TSG-RAN Working Group1 meeting #17 TSGR1#17(00)1441

Stockholm, Sweden, November, 21st – 24th, 2000

Agenda Item : **AH24 : High Speed Dowlink Packet Data Access**

Source : **Nortel Networks**

Title : **Downlink model for High Speed Downlink Packet Data Access**

Document for : **Discussion**

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1. Introduction

In the current version of the Technical report related to the physical layer aspects of High Speed Downlink Packet Data Access (HSDPA) [2], the HSDPA physical layer structure in the code and time domain is shortly discussed. The physical layer structure itself and the operation of the technologies that are proposed for evaluation (Adaptive modulation and coding, Fast cell selection and Hybrid-ARQ) are very much related to the downlink model of the HSDPA. It is well understood that the model is in the scope of RAN 2 work and any modification of the said model for the support of HSDPA will be performed by RAN 2. However it appears that some discussions taking place in RAN 1 on the above mentioned technologies make strong assumptions on how the model would potentially be modified, when setting restrictions on the code usage, user multiplexing and channel coding. In order to facilitate discussions on the technologies and communication with RAN 2, this contribution summarise which are the main characteristics of the DSCH model in Release99 and list possible modifications of the model in the framework of HSDPA.

2. Model for the R99 Downlink shared channels

25.302 [1] describes the UE's physical layer for the downlink model for the DSCH, which is as follows :

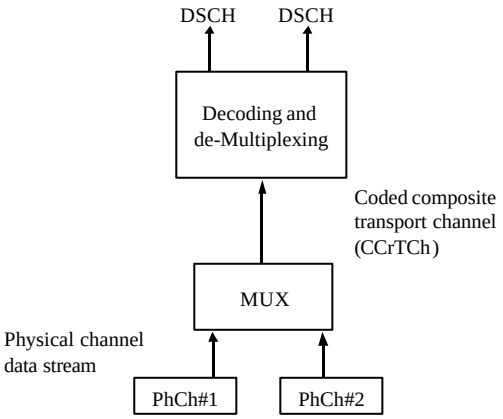

Fig-1 : UE's physical layer model for the downlink shared

A DSCH Coded Composite transport channel (CCtrCH) may hence consist of one of multiple DSCH, and is furthermore mapped onto one or multiple Physical channels, all of which have the same spreading factor (SF). Besides one UE may have to received one or multiple CCTrCH of DSCH type as indicated in section xx, however the signalling effectively supports only one CCTrCH of DSCH type.

This UE model describes the channel coding and multiplexing operation on a TTI basis. TS 25.331 [3] provides further specification as to how the code usage, multiplexing between users and Transport format are concerned.

?? DSCH resource is allocated on a frame by frame basis

?? A UE may be allocated for each TTI (more specifically the largest TTI of the DSCHs part of the CCTrCH of DSCH type), one of multiple physical channels. When multiple channels are allocated (multi-code) these codes have the same spreading factor and they are contiguous in number. The SF of this (these) physical channels may

vary on a TTI basis (largest TTI). The set of physical channels as well as the Transport format combination is provided through the TFCI, more specifically TFCI (field2) and TFCI (Field1) depending on the use of hard split or logical split of TFCI. The TFC is related to the physical channel set, meaning that if the number of channels is adjusted though the SF remains unchanged, the TFC is adapted, in order to retain the same code rate.

?? Considering the model at the UTRAN side, a DSCH transport channel is associated with one UE at a time, so multiple UEs may not share the set of physical channels which are part of the same CCTrCH

?? UEs may be multiplexed in codes and or time, where smallest time granularity corresponds to the radio frame, though TTIs of each user is to be considered.

?? The configuration of the DSCH is performed as for dedicated channels. In effect different users use different DSCH transport channels ,which may have different characteristics (Transport formats, Static rate matching, TFCS).

?? Finally regarding the processing chain, the TTI is static parameter, and rate matching is performed on the CCTrCH level rather than on the transport channel level.

3. Alternatives for the High speed downlink packet data access model

For HSDPA several alternative may be considered or are being proposed within RAN WG1 in terms of code usage , user multiplexing and processing chain. In the following 4 alternatives referred to in [2][3]-[5] or new ones are listed. These should be considered as a preliminary list as other alternative may be developed later. These different alternatives different levels of flexibility in terms of resource management on a cell basis but have different constraints in terms of UE complexity.

3.1. Alternative 1

Alternative 1 consists in keeping the same level of flexibility in terms of resource usage as for the existing DSCH that is to say that users may be multiplexed in code and or time, and one UE may get a varying number of codes and SF on a TTI basis. As a consequence there would be multiple CCTrCHs of HSPDA type per cell getting resource within the same radio frame.

As for the DSCH R99, one user would get one CCrTCh only which means that the Transport format combination would be defined at the CCTrCH level corresponding hence to all allocated codes, rather than normalised per code.

A possible enhancement would be to decrease the smallest TTI value, that TTI being fixed though, since a static parameter.

3.2. Alternative 2

Alternative 2 is identical to alternative 1 apart from the use of fixed spreading factor SF. A user may get one or multiple physical channels at the spreading factor SF as part of their CCTrCH of HSDPA type. These Physical channels allocated to one user would be consecutive in the code tree. In a similar fashion as for alternative1, users may hence be multiplexed in time and or code.

Irrespectively of the consideration of Adaptive Modulation and Coding, the set of TFCs defined for one user should be sufficiently large to support the flexibility in terms of number of codes, and hence granularity in code allocation.

3.3. Alternative 3

In case 1, there is only one CCTrCH of HSPDA type per cell. That single CCTrCH, which is allocated physical channels which are left free from users being allocated Dedicated channel and possibly R99 DSCH. All these physical channels are using a fixed spreading factor. Considering that different users may not be mixed within the same TTI, this means that effectively there is one user per TTI. The number of codes and their position in the code tree, may vary in time.

As for alternative 2, irrespectively of the consideration of Adaptive Modulation and Coding, the set of TFC should be sufficiently large to support the flexibility in terms of number of codes, and hence granularity in code allocation.

This alternative is in effect assumed in proposal documented in [5][6] from the code usage and time multiplexing perspective. However contrary to what may be implied in [5], the uplink model and the multiplexing chain does not require any modification, as this is simply a restriction in terms of resource split on the networks side. Our understanding is that there is no need to define a new concept noted Code shared transport channel CSTrCH, from the

physical allocation point of view. Though the proposal in [5] goes further than restriction in terms of resource usage as it also modifies the rate matching as explained in alternative 4

3.4. Alternative 4

Alternative 4 is the alternative proposed in [5]. It is identical to alternative 3 described above with the following exceptions

?? The TTI is a variable parameter rather than static, which is a significant change with respect to the model as specified by RAN WG2.

?? The rate matching is performed on a Transport channel basis. It is not clear to us how this effectively works, as the rate matching 's function is primarily to balance the resource between the different transport channels.

?? It seems that there is one or multiple DSCH but these are defined as true common channels, meaning that all UES have the same configuration

4. Decision criteria for the different alternatives

The different alternative should be compared according to the following criteria as a minimum :

?? UE capabilities granularity. For example depending on the approach a UE supporting HSDPA may have to support the maximum bit rate and or a large number of code of large SF.

?? Flexibility in dynamic allocation of resource between HSDPA channel(s) and existing R99 channels DCH and DSCH

?? Overall throughput considering overhead on both directions (uplink and downlink).

?? Suitability to address different traffic scenarios, e.g. frequent small packets, in-frequent large packets. The idea in particular is to address loss of resource because of ending transmission.

?? Complexity of the channel coding and multiplexing chain. Introduction of smaller TTI than the radio frame length, variable length TTIs and rate matching modification need to be quantified.

?? Interaction with other technologies (AMC and HARQ). Indeed depending on the applied technologies, we may e.g. want to retain the same number of blocks for a TTI hence decrease the number of code when increasing the number of physical channels or modifying the SF.

5. How to move forward

At this stage we believe that the different alternatives listed above have no been evaluated with a sufficient level of details toward the decision criteria detailed before. Therefore it is very much premature to make any decision at this stage, knowing that we are anyway in the feasibility phase rather than the standardisation phase.

As the resource usage code/time multiplexing is primarily a RAN WG2 issues, RAN WG1 should concentrate on physical layer aspects of the proposals and on aspects that may impact simulation assumptions. As far as the documentation aspects is concerned, we understand that the code usage and time multiplexing is addressed in some sections of the report. Our proposal is to enhance that list based on this above listed alternatives and not go much beyond that before RAN 2 provide us with guidance. We should also consider the need for simulations in either the feasibility phase or standardisation phase in order to support selection or combination of the above mentioned alternatives.

6. References

[1] : 3GPP TS 25.302, Version 3.6.0, Services provided by the Physical Layer

[2] : 3GPP TR xx.xxx, Physical Layer Aspects of UTRA High Speed Downlink Packet Access, Version 0.1.0

[3] : 3GPP TS 25.331,

[4] : High Speed Downlink packet data Access, R1-00-0727, Motorola

[5] : Downlink Transport Channel Multiplexing Structure for HSDPA , R1-00-1383, Lucent

[6] : Downlink and Uplink Channel Structures for HSDPA , R1-00-1381, Lucent