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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Broadband Radio Access Networks (BRAN).

The present document describes the supplemental data transport and radio control functions of the Data Link Control (DLC) of HIgh PErformance Radio Metropolitan Area Network (HiperMAN) systems. A separate ETSI document, TS 102 177 [2], specifies the Physical (PHY).

With permission of IEEE® (on file as BRAN43d016), portions of the present document are excerpted from IEEE 802.16 [1] and IEEE 802.16e [3].

1 Scope

The present document defines the Data Link Control (DLC) of HiperMAN to support PMP and optionally Mesh network topologies. The present document provides the DLC functions required for Fixed applications, in frequencies below 11 GHz, and Nomadic and converged Fixed-Nomadic applications, in frequencies below 6 GHz.

2 References

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2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

[1] IEEE 802.16-2004: "IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems".

[2] ETSI TS 102 177: "Broadband Radio Access Networks (BRAN); HiperMAN; Physical (PHY) layer".

[3] IEEE 802.16e-2005: "IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed and Mobile Broadband Wireless Access Systems - Amendment 2 - Physical and Medium Access Control Layers for Combined Fixed and Mobile Operation in Licensed Bands, And Corrigendum 1".

[4] IEEE 802.3-2005: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specification".

[5] IEEE P802.16-2004/Cor2/D4: "Draft IEEE Standard for Local and metropolitan area networks to IEEE Standard for Local and Metropolitan Area Networks - Part 16: Air Interface for Fixed Broadband Wireless Access Systems Corrigendum 2".

3 Definitions, symbols and abbreviations

3.1 Definitions

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

Adaptive Antenna System (AAS): system adaptively exploiting more than one antenna to improve the coverage and the system capacity

NOTE: AAS-enabled in the context of a PMP BS denotes the implementation of AAS as defined. AAS-enabled in the context of a PMP SS denotes the ability to communicate with an AAS-enabled BS using the AAS specific mechanisms. Though a PMP SS may itself implement AAS as defined, this has no impact on the air interface and hence no specific differentiation is made.

adaptive modulation: system's ability to communicate with another system using multiple burst profiles and a system's ability to subsequently communicate with multiple systems using different burst profiles

ARQ Block: distinct unit of data that is carried on an ARQ-enabled connection

NOTE: Such a unit is assigned a sequence number, and is managed as a distinct entity by the ARQ state machines.

bandwidth stealing: use, by a subscriber station operating on a grant per subscriber station basis, of a portion of the bandwidth allocated in response to a bandwidth request for a connection to send a bandwidth request or data for any of its connections

NOTE: *See also*: grant per subscriber station.

broadcast connection: management connection used by the Base Station (BS) to send Data Link Control (DLC) management messages on a downlink to all Subscriber Station (SS)

NOTE: The broadcast connection is identified by a well-known Connection IDentifier (CID). A fragmentable broadcast connection is a connection that allows fragmentation of broadcast DLC management messages.

connection: unidirectional mapping between Base Station (BS) and Subscriber Station (SS) Data Link Control (DLC) peers

NOTE: Connections are identified by a Connection IDentifier (CID). The DLC defines two kinds of connections: management connections and transport connections. *See also*: **connection identifier**.

Connection IDentifier (CID): 16-bit value that identifies a transport connection or an uplink (UL)/downlink (DL) pair of associated management connections (i.e. belonging to the same subscriber station) to equivalent peers in the DLC of the Base Station (BS) and Subscriber Station (SS)

NOTE: The Connection IDentifier (CID) address space is common (i.e. shared) between UL and DL and IEEE 802.16 [1], table 345 as amended by IEEE 802.16e [3] specifies how it is partitioned among the different types of connections. Security Associations (SAs) also exist between keying material and CIDs. *See also*: **connection**.

DC carrier: in an OFDM or OFDMA signal, the carrier whose frequency would be equal to the RF centre frequency of the station

Dynamic Frequency Selection (DFS): ability of a system to switch to different physical RF channels based on channel measurement criteria to conform to particular regulatory requirements

initial ranging connection identifier: management connection used by the Subscriber Station (SS) and the Base Station (BS) during the initial ranging process

NOTE: The initial ranging connection is identified by a well-known Connection IDentifier (CID) (see IEEE 802.16 [1], table 345 as amended by IEEE 802.16e [3]). This CID is defined as constant value within the protocol since an SS has no addressing information available until the initial ranging process is complete.

management connection: connection used for the purpose of transporting Data Link Control (DLC) management messages (see: basic connection, primary management connection, broadcast connection, initial ranging connection) or standards-based messages (see: secondary management connection) required by the DLC layer

MeSH (MSH): network architecture, wherein systems are capable of forwarding traffic from and to multiple other systems

Multiple Input Multiple Output (MIMO): system employing at least two transmit antennas and at least two receive antennas to improve the system capacity, coverage or throughput

Payload Header Suppression Mask (PHSM): 8 bit value that references the Payload Header Suppression (PHS) rule

RF centre frequency: centre of the frequency band in which a BS or SS is intended to transmit

BS Rx/Tx Transition Gap (RTG): gap, used by TDD and H-FDD systems, between the last sample of the uplink burst and the first sample of the subsequent downlink burst at the antenna port of the base station in a time division duplex transceiver

NOTE: This gap allows time for the BS to switch from receive to transmit mode and SSs to switch from transmit to receive mode. During this gap, the BS is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp up, the Tx/Rx antenna switch to actuate. Not applicable to frequency division duplex systems.

SS Rx/Tx Gap (SSRTG): minimum receive to transmit turnaround gap

NOTE: SSRTG is measured from the time of the last sample of the received burst to the first sample of the transmitted burst, at the antenna port of the SS.

SS Tx/Rx Gap (SSTTG): minimum transmit to receive turnaround gap

NOTE: SSTTG is measured from the time of the last sample of the transmitted burst to the first sample of the transmitted burst, at the antenna port of the SS.

turbo decoding: iterative decoding, using soft inputs and soft outputs

BS Tx/Rx Transition Gap (TTG): gap, used by TDD and H-FDD systems, between the last sample of the downlink burst and the first sample of the subsequent uplink burst at the antenna port of the base station in a time division duplex transceiver

NOTE: This gap allows time for the BS to switch from transmit to receive mode. During this gap, the BS is not transmitting modulated data but simply allowing the BS transmitter carrier to ramp down, the Tx/Rx antenna switch to actuate, and the BS receiver section to activate. Not applicable to frequency division duplex systems.

transport connection: connection used to transport user data

NOTE: It does not include any traffic over the basic, primary or secondary management connections. A fragmentable transport connection is a connection that allows fragmentation of Service Data Units (SDUs).

transport connection identifier: unique identifier taken from the Connection IDentifier (CID) address space that uniquely identifies the transport connection

NOTE: All user data traffic is carried on transport connections, even for service flows that implement connectionless protocols, such as Internet Protocol (IP). An active or admitted service flow (identified by a Service Flow ID (SFID)) maps to a transport Connection IDentifier (transport CID) assigned by the BS.

3.2 Symbols

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

α_{avg}	Averaging parameter for CINR and RSSI computations
$RSS_{IR,max}$	Initial Ranging Max. Received Signal Strength at BS

3.3 Abbreviations

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

AAS	Adaptive Antenna System
ACK	ACKnowledgement
AMC	Adaptive Modulation Coding
ARQ	Automatic Repeat reQuest
BR	Bandwidth Request
BS	Base Station
BSN	Block Sequence Number
BTC	Block Turbo Code
BW	BandWidth
CID	Connection IDentifier
CINR	Carrier to noise and INterference Ratio
CRC	Cyclic Redundancy Check
CS	Convergence Sublayer
CSCF	Centralized Scheduling ConFiguration
CSCH	Centralized SCHedule
CTC	Convolutional Turbo Code
dBm	deciBels relative to one milliwatt
DCD	DL Channel Descriptor
DFS	Dynamic Frequency Selection
DIUC	Downlink Interval Usage Code
DL	DownLink
DLC	Data Link Control
DSA-RSP	Dynamic Service Addition - ReSPonse
DSCH	Distributed SCHedule
DSC-REQ	Dynamic Service Change - REQuest
DSC-RSP	Dynamic Service Change - ReSPonse
FDD	Frequency Division Duplexing
FPC	Fast Power Control
FSN	Fragment Sequence Number
FWA	Fixed Wireless Access
HCS	Header Check Sequence
H-FDD	Half-duplex FDD
HIPERMAN	HIgh PErformance Radio Metropolitan Area Network
HT	Header Type
ID	IDentifier
IE	Information Element
Im	Imaginary
IP	Internet Protocol
LSB	Least Significant Beat
MAC	Media Access Control
MIMO	Multiple Input Multiple Output
MSB	Most Significant Bit
MSH	MeSH
NCFG	Network ConFiGuration
NENT	Network ENTry
OFDM	Orthogonal Frequency Division Multiplexing
OFDMA	Orthogonal Frequency Division Multiple Access
PDU	Protocol Data Unit
PHS	Payload Header Suppression
PHSM	Payload Header Suppression Mask
PHY	PHYsical layer
PKM	Privacy Key Management
PMP	Point-to-MultiPoint
PUSC	Partial Usage of SubChannels
QoS	Quality of Service
Re	Real
REQ	REQuest

RNG	RaNGing
RRPT	Ranging Response Processing Time
RSP	ReSPonse
RSSI	Received Signal Strength Indicator
RTG	Receive/transmit Transition Gap
SA	Security Association
SDU	Service Data Unit
SFID	Service Flow IDentifier
SS	Subscriber Station
STC	Space Time Coding
TEK	Traffic Encryption Key
TLV	Type Length Value
TTG	Transmit/receive Transition Gap
UCD	UL Channel Descriptor
UDP	User Datagram Protocol
UIUC	Uplink Interval Usage Code
UL	UpLink
VLAN	Virtual Local Area Network

4 Packet Convergence Sublayer

The packet Convergence Sublayer (CS) resides on top of the DLC common part sublayer. The CS performs the following functions, utilizing the services of the DLC:

a) Classification of the higher-layer protocol PDU into the appropriate transport connection. Suppression of payload header information (optional).

b) Delivery of the resulting CS PDU to the DLC SAP associated with the service flow for transport to the peer DLC SAP.

c) Receipt of the CS PDU from the peer DLC SAP.

d) Rebuilding of any suppressed payload header information (optional).

The sending CS is responsible for delivering the DLC SDU to the DLC SAP. The DLC is responsible for delivery of the DLC SDU to peer DLC SAP in accordance with the QoS, fragmentation, concatenation and other transport functions associated with a particular connection's service flow characteristics. The receiving CS is responsible for accepting the DLC SDU from the peer DLC SAP and delivering it to a higher layer entity.

The packet CS is used for transport for all packet-based protocols as defined in IEEE 802.16 [1], clause 11.13.19.3 as modified by IEEE 802.16e [3].

4.1 DLC SDU format

DLC SDU format is according to IEEE 802.16 [1], clause 5.2.1 as modified by IEEE 802.16e [3].

4.2 Classification

Packet classification is according to IEEE 802.16 [1], clause 5.2.2 as modified by IEEE 802.16e [3].

4.3 Payload Header Suppression (PHS)

Payload Header Suppression is according to IEEE 802.16 [1], clause 5.2.3 as modified by IEEE 802.16e [3].

4.4 Ethernet specific part

Ethernet specific part is according to IEEE 802.16 [1], clause 5.2.4 as modified by IEEE 802.16e [3].

4.5 Virtual Local Area Network (VLAN) specific part

Virtual local area network specific part is according to IEEE 802.16 [1], clause 5.2.5 as modified by IEEE 802.16e [3].

4.6 IP specific part

IP specific part is according to IEEE 802.16 [1], clause 5.2.6 as modified by IEEE 802.16e [3].

5 DLC common part sublayer

5.1 Point to MultiPoint

Point to MultiPoint is according to IEEE 802.16 [1], clause 6.1 as modified by IEEE 802.16e [3].

5.2 Mesh

Mesh is according to IEEE 802.16 [1], clause 6.2 as modified by IEEE 802.16e [3].

6 Data/Control plane

The data/control plane is according to IEEE 802.16 [1], clause 6.3 as modified by IEEE 802.16e [3].

7 PDU formats

DLC PDUs shall be of the form illustrated in figure 1. Each PDU shall begin with a fixed-length generic DLC header. The header may be followed by the Payload of the DLC PDU. If present, the Payload shall consist of zero or more subheaders and zero or more DLC SDUs and/or fragments thereof. The payload information may vary in length, so that a DLC PDU may represent a variable number of bytes. This allows the DLC to tunnel various higher layer traffic types without knowledge of the formats or bit patterns of those messages. All reserved fields shall be set to zero on transmission and ignored on reception.

MSB LSB

Generic MAC header	Payload (optional)	CRC (optional)

Figure 1: DLC PDU formats

A DLC PDU may contain a CRC, In the case where a CRC is included, for each DLC PDU with HT=0, a CRC, as defined in IEEE 802.3 [4], shall be appended to the payload of the DLC PDU; i.e. request DLC PDUs are unprotected. The CRC shall cover the generic DLC header and the Payload of the DLC PDU. The CRC shall be calculated after encryption; i.e. the CRC protects the Generic Header and the ciphered Payload. Implementation of CRC capability is mandatory.

7.1 DLC header formats

Two DLC header formats are defined. The first is the generic DLC header that begins each DLC PDU containing either DLC management messages or CS data. The second is the bandwidth request header used to request additional bandwidth. The single-bit Header Type (HT) field distinguishes the generic DLC header and bandwidth request header formats. The HT field shall be set to zero for the Generic Header and to one for a bandwidth request header.