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Technical Report

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Study on LTE-HRPD Inter-RAT Self-configuring and self-optimizing network (SON) use cases and solutions (Release 12)

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Foreword

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x the first digit:

1 presented to TSG for information;

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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.

1 Scope

The present document provides descriptions of agreed use cases and solutions with regards to self configuring and self optimizing networks for LTE-HRPD Inter-RAT cases.

The scope of the self configuring and self optimizing functionality is defined in 3GPP TS 36.300 [2].

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 36.300: "Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2".

[3]] 3GPP TR 36.902: "Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Self-configuring and self-optimizing network (SON) use cases and solutions".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] 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 [1].

eHRPD	enhanced High Rate Packet Data in 3GPP2
HRPD	High Rate Packet Data in 3GPP2
RAT	Radio Access Technology
RIM	RAN Information Management

4 Description of envisioned self configuring and self optimizing functionality, Use cases

4.1 Load reporting between LTE and eHRPD

4.1.1 Use Case description

Objective:

For the purpose of load balancing in the scenario where both LTE and eHRPD coverage is present in the same geographical area (overlaid coverage), enable LTE and eHRPD RAN nodes to trigger inter-RAT mobility actions.

These load balancing actions are triggered on the basis of exchanged information about current load in the cells of both RATs. The load balancing can improve the overall system capacity compared to the static/non-optimised load distribution scenario. Such optimisation can also minimize human intervention in the network management and optimization tasks.

User QoS and service capability aspects in the respective RATs are assumed not to require additional standards support in the context of load balancing.

4.1.2 Solution Description

4.1.2.1 Load definition

For the load definition from LTE to eHRPD, the suggested solution is to re-use the current load reporting between LTE/UTRAN/GERAN, namely the Composite Available Capacity Group IE defined in 9.2.44 of 36.423. This provides the separate uplink and downlink load in the form of the Composite Available Capacity IE which contains:

- an optional Cell Capacity Class Value IE which indicates the value that classifies the cell capacity with regards to the other cells, and
- a Capacity Value IE which indicates the amount of resources that is available relative to the total E-UTRAN resources and can be weighted according to the ratio of cell capacity class values, if available.

The same load definition is suggested to be used for load reporting from eHRPD to LTE.

4.1.2.2 Reporting types

The following reporting types, which are a sub set of the types used for intra 3GPP load reporting, are suggested for the load reporting from LTE to eHRPD and from eHRPD to LTE:

- Multiple Cell Load Reporting
  In multiple cell reporting, the requesting node includes a list of cells for which the requesting node would like to receive a load report. The reporting node responds with a list of cell load values for each cell.
- Event-based Load Reporting
  In event based load reporting, the requesting node includes the number of reporting levels and the reporting node triggers a load report every time the load in the cell crosses a load threshold. The load thresholds are achieved by dividing the cell load scale into the indicated number of reporting levels. The load levels are evenly distributed on a linear scale below the reporting node's threshold for overload. The reporting cell also sends a report when the cell load enters and exits overload state, which is indicated by an overload flag in the report.

4.1.3 Conclusion

It is concluded that the following solutions for intra 3GPP load reporting can be re-used for LTE to eHRPD and eHRPD to LTE load reporting:

- the load definition of Composite Available Capacity Group IE, and
- the reporting types: multiple cell load reporting and event-based load reporting.

4.2 Mobility Robustness Optimization (MRO) between LTE and eHRPD

4.2.1 Use Case description

Objective:

Enable the eNB to detect the scenario where a UE connected to the E-UTRAN experiences connection failure and immediately establishes a new radio connection to eHRPD AN (too late handover from LTE to eHRPD). Such detection mechanism can be used by the eNB to adjust the inter-RAT handover trigger from LTE to eHRPD.

Automatic adjustment of the handover triggering threshold may result in unnecessary handovers from LTE to eHRPD with negative impact on the overall use of network capacity or on user QoS. A mechanism to detect unnecessary handover from LTE to eHRPD may therefore be beneficial in addition to detection of too late handover from LTE to eHRPD.

4.2.2 Solution Description

4.2.2.1 Too late LTE to eHRPD mobility

When the UE re-connects after the failure to an eHRPD cell, it stores the necessary failure information. This includes the identity of the last serving LTE cell and the eHRPD cell where the UE re-establishes after the failure. Then, when the UE sets up a connection in an LTE cell, the failure information is made available for the network (e.g. as a RLF Report). The RLF report is forwarded to the last serving eNB where the analysis is performed.

No additional signalling between eHRPD and LTE nodes is needed.

4.2.2.2 Unnecessary handover from LTE to eHRPD

In this solution, the eNB includes a measurement configuration, with measurement criteria and a measurement time, piggy backed with the handover preparation to the eHRPD node. The eHRPD node configures the UE to perform measurements on LTE during this measurement time and reports the result of these measurements back to the eNB.

The report from the eHRPD node to the LTE node contains the following information:

- Identity of the LTE source cell from which the UE was handed over to eHRPD
- Identity of the eHRPD target cell to which the UE was handed over from LTE
- A list of candidate LTE cells, for which the measurement criteria was fulfilled during the measurement period.

The analysis of the feasibility to request these UE measurements while being connected to eHRPD would require input from 3GPP2.

4.2.2 Conclusion

The typical scenario would be to use re-direction to support mobility from LTE to eHRPD.

The impact of this is that:

- the existing solution for unnecessary handover (in 3GPP) cannot be reused, since the measurement configuration is piggybacked in the handover request;
- the existing solution for too late inter RAT handover (where the UE reports the cell where he will attempt to connect in the other RAT) may be re-used. The details on how to use the existing solution to optimise the LTE-eHRPD redirection need to be further analysed.

Hence, the conclusion is that, given this typical scenario, it is at the moment not beneficial to include the solutions for unnecessary handover.

The feasibility of the too late LTE to eHRPD solution depends on whether the UE can include the ID of the eHRPD cell where the UE connects after failure in the RLF report and would require input from RAN2.

5 SON Information transfer mechanisms between LTE and eHRPD

5.1 Extension of RIM

In this solution, the existing RAN interface is re-used, i.e. RIM PDUs are transmitted on S1 between the eNB and the MME using the eNB Direct Information Transfer and the MME Direct Information Transfer procedures. The RIM application must be updated to support addressing of eHRPD cells and nodes.

Drawback	eHRPD needs to implement a GERAN spec which from 3GPP2 point of view, which may be an obstacle.
Benefit	Reusing of existing mechanism will require less effort compared with creating a new application. The current scope of LTE HRPD SON is a sub set of the intra-3GPP SON.
Standard impact	Add target ID (CDMA2000 Sector ID) in RIM Routing Address IE to support routing to HPRD Sector. Update the corresponding SON container to include HPRD in addition to GERAN and UMTS. A new message (on S101) or logic interface (Sxxx) between MME and eAN should be defined.

5.2 New RIM adaptation solution

In this solution, the existing procedures eNB/MME Direct Information Transfer is reused and a subset of the RIM specification for LTE HRPD SON is specified separately.

Drawback	Need to have new specification which means that more work is expected compared with to re-using existing RIM specification. The new specification can be included in existing specification e.g. in 3GPP TS 36.413.
Benefit	Since it will be a new specification, no constraints from previous solutions exist. One example of this is that the existing RIM application needs to have a request & response pair while some application may not need any response,
Standard impact	The application can be carried in the eNB/MME DIRECT INFORMARION TRANSFER message. A new message (on S101) or logic interface (Sxxx) between MME and eAN should be defined.

5.3 New direct interface

In this solution, a new logical interface between eNB and eHRPD AN is defined. This also requires that new procedures and messages for the new interface are defined.

Drawback	Need to specify a new interface from layer 1 so more work is expected than to re-use existing interfaces.
Benefit	The application signalling messages do not need to go through CN side therefore this solution will have no impact on CN e.g. signalling load etc.
Standard impact	New interface, protocol and messages between eNB and eAN should be defined.

5.4 Handover piggybacking based solution

In this solution, the load reports are piggy backed in the handover messages between LTE and eHRPD. There is currently no explicit S1 handover messages between LTE and eHRPD via the EPC, but only the direct transferring messages in S1AP (36.413) and S101AP (29.276) which will convey the CDMA2000 eHRPD handover related messages and pre-registration related messages between UE and eHRPD.

Drawback	The solution was previously ruled out for intra-3GPP since there is no way to send load reporting in case no mobility between the cells takes place.
Benefit	No further impact on CN as the new piggy back IE is added to the existing messages and the new IE can be transparent to the CN.
Standard impact	To add load information of LTE/eHRPD in the following message, as well as procedure text: S1AP: UPLINK S1 CDMA2000 TUNNELING message S1AP: DOWNLINK S1 CDMA2000 TUNNELING message S101AP: DIRECT TRANSFER REQUEST message S101AP: DIRECT TRANSFER RESPONSE message

5.5 Conclusion

Two solutions are considered to be more suitable than the others: Extension of RIM (sub-section 5.1) and New RIM adaptation solution (sub-section 5.2). The solution descriptions in these two sub-sections cover documentation aspects as well as the choice of interface between the 3GPP core network and eHRPD.

Down-selection of documentation options takes into account:

- Extension of RIM
  The advantage of re-using the existing RIM application and extend it by adding the possibility to address eHRPD nodes and cell is that there would not be a need to extend the functionality of RIM since the scenarios discussed for LTE-HRPD is a sub set of the existing LTE/UTRAN/GERAN inter RAT SON functionalities. The impact of re-using RIM from specification point of view would however be that 3GPP TS 48.018 must be implemented in 3GPP2.

- New RIM adaptation solution
  The advantage of defining a new specification is that this would avoid the implementation of 3GPP TS 48.018 in 3GPP2. It also avoids implementing functionality defined in RIM that is not (yet) considered useful for LTE HRPD SON. It may also allow a more efficient implementation of messages that are not request-response in nature.

It is concluded that the "Extension of RIM" documentation option will be used due to significantly lower specification impact and in order to avoid duplication of specification.

Concerning the choice of interface between the 3GPP Core Network and eHRPD, an aspect to consider is that since S101 is defined as UE associated interface, e.g. Session ID is mandatory which is associated with an UE, a new message should be defined. Another option would be to create a new interface (Sxxx). It is concluded to create a new interface (Sxxx) for the reason of the benefits to leave S101 backward compatible and also increase the flexibility with regards to the endpoint on the eHRPD side. The eHRPD endpoint of the Sxxx interface may be at the eHRPD/AN or at an interworking gateway, depending on the choice and configuration of the eHRPD network. The MME may still assume that the eHRPD endpoint is the eHRPD/AN and perform signalling accordingly.

Annex A:
Change history

Change history							
Date	**TSG #**	**TSG Doc.**	**CR**	**Rev**	**Subject/Comment**	**Old**	**New**
RAN3#77bis		R3-122331			First Skeleton provided		
RAN3#78		R3-122887					0.0.1
RAN#58		RP-121785					1.0.0
RAN3#79		R3-130437			Updates include input from 3GPP2 TSG-A (LS in R3-130004)		1.1.0
RAN3#80		R3-130961			Updates of the MRO part and selection of transfer mechanism		1.2.0
RAN3#80		R3-131132			Addition of a conclusion part for load balancing		1.3.0
RAN#60		RP-130671			Updates of References and Abbreviations	2.0.0	2.0.0
-		-			MCC clean-up	2.0.0	2.0.1