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Electronic Meeting, Sept. 13 - 17, 2021
Agenda: 9.0.1
RP-211953

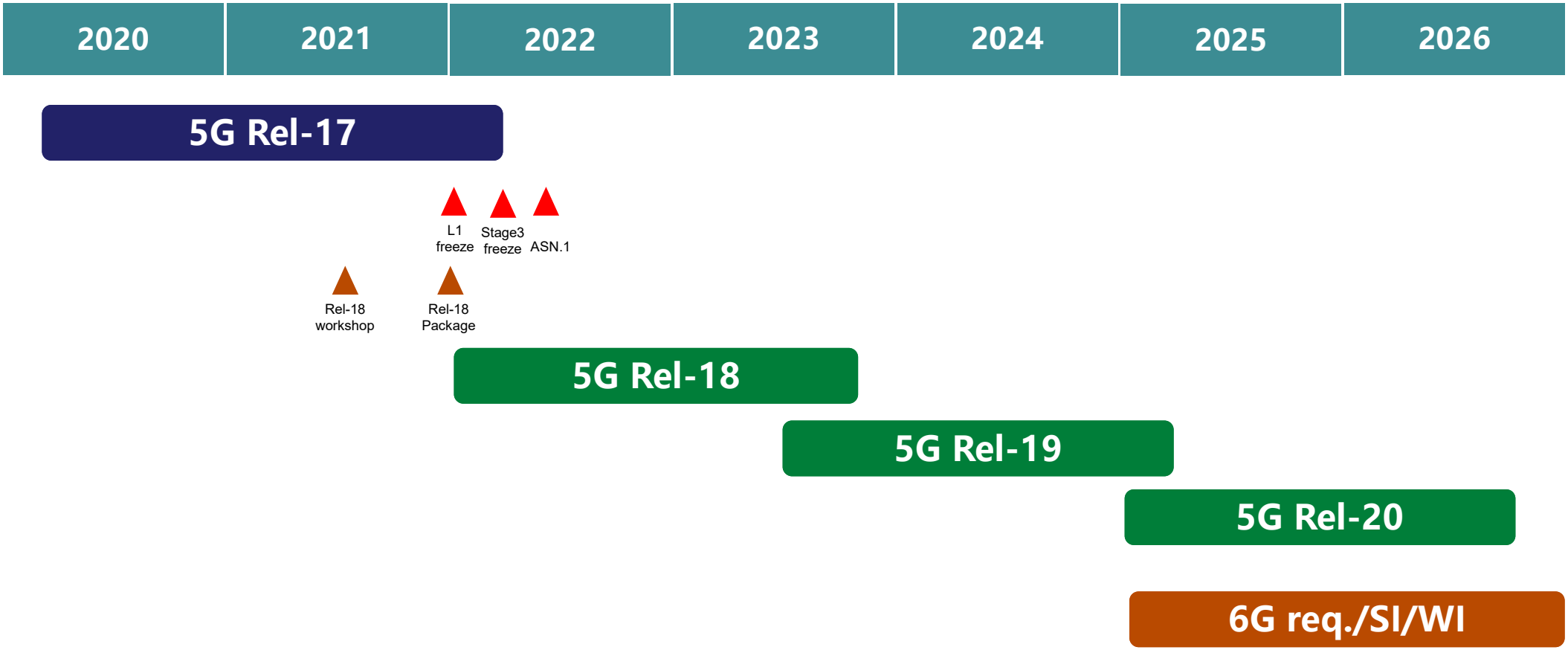
中国电信
CHINA TELECOM

Views on NR Rel-18

China Telecom

2021.9

Possible Timeline



Requirement for Rel-18: from a wireless perspective

1 Higher capability

- » UL enhancement
- » Mobility enhancement
- » CA/DC enhancements

2 Lower cost

- » Network energy saving

3 More flexibility

- » Flexible spectrum fusing
- » Duplex flexibility

4 RAN4 enhancements

Areas for UL enhancement

- Summary of RAN Rel-18 WS on UL enhancements

  2. Uplink enhancements, with the following example areas:

  - >4 Tx operation
  - Enhanced multi-panel/multi-TRP uplink operation
  - Frequency-selective precoding
  - Further coverage enhancements

- In our view, areas for UL enhancement can be divided into two WIs.

  » UL capacity enhancement:

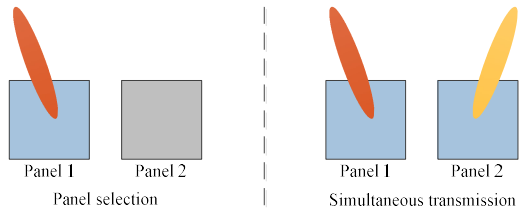
  - >4 Tx operation
  - Enhanced multi-panel/multi-TRP uplink operation
  - Frequency-selective precoding
  - UL Tx switching enhancement

  » UL coverage enhancement:

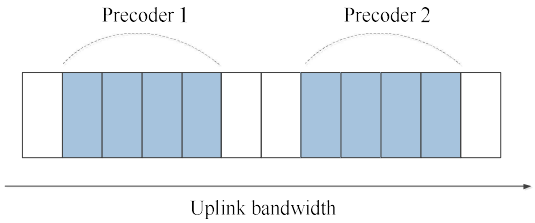
  - PUSCH enhancement
  - PUCCH enhancement
  - PRACH enhancement

Enhanced multi-TRP & frequency-selective precoding

- Enhanced multi-panel/TRP UL operation
  - » Motivations
    - For downlink, simultaneous reception across multiple panels is supported. However, for uplink, UE can only select one panel for transmission and simultaneous transmission across multiple panels is not supported. Thus, uplink performance may still suffer from UE mobility, blockage, especially for FR2.
  - » Potential scope
    - Support simultaneous transmission across multi-panel for uplink transmissions.

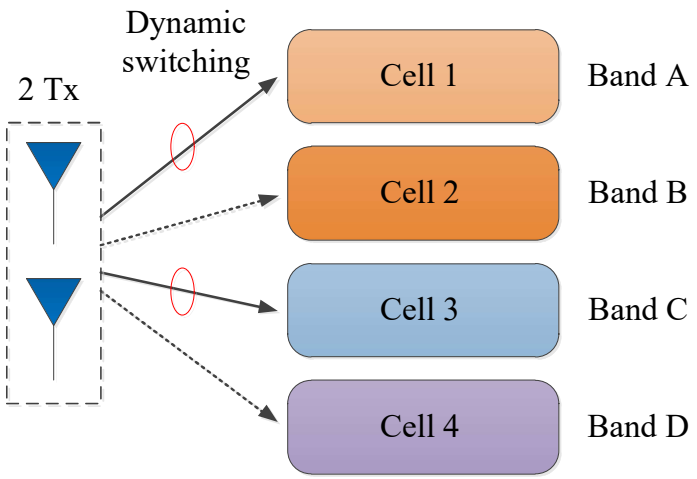


- Frequency-selective precoding
  - » Motivations
    - For downlink, PRG based transmission is supported. However, for uplink, only wideband precoding is supported, which limited the UL performance under frequency-selective channel.
  - » Potential scope
    - Support frequency-selective precoding schemes for uplink transmissions.



UL Tx switching enhancements

- Motivations
  - » Emergence of uplink centric services brings challenge to UL transmission.
  - » Limitations of current specification
    - 2TX UE can be configured with at most 2 UL bands, which only can be changed by RRC reconfiguration.
    - UL Tx switching can be only performed between 2 UL bands for 2Tx UE.
- Potential scopes
  - » Enable more configured UL bands than UL RF capability.
    - Max num. of configured bands >= Max num. of activated bands >= Max num. of Simultaneously transmission bands
  - » UL Tx switching schemes across more than 2 bands.
    - E.g. 4 UL bands can be configured, and dynamic switching can be performed across the 4 bands.



UL coverage enhancement - Motivations

- Motivations
  - » More than 10 companies (including 6 operators) submit UL coverage enhancement related contributions in RAN Rel-18 workshop.
  - » Cov_Enh SI in Rel-17 has identified UL channels as bottleneck channels. Some Cov_Enh solutions were included in Rel-17' Cov_Enh WI scope for PUSCH and PUCCH coverage enhancement.
  - » The performance gap and remaining gap is summarized in the following table. It can be seen that there're still several dBs remaining gap considering practical NR deployment scenarios. Thus, it is beneficial to continue enhancing UL coverage in Rel-18.

Tab. Baseline coverage performance & solutions' gain in TR 38.830

Channels	Scenario	MPL Gap	Solutions in Rel-17 WI	Remaining gap
PUSCH (eMBB)	Urban 4GHz TDD (ISD = 400m)	~(-7) dB	Rep. Type A: 2~3dB gain DMRS bundling: ~1dB gain TB processing: 1~2dB gain	Several dBs
	Rural 4GHz TDD NLOS O2I (ISD = 1732m)	~(-5.4) dB		Several dBs
PUSCH (VoIP)	Rural 4GHz TDD NLOS O2I (ISD = 1732m)	~(-1.8) dB		-
	Rural 4GHz TDD NLOS O2I (ISD = 3000m)	~(-11) dB		Large
PUCCH (F3 11bits)	Rural 4GHz TDD NLOS O2I (ISD = 1732m)	~(-2.5) dB	DMRS bundling: ~1dB gain	~ 1.5 dB

UL coverage enhancement - Potential Scope

- Specification of PUSCH enhancements [RAN1, RAN4]
  - » Specify enhancement on PUSCH repetition type B [RAN1]
    - Actual PUSCH transmission across the slot boundary/invalid symbols
    - The length of actual repetition larger than 14 symbols
  - » Study and if necessary specify power domain enhancement, e.g., UE transmit waveform design to reduce MPR [RAN1, RAN4]
- Specification of PUCCH enhancements [RAN1, RAN4]
  - » Specify DMRS-less PUCCH with UCI payload up to 11 bits
- Specification of PRACH enhancements for short formats for FR2 [RAN1, RAN2]
  - » Multiple PRACH transmissions with the same beam
  - » Multiple PRACH transmissions with different beams
- Left overs of Rel-17 WI on coverage enhancement

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4 RAN4 enhancements

Summary of RAN Rel-18 Workshop

- About 26 companies (contributions and Q&As) provided views on mobility enhancement with wide interest to support, including operators, network vendors, UE vendors, etc.
- Mobility enhancement was included in the set of topics for further discussion in the workshop summary RWS-210659:
  - **3. Mobility enhancements**, with the following example areas:
    - Layer 1/layer 2 based inter cell mobility
    - DAPS (Dual Active Protocol Stack)/CHO (Conditional HandOver) related improvements
    - FR2 (frequency range 2)-specific enhancements
- Other areas related to mobility enhancement discussed in the R18 workshop email-discussions are as follow:
  - Data forwarding optimization (about 2 companies proposed)
  - Support inter-RAT PScell change (about 2 companies proposed)
  - Fast failure detection and recovery (about 6 companies proposed)
  - Network signaling reduction (about 3 companies proposed)
- In our view, it is crucial to enhance current mobility procedures to provide consistent high data rate with low latency performance, based on this, we propose:
  - The L1/L2 based inter cell mobility, DAPS/CHO related enhancement (e.g. DPAS+DC/CA, DAPS+CHO, CHO+MRDC, NG-based CHO, etc…), and data forwarding optimizations should be handled with high priority;
  - For FR2-specific enhancement, reduce data interruption for FR2 to FR2 case is necessary, support DAPS HO in FR2 scenario is worth to be considered;
  - Other areas can be treated with low priority and considered together with the TUs allocated in R18.

L1/L2 based inter cell mobility

L1/L2 based inter cell mobility

- L1/L2 based mobility can reduce the UP data interruption compared with legacy L3 controlled mobility solutions, and it would not increase much UE complexity compared with DAPS solution. However in R17, only L1/L2 centric intra-DU mobility is supported, expanding L1/L2 mobility to serving cell change for intra-DU and inter-DU(intra-CU) scenarios are desirable. For inter-CU scenario, as there may be much impact on the specification, it can be considered as low priority in R18.
- With L1/L2 based mobility solution, the candidate cells are pre-configured (e.g. in NR SA, CA and MR-DC scenarios), UE stores the configuration and performs measurement and beam management, and then UE can initiate fast cell switching based on L1/L2 signaling. For MRDC scenario, switching between PCell and PSCell can be considered at the early stage, other use cases can be further explored if time allowed.

Potential scope:

- Specify L1/L2 based inter-cell mobility solutions which are not addressed in R17, to reduce the data interruption time in multiple scenarios (e.g. NR SA, CA and MR-DC): [RAN2, RAN1, RAN3, RAN4]
  - Support serving cell change for intra-DU and inter-DU(Intra-CU) L1/L2 mobility approaches;
  - Support switching of Pcell, switching of Scell, switching between Pcell and PSCell, etc…

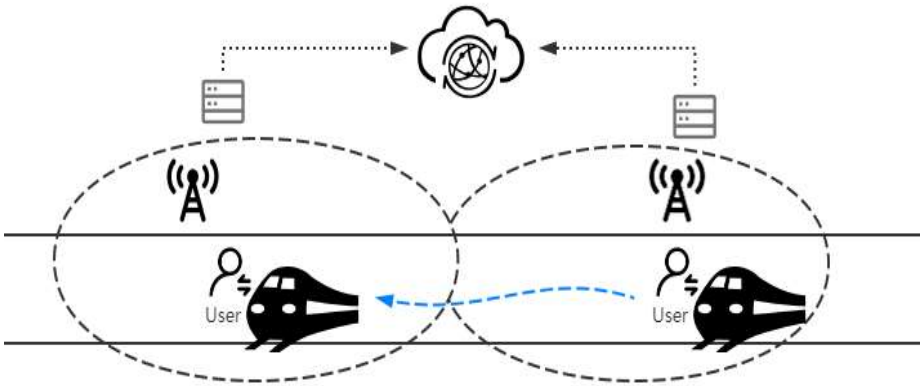
DAPS/CHO related improvements

DAPS/CHO related improvements

- In R16/R17, 3GPP has introduced CHO/CPAC to increase the robustness and DAPS HO to achieve 0ms user plane interruption during mobility procedures, however the above technologies can only be used in limited use cases.
- For many new emerging applications (such as XR, 4K/8K video, cloud gaming, etc…) requiring high data rate with low latency, further extensions should be supported to improve mobility performance.

Potential scope:

- Enhance DAPS and CHO approaches to support consistent high data rate with low interruption during mobility procedures, such as: [RAN2, RAN3, RAN4]
  - DAPS related enhancement, such as DAPS + DC/CA, DAPS+CHO/CPAC…
  - CHO related enhancement, such as CHO+MRDC, NG-based CHO, inter-RAT CHO, CHO+CPAC…



UE experience NG-based handover in high speed train scenario

FR2-specific enhancement

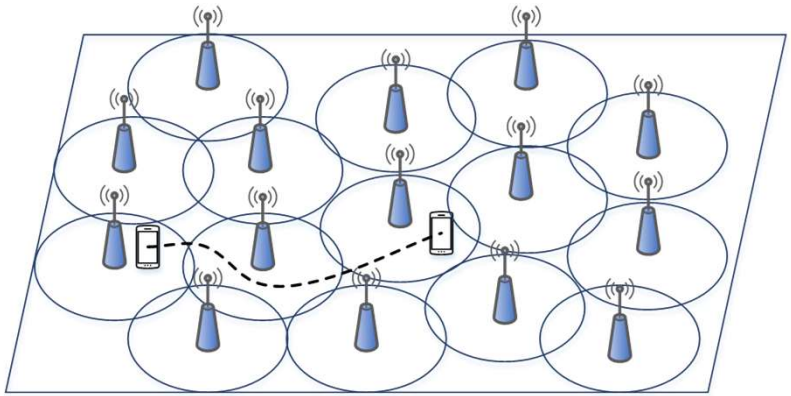
FR2-specific enhancement

- In FR2, users will experience more frequent handovers, the data interruption during the handover procedure will seriously affect the user's service experience. However, the DAPS handover for FR2 to FR2 case is not supported in current specification, this is mainly due to limitations related to UE capabilities.
- Due to the services with high throughput and low latency are popular e.g. 4k/8k TV, online game, and XR/VR according to the market, we need to re-consider if the DAPS handover for FR2 to FR2 case can be supported in Rel-18 (e.g. enable RRC-based DAPS handover in FR2 for multiple-panel UE). Other enhancement such as MBB and RACH-less HO, which were specified in LTE but not supported in NR can also be considered.

Potential scope:

- Specify solutions for mobility enhancements on FR2, especially for reducing interruption, such as DAPS HO, MBB HO, RACH HO, etc... [RAN2, RAN3, RAN4]

  Note: If DAPS HO can be extended to FR2 scenario, then MBB and RACH-less HO can be deprioritized.



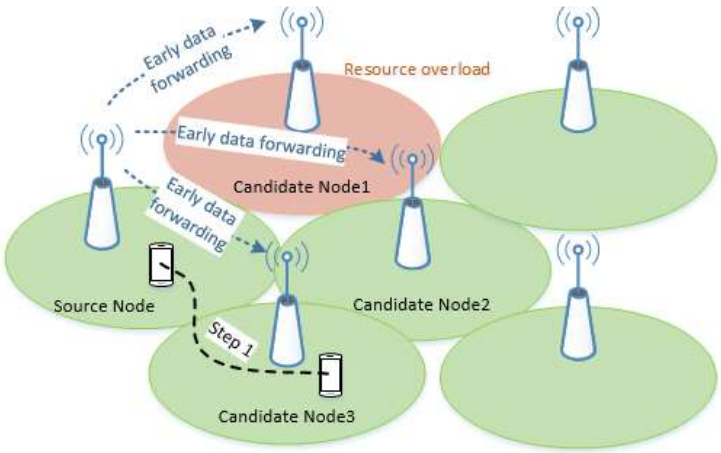
UE Handover more frequent duo to the high frequency deployment

Other aspects related to mobility enhancement

- Other aspects related to mobility enhancement can also be considered in R18, such as:
  - **Data forwarding optimization**: The current data forwarding procedure can be enhanced to ensure data continuity and reduce network latency.
  - **Fast failure detection and recovery:** Given that fast failure recovery is an essential procedure which provides transmission reliability, enhancement of fast failure recovery especially for FR2 should be an important part for mobility procedures.
  - **Support of inter-RAT PScell change**: Inter-RAT SN change procedure with single RRC reconfiguration is not supported in current specification (i.e. no transition from EN-DC to NR-DC), support inter-RAT PScell change procedure can reduce data interruption and ensure service continuity for the users.
  - **Network signaling reduction:** The signaling interaction between the network and users will also become more frequent due to the FR2 deployment, which will undoubtedly cause high signaling overhead and may cause RLF in some cases. Solutions to reduce network signaling are worth to study.

Potential scope:

- Specify the solutions on the following aspects to enhance mobility performance: [RAN2, RAN3, RAN1]
  - Data forwarding optimization
  - Fast failure detection and recovery
  - Support of inter-RAT PScell change
  - Network signaling reduction



Early data forwarding may cause resource overload

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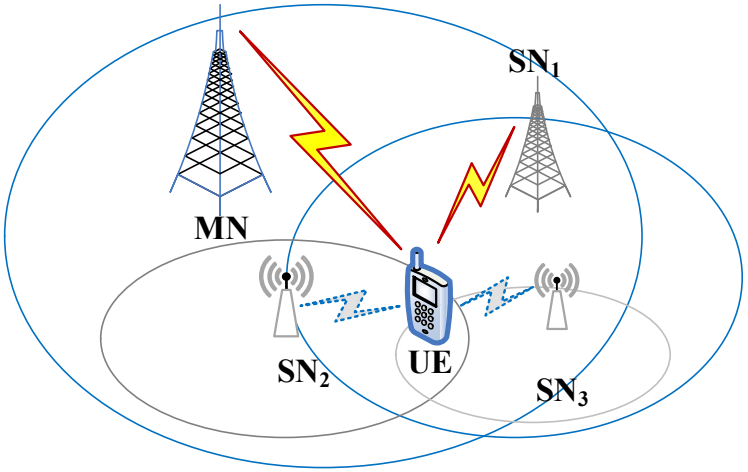
4 RAN4 enhancements

Overall view for CA/DC enhancements in Rel-18

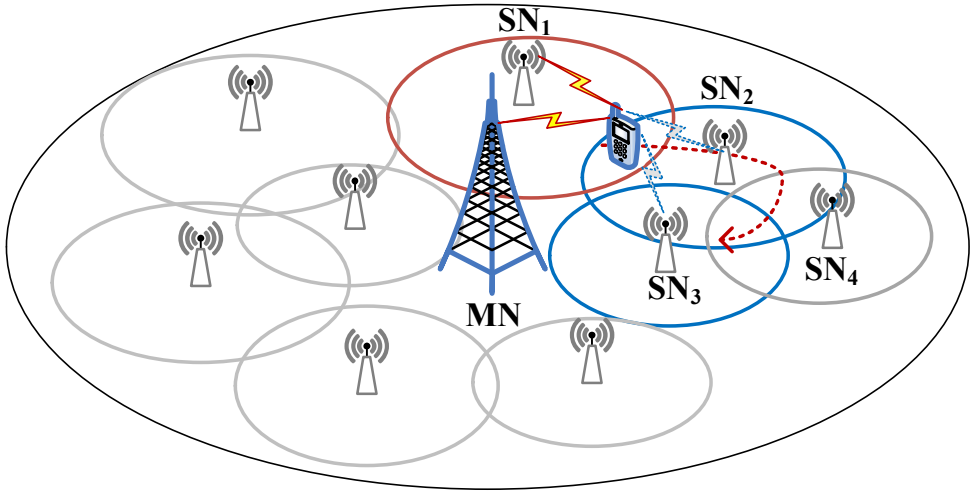
- Summary of RAN Rel-18 workshop on CA/DC enhancements
  - » As summarized in RWS-210659, CA/DC enhancements is listed as one of additional RAN1/2/3 candidate topics for Rel-18
    - **14. Additional RAN1/2/3 candidate topics, Set 1:**
      - UE power savings
      - Enhancing and extending the support beyond 52.6GHz
      - CA (Carrier Aggregation)/DC (Dual-Connectivity) enhancements (e.g., MR-MC (Multi-Radio/Multi-Connectivity), etc.)
      - Flexible spectrum integration
      - RIS (Reconfigurable Intelligent Surfaces)
      - Others (RAN1-led)
  - » About 22 companies (contributions and Q&As) provided views on CA/DC enhancements with wide interest to support, including operators, network vendors, UE vendors, etc.
  - » Potential scopes for CA/DC enhancements proposed in company contributions, including
    - Extending MR-DC to MR-MC (about 10 companies proposed)
    - Other further enhancements on CA/DC (about 7 companies proposed)
- In our view, **CA/DC enhancements** is one of the essential topics for Rel-18.
  - » CA/DC enhancements could be handled as a **higher priority** topic for Rel-18
  - » We suggest a **dedicated WI** for CA/DC enhancements in Rel-18

Motivation for Extending MR-DC to MR-MC

- Motivation
  - » Due to the high 5G frequency bands up to 100GHz and with the gradual 4G frequency refarming, Multi-layer overlapping deployment will be a normal behaviour for future network.
  - » The emergence of new applications and services, such as AR/XR, HD live video, requires not only **higher bandwidth and capacity**, but also **higher quality of service and user experience assurance**.
  - » For future network deployment, **MR-MC** can be considered as an approach to provide operator with more flexible, effective and uniform network control and radio resource management.



MR-MC for higher bandwidth and capacity



MR-MC for guaranteeing higher quality of user experience

Potential scope for MR-MC

- Potential scope for MR-MC
  - » Support at most 2 simultaneous UL transmissions and potential extension to 3 DL receptions in Rel-18
  - » Specify mechanisms and signalling for multi cell groups management, including
    - Fast and dynamic SCell/ SCG activation and deactivation
    - Fast cell group switching
    - UL selective activation mechanism
  - » Specify other aspects for MR-MC, including
    - Bearer management, such as new bearer type, split bearer etc..
    - UE capability management, such as UE capability sharing or coordination etc..
    - UE UL power control

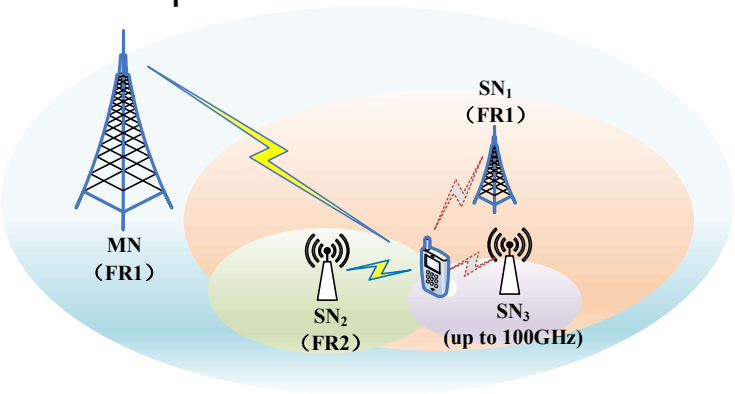


Fig. Multi cell group management

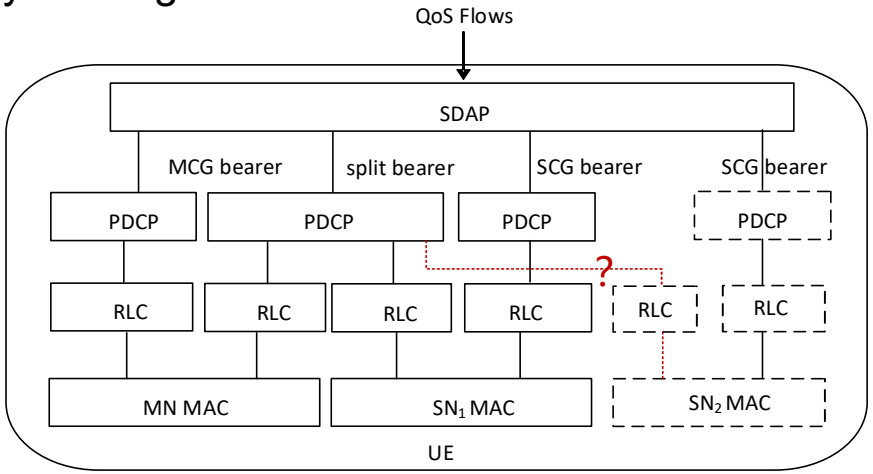


Fig. Radio Protocol Architecture for MCG, SCG and split bearers from UE side

Other further enhancements on CA/DC

- Further CA/DC enhancements for FR2
  - » Motivation
    - FR2 CA/DC cell selection and UE measurement report delay cause great user throughputs degradations. Further enhancement to reduce SCell setup delay would be needed for FR2
    - For dormant SCell in FR2, RACH is needed to get the best beam due to the lack of UL SRS transmission, which increases SCell activation latency in FR2.
    - In FR2, RLF on PCell may happen more frequently. It is necessary to minimize reestablishment caused by RLF on Pcell.
  - » Potential scopes
    - Early measurement enhancement to balance UE power consumption and SCell setup delay
    - Fast SCell activation enhancement, such as supporting UL SRS transmission for dormant SCell
    - RLF enhancement, such as MN/SN role switching

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4 RAN4 enhancements

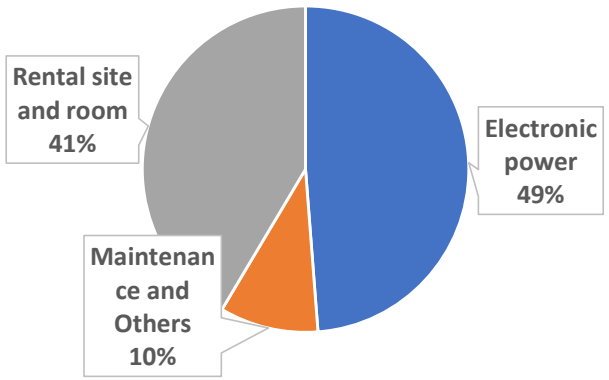
Motivation (1/2) -- A vital issue for operators

5G energy saving -- a vital issue for operators

- 5G network has higher number and density of base stations compared with 4G, as well as power consumption of a single NR base station is **3+ times** higher than LTE, due to higher band, wider bandwidth and more TRXs. The power consumption of 5G network has become a heavy burden to operators;
- The power cost of 5G network is **3.8 times** that of 4G;
- Power consumption has taken **the largest part of network operating costs** (~49%).

	4G		5G	
Base Station	3RRU	1BBU	3AAU	1BBU
Peak Power (W)	840	170	3450	310
Total Power (W)	1010		3760	

Power consumption: LTE vs. NR



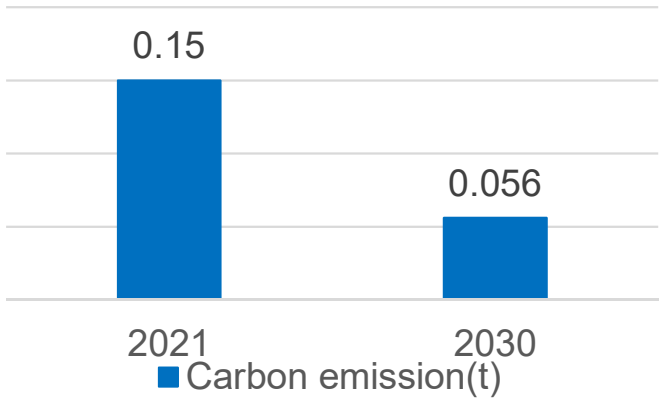
Operating Cost

Motivation (2/2)

Green communication -- a concerned issue for China Telecom

- Emission peak and carbon neutrality is a world-wide environment issue.
  - ✓ China Telecom has drawn up the ‘1236’ strategy for achieving the emission peak till 2030.
- Multiple tests have been conducted on network energy saving by China Telecom.
  - ✓ Evaluated the impact on performance (e.g. coverage, capacity) with network energy saving techniques in different domain.

Carbon emission plan of China Telecom
(t/per 100k operating revenue)



Tests conducted by China Telecom

Summary of RAN Rel-18 Workshop

- More than 20 companies, including operators, network vendors, UE vendors and chip makers provided their views/interests on network energy saving via contributions/email discussion.
- Network energy saving is included in the set of topics for further discussion in the R18 workshop summary (RWS-210659).
- The following aspects were discussed for network energy saving during email discussions/papers during R18 workshop:
  - Evaluation methodology
    - ✓ The power consumption of network/system
    - ✓ The impact on network performance
  - Potential enhancements for network energy saving.
    - ✓ Dynamic and flexible network enhancement for energy saving
    - ✓ UE/intra network assistance information for network energy saving
    - ✓ Others, e.g., improving PA power efficiency

Potential scope 1: Study the Evaluation methodology

- **Study and develop the energy consumption model**
  - The **relative metric** can be used for energy consumption modeling
    - ✓ the **known** relative/absolute **model** should be utilized and as a starting point.
    - ✓ reflect the sleep states and the associated transition times, the factors impact the energy consumption of active state.
    - ✓ Identify the **system model and reference configurations** for better reflecting the realistic network, e.g. the traffic/load model.
- **Study and Identify the evaluation metric**
  - **Energy Efficiency** can be a starting point for the **KPI**:
    - ✓ Reflect both energy consumption and network performance/UE experience.
  - Study and identify the **target scenarios**. E.g. FR1/FR2, downlink/uplink, urban/rural
  - Discuss and identify the detailed configurations used for **SLS** of the evaluation.

Potential scope 2: Study the potential techniques

- **Study the potential network energy saving techniques at least from the following aspects:**
  - Network energy saving enhancement techniques in **spatial domain**
    - ✓ e.g. efficient dynamic TRX/panel/beam on-off
  - Network energy saving enhancement techniques in **time domain**
    - ✓ e.g. efficient dynamic symbol switch-off, longer periodicity of common signals/channels
  - Network energy saving enhancement techniques in **frequency domain**
    - ✓ e.g. efficient multi-carrier adaptation, efficient TX/RX bandwidth adjustment
  - Network energy saving enhancement techniques in **power domain**
    - ✓ e.g. improving PA power efficiency in gNB, dynamic PSD adjustment
  - **UE assistance information**
  - **intra-network information exchange**

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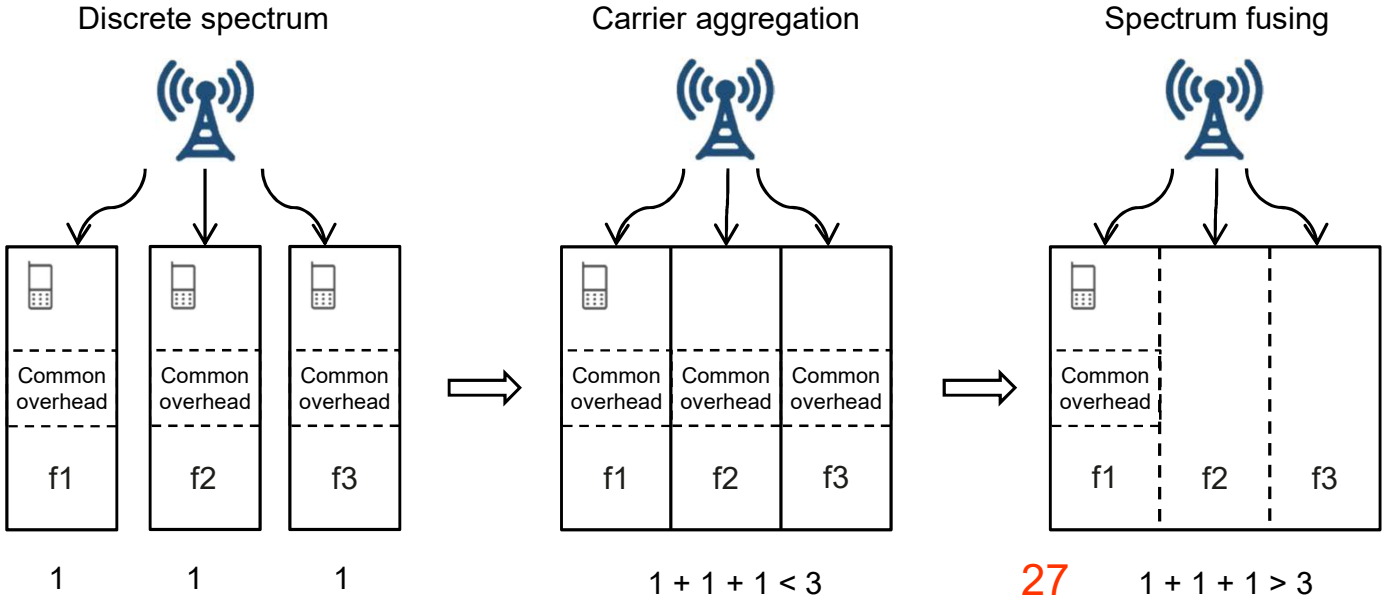
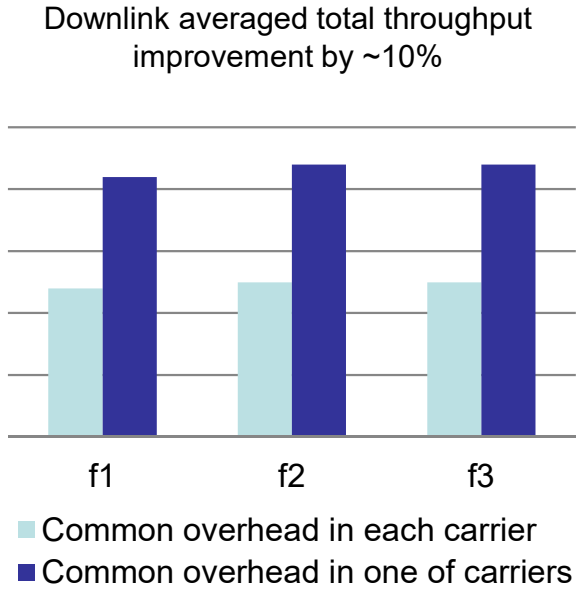
Flexible spectrum fusing - motivation

- As growth of data traffic and explosion of services, up to 5 down link carriers CA are proposed in RAN4. The Carrier Aggregation has been identified as a direct technology to achieve larger bandwidth and high data rate for NR and LTE. However, from operator point two key aspects need to considerate when deploying CA. The first is cost, addition of carrier will increase the network multiple cells management cost; the second is spectrum efficiency of CA, more control channels and signallings will cause CA spectrum efficiency lower than single carrier with the same total bandwidth.
- The flexible spectrum fusion changing the discrete spectrum utilization from simple aggregation to fusion, and will achieve 1+1+1>3 by reducing common overhead. The composite spectrum efficiency improvement is expected to be larger than 10% by comparing to traditional CA.

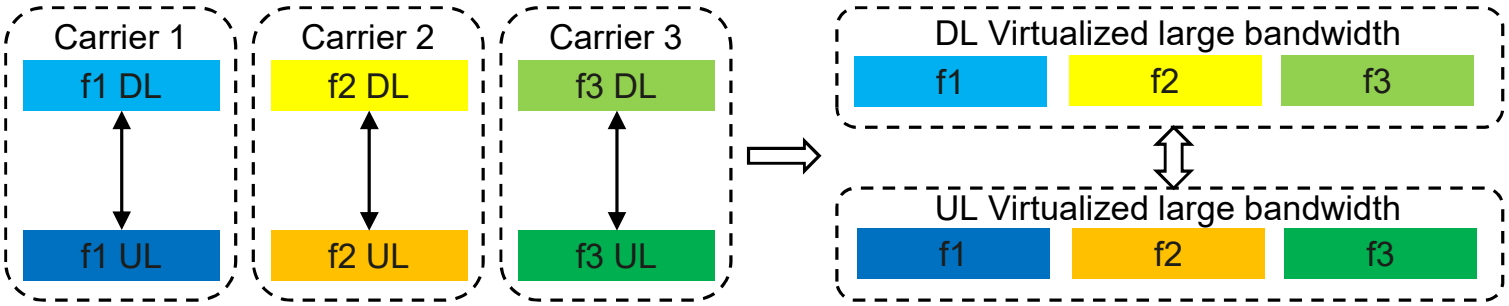




Flexible spectrum fusing - motivation

- Sub-1GHz plays the important role in wireless communication due to outstanding coverage performance, which on contrary made the sub-1GHz spectrum rare and fragmentally allocated in such as 700/800/900 MHz for IMT. In future, possibly more sub-1GHz spectrum bands such as 700/800/900 MHz can be operated under the co-construction and sharing business mode. How to integrate these fragment spectrums efficiently and schedule the resource more flexibly to meet 2B/2C requests will be the key question.
- The idea of flexible spectrum fusing is to integrate the bandwidths from different carriers to one virtualized bandwidth, will make scheduling more flexible and improve the spectrum efficiency extremely. Below figure gives an example for fusing 700/800/900MHz to one virtualized large bandwidth, flexible scheduling could happen in the virtualized bandwidth.

Flexible spectrum fusing



Background

- In RAN #92e workshop, similar views with above mentioned scenarios and motivations for flexible spectrum fusing could be found in amounts of 10 companies including RWS-210147(CTC), 0334(CMCC), 0402(CATT), 0441(Huawei), 0479(ZTE), 0032(DT, T-Mobile USA), 0122(Orange), 0210(Charter), 0199(Rakuten Mobile).
- The proposed scenarios in the workshop include 700/800/900MHz, 1.8G/2.1GHz in 0147 and 0402, 1.9G/2G/2.3GHz in 0304, 600/1900/3500MHz in 0210.
- For the scope of this topic, we think at least the cell management and overhead reduction are worth to be highlighted according to majority companies proposals.
  - » Cell management for CA enhancement is to support more uplink carriers than downlink carriers, for single cell enhancement is to support more SUL carriers concurrent transmission. Which was proposed by 9 companies above mentioned.
  - » The overhead reduction includes simplifying SSB, SIB, OSI, Paging resources to be allocated in one anchor carrier. Which was proposed by 5 companies above mentioned.

Flexible spectrum fusing - scope

- Scenarios
  - » Focus on the FR1 fragmented bandwidths in which the bands are neighboring, e.g. 700MHz/800MHz/900MHz, 1.8GHz/2.1GHz, 1.9GHz/2GHz/2.3GHz etc. (e.g. CBW<=50MHz per carrier)
- Frameworks
  - » The frameworks to achieve flexible spectrum fusing include multiple cells of CA and single cell
  - » Whether to down-select the framework is FFS.
- Cell management
  - » For multiple cell of CA, enable flexible configuration of downlink and uplink physical carrier for one cell in one or multiple frequency bands(RAN1, RAN2)
  - » For single cell, specify single cell mapped into non-contiguous bandwidth of one or multiple frequency bands, subject to aggregated cell bandwidth no more than Rel-17 maximum carrier bandwidth per cell. (RAN1, RAN2)
- Overhead reduction
  - » Combine PDCCHs and simplify SSB to be allocated in one of carriers (RAN1, RAN2)
- RF impact (RAN4)

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4 RAN4 enhancements

Background for Rel-18 evolution of duplex operation discussion

- Evolution of duplex operation won great interest during Rel-18 WS discussion
  - » As shown in the WS summary RWS-210659, it is included in the set of topics for further discussion.

    11. Evolution of duplex operation, with the following example areas:
    - Deployment scenarios, including duplex mode (TDD only?)
    - Interference management

- In pre-RAN 93e email discussion, 30+ companies took part in and the non-controversial/controversial aspects include：

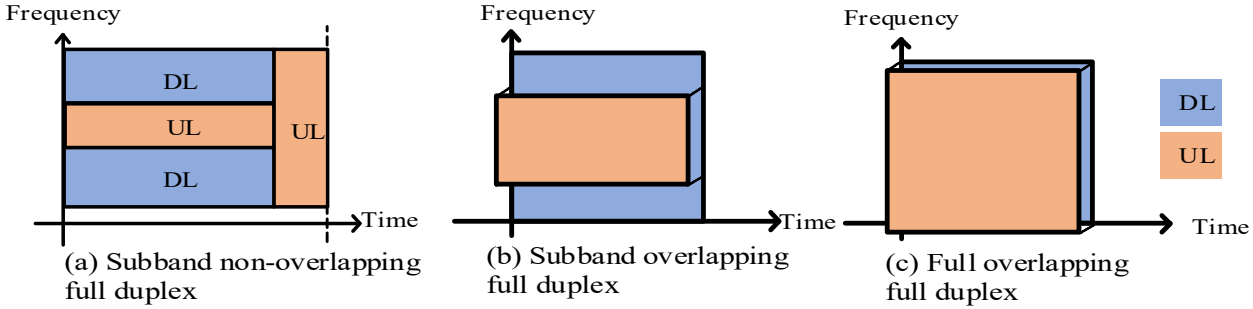
1. Rel-18 work plan:
   - » [Non-controversial] Study should be performed first.
   - » [Controversial] Planning of potential follow-up normative work. Continue discussion.
2. Duplex mode:
   - » [Non-controversial] TDD is included in the scope.
   - » [Controversial] Whether FDD will be included in the scope. Continue discussion.
3. Duplex enhancement at gNB only?:
   - » [Non-controversial] Duplex enhancement at gNB is included in the scope.
   - » [Controversial] Whether duplex enhancement at UE will be included in the scope. Continue discussion.
4. [Controversial] Duplex enhancement approaches:
   - » a) Continue discussion whether all of the three identified full duplex schemes (subband non-overlapping, subband overlapping, full overlapping) or a subset of them should be studied.
   - » b) Continue discussion about the need for CLI enhancement on dynamic/flexible TDD.
5. [Non-controversial] Interference management: Organize the study as follows.
   - » Study inter-gNB and inter-UE CLI and identify solutions to manage them [RAN1]
   - » Study RF requirements considering the self-interference and the inter-operator CLI at gNB [RAN4]
   - » Study co-channel and adjacent-channel co-existence with the legacy operation [RAN1/4]. Continue discussion how to organize interaction between RAN1 and RAN4.
6. [Controversial] Deployment scenarios: Continue discussion aiming to narrow down the deployment scenarios to be considered.
7. [Controversial] Frequency range: There was not much discussion on which frequency ranges have to be considered. Continue discussion on the frequency range to be considered.

Evolution of duplex operation： potential scope(1/2)

- Duplex mode：
  - » NR already supports dynamic change of the UL DL transmission in TDD spectrum to adapt the asymmetric UL DL traffic. TDD is included in the scope aims for higher uplink capacity, shorten latency and coverage enhancement.
  - » For FDD spectrum, it does not offer any means to effectively allocate the UL DL resource split to adapt the traffic with asymmetric and ratio changing DL/UL service. The FDD paired spectrum also has useful scenarios in operators' deployment and some of FDD low band LTE spectrum will likely to begin to be re-farmed for NR usage. To more efficiently utilize FDD spectrum serving asymmetric UL DL traffic, or further improve spectrum efficiency with overlapped UL DL transmission, the duplex mode for evolution needs to consider FDD spectrum as well.
  - » In terms of the regulatory, the SI "Study on regulatory aspects for flexible duplex for E-UTRAN" outcome indicated that at least in one country and in some bands, utilizing UL spectrum for transmission from the network to UEs is possible. The formulate and revision of the regulation may lag behind technological innovation, it is not impossible to apply for the change of regulations in the future due to the proved gain in FDD and the controllable interferences.
- Duplex enhancement at gNB only?
  - » Duplex operation can be evolved in phased way. Considering the UE implementation complexity, feasibility, power consumption, and cost to implement full duplex, the first study phase can only focus full duplex at gNB while UE remains traditional duplex mode.

Evolution of duplex operation： potential scope(2/2)

- Duplex enhancement approaches
  - » The first study phase is expected to have a thorough study about the identified full duplex schemes to investigate the potential gain and applicable scenarios. Based on the SI outcome, later WI can have narrower scope to specify the schemes with high commercial interest.



(a) Subband non-overlapping full duplex (b) Subband overlapping full duplex (c) Full overlapping full duplex

- How to organize interaction between RAN1 and RAN4
  - » To prevent updates to prior studies in RAN1 based on conclusions from RAN4, RAN4 first studies the RF requirements for the self-interference and the inter-operator CLI, and after RAN4 makes the conclusion on the RF requirement, RAN1 can perform system level evaluation based on the conclusion.
- Deployment scenarios and frequency range
  - » Comprehensive study is preferred to figure out the useful scenarios and potential gain, without precluding potential scenarios and frequency ranges in the study objective. The outcome can be taken as reference for future study and deployment. IAB FD can be handled in another SI/WI if needed in Rel-18.

Requirement for Rel-18: from a wireless perspective

1 Higher capability

- » UL enhancement
- » Mobility enhancement
- » CA/DC enhancements

2 Lower cost

- » Network energy saving

3 More flexibility

- » Flexible spectrum fusing
- » Duplex flexibility

4 RAN4 enhancements

General views on RAN4 non-spectrum work

Approval timeline

» Without clear definition, it is difficult to differentiate "old" and "new" areas.

» One-phase approval approach is preferred, i.e., approve RAN4 non-spectrum package in one RAN meeting.
- Few items can be approved earlier based on consensus.

» RAN4-led topics are more relevant to product or deployment roadmaps

» Some RAN1/2/3 features defined in previous releases are still lack of RAN4 requirements by now.

=> *Keep enough room for RAN4-led work.*

Two alternatives are provided in per-RAN email discussion:

» Alt. A (Moderator's proposal based on the email discussion): Approve RAN4 non-spectrum package in Mar 2022, and reserve RAN4 TUs for RAN4-led WI/SI.
- Few items can be approved in Dec 2021, based on consensus.
- The exact number of reserved TUs needs to be discussed further.

» Alt. B: Approve RAN4 non-spectrum package in Dec 2020.

Note 1: The actual time to start the RAN4 work would be the same for the two alternatives.

Note 2: Either alternative can achieve the goal of leaving room for RAN4-led work, and it depends on which one is more feasible to implement from RAN and RAN4 leadership perspective.

General views on RAN4 non-spectrum work

- Categorization of proposals
  - » Category #1: Proposals within one of the five areas (FR1 RF, FR2 RF, BS RF, RRM and Demod)
    - The number of objectives in each area needs to be limited, to control the overall workload.
  - » Category #2: Cross-area proposals, which can be further split into two sub-categories:
    - Proposals involving more than 1 area with major work in 1 area, e.g., FR1 4Tx, FR1 8Rx, FR2 UL CA with CBM, FR2 UL 256QAM, which can be put into the area with major work.
    - Proposals involving more than 2 areas, e.g., FR1 ATG, FR1 non-co-located intra-band NR-CA/EN-DC, FR2 multi-Rx chain DL reception, which can be discussed separately.
  - » Category #3: Testability and EMC related proposals
    - As usual, they are discussed separately.
- General principle on the prioritization of different proposals
  - » To consider the performance benefits as well as the popularity/probability of the corresponding scenarios happened in real networks or implemented in commercial UE/BSs.

General views on RAN4 spectrum work

- Approval timeline: follow the way in Rel-17, i.e.,
  - » Group #1: Spectrum basket items
    - Group 1A): Continuation of Rel-17 basket WIs, which can be approved at March 2022.
    - Group 1B): New basket WIs that cannot be foreseen at the beginning of Rel-18. To accommodate operators' requests in a timely way, not limit the approval of these items to certain meetings or time period, if the objectives are agreeable.
  - » Group #2: Spectrum non-basket items
    - To be treated in the same way as for group 1B), i.e., not limit the approval of these items to certain meetings or time period, if the objectives are agreeable.
- Boundary between spectrum and non-spectrum WI/SIs
  - » If new agreement on the boundary will be agreed, it applies to Rel-18 and not impact Rel-17.
  - » Discuss how to accommodate operators' needs efficiently if some proposals belonging to spectrum work in Rel-17 and before will be moved to non-spectrum items in Rel-18.

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Thanks!