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Technical Report

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Foreword

This Technical Report has been produced by the 3rd Generation Partnership Project (3GPP).

The contents of the present document are subject to continuing work within the TSG and may change following formal TSG approval. Should the TSG modify the contents of the present document, it will be re-released by the TSG with an identifying change of release date and an increase in version number as follows:

Version x.y.z

where:

- x the first digit:
 - 1 presented to TSG for information;
 - 2 presented to TSG for approval;
 - 3 or greater indicates TSG approved document under change control.
- y the second digit is incremented for all changes of substance, i.e. technical enhancements, corrections, updates, etc.
- z the third digit is incremented when editorial only changes have been incorporated in the document.

Introduction

The transmission network is an important component for mobile communication networks. In some parts of the world (e.g. Africa, South America, South Asia etc.), operators face the difficulties to develop services and/or deploy networks due to the lack of or cost of fast and reliable backhaul transport resources. However, according to statistical data, many calls in a mobile communication network, especially in the above-mentioned areas, are local calls. That is, these calls are generated and terminated by users served by the same BTS or the same BTS cluster or the same BSC. For local calls, if local switch (voice data in user plane is looped in a BTS or a BSC) is performed, then transmission resource of the Abis and/or A interface could be saved.

To avoid impacts to the support of various kinds of supplementary services (e.g., Multiparty Call, Explicit Call Transfer, etc.), and the support of Lawful Interception procedures, not only the BSS, but also the MSC needs to be involved in the establishment/release of the local switch. Furthermore, in order to perform local switching, the BSS needs to correlate the two legs of the call, i.e. it needs to know who is talking to whom. This information needs to be provided by the MSC.

A solution for Local Call Local Switching may have major impacts on the core network regarding allocation of resources on the MGW, potential procedures for MGW removal/insertion, binding into supplementary service control within the core network (e.g. MPTY), Lawful Intercept procedures within the Core Network, Handover procedures, interaction with MSC-S pooling, etc. It is thus necessary to perform an analysis of different solutions in order to determine the core network impacts.

1 Scope

The present document provides a study into the Core Network impacts for providing a solution for Local Call Local Switching. The document analyses and evaluates different solutions to determine the benefits provided compared to the identified impacts.

Specific considerations are given to the following areas:-

- Sending of potential correlation information between the two legs of the call to be sent to the BSS (e.g. in case of MSC pooling)
- Triggering to enable/release Local Call Local Switch (e.g. based on activation of Supplementary Services, etc.)
- Support of existing Supplementary Services
- Support of existing Lawful Intercept functionality
- Impacts to the user plane handling on the A-interface
- Impacts to the MSC-S – MGW Interface (Mc Interface)

The solution(s) considered for local call local switch should keep the core network impacts to a minimum, e.g. the impacts on the nodal functions, existing call flows, call establishment and call release.

The contents of this report when stable shall determine the modifications to existing core network specifications.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.
- For a specific reference, subsequent revisions do not apply.
- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 33.106; "3G security; Lawful Interception requirements".

...

[x] <doctype> <#>[([up to and including]{yyyy[-mm]|V<a[b.c]>}{onwards})]: "<Title>".

It is preferred that the reference to 21.905 be the first in the list.

3 Definitions, symbols and abbreviations

Delete from the above heading those words which are not applicable.

Clause numbering depends on applicability and should be renumbered accordingly.

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [x] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [x].

Definition format (Normal)

<defined term>: <definition>.

example: text used to clarify abstract rules by applying them literally.

3.2 Symbols

For the purposes of the present document, the following symbols apply:

Symbol format (EW)

<symbol> <Explanation>

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [x] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [x].

Abbreviation format (EW)

<ACRONYM> <Explanation>

4 System Requirements

The following requirements shall apply for local call local switch:

- The local call local switch shall be transparent to the end user;
- The local call local switch shall be only considered for CS voice call;
- The local call local switch shall not hinder any supplementary services;
- Lawful Interception shall be supported;
- The impact on the core network shall be minimal, e.g. the impacts on the existing call flows, call establishment and call release;
- The MSC in Pool shall be supported.

Editor's Note: Whether the local call local switch is supported or how to handle if excluded for inbound roamers is FFS.

5 Working Assumptions

5.1 GERAN Assumptions

The following assumptions are provided by GERAN:

1. Local Switching reuses existing (Rel-8) Procedures, Messages and Information Elements on the A-Interface as far as possible to keep the impacts small.

2. Local Switching reuses the existing (Rel-8) Architecture Split between BSS and CN as far as possible.
3. One common Local Switching solution supports AoTDM and AoIP and all combinations of them.
4. Local Switching is applicable within a single BTS, but possibly also between BTSes. The standard supports on the A-Interface all kinds of Local Switching within a BSS. The MSC can, however, not know beforehand - without BSS signalling - whether or not Local Switching is possible, therefore the final decision whether to establish Local Switching or not is performed by the BSS.

NOTE: How this is realized inside a BSS is not subject to standardisation.

5. Whether procedures and messages on the A-interface for Local Switching will be performed independently on the two legs of the call is FFS.
6. The Local Switching is established by the BSS by internal means, but only if it got permission from the MSC(s) to do so. If the BSS receives signalling that for one radio leg Local Switching is not or no longer possible, then the BSS does not establish Local Switching or breaks an established Local Switch.
7. The MSC(s) are responsible to bind the two radio legs together by appropriate means and finally submitting this to the BSS to allow seeing the correlation.
8. Local Switching does not involve (has no need for) transcoding between the radio legs, i.e. there is no need for Transcoders in BSS.
9. Transmission of in-band user plane information (ring-back tone at call setup and mid-call in-band announcements) from the Core Network is supported.
10. Local Switching is sometimes not possible, or needs to be released, e.g. if a Supplementary Service (Multi Party Conference, Announcement, etc) is necessary. The MSC controls this. If certain supplementary services for an ongoing call are necessary, implying that the User Plane through the Core Network needs to be (re)established, the Local Switching may be broken by the MSC(s) after negotiation with the BSS.
11. Inter-BSS Handover is possible, leading to a break or an establishment of Local Switching.
12. Inter-MSC Handover is possible, leading to a break or an establishment of Local Switching.
13. Inter-System Handover (e.g. 2G <=> 3G) is possible, leading to a break or an establishment of Local Switching.
14. If AoTDM is used, it is FFS whether the TDM circuit of the A-Interface may be released while the Local Switching is established in the BSS (and after the BSS has informed the MSC).
15. If AoIP is used, it is FFS whether the IP link on the A-Interface may be released while the Local Switching is established in the BSS (and after the BSS has informed the MSC). In any case, user plane transmission on the A-interface can be suspended while the Local Switching is established (even if the IP endpoint on the BSS and MGW sides are not released), making bandwidth saving on the AoIP interface possible.
16. Both sides, BSS and/or MSC(s), are allowed to break the Local Switch any time, if needed.
17. If the Local Switch has to be broken, this needs to be negotiated between BSS and MSC(s).
18. The Codec Type and/or Codec Configuration may be changed by the BSS autonomously after the Local Switch is established, provided that same or compatible Codec Type and/or Codec Configuration are used on the two legs of the call. However, the MSC(s) is (are) informed after the change. One possible exception is when the AoIP with TC in MGW option is being used: it is FFS whether this should trigger the BSS-internal HO procedure and whether this would release the Local Switching.

NOTE1: of course only Codec Types and Codec Configurations provided by the MSC(s) to both radio legs may be used.

NOTE2: if two incompatible Codec Type and/or Codec Configuration are to be used on the two legs of the call, the Local Switching is released beforehand, i.e. this kind of handover is not allowed while local Switching is established.

19. Intra-BSS handovers may be performed by the BSS autonomously after the Local Switch is established. The MSC(s) is (are) informed after the Handover about all changed parameters (Cell ID, Codec Type, whatever).

20. Transmission of DTMF tones is supported.

21. Charging aspects arising from Local Switching (if any) are considered in the standard.

5.2 Core Network Assumptions

<insert assumptions made by CT relevant to CT impacts>

1. any number of MSCs may be in the path and therefore impacts to the Nc interface must be considered.
2. core networks (MSC-Servers and MGW's) owned by different operators can be involved in a call that supports LCLS.
3. upgraded (LCLS compliant) and legacy (non LCLS compliant) MSCs may exist in the path
4. all MSCs (nodes in the path) must permit LCLS
5. if one node denies LCLS (legacy MSC or intentionally), then all other MSCs must be informed, at call setup and during the call and LCLS must be stopped.

6. Lawful Interception Requirements and Solutions

6.1 General

The general requirements on Lawful Interception are specified in 3GPP TS 33.106 [2].

Lawful Interception shall be possible also when the Local Call Local Switch feature is activated, and the main functionality shall remain in the Core Network.

In order to allow support for the Lawful Interception feature in the Core Network, user plane data for CS voice calls to be intercepted needs to be conveyed to the Core Network, even if the calls are local.

Two solutions are possible, and both of them could be specified.

6.2 Solution 1: Restriction of LCLS if Lawful Intercept is applied

6.2.1 Technical Description

This solution is that whenever the MSC-S is aware that a local call needs to be intercepted it shall not allow the BSS to establish local switching in the BSS.

6.2.2 Pros and Cons

The problem of this solution is that it might not be possible to maintain the same end user perception in all the cases, in terms of end-to-end speech delay. The delay might in fact vary between "not locally switched, intercepted local calls" and "locally switched, non-intercepted local calls". This could happen for instance in some scenarios where the Local Call Local Switch feature would be typically deployed, i.e. whenever a satellite backhaul is used to connect a group of BTS's to the BSC/MSC-S. In this case the delay of a locally switched call will be ~600ms shorter than for a normal call, unless an artificial delay is added for all the locally switched calls (which is of course not desirable), and this difference would be easily noticeable by the end user.

6.3 Solution 2: Applying LCLS if Lawful Intercept is applied

6.3.1 Technical Description

This solution enables local switching also for intercepted calls, with the goal to maintain the same end user perception in terms of end-to-end speech delay. This can be achieved if the user plane data is both locally switched and forwarded to the Core Network as well, while user plane data coming from the A interface is dropped at the BSS side. In order to support this, from standardization point of view it is sufficient to introduce a conditional "Bi-casting required to the MSC" Information Element in the new/modified BSSMAP messages (to be defined by 3GPP TSG GERAN) used by the MSC-S to allow the BSS to establish Local Switching.

This solution implies that some sort of indirect indication that a call will be intercepted will be conveyed to the BSS via some signalling message (while this is currently not the case). However, the A-interface control messages containing this information can be protected (e.g. via IPSec) so that such information cannot be sniffed or traced.

Editor's Note: Security aspects of applying IPSec should be more investigated and applying of the principles of 3GPP TS 33.210 are FFS.

Editor's Note: Further technical description is required to detail this solution e.g. message flows, etc.

6.3.2 Pros and Cons

Advantage of this solution is that also for intercepted calls LCLS is possible. The solution also maintains the same end user perception in terms of end-to-end speech delay.

Disadvantage of this solution is that it is complicated especially on BSS side because of required bi-casting capability and additional A-interface signalling.

6.4 Comparison of Solutions for Lawful Interception Requirements

<This section shall provide a comparison of the solutions defined above, and a conclusion for a selected solution>

Editor's Note: Feedback is needed from 3GPP TSG SA3 LI on these two proposed solutions.

7. Solutions for A interface User Plane handling

7.1 General

The intended benefits of Local Call Local Switch feature are mainly to save transmission bandwidth on BSS internal interfaces, Abis and Ater. Establishing local switching means that either the call is switched in the BSC or a direct communication is created between the involved BTSs. In any case the effect is that some resources on the BSS internal interfaces (Abis and Ater) can be saved. The specific solution will be based on BSS network topology and shall remain implementation specific. The only user plane aspects that need to be standardized are the ones affecting the A interface.

7.2 Solution by not releasing core network resources during LCLS

7.2.1 Technical Description

To minimize changes to existing AoTDM deployments and to ongoing AoIP implementations, the impact on the A interface user plane handling shall be kept as low as possible:

- For AoTDM, no changes to the A interface user plane handling should be defined. Even if a call is locally switched, the two corresponding circuits shall always remain active, meaning that bandwidth savings on the A

interface for locally switched calls are not possible, but bandwidth savings can be realized on the Abis/Ater interfaces, of course. While a call is locally switched, the TRAU will send some silence codeword on the A interface (details are FFS).

- Also for AoIP, the two IP connections towards the MSC-S shall always remain active, i.e. the corresponding IP endpoints shall not be released. In any case, for AoIP it shall be possible to suspend user plane transmission, and hence save bandwidth, while the call is locally switched. Therefore it needs to be specified that, while a call is locally switched, the MSC-S (MGW) shall not expect to receive data through the IP endpoints. It should be noted that this solution will have an impact on the H.248 interface: the MSC-S shall inform MGW about established and released Local Switching so that MGW can start and stop to suspend the AoIP user plane transmission (details are FFS)
- For the mixed AoTDM-AoIP case (one leg of the call using AoTDM, the other using AoIP) the proposal is again to keep the circuit and the IP connection active throughout the call. Whether user plane data is sent on the IP connection while the call is locally switched could depend on the presence or not of a Transcoder in the BSS for this leg of the call (details are FFS).

7.2.2 Pros and Cons

It is expected that this approach will greatly simplify the procedures to establish and release Local Switching in the BSS at call setup and handover, on the A-interface and on the Core Network interfaces (e.g. for allocation/release of resources on the MGW).

As a further benefit, this approach simplifies the handling of in-band announcements for a call which is locally switched, because with this solution there is no need e.g. to re-establish circuits or IP endpoints just to deliver the announcement to the target user.

7.3 Comparison of Solutions for A interface User Plane handling

<This section shall provide a comparison of the solutions defined above, and a conclusion for a selected solution>

8. Solution 2

9. Conclusions and Recommendations

Annex A: Change history

It is usual to include an annex (usually the final annex of the document) for reports under TSG change control which details the change history of the report using a table as follows:

Change history								
Date	TSG #	TSG Doc.	CR	Rev	Subject/Comment	Old	New	
2001-07					Copyright date changed to 2001; space character added before TTC in copyright notification; space character before first reference deleted.	1.3.2	1.3.3	
2002-01					Copyright date changed to 2002.	1.3.3	1.3.4	

2002-07					<i>Extra Releases added to title area.</i>	<i>1.3.4</i>	<i>1.3.5</i>
2002-12					<i>“TM” added to 3GPP logo</i>	<i>1.3.5</i>	<i>1.3.6</i>
2003-02					<i>Copyright date changed to 2003.</i>	<i>1.3.6</i>	<i>1.3.7</i>
2003-12					<i>Copyright date changed to 2004. Chinese OP changed from CWTS to CCSA</i>	<i>1.3.7</i>	<i>14.0</i>
2004-04					<i>North American OP changed from T1 to ATIS</i>	<i>1.4.0</i>	<i>1.5.0</i>
2005-11					<i>Stock text of clause 3 includes reference to 21.905.</i>	<i>1.5.0</i>	<i>1.6.0</i>
2005-11					<i>Caters for new TSG structure. Minor corrections.</i>	<i>1.6.0</i>	<i>1.6.1</i>
2006-01					<i>Revision marks removed.</i>	<i>1.6.1</i>	<i>1.6.2</i>
2008-11					<i>LTE logo line added, © date changed to 2008, guidance on keywords modified; acknowledgement of trade marks; sundry editorial corrections and cosmetic improvements</i>	<i>1.6.2</i>	<i>1.7.0</i>