2600-00FZ6IGA2 Ver. 4.0

WEC8050 (APC)

System Description

SAMSUNG ELECTRONICS

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TRADEMARKS

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INTRODUCTION

Purpose

This manual describes the overview of WEC8050 as Samsung Wireless Enterprise Control System and the configuration, specifications and functions of the hardware.

Document Content and Organization

This manual comprises Five Chapters and a list of Abbreviations.

CHAPTER 1. Overview of Wireless Enterprise Solution

This describes the features and main functions of the Wireless Enterprise Solution and the network configuration.

CHAPTER 2. Introduction of WEC8050 System

This introduces the detailed specifications such as the main functions, system capacity, electrical specification and mechanical specification of WEC8050.

CHAPTER 3. WEC8050 Hardware

This chapter introduces the hardware features and interface of WEC8050.

CHAPTER 4. System Service Scenario

This describes the service scenario provided by implementing the Wireless Enterprise System.

CHAPTER 5. Additional Equipment and Tool of WE WLAN System

This describes the additional function equipment and tools used in Wireless Enterprise WLAN System.

ABBREVIATION

This provides the abbreviations in this manual and their explanations.

Conventions

The following types of paragraphs contain special information that must be carefully read and thoroughly understood. Such information may or may not be enclosed in a rectangular box, separating it from the main text, but is always preceded by an icon and/or a bold title.

NOTE

Indicates additional information as a reference.

WEEE Symbol Information

This marking on the product, accessories or literature indicates that the product and its electronic accessories (e.g. charger, headset, USB cable) should not be disposed of with other household waste at the end of their working life. To prevent possible harm to the environment or human health from uncontrolled waste disposal, please separate these items from other types of waste and recycle them responsibly to promote the sustainable reuse of material resources.

Household users should contact either the retailer where they purchased this product, or their local government office, for details of where and how they can take these items for environmentally safe recycling.

Business users should contact their supplier and check the terms and conditions of the purchase contract. This product and its electronic accessories should not be mixed with other commercial wastes for disposal.

Revision History

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CHAPTER 1. Overview of Wireless Enterprise Solution

This chapter introduces the network configuration of Samsung Wireless Enterprise (hereinafter referred to as 'WE') solution and its components.

1.1 Introduction of Samsung Wireless Enterprise Solution

Samsung Wireless Enterprise (WE) solution provides a variety of telecommunication services required by clients in the wireless environment. It allows collaboration applications such as telephone, message, communicator, etc. that have been used in the conventional wired environment to be used on a wireless terminal such as smart phone, tablet PC, or laptop.

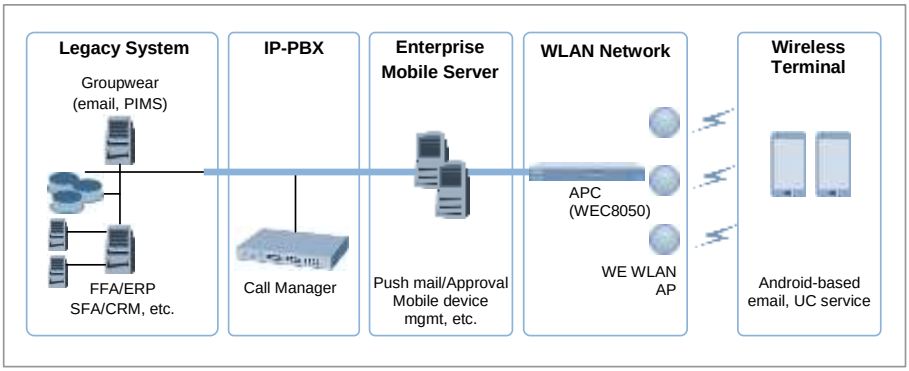

Figure 1. WE System Structure Diagram

The WE solution collectively means a variety of enterprise applications provided by wireless and wired infrastructure products and wireless terminals as shown in Figure 1. Among them, the WLAN network as a wireless infrastructure solution that provides mobility in the enterprise environment consists of WE WLAN Access Point (AP), AP Controller (APC), and Wireless Enterprise WLAN Manager (WEM).

Samsung APC and WE WLAN AP are the core equipments to provide various services including user authentication, wireless management, voice and data services in the 802.11-based Wi-Fi environment.
WE WLAN AP provides the telecommunication environment based on Wi-Fi and APC offers user authentication, quality of service (QoS), handover and security by overall integrating WE WLAN APs. WEM provides the convenient configuration environment and information on various statistics and events for the operator.

1.2 Network Configuration

The network configuration of Samsung WE Solution is as follows:

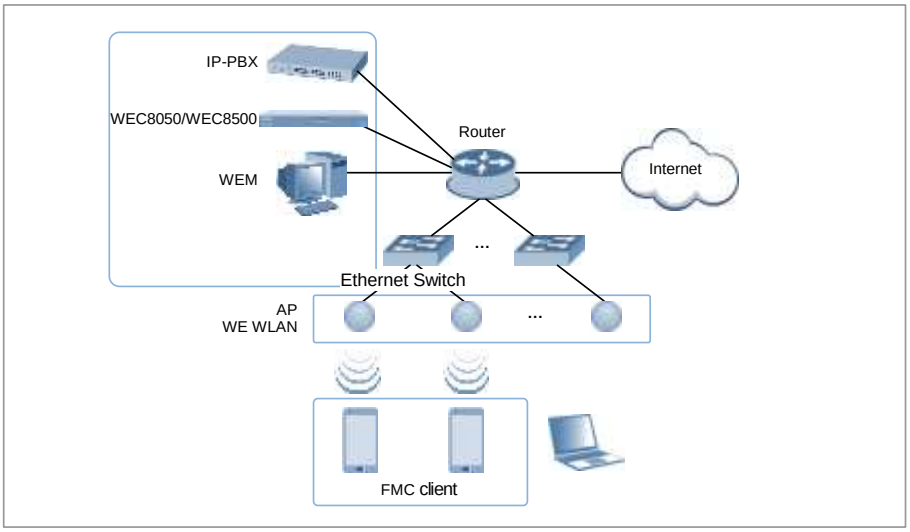

Figure 2. W-EP Network Configuration

APC (WEC8050)

The APC manages all the W-EP WLAN APs installed in an enterprise communication environment and also user information and traffic. Because the W-EP WLAN configuration uses a centralized structure to tunnel all the wireless user traffics through the APC, the APC is one of the most important elements related to traffic management and throughput in the W-EP environment.
The APC is typically installed at a position where it can be connected with a backbone switch, core switch or router in a network. It controls a W-EP WLAN AP and provides handover, QoS, and security/authentication functions.

WEM

In the W-EP WLAN environment, various services are provided through a complex network configuration. Because of many users, management is complicated and difficult and it is difficult for a general network manager to deal with management work as well as problem occurrence at the normal state. The WEM is a network management system (NMS) that effectively manages this kind of W-EP WLAN and service environment.
It manages a WLAN, and retrieves and configures the status of APC or W-EP WLAN AP.

W-EP WLAN AP

The W-EP WLAN AP is a device that provides a wireless connection service to a user terminal.
It must be installed in consideration of the service area or region desired to be provided in the enterprise environment.
In general, the quantity depends on the size and number of users of the region where it is installed to secure the service coverage.

Ethernet Switch

In general, an AP uses a Power over Ethernet (PoE) switch that does not require any separate power cable in consideration of the external view because it is installed in the user area. Install the W-EP WLAN APs by considering current consumption and the power capacity PoE switch. In addition, because power drop may occur if the distance between the switch and W-EP WLAN AP, the relationship between distance and power must be considered. In general, the lowering of the electric power does not occur only if the distance between the two is 100 m or less.

Wireless Terminal/FMC Client

It means a terminal providing 802.11a/b/g/n interfaces including smart phone, tablet PC, and laptop. In an Android smart phone, an enterprise VoIP application equipped with the Samsung voice engine is called a FMC client (The FMC client is an option).

Wireless Additional Service

In the W-EP environment, various application services are required as well as basic wireless connection services.
In the enterprise environment, the Wireless Intrusion Prevention System (WIPS) provides a security service as one of the most important elements in the enterprise environment. The WIPS allows you to seamlessly receive a wireless connection service through the security services such as unauthorized terminal, unauthorized AP, or ad hoc connection blocking, etc.
The location service that manages the location of the terminal used in the wireless environment is also an application service required in the enterprise environment. With this, it is possible to manage the location of an asset, an effective user, or an unauthorized user.

IP Application Service

The IP application servers required in an existing wired network including Dynamic Host Configuration Protocol (DHCP) servers, DNS servers, web servers, or RADIUS authentication servers are also used in the W-EP environment. In particular, the DHCP servers and RADIUS authentication servers play a critical role in the wireless environment.

WIPS Solution

It monitors the properness of the implementation of the wireless network infrastructure by detecting penetration via unauthorized wireless equipment installed in the internal network, the detoured gateway segment of the internal officers and employees who illegally connect to the commercial WLAN service, etc. and provides the wireless network invasion detection which implements the safe and effective wireless network environment by detecting security vulnerabilities.

CHAPTER 2. Introduction of WEC8050 System

This chapter explains the main functions and product specifications of WEC8050.

2.1 Main Functions of WEC8050

WEC8050 is a WLAN APC provided by Samsung WE Solution. It is a system that controls and manages WE WLAN APs and it is not interoperated with APs that are not WE WLAN APs.
It provides L2/L3 seamless roaming and performs QoS. As a security function, it provides authentication (802.1x) and WPA/WPA2 functions.

2.1.1 WLAN Functions

2.1.1.1 Connection and Management of Wireless Terminal

Connection Function

Each wireless terminal may connect to WE WLAN APs through 802.11a/b/g/n protocols. For this, procedures such as connection and authentication are necessary, various access request messages delivered to WE WLAN AP by the wireless terminal are delivered to WEC8050, instead of direct handling of WE WLAN AP. WEC8050 performs load balancing or access control depending on the system status, and allows or rejects the connection of the wireless terminal or leads the connection to another WEC8050 system. In addition, WEC8050 provides an encryption function for security and data traffic by using a variety of Extensible Authentication Protocol (EAP) types such as open security because it provides a variety of authentication algorithms by wireless terminal.
For the various connection functions of the wireless terminal, WEC8050 provides the following functions as well:

- It uses the RADIUS server for the policy management of the wireless terminal. WEC8050 provides the function of the internal RADIUS server and also the connection function with the external RADIUS server. By using the RADIUS server function, it may allot the VLAN and QoS policy by wireless terminal.
- WEC8050 may allot static or dynamic IP address by wireless terminal.

- It performs Call Admission Control (CAC) for the application such as voice service and provides additional functions such as QoS.
- When it is a guest wireless terminal, it provides the guest service through the exclusive WLAN.

Managing Function

WEC8050 provides Command Line Interface (CLI) and Web User Interface (UI) for various settings and views. In addition, complicated information may be easily managed and viewed by using WEM. The managing function provided by WEC8050 is shown as follows:
It provides the status of the wireless terminal as shown below.

Item	Description
IP Address	IP address of the wireless terminal
MAC Address	MAC address of the wireless terminal
Host Name	Name of the wireless terminal
AP Name	The name of the connected WE WLAN AP
AP MAC Address	MAC address of the connected WE WLAN AP
AP Map Location	Location of the connected WE WLAN AP
Controller Name	Name of the connected WEC8050
Controller IP Address	IP address of the connected WEC8050
SSID	WLAN service identifier (up to 32 bytes used)
VLAN	VLAN ID of the wireless terminal
Protocol	802.11 protocol of the wireless terminal
Association	Connection of the wireless terminal
Association Time	Time of starting the connection of the wireless terminal
Session Length	The connection time of the wireless terminal
Authentication Type	Authentication type of the wireless terminal
Authenticated	Authentication of the security protocol of the wireless terminal
EAP Type	EAP type used for the authentication of the wireless terminal
Encryption Cipher	Types of encryption mechanism applied to the wireless terminal
Branch Authentication	Branch AP authentication of the wireless terminal
RSSI	Received Signal Strength Indication (RSSI) of the traffic of the wireless terminal
SNR	Signal to Noise Ratio (SNR) of the traffic of the wireless terminal

- It may set the blacklist. This function allows the system to eliminate a problem waiting to happen by removing the wireless terminal that has a potential problem.
- It checks the status of the wireless terminal by WE WLAN AP and eliminates the terminal in the WLAN if it is deactivated for a specific time.
- It provides the statistical information including data traffic by wireless terminal.
- It manages the history of association by wireless terminal. It may track the history of 10 WE WLAN APs as default values and the history information is as shown below.
  - Association Time, Duration, User Name, MAC Address, IP Address, AP Name, BSSID, Controller Name, AP Map Location, SSID, Protocol, Traffic, Handover Reason
- It provides an alarm by event of the wireless terminal.

2.1.1.2 Handover

Handover means disconnecting to the old AP and connecting to a new AP and allows the wireless terminal to connect seamlessly to the WLAN. WEC8050 provides the handover based on 802.11 Standard and AIRMOVE handover (Network Controlled handover) as Samsung's specialized function.

All decisions on the handover on the 802.11 standard are performed independently by the wireless terminal. On the contrary, the AIRMOVE handover in the hand on the 802.11 standard may allow the wireless terminal to perform the function of being independently performed through the cooperation between WEC8050 and the wireless terminal. Therefore, the handover function may be optimized. On smart phones such as Galaxy S3, Galaxy Note 2 and Galaxy S4 launched after the S3 now provided by Samsung, the AIRMOVE handover function is provided.

WEC8050 performs the following functions when a new access request comes from the wireless terminal:

- Load balancing and access control depending on the system status at the request for the re-connection of the wireless terminal to decide re-connection.
- Opportunistic Key Caching (OKC) to reduce the handover time. OKC reduces the time of deciding the re-connection at handover by eliminating the Extensible Authentication Protocol (EAP) authentication course with the Remote Authentication Dial In User Service (RADIUS).
- Not only intra APC handover but also inter APC handover. The intra APC handover is the handover between WE WLAN APs belonging to the WLAN managed by one WEC8050, and the inter APC handover means the handover between WE WLAN APs connected to different WEC8050s.
- Viewing the moving path by wireless terminal through the handover history management function.

2.1.1.3 Wi-Fi Functions

WEC8050 provides the following Wi-Fi functions:

Parameter Management Related to Wireless Resource of WE WLAN AP

WEC8050 provides CLI and Web UI to set channels and wireless transmission and receiving power for 802.11a/b/g/n wireless resources of WE WLAN AP.

Integrated Wireless Resource Management

WEC8050 guarantees the transmission quality of WLAN by optimally managing the wireless resources of all WE WLAN APs connected in the following method:

- Dynamic power control: Periodically collecting wireless data and automatically setting optimal wireless transmission power in consideration of noise, interference, and congestion degree of each WE WLAN AP
- Dynamic channel selection: Periodically collecting wireless data and automatically setting an optimal channel in consideration of noise, interference, signal strength, etc. of each WE WLAN AP
- Coverage hole detection & correction: When detecting a coverage hole where the signals of the WLAN between WE WLAN APs are not easily caught, gradually increasing the transmission power of the neighboring APs. Compensating and checking until the coverage hole is loosened or it reaches the permissible transmission power level to the maximum.

Setting of Power Constraint and Channel Swift Announcement

The 802.11h standard supported by the WE WLAN APs may give wireless terminals information on channel swift and limit the transmission power of the wireless terminals. For this, WEC8050 may set power constraint and channel switch announcement of the WE WLAN APs.

Load Balancing

WEC8050 provides load balancing to effectively distribute the wireless terminals accessing the WE WLAN APs as follows:

- Distribution by number of terminals: When the number of terminals accessing to specific WE WLAN APs is larger than or equal to the threshold set by the operator, consider that the WE WLAN AP is busy. At the time, the WEC8050 leads the access to the WE WLAN APs where the number of wireless terminals is less than the threshold.
- Spectrum load balancing: Basically, the wireless terminals access to the AP whose strength of the signal is higher. However, when the spectrum load balancing is set, lead terminals to access to the APs whose utilization capacity based on the utilization capacity based on the current channel.

Band Steering

When the performance degradation occurs due to many wireless terminals to the bandwidth of 2.4 GHz, this converts the bandwidth to the 5 GHz where there are many channels and interference is relatively less. To use this function, the bandwidth of 2.4 GHz and 5 GHz must be supported in the wireless terminals and WE WLAN APs.

Spectrum Analysis

Non-802.11 devices such as microwave oven, Bluetooth, and Closed Circuit Television (CCTV) degrade the performance of sending and receiving data by causing interference in the WLAN environment. Spectrum analysis as a function of measuring surrounding interference helps to rapidly solve the interference problem by analyzing the wireless or radio frequency (RF) signal in the real time.
The spectrum analysis of the WEC8050 provides following data:

- Sample Reporting: Wireless capture data converted to Fast Fourier Transform (FFT)
- Duty Cycle Reporting: Channel usage
- Interference Reporting: Information on the interference signals

Country Code Set Control

By setting the country code of the WE WLAN AP, it is possible to change frequency band, wireless interface, channel, and transmission power fit for each country code.

Location Tracking

The WEC8050 provides a function of tracking the location of several terminals in the WLAN network based on the wireless data collected in the managed WE WLAN APs.

Provision of Quality of Service (QoS)

It provides wireless QoS by setting the Enha41nced Distributed Channel Access) parameters of Enhanced Distributed Channel Access (EDCA) of the WE WLAN APs, DSCP, and 802.1p tag values. It is possible to provide another QoS by user.

2.1.1.4 Voice Quality Improvement

WEC8050 provides the following voice quality improvement functions:

Call Admission Control (CAC)

It provides CAC to protect voice calls conventionally maintained from ones flowing from new WLAN. WEC8050 does not allow additional voice calls when it reaches the permissible voice calls to the maximum per radio.

Controlled Voice Optimization (CVO)

It provides a function of improving voice quality by setting EDCA parameters in other WE WLAN APs depending on the number of calls.

Additional Functions

It provides the detection of failure in VoIP call and various call statistics by Base Station System (BSS).

2.1.2 WLAN Security

2.1.2.1 WLAN Standard Security

The WE WLAN equipment supports the security specified in IEEE 802.11 based WLAN security standard as follows:

- WEP (Wired Equivalent Privacy)
- WPA (Wi-Fi Protected Access)
- WPA2 (Wi-Fi Protected Access Version 2)

WEP

IEEE 802.11 is an initial WLAN standard enacted in 1997 and WEP is a security algorithm specified in this standard. WEP is a security method for encrypting transmission data by using a key of 64 bits or 128 bits that combines a secret key for sharing wireless transmission data sent and received by APs connected to the WLAN and the terminal. Now, as WEP is known to be weak in security, the standards, including WPA/WPA2, whose security has been enhanced through IEEE 802.11 working group have been enacted.

WPA/WPA2

IEEE 802.11i provides a function of more enhanced authentication and data encryption with the wireless standard enacted in 2004. It describes the WPA/WPA2 security specification based on EAP and 802.1X authentication, and includes the security mechanism in the WLAN authentication and encryption methods by classification.

The WLAN authentication method is as follows:

- WPA-Personal: Use the method for authenticating the Pre-Shared Key (PSK). The PSK authentication method is generally a method used in the small-sized network where there is no separate authentication server.
- WPA-Enterprise: A method for authenticating through certification servers such as Remote Authentication Dial-In User Service (RADIUS) server. WEC8050 supports a separate external authentication server and integrates a self-authentication server usable in the small-sized WLAN environment.

The WLAN encryption method is as follows:

- Temporal Key Integrity Protocol (WPA TKIP): TKIP is based on RC4 encryption algorithm in the encryption method used in the WPA specification of IEEE 802.11i.
- WPA2 Counter mode encryption with CBC-MAC Protocol (CCMP): CCMP is an encryption method used in the WPA-2 specification of IEEE 802.11i. It is based on the method for encrypting Advanced Encryption Standard (AES) blocks in the Counter mode encryption with CBC-MAC (CCM).

2.1.2.2 WLAN Security Service

The WE WLAN equipment provides the services of detecting and blocking illegal APs or wireless terminals as a WLAN security service. This is a function of detecting and blocking the illegally installed APs without permission of the administrator in the WLAN service zone under operation and wireless terminals connected thereto. It is important to manage because information exposure or attempts at several attacks are possible through illegal APs.

Detection

By using the self sensor function of the WE WLAN AP, it is possible to basically search all packets in the WLAN and provides basic information required to detect illegal APs and wireless terminals with APCs such as WEC8050. WEC8050 detects illegal APs and wireless terminals through the information provided by the AP and the set policy and creates relevant alarms and logs. The detected illegal APs are classified under the set classification policy as follows:

Classification Type	Description
Managed AP	An AP allowed to be used by the administrator among illegal APs detected - Possible to set the managed AP classification policy. - The administrator may classify a specific AP among the detected rouge APs manually detected as a managed AP.
Unmanaged AP	An AP among the detected rouge APs that is not allowed to be used by the administrator or that may be used for a malicious intention - Possible to set the unmanaged AP classification policy. - The administrator may classify a specific AP among the detected rouge APs manually detected as a unmanaged AP.

Main information provided for illegal APs is as follows:

- MAC address
- SSID
- Channel Information
- Strongest AP RSSI
- SNR
- Classification Type: Malicious, Friendly, Unclassified AP
- Blocking State
- Number of connected wireless terminals
- Detection time

Blocking

WEC8050 attempts at blocking under the set policy for illegal APs. The blocking of illegal APs is made by transmitting de-authentication packets to APs wirelessly.

2.1.3 Data Networking

2.1.3.1 L2 Network Managing

It provides L2 network management as follows:

VLAN

A Virtual Local Area Network (VLAN) is a function of switching by grouping similar terminals in a work group under the LAN operating policy regardless of the location of terminals. By separating and processing them as virtual LAN only in the group, it may eliminate the influence over unnecessary broadcasting packets and configure the stabilized switching subnet.

STP/RSTP/MSTP

To prevent the packet forwarding loop from occurring in the L2 network, a forwarding tree is configured by a spanning tree algorithm. It may prevent a loop by VLAN from occurring by using a STP/RSTP algorithm or Multiple Spanning-Tree Protocol (MSTP) by VLAN.

Static Link Aggregation

As it is possible to use several switch ports logically like one interface by providing the static link aggregation, it may create the bandwidth largely that may be used in the interface.

Internet Group Management Protocol (IGMP) Snooping

The L2 switch without IGMP (a switch in the lower IP router layer) works as if it were a group member and the group member as if it were a IP router by using the IGMP message in the location between IP router and multicast group member (host). The operation made by the L2 switch at the time is called as IGMP snooping. By reflecting information on a multicast group in an IP layer included in the IGMP message on the MAC filtering database as its switching database, WEC8050 processes it in a form of MAC multicast address responding to the IP multicast address.

2.1.3.2 L3 Network Managing

Static Routing

By configuring a fixed routing table between network interfaces, it may process static routing all the time. The change in the dynamic routing table is not performed by a routing protocol and a certain routing service is provided under the set routing policy.

Routing Information Protocol (RIP)

It is a protocol widely used to manage routing information in the small or midsized independent network such as groups interconnected by LANs.

Open Shortest Path First (OSPF)

It is a routing protocol used to put priority on RIP in the large autonomy network.
A router detecting change in a routing table or network must be allowed to have routing information such as all routers by informing all other routers in the network of the information immediately.

IGMP

IGMP is an internet protocol that allows IP terminal or internet computer to provide the means informing neighboring routers of multicast groups. Multicasting allows one host computer in the internet to send contents to other IP terminals or computers to the internet.

Protocol Independent Multicast-Sparse Mode (PIM-SM)

PIM-SM is a protocol for multicast routing. After checking the interface to send a multicast packet first, it transmits the multicast packet only with the confirmed interface.

Virtual Router Redundancy Protocol (VRRP)

When there occurs a fault in a router, VRRP allows the telecommunication service by using the backup router in the same network. When there occurs a fault in a master router, it detects such fault and allows the backup router to use an IP address such as master router.

2.1.3.3 Network Interface Managing

The following IP addresses may be allotted to the physical or logistic interface of the system:

- Fixed IP address
- Dynamic IP address
- Secondary IP address

2.1.3.4 Network QoS and ACL Managing

By using the QoS, the operator may provide users with different quality of services.
In addition, Access Control List (ACL) is allowed to provide each user with an access authority to a different network. The ACL analyzes packet information by using several filtering techniques to control the network traffic and provides a function of processing the packet in the method as designated by the operator.
The supporting functions in relation to the ACL are as follows:

- Filtering IPv4 address and MAC address
- Supporting IP, TCP, UDP, and ICMP
- Supporting the destination IP address and port, the source IP address and port as well as a protocol and the IP address and the port may be entered by designating the wildcard format and the scope, respectively
- WEC8050 possible to control the packet as a final destination by supporting Admin ACL
- Supporting various operators

2.1.3.5 Network Solution Managing

It provides the network solution management as follows:

Monitoring CAPWAP Data Channel

To inspect validity in the data packet channel used at the Control And Provisioning of Wireless Access Point (CAPWAP), it periodically sends and receives keep-alive messages. When the keep-alive message fails to be received, it monitors the abnormal status of the CAPWAP channel.

Network Address Translation (NAT)

NAT performs a function of converting a private IP address and a public IP address in the network that requires security.

- Inbound: Forwarding the packet from the WAN to an IP address and port of the LAN designated in the NAT/PT conversion table
- Outbound: A function of transmitting a packet from the internal LAN to the WAN by converting the IP address of the sender to the global IP address by the NAT/PT conversion table
- Exclusive: Used for the IP address to which the NAT/PT conversion is not applied.
- Redirect: If a DNS IP address in the data server control sector is changed, a function of each IP terminal using the DNS IP address before being changed and registering the changed DNS IP address to the redirect table to change the IP address.

Firewall

Firewall is a function to block the traffic which is not desired from the external network. For this, it provides connection filtering, DeMilitarized Zone (DMZ), and port forwarding, and other functions.

- Connection filtering: It means a function of blocking the access to the unauthorized IP address. Used to control the access of the resources not disclosed outside and also control the external resources where members in the LAN must connect.
- DMZ function: Used when the connection is allowed from the outside while the connection control service by the firewall is offered. Separately from the LAN network that the firewall blocking the web server or email server that requires free connection from the outside is not applied even though it is a LAN network protected by the firewall, it is connected to a separate subnet.
- Port forwarding: It is a similar function like DMZ, but a function of being connected to a specific network without using a separate DMZ port. It may give an extra network service accessible to the intranet through the Internet outside with the DMZ function. Provided that it must be careful of security in the intranet during the extra network service.

MAC Filter

To allow or block the connection of the authorized or unauthorized user terminal connected to the internal wireless network, it manages the list of MAC of the user terminals in a unit of WLAN. It provides the whitelist MAC filtering to allow only the desired user terminals and the blacklist MAC filtering to block only the user terminals not desired.

- Whitelist MAC Filtering: It means a function of allowing only the connection to the allowed terminal list. The packets of the user terminals unregistered in the list are blocked.
- Blacklist MAC Filtering: It means a function of blocking all connections of the user terminals existing in the terminal list. The user terminals unregistered in the list are not allowed.

2.1.4 Managing Function

The managing function is required to control WLAN APs that provide the service through WEC8050 and to make the wireless terminals connected to the WE WLAN AP set network information required in the wireless environment.

WEC8050 Management

It is possible to manage information on various configurations and options required to operate WEC8050.

AP Management

- WEC8050 can control up to 200 WE WLAN APs.
- It may monitor the status of the WE WLAN APs and confirm normal operation. It may set and view the information on the WE WLAN AP remotely and provide even a function of collecting performance and statistical information. In addition, APs consider signal interference by wireless frequency characteristics and the normal operation of the WE WLAN APs by using the information.
- When there occurs an alarm or event in the WE WLAN APs, it may view the concerned information. As such, when the WEM requests information, it views the information and delivers the result.
- It provides a function of controlling or viewing software package by WE WLAN AP or for all APs.
- Based on the issued license, it performs the number of allowed WE WLAN APs, firewall, VQM service support and the management of WE WLAN APs differently.

AP Group Management

WEC8050 may manage up to 200 groups of APs and Remote APs.
An operator can add or delete several APs to/from a group. An operator can manage the services for each group by creating a new AP group and can move a specific AP to another group or delete it from the original group.
An operator can apply various settings for individual WE wireless LAN per AP and also per group for flexible management.

Remote AP Group Management

If the APs are placed in an area where the APC is not located, those APs must be classified into a separate group for service. The APC can manage the APs in another area by grouping them into a remote AP group.
When the APC and remote AP are disconnected, the remote APs can authenticate users using a separate authentication server.

WLAN Management

WEC8050 may manage up to 255 WLANs including WLAN used by the root AP.
WEC8050 allows the connection by Service Set Identifier (SSID) for the user terminals and may provide a specific service by SSID. The configurable services may include configuration by group, designation of radio area, guest service, various security configurations, configuration of Dynamic Host Configuration Protocol (DHCP), and the designation of Access Control List (ACL).

2.1.5 System Management

The function carries out the following system management functions:

System Configuration Data Management

The system configuration data includes the current configuration status of the system. WEC8050 may store, manage or initialize the data.

- Save: Because the configuration data of the current system by CLI/Management Information Base (MIB) may be saved, it prevents data loss under the situation of system restarting, etc.
- Configuration sharing: It may import or export the configuration to other WEC8050 systems.
- System initialization to factory settings: It may initialize the system.

Software Management Functions

To boot the system, it performs a function of initializing other software modules by being invoked first and monitoring and managing the status of the initialized software modules. Furthermore, it provides the function of upgrading the system software package and viewing the package information.

System Log Management

When the error occurs, it may restart or stop the software and the log processing module reports the error to the event manager. It provides even the self-log saving function by preparing against the error status of the event manager. It provides even the function of interoperating Simple Network Management Protocol (SNMP) Trap and syslog.

System Device Management

It provides a function of managing and viewing the usage rate of CPU, memory and disk, information on the revolution per minute (RPM) of the fan, and the information on the status of the internal temperature sensor and hardware of the system.

System Statistics Management

It provides a function of managing and viewing the statistical information of the system and the WE WLAN APs.

WE Wireless LAN Statistics Management

This provides a function for managing and retrieving statistical information relating to WE wireless LAN APs.

- AP History Statistics
  An operator can retrieve history statistics in respect of the AP using the WEM.
  If the operator requests the history statistics of the AP, the AP transmits the interface (WAN and WLAN) and CPU load/memory usage statistics collected for a period of five minutes to the APC. The APC forwards the information to the WEM via FTP.
  If the APC does not interoperate with the WEM, the APC stores the information for three days.
- AP Real-time Statistics
  An operator can retrieve the interface information of an AP in real time using the CLI or WEC.
  If the APC requests the interface information from an AP, the AP transmits the interface information (WAN and WLAN) to the APC at intervals of five seconds and the APC stores the information in its internal database.

2.1.6 IP Application Management

DHCP Management

- DHCP client function: It provides a function of setting the dynamic IP address to the interface.
- DHCP proxy function: It hides the location of the DHCP server from the wireless terminals and allows it to connect to the server.
- DHCP relay function: It provides a function of connecting the DHCP request of the wireless terminals to the server.

DNS Management

- DNS settings: It provides a function of setting the external DNS server referred to by WEC8050.
- DNS relay: It provides the relay function with the cache function responding to the DNS request of the wireless terminals.

Time Management

It provides a function of synchronizing the time of the external network time protocol (NTP) server, the internal WE WLAN AP and the wireless terminal.

- Manually time setting
- NTP time setting: Setting the time from the external NTP server
- NTP server: NTP proxy function operating like a server to synchronize time of the internal WE WLAN AP and the wireless terminal

Session Management

It may connect to WEC8050 through Telnet or SSH protocol from the outside by using the terminal or to other Telnet server from WEC8050.

File Management

- FTP server/client function
- SRTP server/client function

IP Utility

It provides the following functions:

- ping: A function of confirming the connection of the network by transmitting the ICMP message
- traceroute: A function of being able to trace the route path to the destination
- tcpdump: A function of confirming the network packet from WEC8050

2.1.7 Operator Interface Managing

It provides user interface that manages several functional blocks of the system to the CLI and Web UI.
Besides, it provides the interoperable interface with the NMS products through the SNMP agent.
In particular, WEC8050 provides the configuration, performance and real-time alarm information in connection with the WEM.

CLI

It performs a function of managing the configuration of the system and viewing the information and monitoring and collecting the operating status of the functional block in the system through Telnet or connection to the console.

Web UI

Web UI is a tool for configuring and managing WEC8050 and the WE WLAN AP. It offers the function of configuration and security management required to provide the WLAN service and WLAN performance monitoring through the web-based GUI.

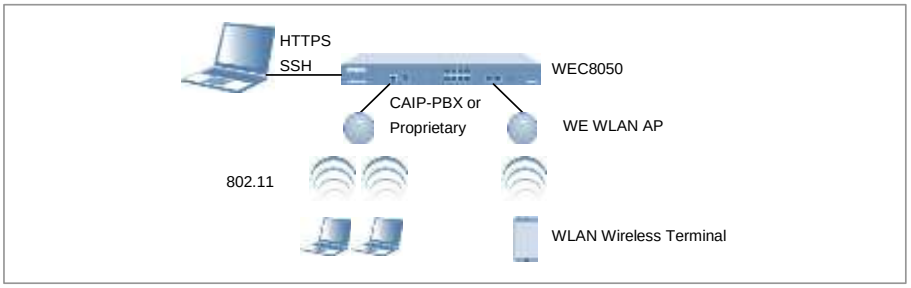

Figure 3. Web UI Map

Below are the functions the Web UI provides.

- Monitoring: Possible to indicate various configurations, status, wireless terminal information, etc. and monitor statistical information.
- WEC8050 configuration: Possible to set various policies applied to interface, Layer2, Layer3, Multicast, and WEC8050.
- Setup of WE WLAN AP configuration: Possible to set up profile management, various configurations and policies of the WE WLAN AP.
- Wireless terminal management: As a function of managing the wireless terminal connecting to the WE WLAN AP, setting the mobility group and its policy.
- WEC8050 system management: It provides protocol setting, user management, log management, file management, software package management, etc. applied to WEC8050.

2.1.8 CAPWAP Function

It creates the secured tunnel and transmits the data by using CAPWAP as a standard protocol between WEC8050 and WE WLAN AP. It provides high security due to the use of the encrypted data in all wired and wireless sections.
CAPWAP is composed of the control channel and the data channel. The control channel processes the messages of provisioning, various settings, and control while the data channel delivers the data traffic sent to, and received from, wireless terminals through CAPWAP tunneling.
The control channel basically provides the retransmission function, because the data loss does not occur due to the delivery of the WLAN configuration information in the control channel. The data channel does not provide re-transmission because response is required faster than confidence in packet delivery due to the delivery of the user data traffic.
The Datagram Transmission Layer Security (DTLS) function provides each control channel and data channel to turn on and off.

The functions provided through CAPWAP are as follows:

IP discovery Function

- WEC8050 IP discovery based on unicast, multicast, and broadcast
- WEC8050 IP discovery by using the DHCP option information
- Auto Discovery function
  - Static IP mode: Last connected APC → Broadcast → Multicast
  - DHCP IP mode: Last connected APC → DHCP option → DNS → Broadcast → Multicast

Provisioning Function

- Radio parameter and WLAN profile provisioning
- Firmware downloading and upgrading

Security Function

- CAPWAP tunneling
- DTLS for control channel and data channel of CAPWAP
- Authentication based on 802.1x, and PSK

QoS Function

- QoS mapping of the wired and wireless network by wireless terminal
- QoS marking of CAPWAP tunnel header

Failover Function

- Failover to Primary, Secondary, Tertiary, and Cluster Groups at the keep-alive error
- Fallback function

Configuration Function

Configuring 802.11 WLAN and radio parameter

Statistics Function

- Various statistics by WE WLAN AP and wireless resource
- Real-time or periodical statistics

Handover Function

Handover of Network Controlled (NC)

2.1.9 Additional Service Function

WEC8050 provides Voice Enhanced Monitoring (VEM) as an additional service. By using this, it is possible to check and manage the statistics of voice calls that pass the WLAN section now and voice status and provide the status information by monitoring the quality of the voice traffic.

2.2 Product Specifications

This chapter explains the specifications of the WEC8050 and the system capacity of it.

2.2.1 Product Specifications

Item	Specifications
Dimensions (mm)	290 (W) × 44 (H) × 280 (D)
Weight (kg)	2.4
System memory	4 GB
SSD memory	16 GB
Booting ROM	16 MB
Power supply	AC 100~240 V, 50~60 Hz
Operating temperature	0~45°C (32~113°F)
Storage temperature	-25~70°C (-13~158°F)
Operating humidity	10~90 %, non-condensable
Altitude	0~4018 m (0~13123 ft)
Specification & safety compliance	- KC Type Approval - FCC Part 15 Class A - IEC/EN 60950-1 - UL60950 - EN55022/EN55024

2.2.2 System Capacity

WEC8050 accepts up to 200 WE WLAN APs. It supports the throughput performance of 1.5 Gbps to the maximum.

Item	Specifications
No. of acceptable WE WLAN APs to maximum	200
Maximum processing capacity under system configuration	Use of 1000 BASE-T 4 Ports: 1.5 Gbps

2.2.3 Electrical Specifications

The electrical specifications by item are as follows:

LAN Signal Specification

[10 BASE-T]

Item	Specifications
Transfer rate	10 Mbits/s ± 50 ppm
Transmission code	Manchester coding
Standard specifications	IEEE802.3
Access control method	CSMA/CD (Carrier Sense Multiple Access/Collision Detect)
Transmission media	UTP (Unshielded Twisted Pair) CAT3, CAT4, CAT5, STP (Shielded Twisted Pair)
Number of UTP pairs	2 pairs
Characteristic resistance	100 Ω

[100 BASE-TX]

Item	Specifications
Transfer rate	100 Mbits/s ± 50 ppm
Transmission code	4B/5B + MLT-3
Standard specifications	IEEE 802.3u
Access control method	CSMA/CD
Transmission media	UTP CAT5, STP
Number of UTP pairs	2 pairs
Characteristic resistance	100 Ω

[1000 BASE-TX]

Item	Specifications
Transfer rate	1000 Mbits/s
Transmission code	8B1Q4
Standard specifications	IEEE 802.3ab
Access control method	CSMA/CD
Transmission media	UTP CAT5 (maximum transmission distance: 100 m)
Number of UTP pairs	4 pairs
Characteristic resistance	100 Ω

2.2.4 Power Specification

WEC8050 is operated with AC input power and supplies the power of +12 V to the system cabinet.

Power Supply		Specifications
Power supply module (APC60)	Input power	AC 100~240 V - Frequency: 50~60 Hz - Power consumption: 60 W
	Output power	DC +12 V, 5 A

2.3 Interface between Components

The physical and logical interfaces between components of WE WLAN are as follows:

WEC8050 Interface

Connection	Physical Interface	Connection Specification
WE WLAN AP	N/A	CAPWAP tunneling, DTLS
Core switch	10/100/1000 BASE-T	802.3ab
WEM	N/A	SNMP
Web UI	N/A	HTTP, HTTPs
Console	RJ45	CLI, Telnet

WE WLAN AP Interface

Connection	Physical Interface	Connection Specification
Wireless terminal	DSSS/CCK, OFDM, 802.11a/b/g/n (2.4 GHz, 5 GHz) 802.11ac (2.4 GHz, 5GHz) (WEA400 series)	802.11a/b/g/n (2.4 GHz, 5 GHz) 802.11ac (2.4 GHz, 5GHz) (WEA400 series)
Ethernet switch	10/100/1000 BASE-T	802.3ab
PoE switch	10/100/1000 BASE-T	802.3af, 802.3at (WEA400 series)
WEC8050	N/A	CAPWAP tunneling, DTLS

WEM Interface

Connection	Physical Interface	Connection Specification
WEC8050	N/A	SNMP
Core switch	10/100/1000 BASE-T	802.3ab, IP

CHAPTER 3. WEC8050 Hardware

This chapter introduces WEC8050 hardware characteristics, configuration and internal configuration.

3.1 Features

The hardware of WEC8050 has the following features:

Safety

The materials and parts used in the hardware are mechanically robust and satisfy mechanical and electrical characteristics required for the telecommunication system.

- It is a stabilized and robust structure of the steel plate-welded assembly by complying with the industrial standards.
- It does not generate toxic or corrosive gases that may give harm to the human body or give influence over the system operation.
- It is made of the materials considering the Electro-Magnetic Interference (EMI) specifications.
- To prevent the damage due to overvoltage, it has a safety device.

Maintenance

It is designed to allow easy and safe maintenance activities.

- It complies with the rack specification that may install the unit with the width of 482.6 mm, and the rack is designed to maintain the full strength.
- With each port connected to the outside in the front panel, it is easy to connect the cable.
- There is a LED at the front of each module indicating its operation status and fault status, helping the operator to identify the status of the system easily.
- On the rear part of the rack, there is a ground hole that may connect the wrist-straps to prevent static electricity.
- The electronic devices are designed not to be damaged by the external environment during installation or maintenance.

Fire Resistance and Exothermal Process

The fire-resistant materials and parts are used against fire and it is designed to prevent heat generated from the inside of the system from being influenced over the performance.

- The special heating part in the hardware is blocked not to give any influence over the component parts sensitive to temperature.
- It discharges the internal air outside by installing two 40 mm fans for cooling.
- The parts installed to the module are placed in consideration of heat distribution.

3.2 Total Configuration

WEC8050 is composed of the cabinet with 1U size installed on the 482.6 mm wide rack and the functional server operating outside. The external configuration is as shown in the figure below.

Figure 4. WEC8050 Configuration

3.3 Hardware Structure

Hardware is composed of one main board, a power module and two fans.

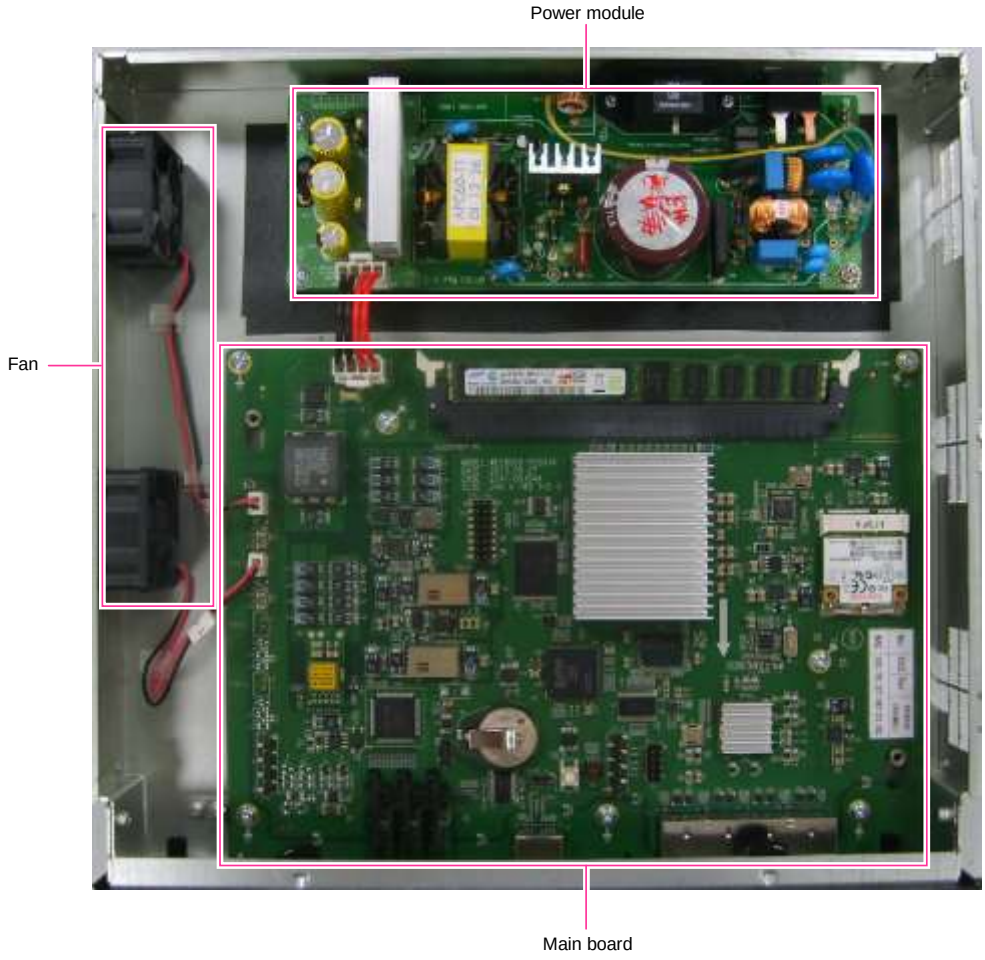

Figure 5. WEC8050 Configuration-Inside

3.3.1 Main Board

The main board of WEC8050 includes the following:

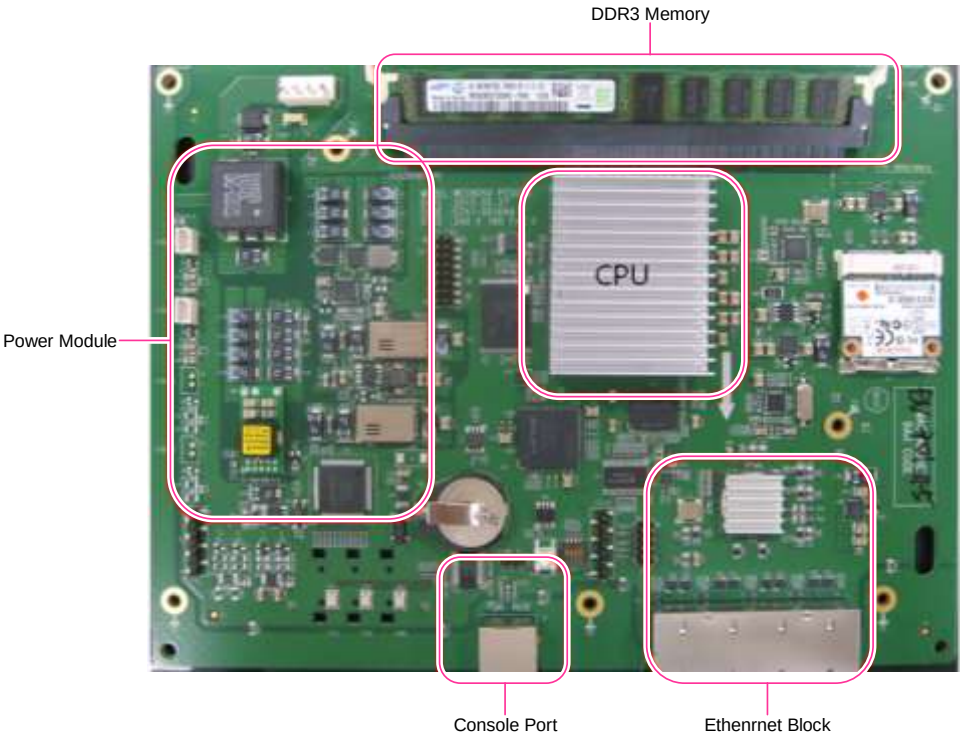

Figure 6. WEC8050 Main Board

Примечание [정1]:

3.3.2 Power Supply

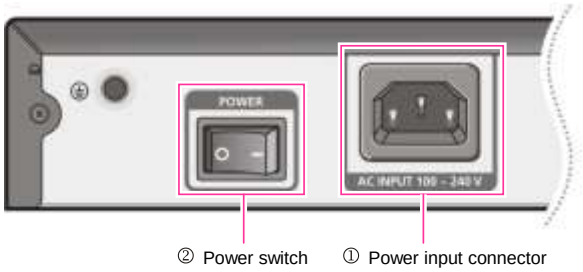

Figure 7. WEC8050 Power Input

Configuration ItemConfiguration Item	Description
① Power input connector	Connector to connect the power cable to
② Power switch	Switch to control the power

3.3.3 Fan

WEC8050 provides two 40 mm built-in fans and has holes for fans on the left side of the product.

Figure 8. WEC8050 Fan Configuration

3.4 External Interface

The external interface is as shown below.

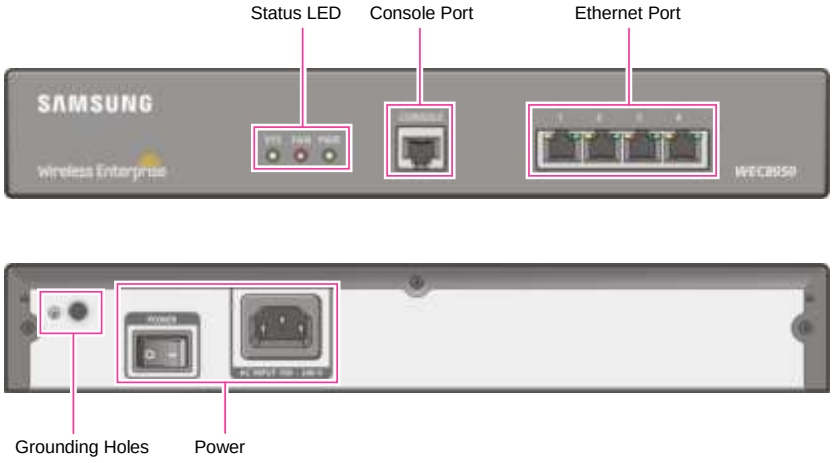

Figure 9. WEC8050 Interface-Front/Back

Status LED

The system LED that indicates various conditions of the system is provided. The following information is displayed by LED.

Figure 10. System Status LED Configuration

LED	Status	Description
SYS	Green on	The system is normally operating.
	Orange on	The system is booting.
	Red on	The system is ready for booting.
Fan	Green on	The installed fan is normally operating.
	Orange on	The system is booting.
	Red on	Fault occurred to the fan.
PWR	Green on	Thanks to the power supply, it is normally operating.
	Off	The power is off or is not supplied.

Console Port (RS232C)

The console port is provided to check the operating status of WEC8050 and input the CLI. It is connected to the terminal program at the speed of 115 kbps.

Ethernet Port

It provides four 10/100/1000 base-T Ethernet ports.

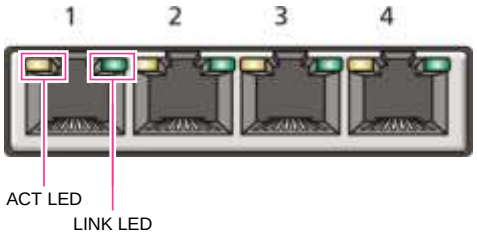

Figure 11. Ethernet Port Configuration

Configuration Item	Status	Description
ACT	Blinking Orange	Transmitting/receiving data
	Off	No transmitting/receiving data
LINK	Green on	LINK connection
	Off	Link disconnection

CHAPTER 4. System Service Scenario

This chapter explains the system building scenario and the using scenario of Samsung WE WLAN and introduces each feature.

4.1 Basic Configuration

To provide the wireless connection service by using the WLAN in the WE environment, WEC8050 is basically required to control WE WLAN AP to allow the terminal to connect to the network wirelessly and control them. In particular, the role of WEC8050 is important to provide a function of quality guarantee and powerful security for various services in the enterprise environment. Besides, the WIPS server, the location server, etc. are required to provide the additional wireless application services. Because the WE environment requires various elements as such, it is necessary to organically and intuitively manage components through the WEM.
In addition, it may provide more convenient and more diverse mobile services for users by interoperating with IP application service servers such as authentication server, DHCP server or DNS server as basic network components included in the wired enterprise environment. As a typical example, there is a FMC service that offers the enterprise-class VoIP through the WLAN, and the wired and wireless integrated voice service there through.

The example of the service configuration by using the WE WLAN system is as shown in the figure below.

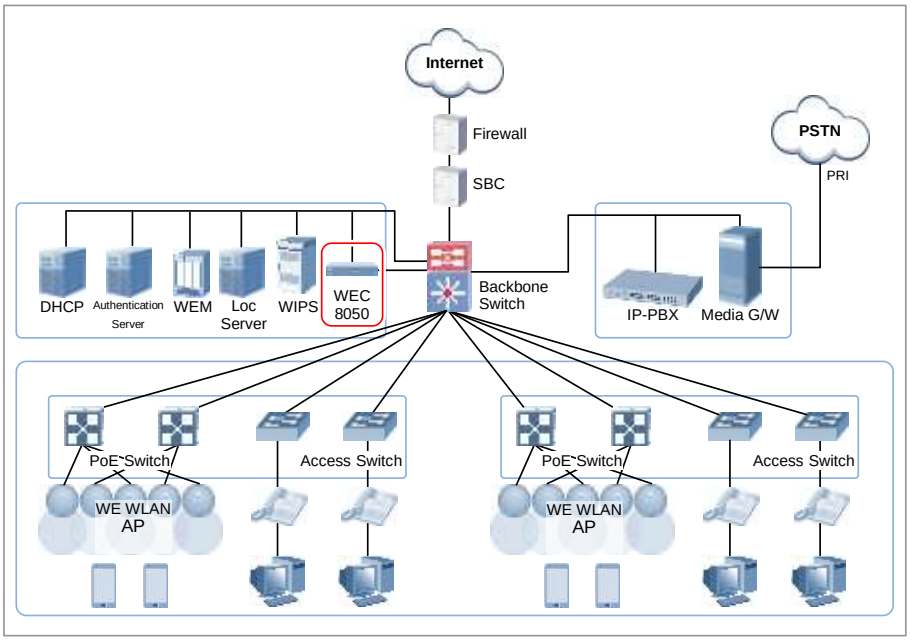

Figure 12. Basic Configuration of WE WLAN System

The basic configuration of the WE WLAN network is the centralized structure tunneling all wireless user traffics between WEC8050 and WE WLAN AP. For the reason, the network information such as the subnet information allotted to wireless users depends on the setting of the backbone network connected to by WEC8050. It provides the following advantages at the configuration and setting of the network.

- Installing WEC8050 is a configuration of adding only WEC8050 in the data center or backbone network conventionally configured. Therefore, it may reduce the possibility of physical change in the core network.
  Besides, it is easy to design the separated wired and wireless networks with the boundary of WEC8050.
- It does not significantly change the network to install the WE WLAN AP. The AP installed in the user space is located to the various local network environments in the wide region. The new establishment or increased installation of the PoE switch will be inevitable, but the change in the local network configured already for the wired line user can be minimized.
- Because WEC8050 relays the traffic of all users, it may restrict the influence by wireless line invader and it is easy to provide the differentiated service by user.

4.2 Multiple Configuration of WEC8050s for Redundancy

The role of WEC8050 is very important to provide a function of quality guarantee and powerful security for various services in the WE environment. Accordingly, it is essential to secure the stability of the wireless network service to configure WEC8050 to complement.
The example of the service configuration is as shown in the figure below.

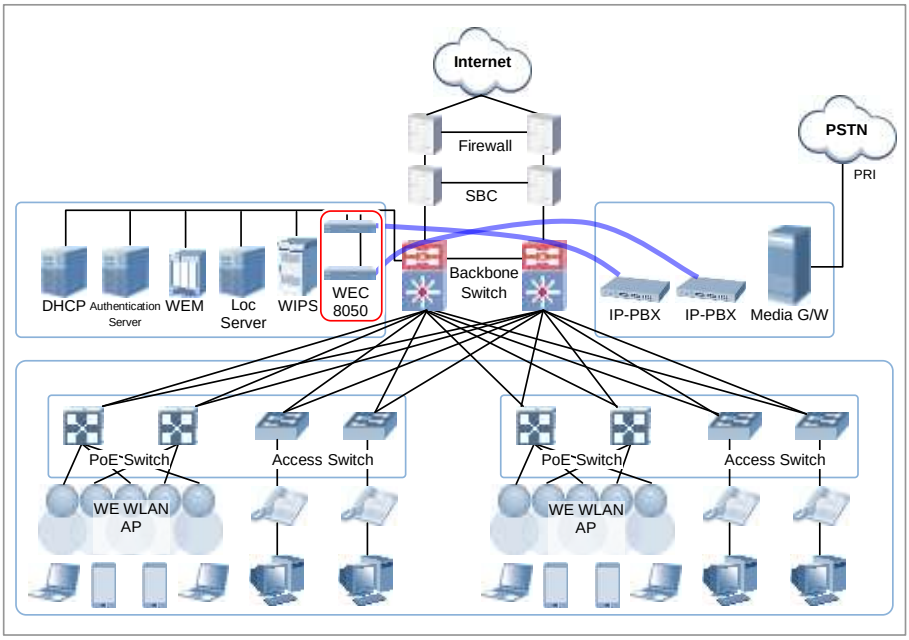

Figure 13. Example of Configuration of WE WLAN System to Provide Redundancy

This method uses several WEC8050s to minimize the service suspension and service consistency due to the disconnection of WEC8050.
Basically, for APC redundancy, one or more WEC8050s must be installed in a same site. The method for configuring redundancy by using this can be largely divided into active-active, active-standby, and many-to-one configuration and it is possible to select which configuration will be used depending on the quantity of the available WEC8050s and the redundancy level.

4.3 Clustering Configuration by Multiple WEC8050s

The WE environment has various region sizes, user density, and number of users. If it is possible to service only basically with one WEC8050, it is possible to completely make the management in one WEC8050 and the complexity is not high in the aspect of network setting or management. In case of the acceptable capacity of one WEC8050, the service must be made through several APCs. To implement the WE network in the environment where multiple WEC8050s are installed, the integrated management system and the user service must be provided through the clustering configuration among WEC8050s.
This allows the inter APC handover. By sharing mutual information through periodic information exchange among WEC8050s configured as inter-clusters, it provides the service like a single WEC8050. When several WEC8050s are installed in one same site, two methods are available: distribution and centralization.

Inter APC handover

The inter APC handover is a handover between APCs. It provides a function by using the clustering group, which means a virtual region. It is possible to tie up to 6 WEC8050s in one group. The APC included in a specific group cannot be put in any other group. It provides the L3 handover and a handover at the move to an APC with a different subnet. The serving APC is called anchor APC, and the target APC is named a foreign APC. In the tunnel for control path and data traffic between APCs, its security is provided through IPSec. The inter APC handover provides a function both to a standard Wi-Fi handover and Samsung NC handover.

4.3.1 Configuration of Clustering Service in Distribution Type

The configuration of the cluster in a distribution type means a method for installing each WEC8050 respectively by building or local site depending on the capacity. If there is no backbone configuration integrated in the site or the network is separated by building, it may be selected and it is proper for the site made of several buildings locally far away. If the seamless handover among WEC8050s is unnecessary or there is few handover, it is favorable to configure in a separation shape for the performance of the wireless network. The example of the service configuration is as shown in the figure below.

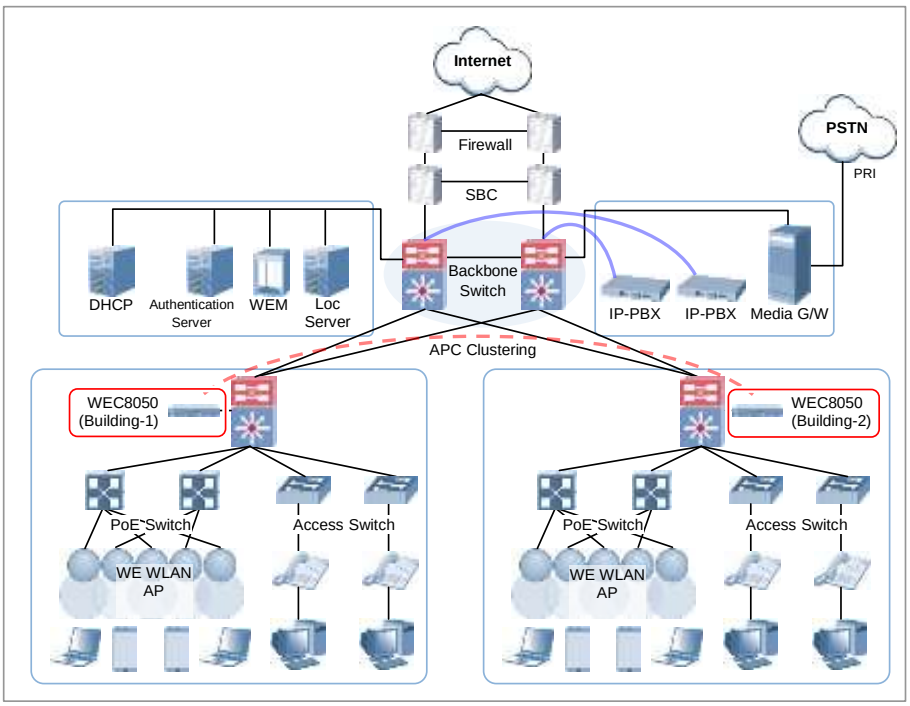

Figure 14. Example of Configuration of WE WLAN System for Clustering Service in Distribution Type

4.3.2 Configuration of Clustering Service in Centralization Type

The cluster configuration in a centralization type is a method for collecting and installing all WEC8050s in the site and if all networks in the site are configured in the center of backbone in the site, this may be selected.
This configuration is appropriate in a site consisting of several buildings that are locally neighboring or a large building with one or more WEC8050s required for seamless handover services. If there is only one backbone network, it is a structure preferred even in the installation or management aspects thanks to the simple service configuration and favorably secured performance.
The example of the service configuration is as shown in the figure below.

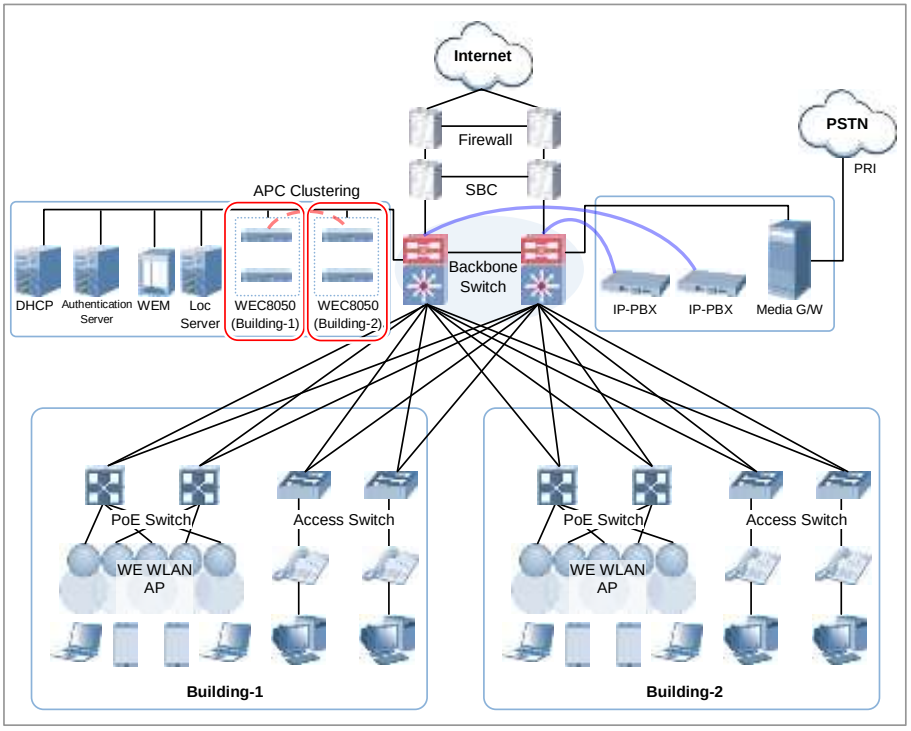

Figure 15. Example of Configuration of WE WLAN System for Clustering Service in Centralization Type

4.4 Configuration of Multiple Sites with HQ and Branches

In the WE WLAN network configuration, there are many cases consisting of one headquarter and several branches.
In the case, the methods for configuring the network are divided into two ways:

- Hierarchical method: Installing WEC8050s not only in the headquarter but also in the branches
- Remote AP method: Installing a WEC8050 only in the HQ and only WE WLAN APs in branches

The hierarchical method has an advantage that a different policy by branch may be applied, but it has a problem that many WEC8050s with complicated management in the center and a low capacity must be installed.
Therefore, the remote AP method is mainly used. In the case, what is different from the structure such as the configuration of the basic WE WLAN is only that the WE WLAN AP installed in each branch is in the remote place.
It has the advantages that it is easy for the WEC8050 in the HQ to manage all WE WLAN APs under the same policy and it is low-cost.
The example of the service in the remote AP method is as shown in the figure below.

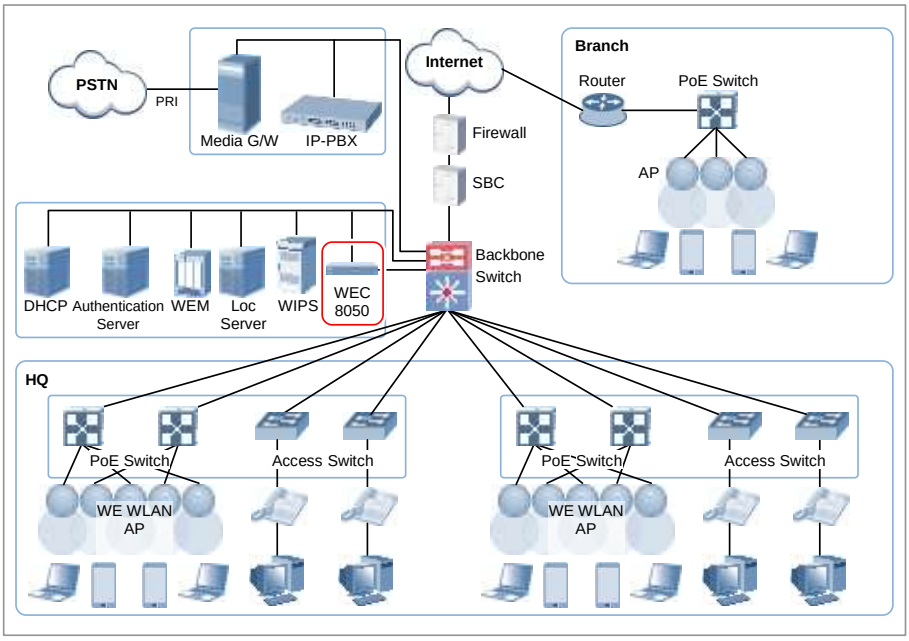

Figure 16. Example of Configuration of WE WLAN System for Multiple Sites Composed of HQ and Branches

The WEC8050 installed in the HQ provides the WLAN service in the building of HQ and if there is a branch, the WLAN service will be provided for the remote WE WLAN AP installed in the branches.
In general, because a branch has few members, there are fewer APs to be installed by branch, but if there are many branches, the total quantity will be increased and the branches may be far away locally from the HQ. When the user traffic is focused to the WEC8050 in a centralization method, it is difficult to secure the performance due to the delay of the network arising from the packet transmitting time. Accordingly, in case of the configuration of the HQ and branches, it is configured to perform different operations depending on the location of the WE WLAN AP.
In other words, the local WE WLAN AP installed in the HQ tunnels the traffic to WEC8050 but the remote AP installed in branches is allowed to switch directly to the destination's address instead of tunneling the user traffic to WEC8050. Even at the time, all WE WLAN APs and user management are made through WEC8050 of the HQ.

CHAPTER 5. Additional Equipment and Tool of WE WLAN System

This chapter explains the additional equipment and tool to operate the WE WLAN system.

5.1 WE AP

The current WE AP is provided in two models: 300 Series and 400 Series.

- WEA300 Series: WEA302i/312i/303i/313i/303e
- WEA400 Series: WEA403i/412i

5.1.1 Product Overview and Key Functions

The WEA300 Series and WEA400 Series are APs for Samsung Wireless Enterprise (WE) wireless LAN. The WEA300 Series supports the IEEE802.11a/b/g/n and the WEA400 Series supports the IEEE 802.11a/b/g/n/ac. They connect a device that supports wireless LAN such as a smart phone, tablet PC, or notebook to a wired network. The WE AP supports the 2 × 2 or 3 × 3 Multiple Input Multiple Output (MIMO) for each model.

Depending on hardware characteristics, the WEA300 Series AP differs as follows:

- The WEA302i/312i has built-in antenna and supports 2 × 2 stream.
- The WEA303i/313i has built-in antenna and supports 3 × 3 stream.
- The WEA303e has external antenna and supports 3 × 3 stream.

Depending on hardware characteristics, the WEA400 Series AP differs as follows:

- The WEA412i has built-in antenna and supports 2 × 2 stream.
- The WEA403i/413i have built-in antenna and supports 3 × 3 stream.
- The WEA403e supports 3 × 3 stream in an external antenna type.
- The WEA453e as an outdoor model supports 3 × 3 stream in an external antenna type.

The WE AP has additional antenna to support multi-antenna.
The WE AP provides a 1 Gbps UTP Ethernet interface and console port to connect to a wired network. The WEA400 Series provides an additional 1 Gbps UTP Ethernet interface. The power is provided through the Ethernet cable to the PoE and an external power adaptor (12 V/2 A) can be used optionally. Also, there is an LED that can indicates operational status.

The WE APs have the following characteristics:

802.11a/b/g/n Standard Support-WEA300 Series

The WEA300 Series supports the standard functions of the 802.11a/b/g/n which is the wireless LAN specification. The 802.11n provides higher bandwidth for data and voice/video services. The WEA300 Series supports the MIMO for multipath transmission/reception and can set the 40 MHz bandwidth using channel bonding. Also, packet aggregation and block ACL function are provided for improving MAC efficiency.

802.11a/b/g/n/ac Standard Support-WEA400 Series

The WEA400 Series supports the 802.11ac function alongside the 802.11a/b/g/n standard which is the existing wireless LAN specification. The 802.11ac provides higher bandwidth than the existing 11n. The WEA400 Series supports the MIMO for multipath transmission/reception and can set the 80 MHz bandwidth using channel bonding. Also, packet aggregation and block ACL function are provided for improving MAC efficiency.

Dual Radio Support

To support the 2.4 GHz and 5 GHz wireless services at the same time, it has two WLAN modules.

Multiple Antenna Support

For TX/Rx per stream, it is possible to select either of two physical antennas.
By configuring the antenna combination through the paths, it provides the optimal wireless service.

RF Monitoring Support

Other than the WLAN modules for user services, the WLAN sensor modules for monitoring the wireless environment are additionally built. The module provides the functions of monitoring the wireless environment and detecting interference to detect illegal APs, manage RF, and trace the paths. WEA302i performs a function of monitoring the independent wireless environment instead of giving hindrance to the function or performance of the WLAN under the service.

Supporting the CAPWAP Standard

As a standard protocol for controlling and provisioning WE WLAN APs and WEC8050s, it performs various control functions for the 802.11 WLAN.

Radio Functions

The following radio-related functions are performed:

- Creating and deleting the radio interface
- Allotting a channel
- Setting the basic rate and the supported rate
- Setting Modulation and Coding Scheme (MCS)
- Setting the transmit power
- Packet aggregation
- Supporting 2 and 3 stream terminals by configuration
- Setting channel bonding (20 MHz, 40 MHz) for the 802.11n mode
- Short guard interval (GI) of PHY
- Regulatory domain support by country

WLAN Functions

The following WLAN functions are performed:

- Creating and deleting WLAN (VAP)
- Hidden SSID
- Release of connection of a specific terminal through the de-authentication messages
- Fragmentation and defragmentation of the WLAN frame
- Setting the RTS threshold value

Voice-Aware Traffic Scheduling (VATS)

VATS, as a technology of controlling the WLAN traffic in consideration of the characteristics of the voice traffic, provides Samsung’s indigenous VATS to allow more VoIP call services in the WLAN environment.

NC Handover

WE AP provides NC handover as Samsung’s unique function to minimize the disconnection of the communication at the transfer between cells. NC handover delivers commands such as the handover time, WE WLAN AP to transfer, channel, etc. to the wireless terminals from the WE WLAN AP and WEC8050 and causes the terminal to be handed over.
Because this provides the handover conditions in the optimal method, Samsung WE WLAN solution may apparently improve problems such as the call drop that might occur at a shadow area or during moving when a VoIP network is configured.

Samsung Downlink Scheduler (SDS) Support

WE AP defines four access categories depending on each service class by supporting the 802.11e standard and transmits the data in order of higher priorities. Without any separate scheduling, it is processed in a First-in and First-out (FIFO) method by an allotted queue by access category. Besides, to provide the priority service to multiple terminals, it provides the best service fit for the service class by supporting the admission control, queuing by terminal, and fairness services, etc.

Virtual Access Point (VAP)

VAP is a virtual network interface that provides the actual WLAN service. WE AP provides two radio interfaces (5 GHz, 2.4 GHz) and may create up to 16 VAPs by radio interface.

Beacon Generation

WE AP must create and transmit a beacon frame at an accurate cycle at the set beacon interval. Receiving the beacon transmitted by the fixed cycle, the wireless terminals connected to WE AP check the status of WE AP and view whether they have data delivered to themselves.

Repeater Service

When an AP is installed for the WLAN service, a shadow area may occur. There is a place where the Ethernet (802.3) interface among the shadow areas cannot be installed, but it may provide a wireless service by using the Wireless Distribution Service (WDS).
WE AP supports the repeater service that changes the general WDS to process the CAPWAP data and manage the configuration of WEC8050. The operating mode to support the repeater service is as follows:

Operating ModeOperating Mode	Function
Root AP	- Provides VAP to which the repeater AP can access. - Local bridge for the user data received from the repeater AP
Repeater AP	- Connects to the root AP (Station Mode) - Possible to transmit the user data of the wireless terminal accessing the AP to the root AP.

Spectrum Analysis

Spectrum analysis is a service to measure the interference of non-082.11 devices including a wireless phone for households or wirelessly connected camera. By analyzing wireless and RF signals in real time, it helps to solve interference problems.

Managing Function

It performs various diagnoses, faults, and statistical data for WE AP and, if necessary, carries out the role in reporting to WEC8050 by collecting the data.

5.1.2 Product Specifications

5.1.2.1 Product Specifications

WEA300 Series

Item	WEA302i	WEA312i	WEA303i	WEA313i	WEA303e
Dimensions (mm)	174 (H) × 174 (W) × 34.1 (D)				
Weight (g)	560	540	640	620	650
System memory	256 MB				
Booting ROM	128 MB				
Power supply	AC/DC 12 V/2 A adaptor supporting PoE (optional)				
WLAN I/F	IEEE802.11a/b/g/n (supporting 2.4 GHz and 5 GHz simultaneously)				
Operating temperature	0 to 45°C (32 to 113°F)				
Operating humidity	5 to 95 %, non-condensable				

WEA400 Series

Item	WEA412i	WEA413i	WEA403i	WEA403e	WEA453e
Dimensions (mm)	205 (H) × 205 (W) × 45 (D)				267 × 184 × 57.5
Weight (g)	790	840	860	870	2,600
System memory	256 MB				
Booting ROM	128 MB				
Power supply	- PoE supported - AC/DC 48V/0.75 A adaptor (optional)				
WLAN I/F	IEEE802.11a/b/g/n/ac (supporting 2.4 GHz and 5 GHz simultaneously)				
Operating temperature	0 to 45°C (32 to 113°F)				-
Operating humidity	5 to 95 %, non-condensable				-

5.1.2.2 Capacity

WEA300 Series

Item	WEA302i/WEA312i	WEA303i/WEA313i	WEA303e
Capacity	- 2.4 GHz: 144 Mbps @ 20 MHz, 2 SS, Short GI - 5 GHz: 300 Mbps @ 40 MHz, 2 SS, Short GI	- 2.4 GHz: 214 Mbps @ 20 MHz, 3 SS, Short GI - 5 GHz: 450 Mbps @ 40 MHz, 3 SS, Short GI	

WEA400 Series

Item	WEA412i	WEA403i
Capacity	- 2.4 GHz: 144 Mbps @ 20 MHz, 2 SS, Short GI - 5 GHz: 867 Mbps @ 80 MHz, 2 SS, Short GI	- 2.4 GHz: 214 Mbps @ 20 MHz, 3 SS, Short GI - 5 GHz: 1300 Mbps @ 80 MHz, 3 SS, Short GI

5.1.2.3 Electrical Specifications

LAN Signal Specification

[10 BASE-T]

Item	Specifications
Transfer rate	10 Mbits/s ± 50 ppm
Transmission code	Manchester coding
Standard specifications	IEEE 802.3
Access control method	CSMA/CD
Transmission media	UTP (Unshielded Twisted Pair) CAT3, CAT4, CAT5, STP (Shielded Twisted Pair)
Number of UTP pairs	2 pairs
Characteristic resistance	100 Ω
Cable thickness	Diameter: 0.51 mm (24 AWG), outer diameter: 5 mm

[100 BASE-TX]

Item	Specifications
Transfer rate	100 Mbits/s ± 50 ppm
Transmission code	4B/5B + MLT-3
Standard specifications	IEEE 802.3u
Access control method	CSMA/CD

Item	Specifications
Transmission media	UTP CAT5, STP
Number of UTP pairs	2 pairs
Characteristic resistance	100 Ω
Cable thickness	Diameter: 0.51 mm (24 AWG), outer diameter: 6 mm

[1000 BASE-TX]

Item	Specifications
Transfer rate	1000 Mbits/s
Transmission code	8B1Q4
Standard specifications	IEEE 802.3ab
Access control method	CSMA/CD
Transmission media	UTP CAT5 (maximum transmission distance: 100 m)
Number of UTP pairs	4 pairs
Characteristic resistance	100 Ω
Cable thickness	Diameter: 0.51 mm (24 AWG), outer diameter: 6 mm

WLAN Signal Specification

[802.11a]

Item	Specifications
Wireless connection type	CSMA/CA
Frequency	5.15~5.825 GHz ISM band
Channel transmission output	20 dBm
Reception sensitivity	- At the 54 Mbps Mode, -79 dBm or less - At the 6 Mbps Mode, -93 dBm or less
Standard specifications	IEEE 802.11a

[802.11b]

Item	Specifications
Wireless connection type	CSMA/CA
Frequency	2.412~2.483 GHz ISM band
Channel transmission output	20 dBm
Reception sensitivity	At the 11 Mbps Mode, -89 dBm or less

Item	Specifications
Standard specifications	IEEE 802.11b

[802.11g]

Item	Specifications
Wireless connection type	CSMA/CA
Frequency	2.412~2.483 GHz ISM band
Channel transmission output	20 dBm
Reception sensitivity	- At the 54 Mbps Mode, -78 dBm or less - At the 6 Mbps Mode, -92 dBm or less
Standard specifications	IEEE 802.11g

[802.11n]

Item	WEA302i/WEA301	WEA303i	WEA303e
Wireless connection type	CSMA/CA		
Frequency	- g/n: 2.412~2.483 GHz ISM band - a/n: 5.150~5.825 GHz ISM band		
Channel transmission output	20 dBm		
Reception sensitivity	- MCS0 (802.11g/n): -92 dBm or less - MCS7 (802.11g/n): -74 dBm or less - MCS0 (802.11a/n): -93 dBm or less - MCS7 (802.11a/n): -75 dBm or less		
No. of supporting channels	- 20 MHz bandwidth: 13 - 40 MHz bandwidth: 9		
Antenna	2Tx2R MIMO supported	3Tx3R MIMO supported	
Standard specifications	IEEE 802.11n		

[802.11ac]-WEA400 Series

Item	Specifications
Wireless connection type	CSMA/CA
Frequency	AC: 5.150 to 5.825 GHz ISM band
Channel transmission output	23 dBm
Receiving sensitivity	- MCS8 (802.11ac, VHT20): -65 dBm or less - MCS8 (802.11ac, VHT40): -63 dBm or less

Item	Specifications
	- MCS9 (802.11ac, VHT40): -61 dBm or less - MCS8 (802.11ac, VHT80): -60 dBm or less - MCS9 (802.11ac, VHT80): -58 dBm or less
Standard specifications	IEEE 802.11ac

5.1.2.4 Power Specification

The WE AP is operated with PoE input power. The WE AP receives -48 to 57 V from the PoE Switch (PSE) and supports the PoE specifications listed below. Optional AC/DC adaptor can be used.

- WEA300 Series PoE supporting specification: IEEE 802.3af
- WEA300 Series AD/DC adaptor supporting specification: 12 V/2 A
- WEA400 Series PoE supporting specification: IEEE 802.3at
- WEA400 Series AD/DC adaptor supporting specification: 48 V/0.75 A

5.1.3 Hardware

5.1.3.1 Features

The hardware of WE AP has the following features:

Safety

The materials and parts used in the hardware are mechanically robust and satisfy mechanical and electrical characteristics required for the telecommunication system.

- The device structure is a stabilized and robust structure of the die casting or press assembly by complying with the industrial standards.
- It does not generate toxic or corrosive gases that may give harm to the human body or give influence over the system operation.
- It was made of the materials considering the EMI specifications.
- To prevent the device from being damaged due to overvoltage, it has a safety device.

Power Structure

The power supply device of the hardware accepts two structures.

- The power supply is made in the PoE method through the Ethernet.
- If it is difficult to use PoE, it is possible to use the external 220 V power and the external AC/DC adaptor to supply the power.

Maintenance

It is designed to safely perform the maintenance activities.

- The device structure is designed to maintain the enough strength. Each port connected to the outside is firmly protected as a device structure to make it difficult for a user other than the operator or the staff at the installation to the ceiling or wall to remove freely.
- There is a LED to help the operator to identify the fault status of the system easily.
- The electronic devices are designed not to be damaged by the external environment during installation or maintenance.

Fire Resistance and Exothermal Process

The fire-resistant materials and parts are used against fire. In addition, it is designed to prevent heat generated from the inside of the system from being influenced over the performance.

- The special heating part in the hardware is blocked not to give any influence over the component parts sensitive to temperature.
- The parts installed to the module are placed in consideration of heat distribution.

5.1.3.2 Total Configuration

The WE AP product is composed of the front part where there are a LED and internal and external antennas and the rear part where various ports and interfaces exist.

WE AP Front

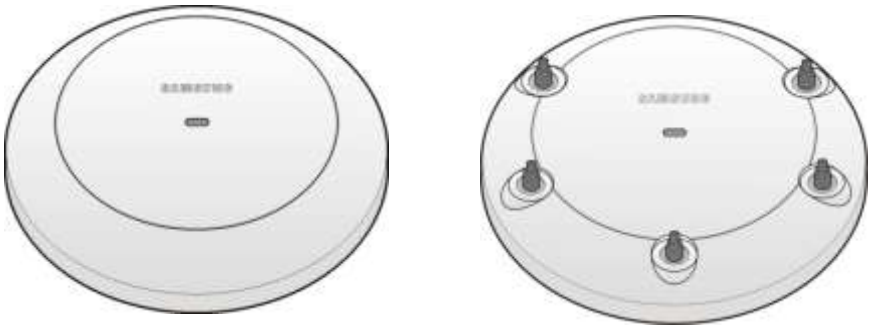

Figure 17. WE AP Front

Outdoor AP Front

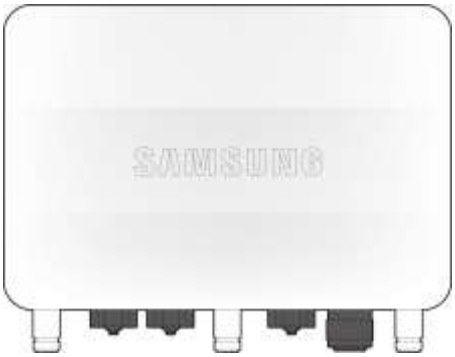

Figure 18. Outdoor AP Front

WEA 300 Series Rear

Figure 19. WEA 300 Series Rear

WEA 400 Series Rear

Figure 20. WEA 400 Series Rear

Outdoor AP Rear

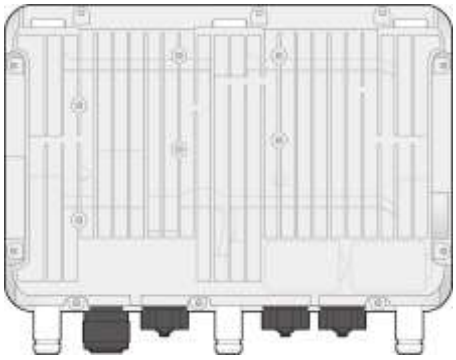

Figure 21. Outdoor AP Rear

5.1.3.3 Hardware Structure

The WE AP is composed of a digital unit (DU) part and a radio unit (RU) part in the functional aspect and it is implemented in one board type in the hardware aspect.

DU Part

The DU part has a main CPU that controls the whole WE AP and does a role in recognizing the RU part and managing the download of the software. With the PoE function, it causes the -48 V power supplied through the Ethernet connected to the outside to be converted and then be used as the power supply for the DU part and the RU part.

RU Part

The RU part is controlled by the DU part. The RU part has 2.4 GHz and 5 GHz WLAN blocks for general service. For the 2.4/5 GHz bandwidth, the RU part includes an RF monitoring function that supports 2 × 2, 3 × 3 IEEE 802.11a/b/g/n/ac. (Supporting specifications vary by model.)
The RU part of WE AP supports two TX/RX radio structures and three TX/RX radio structures with 2.4 GHz and 5 GHz depending on the HW configuration and also supports each of 2 × 2 and 3 × 3 MIMO.

5.1.3.4 External Interface

The external interface is as shown below.

WE AP Front

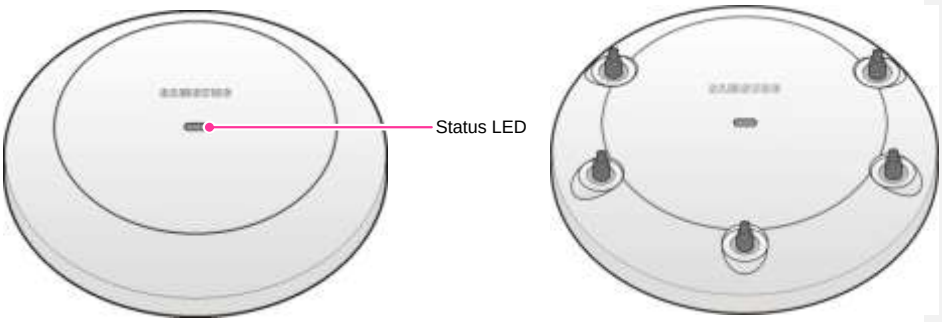

Figure 22. Front configuration of WE AP

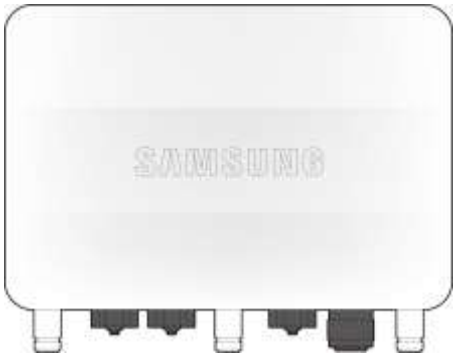

Figure 23. WE AP Front

WEA300 Series Rear

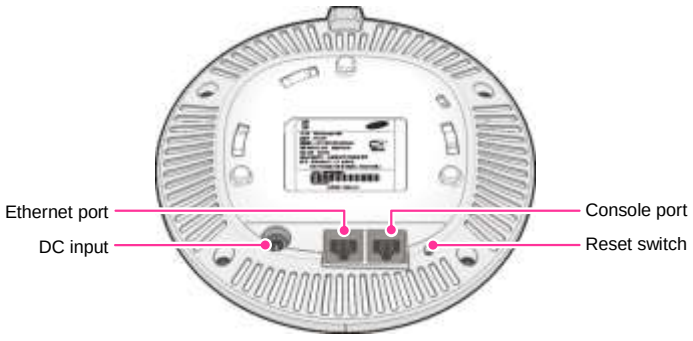

Figure 24. WEA300 Series Interface

WEA400 Series Rear

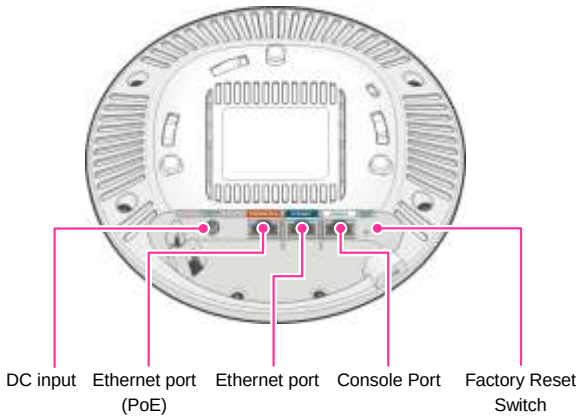

Figure 25. WEA400 Series Interface

Status LED

Category	LED State	Description
System starting status	Blue On	- Initial LED mode - Device initialization and testing
	Red On	Failure in booting (failure in device initialization)
Provisioning status	Red and Green Off in Turn	WEC8050 server connection in progress (Normal status of network link)
	Green Blinking	CAPWAP link connecting (Normal connection status of WEC8050 server)
Normal operating status	Green On	When there is no wireless terminal connected
	Blue On	When there is a wireless terminal connected
Upgrade	Blue Blinking	Software upgrade in progress
Fault status	Red Blinking	Abnormal network link (after disconnection or reconnection, the status of checking the link)
	Yellow Blinking	A collision of IP address occurring
	Violet Blinking	Failure in allocating dynamic IP address
	Green Blinking	Failure in checking the fixed IP
	Red and Blue Off in turn	Status of fault of wireless interface

External Interface for Outdoor AP

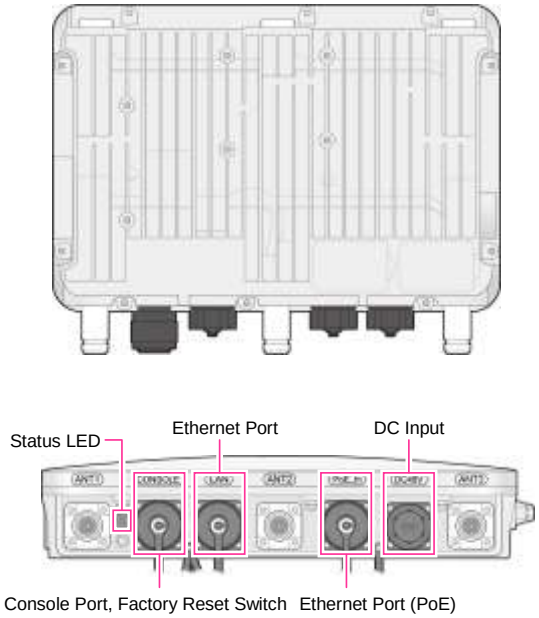

Figure 26. Interface for Outdoor AP

Status LED

Category	LED State	Description
System starting status	Blue On	- Initial LED mode - Device initialization and testing
	Red On	Failure in booting (failure in device initialization)
Provisioning status	Red and Green Off in Turn	WEC8500 server connection in progress (Normal status of network link)
	Green Blinking	Connecting CAPWAP link (WEC8500 server normal connection status)
Normal operating status	Green On	When there is no wireless terminal connected
	Blue On	When there is a wireless terminal connected
Upgrade	Blue Blinking	Software upgrade in progress
Fault status	Red Blinking	Abnormal network link (after disconnection or reconnection, the status of checking the link)
	Yellow Blinking	A collision of IP address occurring
	Violet Blinking	Failure in allocating dynamic IP address
	Green Blinking	Failure in checking the fixed IP
	Red and Blue Off in turn	Status of fault of wireless interface

Reset Switch

The reset switch can restart the WE AP externally to the WEA300 Series.

Factory Reset Switch

This switch can factory reset the WE AP externally to the WEA400 Series.

Console Port (RS232C)

A managing port that allows the operator of the WEA300/WEA400 Series to check and control the status of the WE AP.

Ethernet Port (with PoE)

The WEA300 Series supports the 1000 BASE-T Gigabit Ethernet and PoE IEEE 802.3af.
The WEA400 Series supports the 1000 BASE-T Gigabit Ethernet and PoE IEEE 802.3at.

Ethernet Port (without PoE)

The WEA400 Series supports the additional 1000 BASE-T Gigabit Ethernet 1 Port (for data only).

DC Input

It is a jack for optional DC power supply.
The WEA300 Series supports DC 12 V/2 A power supply as an external option.
The WEA400 Series supports DC 48 V/0.75 A power supply as an external option.

5.2 WEM

As a tool for managing multiple WEC8050s and WE WLAN APs that construct the WLAN, WEM provides the functions of configuration management, fault management, security management, performance management and WLAN performance detection through the web-based GUI.

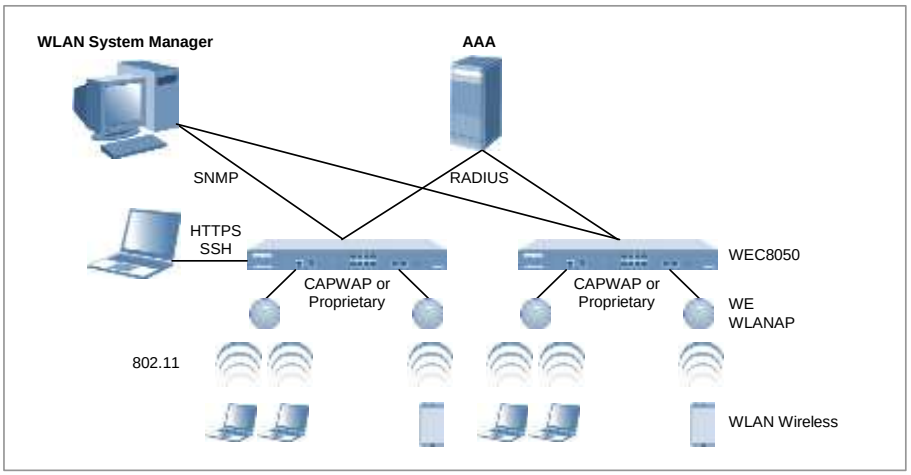

Figure 27. WEM Configuration

The functions provided by the WEM are given below.

General Management

It provides the function of managing the information on the performance and fault of the WEM server. It is composed of process monitoring, resource monitoring, self server diagnosis, monitoring of each network component, database management, and scheduling activity management.

Security management

It provides account management and user access history as functions of account and password management required for the access to the WEM.

Fault management

It expresses the information on various faults of WEC8050s and WE WLAN APs in progress and delivers it to various types to the operator. It is composed of real time fault monitoring, fault history management and statistics of faults.

Performance Management

As a function of managing the performance of WEC8050 and WE WLAN AP in operation, it has the function of collecting and making database the actual documents and creating reports by monitoring in real time and making the past data statistical.

Configuration Management

As a function of managing the information on the configuration of the system, the operator may see the current setting and configuration information of each device without directly connecting to such device. It is composed of system registration, individual setting, template setting, viewing the current setting status, and firmware management.

RF Map

It is a function of managing the current status of WE WLAN APs by area, building and floor through the map.
It is configured as a function of confirming the map configuration through the addition or deletion of the WE WLAN AP, the current location information of WE WLAN AP and wireless terminals and the strength of the signal by location.

WLAN Monitoring

As a function of monitoring the present status of WLAN services, it is composed of WIDS for illegal AP management, interference monitoring, configuration of dashboard, and performance index monitoring.

Troubleshooting

The following functions are provided to analyze the cause if a fault occurs:

- Spectrum analysis: Measures interference from the non-Wi-Fi device in the WE environment.
  By analyzing wireless and RF signals in real time, it provides information to rapidly solve the problem by checking the cause of the interference.
- VQM: It identifies the cause easily when a fault occurs by collecting and managing the call quality information (MOS, Jitter, Delay).
- Packet capture: The problem is possible to identify by checking the packet when the fault occurs because all packets can be captured by interface, port and protocol.

ABBREVIATION

A

AAA	Authentication Authorization Accounting
ACL	Access Control List
AES	Advanced Encryption Standard
AP	Access Point
APC	Access Point Controller

B

BSS	Base Station System

C

CAC	Call Admission Control
CAPWAP	Control And Provisioning Wireless Access Point
CCK	Complementary Code Keying
CCM	Counter mode encryption with CBC-MAC
CCMP	Counter mode encryption with CBC-MAC Protocol
CCTV Closed	Circuit Television
CLI	Command Line Interpreter
CPU	Central Processing Unit
CRM	Customer Relationship Management
CSMA/CD	Carrier Sense Multiple Access/Collision Detect
CVO	Controlled Voice Optimization

D

DDR	Double Date Rate
DDR3	Double Data Rate Type 3
DHCP	Dynamic Host Configuration Protocol
DMZ	DeMilitarized Zone
DNS	Domain Name System
DSCP	Differentiated Services Code Point
DSSS	Direct-Sequence Spread Spectrum
DTLS	Datagram Transmission Layer Security
DU	Digital Unit

E

EAP	Extensible Authentication Protocol
EDCA	Enhanced Distributed Channel Access
EMI	Electro-Magnetic Interference
ERP	Enterprise Resource Planning

F

FFA	Field Force Automation
FFT	Fast Fourier Transform
FIFO	First-In-First-Out
FMC	Fixed Mobile Convergence
FTP	File Transfer Protocol

G

GbE	Giga Bit Ethernet
GI	Guard Interval
GUI	Graphic User Interface

H

HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transfer Protocol over SSL

I

ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPSec	Internet Protocol Security
IV	Initial Vector

L

LACP	Link Aggregation Control Protocol
LAN	Local Area Network
LED	Light Emitting Diode

M

MAC	Medium Access Control
MCS	Modulation and Coding Scheme
MIB	Management Information Base
MIMO	Multiple Input Multiple Output
MLT-3	Multi Level Transmission-3
MOS	Mean Opinion Score
MSTP	Multiple Spanning-Tree Protocol

N

NAT	Network Address Translation
NC	Network Controlled
NMS	Network Management System
NTP	Network Time Protocol

O

OFDM	Orthogonal Frequency Division Multiplex
OKC	Opportunistic Key Caching
OSPF	Open Shortest Path First

P

PBX	Private Branch exchange
PC	Personal Computer
PHY	Physical layer
PIM-SM	Protocol Independent Multicast-Sparse Mode
PoE	Power over Ethernet
PRI	Primary Rate Interface
PSE	Power Sourcing Equipment
PSK	Pre-Shared Key
PSTN	Public Switched Telephone Network
PT	Port Translation

Q

QoS	Quality of Service

R

RADIUS	Remote Authentication Dial-In User Service
RF	Radio Frequency
RIP	Routing Information Protocol
RPM	Revolution Per Minute
RSSI	Received Signal Strength Indication
RSTP	Rapid Spanning Tree Protocol
RTS	Request To Send
RU	Radio Unit

S

SBC	Session Border Controller
SDS	Samsung Downlink Scheduler
SFA	Sales Forces Automation
SFTP	Secure FTP
SSH	Secure Shell

SNMP	Simple Network Management Protocol
SNR	Signal to Noise Ratio
SSD	Solid-State Drive
SSID	Service Set Identifier
STP	Signaling Transfer Point

T

TCP	Transmission Control Protocol
TKIP	Temporal Key Integrity Protocol

U

UC	Unified Communications
UDP	User Datagram Protocol
UI	User Interface
UTP	Unshielded Twisted Pair

V

VAP	Virtual Access Point
VATS	Voice-Aware Traffic Scheduling
VEM	Voice Enhanced Monitoring
VLAN	Virtual Local Area Network
VoIP	Voice over IP
VQM	Voice Quality Monitoring
VRRP	Virtual Router Redundancy Protocol

W

WAN	Wide Area Network
WDS	Wireless Distribution Service
WE	Wireless Enterprise
WEC	Wireless Enterprise Controller
WEM	Wireless Enterprise WLAN Manager
WEP	Wired Equivalent Privacy
Wi-Fi	Wireless Fidelity
WIPS	Wireless Intrusion Prevention System
WLAN	Wireless Local Area Network
WPA	Wi-Fi Protected Access
WPA2	Wi-Fi Protected Access Version 2

WEC8050 (APC)

System Description