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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Digital transmission of television signals – Part 2

Encapsulation of type length value (TLV) packet for cable transmission systems

Recommendation ITU-T J.288

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Encapsulation of type length value (TLV) packet for cable transmission systems

Summary

Recommendation ITU-T J.288 proposes an encapsulation scheme for type length value (TLV), a data structure specified in Recommendation ITU-R BT.1869, for cable transmission systems designed on the basis of Recommendation ITU-T J.83.

Many of the existing digital broadcasting systems use the Motion Picture Experts Group version 2 (MPEG-2) transport stream (TS) as their input format. In contrast, variable-length packet formats such as TLV are specified for transmitting Internet protocol (IP) packets efficiently over broadcasting channels as aggregates of variable-length packets. In order to transmit TLV with the existing Recommendation ITU-T J.83 transmission system, it is necessary that variable-length TLV packets be fragmented and encapsulated into fixed-length 188-byte packets.

History

Edition	Recommendation	Approval	Study Group	Unique ID*
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4K, 8K, fragmented TLV.

* To access the Recommendation, type the URL http://handle.itu.int/ in the address field of your web browser, followed by the Recommendation's unique ID. For example, http://handle.itu.int/11.1002/1000/11830-en.

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Recommendation ITU-T J.288

Encapsulation of type length value (TLV) packet for cable transmission systems

1 Scope

This Recommendation defines an encapsulation scheme for type length value (TLV), a data structure specified in [ITU-R BT.1869], for its transmission over existing cable TV systems designed on the basis of [ITU-T J.83].

2 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; 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. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.222.0] Recommendation ITU-T H.222.0 (2018) | ISO/IEC 13818-1 (2018), *Information technology – Generic coding of moving pictures and associated audio information: Systems*.

[ITU-T J.83] Recommendation ITU-T J.83 (2007), *Digital multi-programme systems for television, sound, and data services for cable distribution*.

[ITU-R BT.1869] Recommendation ITU-R BT.1869 (2010), *Multiplexing scheme for variable-length packets in digital multimedia broadcasting systems*.

3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 fragmented TLV packet: A fixed-length packet that has fragmented type length value (TLV).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

IP Internet Protocol

MPEG-2 Motion Picture Experts Group version 2

TLV Type Length Value

TS Transport Stream

5 Conventions

In this Recommendation:

The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus this requirement need not be present to claim conformance.

The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted if conformance to this document is to be claimed.

The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with the specification.

In the body of this document and its annexes, the words *shall*, *shall not*, *should*, and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required to*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 System overview

The system overview is shown in Figure 1.

At the headend, input TLV packets are fragmented and encapsulated into fixed-length packets called fragmented TLV packets. The fragmented TLV packets are transmitted with the existing transmission scheme specified in [ITU-T J.83]. Each fragmented TLV packet must be 188 bytes in length and its first byte must have the value of 47_{HEX}. These specifications were set because the input format of the transmission scheme specified in [ITU-T J.83] is a Motion Picture Experts Group version 2 (MPEG-2) transport stream (TS) consisting of a continuous data stream of fixed-length, 188-byte packets. The first byte of an MPEG-2 TS is specified to be a sync byte having the value of 47_{HEX}. MPEG-2 is video coding specified in [b-ITU-T H.262], while audio coding is specified in [b-ISO/IEC 13818-3] and in [b-ISO/IEC 13818-7]. TS is a data structure specified in [ITU-T H.222.0].

On the receiver side, fragmented TLV packets are combined and restored to the original TLV packets.

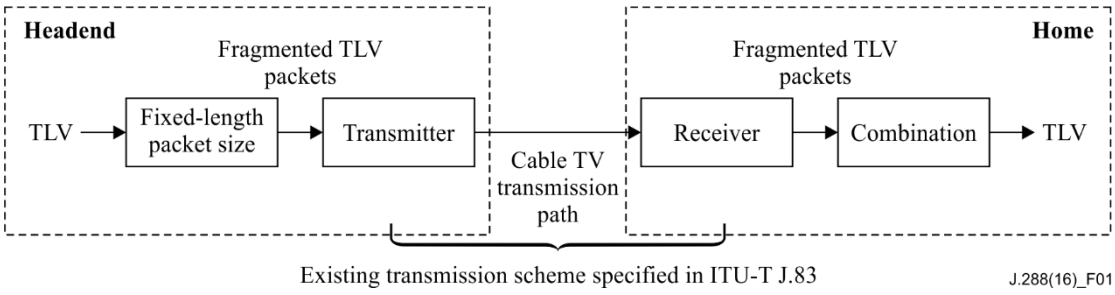


Figure 1 – System overview

Using this encapsulation scheme enables various use cases, examples of which are shown in Appendix I.

7 Encapsulation scheme

7.1 Fragmentation of TLV packets

Figure 2 shows how TLV packets are fragmented into fixed-length 188-byte packets.

Each variable-length TLV packet has the information of its length and type. The length of a TLV packet is indicated by the length field. The type of packet shows IPv4, IPv6, header compressed Internet protocol (IP) packets, and transmission control signals.

In order to transmit variable-length TLV packets like an MPEG-2 TS with the transmission scheme specified in [ITU-T J.83], TLV packets are fragmented and encapsulated into a fragmented TLV packet, which must be fixed-length 188-byte packets. There may be multiple TLV packets in one fragmented TLV packet in order to encapsulate them efficiently, as illustrated in Figure 2.

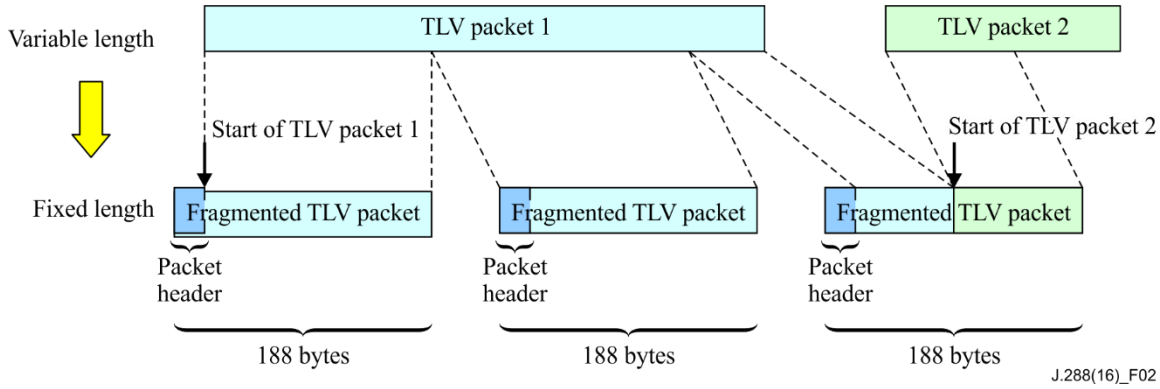


Figure 2 – Fragmentation of TLV packets

7.2 Format of fragmented TLV packet

A fragmented TLV packet consists of a 3-byte packet header, top_pointer_field and payload, as shown in Figure 3.

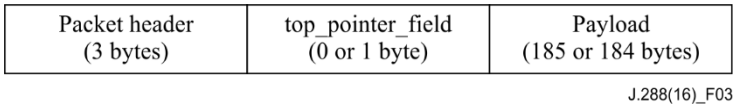


Figure 3 – Format of fragmented TLV packet

7.3 Header of fragmented TLV packet

The header of the fragmented TLV packet is shown in Table 1.

The header of the fragmented TLV packet consists of the first three bytes of the 188 bytes comprising the fixed-length packet. The header identifies the payload as belonging to the fragmented TLV packet. Other values of the header may indicate other service payloads.

NOTE – The semantic definition of the fields in a fragmented TLV packet is as follows:

sync_byte: This is a fixed 8-bit field whose value is '0100 0111' (0x47).

transport_error_indicator: The transport error indicator is a flag that indicates whether there are any bit errors in the reception of the fragmented TLV packet. If this flag contains '1', it indicates that the fragmented TLV packet has an uncorrectable error of at least one bit.

TLV_start_indicator: This indicator shows when there is at least one start of a TLV packet ('1') or when there is no start of a TLV packet ('0').

PID: This is a fixed 13-bit field whose value must be set to a unique value. This unique value differentiates the fragmented TLV packet from other TS packets.

Table 1 – Header of fragmented TLV packet

Parameter	No. of bits	Description
sync_byte	8	0x47: same value as MPEG-2 TS sync byte
transport_error_indicator	1	Indicates that at least one error has occurred in the packet.
TLV_start_indicator	1	A value of '1' indicates the presence of at least one start of a TLV packet. A value of '0' indicates no start of a TLV packet.
'0'	1	
PID	13	A unique value for a fragmented TLV packet

7.4 top_pointer_field of fragmented TLV packet

The 'top_pointer_field' is a fixed 8-bit field whose value indicates the start position of the TLV packet in the payload. The fourth byte of the 'fragmented TLV packet' (first byte following the header) will be a 'top_pointer_field' if the TLV_start_indicator of the header is set to '1'. If the TLV_start_indicator is set to '0', the top_pointer_field does not exist.

If the last portion of a fragmented TLV packet is 184 bytes, the TLV_start_indicator of the header is set to '1' and the value of 'top_pointer_field' is set to 0xb8 (184 in decimal).

7.5 Payload of fragmented TLV packet

The payload of a fragmented TLV packet carries a portion of the original, variable-length TLV packet. If a 'top_pointer_field' exists in the fragmented TLV packet, the payload is 184 bytes following the 'top_pointer_field'. If a 'top_pointer_field' does not exist in the fragmented TLV packet, the payload is 185 bytes following the header.

8 Restoration to original TLV packets

On the receiver side, fragmented TLV packets that contain desired TLV packets are considered demodulation output. After that, the TLV_start_indicator, the top_pointer in the fragmented TLV packet and information on the packet length in the TLV packet are used to restore an original TLV packet from the fragmented TLV packets.

Appendix I

Examples of use cases for encapsulation scheme of TLV

(This appendix does not form an integral part of this Recommendation.)

Three examples of use cases for the encapsulation scheme of TLV are shown in clauses I.1 to I.3.

I.1 Use case 1

One TLV stream is input and transmitted. See Figure I.1.

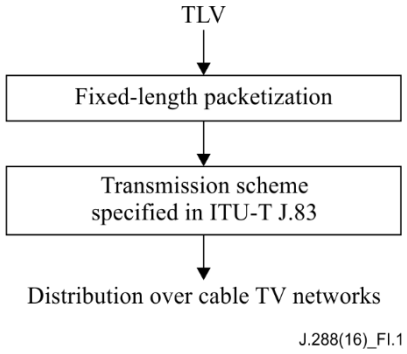


Figure I.1 – Use case 1

I.2 Use case 2

One TLV stream and one MPEG-2 TS stream are input and transmitted. See Figure I.2.

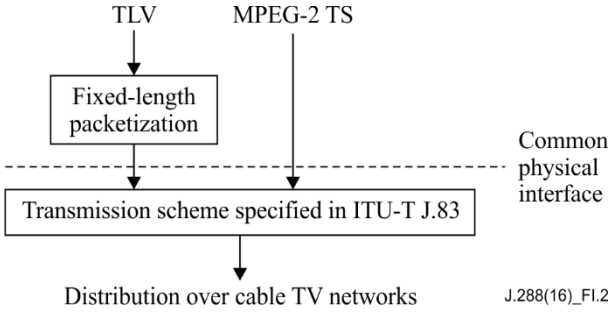


Figure I.2 – Use case 2

NOTE – In this case, a specified PID value for the fragmented TLV packet header is used to identify stream types. Other values of the PID may indicate other payloads of the MEPG-2 TS packet. Figure I.3 shows the interleaving of a fragmented TLV packet with other digital information (digital video in the example shown).

Header='fragmented TLV packet'	'fragmented TLV packet' payload
Header= 'fragmented TLV packet'	'fragmented TLV packet' payload
Header=video	Digital video payload
Header='fragmented TLV packet'	'fragmented TLV packet' payload
Header=video	Digital video payload
Header='fragmented TLV packet'	'fragmented TLV packet' payload
Header=video	Digital video payload

Figure I.3 – Example of interleaving of a fragmented TLV packet with MPEG-2 TS packets

I.3 Use case 3

Multiple TLV streams or multiple MPEG-2 TS streams are input. In order to multiplex multiple streams, multiplexing frame of [b-ITU-T J.183] can be applied. See Figure I.4.

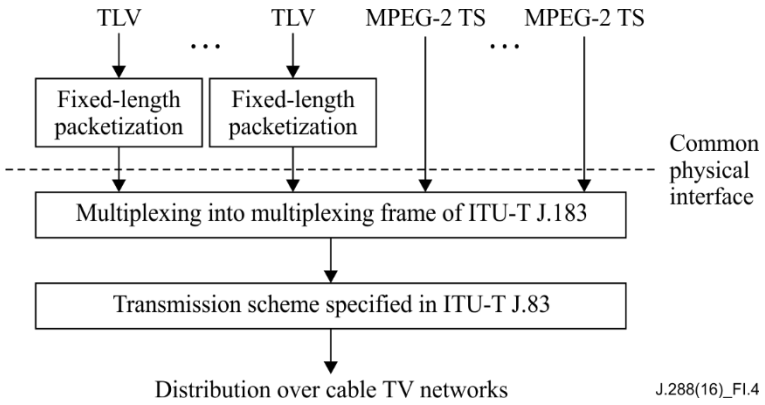


Figure I.4 – Use case 3

Appendix II

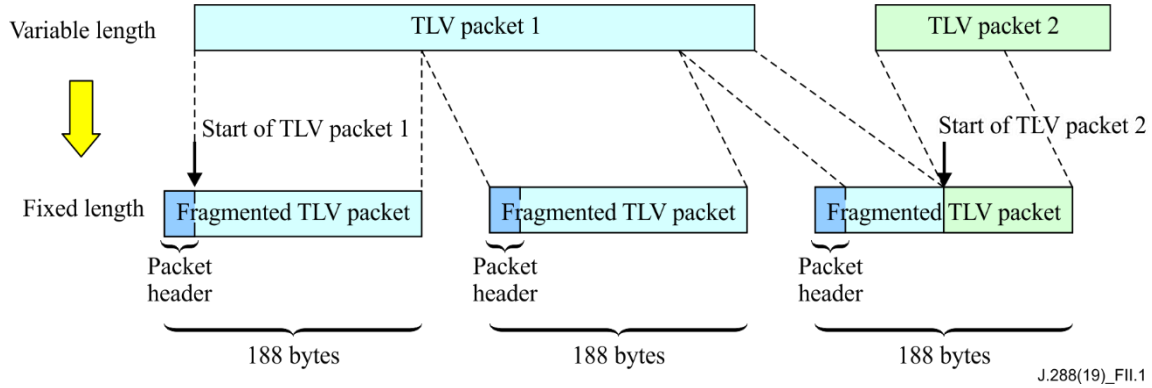
Fragmentation method when the last fragment size is 184 bytes

(This appendix does not form an integral part of this Recommendation.)

This appendix describes a fragmentation method when the last fragment size is 184 bytes.

As described in clause 7.1, in order to transmit variable-length TLV packets like an MPEG-2 TS with the transmission scheme specified in [ITU-T J.83], TLV packets are fragmented and encapsulated into fragmented TLV packets, which each must be a fixed-length 188-byte packet. There may be multiple TLV packets in one fragmented TLV packet to encapsulate them efficiently.

Figure II.1 shows a fragmentation case where the last fragment size, N, is less than 184 bytes (0<N<184). In this case, as the last fragmentation can have the start of the next TLV packet, it has a 'top_pointer_field' and N is set to 'top_pointer_field'. Figure II.1 (1) shows an example of this case, and Figure II.1 (2) shows the usage of 'top_pointer_field' and the supposed payload length of each fragmented packet for this example.



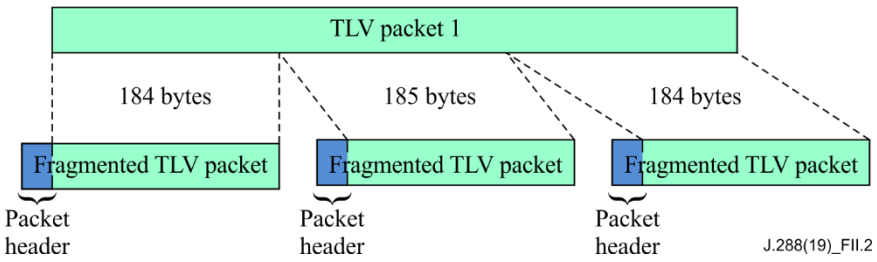
(1) TLV fragmentation between TLV packet 1 and packet 2.

Fragment No.	top_pointer_field		Length of payload	
	Length	Value	for TLV packet 1	for TLV packet 2
1	1	0	184	0
2	0	–	185	0
3	1	(0<) N (<184)	N	184 – N

(2) Value of top_pointer_field and Length of payload in the fragmented packets.

Figure II.1 – The fragment when the last fragment packet size is less than 184 bytes

Figure II.2 (1) shows the fragmentation case when the last fragment size is just 184 bytes. As shown in Figure II.2 (2), the value of 'top_pointer_field' in fragment number 3, the last fragment of TLV packet 1, is set to 184. In this case, the payload of fragment number 3 is completely filled with the partial content of TLV packet 1 and does not include any content of a trailing TLV packet.



(1) TLV fragmentation of TLV packet 1.

Fragment No.	top_pointer_field		Length of payload
	Length	Value	
1	1	0	184
2	0	–	185
3	1	184	184

(2) Values of top_pointer_field and Length of payload in the fragmented packets.

Figure II.2 – The fragment when the last fragment packet size is just 184 bytes

Bibliography

[b-ITU-T H.262] Recommendation ITU-T H.262 (2012) | ISO/IEC 13818-2 (2013), *Information technology – Generic coding of moving pictures and associated audio information: Video*.

[b-ITU-T J.183] Recommendation ITU-T J.183 (2016), *Time-division multiplexing of multiple MPEG-2 transport streams and generic formats of transport streams over cable television systems*.

[b-ISO/IEC 13818-3] International Standard ISO/IEC 13818-3 (1998), *Information technology – Generic coding of moving pictures and associated audio information – Part 3: Audio*.

[b-ISO/IEC 13818-7] International Standard ISO/IEC 13818-7 (2006), *Information technology – Generic coding of moving pictures and associated audio information – Part 7: Advanced Audio Coding (AAC)*.

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