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OVERALL NETWORK ASPECTS AND FUNCTIONS

B-ISDN ATM LAYER SPECIFICATION

ITU-T Recommendation I.361

(Previously "CCITT Recommendation")

FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

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 I.361 was revised by ITU-T Study Group 13 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 2nd of November 1995.

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NOTE

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

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Recommendation I.361

B-ISDN LAYER SPECIFICATION

(Geneva, 1991; revised Helsinki, 1993 and Geneva, 1995)

1 Introduction

This Recommendation specifically addresses:

a) the cell structure and the ATM cell coding;

b) the ATM protocol procedures.

2 Cell structure coding

Two different coding schemes have been adopted; the UNI format and the NNI format. They are described in 2.2 and 2.3.

2.1 Cell structure

The cell consists of a five octet header and a 48-octet information field as shown in Figure 1.
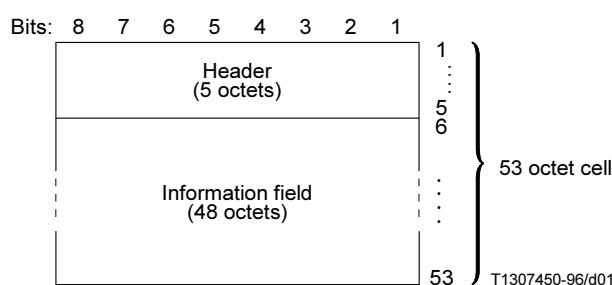

FIGURE 1/I.361

Cell structure at the UNI/NNI

NOTE – The header will be sent first followed by the information field.

When a field within the header is contained within a single octet, the lowest bit number of the field represents the lowest order value.

When a field spans more than one octet, the order of bit values within each octet progressively decreases as the octet number increases; the lowest bit number associated with the field represents the lowest order value.

This leads to the following conventions:

– bits within an octet are sent in decreasing order, starting with bit 8;

– octets are sent in increasing order, starting with octet 1;

– for all fields, the first bit sent is the Most Significant Bit (MSB).

2.2 Cell header format and encoding at UNI

The structure of the header is shown in Figure 2. The fields contained in the header and their encoding are described in the following subclauses.

8	7	6	5	4	3	2	1	Bit Octet
GFC				VPI				1
VPI				VCI				2
VCI								3
VCI				PT			CLP	4
HEC								5

CLP   Cell Loss Priority

GFC   Generic Flow Control

PT   Payload Type

HEC   Header Error Control

VPI   Virtual Path Identifier

VCI   Virtual Channel Identifier

FIGURE 2/I.361

Header structure at UNI

2.2.1   Pre-assigned values of the cell header reserved for use by the physical layer

Pre-assigned values of the cell header (to differentiate cells for the use of the ATM layer from cells for the use of the physical layer) are given in Table 1. All other values are for the use of the ATM layer.

TABLE 1/I.361

**Pre-assigned cell header values at the UNI for use
by the physical layer (excluding the HEC field)**

	Octet 1	Octet 2	Octet 3	Octet 4
Idle cell identification (Notes 1 and 2)	00000000	00000000	00000000	00000001
Physical layer OAM cell identification (Note 2)	00000000	00000000	00000000	00001001
Reserved for use of the physical layer (Notes 1, 2 and 3)	PPPP0000	00000000	00000000	0000PPP1

P   Indicates the bit is available for use by the physical layer.

　　Values assigned to these bits have no meaning with respect to the fields occupying the corresponding bit positions at the ATM layer.

NOTES

1   In the case of physical layer cells, the bit in the location of the CLP indication is not used for the CLP mechanism as specified in 3.4.2.3.2/I.150.

2   Cells having header values which are identified as idle, physical layer OAM, and reserved for use by the physical layer are not passed to the ATM layer from the physical layer.

3   Specific pre-assigned physical layer cell header values are given in Recommendation I.432.

2.2.2   Generic Flow Control (GFC) field

The GFC field contains 4 bits.

The following provides an overview of the GFC functions for the valid codings of the GFC field (see 4.1.1).

Uncontrolled equipment will always set the GFC field to 0000. Coding of this field by controlling and controlled equipment at the S_B and T_B reference points is given in 4.1.1. The coding of the GFC field at the SSB interfaces is for further study. The controlled equipment default mode provides for a single queue for controlled ATM connections and allows uncontrolled ATM connections. The two-queue model provides for two queues for controlled ATM connections and allows uncontrolled ATM connections. At any given instant of time, controlled equipment which may not have any controlled ATM connections active will continue to respond to the HALT command.

In the direction from the controlling equipment to the controlled equipment, the GFC field is defined as follows: (When the GFC function is not used, the value of this field is 0000).

– The first bit indicates HALT (bit set to 1)/NO_HALT(0).

The HALT command stops the transmission towards the network of assigned ATM layer cells, including cells on uncontrolled ATM connections.

In the case of controlled ATM connections, the credit counter(s) is(are) not modified by the HALT command.

– The second bit indicates:

•   in the default mode (1-queue model) mode, SET(1)/NULL(0) for the controlled ATM connections;

•   in the 2-queue model, SET/NULL for the connections of Group A.

The SET/NULL command applies only to controlled ATM connections. It sets the credit counter to its GO_VALUE.

– The third bit is set to 0 in the default mode. In the 2-queue model, it indicates SET/NULL for the connections of Group B.

– The fourth bit is reserved for future GFC functions and is set to 0.

In the direction from controlled equipment to controlling equipment, the GFC field is defined as follows:

– The first bit is unused and set to 0.

– In the default mode, the second bit indicates to the controlling equipment if the cell belongs to the uncontrolled ATM connections (0), or to the controlled ATM connections (1). In the 2-queue model, it indicates if the cell belongs to the controlled ATM connections of Group A (1) or not (0).

– In the default mode, the third bit is unused and set to 0. In the 2-queue model, it indicates if the cell belongs to the controlled ATM connections of Group B (1) or not (0).

– The fourth bit indicates if the equipment is controlled (1) or uncontrolled (0).

2.2.3   Routing field (VPI/VCI)

Twenty-four bits are available for routing: 8 bits for Virtual Path Identifier (VPI) and 16 bits for Virtual Channel Identifier (VCI). Pre-assigned combinations of VPI and VCI values are shown in Table 2. Other pre-assigned values of VPI and VCI are for further study. The VCI value of zero is not available for user virtual channel identification.

The number of bits of the VPI and VCI fields used for routing are established by negotiation between the user and the network as described in 3.1.2.3/I.150. The bits within the VPI and VCI fields used for routing are allocated using the following rules:

– the allocated bits of the VPI field will be contiguous;

– the allocated bits of the VPI field will be the least significant bits of the VPI field (beginning at bit 5 of octet 2);

– the allocated bits of the VCI field will be contiguous;

– the allocated bits of the VCI field will be the least significant bits of the VCI field (beginning at bit 5 of octet 4).

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TABLE 2/I.361

Combinations of pre-assigned VPI, VCI, PTI and CLP values at UNI

Use	VPI	VCI (Note 8)	PTI	CLP
Unassigned cell	00000000	00000000 00000000	Any value	0
Invalid	Any VPI value other than 0	00000000 00000000	Any value	B
Meta-signalling (See Rec. I.311)	XXXXXXXX (Note 1)	00000000 00000001 (Note 5)	0AA	C
General broadcast signalling (See Rec. I.311)	XXXXXXXX (Note 1)	00000000 00000010 (Note 5)	0AA	C
Point-to-point signalling (See Rec. I.311)	XXXXXXXX (Note 1)	00000000 00000101 (Note 5)	0AA	C
Segment OAM F4 flow cell (See Rec. I.610)	Any VPI value	00000000 00000011 (Note 4)	0A0 (Note 11)	A
End-to-end OAM F4 flow cell (See Rec. I.610)	Any VPI value	00000000 00000100 (Note 4)	0A0 (Note 11)	A
VP resource management cell (See Rec. I.371)	Any VPI value	00000000 00000110 (Note 10)	110 (Note 9)	A
Reserved for future VP functions (Note 6)	Any VPI value	00000000 00000111 (Note 10)	0AA (Note 11)	A
Reserved for future functions (Note 7)	Any VPI value	00000000 000SSSSS (Notes 2 and 10)	0AA	A
Reserved for future functions (Note 7)	Any VPI value	00000000 000TTTTT (Note 3)	0AA	A
Segment OAM F5 flow cell (See Rec. I.610)	Any VPI value	Any VCI value other than 00000000 00000000, 00000000 00000011, 00000000 00000100, 00000000 00000110, or 00000000 00000111	100	A
End-to-end OAM F5 flow cell (See Rec. I.610)	Any VPI value	Any VCI value other than 00000000 00000000, 00000000 00000011, 00000000 00000100, 00000000 00000110, or 00000000 00000111	101	A

TABLE 2/I.361 *(end)*

Combinations of pre-assigned VPI, VCI, PTI and CLP values at UNI

Use	VPI	VCI (Note 8)	PTI	CLP
VC Resource management cell (See Rec. I.371)	Any VPI value	Any VCI value other than 00000000 00000000, 00000000 00000011, 00000000 00000100, 00000000 00000110, or 00000000 00000111	110	A
Reserved for future VC functions	Any VPI value	Any VCI value other than 00000000 00000000, 00000000 00000011, 00000000 00000100, 00000000 00000110, or 00000000 00000111	111	A

The GFC field is available for use with all of these combinations.

A   Indicates that the bit may be 0 or 1 and is available for use by the appropriate ATM layer function.

B   Indicates the bit is a "don't care" bit.

C   Indicates the originating entity shall set the CLP bit to 0. The value may be changed by the network.

NOTES

1   XXXXXXXX: Any VPI value. For VPI value equal to 0, the specific VCI value specified is reserved for user signalling with the local exchange. For VPI values other than 0, the specified VCI value is reserved for signalling with other signalling entities (e.g. other users or remote networks).

2   SSSSS: Any value from 01000 to 01111.

3   TTTTT: Any value from 10000 to 11111.

4   Transparency is not guaranteed for the OAM F4 flows in a user-to-user VP.

5   The VCI values are pre-assigned in every VPC at the UNI. The usage of these values depends on the actual signalling configurations. (See Recommendation I.311.)

6   VCI value is reserved to provide the same function for VPs as PTI 111 is reserved to provide for VCs.

7   These VCI values are reserved for future standardization for specific functions.

8   Cells with VCI values 1, 2, 5, 16 through 31, and greater than 31 are monitored by the VP OAM function. Cells with other VCI values are not monitored by the VP OAM function. (See Recommendation I.610.)

Whether a cell with a particular VCI value is conveyed transparently between the end points of the VPC is described in 3.1.4.1 e)/I.150.

9   This specifies the allowed coding of the PTI field on transmission. This VCI value shall only be used for the stated functions regardless of the coding of the PTI field. It is an implementation option on how to process errored cells received with VCI = 6 and PTI not equal to 110. In particular, such cells may be processed as VP RM cells.

10   Transparency of these VCI values is not guarenteed. i.e. cells with these VCI values may be extracted or inserted at midpoints of a VP. The specific situations under which this may occur are for further study. In the absence of this further study these VCIs shall be transparently transported in a VP.

11   This specifies the allowed coding of the PTI field on transmission. These VCI values shall only be used for the stated functions regardless of the coding of the PTI field. On reception, the PTI field is not used for the purpose of identifying the cell type. For example, A cell with VC = 4 will be treated as an End-to-end F4 OAM cell regardless of the coding of the PTI field.

In addition, unallocated bits, i.e. bits not utilized by the user or the network, within the 24-bit routing field will be set to zero.

See 3.1.3/I.150 and 3.1.4/I.150 for VPI/VCI assignment information.

2.2.4 Payload Type (PT) field

Three bits are available for PT identification. The following table describes the payload type identifier (PTI) coding.

	PTI coding	Interpretation
Bits	4 3 2	
	0 0 0	User data cell, congestion not experienced. ATM user-to-ATM-user indication = 0
	0 0 1	User data cell, congestion not experienced. ATM-user-to-ATM-user indication = 1
	0 1 0	User data cell, congestion experienced. ATM-user-to-ATM-user indication = 0
	0 1 1	User data cell, congestion experienced. ATM-user-to-ATM-user indication = 1
	1 0 0	OAM F5 segment associated cell
	1 0 1	OAM F5 end-to-end associated cell
	1 1 0	Resource management cell
	1 1 1	Reserved for future VC functions

Any congested network element, upon receiving a user data cell, may modify the PTI as follows. Cells received with PTI = 000 or PTI = 010 are transmitted with PTI = 010. Cells received with PTI = 001 or PTI = 011 are transmitted with PTI = 011. Non-congested network elements should not change the PTI. See Recommendation I.371.

The use of PTI = 110 is reserved for resource management use. See Recommendation I.371.

The use of PTI = 100 is discussed in Recommendation I.610.

The use of PTI = 101 is discussed in Recommendation I.610.

2.2.5 Cell Loss Priority (CLP) field

Depending on network conditions, cells where the CLP is set (CLP value is 1) are subject to discard prior to cells where the CLP is not set (CLP value is 0). (See Recommendation I.371 for further details about the use of the CLP bit.)

2.2.6 Header Error Control (HEC) field

The HEC field consists of 8 bits. Use of this field is described in 4.3/I.432.

2.3 Cell header format and encoding at NNI

The structure of the header is shown in Figure 3. The fields contained in the header and their encoding are described in the following subclauses.

8	7	6	5	4	3	2	1	Bit Octet
VPI								1
VPI				VCI				2
VCI								3
VCI				PT			CLP	4
HEC								5

FIGURE 3/I.361

Header structure at NNI

2.3.1 Pre-assigned values of the cell header

Pre-assigned values of the cell header (to differentiate cells for the use of the ATM layer from cells for the use of the physical layer) are given in Table 3. All other values are for use of the ATM layer.

TABLE 3/I.361

Pre-assigned cell header values at the NNI for use by the physical layer (excluding the HEC field)

	Octet 1	Octet 2	Octet 3	Octet 4
Idle cell identification (Notes 1 and 2)	00000000	00000000	00000000	00000001
Physical layer OAM cell identification (Note 2)	00000000	00000000	00000000	00001001
Reserved for use of the physical layer (Notes 1, 2 and 3)	00000000	00000000	00000000	0000PPP1

P   Indicates the bit is available for use by the physical layer.

Values assigned to these bits have no meaning with respect to the fields occupying the corresponding bit positions at the ATM layer.

NOTES

1   In the case of physical layer cells, the bit in the location of the CLP indication is not used for the CLP mechanism as specified in 3.4.2.3.2/I.150.

2   Cells having header values which are identified as idle, physical layer OAM, and reserved for use by the physical layer are not passed to the ATM layer from the physical layer.

3   Specific pre-assigned physical layer cell header values are given in Recommendation I.432.

2.3.2   Routing field (VPI/VCI)

Twenty-eight bits are available for routing: 12 bits for VPI and 16 bits for VCI. Pre-assigned combinations of VPI and VCI values are shown in Table 2. Other pre-assigned values of VPI and VCI are for futher study. The VCI value of zero is not available for user virtual channel identification. See Table 4.

TABLE 4/I.361

Combinations of pre-assigned VPI, VCI, PTI and CLP values at NNI

Use	VPI	VCI (Note 6)	PTI	CLP
Unassigned cell	000000000000	00000000 00000000	Any value	0
Invalid	Any VPI value other than 0	00000000 00000000	Any value	B
NNI-signalling (See Rec. I.311)	Any VPI value	00000000 00000101	0AA	C
Segment OAM F4 flow cell (See Rec. I.610)	Any VPI value	00000000 00000011 (Note 3)	0A0	A
End-to-end OAM F4 flow cell (See Rec. I.610)	Any VPI value	00000000 00000100 (Note 3)	0A0	A
VP resource management cell (See Rec. I.371)	Any VPI value	00000000 00000110 (Notes 7 and 8)	110	A
Reserved for future VP functions (Note 4	Any VPI value	00000000 00000111 (Note 8)	0AA	A
Reserved for future functions (Note 5	Any VPI value	00000000 000SSSSS (Notes 1 and 8)	0AA	A
Reserved for future functions (Note 5	Any VPI value	00000000 000TTTTT (Note 2)	0AA	A
Segment OAM F5 flow cell (See Rec. I.610)	Any VPI value	Any VCI value other than 00000000 00000000	100	A
End-to-end OAM F5 flow cell (See Rec. I.610)	Any VPI value	Any VCI value other than 00000000 00000000	101	A
VC Resource management cell (See Rec. I.371)	Any VPI value	Any VCI value other than 00000000 00000000, or 00000000 00000110	110	A
Reserved for future VC functions (Note 6)	Any VPI value	Any VCI value other than 00000000 00000000	111	A

Combinations of pre-assigned VPI, VCI, PTI and CLP values at NNI

A   Indicates that the bit may be 0 or 1 and is available for use by the appropriate ATM layer function.

B   Indicates the bit is a "don't care" bit.

C   Indicates the originating entity shall set the CLP bit to 0. The value may be changed by the network.

NOTES

1   SSSSS: Any VCI value from 01000 to 01111.

2   TTTTT: Any VCI value from 10000 to 11111.

3   Transparency is not guaranteed for the OAM F4 flows in a user-to-user VP.

4   This VCI value is reserved to provide the same function for VPs as PTI 111 is reserved to provide for VCs.

5   These VCI values are reserved for future standardization for specific functions.

6   Cells with VCI values 1, 2, 5, 16 through 31, and greater than 31 are monitored by the VP OAM function. Cells with other VCI values are not monitored by the VP OAM function. (See Recommendation I.610.) Whether a cell with a particular VCI value is conveyed transparently between the end points of the VPC is described in 3.1.4.1 e)/I.150.

7   The VP resource management cell is identified by this VCI value regardless of the value in the PTI field.

8   Transparency of VCI values is not guarenteed, i.e. cells with these VCI values may be extracted or inserted at midpoints of a VP. The specific situations under which this may occur are for further study. In the absence of this further study these VCIs shall be transparently transported in a VP.

The number of bits of the VPI and VCI fields used for routing are established by negotiation between the networks as described in 3.1.2.4/I.150. The bits within the VPI and VCI fields used for routing are allocated usign the following rules:

  – the allocated bits of the VPI field will be contiguous;

  – the allocated bits of the VPI field will be the least significant bits of the VPI field (beginning at bit 5 of octet 2);

  – the allocated bits of the VCI field will be contiguous;

  – the allocated bits of the VCI field will be the least significant bits of the VCI field (beginning at bit 5 of octet 4).

In addition, unallocated bits, i.e. bits not utilized by the user or the network, within the 28-bit routing field will be set to zero.

See 3.1.3/I.150 and 3.1.4/I.150 for VPI/VCI assignment information.

2.3.3   Payload Type (PT) field

Three bits are available for PT identification. The following table describes the Payload Type Identifier (PTI) coding.

Any congested network element, upon receiving a user data cell may modify the PTI as follows. Cells received with PTI = 000 or PTI = 010 are transmitted with PTI = 010. Cells received with PTI = 001 or PTI = 011 are transmitted with PTI = 011. Non-congested network elements should not change the PTI. See Recommendation I.371.

The use of PTI = 110 is reserved for resource management use. See Recommendation I.371.

The use of PTI = 100 is discussed in Recommendation I.610.

The use of PTI = 101 is discussed in Recommendation I.610.

	PTI coding	Interpretation
Bits	4 3 2	
	0 0 0	User data cell, congestion not experienced. ATM-user-to-ATM-user indication = 0
	0 0 1	User data cell, congestion not experienced. ATM-user-to-ATM-user indication = 1
	0 1 0	User data cell, congestion experienced. ATM-user-to-ATM-user indication = 0
	0 1 1	User data cell, congestion experienced. ATM-user-to-ATM-user indication = 1
	1 0 0	OAM F5 segment associated cell
	1 0 1	OAM F5 end-to-end associated cell
	1 1 0	VC resource management cell
	1 1 1	Reserved for future VC functions

2.3.4 Cell Loss Priority (CLP) field

Depending on network conditions, cells where the CLP is set (CLP value is 1) are subject to discard prior to cells where the CLP is not set (CLP value is 0).

2.3.5 Header Error Control (HEC) field

The HEC field consists of 8 bits. The HEC mechanism of the NNI is identical to that at the UNI and is described in 4.3/I.432.

2.4 Cell information field

2.4.1 Pre-assigned values

The pre-assigned values of the information field of all unassigned cells are for further study.

3 Service primitives

Service primitives describe in an abstract manner the logical exchange of information and control through a Service Access Point (SAP). The primitives do not specify nor constrain the implementation of entities or interfaces.

3.1 Primitives exchanged with the upper layer

The information exchanged between the ATM layer and the upper layer (e.g. the AAL) across the ATM-SAP includes the following primitives:

–   ATM-DATA request (ATM-SDU, submitted loss priority, congestion indication, ATM-user-to-ATM-user indication);

–   ATM-DATA indication (ATM-SDU, congestion indication, ATM-user-to-ATM-user indication, Receive Loss Priority).

Additional parameters require further study.

3.1.1 Description of primitives

– ATM-DATA request: This primitive is issued by an upper layer entity (e.g. AAL-entity) to request the transfer of an ATM-SDU to its corresponding entity (or entities) over an ATM connection. The submitted loss priority parameter and the ATM-user-to-ATM-user indication parameter are used to assign the proper CLP and PTI fields to the ATM-PDU generated at the ATM layer. The generated ATM-PDU is transferred over the PHY-CEs assigned to that ATM connection or the indicated group of PHY-CEs.

– ATM-DATA indication: This primitive is issued to an upper layer entity (e.g. AAL-entity) to indicate the arrival of an ATM-SDU from the indicated PHY-CE over an ATM connection, with congestion indication and received ATM-user-to-ATM-user indication. In the absence of error, the ATM-SDU is the same as the ATM-SDU sent by the corresponding upper layer entity in the ATM-DATA request primitive.

3.1.2 Descriptions of parameters

– ATM-SDU: This parameter contains 48 octets of ATM layer user data (e.g. the AAL SAR-PDU) to be transferred by the ATM layer between corresponding upper layer entities;

– Submitted loss priority: This parameter indicates the relative importance of the requested transport for the information carried in the ATM-SDU. It can take only two values, one for high priority and the other for low priority.

– Receive loss priority: This parameter indicates the relative importance of the transport given to the information carried in the ATM-SDU. It can take only two values, one for high priority and the other for low priority.

– Congestion indication: This parameter indicates that the received ATM-SDU has passed through a network node in congestion.

– ATM-user-to-ATM-user indication (AUU): This parameter is transported transparently by the ATM layer.

The use of the parameters is summarized in Table 5.

TABLE 5/I.361

Parameters of ATM-DATA

Parameter	Type	Use	Comments
Received CLP	Indication	M	(Note 1)
ATM-SDU	Request Indication	M M	48 octets of ATM layer user data
Submitted CLP	Request	M	(Note 1)
AUU	Request Indication	M M	(Note 2)
Congestion indication	Request Indication	O (Note 3) M	Indication of congestion experienced
M Mandatory			
O Optional			
NOTES			
1 CLP = 0: CLP bit set to "0". CLP = 1: CLP bit set to "1".			
2 ATM-user-to-ATM-user = "0". ATM-user-to-ATM-user = "1".			
3 This parameter might be needed for interworking (e.g. with Frame Relay service).			

3.2 Primitives exchanged with the lower layer

The ATM layer expects the PHY to provide for the transport of ATM cells between corresponding ATM-entities. The information exchanged between the ATM layer and the PHY across the PHY-SAP includes the following primitives:

  – PHY-DATA request (PHY-SDU);

  – PHY-DATA indication (PHY-SDU).

3.2.1 Description of primitives

  – PHY-DATA request: This primitive is issued by the ATM layer to request the transfer of an ATM cell from a local ATM-entity to the corresponding ATM-entity over an existing PHY connection. Each cell is exchanged between the ATM layer and the PHY across the PHY-SAP. The entire cell (except for the HEC field) is transported unmodified by the PHY via the existing PHY connection.

  – PHY-DATA indication: This primitive is issued by the PHY to the ATM layer to indicate the arrival of a PHY-SDU from a corresponding PHY-entity over an existing PHY connection. In the absence of error, this PHY-SDU (except for the HEC field) is the same as the PHY-SDU sent by the corresponding ATM-entity in a PHY-DATA request primitive.

3.2.2 Description of parameter

  – PHY-SDU: This parameter contains one ATM cell to be transferred between corresponding ATM-entities.

3.3 Primitives exchanged with ATM Management (ATMM)-entity

Figure 4 shows two types of interactions between the ATM-entity and the ATMM-entity. One interaction is for the exchange of local information between these two entities. The other interaction is for peer-to-peer communication between ATMM-entities, and has the following associations between the ATM-entity and the ATMM-entity: segment OAM F5 flow, end-to-end OAM F5 flow and resource management.

For peer-to-peer communication between ATMM-entities:

  – ATMM-DATA request (ATM-SDU, Submitted Loss Priority, PHY-CEI);

  – ATMM-DATA indication (ATM-SDU, Congestion Indication, Received Loss Priority, PHY-CEI).

The exchange of local information between the ATM-entity and the ATMM-entity requires further study.

  NOTE – Figure 4 does not indicate GFC or Unassigned Cell Inseretion (UCI) function. See Annex B for placement of these functions.

3.3.1 Description of primitives

  – ATMM-DATA request: This primitive is issued by an ATMM-entity to request the transfer of a management ATM-SDU.

  – ATMM-DATA indication: This primitive is issued to an ATMM-entity to indicate the arrival of an ATM-SDU.

3.3.2 Description of parameters

  – Submitted Loss Priority: This parameter indicates the relative importance of the requested transport for the information carried in the ATM-SDU. It can take only two values, one for high priority and the other for low priority.

  – Received Loss Priority: This parameter indicates the relative importance of the transport given to the information carried in the ATM-SDU. It can take only two values, one for high priority and the other for low priority.

  – PHY-CEI: This parameter identifies the PHY-CE within the PHY-SAP. Certain characteristics are uniquely associated with this identifier, such as UNI or NNI cell format;[1]

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[1] In some cases, such as multipoint connections, multiple PHY-CEIs could be associated with the same ATM connection. Also, in nodes performing relaying functions, at least two PHY-CEIs are associated with the same ATM connection.

–   ATM-SDU: This parameter contains 48 octets of ATM layer management data to be transparently transferred between corresponding ATMM-entities.

–   Congestion indication: This parameter indicates that the received ATM-SDU has passed through a network node in congestion.

The use of the parameters is summarized in Table 6.
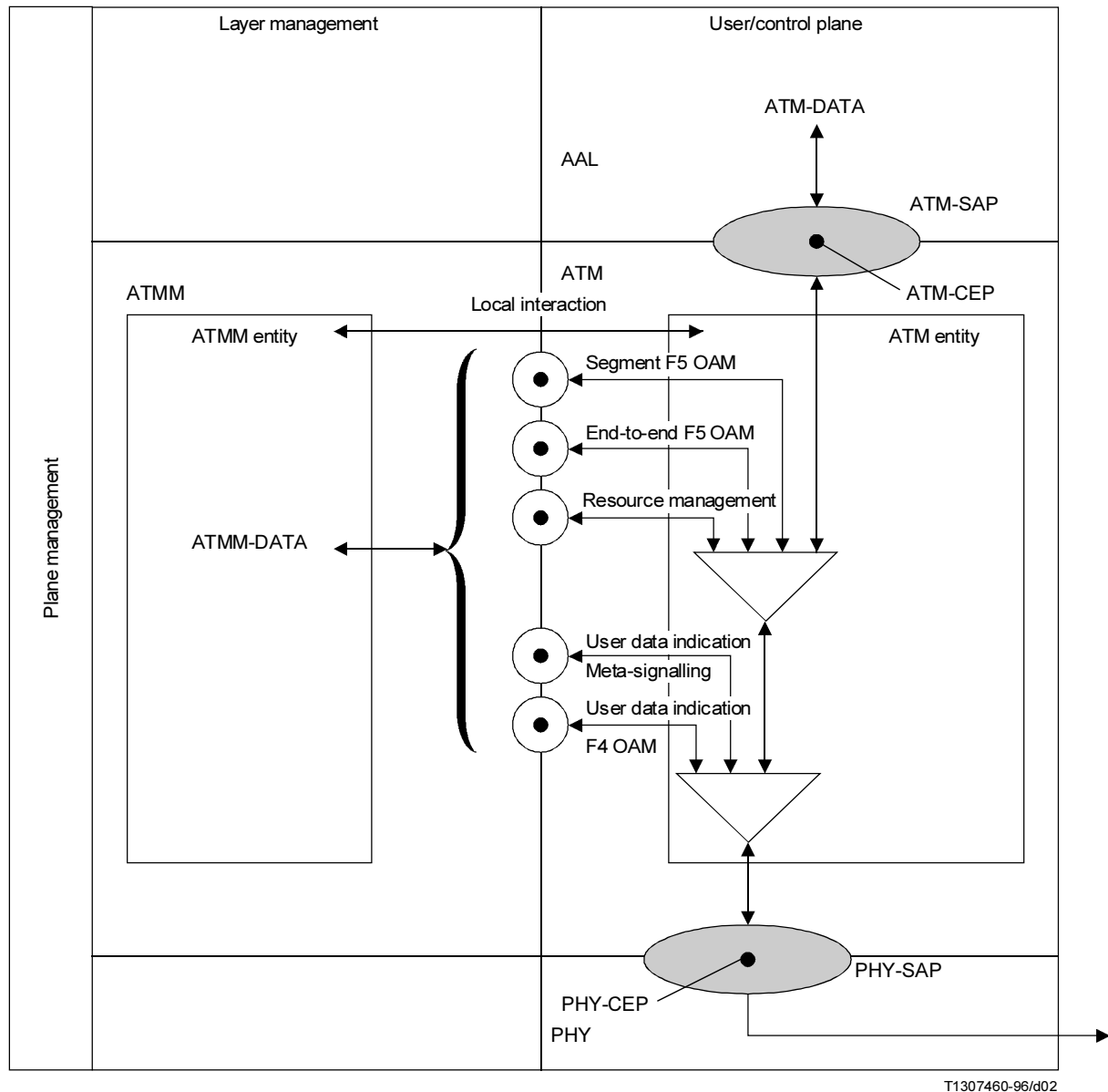
FIGURE 4/I.361

Interactions between ATM- and ATMM-entities

TABLE 6/I.361

Parameters of ATMM-DATA

Parameter	Type	Use	Comments
ATM-SDU	Request Indication	M M	48 octets of ATM layer management data
Submitted CLP	Request	M	(Note)
Received CLP	Indication	O	(Note)
Congestion indication	Indication	M	Indication of congestion experienced
PHY-CEI	Request Indication	M M	Identification of PHY-CE within PHY-SAP
M Mandatory O Optional NOTE – CLP = 0: CLP bit set to "0". CLP = 1: CLP bit set to "1".			

4   ATM protocol procedures

This clause contains procedures that describe the operation of the ATM protocol (including the peer-to-peer and inter-layer information flows).

4.1   GFC protocol procedures

For uncontrolled equipment, the GFC function is not used. Therefore no action is taken on the GFC field setting and the GFC field is always set to all zeros upon transmission. The procedures described below apply to controlled and controlling equipment as described in 3.4.4.1/I.150.

Controlled GFC procedures at the S_B and T_B reference points (see Figures 2/I.413 and 3/I.413), when implemented, provide the possibility for three functions:

1)   an option is cyclic HALT of traffic on all ATM connections for limiting the ATM traffic to the network across the UNI to a fixed fraction of the interface;

2)   access control to the network of traffic on controlled ATM connections; and

3)   explicit indication by controlled equipment to controlling equipment that an offered cell is on a controlled ATM connection.

4.1.1   GFC field assignment at S_B and T_B

GFC uses ATM layer assigned and unassigned cells. In the direction of the controlling to the controlled device, whenever possible, the GFC signals will be superimposed on existing ATM Layer cell flowing from the controlling to the controlled device. If no ATM layer cells exist to superimpose GFC signals on, then the GFC function will create unassigned ATM Layer cell to carry the GFC signals to the controlled device.

The GFC at the S_B and T_B reference points has the following defined bit assignments:

In the direction towards the controlled equipment:

Bit values	Interpretation
0 0 0 0	NO_HALT, NULL
1 0 0 0	HALT, NULL_A, NULL_B
0 1 0 0	NO_HALT, SET_A, NULL_B
1 1 0 0	HALT, SET_A, NULL_B
0 0 1 0	NO_HALT, NULL_A, SET_B
1 0 1 0	HALT, NULL_A, SET_B
0 1 1 0	NO_HALT, SET_A, SET_B
1 1 1 0	HALT, SET_A, SET_B
All Other values ignored.	

In the direction of the controlled device to the controlling device, a direct relationship exists between the setting of the GFC field and the VPI/VCI field of each cell. The determination of uncontrolled, queue A, or queue B setting was made at call set-up time and will be identical for all cells with a given value of VPI/VCI from the controlled device to the controlling device.

In the direction toward the controlling equipment:

Bit values	Interpretation
0 0 0 0	Terminal is uncontrolled. Cell is assigned or on an uncontrolled ATM connection.
0 0 0 1	Terminal is controlled. Cell is unassigned or on an uncontrolled ATM connection.
0 1 0 1	Terminal is controlled. Cell on a controlled ATM connection Group A.
0 0 1 1	Terminal is controlled. Cell on a controlled ATM connection Group B.
All other values ignored.	

4.1.2   GFC procedures across the interface at S_B and T_B reference points

The SDL diagrams for these procedures are given in Annex B.

Controlling equipment link initialization phase protocols

The use of GFC procedures on point-to-point links is determined at link initialization time and does not change while the link is active.

During link initialization the controlling equipment uses the following protocol to determine whether or not to use controlled transmission procedures on this link. On power up, the controlling equipment will start as follows:

In case of PVC links, the use of the GFC "controlling equipment" procedures is determined by provisioning basis.

In case of SVC links, the use of GFC "controlled equipment" procedures is determined by configuration information in the controlled equipment and the selection of uncontrolled, queue A, or queue B per VCI may be confirmed by signalling. Therefore, signalling protocol procedures may be needed to provide this verification. Such signalling procedures are for further study.

The controlling equipment uses the following procedure to dynamically invoke "controlling equipment" procedures.

The controlling equipment starts sending one of the following: HALT, SET_A, or SET_B signals to solicit the GFC capability for some period of time (T), or until the first connection set-up occurs. The default value for timer (T) is five seconds. On timer expiry, the controlling equipment will revert to uncontrolled mode. During this period, the controlling equipment will not prevent the controlled equipment from sending any group of cells, except by cyclic HALT until it has received 0001, 0101, 0011 signals from the controlled equipment or terminates the link start up procedures. Accordingly, controlled equipment must respond with a cell with a valid non-zero GFC field within the period T.

Procedures for the one-queue default model, and the optional two-queue model for controlled equipment are included in this subclauses.

4.1.2.1   GFC procedures across the interface at S_B and T_B reference points (one-queue model, default)

1) On power up, the controlled equipment will start as follows: (see 4.1.2 for the controlling equipment initialization procedures)

   – The TRANSMIT flag is initialized as set. The GO_CNTR is initialized as zero. The GO_VALUE is initialized as one. The GFC_ENABLE flag is reset. The GO_VALUE can be changed by the management procedure.

   – The controlled equipment will perform the uncontrolled GFC procedures until it has received HALT, SET_A, or SET_B signals from the controlling equipment. When the controlled equipment receives HALT, SET_A, or SET_B signals from the controlling equipment, the GFC_ENABLE flag is set and thereafter the controlling equipment performs the controlled GFC procedures.

2) The sending of the HALT code point is an option. When sent, the HALT command shall be cyclic. Cyclic HALT will be used to logically limit the effective ATM transport capacity. The HALT command will be issued by the controlling equipment to decrease the effective ATM transmission capacity of the link, e.g. on a 100 Mbit/s link, HALT would be in effect 50% of the time to reduce the logical ATM transmission capacity to 50 Mbit/s. This would be done on a cyclic (predictable) rate over the lifetime of the physical connection, e.g. from physical link ACTIVATION to DEACTIVATION. The cyclic use of HALT must not alter traffic that conforms to the traffic contract to produce traffic that no longer conforms to the traffic contract. On receiving any NO_HALT, the controlled equipment sets the TRANSMIT flag. On receiving any HALT, the controlled equipment nulls the TRANSMIT flag.

3) If the TRANSMIT flag is set, the controlled equipment is free to send to the network an assigned cell on any uncontrolled ATM connection, provided that the sending of the cell at that time is permitted by the terms of the traffic contract in force on the given connection. When sending a cell on an uncontrolled ATM connection, the controlled equipment marks the GFC of that cell as cell is on an uncontrolled connection.

4) If the TRANSMIT flag is null, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any connection.

5) On receiving any SET_A, the controlled equipment sets the credit counter to a specified integer value (GO_VALUE).

6) Any NULL has no action on the GO_CNTR.

7) If the TRANSMIT flag is set and there is no cell to transmit on any uncontrolled ATM connections, then the following procedures apply:

– If the GO_CNTR is greater than zero, the controlled equipment is permitted to send to the network an assigned cell on any controlled ATM connection. When sending a cell on a controlled ATM connection, the controlled equipment marks the GFC of that cell as cell is on a controlled ATM connection and decrements the GO_CNTR by one.

– Otherwise, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any controlled ATM connection.

4.1.2.2   GFC procedures across interface at S_B and T_B reference points (two-queue model)

1) On power up, the controlled equipment will start as follows: (see 4.1.2 for the controlling equipment initialization procedures)

– The TRANSMIT and GROUP_SELECT flags are initialized as set. The GO_CNTR_A and GO_CNTR_B are initialized as zero. The GO_VALUE_A and GO_VALUE_B are initialized as one. The GFC_ENABLE flag is reset. The GO_VALUE_A and GO_VALUE_B can be changed by the management procedure.

– The controlled equipment will perform the uncontrolled GFC procedures until it has received HALT, SET_A, or SET_B signals from the controlling equipment. When the controlled equipment receives HALT, SET_A, or SET_B signals from the controlling equipment, the GFC_ENABLE flag is set and thereafter the controlling equipment performs the controlled GFC procedures.

2) The sending of the HALT code point is an option. When sent, the HALT command shall be cyclic. Cyclic HALT will be used to logically limit the effective ATM transport capacity. The HALT command will be issued by the controlling equipment to decrease the effective ATM transmission capacity of the link, e.g. on a 100 Mbit/s link, HALT would be in effect 50% of the time to reduce the logical ATM transmission capacity to 50 Mbit/s. This would be done on a cyclic (predictable) rate over the lifetime of the physical connection, e.g. from physical link ACTIVATION to DEACTIVATION. The cyclic use of HALT must not alter traffic that conforms to the traffic contract to produce traffic that no longer conforms to the traffic contract. On receiving any NO_HALT, the controlled equipment sets the TRANSMIT flag. On receiving any HALT, the controlled equipment nulls the TRANSMIT flag.

3) If the TRANSMIT flag is set, the controlled equipment is free to send to the network an assigned cell on any uncontrolled ATM connection, provided that the sending of the cell at that time is permitted by the terms of the traffic contract in force on the given connection. When sending a cell on an uncontrolled ATM connection, the controlled equipment marks the GFC of that cell as cell is on an uncontrolled connection.

4) If the TRANSMIT flag is null, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any connection.

5) On receiving any SET_A, the controlled equipment resets the credit counter of the Group A (GO_CNTR_A) to a specified integer value (GO_VALUE_A).

6) Any NULL_A has no action on the GO_CNTR_A.

7) On receiving any SET_B, the controlled equipment sets the credit counter of the Group B (GO_CNTR_B) to a specified integer value (GO_VALUE_B).

8) Any NULL_B has no action on the GO_CNTR_B.

9) If the TRANSMIT flag is set and no uncontrolled cells are available to transmit; then:

   a) If the GROUP_SELECT flag is set, then the following procedures apply:

   i) If the GO_CNTR_A is greater than zero, the controlled equipment is permitted to send to the network an assigned cell on any controlled ATM connection in the Group A. When sending a cell on a controlled ATM connection in the Group A, the controlled equipment marks the GFC of that cell as cell is on a controlled ATM connection in the Group A and decrements the GO_CNTR_A by one. The GROUP_SELECT flag is reset.

   – Otherwise, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any controlled ATM connection in the Group A. The GROUP_SELECT flag is kept as set.

   ii) If the GO_CNTR_A is equal to zero or there is no cell waiting, then the further procedures are as follows:

   – If the GO_CNTR_B is greater than zero, the controlled equipment is permitted to send to the network an assigned cell on any controlled ATM connection in the Group B. When sending a cell on a controlled ATM connection in the Group B, the controlled equipment marks the GFC of that cell as cell is on a controlled ATM connection in the Group B and decrements the GO_CNTR_B by one. The GROUP_SELECT flag is kept as set.

   – Otherwise, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any controlled ATM connection in the Group B. The GROUP_SELECT flag is kept as set.

   b) If the GROUP_SELECT flag is not set, the following procedures apply:

   i) If the GO_CNTR_B is greater than zero, the controlled equipment is permitted to send to the network an assigned cell on any controlled ATM connection in the Group B. When sending a cell on a controlled ATM connection in the Group B, the controlled equipment marks the GFC of that cell as cell is on a controlled ATM connection in the Group B and decrements the GO_CNTR_B by one. The GROUP_SELECT flag is set.

   – Otherwise, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any controlled ATM connection in the Group B. The GROUP_SELECT flag is kept reset.

   ii) If the GO_CNTR_B is equal to zero or there is no cell waiting, then the further procedures are as follows:

   – If the GO_CNTR_A is greater than zero, the controlled equipment is permitted to send to the network an assigned cell on any controlled ATM connection in the Group A. When sending a cell on a controlled ATM connection in the Group A, the controlled equipment marks the GFC of that cell as cell is on a controlled ATM connection in the Group A and decrements the GO_CNTR_A by one. The GROUP_SELECT flag is reset.

   – Otherwise, the controlled equipment is not permitted to send any assigned ATM layer cell to the network on any controlled ATM connections in the Group A. The GROUP_SELECT flag is kept reset.

4.2 Layer management communication

4.2.1 Functions

For further study.

4.2.2 Procedures

For further study.

4.3 Layer management

4.3.1 Meta-signalling

See Recommendation Q.2120.

4.3.2 Fault management

4.3.2.1 Functions

See Recommendation I.610.

4.3.2.2 Procedures

For further study.

4.3.3 Performance management

4.3.3.1 Functions

See Recommendation I.610.

4.3.3.2 Procedures

For further study.

4.3.4 Configuration management

4.3.4.1 Functions

See Recommendation I.610.

4.3.4.2 Procedures

For further study.

4.3.5 Resource management

4.3.5.1 Functions

See Recommendation I.371.

4.3.5.2 Procedures

For further study.

Annex A

Alphabetical list of abbreviations used in this Recommendation
(This Annex forms an integral part of this Recommendation)

For the proposes of this Recommendation, the following abbreviations are used:

ATM	Asynchronous Transfer Mode
CLP	Cell Loss Priority
GFC	Generic Flow Control
HEC	Header Error Control
MSB	Most Significant Bit
NNI	Network-Node Interface
OAM	Operation And Maintenance

PT   Payload Type

PTI   Payload Type Identifier

UCI   Unassigned Cell Insertion

UNI   User-Network Interface

VCI   Virtual Channel Identifier

VPI   Virtual Path Identifier

Annex B

(This annex forms an integral part of this Recommendation)
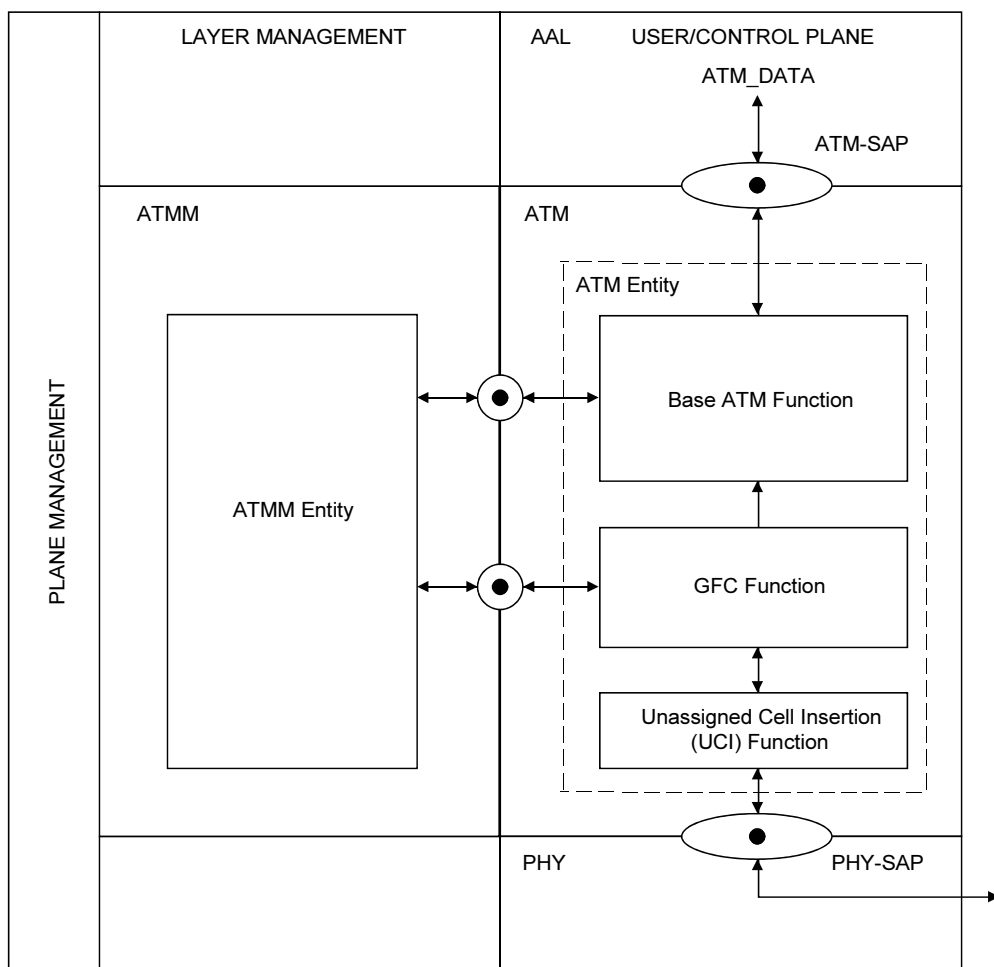
T1303550-95/d03

FIGURE B.1/I.361

**Relationship of GFC Function to other functions
in ATM Entity and to ATMM Entity**

T1303560-95/d04

FIGURE B.2/I.361
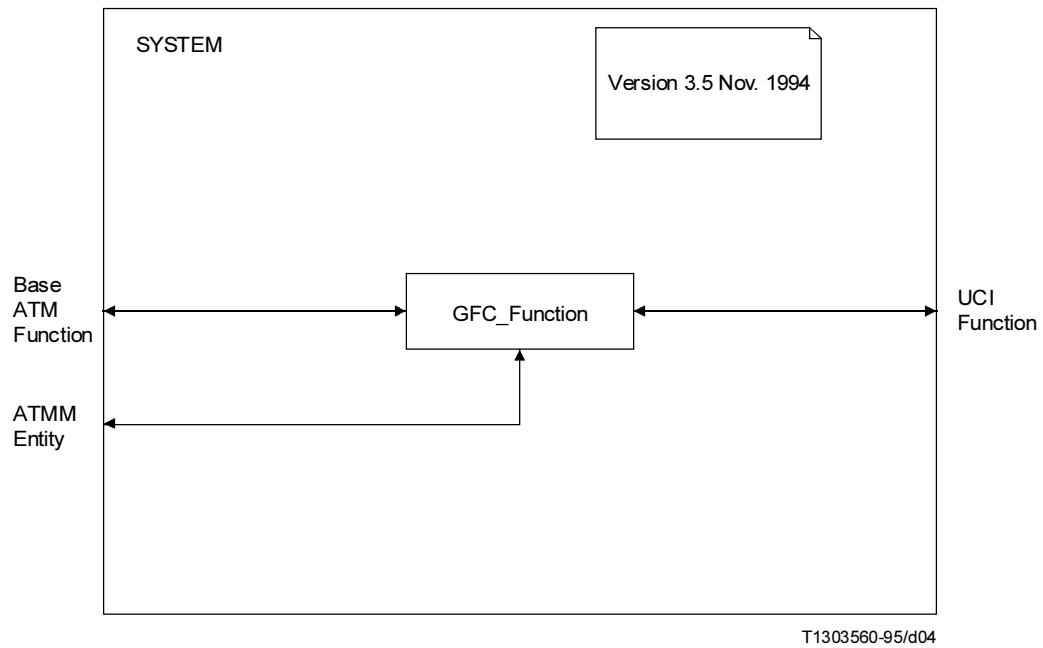
The GFC_Function system

BLOCK GFC_Function

Controlled Side
Version 3.5 Nov. 1994

Base
ATM
Function

RECEIVE_
PROCESS

UCI
Function

(Note 1)

ATMM
Function

(Note 2)

Base
ATM
Function

TX-STORE_
PROCESS

TRANSMIT_
PROCESS

UCI
Function

(Note 3)

ATMM
Function

(Note 4)

T1303570-95/d05
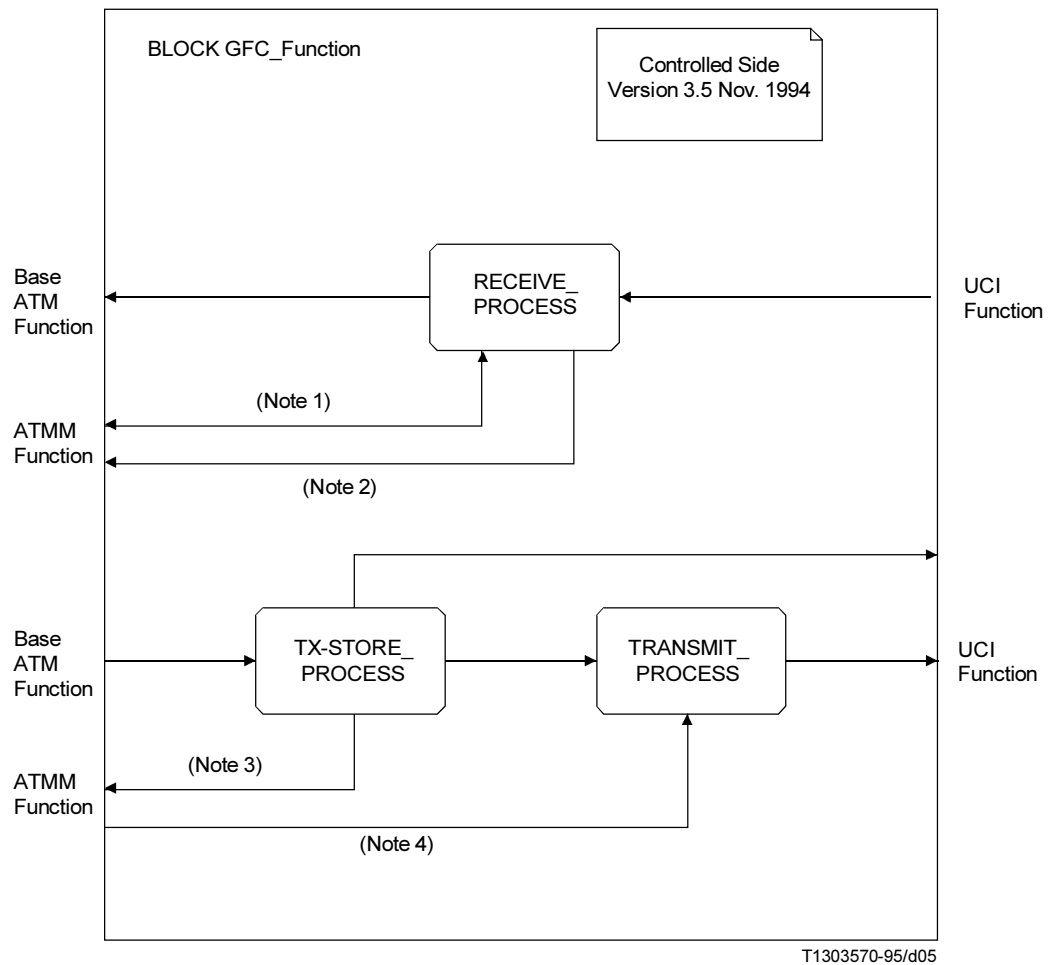
NOTE

1   ATMM Entity sets GO_VALUE(s); default is 1.

2   LM_Sig(GFC_ENABLE).

3   LM_Sig(Invalid_CELL); LM_Sig(Invalid_Class).

4   LM_Sig(C_Start).

FIGURE B.3/I.361

Block diagram of GFC_Function system in controlled equipment

Superseded by a more recent version

PROCESS RECEIVE

Controlled Side
Group A only supported
Version 3.5 Nov. 1994
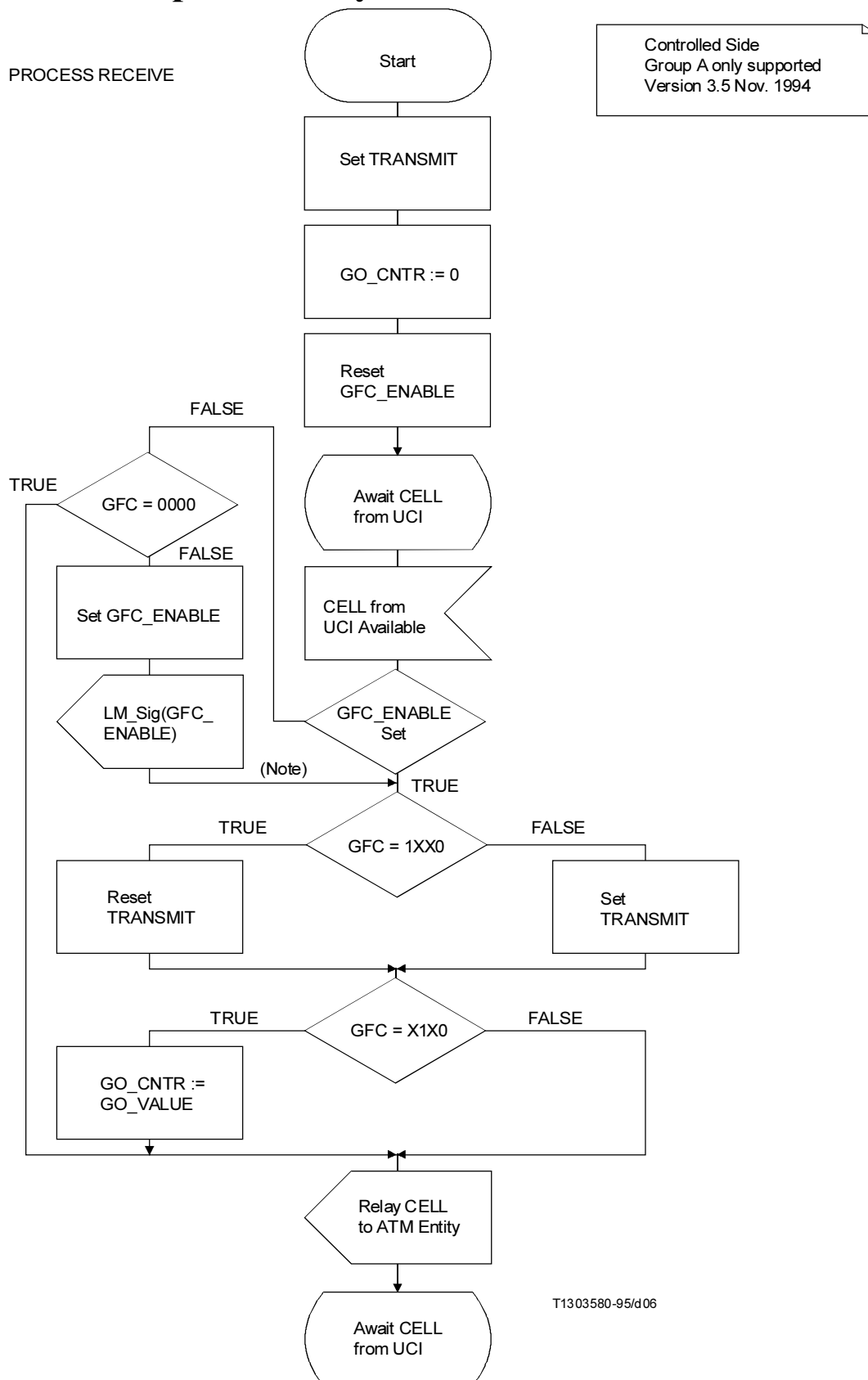
Start

Set TRANSMIT

GO_CNTR := 0

Reset
GFC_ENABLE

Await CELL
from UCI

FALSE

TRUE

GFC = 0000

FALSE

Set GFC_ENABLE

CELL from
UCI Available

LM_Sig(GFC_
ENABLE)

GFC_ENABLE
Set

(Note)

TRUE

TRUE

GFC = 1XX0

FALSE

Reset
TRANSMIT

Set
TRANSMIT

TRUE

GFC = X1X0

FALSE

GO_CNTR :=
GO_VALUE

Relay CELL
to ATM Entity

T1303580-95/d06

Await CELL
from UCI

NOTE – Signal sent to ATMM Entity that GFC_ENABLE is set.

FIGURE B.4/I.361

Receive Process of GFC_Function – Only Group A supported

PROCESS TX_STORE

Start

Await CELL
from ATM Entity

CELL arrives
from
ATM Entity

Controlled Side
Group A only supported
Version 3.5 Nov. 1994

GFC_ENABLE
set

FALSE

TRUE

CELL on
Uncontr Conn'n

FALSE

TRUE

CELL on
Uncontr Conn'n

FALSE

TRUE

Force
GFC := 0000

Force
GFC := 0001

CELL on
Contr Conn'n

TRUE

FALSE

Transmit cell to UCI

LM_Sig(Invalid_
Class)

Place CELL
in Uncon_Q

Force
GFC := 0101

LM_Sig(Invalid_
CELL)

Await CELL
from ATM Entity

Await CELL
from ATM Entity

Await CELL
from ATM Entity

Place CELL
in Con_Q

Await CELL
from
ATM Entity
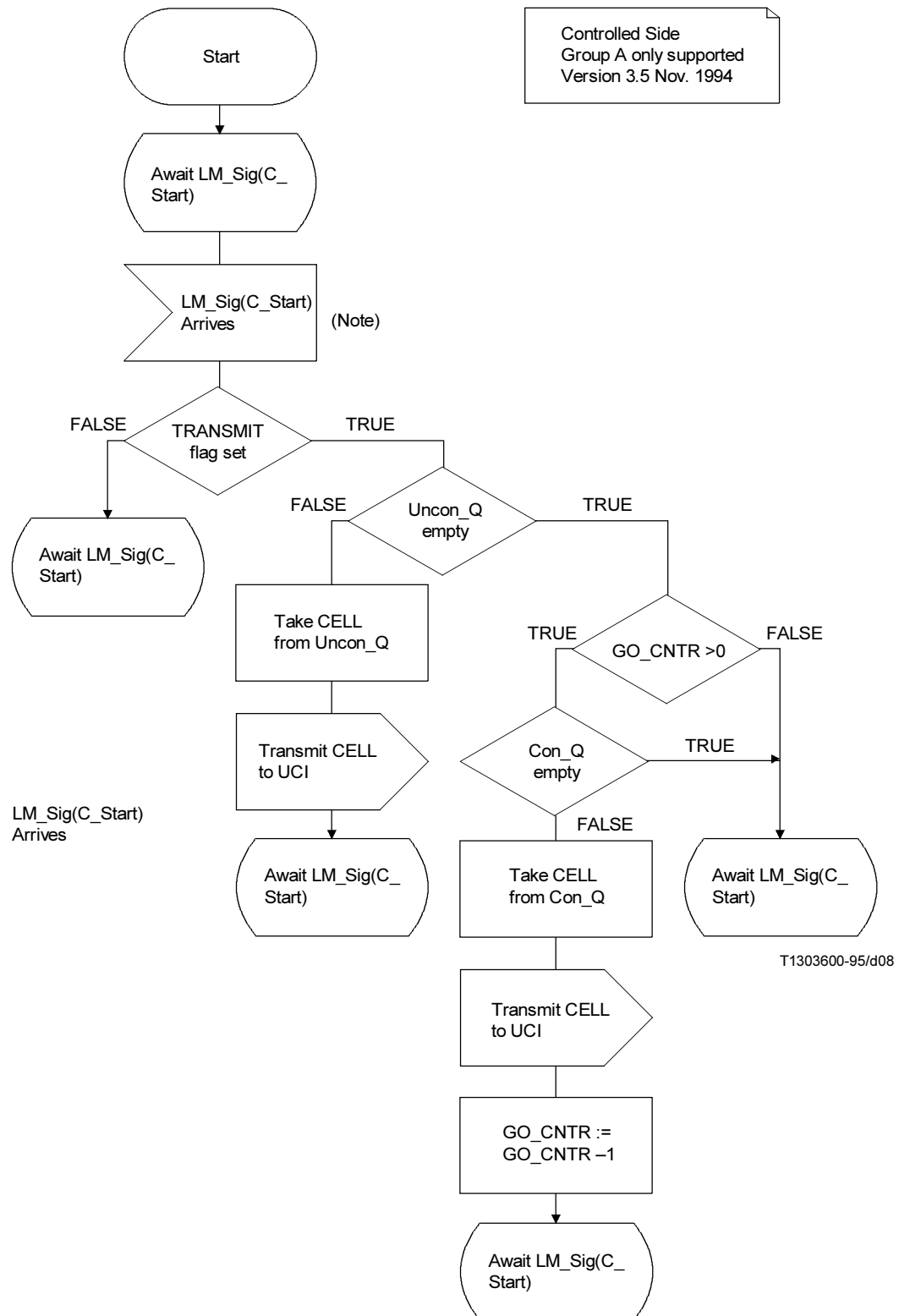
Await CELL
from ATM Entity

T1303590-95/d07

FIGURE B.5/I.361

TX_STORE process in GFC_Function – Only Group A supported

Superseded by a more recent version

PROCESS TRANSMIT

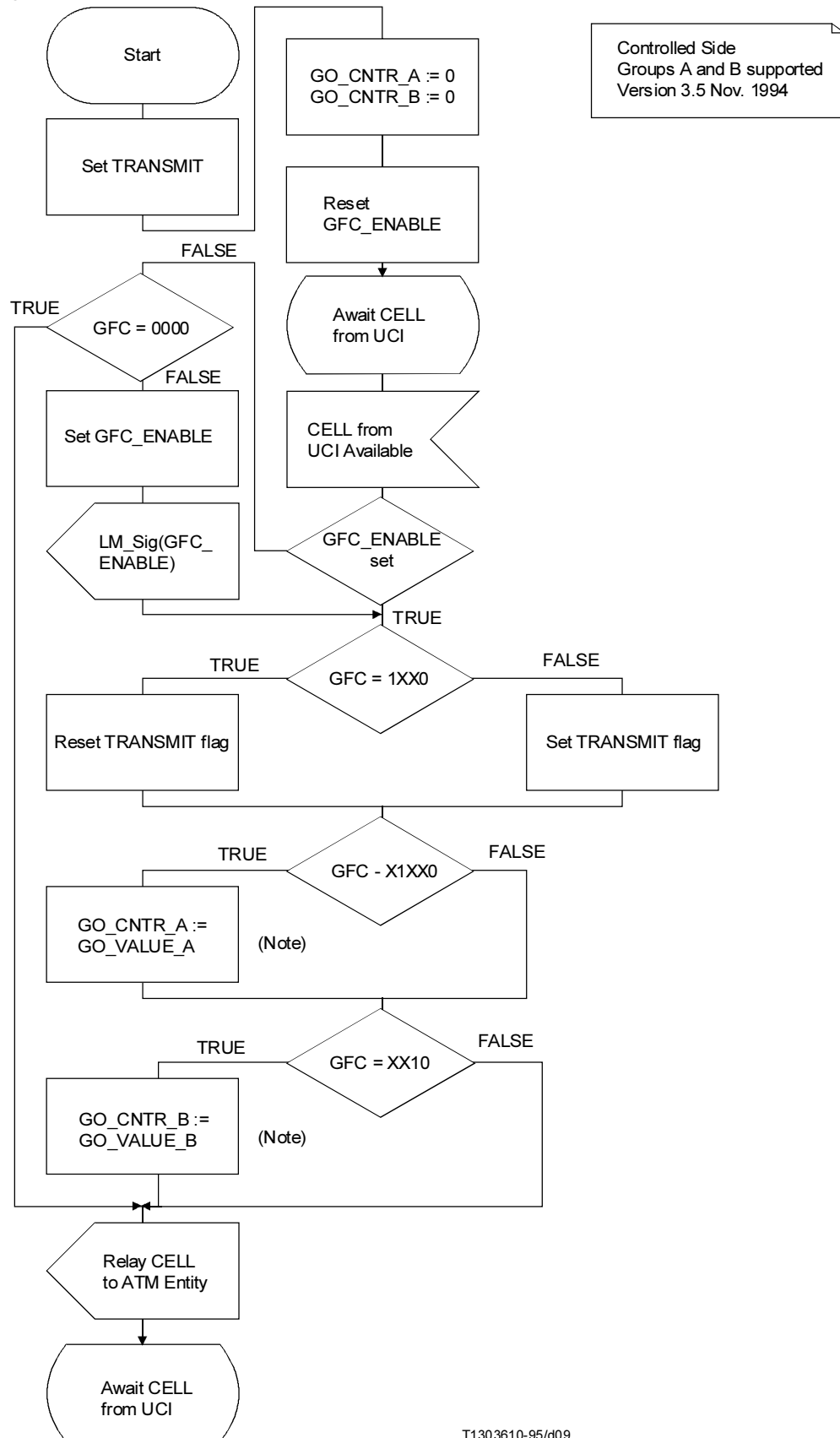Controlled Side
Group A only supported
Version 3.5 Nov. 1994

NOTE – LM_Sig(C_Start) indicates that PHY layer is ready for next cell.

FIGURE B.6/I.361

TRANSMIT process in GFC _Function – Only Group A supported
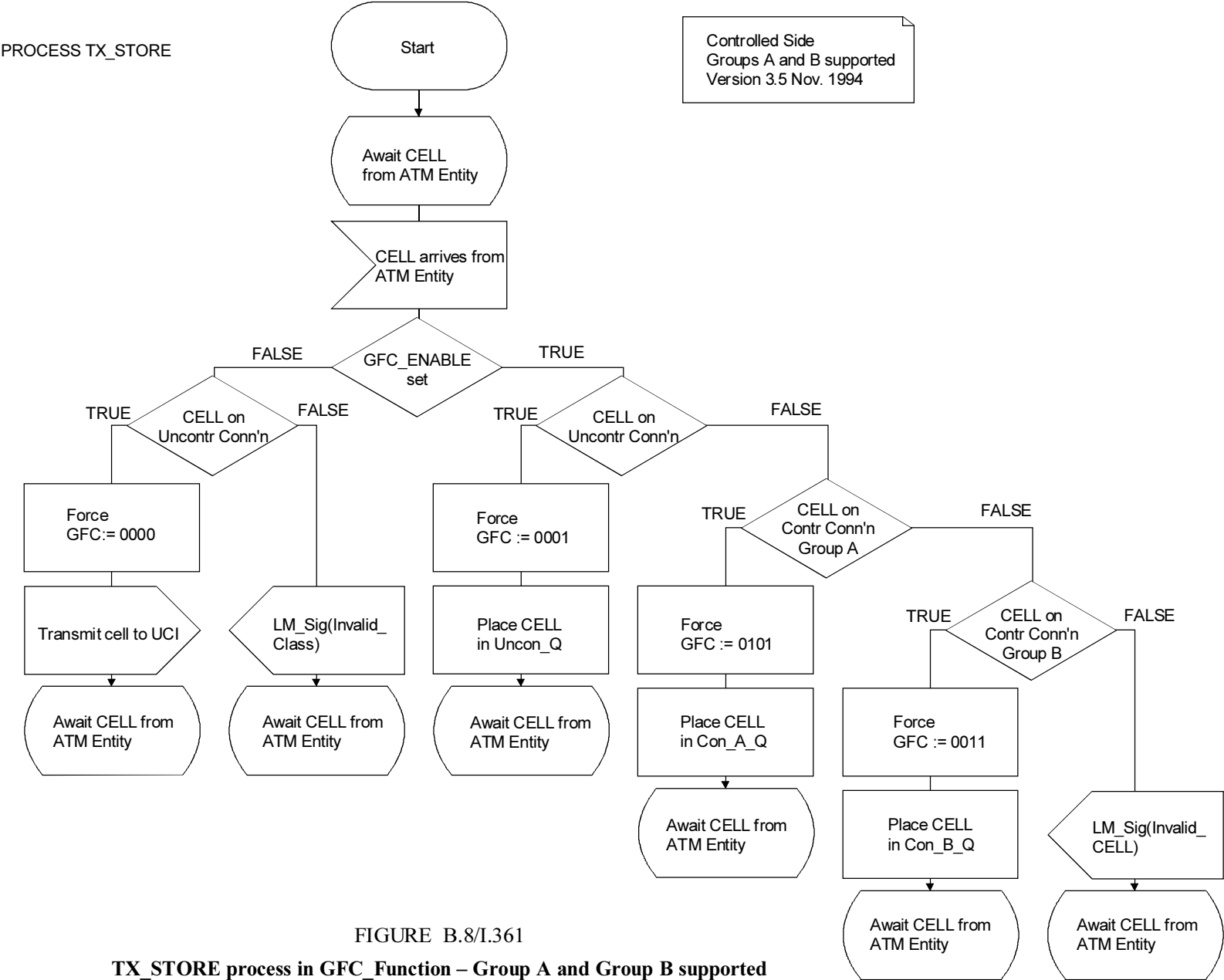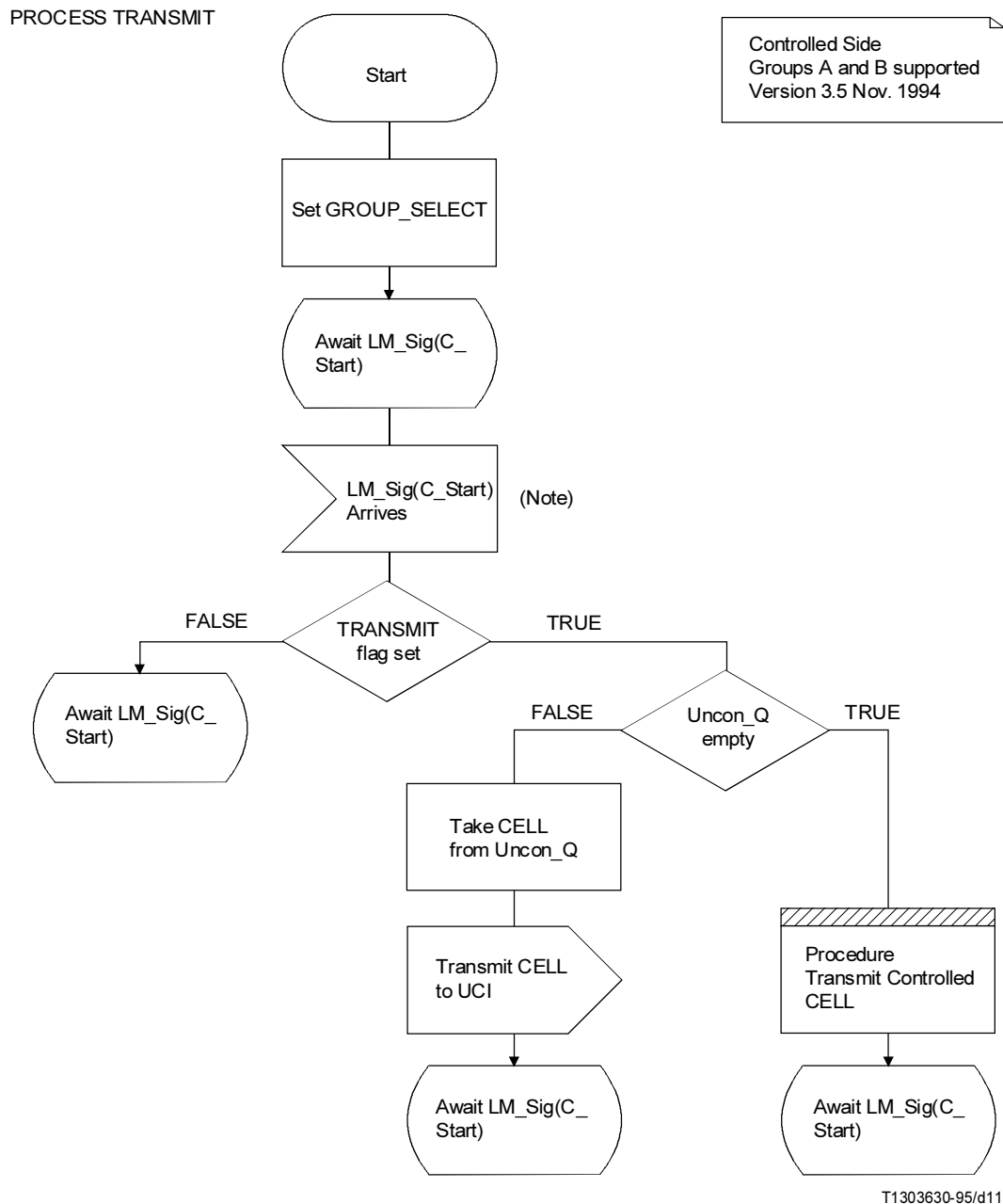
PROCESS RECEIVE

NOTE – GO_VALUE_A and GO_VALUE_B set by ATMM Entity.

FIGURE B.7/I.361

Receive process of GFC_Function – Group A and Group B supported

PROCESS TX_STORE

Start

Controlled Side
Groups A and B supported
Version 3.5 Nov. 1994

Await CELL
from ATM Entity

CELL arrives from
ATM Entity

GFC_ENABLE
set

FALSE

TRUE

CELL on
Uncontr Conn'n

TRUE

FALSE

Force
GFC:= 0000

Transmit cell to UCI

LM_Sig(Invalid_
Class)

Await CELL from
ATM Entity

Await CELL from
ATM Entity

CELL on
Uncontr Conn'n

TRUE

FALSE

Force
GFC := 0001

Place CELL
in Uncon_Q

Await CELL from
ATM Entity

CELL on
Contr Conn'n
Group A

TRUE

FALSE

Force
GFC := 0101

Place CELL
in Con_A_Q

Await CELL from
ATM Entity

CELL on
Contr Conn'n
Group B

TRUE

FALSE

Force
GFC := 0011

Place CELL
in Con_B_Q

Await CELL from
ATM Entity

LM_Sig(Invalid_
CELL)

Await CELL from
ATM Entity

FIGURE B.8/I.361

TX_STORE process in GFC_Function – Group A and Group B supported
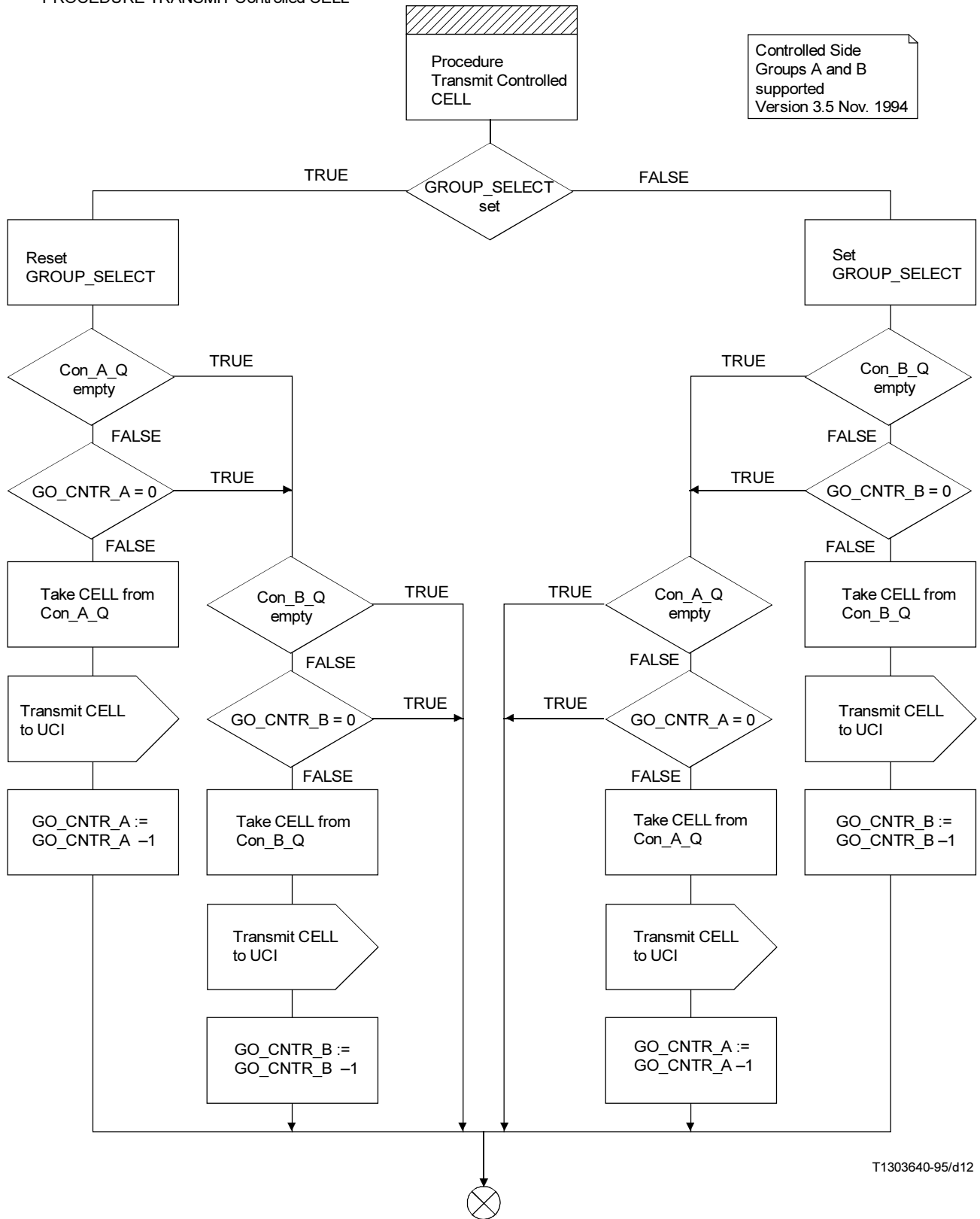
T1303620-95/d10

PROCESS TRANSMIT

NOTE – LM_Sig(C_Start) indicates that PHY layer is ready for next cell.

FIGURE B.9/I.361

TRANSMIT process in GFC_Function – Group A and Group B supported

Superseded by a more recent version

T1303640-95/d12

FIGURE B.10/I.361

**TRANSMIT Controlled CELL procedure of TRANSMIT process in GFC_Function –
Group A and Group B supported**