3GPP RAN TSG / WG2 Tdoc 3GPP/RAN/WG2 02/99
Helsinki
20-22 January 1999
Agenda item: 6
Source: Motorola

Incorporation of ETSI shared channel concepts in 3GPP documentation

1 Introduction

In the ETSI SMG2/Layer 2/3 experts group, the requirement for a Downlink Shared CHannel (DSCH) has been identified and an agreed description of the concept has been included in the ETSI documentation [1,2]. However, the concept is not present in the documentation of some of the other SDO's represented in the 3GPP. In this paper a brief description of the shared channel concept is provided along with some useful references. It is proposed that the 3GPP documentation should include the DSCH concept as described in the ETSI documents. In addition, if agreement can be reached, the concept of the Uplink Shared CHannel (USCH) and Access Control CHannel (ACCH) [3, 4, 5, 6, 7] should also be included (though it should be noted that at the time of writing the USCH concept is not currently agreed within ETSI).

2 Downlink shared channel

The DSCH represents a power and code resource which is shared between users [8]. Access to the DSCH is controlled by a MAC-sh entity in the CRNC [2]. The methods by which the access to the shared channel is signalled is still under discussion, however, for each UE, the signalling could be conveyed either over an associated DCH [9] or on a common signalling channel (eg the ACCH) [3,7], Motorola favours the latter option [7].

3 Uplink Shared channel

The uplink shared channel concept was proposed by Motorola at the Sophia Antipolis meeting of SMG2/Layer 2/3 group. In the case of the USCH there is no short code limitation (each UE will have its own scrambling code), however, there is still a limited power resource, hence the USCH represents a shared power resource. The motivation for the USCH is essentially the same as that for the DSCH. In the proposal described in [3,5] access to the USCH is also managed by a MAC-sh entity in the CRNC [10].

4 Advantages of the shared channel concept

In this section the benefits of the shared channel approach for supporting packet connections are listed. The benefits are described in comparison with the alternative of using DCH's controlled by RRC:

- When RRC admits a new packet call on a DCH it has to assign a peak bit rate to the DCH on the basis of only minimal information (ie. the assignment is based on RRC's prediction of the connection's future requirements). If the assigned bit rate is too high then capacity will be wasted (there is a dis-continuous transmission). With the shared channel concept the resource will always be fully used in every frame (providing of course that there are some packets to transmit!). Note that whilst it is true that dis-continuous transmission can be exploited (and extra calls admitted) this is only possible if there are many users active such that it is possible to rely on statistical averaging. However, if there are many users active then the bit rate of the assigned data pipes will have to be low and packet transfer times increased (and anyway in this case the packet call is probably no longer very dis-continuous).

- In order to avoid the problem of assigning a DCH which is too large, RRC will sometimes assign a DCH which has a bit rate which turns out to be too low [5]. In this case, the DCH is more likely to be fully used (and transmission will be more continuous), however, the packet call will take longer to complete. With the shared channel, packet calls will always be completed at least as quickly as is the case with RRC based control, and on the average will be completed more quickly.

- The shared channel facilitates efficient shared access to a large data pipe. This means that the highest priority packets always get served first, irrespective of which UE the packets are going to/from and this therefore improves QoS [5]. This is not the case with RRC based control of packet users on DCH's in which a high priority packet call will sometimes be queued, waiting for a lower priority packet call to release its DCH.

- It is worth re-iterating that with RRC based control on DCH's capacity will often be wasted whilst the RRC decides whether to either change the size of the DCH or release it (eg. when the MAC buffers are empty and RRC is waiting for timers to expire). When RRC eventually makes the decision to release the DCH, then it will be necessary to initiate a number of RRC procedures to firstly release the DCH and then to re-assign the capacity/code etc. to another user. There will be further delay whilst the PHY, MAC and possibly RLC are re-configured for the new 'owner' of the resource. All this time, the resource is not being utilised. With shared channels this problem does not exist.

- Where packets are carried on DCH's controlled by RRC, the RRC protocol will on occasion release DCH's before the packet call is actually completed (eg. when timers expire), this will also have a detrimental impact on packet call completion times and on customer perceived QoS. Again, with the shared channel this problem does not exist.

- In the case of the downlink, where multiple DCH's are used to carry packet connections, an assignment of power is made to each DCH, however, it is necessary to include a margin to account for power variations resulting from changes in propagation loss and interference conditions which will occur during the lifetime of the DCH's. With the shared channel it is possible to take into account variations in mean propagation loss and interference conditions (with a resolution of a few 10's of ms) when performing the scheduling. It would therefore be possible to avoid having to use such a large margin. Put another way, the proportion of power assigned for carrying packet connections could be packed more efficiently where the shared channel is used and there would be a corresponding increase in system capacity.

- With the shared channel concept the possibility exists to dynamically vary the size of the shared channel in response to rapid changes in conditions. For example, the CRNC could temporarily increase the size of the shared channel for a period of a few frames if it knows, for example, that voice user DCH's are being re-assigned and that capacity would otherwise be wasted. Such responsiveness could not be achieved with an RRC-DCH based approach. In such a way, the shared channel can *soak up* any excess bandwidth which is available in a very dynamic way.

- For the case of the downlink only, the shared channel also provides an efficient method for sharing access to limited downlink short codes without involving lengthy RRC procedures for re-assigning physical channels. This requirement stems from the fact that at any one time there could be on the order of 100 packet users in the system, hence dedicated assignment of short codes is not possible.

5 Proposal

The 3GPP documentation should include the DSCH concept as described in the ETSI documents.

In addition, if agreement can be reached, the concepts of the Uplink Shared CHannel (USCH) and ACCH [10] should also be included (though it should be noted that at the time of writing this concept is not agreed within ETSI).

6 References

[1] UMTS YY.01,'UE-UTRAN radio interface protocol architecture; Stage 2', SMG2/L23 Tdoc 468/98

[2] UMTS YY.21, 'Description of the MAC protocol', SMG2/L23 Tdoc 472/98

[3] Motorola, "Mechanisms for Managing Uplink Interference and Bandwidth", Tdoc SMG2-L23 535/98

[4] Motorola, "Channel Bandwidth Allocation Strategy", SMG2 UMTS L23 534/98

[5] Motorola, "Benefits of the uplink shared channel" SMG 2 UMTS L23 047/99

[6] Motorola, 'Methods for operating the uplink shared channel', SMG 2 UMTS L23 016/99

[7] Motorola, 'Benefits of the ACCH for signalling fast assignments', SMG 2 UMTS L23 046/99

[8] Motorola, "Shared Channel Options for Downlink Packet Data Transmission," SMG 2 UMTS L23 533/98

[9] Nokia, "Utilisation of UTRA FDD Downlink Shared Channels", Tdoc SMG2 UMTS-L23 296/98

[10] Motorola, 'Change requests related to the USCH', SMG2 UMTS L23 Tdoc 048/99