3GPP TSG-RAN Working Group 1, Meeting #7 **TDoc TSG RAN WG1 (99)B69**
Hanover, Germany, August 30 – September 3, 1999

Agenda Item: AdHoc 1
Source: Siemens AG
Title: Association between Midambles and Spreading Codes in TDD
Document for: Approval

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1 Introduction

On WG1 meeting #6 in Espoo a fixed association between midambles and spreading codes was defined for the PRACH, see [1]. The midamble is used by the UE to indicate which spreading code is chosen for the RACH transmission.

In this document reasons are given why the association between the midamble and the spreading code should be applied also for other channels. A proposal for this mapping is made which is similar to the one defined for the PRACH in [2]. Additionally, some simple rules are proposed for multicode transmission, when one midamble is associated with multiple codes.

2 Association between Midambles and Spreading Codes

On the uplink user specific midambles are used in order to allow joint channel estimation in the base station for the different UL channels. In the downlink in general a common midamble is used. However, if beam forming or TxDiversity is applied different midambles are needed for the downlink as well. Moreover, to measure the received CCPCH power by means of the midamble for power control and handover, a separate midamble should be used for the primary CCPCH [3].

At present, in [4] a fixed association between midambles and spreading codes is defined for the PRACH only. For the RACH transmission the network cannot assign a combination of midamble and spreading code to the UE. Therefore, considerable additional complexity would be necessary in the base station to find out this combination.

There are several reasons, why a fixed mapping should be introduced for other physical channels as well:

- At the initial access, the UE must be able to read broadcast information. Therefore, the primary CCPCH, carrying the BCH, must have a fixed configuration, e.g. a fixed spreading code which is associated with a particular midamble.
- Currently, the physical channel configuration, which has to be signalled to the UE, must include not only the spreading code but also the midamble. Transmission of the midamble allocation is not desirable, because it is additional signalling and makes the signalling PDUs different to that defined in the FDD system.
- If user specific midambles are used in the DL, they give an indication to the UE of which spreading codes are active in the DL. This may reduce the terminal complexity and increase detection performance if joint detection is applied in the UE.

There are currently three configurations of the midamble:

- Burst type 1 with a 512 chip midamble sequence and 8 different midambles
- Burst type 1 with a 512 chip midamble sequence and 16 different midambles
- Burst type 2 with a 256 chip midamble sequence and 3 different midambles

Using preliminary information from [5] two additional configurations are possible:

- Burst type 1 with a 512 chip midamble sequence and 4 midambles
- Burst type 2 with a 256 chip midamble sequence and 6 midambles

We propose to define fixed associations between midambles and spreading codes for all physical channels, as given in figures A-1 and A-2. If cells are configured to use a subset of all possible shifts (i.e. 4 or 8 shifts in the case of burst type 1 and 3 shifts in the case of burst type 2) the corresponding subtree is valid only. Please note

that if spreading codes are not assigned to a midamble, these codes may be allocated only in case of multicode transmission. In the case that two basic periodic codes are used for the PRACH the association of figure A-3 applies.

Note that in the case of variable spreading, the midamble may need to change when the spreading factor changes. By appropriate assignment rules it is possible to mostly avoid the need to change the midamble when the spreading factor changes.

For multicode transmission an additional rule has to be applied, since the midambles are user specific (many-to-one mapping) and not code specific (one-to-one mapping). The simple rule adopted for determining which midamble applies in a multicode group is that the midamble with the lowest index applies. Thus, when spreading codes are no longer needed due to say one service in a multiplex ending, the allocation algorithm must remove spreading codes associated with higher indexed midambles first, in order to avoid inconsistencies. Consequently the spreading code associated with the lowest indexed midamble is always the last to be removed. Figure A-4 shows an example for the association of a midamble with a multicode group.

A user that occupies more than one time slot may have different midambles in different time slots. This simply results from the fact that otherwise the midamble determines the codes that have to be used in all time slots. This restriction should be avoided for a flexible resource allocation.

In general, the association is valid both for the uplink and for the downlink. For release 99, however, for uplink transmission at most two codes with different spreading factors should be used, and in downlink only multicode with spreading factor SF=16 should be used. Reasons for this are given in [6]. This restriction and the fixed association of midambles to spreading codes provides a simple means to determine codes that are present in the downlink. At least those codes that have a fixed associated midamble are active if and only if this midamble is used. This indication simply results from the joint channel estimation. If multiple codes are allocated to one user, these codes do not get a separate midamble. Thus, their presence cannot be detected in such an easy manner.

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. Currently, this exists only for the PRACH. At least, for the primary CCPCH this association has to be known as well. Signalling capacity can be reduced when introducing the mapping also for the other channels. Moreover, if user specific midambles are introduced in the downlink also, they provide a means to determine active codes in the downlink.

We propose to include a general remark about the fixed association into the specification text and to put the figures (including the one for the PRACH) into the annex of the specification. An appropriate textproposal is given in section 5 of this document.

4 References

[1] 3GPP TSG RAN WG1 TDoc 99-858, Mapping between Midamble Offsets and Spreading Codes for PRACH in TDD

[2] 3GPP TSG RAN WG1 TDoc 99-A04, Textproposal for the Mapping between Midamble Offsets and Spreading Codes for RACH in TDD

[3] 3GPP TSG RAN WG1 TDoc 99-B65, Common Channel Terminology in TDD mode

[4] 3GPP TSG RAN WG1 TDoc 99-A25, Update of specification document TS25.221

[5] 3GPP TSG RAN WG1 TDoc 99-B66, Physical Channel Definitions in TS25.221

[6] 3GPP TSG RAN WG1 TDoc 99-B68, Inclusion of a Clause for Detailed Channel Coding in TDD

5 Textproposal

We propose to remove subsection 5.3.2.4 ‘Association between Training Sequences and Spreading Codes’ which is for the PRACH only and to include the following new subsection in TS25.221:

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5.2.3.2 Association between Training Sequences and Spreading Codes

There exists a fixed association between the training sequences and the spreading codes. The Figures A-1 and A-2 in annex A show the complete association trees, valid for burst type 1 and 2, respectively. If cells are configured to use a subset of all possible shifts (i.e. 4 or 8 shifts in the case of burst type 1 and 3 shifts in the case of burst type 2) the corresponding subtree is valid only. Please note that if spreading codes are not assigned to a midamble, these codes are used only for multicode transmission.

In the case that two Basic Midamble Sequences m_1 and m_2 are used for the PRACH the association of figure A-3 applies.

In the case of multicode transmission the midamble is not associated with a single spreading code but with a multicode group. In that case the midamble with the lowest index applies for the whole group. An example for this association is illustrated in figure A-4 in annex A.

The allocation algorithm must not allocate spreading codes to a user when the associated midamble of which is already assigned to another user. A user that occupies more than one time slot may have different midambles in different time slots.

---------- End of text proposal ----------

We propose to include the following figures in annex A of [4]:

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A.3 Association between Training Sequences and Spreading Codes

The following mapping schemes apply for the association between training sequences and spreading codes. 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)	-	-

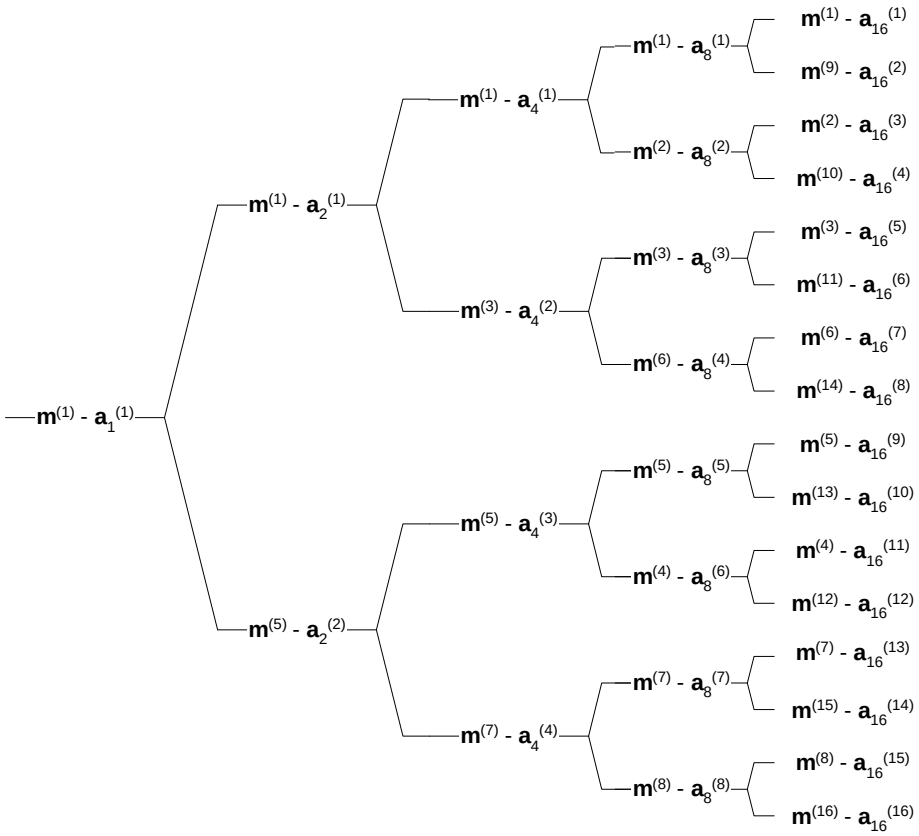


Figure A-1 Association of Midambles to Spreading Codes for Burst Type 1

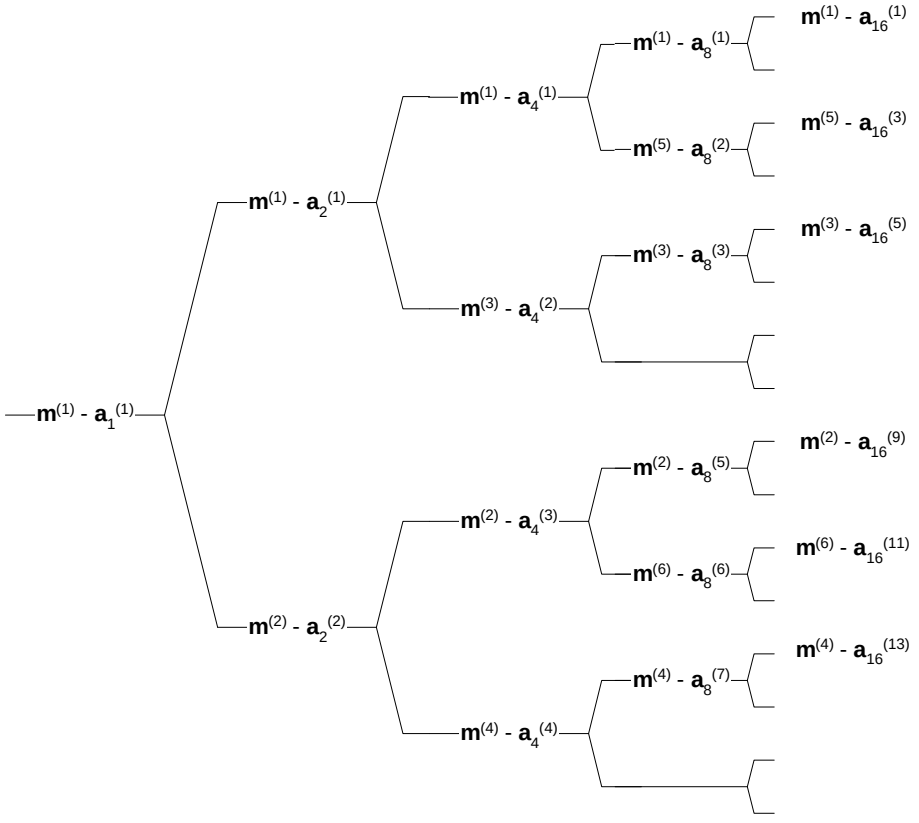


Figure A-2 Association of Midambles to Spreading Codes for Burst Type 2

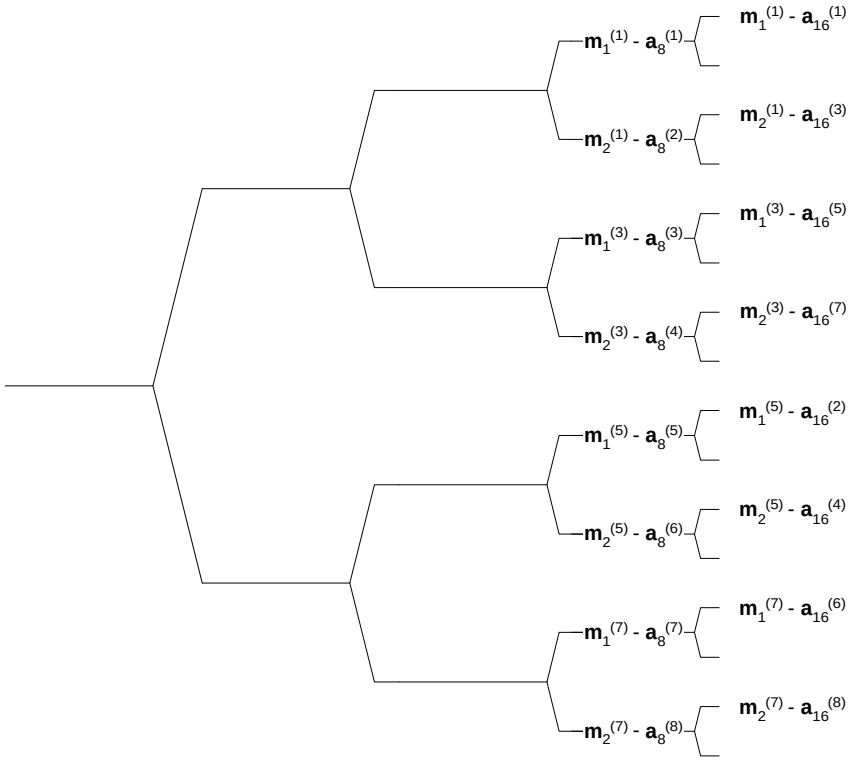
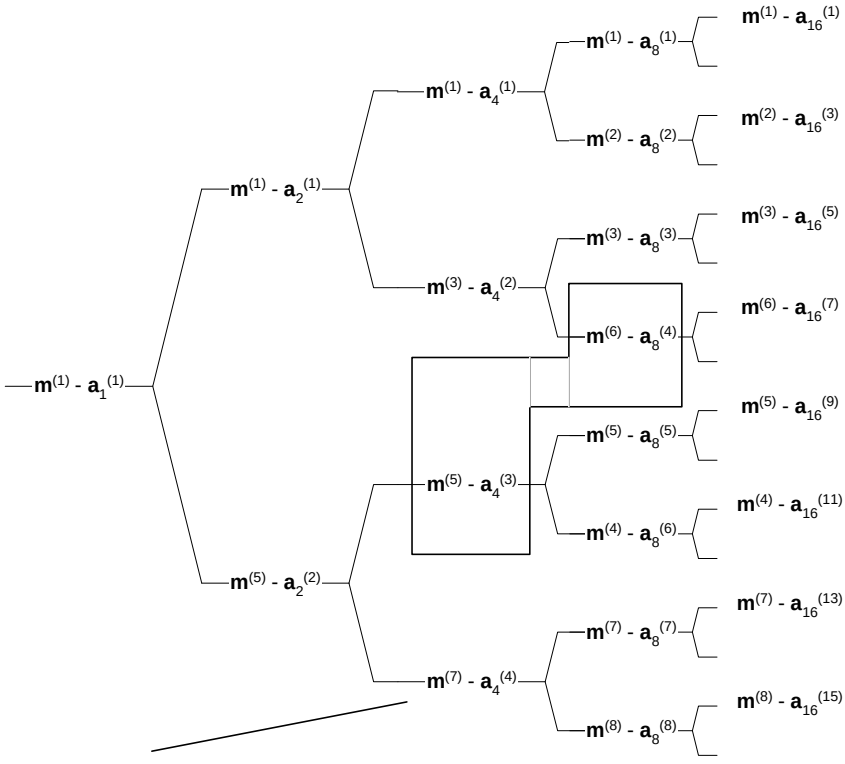


Figure A-3 Association of Midambles to Spreading Codes for the PRACH in the Case of Two Different Periodic Basic Codes and 4 Possible Midambles per Code



Multicode Group with 2 codes SF=4 and 2 codes SF=8, apply midamble with lowest index : $\mathbf{m}^{(5)}$

Figure A-4 Example for the Association of a Midamble with a Multicode Group in Case of Burst Type and 8 Possible Midambles

---------- End of text proposal ----------