

OsmoMSC - Feature #1609

Inter-BSC hand-over is missing (MSC side)

02/23/2016 04:02 PM - laforge

Status: Resolved	Start date: 11/21/2016
Priority: Normal	Due date: 11/21/2016
Assignee: neels	% Done: 100%
Category: A interface (general)	
Target version:	
Resolution:	
Description	
Right now we can only do intra-BTS and intra-BSC hand-over. The networks that we needed to support were happy with that. However, for larger networks that use multiple OsmoBSC attached to one MSC, inter-BSC handover is required.	
Related issues:	
Related to OsmoBSC - Bug #2283: Inter-BSC hand-over is missing (BSC side)	Resolved 05/22/2017
Related to OsmoMSC - Feature #3621: TTCN-3 test suite for inter-BSC handover	New 10/02/2018
Related to OsmoMSC - Feature #3236: Rx Assignment Failure from BSC does nothing	Resolved 05/04/2018
Related to OsmoBSC - Bug #3659: LCLS directly between BTSs	Stalled 10/17/2018
Related to OsmoBSC - Bug #3839: inter-BSC Handover lacks AoIP Transport Layer...	Resolved 03/14/2019
Related to libosmo-sccp + libosmo-sigtran - Bug #3871: osmo_scu_prim_conn_id ...	In Progress 03/28/2019
Blocked by OsmoMSC - Feature #2397: let osmo-msc record location area from lo...	Resolved 07/24/2017
Blocks OsmoMSC - Feature #3618: Inter-MSC hand-over support	In Progress 10/02/2018
Blocked by OsmoMSC - Bug #3355: OsmoMSC doesn't provide unique IDTAG_SERNR in...	Resolved 06/23/2018
Follows OpenBSC - Feature #1845: Full BSC/MSC split in NITB/MSC	Closed 11/18/2016

History

#1 - 02/28/2017 04:36 PM - laforge

- Due date set to 11/21/2016
- Start date changed from 02/23/2016 to 11/21/2016
- Follows Feature #1845: Full BSC/MSC split in NITB/MSC added

#2 - 05/22/2017 06:51 PM - laforge

- Assignee set to sysmocom

#3 - 05/22/2017 06:52 PM - laforge

- Project changed from OsmoNITB to OsmoMSC

#4 - 05/22/2017 06:52 PM - laforge

- Subject changed from Inter-BSC hand-over is missing to Inter-BSC hand-over is missing (MSC side)

#5 - 05/22/2017 06:53 PM - laforge

- Related to Bug #2283: Inter-BSC hand-over is missing (BSC side) added

#6 - 08/15/2017 04:34 PM - laforge

#7 - 11/07/2017 09:58 PM - laforge

- Assignee changed from sysmocom to dexter

#8 - 12/23/2017 05:49 PM - laforge

- Category set to A interface (general)

#9 - 01/08/2018 08:40 PM - dexter

- File messages.txt added

(While working out test scenarios for the MSC I had to go through the Handover topic too)

The attached file messages.txt contains, what I think is the minimal information that we have to exchange in order to perform an external handover. The messages in the order in which they were exchanged between BSC1, BSC2 and MSC. Most things seem to be pretty clear to me. However there are some open questions (see questionmarks). I think it will not make much sense to develop this on a laboratory setup since the things will get way to complicated then. We should go for TTCN3 here and do only the final tests with real base stations.

#10 - 03/12/2018 08:23 PM - dexter

Started to work out a testcase for TTCN3. My plan is to implement a HANDOVER REQUIRED request in TTCN3 and then implement the handling on the MSC side until I reach the point where the MSC can generate the HANDOVER REQUEST for the target BSC. I am not sure if the TTCN3 test can handle multiple BSC instances yet, maybe that isn't even a problem for the test we could just handover back to the originating BSC.

#11 - 03/13/2018 09:17 AM - laforge

On Mon, Mar 12, 2018 at 08:23:45PM +0000, dexter [REDMINE] wrote:

Started to work out a testcase for TTCN3.

great.

My plan is to implement a HANDOVER REQUIRED request in TTCN3 and then implement the handling on the MSC side until I reach the point where the MSC can generate the HANDOVER REQUEST for the target BSC.

good plan.

I am not sure if the TTCN3 test can handle multiple BSC instances yet,

The entire "BSC simulation stack" is encapsulated in the "BSSAP_Adapter", of which the MTC_CT (main test component) currently has only one called g_bssap.

If you extend MTC_CT to have a second (or multiple) BSSAP_Adapters, and use a separate set of SCCP address, M3UA ip/port, ... you end up simulating multiple BSCs. It **should** be almost no effort on the TTCN-3 side, with the primary effort being to configure all your IP/MTP/SCCP layer bits, particularly on osmo-stp side.

#12 - 03/21/2018 11:52 PM - neels

How does the MSC know which BSC to send the Handover Requested to?
It doesn't seem like the BSCs tell the MSC which LAC or LACs they are responsible for.
How does the MSC tell the BSCs apart, and how does it know where to direct the inter-BSC handover?

It will get a cell identifier list from the BSC in the Handover Required message, containing one or more entries of one of these kinds:

- CGI
- LAC+CI
- LAI
- just LAC

#13 - 03/22/2018 07:20 AM - laforge

Hi Neels,

a BSC is normally responsible for an entire pool/list of LACs.

As we only serve one MCC/MNC from one MSC, it basically boils down to having a way to have a per-BSC LAC table.

We are already constructing such a table dynamically as we receive location updates, and/or even the BSMAP RESET?

Of course it could be a problem if you re-start the MSC, then that table is gone. However, at that point the entire VLR state is lost and without the subscribers having performed a location update, you don't know where they are in general.

So it's a trade-off between

- automatically discovering BSCs and their LACs (at the moment)
- explicitly configure BSCs and their LACs via VTY (should be an option)

It will get a cell identifier list from the BSC in the Handover Required message, containing one or more entries of one of these kinds:

- CGI
- LAC+CI
- LAI
- just LAC

you simply discard the MCC,MNC + CI from those and do the lookup on the LAC

#14 - 03/26/2018 09:07 AM - dexter

We do not record the LAC from the location updates yet, but there is a ticket for that [#2397](#).

#15 - 03/28/2018 11:58 AM - dexter

- Status changed from New to In Progress

There is an update on the TTCN3 side: We now have templates for HANDOVER REQUIRED and support for multiple BSC instances:

<https://gerrit.osmocom.org/7549> Cosmetic: Update MSC_Tests.cfg
<https://gerrit.osmocom.org/7550> MSC_Tests: Add support for multiple BSC
<https://gerrit.osmocom.org/7530> BSSMAP_Templates: Add templates for HANDOVER REQUIRED

#16 - 03/29/2018 02:33 PM - neels

Summarizing the above and a discussion on #osmocom:

- We have a list of connected BSCs, populated by BSSMAP Reset
 - We record all LACs coming in from Complete Layer 3 Information IEs with the respective BSC ([#2397](#)).
- The dynamic list of BSCs and LACs works well as soon as each LAC has been recorded with a Complete Layer 3 message.
 - To allow inter-BSC handover even before a LAC has been recorded dynamically, we also allow adding static entries to the list of BSCs, associating the SCCP Called/Calling Party address with a LAC.
(In practice, the effect of such static entries can be seen close to zilch, since it is likely that Complete Layer 3 come flooding in on every cell pretty quickly.
More unusual setups may need such config though -- extreme example is a completely private network with only one subscriber wanting to be handovered across BSCs)
- We enforce: each BSC can handle N different LACs, but they must be distinct from LACs on other BSCs.
 - if the MSC ever sees that the same LAC reports via multiple BSCs then that should trigger a big fat ERROR message,
 - and this assumption/constraint must be well documented in the manuals
- the MSC extracts the LAC from the Handover Required message, looks it up in the table of connected BSCs, and forwards the Cell Identifier List to that BSC.
 - If there are multiple LACs in the Cell Identifier List, just take the first match with any connected BSC.
 - If there is a matching LAC with a "static" entry as described above, but that BSC is currently not connected, skip that entry.
 - *Future* feature: if a BSSMAP Handover Request fails with a given BSC, try the next entry in the list.
(complexities: stay within timeout of the first BSC giving up; do not try the same BSC multiple times)

#17 - 03/29/2018 02:35 PM - neels

- We limit ourselves to a single PLMN across the entire network, so no need to handle anything besides LAC yet in the MSC.
 - But I'm thinking, if we get the full CGI in the Complete Layer 3 Info, we might as well record the whole thing already in our list of BSCs.

#18 - 03/29/2018 02:37 PM - neels

- Blocked by Feature #2397: let osmo-msc record location area from location update for LAC wide paging added

#19 - 04/09/2018 08:33 PM - dexter

I have a draft for the LAC problem ready, however it is not satisfactory yet. See [#2397](#). However, I can now dump the LACs that the MSC has "learned" from the L3 COMPL messages on the VTY. The next thing we need is a TTCN3 test for this. The test I am working on will perform two Location updates from the two different, simulated BSCs. This will let the MSC "learn" the LAC numbers and we can start with the Handover procedure.

On the TTCN3 side the support for the HANDOVER REQUIRED message is complete enough to work with. However I discovered that the "multi BSC support" needs some additional features. There is still some handling missing. At the moment we are able to perform a BSSMAP RESET from two different BSCs, but we yet able to do the same with the LU. When I get the things right we really need two truly independent BSSAP adapters with two independent TTCN3 test ports, so that it is really two independent module instances and not just different BSSAP sender addresses.

#20 - 04/11/2018 09:07 AM - dexter

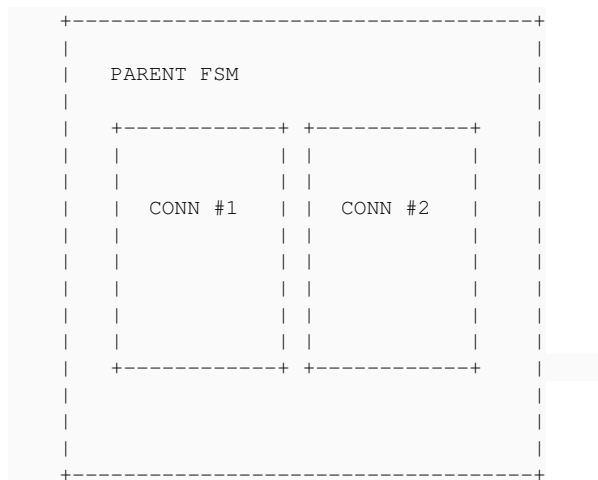
Notes about Inter-BSC-handover in osmo-msc:

At the moment the subscriber handling is handled by a single osmo fsm, implemented in subscr_conn.c. The connection related information is held in struct gsm_subscriber_connection (see gsm_data.h).

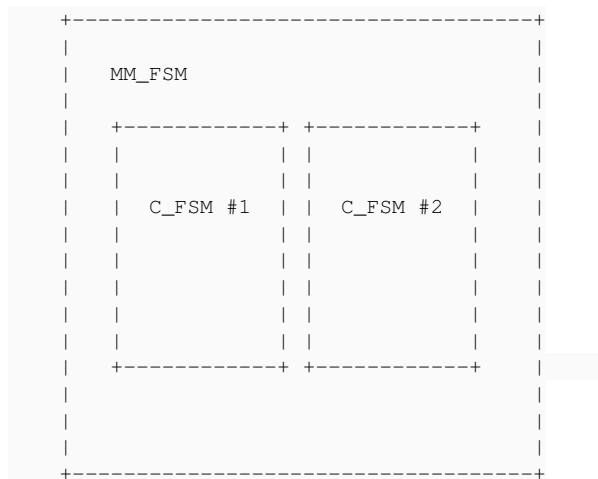
In order to handle an Inter-BSC-handover the MSC must be toughened to handle two SCCP connections at the same time. Technically the SCCP related connection data is nearly the same for lu and A so some unification is desired. (see struct gsm_subscriber_connection, substructs a and iu) However, merging the data would require fundamental changes to osmo-juh, so a less dramatic change is required. In order to reach at least some grade of unification, both substructs may be put into a separate struct as union, so they could be just used from gsm_subscriber_connection as (two) normal struct variables.

Unfortunately unifying those structs alone does not provide an infrastructure that is sufficient to handle Inter-BSC-handover since we still need to deal with the two connections. This means depending from where an SCCP message is received, the right action must be taken and the right data must be altered.

The most logical approach to it is to modularize the Subscr_Conn FSM with two child FSMs that model the up to two active connections:



At first the Subscr_Conn FSM should be renamed to something that expresses the relation to mobility management better. We suggest to call it just "MM_FSM" and the sub FSMs that model the individual connections are just called C_FSM (or maybe alternatively CONN_FSM?):



In general, when it comes to clearing of one connection the child FSM will send


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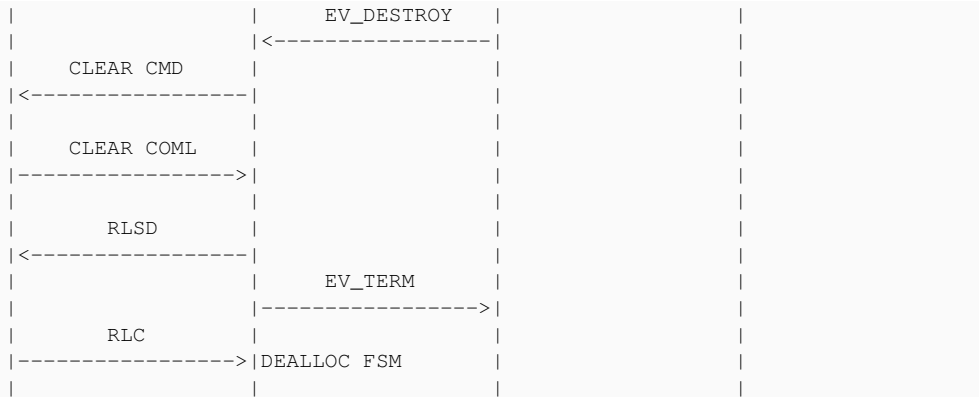
    (The handover has been completed,
    now the old SCCP connection has
    to be terminated. The C_FSM #2
    now takes on the role of C_FSM
    #2, we are now ready for another
    handover)

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<!-- What happens when the next HO
is made while we are still clearing?
probably we might want to implement
a model where n C_FSMs are permitted?

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    (The process is done now, the call
    continues as normal, another handover
    may occur.)

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The message parsing is implemented inside the C_FSM. The parsed messages are then passed to the MM_FSM in form of events. The MM_FSM then inspects the content, takes operational actions (e.g switching over the RTP stream) and finally sends an appropriate event to the other C_FSM.

This approach is oriented on a 2G handover. A 3G or even a 2G to 3G handover may look different, but the principle is the same. When the parsing of the messages is handled in the C_FSM directly and only parsed structs are passed on to the MM_FSM. Then it should be possible to have a 3G capable C_FSM implementation (e.g. C_FSM_3G) as well which may be just dropped in at some later point.

#21 - 05/17/2018 01:28 PM - dexter

- Status changed from In Progress to Stalled

#22 - 05/17/2018 02:02 PM - laforge

- Priority changed from Normal to Low

#23 - 10/02/2018 06:00 PM - laforge

- Tags set to Inter-MSD HO

- Assignee deleted (dexter)

- Priority changed from Low to Normal

#24 - 10/02/2018 06:03 PM - laforge

- Blocks Feature #3618: Inter-MSD hand-over support added

#25 - 10/02/2018 06:26 PM - laforge

- Related to Feature #3621: TTCN-3 test suite for inter-BSD handover added

#27 - 10/21/2018 05:21 PM - laforge

- Assignee set to neels

#28 - 11/26/2018 11:11 PM - neels

- Blocked by Bug #3355: OsmoMSC doesn't provide unique IDTAG_SERNR in IPA CCM added

#29 - 11/26/2018 11:13 PM - neels

Blocked by #3355 because in order to invent how to configure BSS' cell identifiers in osmo-msc.cfg, I need to know how OsmoMSC instances are going to be identified.

I want to avoid implementing something for inter-BSC HO just to notice that it clashes with inter-MSC HO, so first want this resolved.

#30 - 11/26/2018 11:18 PM - neels

Re above charts about a parent FSM and individual Conns:

3GPP TS 49.008 4.3 "Roles of MSC-A, MSC-I and MSC-T" defines different MSC roles that so far we handle in a single MSC, but may be spread across MSCs.

The inter-BSC HO FSMs are (probably) already going to be modeled according to that, i.e.

- an MSC-I FSM for an established BSSMAP connection,
- another MSC-T FSM for a new connection,
- and an MSC-A FSM to orchestrate MM using events that match the E-interface definition (the MAP messages between separate MSCs).

#31 - 11/26/2018 11:58 PM - neels

- Related to Feature #3236: Rx Assignment Failure from BSC does nothing added

#32 - 01/17/2019 04:26 PM - msuraev

- Related to Bug #3659: LCLS directly between BTSs added

#33 - 01/31/2019 04:29 PM - neels

- Status changed from Stalled to In Progress

- % Done changed from 0 to 40

#34 - 03/14/2019 01:39 AM - neels

- Related to Bug #3839: inter-BSC Handover lacks AoIP Transport Layer Address, i.e. only works with SCCPlite added

#35 - 03/14/2019 03:02 AM - neels

- File first_ever_inter_bsc_ho_with_osmo_msc.pcapng added

- % Done changed from 40 to 80

First ever inter-BSC HO with osmo-msc worked!

Historical pcap attached.

The remaining bit is about grooming patches and getting them merged.

#36 - 03/15/2019 01:40 AM - neels

after some fixes to osmo-bsc, now inter-BSC handover with osmo-msc also works when Ciphering is enabled.

osmo-bsc patches pending.

#37 - 03/28/2019 07:59 PM - neels

- Related to Bug #3871: osmo_scu_prim_conn_id should be scoped per-user and direction, and should not correlate with the local-reference spoken on the SCCP wire added

#38 - 05/09/2019 12:12 AM - neels

- % Done changed from 80 to 100

Inter-BSC Handover support is now merged to osmo-msc master

#39 - 05/09/2019 12:13 AM - neels

- Status changed from In Progress to Resolved

Files

messages.txt	2.71 KB	01/08/2018	dexter
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