



**NEW WORLD  
TELECOMMUNICATIONS  
LIMITED**

***Trial Test Report on 3.5GHz  
Broadband Wireless Access Technology***

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## **GLOSSARY**

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| <b>Glossary</b> | <b>Description</b>                                |
|-----------------|---|
| Bps             | Bits Per Second                                   |
| BPSK            | Binary Phase Shift Keying                         |
| BRS             | Broadband Radio Service                           |
| BS              | Base Station                                      |
| BWA             | Broadband Wireless Access                         |
| CINR            | Ratio of Carrier/Interference + Noise             |
| CPE             | Customer Premises Equipment                       |
| ETSI            | European Telecommunication Standards Institute    |
| FDD             | Frequency Division Duplex                         |
| FE              | Fast Ethernet                                     |
| IEEE            | Institute of Electrical and Electronics Engineers |
| IAD             | Integrated Access Device                          |
| IP              | Internet Protocol                                 |
| LAN             | Local Area Network                                |
| LOS             | Line of Sight                                     |
| MAN             | Metropolitan Area Network                         |
| NGN             | Next Generation Network                           |
| NLOS            | Non Line of Sight                                 |
| OFDM            | Orthogonal Frequency Division Multiplexing        |
| PTP             | Point-to-point                                    |
| PMP             | Point-to-multipoint                               |
| QAM             | Quadrature Amplitude Modulation                   |

| <b>Glossary</b> | <b>Description</b>                              |
|-----------------|---|
| QPSK            | Quadrature Phase Shift Keying                   |
| RSSI            | Received Signal Strength Indicator              |
| SC              | Sector Controller                               |
| SS              | Subscriber Station                              |
| SU              | Subscriber Unit                                 |
| TDD             | Time Division Duplex                            |
| TDMA            | Time Division Multiple Access                   |
| UNII            | Universal National Information Infrastructure   |
| VoIP            | Voice Over IP                                   |
| WiMax           | Worldwide Interoperability for Microwave Access |

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## **1. Objective**

- To test the performance of Broadband Wireless Access (BWA) Technology based on the “WiMAX” product working at 3.4 ~ 3.6 GHz frequency spectrum.
- To test the capability and performance of the BWA product on providing Non-Line-of-Sight and Point-to-Multipoint data transmission over the air.

## **2. Introduction**

A product trial test based on the “WiMax” product was conducted in March 2005 by New World Telecommunications Ltd. The objective of the test is to assess the feasibility and performance of WiMax BWA systems in typical urban environment in Hong Kong. Both Line-of-Sight (LOS) and Non-Line-of-Sight (NLOS) scenarios were tested.

## **3. Trial Test Details**

### **3.1 Trial Equipment List**

1. Equipment List:
  - 1 x Sector Controller unit with 60° antenna
  - 2 x Subscriber Station units with 9° antenna
  - 2 x Ethernet switches
  - 2 x Traffic Generators
  - 3 x Notebook computers
2. Central Station transmit frequency: 3500 - 3507 MHz  $\pm$  4 ppm
3. Subscriber Station transmit frequency: 3400 - 3407 MHz  $\pm$  4 ppm

### **3.2 Test Location & Period**

**Site A:** Rooftop, Section Controller (SC)

**Site B:** Rooftop, Subscriber Station (SS1)

**Site C:** Rooftop, Subscriber Station (SS2)

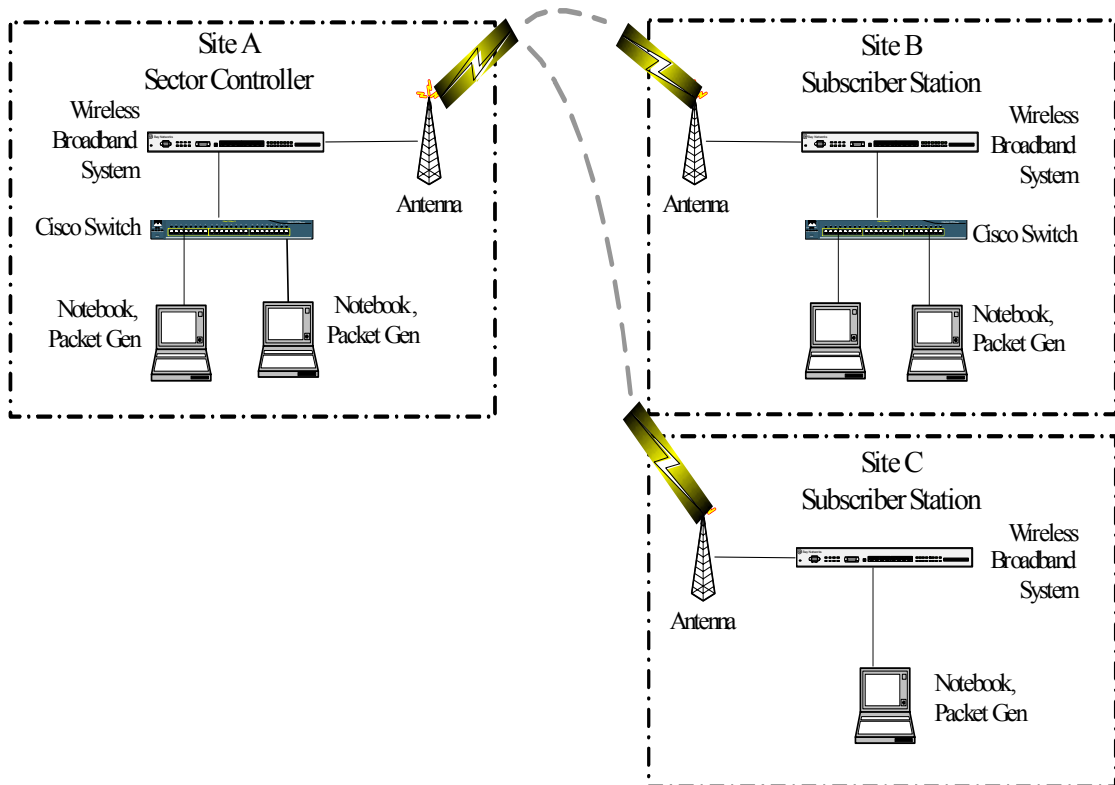
**Date:** 22 Mar 2005 (Tue) and 23 Mar 2005 (Wed)

### 3.3 Site Distance

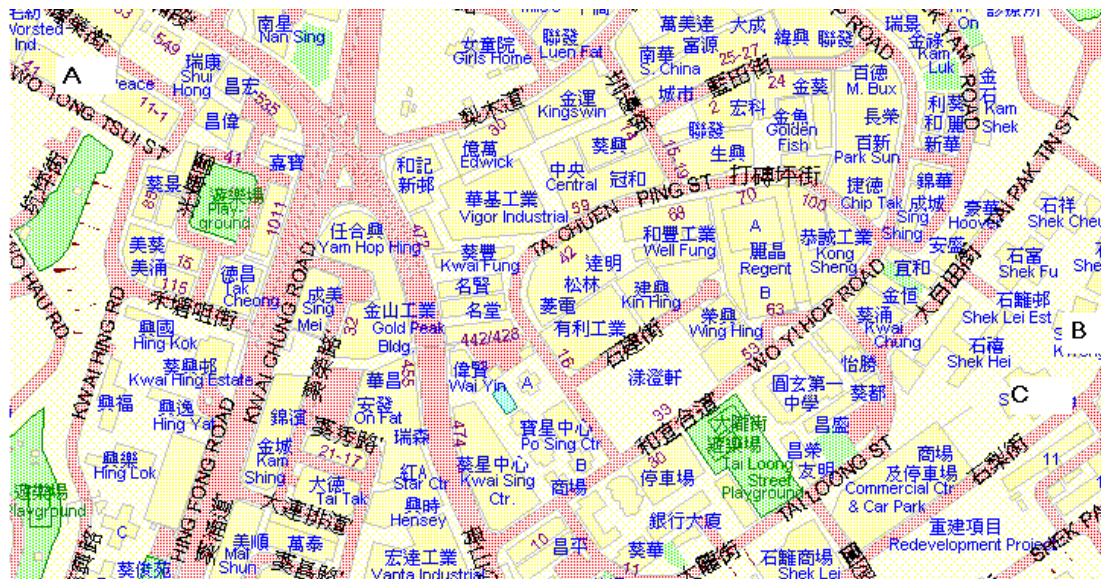
The path distance between Site A and B is about 981m.

The path distance between Site A and C is about 953m

### 3.4 Configuration Diagram



### 3.5 Test Location Map



## 4. Point-to-Point Test between Site A and B

Antenna placement: Line of Sight

Radio Power: RSSI = -48dBm, CINR = 26dB

Channel Bandwidth: 7Mbps Uplink + 7 Mbps Downlink

Modulation: 64QAM

### 4.1 Max Throughput Test between Site A and Site B

Steps:

1. Setup appropriate devices at SC and SS side
2. Run data transfer between site A and B
3. Record the throughput result

Result:

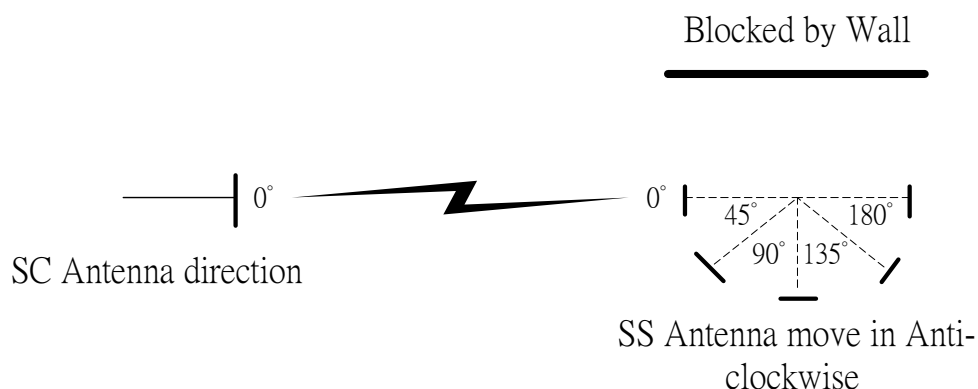
| Max Upload Throughput Test   | Packet Size | Test Results (bps) |
|------------------------------|-------------|--------------------|
|                              | 64 Bytes    | 14M                |
|                              | 512 Bytes   | 12M                |
|                              | 1500 Bytes  | 11.5M              |
| Max Download Throughput Test | 64 Bytes    | 14.3M              |
|                              | 512 Bytes   | 12.2M              |
|                              | 1500 Bytes  | 11.6M              |

### 4.2 Non Line of Sight Test by SS Antenna Rotation at Site B

**Steps:**

1. Setup appropriate devices at SC and SS side
2. Run uni-direction data transfer.
3. Rotate the SS antenna in anti-clockwise direction in steps of 45 degree.
4. Record the result of throughput test and radio power.

**SS Antenna Rotation Diagram**



**Result:**

|                                   | SS Rotating Angle | Packet Size                             | Test Results (bps) | CINR (dB) | RSSI (dBm) |
|-----------------------------------|-------------------|---|--------------------|-----------|------------|
| <b>Max Upload Throughput Test</b> | <b>45°</b>        | Equal mixture of 64, 512 and 1500 Bytes | 10.9M              | 24        | -57        |
|                                   | <b>90°</b>        | Equal mixture of 64, 512 and 1500 Bytes | 8.8M               | 22.5      | -60        |
|                                   | <b>180°</b>       | Equal mixture of 64, 512 and 1500 Bytes | 2.7M               | 12.8      | -67        |

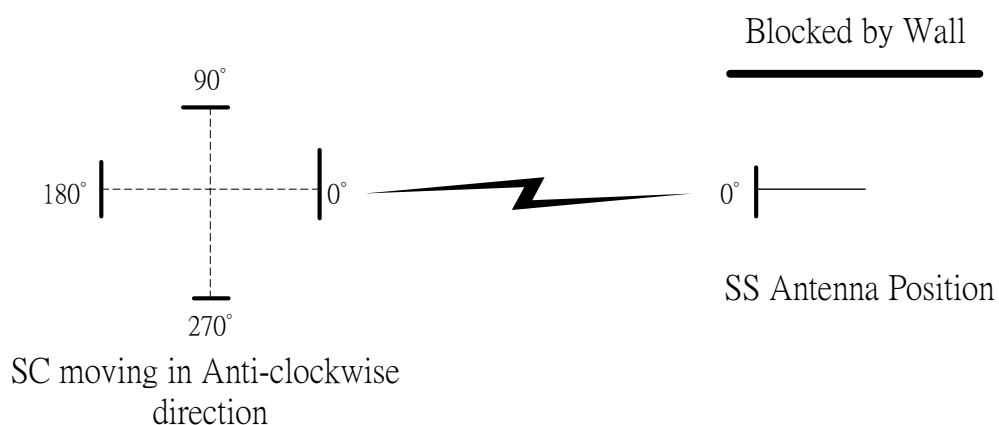
|                                     |             |   |       |      |     |
|-------------------------------------|-------------|---|-------|------|-----|
| <b>Max Download Throughput Test</b> | <b>45°</b>  | Equal mixture of 64, 512 and 1500 Bytes | 11.7M | 24   | -57 |
|                                     | <b>90°</b>  | Equal mixture of 64, 512 and 1500 Bytes | 8.6M  | 22.5 | -60 |
|                                     | <b>180°</b> | Equal mixture of 64, 512 and 1500 Bytes | 6M    | 12.8 | -67 |

### 4.3 Non Line of Sight Test by SC Antenna Rotation at site A

**Steps:**

1. Setup appropriate devices at SC and SS side
2. Run uni-direction data transfer.
3. Turn the SC antenna in anti-clockwise direction in steps of 45 degree.
4. Record the result of throughput test and radio power.

#### *SC Antenna Rotation Diagram*



**Result:**

|                                     | SC Rotating Angle | Packet Size                             | Test Results (bps) | CINR (dB) | RSSI (dBm) |
|-------------------------------------|-------------------|---|--------------------|-----------|------------|
| <b>Max Upload Throughput Test</b>   | 45°               | Equal mixture of 64, 512 and 1500 Bytes | 8.6M               | 26.3      | -44.8      |
|                                     | 90°               | Equal mixture of 64, 512 and 1500 Bytes | 8.6M               | 24        | -61.8      |
|                                     | 180°              | Equal mixture of 64, 512 and 1500 Bytes | 8.7M               | 25.9      | -52.3      |
|                                     | 270°              | Equal mixture of 64, 512 and 1500 Bytes | 0                  | 14.6      | -64.5      |
| <b>Max Download Throughput Test</b> | 45°               | Equal mixture of 64, 512 and 1500 Bytes | 9.3M               | 26.3      | -44.8      |
|                                     | 90°               | Equal mixture of 64, 512 and 1500 Bytes | 9M                 | 24        | -61.8      |
|                                     | 180°              | Equal mixture of 64, 512 and 1500 Bytes | 9.2M               | 25.9      | -52.3      |
|                                     | 270°              | Equal mixture of 64, 512 and 1500 Bytes | 0.2M               | 14.6      | -64.5      |

## **5. Point-to-Multi-Point Test**

### **Max Throughput Test**

#### **Steps:**

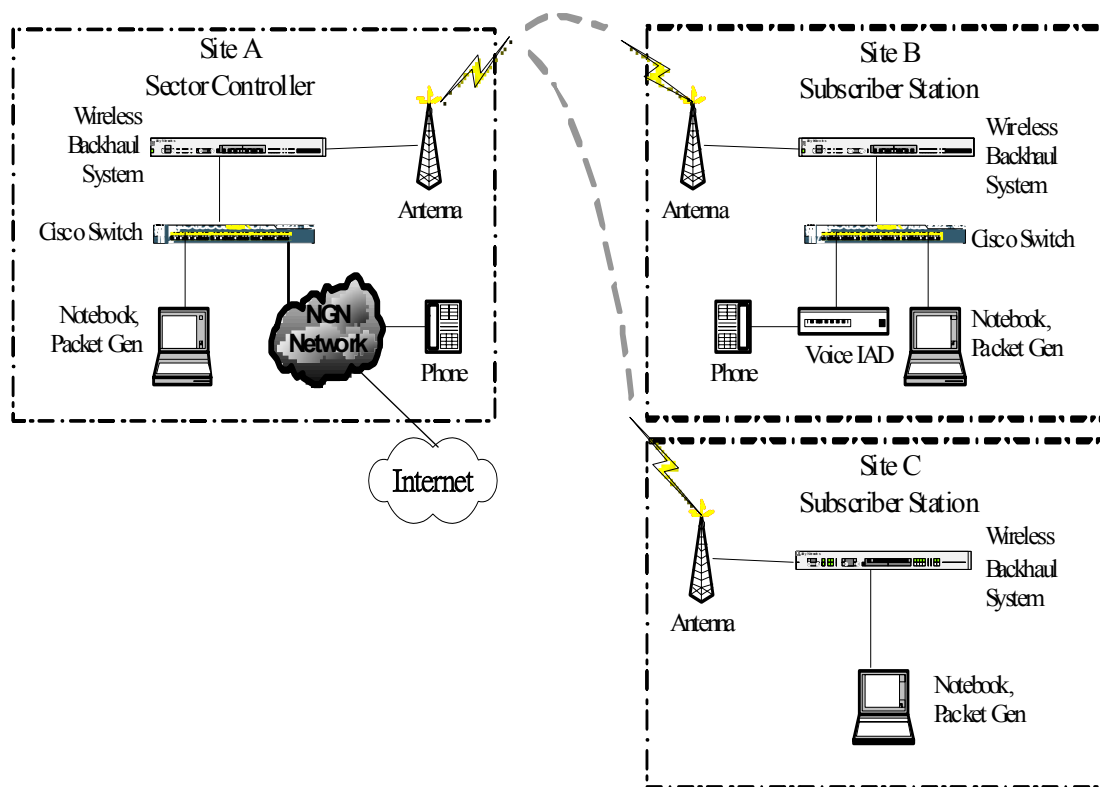
1. The SC is set up at site A while the SS is set up at site B and C.
2. Setup appropriate devices at SC and SS side.
3. Run uni-directional data transfer between site A and B.
4. Run uni-directional data transfer between site A and C.
5. Record the test result.

#### **Result:**

|   | <b>Packet Size</b> | <b>SS1 Test<br/>Results (bps)</b> | <b>SS2 Test<br/>Results (bps)</b> | <b>Total Test<br/>Results (bps)</b> |
|---|--------------------|-----------------------------------|-----------------------------------|-------------------------------------|
| <b>Max Upload<br/>Throughput Test</b>   | 1500 Bytes         | <b>5.9M</b>                       | <b>3.6M</b>                       | <b>9.5M</b>                         |
| <b>Max Download<br/>Throughput Test</b> | 1500 Bytes         | <b>6M</b>                         | <b>4.8M</b>                       | <b>10.8M</b>                        |

## 6. Application Test

### 6.1 Configuration Diagram



### 6.2 VoIP and Internet Broadband Access Test

#### Steps:

1. The wireless equipment is connected to NWT IP backbone network
2. Set up the IAD at Site B.
3. Run the test for voice and broadband access.
4. Record the test result.

#### Result:

| Item             | Result     |
|------------------|------------|
| Voice over IP    | Applicable |
| Broadband Access | Applicable |

## **7. Observations and Conclusion**

The test result shows that the performance of the wireless broadband link is stable and its performance acceptable at 1 km distance under clear line of sight condition. The modulation is maintained as 64QAM during the trial. Hence, the wireless broadband access is applicable for Hong Kong environment.

For Non-Line-of-Sight test it shows that the wireless broadband link could be established by means of reflection or diffraction. However, reception of signals in non-line-of-sight scenarios depends on a lot of factors. There are no explicit configurations or formula that can guarantee good reception for all cases. Each case may need to be examined and on-site adjustment may be required.

The success for running voice over IP and broadband access test over broadband wireless access technology proves that BWA may be an alternative option to replace conventional access technologies. If the BWA is used for backhaul system, it can save the time required for road opening. Furthermore, BWA can replace the copper loop as the solution for last mile access and resolve the problem of insufficient and technical difficulties on in-building block wiring system for telecommunication services.

*END*