Ruijie Wi-Fi 6 (802.11ax) WLAN Access Point
Comparative Performance Evaluation vs. HPE Aruba, Huawei, and Ruckus

Executive Summary

Wi-Fi 6 is the latest generation Wi-Fi technology that brings improvements in individual device and overall system throughput. Built upon more than 15 years experience in the WLAN market, Ruijie Networks Co., Ltd. developed a series of Wi-Fi 6 access point models to cover different application scenarios. Ruijie's Wi-Fi 6 products merges a broad range of technologies together, including 5th Gen X-Sense Smart Antenna, AI deep learning - WIS 3.0 for big data modeling, Software-defined Networking (SDN) for Internet of Things (IoT) along with end-to-end (from indoor, wall plate to outdoor) Wi-Fi 6 access point family suite.

Ruijie commissioned Tolly to evaluate the performance, user capacity, features and IoT integration of its Wi-Fi 6 access points including RG-AP880-I, RG-AP850-I(V2), RG-AP840-I and RG-AP820-L. Test results proved Ruijie Wi-Fi 6 access points' superior performance with RG-AP880-I as the fastest Wi-Fi access point and RG-AP850-I(V2) as the largest user capacity Wi-Fi access point Tolly has ever tested to the date of this test.

The Bottom Line

1. Ruijie's flagship Wi-Fi 6 access point RG-AP880-I supports up to 4Gbps single client wireless throughput on the 5GHz radio which makes it the fastest Wi-Fi access point Tolly has ever tested to the test date

2. Ruijie RG-AP820-L supports 955Mbps single client wireless throughput on the 5GHz radio and 433Mbps single client wireless throughput on the 2.4GHz radio to a client equipped with an Intel Wi-Fi 6 AX200 network adapter

3. Ruijie Wi-Fi 6 AP RG-AP820-L provides 65% multi-client performance improvement over Ruijie Wi-Fi 5 AP RG-AP720-L with the same Wi-Fi 5 clients

4. Ruijie RG-AP880-I, RG-AP840-I and RG-AP820-L support 1,024 Wi-Fi clients per access point; Ruijie RG-AP850-I(V2) supports 1,280 Wi-Fi clients per access point. Ruijie RG-AP850-I(V2) is the largest user capacity Wi-Fi access point Tolly has ever evaluated to the test date

5. Ruijie RG-AP880-I supports built-in or external IoT modules; RG-AP850-I(V2) and RG-AP840-I support external IoT modules

Test Results

Single Client Throughput

8x8:8 Models

The Wi-Fi 6 standard boosted the single radio performance to multi-gigabit per second. To evaluate the performance of Ruijie's flagship Wi-Fi 6 access point, the RG-AP880-I, Tolly engineers used one Spirent MX2 Wi-Fi test module as the single client to be wirelessly connected to the Ruijie RG-AP880-I access point. With 8x8 MIMO, eight spatial streams and 80MHz bandwidth,

the Spirent test tool recorded consistent 4Gbps wireless downstream UDP throughput between the Ruijie RG-AP880-I and the client. This makes the Ruijie RG-AP880-I the fastest access point that Tolly has ever tested to the test date.
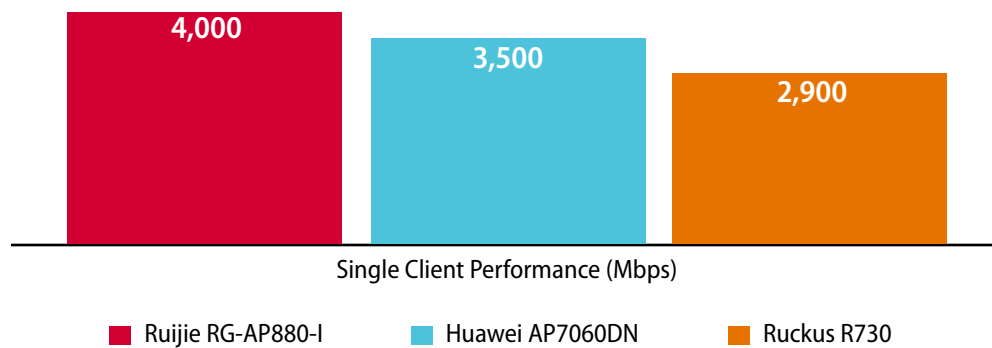
Ruijie Networks Co., Ltd.

Wi-Fi 6 Access Points

Performance Evaluation and Feature Validation

Tested January 2020

Wi-Fi 6 Access Point Wireless Performance - Single Client (8x8:8 Models)
5GHz Radio, UDP, Downstream
(reported by Spirent TestCenter)

Ethernet Client
Emulated by Spirent TestCenter

10GbE Link

RG-AP880-I

5GHz Radio

Wi-Fi 6 Client
Emulated by Spirent TestCenter
MX2 802.11AX Module

	4,000	3,500	2,900

Single Client Performance (Mbps)

■ Ruijie RG-AP880-I   ■ Huawei AP7060DN   ■ Ruckus R730

Source: Tolly, January 2020   Figure 1

2x2:2 Models

Ruijie RG-AP820-L is a cost effective Wi-Fi 6 AP which supports 2x2 MIMO on both the 5GHz radio and the 2.4GHz radio. Using a client equipped with an Intel Wi-Fi 6 AX200 network adapter, Tolly engineers evaluated RG-AP820-L's single client performance.

RG-AP820-L's 5GHz radio delivered 955Mbps downstream throughput or 909Mbps upstream throughput. RG-AP820-L's 2.4GHz radio delivered 424Mbps downstream throughput or 433Mbps upstream throughput. Ruijie RG-AP820-L's results are higher than Huawei's comparable AP AirEngine 5760-10's results in the same test condition. See Figure 2 for details.
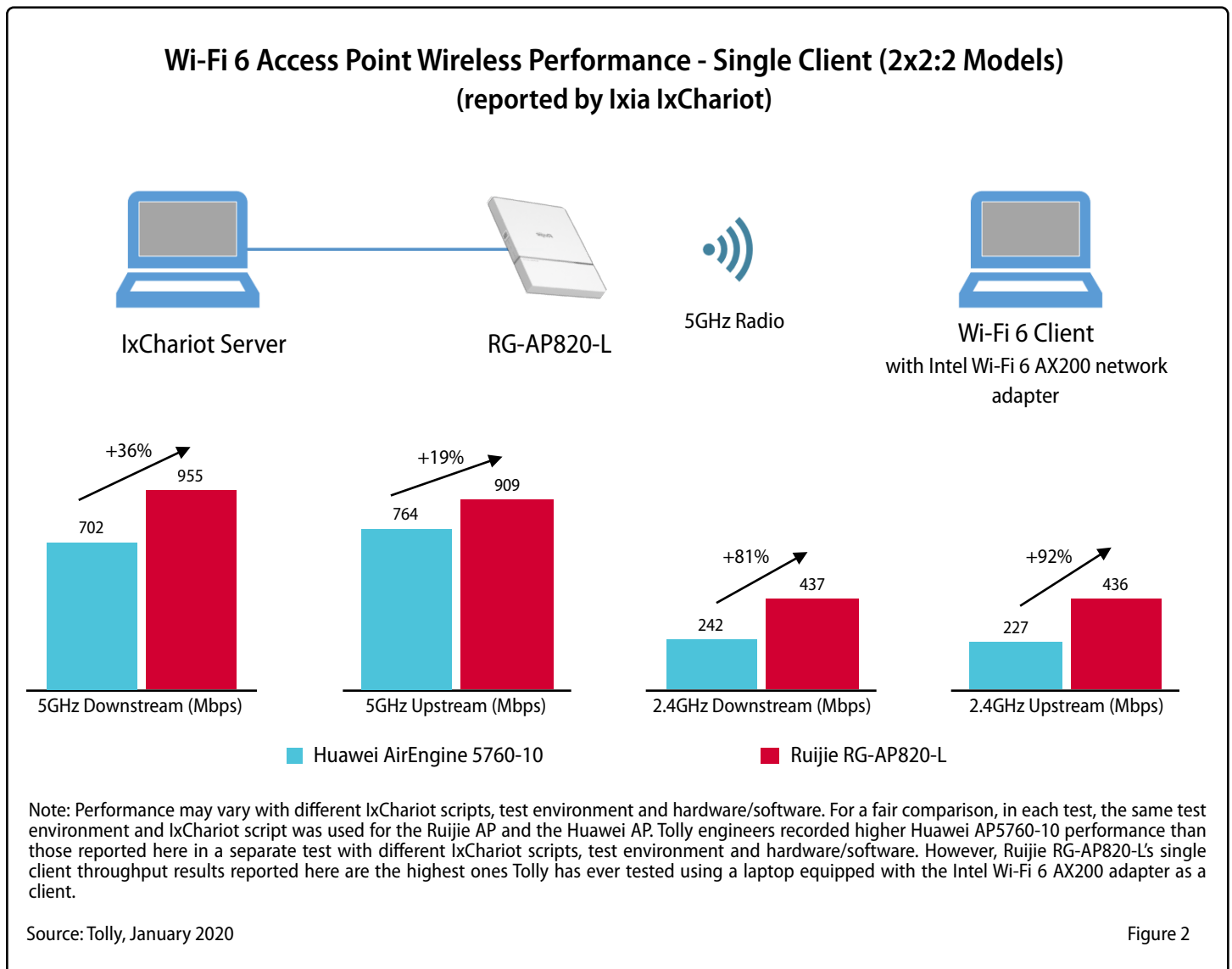

Wi-Fi 6 Access Point Wireless Performance - Single Client (2x2:2 Models)
(reported by Ixia IxChariot)

IxChariot Server   RG-AP820-L   5GHz Radio   Wi-Fi 6 Client
with Intel Wi-Fi 6 AX200 network adapter

	5GHz Downstream (Mbps)	5GHz Upstream (Mbps)	2.4GHz Downstream (Mbps)	2.4GHz Upstream (Mbps)
Huawei AirEngine 5760-10	702	764	242	227
Ruijie RG-AP820-L	955 (+36%)	909 (+19%)	437 (+81%)	436 (+92%)

■ Huawei AirEngine 5760-10   ■ Ruijie RG-AP820-L

Note: Performance may vary with different IxChariot scripts, test environment and hardware/software. For a fair comparison, in each test, the same test environment and IxChariot script was used for the Ruijie AP and the Huawei AP. Tolly engineers recorded higher Huawei AP5760-10 performance than those reported here in a separate test with different IxChariot scripts, test environment and hardware/software. However, Ruijie RG-AP820-L's single client throughput results reported here are the highest ones Tolly has ever tested using a laptop equipped with the Intel Wi-Fi 6 AX200 adapter as a client.

Source: Tolly, January 2020   Figure 2

Coverage

Engineers ran coverage tests in a dormitory's hallway. The AP under test was hang on the ceiling. Multiple clients were placed at different locations in the hallway with distances to the AP as 1 meter, 10 meters, 30 meters and 40 meters. At the 1 meter location, three latest released mobile devices (one Samsung Galaxy S10, one Apple iPhone 11, and one Apple iPad Mini) were used as clients. At the 10 meters, 30 meters and 40 meters locations, each position had one laptop with the Intel Wi-Fi 6 AX200 network adapter as the client. Then engineers ran wireless throughput test to each client independently as single client tests.

Ruijie RG-AP880-I and RG-AP820-L outperformed comparable Huawei and Ruckus access points under test at all positions. See Figure 3 for test environment and Figure 4 for results.

Coverage Test Environment

AP on ceiling

10m client

1m clients
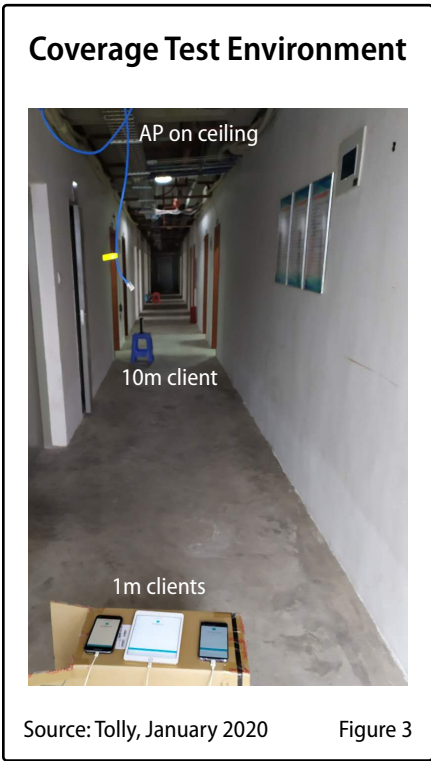
Source: Tolly, January 2020   Figure 3

Wi-Fi 6 Access Point Coverage - Single Client TCP Throughput
(reported by Spirent TestCenter)

8x8:8 Dual-Radio WLAN APs

5GHz Downstream (Mbps)

5GHz Upstream (Mbps)

2.4GHz Downstream (Mbps)

2.4GHz Upstream (Mbps)

2x2:2 Dual-Radio WLAN APs

5GHz Downstream (Mbps)

5GHz Upstream (Mbps)

2.4GHz Downstream (Mbps)

2.4GHz Upstream (Mbps)

■ Ruijie RG-AP880-I   ■ Ruckus R730   ■ Ruijie RG-AP820-L
■ Huawei AP7060DN   ■ Huawei AirEngine 5760-10

Note: Tests were run in a dormitory's hallway. Galaxy means Samsung Galaxy S10; iPhone means Apple iPhone 11; iPad means Apple iPad Mini. All these three devices were 1 meter away from the AP under test. 10m (10 meters), 30m and 40m clients were all laptops with the Intel WI-Fi 6 AX200 adapter. Tests used the TCP throughput script in Ixia IxChariot with twelve pairs of streams.

Source: Tolly, January 2020   Figure 4

Multi-Client Performance

Multimedia Streaming

Engineers used the Spirent TestCenter Wi-Fi modules to emulate Wi-Fi 6 and Wi-Fi 5 clients and evaluated the maximum number of clients that each access point can support with 1Mbps throughput to each client. 1Mbps of throughput can support general online multimedia streaming.

Ruijie's flagship 8x8:8 dual-radio Wi-Fi 6 access point RG-AP880-I supported up to 430 users of concurrent simulated multimedia streaming; Ruijie's tri-radio 4x4:4 Wi-Fi 6 access point RG-AP850-I(V2) supported up to 600 users of concurrent simulated multimedia streaming; Ruijie's 2x2:2 dual-radio Wi-Fi 6 access point RG-AP820-L supported up to 300 users of concurrent simulated multimedia streaming. Ruckus' 8x8:8 dual-radio Wi-Fi 6 access point R730 supported up to 370 users of concurrent simulated multimedia streaming. See Table 1 for results.

4K Video Streaming

Some applications, like 4K video streaming, requires very large wireless throughput. Engineers used the Spirent TestCenter Wi-Fi modules to emulate Wi-Fi 6 clients and run throughput tests. Ruijie's flagship 8x8:8 dual-radio Wi-Fi 6 access point RG-AP880-I supported up to 64 concurrent users with 30Mbps throughput to each client. The throughput of 30Mbps can support 4K video streaming smoothly.

Wi-Fi 6 Throughput

Ruijie RG-AP850-I(V2) supports three radios (one 4x4:4 5GHz radio, one 2x2:2 5GHz radio and one 4x4:4 2.4GHz radio). It provides higher overall throughput than other vendors' dual-radio access points. See Figure 5 for detailed results.

Multi-Client Performance
### Simulated Multimedia Streaming Performance
(reported by Spirent TestCenter)

AP	Number of Concurrent Users with Multimedia Streaming
Ruijie RG-AP880-I (8x8:8 dual-radio)	430
Ruckus R730 (8x8:8 dual-radio)	376
Ruijie RG-AP850-I(V2) (4x4:4 tri-radio)	600
Ruijie RG-AP820-L (2x2:2 dual-radio)	300

Note: Clients were emulated by Spirent TestCenter Wi-Fi modules. The AP under test provided minimum 1Mbps throughput to each emulated client to simulate a general multimedia streaming application scenario.

Source: Tolly, January 2020   Table 1

Multi-Client Performance
Throughput
(reported by Spirent TestCenter)

- Ruijie RG-AP850-I(V2): 629
- Huawei AP7060DN: 375
- Ruckus R730: 335
- HPE Aruba AP-515: 101

Multi-Client Performance (Mbps)
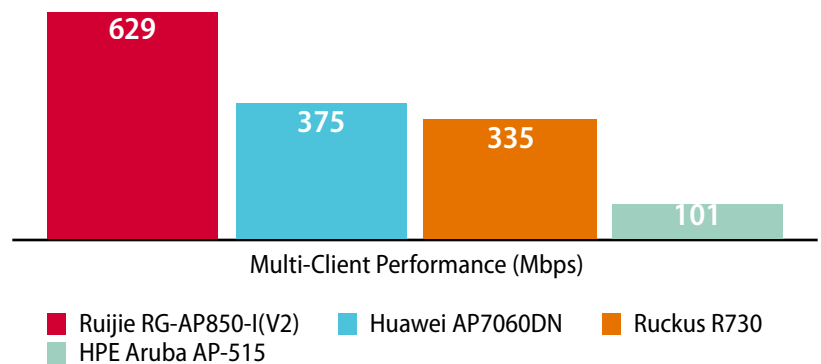
Note: Total twelve Wi-Fi 6 clients were emulated by a Spirent TestCenter Wi-Fi module to connect to the AP under test. For the Ruijie RG-AP850-I(V2) access point which supports three radios, the 2.4GHz radio had two clients connected while the two 5GHz radios each had 5 clients connected. For the other three access points which support two radios, the 2.4GHz radio had two clients connected while the 5GHz radio had 10 clients connected.

Source: Tolly, January 2020   Figure 5
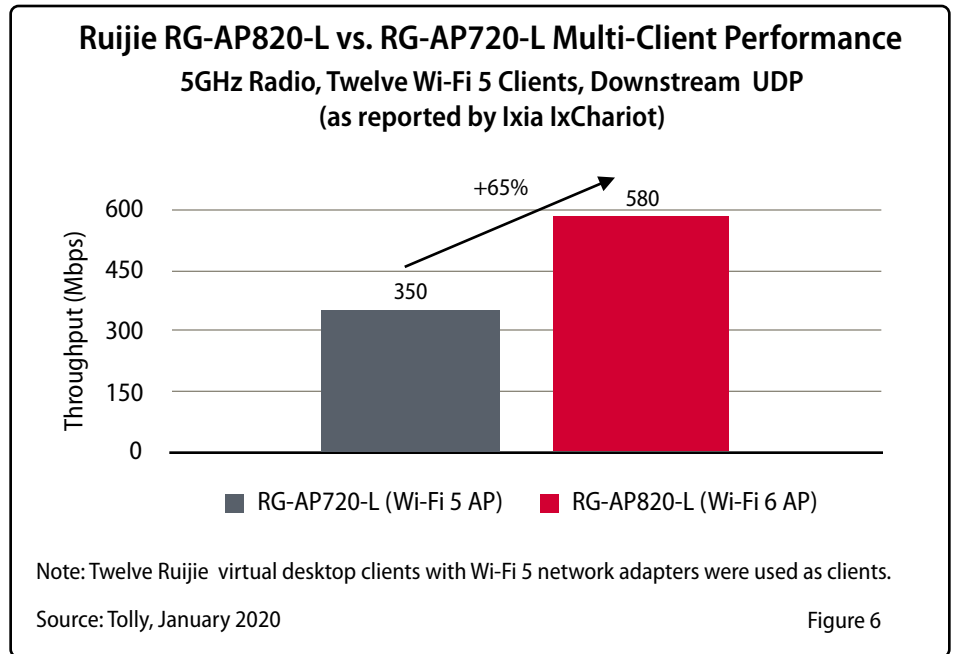
Wi-Fi 6 AP vs. Wi-Fi 5 AP

Since Wi-Fi 6 is quite a new protocol, a large portion of mobile devices on the market can only support Wi-Fi 5. Tolly engineers used twelve Wi-Fi 5 clients to evaluate whether Ruijie's new Wi-Fi 6 access point provides improvement over Ruijie's Wi-Fi 5 access point with the Wi-Fi 5 clients. Results show that Ruijie RG-AP820-L (Wi-Fi 6 AP) provide 65% higher total throughput to the twelve Wi-Fi 5 clients than the Ruijie RG-AP720-L (Wi-Fi AP). See Figure 6 for detailed results.

Ruijie's Wi-Fi 6 APs are not only future-proof but also able to provide instant improvement over the Wi-Fi 5 APs.

User Capacity

Ruijie RG-AP880-I, RG-AP840-I and RG-AP820-L each provides one 2.4GHz radio and one 5GHz radio. Tolly engineers verified that Ruijie RG-AP880-I, RG-AP840-I and RG-AP820-L each supported 1,024 Wi-Fi clients/users on one AP with 512 Wi-Fi clients/users on each radio.

Ruijie RG-AP850-I(V2) provides one 2.4GHz radio and two 5GHz radios. Tolly engineers verified that the Ruijie RG-AP850-I(V2) access point supported 1,280 Wi-Fi clients/users on one AP with 512 Wi-Fi clients/users on the 2.4GHz radio, 512 Wi-FI clients/users on the 5GHz radio 1 and 256 Wi-Fi clients/users on the 5GHz radio 2. See Table 2 for results. Ruijie RG-AP850-I(V2) is the largest user capacity access point that Tolly has ever tested to the test date.

Ruijie RG-AP820-L vs. RG-AP720-L Multi-Client Performance
5GHz Radio, Twelve Wi-Fi 5 Clients, Downstream UDP
(as reported by Ixia IxChariot)

Note: Twelve Ruijie virtual desktop clients with Wi-Fi 5 network adapters were used as clients.

Source: Tolly, January 2020   Figure 6

Ruijie Wi-Fi 6 Access Points User Capacity

	User Capacity
RG-AP880-I	1,024
RG-AP850-I(V2)	1,280 (the largest capacity test that Tolly has run to the test date)
RG-AP840-I	1,024
RG-AP820-L	1,024

Source: Tolly, January 2020   Table 2

Compatibility with Previous Generation Wi-Fi

Tolly engineers used one Windows laptop and configured the network adapter to be in 802.11b, 802.11a, 802.11g, 802.11n (Wi-Fi 4) 2.4GHz/5GHz and 802.11ac (Wi-Fi 5). The laptop successfully connected to Ruijie RG-AP880-I, RG-AP850-I(V2), RG-AP840-I, and RG-AP820-L's Wi-Fi networks in all modes.

Dual Uplink Backup

Ruijie RG-AP880-I supports two LAN Ethernet uplinks as a link aggregation group. When one link failed, the uplink data connection remained.

Uplink Bandwidth

Ruijie RG-AP880-I provides four uplink ports including two 10GbE ports (one fiber and one copper) and two copper GbE ports with a total uplink bandwidth of 22Gbps.

IoT Integration

Ruijie RG-AP880-I provides built-in bluetooth for IoT applications such as bluetooth positioning applications. Ruijie RG-AP880-I also has one IoT Ethernet port to provide PoE and data connection to external IoT modules (such as Ruijie RG-IBS1210(BT) indoor IoT extension module).

Ruijie RG-AP850-I(V2) and RG-AP840-I each has one IoT Ethernet port to provide PoE and data connection to external IoT modules.

Test Methodology

All APs under test worked in the standalone mode without wireless controllers.

Other than the coverage test, all other performance tests were run in a shielded room to avoid outside interference.

Performance tests with Spirent TestCenter as the test tool used UDP traffic with the 1500-byte frame size.

In the capacity test, a Ruijie test tool was used to simulate users and connected to the AP under test. Engineers selected a few users to ping and verify the connectivity.

Devices Under Test

AP Model	Firmware Version
Ruijie RG-AP880-I	AP_RGOS 11.9(0)B7P4
Ruijie RG-AP850-I(V2)	AP_RGOS 11.9(2)B2P2
Ruijie RG-AP840-I	AP_RGOS 11.9(0)B0
Ruijie RG-AP820-L	AP_RGOS 11.9(4)B1
Huawei AP7060DN	V200R010C00SPC600
Huawei AirEngine 5760-10	V200R019C00SPC300
HPE Aruba AP-515	8.5.0.3
Ruckus R730	112.1.0.0.504

Source: Tolly, January 2020   Table 3

Test Equipment Summary

Vendor	Product	Web
Spirent	SPT C50 Chassis MX2 802.11AX 2.4GHz/5GHz Module TestCenter	TESTED WITH SPIRENT https://www.spirent.com
Ixia	IxChariot	ixia TESTED https://www.ixiacom.com

Source: Tolly, January 2020   Table 4

Ruijie Wi-Fi 6 Access Points
Tolly Verified Performance and Features

Performance

✔	RG-AP880-I supports 4Gbps throughput on the 5GHz radio
✔	RG-AP820-L supports: 955Mbps downstream throughput on the 5GHz radio 909Mbps upstream throughput on the 5GHz radio 437Mbps downstream throughput on the 2.4GHz radio 436Mbps upstream throughput on the 2.4GHz radio
✔	Number of concurrent users for simulated multimedia applications (1Mbps throughput for each user): RG-AP880-I: 430 users RG-AP850-I(V2): 600 users RG-AP820-L: 300 users
✔	Number of concurrent users for simulated 4K video streaming (30Mbps throughput for each user): RG-AP880-I: 64 users
✔	Multi-client Throughput for the entire AP with twelve clients: RG-AP850-I(V2): 629Mbps
✔	RG-AP820-L (Wi-Fi 6 AP) had 65% performance improvement over RG-AP720-L (Wi-Fi 5 AP) with twelve Wi-Fi 5 clients
✔	User Capacity: RG-AP880-I: 1,024 users per AP RG-AP850-I(V2): 1,280 users per AP RG-AP840-I: 1,024 users per AP RG-AP820-L: 1,024 users per AP

Features

✔	Compatibility with previous generation Wi-Fi standards including 802.11b, 802.11a, 802.11g, 802.11n (Wi-Fi 4) 2.4GHz/5GHz, 802.11ac (Wi-Fi 5)
✔	Dual uplink backup as a link aggregation group (RG-AP880-I)
✔	22Gbps uplink connection bandwidth (RG-AP880-I provides one copper 10GbE port, one fiber 10GbE port and two copper GbE ports)
✔	IoT Integration RG-AP880-I with built-in and external IoT modules; RG-AP850-I(V2) and RG-AP840-I with external IoT modules

Source: Tolly, January 2020   Table 3

Ruijie Wi-Fi 6 Access Points Overview
Ruijie provided information, not necessarily verified by Tolly

Intelligently optimize the network experience based on the data of the industry's largest wireless cloud platform WIS

The 5th gen smart antenna X-sense provides 360° zero dead zone for all scenarios

The 12th gen RGOS 12.x protocol guarantees a high-reliability and low-latency network experience

Integrated IoT, BLE/Zigbee, Using IoT for interconnection between all devices

Wi-Fi 6 Equipment For All Scenarios: Always One Option Fit For You

RG-AP880-I
Remarkable versatility

RG-AP880(TR)
Perfect experience for high-density

RG-AP850-I
Tri-band Design for high-density

RG-AP840-I
IoT AP for Smart Wi-Fi Project

RG-AP820-L
Highest price-performance ratio

RG-MAP852
Mini Wall AP (i-Share) for Dormitory

RG-AP180
Smart IoT Wall AP for Hotel

RG-AP680(CD)
Ideal for Outdoor (IP68)

Tolly.

Ruijie Wi-Fi 6 Access Points Overview
Ruijie provided information, not necessarily verified by Tolly

Smart Scenario-oriented Deployment-- AP880-I

Directional antenna
60-degree directional coverage for high-density deployment

Omnidirectional antenna
360-degree horizontal omnidirectional coverage, covering a wider area

Dual-band omnidirectional antenna
Reduce the number of antennas and enhance the isolation between antennas

Dual-feed antenna
Patented technology: The single antenna with dual ports guarantees the Bluetooth performance and reduces the number of antennas

- Stacked ultra-high-density antenna design
- Smart scenario-adaptive design

5.95G

Dual-10G (fiber + copper)

IoT

| 4.8G+1.15G=5.95G | Wired uplink speed per AP: 22G | Built-in and external IoT |

Hybrid Management

All Ruijie enterprise APs support hybrid management mode

Customers can choose either below wireless controller options depending on the functionality and capacity

Standalone
Simple & basic connectivity

Private/ Public Cloud Management
Scalable for diversified customer sites

Hardware Controller
High performance for campus network

Powered by MACC

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