



CKC Communications Limited

# **3.5GHz Broadband Wireless Access Trial Report**

**Publication #1.0  
Date Published: 19Oct05**

## Table of Content

<b>1.</b>	<b><i>Objective</i></b> _____	<b>2</b>
<b>2.</b>	<b><i>Scope and Scale</i></b> _____	<b>2</b>
	<b>Trial Frequency &amp; Date</b> _____	<b>2</b>
	<b>Trial Locations &amp; Distance</b> _____	<b>2</b>
	<b>Site Map</b> _____	<b>2</b>
<b>3.</b>	<b><i>Configurations</i></b> _____	<b>3</b>
	<b>Trial Equipment</b> _____	<b>3</b>
	<b>Radio Frequency Transmission &amp; Reception</b> _____	<b>3</b>
	<b>IP &amp; TDM Traffic Control</b> _____	<b>3</b>
	<b>Point-to-Point</b> _____	<b>4</b>
	<b>Point-to-Multipoint</b> _____	<b>4</b>
	<b>Broadband Transport Connect</b> _____	<b>5</b>
<b>4.</b>	<b><i>Results &amp; Observations</i></b> _____	<b>6</b>
	<b><i>Acronyms</i></b> _____	<b>8</b>

# 1. Objective

To conduct end-user performance testing of Broadband Wireless Access (BWA) Technology in the 3.4 – 3.5GHz band in dense urban environment of Hong Kong.

# 2. Scope and Scale

## Trial Frequency & Date

Central station transmit frequency: 3507 – 3517.5MHz ± 4ppm  
 Subscriber station transmit frequency: 3407 – 3417.5MHz ± 4ppm  
 Test period: June – July2005

## Trial Locations & Distance

The BWA trial was conducted in selected rooftops in the Central and Whampoa Gardens areas.

The Line-of-Sight (LOS) distance between the Base Station Site (BSS) and the Subscriber Station Sites (SSS) is about 4km.

## Site Map



Figure 1



### 3. Configurations

The BWA trial was based on a carrier class IEEE802.16a compliant platform employing Orthogonal Frequency Division Multiplex (OFDM) supporting multiple IEEE802.3u and ITU-T G.703 network interfaces.

The trial covered testing of the said IEEE802.16a compliant system operating in both Frequency Division Duplex (FDD) and Time Division Duplex (TDD) mode with Point-to-Point and Point-to-Multi-Point connections.

#### Trial Equipment

- 1xTDD single sector Base Station Unit (BSU) with 60° antenna
- 1xFDD single sector Base Station Unit (BSU) with 60° antenna
- 2xconfigurable Subscriber Station Unit (SSU) with 15° antenna
- 1xEthernet Switch
- 1xBER Tester
- 2xNotebook computers with MAC layer traffic measurement tools
- 1xMedia Server
- 1xNetwork Management Server

#### Radio Frequency Transmission & Reception

- Line of sight propagation between BSU and all SSUs
- EIRP: ~ 33dBm
- RSSI: ~ -58dBm
- Modulation: QAM64

#### IP & TDM Traffic Control

- Bandwidth allocation ratio: 50% downstream, 50% upstream
- Traffic priority: TDM or E1

### Point-to-Point

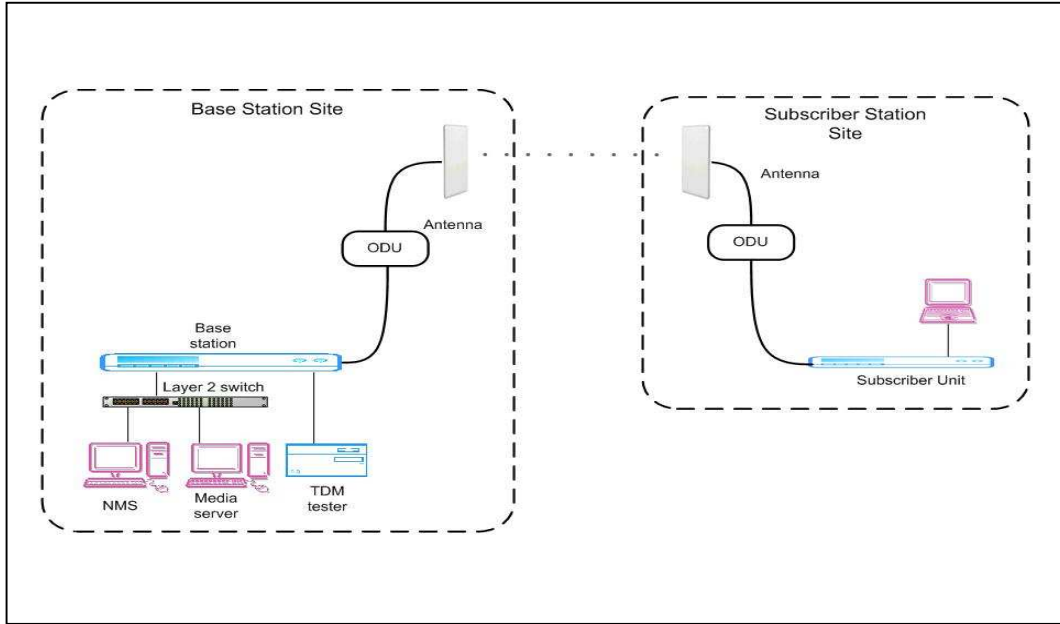


Figure 2

### Point-to-Multipoint

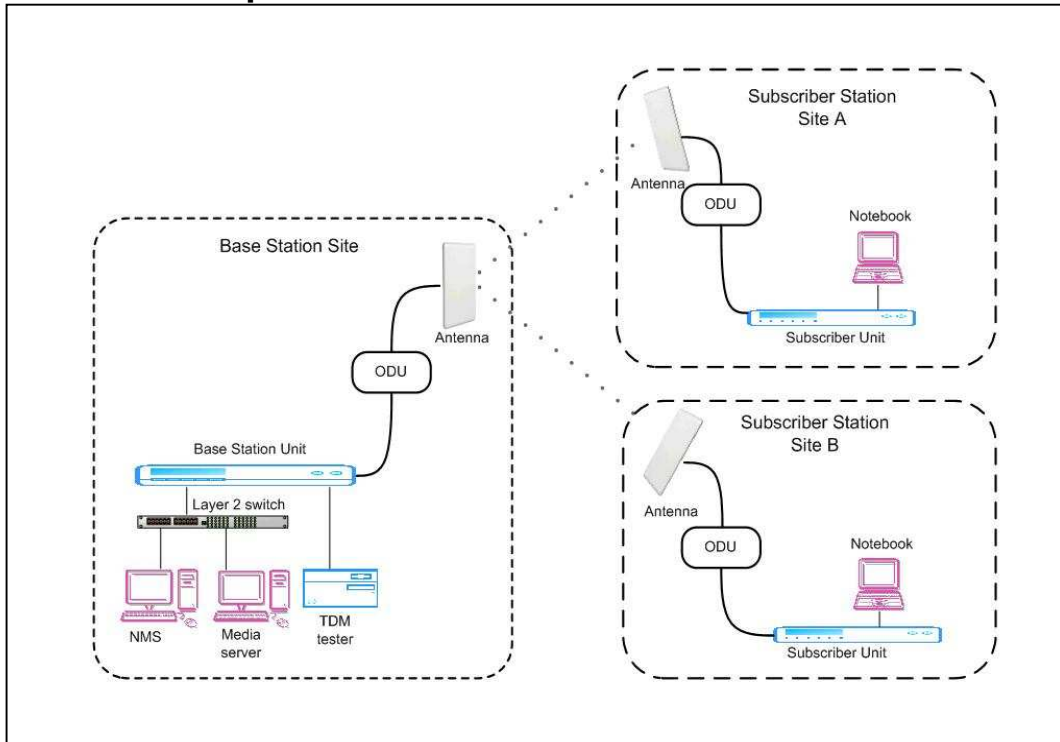


Figure 3

### Broadband Transport Connect

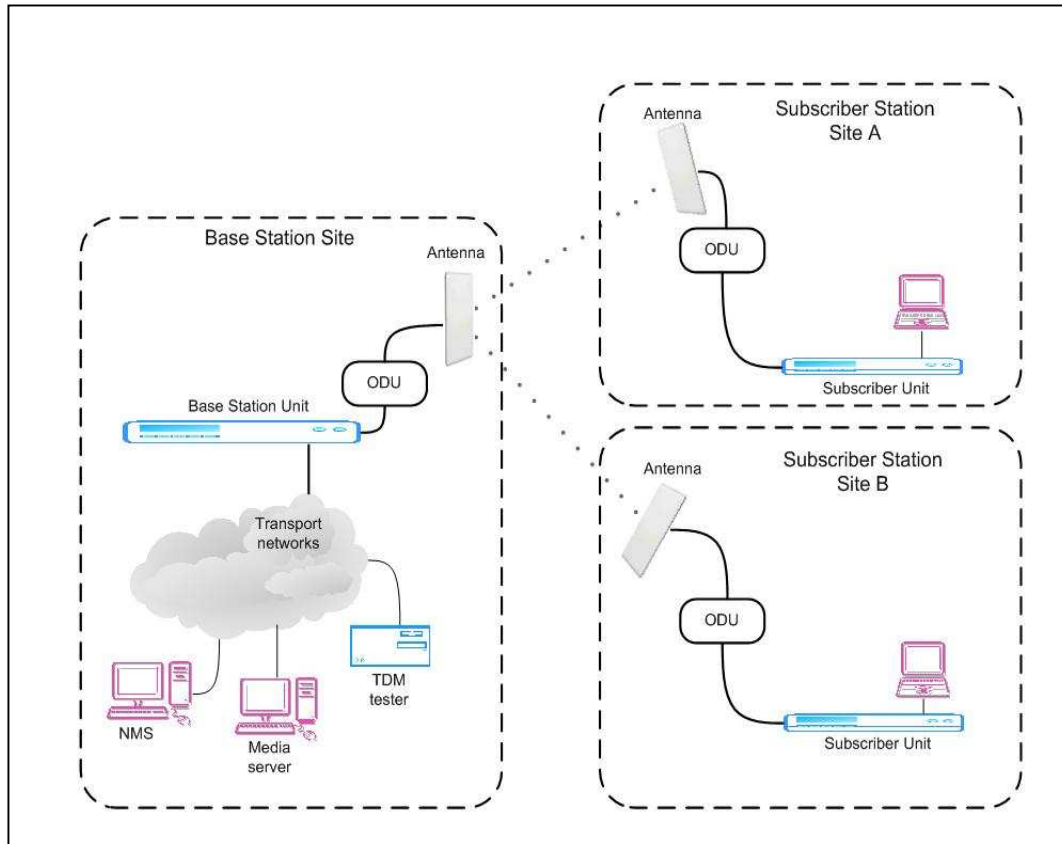


Figure 4

## 4. Results & Observations

PTP	RF Channel BW(MHz)	IP Traffic Only		IP & TDM Traffic		
		Download(Mbps)	Upload (Mbps)	IP Download(Mbps)	IP Upload (Mbps)	#E1
TDD	1x3.5	3.8	3.9	1.9	2	1
	1x7	7.4	7.8	2.4	3.8	2
FDD	2x3.5	4.3	4.4	2.2	2.3	1
	2x7	7.3	7.8	4.9	4.6	2

Table 1

PMP	RF Channel BW(MHz)	BW Limiting	IP Traffic Only			
			SSA		SSB	
			Download(Mbps)	Upload (Mbps)	Download(Mbps)	Upload (Mbps)
TDD	1x3.5	2.25	1.9	2.2	2.1	2.1
	1x7	4.5	4.5	4.3	4.6	4.3
FDD	2x3.5	2.25	2.1	2.1	2.1	2.2
	2x7	4.5	4.1	4.5	4.5	4.3

Table 2

PMP	RF Channel BW(MHz)	BW Limiting	IP & TDM Traffic				#E1
			SSA		SSB		
			IP Download(Mbps)	IP Upload (Mbps)	IP Download(Mbps)	IP Upload (Mbps)	
TDD	1x3.5	1.15	1	1.1	1.1	1.1	1
	1x7	2	1.9	1.9	1.9	1.9	2
FDD	2x3.5	1.15	1	1.1	1.1	1.1	1
	2x7	2	1.9	1.9	2	2	2

Table 3

Summary of observations:

1. throughput measured under FDD mode is comparable to TDD which is in agreement with vendor specification
2. both IP and TDM traffic can be run in parallel on the same system with priority given to TDM traffic
3. bandwidth limiting has been employed by the system under test enabling fairness in the sharing of bandwidth among multiple subscriber station units
4. The IP and TDM traffic were also looped through a live broadband transport network via IEEE802.3u and ITU-T G.703 interfaces without any loss of signal and link failure

LOS performance of TDD and FDD obtained in this trial, as we believe, is predominantly equipment specific, we do not recommend the use of our results as a general performance guideline of TDD and FDD.

According to the data throughput obtained in the trial, the BWA system under test is capable of delivering an average ~3Mbps and ~7Mbps IP traffic in both the downstream and upstream over 4km when the channel bandwidth is 3.5MHz and 7MHz respectively.

When a E1 of 2.048Mbps was set up to run in parallel with the IP traffic, the IP throughput is reduced to ~2Mbps in both the up and downstream direction for a single channel bandwidth of 3.5MHz.

Our trial results demonstrate the BWA band under test provides a good throughput and distance coverage appropriate for the establishment of both access and transport network.

Due to license expiry, further in-depth investigation, NLOS and interference testing has to be discontinued.

## Acronyms

Abbreviation	Description
BER	Bit Error Rate
BWA	Broadband Wireless Access
BSS	Base Station Site
EIRP	Effective isotropic radiated power
IEEE	The Institute of Electrical and Electronics Engineers
ITU-T	International Telecommunications Union – Telecommunications Standardization Sector
LOS	Line of sight
Mbps	Mega bits per second
MHz	Mega Hertz
NLOS	Non line of sight
ODU	Outdoor Unit
OFDM	Orthogonal Frequency Division Multiplex
PMP	Point-to-multipoint
PTP	Point-to-point
QAM	Quadrature amplitude modulation
RSSI	Received signal strength indicator
SSS	Subscriber Station Site
TDM	Time Division Multiplex