

The Vivo logo is displayed in white text on a blue square background in the top left corner.

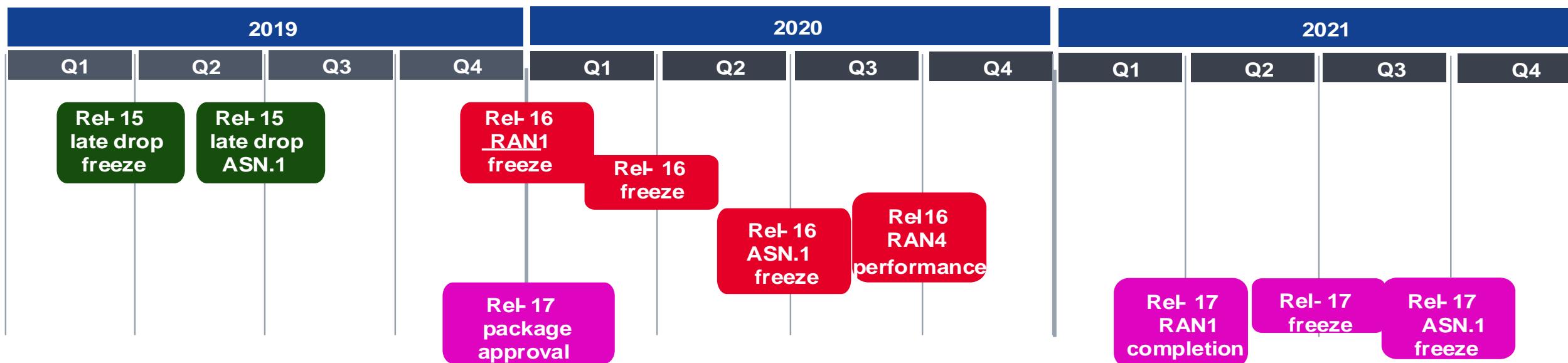
3GPP TSG RAN Meeting #84
Newport Beach, USA, June 3-6, 2019

RP-190833

The background of the slide is a photograph of a person standing on a vast, flat, white salt flat under a blue sky with scattered clouds. The person's reflection is visible on the wet surface of the salt flat.

vivo views on NR
Rel-17

- 15 months release as agreed in RAN#83
 - Package approval – 2019.12
 - RAN1 work starts from 2020Q1, RAN2/3 work starts from 2020Q2
 - RAN1 completion in 2021Q1, RAN2/3/4 completion in 2021Q2
 - Rel-17 ASN.1 freeze in 2021 Q3
- Prioritized areas in Rel-17
 - Enhancements to address commercial deployments demand
 - Enhanced support for vertical applications
 - New areas, e.g. spectrum, technologies.



- **New features**

Study on Multi-SIM devices (R2)

- Paging collision
- RRC CONNECTED for USIMA + IDLE/INACTIVE for USIMB
- UE entering RRC CONNECTED for USIMA while already RRC CONNECTED for USIMB
- Cell selection/re-selection enhancements
- Consider different UE architectures, consider both intra-MNO and inter-MNO scenarios
- Cross-RAT study including at least NR and LTE

Study on NR above 52.6GHz (R1)

- Scenarios with short range, high data rate, large bandwidth, low Tx power, low mobility
- Waveform selection consider RF impairments
- System design aspects considering SA/NSA operation, licensed and unlicensed spectrum, Uu and sidelink

Study on NR diverse UE types (R1)

- Identify use cases and design requirements, wearable devices, industrial IOT...
- Study techniques to reduce UE cost and complexity, e.g. reduced BW, antennas,
- Study other baseband complexity reduction,
- Study lower UE power class
- Further UE power saving

Study on new SL use cases (R1 or R2)

- Identify the requirements and necessary enhancements for new sidelink use cases, e.g.
 - Network Controlled Interactive Service,
 - UE relaying,
 - IOT over sidelink, e.g. home IOT

Small data Tx for IDLE/INACTIVE (R2)

- Latency, signaling reduction, Power saving

QoE (R2)

- Improved end-to-end user experiences for different services.

- **Enhancements from Rel-16**

V2X enh (R1)

- Enhanced sidelink support for FR2
- Sidelink efficiency impr., e.g. CSI, MIMO
- Support of pedestrian UEs,
- Sidelink ranging

Enh. unlicensed spectrum (R1)

- Support of 60GHz (after waveform study is concluded)
- Channel access enhancement (e.g. study on directional LBT and/or coordinated LBT)
- Wideband operation enhancement
- Enh. for IIOT operation over unlicensed spectrum

Coverage enh SI (R1)

- Identify coverage issue and potential enhancements

MIMO enh. (R1)

- Continuations from Rel-16,
 - multi-TRP, multi-beam
- UL MIMO enh
 - Spectral efficiency improvement, e.g. sub-band precoding, enh. to DL/UL channel reciprocity
 - Power efficiency improvement, PAPR reduction
- FDD MIMO enh., e.g. partial reciprocity

Further UE Power saving (R1 or R2)

- Idle/inactive power saving, e.g. Paging WUS
- Further RRM power saving, e.g. additional RS

Positioning enh (R1)

- Positioning for RRC_IDLE/INACTIVE states
- Enhanced positioning accuracy, e.g. for IIOT

- Background

- There are following use cases for dual-SIM phones

- One SIM card for private communication and another one for business purpose
 - One SIM card for local operator and another one for home operator while roaming
 - Different SIM card for different service
 - E.g. SIM A with “family circle” plan for voice service and SIM B with “mobile data” plan for data service

- Multi-SIM devices in practical network

- Almost all UE vendors have dual-SIM phone products
 - Apple, Huawei, Lenovo, LG, OPPO, Samsung, vivo, Xiaomi, ZTE
 - Dual-SIM phone supports either USIM+USIM or USIM+eSIM
 - 34% phones with SIMs from the same operator(intra-MNO) and others with SIMs from different operators(inter-MNO)
 - Statistics based on vivo active Dual-SIM phones in China, which has 3 operators

- Motivation of RAN SI on Multi-SIM UEs
 - Current issues on Multi-SIM UE
 - Paging collision
 - About 4% paging collision possibility between L+L and L+W based on typical configuration calculation (i.e., 1280ms paging cycle and 20ms paging reception),
 - 20% paging collision possibility for some special cases (i.e., full overlapping paging reception with paging re-transmission)
 - Service interruption by unexpected paging
 - Data loss due to paging reception from another system
 - Latency and power consumption for cell selection and reselection
 - Currently non-standardized solutions are used, however, it would cause
 - Non-guaranteed user experience
 - Network scheduling inefficiency due to unpredictable UE behavior
 - Study item for multi-SIM devices approved in SA2 (SP-181251)
 - Delivering paging to USIM A while the UE is actively communicating with USIM B
 - Suspension (or release) on an ongoing with USIM A to go the system with USIM B
 - Avoidance of paging collisions occurring in the UE between USIM A and USIM B
 - Handling of emergency calls and sessions
 - Strong interest is also shown for the multi-SIM study in RAN (RP-191303)

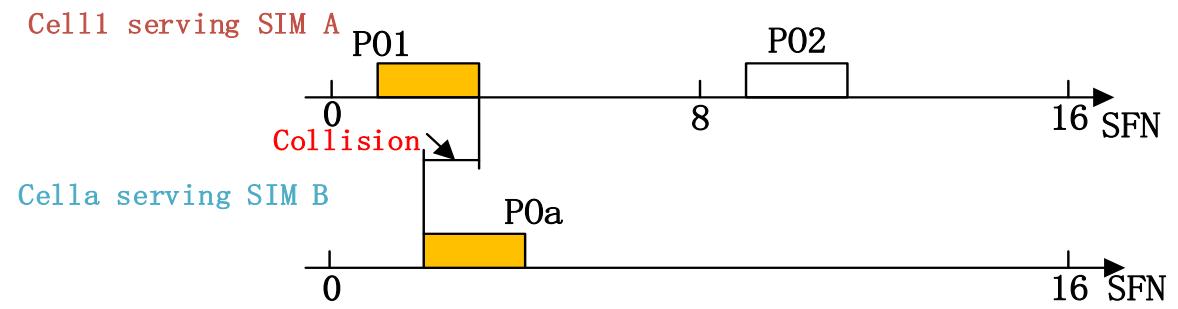
- Possible dual-SIM UE architectures includes single Rx/single Tx, dual Rx/single Tx and dual Rx/dual Tx.
 - Single Rx/Single Tx is the mainstream implementation in the market

	1Rx/1Tx	2Rx/ 1Tx	2Rx and 2Tx
Paging collision	Yes	No issue	No issue
Service Interruption	Yes	Yes (for RRC establishment and DC case)	Yes (for RRC establishment and DC case)
Both SIMs are in RRC connection state	Invalid scenario	Invalid scenario	Yes
Cell Selection/Reselection (intra-MNO case)	Yes	No issue	No issue

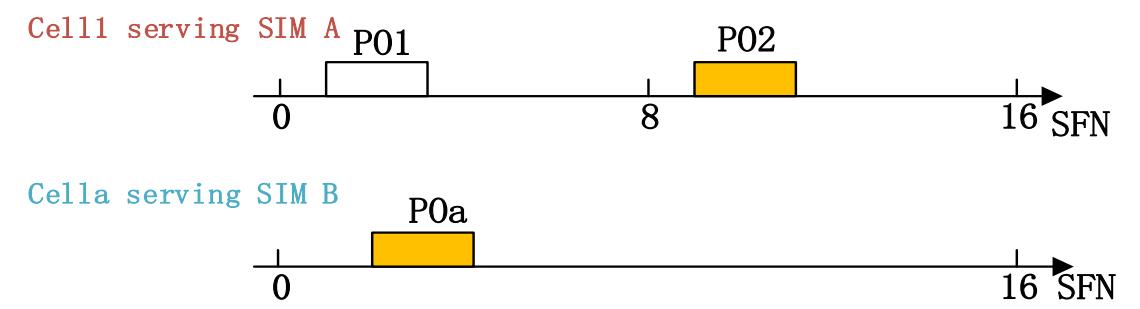
Note: “Yes” means there is issue in the scenario

• Paging collision issue

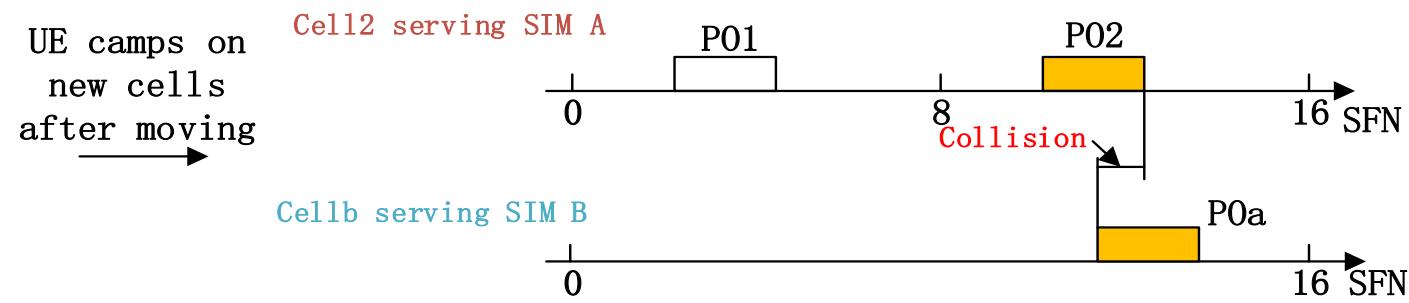
- Some Multi-SIM UEs cannot simultaneously decode multiple pagings, due to RF or baseband limitations.
- Paging collision occurs when the Paging Occasions (POs) for different SIMs are overlapping in time domain
- Paging Occasions (POs) are calculated based on the UE identifier (IMSI and 5G-S-TMSI for EPS and 5GS, respectively) and RAN configurations
 - 5G-S-TMSI allocation is controlled by CN
 - RAN configurations are transparent to CN
 - Paging collision cannot be totally solved by CN alone
- It is not possible for network to identify the presence of paging collision



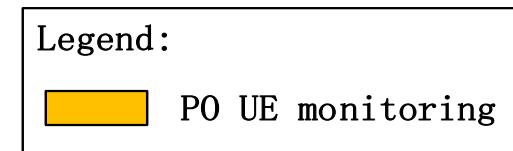
1. paging collision is detected and reported by UE



2. paging collision is eliminated after CN reallocated 5G-S-TMSI for SIM A

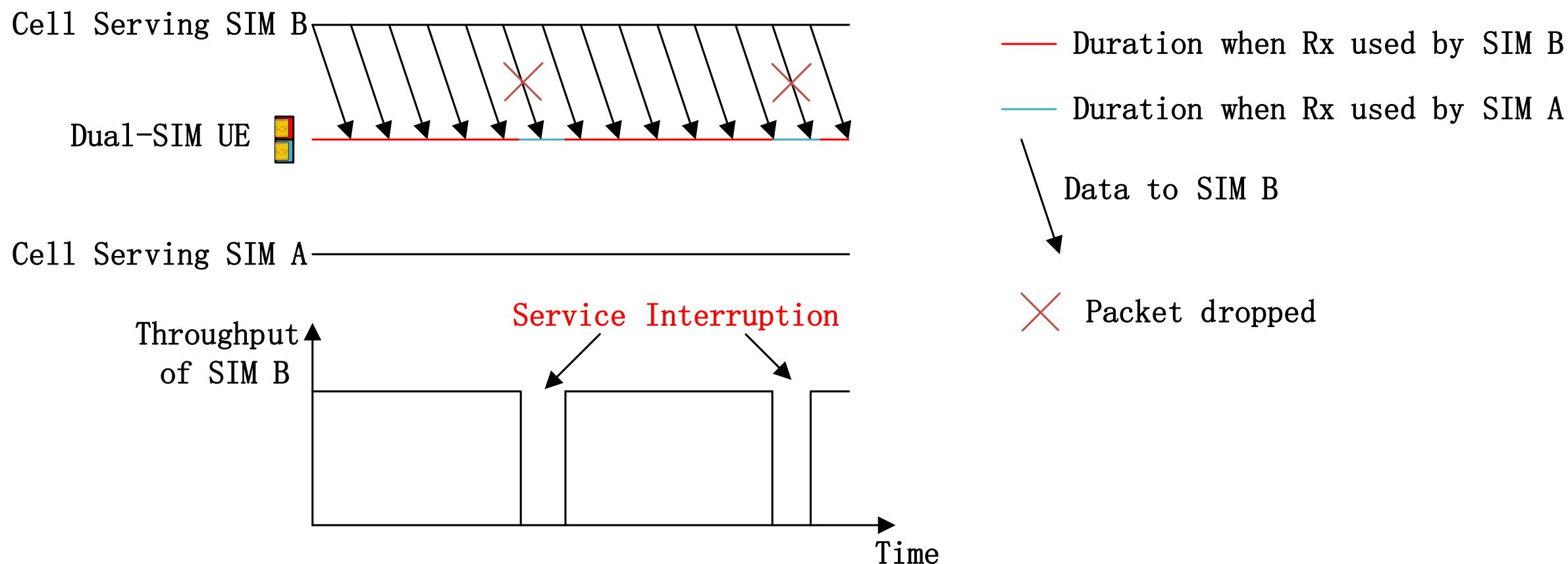


3. paging collision re-occurs since the new cells' RAN PO configurations are different from the previous ones'



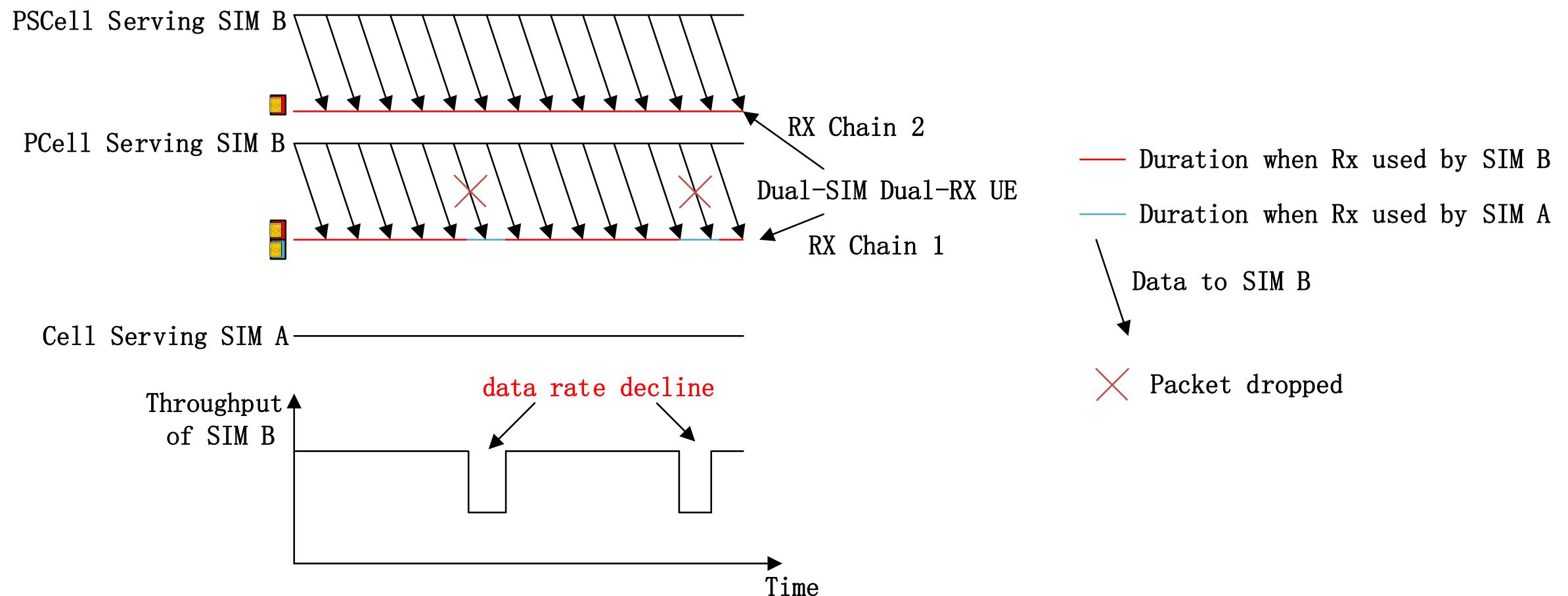
- **Service interruption issue**

- For cost efficiency reasons, common radio and baseband components shared among the multiple SIMs is widely used
- UE equipped with single Rx chain is not able to handle simultaneous reception on different two systems
- To monitor paging to SIM A while the UE is actively communicating with SIM B, UE autonomous gap may be used, which is not controlled by the network with SIM B, thus may cause unpredictable service interruption in the network with SIM B
 - During the gap, UE performs cell-search, sync, measurements for SIM A, the gap is expected to be longer due to longer SSB periodicity and misaligned SSB and paging occasion

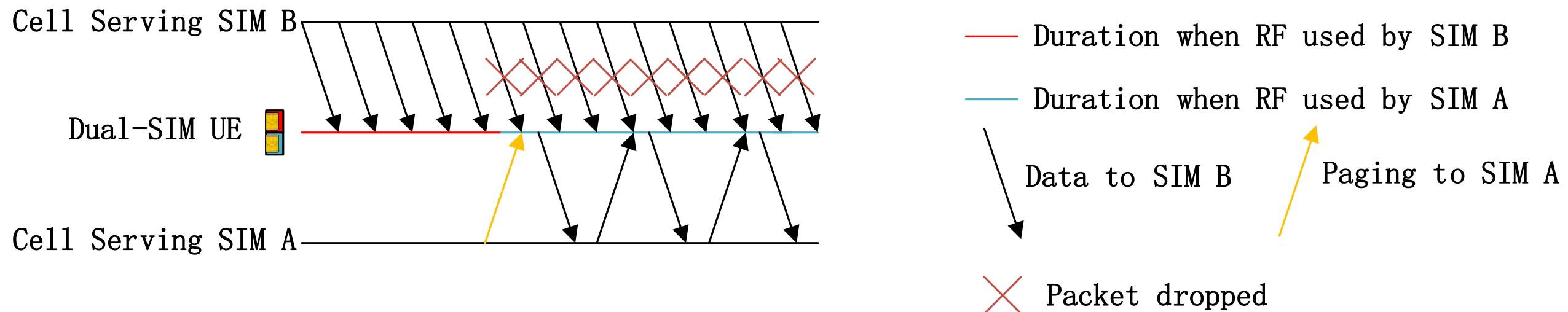


- Data rate dropping issue

- Even when UE is equipped with dual Rx chain, it is not able to handle simultaneous reception on the two systems when dual connectivity (e.g. ENDC) is enabled in one system
- To monitor paging to SIM A while the UE is actively communicating with SIM B with DC, UE autonomous gap may be used, which is not controlled by the network with SIM B thus may cause unpredictable service interruption in one cell group of the network with SIM B
 - During the gap, UE performs cell-search, sync, measurements for SIM A, the gap is expected to be longer due to longer SSB periodicity and misaligned SSB and paging occasion



- Continuous packet dropping due to unpredictable UE leaving
 - UE may suddenly stop reception in one system and switch to another system by RF retuning
 - Upon the reception of paging message to SIM A, UE may setup RRC Connection in cell serving SIM A, while the UE is actively communicating with SIM B
 - The unpredictable leaving of UE will cause continuous packet dropping and resource waste in the concerned network



- A Dual Rx/Tx capable Multi-SIM UE may support the following cases
 - UE has RRC connection in both systems, e.g. with one for voice and one for data; or
 - UE has RRC connection only in one system
- UE capability reporting considering the hardware limitation and the connection to the two systems
 - UE may not indicate DC capability when it is connecting to two systems
 - UE may indicate DC capability when it is connecting to only one system
 - Tx power sharing issue when UE is connecting with two systems

- Cell Selection/Reselection
 - The cell search, measurements are performed independently for each SIM, which may cause unnecessary higher delay and power consumption when two SIMs are belonging to a single MNO.
 - Enhanced cell-selection/reselection procedure should be studied

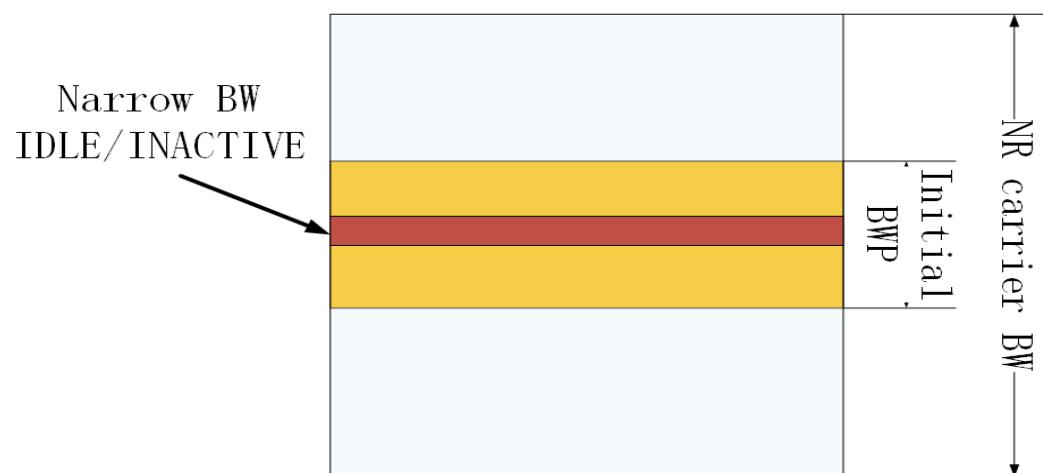
- Proposal for study item objectives
 - Part1: scenarios overlapping with SA2
 - Identify paging collision solutions, including both CN paging and RAN initiated paging cases
 - Identify issues and potential solutions for paging delivery to UE on SIM A while the UE is actively communicating with SIM B
 - Identify issues and potential solutions for UE entering in RRC Connected mode in one system from Idle/Inactive, while UE is already in RRC Connected state in another system
 - Part2: scenarios not covered by SA2
 - Identify issues and potential solutions when both SIM A and SIM B are in RRC connection state
 - Identify necessary cell selection/reselection enhancement for intra-MNO case

- Proposal to progress multi-SIM activity in RAN
 - RAN initiates the email discussion after June plenary on multi-SIM study in RAN with following objectives
 - Identify RAN impacts due to the scenarios/use cases covered by SA2 SID for multi-SIM devices.
 - Identify additional scenarios/use cases to be studied in RAN for multi-SIM devices.
 - Formulate the scenarios/use cases into those that require SA involvement and those that do not.
 - Discuss the potential RAN study objectives and coordination with SA.

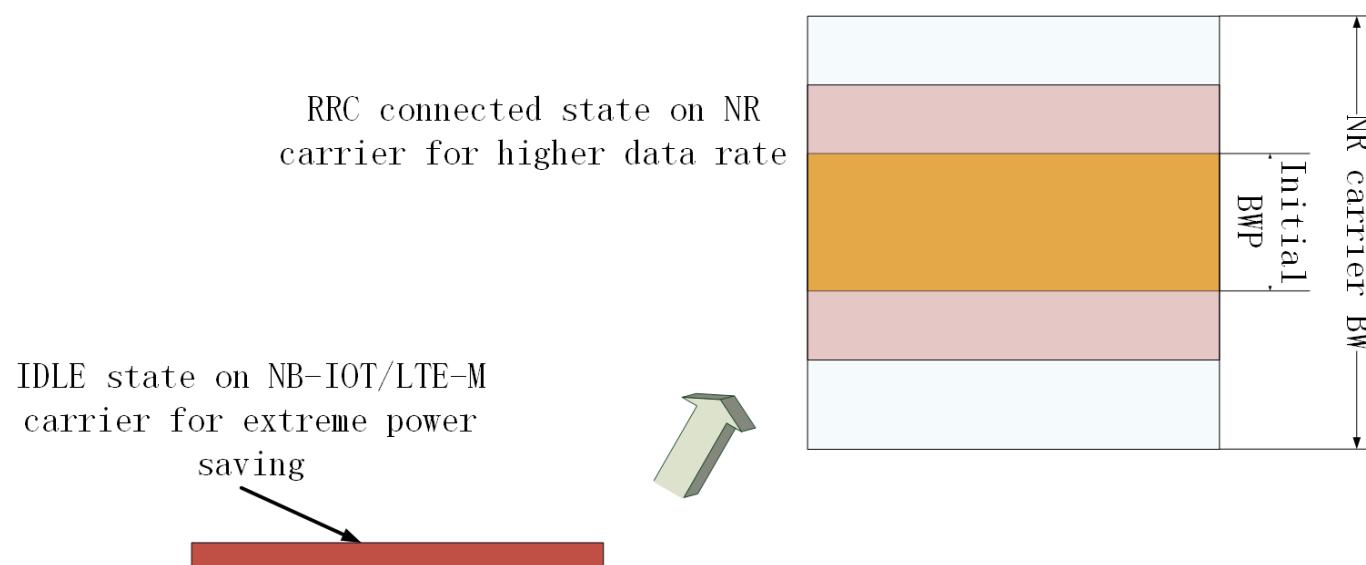
- Motivation of diverse UE types in NR
 - Rel-15/16 UE is designed for high data rate/low latency
 - Mandatory UE BW: 100MHz(FR1) and 200MHz(FR2) for DL/UL
 - Mandatory UE Rx: 4Rx for above 2.5GHz (FR1); 2Rx for below 2.5GHz
 - UE power class: 23dBm, 26dBm
 - Various use cases for diverse UE types
 - Low end eMBB, e.g. NR based wearable devices, cameras,
 - NR based MTC, e.g. industrial sensors
- Diverse UE types should target for
 - lower complexity and cost
 - lower power consumption
 - » E.g. for smart watch, one week battery life using <500mAh battery capacity

- Potential work areas for diverse UE types
 - Reduced UE bandwidth
 - Decoupling of UE DL and UL BW capability
 - Type 1 (preferred)
 - The UE minimum BW is not smaller than Rel-15 initial access BW e.g. 10MHz in 30KHz SCS
 - » Existing L1 channel/signal can be reused
 - Type 2
 - The UE minimum BW is smaller than Rel-15 initial access BW
 - » Requires redesign of L1 channel/signal
 - Less UE Rx antennas, e.g. 2Rx, 1Rx
 - New UE power class, e.g. 20dBm, 14dBm
 - Other baseband complexity reduction, e.g. PDCCH reduction
 - Target data rate depends on the use cases, e.g. up to 100Mbps for wearable devices

- Potential work areas for diverse UE types (cont)
 - Further UE power saving for longer device battery life, e.g.
 - Power saving for RRC IDLE/INACTIVE, e.g. paging indication, RRM enh.
 - Narrow band NR IDLE/INACTIVE
 - IDLE/INACTIVE mode operation over a narrow band smaller than Rel-15 initial access BW
 - » New design for initial access, paging, SI acquisition, mobility procedures...
 - Interworking between NB-IOT/LTE-M with NR
 - IDLE mode on NB-IOT/LTE-M carrier for extreme low standby power consumption
 - RRC connected state on NR carrier for higher data rates



Narrow band NR IDLE/INACTIVE



Interworking between NB-IOT/LTE-M with NR

- Proposed objectives for study on diverse UE types
 - Identify the various use cases and corresponding requirements for diverse UE types (RAN1)
 - Study techniques to reduce UE cost and complexity (RAN1/4/2)
 - Reduce UE bandwidth for both DL and UL
 - Reduce UE Rx antennas, including 2Rx and 1Rx
 - Other baseband complexity reduction techniques
 - Lower UE Tx power class
 - Study techniques to further improve UE energy efficiency (RAN1/2/4)
 - Further UE power saving techniques for RRC CONNECTED state (including leftovers from Rel-16, e.g. UE adaptation, RRM)
 - Power saving techniques for RRC IDLE/INACTIVE, including IDLE mode RRM, paging wakeup
 - Study the UE switching between NB-IOT/eMTC (for IDLE mode) and NR (for RRC CONNECTED mode)

- Continuation of Rel-16 items
 - Multi-TRP:
 - CSI reporting enhancement
 - Enhancement for FR2 including URLLC and eMBB
 - UL enhancement including simultaneous transmission for FR1 and FR2
 - Support of more than 2 TRPs coordination/transmission
 - Multi-beam:
 - Enhancement for supporting multi-panel UE
 - Enhancement on multi-beam considering future support of above 52.6GHz
- UL MIMO enhancement
 - Spectral efficiency improvement
 - Enhancement to DL/UL channel reciprocity
 - Sub-band precoding
 - Power efficiency enhancement, PAPR reduction
- Study enhancement for FDD below 3GHz
 - Including partial channel reciprocity

- **Justification**

- Inactive state introduced in Rel-15
- CP solution introduced for NB-IOT/MTC
- 2-Step RACH specified in Rel-16
- Power saving for variable use cases, including eMBB, wearables, IOT, etc
- Latency reduction, signaling reduction
- Enabling feature, e.g. for positioning in RRC IDLE/INACTIVE

- **Proposed objectives**

- Support both inactive state and idle state
- Support both four step RACH and two step RACH
- Support both UL transmission and DL reception



Thanks