Small Cell Enhancement with Multi-Stream Aggregation (whitepaper proposal for WG C)

HUAWEI TECHNOLOGIES CO., LTD.

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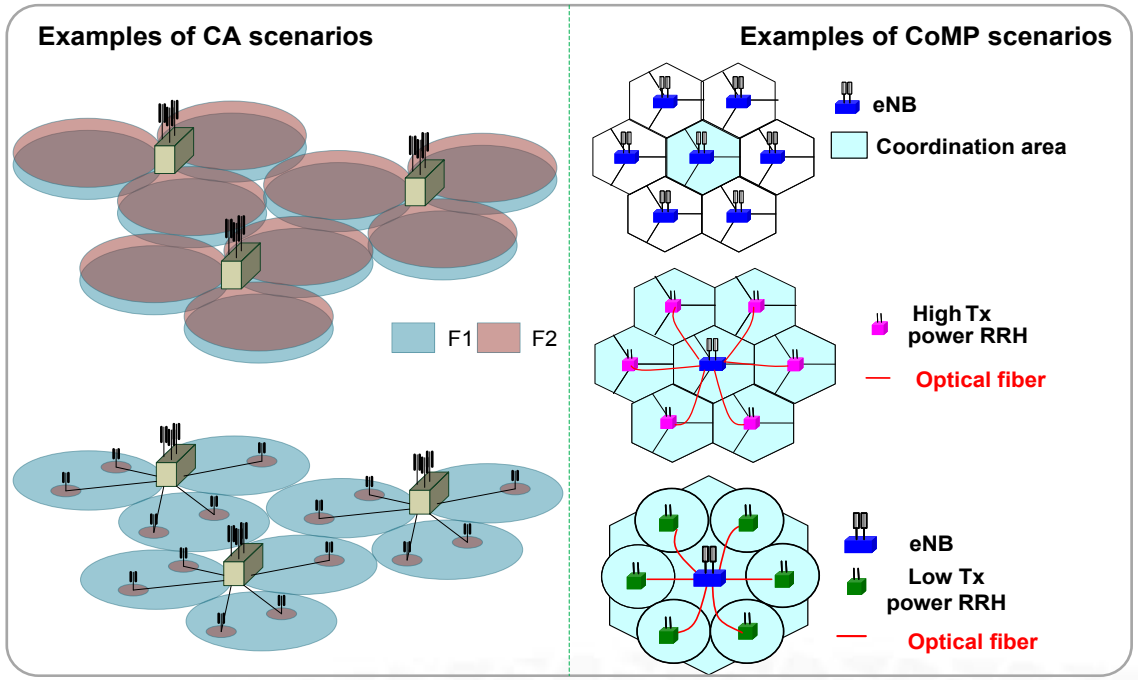
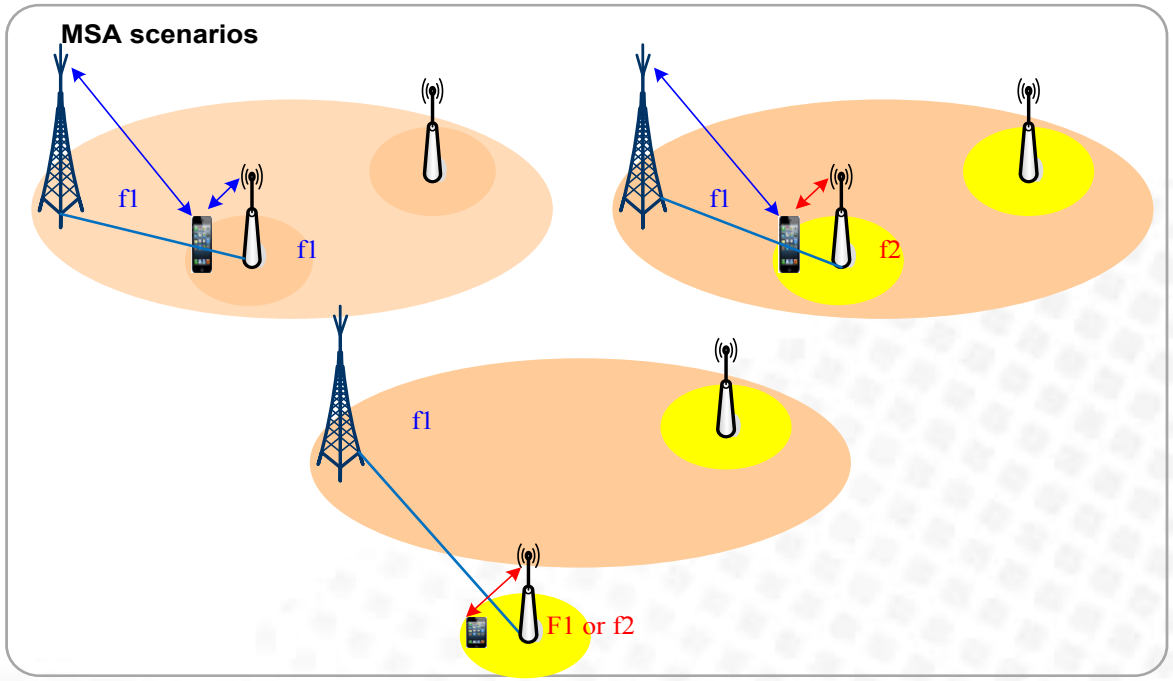
CA/CoMP evolving to MSA

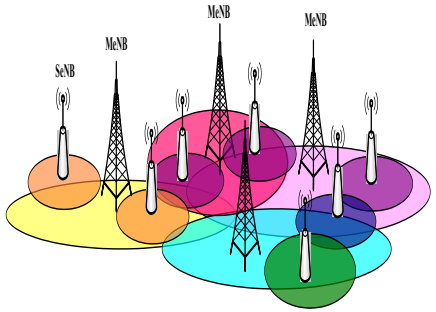




- Carrier aggregation (CA) and Coordinated multi-point transmission/reception (CoMP) apply to intra-eNB and ideal backhaul scenarios.
- MSA addresses to inter-eNB with non-ideal backhaul scenarios which are not covered by CA and CoMP. 3GPP is working on MSA between macro and small cells in Rel-12.

Major challenges for MSA

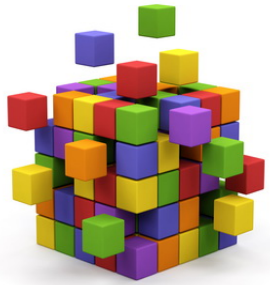
Efficient radio resource utilization across eNBs

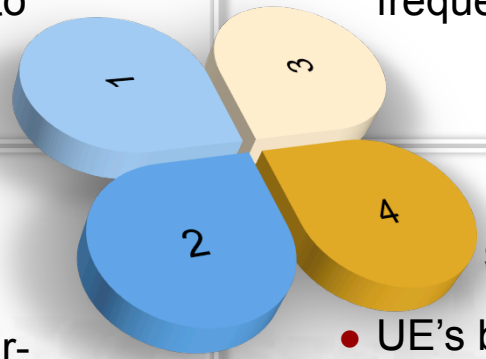


- Difficult to improve per-user throughput by utilizing radio resources in more than one eNBs with non-ideal backhaul while taking QoS requirements into account.

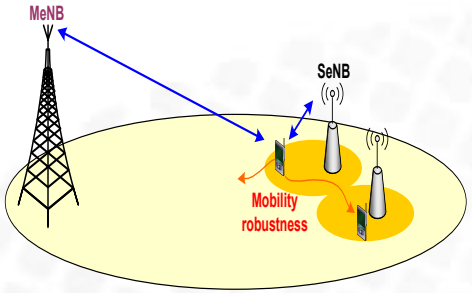
Increased signalling load

- signalling over X2 interface as well as signalling towards the MME and the S-GW are increased with increasing UE speed due to frequent handover.





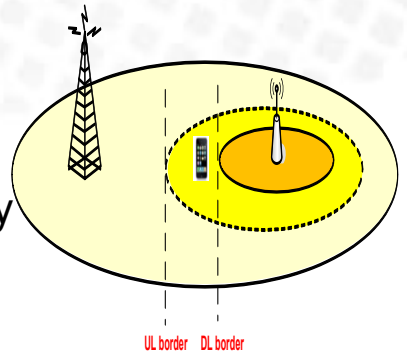
Mobility robustness



- Mobility robustness in inter-frequency scenario is not as good as in a macro only network, but less of a problem than in co-channel scenario if no DRX is used.

UL/DL imbalance between macro and small cells

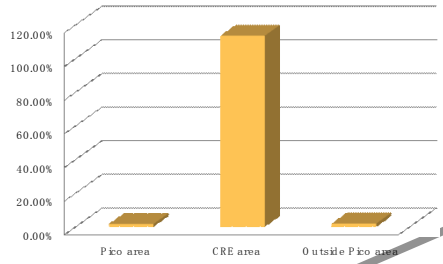
- UE's best uplink cell and best downlink cell may be different.
- Less of an issue for inter-frequency scenario than for co-channel case. Cell Range Extension (CRE) may be used for the latter case.

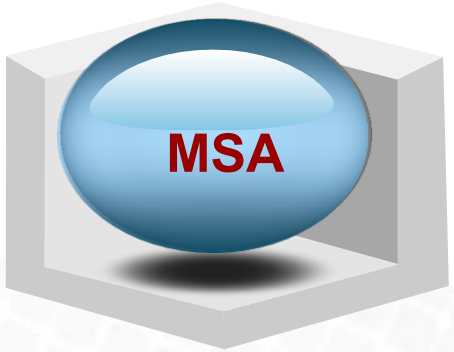


Key values of MSA

Per UE throughput improvement

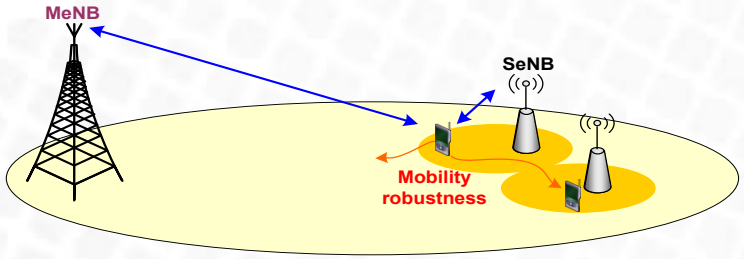
- Increase UE throughput especially for cell edge UEs by receiving multiple streams and dynamically adapting to best radio conditions of multiple cells.





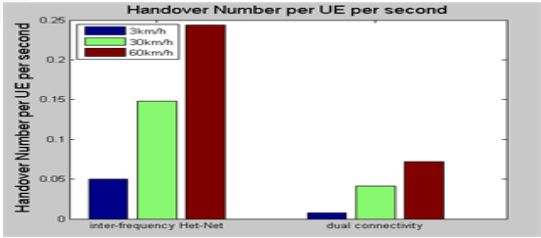
Mobility robustness enhancement

- Greatly reduce handover failure by managing mobility through the macro layer.



Signaling overhead reduction

- Appropriate MSA architecture can reduce signaling overhead towards EPC.



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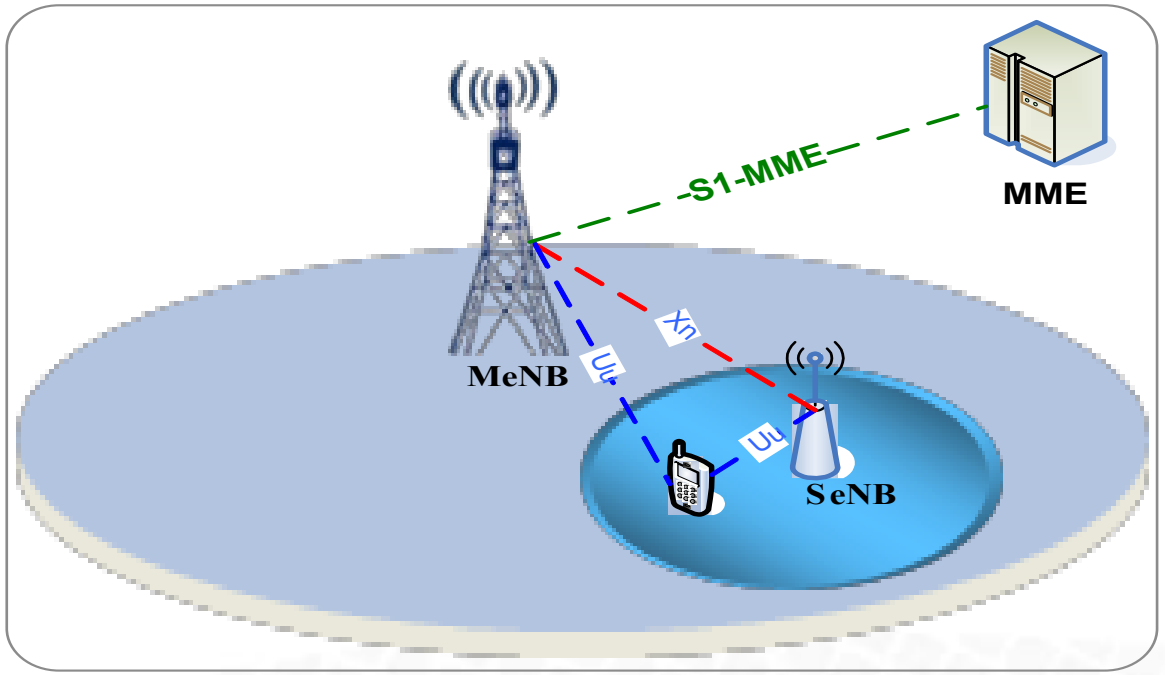
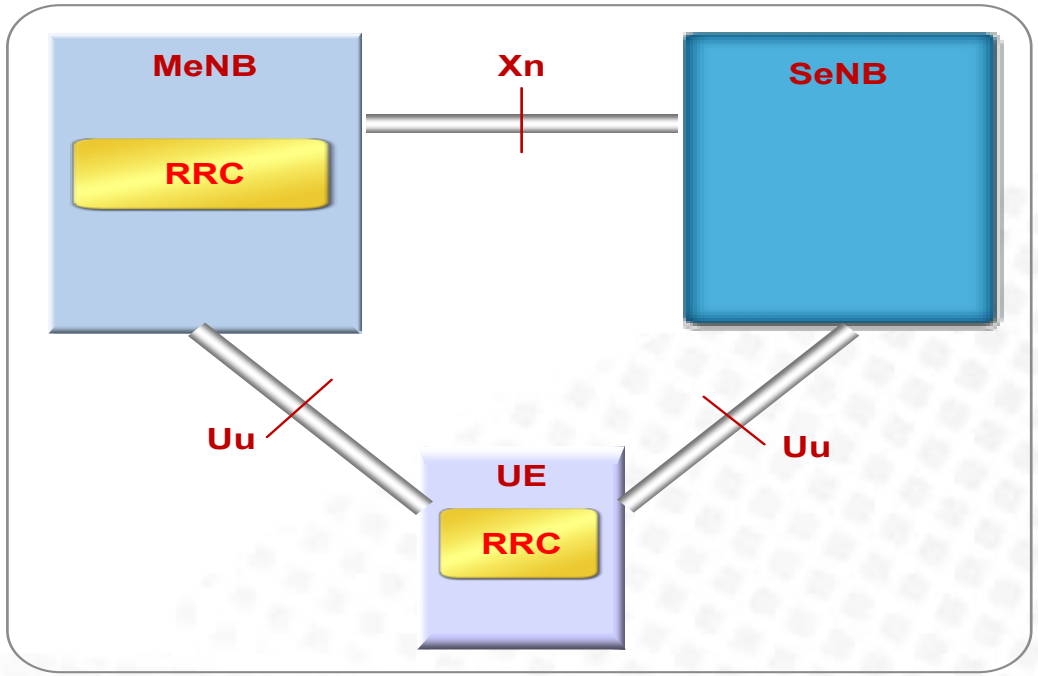
MSA control plane architecture

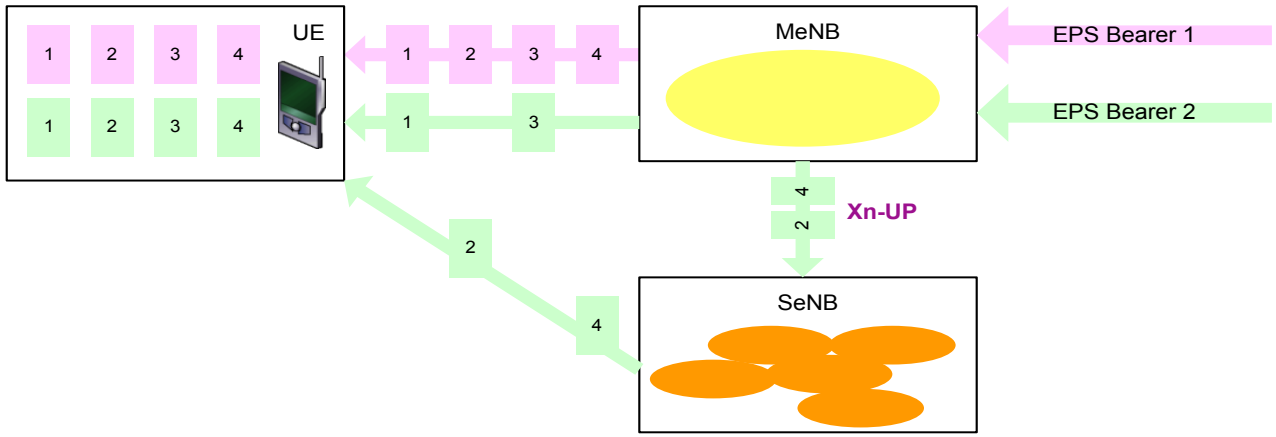




- A single S1-MME connection per UE terminating at the MeNB (master eNB)
- E-RAB operations for SeNB via Xn interface

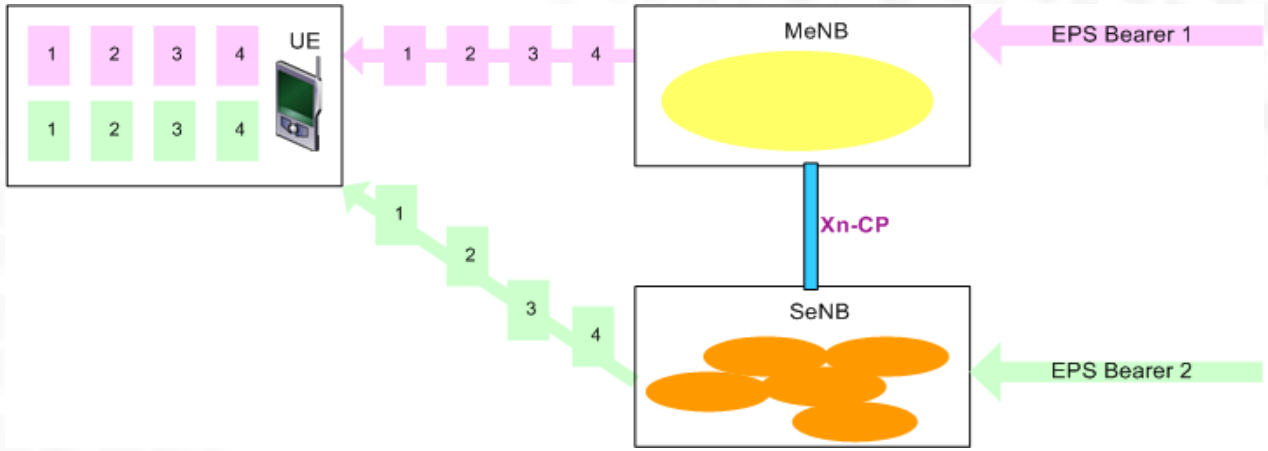
- RRC terminates at the MeNB, no RRC entity at the SeNB (Secondary eNB)
- RRC messages can be transmitted from both eNBs

MSA user plane architecture



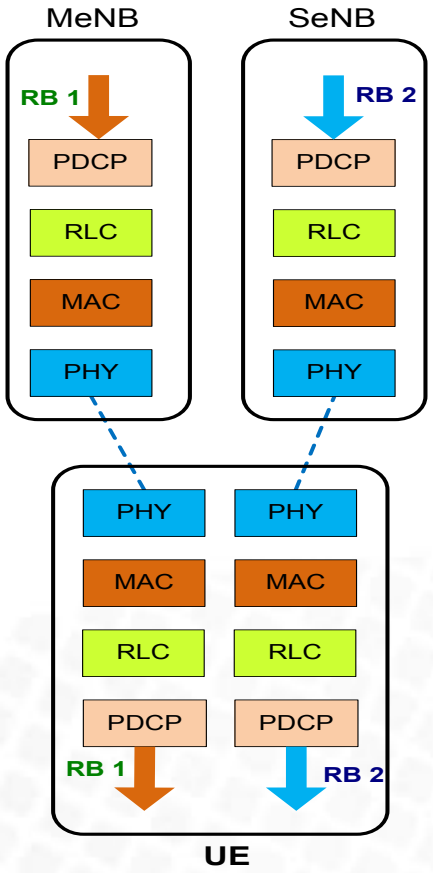
- MeNB routing
  - S1-U terminates in MeNB only
  - bearer split in eNB or no bearer split
  - Pros:
    - SeNB mobility hidden to EPC
    - Radio efficiency by bearer split
  - Cons:
    - More backhaul requirement
    - More MeNB processing load

- SGW routing
  - S1-U terminates in MeNB and SeNB
  - Pros:
    - Less MeNB processing load
    - Less backhaul requirement
  - Cons:
    - SeNB mobility visible to EPC
    - Not optimized for radio efficiency

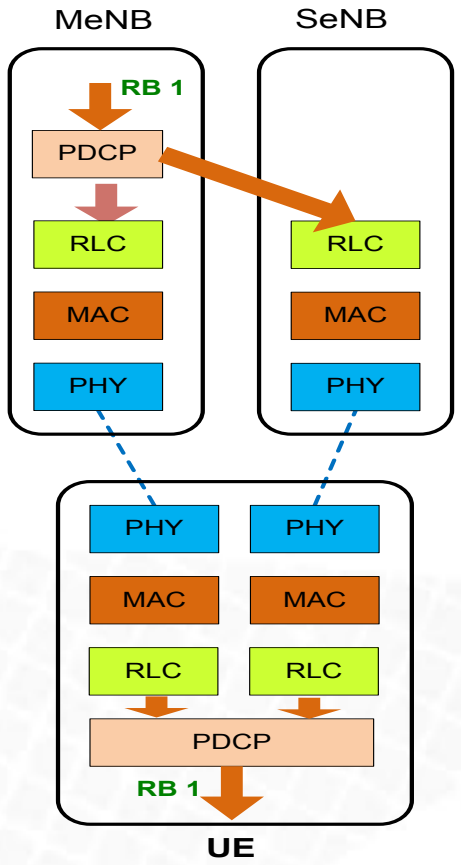


MSA user plane protocol stack typical options

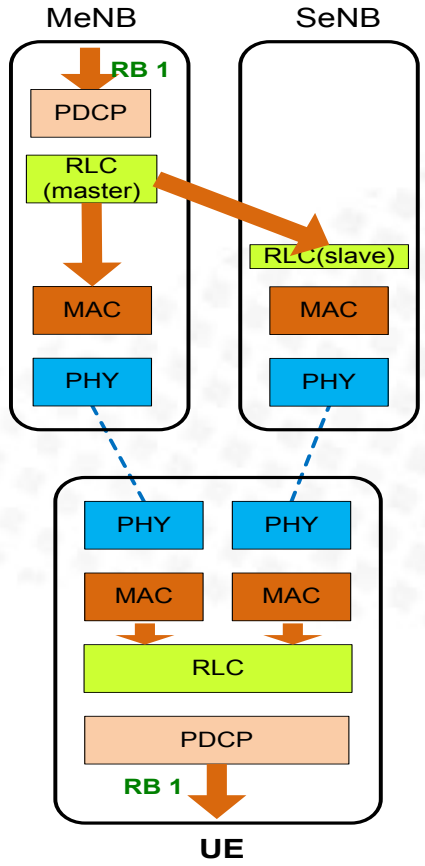
SGW routing



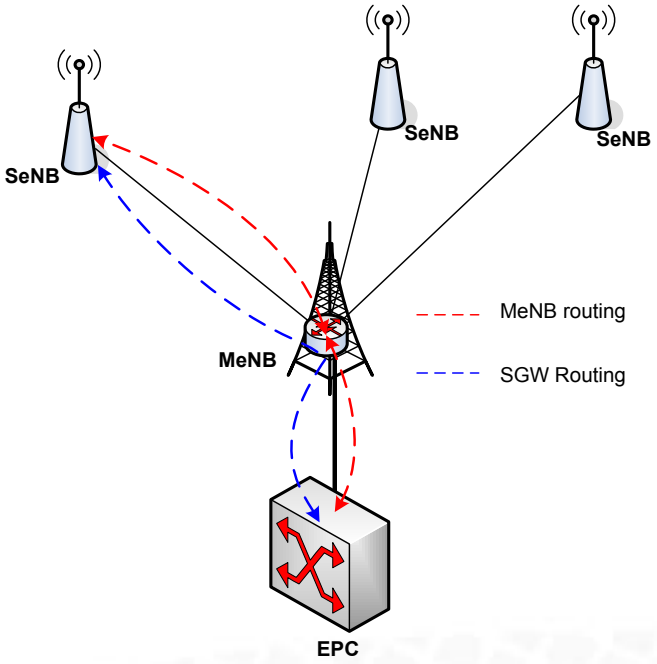
MeNB routing – PDCP PDU split



MeNB routing – RLC PDU split

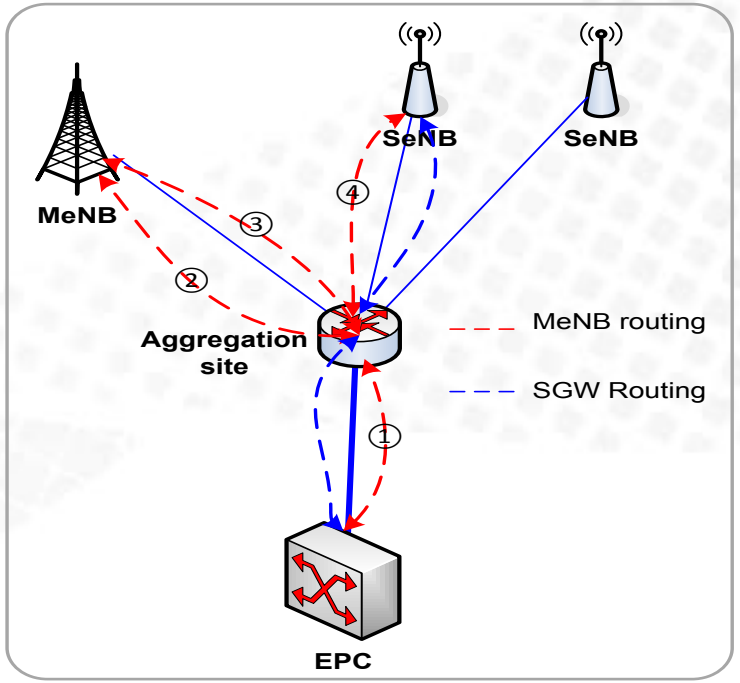


MSA backhaul scenarios



- SeNB directly connects to MeNB
  - User plane packets path for SeNB is the same for MeNB and SGW routing architecture

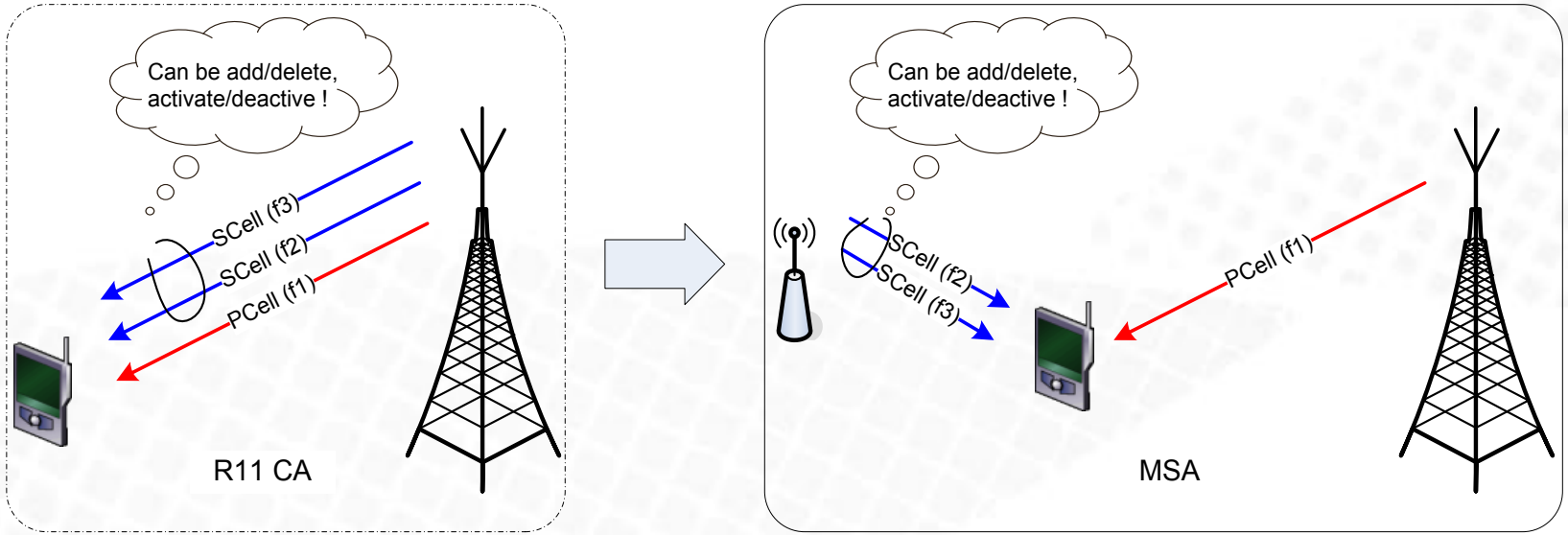
Backhaul



- SeNB connects to MeNB via a higher level aggregation site
  - User plane packets path for SeNB traverses MeNB twice for MeNB routing architecture, while only once for SGW routing architecture

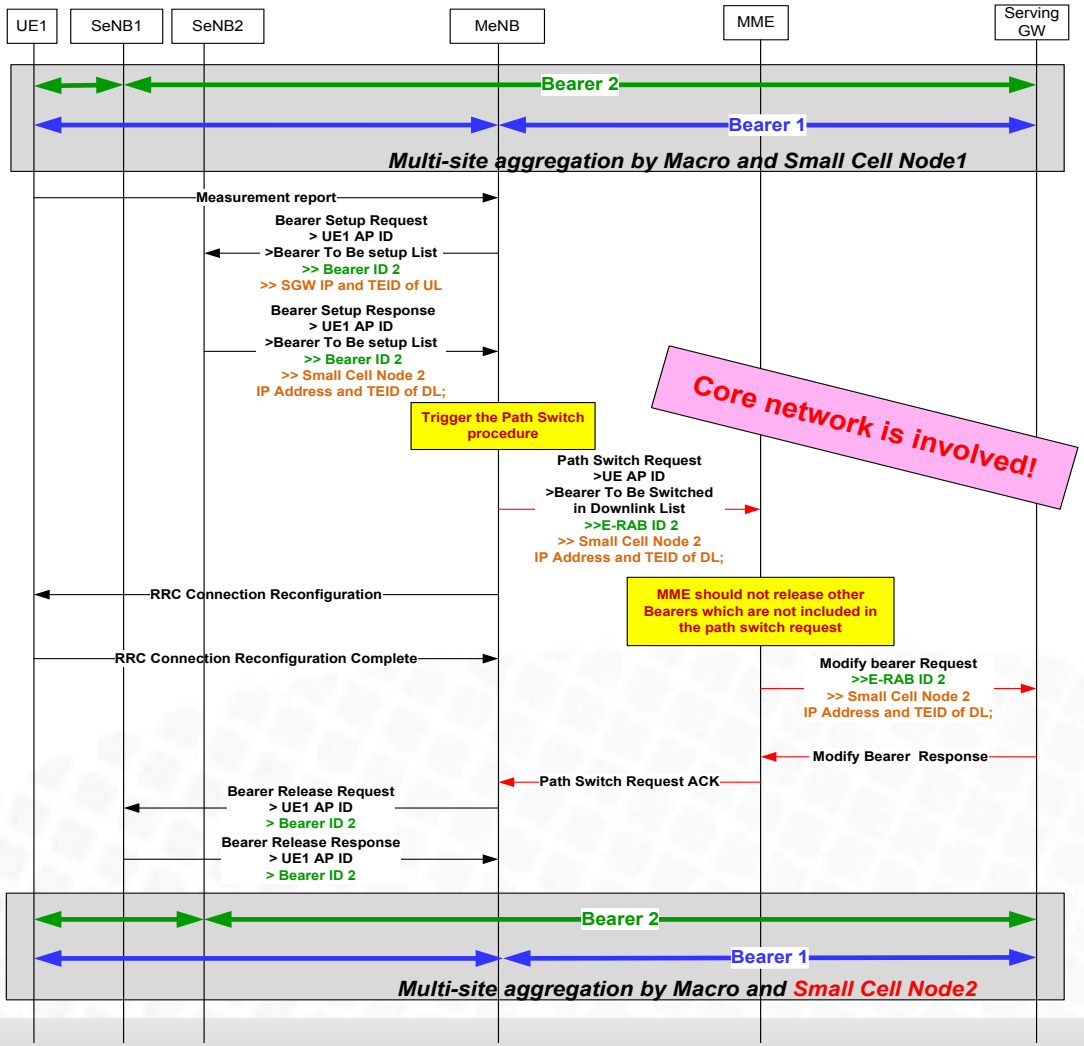
MSA carrier management

- Extend current CA carrier management mechanisms to MSA
  - Reuse PCell concept
  - Add/modify/delete Scells
  - Activation/deactivation of Scells
  - Cross carrier scheduling may not be applicable due to backhaul latency

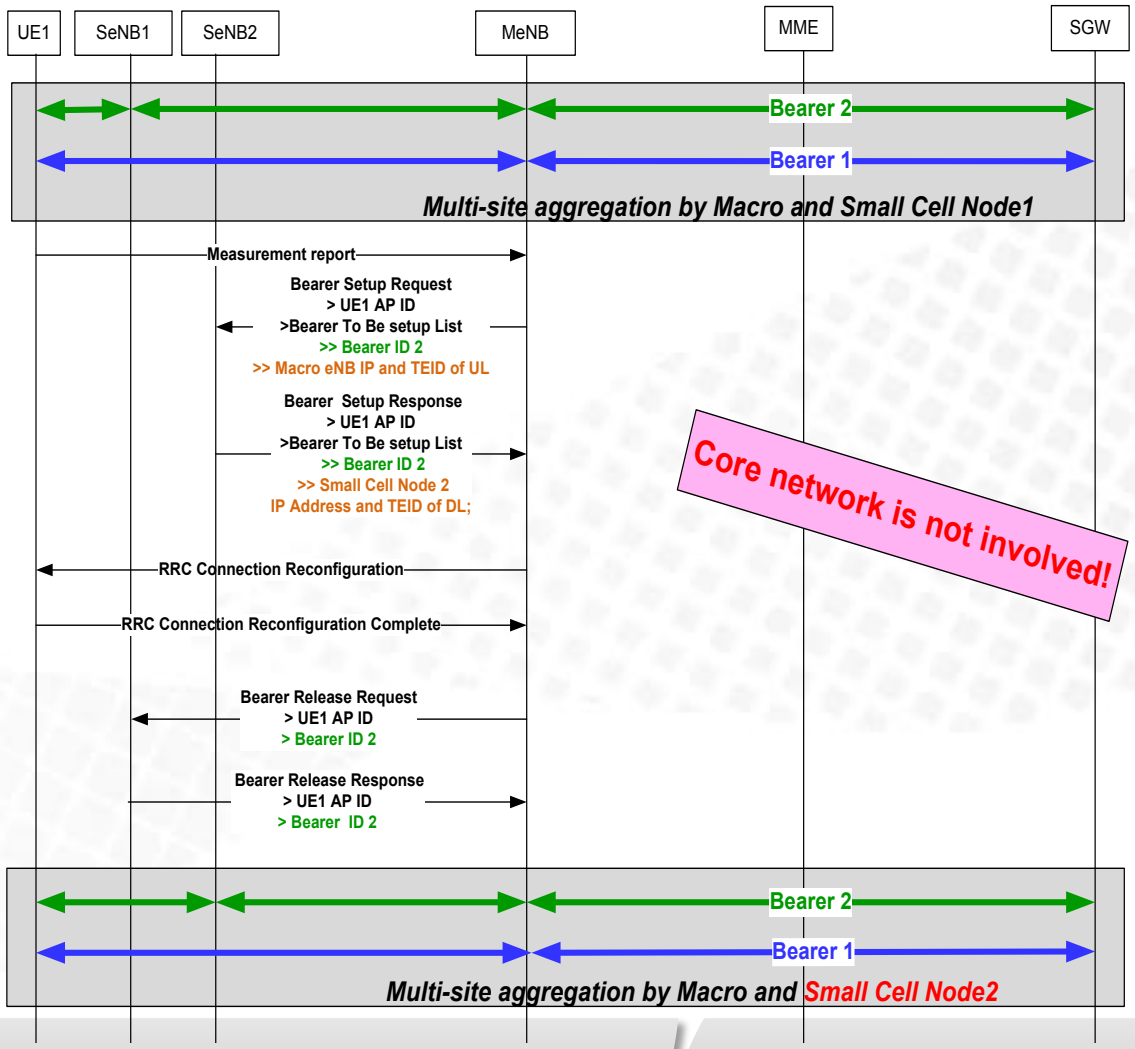


MSA mobility management

SeNB change in SGW routing architecture

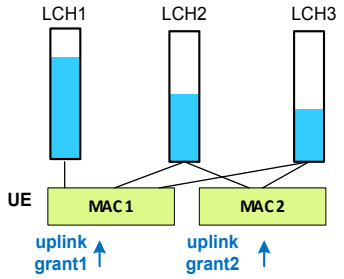


SeNB change in MeNB routing architecture



MSA MAC layer impacts

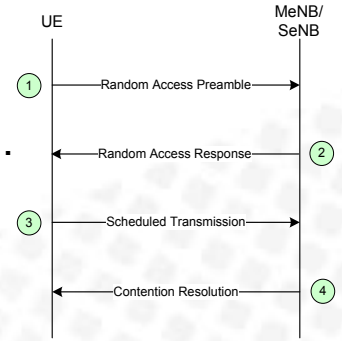
BSR and LCP

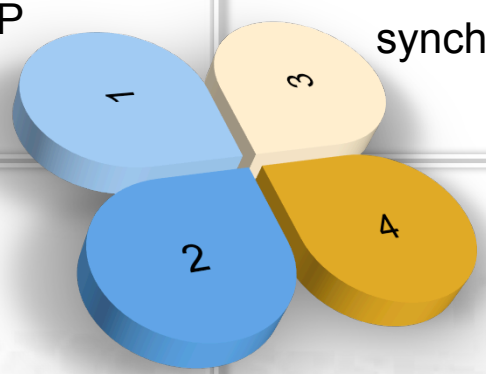


- Buffer status report (BSR) and logical channel prioritization (LCP) procedures are impacted depending on different MSA UP architectures.

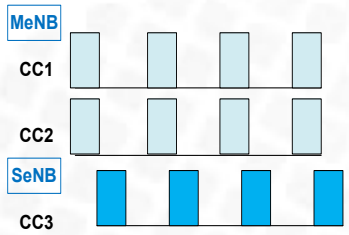
RACH

- Independent RACH procedures and UE need to receive RAR (random access response) from SeNB as well.
- Parallel RACH procedures to reduce latency in case of UE loosing uplink synchronization in MeNB and SeNB.





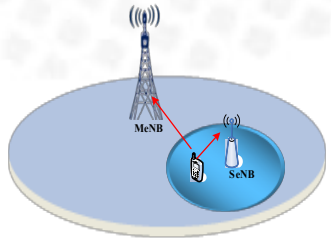
DRX



- common DRX per eNB
  - Common DRX for all component carriers in Rel-10 /11 CA may be modified to common DRX for all component carriers of a eNB in MSA.

HARQ feedback and CSI

- It may not be suitable any more to carry HARQ feedback and CSI of SeNB in PUCCH of PCell in MeNB due to backhaul latency.
  - It is beneficial to support PUCCH in SeNB as well.



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Summary

- **MSA benefits**
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- **MSA technologies**
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  - › Control plane handling
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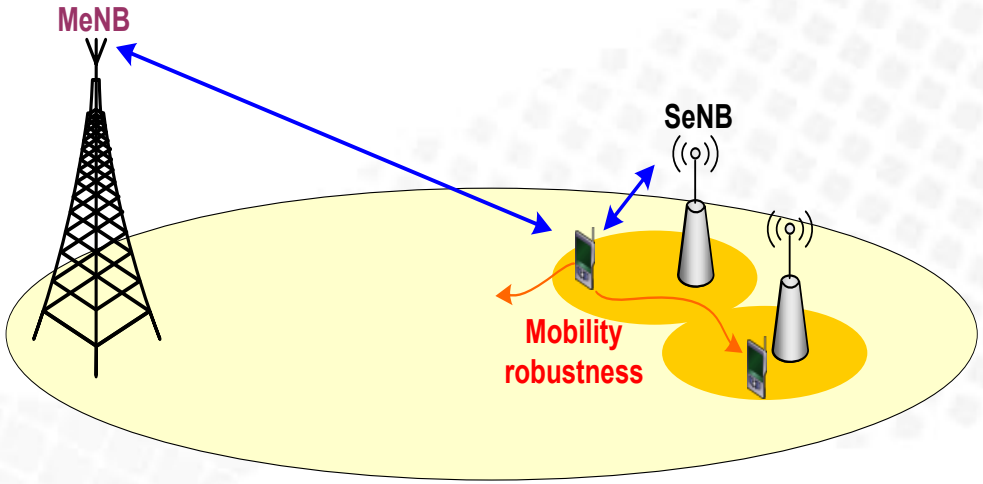
  - › MAC layer impacts



Whitepaper Architecture

- **Overview of LTE MSA**
  - Scenarios
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- **Downlink and uplink split**
- **Mobility management**
- **MAC impacts**
- **conclusion**

Thank You

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