Radio parameters

Parameter	10 GHz		11 GHz		17 GHz		24 GHz	
Frequency range	10.15 - 10.65 GHz		10.70 – 11.70 GHz		ISM band		ISM band	
	10.30 - 10.59 GHz		10.50 – 10.68 GHz		17.10 – 17.30 GHz		24.00 – 24.25 GHz	
Sub-band	Lower (GHz)	Upper (GHz)	Lower (GHz)	Upper (GHz)	no sub-bands		no sub-bands	
sub-band A	10.30-10.42	10.47-10.59	10.70-10.96	11.20-11.45				
sub-band B	10.15-10.30	10.50-10.65	10.96-11.20	11.45-11.70				
sub-band C			10.500-10.551	10.583-10.642				
sub-band D			10.534-10.593	10.625-10.680				
Channel spacing [MHz]	7, 14, 28		A,B: 1.75, 3.5, 7, 14, 28, 30, 40, 56		3.5, 7, 14, 28, 40, 56		3.5, 7, 14, 28, 40, 56	
			C,D: 1.75, 3.5, 7, 14, 28					
Channel duplex spacing	any combination of Lower		490 MHz, 530 MHz for A, B		selectable		selectable	
	and Upper channels		91 MHz for C, D		60 – 192,5 MHz / CS 3.5 MHz		60 – 241,5 MHz / CS 3.5 MHz	
					85 – 143,5 MHz / CS 56 MHz		85 – 192,5 MHz / CS 56 MHz	
Modulation	QPSK, 16, 32, 64, 128, 256 QAM, hitless ACM							
User data speed [Mbps]	8.5 - 170		A,B: 2.5 – 360; C,D: 2.5 – 170		4.9 - 360		4.9 - 360	
Forward Error Correction	LDPC							
Data Sensitivity @BER 10e^{-6}	CS 7 MHz	CS 28 MHz	CS 1.75 MHz	CS 40 MHz	CS 3.5 MHz	CS 56 MHz	CS 3.5 MHz	CS 56 MHz
QPSK	-96	-89	-99	-88	-96	-87	-96	-86
16 QAM	-88	-82	-93	-81	-89	-80	-89	-79
32 QAM	-83	-78	-89	-77	-85	-76	-86	-75
64 QAM	-80	-75	-88	-74	-82	-73	-83	-72
128 QAM		-72	-85	-70		-69	-79	-68
256 QAM		-69		-68		-66	-77	-65
Output power [dBm]	-5 dBm to +10 dBm		+23dBm/QPSK,+17dBm/256QAM		-25 dBm to +5 dBm		-30 dBm to +10 dBm	
ATPC	NO		YES		YES		YES	
Latency (RFC 2544)	typ. 140 µs (64 B/170 Mbps)		typ. 81µs (64 B/360 Mbps); 234 µs (1518 B/360 Mbps)					
User interface	1 Gb Eth. (10/100/1000) (IEEE 802.3ac 1000BASE-T), recommended cable S/FTP CAT7							
Service interface (optional)	100 Mb (10/100) Eth. (IEEE 802.3u 100BASE-TX), S/FTP CAT7 or CAT5e							
Power Supply	PoE, 40 - 60 VDC , IEEE 802.3at to 100m, user interface							
Power consumption	17 W		24 W		21 W		23 W	
Operating Temperature Range	- 30 to + 55°C (ETSI EN 300019-1-4, class 4.1.)							
Mechanical design	FOD (Full Outdoor)							
Size	245 × 245 × 150 mm							
Weight	2.9 kg		2.8 kg		2.5 kg		2.5 kg	
							for complete specifications please see the user manual	

Management

Configuration & management	HTTPS, SSH, Telnet
Real time monitoring	RSS, SNR, BER
Diagnostic tools	spectrum analyzer, pinger, constellation diagram
History charts	temperature, power supply, RSS, SNR, BER, data rate
Statistics	independent counters for radio and Ethernet line and for all types of packets
Installation	RSS voltage indication at BNC connector
Network management	SNMP ver.2c including configurable TRAPs

Antennas

Various Suppliers	Class 2,3; Direct mounting to 30, 60, 99, 120 cm parabolic antennas, mounting via flexible waveguide also possible

Standards

Radio parameters	ETSI EN 302 217-2-2 V1.3.1. (2009-04), limits for ACCP/CCDP	ETSI EN 300 440-2 V 1.4.1
EMC	ETSI EN 301 489-1 V 1.8.1 (2008-04), ETSI EN 301 489-17 V1.3.2 (2008-04)	
Electrical Safety	EN 60 950-1:2004	

RAy

10 GHz | 11 GHz | 17 GHz | 24 GHz

General

RAy is a **high-speed point-to-point microwave link** developed and completely manufactured by RACOM, a global leader in the development and production of industrial grade wireless equipment. In keeping with our twenty-year tradition on the industrial market, it has become a de facto standard that all RACOM products excel in their technical parameters, professional design, **exceptional reliability and quality**.

RAy product line is the **professional solution** for PtP link on both licensed and unlicensed bands. All the models offer an unique solution for the radio part, optimized for excellent sensitivity and interference resistance. This results in possibility to build links both with high capacity and long distance whilst keeping a maximum link availability.

Exceptional system gain and resistance to disturbances (facilitated e.g. by unique input filter design) make RAy the **product of choice** for both the backbone and last-mile microwave links.
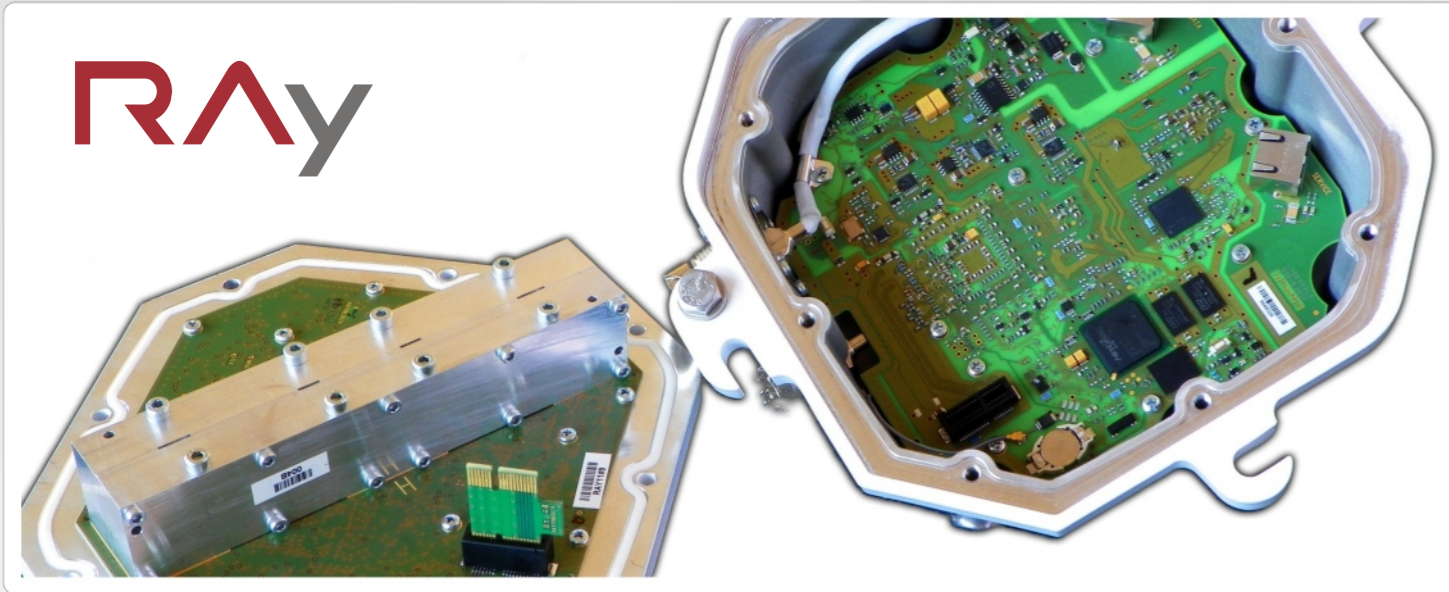
Microwave link

- **Both FREE & licensed bands**
- **Interference tolerant**
- **Long distance**
- **Narrow channels**
- **ACM, ATCP**
- **Web interface + diagnostics**
- **Full outdoor, Easy installation**
- **Low power consumption**
- **Climate chamber tested**
- **Cost effective solution**

Applications

- **LAN Extension**
- **Internet providers**
- **SCADA**

www.racom.eu

ver. 1.4

![RAy logo]
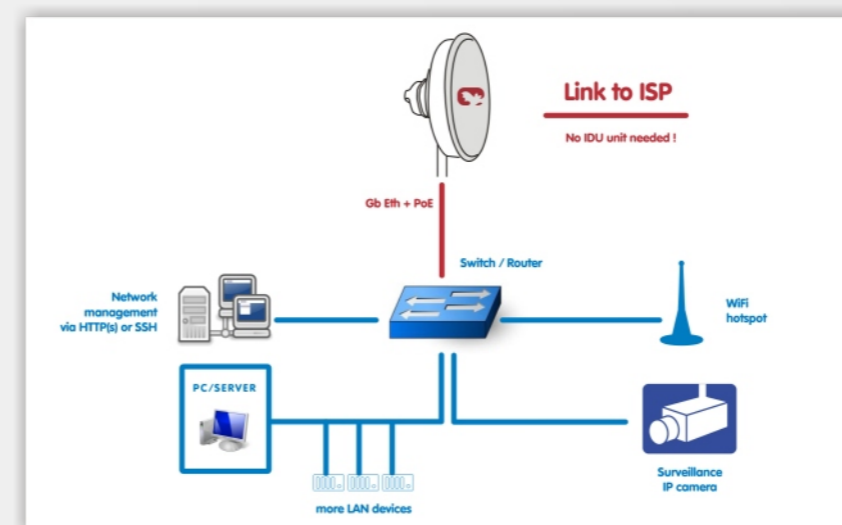
Typical Applications

LAN extension

- Corporate clients
- Fiber line replacement; Building to building interconnect

Key advantages of RAy:

- Low and constant latency < 0.1 ms
- Ethernet, layer L2 transparent
- Excellent resistance to interference

Internet providers

- Backbone and hi-priority last-mile
- Heavy traffic with multiple TCP streams

Key advantages of RAy:

- Free ISM & licensed bands
- Web interface including diagnostics
- SNMP traps, free NMS Support
- VLAN management

SCADA

- Maximal emphasis on reliability and response speed of the networks
- High speed backbone
- Small data packets have to be processed as fast as possible

Key advantages of RAy:

- High reliability
- Long range links
- Low OPEX costs

Radio parameters

- High radio receiver robustness to unwanted interference
- Narrow channels (from 1.75 MHz)
- SW selectable modulation: QPSK, 16, 32, 64, 128, 256 QAM
- Hitless ACM (Adaptive Coding and Modulation)
- ATPC (Automatic Transmit Power Control)

Reliability

- Industrial components
- Overvoltage and electrostatic protection
- Operating temperature range from -30 C to +55 C certified
- Every single unit is thoroughly tested in a climatic chamber
- Rugged input filter without no adjustable components

Licensed bands

- 10 GHz, 11 GHz bands
- Entire frequency range covered by two subbands only resulting in lower distribution / storage costs

FREE ISM band

- 17 GHz, 24 GHz ISM band
- Identical unit type for both ends of the line
- Broad configuration range of duplex spacing

Diagnostics

- Web interface
- Temperature, power supply, RSS, SNR, BER, data rate monitoring and history available as text and charts
- SNMP (including generation of TRAPs)
- Built-in spectrum analyzer for free channel searching
- Automatic detection of unit polarization
- Constellation diagram of the received signal

Simplicity

- FOD (Full Outdoor), aluminum casing, direct mounting to the parabolic antenna
- Change of signal polarization simply by 90° rotation of the unit
- Antenna alignment support - analog voltage on BNC connector, calibrated according to RSS
- Installation and setup tasks can be completed in minutes

Security / Standards

- Configuration via HTTPS, SSH
- Peer station can be paired and permanently monitored to prevent unauthorized station exchange
- Compliance with all relevant international standards
- Key parameters measured and confirmed by certified laboratory

Accessories

- Power sources
- Surge protectors
- Grounding kits
- IP67 connectors
- Direct unit mounting to antennas from various producers, flexible waveguide as a general-purpose option

References

RAy - solution of choice

RAy is successfully installed in all types of environmental and climatic conditions and the number of countries is continuously growing including countries such as **Philippines, Slovakia, Lebanon, Mexico, Poland, Jamaica** and of course **the Czech Republic**.

RAy´s excellent **reliability** is appreciated by numerous types of client e.g.:

- global mobile operator **Vodafone**
- corporate networks operators **ha-vel internet** or **WIA**
- state authorities such as **National Customs Office**

According to RACOM's experiences in **SCADA and Telemetry** field, RAy is also used in SCADA networks both as a backhaul solution or e.g. as a link for surveillance IP cameras.