ZINWAVE 2700
DISTRIBUTED ANTENNA SYSTEM

INSTALLATION AND TECHNICAL MANUAL

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INTRODUCTION

This document describes the installation and technical specifications for the ZinWave 2700 Distributed Antenna System (DAS). The 2700 DAS comprises a Hub Unit (HU) and remote Antenna Units (AUs) with Small Form Pluggable (SFP) modules providing the RF to Optical interface. The simple view of the ZinWave 2700 DAS is that it enables downlink radio signals to be converted into RF modulated optical signals at the HU and then transmitted to remote AUs over any optical fibre medium (single mode or multimode) where the optical RF signal is converted back into pure radio signals for radiation from attached Antennae. Radio signals from client devices take an uplink path back through the AU, via fibre to the Hub. The system enables the Antennae to be situated remotely from the RF signal source by large distances that will vary depending on the choice of fibre type used, but at least 550m for 62.5um diameter fibre and at least 2000m for single mode fibre. Uniquely, the 2700 DAS has a broadband frequency response that will accept and transmit RF signals ranging from 370 MHz to 2.5 GHz enabling a range of cellular and data service formats to be propagated without down conversion or intervention at their carrier frequency. Services that can be carried over the 2700 system include TETRA, GSM, CDMA, TDMA, UMTS, iDEN, WLAN (currently Europe only), Paging, DCS, EDGE, EVDO and DECT. In addition, the HU has a programmable combiner that simply enables the radio signal channels to be connected to one or multiple optical channels or combined with other services to multiple optical channels providing multi-service radio transmission to the AUs. Each channel comprises a full duplex uplink/downlink pair, and the HU has software configurable uplink/downlink gain and attenuation control.

The HU is a 1U 19” rack mountable form factor which can accept up to four concurrent RF services via duplex SMA RF ports at the rear of the module and transmit on up to 8 optical channels via unique analog duplex Small Form Pluggable (SFP) optical modules plugged into sockets in the front panel of the module. Each RF channel is always connected to at least 2 optical channels. Accepted combination options include 1x2, 1x4, 1x8, 2x2, 2x4, 2x8, 3x2, 3x8, 4x2, 4x8 (each of x inputs to y outputs). Where x and y are both numbers greater than 2, this implies that the RF channels are being combined onto multiple optical channels. Visible warning LEDs are incorporated to show individual channel status and overall system status.

The SFP modules are built to fit the physical form of the international standard for digital modules, but specifically operate as analog parts. They are made pluggable so that the HU need only be populated with those optical channels required at any particular time, so providing a low cost but scaleable solution. The interface between the SFP and the customer fibre backbone is via custom ZinWave patchcords, with LC connectors at the HU end and any connector of customer equipment choice at the link end. The SFP modules incorporate SFP industry standard alarms and control features.

The AUs use an SFP as the fibre to RF transceiver. They also incorporate software configurable uplink/downlink gain and attenuation control and radiate/receive RF signals via Antennae connected to SMA ports on the unit. Power for the AU is via an RJ45 connector which accepts industry standard Power over Ethernet (PoE) 48V DC supply.

The antennas are separate to the antenna unit as the specification of these will depend upon the service deployed using the system. A typical deployment is to use two patch antenna, one for the uplink and one for the downlink.

Software control of the HU is PC based from which both configuration of the System (via Command Line Interface (CLI)) and ongoing user control (via Simple Network Management Protocol (SNMP) over the internet) of the System can be achieved. The SNMP Management Interface Base (MIB) is constructed to allow control via any third party SNMP manager such as HP Openview. Direct user control is simple and achieved through a Graphical User Interface (GUI) which is supplied disk with the system. The RS232 connector for the CLI is situated at the back of the HU while internet connectivity is via an RJ45 connector, also at the rear of the HU. Software control features include uplink/downlink gain and attenuation settings on both the HU and AU, RF path combiner control and digital diagnostics for the Optical Link.

TRADEMARK

WARRANTY

The ZinWave 2700 DAS is designed to operate in conditions conformant with Pollution Degree 2 as defined in IEC 60950 (the normal environmental class for offices).

The installation of sub-assemblies into the main units of the The ZinWave 2700 DAS shall only be undertaken if precautions required by IEC/TS 61340-5-1 have been taken. This covers:

- the installation of Zinwave 2780 SFP optical fibre transceiver modules into the ZinWave 2700 Hub;
- the replacement of the Zinwave 2781 SFP optical fibre transceiver modules in the ZinWave 2760 Antenna Unit.

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1.2.1 Conventions

1.2.2 Definitions

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Downlink	From the ZinWave 2700 Hub Unit to the ZinWave 2760 Antenna Unit
Uplink	From the ZinWave 2760 Antenna Unit to the ZinWave 2700 Hub Unit

1.2.3 Abbreviations

2G	2nd Generation
3G	3rd Generation
AP	Access Point
AU	Antenna Unit
CDMA	Code division multiple access
CEN	European Committee for Standardization
CENELEC	European Committee for Electrotechnical Standardization
CISPR	Comite International Special des Perturbations Radioelectriques
CLI	Command line interface
DAS	Distributed antenna system
DCS	Digital Cellular System
EDGE	Enhanced Data rates for GSM Evolution
EMC	Electromagnetic Compatibility
EN	Euronorm (European Standard)
ETSI	European Telecommunications Standards Institute
EVDO	Evolution-Data Optimized
FCC	Federal Communications Commission
GSM	Global System for Mobile Communications
Hi-conn	High concentricity
HU	Hub Unit
iDEN	Integrated Digital Enhanced Network (Motorola)
IEC	International Electrotechnical Commission
MMF	Multimode optical fibre
R&TTE	Radio and Telecommunication Terminal Equipment
RF	Radio frequency
Rx (RX)	Receiver
SFP	Small Form Pluggable
SMF	Singlemode optical fibre
TDMA	Time division multiple access
TETRA	Terrestrial Trunked Radio
Tx (TX)	Transmitter
UL	Underwriters Laboratories Inc. 333 Pfingsten Road, Northbrook, IL 60062-2096 USA Phone: +1-847-272-8800, Fax: +1-847-272-8129
UMTS	Universal Mobile Telecommunications System
VSWR	Voltage Standing Wave Ratio
W-CDMA	Wideband - Code division multiple access
WLAN	Wireless Local Area Network

1.3 External standards compliance

1.3.1 ZinWave 2700 DAS

The ZinWave 2700 DAS products are compliant with Class A Emission limits of the following standards:

- CISPR22: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement;
- EN 55022: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement;
- FCC Part 15: Radio Frequency Devices
    - Code of Federal Regulations: Title 47: Part 15: Radio Frequency Devices.

The ZinWave 2700 DAS products are compliant with the electrical safety requirements of the following standards:

- IEC 60950-1: Information technology equipment - Safety - Part 1: General requirements;
- EN 60950-1: Information technology equipment - Safety - Part 1: General requirements;

The ZinWave 2700 DAS products are compliant with the Class 1 requirements of the following standards:

- IEC 60825-1: Safety of laser products - Part 1: Equipment classification, requirements and user's guide.

The ZinWave 2700 DAS products are compliant with NEBS Level 3 requirements for electrical safety and electromagnetic performance defined in Telcordia SR-3580: NEBS Criteria Levels and are thereby fully compliant with the requirements of the following:

- Telcordia GR-63-CORE:NEBS Requirements: Physical Protection
- Telcordia GR-1089-CORE: Electromagnetic Compatibility and Electrical Safety - Generic Criteria for Network Telecommunications Equipment

1.3.2 ZinWave 2700 System Installation

The installation of electrical supplies in support of ZinWave 2700 DAS products shall be in accordance with national and local regulations.

Other aspects of the installation of ZinWave 2700 DAS products and interconnecting cabling shall be in accordance with the following standards:

Cabling installation

- EN 50174 series: Information technology – Cabling installation

Optical safety:

- IEC 60825-2: Safety of laser products - Part 2: Safety of optical fibre communication systems (OFCS).

1.4 Regulatory compliance

The ZinWave 2700 DAS products are compliant with, and are labelled as such according to, the following European Directives

- EMC: 89/336/EEC;
- EMC: 2004/108/EC;
- R&TTE: 1999/5/EC.

1.5 Other ZinWave publications

XXXXXX ZinWave 2700 DAS User Manual

2 OVERVIEW OF THE ZINWAVE 2700 DAS

2.1 Introduction

The ZinWave 2700 DAS is a simple 2-stage DAS, utilising either multimode optical fibre (MMF) or singlemode 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 singlemode 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. This is dealt with in detail in clause 4.

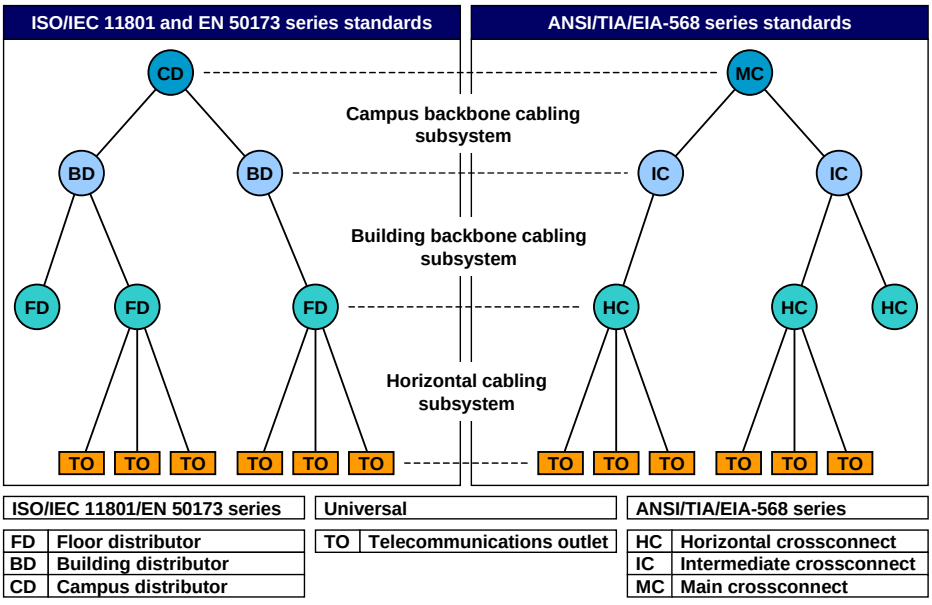


Figure 2-1: Elements of standards-based structured/generic cabling

By building on the existing infrastructures within the campus and building backbone cabling subsystems of professionally designed cabling systems (see Figure 2-1) 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 2.4) 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.

2.2 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 (see clause 3.1);. Each ZinWave 2780 SFP module supports a ZinWave 2760 antenna unit
- **the ZinWave 2760 Multi-service Antenna Unit (AU):** a small enclosure designed for unobtrusive installation with separate antennas in an office environment.

2.3 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.

2.4 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: 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. This is dealt with in detail in clause 4

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

2.5 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 (see 4.8) and Gain Mapping (see 4.9).

2.6 System specification

Table 2-1 : Channel transmission performance

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
Input impedance	*R_in*		50		Ohms	At HU service & AU uplink inputs
Output impedance	*R_out*		50		Ohms	At HU service & AU downlink outputs
Operating Temperature Range	*T_op*	0		+55	°C	Ambient, non-condensing
Channel length - MMF	*L_fmm*	1		550	m	50/125 µm, 62.5/125 µm[1]
Channel insertion loss - MMF		0		4	dB	@ 1300 nm
Channel length - SMF	*L_fsm*	1		2000	m	
Channel insertion loss - SMF		0		4	dB	@ 1310 nm
TX-RX Isolation[2]	*Is,TX1-RX1*	30			dB	HU service input to service output (same service)
TX-RX Isolation[2]	*Is,TX1-RXn*	70			dB	HU service input to any other service output
TX-TX Isolation[2]	*Is,TX-TX*	70			dB	HU service input to any other service input
Antenna Isolation	*Is,ant*	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 2-2: Downlink RF parameters

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
System Bandwidth		370		2500	MHz	
RF input power	*P_in*	-5	0	+10	dBm	At HU service input with 14dB peak-average-ratio
RF output power	*P_out,max*			+6	dBm	Broadband rms composite output power
VSWR				1.5:1		
Return loss				14	dB	
Response variation	*dg,full*	-5		+5	dB	Full bandwidth
Response variation	*dg,200kHz*	-1		+1	dB	Any 200kHz band
Response variation	*dg,100MHz*	-2		+2	dB	Any 100MHz band

Table 2-3: Uplink RF parameters

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
System Bandwidth		370		2500	MHz	
RF input power				-15	dBm	Input gain adjustment for minimum coupling loss
Max RF output power	*P_out,max*	-20	-10		dBm	At HU service output for 1dB compression with maximum AU input power
Response variation	*dg,full*	-5		+5	dB	Full bandwidth
Response variation	*Dg,100MHz*	-2		+2	dB	Any 100MHz band
Response variation	*dg,5MHz*	-1		+1	dB	Any 5MHz band

3 ZINWAVE 2700 DAS EQUIPMENT

3.1 ZinWave 270X Hub

3.1.1 General description

- 1U 19" rack mountable form factor (removable mounting bars allow desk mounting);
- sophisticated software programmable RF combiner supporting:
  - concurrent RF services via four RF input/output ports (SMA);
  - frequency Range 370 - 2500 MHz (upgradeable for support up to 6GHz);
  - multi-service capability e.g. TETRA, GSM, CDMA, TDMA, UMTS, iDEN, WLAN, LMR, SMR, Paging, DCS, EDGE, EVDO;
  - wide variety of "RF to antenna" mappings (see 4.8);
  - delivered to remote ZinWave 2760 Antenna Units via MMF or SMF cabling;
  - up to eight ZinWave 2780 Small Form Pluggable (SFP) optical fibre transceiver modules;
  - LED indicators above each optical port to show existence of transmitted/received optical signal as appropriate;
- system management via:
  - SNMP v2 GUI network management;
  - Command Line Interface (CLI)-based network management via Telnet;
  - RJ-45 Ethernet and serial management interface;
  - health monitoring capabilities for Hub and Antenna Units.

Figure 3-1: ZinWave 2700 Hub Unit with 8 ZinWave 2780 modules

3.1.2 Product description

Table 3-1: ZinWave 2700 Hub Unit and associated product part numbers

Product Reference	Description	Information
2700	Hub	Hub (without optical modules fitted)
2780	2.5GHz SFP	SFP optical fibre transceiver modules
9301	Mains lead, 2m, UK	
9302	Mains lead, 2m, European	
9303	Mains lead, 2m, US	

3.1.3 Technical description

Table 3-2: ZinWave 2700 Hub Unit physical parameters

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
Height			44/1.8		mm/in	
Width			445/17.5		mm/in	
Depth			270/10.6		mm/in	
Weight			3.5		kg	
Mains power voltage		100		240	VAC	
Mains power frequency		50		60	Hz	
Mains power consumption				15	W	
Mains power interface		1			-	IEC Socket
RF interfaces		8			-	SMA connectors (separate Tx and Rx providing 4 RF I/O pairs)
Optical interfaces		-	-	8	-	Using ZinWave 2780 SFP modules
Control interfaces		1			-	IEC 60603-7 (RJ-45) 100BASE-T
Control interfaces		1			-	9-pin D connector (RS232 - CLI)
Temperature - operating		0		+55	^{o}C	
Temperature - storage		-25		+55	^{o}C	

Table 3-3: ZinWave 2780 optical fibre transceiver module physical parameters

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
Weight					kg	
Optical interfaces		-	-	1	-	IEC 61754-20 (LC-Duplex)
Temperature - operating		0		+55	^{o}C	
Temperature - storage		-25		+55	^{o}C	

3.2 ZinWave 2760 Antenna Unit

3.2.1 General description

- Compact, unobtrusive and robust package (roof space, ceiling or wall mountable);
- converts optical I//O from ZinWave 2700 Hub Units to electrical RF I/O;
- upgradeable to support future wireless standards;
- powered either via 48V external power supply (ZinWave 9370) or by “Power over Ethernet” using mid-span insertion panel in accordance with IEEE802.3af.

Figure 3-2: ZinWave 2760 Antenna Unit

3.2.2 Product description

Table 3-4: ZinWave 2760 Antenna Unit and associated product part numbers

Product Reference	Description	Information
2760	Antenna unit	Includes ZinWave 2781 2.5GHz SFP
9370	AU Power Supply Unit	100-240VAC, 50-60Hz (IEC mains socket) to 48 VDC (Lemo plug), included with AU as default
9301	Mains lead, 2m, UK	
9302	Mains lead, 2m, European	
9303	Mains lead, 2m, US	

Warning and safety – The antenna unit must be installed at a distance of greater than 20cm away from the proximity of operators and intended operation.

Technical description

Table 3-5: ZinWave 2760 Antenna Unit physical parameters

Parameter	Symbol	Value			Unit	Comments
		Min.	Nom.	Max.		
Height			215/8.5		mm/in	
Width			130/5.1		mm/in	
Depth			45/1.8		mm/in	
Weight			0.75		kg	
Power supply voltage		40		48	V	
Power supply frequency			DC		-	
Power consumption				3	W	
Power supply interface AC/DC			1		-	LEMO
Power supply interface (IEEE 802.3af)			1		-	IEC 60603-7 (RJ-45)
RF interfaces			2		-	SMA
Optical interfaces			1		-	IEC 61754-20 (LC-Duplex)
Temperature - operating		0		+55	°C	
Temperature - storage		-25		+55	°C	

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.

ZinWave 2700 DAS infrastructure components

3.4 Multimode optical fibre terminations and cords

The implementation of the ZinWave 2700 DAS using multimode optical fibre involves the control of launch conditions at all cabling interfaces within the transmission channel.

NOTE: High modal bandwidth 50/125 μm mulitmode optical fibres including OM3 products specified in ISO/IEC 11801 and EN 50173-1 and the laser optimised products specified in ANSI/TIA/EIA-B.3 do not generally require such controls but are not differentiated in this document.

Where multimode optical fibres are to be used within ZinWave 2700 DAS channels they shall be terminated by the fusion splicing of ZinWave high concentricity (hi-conn) pigtails as listed in Table 3-6.

WARNING: Only fusion splice techniques shall be used to joint the installed optical fibres to the ZinWave hi-conn pigtails. Mechanical splices shall not be used

The bulkhead adaptors (also known as couplers) into which the connectors of the pigtails are fixed shall be those used for singlemode optical fibre connections. These are not listed as ZinWave products since they will be selected to suit the panels into which they are fitted.

Crossconnections or patches (a patch is a crossconnection with identical connectors at each end) between multimode optical fibre panels containing the terminations as described above shall be made via high concentricity (hi-conn) patch cords as listed in Table 3-6.

Where ZinWave 2700 DAS Hub and Antenna Units are connected to multimode optical fibre interfaces it is necessary to use ZinWave 2700 equipment cords listed in Table 3-6. These duplex cords feature an offset launch in the “launch” leg and must be connected in the correct orientatIon.

WARNING: ZinWave equipment cords are marked to indicate which is the launch “leg” and which end shall be connected to the equipment. Incorrect connections can affect the performance of the DAS and in some cases led to complete system failure.

A schematic showing the implementation approach described above is shown in Figure 3-3.

Table 3-6: ZinWave optical fibre infrastructure cords and associated product part numbers

Product Reference	Description	Information
5XX22-ZZ	50/125 μm MMF equipment cord (duplex)	Tight jacket optical fibre meeting ZinWave 2700 offset launch requirements, terminated at one end with LC-Duplex connector
6XX22-ZZ	62.5/125 μm MMF equipment cord (duplex)	Tight jacket optical fibre meeting ZinWave 2700 offset launch requirements with LC-Duplex connector
50191-YY or 50192-YY	50/125 μm MMF hi-con pigtail (simplex or duplex)	900 μm secondary buffered optical fibre 1 m long meeting ZinWave 2700 hi-con requirements
60191-YY or 60192-YY	62.5/125 μm MMF hi-con pigtail (simplex or duplex)	900 μm secondary buffered optical fibre 1 m long meeting ZinWave 2700 hi-con requirements
5XX31YY-ZZ or YY-5XX32-YY-ZZ	50/125 μm MMF hi-con patch cord (simplex or duplex)	Tight jacket optical fibre meeting ZinWave 2700 hi-con requirements
6XX31-YY-ZZ or YY-6XX32-YY-ZZ	62.5/125 μm MMF hi-con patch cord (simplex or duplex)	Tight jacket optical fibre meeting ZinWave 2700 hi-con requirements
XX defines length in metres YY defines connector at end A ZZ defines connector at end B		

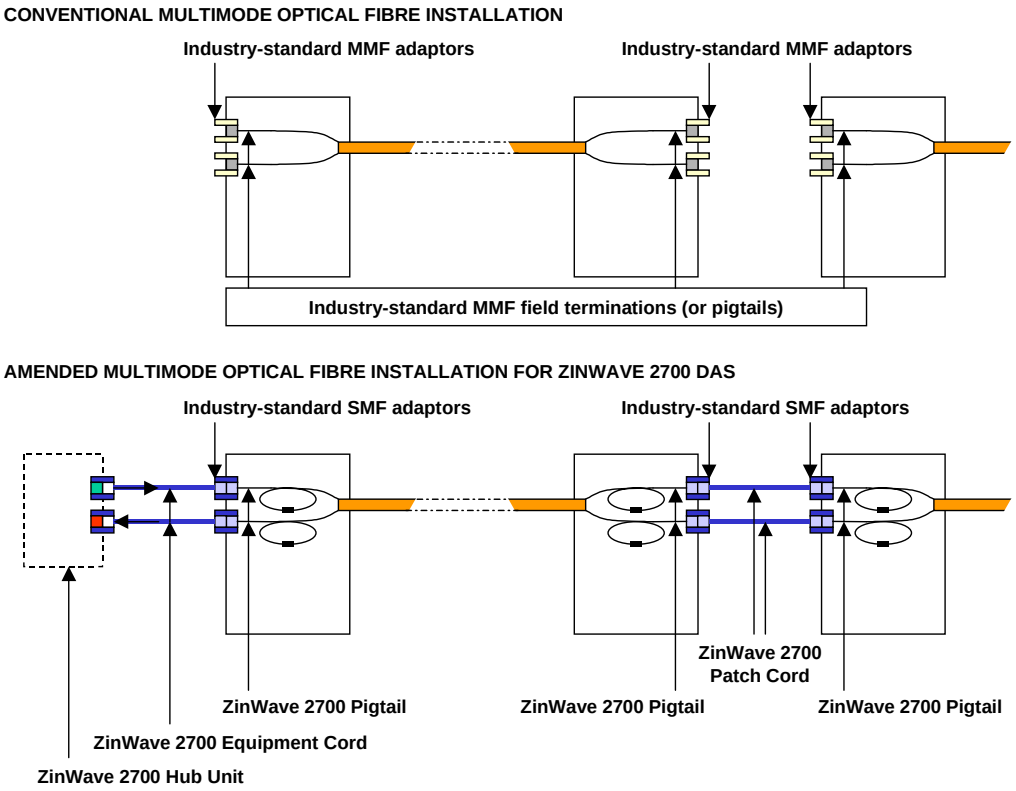


Figure 3-3: ZinWave 2700 DAS installation on multimode optical fibre

3.5 Singlemode optical fibre terminations and cords

There are no ZinWave-specific requirements for the installation of the 2700 DAS using singlemode optical fibre. Industry standard equipment cords and patch cords may be used.

3.6 Telecommunication Outlet (TO) connectivity

Each ZinWave 2760 Antenna Unit is connected to a Telecommunications Outlet (TO) which terminates the wireless application overlay cabling.

In order to simplify the installation of the TO and the cabling to the TO, the ZinWave components listed in Table 3-7 should be used.

The TO Closure is designed to allow the connection of optical fibre cabling and, where required, remote power via "Power over Ethernet" to one or two ZinWave 2760 Antenna Units.

Each TO Closure should be located in a position to allow a simple connection to the ZinWave 2760 Antenna Unit using the appropriate equipment cord of Table 3-6 (for attachment to multimode optical fibre cabling) or a industry-standard singlemode optical fibre cord i.e. not required to be a ZinWave product (for attachment to singlemode optical fibre cabling).

The TO Closure has glanded ports for two LC-Duplex connectors and two shrouded IEC 60603-7 sockets. The required number of optical ports shall be fitted with industry-standard singlemode optical fibre adaptors following the installation of the TO Closure.

The optical fibre TO cables listed in Table 3-7 are installed within the TO Closure without the need for termination or jointing at the TO. The remote ends of both multimode and singlemode TO cables are terminated by the fusion splicing of the appropriate pigtails.

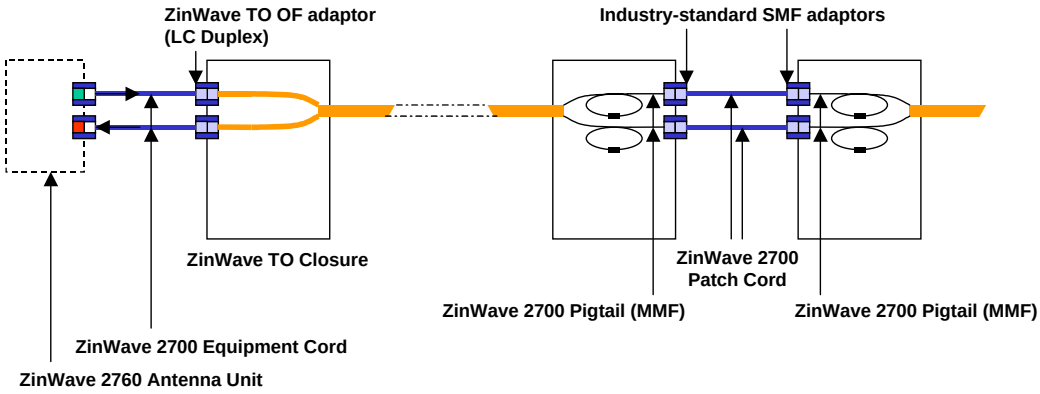
A schematic showing the implementation approaches in shown in Figure 3-4 and Figure 3-5 for multimode and singlemode optical fibre respectively.

The provision of remote power to the ZinWave 2760 Antenna Units is achieved by the termination of an industry-standard Category 5e/Category 5:2002 balanced cables using the IEC 60603-7 socket in the TO Closure.

Table 3-7: ZinWave optical fibre infrastructure cables and housings and associated product part numbers

Product Reference	Description	Information
XXXX-XX	TO Closure	2 No. LC-Duplex connector ports and 2 No. PoE presentation Incoming glands for 2 No. balanced cables and 2 No. OF cables
XXXX-XX	SMF Adaptor	LC-Duplex
10322-H	30 m TO cable, 2 No. SMF OF	Terminated at one end with LC-Duplex connector
50322-H	30 m TO cable, 2 No. 50/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements
60322-H	50 m TO cable, 2 No. 62.5/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements
10522-H	50 m TO cable, 2 No. SMF OF	Terminated at one end with LC-Duplex connector
50522-H	50 m TO cable, 2 No. 50/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements
60522-H	50 m TO cable, 2 No. 62.5/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements
11022-H	100 m TO cable, 2 No. SMF OF	Terminated at one end with LC-Duplex connector
51022-H	100 m TO cable, 2 No. 50/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements
61022-H	100 m TO cable, 2 No. 62.5/125 μm OF	Terminated at one end with LC-Duplex connector meeting ZinWave 2700 hi-con requirements

MULTIMODE OPTICAL FIBRE INSTALLATION FOR ZINWAVE 2760 ANTENNA UNIT - PATCHED ONWARD CONNECTION



MULTIMODE OPTICAL FIBRE INSTALLATION FOR ZINWAVE 2760 ANTENNA UNIT - JOINTED ONWARD CONNECTION

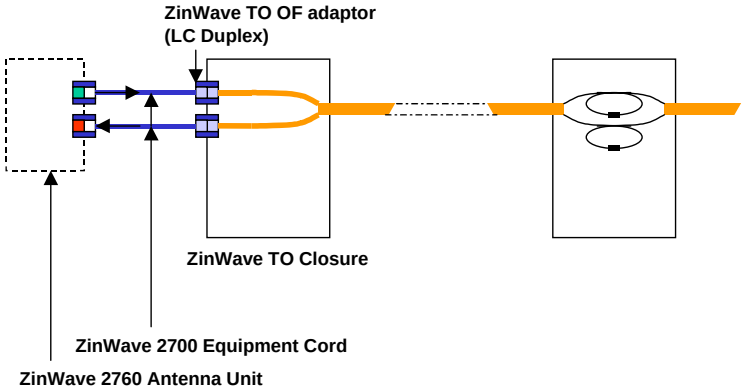
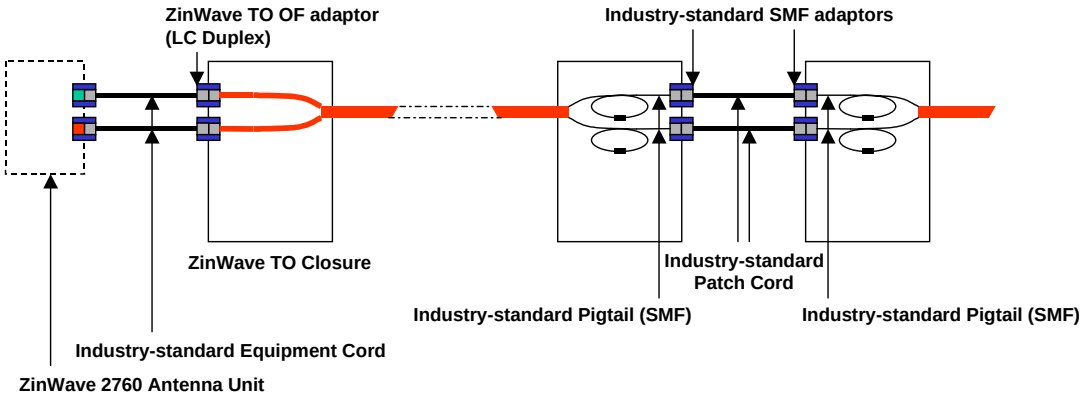


Figure 3-4: ZinWave 2760 Antenna Unit installation on multimode optical fibre

SINGLEMODE OPTICAL FIBRE INSTALLATION FOR ZINWAVE 2760 ANTENNA UNIT - PATCHED ONWARD CONNECTION



SINGLEMODE OPTICAL FIBRE INSTALLATION FOR ZINWAVE 2760 ANTENNA UNIT - JOINTED ONWARD CONNECTION

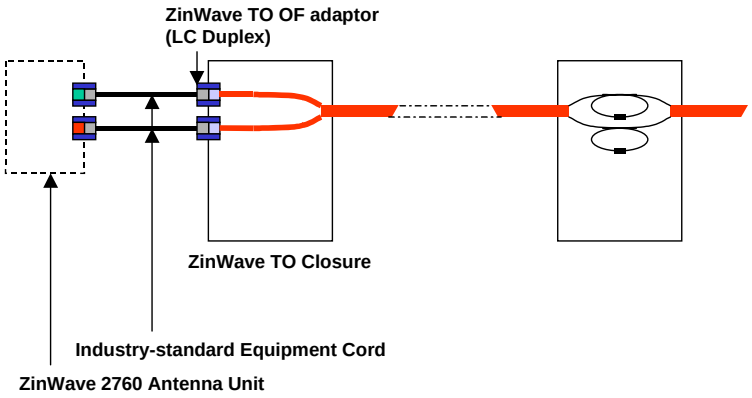


Figure 3-5: ZinWave 2760 Antenna Unit installation on singlemode optical fibre

4 SYSTEM 2700 DESIGN AND PLANNING

4.1 Infrastructure planning

4.1.1 ZinWave 2700 DAS infrastructures

One of the key advantages of the ZinWave 2700 DAS is the way in which it can use and be integrated with generic/structured cabling systems designed in accordance with the following standards:

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

The design and planning considerations for a ZinWave 2700 DAS in such circumstances is described in clause 4.1.2.

It is also possible to use the ZinWave 2700 DAS in situation where premises are not served by generic/structured cabling systems. The design and planning considerations for a ZinWave 2700 DAS in such circumstances is described in clause 4.1.3.

4.1.2 ZinWave 2700 DAS integration within generic/structured cabling infrastructures

ISO/IEC TR2 24704 specifies the cabling overlay for wireless access points in association with generic (i.e. structured) cabling in accordance with either ANSI/TIA/EIA-568 series standards, the EN 50173 series standards or ISO/IEC 11801.

ISO/IEC TR2 24704 specifies that the length between the connection of the generic wireless application overlay cabling at the FD/HC and the TO shall not exceed 90 metres. The ZinWave 2700 DAS recognises this restriction but can, where necessary, operate over extended lengths provided that the total length and the channel insertion loss of the cabling channel from the ZinWave 2700 Hub Unit to each ZinWave 2760 Antenna Unit does not exceed the values shown in Table 2-1. Nevertheless, it is recommended that length between the connection of the generic wireless application overlay cabling at the FD/HC and the TOs should not exceed 90 metres.

NOTE: The provision of remote powering of the ZinWave 2760 Antenna Unit using “Power over Ethernet” should not be implemented if the resulting channel length between the mid-span power insertion panel at the FD/HC and the ZinWave 2760 Antenna Unit exceeds 100 metres.

In cases where the ZinWave 2700 DAS is to use and be integrated with generic/structured cabling systems the design and planning sequence is as follows:

- determine the distribution and number of TOs to be installed in the generic wireless application overlay cabling (see 4.2);
- determine the number of optical fibres to be used in the backbone cabling subsystem;
- determine the optical fibre media to be used:
    - whether the ZinWave 2700 DAS is to be implemented by incorporating the customers existing optical fibre infrastructure or by installing additional generic/structured cabling to support the ZinWave 2700 DAS (see 4.3.1);
    - taking into account the predicted channel lengths and channel insertion loss values (see 4.3.3);
- determine the connection mechanism between the generic wireless application overlay cabling and the building backbone cabling subsystem at the FD/HC (see Figure 4-1 and 4.3);
- determine the space requirements for the ZinWave 2700 DAS infrastructure at each FD/HC ((see 4.4 ,4.6 and 4.7);
- determine the space requirements for the ZinWave 2700 DAS infrastructure at each BD/IC (see Figure 4-1, 4.4 and 4.6);
- where the ZinWave 2700 DAS is to be extended to a separate CD/MC it will also be necessary to:
    - determine the space requirements for the ZinWave 2700 DAS infrastructure at each CD/MC ((see 4.4 and 4.6);
    - determine the connection mechanism between the building backbone cabling subsystem and the campus backbone cabling subsystem at the BD/IC (see Figure 4-1 and 4.3).

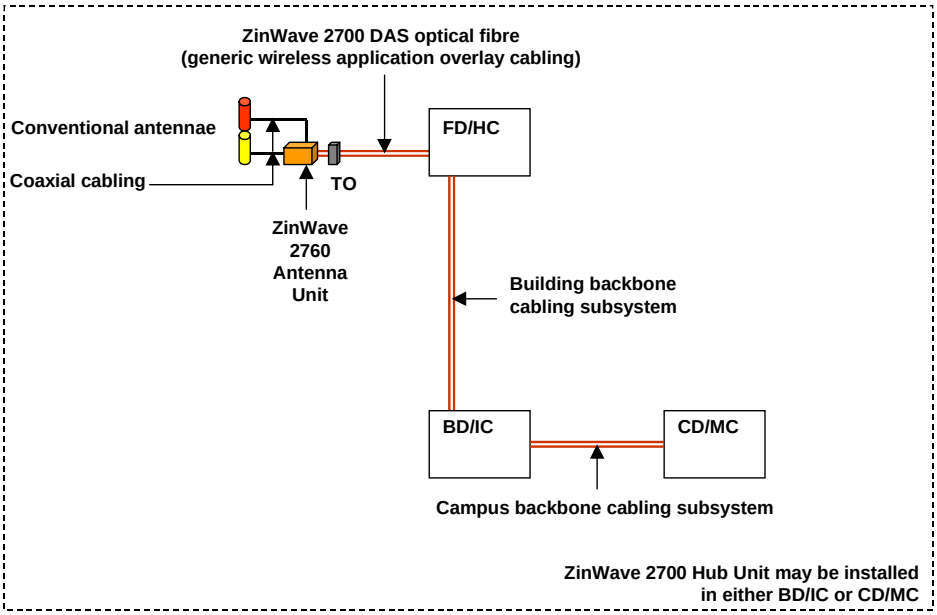


Figure 4-1: ZinWave 2700 DAS within a generic/structured cabling system

4.1.3 ZinWave 2700 DAS in stand-alone infrastructures

ISO/IEC TR2 24704 specifies the cabling overlay for wireless access points in association with generic (i.e. structured) cabling in accordance with either ANSI/TIA/EIA-568 series standards, the EN 50173 series standards or ISO/IEC 11801. However, the principles underlying its requirements and recommendations are equally applicable to stand-alone cabling (perhaps in situations where there is no generic/structured cabling system or the premises do not contain viable locations for distributors/crossconnects).

For distribution in a single building:

- the FD/HCs of Figure 4-1 are replaced by ZinWave Local Splice Panels as shown in Figure 4-2;
    - ZinWave Splice Panels can be installed in any convenient location, are completely passive and require no mains power supplies;
- ZinWave Building Termination Panels are located in association with the ZinWave 2700 Hub Units as shown in the upper diagram in Figure 4-2.

For campus distribution

- the FD/HCs of Figure 4-1 are replaced by ZinWave Local Splice Panels as shown in Figure 4-2;
    - ZinWave Local Splice Panel can be installed in any convenient location, is completely passive and requires no mains power supplies;
- the BD/ICs of Figure 4-1 are replaced by ZinWave Building Splice Panels as shown in the lower diagram in Figure 4-2;
    - ZinWave Building Splice Panels can be installed in any convenient location at the entrance to the buildings, are completely passive and require no mains power supplies;
- ZinWave Campus Termination Panels are located in association with the ZinWave 2700 Hub Units.

In the absence of remote power (due to the passive nature of the ZinWave Local Splice Panel), the ZinWave 2760 Antenna Units will generally be powered using the default 48V DC power supply.

ISO/IEC TR2 24704 specifies that the length between the connection at the FD/HC and the TO shall not exceed 90 metres. The ZinWave 2700 DAS recognises this restriction but can, where necessary, operate over extended lengths provided that the total length and the channel insertion loss of the cabling channel from the ZinWave 2700 Hub Unit to each ZinWave 2760 Antenna Unit does not exceed the values shown in Table 2-1. Nevertheless, to enable integration of the ZinWave 2700 DAS cabling within future generic/structured cabling it is recommended that length between the ZinWave Local Splice Panel and the TOs should not exceed 90 metres.

The design and planning sequence is as follows:

- determine the distribution and number of TOs to be installed in the ZinWave overlay cabling (see 4.2);
- determine the number of optical fibres to be used between each Local Splice Panel and the corresponding ZinWave Building Splice or Termination Panel;
- for campus distribution, determine the number of optical fibres to be used between each Building Splice Panel and the corresponding ZinWave Campus Termination Panel;
- determine the optical fibre media to be used:
    - whether the ZinWave 2700 DAS is to be implemented by incorporating the customers existing optical fibre infrastructure or by installing additional generic/structured cabling to support the ZinWave 2700 DAS (see 4.3.2);
    - taking into account the predicted channel lengths and channel insertion loss values (see 4.3.3);
- determine the space requirements for the ZinWave 2700 DAS infrastructure at the primary and secondary points of distribution in association with the ZinWave 2700 Hub Units (see 4.4 and 4.6).

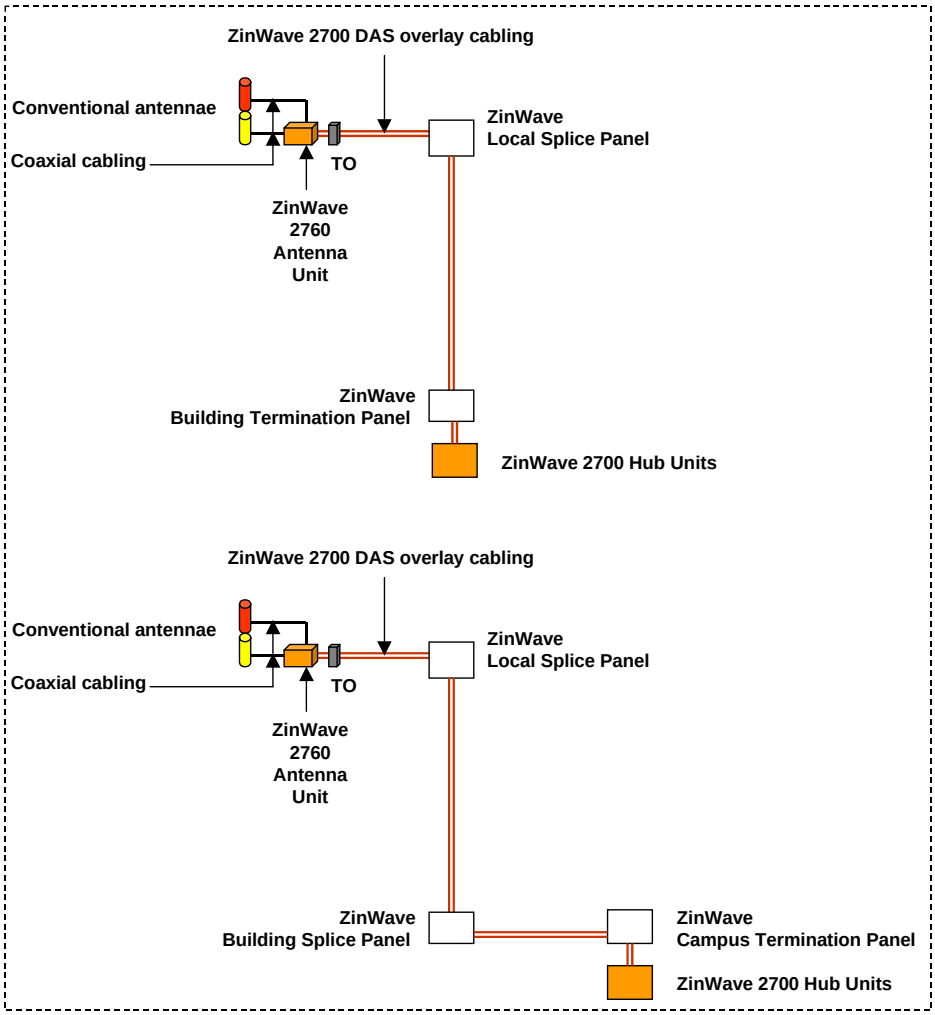


Figure 4-2: ZinWave 2700 DAS as a stand-alone cabling system

4.2 Distribution of overlay cabling

ISO/IEC TR2 24704 specifies the cabling overlay for wireless access points in association with generic (i.e. structured) cabling in accordance with either ANSI/TIA/EIA-568 series standards, the EN 50173 series standards or ISO/IEC 11801. The same distribution of 2760 Antenna Units connection points applies to if the cabling is installed specifically to serve the ZinWave 2700 DAS using stand-alone cabling.

ISO/IEC TR2 24704 recommends a "honeycomb" distribution grid as shown in Figure 4-3 which features the best overall coverage (450 m^2 per TO).

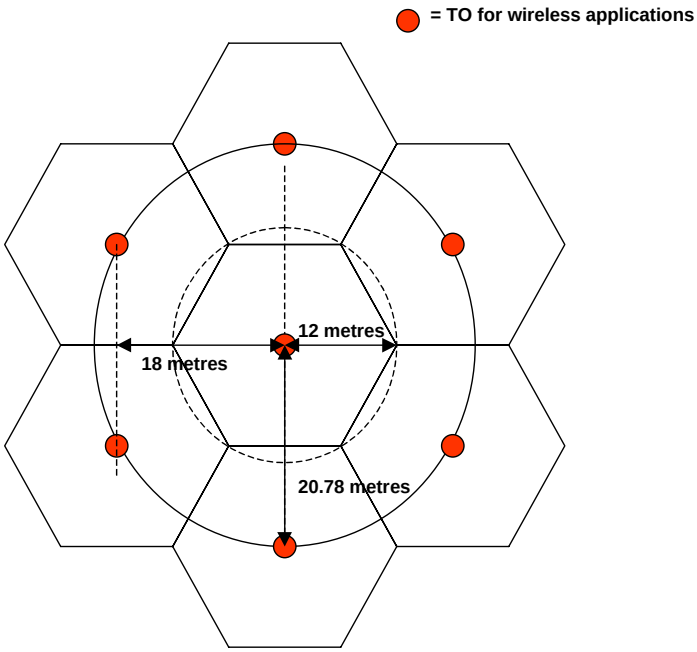


Figure 4-3: ISO/IEC TR2 "Honeycomb" distribution array

However, certain areas and layouts may be better suited with a square array as shown in Figure 4-4 which, although using more TOs (282 m^2 per TO), is more easily analysed in terms of building designs. Table 4-1 shows the spatial coverage of the square array of Figure 5-4.

Table 4-1: Spaces served by TOs in square array of Figure 5-4

		Space served (m x m)					
		TOs in horizontal matrix					
		1	2	3	4	5	6
TOs in vertical matrix	1	16.8 x 16.8	33.6 x 16.8	50.3 x 16.8	67.1 x 16.8	83.9 x 16.8	>100 x 16.8
	2	16.8 x 33.6	33.6 x 33.6	50.3 x 33.6	67.1 x 33.6	83.9 x 33.6	>100 x 33.6
	3	16.8 x 50.3	33.6 x 50.3	50.3 x 50.3	67.1 x 50.3	83.9 x 50.3	>100 x 50.3
	4	16.8 x 67.1	33.6 x 67.1	50.3 x 67.1	67.1 x 67.1	83.9 x 67.1	>100 x 67.1
	5	16.8 x 83.9	33.6 x 83.9	50.3 x 83.9	67.1 x 83.9	83.9 x 83.9	>100 x 83.9
	6	16.8 x >100	33.6 x >100	50.3 x >100	67.1 x >100	83.9 x >100	-

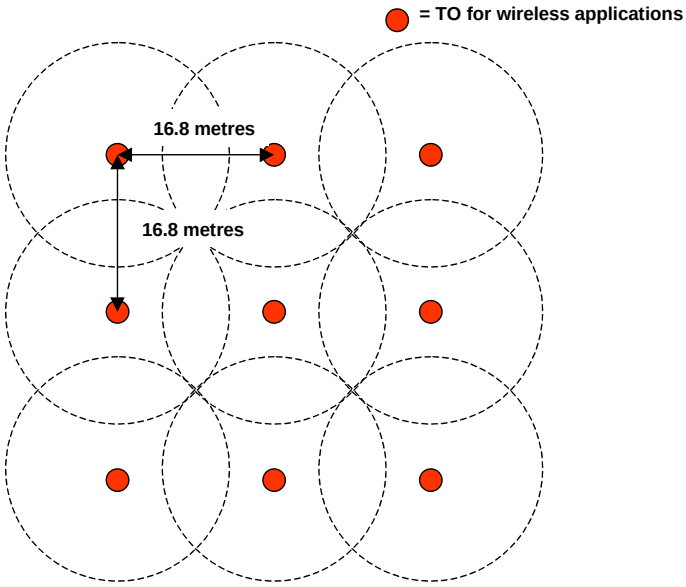


Figure 4-4: ISO/IEC TR2 24704 "Equivalent" square array

ZinWave recommends that cabling to the wireless application TOs is installed to support 2760 Antenna Units using the guidelines of this clause for both generic/structured and stand-alone cabling (where references to the FD/HC should be taken as the ZinWave Local Splice Panel).

The total number of TOs shall be based upon a combination of the total floor area served by each FD/HC and the shape of that floor area. The maximum number TOs required to service the areas and dimensions served by an FD/HC is shown in Table 4-2.

Table 4-2: Quantity of TOs in areas served by each FD/HC

Floor area (m^2)	Floor dimensions (m)	No. of TO (max)
500	10 x 50	3 (square)
	15 x 33	2 (square)
	20 x 25	3 (honeycomb)
1000	10 x 100	6 (square)
	15 x 67	4 (square)
	20 x 50	5 (honeycomb)
	25 x 40	5 (honeycomb)
	30 x 33	4 (honeycomb)
1500	15 x 100	6 (square)
	20 x 75	8 (honeycomb)
	25 x 60	7 (honeycomb)
	30 x 50	6 (square)
	35 x 43	8 (honeycomb)

Floor area (m^2/ft^2)	Floor dimensions (m)	No. of TO (max)
2000	20 x 100	11 (honeycomb)
	25 x 80	9 (honeycomb)
	30 x 67	8 (honeycomb)
	35 x 51.4	9 (honeycomb)
	40 x 50	9 (square)
	45 x 44.4	9 (square)
2500	25 x 100	11 (honeycomb)
	30 x 83.3	9 (honeycomb)
	35 x 71.2	12 (honeycomb)
	40 x 62.5	12 (square)
	45 x 44.4	9 (square)
	50 x 50	9 (square)

Table 4-2 indicates that for an area of 2500 m^2 then the maximum number of TOs is 12 No. for an elongated space and 9 No. for a "square" space. By reference to building drawings and appropriately careful placement of TOs, the actual number of TOs will be less than that specified in Table 4-2.

It should be noted that the number of TOs does not mandate the number of ZinWave 2760 Antenna Units or the usage of those Antenna Units (see 4.8). However, the number of TOs does define the number of optical fibres to be provided from the FD/HC, and where a direct correspondence is applied, the number of optical fibres required in the backbone cabling subsystem which services the FD/HC.

4.3 Selection of optical fibre cabling media

4.3.1 ZinWave 2700 DAS integration within generic/structured cabling infrastructures

4.3.1.1 General

The number of TOs to be served by each FD/HC defines the number of optical fibres required in the building backbone cabling at each FD/HC.

As building backbone cabling already exists it has to be determined if the existing optical fibre cables serving the FD/HCs have adequate numbers of unused (or reassignable) optical fibres. If not then additional backbone cables are required.

Clause 4.3.1.2 discusses the re-use of existing singlemode optical fibre backbone cabling.

Clause 4.3.1.3 discusses the re-use of existing multimode optical fibre backbone cabling.

Clause 4.3.1.4 discusses installation of additional backbone cabling.

The selection of the optical fibre media to be used and how they are to be connected should also take into account the considerations of channel length and channel insertion loss outlined in clause 4.3.3.

4.3.1.2 Re-use of existing singlemode backbone cabling

It is not uncommon for premises to have backbone cabling to comprise both multimode and singlemode optical fibres either as separate or composite cables. If there are insufficient multimode optical fibres available, it may be that the singlemode optical fibres are unused. In such cases, as the ZinWave 2700 DAS is "fibre-agnostic", it reasonable to use the singlemode backbone cabling and to implement the generic wireless application overlay cabling in singlemode cabling also. This has the benefit that no ZinWave proprietary pigtails, launch cords and patchcords are required anywhere within the ZinWave channel.

If there are adequate numbers of unused (or reassignable) singlemode optical fibres in the building backbone cabling then their use for the ZinWave 2700 DAS will require either:

- a crossconnection using an industry-standard singlemode "patch cord" between the existing backbone panel and the ZinWave Termination Panel in the FD/HC as shown in Figure 4-5;

or, where there are enough optical fibres in an existing singlemode optical fibre backbone cable to allow the allocation of a complete cable to the ZinWave 2700 DAS;

- the replacement of the backbone cabling panel and the ZinWave Termination Panel with a ZinWave Splice panel as shown in Figure 4-6.

The latter enables a lower channel insertion loss (see 4.3.3) and more secure distribution of the services provided over the ZinWave 2700 DAS. It is also the preferred approach if additional backbone cabling is to be installed (see 4.3.1.4).

WARNING: Customers may be unwilling to allow partial re-work to be undertaken on a backbone cabling panel if other services are already operating though the optical fibre contained within it.

WARNING: Installers may be unwilling to accept responsibility for the modifications made to existing cable plant. The opening of backbone panels may:

a) be difficult due to poor cable dressing practice in the cabinets that puts both the re-work and other cabling at risk;
b) determine that inadequate lengths of optical fibre exist in the panels to allow fusion splicing of the ZinWave hi-conn pigtails;
c) determine that the management practices for the optical fibre within the panels puts other optical fibres at risk.

Where there is no singlemode content within the backbone cabling, the choice lies between the re-use of existing multimode optical fibre cabling (see 4.3.1.2) and the installation of additional multimode or singlemode backbone cables (see 4.3.1.4).

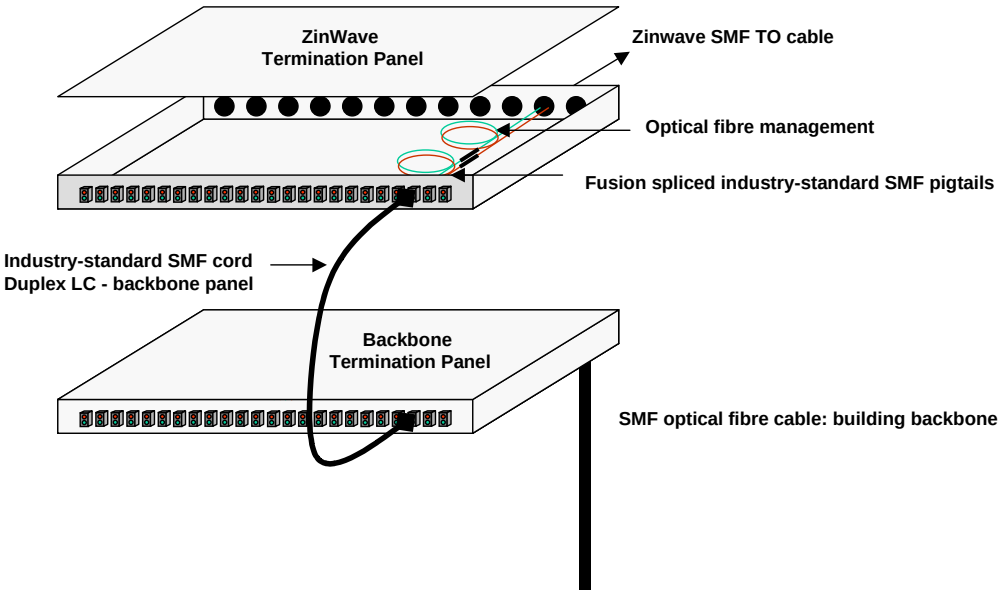


Figure 4-5: Re-use of existing singlemode optical fibre backbone cabling at an FD/HC via patching

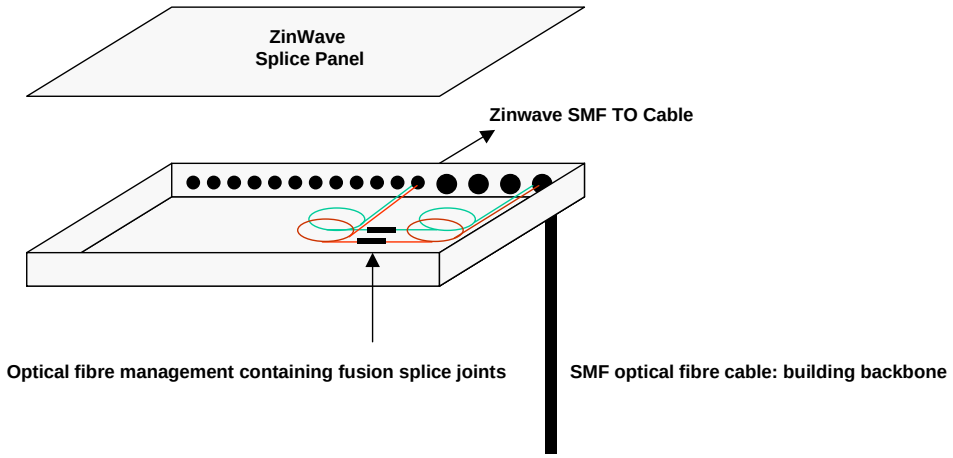


Figure 4-6: Re-use of existing singlemode optical fibre backbone cabling at an FD/HC via splicing within a panel

4.3.1.3 Re-use of existing multimode backbone cabling

If there are adequate numbers of unused (or reassignable) multimode optical fibres in the building backbone cabling then their use for the ZinWave 2700 DAS will require, as shown in Figure 4-7:

- a crossconnection using the appropriate ZinWave hi-conn “patch cord” between the and the ZinWave Termination Panel in the FD/HC;
- the re-termination (at both ends) of the available optical fibres in the existing backbone panel using appropriate hi-conn pigtails of Table 3-6;
- the replacement of the backbone panel adaptors (at both ends) with their singlemode equivalents.

Where there are enough optical fibres in an existing multimode optical fibre backbone cable to allow the allocation of a complete cable to the ZinWave 2700 DAS then the backbone panel at the FD/HC may be replaced with a ZinWave Splice Panel as shown in Figure 4-8. The latter enables a lower channel insertion loss (see 4.3.3) and more secure distribution of the services provided over the ZinWave 2700 DAS. It is also the preferred approach if additional backbone cabling is to be installed (see 4.3.1.4).

However, unless another ZinWave Splice Panel is used at the BD/IC (as part of a campus distribution system) the optical fibre cable at the BD/IC will require:

- the re-termination of the optical fibres using appropriate hi-conn pigtails of Table 3-6;
- the replacement of the backbone panel adaptors with their singlemode equivalents.

WARNING: Customers may be unwilling to allow partial re-work to be undertaken on a backbone cabling panel if other services are already operating though the optical fibre contained within it.

WARNING: Installers may be unwilling to accept responsibility for the modifications made to existing cable plant. The opening of backbone panels may:

a) be difficult due to poor cable dressing practice in the cabinets that puts both the re-work and other cabling at risk;
b) determine that inadequate lengths of optical fibre exist in the panels to allow fusion splicing of the ZinWave hi-conn pigtails;
c) determine that the management practices for the optical fibre within the panels puts other optical fibres at risk.

Where existing backbone cables are to be used for the distribution of the ZinWave 2700 DAS, the optical fibre in the ZinWave TO cables (see Table 3-7), launch cords, hi-conn pigtails and patchcords (see Table 3-6), shall be selected to match those of the backbone cable.

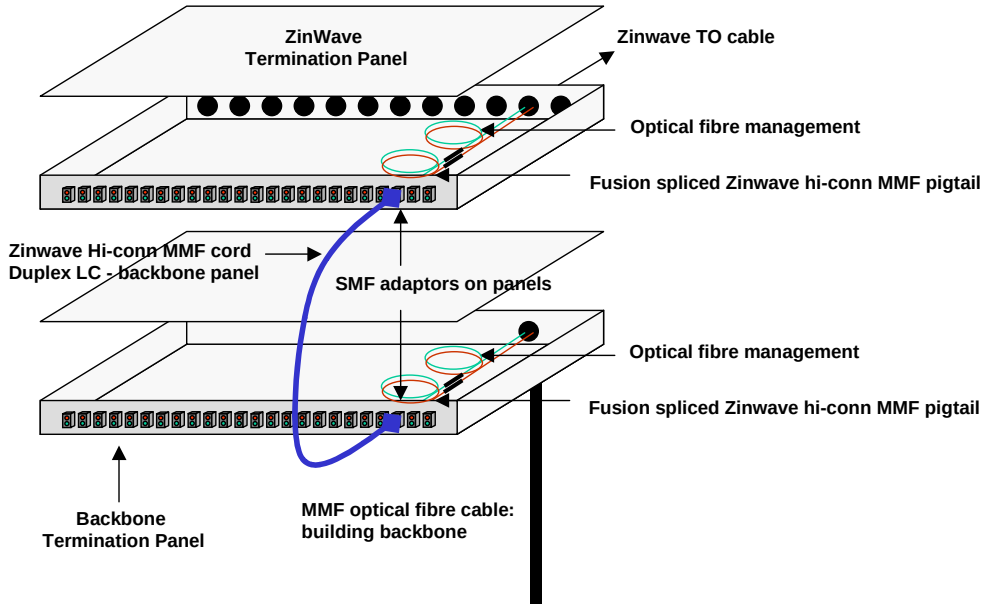


Figure 4-7: Re-use of existing multimode optical fibre backbone cabling at an FD/HC via patching

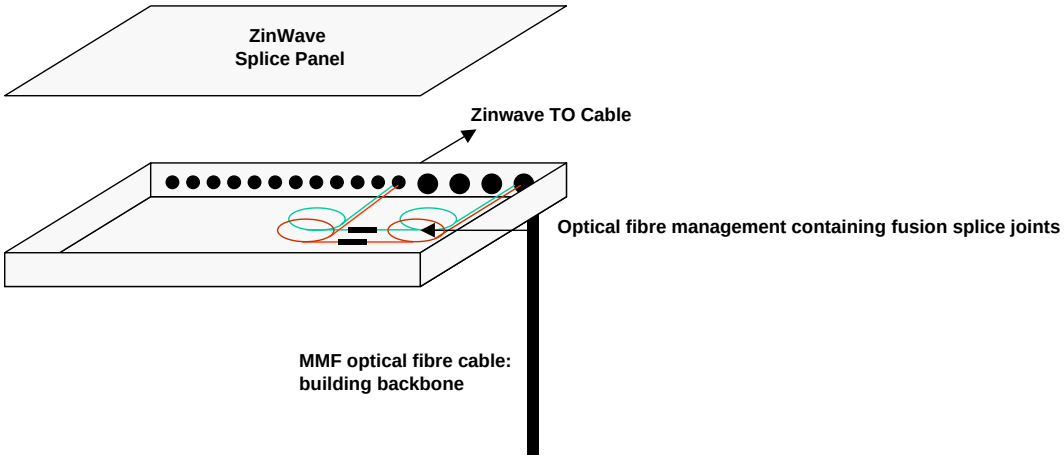


Figure 4-8: Re-use of existing multimode optical fibre backbone cabling at an FD/HC via splicing within a panel

4.3.1.4 Installation of new backbone cabling

The installation of additional backbone cabling, integrated within the generic/structured cabling but intended for the distribution of the ZinWave 2700 DAS has certain advantages by:

- overcoming the reluctance on behalf of customers and/or installers to interfere with existing cable infrastructures;
- maintaining the existing backbone capacity;
- enabling lower channel insertion loss (see 4.3.3) and more secure distribution of the services provided over the ZinWave 2700 DAS by using ZinWave Splice Panels (as shown in Figure 4-6 and Figure 4-8) in as many locations as possible.

The installation of additional generic/structured backbone cabling provides considerable freedom in the selection of the type of optical fibre to be used. The full range of all-silica optical fibres specified in the generic/structured cabling standards including the ANSI/TIA/EIA-568 series standards, the EN 50173 series standards and ISO/IEC 11801 may be considered.

The specifications of the cabled optical fibres in these standards are shown in Table 4-3. The sahded areas show parameters that are not relevant for the ZinWave 2700 DAS but do influence selection for other applications.

As the ZinWave 2700 DAS is “fibre-agnostic”, any selection of media may be made on a number of criteria including requirement to match existing cabling media, cabling installation cost, future requirements etc.

The selection of the optical fibre media to be used and how they are to be connected should also take into account the considerations of channel length and channel insertion loss outlined in clause 4.3.3.

However, the final selection made has to be applied to all the cabling in the ZinWave 2700 DAS infrastructure.

4.3.2 ZinWave 2700 DAS in stand-alone infrastructures

4.3.2.1 Media selection

The number of TOs to be served by each ZinWave Local Splice Panel defines the number of optical fibres required to feed that Local Distribution Panel from the ZinWave Building Termination or Splice Panel.

The installation of a stand-alone ZinWave DAS infrastructure provides considerable freedom in the selection of the type of optical fibre to be used. The full range of all-silica optical fibres specified in the generic/structured cabling standards including the ANSI/TIA/EIA-568 series standards, EN 50173-1 and ISO/IEC 11801 may be considered.

The specifications of the cabled optical fibres in these standards are shown in Table 4-3.

As the ZinWave 2700 DAS is “fibre-agnostic”, any selection of media may be made on a number of criteria including cabling installation cost, future requirements etc. The selection of the optical fibre media to be used and how they are to be connected should also take into account the considerations of channel length and channel insertion loss outlined in clause 4.3.3.

However, the final selection made has to be applied to all the cabling in the ZinWave 2700 DAS infrastructure.

The installation of stand-alone cabling is typically implemented by fusion splicing the cabling at Local Splice Panels (and Building Splice Panels where campus distribution is involved). This enables lower channel insertion loss (see 4.3.3) and more secure distribution of the services provided over the ZinWave 2700 DAS.

Table 4-3: Performance of cabled optical fibres in generic/structured cabling standards

Optical fibre	Applicable standard	Designation with the applicable standard	Attenuation coefficient	Modal bandwidth
SMF	ANSI/TIA/EIA-568-B series	Internal plant	1.0 dB/km @ 1310 nm	N.A.
			1.0 dB/km @ 1550 nm	
		External plant	0.5 dB/km @ 1310 nm	
			0.5 dB/km @ 1550 nm	
	EN 50173-1	OS1	1.0 dB/km @ 1310 nm	
			1.0 dB/km @ 1550 nm	
		OS2	0.4 dB/km @ 1310 nm	
			0.4 dB/km @ 1550 nm	
	ISO/IEC 11801	OS1	1.0 dB/km @ 1310 nm	
			1.0 dB/km @ 1550 nm	
		OS2[1]	0.4 dB/km @ 1310 nm	
			0.4 dB/km @ 1550 nm	
50/125	ANSI/TIA/EIA-568-B series	Basic	3.5 dB/km @ 850 nm	500 MHz.km @ 850 nm
		Laser optimised	3.5 dB/km @ 850 nm	1500[2] MHz.km @ 850 nm
		Basic or laser optimised	1.5 dB/km @ 1300 nm	500 MHz.km @ 1300 nm
	EN 50173-1/ISO/IEC 11801	OM1	3.5 dB/km @ 850 nm	200 MHz.km @ 850 nm
		OM2	3.5 dB/km @ 850 nm	500 MHz.km @ 850 nm
		OM3	3.5 dB/km @ 850 nm	1500[2] MHz.km @ 850 nm
		OM1, OM2 or OM3	1.5 dB/km @ 1300 nm	500 MHz.km @ 1300 nm
62.5/125	ANSI/TIA/EIA-568-B series		3.5 dB/km @ 850 nm	500 MHz.km @ 850 nm
			1.5 dB/km @ 1300 nm	500 MHz.km @ 1300 nm
	EN 50173-1/ISO/IEC 11801	OM1	3.5 dB/km @ 850 nm	200 MHz.km @ 850 nm
		OM2	3.5 dB/km @ 850 nm	500 MHz.km @ 850 nm
		OM1 or OM2	1.5 dB/km @ 1300 nm	500 MHz.km @ 1300 nm

NOTE 1: By reference to ISO/IEC 24702

NOTE 2: 2000 MHz.km for restricted launch

4.3.3 Channel insertion loss considerations

4.3.3.1 General

In this clause the figures show the ZinWave 2700 DAS implemented within generic/structured cabling infrastructures. However, the analysis provided also applies to stand-alone ZinWave infrastructures where the FD/HCs are replaced by ZinWave Local Splice Panels etc.

An optical fibre channel is specified and tested (see clause 5) between the two reference points shown in Figure 4-9.

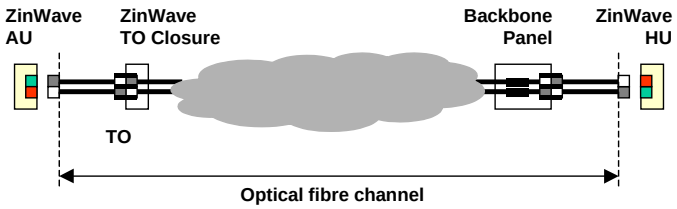


Figure 4-9: Optical fibre channel

A ZinWave 2700 DAS optical fibre channel will comprise lengths of cable and a number of connections and fusion spliced joints.

For the purposes of this clause, the following assumptions are made:

- the attenuation coefficients of the multimode cabled optical fibres are those of Table 4-3 (a common value of 1.5dB/km maximum at 1300 nm;
- the attenuation coefficient of the internal singlemode cabled optical fibres is 1.0dB/km maximum at 1310 nm;
- the attenuation coefficient of the external singlemode cabled optical fibres is 0.5 dB/km maximum at 1310 nm;

The combined insertion loss of multiple connections and fusion spliced joints are treated statistically as shown in Table 4-4.

Table 4-4: Typical channel insertion loss from connecting hardware

		Typical maximum channel insertion loss from connections and splices (dB)						
		Number of connections in channel						
		2	3	4	5	6	7	8
No. of splices in channel	3	1.74	2.11	2.50	2.80	3.06	3.31	3.55
	4	1.84	2.21	2.60	2.90	3.16	3.41	3.65
	5	1.94	2.31	2.70	3.00	3.26	3.51	3.75
	6	2.04	2.41	2.80	3.10	3.36	3.61	3.85
	7	2.14	2.51	2.90	3.20	3.46	3.71	3.95

.

NOTE: It should be noted that the statistical addition of connection and fusion splice losses assumes that all interfaces are in good condition, terminated/jointed in accordance with suppliers instructions and meet the following individual performance criteria:
a) Connections: 100% < 0.75dB, 95% < 0.5 dB
b) Fusion splices: 100% < 0.3dB, 95% < 0.15 dB

If the connections and fusion splices used in a given channel do not meet these criteria the channel insertion loss calculations of this clause will be inaccurate.

4.3.3.2 Multimode channel length and channel insertion loss calculations

The maximum channel lengths and channel insertion loss values shown in Table 2-1 are only applicable to optical fibre cables having modal bandwidth of 500 MHz.km @ 1300 nm minimum. These meet the minimum requirements of all multimode optical fibres in ANSI/TIA/EIA-568 series standards, EN 50173-1 and ISO/IEC 11801 as detailed in Table 4-3.

NOTE: Reduced channel lengths and channel insertion loss values may be supportable for lower modal bandwidth options following detailed analysis by ZinWave.

Figure 4-10 shows typical configurations for ZinWave 2700 DAS channels using multimode optical fibre cables to the specifications quoted in Table 4-3. Figure 4-10 shows that for channels containing up to four connections and four splices the maximum channel insertion is not exceeded at the maximum channel length (550 metres) as per Table 2-1.

If the number of connections and splices changes the typical supported channel lengths are shown in Table 4-5.

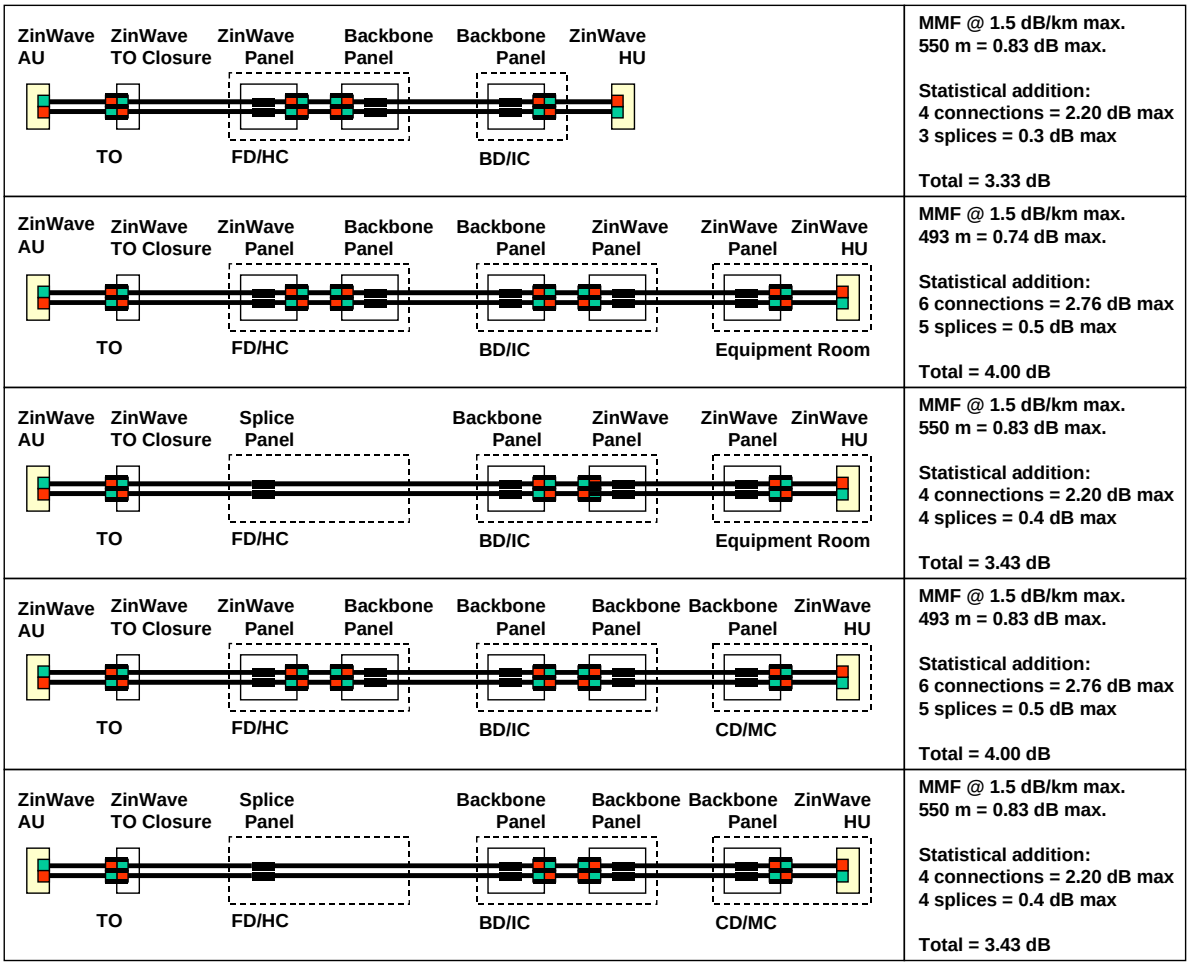


Figure 4-10: ZinWave 2700 DAS channels over multimode optical fibre

Table 4-5: Multimode optical fibre channel length for multiple connections and fusion splices

		Typical channel length (metres)						
		Number of connections in channel						
		2	3	4	5	6	7	8
No. of splices in channel	3						460	300
	4						393	233
	5		550			493	327	167
	6					426	260	100
	7				533	360	193	33

4.3.3.3 Singlemode optical fibre channel length and channel insertion loss calculations

Figure 4-11 shows typical configurations for ZinWave 2700 DAS channels using internal singlemode optical fibre cables to the specifications quoted in Table 4-3. Figure 4-11 shows that for channels containing up to six connections and five

splices the maximum channel insertion is not exceeded at the channel lengths up to 830 metres. It is unlikely that an internal cabling channel would ever exceed this number of connections and splices.

A reduction in the number of connections and splices would increase the maximum channel lengths to 2000 metres. It is also probable that a channel of such a length would, for reason of installation practice, begin to use external grade cables and the maximum channel length supported by the ZinWave 2700 DAS (2000 metres) would be reached before the maximum channel insertion loss of Table 2-1 is attained.

If the number of connections and splices changes the typical supported channel lengths are shown in Table 4-6.

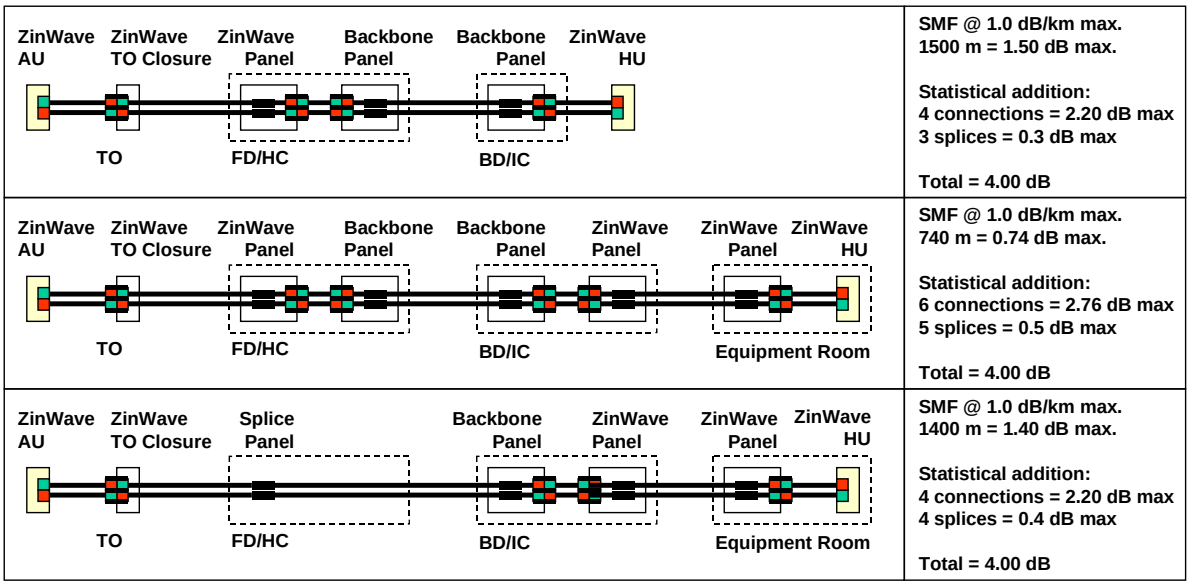


Figure 4-11: ZinWave 2700 DAS channels over internal singlemode optical fibre cabling

Table 4-6: Internal singlemode optical fibre channel length for multiple connections and fusion splices

		Typical channel length (metres)						
		Number of connections in channel						
		2	3	4	5	6	7	8
No. of splices in channel	3	2000	1890	1500	1200	940	690	450
	4		1790	1400	1100	840	590	350
	5		1690	1300	1000	740	490	250
	6		1590	1200	900	640	390	150
	7	1960	1490	1100	800	540	290	50

Figure 4-12 shows typical configurations for ZinWave 2700 DAS channels using combinations of internal and external singlemode optical fibre cables to the specifications quoted in Table 4-3. In Figure 4-12 it is assumed that the length of the channel inside a building is 400 metres. Figure 4-12 shows that for channels containing up to six connections and five splices the maximum channel insertion is not exceeded at the channel lengths up to 1280 metres.

Once again the use of splice panels to reduce the number of connections and splices would increase the maximum channel lengths to the maximum channel length supported by the ZinWave 2700 DAS (2000 metres) before the maximum channel insertion loss of Table 2-1 is attained.

If the number of connections and splices changes or the lengths of internal and external cable are varied the typical supported channel lengths are shown in Table 4-7.

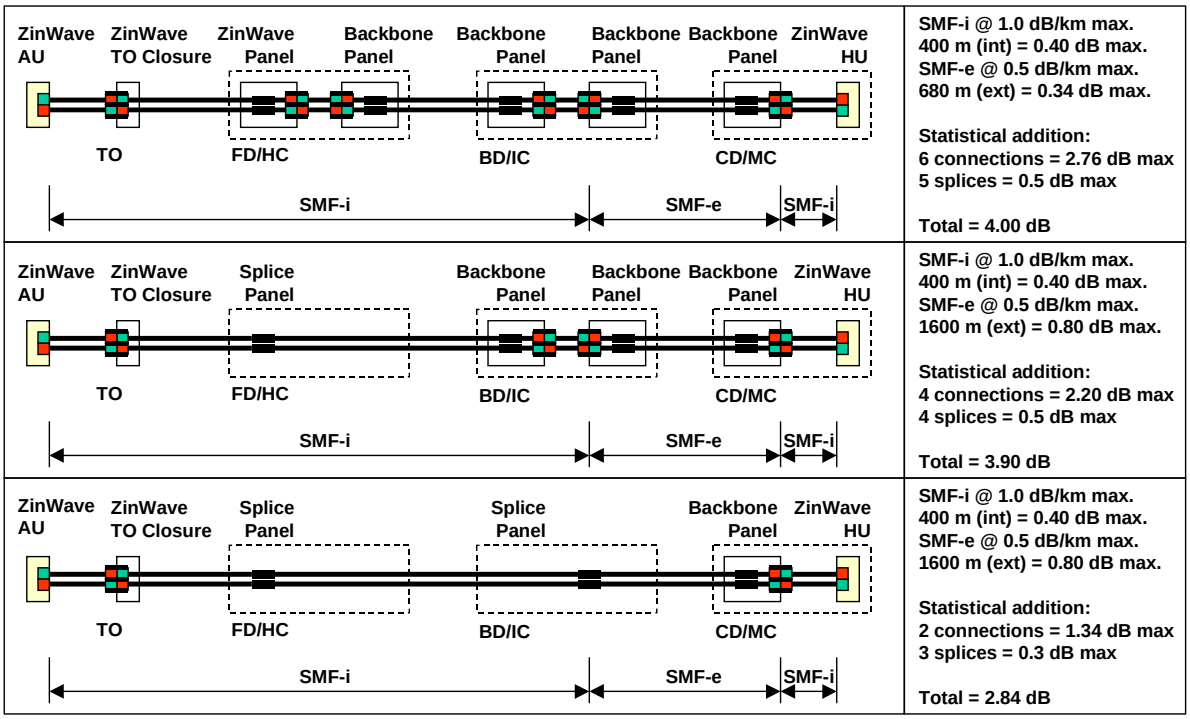


Figure 4-12: ZinWave 2700 DAS channels over internal and external singlemode optical fibre cabling

Table 4-7: Internal/external singlemode optical fibre channel length for multiple connections and fusion splices

		Typical total channel length (metres)						
		Number of connections in channel						
		2	3	4	5	6	7	8
No. of splices in channel	3	4000	3780	3000	2400	1880	1380	900
	4		3580	2800	2200	1680	1180	700
	5		3380	2600	2000	1480	980	500
	6		3180	2400	1800	1280	780	300
	7	3920	2980	2200	1600	1080	580	100
	8	3720	2780	2000	1200	880	380	-
	9	3520	2580	1800	1200	680	180	-

NOTE:
The channel lengths shown above can be divided between internal and external cable in the ratio 1:2.
As an example a value of 2000 metres may be installed as 1500 metres of external cable and 250 metres of internal cable.
The total channel length shall not exceed 2000 metres.

4.4 Accommodation of ZinWave TO Closures

Each ZinWave TO Closure provides the capacity for 2 No. ZinWave TO cables and 2 No. 4 pair balanced cables (for provision of remote power feeding to ZinWave 2760 Antenna Units. If fully populated a ZinWave TO Closure can support

the connection of 2 No. ZinWave 2760 Antenna Units. Alternatively, the TO Closure enables the installation of a dual-redundant connections to a single ZinWave 2760 Antenna Unit.

4.5 Accommodation of ZinWave Termination Panels

In generic/structured cabling infrastructures, ZinWave Termination Panels may be located at:

- FD/HCs to provide:
  - the presentation of the generic wireless application overlay cabling to the TO;
  - the presentation of additional building backbone cabling (although ZinWave Splice Panels are recommended for security);
- BD/ICs to provide:
  - the presentation of additional building backbone cabling;
  - the presentation of the ZinWave presentation cabling from a remote equipment room;
  - the presentation of additional campus backbone cabling (although ZinWave Splice Panels are recommended for security);
- CD/MCs to provide:
  - the presentation of additional building backbone cabling;
  - the presentation of the ZinWave presentation cabling from a remote equipment room;
- remote equipment rooms to provide the presentation for connection to the ZinWave 2700 Hub Units.

In stand-alone infrastructures, ZinWave Termination Panels may be used as:

- Building Termination Panels:
- Campus Termination Panels.

ZinWave Termination Panels are not ZinWave products since they have no ZinWave-specific features. However, they are recommended to contain the following features:

- a 1U 19“ unit (for cabinet/rack/frame fixing);
- front panel access to maximum of 24 No. LC-Duplex interfaces (this number of interfaces are not generally required to provide connections to ZinWave 2760 Antenna Units at each TO - instead they provide, if necessary, spare optical fibres to each TO as a means of resilience);
- glanded rear entry points for 12 No. ZinWave TO cables (see Figure 4-5 and Figure 4-7);
- glanded rear entry points for up to two backbone optical fibre cables (depending upon the approach to resilience adopted by the customer).

The panels are not required to house more than 48 No. optical fibre fusion splices.

One panel is required to support the termination of:

- up to 24 No. TOs
- up to 48 backbone or stand-alone infrastructure optical fibres.

As the ZinWave Termination Panels present interfaces to which cords are to be attached, space shall be allocated for the associated cable management fixtures to hold and prevent damage to those cords.

4.6 Accommodation of ZinWave Splice Panels

In generic/structured cabling infrastructures, ZinWave Termination Panels may be located at:

- FD/HCs to:
  - joint the generic wireless application overlay cabling to the building backbone cabling;
- BD/ICs to:
  - joint building backbone cabling to campus backbone cabling;
  - joint building backbone cabling to ZinWave presentation cabling from a remote equipment room;
- CD/MCs to joint campus backbone cabling to ZinWave presentation cabling from a remote equipment room.

In stand-alone infrastructures, ZinWave Termination Panels may be used as:

- Local Splice Panels;
- Building Splice Panels.

ZinWave Termination Panels are not ZinWave products since they have no ZinWave-specific features. However, they are recommended to contain the following features:

- a 1U 19“ unit (for cabinet/rack/frame fixing) or wall box (for free form fixing);
- glanded entry points for 12 No. ZinWave TO cables (see Figure 4-6 and Figure 4-8);
- glanded entry points for 4 No. “backbone-type” optical fibre cables.

One panel is required to support the jointing of 48 No. optical fibre fusion splices

There are no specific additional accommodation requirements for ZinWave Splice Panels.

The location of the ZinWave Splice Panels shall take into account the installation and operational environment.

4.7 Remote Powering of ZinWave 2760 Antenna Units

Remote powering of the ZinWave 2760 Antenna Units requires the installation at the FD/HC of:

- a balanced cabling panel at which to present the balanced cables providing the power to the TO Closures;
- an IEEE 802.3af compliant mid-span power panel.

These panels are not ZinWave products since they have no ZinWave-specific features.

As these panels present interfaces to which cords are to be attached, space shall be allocated for the associated cable management fixtures to hold and prevent damage to those cords.

4.8 Transceiver Distribution

4.8.1 General

Clauses 4.1 to 4.7 have concentrated on the cabling infrastructure to support a ZinWave 2700 DAS. This clause focuses on the topics required to optimise the functionality of the ZinWave 2700 DAS using the infrastructure.

4.8.2 RF source mapping

The RF combiner within the ZinWave 2700 basic hub operates with the installed ZinWave 2780 SFP optical fibre transceiver modules in specific combinations. The possible combinations are shown in Figure 4-13.

The requirement delivery of services within the premises may influence the way in the RF sources are connected to the ZinWave 2700 Hub Unit and the way in which the RF combiner is configured using the ZinWave management software.

Further information is provided in the ZinWave 2700 DAS User Manual.

4.8.3 Service-specific antenna service mapping

The TO matrix described in clause 4.2 is installed to minimise the need for, and cost of, future re-installation of cabling that may be required as wireless service demands change. However, the installed TO matrix does not define the matrix of ZinWave 2760 Antenna Units.

The number of ZinWave 2760 Antenna Units installed at any given time is required to match the wireless application needs of the customer at that time. In addition the type and number of service-specific antennae attached to each ZinWave 2760 Antenna Units will also depend on the demand for and operating range of those specific services.

Further information is provided in the ZinWave 2700 DAS User Manual.

4.9 Gain Mapping

Once the selection of the necessary RF source and service-specific antenna mapping has been addressed it is necessary to consider mapping the gain applied to each antenna system using the ZinWave management software to ensure that the correct RF channel budget is met.

Further information is provided in the ZinWave 2700 DAS User Manual.

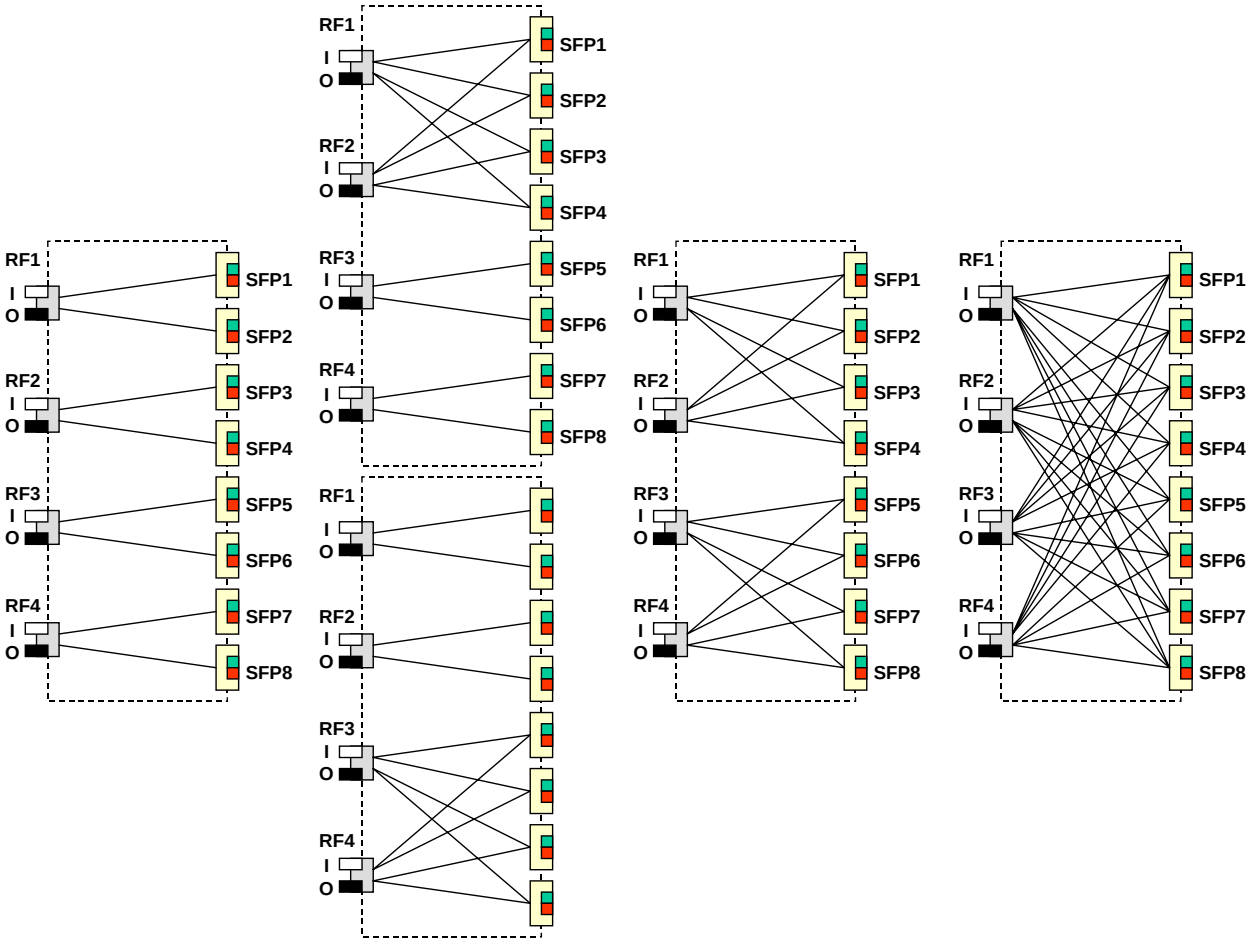


Figure 4-13: RF combiner options

5 ZINWAVE 2700 DAS INSTALLATION

5.1 Cabling installation

5.1.1 General

The installation of optical fibre cabling shall be in accordance with the EN 50174 series of standards.

5.1.2 Cables

5.1.2.1 ZinWave TO cables

The ZinWave TO cables shall be selected from those of Table 3-7 in order to allow sufficient spare cable for subsequent dressing in cabinets/frames/racks and for the inclusion, where appropriate, of service loops at specific locations.

The pre-terminated end of the TO cables shall be protected during their installation and the end caps shall not be removed prior to, or during, the installation of the cables.

5.1.2.2 Coaxial cables

Coaxial cables are used to deliver/access the services supported by the ZinWave 2700 DAS:

- at the ZinWave 2760 Antenna Unit
- at the ZinWave 2700 Hub

The interfaces on both the 2760 Antenna Unit and the ZinWave 2700 Hub are SMA-style.

At the ZinWave 2760 Antenna Unit, it is expected that the service-specific antenna will be connected via small diameter coaxial cables that are compatible to the SMA interface.

In the vicinity of the ZinWave 2700 Hub Unit, the RF sources may be presented on larger coaxial cables that are not physically compatible to the SMA interface of the Hub Unit. It is therefore required to install a separate interface panel, in association with the ZinWave 2700 Hub Unit, that provides a fixed conversion from the larger coaxial cables to cables that are physically compatible to the SMA interfaces on the ZinWave 2700 Hub Unit.

5.1.2.3 Balanced cables for the provision of remote power to the ZinWave 2760 Antenna Units

The cables shall be in accordance with Category 5e of ANSI/TIA/EIA-568-B-2 or Category 5 of EN 50173-1 (equivalent to Category 5 specified in ISO/IEC 11801:2002)

5.1.3 Fitting of the ZinWave TO Closure

The ZinWave TO Closure should be fixed in its desired location after the termination of the balanced cable (see 5.1.2.3 and 5.1.4.3) has been completed and the balanced cable glanded and dressed into position within the closure.

Once the ZinWave TO Closure has been fixed in position and the TO cable(s) installed:

- blanking plate(s) covering optical fibre port(s) may be removed and the SMF adaptor(s) installed;
- the TO cable(s) can be inserted into the SMF adaptor(s);
- the external caps of the SMF adaptor(s) shall remain in place.

5.1.4 Cable termination

5.1.4.1 Multimode optical fibre cables

The termination of all multimode optical fibres to be used by the ZinWave 2700 DAS shall be via the fusion splicing of ZinWave hi-conn pigtails as detailed in Table 3-6. The adaptors shall be SMF variants of the relevant connector style.

WARNING: Only fusion splice techniques shall be used to joint the installed optical fibres to the ZinWave hi-conn pigtails. Mechanical splices shall not be used

NOTE: it may be possible to avoid the use of Zinwave hi-conn pigtails if the multimode optical fibre is of the laser optimised type specified in the ANSI/TIA/EIA-568-B series standards or of Category OM3 specified in EN 50173-1 and ISO/IEC 11801. However, this decision should only be made following agreement with appropriate ZinWave personnel.

5.1.4.2 Singlemode optical fibre cables

The termination of all singlemode optical fibres to be used by the ZinWave 2700 DAS shall be via the fusion splicing of industry-standard pigtails. The adaptors shall be SMF variants of the relevant connector style.

5.1.4.3 Balanced cables for the provision of remote power to the ZinWave 2760 Antenna Units

The pin-pair allocation of the cable at the TO Closure shall be that of the cables at the balanced cabling panel. This may be either T568A or T568B (defined in ANSI/TIA/EIA-568-B series standards) in accordance with the pin-pair allocation elsewhere in the premises.

The connecting hardware at the balanced cabling panel at the FD/HC shall be in accordance with Category 5e of ANSI/TIA/EIA-568-B-2 or Category 5 of EN 50173-1 (equivalent to Category 5 specified in ISO/IEC 11801:2002).

5.1.5 Cords

5.1.5.1 Multimode optical fibre cords

Where ZinWave 2700 DAS Hub and Antenna Units are connected to multimode optical fibre interfaces it is necessary to use ZinWave 2700 equipment cords listed in Table 3-6. These duplex cords feature an offset launch in the “launch” leg and must be connected in the correct orientatIon.

The connection between multimode optical fibre interfaces for the ZinWave 2700 DAS shall be made via ZinWave hi-conn cords as detailed in Table 3-6.

NOTE: it may be possible to avoid the use of Zinwave equipment cords and patch cords if the multimode optical fibre is of the laser optimised type specified in the ANSI/TIA/EIA-568-B series standards or of Category OM3 specified in EN 50173-1 and ISO/IEC 11801. However, this decision should only be made following agreement with appropriate ZinWave personnel.

5.1.5.2 Singlemode optical fibre cords

The connection of singlemode optical fibre interfaces for the ZinWave 2700 DAS shall be made via industry-standard cords.

5.1.5.3 Balanced cables for the provision of remote power to the ZinWave 2760 Antenna Units

The cords shall be in accordance with Category 5e of ANSI/TIA/EIA-568-B-2 or Category 5 of EN 50173-1 (equivalent to Category 5 specified in ISO/IEC 11801:2002).

5.2 Inspection and testing of installed optical fibre cabling

ISO/IEC 14763-3 contains the full set of inspection and test methods for installed optical fibre cabling.

6 MAINTENANCE, TROUBLESHOOTING AND TECHNICAL ASSISTANCE

6.1 Maintenance

6.2 Troubleshooting

6.3 Technical assistance

7 ADDITIONAL TECHNICAL DATA

RF Downlink Technical parameters – not for system installation

System gain[1]		-10		+10	dB	1dB adjustment steps
Spurious emissions				TBC	dBm/Hz	
cdmaONE ACPR		1		TBC	dBc	
Gain control linearity	*g_step*	0.5		1.5	dB	For all system gain settings
Input IP2	*IIP2*	+20			dBm	At maximum AU output power
Input IP3	*IIP3*	+20			dBm	At maximum AU output power
EVM degradation	*EVM*		1	6	%	At maximum AU output power
Phase noise degradation	*N_ph*			0.01	ppm	At maximum AU output power
Narrow-band spurious emissions	*P_sp*			-70	dBc	At AU antenna output
Wide-band spurious emissions	*P_sp*			-132	dBm/Hz	At AU antenna output
NOTE 1: Assuming optical fibre channel insertion loss of 4 dB						

RF uplink Technical parameters – not for system installation

Parameter	**Symbol**	**Value**			**Unit**	**Comments**
		Min.	**Nom.**	**Max.**		
Noise Figure[1]	*NF*		13	19.5		At maximum AU input power
System gain[2]		-10		+10	dB	1dB adjustment steps
Gain control linearity	*g_step*	0.5		1.5	dB	For all system gain settings
Input IP2	*IIP2*	+15			dBm	For all system gain settings
Input IP3	*IIP3*	+15			dBm	For all system gain settings
Wide-band spurious emissions	*P_sp*			-144	dBm/Hz	At AU antenna input connector
NOTE 1: Assuming 300m multi-mode fibre, 15dB input gain NOTE 2: Assuming optical fibre channel insertion loss of 4 dB						

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in revision (07/06)	{Source: IEC 61000-6-3:200X (CISPR/H/121/FDIS)}

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EN 300 386-2 V1.1.3	Electromagnetic compatibility and Radio spectrum Matters (ERM) - Telecommunication network equipment - Electromagnetic compatibility (EMC) requirements - Part 2: Product family standard
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