3GPP TSG RAN Rel-18 workshop
Electronic Meeting, June 28- July 2, 2021

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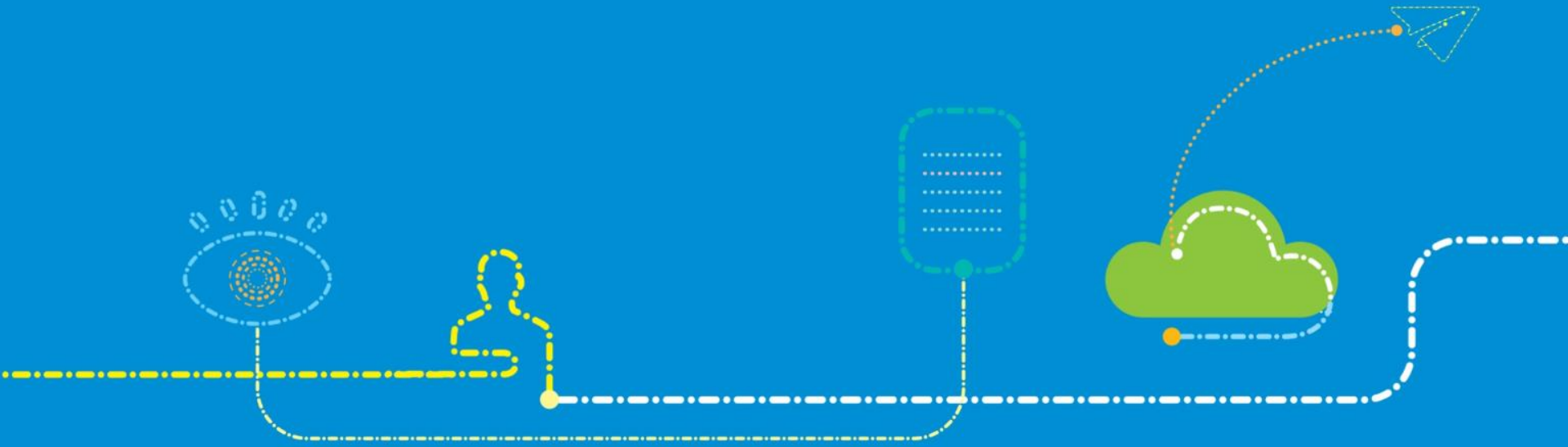
Agenda: 4.3

Further enhancement for IDLE/INACTIVE



IDLE/INACTIVE enhancement for NR

- **Load balance and UE distribution**
- **Enhancement for Paging and MT access**
- **Enhancement for SDT**

Load balance and UE distribution - Motivation

- A strong correlation exists between the idle/inactive mode UE density and the active UE traffic load
  - Redirecting the UEs upon Resume/Connection setup results in latency as well as unnecessary signaling overhead and may not be suitable for some time critical applications
  - Idle/Inactive mode UE distribution is an essential element for traffic load balancing
- In LTE, the “Multicarrier Load Distribution of UEs” feature enables the UE distribution in IDLE mode,
  - *RedistributionFactor based mechanism* has been adopted to redistribute RRC Idle UEs amongst LTE carriers
  - This minimizes the need for load triggered HO or redirection of UE during connected mode

- A mechanism similar to the multicarrier load distribution of UEs in LTE is missing in NR
- With increased penetration of 5G capable UEs, IDLE/INACTIVE mode UE distribution becomes critical to ensure low signalling overhead and low latency for state transitions

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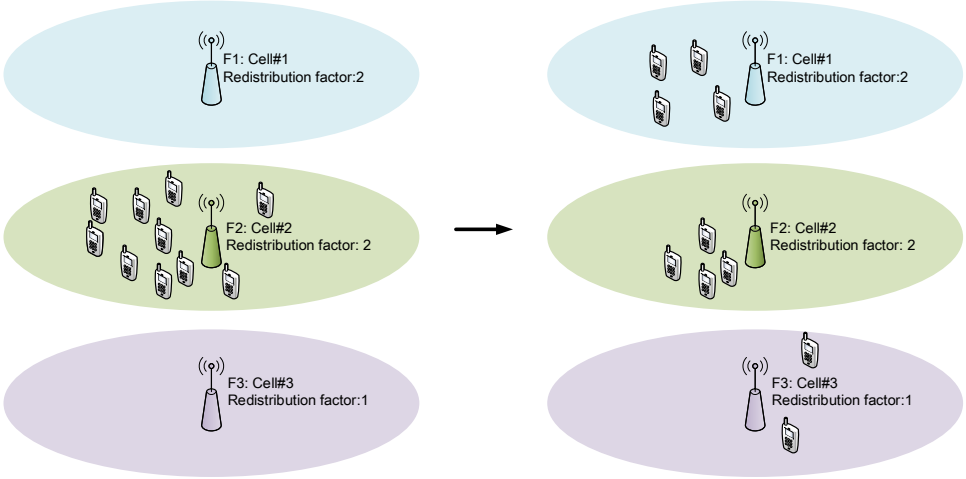
Load balance and UE distribution - Solutions in LTE

- The redistribution factor based mechanism has been adopted in LTE to distribute UE among cells/frequencies
    - Each candidate redistribution target (cell/frequency) configured with redistribution factor
    - UE chooses redistribution target based on UE ID



- **Redistribution among cells/frequencies**

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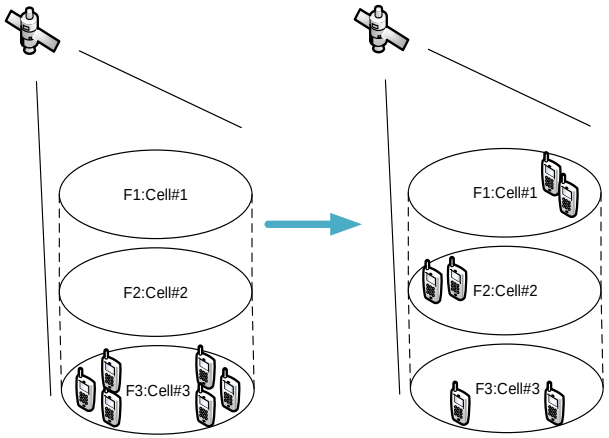
Load balance and UE distribution - New challenges in NR

- Overlapped cells on different frequency will be widely used even more than in LTE.
  - For the wideband carrier, multiple overlapped cells may be configured on different frequency of the wideband carrier (e.g. Multiple-SSB as descibed in the annex B.2 of 38.300).
  - For NTN, in order to improve the UE density supported in NTN network, multiple overlapped cells may be configured in frequency domain.
  - To provide better support to verticals, multiple overlapped cells may be configured for different verticals.



- **Supporting more users**

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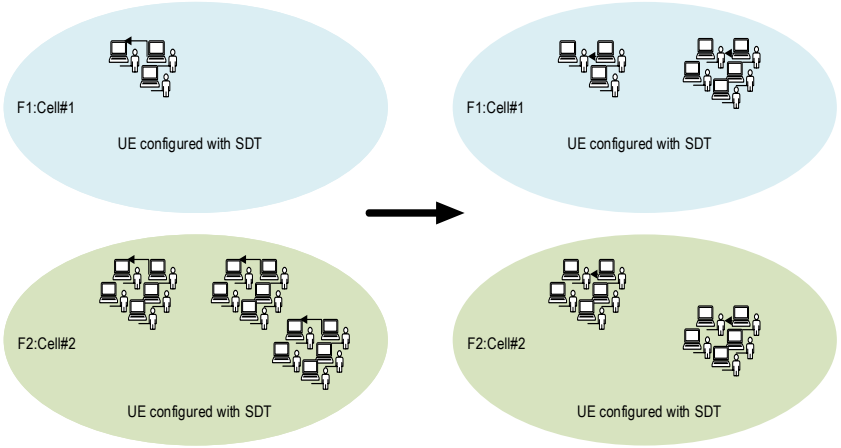
Load balance and UE distribution - New challenges in NR

- New features in NR bring new requirements on the load control and UE distribution
  - Imbalance of load between different SSB: One cell/frequency may be set to low priority even in case there is only one SSB overloaded, while other SSB are still empty
  - Finer granularity for load control and UE distribution: Different NW slice and different UE type (Redcap or normal UE) may require different priority and UE distribution policy
  - Load distribution to support SDT: Data transmission in INACTIVE state is enabled by SDT, thus the traffic load in INACTIVE needs to be managed



- **Load balancing among cells/frequencies**

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Potential solutions in NR

- To enhance the UE distribution in IDLE/INACTIVE, the following two solutions can be studied：
  - Enhanced cell reselection with redistribution factor (similar as LTE), with which the UE can be distributed to different cells by cell reselection.
  - Inter-cell fast initial access (i.e. fast initial access from camped cells to other cells)

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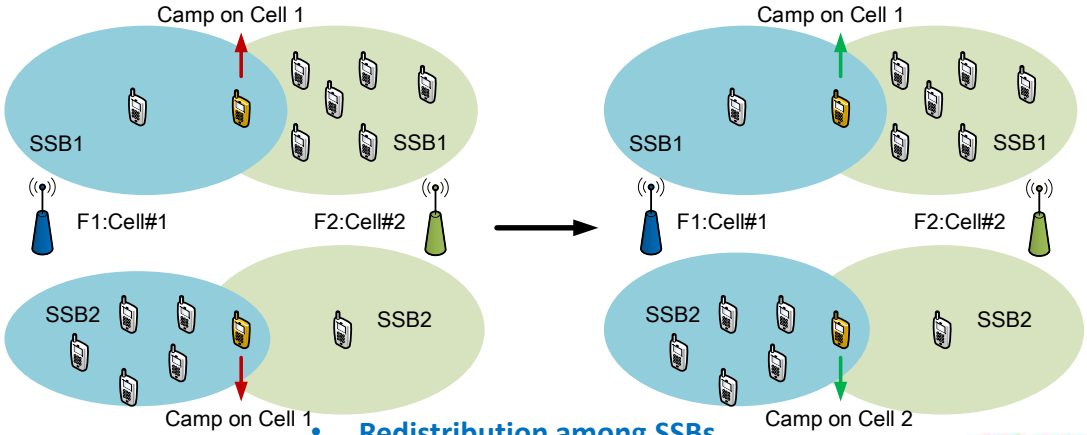
Enhanced cell reselection with redistribution factor

- The cell quality is derived based on the beam measurement quantity of good beams, UE will camp on the cell with good beams.
- Weight factor for each SSB can be considered to impact the cell level measurement results and then the UE behavior in cell (re)selection for load balancing among SSBs.
- For example, smaller factor can be configured for the overloaded beams and if such beam is measured to be among the good beams for a UE, the cell level measurement results will be reduced with the weight factor and this cell becomes less attractive to UE.



- **Redistribution among SSBs**

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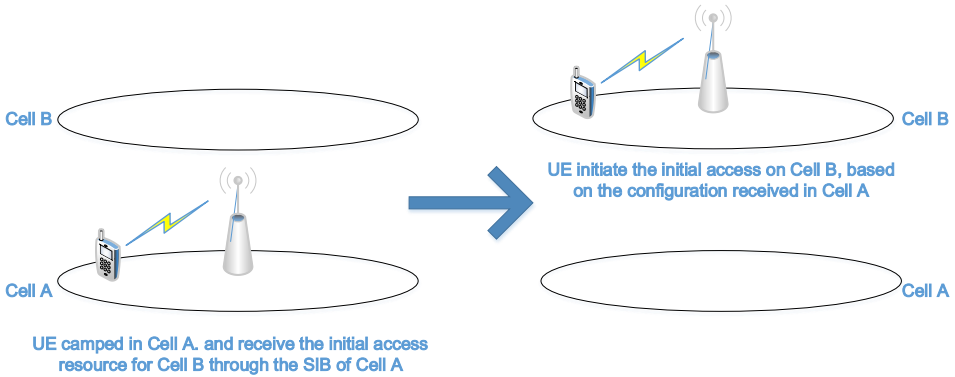
Inter-cell fast initial access

- Inter-cell fast initial access
  - One of the main targets of IDLE/INACTIVE UE distribution is to avoid the load triggered HO or redirection of UE during connected mode
  - Enabling fast initial access from camped cells to other cells achieves the above target
  - The UE will acquire the initial access configuration for other cells through the SIB of camped cell, and can switch to the target cell and initiate the access procedure immediately
  - This enables:
    - *Phantom cells without SIB* to avoid network power consumption for SIB transmission
    - Fast access from the camped cell to another cell supporting the intended service without HO/redirection/reselection
    - Both the inter-cell fast access and fast access to multiple initial BWPs (e.g. different initial BWP for different verticals)



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IDLE/INACTIVE enhancement for NR

- **Load balance and UE distribution**
- **Enhancement for Paging and MT access**
- **Enhancement for SDT**

Enhancement for Paging and MT access - Motivation

- Initial access for MT traffic cannot be differentiated between high-priority and low-priority services or UE types as the same UAC access category for MT access applies
- For MT access, UE awareness of the slice or the service type would be needed to support the use of different RACH resource for different NW slice

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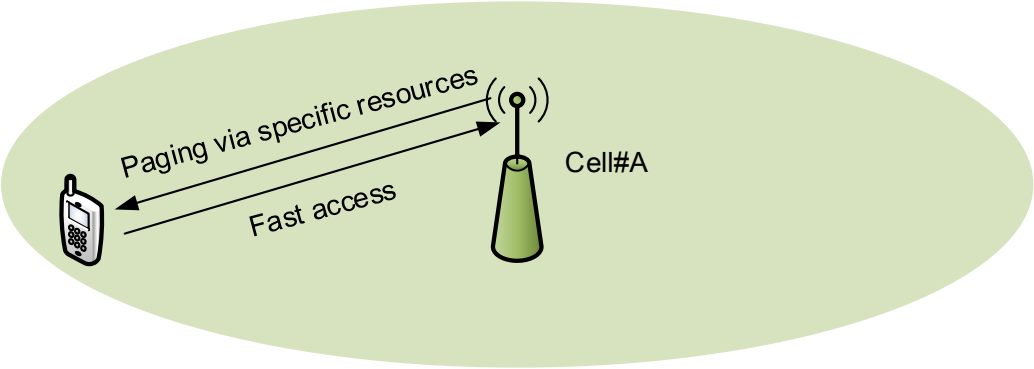
Differentiated Paging and MT access

- Specific paging resources for slice/service type/UE type
- Indicate the slice/service type in paging record



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IDLE/INACTIVE enhancement for NR

- Load balance and UE distribution
- Enhancement for Paging and MT access
- Enhancement for SDT

Enhancement for SDT

- Motivation
  - In Rel-17 small data WI, small data transmission from RRC_INACITVE state will be specified with RACH based or configured grant based procedure for MO traffic
  - IDLE mode support and support for MT traffic is not part of the Rel-17 work
- Enhancement
  - SDT from IDLE state
  - SDT for MT traffic
  - SDT with compact signaling on NW side (e.g. save the context fetch by using default RLC configuration)
  - Left over issues from Rel-17, if any

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Objectives for further enhancement in IDLE/INACTIVE

- Load balance and UE distribution
  - Enhanced cell reselection with redistribution factor
  - Inter-cell fast initial access (i.e. fast initial access from camped cell to other cells).
- Enhancement for Paging and MT access
  - Specific paging resources for slice/service type/UE type
  - Indicate the slice/service type in paging
- Enhancement for Small data transmission
  - Small data transmission through RACH or pre-allocated resources from idle state directly
  - Extend small data transmission schemes to support also the MT traffic.
  - SDT with compact signaling on NW side

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Thanks

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