Lgd: Issues, and Way Forward

Cisco
S2-133092

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Background

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What transpired?

- SA2#91:
  - S2-122622: Issue of DIAMETER'izing Lg was discussed. SA2 determined that CT4 has the right expertise to analyze and proceed on this work. Same was indicated via this LS.
  - In response, CT4 started Dia_SGSN_GMLC work
- SA2#93:
  - S2-122622: CT4 asked SA2 what to do about Gn/Gp SGSN's support for Lg
  - S2-124186:
    - SA2 responded saying legacy SGSNs not supporting DIAMETER had no need to support DIAMETER Lg
    - SA2 recommended the usage of "Lgd" for SGSN – GMLC i/f
    - SA2 asked CT4 to keep SA2 updated on the progress of this work
- SA2#98
  - S2-132351:
    - CT4 LS informing SA2 about the progress made on Diameter'izing Lg (SGSN – GMLC) interface
    - CT4 has already achieved 80% completion for this work
    - CT4 findings indicated that additional savings could be achieved in case of
      - ISR = active + IDLE/CONNECTED mode UE + MT-LR procedures
      - Although no explicit SA2 feedback was requested for this specific case, SA2's opinion was welcomed
    - It was claimed that
      - Combo node functionality not only for GMLC case, but also for SMSC should be considered
      - architectural impacts due to above are large, and ought to be discussed in SA2
  - S2-132737:
    - LS OUT to CT4 couldn't be agreed during email-approval

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Discussion: GMLC aspects

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What does Combined MME/SGSN functionality in current CT4 S6a/d specs mean?

- Combined MME/SGSN node has both an MME identity and SGSN ISDN number
- During Location updates, combined node provides both addresses in ULR
  - When UE is in UTRAN/GERAN on an SGSN, the SGSN provides its SGSN number
  - When UE moves to EUTRAN on a combined node, in ULR, MME provides its MME address and SGSN number
  - For this user, If SGSN numbers match at HSS then HSS knows that the UE is being served by a combined node
- From here on, as long as the registered MME and SGSN for that UE do not change, for
  - Subsequent ULRs, 'skip data indicator' flag is set if data is available due to previous location update
  - Subsequent ISDs (Insert Subscriber Data) message, HSS issues only one request towards the combined node (as opposed to 2 different ISDs)
  - Subsequent RSRs (Reset Request) message, HSS issues only one request towards the combined node (as opposed to 2 different ISDs) to perform Reset after HSS restart
  - Subsequent CLRs (Cancel Location Request), depending on conditions (e.g. subscription withdrawal), CLR is processed by both MME and SGSN part of the combined node
  - Subsequent PURs (Purge UE Request) are processed by both MME and SGSN part of combined node

Conclusion 1: Combined node feature is applicable to a very limited set of cases, and has minimal architectural impact

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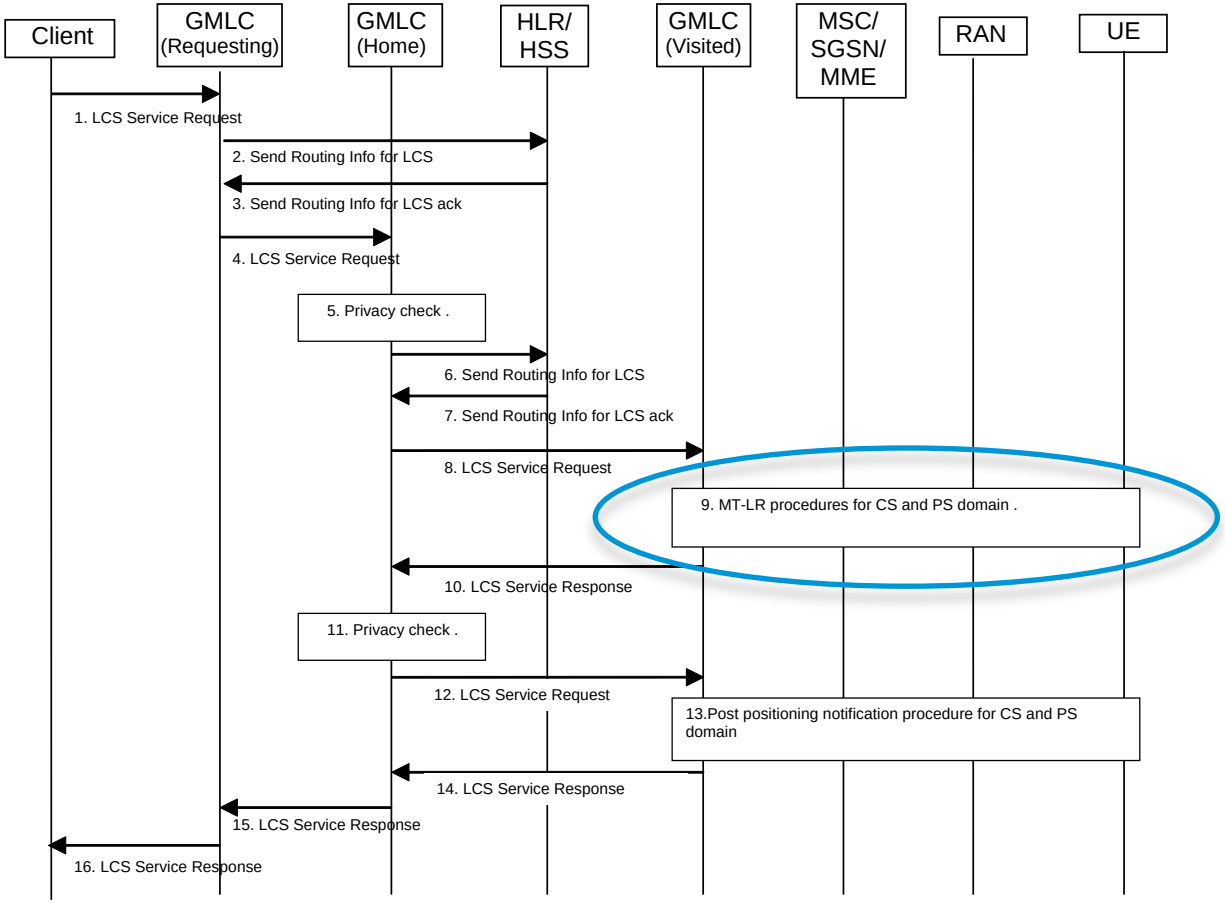
What happens today (without Lgd) for MT-LR? (1/4)



- Focus is on PS-domain:
  - Upon receiving MT-LR request, GMLC pages SGSN and MME

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What happens today (without Lgd) for MT-LR? (2/4)

- 23.271 v11.2.0 clause 9.1.1

9) If the GMLC (H-GMLC, R-GMLC or V-GMLC) receives only the MSC/VLR address, the MT LR proceeds as the CS-MT-LR procedure described in clause 9.1.2.If the GMLC receives only the SGSN address, the MT LR proceeds as the PS-MT-LR procedure described in clause 9.1.6. If the GMLC receives only the MME address, the MT LR proceeds as the EPC-MT-LR procedure described in clause 9.1.15. If the GMLC receives several of the following addresses, SGSN, VMSC, MSC Server and/or MME, it has to decide where to send the location request. If the requested MT-LR is known to be associated with a CS call, the CS-MT-LR procedure shall be invoked. If the requested MT-LR is associated with a PS session in UTRAN, the PS-MT-LR procedure shall be invoked. If the requested MT-LR is associated with a PS session in E-UTRAN, the EPC-MT-LR procedure shall be invoked. Otherwise, two or more of CS-MT-LR, PS-MT-LR and EPC-MT-LR are applicable. If LCS Client indicated deferred location request, GMLC shall indicate this together with applicable event type (e.g. UE available) in the requested PS/CS-MT-LR, see 9.1.8.

NOTE 4: The order in which these procedures are invoked and whether one or both procedures are used may depend on information in the LCS service request, subscription information for the LCS client, possible priority information returned by the HSS or information already stored in the GMLC (e.g. obtained from previous location requests). The order may also depend on operator preference for invoking or not invoking location estimation on a particular access type when CSFB or ISR may be supported.

NOTE 5: If ISR is active for LTE access, the V-GMLC receives both an SGSN and MME address. The VGMLC may then instigate both PS-MT-LR and EPC-MT-LR procedures. This will lead to separate paging of the UE in its registered TA(s) in association with the MME procedure and in its registered RA(s) in association with the SGSN procedure. The UE would then respond to only one paging request leading to continuation of only one of the MT-LR procedures and a termination of the other. The V-GMLC will discover which is which from the responses it later receives from the MME and SGSN for each MT-LR procedure.

- Whether GMLC performs sequential or parallel requests to SGSN and MME is up to operator configuration
- Two different PSL requests are sent today
  - MAP based to SGSN
  - DIAMETER based to MME
- Neither GMLC nor HSS are aware of ISR status for a given UE

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What happens today (without Lgd) for MT-LR? (3/4)

- GMLC sending PSL sequentially (applies for both standalone and combo MME/SGSN):
  - Best case scenario for IDLE mode UE:
    - GMLC sends PSL to either MME or SGSN where UE is camped
    - Serving entity receiving PSL pages UE
    - UE responds
  - Worst case scenario for IDLE mode UE:
    - GMLC sends PSL to serving entity but UE is camped in the other RAT
    - Serving entity receiving PSL pages UE
    - After exhausting page re-transmission strategies, serving entity responds negatively
    - GMLC then sends PSL to the other serving entity where UE is camped
    - Serving entity receiving PSL pages UE
    - UE responds

Wasted time + wasted paging

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What happens today (without Lgd) for MT-LR? (4/4)

- GMLC sending PSL in parallel:
  - Standalone MME and SGSN
    - GMLC sends PSL to both MME (Diameter) and SGSN (MAP)
    - Both MME and SGSN page UE
    - UE will respond only from one RAT
    - Other RAT paging continues
  - Combined MME/SGSN:
    - GMLC sends 2 PSLs: MME (Diameter) and SGSN (MAP) to the same node
    - Both MME and SGSN page UE
    - UE will respond only from one RAT
    - Other RAT paging continues

Wasted paging. CT4 recommends can be optimized by stopping paging in other RAT

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What has CT4 done for Lgd so far?

- Support for PS-MT-LR and PS-NI-LR procedures for Lgd interface is defined by re-using the existing commands defined by Diameter based SLg interface (as defined in 3GPP TS 29.172). Existing AVPs from SLg are re-used and new AVPs are defined, wherever applicable
- Existing commands are re-used and new AVPs are defined to support the deferred MT-LR and periodic MO-LR TTTP procedures for Lgd interface
- Key point:
  - Every DIAMETER application uses a unique Application identifier
  - **SLg's identifier is re-used for DIAMETER Lg**

Means a single message Diameter message esp towards combo MME/SGSN

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What additional recommendations did CT4 make?

- For the specific case of ISR=active + UE on combo node, additional RAN savings could be achieved

- This is what originally questioned in SA2 at SA2#98 during LS discussions

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Analyze various MT-LR scenarios per work done up to CT4#62

- UE is on Standalone MME and SGSN
  - As addresses are different, this case is treated as standalone nodes from HSS perspective
  - Existing specs:
    - GMLC sends two PSLReq: MAP for Lg to SGSN , DIAMETER for SLg to MME
  - Per approved CT4 work:
    - GMLC still sends two PSLReq: both Lg and SLg in DIAMETER
- UE is on One combo node, another is standalone
  - In EUTRAN, UE is on MME1 which is a combo node w/ SGSN1, and in GERAN/UTRAN UE is on standalone SGSN2
    - SGSN# for same UE is different in HSS (SGSN1 from combo node v/s SGSN2) , so these are treated as standalone nodes from HSS perspective
  - Existing specs:
    - GMLC sends two PSLReq: MAP for Lg to SGSN , DIAMETER for SLg to MME
  - Per approved CT4 work:
    - GMLC still sends two PSLReq: both Lg and SLg in DIAMETER
- UE is on combo node
  - UE on same MME part of combo node while in EUTRAN, and on SGSN part of same combo node while in GERAN/UTRAN
  - Existing specs:
    - GMLC sends two PSLReq: MAP for Lg to SGSN , DIAMETER for SLg to MME
  - Per approved CT4 work:
    - GMLC sends two PSLReq: MAP for Lg to SGSN , DIAMETER for SLg to MME
  - Suggested CT4 optimization:
    - HSS informs GMLC that combo node is serving UE
    - GMLC sends single PSL to combo node

Conclusion 2: Message savings on Lg/SLg + RAN paging savings

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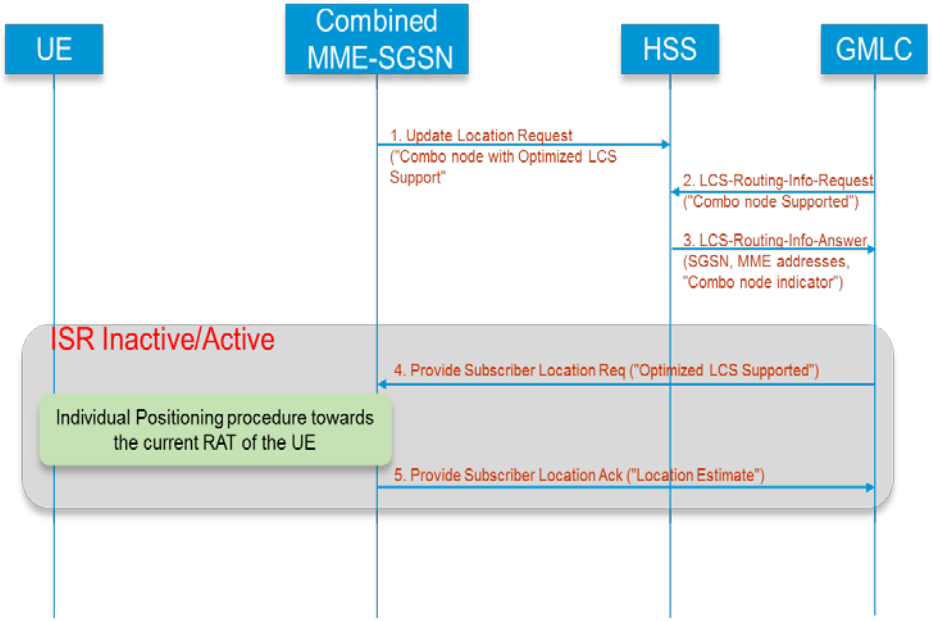
Additional CT4 recommendation for "Optimized LCS procedure"



- In addition to savings on SLg/Lg interface, CT4 recommended that additional RAN savings can be achieved for the case of:
  - ISR active
  - UE served by MME and SGSN part of the same combined node
- When
  - Combined node indicates support for "Optimized LCS" to HSS in ULR
  - In response to LRIR, HSS provides MME + SGSN address along w/ "combo node indicator"
  - GMLC sends 1 PSL w/ "optimized LCS supported" indicator, then
    - If UE is in IDLE mode:
      - If UE responds to MME paging in EUTRAN, then combo node stops paging in GERAN/UTRAN
      - If UE responds to SGSN paging in GERAN/UTRAN, then combo node stops paging in EUTRAN
    - If UE is in CONNECTED mode, then paging in other domain is completely suppressed
  - *IMPACTS:*
    - *HSS (support for new indicator)*
    - *GMLC (support for new indicator)*
    - *MME/SGSN (support for new indicator + inter-node API call to stop paging in other RAT)*

Conclusion 3: Additional RAN paging savings can be achieved in specific case of ISR active and UE being served by combo node

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Additional SA2 considerations (1/)

- For (ISR=active + standalone MME SGSN) case, similar RAN savings can also be achieved in parallel paging scenario:
  - GMLC sends PSL w/ new "parallel paging"+ indication to both standalone nodes
    - If UE responds in EUTRAN,
      - MME responds to GMLC w/ PSA
      - MME sends new* S3 message to SGSN to stop paging in GERAN/UTRAN
      - SGSN acts accordingly
    - If UE responds in GERAN/UTRAN
      - SGSN responds to GMLC w/ PSA
      - SGSN sends new* S3 message to MME to stop paging in EUTRAN
      - MME acts accordingly
  - *IMPACTS:*
    - *GMLC (support for new indicator)*
    - *MME/SGSN (support for new indicator + S3 stop paging indication message)*

+ Parallel paging here indicates whether GMLC has employed parallel paging towards serving nodes. Alternatively, a configuration based approach on MME/SGSN can also be taken into consideration

** Alt#1: STOP PAGING INDICATION is already sent on S11/S4 by SGW to MME, SGSN. Apply it on S3*

Alt#2: Create new S3 message

Alt#3: S3:ISR STATUS INDICATION message can be enhanced

Decision can be left up to CT4

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Is there Backward Incompatibility issue?

- **To account for CT4 recommendations**
  - DIAMETER protocol allows
    - Feature support advertisement via Supported-Features AVP

- Using the above, CT4 can easily come up w/ a mechanism where involved nodes HSS, GMLC, MME and SGSN can negotiate feature support for this

So, in case any of the involved nodes do not support the “optimized LCS feature” set proposed here, then existing pre-R12 mechanisms will apply

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Are there architectural impacts?

- Cases considered:
  - ISR = active + UE on combo node for IDLE UE
    - No new architectural entity
    - Protocol changes to existing interfaces can sufficiently cover the functionality
    - Nodes impacted: GMLC, HSS, MME, SGSN
  - ISR = active + UE on combo node for both IDLE and CONNECTED UE
    - No new architectural entity
    - Protocol changes to existing interfaces can sufficiently cover the functionality
    - Nodes impacted: GMLC, HSS, MME, SGSN
  - ISR = active + UE on standalone node for IDLE mode UE
    - No new architectural entity
    - Protocol changes to existing interfaces can sufficiently cover the functionality
    - Nodes impacted: GMLC, MME, SGSN

Protocol changes can sufficiently cover the optimization

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Discussion: SMSC aspects

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Whether MT-SMS optimization for combined node makes sense?

- In C4-131203, CT4 discussed whether optimization of combined MME/SGSN is justified for MT-SMS
  - Existing behaviour:
    - When the UE is registered on the two parts (MME and SGSN) of a combined node, the normal SMS procedure specifies a first MT SMS delivery to one node (e.g. the MME)and, if it fails, to do another one to the second node (so SGSN)
  - Possible enhancement:
    - Only do one delivery attempt to the combined node, and leave the combined node to locally find which part of the node will do the delivery.
    - So there would be only one MT-Forward-message request/answer pair instead of two request/answer pairs when the first attempt fails
      - Statistically, the first attempt would be successful for 50% of the cases; in these cases, the optimisation functionality is not used
      - We have to take into account the MNRF and the MNRG flags in the HSS and see how often the optimisation functionality would be used
- It was concluded that no significant gain(s) are achieved here

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Conclusions and Proposed way forward

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Proposed way forward

- SA2 to agree to 23.271 CR0400 (S2-133093) documenting Dia_SGSN_GMLC work already agreed by CT4 (up to CT4#62)
- SA2 to agree to 23.271 CR0401 (S2-133095) indicating inclusion of “Optimized LCS procedures” feature which achieves CN signalling + RAN paging savings for cases:
  - ISR = active + UE on combo node for both IDLE and CONNECTED UE
  - ISR = active + UE on standalone node for IDLE mode UE
- SA2 to respond to CT4 LS w/ the above agreements

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Thank you.