Wireless Broadband

Solution Guides

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Airmux-400 – Point-to-Point Radio

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# Introduction

## Purpose

This document describes the tests that RAD has performed successfully to demonstrate the proper functionality of the Airmux-400 high capacity point-to-multipoint wireless system.

## Scope

This ATP is updated to Airmux-400 v. 2.8.40. In case of using older version, some of the features may not exist and cannot be tested.

This document contains details of all tests required for the product POC, designed to use a minimum of equipment.

## Required Test Equipment

| Function | Product | Description | Qty | Comments |
| --- | --- | --- | --- | --- |
| Radios | ODU | Airmux-400 Connectorized/Embedded Radio | 2 |  |
| Indoor unit | PoE | PoE device 100BaseT/GbE interface for Airmux radios | 2 |  |
| Ethernet Cables | Eth. Cables | Eth. Cables – RJ-45 connectors. - 2 meters | 4 |  |
| RF Cable | RF Cable | RF Cable with SMA Connectors - 1 meter | 2 |  |
| N-Type to SMA adaptor | N-Type Adaptor | N-Type Adaptor (male) to SMA (Female). | 4 |  |
| Attenuators | Attenuators | 40 dB Attenuators | 2 |  |
| Attenuators | Attenuators | 30 dB Attenuators | 2 |  |
| Traffic Generator | Traffic Generator | Support RFC-2544 & QoS tests. Gigabit Ethernet Module | 1 | Mandatory for FRC-2544 tests (e.g.; IXIA, SmartBit with 1000BaseT module) |
| Switch | Switch | Manageable Switch - Support VLAN | 1 | Manageable switch for VLAN Test in case traffic generator is not available |
| PC | PC | PC with latest Airmux Manager | 2 |  |

# Acceptance Tests

## Link Installation

##### Test Description

Ensure that Airmux manager is able to install a full link

##### Required Test Equipment

* 2 x ODUs
* 2 x PoE
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |  |
| 1 | Check for continuous single beeps when unit is connected to power trough the POE | The unit sounds continuous single beeps when connected to power |  |  |  |  |
| 2 | Check for continuous double beeps when starting link alignment | The unit sounds continuous double beeps |  |  |  |  |
| 3 | Check for continuous triple beeps on completion of link alignment | When link synchronizes, the unit sounds conntinuous triple beeps |  |  |  |  |
| 4 | Verify that the link is in installation mode | After link synchronizes, manager shows link in install mode |  |  |  |  |
| 5 | Use the manager to install the link by running the Installation wizard. (Defines link parameters: Product Type, Channels [MHz], Link name, , number of streams etc…) | Link parameters defined OK |  |  |  |  |
| 6 | Complete link installation and verify that link is established | Installation is completed and link is established OK |  |  |  |  |
| 7 | Ensure that ODUs stop beeping | Beeping stopped |  |  |  |  |
| 8 | Ensure that the link is in normal mode | Link is configurable (normal mode) |  |  |  |  |
| 9 | Open link Site configuration and move the link to installation mode. Check that the link is back in installation mode and the ODUs are beeping | Link is back in installation mode and three beeps sound |  |  |  |  |



## RFC2544

##### Test Description

RFC2544 Test Description: Throughput, Frame-Loss, Latency.

##### Test Equipment Required

* 2 x ODUs
* 2 x POE
* 1 x PC with latest AIRMUX manager
* Packet generator with 1000BaseT module which supports RFC2544 tests.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step Num** | **Procedure** | **Expected Results** | **Actual Results** |  | **Comments (or Problems)** |
| 1 | Establish a radio link and make sure the link is up.  RSS (dBm) on both sides of the link - between -45dBm to -60dBm CBW - 40Mhz, Antenna mode: MIMO, Rate: Adaptive. Asymmetric ratio - 50%/50%. Open Ethernet service and run the "Estimated Throughput" command from the Maintenance menu Open AIRMUX manager go to Site Configuration -> Ethernet and in "Ethernet Ports Configuration" - Verify Port Mode is 1000 Mbps F/D | Capacity of the link should be stable and expected throughput is according to AIRMUX LBC. @ 40 MHz CBW maximal a-symmetric throughput is 198 Mbps.  In Case only one side transmits link will automatically allow max a-symmetric ratio - 92%:8%. In Case of bi-directional traffic, link will follow the configured ratio. In case of 50%:50% ratio, Max Full-Duplex throughput will be 106.9 Mbps F/D. |  |  |  |
| **Test 1: Throughput** | | Throughput is the maximum rate in frames/sec at which data can be transported from source to destination with zero errors or lost frames. |  |  |  |
| 2 | Check Following Frame sizes: 64, 256, 512 ,1518, 2048. Confirm Ethernet Rate is 1000 Mbps F/D at both sides.  Test properties: **"Initial Rate"**: 25%  **"Granularity"** (steps): 0.1%. **"Duration"**: 30 sec. **"Frame-Loss"** (tolerance) - 0%. | Attach Report |  |  | Set "**Initial rate** "according to link's throughput and used Ethernet module. E.g.: In case link's throughput is 198 Mbps and Ethernet module supports 1000Base-T, there is no use to test rates higher then 250 Mbps, which are 25% of Ethernet Interface rate (1000 Mbps). |
| **Test 2: Frame Loss Rate** | | Latency is the total time taken for a frame to travel from source to destination. This total time is the sum of both the processing delays in the network elements and the propagation delay along the transmission medium. Latency is the total time taken for a frame to travel from |  |  |  |
| 3 | Check Following Frame sizes: 64, 128, 256, 512 ,1518 Confirm Ethernet Rate is 1000 Mbps F/D at both sides.  Test properties: **"Initial Rate"**: 25%  **"Granularity"** (steps): 0.1%. **"Packet-Loss Threshold"** (Pass criteria): 0% | Attach Report |  |  | Set "**Initial rate**" according to link's throughput and used Ethernet module. E.g.: In case link's throughput is 198 Mbps and Ethernet module supports 1000Base-T, there is no use to test rates higher then 250 Mbps, which are 25% of Ethernet Interface rate (1000 Mbps). |
| **Test 3: Latency** | | Latency is the total time taken for a frame to travel from source to destination. This total time is the sum of both the processing delays in the network elements and the propagation delay along the transmission medium. Latency is the total time taken for a frame to travel from |  |  |  |
| 4 | Run Test for 1 min (60 intervals - frame per sec.) per Frame-Sizes: 64, 128, 256, 1518 Set traffic up to **20%** of **link's** throughput. | Attach Report |  |  |  |



## Adaptive Asymetric Test

##### Test Description

Test Adaptive Astmetric functionality.

It is recommended to perform this test using traffic generator. However it is possible to run this test also if a traffic generator is not available - using the Iperf application which is attached below.

##### Test Equipment Required

* 2 x ODUs
* 2 x POE
* 2 x PC running iperf application
* 1 x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step Num** | **Procedure** | **Expected Results** | **Actual Results** |  | **Comments (or Problems)** |
| 1 | Establish a radio link and make sure the link is up.  Open AIRMUX manager go to Site Configuration -> Ethernet and and in "Ethernet Ports Configuration" check that the "Current" Ethernet duplex rate is the properly (e.g 1000Mbps/FD). Configure link to 40 MHz CBW, MIMO mode and Set the Rate [Mbps] to Adaptive Open etherent service and run the "Estimated TroughPut" command from the Maintenance menu | Capacity of the link should be stable and expected throughput is according to AIRMUX LBC. |  |  |  |
| 2 | Save iperf.exe application to c:\ at both remote and local PC's/laptops | iperf.exe is located at c:\ at both sites PC's |  |  |  |
| **Test 1: UL Throughput (Remote to Local)** | |  |  |  |  |
| 3 | Open a command line window at the **local** PC. Change directory to c:\. Set the local PC to be an FTP Server by using the following command line:  **c:\iperf -s -i1** | FTP Server is set |  |  |  |
| 4 | Open a command line window at the **remote** PC. Change directory to c:\. Set the remote PC to be an FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Client is set |  |  |  |
| 5 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic equals to actuall Eth Tput - FTP result not lower then 90% |  |  |  |
| **Test 2: DL Throughput (Local to Remote)** | |  |  |  |  |
| 6 | Open a command line window at the **remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line:  **c:\iperf -s -i1 -p5005** | FTP Server is set |  |  |  |
| 7 | Open a command line window at the **local** PC. Change directory to c:\. Set the local site to be FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** -**p5005** | FTP Client is set |  |  |  |
| 8 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic equals to actual Eth Tput - FTP result not lower than 90% |  |  |  |
| **Test 3: Full Duplex Throughput** | |  |  |  |  |
| 9 | Open two command lines window at the **Local** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1** Set the local site to be an FTP client by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300 -p5005** | FTP Server and client are set in Local PC |  |  |  |
| 10 | Open two command lines window at the **Remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1 -p5005** Set the local site to be an FTP client by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Server and client are set in Remote PC |  |  |  |
| 11 | Cofigure link to dual antenna type and **MIMO**.  Set the Rate [Mbps] to the minimum rate. Start test by running iperf server and client on the local and remote pc. Verify using NMS that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| 12 | Set the Rate [Mbps] to the maximum. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower than 90%  UL:DL ratio is 50%/50% when both sides are transmitting.  F/D throughput = Airmux Manager presentation (per Side) / 92% / 2 |  |  |  |





## Power-Up Recovery

##### Test Description

Verify that the Airmux-200 system always recovers after Power Off and Power On of each unit separately or both of them together and measure time until service is restored

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step Num** | **Procedure** | **Expected Results** | **Actual Results** |  | **Comments (or Problems)** |
| 1 | Power off the local site ODU by unplugging the WAN connection, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 2 | Measure the time to service - TTR (Time To Recover) until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to receive Trap via Manager < 50 sec |  |  |  |
| 3 | Power off the local site ODU unit by disconnecting the power cable from the IDU, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 4 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to receive Trap via Manager < 50 sec |  |  |  |
| 5 | Power off both local and remote units (at the same time) by unplugging the WAN connection, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 6 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to receive Trap via Manager < 50 sec |  |  |  |
| 7 | Power off both local and remote sites units (at the same time) by disconnect the power cable from the IDU, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 8 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to receive Trap via Manager < 50 sec |  |  |  |



## Restoring Factory Setting

##### Test Description

Verify the system will go to default setting

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Configure setup to be different from the default (change channel/rate/name etc..) | Link is configurable |  |  |  |
| 2 | Click on "Restore To Factory Settings" on the manager | There is an alert asking to verify you want to go back to factory setting |  |  |  |
| 3 | Verify that after reboot, the relevant site/ODU is restored to the default settings (except from the IP address) | All unit parameters are at default except for the IP address |  |  |  |
| 4 | Repeat the above test including "Set to default IP address" | All unit's parameters are set to default including IP address (10.0.0.120) |  |  |  |



## Get Diagnostic Information

##### Test Description

The Get Diagnostics feature collects and writes all link and Manager information (from both sites) into a text file. The file information can be used for link diagnostics and understand the installation environment. The purpose of this feature is to verify that this feature works properly and providing the diagnostic information

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Open the Get Diagnostic information from the HELP menu bar. | A diagnostic information window is opend |  |  |  |
| 2 | Make sure all 3 check boxes (System data, Link Information, Events log) are checked | All 8 check boxes are checked |  |  |  |
| 3 | Click the START button. The system start the collection process and at the end of the process the diagnostic file is saved in thw default directoy "My Documents" | Diagnostic file is saved in "My Documents" directory |  |  |  |
| 4 | Change the directory you want the file to be saved to another directory by clicking on the "File Path"button | Changing "File Path"is enabled |  |  |  |
| 5 | Run step number 3 again and verify the file is saved to the new directory you choose. | Diagnostic file is saved in the new directory |  |  |  |
| 6 | Verify all information represented in the text file is correct according to your link and PC setup | The information represented in the Diagnostic file is equal to the link and PC parameters |  |  |  |
| 7 | Open the Get Diagnostic information from the HELP menu bar. | A diagnostic information window is opend |  |  |  |
| 8 | Check only 2 check boxes (Link Information, Events log) | Only 2 check boxes are checked |  |  |  |
| 9 | Click the START button. The system start the collection process and at the end of the process the diagnostic file is saved in thw default directoy "My Documents" | Diagnostic file is saved in "My Documents" directory |  |  |  |
| 10 | Verify only relevant information is saved to the file. | Only relevant information is saved to the file |  |  |  |



## VLAN ODU

##### Test Description

ODU VLAN Working Mode

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 2 x PCs
* 1x CD with latest AIRMUX manager
* 1 x VLAN Switch

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure 2 (below) for setup connection.  Configure Vlan Switch port 1 as access vlan 100, port 2 as trunk.  Open Airmux Manager on "Local\_PC" (ip connection). Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set ingress mode to "Untag all" and egress mode as "Tag vlan 100". |  |  |  |  |
| 2 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Local) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set ingress and egress mode to "Transparent". Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
| 3 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set egress mode as "Tag vlan 200". Perform ping between "Local\_PC" and "Remote\_PC". | ping fail |  |  |  |
| 4 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set egress mode as "Tag vlan 100". Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
| 5 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set Ingress mode to Filter and in the "Allowed VLAN IDs" add the VLAN 200 and VLAN 300. Perform ping between "Local\_PC" and "Remote\_PC". | ping fail |  |  |  |
| 6 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set Ingress mode to Filter and in the "Allowed VLAN IDs" add the VLAN 100. Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
|  |  |  |  |  |  |
| \* Note that some Network Cards have the capability to untag packets with VID tag. In this case these cards will reply to pings even if the packets are tagged. The test procedure above was designed to overcome this phenomenon | | | |  |  |



## Provider QinQ ODU

##### Test Description

* Provider ODU functionality

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 1 x PCs
* 1x CD with latest AIRMUX manager
* Packet Generator with 2 ports

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect the packet generator to local PoE and remote PoE according to figure below.   Packet generator port 1configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100  Stream 3: QinQ with Provider ID 2 and Eth type 9100 (Outer tag); Vlan ID 4 and Eth type 8100 (Inner tag)  Packet generator port 2 configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100 |  |  |  |  |
| 2 | Open Airmux Manager on "Management PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->Configuration->VLAN Configuration**.  In "Vlan Configuration Window", set "Ingress Mode" to "Transparent" In "Vlan Configuration Window", set "Egress Mode" to Transparent |  |  |  |  |
| 3 | Open Airmux Manager on "Management PC". Go to **Site configuration (Local) ->Ethernet->ODU VLAN->Configuration->VLAN Configuration.** In "Vlan Configuration Window", set "Ingress Mode" to "Transparent" In "Vlan Configuration Window", set "Egress Mode" to "Provider Tagging" Configure Provider Vlan ID = 2, priority = 6 |  |  |  |  |
| 4 | Run traffic on both packet generator ports | Check on packet generator port 2 receive (remote): 1) Stream 1 is received untagged (no modification) 2) Stream 2 is received untagged (Vlan is stripped) 3) Stream 3 is received without the Provider tag and with Vlan ID 4 and Eth type 8100  Check on packet generator port 1 receive (local): 1) Stream 1 is received with Provider ID 2, Eth type 9100 and priority 6 2) Stream 2 is received with QinQ: Provider ID 2, Eth type 9100 (Outer tag) and priority 6; Vlan ID 3 and Eth type 8100 (Inner tag) |  |  |  |



## QOS

##### Test Description

* Test QoS - Diffserve and 802.1p

##### Test Equipment Required

* 2 x ODUs
* 2 x PoE
* 1 x PC
* 1x CD with latest AIRMUX manager
* Packet Generator to generate packets with different QoS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Configure Airmux-200 B/C link:  CBW-20MHz, Antenna Mode - MIMO, HSS enabled (Link throughput 50Mbps Symmetric). Connect network test equipment (see setup bellow) Connect traffic ports of testing equipment to LAN port of "local" ODU. Connect traffic evaluation port of network testing equipment to LAN port of "remote" ODU |  |  |  |  |
| 2 | Configure Diffserve priorities for two DL streams (from packet generator port 1 to port 2) traffic from test equipment. Highest priority (63) for packets from port 1 for first stream and low priority (0) for packets from port 1 for second stream. Configure 20Mbps for first first stream of traffic. Configure 40Mbps for second stream of traffic. Disable QoS for the Link and run test. | Some high priority marked packet are droped (as link in one direction is ~50Mbps and) |  |  |  |
| 3 | Configure Diffserve priorities for traffic of packet generator. Highest priority (63) for packets from first stream lowest priority (0) for packets of second stream. Configure 20Mbps for first stream. Configure 40Mbps for second stream. Enable QoS Diffserve for the Link. **Real Time**-50%, **Best effort**-50% (Un-check **Near Real** **Time** and **Controlled Load**). run test | High priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 4 | Configure 802.1p priorities for two DL streams (from packet generator port 1 to port 2) traffic from test equipment. Highest priority (6) for packets from port 1 for first stream and low priority (0) for packets from port 1 for second stream. Configure 20Mbps for first stream of traffic. Configure 40Mbps for second stream of traffic. Disable QoS for the Link and run test. | Some high priority marked packet are droped (as link in one direction is ~50Mbps and) |  |  |  |
| 5 | Configure 802.1p priorities for traffic of packet generator. Highest priority (6) for packets from first stream lowest priority (0) for packets of second stream. Configure 20Mbps for first stream. Configure 40Mbps for second stream. Enable QoS 802.1p for the Link. **Real Time**-50%, **Best effort**-50% (Un-check **Near Real** **Time** and **Controlled Load**). run test | High priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 6 | Repeat steps 1-5 for QoS in UL direction (streams from port 2 of packet generator to port 1 of packet generator | High priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 7 | Repeat steps 1-6 for QoS in full-duplex (UL streams and DL streams should work in parallel) | High priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |



# Throughput Acceptance Tests

## IDU LEDs

##### Test Description

Confirm correct behavior of IDU-E or IDU-C front panel leds

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Verify PWR led. Connect IDU to the power source either using the AC power adaptor or to DC source supplying -20 to -60 Green On – Power Supply OK Off – Power off or power failure | Green On – Power Supply OK |  |  |  |
| 2 | Verify ODU led. Connect the IDU to the ODU via CAT5e cable (on the IDU use the interface labeled with "ODU" and on the ODU use the interface labeled with "IDU" Green On – Communication with ODU  Red On – No Communication with ODU | Green On – Communication with ODU |  |  |  |
| 3 | Verify IDU led. Make sure IDU is connected to the ODU, Power LED is Green, ODU LED is Green IDU LED Blinking Orange – Boot Application is running waiting for ODU to complate the boot process IDU LED Green On – IDU is operational IDU LED Red On – Software failure | Power LED - Green On ODU LED - Green On IDU LED - Green On |  |  |  |
| 4 | Verify AIR I/F led. Make sure IDU is connected to the ODU, Power LED is Green, ODU LED is Green, IDU LED is Green at both sides of the link Air LED Green On – In Service Mode Air LED Orange – ODU in one of sync states but not in service Air LED Red On – ODU in not synchronized | Power LED - Green On ODU LED - Green On IDU LED - Green On  Air LED - Green On |  |  |  |
| 5 | Verify Service LED. When E1 or T1 service is configure, make sure that the E1/T1 cable of the external eqipment is connected properly to the E1/T1 port in the IDU.  Green - E1 or T1 line is synchronized Orange - Alarm detected at the opposite site interface; Normal or LOSS Blinking Orange - Local or remote loopback Red - Alarm detected at this site interface  Off - E1/T1 service not configured | E1/T1 LED - Green On |  |  |  |
| 6 | Verify LAN1 LAN2 led. Connect a PC to LAN1 and to LAN2. Make sure the link is synchronized Green On – Ethernet signal detected Green Off – Ethernet signal not detected Orange Blinking – Ethernet Activity | Green On – Ethernet signal detected Green Off – Ethernet signal not detected Orange Blinking – Ethernet Activity |  |  |  |

## Link Installation

##### Test Description

Ensure that Airmux manager is able to install a full link

##### Test Equipment Required

* 2 x ODUs
* 1 x TBC
* 1 x TBD
* 1 x PC, 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Check for continuous single beeps when unit is connected to power trough the IDU | The unit sounds continuous single beeps when connected to power |  |  |  |
| 2 | Check for continuous double beeps when starting link alignment | The unit sounds continuous double beeps |  |  |  |
| 3 | Check for continuous triple beeps on completion of link alignment | When link synchronizes, the unit sounds conntinuous triple beeps |  |  |  |
| 4 | Verify that the link is in installation mode | After link synchronizes, manager shows link in install mode |  |  |  |
| 5 | Use the manager to install the link by running the Instalation wizard. (Defines link parameters: Product Type, Channels [MHz], Link name, , number of streams etc…) | Link parameters defined OK |  |  |  |
| 6 | Complete link installation and verify that link is established | Installation is completed and link is established OK |  |  |  |
| 7 | Ensure that ODUs stop beeping | Beeping stopped |  |  |  |
| 8 | Ensure that the link is in normal mode | Link is configurable (normal mode) |  |  |  |
| 9 | Open link Site configuration and move the link to installation mode. Check that the link is back in installation mode and the ODUs are beeping | Link is back in installation mode and three beeps sound |  |  |  |

## Ping Latency

##### Test Description

Test ping latency (round trip delay) from Local PC to Remote PC

##### Test Equipment Required

* 2 x ODUs
* 1 x TBD
* 1 x TBD
* 2 x PC running Iperf application
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step Num** | **Procedure** | **Expected Results** | **Actual Results** |  | **Comments (or Problems)** |
| 1 | Establish a radio link and make sure link is up and Ethernet service is opened.and run the "Estimated ThroughPut" command from the Maintenance menu | Capacity of the link doesn't droop |  |  |  |
| 2 | Open a command line window at the local PC and ping the IP address of remote PC. Mesure latency to local ODU | average < 9m/s please embedd results to this sheet |  |  |  |

## Latency

##### Test Description

To measure the latency for different packet sizes generated by a Packet Generator. The test method is based on RFC 2544: Benchmarking Terminology for Network Interconnection Devices

##### Test Equipment Required

* 2 x ODUs
* 1 x TBD
* 1 x TBD
* 1 x PC running latest Airmux manager
* 1 x Packet Generator (Like SmartBit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Esstablish a radio link and make sure the link is up.  RSS (dBm) on both side of the link - between -55dBm to -62dBm CBW - 20Mhz Asymetric ratio (Airmux 2000 B&C&X) - 50%/50%. Open etherent service and run the "Estimated ThroughPut" command from the Maintenance menu | Capacity of the link should be stable and expected throughput is according to Airmux LBC. |  |  |  |
| 2 | Connect first port of the packet gerator to the Etherent port of the local ODU and the second port of the packet generator to the Etherent port of the remote ODU |  |  |  |  |
| 3 | Using the "Smart Bit">"Smart application">"latency test", test the UL system latency for packet sizes of 64,512,1514 bytes. In order to get proper latency test results, the test stream should run at least 120 sec. Repeat the test at least 10 times. The reported value should be the average of the tests values. | < 6m/s .Please embedd results to this sheet |  |  |  |
| 4 | Using the "Smart Bit">"Smart application">"latency test", test the DL system latency for or packet sizes of 64,512,1514 bytes. In order to get properlatency test results, the test stream should run at least 120 sec. Repeat the test at least 10 times. The reported value should be the average of the tests values. | < 6m/s .Please embedd results to this sheet |  |  |  |

## Throughput

##### Test Description

Measure FTP performance of Airmux-200, using iperf SW.

When performing throughput tests, it is recommended using a proffesional traffic generator like SmartBit or Ixia and run test according to RFC 2544. Software application (.e.g. Ipref) can also be used   
In case of preferring s/w application, please note that the results might be differennt from the tests with profesional products. This difference is due to PC performances affected by H/W of PC and OS that running on the PC and the capabilities of the s/w applications.  
Note - use the attached iperf application version 1.7.0.  
In order to get more reliable test results, for full duplex test, on each PC run Iperf server for uplink session and iperf client for downlink session. as described in test 3.

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* TBD2 x PC running iperf application
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Establish a radio link and make sure the link is up.  Open AIRMUX manager go to Site Configuration -> Ethernet and and in "Ethernet Ports Configuration" check that the "Current" Etherent duplex rate is the properly (e.g 100Mbps/FD). Cofigure link to dual antenna type and MIMO and Set the Rate [Mbps] to Adaptive Open etherent service and run the "Estimated TroughPut" command from the Maintenance menu | Capacity of the link should be stable and expected throughput is according to AIRMUX LBC. |  |  |  |
| 2 | Save iperf.exe application to c:\ at both remote and local PC's/laptops | iperf.exe is located at c:\ at both sites PC's |  |  |  |
| Test 1: UL Throughput (Remote to Local) | |  |  |  |  |
| 3 | Open a command line window at the **local** PC. Change directory to c:\. Set the local PC to be an FTP Server by using the following command line:  **c:\iperf -s -i1** | FTP Server is set |  |  |  |
| 4 | Open a command line window at the **remote** PC. Change directory to c:\. Set the remote PC to be an FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Client is set |  |  |  |
| 5 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |
| Test 2: DL Throughput (Local to Remote) | |  |  |  |  |
| 6 | Open a command line window at the **remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line:  **c:\iperf -s -i1 -p5005** | FTP Server is set |  |  |  |
| 7 | Open a command line window at the **local** PC. Change directory to c:\. Set the local site to be FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** -**p5005** | FTP Client is set |  |  |  |
| 8 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |
| Test 3: Full Duplex Throughput | |  |  |  |  |
| 9 | Open two command lines window at the **Local** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1** Set the local site to be an FTP cleint by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300 -p5005** | FTP Server and client are set in Local PC |  |  |  |
| 10 | Open two command lines window at the **Remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1 -p5005** Set the local site to be an FTP cleint by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Server and client are set in Remote PC |  |  |  |
| 11 | Cofigure link to dual antenna type and **MIMO**.  Set the Rate [Mbps] to the minimum rate. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |
| 12 | Set the Rate [Mbps] to the maximum. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |
| 13 | Cofigure link to dual antenna type and **Single**.  Set the Rate [Mbps] to the minimum rate. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |
| 14 | Set the Rate [Mbps] to the maximum. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actuall Eth Tput. FTP result not lower then 90% |  |  |  |

1. Ensure that you have a zip file extractor (e.g. WinZip) installed on your computer.



## E1 BER

##### Test Description

Test E1 performance

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PC, 1x CD with latest AIRMUX manager
* 1 x BER tester + hardware loopback

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Configure the link to Ethernet + E1.  Configure "LoopTime" on the local site and "Recovered" on remote site |  |  |  |  |
| 2 | Connect a loopback on the first E1 interface at remote site |  |  |  |  |
| 3 | Connect BER tester to first E1 interface at local site. Configure the loopback to provide the sorce clock (BER meter use it's internal clock) |  |  |  |  |
| 4 | Keep the BER tester connected without changing link parameters for over night | BER tester show E1 performance as OK |  |  |  |
| 5 | Run it again for 24 hours | BER tester show E1 performance as OK |  |  |  |

## Power Up Recovery

##### Test Description

Verify that Airmux-200 always recovers after Power Off and Power On of each unit separately or both of them together and mesure time until service is restored

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Power off the local site ODU by unplugging the WAN connection, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 2 | Measure the time to service - TTR (Time To Recover) until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to recieve Trap via Manager < 50 sec |  |  |  |
| 3 | Power off the local site ODU unit by disconnecting the power cable from the IDU, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 4 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to recieve Trap via Manager < 50 sec |  |  |  |
| 5 | Power off both local and remote units (at the same time) by unplugging the WAN connection, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 6 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to recieve Trap via Manager < 50 sec |  |  |  |
| 7 | Power off both local and remote sites units (at the same time) by disconnect the power cable from the IDU, wait 10 sec, then re-connect the WAN connection. | Link is up again |  |  |  |
| 8 | Measure the time to service - TTR until Ethernet service is resumed. | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec Time to recieve Trap via Manager < 50 sec |  |  |  |

## Factory Setting

##### Test Description

Verify the system will go to default setting

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PC, 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Configure setup to be different from the default (change channel/rate/name etc..) | Link is configurable |  |  |  |
| 2 | Click on "Restore To Factory Settings" on the manager | There is an alert asking to verify you want to go back to factory setting |  |  |  |
| 3 | Verify that after reboot, the relevant site/ODU is restored to the default settings (except from the IP address) | All unit parameters are at default except for the IP address |  |  |  |
| 4 | Repeat the above test including "Set to default IP address" | All unit's parameters are set to default including IP address (10.0.0.120) |  |  |  |

## Diagnostics

##### Test Description

The Get Diagnostics feature collects and writes all link and Manager information (from both sites) into a text file. The file information can be used for link diagnostics and understand the installation environment. The purpose of this feature is to verify that this feature works properly and providing the diagnostic information

##### Test Equipment Required

2 x ODUs, 2 x Airmux-IDUE/Airmux-IDU/PoE, 1 x PC, 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Open the Get Diagnostic information from the HELP menu bar. | A diagnostic information window is opend |  |  |  |
| 2 | Make sure all 3 check boxes (System data, Link Information, Events log) are checked | All 8 check boxes are checked |  |  |  |
| 3 | Click the START button. The system start the collection process and at the end of the process the diagnostic file is saved in thw default directoy "My Documents" | Diagnostic file is saved in "My Documents" directory |  |  |  |
| 4 | Change the directory you want the file to be saved to another directory by clicking on the "File Path"button | Changing "File Path"is enabled |  |  |  |
| 5 | Run step number 3 again and verify the file is saved to the new directory you choose. | Diagnostic file is saved in the new directory |  |  |  |
| 6 | Verify all information represented in the text file is correct according to your link and PC setup | The information represented in the Diagnostic file is equal to the link and PC parameters |  |  |  |
| 7 | Open the Get Diagnostic information from the HELP menu bar. | A diagnostic information window is opend |  |  |  |
| 8 | Check only 2 check boxes (Link Information, Events log) | Only 2 check boxes are checked |  |  |  |
| 9 | Click the START button. The system start the collection process and at the end of the process the diagnostic file is saved in thw default directoy "My Documents" | Diagnostic file is saved in "My Documents" directory |  |  |  |
| 10 | Verify only relevant information is saved to the file. | Only relevant information is saved to the file |  |  |  |

## 1+1

##### Test Description

Testing the hot stand by solution for 1+1 (E1)

##### Test Equipment Required

* 4 x ODUs
* 4 x TBD
* 2 x PC
* 1x CD with latest AIRMUX manager
* 2 x MHS cables and Patch Pannel
* 2 x HSS cable

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Configure 1+1 system consisting of two synchronized links.CBW-20MHz , two different freq.channels with 20MHz difference between them. | One plus One system configured. Two links are up and running and primary link transfer the E1 traffic |  |  |  |
| 2 | Turn OFF the Primary link IDU at site 1 | Secondary link transfer the E1 |  |  |  |
| 3 | Turn On the Primary link IDU at site 1 | Primary link transfer the E1 |  |  |  |
| 4 | Turn OFF the Primary link IDU at site 1 and site 2 | Secondary link transfer the E1 |  |  |  |
| 5 | Turn On the Primary link IDU at site 1 | Secondary link transfer the E1 |  |  |  |
| 6 | Turn On the Primary link IDU at site 2 | Primary link transfer the E1 |  |  |  |

## RPL

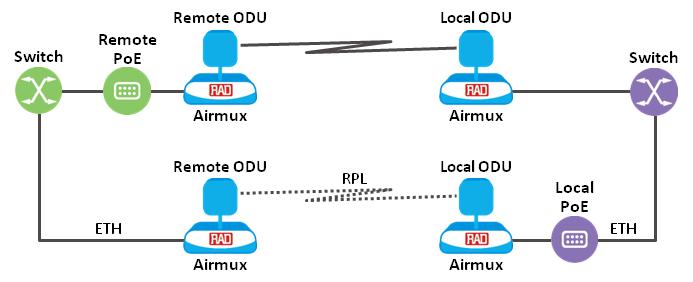
##### Test Description

Test Ethernet ring protection feature

##### Test Equipment Required

* 4 x ODUs
* 2 x TBD
* 2 x PoE
* 2 x PC
* 1x CD with latest AIRMUX manager
* HSS cable

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results | Comments (or problem found) |
| 1 | Configure 1+1 system (Ethernet ring protection) consisting of two synchronized links according to the scheme below. CBW-20MHz , two different freq.channels with 20MHz difference between them. Configure one link (POE) Ring Protection Link (RPL) with Ring VLAN ID: 200. Configure other link (IDU) Ring Link (non RPL) with Ring VLAN ID: 200. Connect PC's\Laptop at both sites. Via AIRMUX Manager observe RPL status. Perform ping from PC LAB1 to Remote PC. | Ring protected system configured. RPL state Idle. Ping replay |  |  |
| 2 | Disconnect Ethernet cable between IDU and ODU (Ring Link) at local site. | RPL state Changed to Active.  Ping Reply. |  |  |
| 3 | Reconnect Ethernet cable between IDU and ODU (Ring Link) at local site. | RPL state Changed to Idle.  Ping Reply. |  |  |
| 4 | Disconnect Ethernet cable between IDU and ODU (Ring Link) at Remote site. | RPL state Changed to Active.  Ping Reply. |  |  |
| 5 | Reconnect Ethernet cable between IDU and ODU (Ring Link) at Remote site. | RPL state Changed to Idle.  Ping Reply. |  |  |
| 6 | Disconnect Ethernet cable between IDU and ODU (Ring Link) at both sites. | RPL state Changed to Active.  Ping Reply. |  |  |
| 7 | Reconnect Ethernet cable between IDU and ODU (Ring Link) at both sites. | RPL state Changed to Idle.  Ping Reply. |  |  |



## VLAN IDU

##### Test Description

IDU VLAN Working Mode Membership (steps 1-6) and LAN port interconnection (steps 7-8)

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 4 x PCs
* 1 x VLAN Switch

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure 1 (below) for setup connection   Vlan Switch configuration: Port 1 = trunk; Port 2 = access vlan 100; Port 3 = access vlan 101  Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**. Configure VLAN Working Mode to "Membership".  In "VLAN Configuration Window", add vlan ID's 100, 101 to LAN 1 in the Membership Table. |  |  |  |  |
| 2 | Open Airmux Manager on "Local\_PC2". Go to **Site configuration (Local) ->Ethernet->IDU VLAN->Configuration->Vlan Configuration**. Configure VLAN Working Mode to "Normal".  In "Vlan Configuration Window", "Ingress Mode", set LAN1 to tag VLAN 100.  In "Vlan Configuration Window", "Ingress Mode", set LAN2 to tag VLAN 101. In "Vlan Configuration Window", "Egress Mode", set LAN1 and LAN2 to untag all. Perform pings between "Local\_PC1" and "Remote\_PC1", and between "Local\_PC2" and "Remote\_PC2". | ping between "Local\_PC1" and "Remote\_PC1" pass ping between "Local\_PC2" and "Remote\_PC2" pass |  |  |  |
| 3 | Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**. In "VLAN Configuration Window", remove vlan ID 101 and add VLAN 201 at LAN 1 in the Membership Table. | ping between "Local\_PC1" and "Remote\_PC1" pass ping between "Local\_PC2" and "Remote\_PC2" fail |  |  |  |
| 4 | Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**. In "VLAN Configuration Window", remove vlan ID 201 and add VLAN 101 at LAN 1 in the Membership Table. | ping between "Local\_PC1" and "Remote\_PC1" pass ping between "Local\_PC2" and "Remote\_PC2" pass |  |  |  |
| 5 | Open Airmux Manager on "PC\_LAB\_2" (ip connection). Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**. In "VLAN Configuration Window", remove vlan ID's 100, 101 from LAN 1 in the Membership Table. In "VLAN Configuration Window", add vlan ID's 100, 101 to LAN 2 in the Membership Table. | ping between "Local\_PC1" and "Remote\_PC1" fail ping between "Local\_PC2" and "Remote\_PC2" fail |  |  |  |
| 6 | Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**. In "VLAN Configuration Window", add vlan ID's 100, 101 to LAN 1 in the Membership Table. | ping between "Local\_PC1" and "Remote\_PC1" pass ping between "Local\_PC2" and "Remote\_PC2" pass |  |  |  |
| 7 | Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Local) ->Ethernet->Port Connections.** In "Port Connections Window", set "LAN1 - LAN2" to "disconnected". Perform ping between "Local\_PC1" and "Local\_PC2" | ping between "Local\_PC1" and "Local\_PC2" fail |  |  |  |
| 8 | Open Airmux Manager on "Local\_PC2" (ip connection). Go to **Site configuration (Local) ->Ethernet->Port Connections.** In "Port Connections Window", set "LAN1 - LAN2" to "connected". Perform ping between "Local\_PC1" and "Local\_PC2" | ping between "Local\_PC1" and "Local\_PC2" pass |  |  |  |
| \* Note that some Network Cards will reply to pings even if the packets are taged, and will untag the packets. The test procedure above was designed to overcome this phenomenon | | | |  |  |



## Provider (QinQ) IDU

##### Test Description

Provider (with and without filtering) IDU fuctionality

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PCs, 1x CD with latest AIRMUX manager
* Packet Generator with 2 ports

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect the packet generator to local IDU and remote IDU according to figure below.   Packet generator port 1configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100  Stream 3: QinQ with Provider ID 2 and Eth type 9100 (Outer tag); Vlan ID 4 and Eth type 8100 (Inner tag)  Packet generator port 2 configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100 |  |  |  |  |
| 2 | Open Airmux Manager on "Management PC". Go to **Site configuration (Remote) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration**.  In "Vlan Configuration Window", "Ingress Mode", set LAN1 and LAN2 to "Transparent" In "Vlan Configuration Window", "Egress Mode", set LAN1 and LAN2 to "Transparent" |  |  |  |  |
| 3 | Open Airmux Manager on "Management PC". Go to **Site configuration (Local) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration.** In "Vlan Configuration Window", "Ingress Mode", set LAN1 and LAN2 to "Transparent" In "Vlan Configuration Window", "Egress Mode", set LAN1 to "Transparent" and LAN2 to "Provider" Configure Provider Vlan ID = 2, priority = 6 |  |  |  |  |
| 4 | Run traffic on both packet generator ports | Check on packet generator port 2 receive (remote): 1) Stream 1 is discarded 2) Stream 2 is discarded 3) Stream 3 is received without the Provider tag and with Vlan ID 4 and Eth type 8100  Check on packet generator port 1 receive (local): 1) Stream 1 is received with Provider ID 2, Eth type 9100 and priority 6 2) Stream 2 is received with QinQ: Provider ID 2, Eth type 9100 (Outer tag) and priority 6; Vlan ID 3 and Eth type 8100 (Inner tag) |  |  |  |
| 5 | Open Airmux Manager on "Management PC". Go to **Site configuration (Local) ->Ethernet->IDU VLAN->Configuration->VLAN Configuration.** In "Vlan Configuration Window", "Ingress Mode", set LAN1 and LAN2 to "Transparent" In "Vlan Configuration Window", "Egress Mode", set LAN1 to "Transparent" and LAN2 to "Provider without filtering" Configure Provider Vlan ID = 2, priority = 6 |  |  |  |  |
| 6 | Run traffic on both packet generator ports | Check on packet generator port 2 receive (remote): 1) Stream 1 is received untagged (no modification) 2) Stream 2 is received 802.1Q with Vlan ID 3 and Eth type 8100 (no modification) 3) Stream 3 is received without the Provider tag and with Vlan ID 4 and Eth type 8100  Check on packet generator port 1 receive (local): 1) Stream 1 is received with Provider ID 2, Eth type 9100 and priority 6 2) Stream 2 is received with QinQ: Provider ID 2, Eth type 9100 (Outer tag) and priority 6; Vlan ID 3 and Eth type 8100 (Inner tag) |  |  |  |



## Provider (QinQ) ODU

##### Test Description

ODU VLAN Working Mode

##### Test Equipment Required

* 2 x ODUs
* 2 x AIRMUX-POE
* 4 x PCs
* 1x CD with latest AIRMUX manager
* 1 x VLAN Switch

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure 2 (below) for setup connection.  Configure Vlan Switch port 1 as access vlan 100, port 2 as trunk.  Open Airmux Manager on "Local\_PC" (ip connection). Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set ingress mode to "Untag all" and egress mode as "Tag vlan 100". |  |  |  |  |
| 2 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Local) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set ingress and egress mode to "Transparent". Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
| 3 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set egress mode as "Tag vlan 200". Perform ping between "Local\_PC" and "Remote\_PC". | ping fail |  |  |  |
| 4 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set egress mode as "Tag vlan 100". Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
| 5 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set Ingress mode to Filter and in the "Allowed VLAN IDs" add the VLAN 200 and VLAN 300. Perform ping between "Local\_PC" and "Remote\_PC". | ping fail |  |  |  |
| 6 | Open Airmux Manager on "Local\_PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->ODU VLAN Configuration**. In "ODU VLAN Configuration Window", set Ingress mode to Filter and in the "Allowed VLAN IDs" add the VLAN 100. Perform ping between "Local\_PC" and "Remote\_PC". | ping reply |  |  |  |
|  |  |  |  |  |  |
| \* Note that some Network Cards have the capability to untag packets with VID tag. In this case these cards will reply to pings even if the packets are tagged. The test procedure above was designed to overcome this phenomenon | | | |  |  |



ODU VLAN Working MOde

## Provider QinQ ODU

##### Test Description

Provider ODU fuctionality

##### Test Equipment Required

* 2 x ODUs
* 2 x AIRMUX-PoE
* 1 x PCs
* 1x CD with latest AIRMUX manager
* Packet Generator with 2 ports

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect the packet generator to local PoE and remote PoE according to figure below.   Packet generator port 1configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100  Stream 3: QinQ with Provider ID 2 and Eth type 9100 (Outer tag); Vlan ID 4 and Eth type 8100 (Inner tag)  Packet generator port 2 configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100 |  |  |  |  |
| 2 | Open Airmux Manager on "Management PC". Go to **Site configuration (Remote) ->Ethernet->ODU VLAN->Configuration->VLAN Configuration**.  In "Vlan Configuration Window", set "Ingress Mode" to "Transparent" In "Vlan Configuration Window", set "Egress Mode" to Transparent |  |  |  |  |
| 3 | Open Airmux Manager on "Management PC". Go to **Site configuration (Local) ->Ethernet->ODU VLAN->Configuration->VLAN Configuration.** In "Vlan Configuration Window", set "Ingress Mode" to "Transparent" In "Vlan Configuration Window", set "Egress Mode" to "Provider Tagging" Configure Provider Vlan ID = 2, priority = 6 |  |  |  |  |
| 4 | Run traffic on both packet generator ports | Check on packet generator port 2 receive (remote): 1) Stream 1 is received untagged (no modification) 2) Stream 2 is received untagged (Vlan is stripped) 3) Stream 3 is received without the Provider tag and with Vlan ID 4 and Eth type 8100  Check on packet generator port 1 receive (local): 1) Stream 1 is received with Provider ID 2, Eth type 9100 and priority 6 2) Stream 2 is received with QinQ: Provider ID 2, Eth type 9100 (Outer tag) and priority 6; Vlan ID 3 and Eth type 8100 (Inner tag) |  |  |  |



## QOS

##### Test Description

Test QoS - Diffserve and 802.1p

##### Test Equipment Required

* 2 x ODUs
* 2 x TBD
* 1 x PC
* 1x CD with latest AIRMUX manager
* Packet Generator to generate packets with different QoS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | ConfigureAirmux-400 B/C link:  CBW-20MHz, Antenna Mode - MIMO, HSS enabled (Link throughput 50Mbps Symmetric). Connect network test equipment (see setup bellow) Connect traffic ports of testing equipment to LAN port of "local" ODU. Connect traffic evaluation port of network testing equipment to LAN port of "remote" ODU |  |  |  |  |
| 2 | Configure Diffserve priorities for two DL streams (from packet generator port 1 to port 2) traffic from test equipment. Highest priority (63) for packets from port 1 for first stream and low priority (0) for packets from port 1 for second stream. Configure 20Mbps for first first stream of traffic. Configure 40Mbps for second stream of traffic. Disable QoS for the Link and run test. | Some high priority marked packet are droped (as link in one direction is ~50Mbps and) |  |  |  |
| 3 | Configure Diffserve priorities for traffic of packet generator. Highest priority (63) for packets from first stream lowest priority (0) for packets of second stream. Configure 20Mbps for first stream. Configure 40Mbps for second stream. Enable QoS Diffserve for the Link. **Real Time**-50%, **Best effort**-50% (Un-check **Near Real** **Time** and **Controlled Load**). run test | high priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 4 | Configure 802.1p priorities for two DL streams (from packet generator port 1 to port 2) traffic from test equipment. Highest priority (6) for packets from port 1 for first stream and low priority (0) for packets from port 1 for second stream. Configure 20Mbps for first first stream of traffic. Configure 40Mbps for second stream of traffic. Disable QoS for the Link and run test. | Some high priority marked packet are droped (as link in one direction is ~50Mbps and) |  |  |  |
| 5 | Configure 802.1p priorities for traffic of packet generator. Highest priority (6) for packets from first stream lowest priority (0) for packets of second stream. Configure 20Mbps for first stream. Configure 40Mbps for second stream. Enable QoS 802.1p for the Link. **Real Time**-50%, **Best effort**-50% (Un-check **Near Real** **Time** and **Controlled Load**). run test | high priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 6 | Repeat steps 1-5 for QoS in UL direction (streams from port 2 of packet generator to port 1 of packet generator | high priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |
| 7 | Repeat steps 1-6 for QoS in full-duplex (UL streans and DL streams should work in parallel) | high priority marked packets are prioritized (actual rate of high priority packets is 20 Mbps). |  |  |  |



## Local Connection to Manager

##### Test Description

Verify the user can login to the ODU via the manager in local connection mode. In this mode the PC should be connected directly to the ODU and not to the network

##### Test Equipment Required

* 1 x ODU
* 1 x TBD
* 1 x PC
* 1x CD with latest AIRMUX manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Connect a laptop directly to the IDU or PoE that connected to the ODU. Verify that PC is connected only to the IDU/PoE and not to other device in the network |  |  |  |  |
| 2 | Run the AIRMUX manager and select "Local Connection". Select the required User Level and enter the passoword | A "Login" window will appear |  |  |  |
| 3 | In the Login window do not check the "Enable Read/Write permissions" and click OK. Verify that you can login to the unit however you can not set or change any parameter | User can login to the unit and can not change or set any parameter |  |  |  |
| 4 | Logout from the AIRMUX manager and login again. Select "Local Connection". Select the required User Level and enter the password | A "Login" window will appear |  |  |  |
| 5 | In the Login window select the "Enable Read/Write permissions" and click OK. Verify that you can login to the unit and you can set or change any parameter according to local connection and user type permissions | User can login to the unit and can change or change parameters according to local connection and user type permissions |  |  |  |

## Tx Power

##### Test Description

To measure theTX power of the Airmux-200 system.  
A link between Local & Remote is established. System works in adaptive rate by default. Set to fix rate for each modulation that is going to be tested.  
Please refer to LBC section to verify what is the maximum TX power for each rate/modulation according to the freuency band (regulation) that is used.  
The attenuation in antenna port 1 and antenna port 2 must be the same, so the RSS levels of the radio are equal and we don’t have any significative difference in the radio chains.

##### Test Equipment Required

* 2 x ODUs
* 2 x AIRMUX-PoE
* 1 x PC
* 1x CD with latest AIRMUX manager
* 1 x Power Meter
* 1 x 30dB RF attenuator
* 1 x 40dB RF attenuator
* RF Step attenuator
* RF Splitter
* 7 x RF cables

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results | Comments (or Problems) |
| 1 | Establish a link between the Local and Remote units. Set the required channel bandwith and UL/DL ratio (duty cycle) 50%/50%. |  |  |  |
| 2 | Set the Local unit to HSS Master |  |  |  |
| 3 | 40 dB high power external attenuator is necessary to avoid damage to the RF power meter and spectrum analyzer. The attenuation of the attenuator and the RF cables must be measured using a signal generator at the requried frequency before the test in order to consider it in the total TX power calculation |  |  |  |
| 4 | Using a variable attenuator, set the attenuation between the Local and Remote units to maximum, verify that the link remains up. |  |  |  |
| 5 | Calibrate the Power Meter (Do not use any offset in the Power Meter) |  |  |  |
| 6 | Set the Duty Cycle in the Power Meter to 45%. There is an option of using a Spectrum analyzer, measure the actual duty cycle. |  |  |  |
| 7 | Run "Estimated Throughput" for 60 seconds in order to fill the air frame |  |  |  |
| 8 | Record the power meter reading. The TX power measurment can be +/-2dB from expected |  |  |  |





|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Example: TX power modulation | | | | | | | | |
| TX Power | RSSI | Air Rate | Modulation | Cable loss (dBm) | Splitter Loss (dBm) | Attenuator 2 (dBm) | TOTAL Attenuation | TX Power Calculation Result |
| 25 |  | 16 | BPSK ½ | 5 | 5 | 40 | -40 |  |
| 25 |  | 26 | QPSK ½ | 5 | 5 | 40 | -40 |  |
| 25 |  | 39 | QPSK ¾ | 5 | 5 | 40 | -40 |  |
| 24 |  | 52 | 16QAM ½ | 5 | 5 | 40 | -40 |  |
| 21 |  | 78 | 16QAM ¾ | 5 | 5 | 40 | -40 |  |
| 19 |  | 104 | 64QAM 2/3 | 5 | 5 | 40 | -40 |  |
| 18 |  | 117 | 64QAM ¾ | 5 | 5 | 40 | -40 |  |
| 18 |  | 130 | 64QAM 5/6 | 5 | 5 | 40 | -40 |  |

Airmux-5000 – Point-to-Multipoint Radio

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# 

# Introduction

## Purpose

This document describes the tests that RAD has performed successfully to demonstrate the proper functionality of the Airmux-5000 high capacity point-to-multipoint wireless system.

## Scope

This ATP is updated to Airmux-5000 v. 4.1.60 GA. In case of using older version, some of the features may not exist and cannot be tested.

This document contains details of all tests required for the product POC, designed to use a minimum of equipment.

## Required Test Equipment

| Function | Product | Description | Qty | Comments |
| --- | --- | --- | --- | --- |
| Radios | ODU | Airmux-5000 Connectorized/Embedded Radio | 2 |  |
| Indoor unit | PoE | PoE device 100BaseT/GbE interface for Airmux radios | 2 |  |
| Ethernet Cables | Eth. Cables | Eth. Cables – RJ-45 connectors. - 2 meters | 4 |  |
| RF Cable | RF Cable | RF Cable with SMA Connectors - 1 meter | 2 |  |
| N-Type to SMA adaptor | N-Type Adaptor | N-Type Adaptor (male) to SMA (Female). | 4 |  |
| Attenuators | Attenuators | 40 dB Attenuators | 2 |  |
| Attenuators | Attenuators | 30 dB Attenuators | 2 |  |
| Traffic Generator | Traffic Generator | Support RFC-2544 & QoS tests. Gigabit Ethernet Module | 1 | Mandatory for FRC-2544 tests (e.g.; IXIA, SmartBit with 1000BaseT module) |
| Switch | Switch | Manageable Switch - Support VLAN | 1 | Manageable switch for VLAN Test in case traffic generator is not available |
| PC | PC | PC with latest Airmux Manager | 2 |  |

The Iperf (Tput) software application is embedded within.

# POC Tests

## Connectivity

##### Test Description

Confirm connectivity to HBS and HSU unit

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Verify PWR LED on PoE | Connect the PoE to the power source. On the PoE unit verify the status of the "POWER" LED  Green On – Power OK Off – Power off or power failure |  |  |  |
| 2 | Verify power to ODU | Connect the PoE to the ODU via CAT5e cable (on the PoE use the interface labeled with "P-LAN-Out" and on the ODU use the interface labeled with "IDU". On the ODU unit, check the status of the green LED on the RG-45  Blinking green – power and connection with PoE  Off – No connection with PoE |  |  |  |
| 3 | IP connectivity to ODU | Connect a PC to the LAN - IN port of the PoE. Open a command line window on the PC at the HBS site and ping the IP address of the ODU (default IP address is 10.0.0.120). Make sure the PC and the ODU are on the same subnet. Ping replay - communication with ODU is OK Time Out - no communication with ODU Repeat the same test for the HSU unit |  |  |  |

## Link Installation

##### Test Description

Ensure that user can perform a full link installation using the Airmux manager

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 1 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect a PC that running the Airmux manager to the HBS. Login to the HBS and click on the Activate button to initiates an activation Wizard. Set all the relevant parameters to the link and when installation wizard is complete, verify that the HBS start transmission by checking that the "Status" parameter on the "Sector" windows changed from Inactive to Active | The HBS start transmission the "Status" parameter on the "Sector" windows changed from Inactive to Active |  |  |  |
| 2 | Connect the HSU to the PoE and power it up. Check for continuous single beep and a pause when unit is connected to power through the PoE | The unit sounds continuous single beep and a pause when connected to power |  |  |  |
| 3 | Check for continuous two beeps and a pause for a signal quality increased when starting link alignment | The unit sounds continuous two beeps and a pause |  |  |  |
| 4 | Check for three beeps and a pause that indicates 'best signal so far' on completion of link alignment | When link synchronizes, the unit sounds continuous three beeps and a pause |  |  |  |
| 5 | On the manager verify that the link with the HSU is established and that the HSU appear in the HSU window | After link synchronizes, manager shows the new HSU in the HSU window |  |  |  |
| 6 | Use the manager to complete the installation of the link and register the HSU to the HBS by running the register wizard of the HSU (Defines link parameters: Name, Location, Number of time slots, etc…) | HSU parameters defined OK |  |  |  |
| 7 | Complete registration wizard and verify that the HSU is register to the HBS | Registration is completed and link is established OK |  |  |  |
| 8 | Ensure that HSU stop beeping | Beeping stopped |  |  |  |
| 9 | Ensure that the HSU is register and that the "Tput" bar on the HSU window show the throughput of the link | HSU is in registration status |  |  |  |
| 10 | Right click on the HSU icon and select "Deregister". Check that the link is up, the HSU is beeping and the HSU is not register | HSU is not register and it sound three beeps |  |  |  |

## Latency

##### Test Description

To measure the system latency for different packet sizes generated by a Packet Generator. The test method is based on RFC 2544: Benchmarking Terminology for Network Interconnection Devices

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 1 x PC
* 1x CD with latest Airmux manager
* 1 x Packet Generator (Like SmartBit)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Step Num** | **Procedure** | **Expected Results** | **Actual Results** |  | **Comments (or Problems)** |
| 1 | Establish a radio link between HBS and HSU and make sure the link is up, the HSU is register and the HSU has Ethernet service of 32 time slots.  Link parameters: \* RSS (dBm) on both side of the link is between -55dBm to -62dBm \* CBW - 20Mhz \* Asymetric ratio - 50%/50%. Open Ethernet service and run the "Estimated ThroughPut" command from the Maintenance menu | Link is stable and expected throughput is according to Airmux LBC. |  |  |  |
| 2 | Connect first port of the packet generator to the Ethernet port of the local ODU and the second port of the packet generator to the Ethernet port of the remote ODU |  |  |  |  |
| 3 | Using the "Smart Bit">"Smart application">"latency test", test the UL system latency for packet sizes of 64,512,1514 bytes. In order to get proper latency test results, the test stream should run at least 120 sec. Repeat the test at least 10 times. The reported value should be the average of the tests values. |  |  |  |  |
| 4 | Using the "Smart Bit">"Smart application">"latency test", test the DL system latency for or packet sizes of 64,512,1514 bytes. In order to get poroper latency test results, thetest stream should run at least 120 sec. Repeat the test at least 10 times. The reported value should be the average of the tests values. | < 6m/s .Please copy the results to this sheet |  |  |  |

## Throughput

##### Test Description

Measure FTP performance of Airmux-5000, using iperf SW.

When performing throughput tests, it is recommended using a professional traffic generator like SmartBit or Ixia and run test according to RFC 2544. Software application (.e.g. Iperf) can also be used   
In case of preferring s/w application, please note that the results might be different from the tests with professional products. This difference is due to PC performances affected by H/W of PC and OS that running on the PC and the capabilities of the s/w applications.  
Note - use the attached Iperf application version 1.7.0.  
In order to get more reliable test results, for full duplex test, on each PC run Iperf server for uplink session and v client for downlink session. as described in test 3.

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 1x CD with latest Airmux manager
* 2 x PC running Iperf application

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Establish a radio link between HBS and HSU and make sure the link is up, the HSU is register and the HSU has Ethernet service of 16 time slots or 32 time slots (max throughput).  Link parameters: \* RSS (dBm) on both side of the link is between -55dBm to -62dBm \* CBW - 20Mhz \* Asymmetric ratio - 50%/50%. \* Configure HBS and HSU to dual antenna type and MIMO. Open Airmux manager on HBS and HSU, go to Site Configuration -> Ethernet and in "Ethernet Ports Configuration" check that the "Current" Ethernet duplex rate is 100Mbps/FD (in HBS can be 1Gbps in case that GbE PoE is connected).  Verify that the same Ethernet speed is status appear in the local PC that connected to the unit. | Link is stable |  |  |  |
| 2 | Run the "Estimated Throughput" command from the HSU menu. Check that the DL and UL throughput is as expected | Throughput is as expected according to Airmux LBC |  |  |  |
| 3 | Save iperf.exe application to c:\ on both remote and local PC's/laptops | iperf.exe is located at c:\ at both sites PC's |  |  |  |
| Test 1: UL Throughput (HSU to HBS) | |  |  |  |  |
| 4 | Open a command line window at the **local** PC. Change directory to c:\. Set the local PC to be an FTP Server by using the following command line:  **c:\iperf -s -i1** | FTP Server is set |  |  |  |
| 5 | Open a command line window at the **remote** PC. Change directory to c:\. Set the remote PC to be an FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Client is set |  |  |  |
| 6 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| Test 2: DL Throughput (HBS to HSU) | |  |  |  |  |
| 7 | Open a command line window at the **remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line:  **c:\iperf -s -i1 -p5005** | FTP Server is set |  |  |  |
| 8 | Open a command line window at the **local** PC. Change directory to c:\. Set the local site to be FTP client by using the following command line:  **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** -**p5005** | FTP Client is set |  |  |  |
| 9 | Start test by running iperf server and client on the local and remote pc. Verify using NMS, that UL Ethernet traffic equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| Test 3: Full Duplex Throughput | |  |  |  |  |
| 10 | Open two command lines window at the **Local** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1** Set the local site to be an FTP client by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300 -p5005** | FTP Server and client are set in Local PC |  |  |  |
| 11 | Open two command lines window at the **Remote** PC. Change directory to c:\. Set the local site to be an FTP Server by using the following command line: **c:\iperf -s -i1 -p5005** Set the local site to be an FTP client by using the following command line: **c:\iperf -c <ip address of iperf server> -P10 -i1 -t 300** | FTP Server and client are set in Remote PC |  |  |  |
| 12 | Configure link to dual antenna type and **MIMO**.  Set the Rate [Mbps] to the minimum rate. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| 13 | Set the Rate [Mbps] to the maximum. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| 14 | Configure link to dual antenna type and **Single**.  Set the Rate [Mbps] to the minimum rate. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |
| 15 | Set the Rate [Mbps] to the maximum. Start test by running iperf server and client on the local and remote pc. Verify using NMS, that Ethernet traffic full duplex equals to actual Eth Tput Verify FTP expected result. **Note: test run 300s=5min** | NMS Ethernet traffic full duplex equals to actual Eth Tput. FTP result not lower then 90% |  |  |  |



## Power Up Recovery

##### Test Description

Verify that the Airmux-5000 system recovers after Power Off and Power On of each unit (HBS/HSU) separately or both of units together and measure time until service is restored.  
Note - when using FCC or ETSI bands that support DFS, the restoration time is longer due to the fact that the system scans the spectrum according to ETSI / FCC regulation.

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 1 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect PC1 that running the Airmux manager to the HBS and connect PC2 to the HSU. Ping from PC1 to PC2 and verify that ping replay.  Power off the HBS by unplugging the IDU/ODU cable, wait 10 sec, then re-connect the cable and wait till radio link will come up | Link is up again |  |  |  |
| 2 | Ping from PC1 to PC2 and verify that ping replay. Measure the time from power up till until Ethernet service is recovered | Time to full service (Ethernet) < 62 sec  Time to full link (Radio Link Established) < 60 sec |  |  |  |
| 3 | Power off the HSU unit by disconnecting the power cable from the PoE, wait 10 sec, then re-connect the power cable. | Link is up again |  |  |  |
| 4 | Ping from PC1 to PC2 and verify that ping replay. Measure the time from power up till until Ethernet service is recovered | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec |  |  |  |
| 5 | Power off both HBS and HSU units (at the same time) by unplugging the IDU/ODU cables, wait 10 sec, then re-connect the cable . | Link is up again |  |  |  |
| 6 | Ping from PC1 to PC2 and verify that ping replay. Measure the time from power up till until Ethernet service is recovered | Time to full service (Ethernet) < 62 sec  Time to full link (Radio Link Established) < 60 sec |  |  |  |
| 7 | Power off both HBS and HSU units (at the same time) by disconnect the power cable from the PoE wait 10 sec, then re-connect the power cable | Link is up again |  |  |  |
| 8 | Ping from PC1 to PC2 and verify that ping replay. Measure the time from power up till until Ethernet service is recovered | Time to full service (Ethernet) < 62 sec Time to full link (Radio Link Established) < 60 sec |  |  |  |

## Diagnostics

##### Test Description

The Get Diagnostics feature collects and writes all link and Manager information (from both sites) into a text file. The file information can be used for link diagnostics and understand the installation environment. The purpose of this feature is to verify that this feature works properly and providing the diagnostic information.

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 1 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or problem found) |
| 1 | Open the Get Diagnostic information from the manager's main menu bar | A diagnostic information window is opened |  |  |  |
| 2 | Make sure that all the check boxes (System data, Event Log, Sector Information etc..) and the checked box of all the HSUs in the sector are checked | All check boxes are checked |  |  |  |
| 3 | Click the START button and verify a file named "Diagnostic Information.txt" is saved by default to the directory of "My Documents" | The system start Read/Write process and at the end you have the file saved to "My Documents" |  |  |  |
| 4 | Change the directory you want the file to be saved by clicking on the "Output Path" button | file path was changed |  |  |  |
| 5 | Run step number 3 again and verify the file is saved to the new directory you choose. | The file was saved to the new directory |  |  |  |
| 6 | Open the file and verify that all information represented in the text file is correct according to the links and PC configuration | The information represented in the Diagnostic file is equal to the link and PC configuration |  |  |  |
| 7 | Open the Get Diagnostic information from the manager's main menu bar | A diagnostic information window is opened |  |  |  |
| 8 | Make sure to check only 2 check boxes (System Data, Sector Information) | Only 2 check boxes are checked |  |  |  |
| 9 | Click the START button and verify a file named "Diagnostic Information.txt" is saved by default to the directory of "My Documents" | The system start Read/Write process and the diagnostic file saved in the directory choose directory |  |  |  |
| 10 | Verify only the relevant information is saved to the file. | Only relevant information is saved to the file |  |  |  |

## HSU Connectivity

##### Test Description

Check the option to enable/ disable wireless connections between HSUs

##### Required Test Equipment

* 2 Laptop PCs
* 2 x HSU
* 1 x HBS

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect a management PC that running the Airmux manager to the HBS. Connect to HSU1 and configure a service from 1-8 time slots. Connect to HSU2 and configure a service from 1-8 time slots. Make sure that HSU1 & HSU2 are registered | HSU1&HSU2 are registered and have a service |  |  |  |
| 2 | Connect PC1 to the HSU1 and Connect PC2 to the HSU2. Ping from PC1 to PC2 and verify ping replay. | Ping from PC2 to PC1 and vice versa and verify that the pings are replied |  |  |  |
| 3 | From the Airmux manager go to HSU connection menu table and disable the connection between HSU1 and HSU2 | Ping from PC2 to PC1 and vice versa and verify that pings are not replied |  |  |  |
| 4 | From the Airmux manager go to HSU connection menu table and enable back the connection between HSU1 and HSU2 | Ping from PC2 to PC1 and vice versa and verify that pings are replied |  |  |  |

## Disabling Management HSU to HBS

##### Test Description

Check the option to enable/ disable management to the HBS from a PC behind HSU.

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 2 x PC, 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect PC1 as management PC that running the Airmux manager to the HBS. Connect to HSU1 and configure a service from 1-8 time slots. Make sure that the HSU is registered | HSU is register and have a service |  |  |  |
| 2 | Connect PC2 as a management PC that running the Airmux manager to the HSU. From PC2 Ping PC1 and verify that PC1 replay. Ping the IP address of the HBS and verify that the HBS replay. Open the Airmux manager and login to the HBS. Verify that HBS is manageable | 1) PC1 replay to ping 2) HBS replay to ping 3) HBS is manageable |  |  |  |
| 3 | From PC1 Airmux manager go to HSU connection menu table and disable the management (MNG) option between HSU to the HBS. From PC2 Ping PC1 and verify that PC1 replay. Ping the IP address of the HBS and verify that the HBS don't replay. Open the Airmux manager on PC2 and login to the HBS. Verify that HBS is not manageable | 1) PC1 replay to ping 2) HBS don't replay to ping 3) HBS is not manageable |  |  |  |
| 4 | From PC1 Airmux manager go to HSU connection menu table and disable the management (MNG) option between HSU to the HBS. From PC2 Ping PC1 and verify that PC1 replay. Ping the IP address of the HBS and verify that the HBS replay. Open the Airmux manager on PC2 and login to the HBS. Verify that HBS is manageable | 1) PC1 replay to ping 2) HBS replay to ping 3) HBS is manageable |  |  |  |

## Disable HSU Traffic

##### Test Description

Check the option to enable/ disable traffic of HSU to the internet / network behind HBS

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 2 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect PC1 as management PC that running the Airmux manager to the HBS. Connect to HSU1 and configure a service from 1-8 time slots. Make sure that the HSU is registered | HSU is register and have a service |  |  |  |
| 2 | Connect PC2 to the HSU. From PC2 Ping PC1 and verify that PC1 replay | PC1 replay to ping |  |  |  |
| 3 | From PC1 Airmux manager go to HSU connection menu table and disable the LAN option between HSU to the HBS. From PC2 Ping PC1 and verify that PC1 don't replay to the ping | PC1 do not replay to ping |  |  |  |
| 4 | From PC1 Airmux manager go to HSU connection menu table and enable the LAN option between HSU to the HBS. From PC2 Ping PC1 and verify that PC1 replay to the ping | PC1 replay to ping |  |  |  |

## VLAN

##### Test Description

Check the Vlan functionality of RW5000 using the following operations:  
Transparent / Tag on Ingress  
Transparent / Untag All / Filter on Egress

***Note****: There are some Network Interface Cards (NIC) that strips the VLAN of the incoming packets that designated to their MAC and replay without VLAN (untagg) instead of reject the packets. For such cases a Layer 2 switch should be connected between the PC on the unit*

##### Required Test Equipment

* 1 x HBS
* 2 x HSU
* 3 x PoE
* 3 x PC
* 1x CD with latest Airmux Manager
* Vlan Switch (e.g. Cisco)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure 1 (below) for setup connection. Configure Vlan Switches A and B as following: Set Port 1 as Trunk; Set Port 2 as Access Vlan 3 Connect PC2 as management PC that running the Airmux manager directly to the HBS and configure management vlan 3 on HBS. Connect Vlan Switch B between PC2 and HBS. Connect to HSU1 and configure 8 time slots service. Connect to HSU2 and configure 8 time slots service. Check that both HSU's are registered. From the Airmux manager go to HSU connection menu table and enable the connection between HSU1 and HSU2 | HSU1 and HSU2 are registered and have a service |  |  |  |
| 2 | From PC2 Airmux manager go to HSU1 Vlan configuration. Set HSU1 Vlan Mode to "Disabled". From PC2 Airmux manager go to HSU2 Vlan configuration. Set HSU2 Vlan Mode to "Tag".  Set HSU2 Ingress mode to Tag VLAN ID 3, VLAN Priority 7 Set HSU2 Egress mode to "Untag All" Perform ping from PC1 to PC3 Perform ping from PC2 to PC1 Perform ping from PC2 to PC3 | Ping between PC1 and PC3 pass Ping between PC2 and PC1 pass Ping between PC2 and PC3 pass |  |  |  |
| 3 | From PC2 Airmux manager go to HSU2 Vlan configuration. Set HSU2 Ingress Mode to "Transparent". Perform ping from PC1 to PC3 | Ping between PC1 and PC3 fail |  |  |  |
| 4 | From PC2 Airmux manager go to HSU2 Vlan configuration. Set HSU2 Ingress mode to Tag VLAN ID 3, VLAN Priority 7 Set HSU2 Egress mode to "Untag All" Perform ping from PC1 to PC3 | Ping between PC1 and PC3 pass |  |  |  |
| 5 | From PC2 Airmux manager go to HSU1 Vlan configuration. Set HSU1 Vlan Mode to "Tag". Set HSU1 Ingress mode to "Transparent" Set HSU1 Egress mode to "Filter" Allowed Vlan ID 3 Perform ping from PC1 to PC3 | Ping between PC1 and PC3 pass |  |  |  |
| 6 | Change HSU1 Egress Mode to Allowed Vlan ID 40 Perform ping from PC1 to PC3 | Ping between PC1 and PC3 fail |  |  |  |
| 7 | Change HSU1 back to Egress Mode to Allowed Vlan ID 3 Perform ping from PC1 to PC3 | Ping between PC1 and PC3 pass |  |  |  |



## Provider (QinQ)

##### Test Description

Check the QinQ functionality of the Airmux-5000 system

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 2 x PC
* 1x CD with latest Airmux manager
* Packet Generator/Analyzer (2 ports)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure below for setup connection.  Pre-configuration: Connect PC as management PC that running the Airmux manager to the HBS. Connect to HSU1 and configure 5 time slots service. Connect to HSU2 and configure 5 time slots service. Check that both HSU's are registered. From the Airmux manager go to HSU connection menu table: Disable the connection between HSU1 and HSU2 Enable the connection between HSU2 and Management  Disconnect the PC from HBS and connect it to HSU2. Connect Packet Generator port 1 to HBS. Connect Packet Generator port 2 to HSU1 | HSU1 and HSU2 are registered and have a service. Management is working from PC connected to HSU2 |  |  |  |
| 2 | From PC Airmux manager go to HSU1 Ethernet->VLAN configuration. SetHSU1 VLAN Mode to "Provider". Set Provider ID = 2, priority = 6 |  |  |  |  |
| 3 | Packet generator port 1 configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100  Stream 3: QinQ with Provider ID 2 and Eth type 9100 (Outer tag); Vlan ID 4 and Eth type 8100 (Inner tag) |  |  |  |  |
| 4 | Packet generator port 2 configuration: Stream 1: Untagged Stream 2: 802.1Q with Vlan ID 3 and Eth type 8100 |  |  |  |  |
| 5 | Run traffic on both packet generator ports | Check on packet generator port 2 receive (HSU): 1) Stream 1 is received untagged (no modification) 2) Stream 2 is received 802.1Q with Vlan ID 3 and Eth type 8100 (no modification) 3) Stream 3 is received without the Provider tag and with Vlan ID 4 and Eth type 8100  Check on packet generator port 1 receive (HBS): 1) Stream 1 is received with Provider ID 2, Eth type 9100 and priority 6 2) Stream 2 is received with QinQ: Provider ID 2, Eth type 9100 (Outer tag) and priority 6; Vlan ID 3 and Eth type 8100 (Inner tag) |  |  |  |



## QOS

##### Test Description

Check the QoS (Diffserv and 802.1p) functionality of the Airmux-5000 system

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE
* 2 x PC
* 1x CD with latest Airmux manager
* Packet Generator/Analyzer (2 ports)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Please see figure 2 (below) for setup connection.  Pre-configuration: Connect PC as management PC that running the Airmux manager to the HBS. Connect to HSU1 and configure 20 time slots service. Connect to HSU2 and configure 20 time slots service. Check that both HSU's are registered. From the Airmux manager go to HSU connection menu table: Enable the connection between HSU1 and HSU2 Enable the connection between HSU2 and Management  Disconnect the PC from HBS and connect it to HSU2. Connect Packet Generator port 1 to HBS. Connect Packet Generator port 2 to HSU1 | HSU1 and HSU2 are registered and have a service. Management is working from PC connected to HSU2 |  |  |  |
| 2 | From PC Airmux manager go to HBS Ethernet->QoS configuration. Set QoS Mode to "Vlan". Set the following Queue Priority Mapping: RT = 6-7 NRT = 4-5 CL = 2-3 BE = 0-1 Go to HBS Ethernet->Transmission Ratio configuration Set Transmission Ratio to 50%/50% |  |  |  |  |
| 3 | Create 4 streams on Packet Generator port 1 with VLAN tag and IP header with following parameters: 1) 802.1p = 7; IP Diffserv = 63; rate = 2Mbps 2) 802.1p = 5; IP Diffserv = 47; rate = 3Mbps 3) 802.1p = 3; IP Diffserv = 29; rate = 2Mbps 4) 802.1p = 1; IP Diffserv = 1; rate = 20Mbps |  |  |  |  |
| 4 | Configure port 2 of the packet generator with the same configuration as written in step 3 above |  |  |  |  |
| 5 | From PC Airmux manager go to HSU1 Ethernet->QoS configuration. Set HSU1 QoS Mode to "Enabled". Set queues weights to Downlink and Uplink as following: RT = 20% NRT = 30% CL = 20% BE = 30% Set MIR to "Unlimited" for all queues |  |  |  |  |
| 6 | Test 1: Run traffic on packet generator port 1 (Downlink direction) for 2 minutes. Traffic of BE stream number 4 is above the link capacity | Verify that overloading the BE queue is not affecting higher queues. Check that RT, NRT and CL streams (streams number 1-3) received without traffic loss on Packet Generator port 2 |  |  |  |
| 7 | Test 2: Run traffic on packet generator port 2 (upload direction) for 2 minutes. Traffic of BE stream number 4 is above the link capacity | Verify that overloading the BE queue is not affecting higher queues. Check that RT, NRT and CL streams (streams number 1-3) received without traffic loss on Packet Generator port 1 |  |  |  |
| 8 | From PC Airmux manager go to HBS Ethernet->QoS configuration. Set QoS Mode to "Diffserv". Set the following Queue Priority Mapping: RT = 48-63 NRT = 30-47 CL = 16-29 BE = 0-15 |  |  |  |  |
| 9 | Test 3: Run traffic on generator port 1 (download direction) for 2 minutes. Traffic of BE stream number 4 is above the link capacity | Verify that overloading the BE queue is not affecting higher queues. Check that RT, NRT and CL streams (streams number 1-3) received without traffic loss on Packet Generator port 2 |  |  |  |
| 10 | Test 4: Run traffic on generator port 2 (upload direction) for 2 minutes. Traffic of BE stream number 4 is above the link capacity | Verify that overloading the BE queue is not affecting higher queues. Check that RT, NRT and CL streams (streams number 1-3) received without traffic loss on Packet Generator port 1 |  |  |  |



##### QoS Test

* Test 1: Download direction, classification according to 802.1p
* Test 2: Upload direction, classification according to 802.1p
* Test3: Download direction, classification according to Diffserv
* Test 4: Upload direction, classification according to Diffserv

# Mobility

## POE-ODU Connectivity

##### Test Description

Confirm connectivity to HBS and HSU unit

##### Required Test Equipment

* 1 x HBS
* 1 x HSU
* 2 x PoE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Verify PWR led on PoE | Connect the PoE to the power source. On the PoE unit verify the status of the "POWER" LED  Green On – Power OK Off – Power off or power failure |  |  |  |
| 2 | Verify power to ODU | Connect the PoE to the ODU via CAT5e cable (on the PoE use the interface labeled with "P-LAN-Out" and on the ODU use the interface labeled with "IDU". On the ODU unit, check the status of the green LED on the RG-45  Blinking green – power and connection with PoE  Off – No connection with PoE |  |  |  |
| 3 | IP connectivity to ODU | Connect a PC to the LAN - IN port of the PoE. Open a command line window on the PC at the HBS site and ping the IP address of the ODU (default IP address is 10.0.0.120). Make sure the PC and the ODU are on the same subnet. Ping replay - communication with ODU is OK Time Out - no communication with ODU Repeat the same test for the HSU unit |  |  |  |

## Link Installation

##### Test Description

Ensure that user can perform a full link installation using the Airmux manager.

##### Required Test Equipment

* 1 x HBS
* 1 x HMU
* 2 x PoE
* 1 x PC
* 1x CD with latest Airmux manager

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect a PC that running the Airmux manager to the HBS. Login to the HBS and click on the Activate button to initiates an activation Wizard. Set all the relevant parameters to the link and verify that the configuration of the radio is according to the radio planning. When installation wizard is complete, verify that the HBS start transmission by checking that the "Status" parameter on the "Sector" windows changed from Inactive to Active | The HBS start transmission the "Status" parameter on the "Sector" windows changed from Inactive to Active |  |  |  |
| 2 | Go to the HBS configuration menu and click on the "Mobility" tab. Configure the "Type" to "Mobility". Select the required "Level", number of "Time Slots DL", number of "Time Slots UL", "Number" of HSUs for each level and the "Maximum Distance" for mobility devices | On the "Level" table, the number of HMUs and number of time slots per HMU should appear |  |  |  |
| 3 | On the manager verify that the link between the HBS and HMU is established and that the HMU appear in the HSUs window | After link synchronizes, manager shows the new HMU in the HSUs window |  |  |  |
| 4 | Ensure that the HMU immediately register and that the HBS assign to the HMU the number of time slots as configured. On the "Tput" bar on the HMU window verify the throughput of the link | HMU is in registration status and display the actual "Tput" of the link |  |  |  |
| 5 | Connect a PC to the HBS and another PC to the HMU and make sure that the PCs are on the same subnet mask. From the PC behind the HBS, ping to PC behind the HMU and verify that ping replied | Ping replay and stable |  |  |  |

## Handover between HBSs

##### Test Description

Check the hand over between HBSs. In this test all the NOC's PCs and the HBSs that provide coverage to the vehicle should be connected to the same wired network (switch) in order to avoid delay between the the HBSs to the NOC's PC.

In addition this test should be done after approving that the HBSs provide full coverage in all the geographical areas where the vehicle drives according to the radio planning.

##### Required Test Equipment

* 2 PCs/Laptops
* 1 x HMU
* 2 x HBS
* Mobile vehicle
* 3 x PoEs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Connect a management PC that running the Airmux manager to the switch in the NOC where all the HBSs are connected. Make sure that the following parameters are the same in all the HBSs: \* Network ID (part of the Sector ID) \* Channel Bandwidth \* Diversity \* Mobility service (Level, distance, number of time slots and number of HMUs per level) Verify that the HBSs provide full coverage in all the geographical areas where the vehicle drives according to the radio planning. | HBSs provide full coverage in all the geographical areas where the vehicle drive |  |  |  |
| 2 | Start the video camera on the vehicle and from the NOC's PC, check that the quality of the video stream camare is good and stable. Start driving the vehicle along the path and check that the quality of the video stream of the camare is good and stable while the vehicle is driving. | Quality of each camera is good while the vehicle is driving |  |  |  |
| 3 | Continue to drive with the vehicle along the path and verify that the HMU leave the current HBS and do handover to another HBS. Verify that the handover is fast and after the HMU complate the handover between the HBSs, the quality of the video stream coming back to normal. | Fast hand over between the HBSs |  |  |  |

## Throughput

##### Test Description

Measure TCP performance of Airmux-5000 with Smart Bandwidth Management protocol, using Iperf SW. The feature of SBM for mobility is supported from release 3.4.85 and above.

When performing throughput tests, it is recommended using a professional traffic generator like SmartBit or Ixia and run test according to RFC 2544. Software application (.e.g. Ipref) can also be used

In case of preferring s/w application, please note that the results might be different from the tests with professional products. This difference is due to PC performances affected by H/W of PC and OS that running on the PC and the capabilities of the s/w applications.

Note - use the attached Iperf application version 1.7.0.

In order to get more reliable test results, for full duplex test, on each PC run Iperf server for uplink session and Iperf client for downlink session. as described in test 3.

##### Required Test Equipment

1 x HBS

2 x HMU (50M)

3 x PoE

1x CD with latest Airmux manager

3 x PC running Iperf application

3 x PoEs

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Step Num | Procedure | Expected Results | Actual Results |  | Comments (or Problems) |
| 1 | Establish a radio link between HBS and two HMUs. Make sure the each radio link is up and each HMU is register to the HBS. HMU1 has Ethernet service with 31 time slots and HMU2 has service with 31 time slots.  Link parameters: \* RSS (dBm) on both side of the link is between -55dBm to -62dBm \* CBW - 20Mhz \* Asymmetric ratio - 50%/50%. \* Configure the HBS and HMU to dual antenna type and diversity Connect with Airmux manager to HBS and the HMU, go to Site Configuration -> Ethernet and in "Ethernet Ports Configuration" check that the "Current" Ethernet duplex rate is 100Mbps/FD (in HBS can be 1Gbps in case that GbE PoE is connected).  Verify that the same Ethernet speed status appears in the local PC that connected to the unit | Link is stable and Eth speed in the PC and the unit is the same |  |  |  |
| 2 | Run the "Estimated Throughput" command from the HMUs menu. Check that the DL and UL estimated throughput is as expected | Throughput is as expected according to Airmux LBC |  |  |  |
| 3 | Save the Iperf.exe application on c:\ directory on the local PC's/laptop that connected to the HBS, remote PC1 that connected to HMU1 and remote PC2 that connected to HMU2 | Iperf.exe is located at c:\ directory on each PC |  |  |  |
| Test 1: UL Throughput (HMU to HBS) | |  |  |  |  |
| 4 | Open a command line window on the local PC. Change directory to c:\.  Set the Iperf on local PC to be a TCP Server to both remote PC1 and remote PC2 by using the following command line:  Server to remote PC1 c:\Iperf -s -i1 -p5001 On the same local PC open another Iperf TCP Server by using the following command line:  Server to remote PC2 c:\Iperf -s -i1 -p5005 Note - the command p5001 set the first TCP server to run on port 5001 and the command p5005 set the second TCP server to run on port 5005. Need to make sure that both ports are not occupied in the PC | TCP Servers are set |  |  |  |
| 5 | Open a command line window at the remote PC1 & remote PC2. Change directory to c:\. Set the remote PC1&PC2 to be a TCP client by using the following command line on each PC:  For Remote PC1: c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5001 For Remote PC2: c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5005 | TCP Clients are set |  |  |  |
| 6 | Start test by running the Iperf server and client on the local and remote PCs. Verify the TCP throughput test result on each HMU is as expected Note: test run 300s=5min | TCP throughput test result on each HMU is as expected |  |  |  |
| 5 | On HMU2 change the number of time slot in the UL to 1 (HMU1 remains with 31 time slots in UL). In this test generate traffic only from Remote PC1.  Open a command line window at the remote PC1. Change directory to c:\. Set the remote PC1 to be a TCP client by using the following command line:  For Client on Remote PC1 c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5001 Server on Local PC: c:\Iperf -s -i1 -p5001 | TCP Client is set |  |  |  |
| 6 | Start test by running Iperf server and client on the local and remote PC1. Verify that the TCP throughput on HMU1 increase accordingly. Note: test run 300s=5min | TCP throughput on HMU1 increases |  |  |  |
| Test 2: DL Throughput (HBS to HMU) | |  |  |  |  |
| 7 | On HMU1 set number of DL time slots to 31 and on HMU2 set number of DL time slots to 31 Open a command line window at the remote PC1 & 2. Change directory to c:\. Set the remote PC1 & PC2 to be TCP Servers by using the following command line on each PC:  Server on remote PC1: c:\Iperf -s -i1 -p5001 Server on remote PC2 c:\Iperf -s -i1 -p5005 Note - the command p5001 set the first TCP server to run on port 5001and the command p5005 set the second TCP server to run on port 5005. Need to make sure that both ports are not occupied in the PC | TCP Servers are set |  |  |  |
| 8 | Open a command line window at the local PC. Change directory to c:\. Set the local PC to run two TCP clients by using the following command lines:  Client for the server on PC1: c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5001 On the same local PC open another Iperf TCP client by using the following command line:  Client for the server on PC2 c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5005 | TCP clients are set |  |  |  |
| 9 | Start test by running Iperf server and client on the local and remote PCs. On each HMU verify that the TCP throughput is as expected  Note: test run 300s=5min | On each HMU verify that the TCP throughput is as expected |  |  |  |
| 10 | On HMU2 change the number of time slots in DL to 1 (HMU1 remains with 31 time slots in DL). In this test generate traffic only to Remote PC1.  Open a command line window at the remote PC1. Change directory to c:\. Set the remote PC1 to be a TCP server by using the following command line:   Server on remote PC1: c:\Iperf -s -i1 -p5001 Client on local PC: c:\Iperf -c <ip address of Iperf server> -P10 -i1 -t 300 -p5001 | TCP Client and server are set |  |  |  |
| 11 | Start test by running Iperf server and client on the local and remote PC1. Verify that the TCP throughput on HMU1 throughput increase accordingly. Note: test run 300s=5min | TCP throughput on HMU1 increases |  |  |  |



