3GPP TSG-RAN WG3 #124 R3-243809

Fukuoka, Japan, 20– 24 May 2024

Agenda Item: 12.1

Source: NTTDOCOMO (moderator)

Title: Summary of Offline Discussion on additional topological enhancement

Document for: Approval

# Introduction

This document provides a summary of the offline discussion on additional topological enhancements.

# Discussion

## WAB

* WAB architecture and general requirements

**Adopt the following terminology:**

**BH-RAN-node: This is an NG-RAN serving the WAB-MT.**

* **BH-gNB: The gNB serving the WAB-MT.**
* **BH-AMF: The AMF serving the WAB-MT.**
* **BH-5GC: The 5GC serving the WAB-MT.**
* **WAB-5GC: The 5GC connected to the WAB-gNB and serving the UEs.**
* **WAB-AMF: The AMF connected to the WAB-gNB and serving the UEs.**
* **BH-UPF: The UPF serving the WAB-MT for backhauling.**

**First three terms are good. FFS all the remaining terms above.**

**RAN3 to capture in the TR 38.799 that based on the current protocol stack, dedicated IP addresses can be allocated to WAB-gNB. And a tunnel (e.g. IPsec or L2TP) could be established to encapsulate the WAB traffic. And a gateway could be deployed to terminate the tunnel.**

**RAN3 to capture the WAB architecture and protocol stack using dedicated IP addresses for WAB-gNB when WAB traffic is encapsulated in a tunnel and transported via PDU session backhaul in the TR 38.799.**

**RAN3 to capture the architecture and protocol stacks for WAB traffic transfer via PDU session without NG GTP-U tunnel in TR 38.799.**

* Integration



**Phase 1: WAB-MT setup.** The WAB-MT of a WAB-node connects to the network in the way as a UE by performing RRC connection setup procedure with gNB serving the WAB-MT, authentication with the 5GC for WAB-MT. During the initial access procedure, the WAB-MT can provide WAB-node indication to help the gNB serving the WAB-MT to select a propoer serving AMF. After the WAB-MT is authorized, the WAB-MT can establish a default PDU session for the backhaul transmission of OAM connectivity, control-plane traffic or user-plane traffic.

**Phase 2: WAB-gNB initialization.** In this phase, OAM can provide the WAB-gNB with the initial configuration to act as a NG-RAN node.

**Phase 3-1: NG connection setup.** The WAB-gNB can initiate NG setup procedure towards the AMF(s) serving the UE.

**Phase 3-2: Xn connection setup.** The WAB-gNB can initiate Xn setup procedure towards the neighbouring NG-RAN node(s), including the WAB-donor and/or other NG-RAN node(s).

Agree the WAB-node integration procedure, including the key steps of WAB-MT setup, WAB-gNB initialization, NG connection setup and Xn connection setup.

* WAB authorization

**General principle:**

**BH RAN node can be unaware of WAB.**

**WAB specific enhancement to BH RAN is not precluded in the study**

**FFS on the scenarios where BH RAN needs to be WAB aware.**

**WAB-MT authorization pertains to the right of the WAB-MT to support BH PDU sessions.**

**In case MT authorization is based on slice, signaling enhancements to the AS layer for the support of WAB-MT authorization are not needed.**

**Authorization of WAB-gNB pertains to *service* authorization and security authentication, i.e., the right to serve UEs.**

**RAN3 understands that authorization of the WAB-MT is different from the WAB-gNB service authorization/configuration/activation by e.g. OAM/SeGW.**

**It is RAN3 understanding that WAB-gNB’s authorization status can change**

**The UEs served by a WAB-node whose authorization status changes from “authorized” to “not authorized” can either be handed over to other RAN nodes or released.**

**The NG connection(s) of a WAB-gNB whose authorization status changes from “authorized” to “not authorized” can be removed. FFS on if it can be suspended.**

**In all scenarios, including roaming scenarios, the WAB-gNB connected to the HPLMN is service-authorized by the home network.**

* SA2 LS

*-* ***Question 1****: SA2 currently considers that the MWAB (MWAB-UE) authorization could be based on dedicated slice ID(s) (S-NSSAI(s)). Therefore, from SA2 perspective no MWAB-specific AS layer indication at MWAB-UE's RRC establishment is required. SA2 would like to also point out that if there was a strict need for indication at AS layer, the existing mechanism of including S-NSSAI in RRC connection establishment could be considered. SA2 would like to invite RAN3 to provide the feedback if any scenario considered by RAN3 needs such a MWAB-specific AS layer indication. Note that SA2 considers the MWAB-gNB and MWAB-UE may register and connect to different PLMNs, and the authorization of the MWAB-UE is different from the MWAB-gNB service authorization/configuration/activation by OAM/SeGW.*

**Reply to SA2 that:**

* **WAB-MT authorization, i.e., verification of whether the WAB-MT has the specific slice in the subscription data for establishment of the BH PDU sessions, can be done by the BH-AMF that supports the requested slice received at NAS level.**
* **There is no need for the WAB-MT to include the S-NSSAI info in AS signalling.**
* **In RAN3 understanding, the above can be supported by existing mechanisms.**

*-* ***Question 2****: For the MWAB (MWAB-UE) authorization result, SA2 could not identify any reason to inform/update that to the NG-RAN serving the MWAB-UE. Therefore, SA2 would like to understand from RAN3's perspective whether the MWAB authorization result needs to be provided to the NG-RAN serving the MWAB-UE.*

**Reply to SA2 that there is no need for the BH-gNB to be explicitly informed by the BH-AMF about the authorization status of the WAB-MT.**

*-* ***Question 3****: To support mobility of the MWAB, some solutions assume that the MWAB-gNB can instantiate two cells (with same gNB ID or different gNB ID), and handover connected UEs between the two cells. The different gNB IDs use case is driven by the need to change AMF if the MWAB moves into a geographic area where a different AMF must be chosen to serve UEs. SA2 would like to ask RAN3 to confirm if this can be supported or not.*

**Reply to SA2 that, supporting WAB-node mobility by instantiating two cells at the WAB-gNB is feasible, and that the details are to be discussed in RAN3.**

***- Question 4****: SA2 discussed the scenario of Xn interface between RAN nodes over the IP connectivity provided by the PDU session of MWAB-UE, and would like to ask RAN3 if this scenario can be supported by RAN3.*

**Reply to SA2 that the scenario where the traffic for the Xn connections(s) of the WAB-gNB is carried via the IP connectivity of the WAB-MT’s PDU sessions can be supported.**

* WAB mobility
* Support scenario

**Support the following scenarios for intra-PLMN WAB-node mobility:**

* **WAB-AMF/UPF remains unchangedas WAB-node moves inside a PLMN.**
* **WAB-AMF/UPF changes as WAB-node moves inside a PLMN.**
* **BH UPF/AMF remains unchanged as WAB-node moves inside a PLMN.**
* **BH UPF/AMF changes as WAB-node moves inside a PLMN.**

**all type of legacy mobility procedures can be supported for WAB-MT.**

**RAN3 assume that roaming scenario for WAB-MT is supported.**

* For NG

**FFS on NG connection suspension.**

* For Xn

**A WAB-gNB can establish an Xn connection with the BH-RAN node or surrounding RAN nodes using legacy procedures.**

* Other

**Upon WAB-gNB mobility:**

* **If needed, the WAB-gNB may power up one or more new cells with new configuration parameters related to its current location and handover UEs between the old and new cell served by the WAB-gNB.**
* **FFS is this procedure needed for AMF relocation.**
* **In case this procedure is used for AMF relocation, new cells can belong to different logical gNB, FFS on if it can belong to the same logical gNB (resolve it in the come back)**
* **For the UEs that detect a new TAC outside their registration area, mobility registration procedures defined in TS 23.502 are triggered.**
* **If needed, UE contexts can be transferred between the old and the new AMF.**
* **WAB-gNB TAC and PCI**

**Handling of the WAB-gNB’s TAC follows the same procedure as defined for mIAB-DU’s TAC.**

**For WAB, PCI collision avoidance is handled in the same manner as for mobile IAB.**

* WAB configuration

**A WAB-node can be pre-configured with the parameters pertinent to different potential locations of the WAB-node.**

**The OAM can provide configuration parameters to the WAB-node based on the location of the node.**

**WAB-node should be provided with the information enabling it to connect to different OAM systems at different locations.**

**In non-roaming scenarios and in the roaming scenarios where the WAB-gNB remains connected to the HPLMN, the WAB-gNB is configured by the OAM system in the HPLMN.**

**For roaming scenarios where the WAB-gNB connects to the VPLMN, if any, the WAB-gNB may connect to the OAM system in the VPLMN. How the WAB-gNB is redirected to connect to the OAM system in the VPLMN, is up to implementation.**

* WAB resource multiplexing

**Focus on out-of-band backhauling scenario for WAB and down-prioritize the in-band backhauling scenario.**

**If RAN3 decides to consider in-band scenarios, for in-band operation, the IAB framework of time-domain H/S/NA resource configuration, including the concept of guard symbols, is the baseline for WAB resource multiplexing.**

**The BH-gNB should be provided with the full D/U/F + H/S/NA resource configuration of the WAB-node.**

**Support co-location discovery of WAB-MT and WAB-gNB at the BH-gNB.**

* QoS support on BH

**In DL, the WAB-MT’s UPF maps the traffic to WAB-MT’s QoS Flows based on the configured DL PDRs, same as legacy.**

RAN3 to discuss the candidate solutions on UL QoS mapping for the WAB-node:

- Sol#1: Based on the QoS parameters mapping

- Sol#2: Based on 5QI to DSCP mapping

- Sol#3: Based on the network slice mapping

## 5G Femto

**Agree to add the figure for Option 3 to TR 38.799 as in the TP in the Annex.**



**Proposal 2: Pending confirmation from SA3, capture the SeGW also in the figures for architecture options 1, 3, and 4 (with appropriate Notes, similar to option 2).**

**Provide TP for SeGW. (Ericsson)**

**The current study should include an optional Xn gateway, independently from architecture of NG (similar to X2 gateway). See TP at this meeting.**

**OptionA without Xn gateway(ZTE)**

**OptionB with Xn gateway (Huawei)**

* 5G Femto architecture evaluation

**Option1: direct connection of NR Femto to 5GC**



**Pros**:

1. .Already supported by current architecture.
2. Less CP latency and no processing delay due to absence of a concentration stage.
3. Suitable for certain deployments depending on number of NR Femtos to connect and/or virtualization support of the 5GC
4. Local breakout can be supported

**Cons:**

1. Not suitable for certain deployments with large number of NR Femtos and/or 5GC not virtualized.
2. Not suitable for residential deployments with frequent switch on/off of NR Femtos.

NOTE: In option 1, we assume that SeGW may also be optionally present like in option 2, but as agreed last RAN3#123bis meeting, “security aspects are under SA3 responsibility”.

ADVANTAGE:

* Less CP latency and no processing delay due to absence of a concentration stage.
* Does not require any architecture change.

DISADVANTAGE:

* Does not provide concentration of NG interfaces, which results in an increased number of CP connections to AMFs: less capable AMFs might potentially have scalability issues.

**Observation 1**: Option one offers no obvious solutions for security, deployment flexibility or robust operation.

**Option 2: NR Femto GW**



**Pros:**

1. Only one SCTP association from 5GC to NR Femto GW,so it can support large number of femtos and/or no virtualization of 5GC.
2. 5GC is shielded from frequent switch on/off of the NR Femtos.
3. Enables operators who have already deployed 4G Femto using HeNB GW to capitalize on operating model and integration process of 5G Femtos.
4. Foreseen specification impact are already well known from 4g .
5. Allows to decouple concentration of CP and concentration of UP: concentration of UP is optional i.e. the NR Femto GW can concentrate CP only while the NR Femto connects directly to the UPF.
6. Local breakout can be supported

**Cons:**

1. Some stage3 specification impact.
2. Some processing delay for CP message.

ADVANTAGES:

* Assuming concentration is a requirement, provides concentration of NG.
* Provides an evolution path for operators that have already deployed a HeNB GW for E-UTRAN, assuming it is feasible to upgrade it to NG-RAN functionality.

DISADVANTAGES

* Likely increased CP latency and additional processing delay.
* Requires specific, dedicated additions to NGAP.
* If messages for the NR Femto Nodes under the NR Femto GW are routed according to TAI like for the HeNB GW, this may put some constraints on TAI allocation.

**Observation 2**: Option 2 addresses security, flexibility, and robustness characteristics.

**Observation 3**: The femto gateway part of the Option 2 architecture is optional, i.e., it may or may not be deployed.

**Option 3: SCTP concentrator**



**Pros:**

1. Only one SCTP association from 5GC to SCTP concentrator due to using multi-streaming.
2. Local breakout can be supported.
3. Only stage2 specification impact.

**Cons:**

1. The solution require consistent configuration and handling of SCTP stream identifiers.
2. The solution require consistent SCTP implementation of AMF, SCTP concentrators and NR femtos.
3. Some processing delay for CP message.
4. Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.

ADVANTAGES

* Assuming concentration is a requirement, provides concentration of NG.
* Transparent to the NG-RAN logical architecture and to NGAP.

DISADVANTAGES

* Likely increased CP latency and additional processing delay.
* May require changes to SCTP layer *implementation* (e.g. consistent handling of SCTP streams in the concentrator and in the AMF)[[1]](#footnote-2).
* Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.

**Observation 4**: More study is needed to determine how Option 3 addresses security issues and if it provides the same degree of isolation which is possible with Option 2.

**Option 4: NR Femto as a gNB-DU**



**Pros:**

1. Reuse existing split gNB architecture.

**Cons:**

1. F1-C was not designed to face frequent switch on/off. Usually F1-C is operated by the network operator and statically configured.
2. Forssen additional Interoperability issue of F1 compared to NG.:
3. F1-C carried over internet backhaul can lead to latency and reliability issue not meeting the stringent requirement for F1-C interface.
4. This option forces the concentration of User Plane and not only control plane i.e. concentration of CP only while NR femto UP connects directly to UPF is not possible.
5. Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.
6. Specification impact for F1 needs to be further assessed.
7. Local breakout cannot be supported

ADVANTAGES

* Assuming concentration is a requirement, provides concentration of NG.
* Native part of NG-RAN architecture: no standards impact
* An NR Femto Node is a gNB-DU: less complex to implement than a gNB.

DISADVANTAGES

* Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.
* Termination on end-user premises (e.g. subject to unforeseen connections and disconnections) and transport on third-party residential broadband are not use cases foreseen by legacy F1 interface.

**Observation 5**: Option 4 is the most significant departure from the EUTRAN architecture. As such, it requires significant study to answer questions regarding security, flexibility, and robustness.

**Proposal 1:** capture the above evaluation in the TR 38.799.

**Proposal 2**: capture in the conclusion of TR that option 3 and option 4 does not qualify for the work item.

* **SA2 LS**
* *The UE partitions CSG-CAG ID and constructs mapped CSG/CAG ID, and reports to the NG-RAN or E-UTRAN (depending on the considered mobility direction) as described in pCR (S2-2405814).*
* *RAN recognizes the target CSG cell (or the target CAG cell) as an open cell during the handover (e.g., via local configuration) and the core network performs access control as described in pCR (S2-2405789).*
* ***Question 1****: SA2 would like to know whether the two solutions mentioned above have any impact on the RAN (e.g., for RAN procedures)?*
* ***Question 2****: SA2 has reserved the time units for the normative work of WT#1 based on the result of RAN3 work (RP-234041), which is expected to start in SA2 from SA2#164. Therefore, SA2 requests to confirm the conclusion of RAN3 on overall architecture, etc., which will be used as the basis for SA2's normative work.*

**On question 1, RAN3 to reply to SA2:**

**“Reply to question 1:**

**Solution 1 has both RAN and UE impacts due to the incorrect use of measurement reports, which would cause malfunction of the NG-RAN and E-UTRAN. RAN3 prefers to have UEs follow the procedures as intended by the specification.**

**Solution 2 has no RAN or UE impact. Solution 2 further envisions RAN procedures to be followed according to their intended use.”**

**On question 2, RAN3 to reply to SA2: “On question 2:**

**RAN3 can provide recommendations on the NR Femto architecture as soon as the study on Additional Topological Enhancements (RP-234041) has concluded. RAN3 is planning to conclude the in RAN3 #124bis.”**

#### 5g to 4g direction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Source gNB | Source AMF | Target MME | Target HeNB |
| Solution 1 | CAG ID added into 4g part of 5g measurement report | Sends CSG ID to target MME | no | no |
| Solution 2 | Frequent Repeated handover failures | 1/ sends CSG ID to target MME2/New access control in AMF duplicating access control in source gNB3/ Frequent repeated handover failures4/ mapping from target HeNB into list of CAG IDs | no | no |

#### 4g to 5g direction

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Source eNB | Source MME | Target AMF | Target NR Femto |
| Solution 1 | CSG ID and membership status added into 5g part of 4g measurement report | no | no | no |
| Solution 2 | Frequent Repeated handover failures | Frequent Repeated handover failures | Frequent Repeated handover failures | Frequent Repeated handover failures |

In summary, all solutions have source RAN node impact. Please note that this was expected and was already communicated to SA2 two years ago in our previous LS in R3-226035.

In 5g to 4g direction, solution 2 has more AMF impact than solution 1 and leads to repeated handover failures. In 4g to 5g direction solution 2 has repeated handover failures impacting all source and target RAN and CN nodes and degrade handover KPI. Therefore, RAN3 think solution 2 is not technically feasible. Solution 1 is technically feasible but has both UE and source RAN impacts.

* 5G femto access control

The existing CAG mechanism can already support all the access modes involved in CSG, i.e. open, hybrid and closed, no gap is found.

* To support the open access mode: The NR Femto activates a PLMN cell, which can be accessed by legacy UE without access control.
* To support the hybrid access mode: The NR Femto cell can be shared by both PLMN and CAG, through broadcast both the *plmn-IdentityInfoList* and the *npn-IdentityInfoList-r16* in the SIB1, but without the *cellReservedForOtherUse*. Then, this cell is accessible as a CAG cell by UEs which has the allowed CAG list including this cell. For the legacy UE not supporting CAG, this cell is viewed as a normal PLMN cell.
* To support the closed access mode: The NR Femto activates an NPN-only cell by broadcasting the *cellReservedForOtherUse IE* with value be set as “true”, then this cell can only be accessed by the UEs whose allowed CAG list includes a CAG-ID broadcasted by the NR Femto cell.

**In an NR Femto Node allowing both CAG and non-CAG member UEs, UE treatment (e.g. whether to hand over, which GBR bearers to admit/deactivate, packet scheduling / QoS reduction for non-GBR bearers) is up to implementation/configuration.**

**An NR Femto Node cell may be a CAG Cell (a CAG Member cell or a CAG-only cell).**

**Existing CAG functionality allows to support a “hybrid access” cell (i.e. a cell that allows access by both CAG members and non-members but may give better treatment to CAG members).**

**Existing CAG functionality allows to support an “open mode” cell (i.e. a cell that allows access**

**We should not preclude restricting a UE to only access CAG cells; such a CAG-only cell may be served by an NR Femto Node.**

**Reference the NR stage 2 text on access control for PNI-NPN in TR 38.799 according to the TP in the Annex.**

**Reference the NR stage 2 text on mobility for CAG cells in TR 38.799 according to the TP in the Annex.**

* 5G femto local service

**In order to access local services through a local breakout, a HgNB may connect to a local UPF (co-located or stand-alone) providing the necessary functionality and terminating N9 toward the central UPF and N6 toward the local data network.**

**If desired, when accessing local services according to 5GC UP architecture for femto deployments, support for Session and Service Continuity should follow current specified behavior by SA2.**

* how to select the local UPF to be collocated with the NR Femto?

**Option 1: use the Cell ID of ULI report from NR Femto**

**Option 2: use the TAI report from NR Femto**

**Option 3: NR Femto indicates an address to 5GC (similar to LIPA)**

# Conclusion, Recommendations

* **WAB**

**Proposal1: Adopt the following terminology:**

**BH-RAN-node: This is an NG-RAN serving the WAB-MT.**

* **BH-gNB: The gNB serving the WAB-MT.**
* **BH-AMF: The AMF serving the WAB-MT.**
* **BH-5GC: The 5GC serving the WAB-MT.**
* **WAB-5GC: The 5GC connected to the WAB-gNB and serving the UEs.**
* **WAB-AMF: The AMF connected to the WAB-gNB and serving the UEs.**
* **BH-UPF: The UPF serving the WAB-MT for backhauling.**

**First three terms are good. FFS all the remaining terms above.**

* **WAB Authorization**

**Proposal2: For WAB authorization , RAN3 to agree the following:**

* + **BH RAN node can be unaware of WAB.**
	+ **WAB specific enhancement to BH RAN is not precluded in the study**
	+ **FFS on the scenarios where BH RAN needs to be WAB aware.**
	+ **WAB-MT authorization pertains to the right of the WAB-MT to support BH PDU sessions.**
	+ **In case MT authorization is based on slice, signaling enhancements to the AS layer for the support of WAB-MT authorization are not needed.**
	+ **Authorization of WAB-gNB pertains to service authorization and security authentication, i.e., the right to serve UEs.**
	+ **RAN3 understands that authorization of the WAB-MT is different from the WAB-gNB service authorization/configuration/activation by e.g. OAM/SeGW.**
	+ **It is RAN3 understanding that WAB-gNB’s authorization status can change**
	+ **The UEs served by a WAB-node whose authorization status changes from “authorized” to “not authorized” can either be handed over to other RAN nodes or released.**
	+ **The NG connection(s) of a WAB-gNB whose authorization status changes from “authorized” to “not authorized” can be removed. FFS on if it can be suspended.**
	+ **WAB mobility**

**Proposal3: For WAB mobility, RAN3 to agree the following:**

* **Support the following scenarios for intra-PLMN WAB-node mobility:**
* **WAB-AMF/UPF remains unchangedas WAB-node moves inside a PLMN.**
* **WAB-AMF/UPF changes as WAB-node moves inside a PLMN.**
* **BH UPF/AMF remains unchanged as WAB-node moves inside a PLMN.**
* **BH UPF/AMF changes as WAB-node moves inside a PLMN.**
* **all type of legacy mobility procedures can be supported for WAB-MT.**
* **RAN3 assume that roaming scenario for WAB-MT is supported.**
* **FFS on NG connection suspension.**
* **A WAB-gNB can establish an Xn connection with the BH-RAN node or surrounding RAN nodes using legacy procedures.**
* **Upon WAB-gNB mobility:**
	+ **If needed, the WAB-gNB may power up one or more new cells with new configuration parameters related to its current location and handover UEs between the old and new cell served by the WAB-gNB.**
	+ **FFS is this procedure needed for AMF relocation.**
	+ **In case this procedure is used for AMF relocation, new cells can belong to different logical gNB, FFS on if it can belong to the same logical gNB (resolve it in the come back)**
* **5G femto**

**Proposal1: Add the figure for Option 3 to TR 38.799.**

**Proposal2: Capture the SeGW also in the figures for architecture options 1, 3, and 4 (with appropriate Notes, similar to option 2). Provide TP for SeGW. (Ericsson)**

**Proposal3: The current study should include an optional Xn gateway, independently from architecture of NG (similar to X2 gateway). See TP at this meeting.**

* **OptionA without Xn gateway(ZTE)**
* **OptionB with Xn gateway (Huawei)**

**Proposal4: Agree the following architecture evaluation for each option.**

**Option1: direct connection of NR Femto to 5GC**

**Pros**:

1. Already supported by current architecture.
2. Less CP latency and no processing delay due to absence of a concentration stage.
3. Suitable for certain deployments depending on number of NR Femtos to connect and/or virtualization support of the 5GC
4. Local breakout can be supported

**Cons:**

1. Not suitable for certain deployments with large number of NR Femtos and/or 5GC not virtualized.
2. Not suitable for residential deployments with frequent switch on/off of NR Femtos.

**Option 2: NR Femto GW**

**Pros:**

1. Only one SCTP association from 5GC to NR Femto GW,so it can support large number of femtos and/or no virtualization of 5GC.
2. 5GC is shielded from frequent switch on/off of the NR Femtos.
3. Enables operators who have already deployed 4G Femto using HeNB GW to capitalize on operating model and integration process of 5G Femtos.
4. Foreseen specification impact are already well known from 4g .
5. Allows to decouple concentration of CP and concentration of UP: concentration of UP is optional i.e. the NR Femto GW can concentrate CP only while the NR Femto connects directly to the UPF.
6. Local breakout can be supported

**Cons:**

1. Some stage3 specification impact.
2. Some processing delay for CP message.

**Option 3: SCTP concentrator**

**Pros:**

1. Only one SCTP association from 5GC to SCTP concentrator due to using multi-streaming.
2. Local breakout can be supported.
3. Only stage2 specification impact.

**Cons:**

1. The solution requires consistent configuration and handling of SCTP stream identifiers.
2. The solution requires consistent SCTP implementation of AMF, SCTP concentrators and NR femtos.
3. Some processing delay for CP message.
4. Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.

**Option 4: NR Femto as a gNB-DU**

**Pros:**

1. Reuse existing split gNB architecture.

**Cons:**

1. F1-C was not designed to face frequent switch on/off. Usually F1-C is operated by the network operator and statically configured.
2. Forssen additional Interoperability issue of F1 compared to NG.:
3. F1-C carried over internet backhaul can lead to latency and reliability issue not meeting the stringent requirement for F1-C interface.
4. This option forces the concentration of User Plane and not only control plane i.e. concentration of CP only while NR femto UP connects directly to UPF is not possible.
5. Does not provide an evolution path for operators that have already deployed a HeNB GW for E-UTRAN.
6. Specification impact for F1 needs to be further assessed.
7. Local breakout cannot be supported

# References

|  |  |  |
| --- | --- | --- |
| [R3-243021](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243021.zip) | LS on FS\_VMR\_Ph2 solution impacts to RAN (SA2(Qualcomm)) | LS in |
| [R3-243174](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243174.zip) | Discussion on Wireless Access Backhaul (NTTDOCOMO, INC.) | discussion |
| [R3-243199](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243199.zip) | (draft Reply LS) Discussion on reply LS to SA2 on VS\_VMR\_Ph2 solution impacts on RAN (Qualcomm Inc.) | other |
| [R3-243200](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243200.zip) | (TP to TR 38.799) WAB requirements and archtiecture (Qualcomm Inc.) | other |
| [R3-243201](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243201.zip) | (TP to TR 38.799) WAB network integration and mobility (Qualcomm Inc.) | other |
| [R3-243202](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243202.zip) | (TP to TR 38.799) WAB resource coordination (Qualcomm Inc.) | other |
| [R3-243217](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243217.zip) | (TP to TR 38.799) Discussion on architecture and protocol stack for R19 WAB (ZTE) | other |
| [R3-243218](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243218.zip) | (TP to TR 38.799) Discussion on supporting WAB and the reply LS on FS\_VMR\_Ph2 solution impacts to RAN (ZTE) | other |
| [R3-243219](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243219.zip) | (TP to TR 38.799) Discussion on WAB mobility and resource multiplexing (ZTE) | other |
| [R3-243247](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243247.zip) | Consideration on architecture and mobility for WAB (NEC) | discussion |
| [R3-243305](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243305.zip) | (TP for TR 38.799) General aspects of WAB (Xiaomi) | other |
| [R3-243306](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243306.zip) | (TP for TR 38.799) SA2’s LS for WAB (Xiaomi) | other |
| [R3-243327](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243327.zip) | (TP to TR 38.799) Discussion on impact of WAB (CATT) | other |
| [R3-243328](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243328.zip) | (draft reply LS) Discussion on LS for VMR from SA2 (CATT) | other |
| [R3-243329](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243329.zip) | (TP to TR 38.799) Discusson on resource multiplexing for WAB (CATT) | other |
| [R3-243339](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243339.zip) | Discussion on the Architecture, Access control and QoS support of WAB (Huawei) | pCR |
| [R3-243340](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243340.zip) | Discussion on the procedures related to the WAB (Huawei) | pCR |
| [R3-243341](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243341.zip) | Discussion on SA2's LS (S2-2405822/R3-243021) on FS\_VMR\_Ph2 solution impacts to RAN (Huawei) | discussion |
| [R3-243351](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243351.zip) | (TP to draft TR 38.799) Discussion on WAB architecture and high level aspects (Nokia, Nokia Shanghai Bell) | other |
| [R3-243352](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243352.zip) | Discussion on WAB integration and mobility (Nokia, Nokia Shanghai Bell) | discussion |
| [R3-243353](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243353.zip) | Resource Multiplexing for WAB (Nokia, Nokia Shanghai Bell) | discussion |
| [R3-243361](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243361.zip) | (pCR for TR 38.799) WAB Architecture and Scenarios (Ericsson) | pCR |
| [R3-243362](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243362.zip) | (pCR for TR 38.799) Functional Aspects of WAB-Nodes (Ericsson) | pCR |
| [R3-243363](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243363.zip) | Handling of Backhaul Link Degradation and Resource Multiplexing for WAB (Ericsson) | discussion |
| [R3-243389](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243389.zip) | Discussion on integration procedure for WAB node (Lenovo) | discussion |
| [R3-243390](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243390.zip) | Discussion on migration procedure for WAB node (Lenovo) | discussion |
| [R3-243391](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243391.zip) | Discussion on resource multiplexing for WAB node (Lenovo) | discussion |
| [R3-243581](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243581.zip) | Discussion on enhancements for WAB (CANON Research Centre France) | discussion |
| [R3-243583](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243583.zip) | Discussion on RAN impact of SA2 solution in WAB (LG Electronics) | discussion |
| [R3-243584](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243584.zip) | (TP for TR 38.799) Architecture and protocol stack for WAB’s Xn (LG Electronics) | other |
| [R3-243585](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243585.zip) | Reply LS on FS\_VMR\_Ph2 solution impacts to RAN (LG Electronics) | LS out To: SA2 CC: RAN2 |
| [R3-243588](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243588.zip) | Views on FS\_VMR\_Ph2 Solution Impacts to RAN (China Telecom) | discussion |
| [R3-243648](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243648.zip) | (TP to TR 38.799) Discussion on network integration for WAB (Samsung) | pCR |
| [R3-243649](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243649.zip) | (TP to TR 38.799) Discussion on WAB mobility (Samsung) | pCR |

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| [R3-243020](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243020.zip) | LS on Support of UE move between CAG cell of 5G Femto and CSG cell (SA2(Docomo)) | LS in |
| [R3-243025](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243025.zip) | LS to request clarification on the potential baseline system architecture of 5G NR Femto (SA3(China mobile)) | LS in |
| [R3-243175](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243175.zip) | Discussion on NR Femto (NTTDOCOMO, INC.) | discussion |
| [R3-243176](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243176.zip) | draft Reply LS on Support of UE move between CAG cell of 5G Femto and CSG cell (NTTDOCOMO, INC.) | LS out To: SA2 CC: RAN2 |
| [R3-243187](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243187.zip) | 5G femto architecture considerations (AT&T Services, Inc.) | discussion |
| [R3-243197](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243197.zip) | Comment on Femto architecture options 1 and 2 (Charter Communications, Inc) | other |
| [R3-243198](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243198.zip) | Xn Gateway in Femto architecture (Charter Communications, Inc) | discussion |
| [R3-243203](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243203.zip) | (draft Reply LS) Discussion on reply LS to SA2 on Support of UE move between CAG cell of 5G Femto and CSG cell (Qualcomm Inc.) | other |
| [R3-243232](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243232.zip) | Access to local services from the 5G Femto via distributed UPF (Huawei) | pCR |
| [R3-243252](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243252.zip) | Open issues on NR femto (NEC) | discussion |
| [R3-243315](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243315.zip) | Discussion on NG connection and interface for Option 2 for NR Femto Architecture (Baicells) | discussion |
| [R3-243316](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243316.zip) | (TP to TR 38.799)NG connection and interface for Option 2 for NR Femto Architecture (Baicells) | discussion |
| [R3-243330](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243330.zip) | (TP to TR 38.799) On 5G Femto architecture (CATT) | other |
| [R3-243331](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243331.zip) | (TP to TR 38.799) On 5G Femto local service access (CATT) | other |
| [R3-243332](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243332.zip) | (TP to TR 38.799) On 5G Femto access control mechanism (CATT) | other |
| [R3-243342](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243342.zip) | Discussion on the architecture and access control for NR Femto (Huawei) | pCR |
| [R3-243343](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243343.zip) | Discussion on SA2’s LS (S2-2405813/ R3-243020) on Support of UE move between CAG cell of 5G Femto and CSG cel (Huawei) | discussion |
| [R3-243374](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243374.zip) | NR Femto Architecture and Ongoing Issues (Ericsson LM) | pCR |
| [R3-243392](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243392.zip) | Architecture for NR Femto (Lenovo) | discussion |
| [R3-243393](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243393.zip) | Access control and handover for NR Femto with CAG (Lenovo) | discussion |
| [R3-243394](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243394.zip) | Discussion on interworking between CAG and CSG cells (Lenovo) | discussion |
| [R3-243409](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243409.zip) | NR Femto Node Access Control with CAG (Ericsson LM) | pCR |
| [R3-243411](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243411.zip) | Access to Local Services via Local UPF (Ericsson LM) | pCR |
| [R3-243562](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243562.zip) | [TP for TR 38.799] Evaluation of NR Femto Architecture Options (Nokia, TMO US, AT&T, Verizon Wireless, KDDI, British Telecom, NTT Docomo Charter) | other |
| [R3-243563](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243563.zip) | Support of UE Move between CAG cell and CSG cell (Nokia) | discussion |
| [R3-243564](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243564.zip) | Reply LS on Support of UE move between CAG cell of 5G Femto and CSG Cell (Nokia) | LS out To: SA2 CC:  |
| [R3-243565](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243565.zip) | [TP for TR 38.799] Access to Local Services (Nokia ) | other |
| [R3-243586](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243586.zip) | Discussion on SA2 solutions to support HO between CAG and CSG cell (LG Electronics) | discussion |
| [R3-243587](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243587.zip) | Reply LS on Support of UE move between CAG cell of 5G Femto and CSG cell (LG Electronics) | LS out To: SA2, RAN2 CC:  |
| [R3-243607](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243607.zip) | On Access Control for NR Femto (China Telecom) | discussion |
| [R3-243608](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243608.zip) | On Architecture for NR Femto Support (China Telecom) | discussion |
| [R3-243650](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243650.zip) | (TP to TR 38.799) Discussion on Femto architecture (Samsung) | pCR |
| [R3-243651](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243651.zip) | (TP to TR 38.799) Discussion on access control for NR Femto (Samsung) | pCR |
| [R3-243686](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243686.zip) | draft Reply LS to request clarification on the potential baseline system architecture of 5G NR Femto (NTTDOCOMO, INC.) | LS out To: SA3 CC: SA2 |
| [R3-243753](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243753.zip) | (TP to TR 38.799)Discussion on architecture and access control of NR Femto (ZTE) | discussion |
| [R3-243754](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243754.zip) | (TP to TR 38.799)Discussion on support of local services (ZTE) | discussion |
| [R3-243755](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243755.zip) | Discussion on CSG-CAG mobility (ZTE) | discussion |
| [R3-243761](file:///D%3A%5C%E4%BC%9A%E8%AE%AE%E7%A1%AC%E7%9B%98%5CTSGR3_124%5CDocs%5CR3-243761.zip) | Draft Reply LS to request clarification on the potential baseline system architecture of 5G NR Femto (CMCC) | LS out To: SA3 CC: SA2 |

1. It should be noted that most of the issues studied in [6] may be superseded due to the evolved SCTP handling in NG-RAN. [↑](#footnote-ref-2)