Papers on UNIVERGE Hardware

Wireless LAN System: UNIVERGE WL Series

By Hideki KUROKAWA,* Yukio MITANI,* Takashi SAITO,* Rei MIYAMOTO* and Iichiro YOKOO*

ABSTRACT UNIVERGE WL Series is a Wireless LAN system built on new distributed access point architecture, improved upon the existing WLAN products. More enterprises are now seeking for a solution integrating both voice and data onto a single WLAN infrastructure. However, many key issues need to be resolved to guarantee voice quality and to deploy WLAN handsets for a critical business use. UNIVERGE WL Series solves these key issues with its proprietary voice call handling mechanism.

KEYWORDS **VoWLAN, VWQCP, Voice QoS, Fast hand-over, Power saving, UNIVERGE WL**

1. INTRODUCTION

With the completion of IEEE802.11b standardization in September 1999, Wireless LAN has been extended to support 11Mbps bandwidth from 2Mbps and is now ready to accommodate a real environment deployment as good as a wired LAN. Also a vendor community leads effort and mechanism to ensure interoperability achieved a much simpler deployment of a wireless LAN infrastructure which uses mixed products from many of the vendors. These achievements had triggered more usage of the WLAN primarily for home use.

On the other hand, a larger WLAN deployment for enterprises has experienced additional obstacles such as security breach issues, radio management difficulties, expensive operational costs and many more. For example, a WLAN is prone to cause more security breaches compared to Wired LAN, because radio signal propagations can extend beyond an intended coverage area and is subject to an information leak outside of the area or a building where the LAN access should be contained. Additionally, unintentional placement of an access point not properly configured against possible threats could create a security hole and risk of confidential information leak to a third party. The operational cost issue is due to a necessity to have certain experiences, skills and man-power in order to deploy many wireless clients and access points at multiple locations, and to efficiently manage and maintain these devices.

These are the major challenges of the WLAN enterprise use, but the solution for these problems, such as the one introduced here, is now available and has contributed to increase in its usage. Moving forward, more needs are started to be observed to employ new communication tools, such as making voice calls and video conferences from a wireless Note PCs of each user, and to integrate voice and PC data traffic onto a single WLAN infrastructure by introducing Voice over WLAN (VoWLAN) handsets.

2. WL SERIES BRIEF

UNIVERGE WL Series is a Wireless LAN system built on new distributed access point architecture, improved upon the existing generation of WLAN products, to provide solutions for enterprise use obstacles described above. Unlike the ordinary WLAN access points where individual access points operate independently, WL Access Points managed from a WL Controller are capable of coordinating their operations between each other. This improved architecture provides many advantages over the ordinary access points especially when many access points are installed close to each other or at many locations; ease of deployments and maintenances achieved with automated dynamic channel assignment and transmission power adjustments, simplifying installation of access points via centralized configuration of radio parameters and security policies.

The WL Series product consists of three components; WL Controller, intelligent access points and WL Control Software.

(1) WL Controller

WL Controller (**Photo 1**) is a key component of the system to provide access point management

*Business Networks Division

integration and gateway to a wired network. The controller centralizes all the processing of MAC layer and above, which in the ordinary access points are processed on its own in each access points.

(2) WL Access Point

The access point (**Photo 2**) supports IEEE 802.11a/b/g WLAN standards. Users have a flexibility of powering the device either from a LAN cable (IEEE 802.3af compliant) or from an AC power injector. Its software maintenance and configurations are made simpler and automatic by a centralized management from the WL Controller.

(3) WL Control Software

The WL Control Software (**Photo 3**) enables a map display of RF signal predicted strength, location of detected rogue access points and performs integrated management of the multiple WL Controllers. It supports monitoring and configuration of controllers, as well as access point RF radio monitoring and simultaneous configurations of multiple access points.

The unique architecture of WL Series where each access point can co-ordinate their functions, provides several additional advantages and resolves WLAN issues which ordinary access points could not before. For example, WL Series is capable of detecting rogue access points within its coverage to provide additional WLAN security. The WL Access Point periodically monitor radio channels and detect any unauthorized installation of access points which does not belong to the WL Series system. Furthermore, the access point can transmit jamming signals to disconnect and prevent clients from associating with this rogue access point (**Fig. 1**).

More efficient management of the WLAN system is achieved by a centralized configuration and monitoring from a Web browser based GUI interface. For example, by monitoring and exchanging RF information between access points and the controller, the system can automate the process of selecting and configuring the best suited parameters for radio channel and output power settings on each and every access points. This allows a simpler and easier design, installation and maintenance of the WLAN network, enabling network administrators to reduce its TCO (**Fig. 2**).

3. CURRENT ISSUES FOR VOICE APPLICATION

Noticeable degradation of voice quality is anticipated due to packet loss and delays of voice packets, induced by burst data traffic sharing the same radio channel in the IEEE 802.11 WLAN environment. Also, the use of CSMA/CA (Carrier Sense Multiple Access with Collision Avoidance) as a media access method can create packet collisions between two voice handsets using the same radio channel, collisions between packets sent from an access point and a handset. This would result in retransmissions of voice

Photo 1 WL Controller.

Photo 2 WL Access Point.

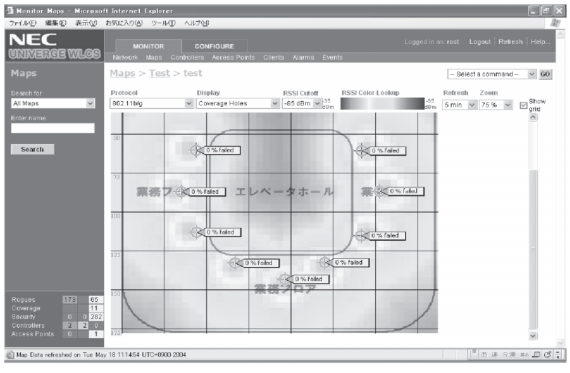

Photo 3 WL Control Software.

packets and causes impact on the available bandwidth due to lowered frame utilization.

Many more issues are found during hand over moving from one access point to another; a few examples are such as loss of connection, gap in a conversation before the handset is re-associated to a new access point, possible inability to acquire sustainable bandwidth for voice conversation at the destination access point and inability to maintain the voice call due to change in network address of the destination access point.

In addition, WLAN handsets are also susceptible to a short call time and standby time because of larger power consumption at the radio circuitry, when compared to a PHS/PCS or a mobile phone.

To address these issues, IEEE 802.11e standardization effort for MAC layer QoS mechanism and efforts to reduce radio device power consumptions are actively pursued, however they are yet away from their completion.

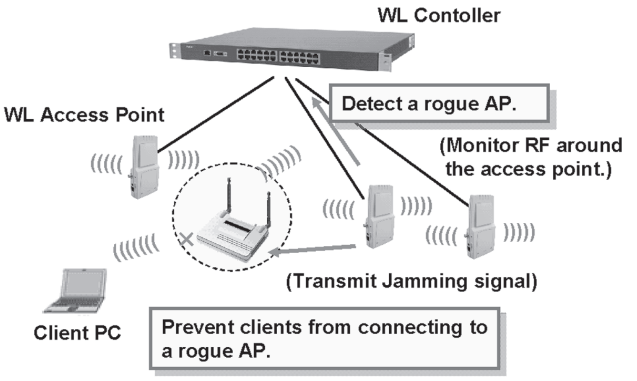

Fig. 1 Eliminating security holes.

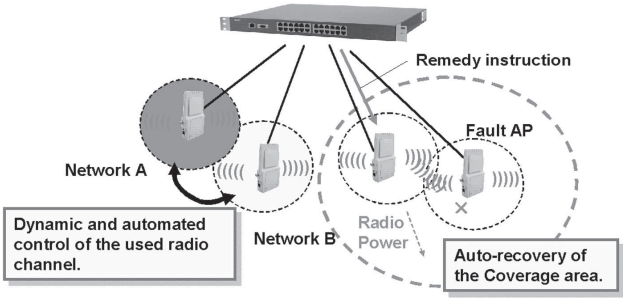

Fig. 2 Improving system management.

4. VWQCP EXTENSION PROTOCOL

WL Series addresses each of the voice packet handling issues with IEEE 802.11 WLAN described above, based on VWQCP (Voice over WLAN Quality Control Protocol) extension protocol. VWQCP is an extension to the IEEE 802.11 protocol proposed to solve issues when deploying VoIP handsets over IEEE 802.11 WLAN infrastructure and it realizes solutions for Voice QoS (Quality of Service), Call Admission Control, fast handover and power saving of the handset. (Some of the VWQCP feature requires a support on VoIP handsets.)

4.1 Voice QoS

(1) Downlink QoS

The traffic from a controller to an access point is prioritized using WFQ (Weighted Fair Queuing). Access points in turn are capable of scheduling downlink transmission of voice packets to VoIP handsets and process at the highest priority for those in an active call. Additionally, Dynamic Access Delay technique enables adjustment of frame intervals, upon negotiation with handsets at the beginning of a call, to prioritize voice packets. At the same time, when there is no handset in an active call state, the technique can maintain throughput of a data only clients (**Fig. 3**).

(2) Uplink QoS

Uplink voice packets transmission in an active call towards the access point is sent at the top priority in synchronization with downlink voice packets received from the access point. This is called a Packet Train technique.

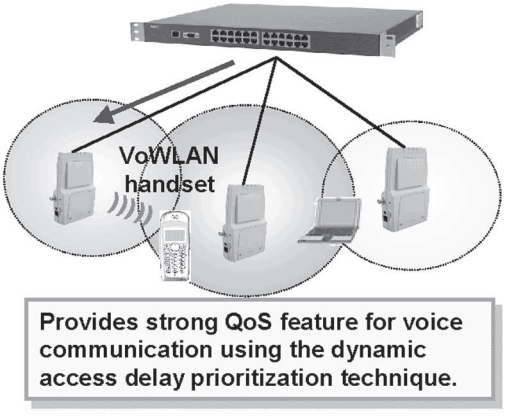

Fig. 3 Downlink QoS.

The voice packets transmitted in downlink direction during an active call act as a timing master, to which uplink voice packets are synchronized. With this technique, collisions in the WLAN segment can be avoided and prevent a poor frame transmission utilization due to collisions of voice packets in either direction (**Fig. 4**).

(3) VoIP Handset Load Balancing

Current mechanism for client handover from one access point to another is totally controlled from the client or the handset. This mechanism only offers a "blind" selection of an access point and does not take any consideration of the status of the access point chosen by the handset. The WL Access Point has an enhanced capability to explicitly inform handsets which access point it should associate with next, allowing handsets to "intelligently" choose a best access point available in its vicinity. Since all the bandwidth are controlled by the WL Controller and the selection of access point is performed taking account of this information, an issue where the handset cannot be allocated with sufficient bandwidth for a high quality conversation would not occur. Additionally, Call Admission Control of the access point denies association of any further handset if the access point is not capable of reserving additional VoIP bandwidth for a new requested call. When the access point denies a new call setup from the handset, it also informs the handset of another access point to which it should attempt to associate in order to satisfy the handset VoIP bandwidth requirement for a quality voice conversation (**Fig. 5**).

- VoIP call setup is performed in a following procedure:

1) Handset negotiates with the access point for a required bandwidth to be reserved on that access point.
2) If the access point cannot allocate sufficient bandwidth for the requested call, the WL Controller would then notifies via the access point, a best available access point to the handset.
3) The handset initiates a handover to the instructed access point and this achieves a better voice quality for the handset, as well as achieving load balancing of handsets across multiple access points.

4.2 Fast Handover

WL Series is capable of supporting non-disrupted voice call session even when the access point to which the handset associates changes or the WL Controller in path of the communication changes over to a second controller. Also the session can be maintained even when the handset is moving to a different IP subnet. This is achieved by tunneling the session dynamically between two controllers. The handset also only attempts to reacquire an IP address via DHCP, only when the access point inform the handset via an extended frame content that an inter-subnet handover has occurred.

These techniques minimize the overhead of the access point handover and re-acquisition of an IP address, enabling a fast and stable handover mechanism (**Fig. 6**, **Table I**).

4.3 Power Saving

By additionally supporting the handset power saving feature, a sufficient standby time and call time for business uses are achieved. While in Standby mode, the handset will only need to receive intermittent

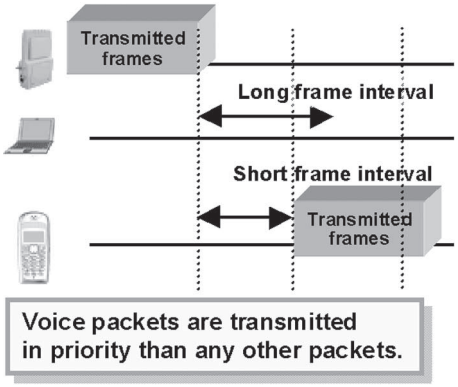

Fig. 4 Uplink QoS.

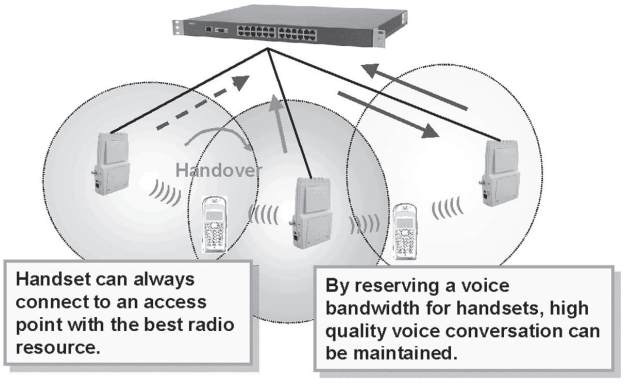

Fig. 5 Load balancing for voice calls.

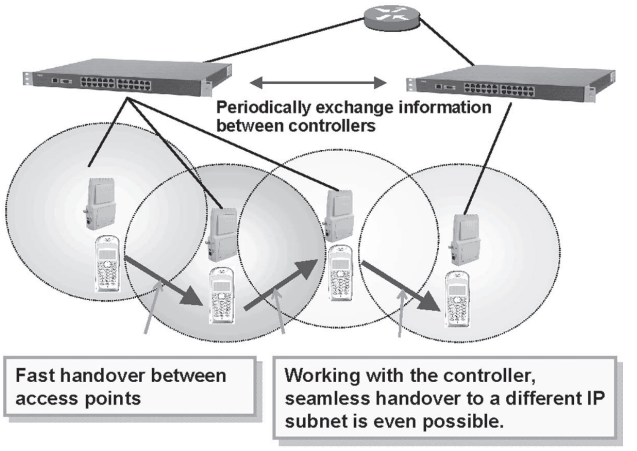

Fig. 6 Fast handover.

beacon signals from the access point; the access point and the controller will in turn proxies all the ARP (Address Resolution Protocol) requests to that handset and send out replies to the requester on behalf of the handset. This technique would remove the handset from a burden of receiving all the broadcast packets and allows handset to be in a sleep state to reduce its power consumption, unless receiving a new voice call. Also, the handset is capable of falling to a sleep mode at the timing other than the scheduled transmission of voice packets as described in Section 4.1 (**Fig. 7**).

5. CONCLUSION

WL Series offers a most suitable WLAN solution for enterprise network, with its enforced security, automated management of radio resources, better WLAN manageability and an enhanced solution for enabling fully IP based communication including VoIP WLAN handsets. The product will enable and assist users in building business infrastructure which supports the migration to a new working style.

Table I Handover change time.

Scenario	Handover Time (Estimated)
(Intra-Subnet)	
WL Access Point	20 to 80msec
Standard access point	60 to 500msec
(Inter-Subnet)	
WL Access Point	20 to 80msec (Omit authentication, etc)
Standard access point	6sec (includes time necessary to authenticate, acquire an IP address and initial SIP transactions)

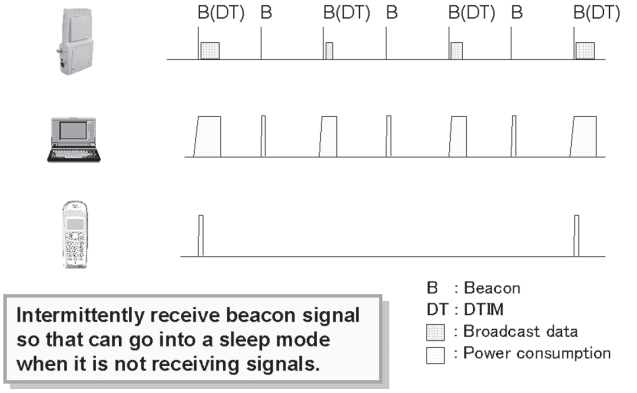

Fig. 7 Power saving.

Received September 2, 2004

* * * * * * * * * * * * * * * *

Hideki KUROKAWA joined NEC Mobile Communication in 1994, and currently he is Assistant Manager of Business Networks Division, Broadband Network Operations Unit, Network Platform Business Unit, NEC Corporation.

Yukio MITANI joined NEC Corporation in 1995, and currently he is Assistant Manager of Business Networks Division, Broadband Network Operations Unit, Network Platform Business Unit.

Takashi SAITO joined NEC Corporation in 1995, and currently he is Assistant Manager of Business Networks Division, Broadband Network Operations Unit, Network Platform Business Unit.

Rei MIYAMOTO joined NEC Corporation in 1996, and currently he is Assistant Manager of Business Networks Division, Broadband Network Operations Unit, Network Platform Business Unit.

Iichiro YOKOO joined NEC Corporation in 2003, and currently he is an engineer of Business Networks Division, Broadband Network Operations Unit, Network Platform Business Unit.

* * * * * * * * * * * * * * * * *