Date: April 30/99

Mainstreet Broadband Wireless (Release 1.1)

System Overview/ Operational Description

INTRODUCTION

This document provides a system overview for the Release 1.1 Newbridge Mainstreet Broadband Wireless Product . The information listed is a simplified version of the overall system technical specification.

System Overview

The Broadband Wireless product portfolio is a family of products that are designed to work together. The Broadband Wireless System is a network of Network Interface Units connected to Base Stations via wireless links and the Base Stations are, in turn, connected to the ATM Backbone Network via wired or point to point wireless links. The network is augmented by a Network Manager.

A high level view of the network is shown below (Figure 1.0). As shown in the figure, the cellular network structure is based on overlapped 4-sectored cells.

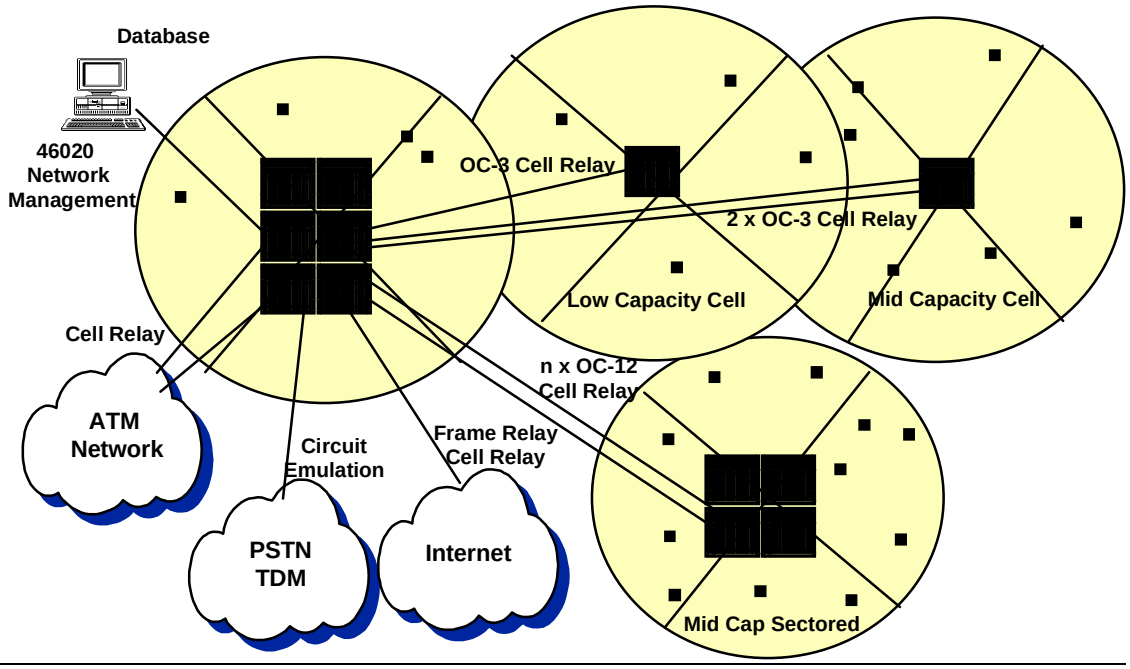

Figure 1.0 Broadband Wireless Network Topology

The Broadband Wireless system provides a communications infrastructure with both WAN and ATM points of attachment.

The key features provided by the Broadband Wireless System are:

a) high-bandwidth
b) flexible bandwidth assignment
c) scalability
d) speed of deployment

Error! Reference source not found. shows a simple application of a Release 1.1 Broadband Wireless System. In the diagram, the devices are divided into the Broadband Wireless System proper (the elements on the unshaded background) and external devices (the elements on the shaded background).

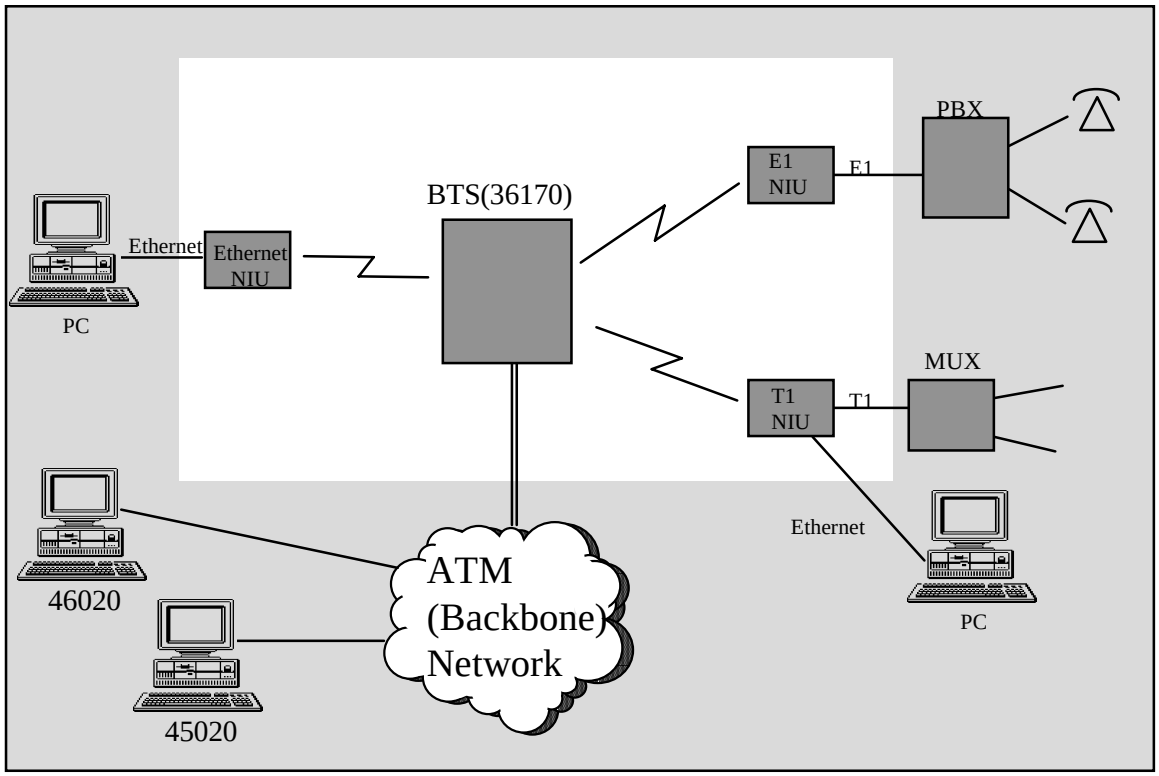

Figure1.2: System Overview

The Broadband Wireless product is targeted at fixed wireless broadband applications, such as local access loops, point-to-point links etc. The system consists of the following components.

- Backbone Network

  The backbone system is an ATM network interconnecting all BTSs to various services and to the 46020 network manager. A BTS may also function as a backbone component.

- Base Transceiver System (BTS)

  The BTS is the hub that delivers and collects all the wireless traffic from and to the subscribers in the BTS coverage area. The BTS is also the linking point between the subscribers and the Backbone Network. The BTS can also support standard 36170 wireline services.

- Network Interface Unit (NIU)

  A NIU is situated at the subscriber location. The NIU is used to provide a wireless connection between the CPE and the BTS. In this release two types of NIUs are supported, each providing a single interface.

Backbone Network

The Backbone Network is an ATM network and/or TDM network connected to the wireless network at one or more points. The 36170 based BTS can easily work with the backbone system through standard cell relay interfaces, such as T1/E1, DS3/E3, or OC3/STM1, etc.

Base Transceiver System

The Rls 1.1 base station platform is based on Rls 4.0 of the 36170 multi services platform.
The card cages are 19" rack assemblies with the following dimensions:

- 48 cm (19") wide
- 53 cm (21") high
- 29 cm (11.5") deep

Single Shelf BTS System

Figure 1.3 shows a typical single shelf base-station / backbone. In this configuration, all switching and control functions are self contained in a single peripheral shelf. Full control and switching fabric redundancy is supported as shown in the figure. Non redundant configurations are also available through de-populating the appropriate control and hub cards.
A single shelf supports 12 universal card slots (UCS), with an aggregate switching capacity of 1.6 Gbps. A single slot is capable of supporting up to an OC-3 of bandwidth.
For the Rls 1.1 product , the TDMA ARIC cards occupy two peripheral card slots.
In addition to the UCS slots, the peripheral shelf supports a fully redundant (X and Y switching planes) switching matrix using two additional card slots. These are optionally populated with either switching hub cards (single shelf configurations) or regular hub cards (in multishelf configurations).

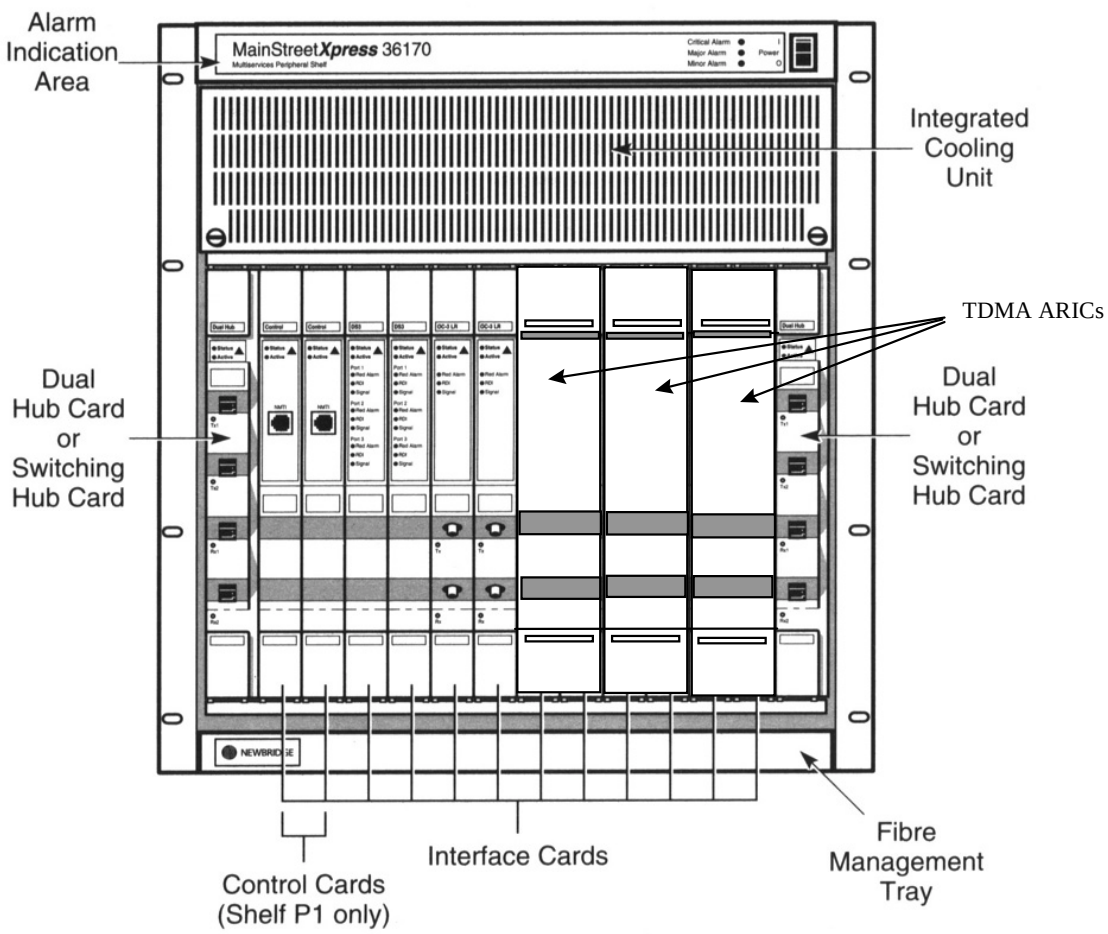

Figure 1.3 Single Shelf Base-Station / Backbone Switch

Single Shelf BTS Configuration

Provides the configuration for a single shelf, 4 sector base station supporting redundancy on the control, switching, backbone interconnect and radios.

Quantity	Card Type	Notes
1	Peripheral shelf	
2	Control cards	Fully redundant control configuration
2	Switching HUB cards	Fully redundant switching matrix
4	TDMA ARICs	One ARIC per sector (non redundant), one down stream & two upstream carriers per sector
2	OC-3 Cell relay	Fully redundant backbone aggregate cards
1	SSU	Timing source
1	GPS receiver	Optional if timing is not taken from the backbone OC-

		3s
8	12 port combiner splitter units	Two per sector (TX and RX)
8	OTUs	Fully redundant OTUs per sector
8	ORUs	Fully redundant OTUs per sector

Single shelf BTS configuration

Multishelf BTS System

For growth beyond a single shelf, the switching matrix capacity is expanded with the addition of a pair of switching shelves, and additional peripheral shelves are added to the BTS forming a multi-shelf complex as shown in **Error! Reference source not found.**.

One switching shelf is required per control plane. In this configuration, the switching hub cards, located in the peripheral shelf, are replaced with regular hub cards and fiber optic inter shelf links (ISLs) are added between the peripheral shelves and the switching shelves.

One or two 800 Mbps ISL links are required, in each direction, between each peripheral shelf and each switching shelf. The use of two 800 Mbps links is required when the required aggregate switching capacity of the UCS cards in the peripheral shelf exceeds 800 Mbps.

For all shelf configurations, except those supporting 4 or more OC-3s, only require a single ISL link.

In this configuration, up to 16 peripheral shelves, using a single ISL per shelf can be supported from a switching shelf pair. Alternately a maximum of 8 peripheral shelves can be supported if two ISLs are used per switching shelf.

When OC-12/STM-4 cards are deployed, a High Speed Peripheral shelf is added to the configuration. Each OC-12/STM-4 card requires a single ISL, reducing the number of available low speed peripheral shelves accordingly.

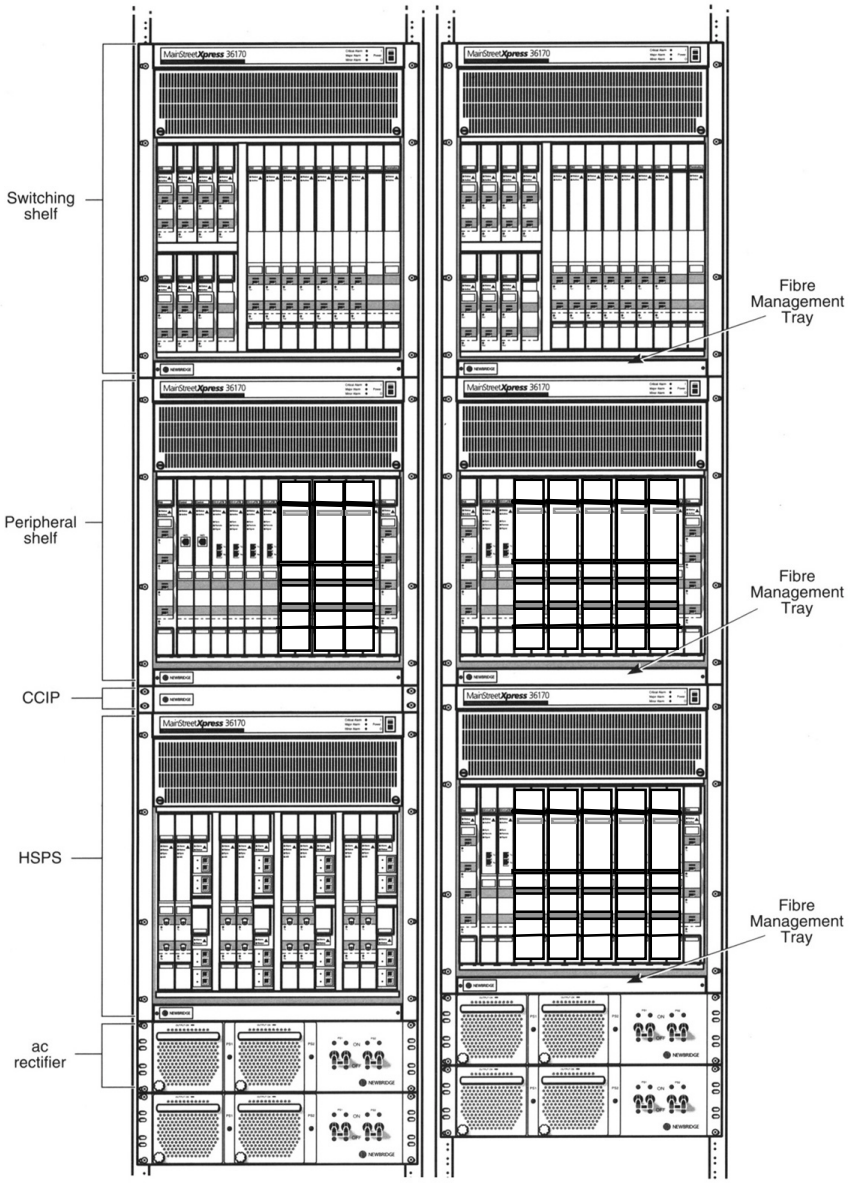

Figure 1.4 Multi Shelf Base-Station/ Backbone Switch

Multishelf Shelf BTS Configuration

Quantity	Card Type	Notes
2	Switching shelves	Fully redundant switching matrix
2	Dual receiver cards	One per switching plane, 800 Mbps max capacity
2	Switching cards	One per switching plane, 800 Mbps max capacity
2	Termination cards	
2	Peripheral shelves	
2	Control cards	Fully redundant control configuration
4	HUB cards	Fully redundant switching matrix
8	TDMA ARICs	Two ARICs per sector (non redundant), two down stream & four upstream carriers per sector
4	OC-3 Cell relay	Fully redundant backbone aggregate cards
1	SSU	Timing source
1	GPS receiver	Optional if timing is not taken from the backbone OC-3s
8	12 port combiner splitter units	Two per sector (TX and RX)
8	OTUs	Fully redundant OTUs per sector
8	ORUs	Fully redundant OTUs per sector

Multishelf BTS configuration

System Configuration

The ATM Radio Interface Cards (ARIC) connect to external transmitters and receivers via coax cable. Typically there is one BTS per cell. The BTS is connected to the Backbone Network usually via OC-3 or OC-12 Sonet interfaces, however OC-3 point-to-point wireless links may be used.

The external transmitters and receivers are typically mast mounted or mounted on a flat surface of the building as shown in Figure 1.6.

Figure 1.5 shows the components that are required for the BTS. The 46020 may be located remotely and be connected to the BTS via the ATM network. The number of ARICs required depends on the number of users supported.

The minimum set of components required to support the first user is:

- 1 36170 Peripheral Shelf
- 1 Control Card Interconnect Panel
- 1 System Synchronization Unit
- 1 or 2 Switching Hub Cards (for redundancy)

- 1 or 2 Control Cards (for redundancy)
- 1 ATM Radio Interface Card
- 1 OC-3/STM1 Card (assuming the BTS is connected to an ATM backbone)
- 1-Combiner/splitter unit
- 1 Transmitter (OTU)
- 1 Receiver (ORU)
- External -48 v power supply for the transmitter, receiver and BTS shelf
- 2 90° sectorized antenna (one for transmit, one for receive)

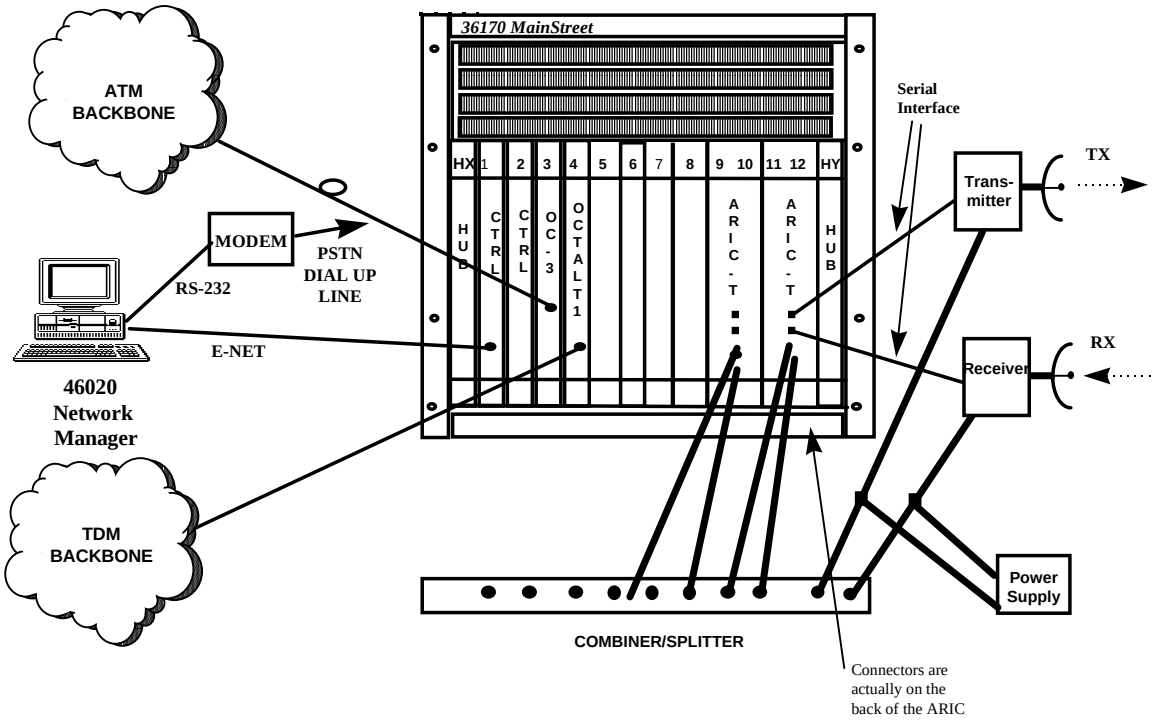

Figure 0-1: Base Transceiver Station

BTS Equipment Room

The 36170 card cages/shelves are housed in Newbridge 19" equipment racks. The racks consume 7.02 ft^2 of floor space (IAW TR-NWT-000063) which includes a wiring and maintenance space. These racks are normally installed within equipment rooms or shelters with the following general attributes;

- The equipment shelter/room requires an air conditioning system (A/C) which is scaled to ensure that the maximum operating air temperature within the shelter does not exceed $+50^{o}$ C.
- The equipment shelter should be provided with a chemical fire suppression system. Local fire codes need to be considered to ensure appropriate regulations are met.
- A lightning protection system is required. Generally this translates into grounding/bonding the shelter perimeter (inside) with the lightning grounding system, the mast run lightning surge suppression system and the AC mains ground.
- The shelter should be equipped with overhead cable guides/ladders suitable for routing all required cabling/harnessing within the shelter.
- The shelter should be provided with an access portal/feedthrough which allows mast run cabling to enter the equipment room/shelter without the need to break the cables or insert connectors (i.e. feed through type). This should allow the cabling to be sealed against weather/rain effects. A feedthrough which is capable of handling between 24 and 64 cables is required (depending upon base station configuration and capacity growth plans).

BTS Power

Power supply for the base station is as follows;

- -48 V DC power is required to power the indoor and outdoor portions of the system. The Newbridge 36170 base station will consume a maximum of 600 W of power per card shelf deployed. Additionally, each DC supply (for powering the upmast receivers and transmitters) will consume ~ 50 W DC.
- Depending upon service provisioning requirements a battery backup (UPS) system is required to ensure system operation during mains power failures.
- optionally, the Newbridge system can be powered from external 120/240 VAC rectifiers.

External RF Equipment

The ARICs are connected to a Combiner/Splitter complex which is used to interface to the mast-mounted transmitter(s) and receiver(s). This equipment is developed/provided by an OEM supplier.
The base station radio equipment is located on pole mounts such that each sector has dedicated transmitters and receivers. The transmitters and receivers are mounted directly onto their respective sector antennas (Release 1.1 onwards) as shown in Figure 1.6 below..

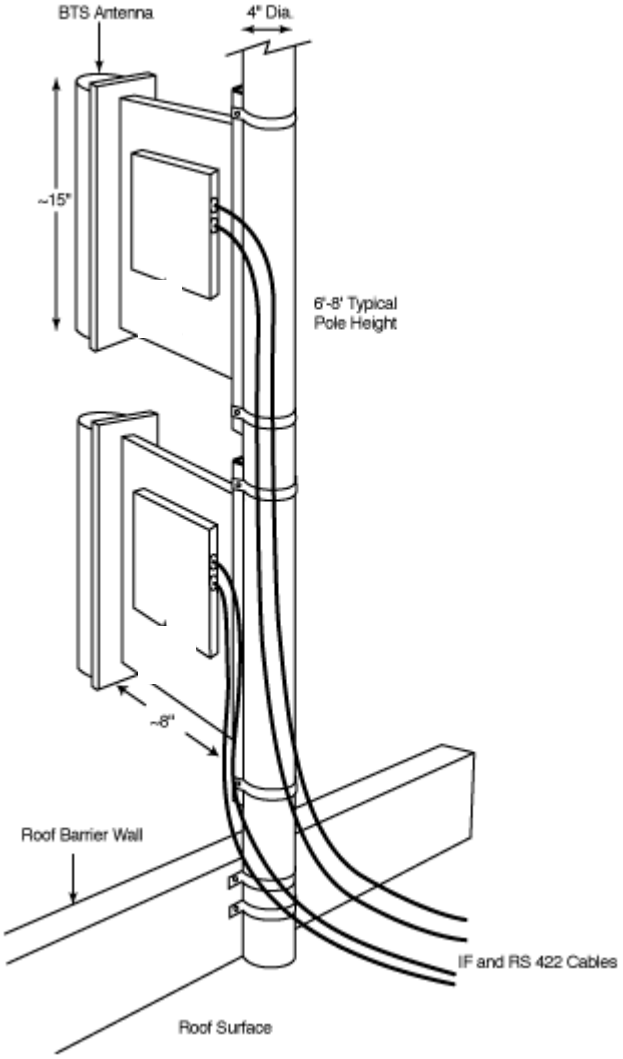

Figure 1.6 Typical multi transmitter or receiver installation (vertical stacking)

Alternately, to minimize pole heights, it is possible to mount the transmitter (or receiver) assemblies side-by-side on the mounting pole.
A minimum spacing requirement of 10 meters is required between transmitters and receivers to endure adequate isolation between the transmit and receive RF signals. Multiple transmitters or receivers can however be stacked either horizontally or vertically with no spacing limitations. A typical 4 sector roof top installation is shown in Figure 1.7.

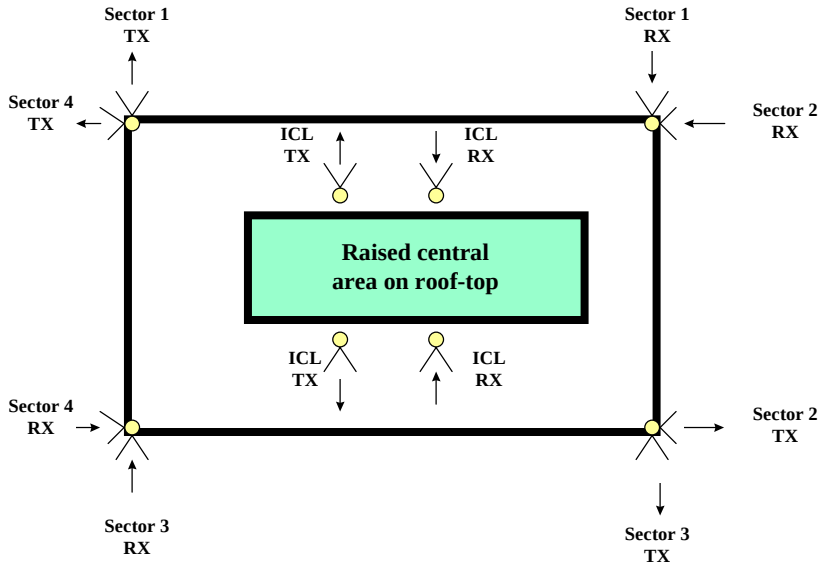

Figure 1.7 Typical BTS Installation Showing Physical Attributes

Customer Premises Equipment

The wireless customer premises equipment consists of two major components; an outdoor radio transceiver/antenna unit (OTRU) and an indoor Network Interface Unit (NIU).

NIU

The NIU resides on the customer premises and, on the network side, is connected to an external transceiver. The customer side connects to various types of customer premises equipment depending on the type of NIU. In Release 1.1 two types of NIUs are supported:

- T1 CE NIU which has a single T1 interface supporting either full or fractional T1 services and a single 10Base-T Ethernet port
- E1 CE NIU which has a single E1 interface supporting either full or fractional E1 services and a single 10Base-T Ethernet Port

The NIU has an RS-232 port for local configuration. In addition, once it has registered with the network, T1/E1 NIUs can be configured from a 45020 Element Manager or NMTI can be accessed via Telnet from a 46020 Network Manager.

A maximum of 2 NIUs can be supported from a single OTRU using a combiner splitter arrangement similar to that used at the base station. In this configuration, both NIUs must share the same up link

operating frequency, however uplink time slots can be assigned to the two NIUs as required by the service being supported.

No support for multicarrier operation from a single OTRU is provided.

OTRU

In addition to the NIU, an external transceiver is required. The external transceiver is typically mounted near the roof of a building and is mounted in a fixed position.
Figure 1.8 shows a typical application for the T1 CE /ethernet NIU.

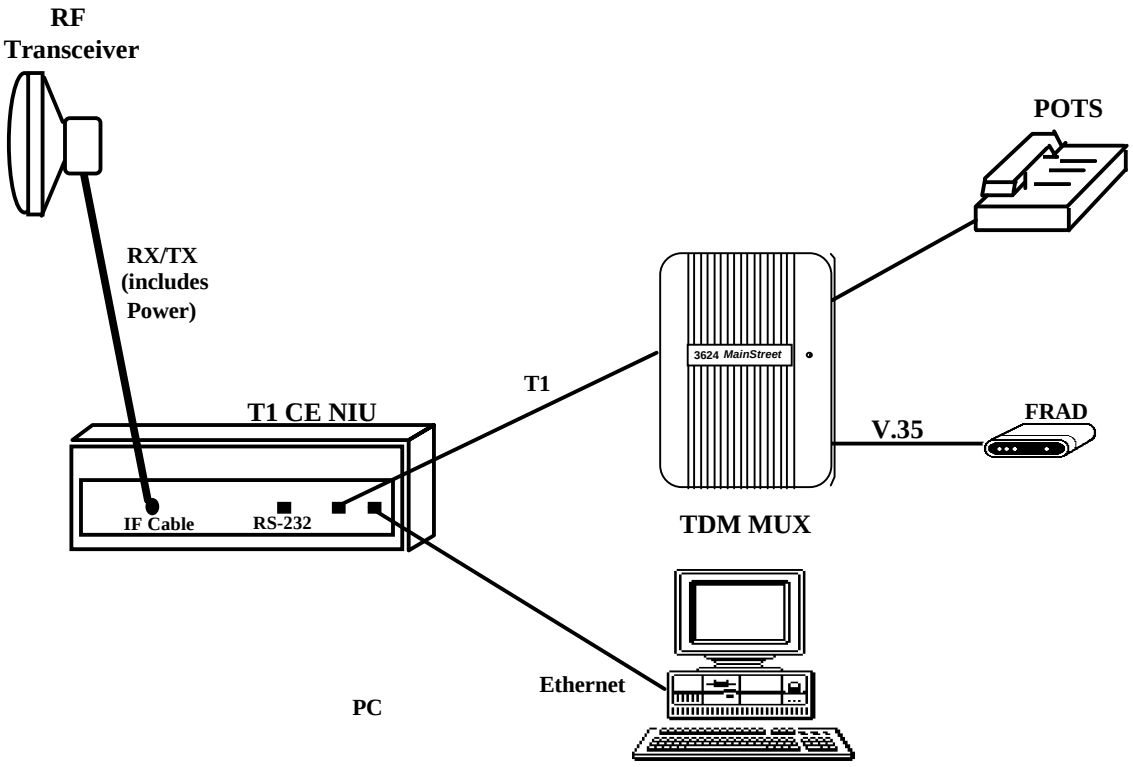

Figure1.8 : T1 Circuit Emulation / Ethernet NIU

TDMA ARIC

A block diagram of the TDMA ARIC is shown in Figure 1.9 below. The card occupies two UCS slots in a 36170 peripheral shelf and supports the following functionality:

- ATM Interface to the 36170 backplane
- ATM Cell queuing on egress and policing on ingress
- One QPSK downstream modulator supporting concatenated RS 204:188 and 7/8 convolutional coding, interleaving and two software provisionable symbol rates
- Two up stream differentially coded QPSK burst demodulators with FEC
- Integral L-band Tuner supporting software provisionable channel assignment from the network manager
- Serial ports for configuration and monitoring of upmast base station radios
- MAC layer supporting dynamic bandwidth allocation
- Support of UBR and CBR traffic ATM classes of service

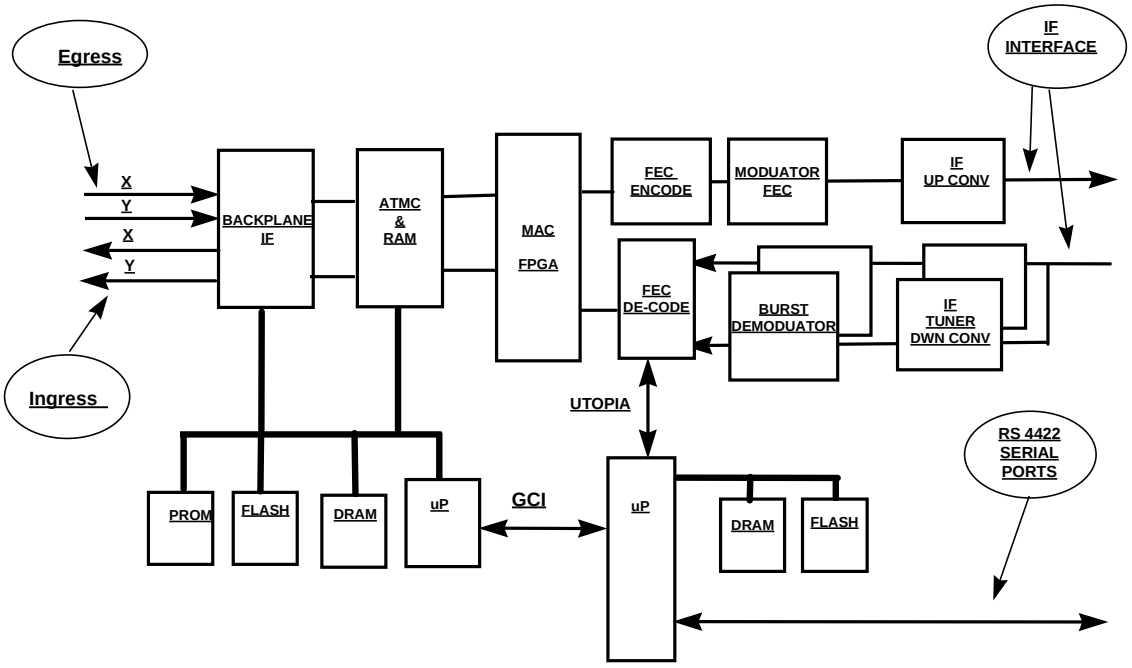

Figure 1.9 TDMA ARIC Block Diagram

A detailed block diagram of the TDMA ARIC modem is shown in Figure 1.10 below.

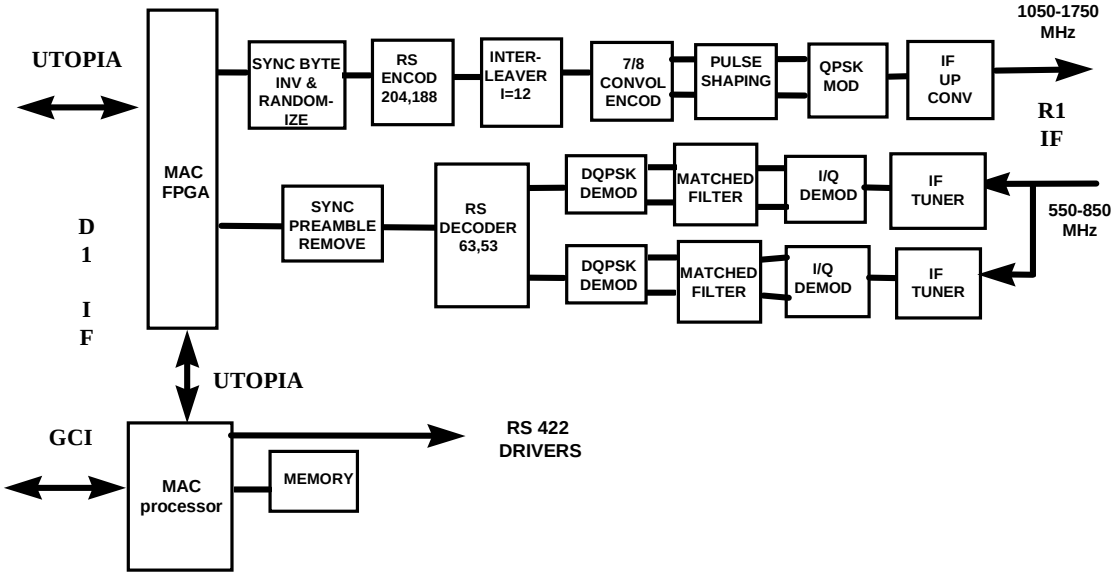

Figure 1.10 TDMA ARIC Modem Block Diagram

IF Combiner/Splitter Unit

The release 1.1wireless TDMA system uses 12:2 passive combiner/splitter units at the base station for combining and splitting the IF signal power. The unit provides 12 SMA ports towards the ARICs and 2 N type ports towards the radios.

In the downstream, the unit combines the transmitted IF signal power from up to 12 ARICs providing two combined IF outputs for redundant applications with two transmitters.

Similarly, in the upstream, the unit splits the power from up to 2 receivers and provide 12 outputs which connect to up to 12 ARICs. In redundant radio applications, only one transmitter and one receiver can be enabled simultaneously.

With the generation of OTUs being deployed in Rls 1.1, the maximum number of carriers which can be combined in the combiner to a single transmitter is 6.

CPE NIU Hardware

T1 NIU Hardware

The T1 CE NIU supports a standard T1 Circuit Emulation interface providing both full and fractional interfaces. In addition, the T1 CE NIU supports a single 10Base-T Ethernet port. The assembly consists of a base modem card, a T1 services card and an integral AC power supply.

The T1 CE NIU supports local configuration via an RS-232 port. A minimal set of data must be configured locally to allow the NIU to connect to the BTS. Once this connection is in place the NIU may be configured from a network manager. Each NIU may have a PVC to the BTS to allow the network manager to communicate with the NIU using Newbridge ATM Control Messaging. This requires dedicated air bandwidth. NIUs are managed using SNMP.

The T1 CE NIU has the following physical attributes:

a) RS-232 Serial Port with a shielded RJ-45 connector - the maximum baud rate is 38400 while the default is 9600.
b) Single T1 Interface - RJ-45 Connector
c) Single 10Base-T Ethernet Port - RJ45 Connector
d) 75-ohm F-type female connector for IF transmit/receive interface to the Transceiver
e) Dimensions: 43cm x 43 cm x 8.9 cm (17 in. x 17 in x 3.5 in)
f) Weight: approx. 4 kg.
g) Lights for Status, power, LOS, LOF, T1 signal, T1 alarm, Net connect, TX data, RX data, Ethernet Activity, Ethernet Link
h) Dual banks of flash to support fail-safe software downloading
i) NVM for storage of configuration and statistics data
j) AC powered. If battery backup is required then an external UPS must be used
k) Transceiver power is supplied by the NIU over the coax cable. This function can be disabled with an external AC-coupler if multiple NIUs are connected to a single Transceiver. In this situation power is supplied by only one NIU.
l) External mounting points so that it may be rack mounted.

The T1 CE NIU supports both structured and unstructured service as defined by the ATM Forum.

CPE Modem Block Diagram

The modem block diagram is shown below. It supports the following functionality:

- One fixed symbol rate QPSK downstream demodulator supporting concatenated RS 204:188 coding, 7/8 convolutional coding, & interleaving
- One up stream differentially coded QPSK burst modulator with Reed Solomon 63:53 FEC
- Integral Tuner supporting software provisionable channel assignment from the network manager
- Diplexer for combining DC power, Transmit and Receive IF signals on to a single coaxial cable
- Serial port for local configuration and monitoring of the modem

•MAC layer supporting dynamic bandwidth allocation
•Single Ethernet port for support of UBR classes of service supporting a single PVC connection.
•Interface to the T1 services card for CBR services, control and NMS

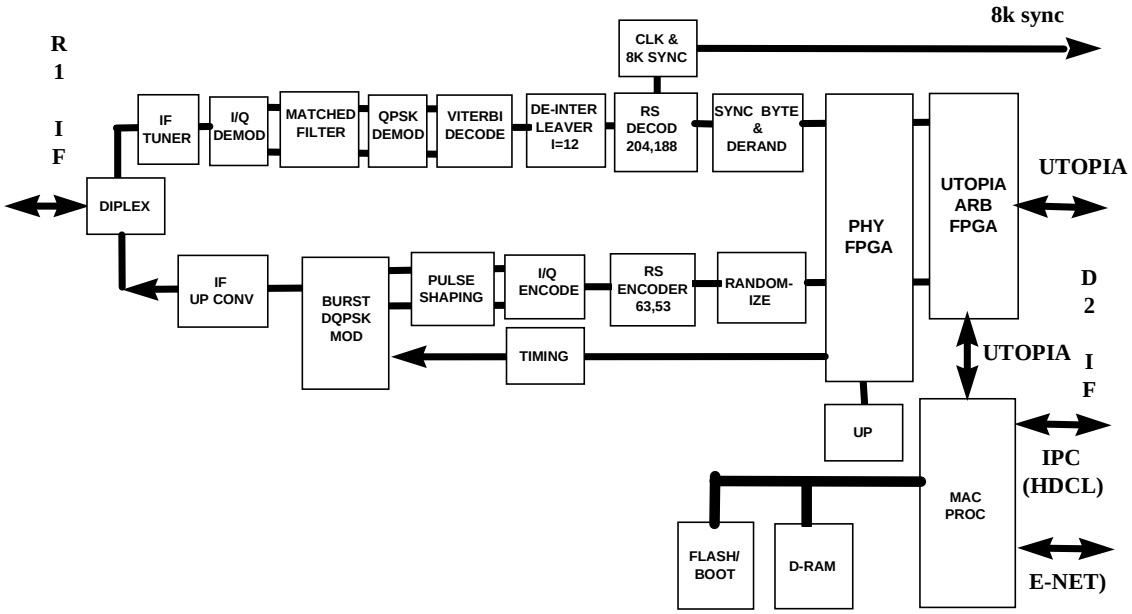

Figure 1.11 TDMA CPE Modem Block Diagram

T1 NIU Services Card

This assembly is a daughter board module to the base modem card in the T1 NIU. A functional block diagram is shown below:

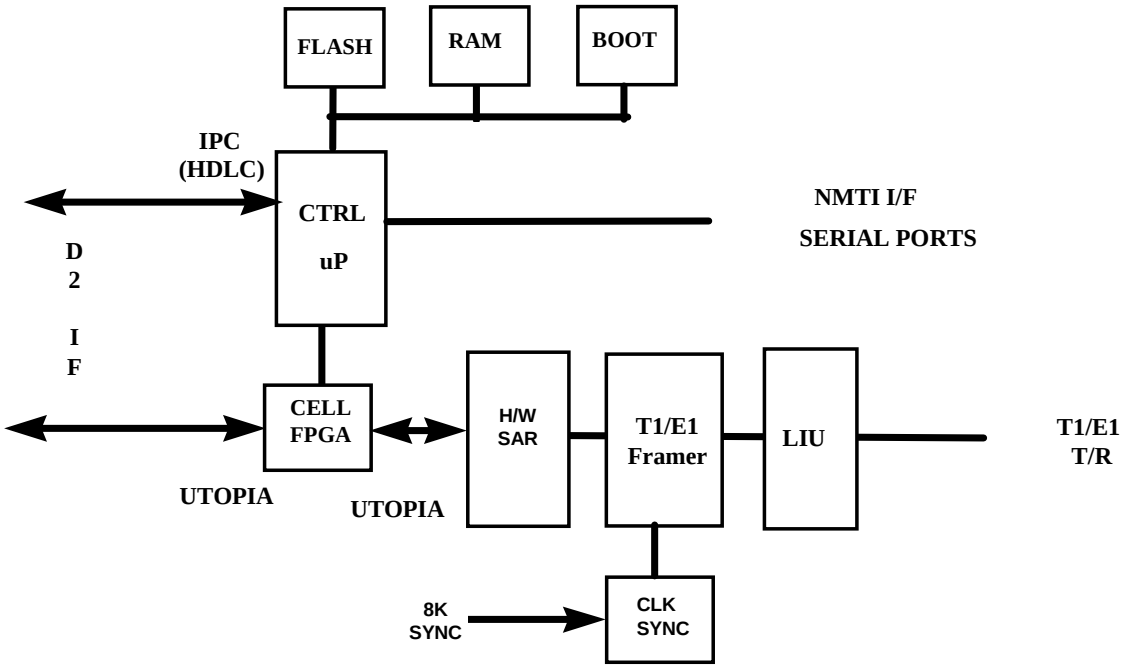

Figure 1.12 T1 NIU Services Card Block Diagram

The T1 interface offers the following physical layer attributes for both structured and unstructured modes.

a) Support for T1 interface at 1.544 Mb/s for both long-haul interface and DSX-1 on-premise interface as per T1.403 and T1.408.

b) Support for T1 for B8ZS, and JB7 line coding as per T1.403.

c) Detection and reporting of LOS.

d) Line and equipment loopbacks.

e) Support for T1 jitter tolerance, generation and attenuation as per ANSI T1.403, AT&T 62411, and ITU G.824.

The T1 interface offers the following synchronization attributes.

a) Support to lock the transmit direction to the 36170 network synchronization via the downlink air interface.

b) Synchronization holdover in case the RF signal is temporarily lost.

c) Support for asynchronous interfaces by use of SRTS (unstructured service only).

The T1 interface offers the following capabilities for both structured and unstructured modes:

a) AAL1 segmentation and reassembly as per T1.630, Bellcore GR-1113-CORE, and ITU I.363.

b) Support for SNMP including the T1 CE MIB