

Jun 15-17, 2016

# On NextGen architecture options

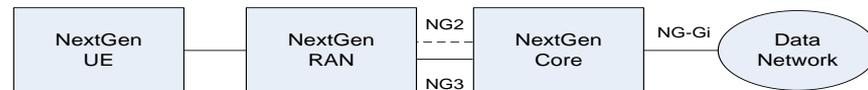
**Source: Intel**

Agenda Item: 5

# SA2/RAN2/RAN3 work on NextGen architecture options (1/2)

- The SA2/RAN2/RAN3 joint meeting held on May 25th in Nanjing revealed a discrepancy between RAN2/RAN3 work and SA2 work regarding the architecture options with New RAT (NR) based RAN
- Current SA2 focus (see [S2-163037](#)) is on:
  - architecture options where NextGen RAN (NG RAN) connects to a NextGen Core (NG Core)
  - NG RAN refers to a radio access network that supports Evolved E-UTRA and/or New RAT and interfaces with the NG Core
- Using the “StandAlone NR” (SA-NR) and “Non-StandAlone NR” (NSA-NR) terminology, it is our understanding that the SA2 scope covers the following three architecture options

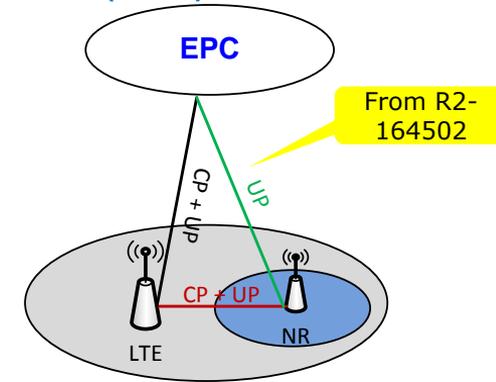
- NSA-NR based radio access network connecting to NG Core
- SA-NR based radio access network connecting to NG Core
- Evolved E-UTRA (or “eLTE”) based radio access network connecting to NG Core



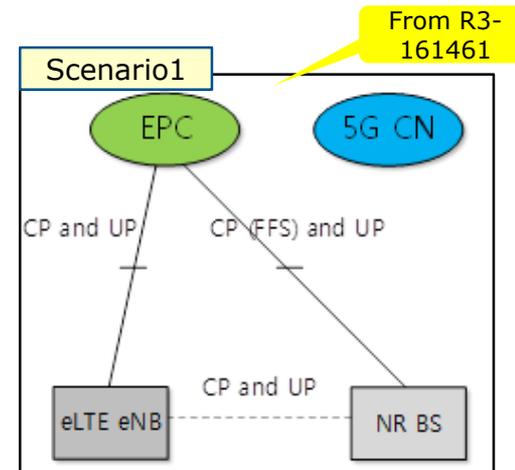
- ... but strictly speaking, SA2 did not have to discriminate between the three RAN options, because each of the three is supposed to connect to NG Core using the common NG2/NG3 interface
- These options match the NGMN Option 3 (see backup slide)

# SA2/RAN2/RAN3 work on NextGen architecture options (2/2)

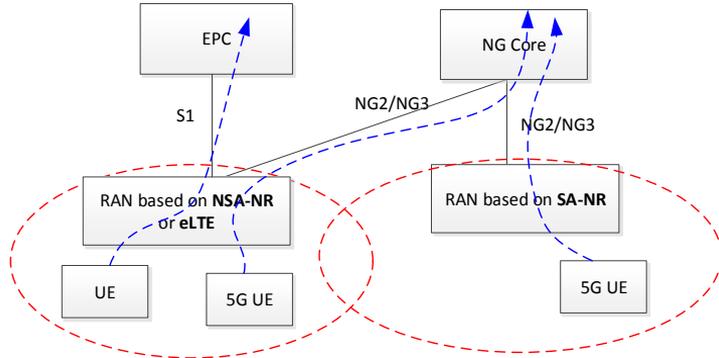
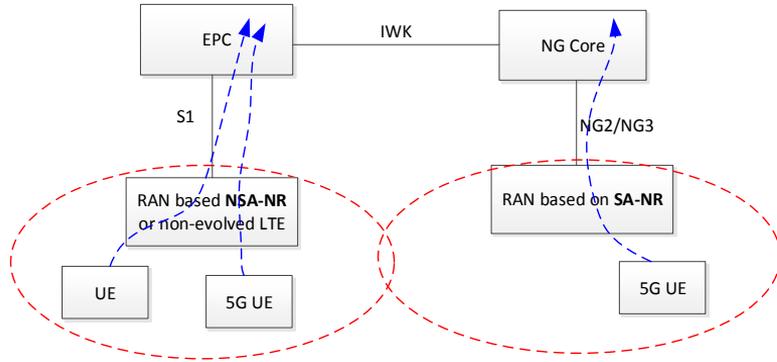
- In contrast, RAN2 (see [S2-163042](#) / [R2-164502](#)) and RAN3 (see [S2-163041](#) / [R3-161461](#)) also consider the option where « NR tightly integrated in LTE » (i.e. NSA-NR) connects to EPC
- It was commented that the EPC-based option requires little or no work in SA2, given that it is based on the Dual Connectivity model already used to support diverse « secondary RATs » (e.g. LWA, LAA)
- A contribution to this RAN#72 plenary ([RP-160812](#)) proposes that for NSA-NR « *at least LTE EPC connectivity (other CN connectivity pending TSG-SA decision)* » should be considered
  - The proposal with LTE EPC connectivity for NSA-NR effectively paves the way towards NGMN Option 2 (see backup)
- Intel believes that, although the EPC option for NSA-NR requires little or no specification work in SA2, SA2 may need to analyze the viability of this option from the perspective of migration and interworking
  - Note: SA2 has already created a key issue on “Interworking and Migration” in TR 23.799, but did not have the chance to do any work so far



1) NR tightly integrated in LTE via [EPC](#)



# Discussion around the EPC-based option (1/2)



- If NSA-NR connects to EPC:
  - The “early” NR-capable UEs that support only NSA-NR mode will be locked on EPC forever
  - When SA-NR is later deployed on the NG Core, there is no way for consolidating all the NR-capable UE population on the NG Core
  - When moving between SA-NR areas and NSA-NR areas, interworking needs to be ensured using CN-level interworking. This will likely increase the legacy baggage on the NG Core
- This option effectively looks like NGMN option 2 (see backup)
  
- If, instead, NSA-NR connects to NG Core:
  - Existing eNBs need to be upgraded to support the NG2/NG3 interface towards NG Core, in addition to supporting the existing S1 towards the EPC
  - All NR-capable UEs are steered to NG Core (even when the RAN is based on eLTE only)
  - EPC is used only for legacy UEs
- This option effectively looks like NGMN option 3 (see backup)

## Discussion around the EPC-based option (2/2)

- NGMN Option 3 is (or used to be?) the recommended option (by NGMN) and the SA2 work scope seems very much compliant to this option
  - Notably because TR 23.799 assumes that NSA-NR based RAN and the eLTE based RAN also connect to the NG Core via NG2/NG3 (in addition to the SA-NR based RAN)
- In this RAN and SA plenary, proposals are made that go in the direction of NGMN Option 2
  - E.g. it is proposed in RP-160812 to have an EPC architecture option for NSA-NR
  - It is also hinted that there may be another option for NSA-NR (presumably, NG Core based)
- If 3GPP eventually decides to allow both EPC-based and NG Core-based option for NSA-NR, UE complexity will significantly increase as UEs will eventually have to support
  - Two flavours of NSA-NR (e.g. different NAS protocols, but also possibly with differences at AS layer)
  - Different set of interworking procedures when moving between SA-NR and NSA-NR areas

# How different NG Core is compared to EPC?

- In the joint SA2/RAN2/RAN3 meeting the current status of the SA2 work on CN-RAN functional split was presented (see [S2-163038](#); also in backup)
- QoS and Mobility Management seem to be the main potential departure from the current RAN-CN functional split defined for EPS
  - Several proposals in TR 23.799 for “flow-based” QoS
  - Several proposals in TR 23.799 for RAN-level “connected inactive” state and its implications (e.g. RAN-level tracking and paging)
- Therefore, accelerating the work on QoS and MM will be beneficial for aligning and expediting the work in SA2 and RAN2/RAN3 around the NG Core option
  - By making the NG Core option available early on, it may be possible to avoid the EPC-based option and the issues it may incur (no clear migration path for NR-capable UEs, UE complexity, legacy baggage on NG Core)

# Proposal

- If TSG-SA confirms that NGMN Option 3 is the preferred option for NextGen, then it is proposed:
  - TSG-SA to task SA2 to prioritise the interworking and migration aspects in Q3
    - In particular the viability of the EPC-based architecture option for NSA-NR should be examined from interworking and migration perspective
  - TSG-SA to task SA2/RAN2/RAN3 to prioritise work on QoS and Mobility Management
    - To expedite the work on the NG Core option
- If TSG-SA confirms that the EPC-based architecture option for NSA-NR should be supported, then it is proposed:
  - TSG-SA to decide whether a second architecture option (NG Core based) should be supported for NSA-NR
    - The concern being to avoid multiple options that increase UE complexity

## Disclaimer

- This discussion in this contribution is independent from the proposal in [RP-160812](#)
- In our understanding the main focus of RP-160812 is on the proposed modified timing for phased completion of NSA-NR and SA-NR, both being part of Rel-15
- The reason for referencing RP-160812 in this document is the hint on the system architecture (« *at least LTE EPC connectivity (other CN connectivity pending TSG-SA decision)* ») which in our understanding is not the main proposal in RP-160812

Backup

# NGMN options

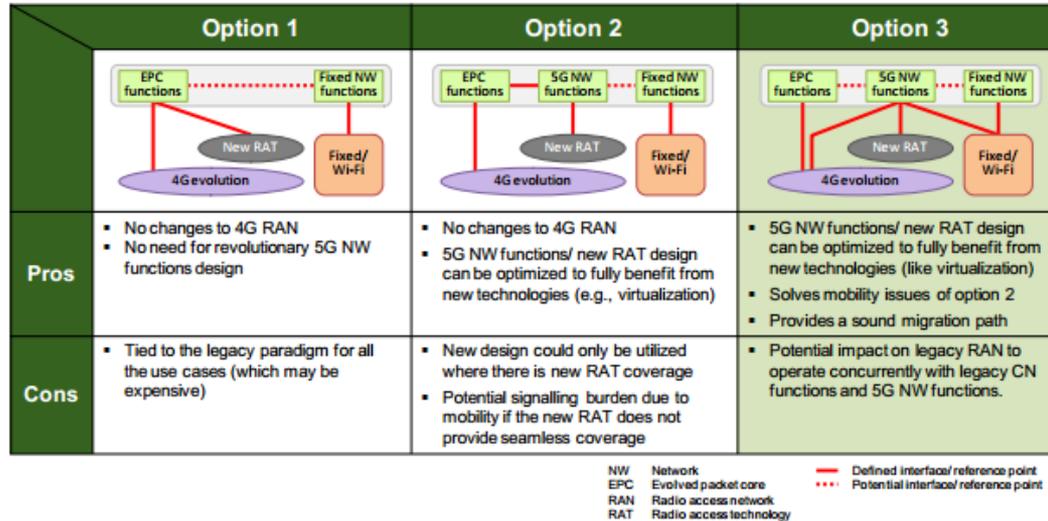


Figure 10: Access-technology interfacing options<sup>2</sup>

- We assume that the “4G evolution” bubble includes the NSA-NR based RAN and/or the “eLTE” based RAN, whereas the “New RAT” bubble includes the SA-NR based RAN
- Option 3 implies a dual-stack LTE eNB i.e. LTE eNB connecting to either EPC or NG Core
- Option 3 is (was? used to be?) the NGMN recommended option (refer to NGMN 5G White Paper v1.0 clause 5.5: “For these reasons Option 3 is currently considered by NGMN as the preferred option.”)

# 1 RAN – CN function split (1/2)

- SA2 achieved “Interim Agreements on NextGen RAN and NextGen Core functional allocation”

- Focuses on functionalities for basic building blocks MM, QoS, SM, authentication.

Location: Function:	NextGen RAN	NextGen CN	Comments
<b>Key Issue #1 – Network Slicing</b>			
CN instance selection when UE attach to a CN network slice	FFS	FFS	
<b>Key Issue #2 QoS</b>			
Radio Resource Admission Control	X		
Radio Resource management (QoS attributes)	X		Packet scheduling with regards to resource utilization and availability (RRM)
Max rate control	X	X	Maximum bitrate policing in the CN and RAN in UL and DL.
QoS Policy Control		X	
Transport marking	X	X	Used for prioritization in the transport network.
Charging Data Collection		X	
Packet classification of DL packets for QoS differentiation on the Radio	FFS	FFS	Some companies think the QoS classification for QoS differentiation of DL packets is performed in RAN.
QoS differentiation and verification for UL packets	FFS	FFS	Some companies think the QoS verification for UL packets is performed in RAN and/or CN.
<b>Key Issue #4 - Session Management</b>			
PDU Session address allocation		X	FFS for non-IP PDU Sessions
PDU Session Termination Point		X	Note that this refers to the ownership of the specification for the function supporting the termination point. In a NW deployment this function may be deployed on or close to a RAN site.
Session Management		X	
Termination of UP security	FFS	FFS	FFS
Subscription Data Handling (incl. default QoS profile)		X	

# 1 RAN – CN function split (2/2)

Location: Function:	NextGen RAN	NextGe n CN	Comments
<b>Key Issue #3 – Mobility Management</b>			
Mobility management control, (Subscription and Policies)		X	
Determination of mobility restriction		X	
Roaming restrictions execution		X	
Mobility restrictions execution, [CN Connected]	X		
Mobility restrictions execution, [CN Idle]		X	If CN Idle exists.
UE registration		X	
Area tracking	FFS	FFS	The need for Hierarchical tracking is FFS. Depends also on the existence of a CN Idle state
UE unreachability detection		X	Assumed to be supported in CN for UEs in CN Idle state. If CN Idle exists.
RAN UE unreachability detection	X		Assumed to be supported in RAN for UEs in RAN Inactive state. If RAN inactive state exists.
NAS state transitions		X	
RRC state transitions	X		
Paging initiation and control in RAN Inactive state	X		RAN Inactive state is RAN state that corresponds to CN connected state. If RAN inactive state exists.
Paging initiation in CN Idle state		FFS	CN Idle state is FFS. Some companies assume that the CN Idle state is replaced by a RAN "Inactive" State. Some companies think that the CN Idle state remains but is used more seldom due to the new RAN "inactive" state
Access Stratum UE Context storage in RAN Inactive state	X		If RAN inactive state exists.
Control of connected state mobility	X	X	
UP buffer for UE in CN Idle state		FFS	Same comment as on Paging initiation in CN Idle state
UP buffer for UE in RAN Inactive state	X		If RAN inactive state exists.
<b>Key issue #12</b>			
Authentication and Key Agreement		X	

