

# Airmux-400

Broadband Wireless Multiplexer



Carrier-class broadband radio solution for Ethernet and TDM traffic over license-free frequencies

- Carrier-class cost-effective broadband wireless radio system with Layer-2 Ethernet capabilities
- Net throughput of up to 200 Mbps aggregated (symmetric and asymmetric)
- Hybrid E1/T1 and Ethernet services on a single platform with transmission range of up to 120 km (75 miles)
- Multiband operation over 2.3 to 2.5 GHz, 3.5 licensed and 4.8 to 5.9 GHz frequencies
- High reliability and availability based on robust air interface protocol



Airmux-400 is a carrier-class, cost-effective multiple point-to-point broadband wireless transmission device. It combines legacy TDM and Ethernet services for transmission over 2.3 to 2.5 GHz, 3.5 licensed and 4.8 to 5.9 GHz bands, and is suitable for deployment in FCC, IC and ETSI-regulated countries.

For the global markets of cellular backhaul, WiMAX and ISP backhaul, broadband access,

large private and government networks, Airmux-400 offers high throughput, longer range and robustness at a competitive price.



**data communications**  
The Access Company

# Airmux-400

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In addition to Airmux-400, the Airmux-400L model is available as a cost-effective solution for backhaul and access application with Ethernet and TDM throughput of up to 50 Mbps.

The Airmux product line is part of RAD's Access+ portfolio for Multiservice Access Platform and First Mile solutions. The portfolio combines extensive support for legacy services with future-proof Ethernet capabilities to address the challenges faced by utilities, transportation networks, carriers, and mobile operators in migrating to next-generation networks and services with flexibility, efficiency and carrier-class reliability.

### TYPICAL APPLICATIONS

The most common wireless applications are described below.

#### Service Providers and ISPs

Providing IP backhaul of 4G/broadband services in multiple point-to-point topologies, Airmux-400 offers broadband access for remote, rural and underserved communities:

- nLOS (no line of sight) in urban environment
- Long haul in rural setting (*Figure 2*).

Large corporate clients can build their networks to eliminate the recurring fee of incumbent leased line services while

maintaining a secured dedicated capacity per site.

#### Private Networks

Airmux-400 can be used in high-capacity interbranch connectivity applications for university campuses, health care organizations, government institutions, large enterprises and public establishments with high traffic requirements (*Figure 1*).

#### Mobile Carriers

In rural-to-urban cellular backhaul applications, Airmux-400 extends mobile reach to rural locations with carrier-grade, long-haul point-to-point E1/T1 and Ethernet services. It also can be used for backhaul of 3G traffic in urban environment with easy migration path from converged TDM/IP networks to all-IP networks.

#### Security and Surveillance

Aggregation and backhaul of traffic from multiple collocated megapixel video cameras, make Airmux-400 suitable for homeland security applications, municipal 'safe city' projects, border control installations.

### AIRMUX-400 MODELS

The following models with different Ethernet or aggregate throughputs exist:

- Airmux-400 100M –200 Mbps aggregated throughput with up to 16 E1/T1s. This model operates in the following modes:

- 100 Mbps full duplex with 40 MHz channel bandwidth
- 100 Mbps asymmetric with 10 and 20 MHz channel bandwidths and user-selectable uplink/downlink capacity (50–50% up to 95–5%)
- Airmux-400L – Supporting up to 50 Mbps aggregated symmetric throughput and up to 8 E1/T1. This model is best suited for combined TDM and IP traffic delivery.

Airmux systems can be deployed to create a single point-to-point link, in a central site collocating a multiple point-to-point array of links, or as a resilient ring for Ethernet-only services.

Transmission range of up to 120 km (75 mi) is attainable with an external antenna.

### PHYSICAL CONFIGURATIONS

Airmux multiplexers consist of a mast- or wall-mountable outdoor unit (ODU), an optional external antenna and an indoor unit (IDU) with redundant DC power supplies.

### SUPERIOR SPECTRAL EFFICIENCY

Built on advanced MIMO and OFDM technologies, a pair of Airmux-400 units provides a high-capacity link at channel bandwidth of 10, 20 or 40 MHz (see *Table 1*). This guarantees a robust air interface able to withstand strong RF interference and harsh ambient conditions.

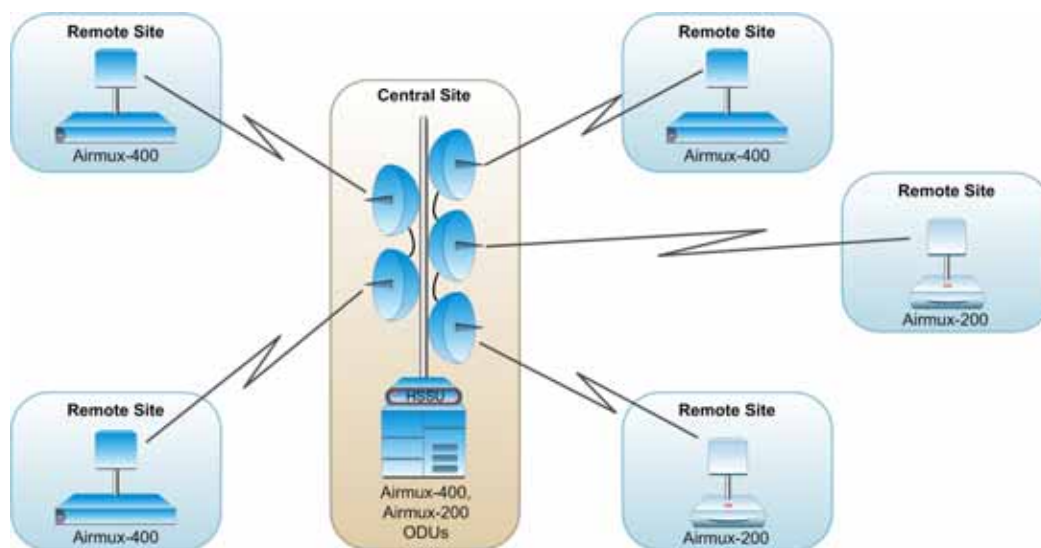


Figure 1. Enterprise Interbranch Connectivity

## SECURITY

Data transmitted over the air interface is encrypted using Advanced Encryption System (AES) with a 128-bit encryption key.

## AIR LINK QUALITY OF SERVICE

When the link quality is low, Airmux-400 automatically searches for a clear channel within a pre-selected list of frequencies.

## SHORT TIME-TO-SERVICE

Because Airmux-400 operates in license-exempt frequencies, it can be deployed in record time, eliminating the costs and delays involved in leasing lines or trenching fiber.

## SITE SYNCHRONIZATION

Hub Site Synchronization (HSS) assists in the collocation of multiple radios by reducing the interference that normally occurs when several radios transmit and receive in close proximity to one another. HSS enables a complex radio environment of mixed services (TDM and Ethernet) and channel bandwidth frequencies. The collocation feature requires ordering the HSS unit as well as its synchronization cables.

**Note:** Like any other RF deployment, the wireless operation is highly dependent on factors such as available frequencies, the physical space between radios, other interfering radios, and whether Airmux-200 or Airmux-400 units are used.

HSS does not eliminate the need for careful RF planning to ensure the design will work as planned.

For long distance coverage, the synchronization can be obtained, using a GPS Synchronization Unit (GSU). The GSU reduces the interference between the collocated radios by providing a GPS signal simultaneously to ODUs at all locations.

## 1+1 LINK REDUNDANCY

The Monitored Hot Standby (MHS) 1+1 link redundancy protects the wireless transmission against equipment failure or air interface loss. Link switchover is performed in less than 50 msec.

## DIVERSITY

With dual bipolar antennas, Airmux-400 links can be configured to transmit the same data through both radios. This ensures data transmission integrity under harsh conditions.

## RESILIENT ETHERNET RING

Ethernet rings are used to protect data against link and node failures.

## LAN PORTS

The IDU-E devices include three LAN ports: two Fast Ethernet UTP (RJ-45) and one SFP slot.

The regular IDUs have two 10/100BaseT ports.

With RAD's MiTOP-E3/T3, SFP-based TDM pseudowire gateway, Airmux-400 delivers E3/T3 data streams over its wireless link.

## MANAGEMENT

A single SNMP-based network management application (Airmux Manager) is used to control multiple Airmux-400 and Airmux-200 links as a unified network.

RADview-EMS, RAD's SNMP-based management software provides access to the Airmux Manager via its topology map.

The Airmux Manager Spectrum View utility is an RF survey tool enabling the link installation prior to full link service activation. It provides comprehensive and clear spectral measurement information for easier installations.

# Specifications

## RADIO

### Regulation

FCC/IC:

FCC 47CFR, Part 15, Subpart C,  
FCC 47CFR, Part 15, Subpart E  
FCC 47CFR, Part 90, Subpart Y  
RSS-111  
IC RSS-210

ETSI:

ETSI EN 302 502  
ETSI EN 301 893

WPC India: GSR-38

China: MII

## Frequencies and Channel Bandwidths

Band [GHz]	Bandwidth			
	5 MHz	10 MHz	20 MHz	40 MHz
6.0	Universal			
5.9	Universal			
5.8	FCC/IC, MII, WPC			
	ETSI			
5.4	–	Universal, FCC/IC		
5.3	Universal, FCC/IC			
	–	ETSI		
4.9	Universal			
	FCC/IC			–
4.8	Universal			
3.4	ETSI, IC, Universal			–
3.6	FCC/IC			–
2.4	FCC/IC			–
2.3	Universal			

## Duplex Technique

TDD

## Transmit Power

See *Table 2*

## Modulation

2×2 MIMO-OFDM, see *Table 2*

## Error Correction

FEC, k = 1/2, 2/3, 3/4, 5/6, see *Table 1*

## Sensitivity

See *Table 1* (measured at BER <10E-11, 20 MHz)

## Encryption

AES 128

## Throughput

Airmux-400L (full duplex):

Up to 50 Mbps aggregated (Ethernet  
and up to 8 E1/T1 combined)

Airmux-400 (full duplex):

Up to 200 Mbps aggregated (Ethernet  
and up to 16 E1/T1 combined)

## TDM INTERFACE

### Number of Ports

2, 4, 8 or 16

# Airmux-400

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<b>Type</b> E1/T1	<b>Line Impedance</b> 100Ω	<b>Grounding and Lightning Protection</b> Individual grounding for each IDU/ODU Internal arrestors for lightning protection Internal ESD protection circuits over power/telecom lines Optional lightning protection kit
<b>Framing</b> Transparent to framing mode	<b>VLAN Support</b> 802.1p & Q <b>MANAGEMENT</b>	<b>Power</b> DC: -20 to -60 VDC via AC/DC converter
<b>Timing</b> Plesiochronous (independent Tx and Rx)	<b>Protocol</b> SNMP, Telnet	<b>Power Consumption</b> 35W max (ODU with IDU)
<b>Line Code</b> E1: HDB3 T1: B8ZS, AMI	<b>Interface</b> 10/100BaseT	<b>Indicators</b> IDU (green/orange/red): IDU status ODU (green/red): ODU status AIR I/F (green/orange/red): Air link status SVC (green/orange/red): TDM service status HSS (green/orange/red): HSS status STBY (green/orange/red): MHS status LINK (yellow): Ethernet link status ACT (green): Ethernet activity status
<b>Latency</b> 8 msec	<b>Connector</b> RJ-45	<b>Environment</b> Outdoor unit and external antenna: Enclosure: IP67 all-weather case Temperature: -35° to 60°C (-31° to 140°F) Indoor units: Temperature: 0° to 50°C (32° to 122°F) Humidity: Up to 90%, non-condensing
<b>Line Impedance</b> E1: 120Ω, balanced T1: 100Ω, balanced	<b>Upgrade Capabilities</b> Local and over-the-air software download	<b>Physical</b> ODU (with integrated antenna): Height: 371 mm (14.8 in) Width: 371 mm (14.8 in) Depth: 9 mm (3.6 in) Weight 3.5 kg (7 lb) IDU: Height: 44 mm (1.7 in) Width: 237 mm (9.3 in) Depth: 165 mm (6.5 in) Weight 0.5 kg (1.1 lb)
<b>Jitter and Wander</b> As per G.823, G.824	<b>SFP PORT</b> <b>Type</b> Fast Ethernet, for full details, see the <i>SFP Transceivers data sheet</i> at <a href="http://www.rad.com">www.rad.com</a> <b>Note:</b> It is strongly recommended to order this device with <b>original RAD SFPs installed</b> . This will ensure that prior to shipping, RAD has performed comprehensive functional quality tests on the entire assembled unit, including the SFP devices. RAD cannot guarantee full compliance to product specifications for units using non-RAD SFPs. For detailed specifications of the SFP transceivers, see the <i>SFP Transceivers data sheet</i> .	
<b>Connector</b> RJ-45	<b>INTEGRATED ANTENNAS</b> <b>Polarization Type</b> Dual	
<b>LAN INTERFACE</b>	<b>Characteristics</b> See <i>Table 3</i>	
<b>Number of Ports</b> 3	<b>GENERAL</b> <b>Diagnostics</b> Local and remote loopbacks	
<b>Type</b> 2 × 10/100BaseT, autonegotiation (802.3u) 1 × SFP	<b>IDU-to-ODU Connection</b> Outdoor Cat.5e cable, 100m (328 ft) max. length	
<b>Framing/Coding</b> IEEE 802.3u		
<b>Bridging</b> Up to 2048 MAC addresses self-learning		
<b>Traffic Handling</b> MAC layer bridging, self-learning		
<b>Latency</b> 3 msec (typical)		

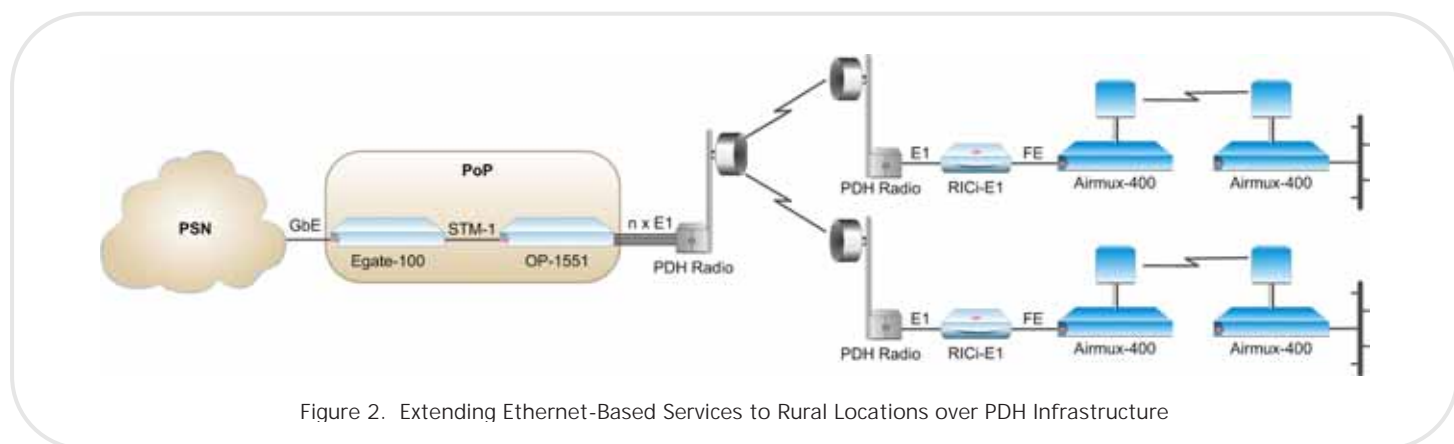


Figure 2. Extending Ethernet-Based Services to Rural Locations over PDH Infrastructure

Table 1. Radio Link Characteristics

Modulation	Rate		FEC [k = ]	Max Tx Power		Sensitivity [dBm]
	Single Antenna [Mbps]	Dual Antenna [Mbps]		4.8–6 GHz [dBm]	2.4 GHz [dBm]	
BPSK	6.5	13	1/2	25	26	-88
QPSK	13	26	1/2			
	19.5	39	3/4			-83
16 QAM	26	52	1/2	24	25	-81
	39	78	3/4	21	24	-77
64 QAM	52	104	2/3	19	24	-72
	58.5	117	3/4			
	65	130	5/6	18	21	-70
					20	-67

Table 2. Integrated Antenna Options

Antenna Type	Frequency [GHz]	Gain [dBi]	Beam [degrees]	Dimensions		Weight	
				[mm]	[inch]	[kg]	[lb]
Flat panel	4.9x–5.875	19 (4.9x GHz) 23 (5.x GHz)	9	371x371x40	14.6x14.6x1.5	2.5	5.5
Flat panel	2.400	16	16	371x371x40	14.6x14.6x1.5	2.5	5.5
Flat panel	3.4–3.7	21	12	371x371x11	14.6x14.6x0.4	3.5	7

**Note:** For description of external antennas, see Airmux-400 External Antennas data sheet at [www.rad.com](http://www.rad.com).

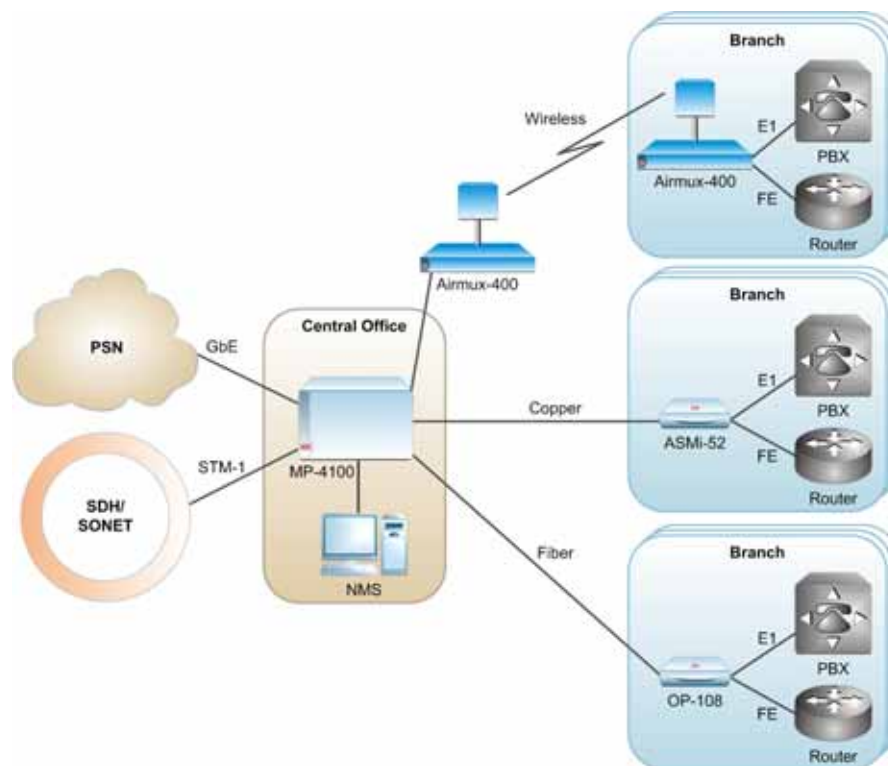


Figure 3. Providing Access for Multisite Connectivity

# Airmux-400

## Broadband Wireless Multiplexer

### Ordering

#### Airmux-400/IDUE/\*

Indoor unit with redundant DC power supply

#### Legend

\* IDU-E interface:

<b>4TDM</b>	4 TDM ports, 3 Ethernet ports (10/100 Mbps) (2 UTP + 1 SFP)
<b>8TDM</b>	8 TDM ports, 3 Ethernet ports (10/100 Mbps) (2 UTP + 1 SFP)
<b>16TDM</b>	16 TDM ports, 3 Ethernet ports (10/100 Mbps) (2 UTP + 1 SFP)
<b>2GbE</b>	2 Gigabit Ethernet ports (2 GbE + 1 SFP)

**Note:** Enhanced Ethernet capabilities (VLANs and QoS) and resilient ring topology are supported by Airmux-400/IDUE/2GbE model only.

#### Airmux-IDU/%

Indoor unit with single DC power supply

% IDU interface:

<b>2TDM</b>	2 TDM (E1/T1) interfaces, 2 ETH interfaces, alarm port
<b>2ETH</b>	2 ETH interfaces

#### Notes:

- Enhanced Ethernet capabilities (VLANs and QoS) and resilient ring topology supported by both IDU/2TDM and IDU/2ETH models.
- For AC power feeding, order external power adapter (Airmux-PS-E-AC/a). See Optional Accessories below.

#### Airmux-OPOE/DC

Outdoor PoE device with wide range DC source (-20 to -60 VDC).

**Note:** A PoE device eliminates the need for ordering an IDU-E. It requires connection via the power adapter. See Optional Accessories below.

#### Airmux-400/ODU/#/+

Outdoor unit with integrated antenna

#### Airmux-400/ODU/@/+EXT

Outdoor unit for external antenna connection

#### Airmux-400L/ODU/^/EMB

Outdoor unit with an embedded antenna and connectorize for external antennas.

Supports 50-Mbps Ethernet throughput only

# Frequency band and regulation:

<b>F23U</b>	2.3 GHz, 2.4 GHz FCC/IC (default – 2.3 GHz universal), 100 Mbps Ethernet throughput only
<b>F25F</b>	2.5 GHz, FCC/BRS with 100-Mbps Ethernet throughput only
<b>F3XF</b>	3.x GHz FCC/IC (default – 3.65 GHz FCC/IC), 100 Mbps Ethernet throughput only
<b>F3XE</b>	3.x GHz ETSI (default – 3.5 GHz ETSI) with 100-Mbps Ethernet throughput only
<b>F49F</b>	4.9 GHz, 5.x GHz (default – 4.9 GHz FCC/IC) with 100-Mbps Ethernet throughput only
<b>F54E</b>	5.x GHz (default – 5.4 GHz ETSI)
<b>F54U</b>	5.x GHz (default – 5.4 GHz universal)
<b>F58F</b>	5.x GHz (default – 5.8 GHz FCC/IC)
<b>F58IDA</b>	5.8 GHz, WPC India
<b>F60U</b>	6.0 GHz and 5.x GHz bands (default 5.8 GHz FCC)

@ Frequency band and regulation:

<b>F23U</b>	2.3 GHz, 2.4 GHz FCC/IC (default – 2.3 GHz universal), 100 Mbps Ethernet throughput only
<b>F2449F</b>	2.x GHz, 4.9 GHz, 5.x GHz (default – 4.9 GHz FCC/IC), 100 Mbps Ethernet throughput only
<b>F25F</b>	2.5 GHz, FCC/BRS, 100 Mbps Ethernet throughput only
<b>F3XF</b>	3.x GHz (default 3.65 GHz FCC/IC), 100 Mbps Ethernet throughput only
<b>F3XE</b>	3.x GHz ETSI (default – 3.5 GHz ETSI)
<b>F54U</b>	5.x GHz (default – 5.4 GHz universal)

<b>F2458F</b>	2.x GHz, 5.x GHz (default – 5.8 GHz FCC/IC)
<b>F2458IDA</b>	2.x GHz, 5.x GHz (default – 5.8 GHz WPC India)
<b>F48ARG</b>	4.8 GHz, according to Argentina radio regulations
<b>F48U</b>	4.8 GHz, 2.x GHz and 5.x GHz, (default – 4.8 GHz universal)
<b>F54E</b>	5.x GHz (default – 5.4 GHz ETSI)
<b>F60U</b>	6.0 GHz and 5.x GHz bands (default 5.8 GHz FCC)
^ Frequency band and regulation:	
<b>F49F</b>	4.9 GHz, 5.x GHz (default – 4.9 GHz FCC/IC)
<b>F50F</b>	5.x GHz FCC/IC (default-5.8 GHz)
<b>F50E</b>	5.x GHz ETSI (default-5.4 GHz)
<b>F54U</b>	5.x GHz (default – 5.4 GHz universal)
<b>F60U</b>	6.0 GHz and 5.x GHz bands (default 6.0 GHz universal)
+ Ethernet throughput:	
<b>10M</b>	10 Mbps (for 3XF and 3XE only)
<b>100M</b>	100 Mbps
<b>200M</b>	200 Mbps

**OPTIONAL ACCESSORIES**

**Airmux-400/ANT/\$**

External antenna with 1m (3.3 ft) cable. **grid** stands for a grid antenna, **fp** – a flat panel antenna, and **dish** – a dish antenna.

*Legend*

*Legend*

**\$** External antenna:

- 19/2427/fp** 19 dBi, 2.30–2.70 GHz, 2.3, 2.4, 2.5 GHz bands
- 21/3338/fp** 21 dBi, 3.30–3.80 GHz
- 22/4451/fp** 22 dBi, 4.40–5.10 GHz, 4.8, 4.9 GHz
- 23/4958/fp** 23 dBi, 4.90–6.06 GHz bands
- 28/5260/DISH** 28dBi, 4.90–6.06 GHz bands
- 32/4958/DISH** 32dBi, 4.90–5.875 GHz bands

**CBL-Airmux-UTP/@**

Assembled cable for connection between IDU and ODU



*Legend*

**@** Cable length:

- 25** 25m (82 ft)
- 50** 50m (164 ft)
- 75** 75m (246 ft)
- 100** 100m (328 ft)

**Note:** For detailed description of external antennas, see Airmux-400 External Antennas data sheet at [www.rad.com](http://www.rad.com).

Table 1. Airmux Family Product Comparison

Features	 Airmux-200 (Ver. 1.9.3)			 Airmux-400 (Ver. 2.6)		
	Airmux-200	Airmux-200L/LC	Airmux-200VS	Airmux-400L	Airmux-400/100	Airmux-400/200
Bandwidth (Mbps)	18	2	5/2	50 total (Ethernet + TDM)	100 total (Ethernet + TDM)	200 total (Gigabit Ethernet)
Services	2 Ethernet + 1, 2, 4 E1/T1	1 Ethernet	1 Ethernet	Up to 3 Ethernet + up to 8 E1/T1	Up to 3 Ethernet + up to 16 E1/T1	Up to 2 Gigabit Ethernet ports
HSS	✓	✓	✓	✓	✓	✓
Maximum range (km/mi)	80/50	20/12.5	20/12.5	120/75	120/75	120/75

## Airmux-400

## Broadband Wireless Multiplexer

**Airmux-PS-E-AC/a**

Power adapter for IDU and IDU-E,  
90–240 VAC to 48 VDC

*Legend*

<b>a</b>	AC adapter plug:
<b>ACEU</b>	Europe
<b>ACUS</b>	US
<b>ACUK</b>	UK
<b>ACIDA</b>	India
<b>ACAU</b>	Australia
<b>ACAG</b>	Argentina
<b>ACOC</b>	Open-ended

**Airmux-HSSU**

Hub site sync unit to connect 8 collocated  
outdoor units and 2 additional HSS units

**Airmux-POE/a**

Power over Ethernet (PoE) device

**Airmux-POE/GbE/a**

Power over Ethernet (PoE) device with a  
100/1000BaseT interface

**Airmux-GSU/a**

Outdoor GPS-based synchronization kit  
(GSU, GPS antenna, 1.5m (4.9 ft) RF cable,  
CBL-Airmux-HSS/5 cable, PoE unit, and  
mounting kits for GSU and GPS antenna)

**a** Power cable with matching plug:

<b>ACEU</b>	Europe
<b>ACUS</b>	US
<b>ACUK</b>	UK
<b>ACIDA</b>	India
<b>ACAU</b>	Australia/China
<b>ACOC</b>	Open-ended connector
<b>ACAR</b>	Argentina
<b>ACSA</b>	South Africa

**CBL-Airmux-HSS/@@**

Assembled cable for HSS connection

*Legend*

**@@** Cable length:

<b>5</b>	5m (16.4 ft)
<b>15</b>	15m (49.2 ft)
<b>50</b>	50m (164 ft)
<b>100</b>	100m (328 ft)

**Airmux-MHS-kit**

Cable and patch panel assembly (8 × RJ-45  
Y-connections) for Monitored Hot Standby  
configuration

**Airmux-Lightning-Protection**

Outdoor lightening protection unit for  
10/100/1000BaseT surge protector.  
Includes 0.5m (1.64 ft) CAT5e cable and  
wall/poll mounting kit.

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