Activities toward Wireless LAN Operation Service

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Abstract

Wireless LAN is suitable for an access network to Unified Communications in the intranet. In enterprise environments, however, their usual events can degrade the communication quality of wireless LAN, such as layout changes, personnel reshufflings and so on. To maintain communication requirements, this paper proposes an operational model that features three control mechanisms based on different units of time; real-time performance improvement, fault detection and countermeasures and the performance maintenance. NEC will incorporate the model in its managed services for Unified Communication environments from the design and SI to the operation and maintenance stages in addition to its competitive wireless LAN products.

Keywords

Wireless LAN, communication performance, operation, managed service

1. Introduction

The network (NW) supporting Unified Communications (UC) requires various means of communications such as telephony, mailing and conferencing as well as a ubiquitous connection of variable terminals as shown in **Fig. 1** . The wireless NW is compatible with UC thanks to the following properties 1) network connectivity for terminals regardless of locations and 2) independence of the terminal capacity from the number of connection points. Particularly, in spite of its narrower outdoor service areas than cellular systems, wireless LAN is expected to form a satisfactory intranet access platform for UC thanks to its following features:

- Broadband capability: Transmission speed of more than tens of Mbps that can support broadband video streaming, etc.
- Area flexibility: The use of unlicensed frequency bands allows areas to be configured flexibly according to the requirements of each enterprise.
- Universality of devices: Bundling with a variety of terminals including PCs and telephone terminals is possible.

However, the events that occur typically in enterprises, such as layout changes and reshuffling of personnel in an office/workplace, produce changes in the radio wave propagation environment and traffic status. The changes can impact on communication quality of the wireless LAN. This indicates that the system conditions of the wireless LAN may vary continuously throughout its system lifecycle. In addition, as the wireless LAN is more prone to attacks such as eavesdropping than the wired LAN, maintenance of the security level is also indispensable. As seen here, the wireless LAN operation of enterprises is suitable for managed service in which staff expertise in the latest wireless LAN technologies and its trends handles the whole of the lifecycle from consulting to design/SI and operation/maintenance.

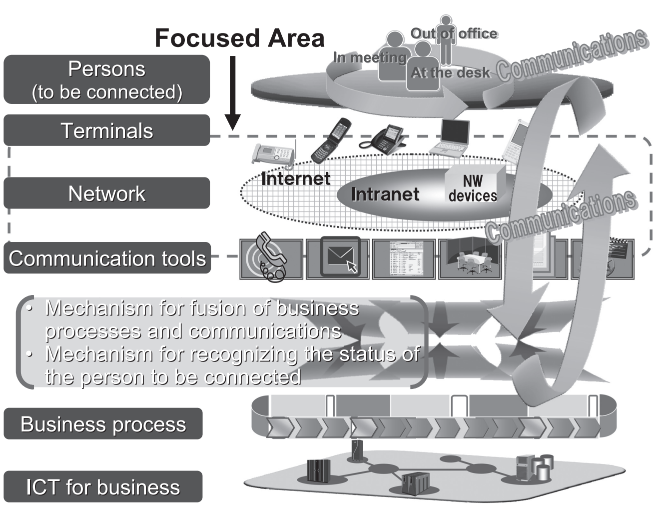

Fig. 1 Wireless LANs for UC.

This paper focuses on the wireless LAN of enterprises and demonstrates the importance of the operation through examples that can threaten the performance requirements of wireless LAN.

Following on the above, we propose objectives for the operation of the wireless LAN.

2. Examples of Threats to the Performance Requirements of Wireless LAN

The most important performance requirements for the wireless LAN to support UC are the following two points; 1) connectivity assuring ubiquitous access; 2) communication quality assuring the quality of the means of communication. In the following, we will define as a fault the status that does not fulfill these two points and introduces the cases in which a layout change or office personnel reshuffling can be the cause of faults in the wireless LAN.

2.1 Layout Change

Layout changes such as addition or removal of partitions and/or cabinets can sometimes be causes for unsatisfactory communication quality. For example, the case of **Fig. 2** shows an example where metallic partitions are installed to convert a part of the office into a meeting corner. The figure shows simulation results of signal levels from the access point (AP) covering the office and approximate APs locations covering the entire office. It shows that the new meeting corner has areas where the signal levels are lower than the quality threshold.

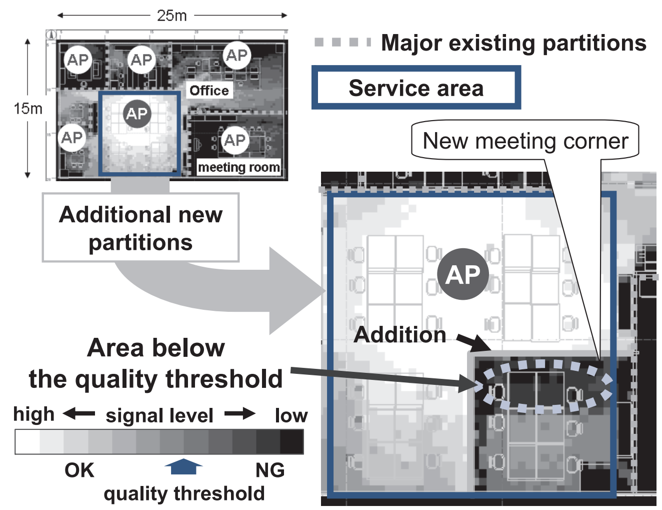

Fig. 2 Example of the impact of a layout change.

2.2 Temporary Change in the Number of Users

One of the advantages of wireless LAN is that automatic association (connection) is possible even when persons assemble temporarily for a conference or meeting. But this also causes a concentration of traffic in a specific area that can be a cause of degradation of the communication quality.

Fig. 3 shows the number of simultaneous associations of an AP accommodating the wireless LAN telephones in an NEC office that were collected at 10-minute intervals for a period of a week. While this AP has been designed for a maximum number of 20 simultaneous associations, the number has sometimes reached nearly 40. Thus, the wireless LAN is accompanied with a wider range of traffic fluctuations and is prone to traffic congestion than the wired LAN in which the correspondence between the user and the NW devices are fixed.

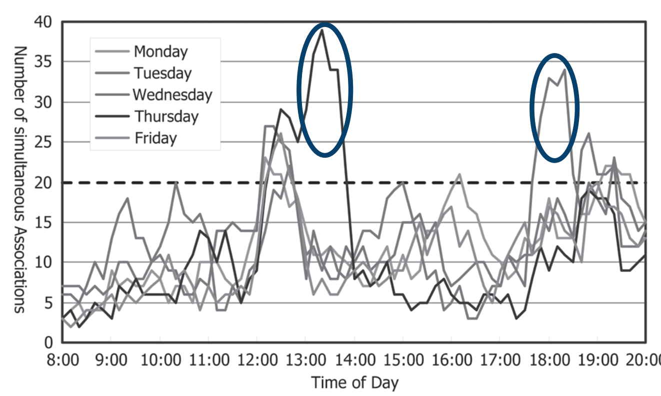

Fig. 3 Example of temporary changes in the numbers of users.

2.3 Changes in the Numbers of Stable Users

In a case when reshuffling of personnel causes a change in the number of stationary NW users, it is required for wired LANs to update configurations of NW devices to provide communication services for new environments caused by the change. This allows the system operator of the wired LAN to identify the changes accurately. On the other hand, the wireless LAN with function to support user mobility does not require the operators to do such work because of the function to support user mobility in the wireless LAN. This feature of the wireless LAN can contribute to a reduction in operational costs. However, it can also cause a delay in the awareness of the changes by the system operators and a subsequent degradation of the performance.

Fig. 4 shows the results of collecting the number of simultaneous associations of an AP accommodating wireless LAN telephones in an NEC office at 10-minute intervals from 8:00 to 20:00 daily for a period of 2 months and arranging the data into the daily maximum and daily average values. The figure shows that both the maximum and average values changed the trends after April 14. When we consulted the office about the change, we found that the personnel's reshuffling was executed near the AP on April 14 and that it was the cause of the change in the number of simultaneous associations. As seen in this example, even when the number of workers decreases, the equipment usage efficiency of the whole NW can be improved by reusing the idle devices in other locations with high NW load. On the contrary, when the number of workers increases, fault prevention measures are necessary to eliminate the cause of congestion.

The examples above are only some of the changes that may be produced in the activities of enterprises. Actually, factors that may impact the wireless LAN extend over a wide range such as co-/adjacent channel interferences from both inside/outside the office. Also, when remote NWs in multiple offices are operated in a concentrated manner, it is not easy for the system operators to quickly identify various environment changes such as layout, and personnel reshuffling in each office. To maintain the performance requirements of wireless LAN, therefore, it becomes critical to apply appropriate operations.

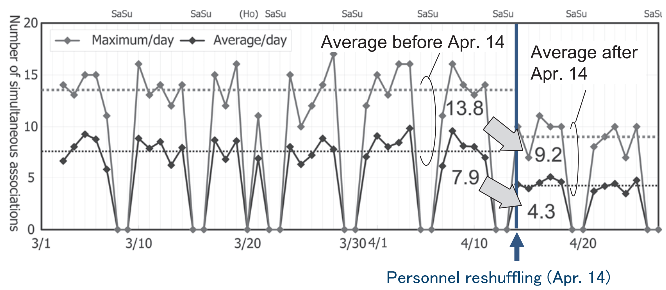

Fig. 4 Example of change in the number of stationary users.

3. Concept of Wireless LAN Operation

As discussed in section 2 above, there are a large variety of factors impacting wireless LAN performance and many of them are even impossible to estimate at the design stage. We propose the model shown in **Fig. 5** as a functional model for the appropriate operation of the wireless LAN. This model features mutual linkage of the control mechanisms based on three different units of time as described below;

- control for real-time performance improvement based on control protocol between the wireless LAN devices;
- control of the maintenance plan for dealing with short-term (in the order of a minute to an hour) faults based on the system monitoring function;
- control of maintenance of the long-/mid-term (in order of a day to a month) performance base on the system operation information analysis function.

The range of faults that can be handled with this model expands as the control time extends. In the following subsections we will discuss the control mechanisms and a preferable NW operation scheme.

3.1 Real-Time Control

This control aims to deal with faults in real time based on the function of directly controlling the traffic in the control protocols among wireless LAN devices. Although it can provide quick responses against faults, it can temporarily and locally deal with the faults that can be handled within the range of the device configuration.

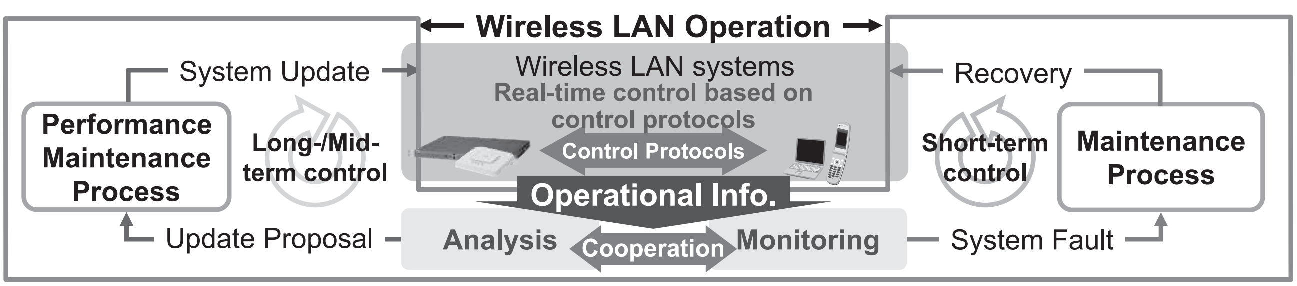

Fig. 5 Function model of wireless LAN operation.

An example of this control can be seen with the CAC (Call Admission Control) in the UNIVERGE WL5000 Series of NEC intelligent wireless LAN system [1] . It reduces congestion at an AP where the wireless bandwidth is subject to tight constraint by reconnecting terminals attempting to send a new traffic to it, either to the adjacent AP or denying the connection requests. This control deals with a temporary increase in peak traffic as shown in Fig. 3 by borrowing the resource of adjacent APs and we regard it as after all only an emergency resort. Also, a sudden increase in the rate of external interference may become a cause of performance degradation.

3.2 Short–Term Control

This control is intended to monitor device operation information such as the MIB (Managed Information Base) and Trap, detect faults quickly and apply proper fault countermeasures. When a fault is detected, the control generally solves it by activating the maintenance process with fault isolation and device replacement functions. Specific examples of its operations include device active/down status monitoring and short-term (in order of a minute to an hour) quality monitoring.

With the active/down-monitoring, when the down status of a device is detected, the control solves the fault by replacing the device through the maintenance process and so on. As an example of the quality monitoring, the control monitors the CAC activation frequency discussed in subsection 3.1. When the frequency exceeds a threshold, it can activate measures to stabilize the operation such as an increase in the adjacent APs transmission power with caring about the overall traffic situation.

We propose that this control works based on a simple rule-based mechanism for quick faults detection. Since communication environments of wireless LANs have time-varying features as shown in section 2, it is important to optimize the rules dynamically. Otherwise, a number of false negatives/positives will increase operational costs. Therefore, we also propose the control to be incorporated with the long-/mid-term control described in subsection 3.3 below so that the faults detection rule can be optimized according to the environment changes.

3.3 Long–/Mid–Term Control

The purpose of this control is to predict faults and derive the preemptive fault detection rules based on analysis on the time-series long-/mid-term operational information. Data mining [2] is one of the key technologies for the controls such as trend analysis and change point detection for the information. Through the analysis, the control derives optimized fault detection rules described in subsection 3.2 as well as basic data for system configuration management. Specific examples of the fault detection rules include derivation of the detection threshold of spatial changes such as the layout change shown in Fig. 2 and the trend analysis of the change in the number of stationary users as shown in Fig. 4. The detection criteria need to be derived without effects of temporary fluctuations such as the signal level fluctuations and human behavior modes. To eliminate the effects, we propose to apply the statistical analysis based on long-/mid-term trends for the criteria determination, which can evaluate stationary components much more accurately.

For instance, the detection threshold for layout change can be obtained from the analysis of mutual received signal levels between APs. The signal level is always fluctuating and a change in the stationary component is produced in a case when a fixed change such as addition or removal of partitions. This control evaluates the stationary component from the signal level data over an averaging period long enough for eliminating the fluctuations. Then it obtains the layout change detection threshold by adding an appropriate margin to the evaluated result and provides the threshold to the short-term control. Similarly, as for the change in the number of stationary users, the control evaluates the stationary component from the connection count data over a period long enough to obtain average human behavior patterns and then identifies the trend from the change of the stationary component. At the same time as reflecting the result in the short-term control, the control also performs predictions and uses them as the basic data system configuration management.

3.4 Provision Scheme of Wireless LAN Operations

Since the factors that cause faults of wireless LAN involve time-varying features as seen above, we believe that operation based on static monitoring is inadequate. Particularly, short-term as well as long-/mid-term controls are required of the following characteristics:

- Abundant IT resources for storage of a large amount of long-/mid-term operational information and high computation capabilities required for its analyses;
- High expertise for interpretation of the results of identification/monitoring of the operations of wireless LAN devices and of the results of their analyses;

● A maintenance system that can deal promptly with faults.

It is possible to allot the functions and processes in the short-term and long-/mid-term controls as shown in Fig. 5 between ourselves and the customer. The allotment, however, does not always ensure efficient operation due to the overheads for information sharing among the allottees. Consequently, we believe that the advantages of wireless LAN for the users can be maximized only by implementing the proposed model in the process of managed service operations as performed by specialized staff.

4. Conclusion

This paper discussed the wireless LAN of enterprises by focusing on its communications performance and indicated that events usually occurring in enterprises can be system fault-causing factors. In order to maintain the performance against the system faults effectively, we proposed an operational model with three optional control mechanisms based on different units of time: real-time, short-term and long-/mid-term control. It is possible to generalize the operational model to systems involving severe time-varying degradation factors other than wireless LAN systems. Operations based on this model require high expertise and ample IT resources in order to enable both the short-term and long-/mid-term control and should be able to deal with faults promptly. In order to provide prompt and appropriate actions against the faults, we believe that it would be an ideal solution to provide the model in support of the operational processes of managed services.

NEC is determined to provide more stable and more comfortable wireless LAN environments as the NW platform for new work styles with UC. We intend to achieve this advance by offering devices as well as consistent system lifecycle management from the consulting to the design & SI and the operation & maintenance stages.

References

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