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

Elbonia, Online, 01 – 12 June 2020

**Agenda item: 6.1.6**

**Source: Nokia, Nokia Shanghai Bell**

**Title: E-mail discussion: [AT110e][048][IAB] UE capabilities (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. |

To progress the topic, a post RAN2#109bis meeting e-mail discussion was agreed: [Post109bis-e][925][IAB] UE Cap (Nokia), which is summarized in [4]. Sections 2, 3, 4 and 5 of this document are a copy of this summary.

At the moment, companies are requested to provide their further input on IAB capabilities related proposals and issues in Section 6 of this document as part of Phase 1 of the following RAN2#110-e meeting offline discussion:

* [AT110e][048][IAB] UE capabilities (Nokia)

Scope: Treat at least R2-2004684 and possibly other relevant input that does not overlap with the input email discussion, make agreements as far as possible.

Part 1: Agreements

Part 2: Agreed/Endorsed CR 306 331, Deadline: EOM

# 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. |
| vivo | We agree with the proposed criterion for wide-aera MTs. |
| LG | Agree with the proposed criterion as a starting point on IAB-MT capabilities.  We ned to decide whether, where, and how to specify IAB-DU capabilities |
| Samsung | We agree with the proposed criterion. Regarding other features that might be essential for IAB operation, we understand having them mandatory makes sense. However, to achieve the timely completion of this item, discussion should be as efficient as it can. It is only possible by having clear criterion and applying them without exception. |

Rapporteur summary for Q1:

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| All companies agree with the principle of the proposed criterium. Several companies raised that also basic BAP procedures and OAM connectivity are required. Therefore, it is proposed to agree on the following criteria as the guideline for the definition of minimum capability set for wide area IAB-MT:  **Proposal 1: Minimum set of IAB-MT capabilities should contain:**   1. **Features which are indispensable for IAB-MT to perform initial access and establish an RRC connection and OAM connection with the network.** 2. **Basic BAP procedures, i.e. routing, bearer mapping, IP assignment over RRC.** |

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 acquisition  9-1 RRC buffer size  9.2 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 size  9-2 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 FR2  4-1 Intra-NR measurements and reports  7-1 Handover:  1) Intra-frequency HO  2) 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 size  9-2 RRC processing time  1) RRC connection establishment  3) RRC connection reconfiguration without SCell addition/release and SCG establishment/modification/release  8) Initial security activation  9) 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 size  9-2 RRC processing time  1-0 Basic PDCP procedures for DRB  5-1 QoS (SDAP), items:  1) Flow-based QoS  2) 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. |
| vivo | 9-1 RRC buffer size  9.2 RRC processing time for  1) RRC establishment,  8) Initial security activation | The counter check (9.2-9) procedure is pending the discussion of DRB.  Counter check is used by the network to request the UE to verify the amount of data sent/ received on each DRB. If DRB-related feature is not mandatory, the procedure shall also be optional. |
| Samsung | Same view as QC |  |

Rapporteur summary for Q2:

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| Companies seem to agree that an IAB-MT needs to meet minimum requirements set for RRC protocol, so features 9-1 and 9-2 should belong to the minimum capabilities set for IAB-MT.  **Proposal 2: The following features should be included in the minimum capabilities set for IAB-MT:**   * **9. RRC: 9-1 RRC buffer size, 9 -2 RRC processing time.**   Other features that were mentioned include:   1. PCell operation on FR2 2. Intra-NR measurements and reports 3. Inter- and intra-frequency HO 4. On-demand SI 5. Basic PDCP and SDAP procedures for DRB   It is understood by the rapporteur that support for FR2 would be required for IAB nodes deployed in SA mode in FR2, but would not be required in other deployments. Hence, bullet 1 seems to be conditional based on the target network deployment.  Bullets 2 and 3 are related to topology management, but based on the input to Question 1 and the resulting criteria for minimum capability set definition, it is proposed not to include them in the minimum capabilities set for Wide-Area IAB-MT.  In rapporteur’s understanding, the companies might have assumed that feature “8. Idle/inactive UE procedures - System information acquisition” is about basic IDLE mode procedures support including acquisition of SI. However, this feature is about on-demand system information, so it is proposed not to capture it in the minimum capability set for IAB-MT.  **Proposal 3: Intra-NR measurements and reports, intra- and inter-frequency HO and on-demand SI are NOT mandatory features for Wide-Area IAB-MT.**  Basic PDCP and SDAP procedures are required by the IAB-MT to establish OAM connectivity using PDU session, so might need to be included in the minimum capabilities set. Since there is a related FFS for this feature, it is proposed to make a decision on this aspect:  **Proposal 4: Decide whether DRB support is mandatory for the IAB-MT.** |

## 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 |
| vivo | Yes | We agree to define the mandatory IAB-MT features in a dedicated sub-section in T3 38.306. |
| LG | Yes | It is desirable to specify mandatory IAB MT features in TS 38 306.  Given that the difference between minimum UE capabilities and minimum IAB MT capabilities would not be significant, adding description on such difference in the relevant capability would work, and we believe that this would require minimal specification work.  Any work on TR 38 822 about IAB-MT capabilities is fine but as a secondary work.  Need to decide whether, where, and how to specify IAB-DU capabilities |
| Samsung | Yes | Capturing them either in 38.822 or in 38.306 would work. However, capturing them in the TS (i.e. 38.306) might be more appropriate in maintenance point of view. |

**Rapporteur summary for Q3a:**

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| All companies agree that mandatory IAB-MT features (minimum set of capabilities) should be defined in a dedicated sub-section in TS 38.306. Some companies indicate that also TR 38.822 could be used, but it would be less appropriate due to potential lack of maintenance of this document. Therefore, the following proposal is kept:  **Proposal 5: Mandatory IAB-MT features (minimum set of capabilities) are defined (indicated) in a dedicated sub-section in TS 38.306.** |

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?**

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| 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 |  |
| vivo | Based on RRCSetupComplete message | In addition to *iab-NodeIndication-r16*, we think there should be a new field added in the *RRCSetupComplete* message to further indicate the class of the IAB-MT.  With the assistance of the newly added field, IAB-donor-CU knows whether the accessing IAB-MT is able to re-use the UE capability signaling framework.  Additionally, in case that a different minimum set of capabilities is applied for different classes of IAB-MT, *iab-MTType-r16* is also required to differentiate wide-aera IAB-MT from local-area IAB-MT. |
| LG |  | Not clear if we understand the question correctly.  But, what we can agree is that a) if a device indicates *iab-NodeIndication-r16*, it means a simple declaration that the device is accessing the network as an IAB node, and b) if the device is standard-compliant, the device should support the minimum mandatory feature set defined for IAB nodes. |
| Samsung | Yes |  |

**Rapporteur summary for Q3b:**

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| All companies agree that the network can deduce support of the minimum capabilities set by receiving *iab-NodeIndication-r16* in RRCSetupComplete message and no capability signalling is needed for that.  **Proposal 6: Inclusion of iab-NodeIndication-r16 in RRCSetupComplete message is used as an indication of IAB-MT supporting the defined minimum IAB-MT capabilities set.** |

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. |
| vivo | 1 | From the perspective of network, wide-area IAB-MTs behave just like regular BS and follow BS requirements. Since the deployment is completely under the control of operators, and the requirements for IAB-nodes keep unchanged once deployed, in this respect, we think that the required capabilities signaling is not necessary. |
| LG | 2 | First of all, standardized capability signalling is well-defined framework to facilitate inter-operability and rapid deployments of IAB networks.  Second, we do not think there is clear cut/distinction between wide-area and local area deployments in terms of capabilities. So it is not clear how different capability declarations are exactly mapped to different IAB deployment scenarios.  Third, allowing different capability declaration would extremely complicate (and hence restrict) integration of IAB nodes when different capability declarations coexist within the same IAB networks  So, we believe that standardized capability signalling should be applied for all IAB nodes, irrespective of wide/local area |
| Samsung | 1 | Agree with other companies that it is more of network node whose capability is known to the other network nodes based on vendor declaration. In addition, we came to think option 1 would be only feasible option at this point of time considering the next meeting is the very last one and signalling details is left to be discussed if we go for option 2. |

**Rapporteur summary for Q4:**

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| Out of 14 companies:   * 8 companies think that the features supported by IAB-MT should be declared by the manufacturer/vendor, i.e. there is no need for capability related signaling between an IAB-MT and Donor-CU. * 6 companies think that UE capability signaling framework should be reused for Wide-Area IAB-MT.   The companies in favour of option 1 indicate that IAB-MTs are part of network nodes and should not be subject to the capability related rules defined for UEs. It is also indicated that it may not be possible to reuse UE capability signaling without any modifications, so option 1 may be the only feasible option at this stage of WI.  The companies in favour of option 2 indicate that using a standardized framework is beneficial mainly as it provides gains in terms of flexibility and interoperability.  Considering the above and the slight majority towards option 1, it is proposed:  **Proposal 7: The features supported by Wide-Area 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.** |

# 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.**

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| 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 procedures  3) SN addition, modification, and release via RRC connection reconfiguration  4) Joint processing on the combined RRC messages  5) Failure handling (including both MN and SN)for IAB-MTs operating in ENDC  For IAB-MTs operating in SA:  0-7 PCell operation in FR2 for  Further:  4-1 Intra-NR measurements and reports for SA 4-2 Inter-NR measurements and reports while in LTE connected for ENDC  7-1 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 operation  0-7 PCell operation on FR2  1-5 PDCP operation with short SN  2-1, 2-2, 2-3 all relating to RLC operation  4-1 Intra-NR measurements and reports  7-1 Handover, components 1), 2), 3), and 6)  8-1 On-demand SI  Additionally, 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 |
| vivo | No | We think a common minimum set is enough for both wide-area and local-area IAB-MTs.  The UE capability signalling process can be re-used for local-area IAB-MTs, so that the additional (optional) features can be signalled to IAB-donor-CU. |
| LG | No | We think a common minimum set is sufficient. Any additional capabilities can be signalled via standardized capability signalling. We think all FR2 capabilities should be precluded from the minimum set. |
| Samsung | Maybe no | It would depend on how minimum set for wide area IAB is defined. But in general we agree with Huawei, since the minimum set for wide area IAB is supposed to be defined as to ensure proper operation until UE capability signalling exchange is done, the same minimum set would be applicable to local area IAB as well. |

**Rapporteur summary for Q5:**

|  |
| --- |
| Out of 14 companies:   * 6 companies indicate that the minimum set of capabilities for Local-Area IAB-MTs should contain more features than that of Wide-Are IAB-MT. * 7 companies indicate that the minimum set of features for Local-Area IAB-MTs can be the same as that for Wide-Area IAB-MTs. * 1 company indicates that this largely depends on what is agreed to be included in the minimum capability set for Wide-Area IAB-MTs.   The companies in favour of including additional features in the minimum capabilities set for Local-Area IAB-MT mention mainly the need to provide more flexibility and ease of deployment as Local-Area IAB-MT may be deployed in the network with less operator control. Mainly (but not only those) features related to mobility/topology management are mentioned (measurements, handover).  The companies in favour of defining a common minimum set of capabilities regardless of IAB-MT type indicate that the need for a certain feature depends on a specific scenario and is not necessarily related to IAB-MT type. Another mentioned point was that other features can be known to the network either via vendor/declaration or via capability signaling.  It is proposed to discuss this further once the minimum capabilities set is defined for Wide-Area IAB-MT.  **Proposal 8: Decide whether the minimum capability set for Local-Area IAB-MT is different than that of Wide-Area IAB-MT, after the minimum capabilities set for Wide-Area IAB-MT is agreed.** |

**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. |
| vivo | Yes | The UE capability signalling process can be re-used for local-area IAB-MTs, so that the additional (optional) features can be signalled to IAB-donor-CU. |
| LG | No | (same answer to question 4)  First of all, standardized capability signalling is well-defined framework to facilitate inter-operability and rapid deployments of IAB networks.  Second, we do not think there is clear cut/distinction between wide-area and local area deployments in terms of capabilities. So it is not clear how different capability declarations are exactly mapped to different IAB deployment scenarios.  Third, allowing different capability declaration would extremely complicate (and hence restrict) integration of IAB nodes when different capability declarations coexist within the same IAB networks  So, we believe that standardized capability signalling should be applied for all IAB nodes, irrespective of wide/local area distinction. |
| Samsung | Yes | Considering the different target scenarios of each IAB node type, it may not be possible to apply the same mechanism. |

**Rapporteur summary for Q6:**

|  |
| --- |
| Since the answer to the question depended on the company view with respect to capability handling for Wide-Area MT, the simple Yes/No summary is not very informative. However, based on the answers, all companies seem to agree that there is benefit in Local-Area IAB-MTs supporting the UE capability signaling framework.  **Proposal 9: Local-Area IAB-MTs have to support the UE capability signaling framework.** |

# 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.

|  |  |
| --- | --- |
| 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 Proposals resulting from [Post109bis-e][925][IAB] UE Cap (Nokia)

Based on the consolidated companies’ view expressed in the e-maul discussion, the following proposals are made:

**Proposal 1: Minimum set of IAB-MT capabilities should contain:**

1. **Features which are indispensable for IAB-MT to perform initial access and establish an RRC connection and OAM connection with the network.**
2. **Basic BAP procedures, i.e. routing, bearer mapping, IP assignment over RRC**

**Proposal 2: The following features should be included in the minimum capabilities set for IAB-MT:**

* **9. RRC: 9-1 RRC buffer size, 9 -2 RRC processing time.**

**Proposal 3: Intra-NR measurements and reports, intra- and inter-frequency HO and on-demand SI are NOT mandatory features for Wide-Area IAB-MT.**

**Proposal 4: Decide whether DRB support is mandatory for the IAB-MT.**

**Proposal 5: Mandatory IAB-MT features (minimum set of capabilities) are defined (indicated) in a dedicated sub-section in TS 38.306.**

**Proposal 6: Inclusion of iab-NodeIndication-r16 in RRCSetupComplete message is used as an indication of IAB-MT supporting the defined minimum IAB-MT capabilities set.**

**Proposal 7: The features supported by Wide-Area 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.**

**Proposal 8: Decide whether the minimum capability set for Local-Area IAB-MT is different than that of Wide-Area IAB-MT, after the minimum capabilities set for Wide-Area IAB-MT is agreed.**

**Proposal 9: Local-Area IAB-MTs have to support the UE capability signaling framework.**

# 6 [AT110e][048][IAB] UE capabilities (Nokia) – Phase 1

## 6.1 Treatment of proposals from R2-2004684 [4]

Based on the views expressed in [Post109bis-e][925][IAB] UE Cap (Nokia), the following proposals are brought up for agreement as they either reached a consensus or there was a great majority of companies agreeing with them:

|  |
| --- |
| **POTENTIAL EASY AGREEMENTS**  **Proposal 1: Minimum set of IAB-MT capabilities should contain:**   1. **Features which are indispensable for IAB-MT to perform initial access and establish an RRC connection and OAM connection with the network.** 2. **Basic BAP procedures, i.e. routing, bearer mapping, IP assignment over RRC**   **Proposal 2: The following features should be included in the minimum capabilities set for IAB-MT:**   * **9. RRC: 9-1 RRC buffer size, 9 -2 RRC processing time.**   **Proposal 3: Intra-NR measurements and reports, intra- and inter-frequency HO and on-demand SI are NOT mandatory features for Wide-Area IAB-MT.**  **Proposal 5: Mandatory IAB-MT features (minimum set of capabilities) are defined (indicated) in a dedicated sub-section in TS 38.306.**  **Proposal 6: Inclusion of iab-NodeIndication-r16 in RRCSetupComplete message is used as an indication of IAB-MT supporting the defined minimum IAB-MT capabilities set.** |

**Question 1: Companies are requested to provide their concerns with the above proposals in the table below, if any (please reply only if you object to any of the proposals).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Objected proposal** | **Justification and alternative proposal** |
|  |  |  |

Another aspect, which was discussed at length in the past and which has not reached a conclusion yet is whether RAN2 should allow non-DRB operation for IAB-MTs. The arguments in favour and against that are well known already – the proponents mention mainly that the only reason for using DRB is to provide OAM connectivity to IAB-MT while there is an alternative way of doing that, which does not require DRB support. The opponents of non-DRB operation mention mainly that configuring a DRB does not mandate using it for OAM, but would allow to reuse the current UE/network behaviour and avoid quite significant changes to RAN2 specifications and potentially specifications of other WGs, e.g. RAN3. Companies are requested to provide their views on this aspect.

**Question 2: Do you think RAN2 should specify non-DRB operation for IAB-MTs.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Ericsson | Yes | Regardless of whether an IAB-MT optionally or mandatorily supports DRBs, it is up to the NW to set up or not set up the DRB. From an RRC point of view, there is no reason to establish a DRB for an IAB-MT unless it is used to connect to OAM and, since DRBs are optional to connect to OAM (as per RAN3 agreement), the NW should not be mandated to set up DRBs. On the other hand, BH RLC channels are mandatory to support traffic for the IAB-DU, which can also be used to connect to OAM. So, in our understanding, there is no need to have two mandatory methods (BH RLC channels and DRBs) to connect to the OAM.  There are no major specs impacts to introduce that the network is not forced to configure a DRB for IAB node(s) as highlighted in our contribution R2-2004611. |

Another aspect, raised e.g. in [5] is whether SDAP needs to be supported. In [5], it is stated that SDAP support should be optional even in case DRB is supported by the IAB-MT. On the other hand, it was indicated by one company in section 2.1 that SDAP is required for DRB operation. It also seems that in the current NR UP protocol stack, SDAP sublayer is mandatory. The following SDAP components are capture in TR 38.822:

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Features | Index | Feature group | Components | Prerequisite feature groups | Field name in TS 38.331 [2] | Parent IE in TS 38.331 [2] | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Note | Mandatory/Optional |
| 5. SDAP | 5-1 | QoS | 1) Flow-based QoS  2) Multiple flows to 1 DRB mapping  3) AS reflective QoS |  | 3) *as-ReflectiveQoS* | *SDAP-Parameters* | No | No | SA only | 1), 2) Mandatory without capability signalling  3) Optional with capability signalling |
| 5-2 | HD format | 1) DL SDAP HD  2) UL SDAP HD  3) SDAP End-marker |  | n/a | n/a | n/a | n/a | SA only | 1) Conditional mandatory if either NAS reflective QoS or AS reflective QoS is supported. No capability signalling is needed.  2), 3) Mandatory without capability signalling |

Companies are then requested to share their understanding on this issue.

**Question 3: In case IAB-MT supports DRB (regardless of whether it is optional or mandatory), does it have to support SDAP sublayer and its mandatory components from TR 38.822 as well?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Justification** |
| Ericsson | No | SDAP is meant to support the 5G QoS framework for the user plane but OAM is not user plane even if it goes on DRBs. |

With respect to the aspect of capabilities signalling, the views from majority of the companies was that Wide-Area IAB-MT should not have to support UE capabilities signalling while UE capabilities signalling should be supported by Local-Area IAB-MT. Hence, the following two proposals are brought up for agreement:

|  |
| --- |
| **Proposal 7: The features supported by Wide-Area 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.**  **Proposal 9: Local-Area IAB-MTs have to support the UE capability signaling framework.** |

**Question 4: Companies are requested to indicate in the table below in case they object to Proposal 7 or Proposal 9, keeping in mind the views expressed previously and summarized in Section 2.2 and Section 3 (please reply only if you object to any of the proposals).**

|  |  |  |
| --- | --- | --- |
| **Company** | **Objected proposal** | **Justification and alternative proposal** |
|  |  |  |

When it comes to the minimum set for Wide-Area IAB-MT, the situation seems to clarify and, in summary, the following features would be mandatory for Wide-Area IAB-MT (if the related proposals above are agreed):

|  |
| --- |
| * PDPC; 1-0 Basic PDCP procedures, at least for SRB,   + FFS for DRB related components and   + FFS for mandatory SDAP components in 5-1 and 5-2 * RLC; 2-0 Basic RLC procedures, 2-4 NR RLC SN size for SRB * MAC; 3-0 Basic MAC procedures * RRC; 9-1 RRC buffer size, 9 -2 RRC processing time. * IAB basic procedures: BAP routing, BAP bearer mapping, IP assignment over RRC |

The next question is then whether the capabilities set needs to be different for Local-Area IAB-MT. As summarized in Section 3, the views on this aspect were split with a minimal majority being in favour of keeping the minimum set of capabilities the same. Among the companies indicating that Local-Area IAB-MT should support additional features, there were features which were commonly proposed, but there were also features mentioned by single companies as well. Another approach that was proposed was to keep all Rel-15 UE mandatory features as mandatory for IAB-MT. If a proposal that Local-Area IAB-MT supports UE capability signalling framework is agreed, then the advantage of mandating more features than already included in the minimum capability set common for Wide-Area and Local-Area IAB-MTs is limited. Considering this and the fact that there was a slight majority in favour of having the same minimum capabilities set for all types of IAB-MTs, it is proposed to agree on the following proposal:

**Proposal: A single minimum set of capabilities is defined commonly for all types of IAB-MTs.**

**Question 5: Do you support the proposal?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Justification** |
| Ericsson | No | As described in clause 2.2 of our paper R2-2004977, we think the other-type IAB-MT must support *additional* feature groups like 0-3 (components 1 and 2), 0-7, 1-5, 2-1, 2-2, 2-3, 7-1 (components 1, 2, 3, and 6), 8-1. Also, mandatory support for feature groups 4-5 and 6-1 can be discussed.  We think there is a need for a difference because the other-type IAB-MT may be deployed in a non-planned manner and/or may not be under operator control. |

## 6.2 Other capability related aspects

Most of the contributions submitted to AI 6.1.6 focus on the aspects already covered by the pre-meeting e-mail discussion. There are however a couple of other aspects worth raising here.

**Channel bandwidths for IAB-MT**

In [6], an LS from RAN4 received by RAN2 in [7] is referred where RAN4 informs that they decided that IAB-MT declares all the supported channel bandwidths rather than having a mandatory set as current UEs. RAN2 is requested to evaluate their signalling and consider this, if needed. In [6], it is indicated that currently the signalling mandates support of maximum channel bandwidth, i.e. 100 MHz for FR1 and 200 MHz for FR2, while for IAB-MT, it should be optional. The related changes are provided in the TP in [6] as well. The companies are requested to provide their views on this aspect.

**Question 6: In case capability signalling is supported by at least Local-Area IAB-MT, do you agree that the changes proposed in [6] are required?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Justification / alternative proposal** |
| Ericsson | Yes |  |

**LS on RAN4 IAB-MT feature list agreement**

In [8], RAN4 asks if RAN2 has concerns on their agreements with respect to making some features optional, especially if there are issues with respect to signalling. This topic is raised, e.g. in [5], [9] and [10] and it seems that regardless of whether the manufacturer declaration or UE capability signalling is applied, this does not seem to be an issue. In case manufacturer declaration is used, no additional work is required as indicated in [5]. In case capability signalling is used, then we might need to introduce new capabilities specifically for IAB-MT as indicated in [9] and [10]. Companies are then requested to provide their views on the following question.

**Question 7: In case capability signalling is supported by at least Local-Area IAB-MT, do you agree that capability bits should be introduced for the features which are mandatory without capability signalling for Rel-15 UEs?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Justification / alternative proposal** |
| Ericsson | Yes |  |

**IAB-MT type indication**

In [11], it is indicated that in case manufacturer declaration is agreed for Wide-Area IAB-MTs and capability signalling is reused for Local-Area IAB-MTs, there needs to be a way for the network to know whether it may request capabilities from the IAB-MT. In [11], it is proposed to extend the IAB node indication introduced in RRCSetupComplete message to additionally indicate the type of the connecting IAB-MT.

**Question 8: In case capability signalling is supported Local-Area IAB-MT and not supported by Wide-Area IAB-MT, do you agree that IAB-MT should indicate its type in RRCSetupComplete?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes / No** | **Justification / alternative proposal** |
| Ericsson | No | The proposed field is not useful to the network as the network needs to know the specific capabilities of this particular node. Only knowing whether it is a local-area or wide-area IAB-MT is not sufficient. The network has the methods to verify and authenticate other network nodes (over NAS) and therefore this proposed method is unnecessary. |

# 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
4. R2-2004684, *Summary of e-mail discussion: [Post109bis-e][925][IAB] UE Cap (Nokia)*, Nokia, Nokia Shanghai Bell
5. R2-2004977 Further discussion on Rel-15 IAB-MT capabilities Ericsson
6. R2-2004805 Discussion on channel bandwidth for Rel-16 IAB-MT ZTE, Sanechips
7. R4-1916165 LS on definition of IAB-MT channel bandwidth Source: RAN4
8. R2-2004373 LS on RAN4 IAB-MT feature list agreement (R4-2005608; contact: Qualcomm) RAN4 LS in Rel-16 NR\_IAB-Core To:RAN2, RAN1
9. R2-2005519 Discussion on inapplicable features for IAB Huawei, HiSilicon
10. R2-2005654 Capabilities of IAB MTs LG Electronics France
11. R2-2004497 Discussion for IAB-MT Capabilities vivo