Special Article on Link Systems

Development of a New Entrance Radio System in the 22GHz Band

A new fixed radio system in the 22GHz band has been developed for use for entrance links to rapidly increasing radio BS (Base Stations) from MLS (Mobile Local Switch) or CN (Connection Node) in DoCoMo's network. The new system (22G-6MD) has realized high reliability employing hot stand-by equipment, as well as improved cost performance. This paper describes outline of the new equipment compared with the existing system.

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Preface

As for radio entrance system, an optimal system is selected from among the 4/5/6G-6M system, the 11G-6M system, and the 22G-6M system, under consideration of conditions such as distance, radio interference and frequency usage order, between BS (Base Station) and MLS (Mobile Local Switch) or between CN (Connection Node) Station.

Among these radio entrance systems, the 4/5/6G-6M system and the 11G-6M system adopt a configuration capable of installing both the active equipment and the stand-by equipment. They provide highly reliable services as equipment is automatically switched over when a line is disconnected due to an equipment failure. However, the 22G-6M system normally used for short distances incities has designed the simplicity of equipment configuration preference. Therefor its (1＋0) configuration contains only the active equipment, and the stand-by equipment can not be mounted. Furthermore, It is inferior in economizing compared with the 11G-6M system of longer application distance. Therefore, introduced areas are restricted.

In this paper, the features of the new 22G-6MD system that is highly reliable and remarkably economized compared with the existing 22G-6M system are described, and the outline of the new equipment is also explained.

Features of 22G-6MD

The configuration of this system is shown in Figure 1 and the specification of this system are listed in Table 1. In addition, major different points between this system and the existing system are described as follows.

■Stand-by Function to be Equipped

Besides conventional 1＋0 configuration, 1＋1 configuration (with stand-by) is available. Therefore, networks can be built up according to the required reliability of service areas.

The switch-over function contained in this system is different from the one contained in the existing 4/5/6G-6M and 11G-6M systems, the receive side RAU (Radio Unit) and the transmission side RAU operate independently their own switch-over.

(1) Switch-over of the transmission side

① Automatic switch-over is controlled by the alarm information (RAU : Tx IF Input alarm etc, MMU : Radio frame alarm etc) from RAU and MMU (Modem Multiplexer Unit).

② Manual switch-over is controlled at the front panel of MMU unit or by a computer connected to operation & maintenance.

(2) Switch-over of the receive side

① When the receiving power of RAU decrease from −60dBm to −90dBm at a speed of 20dB/s or less, uninterrupted switch-over is conducted if RAU in not stand-by has its receive power of −60dBm or over (Hitless automatic switch-over).

② Automatic switch-over is controlled by the alarm information (RAU : Hardware alarm etc, MMU : RRC alarm etc) from RAU and MMU.

③ Manual switch-over is controlled at the front panel of MMU unit or by a computer connected to operation &

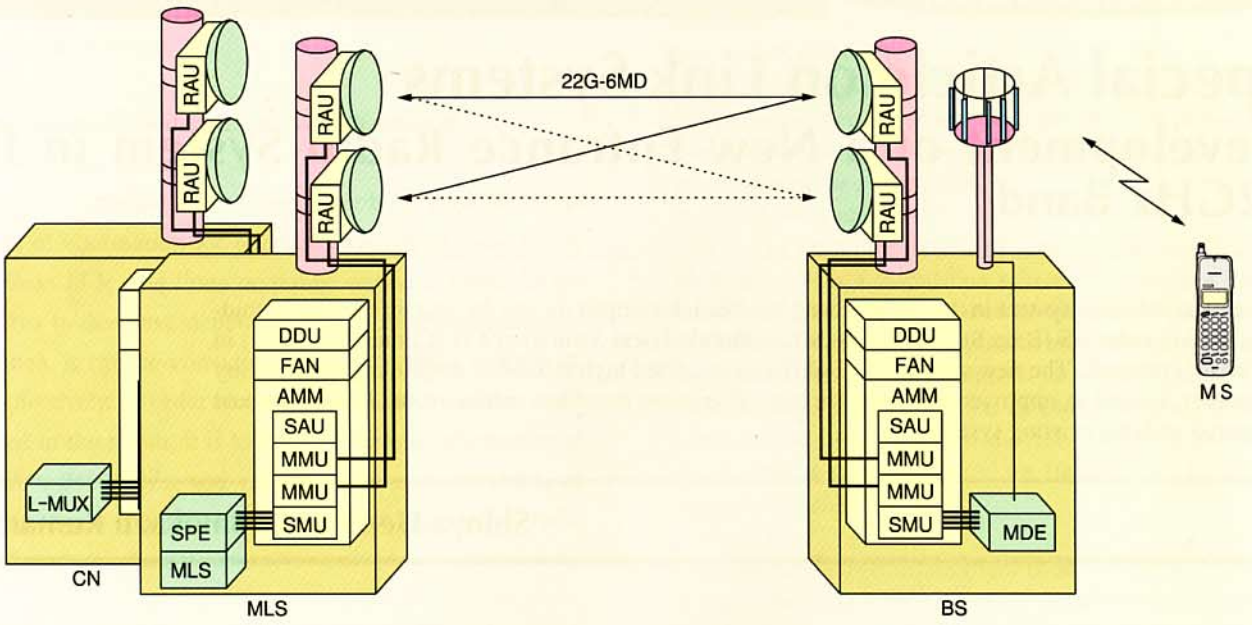

Figure 1 System Configuration

Table 1 Specification

Item	Description
Frequency Band	Low group : 22.4025~22.5975GHz High group : 23.0025~23.1975GHz
Polarization	Vertical polarization
Modulation Scheme	QPSK
Number of Systems	1+0s or 1+1s (with stand-by)
Standard Repeater Spacing	3km (60cm ϕ antenna)
Unavailability (1 Hop)	0.0004%/year, hop or less
Transmission Power	+20dBm
Occupied Bandwidth	6.6MHz or less
Radio Clock Frequency	4.096MHz
Noise Figure	8dB or less
Roll-off Factor	0.5
Intermediate Frequency	Transmission : 350MHz Receive : 140MHz
Baseband Interface (TTC Standards : JT-1431-a)	1.544Mbit/s (Max. : 4)
Antenna (Gain)	30cm ϕ (34dB)
	60cm ϕ (40dB)
	120cm ϕ (46dB)

maintenance.

■ Relay Function to be Equipped

Recreate and relay functionality is not contained in the existing equipment is available. Insertion/drop of traffic data is available at a relay station while, preparation of leased lines is unnecessary at a relay station for supervision and control between each relay station and an operation center due to insertion of supervision and control information into radio transmission signals. This arrangement allows us to build up networks flexibly. Furthermore, it can also serve flexibly as a radio system for preparation of temporary lines with comparably long distance to deal with natural calamities.

■ Signal Multiplexing

Connection cables between IDU (Indoor Unit) and ODU (Outdoor Unit) of the existing system is an integrated cable of ① traffic signals, ② supervision and control signals, and ③ power. Therefore, the cables are thick and weighty, and difficult to install, on top of that, the price is expensive.

In order to solve these problems, this system adopts one co-axial cable and the aforementioned ① ② ③ signals are multiplexed into one for the transmission. Thus, easy installation and economization are improved.

■ Operation Function

The operation and maintenance program of the system supports to PCs equipped with Windows95* as OS. The fol-

* : Windows95 is a registered trademark of Microsoft Corporation.

lowing points improve the maintenance ability of the system.

(1) Improvement in the maintenance ability by GUI (Graphical User Interface)

Since operation and maintenance screens adopt GUI, alarms are displayed for each unit of IDU and ODU during failures. When a failure occurs, it can be instantaneously judged which unit should be changed. In addition, since it is equipped with a function that indicates necessary actions during failures to operation personnel, the time required for instructions to restore the system is reduced.

An example of maintenance screen is illustrated in Figure 2.

(2) Improvement in the maintenance ability

The following functions improve the maintenance ability, besides the normal operation and maintenance functions.

① RAU transmission output (dBm) and reception input (dBm) displays : Transmission output (dBm) and receive input (dBm) of all RAUs in operation can be confirmed on real-time.

② MMU and RAU temperature indicate : Temperature (unit : ℃) condition for MMU and RAU equipment can be confirmed.

③ Loop test function : Since it is equipped with various loop-back functions for each 1.544Mbit/s, a failure can be located easily.

④ Traffic management : Since it is equipped with traffic management function ITU-T (G.826), ES (Errored Second) and SES (Severely Errored Second) etc can be measured without measuring instruments and quality control can be done easily.

In addition, the transition of the equipment to Mobile Synthetic OPS (Operation System) will start at full-scale after introduction of the dedicated IRE (Information Relay Equipment) slated to be introduced in March 2000.

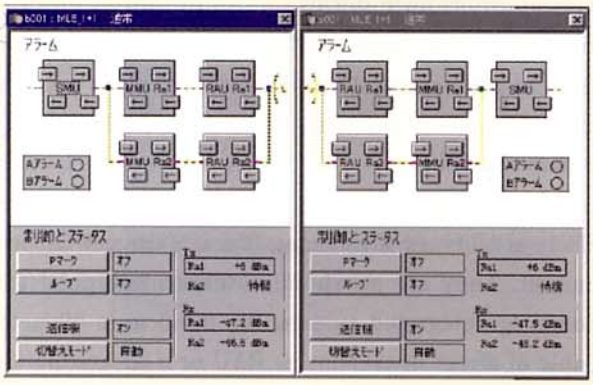

Figure 2 Example of Maintenance Screen

Outline of 22G-6MD Equipment

The equipment is composed of IDU and ODU in the same way as the existing 22G-6M. Figure 3 shows IDU and Figure 4 shows ODU.

■ Indoor Unit (IDU)

Followings are each unit consisting IDU and its main function.

① AMM (Access Module Magazine) : Magazine for each unit. It accommodates 4 units-SMU (Switch Multiplexer Unit), MMU (up to 2), and SAU.

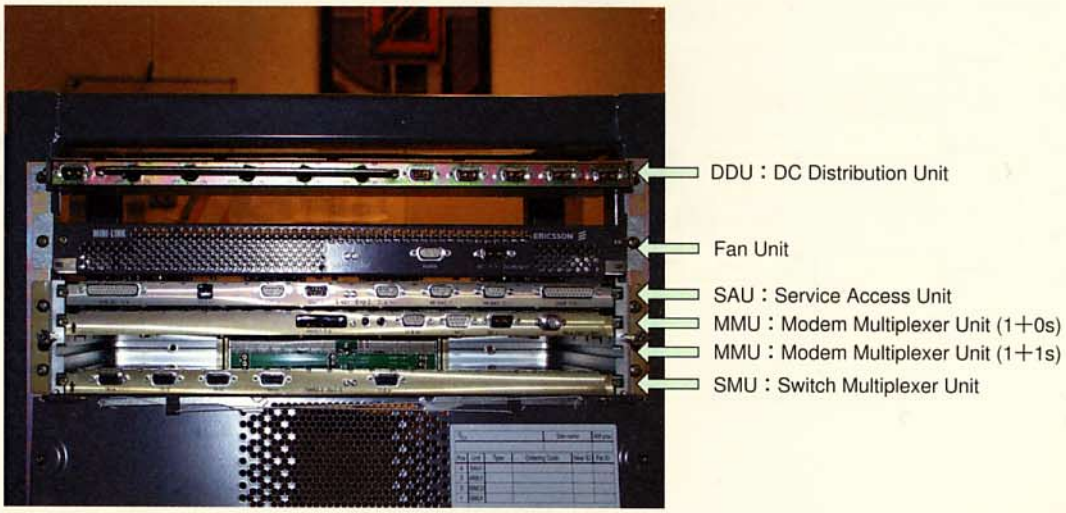

Figure 3 Indoor Unit (IDU)

② SMU (Switch Multiplexer Unit) : It conducts switch-over for 1+1 configuration and performs multiplexing and demultiplexing of traffic data.

③ MMU (Modem Multiplexer Unit) : It conducts QPSK modulation and demodulation processing and provides interface between ODU and IDU.

④ SAU (Service Access Unit) : It has communication function of operation and maintenance supervision data and access to other areas.

⑤ FAN (Fan Unit) : It cools units in AMM.

⑥ DDU (DC Distribution Unit) : It distributes DC from primary power supply up to 5 out puts.

The configuration of SMU and MMU is shown in Figure 5.

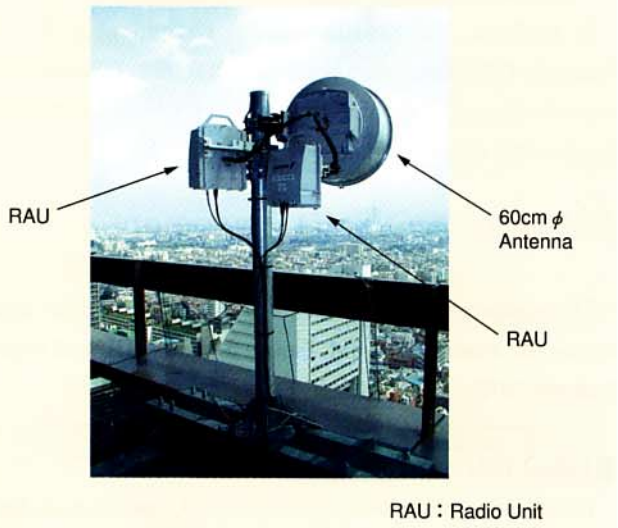

Figure 4 Outdoor Unit (ODU)

■ Outdoor Unit (ODU)

ODU is composed of RAU and the antenna unit. Since it is installed and operated outdoors, it has waterproof structure (comply with JIS C09209). In addition, as for outdoor usage environment, it can operate normally under the condition of ambient temperature of −33～+55℃ and relative humidity of 8～100%.

(1) RAU

RAU is composed of two blocks, the radio interface sub-unit and the microwave sub-unit.

The radio interface sub-unit conducts transmission/receiving of IF signals and supervision and control signals to and from MMU, and performs various kinds of signal processing. Also, the microwave sub-unit conducts transmission/receiving of 22GHz band RF signals and is connected to the radio interface sub-unit by IF signals.

In addition, the radio interface sub-unit outputs analog voltage to RAU external terminals according to receiving level, and it can be monitored. The configuration of RAU is shown in Figure 6.

(2) Antenna

There are 3 types of antennas, 30cm, 60cm and 120cm in diameter. They are parabolic antennas equipped with radome. An integrated antenna (up to 60cm in diameter) capable of direct installation to RAU or a separating type

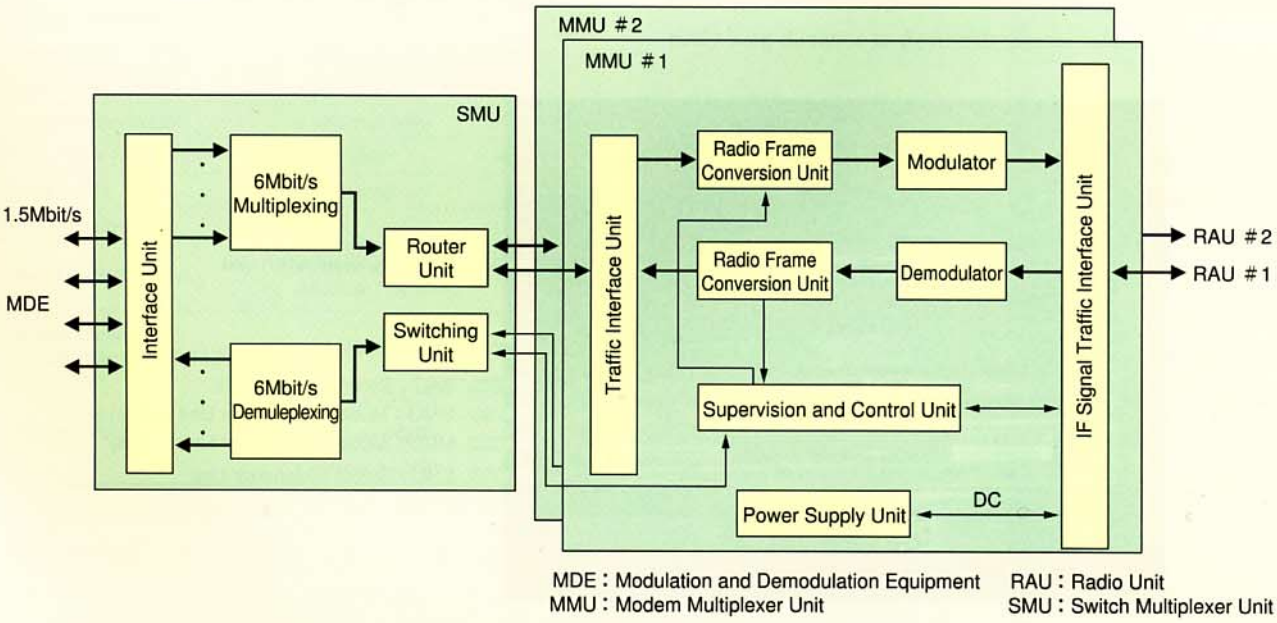

Figure 5 Configuration of SMU and MMU

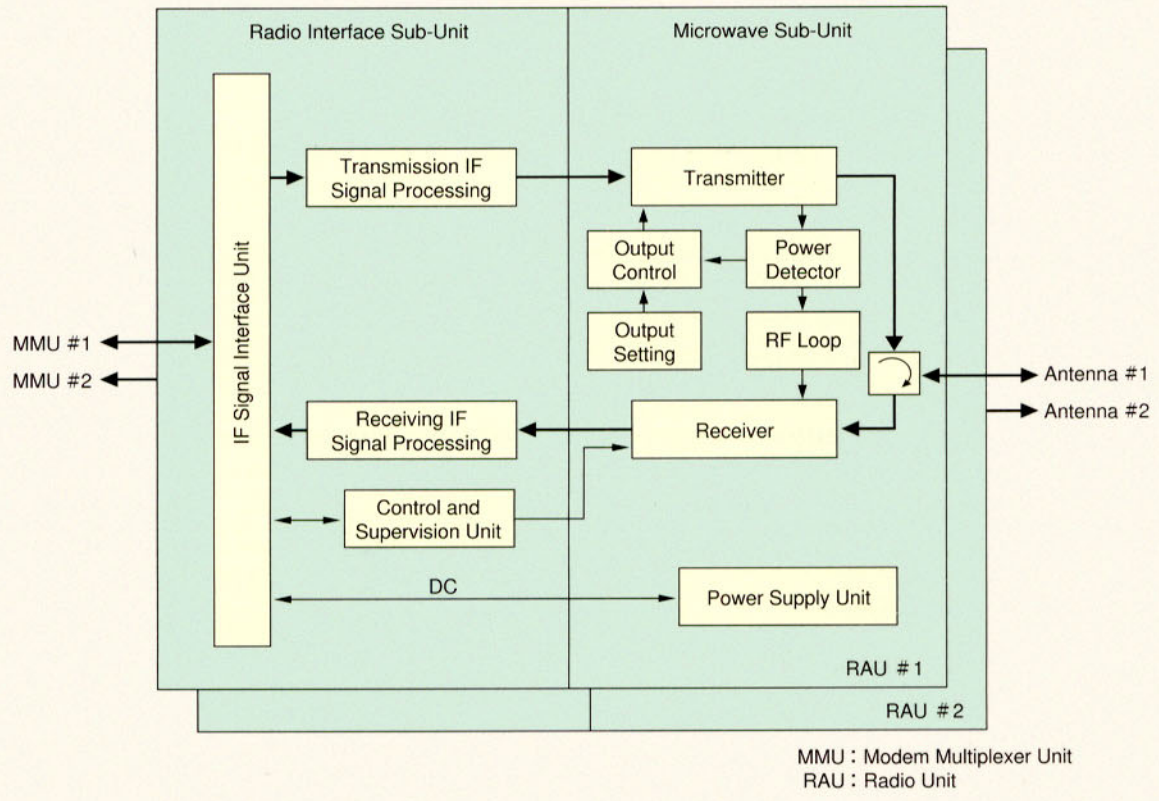

Figure 6 Configuration of RAU

antenna using a flexible waveguide is available. They can be selected according to system configuration and equipment installation condition.

Conclusion

As mentioned above, the features and equipment outline are explained for the economical 22G-6MD system equipped with stand-by function and relay function in Base Station radio entrance system. Thanks to the method, enlargement of applied areas of 22GHz-band radio system and improvement in reliability can be planned at the time of building entrance network. Furthermore, remarkable cost down has been attained compared with the existing equipment (1+0 configuration). From now on, it is expected to contribute to the wide range of introduction such as application to IMCS (In Building Mobile Communication System) and Base Station entrance circuits as well as reduction in cost of building facility for entire radio entrance systems.