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B-ISDN APPLICATION PROTOCOLS FOR ACCESS SIGNALLING

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 2 (DSS 2) – ADDITIONAL TRAFFIC PARAMETERS

ITU-T Recommendation Q.2961

(Previously "CCITT Recommendation")

FOREWORD

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The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation Q.2961 was prepared by ITU-T Study Group 11 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 17th of October 1995.

NOTE

In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

CONTENTS

SUMMARY

This Recommendation defines the operation of the Digital Subscriber Signalling System No. 2 (DSS 2) for the handling of additional traffic parameters that may be used for basic call and connection control at the T_B or at the coincident S_B and T_B reference point of the user-to-network interface of the Broadband Integrated Services Digital Network (B-ISDN). The additional capabilities defined in this Recommendation enable connection control and resource/bandwidth allocation to support communication between users using a connection oriented variable bit rate network provided bearer capability.

Recommendation Q.2961

BROADBAND INTEGRATED SERVICES DIGITAL NETWORK (B-ISDN) – DIGITAL SUBSCRIBER SIGNALLING SYSTEM No. 2 (DSS 2) – ADDITIONAL TRAFFIC PARAMETERS

(Geneva, 1995)

General information

This Recommendation covers the support of additional traffic parameters for the Broadband Integrated Services Digital Network (B-ISDN) at the T_B reference point or coincident S_B and T_B reference point as defined in Recommendation I.413 [1] by means of the Digital Subscriber Signalling System No. 2 (DSS 2). This Recommendation defines the DSS 2 protocol procedures, formats and functions needed to support the identified ATM traffic related additional capabilities.

The specifications provided by this Recommendation allow for the signalling of additional traffic parameters beyond the ones already specified by Recommendation Q.2931 [2] for B-ISDN basic call/connection control at the UNI. The additional traffic parameters support a Broadband Connection-Oriented Bearer Service (BCOB) as specified in Recommendation F.811 [3], in particular for services of bearer classes "C" (VBR without timing requirements), and "X".

This Recommendation is part of the DSS 2 family of ITU-T Recommendations; it specifies extensions to Recommendation Q.2931, and does not repeat states, information elements, messages and procedures contained therein, but only specifies extensions related to additional traffic parameter indications.

This Recommendation does not cover procedures for the negotiation and modification/re-negotiation of traffic parameters.

This is a multipart Recommendation, Part 1 covers only the additional parameters required for the support of the tagging option and the support of Sustainable Cell Rate (SCR) parameter set as specified in Recommendation I.371 [4]. Other parts will be developed to support additional traffic parameters for traffic handling capabilities as they will be defined in the scope of Recommendation I.371 [4].

PART 1 – ADDITIONAL SIGNALLING CAPABILITIES TO SUPPORT TRAFFIC PARAMETERS FOR THE TAGGING OPTION AND THE SUSTAINABLE CELL RATE PARAMETER SET

1.1 Scope

This Recommendation covers the support of additional traffic parameters for the Broadband Integrated Services Digital Network (B-ISDN) at the T_B reference point or coincident S_B and T_B reference point as defined in Recommendation I.413 [1] by means of the Digital Subscriber Signalling System No. 2 (DSS 2). This Recommendation defines the DSS 2 protocol procedures, formats and functions needed to support the identified ATM traffic related additional capabilities.

This Recommendation is part of the DSS 2 family of ITU-T Recommendations; it specifies extensions to Recommendation Q.2931, and does not repeat states, information elements, messages and procedures contained therein, but only specifies extensions related to additional traffic parameter indications.

This part of the Recommendation defines the capabilities to support additional traffic parameters required for the tagging option and the Sustainable Cell Rate parameter set as defined in the Recommendation I.371 [4].

This part of the Recommendation does not cover procedures for the negotiation and modification/re-negotiation of traffic parameters.

1.2 References

The following Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. All references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below. A list of currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation I.413 (1993), *B-ISDN user-network interface.*

[2] ITU-T Recommendation Q.2931 (1995), *Broadband Integrated Services Digital Network (B-ISDN) – Digital Subscriber Signalling System No. 2 (DSS 2) – User Network Interface (UNI) layer 3 specification for basic call/connection control.*

[3] CCITT Recommendation F.811 (1992), *Broadband connection-oriented bearer service.*

[4] ITU-T Recommendation I.371, *Traffic control and congestion control in B-ISDN.*

[5] ITU-T Recommendation I.150 (1993), *B-ISDN asynchronous transfer mode functional characteristics.*

[6] ITU-T Recommendation I.361 (1993), *B-ISDN ATM layer specification.*

[7] ITU-T Recommendation Q.2951 (1995), *Stage 3 description for number identification supplementary services using B-ISDN Digital Subscriber Signalling System No. 2 (DSS 2) – Basic call.*

[8] ITU-T Recommendation Q.2957 (1995), *Stage 3 description for additional information transfer supplementary services using B-ISDN Digital Subscriber Signalling System No. 2 (DSS 2) – Basic call.*

1.3 Definitions

The definitions of Recommendation Annex J/Q.2931 [2] apply. For the purposes of this Recommendation, the following definitions apply in addition:

1.3.1 cell loss priority (CLP): A one-bit indication in the header of each ATM cell. This bit indication may be used by the user to generate traffic flows with two different cell loss ratio objectives, as defined in Recommendation I.150 [5].

1.3.2 traffic contract: A traffic contract specifies the negotiated traffic and QOS characteristics of an ATM layer connection at the B-ISDN UNI (see Recommendation I.371 [4]).

1.3.3 traffic control: Traffic control at the ATM layer refers to the set of actions taken by the network to avoid congested conditions. A list of traffic control functions is given in Recommendation I.371.

1.3.4 traffic parameters: A traffic parameter is a specification of a particular traffic aspect. It may be quantitative or qualitative. Traffic parameters may for example describe peak cell rate, sustainable cell rate, maximum burst size, etc.

1.3.5 tagging: Tagging means that CLP = 0 cells identified by the UPC function performed on CLP = 0 flow as non-confirming are converted to CLP = 1 cells and merged with the user submitted CLP = 1 traffic flow before the CLP = 0 + 1 traffic flow enters the UPC mechanism (see Recommendation I.371 [4]).

1.4 Abbreviations

The abbreviations of Annex J/Q.2931 [2] apply. For the purposes of this Recommendation, the following abbreviations apply in addition:

CAC	Connection Admission Control
CDV	Cell Delay Variation
CLR	Cell Loss Ratio
GCRA	Generic Cell Rate Algorithm
IBT	Intrinsic Burst Tolerance
MBS	Maximum Burst Size
NPC	Network Parameter Control
PCR	Peak Cell Rate
SCR	Sustainable Cell Rate
UPC	Usage Parameter Control

1.5 Description

This Part specifies the signalling of additional traffic parameters beyond the ones already specified by Recommendation Q.2931 [2]. In particular, the following additional capabilities are specified:

- support of traffic parameters for statistical multiplexing using SCR parameter set (sustainable cell rate, maximum burst size);
- use of the “tagging option”.

1.6 Operational requirements

1.6.1 Provision and withdrawal

The additional traffic indications may be included in signalling messages by the user as specified in this Recommendation without any prior arrangement with the service provider.

1.6.2 Requirements at the originating network side

The procedures according to 1.9 shall apply.

1.6.3 Requirements at the terminating network side

The procedures according to 1.9 shall apply.

1.7 Primitive and state definitions

1.7.1 Primitive definitions

Clause 8/Q.2931 shall apply.

1.7.2 Call states

See clause 2/Q.2931. No additional call states are defined.

1.8 Coding requirements

1.8.1 Messages

No additional messages are specified beyond the ones of 3.1/Q.2931. The existing Q.2931 messages that have had their contents modified to support the additional traffic parameters are described below.

1.8.1.1 SETUP

Only the maximum length of the ATM traffic descriptor information element included in the SETUP message is changed from 20 to 30 octets to allow inclusion of additional traffic descriptor parameters.

1.8.1.2 CONNECT

This message is sent by the called user to the network and by the network to the calling user to indicate call acceptance by the called user. See Table 1 for additions to the structure of this message shown in Table 3-2/Q.2931.

TABLE 1/Q.2961

CONNECT message additional content

Message type: CONNECT Significance: global Direction: both				
Information element	Reference	Direction	Type	Length
ATM traffic descriptor	8.2.1/Q.2961	Both	O (Note)	4-6
NOTE – Included in the user-to-network direction only when the SETUP message contained an ATM traffic descriptor information element with the Tb parameter set to “1”. Included in the network-to-user direction only when the SETUP message contained an ATM traffic descriptor information element with the Tf parameter set to “1”. In this message this information element has only local significance and contains only octets 1, 2, 3, 4, 17 and 17.1.				

1.8.2 Information elements

See clause 4/Q.2931. The coding of the ATM traffic descriptor information element is extended and is shown in 1.8.2.1.

1.8.2.1 ATM traffic descriptor

The ATM traffic descriptor information element is specified in Recommendation Q.2931 and is extended as shown in Figure 1 and Table 2. The maximum length of this information element is 30 octets.

1.9 Signalling procedures at the coincident S_B and T_B reference point

The procedures for basic call/connection control as defined in clause 5/Q.2931 [2] shall apply. Only additional procedures to handle the additional traffic parameters that may be present in the ATM traffic descriptor information element are indicated in the following subclauses.

1.9.1 Procedures for the support of Sustainable Cell Rate parameter set

The calling party initiates call establishment as specified in 5.1/Q.2931 and 5.2/Q.2931. The rules for selection of traffic parameters for a given direction are specified below:

- PCR for CLP = (0 + 1) is a mandatory parameter.
- The value of the Sustainable Cell Rate must be less than that for Peak Cell Rate.
- The tagging option may only be used when the traffic descriptor IE includes a parameter on CLP = 0.
- There is a relationship between MBS and Intrinsic Burst Tolerance (IBT) which also depends on the SCR and PCR (see Appendix III).
- The Sustainable Cell Rate and Maximum Burst Size must be provided together for the same CLP indication, for a given direction.
- Forward and backward direction are independent from each other, i.e. the forward direction may use one combination of traffic parameters, while the backward direction uses a different combination of traffic parameters.

Allowable combinations will depend on the ATM layer traffic handling capabilities.

Bits								
8	7	6	5	4	3	2	1	Octets
								1 to 8 see Q.2931 (Note)
Forward Sustainable Cell Rate Id. (CLP = 0)								9*
1	0	0	0	1	0	0	0	
Forward								9.1*
Sustainable Cell Rate								9.2*
(for CLP = 0)								9.3*
Backward Sustainable Cell Rate Id. (CLP = 0)								10*
1	0	0	0	1	0	0	1	
Backward								10.1*
Sustainable Cell Rate								10.2*
(for CLP = 0)								10.3*
Forward Sustainable Cell Rate Id. (CLP = 0 + 1)								11*
1	0	0	1	0	0	0	0	
Forward								11.1*
Sustainable Cell Rate								11.2*
(for CLP = 0 + 1)								11.3*
Backward Sustainable Cell Rate Id. (CLP = 0 + 1)								12*
1	0	0	1	0	0	0	1	
Backward								12.1*
Sustainable Cell Rate								12.2*
(for CLP = 0 + 1)								12.3*
Forward Maximum Burst Size Id. (CLP = 0)								13*
1	0	1	0	0	0	0	0	
Forward								13.1*
Maximum Burst Size								13.2*
(for CLP = 0)								13.3*
Backward Maximum Burst Size Id. (CLP = 0)								14*
1	0	1	0	0	0	0	1	
Backward								14.1*
Maximum Burst Size								14.2*
(for CLP = 0)								14.3*
Forward Maximum Burst Size Id. (CLP = 0 + 1)								15*
1	0	1	1	0	0	0	0	
Forward								15.1*
Maximum Burst Size								15.2*
(for CLP = 0 + 1)								15.3*
Backward Maximum Burst Size Id. (CLP = 0 + 1)								16*
1	0	1	1	0	0	0	1	
Backward								16.1*
Maximum Burst Size								16.2*
(for CLP = 0 + 1)								16.3*
Traffic Management Options Identifier								17*
1	0	1	1	1	1	1	1	
Spare						Tb	Tf	17.1*
0	0	0	0	0	0			

NOTE – The fields "Forward Peak Cell Rate (for CLP = 0 + 1)" and "Backward Peak Cell Rate (for CLP = 0 + 1)" are mandatory if the ATM traffic descriptor information element is included in the SETUP message. They are optional if the ATM traffic descriptor information element is included in the CONNECT message.

FIGURE 1/Q.2961

ATM traffic descriptor information element

TABLE 2/Q.2961

ATM traffic descriptor information element

– Forward/backward sustainable cell rate (octets i.1-i.3, where i may have the values 9-12): A value expressing in pure 3 octet integer representation the number of cells per second, with bit 8 of the first octet being the most significant bit, and bit 1 of the third octet being the least significant bit. The “forward” direction is defined as that from the calling user to the called user. The “backward” direction is the reverse, i.e. from the called user to the calling user (see Annex J/Q.2931 [2]).
– Forward/backward maximum burst size (octets i.1-i.3, where i may have the values 13-16): The maximum burst size is expressed in cells and is coded as pure 3 octet integer with bit 8 of the first octet being the most significant bit, and bit 1 of the third octet being the least significant bit.
– Tb (tagging backward) (octet 17.1) Bit 2 – user-to-network (Note 1) – network-to-user (Note 2) 0 – tagging not allowed – tagging not supported 1 – tagging requested – tagging supported NOTE 1 – At the destination side, if octet 17.1 is omitted, a default of “tagging not allowed” shall apply. At the originating side, the field is spare. NOTE 2 – At the destination side, if octet 17.1 is omitted, a default of “tagging not supported” shall apply. At the originating side, the field is spare.
– Tf (tagging forward) (octet 17.1) Bit 1 – user to network (Note 3) – network to user (Note 4) 0 – tagging not allowed – tagging not applied 1 – tagging requested – tagging applied NOTE 3 – At the originating side, if octet 17.1 is omitted, a default of “tagging not allowed” shall apply. At the destination side, the field is spare. NOTE 4 – At the originating side, if octet 17.1 is omitted, a default of “tagging not applied” shall apply. At the destination side, the field is spare.

1.9.2 Handling of the traffic management options field for the local support of tagging

1.9.2.1 Procedures applicable at the originating interface

The calling user, by use of the Tf subfield in the ATM traffic descriptor information element, may indicate in the SETUP message that tagging requested or not allowed for the user plane traffic in the forward direction (See Recommendation I.371 [4] for definition of tagging).

When the network receives a SETUP message with the Tf subfield set to “tagging requested”, and the network accepts the request to apply tagging for the user plane traffic in the forward direction, the network shall upon call acceptance include an ATM traffic descriptor information element in the CONNECT message, set the Tf subfield to “tagging applied”. Otherwise, the network shall not apply tagging and take one of the following actions:

1) include upon call acceptance an ATM traffic descriptor information element in the CONNECT message with Tf subfield “tagging not applied”;

2) not include upon call acceptance an ATM traffic descriptor information element in the CONNECT message.

1.9.2.2 Procedures applicable at the destination interface

When the network sends a SETUP message, and the network supports the tagging option for the user plane traffic in the backward direction (see 2.3.1/I.371), the network shall include a Traffic Management Options in this message with the Tb subfield set to “tagging supported”. If the network does not support the tagging option, the network shall take one of the following actions:

1) include a Traffic Management Options field in the ATM traffic descriptor information element in the SETUP message with the Tb subfield set to “tagging not supported”;

2) not include a Traffic Management Options field in the ATM traffic descriptor information element in the SETUP message.

When the user receives a SETUP message with the Tb subfield set to “tagging supported”, and the user wishes to request tagging, the user shall upon call acceptance include an ATM traffic descriptor information element in the CONNECT message with the Tb subfield set to “tagging requested”. Otherwise, the user shall take one of the following actions:

1) include an ATM traffic descriptor information element with the Tb subfield set to “tagging not allowed” in the CONNECT message;

2) not include ATM traffic descriptor information element in the CONNECT message.

When the network had indicated to the user that it supports tagging, and it receives a CONNECT message which contains an ATM traffic descriptor information element with Tb subfield set to “tagging requested”, the network shall apply tagging for the user plane traffic in the backward direction. Otherwise, it shall not apply tagging.

1.9.3 Handling of specific error conditions

When the SETUP message is received with an ATM traffic descriptor information element which contains a combination of traffic parameters that is not allowed (see 1.9.1) the ATM traffic descriptor information element shall be treated as a mandatory information element received with content error (see 5.6.7.2/Q.2931).

1.10 Signalling procedures at the T_B reference point for interworking with private B-ISDNs

The procedures of 1.9 shall apply.

1.11 Interworking with other networks

1.11.1 Interaction with entities which do not support the Q.2961 capabilities

If an entity which does not support the capabilities described in this Part receives an ATM traffic descriptor information element in a SETUP message with the additional fields defined in 1.8.2, it shall follow the procedures described in 5.6/Q.2931, 5.7Q.2931 and 5.8/Q.2931 [2].

1.11.2 Interworking with N-ISDN

It is not possible to interwork these capabilities with an N-ISDN entity.

1.12 Interactions with supplementary services

The support of the capabilities covered by this Part have no impact on the support of CLIP, CLIR, COLP, COLR, DDI, SUB, UUS and MSN supplementary services as specified in Recommendations Q.2951 [7] and Q.2957 [8].

1.13 Parameter values

Not applicable for this Recommendation.

1.14 Dynamic description (SDLs)

Not applicable for this Recommendation.

Appendix I

Additional definitions

(This appendix does not form an integral part of this Recommendation)

It should be noted that Study Group (SG) 13 is producing the definitive work in this area. Therefore the informative text in this appendix will be superseded by I.371 text when available. In the event of conflict, Recommendation I.371 takes precedence over the contents of this appendix.

I.1 Usage Parameter Control (UPC)

Usage parameter control is the set of actions taken by the network to monitor and control traffic in terms of traffic offered and validity of the ATM connection, at the user access. Its main purpose is to protect network resource from malicious as well as unintentional misbehaviour which can affect the QOS of other already established connections by detecting violations of negotiated parameters and taking appropriate actions.

I.2 Interpretation of sustainable cell rate and maximum burst size

SCR and MBS are traffic parameters the calling user may use, if the user can upper bound the realized mean cell rate of the ATM connection to a value below the PCR. If used, the calling user must include both parameters. Note that the PCR for CLP = 0 + 1 traffic is a mandatory parameter of the ATM traffic descriptor information element.

The SCR is an upper bound on the possible conforming “mean rate” of an ATM connection, where “mean rate” is the number of cells transmitted divided by the “duration of the connection”, where in this case, the “duration of the connection” is the time from the emission of the first cell until the state of the GCRA for the SCR returns to zero after the emission of the last cell of the connection.

SCR and MBS are defined as parameters of the GCRA (see Appendix II). Enforcement of this parameter set could allow the network operator to allocate sufficient resources for statistical multiplexing using SCR parameter set (sustainable cell rate, maximum burst size), but less than those based on the PCR, and still ensure that the performance objectives (e.g. for cell loss ratio) can be achieved. Further details for the interpretation of the SCR are provided in Appendix III.

NOTE – The SCR parameter set values (indicated in the ATM traffic descriptor information element) specify the sum of both the user plane information and end-to-end user originated OAM F5 flows. Accordingly no additional OAM traffic descriptor for SCR is needed.

Appendix II

Generic Cell Rate Algorithm (GCRA)

(This appendix does not form an integral part of this Recommendation)

It should be noted that Study Group 13 is producing the definitive work in this area. Therefore the informative text in this appendix will be superseded by I.371 text when available. In the event of conflict, Recommendation I.371 takes precedence over the contents of this appendix.

The Generic Cell Rate Algorithm (GCRA) is a virtual scheduling algorithm or a continuous-state leaky bucket algorithm as defined by the flowchart in Figure II.1. The GCRA is used to define, in an operational manner, a relationship between a cell rate and an associated tolerance (e.g. between PCR and CDV tolerance, or between SCR and MBS). In addition, for the cell flow of an ATM connection, the GCRA is used to specify the conformance at the UNI to declared values of the above two tolerances.

For each cell arrival, the GCRA determines whether the cell is conforming with the traffic contract of the connection, and thus the GCRA is used to provide the formal definition of traffic conformance to the traffic contract. Although traffic conformance is defined in terms of the GCRA, the network provider is not obligated to use this algorithm (or this algorithm with the same parameter values) for the Usage Parameter Control (UPC). Rather, the network provider may use any UPC as long as the operation of the UPC does not violate the QOS objectives of a compliant connection.

The GCRA depends only on two parameters: the increment I and the limit L. These parameters have been denoted by T and τ respectively in Annex A/I.371, but have been given more generic labels herein since the GCRA will be used in multiple instances. The notation "GCRA(I, L)" means the generic cell rate algorithm with the value of the increment parameter set equal to I and the value of the limit parameter set equal to L.

The GCRA is formally defined in Figure II.1. Figure II.1 is a generic version of Figure A.1/I.371. The two algorithms in Figure II.1 are equivalent in the sense that for any sequence of cell arrival times, $\{ta(k), k \geq 1\}$ the two algorithms determine the same cells to be conforming and thus the same cells to be non-conforming. The two algorithms are easily compared if one notices that at each arrival epoch, ta(k), and after the algorithms have been executed, TAT = X + LCT, see Figure II.1. An explanation of each algorithm follows.

The virtual scheduling algorithm updates a Theoretical Arrival Time (TAT), which is the "nominal" arrival time of the cell assuming equally spaced cells when the source is active. If the actual arrival time of a cell is not "too" early relative to the TAT, i.e. if the actual arrival time is after TAT – L, then the cell is conforming, otherwise the cell is non-conforming.

Tracing the steps of the virtual scheduling algorithm in Figure II.1, at the arrival time of the first cell $t_a(1)$, the theoretical arrival time TAT is initialized to the current time, $t_a(1)$. For subsequent cells, if the arrival time of the k^{th} cell, $t_a(k)$, is actually after the current value of the TAT then the cell is conforming and TAT is updated to the current time $t_a(k)$, plus the increment I. If the arrival time of the k^{th} cell is greater than or equal to TAT – L but less than TAT (i.e. as expressed in Figure II.1, if TAT is less than or equal to $t_a(k) + L$), then again the cell is conforming, and the TAT is increased by the increment I. Lastly, if the arrival time of the k^{th} cell is less than TAT – L (i.e. if TAT is greater than $t_a(k) + L$), then the cell is non-conforming and the TAT is unchanged.

The continuous-state leaky bucket algorithm can be viewed as a finite-capacity bucket whose real-valued content drains out at a continuous rate of 1 unit of content per time-unit and whose content is increased by the increment I for each conforming cell. Equivalently, it can be viewed as the work load in a finite-capacity queue or as a real-valued counter. If at a cell arrival the content of the bucket is less than or equal to the limit value, L, then the cell is conforming, otherwise the cell is non-conforming. The capacity of the bucket (the upper bound on the counter) is L + I.

Tracing the steps of the continuous-state leaky bucket algorithm in Figure II.1, at the arrival time of the first cell $t_a(1)$, the content of bucket, X, is set to zero and the last conformance time (LCT) is set to $t_a(1)$. At the arrival time of the k^{th} cell, $t_a(k)$, first the content of the bucket is provisionally updated to the value X′, which equals the content of the bucket, X, after the arrival of the last conforming cell minus the amount the bucket has drained since that arrival, where the content of the bucket is constrained to be non-negative. Second, if X′ is less than or equal to the limit value L, then the cell is conforming, and the bucket content X is set to X′ plus the increment I for the current cell, and the last conformance time LCT, is set to the current time $t_a(k)$. If, on the other hand, X′ is greater than the limit value L, then the cell is non-conforming and the values of X and LCT are not changed.

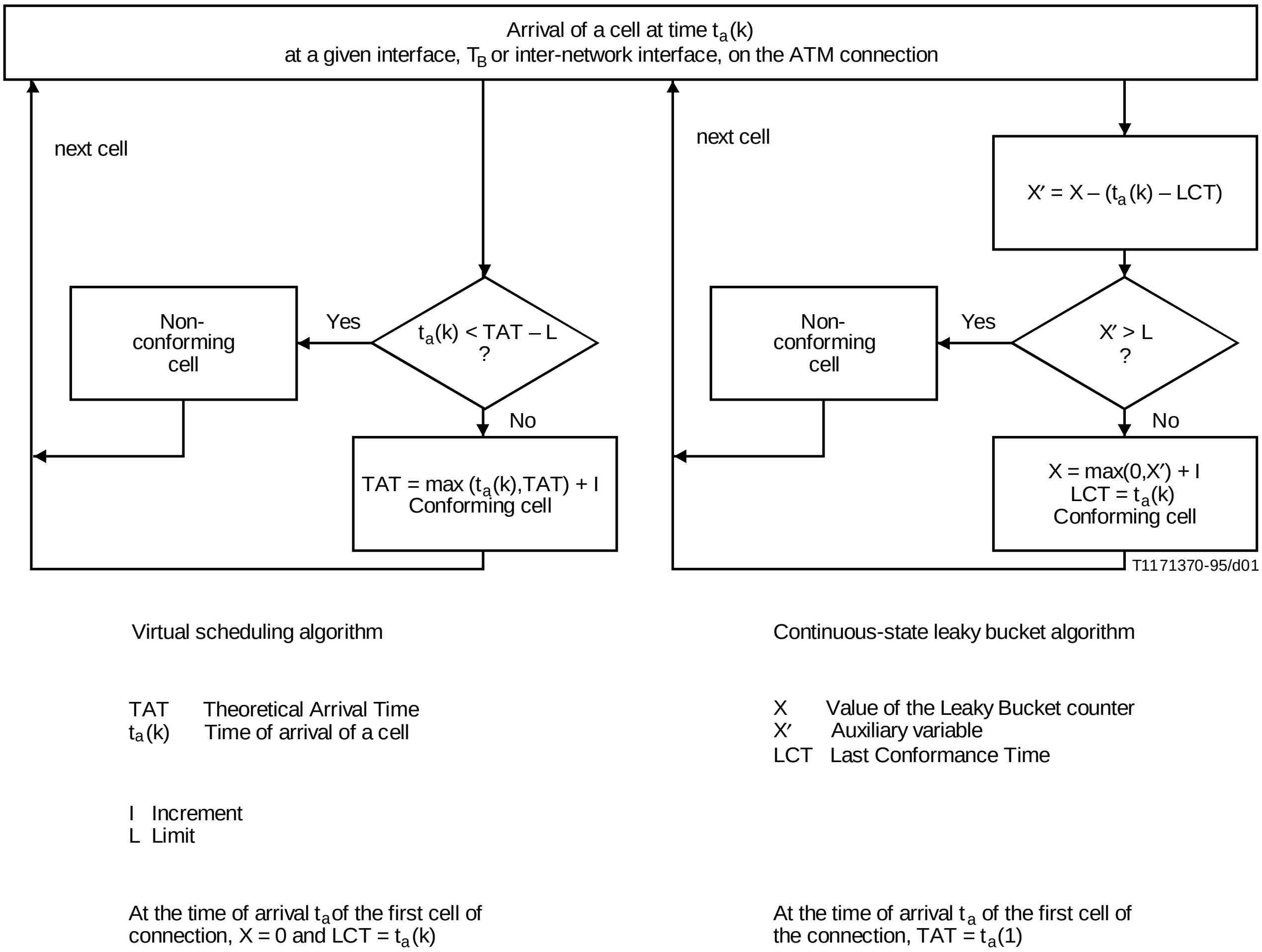

FIGURE II.1/Q.2961

Equivalent versions of the generic cell rate algorithm

Appendix III

Relation between maximum burst size and intrinsic burst tolerance in conjunction with peak cell rate

(This appendix does not form an integral part of this Recommendation)

III.1 Sustainable Cell Rate

It should be noted that Study Group 13 is producing the definitive work in this area. Therefore the informative text in this appendix will be superseded by I.371 text when available. In the event of conflict, Recommendation I.371 takes precedence over the contents of this appendix.

The SCR, denoted as Λ_{sCR}, is an upper bound on the possible conforming "mean rate" of an ATM connection, where "mean rate" is the number of cells transmitted divided by the "duration of the connection"; where in this case, the "duration of the connection" is the time from the emission of the first cell until the state of the GCRA for the SCR returns to zero after the emission of the last cell of the connection. Relative to the peak cell rate parameter, T_{sCR} is greater than the peak emission interval T_{PCR} where T_{sCR} is the inverse of Λ_{sCR}.

SCR and MBS are traffic parameters the calling user may use, if the user can upper bound the realized mean cell rate of the ATM connection to a value below the PCR. If used, the calling user must include both parameters. Note that the PCR for CLP = 0 + 1 traffic is a mandatory parameter of the ATM traffic descriptor information element. The value of the SCR must be less than the PCR. For CBR connections, the user would not declare a SCR and would only declare a PCR.

The SCR and MBS traffic parameters enable the end-user/terminal to describe the future cell flow of an ATM connection in greater detail than just the PCR. If an end-user/terminal is able to specify the future cell flow in greater detail than just the PCR, then the network provider may be able to more efficiently utilize the network resources. This directly benefits the network provider whether public or private, and in the case of public ATM networks, benefits the end-user with possible reduced charges for the connection.

If the source wants to submit traffic that conforms to the SCR ($\Lambda_{sCR} = 1/T_{SCR}$) and the intrinsic burst tolerance (τ_{IBT}) and the peak cell rate ($1/T_{PCR}$) at the physical layer SAP of the equivalent terminal, then it offers traffic that is conforming to the GCRA(T_{sCR}, τ_{IBT}) and the peak emission interval T_{PCR} [i.e. GCRA(T_{PCR}, 0)].

The MBS together with the SCR and the GCRA determine the maximum burst size (MBS) that may be transmitted at the peak cell rate and still be in conformance with the GCRA(T_{sCR}, τ_{IBT}). The maximum burst size in number of cells is given by:

$$MBS = \left\lfloor 1 + \frac{\tau_{IBT}}{T_{sCR} - T_{PCR}} \right\rfloor$$

where $\lfloor x \rfloor$ stands for the integer part of x.

In the signalling message, the burst tolerance is conveyed through the MBS which is coded in number of cells. The granularity supported by the signalling message is one cell. The MBS used to derive the value of τ_{IBT} applies at the physical layer SAP of the equivalent terminal. Note that in order to determine τ_{IBT} from the MBS, the peak cell rate also needs to be specified. By convention, the peak rate used in the calculation of τ_{IBT} is the peak cell rate of the CLP = 0 + 1 cell flow. This convention holds whether τ_{IBT} is associated with the SCR for the CLP = 0, or the CLP = 1, or the CLP = 0 + 1 cell flow of the connection. Also, given the MBS, T_{PCR}, and T_{sCR}, then τ_{IBT} is not uniquely determined, but can be any value in the half-closed interval:

$$\left[(\text{MBS} - 1)(\text{T}_{\text{sCR}} - \text{T}_{\text{PCR}}),\ \text{MBS}(\text{T}_{\text{sCR}} - \text{T}_{\text{PCR}})\right]$$

Hence, in order for all parties to derive a common value for τ_{IBT}, by convention, the minimum possible value is used. Thus, given the MBS, T_{PCR}, and T_{sCR}, then τ_{IBT} is set equal to:

$$\tau_{\text{IBT}} = \left\lceil (\text{MBS} - 1)(\text{T}_{\text{sCR}} - \text{T}_{\text{PCR}}) \right\rceil$$

Where $\lceil x \rceil$ stands for the first value above x out of a generic list of values for τ_{IBT}.

Note that over any closed time interval of length t, the number of cells, N(t), that can be emitted with spacing no less than T_{PCR} and still be in conformance with GCRA(T_{sCR}, τ_{IBT}) is bounded by:

$$N(t) \leq \min\left(\left\lfloor 1 + \frac{t + \tau_{IBT}}{T_{sCR}} \right\rfloor, \left\lfloor 1 + \frac{t}{T_{PCR}} \right\rfloor\right)$$

Observe that if t is greater than or equal to the MBS × T_{PCR}, then the first term of the above equation applies; otherwise, the second term applies.

Note that the maximum conforming burst size, defined above, does not imply that bursts of this size with arbitrary spacing between the bursts would be conforming with the GCRA(T_{sCR}, τ_{IBT}). Rather, in order for a burst this large to be conforming, the cell stream needs to be idle long enough for the state of the GCRA associated with SCR to become zero (i.e. long enough for the continuous-state leaky bucket to become empty) prior to the burst.

If a user chooses to specify values for the SCR and MBS traffic parameters and wishes to cell emit conforming bursts at the peak rate, then the appropriate choice of T_{sCR} and τ_{IBT} depends on the minimum spacing between bursts as well as the burst size. For a cell flow of an ATM connection, if the minimum spacing between bursts at the equivalent terminal is T_I and if the maximum burst size (with inter-cell spacing T_{PCR}) is B, then the cell flow is conforming with GCRA(T_{sCR}, τ_{IBT}), if T_{sCR}, τ_{IBT} are chosen at least large enough to satisfy the following equation:

$$B = 1 + \left\lfloor \frac{\min(T_I - T_{sCR}, \tau_{IBT})}{T_{sCR} - T_{PCR}} \right\rfloor$$

where $\lfloor x \rfloor$ stands for the integer part of x.

The traffic pattern conforming with the GCRA(T_{sCR}, τ_{IBT}) is in general not unique. Two traffic patterns are equivalent in relationship with the GCRA(T_{sCR}, τ_{IBT}) if they both conform at the physical layer SAP with the GCRA(T_{sCR}, τ_{IBT}) within the equivalent terminal. Therefore, any cell stream that complies with the GCRA(T_{PCR}, 0) and GCRA(T_{sCR}, τ_{IBT}) at the physical layer SAP has a peak cell rate of $R_p = 1/T_{PCR}$, a mean cell rate which is bounded by $\Lambda_{sCR} = 1/T_{sCR}$ and a burst length which is bounded by B. Note that the bounds Λ_{sCR} and B are achievable. For example, a periodic cell stream with period $B * T_{sCR}$ which transmits B cells at the peak rate with inter burst spacing $T_I = B * (T_{sCR} - T_{PCR}) + T_{PCR}$ has peak cell rate Λ, sustainable cell rate Λ_{sCR} and burst length B, and is compliant with both GCRAs.

Appendix IV

ATM layer traffic handling capabilities and network specific codepoint

(This appendix does not form an integral part of this Recommendation)

IV.1 ATM layer traffic handling capabilities

Recommendation I.371 will be providing the specification of new ATM layer traffic handling capabilities. Part 2 of this Recommendation will contain an indication of these capabilities that will be specified in revision 1 of Recommendation I.371. The relationship between these capabilities and the Bearer Classes will be specified and it is not expected that there will be a one-to-one relationship.

IV.2 Network specific codepoint

The subfield identifier coded "10111110" of the ATM traffic descriptor information element is reserved for network specific use.