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Where to improve Rel-12 and beyond: Promising technologies

NEC Corporation

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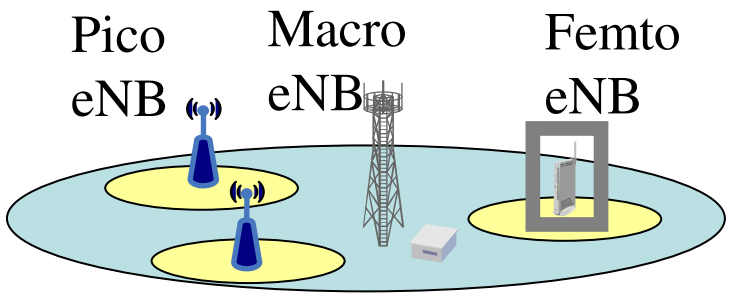
Introduction (1/2)

- The main targets for Rel-10 and Rel-11 were as follows:
  - High spectral efficiency
  - Reduction of CAPEX and OPEX
  - Energy saving
  - Effective control of mixed traffic

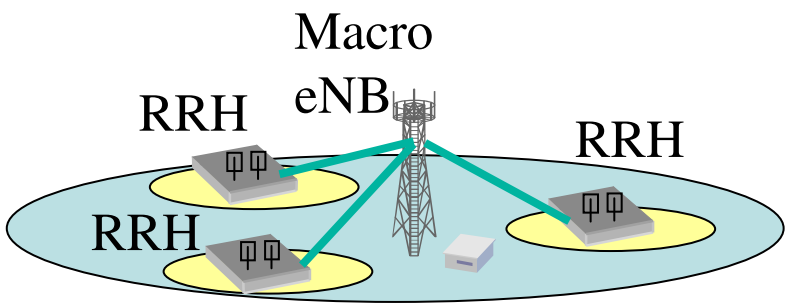
- In addition, heterogeneous deployment was focused on as one of the network deployment scenarios to realize high capacity while meeting the above requirements

- In order to enhance inter-cell coordination, the baseband centralized deployment was also considered especially as one of the important use cases for CoMP

Distributed heterogeneous deployment



Centralized heterogeneous deployment



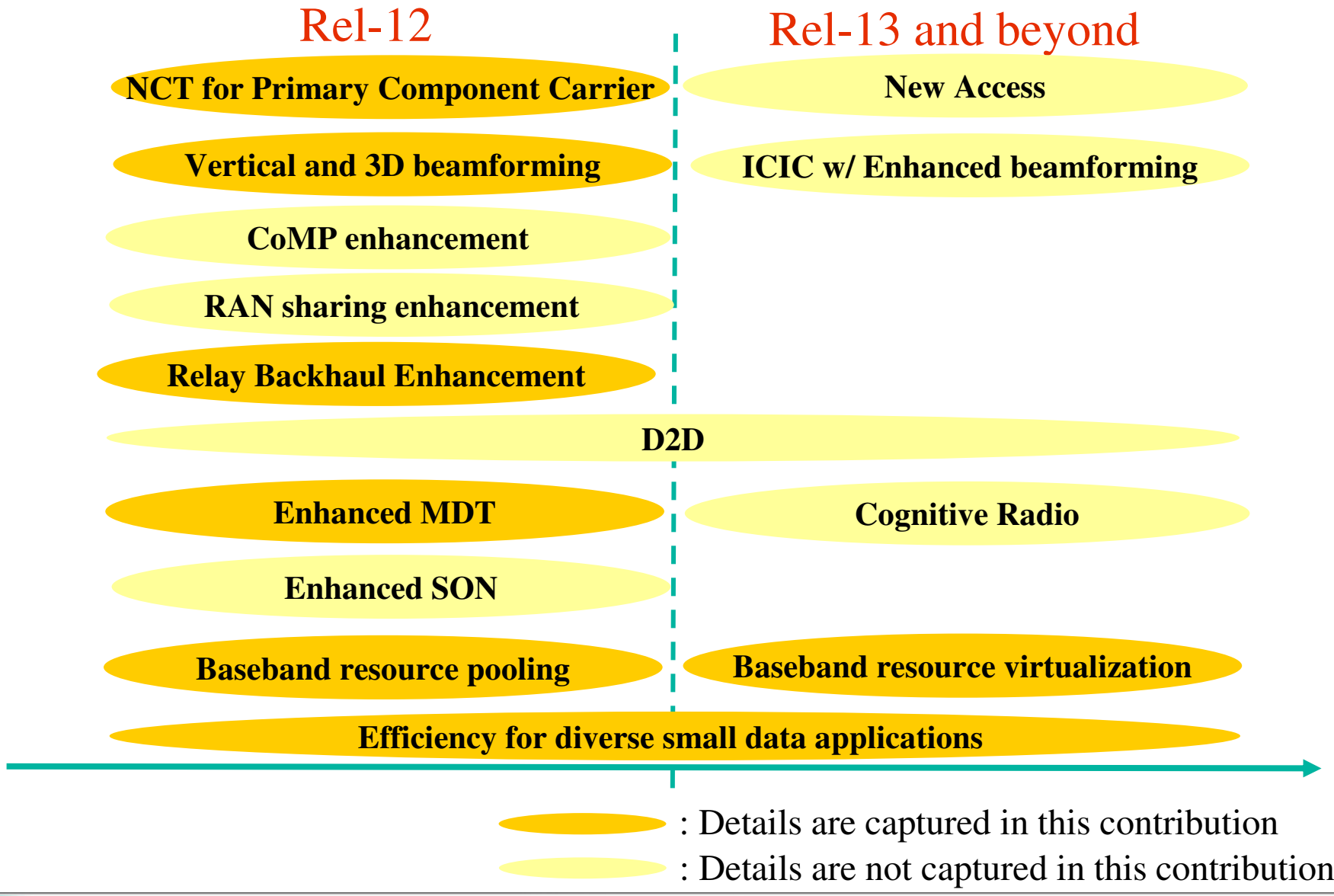
Introduction (2/2)

- It is expected the Mobile Broadband (MBB) traffic will continuously & significantly increase. That will demand higher data rates, maintenance or improvement of the throughput experienced by the user, flexibility and an easy and cost-efficient operation

- Therefore Rel-10 and 11 main requirements remain valid for Rel-12 and beyond and require renewed efforts at least for distributed and centralized heterogeneous deployment scenarios

- NEC has identified the following relevant candidate technologies to achieve these goals
  - New Carrier Type for Primary Component Carrier
  - Vertical and 3D beamforming
  - Relay Backhaul Enhancement
  - Enhanced MDT
  - Baseband resource pooling and virtualization
  - Efficiency for diverse small data applications

Technology Roadmap



New Carrier Type for Primary Component Carrier (1/2)

- In Rel-11, new carrier type is under specification to be applied as secondary CC (Component Carrier)
- By reducing Cell-specific reference signal (CRS), new carrier type can achieve
  - Reduced interference to other cells
  - Energy saving
  - Low overhead of reference signal

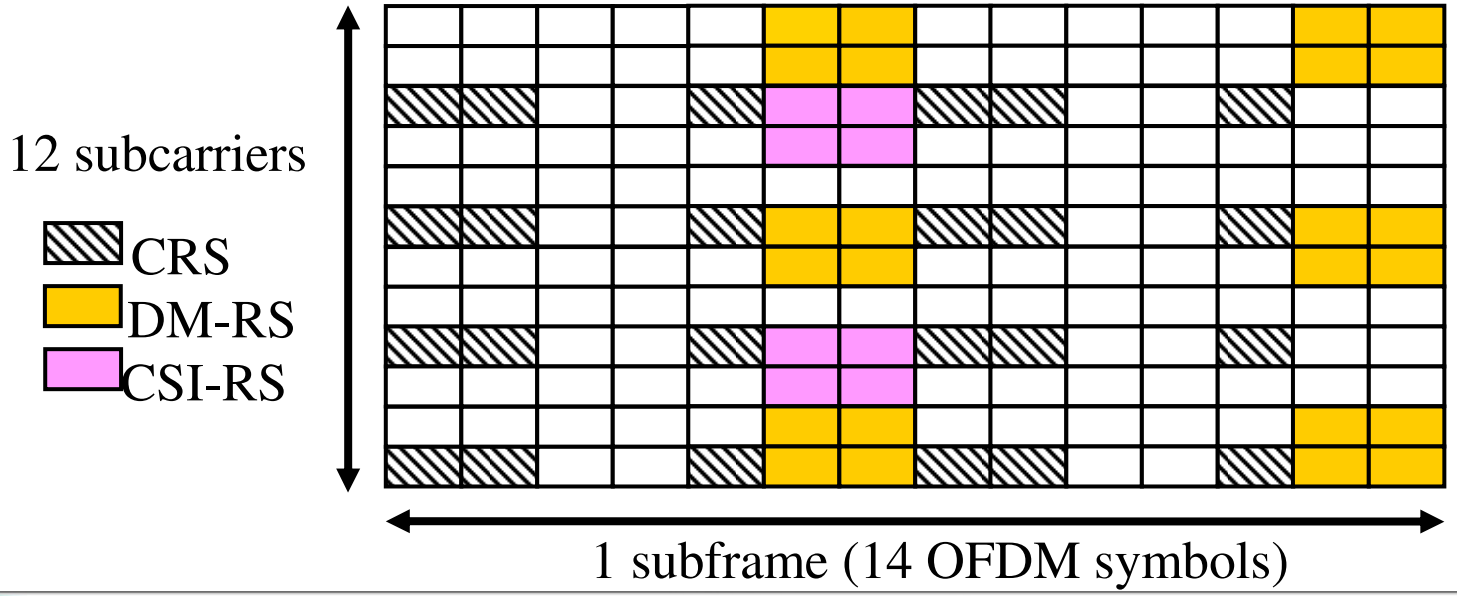
In Rel-12 and 13, new carrier type without CRS or with reduced CRS should be considered to be applied also as Primary CC

- For more effective use
- To be future-proof when moving from CRS based transmission to UE-specific RS based transmission

New Carrier Type for Primary Component Carrier(2/2)

- By eliminating or reducing CRS, significant effect can be achieved on interference reduction, energy saving and overhead reduction
  - How to eliminate or reduce CRS without UE performance degradation should be investigated carefully
  - In addition, reducing other signals may be a promising way forward ex. Reduced control channel or compact signaling operation

An example of RS mapping with in one RB (8 TX) Rel-11

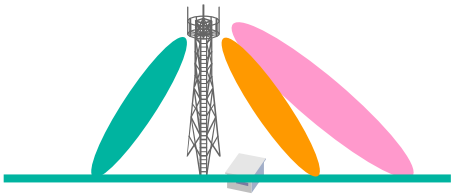


Vertical and 3D beamforming (1/2)

- In Rel-10 and 11, eICIC and CoMP have been specified to mitigate inter-cell interference
- However, it is difficult to mitigate inter-eNB interference dynamically without any restriction in eNB scheduling

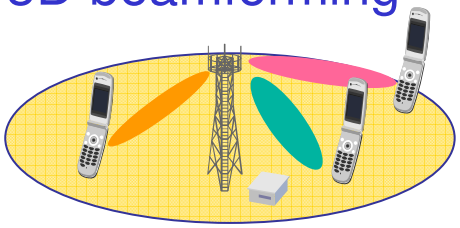
Vertical and 3D beamforming techniques can mitigate inter-cell interference more effectively even without inter-eNB coordination

Vertical beamforming



- Reduced interference to adjacent cell
- Inter-UE orthogonality in vertical direction

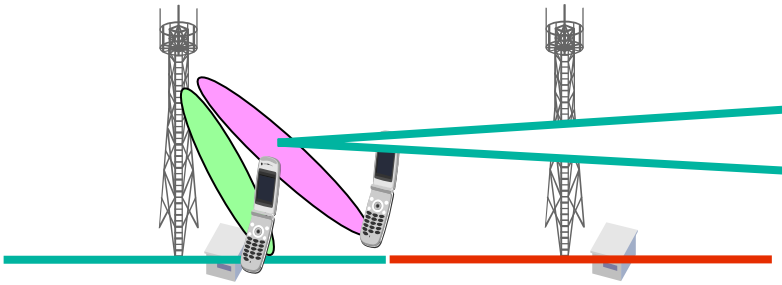
3D beamforming



- Further reduced interference to adjacent cell
- Inter-UE orthogonality in horizontal and vertical direction

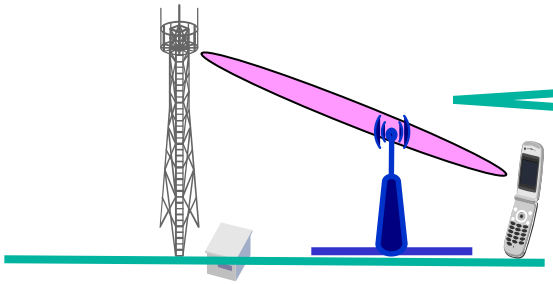
Vertical and 3D beamforming (2/2)

Homogeneous deployment



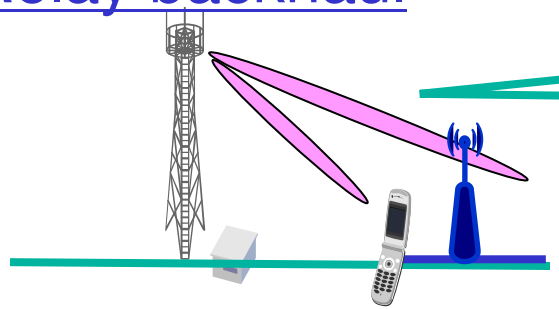
Reduced Interference to neighbor cell

Heterogenous deployment



Reduced Interference from Macro to pico/femto

Relay backhaul



Reduced Interference between Relay backhaul and Macro access

Relay backhaul enhancement (1/2)

- In Rel-10 and 11, high capacity and load balancing between DeNBs have not been considered for Relay backhaul
- However, since data traffic volume has been increasing, not only Macro/Small cell, but also Relay cell is required to increase capacity on both Un and Uu

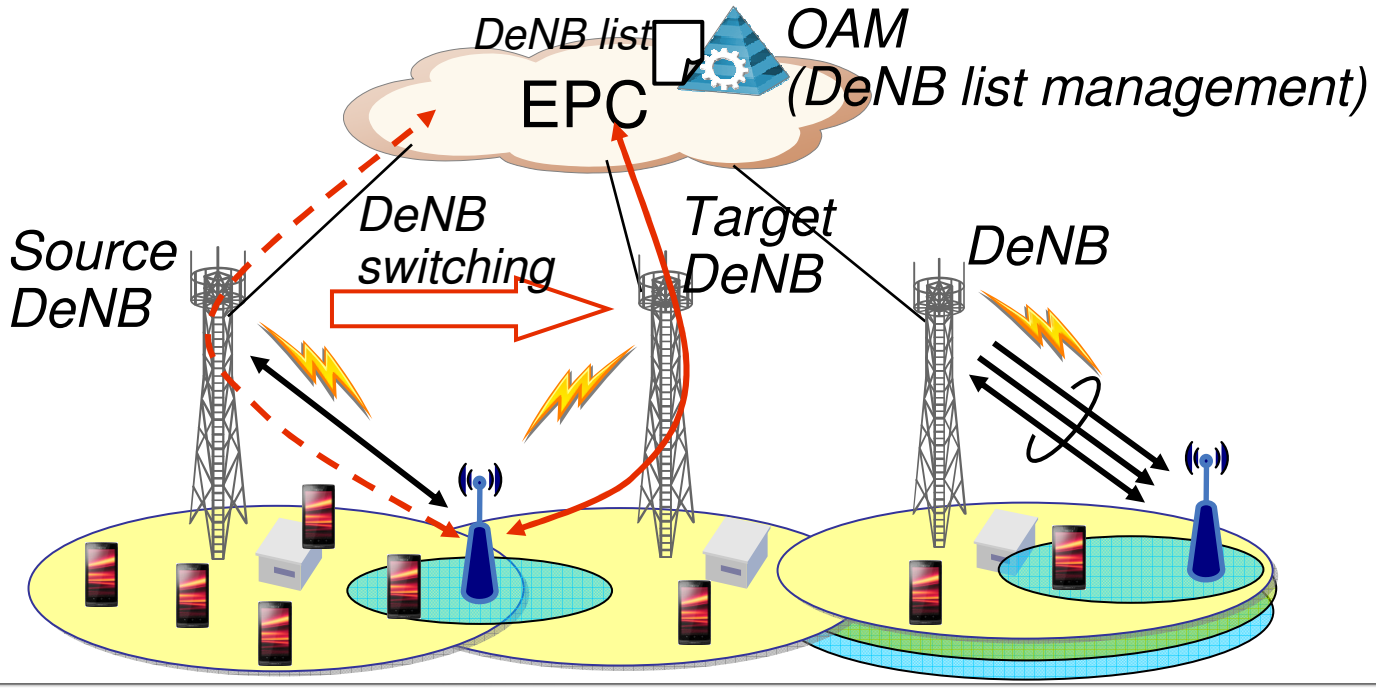
In Rel-12 and beyond, flexible Relay backhaul configuration should be considered.

The flexible Relay backhaul can achieve

- Increase of Relay backhaul capacity
- Load balancing between DeNBs

Relay backhaul enhancement (2/2)

- Possible enhancements for Relay backhaul are assumed as following
  - Carrier aggregation support for Relay backhaul
  - Enhancement for efficient resource allocation on Un by considering Uu resource allocation (e.g. DeNB switching)



Enhanced MDT (1/2)

- MDT has been enhanced by introducing QoS measurements and forced obtainment of location information in Rel-11.
- In order to complete standardization of MDT for maximizing the gain of MDT, i.e. further reducing operators' OPEX, remaining issues need to be investigated.

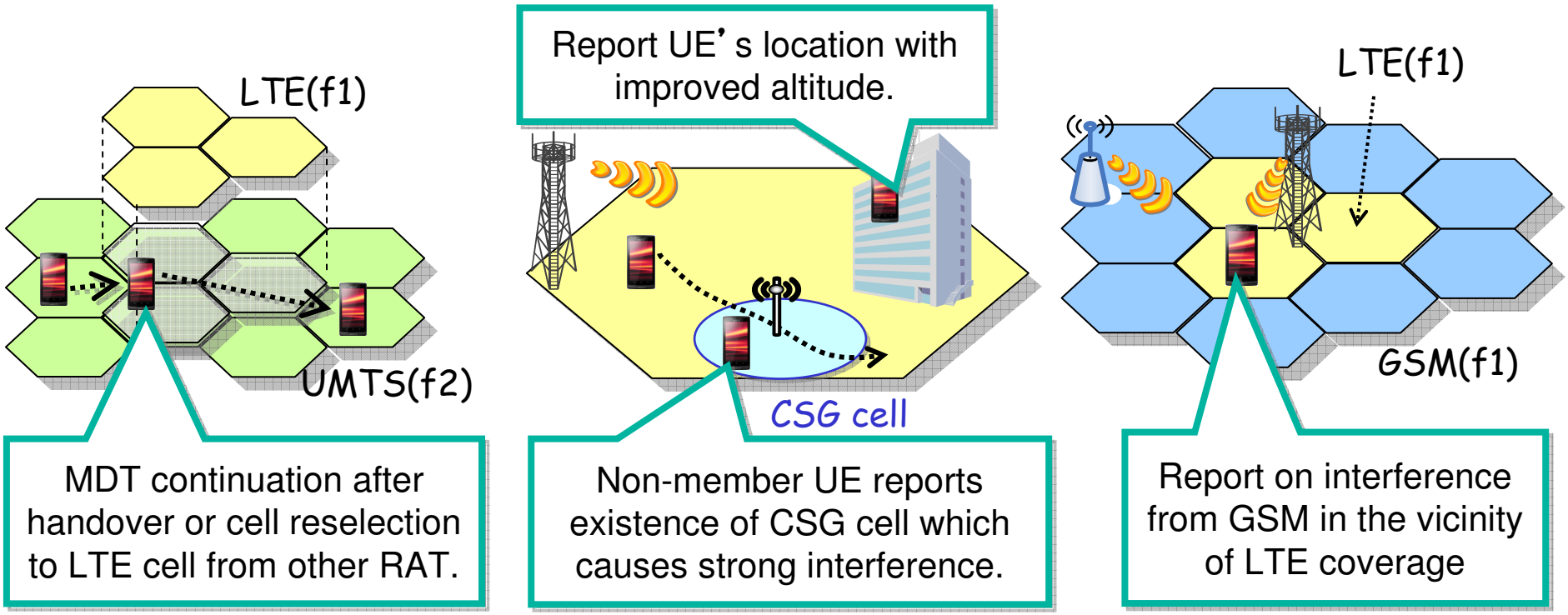
In Rel-12, the MDT should be enhanced so as to collect sufficient information for knowing e.g. following aspects:

- User perceived QoS at boundary of LTE and UMTS cell
- Coverage problems caused by CSG cells
- Altitude information when UE locates indoor
- Inter RAT interference on the same frequency

By utilizing enhanced MDT, OPEX could be further reduced.

Enhanced MDT (2/2)

- Potential enhancements are:
  - Smart MDT continuation at RAT boundary
  - Introduction of CSG cell related measurement
  - Inclusion of indoor location information with improved altitude information
  - Intra Frequency Inter RAT measurements



Baseband resource pooling and virtualization (1/2)

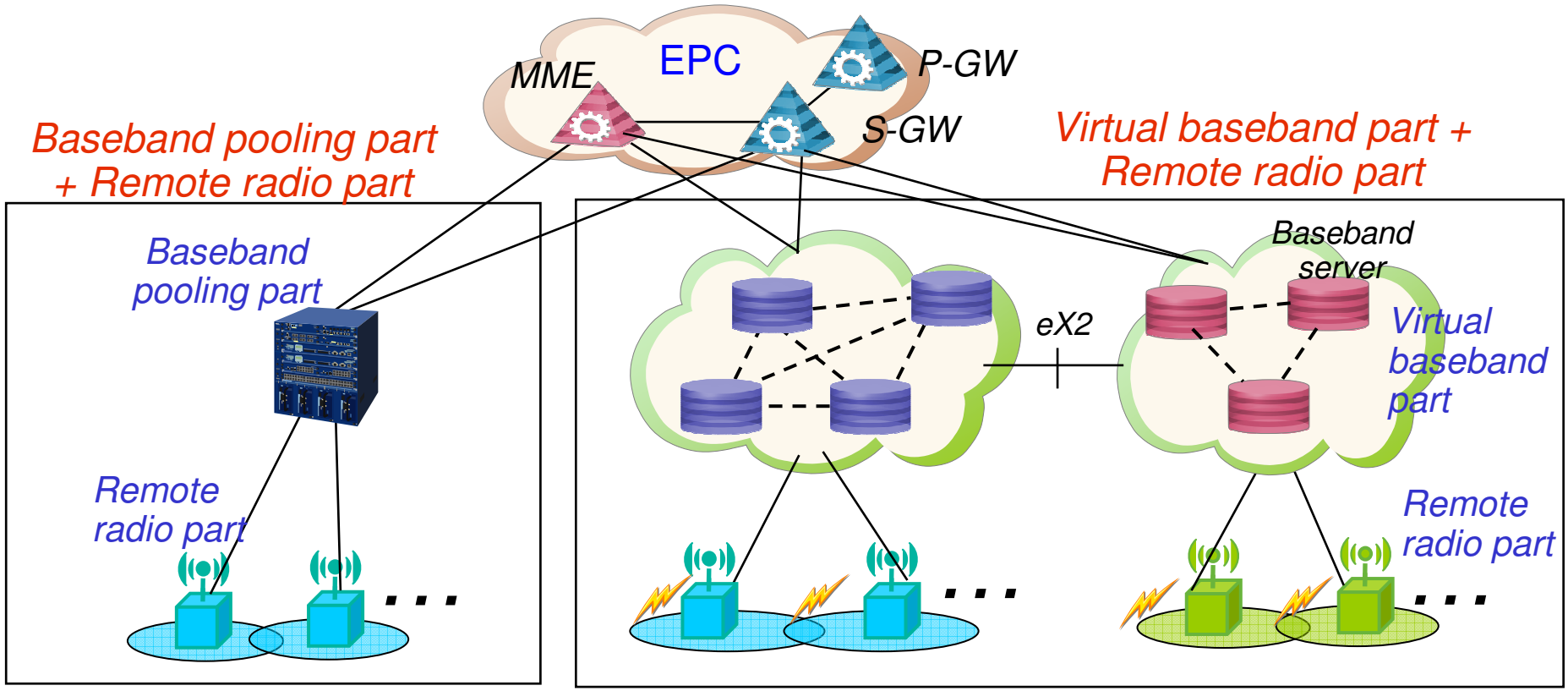
- Due to data traffic expansion, operators have to continue to deploy huge number of eNBs to increase baseband resources.
- It would lead to significant increase of CAPEX/OPEX on eNBs, e.g. site rental etc.

In Rel-12 and 13, Baseband resource pooling may achieve

- Flexible eNB resource usage
- Load balancing between cells
- Reduce CAPEX/OPEX

Multi-vendor interoperability is required to achieve above benefits efficiently.

Baseband resource pooling and virtualization (2/2)



- Flexible resource usage in baseband pooling part
- Load balancing between remote radio parts
- CAPEX/OPEX reduction on remote radio part sites

In addition to the baseband pooling part,

- Flexible resource allocation between virtual baseband parts via eX2
- Distributed deployment on baseband servers
- CAPEX/OPEX reduction on virtual baseband part site

Efficiency for diverse small data applications (1/2)

- New applications introduce a higher diversity of requirements on resource efficiency and quality of service.
- In Rel-10 and Rel-11, enhancements for MTC and diverse data applications have been introduced. Traffic/congestion management based on application types is studied for Rel-12.
- However, RRC in RAN is still inefficient in terms of management overhead for applications with in-frequent, small-volume packet traffic.

In Rel-12 and onward, application-differentiated traffic handling should be introduced together with light-weight RRC for small volume traffic. This can achieve

- Reduced state and control plane overhead
- Lower energy consumption
- Better support for diverse data application

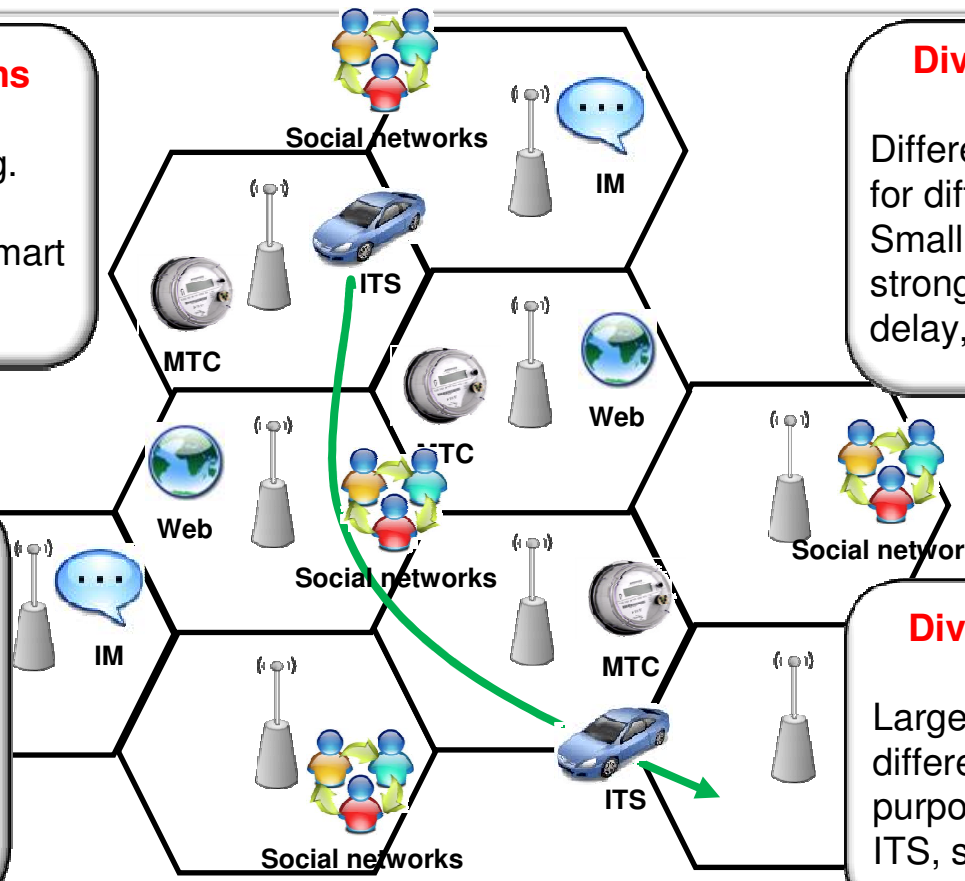
Efficiency for diverse small data applications (2/2)

Diverse mobility patterns

From very high mobility (e.g. ITS) to pedestrian (smart phone) to stationary (e.g. smart metering).

Diverse traffic patterns

Different characteristics for traffic volume, inter-arrival times and randomness (e.g. “always-on” applications like social networks vs. smart metering).



Diverse QoS and QoE requirements

Different user expectations for different applications. Small data traffic may have strong requirements on delay, reliability.

Diverse device capabilities

Large number of devices with different capabilities and purposes (e.g. smart meters, ITS, smart phones, tablets, …)

An increasing diversity of applications with small data transactions needs to be transported efficiently.

- Reduce management and signaling overhead for RRC
- Increase transport efficiency on user and control plane
- Application-specific parameterization of radio access

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