

3GPP TSG RAN #102

RP-233544

Edinburgh, Scotland, December 11-15, 2023

Agenda Item:

9.1.3.3

Document for:

Discussion

Study of customer-installed FR2-femto with NW control

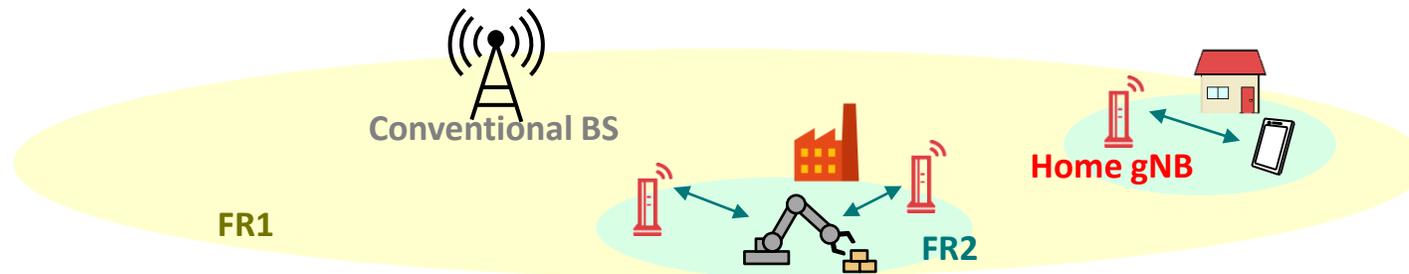
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■ Difficulty of efficient FR2 support

- The initial NR specification supports FR2 spectrum and several enhanced mechanisms were introduced in subsequent releases for more efficient FR2 support
- However, unfortunately, **it is difficult in practical to use FR2 efficiently and effectively based on conventional NW deployments**

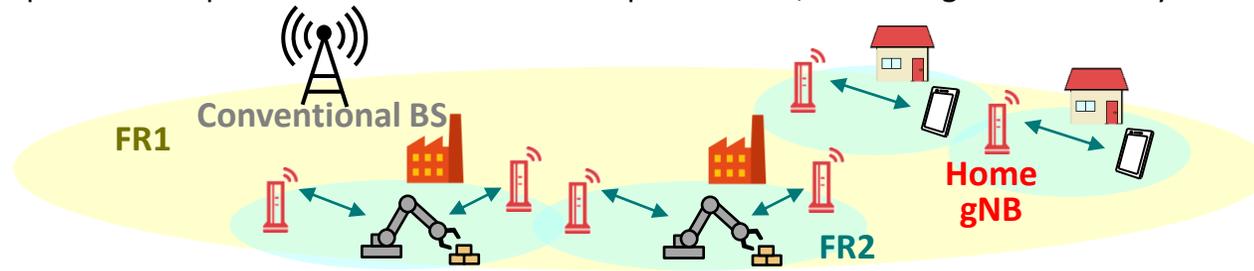
■ Another way for efficient FR2 support

- In 4G era, femtocell/home eNB concept was discussed and specified. Having said that, it is difficult to say in our view that such a mechanism is/was widely-used over the world, due to less motivation or disadvantage
- Meanwhile, for 5G NW especially FR2, **femtocell/home gNB concept** will be a possibility to solve the abovementioned FR2-related problem
 - » **Scheme 1: FR2-femto w/o UPF/GW**
 - i.e., CN functions including UPF/GW are at operator side, and i.e., home BS class in TS 38.104
 - → RP-232087/RP-233751: Proposal of FR2-femto support from DCM (only RAN4 impact is assumed)
 - » **Scheme 2: FR2-femto w/ UPF/GW**
 - → RP-231577: Proposal of 5G femto w/ UPF/GW from Nokia (co-sourced by DCM)

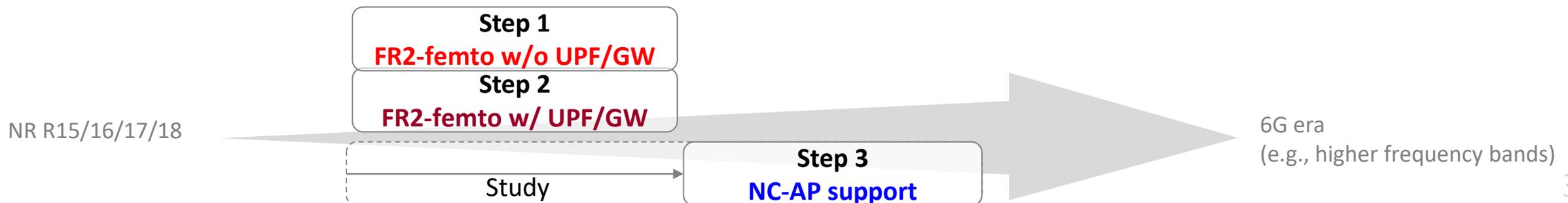


■ Necessity of **customer-installed FR2-femto** – called **‘NW-controlled access point (NC-AP)’**

- Although FR2-femto is good as a kind of temporary solution, it would be insufficient as a final solution at least from the following:
 - » A – **Interference**: If the number of FR2-femto NW is increased, interference between conventional NW and FR2-femto NW or between multiple different FR2-femto NW becomes larger and non-negligible
 - » B – **Immediate NW installation**: Basically femto is installed by NW operator or according to their permission. Wi-Fi AP may be easier from customer side
 - » C – **Flexibility**: both CN C-plane and U-plane are maintained in NW operator side, which degrades flexibility of NW architecture and also latency performance

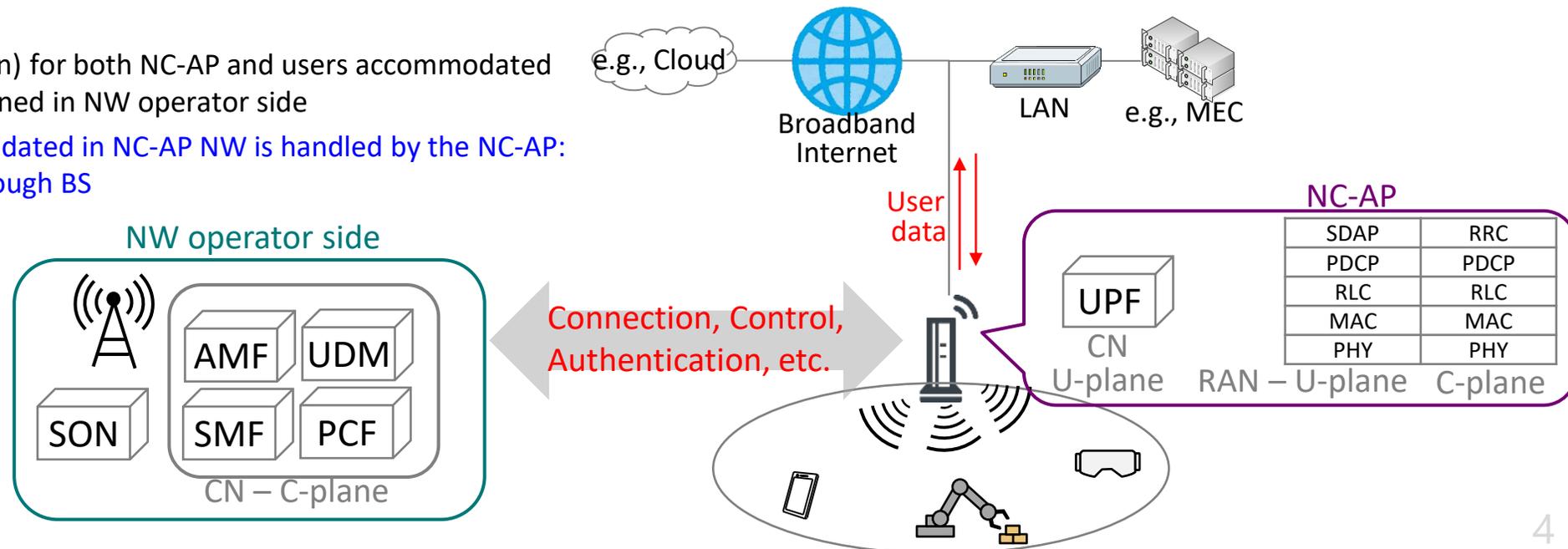


- NC-AP concept is a promising way for future femto-type NW: see the next page for details
 - » With a mechanism for total NW optimization to avoid chaotic NW. Details can be found in the next page
 - » Note: Frequency range in NC-AP is not limited to FR2
- **Normal FR2-femto w/o UPF/GW, i.e., home BS class in TS 38.104** as the first step (RP-232087/RP-233751), **Normal FR2-femto w/ UPF/GW** as the second step (RP-231577), and **NC-AP** as the third step



■ NC-AP NW = **Customer-installed** femto NW with **control function** from NW operator side

- Feature
 - » NC-AP device has BS-like capabilities
 - » Each customer purchases/decides/installs NC-AP device as desired in a similar manner for Wi-Fi AP
 - » NW operator controls NC-AP remotely; e.g., whether to permit operation as a kind of BS, which area to be covered
 - Optimization of NC-AP NW is performed by enhanced 'SON' function well-designed in NW operator side; otherwise, i.e., in femto mechanism, large interference would be observed in many situations as in Wi-Fi NW when 5G femto becomes widely used and each customer puts the femto chaotically
- Connection
 - » NC-AP device is connected to NW operator side and to local NW or broadband Internet
 - » Users perform initial access to NC-AP that is found as a normal gNB
- CN function
 - » C-plane (e.g., authentication) for both NC-AP and users accommodated in the NC-AP NW is maintained in NW operator side
 - » U-plane for users accommodated in NC-AP NW is handled by the NC-AP: User data is not routed through BS

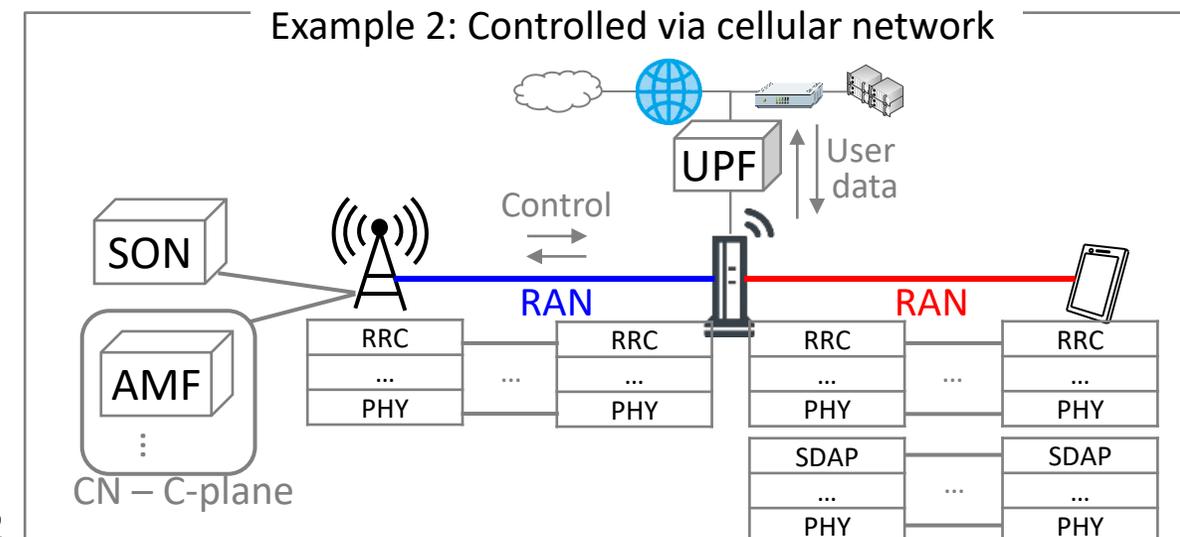
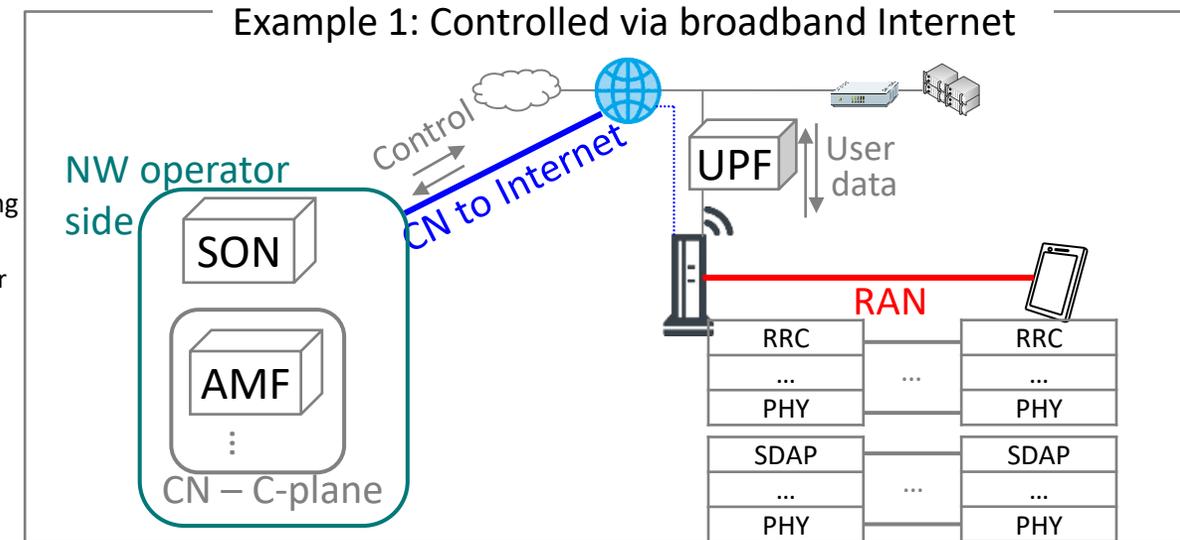


Comparison

	Conventional cellular NW deployments	Wi-Fi AP	Femto/home gNB	NC-AP
Effectiveness/ Efficiency	Not so good	Unclear	Good - FR2 is available without unrealistic-cost of BS installation in conventional manner - Service area is deployed on customer demand	
Immediate NW installation	Not so good	Good	Neutral	Good
Frequency utilization	Good	Not so good	Good Licensed spectrum is available = better capacity/throughput/etc. Note: It is assumed that licensed spectrum is available in NC-AP NW due to control by NW operator	
Reliability	Good	Not so good	Good More reliable than Wi-Fi mechanism	
Fault tolerance (e.g., large-scale system failure)	Not so good	Good	[Good] Even when operator side is down, it may be possible that service area is kept as a kind of emergency mode	
Optimality	Good	Not so good	Not so good	Good NW operator collects information in entire network and decides parameters to be used by NC-AP = total optimization

Proposal (Objective)

- For **normal FR2-femto w/o UPF/GW**,
 - See RP-232087/ RP-233751, i.e., [RAN4]
- For **normal FR2-femto w/ UPF/GW**,
 - See RP-231577, i.e., [RAN3]
 - » Study the overall RAN architecture and required functional/procedural impacts for supporting 5G Femto
 - Including access control, C/U-plane flow, co-located local UPF to access local network and/or internet
- For **NC-AP (customer-installed FR2-femto)**,
 - Study/decide architecture [RAN3]
 - » Including whether the same architecture as in **normal FR2-femto w/ UPF/GW** is reused
 - e.g., via wireless communication including TN/NTN for connection between NW operator and NC-AP (Example 1)
 - e.g., via wireless communication including TN/NTN for connection between NW operator and NC-AP (Example 2)
 - e.g., whether NC-AP may be a mobile device
 - Study SON enhancements for NC-AP NW [RAN3]
 - » e.g., which interface is considered for the SON enhancements
 - For CN-level optimization: Ng interface (i.e., discussion in SA)
 - For BS-level optimization: Xn interface (i.e., discussion in RAN)
 - » e.g., define new information reported from NC-AP/UE
 - » e.g., define control interface from NW to NC-AP
 - Note: FR2 is a main target, but NC-AP concept is not limited to FR2



■ Proposal: The following update with red color is supported

- Study enhancements for the support of WAB including (RAN3-led, RAN2):
 - Study impact of gNB mobility within a stationary RAN and in proximity to other mobile gNBs:
 - Identify the issues of dynamic inter-gNB neighbor relations resulting from gNB mobility, e.g., ANR, inter-gNB HO/DC and SON.
 - Identify potential RAN-related issues when collocating a UPF with the gNB for MEC, local services and/or local inter-UE communications.
 - Identify necessary inter-gNB- and gNB-to-CN signaling to address these issues.
 - Study the signaling enhancements for the authorization of WAB nodes.
 - Study signaling enhancements to extend the IAB resource multiplexing framework to WAB, as necessary.
 - Study enhancements to QoS support on WAB backhaul, as necessary (subject to interaction w/ SA2)
- Study enhancements for the support of single-donor IAB topology, including (RAN2-led, RAN3):
 - Study enhancements to the robustness of multi-hop routing within the IAB topology in presence of local IAB-node mobility.

Note: Access link for WAB backhaul can be TN or NTN.

Femto

- Study the overall RAN architecture and required functional and procedural impacts for supporting 5G Femto deployments.
- Study how to define the 5G access control mechanism by (re-)using the existing CAG functionality and identify needed enhancements (if any).
- Study how to enable access to local services and broadband internet services from the 5G Femto via collocated local UPF.
- Study SON feature for 5G femto

Note: The study involves a gap analysis of existing 5G functionality with HomeNB functionality.

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