Wireless Throughput Calculations and Limitations

This article provides details on MR Access Points' advertised maximum data transfer rates and how they are calculated, including:

- Limitations and factors affecting throughput
- Maximizing throughput
- Testing Client-to-Access Point throughput
- Cisco Meraki Access Point Throughput Rates

Limitations and Factors Affecting Throughput

First and foremost, throughput to the Internet is capped by the ISP and devices upstream of the APs. Also, 802.11 is a shared medium and is limited by other devices connected to the wireless. Therefore throughput should always be considered aggregate throughput. Interference (radio, physical, electrical) and the distance from client device to the Access Point are two major factors that have a negative impact on observed maximum throughput. Physical obstacles, other wireless networks and even everyday household devices like computers, microwaves, and televisions increase interference significantly, especially on the 2.4GHz band.

The half-duplex nature of wireless combined with other overhead also means that the actual aggregate throughput is typically 50 percent or less of the data rate. It is theoretically possible for 802.11n-capable wireless clients to achieve speeds as high as 100Mbps or more depending on the MIMO capabilities of the AP and the wireless client. However, wireless clients operating at 802.11b/g/a can cause 802.11n users to slow to less than 54Mbps because the radio must adjust to the lowest common denominator.

The nature of WiFi technology makes throughput hard to predict. Therefore, network administrators should maintain reasonable expectations for connection speeds and keep the above factors in mind.

Maximizing Throughput

Optimal throughput rates and wireless performance in general can be improved by mounting APs correctly (high up on a wall or on the ceiling). Additionally, placing APs away from kitchens and other areas with high interference will also result in better performance. In a mesh environment, throughput rates will be significantly better with fewer hops to the
Meraki recommends that the end user is located no more than 3 hops away from the gateway. Each hop will reduce the bandwidth by 50%. For example, a 6 Mbps connection to a gateway will reduce to 3 Mbps at the second hop and 1.5 Mbps at the third hop.

**Testing Client-to-AP Throughput**

When testing the throughput of a Cisco Meraki MR Access Point, it is important to remember that any advertised value is the **theoretical total maximum** data transfer rate (transmit and receive) for the AP’s radio(s). Device-to-AP speeds should always be tested using a tool like the Access Point to Client Speed Test available on the Local Status page, my.meraki.com, under Client survey tools (and not a tool like speedtest.net). The Access Point to Client Speed Test tool is especially useful when distinguishing between bandwidth constraints on the Meraki network (ex. repeater AP to gateway) and bandwidth constraints of the Internet connection (gateway to Internet).

**Cisco Meraki Access Point Throughput Rate Calculations**

Please note that the following throughput rates are **theoretical** for the **whole access point**, any individual client will be subject to many additional environmental factors that can affect their throughput.

**Indoor APs**

MR12: Theoretical maximum data transfer rate of 300Mbps

One 2.4GHz radio

Multiple input, multiple output with two spatial streams

\[150\text{Mbps} \times 1 \text{ radio} \times 2 \text{ streams} = 300\text{Mbps}\]

See Datasheet [here](#)

MR16/18: Theoretical maximum data transfer rate of 600Mbps

One 2.4GHz radio

One 5GHz radio

Multiple input, multiple output with two spatial streams

\[150\text{Mbps} \times 2 \text{ radios} \times 2 \text{ streams} = 600\text{Mbps}\]
MR24/26: Theoretical maximum data transfer rate of 900Mbps

One 2.4GHz radio

One 5GHz radio

Multiple input, multiple output with three spatial streams

150Mbps x 2 radios x 3 streams = 900Mbps

See Datasheet here

MR32: Theoretical maximum data transfer rate of 1170Mbps

One 2.4GHz radio

One 5GHz radio

Multiple input, multiple output with two spatial streams on 80MHz-wide channels

2.4 Ghz: 150Mbps x 2 streams = 300Mbps

5 GHz: 433.33Mbps x 2 streams = 866.66Mbps

Total: 1.1666Gbps

See Datasheet here

MR34: Theoretical maximum data transfer rate of 1755 Mbps

One 2.4GHz radio

One 5GHz radio

Multiple input, multiple output with three spatial streams on 80MHz-wide channels

2.4Ghz: 150Mbps x 3 streams = 450Mbps

5Ghz: 433.33Mbps x 3 streams = 1300Mbps

Total: 1.75Gbps
Outdoor APs

MR62: Theoretical maximum data transfer rate of 300Mbps
One 2.4GHz radio
Multiple input, multiple output with two spatial streams

**150Mbps x 1 radio x 2 streams = 300Mbps**

See Datasheet [here](#)

MR66: Theoretical maximum data transfer rate of 600Mbps
One 2.4GHz radio
One 5GHz radio
Multiple input, multiple output with two spatial streams

**150Mbps x 2 radios x 2 streams = 600Mbps**

See Datasheet [here](#)

MR72: Theoretical maximum data transfer rate of 1170Mbps
One 2.4GHz radio
One 5GHz radio
Multiple input, multiple output with two spatial streams on 80MHz-wide channels

**2.4 Ghz: 150Mbps x 2 streams = 300Mbps**

**5 GHz: ~450Mbps x 2 streams = 900Mbps**

**Total: 1.2Gbps**

See Datasheet [here](#)
See Datasheet here