TSG-RAN Working Group 1 meeting #10
Beijing, China
January 18 – January 21, 2000

TSGR1#10(00)0067

Agenda item: AH 8

Source: Nokia

Title: CR 25.212-038, CR 25.215-034:
Adjustment of CM starting slot naming

Document for: Decision

In 25.212, the starting slot of a compressed mode transmission gap is named "N_first", in 25.215 it is named "SN".

This is changed in both documents to TGSN ("transmission gap slot number") to express the close relation to the TGL, TGD, TGP terms and to avoid confusion with the other terms in 25.212 starting with "N_", which count bits, not slots.

3GPP/SMG Meeting #10
Beijing, China, 18-21 Jan 2000

Document R1-00-0067
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**	**038**	Current Version:	3.1.0	

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

For submission to:	RAN # 7	for approval	X	strategic		(for SMG use only)
list expected approval meeting # here ↑		for information		non-strategic		

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: *(at least one should be marked with an X)*	(U)SIM		ME		UTRAN / Radio	X	Core Network	

Source:	Nokia	**Date:**	04-Jan-2000
Subject:	Alignment of CM starting slot in 25.212 and 25.215		
Work item:			

Category:	F	Correction		**Release:**	Phase 2	
	A	Corresponds to a correction in an earlier release			Release 96	
(only one category	B	Addition of feature			Release 97	
shall be marked	C	Functional modification of feature			Release 98	
with an X)	D	Editorial modification	X		Release 99	X
					Release 00	

Reason for change:	CM starting slot is named "N_first" in 25.212 and "SN" in 25.215; it is proposed that both use "TGSN"
Clauses affected:	3.1, 3.2, 4.2.7.1.2, 4.2.9.2, 4.2.12, 4.3.5.2.1, 4.3.5.2.2, 4.4, 4.4.1, 4.4.2, 4.4.4.1, 4.4.4.2

Other specs affected:	Other 3G core specifications	X	→ List of CRs:	25.215-034
	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:	

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

1 Scope

The present document describes the characteristics of the Layer 1 multiplexing and channel coding in the FDD mode of UTRA.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies.

[1] 3G TS 25.201: "Physical layer – General Description"

[2] 3G TS 25.211: "Physical channels and mapping of transport channels onto physical channels (FDD)"

[3] 3G TS 25.213: "Spreading and modulation (FDD)"

[4] 3G TS 25.214: "Physical layer procedures (FDD)"

[5] 3G TS 25.215: "Measurements (FDD)"

[6] 3G TS 25.221: "Physical channels and mapping of transport channels onto physical channels (TDD)"

[7] 3G TS 25.222: "Multiplexing and channel coding (TDD)"

[8] 3G TS 25.223: "Spreading and modulation (TDD)"

[9] 3G TS 25.224: "Physical layer procedures (TDD)"

[10] 3G TS 25.225: "Measurements (TDD)"

[11] 3G TS 25.302: "Services Provided by the Physical Layer"

[12] 3G TS 25.402: "Synchronisation in UTRAN, Stage 2"

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the [following] terms and definitions [given in ... and the following] apply.

TG: Transmission Gap is consecutive empty slots that have been obtained with a transmission time reduction method. The transmission gap can be contained in one or two consecutive radio frames.

TGL: Transmission Gap Length is the number of consecutive empty slots that have been obtained with a transmission time reduction method. $0 \leq TGL \leq 14$.

TGSN: Transmission Gap Starting Slot Number is the number of the first empty slot that has been obtained with a transmission time reduction method. $0 \leq TGSN \leq 14$.

TrCH number: Transport channel number represents a TrCH ID assigned to L1 by L2. Transport channels are multiplexed to the CCTrCH in the ascending order of these IDs.

3.2 Symbols

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

éxù	round towards ¥, i.e. integer such that *x* £ *éxù* < *x*+1
ëxû	round towards -¥, i.e. integer such that *x*-1 < *ëxû* £ *x*
çxç	absolute value of *x*
~~N_{first}~~	~~The first slot in the *TG*.~~
~~N_{last}~~	~~The last slot in the *TG*. N_{last} is either a slot in the same radio frame as N_{first} or a slot in the radio frame immediately following the slot that contains N_{first}.~~

Unless otherwise is explicitly stated when the symbol is used, the meaning of the following symbols is:

i	TrCH number
j	TFC number
k	Bit number
l	TF number
m	Transport block number
n_i	Radio frame number of TrCH i.
p	PhCH number
r	Code block number
I	Number of TrCHs in a CCTrCH.
C_i	Number of code blocks in one TTI of TrCH i.
F_i	Number of radio frames in one TTI of TrCH i.
M_i	Number of transport blocks in one TTI of TrCH i.
P	Number of PhCHs used for one CCTrCH.
PL	Puncturing Limit for the uplink. Signalled from higher layers
RM_i	Rate Matching attribute for TrCH i. Signalled from higher layers.

Temporary variables, i.e. variables used in several (sub)sections with different meaning.

x, X
y, Y
z, Z

3.3 Abbreviations

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

ARQ	Automatic Repeat Request
BCH	Broadcast Channel
BER	Bit Error Rate
BLER	Block Error Rate
BS	Base Station
CCPCH	Common Control Physical Channel
CCTrCH	Coded Composite Transport Channel
CRC	Cyclic Redundancy Code
DCH	Dedicated Channel
DL	Downlink (Forward link)
DPCH	Dedicated Physical Channel
DPCCH	Dedicated Physical Control Channel
DPDCH	Dedicated Physical Data Channel
DS-CDMA	Direct-Sequence Code Division Multiple Access
DSCH	Downlink Shared Channel
DTX	Discontinuous Transmission
FACH	Forward Access Channel
FDD	Frequency Division Duplex

The following relations, defined for all TFC j, are used when calculating the rate matching parameters:

$$Z_{0,j} = 0$$

$$Z_{ij} = \left\lfloor \frac{\sum_{m=1}^{i} RM_m \cdot N_{mj}}{\sum_{m=1}^{I} RM_m \cdot N_{mj}} \cdot N_{data,j} \right\rfloor \quad \text{for all } i = 1 \ldots I \qquad (1)$$

$$\Delta N_{ij} = Z_{ij} - Z_{i-1,j} - N_{ij} \qquad \text{for all } i = 1 \ldots I$$

4.2.7.1 Determination of rate matching parameters in uplink

4.2.7.1.1 Determination of SF and number of PhCHs needed

In uplink, puncturing can be applied to match the CCTrCH bit rate to the PhCH bit rate. The bit rate of the PhCH(s) is limited by the UE capability and restrictions imposed by UTRAN, through limitations on the PhCH spreading factor. The maximum amount of puncturing that can be applied is signalled from higher layers and denoted by *PL*. The number of available bits in the radio frames for all possible spreading factors is given in [2]. Denote these values by N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, and N_4, where the index refers to the spreading factor. The possible values of N_{data} then are $\{N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$.Depending on the UE capability and the restrictions from UTRAN, the allowed set of N_{data} , denoted SET0, can be a subset of $\{N_{256}, N_{128}, N_{64}, N_{32}, N_{16}, N_8, N_4, 2N_4, 3N_4, 4N_4, 5N_4, 6N_4\}$. $N_{data,j}$ for the transport format combination j is determined by executing the following algorithm:

SET1 = { N_{data} in SET0 such that $N_{data} - \sum_{x=1}^{I} \frac{RM_{x,}}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ is non negative }

If SET1 is not empty and the smallest element of SET1 requires just one PhCH then

$N_{data,j}$ = min SET1

else

SET2 = { N_{data} in SET0 such that $N_{data} - PL \cdot \sum_{x=1}^{I} \frac{RM_x}{\min_{1 \le y \le I}\{RM_y\}} \cdot N_{x,j}$ is non negative }

Sort SET2 in ascending order

N_{data} = min SET2

While N_{data} is not the max of SET2 and the follower of N_{data} requires no additional PhCH do

N_{data} = follower of N_{data} in SET2

End while

$N_{data,j} = N_{data}$

End if

4.2.7.1.2 Determination of parameters needed for calculating the rate matching pattern

The number of bits to be repeated or punctured, DN_{ij}, within one radio frame for each TrCH i is calculated with equation 1 for all possible transport format combinations j and selected every radio frame. $N_{data,j}$ is given from section 4.2.7.1.1. In compressed mode $N_{data,j}$ is replaced by $N_{data,j}^{cm}$ in Equation 1. $N_{data,j}^{cm}$ is given from the following relation:

$N_{data,j}^{cm} = 2N_{data,j} - 2N_{TGL}$, for compressed mode by spreading factor reduction

$N_{data,j}^{cm} = N_{data,j} - N_{TGL}$, for compressed mode by higher layer scheduling

$$N_{TGL} = \begin{cases} \frac{TGL}{15} N_{data,j}, & \text{if } \sout{N_{first}}\ \underline{TGSN} + TGL \le 15 \\ \frac{15 - TGSN}{15} N_{data,j}, & \text{in first frame if } \sout{N_{first}}\ \underline{TGSN} + TGL > 15 \\ \frac{TGL - (15 - TGSN)}{15} N_{data,j}, & \text{in second frame if } \sout{N_{first}}\ \underline{TGSN} + TGL > 15 \end{cases}$$

~~N_{first}~~ *TGSN* and *TGL* are defined in section 4.4.

If $DN_{ij} = 0$ then the output data of the rate matching is the same as the input data and the rate matching algorithm of section 4.2.7.5 does not need to be executed.

If $DN_{ij} \neq 0$ the parameters listed in sections 4.2.7.1.2.1 and 4.2.7.1.2.2 shall be used for determining e_{ini}, e_{plus}, and e_{minus} (regardless if the radio frame is compressed or not).

4.2.7.1.2.1 Uncoded and convolutionally encoded TrCHs

$R = DN_{ij} \bmod N_{ij}$ -- note: in this context $DN_{ij} \bmod N_{ij}$ is in the range of 0 to N_{ij}-1 i.e. -1 mod 10 = 9.

if $R \neq 0$ and $2R \le N_{ij}$

then $q = \lceil N_{ij} / R \rceil$

else

$q = \lceil N_{ij} / (R - N_{ij}) \rceil$

endif

-- note: *q* is a signed quantity.

if q is even

then $q' = q + \gcd(|q|, F_i)/F_i$ -- where $\gcd(|q|, F_i)$ means greatest common divisor of $|q|$ and F_i

-- note that *q'* is not an integer, but a multiple of 1/8

else

$q' = q$

endif

for $x = 0$ to F_i-1

$S(I_F(|\lfloor x*q' \rfloor| \bmod F_i)) = (|\lfloor x*q' \rfloor| \operatorname{div} F_i)$

end for

$\Delta N_i = \Delta N_{i,j}$

a = 2

For each radio frame, the rate-matching pattern is calculated with the algorithm in section 4.2.7.5, where :

$X_i = N_{i,j}$., and

$e_{ini} = (a \cdot S(n_i) \cdot |\Delta N_i| + 1) \bmod a \cdot N_{ij}$.

The bits from rate matching are denoted by $g_{i1}, g_{i2}, g_{i3}, \ldots, g_{iG_i}$, where G_i is the number of bits in one TTI of TrCH i. Denote the number of bits in one radio frame of TrCH i by H_i. In normal or compressed mode by spreading factor reduction, H_i is constant and corresponds to the maximum number of bits from TrCH i in one radio frame for any transport format of TrCH i. In compressed mode by higher layer scheduling, only a subset of the TFC Set is allowed. From this subset it is possible to derive which TFs on each TrCH that are allowed. The maximum number of bits belonging to one TTI of TrCH i for the allowed TFs is denoted by X_i. H_i is then calculated as $H_i = \left\lceil \frac{X_i}{F_i} \right\rceil$, where F_i is the number of radio frames in a TTI of TrCH i. The bits output from the DTX insertion are denoted by $h_{i1}, h_{i2}, h_{i3}, \ldots, h_{i(F_i H_i)}$. Note that these bits are three valued. They are defined by the following relations:

$$h_{ik} = g_{ik} \quad k = 1, 2, 3, \ldots, G_i$$

$$h_{ik} = d \quad k = G_i+1, G_i+2, G_i+3, \ldots, F_i H_i$$

where DTX indication bits are denoted by d. Here $g_{ik} \in \{0, 1\}$ and $d \notin \{0, 1\}$.

4.2.9.2 2nd insertion of DTX indication bits

The DTX indication bits inserted in this step shall be placed at the end of the radio frame. Note that the DTX will be distributed over all slots after 2nd interleaving.

The bits input to the DTX insertion block are denoted by $s_1, s_2, s_3, \ldots, s_S$,where S is the number of bits from TrCH multiplexing. The number of PhCHs is denoted by P and the number of bits in one radio frame, including DTX indication bits, for each PhCH by U. The number of available bits on the PhCH is denoted by N_{data} and $N_{data}=15N_{data1}+15N_{data2}$, where N_{data1} and N_{data2} are defined in [25.211]. In normal mode $U=N_{data}$. In compressed mode N_{data} is changed from the value in normal node. The exact value of N_{data} is dependent on the TGL and the transmission time reduction method, which are signalled from higher layers. The number of bits that are located within the transmission gap is denoted N_{TGL} and defined as:

$$N_{TGL} = \begin{cases} \frac{TGL}{15} N_{data}, & \text{if } \sout{N_{first}}\ \underline{TGSN} + TGL \le 15 \\ \frac{15 - TGSN}{15} N_{data}, & \text{in first frame if } \sout{N_{first}}\ \underline{TGSN} + TGL > 15 \\ \frac{TGL - (15 - TGSN)}{15} N_{data}, & \text{in second frame if } \sout{N_{first}}\ \underline{TGSN} + TGL > 15 \end{cases}$$

~~N_{first}~~ $TGSN$ and TGL are defined in Section 4.4.

In compressed mode $U=N_{data}-N_{TGL}$.

The bits output from the DTX insertion block are denoted by $w_1, w_2, w_3, \ldots, w_{(PU)}$. Note that these bits are threevalued. They are defined by the following relations:

$$w_k = s_k \quad k = 1, 2, 3, \ldots, S$$

$$w_k = d \quad k = S+1, S+2, S+3, \ldots, PU$$

where DTX indication bits are denoted by d. Here $s_k \in \{0,1\}$and $d \notin \{0,1\}$.

4.2.10 Physical channel segmentation

When more than one PhCH is used, physical channel segmentation divides the bits among the different PhCHs. The bits input to the physical channel segmentation are denoted by $x_1, x_2, x_3, \dots, x_Y$, where Y is the number of bits input to the physical channel segmentation block. The number of PhCHs is denoted by P.

The bits after physical channel segmentation are denoted $u_{p1}, u_{p2}, u_{p3}, \dots, u_{pU}$, where p is PhCH number and U is the number of bits in one radio frame for each PhCH, i.e. $U = \frac{Y}{P}$. The relation between x_k and u_{pk} is given below.

Bits on first PhCH after physical channel segmentation:

$$u_{1k} = x_k \quad k = 1, 2, \dots, U$$

Bits on second PhCH after physical channel segmentation:

$$u_{2k} = x_{(k+U)} \quad k = 1, 2, \dots, U$$

…

Bits on the P^{th} PhCH after physical channel segmentation:

$$u_{Pk} = x_{(k+(P-1)U)} \quad k = 1, 2, \dots, U$$

4.2.10.1 Relation between input and output of the physical segmentation block in uplink

The bits input to the physical segmentation are denoted by $s_1, s_2, s_3, \dots, s_S$. Hence, $x_k = s_k$ and $Y = S$.

4.2.10.2 Relation between input and output of the physical segmentation block in downlink

The bits input to the physical segmentation are denoted by $w_1, w_2, w_3, \dots, w_{(PU)}$. Hence, $x_k = w_k$ and $Y = PU$.

4.2.11 2nd interleaving

The 2nd interleaving is a block interleaver with inter-column permutations. The bits input to the 2nd interleaver are denoted $u_{p1}, u_{p2}, u_{p3}, \dots, u_{pU}$, where p is PhCH number and U is the number of bits in one radio frame for one PhCH.

(1) Set the number of columns $C_2 = 30$. The columns are numbered 0, 1, 2, …, C_2-1 from left to right.

(2) Determine the number of rows R_2 by finding minimum integer R_2 such that U £ R_2C_2.

(3) The bits input to the 2nd interleaving are written into the $R_2 \times C_2$ rectangular matrix row by row.

$$\begin{bmatrix} u_{p1} & u_{p2} & u_{p3} & \dots & u_{p30} \\ u_{p31} & u_{p32} & u_{p33} & \dots & u_{p60} \\ \vdots & \vdots & \vdots & \dots & \vdots \\ u_{p,((R_2-1)30+1)} & u_{p,((R_2-1)30+2)} & u_{p,((R_2-1)30+3)} & \dots & u_{p,(R_2 30)} \end{bmatrix}$$

(4) Perform the inter-column permutation based on the pattern $\{P_2(j)\}$ $(j = 0, 1, ..., C_2-1)$ that is shown in table 6, where $P_2(j)$ is the original column position of the j-th permuted column. After permutation of the columns, the bits are denoted by y_{pk}.

$$\begin{bmatrix} y_{p1} & y_{p,(R_2+1)} & y_{p,(2R_2+1)} & \cdots y_{p,(29R_2+1)} \\ y_{p2} & y_{p,(R_2+2)} & y_{p,(2R_2+2)} & \cdots y_{p,(29R_2+2)} \\ \vdots & \vdots & \vdots & \cdots \quad \vdots \\ y_{pR_2} & y_{p,(2R_2)} & y_{p,(3R_2)} & \cdots \; y_{p,(30R_2)} \end{bmatrix}$$

(5) The output of the 2nd interleaving is the bit sequence read out column by column from the inter-column permuted $R_2 \times C_2$ matrix. The output is pruned by deleting bits that were not present in the input bit sequence, i.e. bits y_{pk} that corresponds to bits u_{pk} with $k>U$ are removed from the output. The bits after 2nd interleaving are denoted by $v_{p1}, v_{p2}, \ldots, v_{pU}$, where v_{p1} corresponds to the bit y_{pk} with smallest index k after pruning, v_{p2} to the bit y_{pk} with second smallest index k after pruning, and so on.

Table 6

Number of column C_2	Inter-column permutation pattern
30	{0, 20, 10, 5, 15, 25, 3, 13, 23, 8, 18, 28, 1, 11, 21, 6, 16, 26, 4, 14, 24, 19, 9, 29, 12, 2, 7, 22, 27, 17}

4.2.12 Physical channel mapping

The PhCH for both uplink and downlink is defined in [2]. The bits input to the physical channel mapping are denoted by $v_{p1}, v_{p2}, \ldots, v_{pU}$, where p is the PhCH number and U is the number of bits in one radio frame for one PhCH. The bits v_{pk} are mapped to the PhCHs so that the bits for each PhCH are transmitted over the air in ascending order with respect to k.

In compressed mode, no bits are mapped to certain slots of the PhCH(s). If ~~N_{first}~~ *TGSN* + *TGL* ≤ 15, no bits are mapped to slots ~~N_{first}~~ *TGSN* ~~to N_{last}~~ *(TGSN + TGL - 1)*. If ~~N_{first}~~ *TGSN* + *TGL* > 15, i.e. the transmission gap spans two consecutive radio frames, the mapping is as follows:

- In the first radio frame, no bits are mapped to slots ~~N_{first}, N_{first}+1, N_{first}+2~~ *TGSN, TGSN+1, TGSN+2*, …, 14.
- In the second radio frame, no bits are mapped to the slots 0, 1, 2, …, ~~N_{last}~~ *(TGSN + TGL –1) mod 15*.

TGL~~, N_{first},~~ and ~~N_{last}~~ *TGSN* are defined in section 4.4.

4.2.12.1 Uplink

In uplink, the PhCHs used during a radio frame are either completely filled with bits that are transmitted over the air or not used at all. The only exception is when the UE is in compressed mode. The transmission can then be turned off during consecutive slots of the radio frame.

4.2.12.2 Downlink

In downlink, the PhCHs do not need to be completely filled with bits that are transmitted over the air. Bits $v_{pk} \notin \{0, 1\}$ are not transmitted.

The following rules should be used for the selection of fixed or flexible positions of the TrCHs in the radio frame:

- For TrCHs not relying on TFCI for transport format detection (blind transport format detection), the positions of the transport channels within the radio frame should be fixed. In a limited number of cases, where there are a small number of transport format combinations, it is possible to allow flexible positions.
- For TrCHs relying on TFCI for transport format detection, higher layer signal whether the positions of the transport channels should be fixed or flexible.

For TFCI information bits for DCH $a_{1,0}$, $a_{1,1}$, $a_{1,2}$, $a_{1,3}$, $a_{1,4}$ ($a_{1,0}$ is LSB and $a_{1,4}$ is MSB) and for DSCH $a_{2,0}$, $a_{2,1}$, $a_{2,2}$, $a_{2,3}$, $a_{2,4}$ ($a_{2,0}$ is LSB and $a_{2,4}$ is MSB), the output code word bits b_0, b_1, ..., b_{31}, are given by:

$$b_{2i} = \sum_{n=0}^{4} (a_{1,n} \times M_{i,n}) \bmod 2 ; \qquad b_{2i+1} = \sum_{n=0}^{4} (a_{2,n} \times M_{i,n}) \bmod 2$$

where i=0…15, j=0,1.

The output bits are denoted by b_k, k = 0, 1, 2, …, 31.

4.3.5 Mapping of TFCI words

4.3.5.1 Mapping of TFCI word in non compressed mode

The bits of the code word are directly mapped to the slots of the radio frame. Within a slot the bit with lower index is transmitted before the bit with higher index. The coded bits b_k, are mapped to the transmitted TFCI bits d_k, according to the following formula:

$d_k = b_{k \bmod 32}$

For uplink physical channels regardless of the SF and downlink physical channels, if SF≥128, k = 0, 1, 2, …, 29. Note that this means that bits b_{30} and b_{31} are not transmitted.

For downlink physical channels whose SF<128, k = 0, 1, 2, …, 119. Note that this means that bits b_0 to b_{23} are transmitted four times and bits b_{24} to b_{31} are transmitted three times.

4.3.5.2 Mapping of TFCI in compressed mode

The mapping of the TFCI bits in compressed mode is different for uplink, downlink with SF≥128 and downlink with SF<128.

4.3.5.2.1 Uplink compressed mode

For uplink compressed mode, the slot format is changed so that no TFCI bits are lost. The different slot formats in compressed mode 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 and the number of bits in the TFCI field in a slot by N_{TFCI}. Denote by E the first bit to be repeated, E= *TGSN* ~~N_{first}~~N_{TFCI}. If *(TGSN + TGL –1) mod 15* ~~N_{last}~~≠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 mapping.

$d_k = b_{k \bmod 32}$

where k = 0, 1, 2, …, min (31, D-1).

If D > 32, the remaining positions are filled by repetition (in reversed order):

$d_{D-k-1} = b_{(E+k) \bmod 32}$

where k = 0, …, D-33.

4.3.5.2.2 Downlink compressed mode

For downlink compressed mode, the slot format is changed so that no TFCI bits are lost. The different slot formats in compressed mode do not match the exact number of TFCI bits for all possible TGLs. DTX is therefore used if the number of TFCI fields exceeds the number of TFCI bits. The block of fields, where DTX is used, starts on the first field after the gap. If there are fewer TFCI fields after the gap than DTX bits, the last fields before of the gap are also filled with DTX.

Denote the number of bits available in the TFCI fields of one compressed radio frame by D and the number of bits in the TFCI field in a slot by N_{TFCI}. Denote by E the first bit to be repeated, E= TGSN ~~N_{first}~~N_{TFCI}. If (TGSN + TGL –1) mod 15 ~~N_{last}~~≠14, then E corresponds to the number of the first TFCI bit in the slot directly after the TG. Denote the total number of TFCI bits to be transmitted by N_{tot}. If SF ≥ 128 then N_{tot} = 32, else N_{tot} = 128. The following relations then define the mapping:

$d_k = b_{(k \bmod 32)}$

where k = 0, 1, 2, …, min (E, N_{tot})-1 and, if E< N_{tot},

$d_{k+D-Ntot} = b_{(k \bmod 32)}$

where k = E, ..., N_{tot} -1.

DTX bits are sent on d_k where k = min (E, N_{tot}), ..., min (E, N_{tot}) +D - N_{tot} -1.

4.4 Compressed mode

In compressed mode, TGL slots ~~N_{first} to N_{last}~~ starting from slot TGSN are not used for transmission of data. As illustrated in figure 12, 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 12, or requested on demand. The rate and type of compressed frames is variable and depends on the environment and the measurement requirements.

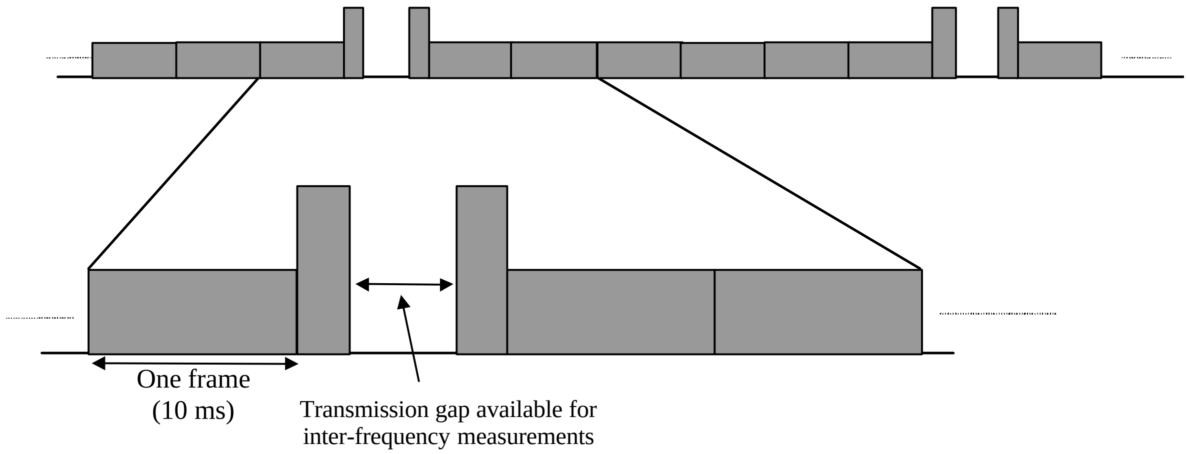


Figure 12: Compressed mode transmission

4.4.1 Frame structure in the uplink

The frame structure for uplink compressed mode is illustrated in figure 13.

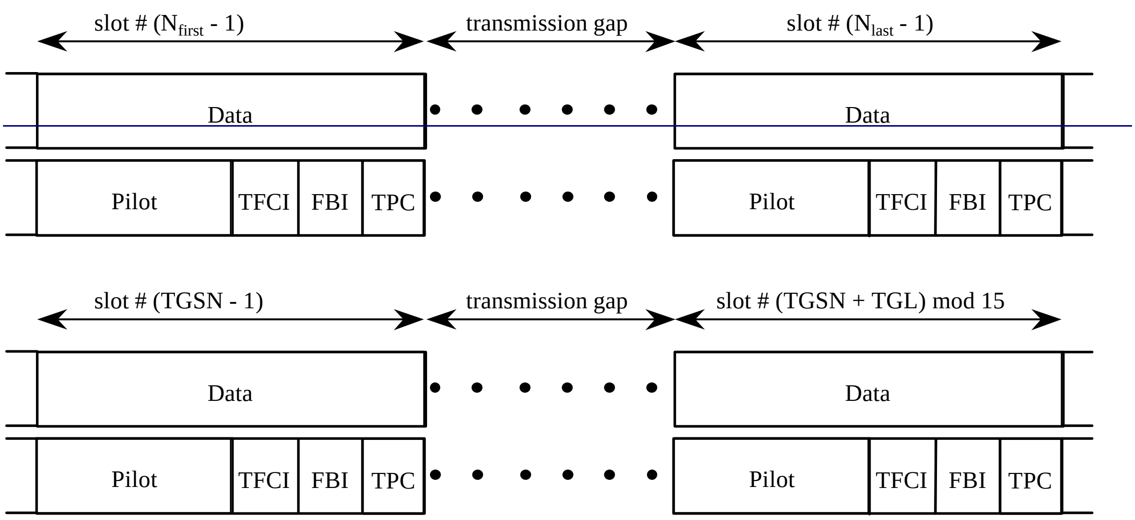
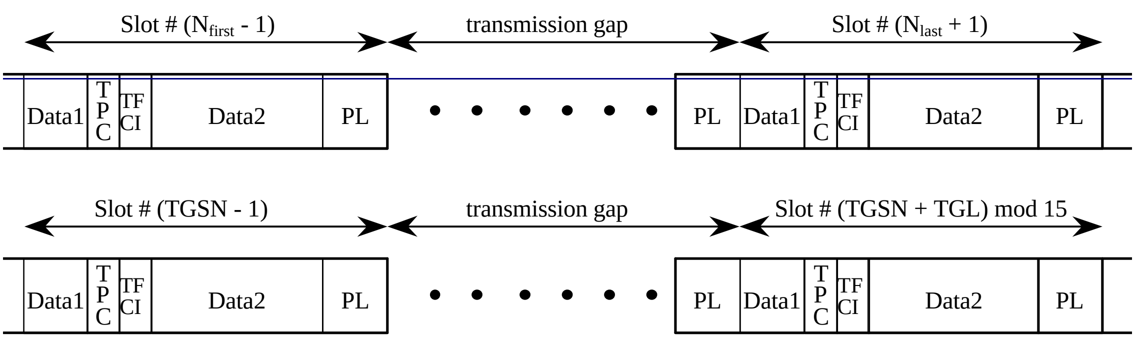


Figure 13: Frame structure in uplink compressed transmission

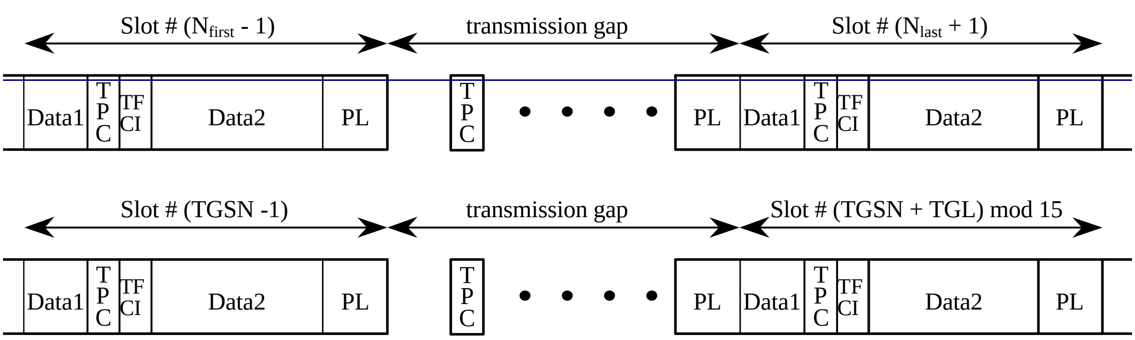
4.4.2 Frame structure types in the downlink

There are two different types of frame structures defined for downlink compressed mode. Type A maximises the transmission gap length and type B is optimised for power control.

- With frame structure of type A, the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 14(a)).
- With frame structure of type B, the TPC field of the first slot in the transmission gap and the pilot field of the last slot in the transmission gap is transmitted. Transmission is turned off during the rest of the transmission gap (figure 14(b)).



(a) Frame structure type A



(b) Frame structure type B

Figure 14: 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 mechanisms provided for achieving this are puncturing, reduction of the spreading factor by a factor of two , and higher layer scheduling. In the downlink, all methods are supported while compressed mode by puncturing is not used in the uplink. The maximum idle length is defined to be 7 slots per one 10 ms frame. The slot formats that are used in compressed mode are listed in [2].

4.4.3.1 Compressed mode 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.

4.4.3.2 Compressed mode by reducing the spreading factor by 2

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

On the downlink, UTRAN can also order the UE to use a different scrambling code in compressed mode than in normal mode. If the UE is ordered to use a different scrambling code in compressed mode, then there is a one-to-one mapping between the scrambling code used in normal mode and the one used in compressed mode, as described in TS 25.213[3] section 5.2.1.

4.4.3.3 Compressed mode by higher layer scheduling

Compressed mode can be obtained by higher layer scheduling. Higher layers then set restrictions so that only a subset of the allowed TFCs are used in compressed mode. The maximum number of bits that will be delivered to the physical layer during the compressed radio frame is then known and a transmission gap can be generated.

4.4.4 Transmission gap position

Transmission gaps can be placed at both fixed position and adjustable position for each purpose such as interfrequency power measurement, acquisition of control channel of other system/carrier, and actual handover operation.

4.4.4.1 Fixed transmission gap position

The transmission gaps can be placed onto fixed positions. When using single frame method, the fixed transmission gap is located within the compressed frame depending on the transmission gap length (TGL) as shown in figure 15 (1). When using double frame method, the fixed transmission gap is located on the center of two connected frames as shown in figure 15 (2). Table 9 shows the parameters for the fixed transmission gap position case.

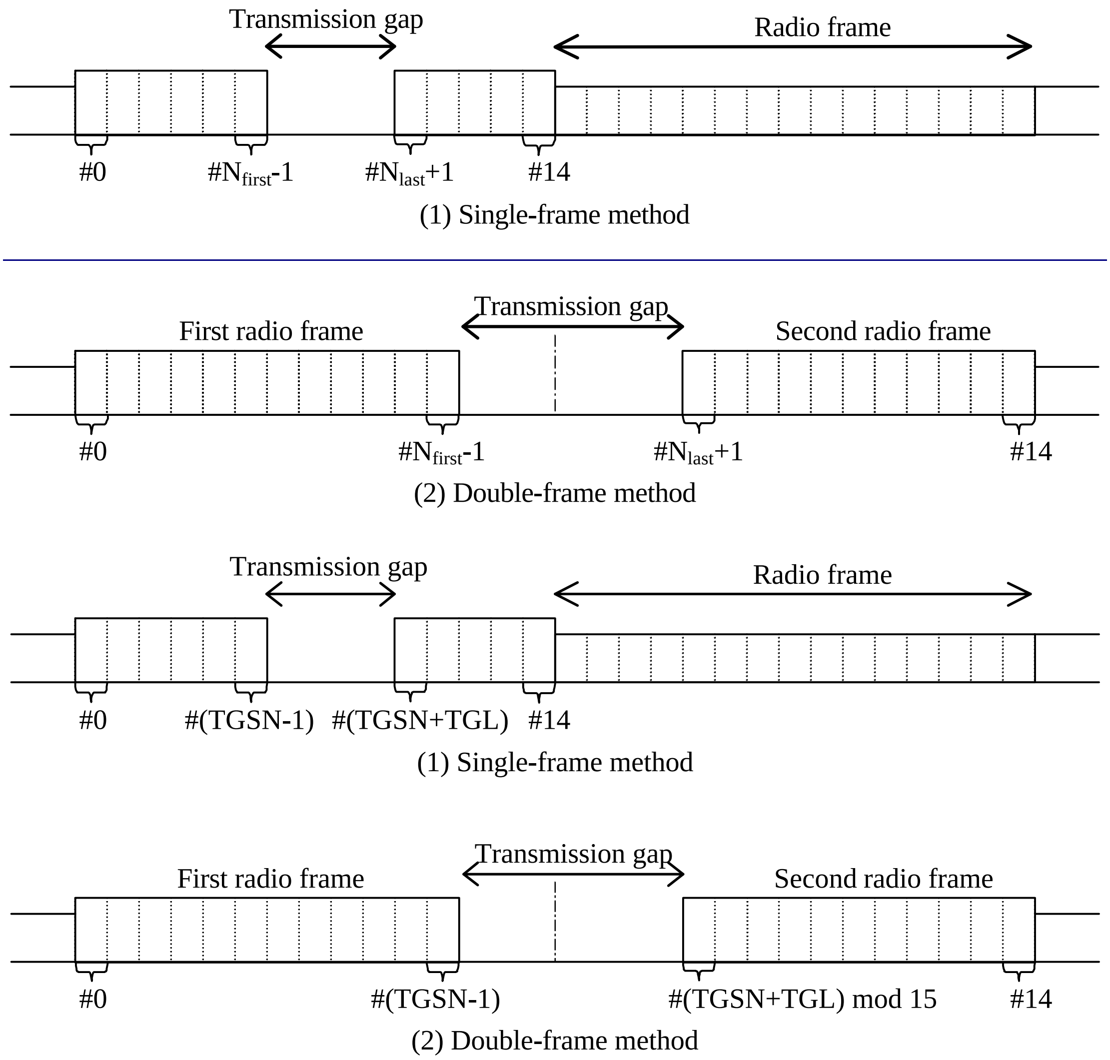


Figure 15: Fixed transmission gap position

Table 9: Parameters for fixed transmission gap position

	Single-frame method	Double-frame method
TGL (slot)	~~N_{first}~~TGSN	TGSN~~N_{first}~~
3	7	14 in first frame
4	6	13 in first frame
7	6	12 in first frame
10	N.A.	10 in first frame
14	N.A.	8 in first frame

4.4.4.2 Adjustable transmission gap position

Position of transmission gaps can be adjustable/relocatable for some purpose e.g. data acquisition on certain position as shown in figure 16. Parameters of the adjustable transmission gap positions are calculated as follows:

TGL is the number of consecutive idle slots during compressed mode,

TGL = 3, 4, 7, 10, 14

~~N_{first}~~ TGSN specifies the starting slot of the consecutive idle slots,

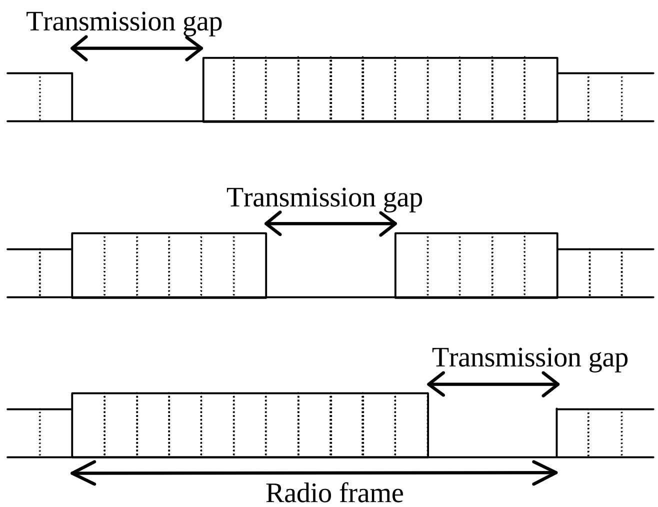
~~N_{first}~~ TGSN = 0,1,2,3,…,14.

~~N_{last} shows the number of the final idle slot and is calculated as follows;~~

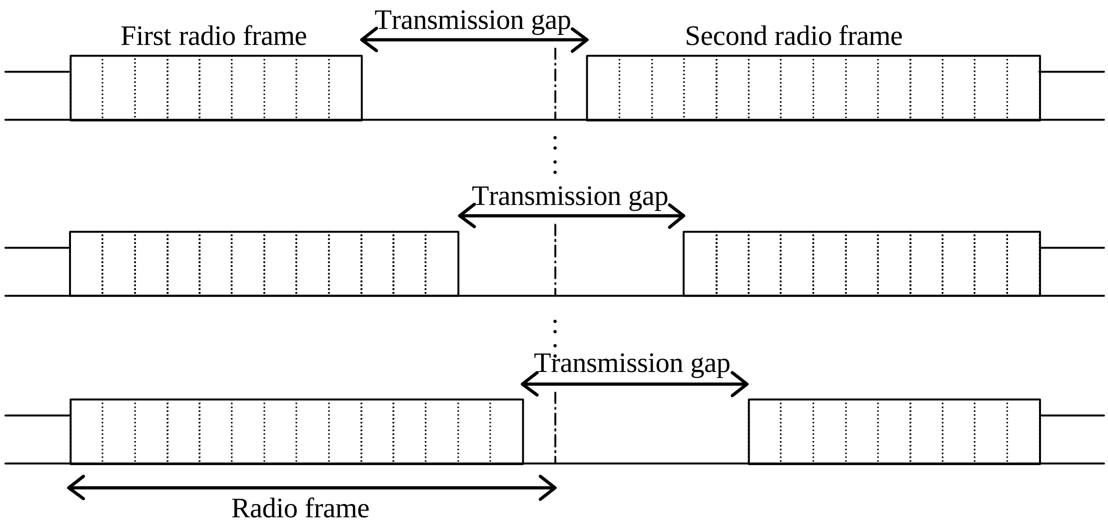
~~If N_{first} + TGL ≤ 15, then N_{last} = N_{first} + TGL – 1 (in the same frame),~~

~~If N_{first} + TGL > 15, then N_{last} = (N_{first} + TGL – 1) mod 15 (in the next frame).~~

When the transmission gap spans two consecutive radio frames, ~~N_{first}~~ TGSN and TGL must be chosen so that at least 8 slots in each radio frame are transmitted.



(1) Single-frame method



(2) Double-frame method

Figure 16: Adjustable transmission gap lengths position

4.4.4.3 Parameters for downlink compressed mode

Table 10 shows the detailed parameters for each transmission gap length for the different transmission time reduction methods.

Table 10: 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 factor reduction by 2 Higher layer scheduling	(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 15 (1).

(D): Double-frame method as shown in figure 15 (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: Compressed mode by spreading factor reduction is not supported when SF=4 is used in normal mode.

3GPP/SMG Meeting #10
Beijing, China, 18-21 Jan 2000

Document R1-00-0067
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.

25.215 CR 034 Current Version: 3.1.0

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

For submission to: RAN # 7
list expected approval meeting # here ↑

for approval	X	strategic		*(for SMG use only)*
for information		non-strategic		

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 [ ] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Nokia **Date:** 04-Jan-2000

Subject: Alignment of CM starting slot in 25.212 and 25.215

Work item:

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

			Release:	
F	Correction		Phase 2	
A	Corresponds to a correction in an earlier release		Release 96	
B	Addition of feature		Release 97	
C	Functional modification of feature		Release 98	
D	Editorial modification	X	Release 99	X
			Release 00	

Reason for change: CM starting slot is named "N_first" in 25.212 and "SN" in 25.215; it is proposed that both use "TGSN"

Clauses affected: 6.1.1.2

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.212-038
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:

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

6 Measurements for UTRA FDD

6.1 UE measurements

6.1.1 Compressed mode

6.1.1.1 Use of compressed mode/dual receiver for monitoring

A UE shall, on upper layers commands, monitor cells on other frequencies (FDD, TDD, GSM). To allow the UE to perform measurements, upper layers shall command that the UE enters in compressed mode, depending on the UE capabilities.

In case of compressed mode decision, UTRAN shall communicate to the UE the parameters of the compressed mode, described in reference [2], 25.212.

A UE with a single receiver shall support downlink compressed mode.

Every UE shall support uplink compressed mode, when monitoring frequencies which are close to the uplink transmission frequency (i.e. frequencies in the TDD or GSM 1800/1900 bands).

All fixed-duplex UE shall support both downlink and uplink compressed mode to allow inter-frequency handover within FDD and inter-mode handover from FDD to TDD.

> < WG1's note : the use of uplink compressed mode for single receiver UE when monitoring frequencies outside TDD and GSM 1800/1900 bands is for further study >

UE with dual receivers can perform independent measurements, with the use of a "monitoring branch" receiver, that can operate independently from the UTRA FDD receiver branch. Such UE do not need to support downlink compressed mode.

The UE shall support one single measurement purpose within one compressed mode transmission gap. The measurement purpose of the gap is signalled by upper layers.

The following section provides rules to parametrise the compressed mode.

6.1.1.2 Parameterisation of the compressed mode

In response to a request from upper layers, the UTRAN shall signal to the UE the compressed mode parameters.

The following parameters characterize a transmission gap :

- TGL: Transmission Gap Length is the duration of no transmission, expressed in number of slots.
- SFN: The system frame number when the transmission gap starts
- TGSN: The slot number when the transmission gap starts

With this definition, it is possible to have a flexible position of the transmission gap in the frame, as defined in [2].

The following parameters characterize a compressed mode pattern :

- TGP: Transmission Gap Period is the period of repetition of a set of consecutive frames containing up to 2 transmission gaps (*).
- TGL: As defined above
- TGD: Transmission Gap Distance is the duration of transmission between two consecutive transmission gaps within a transmission gap period, expressed in number of frames. In case there is only one transmission gap in the transmission gap period, this parameter shall be set to zero.
- PD: Pattern duration is the total time of all TGPs expressed in number of frames.

- SFN: The system frame number when the first transmission gap starts
- UL/DL compressed mode selection: This parameter specifies whether compressed mode is used in UL only, DL only or both UL and DL.
- Compressed mode method: The method for generating the downlink compressed mode gap can be puncturing, reducing the spreading factor or upper layer scheduling and is described in [2].
- Transmit gap position mode: The gap position can be fixed or adjustable. This is defined in [2].
- Downlink frame type: This parameter defines if frame structure type 'A' or 'B' shall be used in downlink compressed mode. This is defined in [2].
- Scrambling code change: This parameter indicates whether the alternative scrambling code is used for compressed mode method 'SF/2'. Alternative scrambling codes are described in [3].
- PCM: Power Control Mode specifies the uplink power control algorithm applied during recovery period after each transmission gap in compressed mode. PCM can take 2 values (0 or 1). The different power control modes are described in [4].
- PRM: Power Resume Mode selects the uplink power control method to calculate the initial transmit power after the gap. PRM can take two values (0 or 1) and is described in [4].

In a compressed mode pattern, the first transmission gap starts in the first frame of the pattern. The gaps have a fixed position in the frames, and start in the slot position defined in [2].

(*): Optionally, the set of parameters may contain 2 values TGP1 and TGP2, where TGP1 is used for the 1st and the consecutive odd gap periods and TGP2 is used for the even ones. Note if TGP1=TGP2 this is equivalent to using only one TGP value.

In all cases, upper layers has control of individual UE parameters. The repetition of any pattern can be stopped on upper layers command.

The UE shall support [8] simultaneous compressed mode patterns which can be used for different measurements. Upper layers will ensure that the compressed mode gaps do not overlap and are not scheduled within the same frame. Patterns causing an overlap or too long gaps will not be processed by the UE and interpreted as a faulty message.

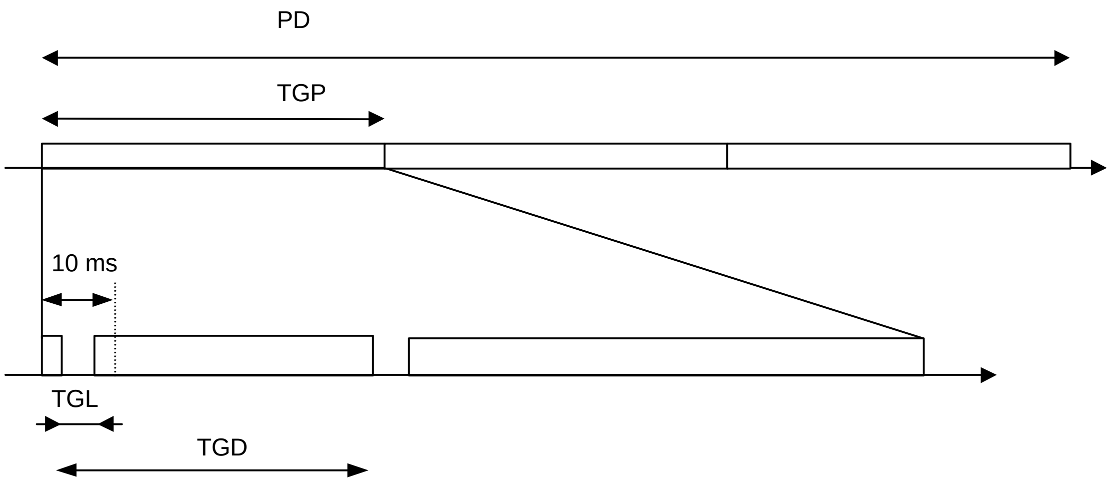


Figure 1 : illustration of compressed mode pattern parameters

6.1.1.3 Parameterisation limitations

In the table below the supported values for the TGL parameter is shown.