TSG-RAN Working Group1 meeting #19 TSGR1#19(01)0290

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Agenda Item	**:**	**AH24 : High Speed Dowlink Packet Data Access**
Source	**:**	**Nortel Networks, Wavecomm, France Telecom**
Title	**:**	**Stand-alone DSCH principles and benefits**
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. The high level characteristics of the Standalone DSCH were identified by RAN WG2. The Stand-alone DSCH is in particular compatible with the protocol architecture as adopted by RAN2 in TR 25.950 and the Release99 architecture. The Stand-alone DSCH is compatible as well with the enhancements brought by the study on HS-DSCH (Adaptive modulation and coding, HARQ, Scheduling in node B among others). By using a separate carrier and possibly new modulations schemes such as OFDM, very spectrally efficient in particular in highly dispersive environments, the Stand-alone DSCH has the potential to further increase the peak bit rate per user and the cell capacity.

In order to get a complete view of feasibility of the standalone DSCH from the RAN perspective, this contribution provides a high level description of the Stand-alone DSCH and identifies its key benefits. Two main categories of stand-alone DSCH are considered: The first one is a DSCH which modulation is identical to that of the DSCH R99, that is to say WCDMA based. The second one is a DSCH which modulation is different, more specifically OFDM based. Detailed characteristics of the two options as far as the physical layer aspects are concerned and impact in terms of UE complexity are addressed in two companion contributions : R1-01-0291 for the OFDM based DSCH and R1-01-0292 for the WCDMA based stand-alone DSCH. A proposal for update of the RAN1 Technical report is available in R1-01-0293.

2. Stand-alone DSCH rationale and high level description

2.1. Stand-alone DSCH principle

In R99 the DSCH is mapped onto the same carrier as the companion DCH. One cell is additionally mono-carrier. Multiple cells may be co-located (same coverage) but there is no sharing of the overhead represented by the common channels (SCH, BCH, FACH, PCH) between these multiple carriers, as considered as multiple cells. The HS-DSCH (High Speed DSCH) considered up-to now in RAN WG1 is very similar to the DSCH R99. The model of RAN 2 is slightly modified in order to accommodate the possibility to apply new modulations (which may be furthermore adapted), Hybrid ARQ and MIMO. The HS-DSCH is not allocated in isolation but together with a Dedicated Channel located onto the same carrier or possibly with a DSCH control channel (although this is only partly covered in the RAN 2 Technical report) again on the same carrier.

A standalone DSCH is defined, as indicated above, as a DSCH on a downlink carrier f2 that is different from the WCDMA carrier f1 that carries its companion DPCH. The separate frequency carrier carrying the stand-alone DSCH here is to be understood either as a 5MHz wide WCDMA carrier or as a 5MHz OFDM spectrum, composed of a set of adjacent narrow band carriers . With a stand-alone DSCH, the notion of multiple carrier or possibly multi-modulation cell is first introduced. A cell may support hence 2 carriers, f1 and f2, where f1 carries the DCH and f2 the Stand-alone HS-DSCH. From the UE perspective the main difference is the need to be able to receive two carriers at the same time f1 and f2, with f2 relying on either WCDMA or OFDM modulation. On one cell basis, f1 may hence carry the dedicated channels from all UEs and the DSCH R99 for a sub-set of UEs, whereas f2 carries the HS-DSCH from multiple UEs.

The transport channel characteristics of the stand-alone DSCH are similar to the DSCH R99. While still being UE specific, the DSCH is based on the sharing of resource, codes for the WCDMA based Stand-alone and narrow band carriers for the OFDM based DSCH. Users may hence be multiplexed in time and code/narrow band frequencies. The resource allocation and transport format are provided onto the DCH.

2.2. Frequency band

The stand-alone DSCH as indicated above may be assigned to a carrier different from the carrier supporting the DCH. Multiple cases can be considered:

1. The Stand-alone DSCH carrier can be in the already allocated paired band for FDD
2. The Stand-alone DSCH carrier can be in the newly identified paired bands for FDD, such as the 1.8 GHz band or the 2.5 GHz band
3. The standalone DSCH carrier can be assigned to unpaired bands, currently not identified for UMTS

2.3. Cell organisation and mobility management

With a stand-alone DSCH concept, multiple carrier cells are introduced. A UE remains connected to one or multiple cells (in the case of soft handover), but the HS-DSCH is always transmitted from one cell which transmits in addition the DCH. As the DCH and the stand-alone DSCH may be onto different carriers, located possibly onto different bands or using different modulation techniques, the set of measurements required to support mobility management may need some adjustment, which in turns may require the introduction of specific channels to perform measurements onto f2.

For the radio mobility management two cases may be considered:

1. the coverage of f1 and f2 are equivalent. In that case, 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. In such a case, there is no need for physical channel such as the CPICH to allow for measurement on f2.
2. coverage of f1 and f2 are different. In that case, measurements on f1 and f2 are needed. This requires that CPICH (for WCDMA and its equivalent for OFDM) on f2 is introduced, provided that relative synchronisation information is made available which does not require Synchronisation channels

2.4. Stand-alone DSCH benefits

Benefits of the stand-alone DSCH irrespectively of whether WCDMA or OFDM based are as follows :

?? The HS-DSCH can be introduced into the networks with no impact onto an existing network. All UEs DCH are located onto the original carrier (f1). In particular the introduction of HS-DSCH transport channels with different QoS and transmit power characteristics (e.g. no power control) does not impact the quality and management of Dedicated channels.

?? f2 is introduced as an overlay network and specific networks engineering may be applied (different power parameters for example) considering that no fast power control is applied and different quality of service is expected e.g. high BLER may be where optimum is reach, similarly as hs-DSCH.

?? The support of stand-alone DSCH located on a different carrier than the DCH, leads to configurations where the number of carriers in up and downlink is different. With the DSCH and DCH onto the same carrier, the same number of carriers would need to be supported on the downlink and uplink. Having is different number of carriers in up and downlink allows to better adapt to a purely asymmetrical type of service, in terms of equipment hardware.

?? Possibility to operate on new bands with downlink only carriers.

Particular benefits of the WCDMA based stand-alone DSCH are the following :

?? The modulation and multiple access schemes are the same as in R99,so the technology is present.

?? The peak bit rate for a single user can be higher compared to the case where the DSCH and DCH are mapped onto the same carrier since one user may get one complete carrier for the DSCH. In the case where the DSCH is one the same carrier as the DCH, one user may get only part of a carrier, as the DSCH capacity is limited by the number of DCH allocated otherwise.

?? With a HS-DSCH WCDMA based stand-alone a second receiver would be needed, for the reception of the HS-DSCH. Such second receiver would benefit the overall system capacity by being used also so as to avoid downlink

compressed mode for inter-frequency measurement and possibly other measurements (inter-RAT measurement), depending in retained second receiver architecture. Therefore, the cost of the second receiver can be shared between gains on existing system operation and St-DSCH, and as well simplify downlink operation by avoiding downlink compressed mode

Particular benefits of OFDM based stand-alone DSCH

?? OFDM is a spectrally efficient modulation allowing reaching high data rates even in difficult propagation environments. Details provided in R1-01-0291

?? OFDM although currently not part of UMTS is a well know modulation considered by other radio based standards: Digital Audio Broadcasting (DAB), DVB-T (Terrestrial Digital Video Broadcasting), Digital Radio Mondial (DRM) and HiperLAN 2.

?? As for the WCDMA, allocating a whole 5MHz band to the stand-alone allows to increase further the peak bit rate compared to a HS-DSCH mapped onto the same carrier as the DCH.

?? Base-band processing for the receiver part of OFDM is simple. No equalisation is indeed necessary as the guard interval is sufficiently large to avoid inter-symbol interference. Additionally only a Fast Fourier Transform is needed to perform the demodulation. (Pleased refer to R1-01-0291). Besides, AMCS can be easily performed with OFDM (as already done in Hiperlan2 e.g.).

3. Conclusion

In this contribution rationale for the introduction of the standalone DSCH is presented into more details.

Principles of the Stand-alone DSCH are first introduced. Frequency bands that may be used for the support of the stand-alone DSCH are discussed.

Finally benefits of the stand-alone DSCH are presented.

?? The stand-alone DSCH is believed to be an attractive solution to take advantage of new bands and for existing band and to provide the asymmetry in terms of cell capacity or bit rate per user in an efficient fashion considering spectrum aspects and hardware resource, whether new bands or existing bands are used.

?? Whereas the WCDMA based Stand-alone has the advantage to correspond to an existing modulation in UMTS, the OFDM modulation allows reaching higher bit rates in highly dispersive environments. Besides, this modulation is flexible : adapting the bit rate to the propagation conditions (AMCS) implies very few changes in the receiver structure.

A drawback of stand-alone DSCH may be the need for the second receiver. However depending on the receiver architecture this may be turned into an advantage as this may reduce the need for compressed mode to allow inter-frequency and possibly inter-RAT handover.

Further details on the impact of the DSCH stand-alone onto the physical layer are discussed in companion contributions. Provided the benefits offered by the stand-alone concept, it is proposed to document the stand-alone DSCH in the RAN 1 technical report for consideration of the concept at RAN level. A proposal for update of the TR is available in R1-01-xxx4.

4. 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