Development of New Mobile Local Switch (NMLS)

A new mobile local switch was developed in response to the rapid increase in the number of subscribers to digital mobile telecommunications services.
This paper gives an overview of the configuration and features of the NMLS.

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1. Introduction

Since 1994, when a new system was introduced whereby customers purchase (rather than lease) phones, a wide variety of phones have been introduced to the market and various network services and price plans have been made available, leading to a dramatic increase in the number of subscriptions to mobile phone services. This increased demand has necessitated an increase in the capacity of mobile switches in order to build an economical and efficient network.

This paper gives an overview of the NMLS (New Mobile Local Switch) (Photo 1), which was developed in response to these requirements.

2. Development Goals

Several goals were set for the development of the NMLS.

- Save space and increase capacity.
- Adopt latest hardware technology of multiple vendors.
- Modularize software through application of a software configuration comprising OS, extended OS, and applications.
- Define API (Application Interfaces) to enable operation in a multi-vendor environment.
- Adopt a platform that can also be used as a switch for IMT-2000 (International Mobile Telecommunications-2000).

Photo 1　View of NMLS

3. Application Stage in PDC Network

The NMLS was developed as a successor to the original and the improved D60 mobile switches and occupies the same positions in the network.

Figure 1 shows the configuration of the PDC (Personal Digital Cellular Telecommunications System) mobile network. The NMLS functions as a subscriber switch, a transit switch, and a gateway switch and may be used on any of these stages or on a combination of them.

3.1 Differences in Interfaces Compared to Existing Nodes

(1) Common-channel Signaling Interface

To increase common-channel signaling transmission capacity, a 384kbit/s interface was added to the SS7 interface of the NMLS, in addition to the conventional 48 and 4.8kbit/s interfaces.

(2) Transmission Path Interface

The NMLS was provided with new transmission-path interfaces of 52 and 156Mbit/s in addition to the 8 and 2Mbit/s interfaces used in conventional switches in order to reduce the number of transmission elements.

It also has a 1.5Mbit/s interface that can be connected to a DSU (Digital Service Unit) for direct connection to a digital leased line.

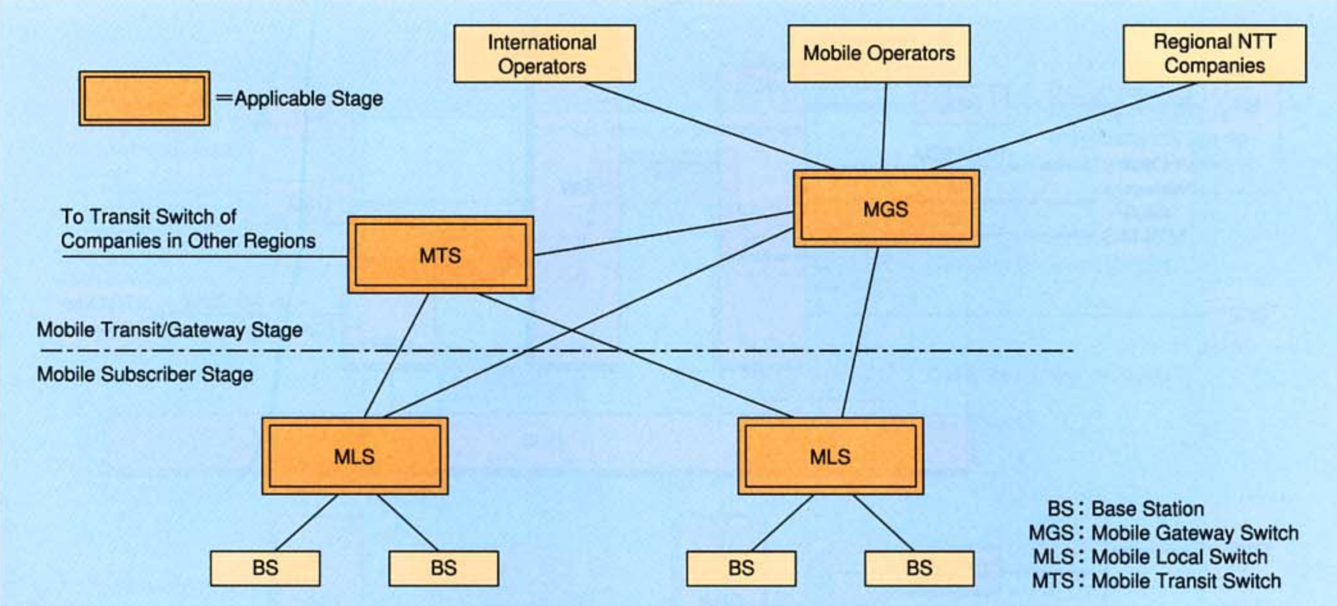

Figure 1 Configuration of PDC Mobile Network

4. Hardware Configuration

The NMLS has a logical hardware configuration constructed virtually with application software. This conceals the differences in hardware configurations between vendors, so that the application software can run seamlessly regardless of the actual hardware configuration.

Figure 2 shows the logical hardware configuration consisting of processors, a voice path switch, and circuit interfaces.

4.1 Processors

The NMLS uses a multi-processor system that vastly improves the throughput compared to that of the conventional switch. It also provides functional distribution and load balancing. The communication capacity between processors was increased by using ATM (Asynchronous Transfer Mode) hub between them.

The processors are physically identical but can be classified into different types based on the logical processor deployed on them. The processor types include OMP (Operation and Maintenance Processor), RMP (Resource Management Processor), CLP (Call Control Processor), and CSP (Common-channel Signaling Processor). A degenerate type with all logical processors on one physical processor is also possible.

4.2 Speech Path Switch

By using a compact, high-capacity voice path switch, we reduced the space required to about 1/2 that of conventional switches.

4.3 Mobile Specific Devices

(1) Data Service Controller (DSC)

The DSC is a trunk that converts the protocol between radio and fixed networks for 9600kbit/s data and G3 fax transmission. A three-fold increase in operational efficiency of the trunk was achieved compared to that of the conventional model.

(2) Service Trunk (SVT)

A channel cut-over circuit for shortening the interruption in speech during handover, a PB signal insertion circuit that enables the user to insert a PB signal by pressing keypad buttons during a call, a frame-clock generator circuit that supplies the radio frame clock to the base station, CODEC (Voice Coding and Decoding)* test circuit that verifies the normal functioning of SPE (Speech Processing Equipment), etc. are implemented in the service trunk.

4.4 Other Features

To minimize the impact of device switching on services, a redundant configuration is used for the main components of the NMLS. Furthermore, the running system and the fallback system operate synchronously, enabling instantaneous switching from the running system to the fallback system.

The NMLS also has an automatic diagnostic capability, so it can autonomously isolate a device running abnormally and perform diagnosis, and a firmware downloading capability to

* : CODEC (Voice Coding and Decoding Circuit) : Does conversion between high efficiency voice coding systems and PCM systems

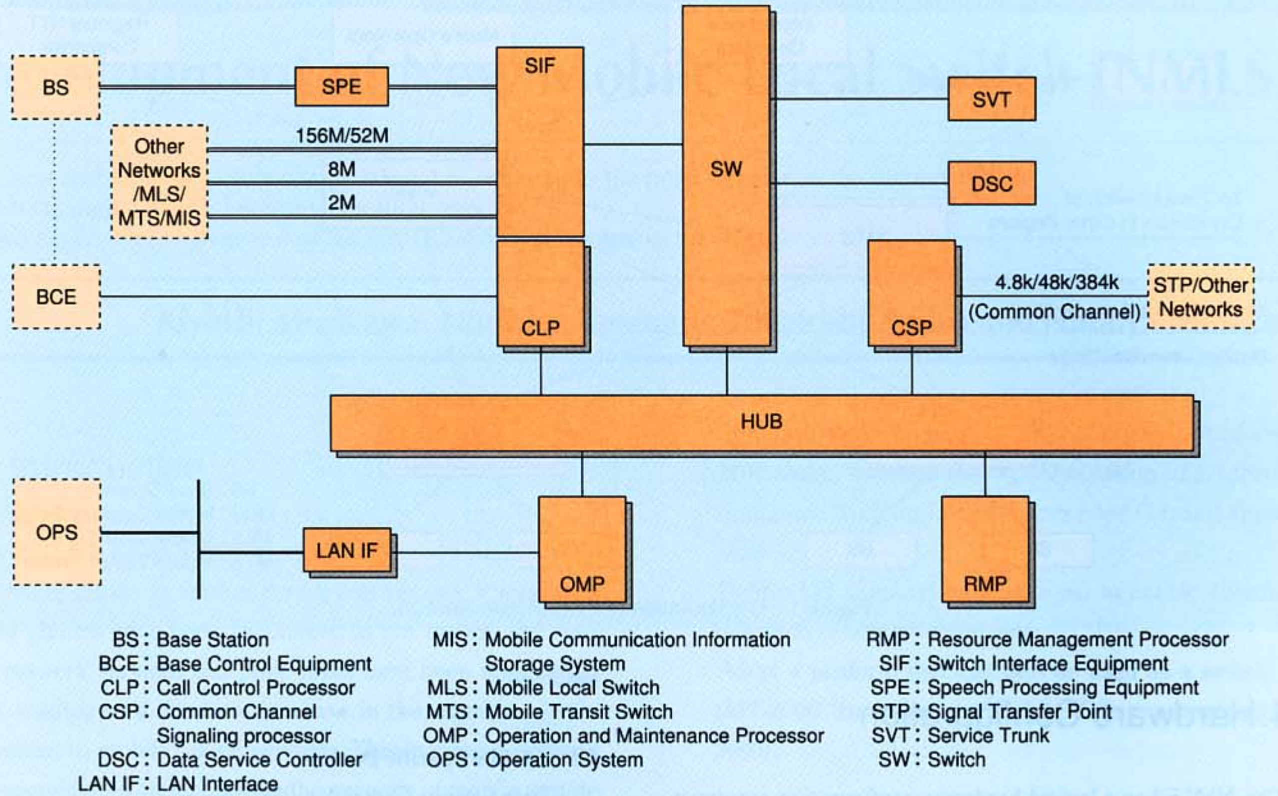

Figure 2 Logical Hardware Configurations

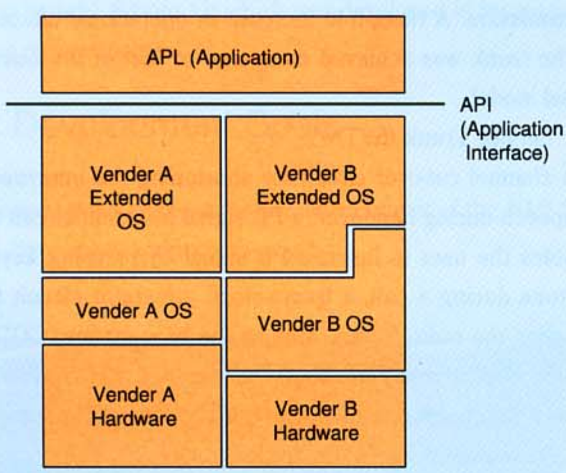

Figure 3 Multi-Vendor Configuration

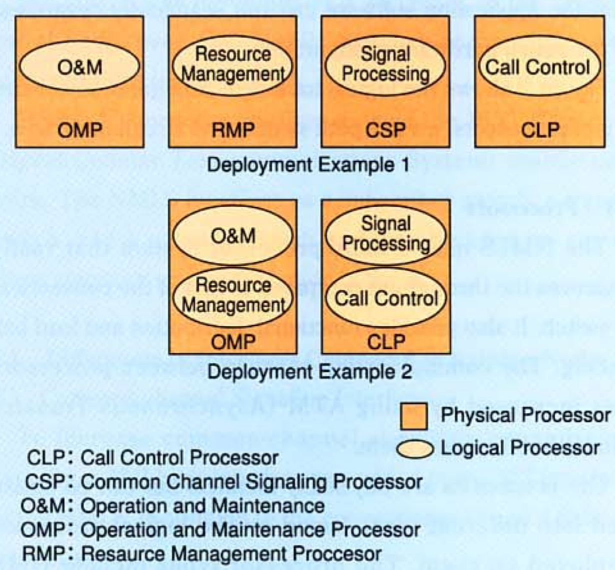

Figure 4 Examples of Deployment of Logical Processors

enable remote re-writing of firmware in devices, greatly reducing the maintenance window for repair and hardware upgrades.

5. Software Configuration

The software configuration of the NMLS differs from that of conventional switches due to implementation of a multi-vendor configuration and to other factors. The software processing also has characteristics different from those of conventional switches.

5.1 Definition of Application Interface (API)

API have been defined for the NMLS in order to achieve a multi-vendor solution and to accommodate the differences between vendors when running applications. The definition of API enables the use of common applications in a multi-ven-

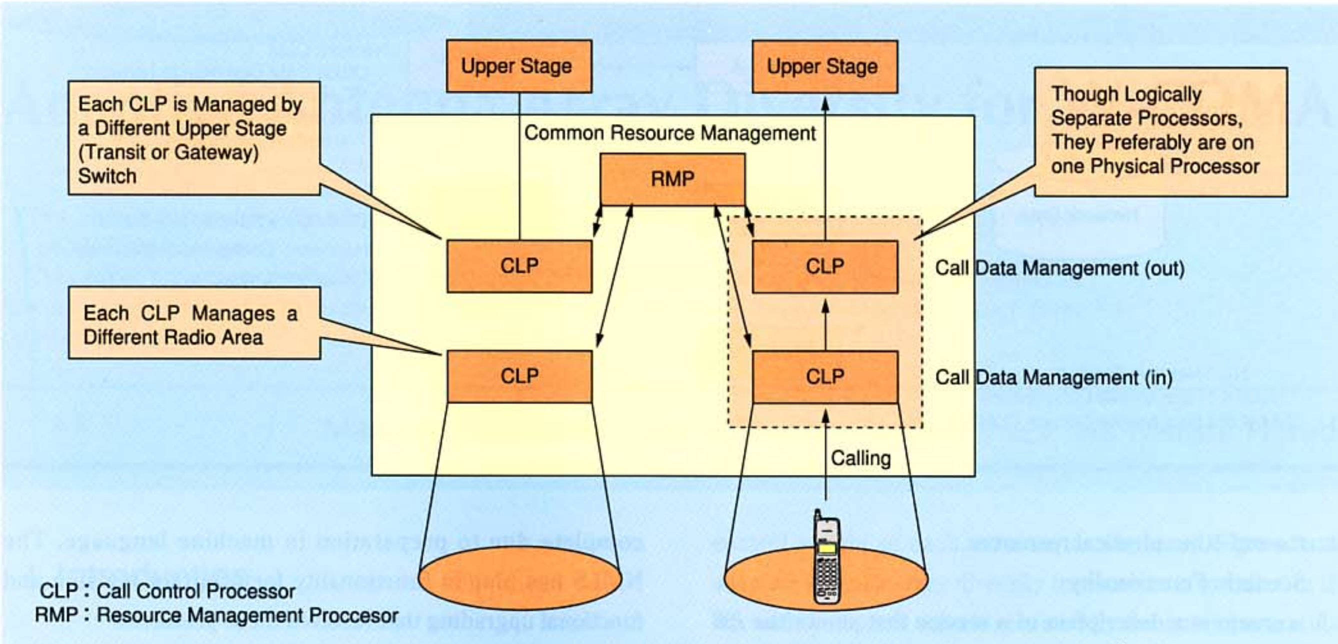

Figure 5 Overview of Software Processing

dor configuration.

Figure 3 shows the concept of this multi-vendor configuration. The extended OS accommodates the vendor-specific hardware and OS characteristics, enabling applications to run seamlessly regardless of the vendor. The basic concept of these API is also applied to the software configuration of switches for IMT-2000, which will use the same platforms as the NMLS. Three basic principles were followed in defining the API.

① Basic call control and service processors are applications.

② Functionalities expected to require additions or changes after service launch are included in applications.

③ Functionalities highly dependent on hardware are as a rule included in the extended OS.

5.2 Logical Processor Configuration

NMLS applications are comprised of multiple functional blocks, grouped together into a number of larger functional units, such as call control and maintenance, to constitute logical processors. The required number and types of processors varies according to the unit size and application stage in a multi-processor configuration and according to the vendor in a multi-vendor configuration. The concept of logical processors is applied to fulfill the requirements for the switch by making it possible to place functions in physical processors as needed and to make wide use of applications. Figure 4 shows examples of the deployment of logical processors.

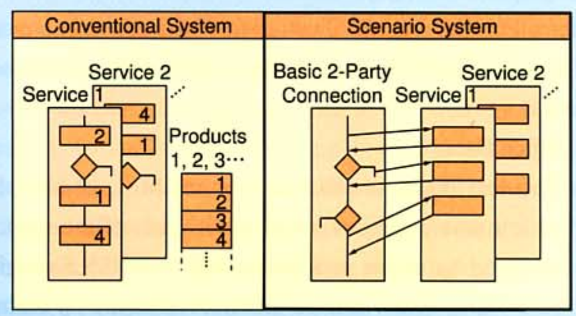

Figure 6 Scenario System

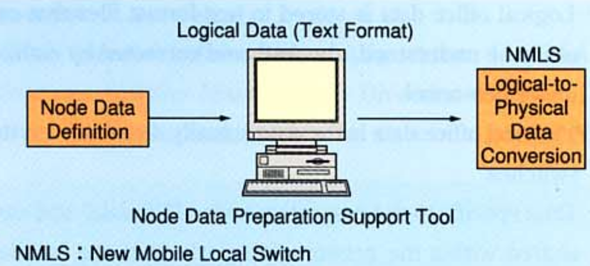

Figure 7 Node Data Input Format

5.3 Software Processing System

(1) Basic Concept

In the NMLS, the independence of processors was increased to minimize communications between processors and to make common memory control unnecessary. This concept is illustrated in Figure 5. As shown in the figure, circuits to specific radio areas or switches on a higher stage are tied to specific CLPs so that they operate independently. The only resources with common management are certain actual

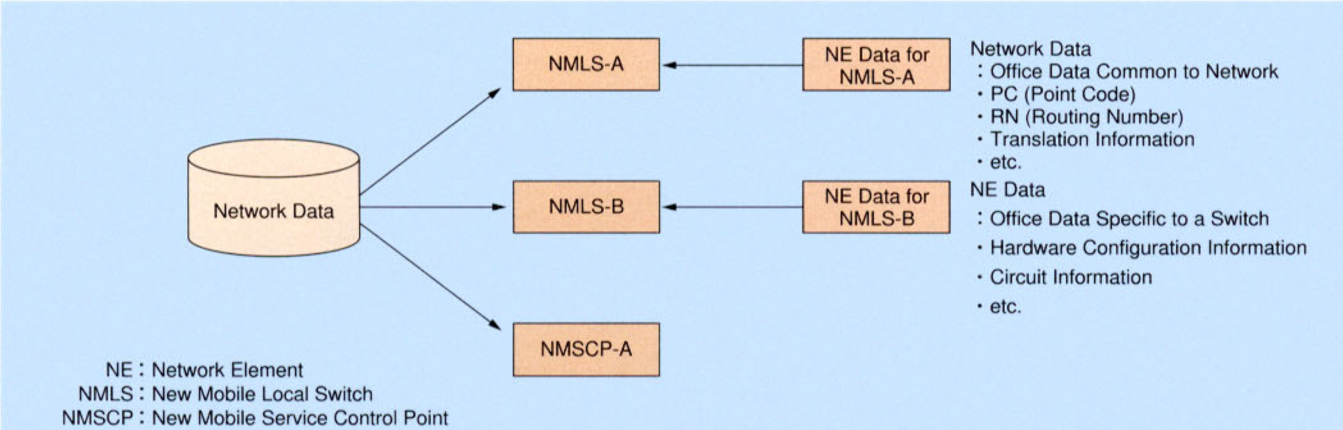

Figure 8 NE Data and Network Data

circuits and other physical resources.

(2) Scenario Functionality

A scenario is a description of a service that shows the difference between the service and basic call processing. By using scenarios, it is possible to easily add new services, etc. merely by describing the difference between the service and basic call processing. An illustration of the scenario concept and a comparison with the conventional system are shown in Figure 6.

(3) Office Data

- The distribution of office data to the LM (Load Module), which was previously done with an offline tool, is achieved by online processing with the NMLS. Logical node data, which can be understood easily by maintenance personnel, is input to the switches. The input format is shown in Figure 7.
- Logical office data is stored in text-format files that can easily be understood, checked, and corrected by maintenance personnel.
- Physical office data is the data actually distributed to the switches.
- Data specific to the respective nodes (NE data) and data shared within the network (network data) are handled separately in order to achieve a major reduction in the size of the maintenance window by making it unnecessary to prepare data separately for each system and for each unit as in conventional systems. A system for referring to data shared within the network was included so that all users can access a single source of network data. Figure 8 shows the configuration used for network and NE data.

(4) Plugin Functionality

The conventional method for program revision (patches) has a high likelihood of errors and requires a long time to complete due to preparation in machine language. The NMLS has plug-in functionality for program revision and functional upgrading that resolves these problems.

- The source program can be revised in a high-level language without considering the machine language.
- There is no impact on online services.

6. Conclusion

The NMLS is now being deployed, and it is expected to contribute to the economical construction of PDC networks.