AS4000
Wireless Local Loop System

Demand Assignment
System Overview

605-0000-450

Draft Issue 1.3dr Date 8/02/00

Notice

1. This manual is subject to revision.

2.

3. Right of modification reserved.

4. This manual is supplied without liability for errors or omissions.

5.

6. This equipment is conditioned by the requirement that no modifications will be made to the equipment unless the changes or modifications are expressly approved by ACC Communications

7. Prerequisite skills: Personnel installing, commissioning, and maintaining the AS4000 products must have a basic knowledge of telephony and radio communications, and have experience in installing, commissioning and maintaining telecommunications products. ACC provides a range of comprehensive training courses specifically aimed at providing operators/users of Airspan products with the prerequisite skills to install, commission and or maintain the product. The courses can be tailored to provide the level of training required by the operator/user.

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Safety Instructions - Warnings and Cautions

SAFETY

1. Read and follow all warning notices and instructions marked on the product or included in this manual

2. When installed in the final configuration, the product must comply with the applicable Safety Standards and regulatory requirements of the country in which it is installed. If necessary, consult with the appropriate regulatory agencies and inspection authorities to ensure compliance.

WARNING - HAZARDOUS VOLTAGES

On AC installations, hazardous voltages exist. Use caution when verifying or working with AC power. Remove metal jewellery that could come into contact with AC power.

On DC sections, short circuiting the low voltage, low impedance circuits can cause severe arcing that may result in burns or eye damage. Remove rings, watches etc. to avoid shorting DC circuits.

Electro-Static Discharge ESD

Electro-Static Discharge. Many circuits contain devices which are susceptible to damage from high impedance voltage sources. To avoid such risks always follow anti-static procedures where marked.

NOTE

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CE

The CE Symbol on an Airspan product signifies that it has been certified according to the EMC directive 89/336/EEC. The product fulfils the requirements according to the following standards:

EN50082-1 for Immunity.
EN55022 Group 1 Class A for the Central Terminal Emissions.
EN55022 Group 1 Class B for the Subscriber Terminal Emissions.

User Response Form

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Document Rating	Excellent	Good	Average	Below Average	Poor
Accuracy / Completeness	❑	❑	❑	❑	❑
Clarity / Organisation	❑	❑	❑	❑	❑
Figures	❑	❑	❑	❑	❑
Table of Contents/Index	❑	❑	❑	❑	❑

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ISSUE CONTROL LIST

Title	Issue	Date	Issue Details
Title Page	13dr	February 2000	Update
ICL-001	13dr	February 2000	Update
IXL-001	13dr	February 2000	Update
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GSI-003	13dr	February 2000	Update
GSI-004	13dr	February 2000	Update
GSI-005	13dr	February 2000	Update
GSI-006	13dr	February 2000	Update
Appendix A	13dr	February 2000	Update

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1.1, May 1999	Updates to all sections	All
1.2, November 1999	Delete ST-V2, delete LCU, add Modular	
1.3dr February 2000	Update to frequency plans	Appendix 2

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Abbreviations

ADPCM	Adaptive Differential Pulse Code Modulation
AC	Access Concentrator
AGC	Automatic Gain Control
CCC	Call Control Channel
CDMA	Code Division Multiple Access
CPE	Customer Premises Equipment
CU	Compression Unit
CT	Central Terminal
CTU	Central terminal Tributary Unit (at AC site)
DA	Demand assignment
DC	Direct Current
DMM	Digital Multi Meter

DRS	Digital Radio System
DTU	Demand Assignment Tributary Unit
FA	Fixed Assignment
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunications Union -Telecommunications
LAC	Link Acquisition Channel
LD	Loop Disconnect
MF	Multi-Frequency
MU	Modular Unit (ST)
NTU	Network Termination Unit
PC	Power Control
PCM	Pulse Code Modulation
PSU	Power Supply Unit
PTC	Priority Traffic Channels
RF	Radio Frequency
RU	Residential Unit (ST)
SC	Shelf Controller
SIU	Service Interface Unit
ST	Subscriber Terminal
SU	Sub Unit (ST)
Rx	Receive
Tx	Transmit
TDM	Time Division Multiple Access
TCH	Traffic Channels
TU	Tributary Unit
VDU	Video Display Unit
VF	Voice Frequency
XTU	Switch Tributary Unit

Related Documentation

605-0000-450	System Overview
605-0000-451	System Operations and Maintenance Manual
605-0000-452	Central Terminal - Equipment Rack Installation & Commissioning
605-0000-433	Central Terminal - Antenna/Feeder Installation & Commissioning
605-0000-454	Subscriber Terminal - Installation & Commissioning
605-0000-436	D128 Terminal Converter
605-0000-435	Material Return and Repair
605-0000-427	Sitespan

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INTRODUCTION

1. General Purpose of Document

The purpose of this document is to familiarise the reader with the features of the AS4000 Demand Assignment Wireless Fixed Access System, sufficient to obtain a good, general understanding of its design, operation, implementation and maintenance principles.

2. Scope of Document

The System Overview document provides an introduction to the product followed by a description of its features and its design.

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SYSTEM OVERVIEW

1. AS4000 Overview

The AS4000 Wireless Fixed Access System is a digital point to multipoint radio access system providing wireless access for fixed subscribers to the telecommunication network. AS4000 delivers telephony, voice band facsimile/data, and leased line Data, providing the same functionality as “copper pairs” and is therefore a direct alternative to the use of copper cabling for the delivery of these services to customers.

The system uses Point-to-Multipoint radio links between the individual customer’s premises and the carriers “local point of presence” as a replacement for the copper pair “local loops ”. The “local point of presence” is typically the Local Exchange premises. If greater flexibility or range is required, the network radio equipment can be located in another suitable building or wayside cabinet.

The AS4000 System provides a substitute or replacement for the more traditional copper-pair local loop. Thus, line plant maintenance costs are eliminated, and digital services can be rapidly deployed to new residential and business customers.

Each individual customer location is served by one or more 144 kbit/s radio links, which can be configured to support a range of services, up to four analogue telephony circuits, or ISDN basic rate access.

The “Demand Assigned” Radio interface makes a temporary call by call assignment of channels, to Subscriber Terminals. This allows for the provision of graded service making more efficient use of the radio channels. The radio interface differs in that links are allocated as either traffic, or as control channels. Traffic channels can also be allocated as normal access or priority channels. Priority channels are set to provide access to emergency services when system channels are being fully used.

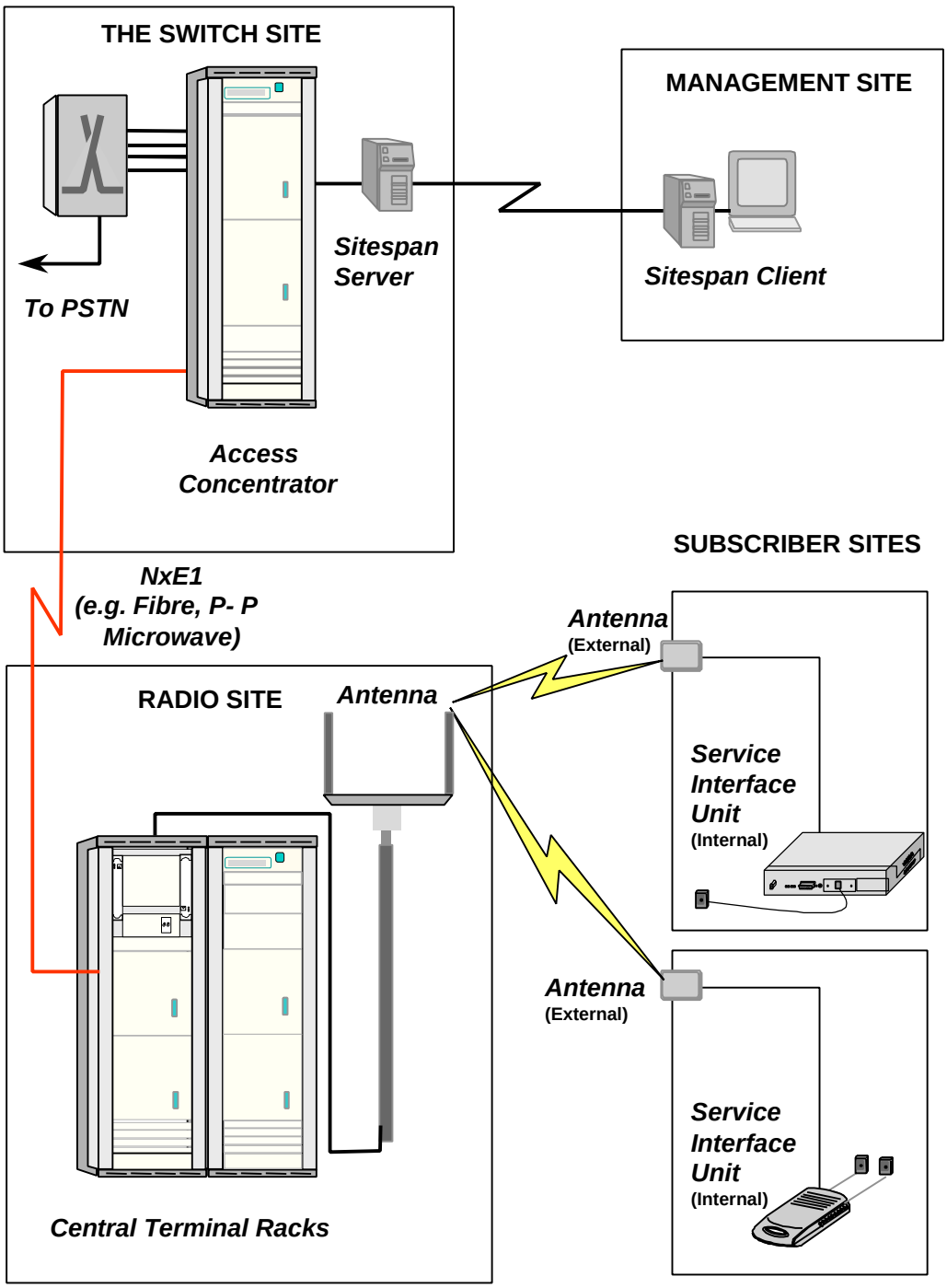


Figure 1. AS4000 System

The AS4000 DA system comprises the following major sub-systems;

The Subscriber Terminals (STs) are located at the customer's premises, The Service Interface Unit (SIU) is located internally and the antenna with I/F amplifier located externally.

The Central Terminal (CT) comprises at least one rack with a RF Combiner Shelf and associated Modem Shelf(s). A CT rack will provide two modem shelves and an RF Combiner Shelf. An Expansion Rack provides for two further modem shelves. All four modem shelves utilise the RF Combiner Shelf in the CT Rack to provide the radio interface. It will typically be remote in a location chosen for best radio coverage with all control, signalling and traffic backhauled to an operator's central office using point-to-point microwave equipment. The CT provides the functionality to terminate the network digital interface and connect to multiple STs simultaneously via the AS4000 DA CDMA radio interface.

The Access Concentrator (AC) is located at the operator's central office or local exchange, it's purpose to consolidate traffic from multiple CT modem shelves and present traffic and signalling interfaces in unconcentrated and concentrated form to the network switching equipment. A fully equipped AC shelf will support up to 64 E1 connections to the switch. The AC may also consolidate management communications back to the management system.

The AS8100 Sitespan Management System interfaces to the AC and dependent CTs either directly or via a communications network. Sitespan supports system configuration and provisioning functions, alarm reporting, performance monitoring and allows tests to be invoked.

1.1. AC Switch Interface

The AC interfaces to the Network Switching Equipment via multiple E1 2Mb/s ports. Each E1 port carries traffic and may also carry signalling information. The architecture supports the following 'standard' signalling protocol types;

i. CAS; Unconcentrated , 30 x 64 kb/s speech channels, ABCD Channel Associated Signalling embedded within timeslot 16.

ii. V5.1; Unconcentrated, 30 x 64 kb/s speech channels, at least one message based signalling channel, embedded within timeslot 16.

iii. V5.2; Concentrated, 30 x 64 kb/s speech channels per E1, at least one message based signalling channel per group of E1s up to a maximum of 16 x E1.

1.2. The DA Radio Interface

The DA radio interface incorporates the signal coding and protocols to support the flexible allocation of radio bandwidth among a large number of STs. The DA radio interface uses the application of overlay codes and time division multiplexing (TDM) to increase channelisation, and DA protocols that manage link access and RF channel switching.

Effective utilisation of RF bandwidth requires that user data rates be efficiently matched to available bandwidth. The DA system supports access rates of 32 kbit/s, 64 kbit/s, 128 kbit/s and 144 kbit/s depending on the type of ST deployed and the configured data rate. Overlay codes extend the CDMA spreading codes employed in AS4000 to allow

high rate channels to be split into multiple lower rate channels. Downlink traffic is time division multiplexed into radio channels of 160 kbit/s. On the uplink, overlay codes are applied so that multiple lower rate traffic channels may be code division multiplexed into a single 160 kbit/s radio channel.

The DA radio interface utilises protocols that allow efficient access to radio resources. A Call Control Channel is reserved to manage a pool of typically up to 480 STs, remaining channels will be dedicated for carrying traffic. When an ST is not being used to make a call it will receive data from the Call Control Channel which is used to broadcast management information, information on radio channel usage and incoming call indications.

1.3. AS4000 DA Channel Structure

The AS4000-DA channel structure is flexible but comprises;

- At least one Link Acquisition Channel (LAC)
- At least one Call Control Channel (CCC)
- Typically one Priority Traffic Channels (PTC)
- 1 to 13 Traffic Channels (TC)

1.4. Services supported:

- Telephony, including the in-band support for G3 facsimile and data modems operating at up to 56kbit/s.
- CLASS services as supported by the Local Switch.
- Leased Line data services supporting currently 2 x 64kbit/s per ST. Future enhancement to 6 x 64kbit/s are planned.
- Basic Rate ISDN. All ISDN implementations fully support:

  ETS 300 011 / 012
  ETS 300 125 - Basic Call Layer 2 Data Link Layer I.440 & I.441 - Q.921
  ETS 300 102 - Basic Call Layer 3 (Q.931)

Interfaces are generally defined by the ITU-T (CCITT) recommendations, I.420 (for Basic Rate) and I.421 for Primary Rate.

Specification for Bearer Services is based on ITU-T recommendations I.230 and I.231.
Circuit Mode Bearer Service 64kbit/s unrestricted 8kHz structured (ETS 300 108)
Circuit Mode Bearer Service 64kbit/s 8kHz structured for 3.1kHz Audio (ETS 300 110)

Specifications for Basic Teleservices are:

I.240 Definition of Teleservices (Blue Book)
I.241 Teleservices supported by an ISDN. Telephony Part 1, Telefax 4 Part 3, Mixed Mode Part 4
ETS 300 111 Circuit Mode Teleservice Telephony 3.1kHz
ETS 300 120 Circuit Mode Telefax Group 4
ETS 300 263 Telephony 7 kHz
ETS 300 264 Video Telephony

The systems also support the following ISDN Supplementary Services:

ETS 300 092 Calling Line Identification Presentation (CLIP)

ETS 300 093 Calling Line Identification Restriction (CLIR)

ETS 300 064 Direct Dialling In (DDI)

ETS 300 052 Multiple Subscriber Number (MSN)

ETS 300 055 Terminal Portability (TP)

ETS 300 061 Sub Addressing (SUB)

ETS 300 027 Call Forwarding Unconditional (CFU)

ETS 300 058 Call Waiting (CW)

ETS 300 141 Call Hold (HOLD)

ETS 300 138 Closed User Group (CUG)

ETS 300 138 Advice of Charge at end of Call (AOC-E)

D-Channel Packet Access Specifications supported include:

ETS 300 007 Support of packet-mode terminal equipment by an ISDN

ETS 300 048 ISDN Packet Mode Bearer Services (PMBS) ISDN Virtual Call (VC) and Permanent Virtual Call (PVC)

ETS 300 049 ISDN Packet Mode Bearer Services (PMBS) ISDN Virtual Call (VC) and Permanent Virtual Call (PVC)

ETS 300 099 Specification of the Packet Handler Access Point Interface (PHI)

In addition the following D-channel based Supplementary Services are supported.

ETS 300 286 User to User Signalling (UUS)

1.5. Data Services Support

Data rates up to 56kbit/s in the voice band using the 64kbit/s codec, and 9.6kbit/s using the 32kbit/s ADPCM codec.

Bit error rates Typically better than 10-6.

One way system delays are below 10ms, having a minimal impact on data applications.

The STs support ISDN, RS-232 and / or 10baseT interfaces.

2. The Central Terminal

The **Central Terminal (CT**) is the AS4000 Base Station. This is deployed in omni or sectored cell configurations supporting variable numbers of Subscriber Terminals (ST) per cell. The CT is a multi-service platform hosting single and dual line telephony, multi-line telephony, digital data leased lines and ISDN basic rate interfaces. The CT can operate in two modes, depending on the type of service and traffic levels supported. Fixed Assignment is used when STs must have a dedicated radio link. Demand Assignment is utilised when STs can share the available radio resources, and sustain an "engineered" grade of service.

The CT provides the traffic interface to the network switching via the Access Concentrator for Demand Assigned systems. The CT also provides an interface to the AS8100 management systems.

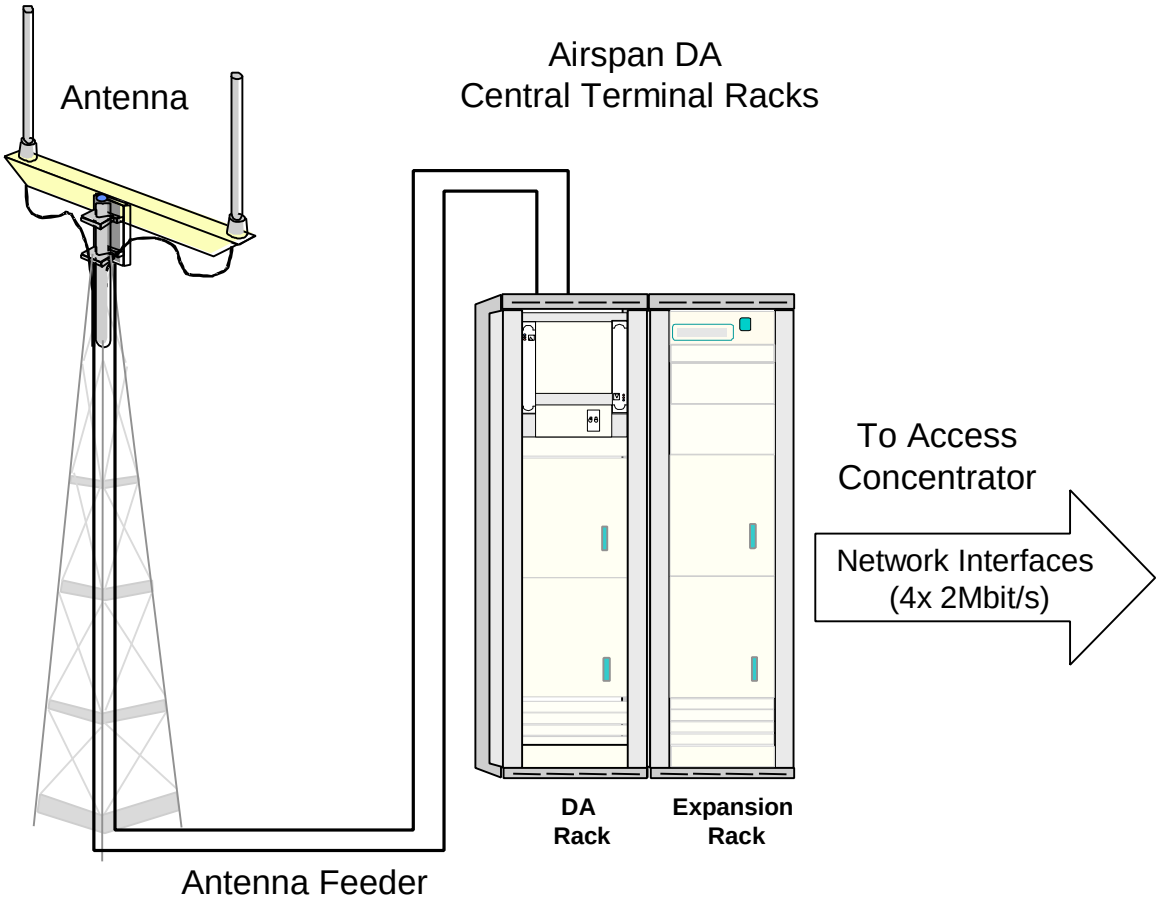


Figure 2. DA Central Terminal with 4 DA Modem Shelves

The Central Terminal consists of the following components:

2.1. The Antenna and Feeder sub-system

The antenna and feeder sub-system consists of either a two stacked dipole -high gain omni-directional antenna, a 65° directional antenna or a 180°directional antenna assembly mounted on a pole or mast and low-loss coaxial feeder cables which connect the antennas to the CT equipment rack.

2.2. Central Terminal DA Rack

The Central Terminal DA Rack contains:

2.2.1. The RF Combiner Shelf

The RF Combiner Shelf forms the interface between the Antenna/Feeder sub-system and individual Modem Shelves. The RF Combiner Shelf performs the functions necessary to connect up to four RF signals to the Antenna/Feeder sub-system.

The RF Combiner Shelf supports up to 4 modem shelves two of those modem shelves are contained in the CT Rack the other two modem shelves are contained in the Expansion Rack.

2.2.2. Modem Shelves

The CT Rack accommodates up to two DA modem shelves. Each Modem Shelf terminates one RF Channel, supporting up to 15 radio links, provides an E1 interface to the Access Concentrator. The Access Concentrator provides CAS, V5.1 or V5.2 network interfaces with the Local Exchange. Each Modem Shelf also connects via a V.24 (RS232) Network Management interface to the Sitespan network management system. Fixed assigned modem shelves can be deployed into a demand assignment rack, in this mode of working the rack can accommodate one DA modem shelf and up to two FA modem shelves.

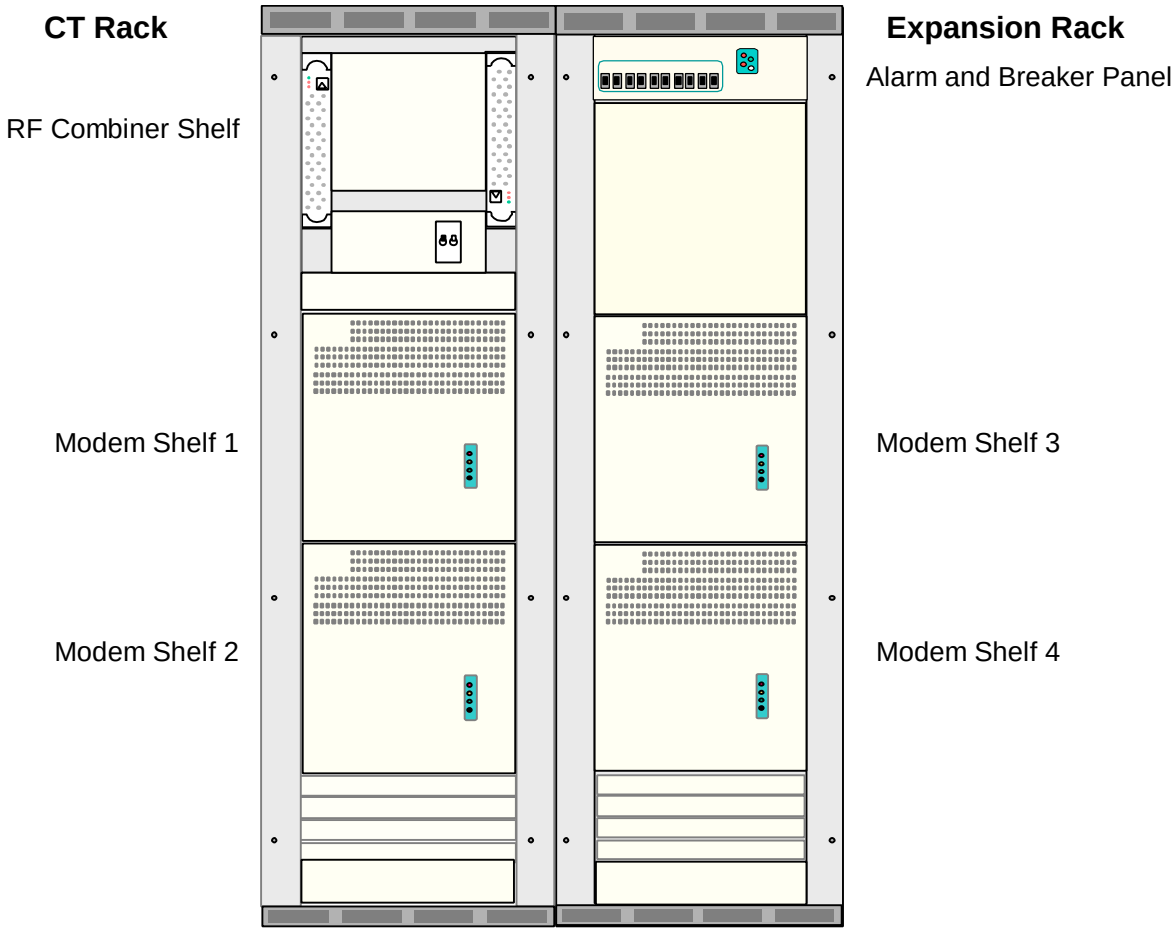


Figure 3. Central Terminal Racks

2.3. Central Terminal Expansion Rack

The Central Terminal Expansion Rack connects to the Combiner Shelf in the DA Rack and contains:

2.3.1. Modem Shelves

The Expansion Rack accommodates up to two modem shelves. Each Modem Shelf terminates one RF Channel, supporting up to 15 radio links, and provides an E1 interface to the Access Concentrator. The Access Concentrator provides CAS, V5.1 or V5.2 network interface with the Local Exchange. Each Modem Shelf also connects via a V.24 (RS232) Network Management interface to the Sitespan network management system.

2.3.2. Alarm and Breaker Panel

The Alarm and Breaker Panel Provides power for the modem shelves and conveys alarms from the modem shelves to the CT station alarm scheme.

3. The Access Concentrator

The Access Concentrator (AC) is required when AS4000 is operating in "Demand Assigned" mode to de-multiplex the traffic concentrated on the air-interface for presentation to the network switching equipment. The Access Concentrator provides CAS, V5.1 or V5.2 network interface with the Local Exchange. Also in system versions using 32kbit/s ADPCM compression the decompression to 64kbit/s is performed within the AC.

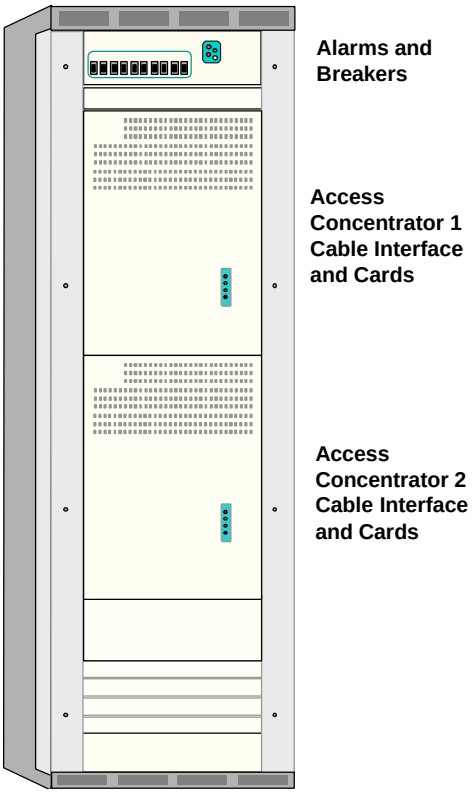


Figure 4. Access Concentrator Rack with two AC Units

4. Subscriber Terminals

The AS4000 Subscriber Terminal (ST) portfolio includes subscriber terminal types: for Voice, Data, and ISDN. In general, the customer has access to the same range of facilities that are supported by a conventional copper pair.

For normal telephony services, these could typically include:

- multi-frequency or loop-disconnect dialling
- subscriber private metering
- intrusion tone
- malicious call interception.
- caller line identification

Note. Line reversal is not supported.

All tones, tone cadences and announcements which are generated by the Local Exchange are passed transparently over the AS4000 System. Line feed voltage, ringing current and ringing cadence are generated by the ST equipment.

The Customer Premises Equipment is connected to the Line Sockets on the internal Service Interface Unit.

The specific impedance of the NTU allows tests to be performed by the SIU to detect any attached CPE.

For Data one 128kbit/s or two 64kbit/s circuits are supported in Fixed Assigned mode only.

For ISDN 2B+D channel S-bus interface in Fixed Assigned mode only.

4.1. The Subscriber Terminal Installation

The majority of the electronics is in Service Interface Unit located inside the customer premises. This is connected to the outdoor unit by an IF drop cable.

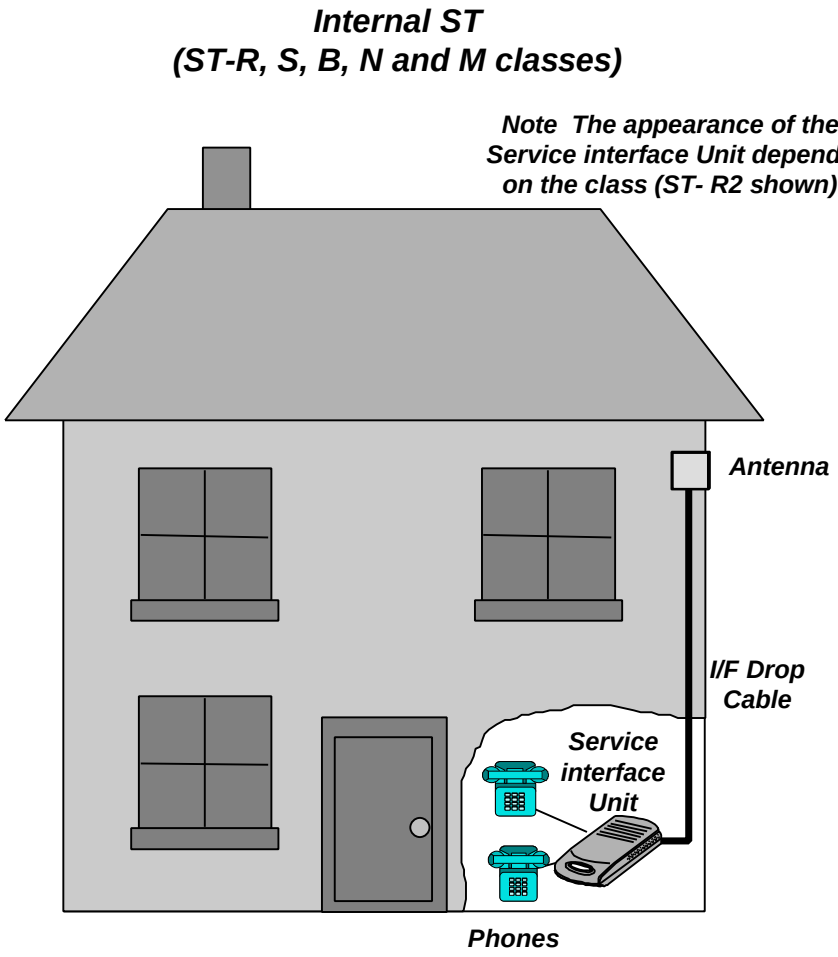


Figure 5. Internal Subscriber Terminal

The main elements, (see Figure 5) comprise:

- External Antenna
- Internal Service Interface Unit
- IF Drop Cable
- Type 5 Socket PSU

4.2. Antenna

The antenna is a sealed weatherproof unit that is mounted on the outside of the customer's premises. The unit is normally positioned on an outside wall or a mounting that faces the general direction of the CT antenna. The ST should be sited to avoid

large obstructions in proximity to and in line of sight from the ST to the Antenna. See the ST installation and commissioning manual for deployment rules.

The Antenna unit contains a flat plate antenna and a Low Noise Amplifier (LNA). It connects to the IF Drop cable using an F type connector. Power for the LNA is provided via the drop cable.

4.3. Antenna Mounting Bracket

The antenna Mounting Bracket provides adjustment (in the azimuth plane) of the Antenna in an arc over 150°, the optimum positioning being determined by measuring the strength of the incoming signal, usually in the direction of the CT antenna.

4.4. IF Drop Cable

The drop cable connects the internal SIU to the Antenna via an environmentally protected F-Type connector that is plugged into the backplate of the Antenna. The IF Drop Cable is 50m or 100m with a 40mm minimum bend radius.

4.5. Subscriber Terminal Types

There is a range of STs available, each supporting different services and numbers of lines See Table 1.

Generic	Subscriber Terminal	Service Interface Unit			Function
		Type	Qty	Construction	
R Series	R1	RU-V1	1	Residential Subscriber Unit	One line voice 64kbit/s PCM / 32 kbit/s ADPCM
	R2	RU-V2	1	Residential Subscriber Unit	Two line voice 64kbit/s PCM / 32 kbit/s ADPCM
S Series	S1	SU-V1	1	Sub-Unit	One line voice 64kbit/s PCM / 32 kbit/s ADPCM
	♣S2	SU-V2	1	Sub-Unit	Two line voice 64kbit/s PCM / 32 kbit/s ADPCM
N Series	N2	MU-V2	1	Modular Unit	Two line voice 64kbit/s PCM / 32 kbit/s ADPCM
	N4	MU-V4	1	Modular Unit	Four line voice 32kbit/s ADPCM
B Series	B1	MU-I	1	Modular Unit	ISDN (FA Mode)
L Series	L128	MU-D128	1	Modular Unit	One line 128kbit/s data (FA Mode)
	L64	MU-D64	1	Modular Unit	One line 64kbit/s data (FA Mode)
	L2x64	MU-D2x64	1	Modular Unit	Two line 64k bit/s data (FA Mode)
M Series	M2	MU-V2	1	Modular Unit in Modular Enclosure	Two line voice 64kbit/s PCM / 32kbit/s ADPCM
	M4	MU-V4	1	Modular Unit in Modular Enclosure	Four line voice 64kbit/s PCM / 32 kbit/s ADPCM
	M4/64	MU-V2	2	Modular Unit in Modular Enclosure	Four line voice 64kbit/s PCM / 32 kbit/s ADPCM
	M8	MU-V4	2	Modular Unit in Modular Enclosure	Eight line voice 32kbit/s ADPCM

Generic	Subscriber Terminal	Service Interface Unit			Function
		Type	Qty	Construction	
	M8/64	MU-V2	4	Modular Unit in Modular Enclosure	Eight line voice 64kbit/s PCM / 32 kbit/s ADPCM
	M16	MU-V4	4	Modular Unit in Modular Enclosure	Sixteen line voice 32kbit/s ADPCM

Table 1. AS4000 DA Subscriber Terminals

General Note: 32kbit/s ADPCM voice services available for Subscriber Terminal hosted on Demand Assigned Modem shelves.

5. The Management System

The Sitespan Manager is a scaleable, distributed PC based management system. monitors, tests and configures the WFA system. All elements of the AS4000 System (AC, CT and ST) can be managed from a single Sitespan server connected at the Access Concentrator.

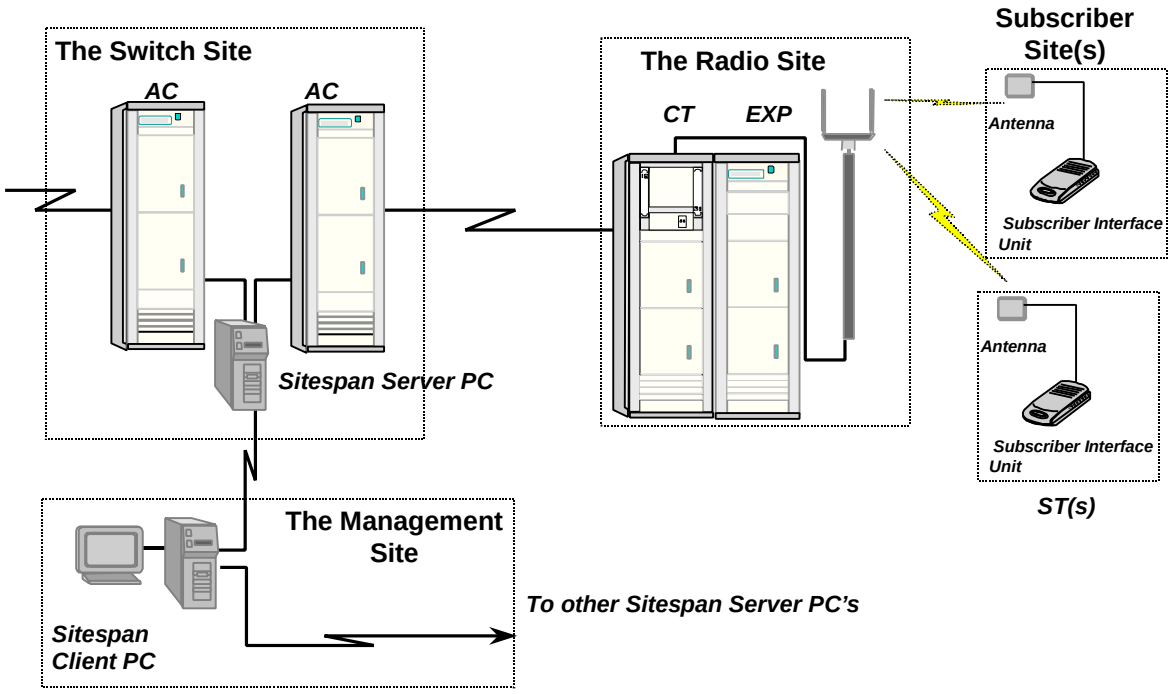


Figure 6. The Management System

6. System Interfaces

Interfaces between the various elements of the AS4000 system are as follows:

6.1. AC Management Interface

The AC provides up to two asynchronous ports for connection to a management system. These ports will carry all management information for the AC and all dependent CTs that do not have independent management communications.

All elements of the AS4000 System (AC, CT and ST) can be managed from a single Sitespan server connected at the Access Concentrator.

6.2. CT Management Interface

CT Modem Shelf management will be either via the AC / CT E1 link in which case communications are presented at the AC management port, or via a direct asynchronous communications link.

6.3. Customer Interfaces

The telephony system supports CAS, V5.1 and V5.2 connections to the switched Network and supports the full range of advanced services supported by this interface, including CLASS services and Subscriber Pulse Metering (SPM).

The data (L128) system connects to the network using 2Mbit/s G703 HDLC protocol.

For ISDN the host network interconnects to the AS4000 using a 2Mbit/s G.703 interfaces. The signalling is a Q.931 message based “Euro-ISDN” protocol, that meets the NET.5 ISDN approval standards for Primary Rate Interfaces.

The AS4000 Wireless Fixed Access System provides a single product platform that can deliver a mixture of dedicated link services. These include:

- Plain Old Telephone System (POTS). equivalent service
- Fixed line 2x 64 kbit/s data services
- Fixed Line ISDN basic rate access 144kbit/s

6.4. The Exchange Interface

The interface between the AS4000 system and the switch is N x 2Mbit/s G703 / G704 (1 per radio carrier typically 4 per CT).

For the **Demand Assigned** AS4000 system the Access Concentrator (AC) provides the primary network interface which is N x 2Mbit/s, as per ITU recommendation G.703, short haul 6dB, G.704 and ETSI ETS 300-166.

All signalling is digital using either Channel Associated Signalling (CAS) or Common Channel Signalling (CCS) protocols. AS4000 DA interfaces to digital switching systems that have 2Mbit/s subscriber ports.

Support for 2 wire VF interfacing is via external channel bank equipment, such as Alcatel's LS-120.

- Channel Associated Signalling. Support for timeslot 16 ABCD bit CAS is provided. The AS8100 management system allows for flexible configuration of the protocol, to interface with switches from various manufacturers.
- Common Channel Signalling. V5.1 and V5.2 are supported by AS4000 DA. Proprietary protocols such as DASS2 and DSS1 may be supported through appropriate software loads.
- The V5.1 network interface as specified in ETS 300-324-1 is used for the presentation of traffic at a non-concentrated interface. The V5.1 interface supports both POTS and ISDN services.
- The V5.2 network interface as specified in ETS 300-347-1 is used for the presentation of traffic at a concentrated interface. The V5.2 interface supports both POTS and basic rate ISDN services. The AC supports V5.2 groups of up to 16 E1 links.
- The AC supports dedicated data services using 64kbit/s timeslots. Cross-connect at the 64 kbit/s level from any input / output port is configurable via the management system.

7. AS4000 Air Interface

7.1. CDMA Technology

AS4000 uses a radio air-interface, specifically designed for Wireless Fixed Access to provide high quality, and low delay bearers for telephony, data and ISDN services.

AS4000 uses Direct Sequence Spread Spectrum Code Division Multiple Access (DS-CDMA) on the air-interface between the CT and STs, allowing multiple radio links to share the same RF channel. A set of specialised codes are used which are shared between the ST and its corresponding modem in the CT.

There are two stages to the CDMA modulation / demodulation process. Firstly direct sequence spreading is performed on each individual radio link by a pseudo-random noise (PN) code. Then multiple access, where multiple links share the same RF channel, is achieved by using a set of orthogonal Rademacher - Walsh (RW) codes. The PN and RW codes are combined into a unique and shared composite code used to modulate and demodulate each radio link.

AS4000 implements a version of CDMA optimised for fixed access This is *significantly* different from other commercial CDMA implementations.

7.2. Demand Assignment

The "Demand Assigned" Radio interface makes a temporary call by call assignment of channels, to Subscriber Terminals in residential telephony applications, where the per line traffic allows the provision of Graded Service. The radio interface differs in that links are allocated as either Traffic, or Control channels.

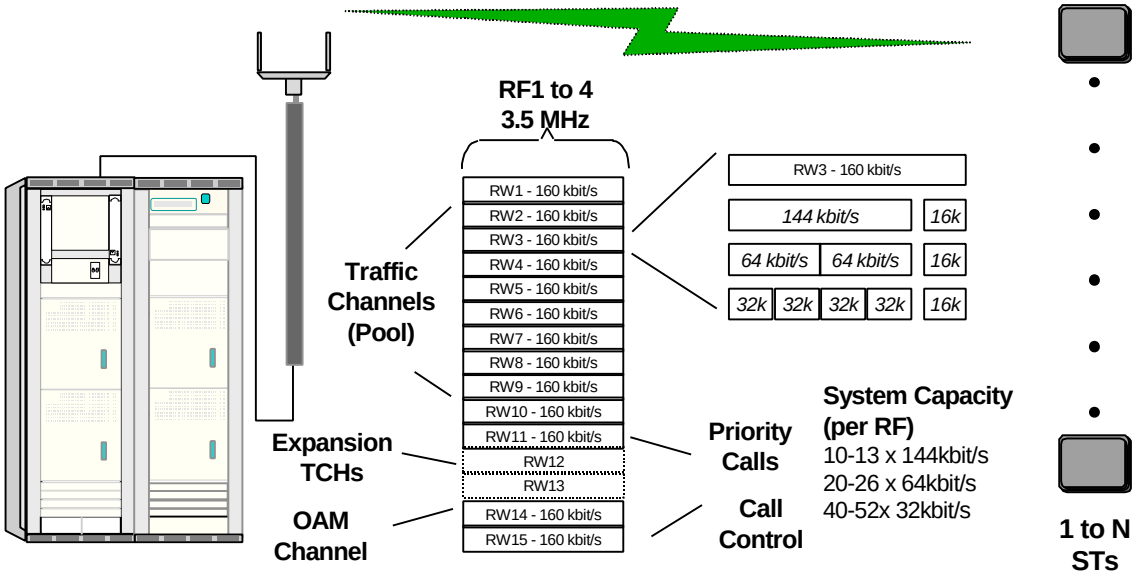


Figure 7. Demand Assigned Air-Interface Structure

Within each RF channel, a pool of traffic channels supports a mix of 32, 64, and 144kbit/s services. Pool management is dynamic so channels may be made available as 32, 64, and 144kbit/s on demand. The size of the traffic pool is automatically and dynamically sized based on radio interface performance and the grade of service requirements thus controlling the level of access noise. The pool can be extended if the interference level permits, or reduced if access noise is too great. The DA access protocol can also support one or more priority channels that allow guaranteed access for emergency calls. The channels allocated to traffic are pooled and configured as either 10 - 13 x 144kbit/s, 20 - 26 x 64kbit/s, or 40 - 52 x 32kbit/s. Two links are reserved for OAM and Call Control.

Each link operates using a master RW code to provide a 160kbit/s channel. These links are then sub-divided using 2nd level RW codes that allow the construction of 2 x 80kbit/s or 4 x 40kbit/s smaller granularity links, while maintaining the same Spectral Density. Hence Traffic Channels (TCH) are composed of either 160kbit/s, 80kbit/s or 40 kbit/s links.

STs maintain communication with CT via the Call Control link, using an "Ethernet" like protocol. All STs are continually polled, and receive regular downloads of available TCHs and their channelisation (i.e. 144kbit/s, 64kbit/s or 32kbit/s).

STs track available TCHs to permit “fast acquisition”. When a user’s line goes “off-hook”, STs request allocation of a TCH from the available pool. The CT instructs STs to “seize” a particular TCH, if access noise permits.

Traffic engineering is via the management system, which allows the following parameters to be programmed:

- Minimum / maximum number of traffic channels
- Number of access channels
- Demand access protocol type
- BER grade of service threshold
- Call blocking threshold
- Number of priority channels

7.3. Frequency Ranges Supported.

AS4000 supports system implementation in various frequency ranges within the ITU-R and ETSI 2GHz and 3GHz frequency ranges. The specific channel plans available (see Appendix A) operate in frequency bands at:

- 2.0-2.3GHz, in accordance with CEPT/ERC/Rec. 13-01E, Annex C, with 175MHz duplex spacing
- 2.3-2.5GHz, in accordance with ITU-R 746, with 94MHz duplex spacing
- 3.4-3.6GHz, in accordance with CEPT/ERC/Rec. 14-03E (Turku 1996), with 100MHz duplex spacing

AS4000 operates in licensed spectrum, normally co-ordinated with other users by the licensing authority. Coexistence with other systems is in-line with ETS EN 301 055.

CENTRAL HARDWARE OVERVIEW

8. Antenna and Feeder Sub-system

8.1. General Description

The antenna and feeder sub-system consists of a high-gain omni-directional antenna assembly and low-loss coaxial feeder cables which connect the antennas to the CT equipment rack. To ensure the antenna assembly is above roof height and has an unobstructed view of the horizon, an antenna mast may be employed.

Two antennas are employed, one for transmitting RF from modem shelves 1 & 2, and for receiving the radio links for all four modem shelves, the second for transmitting RF from modem shelves 3 & 4. In a system where only two shelves are employed only one antenna is needed.

8.2. Antenna Options

Antenna Type	2.0-2.3GHz Band	2.3-2.5GHz Band	3.4-3.6GHz Band
Omni 0.5° Downtilt	Yes	Yes	Yes
Omni 2.5° Downtilt	Yes	No	No
Directional 60/65° Azimuth	Yes	Yes	Yes
Directional 180° Azimuth	No	No	Yes

Omni Antenna System

The omni antenna sub-system consists of 2 Omni-Directional, Stacked Dipole Antenna, mounted on a beam of approximately 2 metres in length. This mechanical assembly is equipped with a bracket for attachment to a suitable pole. The bracket is made of galvanised steel, and is suitable for deployment in harsh environments. Details of the antenna sub-system and pole mount are illustrated in Figure 8.

Directional Antenna System

The directional antenna sub-system consists of a flat plat antenna with mounting brackets suitable for mounting on a pole up to 100mm diameter. And a HPBW azimuth of 60/65°. This mechanical assembly is shown in Figure 9.

8.3. Interface Connections

The coax antenna feeder cables connect via N-Type connectors to the Branching Unit (BU) located in the top left section of the RF Combiner Shelf.

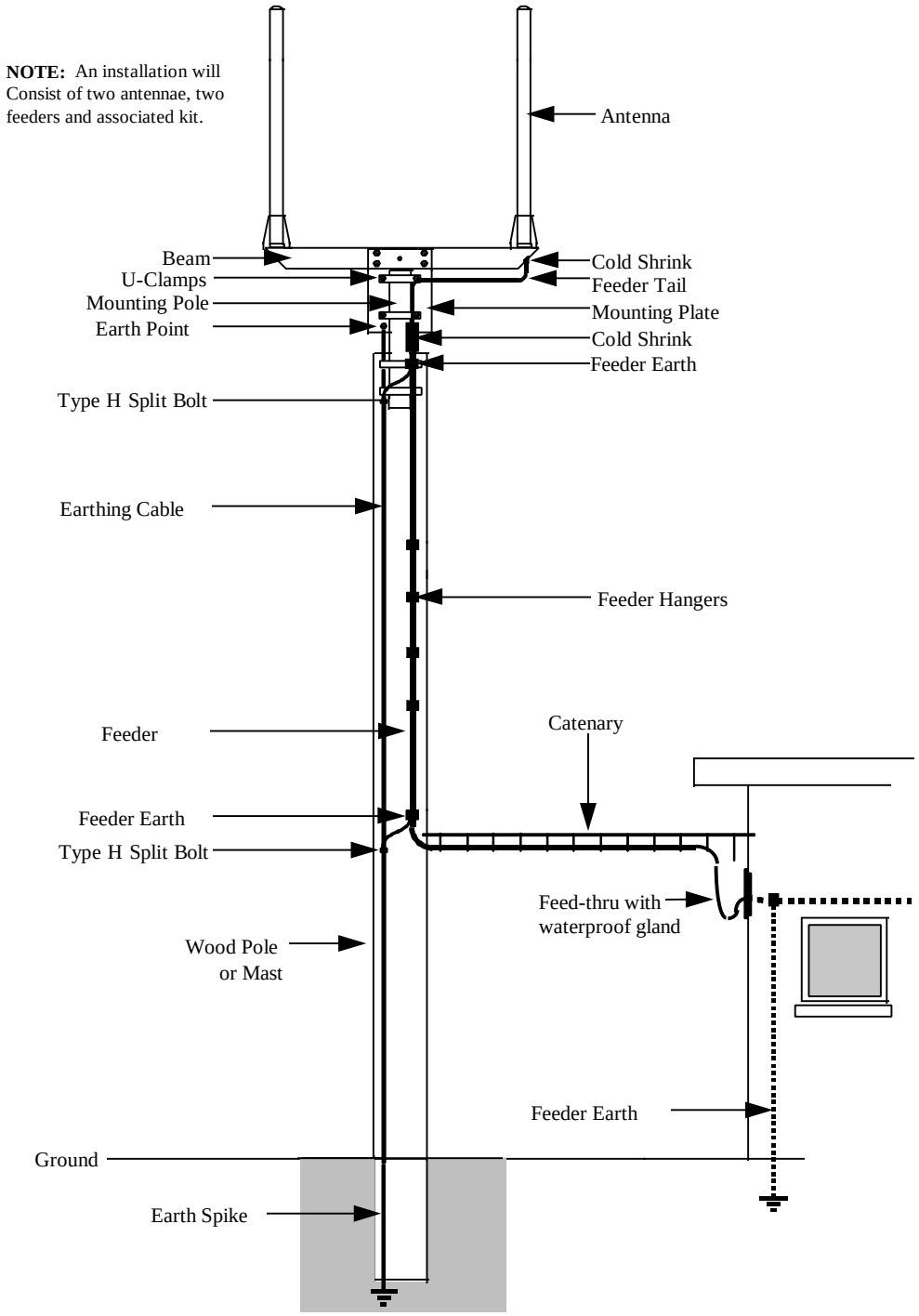


Figure 8. The AS4000 Omni-Directional Antenna System (typical)

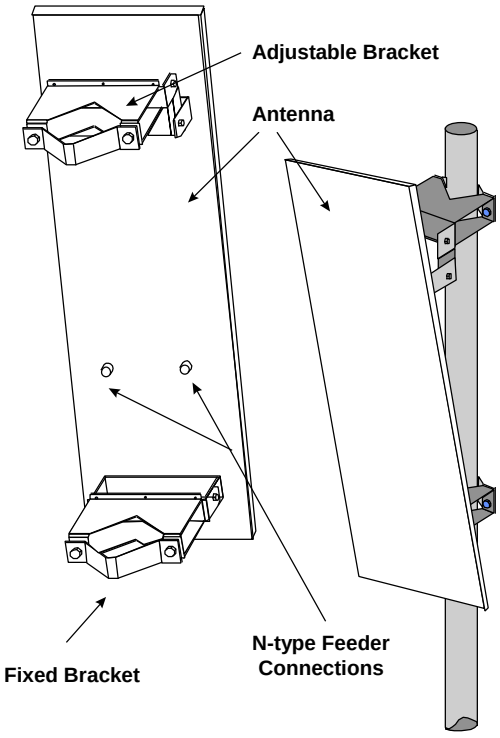


Figure 9. 65° Directional Antenna

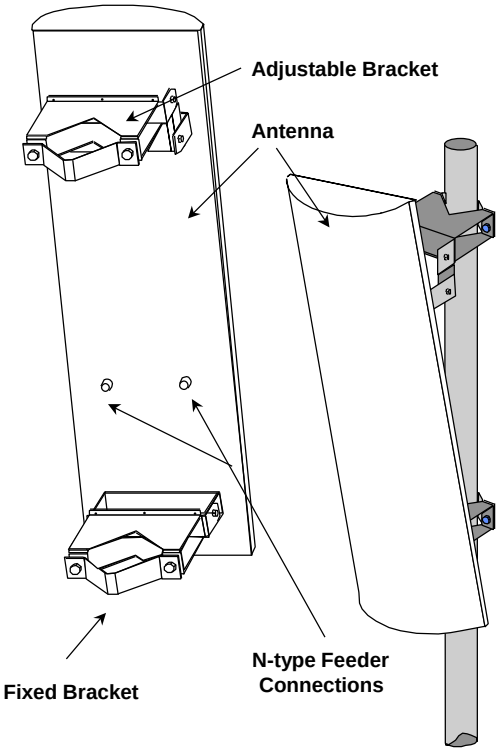


Figure 10. 180° Directional Antenna

9. Central Terminal (CT)

9.1. General Description

The 2.2m high ETSI style AS4000 CT equipment racks containing multiple shelf assemblies. These house the equipment necessary to support from one to 60 customer radio links and from one to four 2Mbit/s CAS or DASS links to the Access Concentrator. (see Figure 11).

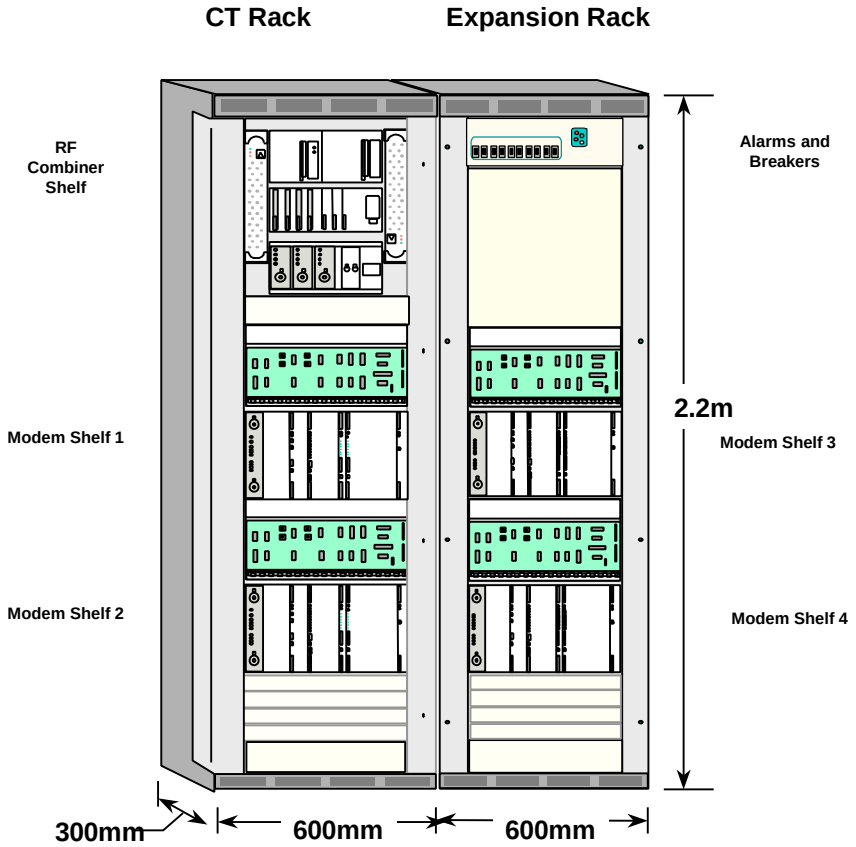


Figure 11. AS4000 DA CT Equipment Racks (covers removed)

9.2. Power Requirements

Each Rack requires two DC power supplies. The supply can range from -22 Volt to -60 Volt DC. The input current for a fully loaded DA Rack is 25 Amps at 22 Volt reducing to 9 Amps at 60 Volt (540W) and for a fully loaded Expansion Rack is 11 Amps at 22 Volt reducing to 4 Amps at 60 Volt (240W).

9.3. CT Equipment Rack Shelves:

9.3.1. Modem Shelves

Each Modem Shelf terminates one RF Channel, supporting up to 15 radio links, provides an E1 network interface with the Access Concentrator and a V.24 (RS232) Network Management interface to the Sitespan. Redundant E1 links can also be provided to maintain the backhaul link to the Access Concentrator if the main link fails. Up to two Modem Shelves can be equipped within the DA Rack and a further two Modem Shelves placed in an Expansion Rack to support a total of 60 radio links and four network management interfaces. The number of traffic channels supported will depend on the bit rates for each circuit.

Each Modem Shelf has:

- **Power Supply Units (PSUs).** Two PSUs are used to supply power to the modem shelf. The DC load is shared between PSUs and in the event of the failure of a PSU the other PSU maintains power to the shelf.
- **Analogue Card (AU).** The AU Card converts the coded signals from the Modem Cards to a base band signal (for the RF Card in the RF Combiner Shelf) and supplies the TU Card with the recovered 2MHz clock signal.
- **Shelf Controller Card (SC)**. The SC Card provides the management interface between the Sitespan and the Modem Shelf. It also holds the configuration details in NVRAM.
- **DA Tributary Unit (DTU).** The DTU Card provides the interface between the Access Concentrator equipment and AS4000 Radio System for traffic and signalling information.
- **Modem Cards** Up to six Modem Cards provide the core SS-CDMA modem functionality interfacing traffic channels between the TU Card and the Analogue Card and management signals to the Shelf Controller Card.
- **LED/Alarm Panel**, The LED/Alarm panel provides LEDs that reflect the overall status of the system and an key switch used to acknowledge that a fault condition is receiving attention.

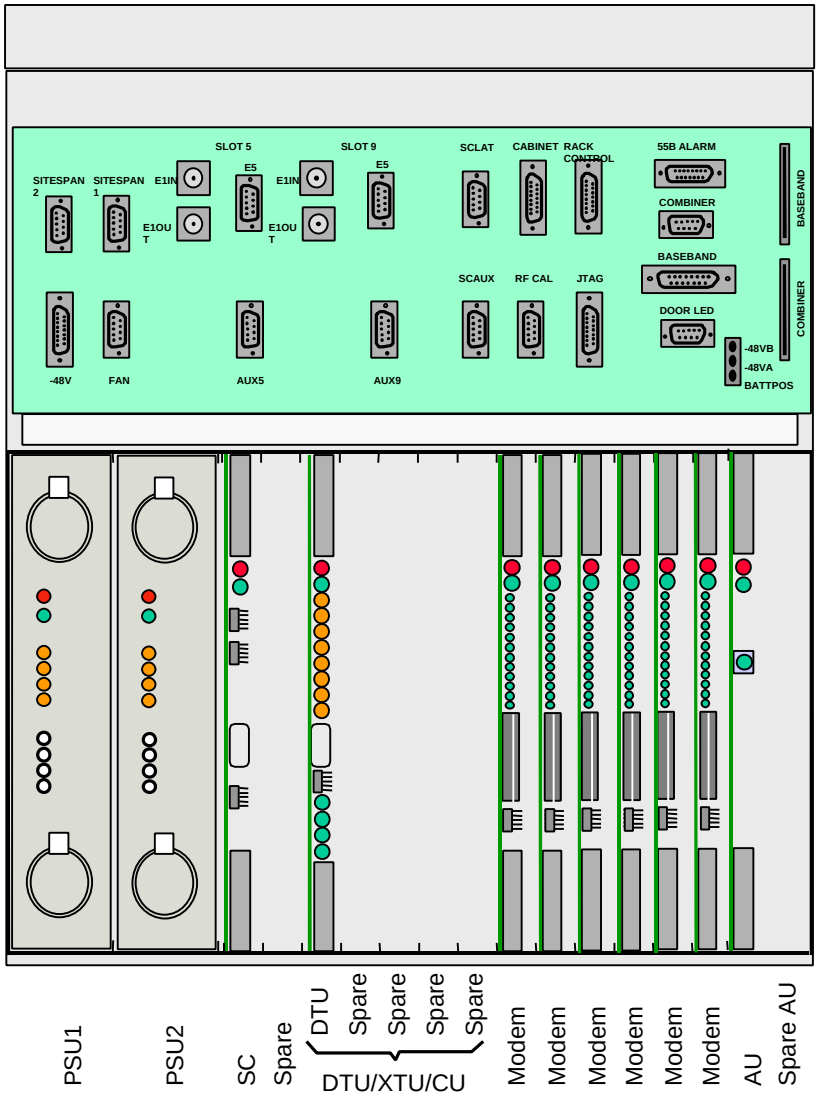


Figure 12. Modem Shelf with front covers removed

9.3.2. RF Combiner Shelf

The RF Combiner Shelf forms the interface between the Antenna/Feeder Sub-system and individual Modem Shelves. The RF Combiner Shelf performs the functions necessary to connect up to four RF signals to the Antenna/Feeder Sub-system.

In the transmit direction, the baseband signals from Modem Shelves one and two are converted to RF, amplified, combined and filtered before being sent to the first antenna. The second pair of RF channels (from Modem Shelves three and four) are similarly treated, but are fed via a duplexer (used in the receive path for extraction of the receive signal) to the second antenna.

In the receive direction, incoming signals from the antenna are extracted, filtered, amplified by the LNA and split among the (up to) four RF Cards and their associated Modem Shelves.

The RF Combiner Shelf (see Figure 13) is equipped with:

- **RF Cards**, (up to four) that convert the baseband signal from each modem shelf into a single RF channel in the 2GHz range (and vice versa). This interfaces to the Antenna/Feeder Sub-system.
- **Power Amplifier** (PA) modules (up to two), each of which caters for 2 RF channels and amplifies the RF channels received from their associated Modem Shelf equipment.
- **Branching Unit** (BU) module, which is essentially a passive unit that performs signal Combiner, splitting and filtering.
- **Low Noise Amplifier** (LNA) module, which amplifies the low-level receive signal, after filtering but before splitting.
- **Shelf Monitor Card**, which collects information from the PAs, LNA and PSUs, and passes it to the Shelf Controller Cards.

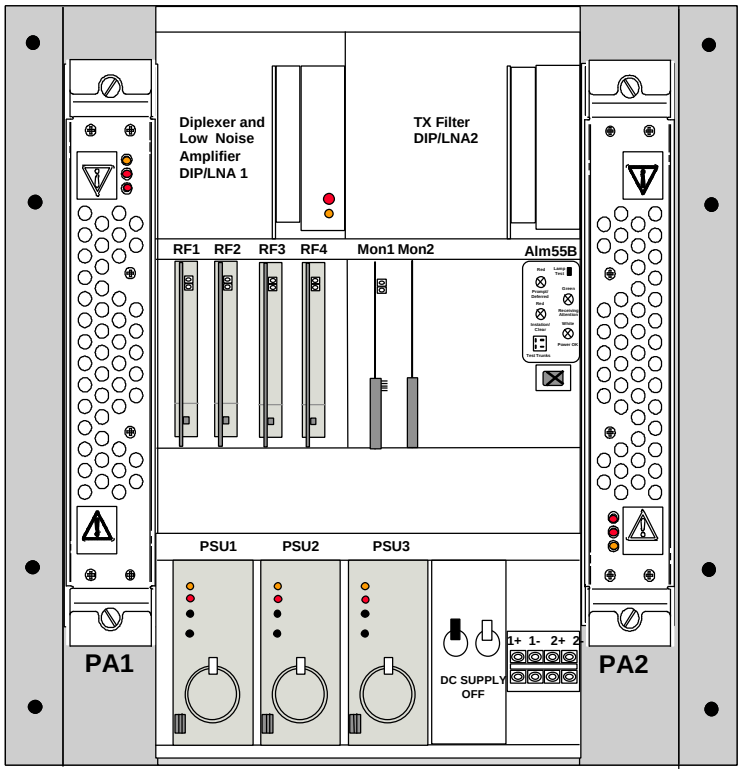


Figure 13. RF Combiner Shelf

- Three Combiner Shelf PSUs to provide the interface between the local DC power source and the equipment of the AS4000 CT Rack. The shelf contains two circuit breakers, to give protection by using two independent DC supplies, and three PSUs that supply a nominal 13.5V DC. The input to the PSU can be in the nominal range of –24V to –60V.
- Power for the RF cards is provided from a PSU contained in the combiner monitor card and a redundant monitor card containing only a PSU is used to provide power backup in the event of failure of the monitor card PSU.
- The RF Combiner Shelf also contains an alarm extension unit which receives alarm information from the AS4000 equipment, analyses it and then informs the local suite alarm system to which certain alarms are extended. Depending on the severity of the condition, the alarm extension unit recognises either a *Prompt* alarm (immediate attention required) or a *Deferred* alarm (action can be delayed).

9.4. CT Expansion Rack Shelves:

The Expansion Rack provides two modem shelves as described in 9.3.1. DC supplies and alarms are fed to the rack via a Alarm and Breaker Panel

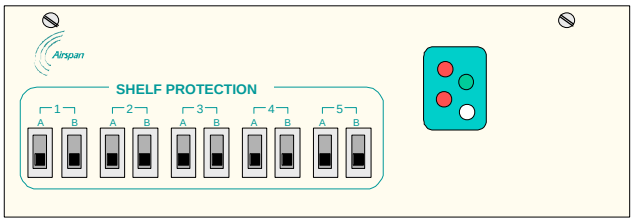


Figure 14 Alarm and Breaker Panel

ACCESS CONCENTRATOR HARDWARE OVERVIEW

10. The Access Concentrator

The Access Concentrator (AC) is required when AS4000 is operating in "Demand Assigned" mode to de-multiplex the traffic concentrated on the air-interface for presentation to the network switching equipment. Also in system versions using 32kbit/s compression the decompression to 64kbit/s is performed within the AC.

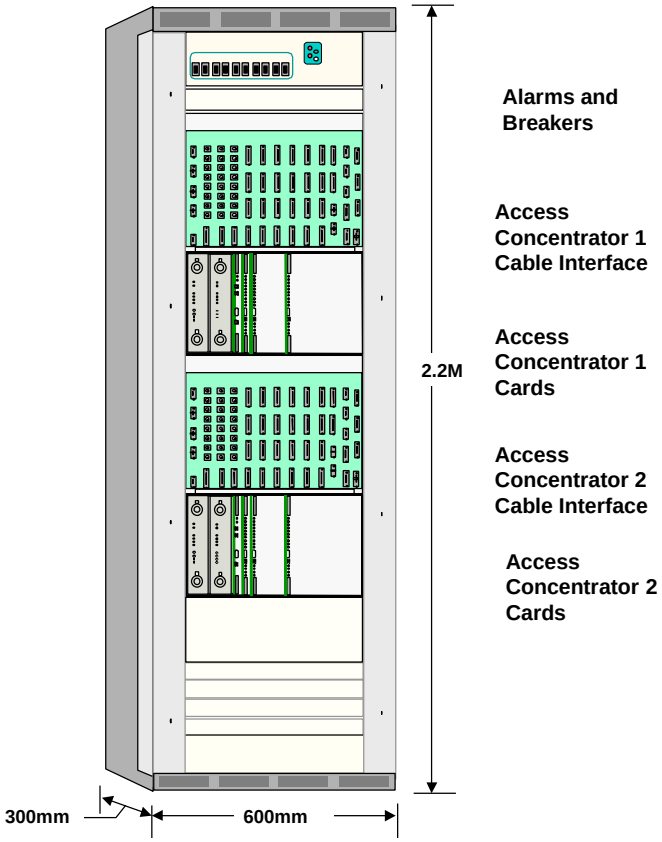


Figure 15. Access Concentrator Rack (covers removed)

The AC Unit consists of a Shelf and backplane for the various DA system cards, and a Connector Panel that terminates all external and internal cable interfaces.

The configuration of the AC depends very much upon the customers' installation. The number of cards fitted will be at the discretion of the network operator, and managed by Sitespan. There are thirteen Auxiliary slots which can take a XTU, CU or. A fourteenth auxiliary slot is normally dedicated to the spare TU to facilitate relay change over.

10.1. Power Requirements

The rack requires two DC power supplies. The supply can range from -22 Volt to -60 Volt DC. The input current for a fully loaded Access Concentrator Rack is 13 Amps at 22 Volt reducing to 4.7 Amps at 60 Volt (280W).

10.2. AC Equipment Rack Shelves:

Up to two AC shelves can be equipped within the AC Rack. Each AC shelf consists of:

10.2.1. Access Concentrator Connector Panel

Each Access Concentrator Connector Panel provides E1 network interfaces to each Modem Shelf at the Central Terminal. Redundant E1 links can also be provided to maintain the backhaul link to the Central Terminal if the main link fails. The Connector Panel also provides interfaces to the Switch

10.2.2. Access Concentrator Card Shelf

Each Access Concentrator Card Shelf has:

- **Power Supply Units** (PSUs). Two PSUs are used to supply power to the Access Concentrator shelf. The DC load is shared between PSUs and in the event of the failure of a PSU the other PSU maintains power to the shelf.
- **Shelf Controller Card (SC)**, The SC Card provides the management interface between the Sitespan and the Modem Shelf. It also holds the configuration details in NVRAM.
- **CT Tributary Unit(s)** (CTU) providing the interface between the Access Concentrator equipment and AS4000 Radio System for traffic and signalling information. The number of CTUs will be dependent on the configuration.
- **Switch Tributary Unit(s) (XTU).** These cards provide the interface between the Access Concentrator equipment and the Switch. The number and type of XTUs will be dependent on the configuration. XTUs are availiable for CAS, Data, Isdn, V5.1 and V5.2
- **Compression Card(s). (CU)** The purpose of the DA Compression Card is to provide ADPCM transcoding on a per channel / timeslot basis in both the CT DA Rack and Access Concentrator. It is initialised by the Shelf Controller but controlled by the TU card.
- **LED/Alarm Panel**, The LED/Alarm panel provides LEDs that reflect the overall status of the system and an key switch used to acknowledge that a fault condition is receiving attention.

SUBSCRIBER TERMINAL HARDWARE OVERVIEW

Located at the customer's premises, the ST equipment terminates the radio link and provides the interface to the customer premises equipment (CPE) e.g., telephone, facsimile machine, personal computer, modem etc.

11. Subscriber Terminals - Service Interface Units

11.1. The R Series Residential Subscriber Terminals

The R series Subscriber Terminals are designed for Voice Telephony and use an external antenna and a plastic injection moulded internal Service Interface Unit. The unit contains a battery compartment. The STs are powered from the AC mains supply with or without backup batteries.

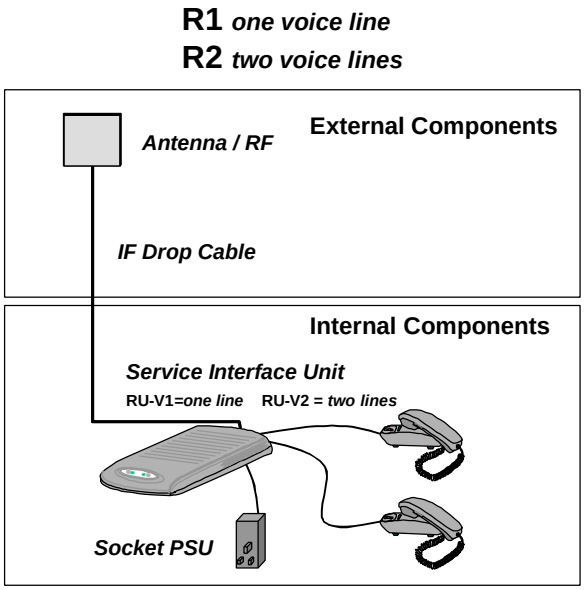


Figure 16. R Series Demand Assigned Subscriber Terminals

The **ST-R1** supports one 32kbit/s ADPCM or 64kbit/s PCM analogue telephony line at the end-users premises. The Service Interface Unit is a RU-V1 single line unit. Provisioning is by the AS8100 management system.

The **ST-R2** supports two 32kbit/s ADPCM or 64kbit/s PCM analogue telephony lines at the end-users premises. The Service Interface Unit is a RU-V2 two line unit. Provisioning is by the AS8100 management system.

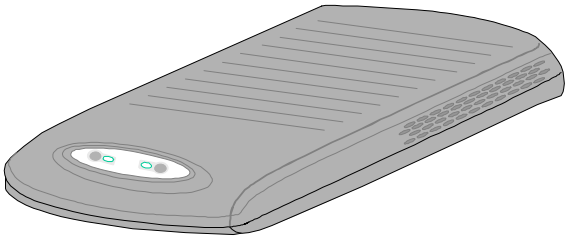


Figure 17. The R Series Service Interface Unit (RU-V2 shown)

11.2. The S Series Sub-Unit Subscriber Terminals

The S series Subscriber Terminals are designed for Voice Telephony and use an external antenna and a internal metal box Sub-Unit Service Interface Unit. The unit is designed for use in places where a more robust unit is needed. i.e. Payphones. The STs are powered from the AC mains supply.

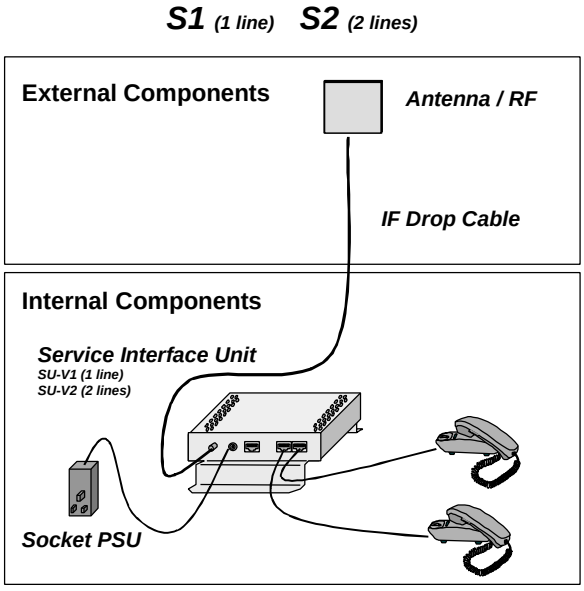


Figure 18. S Series Demand Assigned Subscriber Terminals

The **ST-S1** supports one 32kbit/s ADPCM or 64kbit/s PCM analogue telephony line at the end-users premises. The Service Interface Unit is a SU-V1 single line unit. Provisioning is by the AS8100 management system.

The **ST-S2** supports two 32kbit/s DPCM or 64kbit/s PCM analogue telephony lines at the end-users premises. The Service Interface Unit is a SU-1V two line unit. Provisioning is by the AS8100 management system.

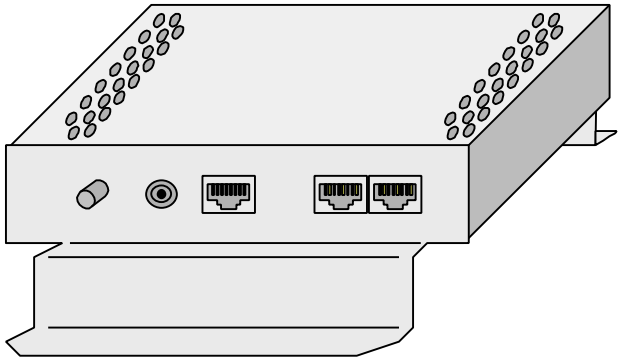


Figure 19. The S Series Service Interface Unit. (SU-V2 shown).

11.3. The N Series Subscriber Terminals

The N series Subscriber Terminals are designed for Voice Telephony and use an external antenna and an internal Modular Service Interface Unit. The STs are powered from the AC mains supply.

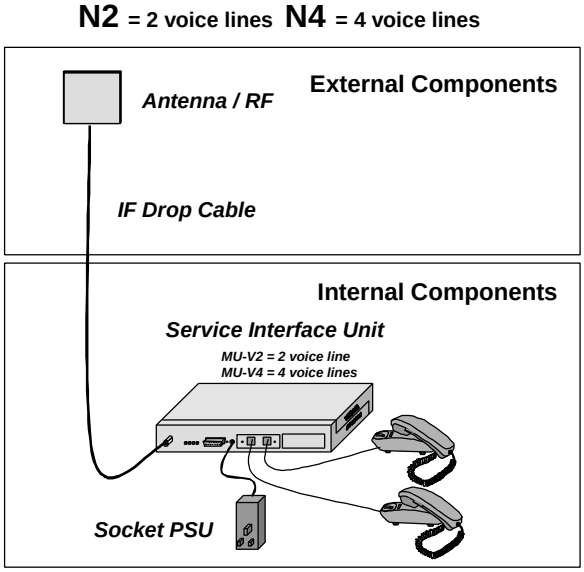


Figure 20. N Series Demand Assigned Subscriber Terminals

The **ST-N2** supports one 32kbit/s ADPCM or 64kbit/s PCM analogue telephony line at the end-users premises. The Service Interface Unit is a MU-V2 with a two line module. Provisioning is by the AS8100 management system.

The **ST-N4** supports four 32kbit/s ADPCM analogue telephony lines at the end-users premises. The Service Interface Unit is a MU-V4 equipped with 2 x two line modules. Provisioning is by the AS8100 management system.

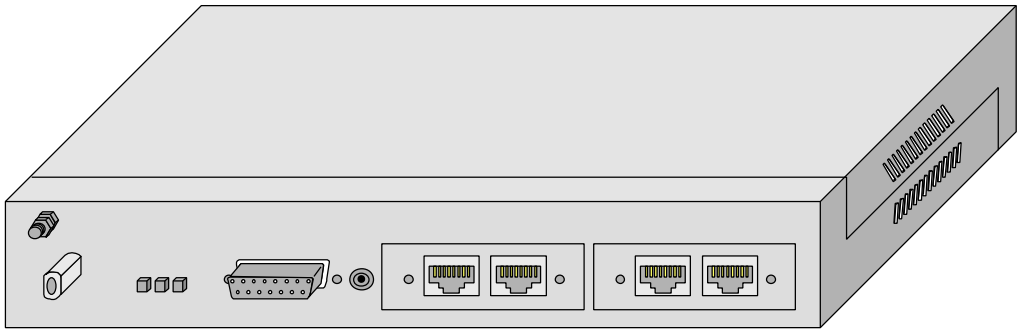


Figure 21. The N Series Service Interface Unit. (MU-V4 shown).

11.4. The B Series Subscriber Terminals

The B series Subscriber Terminals are designed for ISDN and use an external antenna and an internal Modular Service Interface Unit. The STs are powered from the AC mains supply.

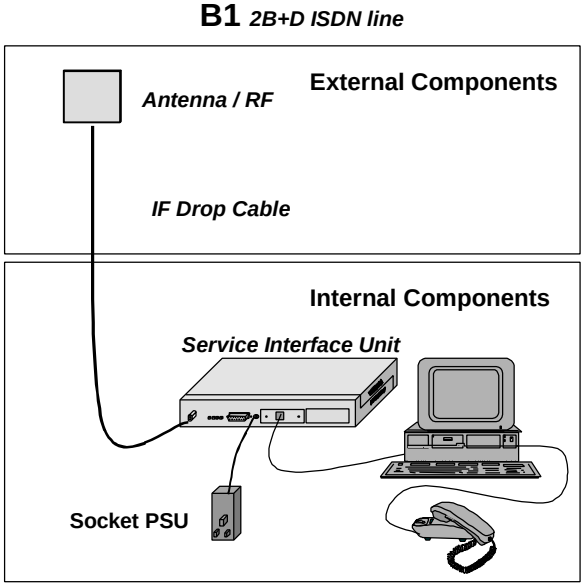


Figure 22. B Series Demand Assigned Subscriber Terminals

The **ST-B1** supports a basic rate ISDN, 2B+D (2 x 64kbit/s + 16kbit/s) "S" interface, and operates in Fixed Assigned mode. The Service Interface Unit is a MU-I with a RJ45 S bus interface.

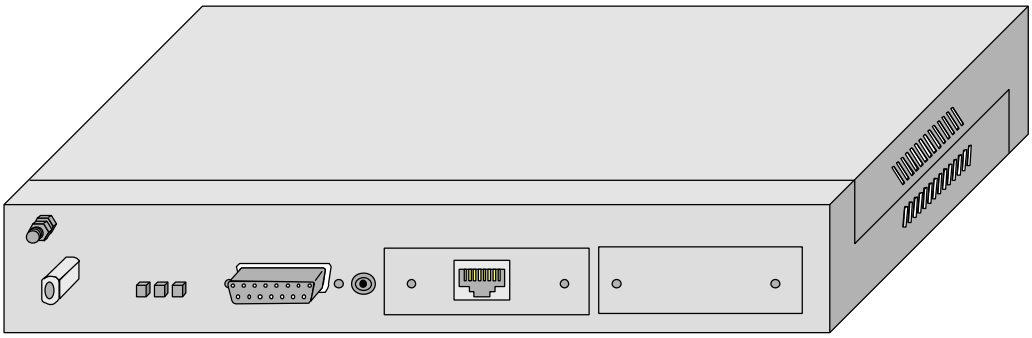


Figure 23. The B Series Service Interface Unit. (MU-I shown).

11.5. The L Series Subscriber Terminals

The L series Subscriber Terminals are designed for Data and use an external antenna and an internal Modular Service Interface Unit. The STs are powered from the AC mains supply.

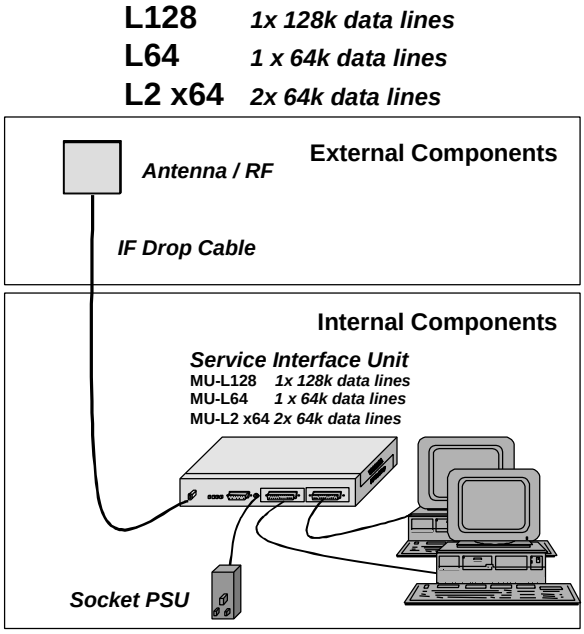


Figure 24. L Series Demand Assigned Subscriber Terminals

The **ST-L128** supports a 128kbit/s serial data transmission operates in Fixed Assigned mode. The Service Interface Unit is a MU-D128 with a 25 way D-Type socket interface (RS530).

The **ST-L64** supports a 64kbit/s serial data transmission operates in Fixed Assigned mode. The Service Interface Unit is a MU-D64 with a 25 way D-Type socket interface (RS530).

The **ST-2xL64** supports two 64kbit/s serial data transmissions and operates in Fixed Assigned mode. The Service Interface Unit is MU-D2x64 with 2x 25 way D-Type socket interfaces (RS530).

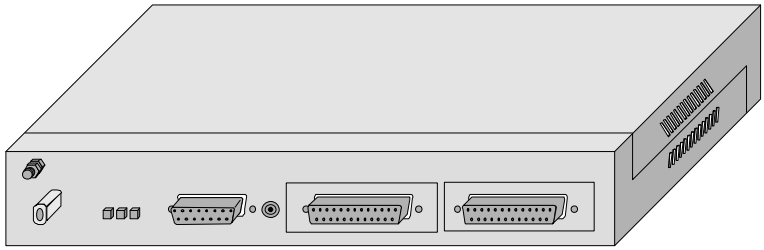


Figure 25. The L Series Service Interface Unit. (MU-D2x64 shown).

11.6. The M Series Subscriber Terminals (provisional information)

The M series Subscriber Terminals are designed for telephony and use external antennas and a number of Service Interface Units. The modular Service Interface Units units are housed in a Modular Enclosure. The STs are powered from the AC mains supply.

Proposed Modular systems are:

Subscriber Terminal	Service Interface Unit	Number of SIUs	Antennas	Function
M2	MU-V2	1	1	Two line voice 64kbits PCM / 32kbit/s ADPCM
M4	MU-V4	1	1	Four line voice 32kbit/s ADPCM
M4/64	MU-V2	2	2	Four line voice 64kbits PCM / 32kbit/s ADPCM
M8	MU-V4	2	2	Eight line voice 64kbits PCM / 32kbit/s ADPCM
M8/64	MU-V2	4	4	Eight line voice 64kbits PCM / 32kbit/s ADPCM
M16	MU-V4	4	4	Sixteen line voice 64kbits PCM / 32kbit/s ADPCM

SYSTEM MANAGEMENT OVERVIEW

12. System Management

12.1. Sitespan

Sitespan can manage a range of ACC products (AS4000 Fixed Assigned, AS4000 Demand Assigned, Multiline, and Alcatel Litespan) and is designed to allow the management of these from a central location.

Sitespan uses two distinct management elements, a Server to manage the equipment racks, and an Equipment View to provide user access. Both use a 133 MHz or better Pentium PC with 16Mbytes of Ram using a Windows NT operating system.

The Server and an Equipment View may run in the same PC or alternatively the Equipment View is set remote from the Server and gains access over a network link.

A Server manages the AS4000 racks regardless of whether any equipment views are connected to it. All operations and alarms are written into a transaction file located in the server machine maintaining a complete record of status. Any Equipment View PC that connects is up loaded with this status.

The Equipment View PC can connect to a number of Server PC's at the same time.

A number of Equipment View PCs can connect to the Server PC at the same time, each Equipment View using secure password access.

Each connected Equipment View is updated in real time reflecting the consequences of any changes initiated by other Equipment Views.

Physical Connections. The Access Concentrator connected to the server PC via a single RS232 cable. A 9 or 25 way D-Type connects to the serial port of the PC and a 25 way D-Type connects to the Modem Shelf. Alternatively a PC card (e.g. Digiboard) can be used to allow a number of Shelf Controllers to access a single serial port.

The Server PC is connects to a remote Equipment View PC using either,

- Dial-up Modem Link *or*
- Fixed Link *or*
- X.25 Packet Switch Network

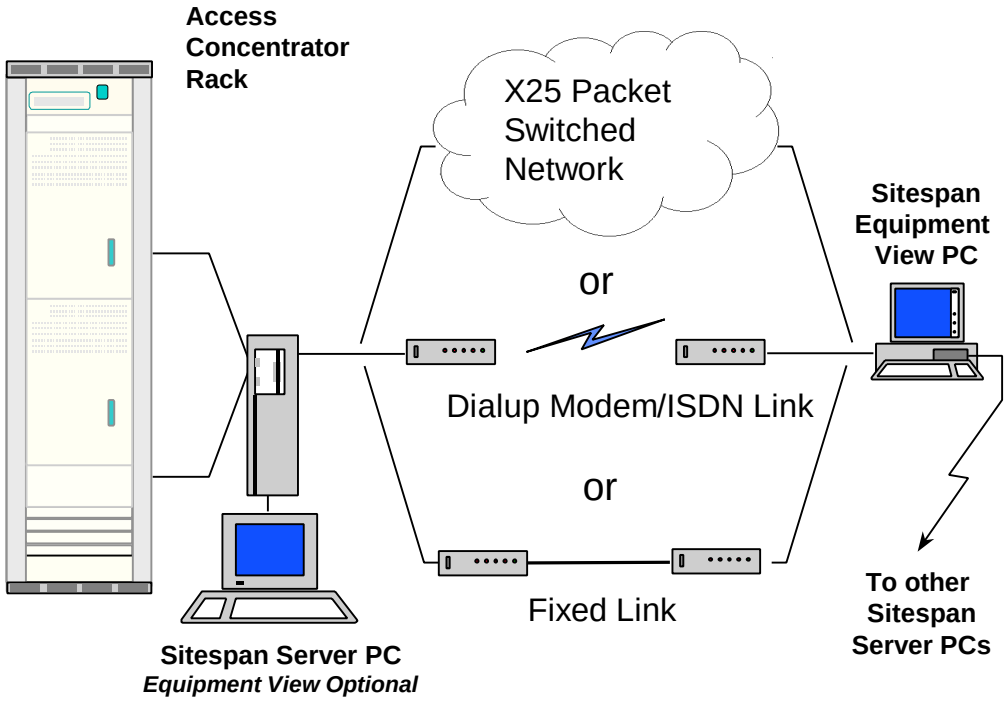


Figure 26. Sitespan Network Management

APPENDIX A - RF CHANNEL PLANS

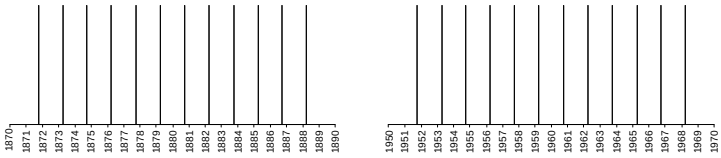
AS4000 supports WFA system implementation in various frequency ranges within the ITU-R and ETSI 2GHz and 3GHz frequency ranges. The specific implementations currently available operate in frequency bands at 1.8-1.9Ghz, 2.0-2.3GHz, 2.3-2.5GHz and 3.4-3.6GHz in accordance with the AS4000 “channel plans” shown below.

The RF channelisation is 1.5/3.5/4.0MHz and Frequency Division Duplexing (FDD) is used. The basic requirement for AS4000 system operation is for a single RF channel (3.0/3.5MHz go, 3.0/3.5MHz return), with go-return spacing dependant on the channel plan used.

1.8-1.9GHz Channel Plan 1

- **Follows FCC Spectrum Allocations for US PCS Band**
  - 1.5 MHz channelisation, with 80 MHz Duplex spacing
- RF carriers occupy 3.0MHz, adjacent channel spacing is subject to cell configuration
- Use of channels 9 & 10 requires contiguous A and D block spectrum.
- In some countries the use of this band may conflict with other allocations, I.e. GSM-1800, DECT & PHS.

1.8-1.9GHz Channel Plan 2

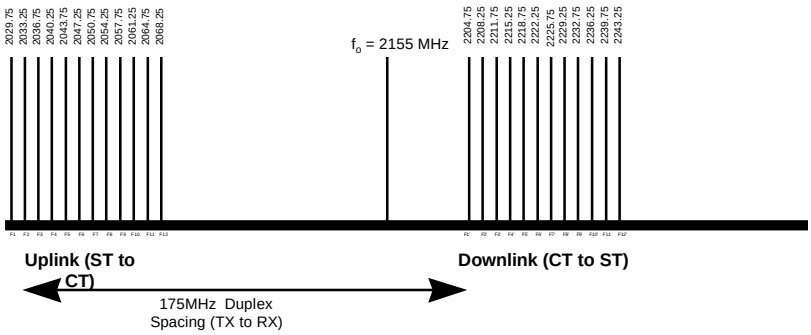


- **Follows FCC Spectrum Allocations for US PCS Band**
  - 1.5 MHz channelisation, with 80 MHz Duplex spacing
- RF carriers occupy 3.0MHz, adjacent channel spacing is subject to cell configuration
- Use of channels 9 & 10 requires contiguous B and E block spectrum.
- In some countries the use of this band may conflict with other allocations, I.e. GSM-1800, DECT & PHS.

1.8-1.9GHz Channel Plan 3

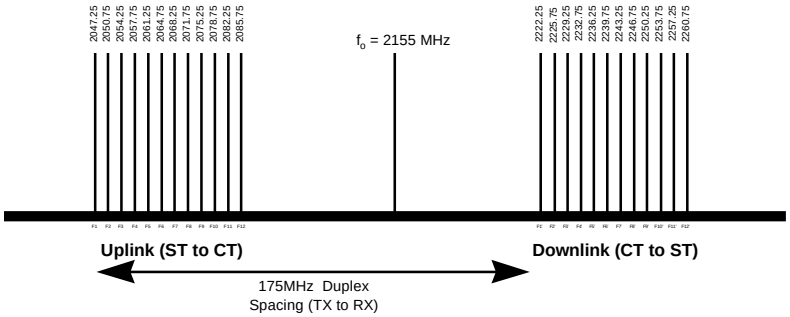
- **Follows FCC Spectrum Allocations for US PCS Band**
  - 1.5 MHz channelisation, with 80 MHz Duplex spacing
- RF carriers occupy 3.0MHz, adjacent channel spacing is subject to cell configuration
- Use of channels 3 & 4 requires contiguous F and C block spectrum.
- In some countries the use of this band may conflict with other allocations, I.e. GSM-1800, DECT & PHS.

2.0-2.3GHz Channel Plan 1



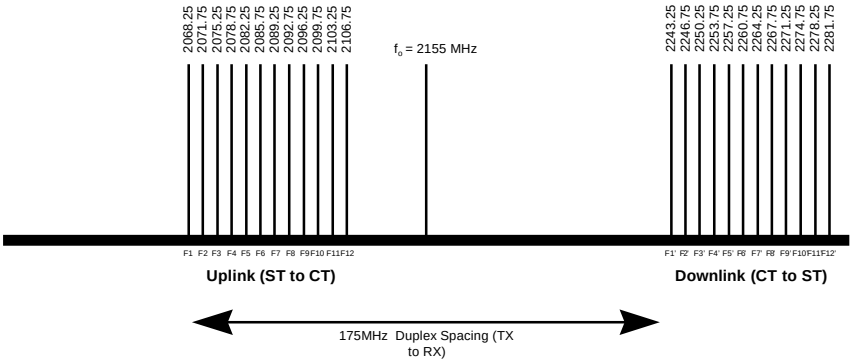
- **CEPT / ERC / Rec. 13-01E, Annex C**
  - 3.5 MHz channelisation, 175 MHz Duplex spacing
  - 'C1' Plan implements bottom 12 of 23 RF channels

2.0-2.3GHz Channel Plan 2



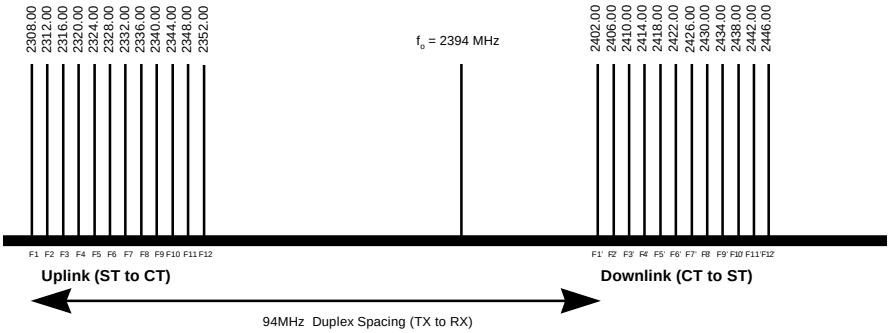
- **CEPT / ERC / Rec. 13-01E, Annex C**
  - 3.5 MHz channelisation, 175 MHz Duplex spacing
  - 'C2' Plan implements middle 12 of 23 RF channels

2.0-2.3GHz Channel Plan 3



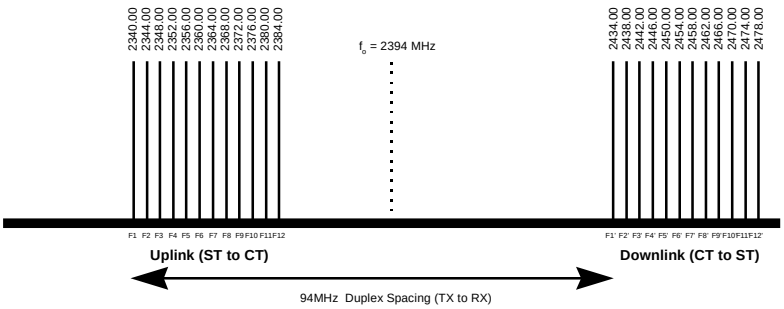
- **CEPT / ERC / Rec. 13-01E, Annex C**
  - 3.5 MHz channelisation, 175 MHz Duplex spacing
  - 'C3' Plan implements top 12 of 23 RF channels

2.3-2.5GHz Channel Plan: 1



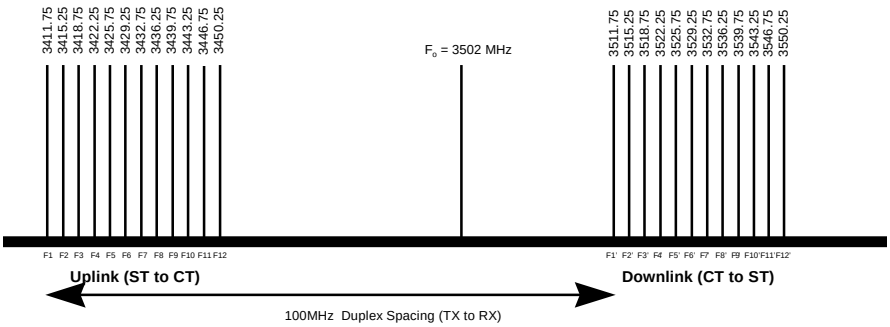
- **ITU-R Rec. 746**
  - 4.0 MHz channelisation, 94 MHz Duplex spacing
  - 'S1' Plan implements bottom 12 of 20 RF channels.

2.3-2.5GHz Channel Plan: 3



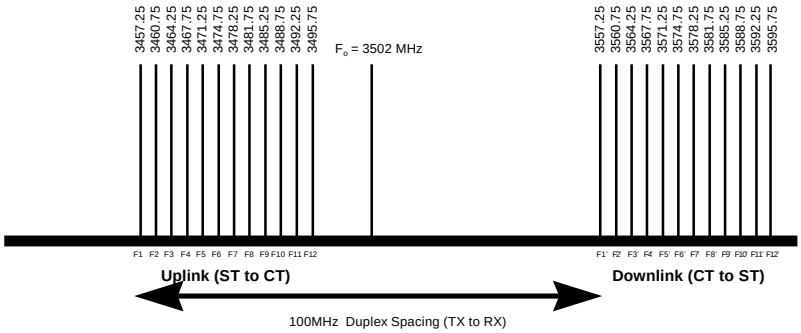
- **ITU-R Rec. 746**
  - 4.0 MHz channelisation, 94 MHz Duplex spacing
  - 'S3' Plan implements top 12 of 20 RF channels.

3.4-3.6GHz Channel Plan 1



- **CEPT / ERC / Rec. 14-03E (Turku 1996)**
  - 3.5 MHz channelisation, with 100 MHz Duplex spacing
  - 'X1' Plan implements bottom 12 of 25 RF channels.

3.4-3.6GHz Channel Plan 3



- **CEPT / ERC / Rec. 14-03E (Turku 1996)**
  - 3.5 MHz channelisation, with 100 MHz Duplex spacing
  - 'X3' Plan implements top 12 of 25 RF channels.