**Agenda Item:**     6.2, 7.3

**Source:**     Siemens AG

**Title:**     Adoption of the USCH and DSCH Channels for UMTS-TDD

**Document for:**     Decision

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## 1. Introduction

In [1] the concepts of a USCH, allocation signalling for the DSCH and USCH on external channels and scheduling of access in the MAC-sh entity are introduced. These concepts match closely the requirements for operating packet data services using shared resources within the TDD implementation of UMTS and it is judged important that these or similar concepts are adopted into UMTS standards.

Because, in the TDD case, there may be advantages if the FACH channel is used to signal resource allocations for the USCH and DSCH rather than the ACCH proposed in [1], a revision of the MAC model amendment presented in[2] is proposed. This will enable the MAC model to represent signalling on either the ACCH or the FACH.

## 2. Discussion

For the TDD implementation of UMTS, it is proposed that there is significant merit in the multiplexing of packet data traffic relating to several UE onto a shared set of resource units (the term resource unit denotes the combination of a spreading code and a time slot). It is contended that this would permit an efficient utilisation of those resource units. A UE would be allocated use of some or all of the resource units for a period of time, matched to the transfer of some or all of the data that they wish to send or receive, after which the resource units are released for assignment to another UE. This sharing of capacity would be applied to both uplink and downlink data transfer and the concept relates directly to the use of the USCH and DSCH channels proposed in [1]. In the TDD implementation of UMTS a UE is able to make use of the USCH and DSCH whilst operating one or more DCH. The DCH and the DSCH/USCH may transport data from the same DTCH or, alternatively, the DTCH that are associated with the DCH may be different from those that are associated with the DSCH and USCH.
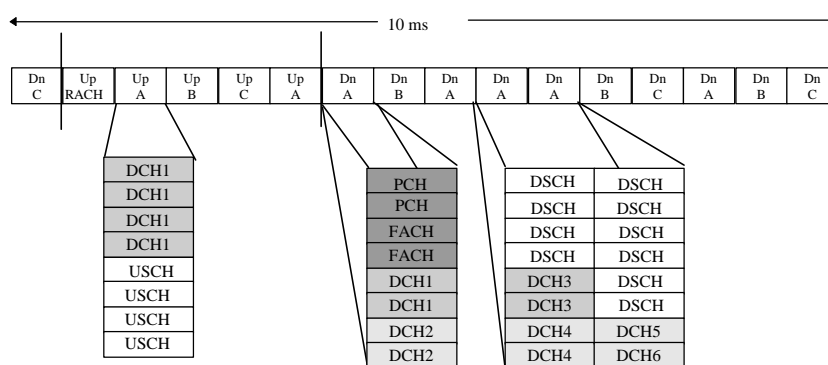


Figure 1: Illustration of TDD Resource Allocation

In the TDD case, it is suggested that the sets of resource units that are assigned to a DSCH or a USCH could change from time to time both in the number of resource units that are assigned and the actual units that are assigned. Consequently, the channels would have both variable capacity and variable location within the frame. It is proposed that a DSCH and USCH would be local to a cell and its resources would be allocated to it by RRC.

In [1] it is proposed that the allocation of access rights to the shared channels is the responsibility of UTRAN MAC-sh. The basis of this proposal is that the MAC can provide both a more efficient use of the shared channel and a better ability to fulfil diverse subscriber quality of service needs than can scheduling by RRC. This is also true in the TDD case.

In [1] it is proposed that resource allocation signalling for the USCH and DSCH should be combined onto a dedicated ACCH signalling channel. The use of the FACH as an alternative to the ACCH is considered but not adopted. It is suggested here that, in the TDD implementation of UMTS, because implementation of both ACCH and FACH may result in under use of allocated resource units, the identification of the FACH as a primary USCH/DSCH signalling channel should not be excluded. Consequently, it is proposed that the MAC architecture model should take account of both ACCH and FACH allocation signalling for the USCH and DSCH.

## 3.    MAC Architecture Diagrams

The following diagrams identify the changes that would be required to the MAC architecture model contained in [3] to accommodate the USCH, ACCH, scheduling of access within the MAC-sh and signalling of allocations on the FACH as an alternative to the ACCH proposed in [1].

Figure 2 illustrates how the UE side MAC architecture (Figure 4.2.3.1 in [3]) would be modified by the proposed changes. The MAC-sh entity is connected to the DSCH and USCH for data transfer and to the MAC-c and ACCH for the receipt of allocation signalling for these channels.
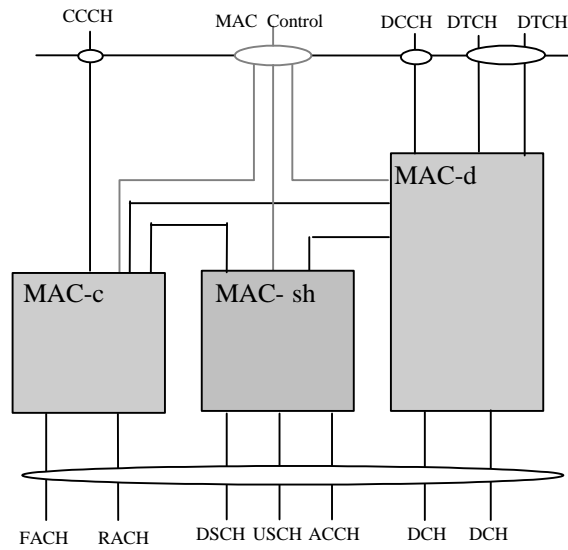


Figure 2: UE side MAC architecture

Figure 3 illustrates the internal functionality of the MAC-sh (Figure 4.2.3.4 in [3]). In the TDD implementation it is proposed that the  multiplexing function would transfers data from the DSCH to the MAC-d and from the MAC-d to the USCH under control of allocation instructions received either from the ACCH or the FACH dependent upon the way the cell common channels have been configured.
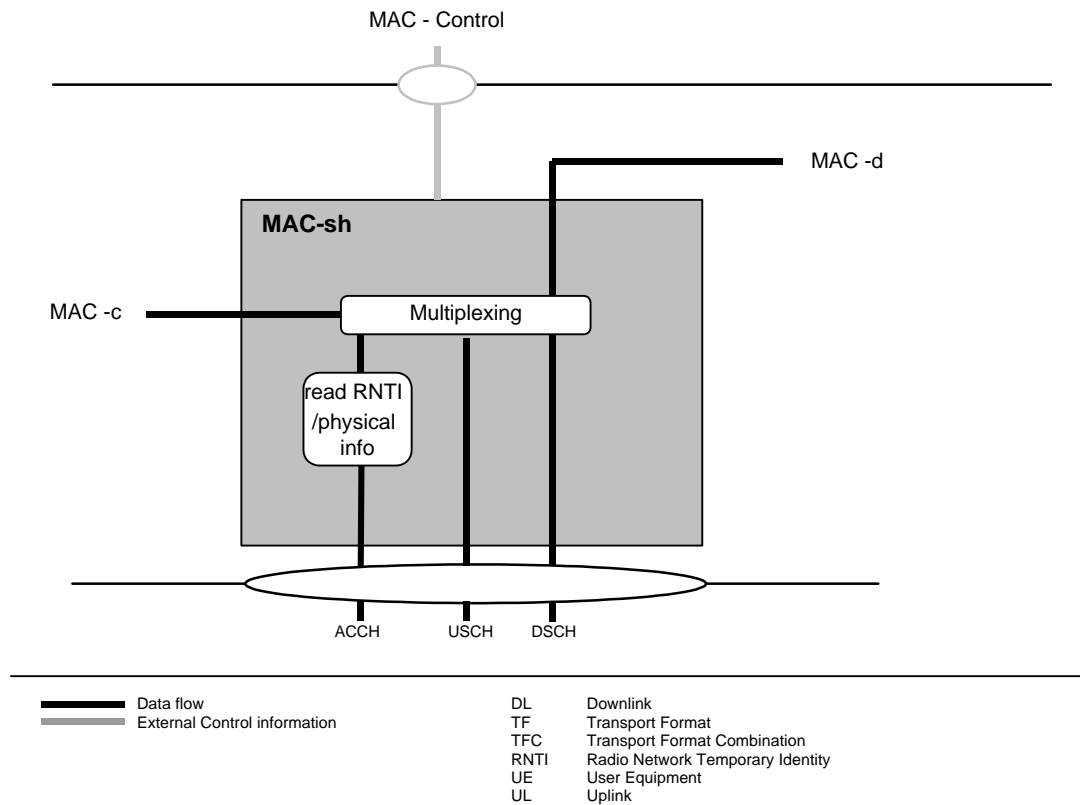
Figure 3: UE side MAC architecture / MAC-sh details

Figure 4 illustrates the UTRAN side MAC architecture model (Figure 4.2.4.1 in [3]) would be modified by the adoption of the proposed concepts. It is a modified version of that presented in [2]. The MAC-sh now interfaces with the USCH for data transfer and the ACCH and MAC-c for USCH and DSCH allocation signalling.
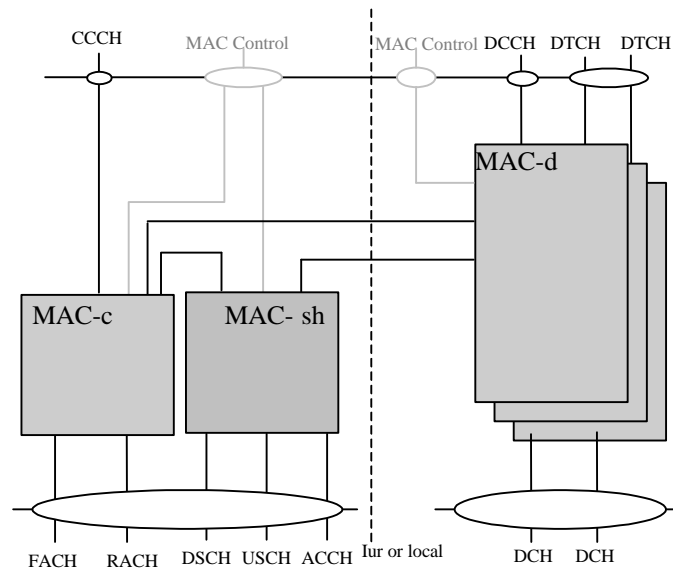


Figure 4: UTRAN side MAC architecture

In figure 5 the revised internal functionality of the MAC-sh is indicated (Figure 4.2.4.4 in [3]). The diagram is a modified version of that presented in [2]. In the TDD implementation it is proposed that the scheduling function would determine when each logical channel could use some or all of the USCH/DSCH channels resources. These would be signalled on the FACH or, alternatively dependent upon the cells configuration, on the ACCH. The mux/de-mux function would interface with MAC-d instances for the transfer of data between them and the USCH/DSCH in accordance with the schedulers resource allocations. The role of DL TF selection in the TDD case is proposed as ffs but is retained in the diagram for compatibility with the FDD case.
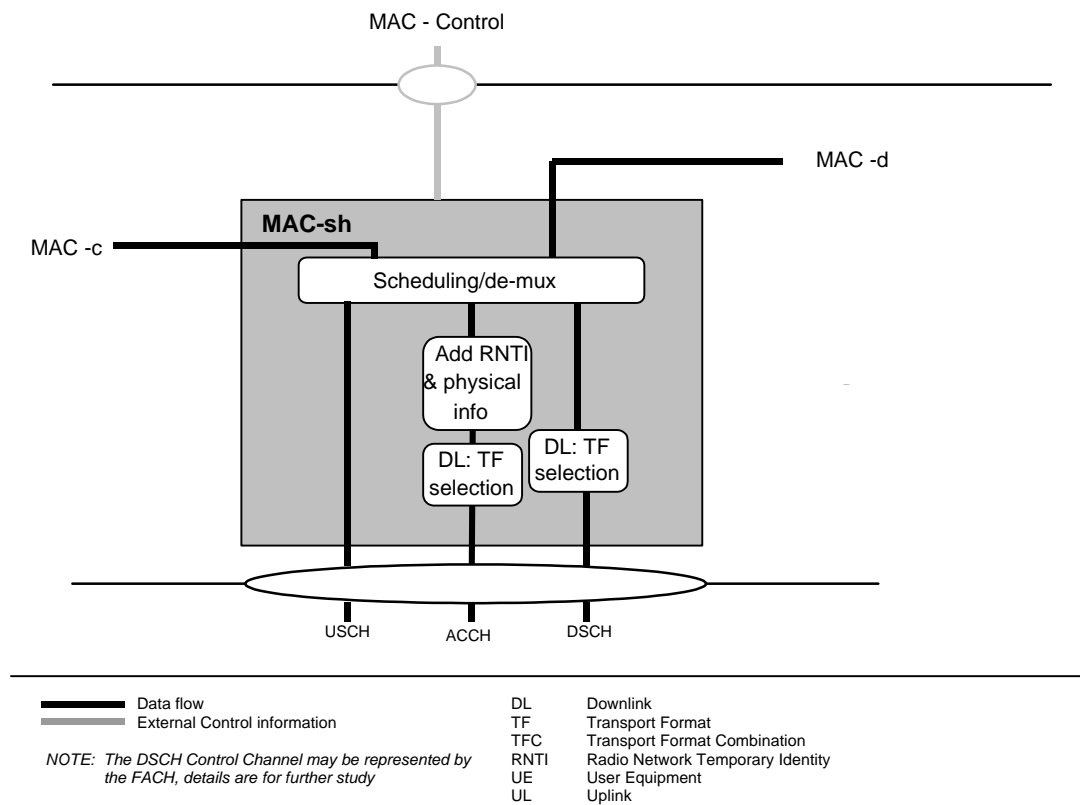
| | |
|---|---|
| ▬▬ Data flow | DL Downlink |
| ▬▬ External Control information | TF Transport Format |
| | TFC Transport Format Combination |
| *NOTE: The DSCH Control Channel may be represented by* | RNTI Radio Network Temporary Identity |
| *the FACH, details are for further study* | UE User Equipment |
| | UL Uplink |

Figure 5: UTRAN side MAC architecture / MAC-sh details

## 4. Conclusions

This paper identifies the applicability of the USCH, the signalling of access to USCH and DSCH resource units on the FACH and the scheduling of access in the MAC-sh to the TDD implementation of UMTS. MAC architecture diagrams that support the adoption of these concepts have been presented. It is proposed that these concepts and the diagrams 2 to 5 are adopted in into [3].

## References

1. 3GPP Technical Document 3GPP RAN WG2 032/99 'Benefits of the Uplink Shared Channel (USCH).

2. 3GPP Technical Document 3GPP RAN WG2 033/99 'Change requests related to the Uplink Shared Channel (USCH).

3. 3GPP Technical Specification S2.21 MAC protocol specification.