**TSG-RAN Working Group1 meeting #3~~_____~~ ~~————~~TSGR1#3(99)19~~2~~~~68~~**

**Source: InterDigital Communications Corporation**

**Title: TDD RACH Frame Structure**

## 1 Introduction

The current TDD RACH frame structure provides two frames per time slot/code . This structure provides 42bits for the "data payload". RACH channels are common to multiple UE's and therefore require ~~the subscriber identifier "RNTI"~~ explicit identification of the subscriber (S-RNTI+RNC-ID or C-RNTI during RRC connection) in the header of each frame. ~~The~~ Already C-RNTI, being the shortest identifier, requires at least 16bits of the data payload, which leaves 26bits of actual transfer per frame. The FDD RACH frame structure allows for a 53 octet payload (@128 Kbps) as shown in the Table 1. It is assumed that 1/3 convolutional encoder is used. This allows for far greater flexibility for higher layer signaling. A Liaison Statement to TSG RAN WG1 from TSG RAN WG2 states that WG2 sees an advantage to have the same amount on user data payload on the RACH for FDD and TDD [1]. This paper proposes a new frame structure for TDD RACH which reduces the imbalance between the payloads of TDD RACH and FDD RACH.

Table 1. Allowable payload in FDD RACH

| Channel transmission rate | # of channel bits per 10-ms frame | # of data symbols per 10-ms frame | In octet (octet) |
|---|---|---|---|
| 128 kbps | 1280 | 427 | 53 |
| 64 kbps | 640 | 213 | 26 |
| 32 kbps | 320 | 107 | 13 |

## 2 Discussion

An important consideration for system design is alignment of RAN layer 2 and 3 signaling for FDD and TDD implementations. With the limited TDD RACH data payload extra steps are required for transfer of higher layer data. Secondary establishment of Dedicated Channels (DCH) or implementation of RACH Segmentation and Re-assembly (SAR) functions could be considered. These options are inefficient and create greater complexity in RAN layer 2-3 design.

Another consideration is the efficient use of air resources. Splitting a single time slot/code between two RACH frames requires two mid-ambles and two guard periods, which greatly reduces the amount of effective data transfer per time slot/code.

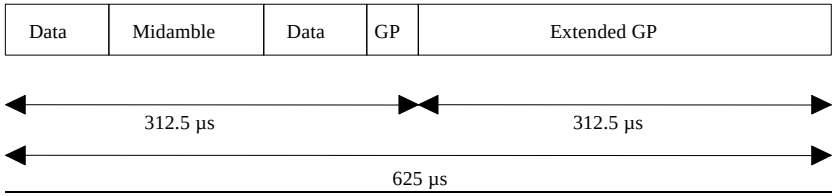
## 3 The Proposed Frame Structure for TDD RACH

The current TDD RACH frame structure is as follows:

ETSI:

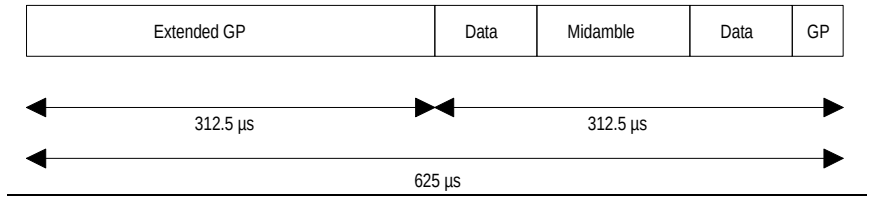
*The contents of the access burst 1 fields*

| Chip Number (CN) | Length of field in chips | Length of field in symbols | Length of field in µs | Contents of field |
|---|---|---|---|---|
| 0-335 | 336 | 21 | 82.0 | Data symbols |
| 336-847 | 512 | - | 125.0 | Midamble |
| 848-1183 | 336 | 21 | 82.0 | Data symbols |
| 1184-1279 | 96 | - | 23.4 | Guard period |
| 1279-2559 | 1280 | - | 312.5 | Extended guard period |

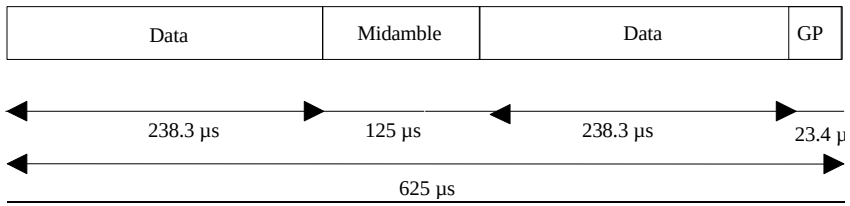


*The contents of the access burst 2 fields*

| Chip Number (CN) | Length of field in chips | Length of field in symbols | Length of field in µs | Contents of field |
|---|---|---|---|---|
| 0-1279 | 1280 | - | 312.5 | Extended guard period |
| 1280-1615 | 336 | 21 | 82.0 | Data symbols |
| 1616-2127 | 512 | - | 125.0 | Midamble |
| 2128-2463 | 336 | 21 | 82.0 | Data symbols |
| 2464-2559 | 96 | - | 23.4 | Guard period |




If this is replaced with the following single RACH frame per time slot structure, the data transported per RACH frame is increased from 42bits (5 octets) to 122bits (15 octets). The effective data transferred is increased by 190% per RACH and overall increase in RACH data throughout 45% per assigned time slot. These figures are more dramatic when the ~~MAC-c RNTI,~~ layer 2 and 3 headers <u>including UE identification</u> are taken into consideration.




Proposed TDD RACH frame structure

## 4 Conclusion

Essentially the proposed frame structure for RACH in TDD is just a more efficient use of resources. Additionally the proposed frame structure provides more flexibility in determining the length of the guard period. It may be desirable to make the guard period longer to address the effect of large propagation delays and channel delay spread as discussed in [2]. The only difficulty with the approach is there is an increase in RACH frame contention, but the maximum number of RACH's can just be increased to address this concern.

## References

[1] Liaison Statement to TSG RAN WG1 on Random Access and Hybrid ARQ Type II/III, TSG-RAN Working Group1 meeting #3, Nynashamn 22-26, March 1999, TSGR1#3 (99) 168.
[2] Dimensioning of RACH capacity for UTRA TDD mode: Packet Delay, Large Cell Radius, Capacity Requirements, TSG-RAN Working Group1 meeting #3, Nynashamn 22-26, March 1999, TSGR1#2 (99) 132.