TSG-RAN Working Group1 meeting #20 TSGR1#20(01)0516

**Busan, Korea, May 21st – 25th 2001**

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| **Agenda Item** | : | **5** |
| **Source** | : | **Nortel Networks** |
| **Title** | : | **Clarifications on PDSCH definitions and timing** |
| **Document for** | : | **Discussion and approval** |

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## 1. Introduction

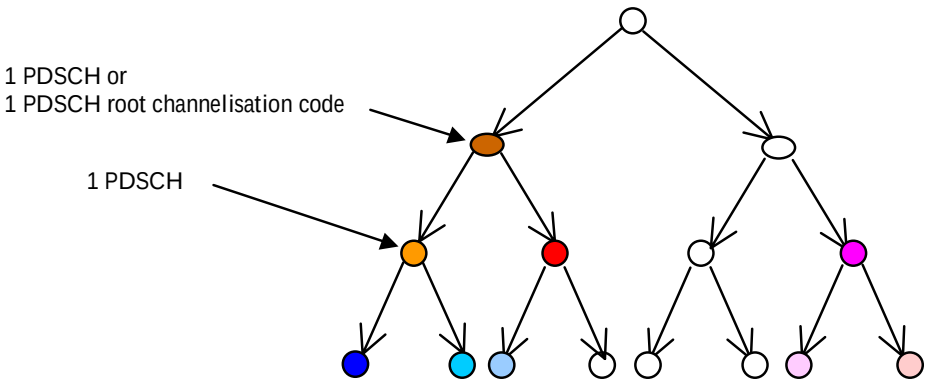
This paper discusses the misalignment of RAN WG1 and RAN WG2 definitions of Physical Downlink Shared Channel. The objective is to highlight the implications of both definitions and come to a clear agreement on how it should be understood. It also highlights some inconsistencies within 25.211 on timing issues related to PDSCH.

## 2. Definition of Physical Downlink Shared Channel

### 2.1. Physical Layer Definition of PDSCH

In [1], the following definition can be found : "A PDSCH corresponds to a channelisation below or at a PDSCH root channelisation code. A PDSCH is allocated on a radio frame basis to a single UE. Within one radio frame, UTRAN may allocate, different PDSCH under the same PDSCH root channelisation code to different UEs based on code multiplexing. Within the same radio frame, multiple parallel PDSCHs, with the same spreading factor may be allocated to a single UE. This is a special case of multi-code transmission".

In addition to the fact that the concept of "PDSCH root channelisation code" is not defined in the specifications, the third sentence seem to imply that during a radio frame, the UTRAN can only allocate codes which are part of the same sub-tree to different UEs as illustrated on the figure below.




This does not preclude the possible configuration by the UTRAN of several sub-trees however for a given radio frame it is not possible to do code multiplexing for different UEs if their associated PDSCH channelisation codes are part of different sub-trees unless a clarification is added in the specifications.

It is not very clear from the physical layer point-of view why such restrictions would be set on the use of the channelisation codes by the UTRAN. If the UE is capable of receiving the DSCH, it should be able to receive it on any code irrespective of the channelisation code used for other users. The UE cannot use the knowledge of this information to perform some sort of pre-despreading because there can be several sub-tree used for DSCH mapping and nothing prevents the UTRAN to switch from one to another from one radio frame to the next. This only sets some limitations on the use of the code tree and forces the code allocation within the UTRAN.

It does not seem necessary to maintain such a limitation unless the concept of PDSCH root channelisation code is more clearly defined in [1] and its purpose clarified.

In any case the following section presents the possible configuration of the mapping between TFCI(field2) values and PDSCH channelisation codes and highlights why it seems in conflict with the physical layer specifications.

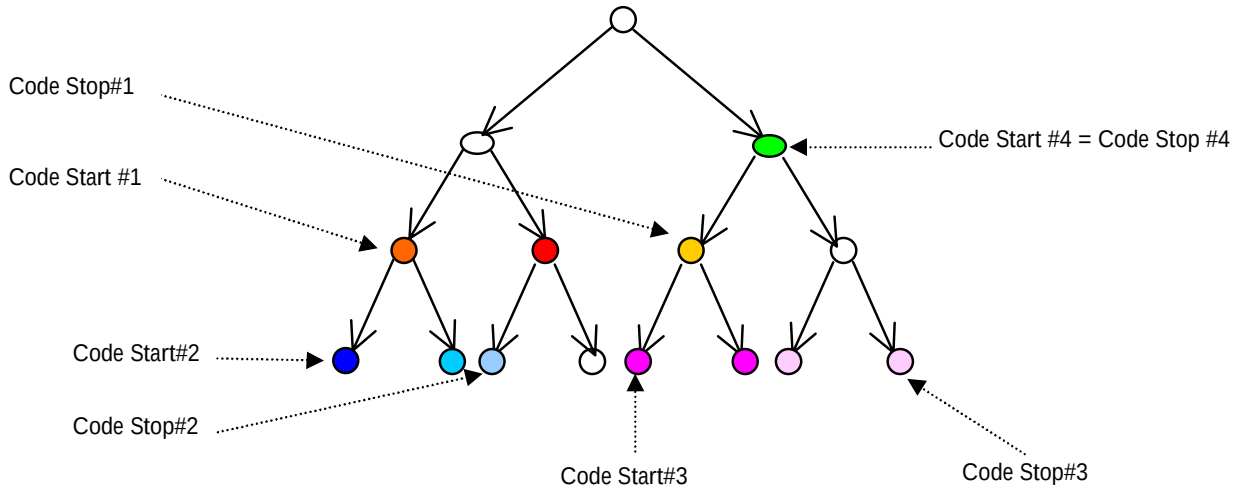
## 2.2. RRC configuration of Physical Downlink Shared Channels

The configuration of DSCH/PDSCH uses a two-step approach. First the relationship between transport format combinations on the DSCH and TFCI(field2) values is defined. TFCI(field2) is the part of the TFCI word (before coding) which corresponds to the DSCH. Then the mapping between TFCI(field2) values and PDSCH channelisation codes is defined in a separate information element. However this is done on a per UE basis so there cannot be a notion of PDSCH root channelisation code (valid for all UEs) since the DSCH is not managed as a common channel but as a dedicated channel, and the UE has no knowledge of this other channelisation codes used for to map the DSCH for other UEs.

This two-step approach allows to have some flexibility in the code allocation for the DSCH allowing for instance to map the same transport format combination on different codes of the OVSF code. Details are provided in the following paragraphs explaining the possible signalling method for the mapping between TFCI(field2) values and PDSCH codes

### *2.2.1. Code range*

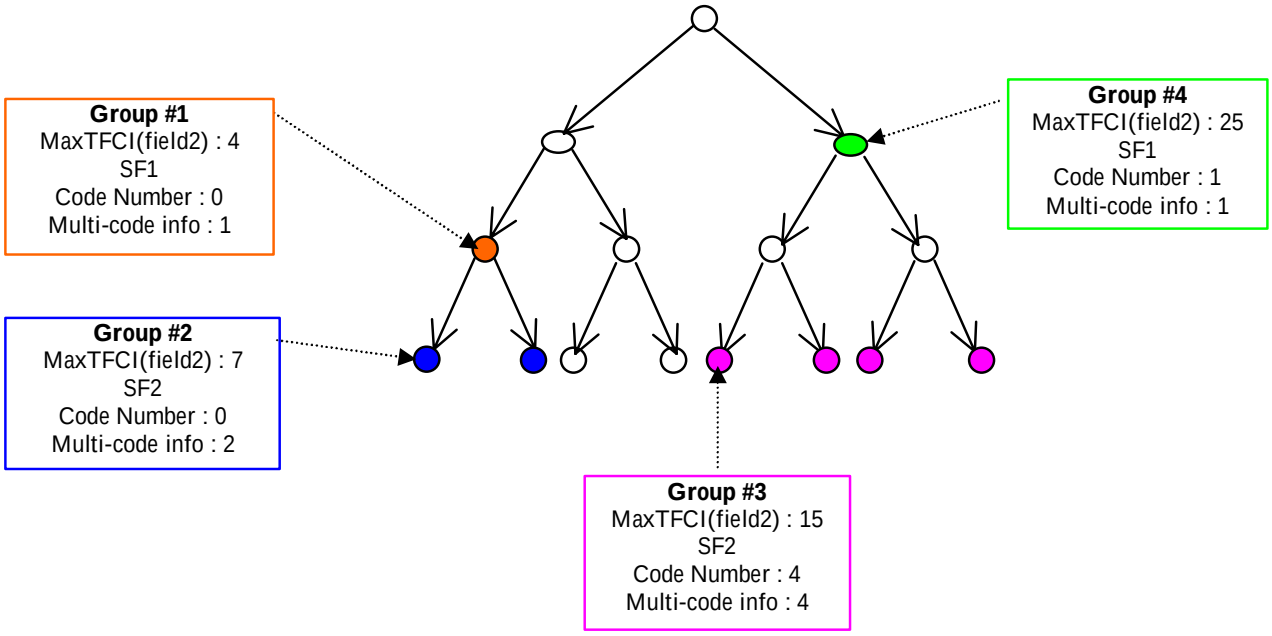
The mapping is described in terms of a number of groups each group being associated with a given spreading factor and a code start and code stop value indicating the sub-tree associated to each group. Then TFCI(field2) values are associated to each code of each group in ascending code number for each group i.e. TFCI(field)2 = 0 maps to the first code ('code start' of the 1st group) of the 1st group, TFCI (field2) = 1 maps to the 2nd code of the 1st group... TFCI(field2) = 'code stop' maps to the last code of the first group and for the 2nd group TFCI(field2) values start at the last TFCI(field2) value from the previous group + 1 and so on. In case multi-code is used several codes are associated to each TFCI(field2) value instead of 1.




### *2.2.2. TFCI range*

With this method, the mapping is described in terms of a number of groups. For each group, one (or several in case of multi-code) channelisation codes is associated to a group of TFCI(field2) values in ascending order.

This is illustrated in the figure below




*2.2.3. Explicit*

With this method each TFCI(field2) value is associated with one (or several in case of multi-code) PDSCH channelisation code.

### 2.3. Conclusion and proposal

It appears that the configuration of the channelisation code for the DSCH is done on a per UE basis. As one given UE does not know which PDSCH code(s) have been allocated to the others for the mapping of the DSCH, it cannot identify and take advantage of the knowledge of the "PDSCH root channelisation code". Therefore it does not seem useful to limit the UTRAN to a code allocation where within one radio frame, different UEs use PDSCH codes which are part of the same sub-tree. This puts some limitations on the UTRAN implementation without allowing the UE to take advantage of it.

The signalling allows the UTRAN to map the TFCI(field2) values to any PDSCH code which are part or not of the same sub-tree. The only restriction is that in case of multicode for one UE consecutive codes (but this does not mean part of the same sub-tree) in the code tree will be allocated to that UE. However when multiple PDSCH(s) are transmitted in parallel to different UEs, the UTRAN has the possibility to put the codes anywhere in the code tree without any co-ordination between code allocated to different UEs.

Therefore it is proposed that the notion of PDSCH root channelisation code is removed. In addition the definition is clarified. See CR25.211-105 (R99) and CR25.211-106(Rel-4) in companion document R1-010502.

## 3. Timing issues

In the same section (5.3.3.6) of [1], it is also indicated "All the PDSCHs under the same PDSCH root channelisation code are operated with radio frame synchronisation". This sentence is useless since all PDSCH codes are frame aligned as explained in section 7.1. Therefore it is also proposed that this sentence is removed. See CR25.211-105 (R99) and CR25.211-106(Rel-4) in companion document R1-010502.

## 4. References

[1] 3GPP TS25.211 v3.6.0, Physical Channels and mapping of transport channels onto physical channels

[2] 3GPP TS25.331 v3.6.0, RRC protocol specification