Video over Frame Relay White Paper

A discussion of the current status of combining Video with existing Voice, Fax, Data and LAN Communications using Frame Relay over Public and Private Lines.

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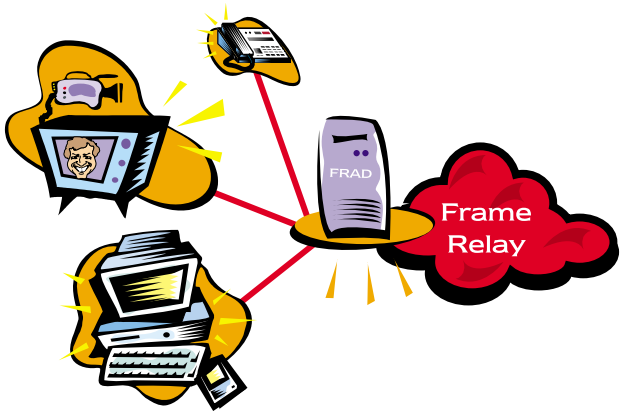
Introduction

The successful transmission of digitized voice over public Frame Relay data services over the past few years has drawn attention to the question of whether video services can be transmitted over the same link.



Voice, Data & Video over Frame Relay

Several companies have attempted to provide solutions for Video over Frame Relay services, however there has been little information on how well these applications perform. This white paper is intended to shed some light on the subject.

Digitized Video is not new. It has been used for several years by a myriad of users on ISDN or leased line connections. The common international standard for the compression of video and accompanying voice is H.320.

Frame Relay is not new either. It has been in existence for several years, and is now the most widely deployed data transmission means in the world.

What is new, and revolutionary, is the ability to take a standard H.320 video stream, "packetize it" and route it over a Frame Relay network.

Historically, Frame Relay has been developed and sold primarily as a data transport technology and service solution. This should be viewed primarily as a marketing and positioning technique, not a fundamental technical limitation. All of the technical challenges of using Frame Relay to transport video have been met. The marketing challenge is to expand the perceived scope of Frame Relay beyond a "data only" image.

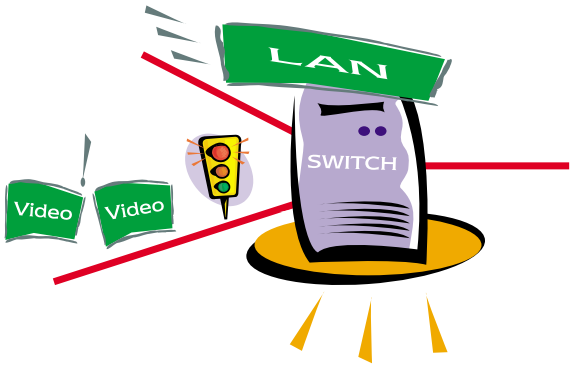
Technical Issues

There are two potential technical issues, which may affect the quality of packetized, digitized video. One is delay, or more properly jitter. Jitter is the variation in delay from one frame to the next. This is critical for video, as video requires a constant bit stream in order to maintain an image. The second is dropped frames. If a video frame is lost, it may cause a click or pop in the audio and some pixelation on the video. Too many lost frames and the video quality is impaired.

In leased line applications using TDM (Time Division Multiplexing) jitter is not an issue, as video frames arrive at known, predictable intervals. Concurrently, there is little likelihood of dropped frames unless the line itself malfunctions.

However, public Frame Relay networks introduce issues that do not occur when running the Frame Relay protocol over private leased lines. Customers who wish to run digitized video over public Frame Relay services need to understand these issues.

Jitter can occur in public frame networks when an intermediate switch is processing someone else's frame when your frame arrives.



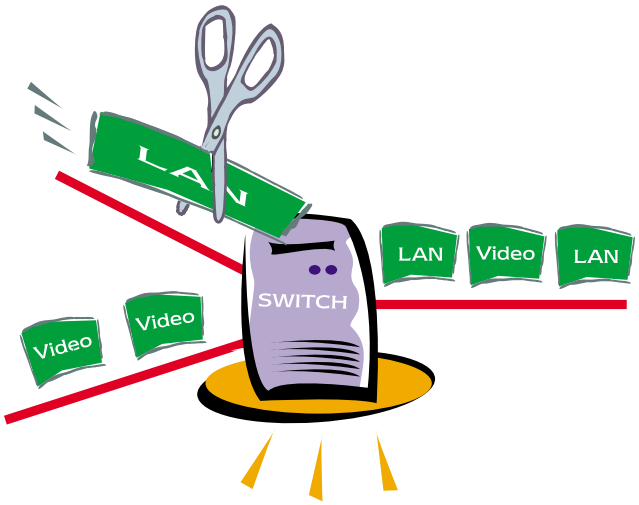
Jitter is created by differences in packet size

The second incoming frame is held in a buffer at the switch until the transmission of the first frame

is completed. The delay that results is dependent on the length of the first frame.

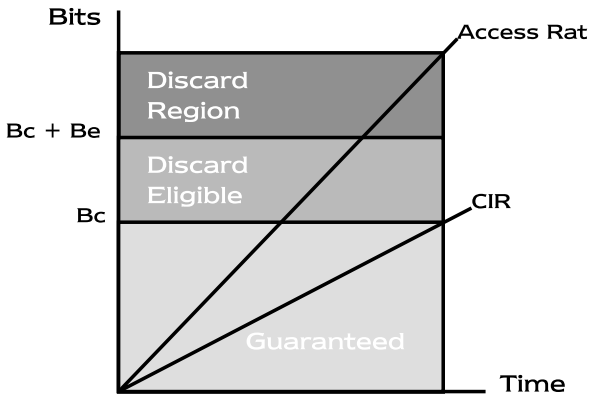
Since Frame Relay allows variable length frames, this delay is variable and unpredictable, resulting in jitter. If this jitter exceeds the ability of the receiving device to compensate by buffering, video quality will be degraded.

However, for the majority of public Frame Relay networks, jitter is more a theoretical problem than a real problem. Public services run on high-speed backbones. Since delay is inversely proportional to speed, this means that delay at intermediate nodes is highly unlikely. Also, many of today's Public Frame Relay networks use a cell (fixed frame length) based architecture between nodes, which also reduces the likelihood of jitter.



Cell based systems cut packets into fixed sizes

Dropped frames are potentially a more serious problem. The Frame Relay standard allows the network service provider to control congestion by simply disposing of any frames which exceed the users Committed Information Rate (CIA). In other words, if you contract for a CIA of 128 kbps but send a burst at 192 kbps, frames which exceed the 128 kbps CIA will have a DE (Discard Eligible) bit set. If some intermediate switch on the network becomes congested, these frames may be discarded. While an occasional lost frame will not seriously degrade video quality, too many will cause a noticeable loss of video quality.



In most networks, dropped frames are unlikely to occur. This depends, of course, on the capacity of the network, the actual traffic load at any given time, how the load varies, and other factors beyond the control of the end user.

The only certain way is to have enough CIR to cover all usage.

This is unnecessary in most cases, as the majority of installed public networks are not oversubscribed. Most carriers are now offering QOS (Quality of Service) or SLA (Service Level Agreement) guarantees, which categorically provide an end user with confidence that more than 99% of frames will arrive at their destination.

For the Video over Frame Relay user, there are other ways of reducing the threat of frame loss. The first is the configuration of the frame size.

Frame Relay allows the payload portion of the frame to be adjusted to carry larger or smaller amounts of information. This allows network administrators to adjust the frame size for optimal network performance. If a small frame packet is lost, it is not carrying too much information as to critically impair video function.

The second method is to establish a traffic prioritization scheme for any channels carrying video through a FRAD on a defined DLCI.

This ensures that video frames are first out. Therefore, Intelligent buffer management ensures video frames, which are less tolerant of delay, have priority over data frames which can usually tolerate some delay.

The Compelling Economics of Video over Frame Relay

The economics of Video over Frame Relay are similar to those driving the use of Voice over Frame Relay. Voice over Frame Relay is fairly well accepted as being economical when used in international applications. With international SON call prices frequently exceeding $1 per minute per line, the payback period for voice or video over Frame Relay, even with the higher international rates for Frame Relay, is dramatic.

Let us assume that there is an international company with offices in New Jersey-USA, San Francisco-USA and London-UK. This company conducts a total of three hours of videoconferencing a week between these offices, at 384kbps. On ISDN, the non-discounted cost per month is $6,040. ($1,170 USA + $4,870 International)

In this instance, assuming the “worst case” for Frame Relay, the user purchases bandwidth for the exclusive use of video, the non-discounted cost (excluding access lines) is approximately $4,300 per month (based upon a 256Kbps CIR), a saving of $20,880 per annum.

Unfortunately, the above ‘video only’ example totally disregards the usual economies found in combining video with existing voice, data and fax applications on Frame Relay. In fact, a more realistic example would be a user who already has a 128 kbps Frame Relay link (with a CIR of 64kbps) for voice/data requirements.

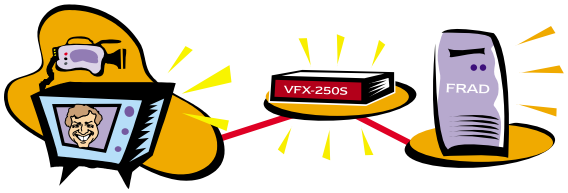
This could then be upgraded to 512kbps (with a CIR of 384kbps). The incremental upgrade cost would then be approximately $2,000, thus the true monthly savings would be approximately $4,000 ($48,000 p.a).

A return on the investment will be realized in a matter months.

Equipment for Video over Frame Relay

There are, of course, thousands of H.320 compliant systems on the market which users may wish to place on a Frame Relay network.

This may be accomplished by an external H.320 to Frame Relay conversion unit.



Using an external converter

This is a simple solution, which maintains existing investment in video equipment, while providing the benefits of operating over a Frame Relay Network.

Note: Some video codec manufactures claim their product to be Frame Relay compatible by outputting HDLC, which can then be carried transparently by a FRAD. This is not a ‘true’ Frame Relay solution and certain limitations apply.

Summary

Credits

Thanks must go to a number of companies in compiling this information...

British Telecom, for International ISDN call rates.
Sprint Communications, for USA ISDN call rates and International Frame Relay tariffs.

Disclaimer

This document has been created using as much accurate information as was available at the time of publication. It is designed as an ‘eye-opener’ to a new technology and possible savings in Enterprise Networking Tariffs, for those using or considering the use of Videoconferencing.

The costs and savings described in this paper should be considered examples only. Science Dynamics disclaims any responsibility for inaccuracies or subsequent changes in the tariffs used in developing the above costs and savings.

Glossary

Buffering — This is a term used to describe a method where data is held in a queue to allow equalization of speeds on either side.

Codec — A device, which takes an analogue or digital video signal and converts it into a serial data bit-stream compatible with a standard data-communications infrastructure. Codecs used in the Videoconferencing market, also employ a complex and powerful real-time compression system.

DLCI — (Data Link Circuit Identifier). A high-level description of a section of the Frame Relay structure that defines addressing information.

FRAD — (Frame Relay Access Device). A device which is designed to take a myriad of different types of information; LAN, data, compressed voice, etc. and multiplex them onto a Single Frame Relay data-stream. These devices can often include switching functionality.

H.320 — An international standard, which defines various functions of encoding and compression for Videoconferencing applications.

HDLC — A standard, low-level, synchronous data bit-stream format, used either in its raw format, or by higher-level data-communications protocols, such as X.25 and Frame Relay.

Pixelation — This is a Videoconferencing term, which is used to identify picture break-up. Digital video pictures are made up of 1000's of pixels, each representing a color on the image. In videoconferencing, pixels are grouped into blocks (the number of which is determined by the speed of the link). Pixelation is a term often used to describe an image, which has errors in the colors of these blocks, creating obvious squares of wrong color on the screen.