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Views on 3GPP RAN Rel-17

Apple Inc.

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Apple Views on Rel-17

- Enhancement for Multi-SIM Devices
- NR-Lite/Wearables
- MIMO Enhancement
- V2X Enhancement
- Mobility Enhancement
- NR Above 52.6 GHz

Enhancement for Multi-SIM Devices | Motivation

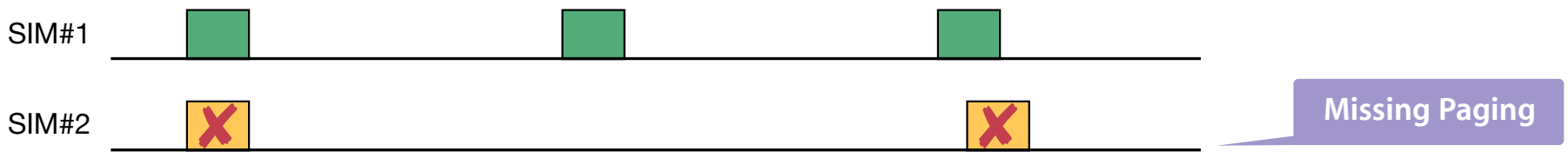
- Huge number of Multi-SIM phones are in the market, especially for the DSDS devices
  - DSDS
    - Devices are registered in two networks simultaneously but just a single radio front-end and base band chain
    - It is assumed that the UE will be in RRC_Connected mode to only one network at a time

- Problems
  - Page misses due to the paging collisions or the collision of paging with CMAS/ETWS reception. CMAS message collisions on two SIMs causing CMAS misses
  - Service interruption in SIM#1 due to paging/SIB reception for SIM#2
  - RRC state mismatch due to switching the connection between SIM#1 and SIM#2
  - Extra power consumption due to the idle/connected mode measurement/mobility

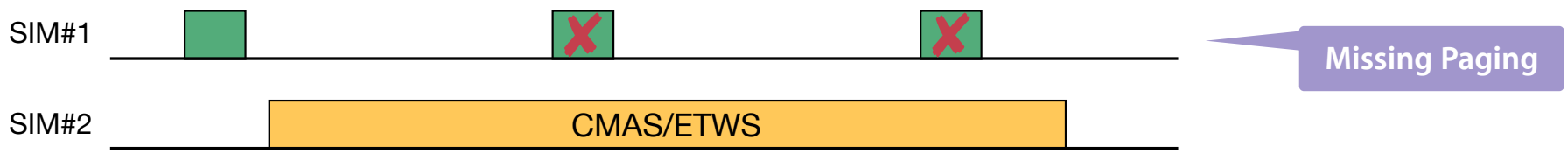
- No standardized solution currently in place
  - No network coordination
  - Up to UE implementation

Enhancement for Multi-SIM Devices | Example Problems

- 1) Paging Collision



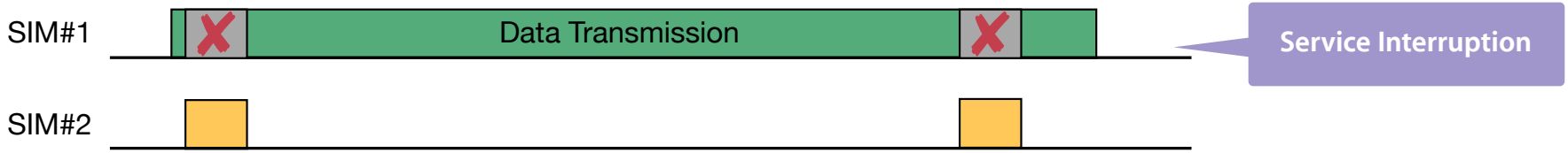
- 1a) Collision between aging and CMAS/ETWS



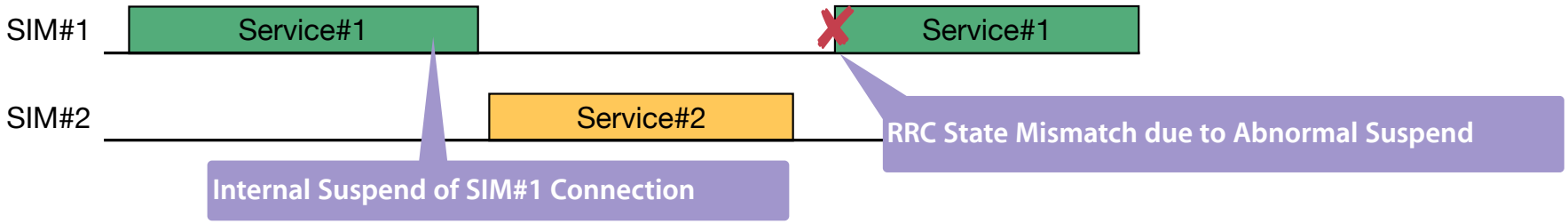
- 1b) CMAS Collision

Enhancement for Multi-SIM Devices | Example Problems

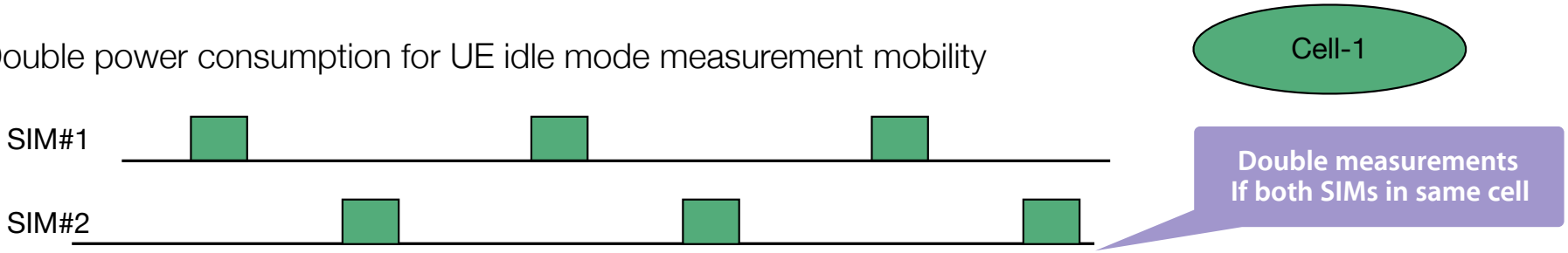
- 2) Service interruption in SIM#1 due to paging/SIB reception for SIM#2



- 3) Abnormal RRC Connection drop of SIM#1 due to the trigger of connection of SIM#2.



- 4) Double power consumption for UE idle mode measurement mobility



NR-Lite | Motivations and Requirements

- Motivation: existing NR specs mainly focus on eMBB devices
  - NR UE mandated to support a BW of 100MHz and 200MHz for FR1 and FR2, respectively
  - NR UE mandated to support 4 RxAnt for NR bands above 2.5GHz and 2 RxAnt for the rest
    - n7, n38, n41, n77, n78, n79
  - Targeting device types: Wearable Devices, Sensor/Camera, Smart Home/Office/City, Metering, etc.

- Key design considerations:
  - **Smaller battery**: size limit
  - **Shorter coverage**: antenna gain loss

- Design trade-offs:
  - Reduced BW, lower data rate
  - Fewer antennas
  - Lower complexity

NR-Lite | Design Requirements & Enhancements

Tx/Rx Antenna	▪ Low band/High band (>2GHz): 1Rx/2Rx; 1 Tx ▪ Coverage loss compared to Phone: ~10dB
Target spectrum	▪ FR1 only;
Power class	▪ 23dBm (smart watch, low-end phone); Reuse existing PA for cellular link
Target BW and data	▪ Cat-1: 10Mbps/5Mbps (DL/UL) equivalent or higher
Coverage ext target	▪ Similar as CE mode A (16x, 32x)
Extended Idle DRX	▪ Allow extended DRX cycle length in IDLE mode and modification of IDLE DRX cycle length

- **Relay link**: over NR sidelink
  - Reuse existing 23dBm PA for cellular link, and achieve larger coverage
  - Leveraging NR sidelink design for unicast, including power control and CSI feedback
    - Expect to be more simplified than a “general” D2D design (i.e. only require subset of D2D functionalities)
  - Security and required QoS support provided by the Relay
  - One hop between device and relay over cellular link

- **Direct link**: Uu interface
  - Coverage extension
  - Power optimization

MIMO Enhancement | Beam Management Enhancement

- Further enhancement on Beam Management: overhead and latency reduction
  - Existing beam management based on period/semi-persistent UE reporting or NW triggered A-Periodic measurement
    - Suboptimal tradeoff between overhead and latency due to insufficient adaptation to the unpredictable radio condition, especially at NW side
  - Existing beam management does not fully utilize the advanced information UE can obtain, such as sensor etc.
    - Beam management is mainly controlled by NW without enough standard support for UE to provide assistance
  - Uplink beam reliability (e.g. beam correspondence, high frequency local motion) may be further improved.

- Enhancement for MPE (Maximum Permissible Emission) Issue, if not fully resolved in R16
  - Further discussion to decide on whether to support any enhancement in next RAN1#98 meeting
  - Even enhancement is supported, it only covers beam measurement and reporting part

Mobility Enhancement | L3-based Mobility in CONNECTED State

- Rel-16 Connected State Mobility Limitation
  - Conditional Handover is introduced to improve the handover robustness.
  - Simultaneous Rx in both source and target cells during handover is introduced to reduce the interruption time.
  - Potential unified solution for LTE and NR mobility enhancement limits the applicability on FR2.
  - In case FR2 specific enhancement not fully completed in Rel-16, it should be continued in Rel-17.

- FR2 challenges: higher number of handover, RLF and signaling overhead
  - High cell density
  - Fast radio quality change
  - Long measurement latency

- Key Technical Areas
  - FR2 specific mobility enhancement to address the fast handover and RLF
  - Handover optimization for the UE mobility amongst a cell set

NR Above 52.6 GHz

- Use case and deployment scenario (centralized, D2D, high resolution positioning)
- Waveform
- Application to unlicensed spectrum:
  - Channel access mechanism and coexistence
- Reusability and improvement of FR2 beam-forming framework

Rel-17 V2X Enhancement | Key Areas

- VRU (Vulnerable Road User) Support
  - Power saving mechanism
  - Enhanced positioning scheme

- Inter-operator / inter-carrier support over SL
  - Multiple carrier configuration for

- V2X over Uu interface

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