AS4000
Wireless Local Loop System

System Overview

605-0000-430
Issue 1.2 7/4/99

This Page Intentionally Blank

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. No part of this manual may be reproduced or used except as authorised by contract or other written permission.

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 AS4000 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.

8. Airspan™ and Sitespan™ are Registered Trademarks of Airspan Communications Corporation.

For additional information on Airspan Systems, please call your ACC Representative, or contact ACC at:

Cambridge House
Oxford Road
Uxbridge
Middlesex
UB8 1UN

Call: (44) 895 4677100

This Page Intentionally Blank

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. Do not allow anything to rest on the power cord and do not locate the product where persons could step or walk on the power cord.

3. 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.

4. No hazardous RF radiation is emitted from the equipment. Measured at the surface of the CRU radium, when transmitting, the maximum total power radiated from the CRU is 0.01% of the UK National Radiological Protection Board basic restriction per kg. of body part.

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

Airspan products do not contain hazardous substances (as defined in UK 'Control of Substances Hazardous to Health Regulations 1989', and the 'Dangerous Substances Regulations 1990'). At the end of any Airspan product's life cycle, the customer should consult with ACC to ensure that the product is disposed of in conformance with the relevant regulatory requirements

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.

NOTE

The Subscriber Terminal equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC Rules.

User Response Form

Mail: Airspan Communications Limited **Fax:** (44) 895 4677182

Cambridge House
Oxford Road
Uxbridge
Middlesex
UB8 1UN

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

The nature of this response is Addition ❑ Deletion ❑ Correction ❑

Please enter details of response below (include precise reference to Section, Page, Paragraph)

Please Complete the following for acknowledgement/response:

Name:	.....	Address	.....
Company	.....		.....
Job Title	.....		.....
Department	.....		.....
Telephone	.....		.....

Thank you for your co-operation and assistance.

This Page Intentionally Blank

ISSUE CONTROL LIST

Title	Issue	Date	Issue Details
Title Page	1.2	April 1999	Band name changes
ICL-001	1.2	April 1999	
IXL-001	1.2	April 1999	
GSI-001	1.2	April 1999	
GSI-002	1.2	April 1999	
GSI-003	1.2	April 1999	
GSI-004	1.2	April 1999	

CHANGE TYPE/DATE	PURPOSE	PAGES AFFECTED
Issue #, Month Year		
1.0 1-7-98	Derived from 152-031-100 for AS4000 product	All
1.1 2/9/98		
1.2 7/4/99	Changes to Band Descriptions	Various

INDEX TASK LIST

List of Figures

Related Documentation

605-0000-431	System Operations and Maintenance Manual
605-0000-432	Central Terminal - Installation & Commissioning
605-0000-433	Central Terminal – Antenna Feeder Installation & Commissioning
605-0000-436	Subscriber Terminal - Installation & Commissioning
605-0000-437	D128 Terminal Converter
605-0000-435	Material Return and Repair
605-0000-427	AS8100 Sitespan
605-0000-428	Level Control Unit

Glossary

Abbreviations

AC	Alternating Current
AGC	Automatic Gain Control
AIS	Alarm Indication Signal
BER	Bit Error Rate
BRA	Basic Rate Access
CAS	Channel Associated Signalling
CCS	Common Channel Signalling
CDMA	Code Division Multiple Access
CRU	Customer Radio Unit
DASS2	Digital Access Switching System No 2
EM	AS8300 Element Manager
FDMA	Frequency Division Multiple Access
FRU	Field Replaceable Unit
GUI	Graphical User Interface
GSM	Global System for Mobile Communications
HCI	Human Computer Interface
ISDN	Integrated Services Digital Network
ISO	International Standards Organisation
LE	Local Exchange (of the host PSTN)
LNA	Low Noise Amplifier
MCI	Malicious Call Indication
MF	Multi-frequency
N/A	Not Applicable
NTE	Network Terminating Equipment (ISDN).
NTU	Network Termination Unit
O & M	Operations and Maintenance
PA	Power Amplifier
PAD	Packet Assembler Disassembler
PCB	Printed Circuit Board
PCM	Pulse Code Modulation
PN	Pseudo-random Noise
POTS	Plain Old Telephony Service (analogue)
PPS	Pulses Per Second (LD dialling)
PSDN	Packet Switched Data Network
PSTN	Public Switched Telephone Network

PSU	Power Supply Unit
RF	Radio Frequency
REN	Ringer Equivalence Number
Rx	Receive
SC	Shelf Controller
SPM	Subscriber Pulse Metering
SS	Spread Spectrum
SVC	Switched Virtual Circuit
TE1/2	Terminating Equipment (ISDN)
TU	Tributary Unit
Tx	Transmit
VF	Voice Frequency

Terms

AS4000	Trade name for ACC Wireless Fixed Access System.
Assembly	A conglomeration of sub-assemblies.
A Subscriber	The customer who initiates the telephone call.
Board	An electronic module based on a PCB.
B Subscriber	The customer who receives the telephone call.
Card	An electronic module that fits in a shelf.
dBm	Decibels relative to 1 milli-watt.
dBr	Decibels relative to the network PCM level.
Downlink	The communication channel from the Central Terminal (CT) to the Subscriber Terminal (ST).
kPa	Kilo Pascals.
Local Loop	The local loop is the connection between the subscriber CPE equipment and the network. It is termed “local loop” because wired POT services are provided when the CPE equipment “loops”, ie connects, the 2 wires of the copper pair from the network together.
Line Generator	The circuitry that drives the VF line for use by the CPE.
Module	A hardware or software building block of a system or sub-system.
Normal Line Feed	This is a state in which the VF line generator circuitry provides the "normal" operational power feed to the line, as appropriate for CPE in "Off-hook" or "On-hook" states.
Off-hook	The VF line is looped by the CPE (call).
Operational Life	The period over which the system is designed to remain operational under normal operating conditions.
On-hook	The VF line is open circuit at CPE (no call).
Rack	Frame for holding multiple electronic shelves, stacked vertically.
Shelf	Frame for holding multiple electronic cards, stacked horizontally.

Sitespan	AS8100 Network management system for a range of ACC products.
System	A conglomeration of sub-systems that together provide a service.
Subscriber	Customer
Sub-assembly	An electronic board or card that requires assembly to manufacture.
Sub-system	A conglomeration of modules that together form a major functional block of a system.
Uplink	The communications channel from the ST to the Central Terminal (CT).
Unit	A uniquely identifiable physical module.
2 MBit/s	2.048 Million bits per second network interface. 1 per ITU-T G703/G704.

This Page Intentionally Blank

INTRODUCTION

1 Purpose of Document

The purpose of this document is to familiarise the reader with the features of of the AS4000 Fixed 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.

3 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, one or two analogue telephony circuits, two 64 kbit/s Data Circuits or ISDN basic rate access.

The telephony (V2) system supports DASS2 and CAS 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 (D128) 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

- The AS4000 System consists of 3 major physical blocks (See Figure 1): Subscriber Terminals (ST)., which are located at the customer's premises up to 60 STs per system; the Central Terminal (CT); and AS8100 Sitespan or the AS8300 Element manager

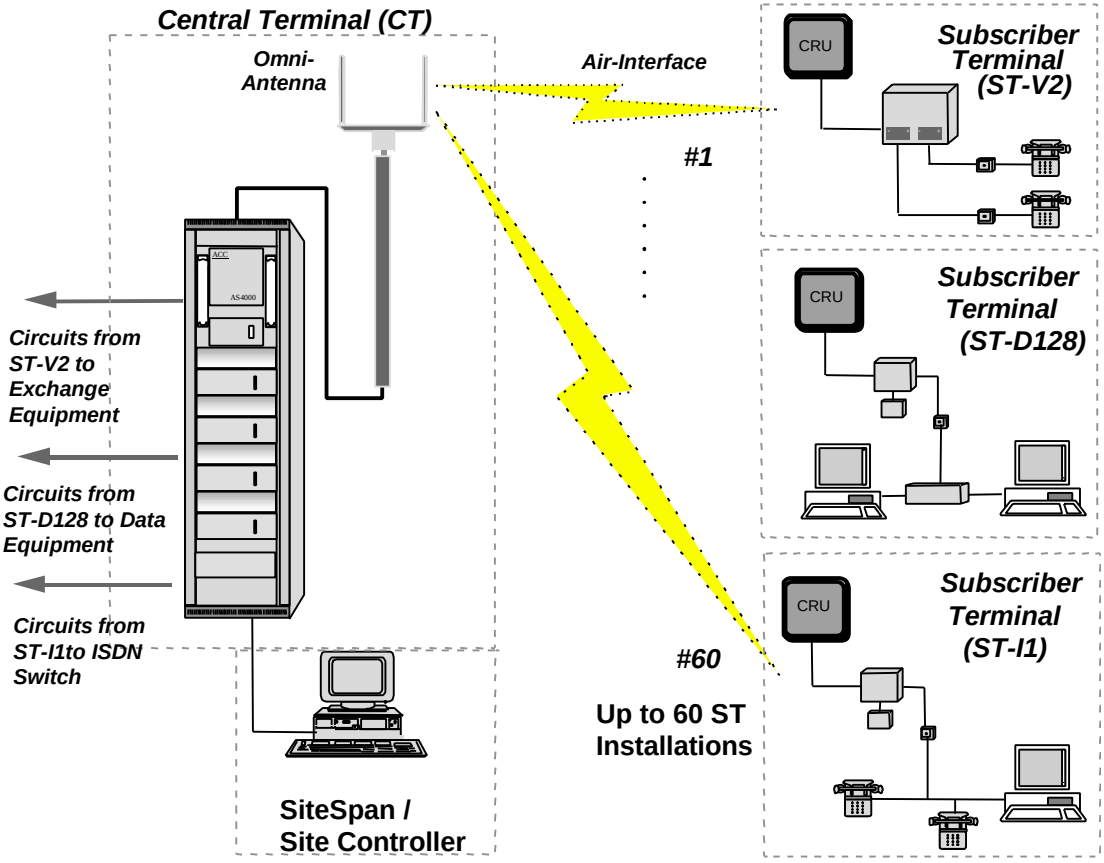


Figure 1. AS4000 System

The CT and ST terminate each end of the radio link and convert them to the appropriate communication interface. In the case of the CT, this is the interface to the network operators equipment. In the case of the ST, this is the service interface to the Customer Premises Equipment (CPE). The AS8100 Sitespan provides an interface for the network operator to control and manage the system's operation and configuration.

4 VF system

The ST-V2 (Figure 2) can be used for:

- Plain Old Telephone System (POTS). Each CRU provides two VF lines that can be used as a direct replacement for those in a copper loop. All the facilities afforded to telephony over copper lines can be offered over AS4000. These include features such Malicious Call Indication (MCI) and Calling Line Identification (CLI). Answering Machines and other devices can be attached up to Ringing Equivalent Number 4 (REN 4).
- Payphones. The AS4000 ST-V2 may be used for payphones and supports the use of 12 &16 kHz tones for operation of the mechanism.
- Modems can be connected for remote terminal access to the Internet and remote access to host computers. All speeds up to 28.8 kbit/s (V34) can be supported.
- Fax. International Telecommunications Union (ITU) Group 3 Fax working is supported.

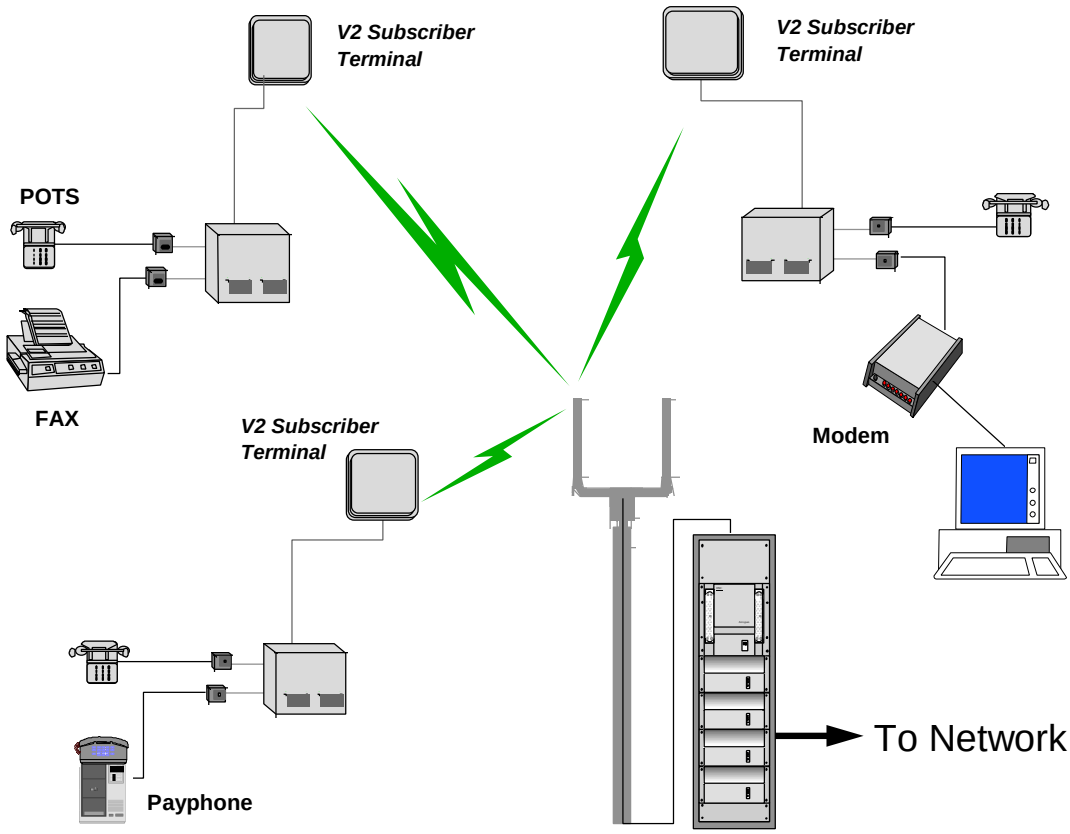


Figure 2. ST-V2 Applications

5 Data

The ST-D128 is designed to provide dedicated leased data circuits for equipment which may include:

- Local Area Network (LAN) bridges/routers
- Direct connect to computers and mainframe front end processors.

- Mixed rate voice (compressed), data and video equipment
- Global System for Mobile Communications (GSM) base stations in microcells

These applications require the use of dedicated fixed links, with 64 kbit/s data rates, and bit error rates (RBER=$1x10^{-7}$ or better).

5.1 Applications of the ST-D128

The equipment to be connected to the ST-D128 is CPE equipment designed to support the private or virtual private networks of business customers. The CPE equipment supports a variety of data, voice and image applications where traditional analogue or low speed (<9,600 kbit/s) digital services are inadequate. Additionally, there are a number of specialised applications, such as the support of microcell base stations, that can be served by the ST-D128.

5.2 Using Interface Converters

Products that are not designed for using the E1 interface can be connected to the system using an interface converter that provides either 2 x 64 kbit/s X.21 or V.35 interfaces. The host can also be interfaced using an interface connector if needed. The Converter plugs into the Network Terminating and Test Point (NTTP) equipped with a RJ45 Socket.

5.3 Statistical Multiplexer (StatMux) Applications

The D128 using a statmux can support asynchronous communications from a remote site to a host site This allows for a number of remote terminals/PCs to simultaneously access a Host Computer.

5.4 Multiplexer Networks

The D128 can support multiple network platforms using Time Division Multiplexers (TDM) to cater for compressed voice and video and synchronous communications.

5.5 Local Area Networks

The D128 can be used to connect bridges and routers together in a LAN (Figure 3).

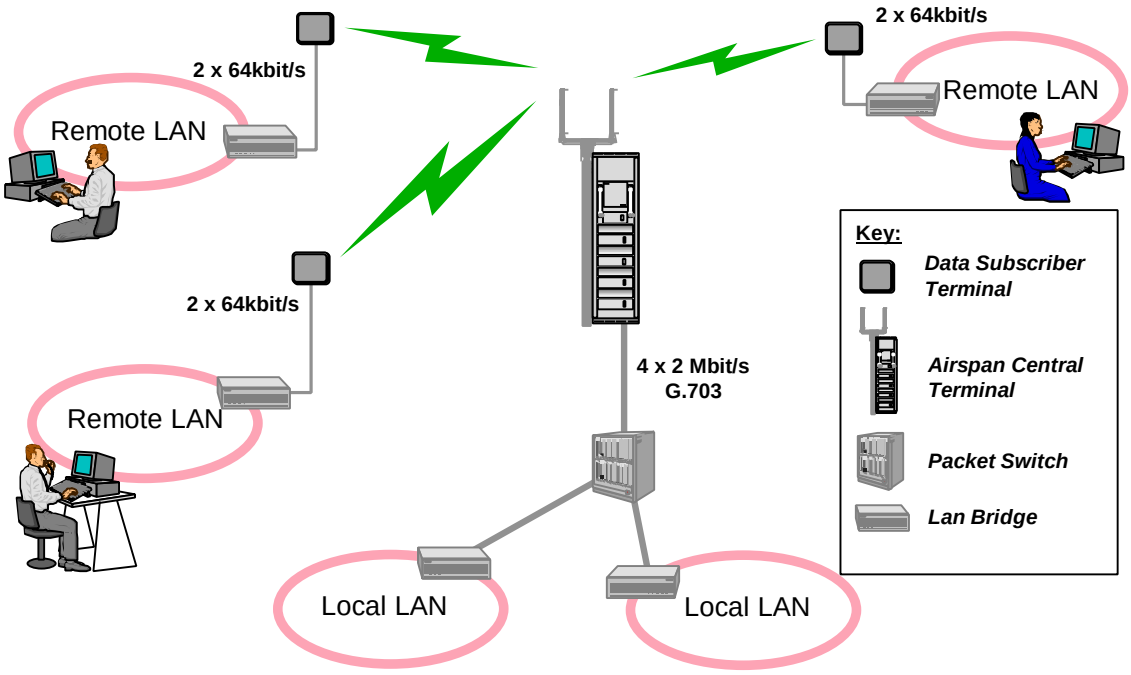


Figure 3. AS4000 using ST-D128 for remote LAN Bridging

5.6 The Micro-Cellular Application

Most "Microcellular" applications (GSM 900 and DSC 1800, and PCS 1900) require one or two GSM transceivers for efficient use of the cellular spectrum. This means that the requirement is for 2-6 x 64 kbit/s. The ST-D128 provides 2 x 64 kbit/s. Higher bit rates can be provided by using multiple ST-D128s and a mux to increase the bandwidth.

6 ST-I1 ISDN

ISDN provides digital links into telephone network so that voice, data, text, graphics, music, video, and other source material can be provided to end users from a single end-user terminal. ISDN applications include high-speed image applications (such as Group IV facsimile), additional telephone lines in homes to serve the telecommuting industry, high-speed file transfer, and video conferencing and voice.

The AS4000 ST-I1 ISDN system provides ISDN's Basic Rate Access (BRA) service offers two B channels and one D channel (2B+D). BRA B-channel service operates at 64 kbit/s and is meant to carry user data; BRA D-channel service operates at 16 kbit/s and is meant to carry control and signalling information, although it can support user data transmission under certain circumstances.

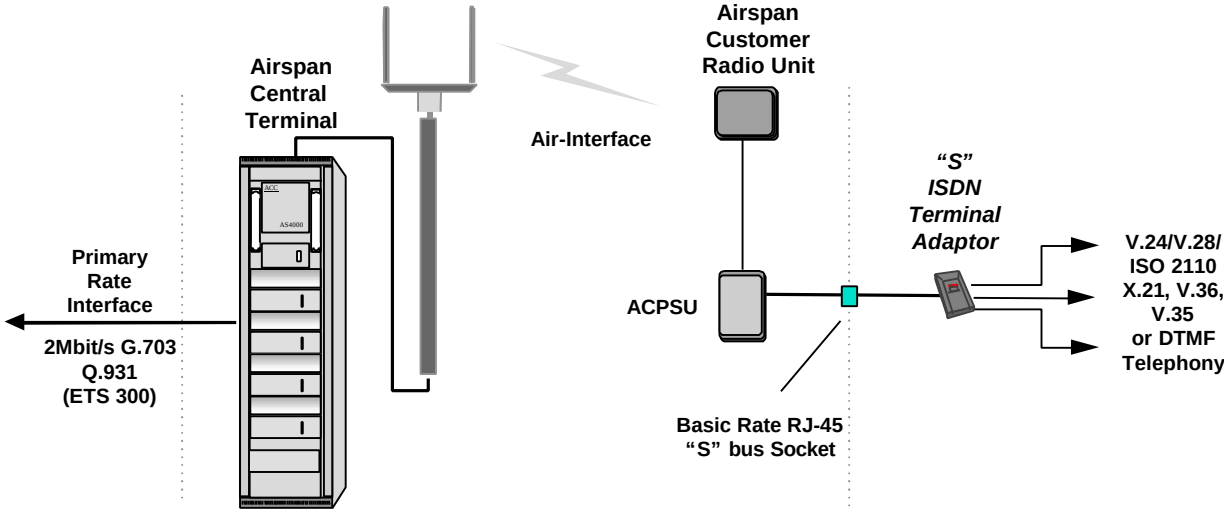


Figure 4. AS4000 ISDN

6.1 ISDN Terminals

ISDN terminals come in two types. Specialised ISDN terminals are referred to as terminal equipment type 1 (TE1). Non-ISDN terminals such as DTE that predate the ISDN standards are referred to as terminal equipment type 2 (TE2). TE1s connect to the Subscriber Terminal network through a four-wire, twisted-pair RJ45 interface. TE2s connect to the ISDN network through a terminal adapter which in turn connects to the RJ45. The ISDN TA can either be a stand-alone device or a board inside the TE2. If the TE2 is implemented as a stand-alone device, it connects to the TA via a standard physical-layer interface (for example, RS232C, V.24, or V.35). Up to eight ISDN user devices can be physically attached to one circuit at the 'S' interface.

The Subscriber Terminal acts as an NT1 network termination to connect the terminal equipment into the ISDN Network.

Reference points define logical interfaces between functional groupings such as TAs and NT1s. The S (the reference point is between user terminals and the AS4000 Subscriber Terminal), and V (the reference point between the AS4000 CT and the line-termination equipment in the carrier network).

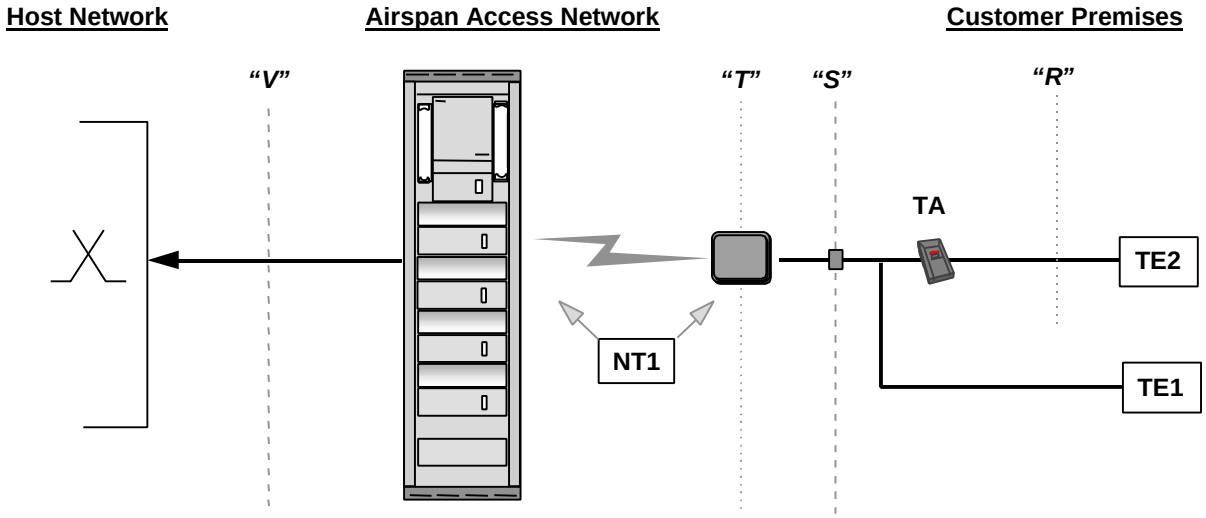


Figure 5. ISDN Reference Points

7 Central Terminal (CT)

The AS4000 CT consists of both an equipment rack and an antenna and feeder system. This equipment is normally located at the Radio Site with transmission backhaul to the Central Office premises. (see Figure 6).

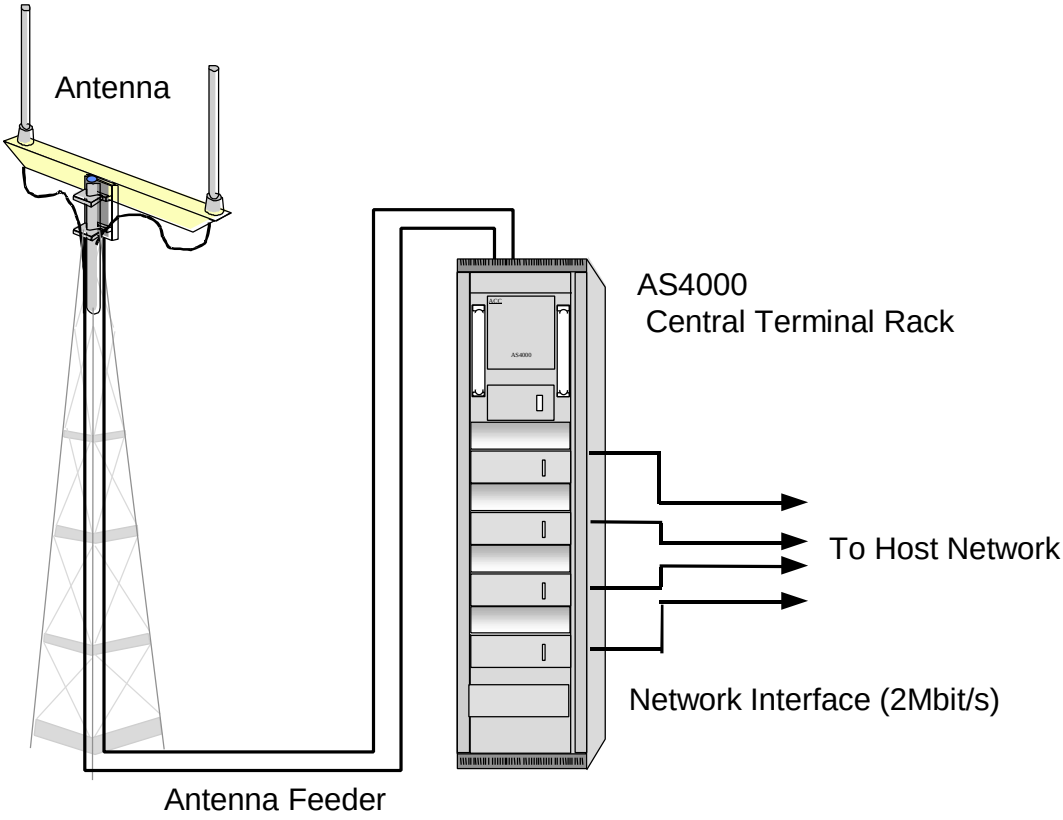


Figure 6. Central Terminal

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

The AS4000 Central Terminal Rack is a 2.2m high ETSI practice equipment rack which contains multiple shelf assemblies. These house the equipment necessary to support up to 60 customer radio links and from one to four 2 Mbit/s links to the Local Exchange (LE).

8 Subscriber Terminals (ST)

The ST is apparatus that is installed in the customer's premises. This unit terminates the radio link and provides the CPE interface. There are a number of options for ST apparatus.

8.1 Subscriber Terminal V2 (ST-V2)

The ST-V2 provides two voice grade Voice Frequency (VF) circuits, suitable for Telephony, Fax, and Data Modem CPE. This unit is partitioned into 3 distinct physical modules known as the Customer Radio Unit (CRU), the Network Terminating Unit (NTU) and the AC Power Supply Unit (ACPSU). Four types of AC power supply units are available:

- Type 1 is an AC/DC converter and a Junction Box,
- Type 2 contains provision for a battery backup supply if the main AC supply fails and the capability of providing status information to Sitespan.
- Type 4 contains provision for a battery backup supply if the main AC supply fails and the capability of providing status information to Sitespan.
- Type 4A is an AC DC converter with facilities to terminate the drop cable and NTUs. Battery back-up is not supported.

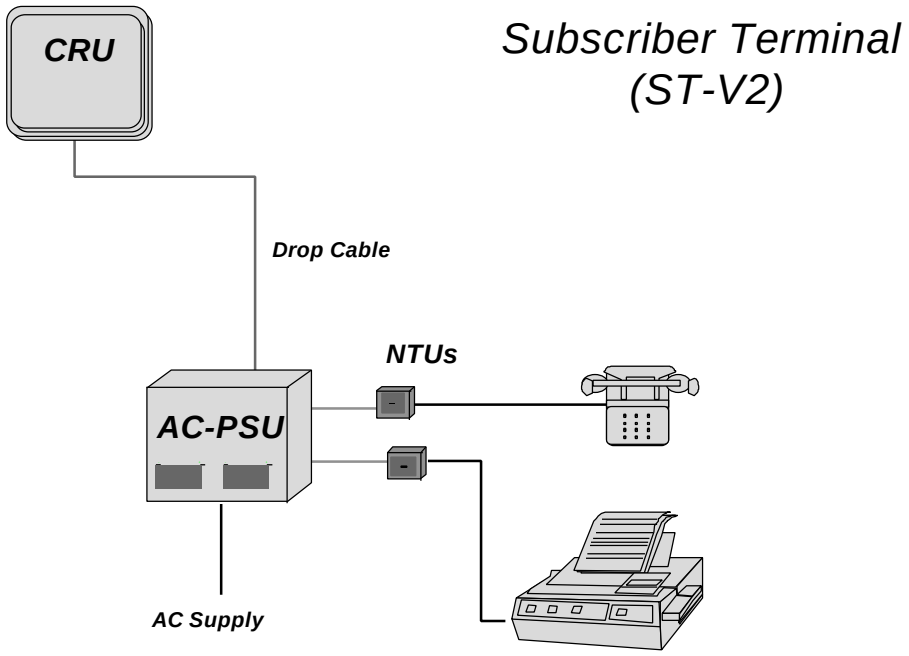


Figure 7. Subscriber Terminal V2

8.2 Subscriber Terminal D128 (ST-D128)

8.2.1 The Subscriber Interface

The ST-D128 (Figure 8) provides fixed link access in support of CPE and special applications that can utilise fractional E1, N x 64 kbit/s services. The ST-D128 supports two 64 kbit/s time-slots on a 2 Mbit/s G.703 interface with TS0 alarm and synchronisation support. TS16 signalling support is not required.

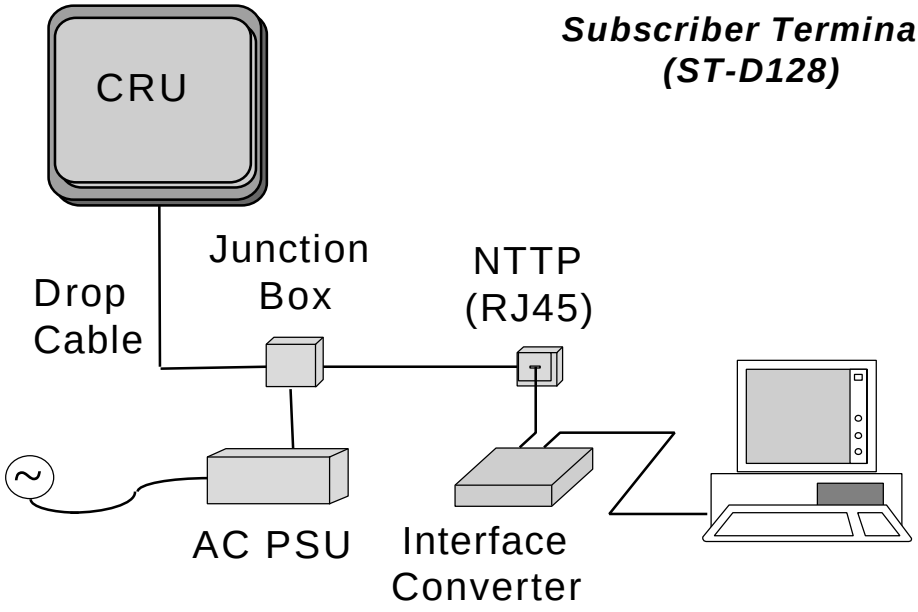


Figure 8. Subscriber Terminal D128

8.3 Subscriber Terminal ISDN (ST- I1)

8.3.1 The Subscriber Interface

The Subscriber interface is an "S" Basic Rate Interface (2B+D) at the customer premises, i.e. NT1 functionality. This interface is according to ITU-T (CCITT) I.420/421 {ETS 300 012, 300 125 and 300 102-1}, and provides a short passive bus connection at the Subscriber Terminal. This passive bus supports up to eight I420 'S' interface compatible devices. See Figure 9

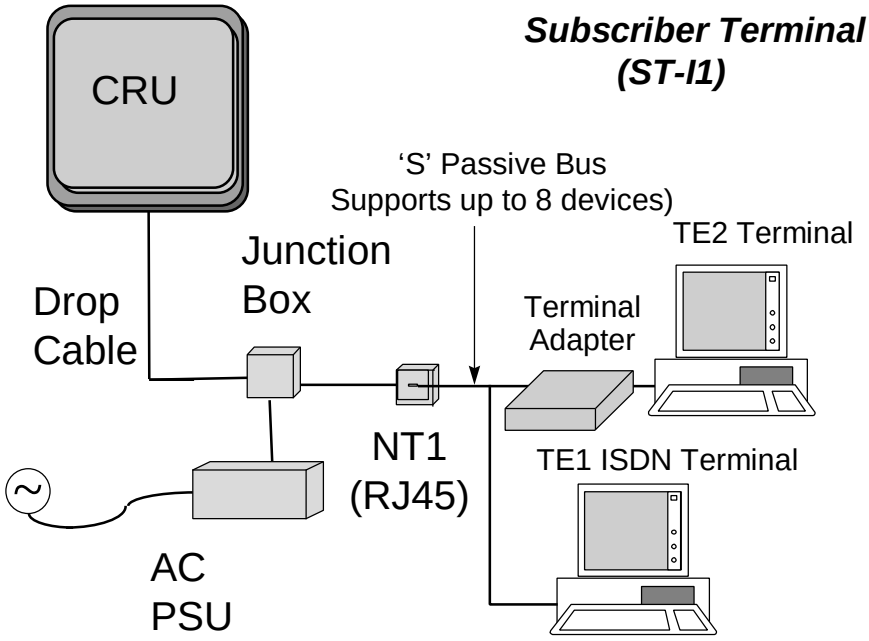


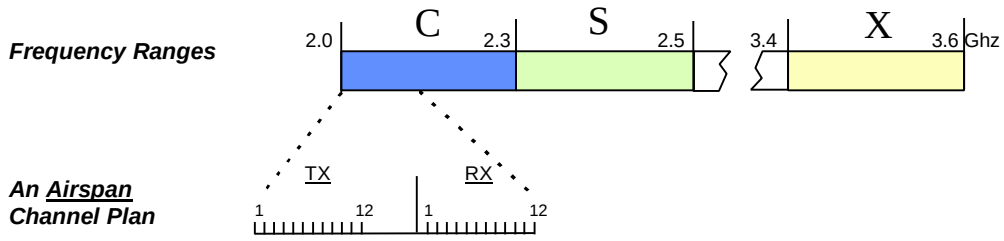
Figure 9. Subscriber Terminal ST-I1

8.4 Frequency Planning

Figure 10 shows the current AS4000 frequency plans.

The deployment of AS4000 will depend upon the requirements for coverage. When deployed over a wide area Central Terminals will be deployed using a reuse pattern of three. This means that all twelve channels required for a wide area deployment as shown in Figure 11 below will be used in three adjacent cells.

The use of a three cell pattern is shown in Figure 11. The 12 frequency channels allocated from the frequency spectrum shown in Figure 10 are distributed over a cluster of three cells in the most efficient way to ensure minimum interference.



– C Band 2.0 - 2.3 GHz

Channel Spacing 3.5 Mhz Duplex Spacing 175Mhz

C1 2028Mhz to 2245Mhz

C2 2045.5Mhz to 2262.5Mhz

C3 2066.5Mhz to 2283.5Mhz

– S Band 2.3 - 2.5 GHz

Channel Spacing 4.0 Mhz Duplex Spacing 94Mhz

S1 2306 Mhz to 2448 Mhz

S3 2338 Mhz to 2480 Mhz

–X Band 3.4 - 3.6 GHz

Channel Spacing 3.5 Mhz Duplex Spacing 100Mhz

X1 Uplink 3411.75 Mhz to 3450.25 Mhz Downlink 3511.75 Mhz to 3550.25Mhz

X2 Uplink 3432.75 Mhz to 3471.25 Mhz Downlink 3532.75 Mhz to 3571.25Mhz

X2 Uplink 3457.25 Mhz to 3495.75 Mhz Downlink 3557.25 Mhz to 3595.75 Mhz

Figure 10. Frequency Plans.

9 Code Division Multiple Access (CDMA) Overview

The design of the AS4000 Wireless Fixed Access System (WFAS)equipment incorporates a number of the latest radio transmission techniques, in addition to the use of digital line-transmission and inter-node signalling techniques.

Included in the design of the AS4000 WFAS equipment are:

- Spread Spectrum (SS), of the Direct Sequence (DS) type
- Code Division Multiple Access (CDMA)

A brief outline of the principles involved now follows:

9.1 Spread Spectrum

To obtain reliable transmission in noisy radio environments, the transmitted signal is ‘spread’ over a frequency range that is in excess of the minimum bandwidth that would otherwise be needed. Direct sequence spread spectrum is used in which the message to be sent is modulated directly with a pseudo-random spreading code. Spreading is achieved by

using a code whose bit rate is much higher than the bit rate of the message (typically in the order of 16 times). The individual bits of the code are referred to as *chips*.

The incoming signal at the receiver consists of the modulated message plus the channel noise. By multiplying the same code by the incoming signal, 'despreading' is achieved. This results in the unwanted noise being spread over a bandwidth equal to the noise bandwidth plus that of the code. The use of bandpass filters effectively eliminates the noise and the noise-free message is then extracted.

9.2 Code Division Multiple Access

In the AS4000 System, one radio channel supports 15 radio links (DS/SS transmissions) which co-exist within the same bandwidth. To achieve this, the technique of CDMA is employed which uses a set of orthogonal (RW) codes to modulate individual channels. These RW codes (0 to 14), are combined with the basic spreading pseudo-random noise (PN) codes (1 to 7) to form ordinals to reference a total of 105 spreading codes, each having 256 bits, to modulate the digital traffic channel. The PN code and frequency channel are used at each end of a radio link to allow transmission to occur. The use of these parameters as a network planning tool enables the same radio channel to be re-used in a seven-cell repeat pattern.

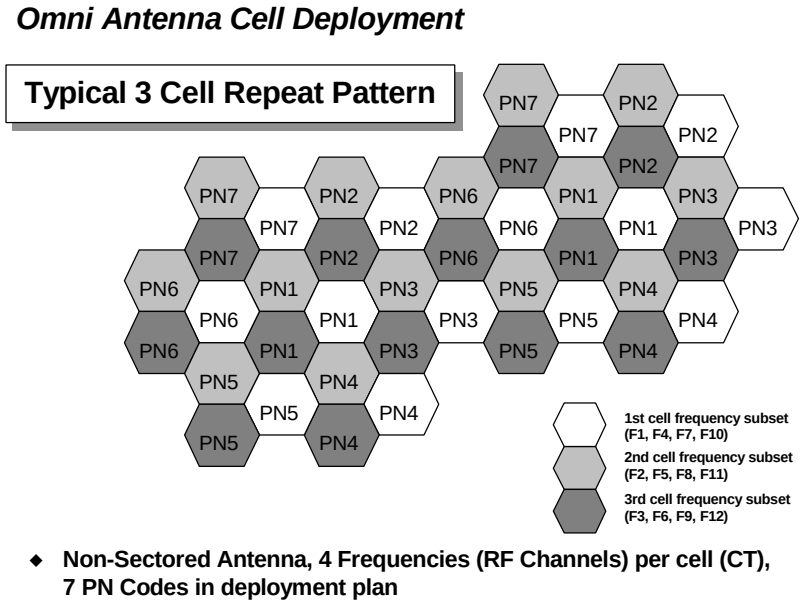


Figure 11. Three Cell Repeat Pattern.

In each of the 3 cells a group of frequencies is allocated as follows:

Group 1 F1, F4, F7, F10

Group 2 F2, F5, F8, F11

Group 3 F3, F6, F9, F12

The 3 cell reuse factor that is used in CDMA systems such as AS4000 cannot be used for other types of Wireless Access systems using TDMA or FDMA systems.

The processing gain of a spread spectrum radio system defines the level of interference that can be tolerated by the received signal. Given a large enough processing gain a signal can be extracted from an environment that has an interference level actually higher than the wanted signal. As the C/I ratio defines the nearest distance at which the same Co Channel carrier can be used, this advantage usually results in a frequency reuse for CDMA system of 3 or less making it suitable for wide area or multi cell deployment.

The relatively low reuse distance involved in CDMA, (less than 4 cells) could, if the basic cell size is small, as both the wanted (nearest) and unwanted (next reuse of frequency) cells could be within the receiver range of the ST lead to the possibility of false acquisition on to a nearby CT,. To avoid this happening AS4000 uses different PN Codes for adjacent cell clusters.

The PN code provides the basic spreading mechanism that is inherent in CDMA systems. The PN codes take their name from the fact that they are basically Pseudo random Noise code sequences of a fixed length. If different PN codes are used between cells using the same frequency then one of the three basic elements has been changed. Therefore, this prevents false acquisition as the next reuse of frequency is seen by the system as noise and cannot be interpreted. PN codes are chosen to have the minimum possible residual dc component when demodulated. A limited number of these codes exist within a PN code of given length and for the purposes of AS4000 a maximum of 7 are used. This extends the distance between cells that are Co channel and same PN to a distance where false acquisition should not be possible.

Allocation of Frequency and PN code will usually form part of the network planning and will not usually be determined by an individual CT configurater.

System Management

There are two systems available for managing the AS4000 System:

AS8100 Sitespan

AS8300 Element Manager

AS8100 Sitespan is a PC-based management and control systems via which the system administrator can test, configure and control most aspects of the AS4000 System. The AS8100 Sitespan controller is designed to manage several sites simultaneously and uses Windows™ based software as a management system.

Typical management and control functions include:

- Configuration, capacity provisioning and assignment of equipment or circuits
- Performing circuit tests and running diagnostics
- Monitoring alarm events and radio performance
- Installation and commissioning of the AS4000 Central terminal

The AS8300 Element Manager (EM) is designed to offer the necessary functionality to manage a large AS4000 sub-network and is located in a central operations and maintenance environment away from the rest of the system. It uses X.25 packet switched data networks to communicate with the Central Terminals (CTs) within the network.

10 Litespan-120 (LS-120) Channel Bank

If the CT is not located within the Central Office/Telephone Exchange and a 2 Mbit/s link is not available, then the Analogue (2 Wire, Twisted Pair) Interface is implemented by using a "Multiplexer" (MUX) or "Channel Bank". This is added to the AS4000 System to convert from the CAS type interface standard to the appropriate analogue interface for the customer in question. (see Figure 12).

The LS-120 channel bank is a small and highly flexible network termination which may be used as the VF interface for the AS4000 Wireless Fixed Access System to provide customer service termination. The LS-120 channel bank equipped with basic channel units is used to connect the AS4000 to the Exchange Switch for POTS services.

The LS120 is capable of providing terminations for a complete AS4000 system for a total of up to 120 customer terminations.

LS120 Interfaces

- 75 ohm connection to the AS4000.
- VF interface to the Exchange switch.

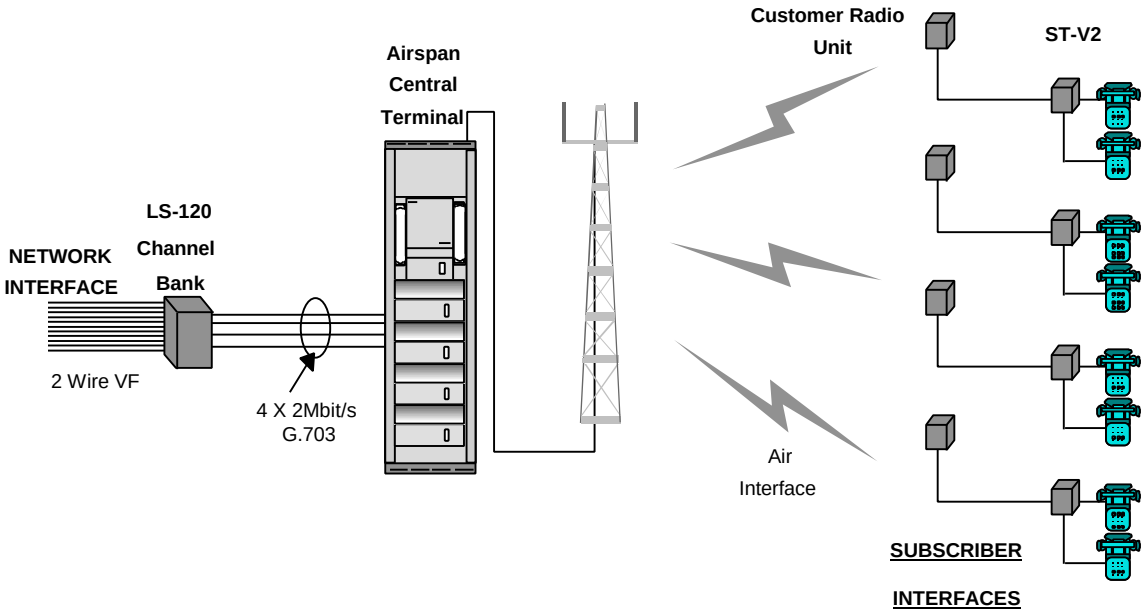


Figure 12. CAS to POTS using LS120.

AS4000 CENTRAL TERMINAL HARDWARE OVERVIEW.

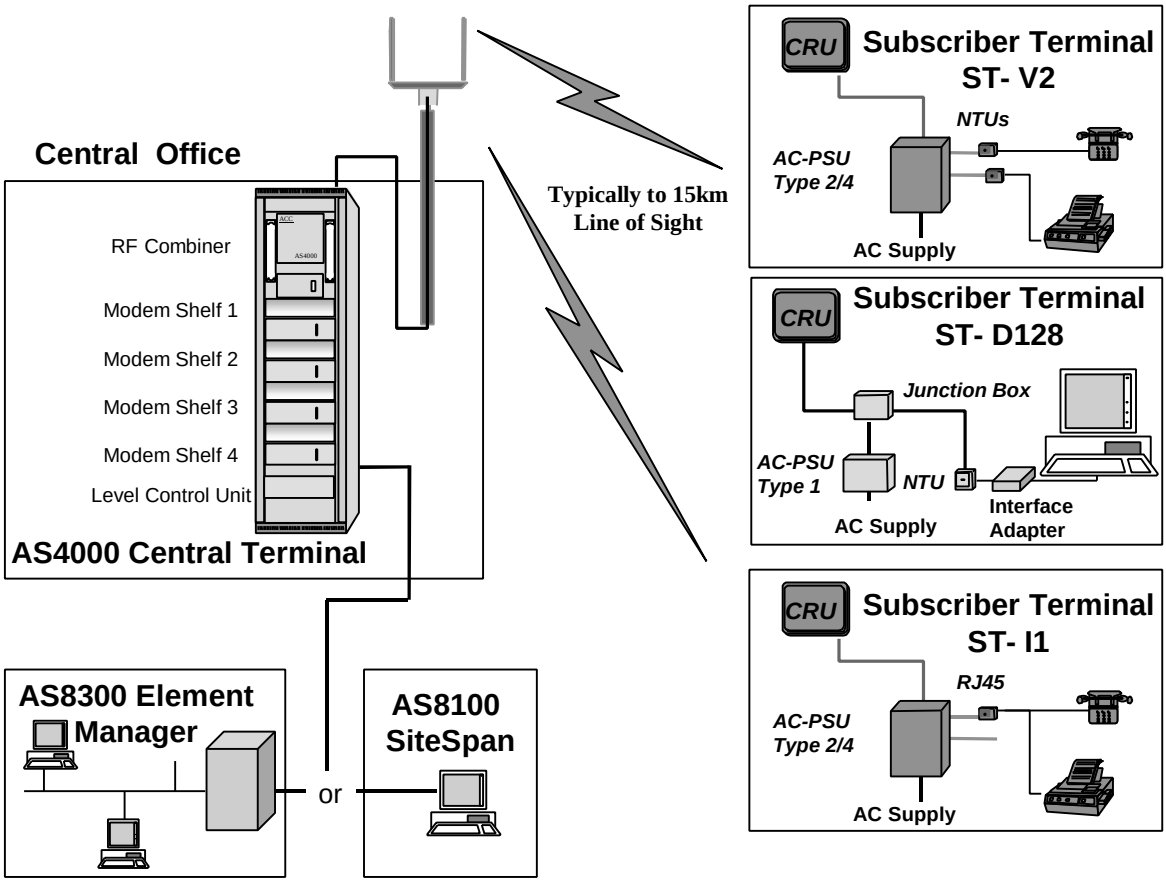


Figure 13. Main Elements of the AS4000 System

The CT is normally located in the Central Office premises (typically a local exchange) and provides access to the network equipment, on one side, and access to the radio paths on the other. A ST is located at the customer's premise where each ST installation supports:

- two, independent analogue connections (for telephones, facsimile, etc.).

or

- One G703 interface providing two 64 kbit/s Channels.
- One ISDN I420 'S' Interface 2B+D.

Each CT is served by a radio link that operates in the 2 GHz to 2.3 GHz range (C1 to C3), the 2.3 GHz to 2.5 GHz range (S1+S3) or the 3.4 to 3.6Ghz range (X1 to X3).

Control of the AS4000 System is vested in a control system, Sitespan, which can be co-located with the CT equipment, or remotely located at a Network Administration Centre.

The standard management interface at the CT equipment is 1 to 4, V.24 (RS232) terminations which is connected to serial ports on a PC (1 port for each Modem Shelf).

1 The Network Interfaces

V2 and D128 Systems

The standard traffic interface at the CT equipment is 1-4, 2 Mbit/s, 30 Channel Pulse Code Modulation (PCM), conforming to ITU Recommendation G703. Between one and four PCM links are required, on the basis of one link per 15 ST installations. The CT supports PCM timeslot 16 Channel Associated Signalling (CAS). The CAS type signalling protocol used is CAS multiframe using ABCD bits. DASS2 signalling protocol is also supported

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.

2 Antenna and Feeder Sub-system

2.1 General Description

The antenna and feeder sub-system consists of a high-gain omni-directional antenna assembly or a directional antenna assembly and low-loss coaxial feeder cables that 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.

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

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 14.

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 15.

2.2 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.

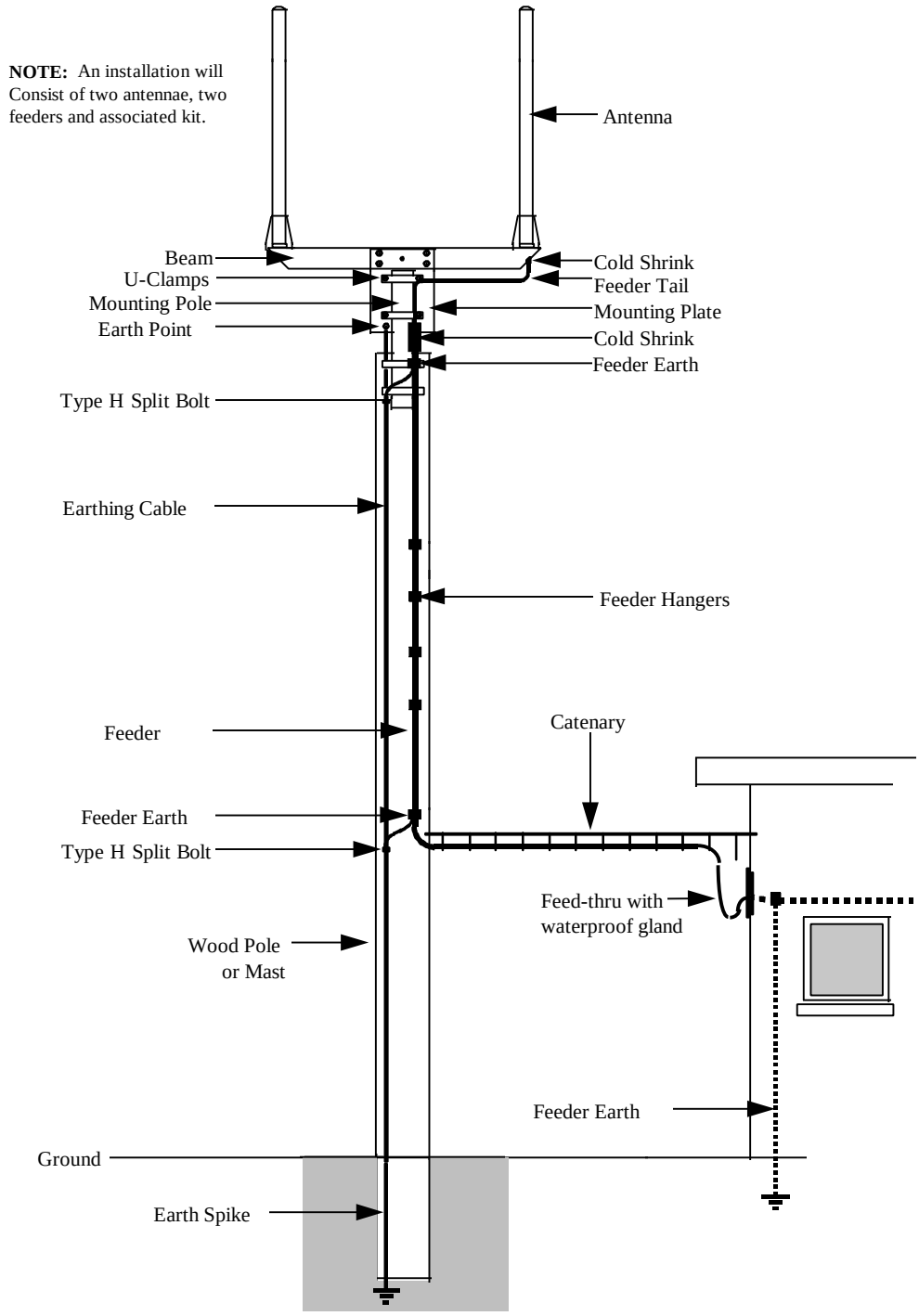


Figure 14. The AS4000 Omni-Directional Antenna System (typical)

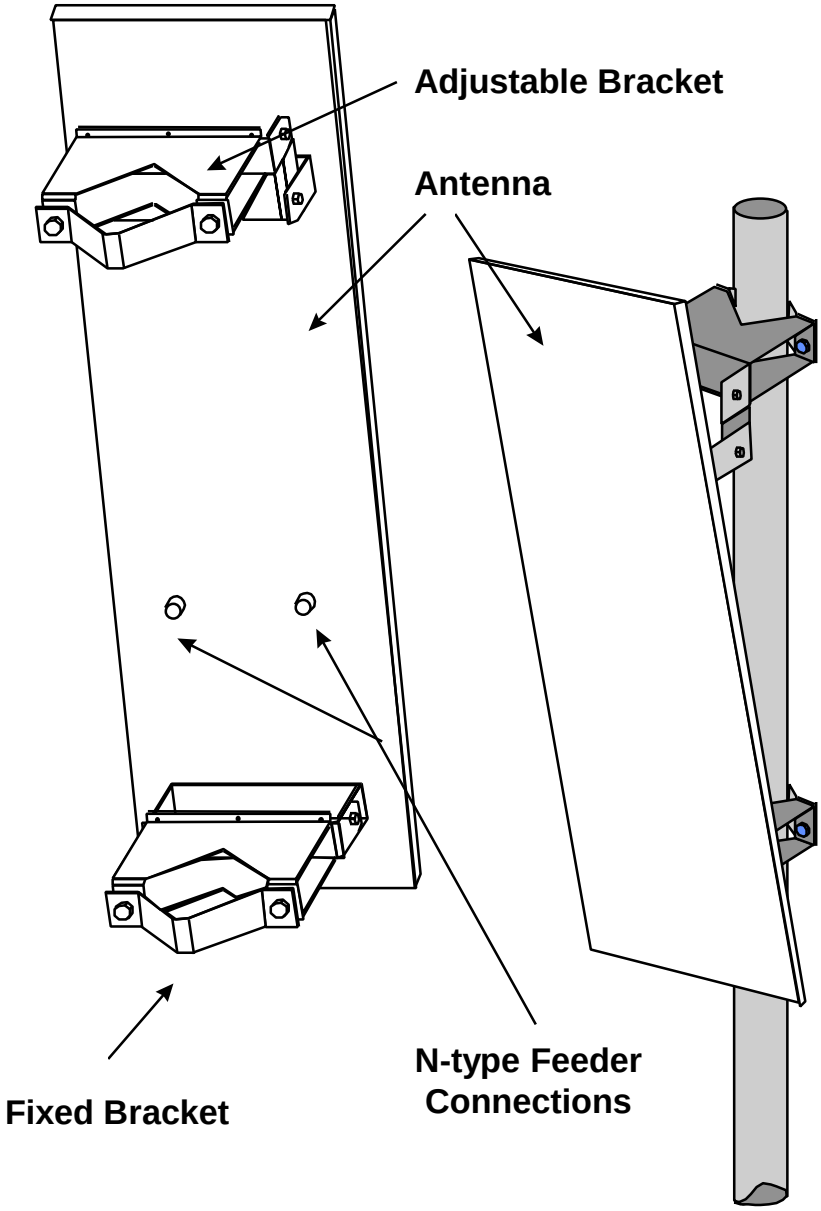


Figure 15. Directional Antenna

3 Central Terminal (CT)

3.1 General Description

The 2.2m high ETSI style AS4000 CT equipment rack is a rack which contains multiple shelf assemblies. These house the equipment necessary to support from one to 60 customer radio links and from one to four 2 Mbit/s CAS or DASS2 links to the Local Exchange (LE). (see Figure 16).

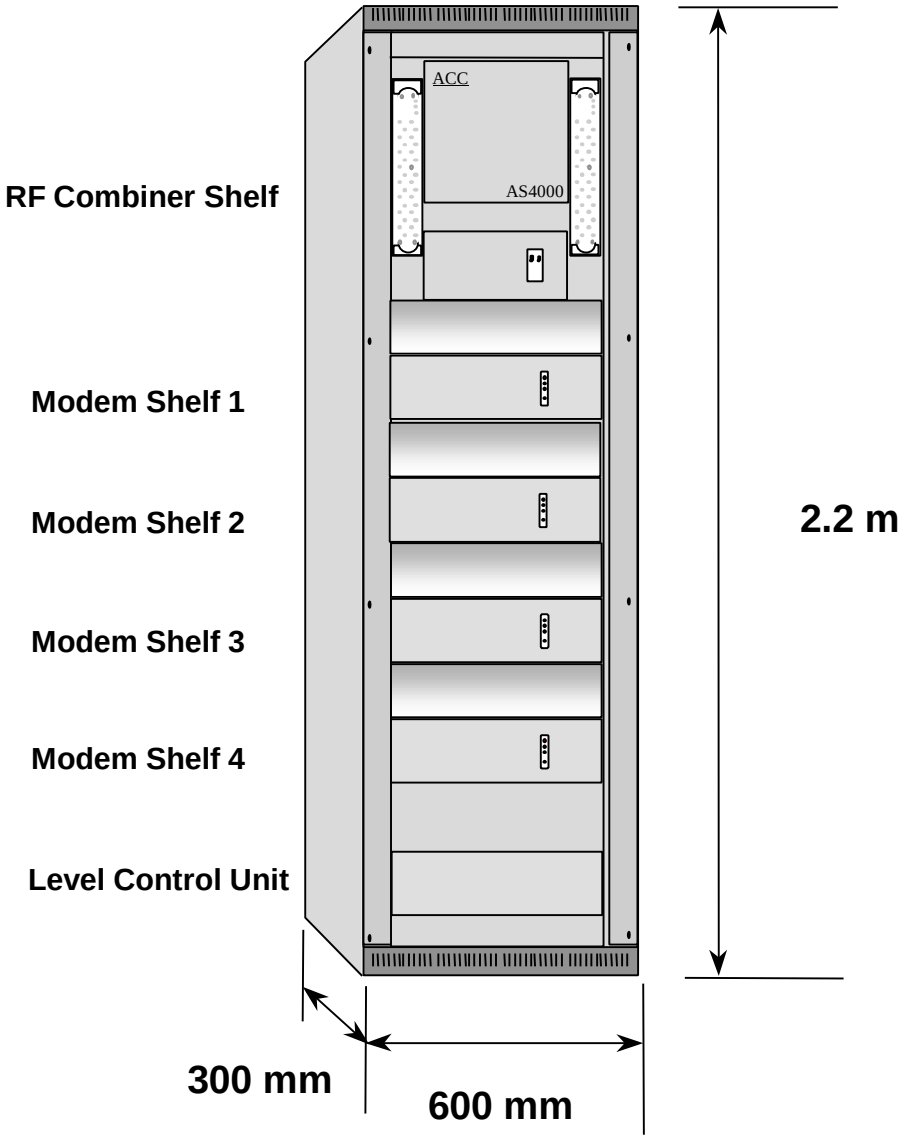


Figure 16. AS4000 CT Equipment Rack

3.2 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 rack is 28 Amps at 22 Volt reducing to 8.5 Amps at 60 Volt.

3.3 CT Equipment Rack Shelves:

Modem Shelves

Each Modem Shelf terminates one RF Channel, supporting up to 15 radio links, provides a CAS or DASS2 network interface with the Local Exchange and a V.24 (RS232) Network Management interface to the Sitespan. Up to four Modem Shelves can be equipped to support 60 radio links and four network management interfaces within a single rack.

Each Modem Shelf has:

- a Tributary Unit (TU) Card, which provides the interface between the Local Exchange equipment and AS4000 Radio System for traffic and signalling information.
- up to eight Modem Cards (each card supports 2 radio links) These 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.
- an Analogue Card, which 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 2 MHz clock signal.
- a Shelf Controller Card, which provides the management interface between the AS4000/ Sitespan /EM and its supported Central Terminals. It also holds the configuration details in NVRAM.
- an LED/Alarm Panel, which provides LEDs that reflect the overall status of the system and an key switch used to acknowledge that a fault condition is receiving attention.

A Modem Shelf can be equipped with up to eight Modem Cards, each card supporting two radio links, (i.e. 16 radio links per shelf of 15 customers). This arrangement results in one spare modem per shelf. The spare modem is held in reserve and, if necessary, can be reconfigured to automatically replace a modem that has a fault. (see Figure 17).

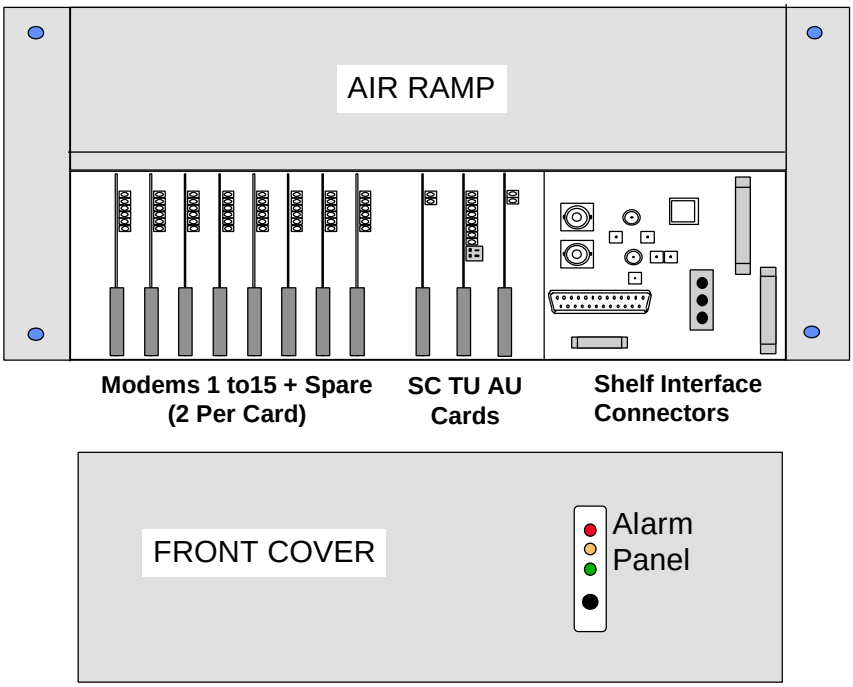


Figure 17. Modem Shelf with front cover removed

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.

A RF Combiner Shelf (see Figure 18) is equipped with:

- four RF Cards, which converts the baseband signal from each modem shelf into a single RF channel in the 2 GHz range (and vice versa). This interfaces to the Antenna/Feeder Sub-system.
- up to two Power Amplifier (PA) modules, each of which caters for 2 RF channels and amplifies the RF channels received from their associated Modem Shelf equipment.
- a Branching Unit (BU) module, which is essentially a passive unit that performs signal Combiner, splitting and filtering.

- a Low Noise Amplifier (LNA) module, which amplifies the low-level receive signal, after filtering but before splitting.
- a Shelf Monitor Card, which collects information from the PAs, LNA and PSUs, and passes it to the Shelf Controller Cards.

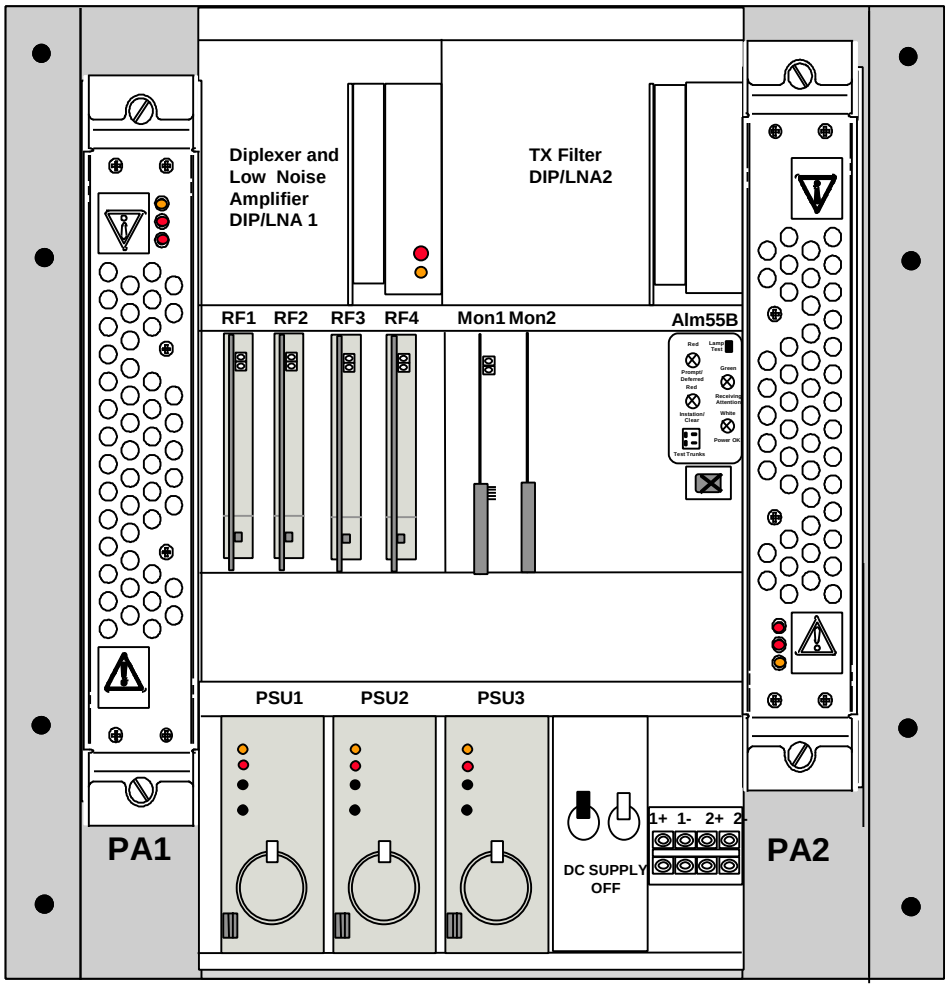


Figure 18. RF Combiner Shelf

- Three 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 which supply a nominal 13.5V DC. The input to the PSU can be in the nominal range of –24 V to –60 V.
- 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).

Level Control Unit

The Level Control Unit manages the performance of the RF combiner shelf and monitors /controls the TX power and RX gain levels.

SUBSCRIBER TERMINAL HARDWARE OVERVIEW

1 General Description

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.

Three types of Subscriber Terminal are available:

- ST-V2 providing 2 telephony circuits
- ST-D128 providing 2 x 64 kbit/s data circuits (G703)
- ST-I1 providing Euro ISDN 2B+d 'S' interface

The main elements, (see Figure 19) comprise:

- Customer Radio Unit (CRU), including a mounting bracket with integral terminal block
- Drop Cable
- Network Termination Unit (NTU) - one or two
- AC Power Supply Unit (AC PSU)

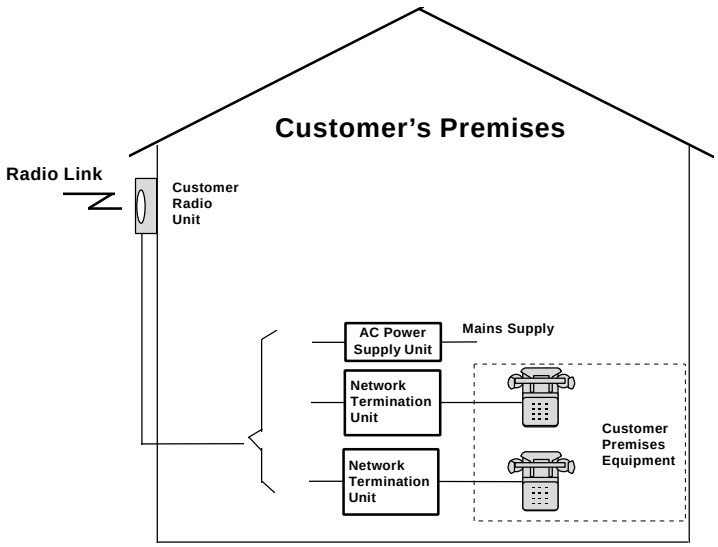


Figure 19. The AS4000 Subscriber Terminal

1.1 Customer Radio Unit

The 2.0 - 2.3GHz Band and 2.3 - 2.5GHz Band CRUs contain two flat-plate integrated antennas and the 2.0 - 2.3GHz Band CRU contains a single flat-plate integrated antenna. They contain most of the electronics circuitry necessary to fulfil the function of terminating the RF communications link to the CT equipment. In addition to carrying traffic, this link carries signalling and management (control) information.

The CRU is a sealed weatherproof unit to tested to IP55 which 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.

1.2 CRU Mounting Bracket

The CRU Mounting Bracket provides adjustment (in the azimuth plane) of the CRU 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.

1.3 Drop Cable

The drop cable connects the PSU/NTUs to the CRU via an environmentally protected connector that is plugged into the backplate of the CRU. It consists of 8 electrical connections:

- 2 wires for DC power for the CRU
- 2 wires for alarm communications between the units
- 2 x 2 wire VF connectors ST-V2 (see Figure 20)

or 2 Mbit/s Tx & Rx connectors ST-D128

or 1 ISDN 2B+D connection STx & SRx .

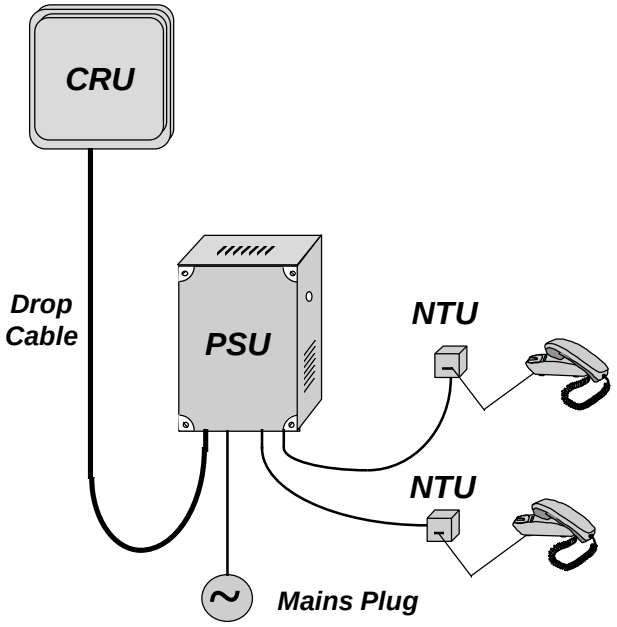


Figure 20. AS4000 ST-V2 Connection

The maximum length of this Drop Cable is 25m. with a 40mm maximum bend radius.

1.4 Network Termination Unit (NTU) when using ST-V2

The two 2-wire VF line feeds connect to the CPE with the one or two NTUs located within the customers premises into which a range of devices can be plugged.

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 NTU

The specific impedance of the NTU allows tests to be performed by the CRU to ascertain whether the NTU is present on a line and if there is any CPE attached.

1.5 Network Termination Unit when using ST-D128

The Single Network Termination Unit can be cabled either from the junction box or cabled direct from the CRU. The 2 Mbit/s Tx and Rx pairs are cabled using twisted pairs. The D128 provides 2 x 64 kbit/s circuits embedded as time slots 1&2 respectively in a 2 Mbit/s G703 interface to the CPE. The Presentation is RJ45 @ 120Ω.

1.6 D128 Interface Converter

The interface converter allows customers whose equipment does not support the E1 presentation to be presented with either 2 x 64 kbit/s X.21 interfaces or 2 x V.35 interfaces.

1.7 Network Termination Unit when using ST-I1

The Subscriber interface is an "S" Basic Rate Interface (2B+D) at the customer premises, and terminates on an RJ45 connector.

1.8 AC Power Supply Unit (Type 1)

The ST equipment is powered from the AC mains supply available at the customer's premises. The Power supply consists of an AC/DC converter, that converts the customers 230/110V (1 Amp) AC mains supply to a 24 Volt DC supply, for the ST-V2/ST-I1 and 30 Volt DC for the D128. It also uses a Junction Box that facilitates the connection of the DC supply to the Drop Cable. The Junction Box also contains test access and connection points to connect NTU's to the Drop Cable.

1.9 AC Power Supply Unit (Type 2/4)

The Type 2 and Type 4 AC PSUs are available for the ST-V2 The AC PSU 230/110V (1 Amp) AC mains supply mains supply is converted to 24 V DC to power the external CRU.

In addition, the AC PSU contains an internal 24 V lead-acid battery which is trickle-charged and which provides a back-up supply for approximately three hours. The battery has an operational life of five years.

The AC PSU generates alarms as follows:

- PSU tamper alarm, in the event the lid is removed
- Mains supply failure
- Low battery voltage alarm
- Failure of the AC PSU

and terminates the following test signals sent from Sitespan to detect:

- A hazardous voltage on VF line
- An earth leakage condition
- Detect the presence of NTU(s) and Customer Equipment
- Dial tone on VF line
- Mains supply failure to the AC PSU

Visual indication of mains failure is by an LED on the side of the unit. Also within the AC PSU are a ‘reset switch ‘an ‘install switch’ (S2) and two LED’s (D8 and D9) which are used during the initial installation of the ST equipment as part of the frequency and code setting procedure. This is describes fully in the ST Installation and Commissioning Procedure 157-036-200.

This Power Supply is available for ST-V2 and ISDN.

This Page Intentionally Blank

SYSTEM MANAGEMENT

There are two systems available for managing the AS4000 System. AS8100 Sitespan and AS8300 Element Manager

1 AS8100 Sitespan

AS8100 Sitespan can manage a range of ACC products (AS4000, Multiline, and Litespan) and is designed to allow the management of these from a central location.

AS8100 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 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 rack 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. Each Central Terminal Equipment Rack Modem Shelf Controller is 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. Rocket Port, 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,

a) Dial-up Modem Link *or*

b) Fixed Link *or*

c) X.25 Packet Switch Network

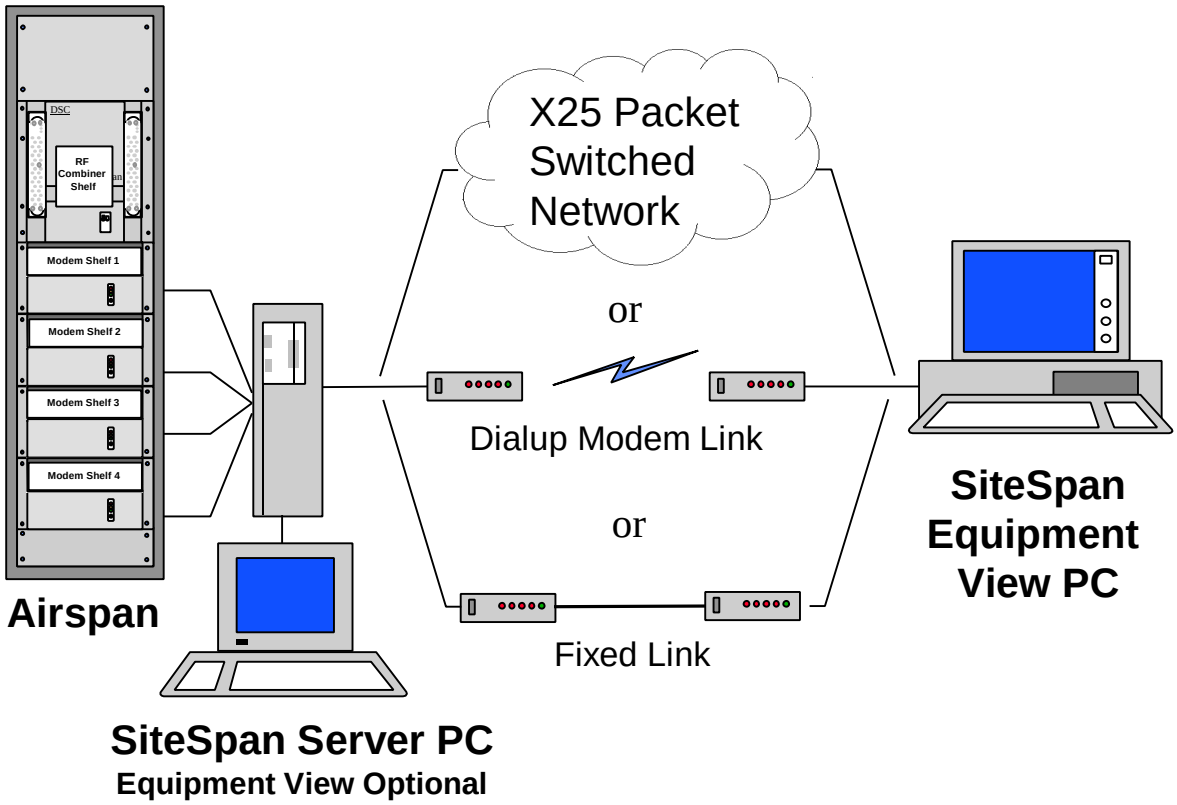


Figure 21. AS8100 Sitespan Network Management

2 AS8300 Element Manger

The AS8300 Element Manager (EM) is an Operations and Management System, a computer based network management system for the AS4000 System that does not use a GUI based screen presentation.

The Element manager can control a number of systems (including the remotely located STs).

The AS8300 EM is designed to offer the necessary functionality to manage a large AS4000 sub-network and be located in a central Operations and Maintenance environment away from the rest of the system. It uses the X.25 packet switched data network to communicate with the Central Terminals (CTs) within the network.

Each Shelf Controller (SC) within an CT communicates via a serial port to an X.25 PAD that serves the four modem shelves in a CT Equipment Rack. (see Figure 22).

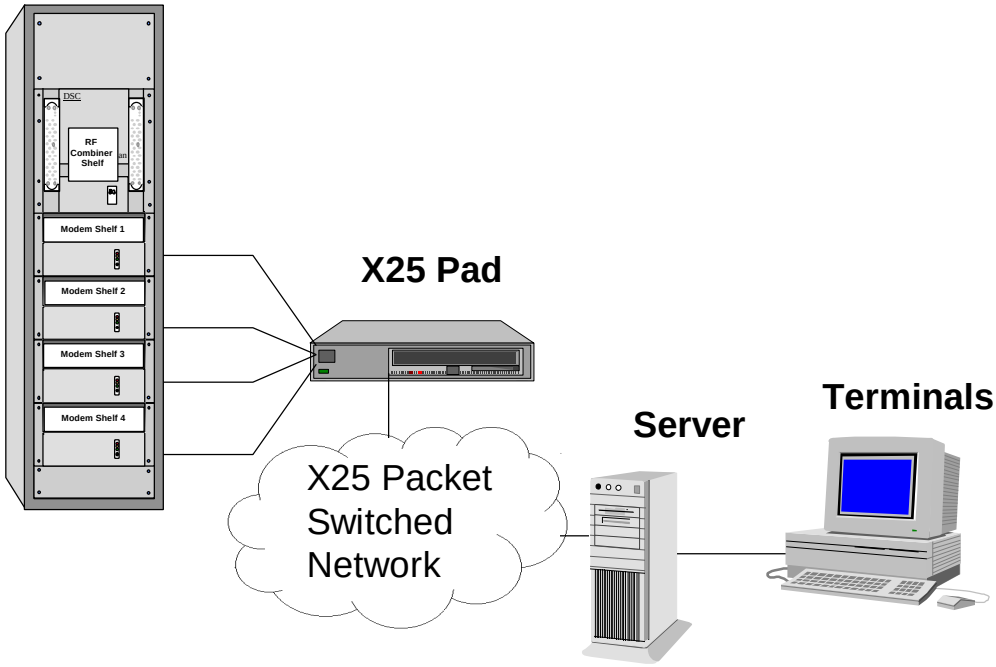


Figure 22. Connection Configuration for a Remote AS8300 Element Manager.

The standard management interface at the CT equipment is 1-4, V.24 (RS232) terminations which is connected to a PAD for transmission over X.25 Network to the Network Administration and Control Centre.

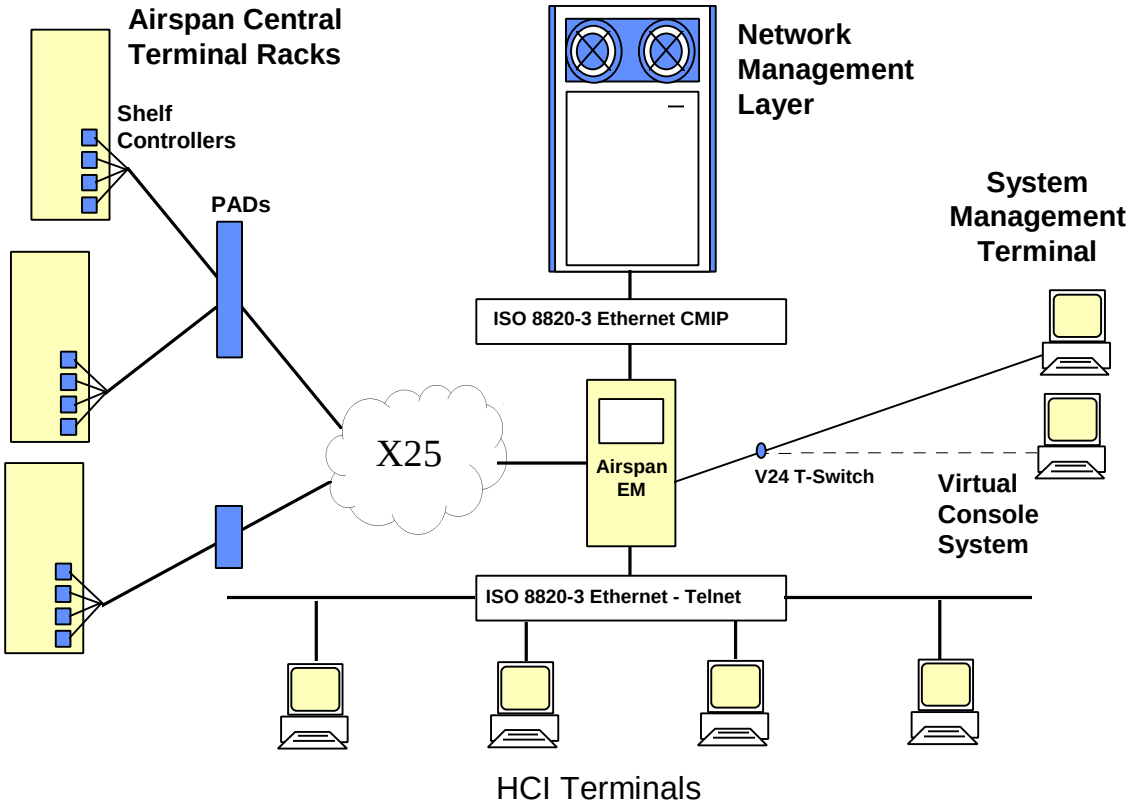


Figure 23. AS8300 EM Physical Connections

Physical Connections

At: the Network Administration and Control Centre.

- AS4000 to HCI - Ethernet (TCP/IP Protocol)
- AS8300 EM to SMT - Similar to ITU-T RS232 (Assent 9600 baud)
- AS8300 EM to Network Management Layer - Ethernet (OSI/CMIP Protocol)
- AS8300 EM to X.25 Network - RS232 Synchronous, 9600 baud)

At each CT Site:

- X.25 Network to X.25 PAD - Network Dependant
- X.25 PAD to each CT Shelf Controller - RS232 (Assent 9600 baud)

2.1.1 EM Interface Specifications

The interfaces to AS8300 EM (see Figure 23) are:

Human Computer Interface (HCI) Terminals.

These are VT220 terminals or emulators, which communicate with the AS8300 EM over an ISO 8802-3 Ethernet, using TCP/IP and Telnet protocols.

System Managers Terminal (SMT) and Virtual Console System (VCS).

The SMT is a Hewlett-Packard terminal, which is connected to the AS8300 EM via a bi-directional asynchronous serial link, using ASCII with embedded escape sequences for display purposes. The VCS is connected to the same serial link via a T switch.

Shelf Controllers (SC).

These are connected to the AS8300 EM via Pads over an X.25 network. They communicate with the AS8300 EM via Switched Virtual Circuits (SVC), using a ACC proprietary protocol.

Network Management Layer.

This is the main directing interface - it communicates with the AS8300 EM over a second, physically separate ISO 8802-3 Ethernet using OSI Transport Services and CMIP protocols.

File Server

The HP Computer System is a cabinet style HP9000 Series 800 Model G40 Server, available in High Availability Configuration or Standard Configuration The former is achieved by equipping a second “warm standby” processor and console plus duplicated disks and disk mirroring software.

This Page Intentionally Blank