3GPP TSG-RAN Working Group 1, Meeting #6   **TDoc TSG RAN WG1 (99)858**
Espoo, Finland, July, 13-16 1999

Agenda Item:
Source: Siemens AG
Title: Mapping between Midamble Offsets and Spreading Codes
                      for RACH in TDD
Document for: Approval

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1 Introduction

Currently within the UTRA TDD system there is no fixed association defined between the midamble offsets and spreading codes used by the mobile. This is no problem for the DCH, since it is assumed that the midamble offset that the mobile should use for the DCH on the uplink is signalled. For the RACH however, the lack of a fixed relationship between midamble offsets and spreading codes causes a problem. If there is no fixed relationship there is a lack of knowledge in the receiver of how the midamble offset and the spreading code are related. It is possible to identify the relationship in the receiver, but at the expense of considerable effort. In this document a fixed relationship between the midamble offset and the spreading code for RACH is introduced.

2 Definition of the Fixed Association between Midambles and Spreading Codes for the RACH

For the RACH transmission, the mobile will not have a spreading code assigned to it, neither will it have a midamble offset assigned to it, as potentially the mobile may have had no previous communication with the base station. Therefore a fixed association between midamble offset and spreading code needs to be defined for the RACH transmisson in order to avoid considerable additional complexity in the base station.

For the PRACH, the different midambles $\mathbf{m}_i^{(k)}$ are time shifted versions of a small set of different periodic basic codes $\{\mathbf{m}_i, \mathbf{m}_i \in \{ \mathbf{m}_{PLj}., j=0,...,127\}, i=1,2,...\}$ The time shifts are obtained by choosing either *all* $k=1,2,3..., K$ (for cells with small radius) or *uneven* $k=1,3,5,...,\leq K$ (for cells with large radius) out of the set of possible time shifted versions $\mathbf{m}_i^{(k)}$. The uplink PRACH uses fixed spreading with a spreading factors $Q=16$ or $Q=8$.

The generic rule to define the association between midambles and spreading codes is based on the order of the spreading codes $\mathbf{a}_Q^{(k)}$ given by k and the order of the midambles $\mathbf{m}_i^{(k)}$ given by k, firstly, and i, secondly, with the constraint that the midamble for a spreading factor Q is the same as in the upper branch for the spreading factor $2Q$.

For the case that all k are allowed and there is only one periodic basic code available for the RACH, the association depicted in figure 1 is straightforward. For the case that only odd k are used and there are more than one periodic codes assigned to the RACH, the principle of the association is shown in figure 2 for two basic periodic codes.

3 Conclusions

Defining a fixed association between the midamble offset and the spreading code is a necessity for the RACH to avoid additional complexity in the base station. Therefore, we propose to define a simple association between codes and midambles that is given by the inherent order of codes and midambles. An appropriate textproposal is given in section 4.
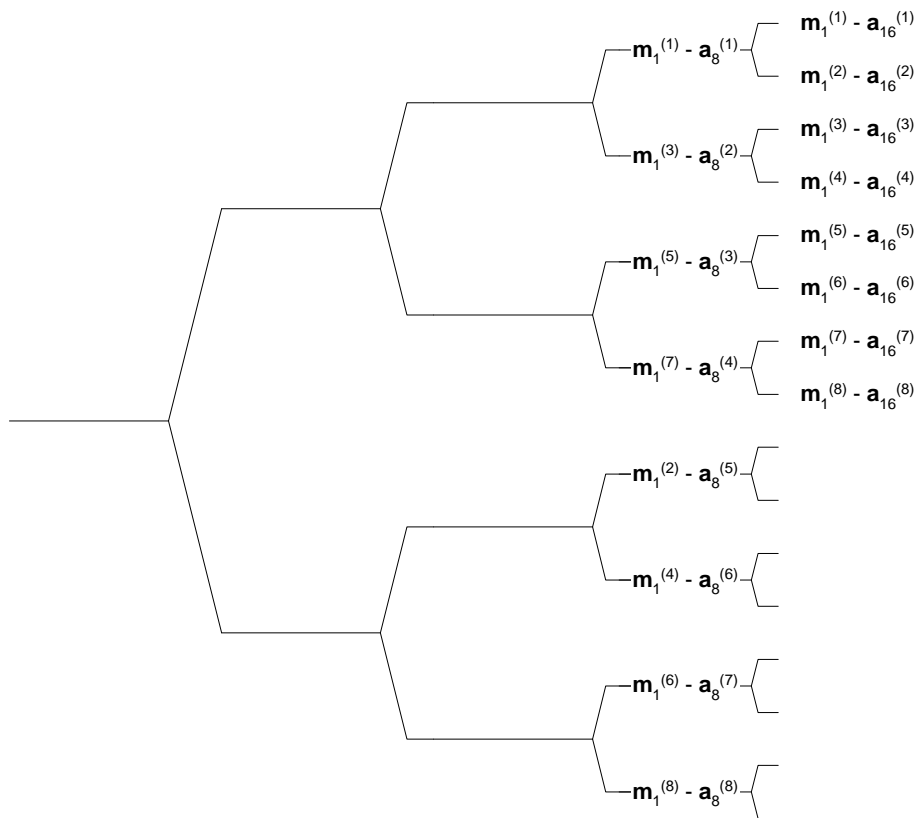
$m_1^{(1)} - a_8^{(1)}$ — $m_1^{(1)} - a_{16}^{(1)}$, $m_1^{(2)} - a_{16}^{(2)}$

$m_1^{(3)} - a_8^{(2)}$ — $m_1^{(3)} - a_{16}^{(3)}$, $m_1^{(4)} - a_{16}^{(4)}$

$m_1^{(5)} - a_8^{(3)}$ — $m_1^{(5)} - a_{16}^{(5)}$, $m_1^{(6)} - a_{16}^{(6)}$

$m_1^{(7)} - a_8^{(4)}$ — $m_1^{(7)} - a_{16}^{(7)}$, $m_1^{(8)} - a_{16}^{(8)}$

$m_1^{(2)} - a_8^{(5)}$

$m_1^{(4)} - a_8^{(6)}$

$m_1^{(6)} - a_8^{(7)}$

$m_1^{(8)} - a_8^{(8)}$

Figure 1 Association of Midambles to Spreading Codes in the OVSF tree for all *k*

$m_1^{(1)} - a_8^{(1)}$ — $m_1^{(1)} - a_{16}^{(1)}$, $m_1^{(3)} - a_{16}^{(2)}$

$m_1^{(5)} - a_8^{(2)}$ — $m_1^{(5)} - a_{16}^{(3)}$, $m_1^{(7)} - a_{16}^{(4)}$

$m_2^{(1)} - a_8^{(3)}$ — $m_2^{(1)} - a_{16}^{(5)}$, $m_2^{(3)} - a_{16}^{(6)}$

$m_2^{(5)} - a_8^{(4)}$ — $m_2^{(5)} - a_{16}^{(7)}$, $m_2^{(7)} - a_{16}^{(8)}$

$m_1^{(3)} - a_8^{(5)}$

$m_1^{(7)} - a_8^{(6)}$
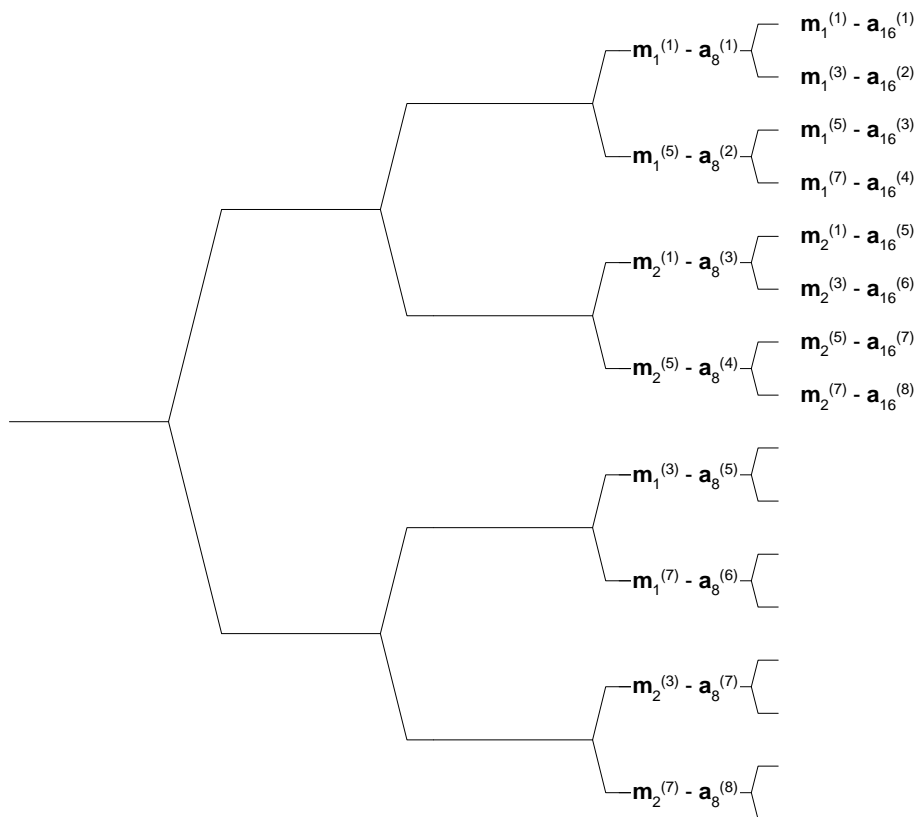
$m_2^{(3)} - a_8^{(7)}$

$m_2^{(7)} - a_8^{(8)}$

Figure 2 Association of Midambles to Spreading Codes in the OVSF tree for odd *k*

4 Textproposal

We propose to include the following new subsection in [1]:

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5.3.2.4 Association between Training Sequences and Spreading Codes

For the PRACH there exists a fixed association between the training sequence and the spreading code. The generic rule to define this association is based on the order of the spreading codes $\mathbf{a}_Q^{(k)}$ given by k and the order of the midambles $\mathbf{m}_i^{(k)}$ given by k, firstly, and i, secondly, with the constraint that the midamble for a spreading factor Q is the same as in the upper branch for the spreading factor $2Q$. The index i indicates the different basic periodic codes.

For the case that all k are allowed and there is only one periodic basic code available for the RACH, the association depicted in figure 23 is straightforward. For the case that only odd k is used and there are more than one periodic codes assigned to the RACH, the principle of the association is shown in figure 24 for two basic periodic codes.
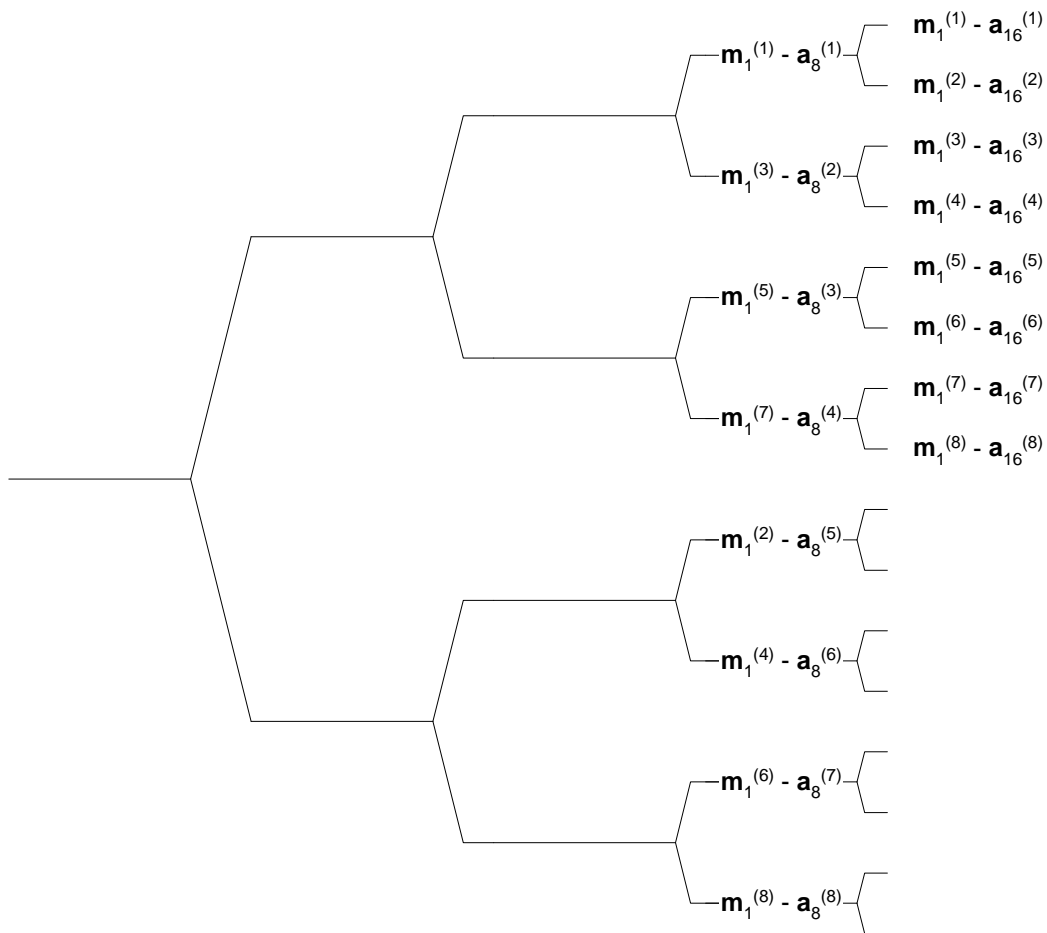

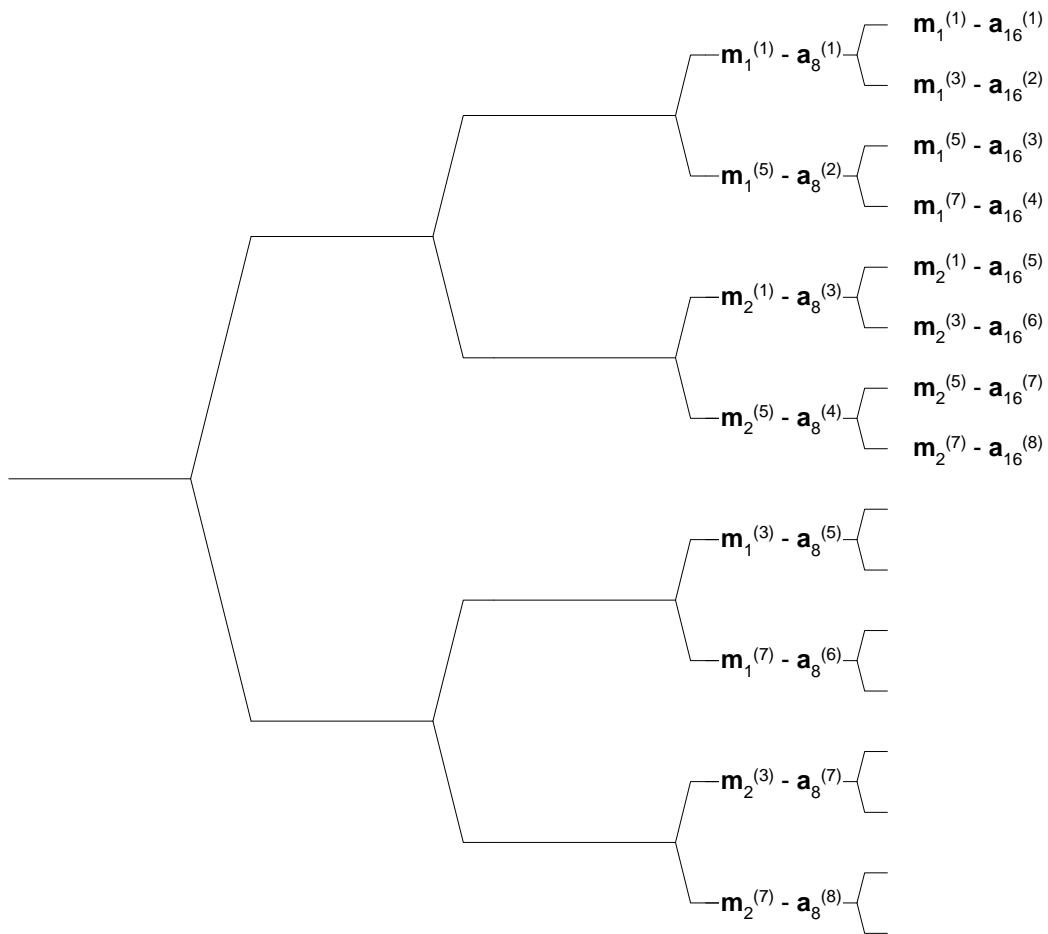**Figure 23 Association of Midambles to Spreading Codes in the OVSF tree for all _k_**

Figure 24 Association of Midambles to Spreading Codes in the OVSF tree for odd _k_

-- End of text proposal   ---

5 References

[1]   3GPP TSG RAN WG1 TS 25.221, vers. 1.1.1, Physical channels and mapping of transport channels onto physical channels (TDD)