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Communication to 3GPP

QUESTIONS: 3GPP TSG RAN
SOURCE: Q4/13 (Munich 5-7 September 2001)
TITLE: Communication on AAL TYPE 2 RESOURCE MANAGEMENT

COMMUNICATION TO 3GPP TSG RAN

TO: 3GPP TSG RAN
APPROVAL: Q4/13 (Munich 5-7 September 2001)
FOR: Request for comments
DEADLINE: ITU-T SG13 meeting in January 2002

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Q4/13 would like to inform you that the new draft recommendation I.371aal2 with the title "Traffic Control and Congestion Control at the AAL2" has been enhanced at the Rapporteur meeting in Munich. We include the new draft for your information. Your comments are welcome.

In particular, two options are identified how to apply the traffic parameters (see 5.3.2.2 of draft I.371aal2).

i) In the first option, the rate applies only to CPS packets containing user data and not to CPS packets containing control information.

ii) In the other option, the rate applies to all CPS packets of the AAL type 2 connection.

As an example, CPS packet containing control information could be PDU type 14 frame on the Iu cs interface (3GPP TS25.415)
Q4/13 prefers the first option because of the following reasons:

- The amount of control packets is difficult to predict
- CPS packets containing control information may be longer than the other CPS packets of the connection.

However, for the first option, it would be preferable to be able to distinguish user data packets and control packets at the CPS level. Q4/13 would appreciate 3GPP comments on this issue.

We expect to complete the work on this new recommendation at the next ITU-T SG 13 meeting in January 2002.

We are looking forward to hearing from you on this matter.

Attachment:

Revised draft recommendation I.371aal2: "Traffic Control and Congestion Control at the ATM Adaptation Layer Type 2"

Traffic Control and Congestion Control at the ATM Adaptation Layer Type 2

(All sections are under study.)

1 Scope

This Recommendation describes traffic control and congestion control procedures at the AAL type 2 level as defined in [3]. Such control procedures are necessary in order to support AAL type 2 connections with QOS.

AAL type 2 traffic control refers to all network actions aiming to meet the negotiated performance objectives at the AAL type 2 level and to allow the avoidance of congested conditions.

AAL type 2 congestion control refers to all network actions to minimize the intensity, spread and duration of congestion.

This Recommendation provides a general description as well as objectives and procedures for AAL type 2 traffic control and congestion control. It introduces the concept of AAL type 2 transfer capability. For each AAL type 2 transfer capability, it specifies AAL type 2 traffic parameters, an AAL type 2 conformance definition and defines AAL type 2 QOS commitments. Additionally, it describes the concepts of the AAL type 2 traffic contract.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other 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 Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

[1] ITU-T Recommendation I.371 (2000), *Traffic Control and Congestion Control in B-ISDN*.

[2] ITU-T Recommendation I.356 (2000), *B-ISDN ATM layer cell transfer performance*.

[3] ITU-T Recommendation I.363.2 (2000), *B-ISDN ATM Adaptation Layer (AAL) Type 2 Specification.*

[4] ITU-T Recommendation Q.2630.1 (2000), *AAL Type 2 Signalling Protocol (Capability Set 1)*

[5] ITU-T Recommendation Q.2630.2 (2001), *AAL Type 2 Signalling Protocol (Capability Set 2)*

[6] ITU-T Draft Recommendation Y.*iptc* (2001), *Traffic Control and Congestion Control in IP Based Networks*

3 Abbreviations

This Recommendation uses the following abbreviations.

AAL type 2	ATM Adaptation Layer Type 2
ARcps	Average CPS byte rate
ATC	ATM Transfer Capability
ATM	Asynchronous Transfer Mode
Bcps	CPS Token Bucket Size
CPS	Common Part Sublayer
DBR	Deterministic Bit Rate
FBW	Fixed Bandwidth
GBRA	Generic Byte Rate Algorithm
IP	Internet Protocol
Mcps	Maximum allowed CPS packet size
PDU	Protocol Data Unit
PRcps	Peak CPS byte rate
QOS	Quality of Service
SBR	Statistical Bit Rate
SCR	Sustainable Cell Rate
SDU	Service Data Unit

TB	Token Bucket
VBW-S	Variable Bandwidth Stringent
VBW-T	Variable Bandwidth Tolerant
VCC	Virtual Channel Connection

4 Introduction

The AAL type 2 was defined in [3]. An AAL type 2 connection uses one or several contiguous ATM VCCs called AAL type 2 paths. An AAL type 2 path can be shared by up to 248 AAL type 2 user connections. QOS for an AAL type 2 connection is then determined by

- the QOS associated with the AAL type 2 paths (the ATM VCCs) along the connection as defined in [2],
- the QOS supported by AAL type 2 multiplexing where the AAL type 2 connection is put inside an AAL type 2 path.

The primary role of traffic control and congestion control procedures at the AAL type 2 level is to protect the AAL type 2 traffic when it is multiplexed onto an AAL type 2 path. The goal is to achieve the AAL type 2 performance objectives and AAL type 2 QOS commitments. Traffic and congestion control allows the use of AAL type 2 paths to be optimised.

Congestion at the AAL type 2 level is defined as a state of network elements (e.g. AAL type 2 switches) in which the network is not able to meet the AAL type 2 performance objectives and the negotiated AAL type 2 QOS commitments for the established AAL type 2 flows. Congestion is to be distinguished from the state where buffer overflow causes CPS packet loss, but the negotiated quality of service is still met.

This Recommendation defines a set of traffic control and congestion control capabilities at the AAL type 2 level. It may be appropriate to consider additional sets of such capabilities, for which additional traffic control mechanisms will be used to achieve increased network efficiency.

It should be noted that AAL type 2 traffic control procedures apply to AAL type 2 connections. For some AAL type 2 connections, the network commits to meet QOS objectives, assuming the AAL type 2 connection conforms to a traffic contract.

5 AAL type 2 traffic parameters and descriptors

5.1 Definitions

5.1.1 AAL type 2 traffic parameter

An AAL type 2 traffic parameter describes one aspect of an AAL type 2 connection. It may be qualitative or quantitative. An AAL type 2 traffic parameter may for example describe the peak byte rate, the average byte rate, the average or maximum CPS packet size, the burst length of an AAL type 2 connection, etc.

5.1.2 AAL type 2 traffic descriptor

An AAL type 2 traffic descriptor is the set of AAL type 2 traffic parameters that is used to capture the traffic characteristics of an AAL type 2 connection as part of the AAL type 2 Traffic Contract.

5.1.3 AAL type 2 traffic contract

For a given AAL type 2 connection, the AAL type 2 traffic descriptor, the AAL type 2 conformance definition and the AAL type 2 QOS commitments define the AAL type 2 Traffic Contract.

5.2 Requirements on AAL type 2 traffic parameters and AAL type 2 traffic descriptors

Any AAL type 2 traffic parameter to be involved in an AAL type 2 traffic descriptor should:

– have the same interpretation on both sides of an interface or within a network

– be meaningful in resource allocation schemes to meet network performance requirements,

– be enforceable by the parameter control.

Whether an AAL type 2 parameter should be enforced is for further study.

5.3 AAL type 2 traffic parameter specifications

5.3.1 AAL type 2 reference configuration

An AAL type 2 connection has a starting point (AAL type 2 source) and an endpoint (AAL type 2 destination). An AAL type 2 connection uses one or several AAL type 2 paths. AAL type 2 traffic parameters are defined at the AAL type 2 source. They are valid along the whole AAL type 2 connection even though the traffic characteristics of the AAL type 2 connection may change due to AAL type 2 packet delay variation after the CPS packets pass through several AAL type 2 paths.

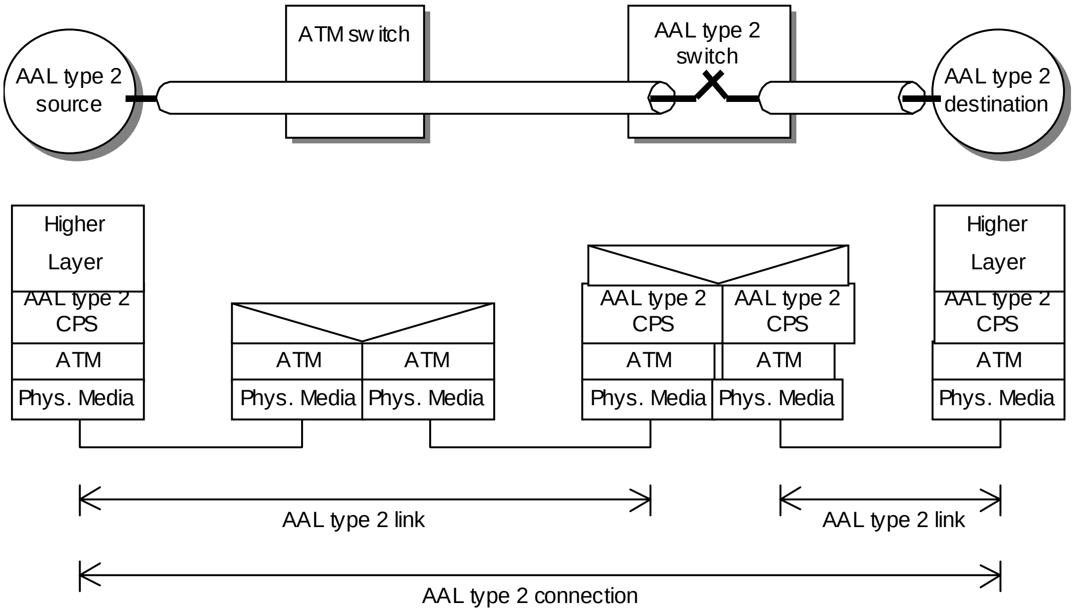

Figure 1: Reference configuration for one AAL type 2 connection

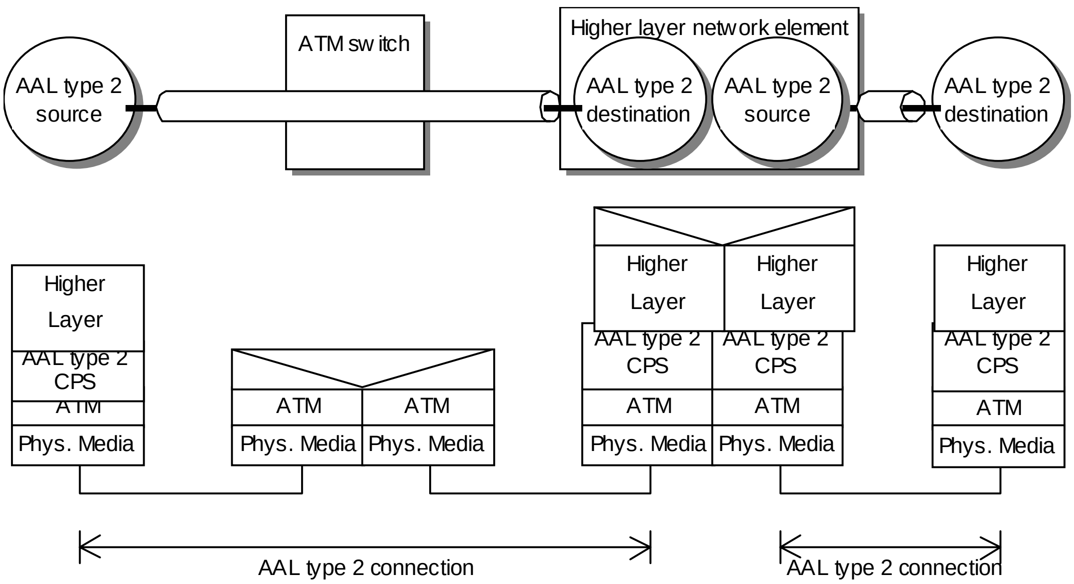

Figure 2: Reference configuration for concatenated AAL type 2 connections

Figure 1 above shows one single switched AAL type 2 connection that consists of two concatenated AAL type 2 links.
On the other hand, Figure 2 shows a concatenation of two separate AAL type 2 connections. If the processing of the higher layer in the network element does not take place, i.e. if it is a null function, figure 2 converts to figure 1 with respect to AAL type 2 traffic aspects.

AAL type 2 conformance is currently defined only at the AAL type 2 source. Whether AAL type 2 conformance is needed at interfaces along the AAL type 2 connection is for further study.
If several AAL type 2 connections are concatenated with the same traffic parameters, then a conformance definition may be required only at the AAL type 2 source of the originating connection.

5.3.2 AAL type 2 traffic parameter description

The following AAL type 2 traffic parameters are defined which may be used in the AAL type 2 traffic descriptor.

5.3.2.1 Maximum allowed CPS packet size

The maximum allowed CPS packet size Mcps is expressed in byte. It is a mandatory traffic parameter for each AAL type 2 transfer capability. The 3 byte CPS packet header is to be included in the computation of Mcps.

5.3.2.2 Peak CPS byte rate and associated Token Bucket size

The Generic Byte Rate Algorithm (GBRA) or Token Bucket (TB) as described in Annex A of [6] defines the rate of an IP flow and its associated burstiness. If IP packets are replaced by AAL type 2 CPS packets, then this algorithm can also be used to characterise an AAL type 2 rate and the associated burstiness.

The GBRA and the TB are equivalent. For AAL type 2 traffic descriptions, they use the following set of two parameters:

– Peak CPS byte rate PRcps expressed in byte/s;

– CPS token bucket size Bcps expressed in byte.

In case of AAL type 2 traffic parameters, the 3 byte CPS packet headers are to be included in the computation of PRcps and Bcps.

Editors note: Only one of the following 2 options will be chosen.

Option 1:

For a given AAL type 2 connection (same CID), the traffic parameters apply only to CPS packets containing user data and not to CPS packets containing control information.

Option 2:

For a given AAL type 2 connection (same CID), the traffic parameters apply to all CPS packets whether they contain user data or control information.

The AAL type 2 Traffic Descriptor contains at least the peak CPS byte rate.

5.3.2.3 Average CPS packet byte rate

The average CPS packet byte rate (ARcps) is defined as the total amount of bytes of the CPS packets transported in the specified direction during the holding time of the connection, divided by the holding time of the connection.

6 AAL type 2 transfer capabilities

An AAL type 2 transfer capability is a set of network capabilities provided for an AAL type 2 connection. For an AAL type 2 transfer capability, the AAL type 2 service model, the AAL type 2 traffic descriptor, the AAL type 2 conformance definition and the AAL type 2 QOS commitments are defined. An AAL type 2 transfer capability is supported by a set of AAL type 2 traffic control and AAL type 2 congestion control functions.

The set of AAL type 2 transfer capabilities may be extended in the future.

For AAL type 2 transfer capabilities, the QoS requirements may be stringent which implies low CPS packet delay and low CPS packet delay variation and that they are suitable for voice traffic transport

They also may be tolerant which means that the CPS packet delay and CPS packet delay variation may be higher than in the stringent case. Tolerant QoS requirements are suitable for data packet transport.

The CPS packet loss is expected to be low in all cases.

6.1 Fixed Bandwidth (FBW) AAL type 2 transfer capability

6.1.1 Description

The Fixed Bandwidth (FBW) transfer capability is intended to support applications which require a fixed AAL type 2 bandwidth and fixed burstiness as well as stringent QoS requirements. Examples are circuit switched data traffic and constant bit rate speech.

6.1.2 Service model

The FBW transfer capability can be used by applications that characterize the traffic at the AAL type 2 layer with a single rate and a burst size by way of a Token Bucket or GBRA. The commitment made by the network is that stringent QoS commitments are assured to all CPS packets when all CPS packets are conforming.

6.1.3 Traffic descriptor

The AAL type 2 Traffic Descriptor consists in the following parameters:

- The peak CPS byte rate PRcps and CPS token bucket size Bcps as specified for the GBRA and TB in 5.3.2.2.
- The maximum allowed CPS packet size Mcps as specified in 5.3.2.1.

6.1.4 Conformance definition

A CPS packet for which the rate PRcps is applicable is conforming if it fulfills both of the following two conditions:

- the CPS packet passes the TB or GBRA with parameters PRcps and Bcps;
- the actual CPS packet length does not exceed the maximum allowed CPS packet size Mcps.

The GBRA is updated only for conforming CPS packets for which the rate PRcps is applicable (see options 1 and 2 of 5.3.2.2). A CPS packet for which the rate PRcps is not applicable is conforming and bypasses the GBRA or TB.

6.1.5 QOS commitments

If all CPS packets are conforming, the stringent QOS commitments apply to all CPS packets. If not all CPS packets are conforming, the network may choose to commit QOS to some of the CPS packets, for example to a volume of CPS packets that is conforming.

6.2 Variable Bandwidth Stringent (VBW-S) AAL type 2 transfer capability

6.2.1 Description

The Variable Bandwidth Stringent (VBW-S) transfer capability is intended to support applications which submit their traffic to the AAL type 2 with the following characteristics :

- a variable rate
- a small burstiness
- stringent QoS requirements

Examples are variable bit rate voice and some multimedia applications.

6.2.2 Service model

The VBW-S transfer capability can be used by applications that characterize the traffic at the AAL type 2 level with two rates: a peak CPS byte rate PRcps together with a Token Bucket size Bcps and an average CPS byte rate ARcps.

The commitment made by the network is that stringent QoS commitments are assured to all CPS packets when all CPS packets are conforming.

6.2.3 VBW-S traffic descriptor

The VBW-S traffic descriptor consists in the following parameters:

- The peak CPS byte rate PRcps and CPS token bucket size Bcps as specified for the GBRA and TB in 5.3.2.2
- The average CPS byte rate ARcps as specified in 5.3.2.3
- The maximum allowed CPS packet size Mcps as specified in 5.3.2.1.

It is assumed that the average CPS byte rate is smaller than the peak CPS byte rate.

6.2.4 VBW-S conformance definition

A CPS packet for which the rate PRcps is applicable is conforming if it fulfills the following two conditions:

- the CPS packet passes the TB or GBRA with parameters PRcps and Bcps
- the actual CPS packet length does not exceed the maximum allowed CPS packet size Mcps.

The GBRA is updated only for conforming CPS packets for which the rate PRcps is applicable (see options 1 and 2 of 5.3.2.2). A CPS packet for which the rate PRcps is not applicable is conforming and bypasses the GBRA or TB.

The impact of the average CPS byte rate on conformance is for further study. The average CPS byte rate may be used for AAL type 2 connection admission control.

6.2.5 QOS commitments

If all CPS packets are conforming, the stringent QOS commitments apply to all CPS packets. If not all CPS packets are conforming, the network may choose to commit QOS to some of the CPS packets, for example to a volume of CPS packets that is conforming.

The impact of the average CPS byte rate on QoS commitments is for further study.

6.3 Variable Bandwidth Tolerant (VBW-T) AAL type 2 transfer capability

6.3.1 Description

The Variable Bandwidth Tolerant (VBW-T) transfer capability is intended to support applications which submit their traffic to the AAL type 2 with the following characteristics :

- a variable rate
- bursty traffic
- tolerant QoS requirements

An example is IP traffic.

6.3.2 Service model

The VBW-T transfer capability can be used by applications that characterize the traffic at the AAL type 2 with two rates: a peak CPS byte rate PRcps together with a (possibly large) token bucket size Bcps and an average byte rate ARcps.

The commitment made by the network is that tolerant QoS commitments are assured to all CPS packets when all CPS packets are conforming.

6.3.3 VBW-T traffic descriptor

The VBW-T traffic descriptor consists in the following parameters:

– The peak CPS byte rate PRcps and CPS token bucket size Bcps as specified for the GBRA and TB in 5.3.2.2.

– The average CPS byte rate ARcps as specified in 5.3.2.3

– The maximum allowed CPS packet size Mcps as specified in 5.3.2.1.

It is assumed that the average CPS byte rate is smaller than the peak CPS byte rate.

6.3.4 VBW-T conformance definition

A CPS packet for which the rate PRcps is applicable is conforming if it fulfills the following two conditions:

– the CPS packet passes the TB or GBRA with parameters PRcps and Bcps

– the actual CPS packet length does not exceed the maximum allowed CPS packet size Mcps.

The GBRA is updated only for conforming CPS packets for which the rate PRcps is applicable (see options 1 and 2 of 5.3.2.2). A CPS packet for which the rate PRcps is not applicable is conforming and bypasses the GBRA or TB.

The impact of the average CPS byte rate on conformance is for further study. The average CPS byte rate may be used for AAL type 2 connection admission control.

6.3.5 QOS commitments

If all CPS packets are conforming, the tolerant QOS commitments apply to all CPS packets. If not all CPS packets are conforming, the network may choose to commit QOS to some of the CPS packets, for example to a volume of CPS packets that is conforming.

The impact of the average byte rate on QoS commitments is for further study.

7 Functions for AAL type 2 traffic control and AAL type 2 congestion control

AAL type 2 traffic control is a set of functions that control the flow of CPS packets via a series of functions such as AAL type 2 connection admission control or AAL type 2 network resource management. The main objective of AAL type 2 traffic control is to satisfy user requirements such as QOS while still supporting efficient AAL type 2 path utilization.

As opposed to traffic engineering, AAL type 2 traffic control is accomplished in a short time scale. Therefore, a well-established and automated mechanism is to be provided to control the flow of AAL type 2 traffic into the AAL type 2 path.

7.1 Introduction to AAL type 2 traffic control and AAL type 2 congestion control functions

7.1.1 AAL type 2 traffic control functions

The following functions are identified for traffic control functions:

i) AAL type 2 path resource management

ii) AAL type 2 connection admission control

iii) CPS packet discard control

iv) AAL type 2 traffic shaping

v) AAL type 2 scheduling control

7.1.2 AAL type 2 congestion control functions

The following functions are identified for congestion control functions:

i) CPS packet discard control

ii) AAL type 2 scheduling control

7.2 AAL type 2 traffic control functions

7.2.1 AAL type 2 path resource management

AAL type 2 path resource management refers to a set of policies and rules for allocating the AAL type 2 path resources. These resources include the bandwidth for the AAL type 2 path and the buffer for multiplexing AAL type 2 connections onto an AAL type 2 path.

7.2.2 AAL type 2 connection admission control

AAL type 2 connection admission control refers to the policies of the network to admit commitments to a new AAL type 2 connection onto an AAL type 2 path or to refuse the commitments when adding the new connection would result in unacceptable QoS for the existing AAL type 2 connections and/or the new AAL type 2 connection.

7.2.3 CPS packet discard control

When CPS packets are put onto an AAL type 2 path, congestion may occur. In this case it may be preferable to discard CPS packets of some connections and not of other connections.

7.2.4 AAL type 2 traffic shaping

AAL type 2 traffic shaping is an action by the network to modify the AAL type 2 traffic characteristics of the AAL type 2 flow such that the flow becomes more suitable for the network. One example is shaping of the flow at the AAL type 2 source so it becomes conforming to the traffic contract.

7.2.5 AAL type 2 packet scheduling

AAL type 2 packet scheduling can bound the queuing delay for an AAL type 2 connection which has stringent delay requirements. E.g. one can introduce delay priorities among the connections to be multiplexed onto an AAL type 2 path. The CPS packets of one connection would wait less time in the CPS multiplexing buffer than the CPS packets of another connection.

7.3 Congestion control functions

For all presently known services that use AAL type 2, CPS packet discard in the network should happen only very seldom. Congestion should therefore be avoided by proper resource dimensioning. However, if congestion occurs, there are functions that can reduce the negative effects of congestion.

7.3.1 CPS Packet discard control

If congestion occurs when CPS packets are put onto an AAL type 2 path, it may be preferable to discard CPS packets of some connections and not of other connections.

7.3.2 AAL type 2 scheduling control

In case of congestion, the scheduling methods or parameters can be adapted to limit the congestion situation.

8 Methods and tools for AAL type 2 path resource management

An AAL type 2 path may be an ATM DBR VCC. In this case, there is a PCR associated with each direction of the AAL type 2 path. When AAL type 2 connections are multiplexed onto such an AAL type 2 path, this AAL type 2 path has to be shaped according to the PCR so that the ATM cells of the resulting ATM VCC are conforming.

If the AAL type 2 path is an SBR VCC, then shaping with respect to the PCR and SCR is required. A similar shaping requirement holds for other ATM Transfer Capabilities (ATCs) if they are used for an AAL type 2 path.

APPENDIX I: MAPPING OF AAL TYPE 2 TRAFFIC PARAMETERS

This appendix contains informative text.

In this appendix a relationship between AAL type 2 parameters in [4] and parameters in this recommendation is provided.
[4] defines the maximum CPS-SDU bit rate (in bit/s) and the maximum CPS-SDU size (in bytes) as follows:

- The **maximum CPS-SDU bit rate** is defined as the maximum bandwidth, available to the AAL type 2 served user in the specified direction. The maximum bandwidth is the maximum ratio of the amount of bits transported during the inter-departure time between subsequent CPS-SDUs, and that inter-departure time. Allowed values are 0 to 2048 kbit/s. The granularity is 64 bits/s.
- The **maximum CPS-SDU size** is defined as the largest CPS-SDU size, in octets, allowed to be sent during the holding time of the connection. Allowed values are 1 to 45.

Remark 1: Both parameters do no include the CPS packet headers.

On the other side, this recommendation defines the rate PRcps (in byte/s) and the maximum allowed CPS packet size Mcps (in bytes). Both parameters do include the CPS packet headers.
To establish a relationship between maximum CPS-SDU bit rate and the maximum CPS-SDU size on one side and the parameters PRcps and Mcps on the other side, it is assumed that the AAL type 2 source sends a CPS packet every time interval T (in seconds).
Then the parameters are related as follows:

$$PRcps = \frac{\max imum\ CPS\ \ SDU\ bit\ rate}{8} + \frac{3[bytes]}{T}$$

Mcps = maximum CPS-SDU size + 3 [bytes]

This relationship is illustrated in two examples:

Example 1:

For a compressed speech AAL type 2 speech connection with T = 20 ms = 0.02 s one gets

$$PRcps = \frac{\max imum\ CPS\ \ SDU\ bit\ rate}{8} + 150[byte/s]$$

Example 2:

For a 64 kbit/s transparent data connection that sends 40 bytes CPS-SDUs every 5 ms one gets that T=0.05 ms and

$$PRcps = (\frac{64\,000}{8} + \frac{3}{0.05})[byte/s] = 8600[byte/s]$$

Remark 2: The relationship between the average CPS-SDU bit rate and an average CPS packet byte rate is analogous to the above.
Remark 3: If an interval T is not known, then this rate conversion formula does not apply anymore.