**3GPP TSG RAN WG1 Meeting #5** ***TSGR1#5(99)552***
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**Source:** **Philips**

**Title:** **Fast Layer 1 acknowledgment for FAUSCH**

**Agenda item:**

**Document for:** **Discussion**

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## Summary

This document proposes methods for using the AICH to achieve fast layer 1 acknowledgment for the FAUSCH in FDD mode.

## Discussion

Whilst the benefits of FAUSCH for fast, collision free, uplink signalling are well known, it is also apparent that the performance of the FAUSCH is constrained by the requirement for acknowledgment via L2/3 signalling on the FACH. Although this constraint is not as limiting on the FAUSCH as it would be on the RACH, it is still beneficial to have fast L1 based acknowledgment for the FAUSCH. This would allow, for example, power ramping on a frame by frame basis, since acknowledgment is available in the same frame as the uplink request. Given that RACH and FAUSCH are both supported by the PRACH, it is considered sensible to achieve this via the AICH [1].

Figure 1 shows the timing of the AICH for a RACH only channel.

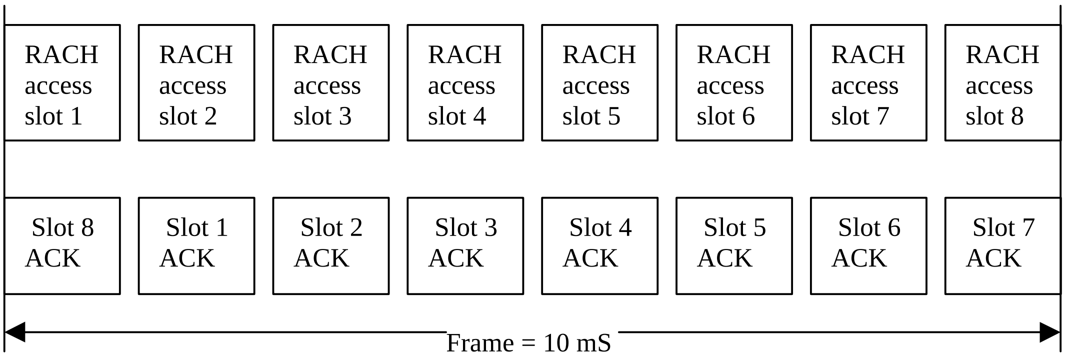


Fig. 1. Relative timing of RACH and AICH.

Figure 2 shows the impact of assigning some FAUSCH slots on the PRACH. Figure 3 shows how the assignment of FAUSCH and RACH could be interleaved. In this case there is no interruption of RACH pre-amble ramping arising from the inclusion of FAUSCH slots.

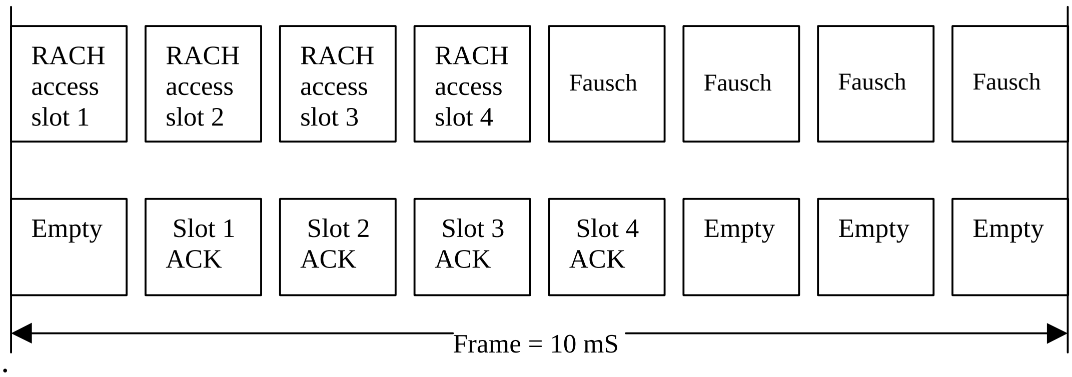


Fig. 2. Relative timing of RACH/FAUSCH and AICH.

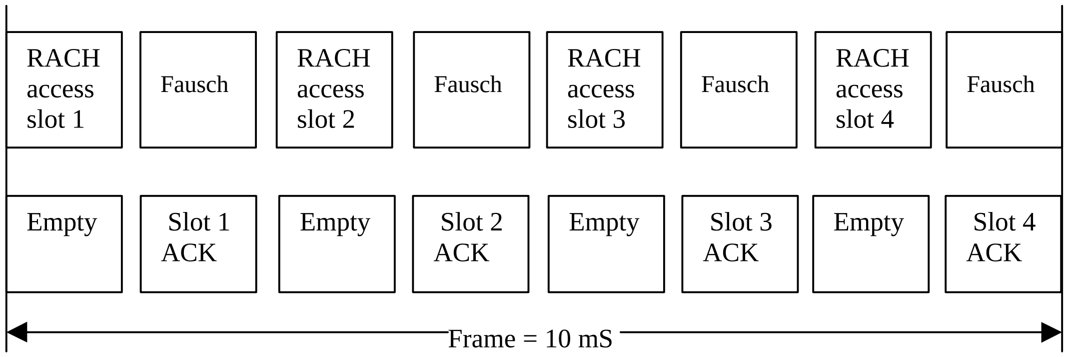


Figure 3. Alternative assignment of RACH/FAUSCH and AICH slots

It is proposed to use the spare (empty) AICH slots for acknowledgment of the FAUSCH signals, and two techniques have been identified.

(1) In the first technique, the structure of the AICH slot is identical to that of the corresponding FAUSCH slot (Fig. 4). One preamble (preferably the same as chosen for FAUSCH signalling, since it is assumed to have the most appropriate correlation properties) is broadcast in a fast access slot to indicate acknowledgment of a FAUSCH transmission within the same fast access slot of the corresponding FAUSCH allocation on the PRACH (Fig. 5). Since the relative power of the AICH transmissions is fixed, the mutual interference of the preambles on the AICH (downlink) will be less than that in the FAUSCH (uplink).

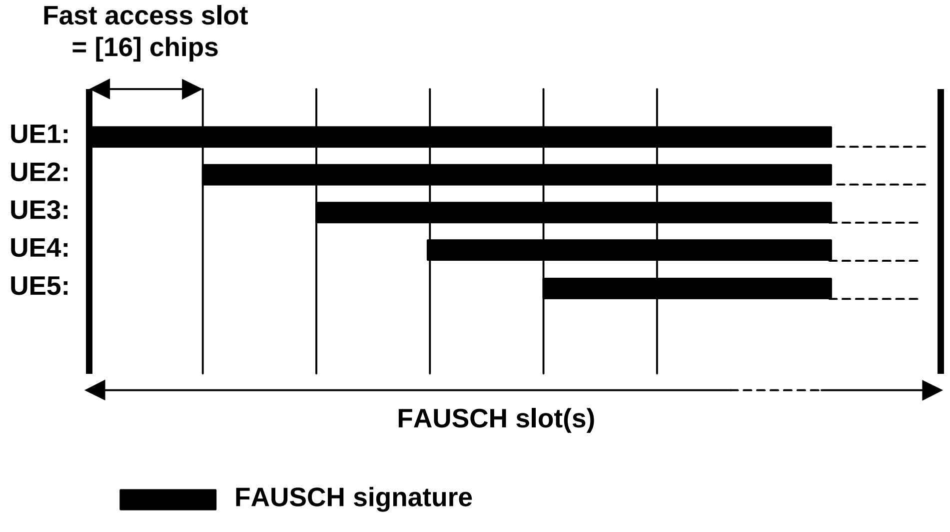


Fig. 4. Structure of PRACH allocation for FAUSCH.

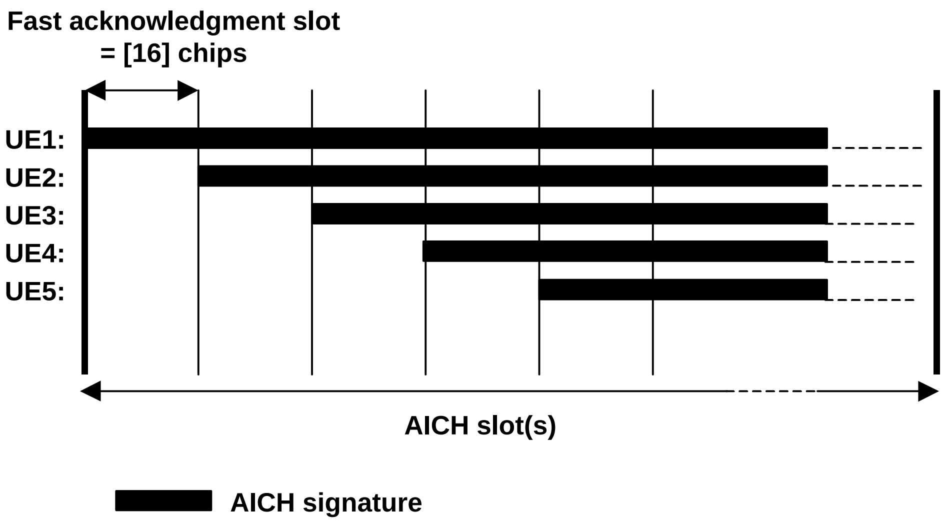


Fig. 5. Possible structure of AICH slot for FAUSCH acknowledgment.

(2) In the second technique, all 16 preambles are used for acknowledgment. Since FAUSCH fast access slots are spaced 16 chips apart, we are able to use 16 parallel acknowledgments spaced 256 chips apart (Fig. 6). This allows us to maintain complete orthogonality of the (256 chip) spreading code.

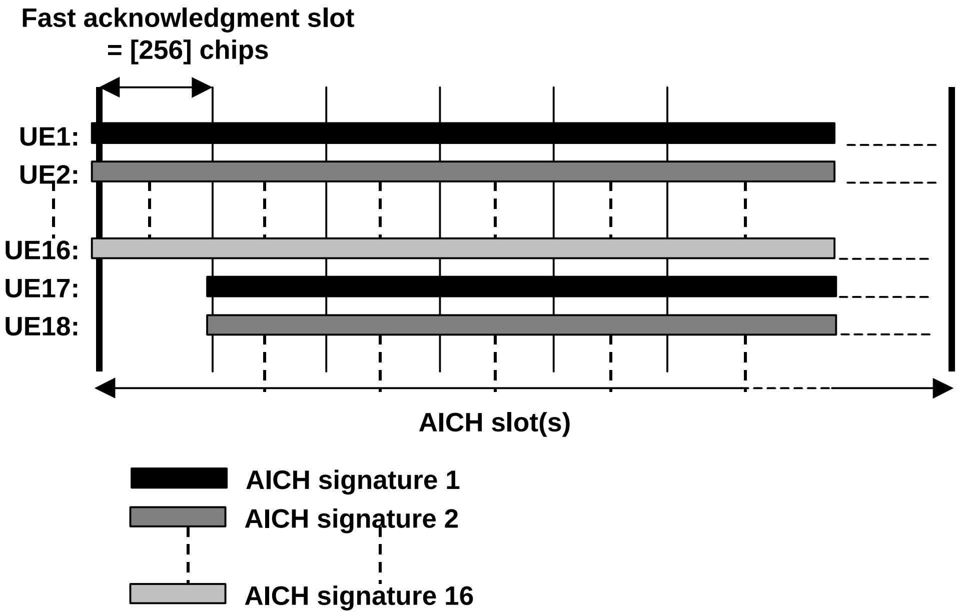


Fig 6. Alternative structure of AICH slot for FAUSCH acknowledgment.

Again, the relative power and timing of the parallel signatures can be optimally controlled, since this is a downlink transmission. Although all 16 signatures are used, a UE will only need to receive one, so there is not a receiver complexity issue.

Comparing the two schemes it appears that there is little to chose between them. Since the first scheme only requires generation of one AICH signature, it may require less complexity at the transmitter - although the capability to generate all 16 signatures is already required to support the RACH. On the other hand, the second scheme guarantees orthogonality of the spreading codes, which may provide slightly higher capacity in the system.

[3] Nokia, “Comments on the proposed RACH sequence structure”, TSGR1(99)377