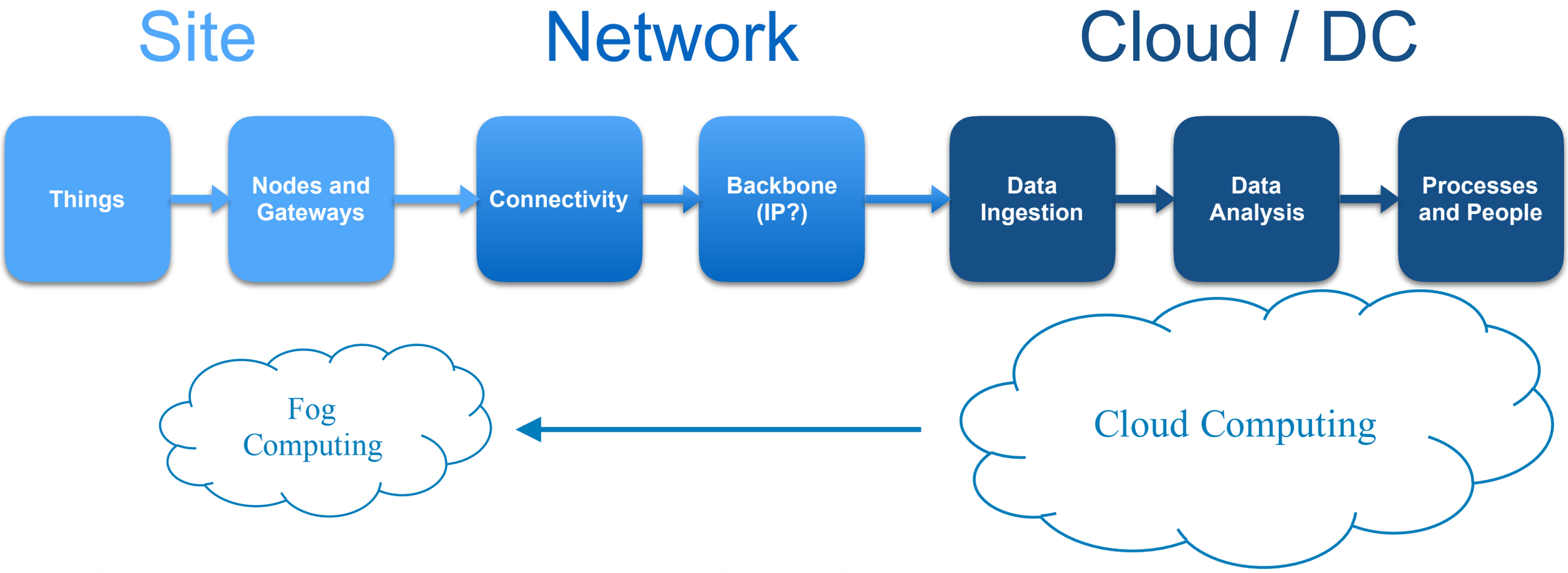
SECURITY

Applications

Integration with other Systems

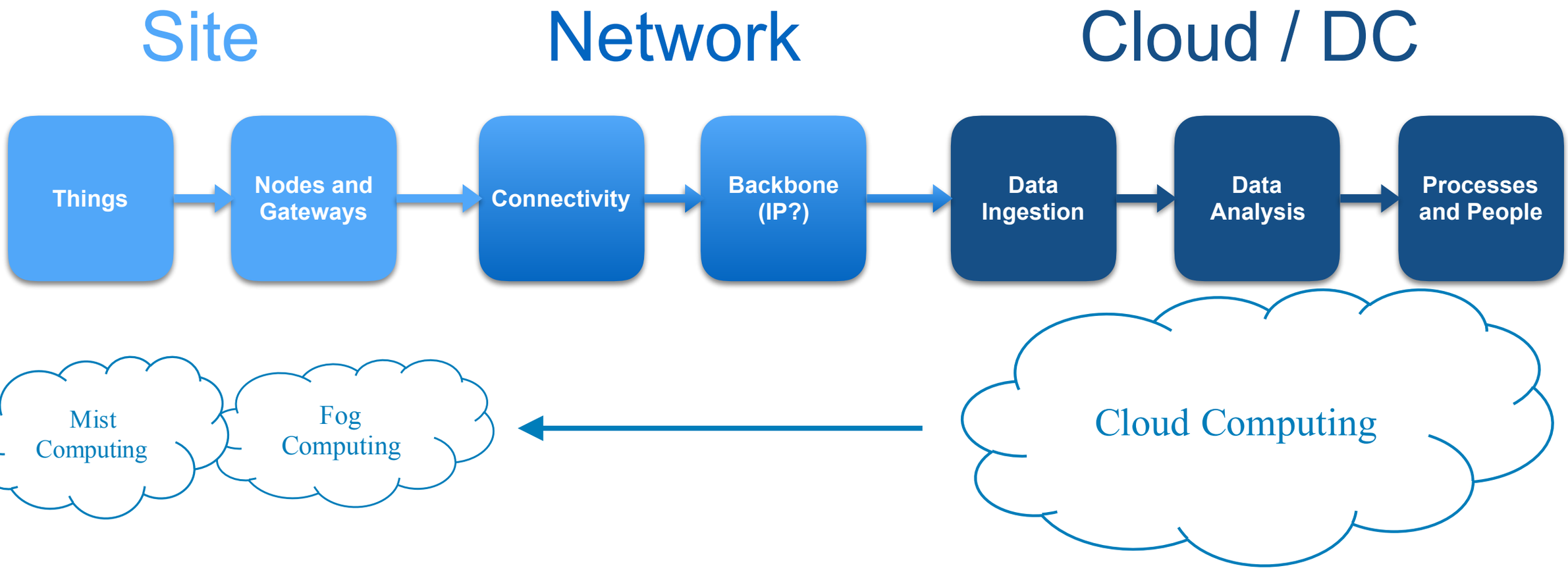
Data streaming between clouds

Fog Computing



- Computing done on the IoT Gateway
- Linux OS gateways and nodes, local computing possible
- Reduce the chatter on the transmission medium
- Push some intelligence towards the edge

Mist Computing



- Some decisions taken at the source
- Discard useless information
- Data processed faster at destination
- Processing done on the level of the sensors

IOT Security

101

IoT Security Landscape

- No one definition of IoT
  - Internet connected device
  - Characterised by a constantly growing network of connected devices and actuators that can sense or interact with their internal states or the external environment (Europol - iOCTA)
  - Smart Devices
  - Consumer Devices / Industrial Control Systems
  - Emerging concept describing a wide ecosystem where interconnected devices and services collect, exchange and process data in order to adapt dynamically to a context (ENISA)

IoT Security Challenges

- Many more devices on the network
- Lack of security updates and patches for remediation by vendors
- Weak or no encryption / Data Protection
- Devices running old services with vulnerabilities
- Lack of computing power on many IoT devices
- Security by design not a concern to some vendors
- Lazy consumers
- Undocumented hard coded passwords

IoT Security Impact

- Devices become part of an IoT botnet
- Devices are bricked or destroyed
- Health related impact (connected medical devices)
- Compromised privacy
- Data theft
- Full networks compromise
- APTs

Access to IoT Devices

- If an IoT Device is not accessing the internet, it does not mean that it is not accessible from the Internet!!!
- Port Forwarding
- UPnP: Universal Plug and Play, widely used today, when you buy a device, it tells your router to expose the device from the internet dynamically
- 275 000 IP cameras exposed to the internet today without users knowing it because of UPnP

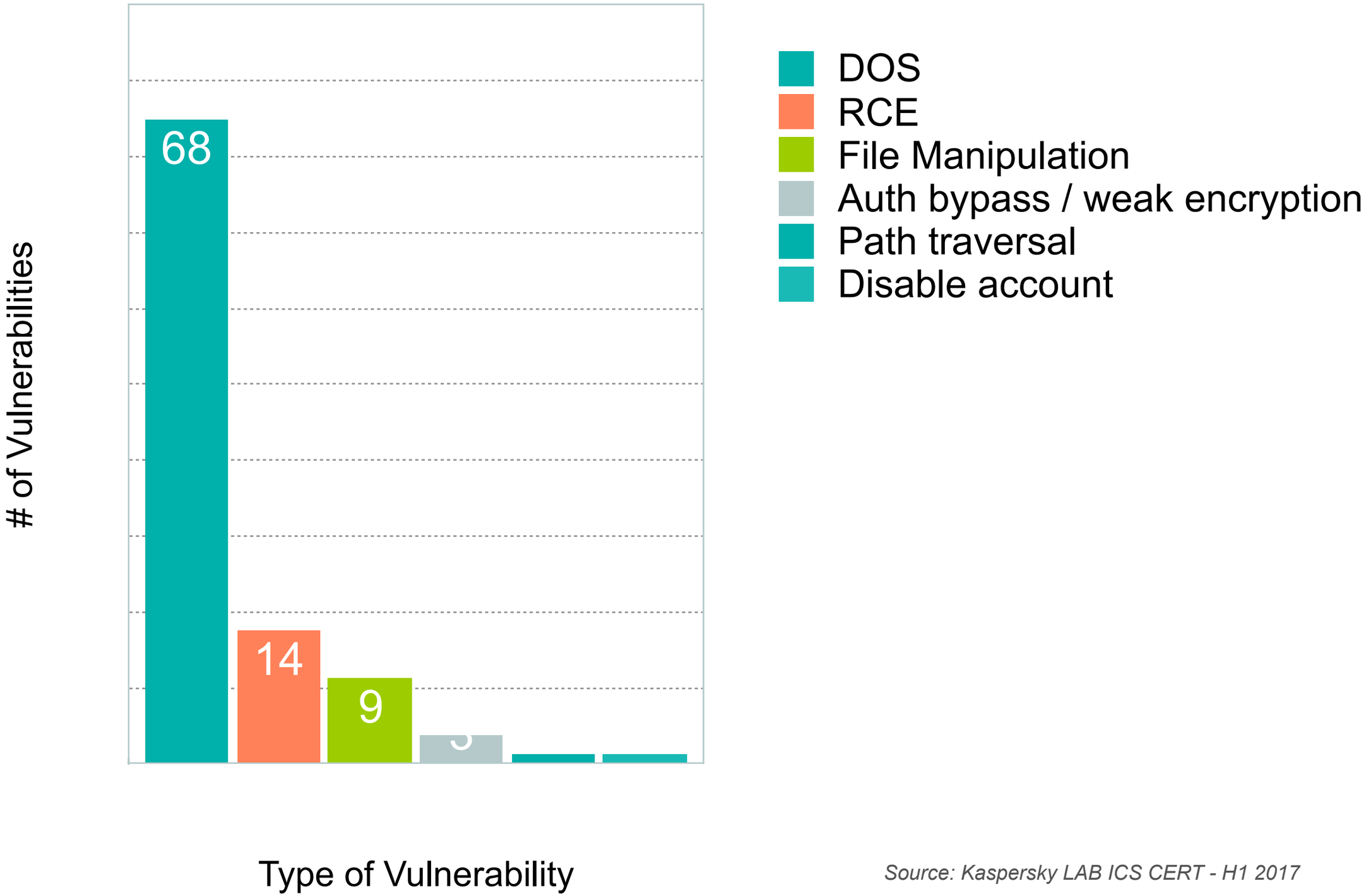
IoT Victims

- Victims can be:
  - Unauthenticated devices
  - Devices with default credentials
  - Devices with strong password but with weak security embedded components
  - Devices with a backdoor account that grants privileged access
  - Devices with old firmware
  - Devices that do not contain fixes to security vulnerabilities
  - ANY DEVICE

DEMO

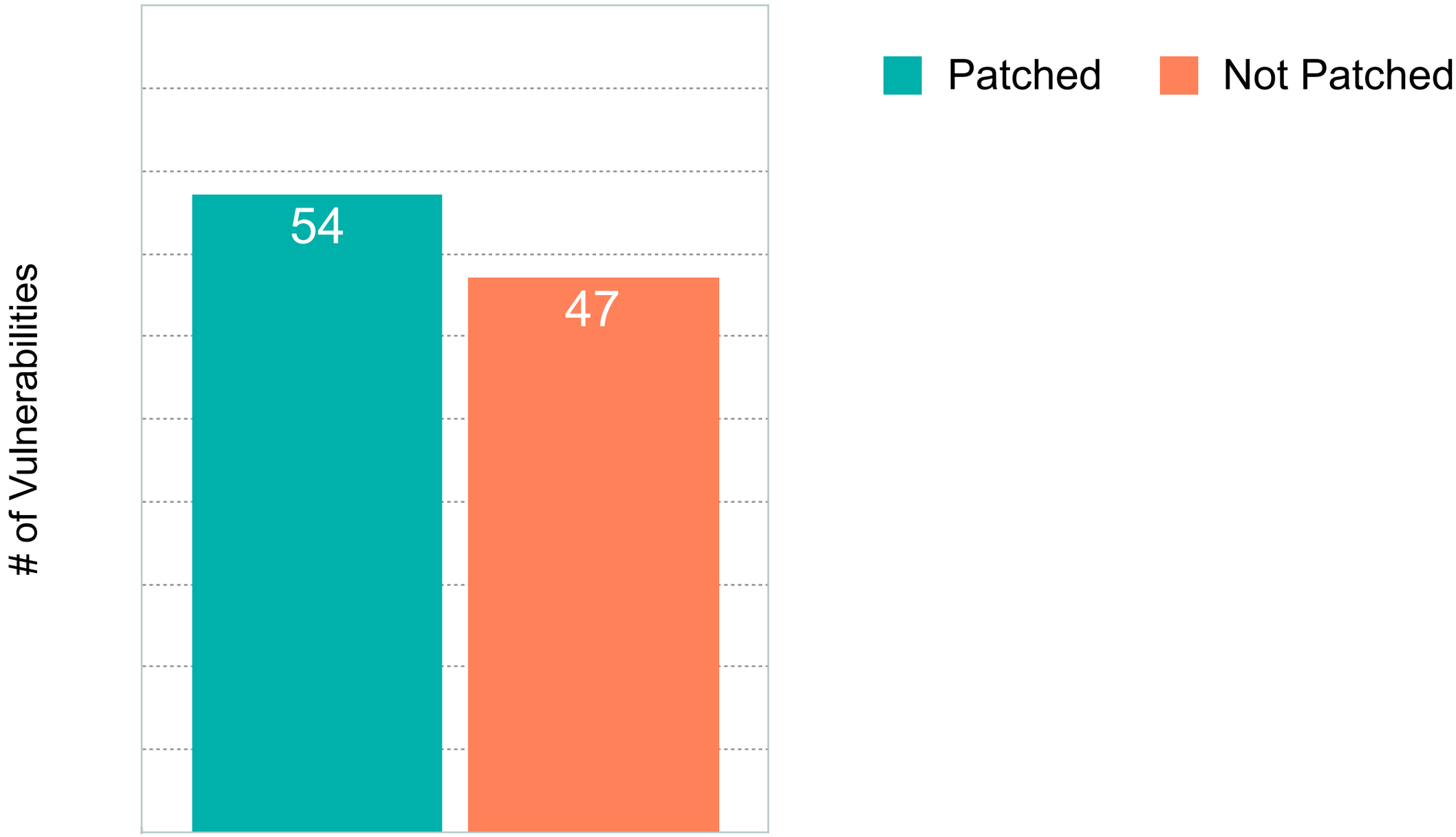
Access to IoT Devices

Vulnerability Research Statistics - ICS



Source: Kaspersky LAB ICS CERT - H1 2017

Vulnerability Research Statistics - ICS



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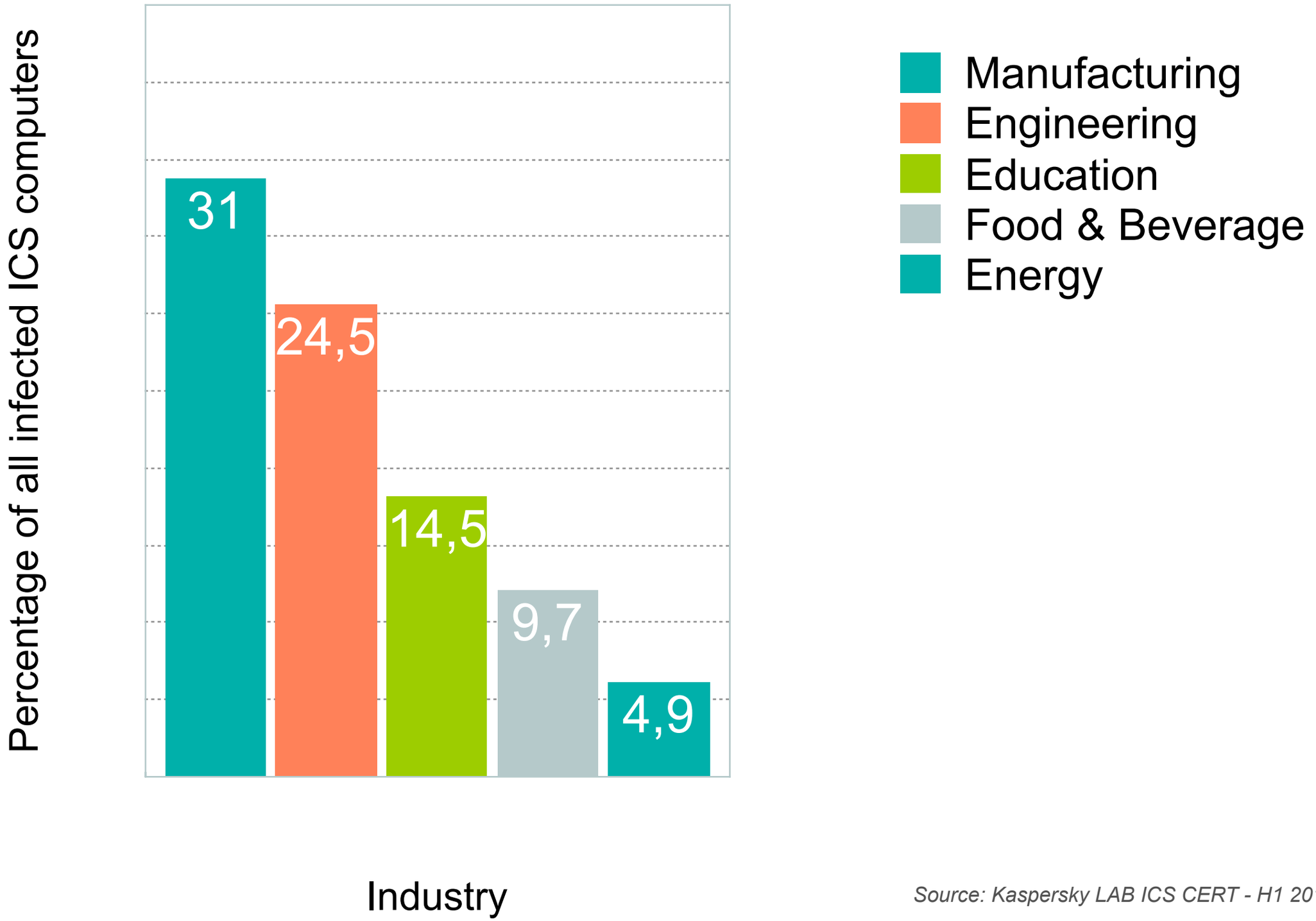

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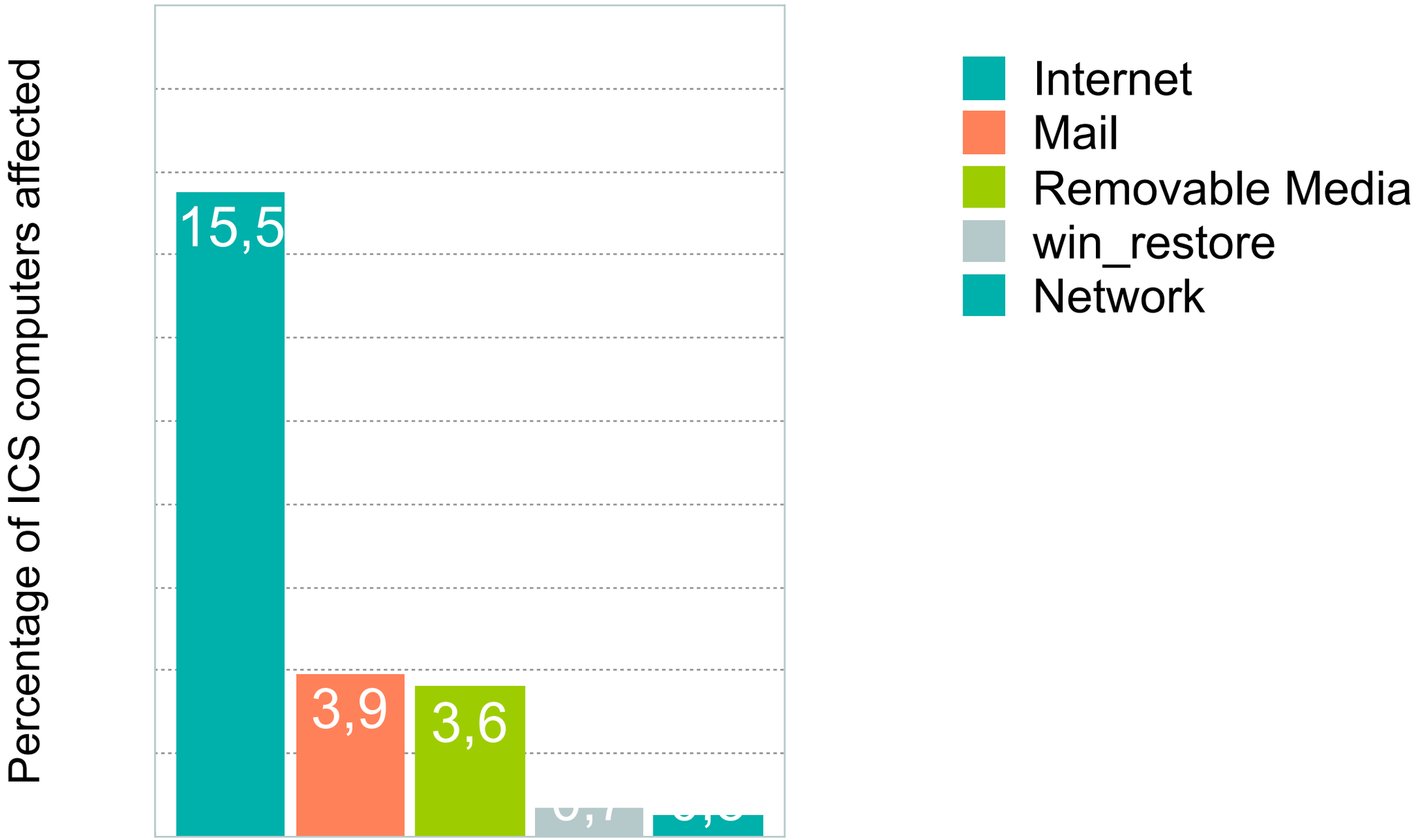
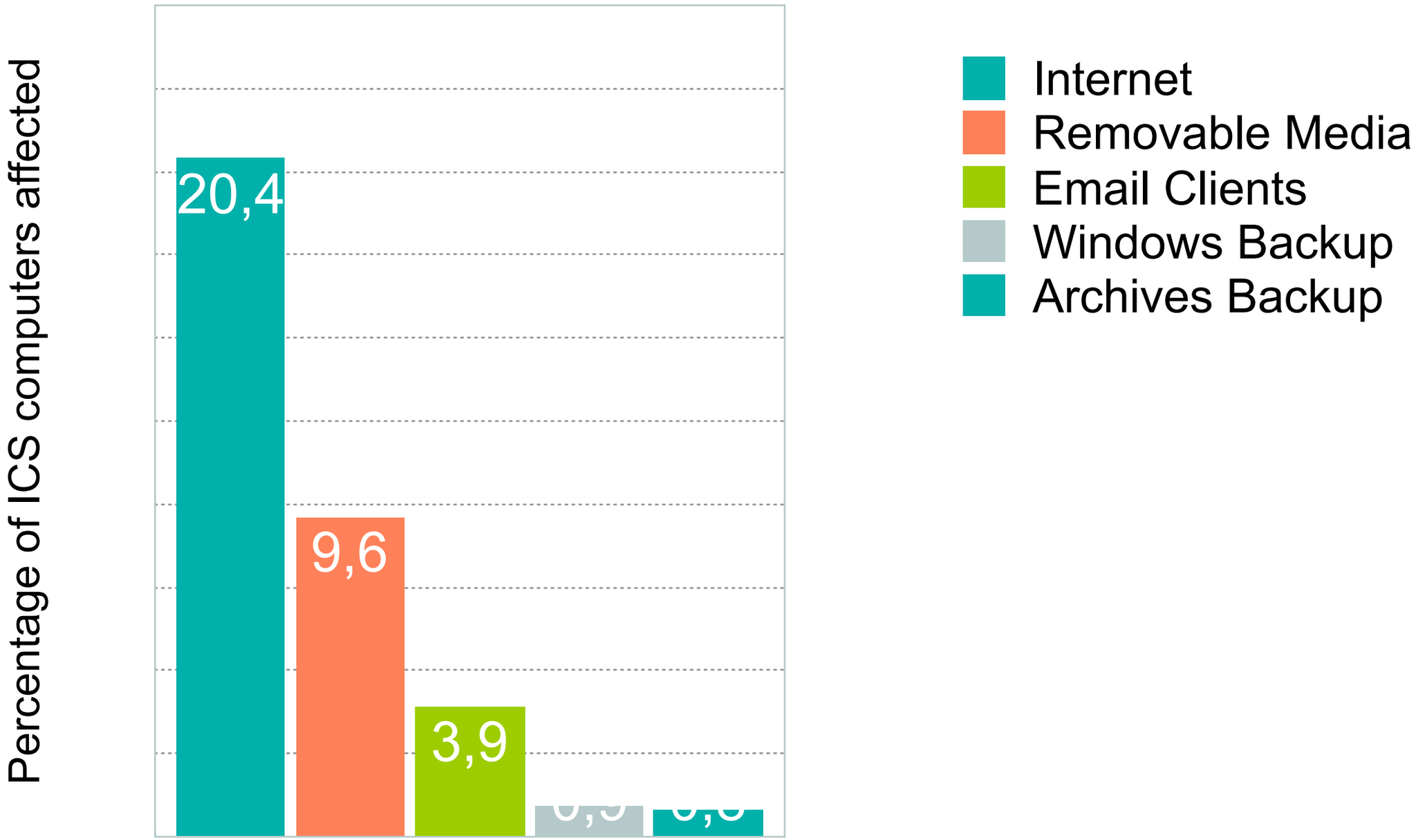


Source of Vulnerability - Europe

Source: Kaspersky LAB ICS CERT - H1 2017

Vulnerability Research Statistics - ICS



Source of Vulnerability - World

Source: Kaspersky LAB ICS CERT - H1 2017

How do we protect ourselves?

- Expose devices to the internet only if you need it; use VPN when possible
- Place IoT Devices on a separate VLAN
- Always change default credentials
- Turn off UPnP
- Always update devices to latest firmwares with latest security patches
- Select carefully your cloud services
- Give preference to known vendors
- Digital hygiene across the network, not only IoT devices

IoT security efforts and initiatives

- **Community effort -** *i.e AIOTI , Project OWASP for the IoT*
- **BCP** - *Best Current Practices for Securing Internet of Things (IoT) Devices draft-moore-iot-security-bcp-01*
- **Governmental Regulation -** *Internet of Things Cybersecurity Improvement Act of 2017*
- **Governmental Guidelines -** *US DHS Strategic Principles for securing IoT*
- **IoT Security Guidelines -** *GSMA* IoT Security Guidelines & Assessment
- **Public Awareness -** *IoT Security focused workshops and conferences*

Smart Cities

Today

Nice - Connected Boulevard

- Congestion reduced by 30%
- Air pollution and noise levels reduced by 25%
- Savings between 20 and 80 % in areas such as street lighting and light management
- Parking income increased by 30%
- Better citizen experience

Image credit: Flickr

Dubai - Smart City

- 40% of city centre traffic caused by parking issues
- Driverless transport set to be common in 2020
- 1000 government services smart by 2017
- Potential investment value of AED 17.9 billion by 2019
- 250 000 Smart meters for Electricity and Water

San Francisco - Connected City

- The goal is to achieve a 10% Shift
- Shift 10% of single-occupied vehicles to public transit
- Reduce 10% in transportation emissions
- Reduce accidents and fatalities by 10%
- Reduce 10% in resident's spending on transportation
- Repurpose unused traffic lanes for a better CX

Image credit: Curbed IM Photo

Oslo - Sustainable City

- 50% reduction in emissions of greenhouse gases by 2020
- 95% climate neutral city by 2030
- 2/3 reduction in energy consumption for street lighting
- Reduction of health care costs by providing flats with assistive technology and smart interior design
- Open data initiative

Image credit: ScandicHotels.com

Why should the RIPE community care?

- The IoT is by all means a massive phenomenon with disruptive implications
- Affects directly the Internet
- Security concerns in the background
- IoT cannot be approached in a conventional network-based mindset
- The RIPE community is highly interested in the IoT direct applications
- Direct effect on number resources??

Questions

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