In 3GPP Rel-7 (?) of GERAN, the concept of "repeated FACCH" was introduced.

The rationale for SACCH improvement can be found in 3GPP TDoc GP-042668 Section 1/2 (even though if later sections have not been implemented as suggested there): Particularly with AMR as a voice codec, the voice quality performance is better than that of control channels (and estimated 5dB).

So in the end, even though the voice channel would still be acceptable, calls fail due to signaling failure, both on SACCH and FACCH.

Downlink repeated FACCH basically works by re-transmitting FACCH frames in downlink even before T200 expires. (this obviously steals additional voice frames, as FACCH always does). Those retransmissions happen 8/9 TDMA frames after the original transmission, i.e. after 33/37ms.

- LAPDm commands can always be re-transmitted even without the MS indicating any support.
- LAPDm responses can only be re-transmitted if the MS indicates the "Repeated ACCH Capability"

As outlined in Section 2 of GP-042668, it is expected that this would particularly help hand-over performance in frequency hopping networks, as the Handover Command there often requires two FACCH blocks to be correctly received by the MS.

Related issues:
Related to OsmoBTS - Feature #4794: Downlink Repeated SACCH support

Associated revisions
Revision a15967ba - 11/09/2020 10:41 PM - dexter

gsm_08_58: add proprietary IE to signal Repeated ACCH Capability

3GPP TS 24.008, section 10.5.1.7 specifies a Repeated ACCH Capability bit in the Classmark 3 IE. Unfortunately, there is no way specified how the Repeated ACCH feature should be controlled on RSL level. Since it is not unusual that BTS/BSC vendors occasionally add proprietary IEs to different RSL messages we may pick this as a solution as well and add a proprietary RSL_IE_OSMO_REP_ACCH_CAP IE, so that we can enable repeated FACCH/SACCH on the BTS side when we send RSL CHAN ACT or RSL CHAN MODE MODIFY messages.

Change-Id: I61ea6bf54ea90bd69b73ea0f03dc19a42142077
Related: OS#4796 SYS#5114

Revision a4939dc8 - 11/10/2020 03:36 PM - dexter

gsm_04_08: add parser for Mobile Station Classmark 3

3GPP TS 24.008 section 10.5.1.7 describes a Mobile Station Classmark 3 IE, which is encoded as CSN.1 struct. This means that it can not be parsed by just casting a memory location to a struct pointer, so lets add a parser to parse the CM3 IE.

Change-Id: lc8b2b030330235fbed00771e421588abfaac1f
Related: OS#4796 SYS#5114

Revision 1680a786 - 11/10/2020 05:46 PM - dexter

abis_rsl: parse cm3 and indicate ACCH repetition cap to BTS
In order to activate FACCH/SACCH repetition on the BTS, the classmark 3 IE in the CLASSMARK CHANGE message must be parsed and depending on the Repeated ACCH Capability bit the RSL_IE_OSMO_REP_ACCH_CAP is added to the RSL_CHAN_ACT and RSL_CHAN_MODE MODIFY. Since RSL_IE_OSMO_REP_ACCH_CAP is a proprietary IE, it may only be added for BTS type osmo-bts.

Change-Id: I39ae439d05562b35b2e47774dc92f8789f8e1a57
Depends: libosmocore Icb2b2fd00330235f5bed00771e421588abfaac1f
Related: OS#4796 SYS#5114

Revision 70d78f21 - 11/10/2020 08:25 PM - dexter
rsl.adoc: add info about RSL_IE_OSMO_REP_ACCH_CAP

The RSL documentation should reflect some explanatory info about the recently added RSL_IE_OSMO_REP_ACCH_CAP IE.

Depends: libosmocore I61ea6bf54ea90bd69b73e0f0f03dc19a4214207b
Change-Id: l1d70846c2c184f7a189074c51137bcf1f8b3859
Related: OS#4796 SYS#5114

Revision e36be56f - 11/12/2020 03:55 PM - dexter
gsm_04_08: add parser for Mobile Station Classmark 3

3GPP TS 24.008 section 10.5.1.7 describes a Mobile Station Classmark 3 IE, which is encoded as CSN.1 struct. This means that it can not be parsed by just casting a memory location to a struct pointer, so lets add a parser to parse the CM3 IE.

This is fixed version of lc8b2b2fd00330235f5bed00771e421588abfaac1f, which got reverted because it used the keyword "class" as struct member, which lead into problems with c++ builds. This is now fixed.

Change-Id: ld8732551b33616227609c0d6cf6c3133751a9f8eb
Related: OS#4796 SYS#5114

Revision 33df2ebc - 11/27/2020 03:02 PM - dexter
l1sap: add repeated downlink FACCH

3GPP TS 44.006, section 10 describes a method how the downlink FACCH transmission can be repeated to increase transmission reliability.

Change-Id: l72f0cf7eaae9f80fc35e752c90ae0e2d20d0c75
Depends: libosmocore I6dd2a239e9cd7033297bed1de5eb1d9f87b8433f
Related: OS#4796 SYS#5114

Revision 7e38cf4e - 11/27/2020 03:02 PM - dexter
l1sap: also include SRR bit in RSL L1 info field.

The SRR bit, which got specified in 3gpp release 6 to support repeated ACCH capability is not yet included in the L1 Information IE on RSL level. Also lets update the spec reference to more modern 3gpp spec ref numbers.

Change-Id: l987c61608b737521ba36756dabf26f215b34c2d6
Related: OS#4796 SYS#5114

Revision 0eb479e2 - 12/01/2020 11:58 AM - dexter
abis_rsl: parse cm3 and indicate ACCH repetition cap to BTS

In order to activate FACCH/SACCH repetition on the BTS, the classmark 3 IE in the CLASSMARK CHANGE message must be parsed and depending on the Repeated ACCH Capability bit the RSL_IE_OSMO_REP_ACCH_CAP is added to the RSL_CHAN_ACT and RSL_CHAN_MODE MODIFY. Since RSL_IE_OSMO_REP_ACCH_CAP is a proprietary IE, it may only be added for BTS type osmo-bts.

Change-Id: I39ae439d05562b35b2e47774dc92f8789f8e1a57
Related: OS#4796 SYS#5114
The downlink FACCH repeated is now implemented on the higher l1sap.c layer. In theory all BTSs should now support Repeated Downlink FACCH. 

https://gerrit.osmocom.org/c/osmo-bts/+/21014 l1sap: add repeated downlink FACCH

Finding out which LAPDm frame is a command frame and which one is not works fine so far, but unfortunately determining the state of the Repeated ACCH Capability bit in CM3 is more difficult as expected. First of all CM3 is not transmitted automatically (not necessarily, there is still early CM sending), it must be inquired by sending a CLASSMARK ENQUIRY to trigger sending a CLASSMARK CHANGE, which then contains the CM3. This is triggered by the core network (MSC) using a CLASSMARK REQUEST message. For now I have patched osmo-msc, so that it sends a CLASSMARK REQUEST before the ciphering starts, so now we get the CM3.

The problem is now that there I see no way to communicate the Repeated ACCH Capability bit back to the BSS. From what I can see, the BTS must parse the CM3 in the CLASSMARK CHANGE and track to which subscriber the Repeated ACCH Capability bit belongs. As far as I know the BTS does none of this. We would need to watch the assignment command to see to which TS the MS is going and track and memorize what CM3 had signaled while the MS was on the SDCCH.

A different solution also might be to trigger the CLASSMARK ENQUIRY automosuly while on the TCH but this is probably a bit too late.

We have now discussed the problem and we came to the conclusion that it is best to add a propritary flag to RSL CHAN ACT and RSL CHAN MODE MODIFY. This way the BSC can control the status of the ACCH Capability bit in the lchan on the BTS. Since the BSC keeps a lot of state it should also be no problem to keep track of the ACCH Capability bit in CM3 / Classmark Update there. Extending the spec this way should be fine, also other BTS types have their specialties here and there.
The BTS side already works fine. Depending on the ACCH Capability bit (which is now communicated via RSL CHAN ACT / MODE MODIFY messages) the FACCH repetition either works with LAPDm command frames only or with all downlink FACCH LAPDm frames. Also the T200 counter value is doubled dynamically if the ACCH Capability bit is set.

(I could make the early classmark sending work, it turned out that it was disabled in my BSC config.)

#13 - 11/09/2020 12:48 PM - dexter
- % Done changed from 80 to 90

I have now finished the implementation of the repeated FACCH capability. Since there is indeed no way to signal the ACCH Capability bit back to the BTS when the channel is activated or modified. I have now added a proprietary IE as discussed recently. This works fine so far. Unfortunately it turned out that parsing the ACCH Capability bit from CM3 is actually very difficult because the CM3 IE is an CSN.1 encoded bitstream. I have added a parser-tests for this to libosmocore, so that we now can parse the CM3 message as well. (CM1 and CM2 can be parsed by just overlaying a C struct)

https://gerrit.osmocom.org/c/libosmocore/+/21082 gsm_08_58: add proprietary IE to signal Repeated ACCH Capability [NEW]
https://gerrit.osmocom.org/c/libosmocore/+/21083 gsm_04_08: add parser for Mobile Station Classmark 3 [NEW]
https://gerrit.osmocom.org/c/osmo-bsc/+/21084 abis_rsl: parse cm3 and indicate ACCH repetition cap to BTS [NEW]
https://gerrit.osmocom.org/c/osmo-bts/+/21014 ltsap: add repeated downlink FACCH

There is still some stuff left to do. The abis manual osmobiab-abis.pdf must be updated. Also a wireshark patch is needed to display the new IE.

#14 - 11/16/2020 10:28 PM - dexter

The repeated FACCH related patches are still in review. I have now fixed most issues there, what I have not addressed yet is the question when the FACCH repetition should be turned on. At the moment it is, if it is enabled in the BSC VTY, permanently on. This comes at the cost of a few voice blocks of course. With the FACCH the this is probably not as paroblematic as with the SACCH since the FACCH only tends to be active at the beginning and at the end/handover of a call (and SMS?). In #4795 I am thinking of a criteria that can be used to decide if the repetition should be turned on or off.

See also:
https://gerrit.osmocom.org/c/osmo-bsc/+/21164 abis_rsl: parse cm3 and indicate ACCH repetition cap to BTS
https://gerrit.osmocom.org/c/osmo-bsc/+/21084 abis_rsl: parse cm3 and indicate ACCH repetition cap to BTS
https://gerrit.osmocom.org/c/osmo-bsc/+/21186 gsm_08_58: add struct for RSL_IE_OSMO_REP_ACCH_CAP
https://gerrit.osmocom.org/c/libosmocore/+/21164 bts: add repeated acch mode flags + vty config

#15 - 11/19/2020 03:11 PM - dexter

I have now added a criterion to decide when the FACCH is turned on or off. I am using the RXQUAL value the MS sends us with the measurement values. Also if the MS decides to turn on repeated DL-SACCH, we should definitely enable repeated FACCH too.

See also: https://gerrit.osmocom.org/c/osmo-bts/+/21014 ltsap: add repeated downlink FACCH

#16 - 11/24/2020 12:05 AM - dexter

The patches are up for review, no open review issues at the moment.

#17 - 11/30/2020 03:00 PM - dexter

I have fixed the currently pending review issues, so no open review issues at the moment.

#18 - 11/30/2020 03:03 PM - dexter

#19 - 12/22/2020 10:57 AM - dexter
- Status changed from In Progress to Resolved
- % Done changed from 90 to 100

All related patches are merged, so we can resolve this ticket now.