



# Confidential

## Document Type

- |   |  |
|---|--|
| <input type="checkbox"/> Requirement (RQ)                                     | <input type="checkbox"/> External Specification (ES) |
| <input type="checkbox"/> Internal Specification (IS)                          | <input type="checkbox"/> Design Specification (DS)   |
| <input type="checkbox"/> Test Plan (TP)                                       | <input type="checkbox"/> Release Note (RN)           |
| <input type="checkbox"/> Bug Report (BR)                                      | <input type="checkbox"/> Training Material (TM)      |
| <input checked="" type="checkbox"/> Other <u>Outdoor Test Report 3KM</u> (OT) |  |

## Document ID.

OT-2011-09-1901

## Subject

Outdoor Test Report  
of  
IOP – APM -10xRH

## Revision History

| Rev. | Date          | Author      | Reason for Changes            |
|------|---------------|-------------|-------------------------------|
| 1.0  | Sep. 20, 2011 | Jacky Cheng | • Initial draft(English Ver.) |
|      |               |             | •                             |
|      |               |             | •                             |



# Contents

|                             |    |
|-----------------------------|----|
| 1.0 SCOPE.....              | 1  |
| 1.1 INTRODUCTION.....       | 1  |
| 1.2 DATE/TIME.....          | 1  |
| 1.3 LOCATION.....           | 1  |
| 1.4 EQUIPMENT.....          | 1  |
| 1.5 TOPOLOGY.....           | 1  |
| 2.0 ENVIRONMENT.....        | 2  |
| 2.1 GPS LOCATION.....       | 2  |
| 2.2 FRESNEL ZONE GRAPH..... | 3  |
| 2.3 SPECTRUM.....           | 4  |
| 3.0 TEST RESULTS.....       | 5  |
| 3.1 TEST1 :.....            | 5  |
| 3.2 TEST2.....              | 8  |
| 3.3 TEST3.....              | 11 |
| 3.4 TEST4.....              | 14 |
| 3.5 TEST5.....              | 17 |
| 3.6 TEST6.....              | 20 |
| APPENDIX I.....             | 22 |



## 1.0 Scope

### 1.1 Introduction

This document primarily demonstrates IO-Power APM-10xRH Outdoor Access Point for outdoor test report ◦

### 1.2 Date/Time

- Test Date : 2011/09/19
- Test Time : PM 16:00 ~ PM 19:30

### 1.3 Location

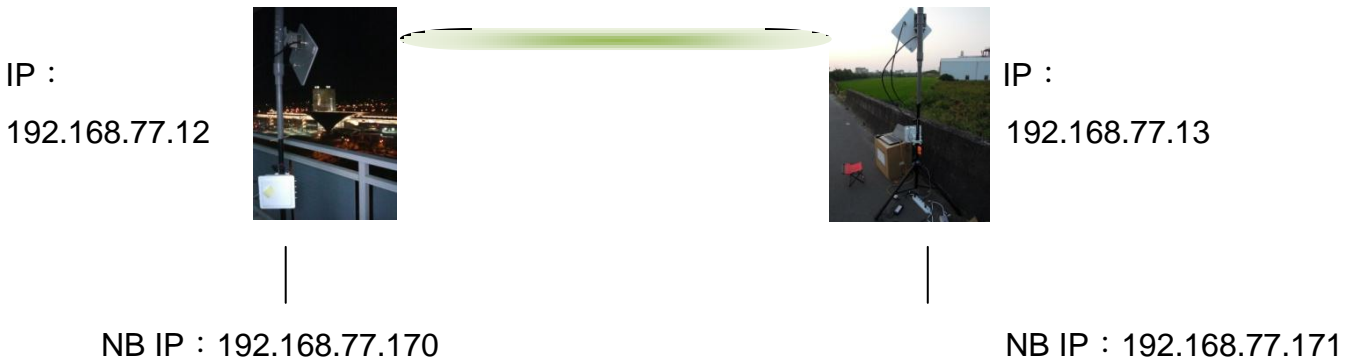
- Test Point A : The high-speed rail station building
- Test Point B : Bamboo bridge

### 1.4 Equipment

- Outdoor AP Device : APM-103R x 2
- Outdoor Antenna : 5GHz 2x2 MIMO 20dBi Panel Antenna x 2
- Test PC : ASUS A43F Series NB x 2
- SW : Windows XP SP3 、IxChariot 5.40
- APM-103R Firmware Version : 1.0(1109.1901)

### 1.5 Topology

- Point to Point





## 2.0 Environment

Of this test, this section describes the environmental condition factor ◦

### 2.1 GPS Location

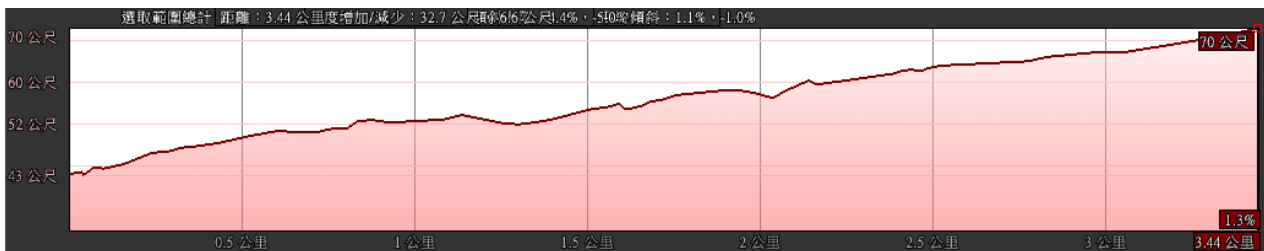
Images1 、"Google Earth GPS Location Mark" ◦

Distance :

Point A- The high-speed rail station building (N24°48'26.40" E121°2'12.72")

Point B- The Bamboo Bridge (N24°47'16.95" E121°3'48.53")

Distance : 3,442m



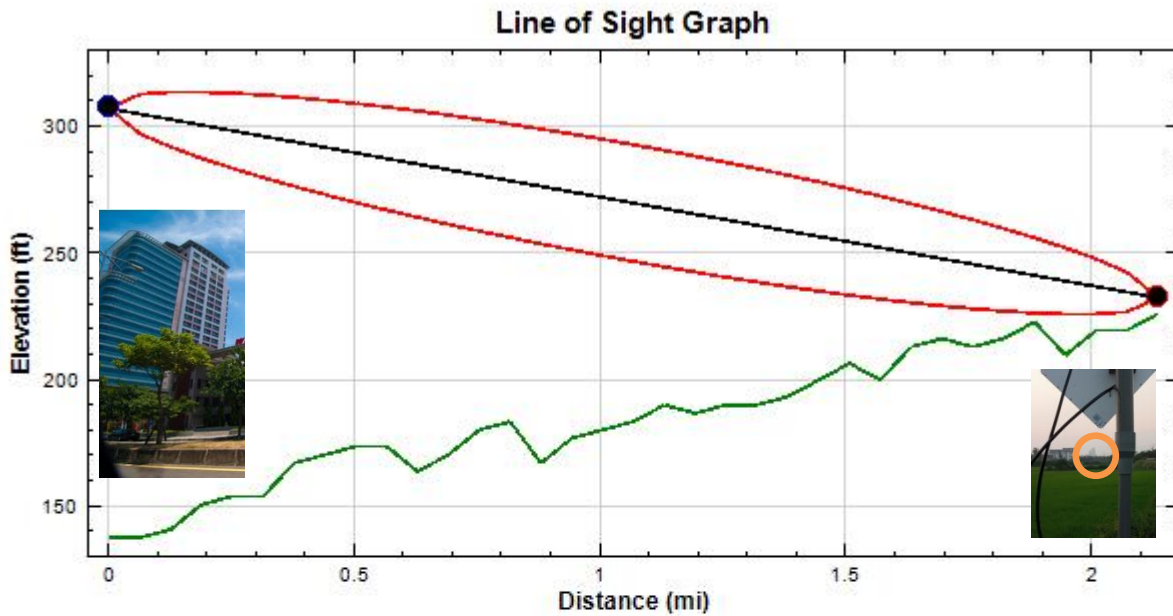


## 2.2 Fresnel Zone Graph

Image2 - "Line of Sight" -

Point A Antenna Height : 170ft (14f)

Point B Antenna Height : 6.6ft (Road Side)



|  |  |   |                            |
|--|--|---|----------------------------|
|  | Elevation Data Line Plot   |   |                            |
|  | Line of Sight Line Plot (Adjusted to Consider Obstruction Caused by Earth Curvature) |   |                            |
|  | First Fresnel Zone Line Plot   |   |                            |
|  | Point 1 Terrain Elevation: 137.80 ft<br>Latitude: 24.807500000077                    | TX/RX Elevation: 170.00 ft<br>Longitude: 121.035833333319 | Total Elevation: 307.80 ft |
|  | Point 2 Terrain Elevation: 226.38 ft<br>Latitude: 24.788333333418                    | TX/RX Elevation: 6.60 ft<br>Longitude: 121.063333333308   | Total Elevation: 232.98 ft |

Earth Curvature Adjustment:  Off  On

Saved Line of Sight Profile Name: **3\_4KM**  
 Approx. Distance Between Points: **2.13 Miles**  
 Earth Obstruction Adjusted For: **0.57 Feet**  
 First Fresnel Zone Peak Radius: **23.04 Feet**  
 Transmission Frequency: **5.220.000000 MHz**



## 2.3 Spectrum

Main Test Item :

Use the Frequency is 5,220MHz 、IEEE802.11A/N Channel 44

Noise Level is -98dBm

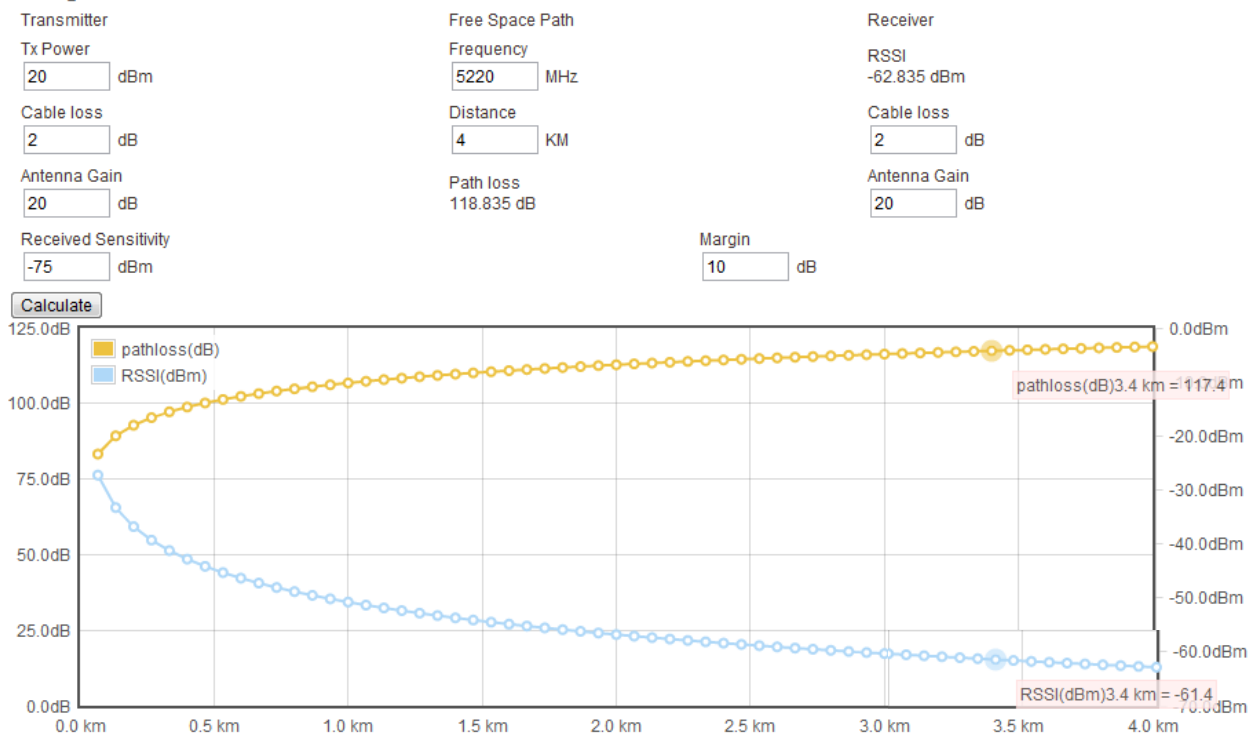
RF TX power is 20dBm

TX/RX Antenna Gain is 20dBi

Cable Loss is 2dB

The Pathloss & RSSI Theory value is : 117.4dB & -61.4dBm

### Simple RSSI Calculator



This test at Point a and Point b on both sides of the actual amount of RSSI about respectively :

Point A : -64dBm ~ -67dBm

Point B : -65dBm ~ -69dBm



### 3.0 Test Results

Testing some combination of the following parameters :

- Distance Parameter Setting is 4Km
- IxChariot test pair numbers
- Frequency Channel Width
- Tx/Rx antenna numbers
- Short GI(Guard Interval) On/Off

All Test Base on IxChariot Throughput.scr script °

#### 3.1 Test1 :

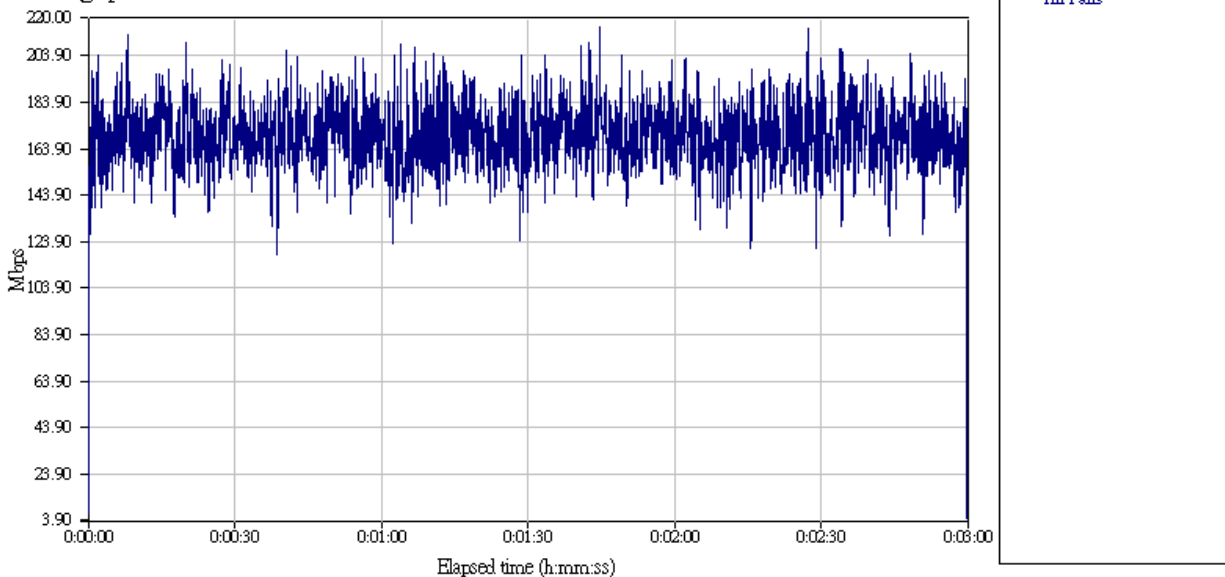
**A MIMO RF Module to spread spectrum +20dBi 40MHz 5GHz +15 15 dual-polarization MIMO antennas receive ' interval reduced from 3Km to 168Mbps Throughput**

| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
|---------------|-------------------------------|----------------------|-------------------------|
| 40MHz         | 2T2R                          | On(400)              | 15T15R                  |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>168.048</b>                | <b>0.143</b>         | <b>211.014</b>          |

Throughput

|         |         |       |        |       |
|---------|---------|-------|--------|-------|
| Pair 30 | 5.230   | 0.704 | 13.333 | 0.179 |
| Totals: | 168.048 | 0.303 | 20.000 |       |

Throughput

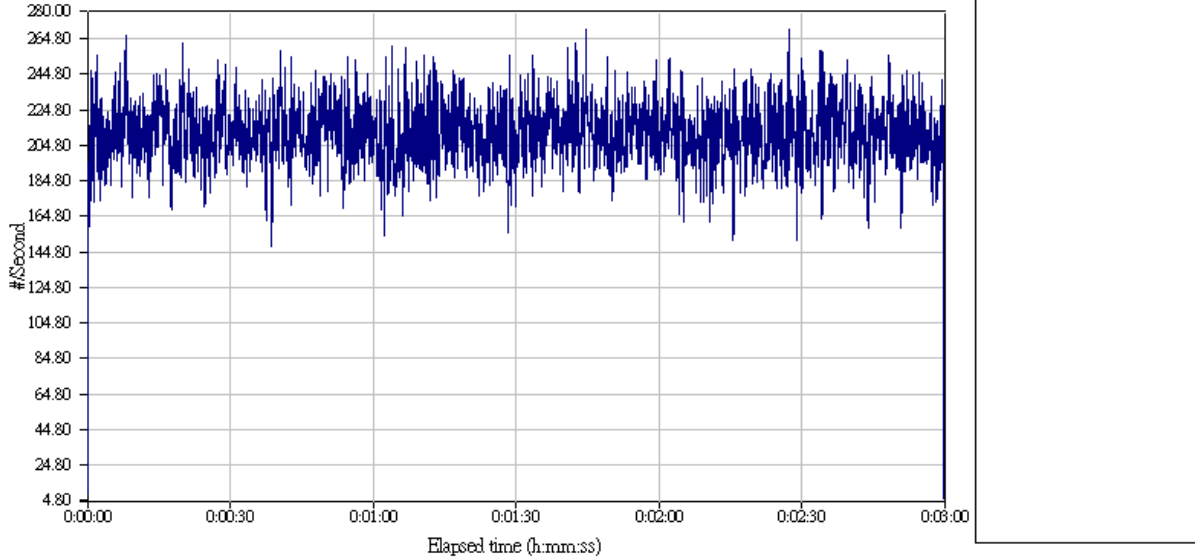




Transaction Rate

|         |         |       |        |
|---------|---------|-------|--------|
| Pair 30 | 6.537   | 0.880 | 16.667 |
| Totals: | 211.014 | 0.379 | 25.000 |

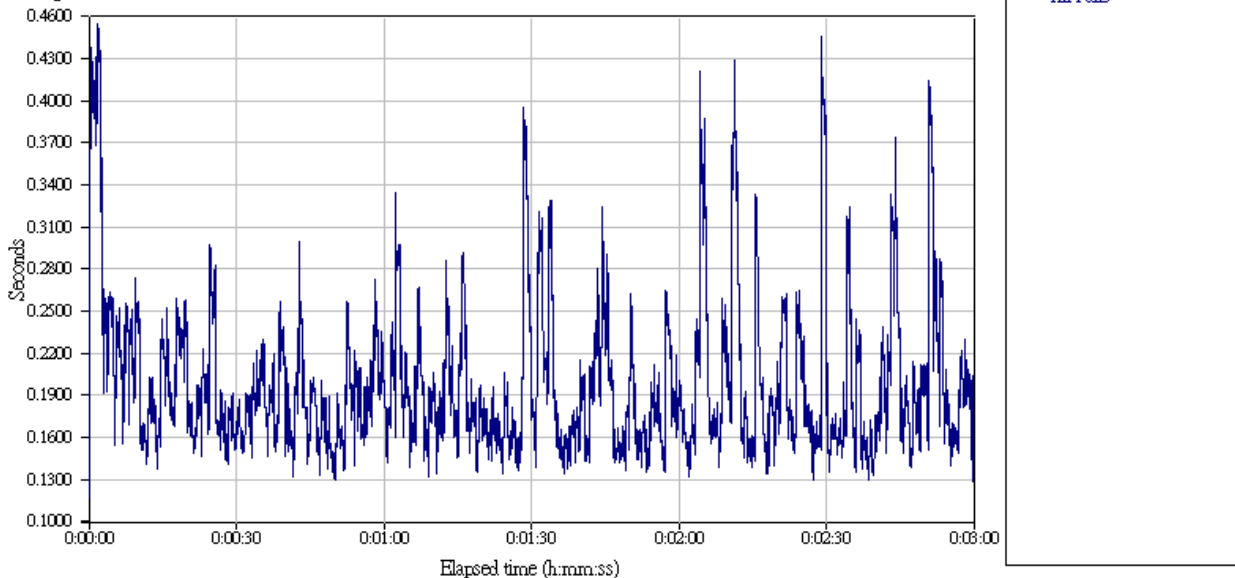
Transaction rate



Response Time

|         |       |       |       |
|---------|-------|-------|-------|
| Pair 30 | 0.153 | 0.060 | 1.137 |
| Totals: | 0.143 | 0.040 | 2.641 |

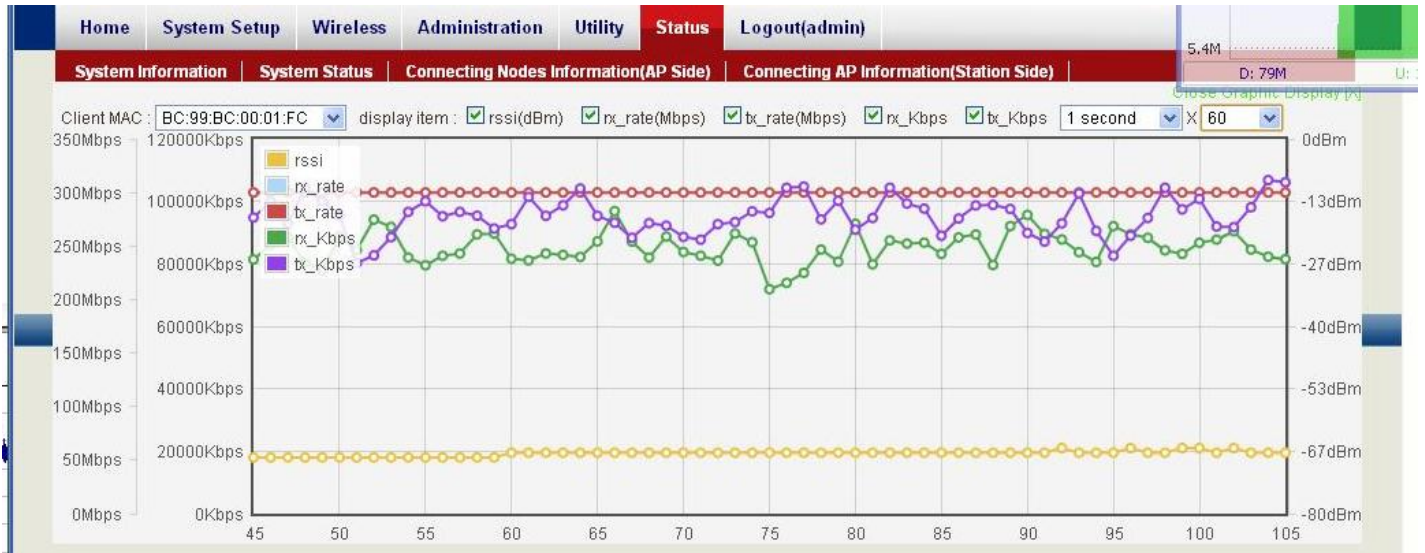
Response time



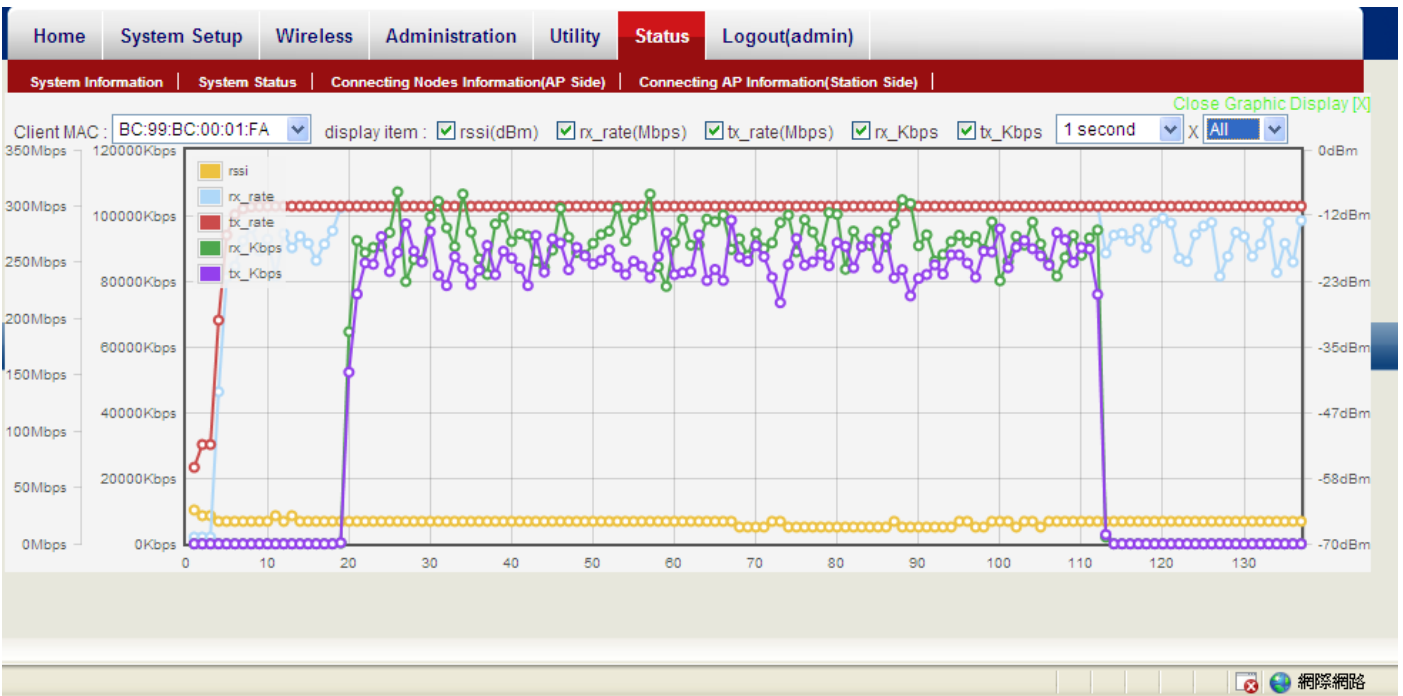




## AP Side Screen



## Station Side Screen





### 3.2 Test2

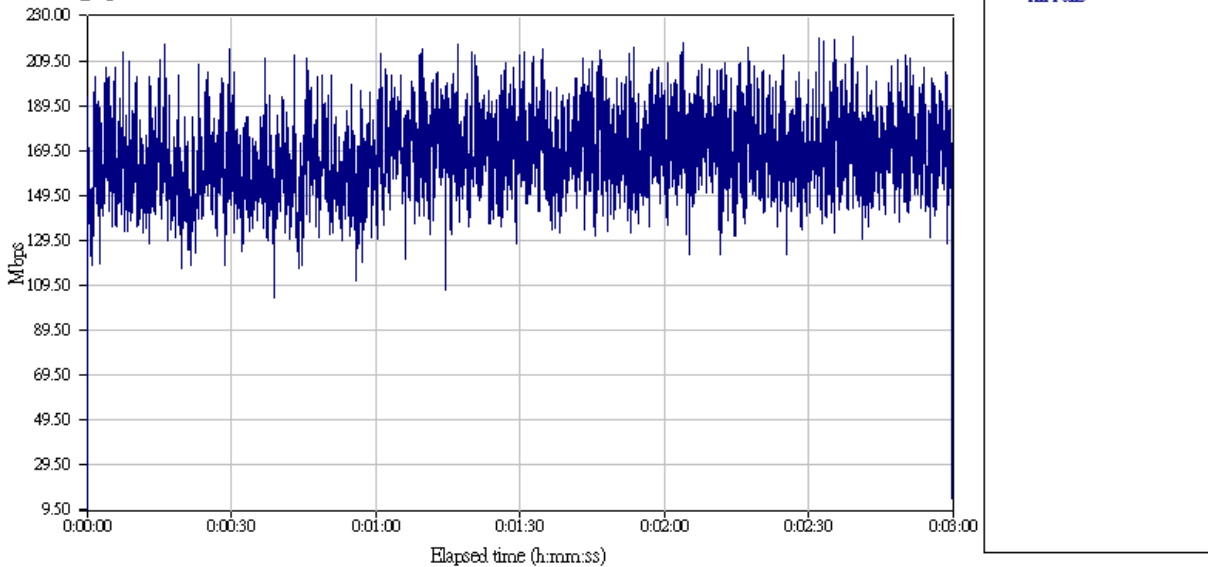
A MIMO RF Module to spread spectrum +20dBi 40MHz +8 5GHz dual-polarization MIMO antenna 8 received ' interval reduced from 3Km to 165Mbps Throughput

| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
|---------------|-------------------------------|----------------------|-------------------------|
| 40MHz         | 2T2R                          | On(400)              | 8T8R                    |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>165.811</b>                | <b>0.077</b>         | <b>208.857</b>          |

#### Throughput

|         |         |       |        |       |
|---------|---------|-------|--------|-------|
| Pair 16 | 10.542  | 1.389 | 23.530 | 0.127 |
| Totals: | 165.811 | 0.710 | 29.630 |       |

#### Throughput

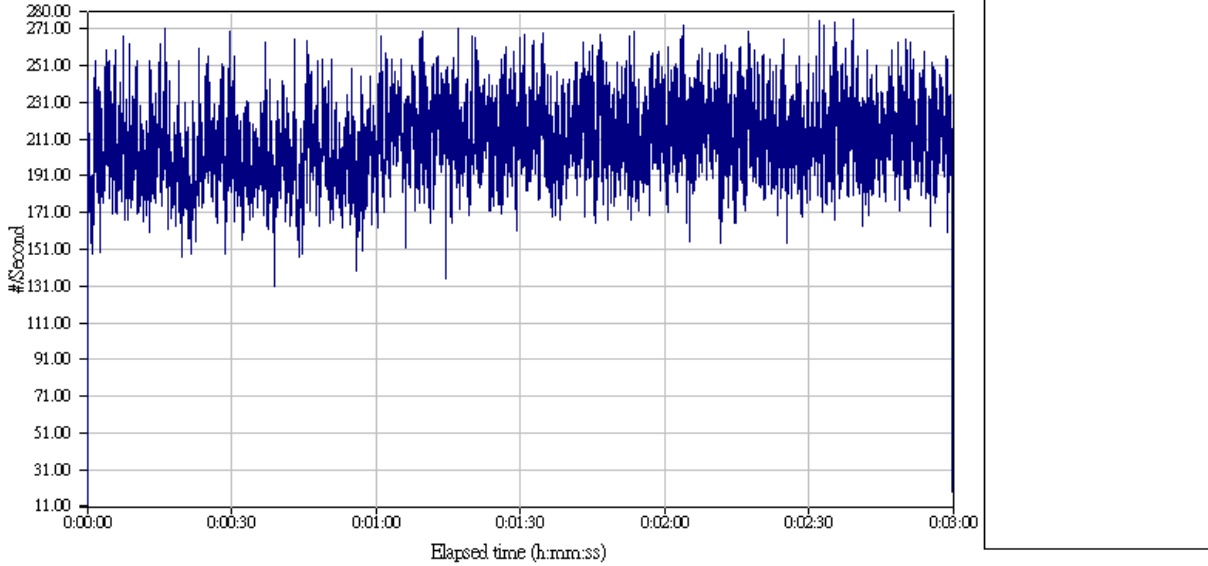




Transaction Rate

|         |         |       |        |
|---------|---------|-------|--------|
| Pair 16 | 13.177  | 1.736 | 29.412 |
| Totals: | 208.857 | 0.887 | 37.037 |

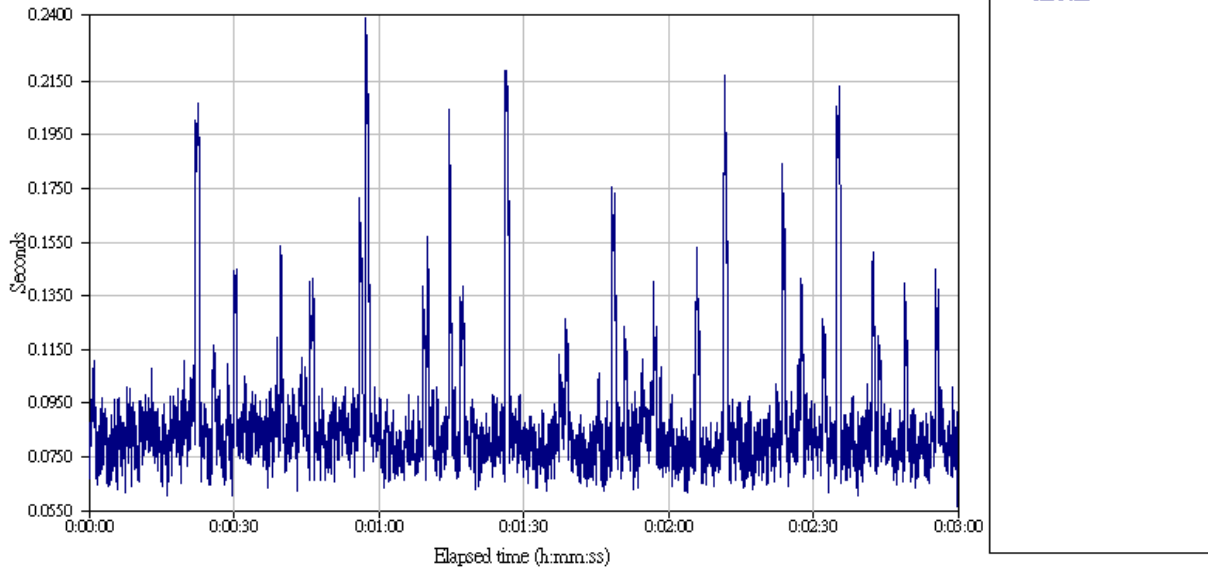
Transaction rate



Response Time

|         |       |       |       |
|---------|-------|-------|-------|
| Pair 16 | 0.076 | 0.034 | 0.576 |
| Totals: | 0.077 | 0.027 | 1.127 |

Response time

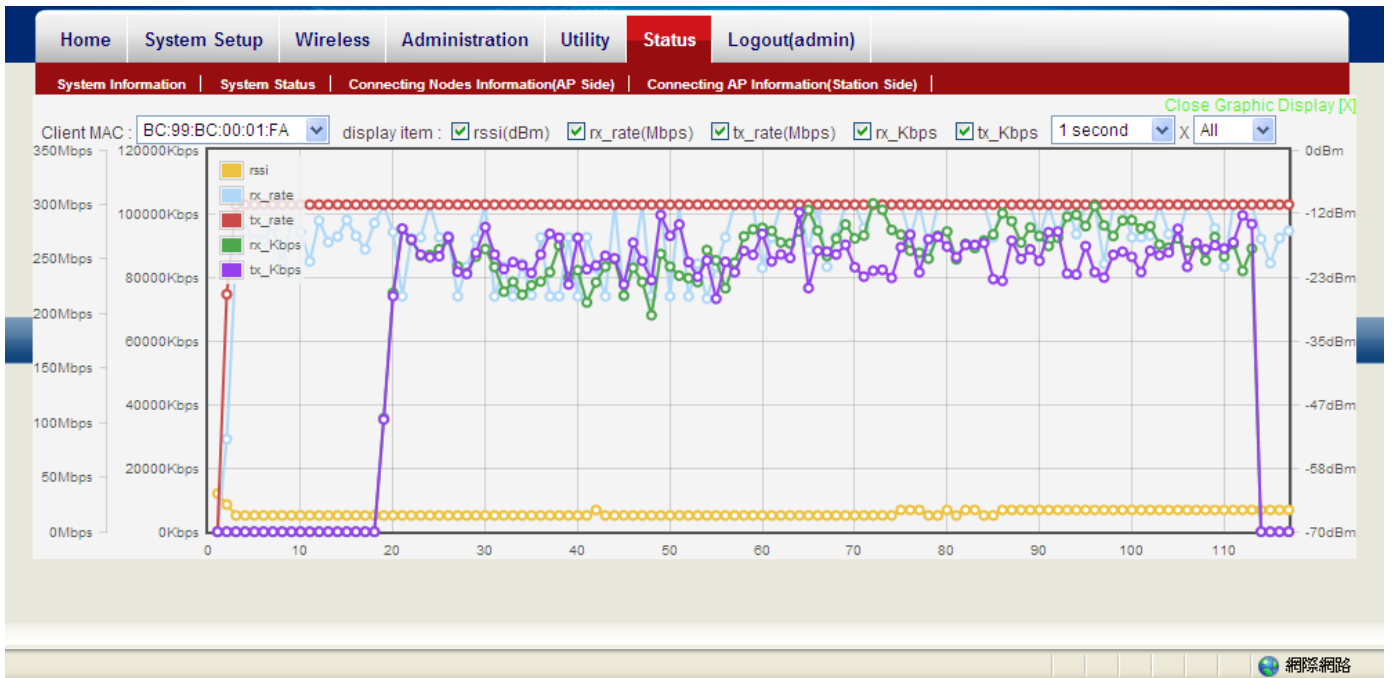




## AP Side Screen



## Station Side Screen





### 3.3 Test3

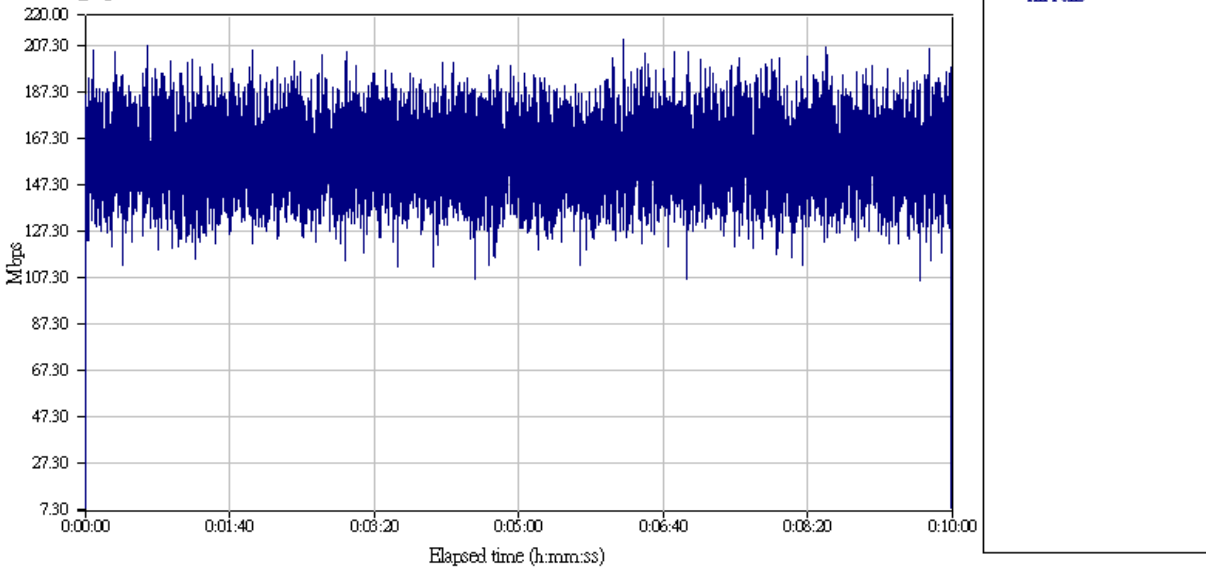
**A MIMO RF Module to spread spectrum +20dBi 40MHz 5GHz +8 dual-polarization MIMO antenna 8 received ' interval is not reduced distance from the 3Km pass 156Mbps Throughput**

|               |                               |                      |                         |
|---------------|-------------------------------|----------------------|-------------------------|
| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
| 40MHz         | 2T2R                          | Off(800)             | 8T8R                    |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>156.812</b>                | <b>0.081</b>         | <b>197.410</b>          |

#### Throughput

|         |         |       |        |       |
|---------|---------|-------|--------|-------|
| Pair 16 | 9.691   | 0.576 | 21.053 | 0.082 |
| Totals: | 156.812 | 0.521 | 26.667 |       |

#### Throughput

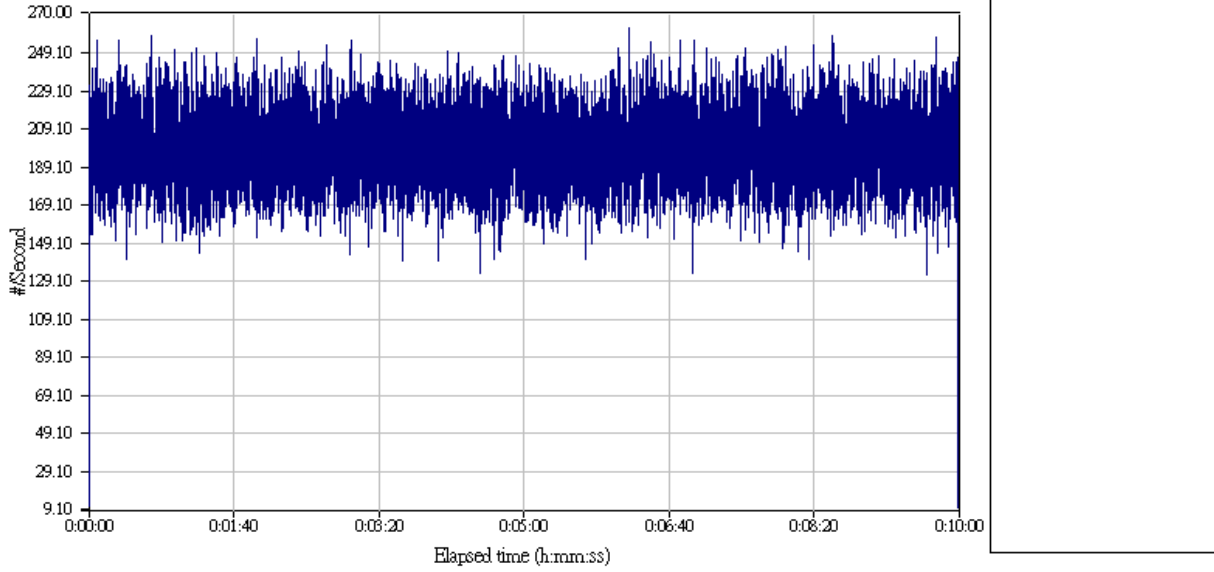




Transaction Rate

|         |         |       |        |
|---------|---------|-------|--------|
| Pair 16 | 12.113  | 0.720 | 26.316 |
| Totals: | 197.410 | 0.651 | 33.333 |

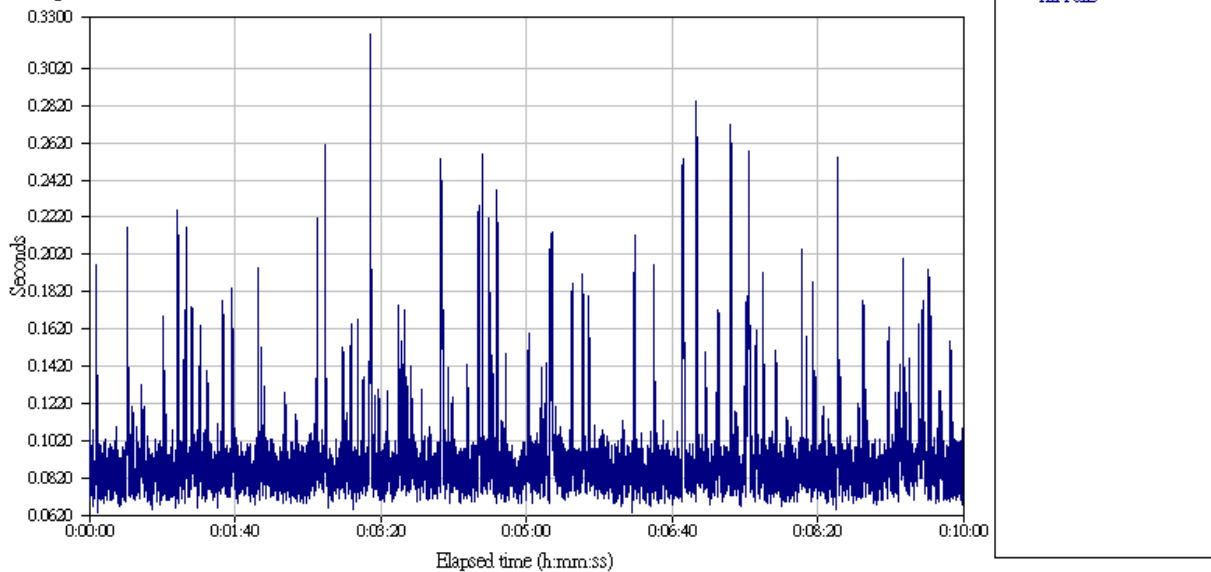
Transaction rate



Response Time

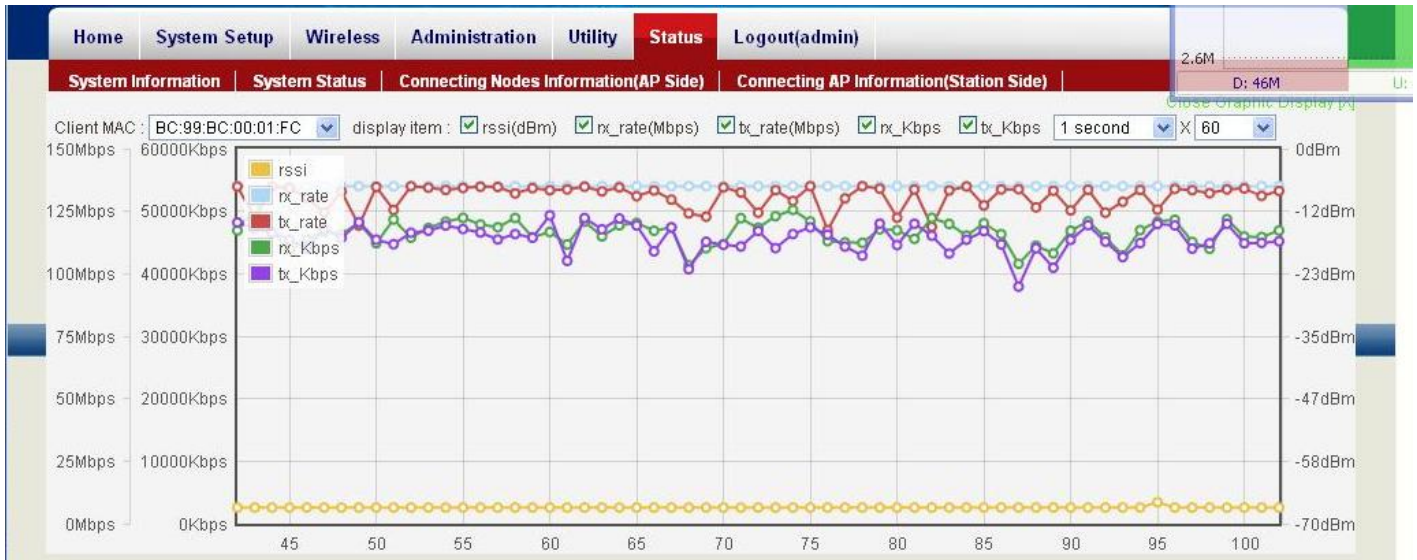
|         |       |       |       |
|---------|-------|-------|-------|
| Pair 16 | 0.083 | 0.038 | 1.389 |
| Totals: | 0.081 | 0.030 | 1.536 |

Response time

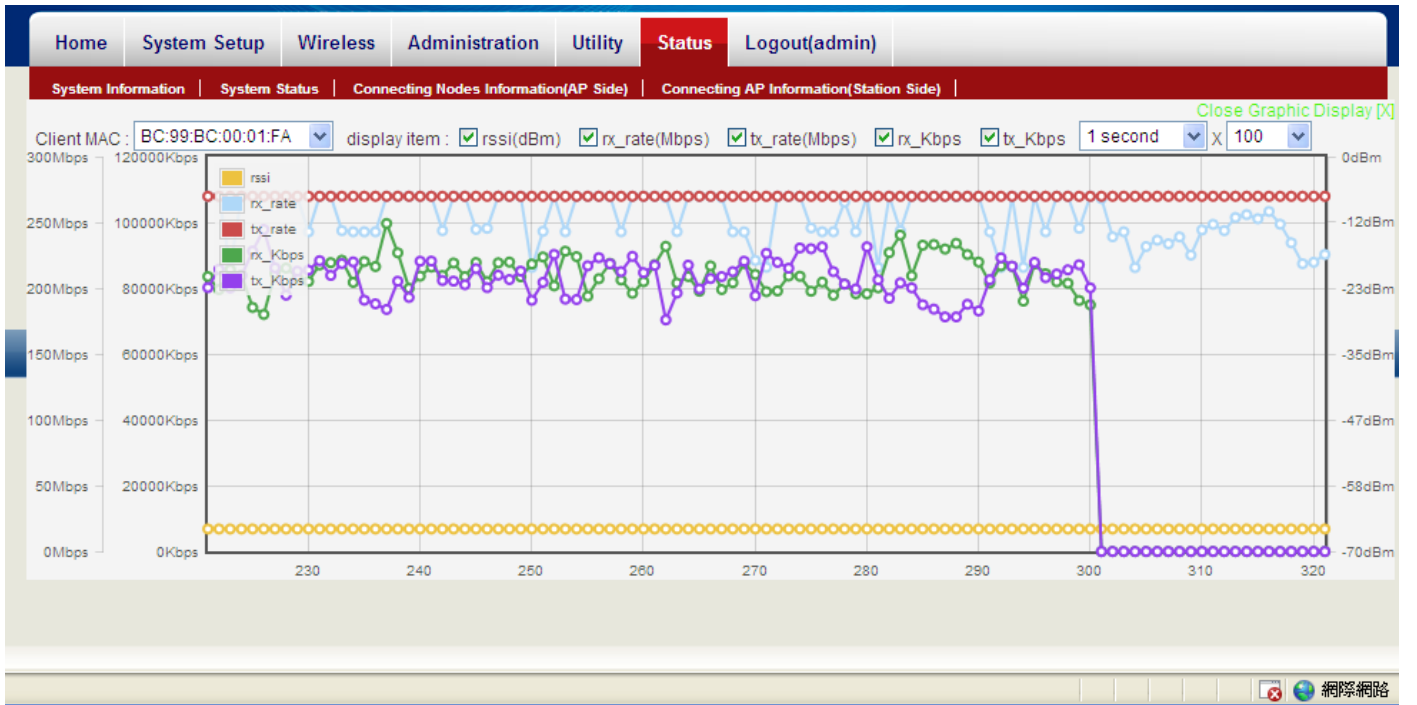




## AP Side Screen



## Station Side Screen





### 3.4 Test4

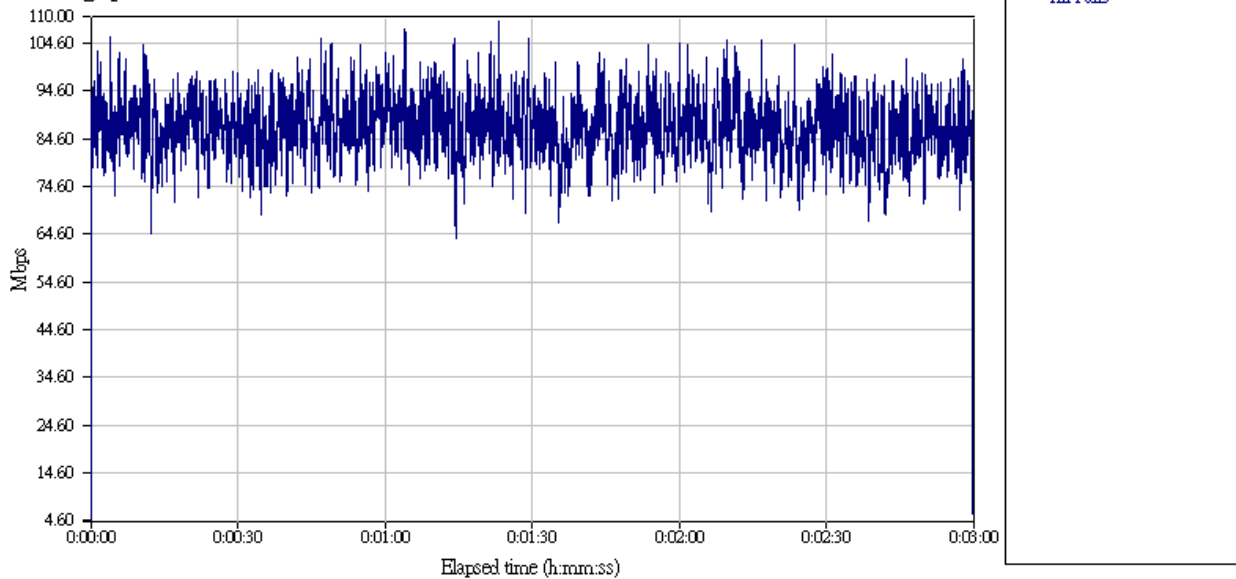
**A MIMO RF Module to spread spectrum +20dBi 40MHz +8 5GHz single-polarization MIMO antenna 8 received ' interval is not reduced distance from the 3Km pass 86Mbps Throughput**

| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
|---------------|-------------------------------|----------------------|-------------------------|
| 40MHz         | 1T1R                          | Off(800)             | 8T8R                    |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>86.379</b>                 | <b>0.148</b>         | <b>108.428</b>          |

#### Throughput

|         |        |       |       |       |
|---------|--------|-------|-------|-------|
| Pair 16 | 5.428  | 1.431 | 8.602 | 0.059 |
| Totals: | 86.379 | 1.431 | 9.524 |       |

#### Throughput



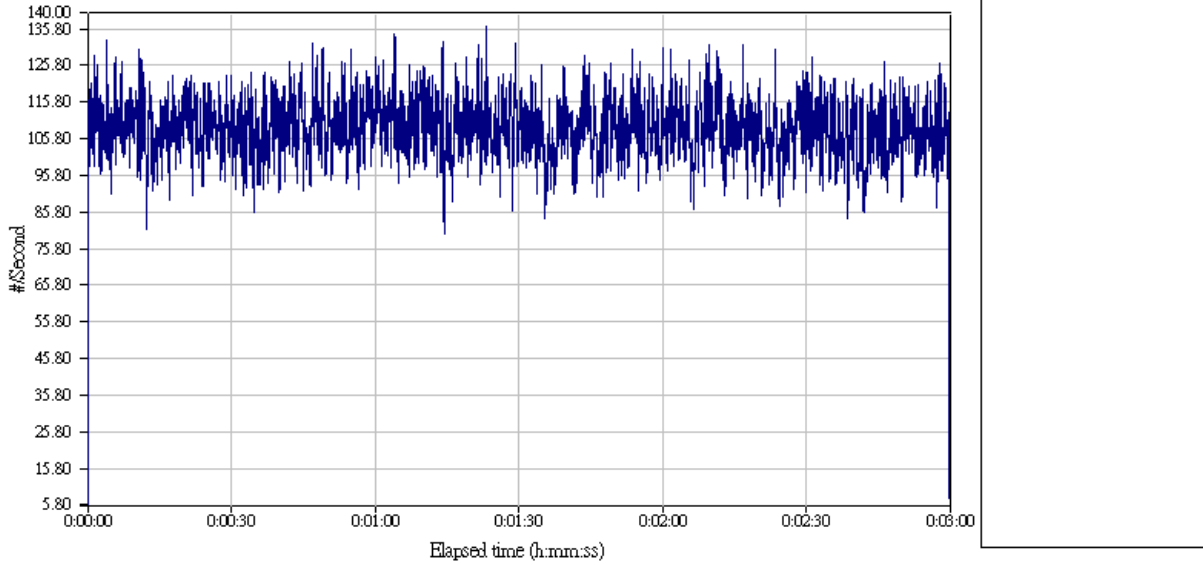




Transaction Rate

|         |         |       |        |
|---------|---------|-------|--------|
| Pair 16 | 6.784   | 1.789 | 10.753 |
| Totals: | 108.428 | 1.789 | 11.905 |

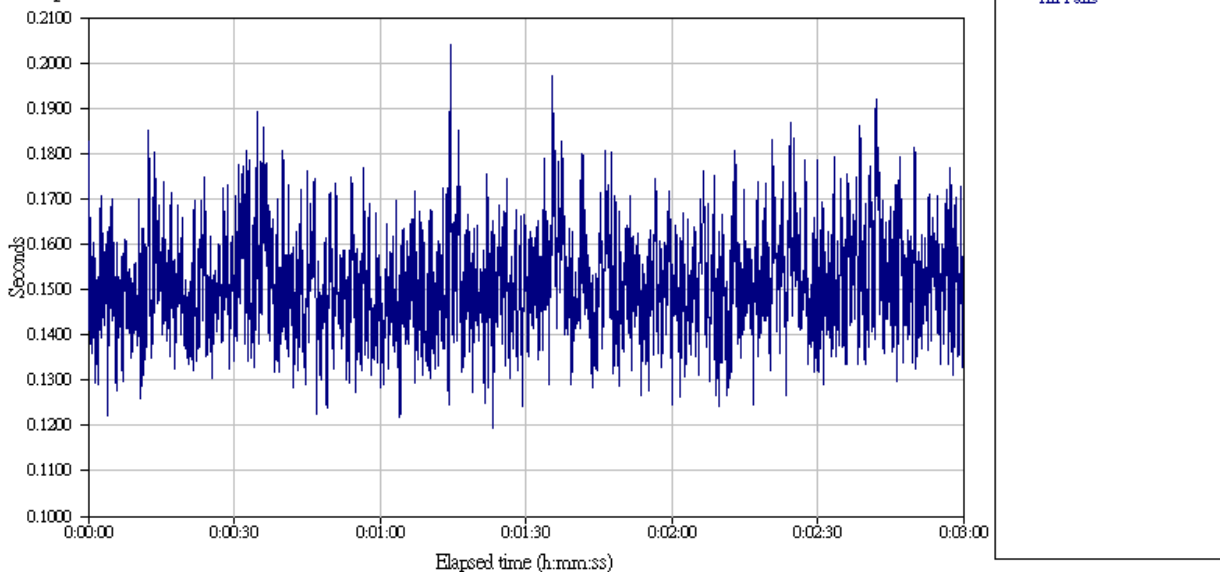
Transaction rate



Response Time

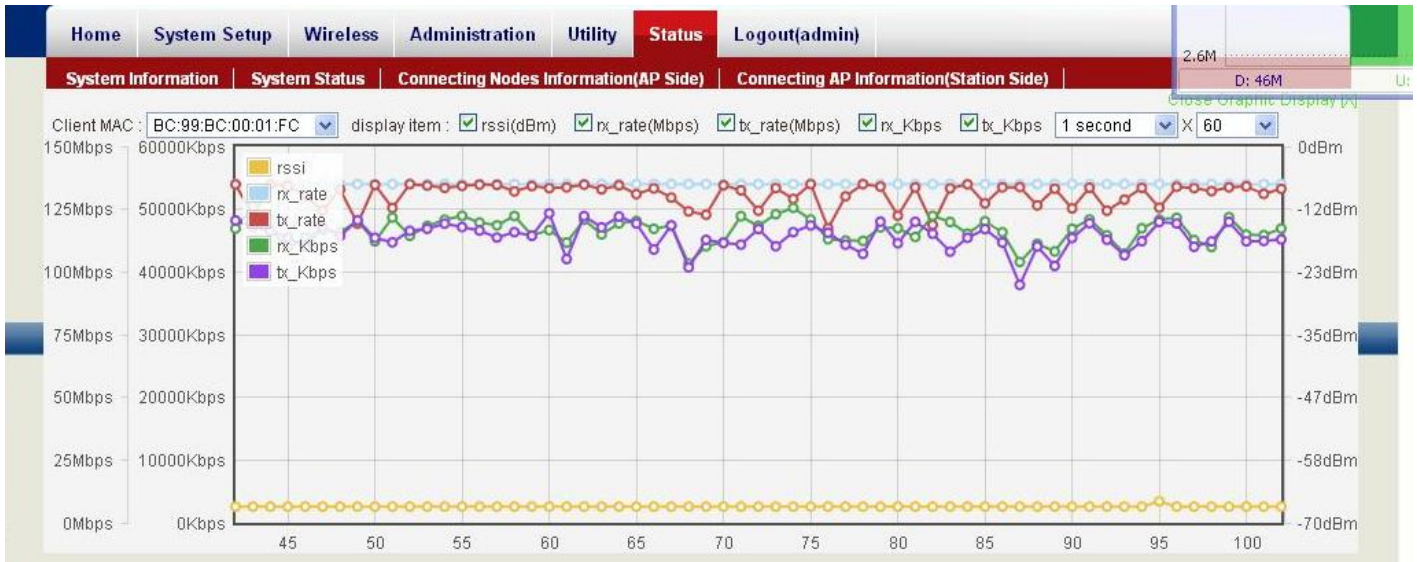
|         |       |       |       |
|---------|-------|-------|-------|
| Pair 16 | 0.147 | 0.093 | 0.559 |
| Totals: | 0.148 | 0.084 | 0.559 |

Response time

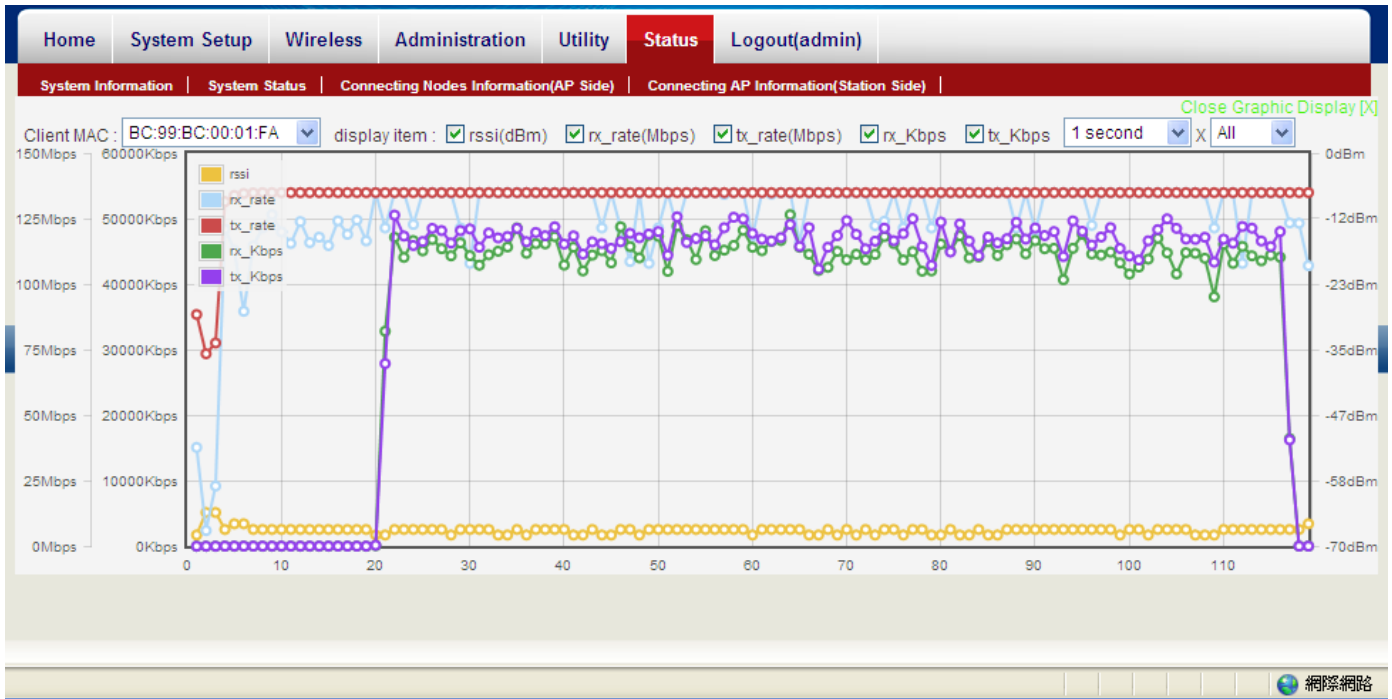




## AP Side Screen



## Station Side Screen





### 3.5 Test5

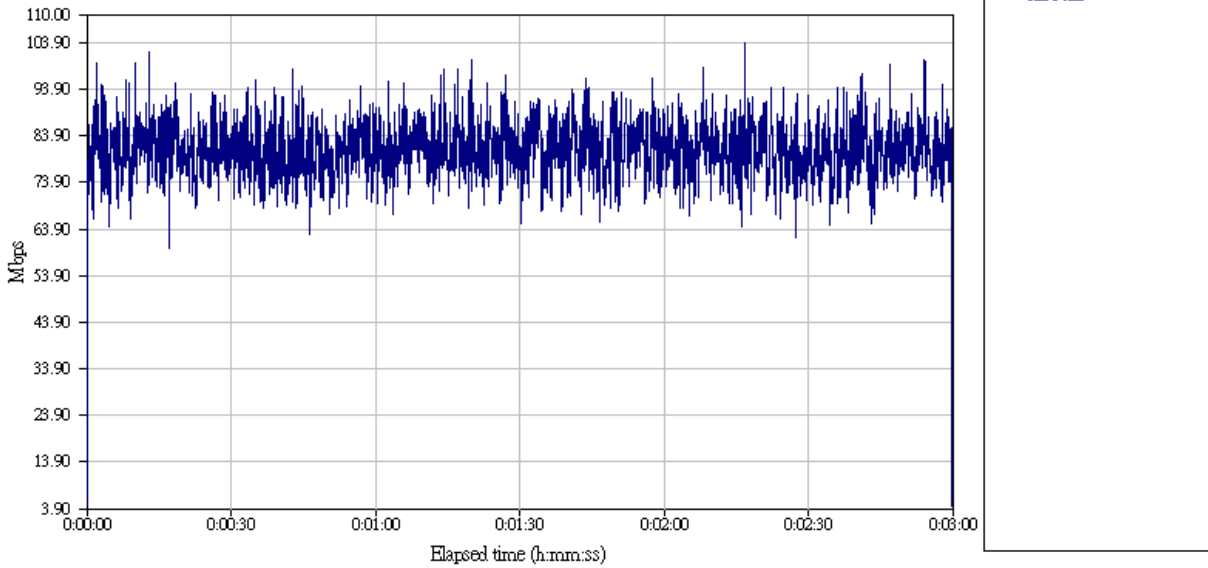
A MIMO RF Module 20MHz Bandwidth +8 8 20MHz+20dBi 5GHz dual-polarization MIMO antennas receive ' interval reduced from 3Km to 80Mbps Throughput

| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
|---------------|-------------------------------|----------------------|-------------------------|
| 20MHz         | 2T2R                          | On(400)              | 8T8R                    |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>80.360</b>                 | <b>0.159</b>         | <b>100.861</b>          |

#### Throughput

|         |        |       |        |       |
|---------|--------|-------|--------|-------|
| Pair 16 | 5.066  | 3.030 | 8.333  | 0.049 |
| Totals: | 80.360 | 1.171 | 10.526 |       |

#### Throughput

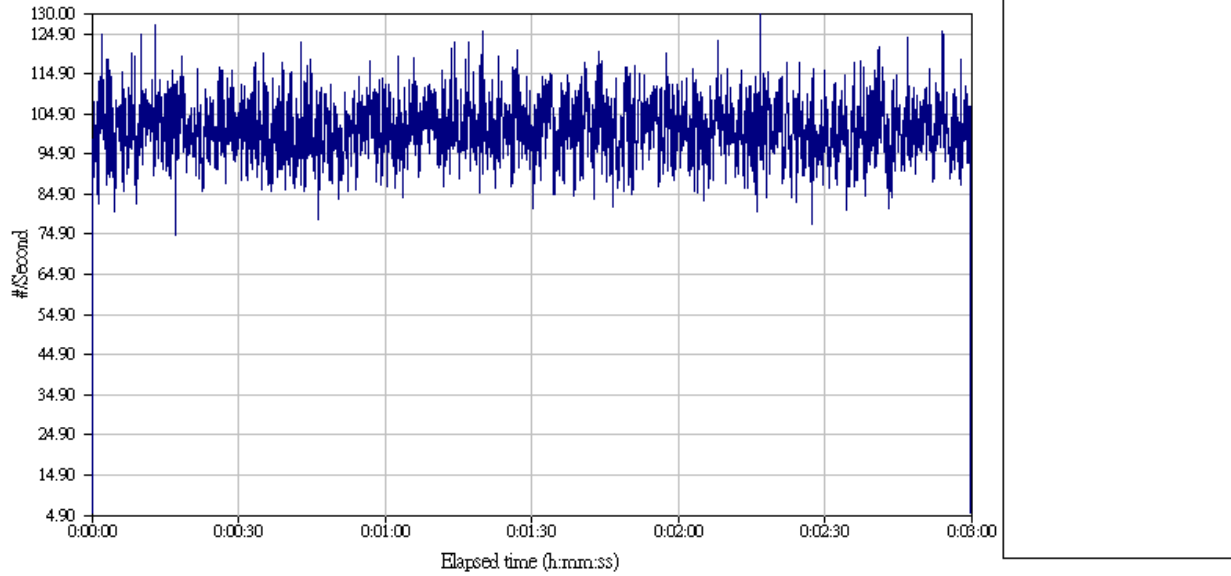




Transaction Rate

|         |         |       |        |
|---------|---------|-------|--------|
| Pair 16 | 6.332   | 3.788 | 10.417 |
| Totals: | 100.861 | 1.464 | 13.158 |

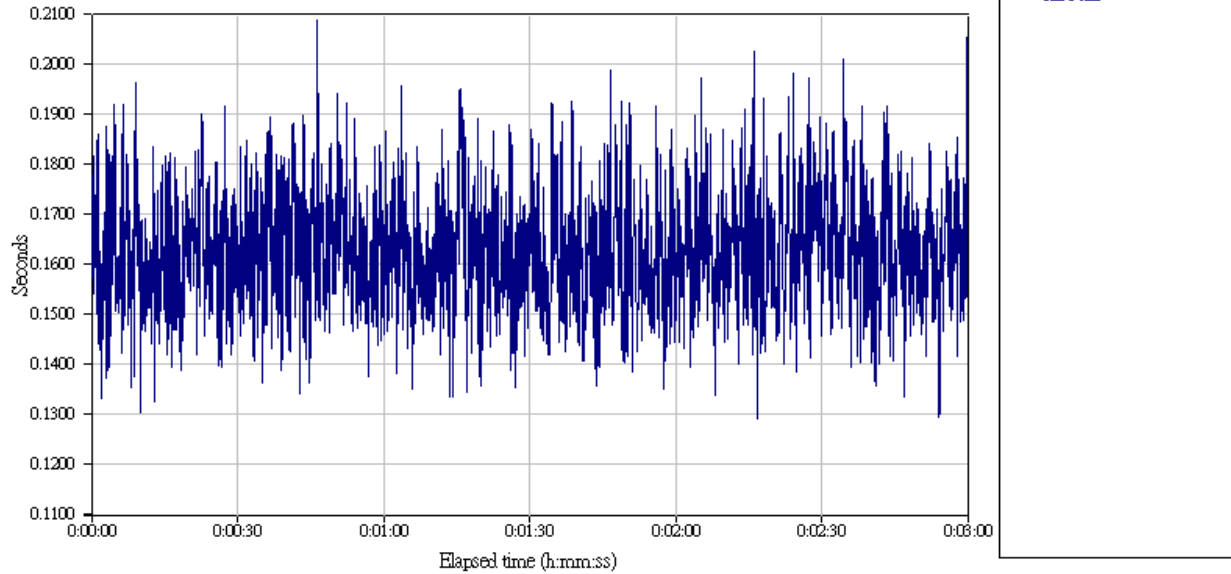
Transaction rate



Response Time

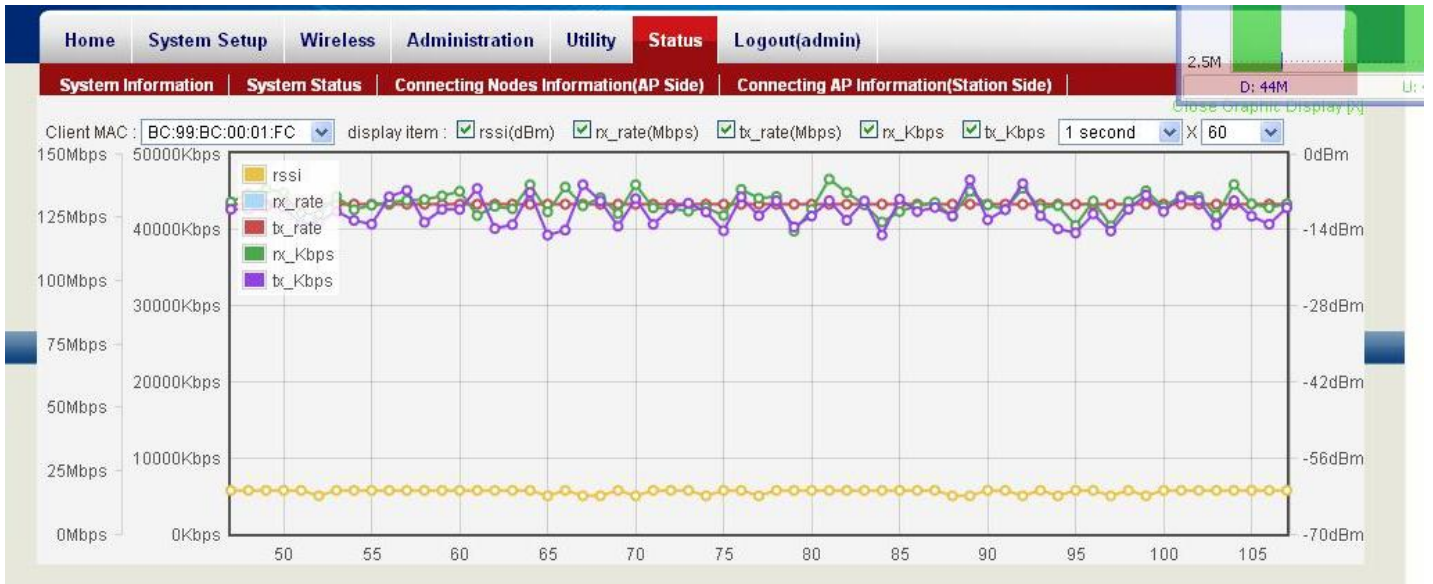
|         |       |       |       |
|---------|-------|-------|-------|
| Pair 16 | 0.158 | 0.096 | 0.264 |
| Totals: | 0.159 | 0.076 | 0.683 |

Response time

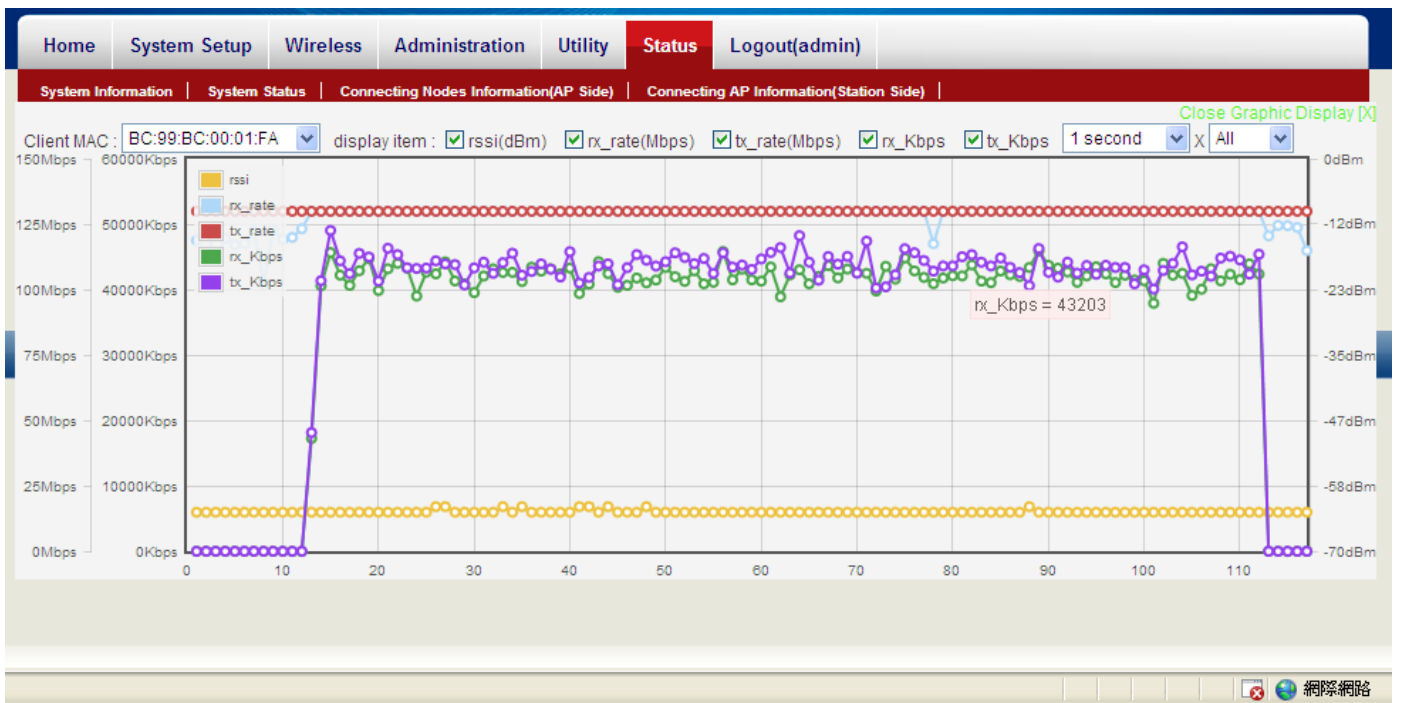




## AP Side Screen



## Station Side Screen





### 3.6 Test6

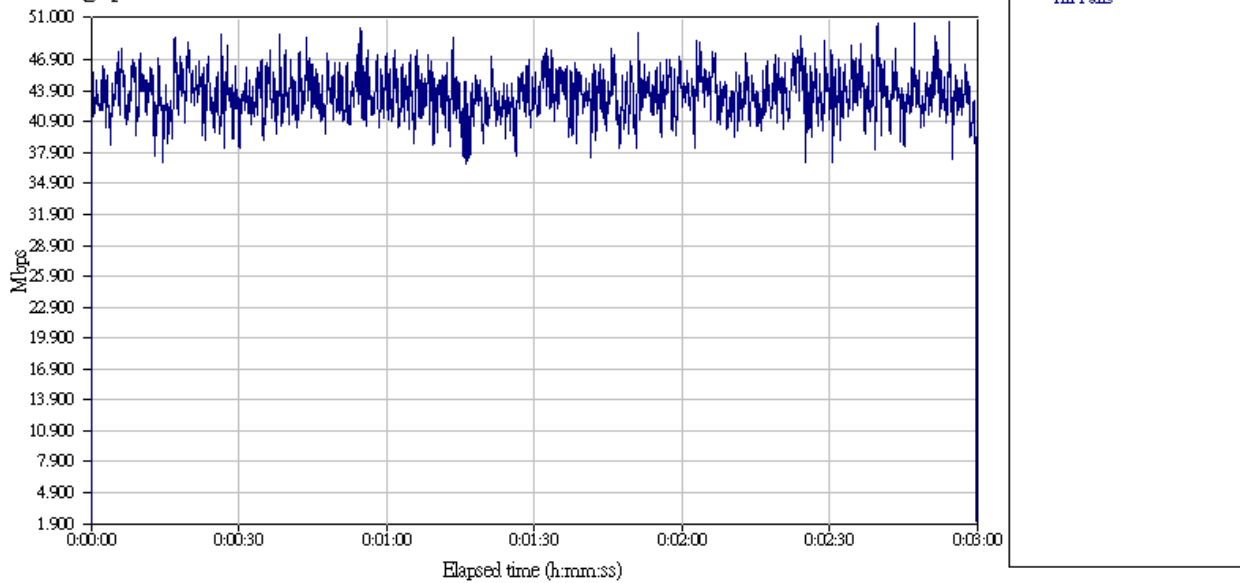
**A MIMO RF Module 20MHz Bandwidth +20dBi 5GHz single +8 polarization MIMO antenna 8 received ' interval is not reduced distance from the 3Km pass 43Mbps Throughput**

| Channel Width | Tx/Rx Antenna Number          | Short GI             | IxChariot pairs         |
|---------------|-------------------------------|----------------------|-------------------------|
| 20MHz         | 1T1R                          | Off(800)             | 8T8R                    |
| <b>Report</b> | <b>Total Throughput(Mbps)</b> | <b>Response Time</b> | <b>Transaction Rate</b> |
|               | <b>43.463</b>                 | <b>0.294</b>         | <b>54.473</b>           |

#### Throughput

|         |        |       |       |       |
|---------|--------|-------|-------|-------|
| Pair 16 | 2.748  | 1.794 | 3.756 | 0.031 |
| Totals: | 43.463 | 1.623 | 4.124 |       |

#### Throughput

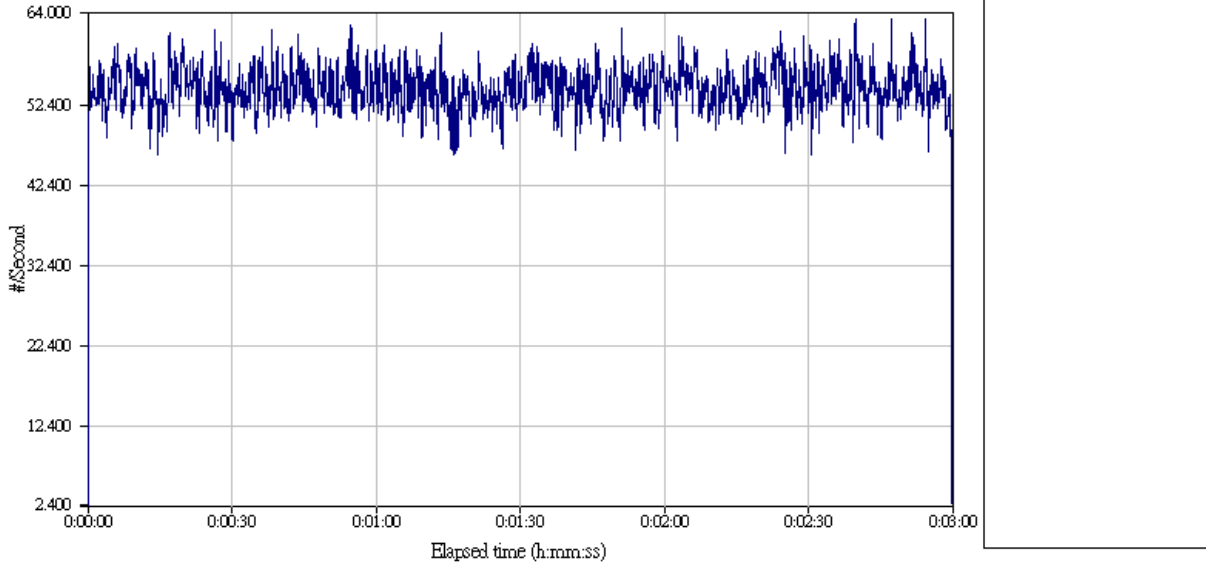




Transaction Rate

|         |        |       |       |
|---------|--------|-------|-------|
| Pair 16 | 3.435  | 2.242 | 4.695 |
| Totals: | 54.473 | 2.028 | 5.155 |

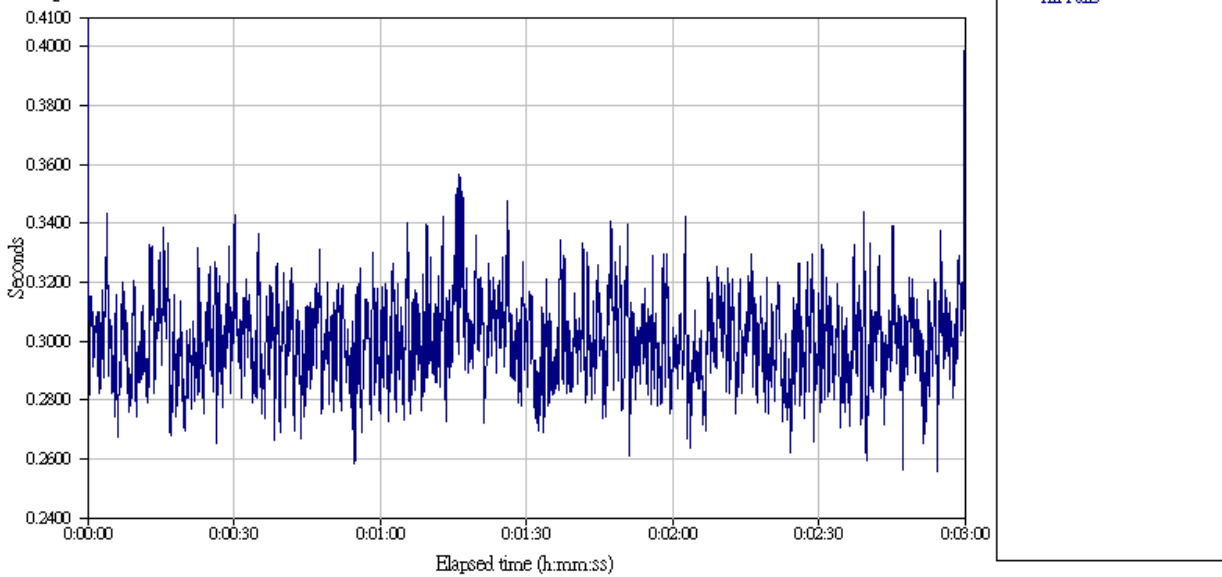
Transaction rate



Response Time

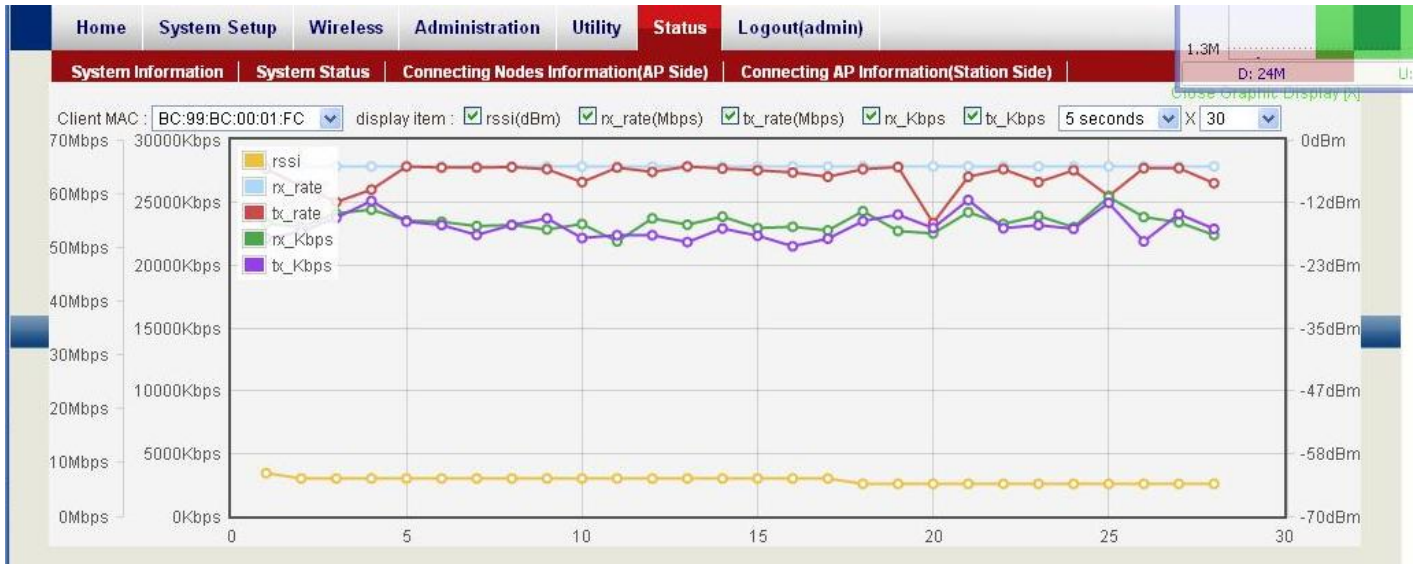
|         |       |       |       |
|---------|-------|-------|-------|
| Pair 16 | 0.291 | 0.213 | 0.446 |
| Totals: | 0.294 | 0.194 | 0.493 |

Response time

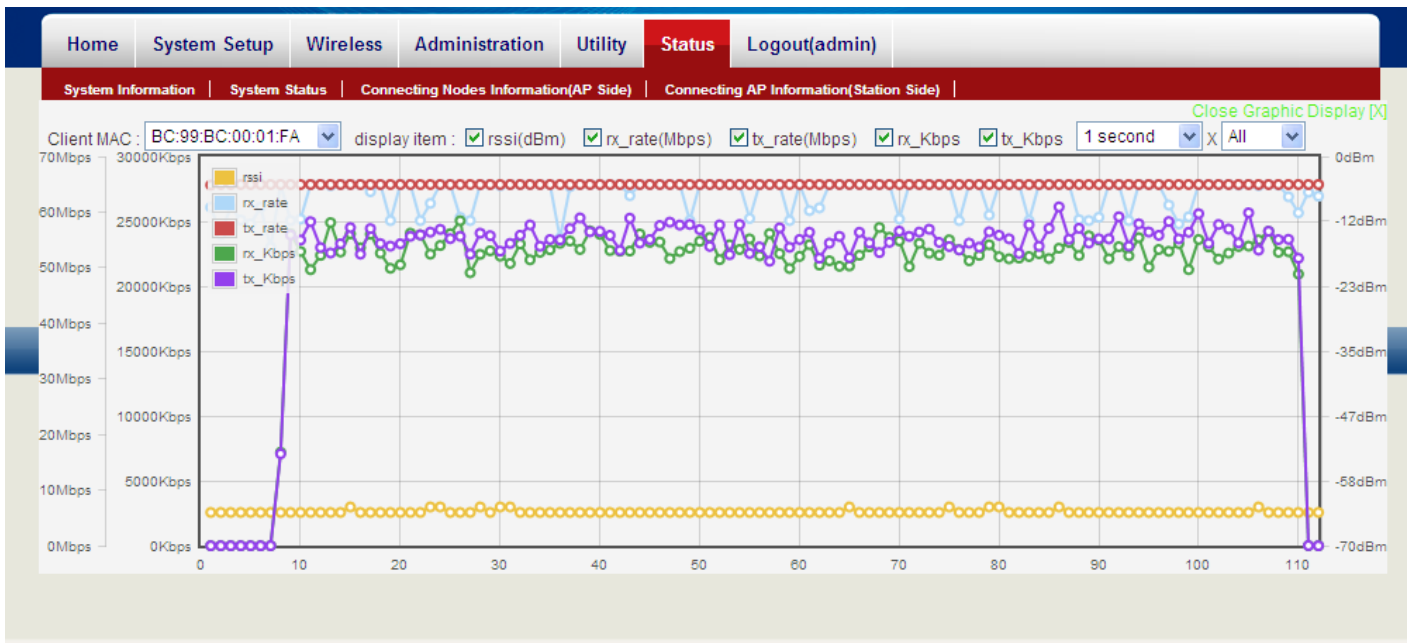




## AP Side Screen



## Station Side Screen



## Appendix I

Non °