3GPP TSG-RAN WG2 Meeting #107bis R2-19xxxxx

Chongqing, China, 14th - 18th October 2019

Source: AT&T

Title: Report for [107#51][NR IAB] F1 over LTE (AT&T)

Agenda Item: 11.1.5

Document for: Discussion and Decision

# Introduction

This is a summary report for email discussion 107#51 regarding solutions for F1AP signaling via LTE for an IAB-MT operating in EN-DC mode.

[107#51][NR IAB] F1 over LTE (AT&T)

Intended outcome: Report identify the impact, attempt to converge on a solution, based on R2-1911782, including the possibility of split SRB3

Deadline: Thursday 2019-10-03

The following five potentials solutions for F1 over LTE were discussed at RAN2#107. This email discussion further discusses the impact of these solutions and tries to converge on a solution.

* **Solution Set 1: Based on MT’s control plane**
  + **Solution 1a**: F1AP interface transported over MT’s RRC
  + **Solution 1b**: F1AP interface transported directly in X2-C container
  + **Solution 1c**: F1AP interface transported using split SRB3
* **Solution Set 2: Based on MT’s user plane**
  + **Solution 2a**: F1AP interface transported via E1 and over MT’s SN-terminated bearer
  + **Solution 2b**: F1AP interface transported over-the-top via local PDN gateway at CU-CP

**Response deadline: October 1st, 2019**

# Solution Details and Impact

## Solution Set 1: Based on MT’s control plane

### Solution 1a: F1AP interface transported over MT’s RRC

This solution is based on [1], and proposes to tunnel the F1AP stack (F1AP/DTLS/SCTP/IP) via the MT’s NR RRC. This solution tries to reuse existing mechanisms already in place to deliver NR RRC signaling over X2AP to/from a UE via LTE MeNB. In this solution the LTE MeNB is not aware that it is transporting F1AP signaling to the MT since this signaling is tunneled through the NR RRC. The following potential specification changes were identified in [1] and during the offline discussion.

* NR RRC (38.331)
  + Add new IABF1APInformationTransferMRDC message to encapsulate IP packet carrying F1AP.
  + Add new UL-DCCH-MessageType to UL-DCCH-Message message, and new DL-DCCH-MessageType to DL-DCCH-Message message to carry the new IABF1APInformationTransferMRDC message.
  + Minor text addition for description and usage.
* LTE RRC (36.331):
  + Define new DLInformationTransferMRDC message to transfer NR DL-DCCH-Message from LTE eNB to IAB-MT.
  + Minor text change to indicate additional usage of UL-DCCH-MessageNR field and DL-DCCH-MessageNR field to transfer a new NR RRC message IABF1APInformationTransferMRDC.
* X2AP (36.423):
  + Possibly new IE in RRC TRANSFER message if usage of existing RRC Container related IEs cannot be extended to carry the required NR RRC message.

Additionally, it was discussed that there may be a need to provide some configuration to the MT from the CU to indicate whether the MT should use the NR RRC path via LTE or the BAP layer path via NR IAB to send uplink F1AP messages. Also, more discussion may be needed to identify an entity on the MT that would be responsible to receive this configuration for NR/LTE selection and enforce it.

***Q1: Regarding impact to X2AP specifications (TS 36.423), do you think that usage of one of the existing RRC Container related IEs in the RRC TRANSFER message can be extended to carry the required NR RRC message? Or do you think a new IE needs to be defined for the RRC TRANSFER message? Please explain.***

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***Q2: Assuming that the MT can be configured via NR RRC signaling to use either the NR RRC path via LTE, or the BAP layer path via NR IAB, to send uplink F1AP messages, is there a need to specify which entity within the MT receives and acts upon this configuration? Can this be left up to implementation, since the interaction between DU and MT inside an IAB node is not specified? Please explain your view. Note that this same discussion will also apply to Solution 1b.***

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***Q3: At a high level is there anything major missing from the above list of impacts for Solution 1a? If so, please explain. In addition to specification impacts, also comment on any potential implementation impacts.***

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***Q4: Is Solution 1a forward compatible to other MR/NR DC architecture options with FR1-FR2 DC? If so, briefly state any additional impact.***

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### Solution 1b: F1AP interface transported directly in X2-C container

This solution was proposed in the offline discussion as a variation of Solution 1a. Rather than tunneling the F1AP stack via the MT’s NR RRC, this solution proposes to directly transport the F1AP stack in an RRC container over the X2-C interface. In this solution, since the F1AP signaling is directly sent to the LTE MeNB via X2-C, the LTE eNB needs to be aware that it is transporting F1AP signaling to the MT. The following specification changes are expected for this solution:

* LTE RRC (36.331):
  + Define new DLF1APInformationTransferMRDC message to transfer F1AP message from the LTE eNB to IAB-MT.
  + Define new ULF1APInformationTransferMRDC message to transfer F1AP message from IAB-MT to LTE eNB.
  + Minor text addition for description and usage.
* X2AP (36.423):
  + New IE in RRC TRANSFER message for an F1AP container to carry the F1AP packet.

Also, as with Solution 1a, there may be a need to provide some configuration to the MT from the CU to indicate whether the MT should use the LTE RRC path or the BAP layer path via NR IAB to send uplink F1AP messages. Again, as with Solution 1a, more discussion may be needed to identify an entity on the MT that would be responsible to receive this configuration for NR/LTE selection and enforce it.

***Q5: At a high level is there anything major missing from the above list of impacts for Solution 1b? If so, please explain. In addition to specification impacts, also comment on any potential implementation impacts.***

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***Q6: Is Solution 1b forward compatible to other MR/NR DC architecture options with FR1-FR2 DC? If so, briefly state any additional impact.***

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### Solution 1c: F1AP interface transported using split SRB3

This solution was identified by multiple companies during offline discussions at RAN2#107. In this solution the F1AP stack (F1AP/DTLS/SCTP/IP), is proposed to be carried by a split SRB3 bearer. Note that currently split SRB is only allowed for SRB1 and SRB2. This solution proposes to extend the split SRB functionality to SRB3. One advantage of this solution is that it naturally reuses mechanisms already designed in the specifications for split SRBs. Furthermore, it also avoids the issue faced by Solutions 1a and 1b regarding configuration of which path to use for F1AP signalling. The split SRB framework naturally allows the transmitting NR PDCP-C entity to send F1AP packets on either path, while the receiving PDCP-C entity can naturally handle duplicate discarding. The following solution impacts are identified:

* NR RRC (38.331)
  + Add new information element to existing DLInformationTransfer and ULInformationTransfer messages to carry F1AP messages for DL and UL respectively.
  + Minor text addition for description and to indicate split SRB support for SRB3.
* LTE RRC (36.331):
  + Minor text addition to indicate split SRB support for SRB3, and usage of Value 3 for SRB3 in srb-Identity field.
* X2AP (36.423):
  + Minor text change to indicate split SRB support for SRB3
* Multi-connectivity (37.340):
  + Minor text change to indicate split SRB support for SRB3

***Q7: At a high level is there anything major missing from the above list of impacts for Solution 1c? If so, please explain. In addition to specification impacts, also comment on any potential implementation impacts.***

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***Q8: Is Solution 1c forward compatible to other MR/NR DC architecture options with FR1-FR2 DC? If so, briefly state any additional impact.***

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## Solution Set 2: Based on MT’s user plane

### Solution 2a: F1AP interface transported via E1 and over MT’s SN-terminated bearer

This solution is based on [2], and proposes to tunnel the F1AP stack (F1AP/DSCP/STCP/IP) via the MT’s SN-terminated LTE DRB. This solution tries to reuse the solution for delivering user plane data for an SN-terminated bearer over X2-U to/from a UE via the LTE MeNB. The following potential specification changes were identified during the offline discussion.

* Indication to associate a DRB with F1-C traffic rather than with EPS bearer / S1-U bearer. This is needed whenever establishing the DRB:
  + RRC (RRCConnectionReconfiguration) (36.331)
  + X2AP (SgNB addition request) (36.423)
  + E1AP (Bearer Context Setup Request) (38.463)
  + Given that MT’s own traffic is expected to be limited, it is proposed to specify that for a MT, a fixed DRB is used for F1-C, e.g. DRB1, which avoids above changes.
  + Corresponding procedural text changes are required.

In case of CU-CP / CU-UP split, we can reuse the S1 GTP-U tunnel configuration for the new tunnel.

* In Bearer Context Setup Request (IE DRB To Setup Item E-UTRAN)
  + “S1 UL UP Transport Layer Information” indicates the endpoint for the associated S1-U bearer GTP-U tunnel in SGW (for UL)
  + It can used by CU-CP to indicate the endpoint in the CU-CP for UL F1-C traffic.
* In Bearer Context Setup Response (IE DRB Setup List E-UTRAN)
  + “S1 DL UP Transport Layer Information” indicates the endpoint for the associated S1-U bearer GTP tunnel in CU-UP (for DL)
  + It can be used by CU-CP to send the DL F1-C traffic.

***Q9: At a high level is there anything major missing from the above list of impacts for Solution 2a? If so, please explain. In addition to specification impacts, also comment on any potential implementation impacts.***

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***Q10: Is Solution 2a forward compatible to other MR/NR DC architecture options with FR1-FR2 DC? If so, briefly state any additional impact.***

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### Solution 2b: F1AP interface transported over-the-top via local PDN gateway at CU-CP

This solution was proposed in the offline discussion as a variation of Solution 2a. Rather than tunneling the F1AP stack via an SN-terminated DRB, this solution proposes to deliver the F1AP stack over-the-top (OTT) to the MT. According to this proposal, the PDN gateway could assign an IP address to the MT, which could be used by SCTP to deliver F1AP traffic. Due to multi-homing feature of SCTP, both paths for delivering F1AP signaling could co-exist simultaneously (i.e. the original path via NR IAB and the new path via PDN gateway through the LTE eNB).

It is not clear if there would be any specification impact of this solution. Furthermore, allocation of a local gateway may be a deployment/configuration issue.

***Q11: At a high level is there anything major missing from the above list of impacts for Solution 2b? If so, please explain. In addition to specification impacts, also comment on any potential implementation impacts.***

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***Q12: Is Solution 2b forward compatible to other MR/NR DC architecture options with FR1-FR2 DC? If so, briefly state any additional impact.***

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## Solution Convergence

Based on solution details discussed in previous section, this section attempts to converge on a solution considering factors such as specification impact, implementation impact, and forward compatibility. The five considered solutions are again listed below for convenience:

* + **Solution 1a**: F1AP interface transported over MT’s RRC
  + **Solution 1b**: F1AP interface transported directly in X2-C container
  + **Solution 1c**: F1AP interface transported using split SRB3
  + **Solution 2a**: F1AP interface transported via E1 and over MT’s SN-terminated bearer
  + **Solution 2b**: F1AP interface transported over-the-top via local PDN gateway at CU-CP

***Q13: Based on an overall consideration, which may include specification impact, implementation impact, and forward compatibility, please indicate a preference for specifying one of the five above listed solutions.***

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# Summary

TBD

# Reference

1. R2-1910773, Delivery of control plane signaling to IAB nodes via LTE MeNB in NSA deployment, AT&T, KDDI, Verizon, KT.
2. R2-1911387, IAB with NSA operation, Sequans Communications