Convergence application of handle platform for industrial data classification and grading and 5G technology

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Abstract. With the continuous upgrading of the national industrial Internet, the traditional application-centric data organization method has gradually been unable to meet the requirements of large-scale interoperability and sharing of industrial data and data security in the era of big data. With the help of the classification and grading of industrial data, cross-regional, cross-departmental, and cross-domain information query and sharing can be realized at the macro level; at the micro level, product information can be traced through identification analysis, and information can be achieved safely and controllably through its internal security management mechanism. In the field of industrial Internet, network equipment is usually required to have a large-scale connection expansion capability; in some fields such as telemedicine and industrial control, it requires the communication process to have low latency and high reliability capabilities; and in some areas such as autonomous driving and ultra-high-definition live transmission, the communication process requires the ability to transmit large-bandwidth data. Compared with 4G technology, 5G communication technology, its massive machine communication capabilities and high reliability and low latency characteristics make it a reliable technical guarantee for the Internet of Everything at this stage. Therefore, it is urgent to realize the integration of 5G technology and industrial data classification and grading technology. Based on the in-depth interpretation of the characteristics of 5G technology and the detailed description of the handle system, this paper proposes a method of fusion of the handle platform and 5G technology, laying the cornerstone for the effective implementation of industrial data classification and grading.

1. Introduction
Industrial data is data generated and applied throughout the entire life cycle of industrial products and services. At this stage, big data, industrial Internet, and artificial intelligence technologies are developing rapidly. How to classify, save, manage and share industrial data to make better use of data value is an issue that needs to be considered urgently. With the rapid development of the Industrial Internet, industrial data as a carrier has been integrated into various fields of industrial manufacturing and has become an important breakthrough point in the current industrial reform and transformation. The deep integration of industrialization and informatization has become the top priority of the development of industrial modernization, and the digital transformation of traditional industries has become the key to promoting the high-quality development of national industries.

First, due to the inconsistent master data standards of various enterprises and the difficulty of
maintenance, multiple sets of master data exist independently in each business system. In the promotion of industrial data classification and grading, industry companies encountered data islands in various branches or related departments, and did not form effective data sharing. At the same time, Internet companies have built ecological closed loops to lock stock users, lacking motivation for information sharing, and the companies which have competitive relationship even block cross-application information sharing with each other, and there is a lack of convenient and simple sharing mechanisms between smart devices of different brands. The concept of the Internet of Everything is still limited to the ecosystem of the application circle and the device circle, and it is not the real Internet of Everything. Therefore, it is urgent to build a basic Internet system for unique identification, analysis and data management of digital objects such as objects, people, institutions, behaviors, and works.

The Handle system is the core part of the Digital Object Architecture (DOA). It is a global Internet identity resolution system with a multi-level distributed architecture. It provides a globally unique permanent identity for digital objects and provides basic services for analysis and data management and built-in safety mechanism.

2. 5G technical characteristics

The fifth-generation mobile communication technology (5G) is the highest peak of the current mobile communication technology development, and it is also an important force that humans hope to not only change life, but also change society. 5G is based on 4G and puts forward higher requirements for mobile communications. It not only has new improvements in speed but also power consumption, delay and other aspects. As a result, the business will be greatly improved, and the development of the Internet will also enter the era of intelligent Internet from the mobile Internet[1].

2.1. high speed

Compared with 4G, the first problem 5G has to solve is high speed. Only with the increase of network speed, the user experience will be greatly improved, the network faces VR/UHD services can it be unrestricted. The services that require high network speed can be widely promoted and used. Therefore, the first feature of 5G defines the speed increase. In fact, like every generation of communication technology, it is difficult to say exactly what the speed of 5G is. On the one hand, the peak speed is different from the user's actual experience speed, and the speed will be different for different technologies in different periods. For 5G base stations, the peak requirement is not less than 20Gb/s. Of course, this speed is the peak speed, not the experience of every user. With the use of new technologies, this speed still has room for improvement. Such a speed means that users can download a high-definition movie every second, and may also support VR video. Such high speed provides opportunities and possibilities for future businesses that have high requirements for speed[2].

2.2. Ubiquitous Network

With the development of services, network services need to be all-encompassing and widespread. Only in this way can we support richer services and can be used in complex scenarios. The ubiquitous network has two meanings. One is extensive coverage and the other is deep coverage.

To a certain extent, the ubiquitous network is more important than high speed. Just building a very high-speed network with a small number of places does not guarantee the service and experience of 5G, and the ubiquitous network is a fundamental guarantee for the 5G experience[3]. In the three 3GPP scenarios, ubiquitous networks are not mentioned, but the ubiquitous requirements are implicit in all scenarios.

2.3. Low power consumption

To support large-scale IoT applications, 5G must have power consumption requirements. In recent years, wearable products have developed to a certain extent, but they have encountered many bottlenecks. The biggest bottleneck is the poor experience. Take a smart watch as an example. It needs to be charged every day, even in less than a day. All Internet of Things products require communication and energy.
Although communication can be achieved through a variety of means today, the supply of energy can only rely on batteries. If the communication process consumes a lot of energy, it will be difficult for IoT products to be widely accepted by users.

In order to meet the needs of 5G for low-power IoT application scenarios, NB-loT, as a part of the 5G network system, can be deployed based on the GSM network and the UMTS network. It does not need to rebuild the network and can greatly reduce power consumption.

2.4. Low latency
For information exchange between people, a delay of 140 milliseconds is acceptable, but if this delay is used for unmanned driving and industrial automation, it is unacceptable. The minimum requirement of 5G for latency is 1 millisecond or even lower. This puts harsh demands on the network. And 5G is an inevitable requirement for applications in these new fields.

To meet the requirements of low latency, various methods need to be found in the construction of 5G networks to reduce latency. Technologies such as edge computing will also be adopted into the 5G network architecture.

2.5. Internet of Everything
In traditional communications, terminals are very limited. In the era of fixed telephones, telephones are defined by the crowd. In the mobile phone era, the number of terminals has exploded, and mobile phones are defined by personal applications. In the 5G era, terminals are not defined by people, because each person may have several, and each family may have several terminals.

In social life, a large number of devices that were previously impossible to connect to the Internet will also work on the Internet, making them smarter. Public facilities such as cars, manhole covers, telephone poles, and trash cans were difficult to manage in the past, and it was also difficult to be intelligent. And 5G can make these devices become smart devices[4].

2.6. Refactoring safety
The traditional Internet has to solve the problem of information speed and barrier-free transmission. Freedom, openness, and sharing are the basic spirit of the Internet, but the intelligent Internet is established on the basis of 5G.Smart Internet is not only to realize information transmission, but also to establish a new mechanism and new system for society and life. The basic spirit of the intelligent Internet is safety, management, efficiency, and convenience. Security is the number one requirement for the smart Internet after 5G.Assuming that 5G is built but the security system cannot be rebuilt, it will have huge destructive power.
In the construction of 5G networks, security issues should be solved at the bottom level. From the beginning of network construction, security mechanisms should be added. Information should be encrypted and the network should not be open. Special security mechanisms should be established for special services. The network is not completely neutral and fair. To give a simple example: In terms of network guarantees, ordinary users may only have one set of systems to ensure the smooth flow of their network, and users may face congestion. However, the intelligent transportation system requires multiple systems to ensure its safe operation and the quality of its network. When the network is congested, the network of the intelligent transportation system must be unblocked. And this system is not accessible to general terminals for management and control.

3. Handle system overview

3.1. Technical characteristics of Handle system

Handle is a set of identification registration, analysis and information security management system aiming at realizing the interconnection of information objects. Handle system defines a set of widely compatible coding rules, has a set of stable parsing system and an independent and reliable distributed management architecture. It is compatible with IPv6, DNS and other network communication protocols, and has comprehensive management capabilities in coding, parsing, information management and information security[5]. Able to achieve multilateral co-management, independent control and information security certification. The Handle system has four important characteristics, as shown in Figure 2.
First of all, compared with the current situation where information is limited to various applications, information sharing cannot be cross-device and cross-platform, which restricts the efficiency of information interconnection. The Handle system embeds useful information that needs to be shared externally when encoding objects, so that Handle has native information management capabilities. It can realize basic information identification and use while realizing information transmission. It also solves the problem of using host equipment as the management equipment and using various transmission protocols as the intermediary to realize information transmission and sharing between devices. Therefore, it helps to realize efficient and collaborative information sharing, processing and application.

Second, Handle has built-in native security management. All interacting roles in the Handle system have a Handle identity, which guarantees the security and control of information based on identity authorization. At the same time, due to the distributed data management capabilities of the Handle system, it can be compatible with distributed, centralized, cloud storage and other data storage methods, which protects user data security and makes data independent of any platform, system, or database. These characteristics make it have a stronger content protection mechanism and anti-attack capability.

Third, Handle has an independent analysis system. Handle does not rely on the original DNS domain name resolution, and adopts the global parallel top-level root node architecture of equality, negotiation, and co-management to ensure the security of data analysis.

Fourth, the Handle code consists of two parts: the globally managed Handle top-level prefix and a custom code. Uniform coding facilitates the classification and definition of data, and the mutual sharing and interrelation of data. By connecting upstream and downstream enterprises to the system, a dynamic data path can be formed to help enterprises deal with complex data integration and effectively reduce information redundancy.

Figure 3. Handle System architecture diagram
The Handle system has multiple root nodes in the world, and each root node is independent and equal to each other. Multi-Primary Administrator (MPA) are responsible for managing the organization and operation of each root node. Now there are 9+1 MPAs around the world responsible for the joint construction and management of the entire DOA/Handle root zone, providing data management and root analysis services for countries and regions in each region[6]. The Handle system includes international top-level nodes, second-level nodes, enterprise nodes, and public recursive nodes. The international top-level node is the top-level identification service node, which can provide integrated top-level identification services, as well as management capabilities such as identification filing and identification verification. The prefixes of China's international top-level nodes are 86. prefix (for domestic services) and 108. Prefix (for services provided in Asia and Oceania). The role of the secondary node is to provide efficient, stable, safe and reliable identification root resolution services, identification distribution information and usage information query functions. At the same time, the secondary node system is responsible for data synchronization and data security between the root node and the secondary node. Enterprise nodes provide logo registration and analysis services for companies in need in the industry. The public recursive node is to provide query and access to the public. Among the various nodes, the national top node is an important basic service facility and the core node of the logo analysis system in the field of China's industrial Internet, providing the most basic logo registration and analysis services for the information objects of the domestic industrial Internet[7].

3.2. The basic functional framework of the Handle system

Figure 4. Schematic diagram of the basic functional architecture of the Handle system

The basic functional framework of the Handle system is shown in Figure 4. The Handle system defines a layered model. The top application layer is composed of Handle client class library, Handle client and Handle tool library. Its function is to provide users with identification registration, resolution services, and information query functions.

The Handle service layer is located below the application layer. Its role is to provide support for the application layer. The service layer includes HTTP server, TCP/UDP server, HTTP REST API, digital object (Do) registration and analysis module, Handle authentication module and Digital object access module. By relying on the transmission capabilities of the underlying network such as TCP/IP/UDP and the basic identification layer that provides support for applications, the Handle service layer realizes the interconnection of equipment and information.

The Handle node is an important part of the distributed architecture of the Handle system. Multiple independent Handle services together form the overall Handle system. Each Handle service can be
carried by one or more service sites. During the resolution process, each service site completely replicates other sites of the same service. Each service site may consist of one or more processing servers. All Handle requests generated by a given service site will be evenly distributed to the Handle processing server.

The function of Handle monitoring module and log module is to record and monitor the process information and data flow of identification registration, analysis, identity verification, and digital object access[8]. Its role is to prevent the leakage of user information and ensure network information security.

4. Convergence of 5G and handle

5G is currently the latest mobile communication technology. On the basis of 4G, in addition to speed, it also has a brand-new improvement in other aspects. 5G technology has six basic characteristics, namely: high speed, ubiquitous network, low power consumption, low latency, interconnection of everything, and reconfiguration security. Handle is a global Internet identity resolution system with a multi-level distributed architecture. It provides a globally unique permanent identity for digital objects and provides basic services for analysis and data management. It has an embedded security mechanism. It has four core functions: coding, analysis, information management and information security.

Handle can define information hierarchically, and can be shared independently by the entire network, and each access organization has autonomy. The 5G technology has the characteristics of "Internet of Everything", the combination of the two can make information sharing more convenient and faster. When the handle integrates the complex data of the industrial chain, it is difficult to obtain the information of the intermediate links. Each enterprise has its own system, and in many cases, the enterprise will not actively feedback information to the upstream. If 5G has the "ubiquitous network" feature, the interaction between multiple information systems can be simplified to the interaction based on 5G and Handle, so that the complex data of the industrial chain can be processed faster and better. The secondary nodes of Handle mainly have functions such as identification resolution, identification query, and data synchronization. In this fast-paced era, people are pursuing a faster speed based on quality. One of the most significant advantages of 5G communication technology is "high speed." The combination of 5G technology and handle will have a very good effect on improving the operating speed of a series of handle functions. At the same time, 5G’s “reconstructed security” feature has security audit and monitoring capabilities, For the formation of a security protection system in terms of architecture, protocols, and data, the stable operation of secondary nodes can be guaranteed. The "low power consumption" and "low latency" features of 5G technology can also significantly improve the handle system.

5. Conclusions

With the help of the classification and grading of industrial data, cross-regional, cross-departmental, and cross-domain information query and sharing can be achieved, product information traceability can also be achieved through identification analysis, and information security and control ability can be achieved through its internal security management mechanism. Using 5G technology's large-scale, large-scale connection expansion capabilities, low latency, high reliability capabilities, and the ability to transmit large bandwidth data, it has solved the data communication bottleneck of Handle's identification analysis, node communication, and data sharing problem. In the future, with the vigorous development of 5G technology, its combined application with the handle platform will become more extensive, and it will continue to lack the defects of the existing industrial data classification and hierarchical management, which will be of great benefit to service industrial enterprises and platform enterprises.

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References

[1] Xu Z.X, Zhu Z. (2020) 5G mobile communication technology characteristics and scenario applications. J. Radio and Television Network, 27(08): 36-37.

[2] Cheng W.H. (2020) Talking about the characteristics and applications of 5G mobile communication technology. J. China Information Technology, 11: 66-67.

[3] Zhang N, Yang J.W., Wang Y, Chen Q.X., Kang C.Q. (2019) 5G communication for ubiquitous power Internet of Things: technical principles and typical applications. J. Proceedings of the Chinese Society of Electrical Engineering, 39(14): 4015.

[4] Shi X.T. (2018) 5G network technical characteristics analysis and wireless network planning considerations. J. Information and Computer (Theoretical Edition), 23: 166-167.

[5] Zou H, Ma D, Wang W. (2019) Interoperation mechanism for Handle system and domain name system: implementation based on markup language describing protocol data unit. J. Application Research of computers, 36(1): 194-198.

[6] Wang T.T., Ji Q.Q. (2019) Research on Handle System in Information Interaction of Manufacturing Supply Chain. J. Technology Innovation and Application, 8: 66-67.

[7] Jia X.Q., Luo S, Hu S. (2019) Research on Industrial Internet Identification and Its Application. J. Information and Communication Technology and Policy, 4: 1-5.

[8] Zhang X.Y., Yang S.F., Wang C.H. (2021) Research on the Classification and Hierarchical Protection Framework of Industrial Internet Data Security. J. Information Technology and Cyber Security.