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SERIES I: INTEGRATED SERVICES DIGITAL NETWORK

ISDN user-network interfaces – Layer 1 Recommendations

B-ISDN user-network interface – Physical layer specification: 1544 kbit/s and 2048 kbits operation

ITU-T Recommendation I.432.3

(Previously CCITT Recommendation)

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ITU-T RECOMMENDATION I.432.3

B-ISDN USER-NETWORK INTERFACE – PHYSICAL LAYER SPECIFICATION 1544 kbit/s AND 2048 kbit/s OPERATION

Summary

This Recommendation covers Physical Layer characteristics for transporting ATM cells using existing Primary Rate ISDN systems. It includes both 1544 and 2048 kbit/s interfaces at the T_B and S_B reference points of the B-ISDN User-Network Interface (UNI). These Physical Layer characteristics may be used to take advantage of existing transmission equipment and building wiring.

This Recommendation is part of the I.432-series, and includes references to Recommendation I.432.1 on general characteristics, and Recommendation I.432.2 on OAM aspects.

Source

ITU-T Recommendation I.432.3 was prepared by ITU-T Study Group 13 (1997-2000) and was approved under the WTSC Resolution No. 1 procedure on the 15th of February 1999.

Keywords

ATM, B-ISDN, UNI, User-Network Interface.

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As of the date of approval of this Recommendation, the ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

CONTENTS

Recommendation I.432.3

B-ISDN USER-NETWORK INTERFACE – PHYSICAL LAYER SPECIFICATION: 1544 kbit/s AND 2048 kbit/s OPERATION

(Geneva, 1999)

1 Scope

This Recommendation covers Physical Layer characteristics for transporting ATM cells using existing Primary Rate ISDN systems. It includes both 1544 and 2048 kbit/s interfaces at the T_B and S_B reference points of the B-ISDN User-Network Interface (UNI).

Functionality is presented in terms of physical media dependent and transmission convergence sublayers.

2 Background

This Recommendation is part of the I.432-series, and contains those characteristics that are specific to transmission systems operating at 1544 kbit/s and 2048 kbit/s. It should be used in conjunction with Recommendation I.432.1 on general characteristics which treats material relevant to all B-ISDN transmission systems at the UNI.

These Physical Layer characteristics may be used to take advantage of existing transmission equipment and building wiring.

Information on other bit rates can be found in other Recommendations of the I.432-series.

3 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.431 (1993), *Primary rate user-network interface – Layer 1 specification.*

[2] ITU-T Recommendation I.361 (1995), *B-ISDN ATM layer specification.*

[3] ITU-T Recommendation G.804 (1998), *ATM cell mapping into plesiochronous digital hierarchy (PDH).*

[4] ITU-T Recommendation G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8488 and 44 736 kbit/s hierarchical levels.*

[5] CCITT Recommendation G.706 (1991), *Frame alignment and cyclic redundancy check (CRC) procedures relating to basic frame structures defined in Recommendation G.704.*

[6] CCITT Recommendation M.3604 (1992), *Application of maintenance principles to ISDN primary rate access.*

[7] ITU-T Recommendation I.432.1 (1999), *B-ISDN user-network interface – Physical layer specifications: General characteristics.*

4 Definitions and abbreviations

4.1 Definitions

None.

4.2 Abbreviations

This Recommendation uses the following abbreviations:

ATM	Asynchronous Transfer Mode
B-ET	Broadband Exchange Termination
B-NT1	Broadband Network Termination 1
B-NT2	Broadband Network Termination 2
B-TE	Broadband Terminal Equipment
CRC	Cyclic Redundancy Check
LCD	Loss of Cell Delineation
LOF	Loss Of Frame
LOS	Loss Of Signal
OAM	Operations, Administration and Maintenance
OCD	Out of Cell Delineation
PMD	Physical Medium Dependent
RAI	Remote Alarm Indication
TC	Transmission Convergence
UNI	User-Network Interface

5 Reference configuration

Refer to Recommendation I.432.1 [7].

6 Interface at 1544 kbit/s for ATM

This clause describes the Physical Layer characteristics for 1544 kbit/s for transporting ATM cells at the User-Network Interface, according to the reference configuration described in Recommendation I.432.1. It covers the Physical Layer characteristics at the T_B and S_B reference points.

6.1 Characteristics of the Physical Media Dependent (PMD) sublayer

The PMD characteristics are as described in Recommendation I.431 [1].

6.2 Functions provided by the Transmission Convergence (TC) sublayer

6.2.1 Bit rate

The interface bit rate at the T_B and S_B reference point is 1544 kbit/s.

6.2.2 Transfer capability

The transport capability available for the ATM cells (user information cells, signalling cells, OAM cells and cells used for cell rate decoupling) excluding Physical Layer overhead cells is 1536 kbit/s.

6.2.3 Transport-specific TC functions

The frame format is as defined in Recommendation I.431 [1].

6.2.4 ATM-specific TC functions

6.2.4.1 ATM cell format

The ATM cell format is as described in Recommendation I.361 [2].

6.2.4.2 Mapping of ATM cells

ATM cells are directly mapped into the frame structure according to Recommendation G.804 [3]. The cells are octet-aligned in the frame structure. See Figure 1.

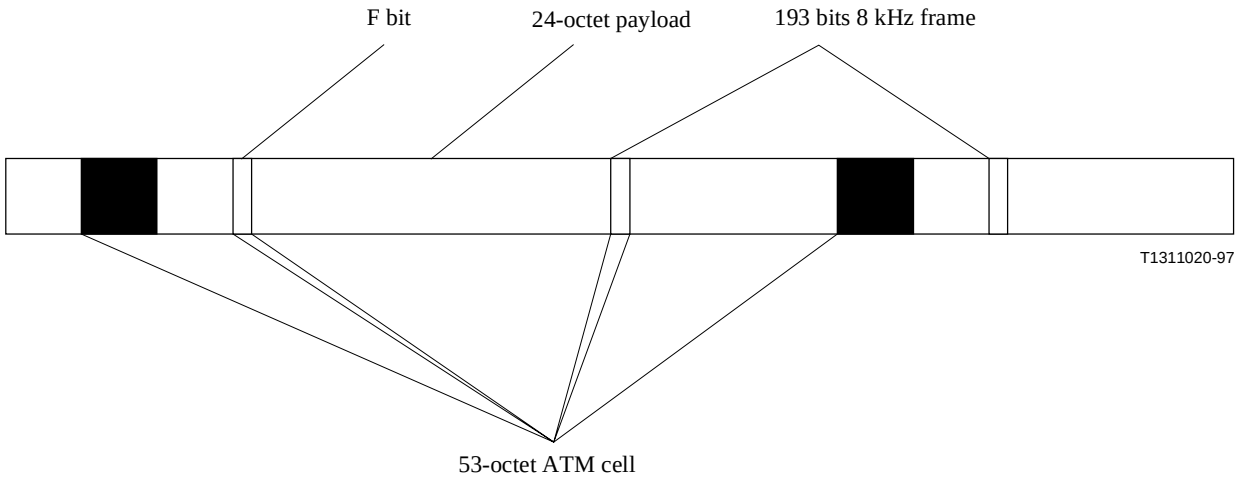


Figure 1/I.432.3 – ATM cell mapping into the 1544 kbit/s frame structure

6.2.4.3 Header error control

Refer to Recommendation I.432.1 [7].

6.2.4.4 Cell delineation

Refer to Recommendation I.432.1 [7].

6.2.4.5 Scrambling

This interface does not use the self-synchronizing scrambler that is described in Recommendation I.432.1.

6.2.4.6 Idle cells

Refer to Recommendation I.432.1 [7].

6.2.5 OAM specific functions

The OAM operational functionality described in 6.1/I.432.2 should be implemented as applicable, using the signals described in 4.7.3/I.431 [1] with the following exceptions:

– there is no distinction between Section and Path;

– the RDI function is implemented using the RAI signal according to Recommendation G.704 [4];

– the performance monitoring functionality is implemented using the CRC-6 procedure as defined in Recommendation G.706 [5].

Additional maintenance functions are specified in Recommendation I.431 [1].

Maintenance state tables are for further study.

6.3 Power feeding

Refer to Recommendation I.431 [1].

7 Interface at 2048 kbit/s for ATM

This clause describes the Physical Layer characteristics for 2048 kbit/s for transporting ATM cells at the User-Network Interface, according to the reference configuration described in Recommendation I.432.1. It covers the Physical Layer characteristics at the T_B and S_B reference points.

7.1 Characteristics of the Physical Media Dependent (PMD) sublayer

The PMD characteristics are as described in Recommendation I.431 [1].

7.2 Functions provided by the Transmission Convergence (TC) sublayer

7.2.1 Bit rate

The interface bit rate at the T_B and S_B reference points is 2048 kbit/s.

7.2.2 Transfer capability

The transfer capability available for the ATM cells (user information cells, signalling cells, OAM cells and cells used for cell rate decoupling) excluding Physical Layer overhead cells is 1920 kbit/s.

7.2.3 Transport-specific TC functions

The frame format is as defined in Recommendation I.431 [1].

7.2.4 ATM-specific TC functions

7.2.4.1 ATM cell format

The ATM cell format is as described in Recommendation I.361 [2].

7.2.4.2 Mapping of ATM cells

ATM cells are directly mapped into the frame structure according to Recommendation G.804 [3]. The cells are octet-aligned in the frame structure. Time Slot 0 (TS0) is used for OAM functions, TS16 is not used in this interface. TS1 to TS15 and TS17 to TS31 are used to transport the ATM cells (30 octets/125 μs). See Figure 2.

<---------- 256 bits/125 µs ---------->

1.....8	9.....128	129…...136	137…….....256
TS0	| Header |	TS16	
TS0		TS16	
TS0	| Header |	TS16	
TS0		TS16	| Header |
TS0		TS16	

Figure 2/I.432.3 – Mapping of ATM cells

7.2.4.3 Header error control

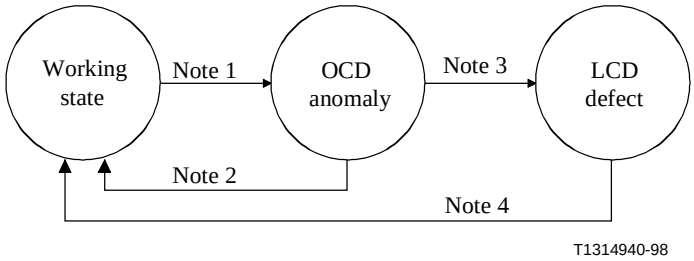
Refer to Recommendation I.432.1 [7].

7.2.4.4 Cell delineation

Refer to Recommendation I.432.1 [7].

For 2048 kbit/s, the Out of Cell Delineation (OCD) anomaly persistence time, defined as the time before the state change from OCD to Loss of Cell Delineation (LCD) will be forced, should be 50 ms.

A LCD defect terminates as soon as possible after the cell delineation process enters and remains in the Sync state. (See Figure 3.)



NOTE 1 – Triggered by state transition (Case A – State change from SYNC to HUNT) due to alpha consecutive incorrect HECs in the cell delineation process. (See Figure 5/I.432.1 [7].)

NOTE 2 – Triggered by state transition (Case B – State change from PRESYNC to SYNC) due to delta consecutive correct HECs in the cell delineation process. (See Figure 5/I.432.1 [7].)

NOTE 3 – Triggered by 50 continuous ms in the OCD anomaly maintenance state.

NOTE 4 – Triggered as soon as possible after entering and remaining in the cell delineation "Sync" state (See Figure 5/I.432.1 [7].)

Figure 3/I.432.3 – Maintenance state transition diagram for cell delineation events

7.2.4.5 Scrambling

$x^{43} + 1$ scrambling function is used for ATM cells, as indicated in Recommendation I.432.1 [7].

7.2.4.6 Idle cells

Refer to Recommendation I.432.1 [7].

7.2.5 OAM specific functions

This subclause applies for broadband access configurations that provide transmission path continuity between B-NT2/B-TE and B-ET. The more general case including ATM cross-connect functionality is for further study.

7.2.5.1 OAM operational functionality

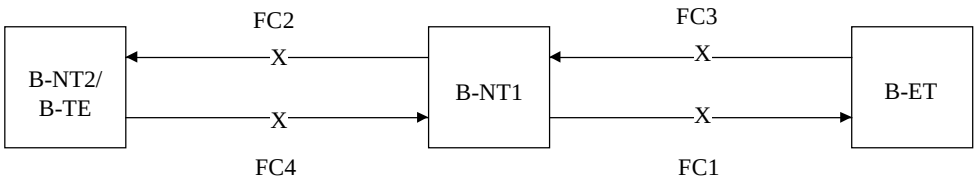
The OAM operational functionality described in 6.1/I.432.2 should be implemented as applicable using the signals described in 4.7.3/I.431 [1] with the following exceptions:

– there is no distinction between Section and Path;

– the RDI function is implemented using the RAI signal according to Recommendation G.704 [4];

– the performance monitoring functionality is implemented using the CRC-4 procedure as defined in Recommendation G.706 [5] using TS0.

The location of fault conditions is shown in Figure 4.



Fault condition	Definition
FC4	Fault in the upstream direction of the interface.
FC2	Fault in the downstream direction of the interface.
FC3	Fault in the downstream direction in access digital section.
FC1	Fault in the upstream direction in access digital section.

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Figure 4/I.432.3 – Location of fault conditions

7.2.5.2 Layer 1 states on the user side of the interface

F0 state: loss of power on the user side

– In general, the TE can neither transmit nor receive signals.

F1 state: operational state

– Network timing and layer 1 service is available.

– The user side transmits and receives operational frames with associated CRC bits and with temporary CRC error information. The interpretation of the CRC error information depends on the option used in the network (see Recommendation M.3604 [6]).

– The user side checks the received frames and the associated CRC bits and transmits to the network side operational frames containing the CRC error information, if a CRC error is detected.

F2 state: fault condition No. 1

– This fault state corresponds to the fault condition FC1.

– Network timing is available at the user side.

– The user side receives operational frames with associated CRC bits and with temporary CRC error information. The interpretation of the CRC error information depends on the option used in the network (see Recommendation M.3604 [6]).

– The received frames contain RAI.

– The user side transmits operational frames with associated CRC bits.

– The user side checks the received frames and the associated CRC bits and transmits to the network side operational frames containing the CRC error information, if a CRC error is detected.

F3 state: fault condition No. 2

– This fault state corresponds to the fault condition FC2.

– Network timing is not available at the user side.

– The user side detects incoming LOS, (this will involve LOF).

– The user side transmits operational frames with associated CRC bits and RAI.

F4 state: fault condition No. 3

– This fault state corresponds to fault condition FC3.

– Network timing is not available at the user side.

– The user side detects AIS.

– The user side transmits to the network side operational frames associated CRC bits and RAI.

F5 state: fault condition No. 4

– This fault state corresponds to the fault condition FC4.

– Network timing is available at the user side.

– The user side receives operational frames with continuous CRC error information (optional).

(This applies only in options 2 and 3 of Annex A/M.3604 [6]. The condition of "continuous CRC error information" corresponds to loss of incoming signal or loss of frame alignment on the network side.)

– The received frames contain RAI.

– The user side transmits operational frames with associated CRC bits.

– The user side checks the received frames and the associated CRC bits. It may transmit to the network side operational frames containing the CRC error information, if a CRC error is detected.

F6 state: power on state

– This is a transient state and the user side may change the state after detection of the signal received.

See Table 1.

Table 1/I.432.3 – Layer 1 state matrix at user side of the interface

	Initial state	F0	F1	F2 (Note 2)	F3	F4	F5	F6
Definition of the states	Operational condition or failure condition	Power off at user side	Operational	FC1	FC2	FC3	FC4	Power on at user side
	Signal transmitted towards interface	No signal	Normal operational frames	Normal operational frames	Frames with RAI	Frames with RAI	Normal operational frames	No signal
New event detected at the receiving side	Loss of TE power	/	PH-DI MPH-EI 0 F0	MPH-EI 0 F0	MPH-EI 0 F0	MPH-EI 0 F0	MPH-EI 0 F0	MPH-EI 0 F0
	Return of TE power	F6	/	/	/	/	/	/
	Normal operational frames from network side	/	–	PH-AI MPH-AI F1	PH-AI MPH-AI F1	PH-AI MPH-AI F1	PH-AI MPH-AI F1	/
	Reception of RAI (Note 1) FC1	/	PH-DI MPH-EI 1 F2	–	MPH-EI 1 F2	MPH-EI 1 F2	MPH-EI 1 F2	MPH-EI 1 F2
	Loss of signal or frame alignment or cell delineation FC2	/	PH-DI MPH-EI 2 F3	MPH-EI 2 F3	–	MPH-EI 2 F3	MPH-EI 2 F3	MPH-EI 2 F3
	Reception of AIS FC3	/	PH-DI MPH-EI 3 F4	MPH-EI 3 F4	MPH-EI 3 F4	–	MPH-EI 3 F4	MPH-EI 3 F4
	Reception of RAI and continuous CRC error report (Note 1) FC4	/	PH-DI MPH-EI 4 F5	MPH-EI 4 F5	MPH-EI 4 F5	MPH-EI 4 F5	–	MPH-EI 4 F5

Single fault conditions

–	No state change
/	Impossible situation
PH-x MPH-y Fz	Issue primitive x Issue management primitive y Go to state Fz

PH-AI PH ACTIVATE indication

PH-DI PH DEACTIVATE indication

MPH-EI n MPH ERROR indication with parameter n (n = 0 to 4)

Table 1/I.432.3 – Layer 1 state matrix at user side of the interface *(concluded)*

NOTE 1 – This event covers different network options. The network options 2 and 3 (see Recommendation M.3604 [6]) of the 2048 kbit/s system (which include CRC processing in the digital transmission link) provide CRC error information which allows the user-side equipment to localize a fault, indicated by means of RAI, to either:

i) the network side (FC1), if frames without continuous CRC error reports are received; or

ii) the user side (FC4), if frames with continuous CRC reports are received.

If network options other than 2 and 3 of the 2048 kbit/s system apply, the faults FC1 and FC4 are indicated identically at the interface, and therefore, the signal "RAI with continuous error report" does not occur.

NOTE 2 – This state covers two user options:

i) if a TE adopting the option to distinguish between F2 and F5 (given by options 2 and 3) is used, but the network does not provide the distinction (see Note 3), then signal "RAI with continuous CRC error report" will not occur and the TE always enters state F2 on receipt of RAI;

ii) the user option of not processing CRC error information when accompanied with RAI, even if provided, merges states F2 and F5.

NOTE 3 – The interpretation of the CRC error information depends on the option used in the network (see Recommendation M.3604 [6]).

7.2.5.3 Layer 1 states at the network side of the interface

G0 state: loss of power on the network side

– In general, the B-NT1 can neither transmit nor receive any signal.

G1 state: operational state

– The network timing and layer 1 service is available.

– The network side transmits and receives operational frames with associated CRC bits and temporary CRC error information.

– The network side checks the received frames and the associated CRC bits and transmits to the user side the CRC error information, if a CRC error is detected.

G2 state: fault condition No. 1

– This fault state corresponds to the fault condition FC1.

– Network timing is provided to the user side.

– The network side receives operational frames with associated CRC bits.

– The network side transmits to the user side operational frames with associated CRC bits and RAI. The operational frames may contain CRC error information. Note that the interpretation of the CRC error information depends on the option used in the network (see Recommendation M.3604 [6]).

G3 state: fault condition No. 2

– This fault state corresponds to the fault condition FC2.

– Network timing is not provided to the user side.

– The network side transmits to the user side operational frames with associated CRC bits.

– The network side receives operational frames with associated CRC bits and RAI.

G4 state: fault condition No. 3

– This fault state corresponds to the fault condition FC3.

– Network timing is not provided to the user side.

– The network side transmits AIS.

– The network side receives operational frames with associated CRC bits and RAI.

G5 state: fault condition No. 4

– This fault state corresponds to the fault condition FC4.

– Network timing is provided to the user side.

– The network side detects incoming LOS or LOF.

– The network side transmits to the user side operational frames with associated CRC bits and RAI and continuous CRC error information. (This only occurs in options 2 and 3 of Annex A/M.3604 [6].)

G6 state: power on state

– This is a transient state and the network side may change the state after detection of the signal received.

See Table 2.

Table 2/I.432.3 – Layer 1 state matrix at network side of the interface

	Initial state	**G0**	**G1**	**G2**	**G3**	**G4**	**G5 (Note 1)**	**G6**
Definition of the states	Operational condition or failure condition	Power off at NT	Operational	FC1	FC2	FC3	FC4	Power on at NT
	Signal transmitted towards interface	No signal	Normal operational frames	RAI (Note 2)	Normal operational frames	AIS	RAI (Note 2)	No signal
New event detected at the receiving side	Loss of NT power	/	PH-DI MPH-EI 0 G0	MPH-EI 0 G0	MPH-EI 0 G0	MPH-EI 0 G0	MPH-EI 0 G0	MPH-EI 0 G0
	Return of NT power	G6	/	/	/	/	/	/
	Normal operational frames. No internal network failure	/	–	PH-AI MPH-AI G1	PH-AI MPH-AI G1	PH-AI MPH-AI G1	PH-AI MPH-AI G1	/
	Internal network failure FC1	/	PH-DI MPH-EI 1 G2	–	MPH-EI 1 (Note 3) G2	MPH-EI 1 (Note 3) –	MPH-EI 1 (Note 3) –	MPH-EI 1 (Note 3) G2
					X	G2	G2	
	Reception of RAI (Note 1) FC2	/	PH-DI MPH-EI 2 G3	MPH-EI 2 (Note 3) –	–	MPH-EI 2 (Note 3) –	MPH-EI 2 (Note 3) –	MPH-EI 2 G3
				G3		G3	G3	
	Internal network failure FC3	/	PH-DI MPH-EI 3 G4	MPH-EI 3 (Note 3) G4	MPH-EI 3 (Note 3) G4	–	MPH-EI 3 (Note 3) G4	MPH-EI 3 G4
				X	X		X	

Table 2/I.432.3 – Layer 1 state matrix at network side of the interface *(concluded)*

	Initial state	**G0**	**G1**	**G2**	**G3**	**G4**	**G5 (Note 1)**	**G6**
	Loss of operational frames FC4 (Note 1)	/	PH-DI MPH-EI 4 G5	MPH-EI 4 (Note 3) G5	MPH-EI 4 (Note 3) G5	MPH-EI 4 (Note 3) –	–	MPH-EI 4 (Note 3) G5
				X	X	G5		

Single fault conditions

–	No state change
/	Impossible situation
PH-x	Issue primitive x
MPH-y	Issue management primitive y
Gz	Go to state Gz

Double fault conditions

MPH-y Gz	Second fault is dominant. Actions to be taken when second fault occurs
X	The disappearance of the first fault is not visible at the interface since the second fault is dominant and the state has changed already to Gz.
MPH-y	First fault is dominant, therefore the state will not change when the second fault occurs, but the error indication may be given to the management if possible.
Gz	Action to be taken when first (dominant) fault disappears.

PH-AI PH ACTIVATE indication

PH-DI PH DEACTIVATE indication

MPH-EI n MPH ERROR indication with parameter n (n = 0 to 4)

NOTE 1 – In case of no CRC processing in the digital link, the state G5 is identical to state G2.

NOTE 2 – In options 2 and 3 of the 2048 kbit/s systems (according to Recommendation M.3604 [6]), the RAI signal must contain CRC error information of the section between TE and NT which can be used by the user to localize faults FC1 and FC4. In option 1 of Recommendation M.3604 [6], the faults FC1 and FC4 are identically at the interface.

NOTE 3 – The issue of this primitive depends on the capability of the digital transmission system and the option used in the network.

7.3 Power feeding

Refer to Recommendation I.431 [1].

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