

RAy3

- 1 Gbps, 24 GHz
- 3.5 – 112 MHz channels
- Asymmetric channels
- AES 256, Sync Eth, PTP
- 1x ETH, 1x SFP, 1x USB
- Solar ready - 22W
- Each unit tested -30 to +55°C
- Full outdoor, easy installation
- Interference & obstacles tolerant
- Wifi management
- RAY Tools (Android, iOS)

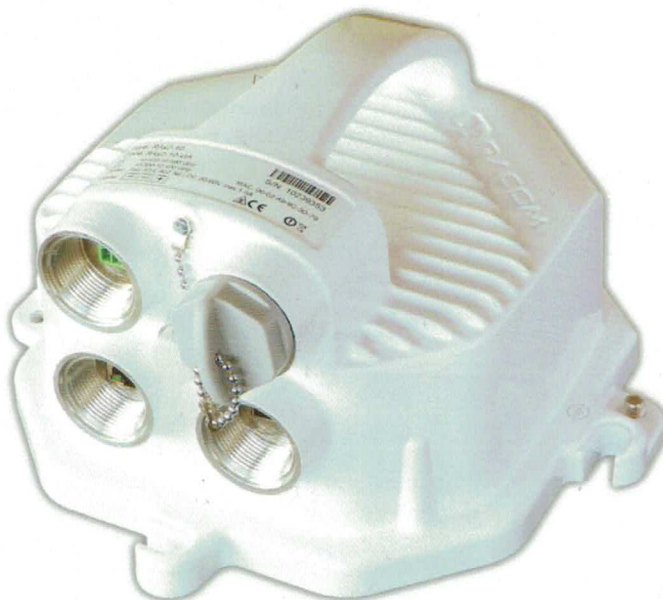
RAy is a high-speed point-to-point microwave link, ideal for establishing robust links in the most challenging conditions.

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.

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.



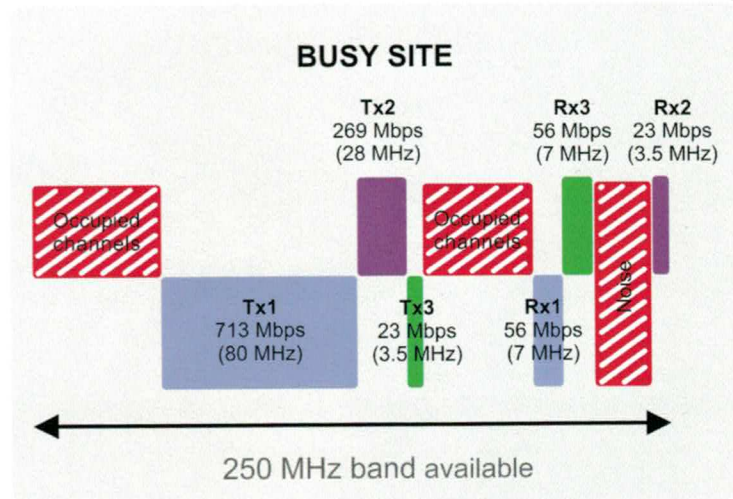
RAy2

- 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 & obstacles tolerant
- Wifi management
- RAY Tools (Android, iOS)

General overview

	RAy2	RAy3
Max. Speed	360 Mbps 256 QAM 56 MHz	1 Gbps 2048 QAM 112 MHz
Speed / 56MHz	360 Mbps 256QAM	540 Mbps 4096 QAM
Bands	10, 11, 17, 18, 24 GHz	24 GHz
Asymmetric channels	No	Yes
Channel size	1.75 – 56 MHz	3.5 – 112 MHz
Modulations	QPSK 16 – 256 QAM	QPSK 16 – 4096 QAM
AES 256	No	Yes
Sync Eth, PTP	No	Yes
ESD	4 kV	8 kV
Surge immunity	1 kV	4 kV

RAy3 – asymmetric channels



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

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

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)

Long range & Data speed

- Exceptional **robustness** against **noise** and **interference**
- Hitless **ACM, ATPC**
- **Exceptional sensitivity:** up to -110 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

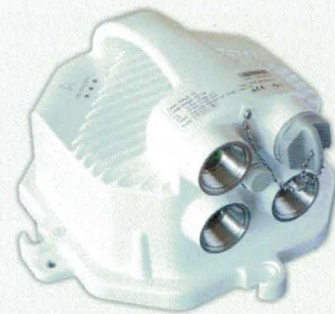
- **Web interface** or CLI via SSH
- **Non-intrusive management** via USB using either ETH/USB adapter or WiFi/USB adapter with DHCP
- **SNMP** including Traps and Informs
- Automatic detection of unit polarization
- **Constellation diagram** of the received signal
- Temperature, Power voltage, RSS,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

Issues in a crowded environment?

Noise from other devices?

Ever increasing demands for wireless communications results in pressure on **noise** and **electromagnetic smog resistance** on equipment used. An antenna site becoming overcrowded with devices, only makes the problem worse. Only a **very high quality device** with **extreme interference immunity** will provide an **acceptable solution!**

Enter **RAY** microwave links from RACOM, professionally designed and built to operate efficiently under such demanding conditions. **Exceptional system gain** and **resistance to disturbances** maximizes signal strength and reliability, making RAY the product of choice for links on busy sites.

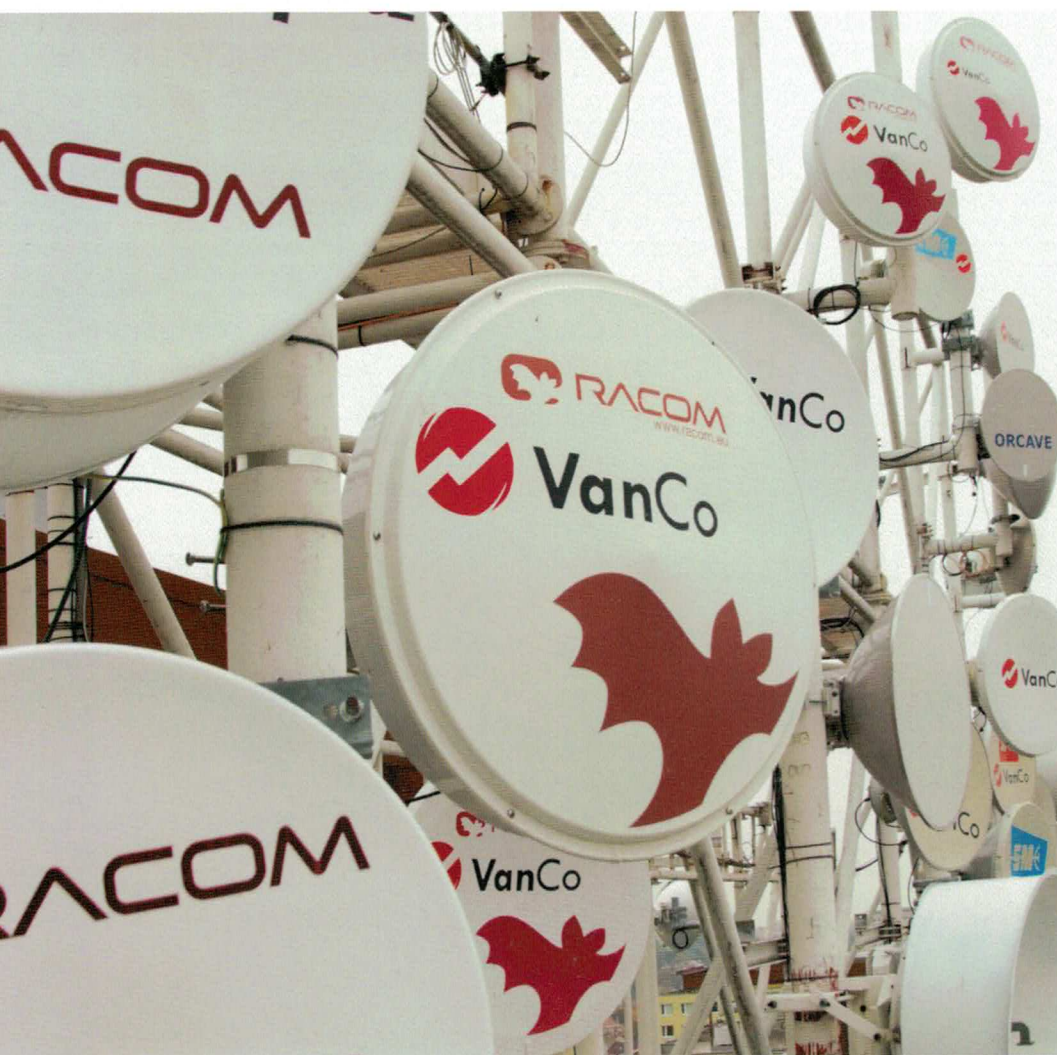


Microwave link

- FREE & licensed bands
- Interference & obstacle tolerant
- Maximum distances & reliability
- Narrow channels from 1.75 MHz
- ACM, ATPC
- Optical + metallic Ethernet
- IPTV optimized
- PoE or DC (20 - 60 V)
- Low power consumption
- Climate chamber tested

Applications

- LAN Extension
- Internet providers
- SCADA

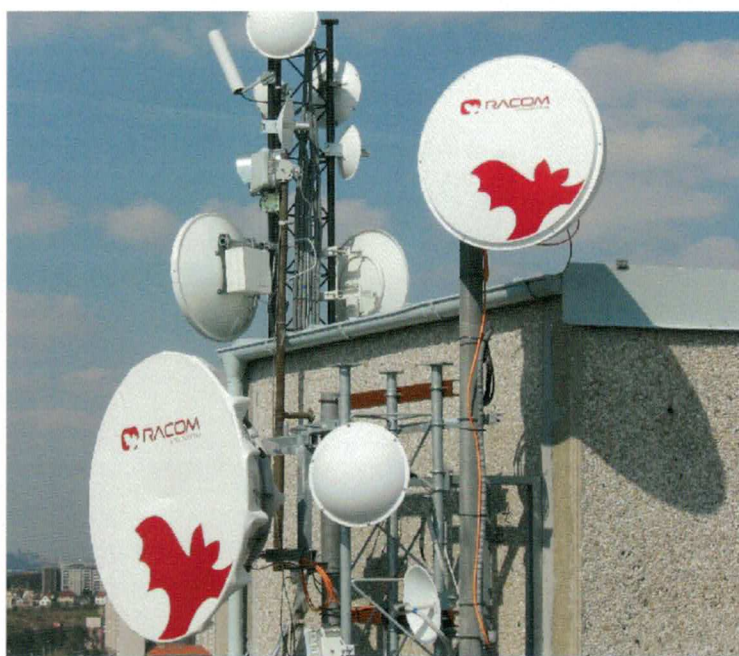
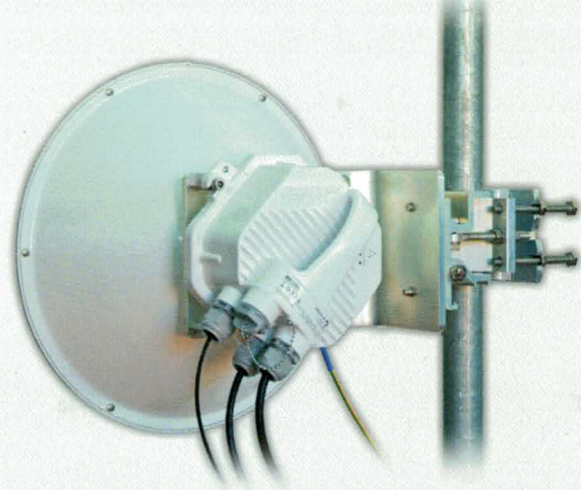


Customer benefits

- More devices on POP sites
- Smaller antennas
- High reliability, even in a noisy environment
- More devices within the same space

Technical Features

- Max. sensitivity while exceptional resistance
- Narrow channels from 1.75MHz
- Link availability 99.999% in harsh environment
- Wide range of Automatic Transmit Power Control
- Extreme reliability of the equipment (MTBF > 100 years)
- Built-in spectrum analyzer for free channel searching
- Asymmetric channels allow the use of the spectrum residues of free bands on busy sites



VanCo s.r.o., Czech Republic

VanCo supplies many networks using various technologies in the Czech Telecommunications market.

Their customers, like UPC, find RAY to be an ideal product for real-life error-free reliable operation even on their busiest sites. This allows them to offer high levels of service and availability to their customers at minimal operating costs.

“Due to its very efficient usage of the spectrum, RAY allows us to increase the number of links we can operate even on the busiest of sites, resulting in a clear economic benefit. Our most demanding sites are nearly all populated with RACOM RAY equipment.”

David Němec
Sales Director at VanCo s.r.o. Czech Republic

Data Pro Links, Lebanon

Dataprolinks, a leading ISP in Lebanon, prefers using RAY on sites where there is an abundance of other devices.

They find that no other product has stood the test of frequency resilience quite like the RAY. It is the only device able to work reliably with so much interference around it.

“You should try the RAY from RACOM. If it doesn’t manage your site conditions and provide the solution you have been looking for, nothing else will!”

Bassel Nasr Eddine
Head of Telecommunications at Data Pro Links,
Lebanon.

RAy3 technical parameters

Radio parameters		RAy3		
Frequency range	24.00 – 24.25 GHz			
Channel spacing	3.5, 5, 7, 10, 14, 20, 28, 40, 56, 80, 100, 112 MHz			
Channel duplex spacing	Flexible, min.18 MHz between channel edges			
Gross data rate	2.7 – 1002 Mbps			
FEC	LDPC, RS			
Modulation / Speed / Sensitivity	3.5 MHz	56 MHz	112 MHz	
QPSK_S	3 Mbps / -99 dBm	48 Mbps / -88 dBm	97 Mbps / -85 dBm	
QPSK	5 Mbps / -95 dBm	81 Mbps / -85 dBm	161 Mbps / -82 dBm	
16 QAM	10 Mbps / -89 dBm	168 Mbps / -78 dBm	334 Mbps / -75 dBm	
32 QAM	11 Mbps / -85 dBm	213 Mbps / -74 dBm	426 Mbps / -71 dBm	
64 QAM	15 Mbps / -82 dBm	267 Mbps / -71 dBm	536 Mbps / -68 dBm	
128 QAM	17 Mbps / -79 dBm	319 Mbps / -68 dBm	636 Mbps / -65 dBm	
256 QAM	19 Mbps / -76 dBm	366 Mbps / -65 dBm	730 Mbps / -62 dBm	
512 QAM	22 Mbps / -73 dBm	413 Mbps / -62 dBm	823 Mbps / -59 dBm	
1024 QAM	23 Mbps / -70 dBm	459 Mbps / -59 dBm	918 Mbps / -56 dBm	
2048 QAM (7 - 112 MHz)	-	501 Mbps / -56 dBm	1002 Mbps / -53 dBm	
4096 QAM (14 - 56 MHz)	-	540 Mbps / -53 dBm	-	
ACM	Hitless			
RF Output power	-30 to +10 dBm			
ATPC	Yes			
MTU	10240 B			
Latency (RFC 2544)	268 µs (64B/366 Mbps); 313 µs (1518 B/366 Mbps) 173 µs (64B/1002 Mbps); 198 µs (1518 B/1002 Mbps)			
Synchronization	Synchronous Ethernet; 1588v2 transparent clock			
Electrical				
Primary power	PoE active 37 – 60 VDC, IEEE 802.3at; 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, RAY Tools, 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				
CE, FCC, RoHS				Pending
Radio parameters	ETSI EN 300 440 V2.1.1 ETSI EN 302 217-2 V3.1.1			Pending
EMC	ETSI EN 301 489-1 V1.9.2 ETSI EN 301 489-4 V2.2.1			Pending
Safety	EN 62368-1:2014			Pending
FCC	CFR 47 part 15			Pending

RAY2 technical parameters

RAY2	10 GHz		11 GHz		17 GHz / 24 GHz		18 GHz	
	Lower	Upper	Lower	Upper	The same HW for L/U		Lower	Upper
Radio parameters								
Sub-band A	10.300 – 10.420	10.476 – 10.588	10.695 – 10.970	11.185 – 11.460	no sub-bands		17.700 – 18.209	18.710 – 19.219
Sub-band B	10.125 – 10.325	10.475 – 10.675	10.935 – 11.195	11.425 – 11.695	17.1 - 17.3		18.167 – 18.690	19.177 – 19.700
Sub-band C	-	-	-	-	24.0 - 24.25		17.700 – 18.300	19.300 – 19.700
Channel spacing	1.75, 3.5, 7, 14, 20, 28/30, 56 MHz		1.75, 3.5, 7, 14, 28/30, 40, 56 MHz		3.5, 7, 14, 28, 40, 50, 56 MHz		1.75, 2.5, 3.5, 5, 7, 13.75, 27.5, 55 MHz	
Channel duplex spacing	min. 58 MHz		490, 530 MHz		min. 60 MHz		1008, 1010, 1560 MHz	
Gross data rate	1.4 – 360 Mbps		1.4 – 360 Mbps		4.9 – 360 Mbps		2.5 – 360 Mbps	
FEC	LDPC							
Modulation/Speed/Sensitivity	1.75 MHz	56 MHz	1.75 MHz	56 MHz	3.5 MHz	56 MHz	1.75 MHz	55 MHz
QPSK	1 Mbps / -103 dBm	73 Mbps / -86 dBm	1 Mbps / -102 dBm	73 Mbps / -87 dBm	5 Mbps / -97 / -96 dBm	73 Mbps / -87 / -86 dBm	3 Mbps / -97 dBm	73 Mbps / -84 dBm
16 QAM	3 Mbps / -97 dBm	160 Mbps / -79 dBm	3 Mbps / -97 dBm	160 Mbps / -80 dBm	10 Mbps / -90 / -89 dBm	160 Mbps / -80 / -79 dBm	5 Mbps / -91 dBm	160 Mbps / -75 dBm
32 QAM	4 Mbps / -94 dBm	203 Mbps / -75 dBm	4 Mbps / -94 dBm	203 Mbps / -76 dBm	12 Mbps / -87 / -86 dBm	203 Mbps / -76 / -75 dBm	6 Mbps / -88 dBm	203 Mbps / -73 dBm
64 QAM	6 Mbps / -91 dBm	257 Mbps / -72 dBm	6 Mbps / -91 dBm	257 Mbps / -73 dBm	14 Mbps / -84 / -83 dBm	257 Mbps / -73 / -72 dBm	7 Mbps / -85 dBm	257 Mbps / -70 dBm
128 QAM	7 Mbps / -88 dBm	304 Mbps / -68 dBm	7 Mbps / -88 dBm	304 Mbps / -69 dBm	17 Mbps / -83 / -79 dBm	304 Mbps / -69 / -68 dBm	9 Mbps / -83 dBm	304 Mbps / -67 dBm
256 QAM	-	338 Mbps / -66 dBm	-	338 Mbps / -67 dBm	20 Mbps / -81 / -77 dBm	338 Mbps / -66 / -65 dBm	-	338 Mbps / -64 dBm
ACM	Hitless							
RF Output power	-10 to +13 dBm		-15 to +24 dBm		-25 to +5 dBm / -30 to +10 dBm		-10 to +24 dBm	
ATPC	Yes							
Latency (RFC 2544)	81 µs (64 B / 358 Mbps), 234 µs (1518 B / 358 Mbps)							
Electrical								
Primary power	PoE active 40 – 60 VDC, IEEE 802.3at; DC 20 – 60 VDC; floating							
Power consumption	21 W		21 – 29 W		21 / 23 W		21 – 28 W	
Interfaces								
Ethernet	1x 10/100/1000 Base-T Auto MDI/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 aluminium							
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)		2.8 kg (6.1 lbs)		2.5 kg (5.5 lbs)		2.7 kg (5.9 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, RAY Tools, web							
SNMP	v2c including configurable TRAPs							
Security								
Management	HTTP, HTTPS, SSH, Telnet, RAYTools App							
Access accounts	3 levels (Guest, Admin, Super)							
Standards								
CE, FCC, RoHS								
Radio parameters	EN 302 217-2-2 V2.2.1		EN 302 217-2-2 V2.2.1		EN 300 440-1 V1.6.1		EN 302 217-2-2 V2.2.1	
	EN 302 217-1 V1.3.1				EN 300 440-2 V1.4.1			
EMC	EN 301 489-1 V1.9.2							
	EN 301 489-4 V2.1.1				EN 301 489-3 V1.6.1			
Safety	EN 60 950-1:2006							
FCC			CFR 47 part 101		CFR 47 part 15 (RAY2-24)		CFR 47 part 101	

