3GPP TSG-RAN WG2 Meeting #110-e R2-200xxxx

Elbonia, Online, 01 – 12 June

**Agenda item: 6.1.6**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Summary of e-mail discussion: [Post109bis-e][925][IAB] UE Cap (Nokia)**

**WID/SID: NR\_IAB - Release 16**

**Document for: Discussion and Decision**

# 1 Introduction

After the discussion in RAN#87-e meeting, RAN WGs were given the following task:

* *RAN WGs to investigate which of the mandatory Rel-15 UE features (as defined in TR 38.822) can be optional for basic operation of [IAB] (and if found useful, for different classes of IAB-MTs as defined by RAN4).*
* *RAN WGs should strive to minimize specification impact.*

As a consequence, after the initial discussion during RAN2#109bis-e meeting, the following agreements with respect to IAB-MT capabilities were made:

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| * All optional features remain optional for IAB-MTs.
* Clarification: EN-DC mode support is not mandatory for IAB-MT.
* The following features are optional for IAB-MT:

**1. PDCP; 1-5: Short SN****3. MAC; 3-3: DRX****4. Measurements; 4-5: ANR****6. Inactive; 6-1: RRC Inactive*** The following features are mandatory for IAB-MT:

**1. PDPC; 1-0 Basic PDCP procedures, at least for SRB, FFS for DRB related components****2. RLC; 2-0 Basic RLC procedures, 2-4 NR RLC SN size for SRB****3. MAC; 3-0 Basic MAC procedures*** It is FFS if in general mandatory features with capability signaling are optional for IAB-MT.
* It is FFS if UE capability signalling will be used at all for Wide Area MTs.
* We consider a min set of features for wide area MT, and whether there may be a need for more mandatory features local area MT.
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To progress the topic, this e-mail discussion was agreed with the aim of defining a minimum set of mandatory Rel-15 UE features for Wide-Area IAB-MT and discussing the need for capability signalling and different options thereof.

* Post109bis-e][925][IAB] UE Cap (Nokia)

 Scope: Characterization of minimum set of mandatory Rel-15 UE features for wide-range MT, discuss need for signalling options.
Intended outcome: Report.
Deadline : Next meeting. (20 May 2020)

# 2 Capabilities for wide area IAB-MT

## 2.1 Minimum set of capabilities for wide-area IAB-MT

This paragraph focuses only on Wide-Area IAB-MT. Local-Area IAB-MT is discussed separately in section 3.

Since IAB-MT is part of a network node, it was agreed that only the “minimum set of capabilities” should be mandatory. It was however indicated that the criteria for defining the minimum set are unclear. The approach, which was used in RAN4, as can be seen based on [1] and [2], was to decide based on whether the IAB-MT will be able to perform initial access in the cell. In other words, the minimum set of features could be defined as features which are required for IAB-MT to establish the RRC connection with the network. Once the connection is established and the connecting device is identified as an IAB-MT, the network may know other capabilities based on other means, e.g. based on OAM or based on capability signalling. Hence, it is proposed to follow the following definition of the minimum capability set when discussing IAB-MT features:

**Proposed criterium for defining the minimum set of IAB-MT capabilities: “Minimum set of IAB-MT capabilities should contain only these features which are indispensable for IAB-MT to perform initial access / establish an RRC connection with the network.“**

NOTE: As per RAN plenary guideline, we should also avoid a situation in which excluding the feature from the minimum set of capabilities would lead to the necessity of introducing another feature to replace it.

**Question 1: Do companies agree with the proposed criterium for defining the minimum set of capabilities for wide-area MTs? Is there anything else that should be considered?**

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| --- | --- |
| Company | Comments |
| QC | This is not enough. The IAB-MT must be able to connect to OAM. OAM-connectivity can be obtained either via PDU session/PDN connection or via BH link. |
| Huawei, Hisilicon | We tend to agree with this proposed criterion. Furthermore, as agreed by RAN2, basic BAP procedure should also be mandatory to IAB nodes. This would also address Qualcomm’s concern above. Once the IAB-MT connects to the donor-CU, the network can select to establish a PDU session (which requires support of DRB by the IAB-MT) or establish BH RLC channels (which requires basic BAP procedure) to connect to OAM. Whether to be via PDU session or via BH link is based on network deployment.It should also be noted that, besides features in the minimum set, most of the elements/procedure essential for IAB operation are not categorized into features and thus not captured in the feature list in TR 38.822, and they are mandatory to UEs and will remain mandatory for IAB-MT to support.  |
| Ericsson | We agree with the proposed definition. |
| KDDI | Yes, we agree with the criterium. OAM- connectivity is included in minimum capability as Qualcomm mentions, however we are not sure whether it is included in IAB-MT capabilities or IAB-DU capabilities. |
| AT&T | We believe that features required for Initial Access/RRC Connection establishment/OAM connectivity are certainly part of the minimum capability set, however we believe that functionality required for basic backhaul link operation should also be included (e.g. BAP/RLC/MAC features, RLF etc.) |
| Intel | Agree. Additionally BAP support is also needed although it is not strictly needed for initial access.  |
| ZTE | Yes, we agree with the proposed criterion. |
| CATT | We agree this proposed principle as a starting point for further discussions. |
| Futurewei | Agree with the criterium proposed |
| Nokia | We agree connectivity to OAM is needed for an IAB-MT. As pointed out by Huawei, this can be either achieved by DRB or with BAP. At least BAP is mandatory for IAB to support and we need to decide about DRB as well. We could clarify the OAM aspect, if needed. |
| Apple | We agree with the criteria. We also agree that OAM and BAP features are needed for minimal access. Further, we do also believe, with Huawei, that these should be captured in 38.822 and remain mandatory for IAB-MT support.  |

The following L2 features have already been agreed to be included in the minimum set of capabilities:



**Question 2: Are there any additional L2 features which should be part of the minimum set for Wide-Area IAB-MT capabilities? If yes, please provide a justification for each proposed feature.**

**NOTE: This question is about operational aspect of IAB and not about impact on capability signalling, which is discussed separately.**

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| Company | Additional required features | Justification |
| QC | 2-4 NR RLC SN size for SRB.8. Idle/inactive UE procedures - System information acquisition9-1 RRC buffer size9.2 RRC processing time for 1) RRC establishment, 8) Initial security activation 9) counter check | 2-4 The UE feature list explicitly states: RAN2 decided only short RLC SN is used for SRB. Obviously, SRB needs to be supported.8. Necessary for IAB-MT to access the network.9.1 and 9.2 sub-bullets: Necessary to ensure interoperability for IAB-MT during network access. |
| Huawei, Hisilicon | 9-1 RRC buffer size* 1. RRC processing time
 | 8) is only on-demand SI, which is not an essential feature for IAB to access the network, as the network may not support on-demand SI. |
| Ericsson | 9-1 and 9-2 | 9-1 is required for RRC to function.9-2, only the aspects not related to EN-DC should be supported. As EN-DC is optional, all its related features should be optional too.8 is only for on-demand SI and therefore not required. |
| KDDI | 2-4 NR RLC SN size for SRB.9-1 RRC buffer size9-2 RRC processing time for 1) RRC establishment, 8) Initial security activation  | We do NOT think the following features should be included in the minimum set for Wide-Area IAB-MT capabilities,* RRC iactive : Mandatory with capability signalling, so it can be optional
* On-demand SI : This featue can be optional under the coordinated SI operation between IAB node and Donor CU/DU.
 |
| AT&T | Same view as QC with the following additions:0-7 PCell operation:1) PCell operation on FR24-1 Intra-NR measurements and reports7-1 Handover:1) Intra-frequency HO2) Inter-frequency HO | Topology formation/adaptation is essential for IAB deployments to ensure optimal routes for the backhaul links can be configured by the Donor CU. |
| ZTE | 9-1 RRC buffer size9-2 RRC processing time 1) RRC connection establishment3) RRC connection reconfiguration without SCell addition/release and SCG establishment/modification/release8) Initial security activation9) Counter check | 9-1 and 9-2 are needed for RRC handling.  |
| CATT | 9-1 and 9-2 | Agree with Huawei, Ericsson and ZTE. |
| Nokia | 9-1 RRC buffer size9-2 RRC processing time1-0 Basic PDCP procedures for DRB5-1 QoS (SDAP), items:1) Flow-based QoS2) Multiple flows to 1 DRB mapping | We agree that the processing need to be kept so that IAB node and Donor CU are in sync. We also think DRB support should be mandatory for IAB-MT as non-DRB operation requires a lot of RRC modifications and does not bring benefit in our opinion. For DRB operation, also basic SDAP support is needed.Please not that 2-4 NR RLC SN size for SRB was already agreed to be in a minimum set.Feature 8., as pointed out by others, is only about on demand SI, which should not be mandatory for IAB-MT. Basic SI acquisition is of course required, but this does not even have a feature/capability defined. |
| Apple | 9-1 and 9-2. Additionally Idle/Inactive UE procedures – System Information Acquisition | Same views as QC and AT&T. We also believe that all IDLE procedures are needed for IAB-MT to access the network with RRC ensuring there are no inter-operability issues. Irrespective of SA or EN-DC (even when it is optional0, we believe RRC features 9-1 and 9-2 are still necessary.  |

## 2.2 Capability signalling for Wide-Area IAB-MT

Another issue discussed in RAN2#109bis-e meeting was related to capability signalling of IAB-MT features. The proposals ranged from not having capability signalling for IAB-MT at all, to indicating that the capability signalling should be reused and should not be impacted by IAB. Some contributions, e.g. [3], were also discussing how to capture IAB-MT specificities in the specifications related to capabilities.

Considering that RAN2 agreed to have a minimum set of features mandatory for IAB-MT, and considering that this set of features can be different from the features which are mandatory for Rel-15 UEs, it is proposed to adopt the approach similar to the one proposed in [3] for capturing mandatory IAB-MT features:

**Proposal: Mandatory IAB-MT features (minimum set of capabilities) are defined (indicated) in a dedicated sub-section in TS 38.306.**

**Question 3a: Do companies agree with the proposal? If not, please propose an alternative approach.**

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| --- | --- | --- |
| Company | Yes/ No | Comments / alternative proposal |
| QC | Yes, for wide area MTs | RAN4 assumes that “wide-area IAB-MT” follow a planned deployment procedure with large inter-site distance similar to macro-cellular RAN node deployments. Under these assumptions, RAN4 can relax requirements for IAB-MTs. Such deployments should certainly be supported. The minimum mandatory IAB-MT features should relate to such “wide-area” deployment scenarios. **Please keep in mind that the wide-area IAB-node is NOT the main goal of the IAB WI, which aims to support easy deployment of highly densified IAB networks with mechanisms to switch BH links in response to short-term blocking.** |
| Huawei, Hisilicon | Yes | Can also consider to capture them in a dedicated subsection in TR 38.822 if RAN2 will agree to maintain this TR in the next meeting. |
| Ericsson | Yes | We think this is the cleanest way to do it and allows evolving capabilities independently from UEs if necessary. We provided an example in R2-2003361 |
| KDDI | Yes | Share the view with Qualcomm. |
| AT&T | Yes | Also agree with Huawei that capturing the feature description in TR 38.822 is very useful. |
| Intel | Yes | 38.306 seems like a good place to capture the min set of IAB MT capabilities. |
| ZTE | Yes |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Nokia | Yes | We could use either 38.306 or 38.822 as pointed out by Huawei. In any case, the IAB-MT mandatory set of features should be described in a section dedicated to IAB-MT. |
| Apple | Yes | 38.306 is a good starting point but we also agree with Huawei that capturing feature description |

The minimum set of capabilities is the one that has to be unconditionally supported by all IAB-MTs and it is assumed that the network can assume support of those features for each device identified as an IAB-MT. Therefore, there is a question whether the support of IAB-MT mandatory features has to be signaled as a capability or can be deduced based on *iab-NodeIndication-r16* presence in RRCSetupComplete message.

**Question 3b: Can the support of mandatory IAB-MT features (minimum set of capabilities) be deduced based on *iab-NodeIndication-r16* presence in RRCSetupComplete message or should it be signaled as a separate capability?**

|  |  |  |
| --- | --- | --- |
| Company | Answer | Comments / justification |
| QC | Yes | The mandatory features set for wide-area IAB-nodes will certainly be also mandatory for other IAB-nodes. The ***iab-NodeIndication-r16*** could indicate compliance with this minimum mandatory feature set.  |
| Huawei, Hisilicon | based on iab-NodeIndication-r16 | IAB-MT should indicate iab-NodeIndication-r16 in RRCSetupComplete message, which is even earlier than UE capability reporting. |
| Ericsson | Yes | It can be assumed that all wide area IAB MTs support these features. |
| KDDI | Yes | Share the view with Qualcomm. |
| AT&T | Yes | Same view as Qualcomm. |
| Intel | Yes | Iab-nodeIndication could indicate compliance with the minimum set. |
| ZTE | Based on *iab-NodeIndication-r16* |  |
| CATT | Yes |  |
| Futurewei | Yes |  |
| Nokia | Yes | We could use either 38.306 or 38.822 as pointed out by Huawei. In any case, the IAB-MT mandatory set of features should be described in a section dedicated to IAB-MT. |
| Apple | Yes |  |

For the features outside the set of minimum IAB-MT capabilities, the similar question applies, i.e. how can the network (e.g. Donor CU) be aware of which features the IAB-MT supports. Two main proposals that were brought up include:

1. The features supported by IAB-MT are declared by the manufacturer/vendor and known in the network by configuration/OAM, i.e. there is no capability related signaling between an IAB-MT and Donor-CU.
2. The UE capability signaling framework is reused.

**Question 4: Which of the approaches should be used for Wide-Area IAB-MT and why?**

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| --- | --- | --- |
| Company | Answer | Comments / justification |
| QC | 1 | Wide-area IAB-nodes can be deployed as a macro-cellular network, and they can therefore follow macro-cellular deployment principles.  |
| Huawei, Hisilicon | 1 | It is our understanding this approach can be applied to all features in Rel-15, Rel-16 and beyond, for wide-area IAB, which means no signalling needed. |
| Ericsson | 1 | An IAB node has to be seen as a whole not in pieces DU/MT. An IAB node is in its whole a network node and the capabilities of the network nodes can be made available by OAM for instance. |
| KDDI | 2 | We prefer to use standardized signalling/interface. |
| AT&T | 2 | Capability signalling is very beneficial to simplify interoperability testing. Different operators may have varying requirements for OAM configuration and support, so relying on non-standardized mechanisms for this indication is not desirable. |
| Intel | 2 | First, the wide area/local area IAB MT differentiation itself is not based on any features/feature sets. Its entirely based on deployment considerations such as min distance to UE, coupling loss, etc.The declaration approach is just trying to recreate what is already enabled with capability signalling. We do not see a need to create yet another framework for this purpose.Capability signalling is needed for both wide area IAB nodes and local area IAB nodes. Some features that are optional are still very beneficial in IAB networks (for example, support of configured grants, which can help reduce latency). In order to discover/know support of such features, capability signalling is needed. It is impractical and unwieldy to do this via vendor declarations. |
| ZTE | 2 | We slightly prefer that UE capability signaling framework is reused for both wide-area and local-area IAB-MT for easier inter-operation.  |
| CATT | 1 | With the assumption that wide-area IAB-MT is well planned, its capabilities/features can be known based on predefinition/OAM, therefore not necessarily requiring signalling in the air interface.  |
| Futurewei | 1 | In any case, OAM is needed for configuration of IAB DU. This approach is widely established for configuration of all network nodes and is standard operating procedure for network operators. As such, we don’t see the benefit of using a different approach for the IAB-MT compared to the rest of the node. |
| Nokia | 1 | We agree with the justification provided by Ericsson. Since, these are network nodes, they should be treated in a similar way as network nodes are treated nowadays and there are no capabilities being exchanged by the network nodes. |
| Apple  | 2 | Agree that using the UE capability signaling framework can be used. We too feel that leaving it up to Manufacturer/Vendor implementation will lead to wide-ranging inter-operability issues.  |

# 3 Capabilities for Local-Area IAB-MT

During RAN4#94bis-e meeting, RAN4 agreed to introduce a second class of IAB-MT as Local-Area IAB-MT in addition to Wide-Area IAB-MT. Even though the criteria to define whether an IAB-MT belongs to the first or the second IAB-MT class are not yet entirely clear, from the discussion in RAN4, it can be seen that the achievable range of the communications and/or deployment scenario are the factors which are considered.



Based on the current status of IAB-MT classes definitions companies are requested to answer the following two questions.

**Question 5: Do you think there should be additional features included in the minimum set of capabilities for Local-Area IAB-MT, in addition to those defined for Wide-Area IAB-MT? If yes, please name these features and provide a justification.**

|  |  |  |
| --- | --- | --- |
| Company | Yes / No / Too soon to tell | Justification and comments |
| QC | Absolutely YES | The IAB WI aims to enable easy deployment of highly densified networks with self-backhauling functionality and means to switch backhaul links in response to short-term blocking. This “local-area” IAB-MT should certainly support this functionality.The mandatory features for local IAB-MTs should include:For IAB-MTs operating in ENDC:0-0 Basic ENDC procedures3) SN addition, modification, and release via RRC connection reconfiguration4) Joint processing on the combined RRC messages5) Failure handling (including both MN and SN)for IAB-MTs operating in ENDCFor IAB-MTs operating in SA:0-7 PCell operation in FR2 for Further:4-1 Intra-NR measurements and reports for SA4-2 Inter-NR measurements and reports while in LTE connected for ENDC7-1 Handover 1) Intra frequency handover |
| Huawei, Hisilicon | Maybe no | The minimum set defined for wide area IAB can ensure any type of IAB nodes to access the network and OAM. In case the local Area IAB nodes are deployed in an unplanned way, i.e. without negotiation between vendors and operators beforehand, capability signalling reporting from IAB-MTs to the network can be supported, so that the donor-CU can decide how to handle this IAB node based on its capabilities. For example, if IAB-MT does not support FR2, the donor-CU should not configure FR2 carriers to the IAB-MT. The donor-CU does not need to configure measurement and perform handover if the IAB-MT doesn’t support them, if the local area IAB node is supposed to be deployed in a fixed position. |
| Ericsson | Yes | If the local area IAB-MTs can be deployed without operator control, they need additional features like mobility, measurements. See below for SA operation.0-3 DRB operation0-7 PCell operation on FR21-5 PDCP operation with short SN2-1, 2-2, 2-3 all relating to RLC operation4-1 Intra-NR measurements and reports7-1 Handover, components 1), 2), 3), and 6)8-1 On-demand SIAdditionally, we think that access stratum indicator is essential to support.For operation in EN-DC additional features may apply. |
| KDDI | Yes | We agree with Qualcomm, plus we want to make 4-5 ANR mandatory also. |
| AT&T | Yes | We generally agree with Qualcomm and KDDI. Given that the number of additional mandatory features required for local-area nodes may be significantly more than wide-area nodes, we believe a simpler approach may be to keep all existing Rel-15 features which are mandatory for UEs as mandatory for local-area IAB nodes as well, with the possible exception of DRB support assuming that OAM connectivity may be applied in the same manner for wide-area and local-area IAB nodes.  |
| Intel | Yes | In addition to the features mentioned by QC and Ericsson, feature 4-4 (Measurement gaps) may be needed. |
| ZTE | No | Minimum/typical distance from parent and/or target deployment scenario were discussed in RAN4 for IAB class definition. In our view, there is no requirement for different L2/L3 minimum set of capabilities for Wide-area/Local-Area IAB-MT based on the candidate IAB-MT classification criteria discussed in RAN4. |
| CATT | No | First of all, the question is about minimum set, which in our understanding is mandatory for IAB to support. Then the discussions here are not about whether additional features/capabilities would be useful but it is for the set of basic features/capabilities for Rel-16 IAB to work. So our preference is to keep this minimum set ‘minimum’. As discussed in our contribution R2-2003439, sets such as 0-0 EN-DC, 4-2 Inter-NR measurement and reports while in LTE connected, and 8-1 can be optional. 0-3 and 5-x can also be discussed. |
| Futurewei | Too soon to tell | Probably we first need to agree what is the minimum set of capabilities for wide-area IAB-MT, and then we can evaluate this to decide if anything additional is needed for local-area IAB-MT. |
| Nokia | Not necessarily | We agree more features will probably be required for local area IAB-MT operation, but this can also be decided by an operator/vendor and tailored to a specific network deployment. |
| Apple | Yes | We share the combined views of QC, Ericsson and AT&T |

**Question 6: Do you think there should be any difference with the approach towards capability signalling for Local-Area IAB-MT as compared to the one used for Wide-Area IAB-MT?**

|  |  |  |
| --- | --- | --- |
| Company | Yes / No / Too soon to tell | Justification and comments |
| QC | YES | The WID claims that IAB allows “..**easier deployment of a dense network of self-backhauled NR cells**”. The high density of nodes implies that IAB-nodes are “local-area” rather than “wide-area”. For a dense network, capability signalling can help easing deployment and should therefore be supported. |
| Huawei, Hisilicon | Maybe yes | If there is a need to deploy the local Area IAB nodes in an unplanned way, i.e. without negotiation between vendors and operators beforehand, it is fine to support capability signalling reporting from IAB-MTs to the network. |
| Ericsson | Yes | The wide-area IAB node is considered a network node and as such does not need any support for standardized capability signalling. The local-area IAB node is designed for unplanned deployment and therefore needs to be more flexible and support standardized capability signalling, such as UE capability signalling. |
| KDDI | Yes | Agree with Qualcomm |
| AT&T | No | We believe capability signalling should be applied for both wide-area and local-area IAB nodes. Simplified interoperability testing is essential in case of mixed deployments of different classes of IAB nodes. |
| Intel | No | We support capability signalling for both wide area IAB nodes and local area IAB nodes. Some features that are optional are still very beneficial in IAB networks (for example, support of configured grants). In order to discover/know support of such features, capability signalling is needed. It is impractical and unwieldy to do this via vendor declarations and could slow IAB deployments. |
| ZTE | ZTE | We slightly prefer that UE capability signaling framework is reused for both wide-area and local-area IAB-MT for easier inter-operation.  |
| CATT | Yes | This relates to Q4. If we can agree on ‘no signalling’ for wide area IAB-MT then in our view local area IAB-MT uses a different mechanism. Some capability signalling similar as for UE can be used to report to network.  |
| Futurewei | Yes | Assuming that OAM configuration does not scale for local-area IAB nodes, then more details of the IAB node’s capabilities would need to be signalled. The real question is whether it would be sufficient to only signal IAB-MT capabilities, or if this needs to also be extended to address the IAB-DU in some way. |
| Nokia | Maybe | We assume there always will be some negotiation between a vendor and an operator for deployment of any nodes in the network. Local area IAB nodes are similar to small cells in that regards for example. On the other hand, having some capability signalling could improve the simplicity and flexibility of such deployments. |
| Apple | No | Capability signaling is a simple defined way to achieve rapid deployment for both Wide-Area and Local-Area IAB networks. It also allows for easier handling and dynamism for additional capabilities to be added/removed with reduced inter-operability testing. |

# 4 Other issues related to IAB-MT capabilities

Companies are requested to raise other issues related IAB-MT capabilities aspect which fall into the scope of this e-mail discussion and which were not addressed by the questions in the previous sections.

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| Company | Comments |
| QC | The introduction of capability signalling for RAN nodes is certainly a novelty. We need to recognize that it helps easing deployments and therefore provides operators with more flexibility to invest into network expansion. One would expect that this benefits both, operators as well as network vendors. From that perspective, companies in RAN2 should be supportive of capability signalling for IAB. |
| Intel | While IAB nodes are technically RAN nodes, there are expected to be significantly more of them than traditional RAN nodes. This distinction is lost if they are simply treated as RAN nodes. Having an established framework in place to discover capabilities as IAB deployments scale up is important to enable faster deployment. |
| Apple | IAB Nodes as an architecture itself brings in a novelty to the 3GPP ecosystem. While it looks quirky to have capabilities attached to IAB MTs, we believe this would be the fastest way to achieve rapid deployments and adjust to unforeseen circumstances and try out additional features in a quick and easy way with least amount of time spent on inter-operability. |

# 5 Summary

TBD

# References

1. R4-2005608, *Draft LS on RAN4 IAB-MT feature list agreement*, Source: RAN4
2. R4-2005606, *WF on IAB-MT RAN4 Features*, Qualcomm Incorporated
3. R2-2003361, *Capability signalling for IAB*,Ericsson