TSG GERAN #3
Boston, United States
15th-19th January 2001

Tdoc GERAN 01-0272
Agenda Item 7.1.5.4

Source : Motorola

FACCH Transmission during Silence Periods in OS2

1. Introduction

This document proposes a mechanism for encapsulating FACCH traffic into CS-1 RLC packets during the speech silence periods in OS2. This mechanism does not involve the RLC layer and eliminates the overhead associated with the current proposal of transmitting FACCH traffic as a short speech burst [2].

This proposal is inspired on the mechanism for encapsulating either LAPDm or RLC packets into FACCH or PACCH proposed by Lucent [1], which is RLC-based. However, impacts on GERAN fixed network are avoided as the proposal only affects the physical layer and therefore the PCU is not involved anymore.

2. Existing Proposals

There are two proposals for OS2 multiplexing. In each of them the transmission of FACCH during silence periods is tackled in a different way.

2.1 Solution associated with the agreed Working Assumption for OS2

A working assumption for OS2 was agreed upon in Norrtalje, November 2000 [4]. It proposes a state-based physical layer, using the AMR-based physical layer markers (see [3], [6]) ONSET, SID-FIRST, SID-UPDATE and FORCE-SILENCE. The multiplexing capabilities among speech, best-effort data and high-priority data (e.g. SIP traffic) are provided by the physical layer. Figure 1 and Figure 2 illustrate the agreed operation mode in OS2 for transitions between talkspurts and silence periods.

During speech silence periods, best-effort data is transmitted using MCS1-9 or CS1-4 and block interleaving (see Figure 2). The beginning of a talkspurt is identified by the detection of an ONSET frame and (if this frame is lost) by the all-zero stealing bits sequence, which is reserved for speech frames.

The solution proposed for transmission of FACCH traffic during speech silence periods is illustrated in Figure 3. The FACCH burst is treated as a short speech burst and therefrom it is framed by an ONSET and a SID-FIRST frames.

Figure 1. Full-rate speech, FACCH and data after end of talkspurt

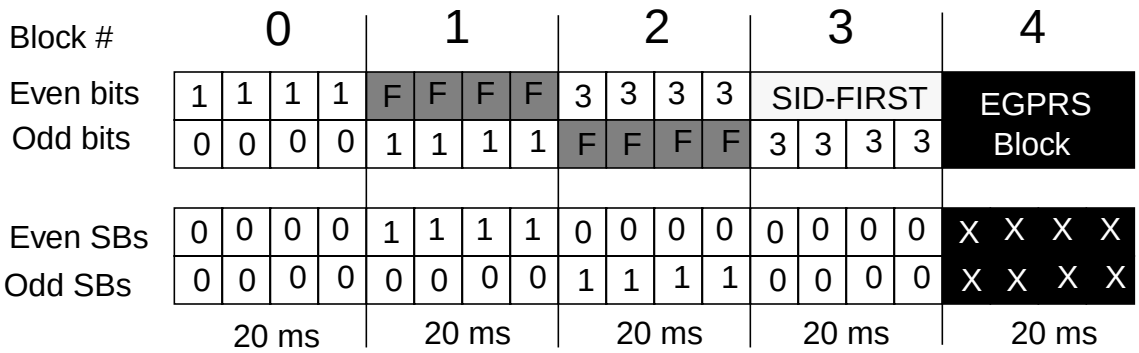


Figure 2. Full-rate talkspurt after speech silence period

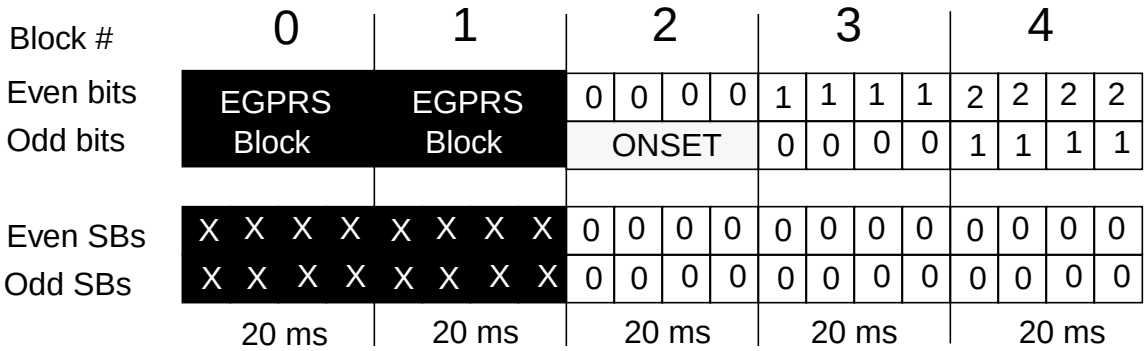
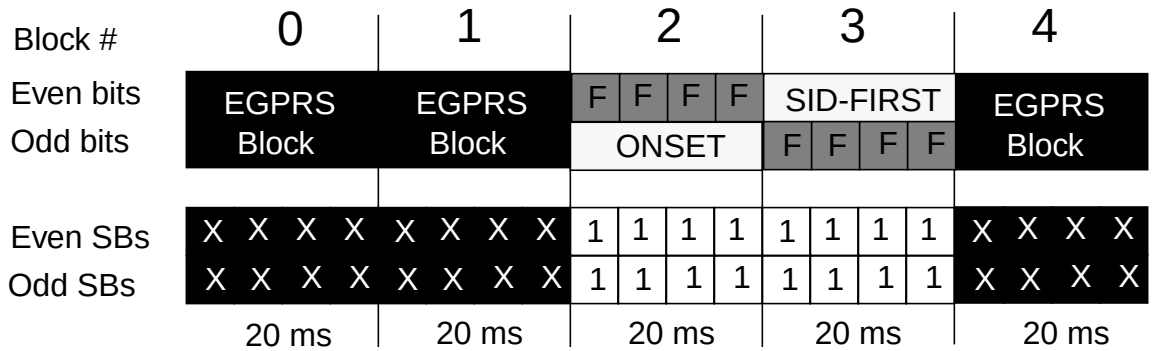


Figure 3. FACCH Transmission during speech silence period



2.2 Nortel proposal for OS2

In the GERAN ad-hoc meeting held in Orlando, December 2000, Nortel presented an alternative proposal for OS2 [6]. This approach is stateless.

It proposes two different schemes:

- A basic scheme for legacy transceiver support where all the data are conveyed in FACCH (and therefore diagonally interleaved with the all-1s stealing bits sequence). In this approach, during silence periods it is proposed that FACCH is handled like a short speech burst, i.e. preceded by an ONSET and followed by a SID-FIRST frame (we assume that the rationale behind this is to distinguish between data and real FACCH during silence periods, as both traffics have associated the same all-1s stealing bits sequence).

- A stateless approach where three different stealing bits sequences maximizing the hamming distance (i.e. the all-0s and all-1s SB sequences are not used anymore) are possible. The three SB sequences identify Speech, data (MCS1-4) and FACCH/PACCH/CS-1.

3. Proposed Solution

The FACCH blocks are channel coded using LAPDm. This packet is passed to the physical layer, which sets the first two bits of the header to 1, code the packet using the standard SACCH/FACCH/CS-1 channel coding and transmit it with the CS1 associated stealing bits.

The receiving physical layer entity reads the stealing bits, uses the CS1 channel decoding and reads the two first bits of the packet. If the combination [1,1] occurs, the phisical layer resets the first two bits and passes the packet to DLC.

This mechanism works because the first two bits of a CS-1 packet correspond to the PT field, whose [1,1] combination is so far unused. On the other hand, only SMSCB messages cannot be transmitted over FACCH using this mechanism (see [1]), but they still can be transmitted during talkspurt periods.

Thus, during the speech silence periods, instead of transmitting the FACCH block preceded by an ONSET frame and followed by a SID-FIRST frame, FACCH radio blocks are transmitted over the air the first two bits of the packet set to 1, block interleaved, and with the stealing bits sequence associated with CS1.

In summary, the unused value [1,1] of the PT field is used to identify FACCH packets from other data.

4. Advantages of the Mechanism

The advantages of the proposed mechanism are twofold. Firstly, increased bandwidth efficiency: FACCH packets are coded using LAPDm and are transmitted without any added overhead. On the contrary, if just one FACCH packet is transmitted during a silence period, the mechanisms based on transmission as short speech bursts (see Figure 3) incur in an overhead which amounts to 100%. If the FACCH traffic is bursty, the bandwidth efficiency of the “speech-based” mechanisms is bound to be poor.

The second advantage is simplicity. If an ONSET frame is missed by the receiver and what follows is speech there is a straightforward recovery mechanism based on the stealing bits, as the all-0s SB sequence is reserved for voice. However, if what follows the ONSET frame is FACCH traffic carrying the all-1s SB sequence, there is not such a recovery mechanism as the all-1s SB sequence is only used during speech activity periods and is not reserved during silence periods. Thus, the proposed mechanism reduces the number of error scenarios that need be studied for the state-based approach for OS2.

5. Conclusions

A new mechanism for transmission of FACCH traffic during silence periods in OS2 has been presented. The proposed solution affects neither the RLC layer nor (consequently) the PCU, so no impact on GERAN fixed network is expected.

FACCH packets are coded using LAPDm. The physical layer sets the first two bits of the packet to 1, uses the legacy channel coding (SACCH/FACCH/CS1) and the stealing bits sequence associated with CS1.

The advantages of the proposed solution are bandwidth efficiency and simplicity, as the number of error scenarios in the state-based approach for OS2 is significantly reduced. Moreover, as the stealing bits sequence of CS1 is reused, no new SB sequence is defined and therefore the SB decoding performance is not degraded.

The channel coding of FACCH packets is unchanged and the degradation due to the block interleaving (vs. the traditional diagonal interleaving of FACCH) is not expected to be significant.

6. References

[1] Proposal of GERAN Data Link Control Signaling in Dedicated MAC Mode. Tdoc GP-000886. Lucent 6-10 November 2000, Norrtalje, Sweden.

[2] GERAN Voice and Data Multiplexing on Dedicated Physical Sub-channels. Tdoc GP-000926. Ericsson, Lucent, Nokia 6-10 November 2000, Norrtalje, Sweden.

[3] OS2 solution using AMR procedures - Detailed description. Tdoc GERAN 0660/00. AT&T, Ericsson 6-10 November 2000, Norrtalje, Sweden.

[4] Working assumption on OS2 concept. Tdoc GERAN 0661/00. AT&T, Ericsson, Lucent, Nokia, Nortel Networks 6-10 November 2000, Norrtalje, Sweden.

[5] Physical Layer Multiplexing Concept. Tdoc GAHW-00165/00. Ericsson 11-15 December 2000, Orlando, Florida.

[6] Layer 1 Scheme for Speech and Data Multiplexing. Tdoc GAHW-000221. Nortel 11-15 December 2000, Orlando, Florida.