

ETSI EN 301 823-1-1 V1.1.1 (2001-01)

European Standard (Telecommunications series)

**Broadband Radio Access Networks (BRAN);
HIPERLAN Type 2;
Conformance testing for the
Data Link Control (DLC) protocol;
Part 1: Basic data transport function;
Sub-part 1: Protocol Implementation Conformance
Statement (PICS) proforma**



Reference

DEN/BRAN-002T004-1-1

Keywords

access, control, data, HIPERLAN, PICS, radio

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Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

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Contents

Intellectual Property Rights	5
Foreword.....	5
Introduction.....	5
1 Scope.....	6
2 References.....	6
3 Definitions and abbreviations.....	6
3.1 Definitions	6
3.2 Abbreviations.....	7
4 Conformance to this PICS proforma specification.....	7
Annex A (normative): Protocol ICS proforma for TS 101 761-1	8
A.1 Guidance for completing the PICS proforma.....	8
A.1.1 Purposes and structure.....	8
A.1.2 Abbreviations and conventions	8
A.1.3 Instructions for completing the PICS proforma	10
A.2 Identification of the implementation.....	10
A.2.1 Date of the statement.....	10
A.2.2 Implementation Under Test (IUT) identification	10
A.2.3 System Under Test (SUT) identification	11
A.2.4 Product supplier	11
A.2.5 Client (if different from product supplier).....	11
A.2.6 PICS contact person	12
A.3 Identification of the TS 101 761-1 V1.1.1	12
A.4 Global statement of conformance.....	13
A.5 Roles	13
A.6 PICS for Mobile Terminal MT or Access Point AP.....	13
A.6.1 Major capabilities.....	13
A.6.1.1 Acknowledged mode procedures	13
A.6.1.1.1 Acknowledged mode - transmitter capabilities.....	14
A.6.1.1.2 Acknowledged mode - receiver capabilities.....	15
A.6.1.1.3 Acknowledged mode - logical channel for data flow.....	15
A.6.1.1.4 Acknowledged mode - logical channel for control flow	15
A.6.1.1.5 Acknowledged mode - messages.....	15
A.6.1.2 Repetition mode procedures	16
A.6.1.2.1 Repetition mode - transmitter capabilities.....	16
A.6.1.2.2 Repetition mode - receiver capabilities.....	16
A.6.1.2.3 Repetition mode - logical channel for data flow.....	16
A.6.1.2.4 Repetition mode - logical channel for control flow	16
A.6.1.2.5 Repetition mode - messages.....	17
A.6.1.3 Unacknowledged mode procedures	17
A.6.1.3.1 Unacknowledged mode - transmitter capabilities.....	17
A.6.1.3.2 Unacknowledged mode - receiver capabilities	17
A.6.1.3.3 Unacknowledged mode - logical channel for data flow	17
A.6.1.3.4 Unacknowledged mode - logical channel for control flow.....	17
A.6.1.3.5 Unacknowledged mode - messages	18
A.6.2 PDU descriptions	18
A.6.3 PDU parameters	18
A.6.3.1 Parameters of ARQ_feedback_UP PDUs.....	18
A.6.3.2 Parameters of ARQ_feedback_Down PDUs	18
A.6.3.3 Parameters of Discard_UP PDUs.....	19

A.6.3.4	Parameters of Discard_Down PDUs	19
History	20

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Foreword

This European Standard (Telecommunications series) has been produced by ETSI Project Broadband Radio Access Networks (BRAN).

The present document is part 1, sub-part 1 of a multi-part deliverable covering Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Conformance testing for the Data Link Control (DLC) protocol; Part 1: Basic data transport function, as identified below:

Each part consists of the following sub-parts:

Sub-part 1: "Protocol Implementation Conformance Statement (PICS) proforma";

Sub-part 2: "Test Suite Structure and Test Purposes (TSS&TP) specification";

Sub-part 3: "Abstract Test Suite (ATS) specification".

National transposition dates	
Date of adoption of this EN:	19 January 2001
Date of latest announcement of this EN (doa):	30 April 2001
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 October 2001
Date of withdrawal of any conflicting National Standard (dow):	31 October 2001

Introduction

To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented for a telecommunication specification. Such a statement is called a Protocol Implementation Conformance Statement (PICS).

1 Scope

The present document provides the Protocol Implementation Conformance Statement (PICS) proforma for BRAN HIPERLAN Type 2; Conformance testing for the Data Link Control (DLC) protocol, Part 1: Basic data transport function, as defined in TS 101 761-1 [1] in compliance with the relevant requirements, and in accordance with the relevant guidance given in ISO/IEC 9646-7 [4] and ETS 300 406 [2].

It details (in tabular form) the implementation options, i.e. the optional functions additional to those which are mandatory to implement.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.
- A non-specific reference to an ETS shall also be taken to refer to later versions published as an EN with the same number.

- [1] ETSI TS 101 761-1 (V1.1.1): "Broadband Radio Access Networks (BRAN); HIPERLAN Type 2; Data Link Control (DLC) Layer; Part 1: Basic Data Transport Functions".
- [2] ETSI ETS 300 406 (1995): "Methods for Testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".
- [3] ISO/IEC 9646-1: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 1: General concepts".
- [4] ISO/IEC 9646-7: "Information technology - Open Systems Interconnection - Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

- terms defined in TS 101 761-1 [1];
- terms defined in ISO/IEC 9646-1 [3] and in ISO/IEC 9646-7 [4].

In particular, the following terms defined in ISO/IEC 9646-1 [3] apply:

Implementation Conformance Statement (ICS): statement made by the supplier of an implementation or system claimed to conform to a given specification, stating which capabilities have been implemented. The ICS can take several forms: protocol ICS, profile ICS, profile specific ICS, information object ICS, etc

ICS proforma: document, in the form of a questionnaire, which when completed for an implementation or system becomes an ICS

Protocol ICS (PICS): ICS for an implementation or system claimed to conform to a given protocol specification

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AP	Access Point
ARQ	Automatic Repeat Request
BCH	Broadcast CHannel
CC	Central Controller
CL	Convergence Layer
DCC	DLC user Connection Control
DCCH	Dedicated Control CHannel
DLC	Data Link Control
EC	Error Control
ICS	Implementation Conformance Statement
IUT	Implementation Under Test
LCCH	Link Control CHannel
LCH	Long CHannel
MAC	Medium Access Control
MT	Mobile Terminal
PDU	Protocol Data Unit
PHY	Physical layer
PICS	Protocol ICS
RLC	Radio Link Control
RSS	Received Signal Strength
SCH	Short CHannel
SCS	System Conformance Statement
SUT	System Under Test

4 Conformance to this PICS proforma specification

If it claims to conform to the present document, the actual PICS proforma to be filled in by a supplier shall be technically equivalent to the text of the PICS proforma given in Annex A, and shall preserve the numbering/naming and ordering of the proforma items.

A PICS which conforms to the present document shall be a conforming PICS proforma completed in accordance with the guidance for completion given in Clause A.1.

Annex A (normative): Protocol ICS proforma for TS 101 761-1

Notwithstanding the provisions of the copyright clause related to the text of the present document, ETSI grants that users of the present document may freely reproduce the PICS proforma in this annex so that it can be used for its intended purposes and may further publish the completed PICS.

A.1 Guidance for completing the PICS proforma

A.1.1 Purposes and structure

The purpose of this PICS proforma is to provide a mechanism whereby a supplier of an implementation of the requirements defined in TS 101 761-1 [1] may provide information about the implementation in a standardized manner.

The PICS proforma is subdivided into subclauses for the following categories of information:

- guidance for completing the PICS proforma;
- identification of the implementation;
- identification of the TS 101 761-1 [1];
- global statement of conformance;
- roles;
- major capabilities;
- PDUs;
- PDU parameters.

A.1.2 Abbreviations and conventions

The PICS proforma contained in this annex is comprised of information in tabular form in accordance with the guidelines presented in ISO/IEC 9646-7 [4].

Item column

The item column contains a number which identifies the item in the table.

Item description column

The item description column describes in free text each respective item (e.g. parameters, timers, etc.). It implicitly means "is <item description> supported by the implementation?".

Status column

The following notations, defined in ISO/IEC 9646-7 [4], are used for the status column:

- | | |
|-----|---|
| m | mandatory - the capability is required to be supported. |
| o | optional - the capability may be supported or not. |
| n/a | not applicable - in the given context, it is impossible to use the capability. |
| x | prohibited (excluded) - there is a requirement not to use this capability in the given context. |

o.i	qualified optional - for mutually exclusive or selectable options from a set. "i" is an integer which identifies a unique group of related optional items and the logic of their selection which is defined immediately following the table.
ci	conditional - the requirement on the capability ("m", "o", "x" or "n/a") depends on the support of other optional or conditional items. "i" is an integer identifying a unique conditional status expression which is defined immediately following the Table.
i	irrelevant (out-of-scope) - capability outside the scope of the reference specification. No answer is requested from the supplier.

NOTE 1: This use of "i" status is not to be confused with the suffix "i" to the "o" and "c" statuses above.

Reference column

The reference column makes reference to TS 101 761-1 [1], except where explicitly stated otherwise.

Support column

The support column shall be filled in by the supplier of the implementation. The following common notations, defined in ISO/IEC 9646-7 [4], are used for the support column:

Y or y	supported by the implementation.
N or n	not supported by the implementation.
N/A, n/a or -	no answer required (allowed only if the status is n/a, directly or after evaluation of a conditional status).

If this PICS proforma is completed in order to describe a multiple-profile support in a system, it is necessary to be able to answer that a capability is supported for one profile and not supported for another. In that case, the supplier shall enter the unique reference to a conditional expression, preceded by "?" (e.g. ?3). This expression shall be given in the space for comments provided at the bottom of the table. It uses predicates defined in the SCS, each of which refers to a single profile and which takes the value TRUE if and only if that profile is to be used.

EXAMPLE 1: ?3: IF prof1 THEN Y ELSE N

NOTE 2: As stated in ISO/IEC 9646-7 [4], support for a received PDU requires the ability to parse all valid parameters of that PDU. Supporting a PDU while having no ability to parse a valid parameter is non-conformant. Support for a parameter on a PDU means that the semantics of that parameter are supported.

Values allowed column

The values allowed column contains the type, the list, the range, or the length of values allowed. The following notations are used:

- range of values: example:	<min value> .. <max value> 5 .. 20
- list of values: example: example: example:	<value1>, <value2>, ..., <valueN> 2 ,4 ,6 ,8 ,9 "1101"B, "1011"B, "1111"B "0A"H, "34"H, "2F"H
- list of named values: example:	<name1>(<val1>), <name2>(<val2>), ..., <nameN>(<valN>) reject(1), accept(2)
- length: example:	size (<min size> .. <max size>) size (1 .. 8)

Values supported column

The values supported column shall be filled in by the supplier of the implementation. In this column, the values or the ranges of values supported by the implementation shall be indicated.

References to items

For each possible item answer (answer in the support column) within the PICS proforma a unique reference exists, used, for example, in the conditional expressions. It is defined as the table identifier, followed by a solidus character "/", followed by the item number in the Table. If there is more than one support column in a table, the columns are discriminated by letters (a, b, etc.), respectively.

EXAMPLE 2: A.5/4 is the reference to the answer of item 4 in Table A.5 of Annex A.

EXAMPLE 3: A.6/3b is the reference to the second answer (i.e. in the second support column) of item 3 in Table A.6 of Annex A.

Prerequisite line

A prerequisite line takes the form: Prerequisite: <predicate>.

A prerequisite line after a clause or table title indicates that the whole clause or the whole table is not required to be completed if the predicate is FALSE.

A.1.3 Instructions for completing the PICS proforma

The supplier of the implementation shall complete the PICS proforma in each of the spaces provided. In particular, an explicit answer shall be entered, in each of the support or supported column boxes provided, using the notation described in subclause A.1.2.

However, the tables containing in "user role" or "Mobile Terminal MT" Subclause shall only be completed for MT implementations, and the tables containing in "network role" or "Access Point AP" Subclause shall only be completed for AP implementations.

If necessary, the supplier may provide additional comments in space at the bottom of the tables or separately.

More detailed instructions are given at the beginning of the different subclauses of the PICS proforma.

A.2 Identification of the implementation

Identification of the Implementation Under Test (IUT) and the system in which it resides (the System Under Test (SUT)) should be filled in so as to provide as much detail as possible regarding version numbers and configuration options.

The product supplier information and client information should both be filled in if they are different.

A person who can answer queries regarding information supplied in the PICS should be named as the contact person.

A.2.1 Date of the statement

.....

A.2.2 Implementation Under Test (IUT) identification

IUT name:

.....

.....

IUT version:

.....

A.2.3 System Under Test (SUT) identification

SUT name:

.....
.....

Hardware configuration:

.....
.....
.....

Operating system:

.....

A.2.4 Product supplier

Name:

.....

Address:

.....
.....
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

Additional information:

.....
.....
.....

A.2.5 Client (if different from product supplier)

Name:

.....

Address:

.....
.....
.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

Additional information:

.....
.....

A.2.6 PICS contact person

(A person to contact if there are any queries concerning the content of the PICS)

Name:

.....

Telephone number:

.....

Facsimile number:

.....

E-mail address:

.....

Additional information:

.....
.....
.....

A.3 Identification of the TS 101 761-1 V1.1.1

This PICS proforma applies to the ARQ protocol described in the following standard:

TS 101 761-1 (V1.1.1): Broadband Radio Access Networks (BRAN) HIPERLAN Type 2; Data Link Control (DLC) Layer; Part 1: Basic Data Transport Functions.

A.4 Global statement of conformance

Are all mandatory capabilities implemented? (Yes/No)

NOTE: Answering "No" to this question indicates non-conformance to the TS 101 761-1 specification. Non-supported mandatory capabilities are to be identified in the PICS, with an explanation of why the implementation is non-conforming, on pages attached to the PICS proforma.

A.5 Roles

Table A.1: Roles

Item	Role	Reference	Status	Support
1	Mobile Terminal MT	4	o.1	
2	Access Point AP	4	o.1	

o.1: It is mandatory to support at least one of these items.

Comments: According to the answer to items of Table A.1 of this proforma, the completed PICS becomes a PICS relative to an AP or to an MT. If you want to describe both AP and MT, then two copies of this PICS proforma shall be filled in, one copy for each role.

A.6 PICS for Mobile Terminal MT or Access Point AP

This Subclause contains the PICS proforma tables describing the ARQ protocol related either to the Mobile Terminal MT or to the Access Point AP. They need to be completed according to the type of implementation declared in Table A.1.

A.6.1 Major capabilities

Table A.2: Error Control modes

Item	Error Control Mode	Transmitter			Receiver		
		Reference	Status	Support	Reference	Status	Support
1	Acknowledged mode	6.4.2	m if MT o if AP		6.4.2	m if MT o.2 if AP	
2	Repetition mode	6.4.3	o		6.4.3	m if MT o if AP	
3	Unacknowledged mode	6.4.4	m if MT o if AP		6.4.4	m if MT o.2 if AP	

o.2: It is mandatory to support at least one of these items.

A.6.1.1 Acknowledged mode procedures

Prerequisite: A2/1 Acknowledged mode supported

A.6.1.1.1 Acknowledged mode - transmitter capabilities

Table A.3: Acknowledged mode - Transmitter

Item	Capabilities	Reference	Status	Support
1	Generation of CRC	6.4.2.1	m	
2	Transmit LCH data, Handling of transmission buffer	6.4.2.1	m	
3	Handling of sequence numbers	6.4.2.2	m	
4	Handling of window sizes	6.4.2.4	m	
5	Handling of transmitter window	6.4.2.6	m	
6	Handling of Round Trip Time (rtt) calculation	6.3.5.5	m	
7	Logical integrity check (Determination of lowest negatively acknowledged LCH)	6.4.2.11	m	
8	Logical integrity check (A positively acknowledged LCH shall be placed within the negotiated window)	6.4.2.11	o	
9	Handling of F counter used for logical check	6.4.2.11	m	
10	Handling of cumulative acknowledgement	6.4.2.8	m	
11	Handling of transmission timer	6.4.2.11	m	
12	Handling of flow control indication at transmission	6.4.2.14	m	
13	Analysis and handling of received ARQ feedback messages	6.4.2.1	m	
14	Retransmission of missing LCHs in accordance to the ARQ feedback	6.4.2.1	m	
15	Generation and transmission of discard messages and discard of LCHs	6.4.2.1, 6.4.2.12	m	
16	Transmission and handling of RLC_RESET REQUEST messages	6.4.2.9	m	
17	Transmission and handling of RLC_RESET_ACK messages	6.4.2.9	m	
18	Handling of received Dynamic ARQ bandwidth allocation requests	6.4.2.13	m if AP n/a if MT	
19	Handling of the ARB (request of ARQ feedback message)	6.4.2.14	m	

A.6.1.1.2 Acknowledged mode - receiver capabilities

Table A.4: Acknowledged mode - Receiver

Item	Capabilities	Reference	Status	Support
1	Evaluation of CRC	6.4.2.1	m	
2	Receive LCH data, Handling of reception buffer	6.4.2.1, 6.4.2.9	m	
3	Handling of sequence numbers	6.4.2.2	m	
4	Handling of CRC errors	6.4.2.10	m	
	Handling of window sizes	6.4.2.4	m	
5	Handling of receiver window	6.4.2.5	m	
6	Generation of CumAck (cumulative acknowledgement)	6.4.2.8	m	
7	Handling of flow control indication at reception	6.4.2.14	m	
8	Setting and Handling of ARB bits	6.4.2.14	m	
9	Detection of missing LCHs	6.4.2.1	m	
10	Delivery of LCHs in order to the CL (Re-ordering if necessary)	6.4.2.1	m	
11	Generation and Transmission of ARQ feedback messages	6.4.2.1	m	
12	Handling of received Discard messages	6.4.2.1	m	
13	Handling of discarded data and correct data (Delivery of LCHs below discard sequence)	6.4.2.12	m	
14	Handling of RESET REQUEST messages	6.4.2.9	m	
15	Handling of RESET_ACK messages	6.4.2.9	m	
16	Transmission of Dynamic ARQ bandwidth allocation requests	6.4.2.13	m if MT n/a if AP	

A.6.1.1.3 Acknowledged mode - logical channel for data flow

Table A.5: Acknowledged mode - data channel

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	UDCH	6.4.1	m		6.4.1	n/a	

A.6.1.1.4 Acknowledged mode - logical channel for control flow

Table A.6: Acknowledged mode - control channel

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	LCCH	6.4.1	m		6.4.1	m	

A.6.1.1.5 Acknowledged mode - messages

Table A.7: Acknowledged mode - messages

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	RLC Reset Request	6.2.9	m		6.2.9	m	
2	ARQ Feedback	6.2.9	n/a		6.2.9	m	
3	Discard	6.2.9	m		6.2.9	n/a	

A.6.1.2 Repetition mode procedures

Prerequisite: A2/2 Repetition mode supported

A.6.1.2.1 Repetition mode - transmitter capabilities

Table A.8: Repetition mode - transmitter

Item	Capabilities	Reference	Status	Support
1	Generation of CRC	6.4.3.1	m	
2	Transmit LCH data, Handling of transmission buffer	6.4.3.1	m	
3	Handling of transmitter window	6.4.3.4	m	
4	Arbitrary Retransmission of any LCHs	6.4.3.6	m	
5	Generation and transmission of discard messages and discard of LCHs	6.4.3.8	m	

A.6.1.2.2 Repetition mode - receiver capabilities

Table A.9: Repetition mode - receiver

Item	Capabilities	Reference	Status	Support
1	Evaluation of CRC	6.4.3.1	m	
2	Receive LCH data, Handling of reception buffer	6.4.3.1	m	
3	Handling of CRC errors (discard LCHs)	6.4.3.7	m	
4	Handling of receiver window	6.4.3.4	m	
5	Handling of sequence numbers	6.4.3.3	m	
6	Detection of duplicate LCHs	6.4.3.1	m	
7	Detection of missing LCHs	6.4.3.1	m	
8	Delivery of LCHs in order to the CL, after possible Re-ordering	6.4.3.1	m	
9	Handling of received Discard messages	6.4.3.9	m	
10	Proper handling of discarded data and correct data (Delivery of LCHs below discard sequence)	6.4.3.9	o	

A.6.1.2.3 Repetition mode - logical channel for data flow

Table A.10: Repetition mode - data channel

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	UBCH	6.4.1	m		6.4.1	n/a	

A.6.1.2.4 Repetition mode - logical channel for control flow

Table A.11: Repetition mode - control channel

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	LCCH	6.4.1	m		6.4.1	n/a	

A.6.1.2.5 Repetition mode - messages

Table A.12: Repetition mode - messages

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	Discard	6.2.9.2.4 6.2.9.2.5 6.4.3.9	m		6.2.9.2.4 6.2.9.2.5 6.4.3.9	n/a	

A.6.1.3 Unacknowledged mode procedures

Prerequisite: A2/3 Unacknowledged mode supported

A.6.1.3.1 Unacknowledged mode - transmitter capabilities

Table A.13: Unacknowledged mode - transmitter

Item	Capabilities	Reference	Status	Support
1	Generation of CRC	6.4.4.1	m	
2	Handling of sequence numbers	6.4.4.2	m	
3	Transmit LCH data in ascending Seq nr ordering, Handling of transmission buffer	6.4.4.3	m	
4	Ignore received ARQ feedback messages	6.4.4.3	m	

A.6.1.3.2 Unacknowledged mode - receiver capabilities

Table A.14: Unacknowledged mode - receiver

Item	Capabilities	Reference	Status	Support
1	Evaluation of CRC	6.4.4.1	m	
2	Handling of sequence numbers	6.4.4.2	m	
3	Receive LCH data, Handling of reception buffer	6.4.4.4	m	
4	Handling of CRC errors	6.4.4.1	m	
5	Delivery of LCHs in order to the CL or RLC, after possible Re-ordering	6.4.4.1	m	

A.6.1.3.3 Unacknowledged mode - logical channel for data flow

Table A.15: Unacknowledged mode - data channel

Item	Channel	Data Transmitter to Receiver			Data Receiver to Transmitter		
		Reference	Status	Support	Reference	Status	Support
1	UDCH	6.4.1, 6.4.4.1	m for MT o for AP		6.4.1, 6.4.4.1	n/a	
2	UBCH	6.4.1, 6.4.4.1	m for MT o for AP		6.4.1, 6.4.4.1	n/a	
3	UMCH	6.4.1, 6.4.4.1	m		6.4.1, 6.4.4.1	n/a	
4	RBCH using LCH	6.4.1, 6.4.4.1	m		6.4.1, 6.4.4.1	n/a	
5	DCCH using LCH	6.4.1, 6.4.4.1	m		6.4.1, 6.4.4.1	n/a	

A.6.1.3.4 Unacknowledged mode - logical channel for control flow

No control flow, no channel.

A.6.1.3.5 Unacknowledged mode - messages

No control messages.

A.6.2 PDU descriptions

Table A.16: List of CONTROL PDUs

Item	Capabilities	Reference	Status	Support
1	ARQ_feedback_UP (MT is receiver)	6.2.9.2.1	m	
2	ARQ_feedback_Down (AP is recvr)	6.2.9.2.2	m	
3	Discard_UP (MT is Xmitter)	6.2.9.2.4	m	
4	Discard_Down (AP is Xmitter)	6.2.9.2.5	m	

Comments:

A.6.3 PDU parameters

A.6.3.1 Parameters of ARQ_feedback_UP PDUs

Table A.17: ARQ_feedback_UP PDU

Item	Parameters	Reference	Status	Support
1	SCH PDU type	6.2.9.2.1	m	
2	LCH PHY mode	6.2.9.2.1	m	
3	SCH PHY mode	6.2.9.2.1	m	
4	Flow Control FC	6.2.9.2.1	m	
5	ABIR additional bandwidth for ARQ fb	6.2.9.2.1	m	
6	CAI - Cum ACK	6.2.9.2.1	m	
7	BMN1 Block Number (absolute)	6.2.9.2.1	m	
8	BMB1 bit map block	6.2.9.2.1	m	
9	BMN2 Block Number (relative)	6.2.9.2.1	m	
10	BMB2 bit map block	6.2.9.2.1	m	
11	BMN3 Block Number (relative)	6.2.9.2.1	m	
12	BMB3 bit map block	6.2.9.2.1	m	
13	CRC	6.2.9.2.1	m	

Comments:

A.6.3.2 Parameters of ARQ_feedback_Down PDUs

Table A.18: ARQ_feedback_Down PDU

Item	Parameters	Reference	Status	Support
1	SCH PDU type	6.2.9.2.2	m	
2	Flow Control FC	6.2.9.2.2	m	
3	CAI - Cum ACK	6.2.9.2.2	m	
4	BMN1 Block Number (absolute)	6.2.9.2.2	m	
5	BMB1 bit map block	6.2.9.2.2	m	
6	BMN2 Block Number (relative)	6.2.9.2.2	m	
7	BMB2 bit map block	6.2.9.2.2	m	
8	BMN3 Block Number (relative)	6.2.9.2.2	m	
9	BMB3 bit map block	6.2.9.2.2	m	
10	CRC	6.2.9.2.2	m	

Comments:

A.6.3.3 Parameters of Discard_UP PDUs

Table A.19: Discard_UP PDU

Item	Parameters	Reference	Status	Support
1	SCH PDU type	6.2.9.2.4	m	
2	LCH PHY mode	6.2.9.2.4	m	
3	SCH PHY mode	6.2.9.2.4	m	
4	Discard Sequence number	6.2.9.2.4	m	
5	Repeated Discard Sequence number	6.2.9.2.4	m	
6	Number of SCH	6.2.9.2.4	m	
7	Number of LCH	6.2.9.2.4	m	
8	Error indication	6.2.9.2.4	m	
9	RSSo sample	6.2.9.2.4	m	
10	Retry bit	6.2.9.2.4	m	
11	CRC	6.2.9.2.4	m	

Comments:

A.6.3.4 Parameters of Discard_Down PDUs

Table A.20: Discard_Down PDU

Item	Parameters	Reference	Status	Support
1	SCH PDU type	6.2.9.2.5	m	
2	Discard Sequence number	6.2.9.2.5	m	
3	Repeated Discard Sequence number	6.2.9.2.5	m	
4	CRC	6.2.9.2.5	m	

Comments:

History

Document history		
V1.1.1	September 2000	Publication as TS 101 823-1-1
V1.1.1	September 2000	One-step Approval Procedure OAP 20010119: 2000-09-20 to 2001-01-19
V1.1.1	January 2001	Publication