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PHS MoU Group News

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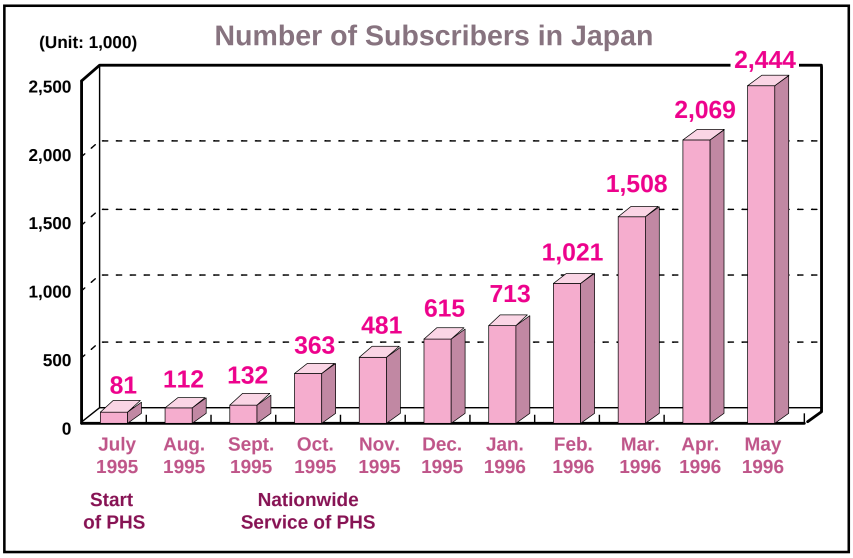
PHS Subscribers in Japan Top 2 Million



The number of subscribers to Personal Handy-phone System (PHS) service surpassed two million at the end of April, reaching this milestone in a short span of 10 months since service was launched in July 1995.

The NTT Personal Communications Network Group and the DDI Pocket Telephone Group initiated PHS service in Tokyo and Sapporo in July 1995 with around 90,000 subscribers combined. These two groups were then joined by the Astel Group which launched its PHS service in October 1995, making a total of three service provider groups in the PHS market. At the same time, the PHS service area was extended to cover the entire country, and the subscriber base soared to 360,000 at one stroke, roughly a threefold increase over the number in September 1995.

Subsequently, the number of new subscribers continued to increase at a pace of more than 100,000 every month. Since February 1996, the subscriber base has mushroomed rapidly. Some 300,000 people signed up for PHS service in February, 500,000 in March and 500,000 in April as well. That pushed the cumulative number of subscribers above the two-million mark in just 10 months since service began. Moreover, the number reached 2,400,000 as of the end of May this year.

One reason behind this surge is that consumers are beginning to understand the inherent merits of PHS service, which provides excellent speech quality at low call rates. Another factor is that the dead areas where PHS signals were not supported initially have been reduced as a result of competition among PHS service providers to expand their service areas.

Other factors apparently contributing to this increase

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in subscribers include the introduction of answering phone service and the release of handsets combining PHS with a paging function. These new features are designed to compensate for the drawbacks of PHS compared with cellular phones, including limited service areas and the inability to complete calls when moving at high speed, such as when traveling on trains. The answering phone service enables a caller to leave a message with a voice mail center implemented by the PHS service provider, when a PHS user cannot be reached. With the integrated terminals that combine PHS with a paging function, the pager automatically receives an incoming call and rings when a user is outside a PHS service area.

Recent TTC Activities Concerning PHS Standards

Japanese national standards concerning the network portion of the Personal Handy-phone System (PHS) were previously formulated by the Telecommunication Technology Committee (TTC). This article outlines the major PHS standards drawn up by TTC from last autumn to this spring.

1. Addition of 3.1 kHz audio communications

Unlike JT-Q931, JT-Q931-b which specifies the interface between PHS cell stations and the digital network previously did not allow a “3.1 kHz audio signal” as a parameter for the “information transfer capability.”

A provision was added to JT-Q931-b for the purpose of transmitting data by a modem using PHS. The said standard was changed to allow 3.1 kHz audio communications. This change was adopted by the Technical Assembly on November 28, 1995, and was put effect following a procedural examination at the Councilors’ Meeting on December 16, 1995.

2. Realization of 32 kbps digital communications

TTC formulated a standard with an eye toward realizing 32 kbps digital communications over the PHS wireless section which the system has the inherent capability to support.

A rate adaption provision was previously stipulated in JT-Q931 (and ITU-T Recommendation Q.931), which specifies the subscriber line signalling system of ISDN. A Supplement was added this time that clearly specifies this provision is to be applied to 32 kbps and 64 kbps rate adaption by PHS cell stations.

Further, a provision specifying 32 kbps for the layer 1 protocol of the bearer capability information element was newly added to JT-Q931-b. The respective value of the low layer and high layer compatibility information elements was also made the same as that specified in JT-Q931, thereby facilitating rate control between end systems.

These changes were adopted by the Technical Assembly on April 24, 1996, and took effect at the Councilors’ Meeting on May 16, 1996.

3. Addition of VLR roaming method

The only roaming system standardized previously for PHS was the HLR method, whereby the service profile is provided only on a subscriber’s home network. The standard has now been revised to include the VLR method as well, whereby a portion of the service profile is also redundantly provided on the network serving the area where a PHS subscriber is present. This change expands the selection of roaming methods and makes it possible to achieve an efficient method matching the situation involved.

The standard revised in this connection was JT-Q1218-a, which specifies the roaming procedure between networks for PHS services. The VLR method was newly added as capability set 2 to this standard. The provision incorporates the latest results of the work by ITU-T Study Group 11 on Intelligent Networks (IN) and adopts the SDF-SDF interface.

4. Other changes

4.1 Notification of calling party number

In order to support a wide variety of PHS services, it is desirable to have calling party number information exchanged between PHS cell stations and the digital network via the JT-Q931-b interface. JT-Q931-b has now been revised to allow notification of calling party number information between PHS cell stations and the digital network even in cases where a display of the caller’s number to the called party is prohibited.

4.2 Unification of terminology

The term "Second Generation Cordless Telephone System" has also been used in TTC standards to date to indicate PHS. The terminology has now been unified to PHS.

WLL Systems

1. What is a wireless local loop?

In a telephone network, a wireless local loop (WLL) is a generic term for an access system that uses a wireless link to connect subscribers to their local exchange in place of conventional copper cable. Using a wireless link shortens the construction period and also reduces installation and operating costs.

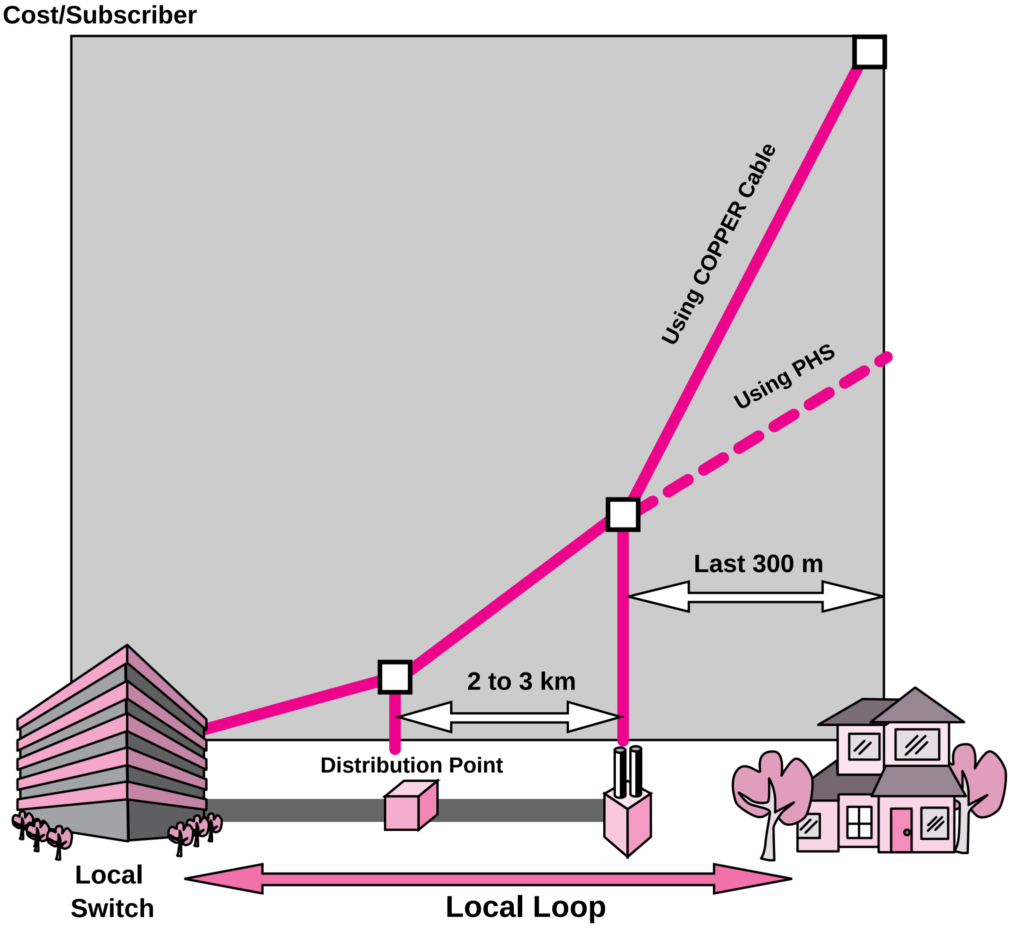
2. Market for WLL systems

The telephone penetration rate differs greatly from one country or region to another, with some areas of the world not even having one telephone per 100 population. There is an urgent need to eliminate the backlog for telephone service, now estimated at over 50 million lines, in order to make global communications a true reality. Moreover, as countries move ahead with plans to privatize telecommunications businesses and introduce competition, investments in telephone network facilities are continually increasing. Subscriber access lines account for a relatively large share of the total investment in outside plant and equipment. If the cost of the local loop could be reduced, it is believed that telephone penetration would advance dramatically at one stroke.

The cost breakdown of installing subscriber lines, including the construction work is in Fig. 1. The "last 300-meter" segment to each subscriber's premises accounts for a large share of the total, in terms of both the work and cost involved. Using a wireless link for subscriber access makes it possible to initiate service in a very short period of time, because the installation of the wireless facilities involves only a limited amount of small-scale construction. Wireless links are especially effective for the last 300 meters.

As a result of the explosive diffusion of cellular phones in recent years, wireless equipment prices have dropped dramatically. The cost of installing a WLL system for subscriber access lines is now virtually the same as that of copper cable, though it can vary depending on the subscriber line length and local conditions. In the coming years, the superiority of WLL systems will only increase.

Fig. 1 Installation Cost Breakdown for Subscriber Lines



3. Technical requirements of WLL systems

The following conditions are required of WLL systems which are looked to as a replacement for existing copper subscriber lines.

1) Communications quality

Since a WLL system serves as the access line for fixed telephone sets, it must provide the same level of quality as conventional telephone systems with respect to such aspects as speech quality, grade of service (GOS), connection delay and speech delay.

In addition, since radio waves are used, careful consideration must be given to protection of confidentiality and terminal authentication.

2) Short construction period

3) Low cost

The overall cost must be low, including equipment, construction and maintenance costs.

4) Absence of interference with other wireless systems

A WLL system must not cause any interference with the operation of existing systems, such as microwave communications and broadcasting systems.

5) High traffic volume

One characteristic of a WLL system is that it must support a larger traffic volume per subscriber than mobile communications systems.

4. Comparison of WLL system technologies

WLL systems incorporating various types of wireless technologies are already being provided primarily for use in rural areas. A comparison will be made here of a number of typical technologies.

1) TDM/TDMA and P-MP communications equipment

Communications equipment based on time division multiplex/time division access (TDM/TDMA) technology and a point-to-multipoint (P-MP) system is relatively well suited for rural use, because it provides service coverage over a wide area encompassing the base station, relay stations and subscriber stations.

2) Fixed use of cellular systems

This approach involves using the wireless equipment of a cellular phone system, thereby curtailing the mobile function. Using cellular phones as the subscriber terminals makes it possible to hold down the system cost. The use of advanced speech compression technology increases frequency utilization efficiency, but speech quality deteriorates as a consequence.

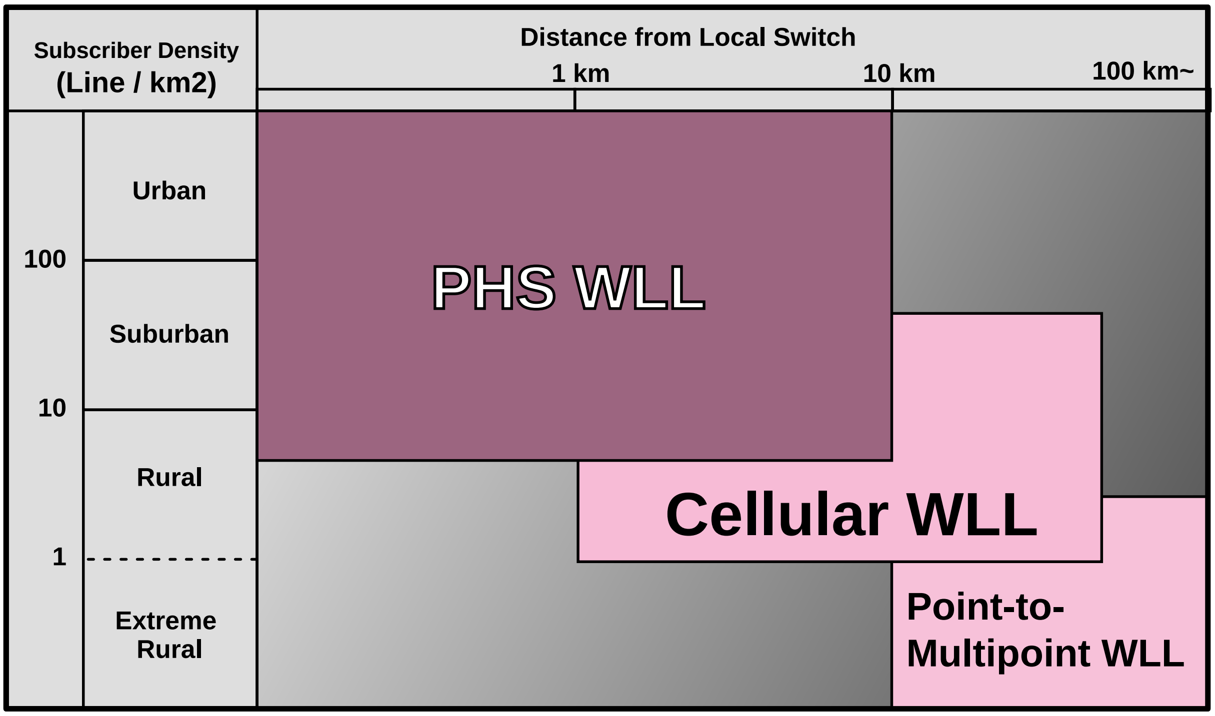
3) PHS-WLL system

Similar to 2) above, the system cost is reduced by using PHS terminal technology and wireless equipment. Since the voice encoding system uses 32 kbps adaptive differential pulse code modulation (ADPCM), speech

Table 1. Comparison of WLL Technologies

	PHS	Cellular	Point-to-multipoint
CS coverage	Small	Medium	Large
Voice quality	Higher	Lower	Higher
Delay	Shorter	Longer	Shorter
Terminal	PHS PS	Cellular terminal	Special terminal
CS cost	Economical	Expensive	Expensive
NW side equipment	Complicated	Very complicated	Simple
Frequency	1,900 MHz	450 / 800 / 900 MHz	1,500 / 2,400 MHz
Upgrade to mobile service	OK	OK	NG

Fig. 2 Potential Markets for WLL



quality on a par with that of fixed telephony is obtained.

A comparison of these technologies is given in Table 1. It is clear that a PHS-WLL system is superior in terms of speech quality and economy, among other aspects. In addition, while fixed use is the main objective at the time of system implementation, extensibility to mobile service in the future is also demanded in many cases. PHS is also advantageous in this respect, because the system was originally designed to provide mobile service.

5. Scope of application of each technology

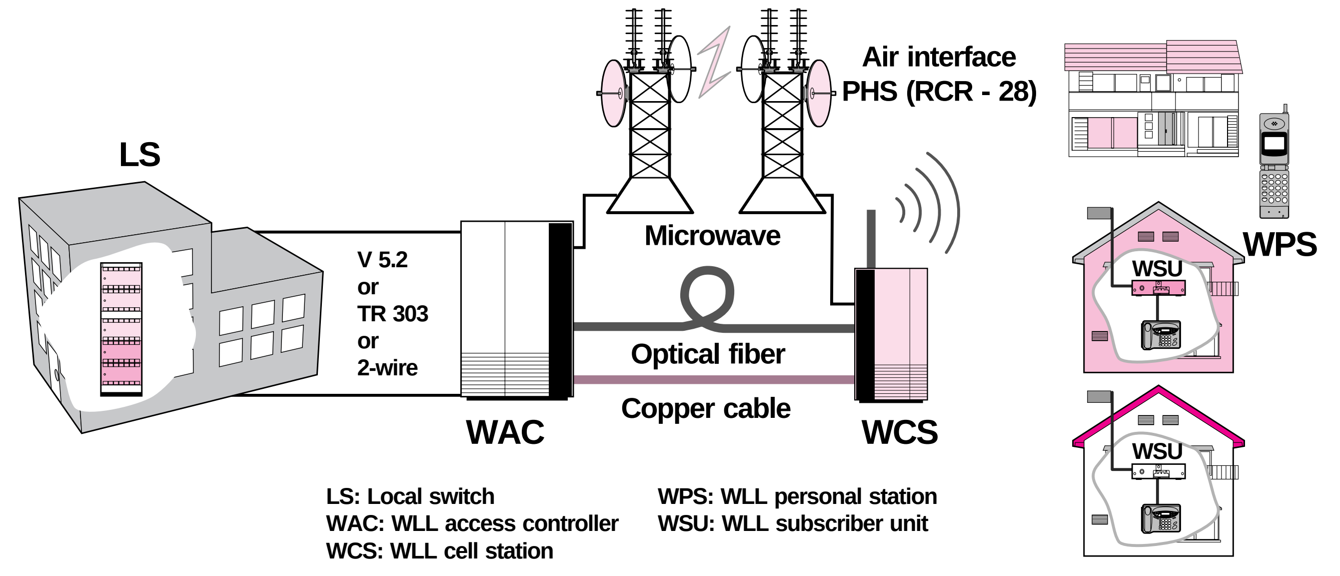
In order to optimize the investment in equipment, suitable WLL systems can be used selectively according to the subscriber density as a main consideration. Fig. 2 maps the optimum scope of system application in terms of the subscriber density and distance from the local switch (LS).

6. Moves toward PHS-WLL system standardization

For the purpose of supporting WLL applications of PHS, the Association of Radio Industries and Businesses (ARIB) completed studies on the items noted below during 1995 for inclusion in Version 2 of RCR STD-28.

- Mobility limitation
- Expansion of service coverage

FIg. 3. PHS-WLL System Configuration



- Supplementary services for supporting fixed telephony service, including public telephone service (metering pulse, subscriber line testing and hooking)

7. Product example

A PHS-WLL system has already been commercialized and is scheduled to be implemented for commercial service in several countries before the end of this year. Fig. 3 shows a PHS-WLL system configuration, and Photo. 1 and Photo. 2 shows the appearance of the product.

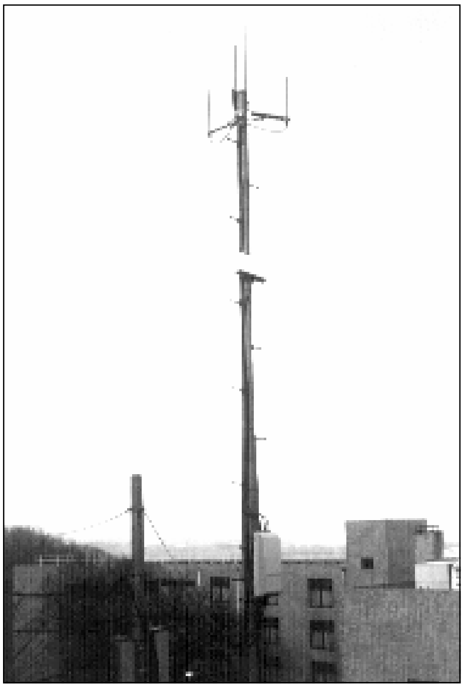


Photo 1. WLL cell station

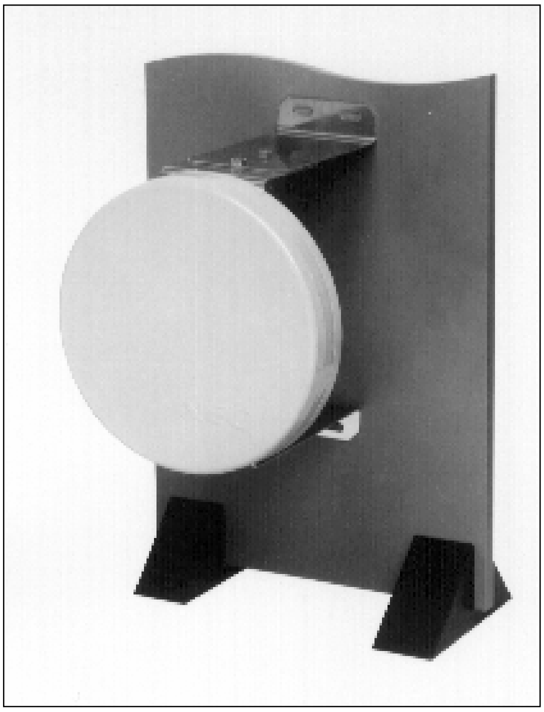


Photo 2. Antenna for WLL subscriber unit

PHS Technology (3)

PHS Cell Stations

Cell stations of the Personal Handy-phone System (PHS) consist of the cell station equipment and antennas, and form service areas with microcells having a radius of several hundred meters. The system configuration assures large capacity for accommodating subscribers because frequencies can be utilized repeatedly between microcells. On the negative side, however, it requires the installation of many cell stations. This means that cell stations must be compact in size and easy to install.

A new compact cell station has now been developed that weighs only 3-5 kg and has a volume of just 3-4 liters. Several types of cell station equipment and antennas are available, allowing various combinations for meeting the type of cell station installation requirements. As a result, cell stations can now be installed economically in a wide variety of locations.

Cell Station Installation Concept

The equipment cost has been reduced by sharing constituent units as much as possible among different types of installations. Moreover, future increases in traffic can be accommodated by installing additional units to expand the number of available communications channels. Construction work has been simplified by employing easy-to-use connectors, developing dedicated fixtures for each type of installation and adopting a unified interface between fixtures and cell station equipment. In addition, since most installations are outdoors, thoroughgoing measures have been taken to make sure the equipment is waterproof and dustproof.

Low-power cell station equipment has a volume of just 3-4 liters (A4 size) and weighs a light 3-5 kg, allowing easy installation in many different places.

Outdoor Installation Types

Cell station equipment for outdoor installation includes types that can be installed on public telephone booths, utility poles and building roofs. Digital circuits from the public switched telephone network are connected to the cell station equipment via an arrester. The equipment operates on a commercial AC 100 V power supply. If necessary, power can be supplied to the cell station equipment via a non-fuse breaker (NFB). A centralized power supply system using DC power supplied from the switching office is also possible.

Indoor Installation Types

PHS service areas also include indoor locations, such as underground shopping malls and department stores, in addition to outdoor service.

Indoor installations use two rod antennas about 20 cm in length. A flat antenna resembling a fire alarm is also available for inconspicuous installation on the ceiling.

Indoor service areas, such as in department stores, are much smaller per cell station than their outdoor counterparts, because it is more difficult for radio waves to be propagated through enclosed spaces partitioned by floors or walls. This makes it necessary to have a higher density of cell station equipment, including a cell station installation on every floor.

For that reason, compact indoor cell station equipment and a line concentration controller are used to configure service areas economically.

Basic Configuration and Functions of Cell Station Equipment

Cell station equipment primarily consists of an RF unit, a TDMA/TDD (Time Division Multiple Access/Time Division Duplex) processing unit, an ADPCM (Adaptive Differential Pulse Code Modulation) transcodec unit, a digital network interface unit and others.

In addition to such basic capabilities as a function for terminating the line from NTT's digital network, other functions provided include one for remote control by a maintenance center and one for monitoring the overall operation of the equipment.

1) RF unit

The radio signal interface supports transmission and reception of þ/4 QPSK modulated signals using a 4-channel TDMA/TDD system that conforms to the RCR STD-28 specification formulated by ARIB's predecessor, the Research and Development Center for Radio Systems (RCR). The cell station equipment adopts a diversity system that assures stable transmission and reception even in environments susceptible to fading. It also incorporates a function for detecting interference on radio channels, which gives each cell station autonomous and distributed control over the assignment of radio control and radio communications channels. Other functions are provided for monitoring and assuring speech quality. These include a function that constantly monitors speech quality on the wireless circuit to a personal station (PS) and switches a call to another channel if line quality deteriorates due to interference, and one that works to restore speech quality following handover of a call to another cell station.

2) TDMA/TDD processing unit

This unit assigns communications channels to time slots on radio circuits and disassembles and assembles radio frames on control channels and communications channels.

3) ADPCM transcodec unit

This unit handles the conversion of the 32 kbps ADPCM signals used on the PHS radio links and the 64 kbps µ-low PCM signals used on NTT's digital network. Signal conversion is performed in accordance with ITU-T Recommendation G.726.

4) Digital network interface unit

PHS cell stations are interconnected to NTT's digital network via the I'-interface standardized by the Telecommunication Technology Committee (TTC). In addition to information concerning location registration, authentication and call setup, they also exchange information with the maintenance center using D-channel data packets. Because one slot is used for the radio circuit control channel in the basic configuration, each cell station accommodates three communications channels.

5) Monitoring and other functions

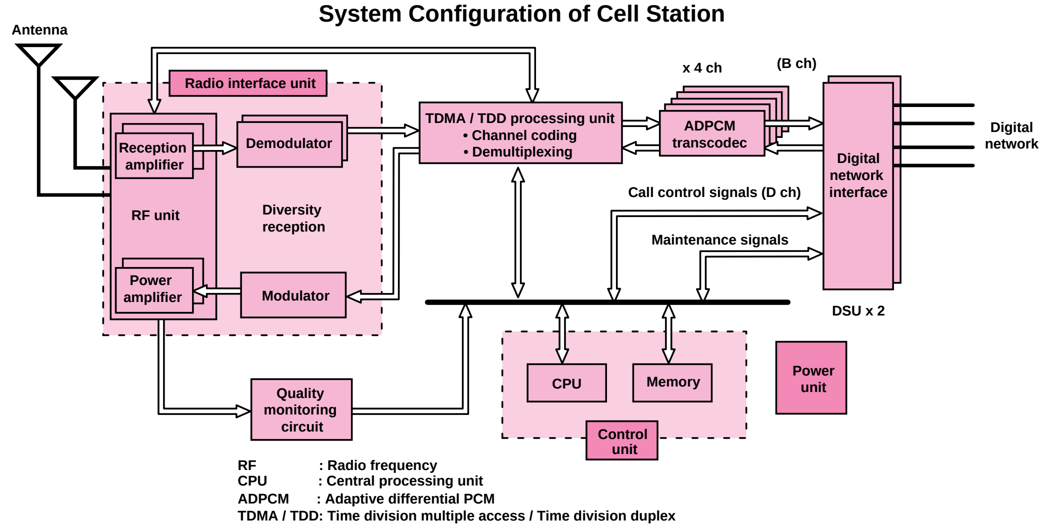
The cell station equipment incorporates a self-diagnostic function for automatically detecting any hardware failures. In the event a failure occurs, it is reported to the maintenance center via a D-channel data packet.

Types of Cell Station Equipment

1) Low-power cell station equipment

The low-power cell station equipment (20 mW) is used when the service area per cell station forms a microcell having a radius of 100-300 m. It is equipped with two

System Configuration of Cell Station



antennas for diversity transmission and reception.

This unit can be mounted with a battery pack as an emergency power supply to assure continued use even during commercial power outages.

2) High-power cell station equipment

The high-power cell station equipment (100 - 500 mW) expands the service area per cell station to a radius of 300 - 500 m, by increasing transmitting power and improving antenna gain.

This unit is equipped with four antenna branches for improved receiver sensitivity and enhanced diversity reception against fading.

3) Compact indoor cell station equipment

The compact indoor cell station equipment is used in combination with a line concentration controller for installations inside buildings.

This compact cell station equipment provides transmitting power of 10 mW, which is sufficient to cover indoor service areas that generally require a cell radius of less than 50 m.

One compact cell station equipment can support up to three communications channels, enabling simultaneous communications on all the circuits accommodated in the line concentrator controllers located throughout the entire building.

Future Activities

Cell stations with higher transmission power and capable of supporting more communications channels are now being researched for future implementation in suburban areas. These include cell stations with fewer channels yet wide area coverage for use in low-traffic areas and cell stations with more channels plus wide-area coverage for installation in high-traffic areas. Cell stations with very high transmission power capabilities are also being examined for use in areas with extremely low traffic volumes.

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(As of May 1, 1996)

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The Editorial Committee of the Preparatory Group for PHS MoU is pleased to have published the fourth issue of the PHS MoU News. This newsletter includes PHS-related news and information. Your comments and opinions are welcomed. Please feel free to contact us.

We hope this newsletter will contribute to your business.

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