



#219101

February 2019

Commissioned by
Ruijie Networks Co., Ltd.

Ruijie Networks Public Cloud Solution (Ruijie Cloud)

Cloud Functionality and Comparative Access Point 2x2 Client Performance Evaluation versus Ubiquiti Networks and Huawei

EXECUTIVE SUMMARY

In wireless LAN (WLAN) environments, performance is limited by the capability of the client stations. Most clients deployed today possess 2x2 or 1x1 MIMO capabilities and, thus, cannot take full advantage of access points (APs) that might offer 3x3 capabilities. It is instructive to benchmark AP throughput capabilities when used with legacy 2x2 or 1x1 clients.

Ruijie Networks Co., Ltd. commissioned Tolly to evaluate the performance and features of several APs from their 802.11ac Wave 2 AP700 product line along with APs from Ubiquiti Networks and Huawei. Specifically, Tolly tested the Ruijie RG-AP710, RG-AP720-L and RG-AP730-L. These APs were compared to the Ubiquiti UniFi UAP-AC-LR and UAP-AC-PRO as well as the Huawei AP4051TN with various APs used in various test scenarios.

The Ruijie APs demonstrated better performance than competing solutions in nearly every test scenario in tests of video streaming, 2x2 TCP performance, long-range performance and roaming. Additionally, Ruijie demonstrated a feature-rich cloud management platform.

THE BOTTOM LINE

The Ruijie Networks' AP700 802.11ac Access Point Line:

- 1 Delivered better high density users video streaming results than Ubiquiti UniFi with 90% less lag time
- 2 Delivered up to 34% higher upstream and downstream throughput than competing products in 2x2:2 client tests in both 2.4GHz and 5GHz
- 3 Delivered better or comparable long range performance compared to Ubiquiti Networks
- 4 Demonstrated zero packet loss with better or comparable roaming performance compared to Ubiquiti Networks with up to 2 seconds interruption
- 5 Provides more enterprise-grade cloud management functionality than the Ubiquiti Cloud Key
- 6 Provides an easier and more cost effective Enterprise solution that requires no on premise controller while Ubiquiti Networks requires the Cloud Key or software installed at customer site

High Density Users Video Streaming Results

		Video Streaming User Experience Score (1 to 10, higher is better)	Lag Time (seconds) - Less is better	Lag Percentage - Less is better
32 Clients	Ruijie RG-AP710	8.3	7.2	12.5%
	Ubiquiti UniFi UAP-AC-LR	6.8	15.2	26.3%
100 Clients	Ruijie RG-AP730-L	9.4	2.1	3.6%
	Ubiquiti UniFi UAP-AC-PRO	5.5	23.3	41.6%
	Huawei AP4051TN	9.1	3.2	5.7%

Note: Clients were 1x1:1 Android tablets. The test platform included one management server which integrated the video streaming server, and the Android app on each client. Once engineers launched the test, all clients started streaming the 2.1Mbps bitrate 720p video in the app over the AP at the same time using unicast. Results as reported by Ruijie proprietary test platform. See Figure 1 for the test environment.

Source: Tolly, December 2018

Table 1



Test Results

Video Streaming

Tests were conducted using 1x1 Android tablets as clients with groups of 32 and 100 simultaneous clients streaming 720p video. See Table 1 for all video streaming results. See Figure 1 for the test bed.

32 Clients

In this test, the Ruijie RG-AP710 was compared with the Ubiquiti UniFi UAP-AC-LR. The Ruijie AP scored better than the Ubiquiti AP both in the quality measurement application and as verified subjectively by Tolly. The video lag time of 7.2 seconds was significantly better than the 15.2 seconds for the Ubiquiti AP.

100 Clients

In this test, the Ruijie RG-AP730-L was compared with the Ubiquiti UniFi UAP-AC-PRO and the Huawei AP4051TN. The Ruijie AP scored better than the Ubiquiti and Huawei APs both in the quality measurement application and as verified subjectively by Tolly. The video lag time of 2.1 seconds was significantly better than the 23.2 seconds for the Ubiquiti AP and better than the 3.2 seconds for the Huawei AP.

High Density Users Video Streaming Test Environment



Note: The test includes four of this rack in different directions to the AP. Each rack had 25 1x1:1 Android tablets.

Source: Tolly, December 2018

Figure 1



Throughput

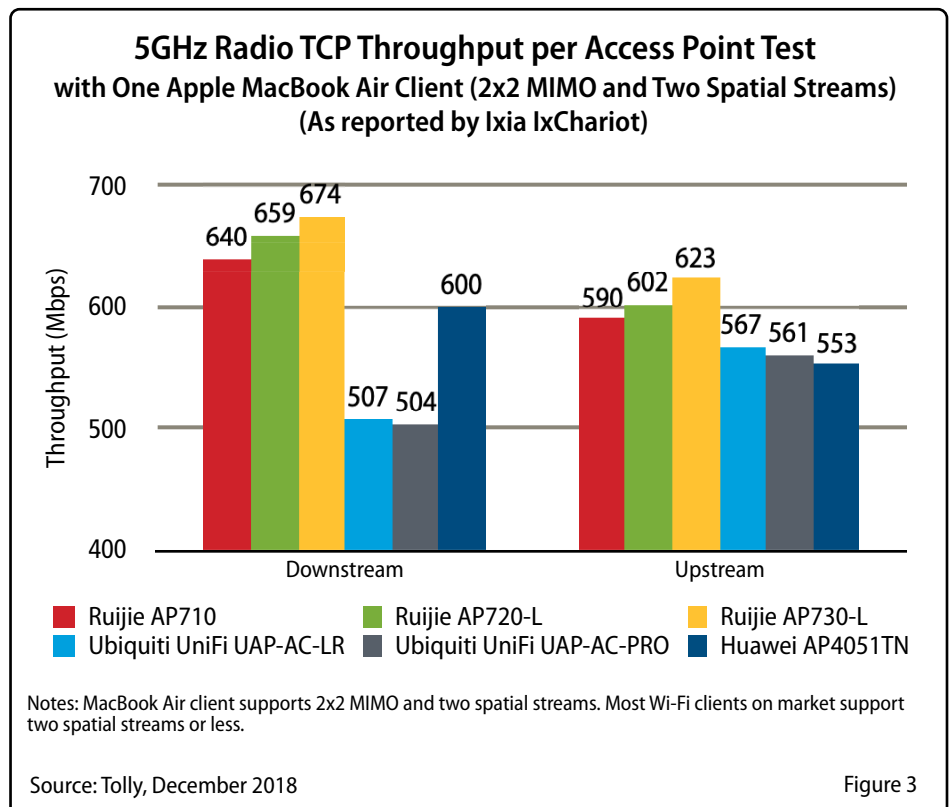
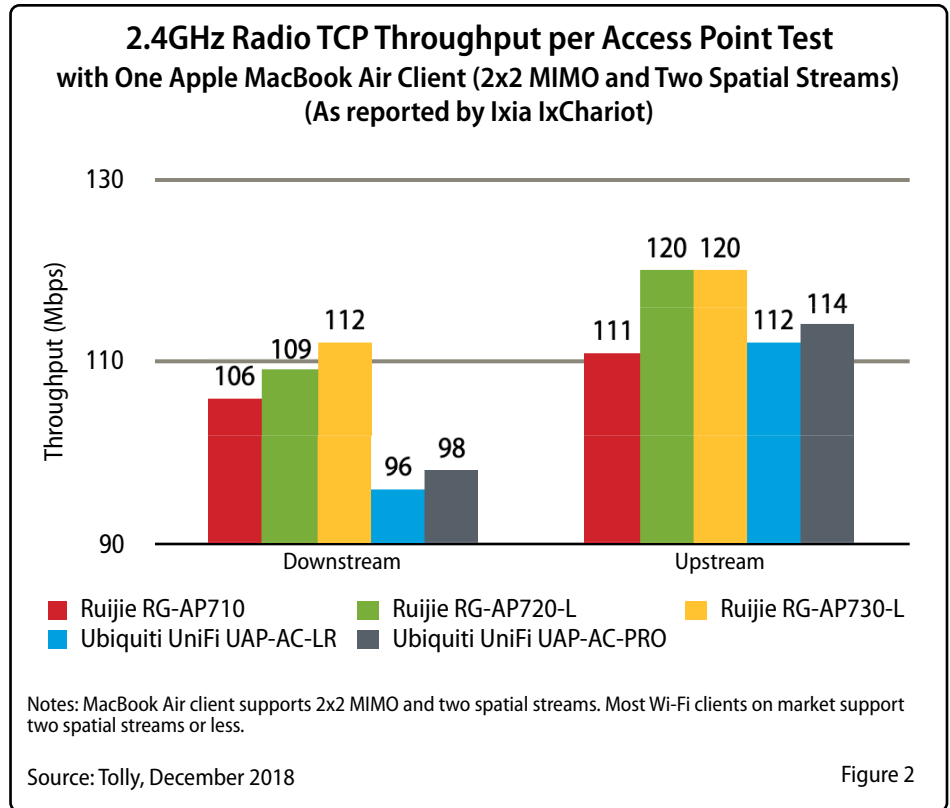
Tests of TCP throughput were conducted using a single 2x2 MIMO client (two spatial streams) in separate tests of downstream and upstream throughput in both 2.4GHz and 5GHz bands. All three Ruijie APs were compared to both Ubiquiti APs in the 2.4GHz and, additionally, with the Huawei AP in the 5GHz test. See Figures 2 and 3 for all throughput test results.

2.4GHz Radios

In the test of downstream traffic, all of the Ruijie APs outperformed the Ubiquiti APs by anywhere from 10Mbps to 16Mbps. In the test of upstream traffic, the Ruijie RG-AP720-L and RG-AP730-L outperformed Ubiquiti APs by 6 to 8Mbps. The Ruijie RG-AP710 had throughput 1 to 3Mbps lower than Ubiquiti.

5GHz Radios

In the test of downstream traffic, all of the Ruijie APs outperformed the other APs by anywhere from 40Mbps to 170Mbps. In the test of downstream traffic, all of the Ruijie APs outperformed the other APs by anywhere from 23Mbps to 70Mbps.





Long Distance (40 Meters)

Tests of TCP throughput were conducted using a single Apple iPhone 6s client (2x2 MIMO, 2 spatial streams) using a hotel corridor having no obstructions with APs installed on the ceiling. Tests were run between the Ruijie AP-710 and the Ubiquiti "long range" AP, the UAP-AC-LR at both 2.4GHz and 5GHz bands and separately for downstream and upstream traffic. See Figure 4 and Table 2 for all long-range test results.

2.4GHz Radios


In the 2.4GHz tests, the Ruijie and Ubiquiti results were comparable with the Ruijie AP delivering 3Mbps higher throughput in the downstream test and the Ubiquiti AP delivering 3Mbps higher throughput in the upstream test. Engineers noted that the Ruijie signal strength of -44 dBm was better

than the Ubiquiti signal strength of -56 dBm at 2.4GHz.

5GHz Radios

In the 5GHz tests, the Ruijie results were better in both the downstream and upstream traffic scenarios. In the downstream scenario, Ruijie's throughput was 48Mbps greater than Ubiquiti and in the upstream scenario it was 7Mbps greater than Ubiquiti.

Ruijie Networks
Ruijie Cloud
Wi-Fi Performance/Cloud Management Evaluation



Tested December 2018

Long Distance (40 Meters) Line-of-Sight Signal Strength with One Apple iPhone 6s

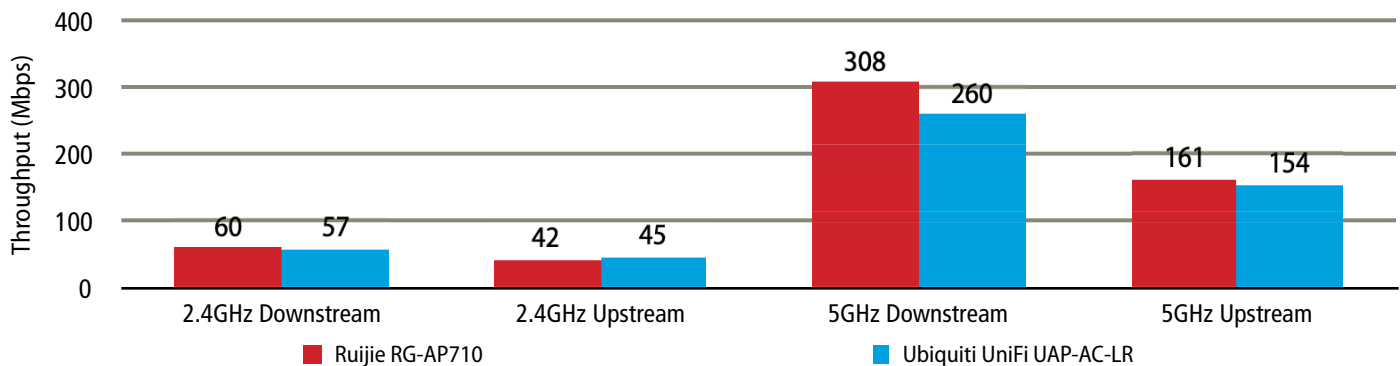
	RSSI (dBm)	
	2.4GHz	5GHz
Ruijie RG-AP710	-44	-56
Ubiquiti UniFi AP-AC-LR	-56	-56

Note: -44 dBm RSSI has higher signal strength than -56 dBm.

Source: Tolly, December 2018

Table 2

Long Distance (40 Meters) Line-of-sight TCP Throughput with One Apple iPhone 6s (As reported by Ixia IxChariot)



Note: Test was run in the hallway of a hotel. There was no obstacle between the AP and the client. APs under test were installed on the ceiling. The distance between the AP and the client was 40 meters.

Source: Tolly, December 2018

Figure 4

L2 & L3 Roaming

Tests of roaming frame loss were conducted for pairs of Ruijie and Ubiquiti APs at both layer 2 and layer 3. In the layer 2 scenario both APs under test were part of the same IP subnet. In the layer 3 test, each AP was part of a different IP subnet.

In both scenarios, the client was able to roam seamlessly using the Ruijie APs with no frame loss and, thus, no session interruption.

For Ubiquiti, engineers measured one frame dropped in the layer 2 scenario and eight frames dropped in the layer 3 scenario. The Ubiquiti re-association in the layer 3 scenario caused more than two seconds of service interruption each time the test was run. See Figure 5 for results.

Cloud Management Architecture

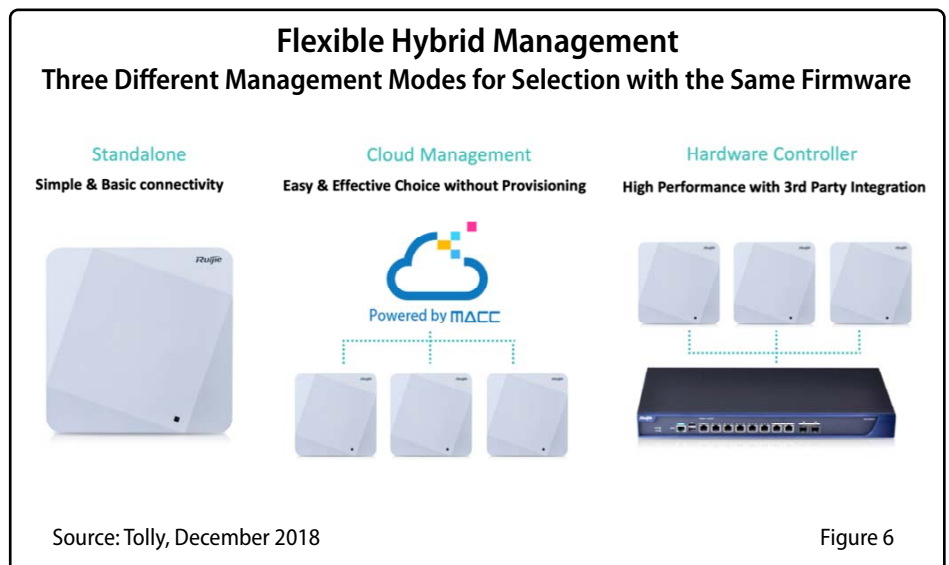
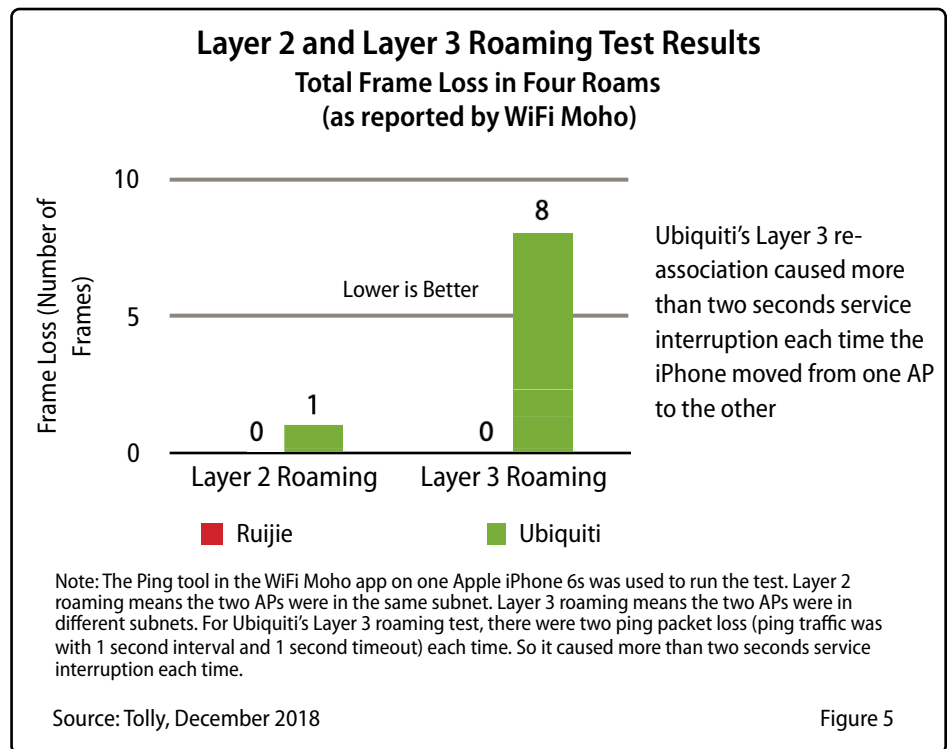
The Ruijie APs under test were all cloud-managed. There was no on-premise controller required. Ruijie APs support flexible hybrid management, in either standalone, or on-premise controller managed, or cloud managed mode. All modes are supported with the same firmware. See Figure 6. By contrast, Ubiquiti has a hybrid architecture that requires an on-premise controller.

The Ubiquiti controller can either reside on a standard Windows computer or it can be implemented using the Ubiquiti “Cloud Key,” as done in this test. The Cloud Key is a dedicated controller/computer implemented in a small form

factor dongle that is connected to and powered by a power-over-Ethernet (PoE) switch port.

Thus, the Ruijie cloud management solution is less complicated and easier to implement than the Ubiquiti solution. Furthermore, because Ubiquiti

records a hardware controller on premises at each site, the Ubiquiti management solution can be more expensive to deploy and, if a Windows computer is deployed as the controller, more expensive to maintain.





Cloud Management Functionality

		Ruijie Cloud	Ubiquiti Cloud Key Gen2
Monitoring	AP, Switch and Gateway Unified Management	✓	✓
	Top AP/SSID of Traffic/Clients	✓	✓
	AP/Gateway/User Traffic Trend	✓	✓
	Device and Device Group Location Monitoring on Google Maps	✓	✓
	Device List and Details	✓	✓
	Client List and Details	✓	✓
Management	Device Capacity	No limit	50
	Ease of Provisioning	Easy on any L2/L3 Network Works with any network topology with DHCP and internet access. Scan the QR code on the AP to add it to the Ruijie Cloud.	Difficult for L3 Network By default, the solution can only discover APs on the same L2 network with the Cloud Key or the station running the UniFi Controller software. L3 support has limitations and requires additional work.
	RRM (Radio Resource Management, AP power and channel auto adjustment based on wireless spectrum scan results)	✓	✗
	Batch Device Upgrade and Scheduled Upgrade	✓	✓
	Configuration Share or Copy between Different Sites	✓	✗
	Multi-level Group	✓	✗
	Layer 3 Roaming	✓	✗
	Remote Assistance	✓ with write and read permissions	✗
Email Alarm Notification	✓	✓	
Guest Portal	Different Portal Page for Different SSID	✓	✗
	Social Media Authentication	Facebook (with Like option)	Facebook
	Voucher Authentication	✓	✓
	One-click Authentication	✓	✓
Staff Authentication	PPSK (Private Pre-Shared Key)	✓	✗

Source: Tolly, December 2018

Table 3

Cloud Management Features

Tolly engineers verified that Ruijie provides unified management of APs, switches and gateways. Ruijie offers the core cloud managed features Ubiquiti offers and provides notable additional features as well. This section will summarize some of those features. See Table 3 for a feature comparison.

Monitoring

See Figures 7 and 8 for examples of the Ruijie cloud management monitoring screens.

Monitoring information available includes “Top Talker” lists of APs and clients, traffic trends for APs/gateways/users, location monitoring via Google

Maps, device lists and details, and client lists and details among other information.

Management

Ruijie offers management features and capabilities beyond those available in the Ubiquiti solutions. Some of these feature differences are discussed below.

Device Capacity

Ruijie has no limit imposed on the device management capacity where Ubiquiti limits management to 50 devices.

Ease of Provisioning

Setting up new devices is both easy and flexible with Ruijie. Ruijie’s cloud management works with any network topology that has Internet access and a DHCP server. One merely needs to scan

the QR code on the AP to add the device to the Ruijie cloud.

The Ubiquiti solution is limited. By default, the solution can only discover APs on the same L2 network with the Cloud Key or the station running the UniFi Controller software. L3 support has limitations and requires additional work.

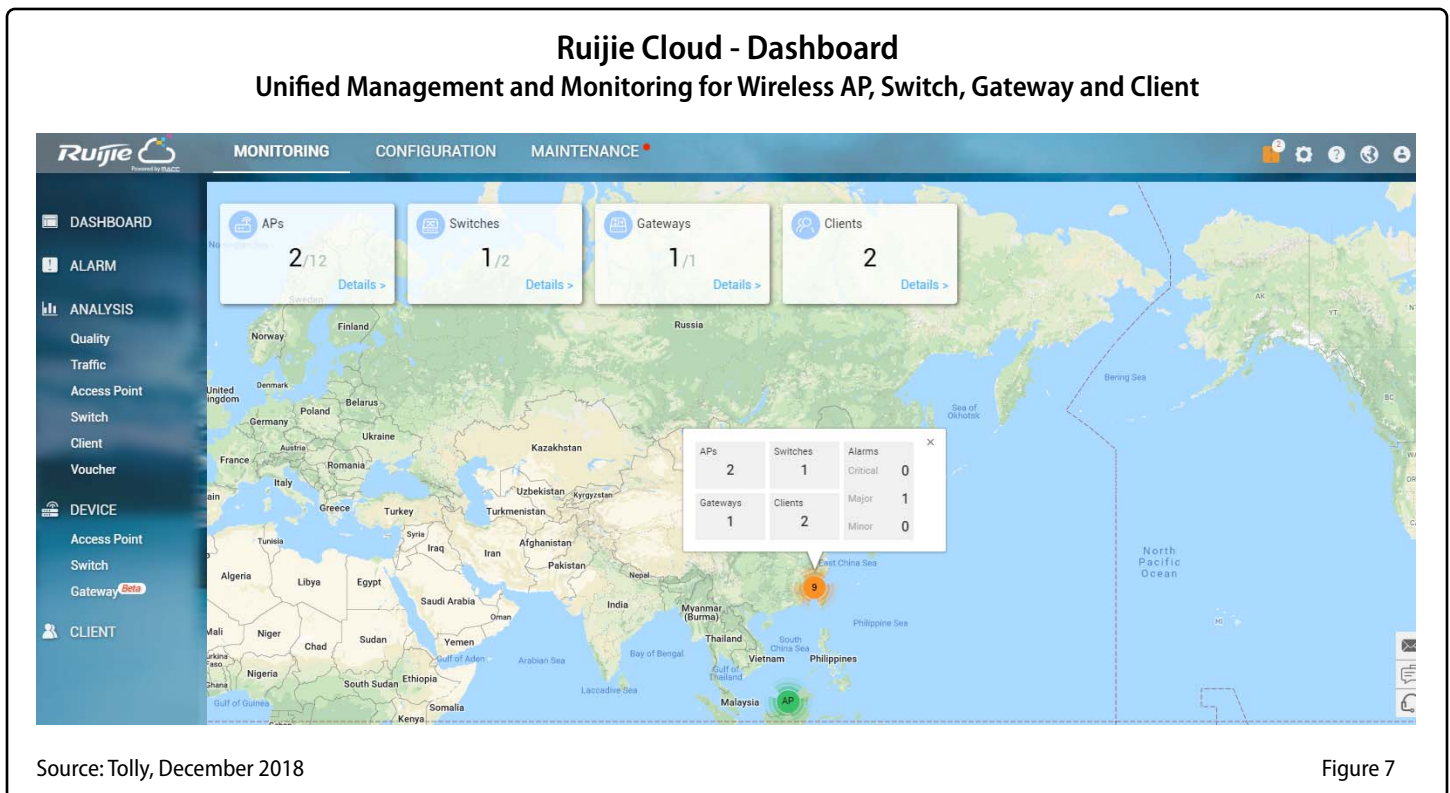
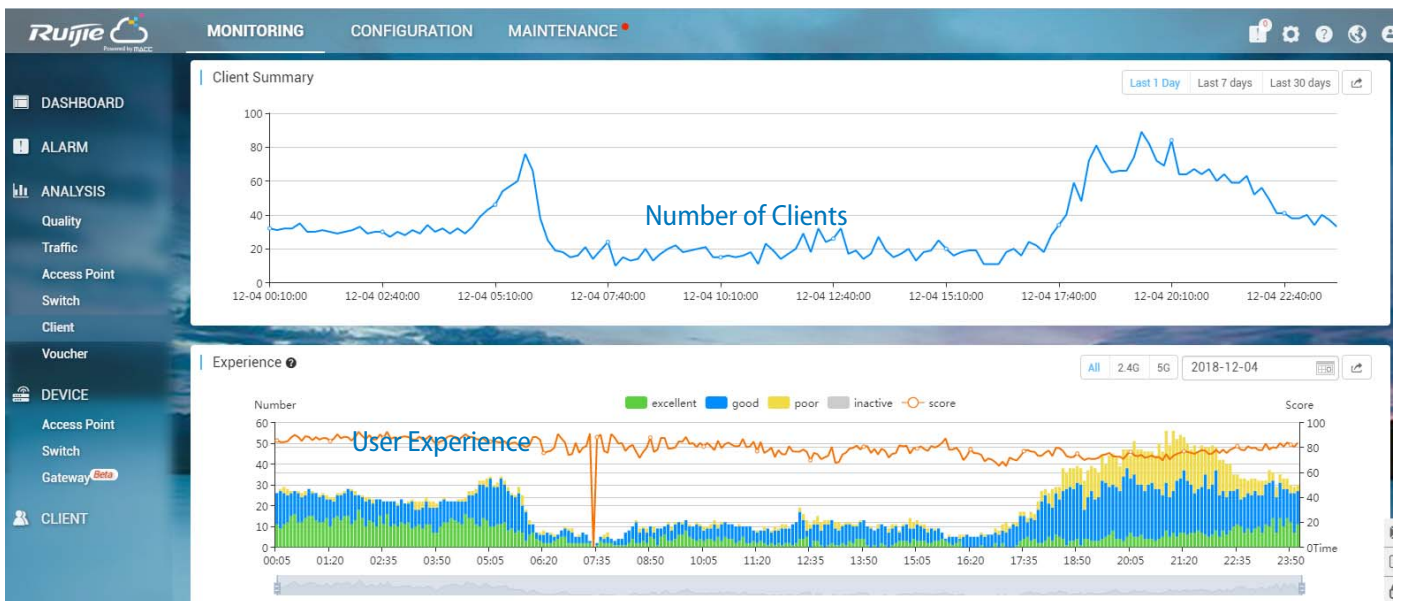
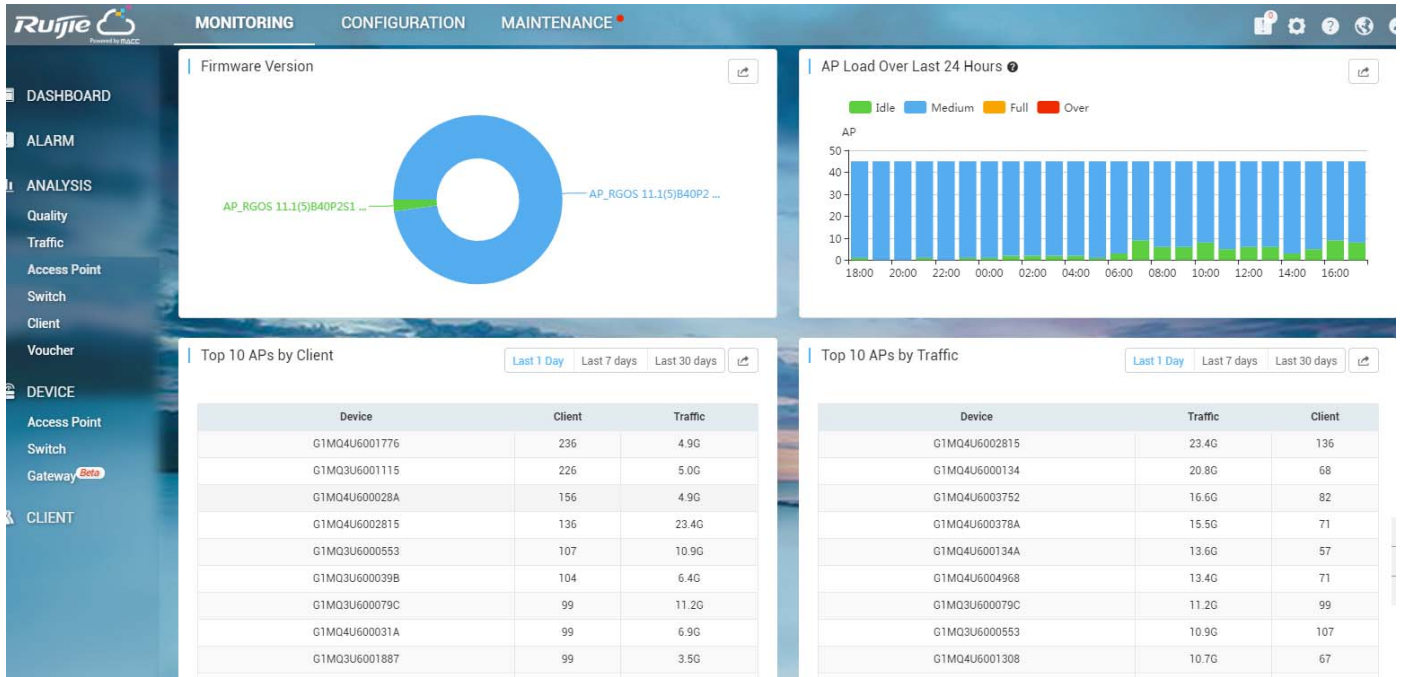


Figure 7

Ruijie Cloud - Wi-Fi Service Monitoring



Source: Tolly, December 2018

Figure 8



Radio Resource Management

Ruijie's radio resource management (RRM) capabilities allows network managers to monitor and optimize their wireless LAN environment. The scan provides insights into AP power and channel usage and provides

recommendations for channel adjustment based on scan results. See Figure 9 for an example RRM wireless scan results screen.

Ubiquiti does not provide similar functionality.

Configuration Share/Copy

It is quite common for many sites to have the same configuration needs. For example, a fast food franchise or hotel might have the same network configuration requirements across hundreds of locations.

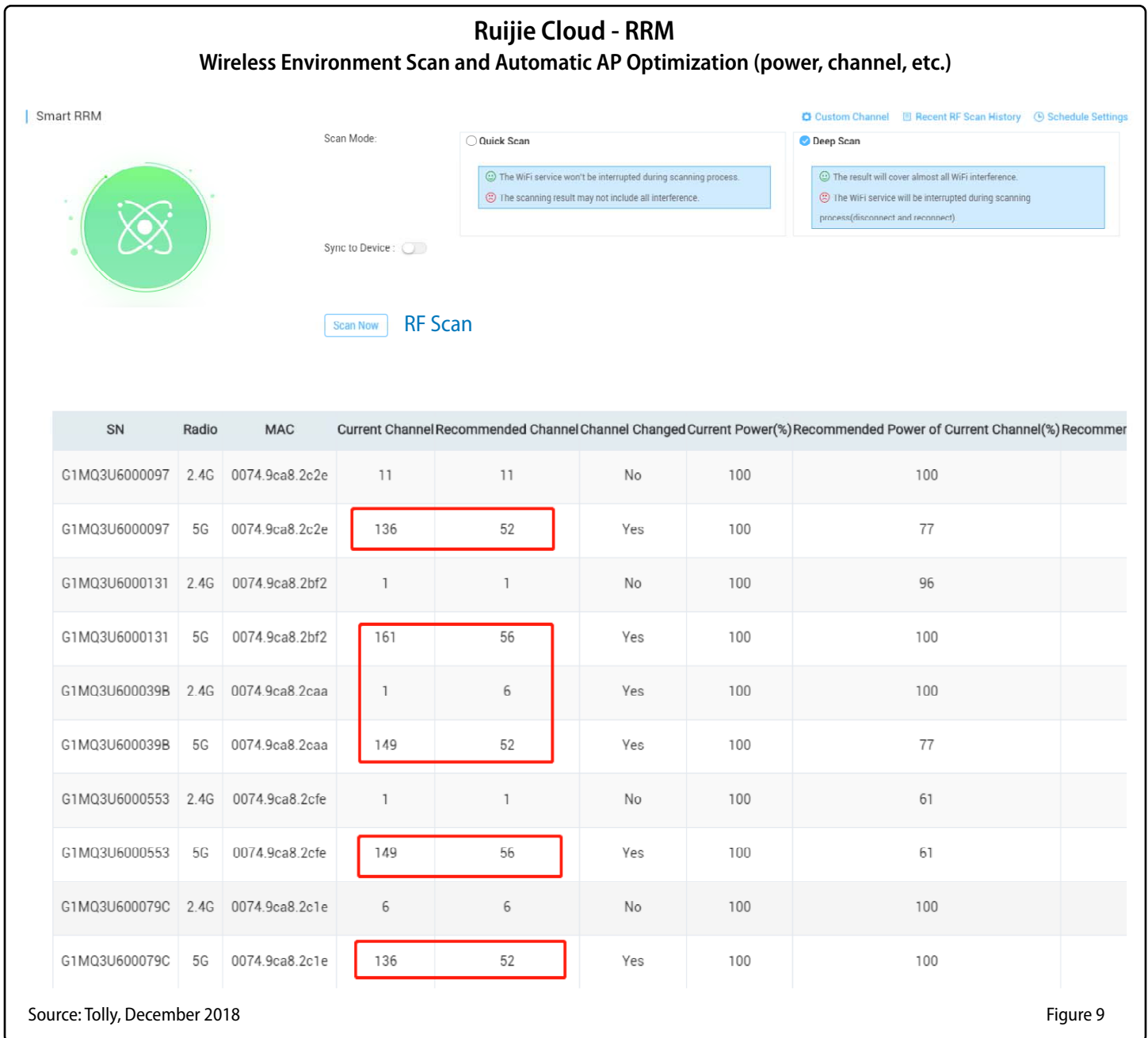


Figure 9

Ruijie provides for sharing and copying between different sites. This can save time and labor compared to having to recreate configurations manually for each location.

Ubiquiti does not offer this capability.

Remote Assistance

While networking devices are much easier to deploy than they were in prior years, there may still be times when the person physically deploying an AP can benefit from remote assistance.

Ruijie provides remote assistance that can either be limited to viewing the local device configuration (read) or, optionally, could be configured to allow the remote assistant to make changes (write). Ubiquiti does not offer this capability.

Guest Portal

Ruijie offers guest portal features and capabilities beyond those available in the Ubiquiti solutions

Per-SSID Portal Page

Many environments might have multiple AP SSIDs with some dedicated to different functions. In such cases, it would be useful to be able to provide portals linked to specific SSIDs. Ruijie provides this capability where Ubiquiti does not.

Voucher Management

Many environments, particularly hospitality deployments, make use of vouchers to allow access to Wi-Fi services.

Ruijie provides a flexible voucher management function that allows

authorized “front desk” users to generate and print voucher keys. See Figure 10 for an example screen.

Staff Authentication

Private Pre-Shared Key (PPSK)

PPSK allows every staff with one-time unique password, the login operation is as easy as WPA/WPA2-PSK, only need to type in the PPSK password for one time.

Management/Monitoring via Phone App

To provide greater flexibility for network managers, Ruijie has implemented a phone app that provides for both monitoring and management (i.e., configuration changes) from a phone device. See Figure 11 for a panel of screens that shows a commonly used path for device monitoring and management.

PPSK Authentication for Staff

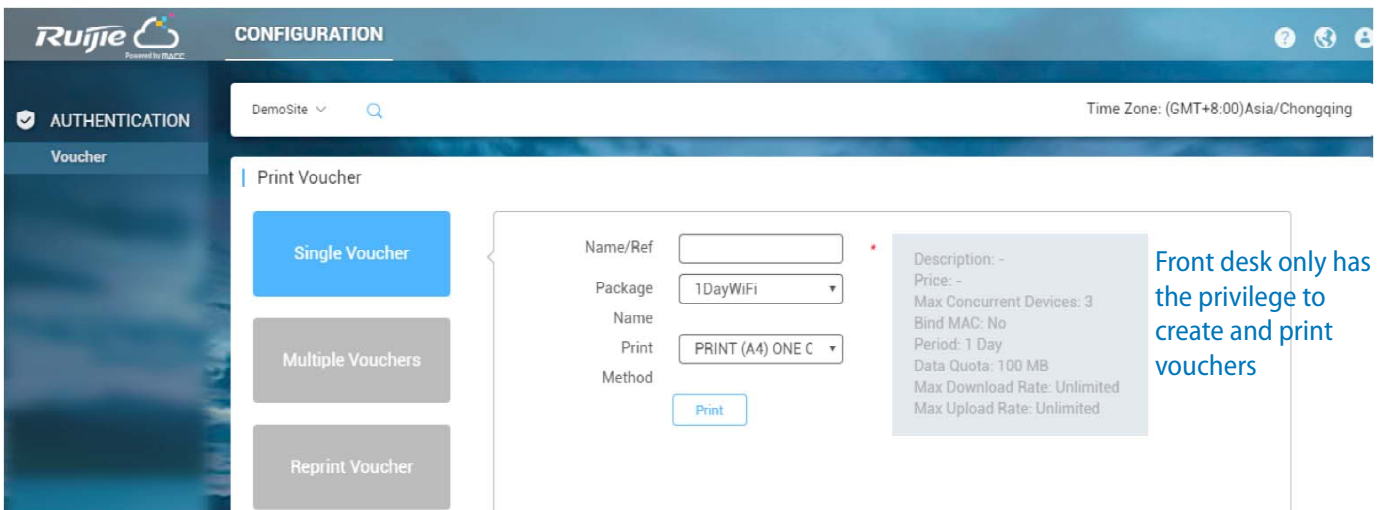
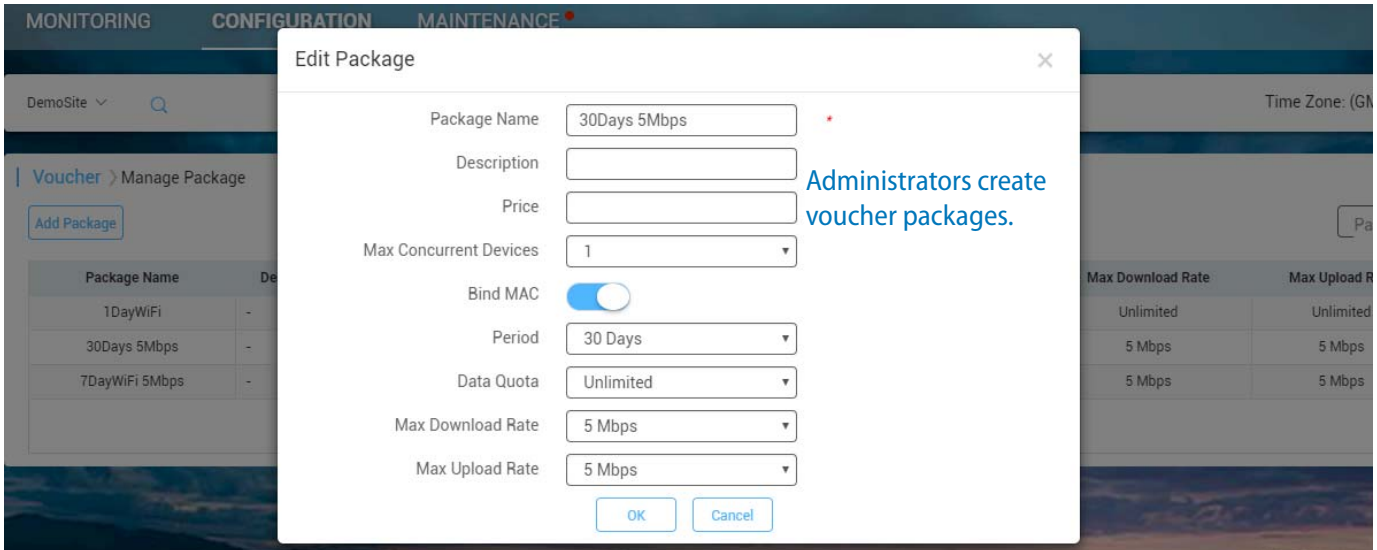


Every Staff with One-time Unique Password

- ✓ High security by using different passwords for each user and device at individual SSID
- ✓ Simple deployment, allow for batch account creation
- ✓ Ease of use and offers the same experience as WPA / WPA2-PSK
- ✓ Out-of-box feature in AC controller
- ✓ No additional authentication server or software required

Source: Ruijie Networks, December 2018

Ruijie Cloud - Guest Wi-Fi Voucher Management

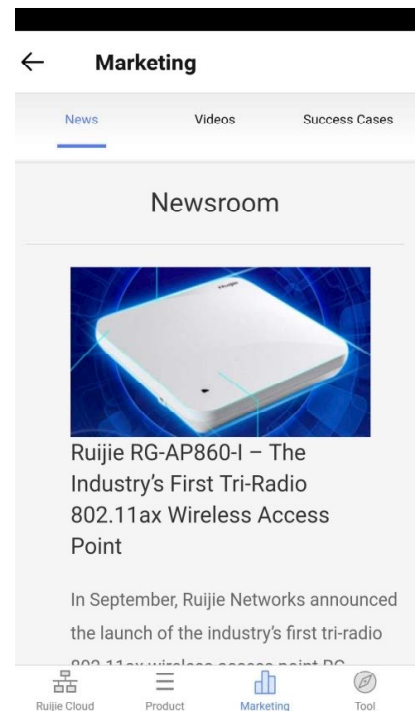
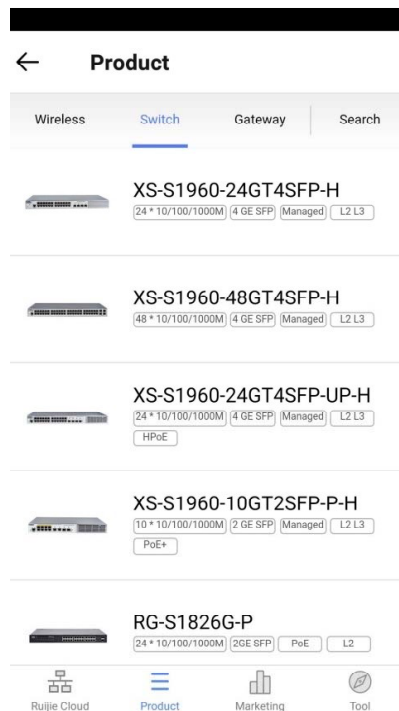
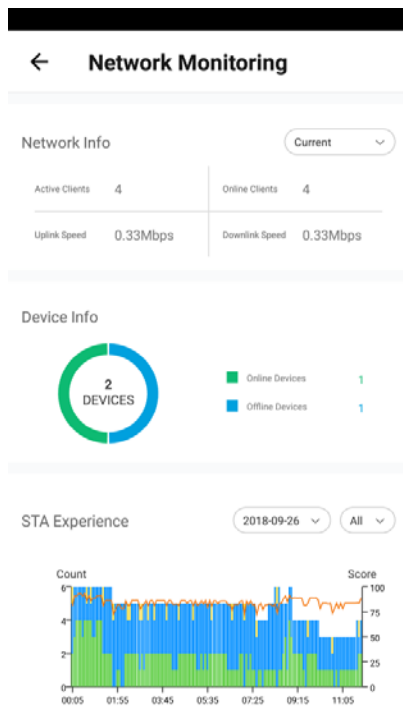
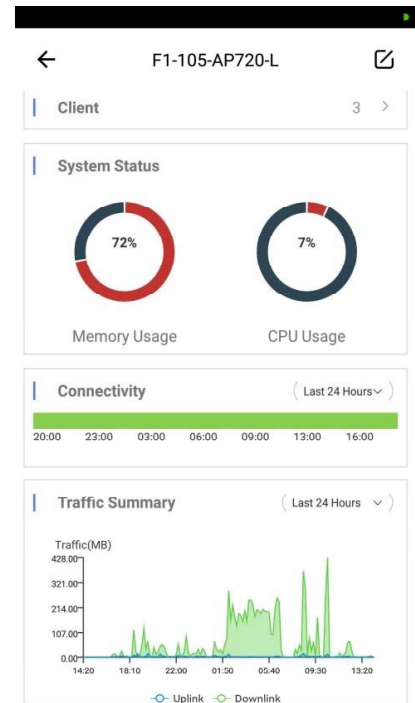
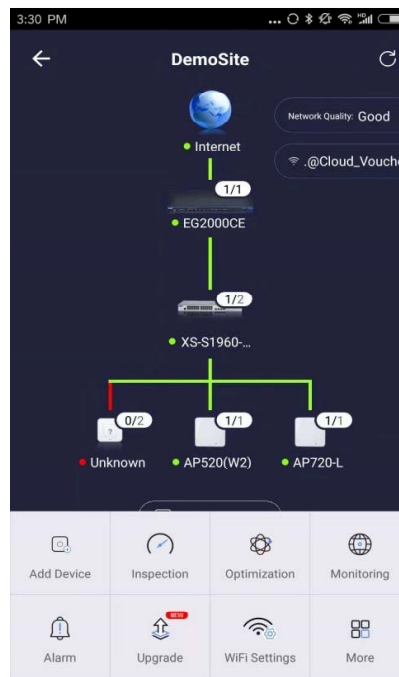
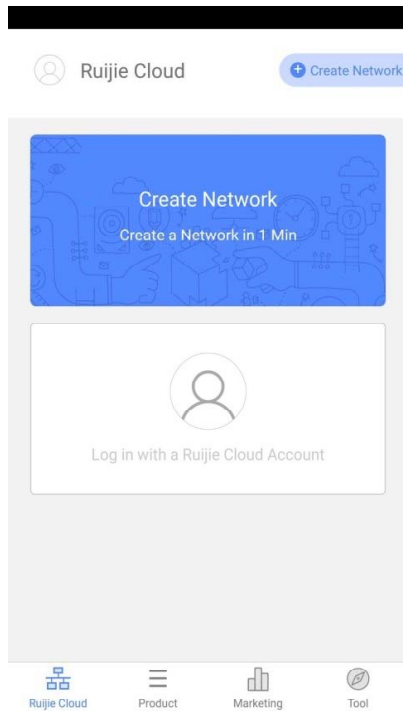


Source: Tolly, December 2018

Figure 10

Ruijie Cloud - App Access

Access Ruijie Cloud on The Phone For Network Management and Monitoring



Source: Tolly, December 2018

Figure 11



Test Methodology

High Density Users Video Streaming

In each test, the AP under test was installed on the ceiling. The management server was connected to the network using Gigabit Ethernet. Android tablets (1x1 MIMO 1 spatial stream) were used as the wireless clients.

Ruijie RG-AP710 and Ubiquiti UniFi UAP-AC-LR support one 2.4GHz radio and one 5GHz radio. 32 clients were connected to the 5GHz radio with channel 157 and 40MHz bandwidth.

Ruijie RG-AP730-L and Huawei AP4051TN each supports three radios (one 2.4GHz radio and two 5GHz radios). 45 clients were connected to each 5GHz radio and 10 clients were connected to the 2.4GHz radio. Ubiquiti UniFi UAP-AC-PRO supports two radios (one 2.4GHz radio and one 5GHz radio). Two radios shared the same SSID. All clients connected to the SSID. The radio was auto assigned by the Ubiquiti AP (97 to the 5GHz radio and three to the 2.4GHz radio). Each 5GHz radio used 80MHz bandwidth while each 2.4GHz radio used 40MHz bandwidth.

The Ruijie self-developed test tool bundle includes the management server which integrates the video streaming server and the app on each 1x1Android client. Once engineers launched the test in the management console, all clients started streaming the 2.1Mbps bitrate HD video from the

Systems Under Test		
Vendor	Model	Version
Ruijie Networks Co., Ltd.	Ruijie Cloud for management; RG-AP710, RG-AP720-L, RG-AP730-L access points	RGOS 11.1(5)
Ubiquiti Networks, Inc.	Ubiquiti Cloud Key Gen2 for management; UniFi UAP-AC-LR, UniFi UAP-AC-PRO access points	3.9.42.9152
Huawei Technologies, Co. Ltd.	AP4051TN	V200R008C10 SPC700

Note: Huawei's firmware was the out-of-box version and not up to date at the time of test.

Source: Tolly, December 2018 Table 4

server at the same time using unicast traffic. Each client reported test results and submitted to the server. Lag time means the duration of lagging. Lag percentage = (lag time) / (total test time). Tolly engineers verified that the test results match the subjective user experience. See Figure 1 for the test bed.

TCP Throughput per Access Point Test with One Client of Two Spatial Streams

Most Wi-Fi clients on the market support two spatial streams or less. Tolly engineers used one Apple MacBook Air client (2x2 MIMO and two spatial streams) to evaluate each AP's single client TCP throughput. Some APs support more than two spatial streams. So results reported here do not mean the maximum throughput of the AP. The IxChariot built-in TCP High_Performance_Throughput script was used for 5GHz radio tests while the built-in TCP Throughput script was used for 2.4GHz radio tests. 20 pairs of

streams were used in each test. The AP under test and the client were placed in a shielded box during the test.

Long Distance (40 Meters) Line-of-sight Performance

The AP under test was installed on the ceiling in a hotel hallway. One Apple iPhone 6s (2x2 MIMO with two spatial streams) was place 40 meters away from the AP and also in the hallway. There was no obstacle between the AP and the client. Tolly engineers checked the signal strength (RSSI) on the client and tested the single client throughput. The built-in TCP Throughput script was used. 20 pairs of streams were used in each test.

Roaming

Roaming is the action that the moving client disassociate with the weaker signal AP and associate with the stronger signal AP in a controlled manner. With roaming, the service interruption could be unnoticeable. To evaluate the service interruption time,



Tolly engineers used the ping tool in the WiFi Moho app on one iPhone 6s to ping one wired client while walking between two APs for two round trips.

Ruijie and Ubiquiti both support Layer 2 roaming (two APs in the same subnet). In addition, Ruijie provides the Layer 3 roaming option (two APs in different subnets). There was no frame loss in the Ruijie L2 and L3 roaming tests. Ubiquiti does not provide the Layer 3 roaming option. The unmanaged disassociation and re-association caused two ping packet loss each time the engineer walked the iPhone from one AP to the other.

Two Ruijie APs in the test were one RG-AP710 and one RG-AP730-L. Two Ubiquiti APs in the test were one UniFi UAP-AC-LR and one UAP-AC-PRO.

Cloud Management Functionality

Ruijie APs under test was managed by the Ruijie Cloud management portal via Internet. Ubiquiti APs under test were managed by the Ubiquiti UniFi Cloud Key which was placed onsite with the APs and configured to have Internet management access.

About Ruijie Networks

Ruijie Networks is a leading data communication solution supplier of China. Since founded in 2000, Ruijie has been building in-depth scenario-oriented application experience through solution design and innovation in the industry and utilizing new technologies such as cloud computing, SDN, mobile Internet, big data and Internet of Things to provide end-to-end solutions for different industries, thus assisting the upgrade into the digitalization of all industries. As one of the first innovative enterprises in China, Ruijie has researched and self-developed 9 product lines, including switches, routers, wireless, cloud data center, cloud class, security, gateways, IT management and authentication & accounting. Ruijie has 5 R&D centers, 41 branch offices and over 5,000 channel partners with service covering over 30 countries and regions, including Asia, Europe, Africa and America. The innovations based on user applications have been widely used in government agencies, telecom carriers, financial services, education, healthcare, Internet, energy, transportation, commerce, manufacturing and other industries for informatization construction.

Ruijie Cloud Overview

Ruijie provided information, not necessarily verified by Tolly

Overview

Beyond Your Expectations

The ONLY Vendor offering ENTERPRISE Cloud for SME at **Lifetime FREE**

- Ruijie Cloud Service is Ruijie's easy and efficient cloud solutions for chain stores, small and medium-sized businesses and boutique hotels.
- The solutions include equipment deployment, monitoring, network optimization and operational lifecycle management; enabling customers with simple plug and play deployment and operation and maintenance.
- Meeting the needs for automatic cloud RF planning and user experience monitoring, it also support mobile monitoring (add equipment using QR code scanning, network status monitoring and alarm). At the same time it provides flexible wireless user access control features, including high security "One person, one machine and one password" PPSK, built-in cloud Portal and Facebook authentication.

Key Values

- Full Networking Product from Internet Gateway, Switches to Wireless AP
- Enterprise Cloud Functionality and Ultimate Wireless Performance verified by Tolly
- Dummy Provisioning by Mobile App

Unlimited Capacity Platform

Enterprise Grade Feature

Easy Maintenance

Cloud Management

- Unified device management
- Flexible Group Configuration

Mobile Operation

- Seamless Provisioning
- Anywhere Monitoring & Alert

Simplified Security

- PPSK Staff Authentication
- Portal Authentication (Social Login)

Cloud Analytics

- Automated WiFi Optimization
- WiFi Experience Analysis



No Hardware AC
Low Entry Cost

Centralized Management
Low OpEx

Cloud Deployment
50% Faster deployment

Ruijie Cloud Product Family

Ruijie provided information, not necessarily verified by Tolly

Cloud Service



- Unified Device Management
- Cloud Optimization & Analytic
- Reporting & Compliance

Mobile APP (Android/iOS)



- FREE for Download
- Mobile Provisioning
- Mobile Inspection & Optimization
- Mobile Monitoring & Alarm

Cloud Managed Switches



XS-S1960 Series Full Managed

- 8/24/48 Port GE PoE/Non-PoE models
- Conformal Coating Protection

NEW



XS-S1920E Series Smart Managed

- 8/24 Port FE/GE PoE/Non-PoE models
- Half-power PoE option

Cloud Managed AP

Indoor

NEW



AP730-L

- Tri-band Wave2
- 2130Mbps



AP720-L

- Wave2
- 1167Mbps



AP710

- 11ac
- 1167Mbps



AP210-L

- 11n
- 300Mbps

Wall Plate



AP130L

- 11ac
- Replaceable Plate
- 4FE LAN



AP110-L

- 11n
- Sliding Cover
- 1FE LAN

Outdoor



AP630(CD)

- 802.11ac
- IP67 Weather-proof
- Integrated Antenna



AP630-L

- Entry-level 11ac Outdoor AP

Security Gateway

NEW



EG2100-P v2

- Routing/ NAT / VPN
- 8xGE (7xPOE)
- FREE Layer 7 DPI
- Max 1000Mbps Throughput

NEW



EG3250

- Routing / NAT / VPN
- 8xGE, 1x 10G SFP+
- FREE Layer 7 DPI
- 1T Storage
- Max 6800Mbps Throughput

	AP730-L	AP720-L	AP710
Protocol	802.11a/b/g/n/ac Wave 2	802.11a/b/g/n/ac Wave 2	802.11a/b/g/n/ac
Radio	2.4G + 5G + 5G	2.4G + 5G	2.4G + 5G
WLAN Performance (Mbps)	2130Mbps	1167Mbps	1167Mbps
Max Client	768	256	256
Spatial Stream	2x2:2	2x2:2	2x2:2
Network Interface	1 x 10/100/1000 Mbit BASE-T, auto-sensing LAN port		
Operating Modes	Standalone/Cloud Managed/Controller Managed		
BSSID	48	32	32
Security	WEP, WPA/WPA2-PSK, WPA/WPA2-enterprise		
Special Features	Layer 2 isolation, Rogue AP detection, CLI		
Installation	Indoor Ceiling/Wall-mounting (mount kit included)		



About Tolly

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

You can reach the company by E-mail at sales@tolly.com, or by telephone at +1 561.391.5610.

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

Learn More About Ruijie Networks

Since its founding in 2000, Ruijie has been building in-depth scenario-oriented application experience through solution design and innovation in the industry, thus assisting the upgrade into the digitalization of all industries. Ruijie has researched and self-developed nine product lines, including switches, routers, wireless, cloud data center, cloud class, security, gateways, IT management and authentication & accounting.

For more information, visit:

<https://www.ruijienetworks.com/>



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