The General Development Trends of IoT

Dr. Wang Sibo

Industry and Planning Research Institute,CAICT

2017.10.31

Course Objectives:

- Background of IoT
  - Basic knowledge
  - Current development stage
- Major advances in the key points of IoT
- The development and competition of global IoT industry
- IoT Application progress

THE History and definition of IoT

History of development:

- 1970's→Large scale implementation of key technology (Sensors, RFID…)
- 1990 → Early IoT devices (Xerox PARC networked coke machine…)
- 1999 → The Internet of Things term is coined by Kevin Ashton
- 2010's → National strategy (Internet of Things - An action plan for Europe. Chinese Premier Wen Jiabao calls the IoT a key industry for China. …)

The IoT definition in ITU Standards:

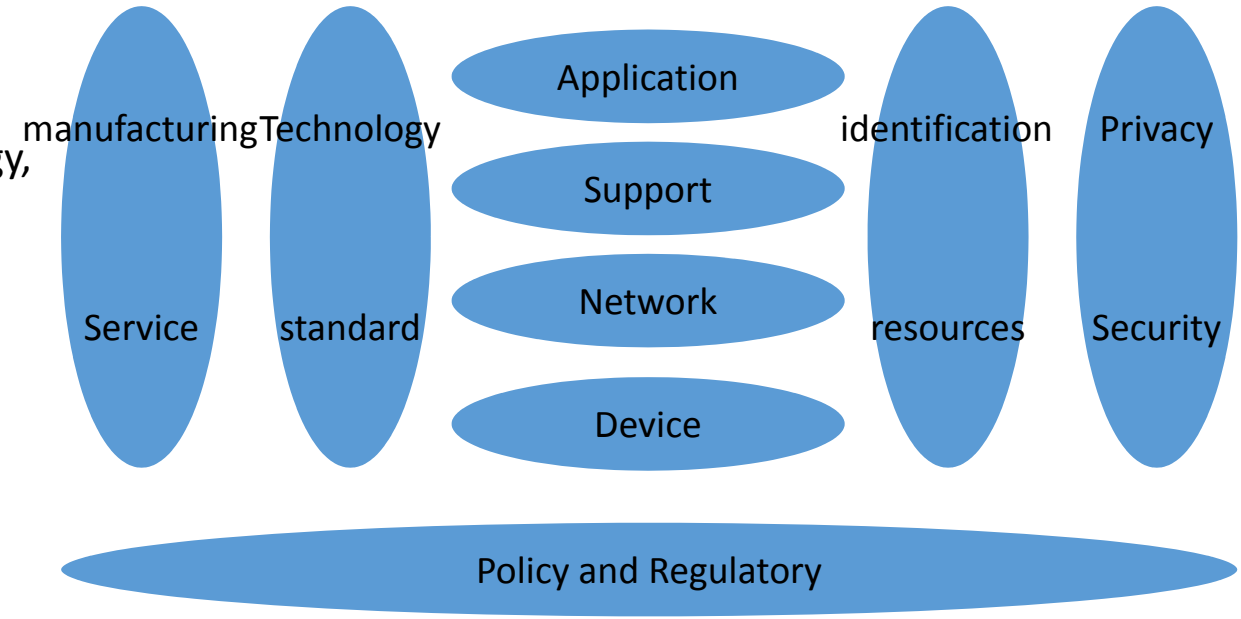
• The Internet of things (IoT) can be perceived as a far-reaching vision with technological and societal implications.

•From the perspective of technical standardization, the IoT can be viewed as a global infrastructure for the information society, enabling advanced services by interconnecting (physical and virtual) things based on existing and evolving interoperable information and communication technologies.

• Through the exploitation of identification, data capture, processing and communication capabilities, the IoT makes full use of "things" to offer services to all kinds of applications, whilst ensuring that security and privacy requirements are fulfilled.

Development Factors of IoT

- **IoT Framework:** including device layer, network layer, support layer and application layer.
- **IoT technology and standard:** e.g. sensor technology, LPWAN technology, data analysis technology
- **IoT industry:** related manufacturing industry and service industry
- **IoT identification:** systems that can address the full range of physical and logical/virtual objects.
- **Privacy and Security**
- **Policy and Regulatory**



IoT Framework

Device layer

•interaction with the communication network

Network layer

•Networking capabilities: provide relevant control functions of network connectivity.

• Transport capabilities: focus on providing connectivity for the transport of IoT service and application specific data information, as well as the transport of IoT-related control and management information.

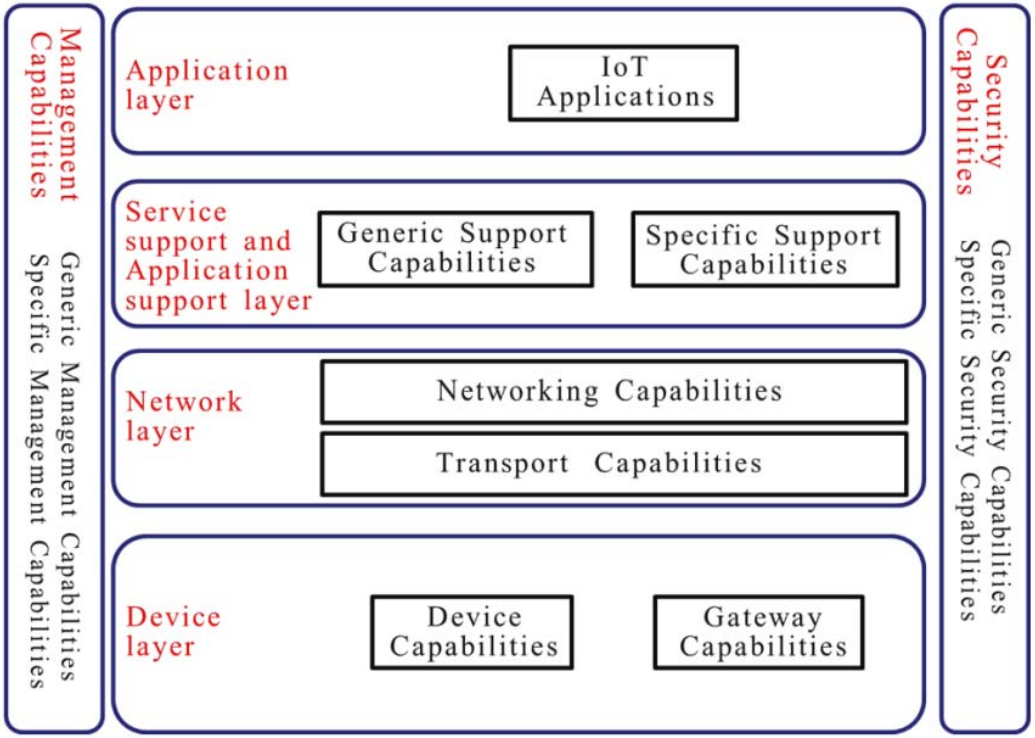
Service support and application support layer

•Generic support capabilities:such as data processing or data storage

•Specific support capabilities: cater for the requirements of diversified applications

Application layer

•The application layer contains IoT applications.



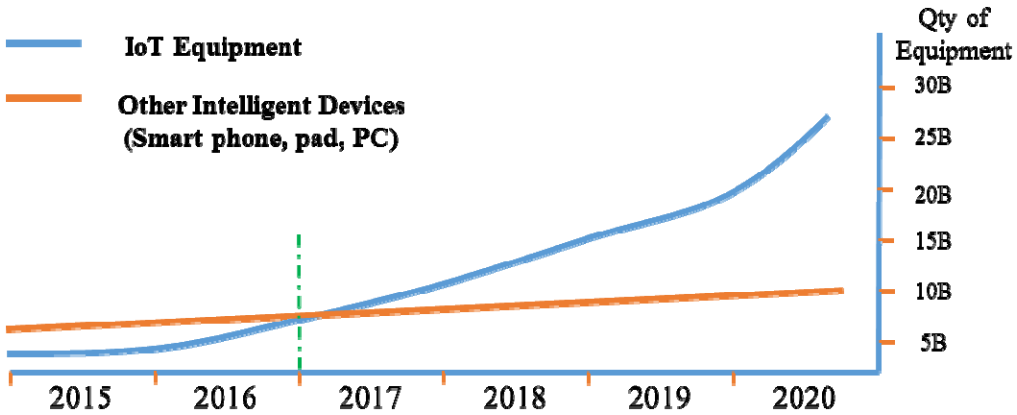
ITU-T Y.2060

Course Objectives:

- Background of IoT
  - Basic knowledge
  - Current development stage
- Major advances in the key points of IoT
- The development and competition of global IoT industry
- IoT Application progress

The overall situation of IoT development

- The IoT has been highly spoken of by the world and the Internet of Things has shown a notable scale, creating a new space for the development of the information industry.



By 2020	Qty of Equipment	Total Market (USD)
Gartner	26B	1.9T
cisco	50B	
McKinsey&Company		2.7T
IDC Analyze the Future	30B	
ERICSSON	50B	

1. New spaces for economic growth

stimulates innovations in technologies such as the 5G network, cloud computation and big data, promotes convergent innovations across industries as intelligent manufacturing, Internet of Vehicles (IOV), and new materials and so on.

2. New spaces for industrial investment

promotes the construction of high speed, mobile, safe and ubiquitous information infrastructures and intelligentized reconstruction of important infrastructures in energy sources and traffic, etc.

3. New spaces for information consumption

emergence of new products such as smart wearables, smart home, and intelligent vehicles; new demands for information products and information services and creates new spaces for the development of the manufacturing industry.

Two driving forces of IoT development

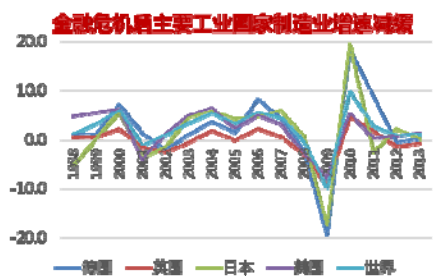
- The function of the IoT in defining and supporting industrial development becomes conspicuous and is converted into practical productivity increasingly faster than ever.

Competitive benefits in reconstructing national strategic fundamental industries with IoT technologies

IoT

Aggregate to the high added-value and mass consumer market through the IoT to improve the quality of economic development and provide the impetus for development

Developed countries use the IoT to rebuild their fundamental industrial development concepts and their national competitiveness

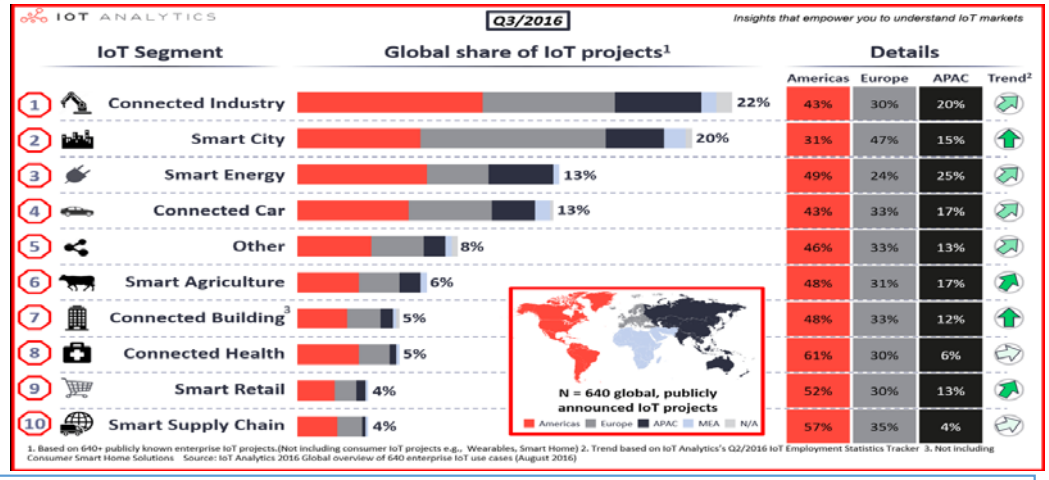


Rebuild the concepts

"Advanced manufacturing partnership initiative"

"Industry 4.0"

"China Manufacturing 2025"



Typical application of population-oriented market scale: social services (Smart City), IOV, Smart Home

National development strategies——US

- The US reconsiders their IOT development strategies and promotes the construction and development of core capabilities in industries such as intelligent manufacturing and IOV to give full play of their comprehensive advantages.

1. Oriented to innovative development, evaluate the overall policies of the US on the IoT

- The US Senate: April 2016, "Developing Innovation and Growing the Internet of Things (DIGIT) Act" was approved by the Senate Committee on Commerce and a working committee was set up to provide top level framework design, innovation suggestions and frequency spectrum planning for the US government to promote the IoT innovations;

2. Occupy the high point in the informatization infrastructure of the industry/manufacturing, and maintain the advantageous position in the Intelligent Connected Vehicles (ICV)

- The IMSs set up according to the National Network of Manufacturing Innovation (NNMI) all have the responsibility of **building the industrial Internet platforms**.
- Launched the ITS plan, focusing on vehicle automation innovation and taking advantage of the benefits in the ICT to implement reconstruction and upgrade of traffic infrastructure and management modes

3. Consider the IoT security in terms of national security

- The US Department of Homeland Security (DHS) released the IoT Security Guidance and stated that "**the IoT security had become a homeland security issue**".
- The main principles are included in **security in the design stage, use of security updates and bug management, based on reliable security best-practices, considering security measures based on priorities, enhancing the transparency, taking precautions before connecting**.

National development strategies——EU

1. continue to increase financial support

IoT-01-2016: Large Scale Pilots with total Budget 100 Mio EUR

- Pilot 1: Smart living environments for ageing well (EU contr. up to 20 Mio EUR)
- Pilot 2: Smart Farming and Food Security (EU contr. up to 30 Mio EUR)
- Pilot 3: Wearables for smart ecosystems (EU contr. up to 15Mio EUR)
- Pilot 4: Reference zones in EU cities (EU contr. up to 15Mio EUR)
- Pilot 5: Autonomous vehicles in a connected environment (EU contr. up to 20 Mio EUR)

2. building and improving the external ecological environment to indirectly influence the industry in an all-round way.

IoT European Platforms Initiative

interiot, IoT Week, TAG IT SMART, VICINITY, AGILE, BIG IoT, bIoTope, symbioTe, ACCESS IoT Open Platforms

- The IoT-European Platforms Initiative (IoT-EPI) was formed in 2016 to build a vibrant and sustainable IoT-ecosystem in Europe, maximising the opportunities for platform development, interoperability and information sharing.

National development strategies——China

- The government regard IoT as new industries of strategic importance, takes active measures to push the development.

Policy system for IoT in China:

2010→

- Premier Wen Jiabao calls the IoT a key industry for China
- Concept of ” Sensing China ” was proposed

2011-2015→

- "The 12th Five Year Plan“ for IoT
- Develop an action plan for IoT, including IoT technology, standard, industry, application, etc.
- The State Council’s guidance on facilitating IoT healthy and rapid development
- Set up the Inter-ministry Joint Meeting of IoT development(MIIT, DRC, MST…14 Ministries)
- Guidance on Smart city development by 8 Ministries

2016→

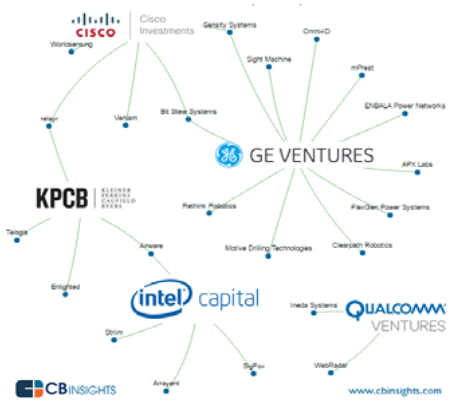
- "The 13th Five Year Plan“ for IoT
- guidance on facilitating NB-IoT development

The world IoT capital market

- Leading countries and enterprises have made investment plans focusing on strategic fundamental industries.

Country/Region	IoT spending (2016)	CAGR (as of 2019)	Main Fields
USA	232B	16.1%	Manufacturing, traffic, intelligent building
West Europe (France, Germany, Italy, Spain, UK)	140B	21.8%	Industry, intelligent grid, IOV

Based on 《the Worldwide Semiannual Internet of Things Spending Guide》, issued by IDC in July 2016



According to the estimates of foreign consultation agencies, the worldwide investment in the IoT increased from 1.2 billion in 2011 to nearly 2.9 billion in 2015. In the past five years, more investment transactions had been made in the wearables/health fields. Since 2015, industry-related investment grows fast and becomes the hottest investment field of the IoT.

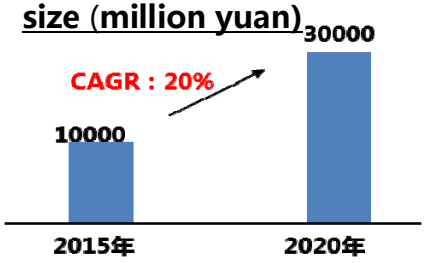
From 2015 to the first half of 2016, the top 5 industrial investments are mainly in the fields of industrial robot, energy, and LPWAN

The market space of IoT in China

Intelligent Manufacture

- The size of China's intelligent manufacturing market is expected to exceed RMB 30000 billion in 2020.

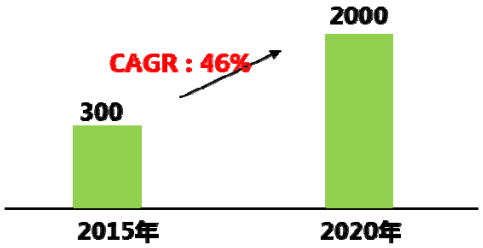
China's intelligent manufacturing market size (million yuan)



IoV/ Transport and Logistics

- The size of China's IoV market is expected to exceed RMB 2000 billion in 2020.

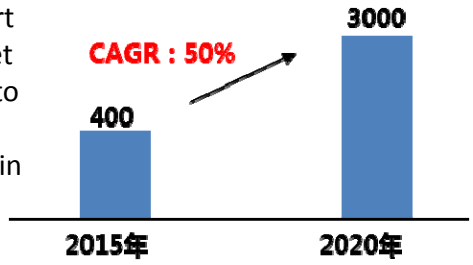
China's IoV market size (million yuan)



Smart Home

- The size of China's smart home market is expected to exceed RMB 3000 billion in 2020.

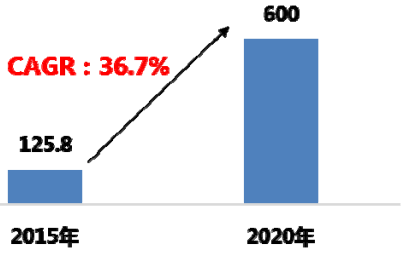
China's smart home market size (million yuan)



Wearable

- The size of China's wearable market is expected to exceed RMB 600 billion in 2020.

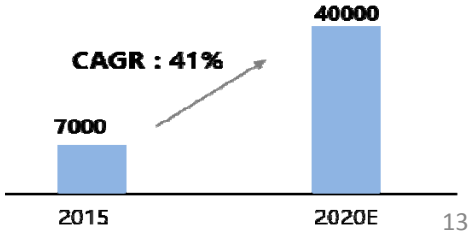
China's wearable market size (million yuan)



Public Service/ Smart City

- The size of China's smart city market is expected to exceed RMB 40000 billion in 2020.

China's smart cities market size (million yuan)

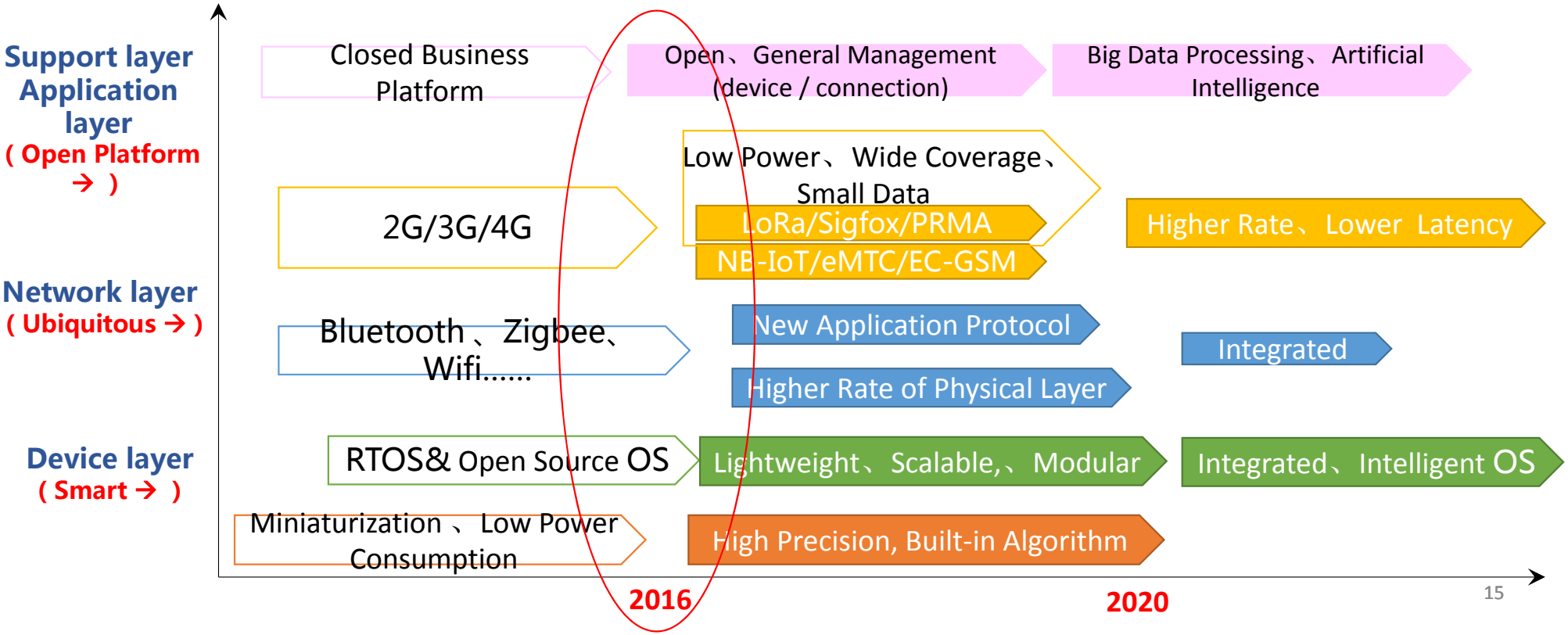


Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
  - Device layer
  - Network layer
  - Application layer
- The development and competition of global IoT industry
- IoT Application progress

Key technology system

- The accelerated spillover effect of mobile Internet, maturity of cloud computing (Paas), and evolution of network technologies oriented to IoT drive the IoT technology into a new stage - the gradual construction of a ubiquitous, open, intelligent IoT system provides the technological foundation and capability guarantee for the development of the industry.

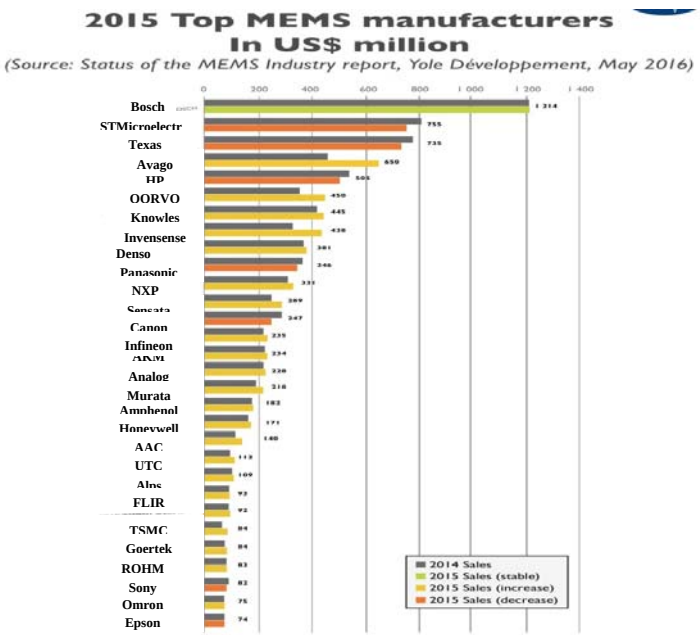


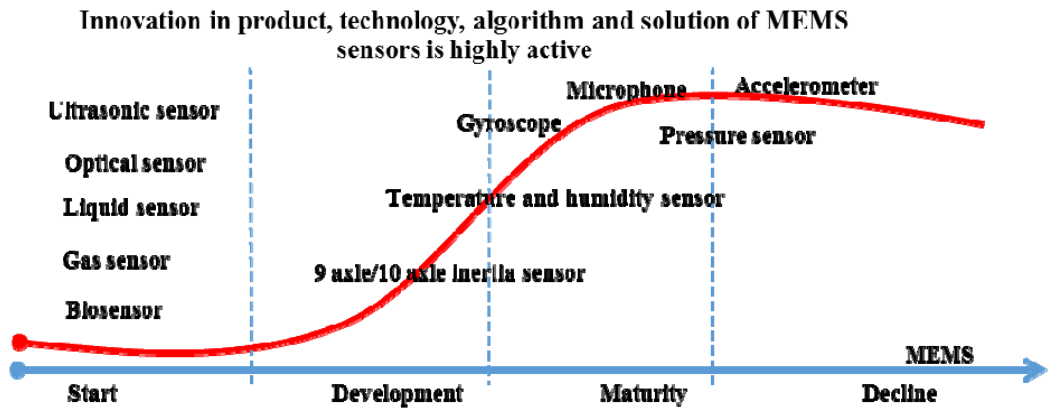
Development of Sensors

The future----MEMS(Micro-Electro-Mechanical System)

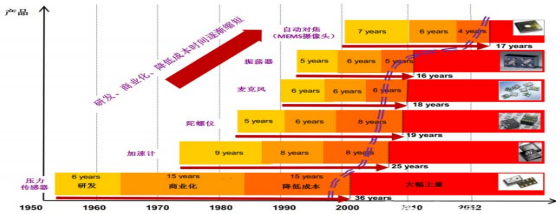
- competitions become fiercer and fiercer, technological innovation becomes highly active

In 2015, TOP 15 MEMS manufacturers take up more than 50% of the market shares, and BOSCH ranked the first with sales of 1.2 billion USD and 8.4% market shares; active innovation occurs in MEMS sensors, the R&D period of new product is about 5-7 years, and the industrialization period is continually reduced.





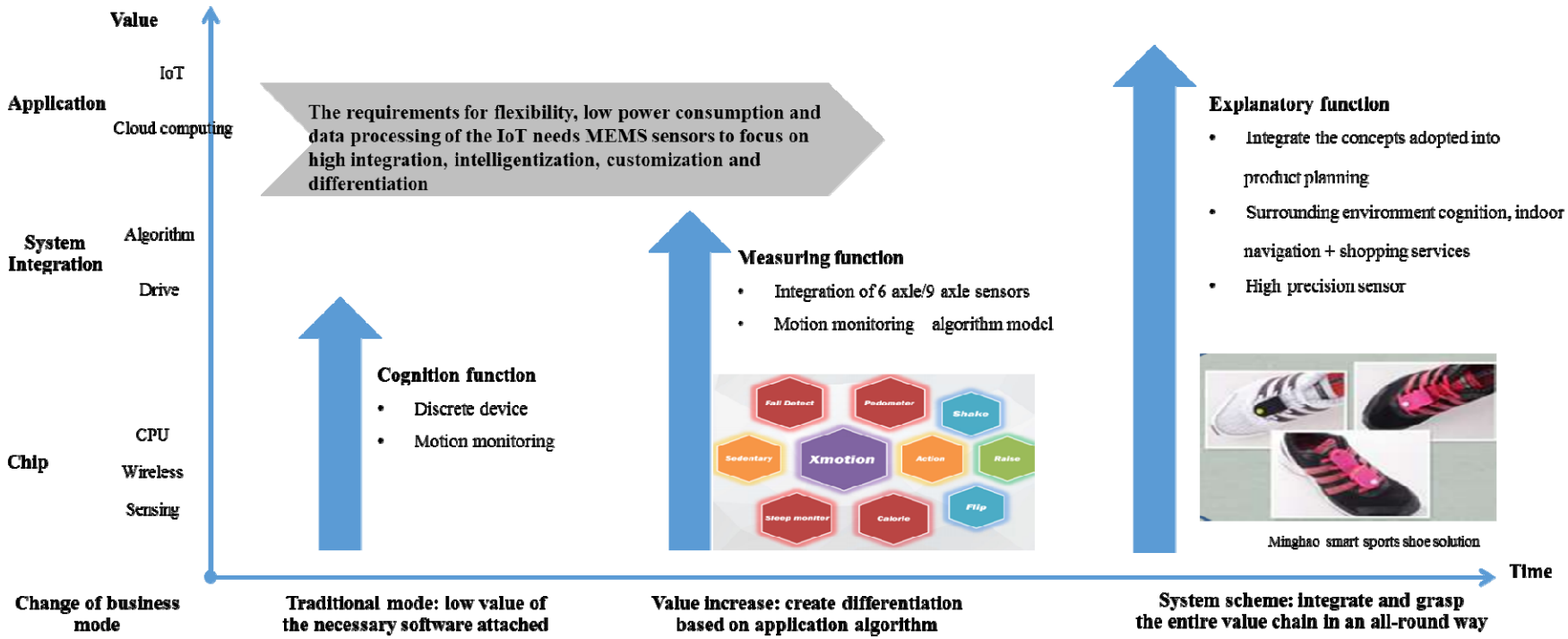
The MEMS R&D period is steady and the commercialization process is obviously accelerating



Development of IoT Sensors

- The business mode is continually upgraded centering on value increase and the system integration solution becomes the focus of manufacturers

Starting from a simple discrete device, MEMS sensors develop constantly toward the intelligentization and systematization of high precision models with data processing algorithms.



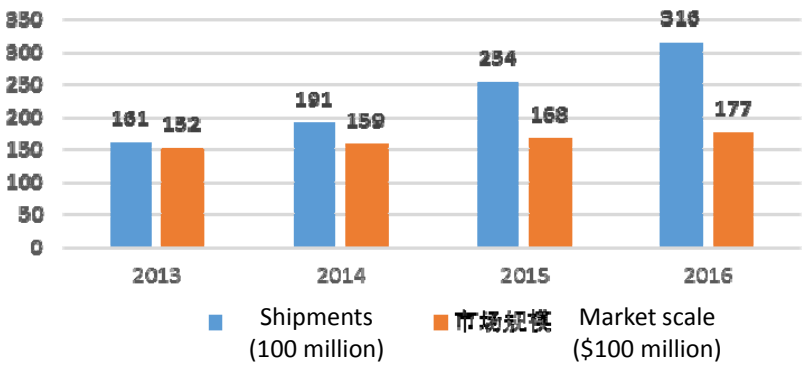
Development of IoT Chips

- IoT chips are evolving into 32-bit low power consumption and high integration "MCU+"

IoT chips consist of three categories: MCU, RFIC and Sensor; the sales volume of MCU grows fast and 32-bit MCU takes up more than 50% of the market share, and will soon dominate the market; high integration, low power consumption, miniaturization and multi-purpose will be the direction of the evolution of MCU.

IoT promotes fast growth of MCU

MCU shipments and market scale



Early stage	Present	Future
Discrete MCU, wireless chip	Integrate wireless chips and single-chip MCU of sensors	Integrated sensor + MCU + wireless module + other

MXCHIP, High-Flying, and BeeLinker, etc., wireless chip with external MCU, communication protocols are written into the MCU

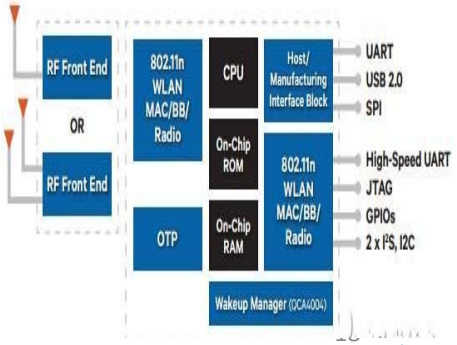
Bosch BHI160, BHA250

- Integrated Bosch Sensortec's data signal processing module (Fuser Core) with world leading 6 axle inertia measuring unit (IMU) and 3 axle accelerometer

Qualcomm atheros4004

- Single-chip integrated MCU, IP stack, middleware architecture and complete network services.

- **High integration**
- **Low power consumption**
- **Multi-purpose**
- **Miniaturization**

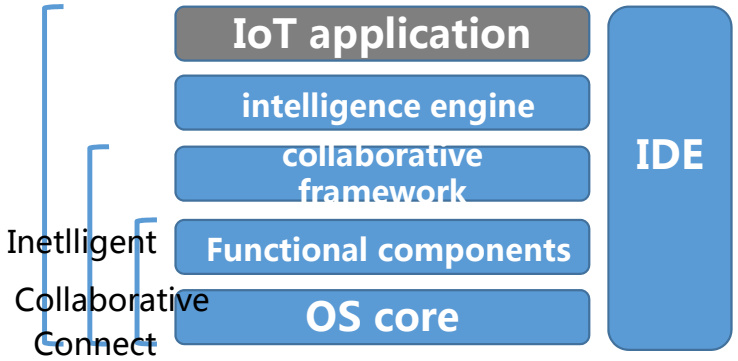


Development of IoT OS

- -Rising IoT application scenarios put forward new requirements for the OS and three different type of technical routes arise.

- **Trimmed desktop and mobile phone OS**: A heavy OS has powerful data processing and man-machine interaction capabilities, but has high power consumption.
- **Upward integration of traditional embedded systems**: A light OS has low power consumption, good stability and real-time performance, but has weak interactive capabilities.
- **New IoT OS**: low power consumption, high security, supporting various communication protocols, good interconnection performance, but weak interactive capabilities.

IoT OS architecture



Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
  - Device layer
  - Network layer
  - Application layer
- The development and competition of global IoT industry
- IoT Application progress

Restriction of existing IoT network

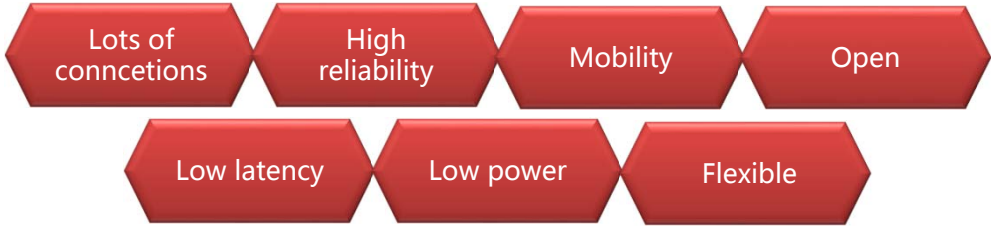
- The IoT has wide application scope and various application scenarios but existing network technologies will restrict the growth of the IoT.

- The development of the IoT turns the connected subjects into "things" - actually, except short distance communication and sensing technologies, **fundamental technological innovations for mass deployment and application of the IoT are insufficient**.
- Using the existing telecommunication networks to support the development of the IoT will lead to **mismatch between the application demand side and the technology supply side**: different terminal systems, high cost and high power consumption; limited number of network support terminals; insufficient coverage for typical scenarios.

Mismatch in WAN technologies

- **Wireless access network**: Wide area IoT applications are carried by 2G/3G/4G networks. 2G/3G/4G networks are designed to address the deluge of individual users and cannot satisfy the requirements of the IoT in aspects as coverage, bandwidth, time delay and power consumption
- **Backbone network**: Open IoT services are carried over the Internet. And no VPN is set up.

Development direction of IoT network

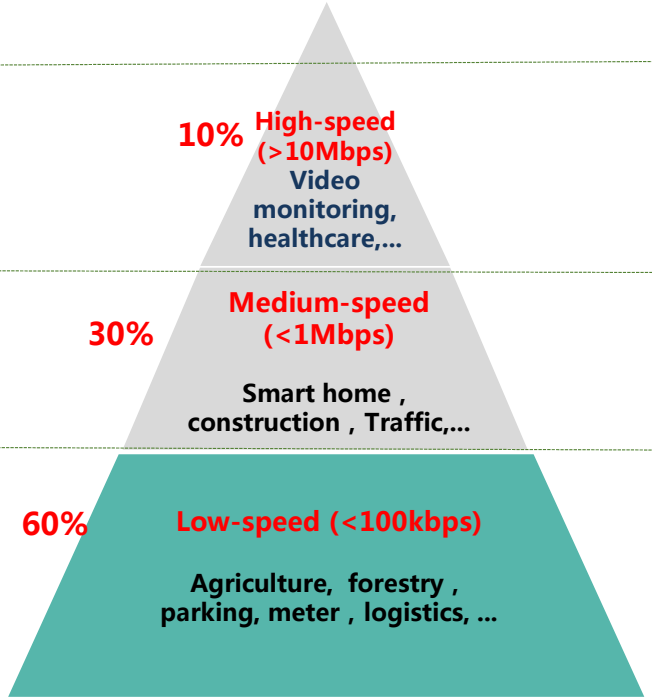


LPWAN+5G

Advances in network technology

- The industrialization of the LPWAN technoloty(NB-IoT, eMTC...) speeds up and provides new opportunities for telecommunication carriers to enter the IoT market.

Distribution of IoT connections in 2020



Network Technology

- 3G:HSPA/TDS
- 4G: LTE/LTE-A
- WiFi 802.11技术
- **5G**
- 2G: GPRS
- **eMTC/MTC**
- **NB-IoT**
- SigFox
- LoRa
- ZigBee

5G

- standard setting and testing in the outfield
- plan to be put into commercial operation in 2020

eMTC

- start experimenting

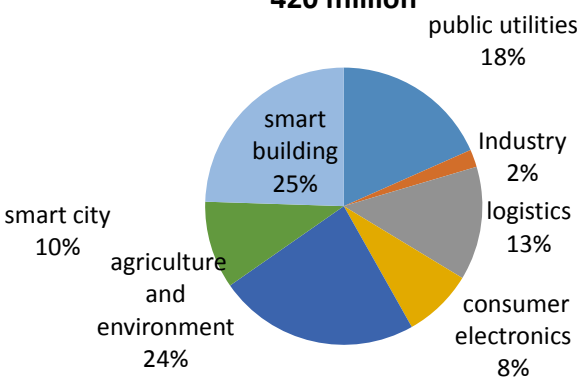
NB-IOT

- already been put into commercial operation
- Application includes metering, parking, environmental monitoring, etc.

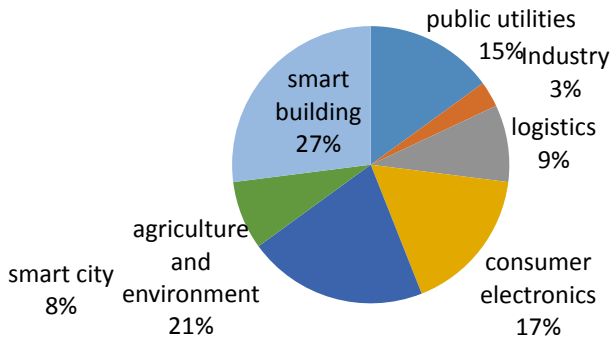
LPWAN(Low-Power Wide-Area Network)

- LPWAN is a wireless wide area network technology that is specialized for interconnecting devices with low-bandwidth connectivity, focusing on range and power efficiency.
- Includes NB-IoT, LoRa, Sigfox, TD-LTE Cat.1, TD-LTE Cat.0,...
- LPWAN technologies continue to mature, and have wide market prospect.

M2M connections by LPWAN in 2018，420 million



M2M connections by LPWAN in 2022， 2.7 billion



Data Resource：GSMA

LPWAN matches two kinds of apllications :

- ☐ Location fixed and centralized: smart meter, storage management;;
- ☐ Remotely, need battery : smart parking, water quality monitoring

Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
  - Device layer
  - Network layer
  - Application layer
- The development and competition of global IoT industry
- IoT Application progress

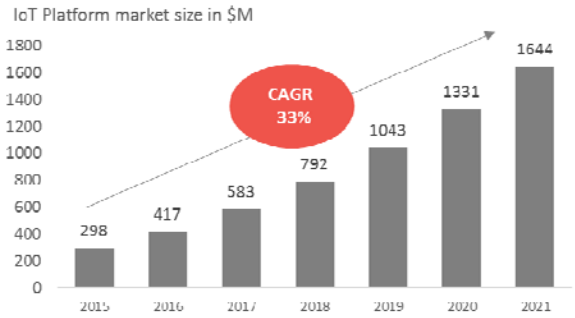
The value of IoT platform

- Platforms will become the high point in the development of the IoT industry,
- Leaders across the industrial chain have accelerated their planning in various ways

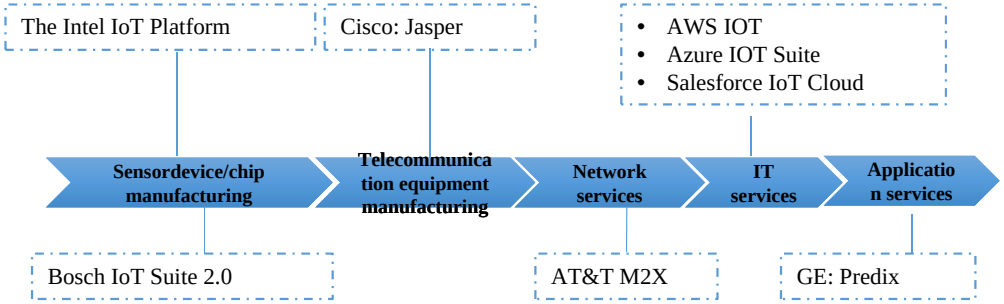
IoT platforms will overturn the development modes of traditional industries and deeply change the future international industrial divisions of labors and the competition layout of international trade

The industrial community thinks high of the commercial values of IoT platforms.

- IOT Analytics estimated that， the revenues of IoT platforms would maintain a growth of 33%， and reach 1.6 billion USD by 2020.
- According to the estimation of Berg Insight, the revenues of 2015 was 610 million euros and it would reach 3.05 billion euros by 2021, with a CAGR of 30.8%.



Leading enterprises across the industrial chain of the IoT all start their planning.



Strategy of IoT platform providers

- Enriching platform functionalities and enhancing industrial application supporting capabilities become the focus of platform service providers

- Early platform service providers usually built independent platforms oriented to single layer functions， while current they focus on construction of multi-purpose integrated platforms.

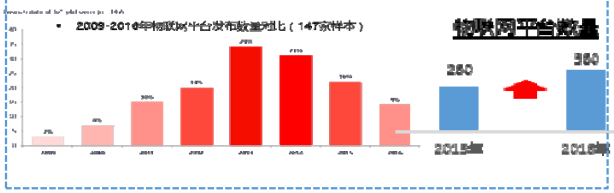
• Cloud service providers • Internet service providers	Data analysis and management platforms
• IT service providers • Vertical field service providers	Application enabling platform
• Telecommunication carriers • M2M platform service providers	Connection management platform
• Intelligent device manufacturers	Equipment management platform

- Industrial giants actively expand, merge and cooperate in IoT platforms， and the platform competitions become increasingly fiercer.

Build IoT platform

- Platform service providers such as Amazon, Microsoft, and IBM etc. actively released their IoT suites.
- GE has built a new platform Predix.

As of June 2016, the number of famous IoT platforms exceeded 360, about 70% of which were newly built after 2013.



Data source: IOT analytics

Merge platform service providers

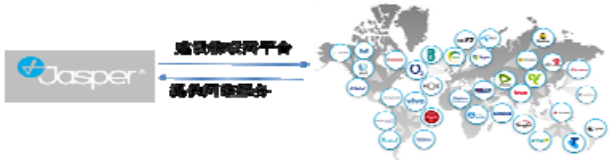
- PTC merged ThingWorx and Axeda, and Cisco merged Jasper to make up their gaps in IoT platform services.
- Amazon AWS merged 2elemtry to strengthen its platform service capacity.

Since 2014，worldwide merging of IoT platforms has exceeded 20 times.

Data source: First Analysis

Cooperate with platform service providers

- Telecommunication carriers cooperate with Jasper to provide IoT solutions so as to deepen their IoT business distribution.



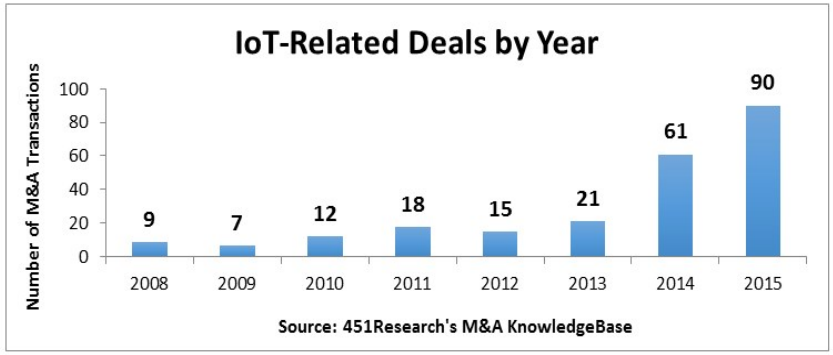
Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
- The development and competition of global IoT industry
  - Overall situation
  - The IoT industrial eyosystem
- IoT Application progress
- Aanalysis of the challenge

Cooperation and merger

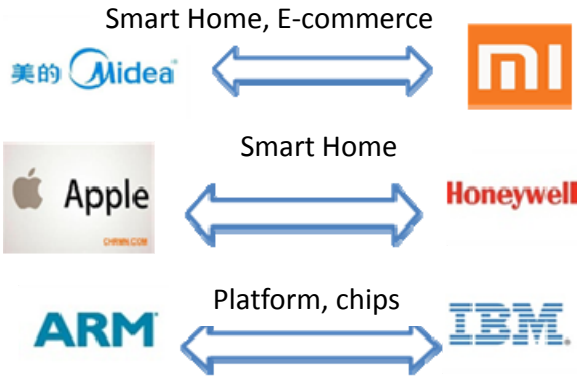
- The main focus of IoT began to change from free growth to Cooperation and merger.

1.Sensors, chips and IoT platform become the focus of enterprise mergers.



- Since 2015-2016.8, Internet chips mergers more than 10, Amounting have more than $ 100 billion;
- Since 2015-2016.8, Major acquisitions of MEMS sensor industry has occurred more than 20. MEMS manufacturers quickly expand product line in the form of M & A, in order to layout or cut into IoV emerging markets, and also enhance the ability to integrate problem-solving.
- Since 2014-2016.8, global IoV M & A platform has more than 18, Enterprise M & A platform has strengthen service capabilities, and provide end-to-end solutions.

2. Enterprises in different sectors of the industry chain actively cooperate to achieve complementary advantages.

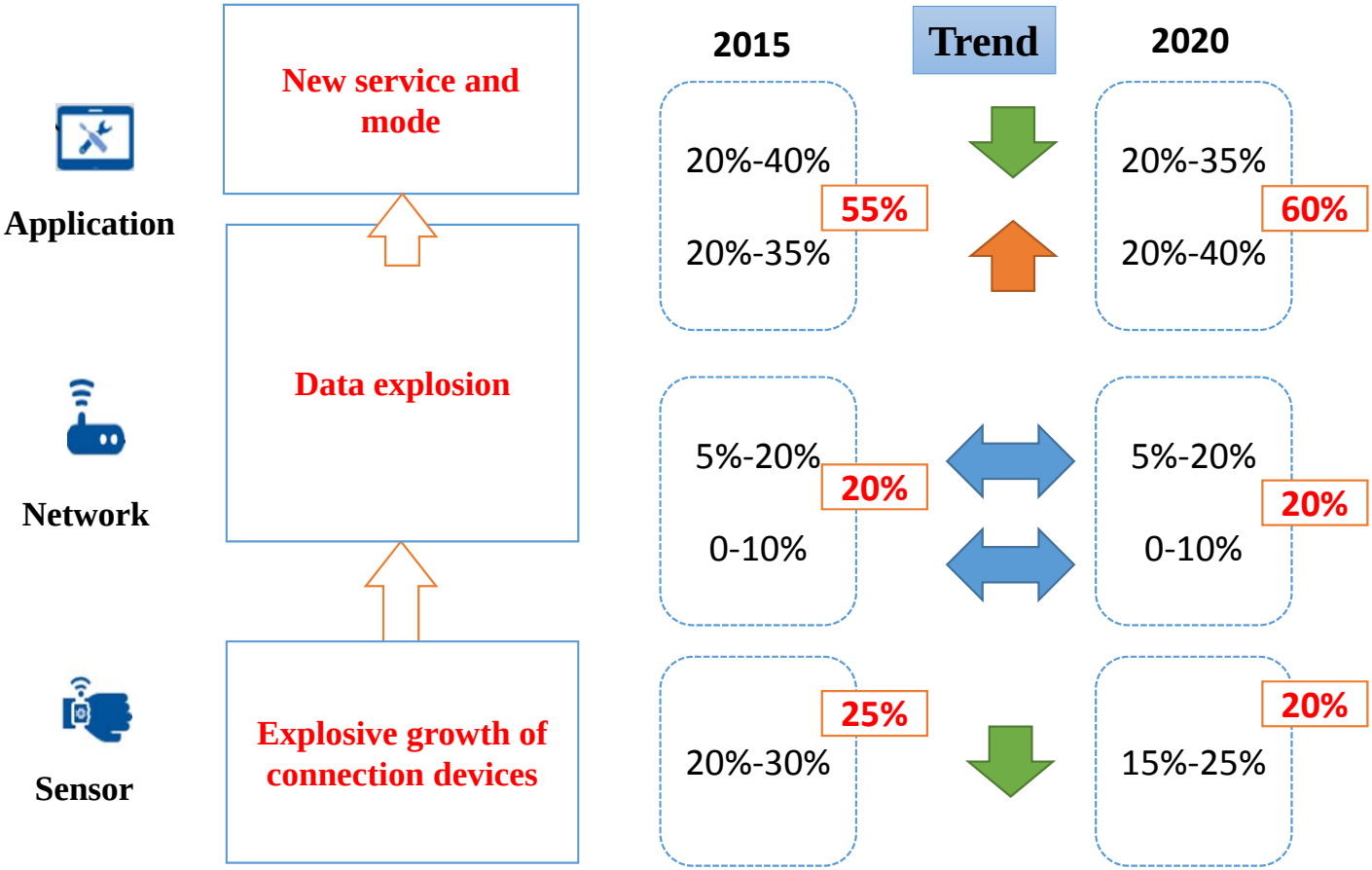


Example:GE's Predix platform will land on Microsoft's Azure cloud platform

The cooperation of Paas and Saas will fast to achieve complementarity

IoT Industry value migration

- Transfer of the industrial value to services based on software and data



The maturity of the cloud computing and big data grants the IoT platform with characteristics of small investment, short develop time, and easy deployment as well as advantages in data processing

The SDN+NFV enhances the stiffness and intelligentization of networks and enables future connection expansion and easy development

MEMS sensors develop toward the intelligentization and systematization of high precision self-algorithm models

- IoT data value has not been applied
- 75% platforms only provide device-conncecting and data storage service

Action of leading Internet and IT firms

- Internet and IT giants begin planning their IoTs with the advantages in software and services to grasp the strategic guidance and controlling forces in development of the IoT

Internet and IT enterprises powerfully promote the changes in the industrial development mode, contend for the dominant power of the IoT development from product trials in the early stage to overall industrial planning relying on their advantages and service mode innovative capabilities in the cloud and end technologies, leading to fast change in the market pattern.

Internet service providers

homeKit	NEST Brillo OS	Echo AWS IoT suite	Alibaba YunOS IaaS/PasS

IT service providers

Jasper platform	Cognitive computing Waston platform	WIN10 Azure suite	HANA platform

Microsoft: Launched the Azure IoT Suite in 2016 to help the company simplify the deployment and management of IoT applications

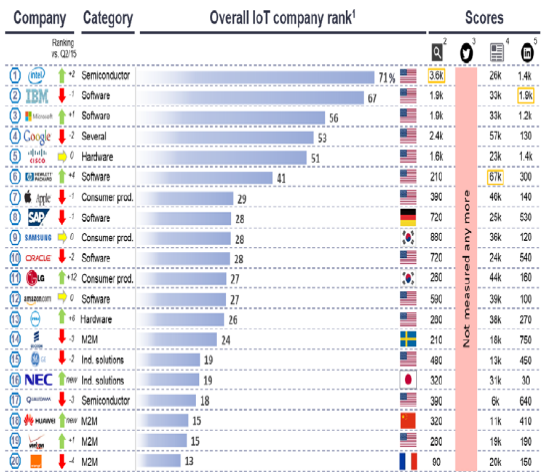
Google: Launched the Android-based IoT operation system Brillo and released the cross-platform IoT communication protocol Weave

CISCO: In March 2016, Cisco merged Jasper with 1.4 billion USD, set up the IoT Division and started to provide services such as enterprise Wi-Fi, security and advanced analysis, and so on

ARM: In July 2016, SoftBank merged ARM with 32.2 billion USD. SoftBank thought highly of the prospects of ARM in the IoT era

Participate in competition

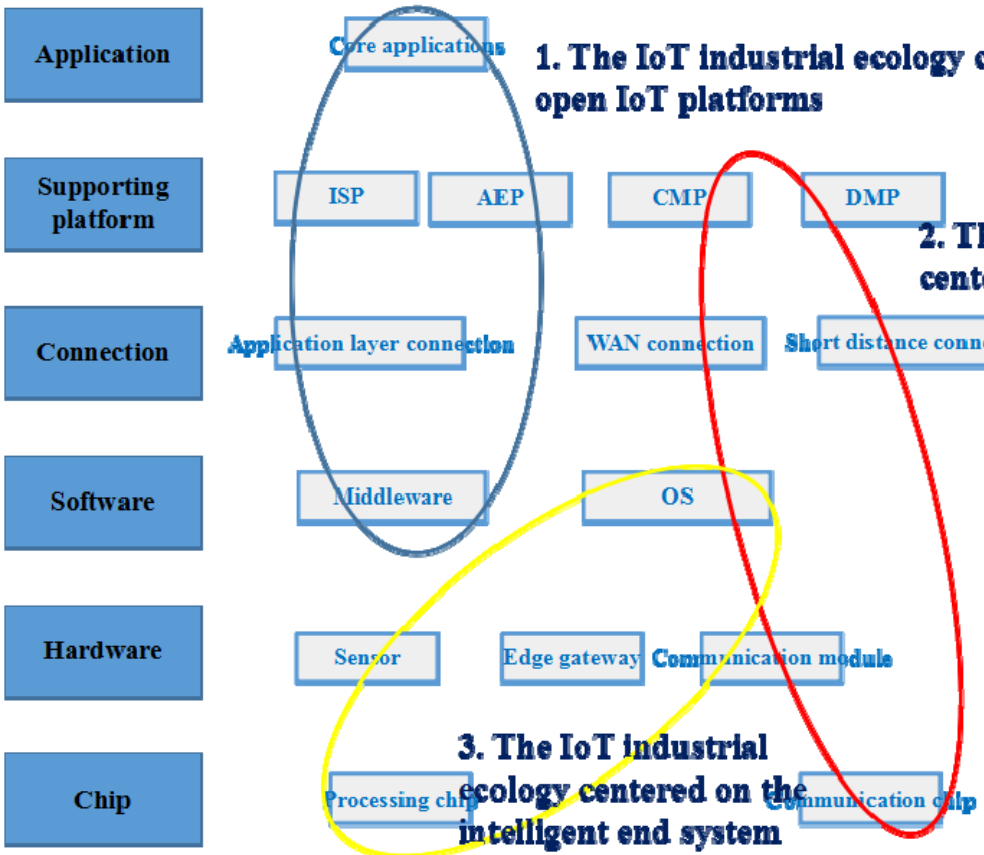
Ranking by revenues: Top 1 Intel, 580M USD, 2015Q3

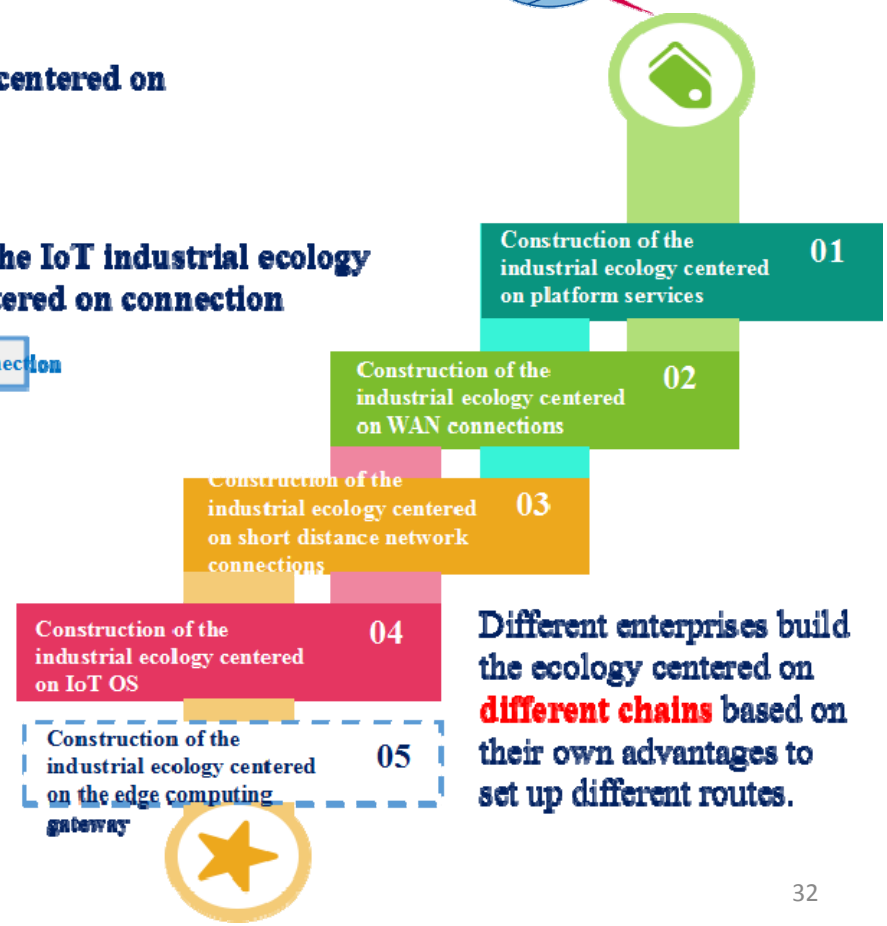


Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
- The development and competition of global IoT industry
  - Overall situation
  - The IoT industrial eyosystem
- IoT Application progress

Basic ways to build the IoT industrial eyosystem





Different enterprises build the ecology centered on **different chains** based on their own advantages to set up different routes.

Dominating power of the IoT industrial eyosystem

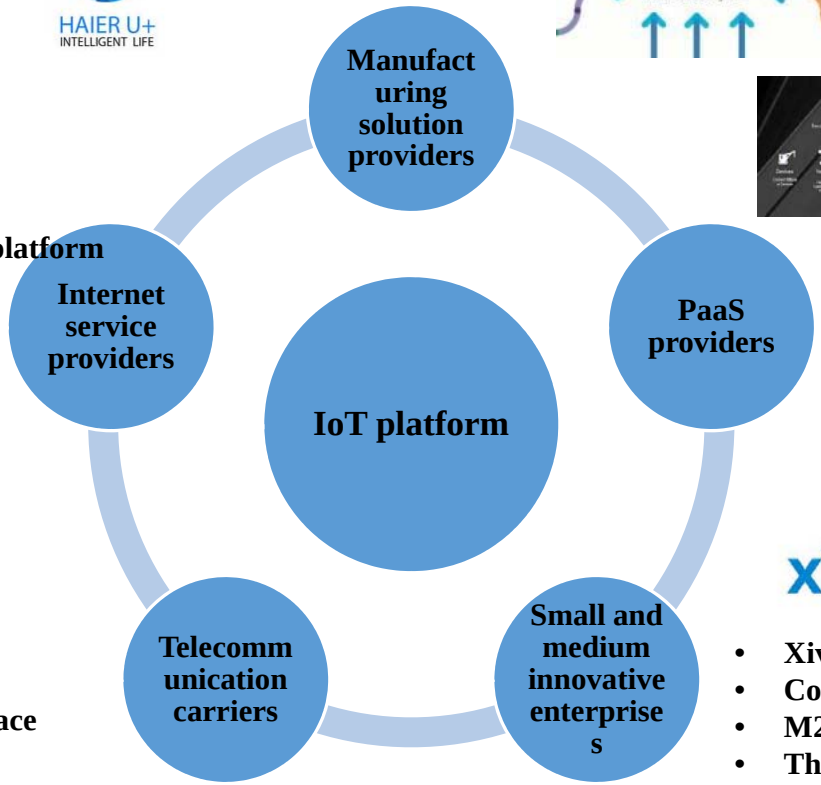
- The IoT platforms have been divided into five groups and build their own industrial eyosystem centering on the platform services.

- **GE Predix**
- **Haier U+**

- **Amazon AWS IOT**
- **IBM Watson IoT Platform**
- **Microsoft Azure IoT Suite**

Apple Homekit

- **WeChat hardware platform**



- **AT&T M2X**
- **SKT ThingPlug**
- **Verizon Thing Space**

- **Xively (2007)**
- **Connecthings (2007)**
- **M2Mi (2006)**
- **Thingworx (2009)...**

Dominating power--PaaS provider

- PaaS provider cooperate with upstream hardware and downstream application manufacturers to build the IoT industrial eyosystem based on the cloud ecological circle

Enterprises such as Amazon, Microsoft and IBM have set up their cloud ecological circle and successively launched IoT suites including AWS IOT and Azure IOT Suite, and become powerful competitors on the IoT platform market. The key to building the IoT industrial eyosystem is to cooperate with upstream cognitive equipment manufacturers to set up end-to-end solutions so as to diffuse to the industry.

Advantages: mature cloud service systems

Strategy 1: cooperate with upstream hardware manufacturers to make up their device connection and management capabilities

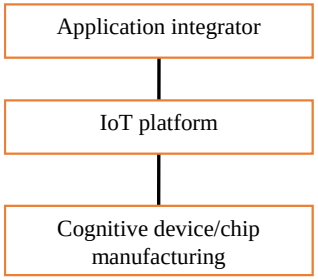
- PaaS providers are highly capable of data analysis and application enabling, but lack of the support from the sensing layer in building end-to-end solutions.
- **AWS hardware partnership program**

  Provide AWS IOT suites and other services to manufacturers.

- **Launch platform-based hardware development suites**

  AWS IOT Button
  MS IOT Starter Kit

Subject of the industrial eyosystem



Strategy 2: cooperate with application integrators to penetrate into the industry

- PaaS providers are lack of professional understanding of industrial fields and the application fields of IoT platforms are defined as a full-modernized industry for general scenarios; therefore, they need the support of industrial application integrators and solution providers to build the industrial eyosystem.
  - Microsoft merged Solair which is dedicated to provide IoT services to manufacturing, retailing and transport industry.
  - AWS IOT cooperates with application integrators such as Rachio and LinkNYC.

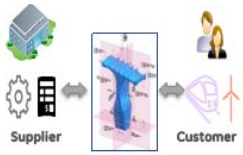
Dominating power--Manufacturing solution providers

- Manufacturing solution providers utilize the industrial advantages to build the industrial eyosystem centered on the industrial applications on the platform

Compared with the consumer field and enterprise application field, manufacturing solution providers such as GE, Siemens and Bosch show prominent advantages in the industrial manufacturing field, the IoT platforms they released precisely address the needs of detailed fields and are helpful to converge wisdom resources, promote industrial application R&D and implementation, and realize deepened integration between IT and OT.

GE's "Predix platform + industrial application" industrial ecological chain strategy

- It was estimated that Predix platform would gather 20000 industrial application developers in 2016 and reach 100000 by 2020 with 500000 applications and rich software services.



Build a manufacturing APP store

Learn the operation modes of the mobile Internet industrial eyosystem

- Set up a cooperative and mutual beneficial mechanism with application developers and distribute profits and provide services in an open and cooperative manner so as to aggregate considerable application developer resources.
- Realize fast gathering of mass scale funds through opening of platforms and increase the attractiveness to maximize the commercial value of platforms.

Strengthen the advantages of the application enabling platform

- GE has professional knowledge and resources of over 60 fields
- Provide platform-based industrial application development tools aiming at professional demands of the manufacturing industry
- Set up the application developer community to enhance the collaboration efficiency of application development

Prospect of GE in 2020

Revenues from software applications 125B

Revenues from platform operation 100B

Promote implementation of solutions and applications

- Predix platform lowers the threshold for deploying IoT solutions
- GE, as the leader of the industry, reorganizes GE service solutions through Predix platform and industrial applications to increase production efficiency and promote the implementation of industrial applications.

Dominating power--Internet service providers

- Internet service providers utilize the advantages in entry and users and cooperate with intelligent hardware manufacturers to build the industrial eyosystem

Building mode: utilize the user advantages in the livelihood consumption field to strengthen interconnection and interaction and build the IoT application platform quickly

- **Huge user group**
- **Mature operation experience**
- **Good use habit**
- **Simple and fast user entry**
- **Powerful social intercourse properties**

Control pivot and tie

Intelligent OS or super application ↔ Application software

- Intelligent home
- Intelligent wearables
- Intelligent building
- Intelligent security
- Other intelligent terminals

Development strategies: Utilize the user advantages, accommodate to users' habits and strengthen cooperation with intelligent hardware manufacturers

User advantages:

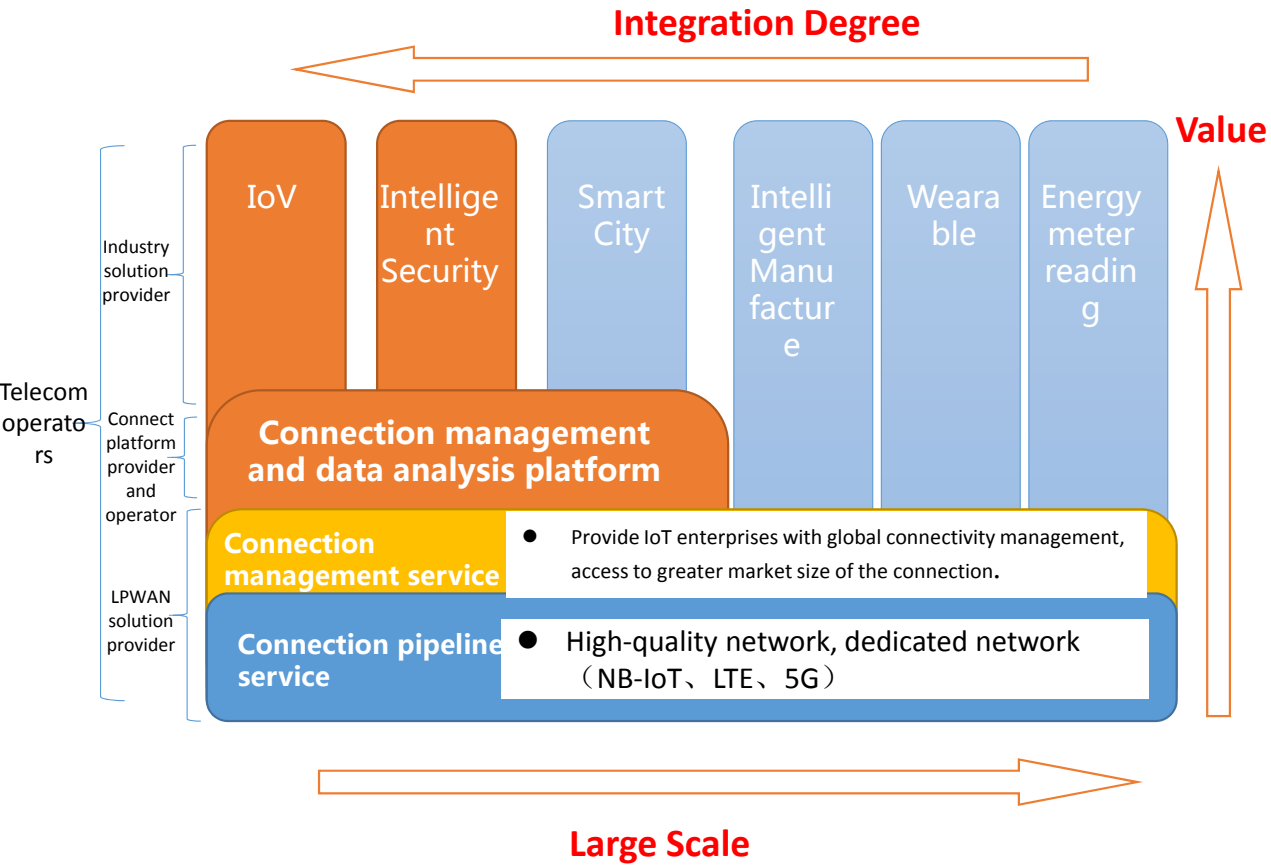
- The only user entry, the unified account management system, simplified access operation
- Huge user groups, reliable user adhesion, easy popularization
- The light development interface developed for developers saves a lot of expenses and efforts by comparing with independent application development
- The Internet use habit can be inherited, reducing the difficulties and cost in acquainting with new APP

Build the eyosystem - the homekit intelligent home platform based on smart phone OS

- In 2016, iOS10 has integrated with the homekit platform. Currently, products supporting HomeKit are mainly Hub or Bridge and can control intelligent household apparatus with HomeKit App

Dominating power--Operators

Based on the pipeline, the vertical extension of the business sector — **products as the core, polymerization industry chain partners**

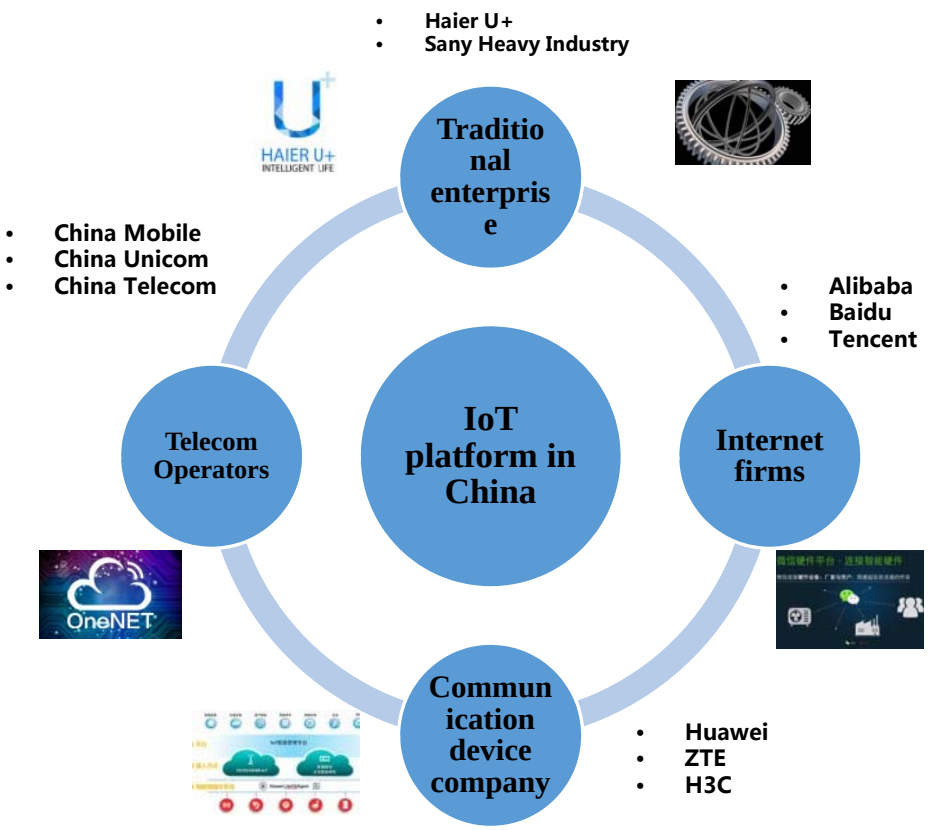


Domestic and foreign operators in the strategy basically based on the pipeline, extending vertically, expand business map to the terminal and platform layer.

- In terms of business model, products as the core, polymerization industry chain advantage resources have become development consensus.
- In terms of product system, operators have formed a typical product application including IoV, smart home, smart medical, intelligent manufacturing and so on.

IoT industrial eyosystem in China

- Leading Internet firms, communication device companies, telecom operators and traditional enterprises released IoT industrial eyosystem strategy.



- Tencent: based on QQ and Wechat, taking advantage of large use scale, develop IoT platforms
- Baidu: AI+IoT, TianGong IoT platform
- Alibaba: expand Aliyun cloud computing platform to IoT platform

- Huawei:" 1+2+1 strategy=OceanConnect platform+the wireless access and the wire access+LiteOS

- Haier: U+ platform for smart home, connecting 1 million household appliances

- China Mobile: OneNET platform;
- China is largest M2M application market (100 million+)

Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
- The development and competition of global IoT industry
- IoT Application progress
  - Industry field
  - Consumption field
  - Smart city field

Industrial Internet of Things application scenario

Production equipment interconnection

Using the data interface provided by the digital production equipment, each production equipment is physically connected to a network, then collect data and upload。

Production equipment status detection

Collecting the internal parameters of the production equipment and the dynamic parameters in the process of running, manage data, implement device monitoring and fault tracking

Equipment remote control and maintenance

using mobile IoT achieve remote control, diagnosis and maintenance of equipment and product in the equipment manufacturing, smart home and other industries.

IoT application scenario

Materials and vehicle logistics

Using the mobile IoV to manage intelligent logistics , and accessing the system to a computer network, to complete the digital management of the goods quantity, location, responsible personnel information.

Intelligent production and management

Strengthen data collection of the parts processing, product / semi-finished product testing, production and operation management and so on, achieve intelligent control, intelligent detection, intelligent management and other models.

Energy consumption detection

Using related device to complete data automatic collection of the power, gas and heat energy, access to things networking, access to the Internet, using provided information of computer network to manage these data.

Production assessment

The traditional assessment system is used in manual reproduction, recording, etc., time-consuming, laborious,. collecting production data, establish the correspondence relationship between production data and employee number.

Environmental monitoring

The integration of IoT and environmental protection equipment have achieve the key indicators of real-time monitoring for all kinds of pollution sources and pollution control produced in industrial production.

Application progress in industry field

Safe production area

Resulting in enormous social and economic benefits

- Mountain flood geological disaster monitoring system
- Underground pipe network control platform
- Elevator operation monitoring platform
- Coal mine production monitoring platform

Traditional manufacturing area

Efficiency increased by 20%, cost reduction of 20%, energy saving 10%.

Metallurgy, machinery, automobile and other industries to gain a place.

- Flexible production line
- Remote operation and maintenance
- EVI(Supplier intervention)

Traffic area

- Intelligent traffic lights
- Intelligent parking
- Smart bus
- High speed ETC
- Traffic collision monitoring system

Energy saving and environmental protection area

Energy consumption fell 30%

- Establishing dynamic energy efficiency model based on big data with the energy management project application virtualization, accurate positioning of peak and valley power consumption, energy saving.

Agriculture area

High-quality agricultural products value nearly 10 times than the ordinary

- The "urban agriculture" system for urban high-end people is increasingly sought after in developed coastal areas
- "Field server", "true color three-dimensional code traceability" and other fresh applications continue to use mobile smart terminals

Course Objectives:

- Background of IoT
- Major advances in the key points of IoT
- The development and competition of global IoT industry
- IoT Application progress
  - Industry field
  - Consumption field
  - Smart city field
- Aanalysis of the challenge

Smart home development trend

Provide the general function product	Service →	Product additional personalized service
Home-oriented smart home system and large appliance	personalize →	Personal oriented intelligent hardware
Achieve remote control	Intelligent →	Self-learning, intelligent operation
Each product independently control	Synergistic →	Devices communicate with each other and work together

Weighing scales provide analysis reports and health advice

A large number of entrepreneurial teams launched a variety of smart small objects

Home control system can learn the user habits, to achieve automatic operation

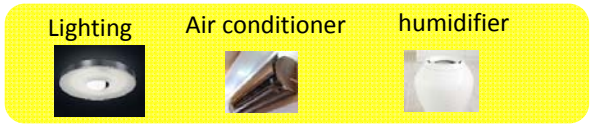
devices even devices and applications can work together

Smart home development trend

- **Gartner : in 2016 the number of connected devices in smart home area will be 339 million.**

- Security

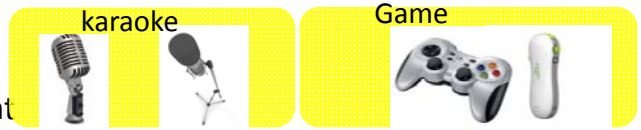
- Ambient assisted living



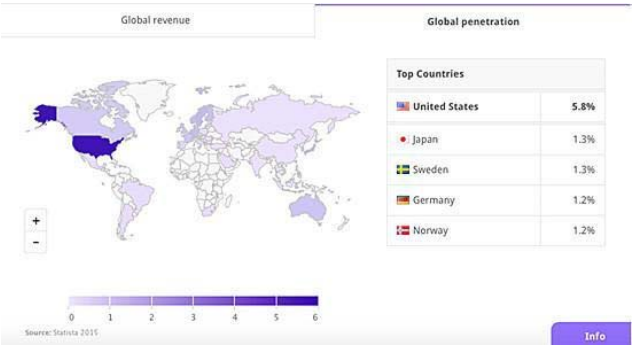
- Energy management

- Home automation

- Home entertainment



Market capacity top 5
- USA
- Japan
- Germany
- China
- UK



Popularizing rate top 5 :
- USA
- Japan
- Sweden
- Germany
- Norway

Course Objectives:

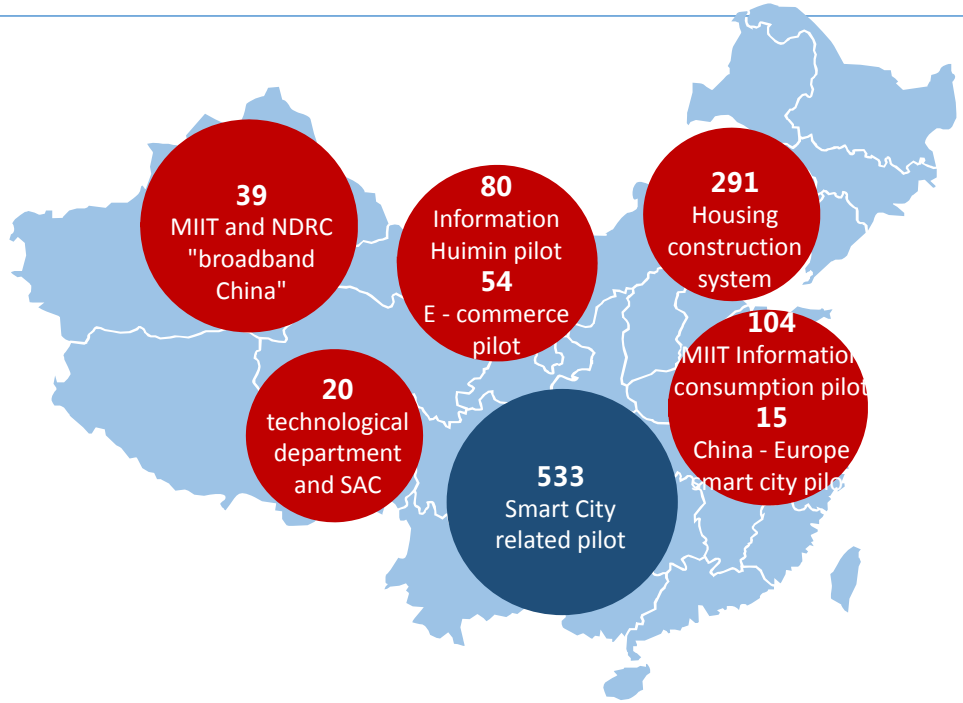
- Background of IoT
- Major advances in the key points of IoT
- The development and competition of global IoT industry
- IoT Application progress
  - Industry field
  - Consumption field
  - Smart city field
- Aanalysis of the challenge

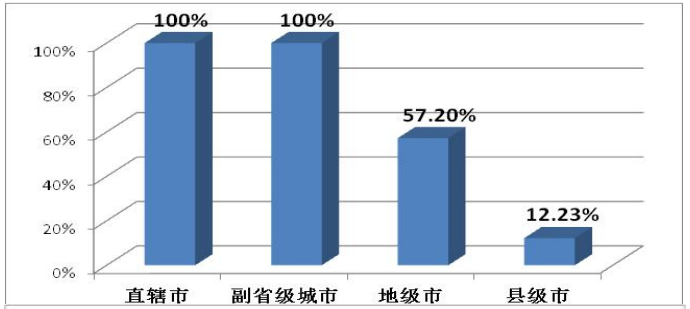
Smart City

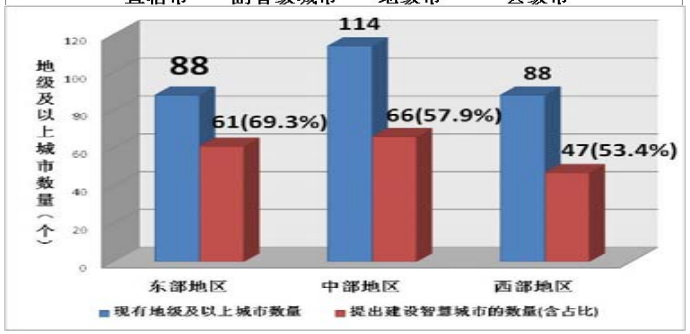
Top-level deployment

- 《National 13th Five - Year Plan》 2016. 3
  - **Strengthen the construction of modern information infrastructure, promote the development of big data and IoT, build smart city.**
- 《National information strategy outline 2015–2025》 2016. 7
  - **Strengthen the top-level design, improve the information technology of urban infrastructure, operation management, public service and industrial development , and promote new smart city construction by classification .**

Pilot demonstration







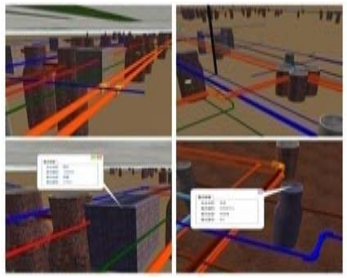
Smart City——The management of underground pipeline

- The deployment of Connected sensing devices enable pipeline state can be monitored in real-time, which increases the government's ability to respond to pipeline problems, such as water leaking, gas leaking, cable damage.

Smart management system based on GIS

Application layer

DATA



- ✓ Display teal-time pipeline state
- ✓ Organize the daily maintenance work
- ✓ Accident warning
- ✓ …

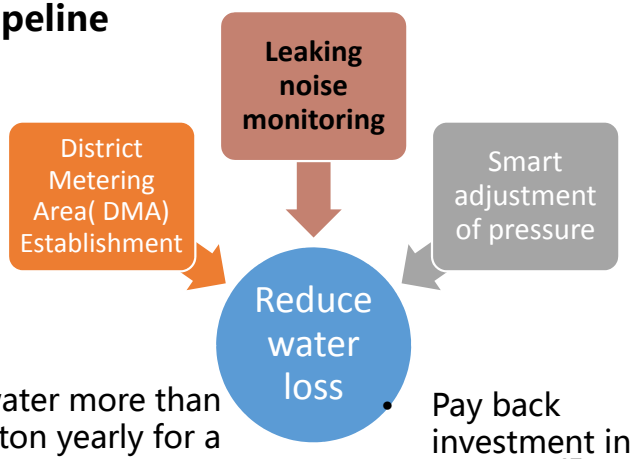
Deployment of connected sensors

Sensing layer

Water supply	**Pressure, Flow, Quality, Audio, Video**
Drain	**Flow、Level、Quality、Audio**
Fuel gas	**Flow、Pressure、Valve、Leaking**
Heating	**Temperature, pressure**
electric	**…**

- **Taiyuan： "Underground Eye Project"**
  - Deploy connected sensing devices of all underground pipeline to ensure safety.

- **Beijing : Smart management system for water supply pipeline**



- Saved water more than 220000 ton yearly for a community (5000 homes)
- Pay back investment in 18 month

Smart City——The management of energy consumption

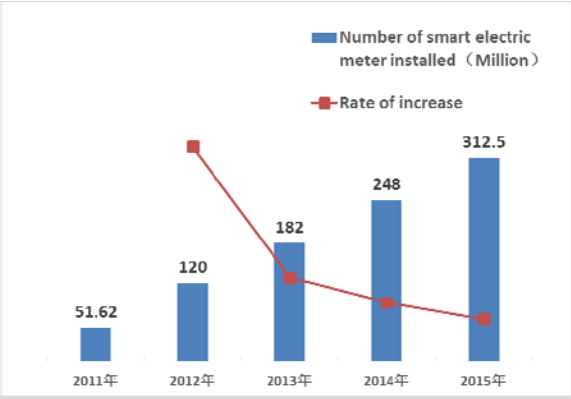
- The deployment of Connected data acquisition terminal, enable water, electricity and fuel gas consumption data can be monitored and integrated in real-time for analysis.

Practice case: Smart Dubuque

- Digitize and integrate water, electricity and fuel gas consumption data of the whole city.
- Help families to develop energy saving plan.

China：Energy saving system for public building

■ **Promote remote meter reading terminal**



- **The number of smart electric meter installed in China is 310 million (2015).**
- CHINA'S State Grid is promoting the integrated smart meter for water, electricity, gas and heat.

■ **Smart management system of energy conservation**

Data

With the help of the smart management system of energy conservation, the energy-saving economic benefits achieved by public institutions in Haidian District worth **tens of millions yuan**!

■ **Deploy the Connected data acquisition terminal**

Smart City——The management of traffic

- The deployment of Connected sensing devices on vehicles, highway and parking lot optimizes urban traffic management.

Electronic Vehicle Identification

- High speed for identification
- Long working range
- Long serving life
- Strong security

- Registration management
- Traffic safety management
- no-stop tolling

DATA	Size	Type	Processing complexity	Redundancy	Time-consuming
Video	Large	Analog	Hard	90%	Long
EVI	Small	Digital	Easy	Low	Short

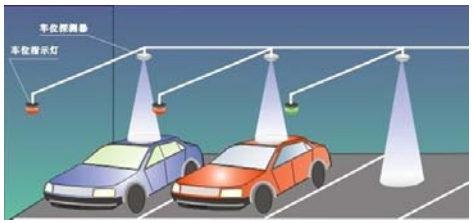
Chongqing：

✓ **3.5 million installed**

Vehicle number of China：172 million (2015), 193 million (2016).

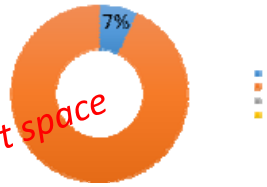
Smart parking

Large scale deployment of sensors for parking space



■ Intelligent parking lots

- Account for only **7%**



■ Sharing economy

- APPs such as Parkme, Justpark are based on the parking lot information monitoring and sharing.

Tremendous development space

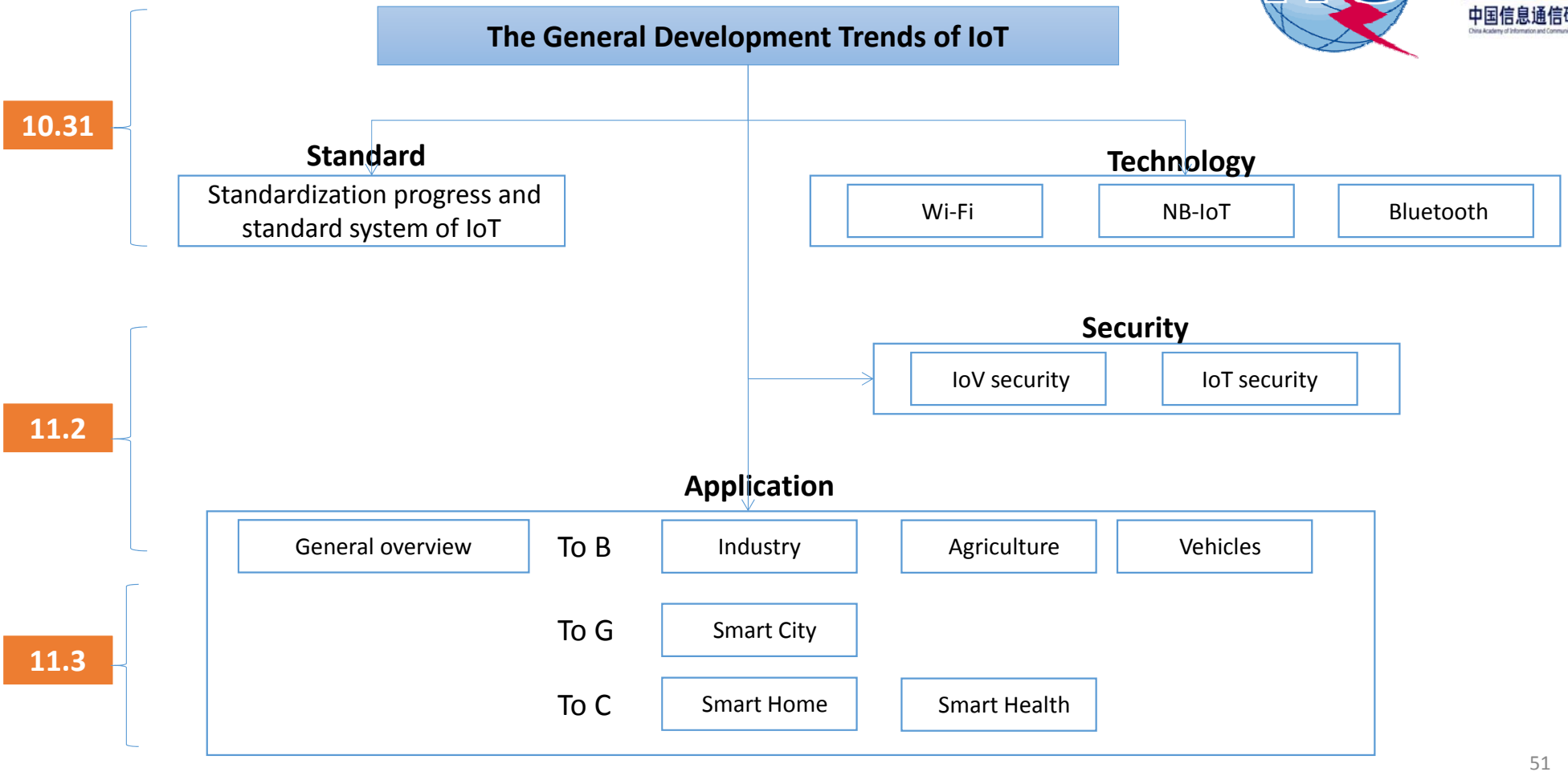
Trainer: Wang Sibo

E-mail: wangsibo@caict.ac.cn

Department: Institute of Industry and Planning Research

Address: Huayuan building, No. 36 Nanlishi Road, Xicheng District, Beijing, China

Following Course Schedule



Thanks!

中国信息通信研究院 http://www.caict.ac.cn