CAICT 中国信息通信研究院
China Academy of Information and Communications Technology

Development trend and the ecosystem construction of IoT

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outline

1
Overview
2
Policy and Strategy
3
Deployment and Application
4
Technologies and Standard
5
Security and Privacy

Hot: Global capital markets are active in the IoT domain!

" Worldwide Semiannual Internet of Things Spending Guide" , IDC, July 2016

Country / Region	IoT Spending (2016)	CAGR (to 2019)	Area
USA	232 billion	16.1%	Manufacturing, transportation, building
Europe (France, Germany, Italy, United Kingdom, Spain)	140 billion	21.8%	Industry, smart grid, connected vehicle

2011→2015:
Investment on **Wearable and healthy** areas are the most popular

2015→now:
Investment on **industrial** areas is the most popular

Why: IoT will open up a new space for development!

A new space for economic growth

- The development of IoT greatly stimulated the technological innovation vitality, such as 5G network, cloud computing, big data, etc.
- The development of IoT also drive the integration innovation across different industry, such as smart manufacturing, connected vehicle, new material, etc.
- New economic growth points are emerging.

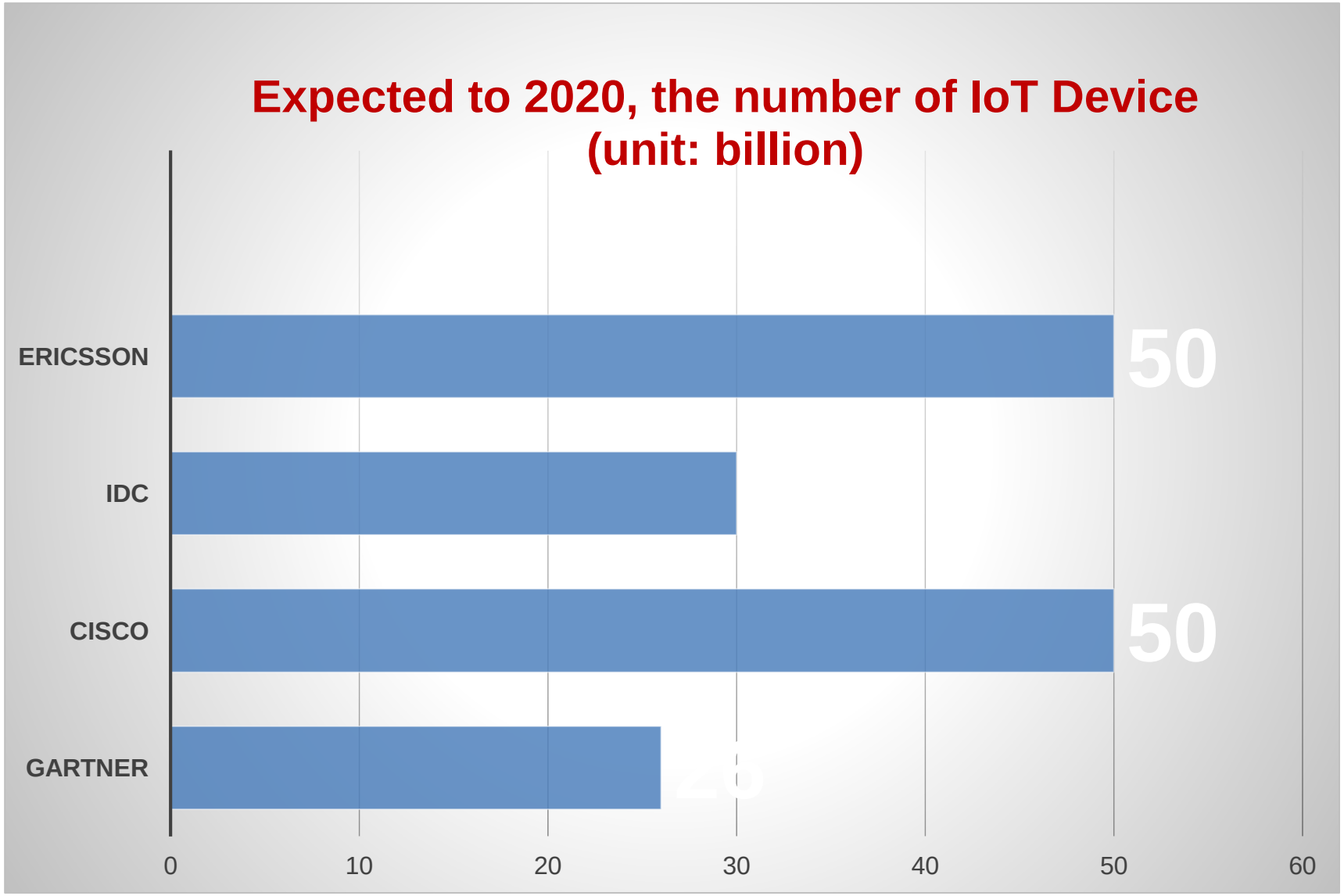
A new space for industrial investment

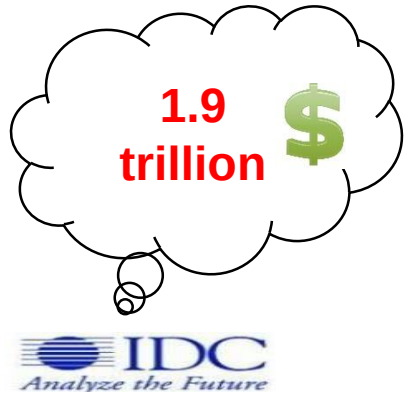
- The development IoT will further promote high-speed, mobile, security, ubiquitous information infrastructure.
- The development of IoT will drive intelligent transformation on energy, transportation and other important social infrastructure.

A new space for information consumption

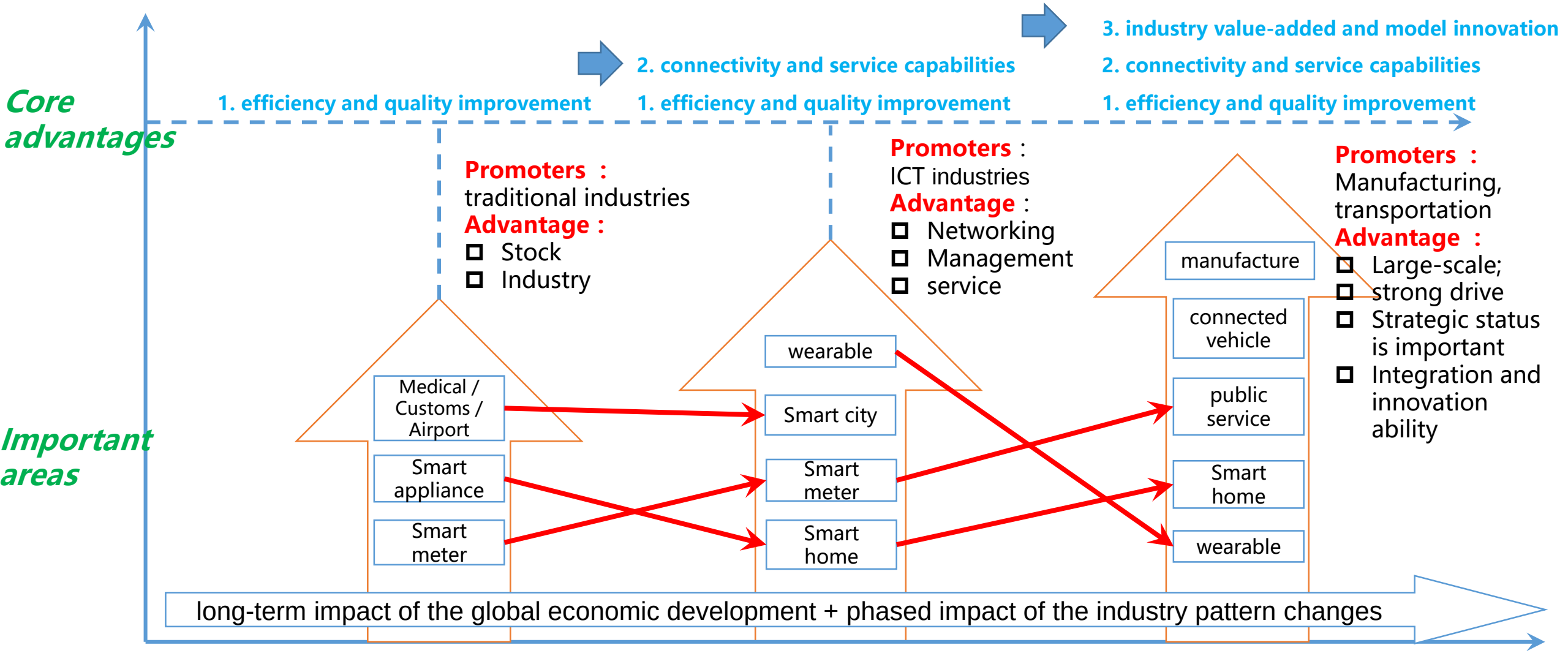
- Intelligent wearable device, smart home, self-driving car, and many other new products continue to emerge. These new information products and information services will constantly stimulate the demand of consumer.

Long-term: Internet of Everything (IoE) scale is significant





Short-term: IoT is entering the third wave of development

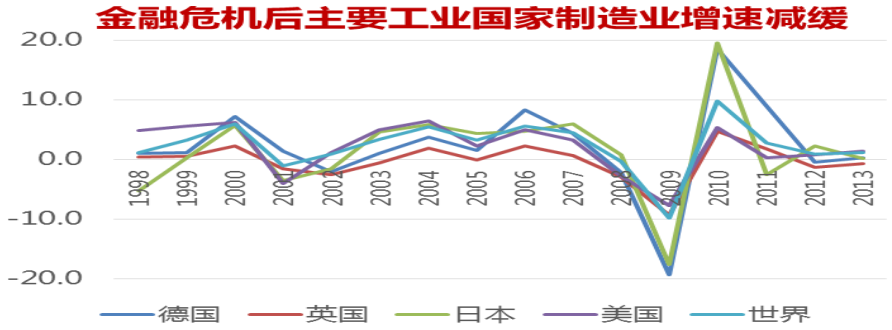


Driving force: strategic industry + large-scale market

National Strategy: reconstruction of national strategic basic industries

IoT

Within the industry : focusing on high value-added and large-scale consumer market



refactoring advantage

- **USA**: Advanced Manufacturing
- **Germany**: Industry 4.0
- **France**: New Industrial France
- **China**: China manufacturing 2025

large number of users

large-scale market

typical applications

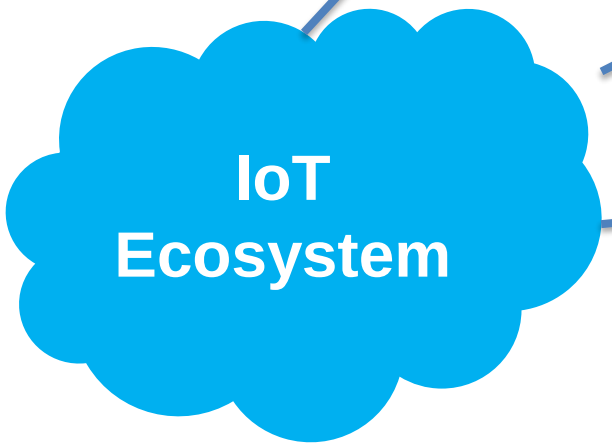
meter reading

connected vehicle

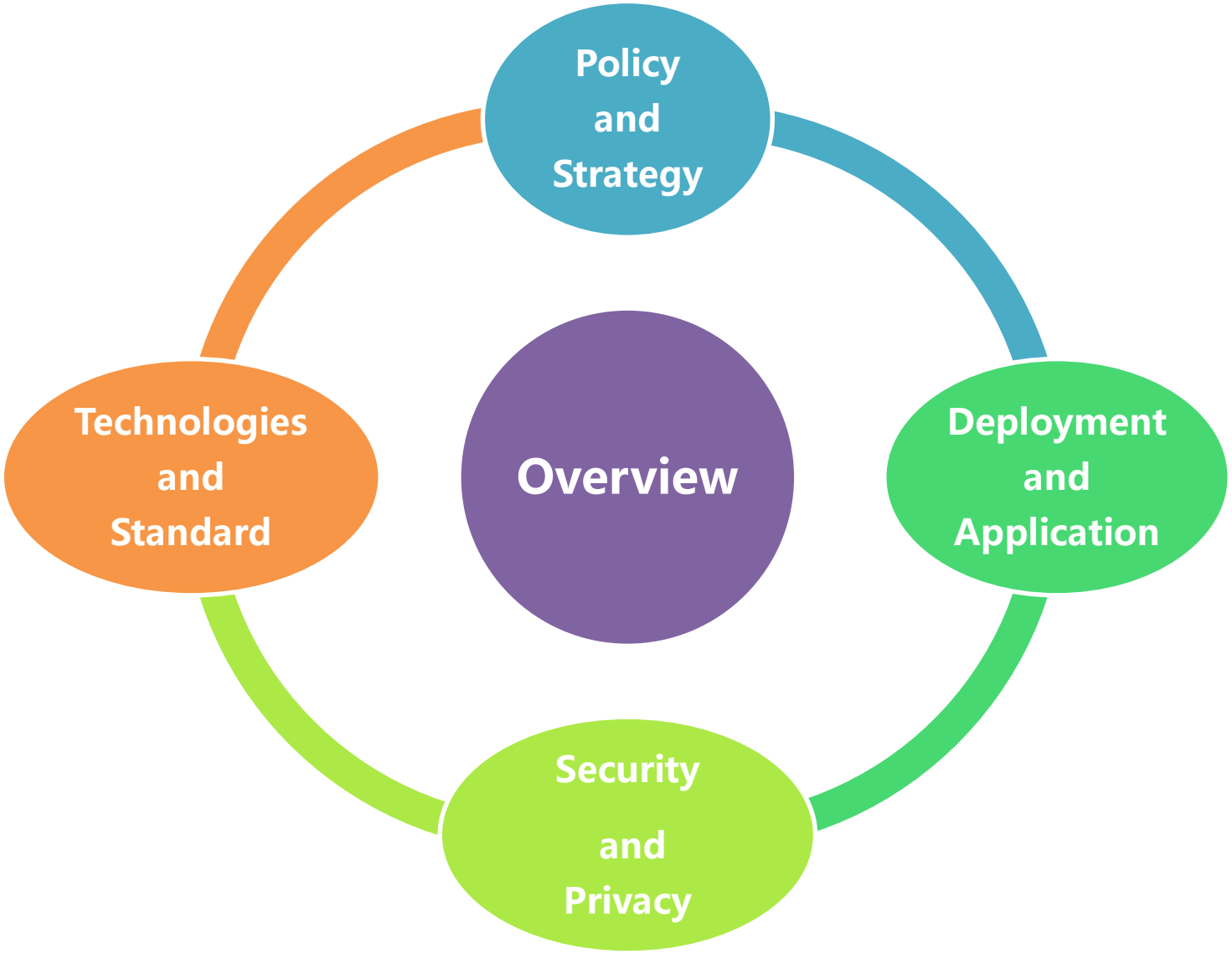
smart home

Question

- How to follow the wave ?
- How to meet the challenges ?
- How to promote the development ?



Solution. Ecosystem construction of IoT



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Change: from “ comprehensive” to “focus”

V.S

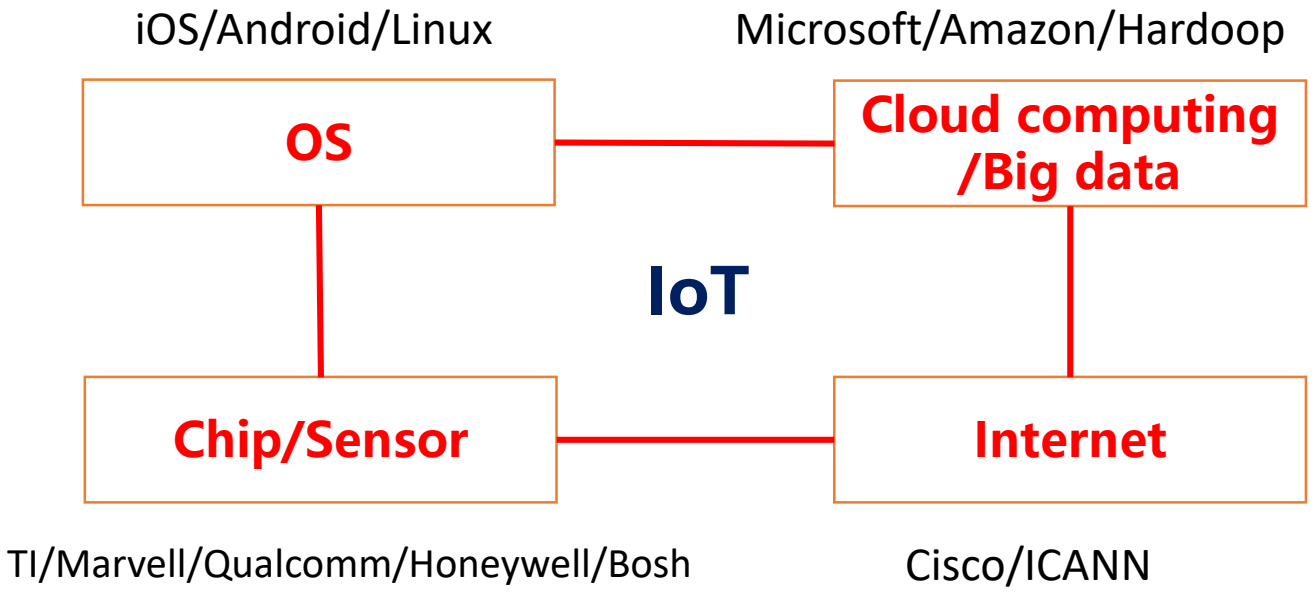
V.S

- In June 2016, the US government announced the establishment of a new intelligent manufacturing innovation institutions, which is led by the Department of Energy, and managed by the US Smart Manufacturing Leadership Coalition (SMLC).
- The US government will spend $ 70 million to focus on promoting the adoption of open source digital platforms and technology, in order to integrate advanced sensors, controllers, platforms and modeling techniques into commercial intelligent manufacturing systems.

- In March 2015, the China Ministry of Industry and Information Technology launched intelligent manufacturing pilot.
- In May 2015, the China State Council issued the "Made in China 2025" and deploy the comprehensive strategy to promote the implementation of manufacturing power.
- In 2016.6, the China Ministry of Industry and Information Technology issued “Innovation and development work program for Internet of Vehicle(IoE)“.

- The Germany government issued the “High-tech strategy 2020 for Germany" and "Industry 4.0”.
- As one of the top ten projects, Germany will invest € 200 million to support the development and innovation of a new generation of revolutionary technologies in industry, and upgraded “Industry 4.0” to national strategies.
- The three major industrial associations in Germany, BITKOM, VDMA, ZVEI, jointly established the " Industrial 4.0 Platform" to establish cross-border research groups and coordinate the resources of all parties.

USA: comprehensive advantages



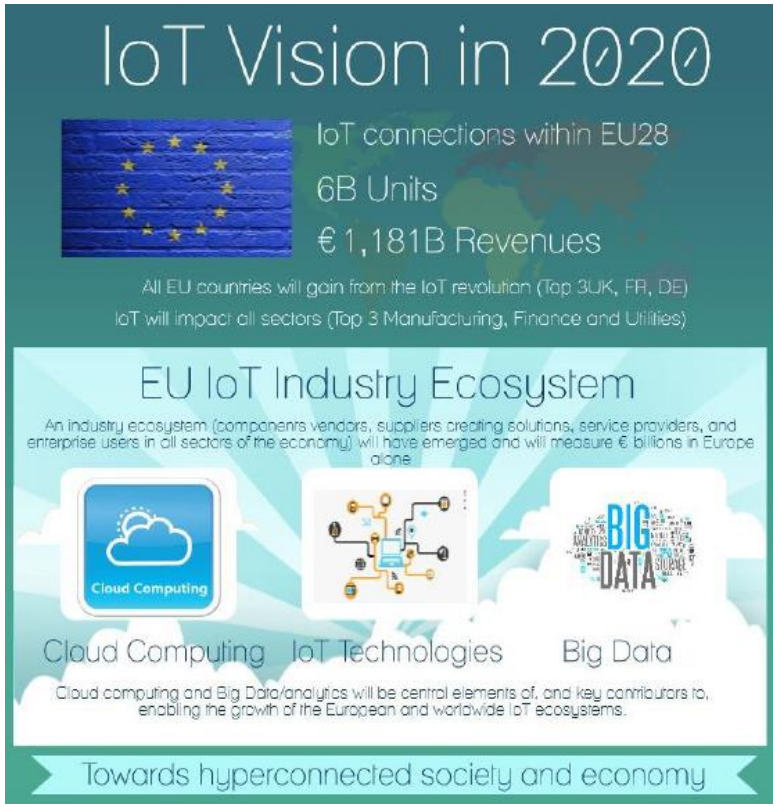
- **US States House of Representatives**: Energy and Commerce Committee announced the establishment of a bipartisan working group to review the Internet of Things policy, and submit a summary of recommendations.

- **US States Senate**: In April 2016, "Developing Innovation and Growing the Internet of Things (DIGIT) Act" was approved by the Senate Commerce Committee. A working committee will be established for the US government to promote IoT top-level framework design, innovative proposals, and spectrum planning, etc.

Europe: open-loop → an ecosystem

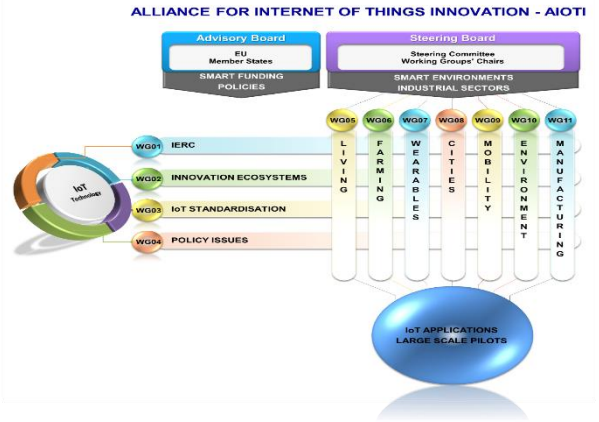
Digital Single Market (DSM):

- a single market for IoT;
- a thriving IoT ecosystem;
- a human-centered IoT approach.



1. Research

2. Alliance



3. Platform

IoT European Platforms Initiative

Year	Project	ID	Project Name	Sum
2014-2015	LEIT-ICT	ICT-30–2015	Internet of Things and Platforms for Connected Smart Objects	49
2016-2017	Cross domain	IoT-01-2016	Large Scale Pilots	100
		IoT-02-2016	IoT Horizontal activities	4
		IoT-03-2017	R&I on IoT integration and platforms	35

Smart living environments for ageing well [€ 20 million]

Smart Farming and Food Security [€ 30 million]

Wearables for smart ecosystems [€ 15 million]

Reference zones in EU cities [€ 15 million]

Autonomous vehicles in a connected environment [€ 20 million]

China: transformation & upgrade & cooperation

China attaches high importance to the integration and development of new information technology and advanced manufacturing

Roadmap and main contents

2002 — Propose "Using Information technology to drive industrialization, while industrialization to promote information technology

2007 — "To develop modern industrial system, and vigorously promote the integration of information and industrialization", the concept of the integration of these two aspects."

2010 — Promote the deep integration of information and industrialization, promote the informatization of economic and social fields

Currently — Comprehensively promote the deep integration of the two.

Made in China 2025

Internet+

China： Internet+

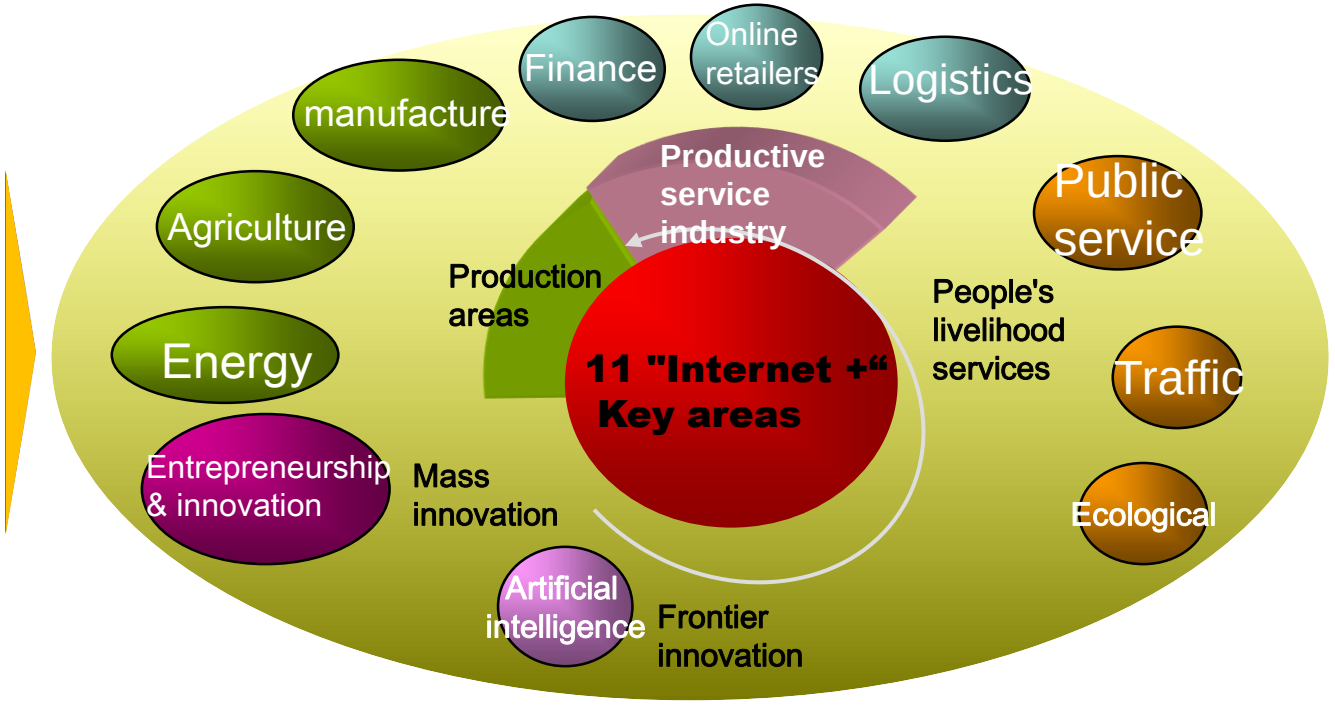
The key direction of "Internet+" action

"Internet+ " Guideline put forward 11 special actions, covering production, human living, innovation and others. "Internet + manufacturing" is focus on industry, which is the most important field.

Key economic areas

Important human living areas

Entrepreneurship & innovation



China：Made in China 2025

"Made in China 2025 "is adapt to global a new round of science and technology revolution and the industrial revolution trend, to accelerate the development of Chinese manufacturing industry, to provide new impetus to the development of China and the global strategic partnership to develop, upgrade and prosper.

Ten key areas

The new generation of information technology, high-end CNC machine tools and robots, aerospace equipment, etc.

Nine tasks

Improve the innovation capability of the national manufacturing industry, **Promote the integration of information and industrialization** , etc.

Five major projects

Manufacturing innovation center construction, intelligent manufacturing, strong industrial base, green development, high-end equipment innovation , etc.

Promote the integration of information and industrialization

Intelligent manufacturing development strategy

Intelligent manufacturing equipment and products

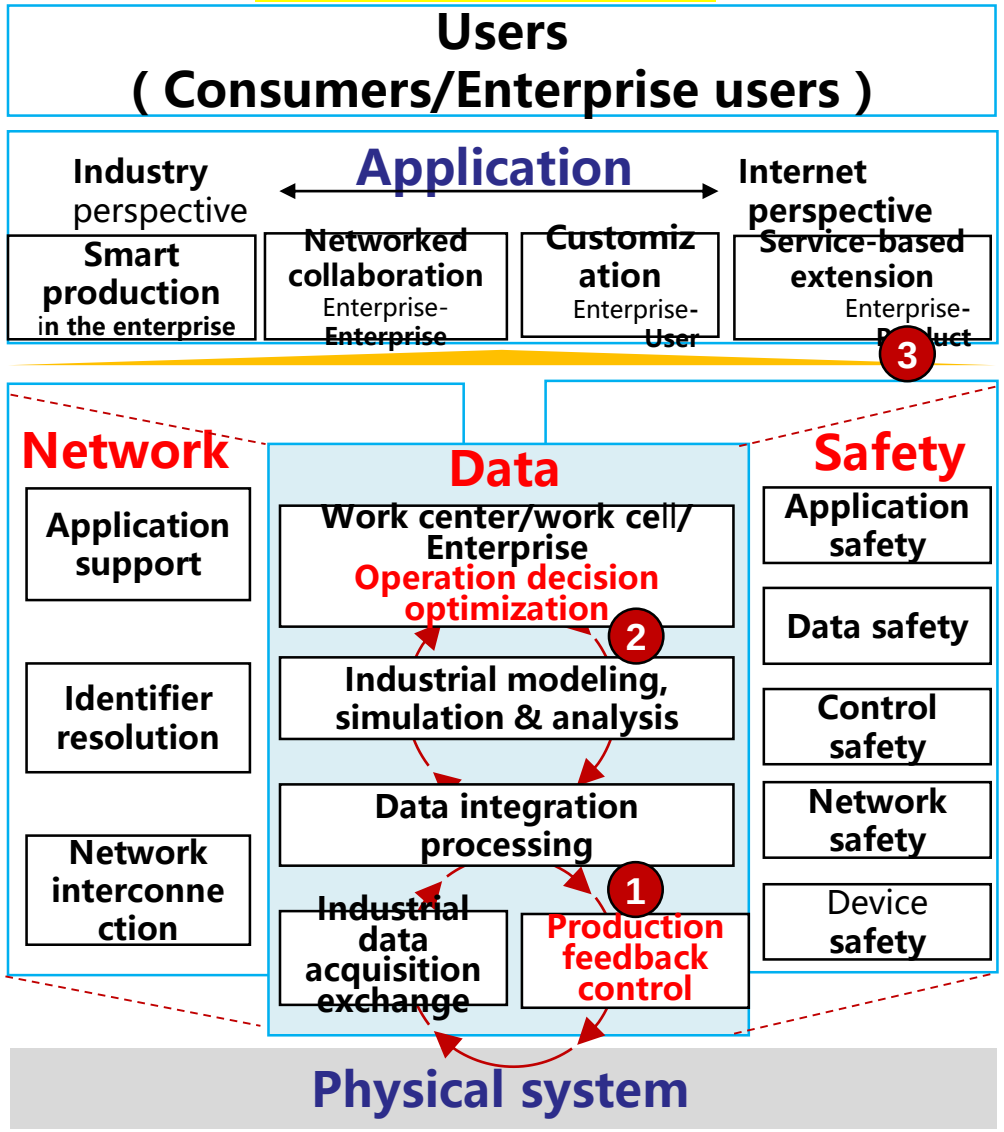
Intelligent manufacturing process

Deepen the application of the Internet in the manufacturing field

Internet infrastructure construction

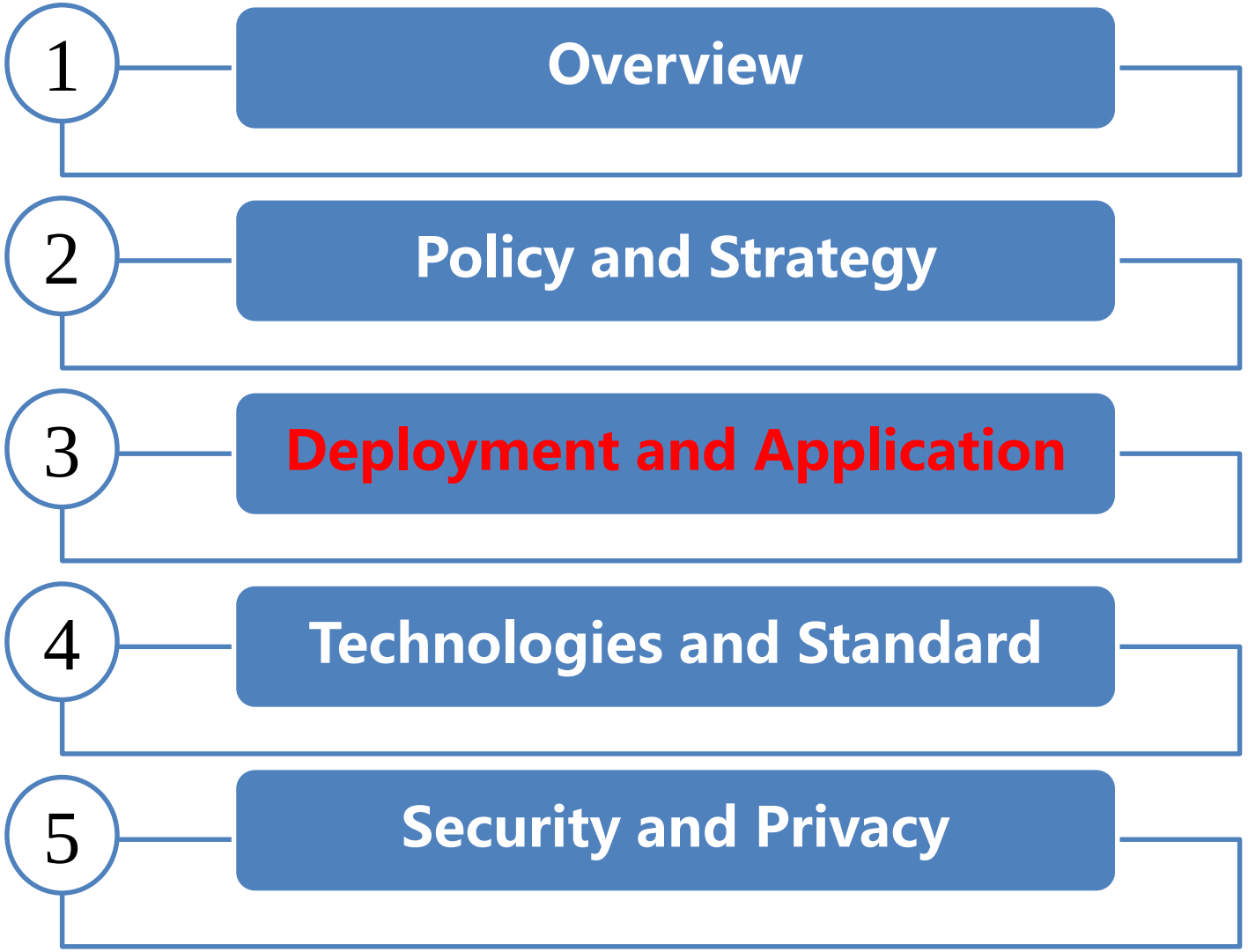
China： Industrial Internet

Architecture



Alliance

outline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1. added value is based on software and data services

App | Software | Business aggregation

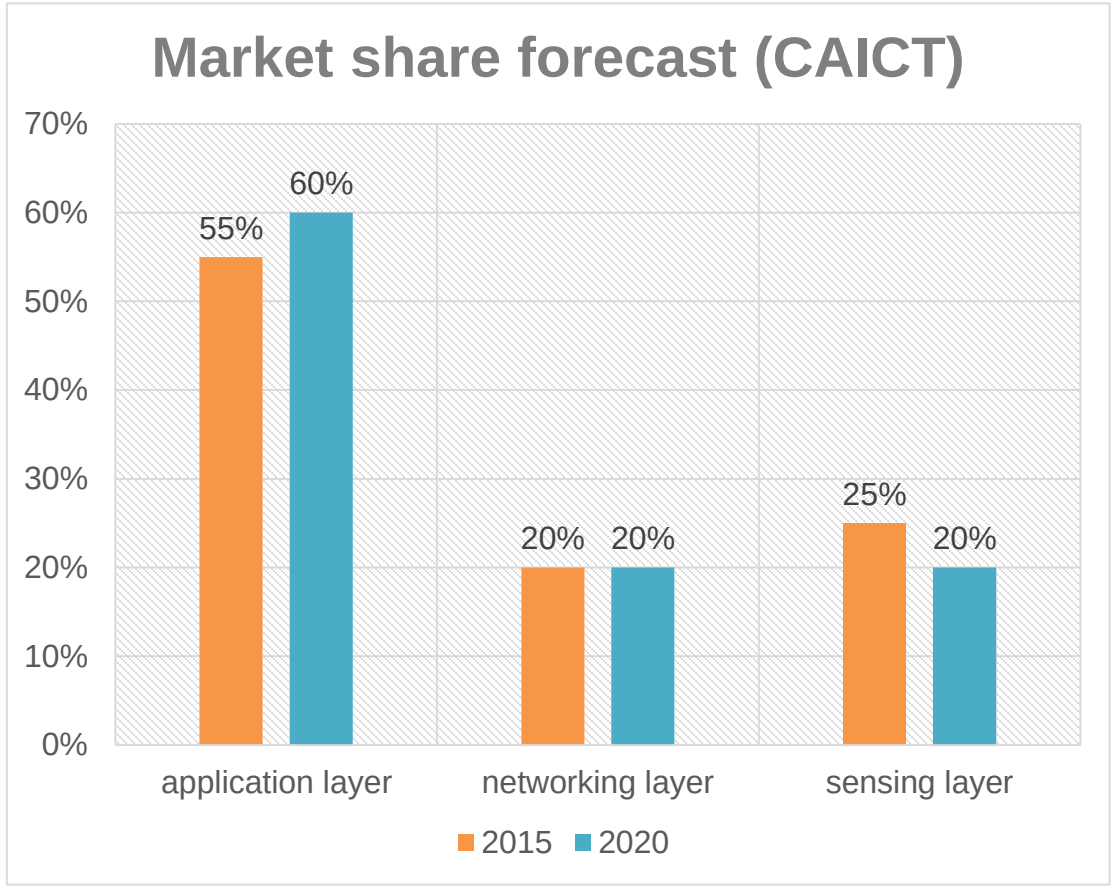
Application layer

Platform | Connection service | Cloud

Network layer

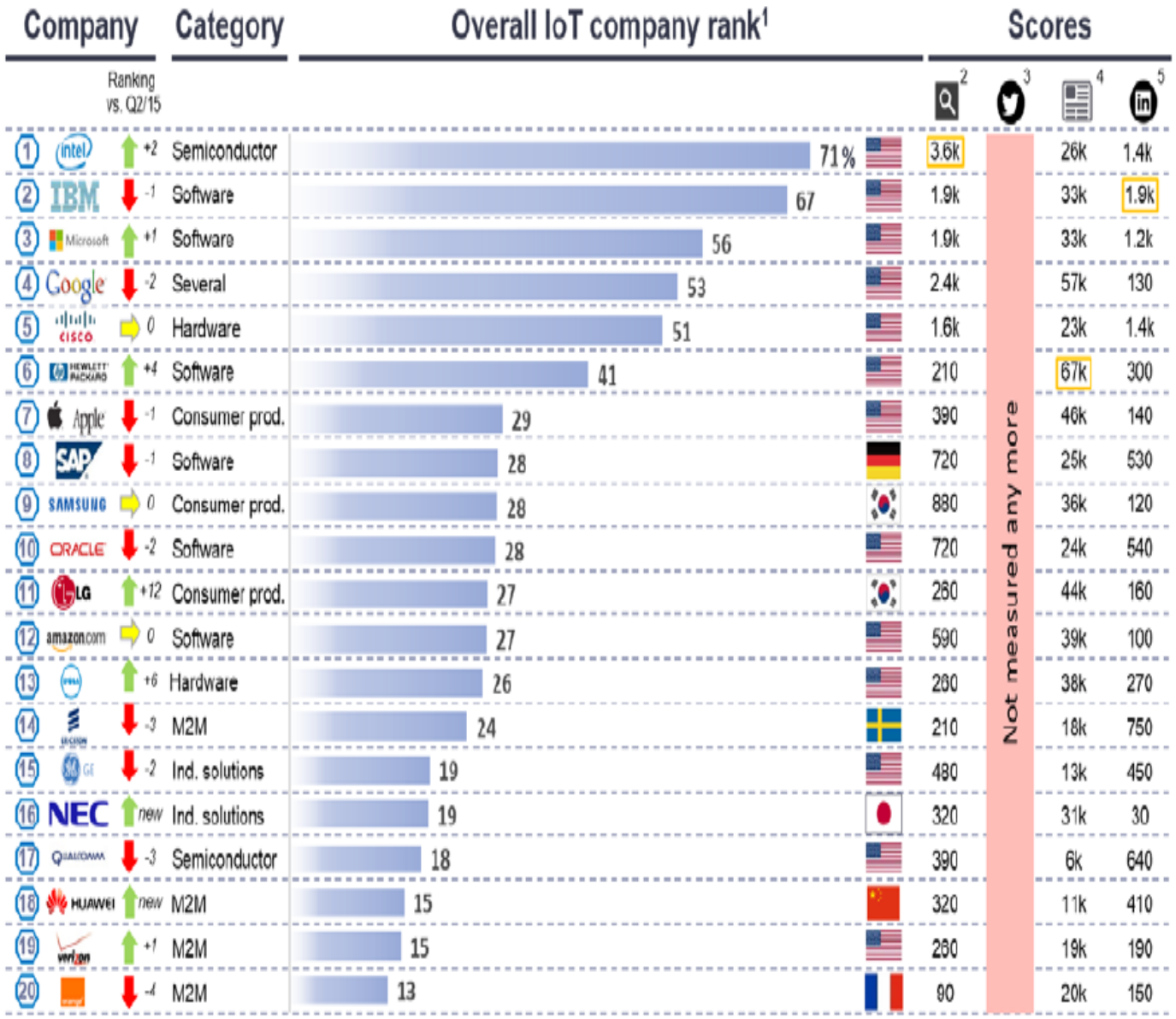
Sensor | Actuator | Robot | Hardware

Sensing layer



- **Now, the value of IoT is only a tip of the iceberg.**
- **75% of the platform service is still for storage and connection.**
- **The value of data is not fully reflected.**

2. Internet and IT giants become the new pillar



Ranking vs. Q2/15	Company	Category	Overall IoT company rank[1]		Scores [2]	[3]	[4]	[5]
1	intel	+2 Semiconductor	71%		3.6k	Not measured any more	26k	1.4k
2	IBM	-1 Software	67		1.9k		33k	1.9k
3	Microsoft	+1 Software	56		1.9k		33k	1.2k
4	Google	-2 Several	53		2.4k		57k	130
5	cisco	0 Hardware	51		1.6k		23k	1.4k
6	Hewlett Packard	+4 Software	41		210		67k	300
7	Apple	-1 Consumer prod.	29		390		46k	140
8	SAP	-1 Software	28		720		25k	530
9	SAMSUNG	0 Consumer prod.	28		880		36k	120
10	ORACLE	-2 Software	28		720		24k	540
11	LG	+12 Consumer prod.	27		260		44k	160
12	amazon.com	0 Software	27		590		39k	100
13		+6 Hardware	26		260		38k	270
14	Ericsson	-3 M2M	24		210		18k	750
15	GE	-2 Ind. solutions	19		480		13k	450
16	NEC	new Ind. solutions	19		320		31k	30
17	Qualcomm	-3 Semiconductor	18		390		6k	640
18	HUAWEI	new M2M	15		320		11k	410
19	verizon	+1 M2M	15		260		19k	190
20	orange	-4 M2M	13		90		20k	150

Leader

IT Company

CISCO Jasper platform

IBM Waston platform

Microsoft WIN10 Azure

SAP HANA

+

Internet Company

homeKit

Google NEST Brillo OS

amazon.com Echo AWS IoT

Alibaba Group YunOS IaaS/PasS

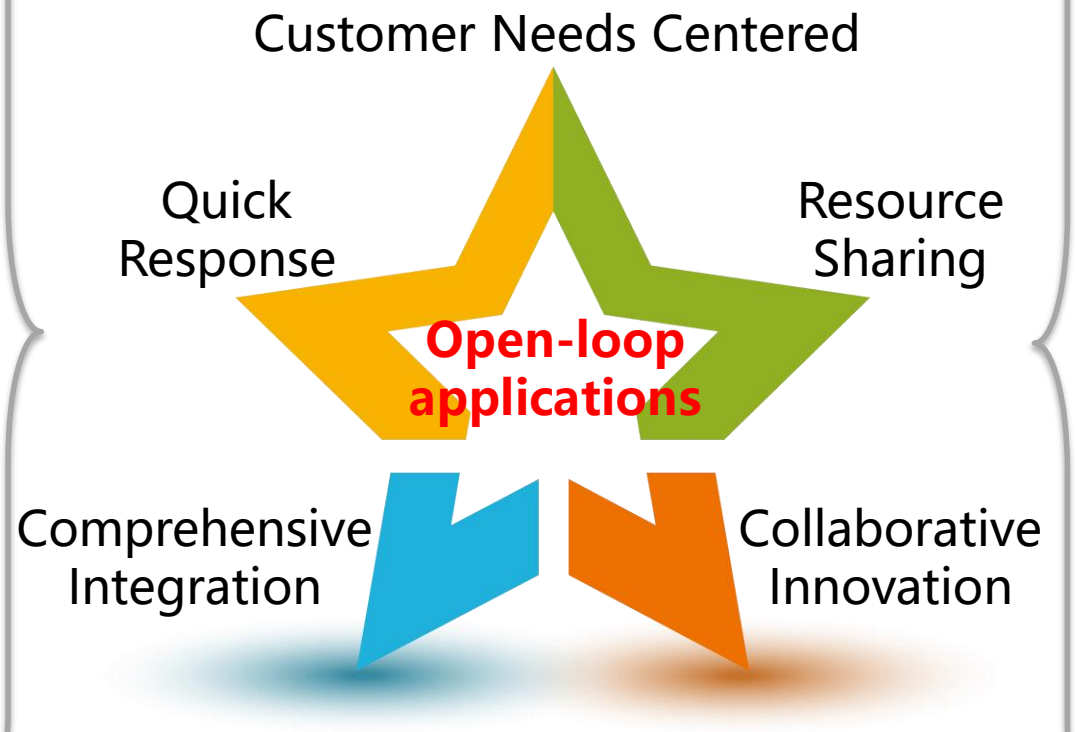
Promoter

3. from closed-loop to open-loop applications

- emphasis on system construction, neglect operations;
- emphasis on hardware, neglect software;

- A large number of information islands;
- Data values are not reflected;

- The service pattern for user needs is a fragmented and passive response mode.



Service Content:
- Sensing drive data aggregation;
- Data drive innovation services;

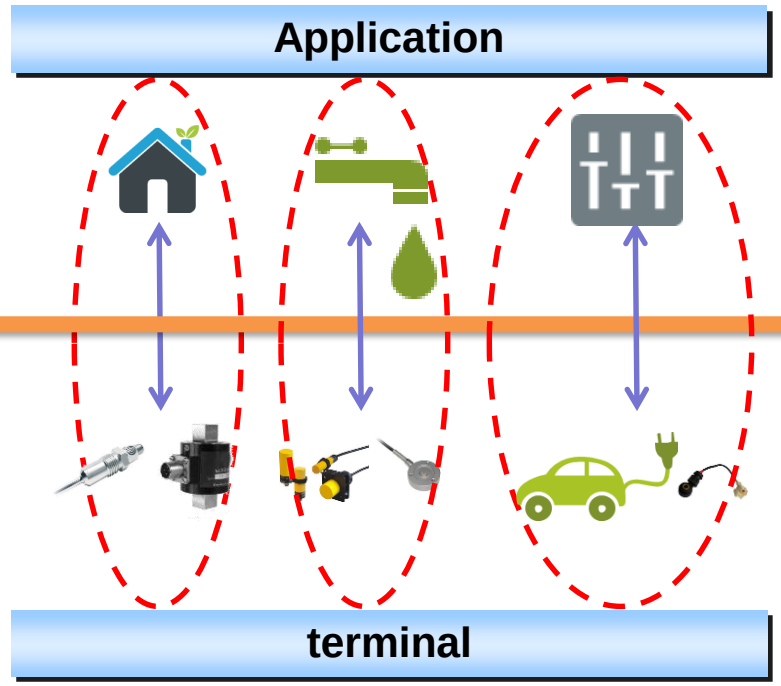
Service Range:
- Integration the scattered resources from different industries;

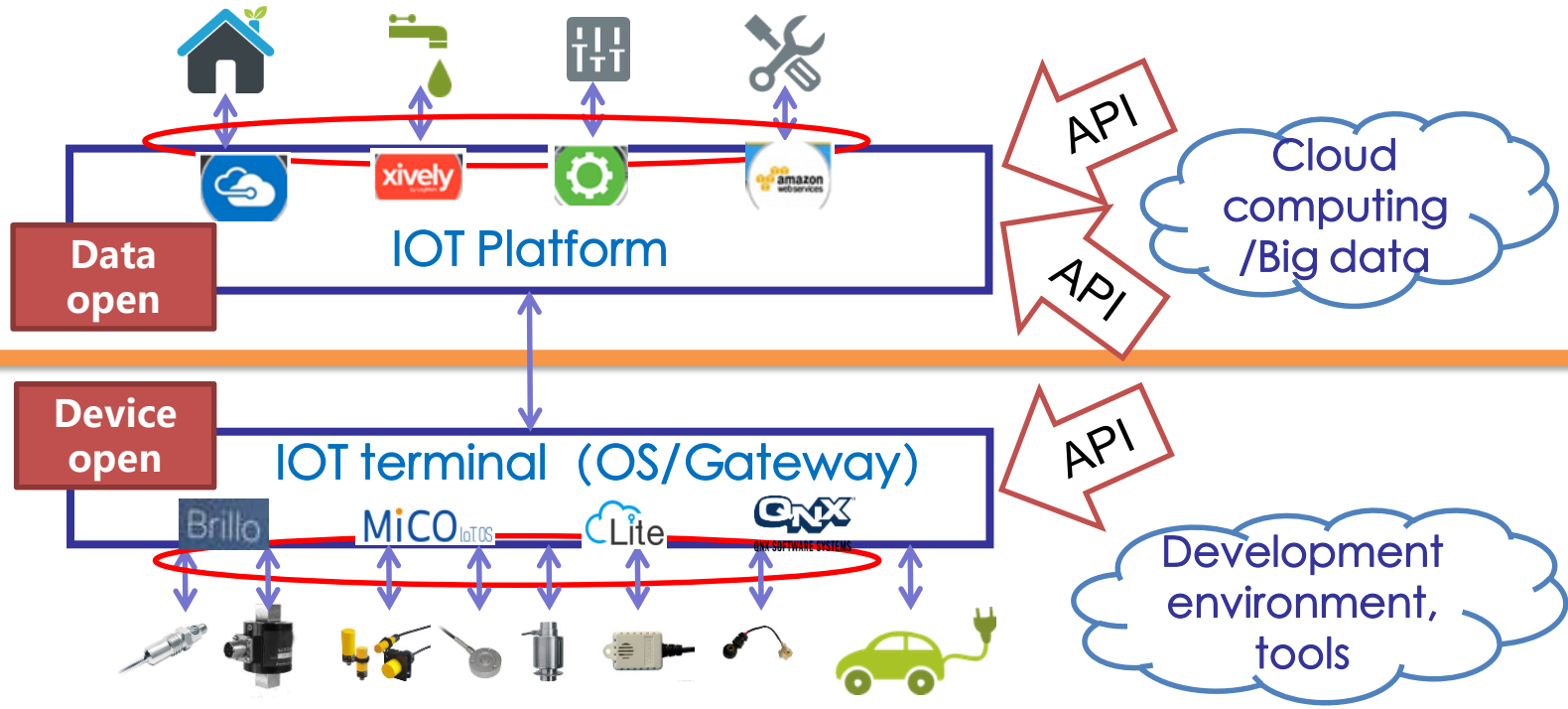
Service Mode:
- Sharing resources and data among the upstream and downstream of the industrial chain;
- Forming a win-win ecosystem.

4. from vertical closing to horizontal opening

Vertical & closure

Horizontal & opening





"Application" as the core

"Platform + AI + Big data" as the core

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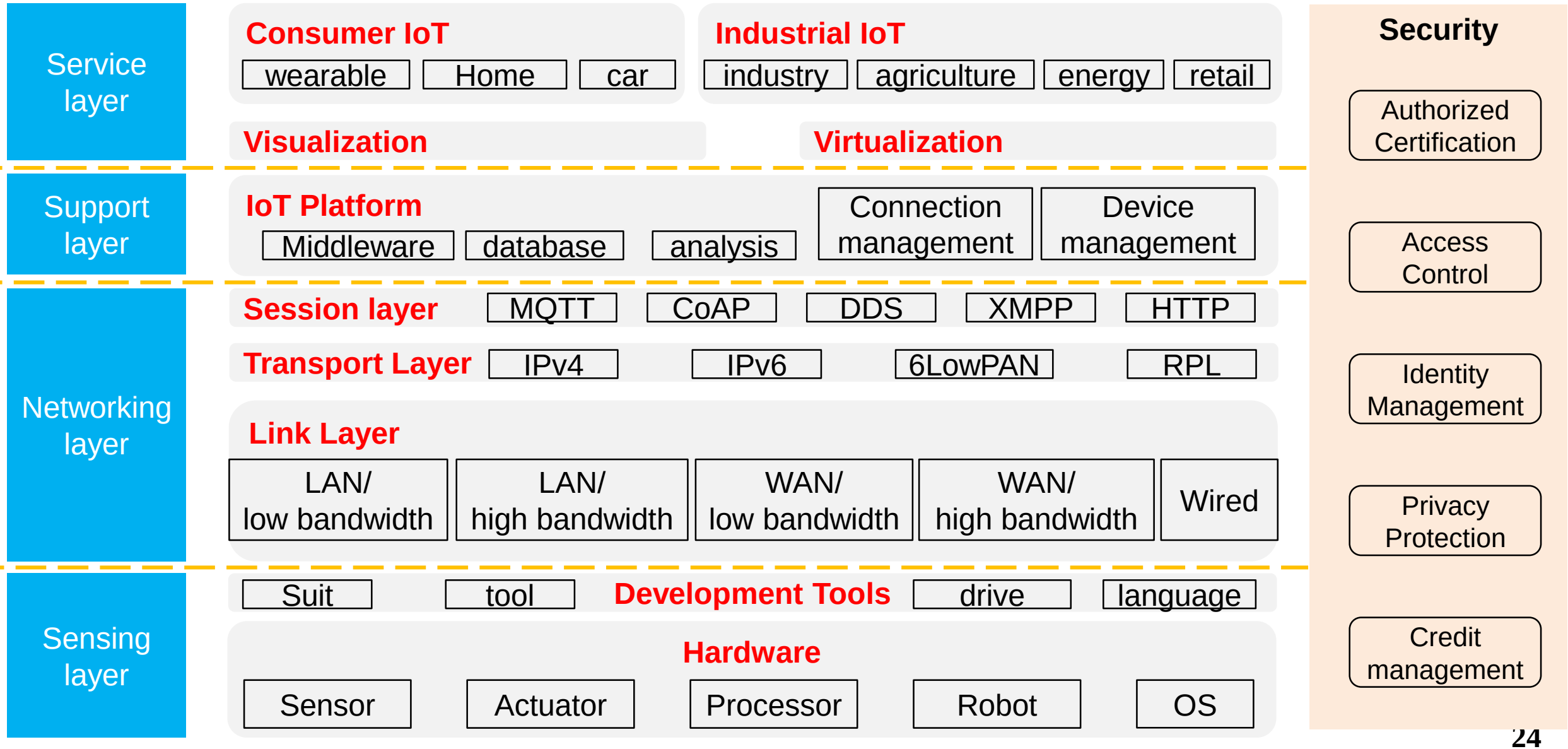
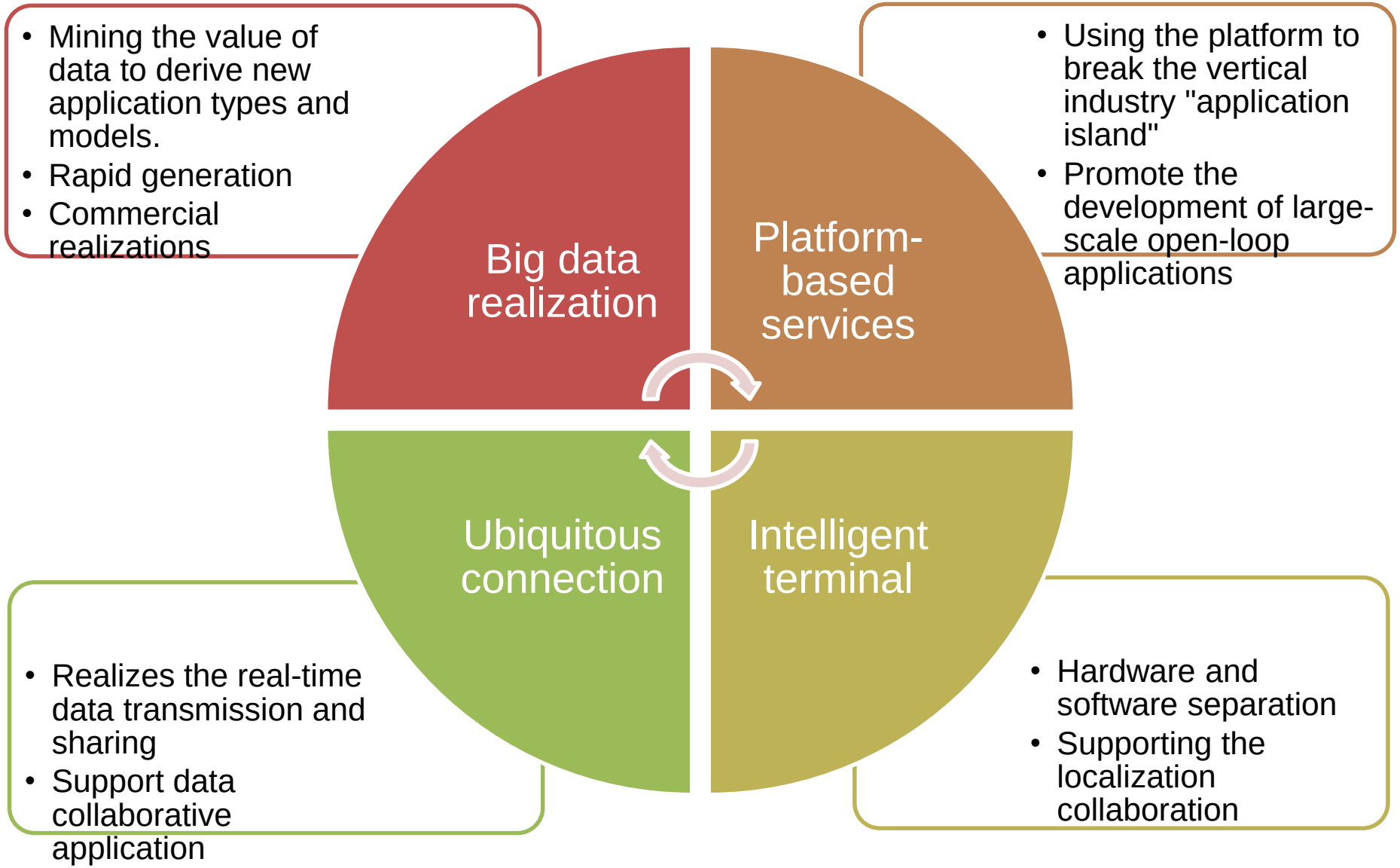
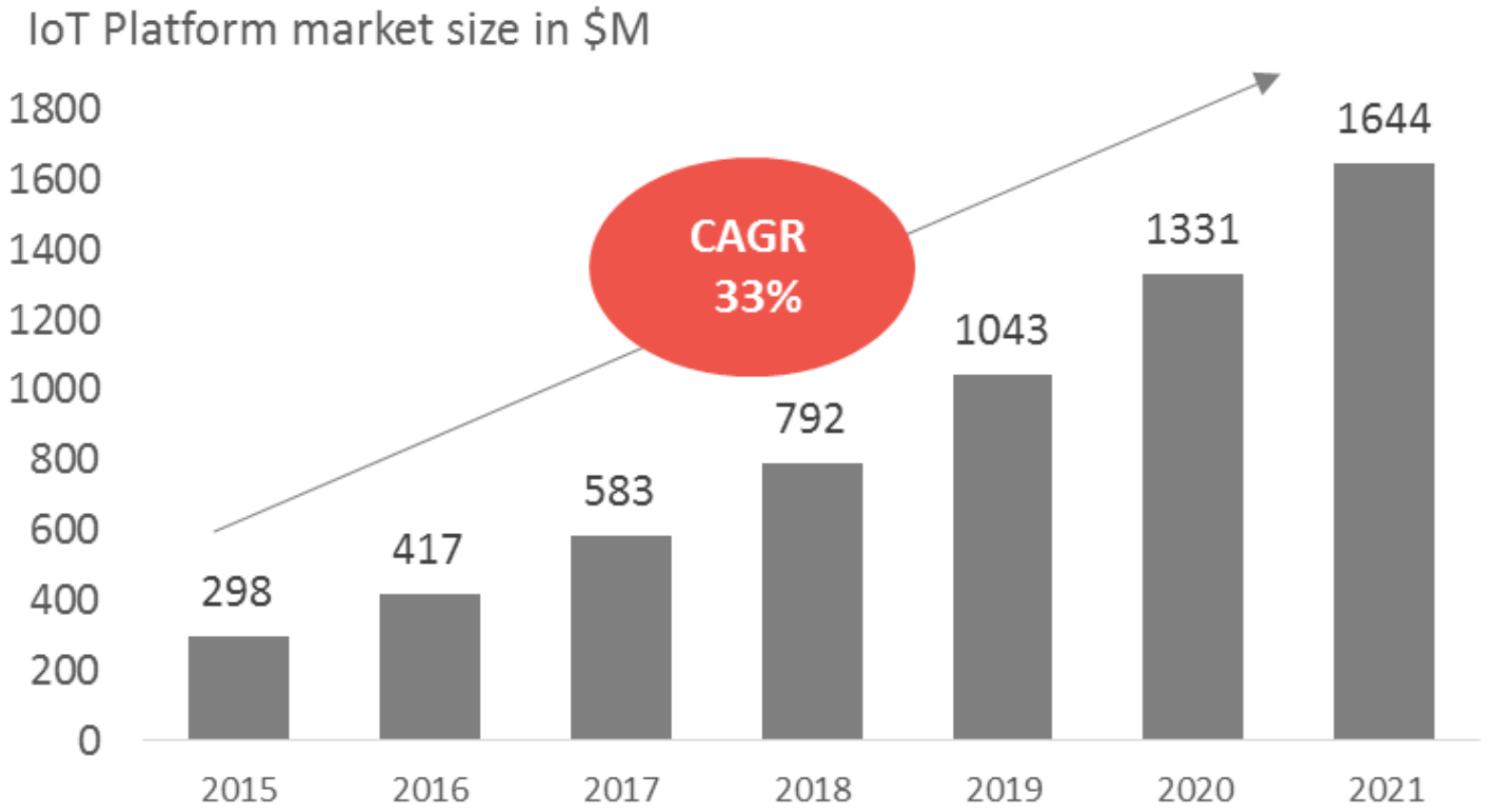
Technology: framework and architecture



Technology: in order to eliminate fragmentation

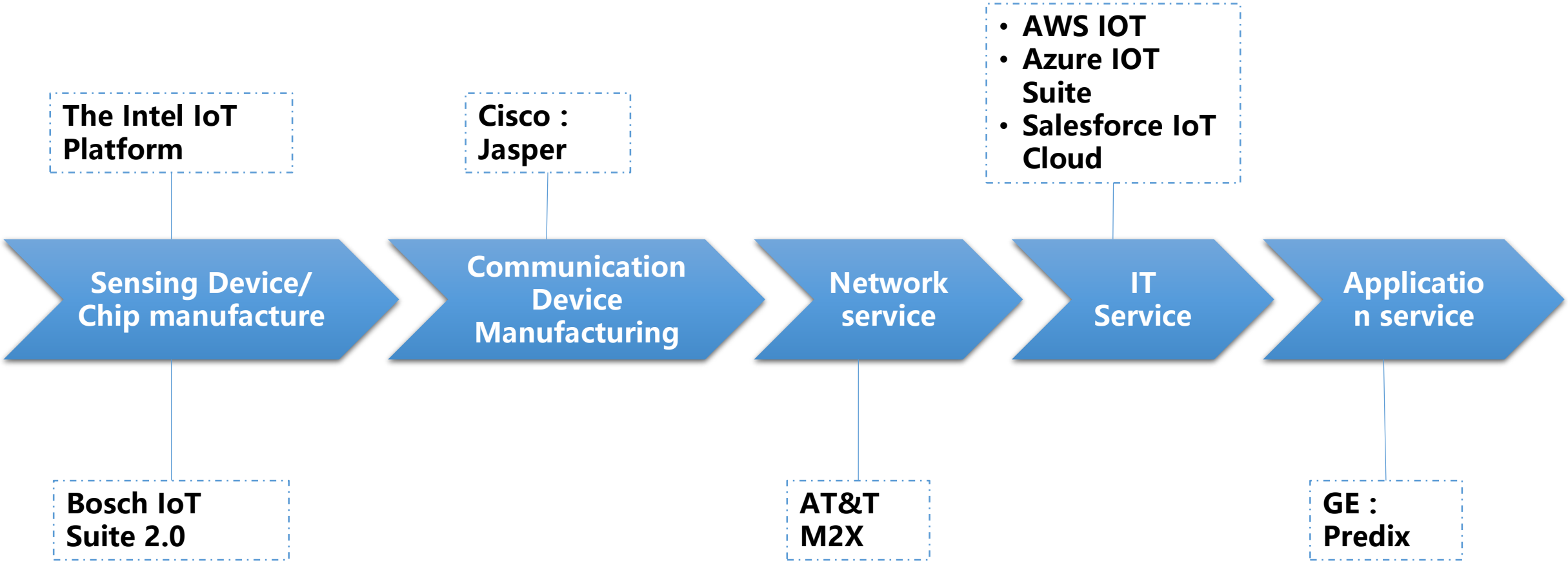


1. Platform-based services



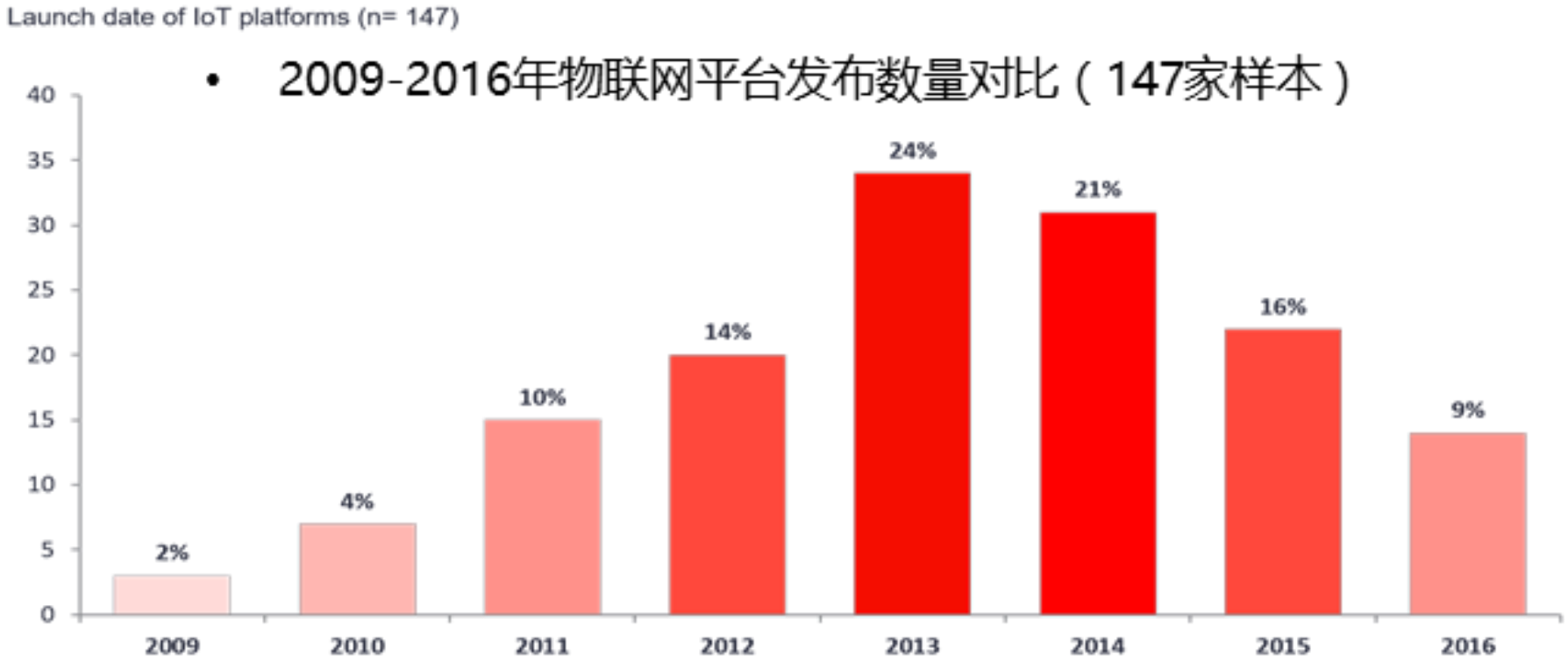
- IOT Analytics estimates that the IOT platform revenue scale will remain 33% growth in 2020 to 1.6 billion $.
- Berg Insight estimates that the revenue will reach € 610 million in 2015 and is expected to reach 3.05 billion in 2021, in line with a growth rate of 30.8%.

Leading enterprises in every sectors are to start the layout



(A). Construction

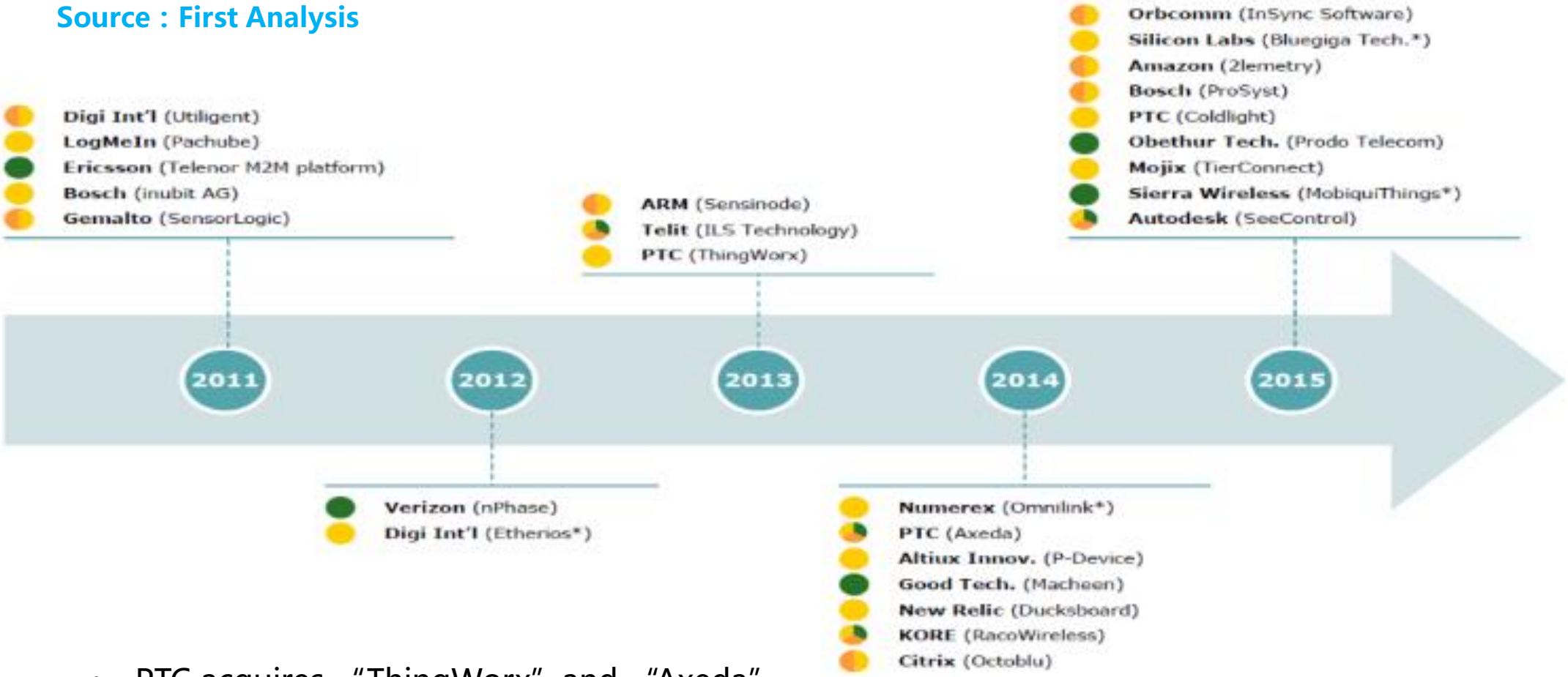
Source：IOT analystics



- Amazon, Microsoft, IBM, and other enterprises actively launch the Internet of Things suite.
- GE create a new platform such as “Predix”.

(B). Merger

Source：First Analysis



- PTC acquires "ThingWorx" and "Axeda".
- Cisco acquires "Jasper".
- Amazon AWS acquires "2elemtry".

(C). Cooperation

Jasper®

建设物联网平台

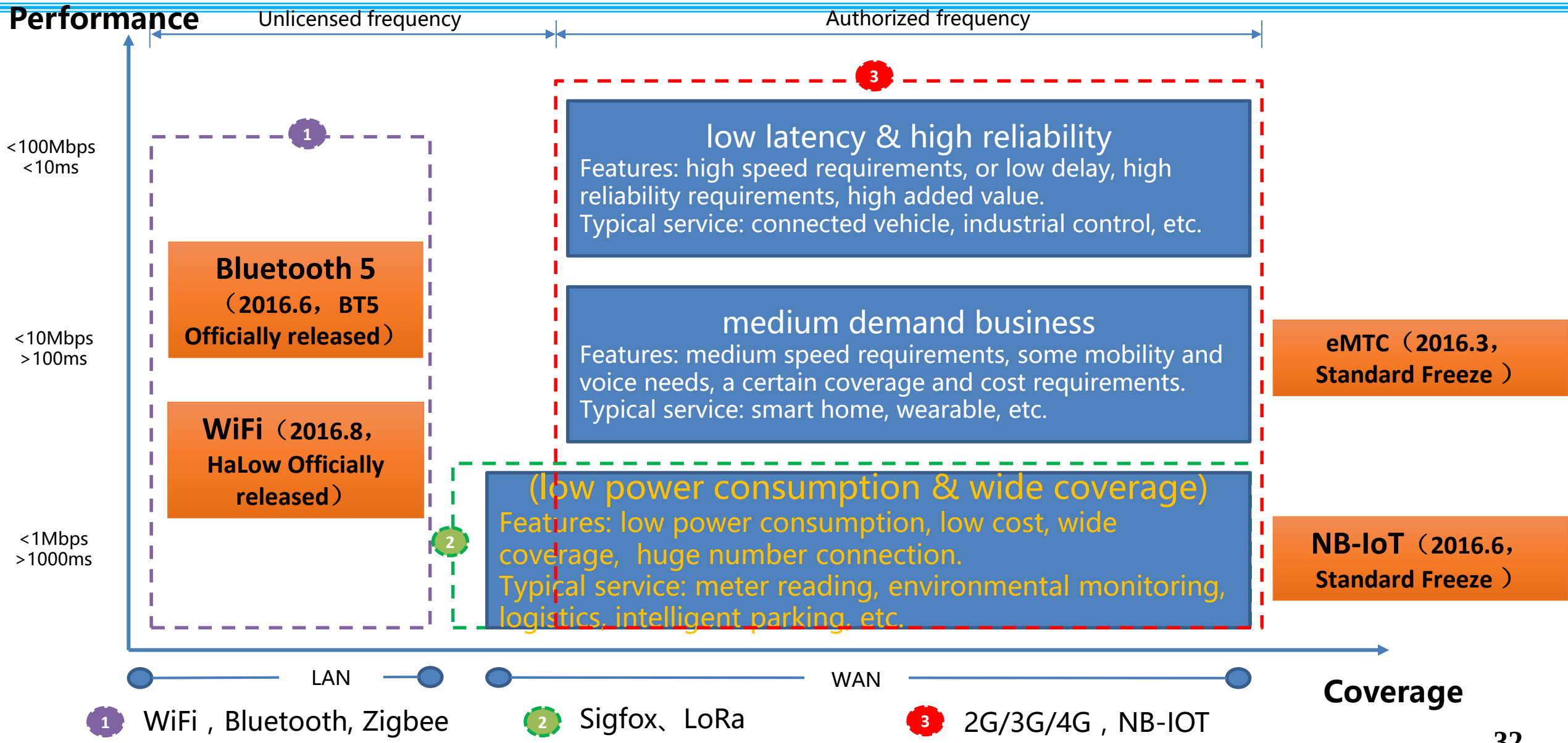
提供网络服务

1. Platform-based services

	连接与标准化	设备管理	事件处理	数据库	数据分析	数据可视化	外部接口	附加工具
Predix	√+	√	√+	√	√	√	√	√
微软Azure	√	√	√+	√+	√+	√+	√	√
IBM Watson	√	√-	√-	√+	√+	√+	√	√+
Inter IoT	√+	√+	√-	√-	√	√	√	√
AWS IoT	√-	√-	√	√+	√	√	√+	√
M2M智能	√+	√+	√-	√-	√-	√	√	√-
ThingWorx	√+	√	√-	√+	√-	√	√	√-
Salesforce	√	√	√+	√-	√	√	√-	√-
SAP HANA	√-	√	√	√-	√	√	√	√

- Early platform service providers mainly for the single-layer function to build an independent platform, while the current giant enterprise platform provide a full-featured integration.
- In the future, the Industrial Internet of things will has a large number of applications, devices, and data, so that produce higher requirements for the IoT platform.

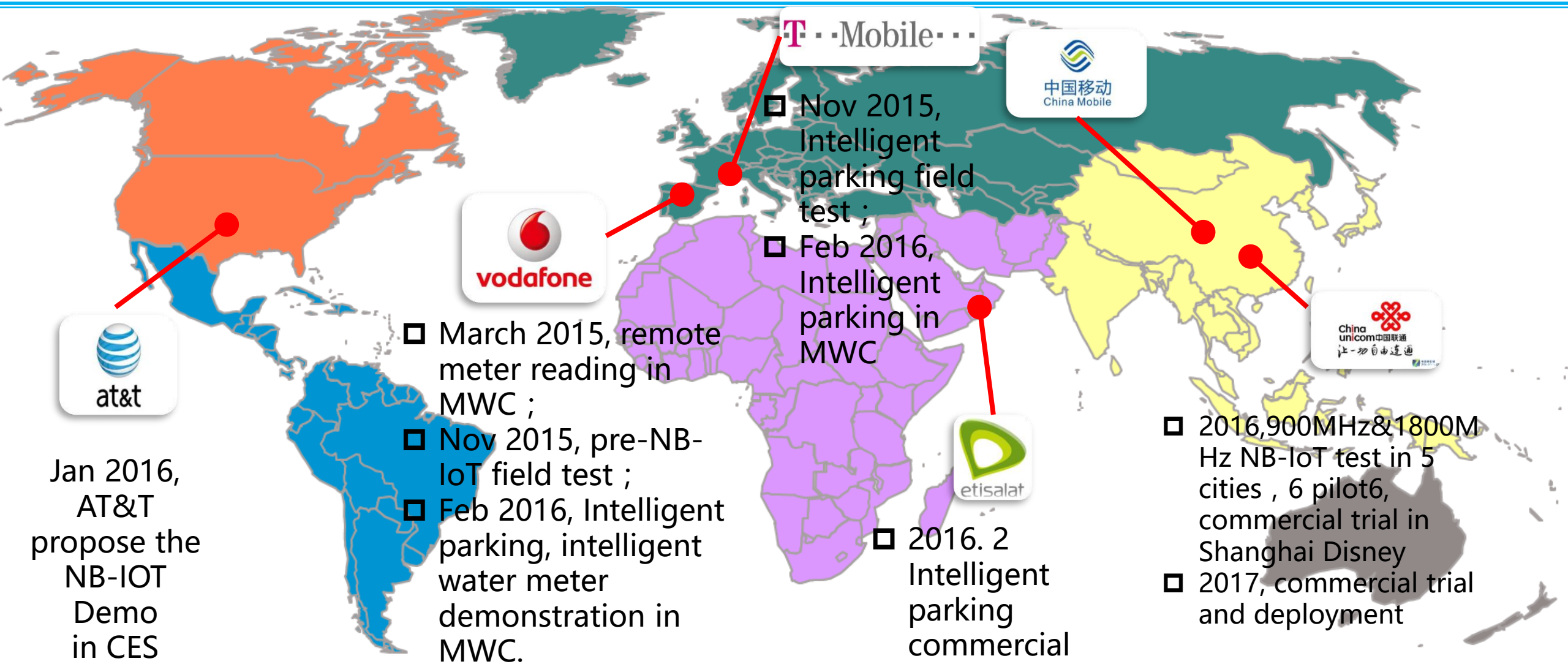
2. Ubiquitous connection



NB-IOT has obvious advantages than other WAN technology

		Low power and wide area needs	New	No-Cellular		IoT Optimization Based on Existing Cellular				
			NB-IoT	LoRA	Sigfox	EC-GSM	TD-LTE Cat.1	TD-LTE Cat.0	TD-LTE Cat.M	FDD Cat.M
cover		Extensive	**164dB**	155dB	160dB	154dB	146.7dB	146.7dB	155.7dB	155.7dB
consumption		> 10 year	**10 year**	3-5 year	10 year	10 year	<0.1 year	5 year	10 year	10 year
module cost		<5$	**<5$**	7$	<5$	15$	15$	10$	<10$	<10$
connections		50 000/Cell	**50 000**	10 000	10 000	20 000	1200（RRC）	1200（RRC）	18 000	18 000
speed	Up peak	>160kpbs	**70kpbs**	5.9kpbs	100kpbs	170kpbs	1Mkpbs	200kpbs	200kpbs	1Mkpbs
	Down peak	<160kpbs	**30kpbs**	5.9kpbs	100kpbs	290kpbs	7Mkpbs	750kpbs	750kpbs	800kpbs
other	mobility	**Low speed / no business continuity**					High speed /business continuity			
	voice	No need	**not support**	not support	not support	not support	support	not support	support	
maturity			**Commercial trial in 2016**	Commercial	Commercial	Commercial	deployment	Stand freeze	Stand freeze in late 2016	

NB-IOT accelerates the global business process



Jan 2016, AT&T propose the NB-IOT Demo in CES

- March 2015, remote meter reading in MWC ;
- Nov 2015, pre-NB-IoT field test ;
- Feb 2016, Intelligent parking, intelligent water meter demonstration in MWC.

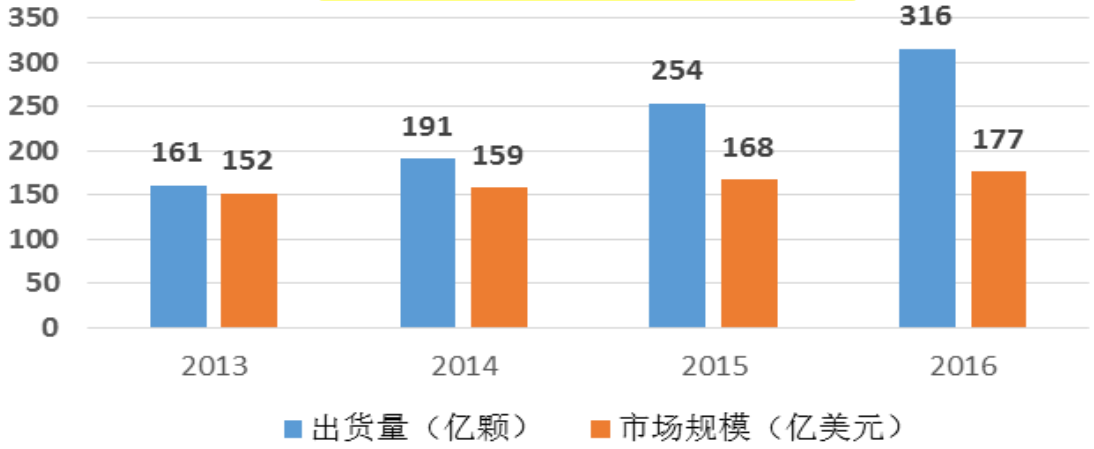
- Nov 2015, Intelligent parking field test ;
- Feb 2016, Intelligent parking in MWC

- 2016. 2 Intelligent parking commercial trial

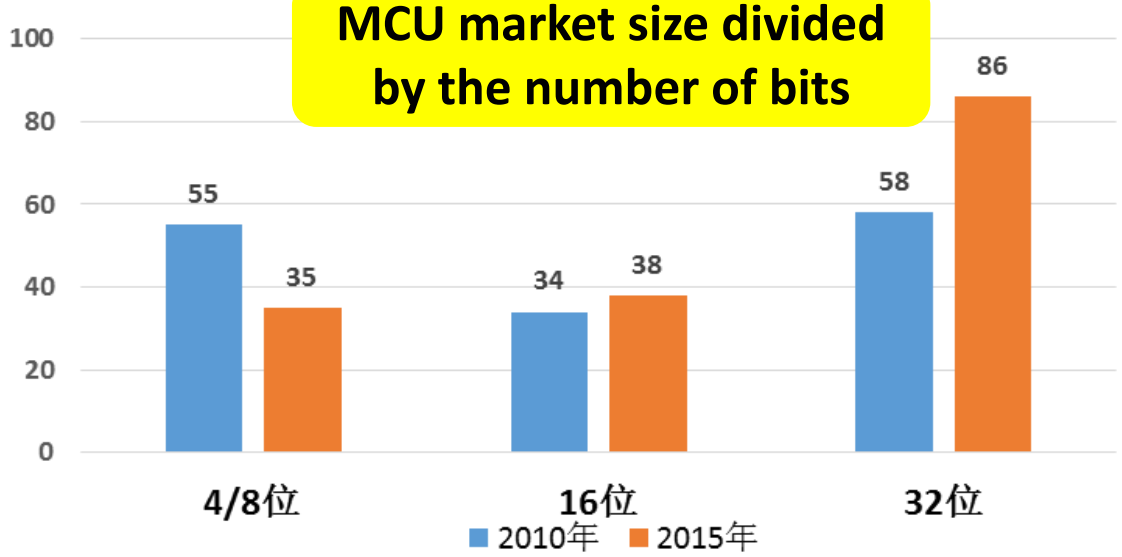
- 2016,900MHz&1800MHz NB-IoT test in 5 cities，6 pilot6, commercial trial in Shanghai Disney
- 2017, commercial trial and deployment

3. Intelligent terminal——IoT Chip (Microcontroller Unit, MCU)

MCU shipments and market size

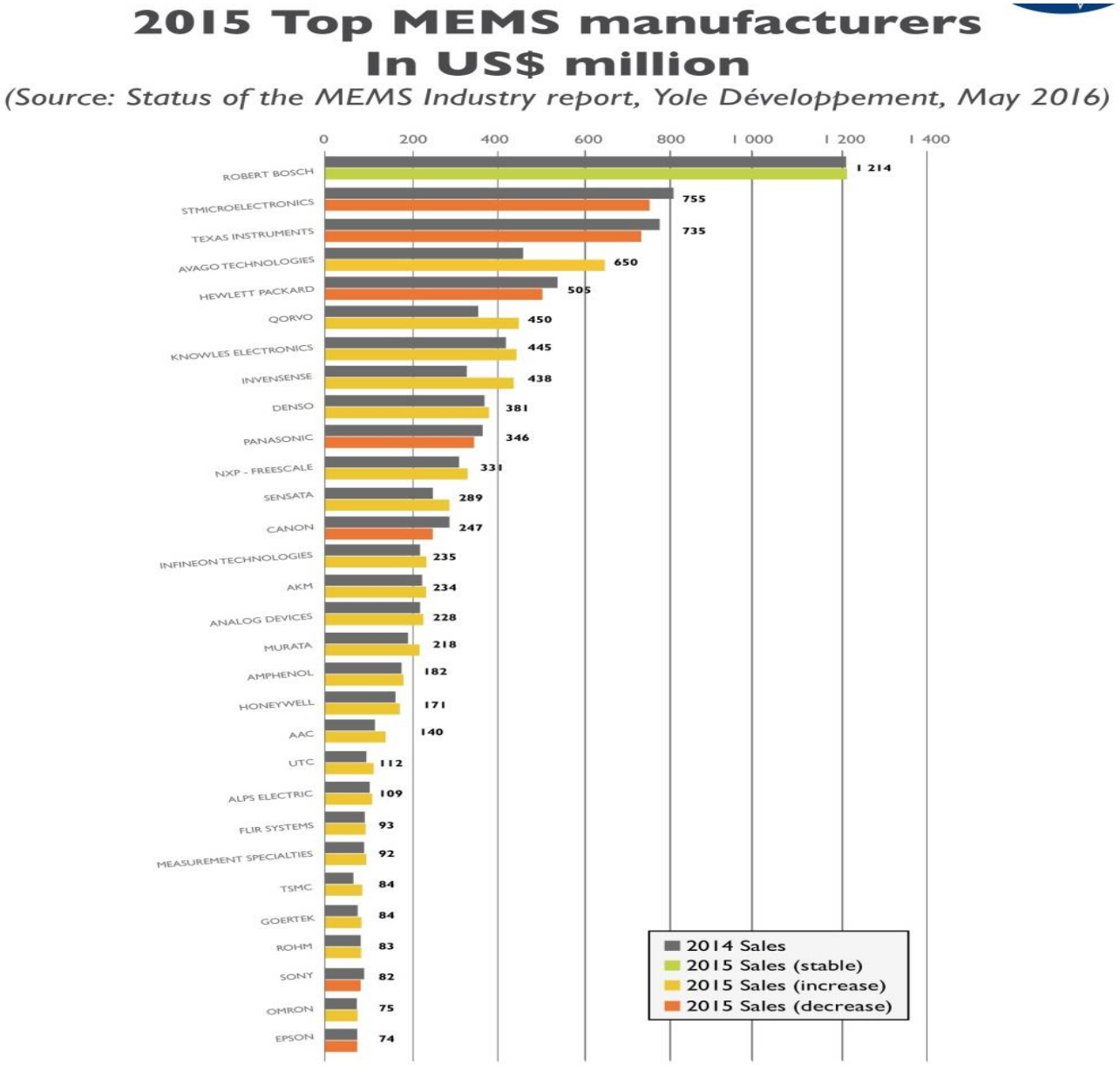


MCU market size divided by the number of bits



- IoT chips mainly include: MCU, RFIC, FPGA, Sensor, etc.
- MCU shipments grew rapidly.
- 32-bit MCU share more than half of the total market, accelerating to be the market mainstream.
- High integration, low power consumption, miniaturization, and multi-function will be the future evolution trend of MCU.

3. Intelligent terminal——Sensor (Micro-Electro-Mechanical System, MEMS)



MEMS industry is still dynamic

- In 2015, TOP15 MEMS manufacturers share more than 50% global market.
- In 2015, TOP5 MEMS manufacturers' growth rate is lager than 20%.
- With 1.2 billion $ in revenue and 8.4% growth, BOSCH become the top one in the list.

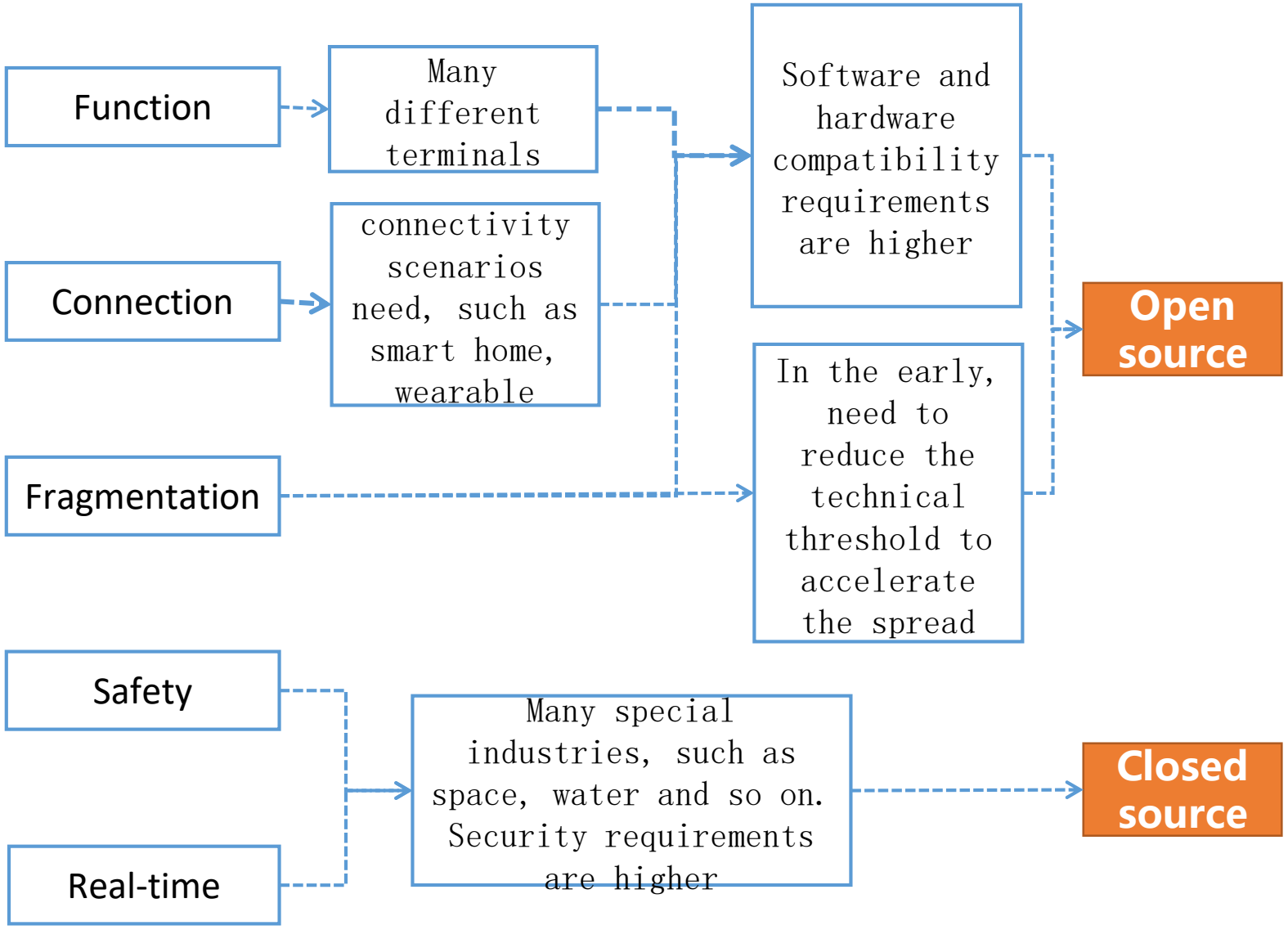
MEMS technology innovation is highly active

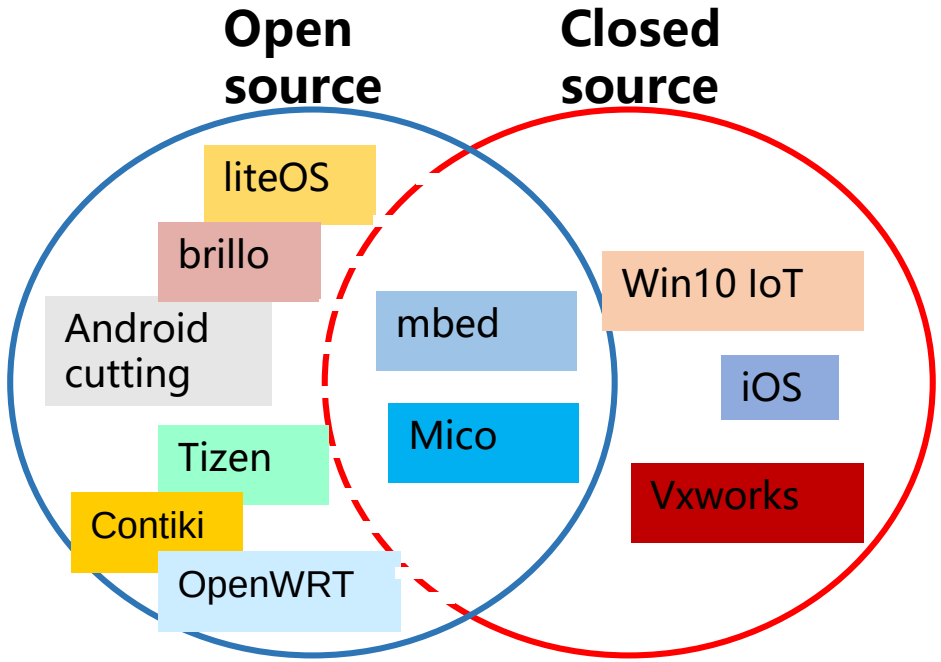
- MEMS sensor products, processes, algorithms and innovative solution are all highly active.
- MEMS research and development cycle is stable, while new product development cycle needs 5-7 years.
- MEMS industry cycle continued to shorten, while its commercialization process significantly accelerated.

3. Intelligent terminal——OS

- **After cutting the desktop and mobile phone OS:** Heavy-weight, data processing, human-computer interaction is strong, but high power consumption.
- **Traditional embedded OS are integrated upward:** Light-weight, low power consumption, stability, real-time, but weak interaction.
- **New IOT OS:** Low power consumption, strong security, support a variety of communication protocols, interoperability is strong, but interoperability is weak.

3. Intelligent terminal——OS





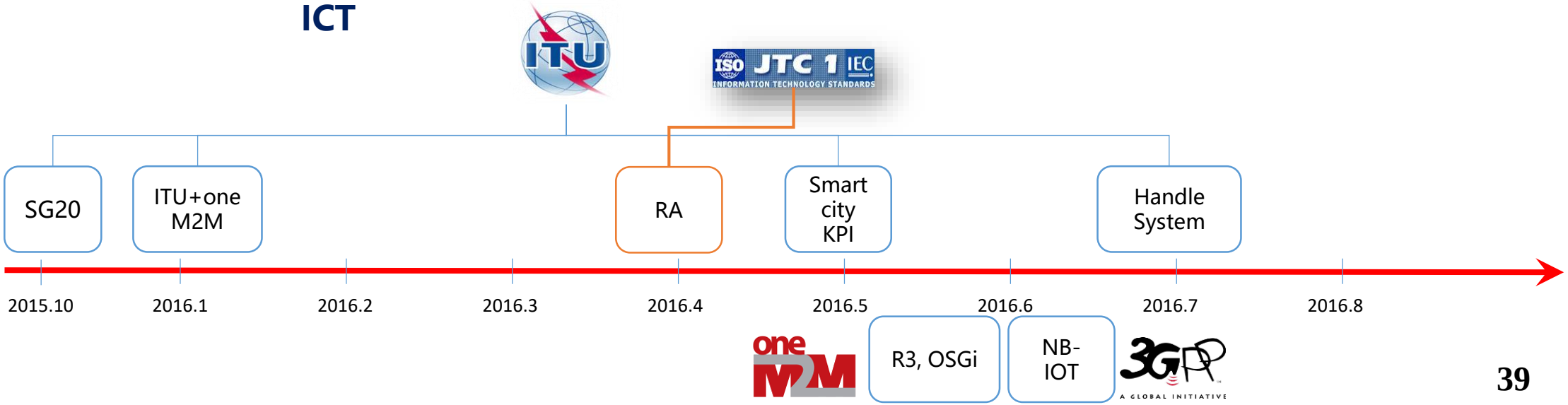
Standard.

以连接性技术为主要标准化对象

- 3GPP → Sep 2016, V2V; Mar 2017, V2I
- GSMA → April 2016, esim
- WiFi Alliance → Feb 2016, “HaLow”

ICT

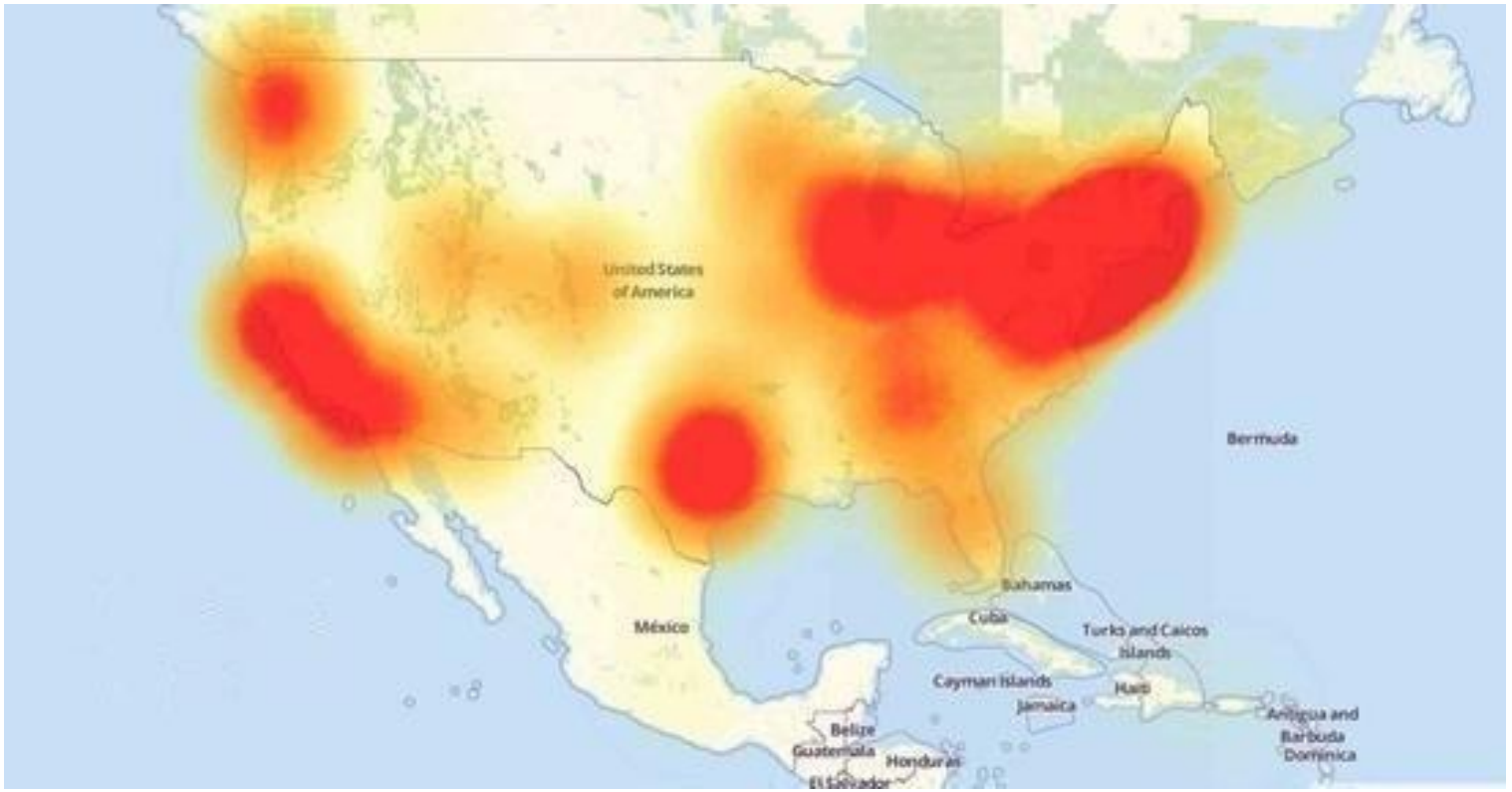
Common + Horizontal



outline

1
Overview
2
Policy and Strategy
3
Deployment and Application
4
Technologies and Standard
5
Security and Privacy

Problem. Half of American Internet was attacked



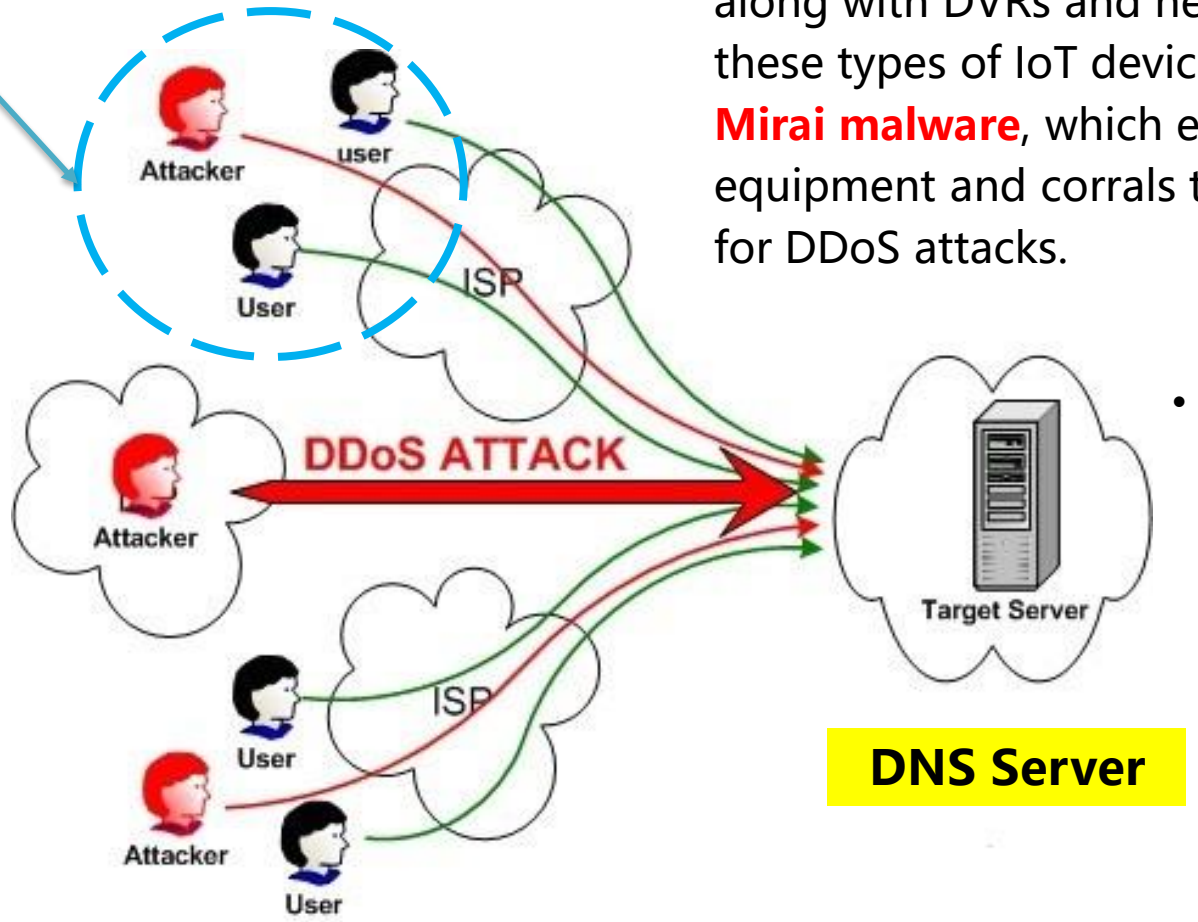
- Oct 24, 2016: US domain name service provider "Dyn" suffered malicious software attacks.
- Dozens of sites were down, such as Twitter, Spotify, Netflix, Airbnb, Github, Reddit, etc.
- The first wave started around 7 a.m. Eastern time with the second commencing around noon. Dyn said the second attack was "global in nature" and was mitigated in an hour. The company said a third attack was attempted, but mitigated before customers were impacted.

Problem. IoT devices cause DDoS attack

IoT Things

- The Chinese manufacturer **Hangzhou Xiongmai** sells OEM white-label circuit boards and software for cameras, along with DVRs and network video recorders. Many of these types of IoT devices were compromised by the **Mirai malware**, which exploits default credentials in the equipment and corrals them into botnets used and sold for DDoS attacks.

- Most users do not change default passwords on the IoT devices, so that they can be attacked very easy.

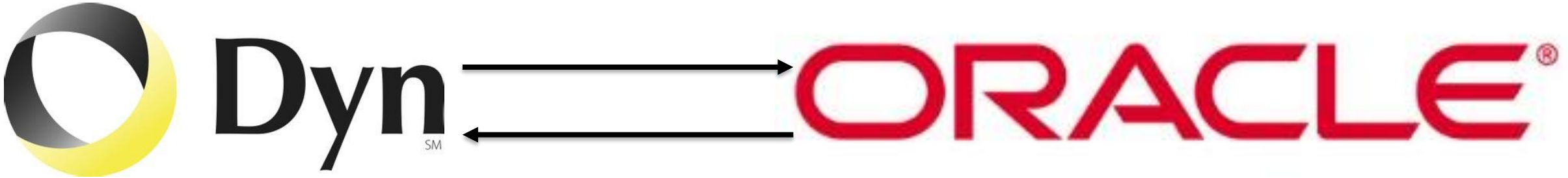


DNS Server

- Because DNS is vital to every person, business and website across the entire internet for system stability and performance, online businesses commonly outsource DNS management to third-party providers who have better and more reliable infrastructures to operate on behalf of their customers.

Solution. IoT Security can not be ignored

1. **Incorporate Security at the Design Phase**: Security should be evaluated as an integral component of any network-connected device. While there are notable exceptions, economic drivers motivate businesses to push devices to market with little regard for security.
2. **Promote Security Updates and Vulnerability Management**: Even when security is included at the design stage, vulnerabilities may be discovered in products after they have been deployed. These flaws can be mitigated through patching, security updates, and vulnerability management strategies.
3. **Build on Recognized Security Practices**: Many tested practices used in traditional IT and network security can be used as a starting point for IoT security. These approaches can help identify vulnerabilities, detect irregularities, respond to potential incidents, and recover from damage or disruption to IoT devices.
4. **Prioritize Security Measures According to Potential Impact**: Risk models differ substantially across the IoT ecosystem, as do the consequences of security failures. Focusing on the potential consequences of disruption, breach, or malicious activity is critical for determining where in the IoT ecosystem particular security efforts should be directed.
5. **Promote Transparency across IoT**: Where possible, developers and manufacturers need to know their supply chain, namely, whether there are any associated vulnerabilities with the software and hardware components provided by vendors outside their organization. Increased awareness can help manufacturers and industrial consumers identify where and how to apply security measures or build in redundancies.
6. **Connect Carefully and Deliberately**: IoT consumers, particularly in the industrial context, should deliberately consider whether continuous connectivity is needed given the use of the IoT device and the risks associated with its disruption.



600 million $

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Thanks !

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