ZINWAVE 2700
DISTRIBUTED ANTENNA SYSTEM

Operational Description

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1 OVERVIEW OF THE ZINWAVE 2700 DAS

1.1 Introduction

The ZinWave 2700 DAS is a simple 2-stage DAS, utilising either multimode optical fibre (MMF) or single mode optical fibre (SMF) to connect the two system units together.

The ZinWave 2700 DAS unifies the distribution of multiple cellular and WLAN signals over a single cabling infrastructure and supports current and future wireless technologies. Initial support is provided in the frequency range 370 -2500 MHz which covers the following services: TETRA, GSM, CDMA, TDMA, UMTS, iDEN, WLAN (IEEE 802.11b/g), Paging, DCS, EDGE, EVDO, DECT.

The programmable RF combiner within the ZinWave 2700 Hub Unit enables a wide variety of "RF to antenna" mappings and provides the flexibility to move/add capacity as needed within the building without the need to change the deployed antenna devices.

ZinWave's patented technology allows the multimode or single mode optical fibres specified for structured (or generic) cabling by the following standards to be used as the transmission system:

- North America: ANSI/TIA/EIA-568 series;
- European: EN 50173 series;
- international: ISO/IEC 11801.

NOTE: Optimal performance of the ZinWave 2700 DAS may require the re-termination of the optical fibres within legacy multimode optical fibre infrastructures installed using components meeting the above mentioned standards.

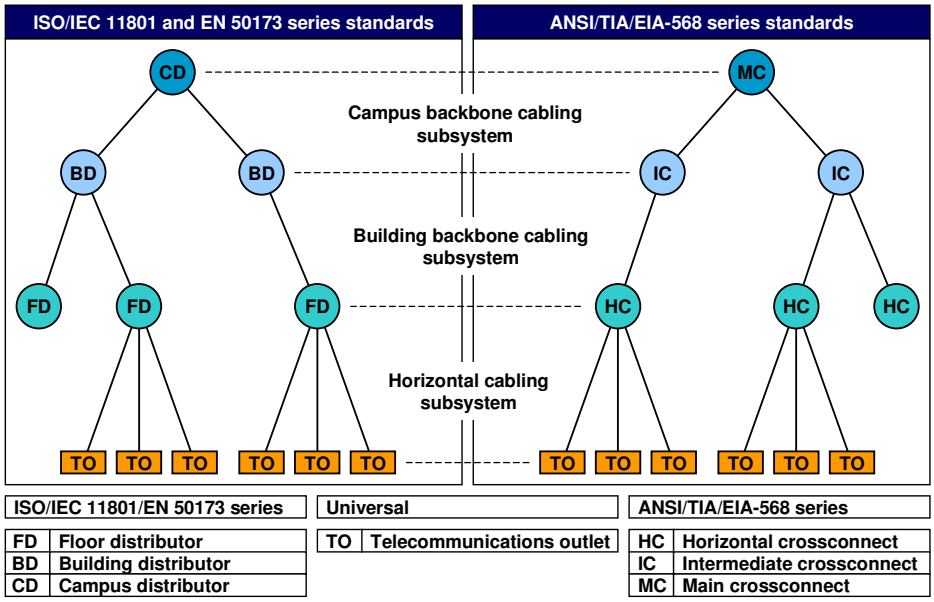

Figure 1-1: Elements of standards-based structured/generic cabling

By building on the existing infrastructures within the campus and building backbone cabling subsystems of professionally designed cabling systems (see Figure 1-1) and by removing the need for network-specific overlay architectures, the ZinWave 2700 DAS is simple to install and has low maintenance overheads.

The extended channel lengths over which the ZinWave 2700 DAS operates using these cabling systems (see 1.4) enables centralised location of all equipment within even the largest buildings. This in turn:

- provides enhanced network security by allowing all vulnerable devices to be placed in one secure location;
- reduces equipment and support costs;
- provides the ability to remotely maintain and upgrade WLAN APs etc.

1.2 The components

The ZinWave 2700 DAS units are:

- **the ZinWave 2700 Hub Unit (HU):** which comprises a ZinWave 2700 Hub, a stackable 1U high 19" rack mount device, supporting four independent RF (370 - 2500 MHz) service inputs/outputs, together with up to eight ZinWave 2780 Small Form Pluggable (SFP) optical fibre transceiver modules. Each ZinWave 2780 SFP module supports a ZinWave 276x antenna unit
- **the ZinWave 276x Multi-service Antenna Unit (AU):** a small enclosure designed for unobtrusive installation with separate antennas in an office environment
- **the ZinWave 277x Narrow-band Antenna Unit (AU):** a wall-mounted enclosure designed for installation with a separate antenna in an office environment.

1.3 The technology

ZinWave's patented technology renders conventional MMF a practical transmission medium for wideband, high frequency, radio frequency (RF) signals by extending the bandwidth of legacy, in-situ, cabling to permit the transmission of multiple RF signals, supporting different services, at original carrier frequency over long distances using low cost uncooled transceivers.

1.4 The system

The ZinWave transceivers within the hub and antenna units are "fibre agnostic" i.e. they can be used with either 50/125 mm or 62.5/125 µm MMF. ZinWave 2700 channels can be up to 550 metres long provided that the MMF cable has a modal bandwidth of at least 500MHz.km @ 1300 nm.

This length of channel is more than adequate to facilitate a high quality, broadband, in-building coverage extension system for multiple, simultaneous wireless feeds for 2G/3G Base stations, WLAN APs, TETRA etc

Without ZinWave's technology, such distances can only be achieved in most scenarios by expensive re-cabling of buildings using coaxial cables or single mode optical fibre, or by reverting to narrowband techniques which restrict the systems' capability.

The ZinWave DAS is ideally suited to applications where multiple cellular and/or WLAN services are required and can be easily configured for various deployment scenarios such as .at campuses, large high-rise buildings and multi-tenanted units.

NOTE: In the US and Canada, only the use of the Cisco® Aironet ®1200 WLAN access point (Model AIR-AP1231-A-K9) is approved for connection to the 2700 hub for providing WLAN services.

NOTE: Optimal performance of the ZinWave 2700 DAS may require the re-termination of the optical fibres within legacy multimode optical fibre infrastructures installed using components meeting the above mentioned standards.

NOTE: Channels lengths of up to 2000 metres can be delivered, using the same 2700 System components, over SMF cabling.

1.5 Integrated Management Software

Management of the ZinWave 2700 system is implemented by proprietary software which allows remote configuration via the World Wide Web, Telnet and/or SNMP. The management system allows Hub and Antenna Unit health monitoring and provides a flexible approach to both RF to Transceiver Distribution and Gain Mapping.

System specification

Table 1-1 : Channel transmission performance

Parameter	Value			Unit	Comments
	Min.	Nom.	Max.		
Input impedance		50		Ohms	At HU service & AU uplink inputs
Output impedance		50		Ohms	At HU service & AU downlink outputs
Operating Temperature Range	0		+55	℃	Ambient, non-condensing
Channel length - MMF	1		550	m	50/125 µm, 62.5/125 µm[1]
Channel insertion loss - MMF	0		4	dB	@ 1300 nm
Channel length - SMF	1		2000	m	
Channel insertion loss - SMF	0		4	dB	@ 1310 nm
TX-RX Isolation[2]	30			dB	HU service input to service output (same service)
TX-RX Isolation[2]	70			dB	HU service input to any other service output
TX-TX Isolation[2]	70			dB	HU service input to any other service input
Antenna Isolation	35			dB	AU antenna output to AU antenna input
NOTE 1: Minimum modal bandwidth @ 1300 nm = 500MHz.km. Reduced channel lengths/insertion loss values may be supportable for lower modal bandwidth options following detailed analysis by ZinWave. NOTE 2: At max HU RF input power, max AU RF output power, maximum uplink noise figure and for any RF combiner distribution					

Table 1-2: Downlink RF parameters

Parameter	Value			Unit	Comments
	Min.	Nom.	Max.		
System Bandwidth 276x AU 2776 AU	 370 869-894		 2500 1930-1990	MHz	
RF input power	-5	0	+10	dBm	At HU service input with 14dB peak-average-ratio
RF output power 2760 AU 2765 AU 277x AU			 + 6 +12 +18	dBm	Broadband rms composite power at AU antenna output
VSWR			1.5:1		
Return loss			14	dB	
Response variation	-5		+5	dB	Full bandwidth
Response variation	-1		+1	dB	Any 200kHz band
Response variation	-2		+2	dB	Any 100MHz band

Table 1-3: Uplink RF parameters

Parameter	Value			Unit	Comments
	Min.	Nom.	Max.		
System Bandwidth 276x AU 2776 AU	 370 869-894		 2500 1930-1990	MHz	
RF input power			-15	dBm	Input gain adjustment for minimum coupling loss
Max RF output power	-20	-10		dBm	At HU service output for 1dB compression with maximum AU input power
Response variation	-5		+5	dB	Full bandwidth
Response variation	-2		+2	dB	Any 100MHz band
Response variation	-1		+1	dB	Any 5MHz band

2 EQUIPMENT DESCRIPTION

2.1 2700 Hub Unit

2.1.1 Overview

The HU is a 1U high rack or shelf mountable device with four RF input ports (each port has two simplex connectors, 1 for downlink and 1 for uplink). The signals are routed from the RF I/O ports to 8 SFP ports through a dynamically configurable distribution circuit. In addition the signal amplitudes can be adjusted using 8 controllable attenuators (4 in the downlink and 4 in the uplink direction). A block diagram of the HU is shown in Figure 2-1.

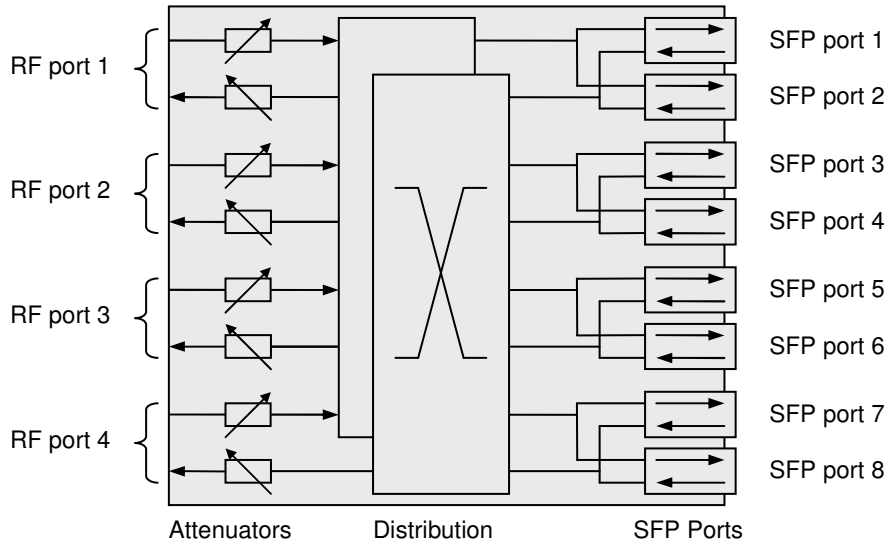

Figure 2-1: Block diagram of the 2700 HU.

2.1.2 Dimensions and Weight

Dimensions and weight of the HU are listed in Table 2-1. These are for a HU not populated with SFP modules and without the rack mounting brackets attached.

Table 2-1: Dimensions and weight of the 2700 HU.

Parameter	Value	Unit
Height	4.4 (1.8)	cm (inch)
Width	44.5 (17.8)	cm (inch)
Depth	27.0 (10.6)	cm (inch)
Weight	3.5	kg

2.1.3 Connection panels and LED indicators

A drawing of the front view is shown in Figure 2-2. The front panel of the HU contains

- 8 SFP ports for the 2780 SFP modules
- Hub + System LED indicators for status information and alarms.
- SFP port LED indicators

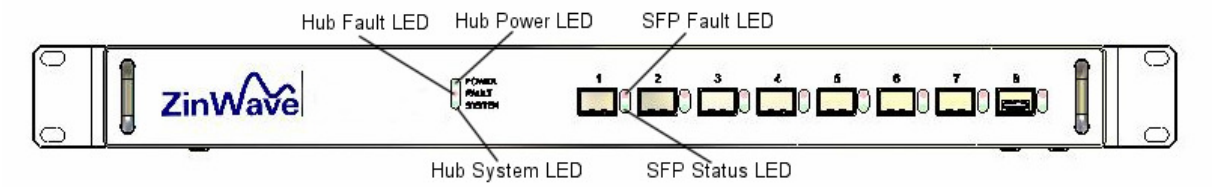

Figure 2-2: Front View of the 2700 Hub Unit.

A drawing of the rear view is shown in Figure 2-3. The back panel of the HU contains

- 8 SMA-female RF connectors (4 × downlink / 4 × uplink)
- RJ45 Ethernet port
- RS232 Serial port (9 pin sub-D)
- Mains input connector
- Fuse drawer
- ON/OFF switch
- Reset switch

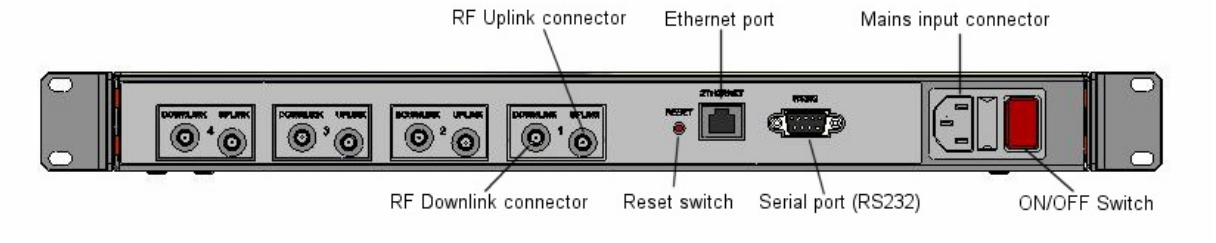

Figure 2-3: Rear View of the 2700 Hub Unit.

2.1.3.1 Mains cable

The specifications of the power supply unit (PSU) of the HU are listed in Table 2-2. Ensure that the ON/OFF switch is in the OFF (O) position before connecting the IEC mains cable to the Hub (**Error! Reference source not found.**). Plug the mains cable into an outlet providing AC power with a voltage of 100 – 240 VAC and a frequency of 47 – 63 Hz.

Table 2-2: Power supply unit (PSU) parameters.

Parameter	Min	Typical	Max	Unit	Comment
Input voltage	100		240	VAC	
Input Frequency	47		63	Hz	
Fuse		2		A	Anti-surge
Current consumption			220	mA	
Power consumption			15	W	

2.1.3.2 Control cables

The 2700 DAS can be controlled locally via the serial port or remotely via the network interface (**Error! Reference source not found.**). For details on controlling the 2700 DAS refer **Error! Reference source not found.** of this guide. To attach the required cables to the Hub Unit follow these steps:

- **Serial Port:** The serial interface connector is a 9 pin sub-D male connector. To connect the HU directly to a computer, use a RS 232 null modem. Connect the RS232 cable to the serial connector, hand tightening the screws to prevent the connector from loosening.
- **Ethernet Port:** Connect the Ethernet port of the HU to your network using a RJ45 category 5e patch cable.

2.1.3.3 RF transceiver

Connection of the RF signal sources (e.g. BDA, BTS, WLAN access point) is via a pair of simplex SMF-female connectors per RF port. The ports are labelled 1 to 4 for connecting up to four RF transceivers. Connect the ports labelled “IN” to the transmit port of the RF transceiver (= downlink). Connect the ports labelled “OUT” to the receive ports of the RF transceivers (= uplink).

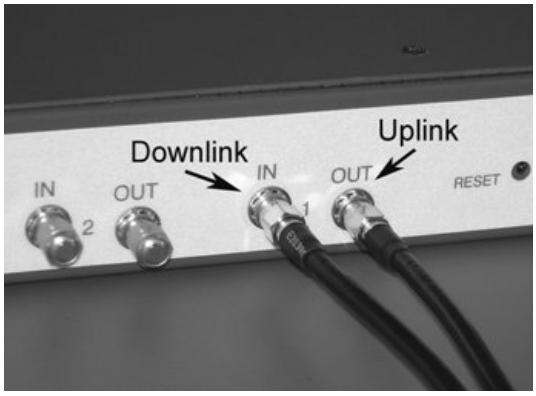

Figure 2-4: Connecting a pair of jumper leads from a RF transceiver.

As the 2700 DAS is a broadband system, the connections to the RF transceivers are via simplex connectors. In cases where the RF transceiver has a common duplex connector for uplink and downlink the signals traveling in opposite direction need to be separated. This is done with an external duplexer or circulator.
For a larger system with more than eight AU, the RF signals have to be routed to several hubs. This is achieved by inserting a passive splitting/combining circuitry.

2.1.4 Environmental

The environmental specifications of the HU for operation and storage are listed in Table 2-3.

Table 2-3: Environmental specifications of 2700 HU.

Parameter	Min	Typical	Max	Unit
Temperature - Operating	0		+55	℃
Temperature - Storage	-25		+55	℃
Relative Humidity (non-condensing)	10		95	%

2.2 2780/2781 SFP module

2.2.1 Overview

The 2780/2781 small form-factor pluggable (SFP) modules are broadband components (350-2700MHz) converting electrical to optical signals (Transmit) and optical to electrical signals (Receive). A block diagram of the SFP module is shown in Figure 2-5.

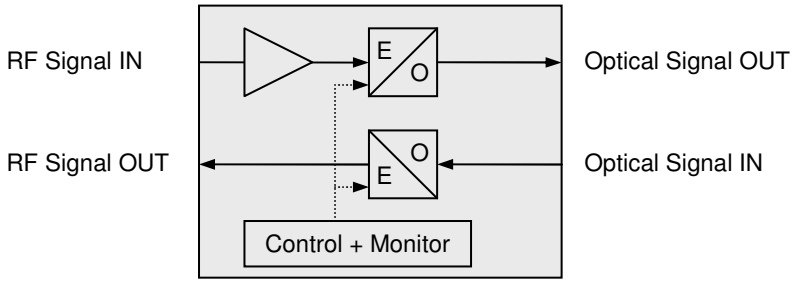

Figure 2-5: Block diagram of the 2780/2781 SFP module.

The electrical input signal is amplified before it is modulated onto the optical carrier wave. The optical input signal is directly routed to the electrical connector. A micro controller is included for control and monitoring purpose.
The 2780 SFP is designed to be used in the 2700 Hub Unit. The 2781 SFP is designed to be used in the 2760 Antenna Unit. While the modules are identical in their design they differ in the rated operating temperature range.

2.2.2 Dimensions and Weight

The physical design of the 2780/2781 SFP module follows the design of standard digital SFP transceivers as outlined in the SFP Multi-Source Agreement (MSA).

Table 2-4:.Physical parameter of the 2780/2781 SFP modules.

Parameter	Value	Unit
Height	0.85 (0.33)	cm (inch)
Width	1.37 (0.54)	cm (inch)
Length	5.65 (2.22)	cm (inch)
Weight	40	g

2.2.3 Ports

2.2.3.1 Electrical port

The electrical connection of the SFP is via a push-fit 20-pin connector located at the rear of the module.

2.2.3.2 Optical port

The optical port on the SFP module is LC duplex (according to IEC 61754-20

2.2.4 Environmental

Table 2-5: Environmental specifications of 2780 SFP module (designed for the 2700 Hub Unit).

Parameter	Min	Typical	Max	Unit
Temperature - Operating	0		+85	℃
Temperature - Storage	-25		+55	℃
Relative Humidity (non-condensing)	10		95	%

Table 2-6: Environmental specifications of 2781 SFP module (designed for the 2760 Antenna Unit).

Parameter	Min	Typical	Max	Unit
Temperature - Operating	0		+55	℃
Temperature - Storage	-25		+55	℃
Relative Humidity (non-condensing)	10		95	%

2.3 2760 + 2765 Antenna Unit – Wideband

2.3.1 Overview

- The 2760/2765 AUs are small wall- or ceiling mountable units which amplify the received optical signals for transmission over a wireless link (in the case of the downlink signals) and amplify the received wireless signals for transmission over the optical link (in the case of the uplink signals).
- The 2760 AU utilizes the 2781 SFP optical transceiver for the electrical-optical signal conversion. The 2765 AU utilizes an integrated optical transceiver which is not pluggable.
- Because of the wide bandwidth of the units (370 – 2500 MHz) separate wideband antennas are required for Transmit and Receive.
- Adjustable gain settings allow you to define the coverage area of each AU individually. Control of the AU is remotely via the HU. These are controlled remotely via the Hub Unit.
- The 2760 AU can be powered via a 48 V DC supply or Power-over-Ethernet (PoE). The 2765 is powered only via PoE.

Figure 2-6 and Figure 2-7 show a block diagram of the 2760 and 2765 AU, respectively.

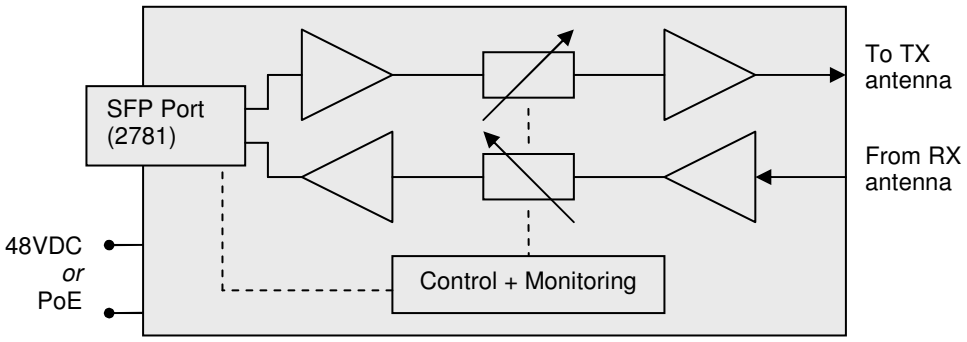

Figure 2-6: Block diagram of the 2760 AU.

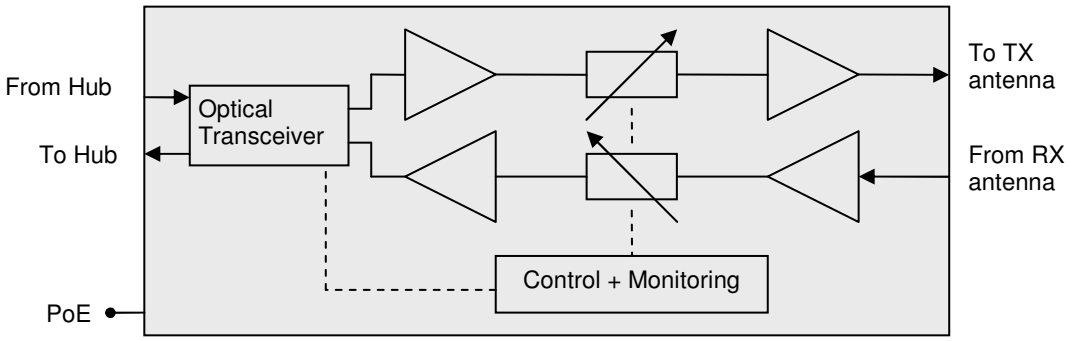

Figure 2-7: Block diagram of the 2765 AU.

2.3.2 Dimensions and Weight

Dimensions and weight listed in Table 2-7 are for an AU without the optional cover.

Table 2-7: Dimensions and weight of the 2760 + 2765 AU.

Parameter	2760	2765	Unit
Height	21.5 (8.5)	20.0 (8.0)	cm (inch)
Width	13.0 (5.125)	12.0 (4.75)	cm (inch)
Depth	4.5 (1.8)	6.0 (2.4)	cm (inch)
Weight	0.75	0.75	kg

2.3.2.1 2760 AU

A drawing of the front view is shown in
Figure 2-8. The front panel of the AU contains:

- SFP port for the 2781 SFP module
- RJ45 connector for powering via Power-over-Ethernet (PoE, IEEE 802.3af)
- 2-pin 48VDC input for powering via AC/DC
- Status LED, incorporated in the RJ45 connector
- Power LED, incorporated in the RJ45 connector

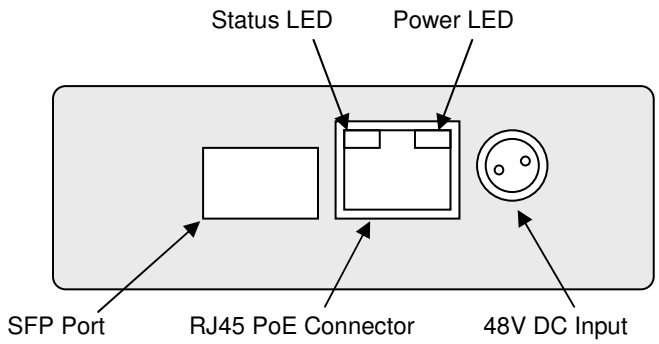

Figure 2-8: Front view of the 2760 AU.

A drawing of the rear view is shown in Figure 2-9. The rear panel of the AU contains

- 2 SMA-female RF connectors, one for TX and one for RX

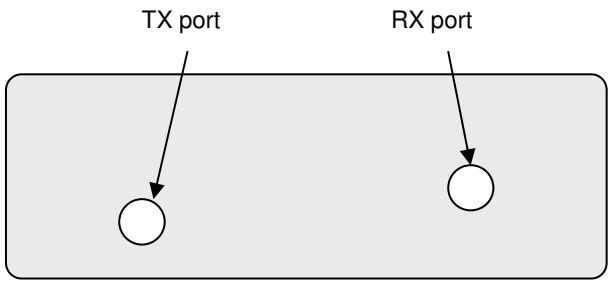

Figure 2-9: Rear view of the 2760 AU.

Following is a description of all interfaces and LED indicators of the 2760 AU.

Optical and Electrical I/O ports		
	SFP port	SFP port which can be populated with the Zinwave 2781 SFP module.
	RF ports	Two simplex wideband (370 – 2500 MHz) SMA-female connectors, one for TX (downlink) and one for RX (uplink)
Powering and LED indicators		
	48 VDC Input	2-pin latching connector (LEMO, EGG.00.302.CLL) for powering via the DC mains adapter
	PoE Connector	RJ45 connector for powering via PoE
	Status LED	Indicates the status of the AU (see **Error! Reference source not found.**)
	Power LED	Indicates the power state of the AU (see **Error! Reference source not found.**)

2.3.2.2 2765 AU

A drawing of the front view is shown in Figure 2-8. The front panel of the AU contains

- RJ45 connector for powering via Power-over-Ethernet (PoE, IEEE 802.3af)
- Status LED, incorporated in the RJ45 connector
- Power LED, incorporated in the RJ45 connector

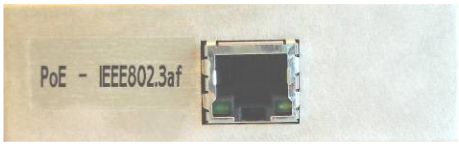

Figure 2-10: Front view of the 2765 AU.

A drawing of the rear view is shown in Figure 2-9. The rear panel of the AU contains

- 2 SMA-female RF connectors, one for TX and one for RX
- Optical Duplex SC connector

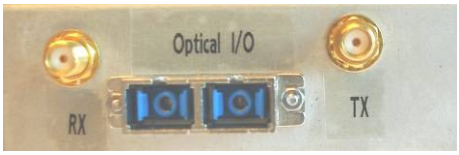

Figure 2-11: Rear view of 2765 AU.

Following is a description of all interfaces and LED indicators of the 2765 AU.

Optical and Electrical I/O ports		
	Duplex SC connector	Optical port which connects to the fiber-infrastructure.
	RF ports	Two simplex wideband (370 – 2500 MHz) SMA-female connectors, one for TX (downlink) and one for RX (uplink)
Powering and LED indicators		
	PoE Connector	RJ45 connector for powering via PoE
	Status LED	Indicates the status of the AU (see **Error! Reference source not found.**)
	Power LED	Indicates the power state of the AU (see **Error! Reference source not found.**)

2.3.3 Antenna

• The ZinWave DAS system can use a variety of Antennae connected to the Antenna Unit via Coax Cable. The choice of Antenna will depend on the service requirement within the operational bandwidth of the system. We recommend the use of a broadband patch antenna with specifications listed below:
• Gain (Max): 8dBi
• Azimuth beamwidth: > 90° in all bands
• Elevation beamwidth: Not less than 45° in any band
• Front-to-back ratio >10dB
• Pattern squint: Less than 10° in both planes in any band
• Polarization: Linear or circular (to be stated)

- For example an antenna that meets this requirement is the Huber and Suhner 824-2500MHz Planar Antenna SWA 0824/55/8/0/V.
- **Warning and Safety.** The antennas must be installed at a distance of greater than 20cm away from the proximity of operators and intended operation. A maximum antenna gain of 8dBi should be used.