

Application of Industrial Internet Identifier in Optical Fiber Industrial Chain



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Abstract: The industrial Internet has germinated with the integration of the traditional industry and information technologies. An identifier is the identification of an object in the industrial Internet. The identifier technology is a method to validate the identification of an object and trace it. The identifier is a bridge to connect information islands in the industry, as well as the data basis for building a technology application ecosystem based on identifier resolution. We propose three practical applications and application scenarios of the industrial Internet identifier in this paper. Future applications of identifier resolution in the industrial Internet field are also presented

Keywords: industrial Internet; application of identifier; ecology of information application; industrial big data; identifier resolution

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1 Introduction

The Identifier Resolution System (IRS) is an important part of industrial Internet network architecture. It is a center to connect every segment of the industrial Internet. Once the big data of every company are connected, the information islands may be linked and the information barriers may be broken [1]. Also, the resolution system is the groundwork for technology such as the Internet of Things (IoT), Artificial Intelligence (AI) and intelligent manufacturing in the Industrial internet. In this system, the identifiers map to the articles in the physical environment by digital simulation [2].

Combining the advantages of industrial manufacturing and information technology [3], the IRS provides basic supports for both the Internet companies and the industrial field. Especially, the system may promote the growth of their intersec-

tion. Therefore, a new industry may be set up and developed. Moreover, the applications of identifiers will support the modernization of economic system and promote economic development with high quality. The identifier can be used to monitor the all-life-cycle and trace the quality of a product [4].

From now on, the development of the industrial Internet is in an acceleration period. It is also a critical period of information infrastructure upgrading and industry data integration. Thus, the Chinese government is increasing the speed of the construction of the industrial Internet resolution system.

This paper introduces concepts, mainstream technologies and applications of the identifier. The paper develops the objects, scenarios and challenges of the application in the optical fiber industrial chain [5]. It also analyzes the application

directions of the identifier in the future.

2 Background

2.1 Identifiers and Identifier Technology

An identifier is a string that consists of digits, letters, and symbols organized by some rules and standards, and it aims to identify an object. It plays a similar role as the “pointer” in computer language. The pointer points to an address that stores the value in the register. Analogously, the identifier maps the address that stores the description of the object. A user may access the address and request the description by submitting an identifier from a terminal device, such as a smartphone, Radio Frequency Identification (RFID) card reader and bar-code scanner to the resolution system. After the identifier being authenticated, the details of the object can be acquired and retrieved.

The whole system constructs an underlying architecture that connects all the resolved information and other data. The architecture provides the services and functions that the industrial manufacturers need. For example, the system may be used to trace back the product quality by analyzing the time and space record of the product. Besides, the manufacturer may conduct warehouse management by stocking and storing data.

The identifier technology mainly consists of encoding, the identifier carrier, and resolution [6].

The encoding technology gives an entity object such as a product and a process a set of scientific and standardized digits, symbols or other information that can be recognized by terminal equipment. Encoding is aimed to set encoding norms for various industries and fields and provide a unified standard for data exchange and collection between different enterprises.

An identifier carrier implements data transfer. The identifier exists in real life as a carrier such as an RDIF card, 2D code or bar code. Terminal equipment may recognize the identifier and its address. A user with authority may request more descriptions by accessing the address.

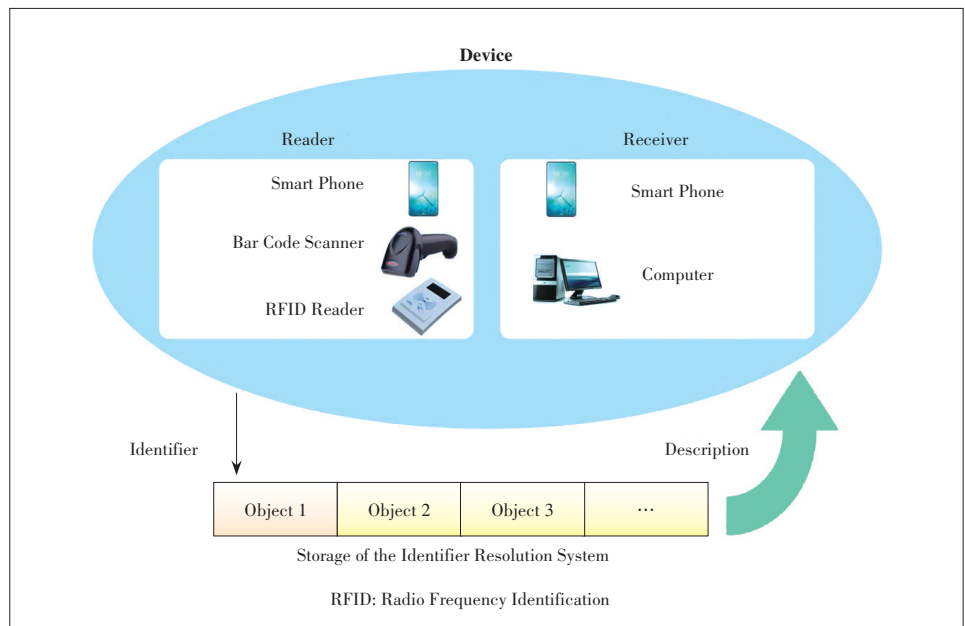
The resolution technology is the process that is mapping the identifier to the descriptions stored in the servers. For example, the resolution result may be a URL link to the detail description of the product.

2.2 Application of Identifiers in the Industrial Internet

The industrial Internet is a new network that serves industrial manufacturing. The identifier in it is similar to the domain name on the Internet, which is unique identification information of every material, product, component, equipment, system or technical proposal. As the identifier technology collects the production data, the resources are classified and managed effectively. Likewise, the resolution of the industrial Internet is like the domain name resolution. In the IRS (**Fig. 1**), a domain name could be achieved by a 2D code which contains the identifier information. Besides, the data, service record and flow record in the industrial manufacture management system of objects may be retrieved by the identifier.

The industrial Internet is the basic part of the process of informational upgrading and transition of the manufacturing enterprises. Nowadays modern industrial producers manage a large number of information systems and equipment, which are difficult to recognize. Moreover, the data is collected by dis-unified mechanisms, rules, and frames because of the wide spectrum demand of software and hardware equipment and the diverse suppliers. Thus, the factories have no effective way to link the inside and outside and cannot connect the front-back end information in the industrial chain [7]. This restricts the national modernization and informatization process.

The significance of the application of identifiers in the industrial Internet is that the application is a bridge linking the data simulation environment and the real environment, which map to each other. By mapping, the operational effec-



▲ Figure 1. The Industrial Internet resolution system.

tiveness of all types of modeling optimized environment may be applied rapidly and the best method of management and control may be chosen for maximum efficiency and cost reduction.

Identifiers and identifier technologies may be widely applied in the primary and secondary factories. The industry informatization upgrading process can list entities like materials and products by some standardized regulations such as their names and features in a digital system and making entities digitized, modularized, systematized, robotized and intelligent. In the process, the industrial Internet plays an important role and the identifier is the core part.

According to the breadth of the industry, to give every product an identifier, a scientific digital basis accepted by the system is in need. The most important work is mapping the topology structure based on the digit to the industrial Internet, realizing the unity of opposites of the basic entity objects structure, meeting the demand of industrial manufacturing by software development and data operation, interacting products, people and software data. The ultimate goal of the application is developing an industrial mode and build an informational ecosystem whose core is the identifier.

3 Applications of the Industrial Internet

3.1 Industrial Equipment Cloud Platform

Manufacturing enterprises have their systems in data interconnection, producing process joint and equipment coordination. The monitoring of equipment is the most important function in these systems. Using new technologies such as big data, AI and IoT, the modern industrial equipment cloud platform [8] combines image big data and hardware like industrial robots, monitor and switch, and supports multiple communication protocols. This cloud platform can help the enterprises use industrial equipment effectively.

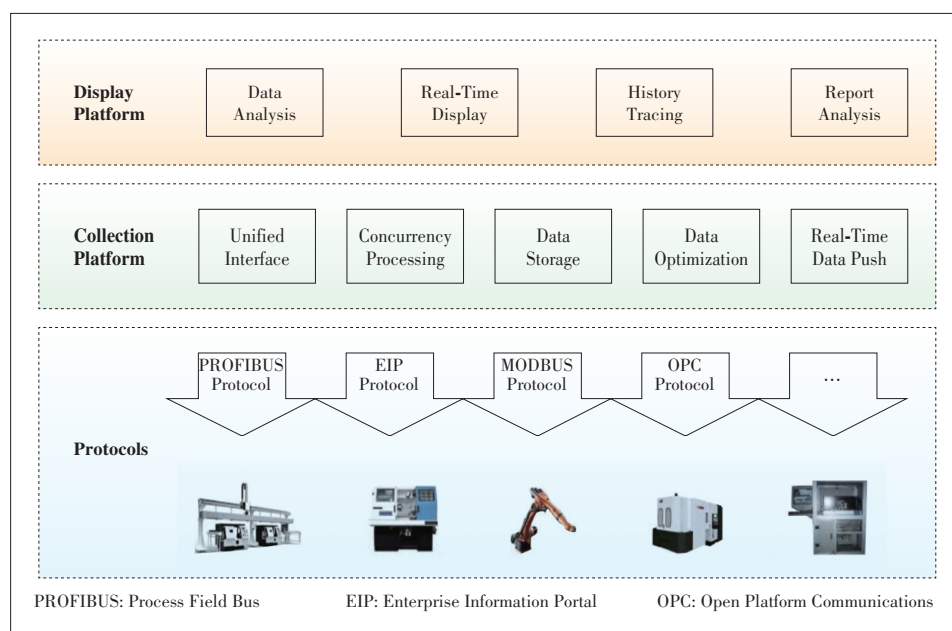
The equipment management is integrated into the cloud platform management system (Fig. 2). Using identifier resolution technology, 2D code, and RFID, the system realizes full-lifecycle equipment management. This system provides abundant functions such as centralized equipment monitoring, equipment management, maintenance management, inspection management, spare parts management, tools management, statistics analysis, unit organization, and ba-

sic setting. This platform has a sound mechanism and high-level security. In addition, it stores huge amounts of data and intelligent management equipment in the cloud.

Different from the common equipment cloud management, this equipment cloud connects the national industrial Internet identifier system. Every equipment access to the platform has registered in the identifier resolution secondary node and is given a unique industrial Internet identifier. The user can acquire the information about equipment and use the functions on the platform by the resolution system. This platform realizes the informationalization of equipment management, paperless processing, system modulization, and the improvement of management modes.

The industrial cloud platform is able to realize real-time data collection, real-time monitoring, failure data collection, equipment health management, and predictable maintenance. Moreover, the platform can store the equipment ledger and basic data that are easy to lose. Based on the data collected by the platform, the big data technology implements the analysis of the life cycle of workpieces, rational equipment inspection and alert to maintenance. Early maintenance may reduce the loss of sudden failure. The identifier of a workpiece may associate with the equipment identifier to match the workpiece with the equipment. The platform enables data statistics, which are required by the production management. The data analysis facilitates the operation management and producing strategy.

On the cloud platform, different roles have distinct authorities. After scanning the identifier code, the common employees can only retrieve the basic parameters, maintenance tasks, repairing record and inspection record while the man-



▲ Figure 2. Cloud platform management system for equipment monitoring and collection [9].

ager can read two more reports that are the real-time monitored data and alert record. The separated authorities enhance information security.

The cable production of Zhongtian Technology (ZTT) LINK Company has applied the industrial Internet equipment cloud platform (Fig. 3). The platform guarantees the stability of the cable quality. In the Modified Chemical Vapor Deposition (MCVD) processing line, the staff can monitor the equipment continuously, and test the gas Mass Flow Controller (MFC) online. The platform can also test every part of the lathe and keep the stability of the operating parameters. According to the practice of ZTT LINK Company, the mainte-

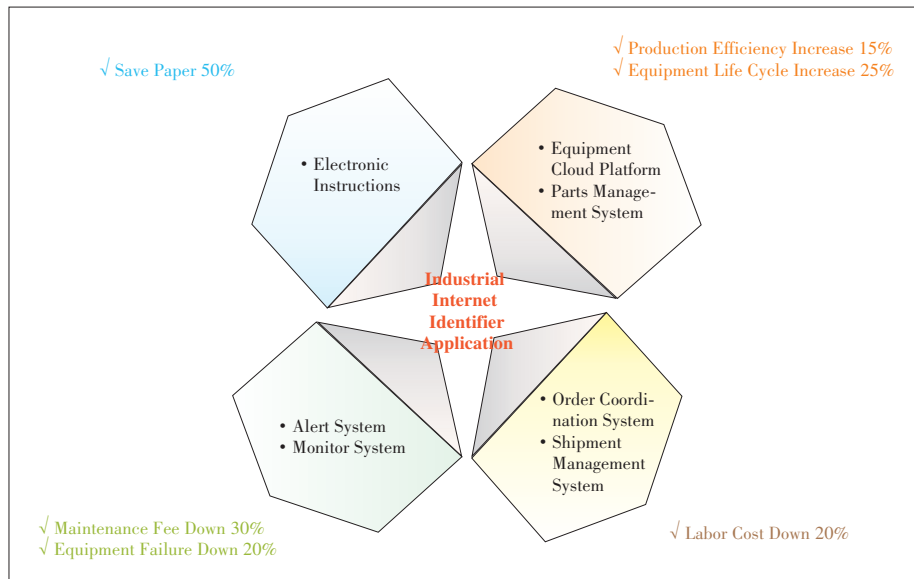
nance fee has been down by 25% - 30%, the life of equipment has prolonged by 25% - 30%, the unpredictable shut-down of equipment has dropped by 30% - 40%, and the production efficiency has promoted by 15% - 25%.

3.2 Tracing Quality

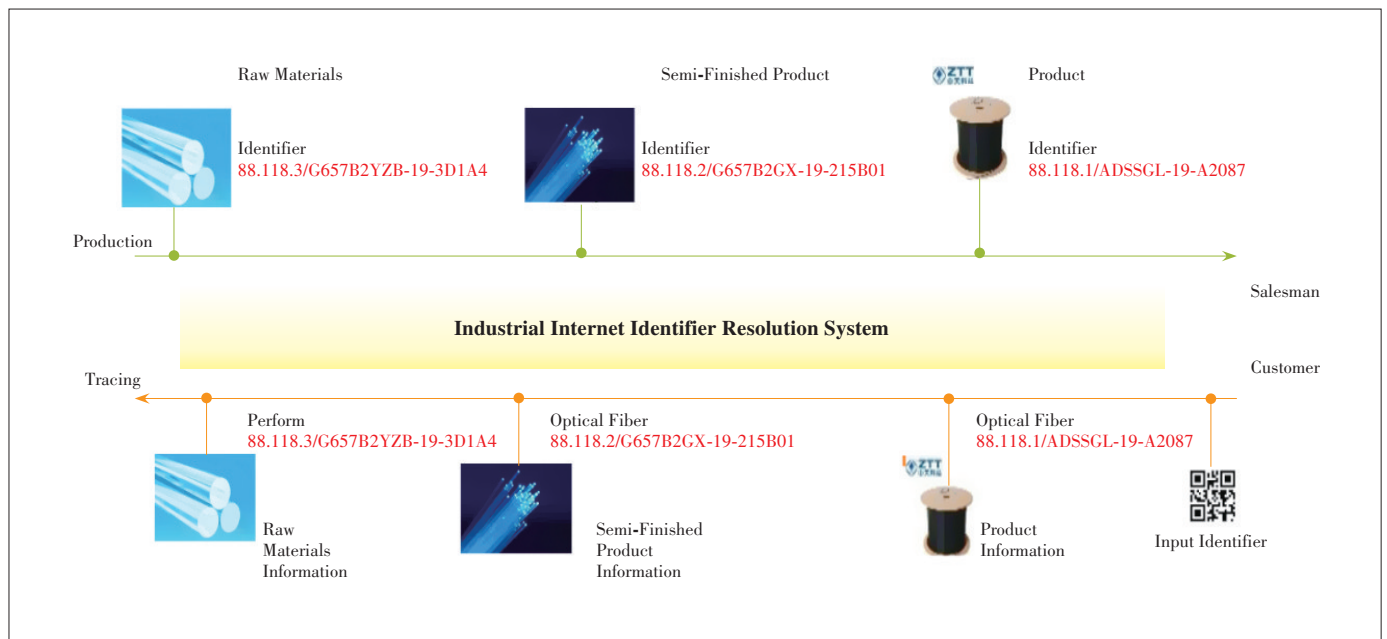
The identifier resolution system provides a method to trace the product. In this system, every company has a unique identifier. Every product made by this company would be given a product code which could be its serial number or a code representing its features. Thus, a product will have a unique identifier consists of the company identifier and product code [10].

An identifier of a product can map to an address in the resolution system where the product information is stored. After scanning the code and uploading the identifier, a user would be able to access the address of the identifier and get the details of the product. Therefore, the product information can be traced by the identifier.

ZTT LINK Company has applied the identifier resolution system in the optical fiber manufacturing chain (Fig. 4). This company distributed different identifiers to its factories. The identifier of the optical fiber pre-form factory is 88.118.3 while the identifier of the optical fiber factory is 88.118.2 and the identifier of the raw materials factory is 88.118.1.



▲ Figure 3. Application of the Industrial Internet identifier at ZTT LINK Company.



▲ Figure 4. Industrial Internet identifier resolution system for the optical fiber industrial chain.

Identifiers are distributed to products made by these three factories. The optical fiber preforms are produced in the material factory. In the semi-finished factory, the optical fibers are made. The optical cables are then manufactured in the production factory. All the products made by these three factories are attached by a 2D code label.

ZTT fiber industrial chain has realized the tracing function of the identifier in the three factories. Both the factory staff and clients can search the information by inputting the identifier. When a problem happens in the production process, the staff may scan the 2D code to find the origin of the materials. If the clients find a bad product, they can search the producer and the parameters of the product in the tracing system.

In the identifier system, different users have distinctive authorities. The clients can check the basic information and access the logistics page. The manager and quality inspectors have the authority to check two more pages that are quality information and tracing information.

In the optical cable resolution page, the product information contains basic information, structure parameters, and technical parameters. While installing the cable, a client may scan the 2D code to check the parameters. When the client has a bad cable, the producer can find out by the identifier resolution system. This is the tracing function.

The logistic page consists of the order number and tracking number. The client can trace the product when it is on the way. Once receiving a bad product, the client can check whether the logistics company should take responsibility for the problem.

The quality information includes optical fiber features, mechanism features, and environmental performance. It is very important and therefore, it can only be acquired by factory managers.

In the tracing page, the quality report of the optical fiber is shown. Furthermore, the factory staff can access the report of the optical fiber and the preform. Due to the confidential data in these quality reports, only the factory staffs have the authority to read them.

3.3 After-Sales Service Feedback

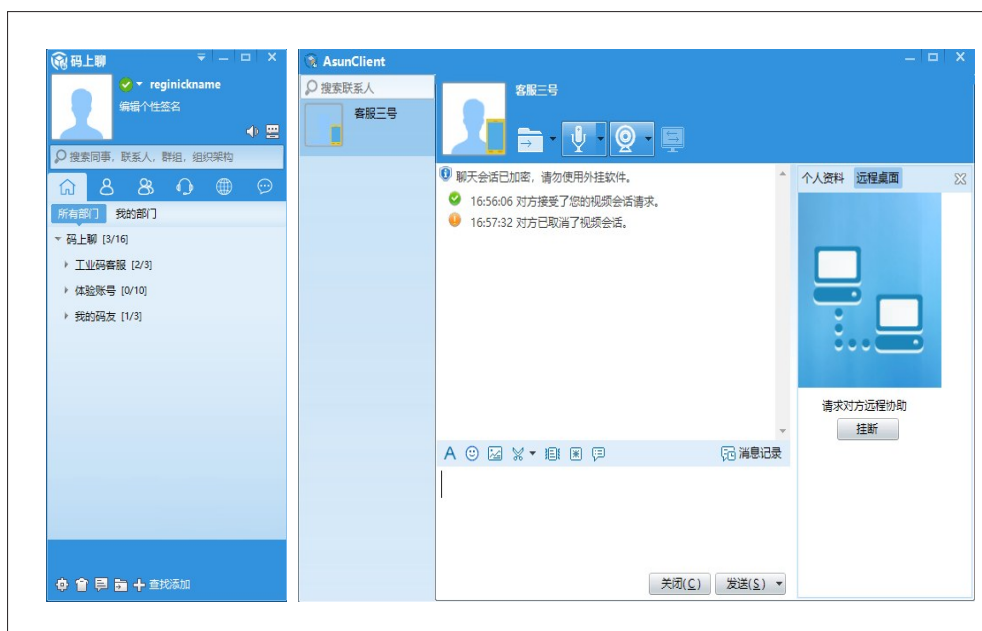
After-sales service feedback includes system information collection, comment query, and data statistics. This application can collect the data of a product identifier, comment records,

comment time, device location and trading code, aiming to increase the satisfaction of customers. It can manage and display these comments and can also analyze the correlation between locations, clients, and their satisfaction. Thus, the suppliers will be able to solve problems specifically. Moreover, this application may promote product quality and increase sales. It also enables enterprises to optimize their production parameters, adjust the processing flow, and improve production efficiency and product quality.

An identifier is the carrier of information. The after-sales service application can collect and analyze the data of consumers. By dynamically updating these data, the application may be used to push and show the products and services that are suitable for customers to satisfy their interests. Technologies like machine learning and data mining can be used to predict the deep demands of users. The precise marketing may expand the consumer group and increase the profit of the enterprise [11].

Base on the identifier, the after-sales service application can feedback the market by analyzing the collected data. This application helps manufacturers improve their products and provides methods for sellers to manipulate the market. The user may access the online retailers of the producer by scanning the 2D code of the product, which benefits the brand spreading. This application can also facilitate and monitor a promotional campaign.

Combining with social networks, the after-sales service feedback system can get through the barriers among the manufacturing enterprise, dealers and customers. This application also links the production and use, and supports the upgrading of products. ZTT LINK Company has released an instant messaging app based on the identifier, MaMsg (Fig. 5),



▲ Figure 5. User interface of MaMsg.

which integrates the factories on the supply chain for convenient communication and cooperation of upstream and downstream enterprises.

4 Identifier-Based Industrial Internet Ecosystem

In China, the industrial Internet is expanding and extending to various fields of the real economy and setting up connections across various enterprises, fields, and industries. The standardization and further research of identifiers and the identifier technology are significant for data sharing and diversified operation, facilitating the forming of an identifier-based industrial Internet ecosystem.

Thus, the definition of industry semantics (standard) based on the identifier and the corresponding standardization of the expansion of the semantics need pushing. The standard of identifier codes and the definition of industry semantics are the basement of the interconnection of everything. The former provides a basis for the connection of enterprises on the whole industry chain. The product object may be digitized by effectively monitoring and counting the data generated in the full-life circle of the object. Enterprises may establish and improve the criteria of the data interpretation according to their own demands or those of the industry. An enterprise may refine the standards of identifier codes to improve its manufacturing process. Furthermore, a country may lead and set a couple of standards to enhance the level of its industrialization and informationalization.

There are still several challenges to be solved during the development of the industrial Internet, identifier and identifier technology in terms of the following four aspects.

1) Technology: The identifier is not only a code but also the description of information. It is necessary to deeply explore what information to be kept or rejected, how to connect the isolated information and how to integrate the information of the present and the future.

2) Standardization: This involves multiple fields and nations and is difficult to make a decision of compromise or reset.

3) Benefits of enterprises: In the process of establishing the criteria of encoding, some powerful companies may play the leading role, while small businesses have a high probability to be out.

4) Promotion: The industrial Internet has a long way to go. It is especially hard to promote the identifier resolution system. It would be better to insist on a long-time strategy. Meanwhile, one standard, mass registration, and high value need a long time to achieve.

The industrial Internet resolution system involves many crucial industrial fields that influence the national economy and people's livelihood. As a bond connecting the layers of production management, commerce circulation, and marketing, the identifier resolution system will build an ecosystem

of information application. In the future, the system tends to the omnidirectional development and becomes a cornerstone of the development of the national industrial Internet.

5 Conclusions

The collision and integration of the industry and the Internet are not only in the construction and use of the network but also in the communication of information. The industrial Internet identifier, the identifier technology and the application of the identifier are the core of the informatization upgrading, as well as the important components of the basic information infrastructure such as the IoT, smart cities and intelligent manufacturing. Now, the industrial Internet identifier has been applied in various industrial scenarios. The identifier technology enables the customization based on business demands and some technologies may be applied across multiple platforms. ZTT LINK Company is operating a second node of the industrial Internet led by the Ministry of Industry and Information Technology of People's Republic of China. It has applied the identifier resolution system to the optical fiber industry for sake of manufacturing, logistics, and marketing. Besides, it provides solutions for identifier applications of other industries. It has applied functions such as equipment cloud platform, anti-fake, anti-fleeing and quality tracing to the industries of energy, home textiles, and medicine. The development of the identifier application has a long way to go. Especially the standardization of identifier encoding has to correspond to the practical demands of the manufacturing enterprises. The standards should be set scientifically and corresponding to certain criteria.

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