SOURCE: BELGIUM
TITLE: Multimedia multiplex in ATM networks used in the Belgian Broadband Experiment
PURPOSE: Information

I.   INTRODUCTION

Most broadband services inherently involve more than one information type. These services are called multimedia services. For example, videotelephony will include audio, video and possibly some form of data. In draft rec. I.211 (B-ISDN service aspects), a structured approach to the development of multimedia services is recommended to ensure flexibility to the user, simplicity for the network operator, control of interworking situations and commonality of terminal & network components. This contribution describes the option taken in the Belgian Broadband Experiment (BBE) to fulfill these objectives.

II.   DEFINITIONS [1]

CONNECTION

In the Blue Book I.122, a connection is defined as a concatenation of transmission channels or telecommunication circuits switching and other functional units set up to provide for the transfer of signals between two or more points in a telecommunications network to support a single communication.

Applied to broadband we can consider that a connection is a set of capabilities (e.g. path through the network) which are used for the uni- or bidirectional transfer of information of a particular type.

SERVICE COMPONENT

A service component is an indivisible group of one or more connections.

Operations are defined on service components, not on individual connections.

The allocation of a service component is succesful if all connections indicated in it can be established; deallocation of a service component implies the release of all its connections. If the network detects a failure for a connection (path), all other connections belonging to the same service component will be released.

III. EXPLOITATION FLEXIBILITY ATM NETWORK

The composition of service components is dependent on the service definition. If the service needs control of an individual connection, then it is required to have a service component which contains only this single connection. Different connections are identified by separate virtual channel connections.

Easy addition/deletion of service components during a call:

The service component concept is a way to maximally exploit the flexibility offered by the ATM network. Consider e.g. a videophony call, in which only a voice connection is established between both parties. In this case, the service component consists of only one (voice) connection. If both parties should decide during the call to establish an additional video (and possibly a data connection) in order to start with a real audiovisual communication, an additional service component can be added to the voice component. This additional service component exists of a video and possibly a data connection.

Service integration:

In order to achieve a maximum of service integration, the service component concept is a very important one. Consider a communication between a normal ʼ:one (voice only) and a videophone. Only a voice virtual channel connection has to be established between both parties. The scheme is also bandwidth efficient, since no bandwidth must be allocated to the video component.

Information can be shared over subscribers:

In the BBE experiment, the HDTV video component is split into a standard resolution video component and a HDTV video component. Both video components are routed over separate virtual channel connections. Consider STDV and HDTV receivers connected via the ATM network to the same service provider, which is providing TV programs. A standard TV receiver is allocated a service component consisting of a standard video, audio and data connection. The HDTV receiver on the other hand is allocated a service component

consisting of the same VC connections plus a HDTV overhead video VC connection. In such a way, standard video component, audio and data are shared over the SDTV and HDTV user.

IV. IMPACT ON SERVICE COMPONENT CONTROL

A. Requirements on differential delay

Delay due to transmission and routing through the ATM network.

In a multimedia service, the differential delay between the different components must be bounded. If the different components are routed over the same exchanges, the encountered differential delay is variable but bounded (absolute theoretical maximum differential delay is of the order of a few msec for a hypothetical reference configuration of 15 BBE exchanges in cascade, with each seven stages [2]; each stage has a maximum delay of roughly 50 cells). This network differential delay falls within the requirements for lipsynchronization between video and associated audio which is in the order of 25/50msec.

In practice, the differential delay in the network will be much lower than this theoretical maximum, and it has to be considered as a statistical process.
In a hypothetical reference configuration based on the BBE switch, a cell delay jitter of approx. 250 microsec is expected for a mean link load of 80% and a link speed of 600Mbps [2].

In case of ulti-resolution components (components carrying different resolution information of the same source; e.g. a HDTV application in which a standard TV video component and an additional HDTV enhancement video component are offered to the user), these components are to be synchronized at the receiver.

Delay due to packetization, coding and AAL.

Another aspect is the delay introduced for each component by packetisation, coding and ATM adaptation layer processing. Delay introduced by cell loss handling using cell interleaving mechanisms in the AAL can be rather large for low bit rate VBR information flow. Since components as video and associated audio have different coding and AAL processing delays, care must be taken to

fulfil the lipsynchronization requirements. A possible solution is the introduction of audio compensation delays (cfr. H261).

B. Possible use of VP connections

At the november 90 Experts Group meeting of CCITT SGXV/1 in Den Hague [3], the idea was introduced that one way to insure a bounded differential delay between the different components, is the use of virtual paths (VPs). The VP consists of an ensemble of VCs, depending upon the application. All connections in the same VP are by definition routed through the same exchanges, and therefore the maximum differential delay is bounded and maximum a few msecs. The statistical delay jitter is approx. 250 microsecs.

Although this approach seems attractive at first glance, one must consider the following. Virtual paths were introduced for logical service separation by creation of overlay networks (e.g. access to N-ISDN, connectionless server, ...). The VP control is not a real-time control (quasi-static), since virtual paths are drafted as semi-permanent connections. ATM VP switches for instance, have a very limited control.

To be useful in multimedia communication, VP connection control should be as dynamic as VC connection control. Therefore, the **VP concept is not well suited for multimedia service multiplex.**

C. Solution within the Belgian Broadband Experiment.

If the different com⁻ ₍nents are routed over different exchanges, the differential delay could be substantial. In that case, it is very hard to synchronize the different components in the receiving terminal. This would require enormous buffers at the receiver, which implies long delays. For real-time services, this is not allowed.
A bounded differential delay must be insured at the expense of a more complex connection control mechanism. Connection control must allow to route information on a VC along the same route as a set of already established VCs.

Within the BBE experiment, the service component concept was introduced to meet the requirements on differential delay between the connections belonging to the service component. These connections are grouped together and network signalling and operations refer to the service component, not to the individual

connections. In this way, minimal differential delay between these connections is insured.

In case of certain applications with single connection service components (e.g. the example of videophone applications with an established service component existing of a voice connection where during the call a service component with a video connection can be added), an extension of the BBE solution for service component control is proposed in which service component control can be asked for establishment of a service component referenced to an already established service component with minimum differential delay.

V.   IMPACT ON AAL

Since multimedia components (audio, video, ...) are multiplexed using different virtual channels, no multiplexing overhead is needed in the Segmentation And Reassembly (SAR) layer of the AAL. Cell multiplex is used, based on VCIs. In this way, overhead in the SAR is minimized and more effective bandwidth is available to the CS sublayer.

VI. CONCLUSION

In order to fully exploit the flexibility offered by the ATM network, and to achieve the objectives of draft rec. I.211, the following was concluded:
- multimedia multiplexing based on VCI multiplex,
- VP concept not useful in multimedia multiplex,
- BBE solution based on the service component concept to meet differential delay requirements.

References
[1] F.Haerens, "Service component concept", CCITT SWP XI/4-3, 4-8/2/91, Melbourne.
[2] RTT Belgium, "Priorities in an ATD based B-ISDN network", CEPT/NA5 experts meeting, 7-8 dec 1987, Bern.
[3] Report of the first meeting of the experts group for ATM video coding in The Hague (November 13 - 16, 1990), AVC-22R, CCITT SGXV/WP1