Frequently Asked Questions

SEPTEMBER 2020

AIRVINE

EXECUTIVE SUMMARY

Airvine has developed the first ultra high-capacity all-wireless backbone solution designed for indoor enterprise environments across a variety of vertical markets including hospitals, warehouses, and manufacturing facilities to name a few.

As organizations migrate to higher-speed wireless access technologies, such as the new Wi-Fi 6 standard, pressure is being placed on the enterprise backbone networks to aggregate and reliably transport multi-gigabit traffic in a flexible and economical fashion.

Legacy approaches to upgrading enterprise backbones to accommodate this explosion of bandwidth, users, and media-rich applications, have become expensive and lack the flexibility required to help enterprises remain agile.

The move to higher-speed Cat6 cabling or optical fiber, neither of which is common within companies today, is costly and cumbersome, and does not easily support moves, adds, and changes.

Airvine's patented wireless system was purpose-built to address these issues while opening the door to extending corporate backbone networks into locations where pulling more cable simply isn't feasible.

Operating in the capacity-rich and effectively interference-free V-band (57-71 GHz), the Airvine system uniquely combines this spectrum with a number of recent advances in wireless technology to reliably deliver multi-gigabit data rates at longer distances.

The Airvine system enables an all-wireless enterprise and is the only indoor wireless backbone solution of its kind that future-proofs enterprise networks. It enables organizations to tackle unforeseen challenges, gain more flexible deployment options, and meet the overwhelming capacity demands of today's coporate networks.

GENERAL / COMMERCIAL

1. Who started the company and what was the initial vision?
   Hatch Graham and Harry Peterson – their initial vision was to create a self-organizing wireless backbone in the V-band (around 60 GHz) for indoor bandwidth expansion. The system would be able to penetrate walls and have a range of up to 100 meters.

2. Who has invested in the company?
   Valley Capital Partners (VCP) was the lead investor in the seed round and Orbit Ventures, a special purpose vehicle fund, invested in the seed plus round along with VCP.

3. What industry problem is Airvine trying to solve?
   Support the rapid growth of bandwidth in commercial buildings, large public venues (LPVs), and campus environments with an easily reconfigurable wireless backbone that avoids the cost and time required to pull fiber or Cat6 copper.

4. How big is this problem for today's enterprise and why now?
   Bandwidth needs are rapidly increasing, and legacy backbones (Cat5/5e) cannot keep up. This problem affects commercial buildings in all market segments. There are over 5 million such buildings in the U.S. alone, and over 90% of them have old wiring that must be upgraded.

5. What do you see at the addressable market for Airvine?
   According to a number of industry analysts, the backbone network market for commercial buildings will be worth well over $6 billion over the next 5 years.

6. What innovations has Airvine made that others haven't?
   The Airvine solution has focused on systems, RF, modem, and antenna design, with extra attention paid to beamforming, beam steering, low BER, ultra-low latency, redundancy, and security. The result is a multi-gigabit backbone network for indoor applications at distances of up to 100 meters in line of sight (LOS) or non-line of sight (NLOS) situations.

7. How are you planning to bring these products to market?
   Airvine has a multi-tiered sales strategy that includes both direct and indirect channels. Our go-to-market approach will be achieved through our field sales and marketing teams as well as through traditional channels such as systems and network integrators as well as value-added resellers.

8. Is this solution based on patented and/or proprietary technology? If so what?
   Yes, three broad patents were awarded that cover all aspects of network design, and a fourth patent is pending.

9. Why hasn't indoor wireless Ethernet solutions for network backbone applications been attempted before?
   Penetrating walls at 60 GHz and traversing longer distances are hard problems to solve. The technologies to make this happen at low cost have finally become available. Our team has led the way in areas like antenna gain, interference rejection, LNA noise figure, along with filter and modem technologies

10. What are some of the ideal use cases for Airvine's solution?
    a) Support for high bandwidth applications requiring rapid moves, adds, and changes.

b) Areas where it is difficult or cost-prohibitive to pull fiber or Cat6 cabling
c) Environments where longer distances must be traversed with obstructions of various types
d) Reaching remote locations like a parking gagarge (hospital COVID screening)
e) Backhauling Wi-Fi 6, 5G cellular, and IoT (Internet of Things)

PRODUCTS / TECHNOLOGY

11. What are the products being offered and developed by Airvine?
    The initial Airvine product set includes high-capacity nodes along with a network management platform (software) that can be deployed on premise or within the cloud.

12. How does the Airvine system work?
    In a typical configuration, the Airvine system will operate as a wireless dual-ring network with Wi-Fi APs, 5G APs, and other devices accessing the backbone at selected points along the ring. 5G traffic can be prioritized on the ring if required.

13. What is the difference between using the Airvine system versus simply running Cat6 copper or fiber?
    The Airvine system can match the performance of fiber without costly and cumbersome cabling. It can also be quickly reconfigured, which is not easily done with fiber or Cat6 cabling.

14. On what underlying wireless technology are Airvine's products based?
    IEEE 802.11ad 60 GHz DMG (Directional Multi-Gigabit) modem for the first generation product.

15. What is the aggregate throughput or capacity of the system?
    6.3 Gbps for the first generation product and upwards of 40 Gbps for the second generation product. The higher speeds in the second generation product will be accomplished without the need for channel bonding or multi-user MIMO technologies.

16. Is the Airvine system based on proprietary technology or an industry standard?
    The first generation product uses an Industry-standard modem (RWM6050) and network processor (NXPLS1043A) with a proprietary antenna. The second generation product will use proprietary silicon to enable much higher speeds.

17. What antenna/RF technology is used?
    The antenna consists of a transmit phased array that accepts 16 transmit RF sources (1 for each column of 16 elements) and a received phased array that provides 16 RF sources (1 for each column of 16 elements). This translates into a total of 256 transmit and receive antennas.

18. Are proprietary directional antenna arrays being used?
    Yes.

19. How much signal gain can be expected?
    The initial implementation will see up to 28 dBi of antenna gain with a follow-on goal of 30 dBi.

20. How is traffic encapsulated between nodes?
    Between WaveTunnel nodes, standard 802.11 packets are used, the same as any 2.4/5 GHz Wi-Fi Access Point except it operates at 60 GHz.

21. How does Airvine uniquely address indoor wireless requirements that other 60 GHz equipment vendors can't?
    By applying a revolutionary RF antenna design coupled with technical advances such as beamforming, beam steering, high bitrate modulation (256 QAM), forward error correction (FEC) and much more. To our knowledge Airvine is currently the only supplier of a dual-ring indoor wireless backhaul solution. It is the only product to combine multi-gigabit Ethernet ports and PoE PD and PSE for Wi-Fi AP and peripheral access. WaveTunnel nodes can also be upgraded with software to provide an integrated Wi-Fi AP at 2.4 and 5 GHz.

22. How does Airvine's system work with the existing Enterprise WLAN?
    Airvine's system accepts an Ethernet connection from existing Wi-Fi Access Points or an external Ethernet switch.

23. Are Airvine products designed to replace traditional enterprise wired/fiber networks or simply augment them?
    The initial product has been designed to augment existing Cat5 Ethernet networks. In the future, network upgrades may be completely wireless.

24. Is this a line of sight only wireless product or does it provide non-line of sight capabilities?
    The system is designed for NLOS operation by using intermediate WaveTunnel nodes to relay the signal if required.

25. What type of throughput, speeds and range are Airvine products been developed to deliver?
    Aggregate throughput for the first generation product will be 6.3 Gbps. The link speed is 3.15 Gbps for each of the two radios in a dual ring configuration. In LOS applications, the range is up to 100 meters.

    In NLOS applications, the range can still reach 100 meters depending on the nature of the obstruction. Any link can be equipped with additional WaveTunnel nodes (mid-span repeaters) that can help punch through obstructions. For the second generation product, the aggregate throughput will approach 40 Gbps.

26. What type of commercial silicon, if any, is used within the products?
    The two main processors are the Renesas (IDT) RWM6050 dual modem and the NXP LS1043A packet processor, both of which require DDR, flash memory, a few support ICs, and power supply components. Each antenna board also requires a single Sivers RF IC device. For the second generation product, we will use custom silicon.

DEPLOYMENT / OPERATIONS

27. How is Airvine's system deployed? What is required?

An Airvine ring or spine is installed by an on-site technician using an iPhone or Android app that sets up the beam and steers it from one WaveTunnel node to the next. The network is then configured and brought up instantly.

28. Are there any deployment prerequisites?
    None.

29. Can Airvine be deployed faster than pulling fiber or Ethernet? If so, how much?
    The Airvine network of WaveTunnel nodes can be installed in hours rather than the days or weeks required for copper or fiber.

30. Are there different types of nodes that must be purchased?
    No, there is only one type of WaveTunnel node.

31. Can an Airvine node operate in a point-to-multipoint configuration?
    An Airvine node communicates with one node in the upstream direction and one node in the downstream direction. Since the Airvine node provides electronic steering of the antennas (±60 degrees on the azimuth), there is no hardware limitation on multiplexing in time across more than one node in each direction. This could be a future enhancement.

32. Is the solution designed to be collocated with Wi-Fi Access Points?
    Yes, access points may be collocated with the Airvine node.

33. How many Wi-Fi Access Points can be directly attached to an Airvine node?
    Currently, two Wi-Fi APs can be directly attached to the WaveTunnel node. The internal design can support up to 4 interfaces, with 3 of them being supplied with PoE PSE power.

34. If an Airvine node fails, what happens?
    When configured in a ring, the neighbor nodes turn the ring around on itself, and the rest of the network stays up.

35. Is this a bi-directional system?
    Yes, the system is functionally full-duplex.

36. What type of egress from the system is supported?
    Currently, the network interface is via two 1 Gbps Ethernet interfaces with expansion to four being possible with minimal design changes. A design change could support 10 Gbps Ethernet or fiber ports.

37. What changes are required to existing enterprise backbone network to support Airvine's solution?
    The Airvine network only requires access to a power source, and the options are AC or PoE (power-over-Ethernet).

38. What type of site survey, if any, is needed beyond those for traditional Wi-Fi access/coverage?
    The 60 GHz links will not interfere with the Wi-Fi 2.4 and 5 GHz links. A simple traffic estimate needs to be

made for each Wi-Fi AP to see if it exceeds the CIR (committed information rate) allocated to it.

39. How much power is required to support a given Airvine node?
    A WaveTunnel node requires no more than 30 watts for its internal needs. If it is configured to supply power to a collocated Wi-Fi Access Point using PoE, then additional AC power would be required.

40. What is the maximum distance supported between nodes assuming common building materials?
    The maximum LOS distance between nodes is 100 meters. In NLOS applications, it should still reach the 100-meter target assuming sheetrock (aka drywall) as the primary obstruction.

41. How many channels within the 60 GHz band are used?
    Each Airvine node uses a maximum of two of the 6 V-band channels. These channels can be reused elsewhere in the network. The extremely narrow beam of the WaveTiunnel antenna and limited propagation characteristics of the V-band will limit co-channel interference.

42. Does the system support channel bonding?
    No. The goal is to deliver extremely high performance without requiring channel bonding as there are only 6 V-band channels availble and the addition of another channel (or two) will increase cost and complexity.