TEST REPORT

Tolly.

#219133

August 2019

Commissioned by

Huawei Technologies Co., Ltd.

Huawei WLAN Access Controllers

Application Identification, Smart Roaming, and Easy Operation & Management

EXECUTIVE SUMMARY

With the development of smart devices, more and more applications are running over the wireless network. To improve the security and network resource management, administrators require visible application traffic statistics and application-based control. Huawei WLAN Access Controllers (ACs) provides the Application Identification function to support visible management and control of Layer 4 to 7 network attributes.

In the multi-AP environment, some clients may remain associated to the initially-connected AP even after the clients have moved and the signal has become degraded. Huawei Access Controllers support the Smart Roaming function to assist roaming clients in finding the best available AP for better single-user and overall network performance.

Huawei WLAN Access Controllers provide a built-in Web network management interface to support service deployment, network status monitoring, and problem intelligent diagnosis. Please see Table 3 and 4 on page 14 and 15 for all Tolly verified features.

Huawei Access Controllers - Tolly Certified Highlights

Huawei WLAN Access Controllers (AC6003, AC6005, AC6507S, AC6508, AC6605, AC6800V, AC6805, AirEngine 9700-M, AirEngine 9700S-S appliances, and the ACU2 module for Huawei S7700/S9700/S12700 series switches) support:

Layer 4 to 7 Application Identification

Display the identified applications in the Access Controller's Web interface. Support rate limiting, traffic blocking, or priority increasing actions for each application. Optimize voice and video quality over the wireless network. Provide built-in signatures for more than 6,400 listed applications as well as application signature update support.

Smart Roaming

Support 802.11k and 802.11v protocols. Help clients roam to the best available AP to solve the problems caused by clients with low roaming sensitivity. With 10 moving clients and two APs, Huawei solution's performance varied 15% while Cisco solution's performance dropped 44%.

Easy Web O&M

Support group-based AP configuration as well as single AP personalization. Provide AC/AP/STA performance monitoring and intelligent diagnosis. Support packet capture and spectrum analysis of the wireless network.

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Test Results

Application Identification

Application Identification and Display

Tolly engineers verified that the Huawei WLAN Access Controller (AC) supported application identification. The web management interface displayed the top applications running in the wireless network. See Table 1 for Tolly tested applications.

The Huawei AC provides built-in signatures for more than 6,400 listed applications in categories of P2P, IM, VoIP, Game, Web_Video, Stock, etc. It also supports signature update.

With the NetStream feature, the Access Controller can monitor the network traffic statistics based on applications. The Huawei eSight Unified Network Management application's web interface can then display the statistics for each application.

Tolly engineers verified that the Application Identification feature had minor impact on the wireless performance. One HP laptop was connected to the Huawei AP5030DN with the 2.4GHz band. In the multiple tests with the IxChariot application, the downstream throughput was in the 80Mbps to 87Mbps range with or without the Application Identification feature.

Application-based Policy

With the Application Identification capability, the Huawei WLAN Access Controller supports application-based policies. Tolly engineers verified three actions: limiting the traffic rate, denying the traffic, and increase the traffic priority value. For example, engineers used the application-based policy to deny all Tencent QQ Instant Messenger traffic, limit the P2P download speed, and increase the Voice over IP (VoIP) and video traffic's priority.

Huawei Technologies Co., Ltd.

WLAN Access Controllers

Feature Validation

Tested July 2019

Huawei Application Identification Test Results

Application	Identificatoin by the Huawei WLAN AC
Youtube	✔
Fox News	✔
BBC	✔
Speedtest.net	✔
Instagram	✔
Apple App Store	✔
WebEx	✔
ESPN	✔
Dropbox	✔
WeChat	✔
Weibo	✔
QQ	✔
Taobao	✔
Alipay	✔
Tencent News	✔
QQ File Transfer	✔
Baidu Cloud Storage	✔

Note: ✔ means the web management console displayed the application or website under test in the monitoring page.

Source: Tolly, July 2019

Table 1

Smart Roaming

Traditionally, roaming is controlled by the wireless client side. In a complex multi-AP environment, clients with low roaming sensitivity may not always connect to the best AP available to them. Instead, they may stick to the first connected AP (e.g. the AP at the entrance) even with very poor signal. This affects the wireless network's performance and user experience.

Based on the 802.11k and 802.11v standards, Huawei developed the Smart Roaming feature to assist clients connect to the better AP available.

Tolly engineers used 10 clients (5 Apple MacBook Pro laptops and 5 Samsung Galaxy S4 smartphones) to evaluate roaming performance of multiple clients moving between two APs.

At the beginning of the test, all 10 clients were connected to AP A at the baseline position. Engineers then moved all clients to different roaming positions and evaluated the performance.

With the Huawei solution, all 10 clients roamed to the best available AP in a short time in all tested roaming positions. With the Cisco solution, in each roaming position, there were 2 to 4 clients that remained associated to the distant AP. See Table 2 for the number of clients connected to the best available AP.

With the Huawei solution, the aggregated roaming throughput were always more than 300Mbps and had less than 15% variance from the baseline. With the Cisco solution, the aggregated roaming throughput was 17% to 44% percent less than the baseline depends on the number of clients sticked to the far away AP. See Table 2 for the aggregated throughput and performance drop in each roaming position. See Figure 1 for the test environment.

Multi-client Roaming Test Results
802.11ac, 5GHz, 80MHz Bandwidth, 10 clients Aggregated Throughput
(as reported by IxChariot v7.1)

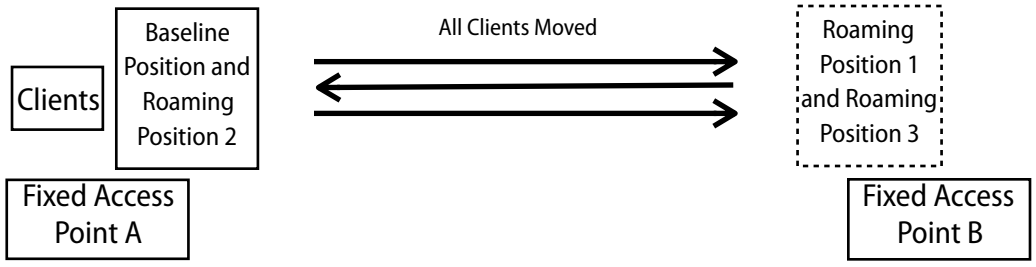
		Baseline	Roaming Position 1	Roaming Position 2	Roaming Position 3
Aggregated Throughput (Mbps) (Higher is better)	**Huawei AP5030DN**	364	315	365	313
	Cisco AIR-CAP2702I-C-K9	236	197	152	133
Performance Drop from the Baseline Position (Closer to 0% is better)	**Huawei AP 5030DN**	0%	-13%	0%	-14%
	Cisco AIR-CAP2702I-C-K9	0%	-17%	-36%	-44%
Number of Clients Connected to the Best Available AP (Higher is better)	**Huawei AP 5030DN**	10	10	10	10
	Cisco AIR-CAP2702I-C-K9	10	8	7	6

Note: Five Apple MacBook Pro with Retina Display laptop and 5 Samsung Galaxy S4 smartphones were used as the clients. The same clients at the same locations were tested for each solution.

Source: Tolly, July 2019

Table 2

WLAN Multi-Client Roaming Test - Test Environment



Notes: 1. All clients (5 Apple MacBook Pro with Retina Display laptop and 5 Samsung Galaxy S5 smartphone) moved from Baseline Position --> Roaming Position 1 --> Roaming Position 2 --> Roaming Position 3. Baseline position and roaming position 2 are at the same location. Roaming position 1 and roaming position 3 are at the same location. At each position, engineers evaluated the aggregated throughput of all 10 clients and recorded the humber of clients connected to each AP.

Source: Tolly, July 2019

Figure 1

Operation and Management (O&M)

Web Interface Configuration

Tolly engineers verified that the Huawei WLAN AC supported group-based AP configuration using the web interface or the Command Line Interface (CLI). So administrators can configure all APs in the same area together.

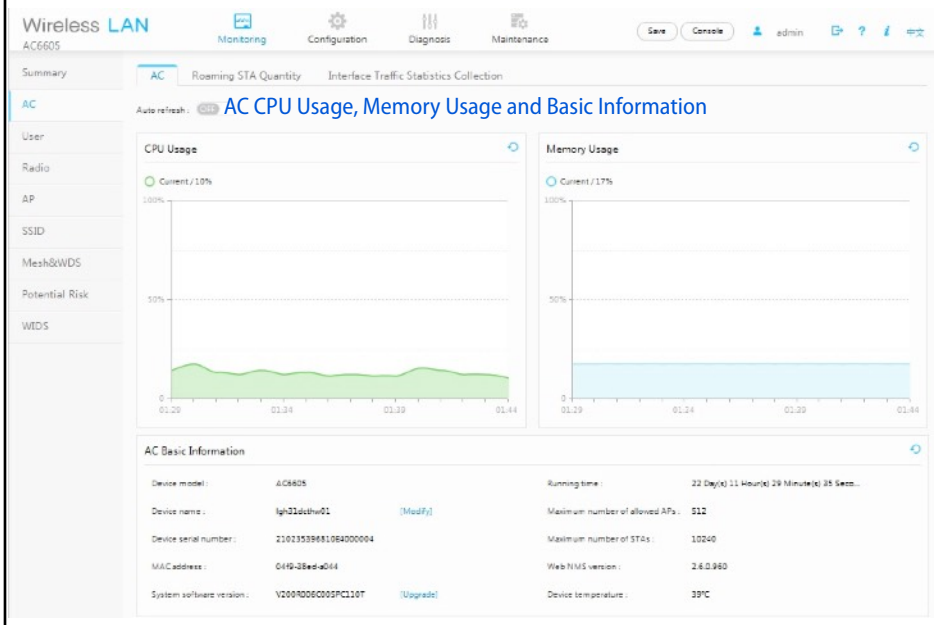
The Huawei WLAN AC provides built-in configuration templates in typical scenarios for fast deployment. It also allows administrators to copy the configuration of one AP group to another and make changes. If administrators prefer personalized configuration for a certain AP, they can specify the personalized configuration which has higher priority than the group configuration.

With the batch loading feature, Tolly engineers used one CSV file with new APs' MAC address, name and group to load the new APs to the AC. When the new APs were physically connected to the network, they were discovered and managed by the AC automatically.

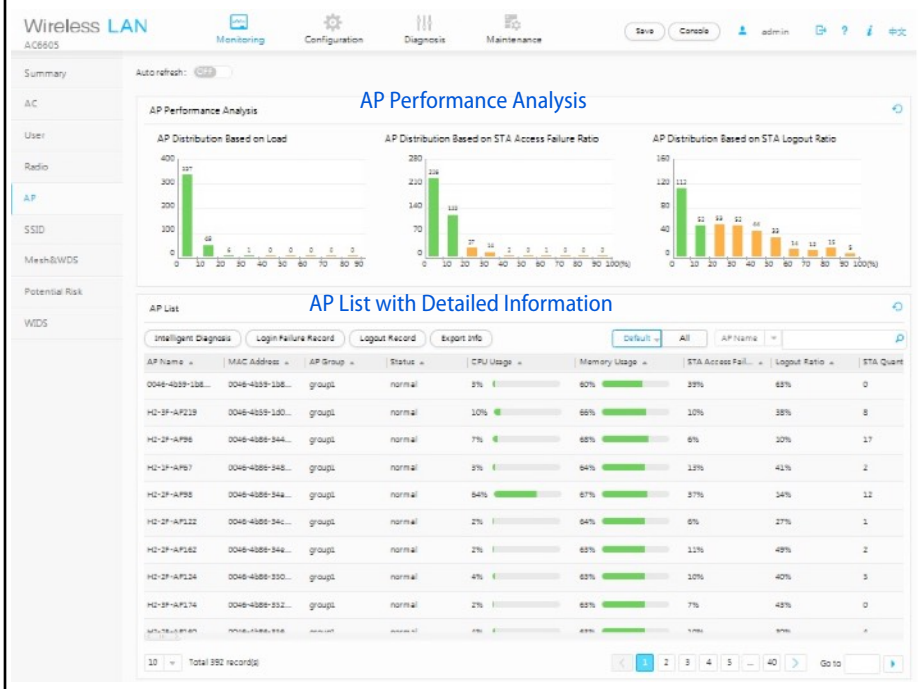
Monitoring

The Huawei WLAN AC's web interface dashboard displays the wireless network performance. It analyzes AC, AP and station (STA)/user performance and monitors the spectrum. See Figures 2, 3 and 4 for the screenshots.

Huawei WLAN AC Web Interface - AC Monitoring



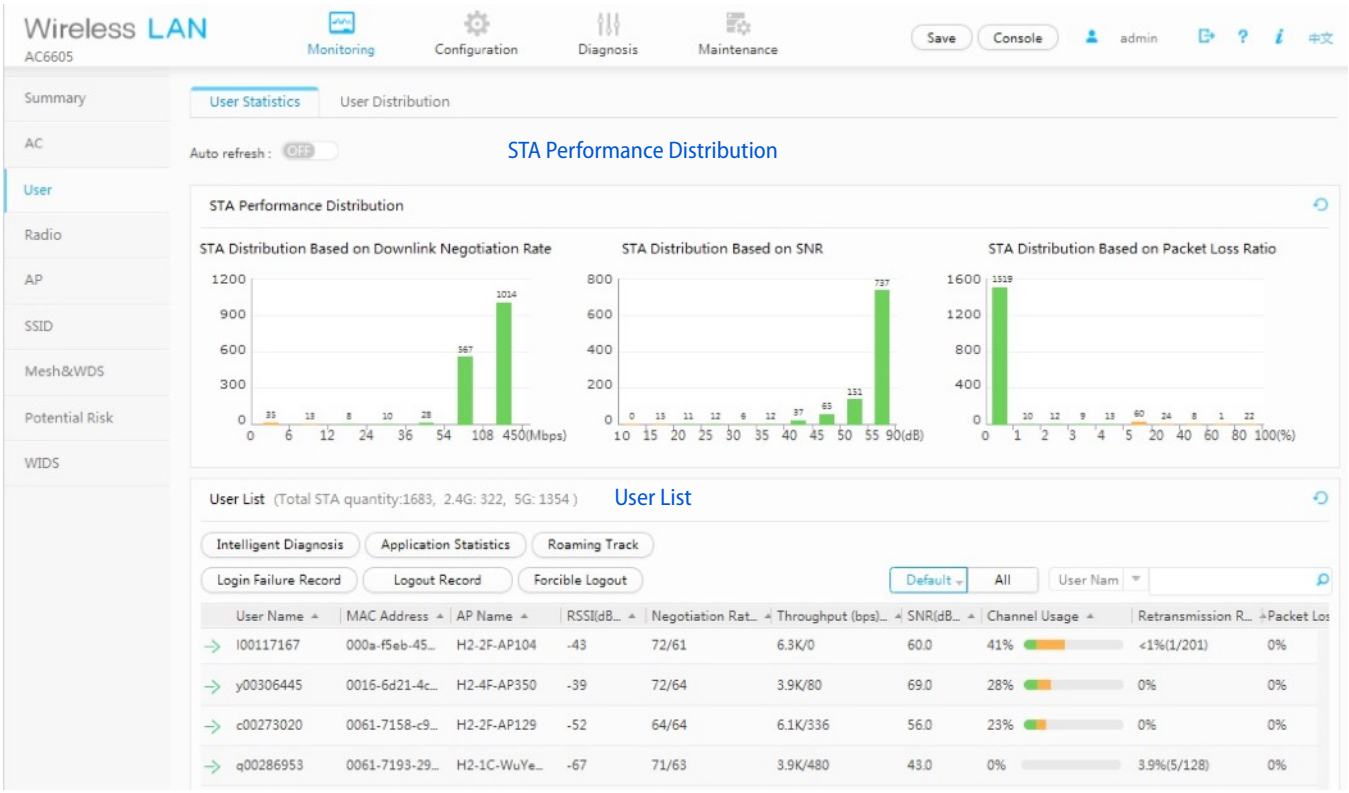
Huawei WLAN AC Web Interface - AP Monitoring



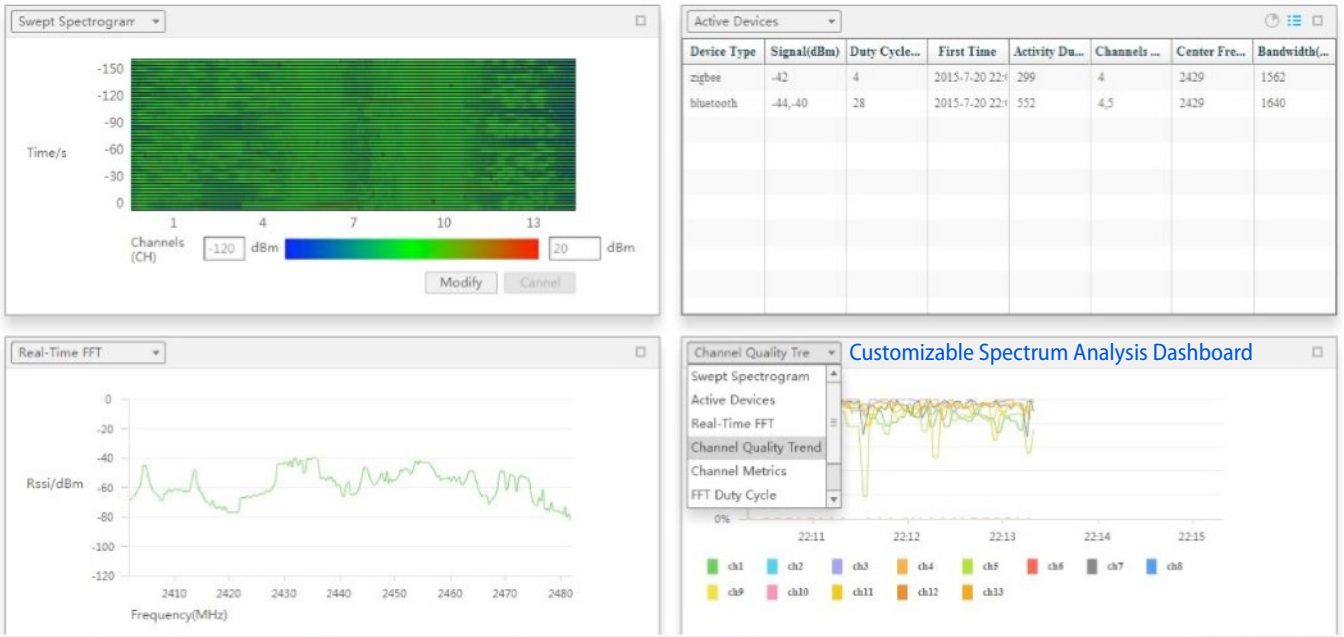
Source: Tolly, July 2019

Figure 2

Huawei WLAN AC Web Interface - STA Monitoring



Huawei WLAN AC Web Interface - Spectrum Analysis



Source: Tolly, July 2019

Figure 3

Intelligent Diagnosis

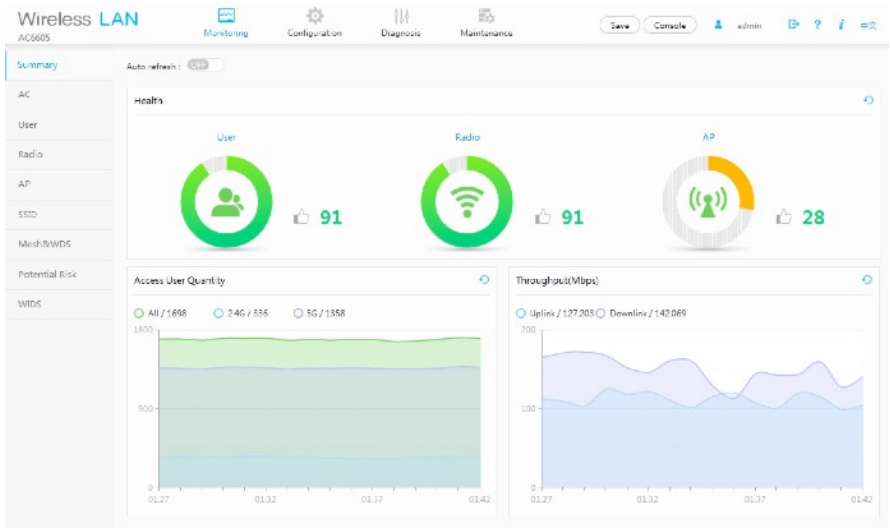
The Huawei WLAN AC supports end-to-end visible diagnosis with the User/AP/AC drill down trouble shooting capability. It can use the diagnosis information and logs to intelligently analyze the problem. See Figure 5.

For example, when one user cannot connect to the wireless network, administrator can use the user's MAC address to diagnose the problem. The Huawei AC can intelligently analyze the issue as "The radius server is not reachable". Administrators can then click the "suggestion" link to see "Check the RADIUS server status and link between the device and RADIUS server" help information.

When one AP cannot be associated with the AC, the AC can also analyze the problem as "The number of APs on the network exceeds that supported by the license" and give administrator the suggestion to check the license and apply a new one.

When the AP is abnormal and the AC cannot analyze the problem, the AC will ask the administrator "Collect the information and contact the HUAWEI engineer". It then gives two buttons to export diagnostic information and related logs.

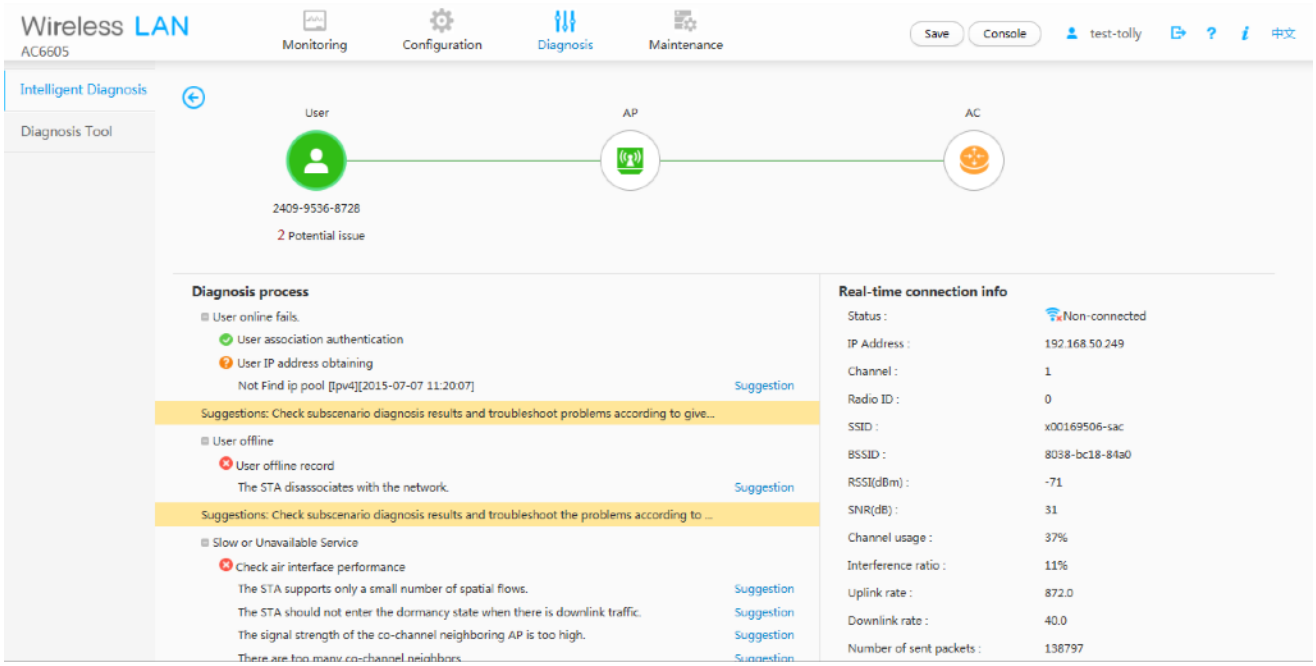
Huawei WLAN AC Web Interface - Dashboard



Source: Tolly, July 2019

Figure 4

Huawei WLAN AC Web Interface - Intelligent Diagnosis



Source: Tolly, July 2019

Figure 5

Diagnostic Tools

The Huawei WLAN AC provides multiple tools to assist administrators to diagnose the network problem. See Figure 6.

The "one-click diagnosis information collection" feature allows administrators to collect detailed information of all WLAN components with one click. Administrators can then send the information to the Huawei support team for more comprehensive analysis.

The "wireless packet obtaining" feature supports capturing packets being transmitted over the Wi-Fi networks close by. This feature is supported natively with the Huawei WLAN AC and AP. There is no need for additional third-party tools.

The "trace route" feature supports tracing the wireless packets' route.

The "AAA test" feature supports checking whether the RADIUS server's address, user name and password are correct.

The "RF-Ping" tool can ping the MAC address of a Wi-Fi client with different priority values to check difference service's performance.

Test Results - V200R010 Version Update

Features mentioned in the previous section were tested by Tolly engineers in 2015. In early 2019, Tolly engineers verified a few updated features in the R010 software version.

WAN Authentication Escape

In a typical headquarters-branch campus network scenario, ACs in the headquarters manage WLAN APs in different branches over Layer 3 WAN connections. The availability of branch's wireless network environment is dependent on the WAN connections.

Even when the WAN connection is down, branch users may still need to access the local WLAN for work. To achieve this, Huawei WLAN AC supports multiple WAN authentication escape policies. Tolly engineers verified the following aspects.

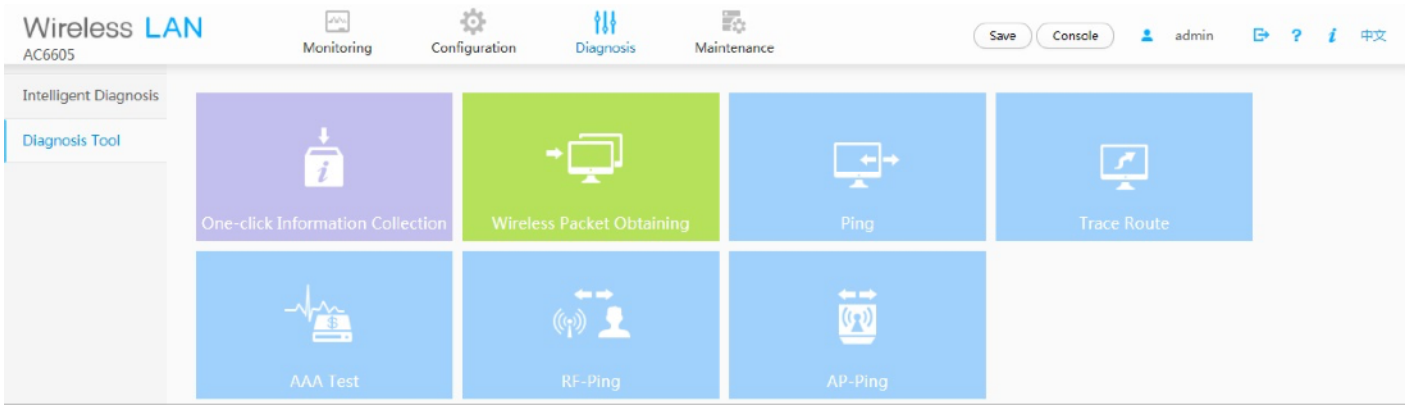
First, web portal authentication, MAC authentication and WEP/WPA/WPA2-PSK authentication could fail over to "open" without authentication when the CAPWAP link was down between the AC and the AP. So all users could access the local WLAN without any authentication.

Second, MAC and 802.1X authentication could fail over to local authentication. Users could access the WLAN after being authenticated locally.

Third, clients could still roam between APs. When the CAPWAP link was down, local APs automatically selected an AP as the HAP to synchronize user entries.

Fourth, when the CAPWAP link went down, the online users which were authenticated before the link down could still access the WLAN without the need for further authentication.

Huawei WLAN AC Web Interface - Diagnosis Tools



Source: Tolly, July 2019

Figure 6

Client Address Conflict Uncheck

In the same headquarters-branch campus network scenario as mentioned above, it's possible that clients in different branches have the same private IP addresses. By default, the AC does show user IP addresses in its management console if there is a conflict. When Client Address Conflict Uncheck is enabled, Huawei AC's console can show both user IP addresses even with conflict for proper management.

EoGRE

The Huawei WLAN AC supports Ethernet over GRE (EoGRE). Administrators can configure EoGRE with a GRE tunnel between two ACs over an IP/MPLS backbone network and provide Layer 2 communication between them.

VRRP

Two Huawei WLAN ACs can be deployed as a VRRP group with one virtual IP for high availability. Tolly engineers verified that the ping test from a Windows laptop to a wired Windows server did not have any failed attempt. The laptop was connected to the WLAN managed by the Huawei WLAN AC VRRP group.

802.11r Fast Roaming

The Huawei WLAN AC supports 802.11r fast roaming.

Intelligent Upgrade

The Huawei WLAN AC supports intelligent upgrade. It can check whether the current firmware is up to date, download the latest firmware from the cloud, and upgrade the AC and AP with scheduled tasks.

AC N+1 Backup

The Huawei WLAN AC supports AC N+1 backup. One standby AC works as the backup AC for multiple active AC (each active AC works separately to manage different APs).

License Pool

The licenses on active ACs can be synchronized to the backup AC. When one Huawei WLAN AC fails in the N+1 setup, the backup AC can use the license pool to manage the APs.

IPv6 SAVI

The Huawei WLAN AC supports Source Address Validation Improvements (SAVI) for IPv6 security.

Cloud-managed AC

The Huawei WLAN AC can be managed by the Huawei Agile Controller for cloud-based management. Huawei Agile Controller can be deployed in private cloud, in public cloud or as a hosted service.

Private Pre-Shared Key (PPSK)

The Huawei WLAN AC supports PPSK. Administrators can create unique pre-shared keys for devices on the same SSID. It provides simplicity like PSK while improve security by having each device use its unique key.

Navigator AC

The Huawei WLAN AC supports the navigator AC (Navi AC) feature. After the Navi AC feature is enabled, an AP can be managed by the local AC and the remote Navi AC simultaneously. Traffic of different types of users are directed to different WLAN ACs for traffic isolation with secure user access.

Taking the bank scenario for example, by using this feature, bank branch customers (Wi-Fi users) are authorized by the RADIUS server at the headquarters and can access internet only via the headquarters. Bank branch customers do not have access to any branch network local resources.

Local 802.1X Authentication

Administrators can create user accounts on the Huawei WLAN AC. The Huawei WLAN AC can host the user credential database locally on the AC and authenticate 802.1X users without communicating with a RADIUS server.

VIP User Identification and Traffic Prioritization

Administrators can create the VIP user group using the "ACL Rule/AAA User Group" attribute in the Huawei Agile Controller RADIUS server. Once a user in the VIP user group logs on, it has higher priority in the Wi-Fi network controlled by the Huawei WLAN AC.

Tolly engineers verified that after the WLAN AP reached its user capacity, a VIP user could still log on. A lower priority user session was terminated. Tolly engineers also verified that VIP user's traffic had higher priority. The VIP user's maximum throughput was obviously higher than lower priority users'.

Multicast DNS (mDNS) Gateway

Cross VLAN Apple AirPlay Discovery

The Huawei WLAN AC's mDNS gateway feature allows Apple device (e.g. iPhone, iPAD) discover other Apple device (e.g. Apple TV) even when they are in different VLANs.

AP/AP Group/AP Location-Based Apple AirPlay Service Area

The Huawei WLAN AC can separate Apple AirPlay area based on AP, AP Group, or AP location. For example, an iPhone connected to conference room A's AP can only discover the Apple TV in the conference room A.

VR Acceleration

Huawei AP2051DN and AP7060DN access points with the Huawei WLAN AC are optimized for virtual reality (VR) applications. Tolly engineers used one Pico VR headset to connect to the PC via Wi-Fi and play one VR game. The captured packets demonstrated that all packets had less than 7ms roundtrip latency from the PC to the VR headset even with more than 50% channel usage from co-channel interference. The gaming experience was smooth without lagging.

Test Results - V200R019 Version Update

In mid 2019, Tolly engineers verified a few updated features in the R019 software version.

Version Compatibility

Tolly engineers verified that the Huawei WLAN AC with the V200R019 software version was able to manage Huawei WLAN APs with the same or two previous software versions (V200R010 and V200R009).

IPv4 and IPv6 CAPWAP Dual-stack

IPv4 and IPv6 WLAN AP Management

The Huawei WLAN AC supports IPv4 CAPWAP and IPv6 CAPWAP simultaneously. Tolly engineers verified that, IPv4 WLAN APs and IPv6 WLAN APs were managed by the same WLAN AC properly.

Roaming Within One WLAN AC

Tolly engineers verified that WLAN clients were able to roam between one IPv4 WLAN AP and one IPv6 WLAN AP which were managed by the same Huawei WLAN AC.

Roaming Between Two WLAN ACs

Two Huawei WLAN ACs were used in the test. Each WLAN AC managed two WLAN APs (one IPv4 AP and one IPv6 AP). Tolly engineers verified that WLAN clients were able to roam between any two of the four APs.

Dual-link Backup for Dual-stack WLAN ACs

Tolly engineers verified that dual-link backups can be performed between two dual-stack Huawei WLAN ACs. Each AP (whether IPv4 or IPv6) establishes a CAPWAP tunnel with each of the two WLAN ACs. Wireless clients' information is backed up between the two WLAN ACs.

VRRP Backup for Dual-stack WLAN ACs

Tolly engineers verified that VRRP backup can be performed between two dual-stack Huawei WLAN ACs. The VRRP system uses a virtual IP address to establish a CAPWAP tunnel with each wireless access point (whether IPv4 or IPv6). Wireless clients' information, AP information, and CAPWAP link information is backed up between two WLAN ACs.

IPv6 Network Access Control

IPv6 MAC/802.1X/Web Portal Authentication

Tolly engineers verified that the Huawei WLAN AC can be used as the Network Access Control (NAC) policy enforcement point for IPv6 wireless clients' MAC, 802.1X and web portal authentication.

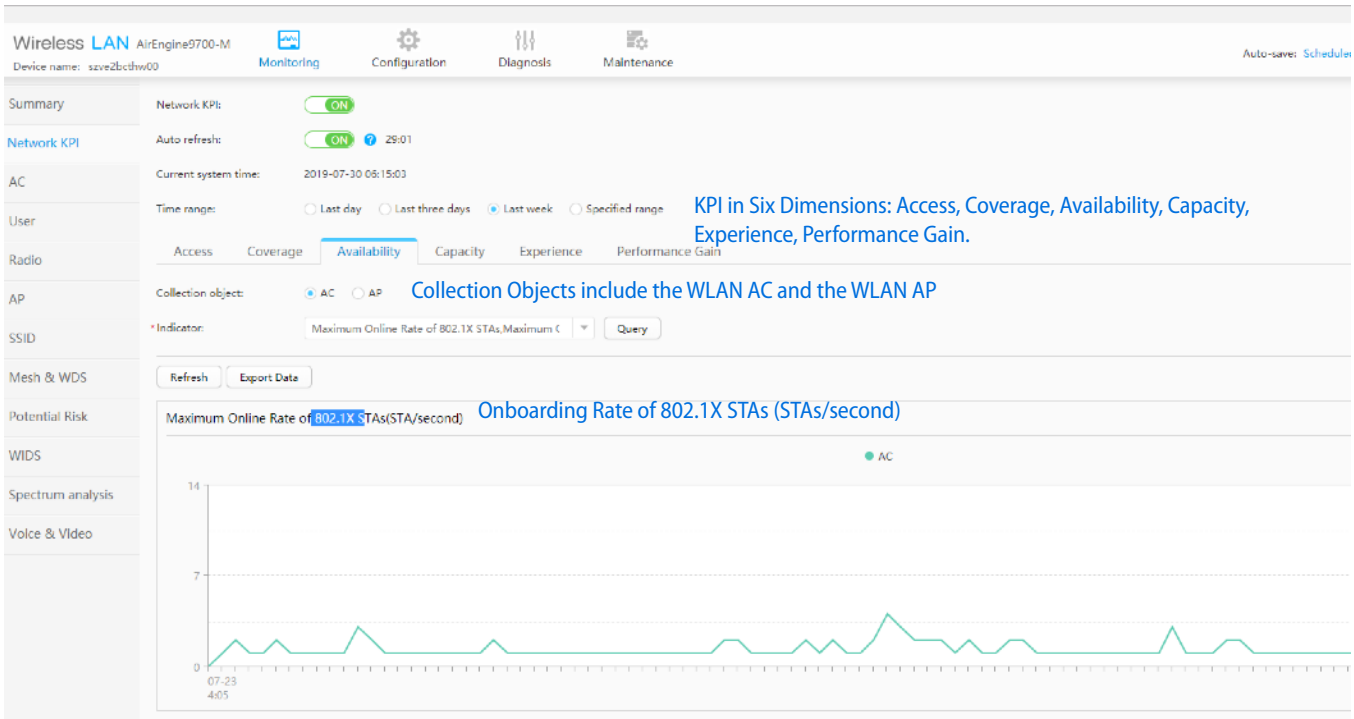
5GHz Dynamic Bandwidth Selection

Tolly engineers verified that the Huawei WLAN AC supports Dynamic Bandwidth Selection (DBS) to optimize 5GHz channel bandwidth (20MHz, 40MHz or 80MH) for higher spectrum resources utilization and bandwidth capacity.

Graphical KPI

Tolly engineers verified that the Huawei WLAN AC demonstrated graphical KPI in six dimensions: Access, Coverage, Availability, Capacity, Experience, and Performance Gaines. See Figure 7 to 9 for examples.

Huawei WLAN AC Web Interface - Graphical KPI (Availability)



Source: Tolly, July 2019

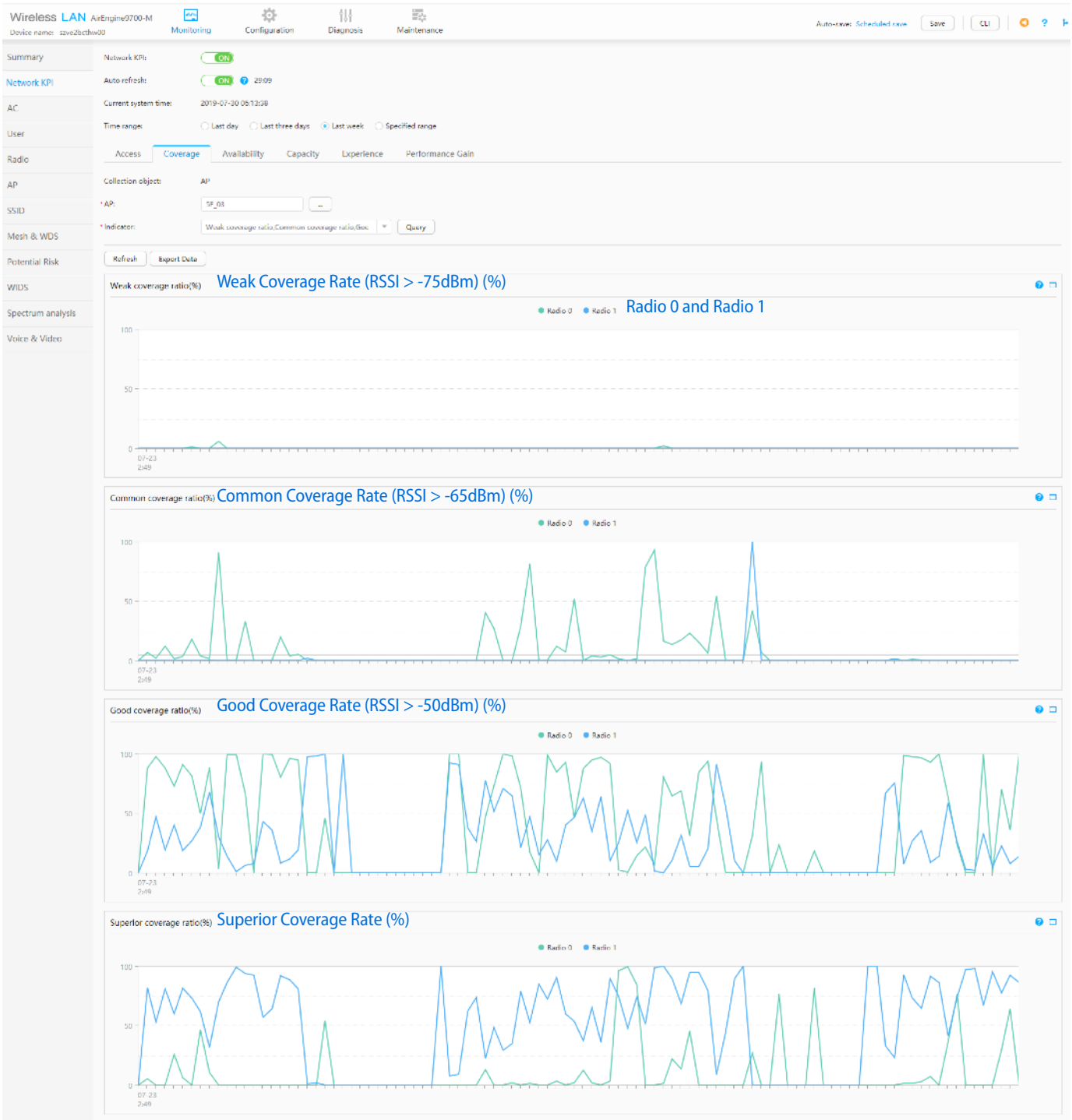
Figure 7

Huawei WLAN AC Web Interface - Graphical KPI (Access)

Source: Tolly, July 2019

Figure 8

Huawei WLAN AC Web Interface - Graphical KPI (Coverage)



Source: Tolly, July 2019

Figure 9

AP Serial Port Connection via Bluetooth

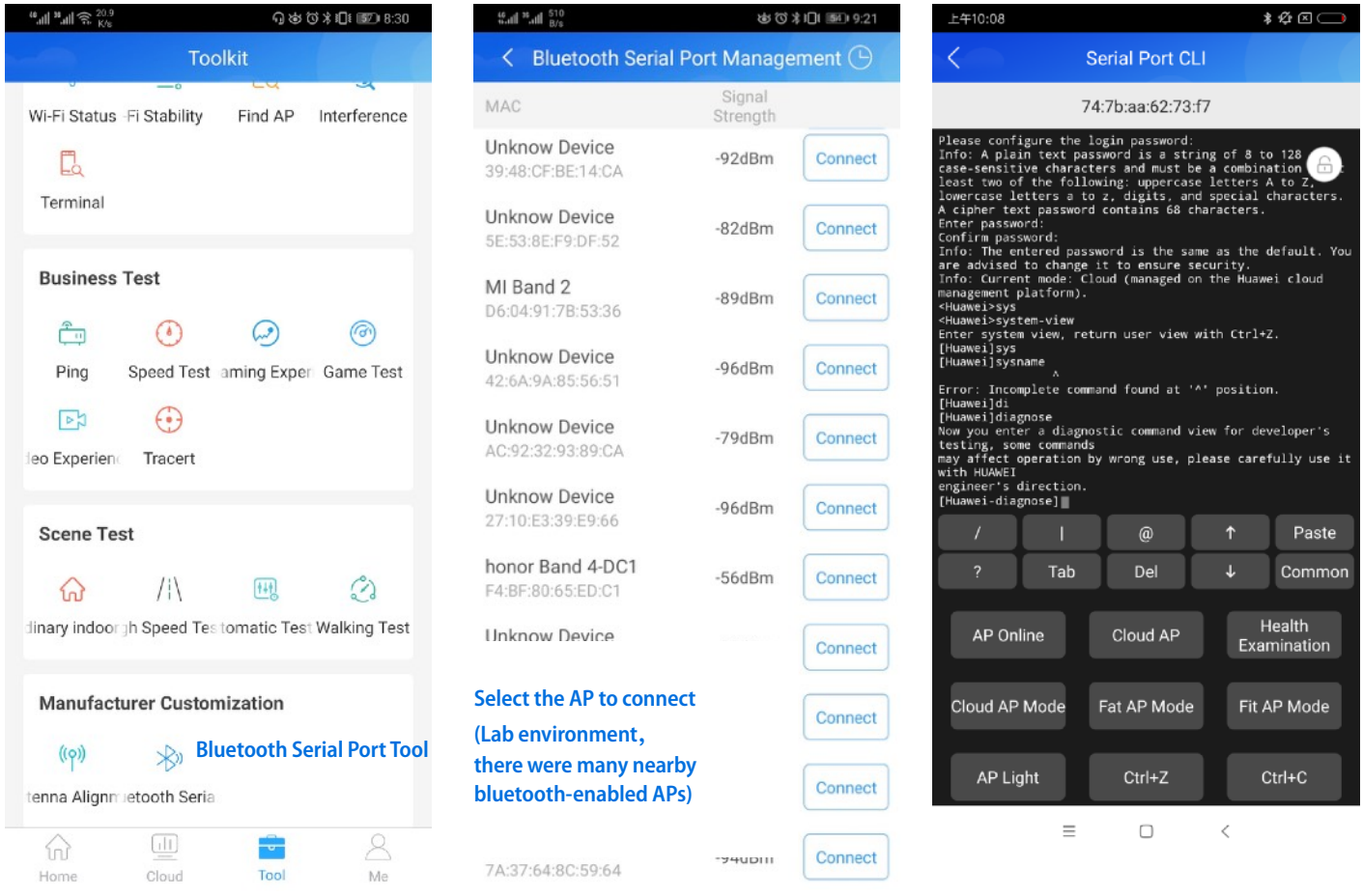
When the wireless access point malfunctions and loses communication with the wireless access controller, administrators need to access the wireless AP's serial port and troubleshoot. Wireless APs are typically mounted on a ceiling, so accessing with a traditional serial cable can be complicated. Tolly engineers verified that Huawei wireless access points support serial port access with a mobile device' bluetooth. In the "CloudCampus APP" mobile app, engineers selected a nearby Huawei WLAN AP, accessed the serial port, and executed CLI commands. Huawei WLAN APs (for bluetooth capable models) support two modes: bluetooth can be always on, or automatically turned on after CAPWAP tunnel fails. This feature is enabled through the WLAN AC. See Figure 10 for examples.

Bluetooth Positioning

The Huawei WLAN solution supports Bluetooth positioning with Huawei's Bluetooth-enabled WLAN AP models and third-party Bluetooth positioning modules.

Serial Port Connection via Bluetooth

Following screenshots are from the CloudCampus APP mobile app on an Android phone



Source: Tolly, July 2019

Figure 10

Huawei WLAN Access Controller
Tolly Verified Features - Part 1 of 2

Application Identification	
Application Identification and Display	
✔	Application Identification Display applications in the web network management interface
✔	Monitor application-based network traffic statistics using the NetStream feature Display the application statistics in the Huawei eSight Unified Network Management application
✔	Provide built-in signatures for more than 6,400 applications
✔	Application signature update
✔	The Application Identification feature had minor impact on wireless performance
Application-based Policy	
✔	Application-based rate limit
✔	Deny certain applications (e.g. Wechat, QQ, etc.)
✔	Increase the priority value of certain applications' packets e.g. improve user experience of video or audio chat
Smart Roaming	
✔	Help clients roam to the best available AP to solve the problems caused by clients with low roaming sensitivity With 10 moving clients and two APs, Huawei solution's performance varied 15% while Cisco solution's performance dropped 44%

Operation and Management (O&M)	
Web Interface Configuration	
✔	Group-based AP configuration using the web interface or CLI
✔	Personalized configuration for a single AP
✔	Copy AP Group Configuration to another group
✔	Built-in configuration templates
✔	Batch load new APs using a CSV file
Monitoring	
✔	Wireless network performance display in the Web interface dashboard
✔	AC/AP/STA/Spectrum monitoring and performance analysis
Intelligent Diagnosis	
✔	End-to-end visible diagnosis
✔	User/AP/AC drill down trouble shooting
Diagnosis Tools	
✔	One-click Information Collection
✔	Wireless Packet Obtaining
✔	Trace Route
✔	AAA Test
✔	RF-Ping

Note: Features are applicable to Huawei AC6003, AC6005, AC6507S, AC6508, AC6605, AC6800V, AC6805, AirEngine 9700-M, AirEngine 9700S-S appliances, and the ACU2 module for Huawei S7700/S9700/S12700 series switches.

Source: Tolly, July 2019

Table 3

Huawei WLAN Access Controller
Tolly Verified Features - Part 2 for 2

Advanced Features		V200R019 Version New Features	
✔	WAN Authentication Escape (after CAPWAP link down): 1. web portal, MAC and open/WEP/WPA/WPA2-PSK authentication fail over to open 2. MAC or 802.1x authentication fail over to local authentication 3. Local roaming 4. Online users survival	✔	Version Compatibility V200R019 WLAN AC is compatible with V200R019, V200R010, and V200R009 WLAN APs
✔	Client Address Conflict Uncheck	**IPv4 and IPv6 CAPWAP Dual-stack**	
✔	Ethernet over GRE (EoGRE) - Layer 2 connection over the GRE tunnel	✔	IPv4 and IPv6 WLAN AP Management
✔	VRRP	✔	Roaming Within One WLAN AC between one IPv4 AP and one IPv6 AP managed by the same WLAN AC
✔	802.11r Fast Roaming	✔	Roaming Between Two WLAN ACs between one IPv4/IPv6 AP and one IPv4/IPv6 AP managed by different WLAN ACs
✔	Intelligent Upgrade - auto cloud download with scheduled tasks	✔	Dual-link Backup for Dual-stack WLAN ACs
✔	N+1 Backup Use one standby AC to provide backup for multiple ACs	✔	VRRP Backup for Dual-stack WLAN ACs
✔	Shared License Pool Active ACs' licenses can be synchronized to the backup AC in the N+1 backup setup	**IPv6 Network Access Control (NAC)**	
✔	IPv6 SAVI	✔	IPv6 MAC Authentication with the integrated or external RADIUS server
✔	The WLAN AC can be Cloud Managed by the Huawei Agile Controller V3.0	✔	IPv6 802.1X Authentication with the integrated or external RADIUS server
✔	Private Pre-Shared Key (PPSK)	✔	IPv6 Web Portal Authentication with an external RADIUS server
✔	Navigator AC Taking the bank scenario for example, by using this feature, bank branch customers (Wi-Fi users) are authorized by the RADIUS server at the headquarters and can access internet only via the headquarters. Bank branch customers do not have access to any branch local network resources.	**Other Features**	
✔	Local 802.1x Authentication The AC hosts credential database locally and authenticate users without using a RADIUS server	✔	5GHz Dynamic Bandwidth Selection (DBS)
✔	VIP User Identification and Traffic Prioritization	✔	Graphical KPI
✔	Multicast DNS (mDNS) Gateway - Cross VLAN Apple AirPlay Discovery	✔	Enabling The "AP Serial Port Connection via Bluetooth" Feature
✔	Multicast DNS (mDNS) Gateway AP/AP Group/AP Location-Based Apple AirPlay Service Area	✔	Bluetooth Positioning
✔	VR Acceleration		

Note: Features are applicable to Huawei AC6003, AC6005, AC6507S, AC6508, AC6605, AC6800V, AC6805, AirEngine 9700-M, AirEngine 9700S-S appliances, and the ACU2 module for Huawei S7700/S9700/S12700 series switches.

Source: Tolly, July 2019

Table 4

User Access Capacity and Performance

AC6800V

Two Huawei AC6800V WLAN ACs were configured as one VRRP group for high availability and worked as the DHCP server.

With MAC authentication, they supported 3,500 new clients (STAs) per second for WLAN access with maximum 100K (102,400) concurrent users.

With web portal authentication, they supported 2,800 new clients (STAs) per second for WLAN access with maximum 80K (81,920) concurrent users.

With 802.1X authentication, they supported 2,800 new clients (STAs) per second for WLAN access with maximum 64K (65,536) concurrent users.

The Huawei AC6800V AC supported managing 10K (10,240) WLAN APs.

AC6805

The Huawei AC6805 WLAN AC supported 64K (65,535) concurrent users with open, MAC, web portal, or 802.1X authentications. It managed 6K (6,144) APs in the test.

AC6508

The Huawei AC6508 WLAN AC supported 4K (4,096) concurrent users with open, MAC, web portal, or 802.1X authentications. It managed 256 APs in the test.

AC6507S

The Huawei AC6805 WLAN AC supported 2K (2,048) concurrent users with open, MAC, web portal, or 802.1X authentications. It managed 128 APs in the test.

AirEngine 9700-M

The Huawei AirEngine 9700-M WLAN AC supported 32K (32,768) concurrent users with open, MAC, web portal, or 802.1X authentications. It managed 2K (2,048) APs in the test.

AirEngine 9700S-S

The Huawei AirEngine 9700S-S WLAN AC supported 2K (2,048) concurrent users with open, MAC, web portal, or 802.1X authentications. It managed 64 APs in the test.

Forwarding Performance

Tolly engineers evaluated Huawei AC6800V's L3 forwarding, CAPWAP forwarding and EoGRE forwarding performance with six 10GbE ports.

The Huawei AC6800V supported up to 60Gbps aggregated L3 throughput.

The Huawei AC6800V supported up to 59.96Gbps aggregated throughput with CAPWAP encapsulation.

The Huawei AC6800V supported up to 57.81Gbps aggregated EoGRE throughput. It did not reach 60Gbps because the test generator did not consider the GRE header overhead into the result. In the EoGRE test, two AC6800V used one GRE tunnel between them to pass the test traffic.

See Table 5 for detailed results.

Tolly engineers also evaluated L3 performance of the Huawei AC6805, AC6508 and AC6507S, AirEngine 9700-M and AirEngine 9700S-S. See Table 6 for detailed results.

Huawei AC6800V Performance
L3 Throughput, CAPWAP Throughput, and EoGRE Throughput (Gbps)
(as reported by Spirent TestCenter)

Throughput (Gbps)	Frame Sizes								
	64-Byte	128-Byte	256-Byte	512-Byte	768-Byte	1024-Byte	1280-Byte	1460-Byte	1518-Byte
L3	6.00	11.48	21.61	41.44	60.00	60.00	60.00	NA	60.00
CAPWAP	16.73	24.46	40.00	59.77	59.89	59.93	59.96	59.96	59.96
EoGRE	5.65	10.37	19.44	37.12	54.72	57.36	57.78	57.81	NA

Note: NA means the test was not run. Six 10GbE ports on one Huawei AC6800V AC was used. CAPWAP results include the CAPWAP header encapsulated. EoGRE results did not reach 60Gbps because the result did not include the EoGRE header overhead.

Source: Tolly, July 2019 Table 5

Huawei WLAN AC Forwarding Performance
L3 Throughput (Gbps)
(as reported by Spirent TestCenter)

Throughput (Gbps)	Frame Sizes							
	64-Byte	128-Byte	256-Byte	512-Byte	768-Byte	1024-Byte	1280-Byte	1518-Byte
AC6805	4.2	5.6	14.6	28	33	42	42	42
AC6508	0.68	1.2	2.2	4	6.4	8.5	10	10
AC6507S	0.68	1.2	2.2	4	6.4	8.5	10	10
AirEngine 9700-M	3	5.2	9.9	18	20	20	20	20
AirEngine 9700S-S	0.69	1.2	2.2	4	5.5	7	8.5	8.5

Source: Tolly, July 2019 Table 6

Test Methodology

Application Identification Performance Test

One HP laptop was connected to one Huawei AP5030DN AP with 87Mbps downstream throughput. After the application identification feature was enabled, the downstream throughput was 80Mbps. See Table 7 for SUT information.

Smart Roaming Test

At the baseline position, all 10 clients connected to AP A for both the Cisco and the Huawei solution. Engineers then moved all 10 clients close to AP B which is about 20 meters away from AP A. This position is marked as Roaming Position 1.

Engineers then moved all 10 clients back to the baseline position which is close to AP A. This test is marked as roaming position 2 test. Lastly, engineers moved all 10 clients back to roaming position 1 which is close to AP B. This test is marked as roaming position 3 test. See Figure 1 for the test bed diagram.

With the Huawei solution, all 10 clients roamed to the best available AP in a short time. With the Cisco solution, 6 to 8 clients eventually roamed to the best available AP in different roaming positions.

Each client used one bidirectional TCP stream with the Ixia IxChariot application.

VR Acceleration

The Pico VR headset was connected to the Huawei access point via Wi-Fi. The access point used the local forwarding mode. To create the co-channel interference, engineers used another laptop to run traffic with another AP working on the same band as the AP under test.

Systems Under Test

Vendor	Access Point Model	Access Controller Model	Version
Huawei Technologies Co., Ltd.	AP7060DN (8x8 MIMO eight-spatial-stream 802.11ax Wi-Fi 6 AP, internal antennas)	AirEngine 9700-M, AirEngine 9700S-S	V200R019
Huawei Technologies Co., Ltd.	AP7060DN (8x8 MIMO eight-spatial-stream 802.11ax Wi-Fi 6 AP, internal antennas)	AC6805, AC6508, AC6507S	V200R0010
Huawei Technologies Co., Ltd.	AP6052DN (4x4 MIMO four-spatial-stream 802.11ac wave 2 AP, internal antennas)	AC6800V	V200R009
Huawei Technologies Co., Ltd.	AP5030DN (3x3 MIMO three-spatial-stream 802.11ac AP, internal antennas)	AC6605	V200R006
Cisco Systems, Inc.	AIR-CAP2702I-C-K9 (3x4 MIMO three-spatial-stream 802.11ac AP, internal antennas)	AC5508	8.0.115.0

Source: Tolly, July 2019

Table 7

About Tolly

The Tolly Group companies have been delivering world-class IT services for over 30 years. Tolly is a leading global provider of third-party validation services for vendors of IT products, components and services.

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Visit Tolly on the Internet at: http://www.tolly.com

Test Equipment Summary

The Tolly Group gratefully acknowledges the providers of test equipment/software used in this project.

Vendor	Product	Web
Ixia	**IxChariot**	http://www.ixiacom.com
Spirent	**TestCenter**	http://www.spirent.com
Huawei	**xStorm**	

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