**RAy** is a high-speed point-to-point microwave link, ideal for establishing robust links in the most challenging conditions.

This Full Outdoor Software Defined Radio with Linux OS, is designed for **high performance links** with **maximum reliability, exceptional system gain** and **resistance to disturbances**. All relevant state-of-the-art concepts have been carefully implemented without compromise.

RAy is well proven within the market since 2009 in thousands of installations in tens of countries from the poles to the equator.

**RAy3**

- **1 Gbps / 24 GHz / 250 MHz**
- **713 Mbps / 17 GHz, 24 GHz / 200 MHz**
- **3.5 – 112 MHz channels**
- Asymmetric channels
- **AES 256, SyncEth, PTP**
- **1x ETH, 1x SFP, 1x USB**
- Solar ready - 22W
- Each unit tested -30 to +55°C
- Full outdoor, easy installation
- Interference tolerant
- Wifi management
- **RAy Tools (Android, iOS)**

It is used by Internet Service Providers as well as global Telco operators for both, backbone and last-mile microwave links.

**RAy3, the 3rd generation** of RAy, with possibility of **asymmetric channels** and **1 Gbps FDD** is the top equipment for license free bands.

**RAy2**

- **360 Mbps / 10, 11, 17, 18, 24 GHz**
- **1.75 – 56 MHz channels**
- **1x ETH, 1x SFP, 1x USB**
- Solar ready - 22W
- Each unit tested -30 to +55°C
- Full outdoor, easy installation
- Maximum distance & reliability
- Interference tolerant
- Wifi management
- **RAy Tools (Android, iOS)**
General overview

Example: RAy3 asymmetric channels in 24 GHz band

<table>
<thead>
<tr>
<th>Max. Speed</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>360 Mbps</td>
<td>1 Gbps</td>
<td></td>
</tr>
<tr>
<td>256 QAM</td>
<td>2048 QAM</td>
<td></td>
</tr>
<tr>
<td>56 MHz</td>
<td>112 MHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed / 56MHz</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>360 Mbps</td>
<td>540 Mbps</td>
<td></td>
</tr>
<tr>
<td>256 QAM</td>
<td>4096 QAM</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Bands</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>10, 11, 17, 18, 24 GHz</td>
<td>17, 24 GHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Asymmetric channels</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Channel size</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.75 – 56 MHz</td>
<td>3.5 – 112 MHz</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Modulations</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>QPSK</td>
<td></td>
</tr>
<tr>
<td>16 – 256 QAM</td>
<td>16 – 4096 QAM</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>AES 256</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sync Eth, PTP</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ESD</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 kV</td>
<td>8 kV</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Surge immunity</th>
<th>RAy2</th>
<th>RAy3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 kV</td>
<td>4 kV</td>
<td></td>
</tr>
</tbody>
</table>

RAy Tools Mobile App

- Wifi connection between unit and mobile phone
- Link calculation  
  - fade margin for given distance
- Antenna Alignment  
  - RSS & SNR, displayed and acoustic notification
- Link management  
  - responsive web interface

Security & Integrity

- Licensed bands available (RAy2)
- FEC, interleaving, proprietary data compression
- Proprietary protocol on Radio channel
- Assigned peer unit permanently monitored
- Management - https, ssh,
- Unique ssh key for each unit
- Role-based access control (2 levels)
- AES256 encryption (RAy3)

Reliability

- Each unit tested in a climatic chamber and in real traffic
- Robust input filter with no adjustable components
- All our free band units meet licensed band standards
- Built-in surge protections
- Heavy-duty industrial components
- Industrial rugged die-cast aluminium case
- - 30 to +55 °C
- 3 year warranty

Long range & Data speed

- Exceptional robustness against noise and interference
- Hitless ACM, ATPC
- Exceptional sensitivity: up to -103 dBm
- Narrow channels: 3.5 – 112 MHz (RAy3)
- Wide ranging modulation options: QPSK – 4096 QAM (RAy3)
- Asymmetric channels (RAy3)
- 2+0 solution for double speed available (10, 11, 18 GHz)

Easy to install and maintain

- Full outdoor unit with aluminum casing
- Direct mounting to parabolic antennas
- Simple signal polarization change through unit rotation
- Built-in spectrum analyzer for free channel search
- RSS voltage output for antenna alignment
- 17, 24 GHz - the same HW for both, L/U units
- HW button for factory and customers settings
- RAy2 and RAy3 are mechanically compatible

Configuration & Diagnostic

- Web interface or CLI via SSH
- Non-intrusive management via USB using either ETH/USB adapter or WiFi/USB adapter with DHCP
- SNMP including Traps and Informs
- Automatic detection of unit polarization
- Constellation diagram of the received signal
- Temperature, Power voltage, RSS, MSE, BER, Data rate, Output power status and history avail. as text or charts
### Radio parameters

<table>
<thead>
<tr>
<th>Modulation</th>
<th>3.5 MHz</th>
<th>56 MHz</th>
<th>112 MHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK, S</td>
<td>2.7 Mbps / -99.0 dBm</td>
<td>48 Mbps / -88.0 dBm</td>
<td>97 Mbps / -85.0 dBm</td>
</tr>
<tr>
<td>QPSK</td>
<td>5.0 Mbps / -94.5 dBm</td>
<td>81 Mbps / -84.5 dBm</td>
<td>161 Mbps / -81.5 dBm</td>
</tr>
<tr>
<td>16 QAM</td>
<td>9.5 Mbps / -88.5 dBm</td>
<td>168 Mbps / -77.5 dBm</td>
<td>334 Mbps / -74.5 dBm</td>
</tr>
<tr>
<td>32 QAM</td>
<td>11 Mbps / -85.0 dBm</td>
<td>213 Mbps / -73.5 dBm</td>
<td>426 Mbps / -70.5 dBm</td>
</tr>
<tr>
<td>64 QAM</td>
<td>15 Mbps / -82.0 dBm</td>
<td>267 Mbps / -70.5 dBm</td>
<td>536 Mbps / -67.5 dBm</td>
</tr>
<tr>
<td>128 QAM</td>
<td>17 Mbps / -79.0 dBm</td>
<td>319 Mbps / -67.5 dBm</td>
<td>636 Mbps / -64.5 dBm</td>
</tr>
<tr>
<td>256 QAM</td>
<td>19 Mbps / -76.0 dBm</td>
<td>366 Mbps / -64.5 dBm</td>
<td>730 Mbps / -61.5 dBm</td>
</tr>
<tr>
<td>512 QAM</td>
<td>22 Mbps / -73.0 dBm</td>
<td>413 Mbps / -61.5 dBm</td>
<td>823 Mbps / -58.5 dBm</td>
</tr>
<tr>
<td>1024 QAM</td>
<td>23 Mbps / -69.5 dBm</td>
<td>459 Mbps / -58.5 dBm</td>
<td>918 Mbps / -55.5 dBm</td>
</tr>
<tr>
<td>2048 QAM (7 - 112 MHz)</td>
<td>-</td>
<td>501 Mbps / -55.5 dBm</td>
<td>1002 Mbps / -52.5 dBm</td>
</tr>
<tr>
<td>4096 QAM (14 - 56 MHz)</td>
<td>-</td>
<td>540 Mbps / -52.5 dBm</td>
<td>-</td>
</tr>
</tbody>
</table>

#### Electrical

- **Primary power**: PoE active 37 – 60 VDC, PoE passive 20 – 60 VDC; DC 20 – 60 VDC; floating
- **Power consumption**: typ. 22.5 W (w/o SFP)

#### Interfaces

- **Ethernet**: 1× 10/100/1000 Base-T Auto MDI/MDIX / RJ45
- **SFP**: 1× 10/100/1000 Base-T/1000Base-SX/1000Base-LX (power max. 1.25 W)
- **USB**: USB 2.0 / Host A
- **RSS voltage**: Two contact sockets
- **Indication LED**: SYS

#### Environmental

- **IP Code (Ingress Protection)**: IP66
- **MTBF (Mean Time Between Failure)**: > 750,000 hours (> 85 years)
- **Operating temperature**: - 30 to + 55°C (ETSI EN 300019-1-4, class 4.1.)
- **Operating humidity**: 5 to 95% non-condensing
- **Surge immunity**: 4 kV acc. EN 61000-4-5
- **ESD resistance**: 8 kV acc. EN 61000-4-2

#### Mechanical

- **Casing**: Rugged die-cast aluminium
- **Size**: 160 H x 245 W x 245 D mm (6.3 x 9.6 x 9.6 in)
- **Weight**: 2.6 kg (5.7 lbs)
- **Mounting**: FOD, direct mounting to antenna

#### Diagnostic

- **Real time monitoring**: RSS, MSE, BER
- **Diagnostic tools**: Spectrum analyzer, Pinger, Constellation diagram
- **History charts**: Temperature, Power voltage, RSS, MSE, BER, Data rate, RF Output power
- **Statistics**: RMON counters for all interfaces
- **Antenna alignment**: RSS voltage, RAyTools, web
- **SNMP**: v2c including configurable TRAPs

#### Security

- **Management**: HTTP, HTTPS, SSH, Telnet, RAyTools App
- **Access accounts**: 3 levels (Guest, Admin, Super)
- **Encryption**: AES256, 192, 128

#### Standards

- **Approvals**: 17 GHz CE (RED), RoHS
- **24 GHz CE (RED), FCC, RoHS**
### Ray2 technical parameters

<table>
<thead>
<tr>
<th>Modulation</th>
<th>Speed / Sensitivity</th>
</tr>
</thead>
<tbody>
<tr>
<td>QPSK</td>
<td>8.9 Mbps / -92.0 dBm</td>
</tr>
<tr>
<td>QPSK</td>
<td>7.4 Mbps / -91.0 dBm</td>
</tr>
<tr>
<td>16 QAM</td>
<td>6.3 Mbps / -90.0 dBm</td>
</tr>
<tr>
<td>32 QAM</td>
<td>6.3 Mbps / -90.0 dBm</td>
</tr>
<tr>
<td>64 QAM</td>
<td>7.4 Mbps / -90.0 dBm</td>
</tr>
<tr>
<td>128 QAM</td>
<td>8.9 Mbps / -89.0 dBm</td>
</tr>
<tr>
<td>256 QAM</td>
<td>338 Mbps / -90.0 dBm</td>
</tr>
<tr>
<td>256 QAM_TO</td>
<td>359 Mbps / -66.0 dBm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ACM</th>
<th>Hitless</th>
</tr>
</thead>
<tbody>
<tr>
<td>RF Output power</td>
<td>-10 to +13 dBm</td>
</tr>
<tr>
<td>ATPC</td>
<td>Yes</td>
</tr>
<tr>
<td>Latency (RFC 2544)</td>
<td>81 μs (64 B / 358 Mbps), 234 μs (1518 B / 358 Mbps)</td>
</tr>
</tbody>
</table>

### Electrical

- **Primary power**: PoE active 40 – 60 VDC, IEEE 802.3at; DC 20 – 60 VDC; floating
- **Power consumption**: 21 W
- **Interfaces**: Ethernet 1x 10/100/1000 Base-T Auto MDIX / RJ45
- **SFP**: 1x 1000Base-SX / 1000Base-LX (power max. 1.25 W)
- **USB**: USB 2.0 / Host A
- **RSS voltage**: Two contact sockets
- **Indication LED**: AIR, SYS, ETH

### Environmental

- **IP Code**: IP66
- **MTBF**: > 750,000 hours (> 85 years)
- **Operating temperature**: -30 to +55°C (ETSI EN 300019-1-4, class 4.1)
- **Operating humidity**: 5 to 95% non-condensing
- **Surge immunity**: 1 kV acc. EN 61000-4-5
- **ESD resistance**: 4 kV acc. EN 61000-4-2

### Mechanical

- **Casing**: Rugged die-cast aluminum
- **Size**: 157 H x 244 W x 244 D mm (6.2 x 9.6 x 9.6 in)
- **Weight**: 2.8 kg (6.1 lbs)
- **Mounting**: FOD, direct mounting to antenna

### Diagnostic

- **Real time monitoring**: RSS, MSE, BER
- **Diagnostic tools**: Spectrum analyzer, Pinger, Constellation diagram
- **History charts**: Temperature, Power voltage, RSS, MSE, BER, Data rate, RF Output power

### Statistics

- **Statistics**: RMON counters for all interfaces
- **Antenna alignment**: RSS voltage, Ray Tools, web
- **SNMP**: v2c including configurable TRAPs

### Security

- **Management**: HTTP, HTTPS, SSH, Telnet, RayTools App
- **Access accounts**: 3 levels (Guest, Admin, Super)

### Standards

- **Approvals**: 10 GHz CE (RED), RoHS
- **11 GHz CE (RED), RoHS, FCC**
- **17 GHz CE (RED), RoHS**
- **18 GHz CE (RED), RoHS, FCC**
- **24 GHz CE (RED), RoHS, FCC**