**3GPP TSG-RAN WG2 Meeting #115 R2-21xxxxx**

**Electronic Meeting, August 09 – August 27, 2021**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **38.300** | **CR** |  | **rev** | **-** | **Current version:** | **16.6.0** |  |
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| *For* [***HELP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **x** | Radio Access Network | **x** | Core Network |  |

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| ***Title:***  | Running CR to 38.300 for eIAB |
|  |  |
| ***Source to WG:*** | Qualcomm |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_IAB\_enh-Core |  | ***Date:*** | 2021-09-06 |
|  |  |  |  |  |
| ***Category:*** | **B** |  | ***Release:*** | Rel-17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | **RLF Indication*** RAN2 to discuss enhancements to RLF indication/handling with the focus on the reduction of service interruption after BH RLF.
* RAN2 to support type-2/3 RLF indication (FFS specified behavior(s) TS impact, FFS details).
* Type-2 RLF indication may be used to trigger local rerouting
* Type-2 RLF indication may be used to trigger deactivation of IAB-supported in SIB
* Type-2 RLF indication may be used to trigger deactivation or reduction of SR and/or BSR transmissions
* The trigger to generate a type 2 RLF indication is at RLF detection. FFS whether for both: single and dual connection cases.
* The trigger for type 3 RLF indication transmission is successful recovery after BH RLF. FFS whether for both: single and dual connection cases.
* Type 2 and Type 3 BH RLF Indications are transmitted via BAP Control PDU.
* Upon reception of the type-2 indication, the IAB node does not initiate RRC re-establishment.
* If an IAB node with dual parents (via DC) receives type-2 BH RLF indication from one parent, IAB-node may trigger a local re-routing to the other parent. The detail of local re-routing and whether/how the action on type-2 indication is configurable is FFS.

**Local rerouting** * RAN2 to discuss local rerouting, including the benefits over central route determination, and on how topology-wide objectives can be addressed.
* Local rerouting can be triggered by indication of hop-by-hop flow control. Further details, e.g., on trigger information, trigger conditions, role of CU configuration, are FFS.
* RAN2 considers inter-donor-DU local rerouting to be in scope
* Assume that the IAB-donor will configure (alternative) egress links that can be used at local re-routing (at least with same destination, FFS same routing ID)
* Local re-routing based on flow control feedback is allowed based on certain value of available buffer size. FFS further details. (Current hbh fc is for DL traffic.
* A configured threshold of available buffer size based on flow control feedback is used to determine the congestion, for the purpose of local re-routing.
* For intra-CU cases, Support inter-donor-DU re-routing at least in the scenarios of NR-DC among donor-DUs, inter-donor-DU recovery and inter-donor-DU migration.
* Support inter-CU re-routing, i.e. IAB-node re-routes the data to its original donor-CU via the alternative BAP path over the topology in target CU.
* For inter-donor-DU re-routing, support the “previous routing ID to new routing ID” BAP header rewriting.

**CHO*** CHO and potential IAB-specific enhancements of CHO is on the table.
* RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration.
* R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed).
* R2 assumes that Rel-16 specification is the baseline for the configuration of default route, IP address(es) and target path for intra-donor CHO.
* The use cases for IAB-MT CHO should be migration and RLF recovery.
* RAN2 should have a common solution for intra-CU/intra-DU CHO and intra-CU/inter-DU CHO.
* condEventA3 and condEventA5 are applicable to IAB-MT
* FFS if other CHO execution condition is needed (e.g. whether type 2 RLF indication can be used as trigger)
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|  |  |
| ***Summary of change:*** | **RLF indication:**Introduction of BH RLF detection indication and BH recovery indication. Renaming of Rel-16 BH RLF indication to Rel-16 BH recovery failure indication.Description of conditions for transmission of BH RLF detection indication and BH recovery indication.Description of potential behavior upon reception of BH RLF detection indication and BH recovery indication.**Local rerouting:**Addition of conditions for local rerouting: * Local rerouting based on congestion (for DL)
* Local rerouting due to unavailability of the BH link due to migration or recovery.

Addition of BAP header rewriting in case of local rerouting in UL direction. **CHO:**CHO is also appliable to IAB-MT in the context of intra/inter-donor migration and recovery.   |
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| ***Consequences if not approved:*** | Rel-17 eIAB is not supported. |
|  |  |
| ***Clauses affected:*** | 6.11 Backhaul Adaptation Protocol sublayer 6.11.1 Services and Functions 6.11.3 Routing and BH-RLC-channel mapping on BAP sublayer9.2.3.4 Conditions Handover9.2.7 Radio link failure |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ... |
| ***affected:*** |  | **x** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **x** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** | This Running CR is based on the version 16.6.0 of TS 38.300 |
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| ***This CR's revision history:*** |  |

*First Modified Subclause*

### 6.11.1 Services and Functions

The main service and functions of the BAP sublayer include:

- Transfer of data;

- Routing of packets to next hop;

- Determination of BAP destination and BAP path for packets from upper layers;

- Determination of egress BH RLC channels for packets routed to next hop;

- Differentiating traffic to be delivered to upper layers from traffic to be delivered to egress link;

- Flow control feedback and polling signalling;

- BH RLF detection indication, BH recovery indication, and BH recovery failure indication.

*Next Modification*

### 6.11.3 Routing and BH-RLC-channel mapping on BAP sublayer



Figure 6.11.3-1: Routing and BH RLC channel selection on BAP sublayer

Routing on BAP sublayer uses the BAP routing ID, which is configured by the IAB-donor-CU. The BAP routing ID consists of BAP address and BAP path ID. The BAP address is used for the following purposes:

1. Determination if a packet has reached the destination node, i.e. IAB-node or IAB-donor-DU, on BAP sublayer. This is the case if the BAP address in the packet's BAP header matches the BAP address configured via RRC on the IAB-node, or via F1AP on the IAB-donor-DU.

2. Determination of the next-hop node for packets that have not reached their destination. This applies to packets arriving from a prior hop on BAP sublayer or that have been received from IP layer.

For packets arriving from a prior hop or from upper layers, the determination of the next-hop node is based on a routing configuration provided by the IAB-donor-CU via F1AP signalling or a default configuration provided by the IAB-donor-CU via RRC signalling. This F1AP configuration contains the mapping between the BAP routing ID carried in the packet's BAP header and the next-hop node's BAP address.

Table 6.11.3-1: Routing configuration

|  |  |
| --- | --- |
| BAP routing ID | Next-hop BAP address |
| Derived from BAP packet's BAP header | Egress link to forward packet |

The IAB-node resolves the next-hop BAP address to a physical backhaul link. For this purpose, the IAB-donor-CU provides the IAB-node/IAB-donor-DU with its child-node's BAP address via F1AP, and it provides the IAB-node with its parent-node's BAP address via RRC.

The IAB-node can receive multiple routing configurations with the same destination BAP address but different BAP path IDs. These routing configurations may resolve to the same or different egress BH links. In case the BH link resolved from the routing entry is unavailable or congested, the IAB-node may perform local rerouting, i.e., select another BH link based on routing entries with the same destination BAP address, i.e., by disregarding the BAP path ID. In this manner, a packet can be delivered via an alternative path in case the indicated path is not available, as defined in TS 38.340 [zz].

A BH link may be considered unavailable in case the BH link has RLF. For UL traffic, a BH link may also be considered unavailable after the IAB-MT has migrated to or recovered at a different parent node.

For DL traffic, a BH link may be considered congested based on flow-control feedback information as defined in TS 38.340 [zz].

For local rerouting in UL direction, the destination may be the same or a different IAB-donor-DU. In case the destination is a different IAB-donor-DU, the IAB-node rewrites the BAP header with the destination BAP address of the new IAB-donor-DU and (potentially) a new BAP path ID. The mapping between initial and new BAP address and BAP path ID is configured by the IAB-donor-CU.

**Editor’s NOTE: It is not clear why inter-donor DU rerouting would be applied in case of NR-DC unless one parent link has RLF.**

**Editor’s NOTE: FFS if more detail needs to be added on congestion-based rerouting.**

When routing a packet from an ingress to an egress BH link, the IAB-node derives the egress BH RLC channel on the egress BH link through an F1AP-configured mapping from the BH RLC channel used on the ingress BH link. The BH RLC channel IDs used for ingress and egress BH RLC channels are generated by the IAB-donor-CU. Since the BH RLC channel ID only has link-local scope, the mapping configurations also include the BAP addresses of prior and next hop:

Table 6.11.3-2: BH RLC channel mapping configuration

|  |  |  |  |
| --- | --- | --- | --- |
| Next-hop BAP address | Prior-hop BAP address | Ingress RLC channel ID | Egress RLC channel ID |
| Derived from routing configuration | Derived from packet's ingress link | Derived from packet's ingress BH RLC channel | BH RLC channel on egress link to forward packet |

The IAB-node resolves the BH RLC channel IDs from logical channel IDs based on the configuration by the IAB-donor-CU. The IAB-MT obtains the BH RLC channel ID in the RRC configuration of the corresponding logical channel. The IAB-DU obtains the BH RLC channel ID in the F1AP configuration of the BH RLC channel.

*Next Modification*

#### 9.2.3.4 Conditional Handover

##### 9.2.3.4.1 General

A Conditional Handover (CHO) is defined as a handover that is executed by the UE when one or more handover execution conditions are met. The UE starts evaluating the execution condition(s) upon receiving the CHO configuration, and stops evaluating the execution condition(s) once a handover is executed.

The following principles apply to CHO:

- The CHO configuration contains the configuration of CHO candidate cell(s) generated by the candidate gNB(s) and execution condition(s) generated by the source gNB.

- An execution condition may consist of one or two trigger condition(s) (CHO events A3/A5, as defined in [12]). Only single RS type is supported and at most two different trigger quantities (e.g. RSRP and RSRQ, RSRP and SINR, etc.) can be configured simultaneously for the evalution of CHO execution condition of a single candidate cell.

- Before any CHO execution condition is satisfied, upon reception of HO command (without CHO configuration), the UE executes the HO procedure as described in clause 9.2.3.2, regardless of any previously received CHO configuration.

- While executing CHO, i.e. from the time when the UE starts synchronization with target cell, UE does not monitor source cell.

CHO is also supported for the IAB-MT in context of intra- and inter-donor IAB-node migration and RLF recovery.

**Editor’s NOTE: FFS if any IAB-specific specifications or needed. FFS further details related to intra-/inter-donor migration/recovery. RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration.**

CHO is not supported for NG-C based handover in this release of the specification.

*Next Modification*

### 9.2.7 Radio Link Failure

In RRC\_CONNECTED, the UE performs Radio Link Monitoring (RLM) in the active BWP based on reference signals (SSB/CSI-RS) and signal quality thresholds configured by the network. SSB-based RLM is based on the SSB associated to the initial DL BWP and can only be configured for the initial DL BWP and for DL BWPs containing the SSB associated to the initial DL BWP. For other DL BWPs, RLM can only be performed based on CSI-RS. In case of DAPS handover, the UE continues the detection of radio link failure at the source cell until the successful completion of the random access procedure to the target cell.

The UE declares Radio Link Failure (RLF) when one of the following criteria are met:

- Expiry of a radio problem timer started after indication of radio problems from the physical layer (if radio problems are recovered before the timer is expired, the UE stops the timer); or

- Expiry of a timer started upon triggering a measurement report for a measurement identity for which the timer has been configured while another radio problem timer is running; or

- Random access procedure failure; or

- RLC failure; or

- Detection of consistent uplink LBT failures for operation with shared spectrum channel access as described in 5.6.1; or

- For IAB-MT, the reception of a BH recovery failure indication received from its parent node.

After RLF is declared, the UE:

- stays in RRC\_CONNECTED;

- in case of DAPS handover, for RLF in the source cell:

- stops any data transmission or reception via the source link and releases the source link, but maintains the source RRC configuration;

- if handover failure is then declared at the target cell, the UE:

- selects a suitable cell and then initiates RRC re-establishment;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after handover failure was declared.

- in case of CHO, for RLF in the source cell:

- selects a suitable cell and if the selected cell is a CHO candidate and if network configured the UE to try CHO after RLF then the UE attempts CHO execution once, otherwise re-establishment is performed;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after RLF was declared.

- otherwise, for RLF in the serving cell or in case of DAPS handover, for RLF in the target cell before releasing the source cell:

- selects a suitable cell and then initiates RRC re-establishment;

- enters RRC\_IDLE if a suitable cell was not found within a certain time after RLF was declared.

When RLF occurs at the IAB BH link, the same mechanisms and procedures are applied as for the access link. This includes BH RLF detection and RLF recovery.

When the single-connected IAB-MT detects RLF at the BH link, the collocated IAB-DU may transmit a BH RLF detection indication to its child nodes. After the IAB-MT’s BH link has successfully recovered, the collocated IAB-DU may transmit a BH recovery indication to its child nodes.

**Editor’s NOTE: FFS if and/or under what circumstances BH RLF-detection indication and BH recovery indication are transmitted in case the IAB-MT is dual-connected.**

**Editor’s NOTE: FFS if BH recovery indication is only sent in case BH RLF detection indication has been sent before. FFS if it can also be sent if BH RLF detection indication has not been sent before.**

In case the RRC reestablishment procedure fails, the IAB-node may transmit a BH recovery failure indication to its child nodes. The BH RLF detection indication, BH recovery indication and BH recovery failure indication are transmitted as BAP Control PDUs.

Upon reception of the BH RLF detection indication, the IAB-node may deactivate the IAB-supported indicator in SIB. It may further deactivate or reduce SR and/or BSR transmissions to its parent node. In case the IAB-node is dual-connected, it may further apply local rerouting for UL traffic to the other parent node.

**Editor’s NOTE: FFS on the receiving node’s behavior upon reception of BH recovery indication.**

*End of Changes*

# Annex (not part of the specification) - collection of RAN2 agreements on NR IAB enhancements WI

Cyan highlight – agreement captured in this running CR

No highlight – agreement with no direct impact on specifications

## RAN2#115-e agreements

**Organizational**

* R2 assumes that the UE need to be able to treat the separate resources as different cells on L1.
* LS is agreeable with the addition of the above assumption. Can consider one more round of details checking.

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* The length of LCG to be extended to 8 bits (i.e., at most 256 LCGs).
* New Short (Truncated) BSR format to specified that has a fixed size and consists of an 8-bit LCG ID field and an 8-bit Buffer Size field.
* Exclude P1

**On Topology adaptation enhancements**

* A configured threshold of available buffer size based on flow control feedback is used to determine the congestion, for the purpose of local re-routing.
* For intra-CU cases, Support inter-donor-DU re-routing at least in the scenarios of NR-DC among donor-DUs, inter-donor-DU recovery and inter-donor-DU migration.
* Support inter-CU re-routing, i.e. IAB-node re-routes the data to its original donor-CU via the alternative BAP path over the topology in target CU.
* For inter-donor-DU re-routing, support the “previous routing ID to new routing ID” BAP header rewriting.
* RAN2 to further discuss the open issues for inter-CU routing:
	+ What’s the BAP address added in BAP header in the first topology (i.e. the BAP address of ingress data at the boundary node);
	+ How to differentiate the concatenated traffic and non-concatenated traffic;
	+ How to determine whether a data should be delivered to upper layer (for downstream);
	+ How to determine whether the BAP header of a data should be rewritten (i.e. whether being routed to another topology or its own topology).
* As baseline, support the 1:1 and N:1 mapping from “previous routing ID” to “new routing ID” for BAP header rewriting at the boundary node, in inter-CU routing.
* As baseline, support the 1:1 and N:1 mapping from “ingress BH link + ingress BH RLC ID” to “egress BH link + egress BH RLC ID” for bearer mapping at the boundary node, in inter-CU routing.

## RAN2#114-e agreements

**On Topology adaptation enhancements**

* RAN2 preference is to support inter-topology routing via BAP header rewriting based on BAP routing ID option 4
* Assume that the IAB-donor will configure (alternative) egress links that can be used at local re-routing (at least with same destination, FFS same routing ID)
* Local re-routing based on flow control feedback is allowed based on certain value of available buffer size. FFS further details. (Current hbh fc is for DL traffic.
* NR DLInformationTransfer and ULInformationTransfer messages can be enhanced to transfer F1-C related packets in CP/UP separation.
* A new IE named DedicatedInfoF1c can be defined to transfer F1-C related packets via NR RRC message
* F1-C over RRC and F1-C over BAP should not be supported simultaneously on the same parent link.
* The trigger to generate a type 2 RLF indication is at RLF detection. FFS whether for both: single and dual connection cases.
* The trigger for type 3 RLF indication transmission is successful recovery after BH RLF. FFS whether for both: single and dual connection cases.
* Type 2 and Type 3 BH RLF Indications are transmitted via BAP Control PDU.
* Upon reception of the type-2 indication, the IAB node does not initiate RRC re-establishment.
* If an IAB node with dual parents (via DC) receives type-2 BH RLF indication from one parent, IAB-node may trigger a local re-routing to the other parent. The detail of local re-routing and whether/how the action on type-2 indication is configurable is FFS.

## RAN2#113bis-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* LCG range to be extended for IAB-MT. Size of LCG and enhancements to BSR are FFS

**On Topology adaptation enhancements**

* The use cases for IAB-MT CHO should be migration and RLF recovery.
* RAN2 should have a common solution for intra-CU/intra-DU CHO and intra-CU/inter-DU CHO.
* condEventA3 and condEventA5 are applicable to IAB-MT
* FFS if other CHO execution condition is needed (e.g. whether type 2 RLF indication can be used as trigger)
* SRB2 can be used for F1-C transport in CP/UP-separation scenario 1 (FFS other cases)
* Split SRB2 can be used for F1-C transport in CP/UP-separation scenario 2 (FFS other cases)

## RAN2#113-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation**

* RAN2 will not further discuss ways of evaluating success of any fairness mechanisms that may be introduced, beyond the already agreed definition of topology-wide fairness and its variants.
* Chair: On the agreed issues below, the agreement doesn’t mean that we have agreed that there need to be a solution for it in R17. Furthermore, liberal interpretation of the text is ok.
* ISSUES: eIAB work on topology-wide fairness will focus on the following issues
* IF-1: The scheduler of an IAB node does not have all the information needed (e.g. link quality across multiple hops) to make appropriate upstream or downstream scheduling decisions which take into account the overall route link quality (such as e.g. using downstream link quality measurements to adjust the scheduling weights so as to achieve proportional fairness for different bearers/RLC channels across multiple child-IAB nodes)
* IF-2: Congestion conditions on BH RLC channels carrying UE bearers with same or similar QoS requirements can be unbalanced and some channels may even be congested, thereby leading to some users experiencing longer latency and violating fairness requirement.
* IF-4: IAB node cannot give more resource to those BH RLC CHs that aggregate more bearers and/or carry bearers with higher load per bearer (i.e. IAB node cannot give more resource to those BH RLC CHs with higher aggregate load)
* ISSUES: In the first instance, eIAB work on multi-hop latency will focus on the following issues:
* IL-1: IAB node cannot help ensure that overall or remaining PDB is met for a packet (e.g. by prioritizing bearers with higher number of hops), as it does not have a latency reference for the packets being scheduled, resulting in packets with the same QoS requirement ending up with different latency
* IL-2: IAB node may need to report joint buffer status for LCHs which have rather differing QoS requirements, due to the current (Rel-16) limit on the number of LCGs
* IL-3: Buffer size calculation for pre-emptive BSR may differ for nodes of different vendors as it is left to implementation in Rel-16
* IL-5: The CU is unable to put bearers with lower PDB on routes with less congestion risk (higher resource efficiency) or which are RLF-free
* IL-6: The CU is unable to configure routing based on actual (real-time) latency per BH RLC channel

**On Topology adaptation enhancements**

* RAN2 to discuss CHO and start with intra-donor CHO until RAN3 has made progress on inter-donor IAB-node migration.
* R2 confirm the intention Rel-16 CHO is / can be used for IAB-MT (FFS whether any modification is needed).
* R2 assumes that Rel-16 specification is the baseline for the configuration of default route, IP address(es) and target path for intra-donor CHO.
* RAN2 to support type-2/3 RLF indication (FFS specified behavior(s) TS impact, FFS details).
* Type-2 RLF indication may be used to trigger local rerouting
* Type-2 RLF indication may be used to trigger deactivation of IAB-supported in SIB
* Type-2 RLF indication may be used to trigger deactivation or reduction of SR and/or BSR transmissions
* Local rerouting can be triggered by indication of hop-by-hop flow control. Further details, e.g., on trigger information, trigger conditions, role of CU configuration, are FFS.
* RAN2 considers inter-donor-DU local rerouting to be in scope

## RAN2#112-e agreements

**On Enhancements to improve topology-wide fairness multi-hop latency and congestion mitigation:**

* R2 assumes Rel-17 IAB work will not define any new end-user QoS metrics on top of the existing 5G QoS framework.
* Rel-17 IAB work will comprise agreeing on a definition of topology-wide fairness.
* Topology-wide fairness provides mechanisms for the management of QoS so that the required QoS is met across the topology, regardless of where a UE attaches to the IAB network. Variants of this definition is not precluded. FFS how the success of such mechanisms is evaluated.
* RAN2 will not discuss enhancements to DL E2E flow control without input from RAN3
* FFS if RAN2 will deprioritize splitting data of a radio bearer into two or more paths (RAN3 agreements to deprioritize Multi-Route Support with data split in IAB)

**On Topology adaptation enhancements:**

* Consider enhancements to topology adaptation that improve:
	+ Robustness, e.g., to rapid shadowing,
	+ service-interruption,
	+ load balancing among different IAB-nodes, IAB-donor-DUs and IAB-donor-CUs, and
	+ reduction in signaling load.
* RAN2 to discuss enhancements to RLF indication/handling with the focus on the reduction of service interruption after BH RLF.
* CHO and potential IAB-specific enhancements of CHO is on the table.
* DAPS and potential IAB-specific enhancements of DAPS is not precluded for now (but as there is no PDCP it is not clear how to support DAPS).
* For message bundling, RAN2 at least wait for more progress to be made in RAN3 on topology adaptation procedures.
* RAN2 to discuss local rerouting, including the benefits over central route determination, and on how topology-wide objectives can be addressed.