The Discussion about Mechanism of Data Transmission in the OSI Model

Jinxiong Zhao[1, a], Jing Bai[2, b], Qin Zhang[3, c], Fan Yang[1], Zhiru Li[1], Xun Zhang[1], Xiaoqin Zhu[1], Runqing Bai[1]

[1]Grid Technology Center, State Grid Gansu Electric Power Research Institute, Lanzhou 730070, China;

[2]Liu Yuanzi Primary School of Chedao, Qingyang 745717, China;

[3]State Grid Lanzhou Electric Power Supply Company, Lanzhou 730050, China.

[a]18352449382@163.com, [b]786376280@qq.com, [c]79836025@qq.com

Abstract. An important milestone in network development is ISO's (International Standardization Organization) definition of the OSI (Open System Interconnection) seven-layer network model. The OSI reference model is a logical definition, that is specification, it logically divides the network into seven layers. Each layer has related and corresponding physical devices, such as routers, switches, etc. It not only becomes the basis for the evaluation and analysis of various network technologies before and after, but also becomes the reference model of network protocol design and unification. Therefore, it is of great significance to explore the data transmission mechanism of the OSI model.

Keywords: network development, open system interconnection, seven-layer network model.

1. Introduction

In 1947, IBM proposed the world's first network architecture, called system network architecture (SNA) [1-5]. Since then, many companies have proposed their own network architecture [6-10]. What these architectures have in common is that they all adopt layered technologies, but the division of layers, distribution of functions and technical terms are different [11-12]. Therefore, it is difficult for computers with different architectures to communicate online. With the rapid development of information technology, the networking of various computer systems and the interconnection of computers have become an urgent problem to be solved, the OSI reference model was proposed and studied in this context [13].

The main purpose of building the seven-layer model is to solve the compatibility problem of heterogeneous network interconnection. The biggest advantage of it is that the three concepts of service, interface and protocol are clearly separated. The service explains what a layer provides for the next layer, the interface explains how the next layer uses the service, and the protocol refers to how to implement the service of this layer. In this way, each layer has strong independence. There is no restriction on the protocol adopted by the entities in the interconnection network, as long as they provide the same service up and do not change the interface of the adjacent layers. The division of the seven layers of the network is also to make different functional modules of the network share different responsibilities, which brings the following benefits: it can reduce the complexity of the problem; once the network failure occurs, the fault hierarchy can be quickly located, which is easy to find and correct the fault; Standard interfaces are defined in each layer so that different network devices with the same peer layer can achieve interoperability; It can effectively stimulate the innovation of network technology, because each update can be carried out on a small scale, and does not need to operate on the whole network.

2. OSI 7 Layer Reference Model

2.1 Reference Model Architecture.

According to the principle of divide and conquer, ISO divides the entire communication function into seven levels, namely physical layer, data link layer, network layer, transmission layer,

conversation layer, presentation layer and application layer. The main principles of dividing the levels are as follows:

(1) All nodes in the network have the same level;

(2) The same layer of different nodes has the same function;

(3) Communication can be done between adjacent layers within a node through the interface;

(4) Each layer can use the services provided by the next layer and provide services to the upper layer;

(5) The peer layer of different nodes realizes communication between peers through protocols.

An OSI standards-compliant system can communicate with any system located anywhere in the world that adheres to the standards. When a system can communicate with another system with OSI, it is called an open source system (Fig. 1).

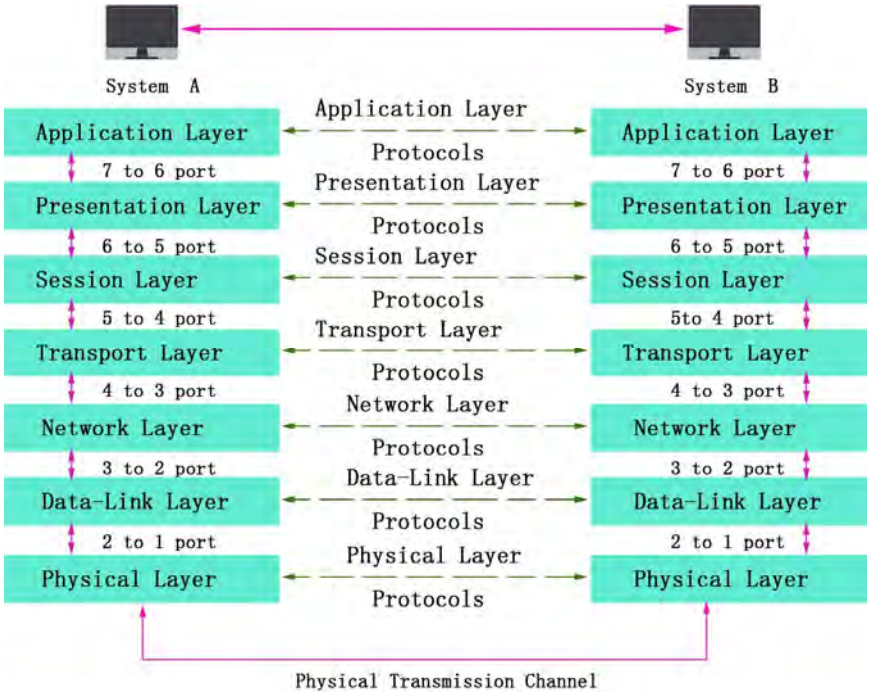

Fig. 1 OSI 7 Layer Reference Model

2.2 OSI Model Layer Functionality.

The main functions of the latter three layers are described below. Physical Layer: Layer 1 of the OSI model, which includes physical networking media, is the data transmission medium for network communications. The physical layer generates protocol and detects the voltage while sending and receiving the carried data signal. Popularly speaking, the network interface card is inserted at a person's desktop PC, one can establish access from the computer to the network. In other words, that provides a physical layer for you. Although the physical layer does not provide error correction services, it can set data transmission rates and detect data error rates. Physical media, such as twisted pair and coaxial cable, are used by the user to deliver information, but the physical media is not within the OSI layer 7. Physical media can be considered as the zeroth layer, and the task of the physical layer is to provide a physical link to its upper layer. In this layer, the data has not yet been organized and is treated as raw bit streams or electrical voltages in bits; Data-link Layer: The second layer of the OSI model controls communication between the network layer and the physical layer. Its main function is how to transmit data reliably on unreliable physical lines. To ensure transmission, data received from the network layer is segmented into frames that can be transmitted by the transport layer. Frames are structural packages used to move data, which include not only the original data, but also the physical addresses of the sender and receiver as well as error correction and control information; Network Layer: The OSI layer 3, which translates network addresses into corresponding physical addresses, determines how data is routed from the sender to the receiver. The network layer

determines the optimal path from network node A to another network node B by combining the sending priority, network congestion, quality of service, and the cost of alternative routing;

The primary functions of the upper four layers of the OSI model are as follows. Transport Layer is One of the most important functional layers in the OSI model. The transmission protocol provides simultaneous traffic control or an appropriate rate of transmission based on how fast the data can be received by the receiver. In addition, the transport layer is forced to segment longer packets at the maximum scale that the network layer can handle. For example, Ethernet cannot receive packets larger than 1500 bytes; The session layer is responsible for establishing, maintaining, and terminating communication between two nodes in the network. The functions of the session layer include: establishing the communication link, keeping the communication link of the session process unblocked. It can also synchronize conversations between two nodes to determine if communication is interrupted and where to resend from when communication is interrupted; The presentation layer is the 6th layer of the OSI model, the translator between the application and the network. At the presentation layer, the data is formatted according to a schema that the network understands, and this formatting varies depending on the type of network. The presentation layer is responsible for managing the decryption and encryption of data and the processing of incoming system passwords. It is used to deal with the representation of information exchange in two communication systems, including data format transformation, data encryption and decryption, data compression and recovery; The application layer is the top layer of the OSI, responsible for providing an interface to an application to enable it to use network services, not a particular application running on the network.

3. OSI Model Data Transfer Mechanism

When two systems A and B that use the OSI reference model communicate with each other, the data transfer process is shown below:

(1) When the data of the application process of system A is transmitted to the application layer, the data of the application layer is combined with the control header of this layer to form the data service unit of the application layer, and then transmitted to the presentation layer.

(2) After the presentation layer receives the data unit, it will add the control header of this layer to form the data service unit of the presentation layer and transmit it to the session layer. By analogy, the data is transferred to the transport layer.

(3) When the transport layer receives this data unit, the control header of this layer is added to form the transport layer service data unit.

(4) When the newspapers of the transmission layer are sent to the network layer, because the length of the network data unit is limited, the long messages of the transmission layer will be divided into several shorter data fields, plus the control header of the network layer, forming the data service unit of the network layer.

(5) When the grouping of the network layer is transmitted to the data link layer, add the control information of the data link layer, and the data service unit of the data link layer becomes the domain.

(6) After the frames of the data link layer are transmitted to the physical layer, the physical layer will be transmitted through the transmission medium in the form of bit flow.When the bitstream reaches the target node system B, it is uploaded from the physical layer. After each layer processes the control header of its own layer, the user data is submitted to the upper layer, and finally the application data of system A is transmitted to the application of system B.

4. Summary

Although the system data in the OSI environment through A complex process can be sent to another system B, but for each computer application process of this process is transparent, A process of the application of the data seems to be directly transmitted to the process of application of B this is the nature of open system in the process of network communication.

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References

[1]. Chenqi Yang, Emilio Mistretta, Sara Chaychian, Johann Siau. Smart Home System Network Architecture. Smart Grid Inspired Future Technologies. Vol.175 (2017), p. 174-183.

[2]. Jan Lunze. Small-world architecture of networked control systems. International Journal of Control. Vol.91 (2018) No. 7, p. 1652-1668.

[3]. Eduardo A. Gerlein, T. M. Mcginnity, Ammar Belatreche, Sonya Coleman. Network on Chip Architecture for Multi-Agent Systems in FPGA. ACM Transactions on Reconfigurable Technology and Systems. Vol.10 (2017) No. 4.

[4]. G. Maciej, A. Ismail, F. Janusz, L. Jarosław. Advances in Network Systems: Architectures, Security, and Applications. Advances in Intelligent Systems and Computing. Vol.461 (2017).

[5]. C. Alfredo, C. Eugenio, P. Adam. Evaluation of Neural Network Architectures for Embedded Systems. 2017 IEEE INTERNATIONAL SYMPOSIUM ON CIRCUITS AND SYSTEMS (ISCAS). 2017, p. 224-227.

[6]. I. PIRES, M. ALVES, L. ALBINI. Expansible Network-on-Chip Architecture. Advances in Electrical and Computer Engineering. Vol.18 (2018) No. 2, p. 61-68.

[7]. Ghada Arfaoui, Pascal Bisson, Rolf Blom, Ravishankar Borgaonkar, Håkan Englund, etc. A Security Architecture for 5G Networks. IEEE Access. Vol.6 (2018), p. 22466-22479.

[8]. A Pirker, J Wallnöfer and W Dür. Modular architectures for quantum networks. New Journal of Physics. Vol.20 (2018) No. 5, p. 053054.

[9]. Diomidis S. Michalopoulos, Borislava Gajic, Beatriz Gallego-Nicasio Crespo, Aravinthan Gopalasingham, Jakob Belschner. Network Resilience in Virtualized Architectures. Interactive Mobile Communication Technologies and Learning. Vol.725 (2018), p. 824-839.

[10]. Muhammad Athar Javed Sethi, Fawnizu Azmadi Hussin, Nor Hisham Hamid. Review of Network on Chip Architectures. Recent Advances in Electrical & Electronic Engineering. Vol.10 (2017) No. 1, p. 4-29.

[11]. Pablo Ameigeiras, Francisco Hernando, Jose Martin. Physical Layer Technologies in 5G. Opportunities in 5G Networks. 2016, p. 285-324.

[12]. P. Zhao. Application and Analysis of the Layered Technology in the Development of Computer Software. AGRO FOOD INDUSTRY HI-TECH. Vol.28 (2017) No. 3, p. 80-84.

[13]. Gaurav Bora, Saurabh Bora, Shivendra Singh, Sheikh Mohamad Arsalan. OSI Reference Model: An Overview. International Journal of Computer Trends and Technology. Vol.7 (2014) No. 4, p. 214-218.