IP Transport | Radio Access Network Equipment | Economization

Technology Reports

Special Articles on IP-based RAN for Economical and Flexible Network Construction

IP-based RAN Overview

*By introducing IP-based RAN, which applies IP transport to the FOMA radio access network, NTT DoCoMo aims for economical network construction, easier and more flexible network expansion, provision of new services such as OFFICEED®[*1], and greater expansibility for the future introduction of more advanced functionality.*

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1. Introduction

The IP-based Radio Access Network (IP-based RAN), which applies IP transport to the FOMA radio access network, began operation in 2006 with the introduction of the IP-Radio Network Controller (IP-RNC) in April, the compact indoor IP Base Transceiver Station (IP-BTS) in September, and the outdoor high-density multi-band BTS in October.

In this article, we briefly describe the purposes of introducing IP-based RAN, the network configuration, and the systems that constitute the network.

2. Purposes of Introducing IP-based RAN

IP-based RAN was introduced for the following purposes.

1) Economical Entrance Transport by the Introduction of IP Technology

Since first being introduced, the FOMA network has adopted Asynchronous Transfer Mode (ATM)[*2] technology. Being capable of efficiently sending/receiving various kinds of communication data including audio, data, and images, over a single transmission path according to discrete Quality of Service (QoS)[*3] for each communication, ATM satisfied the FOMA network requirements. Nevertheless, the amount of packet communication traffic has increased in recent years, as exemplified by the August 2006 introduction of High Speed Downlink Packet Access (HSDPA)[*4], and that tendency is expected to continue into the future. As a result, there is now a demand for the construction of networks with IP transport, which makes it possible to provide broadband communication services even more economically and is also capable of QoS control.

2) Economical and Flexible Network Expansion

As the FOMA network expands and the number of users increases, the countermeasures to increase network capacity and to expand the service area inside the buildings and underground locations, which are difficult for radio signals to reach, have been thoroughly pursued. Introducing IP-based RAN makes it possible to construct networks in such areas using LAN and IP-BTSs, which allows the economical and flexible construction of an In-building Mobile Communication System (IMCS)[*5] compared with the previous technology. IP-RNC also allows economical construction of networks by connecting and controlling many small-capacity base stations such as the IP-BTS.

3) Development of Economical and Expansible System

Application of IP technology makes it possible to use ordinary IP routers,

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*1 **OFFICEED®**: A flat-rate communication services among group of people pre-registered to an area within IMCS(see*5)-introduced buildings. This makes in-house communications possible with FOMA terminals.

*2 **ATM**: A communication scheme in which fixed-length frames called cells are transferred successively.

*3 **QoS**: A level of quality on the network that can be set for each service. The amount of delay or packet loss is controlled by controlling the bandwidth that the service can use.

*4 **HSDPA**: A high-speed downlink packet transmission system based on W-CDMA. Maximum downlink transmission speed under the 3GPP standard is approximately 14 Mbit/s. Optimizes the modulation method and coding rate according to the radio reception status of the mobile terminal.

switches and so on as network devices. Furthermore, using general-purpose technology for the network systems means that the hardware itself can be economized. The IP-RNC aims for economy through application of general-purpose blade servers[*6] that conform to the advanced Telecom Computing Architecture (aTCA)[*7] specifications and general-purpose technology such as Carrier Grade Linux (CGL)[*8]. It is also configured to allow expansibility for the introduction of future new services and for packet communication with higher speed and more advanced features. The IP-BTS is specialized for indoor use with respect to transmission power and accommodation capacity, making it much smaller and more economical. In another effort to economize, the high-density multi-band BTS has adopted the Common Public Radio Interface (CPRI)[*9] standard specifications as a common interface between the transmission power AMPlifier (AMP) and Modulation and Demodulation Equipment (MDE).

4) Introduction of OFFICEED Services

In the connectionless IP network, routing of the communication can be flexibly controlled by simply specifying the destinations of frames. We make use of that advantage to provide the OFFICEED for corporate-use in-house communication service, for which the demand is expected to grow. OFFICEED combines IP-BTS with Base Station-Data Transfer Module (BS-DTM), which is a dedicated module for the service, to provide flat-rate communication among registered members within the OFFICEED area. The OFFICEED service was commenced in February 2007.

3. Configuration of IP-based RAN

The IP-based RAN configuration is shown in **Figure 1**. The functions of each system are described below.

1) IP-RNC

This is an RNC that has been adapted for IP. It can accommodate conventional ATM-based BTSs as well as IP-based RAN systems such as IP-BTSs and BS-DTMs. It performs call connection control and hand-over control in the radio access network.

2) BTS Supporting IP Transport

This is a BTS that has been adapted for IP. Two types of BTS have been developed: indoor IP-BTS and outdoor high-density multi-band BTS.

3) BS-DTM

This is a dedicated module for use with OFFICEED. It has functions for call connection and hand-over between IP-BTSs.

4) IP Network Devices and IP Transport

General-purpose IP routers and switches are used in the IP network. They provide for communication QoS control and rerouting control at times of network failure. For the IP transport, an

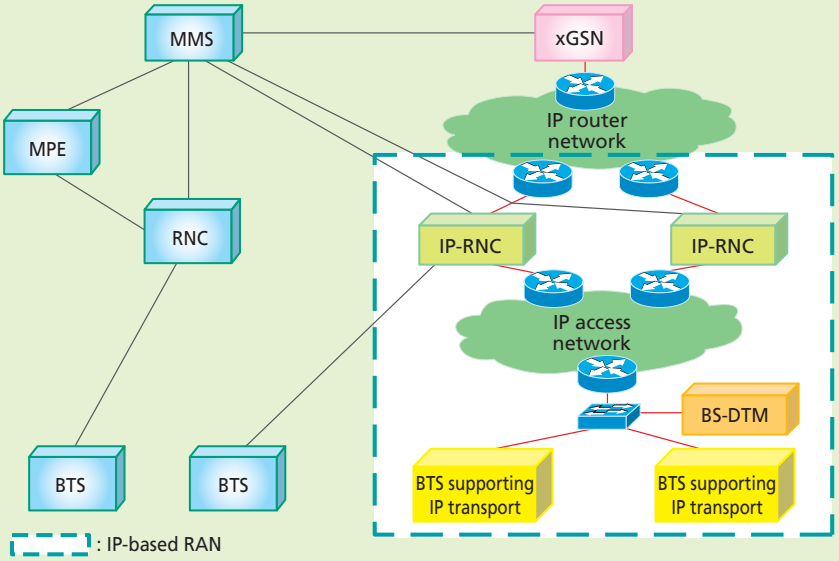

Figure 1 Configuration of IP-based RAN

*5 **IMCS**: NTT DoCoMo's system that allows communication in places such as high-rise buildings, underground areas and other locations where it is difficult or impossible for mobile terminals to make connections.

*6 **Blade server**: A server that is configured of multiple boards, and all of the components of a computer are installed on each board. They are mounted in a chassis that provides power, LAN and other such functions.

*7 **aTCA**: Industrial standard specifications for carrier-oriented next-generation communication equipment defined by the PCI Industrial Computer Manufacturers Group (PICMG).

*8 **CGL**: A highly-reliable version of the Linux, an Unix-style open source OS, defined by the Open Source Development Lab (OSDL) which is an organization that promotes business-use Linux. This can be used by telecommunication carriers.

Ethernet leased-line service and/or NTT DoCoMo's IP router network is used.

4. Conclusion

We explained the purposes and configuration of the IP-based RAN. Introduction of the IP-based RAN economizes network construction and provides more advanced FOMA services in the future.

The systems in the IP-based RAN are further explained in the following articles.

*9 **CPRI**: Internal interface specification of Third-Generation BTS defined by the CPRI, an industry organization.