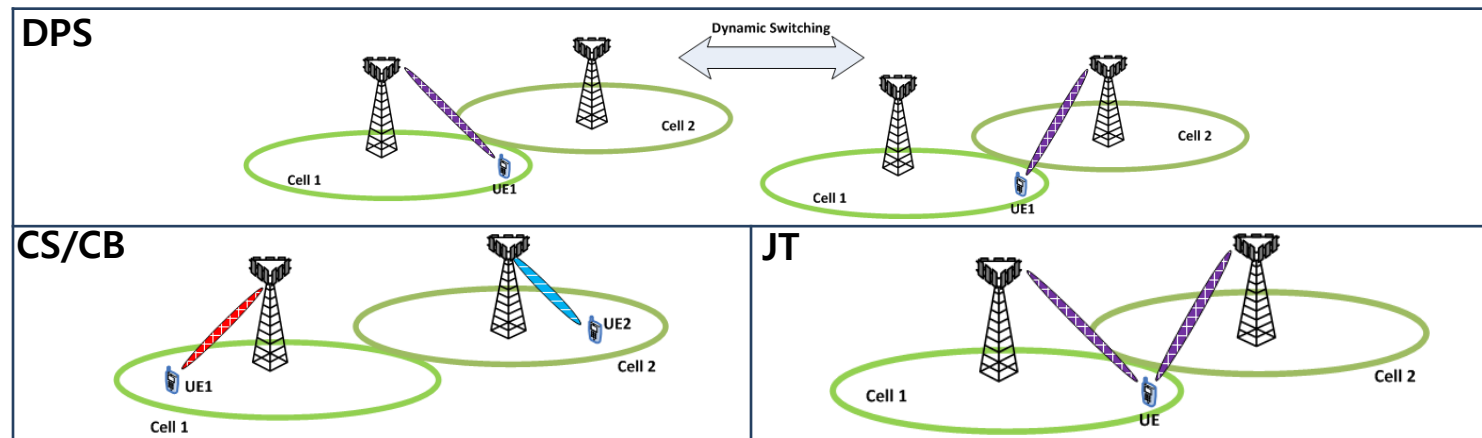


# Motivation for Inter-eNB CoMP for LTE

Samsung, KT, LG Uplus, SK Telecom

# CoMP in Rel-11

- Rel-11 CoMP focused on air-interface between UE and network
  - No network interface was specified (ideal/proprietary backhaul was assumed)
- CoMP techniques considered in Rel-11
  - Coordinated scheduling/beamforming (CS/CB)
  - Dynamic point selection (DPS)
  - Joint transmission (JT)

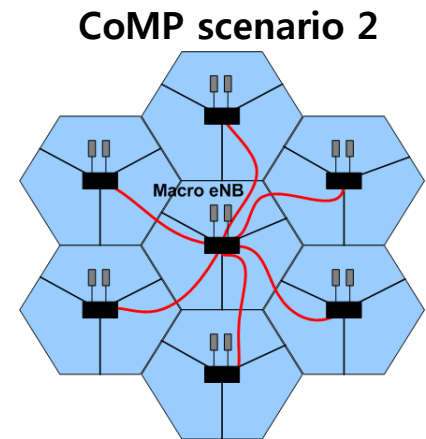
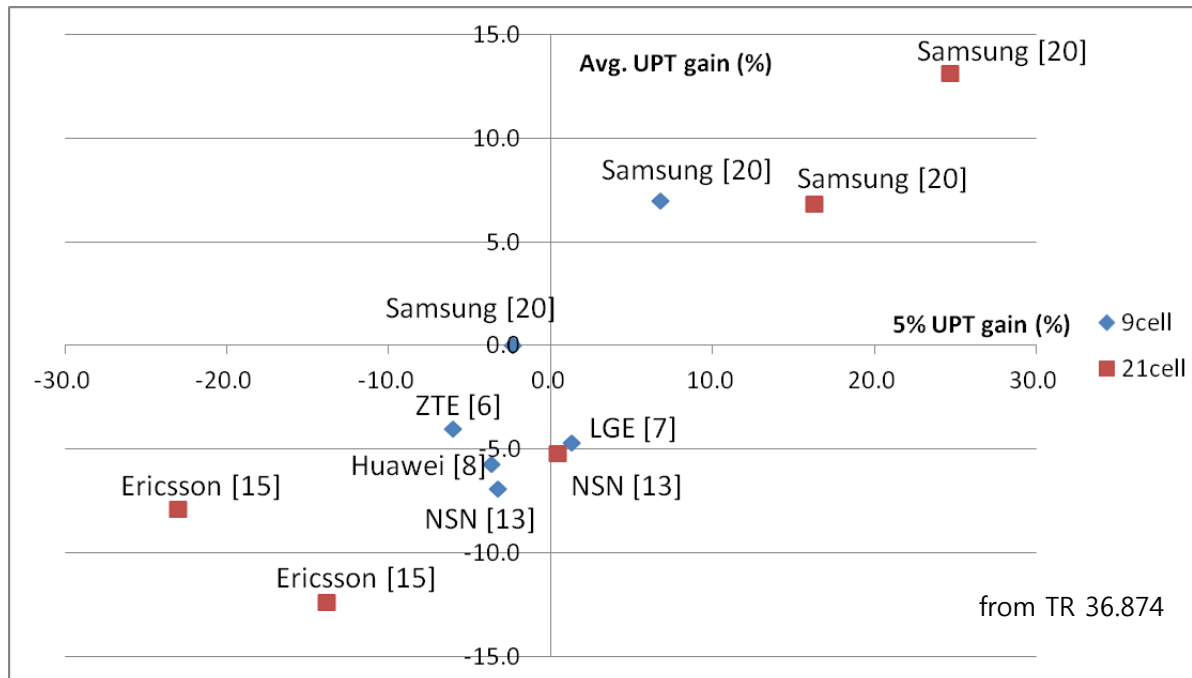


# CoMP-NIB (Non-Ideal Backhaul) in Rel-12

- Objective of CoMP-NIB study item:
  - Evaluation of inter-eNB CoMP considering delay from non-ideal backhaul
  - For coordinated scheduling and coordinate beamforming including semi-static point selection/muting
- Outcome of CoMP-NIB study item
  - Performance gain of Inter-eNB CoMP varies as a factor of
    - deployment scenario
    - backhaul delay
    - coordination scheme (centralized vs distributed)
    - scheduling approach
    - resource utilization factor
    - coordination size

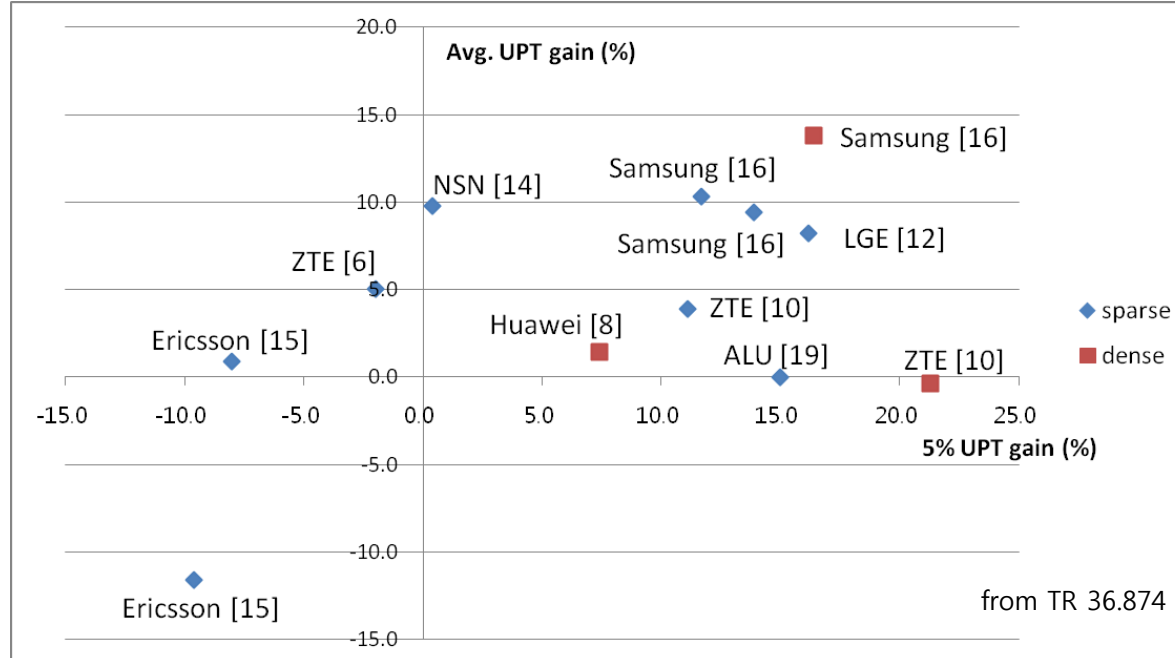
# Performance Results (CoMP scenario 2)

- In case of 5ms backhaul delay and high RU (0.5-0.8)
  - For coordination size of 9, it is observed that
    - 5% UPT gain has a median of -3.2% and a range of -6.0% ~ 6.8%
    - Mean UPT gain has a median of -4.7% and a range of -6.9% ~ 7.0%
  - For coordination size of 21, it is observed that
    - 5% UPT gain has a median of 0.5% and a range of -23.0% ~ 24.7%
    - Mean UPT gain has a median of -5.2% and a range of -12.4% ~ 13.1%

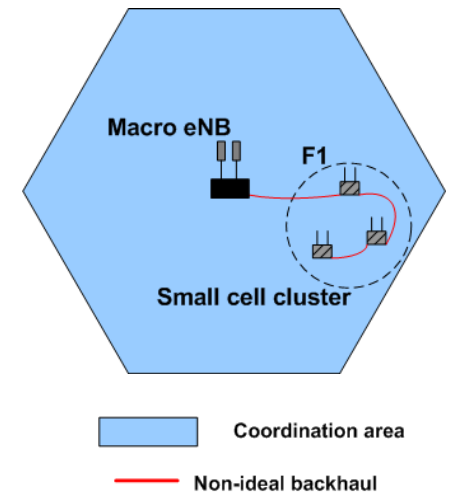


# Performance Results (SCE scenario 1)

- In case of 5ms backhaul delay and high RU (0.5-0.8)
  - (Sparse) For 4 small cells within one macro area, it is observed that
    - 5% UPT gain has a median of 11.4% and a range of -9.6% ~ 16.2%
    - Mean UPT gain has a median of 6.1% and a range of -11.6% ~ 10.3%
  - (Dense) For 10 small cells within one macro area, it is observed that
    - 5% UPT gain has a median of 16.4% and a range of 7.4% ~ 21.3%
    - Mean UPT gain has a median of 1.4% and a range of -0.4% ~ 13.8%



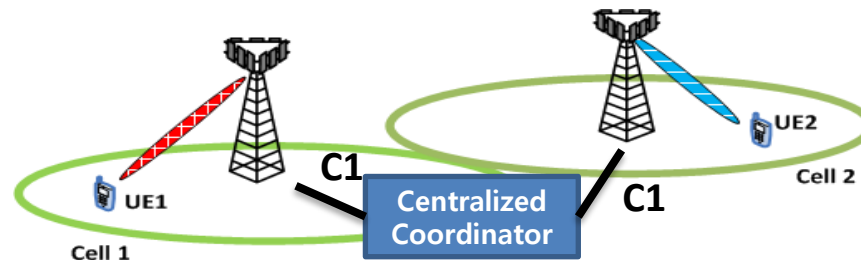
## SCE scenario 1





# Conclusions

- Observation from CoMP-NIB study item evaluation results
  - Centralized coordination of wireless resources, if properly done, can provide significant system performance enhancement
  - X2 is designed for peer-to-peer eNB signaling, making it inappropriate for centralized coordination of large scale
- Proposal
  - Start RAN3 work item to specify a new interface (C1) between eNBs and a centralized coordinator



# **ANNEX : Delay Impact of Inter-eNB CoMP with Non-Ideal Backhaul**

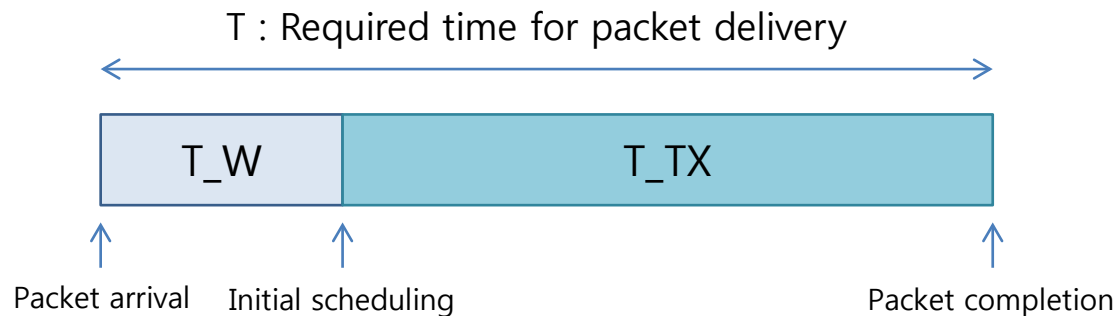


# Delay Analysis on CoMP-NIB

- Some companies expressed concerns that a centralized coordination of wireless resources incurs additional delay on packet delivery
- Following set of slides are provided to address the above issue
  - Evaluation results show that the overall delay on packet delivery is reduced, not increased

# Overall Delay in Packet Delivery

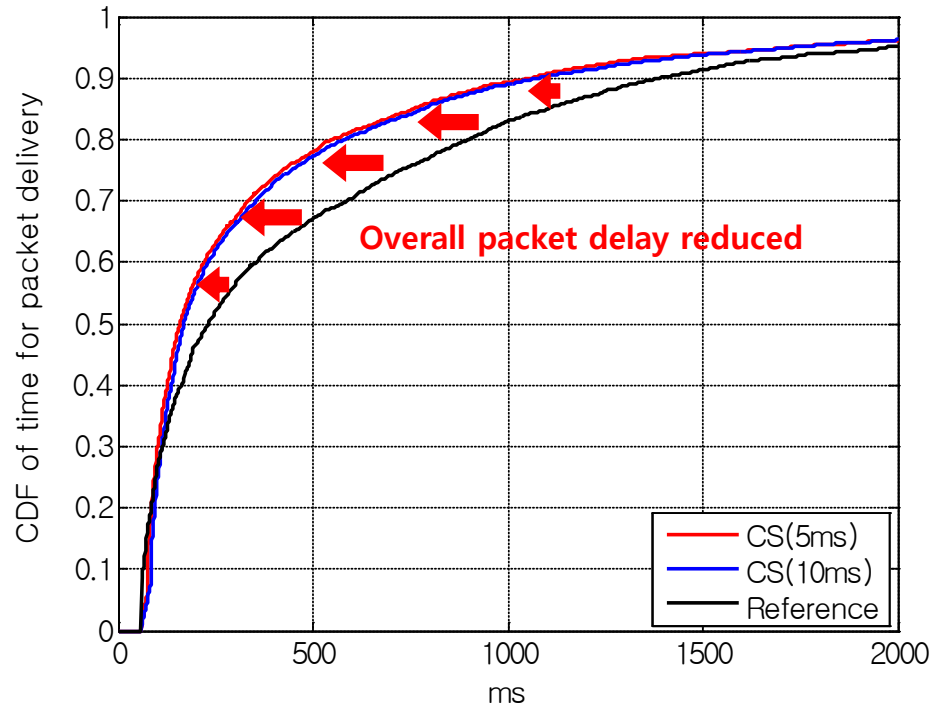
- Overall delay in packet delivery is the sum of  $T_W$  and  $T_{TX}$



- $T_W$  : waiting time to assign available resources
    - May include time duration between the point of eNB requesting resource allocation and the point of eNB being allocated resource
    - May increase as the backhaul delay increases
  - $T_{TX}$  : transmission time for packet delivery
- Concern from some companies is that due to  $T_W$ , centralized coordination might end up increasing overall delay on packet delivery

# Evaluation Result

- Overall delay in packet delivery is reduced significantly even in non-ideal backhaul
  - Increase of  $T_W$  much less than decrease of  $T_{TX}$  → Overall delay of packet delivery reduced



Scheme	Backhaul Delay	Avg $T_W + T_{TX}$	Avg $T_W$	Avg $T_{TX}$
Reference	0	570.9	10.9	559.9
CoMP	5	440.1	18.8	421.3
CoMP	10	460.1	23.9	436.2

# Evaluation Environments

- Simulation parameters
  - Scenario : SCE scenario 2a (sparse)
  - CoMP scheme : coordinated scheduling (CS)
    - Step 1 : Coordinated scheduling is performed to decide the resource allocation for each eNB in the resource coordinator
    - Step 2 : Each eNB conducts UE scheduling on the assigned resource with the latest CSI
  - Reference scheme : non-CoMP
  - Backhaul delay : 5ms, 10ms
  - RU : high RU (60%)
  - Detailed parameters : R1-135826 (SCE 2a)