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TITLE: Packetisation of H.221 frames for LANs

PURPOSE: Discussion

Abstract

A means of adapting H.320 terminals for use on packet switched LANs, in which the H.221 frame structure is retained, is discussed. The appeal of this approach is that it allows maximum use to be made of existing H.320-related recommendations and equipment. However, the effect of packet loss is identified as an important unresolved issue, requiring further study.

1. Introduction

The adaptation of H.320 audiovisual terminals to packet switched LANs has been considered in AVC-512 and AVC-513. In AVC-512, it was concluded that the replacement of the H.221 multiplex and framing structure with an alternative, H.22z, would provide the greatest benefits in terms of performance and flexibility. Nevertheless, it was recognised that the design of H.22z was a substantial task, and that this approach might preclude the use of existing H.320 hardware in H.32z terminals. The alternative H.221-based approach is therefore discussed further in the present document, in order to provide greater insight into the relative merits of the two approaches.

2. Network configuration

An example network configuration is shown in Fig. 1. In this scenario, an H.32z terminal connected to a LAN is able to communicate with another H.32z terminal on the same LAN, as well as with a remote H.320 terminal connected to an ISDN network. Interworking with an H.32x terminal connected to a B-ISDN network is also possible, assuming that the H.32x terminal has an H.320 compatibility mode.

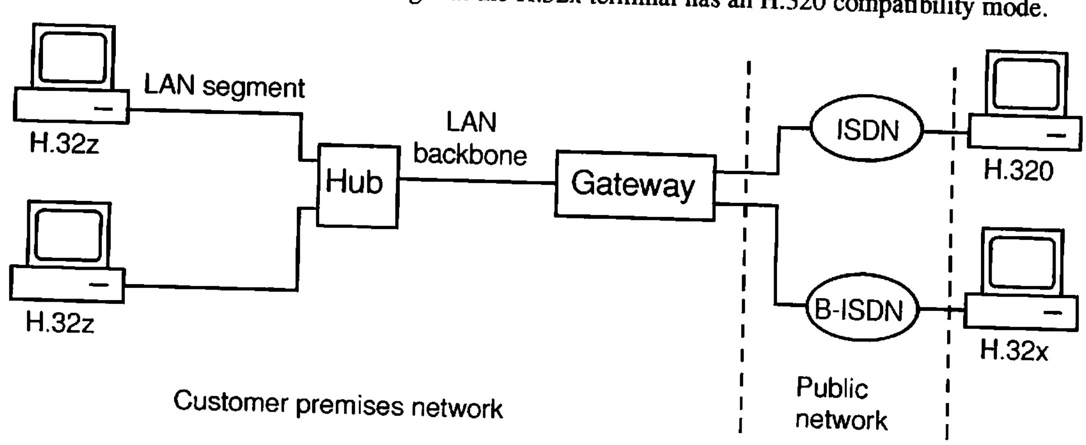

Fig. 1 An example network configuration

The function of the gateway is to terminate the packet protocols used on the LAN. However, it does not need to perform any special operations on the H.221 bit stream itself (such as remultiplexing), so its processing load is relatively low. It is therefore likely that existing LAN data gateways could be adapted for this application by means of a software upgrade.

2. Protocol stack

A possible protocol stack in an H.32z terminal is shown in Fig. 2. At the lowest layer, the LAN protocol controls access to the physical medium, and provides basic functions such as framing and bit error detection. Above this, a "packet adaptation layer" implements the additional functions required to handle real-time traffic, such as timing recovery. It thus appears to a device above the adaptation layer (in particular an H.320 terminal), that it is talking directly to an ISDN terminal adapter.

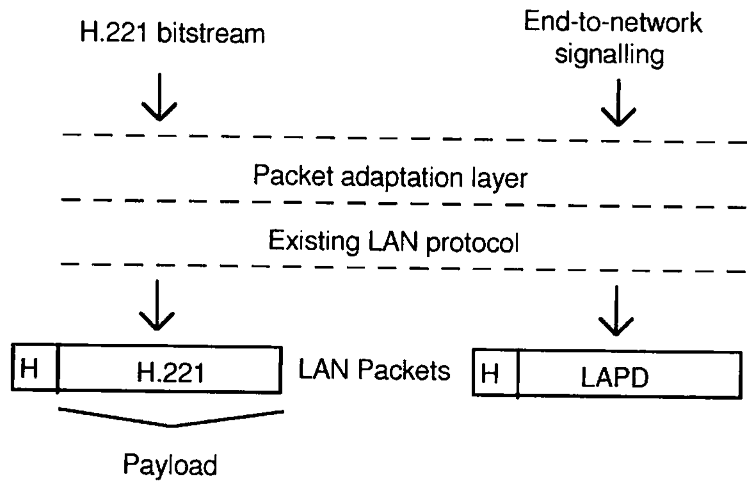

Fig. 2 Possible protocol stack in an H.32z terminal

In addition to the H.221 bitstream, it is necessary to provide a path for the end-to-network signalling (in particular, call control signalling) from the H.32z terminal, across the LAN, to the ISDN network. This can be done by encapsulating ISDN D-channel messages within LAN packets.

3. Packet adaptation layer design issues

Data Alignment

An H.320 terminal transmits and receives streams of data at a constant bit rate. The simplest way of carrying this information across a packet switched LAN is to segment a bit stream into blocks of a suitable size (say a few hundred bytes), and then to put these blocks into packets. It may at first appear that the packetisation process should be aligned to the H.221 framing structure, so that a packet always contains an integral number of frames. This technique can improve loss resilience when applied to the packetisation of individual media streams (eg. aligning packets to video GOBs, as described in AVC-513). However, in the configuration described here, the media streams have already been multiplexed into H.221 frames in such a way that there is no alignment to media units. Furthermore, the fact that the H.221 frames are of a constant length makes it relatively straightforward for the packet adaptation layer to maintain the H.221 frame structure in the event of packet loss, provided it knows how much data has been lost. For these reasons, packet/frame alignment is not necessary, which gives greater freedom in the choice of the packet size.

Packet size

The packet size on popular LANs (eg. Ethernet, Token Ring, FDDI) can be chosen by an application from a fairly wide range, typically 64 - 1500 bytes, with a packet header of 20 - 30 bytes. The need to minimise the packetisation delay at low bit rates leads to the requirement for fairly short packets, in the region of a few hundred bytes. For example, when the H.221 bit rate is 128 kbit/s, a packet payload of 320 bytes takes 20 ms to accumulate. The packetisation delay is incurred at each point where data enters the LAN, ie. once in the transmit direction and once in the receive direction in Fig. 1.

In general, successive LAN packets may have different sizes. However, in this application, a fixed packet size is appropriate, as this corresponds to a constant packetisation delay, and makes it easier to decide how much dummy data should be generated to replace a lost packet.

Packet loss

LAN protocols automatically perform error checking on both header and payload bits, and corrupted packets are discarded. However, LANs typically have very low bit error rates, in the region of 10^{-9}, so that packet losses due to bit errors are correspondingly rare. Packet losses due to queue overflows are more likely, but can be minimised by good network design and management. In any event, the loss of a packet containing H.221 data is equivalent to a lengthy error burst on an ISDN channel (assuming that the lost packet is replaced with dummy data). This may have a severe subjective effect on the communication, particularly if it causes a loss of H.221 frame or multiframe alignment in the H.320 terminal. It is to be expected that the packet size would have a strong correlation with the effect of packet loss, but no quantitative results on this issue are available at present.

Packet loss can be detected in the LAN environment by means of sequence numbers in the packet headers. It may therefore appear that the effect of packet loss on the video signal could be mitigated by initiating a picture refresh through a "Fast Update Request". However, this BAS code can only be sent in the H.221 service channel, which is not available to the packet adaptation layer.

In contrast, the loss of a LAN packet containing end-to-network signalling will be taken care of by the D-channel protocol, which will automatically perform retransmission.

Timing recovery

As the transport time on packet switched LANs is variable, it is necessary to buffer the received packets in the adaptation protocol, in order to recreate a constant bit rate stream. The extra delay incurred in this process can be kept small by minimising the packet jitter through appropriate design and control of the LAN.

The fact that the ISDN network clock is not directly available to the H.32z terminal must also be taken into account. This means that the H.32z terminal may produce data faster than it can be transmitted on the ISDN link, leading to data loss. A solution is to generate a suitable clock signal within the packet adaptation layer, and to lock this to the ISDN network clock, by passing flow control information across the LAN in the packet headers.

4. Conclusion

One approach to creating an H.32z terminal, in which the H.221 bitstream and signalling messages from a conventional H.320 terminal are packetised, has been discussed. The advantages are that maximum use is made of existing H.320-related recommendations in the H.32z design, and that existing H.320 equipment may be converted to H.32z by means of an "add-on" adapter. However, the subjective impact of packet loss is unknown, and further study of this issue is therefore required before a conclusion can be reached on the feasibility of this approach.

References

AVC-512 (Australian UVC Consortium), "Design of H.32z terminals for LANs", July 1993.

AVC-513 (Australian UVC Consortium), "H.22z protocol for LANs", July 1993.