TSG-RAN Working Group1 meeting #19 TSGR1#19(01)0292

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

Source : **Nortel Networks, Wavecom**

Title : **WCDMA based Stand-alone DSCH physical layer related aspects**

Document for : **Discussion**

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1. Introduction

At the last RAN WG2 meeting the concept of a stand-alone DSCH was introduced [1] and documented into the RAN 2 Technical report on High Speed downlink packet data access [2].A standalone DSCH is defined as a DSCH on a downlink carrier that is different from the WCDMA carrier that carries its companion DPCH In a companion contribution (R1-01-0290) the principles and benefit of the stand-alone DSCH are introduced. Two options are considered : a WCDMA based Stand-alone DSCH and a OFDM stand-alone DSCH

In order to get a complete view of feasibility of the standalone DSCH from the RAN perspective, this contribution evaluates the feasibility of the WCDMA based stand-alone DSCH from the physical layer point of view while contribution R1-01-0291 focuses on the OFDM solution. Impact on the physical channels, cell organisation, measurements for the support of mobility and interaction with other features are discussed. Impact on the terminal complexity is then evaluated. Update of the RAN 1 technical report based on the present contribution is proposed in a companion document [6].

2. WCDMA based Stand-alone DSCH physical layer description

2.1. Impact on physical channels carrying the stand-alone DSCH

Details of the structure of the physical channels for the WCDMA based DSCH located on the same carrier as the DCH is still for further study. The current status is as follows

?? Multiple cases have been identified in terms of code and time usage. Sharing in codes may be restricted to the use of fixed spreading factors, whereas in R99 multiple and varying SF are allowed. There may be hence a possibility to combine multi-code on a per UE basis and code multiplexing (multiplexing of users in code).

?? A far as the DPCCH/DPDCH structure of the physical channel carrying the HS-DSCH is concerned, also multiple cases are under consideration. It is expected that we may depart from the structure of the PDSCH in R99 for which only the DPDCH is transmitted as channel estimation, power control and eventual beam-forming are based on the CPICH and/or DPCH. Indeed specific signalling requiring a DPCCH on the HS PDSCH may be required.

Impact of the WCDMA based stand-alone DSCH onto the physical channel structure and principle of the physical layer is small compared to the WCDMA based DSCH on the same carrier as the DCH :

1) The code and time multiplexing principles are the same, the only different being that the whole code tree may be assigned to the stand-alone. In a similar fashion as for the HS-DSCH on the same carrier as the DCH, it is assumed that the code and transport format allocated in conveyed by the DCH.

2) The minimum modification for a WCDMA based stand-alone DSCH is required by the need to provide a reference on f2 for the channel estimation either through the CPICH on f2 or dedicated pilots on the PDSCH, if beam-forming is used. As there is no fast power control on the WCDMA based stand-alone DSCH as for the HS-DSCH case, there is no need for Power control bits on the standalone PDSCH.

    a) So compared to the WCDMA HS-DSCH on the same carrier as DCH, there may be no need for further modification of the DPCCH/DPDCH for the physical shared channel (PDSCH) unless beam-forming is applied. a CPICH on f2 is introduced to provide the reference for channel estimation.

b) If beam-forming is used, dedicated pilots would be introduced, leading some small modification of the Physical channel PDSCH compared to the HS-DSCH on the same carrier to introduced a DPCCH containing pilot bits.

3) The synchronisation of the stand-alone DSCH on f2 may be shifted with respect to that of the primary frequency f1 carrying the DCH. Relative synchronisation may be provided on the BCH as for the SFN-SFN time difference between cell, unless f2 carries its own set of channels allowing for synchronisation acquisition.

2.2. Cell organisation

In this proposal multiple carrier cells are introduced. A UE remains connected to one or multiple cells, but the HS-DSCH is always transmitted from one cell which transmits in addition the DCH. In order to determine the transport channel organisation on each carrier or on the cell basis, mobility management (and the associated required measurement) and activation of several features such as beam-forming or Dl TX diversity are to be considered.

2.2.1. Processes to consider to derive set of channels

For the radio mobility management two cases may be considered as explained in a companion contribution [4].

1. either the coverage of f1 and f2 are equivalent in which cases, measurements on f1 may be sufficient for the mobile assisted handover. This may be the case for f1 and f2 in the same band or close-in band and cell areas being determined by capacity rather than coverage. This is analogous to the multi-band cells in GSM.

2. coverage of f1 and f2 are different. in which case measurements on f1 and f2 are needed. This requires that CPICH on f2 is introduced, provided that relative synchronisation information is made available which does not require Synchronisation channels

When Dl Transmit diversity with feed-back is needed, Primary and secondary CPICH are needed.

The stand-alone DSCH may be combined together with other concept evaluated for HSDPA , namely Adaptive modulation and coding, H-ARQ, Fast Cell selection, MIMO. Some channels on f2 may be required in order to provide control information for these adaptive processes in particular adaptive modulation and coding. a CPICH on f2 may hence be needed unless other channels are available to derive propagation and interference conditions.

2.2.2. Set of channels on each frequency

The channels configuration may be as follows :

1) On the main frequency : no modification with respect to R99

2) On the “secondary” carrier conveying the Stand-alone DSCH

   a) One or multiple HS-DSCH

   b) None or one primary CPICH depending on need to allow for measurements on f2 (mobility case 2 above) or Dl Tx Diversity with feed-back

   c) None or one secondary CPICH depending on Dl TX diversity with feed-back

   d) None or one SCH, depending on the existence of fixed relationship between the synchronisation on f2 and synchronisation on f1. However if one SCH is transmitted, the codes should be different from those of the normal SCH in order to avoid any adverse effect on cell selection in a similar fashion as for the Positioning Elements.

   e) Possibly some DCHs

3. Impact on the UE

The WCDMA based stand-alone DSCH has some impact on the UE compared to a HS-DSCH on the same carrier as follows :

?? A second receiver or part of the receiver is to be duplicated as the DSCH is located onto a separate carrier. Some of the base-band processing capability may indeed be shared between the processing of f1 and f2, as only the channel estimation needing to be effectively duplicated separate. The UE capability for the channel decoding, de-multiplexing.... may be shared between the DCH and DSCH as in R99.

?? That second receiver may be considered as an evolved version of a second receiver which is referred to for UE which do not required compressed mode for the inter-frequency measurements, when the Stand-alone is mapped onto the existing FDD band.

?? The impact of the second receiver introduction depends on the frequency band that is used. In a similar fashion as for the OFDM based Stand-alone DSCH (refer to [5]), different technical solutions may be envisaged depending on the distance between the frequency, such as two receiver antennas or modified duplexer compared to the HS-DSCH on the same carrier.

4. Impact on the Node B

One Node B would need to support multiple frequencies simultaneously. For Node B of a minimum capacity this should be already the case, so the impact of the RF would only be limited to small capacity Node B.

The only difference with respect to a Node B support HS-DSCH on the same carrier is that the DSCH and it associated DCH are to be transmitted onto different carrier. Impact of this small difference depends on the internal architecture of the Node B and dimensioning of the communication links. However it is expected that significant modifications would be needed for the support of features such as AMC, HARQ and a MAC-HSDPA in the Node B, so enhancing communication links to provide a frequency indication for the DCH and DSCH separately is very minor compared to amount of update due to other features of HSDPA.

5. Conclusion

In this contribution the impact on the physical layer for a WCDMA based stand-alone DSCH is evaluated. There is little difference between a WCDMA based stand-alone DSCH and a HS-DSCH on the same carrier as the DCH. Only some adjustment of the set of channels transmitted onto the second carrier is required and a similar amount of modifications of the physical channel carrying the DSCH may be needed as for the HS-DSCH on the same carrier. It should de noted that the WCDMA stand-alone DSCH concept may be combined with any of the concepts that were already evaluated for HSDPA such as adaptive modulation and coding, HARQ, Fast cell selection and MIMO. This is accounted for in the evaluation of the adjustment of the physical channel structure namely the set of channels transmitted on each carrier. Provided the small amount of difference, it is expected that the achievable bit rate and throughput per carrier is similar or higher compared to the HS-DSCH on the same carrier, with the only difference that the DCHs do not eat up part of the capacity leading hence to a possibly higher peak bit rate for the stand-alone DSCH.

Impact is more on the UE side as a dual receiver is required. Different technical solutions are possible depending on the band, which is in use, namely the distance between the two carriers. The second receiver may be used to avoid the use of compressed mode in downlink, which would improve the capacity of the frequency carrying the DCHs. Impact on Node B depends on the selected internal architecture. However it is expected that Node B providing a minimum capacity are able to transmit multiple frequencies in parallel. Therefore the RF impact of the stand-alone is small or non existent. Impact in the overall architecture may be very small as well, and in any significantly lower than modifications required for the support of AMC, HARQ and moving the MAC-HSDPA to the Node B. Therefore it is believed that adding the stand-alone concept onto a R99 Node B or a Node B supporting the HS-DSCH onto the same carrier is small.

On the basis of the evaluation of the WCDMA based Standalone DSCH impact onto the physical layer definition, UE and Node B impact and performance it is proposed to document the WCDMA based Stand-alone DSCH into the technical report of RAN1. A proposal for text is provided in a companion contribution [6].

6. References

[1] : Support of standalone carrier for DSCH, R2A0002/01, Nortel Networks

[2] : TR 25.950 v0.0.3, UTRA High Speed Downlink Packet Access, RAN2

[3] : TR 25.948, v0.4.0, UTRA High Speed Downlink Packet Access, RAN1

[4] : R1-01-0290, Stand-alone DSCH principles and benefits, Nortel Networks, France Telecom and Wavecom

[5] : R1-01-0291, Stand-alone carrier - A high speed channel in downlink, Nortel Networks, France Telecom and Wavecom

[6] : R1-01-0293, Stand-alone DSCH, proposed text for inclusion in TR 25.848 v 0.4.0, Nortel Networks, France Telecom and Wavecom