3GPP RAN workshop on REL-12 onwards

Ljubljana, Slovenia, June 11-12, 2012
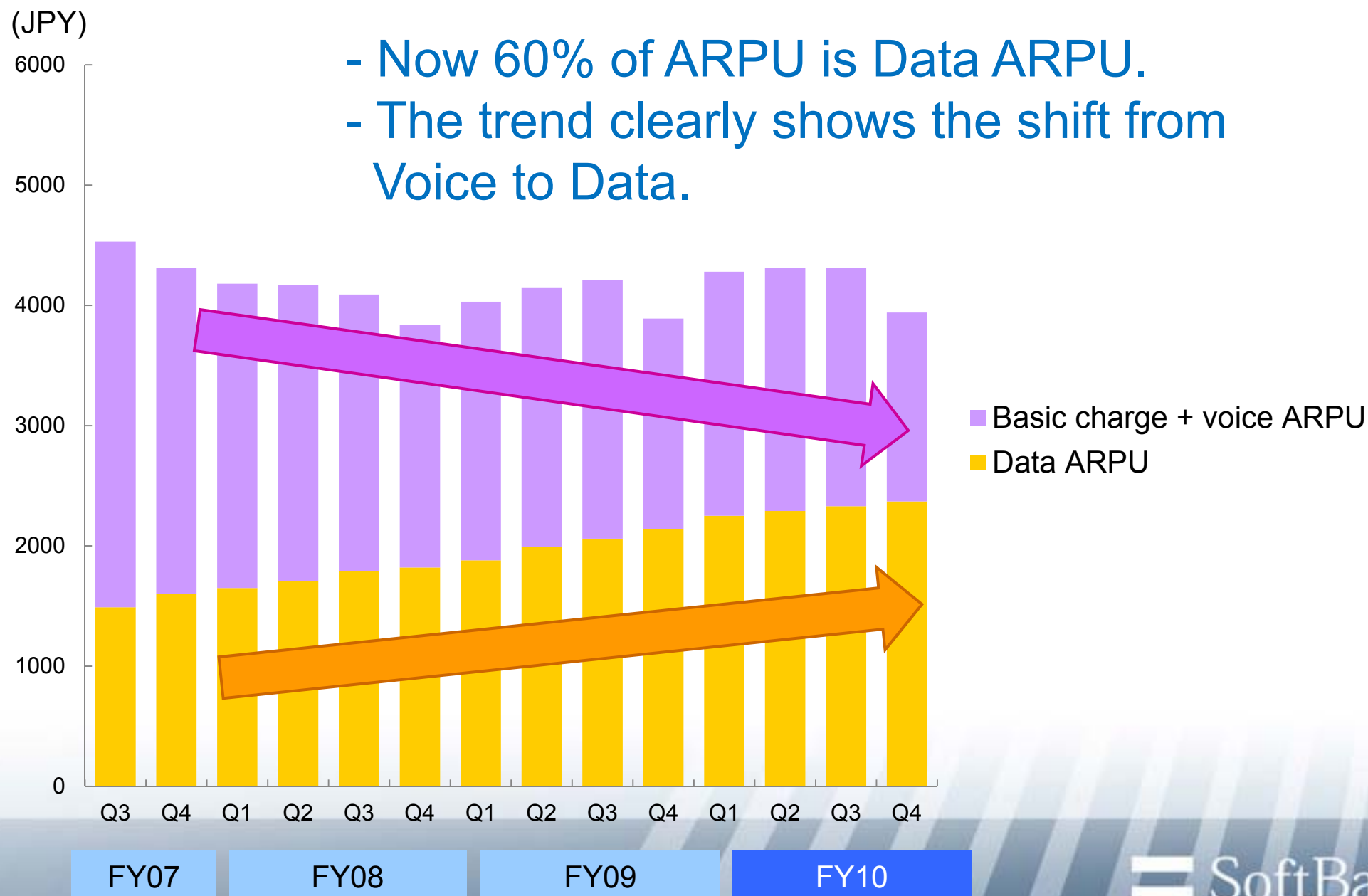
SoftBank Mobile Corp.

SoftBank

Trend of mobile communitaions

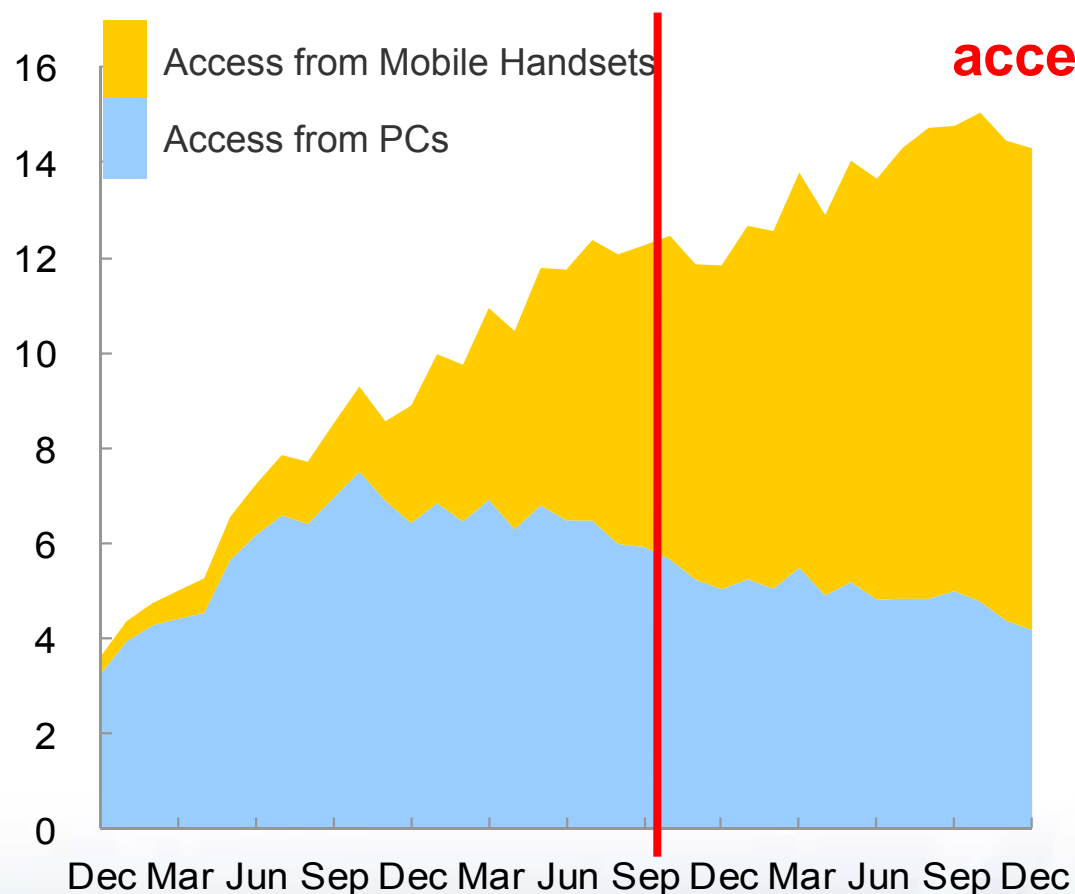## Towards Mobile Internet

Trends in Voice and Data ARPU

- Now 60% of ARPU is Data ARPU.
- The trend clearly shows the shift from Voice to Data.

Legend:
- Basic charge + voice ARPU
- Data ARPU

Y-axis: (JPY) — 0, 1000, 2000, 3000, 4000, 5000, 6000

X-axis quarters: Q3, Q4 | Q1, Q2, Q3, Q4 | Q1, Q2, Q3, Q4 | Q1, Q2, Q3, Q4

FY07 | FY08 | FY09 | FY10

Internet Access - from PC to Mobile Terminal

(Billion PV)

Page views of Mixi

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

Access from Mobile Handsets

Access from PCs

16
14
12
10
8
6
4
2
0

Dec Mar Jun Sep Dec Mar Jun Sep Dec Mar Jun Sep Dec

| 2005 | 2006 | 2007 | 2008 |

Reference: IR Data sheet, Mixi corporation

SoftBank

From Voice to Data & From PC to Mobile

Voice ➡ **Data**

Mobile Terminal ⬅ PC

Smart Phone

SoftBank

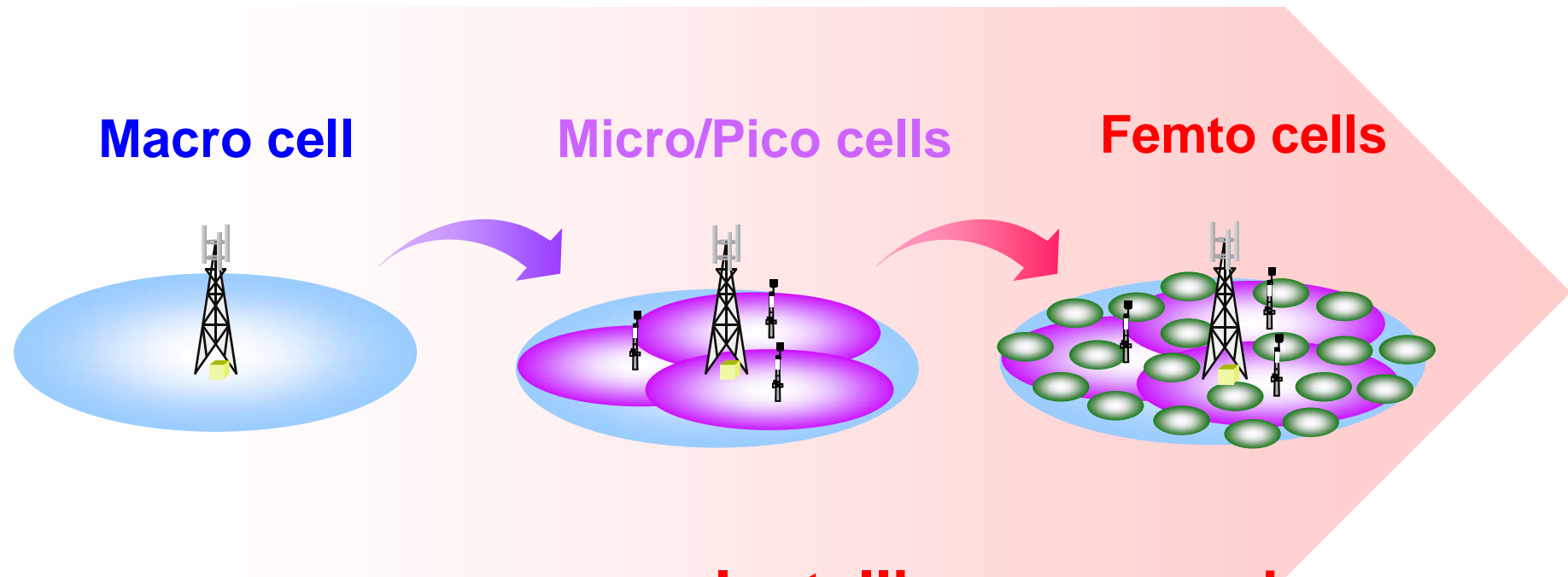# Mobile Traffic Growth Forecast for Next Decade

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

(BH-Tbyte)

- – **It is impossible to accommodate the traffic expected by simple expansion of current system architecture.**

- – **100% annual growth rate in last 4 years**

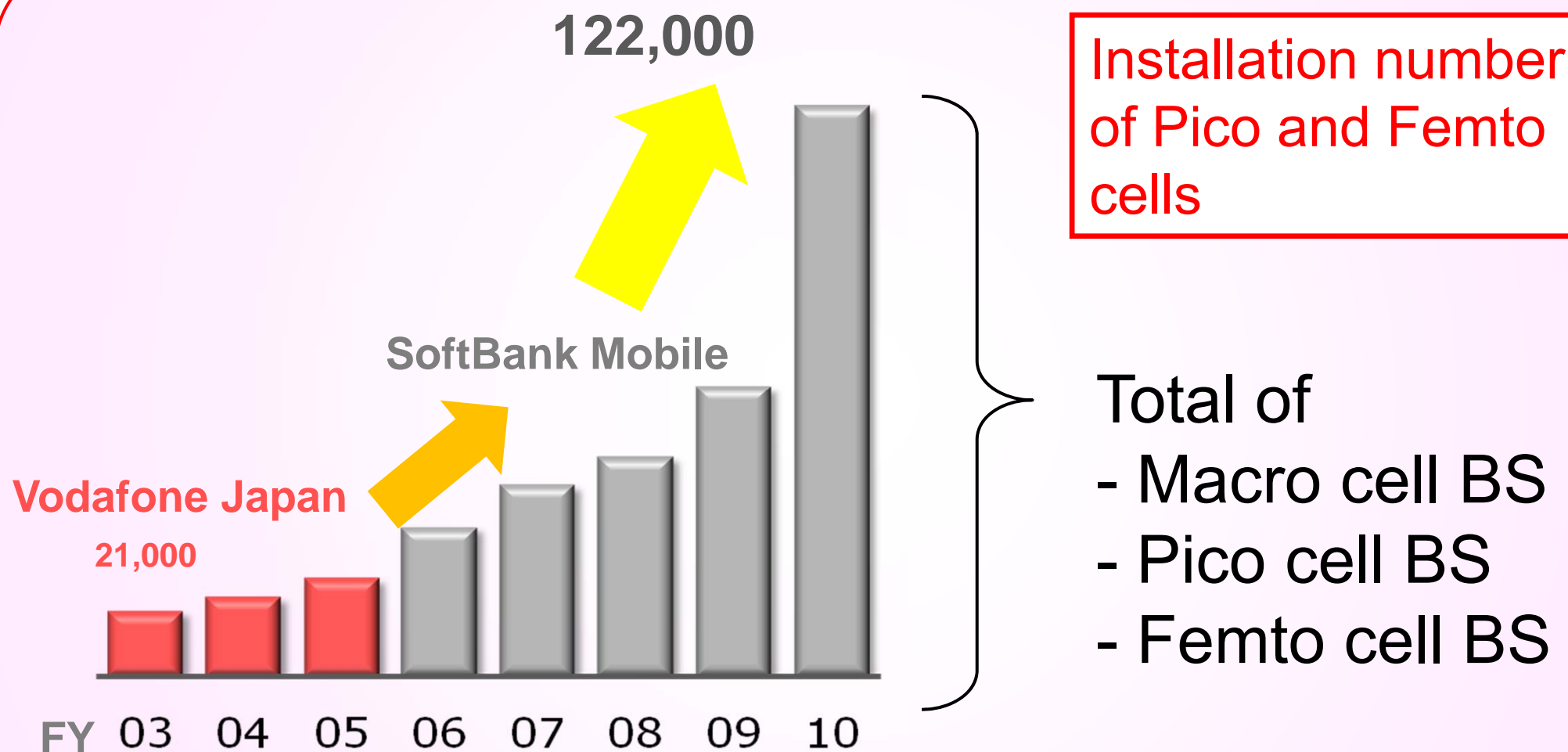- – **Technologies for efficient spectrum usage and new spectrum licences are required**

SoftBank

Accommodating Explosion in Mobile Traffic

Introduction of Micro cell and Femto cell

Macro cell

Micro/Pico cells

Femto cells

**Installing more and more
Pico and Femto cells**

SoftBank

Number of Base Stations Deployed by SBM

122,000

SoftBank Mobile

Vodafone Japan

21,000

FY 03 04 05 06 07 08 09 10

Installation number of Pico and Femto cells

Total of
- Macro cell BS
- Pico cell BS
- Femto cell BS

SoftBank

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

- **Flexible deployment for cost reduction**
  - increasing number of pico and femto cells in mobile network

SoftBank

A proposed focus area of CoMP technologies

CoMP Technologies

- CoMP (<u>Co</u>ordinated <u>M</u>ultiple <u>P</u>oint 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 LTE-Advanced

SoftBank

CoMP technogloy – 3GPP scenario 2 -

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

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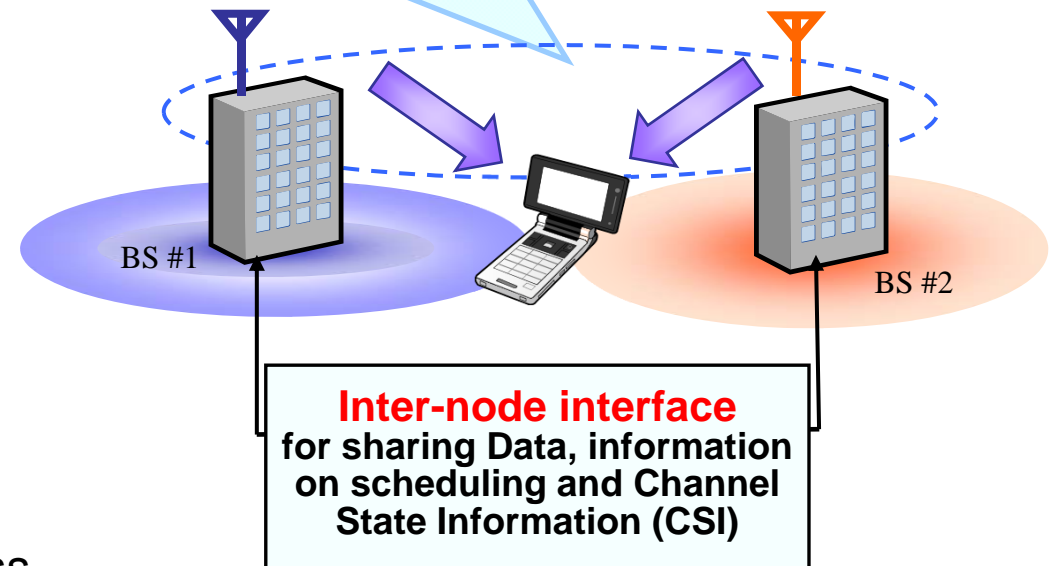
(3) Coordinated Scheduling/Beamforming (CS/CB)
- to transmit signals only from a serving node by scheduling of the serving node
- to improve SINR at cell-boundary by interference coordination or beamforming.

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

BS #1

BS #2

Inter-node interface
for sharing Data, information on scheduling and Channel State Information (CSI)

Inter-node interface is a key in CoMP

SoftBank

13

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
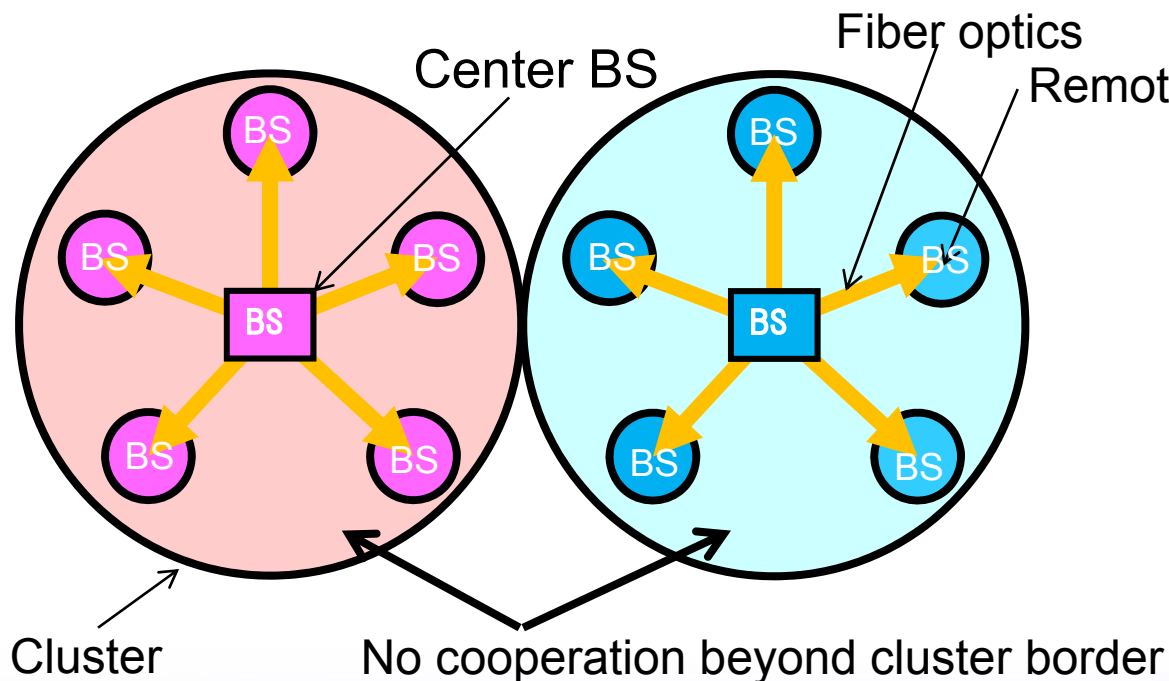- No additional standard specification is required.

(2) X2 interface :
- High-capability X2 interface: Information volume and delay may not be an issue in some cases, although further capability enhancement is required.
- Availability of Fiber optics is no more mandatory. -> To Increase Flexibility in deployment, which contributes to cost-reduction

SoftBank

Standardized CoMP X2 interface enables to deal with 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

Center BS

Fiber optics

Remote BS

Cluster

No cooperation beyond cluster border
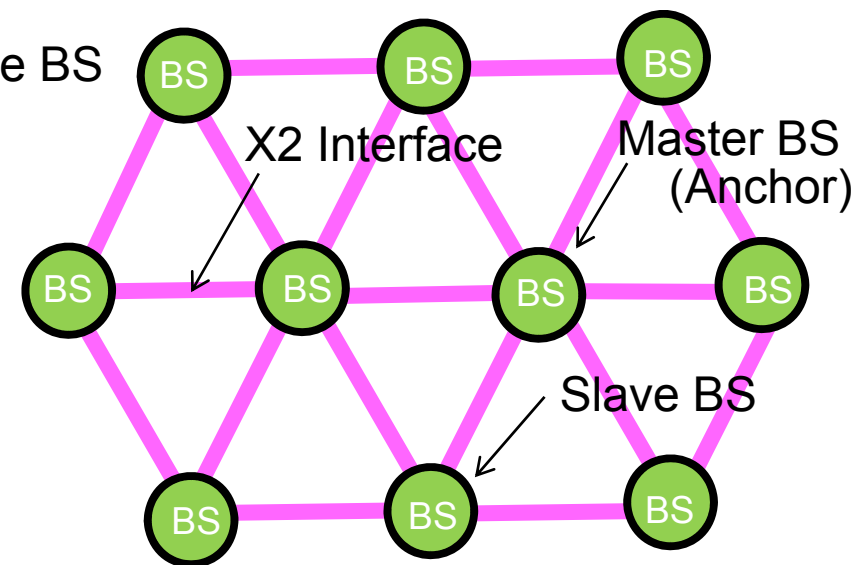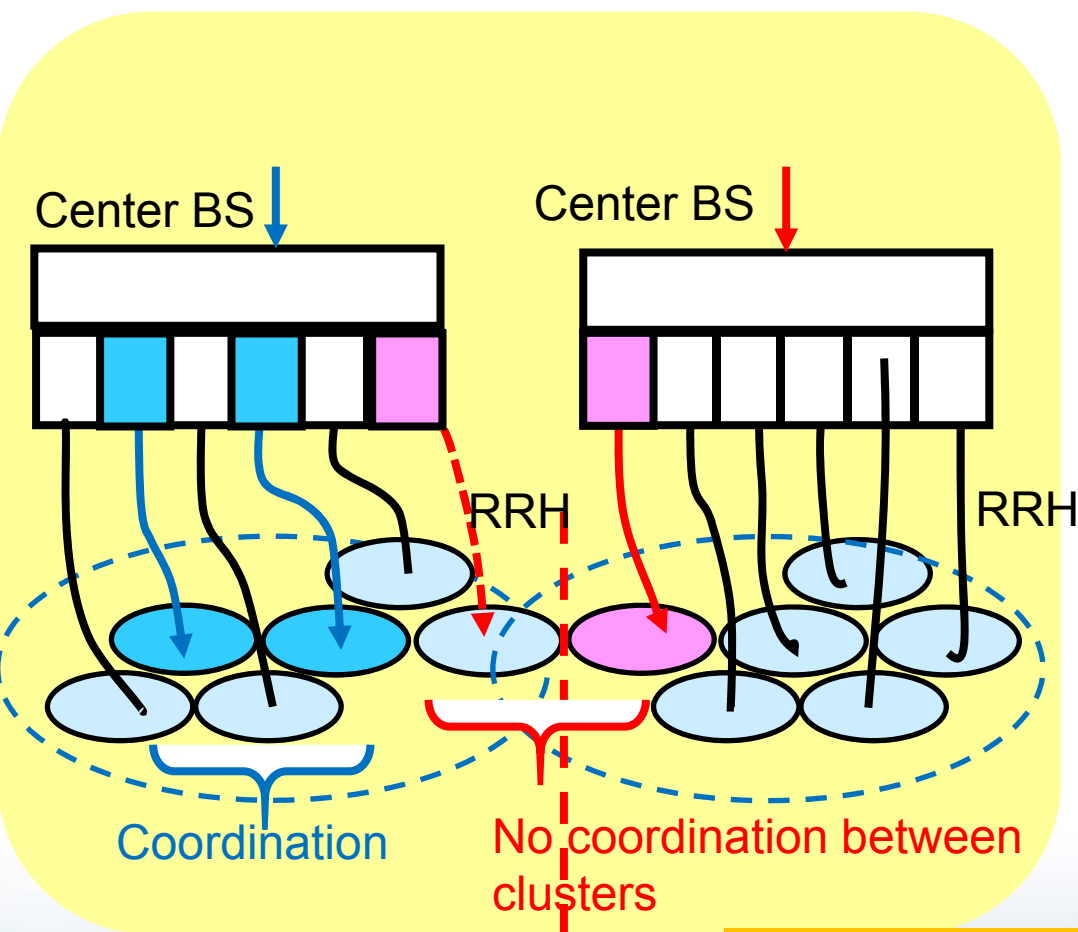
X2 Interface

Master BS (Anchor)

Slave BS

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.
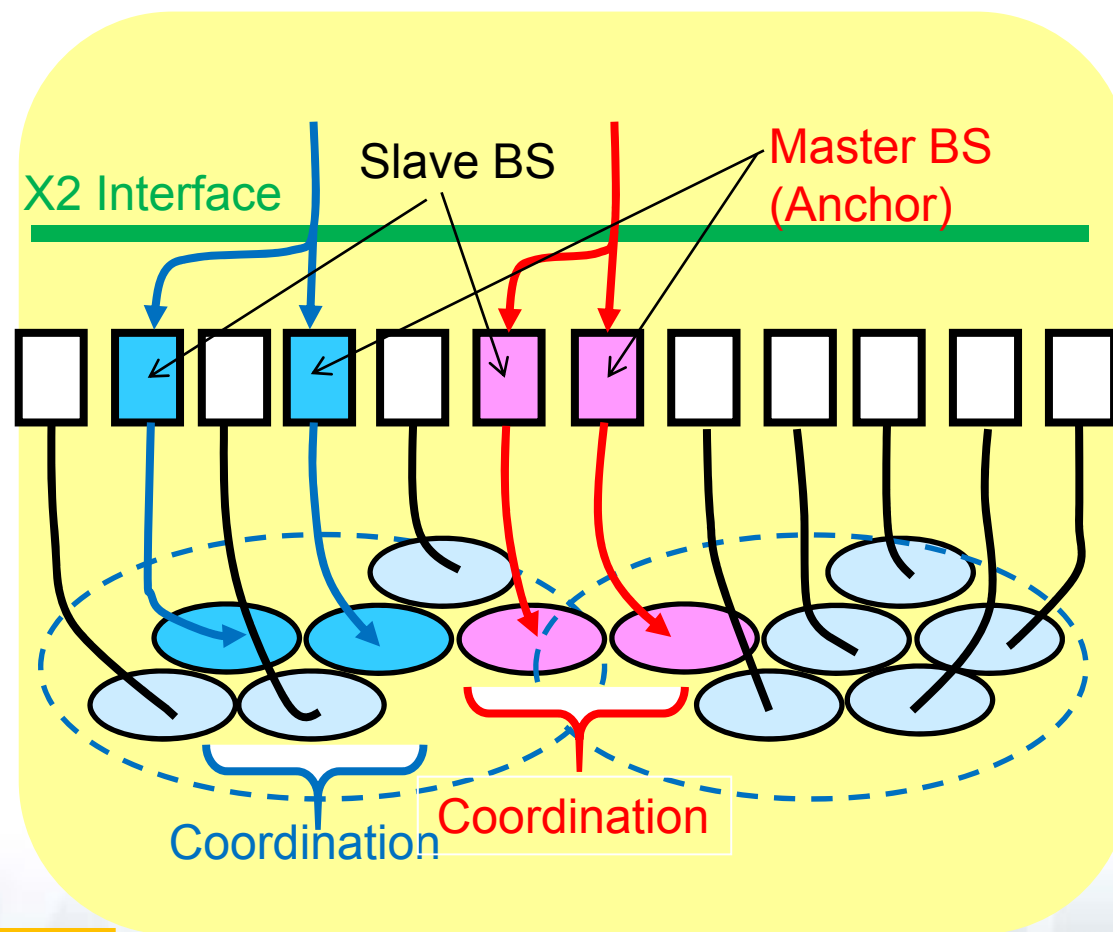
15

Examples of backhaul network implementation

(1) Static coordination over Fiber Optics
(Center BS & RRH, Remote Radio Head)

(2) Dynamic coordination over X2 Interface
(Master (Anchor) & Slave BS)

Center BS

Center BS

RRH

RRH

Coordination

No coordination between clusters

Severe Interference due to discontinuity between clusters

X2 Interface

Slave BS

Master BS (Anchor)

Coordination

Coordination

SoftBank

16

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.

SoftBank

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;

(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.

(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.

Capability enhancement of X2 interface should also be considered

SoftBank

Thank you for your attention