



## Inovatian Mesh Technology

### InoMesh Specifications & System Performance Q&A

#### **WMN Technical Requirements and specifications:**

In this part, we analyze technical specifications and requirements for the Wireless Mesh Network:

#### **General Requirements**

**WMN.R1** : WMN shall be self-organizing, self-balancing and self-maintained network, by the nodes automatically built mesh connection among themselves.

When one node can no longer operate, the rest of the nodes can still communicate with each other, directly or through one or more intermediate nodes.

#### **Answer:**

This feature is available in Ubiquiti 5Ghz Devices with our InoMesh™ Firmware. They automatically without any operator interference reconfigure themselves based on the available resources, this is done within 9 seconds in the InoMesh.

**WMN.R2** : WMN that contain multiple hops may become vulnerable to performance problems such as bandwidth degradation, radio interference and network latency.

In extreme case, the maximum number of hops that can be configured and explain the impact on the network performance (throughput, latency, interference ...).

#### **Answer**

InoMesh supports up to 4 Hops with reasonable data rates, typically;

- 1 hop - 50% of the possible bandwidth.
- 2 hops - 25% of the possible bandwidth.
- 3 hops - <10% of the possible bandwidth.
- 4 or more hops - it stabilizes at 7% of the available bandwidth.



**WMN.R3 :** Radio interference is a serious issue that affects the performance of any wireless mesh network since when any part of the network is affected, the overall network performance degrades (mainly if wireless access and backhaul share the same radio).

WMN shall support a radio Interference protection/cancellation mechanism to limit interference impact.

**Answer**

InoMesh uses 5GHz frequency band for mesh connectivity and mesh nodes use non-overlapping channels to avoid interference. If interference is detected the controller (an intelligent switch between the mesh and the internet) will manage switching the units to another channel. We do not recommend that the units do this function all by themselves since with a large mesh much of the bandwidth (possibly 90%) is wasted on this function. We do not recommend using the same radio for mesh and access at the same time. This has drastic effects on the bandwidth since coordination between both functions between multiple devices is wasteful of bandwidth.

Our UniFi units, mostly APs, follow the 802.11 standard that has built in dynamic channel allocation based on interference.

**WMN.R4 :** the wifi mesh network shall support a seamless mobility/roaming inter AP.

**Answer**

With our InoMesh Node Clients can seamlessly hop between Mesh nodes without experiencing any disconnections. The MAC address is bound to a particular IP address. The controller controls the user session and will maintain it if the user moves from one AP to another within the same network. If a user is sitting at the edge between two APs and keeps switching between them, this could lead to poor performance. However, the controllers can in this case force the user to stay within one AP.

**WMN.R5 :** WMN shall support security mechanism for authentication and encryption (for both wireless access and wireless backhaul interfaces). What are the supported security standards?

**Answer**

We are Using Separate frequency for Backbone Mesh Devices (5Ghz) and End User device (2.4 Ghz) to avoid interference. We do not broadcast the mesh SSID to make things more difficult for the amateur hacker.

UAP-AC-PRO AP supports

WEP, WPA-PSK, WPA-Enterprise (WPA/WPA2, TKIP/AES)



### **Access Point Requirements**

**AP.R1:** WiFi Access Points (AP) must be compliant with IEEE802.b/g/n standards in order to have flexibility in term of frequency band, offered throughput and bandwidth.

Should specify the 802.11 protocol compliance.

#### **Answer**

Ubiquity Bullet HP M2 and M5 support 802.11b/g/n and 802.11a/n respectively.

Ubiquiti UniFi AP supports 802.11 a/b/g/n/ac

Dual-band upto 3X3 Mimo Technology and convenient 802.3af PoE+ compatibility..

**AP.R2:** WiFi AP must be able to cover indoor and outdoor deployment scenarios.

Indoor AP should interoperate with Outdoor AP and vice versa.

#### **Answer**

UniFi AP provides support for indoor deployment it has a weather proof design, UniFi AP features simultaneous, Dual-band, up to 3X3 Mimo Technology and convenient 802.3af PoE+ compatibility.

**AP.R3:** WiFi AP shall offer automatic discovery and must be self-configured from Access controller.

#### **Answer**

Feature is available in UniFi AP and Bullet HP M2 and M5.

**AP.R4:** WiFi AP shall offer possibility to balance traffic (User & Backhaul) between 2.4 & 5 Ghz frequencies band.

#### **Answer**

We recommend using separate radios for mesh and access. We recommend the mesh to be in the less popular 5GHz band and the access to be in the more popular 2.4GHz band. This is because of the abundance of devices in the 2.4GHz band. In this scenario, balancing is achieved automatically. Support is available for both indoor and outdoor APs.

UniFi AP is dual band and capable of load balancing.

**AP.R5:** WiFi AP must be interoperable with all WiFi products compliant with IEEE802.11b/g/n/s



**Answer**

Supported by both indoor and outdoor APs

**AP.R6:** AP WiFi must support automatic/manual-configured power control feature.

**Answer**

Support Available for Both indoor and outdoor APs

**AP.R7:** WiFi AP must support 2.4 and 5 GHz frequencies band.

**Answer**

The devices we use all have a country setting and automatically comply with the regulations of the country set. We will focus on parts of the 5GHz band for our mesh and access functions.

Our UniFi APs support dual band operation. Our Bullet M2 and M5 are band specific.

**AP.R8:** WiFi AP must support BPSK, QPSK, 16 QAM and 64 QAM modulation scheme.

**Answer**

Support is available for both indoor and outdoor APs.

**AP.R9:** WiFi AP shall be modular and shall operate on multi-radio, multi-channel and multi RF mode.

**Answer**

Both indoor and outdoor APs support multi-radio multi-channel and multi RF modes. The UniFi AP is simultaneous dual band.

**AP.R10:** WiFi AP shall support Dynamic Channel/Frequency Assignment. This feature will allow AP to change Channel/Frequency when there are interference/bad SNR.

If supported, should specify in which frequency band is applicable (2.4 Ghz or 5 Ghz or both).

**Answer**

Yes Support Available for Both indoor & Outdoor APs accordingly we can configure them.

IEEE 802.11 b/g/n: 2.4 – 2.484 GHz

IEEE 802.11a/ac: 5.15 – 5.25 GHz; 5.47 – 5.725 GHz; 5.725 – 5.85 GHz.



**AP.R11:** specify all supported power source (AC, DC, PoE...).

**Answer**

Standard 802.3af Power over Ethernet (PoE), the units come ready for AC power. A power injector is available with every unit (when a mesh unit is combined with an AP, they are housed in a plastic pipe), and the power injector is placed within the pipe. The only input to such a device is AC power. DC power is optional but must be stated in the purchase order.

**AP.R12:**

specify the supported radio mode.

- Single radio mode : one channel (a half-duplex connection) is shared by all traffic (wireless access and wireless backhaul...)
- Dual radio mode : one radio is dedicated to wireless access traffic and the other radio is dedicated to wireless backhaul traffic, this mode offers minimal improvement with bottleneck still existing in the shared backhaul connection (ingress and egress traffic) since wifi connection is half-duplex.
- Multi-radio mode: a dedicated link interfaces for backhaul and user traffic: One radio for wireless client traffic, a second radio for ingress wireless backhaul and a third radio for egress backhaul traffic, this mode allows for dedicated backhaul links that can transmit and receive simultaneously because each link is on a separate channel.

**Answer**

We recommend using a separate radio for the mesh functionality and another for the access functionality with the mesh in 5GHz and the access in 2.4GHz or 5GHz as desired or needed for the particular environment.

Our Unifi AP is dual band concurrent 2 x 2 (and 3x3):2 stream radios, Admission control/load balancing, band balancing

- IEEE 802.11g/n 2.4-2.472GHz (ch1-13 CE, ch1-11 US) • IEEE 802.11ac 5GHz

**Antennas:**

**AN.R1:** Based on deployment scenario, WiFi AP must be equipped with separated or integrated omni and directive antennas.

**Answer**

Ubiquiti Bullet HP M2 and M5 have an external antenna connected via a reverse type N connector. We can supply directional, Sectorial, and Omni antennas for these units.



UniFi AC Pro AP having (3) Dual-Band Antennas, 2.4 GHz: 3 dBi, 5 GHz: 3 dBi

**AN.R2:** Antennas shall ensure coverage radius at least between 30-50 meters for indoor scenario and between 100-300 meters for outdoor case.

**Answer**

Feature available for both indoor and outdoor APs

**AN.R3:** Antennas shall support at least 2\*2 MIMO technologies.

**Answer**

Yes Feature Available for both indoor and outdoor APs on the UniFi product. Some UniFi models have 3 x 3 MIMO.

AN.R4: WiFi AP must support Mesh technology (compliant with IEEE802.11s).

**Answer**

Yes Feature Available for indoor and outdoor APs

**AN.R5:** Antennas shall offer a good sensitivity for higher throughput.

**Answer**

UniFi AC Pro AP

Integrated 5 dBi Omni (Supports 3x3 MIMO with Spatial Diversity)

**Access Controller Requirements**

**AC.R1 :** the Access Controller shall be centralized and shall control and manage all AP (several WMN sites).

shall specify AC capacity: maximum number of AP.

**Answer**

UniFi Controller software can manage unlimited concurrent APs.

We also use an intelligent network switch on each mesh network at its connection to the internet. This switch provides full control over the various functions of the units, we use a 1Gbps switch that can simultaneously control 2000 users with 200APs.

**AC.R2 :** the Access Controller shall support a virtualized Server (VM) deployment.

shall specify the characteristic of the server.



If the Access Controller couldn't be virtualized, shall specify the HW architecture and all technical requirement.

**Answer**

UniFi Controller supports virtual server. However, this is only for the control of UniFi products. To support all units on the mesh and APs, we use an intelligent network switch with a centralized controller over the cloud that can connect to the various switches and control the various units.

**OM & OSS Requirements**

**OM.R1:** describe the overall O&M centralized architecture, including AP management with AC.

**Answer**

UniFi Controller's and the Switch Controller's open architecture allows you to include unlimited content while keeping development simple through the use of plain .html (hand code or use any editor of your choice). Testing is simple and immediate; simply reload changes from any browser. The software produces alerts and alarms to indicate faults in the network.

**OM.R2:** OM & OSS solution shall support Fault Management (Alarms), Performance Management (Kpis).

Each error either OMC or NE side that impact feature or need human intervention will raise a categorized alarm.

specify the main available Kpis (ie Max/AVG Throughput per AP and per User, Nb of concurrent/associated users per AP ...)

**Answer**

UniFi Controller and the Switch Controller allow operation of all APs and alerts on faults. Faults will generate alarms on the screen and can generate emails to be sent to the relevant parties. We can generate alarms for MAX throughput reached by a user, user using VoIP, user downloading video, number of concurrent users exceeding a threshold, capacity of network reached; number of users on an AP exceeds a threshold. Practically any statistic could be used to generate an alarm if exceeds a certain level.

**OM.R3:** FM External interface: OMC shall offer bi-directional northbound interface toward a Temip like system (TMN compliant).

**Answer**



Support is available with UniFi Controller and the Switch Controller. Both generate TMN compliant alarms and alerts that can be integrated with Temip like system. We can also connect with HP Open view.

**OM.R4:** Maximum simultaneous user's sessions: describe administration of number of logged users & provide maximum number of simultaneous user's sessions.

#### **Answer**

UniFi Controller and the Switch Controller offer unlimited Number of Users Simultaneously. However, we recommend not more than 30 simultaneous user sessions on the same AP, The number of logged users per AP should not exceed 100. The number of users logged within a given network should not exceed 2000. To have more than 2000 users, we just need to use a larger switch.

**OM.R4:** AP shall be fully managed remotely (by AC or OSS tools), allowing downloading of system configuration, equipment software or system operation firmware changes.

#### **Answer**

One-click provisioning

- Downloads AP configurations from the cloud automatically

Simplified deployment

- Simplifies configuration by applying consistent configurations and firmware to a group of APs.
- Smart Meshing streamlines costly and complex deployment.

Monitoring

- Enables quick views of the health of the network, APs, connected devices, and alerts.
- Provides detailed views of the AP status and client data.

Remote troubleshooting

- Speeds problem resolution across multiple sites with easy drill-down menus.
- Enables IT to perform troubleshooting commands from the cloud

Reporting

- Creates scheduled or on-demand network and security reports.
- Delivers PCI-compliance reports for compliance.





## **Backhauling & Transmission Specification**

**Tran.R1:** MPGW shall support also optical interfaces to support huge traffic.

List the type and number of supported network interfaces for the backhauling in the proposed MPGW (indoor and outdoor). For the optical interface, the Vendor should list all supported SFPs.

### **Answer**

Our units connect to external devices via Ethernet. The switch that sits between the gateway and the cloud could be configured with an optical pigtail (SFP-10GCU1M)

**Tran.R2:** Wi-Fi AP should support the interconnection to its Wi-Fi controller across a layer-2 and layer-3 network.

### **Answer**

UniFi Controller and the Switch Controller (for InoMesh) have this support

**Tran.R3:** Both indoor and outdoor Wi-Fi AP must support the mesh networking for adhoc topologies and should be compliant with the IEEE 802.11s (amendment for mesh networking) standard.

If IEEE 802.11s is not supported, the Vendor should list the used proprietary protocol:

### **Answer**

IEEE 802.11a/b/g/n/ac

We also use one of two proprietary protocols: InoMesh that is a substantial modification of the OpenWRT and hyMesh™ which is a patented protocol also based on the OpenWRT.

**Tran.R4:** Routing is a fundamental characteristic of WMNs, it shall provide:

- Reliability: The routing protocol should be able to reroute fast around failed nodes and broken links; upon the failure of a MP, it should be able to redistribute the orphaned clients among neighboring MP. For this property, fast reconfiguration and support of multiple gateways is essential.
- Mobile user connectivity: To ensure seamless mobile user connectivity, the routing protocol should enable fast hand-offs.



- Scalability/efficiency: If the routing protocol has a high overhead, it will be impossible to scale the WMN to a large number of nodes.
- QoS: In addition to support from the medium access control (MAC) layer and the forwarding engine, selecting the “best” routes for different traffic classes is an essential ingredient for QoS support. The radio link performance between hops shall be considered in the “best” routes metric calculation.

specify all routing protocol supported by WMN solution.

**Answer**

The WMN supports proprietary Layer2/Layer3 routing protocol.

The routes are chosen based on the best RSSI which in the case of WiFi translates to the best speed.

The overhead of the protocol used is minimal. By avoiding looping and the hidden node problem, we removed a lot of the waste of other mesh standards including the 802.11s.

InoMesh provides the capability to test any individual hop for speed and can provide RSSI information for each node of a hop.

The user connectivity is maintained through the switch that oversees the whole network. If a user moves between APs in the same mesh network, the switch will maintain its IP address that is bound to its MAC and will accordingly maintain the session.

**Tran.R5:** Wi-Fi AP must support IEEE 802.1Q VLAN tagging and the mapping of one or many SSID to a specific VLAN.

specify if Wi-Fi AP support IEEE 802.1ad Q-in-Q.

**Answer**

Multiple SSIDs and VLANs are supported for high-speed Internet access and other services

**Tran.R6:** specify which spanning-tree versions are supported in its Wi-Fi AP

**Answer**

STP supported



**Tran.R7:** Wi-Fi AP should support the following quality of service features:

- IEEE 802.1p and L2 QoS.
- DiffServ and L3 QoS.
- DiffServ Code Point and Priority Code Point marking
- Implement a scheduling mechanism which treats real-time traffic flows with Strict Priority (SP) and it allows configuring weights to schedule fairly non-real time traffic.
- Traffic Policing and shaping.

specify the number of supported QoS queues.

describe the QoS supported features in the proposed APs.

**Answer**

Advanced QoS packet classification and automatic priority for latency-sensitive traffic in zoneflex-R500 and Smart QoS for Zone flex T-300

**Tran.R8:** MPGW shall support also optical interfaces to support huge traffic.

**Answer**

Support is available on the switch. The gateway supports 10-100-1000 Ethernet.

**Tran.R9:** specify if Wi-Fi AP supports multicast traffic replication

**Answer**

WiFi AP Supports multicast traffic replication.

**Tran.R10:** Wi-Fi AP should be capable to connect UE (fixed or mobile) operating in IPv4-only, IPv6-only, or in dual-stack mode, specify the list of supported IPv6 protocols.

**Answer**

Both IP v4 and v6 user equipment is supported on our APs.