CCITT SGXV
Working Party XV/1
Experts Group for ATM Video Coding

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SOURCE: SGXVIII
TITLE : OUTCOME of AAL STUDY

The following outcome on the AAL study is attached;

1) Draft text of I.363 Section 2 (AAL type 1) pp.3-22

2) Possible candidate functions for AAL type 2 pp.23-24

END

添付 8)
I.363 section 2 (AAL タイプ 1)

SOURCE : SWP XVIII/8-3

TITLE : Revised text of I.363 section 2 (AAL type 1)

ANNEX 3; Appendix 2

Rapporteur's Note :

This document presents draft text of I.363 section 2 (AAL type 1). The following notations are used in this document;

- Single vertical line : Changes from 1990 Rec. agreed up to the Ottawa October 1991 meeting.
- Double vertical line : Changes from 1990 Rec. agreed at the Melbourne December 1991 meeting.

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2. AAL type 1

2.1 Service provided by AAL type 1

2.1.1 Definitions

The layer services provided by AAL type 1 to the next higher layer are:

- transfer of service data units with a constant source bit rate and the delivery of them with the same bit rate;
- transfer of timing information between source and destination;
- transfer of structure information between source and destination end;
- indication of lost or errored information which is not recovered by AAL type 1, if needed.

2.1.2 Primitives

2.1.2.1 General

At the AAL-SAP, the following primitives will be provided by the AAL type 1 to the AAL user:

- From an AAL user to the AAL,
  AAL-UNITDATA-REQUEST;
- From the AAL to an AAL user,
  AAL-UNITDATA-INDICATION.

An AAL-UNITDATA-REQUEST primitive at the local AAL-SAP results in an AAL-UNITDATA-INDICATION primitive at its peer AAL-SAP.

2.1.2.2 Definition of primitives

2.1.2.2.1 AAL-UNITDATA-REQUEST

AAL-UNITDATA-REQUEST (DATA[mandatory],
STRUCTURE[optional])

The AAL-UNITDATA-REQUEST primitive requests the transfer of the AAL-SDU, i.e. contents of the DATA parameter associated with this primitive, from the local AAL entity to its peer entity. The length of the AAL-SDU should be constant and the time interval between two consecutive primitives should be constant. These two constants are a function of the AAL service provided to the AAL user.

2.1.2.2.2 AAL-UNITDATA-INDICATION

AAL-UNITDATA-INDICATION (DATA[mandatory],
STRUCTURE[optional],
STATUS[optional])

An AAL user is notified by the AAL that the AAL-SDU, i.e. contents of the DATA parameter, associated with this primitive coming from its peer, are available. The length of the AAL-SDU should be constant and the time interval between two consecutive primitives should be constant. These two constants are a function of the AAL service provided to the AAL user.

2.1.2.3 Definition of parameters

2.1.2.3.1 Structure parameter

The STRUCTURE parameter can be used when the user data stream to be transferred to the peer AAL-SAP is organised into groups of bits or octets. The length of structured block is fixed for each instance of the AAL service. The length is multiple of 8 bits. An example use of this parameter is to support circuit mode bearer services of 64 kbit/s based ISDN. The two values of the STRUCTURE parameter are;

START, and
CONTINUATION.

The value START means that the DATA is the first part of structured block which can be composed of consecutive DATA. In other cases, the STRUCTURE parameter is set to CONTINUATION. The use of the STRUCTURE parameter depends on the type of AAL service provided.

2.1.2.3.2 Status parameter

The STATUS parameter identifies that the DATA is judged to be non-errored or errored. That STATUS parameter has two values;

VALID, and
INVALID.

The INVALID status could also imply that the DATA is a dummy value. The use of the STATUS parameter and the choice of dummy value depend on the type of AAL service provided.

2.2 Interaction with the management and control planes

2.2.1 Management plane

The following indications may be passed from the user plane to the management plane:

- errors in the transmission of user information;
- lost or misinserted cells (further study is required on whether it is necessary to distinguish between lost and misinserted cells for management purpose);
- cells with errored AAL Protocol Control Information (AAL-PCI) (further study is required to determine if this indication is necessary for layer services supported by this AAL type);
- loss of timing and synchronization;
- buffer underflow and overflow.

2.2.2 <u>Control Plane</u>

For further study.

2.3 <u>Functions in AAL type 1</u>

The following functions may be performed in the AAL in order to enhance the layer service provided by the ATM layer:

a) segmentation and reassembly of user information;
b) handling of cell delay variation;
c) handling of lost and misinserted cells;
d) source clock frequency recovery at the receiver;
e) recovery of the source data structure at the receiver;
f) monitoring of AAL-PCI for bit errors;
g) handling of AAL-PCI for bit errors;
h) monitoring of user information field for bit errors and possible corrective action.

Other functions are for further study.

Note - For some AAL users, the end-to-end QOS may be monitored. This may be achieved by calculating a CRC for the CS-PDU payload, carried in one or more cells, and transmitting the CRC results in the CS-PDU. This could also be achieved by the use of OAM cells. Further study is required.

2.3.1 <u>Segmentation and Reassembly sublayer</u>

2.3.1.1 <u>Functions of the SAR Sublayer</u>

The SAR sublayer functions are performed on an ATM-SDU basis.

a) Mapping between CS-PDU and SAR-PDU

The SAR sublayer at the ~~receiving~~ transmitting end accepts a 47 octet block of data from the CS, and then prepends one octet SAR-PDU header to each block to form the SAR-PDU.

The SAR sublayer at the receiving end receives the 48 octet block of data from the ATM layer, and then separates the SAR-PDU header. The 47 octet block of SAR-PDU payload is passed to the CS.

b) Existence of CS function

The SAR sublayer has the capability to indicate the existence of a CS function. Associated with each 47 octet SAR-SDU, it receives this indication from the CS and conveys it to the peer CS entity. The use of this indication is optional.

c) Sequence numbering

Associated with each SAR-SDU, the SAR sublayer receives sequence number from the CS. At the receiving end, it passes the sequence number value to the CS. The CS may use these sequence number values to detect lost or misinserted SAR-PDUs (corresponding to lost or misinserted ATM cells).

d) Error protection

The SAR sublayer protects the sequence number value and the CS indication against bit errors. It informs the receiving CS when the sequence number value and the CS indication are errored and can not be corrected.

Note - For certain applications such as speech, some SAR functions may not be needed. This item is for further study.

[Rapporteur's note : This Note needs to be revised for 1992 Recommendation.]

2.3.1.2 <u>SAR protocol</u>

The SAR-PDU header together with the 47 octets of SAR-PDU payload comprises the 48 octet ATM-SDU (cell information field). The size and positions of the fields in the SAR-PDU are given in Figure 1/I.363.

```
+ - - - - - - -+----------------------------------------+
|Cell header  |  SN   |  SNP   |  SAR-PDU payload       |
+ - - - - - - -+----------------------------------------+

              |SAR-PDU header |                         |
              |                                         |
              | - - - - - - - SAR-PDU - - - - - - - - - |

     SN  : Sequence Number              (4 bits)
     SNP : Sequence Number Protection   (4 bits)
```

FIGURE 1/I.363
SAR-PDU format for AAL type 1

2.3.1.2.1 <u>Sequence number field</u>

The SN field is divided into two subfields as shown in Figure 1-A/I.363. The sequence count field carries the sequence number provided by the CS. The CSI bit carries CS indication provided by the CS.

The least significant bit of the sequence number is right justified in the sequence count field.

```
| - - - - - - - - -  SN field - - - - - - - - - |

+---------------------------------------------+
|          |          |          |            |
+---------------------------------------------+

|          |                                  |
|CSI bit   |    Sequence count field          |
|          |                                  |
```

Figure 1-A/I.363
<u>SN format of AAL type 1 SAR-PDU</u>

2.3.1.2.2 <u>Sequence number protection field</u>

The SNP field provides error detection and correction capabilities over the SAR-PDU header. The format of this field is given in Figure 1-B/I.363. A two step approach is used for the protection:

1) The SN field is protected by a 3 bit CRC code;
2) The resulting 7 bit codeword is protected by an even parity check bit.

```
| - - - - - - - - -  SNP field  - - - - - - - - |

+---------------------------------------------+
|          |          |          |            |
+---------------------------------------------+

|                                |Even        |
|     Control bits field         |parity      |
|                                |bits        |
```

Figure 1-B/I.363
<u>SNP format of AAL type 1 SAR-PDU</u>

The receiver is capable of either single-bit error correction or multiple-bit error detection.

a) Operations at transmitting end

The transmitter computes the CRC value across the first 4 bits of the SAR-PDU header and inserts the result in the control bits field.

The notation used to describe the CRC is based on the property of cyclic codes. The elements of an n-element codeword are thus the coefficients of a polynomial of order n-1. In this application, these coefficients can have the value 0 or 1 and the polynomial operations are performed using modulo 2 operations. For example a code vector such as 1011 can be represented by the polynomial P(x)=x3+x+1. The polynomial representing the content of the SN field is generated using the first bit of the SN field as the coefficient of the highest order term.

The control bits subfield consists of three bits. It shall contain the remainder of the division (modulo 2) by the generator polynomial x3+x+1 of the product x3 multiplied by the content of the SN field.

After completing above operations, the transmitter inserts the even parity bit.

b) Operations at receiving end

The receiver has two different modes of operation : correction mode and detection mode. These modes are related as shown in Figure 1-C/I.363. The default mode is the correction mode, which provides for single-bit error correction.

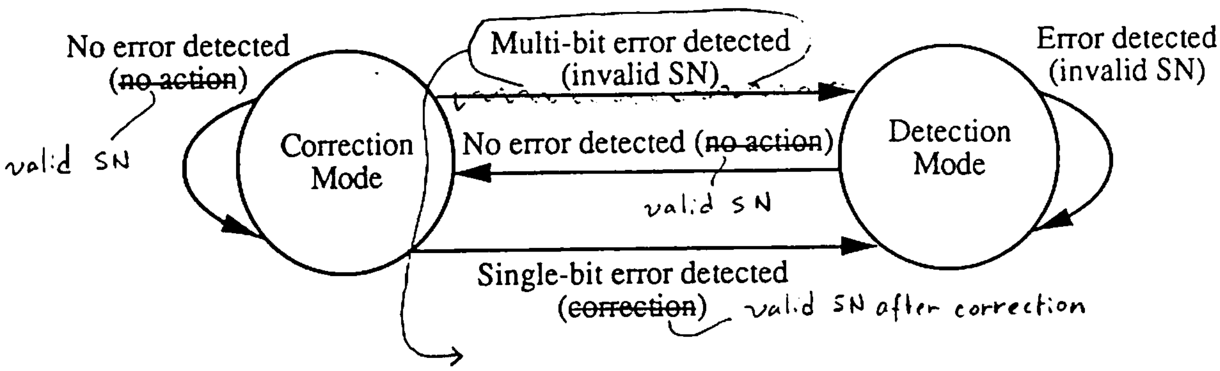

Figure 1-C/I.363
<u>SNP : receiver modes of operation</u>

The receiver examines an each SAR-PDU header by checking control bits and even parity bit. If a header error is detected, the action taken depends on the state of the receiver. In the "Correction Mode", only single-bit errors can be corrected and the receiver switches to "Detection Mode". In "Detection Mode", all SAR-PDU headers with detected errors are declared to have an invalid SN. When a SAR-PDU header is examined and found not to be in error, the receiver switches to "Correction Mode".

Tables 1/I.363 and 2/I.363 give the detailed operations of the receiver in the "Correction Mode" and "Detection Mode", respectively. The operation is based on the combined validity of the CRC and parity check bit.

Table 1/I.363 Operations in Correction Mode

CRC Syndrome	Parity	Action on Current SN+SNP	Reaction for Next SN+SNP
Zero	No Violation	No Action Declare SN Valid	Continue in Correction Mode
Non-Zero	Violation	Single Bit Correction based on Syndrome Declare SN Valid	Switch to Detection Mode
Zero	Violation	Correct Parity Bit Declare SN Valid	Switch to Detection Mode
Non-Zero	No Violation	No Action - Muti-bit Error is uncorrectable Declare SN Invalid	Switch to Detection Mode

Table 2/I.363 Operations in Detection Mode

CRC Syndrome	Parity	Action on Current SN+SNP	Reaction for Next SN+SNP
Zero	No Violation	No Action Declare SN Valid	Switch to Correction Mode
Non-Zero	Violation	No Action Declare SN Invalid	Continue in Detection Mode
Zero	Violation	No Action Declare SN Invalid	Continue in Detection Mode
Non-Zero	No Violation	No Action Declare SN Invalid	Continue in Detection Mode

The receiver conveys the sequence number count and the CS indication to the CS together with SN check status (valid or invalid).

2.3.2 <u>Convergence Sublayer</u>

2.3.2.1 <u>Functions of the CS</u>

The CS may include the following functions; For performing some of these functions, the CS will need a clock. This clock may be derived from SB or TB interface.

a) For video and high quality audio signal transport, forward error correction may be performed to protect against bit errors. This may be combined with octet interleaving to give more secure protection against errors.

b) For some AAL users, this sublayer provides the clock recovery capability for the receiver, e.g., by monitoring the buffer fill. This requires no specific field in the CS-PDU.

c) For AAL users requiring recovery of source clock frequency at the destination end, the AAL can provide a mechanism for a timing information transfer.

d) Sequence number processing may be performed at this sublayer. The SN count and its error check status provided by the SAR sublayer can be used by the CS to detect cell loss and misinsertion. Further handling of lost and misinserted cells is also performed in this sublayer.

e) The CS can utilize the CS indication provided by the SAR sublayer to support CS functions for some AAL users.

f) The CS may generate reports giving the status of end-to-end performance as deduced by the AAL. The performance measures in these reports could be based on;
- events of lost and misinserted cells,
- buffer underflow and overflow,
- bit error events.

2.3.2.1.1 Functions of the CS for asynchronous circuit transport

The following functions support asynchronous circuit transport, i.e., transport of signals from constant bit rate sources whose clocks are not frequency-locked to a network clock. Examples are G.702 signals at 1.544, 2.048, 6.312, 8.448, 32.064, 44.736 and 34.368 Mbit/s.

a) Handling of AAL user information
The length of AAL-SDU is one bit.

b) Handling of cell delay variation
A buffer is used to support this function. The size of this buffer is dependent upon specifications provided in Recommendation I.35B.

In the event of buffer underflow, it may be necessary for the CS to maintain bit count integrity by inserting the appropriate number of dummy SAR-PDU payloads. In the event of buffer overflow, it may be necessary for the CS to maintain bit count integrity by dropping the appropriate number of SAR-PDU payload.

c) Handling of lost and misinserted cells
The SN counter values are further processed at this sublayer to detect lost and misinserted cells. Misinserted cells are discarded.

In order to maintain the bit count integrity of the AAL user information, it may be necessary to compensate for lost cells detected by buffer underflow and SN processing by inserting the appropriate number of dummy SAR-PDU payloads. The content of this dummy SAR-PDU payload depends on the AAL service being provided. For example, this dummy SAR-PDU payload is all "1"s for G.702 1.544 Mbit/s and 2.048 Mbit/s signals.

d) Source clock frequency recovery

Recovered source clock should have satisfactory jitter performance. The jitter performance for G.702 signals is specified in Recommendations G.823 and G.824.

The CS protocol to be used for source clock frequency recovery is described in section 2.3.2.2.2.1.

2.3.2.1.2 <u>Functions of the CS for synchronous circuit transport</u>

The following functions support synchronous circuit transport, i.e., transport of signals from constant bit rate sources whose clocks are frequency-locked to a network clock. Examples are signals at 64, 384, 1536 and 1920 kbit/s as described in Recommendation I.231;

a) Handling of AAL user information

The length of AAL-SDU is one octet.

For those AAL users which require transfer of structured data, e.g. 8 kHz structured data for circuit mode bearer services of 64 kbit/s based ISDN, the STRUCTURE parameter of primitives defined in section 2.1.2 will be used. The CS protocol to be used for structured data transfer is described in section 2.3.2.2.3.

b) Handling of cell delay variation

A buffer is used to support this function. The size of this buffer is dependent upon specifications provided in Recommendation I.35B.

In the event of buffer underflow, it may be necessary for the CS to maintain bit count integrity by inserting the appropriate number of dummy SAR-PDU payloads. In the event of buffer overflow, it may be necessary for the CS to maintain bit count integrity by dropping the appropriate number of SAR-PDU payload.

c) Handling of lost and misinserted cells

The SN counter values are further processed at this sublayer to detect lost and misinserted cells. Misinserted cells are discarded.

In order to maintain the bit count integrity of the AAL user information, it may be necessary to compensate for lost cells detected by buffer underflow and SN processing by inserting the appropriate number of dummy SAR-PDU payloads. The content of this dummy SAR-PDU payload depends on the AAL service being provided.

Note - Another possible example of this synchronous circuit transport is conveyance of SDH signals described in G.709.

2.3.2.1.3 <u>Functions of the CS for video signal transport</u>

The following functions support transport of video signals for interactive and distributive services.

a) Handling of AAL user information

The length of AAL-SDU is one octet.

For those AAL users which require transfer of structured data, the STRUCTURE parameter of primitives defined in section 2.1.2 will be used. The CS protocol to be used for structured data transfer is described in section 2.3.2.2.3.

As an option, the STATUS parameter defined in section 2.1.2 will be passed to the AAL user to facilitate further picture processing, e.g. error concealment.

b) Handling of cell delay variation

A buffer is used to support this function. The size of this buffer is dependent upon specifications provided in Recommendation I.35B.

In the event of buffer underflow, it may be necessary for the CS to maintain bit count integrity by inserting the appropriate number of dummy SAR-PDU payloads. In the event of buffer overflow, it may be necessary for the CS to maintain bit count integrity by dropping the appropriate number of SAR-PDU payload.

c) Handling of lost and misinserted cells

The SN counter values are further processed at this sublayer to detect lost and misinserted cells. Misinserted cells are discarded.

In order to maintain the bit count integrity of the AAL user information, it may be necessary to compensate for lost cells detected by buffer underflow and SN processing by inserting the appropriate number of dummy SAR-PDU payloads. The content of this dummy SAR-PDU payload depends on the AAL service being provided.

Information in lost cells may be recovered by the mechanism described in e).

d) Source clock frequency recovery

This function is provided for those AAL users which require source clock frequency recovery, e.g. recovery at the receiving end of camera clock frequency which is not locked to the network clock. The exact method is for further study.

e) Correction of bit errors and lost cells

This function is provided for those AAL users requiring bit error and cell loss performance better than that provided by the ATM layer. Example are unidirectional video services for contribution and distribution. This function is optional. This function may be performed by the method described in section 2.3.2.2.4.1.

2.3.2.1.4 <u>Functions of the CS for voice-band signal transport</u>

The following functions support transport of voice-band signals, e.g. 64 kbit/s A-law and u-law coded G.711 signals, and 64 kbit/s G.722 signals;

a) Handling of AAL user information

The length of AAL-SDU is one octet.

b) Handling of cell delay variation

A buffer is used to support this function. The size of this buffer is dependent upon specifications provided in Recommendation I.35B.

c) Handling of lost and misinserted cells

The detection of lost and misinserted cells, if needed, may be provided by processing the SN counter values. The monitoring of the buffer fill level can also provide an indication of lost and misinserted cells. Misinserted cells are discarded.

Handling of lost cells and buffer underflow is for further study.

Note - For transporting signals of speech and 3.1 kHz audio bearer services as specified in 64 kbit/s ISDN, the need for A/u-law conversion is identified. This conversion function is provided outside the AAL.

2.3.2.1.5 <u>Functions of the CS for high quality audio signal transport</u>

The capabilities of AAL type 1 are in principle applicable for transfer of high quality audio signals.

[Rapporteur's Note : The need to include this subsection should be addressed for 1992 Recommendation.]

2.3.2.2 <u>CS protocols</u>

The following sections describe CS protocols to be provided for implementing CS functions. The use of each protocol depends on the required CS functions as given in section 2.3.2.1.

2.3.2.2.1 <u>SN operations</u>

2.3.2.2.1.1 <u>SN operations at the transmitting end</u>

At the transmitting end, the CS provides the SAR with a sequence number count and a CS indication associated with each SAR-SDU. The count value starts with 0, is incremented sequentially and is numbered modulo 8.

2.3.2.2.1.2 <u>SN operations at the receiving end</u>

At the receiving end, the CS receives from the SAR the following information associated with each SAR-SDU;

- SN count,
- CS indication,
- other status of the SN count and CS indication,

The use of SN counter values and CS indications will be specified on a service specific basis. See section 2.3.1.2 for details about the check status processing.

The CS processing at the receiving end may be responsible for identification of lost or misinserted SAR-SDUs. This will be useful for many CBR services.

The CS will have available as input the SN counter values and its check status. CS processing may identify the following conditions;

- SAR-SDU sequence normal (i.e. in correct sequence),
- SAR-SDU loss,
- SAR-SDU misinsertion.

The SN counter processing may provide additional information to related entities within the CS, as required. Some examples are;

- location of lost SAR-SDU in the incoming SAR-SDU stream,
- number of consecutive SAR-SDUs lost,
- identification of misinserted SAR-SDU.

Note - The SN counter processing may be subject to performance specifications. The performance specifications will be applied on a service specific basis.

2.3.2.2.2 <u>Source clock frequency recovery method</u>
2.3.2.2.2.1 <u>Synchronous Residual Time Stamp (SRTS) Method</u>
(a) <u>General</u>

The Synchronous Residual Time Stamp (SRTS) method uses the Residual Time Stamp (RTS) to measure and convey information about the frequency difference between a common reference clock derived from the network and a service clock. The same derived network clock is assumed to be available at both the transmitter and the receiver. The SRTS method is capable of meeting the jitter specifications of the 2.048 Mbit/s hierarchy in Recommendation G.823 and the 1.544 Mhz hierarchy in Recommendation G.824.

The following is a description of the SRTS method. The description uses the notation below;

fs --- service clock frequency,
fn --- network clock frequency, e.g. 155.52 MHz,
fnx -- derived network clock frequency, fnx=fn/x, where x is an integer to be defined later,
N ---- period of RTS in cycles of the service clock of frequency fs,
T ---- period of the RTS in seconds,
M(Mnom, Mmax, Mmin) ---- number of fnx cycles within a (nominal, maximum, minimum) RTS period,
Mq --- largest integer smaller than or equal to M.

The SRTS concept is illustrated in Figure 1-D/I.363. In a fixed duration T measured by N service clock cycles, the number of derived network clock cycles Mq is obtained at the transmitter. If Mq is transmitted to the receiver, the service clock of the source can be reconstructed by the receiver, since it has the necessary information: fnx, Mq and N. However, Mq is actually made up of a nominal part and a residual part. The nominal part Mnom corresponds to the nominal number of fnx cycles in T seconds and is fixed for the service. The residual part conveys the frequency difference information as well as the effect of the quantisation and thus can vary. Since the nominal part is a constant, it can be assumed that the nominal part of Mq is available at the receiver. Only the residual part of Mq is to be transmitted to the receiver.

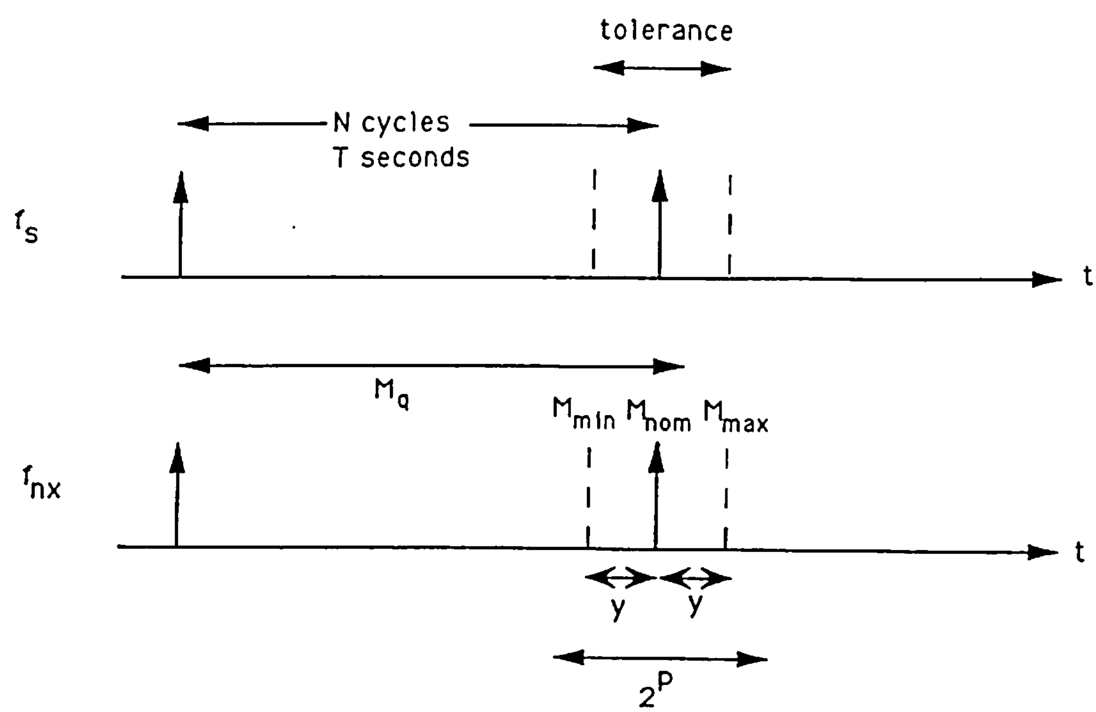

Figure 1-D/I.363 The SRTS concept

A simple way of representing the residual part of Mq is by means of the RTS, whose generation is shown in Figure 1-E/I.363. Counter CT is a P-bit counter which is continuously clocked by the derived network clock. The output of counter CT is sampled every N service clock cycles. This P-bit sample is the Residual Time Stamp.

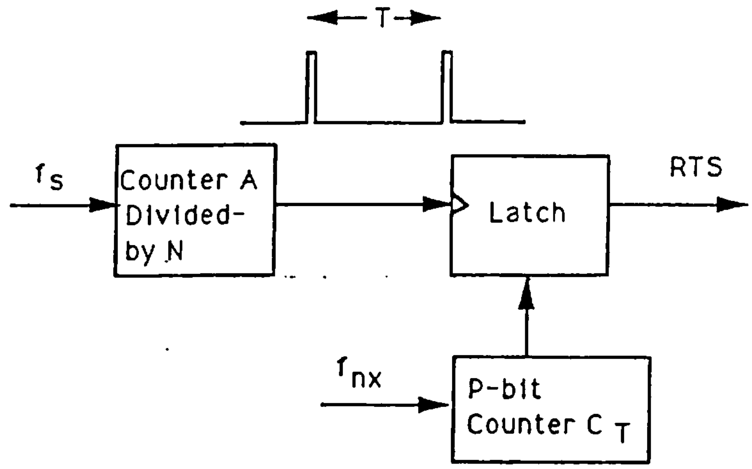

Figure 1-E/I.363 Generation of RTS

With a knowledge of the RTS and the nominal part of Mq at the receiver, Mq is completely specified. Mq is used to produce a reference timing signal for a Phase-Locked Loop (PLL) to obtain the service clock.

(b) <u>Choice of parameter</u>

The minimum size of the RTS required to unambiguously represent the residual part of Mq is a function of N, the ratio fnx/fs, and the service clock tolerance, $\pm\varepsilon$. Let y be the difference between Mnom and the maximum or minimum value of M (denoted as Mmax, Mmin). The difference y is given by

$$y = N * fnx/fs * \varepsilon.$$

In order that Mq can be unambiguously identified, the following conditions must be satisfied (See Figure 1-D/I.363);

$$2^{(p-1)} > [y],$$

where [y] denotes the smallest integer larger than or equal to y.

The following parameter values are used for the asynchronous circuit transport of Recommendation G.702 signals:

N = 3008 (total number of bits in eight SAR-SDUs),
$1 \leq fnx/fs \leq 2$,
Tolerance = $200 * 10^{-6}$
Size of RTS = 4 bits

The introduction of any AAL Convergence Sublayer overhead into the SAR-SDU will reduce the amount of payload available for the transport of AAL user data. This will reduce the number of service clock cycles over which the RTS period is specified, since the RTS period is defined over a fixed number of SAR-SDUs. The RTS period parameter, N, can be adjusted to accommodate such cases. For example, if four octets of CS overhead are required from every eight SAR-SDUs, then N would be reduced from 3008 to 2976. However, the CS overhead has to be allocated so that the RTS period always remains a constant number of service clock cycles. Therefore, the CS overhead must reduce the user data transport capacity by a constant amount over the fixed number of SAR-SDUs for which the RTS period is defined. See section 2.3.2.2.3.2 for an example.

(c) Network clocks

For an SDH network, a 155.52 MHz network clock (fn) is available from which the following clocks can be derived:

$155.52\ \text{MHz} * 2^{-k}$, k=0,1,,,,11

This set of derived network clocks can accommodate all service rates ranging from 64 kbit/s up to the full capacity of the STM-1 payload. The derived network clock to be used for a given service rate is uniquely specified, since the frequency ratio is constrained by $1 \leq fnx/fs \leq 2$.

Administrations/RPOAs may use existing network clocks to support national service in a non-SDH ATM network.

(d) Transport of the RTS

The 4-bit RTS is transmitted in the serial bit stream provided by the CSI bit in successive SAR-PDU headers. The modulo 8 SN count provides a frame structure over 8 bits in this serial bit stream. Four bits of the framed 8 bits are allocated for the RTS and the remaining 4 bits are available for other uses. If the four bits available for other uses are not utilized, they are set to 0. The SAR-PDU headers with the odd sequence number values of 1, 3, 5 and 7 are used for RTS transport. The MSB of the RTS is placed in the CSI bit of the SAR-PDU header with the sequence number of 1.

(e) Plesiochronous Operation

The issue about the accommodation of plesiochronous operation (i.e. when a common reference clock is not available from the network) needs to be addressed. This scenario must be accommodated in such a way that the recovered clock satisfies the jitter requirements specified in Recommendations G.823 and G.824 for G.702 signals. However, the detailed method of dealing with plesiochronous operation is not standardized.

2.3.2.2.2.2 Adaptive clock method

The following is a general description of the method. The receiver writes the received information into a buffer and then reads it with a local clock. The fill level of the buffer is used to control the frequency of the local clock. The control is performed by continuously measuring the fill level around its medium position, and by using this measure to drive the Phased Locked Loop (PLL) providing the local clock. The fill level of the buffer may be maintained between two limits in order to prevent buffer overflow and underflow.

2.3.2.2.3 <u>Structured data transfer method</u>

2.3.2.2.3.1 <u>Structured data transfer method without use of SRTS</u>

The CS protocol for structured data transfer uses a pointer to delineate the structure boundaries. The protocol supports any fixed, octet-based structure. In particular, it supports 8 kHz based structures used in circuit-mode services of Recommendation I.231.

The protocol description given here is intended for data transfer which does not use the SRTS protocol (see section 2.3.2.2.2.1) for recovery of the user clock. However, since this protocol and the SRTS protocol use the CS indication in alternating SAR-SDUs, it is possible to use the two protocols simultaneously to support both structured data transfer and SRTS clock recovery. This combined use is described in the next section.

The STRUCTURE parameter in the AAL-UNITDATA-REQUEST and AAL-UNITDATA-INDICATION primitives is used to convey structure information between the AAL and the user. (See section 2.1.2 for definition of primitives and parameters)

The 47-octet SAR-SDU used by the CS has two formats, called non-P and P, as shown in Figure 1-F/I.363.

```
                 |                                     |
                 |--------- SAR-SDU -------------------|
                 |         (47 octets)                 |

         +-------+-------------------------------------+
         |       |          User Information           |
         +-------+-------------------------------------+
             ^
             |
             +-- CSI bit = 0 in SAR-PDU header

                    (a) Non-P format of SAR-SDU

                 |                                     |
                 |--------- SAR-SDU -------------------|
                 |         (47 octets)                 |

         +-------+-------+-----------------------------+
         |       |   P   |      User Information       |
         +-------+-------+-----------------------------+
             ^
             |
             +-- CSI bit = 1 in SAR-PDU header
```

(b) P format of SAR-SDU

Figure 1-F/I.363 SAR-SDU Formats

a) Operations of the non-P format

In the non-P format, the entire SAR-SDU is filled with user information.

b) Operations of the P format

In the P format, the first octet of the SAR-SDU is the pointer field. The remainder is filled with user information. This format may be used only if the SN count in the SAR-PDU header is 0, 2, 4 or 6.

The format of the pointer field is shown in Figure 1-G/I.363.

```
+-----------------------------------------------+
|     |     |     |     |     |     |     |     |
+-----------------------------------------------+

|Rese-|                                         |
|rved |----------- Offset field ----------------|
|field|                                         |
```

Figure 1-G/I.363 Format of pointer field

The pointer field contains the binary value of the offset, measured in octets, between the end of the pointer field and the first start of the structured block in the 93 octet payload consisting of the remaining 46-octets of this SAR-SDU and the 47-octets of the next SAR-SDU. The offset ranges between 0 and 92 inclusive.

The binary value of the offset is inserted right justified in the offset field, i.e., the least significant bit of the offset is transmitted last. The first bit of the pointer field is reserved for future standardization and is not used for the offset; this bit is set to 0.

The pointer should be used as often as necessary to ensure that the structure recovery is robust. The frequency of pointer utilization is an item for further study.

The first structured block to be transmitted after the AAL connection is established uses the P format with SN count in the SAR-PDU header equal to 0 and with the first octet of the structured data placed in the first octet of the SAR-SDU.

Partially filled cells

The SAR-SDU may be filled only partially with user data in order to reduce the cell packetization delay. In this case, the number of leading octets utilized for user information in each SAR-SDU is a constant which is determined by the allowable packetization delay. The remainder of the SAR-SDU consists of dummy octets. The value of the dummy octet is for further study.

The offset value in the pointer field includes all octets of the SAR-SDU regardless of whether the octet is utilized for user data or consists of dummy octets.

2.3.2.2.3.2 Structured data transfer method with use of SRTS

The CS protocol for supporting structured data transfer together with SRTS clock recovery is basically a simple combination of the CS protocols of section 2.3.2.2.2.1 and section 2.3.2.2.3.1.

The 47-octet SAR-SDU uses the two formats shown in Figure 1-F/I.363.

a) Operations of the non-P format

The non-P format is used if the SN count within the SAR-PDU header is 1, 3, 5 or 7. The CS indication bits carry the RTS value as described in section 2.3.2.2.2.1. The 47-octets of the CS-PDU are filled with user information.

b) Operations of the P format

The P format is used if the SN count within the SAR-PDU header is 0, 2, 4 or 6. The first octet of SAR-SDU is the pointer field and the remainder is filled with user information.

If pointer action is not needed for delineating a structured block contained in this SAR-SDU or in the next SAR-SDU, then the seven bits denoting the offset are set to the dummy value of all ones. The CS indication is set to 1 because the pointer field is present.

If pointer action is needed for delineation, the offset and pointer operation are as described in section 2.3.2.2.3.1.

The first structured block to be transmitted after the AAL connection is established uses the P format with SN count in the SAR-PDU header equal to 0 and with the first octet of the structured data placed in the second octet of the SAR-SDU.

2.3.2.2.4 Connection method for bit errors and lost cells

2.3.2.2.4.1 Correction method for bit errors and cell losses for unidirectional video services

This correction method combines Forward Error Correction (FEC) and octet interleaving, from which a CS-PDU structure is defined. FEC uses the Reed-Solomon (128,124) code which is able to correct up to 2 errored symbols (octets) or 4 erasures in the block of 128 octets. An erasure is an errored octet whose location in the block is known. In the transmitting CS, the 4 octet Reed-Solomon code is appended to 124 octets of incoming data from the upper layer. The resulting 128 octet long blocks are then forwarded to the octet interleaver. See Figure 1-H/I.363 for format of the interleave matrix.

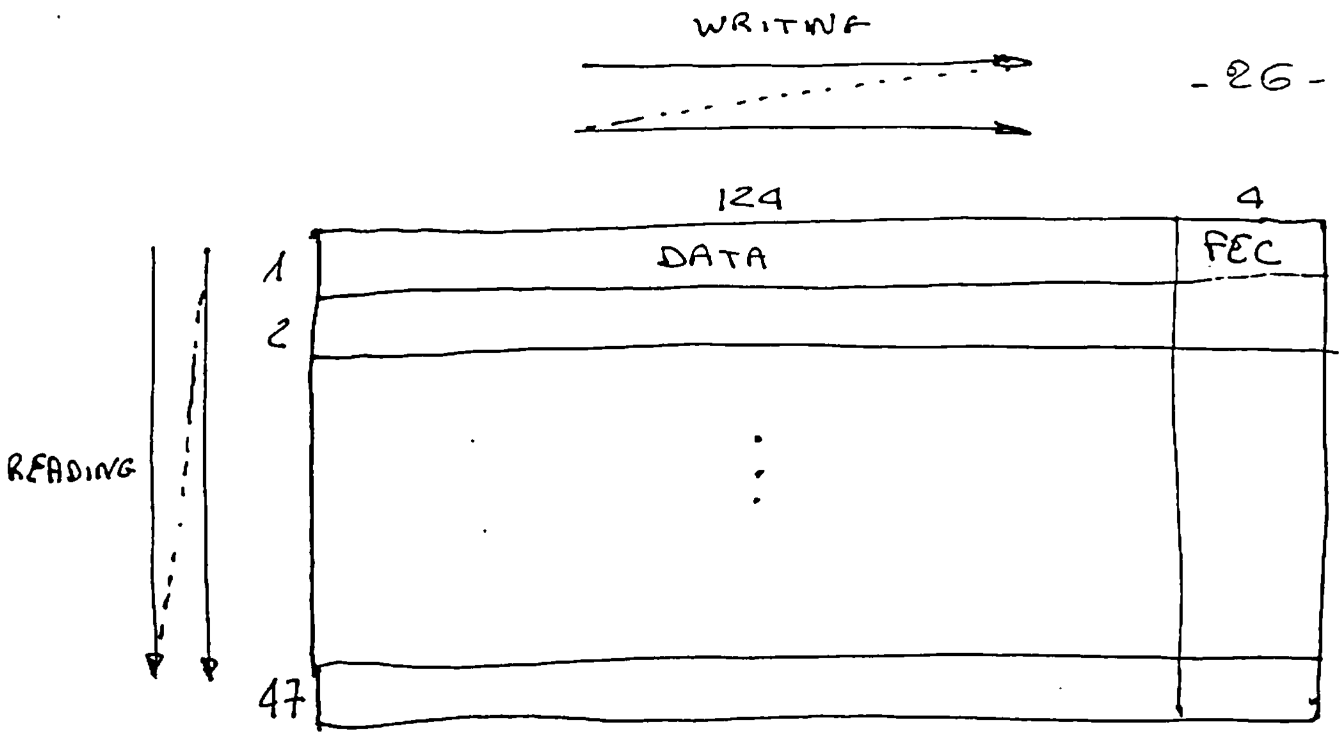

Figure 1-H/I.363 Format of the interleave matrix

The octet interleaver is organised as a matrix of 128 columns and 47 rows. The interleaver is used as follows; at the input, incoming 128 octet long blocks are stored row by row (one block corresponding to one row); at the output, octets are read out column by column. The matrix has 128 x 47 = 6016 octets, corresponding to 128 SAR-SDUs. These 128 SAR-SDUs constitute one CS-PDU.

In this process, the loss of one SAR-SDU in the ~~block~~ matrix implies one erasure to correct in each row of the matrix. Erasures correspond to dummy cell payloads inserted in the cell flow when a cell loss has been detected. Misinserted cells which have been detected are merely discarded in the CS.

For the synchronization of the CS-PDU, the CS indicator bit of the SAR-PDU header is set to 1 for the first SAR-SDU of the CS-PDU.

Within any CS-PDU matrix, this method can perform the following corrections;

- 4 cell losses ; or
- 2 cell losses and 1 errored octet in each row; or
- 2 errored octets in each row if there is no cell loss.

The overhead of the this method is 3.1%, and the delay is 128 cells.

ATTACHMENT 2
(to Annex 2)

TITLE : Possible candidate functions for AAL type 2

To further progress in AAL type 2 work, candidate functions were drafted and listed below. Listed functions are, firstly, those which are not covered in AAL type 1 and are suggested for AAL type 2. Secondary, the need of AAL type 1 functions for type 2 purpose is addressed, and if necessary, applicability of AAL type 1 method and protocol for such function should be examined.

At this stage, SWP XVIII/8-3 does not have any specific intention on inclusion of each function into Recommendation I.363, but wish to use this list as a starting point. It should also be noted that this is not a complete list.

The list should also be considered by SG XV ATM video coding experts group and CMTT, and comments are invited that will allow SWP XVIII/8-3 to progress in work for AAL type 2 video signal transport.

A. Functions not covered in AAL type 1 but suggested for AAL type 2

1. Multiplexing of information type or media

Possible user of this function may be multimedia multiplexing as suggested by SG XV ATM coding experts group.

2. Mapping of Cell Loss Priority (CLP)

This function will allow an AAL user to use CLP capability by setting CLP as high priority at the transmitting end. The use of this function may be carefully studied in conjunction with layered coding techniques as suggested in I.211 section 3 (Video aspects). The impact of violation tagging should also be addressed, for which SWP XVIII/8-7 has been studying.

3. Per-cell error protection

The need for this function and required performance should be addressed.

5. Framing of user data

This function may be provided by the field identifying cell payload as begging, continuation, end and single segment of user data. The possible other method to support this functions is to use a pointer that indicates the beginning of framed user data.

5. Partially filled cell

This function relates to the necessity of length indicator field. Packetizing delay issues should at first be studied.

B. Functions of AAL type 1 to be examined for AAL type 2

1. Source clock frequency recovery

Two method are described in AAL type 1, i.e., SRTS and adaptive clock. SRTS has been invented in SWP XVIII/8-3 to meet specific jitter performance specified in G.823/824 for transporting PDH signals. While adaptive clock is conventional method widely used in the existing terminals and the network. It should also be noted that this function can be provided by a AAL user implanting synchronization pattern within a layer above AAL. Therefore, required performance and applicability of the method to an AAL user should be studied.

2. Correction of bit errors and cell losses

The AAL type 1 specifies the method for this function as requested by CMTT for their unidirectional vide services. The method is a combination of Reed-Solomon code and octet interleaving. The need for this function for AAL 2 purpose and applicability of AAL type 1 method should be studied. Delay issue introduced by such method should also be examined.

注) ATM Layer user to user indication の Mapping は、このリストに含まれていません。（審議の順序の都合上）当然含まれるべき機能です。