TSG-RAN Working Group 1 meeting #9 **_TSGR1#9(99)i51_**

Dresden, Germany

November 30 – December 3, 1999

Agenda item:

Source: Ericsson

Title: CR 25.212-006: Removal of compressed mode by puncturing

Document for: Decision

It was proposed in TSGR1#8(99)g78 that compressed mode by puncturing should be removed. At TSG-RAN Working Group 1 meeting #8 it was recommended that a CR should be generated from the text proposal in g78.

3GPP TSG RAN WG1 Meeting #9
Dresden, Germany, Nov 30 – Dec 3, 1999

Document ???99???
e.g. for 3GPP use the format TP-99xxx
or for SMG, use the format P-99-xxx

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.212 CR 006 Current Version: 3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: TSG-RAN #6
list expected approval meeting # here ↑

for approval	X	Strategic	
for information		non-strategic	

(for SMG use only)

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Ericsson **Date:** 1999-11-04

Subject: Removal of compressed mode by puncturing

Work item:

Category:
(only one category shall be marked with an X)

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	X
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Compressed mode by puncturing is not sufficiently described and should therefore be moved out of release 99.

Clauses affected: 4.3.5.3, 4.4.3, 4.4.4.3

Other specs affected:

Other 3G core specifications		→ List of CRs:
Other GSM core specifications		→ List of CRs:
MS test specifications		→ List of CRs:
BSS test specifications		→ List of CRs:
O&M specifications		→ List of CRs:

Other comments:

help.doc

<--------- double-click here for help and instructions on how to create a CR.

Table 10: Mapping order of repetition encoded TFCI code word bits to slots in Split Mode

Slot	TFCI code word bits in split mode							
0	$b_{1,14}^1$	$b_{1,14}^2$	$b_{1,14}^3$	$b_{1,14}^4$	$b_{2,14}^1$	$b_{2,14}^2$	$b_{2,14}^3$	$b_{2,14}^4$
1	$b_{1,13}^1$	$b_{1,13}^2$	$b_{1,13}^3$	$b_{1,13}^4$	$b_{2,13}^1$	$b_{2,13}^2$	$b_{2,13}^3$	$b_{2,13}^4$
2	$b_{1,12}^1$	$b_{1,12}^2$	$b_{1,12}^3$	$b_{1,12}^4$	$b_{2,12}^1$	$b_{2,12}^2$	$b_{2,12}^3$	$b_{2,12}^4$
3	$b_{1,11}^1$	$b_{1,11}^2$	$b_{1,11}^3$	$b_{1,11}^4$	$b_{2,11}^1$	$b_{2,11}^2$	$b_{2,11}^3$	$b_{2,11}^4$
4	$b_{1,10}^1$	$b_{1,10}^2$	$b_{1,10}^3$	$b_{1,10}^4$	$b_{2,10}^1$	$b_{2,10}^2$	$b_{2,10}^3$	$b_{2,10}^4$
5	$b_{1,9}^1$	$b_{1,9}^2$	$b_{1,9}^3$	$b_{1,9}^4$	$b_{2,9}^1$	$b_{2,9}^2$	$b_{2,9}^3$	$b_{2,9}^4$
6	$b_{1,8}^1$	$b_{1,8}^2$	$b_{1,8}^3$	$b_{1,8}^4$	$b_{2,8}^1$	$b_{2,8}^2$	$b_{2,8}^3$	$b_{2,8}^4$
7	$b_{1,7}^1$	$b_{1,7}^2$	$b_{1,7}^3$	$b_{1,7}^4$	$b_{2,7}^1$	$b_{2,7}^2$	$b_{2,7}^3$	$b_{2,7}^4$
8	$b_{1,6}^1$	$b_{1,6}^2$	$b_{1,6}^3$	$b_{1,6}^4$	$b_{2,6}^1$	$b_{2,6}^2$	$b_{2,6}^3$	$b_{2,6}^4$
9	$b_{1,5}^1$	$b_{1,5}^2$	$b_{1,5}^3$	$b_{1,5}^4$	$b_{2,5}^1$	$b_{2,5}^2$	$b_{2,5}^3$	$b_{2,5}^4$
10	$b_{1,4}^1$	$b_{1,4}^2$	$b_{1,4}^3$	$b_{1,4}^4$	$b_{2,4}^1$	$b_{2,4}^2$	$b_{2,4}^3$	$b_{2,4}^4$
11	$b_{1,3}^1$	$b_{1,3}^2$	$b_{1,3}^3$	$b_{1,3}^4$	$b_{2,3}^1$	$b_{2,3}^2$	$b_{2,3}^3$	$b_{2,3}^4$
12	$b_{1,2}^1$	$b_{1,2}^2$	$b_{1,2}^3$	$b_{1,2}^4$	$b_{2,2}^1$	$b_{2,2}^2$	$b_{2,2}^3$	$b_{2,2}^4$
13	$b_{1,1}^1$	$b_{1,1}^2$	$b_{1,1}^3$	$b_{1,1}^4$	$b_{2,1}^1$	$b_{2,1}^2$	$b_{2,1}^3$	$b_{2,1}^4$
14	$b_{1,0}^1$	$b_{1,0}^2$	$b_{1,0}^3$	$b_{1,0}^4$	$b_{2,0}^1$	$b_{2,0}^2$	$b_{2,0}^3$	$b_{2,0}^4$

4.3.5.3 Mapping of TFCI in compressed mode

The mapping of the TFCI bits in compressed mode is dependent on the transmission time reduction method. Denote the TFCI bits by c_0, c_1, c_2, c_3, c_4, …, c_C, where:

- $c_k = b_k$, C = 29, when there are 2 TFCI bit in each slot.
- $c_0 = b_0^4, c_1 = b_0^3, c_2 = b_0^2, c_3 = b_0^1, c_4 = b_1^4, c_5 = b_1^3, \ldots, c_{119} = b_{14}^1$, when there are 8 TFCI bits in each slot.
- $c_0 = b_{2,0}, c_1 = b_{1,0}, c_3 = b_{2,1}, c_4 = b_{1,1}, \ldots, c_{29} = b_{1,14}$, in split mode when there are 2 TFCI bits in each slot.
- $c_0 = b_{2,0}^4, c_1 = b_{2,0}^3, c_2 = b_{2,0}^2, c_3 = b_{2,0}^1, c_4 = b_{1,0}^4, c_5 = b_{1,0}^3, \ldots, c_{119} = b_{1,14}^1$, in split mode when there are 8 TFCI bits in each slot.

The TFCI mapping for each transmission method is given in the sections below.

~~4.3.5.4.1 Compressed mode method A~~

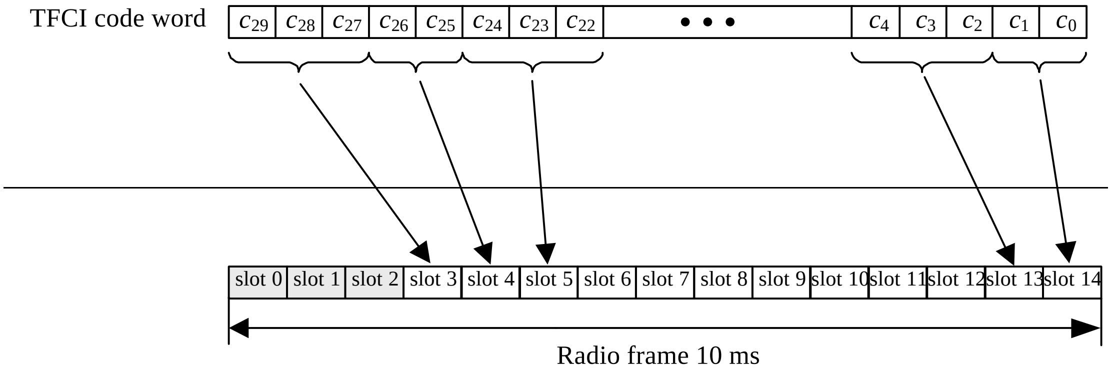
~~For compressed mode by method A, all the TFCI bits are mapped to the remaining slots. The number of bits per slot in uncompressed mode is denoted by Z and $Z = (C + 1)/15$. The mapping to slots for different TGLs are defined below.~~

~~4.2.5.4.1.1 TGL of 3 slots~~

~~Slot number 3 + 2x contain bits $c_{C-(\frac{5}{2}Z)x}, c_{C-(\frac{5}{2}Z)x-1}, \ldots, c_{C-(\frac{5}{2}Z)x-(\frac{3}{2}Z-1)}$, where x = 0, 1, 2, 3, 4, 5~~

~~Slot number 4 + 2*x* contain bits $c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x}, c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x-1}, \ldots, c_{C-\frac{3}{2}Z-(\frac{5}{2}Z)x-(Z-1)}$, where *x* = 0, 1, 2, 3, 4, 5~~

~~The case when *C* = 29 is illustrated in figure 14.~~



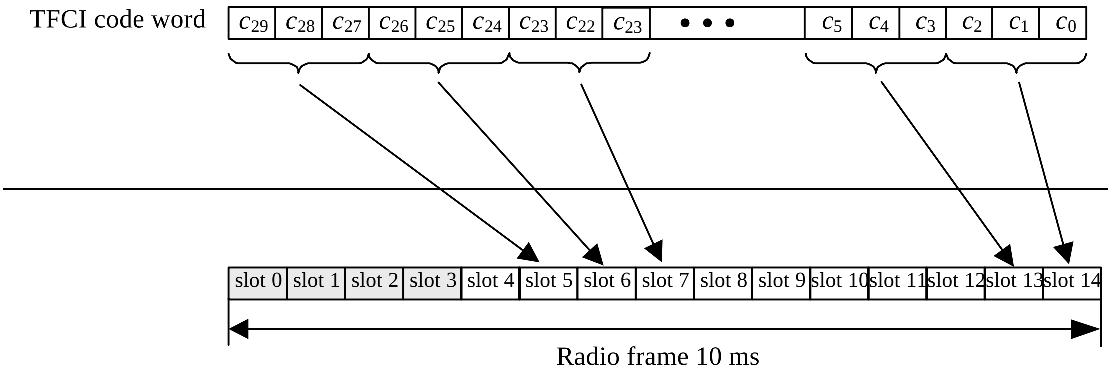
~~Figure 14: Mapping of TFCI code with TGL of 3 slots.~~

~~4.2.5.4.1.2 TGL of 4 slots~~

~~Slot number 4 does not contain any TFCI bits.~~

~~Slot number 5 + *x* contain bits $c_{C-(\frac{3}{2}Z)x}, c_{C-(\frac{3}{2}Z)x-1}, \ldots, c_{C-(\frac{3}{2}Z)x-(\frac{3}{2}Z-1)}$, where *x* = 0, 1, 2, 3, …, 9~~

~~The case when *C* = 29 is illustrated in figure 15.~~



~~Figure 15: Mapping of TFCI code with TGL of 4 slots~~

4.3.5.34.1~~2~~ Uplink ~~C~~compressed mode ~~method B~~

~~4.2.5.4.2.1 Uplink~~

For uplink compressed mode, ~~by method B~~ the ~~frame~~slot format is changed so that no TFCI bits are lost. The different ~~frame~~slot formats in compressed mode ~~can~~do not match the exact number of TFCI bits for all possible TGLs. Repetition of the TFCI bits is therefore used.

Denote the number of bits available in the TFCI fields of one compressed radio frame by *D*, the repeated bits by d_k, and the number of bits in the TFCI field in a slot by N_{TFCI}. Let E=30-1-($N_{first}N_{TFCI}$)mod 30. If $N_{last}\neq 14$, then *E* corresponds to the number of the first TFCI bit in the slot directly after the TG. The following relations then define the repetition.

$$d_{D-31} = c_{E \bmod 30}, d_{D-32} = c_{(E-1) \bmod 30}, d_{D-33} = c_{(E-2) \bmod 30}, \ldots, d_0 = c_{(E-(D-31)) \bmod 30}$$

The bits are mapped to the slots in descending order starting with the original bits and followed by the repeated ones, i.e. c_{29} is sent as first bit in the TFCI field of the first transmitted slot and d_0 as last bit in the TFCI field of the last transmitted slot.

4.32.5.34.2.2 Downlink compressed mode

<Editor’s note: Detailed description for downlink is FFS>

4.4 Compressed mode

In compressed mode, slots N_{first} to N_{last} are not used for transmission of data. As illustrated in figure 16, which shows the example of fixed transmission gap position with single frame method, the instantaneous transmit power is increased in the compressed frame in order to keep the quality (BER, FER, etc.) unaffected by the reduced processing gain. The amount of power increase depends on the transmission time reduction method (see section 4.4.3). What frames are compressed, are decided by the network. When in compressed mode, compressed frames can occur periodically, as illustrated in figure 16, or requested on demand. The rate and type of compressed frames is variable and depends on the environment and the measurement requirements.

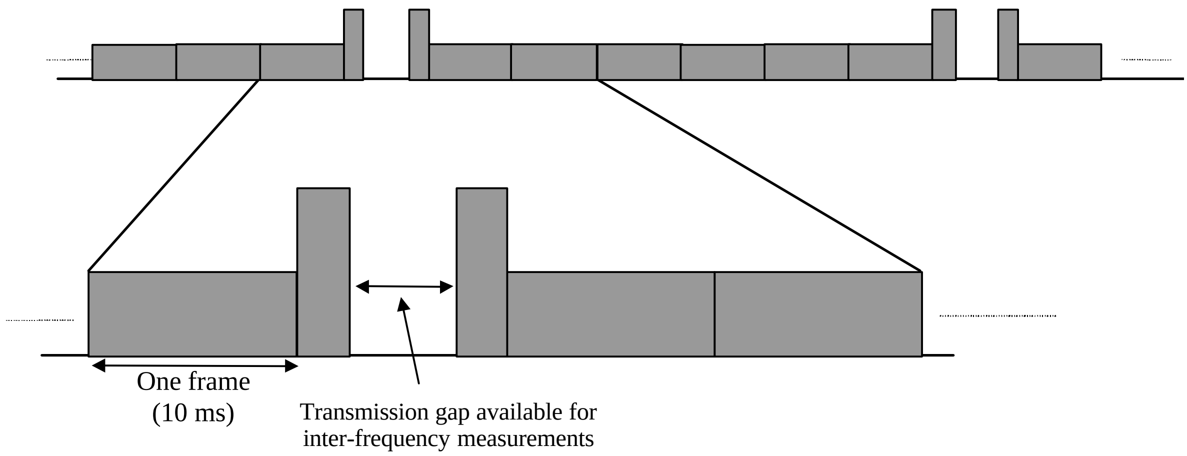


Figure 16: Compressed mode transmission

4.4.1 Frame structure in the uplink

The frame structure for uplink compressed mode is illustrated in figure 17.

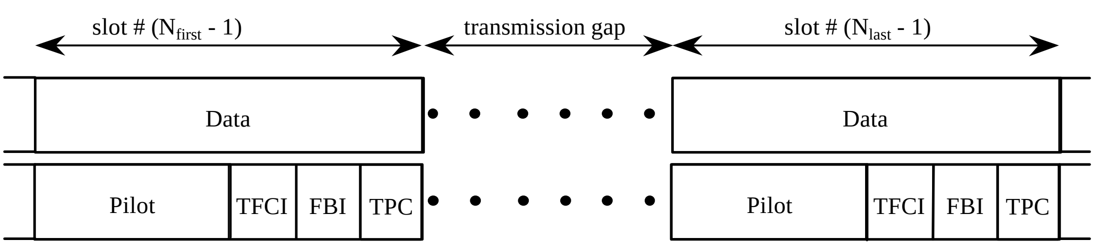
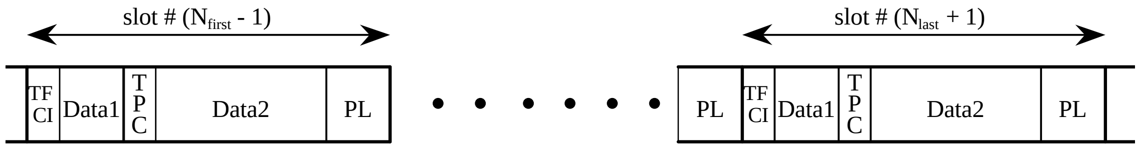


Figure 17: Frame structure in uplink compressed transmission

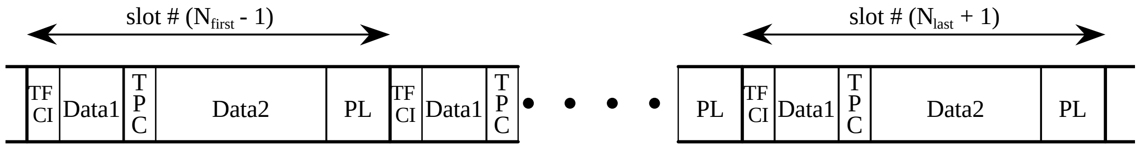
4.4.2 Frame structure types in the downlink

There are two different types of frame structures defined for downlink compressed transmission. Type A is the basic case, which maximises the transmission gap length. Type B, which is more optimised for power control, can be used if the requirement of the transmission gap length allows that.

- With frame structure of type A, BTS transmission is off from the beginning of TFCI field in slot N_{first}, until the end of Data2 field in slot N_{last} (figure 18(a)).
- With frame structure of type B, BTS transmission is off from the beginning of Data2 field in slot N_{first}, until the end of Data2 field in slot N_{last} (figure 18(b)) Dummy bits are transmitted in the TFCI and Data1 fields of slot N_{first}, and BTS and MS do not use the dummy bits. Thus BTS and MS utilize only the TPC field of N_{first}.



(a) Frame structure type A



(b) Frame structure type B

Figure 18: Frame structure types in downlink compressed transmission

4.4.3 Transmission time reduction method

When in compressed mode, the information normally transmitted during a 10 ms frame is compressed in time. The mechanism provided for achieving this is ~~either changing the code rate (method A), which means puncturing in practice, or the~~ reduction of the spreading factor by a factor of two ~~(method B). In the downlink, both method A and B are supported while only method B is used in the uplink.~~ The maximum idle length is defined to be 7 slots per one 10 ms frame.

~~4.4.3.1 Method A: By puncturing~~

~~During compressed mode, rate matching (puncturing) is applied for creating transmission gap in one frame. The algorithm for rate matching (puncturing) as described in section 4.2.7 is used.~~

~~DPDCH and DPCCH fields for compressed mode when puncturing 4 slots and 3 slots, respectively, are shown in table 11 and table 12. Because of higher encoding rate, some DPDCH symbols remain unused and shall be indicated as DTX.~~

Table 11: DPDCH and DPCCH fields in compressed mode when puncturing 4 slots

Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Frame			Bits/ Slot	DPDCH Bits/Slot		DPCCH Bits/Slot			Extra DPDCH symbols for DTX
			DPDCH	DPCCH	TOT		N_{Data1}	N_{Data2}	N_{TFCI}	N_{TPC}	N_{Pilot}	
15	7.5	512	40	66	110	10	2	2	0	2	4	4
30	15	256	160	44	220	20	2	14	0	2	2	16
30	15	256	140	74	220	20	0	14[1]	2[1]	2	2	6
30	15	256	140	66	220	20	2	12	0	2	4	14
30	15	256	120	96	220	20	0	12[1]	2[1]	2	4	4
30	15	256	100	110	220	20	2	8	0	2	8	10
30	15	256	80	140	220	20	0	8[1]	2[1]	2	8	0
60	30	128	340	66	440	40	6	28	0	2	4	34
60	30	128	320	96	440	40	4[1]	28	2[1]	2	4	24
60	30	128	300	110	440	40	6	24	0	2	8	30
60	30	128	280	140	440	40	4[1]	24	2[1]	2	8	20
120	60	64	600	252	880	80	4[1]	56	8[1,2]	4	8	28
240	120	32	1400	252	1760	160	20[1]	120	8[1,2]	4	8	108
480	240	16	2880	384	3520	320	48[1]	240	8[1,2]	8	16	256
960	480	8	6080	384	7040	640	112[1]	496	8[1,2]	8	16	576
1920	960	4	12480	384	14080	1280	240[1]	1008	8[1,2]	8	16	1216

1) This figure does not take into account the extra TFCI bits from deleted slots
2) If TFCI bits are not used, then DTX shall be used in TFCI field

NOTE: Compressed mode with puncturing cannot be used for SF=512 with TFCI.

Table 12: DPDCH and DPCCH fields in compressed mode frame when puncturing 3 slots

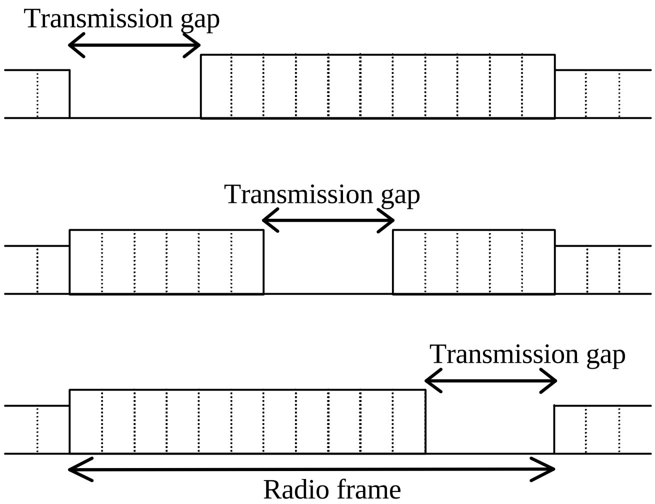
Channel Bit Rate (kbps)	Channel Symbol Rate (ksps)	SF	Bits/Frame			Bits/ Slot	DPDCH Bits/Slot		DPCCH Bits/Slot			Extra DPDCH symbols for DTX
			DPDCH	DPCCH	TOT		N_{Data1}	N_{Data2}	N_{TFCI}	N_{TPC}	N_{Pilot}	
15	7.5	512	40	72	120	10	2	2	0	2	4	8
30	15	256	160	48	240	20	2	14	0	2	2	32
30	15	256	140	78	240	20	0	14[1]	2[1]	2	2	22
30	15	256	140	72	240	20	2	12	0	2	4	28
30	15	256	120	102	240	20	0	12[1]	2[1]	2	4	18
30	15	256	100	120	240	20	2	8	0	2	8	20
30	15	256	80	150	240	20	0	8[1]	2[1]	2	8	10
60	30	128	340	72	480	40	6	28	0	2	4	68
60	30	128	320	102	480	40	4[1]	28	2[1]	2	4	58
60	30	128	300	120	480	40	6	24	0	2	8	60
60	30	128	280	150	480	40	4[1]	24	2[1]	2	8	50
120	60	64	600	264	960	80	4[1]	56	8[1,2]	4	8	96
240	120	32	1400	264	1920	160	20[1]	120	8[1,2]	4	8	256
480	240	16	2880	408	3840	320	48[1]	240	8[1,2]	8	16	552
960	480	8	6080	408	7680	640	112[1]	496	8[1,2]	8	16	1192
1920	960	4	12480	408	15360	1280	240[1]	1008	8[1,2]	8	16	2472

1) This figure does not take into account the extra TFCI bits from deleted slots
2) If TFCI bits are not used, then DTX shall be used in TFCI field

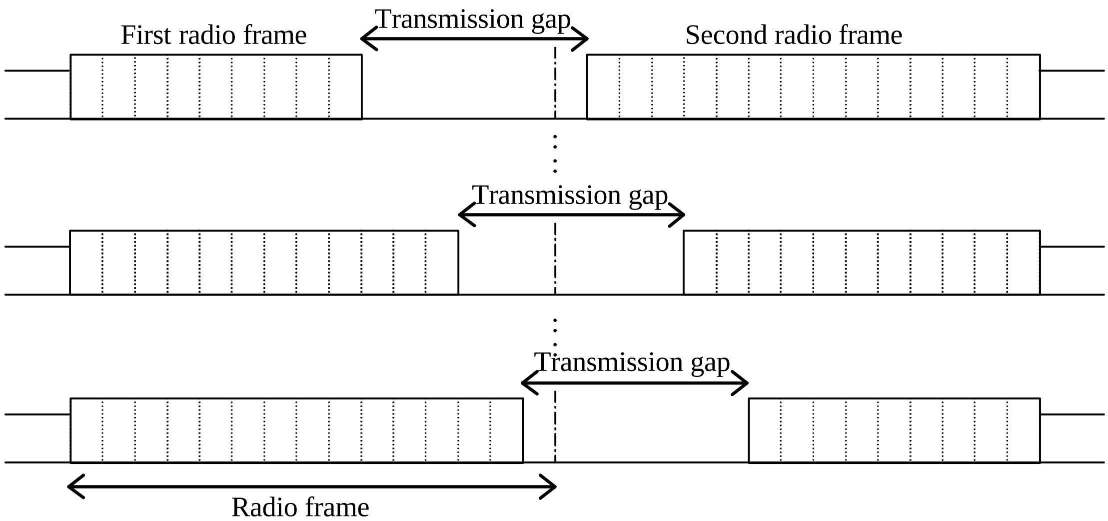
NOTE: Compressed mode with puncturing cannot be used for SF=512 with TFCI

4.4.3.12 Method B:Compressed mode Bby reducing the spreading factor by 2

During compressed mode, the spreading factor (SF) can be reduced by 2 to enable the transmission of the information bits in the remaining time slots of a compressed frame.



(1) Single-frame method



(2) Double-frame method

Figure 20: Adjustable transmission gap lengths position

4.4.4.3 Parameters for downlink compressed mode

~~< Editor's note: WG1 suggestion is that there is need for further clarifications in table 15 (e.g. rationales between change of coding rate/puncturing/change of spreading factor and idle time size, spreading factor range for different modes, etc.).>~~

Table 15 shows the detailed parameters for each transmission gap length~~ when transmission time reduction methods A or B are used~~.

Table 15: Parameters for compressed mode

TGL	Type	Adjustable /fixed gap position	Spreading Factor	Idle length[ms]	Transmission time Reduction method	Idle frame Combining
3	A	Adjustable Or Fixed	512 – 4	1.73-1.99	~~Puncturing~~ Spreading factoer reduction by 2	(S) (D) =(1,2),(2,1)
	B		256- 4	1.60-1.86		
4	A		512 - 4	2.40-2.66		(S) (D) =(1,3),(2,2),(3,1)
	B		256- 4	2.27-2.53		
7	A		512 -4	4.40-4.66		(S) (D)=(1,6),(2,5),(3,4),(4,3),(5,2),(6,1)
	B		256- 4	4.27-4.53		
10	A		512 - 4	6.40-6.66		(D)=(3,7),(4,6),(5,5),(6,4),(7,3)
	B		256- 4	6.27-6.53		
14	A	Fixed	512 - 4	9.07-9.33		(D) =(7,7)
	B		256- 4	8.93-9.19		

(S): Single-frame method as shown in figure 19 (1).

(D): Double-frame method as shown in figure 19 (2). (x,y) indicates x: the number of idle slots in the first frame, y: the number of idle slots in the second frame.

NOTE: Details for the use of the spreading factor reduction method with SF=4 are FFS