AVC-1040

DISCUSSION OF AAL1/AAL5 RELATED ISSUES

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PROJECT: ATM Forum Technical Committee
Service Aspects and Applications Working Group

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DISTRIBUTION: SAA/AMS (for action)
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TITLE: **Topics for the Interworking Document**

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ABSTRACT: **This contribution identifies four aspects of interworking that may be considered important to SAA/AMS. It is proposed that the topics be entered in the living list with a status of Under Study.**

INTRODUCTION

At the August 1996 meeting in Baltimore, it was voted to organize the Phase 2 work of SAA/AMS around three documents:

1. Broadband Multimedia Services
2. VBR-encoded MPEG-2 over ATM

3. Interworking

This contribution proposes topics to be covered in document #3, which currently has no outline or statement of scope.

Details of the interworking required will depend, of course, on a specific profile for the Phase 2 SAA/AMS Terminal (P2SAT). That profile is still a work in progress. However, it was voted in April 1996 to use H.310 as a basis for development of the P2SAT.

1. P2SAT and N-ISDN voice

1.01 A first premise is that the P2SAT must subsume the functions of a telephone to make voice connections worldwide. A necessary and sufficient condition is that it interwork with the N-ISDN bearer capabilities of speech and 3.1 kHz audio. Through N-ISDN the P2SAT can then reach other networks (analog, mobile, etc.).

1.02 As background, we note that UNI 4.0 defers to Q.2931 (Section 6 and Annex E) for the specification of interworking between B-ISDN and N-ISDN:

- Incoming calls from N-ISDN are presented over B-ISDN with the information elements N-BC, N-HLC, N-LLC, and B-BC (among others) but not B-HLI or B-LLI (cf. Table 3-19/Q.2931).
- B-ISDN calls that request equivalent N-ISDN services, whether they ultimately terminate at a B-ISDN or N-ISDN destination, are to be signaled in the same way (cf. 1.3.13/Q.2931).
- For speech and 3.1 kHz audio, the Bearer Class is BCOB-A and AAL-Type is value 0, known as the AAL for voice (cf. E.4.2/Q.2931). This means AAL 1 with the Convergence Sublayer of 2.5.1.3/I.363.1, i.e. 47-octet payload per cell, G.711 A- or u-law coding, and timing locked to a clock derived from the network.

1.03 The interworking function of I.580 is consistent with UNI 4.0 but much less specific.

1.04 If the P2SAT is an H.310 terminal of type RAST-1&5 (receive and send, both AALs), it will be able to terminate an incoming N-ISDN voice call itself directly, distinguish it from other kinds of calls, and apply the correct encodings.

1.05 If the P2SAT is of type RAST-5 only, it will require the services of a gateway (located in the customer premises ATM network) to transform the incoming voice call to a new format. A gateway must be inserted not just for calls entering from a N-ISDN but also for calls originated on the B-ISDN itself by other terminals that conform to UNI 4.0. This would require extensive screening of calls, as part of ATM switch operation, to decide if call attributes were consistent with what was recorded about the destination's capabilities. The remedy for mismatch would be to divert the call through a gateway possessing enough spare capacity to transform the payload.

1.06 Outgoing N-ISDN calls are an additional problem, because they can be attempted in different modes. The originating user at a P2SAT may need to give an explicit command to set up a simple voice call. Otherwise, the first call of a audiovisual session, according to H.310, will be a VC designed to carry H.245. This uses Bearer Class BCOB-C and AAL 5 with a maximum CPCS-SDU size exceeding 2048. Special B-LLI codepoints for it are defined in UNI 4.0. Each of these details is inconsistent with a voice call and should be rejected by a N-ISDN gateway.

1.07 Thus, if audiovisual mode is mistakenly commanded, the first VC may fail. In that case, the P2SAT could automatically retry using voice mode. If voice mode is commanded instead, the call would normally succeed. But then there is a possibility of suboptimal operation. Two P2SATs that become connected in voice mode cannot achieve their full audiovisual potential.

2. P2SAT and N-ISDN audiovisual

2.01 N-ISDN audiovisual service, in practice, means H.320, although in theory, G.722 voice (with 7 kHz fidelity) is a subset. The intended N-ISDN bearer capability for both is UDI-TA, unrestricted digital information with tones and announcements. But because little is deployed, ordinary UDI is more often used instead.

2.02 A common means of access to UDI for video conferencing is through a terminal adapter that does not respect the 8 kHz structure of octets on a 64 kb/s channel. Hence, H.320 has grown over time to support the use of UDI without requiring alignment into network octets. This undermines to some extent the original intent that H.320 should support a voice conversation from the very beginning of a call, without clipping, while negotiating a transition to audiovisual. These days, a UDI receiver must lock onto the framing carried in an H.320 stream before it can locate the high order bits and begin decoding G.711 voice samples.

2.03 H.320 terminals can connect directly to N-ISDN voice terminals only by reverting to a bearer capability of speech or 3.1 kHz audio. In this situation, there is no reason to generate framing, because the network is not supplying a clear digital channel, hence no opportunity to negotiate enhanced capabilities.

2.04 N-ISDN interworking of UDI and UDI-TA follows the same principles (same information elements) as speech and 3.1 kHz audio. But some of the details still remain to be worked out. E.2&E.3/Q.2931 only covers 64 kb/s connections, whereas UNI 4.0 specifies that the N-BC shall also support N*64 kb/s service. And though Q.2931 specifies that UDI at 64 kb/s shall use AAL 1 circuit transport, i.e. 2.5.1.1/I.363.1, it leaves UDI-TA at 64 kb/s for further study. UNI 4.0 gives no further guidance concerning N*64 or UDI-TA.

2.05 To improve video quality, H.320 relies on multiple connections and/or connections of greater bandwidth. Synchronizing across multiple connections by differential delay is one of the functions of H.320 framing. The maximum number of connections is negotiated during a call, up to 6 B or 5 H0 or 1 H1. H.310 RAST terminals are required to support at least B, 2B, and H0. Since connections are interworked individually, a P2SAT has direct control over the multiplex.

2.06 As in the case of voice interworking, it is easy for a P2SAT to adapt automatically to different kinds of incoming H.320 calls. Outgoing H.320 calls, on the other hand, because they begin with connections of greater or lesser bandwidth, require an explicit or implicit command from the originating user.

2.07 Much more than voice, which can tolerate the infrequent addition or deletion of G.711 samples, H.320 is sensitive to any loss of synchronization with the source clock. Its framing is a distinctive pattern in the payload that repeats every 20 msec., e.g. every 160 octets at 64 kb/s. Disturbing this bit stream can cause noticeable glitches at the receiver. It takes at least 4 cycles, 80 msec., to detect a loss of framing and to recover it at a different position. During the interval, compressed voice coefficients can be parsed incorrectly, causing artifacts that may slowly fade away. Video coefficients, subject to forward error correction, are unlikely to be misread but would be dropped, leaving defects that may persist and that motion vectors can propagate.

2.08 Susceptibility to slips, therefore, should be a key criterion for evaluating the combinations of AAL and Convergence Sublayer that are proposed for the P2SAT.

3. P2SAT and H.323 IP/ATM

3.01 H.323, audiovisual systems for LANs with non-guaranteed QoS, has status as a standard equal to H.310. It was approved by SG 15 in May 1996 and is now going through the formality of an ITU-T letter ballot. Leading companies in the PC and video conferencing industries are actively cooperating towards interoperable implementations of H.323, and demonstrations have begun to appear at trade shows.

3.02 In the near term, H.323 will be easier than H.310 to deploy, because it does not depend on ATM to the desktop. Over the last segment of many meters, H.323 can be carried by IP legacy LANs. It requires only that the traffic load be properly controlled.

3.03 This will be feasible first in the local subnets of a corporation, where network engineers and management have enough control to choose proper network components and to design traffic routings, before it becomes true of the internet as a whole. A currently workable configuration involves transforming IP from LAN to ATM at an egress point close to each workstation.

3.04 In the future, when ATM reaches all the way to a desktop, H.323 can continue to provide service by running in conjunction with LAN Emulation or MPOA. The advantage would be that it connects to distant IP destinations that ATM has not yet reached.

3.05 These trends favoring H.323 suggest that the interworking of P2SAT with H.323 will be required for customer satisfaction.

3.06 H.323 itself already places a high priority on interworking. It recognizes the concept of a gateway as a major functional component. It specifies characteristics of a gateway and provides scenarios for signaling call set-up through it. It devotes one section to interoperation with other terminal types (voice, H.320, etc.) and identifies, in each case, the conversion options that a gateway ought to consider. Since G.711 and H.261 are mandatory, the audio and video of H.323 mate directly, without recoding, to N-ISDN voice and audiovisual.

3.07 H.323 happily avoids the enduring controversy of AAL 1 versus AAL 5. When it is run over ATM, there is an IP layer underneath, so only AAL 5 provides a sensible adaptation. Conversion to N-ISDN services is the responsibility of an H.323 gateway.

3.08 If the P2SAT is an H.310 RAST terminal, interworking with H.323 will also be through an H.323 gateway. End-to-end control is facilitated by the common use of H.245. Basic audio and video modes would be H.320-compatible, G.711 and H.261. Optional capabilities could upgrade this to G.722 and/or H.263. In its first edition, H.323 does not mention the possibility of MPEG media encodings, but that should be easy to fix, because the codepoints are already in H.245.

4. P2SAT private and public

4.01 If the P2SAT is an H.310 RAST-5 terminal, it will require the services of a gateway (located in the customer premises ATM network) to reformat any of its calls that enter the public network. Because a gateway cannot accurately predict whether the destination is ultimately on a public network (hence RAST-1 or RAST-1&5) or on a private network (hence RAST-5 or RAST-1&5), its only sensible course is always to transform to the public mode, i.e. to AAL 1.

4.02 In the opposite direction, from public to private, it might be easiest always to perform the reverse conversion, i.e. to AAL 5. Being more selective would pay off if some private terminals were actually RAST-1&5, but this would require extensive screening of calls, as part of ATM switch operation, to decide if call attributes were consistent with what was known about the destination's capabilities, the remedy being to divert a call through the gateway.

4.03 Whether incoming or outgoing, calls through a gateway entails one conversion from AAL 5 to AAL 1 and, in the reverse path, one from AAL 1 to AAL 5. Assuming payloads are formatted as Transport Stream (TS) packets (since use of the Program Stream with AAL 5 is marked for further study), it is the AAL 1 to AAL 5 part of H.310 conversion that is the more intensive.

4.04 The reason is that the AAL 1 input format is only vaguely defined by 10.1/H.222.1. Its TS packets have no fixed position relative to cell boundaries. It is not even mandated that they be octet-aligned. The corresponding AAL 5 output, on the other hand, exactly aligns 2 TS packets to every 8 cells. To create the output, therefore, a P2SAT gateway must find and lock onto a TS framing pattern in the input. This is more than we ask of a corresponding voice gateway.

4.05 Some calls, of course, will cross a public network, entering on one side and leaving on another. Audiovisual contacts with customers and suppliers, for example, will be calls connected between independent enterprises, for which no purely private routing network typically exists. Such calls will then experience a double conversion, from AAL 5 to AAL 1 and back to AAL 5. It should be studied what degradation this double conversion may cause.

4.06 It should be noted that H.320 and H.323 avoid problems of gatewaying between public and private networks by mandating an identical standard for both. The analogous solution for H.310 might be to require all terminals, public and private alike, to be RAST-1&5.

MOTIONS

To be voted by individual item, N = 1..4, after discussion at the meeting:

> "SAA/AMS considers the subject of Section N above to be an important topic of the Interworking document and assigns it status Under Study in the living list".