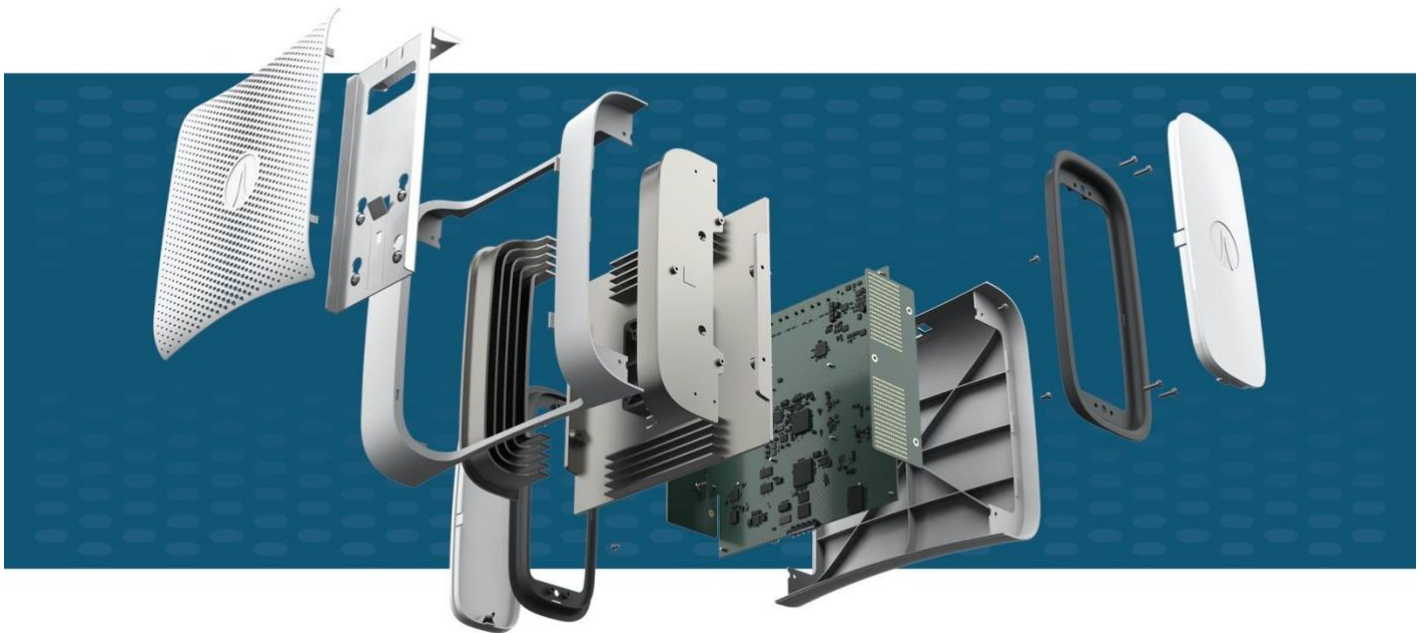




Airvine WaveTunnel™

Frequently Asked Questions



| | |
|--|---|
| <i>RF</i> | 1 |
| <i>Interfaces and Power</i> | 2 |
| <i>Performance and Operation</i> | 3 |
| <i>Planning and Deployment</i> | 6 |
| <i>Roadmaps</i> | 7 |
| <i>Comparisons</i> | 8 |

RF

What are the Fresnel Zone recommendations?

Using the ceiling mount bracket that ships with the WaveTunnel™, 4 inches of drop from the ceiling provides over 70% open path for Fresnel zone clearance for hops less than 24 meters.

For distances above 24 meters, use the 6-inch configuration on the bracket and over 48 meters, use the 8-inch configuration on the bracket.

What is the system loss in dB at 45° compared to a bore site performance?

Beam steering from 0° boresight to ±45°, antenna gain is reduced by up to 2dB. This is a linear effect model.

Automatic Gain Control (AGC) allows for the amplification of received signal and can typically correct for any dB loss introduced by beam steering configurations.

How is the RF focused? Is the beamforming adaptive?

Airvine uses a 64-element flat panel antenna array to create an adaptive beamforming and beam steering link between WaveTunnel™ bridges.

Why does Airvine use 60GHz instead of 2.4, 5 or 6GHz?

Airvine chose to use 60GHz due to the small wavelength (approx. 5 mm) of the frequency that allows for the construction of a very compact antenna array required to achieve the high gain necessary to penetrate indoor obstacles like walls and deliver multi-Gigabit speeds avoiding interference from other unlicensed spectrum devices.

How does Airvine penetrate walls with 60GHz when no one else has done this?

Wall penetration is a function of high system gain. The WaveTunnel™ PHY design generates enough system gain through a combination of technologies, some patented, to overcome most indoor wall attenuation.

What is dB loss through various building materials?

Some sample losses: painted sheetrock – 0.6dB/cm, Wood – 1.3dB/cm, Glass - 4.3dB/cm

A dB loss “VineCalculator” is available on the Airvine website:

<https://services.airvine.com/calculator/>

What is the beam width of the WaveTunnel™ antenna pattern?

The WaveTunnel™ antenna pattern is $\pm 3^\circ$ horizontal and $\pm 9^\circ$ vertical.

Do I need to post any RF emissions signs to utilize WaveTunnel™ with my network?

No. WaveTunnel™ complies with FCC EIRP limits and does not require any safety signage.

Interfaces and Power

Do WaveTunnel™ bridges support a fiber connection?

The current WaveTunnel™ product does not have an SFP interface, but this is a roadmap item for later in 2024.

An industry media converter may be used to connect a WaveTunnel™ to a fiber backbone.

Are WaveTunnel™ ports Gigabit or Multi-Gigabit?

WaveTunnel™ ports are 1Gbps with 2.5GE and 10GE on the roadmap for later in 2024.

Can a WaveTunnel™ be powered by PoE?

WaveTunnel™ nodes must be powered by the power brick that ships with the unit.

If a WaveTunnel™ is connected through an Ethernet cable to an active PoE interface, will it damage the WaveTunnel™?

Yes, a WaveTunnel™ may be damaged if connected to an active PoE interface.

Disable the PoE out on an interface before connecting it to a WaveTunnel™.

What is the power available on the PoE ports on the WaveTunnel™?

The WaveTunnel™ has 4 Gigabit Ethernet ports that are PoE out with a PoE budget of 120 watts total across all 4 ports. Each port can be independently configured for 0, 15, 30 or 60 watts up to the power budget limit.

Do WaveTunnel™ nodes have auto cut off on PoE if it exceeds 120W?

A WaveTunnel™ port will not provide power beyond what the port is configured for.

Performance and Operation

What is the max recommended number of nodes in a WaveTunnel™ topology?

The number of nodes is limited by throughput capacity requirements and the amount of latency supported applications can tolerate. Latency is around 2ms per hop.

The number of clients, idea of the applications, and bandwidth requirements that will be running across the WaveTunnel™ backbone should be designed for roughly 80% of the available capacity.

Airvine has tested in our labs a configuration with 6 WaveTunnel™ nodes.

What is the WaveTunnel™ minimum distance for maximum performance/throughput?

Minimum distance for optimized WaveTunnel™ throughput is estimated at greater than 3 meters for the signal processing to set up the beamform.

What's the maximum distance limit between nodes?

WaveTunnel™ nodes are spec 'ed at up to 100m distance to preserve performance but longer distances are achievable. For longer-distance installations, Fresnel zone considerations will need to be made.

Testing has been done over 220 meters in a manufacturing facility with over a Gigabit per second throughput.

What is the current maximum throughput that we are seeing?

Around 1.3-1.5Gbps depending on packet size and application.

Do you attach Wi-Fi access points to WaveTunnel™ units to provide client access?

Correct, the four PoE interfaces commonly are connected to Wi-Fi access points for client connectivity, IP security cameras, IoT gateways or other network end-nodes.

Can you have multiple root nodes?

A WaveTunnel™ chain or ring topology is created with an initial node that is configured as a Root node. After this, any node added to the topology can be labeled as a Root node, Leaf node, or any other label preference.

Any node in the topology is allowed to connect to a network backbone switch port or ports. WaveTunnel™ nodes run a spanning-tree like protocol to eliminate the concern of network loops.

With multiple links to the network backbone, if the Root node fails or becomes disconnected, the WaveTunnel™ chain or ring would continue to function, and traffic would be re-routed.

Can a Wave Tunnel™ network be considered as a back-up system for existing wired infrastructure?

Yes, as a completely independent network, a system of WaveTunnel™ nodes is an ideal backup solution.

Can a WaveTunnel™ penetrate stucco, or a pillar as opposed to dry wall?

This is not recommended, the attenuation per cm or inch for those materials is too high.

When you have a temporary line of sight blockers such as metal, how do you recover from that momentary loss?

WaveTunnel™ links that are broken by a high attenuation material are automatically recovered within a few seconds after the blocking material is removed.

What happens again if a node fails?

In a ring topology, the system will detect the loss of traffic and re-route traffic around the ring.

In a chain topology, if redundant paths are configured, traffic will automatically be re-routed to the alternative network path.

What if any QOS features are supported with the WaveTunnel™?

The WaveTunnel™ bridges integrated smart switch will honor Type of Service (ToS) and DSCP bits with future enhancements on the roadmap.

Are there any limitations to attaching a wireless mesh cluster to a WaveTunnel™? For example, one backhauled Ruckus unit serving several mesh units in each area.

No, this type of configuration is allowed. The limitation of the WaveTunnel™ network is in the capacity of the WaveTunnel™ backhaul capacity to be able to supply network requirements.

Planning and Deployment

Does the WaveTunnel™ offer a diagnostic traffic testing tool?

The WaveTunnel™ diagnostic testing tool is used to get real-time data-link feedback. Please note that as the tool is not capped, network performance will be affected while the tool is in use.

The performance test utilizes netperf with 1518-byte TCP packets over IPv6, port 12865

What are the color definitions for the VineCalculator?

When using the VineCalculator to determine the viability of a given WaveTunnel™ link, the tool outputs one of three possible results – Green, Yellow or Red. The definitions for these results are defined here.

Green: A green result from the VineCalculator tool indicates that the path defined will support a minimum 1Gbps throughput with high availability, i.e. virtually no down time due to RF path issues.

Yellow: A yellow indication from the VineCalculator tool indicates that the link defined is marginal. While it may operate properly most of the time, the link margin is small and as a result performance and availability may be marginal.

Red: If the VineCalculator returns a red result, this means the defined path is not a viable link for the WaveTunnel™ units. The units will either not achieve a connection or if a link is created it will suffer extensive downtime and subpar performance.

Can I incorporate a WaveTunnel™ with my Ethernet based Distributed Antenna System? (Corning Spidercloud, CommScope ONECELL, Ericsson DOT)

If your DAS network (Public or Private) does not require handoffs to an external network, then WaveTunnel™ nodes can be used to assist in distributing your internal network.

If your DAS network (Public or Private) DOES require handoffs to an external network, Airvine is actively working on implementing the timing required to assist in these handoffs with estimated availability in late 2024.

What is the maximum angle a WaveTunnel™ can support?

The WaveTunnel supports angles up to $\pm 45^\circ$. This is ideal for going around 90° corners.

Is there any licensing involved in the solution?

There are no license fees. WaveTunnel™ bridges run on the unlicensed 60GHz spectrum.

Roadmaps

Any plans in the roadmap to provide integrated AP?

Not currently. Airvine is essentially a wireless backhaul switch that uses the 60GHz frequency to connect WaveTunnel™ bridges instead of copper or fiber. WaveTunnel™ PoE ports are commonly used to connect Wi-Fi access points from industry manufacturers.

Any plans to add a small, low powered CPE device to the system, so a remote wireless camera for example can attach to the system without a WLAN present?

Adding an IoT gateway to the WaveTunnel™ product line is a consideration.

Do you support Cellular indoor small cells?

We do not support LTE small cells at first release. We do, however, have this in our roadmap to support 1588v2 in 2024.

Comparisons

How is the Airvine solution different from the Qualcomm solution demonstrated in MWC a few years ago?

[60 GHz Wi-Fi technology evolution video](#)

There are a couple of differences that we can see.

First, the Qualcomm solution is a mesh implementation using wide angle antennas. This opens the entire network up to interference, either externally or via self-interference.

Second, they are using mesh in a line-of-site mode to route around barriers that the WaveTunnel™ solution blasts through, NLOS.

Mesh solutions decrease performance by about half throughput at each hop. Airvine WaveTunnel™ nodes have a dedicated upstream and downstream radio to maintain network throughout the entire WaveTunnel™ topology.

How does the cost compare to re-wiring in general?

It is difficult to cite a single number on cost savings. The reason for this is that the largest cost component involved in running cable/fiber is the labor. And labor cost is highly variable depending on if you are in a dense urban city or a more rural location. What we can say is deploying WaveTunnel™ is almost always less expensive than re-wiring.

Is there a plan to update to the new 60 GHz standards?

The WaveTunnel™ system is a closed network and does not connect to 3rd party 60GHz clients so does not follow industry 60GHz standards. There are currently no plans to build a 60GHz 802.11ay compliant product but Airvine does plan on building a higher capacity WaveTunnel™ product that utilizes the 60 GHz frequency.

[Visit the Airvine website for the most current FAQs.](#)