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Research and Application of the Intelligent Perceptive IOT Architecture for Aerospace Experiment Business Network

Hongyan Chen[a], Junwei Wan, Wensu Li

Beijing Institute of Tracking and Telecommunications Technology Beijing, China

[a]child_smile@163.com

Abstract. Based on the analysis of the current situation and requirements of the aerospace business network, faced with the emerging intelligent perception IOT system, the shortcomings of the existing aerospace business network, especially the inadequacies of the existing architecture, are summarized and analyzed, An Intelligent perceptive IOT architecture based on aerospace experiment business network is proposed. From the aspects of system composition and structure characteristics, the new architecture and the existing architecture are analyzed and compared. The key technologies and application advantages involved in the construction of future aerospace business network under the new architecture are discussed.

Keywords: Aerospace experiment business network; Intelligent Perceptive model; IOT; Architecture; Infrastructure and services.

1. Introduction

In recent years, with the emergence and development of IOT, Cloud Computing, Next Generation Internet and new generation mobile network application technology, the concept of "intelligent system" of "real-time perception, massive computing, timely feedback" has become possible and technological basis. Intelligent system construction is to connect the intelligent sensors embedded in the system everywhere through the IOT, so as to realize the overall perception of the whole system. Intelligent processing technologies such as cloud computing are used to process and analyze massive perceptual information, realize the integration of digital aerospace and IOT, and issue instructions. Intelligent response and intelligent decision support are made to various needs, including scientific research, office, equipment assets, environmental security and so on [1].

Aerospace experiment business network is a special network system designed and built to meet the requirements of specific experiment tasks. It is an important support for China's aerospace forces. It is a basic platform for connecting all the experiment elements of various aerospace missions, realizing information exchange and integration, as well as networked, service-oriented and systematic collaborative use of resources. It has specific high requirements for real-time, reliability and security. The technical characteristics and application advantages of the intelligent object-linked sensing system, such as "real-time perception, massive computing, timely feedback", provide opportunities for the expansion of the system architecture, the sharing of system resources, the generation of mission capability and the optimization of operation mode of the information system in the field of Aerospace experiment[2].

In this paper, through the construction of the intelligent IOT sensing data resource system of the aerospace Experiment business network, the IOT sensing information collection, aggregation, management and sharing can be realized. Perfect the construction of real-time perception system of aerospace Experiment business network, provide dynamic perception data support for large data management platform, and realize data integration based on integrated services. It provides support for comprehensive research and rapid decision-making of fine aerospace Experiment business network management, optimizes and improves the collaborative support mechanism and efficiency, and strengthens the multi-system collaborative management and comprehensive governance mechanism.

2. Current Situation Analysis

2.1 Status of Architecture

The aerospace experiment business network is based on the former aerospace experiment communication network, and is constructed on the basis of integrating the special business networks transferred to the aerospace forces. Its architecture is mainly composed of service layer, bearing layer, transport layer, communication network management system and communication security and secrecy system, as shown in Figure 1.

The main task of the transport layer is to provide transport channels for the carrier layer. Business layer devices do not connect directly with the transport layer devices, and the interconnection of the internal systems of the transport layer does not involve the business layer. Business bearer layer adopts IP technology system, and carries all kinds of business through unified networking mode and interface. Business layer provides business applications, using the bearer layer to achieve information acquisition, processing and application functions. Communication security mainly uses network encryption and security protection to realize the security protection of all kinds of nodes and transmission network. According to the mode of "equipment-specialty-system", communication network management realizes hierarchical organization and hierarchical management, completes the functions of monitoring the operation status of communication system, remote monitoring of equipment and resource scheduling.

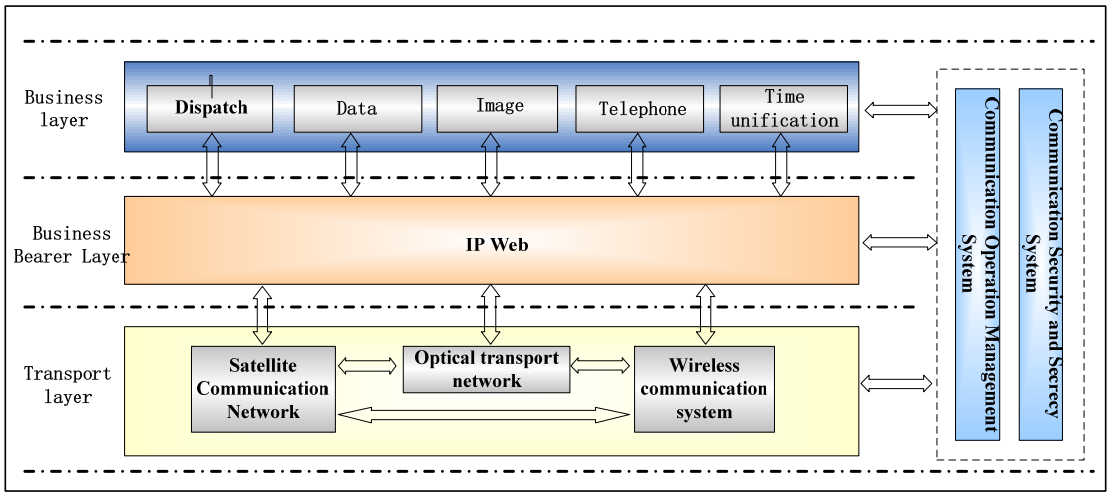

Fig 1. System technology architecture

2.2 Insufficiencies and Gaps

According to the use of the existing aerospace Experiment business network, there are a series of problems that need to be solved urgently. The analysis is as follows:

At present, the special operational networks of aerospace forces such as TT&C, remote sensing, communication, navigation and meteorology are being constructed for the application of the IOT. However, the problems of rebuilding, setting standards lightly, emphasizing systems and overlooking interoperability are prominent, and a new round of "information island" has been formed. This problem is particularly prominent in the data processing centers of various types of special business networks. Lack of overall unified management and dynamic resource allocation mechanism leads to inefficient use of system resources, low dynamic resource regulation ability, difficult to achieve resource sharing and efficient operation and maintenance, unable to meet the multiple information transmission needs of various aerospace forces, and limited data and information sharing, service and application integration.

At present, the network monitoring means are limited, the real-time monitoring ability is insufficient, and the perception and interaction of network applications have not yet been realized. The lack of service-oriented perception ability and means will directly affect the collaboration ability of the system. In the new historical period, the external situation faced by aerospace forces is more complex and changeable,

the organizational modes of various missions are mobile and flexible, the forms of aerospace and ground networking are diverse, and the demand for accurate prediction and rapid response in aerospace missions is increasing day by day. In the face of these new requirements, the demand for self-healing ability of information networks and reliability of information transmission is increasing.

Therefore, according to the unified planning, it is urgent to construct an intelligent IOT perceptual data resource information system with reasonable network division, clear function orientation and advanced technical means, so as to realize the data and information sharing, service and application integration of the aerospace experiment business network.

3. Architecture Design

3.1 Construction Demand

From the aspects of unified construction, management, integration and sharing of the aerospace experiment intelligent IOT perception information system, the construction of the IOT management platform and supporting facilities system is carried out under the overall thinking framework. According to the development of economy and information system, it is implemented in stages to ensure that the results of each stage become an organic whole of the platform and promote the sustainable development of the platform.

1) The IOT management platform system has functions: equipment management, connection management, data management, application support, network management, security management, system management, unified display portal, business portal, platform management and operation portal, etc.

2) Inter-system docking is carried out by IOT management platform, including: large data platform, information resource sharing and exchange platform, business network operation command center, video surveillance platform and building control management system.

3) The IOT management platform integrates the IOT sensing terminals, provides relevant sensing data, realizes business support and unified intelligent terminal management, including intelligent measurement and control, intelligent remote sensing, intelligent communication, intelligent navigation, intelligent meteorology, intelligent mapping and other intelligent applications, and provides sensing data and business support for the information resources system management platform.

4) Deployment of IOT management platform based on business private cloud infrastructure environment.

3.2 Overall Architecture Design

Based on the architecture of the intelligent IOT perception management network of the aerospace business network, with the requirements of the intelligent IOT, it realizes the unification of the assets management of sensing equipment, strengthens the ability of fine management, and forms a set of innovative standards and norms system of the IOT perception management mode. The overall project construction goal is to meet the requirements, which is divided into application, platform, data, cloud infrastructure and so on. Perception network, perception and other levels, as well as security and security management system and operation and maintenance standard management system to carry out the overall architecture design. As shown in Figure 2.

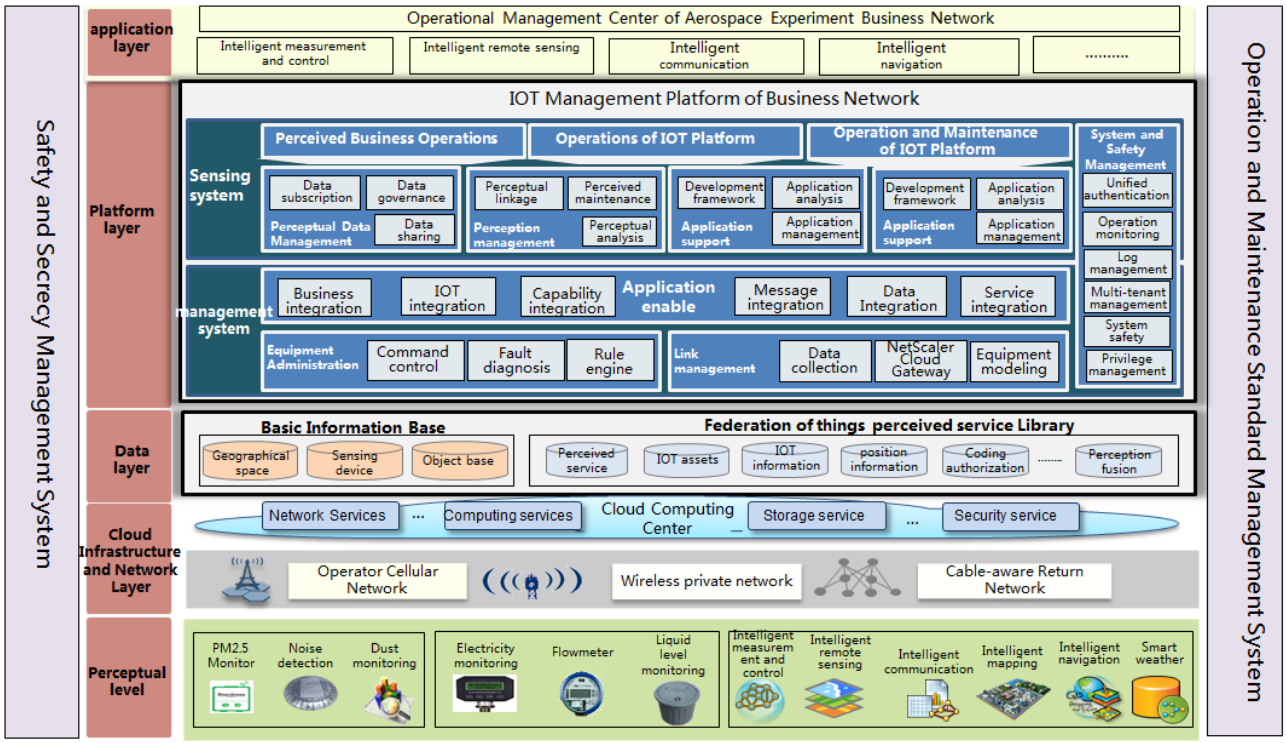

Fig 2. System technology architecture

1) Application layer

The operation and management center of the intelligent IOT sensing system oriented to the aerospace experiment business network and related intelligent sensing applications such as measurement and control, remote sensing, communication, navigation, meteorology etc. Obtain the monitoring and sensing data of the IOT through the IOT management platform. At the same time, according to the needs of business collaboration, obtain other business monitoring and sensing shared data, and uniformly through the IOT management platform. The unified management and operation status monitoring of related sensor equipment. According to the requirements and characteristics of their respective business management and regional business management, the related IOT management platform is invoked to provide various services and open interfaces, so as to enhance the intelligent business capability.

2) Platform layer

To achieve diversified sensing equipment management capabilities, to unify sensing equipment assets and management, to gather and share perceptual information on the IOT, to unify perceptual assets management and fine management, and to form standards and norms for the perceptual management model of the IOT, and to build a unified management platform for the IOT.

The IOT management platform includes perception system, management system, and unified system management and security management. The perception system includes: Perception business operation sub-portal, Wulian platform operation sub-portal, Wulian platform maintenance sub-portal, as well as perception data management, perception management, perception management, application support, integrated services and other modules. The management system is responsible for accessing the terminal devices in the perception layer and managing them in a unified way, including application enablement, device management, link management and other modules. On the premise of ensuring the security and reliability of the IOT, in principle, the unified access and management of regional IOT resources, the unified aggregation and service of IOT perceived data, and the related IOT services for multiple business subsystems should be realized.

3) Data Layer

Based on the management platform of the IOT, the related basic information base and the ITU sensing business base are formed for the intelligent perception of ITU data service. Based on spatial information, perceptual device information and object management dimension, the basic information

base is formed. At the same time, according to the actual business needs and the related business needs of IOT, such as asset management, information catalogue, coding and coding, information fusion and so on, the corresponding IOT-aware business library is established. At the same time, in accordance with the requirements of the existing standards and specifications framework of the business network, a new IOT is formed based on data-related standards and specifications.

4) Cloud Infrastructure and Network Layer

Aiming at the infrastructure deployment environment of IOT management platform, based on the requirement of private cloud management of aerospace experiment business network, IOT management platform is deployed in the private cloud infrastructure environment of business network. Private cloud provides computing resource service, storage resource service, network resource service and security resource service. At the same time, the platform can deploy running programs, middleware, database software, operating system and so on in private cloud environment.

The perceptual return network generally includes carrier cellular network, wireless network and limited perceptual return network. At the same time, for the security video surveillance platform, management system, intelligent application and other related IOT sensing data, when interacting with IOT management platform, it is necessary to take necessary network security assurance and protection. Wired sensing is used to collect and acquire relevant meteorological, remote sensing, measurement and control sensor data, and a network based on wisdom application is built to realize the fine management ability of regional business network, so as to promote the uniform sensing facility mounting service mode and management mode based on wisdom application.

5) Perceptual Layer

The service network IOT sensing device collects the IOT sensing information and accesses the IOT management platform through the sensing network. The related IOT sensing applications, such as measurement and control, remote sensing, communication, navigation, meteorology and so on, obtain the monitoring and sensing data of the IOT through the IOT management platform. At the same time, other business monitoring and sensing shared data are acquired according to the needs of business collaboration, and unified through the IOT management platform. The network management platform carries out unified management and operation status monitoring of related sensor equipment. Relevant applications in various fields and regional management applications can rely on the perceptual network system to transmit and collect relevant data, and call the relevant IOT management platform to provide various services and open interfaces, so as to enhance the intelligent business capabilities.

4. Key Technology

1) Support access of various types of devices by using device agent and cloud gateway

The intelligent sensing system of business network is faced with a variety of physical sensing devices, which have various types of hardware, Include 8051, ARM, Intel etc. Running all kinds of operating systems, Include Linux, RTOS, WinCE, Android. Access modes are also different, Include RS232/RS485/Ethernet etc. wired mode, also include 2G/3G/4G/NB-IoT/eLTE etc. wireless mode. Access protocols are also diverse, include MQTT/COAP/HTTP/JT808 and some private agreements. The IOT management platform supports the access of a variety of IOT-aware devices through device agents and cloud gateways, regardless of the type of access devices and manufacturers.

2) Using Deep Defense Mechanisms to Guarantee the Security of IOT

IOT management platform adopts in-depth defense mechanism. In the IOT sensing devices, it provides certain security protection capabilities through secure access. After the equipment is invaded, it detects and isolates the invaded equipment in the platform to ensure the security of the IOT.

3) Flexible scaling of business supported by Cloud Architecture

The IOT management platform is based on Cloud Architecture design, which can be deployed on cloud platform to support smooth expansion. By partitioning the platform, different business needs can be docked flexibly.

4) Using Multilevel Load Balancing Mechanism to Achieve Massive Terminal Access

The IOT management platform is based on the architecture design of SOA, which adopts the structure of stateless distributed system and separation of data and business. Through multi-level load balancing mechanism to achieve massive terminal access, the maximum support for 10 million concurrent connections.

5) Integration of Open Standards with Peripheral Systems

The management platform of the IOT provides powerful open and integrated capabilities, which simplifies the difficulty of application development and integration. The platform provides a standard REST interface.

6) Using edge computing architecture to integrate network, computing, storage, application and other core competencies

Edge computing gateway has abundant industrial interface, supports various wired and wireless access modes, meets various terminal access, has the characteristics of wide temperature, dust-proof and waterproof, anti-electromagnetic interference, anti-vibration, etc. Edge computing gateway has edge computing ability, can provide open containers, virtual machines and computing resources, and can install Agent APP to process data quickly in local area to support data. Local pre-analysis meets the key requirements of business real-time, business intelligence, data aggregation and security.

7) Integration of Large Data, Face Recognition and IOT

Using large data platform architecture, it has the advantages of massive data processing, data storage, data processing and analysis integration structure; combining human, vehicle and things for comprehensive correlation analysis, using video recognition, IOT acquisition and perception, business network perception Wi-Fi detection technology, and combining with the intelligent analysis algorithm of things perception, it realizes intelligent things linkage, people interaction and people-to-people interaction. Services, strong support for intelligent measurement and control, intelligent remote sensing, intelligent communication, intelligent navigation, intelligent meteorology, intelligent mapping and other business application scenarios

5. Conclusion

The intelligent perception information system based on aerospace business network is a complex system closely related to the future mission organization and command mode of aerospace force, information application and service demand, and the development trend of information network technology. Based on the deficiencies of the existing system architecture and the needs of future aerospace missions, this paper makes overall planning for the construction and sustainable development of the platform, aiming at the needs of information sharing and perception services for the aerospace experiment information system business, and achieves a new system architecture with more advantages in integration, automation, intelligence and service.

Through the perception ability of the IOT, we can effectively support the overall informatization work of the aerospace experiment business network and gradually eliminate the information islands. Aiming at the goal of "comprehensive perception and intelligent control of objects, precise service to people and integrated office work", and relying on perceptual data flow, the operation and management of aerospace experiment business network with one network, all-round perception and all-chain connection are unified. It can be predicted that the future aerospace business network will be greatly improved in the aspects of knowability, manageability, controllability and credibility, which will eventually provide a good network basis for the integration and collaborative development of aerospace forces.

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