Research on Application of Time Sensitive Network Technology in Industrial Internet

Shuo Wang[1], Yinghui Yang[1], Hongjuan Li[1]

[1]Henan Animal Husbandry School of Economics.

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Abstract：Time-sensitive network technology is an important part of industrial development. At present, the development of the Internet of Things lacks a complete and unified Internet specification. It only allows data to be transmitted to the back-end database in the form of collection at the front end of the object, and then passed up to the application layer layer by layer. Based on the development of industrial Internet, this paper deeply explores the application of time-sensitive network technology in the industrial Internet.

1. Introduction

At present, the rapid development of time-sensitive network technology has attracted the attention of the industry. A large number of international standardization organizations have begun to design time-sensitive network standards and it has also prompted industrial enterprises to start promoting time-sensitive network technology internally. There are still many cases where domestic industry uses time-sensitive network technology, and corresponding experimental beds have been constructed, which has a positive effect on the research work of time-sensitive network technology. The application research of time sensitive network technology in the industrial Internet is as follow.

The "Industrial Internet" refers to an open, global network that connects people, data, and machines together, and belongs to a category of pan-Internet directories. It is a highly integrated global industrial system with advanced computing, analysis, sensing technology and the Internet.

From the past development situation in China, the concept of the Industrial Internet has always existed, not just imported. In essence, the Industrial Internet is first and foremost connected, and on the basis of this, it combines data flow and research to accelerate intelligent innovation, and then acquire new development situations and formats. Interconnection is the foundation of development, and the Industrial Internet is to interconnect various elements of industrial systems, whether they are humans,

machines, or systems. Although it solves the communication problem, the more crucial point is the end-to-end flow of data. Therefore, we must move across the system and explore in depth in data flow technology to build models. Burt proposed that intelligent production, personalized customization and service extension are

implemented on the basis of interconnection. This is the basic principle of the Industrial Internet. It pays more attention to data and connection than the current Internet. It also emphasizes data flow,

integration and research, modeling, etc. This is a completely different content from the Internet. It can be seen that the essence of the Industrial Internet is to have data flow and analysis.

In the context of the development of the new era, with the gradual integration of the three elements, the advantages of the Industrial Internet have been highlighted, which has a completely new change compared to the traditional operation mode. The traditional statistical method is historical data collection technology, which mainly refers to the separate implementation of data, analysis, and decision-making. With the reduction of modern system monitoring and information technology costs, the improvement of work capabilities has led to the expansion of data processing scope. It also provides a broader perspective for system operation. The proposal of machine analysis can put forward new ideas for research flow. Different physical methods and expertise contained in specific areas of the industry will cooperate with the current set of "big data" tools. In the end, the Industrial Internet will include traditional and new hybrid methods, and scientifically reference historical and real-time data based on advanced industry-specific analysis. It should be noted that although the introduction of the Industrial Internet has accelerated the development of industrial enterprises, it has also brought a lot of security risks, and the use of time-sensitive network technology can effectively solve the problem.

industrial systems, whether they are people or machines or systems. Although it solves the communication problem, the more important thing is the end-to-end flow of data. Therefore, it is necessary to make a cross-system flow and deep exploration in data flow technology to build a model. Bert suggested that intelligent production, customization and service extension are all implemented on the basis of interconnection. This belongs to the basics of the industrial Internet. It pays more attention to data than the current Internet, and pays more attention to connectivity. It emphasizes the flow of data, integration and research, modeling, etc., which is completely different from the Internet. It can be seen that the essence of the industrial Internet is to have the flow and analysis of data.

In the context of the development of the new era, with the gradual integration of the three elements, the advantage of the industrial Internet has been highlighted, which has changed completely compared with the traditional operation mode. The traditional statistical method is historical data collection technology, which mainly refers to the separate implementation of data, analysis and decision-making. With the reduction of the cost of modern system monitoring and information technology, the improvement of work ability has promoted the scope of data processing. It also provides a broader perspective for system operation. The introduction of machine analysis can propose new ideas for research flow. Different physical methods and professional knowledge contained in specific fields of the industry will work in cooperation with the current set of "Big Data" tools. Ultimately, the Industrial Internet will include traditional methods and new ways of mixing, and based on advanced industry-specific analysis, scientific references to historical and real-time data. It should be noted that although the introduction of the Industrial Internet has accelerated the pace of industrial enterprise development, it has also brought a lot of security risks, and the reference time-sensitive network technology can effectively solve the problem. The following is a deep exploration[1].

2. Analysis Of Time Sensitive Network Technology

2.1. Definition

Time-sensitive networks are based on real-time Ethernet. In the concept of real-time Ethernet, there are many application scenarios where deterministic latency is defined as the basic content, such as the driving system of the vehicle and the control system of the factory. In these cases, the acceptable range of time-sensitive data stream transmission delays is less than 1 millisecond. In order to achieve the expected delivery requirements, the real-time communication technology with EtherCAT and Profinet as the core has been fully promoted in the market and has become the fundamental content of development in various fields. According to research practice cases, these technologies are based on traditional Ethernet, but they also have proprietary mechanisms, which also make them incompatible with each other under working conditions, which hinders the development of real-time Ethernet. At this time, the IEEE802 working group put forward the concept of "time-sensitive network", and wanted to construct a unified and perfect physical layer and data link layer protocol, so that it can work in all areas in a standardized state. , in turn, provide real-time data information to the system. This has a positive effect on the development of real-time Ethernet[2].

2.2. Characteristics

Literally, the most important point about time-sensitive networks is time. Its fundamental goal in application is to provide a method to ensure that information is transmitted from the source node to the destination node within a clear and predictable time range. At this time, the IEEE802 working group proposed that time-sensitive networks can provide data transmission capabilities with bounded low latency, low jitter, and extremely low data loss rates. The specific characteristics are divided into the following points: First, time synchronization. The end-to-end synchronization time is maintained on the device running the application and the control application, and the worst case is expected to reach $\pm$ 500ns. This feature belongs to the fundamental content of time-sensitive networks. Second, it has bounded low latency. Based on the bounded low latency proposed by a variety of scheduling and management mechanisms, zero loss of congestion is finally achieved; third, low jitter. Control the jitter in the data transfer stage according to the time synchronization and data flow scheduling mechanism; fourth, high availability. Combines data frame replication, master-slave time sources, and other mechanisms to provide network high availability. Fifth, the convergence network. Time-sensitive network technology supports the simultaneous delivery of a large number of loads with very different requirements; and sixth, compatibility. According to the standardization technology, it is compatible with different reference scenarios and existing protocols.

With the support of the above characteristics, time-sensitive networks can exhibit the following advantages: First, the data transfer delay in the switched network is guaranteed; third, critical loads and non-critical loads can be mixed in the same network. The parallel delivery of key loads will not affect the delay of key load delivery. Third, a large number of real-time loads of upper-layer protocols can be delivered together in the network. Fourth, network errors can be repaired and studied in time [3].

3. Application Analysis of Time Sensitive Network Technology in Industrial Internet

With the rapid development of the Industrial Internet, people's requirements for communication networks are also increasing. At this time, the innovative manufacturing process and gradually perfected control process need a network that can communicate quickly and in time. As a guarantee, after all, Ethernet in the traditional sense cannot meet the current industrial development needs. Therefore, the staff must deeply explore the development needs of the Industrial Internet on the basis of integrating previous work experience. Time-sensitive network technology, as an important content of the development of the new era, is the key to the current industrial Internet to achieve the expected development goals.

3.1. Factory Automation

In a discrete industrial plant, there are a large number of robots operating on each production line. At this time, the reference time-sensitive network technology helps to improve the sensitivity of the operation. At this stage, these robots are controlled locally, with limited synchronization to each other, and data access from outside the factory floor is limited. In this case, in order to implement interconnection, in addition to communication based on a proprietary network, it is implemented according to the industrial gateway. It can be seen that in this context, in order to eliminate local control, it will increase the non-critical load in the communication network, which will inevitably affect the effect of critical load communication[4].

The reference of time-sensitive network technology can not only solve the problem, but also help to improve work efficiency and quality. Let these robots communicate with the help of time-sensitive network technology, and then synchronize to a global clock. Even if non-critical loads appear in the network, the transmission of key loads such as control signals can be ensured. In other words, in this context, the staff can not only inherit the control network and the data network, but also integrate the control functions dispersed into the various robots into a control cloud with powerful computing power. The most important thing is that the data collected from the robot can be directly transmitted to the upper network without relying on the gateway facilities, which not only optimizes the service level, but also controls the infrastructure expenditure.

3.2. Power Industry

Time-sensitive networks help provide more accurate optimization work and lower-cost power generation and maintenance for the power industry. The range of power stations is very wide and the composition is very cumbersome, and new applications are added to the power station infrastructure from time to time. Therefore, in order to ensure the safety and effectiveness of the operating process system, the staff must let multiple types of systems work together in order to effectively generate electricity. However, understanding the practical cases shows that there are generally different communication platforms between systems and systems, which will increase the complexity of the system. In areas with real-time communication needs, these systems must be separated from the upper network.

The use of time-sensitive network technology in power plants as a standard communication platform for different systems helps to improve the effectiveness of the power plant architecture. Research practice cases show that for systems that require deterministic real-time communication, after time-sensitive

network technology is referenced, each system can be integrated to adjust their time-sensitive loads together. For other high-level management and security protocols, etc., they can be delivered together in the same network, and there will be no differences between them. In addition, a key feature of time-sensitive network technology is that network faults can be discovered in time and trimmed at the component level. Therefore, the more intensive integration of various systems helps to improve the efficiency of practical work[5].

4. Conclusions

In summary, the development of time-sensitive network technology in China is in its infancy and research on relevant standards is gradually being implemented. Therefore, China must clarify the development of China's industry on the basis of integrating international standards research work, and then propose appropriate Standard content. In addition, various industrial enterprises must strengthen communication and exchanges, work together, actively research time-sensitive networks to promote their application and development in the industrial field, and continuously obtain new research results in order to provide an effective basis for the development of the Industrial Internet.

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