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Presentation of Specification to TSG or WG

Presentation to:	**TSG-RAN Meeting #14**
Agenda item:	**9.1.8 Enhancement on the DSCH hard split mode**
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Abstract of document:

This technical report is for the Release 5 work item "Enhancement on the DSCH hard split mode". In this report, the changes in TR25.870 are described since the last TSG RAN meeting #13.

Changes since last presentation to TSG-RAN Meeting #13:

- In section 4.4.1, the impact of TFCI coding scheme on WG1 specification is described.
- In section 4.4.3, the impact of TFCI coding scheme on WG3 specifications is described according to the WG3 internal TR.
- In section 5.2, the requirement for the TFCI power control is described with revision mark according to the results of WG 1 discussion.
- In section 5.3, the proposed power control scheme is described with revision mark according to the results of WG1 discussion.
- In section 5.4, the impact of the proposed power control scheme on WG3 specifications is described according to the WG3 internal TR.

Outstanding Issues:

None

Contentious Issues:

None

3G TR 25.870 V1.1.0 (2001-12)

Technical Report

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Foreword

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The contents of this TR are subject to continuing work within the 3GPP TSG and may change following formal TSG approval. Should the TSG modify the contents of this TR, it will be re-released with an identifying change of release date and an increase in version number as follows:

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where:

x the first digit:

1 presented to TSG for information;

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y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.

z the third digit is incremented when editorial only changes have been incorporated in the document.

1 Scope

The purpose of the present document is to help the TSG RAN WG1 group to specify the changes to existing specifications, needed for the introduction of the "Enhancement on the DSCH hard split mode" option for Release 5.

"Enhancement on the DSCH hard split mode" is proposed to specify the enhancements of TFCI coding and power control in DSCH hard split mode for UTRA FDD. Based on [1], this work item is composed of two work tasks.

1) TFCI coding in DSCH hard split mode
2) TFCI power control in DSCH hard split mode

The different WTs will be described in subsequent chapters. It is intended to gather all information in order to trace the history and the status of the WTs in RAN WG1. It is not intended to replace contributions and Change Requests, but only to list conclusions and make references to agreed contributions and CRs. When solutions are sufficiently stable, the CRs can be issued.

It describes agreed requirements related to the WTs.

It identifies the affected specifications with related Change Requests.

It also describes the schedule of the WTs.

This document is a 'living' document, i.e. it is permanently updated and presented to all TSG-RAN meetings.

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] RP-010205, "Proposed WI Enhancement on the DSCH hard split mode", approved at RAN#11

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply.

3.2 Symbols

3.3 Abbreviations

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

TFCI Transport Format Combination Indicator

DSCH Downlink Shared Channel

4 TFCI coding in DSCH hard split mode

4.1 Introduction

In the current Rel99 specification, as identified by RAN WG's (WG1, WG2 and WG3), when DSCH scheduling be done in DRNC, logical split cannot be supported over Iur during the DSCH soft handover. Furthermore, hard split has advantage over logical split in the sense that it can be supported over Iur. However, it was also identified that hard split has some limitation and therefore there is some need to study the enhancement for TFCI coding in the DSCH hard split mode

Currently DSCH hard split mode can support only 5 bit long DSCH and DCH TFCIs. As a result, the number of TFCI is limited upto 32 for DCH and DSCH in DSCH hard split mode. A new TFCI coding scheme to support the variable bit length can enhance the DSCH hard split mode.

4.2 Requirements

The new TFCI encoding scheme should be an extension of the existing scheme and include the TFCI encoding scheme for non-split mode and 5:5 split mode as a subset. This implies that full backward compatibility to the TFCI encoding and mapping schemes used in R99/Rel-4 must be guaranteed.
The requirements on the new TFCI encoding scheme are summarised as follows:

- There shall be only one TFCI encoding scheme, both for non-split mode and for variable/fixed split mode. The new TFCI encoding scheme shall give identical output for non-split mode and 5:5 hard split as in R99/Rel-4.
- The mapping of encoded TFCI bits to the bits in the TFCI fields of the PhCH shall not be changed. This implies that 32 bits shall be output from the TFCI encoding process for all hard split combinations.
- Reuse of existing encoder structure, i.e. use of the same basis sequences $M_{i,0}$ … $M_{i,9}$ as in Table 8 of [3].
- The amount of additional HW, e.g. for storing additional puncturing patterns, shall be minimised.

The new scheme must show acceptable performance.

4.3 Proposed TFCI Coding Scheme for the flexible Hard Split mode

This section describes the modification of the current TFCI coding scheme to support the variable code length, and explains the performance, backward compatibility and H/W complexity due to an encoding scheme and an example of decoder structure. The modified TFCI coding scheme is called as “Flexible Hard Split mode TFCI coding scheme (VHS-TFCI)”.

In the current specification, (16,5) Bi-Orthogonal Code and (32,10) sub-code of the second order Reed-Muller code are used as TFCI coding schemes. Actually, these coding schemes can be implemented by one encoder and one decoder. This means that (16,5) Bi-Orthogonal Code can be obtained from (32,10) sub-code of the second order Reed-Muller code, by selecting some basis and by puncturing some bits. “Shortening techniques” are used in the consideration of the backward compatibilities. The shortening techniques create a new code by selecting basis and puncture some coded symbols from mother code. `VHS-TFCI using shortening technique has a good performance. Moreover, the difference between the current TFCI coding scheme and the variable hard split mode TFCI coding scheme (VHS-TFCI) is the number of puncturing patterns. That is, VHS-TFCI can use the current TFCI coder and decoder and requires small memory for storing puncturing patterns. This means that the impact of VHS-TFCI is very small in the viewpoint of H/W.

In the following sections, the encoder structure and an example of decoder structure are described in detail.

4.3.1 Effective code rate after mapping of TFCI codeword in normal mode

Before describing VHS-TFCI, we consider the coded symbol length relative to TFCI information ratios. The most natural way is to maintain uniform code rate. The current TFCI coding scheme uses (32,l0) codes. However, according to TS 25.212, if TFCI codeword is not repeated, then the effective TFCI code rate after mapping of TFCI codeword in normal mode is 1/3. Consequently, if the effective code rate is maintained as 1/3, then the effective code lengths relative to TFCI information ratios after the codeword mapping in normal mode are as shown in Table 1:

TFCI Ratio	Effective Code Length		Effective Code Rate
1:9	(3,1) Code	(27,9) Code	1 / 3
2:8	(6,2) Code	(24,8) Code	1 / 3
3:7	(9,3) Code	(21,7) Code	1 / 3
4:6	(12,4) Code	(18,6) Coäe	1 / 3
5:5 (exist already)	(15,5) Code	(15,5) Code	1 / 3

Table 1. Effective Code Length for TFCI information ratio

For backward compatibility, however, code length at the output of TFCI coder should be maintained as 32 while the sum of the effective code lengths for DCH and DSCH is 30 for each case as shown in Table 1. Thus, in TFCI coding scheme that will be implemented, it is necessary to add 1 bit to the code word for DCH and DSCH, respectively, as shown in Table 2.

TFCI Ratio	Code Length		Note
1:9	(4,1) Code	(28,9) Code	New
2:8	(7,2) Code	(25,8) Code	New
3:7	(10,3) Code	(22,7) Code	New
4:6	(13,4) Code	(19,6) Code	New
5:5	(16,5) Code	(16,5) Code	Already exists

Table 2. Code length at the TFCI coder output for TFCI information ratio

4.3.2 TFCI encoder structure for variable hard split mode

According to the code length in Table 2, the encoder structure of VHS-TFCI is as shown in figure 1:

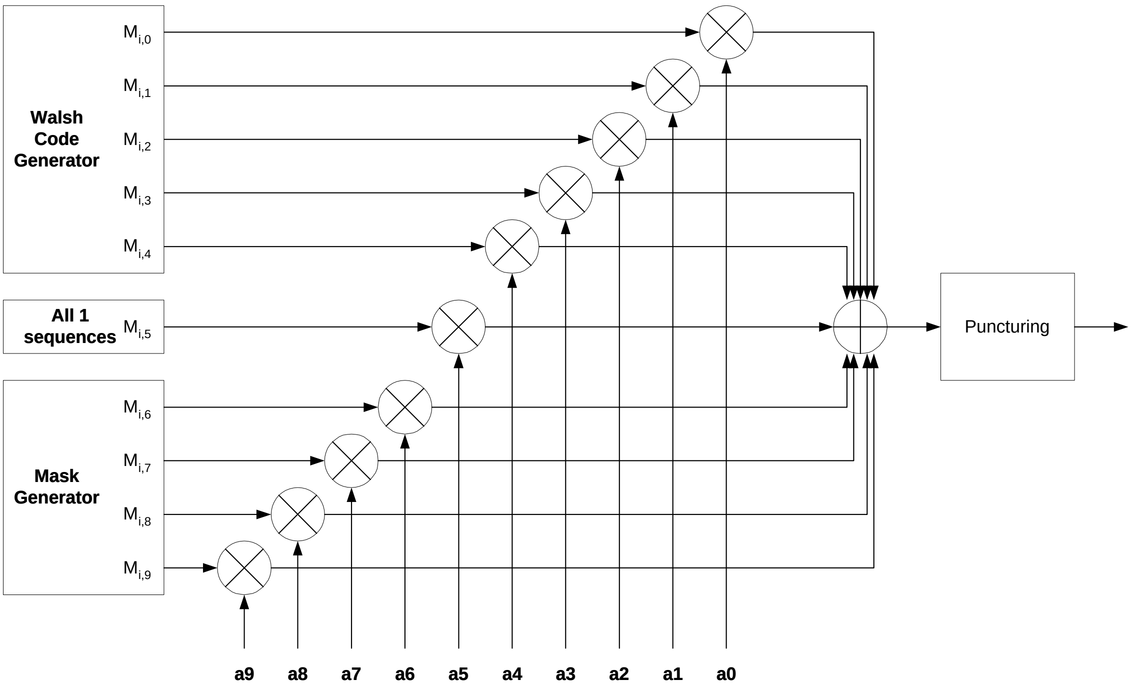


Fig 1. Encoder Structure

In Fig 1, the encoder consists of (32,10) sub-code of the second order Reed-Muller code and a puncturer for each code length. The puncturing pattern and the used basis for each code length are listed in table 3.

Code Length	Puncturing Pattern	Used basis
(4,1)	1, 3, 5, 7, 8, 9, 10, 11, 12, 13, 14,15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	M_0
(7,2)	3, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	M_0, M_1
(10,3)	7, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	M_0, M_1, M_2
(13,4)	0, 1, 2, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31	M_0, M_1, M_2, M_3
(16,5) (exist already)	15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31	M_0, M_1, M_2, M_3, M_5
(19,6)	6, 10, 11, 13, 14, 16, 17, 19, 20, 22, 24, 26, 31	M_0, M_1, M_2, M_3, M_4, M_5
(22,7)	8, 12, 16, 18, 19, 23, 26, 27, 30, 31	M_0, M_1, M_2, M_3, M_4, M_6, M_7
(25,8)	4, 11, 14, 15, 20, 21, 22	M_0, M_1, M_2, M_3, M_4, M_5, M_6, M_7
(28,9)	6, 10, 11, 30	M_0, M_1, M_2, M_3, M_4, M_5, M_6, M_7, M_8
(32,10) (exist already)	N.A	M_0, M_1, M_2, M_3, M_4, M_5, M_6, M_7, M_8, M_9

where *M0 = 10101010101010110101010101010100*
M1 = 01100110011001101100110011001100
M2 = 00011110000111100011110000111100
M3 = 00000001111111100000001111111100
M4 = 00000000000000011111111111111101

M5 = 11111111111111111111111111111111
M6 = 01010000110001111110000011101101
M7 = 00000011100110111011011100011100
M8 = 00010101111100100110110010101100
M9 = 00111000011011101011110101000100

Table 3. Puncturing pattern and used basis

4.3.3 Performance of VHS-TFCI coding scheme

In consideration of fig 1 and table 3, (19,6), (22,7), (25,8), and (28,9) encoders are the shortening version of (32,10) sub-code of second order Reed-Muller code, while others have the following basic structure.

- (4,1) encoder : 4 time repetition code
- (7,2) encoder : Repetition & Puncturing of (3,2) simplex code
- (10,3) encoder : Repetition & Puncturing of (7,3) simplex code
- (13,4) encoder : Puncturing of (15,4) simplex code

As we can see, (4,1), (7,2), (10,3), and (13,4) encoders are based on (2^k-1,k) simplex encoder. These codes have an advantage of designing the decoder because IFHT(Inverse Fast Hadamard transform) can be used for decoder. Using IFHT in decoder can reduce H/W complexity.

As in the current specification, certain 30 bits of 32-bit output of TFCI coder will be transmitted or 32-bit TFCI codeword will be repeatedly transmitted, according to a mapping rule to map the TFCI codeword to the slots of the radio frame. The mapping rule is FFS. However, to get the optimal (or near optimal) performance in the case that only 30 bits are transmitted in normal mode, VHS-TFCI is designed based on the assumption as follows. In the case that only 30 bits are transmitted, the mapping rule shall satisfy that

- The last bit of TFCI codeword for DCH is not transmitted.
- The last bit of TFCI codeword for DSCH is not transmitted.

It is noted that the above assumption preserves the consistency with the TFCI ratio of (5:5) in split mode operation, which is defined in the current specification.

In general, the performance of block code is determined by minimum distance d_{min}. In the viewpoint of performance, d_{min}'s of VHS-TFCI for each code length is shown in table 4.

TFCI coder output			Effective codeword			Note
Code Length	Optimal Bound	D_{min}	Code Length	Optimal Bound	D_{min}	
(4,1)	4	4	(3,1)	3	3	New
(7,2)	4	4	(6,2)	4	4	New
(10,3)	5	5	(9,3)	4	4	New
(13,4)	6	6	(12,4)	6	6	New
(16,5)	8	8	(15,5)	7	7	Already exists
(19,6)	8	7	(18,6)	8	7	New
(22,7)	8	8	(21,7)	8	8	New
(25,8)	9	8	(24,8)	8	8	New
(28,9)	10	10	(27,9)	10	9	New
(32,10)	12	12	(30,10)	11	10	Already exists

Table 4. Performance of VHS-TFCI

As shown in Table 4, VHS-TFCI is the optimal code in (3,1), (4,1), (6,2), (7,2), (9,3), (10,3), (12,4), (13,4), (16,5), (15,5), (21,7), (22,7), (28,9), (32,10), and (24,8) cases, while in (18,6), (19,6), (25,8), and (27,9) cases, the performance of VHS-TFCI is very close to the optimal bound.

4.3.4 Decoder

There are a lot of decoding methods of block code, e.g., " Brute-force method". This section describes an example of the decoder structure according to VHS-TFCI. The decoder structure in this section is only an example and informative. The purpose of this section is to show the possible way for the current TFCI coding scheme and VHS-TFCI to coexist without significant complexity increase.

Similar to encoder structure for VHS-TFCI in 4.3.2, the decoding scheme for VHS-TFCI can be implemented by one decoder (which is included in current TFCI coding scheme) regardless of the code length. Furthermore, the decoder of "(32,10) the sub-code of the second order Reed-Muller code" for the current TFCI coding scheme can be reused. The decoder structure is as shown in Fig 3.

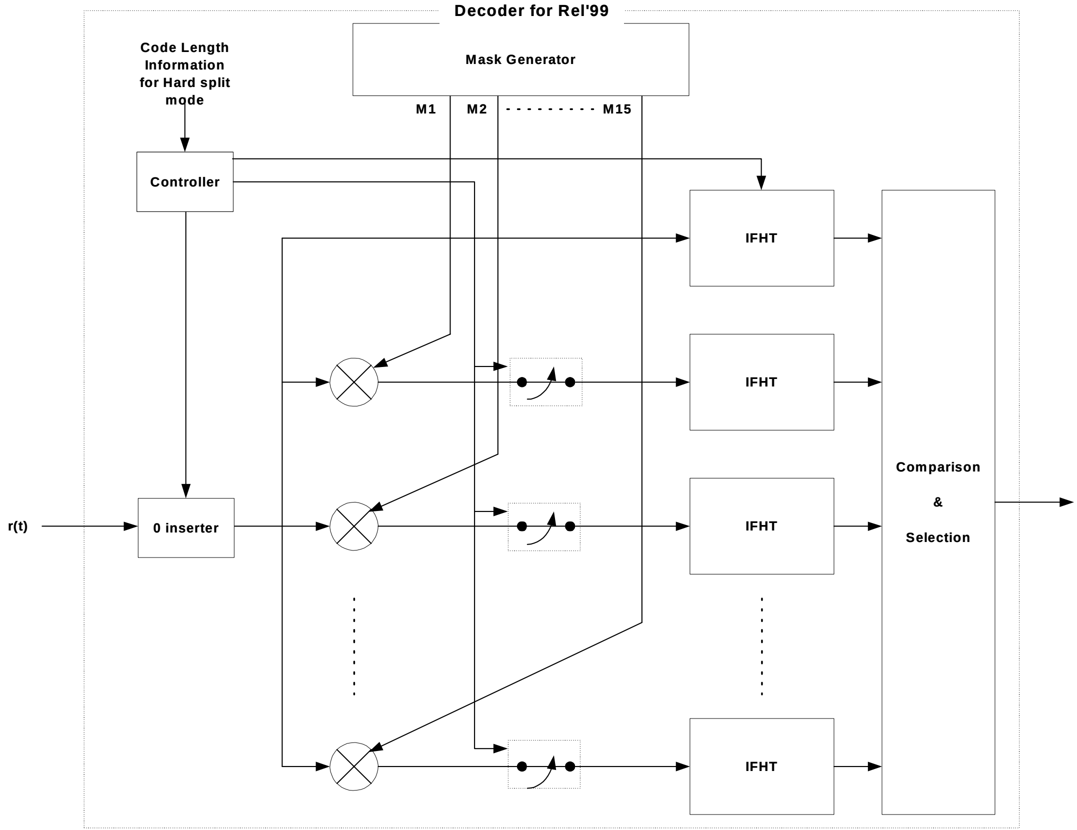


Fig 3. Decoder Structure

The decoder in fig 3 is the decoder of "(32,10) the sub-code of the second order Reed-Muller code" for Rel'99/Rel 4. There is no additional H/W block required for VHS-TFCI and only the code length information is needed for VHS-TFCI. Controller in fig.2 controls the operation of 0 inserter, mask multipliers and IFHT according to code length information. 0 inserter inserts 0 symbols into the received symbols at the puncturing position listed in table 2. Mask multipliers multiplies the received bits by the mask that is generated from mask generator and also used for the current TFCI coding scheme. IFHT performs Inverse Fast Hadamard Transform operation. The number of IFHTs used for VHS-TFCI depends on code length and the maximum number of IFHTs is identical to that of the current TFCI coding scheme in this example. In detail, when the number of information bits is less than or equal to 6 ($k \leq 6$) , no mask-multiplier is used and the one IFHT-the first IFHT- is used. On the other hand, when the number of information bits is over 6 ($k > 6$), (2^{k-6}-1) mask-multipliers and 2^{k-6} IFHTs are used.

4.3.5 Complexity

Considering the encoder structure, there is no additional block except increasing the memory size for storing the puncturing patterns. The decoder in fig 3 is an example to show VHS-TFCI will not increase the H/W complexity of the current decoder.

Thus, in implementing VHS-TFCI, there is no significant increase in complexity, and backward compatibility can be maintained.

4.3.6. Mapping rule of the TFCI Coded symbol

4.3.6.1. Criterion for the Mapping rule

In this section, we mention about the criterion for mapping rule. Criterion is as follows :

1) n coded symbols with smaller size is ordered as uniformly as possible.
2) In the normal case(non-compressed mode & SF > 64), out of total 32 symbols, 1bit for DSCH and 1bit for DCH is not transmitted.
3) Have a generalized form to include 5:5 hard split case which is in Rel.99/Rel.4 specification.

The first criterion means that the uniform distribution of the transmitted symbol in the time domain guarantee the good time diversity. Actually, when n coded symbols with smaller size are transmitted in the positions uniformly distributed and (32 – n) coded symbols with larger size are transmitted in the other positions, the positions for (32 – n) coded symbols with larger size have also almost uniformly distributed. The second one is for maintaining the code rate 1/3(the code rate 1/3 is the one in non-split mode) in the normal case(non-compressed mode & SF > 64).

4.3.6.2. Mapping rule

In this section, we described about mapping rule based on the criterion as seen in the previous section. We will introduce a formula for calculating the mapping positions. In terms of the criterion, first, the mapping position according to formula is uniformly distributed, and second, the last symbol of the codeword is mapped to the last position in all cases. Before we describing the mapping position, the number of the coded symbol is as the following table 5.

TFCIDCH : TFCIDSCH	Coded symbol for TFCIDCH	Coded symbol for TFCIDSCH
1 : 9	4	28
2 : 8	7	25
3 : 7	10	22
4 : 6	13	19
5 : 5	16	16
6 : 4	19	13
7 : 3	22	10
8 : 2	25	7
9 : 1	28	4

Table 5. The number of coded symbol

We introduce the formula for calculating the mapping position uniformly distributed within 32 positions. In case n ≤ 16, the formula is as follows :

$$\text{i-th symbol position} \quad P_i = \{\frac{32}{n} \times (i+1)\} - 1 \qquad (1)$$

,where {t} = r iff r – 0.5 ≤ t < r + 0.5, r is an integer, i = 0,…,n–1.

Then, when we decide the mapping position of the n coded symbols of the field with the smaller size by using the above formula, that of the coded symbol with larger size is all other. The formula for this is as follows :

i-th symbol position $P_i = i + \left\lfloor \frac{n}{32-n} \times (i + \frac{1}{2}) \right\rfloor$ (2)

,where $\lfloor t \rfloor$ is the greatest integer less than or equal to t and i = 0,…, 32 – n – 1.

As an example, in 2 : 8 case. 7 mapping positions for TFCIDCH are 4, 8, 13, 17, 22, 26, 31 according to the equation (1). In the other hand, mapping position for TFCIDSCH are the others, say, 0, 1, 2, 3, 5, 6, 7, 9, 10, 11, 12, 14, 15, 16, 18, 19, 20, 21, 23, 24, 25, 27, 28, 29, 30 according to the equation (2).

We define d*,i as a output coded symbol after puncturing. Then, the mapping rule into the transmitted TFCI coded symbols is

(3) $$b_{i + \left\lfloor \frac{n}{32-n} \times (i + \frac{1}{2}) \right\rfloor} = d_{1,i}$$ i = 0,1,…, 32 – n – 1,

and

(4) $$b_{\{\frac{32}{n} \times (i+1)\} - 1} = d_{2,i}$$, i = 0,1,…, n – 1.

Actually, this formula is the generalized form of 5:5 case, which is in the current specification. For this, substituting n for 16,

$$\left\{ \frac{32}{n} \times (i+1) \right\} - 1 = \left\{ 2 \times (i+1) \right\} - 1 = 2i + 1,$$

and

$$i + \left\lfloor \frac{n}{32-n} \times (i + \frac{1}{2}) \right\rfloor = i + \left\lfloor i + \frac{1}{2} \right\rfloor = 2i$$

Therefore, equation (3) and (4) are the same as 5:5 case in the current specification.

4.4 Specification Impact and associated Change Request

4.4.1 WG1

========= Start of change in TS 25.212 ====================================

4.3.4 Operation of TFCI in Flexible Hard Split Mode~~Operation of Transport-Format-Combination Indicator (TFCI) in Split Mode~~

~~If one of the DCH is associated with a DSCH, the TFCI code word may be split in such a way that the co de word relevant for TFCI activity indication is not transmitted from every c e l l. The use of such a functionality shall be indicated by higher layer signalling.~~

~~The TFCI is encoded using a (16, 5) bi-orthogonal (or first order Reed-Muller) code. The coding procedure is as shown in figure 10.~~

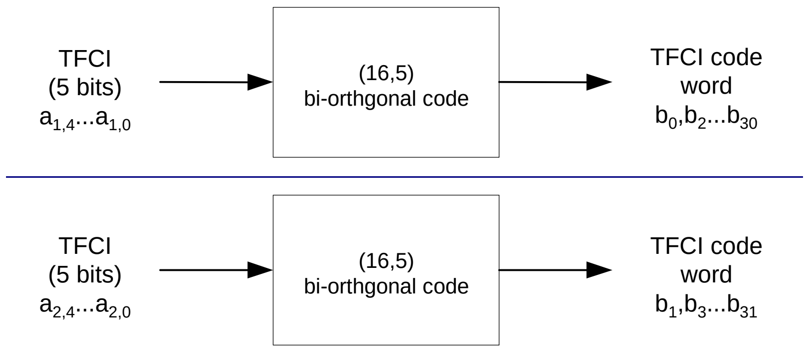


Figure 10: Channel coding of split mode TFCI information bits

The code words of the (16,5) bi-orthogonal code are linear combinations of 5 basis sequences as defined in table 9.

Table 9: Basis sequences for (16,5) TFCI code

i	$M_{i,0}$	$M_{i,1}$	$M_{i,2}$	$M_{i,3}$	$M_{i,4}$
0	1	0	0	0	1
1	0	1	0	0	1
2	1	1	0	0	1
3	0	0	1	0	1
4	1	0	1	0	1
5	0	1	1	0	1
6	1	1	1	0	1
7	0	0	0	1	1
8	1	0	0	1	1
9	0	1	0	1	1
10	1	1	0	1	1
11	0	0	1	1	1
12	1	0	1	1	1
13	0	1	1	1	1
14	1	1	1	1	1
15	0	0	0	0	1

The first set of TFCI information bits ($a_{1,0}$, $a_{1,1}$, $a_{1,2}$, $a_{1,3}$, $a_{1,4}$ where $a_{1,0}$ is LSB and $a_{1,4}$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the DCH CCTrCH in the associated DPCH radio frame.

The second set of TFCI information bits ($a_{2,0}$, $a_{2,1}$, $a_{2,2}$, $a_{2,3}$, $a_{2,4}$ where $a_{2,0}$ is LSB and $a_{2,4}$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the associated DSCH CCTrCH in the corresponding PDSCH radio frame.

The output code word bits b_k 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.

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

If one of the DCH is associated with a DSCH, the TFCI code word may be split in such a way that the code word relevant for TFCI activity indication is not transmitted from every cell. The use of such a functionality shall be indicated by higher layer signalling.

The TFCI is encoded by using punctured code of (32,10) sub-code of second order Reed-Muller code. The coding procedure is as shown in figure 11.

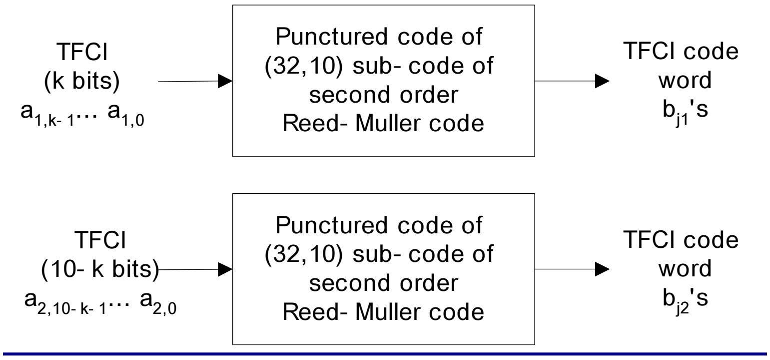


Figure 11: Channel coding of flexible hard split mode TFCI information bits

The code words of the punctured code of (32,10) sub-code of second order Reed-Muller code are linear combinations of basis sequences generated by puncturing 10 basis sequences defined in table 8 in section 4.3.3.

The first set of TFCI information bits ($a_{1,0}$, $a_{1,1}$, $a_{1,2}$, $a_{1,3}$, …, $a_{1,k-1}$ where $a_{1,0}$ is LSB and $a_{1,k-1}$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the DCH CCTrCH in the associated DPCH radio frame.

The second set of TFCI information bits ($a_{2,0}$, $a_{2,1}$, $a_{2,2}$, $a_{2,3}$, .., $a_{2,10-k-1}$ where $a_{2,0}$ is LSB and $a_{2,10-k-1}$ is MSB) shall correspond to the TFC index (expressed in unsigned binary form) defined by the RRC layer to reference the TFC of the associated DSCH CCTrCH in the corresponding PDSCH radio frame.

The output code word bits are given by :

$$b_{j1} = \sum_{n=0}^{k-1} (a_{1,n} \times M_{\pi_1(k,i_1),\pi_2(k,n)}) \bmod 2 ; \qquad b_{j2} = \sum_{n=0}^{10-k-1} (a_{2,n} \times M_{\pi_1(10-k,i_2),\pi_2(10-k,n)}) \bmod 2$$

where $i_1 = 0, \ldots, 3k$ and $i_2 = 0, \ldots, 30-3k$. Define t = 3k+1. Then, the relation between j1 (or j2) and i1 (or i2) is as follows:

- If $t \le 16$,

$$j1 = \left\{ \frac{32}{t} \times (i_1 + 1) \right\} - 1 ; \qquad j2 = \left\lfloor \frac{t}{32-t} \times (i_2 + \frac{1}{2}) \right\rfloor$$

, where $\{s\} = m$ if $m - \frac{1}{2} \le s < m + \frac{1}{2}$ and m is an integer.

- If $t > 16$,

$$j1 = \left\lfloor \frac{t}{32-t} \times (i_1 + \frac{1}{2}) \right\rfloor ; \qquad j2 = \left\{ \frac{32}{t} \times (i_2 + 1) \right\} - 1 .$$

The functions π_1, π_2 are defined as shown in the following table 10.

Table 10. π_1, π_2 functions

k	$\pi_1(k,i)$ for i = 0, …, 3k	$\pi_2(k,n)$ for n = 0,…, k-1
1	0, 2, 4, 6	0
2	0, 1, 2, 4, 5, 6, 8	0, 1
3	0, 1, 2, 3, 4, 5, 6, 8, 9, 11	0, 1, 2
4	3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15	0, 1, 2, 3
5	0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 30	0, 1, 2, 3, 5
6	0, 1, 2, 3, 4, 5, 7, 8, 9, 12, 15, 18, 21, 23, 25, 27, 28, 29, 30	0, 1, 2, 3, 4, 5
7	0, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 15, 17, 20, 21, 22, 24, 25, 28, 29	0, 1, 2, 3, 4, 6, 7
8	0, 1, 2, 3, 5, 6, 7, 8, 9, 10, 12, 13, 16, 17, 18, 19, 23, 24, 25, 26, 27, 28, 29, 30, 31	0, 1, 2, 3, 4, 5, 6, 7
9	0, 1, 2, 3, 4, 5, 7, 8, 9, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 31	0, 1, 2, 3, 4, 5, 6, 7, 8

========= End of change in TS 25.212 ======================================

4.4.2 WG2

To support the work task “TFCI coding in DSCH hard split mode”, following two requirements shall be fulfilled.

1) UE shall have a method to inform UTRAN whether or not it supports the enhanced TFCI coding in DSCH hard split mode.

2) UTRAN shall have a method to inform UE of the length of TFCI (field1) or TFCI (field2).

The first requirement can be satisfied if a new IE, which represents whether UE supports enhanced TFCI coding in DSCH hard split mode or not, is added in UE CAPABILITY INFORMATION message.

Regarding the second requirement, UTRAN can inform UE of TFCI (field2) length by IE “Length of TFCI(field2)” which is already included in “Transport Format Combination Set”. In current specification, however, the IE “Length of TFCI(field2)” is required only if the logical split mode is applied. So only what we need is to make the IE “Length of TFCI(field2)” available even if the hard split mode is applied by removing the restriction that both TFCI (field1) and TFCI (field2) have a static length of five bits.

4.4.3 WG3

4.4.3.1 Study Areas

4.4.3.1.1 Impact on NBAP messages

Currently, on Iub interface, it is assumed that the TFCI bit for DCH and DSCH in hard split mode have 5 bit/5 bit length. TFCI signalling mode that contains TFCI split information is included in following NBAP messages for DSCH split mode setting.

- RADIO LINK SETUP REQUEST
- RADIO LINK RECONFIGURATION PREPARE
- RADIO LINK RECONFIGURATION REQUEST

The information for TFCI signalling mode described in NBAP message as follows:

========= TS 25.433 ==

9.2.2.50 TFCI signalling mode

This parameter indicates if the normal or split mode is used for the TFCI. In the event that the split mode is to be used then the IE indicates whether the split is 'Hard' or 'Logical', and in the event that the split is 'Logical' the IE indicates the number of bits in TFCI (field 2).

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TFCI signalling option	M		ENUMERATED (Normal, Split)	'Normal' : meaning no split in the TFCI field (either 'Logical' or 'Hard') 'Split' : meaning there is a split in the TFCI field (either 'Logical' or 'Hard')
Split type	C-IfSplit		Enumerated (Hard, Logical)	'Hard' : meaning that TFCI (field 1) and TFCI (field 2) are each 5 bits long and each field is block coded separately. 'Logical' : meaning that on the physical layer TFCI (field 1) and TFCI (field 2) are concatenated, field 1 taking the most significant bits and field 2 taking the least significant bits). The whole is then encoded with a single block code.
Length of TFCI2	C-SplitType		Integer (1..10)	This IE indicates the length measured in number of bits of TFCI (field2).

==

First Solution:

To support variable TFCI bit length in the case of hard split mode, the TFCI length information should be sent to Node B. For the backward compatible change, a new optional IE (see below) can be added in the above NBAP messages with a criticality for supporting variable TFCI bit length in DSCH hard split mode.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Length of TFCI2 for Hard Split	O	1	Integer (1..10)	This IE indicates the length measured in number of bits of TFCI (field2).	YES	reject

Second solution:

Since The *Length of TFCI2* IE is conditional, the IE present only when split type is Logical. To support variable TFCI bit length in the case of hard split mode, the TFCI length information (e.g., *Length of TFCI2* IE) should be sent to Node B for the case of hard split mode. It should be noted that the change of the NBAP message should be backward compatible.

Length of TFCI2 IE in the existing messages can be re-used for hard split with the following modification:

- The explanation of the condition "SplitType" is changed into "The IE shall be present if the Split type IE is set to "Logical" or "Hard" with the Length of TFCI2 only except for 5 bits.

When Split type is equal to Hard and *Length of TFCI2* IE is present, an e.g., Rel99 Node B may not understand the IE and reject the procedure since the DL DPCH Information IE group has criticality "reject".

The following is the modified IE structure in order to reuse *Length of TFCI2* IE for hard split mode.

9.2.2.50 TFCI signalling mode

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TFCI signalling option	M		ENUMERATED (Normal, Split)	'Normal' : meaning no split in the TFCI field (either 'Logical' or 'Hard') 'Split' : meaning there is a split in the TFCI field (either 'Logical' or 'Hard')
Split type	C-IfSplit		Enumerated (Hard, Logical)	'Hard' : meaning that TFCI (field 1) and TFCI (field 2) are ~~each 5 bits long and each field is~~ block coded separately. 'Logical' : meaning that on the physical layer TFCI (field 1) and TFCI (field 2) are concatenated, field 1 taking the most significant bits and field 2 taking the least significant bits). The whole is then encoded with a single block code.
Length of TFCI2	C-SplitType		Integer (1..10)	This IE indicates the length measured in number of bits of TFCI (field2). If the IE is absent, the Length of TFCI2 is equal to 5 bits for the case of hard split type.

Condition	Explanation
IfSplit	The IE shall be present if the *TFCI signalling option* IE is set to "Split".
SplitType	The IE shall be present if the *Split type* IE is set to "Logical" or "Hard" with the Length of TFCI2 only except for 5 bits.

Open issue:

- Conditional statements in tabular should only depend on information present in the message. Therefore the currently specified condition in NBAP is not valid.

- One solution (other solutions invited) could be to indicate the *TFCI2 length* IE optional in the tabular, and move the condition description to procedure text. Care should be taken that the specification specifies the behavior of the receiver. E.g.:
- in successful operation, if the IE is not present, the TFCI2 = 5 bits;
- in addition, include an abnormal condition when a length of 5 is explicitly signaled in case of a hard split

4.4.3.1.2 Impact on RNSAP messages

Currently, on Iur interface, hard split mode is assumed that the TFCI bit for DCH and DSCH have 5 bit/5 bit length. TFCI signalling mode that contains TFCI split information is included in following RNSAP messages for DSCH split mode setting.

- RADIO LINK SETUP REQUEST
- RADIO LINK RECONFIGURATION PREPARE
- RADIO LINK RECONFIGURATION REQUEST

Since logical split mode information does not need to be transmitted to DRNC, the information for TFCI signalling mode described in NBAP message contains only the information on TFCI Signalling mode for hard split as follows:

========== TS 25.423 ==

9.2.2.46 TFCI Signalling Mode

This parameter indicates if the normal or split mode is used for the TFCI.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
TFCI Signalling Mode			ENUMERATED (Normal, Split)	

==

In the above message, if the TFCI Signalling Mode is set to be "Split" then it means hard split mode used. To support variable TFCI bits for hard split, the TFCI bit length information should be signalled to DRNC using the above RNSAP messages. For the backward compatible change, a new optional IE can be added in the above RNSAP messages with a criticality for supporting variable TFCI bit length in DSCH hard split mode.

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Length of TFCI2 for Hard Split	O		Integer (1..10)	This IE indicates the length measured in number of bits of TFCI (field2).	YES	reject

Before SRNC sets up a Radio Link in a target cell controlled by other RNC, SRNC should know if the target cell supports flexible hard split mode. In order for SRNC to get the information, DRNC can transmit the information using UPLINK SIGNALLING TRANSFER INDICATION message and *Neighbouring FDD Cell Information* IE in RADIO LINK SETUP/ADDITION RESPONSE/FAILURE message.

Flexible Hard Split Support Indicator IE can be transmitted by the following messages

- RADIO LINK SETUP RESPONSE
- RADIO LINK SETUP FAILURE
- RADIO LINK ADDITION RESPONSE
- RADIO LINK ADDITION FAILURE
- UPLINK SIGNALLING TRANSFER INDICATION

9.2.2.x Flexible Hard Split Support Indicator

The Flexible Hard Split Support Indicator indicates whether the particular cell is capable to support Flexible Hard Split or not

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Flexible Hard Split Support Indicator			ENUMERATED (Flexible Hard Split Supported, Flexible Hard Split not Supported).	

4.4.3.1.3 Impact on User Plane

There is no impact on User Plane to support variable length of TFCI bit for hard split since

Frame protocol already supports variable length of TFCI bit for both logical split and hard split.

4.4.3.2 Agreements and associated contributions

4.4.3.2.1 Impact on TS 25.423

4.4.3.2.1.1 RADIO LINK SETUP REQUEST

FDD Message

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.40		YES	reject
Transaction ID	M		9.2.1.59		–	
SRNC-Id	M		RNC-Id 9.2.1.50		YES	reject
S-RNTI	M		9.2.1.53		YES	reject
D-RNTI	O		9.2.1.24		YES	reject
Allowed Queuing Time	O		9.2.1.2		YES	reject
UL DPCH Information		*1*			YES	reject
>UL Scrambling Code	M		9.2.2.53		–	
>Min UL Channelisation Code Length	M		9.2.2.25		–	
>Max Number of UL DPDCHs	C – CodeLen		9.2.2.24		–	
>Puncture Limit	M		9.2.1.46	For the UL.	–	
>TFCS	M		TFCS for the UL 9.2.1.63		–	
>UL DPCCH Slot Format	M		9.2.2.52		–	
>Uplink SIR Target	O		Uplink SIR 9.2.1.69		–	
>Diversity mode	M		9.2.2.8		–	
>SSDT Cell Identity Length	O		9.2.2.41		–	
>S Field Length	O		9.2.2.36		–	
>DPC Mode	O		9.2.2.12A		YES	reject
DL DPCH Information		*1*			YES	reject
>TFCS	M		TFCS for the DL. 9.2.1.63		–	
>DL DPCH Slot Format	M		9.2.2.9		–	
>Number of DL Channelisation Codes	M		9.2.2.26A		–	
>TFCI Signalling Mode	M		9.2.2.46		–	
>TFCI Presence	C-SlotFormat		9.2.1.55		–	
>Multiplexing Position	M		9.2.2.26		–	
>Power Offset Information		*1*			–	
>>PO1	M		Power Offset 9.2.2.30	Power offset for the TFCI bits.	–	
>>PO2	M		Power Offset 9.2.2.30	Power offset for the TPC bits.	–	
>>PO3	M		Power Offset 9.2.2.30	Power offset for the pilot bits.	–	
>FDD TPC Downlink Step Size	M		9.2.2.16		–	

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
>Limited Power Increase	M		9.2.2.21A		–	
>Inner Loop DL PC Status	M		9.2.2.21a		–	
>Length of TFCI2 for Hard Split	O		9.2.2.x		YES	reject
DCH Information	M		DCH FDD Information 9.2.2.4A		YES	reject
DSCH Information	O		DSCH FDD Information 9.2.2.13A		YES	reject
RL Information		*1…<maxnoofRLs>*			EACH	notify

4.4.3.2.1.2 RADIO LINK RECONFIGURATION PREPARE

FDD Message

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
Message Type	M		9.2.1.40		YES	reject
Transaction ID	M		9.2.1.59		–	
Allowed Queuing Time	O		9.2.1.2		YES	reject
UL DPCH Information		*0..1*			YES	reject
>UL Scrambling Code	O		9.2.2.53		–	
>UL SIR Target	O		Uplink SIR 9.2.1.69		–	
>Min UL Channelisation Code Length	O		9.2.2.25		–	
>Max Number of UL DPDCHs	C – CodeLen		9.2.2.24		–	
>Puncture Limit	O		9.2.1.46	For the UL.	–	
>TFCS	O		9.2.1.63	TFCS for the UL.	–	
>UL DPCCH Slot Format	O		9.2.2.52		–	
>Diversity Mode	O		9.2.2.8		–	
>SSDT Cell Identity Length	O		9.2.2.41		–	
>S-Field Length	O		9.2.2.36		–	
DL DPCH Information		*0..1*			YES	reject
>TFCS	O		9.2.1.63	TFCS for the DL.	–	
>DL DPCH Slot Format	O		9.2.2.9		–	
>Number of DL Channelisation Codes	O		9.2.2.26A		–	
>TFCI Signalling Mode	O		9.2.2.46		–	
>TFCI Presence	C-SlotFormat		9.2.1.55		–	
>Multiplexing Position	O		9.2.2.26		–	

IE/Group Name	Presence	Range	IE Type and Reference	Semantics Description	Criticality	Assigned Criticality
>Limited Power Increase	O		9.2.2.21A		–	
>Length of TFCI2 for Hard Split	O		9.2.2.x		YES	reject
DCHs to Modify	O		FDD DCHs to Modify 9.2.2.13C		YES	reject
DCHs to Add	O		DCH FDD Information 9.2.2.4A		YES	reject
DCHs to Delete		*0..<maxnoofDCHs>*			GLOBAL	reject

4.4.3.2.1.3 UPLINK SIGNALLING TRANSFER INDICATION

FDD Message

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Message Type	M		9.2.1.40		YES	ignore
Transaction ID	M		9.2.1.59		–	
UC-Id	M		9.2.1.71		YES	ignore
SAI	M		9.2.1.52		YES	ignore
Cell GAI	O		9.2.1.5A		YES	ignore
C-RNTI	M		9.2.1.14		YES	ignore
S-RNTI	M		9.2.1.54		YES	ignore
D-RNTI	O		9.2.1.24		YES	ignore
Propagation Delay	M		9.2.2.33		YES	ignore
STTD Support Indicator	M		9.2.2.45		YES	ignore
Closed Loop Mode1 Support Indicator	M		9.2.2.2		YES	ignore
Closed Loop Mode2 Support Indicator	M		9.2.2.3		YES	ignore
L3 Information	M		9.2.1.32		YES	ignore
CN PS Domain Identifier	O		9.2.1.12		YES	ignore
CN CS Domain Identifier	O		9.2.1.11		YES	ignore
URA Information	O		9.2.1.70B		YES	ignore
Cell GA Additional Shapes	O		9.2.1.5B		YES	ignore
Flexible Hard Split Support Indicator	O		9.2.2.x		YES	ignore

4.4.3.2.1.4 (9.2.1.41B) Neighbouring FDD Cell Information

The *Neighbouring FDD Cell Information* IE provides information for FDD cells that are a neighbouring cells to a cell in the DRNC.

IE/Group Name	Presence	Range	IE type and reference	Semantics description	Criticality	Assigned Criticality
Neighbouring FDD Cell Information		*1..<max noofFDD neighbours>*			–	
>C-Id	M		9.2.1.6		–	
>UL UARFCN	M		UARFCN 9.2.1.66	Corresponds to Nu in ref. [6]	–	
>DL UARFCN	M		UARFCN 9.2.1.66	Corresponds to Nd in ref. [6]	–	
>Frame Offset	O		9.2.1.30		–	
>Primary Scrambling Code	M		9.2.1.45		–	
>Primary CPICH Power	O		9.2.1.44		–	
>Cell Individual Offset	O		9.2.1.7		–	
>Tx Diversity Indicator	M		9.2.2.50			
>STTD Support Indicator	O		9.2.2.45		–	
>Closed Loop Mode1 Support Indicator	O		9.2.2.2		–	
>Closed Loop Mode2 Support Indicator	O		9.2.2.3		–	
>Restriction State Indicator	O		9.2.1.48C		YES	ignore
>Flexible Hard Split Support Indicator	O		9.2.2.x		YES	ignore

4.4.3.2.1.5 New Introduced Information Elements

4.4.3.2.1.5.1 Length of TFCI2 for Hard Split

This IE indicates the length measured in number of bits of TFCI (field2).

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Length of TFCI2 for Hard Split			Integer (1..10)	

4.4.3.2.1.5.2 Flexible Hard Split Support Indicator

The Flexible Hard Split Support Indicator indicates whether the particular cell is capable to support Flexible Hard Split or not.

IE/Group Name	Presence	Range	IE type and reference	Semantics description
Flexible Hard Split Support Indicator			ENUMERATED (Flexible Hard Split Supported, Flexible Hard Split not Supported).	

4.4.3.2.2 Impact on TS 25.433

4.4.3.3 Specification Impact and associated Change Request

4.4.3.4 Backward Compatibility

5 TFCI power control in DSCH hard split mode

5.1 Introduction

In Rel99 specification, TFCI2 (TFCI for DSCH) is not transmitted from all the cells in the active set when the UE is in soft handover. Furthermore, the power offset is always set to be high enough to detect TFCI bits reliably even if UE is not in soft handover. In the view of power resource management, it may be inefficient due to high power offset. Therefore, it is needed to study the enhancement for TFCI power control in the DSCH hard split mode

The power offset for TFCI in current specification is not changed so that the power offset in the radio link setup is set to be high enough to detect TFCI bits reliably even if UE is not in soft handover. By the proposed power control scheme, we can improve the TFCI power control in the DSCH hard split mode.

5.2 Requirements

The new TFCI power control adjusts the TFCI power offset. The requirement on the new TFCI power control are summarised as follows.

- The backward compatibility to Release 99/Rel 4 should be guaranteed.
- Hardware increase shall be minimised.
- The proposed scheme shows an acceptable performance.
- Compatibility with other proposed methods.

5.3 Proposed TFCI power control scheme~~Study Areas~~

In this section, the allocation of variable power offset for TFCI is explained. The proposed scheme is to enhance the performance of TFCI2 detection in the DSCH hard split mode, where TFCI2 is denoted as TFCI for DSCH.

5.3.1 TFCI power control in Release 99 and Rel 4

In current specification, the power offset is set regardless of whether UE is in soft handover or not. The power offset for TFCI, PO1, is determined at radio link setup procedure [2] and does not change. In this case, a larger power offset value is required to obtain the correct TFCI bits in soft handover. However, since the power offset is not changed, large power offset is applied to UE even in non-soft handover. This large power offset causes the undesirable power increase in non-soft handover mode and consequently increases the interference level.

5.3.2 Proposed TFCI power control for Rel 5

The proposed TFCI power control adjusts the power offset for TFCI according to radio link configuration and the channel condition. Since there is only one offset (PO1) for TFCI in Release 99/Rel4 [3], the proposed power offset for TFCI should be applied to both TFCI1 and TFCI2 in the DSCH hard split mode and result in different value of PO1 depending on radio link configuration and the channel condition. The power offset for TFCI can be determined by two methods as shown in table 1.

Table 1. Power offset for TFCI in the DSCH hard split mode

	Non-Handover region	Handover region	
		Primary	Non-primary
Release 99/R4	PO1		
Method 1	$PO1_{nh}$	$PO1_{h}$	
Method 2	$PO1_{nh}$	$PO1_{h-p}$	$PO1_{h-np}$

where PO1 represents power offset for TFCI, $PO1_{nh}$ power offset for TFCI in non-soft handover, $PO1_{h}$ power offset for TFCI in soft handover, and $PO1_{h-p}$ and $PO1_{h-np}$ power offset for TFCI transmitted from primary cell and non-primary cell in soft handover, respectively.

For method 1, the power offset is determined by whether UE is in soft handover or not. If the UE moves from non-handover to handover region, the power offset for TFCI is changed to $PO1_{h}$ by high layer signalling. As well, the different power offset for TFCI, $PO1_{h}$, can be set by RNC according to the number of radio links.

For method 2, it is the same case with the method 1 in the point that the power offset is determined by whether UE is in soft handover or not. Additionally, the power offset is determined by whether the cell transmitting the TFCI2 is primary cell or not. The condition of primary or non-primary is determined using SSDT signalling that is activated in uplink only for DSCH power control. Note that the SSDT uplink only signalling for DSCH power control is activated in the method 2 in a similar way to enhanced DSCH power control in Rel 4 [4]. When the cell that transmits TFCI2 is primary, the power offset for TFCI field is $PO1_{h-p}$. Otherwise, the power offset $PO1_{h-np}$ is applied.

Figure 1 shows the proposed TFCI power control . One or two power offsets are signalled by RNC to Node B when the radio link configuration is changed.

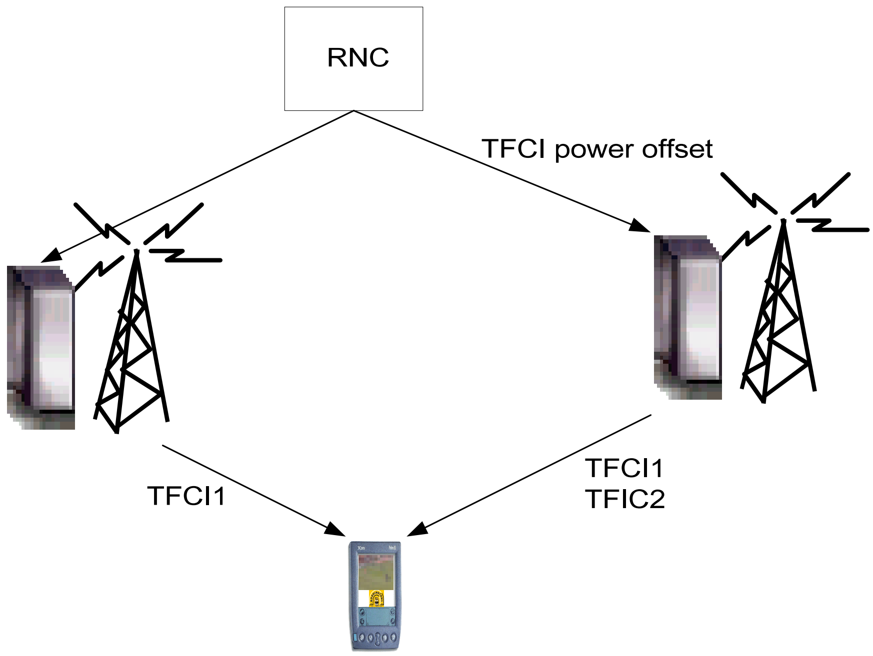


Figure 1. TFCI Power control in soft handover.

5.3.3 Considerations on the required power offset

The required power offset of various radio link configuration is obtained by simulations. The simulation assumptions are shown in table 2.

Table 2. Simulation assumptions.

Fading channel	Flat Rayleigh
Mobile speed	3 Km/h
Active set in soft handover	2 or 3
Received power from cells in active set	Equal
TFCI coding for DSCH	Same as in Release 99
Power control	Perfect

In table 3, the required power offset to achieve a word error rate (WER) of 1 % when all the cells transmit TFCI2 is shown. In table 3, 3-way(1 cell) and 3-way(2 cells) mean that 1 and 2 cells transmit TFCI2 in 3-way handover, respectively. From this table, when power offset for TFCI2 is set adaptively to the radio link condition, reliable and power efficient transmission of TFCI2 can be guaranteed. Therefore, the power offset for TFCI is determined by following conditions:

- The number of cells in the active set
- The number of cells in the active set that transmit TFCI2

Table 3. Required power offset for TFCI2.

Handover case	Method 1	Method 2	
	PO1	$PO1_{h-p}$	$PO1_{h-np}$
2-way	16.5 dB	1.6 dB	16.5 dB
3-way(1 cell)	18.5 dB	1.5 dB	18.5 dB
3-way(2 cells)	7 .2 dB	1.7 dB	7. 2 dB

5.3.3 Complexity

There is no increase in hardware complexity. To support the proposed scheme, a higher layer signalling from RNC to Node B is required. The power offset should be determined and signalled by higher layer when radio link configuration is changed.

~~5.4 Agreements and associated contributions~~

5.~~5~~4 Specification Impact and associated Change Request

WG3

5.4.1 Study Areas

5.4.1.1 TFCI power control in Release 99 and Rel 4

In the current specification, the power offset is set regardless of whether UE is in soft handover or not. The power offset for TFCI, PO1, is determined at radio link setup procedure and does not change. In this case, a larger power offset value is required to obtain the correct TFCI bits in soft handover. However, since the power offset is not changed, large power offset is applied to UE even in non-soft handover. This large power offset causes the undesirable power increase in non-soft handover mode and consequently increases the interference level.

5.4.1.2 Proposed TFCI power control methods for Rel 5

The proposed TFCI power control adjusts the power offset for TFCI according to radio link configuration and the channel condition. Since there is only one offset (PO1) for TFCI in Release 99/Rel4, the proposed power offset for TFCI should be applied to the DPCCHs which send both TFCI1 and TFCI2 in the DSCH hard split mode and result in different value of TFCI power offset depending on radio link configuration and the channel condition. The power offset value for TFCI can be determined by setting the power offset parameters in two methods of table 1.

Table 1. Power offset parameters for TFCI in the DSCH hard split mode

<table>
<tr><td rowspan="3"></td><td rowspan="3">Non-Handover region</td><td colspan="3">Handover region</td></tr>
<tr><td colspan="2">Cell sending the DSCH</td><td rowspan="2">Cell(s) not sending the DSCH</td></tr>
<tr><td>Primary</td><td>Non-primary</td></tr>
<tr><td>Release 99/Rel 4</td><td colspan="4">PO1</td></tr>
<tr><td>Method 1 (Rel 5)</td><td>PO1</td><td colspan="3">TFCI PO</td></tr>
<tr><td>Method 2 (Rel 5)</td><td>PO1</td><td>TFCI PO_primary</td><td>TFCI PO</td><td>TFCI PO</td></tr>
</table>

PO1 represents power offset for TFCI in Release 99. As well, this can indicate power offset for TFCI in non-soft handover in Rel 5. TFCI PO defines power offset for TFCI in soft handover in Method 1. In Method 2, this power offset is used for TFCI from cell(s) not sending the DSCH in handover region or the cell sending the DSCH when the cell is non-primary. TFCI PO_primary represents power offset for TFCI in the cell sending the DSCH when cell is decided to be primary in handover region. Note that these new power offset values are applied to only cells transmitting TFCI2. Power offset values for cells transmitting TFCI1 only are set by procedure defined in Release 99 or Rel 4.

For Method 1, the power offset is determined by whether UE is in soft handover or not. If the UE moves from non-handover to handover region, the power offset for TFCI is changed to TFCI PO by high layer signalling. For Method 2, it is the same case with the Method 1 in the point that the power offset is determined by whether UE is in soft handover or not. Additionally, the power offset is determined by whether the cell transmitting the DSCH is primary cell or not. The condition of primary or non-primary is determined using SSDT signalling that is activated in uplink only for DSCH power control. Note that the SSDT uplink only signalling for DSCH power control is activated in the Method 2 in a similar way to enhanced DSCH power control in Rel 4. When the cell that transmits DSCH is primary, the power offset for TFCI field (TFCI PO_primary) is set on appropriate value for primary cell. Otherwise, the cell that transmits DSCH uses the power offset TFCI PO. The power offset TFCI PO is assigned to the other cells transmitting TFCI2.

Figure 1 and Figure 2 show the example cases of the proposed TFCI power control in Method 1 and Method 2 respectively. One or two power offset(s) is signalled by RNC to Node B when the radio link configuration is changed.

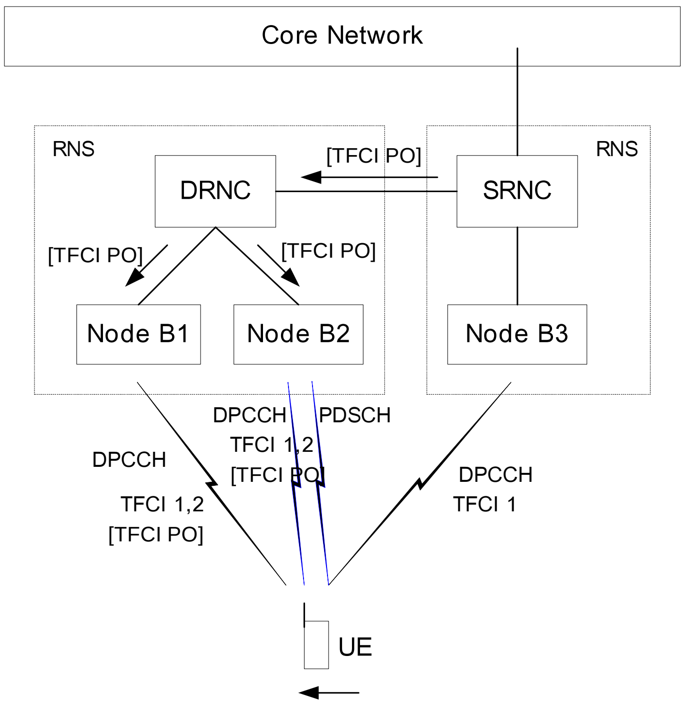


Figure 1. TFCI Power control Method 1 in soft handover.

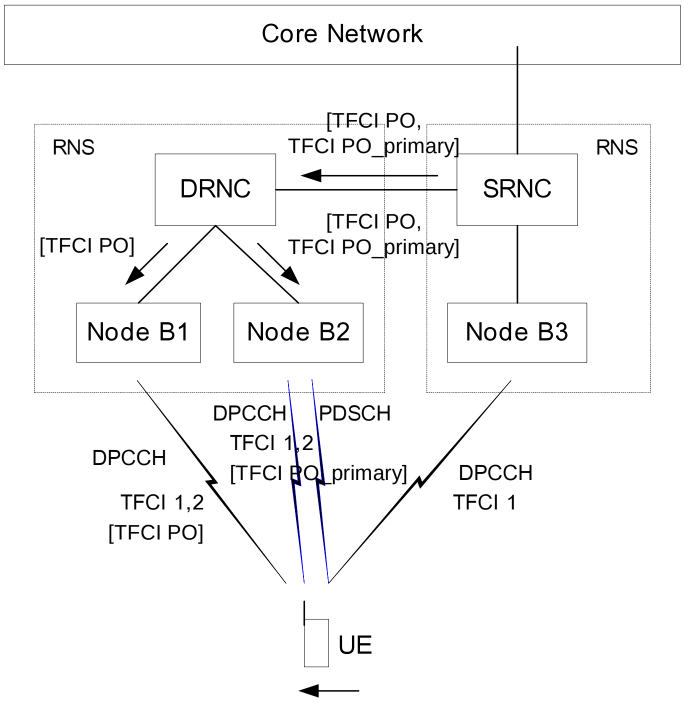


Figure 2. TFCI Power control Method 2 in soft handover.

5.4.1.3 New Information

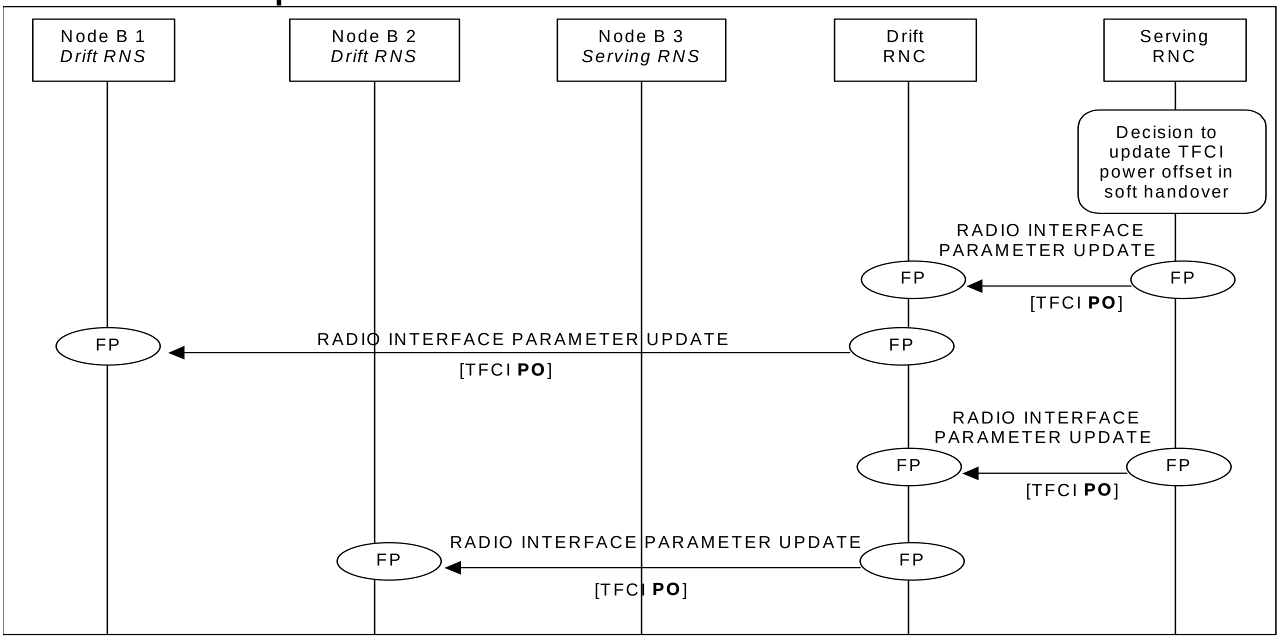
The parameters to be needed for supporting TFCI power control in the DSCH hard split mode are as followings:

1) for TFCI power control method 1 : TFCI PO
2) for TFCI power control method 2 : TFCI PO, TFCI PO_primary

For the method 2, the parameters for the primary/secondary status determination from SSDT commands in the uplink FBI (Feedback Information) field would be shared with DSCH Power Control Improvement. When the improved DSCH PC is activated, the TFCI power control method 2 is also activated.

5.4.1.4 Example Scenario

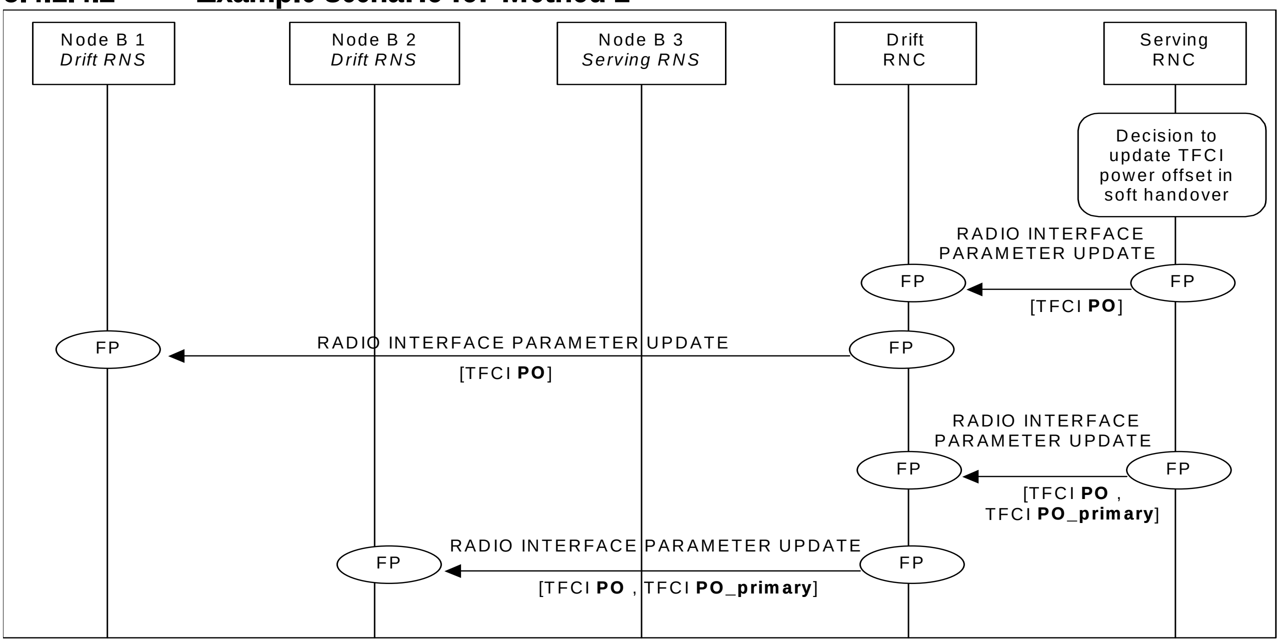
5.4.1.4.1 Example Scenario for Method 1



This signalling procedure is for figure 1, and shows how the new power offset is applied.

When associated DCHs are in soft handover, SRNC decides to update TFCI power offset value. SRNC sends RADIO INTERFACE PARAMETER UPDATE control frame to all Node Bs which transmit TFCI2 field for the concerning UE. In RADIO INTERFACE PARAMETER UPDATE control frame, SRNC will provide necessary parameter[TFCI PO].

5.4.1.4.2 Example Scenario for Method 2



This signalling procedure is for figure 2, and shows how the new power offsets are applied.

When enhanced DSCH power control is activated and associated DCHs are in soft handover, SRNC decides to update TFCI power offset value. SRNC sends RADIO INTERFACE PARAMETER UPDATE control frame to all Node Bs which transmit TFCI2 field for the concerning UE. In RADIO INTERFACE PARAMETER UPDATE control frame, SRNC will provide necessary parameters[TFCI PO, TFCI PO_primary].

5.4.1.4.3 Open issues

Open issue 1: is it required to sent the actual offsets in the userplane, or could they be signalled in CP and activated by the UP ?

Open issue 2: does the application of the power offset in handover states require that synchronised activation between UE and UTRAN is applied ?

5.4.2 Agreements and associated contributions

5.4.3 Specification Impact and associated Change Request

5.4.4 Backward Compatibility

5.~~6~~5 Backward Compatibility

Appendix (Informative)

- **IFHT Algorithm for supporting the variable length**

When the number of information bits is less than 6 (k < 6), there are some alternatives to decode the received data efficiently. In fact, it doesn't matter if we do not use the following structure for decoding. The following structure only provides an example of efficient decoding scheme.

When the number of information bits < 6, only the first IFHT is performed. But, this structure is so loose in terms of the number of operation because the first IFHT with 32x32 size is always fully performed for each k < 6 case. Actually, it is desirable to use IFHT with size $2^k x 2^k$ for each k. That is, it is desirable to use IFHT with the variable size. Therefore, the variable IFHT can be used as shown in Fig A1.

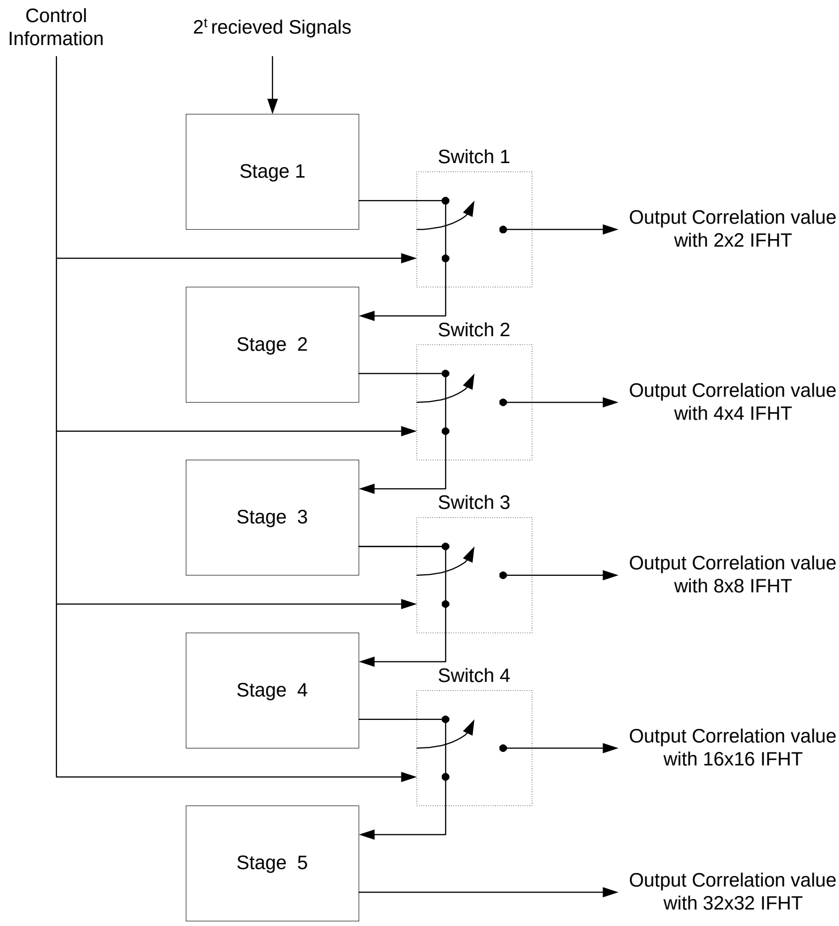


Fig A1. Variable IFHT Structure

Fig. A1 describes the overall structure of the variable IFHT. Generally, 2^kx2^k IFHT performance consists of k stages. For example, 32x32 IFHT consists of 5 stages. Hence, by using this property, the size of IFHT can be varied adaptively. That is, if 2 stages out of 5 stages are performed, then 4x4 IFHT is effectively calculated, and if 3 stages out of 5 stages are performed, then 8x8 IFHT is effectively calculated, and so on. This is called “Nested Property”. Fig A.1 is a well-designed structure based on this “Nested Property”. But this structure requires some new circuits in each stage, instead of the well-known “Butterfly Logic”, because “Butterfly Logic” is not suited for “Nested Property”. The new circuit suited for “Nested Property” is as shown in Fig A.2.

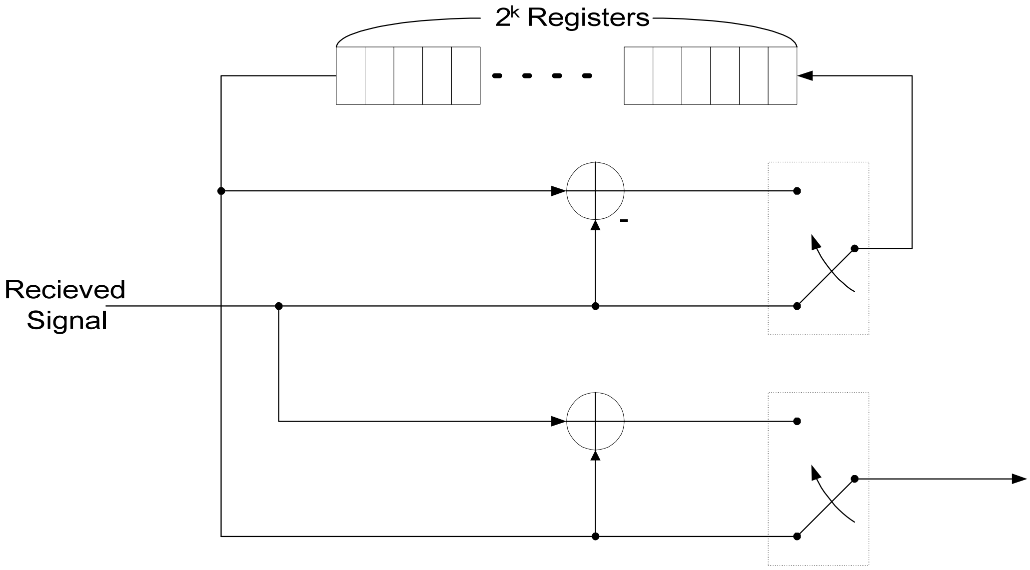


Fig A2. Circuit of Stage

■ Implementation of mapping rule

In this section, we describe the method to implement the mapping rule. Actually, instead of the formula, it may be very useful to use a mask for presenting the transmission position that is calculated according to the position calculation method described above. That is, we define as follows:

- "0" means that the coded symbol of TFCI for DSCH is holding, not transmitted, and that of TFCI for DCH is transmitted.
- "1" means that the coded symbol of TFCI for DCH is holding, not transmitted, and that of TFCI for DSCH is transmitted.

By using such presentation, mask patterns for all case are as shown in the following table A1.

$TFCI_{DCH}$: $TFCI_{DSCH}$	Mask for mapping position
1 : 9	000000010000000100000000100000001
2 : 8	000010001000010001000010001000100001
3 : 7	001001000100100100100100010010001001
4 : 6	010010100101001010010100101001001010
5 : 5	010101010101010101010101010101
6 : 4	101101011010110101101011010110
7 : 3	110110111011011011011011101101101
8 : 2	111101110111110111011111011101110
9 : 1	111111101111111110111111110111111110

Table A1. Masks for mapping position

We see an example to transmit the coded symbol. Before this, we define the i-th output coded symbol after puncturing for DCH as $d_{1,i}$ and the k-th outputted coded symbol after puncturing for DSCH as $d_{2,k}$.
In 3 : 7 case, the first bit in mask for mapping rule is 0. Hence, the first coded symbol $d_{2,0}$ of TFCI for DSCH is holding, not transmitted, and the coded symbol $d_{1,0}$ of TFCI for DCH is transmitted. The second bit in mask for mapping rule is 0. Hence, the first coded symbol $d_{2,0}$ of TFCI for DSCH which is not transmitted is holding again, not transmitted, and the coded symbol $d_{1,1}$ of TFCI for DCH is transmitted. The third bit in mask for mapping rule is 1. Hence, the coded symbol $d_{1,2}$ of TFCI for DCH is held, not transmitted, and the coded symbol $d_{2,0}$ of TFCI for DSCH is transmitted. And so on.
According to this operation, the output symbol after symbol mapping is as following Fig A3.

$d_{1,0}$	$d_{1,1}$	$d_{2,0}$	$d_{1,2}$	$d_{1,3}$	$d_{2,1}$	$d_{1,4}$	$d_{1,5}$	$d_{2,2}$	$d_{1,6}$	$d_{1,7}$	$d_{2,3}$	$d_{1,8}$	$d_{1,9}$	$d_{1,10}$	$d_{2,4}$
$d_{1,11}$	$d_{1,12}$	$d_{2,5}$	$d_{1,13}$	$d_{1,14}$	$d_{2,6}$	$d_{1,15}$	$d_{1,16}$	$d_{2,7}$	$d_{1,17}$	$d_{1,18}$	$d_{2,8}$	$d_{1,19}$	$d_{1,20}$	$d_{1,21}$	$d_{2,9}$

Fig A3. Example of mapping rule in 3 : 7 case

6 Project Plan

6.1 Schedule

Date	Meeting	Scope	[expected] Input	[expected]Output
2001.09	RAN #13	TR submission		TR V1.0.0
2001.12	RAN #14	TR submission		TR V2.0.0
2002.03	RAN #15	TR and CR submission		TR V5.0.0 and CR

6.2 Work Task Status

	Planned Date	Milestone	Status

7 History

Document history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
2001.8	RAN 1 #21	R1-01-0886			The requirement section 4.2 is filled	0.1.0	0.2.0
2001.8	RAN 1 #21	R1-01-0963			The Proposed TFCI Coding scheme and mapping rule are included.	0.2.0	0.3.0
2001.9	RAN #13	RP-01-0534			RAN submission	0.3.0	1.0.0
2001.11	RAN1 #22	R1-01-1173			Addition of TFCI power control section (with revision mark)	1.0.0	1.0.1
2001.11	RAN1 #22	R1-01-1329			Addition of Impact on WG1	1.0.1	1.1.0
Rapporteur for 3GPP RAN TR 25.870 is:							
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