



PSINET

Wireless Test and Evaluation Report

Date: 30 December 1999



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1.Site Information

Type of Site:	Basestation: 1	CPE: 1
Site#:	Lever Building	
Site Name:	PSINET	
Date:	November 27 to December 17, 1999	
Location:	Hong Kong	
GPS:	Latitude:	Longitude:
Address:	Kwun Tong	
Contact:	Mr. Calvin Chu / Doris Mui	
Telephone No:	(852)2331-8123	
Direction to Site:	500m apart from BTS to CPE	
Notes:		

Table 1: Site Information



2. Introduction

DOCUMENT SCOPE

The intent of the PSINET Wireless Test Plan is to demonstrate the Wireless Solution and its capabilities. The document will cover the following functionality(**Trial period: Nov 27 to Dec 17, 1999**)

- Services (Ethernet)
- BTS Station Unit
- CPE Station Unit
- NMS Support
- Voice over IP

3. Network Diagram

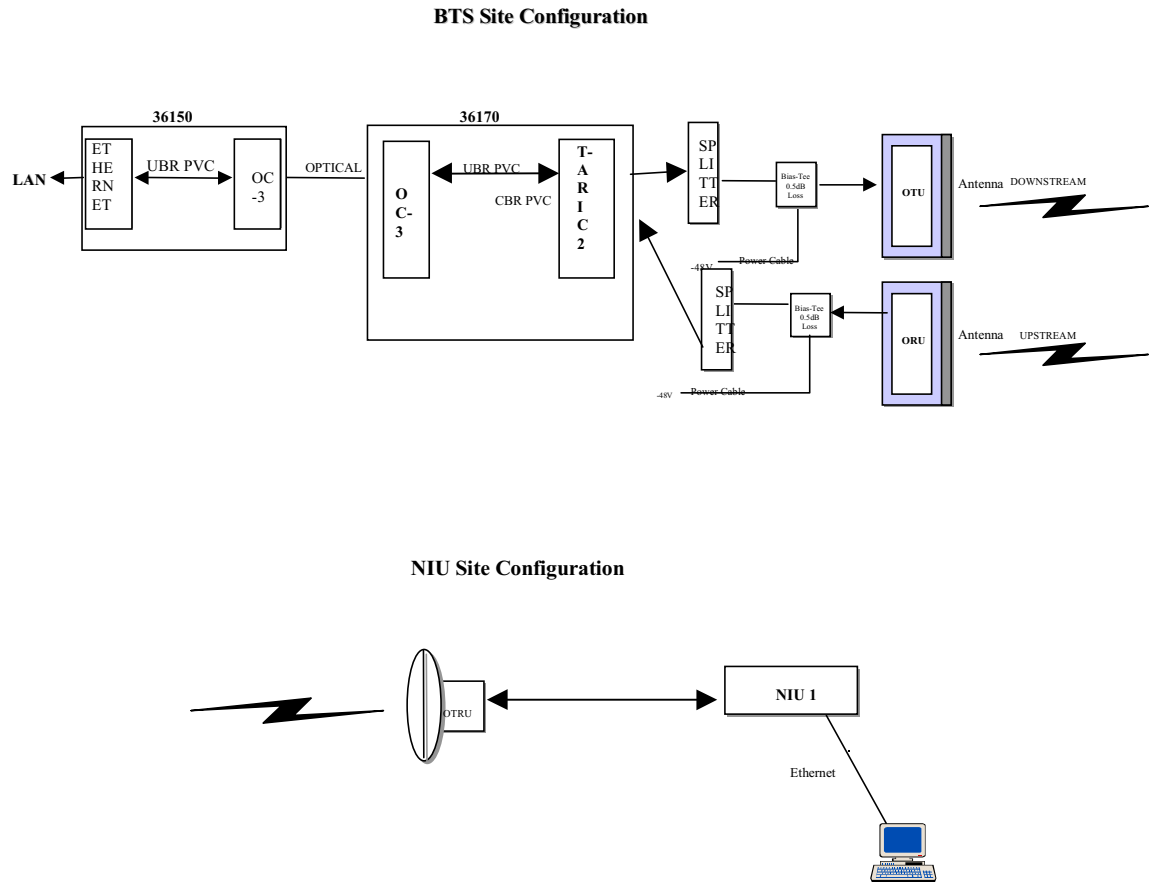


Figure 1: PSINET’s T&E Network Diagram

PSINET’s T&E will require all of the above equipment. Mainly one 36170 shelf with OC3, STM1 and wireless ATM interfaces, one 36150 with STM-1 and Ethernet interface, and an NIU at a remote site.



4. T&E Equipment List

Equipment	Quantity	Part Number or Card Rev
Basestation Radio Components		
ANT 90H W/MTG Holes 26.35-31.3 GHz	1	90-4563-02
ANT 90V W/MTG Holes 26.35-31.3 GHz	1	90-4564-02
Radio OTU Canada 27.65-28.35/1.05-1.75GHz	1	90-4568-01
Radio ORU Canada 27.35-27.65/0.55-0.85GHz	1	90-4567-01
BIAS-TEE N(J) -48V/BNC 400-2050MHz	8	90-6516-01
Lightning Arrester N(J) 400-2050MHz	8	90-6517-01
Cable BIAS-TEE Power 10M	8	90-6518-01
Lightning Arrester RJ45 RS422	8	90-6519-01
Cable IF SMA(P) 3M	8	90-6656-01
Conn Helix N(P) 25Pack	1	90-6657-02
C-S 12:2 IF SMA(J)-N(J) 400-2050MHz	8	90-6659-01
Bias-Tee -48V Surge Arrestor	8	90-6739-01
Connector RJ45 Plug Shielded	12	90-6815-01
Connector LEMO Plug (for outdoor RS422 cable)	8	90-6816-01
Wireless R1.1 System Documentation (hardcopy)	1	90-4434-01
ARIC-T R1.1 TDMA	1	90-6206-01
CPE Components		
Radio OTRU Canada 27.35-27.65/27.65-28.35GHz	1	90-6626-01
28120 NIU E1 CE 120 Ohm & Ethernet	1	90-6210-04
Lightning Arrester F(J) 500-2000MHz	1	90-6522-01
Conn F(P) RG11 50Pack	1	90-6735-02
Basestation 36170 Components		
220/240VAC to 48VDC Power Supply	1	90-2844-01
Peripheral Shelf Card File v2	1	90-4907-01
SHUB v2	2	90-6085-01
CTL CARD I/O PNL INTN'L	1	90-2295-02
CONTROL CARD 2 R4.0	2	90-3346-11
Stratum 3 SSU-2 Module	2	90-3347-01
STM1-2/OC-3 ATM MMF Card	1	90-4909-23
E1 120 Ohm CE 8 port Card R4.0	1	90-2517-42
RJ-45 Distribution Panel	1	90-2543-01
T1/E1 Distribution Panel Cable (3meter)	1	90-2767-12
36170 R4.0 System Documentation	1	90-2480-61
36150 Components		
36150 shelf	1	
STM-1/ OC-3 card	1	
Ethernet Card	1	
NMS Components		
46020 Release 3.2	1	90-0617-45
46020 R3.2 EN points	42	90-1524-45
45020 R3 Element Manager	1	90-2707-35
45020 Descriptor R3 CD	1	90-4646-35



5. Test Equipment Requirements

There are basically 3 major pieces of test equipment, covering the IF, baseband (data) interfaces and voltages used to debug either the basestation or CPE equipment. The following is a list of Field oriented test equipment that will be used to commission the sites and perform RF measurements.

List of Field Oriented Test Equipment	
1. HP 8560E - Spectrum Analyzer	<ul style="list-style-type: none"> • Spectrum Analyzer has a range of 30Hz to 2.9GHz • For checking IF signal quality, interference, power levels, etc...
2. Anritsu S331A - Site Master	<ul style="list-style-type: none"> • Basestation cable loss measurement and calibration
3. HP 8648C - Signal Generator	<ul style="list-style-type: none"> • Signal Generator has a range of 9KHz to 3.2GHz • For generating tone Signal to measure cable loss.
4. Fireberd 6000 (with E1 module and cable)	<ul style="list-style-type: none"> • Data (BERT) test set for E1 Links
5. Inclinometer	<ul style="list-style-type: none"> • For elevation angle measurement at the BTS site
6. Compass or Map	<ul style="list-style-type: none"> • For azimuth angle measurement at the BTS site
7. Miscellaneous	<ul style="list-style-type: none"> • Various Test Cables, Adapters, Power Cables, Hub, DMMS, PCs, etc...

Table 2: Test Equipment for the Field



6. Service

SCOPE

This section of the test plan covers the Ethernet services provided by the Wireless solution.

TEST CASE DESCRIPTION

6.1 Ethernet Services

Test Case #1 – PC to PC Access using 36150

The purpose of this test is to show that Ethernet services can be provided over wireless by connecting PCs to the Ethernet port of NIUs directly at the CPE sites and using 36150 at the BTS site.

Configuration -1

Connect a PC to the base station using a 36150 and 36170.

Connect a second PC to the Ethernet port of the remote NIU.

Result: The users are able to ping and download file from Web pages over Wireless.

The PC is able to ping and download file from web pages over wireless.

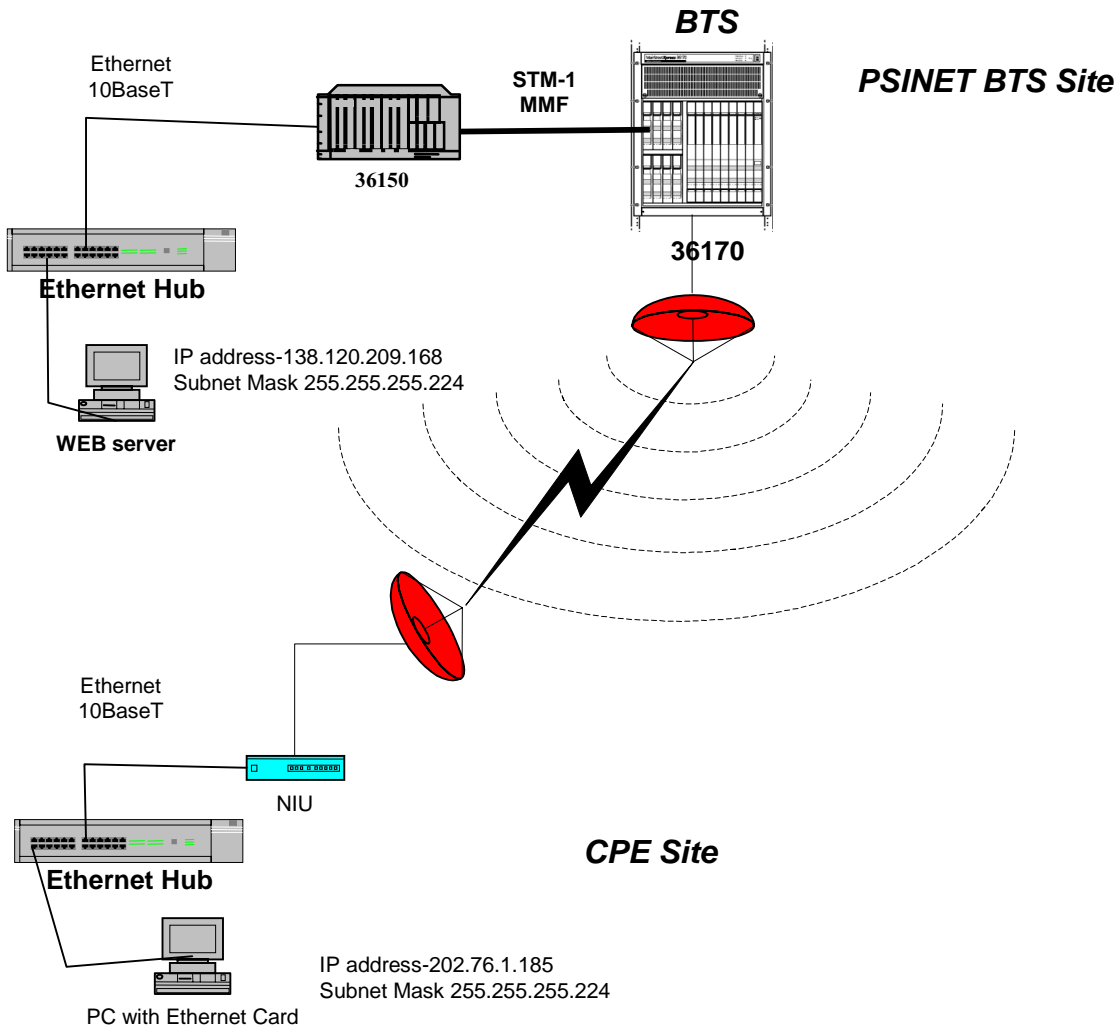


Figure 2: PSINET Network diagram using 36150 to access Ethernet



6.2 Service Quality

SCOPE

This section of the test plan covers the quality of the Ethernet services provided by the Wireless solution.

TEST CASE DESCRIPTION

Test Case #1 – Long Run

In this test we want to observe how long the PCs will remain pinging each other without being cut-off. The test run for a minimum of 2 hours.

Configuration

Establish an Ethernet connection between the NIU's Ethernet port and the PC at BTS or 2nd NIU. Start Pinging from one of the PCs and let the connection run for at least 2 hours.

Result: The result shows the link keep alive and without interruption during the testing period, and this guarantee a stable & reliable IP transport over the LMDS link, hence suitable for IP application likely broadband internet access. The access speed for internet access and interactive internet application reach approximately 2Mbps for a single user, and this prove the network support IP based video application.

22MB files was downloaded using the wireless through the PSINet ISP backbone, the result are:

PC1 with: P5 300MHz, 96M RAM, 4G harddisk used 1 minutes and 30 sec. The bandwidth is using 2M, approximate calculation, $22M * 8 \text{ bit} / 90 \text{ sec} = 1.96 \text{ Mbps}$

PC2 with: P5 266MHz, 96M RAM, 4G harddisk used 1 minutes and 35 sec. The bandwidth is using 2M, approximate calculation, $22M * 8 \text{ bit} / 95 \text{ sec} = 1.85 \text{ Mbps}$

As a result, the 4 M bandwidth, is used up in the 6 M bandwidth of NIU.

Test Case #2 – Traffic Statistics

Verify the ATM traffic using the NMTI screen.



7. Base Station Test

7.1 Initialization and Functional Test

SCOPE

This section covers the Base Station Initialization Procedure during Power On.

TEST CASE DESCRIPTION

Test Case #1 – Power-On Initialization

Demonstrate that the system is correctly initialized when power is turned on.

Configuration

Power up the System

Result: System is initialized in a pre-determined time (in this trial, 4 mins) once power is fed.

The LED system start-up sequence is as expected

Test Case #2 – Console/Reset Initialization

Show that a console reset and H/W reset are correctly made when any fault occurs to the system.

Configuration-1

Using NMTI cause the system to reset.

Result: System is initialized in a pre-determined time (in this trial, 4 mins) after the console reset.

The LED system start-up sequence is as expected

Configuration-2

Cause a H/W reset

Result: System is initialized in a pre-determined time after a H/W reset.

The LED system start-up sequence is as expected.

The timing for T-ARIC pull out the card and reset: 1 minutes and 50 sec to bring the Radio back.



The timing for 36170shelf power down: 4 minutes to bring the whole system back

7.2 RF Unit Performance

SCOPE

This section covers some of the RF performance and specifications.

1. Modulation Scheme:
 - Down Link : 26.2Msps transmission rate, QPSK
 - Up Link : 6.4Msps transmission rate, DQPSK
2. Polarization:
 - Down Link : V Linear with -24dB Isolation for cross polarization
 - Up Link : H Linear with -30dB mainbeam isolation & -15dB side/backlobes isolation for cross polarization
3. Theoretical Link Budget in this T&E:

Link Parameters	
Scenario:	Point to Multipoint
Rain Region	n
Rain Region Selected	n
99.99% Rain Rate (mm/hr)	95.0 <input type="checkbox"/> 38.0 <input type="checkbox"/> Manual Entry Rain Rate.
Req'd Link Availability (%)	99.990

Modulator	QPSK	DQPSK	16 QAM	16 QAM
	Down Link	Up Link	Down Link	Up Link
Access Type	TDMA	TDMA	FDMA	FDMA
Channel B.W. (MHz)	36	9	24	6
BER	10 ⁻¹⁰	10 ⁻¹⁰	10 ⁻¹⁰	10 ⁻¹⁰
Roll Off Factor	0.35	0.25	0.25	0.45
ATM Rate (Mb/s)	42	10	52	13

BAND PLAN	
Country:	Generic Frequency Bands (Toggle Down for Country Specific)
Down Link:	27 GHz Contiguous (Generic)
Up Link:	25 GHz Contiguous (Generic)

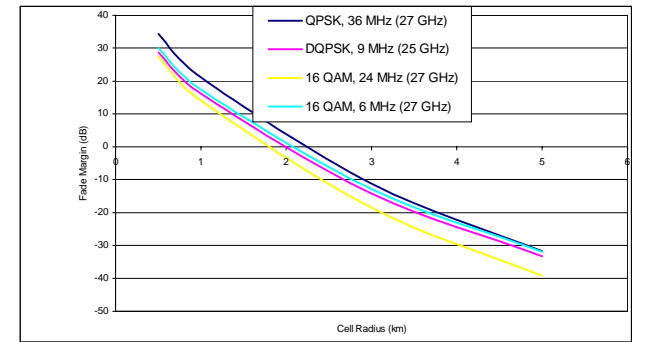
RF Transmitter	QPSK	DQPSK	16 QAM	16 QAM
	Down Link	Up Link	Down Link	Up Link
Tx Frequency (GHz)	27	25	27	25
Transmit Power (dBm)	26.5	20.0	26.5	20.0
Back Off req'd (dB)	1	3	5	5
Max No. of Carriers	1	1	1	1
RF Line Losses (dB)	0.0	0.0	0.0	0.0
P/Carrier (dBm/Carrier)	25.5	17.0	21.5	15.0
Tx Ant BW/Diameter	90 deg	1 ft	90 deg	1 ft
Tx Antenna Gain (dBi)	20	35	20	35
Mask Filter Loss (dB)	1.0	0.0	1.0	0.0
TX E.I.R.P. (dBm)	44.5	52.0	40.5	50.0

Values presented are for illustrative purposes and are subject to change without notice.

Antenna and Propagation Losses	QPSK	DQPSK	16 QAM	16 QAM
	Down Link	Up Link	Down Link	Up Link
Ant Ripple Loss (dB)	1	1	1	1
Radome Wetness (dB)	1	1	1	1
Tx Ant Misalignment (dB)	1.0	1.0	1.0	1.0
Atm Attn (dB/km)	0.11	0.11	0.11	0.11
Depolarization Loss (dB)	0.0	0.0	0.0	0.0
Free Space Loss (dB)	128.3	126.6	126.4	127.0
Total Rain Attenuation (dB)	31.0	25.8	26.1	26.6

Receiver	QPSK	DQPSK	16 QAM	16 QAM
	Down Link	Up Link	Down Link	Up Link
Rx Antenna gain (dB)	34.5	20	34.5	20
Thermal Noise (dBm/Hz)	-173.8	-173.8	-173.8	-173.8
RX NF (dB)	6.0	6.5	6.0	6.5
Antenna NF (dB)	0.5	0.5	0.5	0.5
RX Noise Floor (dBm)	-91.8	-97.3	-93.5	-99.0
Min SNR for BER 10 ⁻¹⁰ (dB)	8.25	14.35	12.92	12.28
Multi Cell C/I Loss (dB)	2.0	2.0	2.0	2.0
Min. Detectable Signal (dBm)	-81.5	-81.4	-78.6	-84.8

n Region 99.99 % availability Maximum Range (km)	QPSK	DQPSK	16 QAM	16 QAM
	Down Link	Uplink	Down Link	Uplink
	2.3	2.1	1.9	2.2



Newbridge Networks Proprietary Data

TEST CASE DESCRIPTION

Test Case #1 – Tx/Rx Power Level Adjustment (Rain Fade Margin)

The simulated rain fade margin test is done by changing Tx power on the ARIC at the BTS to simulate the rain fall effect.

To simulate the Tx/Rx power level attenuation due to rain fall effect, the signal power is adjusted efficiently from +8 to -22 dBm @ decrements of 2 dbm

Configuration



Using the Spectrum analyzer, verify the power level. Keep lowering the Tx power to a predetermine level (+4dbm), the power is still on.

Result: The Link is up and OK.

Test Case # 2 – IDU-ODU Interface

Verify the physical interface between the IDU and the ODU for power, Tx, and Rx IF signals.

The expected results should be:

- 1- DC –48V DVM
- 2- I/F DownStream – 36Mhz
Spectrum Analyzer at Combiners Tx
3. I/F UpStream – 9Mhz
Spectrum Analyzer at Combiners Rx

Test Case # 3 – Registration

Show the NIU's registration with the NMTI after start-up

Configuration

Establish NMTI communication with the 36170 T-ARIC and cause the wireless link to fail. The NIU should be in “out of network” status. Reestablish the connection and keep refreshing the NMTI screen.

Result: The NMTI shows all the NIU parameters and the status should change to “in network” when registration is complete.

Previous Test Results for Reference:

Due to the time constraint & availability of test equipment to evaluate the RF Test Cases, PSINET accepted the results captured by Newbridge from previous T&E in Hong Kong as reference:

Reference One: Simulated Rain Fade Margin Test

Distance Between BTS & CPE : 2.7km approx.

17 October 1999

PSINet Hong Kong Ltd.

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Time start the BERT 4:52pm of Oct 16
AIS=16 sec
AVG BER = 10E-10
Time stopped BERT= 11:14am of Oct 17
TX power = +4dBm

18 October 1999
Time start the BERT at 11:20am of Oct 17
AIS= 17 sec
AVG BER = 10E-11
Time stopped BERT = 11:18am of Oct 18
TX power at ARIC = -2dBm

19 October 1999
Time start the BERT at 11:20am of Oct 18
AIS = 26 sec
AVG BER = 10E-10
Time stopped BERT = 11: 15am of Oct 19
TX power at ARIC = -14dBm

Reference Two: Co-channel Frequency Interference

Configuration

This test requires 2 x 90 degree sectors of OTU/RTU at BTS and the downlink frequencies to be the same.

- a. Two OTU/RTUs positioned back-to-back
- b. Rotate/step one OTU/ORU into 60, 75, 90, 120 degree towards the other

Result: AVE BER was zero for all the 4 different setup.



7.3 Exception Handling at BTS Site

SCOPE

This section covers exceptional link loss to the RF equipment up and how the system behaves in case of any system fault occurrences.

TEST CASE DESCRIPTION

Test Case #1 – Cable Plug after Pull

Verify the status report and automatic link recovery after disconnecting and reconnecting the RF/IF cable and the network line.

Configuration-1

Disconnect the RF/IF Cable. (Tx or Rx)

To set up a UBR test towards Nanyang Plaza E1 bert test:

Log into the 36170 and configure the E1CE port .CONFIG OBJECT PORT <1-7-1>

To make the connection on the 36170, select CONFIG CONNECT <P1-8-1>

TO_ENDPOINT < P1-9-1; NIU268/34 < PROCEED> then SERVICE CATEGORY :

Constant Bit Rate

PEAK RATE : 2M

Result: The unit loses sync.was shown on fireberd tester with RED “LED” turn on while we are running 2M E1 bert.

Bert test result:

30 Nov evening to 1 Dec morning

Total time run=57741 sec

AVG bit error=10E-09

Pat loss=45

Sig loss = 0

AIS sec=24

Power loss=0

Bert test result:

1Dec afternoon to 3 Dec

Total time=173305 sec

AVG bit error=10E-09

Pat loss=251

Sig loss=0

AIS sec=80 sec

Power loss=0



Configuration-2

Reconnect the RF/IF Cable. (Tx or Rx)

Result: The original link is restored. The link was down by shown the amber LED on.

Configuration-3

Disconnect the Ethernet Cable.

Result: The Ethernet loses sync. (Pinging will stop)

Configuration-4

Reconnect the Ethernet Cable.

Result: The Ethernet link is restored within 10 seconds. (Pinging will resume)



8.NIU - Network Interface Unit Test

8.1 Initialization and Functional Test

SCOPE

This section covers the NIU Initialization Procedure during Power up

TEST CASE DESCRIPTION

Test Case #1 – Cold Start-up (Power On/Off)

Demonstrate that the system is correctly initialized when power it turned on.

Configuration

Power up the System

Point out the following initialization states

- Downstream Scanning (LED activity)
- Upstream Parameters acquisition
- Ranging completion
- Registration

Result: System is initialized in 50 seconds

The LED system demonstrates the Downstream Scanning

Test Case #2 – Warm Start-up

Demonstrate that we can perform a warm start up from the NMTI menu.

Configuration

Under the Maintenance menu select the Reset

Result: The NIU resets and comes back up in 50 seconds.



8.2 Exception Handling at CPE Site

SCOPE

This section covers the NIU's exception handling

TEST CASE DESCRIPTION

Test Case #1 – Ethernet

Show how the NIUs Ethernet port recovers from loss of sync

Configuration- 1

Disconnect the Ethernet cable between the NIU-E1 and the PC/Hub.

Result: The PC no longer has access to the 2nd PC at the other end.

Configuration- 2

Reconnect the Ethernet cable between the NIU-E1 and the PC/Hub.

Result: The Ethernet port should regain sync, the PC should regain pinging the 2nd PC

Test Case #2 – RF

Show how the NIU recovers when it's accidentally loses power.

Configuration- 1

Power down the NIU.

Result: The NIU loses Downstream signal

Configuration- 2

Power up the NIU.

Result: Without any intervention the NIU should initialize properly and come up. The RF and Ethernet link should resume as well.



9.NMS Support

SCOPE

This section covers some general aspects of the NMS and how it interacts with the Wireless equipment.

The software 46020 Rel.3.2 is the simulator version we are using for the demo.

9.1 BTS NMS Support

TEST CASE DESCRIPTION

Test Case #1 – Base Station Configuration Management

Demonstrate that it is possible to add, modify, and delete a Base Station through the NMS

Configuration- 1: Adding a Base Station

Add a new icon for a Base Station

Configure all the parameters of the Base Station

Connect the Base Station and the NIU to the Wireless network

Result: The NMS should display the new icon in Green.

Configuration- 2: Making Changes

Pull up the Base Stations configuration

Make the required changes, making sure that they coincide with the unit, otherwise the icon will not return to its normal operation color (green)

Result: The NMS should display the new icon in red, since its parameters are not accurate. Once the changes are completed the icon should become green.

Configuration- 3: Deleting a Base Station from the NMS

Select the Base Station icon and choose to delete it.

Result: The icon will be deleted



Test Case #2 – System Information

Show that the Network Manager can display the BTS's system information, such as Ethernet Address, IP Address, S/W Version

Configuration

Pull up the BTS's configuration window

Result: In the window is all the relevant information.

9.2 CPE NMS Support

TEST CASE DESCRIPTION

Test Case #1 – CPE Configuration Management

Demonstrate that it is possible to add, modify, and delete a CPE through the NMS

Configuration- 1: Adding a NIU Information

Add a new icon for a NIU

Configure the NIU parameters

Connect the NIU and the Base Station to the Wireless network

Result: The NMS should display the new icon in Green.

Configuration- 2: Making Changes

Pull up the NIU configuration

Make the required changes, making sure that they coincide with the unit, otherwise the icon will not return to its normal operation color (green)

Result: The NMS should display the new icon in red, since its parameters are not accurate. Once the changes are completed the icon should become green.



Configuration- 3: Deleting the NIU from the NMS

Select the Base Station icon and choose to delete it.

Result: The icon will be deleted. This may fail if any links or paths involve this unit. All links and paths will have to be deleted prior to deleting the icon.

Test Case #2 – System Information

Show that the Network Manager can display the NIU's system information, such as Ethernet Address, IP Address, S/W Version, are displayed

Configuration

Pull up the NIU's configuration window

Result: In the window is all the relevant information.



9.3 General Wireless NMS Support

TEST CASE DESCRIPTION

Test Case #1 – Access Control

Users will be able to modify the password access to the Units.

Configuration- 1: Operation Test

Access the system console, enter the user password as requested.

Result: User is given access to the unit's console.

Configuration- 2: Password Update

Access the system console, enter the user password as requested. User requests to change the original Password.

Result: User is given the possibility to change the password

Configuration- 3: Time Management

Demonstrate the possibility of changing the system's date and time. Note that the NMS will use the Sparc's date and time

Result: Display of date and time

Configuration- 4: Port Management

Verify the Network management support of the NIU's subscriber port. Select the subscriber port and show all its configuration information.

Result: Window displaying the NIU's E1 and Ethernet port information.

Configuration- 5: ATM Statistics

Display the Network Management Statistics for the Wireless link. We want to demonstrate the collection of statistics related to the ATM traffic transported over the radio network.

Result: On the console, transported ATM cell count and HEC error detected cell count is displayed

Configuration- 6: ATM Connections

Show the ATM PVC connection status between the Base Station and the NIU.



Result: Display of the ATM PVC connection, its status and the port VPI/VCI status.

Configuration- 7: ATM PVC Creation

Create the PVC connection between the Base Station and the NIU.

Result: The customer can see how to create a PVC connection

Configuration- 8: ATM PVC Deletion

Delete the PVC connection

Result: The customer can see how to remove a PVC connection involving the Base Station and the NIU

Configuration- 9: Wireless Link status

List all NIUs to show the wireless link status

Result: The customer can see if each NIU is registered with the NMS and what its status is.

Test Case #2 – Operation Status

Show the system operation status

Configuration

Display the Radio link's normal status

Display the voice/data Tx/Rx status,

Display the power supply status

Result: All the information required is available.

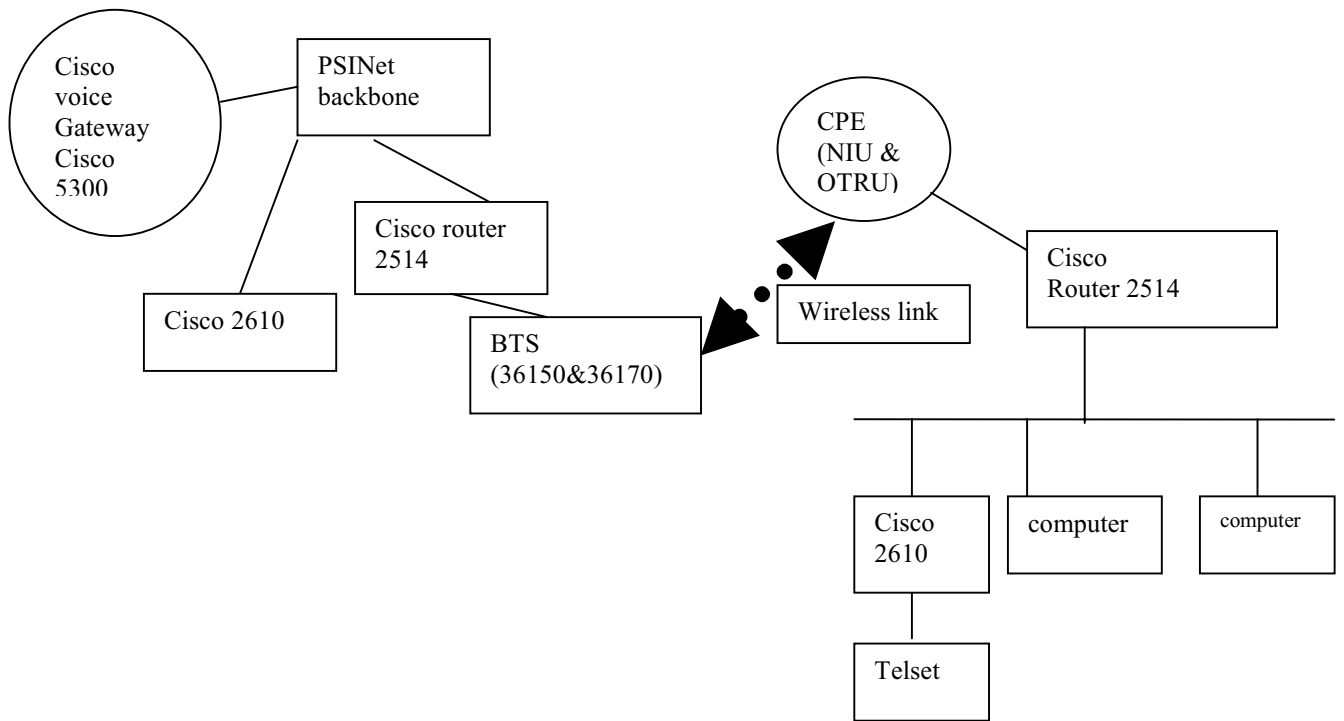
Test Case #3 – On Line Documentation

NMS has on-line documentation

Configuration

Click on the information icon at the bottom of the map window.

10. Voice over IP test (outgoing call)



The call setup are as follows:

Voice over IP using Cisco 2610- software RS,Rel-12.0

Call process setup local call outgoing, time for call setup=2 sec

Call process setup local mobile call outgoing, time for call setup=3sec

Call process setup IDD call outgoing, time for call setup=5sec

Result : Voice call has been tested successfully