Fixed Wireless Access for Unlicensed 60 GHz with Perspectus Modules

Multi-gigabit fixed wireless access use case from Peraso

FWA Challenges

As consumer demand for data bandwidth grows worldwide, service providers face difficult challenges to expand capacity and coverage. While cable and fiber can provide impressive, gigabit-level speeds for connected customers, the cost of expanding these networks is becoming prohibitive due to the labor involved in trenching or stringing cables and the high cost of equipment, especially optical.

In fact, installation may be nearly impossible in some remote geographic areas or dense urban areas where it is impractical to install a point-of-presence in every residence.

Fixed wireless access systems have overcome many service-provisioning challenges:

- Wireless networks can be quickly deployed to service wide coverage areas.
- Hardware costs have become competitive and provides more system options.
- Large, unlicensed 60 GHz spectrum slices have been allocated in many countries, which:
  - Allows service providers to set-up networks without up-front capital investment to purchase or lease spectrum
  - Overcomes disadvantages of Wi-Fi bands in 5-6 GHz range, which suffer from limited spectrum and congestion due to high consumer utilization
- Standards, such as IEEE 802.11ad and 802.11ay “WiGig” have standardized access protocols.

System Considerations

System developers also face challenges to produce low-cost, highly efficient mmWave radio equipment. They must be sensitive to market and technological requirements such as:

- Scalable, high-performance to meet growing bandwidth demand
- Easy to install and maintain equipment
- Low latency transport
- Flexible bandwidth allocations
- Compact, attractive and cost-effective CPE devices
- Fast time-to-market
Furthermore, developers must make ramp-up investments in mmWave technologies and tools for production, such as:

- Techniques for beam-steering with high-gain phased array antennas
  - Once the domain of only military and satellite systems, they had to be dramatically cost-reduced and prepared for mass production.
- Testing methodologies and equipment
  - Testing processes suitable for mmWave operation
  - Specialized test equipment for development and volume manufacturing

Peraso, as a pioneer in commercial mmWave, has overcome these impediments and produced:

- highly integrated chipsets matched to work together,
- innovative antenna solutions optimizing RF antenna power transmission and beamforming,
- field proven software for point-to-point and point-to-multipoint, and
- module solutions that remove the risk and cost for systems developers.

The Perspectus Solution

Peraso has introduced the Perspectus line of 60 GHz modules targeting the fixed wireless access market.

The modules can be used in point-to-point or point-to-multipoint applications, offer low latency, high reliability, multi-gigabit throughput and are easy to integrate with host processors over the USB 3.0 interface.

Utilizing Peraso’s in-house RF and baseband silicon, as well as PCB-integrated antenna arrays, Perspectus modules eliminate the design concerns that come with mmWave antenna design and trying to match components from different suppliers. The modules are fully tested, do not require factory calibration, and hold FCC modular certification.

Key Features

- Unlicensed 57-71 GHz band operation
- Up to 3 Gbps user throughput
- Interference-free spectrum
- Dynamic beamforming
- High EIRP and high-gain antenna options
- Low-cost modules ready for mass-production

Typical Applications

- Point-to-multipoint fixed wireless access in urban and sub-urban environments
- Backhaul with range >20 km using parabolic dish
- Smart cities and private networks
- Industrial automation
Architecture Details

Perspectus modules utilize the PRS1165 transceiver with 16 high-power RF beamformer chains. All 6 of the 802.11ad/ay defined channels over 57-71 GHz are supported; channels 5 and 6 are outside the oxygen absorption band, thereby allowing for long-range operation.

Selectable RF filters and frequency synthesizer allow operation on ½-bandwidth channels with ½-channel frequency step.

The MAC PHY baseband processor, PRS4601 B2E, provides functionality necessary for 802.11ad operation and supports point-to-point or point-to-multipoint capability.

Peraso provides Linux drivers and offers a variety of software/firmware versions that are optimized for FWA applications.

The modules are differentiated by the antenna arrays that offer a variety of gain and field-of-view options. Antenna arrays are integrated into the PCB, which improves RF matching, cost and overall reliability. The PRM2141X also allows integration with high-gain parabolic reflectors to enable gigabit data rates at ranges exceeding 20 km on the upper channels.

Each module may be used as either an access point (AP), station (STA) or in a peer-to-peer (P2P) configuration. Typically, the modules with wider field-of-view, PRM2141X or PRM2142X, will be used as an AP, and the PRM2143X is employed as the STA. For longer links, the PRM2141X with a dish can be used as the STA.
Software Features

Peraso’s infrastructure software package enables point-to-multipoint networks with up to 32 STA.

Proprietary enhancements to the 802.11ad protocol, such as Directional Beam Scan and Connect (DBSC) and STA Focus, enhance beamforming operation over the extended distances enabled by the hardware.

The software also provides an aiming mode to facilitate installation and provides link monitoring statistics required to manage the network.
Integration

Peraso provides drivers for the host processor that are easily ported to common Linux OS platforms. Peraso is currently supporting a range of kernels from 4.9 to 5.10, depending on the host hardware platform.

Recommended host hardware platforms are ARM64 or x86 processors with at least 2 cores and operating at over 1 GHz. A USB 3.0 host interface is required for the data and control interface to the module. Peraso currently has direct support for NXP Layerscape LS1046, NXP iMX8(+), Marvell Armada 3700 (Espressobin), and Armada A388 (SolidRun Clearfog).

![Host-Module Hardware Interface](image)

**Figure 3: Host-Module Hardware Interface**

Ordering Information

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRM2141X-V-EGS</td>
<td>60 GHz RF/mmWave Transceiver Module with Baseband. 16 element standard gain antenna. RF shield installed.</td>
</tr>
<tr>
<td>PRM2142X-V-EGS</td>
<td>60 GHz RF/mmWave Transceiver Module with Baseband. 32 element medium gain antenna. RF shield installed.</td>
</tr>
<tr>
<td>PRM2142X-V-EGS</td>
<td>60 GHz RF/mmWave Transceiver Module with Baseband. 64 element high gain antenna. RF shield installed.</td>
</tr>
</tbody>
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Evaluation kits for each module are available.

Field-Proven Performance

Perspectus modules are field-proven and have demonstrated outstanding performance in real-world network installations.

The following graphs demonstrate expected throughput rates vs. range for various module pairing combinations.
Figure 4: Rate vs. Range with PRM2142X and PRM2143X

Figure 5: Rate vs. Range with PRM2143X

Figure 6: Rate vs. Range with PRM2141X and parabolic dish
Summary

Peraso’s modules eliminate the RF design concerns that come with using different component suppliers, component matching, trying to minimize power transition losses, board reliability and quality, difficulty of testing to specific RF power and beamforming performance, etc. Peraso modules allow customers to focus on what they do best—delivering on system and product value propositions.

The module’s antenna, RFIC, baseband IC, and board (substrate) are all from Peraso, providing a single source for all key elements.

Module designs utilize the technology, design techniques and manufacturing flows of field-proven modules that are already in volume production.

Peraso modules benefits include:

• Selection of modules for diverse applications
  - Different power requirement
  - Beamforming antenna RF profiles
  - Allows interoperability of different Perspectus family modules

• Technology
  - Single point of support for RFIC, baseband IC and antenna

• Board design
  - Eliminates risk of complex high frequency board design challenges
  - Eliminates the cost of extended design iterations

• Manufacturing
  - Eliminates development of testing equipment and testing software
  - Proven quality and reliability and volume availability
  - Pre-scanned for compliance with FCC regulations

• Support
  - Comprehensive technical level support for multiple platforms
  - Draw upon Peraso’s years of experience

**Peraso Modules Eliminate Risks and Shortens Time-to-Revenue**