

Original Research Article

Analysis and Application of Frame Relay

Dongyue Cheng, Guoyou Han, Yuanguo Pan

Information Engineering College, Xining University of Technology, Qinghai, China

ABSTRACT

Frame relay is developed from integrated services digital network, in 1984, recommended as the International Telegraph and telephone Consultative Committee (CCITT) standard, in addition, TIS the United States authorized by the American National Standards Institute Standards Committee also made some preliminary work on frame relay. Due to the optical fiber network of the bit error rate (less than 10^{-9}) than early telephone network error rate (10^{-4} ~ 10^{-5}) is much lower, therefore can reduce some X.25 procedures, which can reduce processing time and improve network throughput. Frame relay is produced in this environment. Is provided by the frame relay data link layer and physical layer specification, any higher-layer protocols are independent of the frame relay Protocol, therefore, greatly simplifies the implementation of frame relay. Frame Relay LAN interconnection is one of the main application, especially when the LAN interconnection over a wide area network, using frame relay can reflect the low network delay, the advantages of low cost, high bandwidth utilization. Frame relay is an advanced WAN technologies is a form of group communication, except that it will be between X.25 packet switches in the network, error recovery, to prevent the obstruction of the process was simplified.

KEYWORDS: Frame Relay throughput WAN technology packet communication

1. Overview

Frame relay is a provider of connectivity and the ability to support multiple protocols, multiple applications of WAN technology for communication between multiple locations, which defines the process that sends data in public data networks, belonging to high-performance, high-speed data connectivity technologies. Frame relay uses high-level data link control protocol (HDLC) between the connected device management virtual circuit (PVC), and virtual circuit to connect on a connection-oriented service. In the OSI reference model, it works at the physical layer and data link layer, by relying on upper layer protocols (such as TCP) to provide error correction. As an interface between the user and network equipment, frame relay provides a multiplexed way. You can assign a different DLCI for each pair of data terminal equipment (data link connection identifier), shared physical media to create many logical data session (i.e. virtual circuit).

Frame relay design is very simple, the X.25 protocol between the network nodes, between the network node and the user device on each link between the data error retransmission control pushed to the edge of the network terminal to perform, the network only Error checking, thus simplifying the processing between nodes.

1.1. The possibility of frame relay implementation

In the 1980 of the 20th century, many users locally using the local area network (LAN) technology. Companies, enterprises and institutions with the LAN connecting the unit's multi-PC and shared local network resources through a bridge or router connected to the public telecommunications network. This user data is characterized by a large volume of data, unexpected high. Apart from the LAN, computer-aided design (CAD), computer aided manufacturing (CAM) as well as image transfer business also has the characteristics of sudden, this is because their files are often very large amount of data, such as an ordinary x ray will have 8 MB of data volume.

For these user groups network, open service, because the user is transmitting large amounts of data, and extend the low access rate, transmission of packet network users to send and receive messages will be waiting for a long time, so that users are not satisfied with. If you use the digital data network (DDN) digital data lines for these users open the

business, improve communication efficiency, but more expensive. New communication requirements from the user prompted to reflect on new communications technologies.

Meanwhile, the network has undergone great changes. General Intelligence of user equipment, transmission line has been generally adopted by optical fiber, optical fiber transmission performance is high, and low error rate. In this case, error correction and flow control problem can be resolved by the user device on the upper layer protocols, the network protocol can simplify. Therefore, the packet-switched Protocol was simplified, resulting in a frame relay (FR) technology.

1.2. FR frame relay protocol structure

The protocol structure of the frame relay is shown in the figure. The intelligent terminal sends the data to the link layer, encapsulates it in the frame structure, and carries out the information transmission in frame units. Frames do not require a third layer of processing, can pass directly in the switch.

Some of the third layer of processing functions, such as flow control, left to the intelligent terminal to deal with. For the second layer, the frame relay only completes the data link layer Q.922 core layer function:

Frame delimitation, positioning and transparent transmission;

Use the frame header address field for frame multiplexing and sub-use;

Test transmission frame is not long, but short;

Verify that the transmission frame is an integer multiple of 8 bits before '0' is inserted before '0' is deleted;

Frame transmission error detection, but not correct, if wrong, then discard;

Control of network congestion.

1.3. Basic requirements of frame relay technology

The user's business requirements, based on the flow and flow of business:

- (1) Easy to expand and upgrade the network
- (2) Considering the existing network resources and interoperability
- (3) The economic construction of the network
- (4) Network reliability and security
- (5) To ensure the quality of service network

1.4. Frame format

Frame relay frame structure is proposed by the ITU-t recommendation Q.922, also known as the Q.922 HDLC frames. It with the high data link control (HDLC) frame format is similar, the main difference is the absence of control field, and it uses the extended addressing fields to achieve the link layer multiplexing and "common channel signaling" when data enters the frame relay network, the frame format of frame relay encapsulation. Conversion of the frame by the router.

Here, the router needs to configure the S0 port frame relay package. (The default encapsulation of the general router is HDLC or PPP)

1. Frame format:

Flag	Frame Relay Header	Data	FCS	Flag
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The frames of the frame relay consist of four fields: the flag field F, the address field A, the information field I, and the frame check sequence field FCS. The contents and functions of each field are as follows:

Flags: Indicates the start and end of a frame, as a value of 7E.

Frame Relay header: 16 bits, address field, for frame addressing.

Data: The data carried by the frame, variable length, generally no more than 4096 bytes.

FCS: Frame check sequence.

2. Frame Relay Header:

DLCI(6)	C/R	EA	DLCI(4)	FECN	BECN	DE	EA
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Usually 2 bytes, can also be extended to 3 to 4 bytes, its contents include:

DLCI - Data link connection identifier. The frame relay transmits the data frame by means of a virtual circuit, and each frame of the frame relay is transmitted in the network along the respective virtual circuits. For this purpose, each frame must carry a 'virtual circuit number' called a data link identifier (DLCI) to identify the communication address of each frame.

C / R - Command / response bit, and high-level applications, frame relay itself is not used.

EAB - Address extension that can be extended to 3 or 4 bytes. EAB = 0, that the next byte is still the address byte; EAB = 1, that address field so far.

FECN - Forward blocking explicit notification, FECN = 1, there may be positive blocking and delay.

BECN - Reverse blocking explicit notification, BECN = 1, there may be reverse blocking and delay.

DE - Frame discard permission indication, the user terminal according to the instructions of FECN and BECN, use DE to tell the network, if the network blocking, priority transmission (DE = 0) those delay sensitive frame, discard (DE = 1) Those secondary frames.

3. Frame structure and HDLC frame different

Is the frame without the serial number, the reason is that frame relay does not require receiving confirmation, there is no link layer error correction and flow control function;

Is not monitored (S) frames because the frame relay control signaling is transmitted using a dedicated channel (DLCI = 0). Frame relay encapsulation in two formats: cisco and ietf, two packages are slightly different, not compatible. Cisco device default encapsulation format is cisco, but it also supports ietf, the domestic frame trunks using ietf.

2. Frame relay network principle

Frame relay is a simple connection-oriented virtual circuit packet service, which provides both switched virtual connection (SVC) and permanent virtual circuit (PVC) as support for ISDN, Following the principle of ISDN, so that the user data and signaling separation.

2.1. Frame relay network work process

The MAC frame transmitted by the user on the local area network is transmitted to the router connected to the frame relay network.

The router stripped the head of the MAC frame and handed the IP datagram to the network layer of the router.

The network layer then 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.

(Including the frame of the frame relay and the address field, the frame field of the frame relay frame and the same as the PPP frame), after the CRC check is performed, the tail of the frame relay frame (including the frame check the sequence field and the flag field) to form a frame relay frame.

To distinguish between different permanent virtual circuit PVC, each PVC's two endpoints each have a data link connection identifier DLCI (Data Link Connection Identifier).

The frame relay interface card sends the encapsulated frame to the frame relay switch in the frame relay network through the leased line leased to the telecommunication company.

The frame relay switch receives the frame relay frame and forwards the frame according the virtual circuit number in the address field (if there is an error, it is discarded).

When frame relay frames are forwarded to the end of a virtual circuit router endpoint router on the stripped end of the frame relay frame header and, with LAN's head and tail, delivered to the connection on the local area network of the destination host. Destination host if errors are found, reports upper layer TCP protocol processing.

Even if the TCP protocol retransmits the erroneous data, the frame relay network is still transmitted as a new frame relay frame, and it is not known that it is retransmitted data.

2.2. Comparison of frame relay network and X.25 network

X.25 network is a connection-oriented three-tier structure of the network, the terminal to send data before the establishment of virtual circuits, communication is complete to release the virtual circuit. Network layer protocol, physical layer X.21 protocol, data link layer LAPB protocol, packet layer X.25 protocol. Packet transmission in the network using statistical multiplexing, storage and forwarding mode, the link layer has a strict error control function, to ensure that the data communication on the bit error rate requirements.

Both have the following main differences:

Frame relay is based on X.25, simplifying error control (including detection, retransmission and acknowledgment), flow control and routing functions, and the formation of a fast packet switching technology. Frame relay network and X.25 network are connection-oriented packet switching network, and the length of the frame are also variable. However, both have the following main differences:

(1) X.25 network nodes have network layer, end to end confirmation by the fourth layer (transport layer), and frame relay not only the node has no network layer, and the data link layer only X.25 part of the network function, end to end confirmation by the second layer (data link layer).

(2) When transmitting one frame of information from the source station to the destination station, the information to be transmitted on each link of the X.25 network and the frame relay network is different. On the X.25 network, each node after receiving a frame to be sent back to confirm the frame, and the destination station after receiving a frame back to the end of the confirmation, but also by station to confirm. The frame relay because it is only the middle of the node to forward the frame, do not confirm the frame, that is, the middle node is not paragraph by paragraph of the link control, so only after the end of a frame received only to the source station back End to end confirmation. Therefore, in the frame relay mode, is not required network layer.

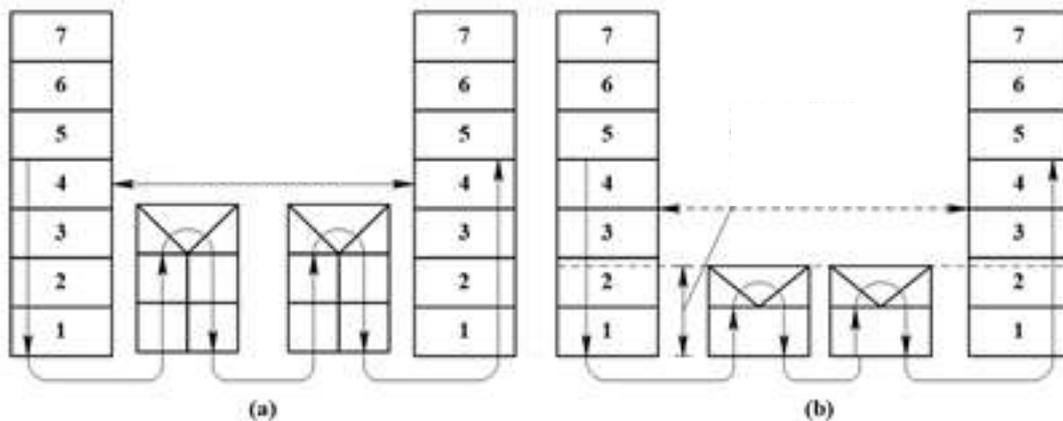


Figure 2.1: Compare X.25 networks and frame relay networks from the hierarchy

(a) X.25 network; (b) Frame relay network

(3) The X.25 network provides connection-oriented services from the network layer, including permanent virtual circuits and switching virtual circuits, while the frame relay network provides connection-oriented services from the data link layer and supports only permanent virtual circuits. The order of the frames transmitted at the network link and the exit at the data link layer ensures that no repeat frames are delivered and the frame loss rate is small.

(4) In the X.25 network, each node should carry out error detection and error correction on the user data, set the flow control at the data link layer and the network layer, and the error control and flow control of the frame relay network are mainly composed of High-level agreement is completed. X.25 network in the network layer to set the routing function, and frame relay is in the data link layer for permanent virtual circuit mapping.

(5) packet switching network is in the network layer to achieve multiplexing, and frame relay is in the data link layer to achieve multiplexing.

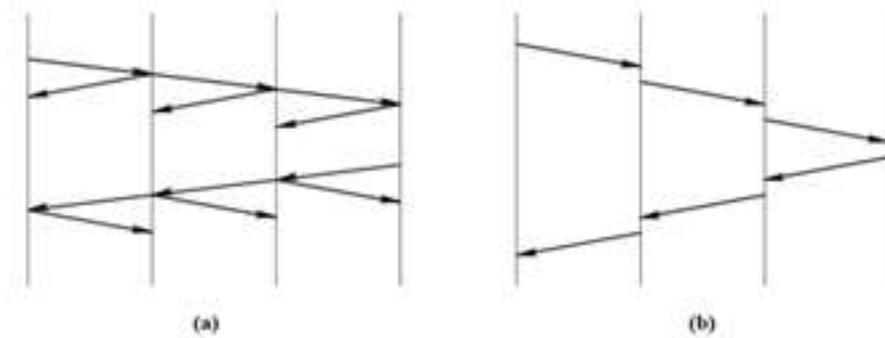


Figure 2.2: X.25 network and frame relay network transmission of information comparison (a) X.25 network storage and forwarding methods; (b) Frame relay mode

(6) packet transfer rate of 64 kb / s, while the frame relay transmission rate of up to 2.048 Mb / s,

and its maximum rate is not theoretically limited. At present, this rate is not high relative to the local area network, but in the practical application of the wide area network has been very easy.

Therefore, the frame relay network has the following advantages over the X.25 network:

(1) Frame relay inherits the characteristics of X.25 packet switching statistical multiplexing. By multiplexing multiple virtual circuits on a physical circuit, data bandwidth resources are dynamically allocated among users, and the line utilization is improved.

(2) Frame relay greatly simplifies the X.25 communication protocol, the network in the information processing only error detection, error correction, found that the error frame to be discarded, the end of the flow control to the user terminal to complete, to reduce the processing burden of the network switch reduces the end-to-end transmission delay of the user information.

(3) Frame Relay provides the user with a preferential billing policy that charges at the guaranteed information rate (CIR) and guarantees the transmission of information below CIR; and allows the user to transmit data above CIR Information, this part of the information transmission is not charged, the network will be sent when idle, congestion will be discarded.

(4) The frame length of frame relay is longer (up to 4096 bytes), which is more efficient when transmitting LAN data frame with long frame length (about 1500 bytes), and is suitable for realizing local area network interconnection.

3. Frame relay

3.1. LAN interconnection

It is more efficient to use frame relay when interconnecting a LAN through a bridge and a router. The 'pipeline' feature of the Frame Relay protocol is particularly suited for burst, high-rate and high-traffic data generated by the LAN. When relaying data frames on a LAN, a variable-length frame format is required and the conversion processing software is reduced as much as possible. This is the characteristic of frame relay.

In the built-in frame relay network, the number of LAN interconnection users accounted for more than 90%, because the frame relay is suitable for LAN users to send a lot of sudden data.

3.2. Image transmission

Frame relay network can provide images, charts of the transmission business, the transmission of these information often take a lot of bandwidth. The frame relay network has the characteristics of high speed, low delay, dynamic allocation bandwidth and low cost. It is very suitable for transmitting such image information. Therefore, applications such as telemedicine diagnosis can be realized by frame relay network.

3.3. Virtual Private Network

Frame relay network can be divided into several nodes in the network, and set up a relatively independent management agencies, the partition of data traffic and a variety of resources to manage. Each node in the partition shares the network resources in the partition, and the partition is relatively independent. The partition structure is the virtual

private network. The use of virtual private network than the establishment of the actual private network to be cost-effective, especially for large enterprise users.

3.4. The purpose of the frame relay network

The purpose of a frame relay network is to provide end users with a high-speed virtual private network (VPN) capable of supporting applications with high bit rate transmission requirements. The Frame Relay network provides fast service to users by minimizing or eliminating the various functions performed by most data networks. Because of the large number of fiber applications, Frame Relay can cancel many time-consuming and expensive error detection, editing and retransmission functions. The important feature of frame relay is the ability to provide bandwidth on demand. Another factor in the growth of frame relay applications is the need for higher capacity network interfaces.

4. Frame relay development application

4.1. Frame relay current application direction

(1) Frame relay technology is mainly used to pass data services; it uses a set of procedures to data information in the form of frames (referred to as frame relay protocol) to effectively carry. It is a way of WAN communication.

(2) Frame relay is a logical connection, rather than a physical connection, in a physical connection can be multiple logical connections (that can create multiple logical channels), can achieve bandwidth reuse and dynamic allocation.

(3) Frame relay protocol is the simplification of X.25 protocol, so the processing efficiency is very high, the network throughput is high, the communication delay is low, frame relay users access rate is 64kbit / s to 2Mbit / s, even Can reach 34Mbit / s.

(4) Frame relay frame information length is longer than the X.25 packet length, the maximum frame length of up to 1600 bytes / frame, suitable for encapsulating the LAN data unit, suitable for sending burst traffic (such as compressed video services, WWW business, etc.). Frame Relay Testing Technology: The current major data communication technologies are based on packet switching techniques such as packet switching, frame relay (FR), switched multi-megabit data services (SMDS), asynchronous transfer mode (ATM). At first, China did not want to develop 'backward' frame relay technology, but to develop ATM technology, but with the passage of time, frame relay technology to show its strong vitality. Because the first frame relay technology access technology is relatively mature, to achieve a relatively simple, suitable for 64kbit / s ~ 2Mbit / s rate of data within the scope of business. ATM access technology is more complex; it is more difficult to achieve. Second, ATM equipment and frame relay equipment compared to the price is expensive, ordinary users are difficult to accept. Therefore, frame relay and ATM complement each other, as the user access ATM the best mechanism.

The frame relay network is composed of a plurality of frame relay switches connected through a relay circuit. Canada's Nortel, New bridge, Lucent, FORE and other companies can provide a variety of capacity frame relay switches. In general, the FR router (or FRAD) is placed close to the local area network, the router can be connected to the switch through the dedicated circuit. If the user to buy a frame relay with the function of the router (the general router are supported), and then apply for a telecommunications office frame relay switch DDN line or HDSL line circuit, with long-distance frame relay circuit condition.

4.2. Frame foreground

(1) Interconnection between LANs. Frame relay can be applied to banks, securities and other financial and large enterprises, government departments and local branches of the local network between the interconnection.

(2) LAN and WAN connection. Frame relay composed of high-speed LAN and WAN connection, can improve the leased line bandwidth utilization.

(3) The formation of virtual private network. Frame relay only uses the physical layer of the communication network and part of the link layer to perform its exchange function, has a high network utilization, using it to form a virtual private network, not only with high speed and high through, the cost also quite low.

(4) Electronic file transfer. As the frame relay uses the virtual circuit, the signal path and bandwidth can be dynamically allocated, so it is in the remote medical, financial institutions and CAD / CAM (computer aided design / computer aided production) file transfer, computer images, chart query has a particularly good applicability.

5. Conclusion

In this times papers of finishing process in the, frame relay although is not is understand before, in this times reviewed report of overall process in the, I roughly understand has what is frame relay, also has frame relay of several features, frame relay provides of is a oriented connection of transmission service, in two a user transmission data before, on through network established logic Shang of pathway, this pathway called virtual circuit. In the process of finishing the report, I think communication online lessons when it comes to congestion, when network congestion occurs, discover frame relay also has a role in solving this problem, the combination of textbook and this report, frame relay switching opportunities to the sender and the receiver sends congestion notification, require the device to reduce the sending rate. If necessary, the discarded received packets. Believes in this times report in the I can learning to must of theory knowledge and on new knowledge of understanding, in next year of graduated papers in the accumulated must of experience, last thanks teacher to I this opportunities to exercise himself, in making report in the learning to many new knowledge, for future of learning work lay has based, we Department of communications real training center in the also learning to must of knowledge, I in finishing of process in the found many knowledge himself also compared strange, but in himself of efforts understanding in the, learned also not so difficult, Finally thanks to Mr. Hu's careful guidance.

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