3GPP TSG-RAN Working Group 1, Meeting #9 **TDoc TSG RAN WG1 (99)I88**
Dresden, Germany, November 30 – December 3, 1999

Agenda Item: AdHoc 1
Source: Siemens AG
Title: Allocation of Midambles to Physical Channels in UTRA TDD mode
Document for: Discussion

1 Introduction

Currently within the UTRA TDD system midambles may be allocated to physical channels in an arbitrary manner. Fixed rules exist only for the P-CCPCH which exclusively always uses the first two midambles **m(1)** and **m(2)** and the PRACH where a fixed association between midambles and channelisation codes allows for an easy detection of PRACH bursts in the NodeB [1]. Moreover, the midambles **m(1)** and **m(2)** shall be used exclusively also by all physical channels providing the beacon function.

For all other physical channels no explicit allocation rule for midambles is provided although it is obvious that in UL different midambles have to be allocated to each UE while in DL a common midamble may be used for all channels or different midambles are allocated to the UE's in case of Tx Diversity or Beamforming. For both UL and DL, the midamble that the mobile shall use is signalled in the physical channel configuration messages.

In this document alternatives are shown how midambles can be allocated and reasons are given why a fixed association between midambles and channelisation codes is favourable also for other channels. It is proposed to use this fixed association as an option if no midamble is allocated in the physical channel configuration messages.

2 Rules How to Allocate Midambles

2.1 Downlink Channels

For the DL channels the rule how midambles should be allocated to physical channels depends on the use of TxDiversity/Beamforming in the NodeB and the use of Joint Detection (JD) in the UE:

1. no TxDiversity - no JD: For detection it is sufficient if one midamble is used for all codes that are allocated to one UE within one time slot; this midamble is signalled to the UE by means of higher layers. If less than 16 midambles are available in a cell, a common midamble for all UE's allows for more UE's than midambles and facilitates channel estimation, because only one channel has to be estimated. However, for measuring the received signal code power (RSCP) on the midamble instead of measuring on the data, a UE specific midamble may be preferable.

2. no TxDiversity - JD: The same applies as for case 1 if joint detection is carried out only on all codes that are allocated to one UE. However, if codes that are allocated to different UE's shall be involved in the JD processing, it would be desirable to have a simple indicator for the presence of these codes. Therefore, as an alternative a code specific midamble can be used, i.e. to each channelisation code a particular midamble is assigned. This assignment is similar to the one used for PRACH. This mapping allows for an easy detection of active codes by means of the midamble and avoids additional processing for blind detection and power measurements of active codes; however, it restricts the number of codes that can be used if less than 16 midambles are available.

3. TxDiversity - no JD: In case of TxDiversity the midambles must be different for all UE's in order to allow correct channel estimation for all the different user channels that depend on the weighting factors applied to the first and to the diversity antenna.

4. TxDiversity - JD: If the (UE specific) midamble is signalled, the UE can detect only those codes that are allocated to itself, because the JD has to know the relation between channelisation code and channel (i.e. midamble). In particular, if one UE occupies a complete slot this signalling can be applied. If the code specific midamble is used, the JD processing can include also additional codes, because in this case it knows

the relation between the code and the midamble. Again, in this case the number of codes is limited to the number of available midambles.

Conclusion for DL transmission:

For the DL channels three possibilities for midamble allocation can be considered:

- **Common Midamble:** A common midamble per time slot can be signalled to each UE within the physical channel configuration messages. This allows for an unrestricted allocation of channelisation codes and a maximum number of UE's. This option can not be used in case of beamforming.
- **UE specific Midamble:** The physical channel configuration messages contain different midambles for each UE per time slot. This allows for an unrestricted allocation of channelisation codes, however, the number of UE's is limited to the number of midambles. This option has advantages regarding the power measurements of RSCP. Moreover, it includes the possibility of PDSCH physical layer signalling as proposed in [2].
- **Code specific Midamble:** If no midamble is signalled to the UE, a default mapping is used, that assigns to each channelisation code a particular midamble. This option enhances JD performance in the UE for two reasons: In general it provides a simple means to indicate active codes in the DL. In case of TxDiversity it allows for the JD processing of codes that are allocated to different UE's. In DL this option is used only if all physical channels within one time slot are using the same SF, in order to ensure that the mapping is unique.

The code specific mapping can be made more or less restrictive. Figure 1 shows a mapping example for the case of 8 midambles.

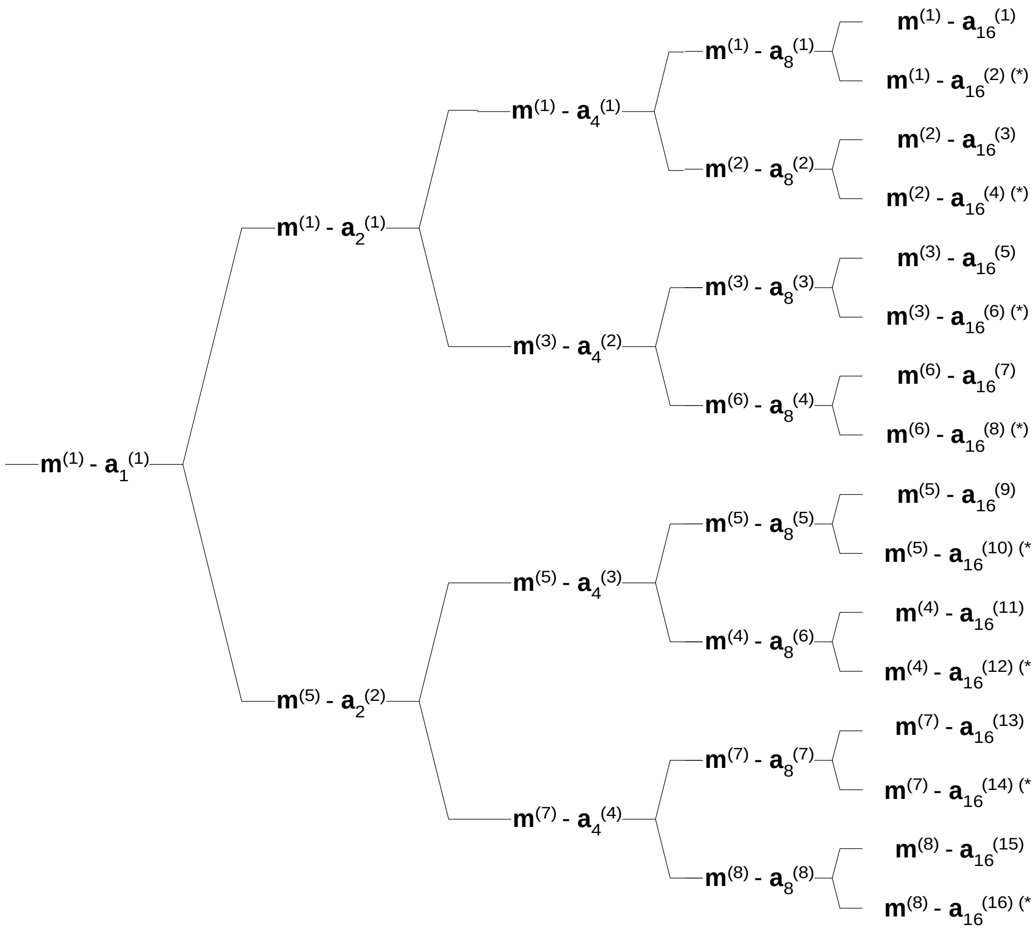

Figure 1 Example of code specific midamble allocation for K=8 midambles in a cell

In the restrictive case only those codes that are not marked with a * may be allocated by the RRC, i.e. there is a one-to-one mapping between channelisation codes and midambles. This limits the number of available codes to the number of available midambles. These channelisation codes are named *primary channelisation codes*.

In the less restrictive case all codes may be allocated, i.e. the code shortage is eliminated. However, the allocation of *secondary channelisation codes* reduces the information about active codes. Therefore, the RRC shall allocate primary codes prior to secondary codes if they are assigned to the same midamble. In this way, the UE can always perform JD for the own codes and all primary codes that are indicated by the midamble. To include also the remaining secondary codes in JD some additional processing effort has to be spend to find out, if these codes are active or not. It is up to the RRC to decide if secondary codes are allocated at all.

2.2 Uplink Channels

For the UL midambles are always UE specific. Since the NodeB knows the relation of all codes and midambles no mapping is required. However the use of the mapping may avoid unnecessary signalling of midambles. Moreover, also the NodeB could profit from the use of a fixed mapping since it offers the possibility of easy detection of active codes in case of multicode and DTX.

In addition, if the mappings are chosen in such a way that the midamble changes if the SF changes, the midambles could optionally be used to indicate the SF used by the UE in the UL. Taking the example of figure 1, this can be achieved if the UE always varies the channelisation code along the lower branch of the OVSF tree if the SF changes. It has to be noted that SF 16 cannot been distinguished from SF 8 in this way.

For UL the distinction between primary and secondary codes needs not to be made.

3 Conclusions

This contribution has shown some reasons why a fixed association between the midamble and the spreading code for both uplink and downlink should be defined and included in the specifications. Signalling capacity can be reduced. Moreover, if code specific midambles are introduced in the downlink, they provide a means to determine active codes in the downlink and enhance performance of joint detection, in particular in case of TxDiversity.

We propose to include in TS25.221 the rules on the allocation of midambles that are given in this contribution. In case of signalling UE specific midambles should be used for UL and DL. Additional assignments between channelisation codes and midambles for channels other than PRACH are proposed to be included in the annex of TS25.221. These assignments shall optionally be used for DPCH, PDSCH, PUSCH, S-CCPCH and PICH. An appropriate CR for TS25.221 is included in this document. Because this CR overlap with changes according to CR001r1-225, the proponents will include the relevant changes in a second revision of this CR.

4 References

[1] 3GPP TSG RAN WG1 TS25.221 v3.0.0, Physical channels and mapping of transport channels onto physical channels (TDD)

[2] 3GPP TSG RAN WG1 TDoc 99-B09, Nokia, Downlink Shared Channel (DSCH) physical layer signalling with TDD

CHANGE REQUEST

Please see embedded help file at the bottom of this page for instructions on how to fill in this form correctly.

25.221 CR xxx Current Version: 3.0.0

GSM (AA.BB) or 3G (AA.BBB) specification number ↑ *↑ CR number as allocated by MCC support team*

For submission to: RAN #6
list expected approval meeting # here ↑

for approval	X	strategic		*(for SMG use only)*
for information		non-strategic		

Form: CR cover sheet, version 2 for 3GPP and SMG The latest version of this form is available from: ftp://ftp.3gpp.org/Information/CR-Form-v2.doc

Proposed change affects: (U)SIM [ ] ME [X] UTRAN / Radio [X] Core Network [ ]
(at least one should be marked with an X)

Source: Siemens AG **Date:** 1999-11-25

Subject: Midamble allocation in TDD

Work item:

Category: *(only one category shall be marked with an X)*

F	Correction	
A	Corresponds to a correction in an earlier release	
B	Addition of feature	
C	Functional modification of feature	X
D	Editorial modification	

Release:

Phase 2	
Release 96	
Release 97	
Release 98	
Release 99	X
Release 00	

Reason for change: Default mappings between midambles and channelisation codes reduce signalling overhead and enhance UE detection performance.

Clauses affected:

Other specs affected:

Other 3G core specifications	X	→ List of CRs:	25.331-xxx
Other GSM core specifications		→ List of CRs:	
MS test specifications		→ List of CRs:	
BSS test specifications		→ List of CRs:	
O&M specifications		→ List of CRs:	

Other comments:

help.doc

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5.2.3.2 Midamble Allocation

In general midambles are part of the physical channel configuration which is performed by higher layers. In both UL and DL an individual midamble shall be assigned to each UE per time slot.

Optionally, if no midamble is allocated by higher layers, a default midamble allocation is used. This default midamble allocation is given by a fixed association between midambles and channelisation codes, see annex A.3, and shall be applied individually to all physical channels within one time slot. Thus, if no midamble is signalled the UE shall derive the midamble from the assigned channelisation code and use an individual midamble for each channelisation code. Different associations apply for different burst types and cell configurations with respect to the maximum number of midambles.

The fixed associations between midambles and channelisation codes distinguish between primary and secondary channelisation codes. For DL channels primary channelisation codes shall be allocated prior to secondary channelisation codes, if they are assigned to the same midamble.

If the UE changes the SF according to the data rate, it shall vary the channelisation code along the low branch of the OVSF tree.

5.3.2 Secondary common control physical channel (S-CCPCH)

PCH and FACH as described in section 4.1.2 are mapped onto one or more secondary common control physical channels (S-CCPCH). In this way the capacity of PCH and FACH can be adapted to the different requirements.

5.3.2.1 Spreading codes

The S-CCPCH uses fixed spreading with a spreading factor SF = 16 as described in section 5.2.1.1.

5.3.2.2 Burst Types

The burst types 1 or 2 as described in section 5.2.2 are used for the S-CCPCHs. No TFCI is applied for S-CCPCHs.

5.3.2.3 Training sequences for spread bursts

The training sequences, i.e. midambles, as described in section 5.2.3 are used for the S-CCPCH. To all S-CCPCH within one time slot one midamble shall be allocated by means of higher layers. This midamble shall not be allocated to other physical channels in the same time slot. If no midamble is signalled the default midamble allocation , cf. 5.2.3.2, applies also for the S-CCPCH.

5.3.5 Physical Uplink Shared Channel (PUSCH)

For Physical Uplink Shared Channel (PUSCH) the burst structure of DPCH as described in section 5.2 shall be used. User specific physical layer parameters like power control, timing advance or directive antenna settings are derived from the associated channel (FACH or DCH). PUSCH provides the possibility for transmission of TFCI in uplink.

For PUSCH midambles are allocated as for UL DPCH.

5.3.6 Physical Downlink Shared Channel (PDSCH)

For Physical Downlink Shared Channel (PDSCH) the burst structure of DPCH as described in section 5.2 shall be used. User specific physical layer parameters like power control or directive antenna settings are derived from the associated channel (FACH or DCH). PDSCH provides the possibility for transmission of TFCI in downlink.
To indicate to the UE that there is data to decode on the DSCH, three signalling methods are available:

1) using the TFCI field of the associated channel or PDSCH
2) using on the DSCH user specific midamble derived from the set of midambles used for that cell
3) using higher layer signalling.

When the midamble based method is used, the UE shall decode the PDSCH if the PDSCH was transmitted with the midamble indicated for the UE by UTRAN.

For PDSCH midambles are allocated as for DL DPCH.

A.3 Association between Midambles and Channelisation Codes

The following mapping schemes apply for the association between midambles and channelisation codes if no midamble is allocated by higher layers. Secondary channelisation codes are marked with a (*). These associations apply both for UL and DL.

A.3.1 Association for Burst Type 1 and K=16 Midambles

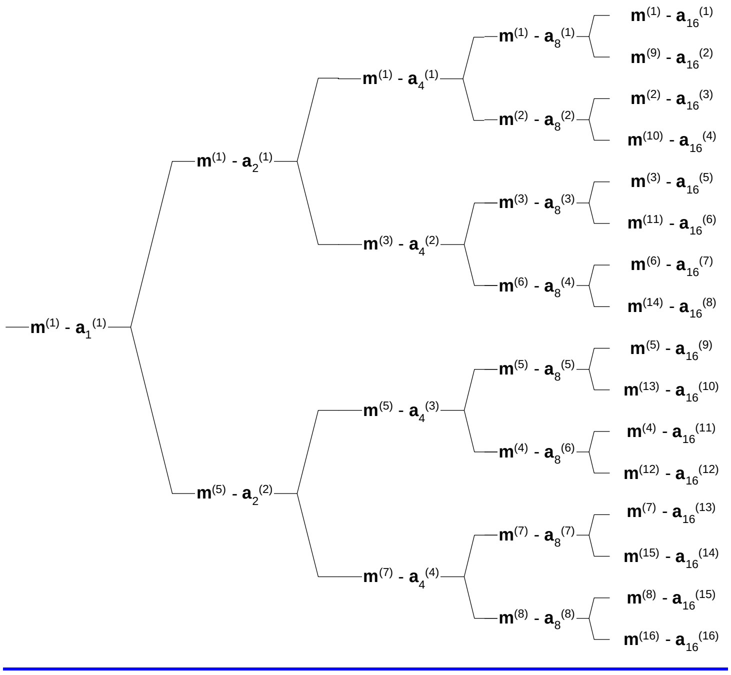

Figure A-1 Association of Midambles to Spreading Codes for Burst Type 1 and K=16

A.3.2 Association for Burst Type 1 and K=8 Midambles

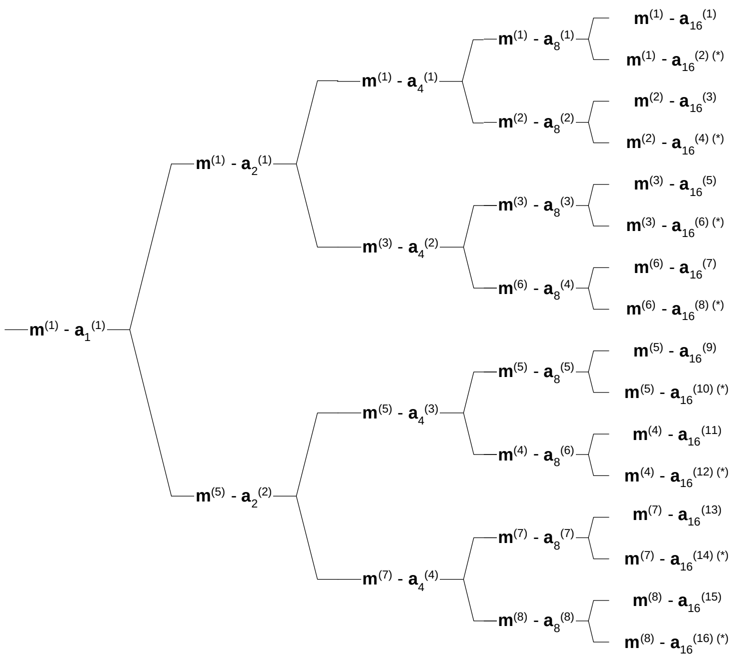

Figure A-2 Association of Midambles to Spreading Codes for Burst Type 1 and K=8

A.3.2 Association for Burst Type 1 and K=4 Midambles

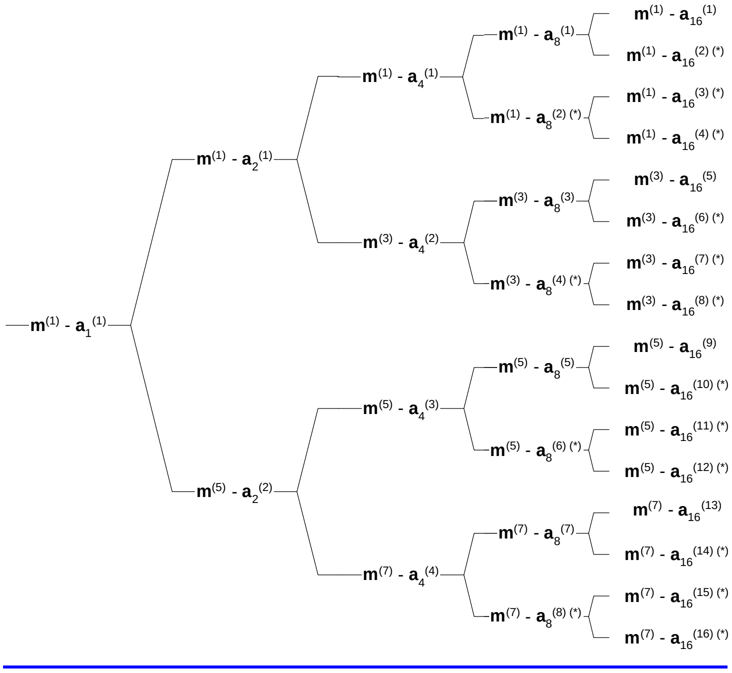

Figure A-3 Association of Midambles to Spreading Codes for Burst Type 1 and K=4

A.3.4 Association for Burst Type 2 and K=6 Midambles

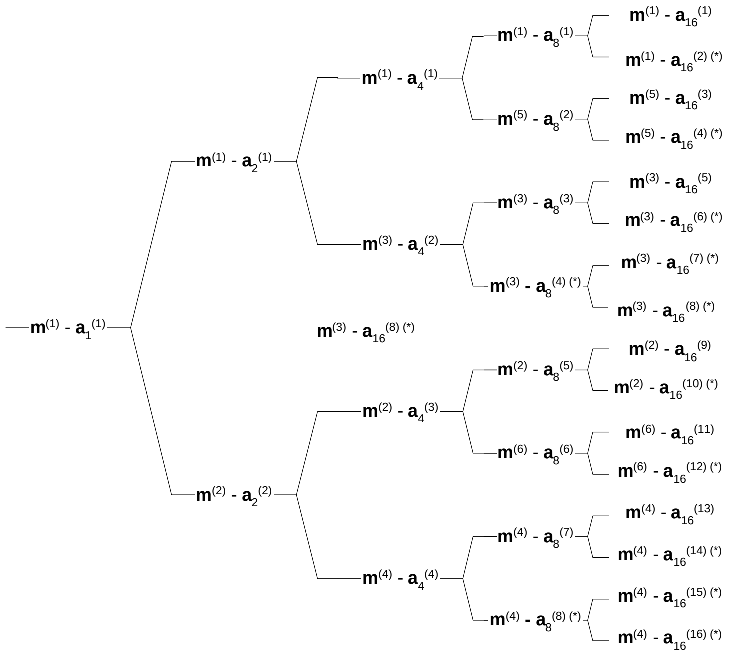

Figure A-4 Association of Midambles to Spreading Codes for Burst Type 2 and K=6

A.3.5 Association for Burst Type 2 and K=3 Midambles

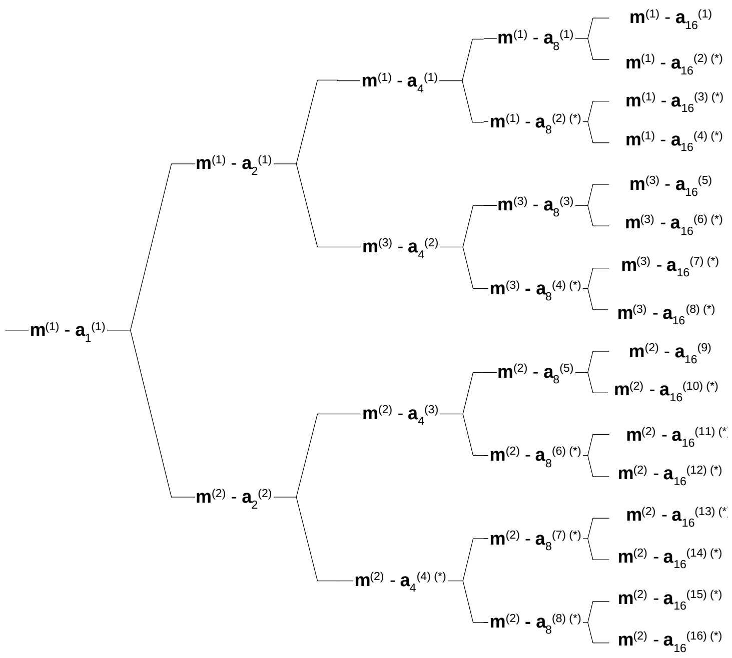

Figure A-5 Association of Midambles to Spreading Codes for Burst Type 2 and K=3

Note that the association for burst type 2 can be derived from the association for burst type 1, using the following table:

Burst Type 1	m(1)	m(2)	m(3)	m(4)	m(5)	m(6)	m(7)	m(8)
Burst Type 2	m(1)	m(5)	m(3)	m(6)	m(2)	m(4)	-	-