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Infrastructure of audiovisual services – Communication
procedures

**Gateway control protocol: PCM frame spare bit
package**

ITU-T Recommendation H.248.33

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ITU-T Recommendation H.248.33

Gateway control protocol: PCM frame spare bit package

Summary

The H.248 PCM Frame Spare Bit package provides support for spare bits S_i and S_{a4} - S_{a8} , which are defined for the ITU-T Rec. G.704 2048 kbit/s basic frame structure. The PCM Frame Spare Bit package may be applied for PCM30 and PCM31 systems.

Source

ITU-T Recommendation H.248.33 was approved on 8 January 2005 by ITU-T Study Group 16 (2005-2008) under the ITU-T Recommendation A.8 procedure.

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ITU-T Recommendation H.248.33

Gateway control protocol: PCM frame spare bit package

1 Scope

This package defines H.248 methods to allow the following functions for the S_i and S_{a4} - S_{a8} bits of the 2048 kbit/s basic frame structure defined in ITU-T Rec. G.704:

- 1) The MGC instructs the MG to monitor and report changes in received spare bit states.
- 2) The MG reports changes in received spare bits to the MGC.
- 3) The MGC instructs the MG to change the state of spare bits being sent.

In order to support various applications in an efficient manner, the coding allows changes to be specified either for individual bits or for the 4-bit codewords that occupy a sub-multiframe.

Spare Bits are intended for national and international usage according to 2.3.3/G.704. The G.704 scope is still applicable for H.248 systems using the H.248.33 PCM Frame Spare Bit package.

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

2.1 Normative references

- ITU-T Recommendation G.704 (1998), *Synchronous frame structures used at 1544, 6312, 2048, 8448 and 44 736 kbit/s hierarchical levels*.
- ITU-T Recommendation H.248.1 (2002), *Gateway control protocol: Version 2*.

2.2 Informative references

- ITU-T Recommendation G.705 (2000), *Characteristics of plesiochronous digital hierarchy (PDH) equipment functional blocks*.
- ITU-T Recommendation G.711 (1988), *Pulse code modulation (PCM) of voice frequencies*.
- ITU-T Recommendation G.732 (1988), *Characteristics of primary PCM multiplex equipment operating at 2048 kbit/s*.
- ITU-T Recommendation G.962 (1993), *Access digital section for ISDN primary rate at 2048 kbit/s*.

3 Definitions

This Recommendation defines the following terms:

3.1 PCM3x system: A G.704 E1 frame where there are "3x" 64-kbit/s channels available for user traffic. Common E1 structures are PCM30, PCM31, or PCM32 systems.

3.2 PCM3xC system: A PCM3x system with an additional Cyclic Redundancy Check procedure according to clause 2.3.3/G.704. Common CRC-protected E1 structures are PCM30C, and PCM31C systems.

4 Abbreviations

This Recommendation uses the following abbreviations and symbols:

CRC	Cyclic Redundancy Check
CW	Codeword
FAS	Frame Alignment Signal
IC	Incoming
ID	Identifier
MF	Multiframe
MG	Media Gateway
MGC	Media Gateway Controller
NFAS	Non-Frame Alignment Signal
OG	Outgoing
PCM	Pulse Code Modulation
PDH	Plesiochronous Digital Hierarchy
S _a	<i>Additional Spare Bit (ITU-T Rec. G.704)</i>
S _i	<i>Spare Bit reserved for international use (ITU-T Rec. G.704)</i>
SB	Spare Bit (also abbreviated as "sb")
SMF	Sub-Multiframe (e.g., ITU-T Rec. G.704: MF _{E1} = SMF I + SMF II)
SSM	Synchronization Status Message (ITU-T Rec. G.704)
TS	Time-Slot

5 PCM systems and E1 operation modes

The purpose of this clause is to outline the use of the PCM Frame Spare Bit package in G.704 environments.

5.1 Background from transmission perspective

ITU-T Rec. G.704 specifies frame structures for synchronous transmission interfaces. This H.248 Package is exclusively scoping the 2048 kbit/s basic frame structure according to 2.3/G.704. This hierarchy level is traditionally called **E1** in ITU-T, or **P12** in ITU-T Rec. G.705.

Every G.704 frame defines in structured mode (see below) a number of 64-kbit/s channel time-slots, see clause 5/G.704 (E1 frames carrying 64-kbit/s channels are commonly termed as "channelized E1"). These frame structures were originally developed for the digitization of the transmission infrastructure in fixed telecommunication networks.

Thus, the prime scope were PCM signals, which is still reflected in ITU-T Recs G.732 and G.704: *Each 64-kbit/s channel time-slot can accommodate, for example, a PCM-encoded voiceband signal conforming to G.711, or data information with a bit rate up to 64-kbit/s.*

The term "PCM system" came into use due to that background and is still common vocabulary, particularly for E1 usage in circuit-switched telephone networks.

5.2 PCM systems for E1

An E1 frame consists of 32 code words called time-slots and are numbered from 0 to 31 (see 5.1.1.2/G.704). This general structure is often also known as **PCM32** system. The abbreviation "PCM" points out again that in telephone networks the dominant application of individual E1 time-slots is for the PCM-based voice codec G.711. The number "3x" denotes how many 64-kbit/s channels of the G.704 frame are available for user traffic, typically PCM encoded traffic. A **PCM31** comprises 31 time-slots for user traffic (referred to as channels 1 to 31), and one time-slot primarily for frame synchronization (= E1 TS0, channel 0). A **PCM30** comprises 30 time-slots for user traffic (referred to as channels 1 to 15, and 17 to 31), one time-slot for frame synchronization (channel 0), and one time-slot for signalling traffic (channel 16).

The PCM Frame Spare Bit package solely focuses on PCM30 and PCM31 systems; PCM32 and other potential interface types are out of scope (Figure 1).

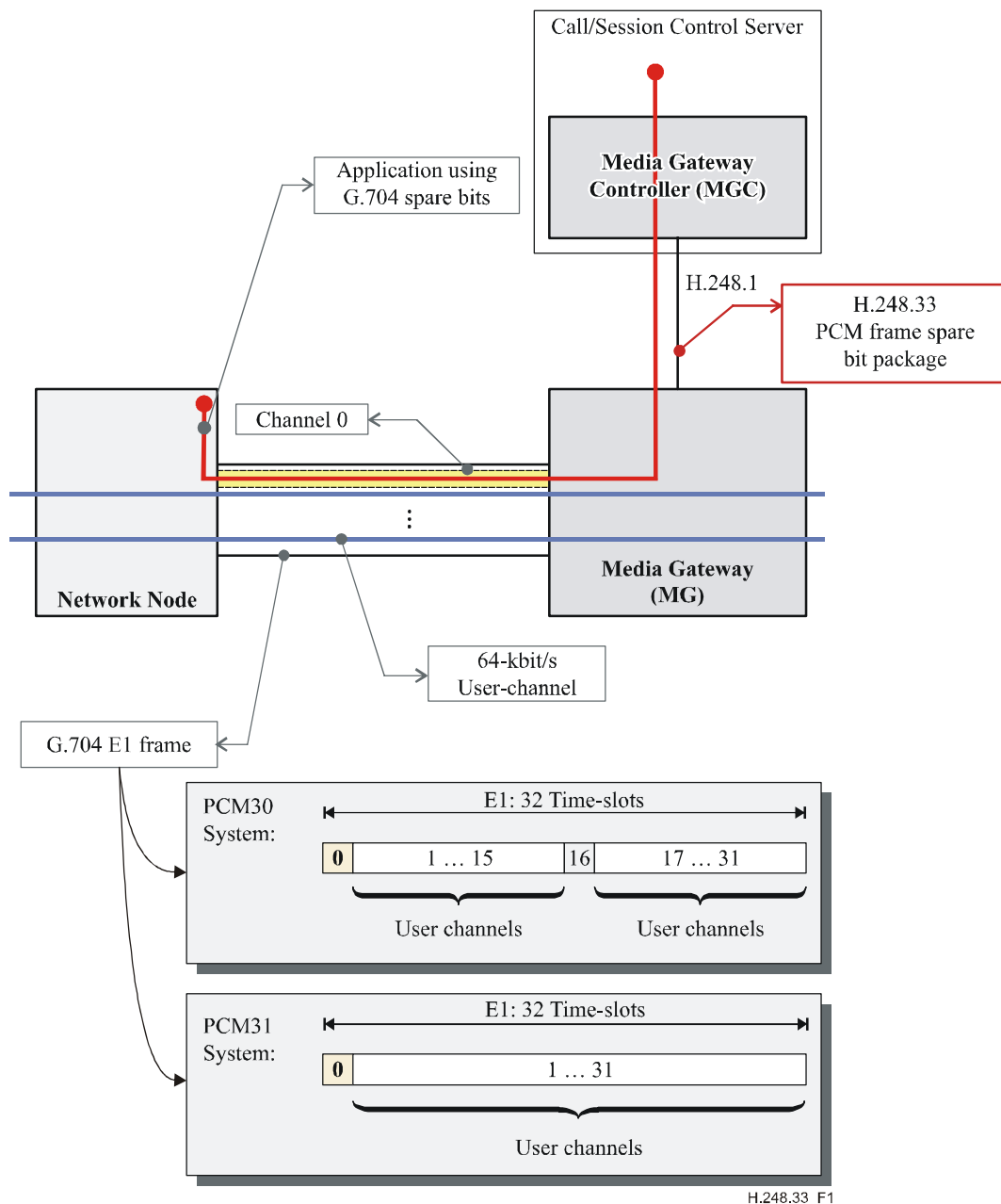


Figure 1/H.248.33 – Scope of the PCM Frame Spare Bit package

5.3 E1 operation modes

A PCM system conforms to specific operation modes of a G.704 interface. E1 interfaces may be fundamentally operated either in *unstructured mode* or in *structured mode*. **Unstructured mode** is typically used for cell-, frame-, or packet-switched traffic (e.g., ATM-over-E1 according to ITU-T Rec. G.804), and is out of scope for the PCM Frame Spare Bit package. The **structured mode** is intended for circuit-switched traffic, and may be further subdivided into modes with or without multiframing. Both are in scope for the PCM Frame Spare Bit package, but with a slightly different focus due to the different usage of spare bits in these modes.

5.3.1 E1 multiframes and sub-multiframes (SMF)

Multiframing is applied where there is a need to provide additional protection against simulation of the frame alignment signal, and/or where there is a need for an enhanced error monitoring capability. The structured E1 multiframing mode is realized by introducing a CRC-4 procedure, and is defined in 2.3.3/G.704.

In case of *structured* H.248 MG E1 interfaces operated in *multiframe mode*, spare bits carried in the four odd-numbered frames of the E1 SMF are in scope for the PCM Frame Spare Bit package, whereas the four even-numbered frames are out of scope. For instance, any G.704 CRC procedures are not considered.

NOTE – Table 5B/G.704 (E1 CRC-4 multiframe structure): odd numbered frames do carry CRC-4 multiframe information, which is a prerequisite to define S_a code words per SMF; thus, at least the usage of S_i bit signals are forbidden in this mode (setting of S_i would destroy multiframe detection capability of the receiving side).

The PCM Frame Spare Bit package may be applied for **PCM30C** and **PCM31C** systems.

5.3.2 E1 structure without multiframeing

The use of *structured* H.248 MG E1 interfaces *without multiframeing* is characterized by alternating FAS and NFAS patterns in successive E1 frames. Annex A coding is simplified in this case. Since no SMF structure exists, spare bit signals and events degenerate into binary code words (see A.2). Whereas S_a spare bits are carried only in the odd numbered frames, the S_i bit is carried in every frame.

The PCM Frame Spare Bit package may be applied for **PCM30** and **PCM31** systems.

5.4 Conclusion for the PCM Frame Spare Bit package

This package defines H.248 methods for accessing the S_i -bit and the S_a -bits of an E1 frame described previously.

NOTE – These bits are typically designated for national and international use, specific point-to-point applications, etc. Further applications are, e.g., G.704 E1 frame-based data link protocols, or spare-bit-based protocol procedures for access digital sections for ISDN primary rate at 2048 kbit/s [ITU-T Rec. G.962].

These spare bits belong to channel 0 in structured E1 frames. Other channel 0 bits or protocol control information are out of scope of this package.

This time-slot (channel 0) cannot be used in such dedicated E1 operation modes as a bearer channel for user plane traffic, and must remain therefore in the **H.248 Null Context**. In some applications, it may be possible for a signalling channel to be defined using one or more of the spare bits of this time-slot as a data link, but such operation is outside the scope of this Recommendation.

From the H.248 perspective, this channel represents an **H.248 TDM Termination**; however, it cannot leave the Null Context or be associated with a "regular H.248 call Context".

6 PCM Frame Spare Bit package

Package name: PCM Frame Spare Bit package

PackageID: pcmsb (0x0085)

Description:

This package defines H.248 methods for accessing S_i -Bit and S_{a4} - S_{a8} Bits of the 2048 kbit/s Basic Frame Structure according to ITU-T Rec. G.704. Spare bit coding is defined in Annex A.

Version: 1

Extends: None

6.1 Properties

None.

6.2 Events

6.2.1 Reading State of Spare bit SBy

Event name: Spare bit SBy is detected as 'z' (see Table 1).

NOTE – SBy may be G.704 bit S_i for $y = 1$, or S_{a_y} for $y = 4, 5, \dots 8$.

EventID: sby_z (0x00yz)

Description:

Identifies Spare bit SBy with value z. Value z represents a hexadecimal character and is coded according to Annex A. Numerical codepoint is generally 0x00yz. 'y' corresponds to the spare bit, 'z' represents the value of the spare bit.

Table 1 summarizes all relevant events related to the ITU-T Rec. G.704 2048-kbit/s basic frame structure.

Table 1/H.248.33 – List of event identifiers

Spare bit (ITU-T Rec. G.704)	Event Identifier (EventID) Spare bit is z
1 (S_i)	"sb1_z"
4 (S_{a4})	"sb4_z"
5 (S_{a5})	"sb5_z"
6 (S_{a6})	"sb6_z"
7 (S_{a7})	"sb7_z"
8 (S_{a8})	"sb8_z"

6.2.1.1 EventsDescriptor parameters

6.2.1.1.1 Strict Transition

Parameter name: Strict Transition

ParameterID: strict (0x0001)

Description: –

Type: Enumeration

Optional: No

Possible values:

"exact" (0x00)

"state" (0x01)

"failWrong"(0x02)

"exact" means that only an actual state transition to is to be recognized.

"state" means that the event is to be recognized either if a state transition is detected or if the observed spare bit is already in this state.

"failWrong" means that if the state is already there, the command fails and an error is reported.

Default: –

6.2.1.2 ObservedEventsDescriptor parameters

6.2.1.2.1 Initial State

Parameter name: Initial State

ParameterID: init (0x0002)

Description: –

Type: Boolean

Optional: Yes

Possible values:

"False" means that the event was reported because the bit was already equal to the requested value when the events descriptor containing this event was activated.

"True" means that the event represents an actual state transition.

Default: –

The other events for the other spare bits are specified in exactly the same way. All event names and event identifiers are listed in Table 1.

6.3 Signals

6.3.1 Setting of Spare bit SBy

Signal name: Spare bit SBy is set to 'z' (see Table 2).

NOTE – SBy may be G.704 bit S_i for $y = 1$, or S_{a_y} for $y = 4, 5, \dots, 8$.

SignalID: sby_z (0x01yz)

Description:

This signal is setting a dedicated spare bit in time-slot 0 of the ITU-T Rec. G.704 2048-kbit/s Basic Frame structure. Sets Spare bit SBy to value z.

Value z represents a hexadecimal character and is coded according to Annex A. Numerical codepoint is generally 0x01yz. 'y' corresponds to the spare bit, 'z' represents the value of the spare bit.

Signal type: OO (On/Off)

Duration: –

The other signals for the other spare bits are specified in exactly the same way. All signal names and signal identifiers are listed in Table 2.

Table 2/H.248.33 – List of signal identifiers

Spare bit (ITU-T Rec. G.704)	Signal Identifier (SignalID) Spare bit is z
1 (S_i)	"sb1_z"
4 (S_{a4})	"sb4_z"
5 (S_{a5})	"sb5_z"
6 (S_{a6})	"sb6_z"
7 (S_{a7})	"sb7_z"
8 (S_{a8})	"sb8_z"

6.3.1.1 Additional parameters

None.

6.4 Statistics

None.

6.5 Error code

Error Code #: 541

Name: Unexpected Spare Bit State

Definition: Reports an unexpected bit state associated with this package.

Error Text in the Error Descriptor: –

Comment: The procedure for use of this code is given in 6.6.2.

NOTE – The underlying functionality for requesting the state information corresponds to similar detection capabilities in the a1 Package; see E.9/H.248.1.

6.6 Procedures

6.6.1 Signal procedures

A spare bit signal must always be present on an H.248 TDM Termination belonging to an ITU-T G.704 E1 2048-kbit/s basic frame structure. Therefore, the setting of spare bit signals shall be considered to be state changes in the spare bit state, rather than as persistent signals in themselves. The state change shall be considered to be completed instantaneously by the MG. Consequently, there is no active signal to be terminated by any subsequent event detection or by a new signal descriptor.

The MG shall maintain the existing spare bit state on such a TDM Termination type until such time as the MGC sends a new spare bit signal to the MG to change state.

6.6.2 Unexpected bit state

If the MGC sets an EventsDescriptor containing a spare bit transition event with the "strict" parameter set to "failWrong", and the spare bit state is already what the transition implies, the execution of the command containing that EventsDescriptor fails. The MG shall report the error code specified in 6.5.

6.6.3 Moving TDM Terminations from Null Context

The PCM Frame Spare Bit package may be applied for "E1 channel 0" H.248 TDM Terminations in PCM31 or PCM30 systems. For these types of E1 interfaces, channel 0 of the 2048 kbit/s Basic Frame Structure may reside in the H.248 Null Context. In this case, any ADD command, which tries to move this "channel 0" related H.248 TDM Termination to a regular H.248 call Context, is not allowed. Those MGC commands, which request a Termination to leave the Null Context, shall be replied to by the MG with the error code '542 – Command is not allowed on this Termination'.

Annex A

Spare bit coding

Annex A provides the coding schemes of spare bit information at the H.248 interface. There are two structured E1 operation modes in the scope of this package. The coding scheme for structured E1 with multiframing is defined in A.1. The coding scheme for structured E1 without multiframing is defined in A.2. The coding scheme for both modes is aligned.

A.1 Sub-multiframe based codeword coding

ITU-T Rec. G.704 defines vertical codewords using the spare bits on a Sub-multiframe (SMF) basis. A codeword is a 4-bit pattern formed from the four consecutive occurrences of the same spare bit within a single SMF.

The codeword shall be coded within events and signals as a single hexadecimal character, in which the most significant bit of that hexadecimal character shall be the bit in the first occurrence of the spare bit within the SMF, that is, in frame 1 or 9.

NOTE – The allocation of codewords is defined, for example, in Table 5C/G.704, Synchronization Status Message (SSM) bit allocation for 2048 kbit/s.

An example for a specific codeword (CW), based on additional spare bit S_{a4} is:

$$CW_{SMF,S_{a4}} = \{S_{a41}, S_{a42}, S_{a43}, S_{a44}\} \text{ for } S_{a4}$$

4-bit pattern	Hexadecimal character
1011	B

A.2 Single bit coding

In mode "structured E1 without multiframing" there are no vertical codewords; therefore, the 4-bit pattern degenerates to 1-bit codepoints. The single bit codepoint shall be coded with the same coding scheme as described in A.1. Thus, the code set contains only two hexadecimal characters. The hexadecimal characters '0' and 'F' shall be used for the spare bit coding of '0' and '1'.

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