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TECHNICAL SPECIFICATION

Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE); Part 2: Logical Link Control (LLC)

PREVIEW
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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECTrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardization, interoperability and future proof specifications.

The present document is part 2 of a multi-part deliverable covering the Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE), as identified below:

- Part 1: "Protocol";
- Part 2: "Logical Link Control (LLC)";**
- Part 3: "Robust Header Compression (ROHC) for IP".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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Introduction

As introduced in ETSI TS 102 606-1 [1], the Generic Stream Encapsulation (GSE) protocol is a link layer which provides multiplexing mechanisms that make it possible for several network protocols (for example IP, IPX, Decnet, and Appletalk) to coexist within a multipoint network and to be transported over the same network media. GSE is designed to be deployed across all DVB broadcast bearers which provide a Generic Stream mode.

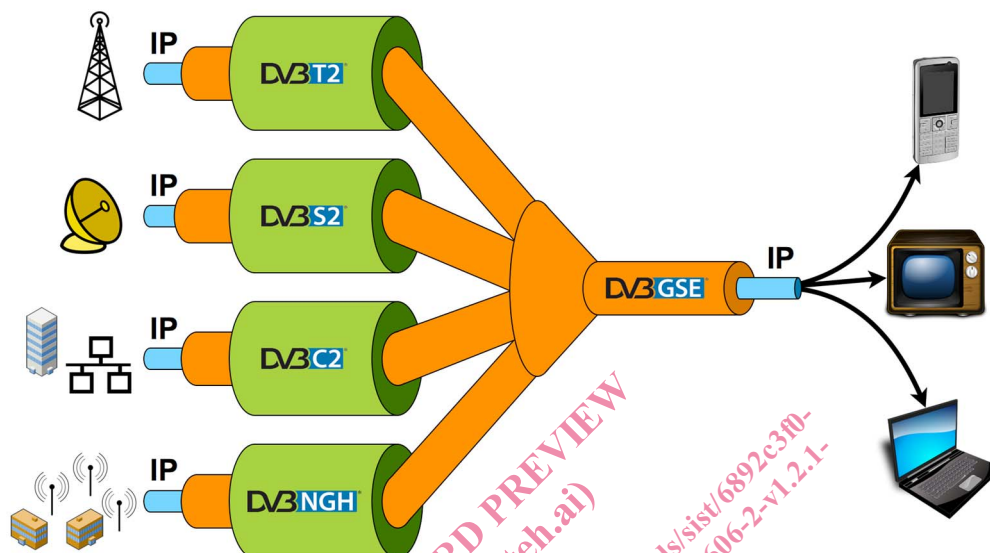


Figure 1: Role of DVB-GSE across broadcast bearers

This abstraction from the MAC layer allows to provision services on top of network protocols independently of the underlying physical layer. This is illustrated from a network operator's perspective in Figure 1, and from a protocol stack perspective in Figure 2.

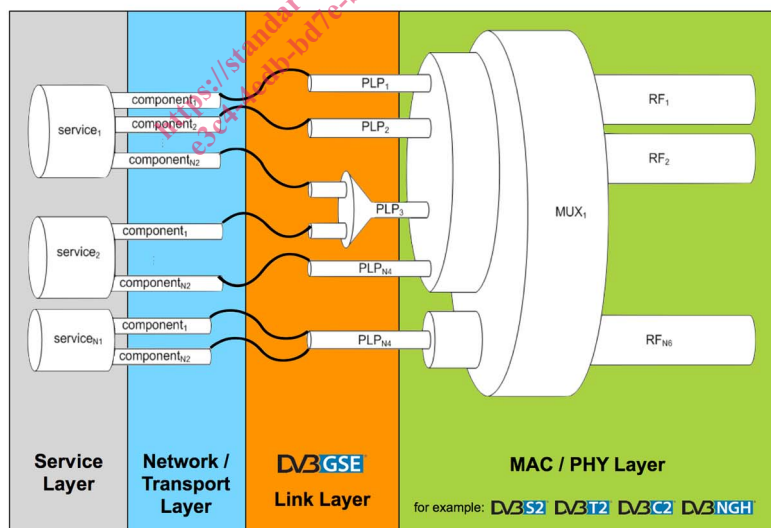


Figure 2: Protocol layers when using DVB-GSE

As shown in Figure 2, the DVB-GSE link layer hides any MAC layer specifics from the upper layers. It thus enables receivers to present DVB-GSE streams as regular, LAN-type network interfaces to upper layers. The logical link control protocol defined in the present document provides the necessary information to receivers to accomplish this.

On a Point-to-Point Protocol (PPP) link according to IETF RFC 1661 [i.3], two hosts establish a connection on any point-to-point serial interface (e.g. RS-232), and exchange IP datagrams. The PPP implementation encapsulates this link as a normal network interface, so that applications can use it as if it were a regular LAN interface. To achieve this, a Link Control Protocol (LCP) for establishing, configuring, and testing the data-link connection, and a family of Network Control Protocols (NCPs) for establishing and configuring different network-layer protocols is defined in IETF RFC 1661 [i.3]. When the connection establishment begins, the two hosts first use the LCP to negotiate the configuration parameters (e.g. link speed) of the serial data link. After this is completed, the two hosts use the appropriate NCPs to negotiate the configuration of the network interface (e.g. use of IPv4 or IPv6, IP addresses to use), and thus conclude the connection establishment phase. After this, the hosts present new LAN-type network interfaces to applications running on them.

The LLC protocol for DVB-GSE adopts the same partitioning of information. One set of information is needed to enable the DVB-GSE layer to configure the underlying MAC and physical layer devices. This first set of information is referred to as Link Control Data (LCD) in the present document. A second set of information is needed to configure the network interfaces which represent the DVB-GSE streams and make them available for the upper layers. This second set of information is referred to as Network Control Data (NCD) in the present document.

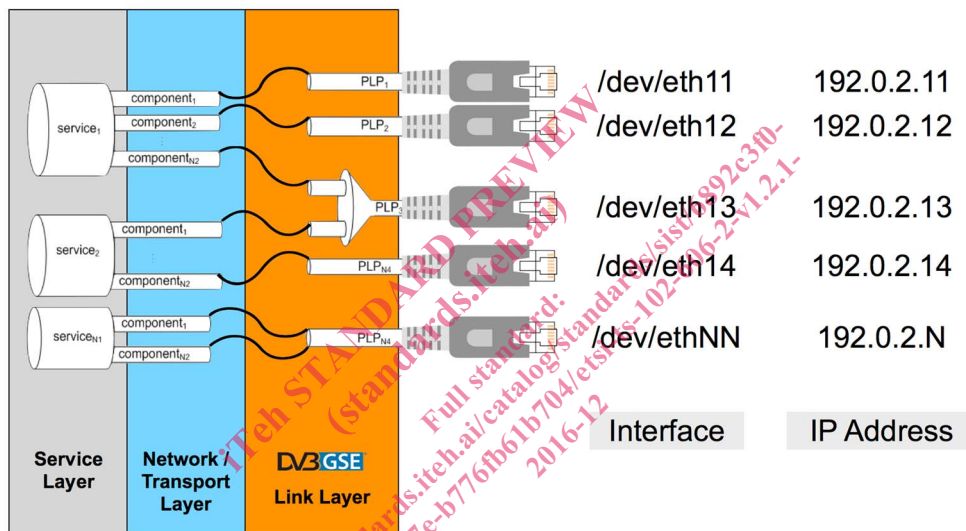


Figure 3: Application programming model of DVB-GSE with LLC

Once these network interfaces have been made available to the upper layers (see Figure 3), the properties of the MAC and physical layers are no longer exposed to upper layers, and applications can act on these interfaces like on any other network interface. Use of the tunnelling mechanism defined in IETF RFC 3077 [11] in combination with a return channel allows for the interfaces to be used for reading and writing.

1 Scope

The present document specifies a Logical Link Control (LLC) method to be used on DVB streams where the Generic Stream Encapsulation (GSE) [1] protocol is used as the link layer.

2 References

2.1 Normative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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The following referenced documents are necessary for the application of the present document.

- [1] ETSI TS 102 606-1: "Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE); Part 1: Protocol".
 - [2] ETSI TS 102 606-3: "Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE); Part 3: Robust Header Compression (ROHC) for IP".
 - [3] ETSI EN 301 192: "Digital Video Broadcasting (DVB); DVB specification for data broadcasting".
 - [4] ETSI EN 301 545-2: "Digital Video Broadcasting (DVB); Second Generation DVB Interactive Satellite System (DVB-RCS2); Part 2: Lower Layers for Satellite standard".
 - [5] ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".
 - [6] ETSI TS 101 162: "Digital Video Broadcasting (DVB); Allocation of identifiers and codes for Digital Video Broadcasting (DVB) systems".
 - [7] IETF RFC 2131: "Dynamic Host Configuration Protocol".
 - [8] IETF RFC 2132: "DHCP Options and BOOTP Vendor Extensions".
- NOTE: A complete list of all DHCP options defined by various sources is available from IANA at <http://www.iana.org/assignments/bootp-dhcp-parameters/bootp-dhcp-parameters.xml>.
- [9] IETF RFC 5795: "The Robust Header Compression (ROHC) Framework".
 - [10] IETF RFC 3095: "Robust Header Compression (ROHC): Framework and four profiles: RTP, UDP, ESP, and uncompressed".
 - [11] IETF RFC 3077: "A Link-Layer Tunneling Mechanism for Unidirectional Links".
 - [12] ETSI EN 302 769: "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital transmission system for cable systems (DVB-C2)".
 - [13] ETSI EN 302 755: "Digital Video Broadcasting (DVB); Frame structure channel coding and modulation for a second generation digital terrestrial television broadcasting system (DVB-T2)".
 - [14] ETSI EN 302 307-1: "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 1: DVB-S2".

- [15] DVB BlueBook A160: "Digital Video Broadcasting (DVB); Next Generation broadcasting system to Handheld, physical layer specification (DVB-NGH)".
- [16] IETF RFC 3986: "Uniform Resource Identifier (URI): Generic Syntax".
- [17] IANA: "Unidirectional Lightweight Encapsulation (ULE) Next-Header Registry".
- NOTE: See <http://www.iana.org/assignments/ule-next-headers/ule-next-headers.xml>.
- [18] IETF RFC 4776: "Dynamic Host Configuration Protocol (DHCPv4 and DHCPv6) Option for Civic Addresses Configuration Information".
- [19] IETF RFC 4833: "Timezone Options for DHCP".
- [20] IETF RFC 3011: "The IPv4 Subnet Selection Option for DHCP".
- [21] IETF RFC 3442: "The Classless Static Route Option for Dynamic Host Configuration Protocol (DHCP) version 4".
- [22] IETF RFC 3495: "Dynamic Host Configuration Protocol (DHCP) Option for CableLabs Client Configuration".
- [23] IETF RFC 6225: "Dynamic Host Configuration Protocol Options for Coordinate-Based Location Configuration Information".
- [24] IETF RFC 3315: "Dynamic Host Configuration Protocol for IPv6 (DHCPv6)".
- [25] IETF RFC 3633: "IPv6 Prefix Options for Dynamic Host Configuration Protocol (DHCP) version 6".
- [26] IETF RFC 6603: "Prefix Exclude Option for DHCPv6-based Prefix Delegation".
- [27] IETF RFC 3646: "DNS Configuration options for Dynamic Host Configuration Protocol for IPv6 (DHCPv6)".
- [28] IETF RFC 4326: "Unidirectional Lightweight Encapsulation (ULE) for Transmission of IP Datagrams over an MPEG-2 Transport Stream (TS)".
- [29] OMA BCAST DVB-NGH Adaptation: OMA-TS-BCAST-DVB-NGH-Adaptation: "BCAST Distribution System Adaptation - over DVB-NGH".
- NOTE: See <http://www.openmobilealliance.org>.
- [30] ETSI EN 302 307-2: "Digital Video Broadcasting (DVB); Second generation framing structure, channel coding and modulation systems for Broadcasting, Interactive Services, News Gathering and other broadband satellite applications; Part 2: DVB-S2 Extensions (DVB-S2X)".

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

- [i.1] ETSI TS 102 771: "Digital Video Broadcasting (DVB); Generic Stream Encapsulation (GSE) implementation guidelines".
- [i.2] ETSI TS 102 006: "Digital Video Broadcasting (DVB); Specification for System Software Update in DVB Systems".

[i.3] IETF RFC 1661: "The Point-to-Point Protocol (PPP)".

NOTE: The assigned Next-Header values are published at <http://www.iana.org/assignments/ule-next-headers/ule-next-headers.xml>.

[i.4] IETF RFC 3736: "Stateless Dynamic Host Configuration Protocol (DHCP) Service for IPv6".

[i.5] IEEE 1003.1™-2008: "Standard for Information Technology - Portable Operating System Interface (POSIX®)".

3 Symbols and abbreviations

3.1 Symbols

For the purposes of the present document, the symbols given in ETSI TS 102 606-1 [1] and the following apply:

123	A number without prefix denotes a decimal integer (base 10)
0x123	A number with a "0x" prefix denotes a hexadecimal integer (base 16)
0123	A number with a "0" prefix denotes an octal integer (base 8)
(1010) ₂	A number enclosed in parentheses, and with a number suffix denotes an integer to the base indicated by the suffix.

EXAMPLE: The representations for the number one-hundred and twenty three are: 123 to the base 10 (decimal), 0x7B to the base 16 (hexadecimal), 0173 to the base 8 (octal), and (1111011)₂ to the base 2 (binary).

NOTE: For binary and hexadecimal representations it may sometimes be convenient to group digits, and fill in leading zeroes to accommodate common word sizes. The number one-hundred and twenty three can hence for example also be represented as 0x007B, 0x0000 007B, (0111 1011)₂, or (0000 0000 0111 1011)₂.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 102 606-1 [1] and the following apply:

BCAST	OMA Mobile Broadcast Services
GSE	Generic Stream Encapsulation
IANA	Internet Assigned Numbers Authority

NOTE: See <http://www.iana.org/>.

IP	Internet Protocol
ISP	Internet Service Provider
LAN	Local Area Network
LCD	Link Control Data
LLC	Logical Link Control
MAC	Media Access Control
NCD	Network Control Data
NSAP	Network Service Access Point
OMA	Open Mobile Alliance™

NOTE: See <http://www.openmobilealliance.org/>.

PLP	Physical Layer Pipe
-----	---------------------

NOTE: See ETSI EN 302 755 [13], ETSI EN 302 769 [12], and DVB BlueBook A160 [15].

SNPA	SubNetwork Point of Attachment
------	--------------------------------

4 Overview

To enable receivers to process LLC data in an efficient way, it is sent in GSE packets with a specific protocol type (see clause 6.1.3). This allows for very lightweight processing in the DVB-GSE layer: packets with the protocol type for LLC are processed within the GSE layer, all other packets are forwarded to higher layers.

The two sets of LLC data, the LCD for configuring the MAC and physical layer devices, and the NCD for configuring the network interfaces are transmitted in tables, which bear a table_id value for demultiplexing them. These LLC tables are carried in an extension header of LLC GSE packets. To provide faster access and support local caching mechanisms, an index structure is conveyed in an extension header. This scheme is shown in Figure 4.

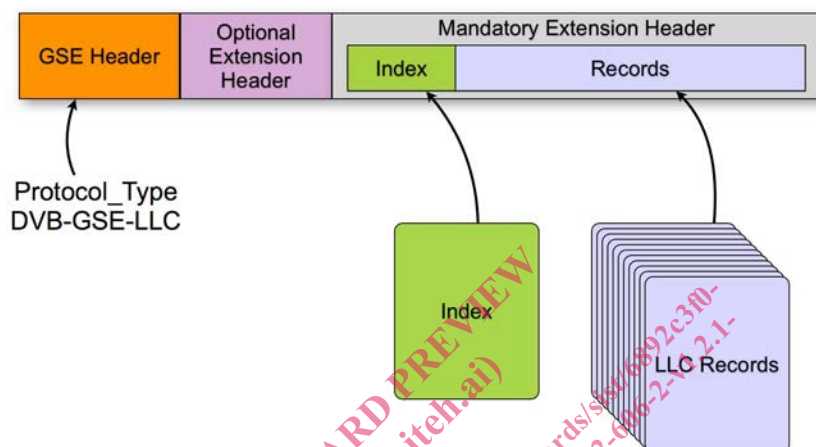
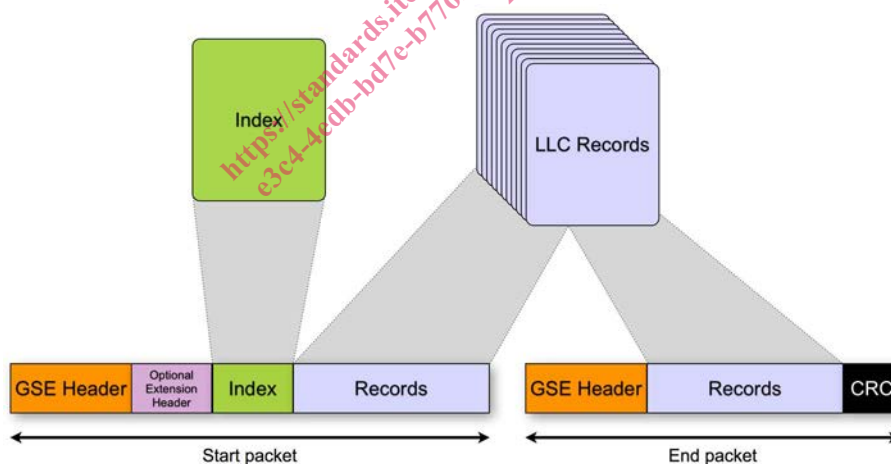


Figure 4: Basic scheme of LLC transport

To allow for large configurations, the LLC tables in the payload may of course be fragmented as defined in part 1 [1]. The basic fragmentation scheme is shown in Figure 5.



NOTE: For a definition of Start and End packet, see clause 4.2.3 of part 1 [1].

Figure 5: Basic scheme of fragmenting LLC data

5 Protocol Elements

5.0 LLC protocol architecture

This clause defines the data structures and the associated semantics that constitute the GSE LLC protocol. For information on how these data structures are conveyed, see clause 6.

The present document defines two table structures (see Figure 6):

- The first table structure (the LCD) conveys records describing the physical layer parameters in use on the broadcast links, and associates the data channels in the broadcast links with stream identifiers.
- The second table structure (the NCD) conveys records describing the network protocol configurations in use on the network interfaces, and associates the network interfaces with stream identifiers.

The concept of the stream identifier used in both record tables allows to associate network interfaces with broadcast links as shown in Figure 6. This partitioning of the information in link-related and network-related data allows for flexible end-to-end system management, where different entities can manage different parts or aspects of the operations. These entities can generate the LLC records describing the applied configurations independently. The use of the stream identifiers will only need to be coordinated when the set of streams changes, i.e. streams are added or removed from the system. For typical changes of operational parameters, e.g. a modulation parameter change on the broadcast physical layer, or the reallocation of a multicast group address to a different network interface, only the corresponding records table needs to be updated, while the other table may remain unchanged.

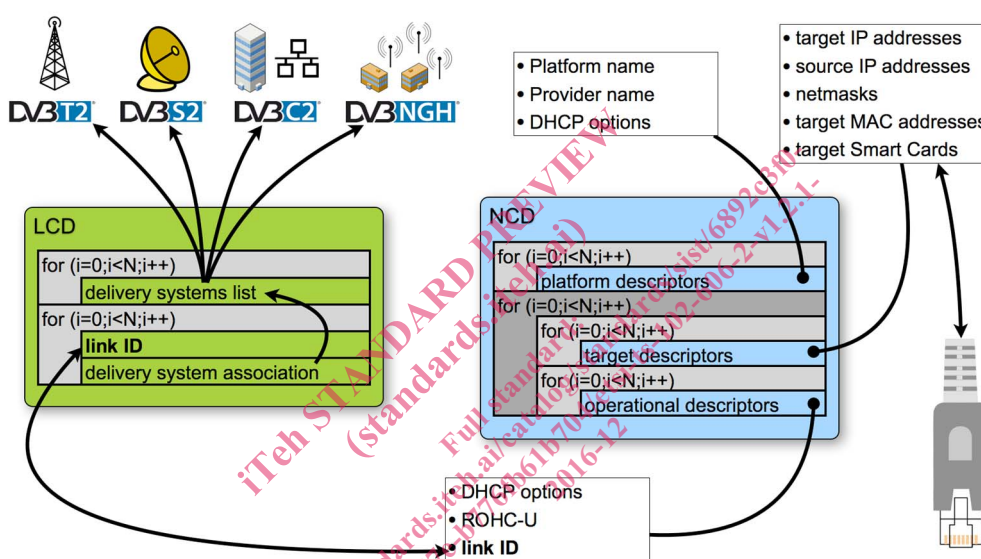


Figure 6: Overview of LLC record structures

For the sake of clarity and brevity, the syntax definitions in the present document make use of a template for descriptor loops. For the purposes of the present document, wherever a syntax element called "descriptor_loop()" - optionally preceded by a prefix - occurs, it shall be encoded according to Table 1.

Table 1: Descriptor loop template structure

Syntax	No. of Bits	Mnemonic	Applicable as of protocol version
<pre> descriptors() { descriptors_length for (i=0;i<N;i++) { descriptor() } } </pre>	16	uimsbf	0
	variable	bslbf	0

Semantics for the descriptor loop template:

descriptors_length: This 16-bit field specifies the number of bytes following for descriptors.

descriptor(): This variable size field conveys descriptors as applicable.

NOTE: The type and size of each of the descriptors can be inferred from its tag value and length field.

5.1 Record Structures

5.1.1 Index Structure

5.1.1.0 Index structure syntax and semantics

The LLC index structure provides information on the presence and location of LLC tables in the extension header, and on the version of each table to allow for timely detection and processing of any updates by receivers.

Table 2: Syntax of the Index Structure

Syntax	No. of Bits	Mnemonic	Applicable as of protocol version
LLC_index() {			
protocol_version	8	uimsbf	1
num_table_entries	8	uimsbf	0
for (i=0;i<N;i++) {			
table_id	8	uimsbf	0
reserved	2	bslbf	0
version	5	uimsbf	0
current_next_indicator	1	bslbf	0
offset	32	uimsbf	0
}			
}			

Semantics of the LLC index:

protocol_version: This 8-bit field that indicates the version of the LLC protocol used. It shall be encoded according to Table 3.

Table 3: Protocol version coding

protocol_version	Description
0	version 1.1.1 of the present document
1	version 1.2.1 of the present document
1 to 255	reserved for future use

NOTE: This field was added with version 1.2.1 of the present document. Since it was inserted at the beginning of the index data structure, a parser implementing ETSI TS 102 606 V1.1.1 will not be able to process data encoded according to version 1.2.1 or later of the present document.

table_id, version, and current_next_indicator: These fields shall be set according to the corresponding fields in the gse_table_structure() being described by the instance of the loop.

offset: This 32-bit field indicates the offset of the first byte of the LLC table being described in the respective instance of the loop. It shall be encoded according to clause 5.1.1.1.

The LLC index shall correctly describe all the tables for the interactive network present in the stream up to (and including) the next GSE end packet carrying LLC data (see also Figure 7).

5.1.1.1 Offset Mechanism

For the calculation of the offset field in the LLC index structure, it is assumed that the index structure itself, and all LLC table structures are assembled in a theoretical buffer in the order they have been received. This is illustrated in Figure 7.