Audio-based Network Services | Media Processing | Device Upgrade

Technology Reports

Low-cost Media Processing Node Upgrade with Minimal Impact on User Services

Core Network Development Department Atsushi Mizuki †1
Sachiko Kichimi †2

NTT DOCOMO's media processing nodes consist of server devices that provide audio-based network services. As these server devices near the end of their serviceable life, they must be upgraded or replaced one by one.
In our latest upgrade, we implemented devices and licensed products designed for OPEX/CAPEX reduction that do not result in lower service quality or require specifications changes. We also developed equipment replacement and maintenance functions that do not affect ongoing services.

1. Introduction

NTT DOCOMO has deployed media processing nodes (MPN)*1 as system infrastructure to consolidate user services for audio, video and text media data and to enable new media services [1]. However, because a range of commodity products are included in the system infrastructure to provide high-quality user services as soon as possible, and these products are nearing the end of their serviceable life, they must be upgraded or replaced so that services can be continued.

Upgrading equipment does not just involve replacing it, but entails rethinking design policies to fit the external environments that have changed since equipment was deployed, and endeavoring to reduce costs by using existing facilities and consolidating and eliminating functions. These processes also require the inclusion of switching functions and procedures to minimize the impact on services provided to users during upgrades.

To upgrade MPN equipment nearing the end of its serviceable life, at NTT DOCOMO we have implemented equipment and licensed software products and reconsidered equipment structure to reduce operating expense (OPEX)*2 and capital expenditure (CAPEX)*3, and have developed switching and maintenance functions to minimize the impact on services during upgrades. This article describes these approaches and the newly developed functions.

2. Equipment Upgraded

MPN equipment handles a variety of network services (**Table 1**), and involves layered and linked service control equipment and processing equipment for media to provide those services (**Figure 1**). Service control equipment adopts Advanced Tele-com Computing Architecture (ATCA)*4, while media processing equipment consists of high-quality, commercially available solutions. Control of the maintenance infrastructure for operating the service control and media processing equipment that makes up these MPN is performed by dividing the ATCA's common operation and maintenance platform and operation and maintenance platform for unified management of commercially available

† 1 Currently, Multimedia Division, DOCOMO Technology, Inc.
† 2 Currently, Core Network Engineering Department

*1 **MPN:** A node of the NTT DOCOMO core network. It currently provides various media services including voice mail, melody call and other audio media services, video media services such as voice mail with videophone and SMS.

products into their respective roles.

This article describes upgrading of audio media processing equipment, and the operation and maintenance platform for unified management of commercially available products that are nearing the end of their serviceable life in MPN media processing equipment. Audio media processing equipment consists of media control, media processing and database equipment that provides audio services such as voice mail and melody call through media control, media processing and media data storage and management.

3. Upgrading Audio Media Processing Equipment

3.1 Reducing Costs

1) Media Control Example

Media control is part of audio media processing equipment deployed with original MPN implementation to control audio with voice mail and melody call services. After MPN implementation, handling of a range of new services such as Koe-no-Takuhaibin, call recording, disaster voice messaging and translation services became necessary. New licensed software was required to run on existing servers to provide these new services. However, the existing servers did not meet the recommended system specifications for some of these licensed software products or did not support them, or sales of existing servers had ceased and new servers with different specs had been deployed, sometimes resulting in new issues. The following describes the deployment of the Hanashite Hon'yaku translation server as an example of one of these issues and its solution.

Table 1　Services provided through MPN

Media	Service name
Audio	Voice mail service Melody call Disaster voice messaging service Koe-no-Takuhaibin (A service for directly delivering a message with your voice) Call recording service Hanashite Hon'yaku (Translation service)
Video	Video mail with videophone Video guidance service
Text	Short message service (SMS)

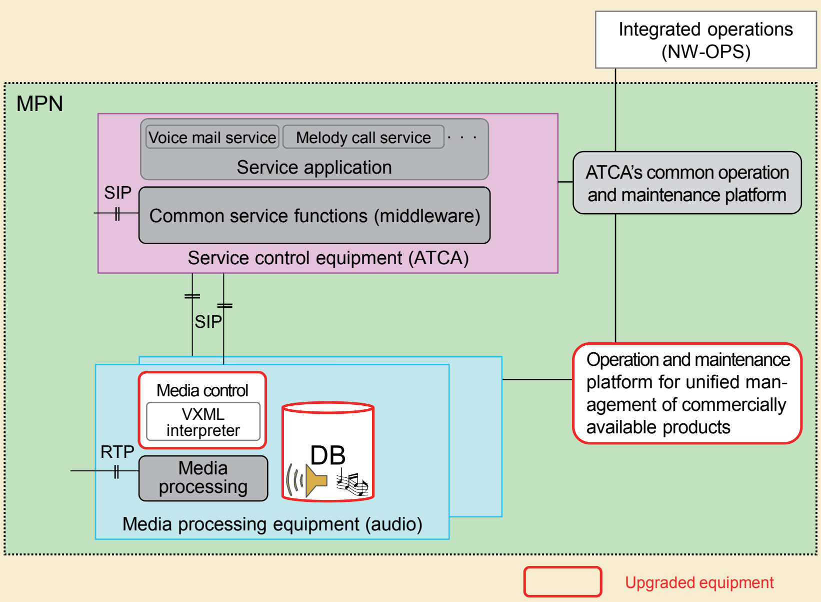

Figure 1　Upgraded equipment

*2　**OPEX:** Amount of money expended managing operations.

*3　**CAPEX:** Amount of money expended investing in facilities.

*4　**ATCA:** An industry standard defined by PCI Industrial Computer Manufacturers Group (PICMG) for communications equipment used by telecommunications carriers.

(1) Issues with Hanashite Hon'yaku translation server deployment

Upon implementing the Hanashite Hon'yaku audio processing server, sales of the existing servers had ceased and a new server with different specs was deployed. However, this commodity server was not intended for large-scale call processing, which resulted in resource usage issues. In this server, CPU resources to process user voice recognition calls were randomly assigned, and resource conflicts in layers where resources could not be sufficiently used resulted in call loss. This hindered CAPEX reduction because the number of servers had to be increased to maintain the call loss rate below the allowable level (**Figure 2**).

(2) Reduce CAPEX by solving the issue

We examined a number of solutions to the above issues, made comprehensive assessments of solutions including effects on cost and performance etc, and decided to include queuing in the commodity servers, so that if resource conflicts occur, the most recent call is quickly returned to the queue to reacquire different resources. This enables more effective use of server resources and minimization of the number of servers required (**Figure 3**). Thus, surplus facilities originally deployed as Hanashite Hon'yaku translation servers could be taken out of service.

We then examined the performance of the spare Hanashite Hon'yaku servers and confirmed that they could be used to succeed server equipment that was nearing the end of its serviceable life. This resulted in hardware cost savings (CAPEX reduction).

2) Example with Operation and Maintenance Platform for Unified Management of Commercially Available Products

(1) Issues with operation and maintenance platform for unified management of commercially available products

Initially, the operation and mainte-

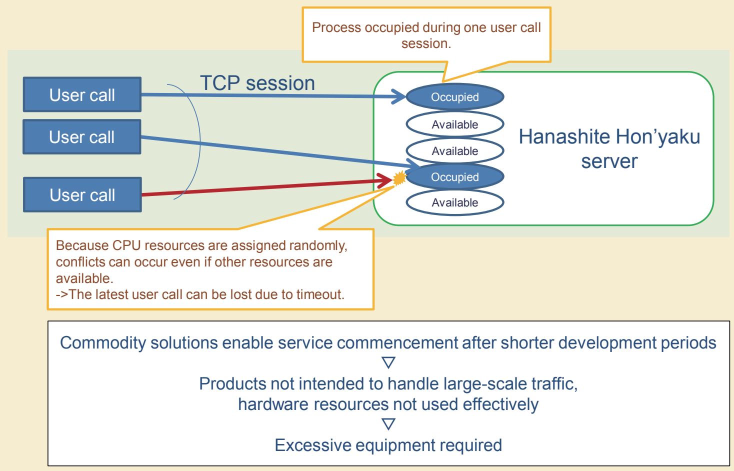

Figure 2 Issues with initial Hanashite Hon'yaku equipment deployment

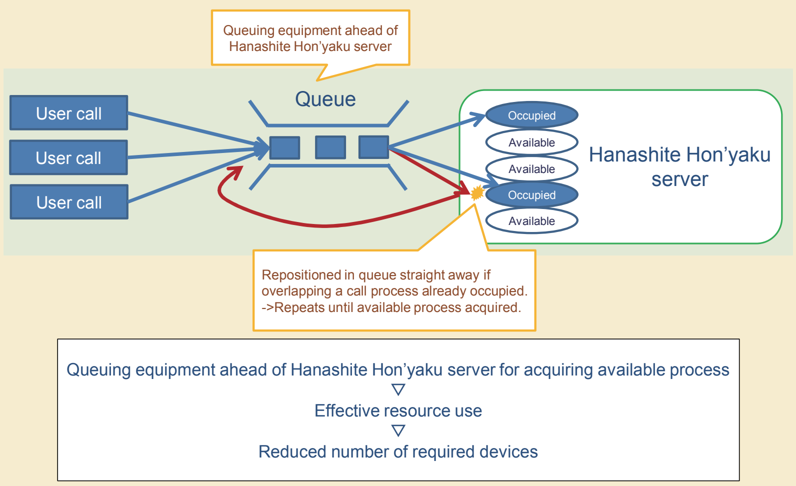

Figure 3 Improving functionality for Hanashite Hon'yaku equipment cost reductions

nance platform for unified management of commercially available products did not include many devices that required monitoring - one server provided monitoring, traffic collection, log and trace functions. Later however, with the addition of a variety of new services, the number of devices that required monitoring rose sharply, resulting in higher loads on the server. Since increasing the number of servers for load balancing would result in design and facility cost blowouts, we improved functionality so that hardware resources could be more effectively used.

(2) Separating functionality in the same machine (virtualization)

As well as upgrading equipment that was nearing the end of its serviceable life, we separated functions within the same machines (virtualized them) so that processing loads for various functions would not affect each other. This entailed virtualizing and separating functions for server and network monitoring and functions for traffic collection, log and trace so that they could run in the virtually separated server environment. Thus, by giving high level of independence to functions, we created a system in which processing loads cannot easily affect each other (**Figure 4**). This made it possible to use hardware resources more effectively by eliminating resource occupation through processing, by giving more physical server memory or CPU resources to OSs on which high load applications are running.

Virtualizing functions enables the same maintenance functions as existing maintenance infrastructure to run on the minimum amount of hardware, minimizing the amount of server equipment required, thus resulting in CAPEX reduction. This system enables more effective maintainability if some software application shuts down due to error, because it doesn't affect functions on other OSs easily, since different functions operate on different OSs.

3) Network Equipment Example

Although network equipment that was nearing the end of its serviceable life at

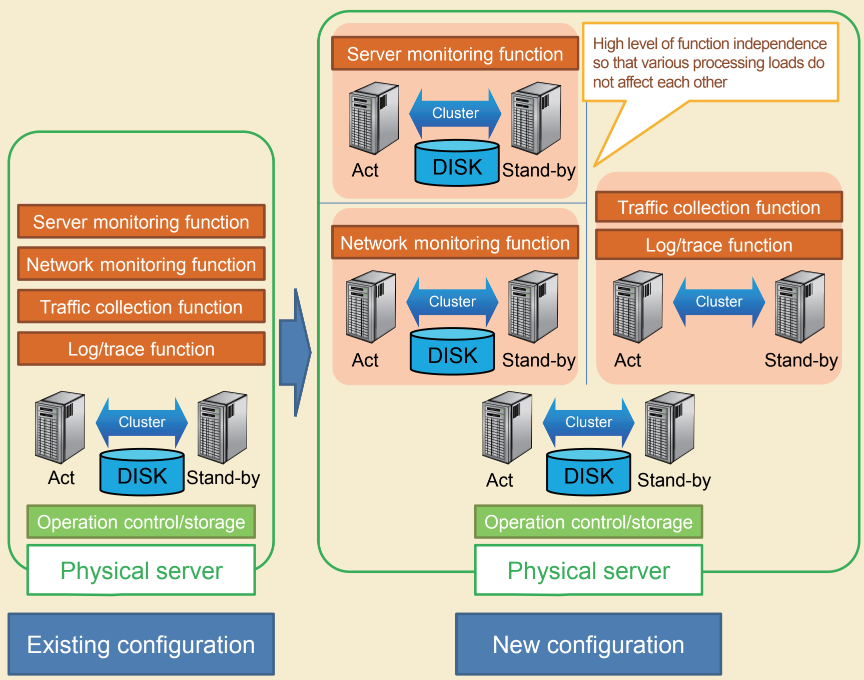

Figure 4 Virtualized operation and maintenance platform for unified management of commercially available products

the same time had some differences in performance requirements, the model numbers of the deployed replacement devices were basically consistent. Therefore, if an issue occurs in one device and the root cause can be determined, it's easy to assume that same issue will occur in other similar devices, which means common prevention measures can be taken for all the devices. This improves overall quality, lowers purchasing price when buying multiple units of the same model (CAPEX reduction), and reduces running costs through more efficient maintenance (OPEX reduction).

3.2 Minimizing Impacts on Services

To minimize the impact on services with equipment upgrades due to malfunctioning replacement servers or incorrect replacement settings etc, preliminary testing under commercial conditions is performed in a commercial environment. This entails using functions to judge test calls*5 with service control equipment and register test calls. Then, normal functioning of routes through new equipment can be checked by passing only calls from numbers registered with the test call through newly configured routes (**Figure 5**).

Checking normal operation with preliminary testing and immediately switching all to general user service calls could cause significant impact if a contingency arises. MPN provides critical services that cannot be halted - losing customer voice data stored in the voice mail or call recording services or preventing voice replay by causing service to stop are unacceptable conditions - thus, the scope of impact on services (the number of users affected, the amount of time services are shutdown etc) must be kept to a minimum.

The switching procedure to minimize impacts is as follows.

Step (1): Firstly, in a new load balancer*6 that distributes calls from service control equipment to media control, existing media control is specified as the distribution destination for calls. Then, by switching service control equipment, the operation of the newly deployed load balancer can be checked, and if there is an issue, processing is switched over to the old load balancer by the service control equipment (**Figure 6**).

Step (2): If there are no issues with

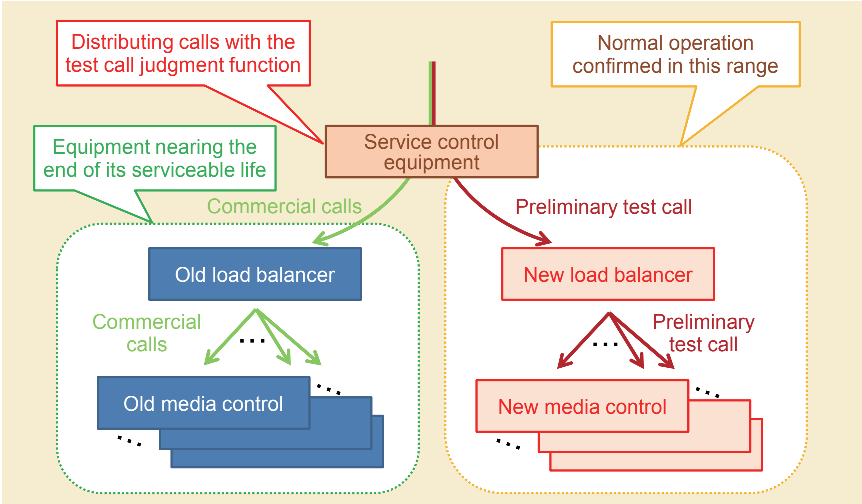

Figure 5　Preliminary testing

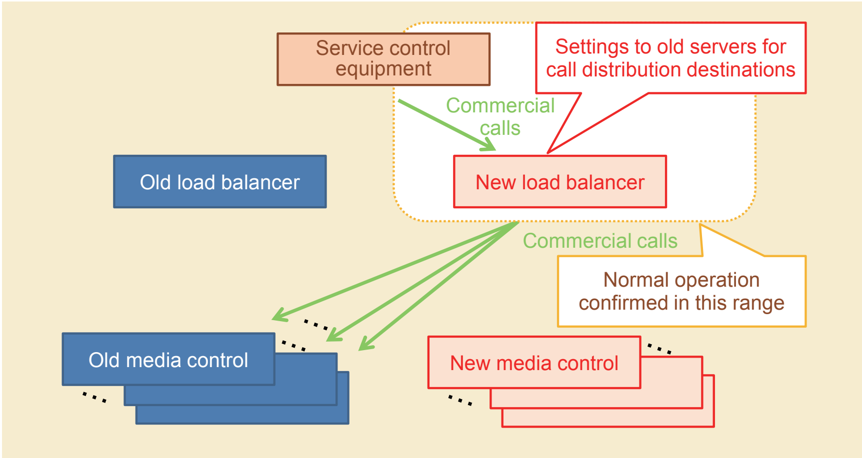

Figure 6　Step (1) for switching to commercial calling

---

*5 **Test call:** A call that is different from ordinary user calls and is placed in order to perform tests such as checking normal operation of the network or isolating failures.

*6 **Load balancer:** A device that centrally manages external requests and transmits them to servers with equivalent functionality. Used to distribute load over the servers.

the above procedure, round robin*7 settings are made to the load balancer to distribute some commercial calls to some of the new media control. Test connections are made several times, and if there is an issue, the procedure returns to step (1) (**Figure 7**).

Step (3): If there are no issues with the above procedure, final round robin settings are made to the load balancer to distribute all commercial calls to all the new media control. Test connections are made several times, and if there is an issue, the procedure returns to step (2) (**Figure 8**).

Because call distribution is switched one step at a time with the above procedures, call distribution rules for the new load balancer must be set. However, if distribution is only set with load balancer rules, rule settings must be changed with each procedural step. For this reason, when changed rules were reflected, changes to distribution details with rule changes resulted in service interruptions of several seconds (**Table 2**).

Here, by isolating media control and making settings with each procedural step without changing rules settings, we were able to upgrade equipment without affecting services (**Table 3**).

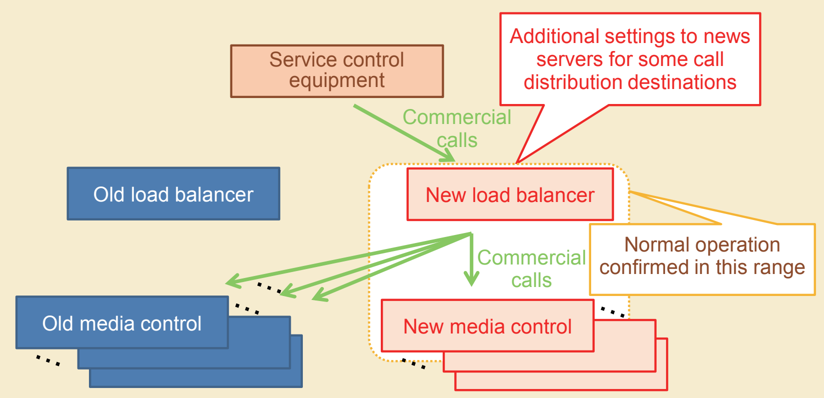

Figure 7　Step (2) for switching to commercial calling

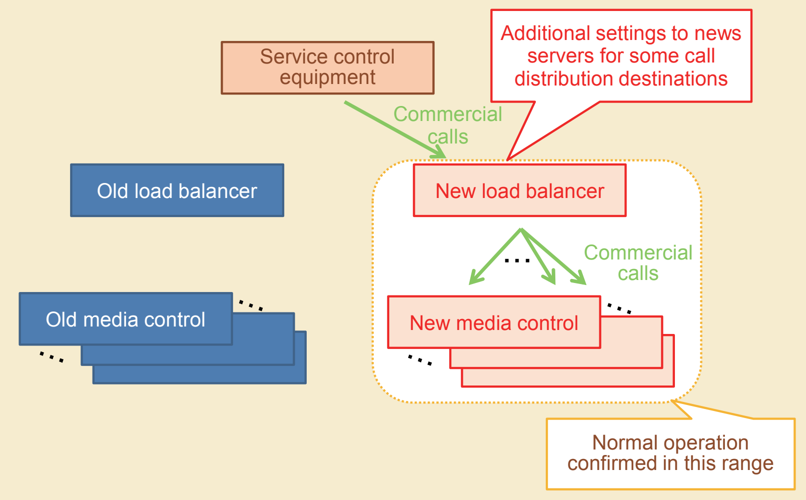

Figure 8　Step (3) for switching to commercial calling

*7 **Round robin:** One of the techniques of load distribution in networks. A number of devices capable of performing the same function are prepared and the requested process is allocated to them in turns.

4. Upgrading Audio Media Processing Equipment Database

1) Equipment Selection

In selecting equipment, consideration was given to performance aspects such as functionality, scalability, track record, life cycle and so forth, and equipment had to be thoroughly screened to ensure that it could provide the continuous services essential for providing telecommunications. For example, some products require several hours to upgrade their OSs, which can result in services being stopped. Generally, OS versions must be upgraded several times every year - a requirement for ongoing support – which must be considered in advance with regard to anticipated maintenance work. As policy, we do not adopt such products that cannot provide continual services.

2) Data Moving and Switching Functions

Media data for voice mail and melody call services are stored in audio media processing equipment databases. For example, messages addressed to subscribers are recorded in the voice mail service, while the melody call service contains personalized sound source data for calling that is set by subscribers themselves.

When performing upgrades, these types of media data must be moved from the old database to the new. Service control equipment also links service user information and manages audio media processing equipment databases where media data is stored. For this reason, information about media storage in service control equipment must also be upgraded (switched) when moving media data from old databases to new ones.

Similar to equipment selection, design for continuity and reliability essen-

Table 2　Existing setting rules for complicated load balancer distribution

Media	Load balancer rules setting	Remarks
Step (1)	Rule setting ・Test call distribution to A group (all new media control units) ・Other distribution to B group (all old media control units)	
Step (2)	Rule changing ・Test call distribution to A group (the remainder of all new media control units with one unit deleted) ・Other distribution to B group (all old media control units + one new media control unit deleted from group A)	Rule changing affects services
Step (3)	Group changing ・Test call distribution to A group (all new media control units) ・Other distribution to B group (changed again for all new media control units)	Group changing affects services
After above settings complete	Rules deleted	All old media control units removed from system

Table 3　Setting new distribution rules for load balancer

Media	Load balancer rules setting	Remarks
Step (1)	Rule Setting ・Test call distribution to A group (all new media control units) ・Other distribution to B group (all old media control units + all new media control units)	As equipment destined for B group, all new media control units remain unconnected
Step (2)	No rule changes	One new media control unit for B group connected to the system
Step (3)	No rule changes	All new media control units for B group connected to the system
After above settings complete	Rules deleted	All old media control units removed from system

tial for providing telecommunications services must be considered with data moving and switching functions. When moving data, ordinary products often employ batch data copy functions. However, because of the risk of data destruction or data mismatch etc with service control equipment, these types of products cannot be used. Regarding operations also, data must be split up into subscriber units etc and moved because moving data in batches that affects all subscribers is not permissible. Although moving split data takes more time, we took measures to efficiently control processing load when moving data to balance performance of the old and new databases and their data moving interfaces with overall data processing capability. Furthermore, in implementing these functions, we were able to reduce costs by using existing functions as maintenance functions.

Figure 9 describes an overview of the functions for moving data and switching between the old and new databases. These functions have the following characteristics.

(1) Exclusive control per subscriber with data moving and switching. Usually, when many user service calls (voice mail service or melody call replay etc) occur simultaneously, exclusive control prevents conflicts with database operations and informs subsequent calls that services are temporarily unavailable. In this way, control inhibits database operational conflict by informing the user service calls whose data is being moved that services are temporarily unavailable. This process is repeated for all subscribers (Maintenance staff can perform it for multiple subscribers).

In fact, the time it takes to move the data for one subscriber depends on the amount of media data for that subscriber, but is usually complete in less than a second. Continuous services are enabled because encounters with exclusive control (temporary unavailability) almost never occur. Furthermore, because processing is controlled independently for each sub-

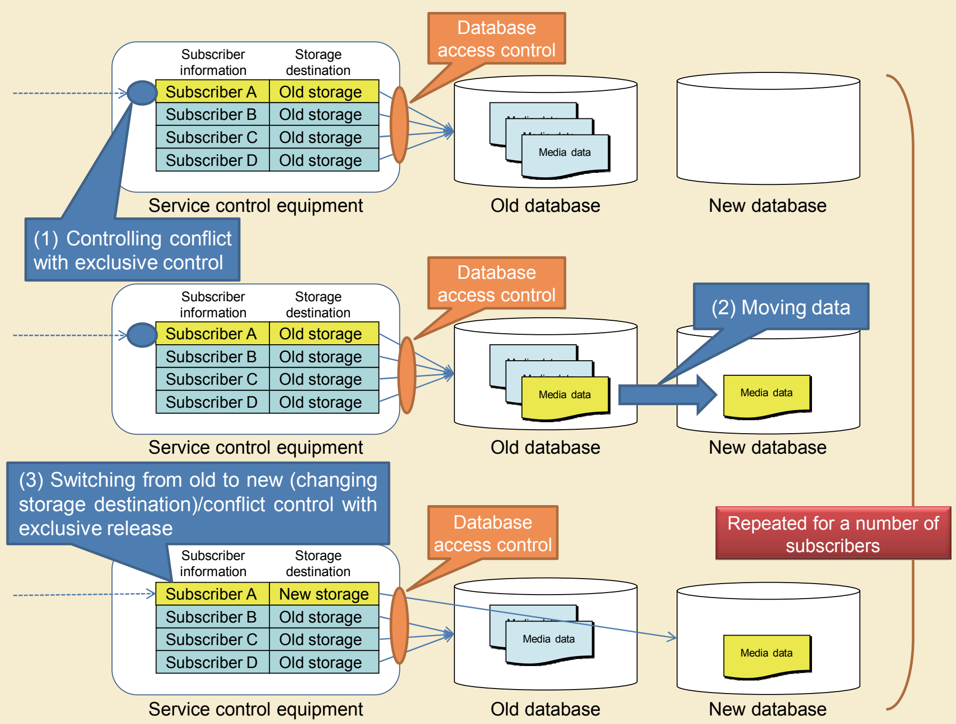

Figure 9 Function overview

scriber, services for other users can be continued even if an issue occurs with moving a particular user's data. Exclusive control enables simple and stable operations without high system load and complicated processing such as complicated call recovery processing or database mismatch prevention etc.

(2) System monitored for data moving and the state of switching between old and new databases. If overall continuity is found to be problematic with data moving, the issue is displayed so that the process can be quickly stopped. If an issue is detected for a subscriber, failure processing is performed for that subscriber only, while data moving and switching from old to new databases for all other users is continued. Failed subscribers are displayed on screen to enable retry.

System monitoring enables errors to be dealt with quickly which improves service continuity. Service reliability is also improved by enabling data moving management for individual users when moving data and switching between old and new databases.

Data moving and switching between old and new databases is performed at night while there is less traffic. Normal operations are enabled for commercial work once data moving, switching between old and new databases and preliminary testing have been performed for leading subscribers. In this way, the impact of switching work on services is minimized.

5. Conclusion

This article has described approaches to upgrading audio media processing equipment and the operation and maintenance platform for unified management of commercially available products.

For upgrading equipment, we intend to continue implementing equipment and licensed products designed to reduce OPEX/CAPEX and further study service continuity and reliability. In anticipation of future architecture changes, we also intend to further study efficiency for coming equipment upgrades.

Reference

[1] A. Miyata et. al: "Media Processing Node for Providing Value-added Media Services," NTT DOCOMO Technical Journal, Vol. 11, No. 1, pp. 4-12, Jun. 2009.