VoWLAN Access Point
MWINS BR2100 Series

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We developed the VoWLAN (Voice over Wireless LAN; hereinafter simply referred to as "VoWLAN") an access point product with built in features that provide smooth VoIP communications over wireless LAN. This paper will introduce the functions and features of the MWINS BR2100 series of the VoWLAN access point product.

Background of MWINS BR2100 Series Development

The FOMA®*1) / wireless LAN dual terminal, which can be used as a mobile phone while outdoors and as an internal extension line in the office, was introduced to the market last year, triggering the implementation of the Mobile Centrex services in business enterprises (**Figure 1**). This resulted in the promotion of increased laptop computer usage in the office and elimination of assigned desk spaces, thereby realizing an innovative change of work style to one that enables workers to "respond at any time and from anywhere".

This led to a heightened interest in mobile and wireless systems based on wireless LAN due to expected reductions in costs arising from the integration of voice and data systems' networks into IP networks, which made it possible to unify the management of networks, inhibit investments on fixed line telephones and communication costs arising from mobile phone calls, as well as expected improvements in business efficiency resulting from the fusion of information with communications (collaborative functions of business applications and the web, as well as presence functions, etc.).

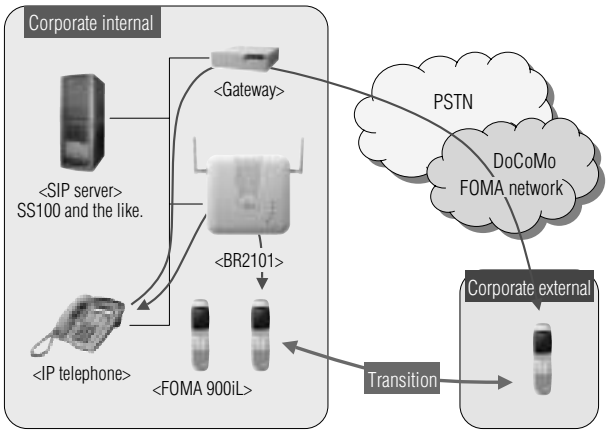


Fig. 1 Mobile Centrex

Unfortunately, there were a variety of issues relating to the building and operating of a smooth running VoWLAN in a corporate environment for wireless LAN systems in their current condition. The MWINS BR2100 series of products are VoWLAN access point products (hereinafter referred to simply as "AP") that have resolved such issues and are able to "provide high quality sound with wireless VoIP that can be used with peace of mind at a low cost as well as easily implemented for customers who desire work styles that emphasize mobility".

Issues and Resolutions for VoWLAN

The following five issues are for the building and operating of VoWLAN with wireless LAN systems in the current conditions:

- Issue 1: It is difficult to transmit voice over wireless LAN.
- Issue 2: Existing wireless LAN system is expensive.
- Issue 3: Security is weak with wireless LAN.
- Issue 4: It is difficult to build VoWLAN.
- Issue 5: It is difficult to manage VoWLAN.

Details and solutions for the respective issues will be described below.

Issue 1: It is difficult to transmit voice over wireless LAN

Problems, such as the deterioration of sound quality and sound interruptions during handovers often occur with wireless LAN. Furthermore, other problems, such as call duration and standby times of the terminal as well as heating, also exist. In order to resolve these issues the QoS function, connection limiting function, high-speed handover function and terminal power saving function were incorporated and improvements have been made with regards to the performance of the radio section of the MWINS BR2100 series of products.

(1) QoS Function (Figure 2)

Fluctuations, delays and packet losses often occur with wireless LAN, deteriorating the sound therefore, the quality of communications becomes poor. The causes of these issues lie in the characteristics of the IEEE 802.11, which stipulates that the priority for the transmission of AP and terminal devices is equal and the right to transmit is granted to the party claiming it first, despite the characteristics of voice packets in periodical bi-directional communications.

Voice packets are prioritized into allocations for the right to transmit rather than first-come first-served and for

*1) FOMA is a registered trademark of NTT DoCoMo, Inc.

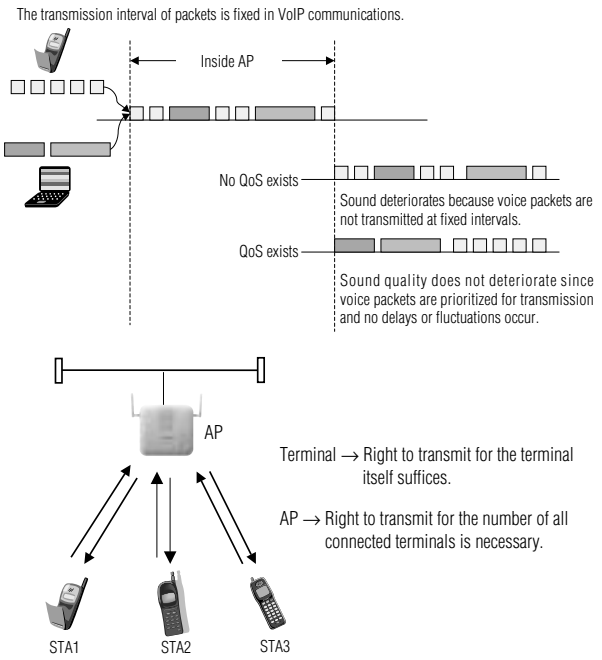


Fig. 2 Causes for sound quality deterioration

the purpose of implementing this method, the IEEE 802.11e (EDCA method) is loaded in the MWINS BR2100 series of products. Furthermore, an Oki Electric proprietary specification is loaded as a means to prioritize the right of AP to transmit over all other terminals.

(2) Connection Limiting Function

The rate of wireless communications is slower than that of wired communications. On one hand, even though voice packets are short packets, each packet is assigned a wireless header that makes the overhead of each packet larger, resulting in a poor transmission efficiency and therefore, not many voice communications are tolerated by a single AP. Once a voice communication exceeding the tolerated amount is connected, traffic overflow results from an excessive amount of voice data and sound quality deteriorates. A function that limits the number of calls that can be connected simultaneously with the AP is incorporated in order to prevent traffic overflow arising from excessive voice data.

(3) High-speed Handover Function

Sound interruptions occur when handovers take time. The cause for the time required for handovers is due to the long duration of the channel scanning of the terminal and that of the RADIUS authentication process. The channel scanning time depends on the performance of the terminal but mobile phone handset terminals intended primarily for voice communications are loaded with functions that can shorten the channel scanning time by limiting the number of wireless channels. Furthermore, with regards to the RADIUS authentication time, such terminals are loaded with functions that can reduce the transmission and reception time of packets to and from the authentication server by passing on the authentication information from the AP to the AP on the receiving end of the handover.

A method used to reduce the authentication time by relaying authentication information through the collaborated operations of terminals (IEEE 802.11r) will be incorporated in the future.

(4) Terminal Power Saving Function

The currently available mobile phone handset terminals consume a lot of power in their radio section, which leads to issues including the short amount of time available from a single recharging for calls and in standby mode as well as the large amount of heat that is generated during calls. Although these are basically problems of the terminals, some assistance in terms of energy conservation for the terminals can be provided by loading the AP with functions that respond to power saving during calls or cutting down on the unnecessary broadcasting of packets.

(5) Improvement in Performance of Radio Section

Business use requires coverage in a wider area than consumer use. The wireless transmission and reception performance is improved by externally mounting a diversity antenna to the equipment. Furthermore, a directional antenna will also be made available as an optional accessory for the purpose of limiting the area of coverage.

There is a limit as to how much a built-in QoS connection limitation function would be able to perform in areas with a massive amount of traffic, which leads to a request for the separation of voice and data. In such cases, since it would be possible to use both the IEEE 802.11a mode and 11b/g mode simultaneously with the BR2102, the use of 11b/g for voice and 11a for personal computers for example, would be feasible.

Issue 2: Existing wireless LAN system is expensive

Existing wireless LAN systems require a controller. A controller provides end users with a solution for concerns regarding security (during the initial phase, whereas currently security is realized by AP) and ease for setting up networks. Furthermore, for those of us who were on the creation side (manufacturers) there were other benefits, such as the ease for achieving high-speed handovers, integrated control functions, etc. Unfortunately, problems relating to improper operation, with large communication delays between the controller and the AP as well as the fact that the controller itself is quite expensive, which greatly pushes up the overall costs of the wireless LAN system, are obstacles for the implementation of wireless LAN particularly for small-scale systems or satellite systems.

In order to resolve these issues we intend to provide wireless LAN systems at a low cost that can be used for small-scale systems by realizing controller functions in distributed AP without any controller (**Figure 3**).

Functions provided by conventional controllers are realized with the distributed AP in the following manner:

(1) Integrated Management Functions

Batch settings and monitoring are provided as part of the integrated management functions. These features are necessary for some and not necessary for others depending on the scale and other aspects of networks. These features therefore, are treated as optional functions and provided as a separate system (Batch setting: Maintenance console software on personal

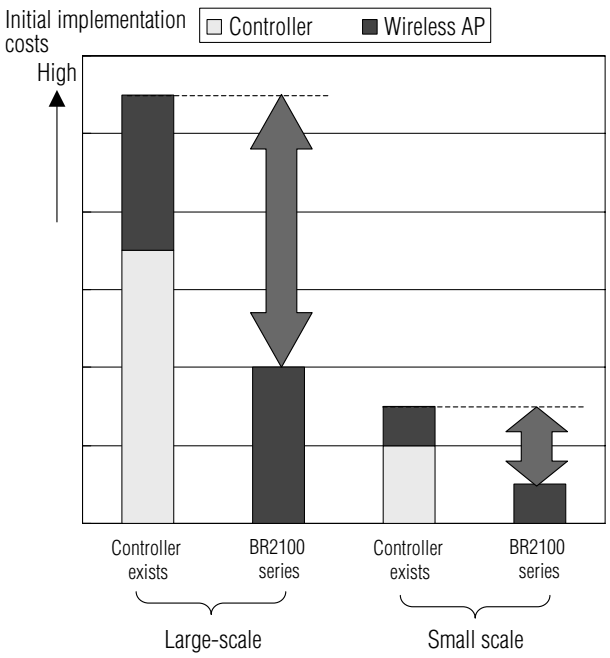


Fig. 3 Comparison of initial implementation costs

computers; Monitoring: Integration with other NMS [Network Management System] using OpenView*2) when they are needed.

(2) High-speed Handover Functions

High-speed handover between controllers is required for wireless LAN systems of the controller-type on a relatively large scale. With distributed AP on the other hand, all controls are realized through collaborative operations of APs and scalability of a higher degree is provided (refer to Issue 1).

(3) Ease of Setting Up Networks

VPN is set up between the controller and the AP with controller-type wireless LAN systems to ensure that there will be no impact on existing networks. Since all traffic is concentrated in the controller, however, it is necessary to make the line, which is connected to the controller, thick (using 1000BASE). With distributed AP traffic is also distributed and the existing networks are segregated by the VLAN.

Issue 3: Security is weak with wireless LAN

It has been said that the security available for wireless LAN is weak against threats, such as wiretapping, tampering, unauthorized access and interference. A problem was detected relating to the vulnerability of WEP for the encryption of wireless signals, which is a defensive measure against wiretapping and tampering. Furthermore, a problem was also detected relating to the ease with which unauthorized entities can impersonate an AP or a terminal (unauthorized access), since wireless LAN equipment can be installed anywhere and radio waves can be received anywhere.

(1) Enhancing Encryption

Encryption will be enhanced by incorporating the 128/152bit WEP with improvements for vulnerability by lengthening the encryption key, the TKIP that continuously changes encryption keys automatically during communications and the AES, which is a powerful encryption method with a common key encryption method, in order to avert wiretapping and tampering.

(2) Implementing Authentication

Unauthorized access is gained when an entity impersonates a user, a terminal or an AP. It is possible to avert the impersonation of users and APs by implementing user authentications and avert the impersonation of terminals by implementing terminal authentications. The IEEE 802.1x is incorporated for user authentication, while MAC address filtering is incorporated for terminal authentication.

Issue 4: It is difficult to build VoWLAN

The installation location for the AP, a wireless channel, as well as channels and the installation design that determine the size of the cell (output of AP) are needed for building a stable wireless LAN. Creating an appropriate design, however, is difficult due to complexities arising from the many characteristics of wireless communications, which need to be considered, along with conditions relating to use and environment, together with the many related restrictions, which are all interrelated. Furthermore, changes to the environment due to mobility (movement of terminals) and conditions for securing the quality of VoIP are also added for the VoWLAN, compounding the difficulty even further. The condition of the radio waves in space is unstable, therefore, the written theory differs from the practice and designing as well as measurement taking must be done repeatedly.

In order to build a VoWLAN, therefore, it becomes necessary for a specialized team possessing know-how on the building of such networks to work with tools, such as site survey software and simulation software.

Oki Electric provides a network building service so that users can easily implement their VoWLAN and training services intended to make network designers and installation workers capable of building an appropriate VoWLAN.

Issue 5: It is difficult to manage VoWLAN

Changes with the settings of the AP, as well as status monitoring and failure analysis conducted when incidents occur, are the types of work required as part of the management of the VoWLAN.

(1) Changing Settings

Once a VoWLAN network is built the settings may need to be changed due to alterations within the environment (such as changes in layout, personnel allocations including the number of personnel in an area, incoming radio waves, etc.). In order to carry out setting work for the AP in an efficient manner a setting tool, designed to enable preparation, changes and easy batch setting of setting values for multiple APs, will be provided.

*2) OpenView is a registered trademark of Hewlett-Packard Company in the United States.

(2) Failure Analysis and Monitoring

Failure analysis conducted for the VoWLAN requires special tools (such as a wireless network monitor, site survey software, etc.). Some information cannot be obtained even when such special tools are used (such as VoIP information jitter, delays, etc.) therefore, segregating and pursuing the causes of problems (including wired and wireless, APs and terminals, issues arising from environmental changes, such as obstructions or incoming radio waves or network designing errors), are difficult to accomplish. In order to make these tasks simpler to carry out a function for collecting the log information of VoIP communications, along with failure information, is incorporated into the AP. A function that forwards such log information to the syslog server will also be incorporated.

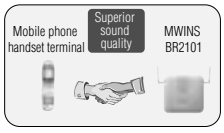
Furthermore, although at times integrated monitoring is required for large-scale systems, such functions are usually not required for small to medium scale systems. Large-scale systems also require integration with the NMS of other systems. A collaborative operation with OpenView using SNMP is, therefore, made possible providing such features in an embedded form to the NMS of other systems, when required.

MWINS BR2100 Series Equipment Specifications

Provide high quality sound with wireless VoIP that can be used with peace of mind at a low cost and with ease of implementation to customers who desire work styles that emphasize mobility.

Incorporate Latest Technologies Supporting Superior Sound Quality

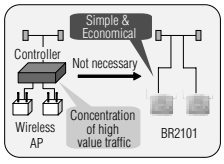
- Wireless segment QoS control function (IEEE 802.11e EDCA compliant) suitable for VoIP.
- Connection limiting function for the prevention of sound quality deterioration arising from excessive terminal connections.
- High-speed handover function for the prevention of sound interruptions.
- Terminal energy conservation support.



Economical Distributed AP Without Controllers

- Controllers are not required due to the distributed AP system.
- Initial implementation costs are reduced up to 70% in comparison with conventional wireless LAN systems that require controllers*1.
- It is possible to build a wireless VoIP network at a low cost for small-scale businesses or satellite offices (branch offices).

*1: A trial calculation regarding implementation of the system in a small-scale business location (based on list prices as of April 2005).



Wireless LAN Environment Easily Used With Peace of Mind Built and Simply Managed

- Enhancement of authentication and encryption by incorporating the IEEE 802.11i, which is a regular security standard for wireless LAN.
- Without controller requirements the building of a wireless LAN network is easy.
- Existing networks can also be used*2.
- Settings and managing (batch setting, management and failure analysis) are simple with the use of the maintenance console software.

*2: Some networks cannot be used due to their network configurations.

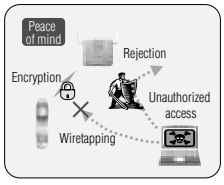


Fig. 4 Features of the MWINS BR2100 series of products

Photo 1 External view of the BR2102

Photo 2 External view of the BR2102

Table 1 The MWINS BR2100 series equipment specifications

Model name		MWINS BR2101	MWINS BR2102
Wireless	Radio standards	IEEE 802.11a compliant (W52 / W53)	5.15 to 5.35GHz: 8 channels*1.
		IEEE 802.11b compliant	2.400 to 2.487GHz: 14 channels.
		IEEE 802.11g compliant	2.400 to 2.4835GHz: 13 channels.
	Simultaneous use of 11a and 11b/g	-	Possible
	Antenna	Omnidirectional antenna ×2 (diversity system)*2	Omnidirectional antenna ×4 (diversity system)*2.
LAN	Interface	LAN port ×1: RJ-45, IEEE 802.3u (10BASE-T / 100BASE-TX), PoE power supply (IEEE 802.3af compliant), AutoMDIX.	
		Maintenance port ×1: RJ-45, IEEE 802.3u (10BASE-T / 100BASE-TX) ×1.	
Communication control function	QoS control	IEEE 802.11e (EDCA) + proprietary system.	
	Priority control function	Priority control for individual categories of inbound traffic and outbound traffic.	
	Connection control function	Proprietary system.	
	VLAN support	IEEE 802.1p/Q	
Security	Encryption function	WEP 64bit/128bit/152bit, TKIP (WPA), AES (WPA2).	
	Authentication function	IEEE 802.1X (MD5, TLS, TTLS, PEAP).	
	Terminal access limitation	MAC address authentication, SSID non-notification, ANY connection rejection.	
	DoS assault detection	Wired LAN side, wireless LAN side (for AP).	
	Stealth function	ICMP / UDP / TCP (for AP).	
Maintenance operation function	IP address setting	DHCP and fixed.	
	AP settings and changes	Web interface, command interface and via configuration utility. Used protocol: HTTP, Telnet, FTP and SNMP.	
	Failure display and log	LED, syslog and SNMP V2c.	
	Clock	NTP client and internal clock.	
Physical features and environment	External dimensions	195×190×50 (mm) (excluding external antenna).	
	Weight	Approx. 0.7Kg.	
	Environmental conditions (temperature & humidity)	During operations: 0 to 50˚C (wall mounted), 20 to 85% relative humidity (no condensation). During maintenance: -20 to 60˚C, 20 to 90% relative humidity (no condensation).	
	Power source	PoE supported: IEEE 802.3af compliant, AC adapter (optional): AC100 ± 10V*2.	
	Maximum power consumption	6W	9.4W

*1: Some channels may become unusable due to the impact of meteorological radar.
*2: A directional antenna and AC adapter are optional accessories.

Conclusion

Oki Electric has been providing a diverse range of VoIP products and the MWINS BR2100 series of products enables smooth VoIP communications even for wireless networks (**Figure 4, Table 1, Photo 1 and 2**).

Wireless communications are an essential technology for the ubiquitous society of the future and a technology that deserves close attention. We at Oki Electric intend to offer a substantial range of wireless LAN products and solutions starting with the MWINS BR2100 series of products.

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