



Introduction about Industrial Internet(IIoT) and relevant standardization activities

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Course Objectives:

- Have a clear understanding about the Industrial Internet
- Have knowledge of development status, key directions, typical use cases and standardization requirements of the Industrial Internet



Agenda

- **Basic understanding**
- Origin of Industrial Internet
- Architecture of Industrial Internet
- Key Directions of Industrial Internet
- Development of Industrial Internet
- Standardization Activities

Basic Concept



Process industry



i.e: petroleum, chemical, electric power...

Sampling period: 500ms

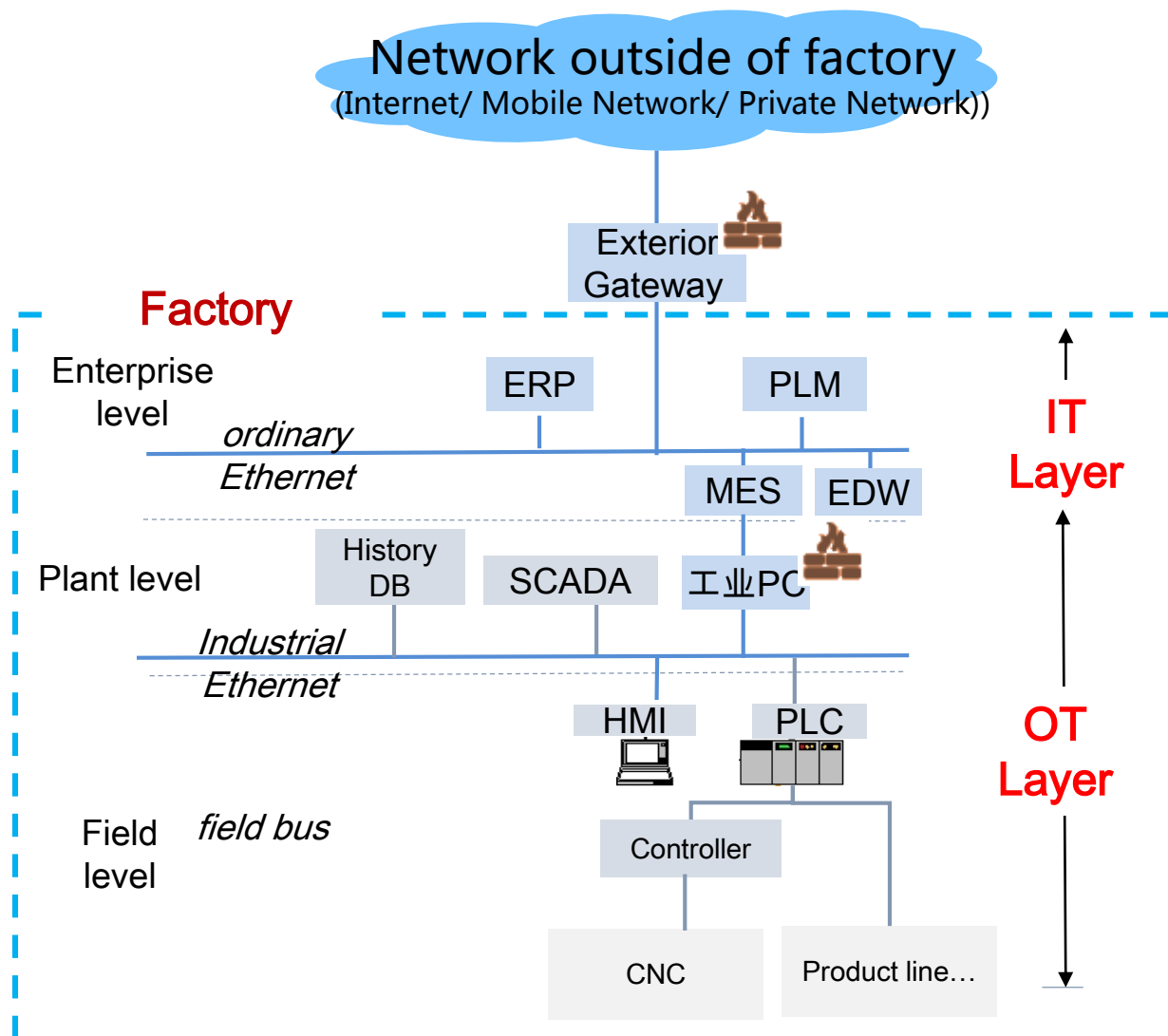
Discrete industry



i.e.: automobiles, ships, aircraft, ...

Sampling period : <10ms

Industrial System Architecture



- IT layer and OT layer are **isolated**
- Factory is **relatively enclosed**, and the interaction with internet is mainly limited to commercial activities



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The origin of industrial Internet



**Concept
Leading**

2012.11, GE proposed the concept of industrial Internet

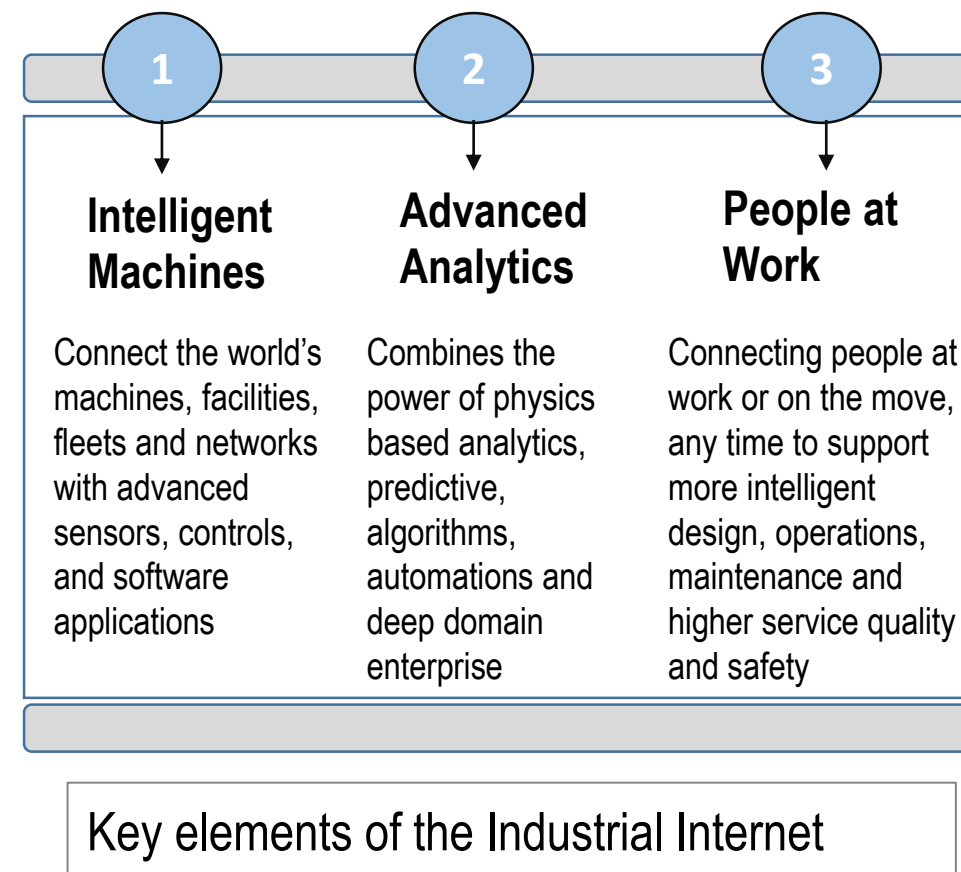
**Ecological
Construction**

2013.6, GE published "industrial Internet: breaking the boundaries of intelligence and machines"

**Internal
Adjustment**

2014.3, GE, Cisco, IBM, AT&T, Intel set up Industrial Internet Consortium(IIC)

2015.9, GE established GE Digital by integration of software department & IT functional departments



The origin of industrial Internet



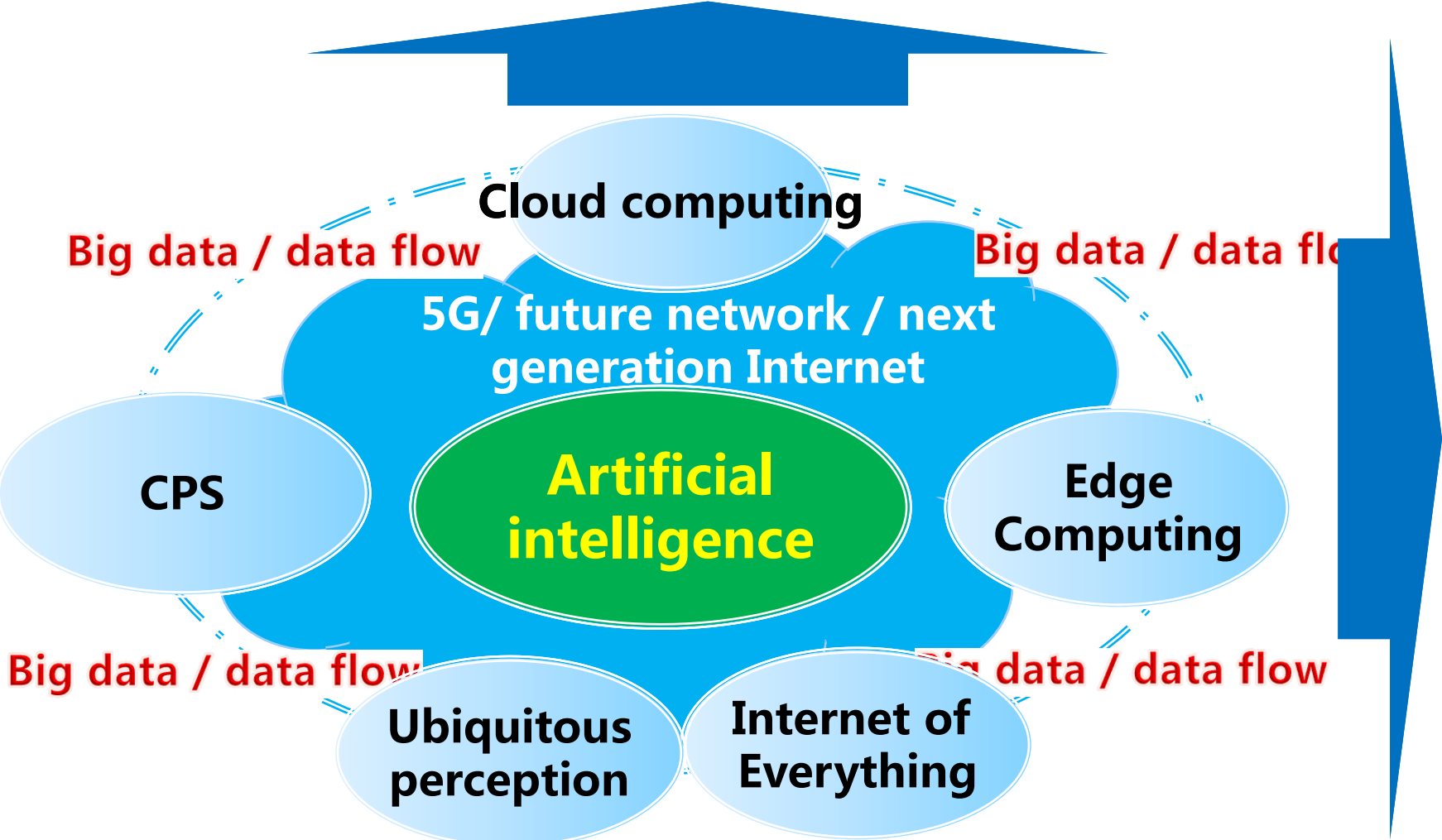
Industrial Internet stems from endogenous requirements raised by industrial development and technology driven raised by Internet development.

In the final analysis, it is the inevitable result of productive forces development

Global digital wave and its technological drivers



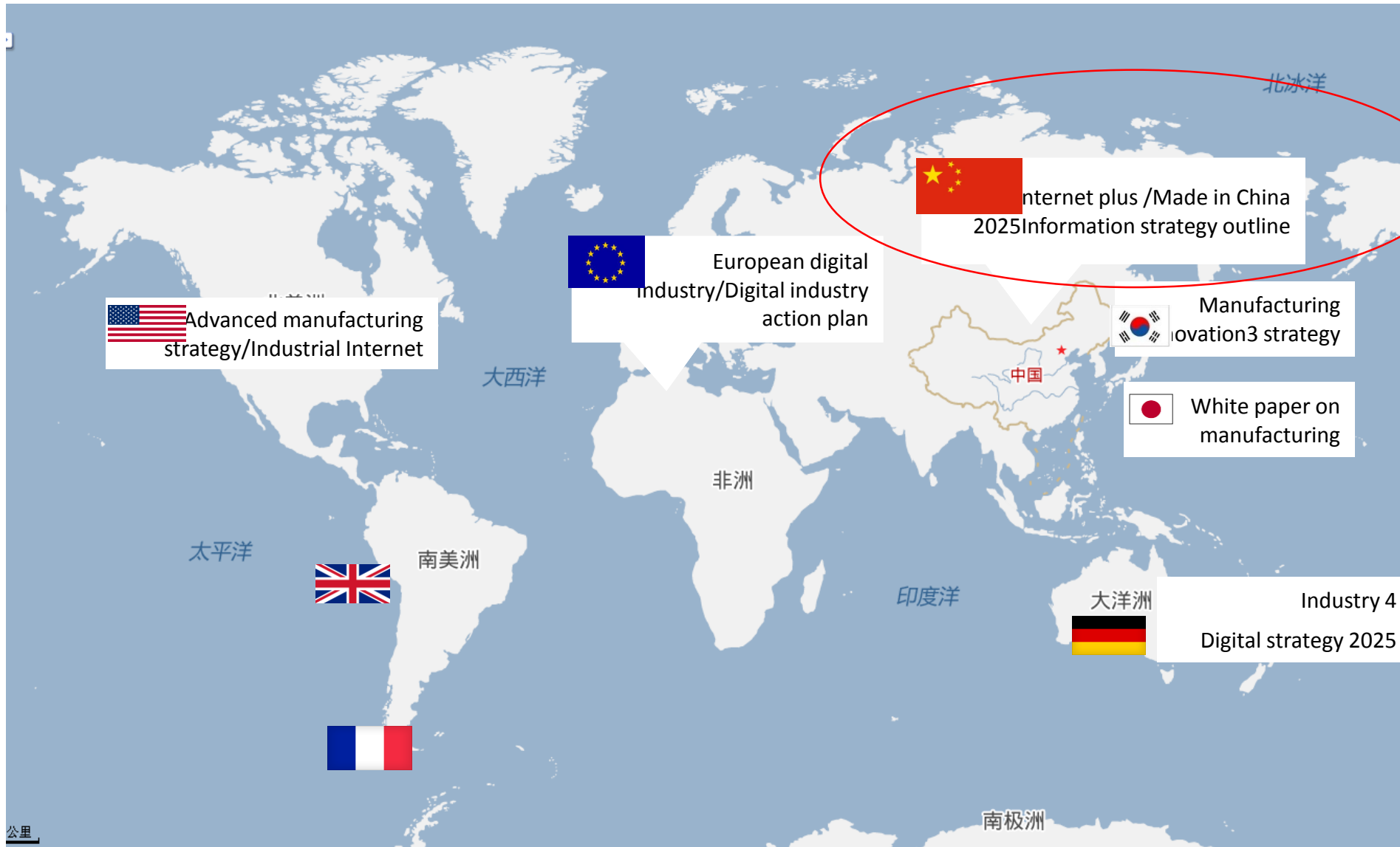
Digital economy and society: digitization, networking and intelligent transformation in various fields



New Model I

Fully connection
Sharing economy
Application in APP style
Cloud-based resource
Data driven intelligence
Data-driven innovation
.....

Lots of countries are trying to catch the opportunities of digital economy and new industries revolution



In these strategies, manufacturing sector is the core, but they are **not only limited to manufacturing sector**, but covering all sectors of the real economy

(1) Germany-Industrie 4.0



Industries 4.0 is a strategic choice for Germany to the digital wave and manufacturing competition (2006 -)

- Production mode changes to **large-scale customization**, and fully meets the individual needs
- Through dynamic resource allocation, the production resource and production line can be adjusted and optimized in real time, and **the flexibility of production organization** can be realized
- Through the real-time and transparent information transfer, the whole process of enterprise decision-making, the whole life cycle and the whole value chain **dynamic optimization** are realized
- Intelligent analysis is used to maximize resource utilization and **minimize energy consumption**
- Around the whole life cycle of the product Constantly integrate value-added services and **create new values**

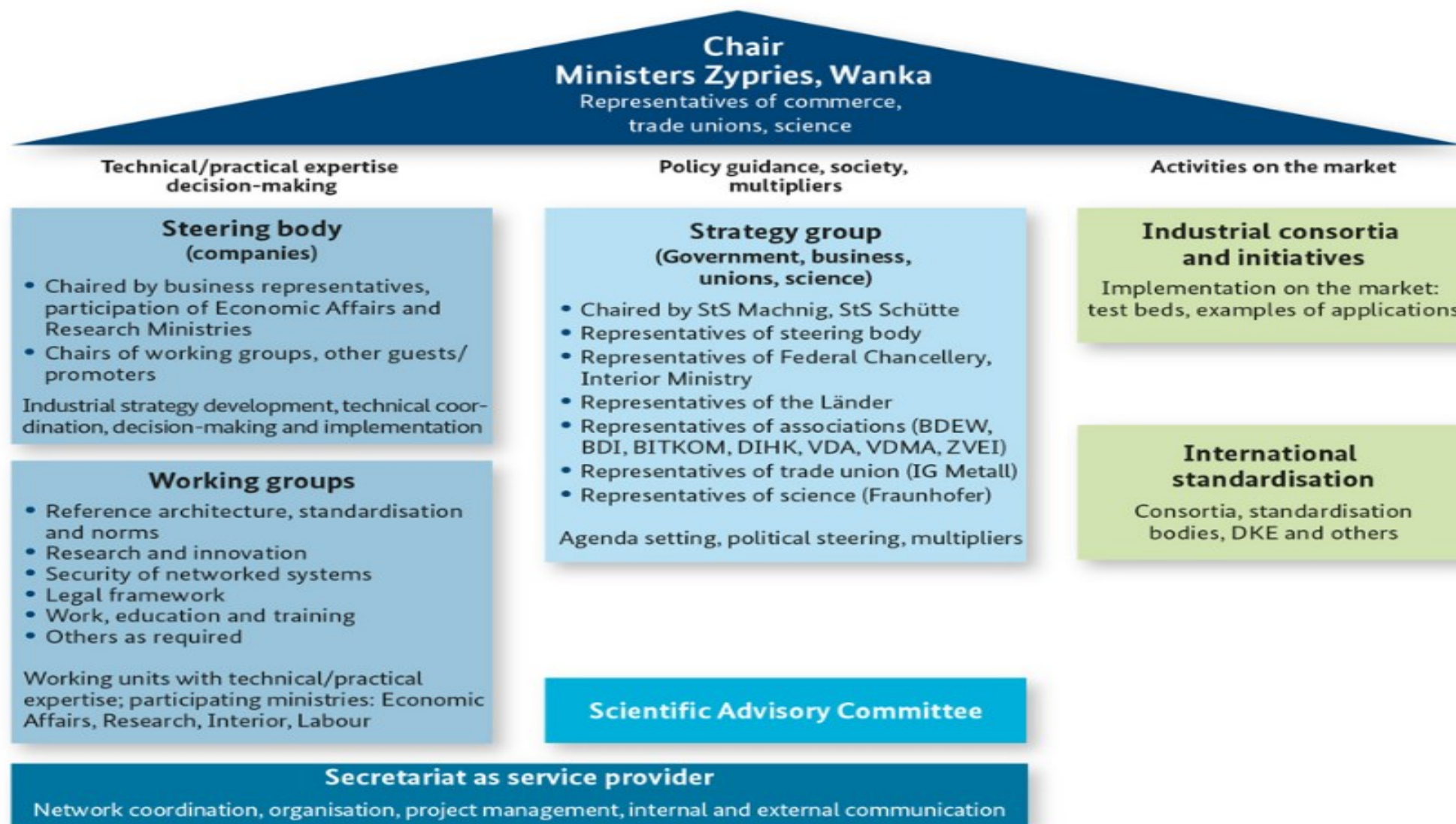
objectives

- High flexibility, productivity increased by more than **40%**
- Optimize the value creation process in real time and on demand
- Resource efficiency is improved by more than **50%** and compatible with urban life
- Adaptive and intelligent systems **help workers** expand their scope of work
- **Balance of work and life** and human centered production organization

The technical foundation is the Cyber Physics System (CPS)

In 2011, the concept of industrie 4.0 was introduced on Hannover Industrial Exposition

industry 4 Platform (ecosystem)



US-Advanced manufacturing, CPS, and industrial Internet

In 2007, PACAST proposed CPS is the priority R&D agenda for the U.S. federal government.
In 2011, the U.S. government issued a “win the future through the intelligent systems technology of twenty-first Century” (Involving manufacturing, medical, transportation, energy, materials and other fields)

In 2011, US proposed advanced manufacturing strategy in March 2012, US CPS Workshop



Boeing (aviation industry)

3 scenarios: aircraft manufacturing (factories), aircraft operations (flight), ATC systems



Controls Challenges for CPS: A GE Perspective

Brent Brunell

Technology Leader, Controls Electronics and Signal Processing

GE (Automotive Industry)

One hundred years of change: power drives, electronic controls, connections, personalization
New DNA:CPS

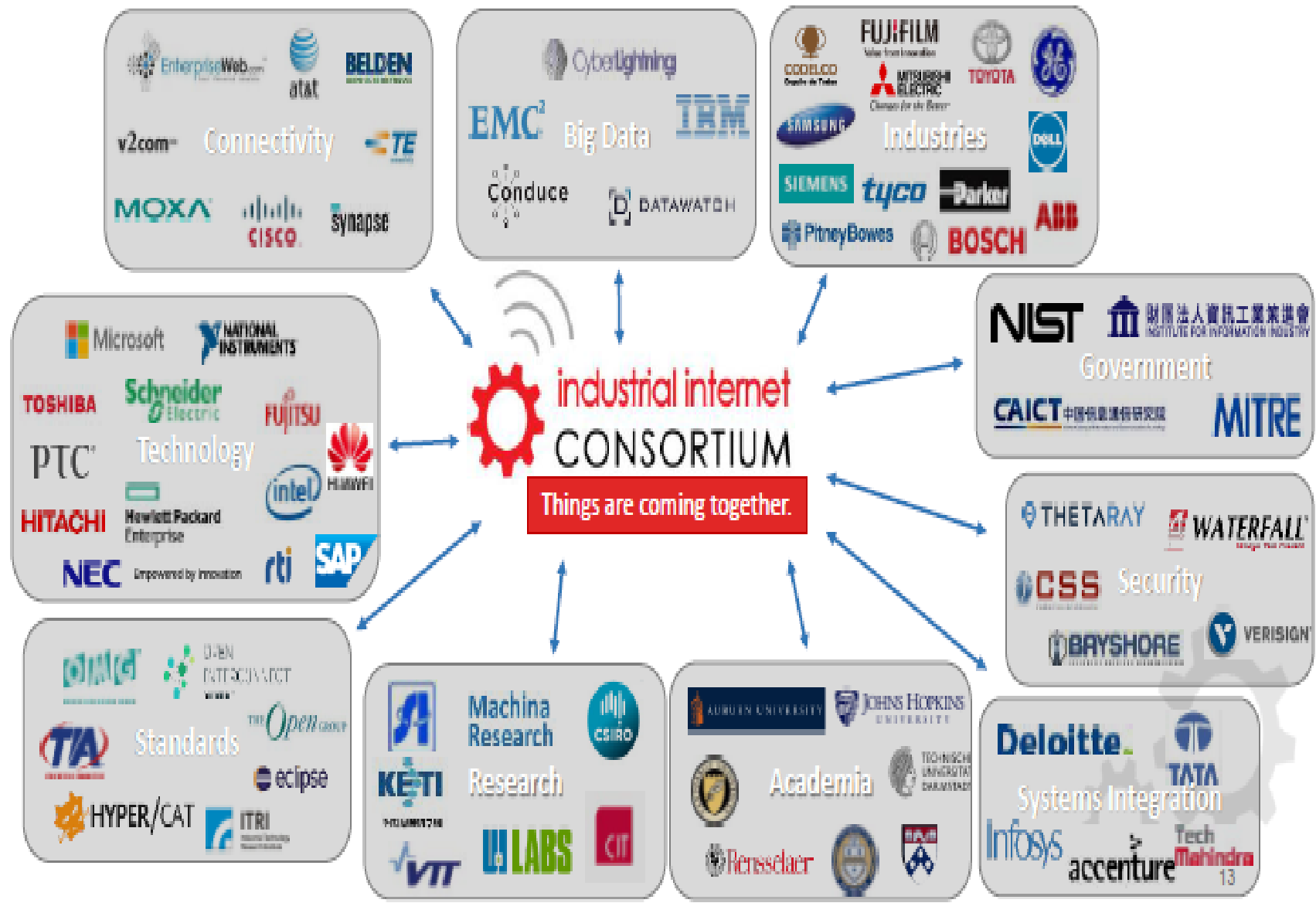
GE

Challenge of controlling: from components - > system - > enterprise
Features: system of system, space distribution, fault tolerance, environment adaptability, safety, energy saving and economy

In 2012, GE proposed the industrial Internet



Industrial Internet development in the United States is dominated by IIC



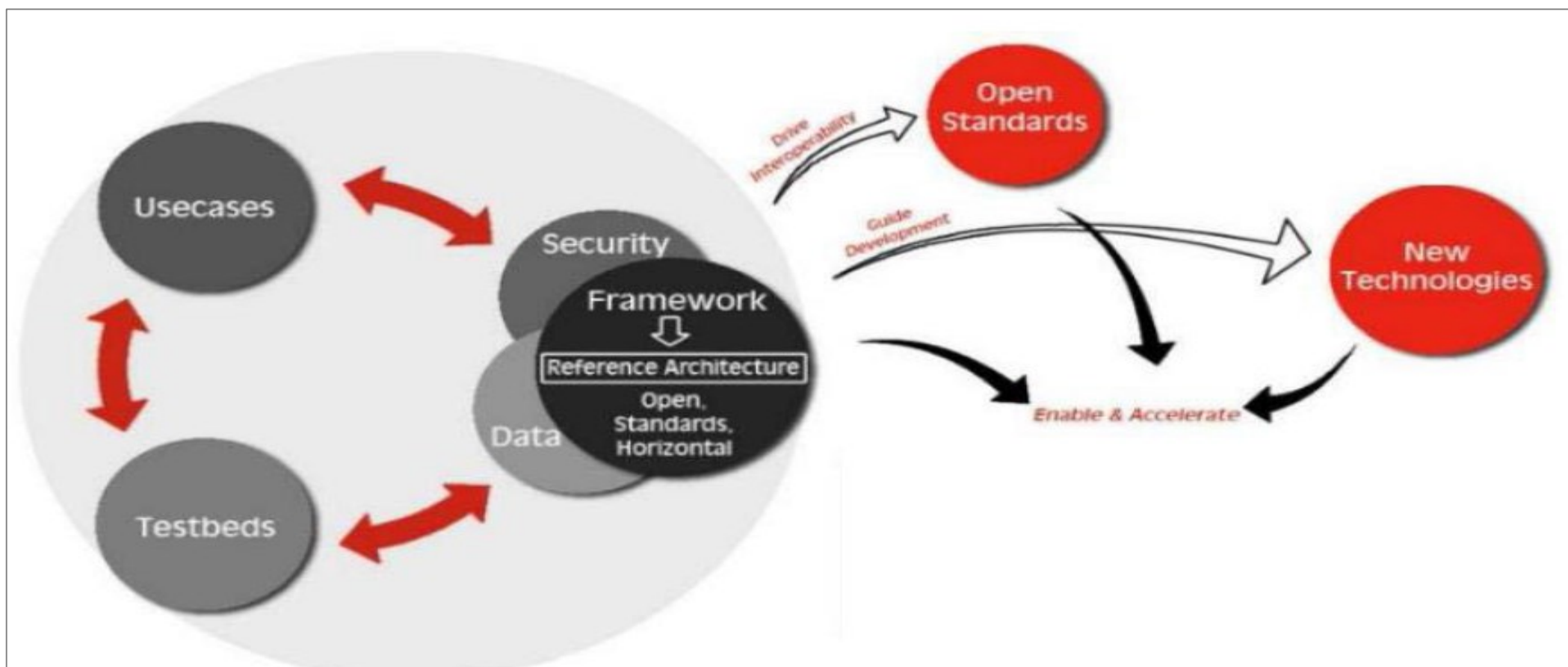
IIC main members

- US: GE, Boeing, IBM, Intel, CISCO, Microsoft, AT&T, PTC, HP, DELL, EMC...
- Europe: SAP, BOSCH, Schneider, SIEMENS, ABB...
- Japan: MITSUBISHI, Toshiba, Hitachi, SONY, Fujitsu, Fuji...
- South Korea: samsung...India: Infosys, Tata.....
- China: HUAWEI, Haier, China Telecom, wapwag, China ICT institute...

IIC core focus



IIC developed reference architecture (IIRA), then based on IIRA, to establish procedures and templates through use cases, provide the verification by test bed , hatch new products, solutions and services, driving standardization, accelerate the industrialization and deployment of industrial Internet



Germany's judgment on the strategies



U.S.

- Business model innovation
- Enterprises promote the development of test bed

Japan

- Focusing robotics and automation Technology
- Advanced implementation plan

Germany

- Optimizing production by science and technology
- Ensure the leading position of production and Engineering Technology

China

- Focus on industrial modernization (made in China 2025)
- The rapid growth of the domestic market and the consequent internationalization



Agenda

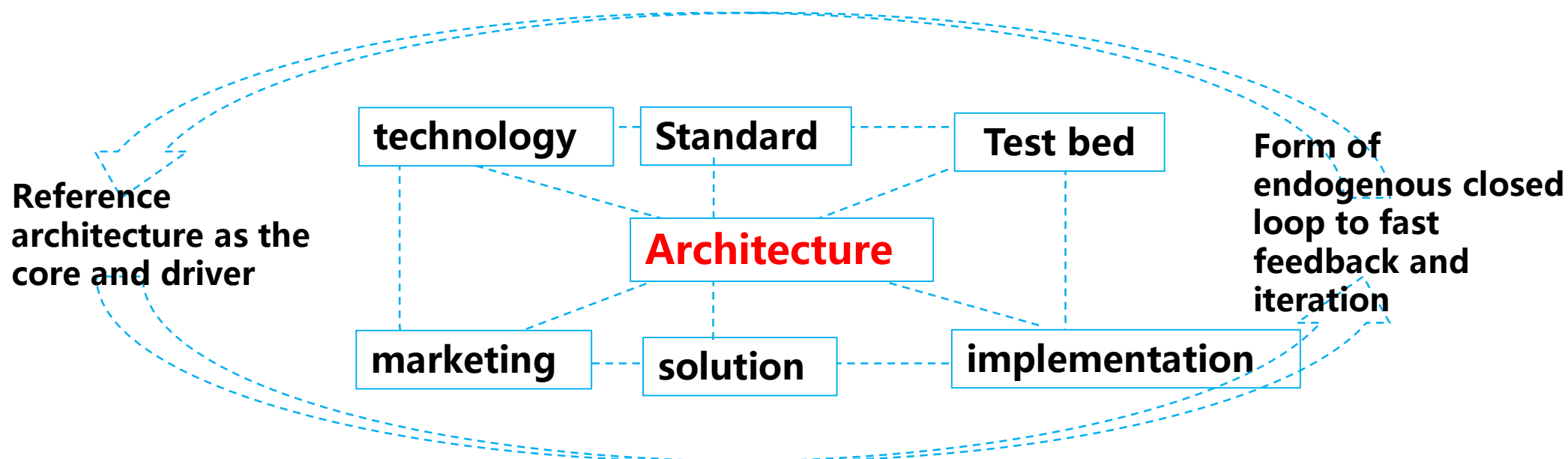
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Industrial Internet Architecture

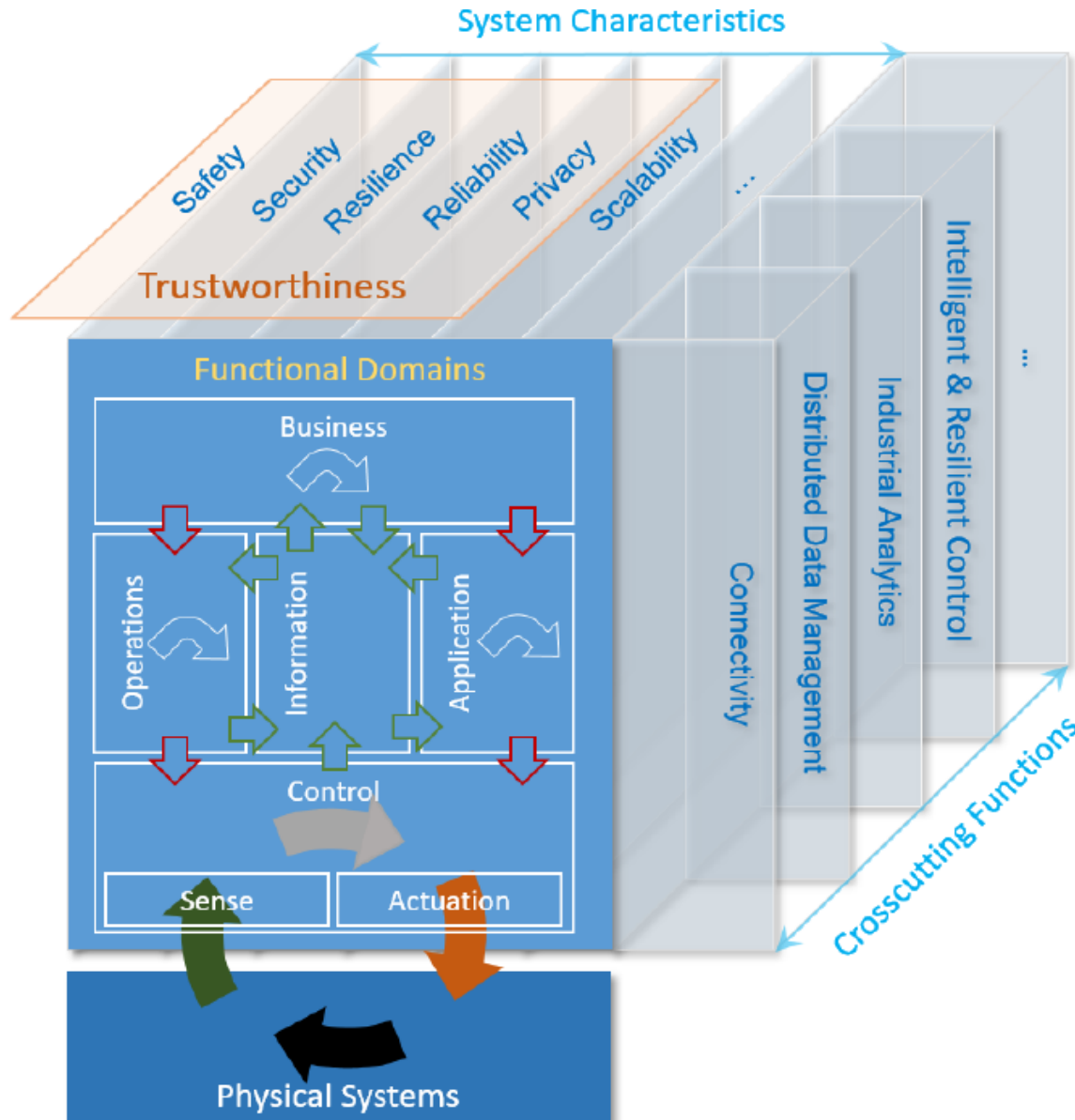


Industrial Internet architecture is the top-level design.

The key point is to establish the overall view, form the top-level design and guide the related technology research, standards development, test, system integration and application development etc..



IIC: IIRA(Industrial Internet Reference Architecture)

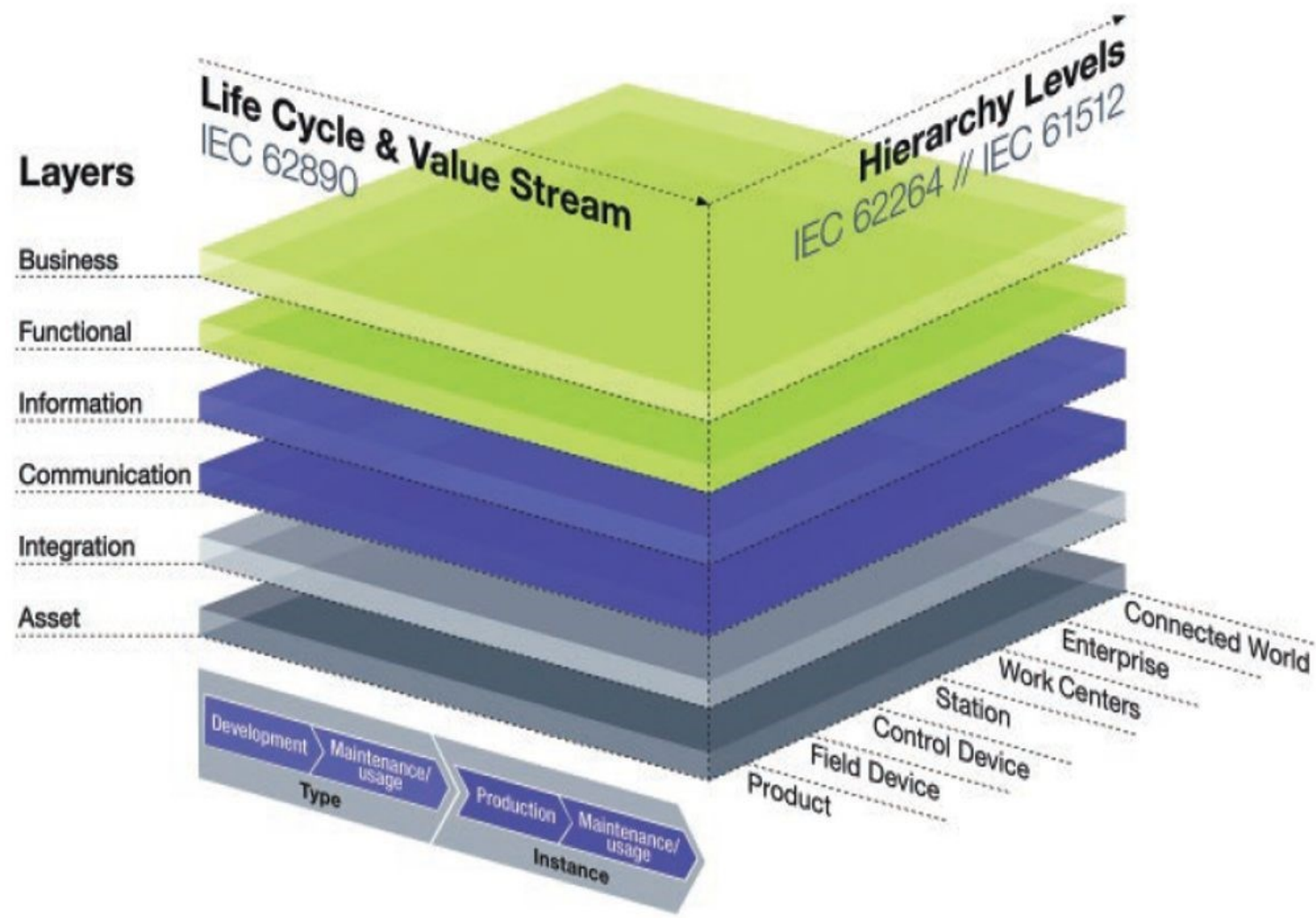


- **Functional domains**

- five aspects: control, operation, information, application and business.
- The control domain is the key to realize the interaction between the information world and the physical world.
- The information domain has the function of data collection, analysis and distribution, which is the core driver of other module optimization.

- **Crosscutting functions** which may require consistent consideration across the viewpoints
- **Trustworthiness** is the degree of confidence one has that the system performs as expected in respect to all the key system characteristics in the face of environmental disruptions, human errors, system faults and attacks.

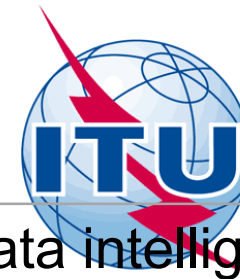
Germany: Reference Architecture Model Industrie 4.0



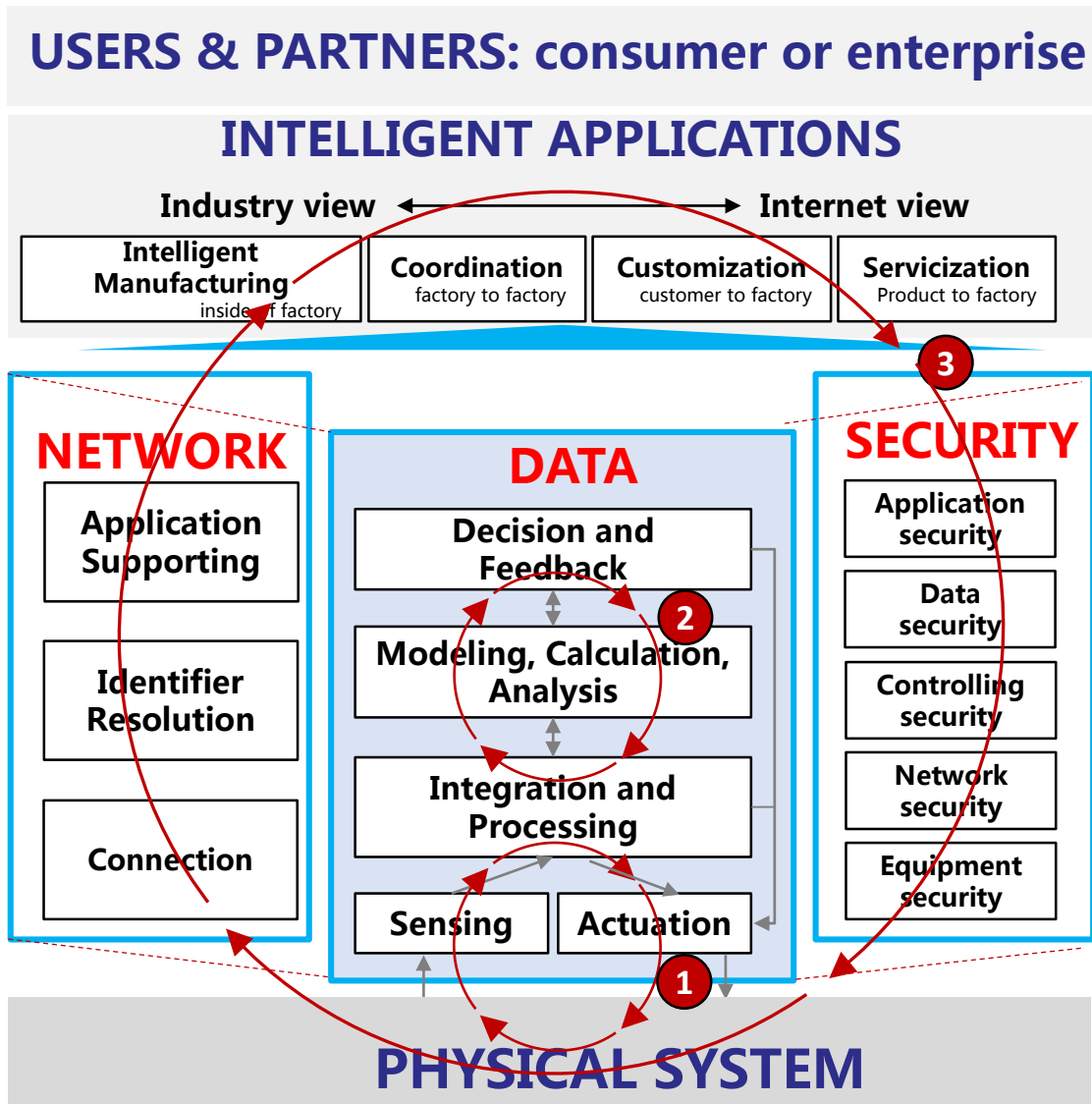
Layer perspective (Functional):
is the deconstruction of intelligent production capacity.

Life cycle & value stream perspective:
Based on IEC62890, describes the whole process of value generation from prototype to object in parts, machines, factories and other units

Hierarchy levels perspective:
based on IEC62264 and 61512, build a complete industrial system.



China: Architecture of Industrial Internet



DATA : data flow and data intelligence in the whole lifecycle of product

NETWORK: the basis for the data collection, transmission, exchanging, etc.

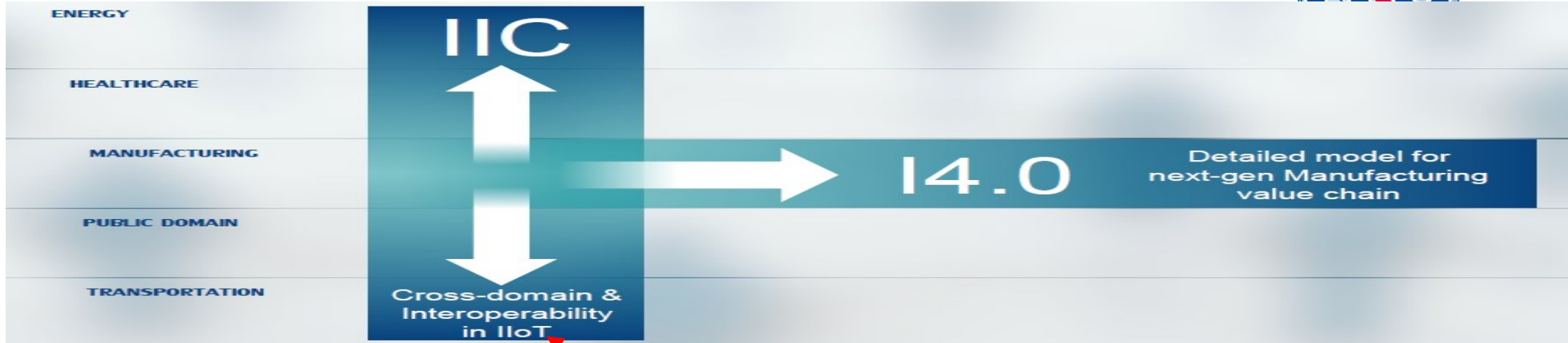
SECURITY: the basis to ensure the running of the industrial internet system

To realize kinds of intelligence applications, consist both industry views and internet views.

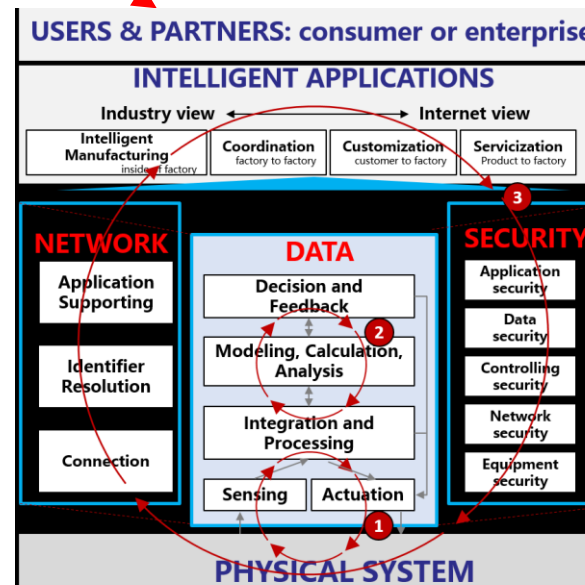
THREE CLOSED – LOOP OPTIMIZATION:

- equipment operation optimization
- enterprise management optimization
- ecosystem optimization

Views on IIRA, RAMI 4.0 & China architecture



Similar



Why does All define architecture of Chinese Industrial Internet



- Chinese Internet Enterprises, such as BAT, actively carry out business innovations, have grave influence on Chinese industry
- **On the other hand**, industrie 1.0, 2.0, 3.0 coexist, development of digitization, networking, intelligentialization are in different phases, demands are quite different. Most factories do not realize the IP-based networking
- China has tens of millions of SMEs, and these enterprises focus on the domestic market. Most of them are lack of technology and knowledge to deploy the Industrial Internet or industrie 4.0
- Security challenges are becoming more and more serious

Chinese Industrial Internet

= **IIoT + Internet** (Including e-Commerce, C2B, Mobile Internet, SNS, AI...)

= **International Industrial Internet + Localization**

2016, industrial internet system architecture 1.0 published by AII



OUTLINE

1. Industrial Internet and Smart Manufacturing

Definition

2. Industrial Internet Architecture

Architecture

3. Industrial Internet Network System

4. Industrial Internet Data System

5. Industrial Internet Security System

6. Industrial Internet Implementation

Appendix 1: Terms and Definition

Appendix 2: Acronyms and Abbreviations

Current Situation

Problems

Trends

Target Architecture

**Ways of
Implementation**

DOWNLOAD: <http://en.aii-alliance.org/index.php?m=content&c=index&a=lists&catid=17>



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Definition of industrial Internet



IIC **internet of** things, machines, computers and people, enabling intelligent industrial operations using **advanced data analytics** for transformational business outcomes

AI Industrial Internet is an **industry and application ecosystem** that integrates new-generation ICT with global industry system, as well as **a key ICT infrastructure** of industry intelligence

Network System and trends



3-Application Supporting Sub-system

(to support the integration of Service & Data)

- Application protocols, i.e. OPC, MQTT
- CC-based platform, i.e. IaaS, PaaS, SaaS
- Service oriented encapsulation & integration

2-Identifier Resolution Sub-system

(ID → Server for information acquisition)

- Multiple solutions such as OID, ONS, but improvement is required to meet the needs of industrial internet

1-Network interconnection Sub-system

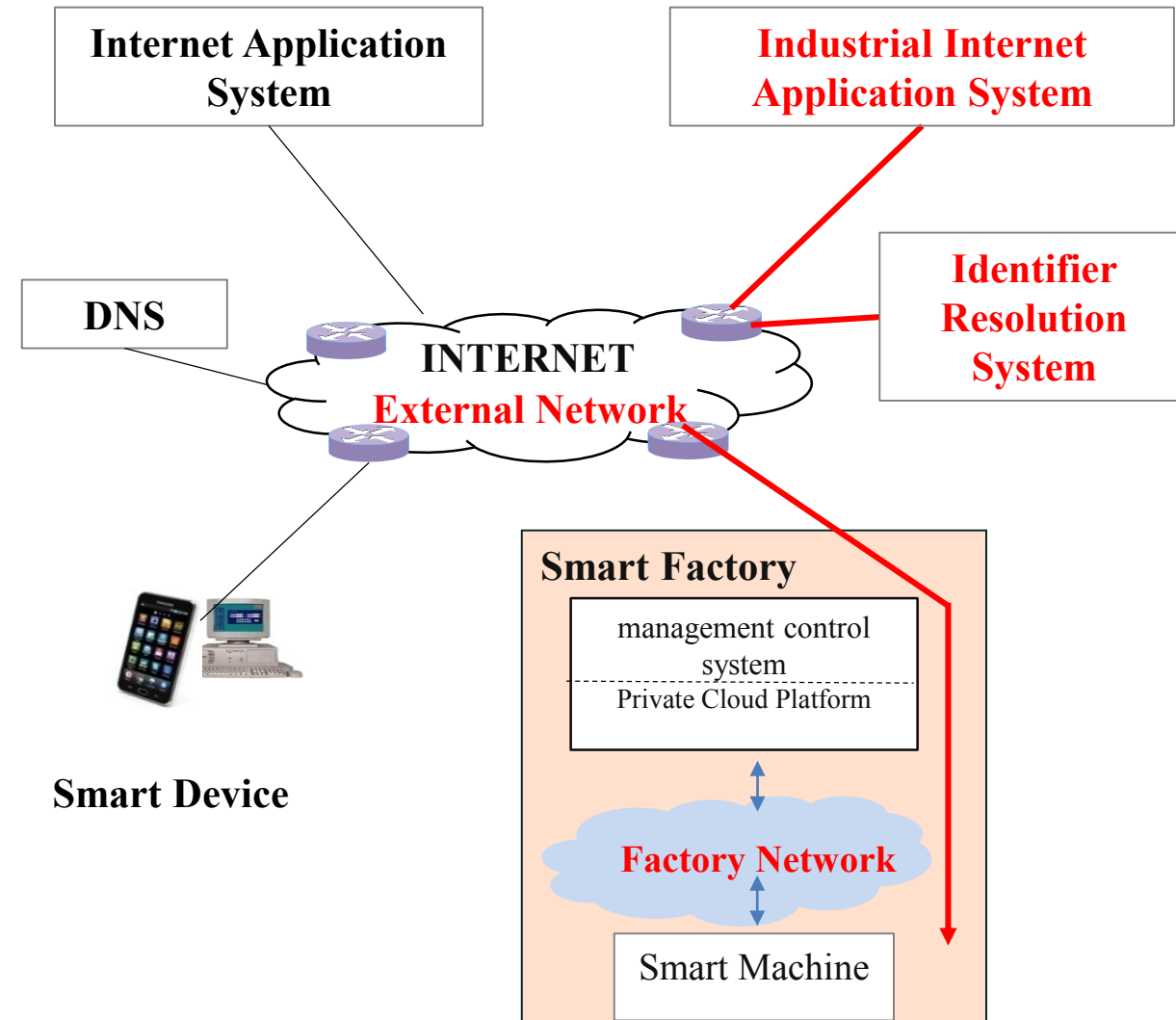
(IP-based technology extends to inside factory)

INSIDE FACTORY

- IP-based
- Wireless
- Flattening
- Flexible networking

OUTSIDE FACTORY

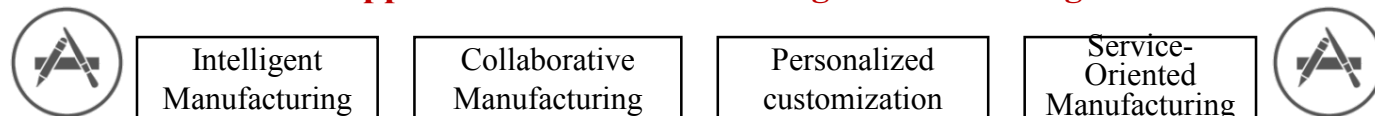
- Billions devices access
- Hundred service planes
- Millions VPN
- network programming
- QoS, security





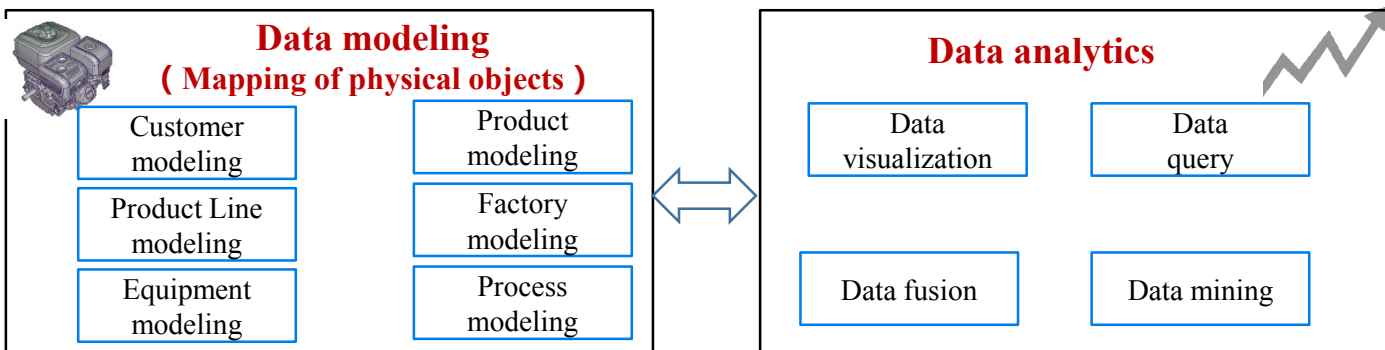
Data System, characteristic and trends

Application of decision making and controlling

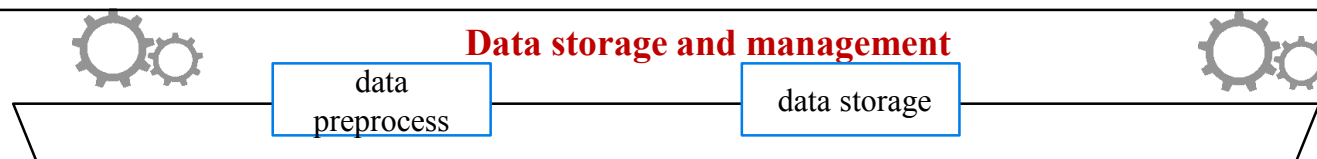


Data modeling

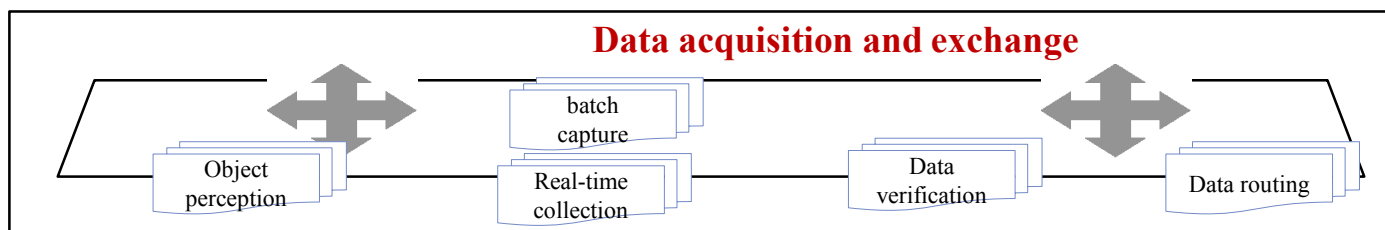
(Mapping of physical objects)



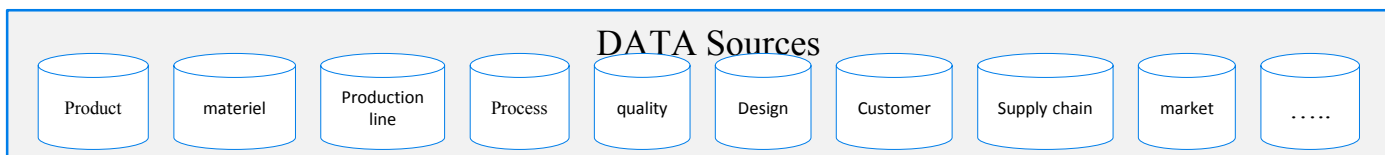
Data storage and management



Data acquisition and exchange



DATA Sources



Five characteristic

legacy 4V

- Volume
- Variety
- Velocity
- Value



- Volume
- Distribution widely
- Structure complicated
- Velocity diversely
- High confidence level in data analytics

Trends

- Data integration across layers & parts
- Data process with assistant of the edge
- Data integration management in cloud
- Advanced data analytics
- Data visualization as analytic tools

Security System, Challenges and trends



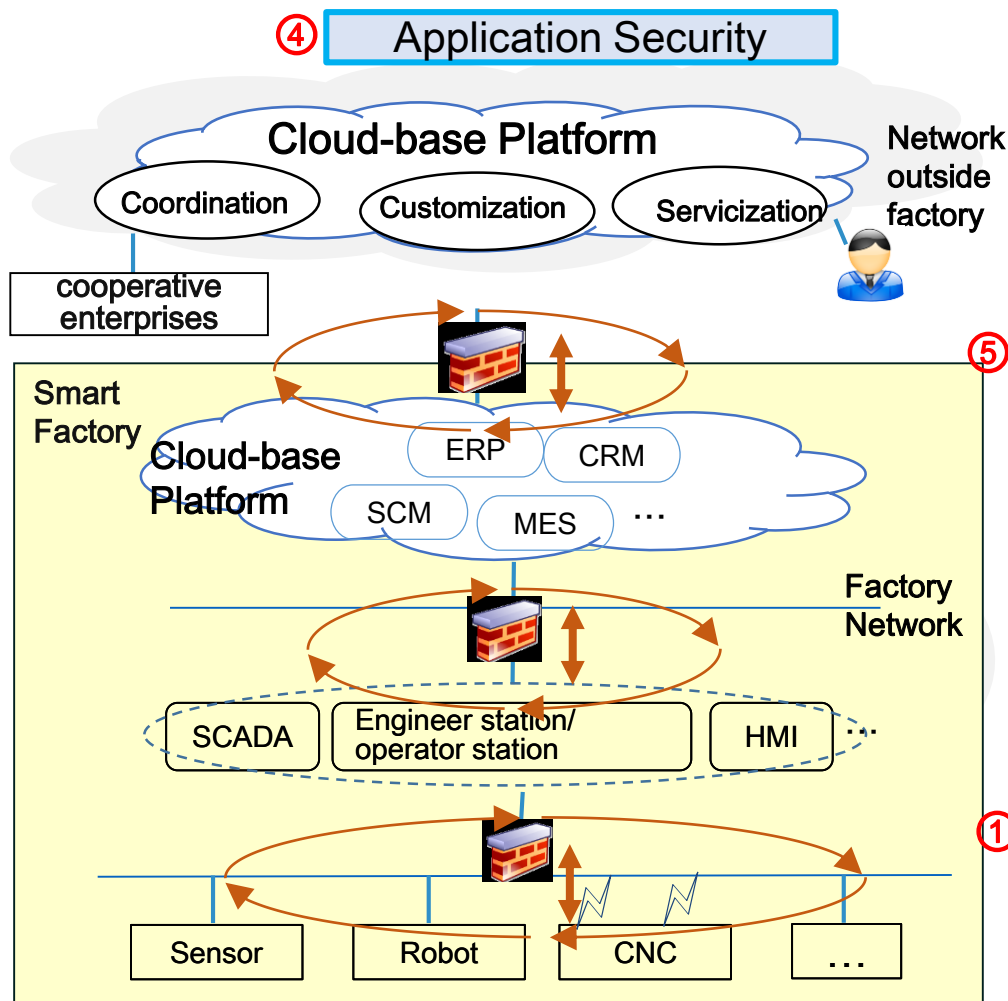
Challenges to the internet security to support various Industrial Internet applications

external Internet threat penetrating into factory due to openness of controlling environment

③ Controlling Security and Safety

Challenges due to IP technology, wireless technology introduced as well as flexible networking

② Network Security



data & privacy protection
Challenges due to data open, flow, sharing

⑤ Data Security

Challenges due to Intelligitized equipment exposed to the network attacks directly

① Equipment Security and Safety

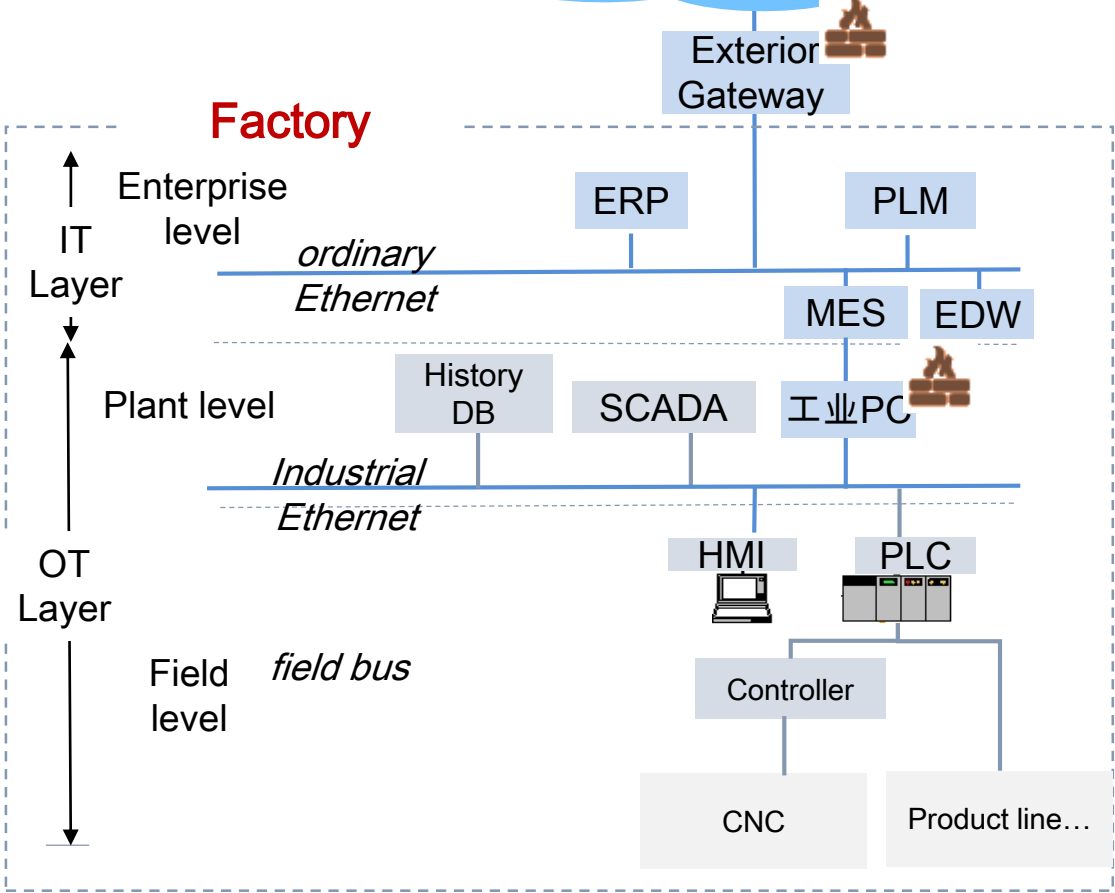
Trends

- Convergence of **security and safety**
- Equipment embedded security
- Dynamic network security defense
- Flexible security assurance capability
- Classified protection to industrial data and user data

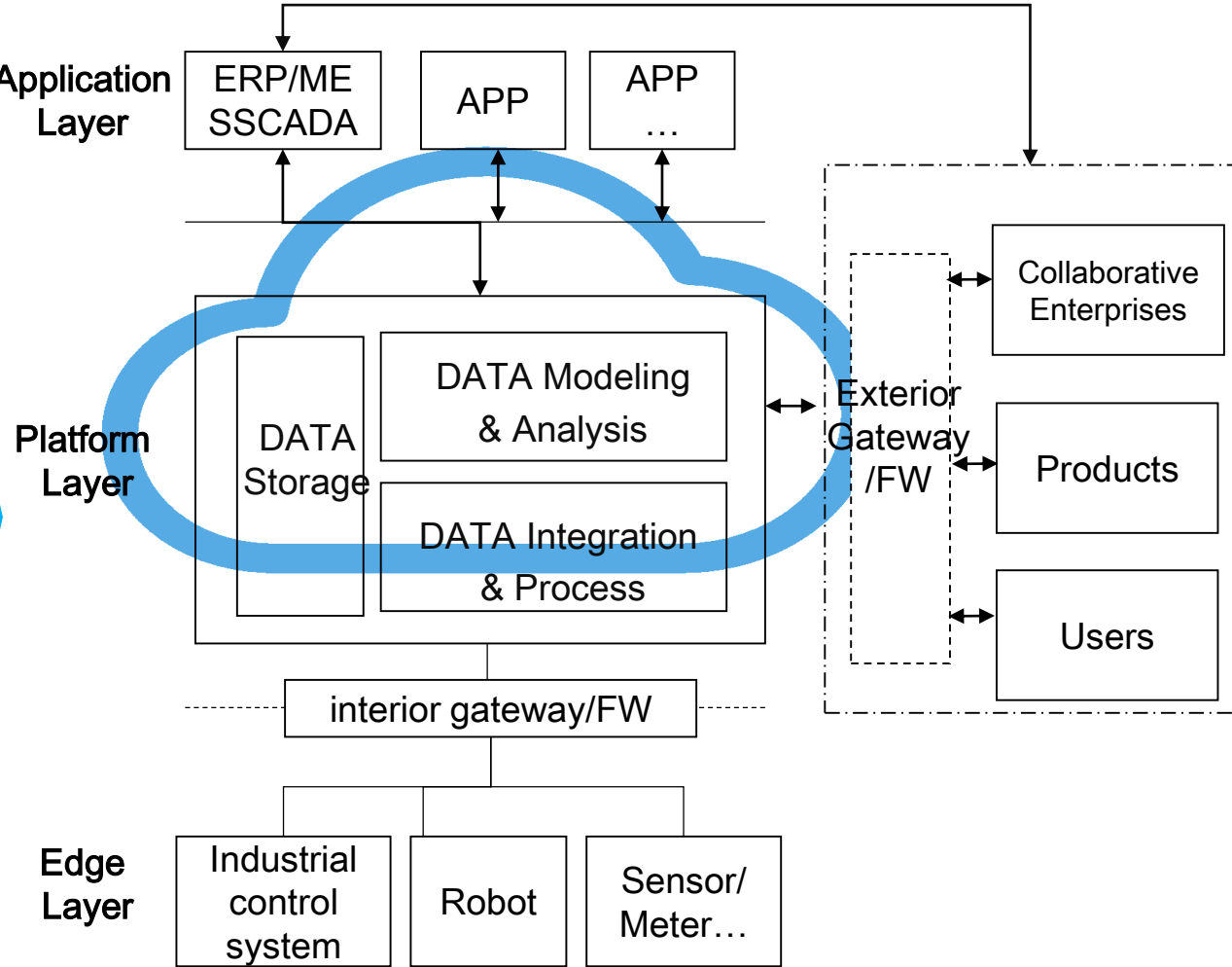
Implementation Roadmap for Industrial Internet

CURRENT

Network outside of factory
(Internet/ Mobile Network/ Private Network))



TARGET



Huge Changes will happen in different levels of industrial system, network interconnection, data intelligence, security will be evolved rapidly, meanwhile integrated deeply with Internet



Agenda

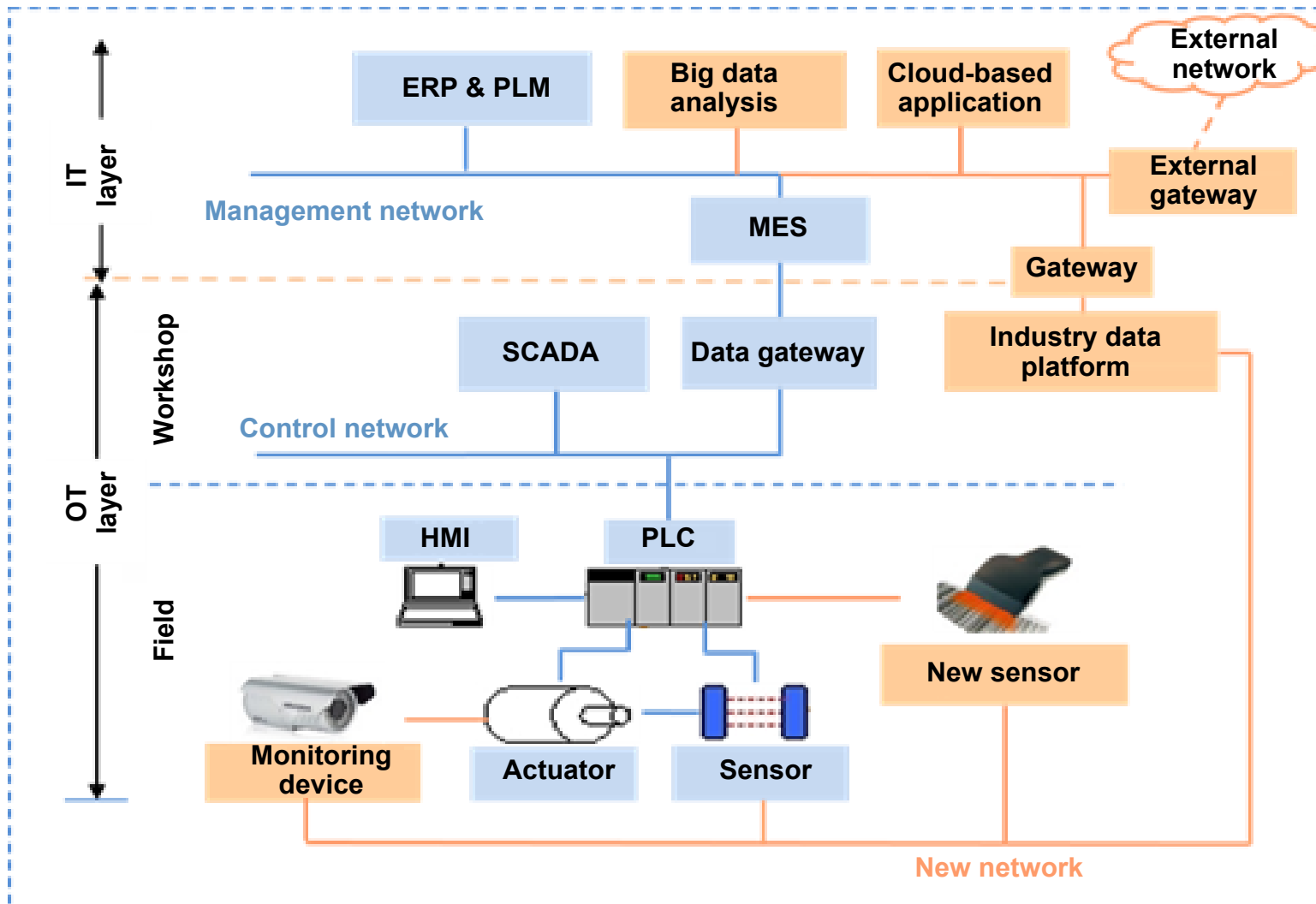
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Based on the massive investigations, **FOUR** categories of industrial internet models are summaries:

- **Intelligent Manufacturing (inside of factory)**
- **Collaborative Manufacturing (factory to factory)**
- **Personalized Customization (customer to factory)**
- **Service-Oriented Manufacturing (product to factory)**

Enterprise Exploration-- Intelligent Manufacturing

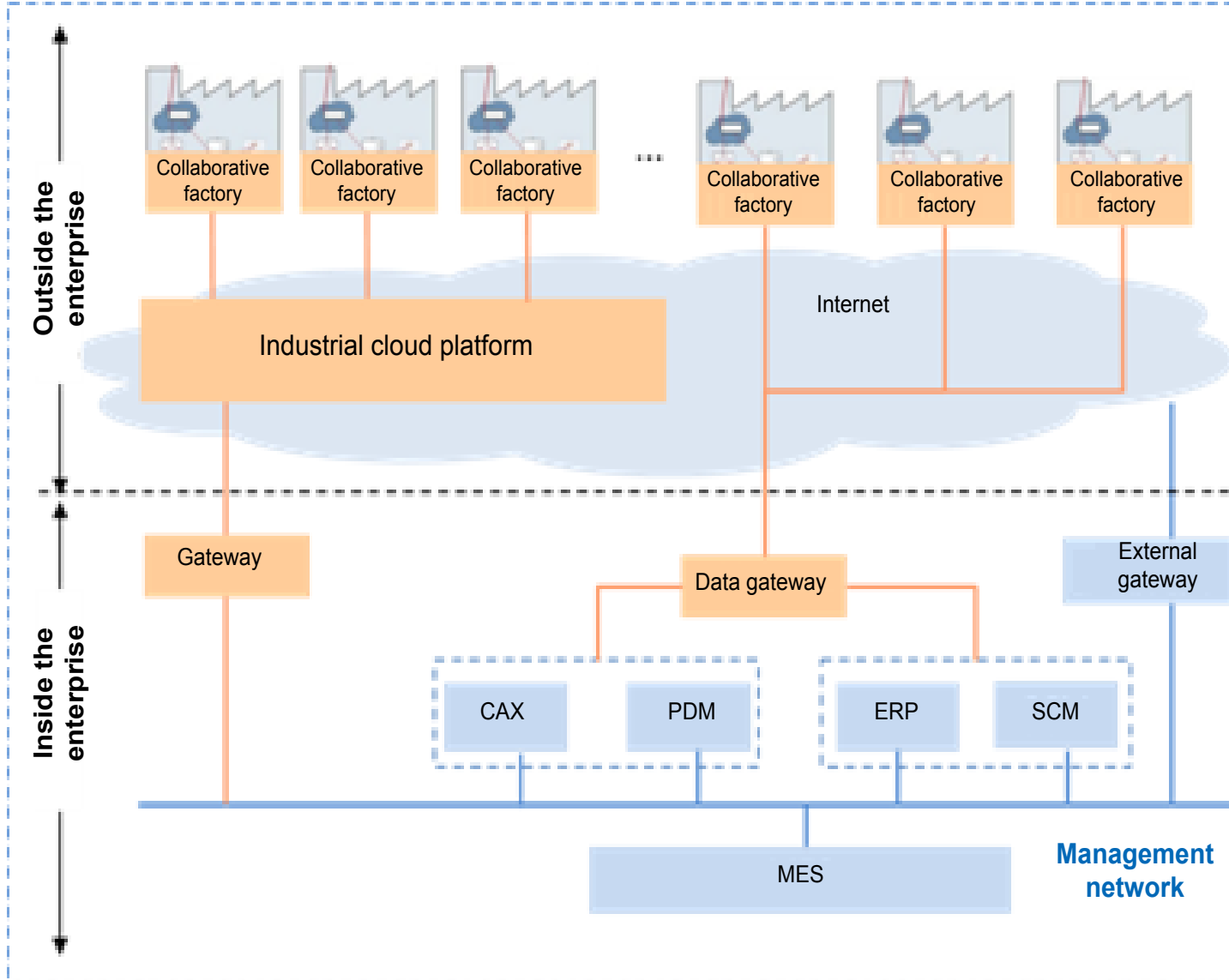


Deploy **built-in systems** and **new networks** on legacy manufacturing systems to implement data collection & integration, **big data analysis & optimization**, as well as smart production & management

Example: **Haier Internet factory**

- Interconnection of device layer, production zone interconnection layer, headquarter interconnection layer, internet layer
- Develop factory information cloud platform (COSMO)

Enterprise Exploration-- Collaborative Manufacturing

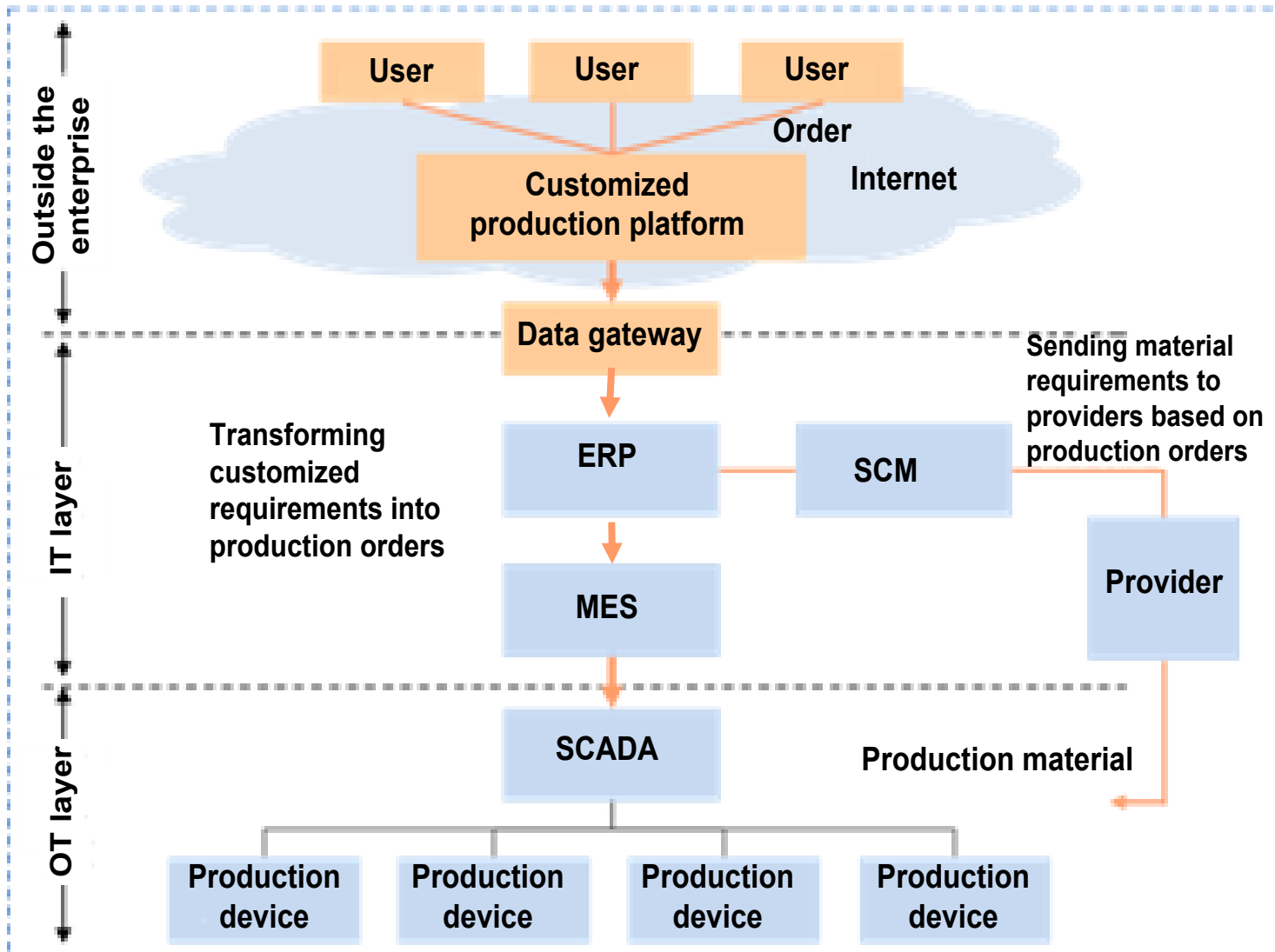


Use the inter-enterprise network or industrial **cloud platform** to implement new manufacturing modes such as collaborative design, crowdsourcing design, and supply chain coordination

Example: **CAXA industrial cloud service platform**

- Supply with cloud design tools, cloud manufacturing applications, cloud coordination platform, cloud storage, etc.
- In one children's electric vehicle project, products are brought to market in 3 months by collaboration, while 1 year is required at least using legacy manufacturing mode, including design, experiment, supplier adjustment, product...

Enterprise Exploration-- Personalized Customization

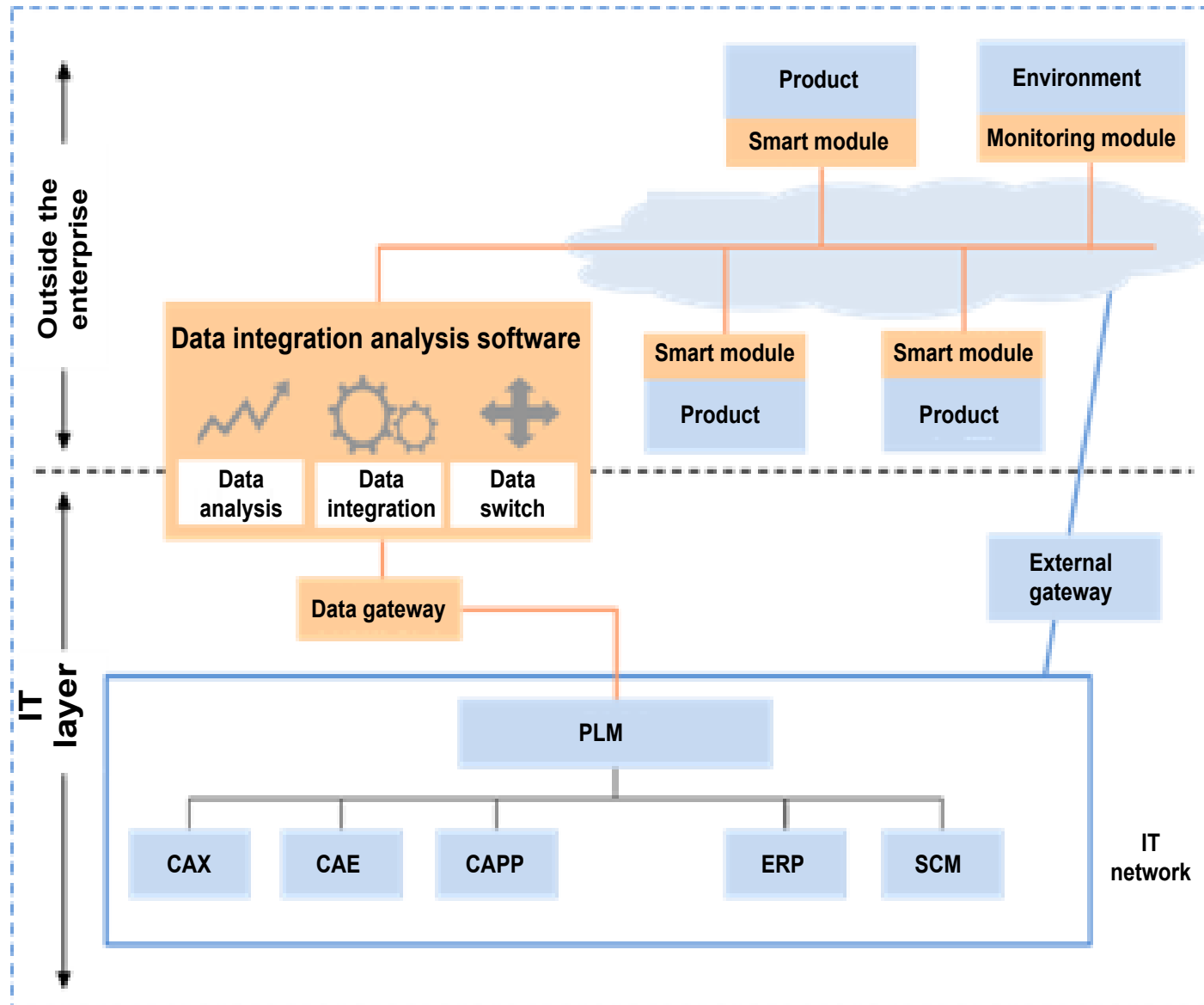


Reconstruct the **Internet platform** and **enterprise management system** to transform customized requirements into production orders and implement on-demand production

Example: **Homekoo Furniture Customized**

- 300,000 new customs information per year. Based on big data, support market prediction, partner selection, product optimization, etc. Have modularization and flexible production line
- Revenue keeps rising in 60%, lumber utilization rate is 93%, while the whole industry is 12% and 85% respectively on average

Enterprise Exploration-- Service-Oriented Manufacturing



- Add **smart modules** on products to implement product networking and operation data collection
- Provide smart services such as product predictive maintenance using **big data analysis**

Example: **SANY remote services**

- More than 230 thousand equipment are connected to internet
- More 5000 parameters are collected
- By O&M system, customer portal GCP and CRM system, rapid response could be given.

conclusion of current china industrial internet practical exploration



- The industrial internet **is still in the beginning stage**, implement approach diversified development, industry, internet and ICT enterprise have appeared very good creativity
- **Implement approach** depends on the overall strategy of the enterprise and its competitiveness, choose the most pain points of attention
- Deep interconnection, three integration and data intelligence of the industrial internet, could be rolled out **from some special aspect, economic outcome are important**
- **Current challenges** are device interconnection, data intelligibility and data analysis together with enterprise manufacturing and management
- **Security and safety** is the potentially biggest challenge

Alliance of Industrial Internet (All) to cultivate the ecological system



Established on **FEB. 1, 2016**, under the guidance of **MIIT**



STEERING COMMITTEE

Chairperson

- **Miao Wei, Minister of MIIT**

Vice chairpersons

- Chen Zhaoxiong, Vice Minister of MIIT
- Hua Jinpeng, Vice Minister of MIIT
- Xin Guobin, Vice Minister of MIIT
- Zhang Feng, Chief Engineer of MIIT

Members

- Leaders from 15 departments of the MIIT

EXPERT COMMITTEE

Chairperson

- Wu Hequan, Academician of Chinese Academy of Engineering (CAE)

Vice chairperson

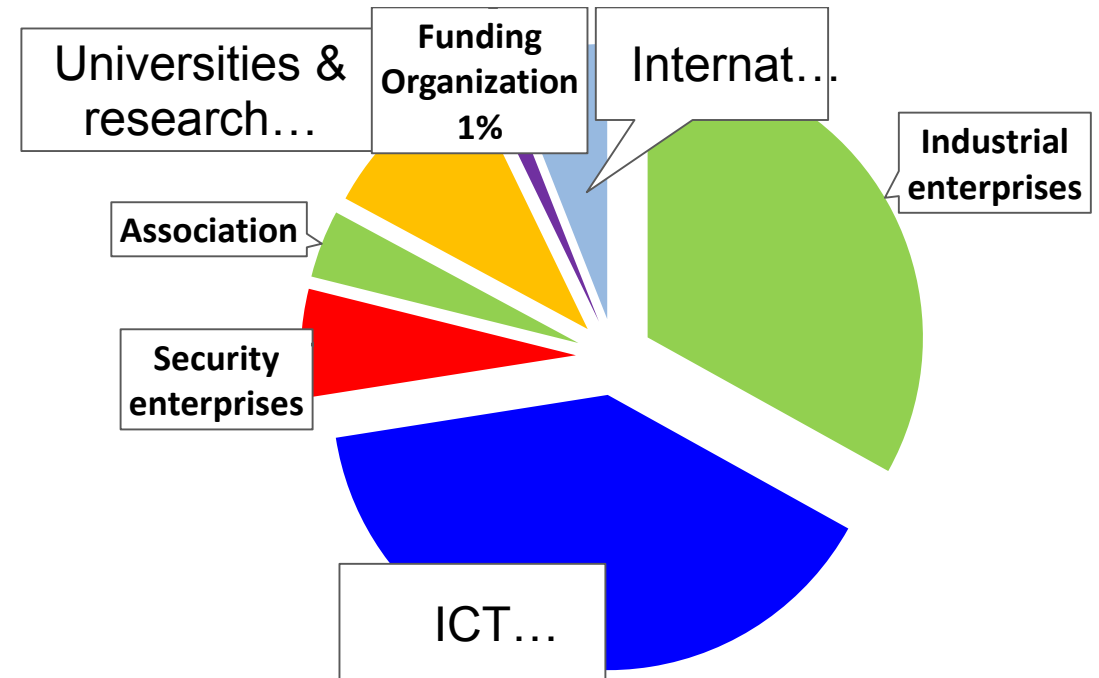
- Li Bohu Academician of CAE

Members

- 10 academicians & 5 experts

MEMBERSHIP: **362** Members

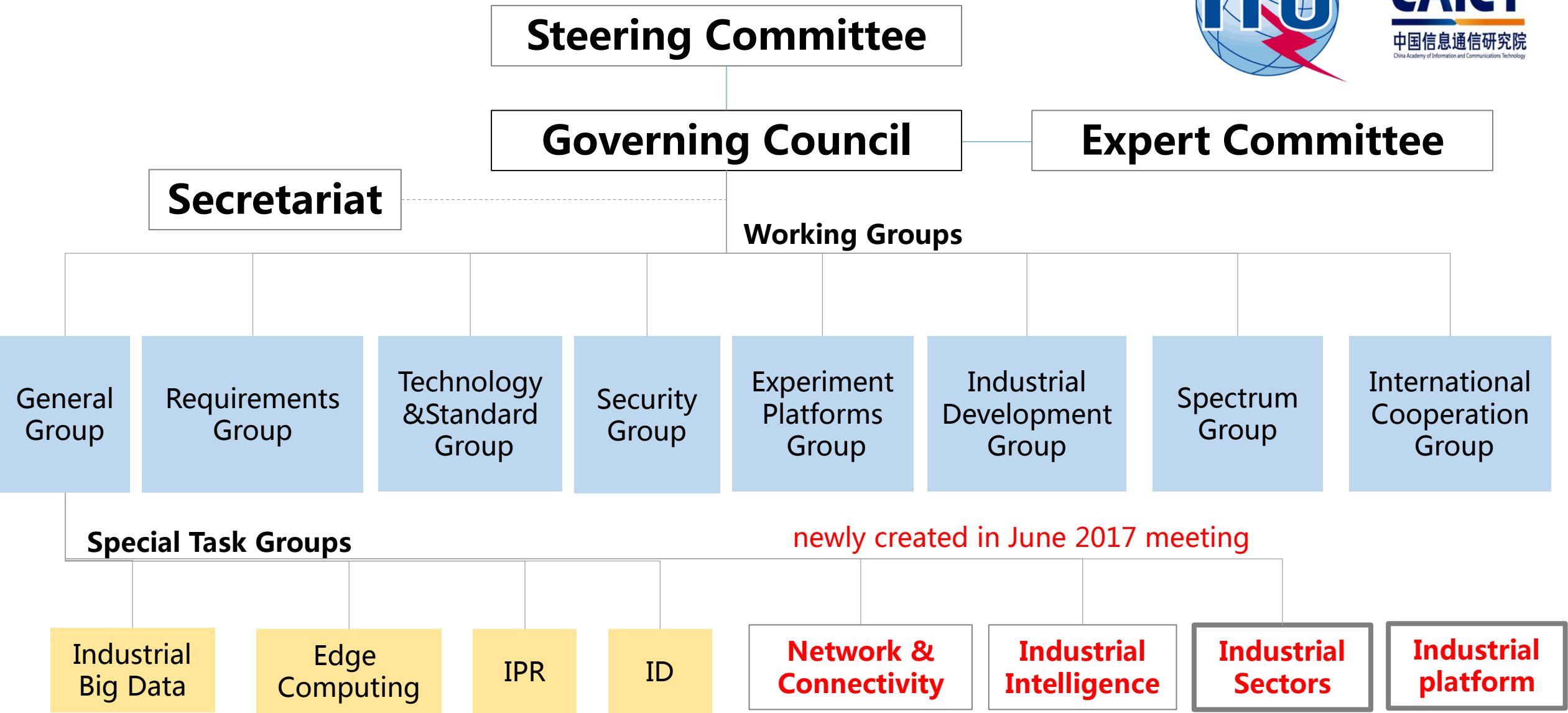
- Chairperson: **CAICT**



BAT (Baidu, Alibaba, Tencent) are members



AII organization (8+X)

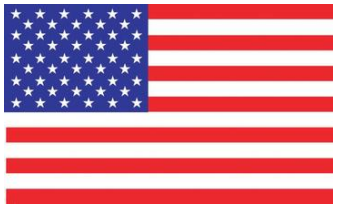




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Standardized is main strategy



IIC

Initiate top-level design, study standard requirements, and establish collaborative relationships with a number of international standardization organizations, open source organizations and regional standards research and development departments

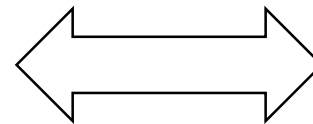
Industrie 4.0 platform



CAICT



Standardization is first task of industrie 4.0, Germany has set up specialized standardization organization, published standard road map and are accelerating standard development



Standardization is one of the six major tasks between IIC and Industrie 4.0 joint activities IEC, ISO, ITU-T, etc. are developing the related standards.

AI: IIoT standard system framework



Industrial internet Standard system Framework

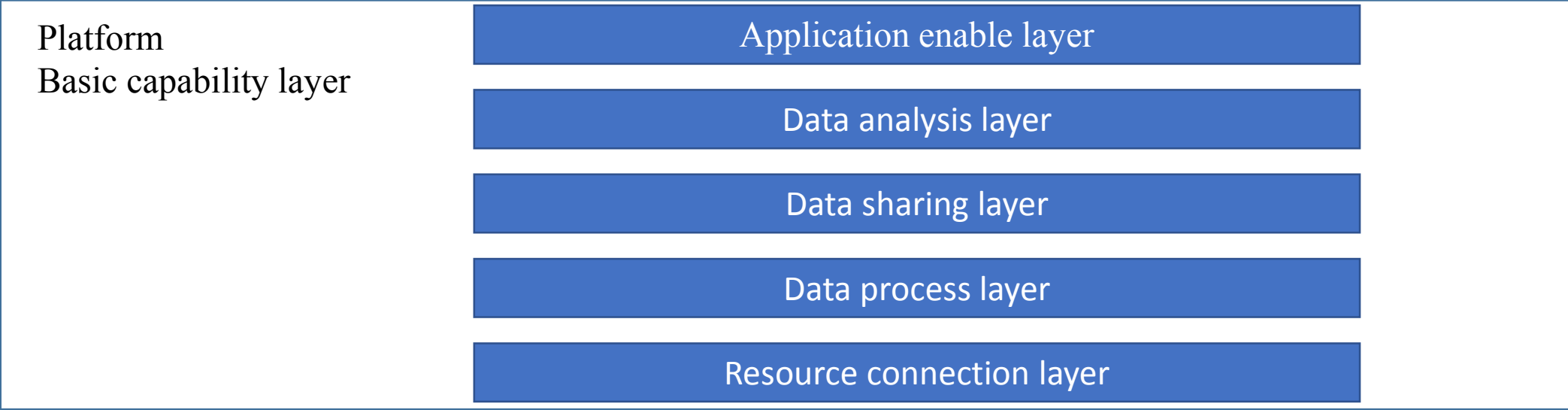
- Under the guidance of MIIT, 28 companies developed together
- Base on IIoT architecture and standards requirements
- **3** categories, **44** key standards direction, **Guidance** for the standards development

Standard items



- Overall network architecture of the industrial Internet
- **Industrial Internet platform, general requirements(published)**
- Industrial Internet platform, trustworthy evaluation
- Industrial Internet platform, development interface requirements
- Industrial Internet platform, management interface requirements
- Requirements of ID resolution system
- EPON requirements in Industrial Internet
- intelligentialization requirements of Connected equipment
- Industrial Internet security, overall requirements
- Industrial Internet security, access requirements
- Industrial Internet Generic Threat Description Model
-

AII: standard item-Industry Internet Platform General Requirements



guarantee
& supporting
system

Technical R&D is **HOT**



Networking technology

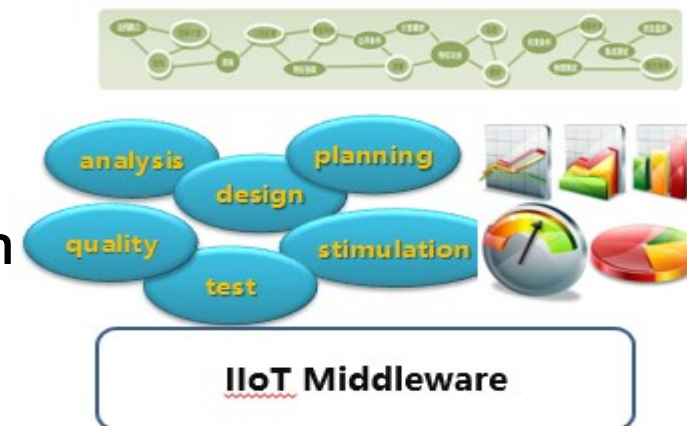
- **NB-IoT**
- eLTE
- Industrial PON
- TSN
- SDN



- 2016.1.22, NB-IoT network established in YingTan, JiangXi province, 135 base station
- Carry out NB-IoT, eMTC pilot in four cities, such as HangZhou,

Data related technology

- Message middleware
- Big data analysis
- Data visualization
- **Knowledge automation**



Emerging technology

AI, AR/VR, Block chain are converging with IIoT,
Some Chinese companies are exploring



Deep Learning
Machine Learning
Artificial Intelligence



Summary



- **IIoT is a hot topic, lots of countries made and are making strategy to promote the IIoT development, and take actions**
- **The technical R&D, applications, IIoT platform, standardization, are developing quickly, more and more innovative ICT technology will be introduced into IIoT**
- **Enterprises are stepping forward quickly also, there are lots of practices**
- **Security becomes more and more important**
- **Hope to deepen cooperation & collaboration with international community**



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ITU-T Experience: Vice chair of FG Smart Grid, Vice chair of ASTAP

Photo:





THANKS FOR YOUR ATTENTION!

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