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TITLE: Virtual Channels for Multimedia Support in the B-ISDN

PURPOSE: Proposal

Abstract

The separation of multimedia connections into separate virtual channels provides users with the flexibility and control necessary to customise the delivery of multimedia services in a cost effective manner. It is essential that any early definition of arrangements for multimedia support should include the ability to separate elements of a multimedia connection into separate virtual channels.

1. Introduction

The Broadband ISDN (B-ISDN) will support a wide range of services to a wide range of users who will in turn require the support of a vast range of applications. Most services will inherently involve the transfer of more than one information type and many will also require multiparty service support. A well structured means of handling multiparty and multimedia services is therefore necessary to maximise key service features, for example : accessibility and flexibility for users, commonality of terminals, commonality network components and ease of interworking.

The manner in which service information is transported and handled within the network has far reaching implications for service support. This is particularly so for ATM based networks, such as the B-ISDN, which introduce new and enhanced networking concepts which may be exploited for service support. For example, many of the functions previously associated with the multiplexing of the components of a multimedia connection, and embodied in end-to-end signalling and framing systems such as Rec. H.221, are provided by basic ATM network functionality. Changes at such a fundamental network level therefore require reassessment of the manner in which service information flows are moved and managed by networks and terminals alike.

This contribution addresses key issues associated with the use of virtual channels for the network support of multimedia, multiparty services. The separation of multimedia connections into separate virtual channels offers many significant advantages over explicit multiplexing controlled by an end-to-end protocol.

2. The Need for Customised Multimedia Service Delivery

From a user perspective multimedia service delivery is characterised by issues such as:

- service range
- the flexible addition and deletion of component services from a multimedia call
- access control and other general security issues
- service quality
- reliability

We may confidently expect that users will wish to vary the parameters of their multimedia calls depending on such variables as the performance and cost of terminal equipment, transmission tariffs and the nature of the network (public switched network, virtual private network) via which they communicate. Further, many of these parameters may be required to vary within a call.

Examples of customised information service delivery include :

- Add/drop a service within the call, under user control e.g. a video telephony call may be audio only initially with the video component added later on request, a private video window may be brought into an existing multimedia conference.
- The network may deliver only a subset of the full multimedia call consistent with the capabilities of the receiving terminal.
- Media conversion to support service interworking, or further customise service delivery, may also be required. e.g. text to speech. Conversion as a network resident function requires access to individual service elements within the media multiplex.
- Intermedia control to allow change in one medium as a direct result of action taken in a different medium e.g text or voice activation of video. This concept could also be extended to include services calling other services from within a multimedia application.
- Multilingual television distribution allowing users the flexibility to select the audio service component to match, on-demand, their specific language needs or preferences.This concept could be extended to include special audio channels for the hearing impaired and on-demand subtitling.
- Flexible multimedia bridging enabling bridges to handle different services in a manner consistent with their individual needs.
- Selectively disseminating the multimedia components of a conference call, delivering only those services the receiving terminal is authorised to access. This facility would be required to allow the splitting of conference calls to support the private sharing of information between nominated conference participants in a manner requiring no mediation by the conference chairman.
- Flexible support for layered video systems to allow different layers, or combinations of layers, to different destination terminals to ease interworking. Layers unwanted in a particular part of a call could be dropped completely.
- Optimising service cost and quality for individual elements of the multiservice ensemble. Quality of service, and hence the associated network performance required, may differ between different media such as voice, video, data transfer and messaging. It would be desirable to have the flexibility to select the appropriate quality of service (and therefore cost) to suit the media characteristics.

3. Virtual Channels for Multimedia Support in B-ISDN

The provision of independent call and connection control facilities in the B-ISDN will assist the development and support of efficient and well structured multiparty, multimedia services. Within a single call it will be possible to establish a number of associated connections each of which may represent a specific information type.

The separation of multimedia services into separate virtual channels provides the flexibility and control necessary for the user to customise the support and delivery of multimedia services in a cost effective manner. Many aspects of multimedia service optimisation will be dependent upon separate network processing of the individual service components of a multimedia call. The following examples have been provided to demonstrate the broad scope and nature of virtual channel based multimedia support.

Virtual channels as the basis of supporting multimedia services within B-ISDN are characterised by the following general features :

3.1 Call Admission

The separation of call and connection control allows the call admission process to recognise individual connections within the call. Call acceptance is therefore not dependent upon the full network resources being available to match the requirements of the aggregated multimedia service. In the event that resources are not available to support specific media at the desired

service quality, the user can negotiate with the network to support individual services at an agreed lower service quality. This flexibility is directly available only when the network can identify individual service components within a multimedia information stream.

3.2 Usage Monitoring

Within the B-ISDN it is proposed that the individual virtual channels will be subject to usage monitoring. Where all services comprising a multimedia call are multiplexed onto a single virtual channel it will be very difficult to accurately characterise the demands such a call may make on network resources. The action taken by the network in the event that the user exceeds agreed usage parameters is for further study within SGXVIII. However, discarding cells which violate agreed traffic parameters is the prime option, with tagging the violating cells for possible later discarding and releasing the connection as less likely alternatives. All of these options could directly impact user service quality and satisfaction. Thus to ensure that any one service within a multimedia ensemble does not prejudice the quality or viability of the entire multimedia service it will be necessary for very conservative usage estimates to be used, with a corresponding economic penalty for the user.

Alternatively, if multimedia support is based on decomposing the service into individual media allocated to separate virtual channels it becomes possible to very accurately reflect actual resource needs as connections are established at call set-up or added during a call. Per-service usage monitoring will result in a degree of flexibility and service control which cannot be achieved using existing network or framing concepts.

3.3 Service Specific Network Actions

In some instances, the user may obtain direct economic benefit from allowing the network to undertake some service specific processing of the multimedia information stream. This is only possible if the network can identify the service involved and operate on it in a manner which is independent of any other services included in the call. For example, consider the case in which the user may wish to take advantage of media conversion facilities provided by the network.

Where such services are carried on separate virtual channels, it is possible to support user requested processing of service information within the network. This support would be based on the use an appropriate ATM Adaptation Layer (AAL) and suitable higher layer standardisation of the service.

3.4 Layered coding

There may be advantages in transporting the different layers of a layered coding system in separate virtual channels. Flexible service interworking could be based on the ease with which it would be possible to direct layers, and combinations of layers, to different destination terminals.

4. Cross Media Synchronisation

In supporting multimedia services on the basis of one medium per virtual channel, several options exist for the aggregation of these channels to form the desired multimedia service.

At call establishment, multiple VCs can be established at the same time, and assigned to the same Virtual Path thus ensuring they follow the same physical path across the network. This minimises cross-media differential delay. In the case that cell sequence integrity is guaranteed across all virtual channels in a virtual path, the cross media delay is zero.

Cross media delay for virtual channels spread across multiple virtual paths will be network dependent. Initial results suggest typical cross-media delay will be considerably less than 10 ms for an optical fibre based B-ISDN and unlikely to represent a major impediment to service transport, delivery or presentation. VC based media multiplexing offers the additional advantage of allowing users the flexibility to implement potentially attractive tradeoffs between service quality and cost. For example, services less sensitive to cell delay may be more economically transported over Virtual Paths matched to their particular performance needs. This is in sharp contrast to the case where all services are multiplexed onto a common virtual circuit and the user

is therefore forced to transport all services at a service quality matched to the most demanding service in the multimedia ensemble.

The example shown in Figure AVC-39/1 describes a typical multinode network of ATM switches interconnected by 155 Mbit/s transmission systems. Table AVC-39/1 provides typical values for the individual delay components of two paths differing in physical route and overall length. In the example given, the worst case differential delay between the two paths is approximately 3.5 ms. Note that the magnitude of the differential delay is dominated by propagation delay; in the example given, a difference in path length of 2000 km would add only 10 ms to the differential delay.

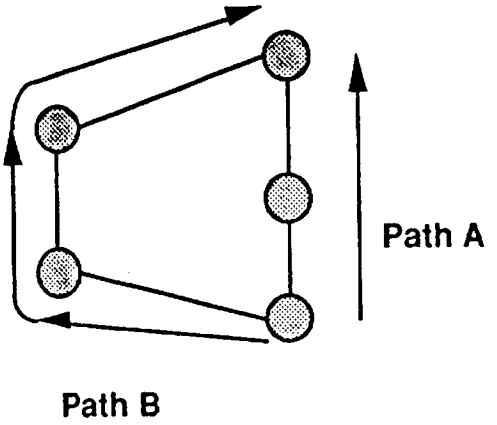

Figure AVC-39/1 - Example of an ATM Multinode Network

Parameter	Path A	Path B
Path Length (km)	500	1000
Propagation Delay (ms)	2.5	5
Cell Transmission Delay per node assuming 155 Mbit/s links (ms)	0.0027	0.0027
Node Processing Time Per Cell for max throughput of 155 Mbit/s (ms)	0.0027	0.0027
Average Queueing Delay per node (for random traffic, 90% utilisation) (ms)	0.012	0.012
Worst case queueing delay per node (for 100 cell buffer) (ms)	0.270	0.270
Worst Case Total Transit Time (ms)	3.33	6.10
Average Total Transit Time per Cell (ms)	2.55	5.07

Table AVC -39/1 : Typical Delays Encountered in a Multinode ATM Network

Note that this example assumes common transmission media, and hence propagation delay characteristics, for both paths. In a practical communications network, it may be necessary to indicate at call establishment those services, i.e. virtual circuits, sharing a synchronous association within the service. This indication could then form the basis of physical routing which ensured cross media delays within the limits indicated above.

3. Conclusion

The separation of multimedia connections into separate virtual channels provides the flexibility and control necessary to customize the delivery of multimedia services within the B-ISDN. In addition it provides the user with the necessary network tools to achieve a degree of multimedia service optimization and functionality which may not be achievable through the use of explicit multiplexing controlled by an end-to-end protocol. It is therefore essential that any early definition of arrangements for multimedia support should include the ability to separate elements of a multimedia connection into separate virtual channels.