RWS-120048

A view on Rel-12 and onwards from an operator's viewpoint

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SoftBank Mobile Corp.

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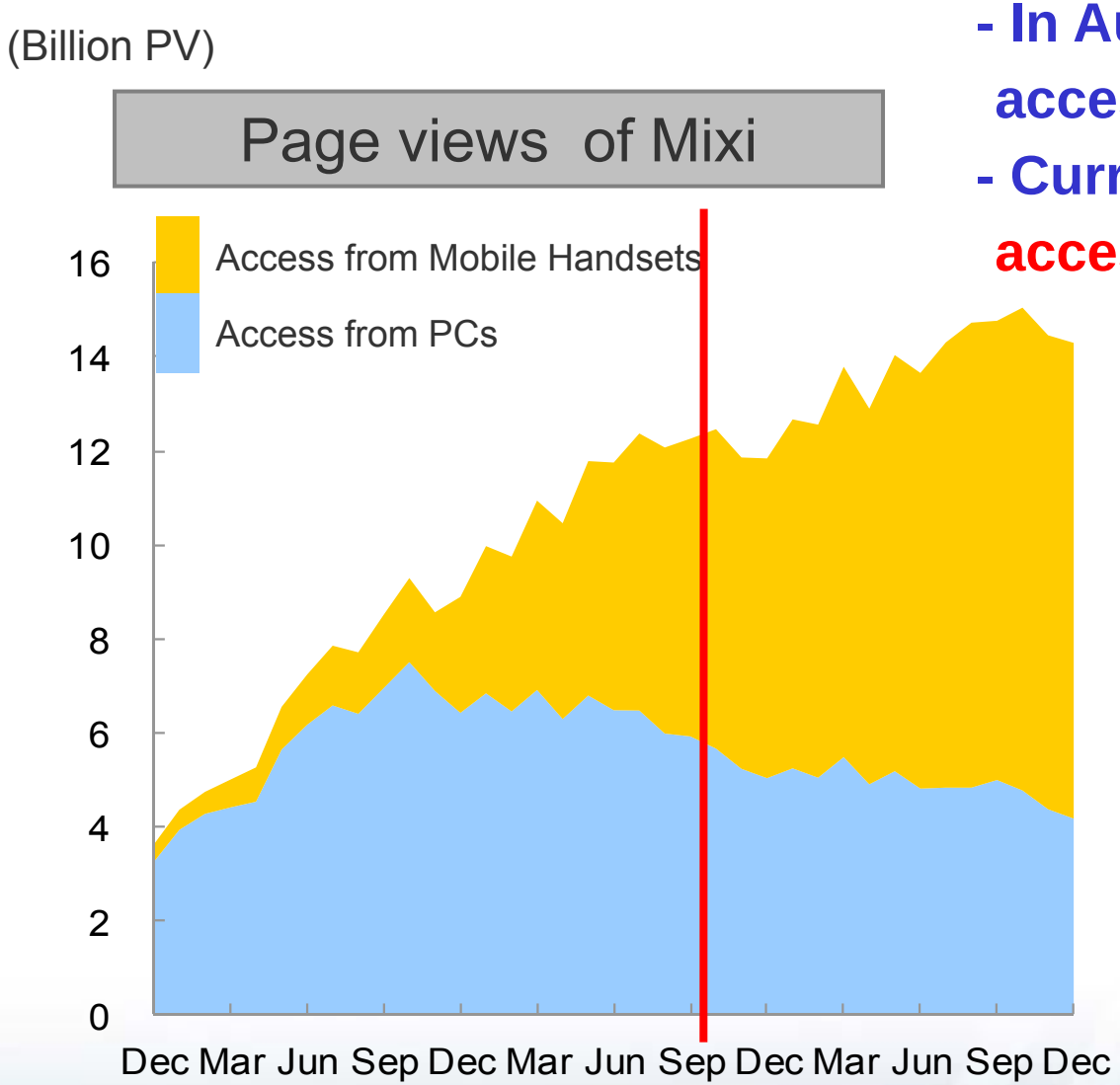
Trend of mobile communitaions

Towards Mobile Internet

Internet Access - from PC to Mobile Terminal



- **In August, 2007, Mobile Handset access overtook PC access**
- **Currently, more than 70% of Internet access is from Mobile Handsets**

Reference: IR Data sheet, Mixi corporation

2005	2006	2007	2008

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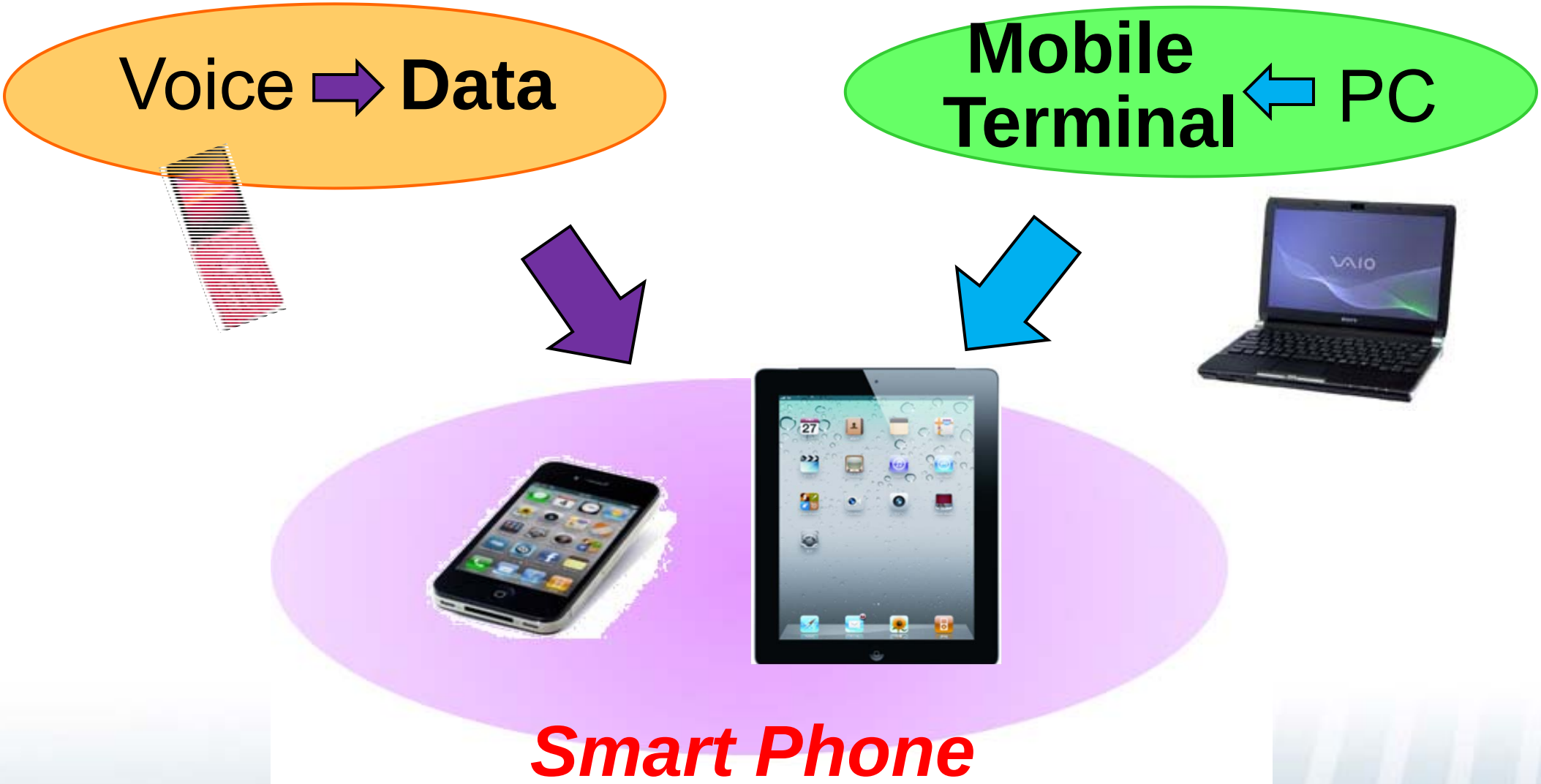
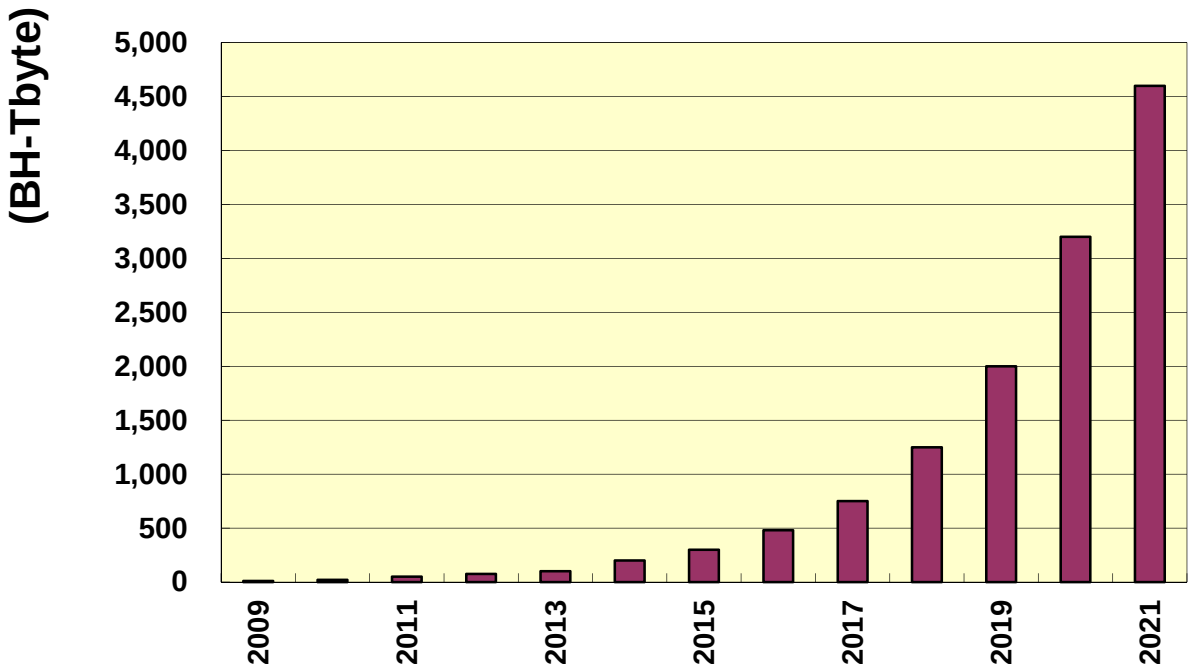
From Voice to Data & From PC to Mobile



Mobile Traffic Growth Forecast for Next Decade

1000 (=2^{10}) times more than 2011



- **100% annual growth rate in last 4 years**
- **It is impossible to accommodate the traffic expected by simple expansion of current system architecture.**
- **Technologies for efficient spectrum usage and new spectrum licences are required**

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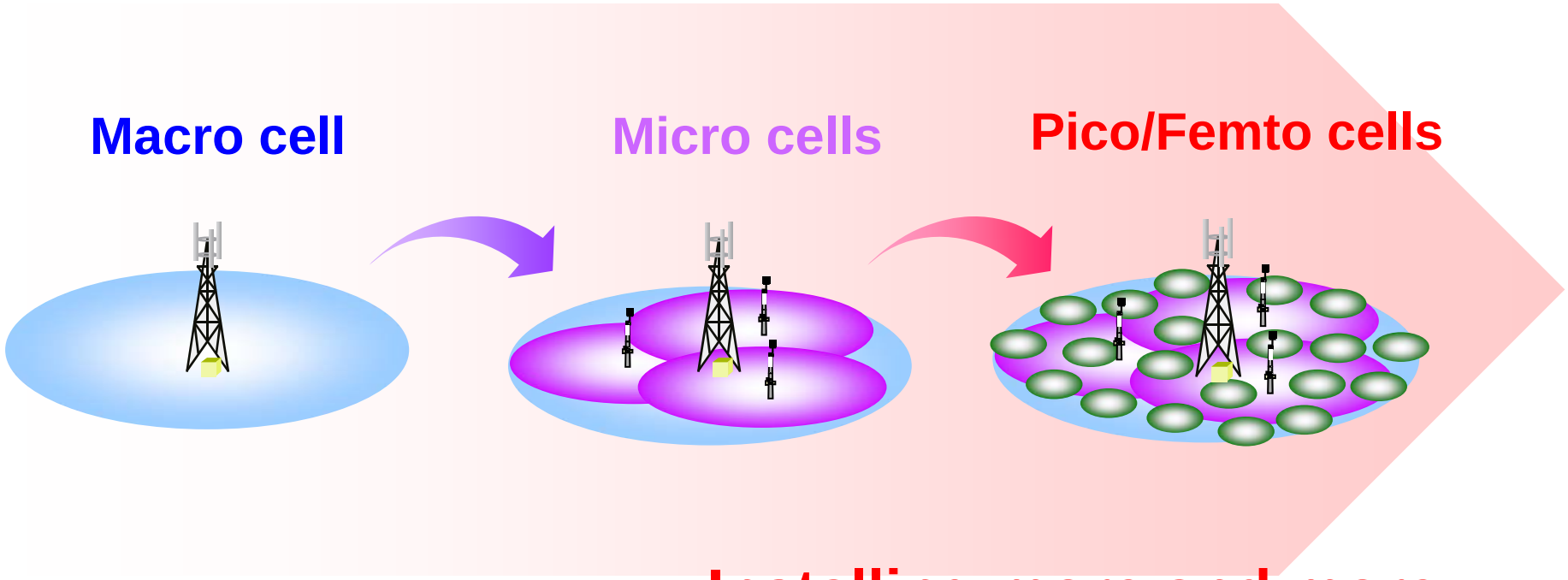
Accommodating Explosion in Mobile Traffic

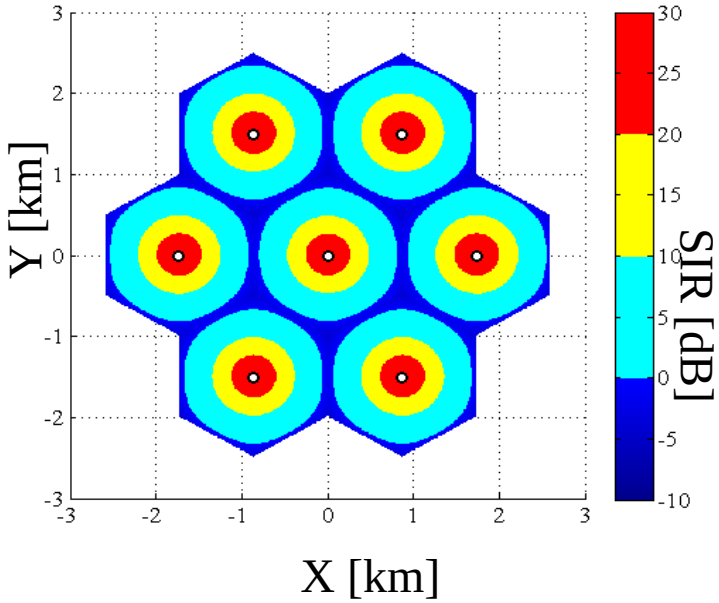
Introduction of Micro cell and Pico/Femto cell



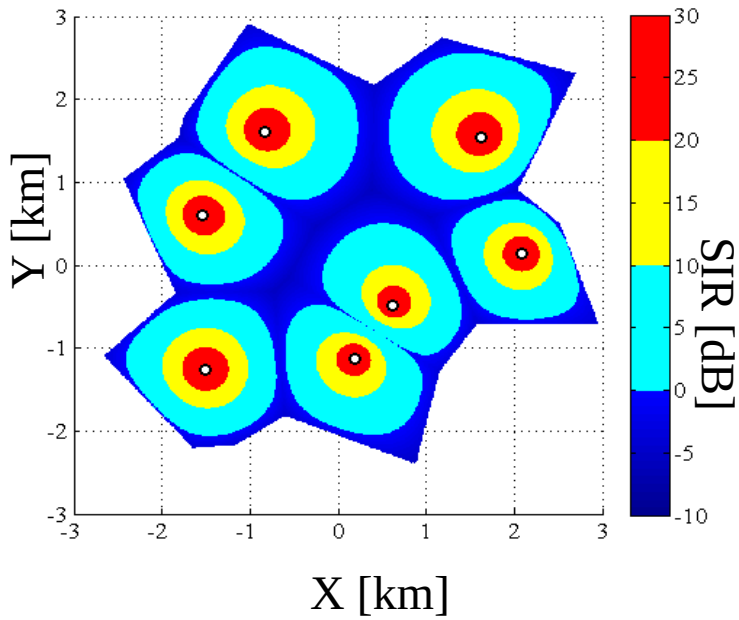
Installing more and more Pico and Femto cells

Ideal cell configuration and real deployment

In real cell deployment, user experience is further degraded.



(a) Ideal deployment



(b) Real deployment

Cell-border throughput is more important than peak throughput

Requirements from operator's viewpoint

Requirements for REL-12 and onwards

- Capacity improvement (x1000)
  - limited spectrum but ever-increasing traffic
- Cell-border throughput improvement
  - prevalance of high-data rate applications
  - improvement of user experience
- Flexible deployment for cost reduction
  - increasing number of pico and femto cells in mobile network

A proposed focus area of CoMP technologies

CoMP Technologies

- CoMP (Coordinated Multiple Point Transmission) is a technology to improve quality of communications, e.g. throughput, by cooperating transmission at geographically separated points (nodes)

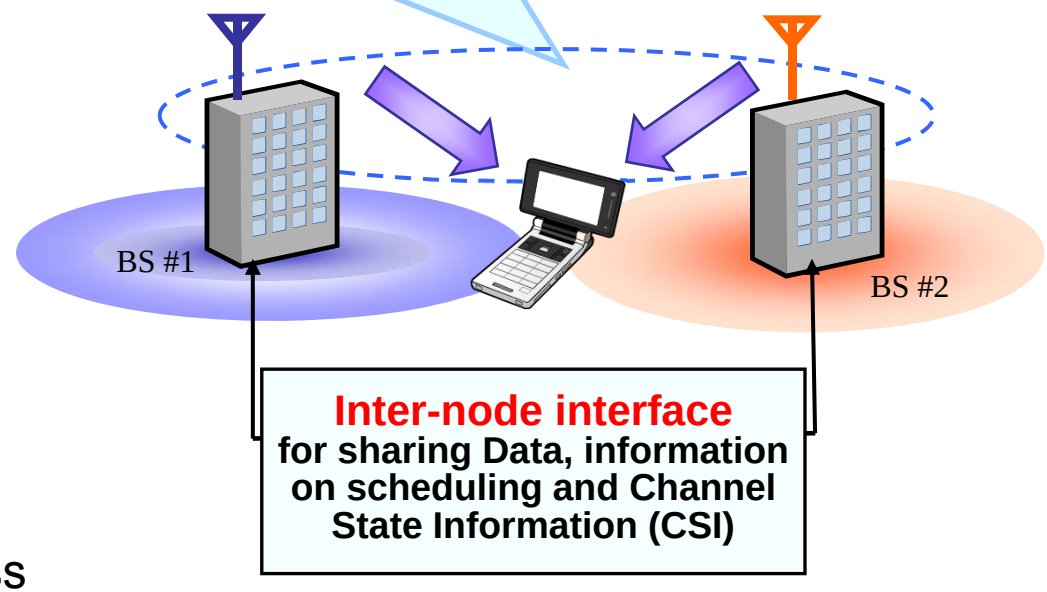
- CoMP technologies:
  - Joint Transmission: simultaneous transmission from multiple nodes (JT)
  - Dynamic Point Selection: coordination by transmission muting of other nodes (DPS)

- For inter-BS solution (3GPP Scenario 2), SoftBank would like to propose a CoMP backhaul scheme using X2 Interface, in addition to Fiber Optics solution, in 3GPP Work Item for REL-12 and onwards

CoMP technogloy – 3GPP scenario 2 -

- CoMP: a technology to improve quality of communmications, e.g. throughput, by cooperating transmission at geographically separated points (nodes)

JT: simultaneous transmission
DPS: fast selection of transmit signals
CS/CB: interference coordination



Coordination methods:

(1) Joint Transmission (JT)
- to simultaneously transmit signals from multiple nodes
- to use signals from other nodes as desired signals

(2) Dynamic Point Selection (DPS)
- to transmit signals dynamically from a selected node with the minimum path loss
- to improve SINR at cell-boundary by muting interferences from other nodes

(3) Coordinated Scheduling/Beamforming (CS/CB)
- to transmit signals only from a serving node by scheduling of the serving node
- to improve SINR at cell-boundary by interference coordination or beamforming.

Inter-node interface is a key for CoMP in deployment

Fiber Optics vs. X2 Interface

- **CoMP performance depends on how to share information between nodes**

- Amount of Control Information: a factor to determine the accuracy of control
- Control delay : a factor to determine a limit of performance

Due to this reason, fiber optics solution is deemed superior as CoMP backhaul network
→ 3GPP gives a priority to Fiber Optics backhaul network

- **However, omitting X2 Interface from the standard will cause a problem**

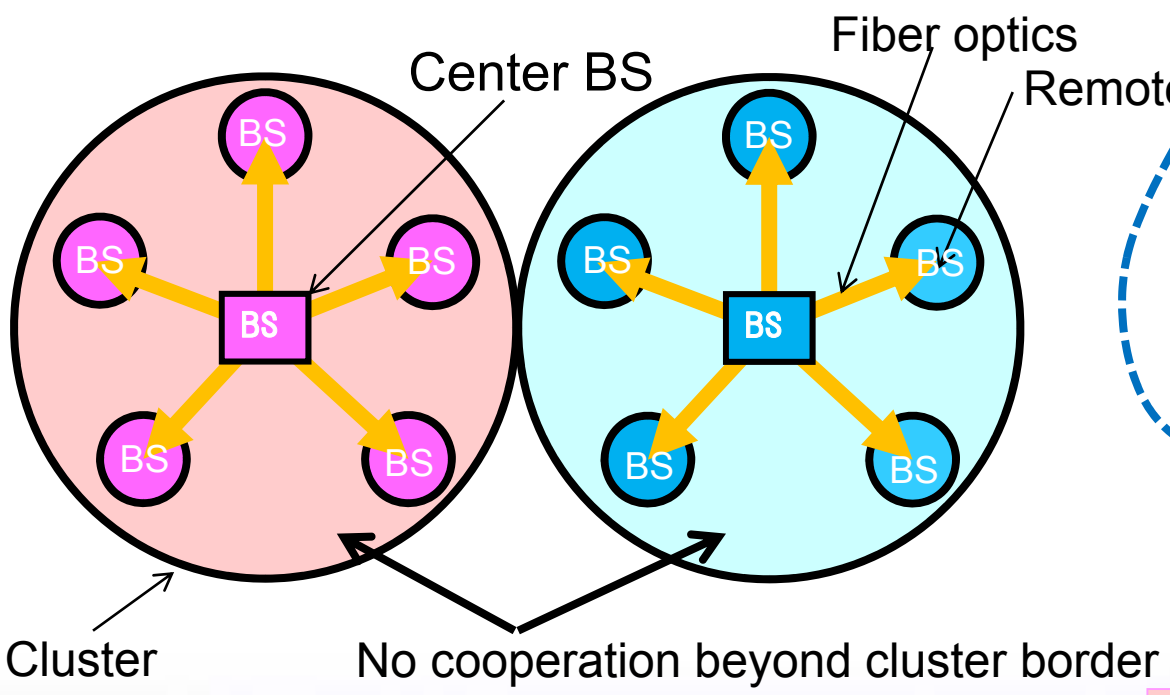
(1) Fiber optics:
- Amount of information and small delay (some μs) is in the ideal level
- No additional standard specification is required.

(2) X2 interface :
- Flexibility increase in deployment, which contribute to cost-reduction,
- Even in current X2 interface, availability of Fiber optics is no more mandatory, if 3GPP focuses on CoMP scheme which less impacts on X2 interface,
- In high-capability X2 interface, Information volume and delay may not be an issue, although further capability enhancement of X2 I/F is also required.

X2 Interface Advantage: - No cluster boundary issues

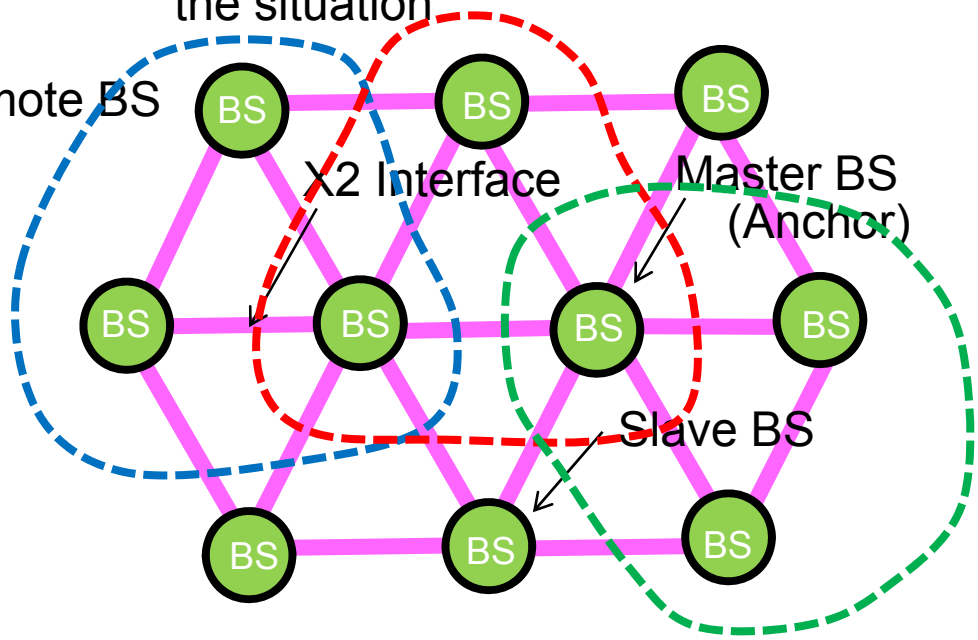
(1) Static coordination over Fiber Optics

Cooperation by Center BS



(2) Dynamic coordination over X2 Interface

Cooperation by Master (Anchor) BS to be dynamically set up according to the situation



Cooperation between any BSs

- This becomes crucial when CoMP deploys in urban area, in which typical cluster size is less than 1km in radius.

- In the dense urban area, the capability to deal with boundary area (seamless operation) might be more important than high volume of data and no delay.

Possible issue:
- Impact on X2 interface traffic (1)

Issue: *CoMP requires a large amount of shared information, but X2 interface may not provide enough capacity for it.*

Solutions:

Impact on X2 interface can be reduced by;

(1) CoMP scheme:

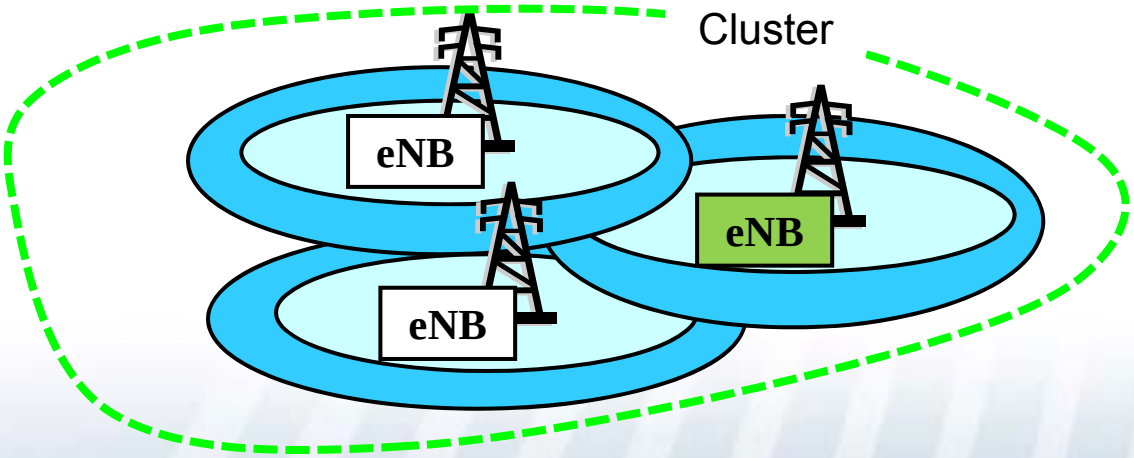
Some scheme have less impact on X2 interface traffic, e.g. DPS and CS/CB,

Possible issue:
- Impact on X2 interface traffic (2)

(2) Coordination area

By setting appropriate coordination area, it has less impact on X2 interface traffic;

- Only 20% of UEs are in coordination if coordination area is focusing on *near cell-border area*.
- This can reduce amount of traffic load in the order of conventional hand-over traffic load



Possible issue:
- Impact on X2 interface traffic (3)

(3) Coordination criteria

- Appropriate choice of the criteria can make the coordination take place only in a necessary situation and obtain better improved user throughput

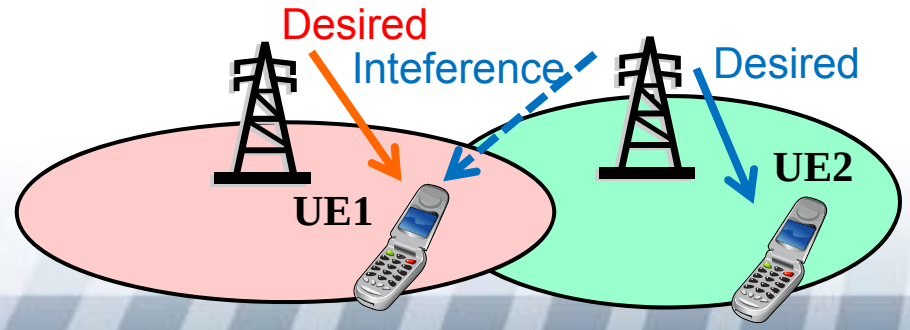
For example, dynamic BS coordination is performed only when

$$\alpha (Th_1 + Th_2) < Th'_1 \quad [\alpha : \text{factor } (0 < \alpha)]$$

where

- *Th*1, *Th*2 : UE1 & UE2 throughputs before coordination
- *Th*'1 : improved UE1 throughput after coordination by stopping UE2

- α=1.0 keeps overall throughput i.e. no overall throughput loss
- α<1.0 improves UE1 throughput at cell-border



Usage of X2 Interface is important for Operators due to practical reasons

- CoMP scheme using X2 interface is necessary to realize it in rural areas, where optical fiber is not available.

- CoMP scheme using Fiber optics might be problematic in urban areas, where a lot of cluster borders exist even in a very small area.

A proposed two step approach for CoMP standardization

In addition to the on-going standardization toward Rel-11 on

- JT, DPS & CS/CB over Fiber Optics

3GPP should further take the following two step approach to fully address the CoMP issue;

CoMP scheme less impacted on X2 interface should be considered

(1) Step 1 (Rel-12):

- DPS & CS/CB over X2 Interface,
  since their smaller amount of control information and looser demand for control delay, being compared with JT.

Capability enhancement of X2 interface should also be considered

(2) Step 2 (Rel-12 or Rel-13):

- JT over X2 Interface,
  since its larger amount of control information and tighter demand for control delay.

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Thank you for your attention