Reasons for and Measures to Counter a Series of LTE Communication Outages

June 10, 2013

KDDI CORPORATION
President　Takashi Tanaka

Overview of Service Impact

Situations arose in which au's 4G LTE data communication and voice communication became unavailable or difficult to access

Date of Occurrence		April 27	May 29	May 30
Data communication service[Note1]	Time occurred	4:01pm-10:18pm (6 hours, 17 minutes)	4:30am-11:13pm (18 hours, 43 minutes)	1:04pm-11:02pm (9 hours, 58 minutes)
	[Impact] Subs/ Area	Max. of approx. 590k Part of Tokyo, Kanagawa, and Yamanashi prefecture	Max. of approx. 560k Part of Tokyo, Kanagawa, and Yamanashi prefecture	Max. of approx. 640k Part of Tokyo, Kanagawa, and Yamanashi prefecture
Voice communication service	Time occurred	–	9:30am-12:22pm[Note2] (2 hours, 52 minutes)	Note3
	[Impact] Subs	–	Transmission: approx. 28k[Note2] Receipt: approx. 86k[Note2]	Note3

Note1: Some customers with 4G LTE compatible terminals were affected.
Note2: Some au customers (including 3G) who subscribed in Kanto area were affected. Also, some reception delays in the SMS service were experienced.
Note3: During the restoration process, some customers experienced temporary difficulties with receipt.

Promise Made at the Time of Our Results Announcement on April 30

I will take the lead in investing capital expenditures to drastically improve our technologies and operation, including higher software quality, shorter restoration time, stronger response to unforeseen outages, and enhanced system via dispersed facilities.

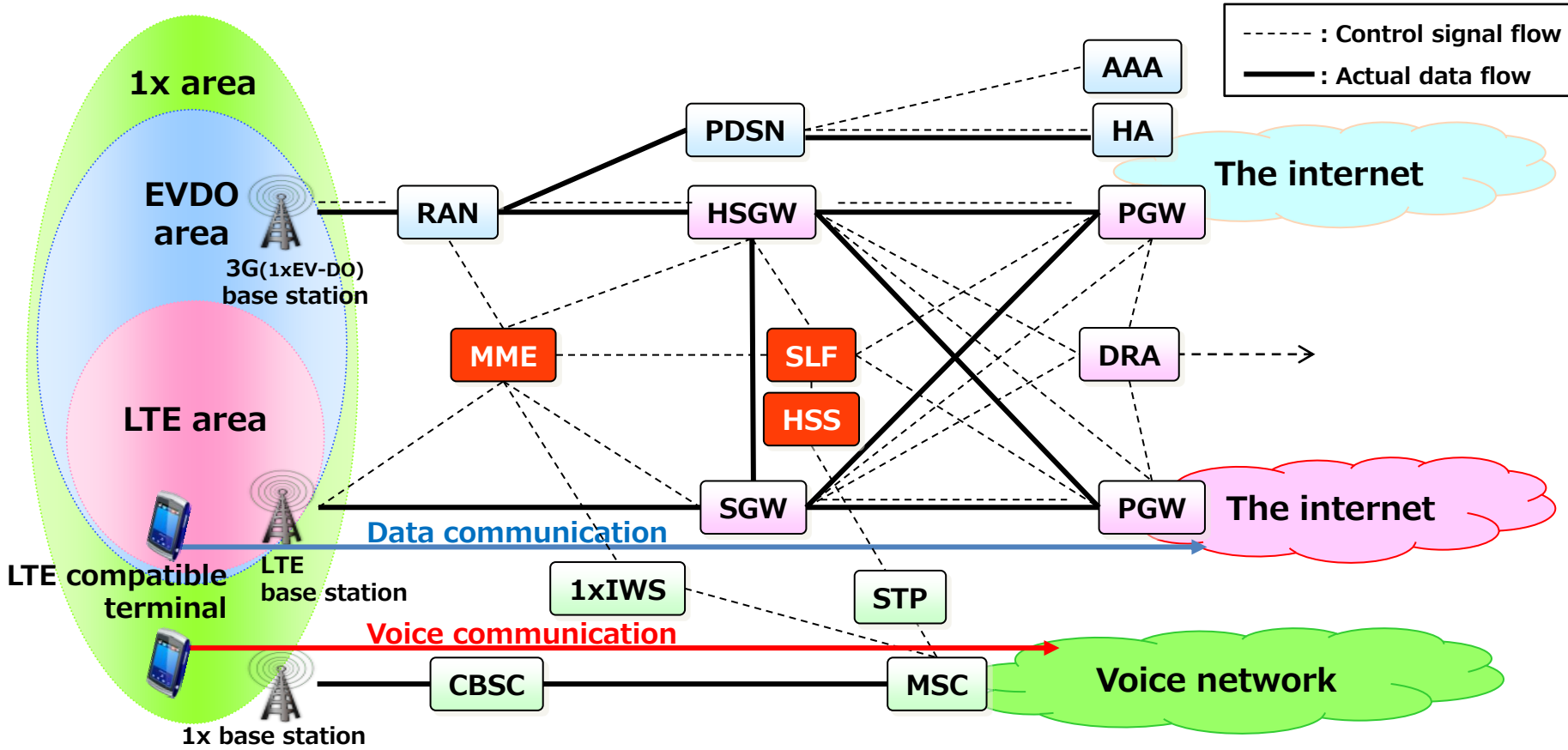
Just as we had made this our topmost management priority, LTE communication outages occurred

Overview of Serial LTE Communication Outages

Communication outages originated with LTE base station control devices (MMEs)

April 27	■ Within the MMEs, a reset bug related to fragmentation processing caused failure at one port. This triggered an internal recovery processing bug, which led to failure at both MME ports.
May 29	■ Hardware failure occurred when uploading to one MME port a correction file to resolve the failure that occurred on April 27, leading to a decision to return system to its original state (resulting in failure at one MME port). As processing was passed to another MME port, some congestion occurred at that port, triggering the recovery processing bug mentioned above. As a result, the problem spread to both MME ports. ■ In line with the failures at both MME ports, subscriber information management systems (HSSs) grew congested, and at the subscriber determination node (SLF) for selecting those HSSs, some HSS connections were not performed normally.
May 30	■ When preparing to again upload the correction file to resolve the cause of the failure on April 27, overloading of one specific process on one MME port caused the one port to fail. As processing was passed to another MME port, some congestion occurred at that port, triggering the recovery processing bug described above. As a result, the problem spread to both MME ports.

Overall Structure of the au Mobile Network



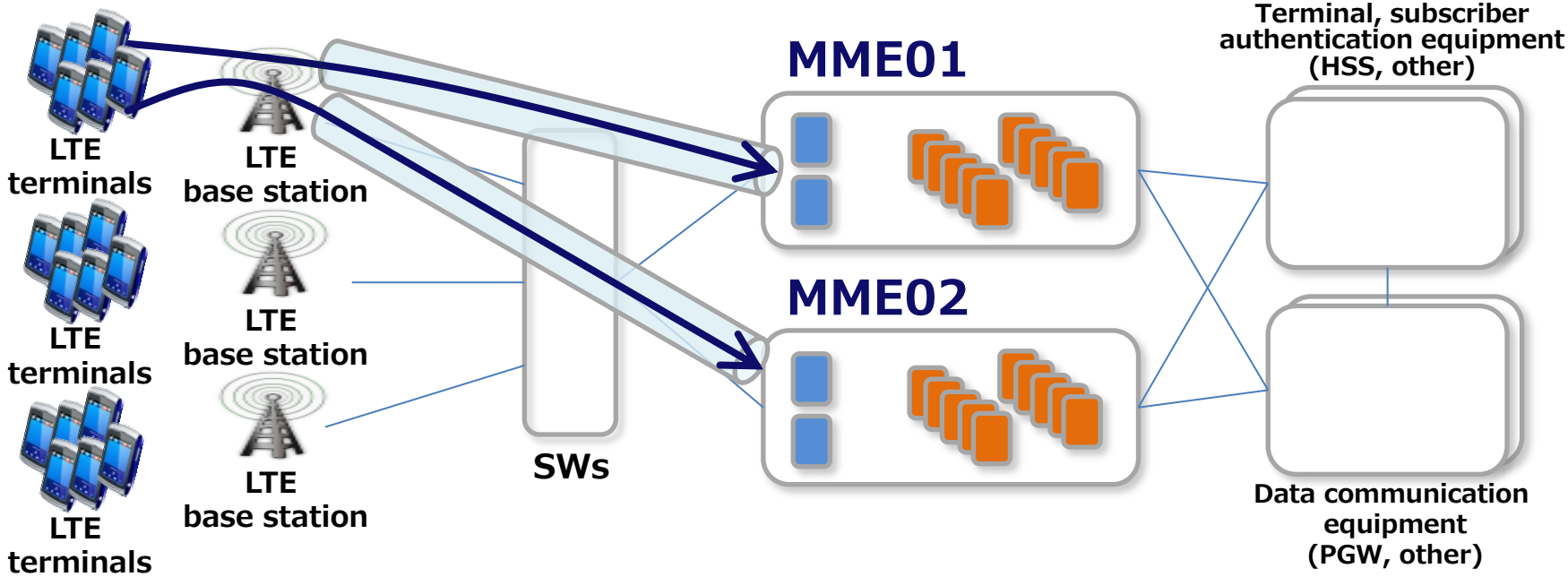
*MME: Mobility Management Entity *SLF: Subscriber Location Function *HSS: Home Subscriber Server

LTE Base Station Control Devices (MMEs)

Manage LTE base station connections and control transition between LTE terminals in LTE base station areas

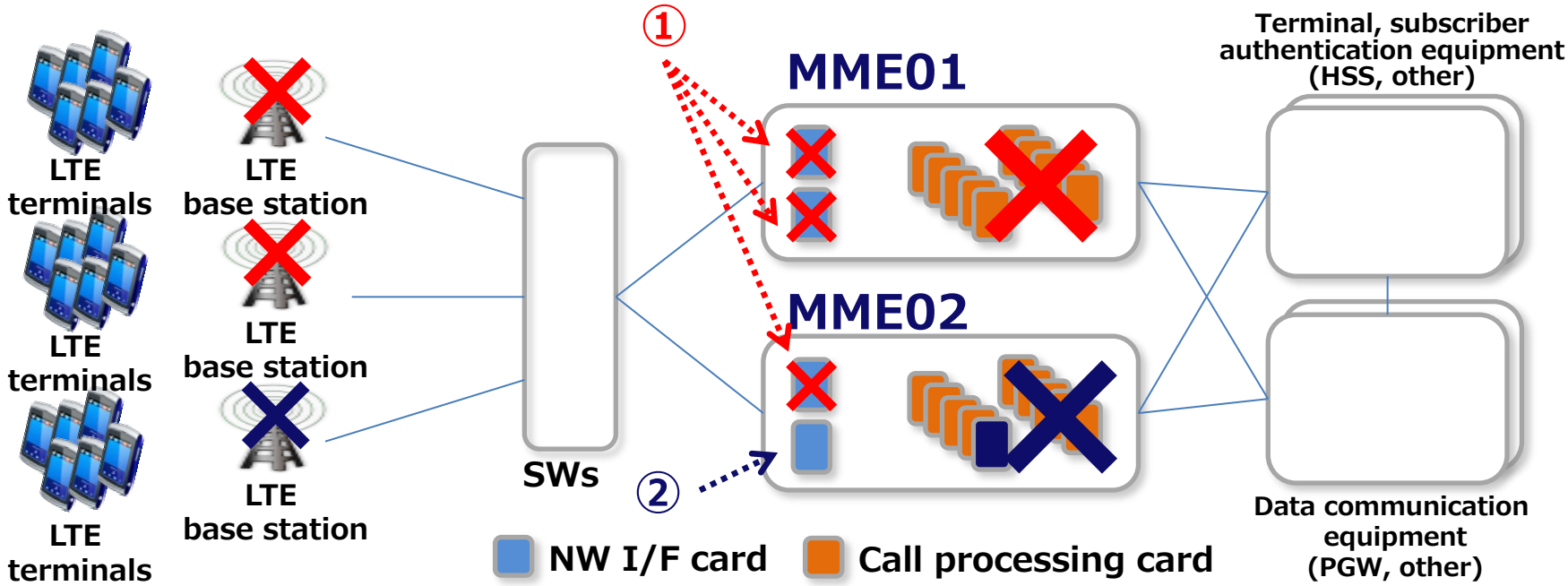
NW I/F cards: Process network connections between base stations and nodes

Call processing cards: Process various MME functions



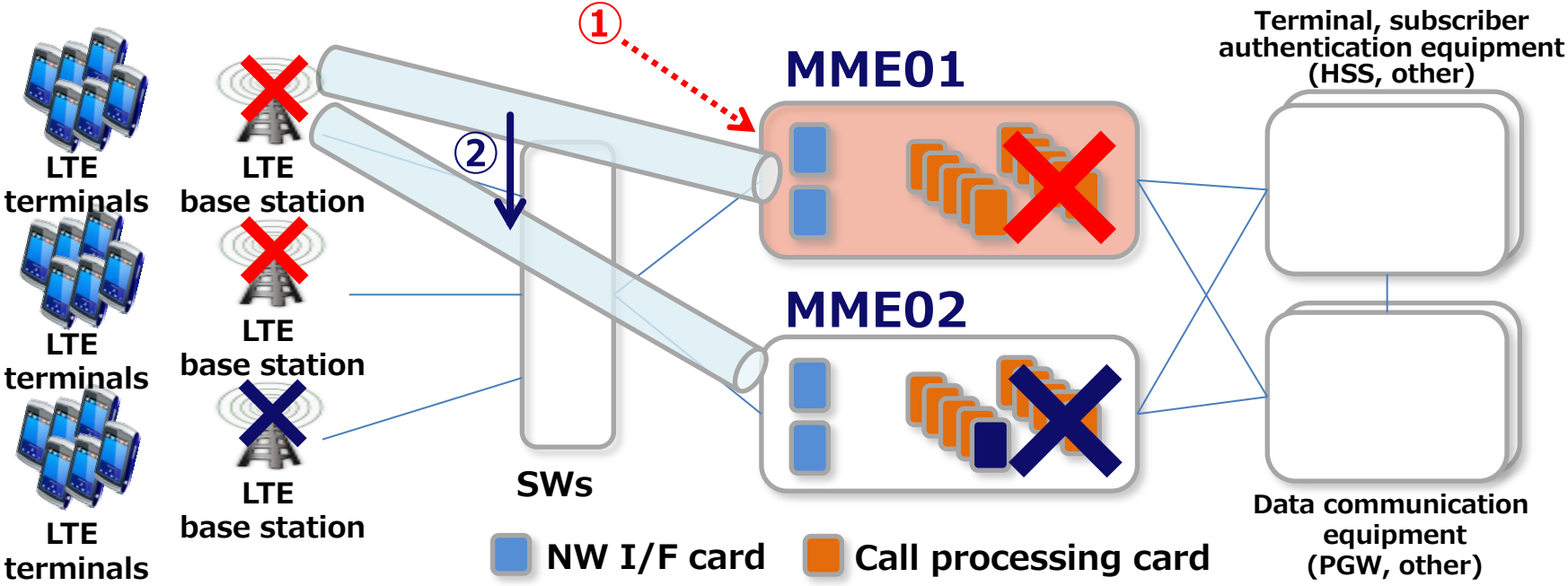
April 27: Details of the Data Communication Outage

(1) On the MME, a reset bug related to fragmentation processing caused failure at one port.
(2) This triggered an internal recovery bug, which led to failure at both MME ports.



May 29: Details of the Data Communication Outage

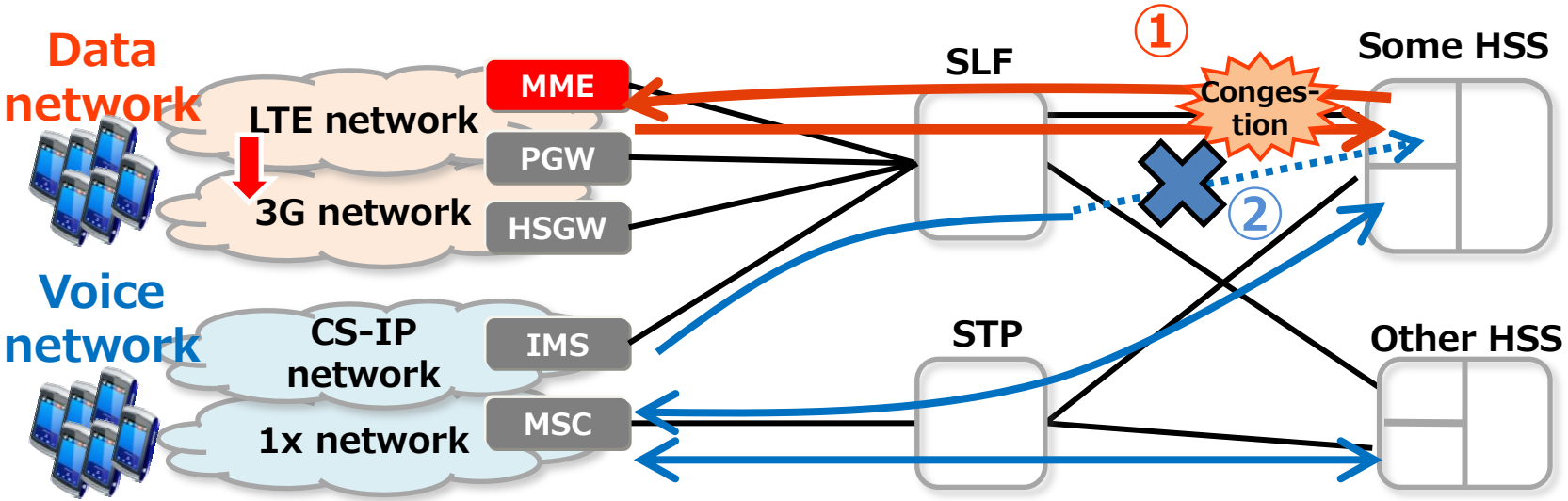
(1) Hardware failure occurred when uploading to MME01 a correction file to resolve the failure that occurred on April 27, leading to a decision to return system to its original state. As a result, MME01 failed.
(2) Following on from MME01 processing, some congestion in processing occurred at MME02. This triggered an internal recovery processing bug. As a result, the problem spread to both MME ports.



May 29: Details of the Voice Communication Outage

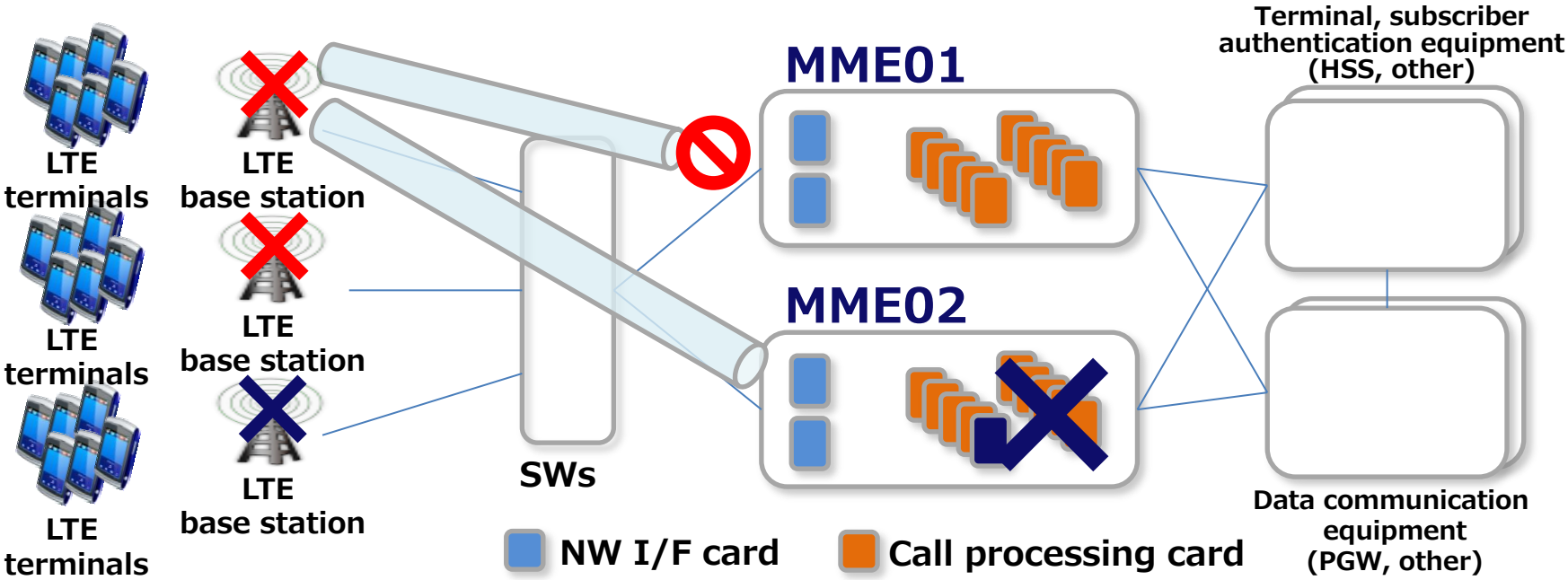
(1) In line with the MME failure, mobile devices handed down from LTE to 3G networks. Subscriber information management systems (HSSs) received a large volume of connection notifications, leading to congestion at the MME and some HSSs (two units).

(2) At the subscriber management node (SLF), which handles the function of selecting connections to HSSs, some connections to this HSS did not occur normally, making voice transmission and reception difficult or impossible for some subscribers and delaying SMS delivery.



May 30: Details of the Data Communication Outage

When preparing to again upload the correction file to resolve the cause of the failure on April 27, overloading of one specific process on an MME port caused one port to fail. Processing at one MME port led in turn to some congestion at other ports, triggering an internal recovery processing bug. As a result, the problem spread to both MME ports.



Serial Communication Outage Issues

April 27	■ Handling of the reset bug related to fragmentation processing [Critical] ■ Handling of the recovery processing bug [Critical] ■ Service quality improvement, shortening of restoration period
May 29	■ Hardware quality improvements ■ Handling of the recovery processing bug [Critical] ■ Service quality improvement, shortening of restoration time ■ Increased tolerance to high instantaneous loads when switching
May 30	■ Handling of the recovery processing bug [Critical] ■ Service quality improvement, shortening of restoration time ■ Increased tolerance to high instantaneous loads when switching

Currently managing operations stably

Basic Policy on Countermeasures to Serial Communication Outages

Ensure "functional safety" appropriate to the smartphone/4G era
<Fail safe>

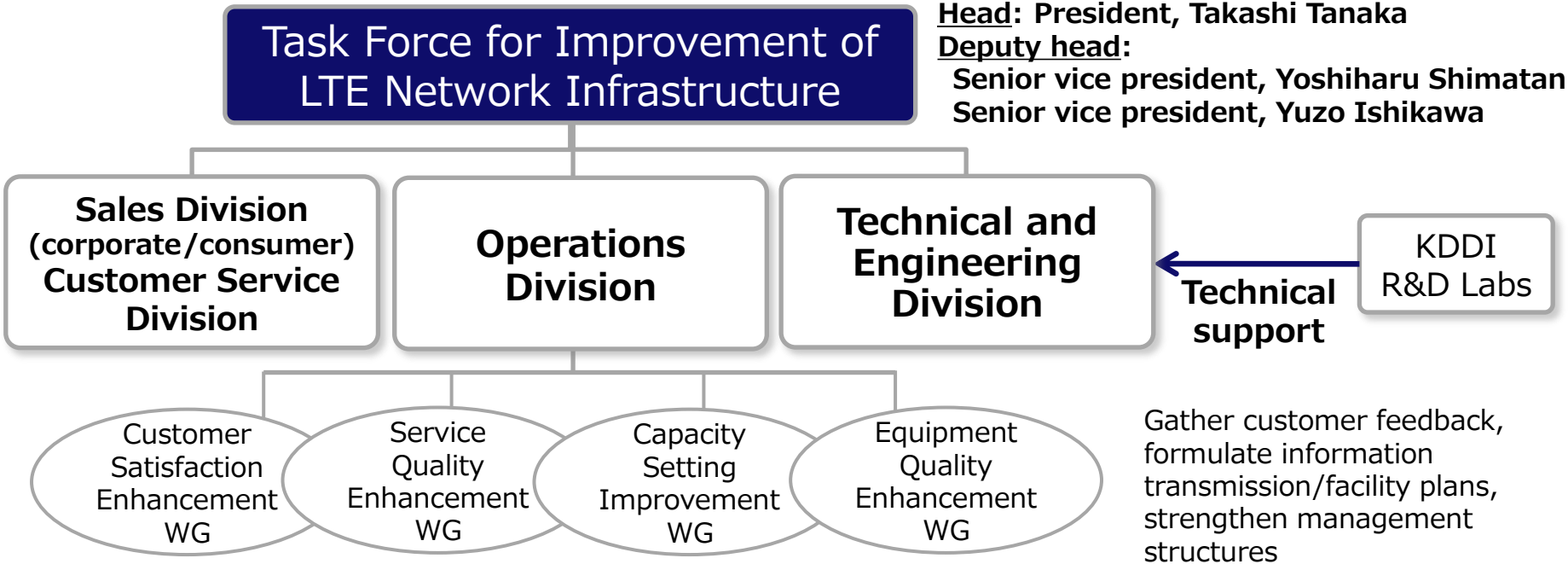
Software and hardware quality improvements
<Base>

Preventing communication outages in the smartphone/4G era
[Operation quality improvements]
(Work procedure re-establishment, promptness, certainty)

Preventing communication outages in the smartphone/4G era
[Establishment of design concept and guidelines for setting capacity]

Promotion Framework

Establishment of new companywide cross-sectional structure chaired by the president to ensure “functional safety” appropriate to the smartphone/4G era



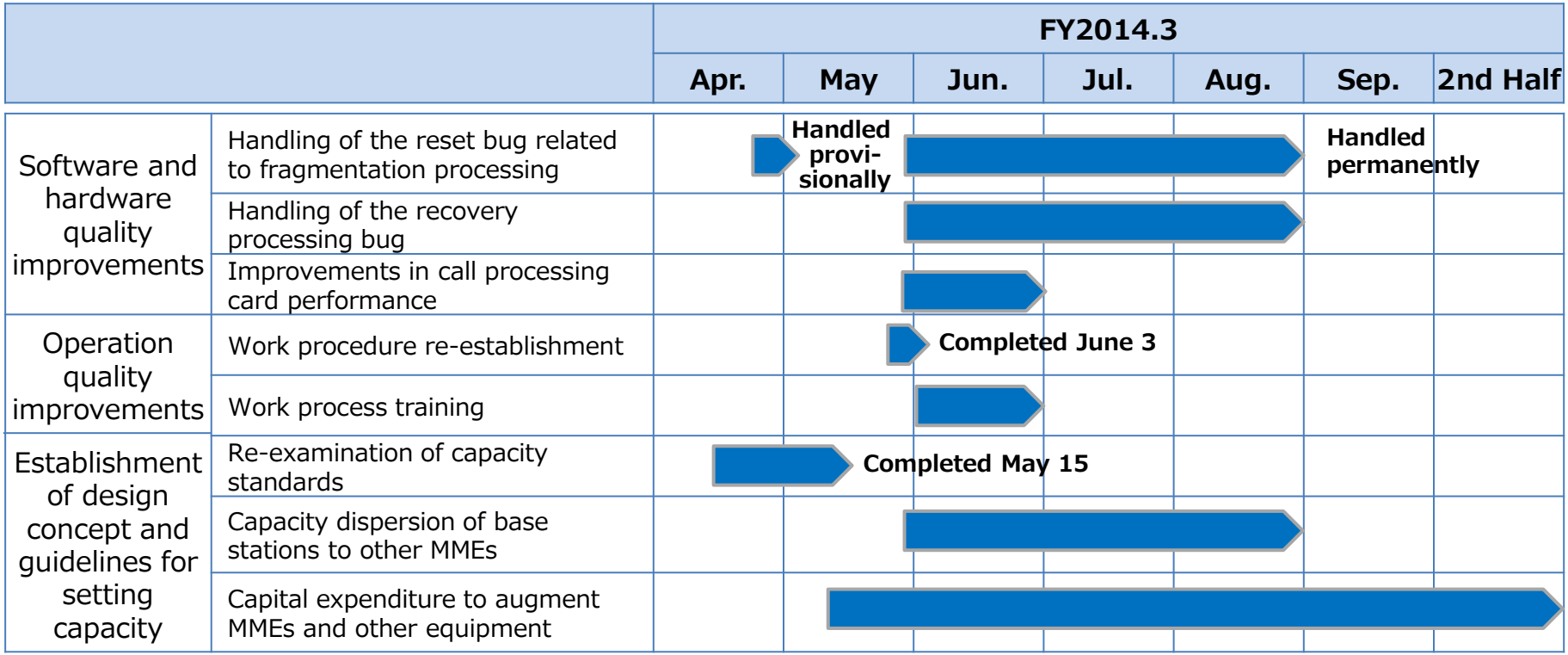
Specific Initiatives from April Onward

Date	Content of Initiatives
April 28	・Design procedures and system for shortening of restoration time ・Start strengthening monitoring system for nights and holidays
May 15	・Decide on capital investment measures for dispersing capacity on MMEs and other important equipment (¥23.0 billion)
May 24	・Decide to strengthen monitoring system (increase personnel) (implemented from June 1)
June 2	・Re-establish procedures for shortening of restoration time ・Roll forward schedule for increasing MME equipment
June 10	・Establish new Task Force for Improvement of LTE Network Infrastructure ・Increase capital investment in MME and other equipment (total of ¥30.0 billion), up ¥7.0 billion from amount decided on May 15

Schedule

Immediate Response to Resolve Serial LTE Communication Outages and Ensure “Functional Safety”

During FY2014.3, total additional capital investment of ¥30.0B to augment MMEs and other equipment



Our Apology to Customers

By way of apologizing to customers who were unable to use data communications or voice communications owing to the serial LTE communications outages, we propose to make amends as follows.

- Target customers:
  Customers[Note1] who at some point during the serial communication outages were unable to use LTE data communication at all, or who were unable to use voice communication during the outage period on May 29
- Amends:
  When requesting payment, we will reduce by ¥700 (net of tax)[Note2] the amount billed as communication fees.

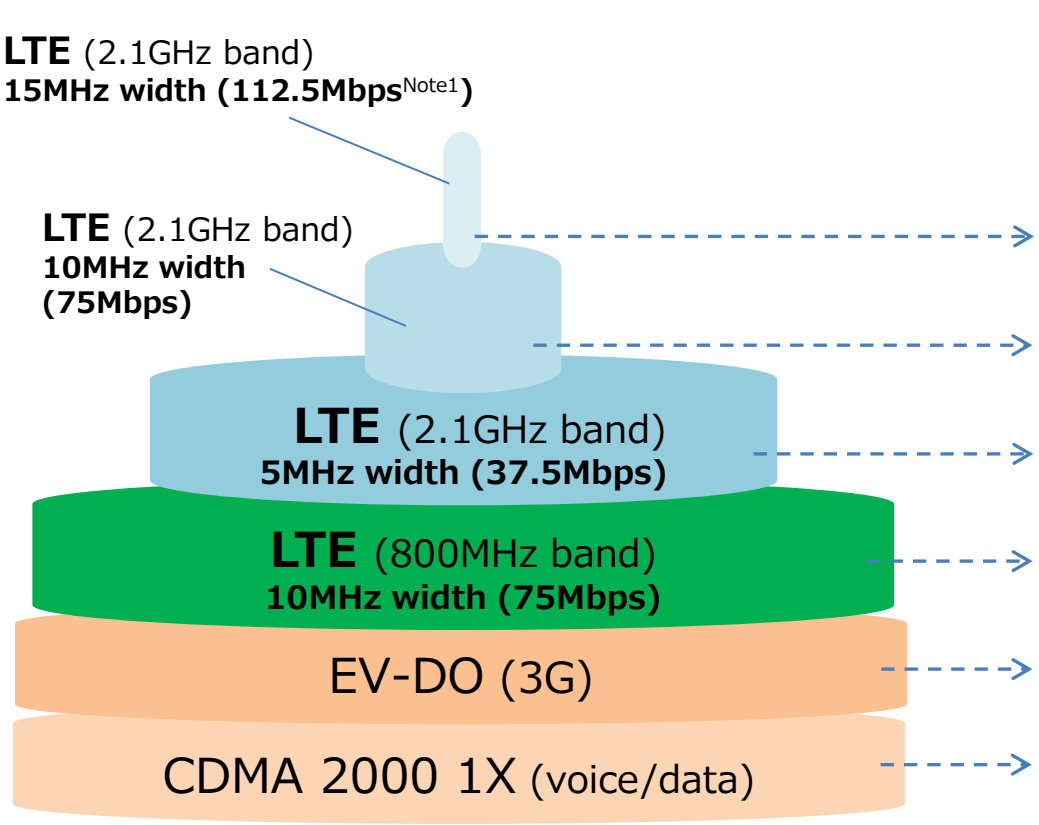
Note1: KDDI requests that target customers respond by sending us an “Important Notice” e-mail by June 30.
Note2: The amount corresponding to three days of LTE subscriber service, including basic monthly charge, ISP usage fee, and LTE packet basic rate. This reduction will be applied to a bill submitted in July or after, as soon as preparations are in place.

We will put forth our utmost effort throughout the Company to prevent recurrence. In addition, in response to rising data communication volumes, we will provide communication networks that customers can have peace of mind in using by ensuring “functional safety.”

LTE Area Coverage

Mobile Network System

*"Android" is a trademark or a registered trademark of Google Inc.



Android™ LTE ter-minalNote2 (2013 Summer~)	Android™ LTE ter-minalNote2 (~ 2013 Spring)	2.1 GHz band LTE terminal	3G handset
●		●	
●		●	
●		●	
●	●		
●	●	●	●
●	●	●	●

Note: Communication speeds indicated above are maximum downlink speeds, according to wireless technology specifications.
Note1: Compatible terminals currently being offered for sale have a **maximum downlink speed of 100Mbps**.
Note2: In addition to the frequencies indicated above, Android LTE handsets also support the **1.5GHz band.**

LTE Actual Population Coverage Ratio

Communication method	March 31, 2013 (actual)	**Present (May 31, 2013)**	March 31, 2014 (forecast)
CDMA2000 1x (voice/data)	99%	99%	99%
EV-DO (3G)	99%	99%	99%
LTE (800MHz band) 10MHz width (mainly 75Mbps) Note1	96%	97%	99%
LTE (2.1GHz band) 5MHz width~ (mainly 37.5Mbps) Note1	63%	71%	80%
Of which, 10MHz width~ (mainly 75Mbps) Note1	14%	20%	Confirming
Of which, 15MHz width (112.5Mbps) Note1 Note2	–	1% or less	Confirming

Note: Please refer to the KDDI website for details regarding area. Actual results may differ from maximum speeds depending on the radio wave environment and other factors in the actual usage area (best-effort service).

Note1: Communication speeds indicated above are maximum downlink speeds, according to wireless technology specifications.

Note2: Compatible terminals currently being offered for sale have a maximum downlink speed of 100Mbps.

Standards for Calculating the Actual Population Coverage Ratio

[KDDI's Actual Population Coverage Ratio]

- For calculation purposes, Japan has been divided into 500m^2 grid squares. Actual population coverage is the coverage ratio in comparison to the total population of grid squares designated as part of KDDI's service area.
- In the event that part of the a grid square is in the coverage area, the area within the grid square is used to calculate the area coverage ratio (grid square area ratio), calculating the covered population as the population within that grid square times the grid square area ratio.

Methods of computing area coverage ratios **differ by company**.
Going forward, KDDI will use the presentation method determined after deliberations on this method by Ministry of International Affairs and Communications study groups and industry organizations.


KDDI