

Performance optimization of data link communication in frame relay network

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Abstract

Frame Relay (Frame Relay) is developed from ISDN and is recommended as a standard of the International Telephone and Telegraph Advisory Committee. The TIS Standards Committee authorized by the National Standards Association of the United States has also done some preliminary work on frame relay. Because the error rate of optical fiber network (less than 10^{-9}) is much lower than that of early telephone network ($10^{-4} \sim 10^{-5}$). Frame relay is generated in this environment. Frame relay provides protocol specifications for data link layer and physical layer, and any high-level protocol is independent of frame relay protocol. Therefore, the implementation of frame relay is greatly simplified. One of the main applications of frame relay is LAN interconnection. Especially when LAN is interconnected through WAN, using frame relay can better reflect its advantages of low network delay, low equipment cost and high bandwidth utilization. Frame relay is an advanced WAN technology, which is essentially a form of packet communication. The process of blocking prevention is simplified.

Keywords

Frame relay , bit error rate, WAN interconnected, packet communication.

1. Introduction

Frame relay is a bearer service that provides bidirectional transmission of user information flow between user-network interfaces and keeps the order of information unchanged. Frame relay network consists of frame relay nodes and transmission links. The network provides a connection between two or more user terminals for communication. In frame relay network, it is difficult to connect each frame relay node in terms of economy and construction[1]. So how to set up the network reasonably is very important.

Frame relay is a WAN technology that provides connection and can support communication between multiple protocols and multiple applications. It defines the process of sending data on public data network and belongs to high performance and high speed data connection technology[2]. As an interface between users and network devices, frame relay provides a means of multiplexing. Different DLCI (Data Link Connection Identifier) and physical media can be assigned to each pair of data terminal devices to establish many logical data session processes (virtual circuits). The idea of frame relay design is very simple. The data error retransmit control in each link between network nodes, network nodes and user equipment stipulated in X.25 protocol is pushed to the terminal at the edge of the network for execution. The network only performs error checking, thus simplifying the processing process between nodes.

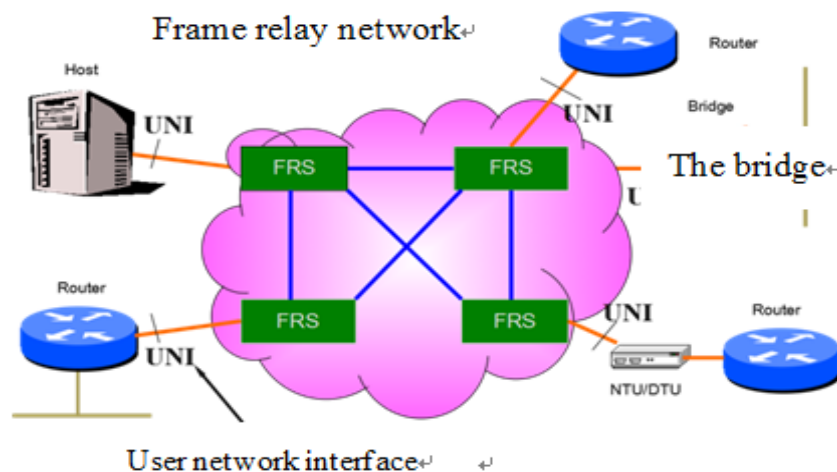


Figure 1 Frame Relay

2. FR Frame Relay Protocol Architecture

Intelligent terminals send data to link layer, encapsulate it in frame structure, and transmit information in frame. Frames do not need to be processed in the third layer and can pass directly through the switch. Some third-tier processing functions, such as flow control, are left to intelligent terminals for processing[3]. For the second layer, frame relay only completes Q.922 core layer function of data link layer:

- (1) Frame delimitation, location and transparent transmission;
- (2) The address field of the frame header is used for frame multiplexing and sharing;
- (3) Verify that the transmission frame is not too long or too short;
- (4) Check whether the transmission frame is an integer multiple of 8 bits before inserting /"0" and after deleting /"0";
- (5) Frame transmission error detection, but no error correction, if there are errors, then discarded;
- (6) Control network congestion.

The frame structure of frame relay is proposed by ITU-T Q.922, also known as Q.922 HDLC frame. Its high data link control (HDLC) frame format is similar, the main difference is that there is no control field, and it uses extended addressing field to achieve link layer multiplexing and "common path signaling". When data enters the frame relay network, it encapsulates the frame format of frame relay. The frame conversion is done by the router.

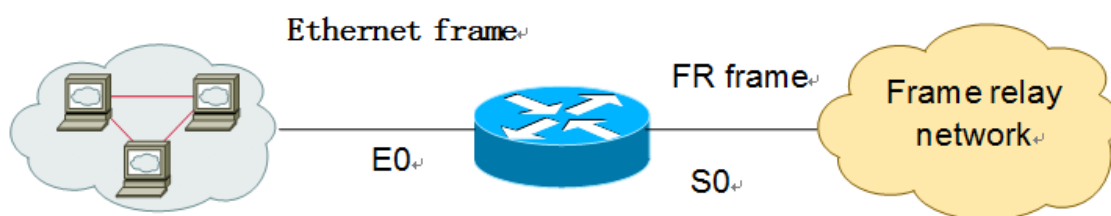


Figure 2 Protocol Structure

Here, we need to configure the S0 port of the router as a frame relay package. The default encapsulation of a general router is HDLC or PPP.

3. Principle and Comparison of Frame Relay Networks

Frame relay is a simple connection-oriented virtual circuit packet service, which provides both switched virtual connection (SVC) and permanent virtual circuit (PVC), as the support service of ISDN. Frame relay also follows the principle of ISDN, separating user data from signaling.

The MAC frame transmitted by the user on the LAN is transmitted to the router connected to the frame relay network[4]. The router strips the first part of the MAC frame and gives the IP datagram to the network layer of the router.

The network layer passes the IP datagram to the frame relay interface card. The frame relay interface card encapsulates the IP datagram into the information field of the frame relay frame.

The frame relay frame is composed of the first part of the frame relay frame (including the symbol field and address field of the frame relay, the same as that of the PPP frame), the CRC check and the tail of the frame relay frame (including the sequence field and the flag field of the frame test).

In order to distinguish different permanent virtual circuit PVC, each PVC has a data link connection identifier DLCI (Data Link Connection Identifier).

Frame Relay Interface Card sends encapsulated frames to Frame Relay Switches in Frame Relay Network through leased dedicated lines to telecommunications companies. The frame relay switch receives the frame relay frame and forwards the frame according to the virtual circuit number in the address field (discarded if errors are detected).

When the frame relay frame is forwarded to the end-point router of virtual circuit, the end-point router strips the head and tail of the frame relay frame and adds the head and tail of the LAN to the destination host connected to the LAN. If the destination host finds any errors, it will report the TCP protocol processing of the upper layer.

Even if the TCP protocol retransmits the wrong data, the frame relay network still transmits as a new frame relay frame without knowing that it is retransmitted data.

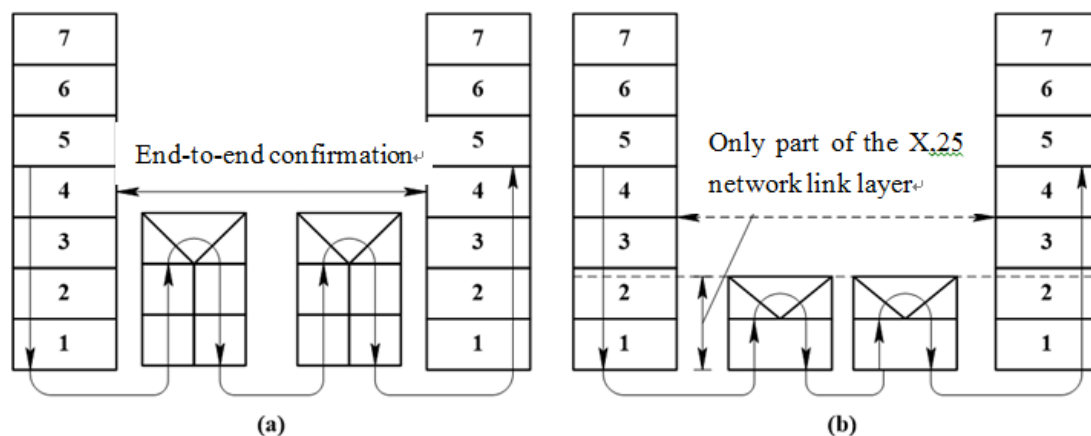


Figure 3 Compares X25 network and frame relay network hierarchically

X.25 network is a three-tier connection-oriented network. The virtual circuit must be established before the terminal transmits data, and the virtual circuit should be released after communication[5]. Network Layer Protocol, Physical Layer X.21 Protocol, Data Link Layer LAPB Protocol, Packet Layer X.25 Protocol. Statistical multiplexing and storage and forwarding mode are adopted for packet transmission in network. The link layer has strict error control function, which can ensure the requirement of error rate for data communication.

Each node of X.25 network has network layer. End-to-end confirmation is carried out by the fourth layer (transport layer). Frame relay not only has no network layer, but also has only part of the function of X.25 network. End-to-end confirmation is carried out by the second layer (data link layer).

When transmitting a frame of information from the source station to the destination station, the information to be transmitted on the links of X.25 network and frame relay network is different. For X.25 network, each node sends back the confirmation frame after receiving a frame, and the destination station also needs to confirm the end-to-end confirmation after receiving a frame. Frame relay, because its intermediate node only forwards frames and does not send confirmation frames, that is to say, the intermediate node has no link control capability of segment by segment. Therefore,

only after receiving a frame at the destination, can it send back end-to-end confirmation to the source station[6]. Therefore, in frame relay mode, there is no need for network layer.

And its maximum rate is not theoretically limited. At present, this rate is not high relative to LAN, but it is not easy in practical application of WAN. Therefore, frame relay network has the following advantages over X.25 network:

(1) Frame relay inherits the characteristics of X.25 packet switching statistical multiplexing. By multiplexing multiple virtual circuits in one physical circuit, it can dynamically allocate data bandwidth resources among users and improve line utilization.

(2) Frame relay greatly simplifies the X.25 communication protocol. The network only detects and does not correct errors in information processing, and discards erroneous frames when it finds them. The end-to-end flow control is handed over to the user terminal to complete, which reduces the processing burden of the network switch and the end-to-end transmission delay of user information.

4. Conclusion

According to several characteristics of frame relay, frame relay provides a connection-oriented transmission service. Before two users transmit data, they establish a logical path through the network, which is called virtual circuit. When network congestion occurs, frame relay is also found to play a role in solving this problem. Combining it, frame relay switching opportunities send congestion notifications to the devices at the sender and receiver, requiring the devices to reduce the transmission rate.

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