Special Article on IMT-2000 Services (2)
— Launch of FOMA, the Pioneer of the New Mobile Age —

Radio Access Network Technologies

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The IMT-2000 introductory service launched in May 2001 is due to roll out as a fully-fledged service in October.
This article describes the radio access network technologies applied to the commercial IMT-2000 system, with reference to the architecture of radio access protocols, the configuration of radio channels, and the configuration of devices in the radio access network.

1. Introduction

Specifications for radio interfaces and inter-node interfaces in radio access networks pursuant to International Mobile Telecommunications-2000 (IMT-2000) have been standardized under the 3rd Generation Partnership Project (3GPP). NTT DoCoMo's Radio Access Networks (RAN) for commercial systems have been developed in compliance with these standard specifications, which adopts Wideband Code Division Multiple Access (W-CDMA) [1], the radio access system proposed by NTT DoCoMo. The RAN consists of the Base Transceiver Station (BTS), the Radio Network Controller (RNC) and the Multimedia signal Processing Equipment (MPE), which are interconnected via Asynchronous Transfer Mode (ATM) lines.

This article reviews the architecture of radio access protocols, the configuration of radio channels, and the devices constituting radio access networks.

2. Architecture of Radio Access Protocols

Figure 1 shows the architecture of radio access network protocols [2]. The protocols consist of three layers: the physical layer (Layer 1), the data link layer (Layer 2) and the network layer (Layer 3).

Layer 2 can be divided into two sublayers: Medium Access Control (MAC) [3] and Radio Link Control (RLC) [4]. The former coordinates the physical channel with the logical channel, whereas the latter is in charge of retransmission control, etc.

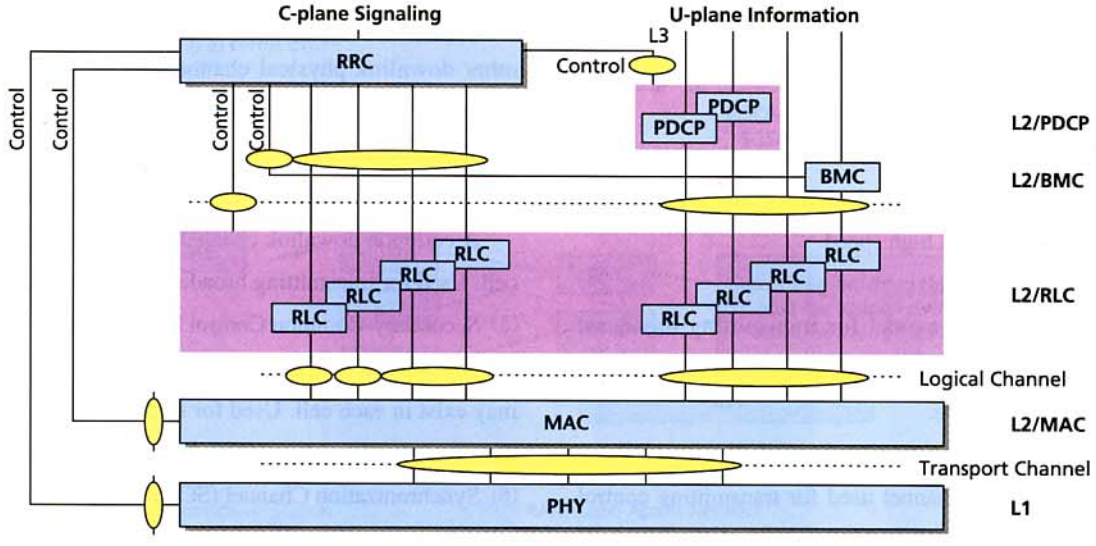
The Control-Plane (C-Plane) is engaged in transmitting control signals, whereas the User-Plane (U-Plane) is in charge of transmitting user information. In Layer 2, Packet Data Convergence Protocol (PDCP) [5] and Broadcast/Multicast Control (BMC) [6] are applicable only to the U-Plane. Layer 3 consists of Radio Resource Control (RRC) [7] terminated at the RAN [7], the upper layer, i.e. Call Control (CC) and Mobility Management (MM) terminated at the Core Network (CN).

Layer 1 in the radio interface is terminated at the BTS, whereas the MAC sublayer, the RLC sublayer in the C-Plane and RRC are terminated at RNC. The RLC sublayer in the U-Plane and PDCP are terminated at MPE.

3. Radio Channel Configuration

In order to deal flexibly with various types of services and multi-access, the radio interface is configured based on three layers of channels: physical channels, transport channels and logical channels.

Each ellipses in Figure 1 indicates the Service Access Point (SAP) between layers and sublayers. SAP between RLC and MAC offers logical channels. The logical channels, which run from the MAC sublayer to the RLC sublayer, are categorized depending on the function of transmission signals and their logical properties, and are characterized by the content of transmitted information. The main logical channels and their purposes are as shown below.



BMC: Broadcast/Multicast Control
MAC: Medium Access Control
PDCP: Packet Data Convergence Protocol
PHY: PHYsical layer Protocol
RLC: Radio Link Control
RRC: Radio Resource Control

Figure 1 Protocol Architecture

(1) Control CHannel (CCH)

① Broadcast Control CHannel (BCCH)

A downlink channel used for broadcasting system control information.

② Paging Control CHannel (PCCH)

A downlink channel used for broadcasting paging information.

③ Common Control CHannel (CCCH)

An interactive channel used for transmitting control information between UE (User Equipment) and the network. Used when there is no RRC connection or when accessing a new cell.

④ Dedicated Control CHannel (DCCH)

An interactive point-to-point channel used for transmitting individual control information between UE and the network. Established by RRC Connection Setup.

(2) Traffic CHannel (TCH)

① Dedicated Traffic CHannel (DTCH)

An interactive channel used for transmitting user data, dedicated to one UE. Has both uplink and downlink.

② Common Traffic CHannel (CTCH)

A simplex point-to-multipoint channel for broadcasting user data to all UEs or certain UEs.

SAP between MAC and physical layer L1 offers transport channels. Transport channels, which run from the physical layer to the MAC sublayer, are categorized depending on the transmission format, and are characterized depending on how and what kind of information is transmitted through the radio interface. The physical channel names and purposes of main transport channels are as shown below.

(1) Dedicated CHannel (DCH)

An interactive channel used for transmitting user data. Assigned to each UE on an individual basis, and can vary the rate and control the power at high speed.

(2) Broadcast CHannel (BCH)

A common downlink channel for transmitting broadcast information (e.g. system information, cell information). BCH transmission is at a fixed rate.

(3) Forward Access CHannel (FACH)

A common downlink channel used for transmitting control information and user data. Shared by multiple UEs. Used for low-bitrate data transmissions from the upper layer.

(4) Random Access CHannel (RACH)

A common uplink channel used for transmitting control information and user data. Random access is applied. Used for low-bitrate data transmissions from the upper layer.

Physical channels are categorized in consideration of their physical-layer functions, and are specified based on the spreading code, frequency carrier and uplink channel modulation phase (I phase, Q phase). The main physical channels and their purposes are as shown below.

(1) Dedicated Physical CHannel (DPCH)

An interactive uplink/downlink channel, assigned to each UE on an individual basis. Consists of the Dedicated Physical Data CHannel (DPDCH) and the Dedicated Physical Control CHannel (DPCCH). For downlink, DPDCH and DPCCH are time-multiplexed in the time slot; for uplink, they are mapped in I phase and Q phase, respectively.

① DPDCH

At least one DPDCH is assigned to each UE using DPCH. Used for transmitting data from the upper layer.

② DPCCH

Only one DPCCH is assigned to each UE using DPCH. Used for controlling the physical layer of DPCH (DPDCH and DPCCH).

(2) Physical Random Access CHannel (PRACH)

A common uplink channel. Used for transmitting data from the upper layer (mainly low bitrate).

(3) Common PIlot CHannel (CPICH)

A common downlink channel. There are two types of CPICH: Primary CPICH and Secondary CPICH. Primary CPICH is mainly used for downlink channel estimation, for UE cell search, and as the criteria for determining the timing of other downlink physical channels in the same cell. The secondary CPICH is mainly used upon the application of Adaptive Array Antenna (AAA).

(4) Primary-Common Control Physical CHannel (P-CCPCH)

A common downlink channel. One P-CCPCH exists in each cell. Used for transmitting broadcast information.

(5) Secondary-Common Control Physical CHannel (S-CCPCH)

A common downlink channel. More than one S-CCPCH may exist in each cell. Used for transmitting paging signals and data from the upper layer (mainly low bitrate).

(6) Synchronization Channel (SCH)

A common downlink channel. Each cell consists of one Primary SCH and one Secondary SCH. Used for UE cell search.

(7) Acquisition Indication CHannel (AICH)

A common downlink channel, which forms a pair with

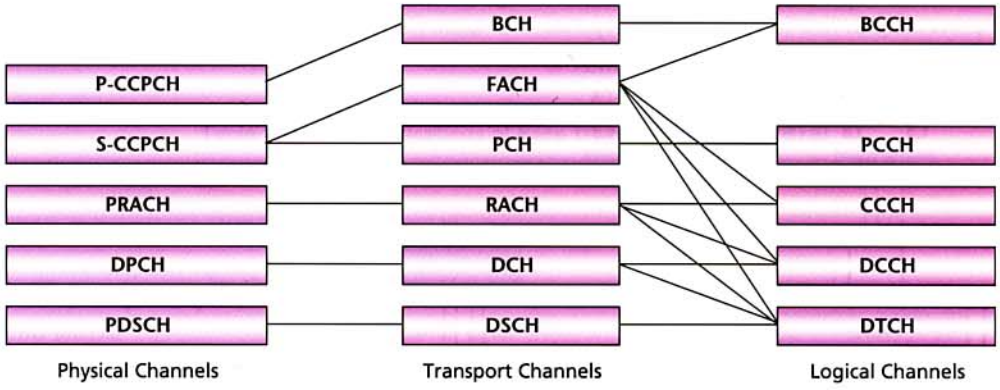
PRACH. Used for PRACH random access control.

(8) Page Indication CHannel (PICH)

A common downlink channel, which forms a pair with S-CCPCH (for which paging signals are mapped). Transmits call-termination information for each group of terminating calls. UE belonging to call termination #n receives a Paging CHannel (PCH) in the radio frame mapped in S-CCPCH when it is informed of a terminating call at call termination #n through PICH.

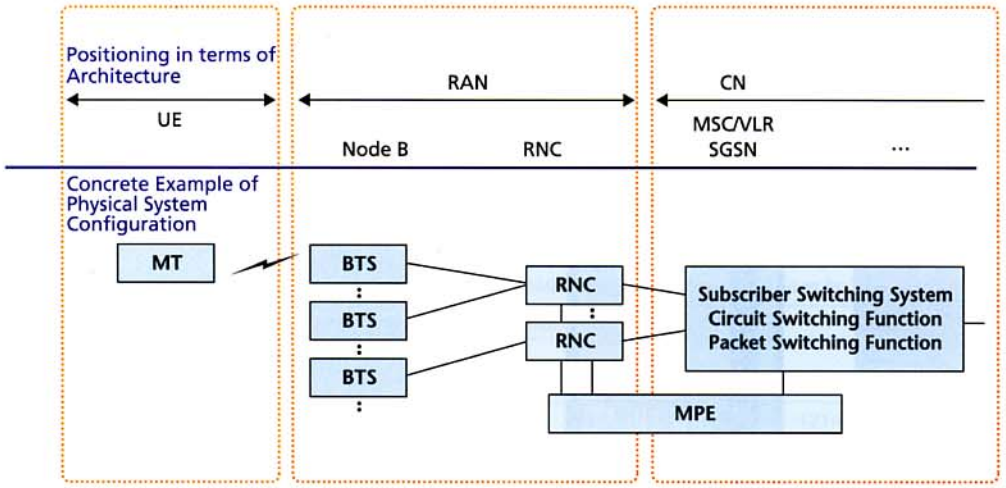
Multiplexing and transmitting signals through multiple transport channels over these physical channels make it possible to multiplex user data and control information, and multiplex and transmit multiple user data associated in multi-access. Also, linking multiple logical channels to a single transport channel enables efficient transmission. Mapping from the transport layer to the physical layer takes place in the physical layer, whereas mapping from the logical channel to the transport channel takes place in the MAC sublayer.

Figure 2 shows how mapping takes place between the main physical channels, transport channels and logical channels.



BCCH: Broadcast Control CHannel
BCH: Broadcast CHannel
CCCH: Common Control CHannel
DCCH: Dedicated Control CHannel
DCH: Dedicated CHannel
DPCH: Dedicated Physical CHannel
DSCH: Downlink Shared CHannel
DTCH: Dedicated Traffic CHannel
FACH: Forward Access CHannel
P-CCPCH: Primary-Common Control Physical CHannel
PCCH: Paging Control CHannel
PCH: Paging CHannel
PDSCH: Physical Downlink Shared CHannel
PRACH: Physical Random Access CHannel
RACH: Random Access CHannel
S-CCPCH: Secondary-Common Control Physical CHannel

Figure 2 Mapping between Main Physical Channels, Transport Channels and Logical Channels



BTS: Base Transceiver Station
CN: Core Network
MPE: Multimedia signal Processing Equipment
MSC: Mobile Switching Center
MT: Mobile Terminal
RAN: Radio Access Network
RNC: Radio Network Controller
SGSN: Serving GPRS Support Node
UE: User Equipment
VLR: Visitor Location Register

Figure 3 W-CDMA Radio System Configuration

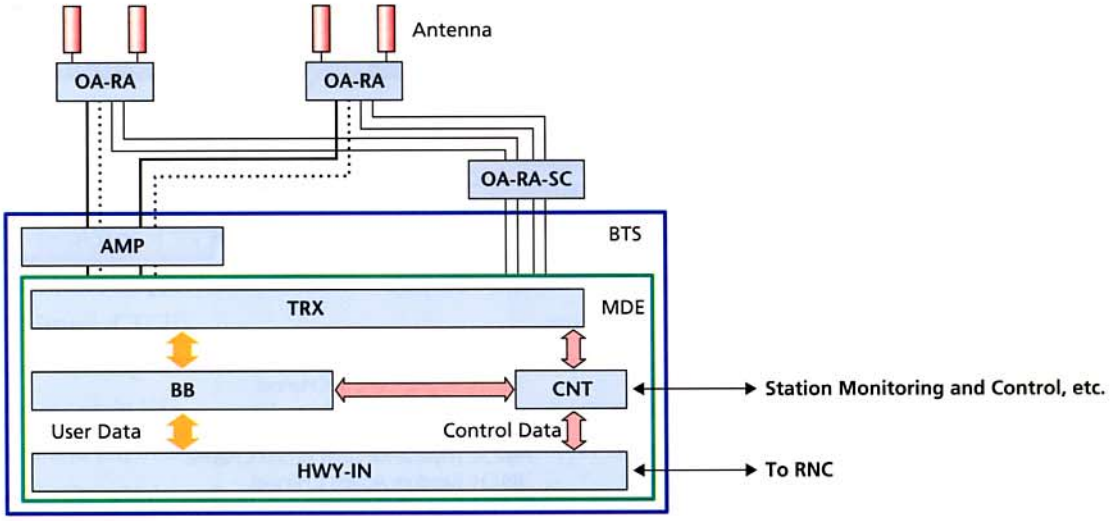
4. System Configuration of Radio Equipment

This section describes the system configuration of the radio access network based on a logical architecture in concrete terms. **Figure 3** shows the configuration of an IMT-2000 system. Radio equipment consists of MT, BTS, RNC and MPE. Although BTS is called Node B as a logical node in terms of architecture, it is referred to as BTS as a physical device in this Figure. Signal processing functions of MPE may be added to RNC, as it constitutes a part of RNC in terms of architecture—however, the signal-processing device is depicted as a separate piece of equipment in the current network configuration. As the signal processing functions in parts of the core network are also collectively added to MPE, the MPE is connected with the subscriber switching system as well, as shown in Figure 3.

5. BTS

(1) Functional Configuration

Figure 4 shows the functional configuration of BTS. BTS consists of the Open Air Receive Amplifier (OA-RA), the Open Air Receive Amplifier Supervisory Controller (OA-RA-SC), the AMPlifier (AMP) and the Modulation and Demodulation Equipment (MDE).



AMP: AMPlifier
BB: Base Band
BTS: Base Transceiver Station
CNT: CoNTroller
HWY-IN: HighWaY-INterface
MDE: Modulation and Demodulation Equipment
OA-RA: Open Air Receive Amplifier
OA-RA-SC: Open Air Receive Amplifier Supervisory Controller
RNC: Radio Network Controller
TRX: Transmitter/Receiver

Figure 4 Functional Configuration of Base Transceiver Station (BTS)

Photo 1 Exterior of Base Transceiver Station (BTS)

MDE consists of functional modules including the Transmitter/Receiver (TRX), the controller, the transmission line interface, and the Base Band signal processing unit (BB). AMP, OA-RA and TRX are independent units in each sector, whereas other MDE functional modules are shared by multiple sectors. **Photo 1** shows the exterior of BTS.

(2) Basic Specifications

Table 1 shows the basic radio specifications of BTS. The radio properties of BTS are in compliance with TS25.104 "UTRA (BS) FDD; Radio Transmission and Reception" and S25.141 "Base station conformance testing (FDD)" prepared by the 3GPP Technical Specification Group (TSG) RAN Working Group (WG) 4.

(3) AMP

AMP collectively amplifies the power of the output signals of the modulator/demodulator (multi-code, multiplexed signals, multi-carrier) up to the required antenna input level. The gain is about 40-50dB. At the point of detuning at 5MHz, the adjacent channel leakage power ratio (ACPR) must meet the 3GPP specification requirements at 5dBc during multi-code, multi-carrier transmission; hence, a common amplifier with superior linear properties is necessary. Distortion compensation technologies for common amplifiers include feed forward and pre-distortion. Feed forward is the dominant technology due to its high distortion compensation performance. We managed to reduce the size of AMP by creating a common amplifier meeting these require-

Table 1 Basic Specifications of Base Transceiver Station (BTS)

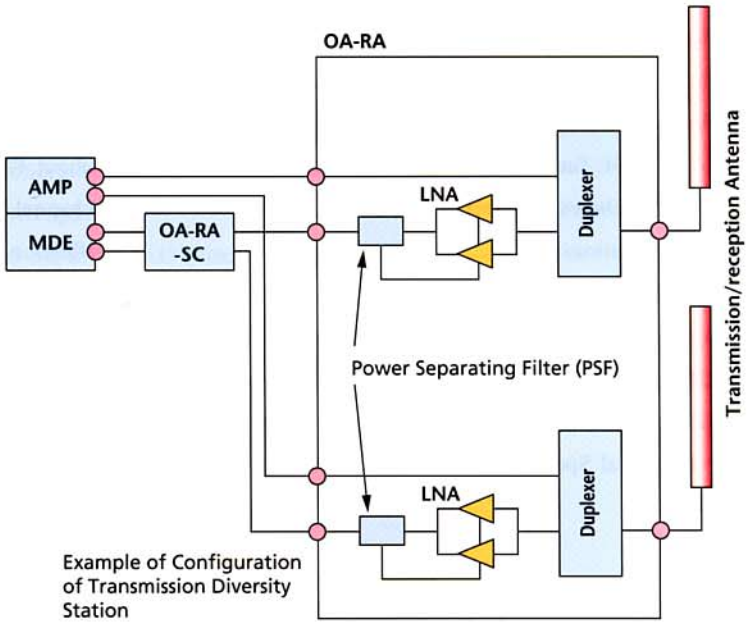
Item Number	Item	Specifications	
1	Radio Access System	DS-CDMA FDD	
2	Transmission/Reception Frequency Band	IMT-2000 Band	
3	Transmission/Reception Frequency Interval	190MHz	
4	Carrier Interval	200kHz Carrier raster	
5	Chip Rate	3.84Mcps	
6	Symbol Rate	7.5ksps-960ksps	
7	Modulation Scheme	Data Modulation: QPSK, Spreading Modulation: QPSK	
8	Demodulation Scheme	Pilot-symbol aided coherent detection	
9	Data Transfer Speed	Max. 384kbit/s (2Mbit/s)	
10	Max. Transmission Power	20W±2dB/carrier/sector (10W±2dB/carrier/sector/antenna when subject to transmission diversity)	
11	Frequency Stability	±0.05ppm or lower	
12	Occupied Bandwidth	5MHz or lower (99% bandwidth)	
13	Adjacent Channel Leakage Power Ratio (ACPR)	5MHz detuning	45dB or higher/3.84MHz bandwidth
		10MHz detuning	50dB or higher/3.84MHz bandwidth
14	Spurious Emissions	9kHz-150kHz	-13dBm (1kHz BW)
		150kHz-30MHz	-13dBm (10kHz BW)
		30MHz-1GHz	-13dBm (100kHz BW)
		1GHz～12.75GHz	-13dBm (1MHz BW)
		However, 1893.5MHz-1919.6MHz: -41dBm (300kHz BW), 1920MHz-1980MHz: -96dBm (100kHz BW). If there is any overlapping in the frequency bands above, the strictest figure is applicable (unless the carrier wave frequency is less than ±12.5MHz).	
15	Transmit Intermodulation	The requirements for ACPR and spurious emissions are satisfied when entering a signal detuned by ±5MHz, ±10MHz or ±15MHz from the target wave and lower by 30dB. (W-CDMA modulated wave).	
16	Roll-off Factor	Root Nyquist raised-cosine filter α=0.22	
17	Modulation Accuracy	17.5% RMS or less	
18	Reference Sensitivity	Data Rate	12.2kbit/s
		Input Signal Level	-121dBm
		Bit Error Rate	10^{-3} or less
19	Spurious Emissions in a Receiver	9kHz-1GHz	-57dBm (100kHz BW)
		1GHz-12.75GHz	-47dBm (1MHz BW)
		However, 1920MHz-1980MHz: -78dBm (3.84MHz BW).	

DS-CDMA: Direct Sequence Code Division Multiple Access
FDD: Frequency Division Duplex
IMT-2000: International Mobile Telecommunications-2000
QPSK: Quadrature Phase Shift Keying
W-CDMA: Wideband Code Division Multiple Access

ments.

(4) OA-RA and OA-RA-SC

The receiving amplifier used in OA-RA normally consists of Low Noise Amplifiers (LNA) in parallel configuration aimed at improving reliability. The gain is around 40dB, and power is fed based on the phantom power supplying method, which involves the use of radio frequency coaxial cables to ensure economic efficiency of installation work. This requires a power separating filter, and coaxial arrestors and other surge-protection measures are taken as it is prone to power surge caused by lightning. **Figure 5** shows an example of an OA-RA connection configuration of a station subject to transmission diversity. OA-RA uses a low-loss, small duplexer and reception filter, and the two-branch support equipment amounting to 15 liters in volume achieves a Noise Figure (NF) of no more than 3dB. Provisions for spurious emissions take fully into account the PHS band, etc.



AMP: AMPlifier
LNA: Low Noise Amplifier
MDE: Modulation and Demodulation Equipment
OA-RA: Open Air Receive Amplifier
OA-RA-SC: Open Air Receive Amplifier Supervisory Controller

Figure 5 Example of Basic Configuration of Open Air Receive Amplifier (Subject to Transmission Diversity)

(5) TRX

TRX converts transmission signals spreading in base band from digital to analog, converts them into radio frequency signals based on orthogonal modulation, quasi-coherently detects reception signals from OA-RA, converts them from analog to digital and sends them to BB. Each sector is assigned to an independent unit, equipped with a spare TRX. In the event of any problems, the spare TRX automatically takes over in this redundant configuration, and each system can deal with up to 6 sectors.

(6) BB

BB is responsible for the forward error correction encoding, framing, data modulation and spreading modulation of transmitting signals, despreading of recieving signals, chip synchronization, error correction decoding, multiplexing and demultiplexing data, maximum-ratio combiningupon diversity-handover from sector to sector, and other signal processes.

In contrast with TRX, in which the hardware in each sector is independent of each other, the hardware resources for the base-band signal-processing card may be assigned to any sector or carrier. By sharing them in BTS, it is possible to flexibly assign channels to cope with uneven services and traffic. The first-generation BTS was able to process more than 720 speech channels per system in base band, which is enough to take up the full radio channel capacity in a two-carrier, three-sector configuration.

(7) Transmission Line Interface

BTS and RNC are interconnected via a 1.544Mbit/s, 6.312Mbit/s or ATM mega-link transmission line. Highly efficient transmission of control data and user data is achieved by ATM transmission technology. The transmission line interface has an ATM processing function, the signal processing function of ATM Adaptation Layer (AAL)-Type 2 and Type-5, and the Service Specific Connection Oriented Protocol (SSCOP) function. The interface is also equipped with various reference clocks and reference timing phasing functions required for BTS to operate from the transmission line, as well as a time stamp function for synchronizing nodes between BTS and RNC.

(8) Control Function

This part is responsible for transmitting call-control signals to RNC and receiving these signals from RNC, managing radio channels, and establishing/releasing radio channels. The control software (call control, maintenance monitor and control) and various system parameters can be recorded in a nonvolatile memory in a PCMCIA (Personal Computer Memory Card

International Association) Card, and software upgrading can be centralized. Also, the layer function and the application software are stratified to enable the development of applications independently of each other, and to simplify the enhancement and modification of functions. The maintenance interface function is a standard one like Common Object Request Broker Architecture (CORBA). It also has an Initial Program Loader (IPL) function and a remote file forwarding function, and is capable of monitoring and controlling the status of the card mounted in BTS, as well as monitoring and controlling station information outside BTS and peripheral equipment through an external monitor/control interface.

6. RNC

RNC has a control signal processing function, Operation And Maintenance (OAM) function, common channel multiplexing/demultiplexing function, ATM switching function, and diversity handover function. RNC, which is connected with the subscriber switching system, MPE and BTS, is engaged in connecting and controlling radio bearers and controlling handovers. **Figure 6** shows the functional configuration of RNC. The Figure illustrates each function of RNC as one block. In practice, the hardware configuration may be such that more than one function is carried out by one hardware or software. The functional blocks are described in brief below.

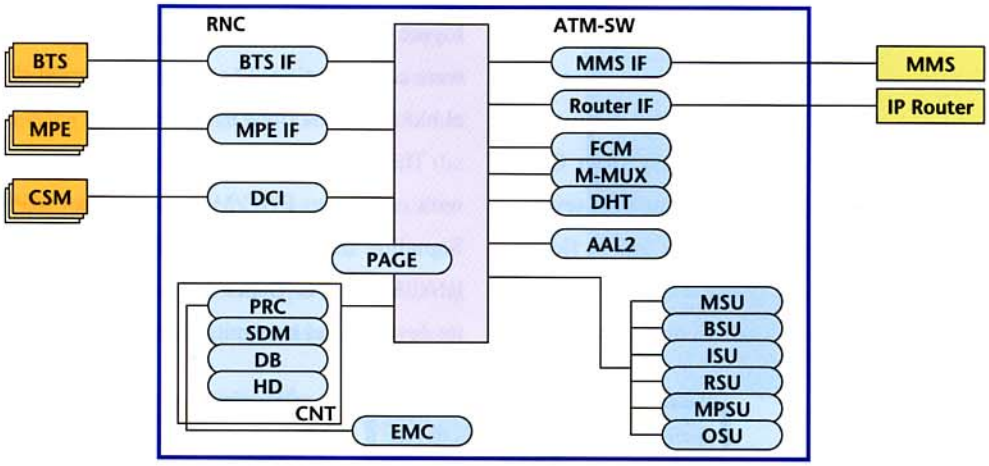
(1) Interface Function and Transmission Line Interface Function

The BTS InterFace (BTS IF) and the MMS InterFace (MMS IF) serve as the transmission line interfaces providing connections to Mobile Multimedia switching System (MMS), MPE and BTS. The Router InterFace (Router IF) provides the connection to the OAM system for the operation and maintenance of belonging BTSs. The Digital clock supply Clock Interface (DCI) receives the external clock and feeds the reference clock for RNC operation.

RNC efficiently supports low-bitrate communications over ATM transmission lines by the ATM SWitch (ATM-SW) and the AAL Type 2 (AAL2) function.

(2) Signal Termination Function

The signal termination function transmits control signals to other nodes and receives control signals from those nodes (including signal retransmission and address functions) in order to fulfill the radio network control function in RNC. The BTS Signaling Unit (BSU), the Iu interface Signaling termination Unit (ISU) and the MPE Signaling termination Unit (MPSU) perform control signal transmission/reception functions with respect to BTS, MMS and MPE, respectively. The RNC



AAL: ATM Adaptation Layer
ATM-SW: ATM-SWtich
BSU: BTS Signalling termination Unit
BTS: Base Transceiver Station
BTS IF: BTS InterFace
CNT: CoNTroller
CSM: Clock Supply Module
DB: DeBugger
DCI: Digital clock supply Clock Interface
DHT: Diversity Handover Trunk
EMC: EMergency Controller
FCM: Frame Clock synchronization Module
HD: HardDisk
IP: Internet Protocol
ISU: Iu interface Signaling termination Unit
M-MUX: MAC MUltipleXer
MMS: Mobile Multimedia switching System
MMS IF: MMS InterFace
MPE: Multimedia signal Processing Equipment
MPE IF: MPE InterFace
MPSU: MPE Signaling termination Unit
MSU: Mobile Signaling termination Unit
OSU: OpS Signaling termination Unit
PAGE: PAGE function
PRC: PRoCessor
RSU: RNC Signaling termination Unit
SDM: System Data Module

Figure 6 Functional Configuration of Radio Network Controller (RNC)

Signaling termination Unit (RSU) is in charge of the transmission and reception of signals associated with handover control between RNCs, whereas the Mobile Signaling termination Unit (MSU) transmits and receives signals between the UE and the network. Operation System (OpS) Signaling termination Unit (OSU) transmits and receives signals over the operation and maintenance interface.

(3) DHT, M-MUX, PAGE and FCM

The Diversity Handover Trunk (DHT) fulfills the selection & combining function and the distribution function to achieve diversity handover between BTSs (including between RNCs and between MMSs). The MAC MUltipleXer (M-MUX) offers the function to distinguish UEs over the common control channels in each cell. The PAGE function (PAGE) is for broadcasting of paging signals in the belonging cells. The Frame Clock synchronization Module (FCM) enables the measurement of the phase difference between the RNC and the BTSs concerned with it.

(4) Controller and Others

The controller includes the processor, the System Data Module (SDM) which stores system data, etc., the hard disk, the DeBugger (DB) which serves as the interface for logging, etc. The EMergency Controller (EMC) serves as RNC's emergency control interface open to external access.

Photo 2 shows the exterior of RNC.

RNC needs to flexibly accommodate a wide range of areas, from traffic-intensive cities to suburbs. Accordingly, it must be able to process at least tens of thousands of Busy Hour Call Attempts (BHCA), have a switching capability of at least several Gbit/s, be able to accommodate dozens of BTSs, and be flexible enough to adapt to area designs. Also, call connection processes should not be the only focus –sufficient consideration must be given to operation and maintenance as well. RNC therefore has a standard operation and maintenance interface function like CORBA.

7. MPE

MPE has packet signal processing functions including the protocol conversion function for packet-switched data, as well as speech signal processing functions to convert speech data from Adaptive Multi Rate (AMR) to μ-law Pulse Code Modulation (PCM) and vice versa. As described in Chapter 4, the packet signal processing function constitutes part of RAN, and the RNC function is concentrated in MPE, which is a physically separate device.

Hence, packet signal processing takes place via connection with multiple RNCs. Hardware resources for signal processing are centralized in MPE and can be shared by multiple RNCs. Signal processing functions for circuit switching services, such as speech signal processing, are regarded as CN functions in the standard specifications, and therefore are performed in connection with the subscriber switching system. As MPE is a piece of hardware that integrates the signal processing functions of RAN and CN, it is able to perform both functions with a single device.

Figure 7 shows the functional configuration of MPE. The Figure shows the functional configuration rather than the hardware configuration. The processes carried out by each functional block are described in brief below.

The CoNTroller (CNT) transmits and receives control signals with respect to RNC/MMS to control MPE. The RNC/MMS Signaling termination Unit (RMSU) terminates the signals of RNC/MMS. The SuperVisory CoNTroller (SV-CNT) monitors its devices, and transmits/receives OAM signals with respect to

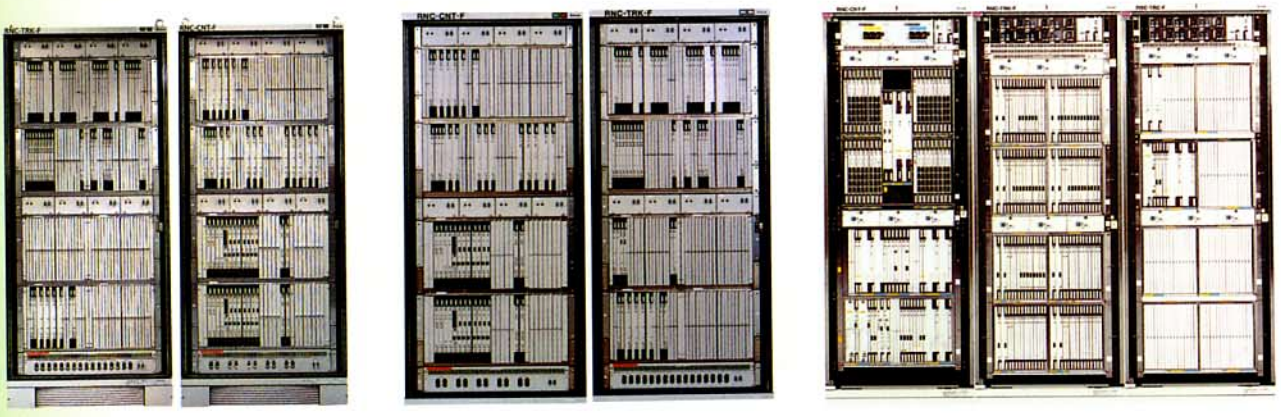
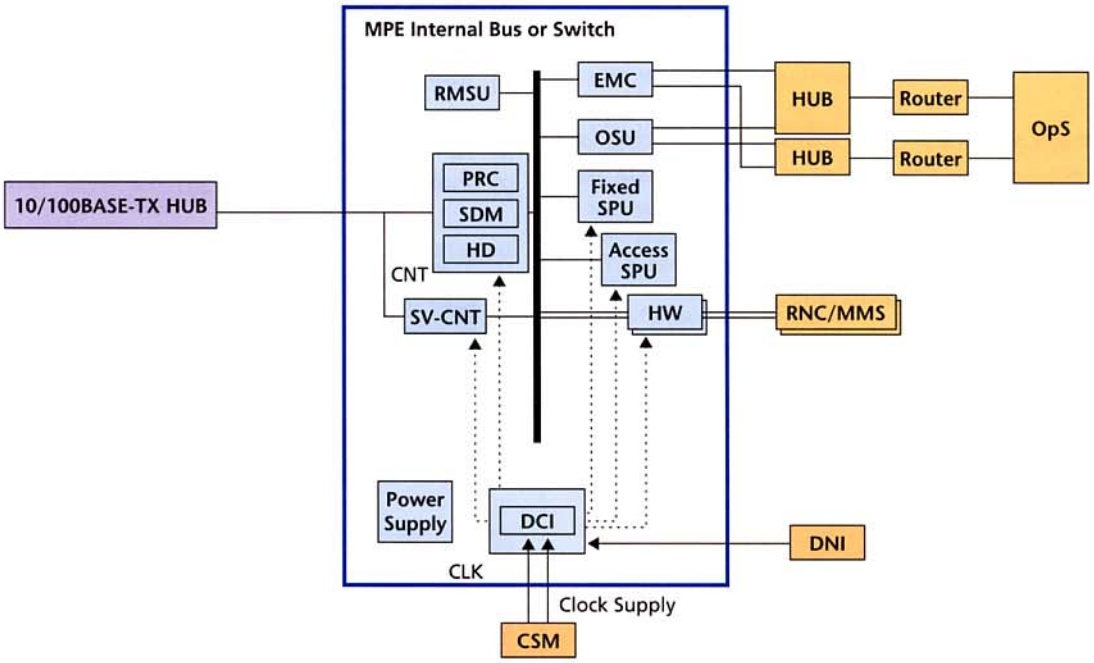


Photo 2 Exterior of Radio Network Controller (RNC)



CLK: CLocK
CNT: CoNTroller
CSM: CLocK Supply Module
DCI: Digital clock supply Clock Interface
DNI: Day Night pulse Interface
EMC: EMergency Controller
HD: HardDisk
HW: HighWay
MMS: Mobile Multimedia switching System
OpS: Operation System
OSU: OpS Signaling termination Unit
PRC: PRoCessor
RMSU: RNC/MMS Signaling termination Unit
RNC: Radio Network Controller
SDM: System Data Module
SPU: Signal Processing Unit
SV-CNT: SuperVisory CoNTroller

Figure 7 Functional Configuration of Multimedia signal Processing Equipment (MPE)

the Operating System (OpS) to monitor its devices. The Signal Processing Unit (SPU) carries out various signal processes specified for each service type. The HighWay (HW) terminates the wired transmission line with RNC/MMS. At DCI, the CLocK (CLK) generates the reference clock based on the external clock, and feeds it to each functional block. OSU is the termination for transmitting OAM signals to OpS and receiving the signals from OpS. EMC is in charge of control in the event of emergency.

MPE can process at least hundreds of thousands of BHCA, has a switching capability of at least several Gbit/s and is able to accommodate dozens of RNCs, in order to flexibly adapt to a wide range of area designs.

Photo 3 shows the exterior of MPE.

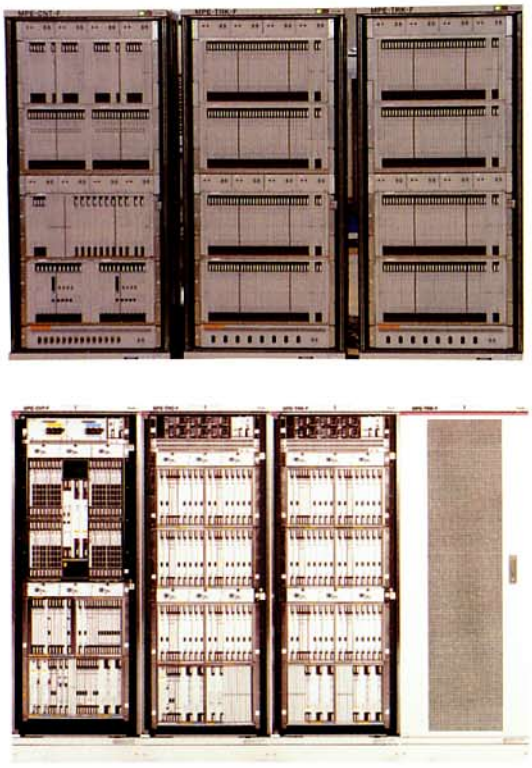


Photo 3 Exterior of Multimedia signal Processing Equipment (MPE)

8. Conclusion

This article reviewed the architecture of radio access protocols in radio access networks, the configuration of radio channels, and devices constituting radio access networks. We will continue to advance the functions of devices in radio access net-

works to further enhance functionality and capacity in order to deal with the trends in user traffic and service diversification.

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GLOSSARY

3GPP: 3rd Generation Partnership Project
AAL: ATM Adaptation Layer
AICH: Acquisition Indication CHannel
AMP: AMPlifier
AMR: Adaptive Multi Rate
ATM-SW: ATM-SWitch
ATM: Asynchronous Transfer Mode
BB: Base Band
BCCH: Broadcast Control CHannel
BCH: Broadcast CHannel
BHCA: Busy Hour Call Attempt
BMC: Broadcast/Multicast Control
BSU: BTS Signaling termination Unit
BTS: Base Transceiver Station
BTS IF: BTS Interface
C-Plane: Control-Plane
CC: Call Control
CCCH: Common Control CHannel
CCH: Control CHannel
CLK: CLocK
CN: Core Network
CNT: CoNTroller
CORBA: Common Object Request Broker Architecture
CPICH: Common PIlot CHannel
CSM: Clock Supply Module
CTCH: Common Traffic CHannel
DB: DeBugger
DCCH: Dedicated Control CHannel
DCH: Dedicated CHannel
DCI: Digital clock supply Clock Interface
DHT: Diversity Handover Trunk
DNI: Day Night pulse Interface
DPCCH: Dedicated Physical Control CHannel
DPCH: Dedicated Physical CHannel
DPDCH: Dedicated Physical Data CHannel
DS-CDMA: Direct Sequence Code Division Multiple Access
DSCH: Downlink Shared CHannel
DTCH: Dedicated Traffic CHannel
EMC: EMergency Controller
FACH: Forward Access CHannel
FCM: Frame Clock synchronization Module
FDD: Frequency Division Duplex
HD: Hard Disc
HW: HighWay
HWY-IN: HighWaY-INterface
IMT-2000: International Mobile Telecommunications-2000
IP: Internet Protocol
IPL: Initial Program Loader
ISU: Iu interface Signaling termination Unit
LNA: Low Noise Amplifier
M-MUX: MAC MUltipleXer
MAC: Medium Access Control
MDE: Modulation and Demodulation Equipment
MM: Mobility Management
MMS: Mobile Multimedia switching System
MMS IF: MMS InterFace
MPE: Multimedia signal Processing Equipment
MPE IF: MPE InterFace
MPSU: MPE Signaling termination Unit
MSC: Mobile Switching Center
MSU: Mobile Signaling termination Unit
MT: Mobile Terminal
NF: Noise Figure
OAM: Operation And Maintenance
OA-RA-SC: Open Air Receive Amplifier Supervisory Controller
OA-RA: Open Air Receive Amplifier
OpS: Operation System
OSU: : OpS Signaling termination Unit
P-CCPCH: Primary Common Control Physical CHannel
PAGE: PAGE function
PCCH: Paging Control CHannel
PCH: Paging CHannel
PCM: Pulse Code Modulation
PCMCIA: Personal Computer Memory Card International Association
PDCP: Packet Data Convergence Protocol
PDSCH: Physical Downlink Shared CHannel
PHY: PHYsical layer Protocol
PICH: Page Indication CHannel
PRACH: Physical Random Access CHannel
PRC: PRoCessor
QPSK: Quadrature Phase Shift Keying
RACH: Random Access CHannel
RAN: Radio Access Network
RLC: Radio Link Control
RMSU: RNC/MMS Signaling termination Unit
RNC: Radio Network Controller
Router IF: Router InterFace
RRC: Radio Resource Control
RSU: RNC Signaling termination Unit
S-CCPCH: Secondary Common Control Physical CHannel
SAP: Service Access Point
SCH: Synchronization CHannel
SDM: System Data Module
SGSN: Serving GPRS Support Node
SPU: Signal Processing Unit
SSCOP: Service Specific Connection Oriented Protocol
SV-CNT: SuperVisory CoNTroller
TCH: Traffic CHannel
TRX: Transmitter/Receiver
TSG: Technical Specification Group
U-Plane: User-Plane
UE: User Equipment
VLR: Visitor Location Register
W-CDMA: Wideband Code Division Multiple Access