

Vubiq HaulPass Fiber



Making Millimeter Wave Ubiquitous



Vubiq Networks' HaulPass Fiber Radio

Vubiq Networks' HaulPass Fiber millimeter wave radio offers a paradigm shift for a range of high-capacity wireless communications applications. Using Vubiq's patent-pending technology, HaulPass Fiber radio was designed from the ground up to meet emerging network demands, including low latency fiber-like transmission; an open SDN-ready, management approach; and extreme ease of integration into existing networks. The speed of installation, extremely small form factor, and a price point that competes with far less capable solutions completes this value-oriented, performance-driven solution.

Delivering a full-duplex (FDD) capacity of 10 Gbps with 5G-ready latency under 10 microseconds, the HaulPass Fiber radio offers true wireless fiber transparent connectivity. Simply plug in the radio to seamlessly extend an existing fiber network. Full-featured Adaptive Code Modulation and Baud (ACMB) offers reliable connectivity over the widest possible range of weather at link distances up to 10 kilometers. Industry-leading RF performance results from Vubiq's patented, adaptable waveguide design. The HaulPass Fiber radio operates in the lightly-licensed E-Band and will soon offer capacities up to 20 Gbps. In addition, Vubiq's innovative modular RF front-end makes the platform spectrum agnostic, allowing a direct path to W- and D-Band applications.

Unlike traditional E-Band radios, the HaulPass Fiber radio easily integrates into existing networks, without redundant functionality. HaulPass Fiber can be managed as an extension of an adjacent switch or directly and wirelessly by any network controller over open APIs. The elimination of redundant functionality, and the related hardware and software, not only dramatically reduces the complexity of the radio, it provides corresponding reductions in size, weight and cost – allowing the radio to easily fit into street furniture and tight budgets.

Due to the nature of wireless link technology, millimeter-wave radios are typically closed, black-box network elements. Vubiq's API-driven management approach is a true step toward open, software-defined network design. By moving the network stack outside of the radio, the HaulPass Fiber radio seamlessly integrates and positions control of the radio where network operators want it – either at the network controller or as an extension of a nearby switch – while allowing efficient re-use of existing network switches. The included software development kit (SDK) supports a development environment allowing operators to perform custom commands directly to the RF front-end via any switch, router or network controller. This approach simplifies integration in nearly every network topology and allows the freedom to customize, configure and monitor wireless fiber extensions.

The HaulPass Fiber radio supports line-of-sight, point-to-point wireless ranges up to 10 kilometers (6.2 miles). It supports the attachment of an external antenna chosen to meet the spectrum and link distance requirements. The solution provides 100 MHz to 2 GHz channel bandwidth, advanced intelligence, and comprehensive functionality via an included library of APIs. Integrated low-latency forward error correction (FEC) and modern ACMB assures data transmission reliability over the widest range of weather conditions.

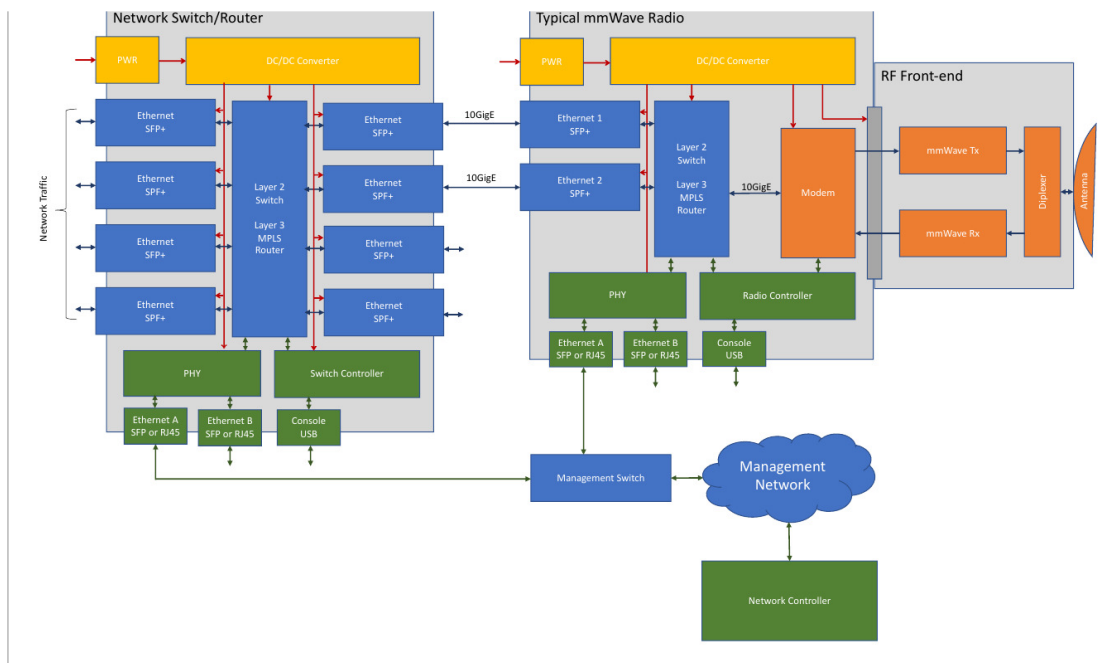
Weighing only 2.6 kilograms and designed for extreme weather operation, the HaulPass Fiber radio features a ruggedized outdoor enclosure with a compact footprint of only 6.7" x 6.9", and is powered by 48 VDC input, drawing only 35 Watts.

Advantages of the HaulPass Fiber Radio

Traditional Millimeter-Wave Radio Integration

Traditional, carrier-grade millimeter wave (mmWave) radios can be overly complex, difficult to integrate into enterprise and carrier networks, and require significant management overhead. Typically, mmWave radios are deployed along with a full-featured network switch/router, which performs most if not all traffic shaping, traffic aggregation, and switching functionality necessary in modern networks.

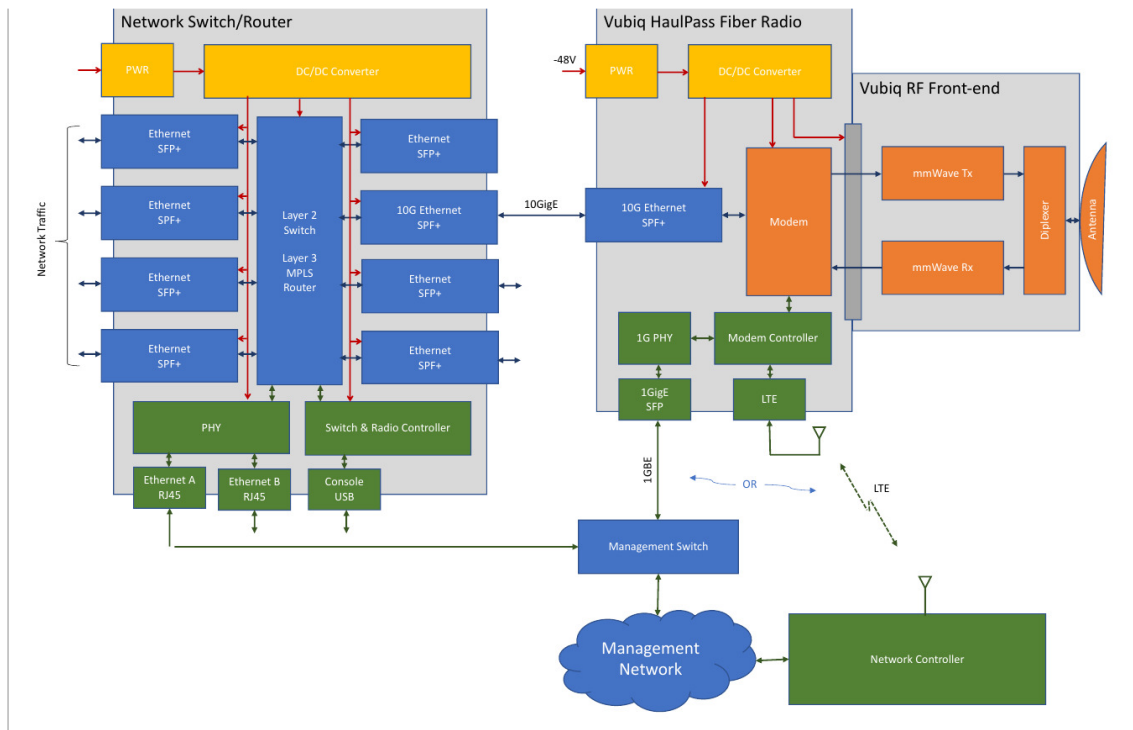
The groomed, shaped traffic is provided to the mmWave radio over standard, often redundant, 10 Gbps Ethernet (10GigE) interfaces for wireless transmission. Typical mmWave radios include additional switching functionality and the associated hardware and software complexity required to support it, before the traffic reaches the core of the radio – the modem and RF front-end. Both the radio and network switch/router are typically managed independently, as separate network elements, requiring full-featured, carrier-grade management software and interfaces, and management overhead such as a local management switch.



Typical Configuration with a Network Switch/Router and mmWave Radio

In contrast, Vubiq's HaulPass Fiber radio offers all of the advantages of modern mmWave technology without the redundancy, overhead and complexity of traditional carrier-grade mmWave radios. The HaulPass Fiber radio can be managed as an extension of the network switch/router – appearing as an advanced 10 Gbps port that happens to traverse a wireless link – or all of the HaulPass Fiber radios in the network can be reliably managed via LTE and the cloud.

As an extension of the network switch/router, only the network switch/router need be managed. The switch/router interface is optimized, size and cost of the radio is reduced, and the link latency is minimized. Radio control functionality can easily be implemented within the network switch/router controller using the included SDK and the GigE API management port. When managed via LTE, the radio control functions can be performed as part of the network controller using the SDK and a wireless API, making the wireless links transparent to the rest of the network.



Efficient Configuration with Vubiq's HaulPass Fiber

HaulPass Fiber Radio Product Brief



API-driven FDD RF Front-end Solution

Moving the network stack outside of the radio, the HaulPass Fiber Radio seamlessly integrates into the most complex network and positions control of the radio where network operators want it – at the network controller or as an extension of a nearby switch. This transformational approach to millimeter wave point-to-point connectivity drastically reduces the bill of materials, eases production costs and results in the industry's most compact outdoor radio enclosure.

As the industry's first SDN API-driven mmWave radio, HaulPass Fiber is truly "wireless fiber." Simply plug the radio into an existing network and instantly extend the fiber network wirelessly. The included integrated LTE modem provides an alternate, easy-to-use method for out-of-band management and monitoring.



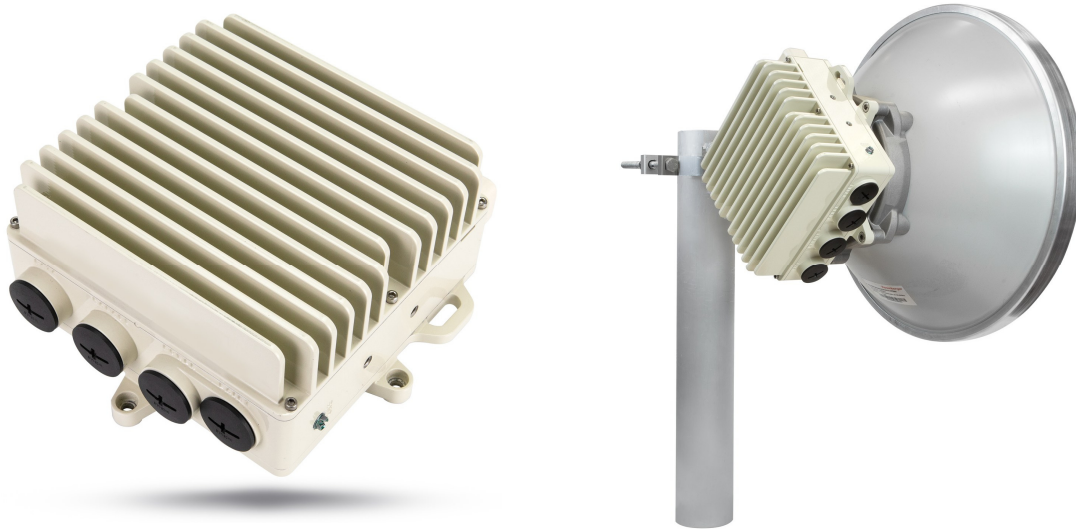
Product Specifications

Operating Frequencies	E-Band lightly licensed (71-76 GHz; 81-86 GHz) programmable
Channel Bandwidth	100 MHz to 2 GHz (baud rate, coding, and modulation programmable)
Modulation	BPSK, QPSK, 8PSK, 16QAM, 32QAM, 64QAM, 128QAM
Throughput	1.4 Gbps to 10 Gbps range dependent, adaptive (hitless)
Transmit Power	16 dBm; programmable
Receive Noise Figure	5 dB typical
Antenna Gain	Internal 38 dBi, 30cm parabola 44 dBi, 60cm parabola 50 dBi
Antenna Beamwidth	Internal 1.8°, 30cm 0.9°, 60cm 0.5°
FEC	LDPC
Overall Link Latency	< 6.5 μs, link distance dependent
Network Topologies	Ring, daisy chain, mesh
Software Features	- Modern API and SDK for direct network integration - Enhanced Intelligent Automatic Gain Control (AGC) - Hitless Adaptive Coding, Modulation, Baud rate (ACMB) - Mean squared error (MSE)/Signal to Noise Ratio (SNR) based ACMB
Radio Management	1 GigE API management port Browser-based Web GUI and SSH command-line interface

- **SNMP v1, v2c, and v3**
- **Role-based access control (Guest, User, Admin, Engineering)**
- **Remote event logging via Syslog**
- Out-of-band management via integrated LTE modem

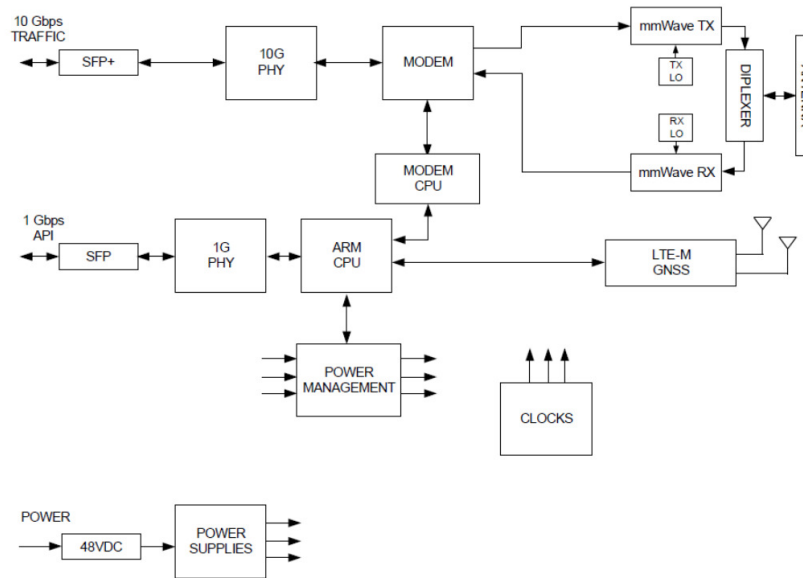
Throughput and Link Ranges	● Up to 10 Gbps at distances up to 10 km, spectrum and weather dependent ● ACMB assures high link availability, providing reduced throughput even in heavy rain
Power Requirements	● 48 VDC, 35 Watts
Weight	● 2.6 Kg (5.7 lbs)
Dimensions	● 17.0 cm x 17.5 cm x 9.5 cm (6.7" x 6.9" x 3.7")
Operating Temperature	● -40°C to +55°C (-40°F to +130°F)

HaulPass Fiber Radio – Outdoor Enclosure and Deployment



Ruggedized outdoor enclosure and pole-mounted deployment with parabolic antenna

System Block Diagram



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Vubiq Networks, Inc.
 9231 Irvine Blvd, Irvine, CA 92618 USA
www.vubiqnetworks.com