



工业互联网产业联盟
Alliance of Industrial Internet

Industrial Internet Standard System

(Version 1.0)

Alliance of Industrial Internet (AII)

Feb, 2017

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Forewords

Industrial Internet involves all industrial segment and all entities of industry field and ICT field, and it's forming a complicated and total new ecological system. With industrial system networking and collaboration increasing, lots of new standardization requirements rise. While considering about the problems for Industrial Internet such as standard lacking, standard lagging, and standard duplicated, under the guidance of the Ministry of Industry and Information Technology (MIIT), Alliance of Industrial Internet (referred to as AII hereinafter) launched the study on the Industrial Internet standard system. Based on *Industrial Internet Architecture (Version 1.0)* and research on Industrial Internet standard requirements, AII drafted the *Report on Industrial Internet Standard System (Version 1.0)*. In this Report, we propose the general idea, basic principles, standard system framework, key standardization directions and promotion suggestions. It aims to provide a systemized guidance of Industrial Internet standardization for the industrial communities, to provide references and basis for development and amendment of Industrial Internet national standards, industrial standards and group standards, and to provide support for Industrial Internet development.

It's no doubt that Industrial Internet is a long-term development and evolution. AII will continue to revise and publish updated versions of the report on the basis of continuous and in-depth studies on the standard requirements, the

development of industrial internet at both domestic and abroad, as well as feedbacks from the industrial communities.

Guiding Body: Ministry of Industry and Information Technology (MIIT)

Co-leading Bodies for Composition: China Academy of Information and Communications Technology (CAICT), China Aerospace Science & Industry Corporation

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Industrial Internet is an essential internet infrastructure to satisfy the industrial intelligence development– it is a newly-developing industry ecosystem and application model through the deep and comprehensive integration of new generation of information technology and modern industry. Developing industrial internet with Chinese characteristics is not only an important foundation for China– transforming from a major industrial country to an industrial power, but also a significant opportunity for China’s internet development. And it’s very important to promoting China’s industrial transformation and upgrading.

I. Development Situation of Industrial Internet Industry

Industrial Internet industry ecosystem mainly refers to data acquisition, data transmission, data processing, and feedback related industries in the manufacturing system, involving device intelligentialization enablement, system integration, network interconnection, Industrial Internet platform, application, security of manufacturing system. At present, the global industrial Internet industrial ecosystem is accelerating to form, with the needs of cross systems interaction and cross enterprises interaction increasing, the standardization requirements of Industrial Internet are also rising.

1. Equipment Transformation and System Integration

China already has a certain level of R&D abilities and basis in

equipment and product, but the degree of networking is low and the data has not been fully utilized, there's an urgent need to strengthen digitalization, networking, intelligentialization of equipment and products. Most of the system integration are using private solutions, they often appear less replicable, lack of core technologies and the application areas are quite simple. The need to enhance systematic openness and the interoperability also cannot be ignored.

2. Industrial Internet Network Interconnection

The Industrial Internet network interconnection includes the factory external network and the factory internal network. China has a good foundation in the factory external network-related industries. In the factory internal network, some independent intellectual technology, such as Ethernet factory automation protocol (EPA), industrial wireless network standard technology for industrial process automation (WIA-PA) have become international standards and formed a better technical foundation. With the development of Industrial Internet, industrial Ethernet, industrial PON, industrial wireless, time-sensitive networks, low-power wireless networks, IPv6-enabled technologies and products have become the focuses. In addition, resource identification and addressing technology are the basis to achieve resource management, information exchange, equipment interconnection, and relevant overall consideration needs to be strengthened.

3. Industrial Internet Platform

As vital elements for industrial Internet platform, cloud computing and data services have developed rapidly in China, and there are a number of R&D, service and system solutions provider. In general, the Industrial Internet platform is still in the early stage of development and has become the key to construct industrial ecology. The integration, processing, analysis and application software of industrial big data need to be accelerated. The edge computing is gradually emerging to build up a new edge-cloud collaborative data processing and analysis system. There're urgent needs to accelerate the R&D, technology research and deployment of the industrial Internet platform.

4. Industrial Internet applications

Under the promotion of a series of policies, such as Made in China 2015, Internet Plus, broadband China, China's industrial enterprises, ICT enterprises, Internet companies are actively carrying out industrial Internet application exploration and business model innovation, and are forming new models and new ecosystem, such as intelligent production, personalized customization, networking collaboration, servicization extension. It's required urgently to develop industrial Internet application standards to improve the services quality and guide the application development.

5. Industrial Internet Security

At present, the research on Industrial Internet security and relevant supporting industries are still in its initial stage. Industrial Internet will promote the flexibility of manufacturing process, enterprises, users and products will be highly collaborative, open and sharing. The security border of industrial Internet is becoming more and more blurred, the surfaces of attacking behaviors continue to expand. In future, security questions will penetrate into all aspects including equipment, network control, data and application, and it will become a vital prerequisite to ensure the development of Industrial Internet. It's required urgently to construct industrial network security development environment from multi-angle including technology, management, service, etc..

II. Ideas and principles to construct the Industrial Internet standardized system

1. General ideas

The general ideas for constructing the Industrial Internet standard system is to grasp the opportunity of new-round technological revolution and industrial transformation, to build a unified, comprehensive, open standardized system for the Industrial Internet according to China's Industrial Internet development and standardization requirements by taking the principle of "overall-planning, requirement-driven, and

inclusively-assembling”, to specify the key standardization areas and key standardization directions, and to promote the international standards development coordinately, which can provide support and guarantee for the orderly and fast development of China’s Industrial Internet industry.

2. Basic Principles

1) overall-planning, creating top-level design

Strengthen the design of Industrial Internet standard system as well as the organization and deployment of Industrial Internet standardization, specify the key standardization areas and directions, and guide the Internet Industry national level, industrial level and group level standardization activities.

2) requirement-driven, promoting the industry development

Adhere to the application requirements driven, strengthen the advancement, applicability and effectiveness of the standards, and update the standard system dynamically according to the industrial requirements and phase objective as well as focuses of development planning.

3) inclusively-assembling, enhancing the international cooperation

Accelerate the converting the China’s Industrial Internet innovative achievements to international standards, refer to international Industrial Internet technology and standardization outcome as well and push forward

the standard development of domestic standards and international standards coordinately.

III. Industrial Internet Standard System framework

1. Industrial Internet Standard System framework

The Industrial Internet Standard System framework consists of three categories, they are: generality standards, key technique standards and application standards. (See Figure 1)

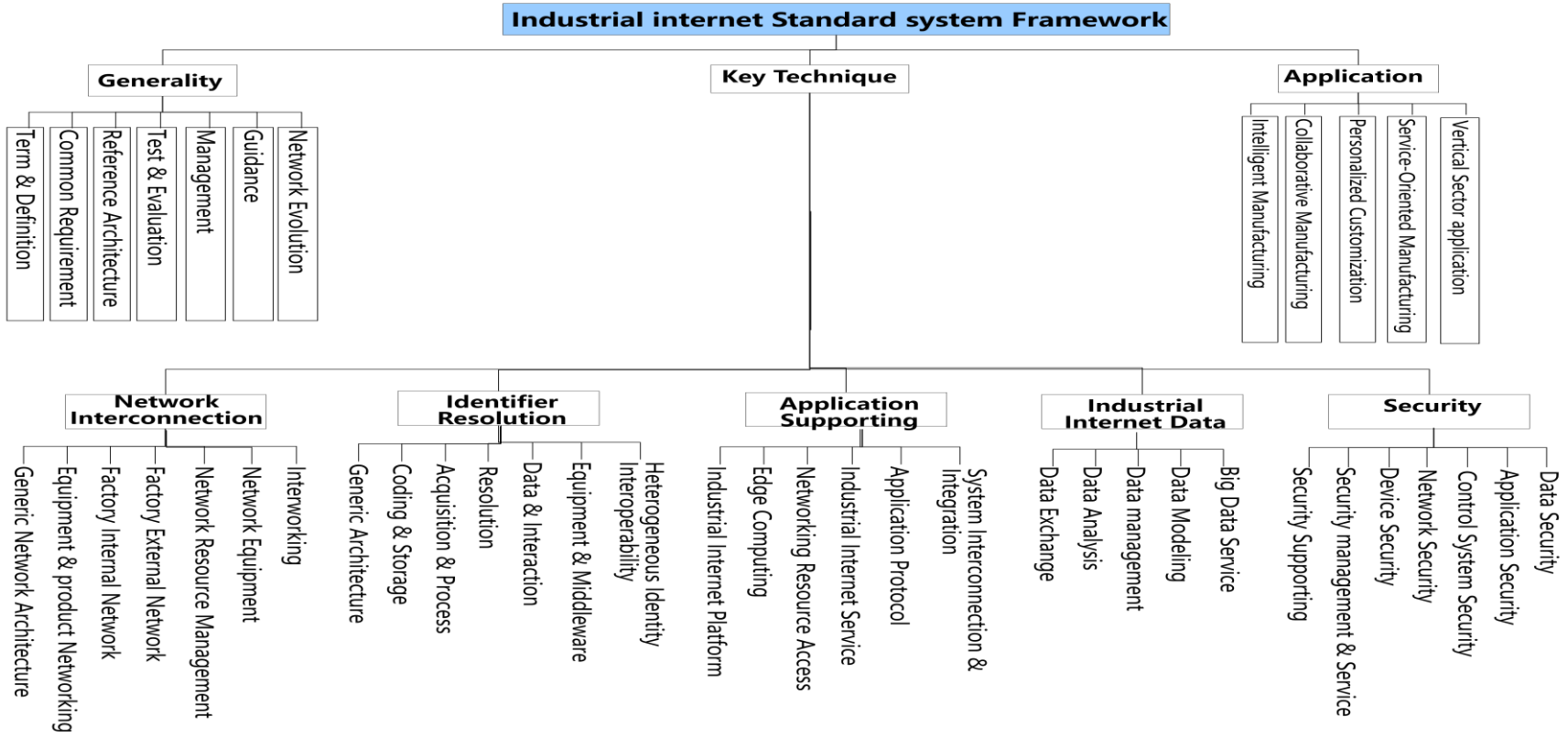


Figure 1 Industrial Internet Standard System framework

2. Key standard areas and directions

1) Generality standards

The generality standards mainly specify the comprehensiveness, universality and guiding standards, including terms and definitions standards, common requirements standards, reference architecture standards, test and evaluation standards, management standards, guidance and network evolution standards.

- Terms and definitions standards are used to unify the main concepts of Industrial Internet and provide reference and support for terms and definitions in other Industrial Internet related standards. The standards include the concept categorization and collection, new concept definitions, old terms' perfection and the relationship between closely related concepts related to Industrial Internet use case, technology, services, etc.
- Common requirements standards mainly specify the general capability requirements of typical use cases at the aspect of intelligent production, personalized customization, networking collaboration, servicization extension. The standards include the requirements for functions, performance, security, reliability and management.
- Reference architecture standards are used to specify and define the

objects, boundaries, hierarchical and inner relationship between each layer. The standards include Industrial Internet general reference model, general architecture, core functions, relationship between various layers and core functions, as well as the common capability requirements for Industrial Internet.

- Test and evaluation standards are used to specify the test methods of Industrial Internet technologies, products and systems, as well as specify the maturity evaluation of application sectors, enterprises and projects. The standards include testing methods, evaluation index and evaluation methods.
- Management standards are used to specify the construction and operation of the Industrial Internet system and the enterprise activities. The standards include O&M standards and service management standards of Industrial Internet system, as well as the enterprise-specific management mechanism.
- Guidance standards give instruction to the planning, construction, deployment, O&M of Industrial Internet projects and systems. The standards include device intelligentization transformation standards, factory internal network interconnection standards, and factory external network interconnection standards.
- Network evolution standards mainly specify new network deployment standards, IPv6 promotion standards, network

flattening standards, etc. according to the technology deployment and network transformation.

2) Key technique standards

<1> Network Interconnection Standards

The network interconnection standards mainly specify the key technologies, equipment and networking, including the generic network architecture standards, equipment & product networking standards, factory internal network standards, factory external network standards, network resource management standards, network equipment standards, interworking standards.

- Generic network architecture standards mainly specify network interconnection architecture of different layers in the factory, as well as interconnecting architecture of factories with design, manufacturing, supply chain, user, etc.
- Equipment & product networking standards mainly specify the functions interfaces, communication protocols, data exchange, clock synchronization, etc..
- Factory internal network standards mainly specify interconnection standards between equipment, control system and information system. The standards include industrial wireless, industrial Ethernet, industrial PON, time sensitive network, and low power

wireless network related standards.

- Factory external network standards include factory external network architecture, industrial virtual private network (VPN) , etc.
- Network Resources Management Standards include Industrial Internet IPv6 address management planning, wireless spectrum planning in industrial environment related standards.
- Network equipment standards include industrial gateways, industrial switches, chips and communication modules, etc. related standards.
- Interworking standards mainly specify the interoperability of different management domains. The standards include interoperability architecture, interoperable devices and interworking management related standards.

<2> Identifier Resolution Standards

The identification standards include generic architecture standards, coding and storage standards, acquisition and process standards, resolution standards, data and interaction standards, equipment and middleware standards, heterogeneous identity interoperability standards.

- Generic architecture standards mainly specify network architecture and hierarchical model of Industrial Internet identifier resolution system, define various functional components and

information objects of identifier resolution system as well as common capabilities provided by identifier resolution system, such as registration, analysis, query, search, etc.

- Coding and storage standards mainly specify code solution of Industrial Internet identifier including encoding length, coding format, allocation principle, as well as the specific storage mode of identifier code in the bar code, 2D code, RFID, etc.
- Acquisition and process standards mainly specify collection methods of Industrial Internet identifier-related data, including communication protocol between carrier equipment storing the identifier and reader equipment, communication protocol between reader equipment and middleware equipment, communication protocol between reader equipment/middleware equipment and information server as well as raw data processing methods in reader equipment/middleware equipment such as identifier related data filtering, de-duplication, etc.
- Resolution Standards mainly specify the system architecture of the Industrial Internet identifier resolution, procedure, data package format for resolution and query, the response data package format, the communication protocol, etc.
- Data and Interaction standards mainly specify mapping method of different identifier related recorded data as well as the metadata

format of product related information.

- Equipment and middleware standards mainly specify the functions, interfaces, protocols, synchronization, etc. of service equipment of Industrial Internet identification resolution.
- Heterogeneous identity interoperability standards mainly specify realization mechanism, interactive protocols, data mutual recognition, etc. of interworking and interoperability between different Industrial Internet identification resolution services .

<3> Application Supporting Standards

Application supporting standards include Industrial Internet platform standards, edge computing standards, networking resource access standards, Industrial Internet service standards, application protocol standards, and system interconnection and integration standards.

- Industrial Internet platform mainly specify general requirements of Industrial Internet platform including factory internal Industrial Internet platform standard and factory external Industrial Internet platform standard. The standards mainly specify platform-related functions, performance, security, O&M, data protection, openness.
- Edge computing standards include edge computing reference architecture, open interface and service standards of application domain, data domain, network domain, equipment standards of

edge computing open platform, and edge computing gateway as well as edge-cloud collaboration standards.

- Networking resource access standards mainly specify the resources access and capabilities access, the resource and capabilities include the networking elements inside factory, such as goods in process, equipment, product, industrial controlling system, industrial IT system, and the networking elements outside factory, such as design, simulation, supply chain, and industrial Internet applications, etc. The standards specify the classification of these resources and capabilities, formalized description, resource invoke mode and so on.
- Industrial Internet service standards mainly specify service supporting capabilities provided by Industrial Internet platform, including service publish, service management, etc.
- Application protocol standards mainly specify data integration and transmitting protocols among production equipment, industrial control systems and industrial IT systems inside factory, as well as data integration and delivery protocols between production equipment and industrial IT systems to cloud platforms outside the factory.
- System interconnection and integration standards mainly specify the interconnection and interoperability between devices, products,

industrial control systems, industrial IT systems, Industrial Internet applications, etc., to ensure the data interaction between these elements, including integration mode, interoperability capability description, template specifications, etc.

<4> Industrial Internet Data Standards

Industrial Internet data standards include Industrial Internet data exchange standards, Industrial Internet data analysis standards, Industrial Internet data management standards, Industrial Internet data modeling standards and Industrial Internet big data service standards.

- Industrial Internet data exchange standards mainly specify data exchange system architecture, interoperability, performance , etc. between end nodes (such as equipment, products) and various industrial systems (including industrial control systems, industrial IT systems, Industrial Internet platforms, Industrial Internet applications) as well as between different industrial systems.
- Industrial Internet data analysis standards mainly specify data analysis procedures and methods of Industrial Internet, to provide instruction for Industrial Internet data analysis as well as its implementation. The standards include the general data analysis procedure and tools which can be used by data analysis in some typical scenarios.

- Industrial Internet data management standards mainly specify storage structure of Industrial Internet data, data dictionary, metadata, data quality requirements, data lifecycle management requirements. The standards include cloud-based Industrial Internet data management standards as well as Industrial Internet data management standards in the legacy architecture.
- Industrial Internet data modeling standards mainly specify the images and relationship of physical entities (products, equipment, production lines, products, etc.) in the network space. The standards include static attribute data description, dynamic data description such as operation status as well as the rule description of interaction and incentive relationship between physical entities.
- Industrial Internet big data service standards mainly specify the services provided by Industrial Internet platform taking advantage of big data capabilities. The standards include big data storage services, big data analysis services, big data visualization services, data modeling and data openness related standards.

<5> Security Standards

Security standards include security supporting standards, security management and service standards, device security standards, network security standards, control system security standards, application security

standards and data security standards.

- Security supporting standards mainly specify the fundamental and common security technologies of Industrial Internet. The standards include security terms and definitions, security models, security frameworks, security algorithms and protocols.
- Security management and service standards mainly specify security management and service requirements of Industrial Internet. The standards include risk management, responsibility management, risk assessment, security assessment, and emergency response related standards.
- Device security standards mainly specify the security requirements of Industrial Internet intelligent equipment, intelligent products, etc. in the process of design, R&D, manufacturing and operation. The standards include chip security, embedded operating system security, application software security related standards.
- Network security standards mainly specify network security requirements of factory internal network and factory external network which carrying on the industrial intelligent production and application. The standards include network access security, network transmission security, network security monitoring related standards.
- Control system security standards mainly specify security

requirements related to Industrial Internet control system. The standards include control protocol security, control system security, control software security related standards.

- Application security standards mainly specify security requirements of Industrial Internet applications and services. The standards include industrial cloud security, networking collaborative security, product service security, personalized customization, security related standards.
- Data security standards mainly specify security requirements for Industrial Internet data. The standards include industrial big data security, user data security related standards.

3) Application Standards

Application standards mainly include intelligent manufacturing standards, personalized customization standards, collaborative manufacturing standards, service-oriented manufacturing standards and vertical sector application standards. Application standards should specify general application standards as well as standards for different industry sectors and use cases based on generality standards and key technique standards.

- Intelligent manufacturing standards include the application guidelines for intelligent production , application standards,

business process standards, technology and product standards, security standards, management standards, testing and evaluation standards applying to different production process of industrial enterprises.

- Personalized customization standards include the guidelines for personalized customized application, application standards, business process standards, technology and product standards, security standards, management standards, testing and evaluation standards applying to different industrial sectors, different use cases and different custom requirements.
- Collaborative manufacturing standards include the guidelines for collaborative manufacturing standards, application standards, business process standards, technology and product standards, security standards, management standards, testing and evaluation standards applying to different collaborated use cases such as collaborated design, collaborated manufacture and collaborated supply chain.
- Service-oriented manufacturing standards include the guidelines for service-oriented manufacturing standards, application standards, business process standards, technology and product standards, security standards, management standards, testing and evaluation standards applying to product remote maintenance,

added-value services based on big data and so on.

- Vertical sector application standards include comprehensive application standards, business process standards, technology and product standards, security standards, management standards, testing and evaluation standards applying to different vertical application sectors.

IV. Suggestions on promotion of Industrial Internet standardization

1. Overall plan and coordinate Industrial Internet standardization

It is recommended to make standard development planning and initiate the standard items under the guidance of Industrial Internet standard system. Following the principle of “fundamental and common standard priority, urgently-needed priority, innovation-driven priority and security and reliability priority”, it is suggested to overall plan the national standards, industrial standards and group standards, coordinate well the relationship between the fundamental & common standards and the urgently-needed standards, humanize domestic standards and international standards in order to promote the Industrial Internet standardization coordinately. Update the standard system timely and dynamically according to the latest development and standard requirements of Industrial Internet.

2. Strengthen standard verification and standard promotion

It is suggested to strengthen the Industrial Internet standard verification, accelerate the verification environment construction for industrial internet technology, standards, products, system and application, accelerate the research and consummation of relevant technology and standards, and provide experiment environment for the testing and running of products, systems and applications. It is also suggested to promote the construction of public service platforms for Industrial Internet standards, to provide standard search, consultation, testing, etc. services for industry community. It is suggested to make use of industrial internet pilot demonstrations to accelerate the promotion of technology, standards, products of Industrial Internet.

3. Enhance the international cooperation and exchange on standardization

It is suggested to deepen the international cooperation and exchange on standardization, enhance the cooperation and exchange with German industry 4.0 platform, Industrial Internet Consortium (IIC), etc. It's suggested to participate the relevant activities of international standardization organization as well as international standards development, and overall plan the activities of domestic and international standardization.



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