



Hong Kong Broadband Network Limited

3.5GHz BWA Technology Trial Test Report 2

Version 2.0

Date: 22-Feb-2005



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1. Objective

- To assess the general performance of the 3.5GHz Broadband Wireless Access (“BWA”)Technology in Hong Kong.
- To verify that the 3.5GHz BWA system can utilize the platform to offer a range of innovative services for subscribers.
- Trial Period: from 01-Oct-2004 to 31-Dec-2004.

2. Introduction

Recognizing the important role of broadband technologies in Hong Kong, a model of 3.5GHz broadband wireless access point-to-multipoint system, which provided by a leading telecommunication equipment vendor had been selected in this trial. To evaluate the performance of the BWA system, a simple system had been set up to test the point-to-multipoint wireless links under both indoor and outdoor environment.

This trial implemented 3G Project Partnership (3GPP) UMTS Time Division Duplex (TDD) standards, which is also known as TD-CDMA. TDD is one of the good choice for provisioning ubiquitous broadband data and voice services not only because of the unmatched performance and economics of the solution, but its standards-based nature, and the growing market lead of the technology in commercial deployment. This system can operate in either 5 or 10MHz of spectrum in the band of 3400 – 3600MHz. With modulation QPSK and 10MHz spectrum, the theoretical maximum sector downlink data rate is 5.5Mbps and the maximum sector uplink data rate is 1.5Mbps (wider spectrum permitting higher data rates). The maximum downlink data bandwidth per user is 2.5Mbps and the maximum uplink data bandwidth per user is about 1.1Mbps. The data bandwidth per user located inside one sector of a cell site is depended on the radio propagation conditions and sharing factors.

The characteristics of working in non-line-of-sight and multi-path environment were demonstrated in this trial and the non-LOS property may improve the service provision over the existing LMDS technology.

Through the trial, we would like to estimate the viable of the BWA technology under the unique environment of Hong Kong.

3. Trial Configuration

3.1 Trial Test locations

The BWA field trial was performed under both in indoor and outdoor environment at various approved locations in Tsuen Wan District. For the outdoor test, a base station with a sector was installed at a location named TAC and four test points (named A, B, C and D) are selected to perform the tests respectively.

The path distance between TAC and test point A is about 625m.

The path distance between TAC and test point B is about 463m.

The path distance between TAC and test point C is about 1.35km.

The path distance between TAC and test point D is about 1.65km.

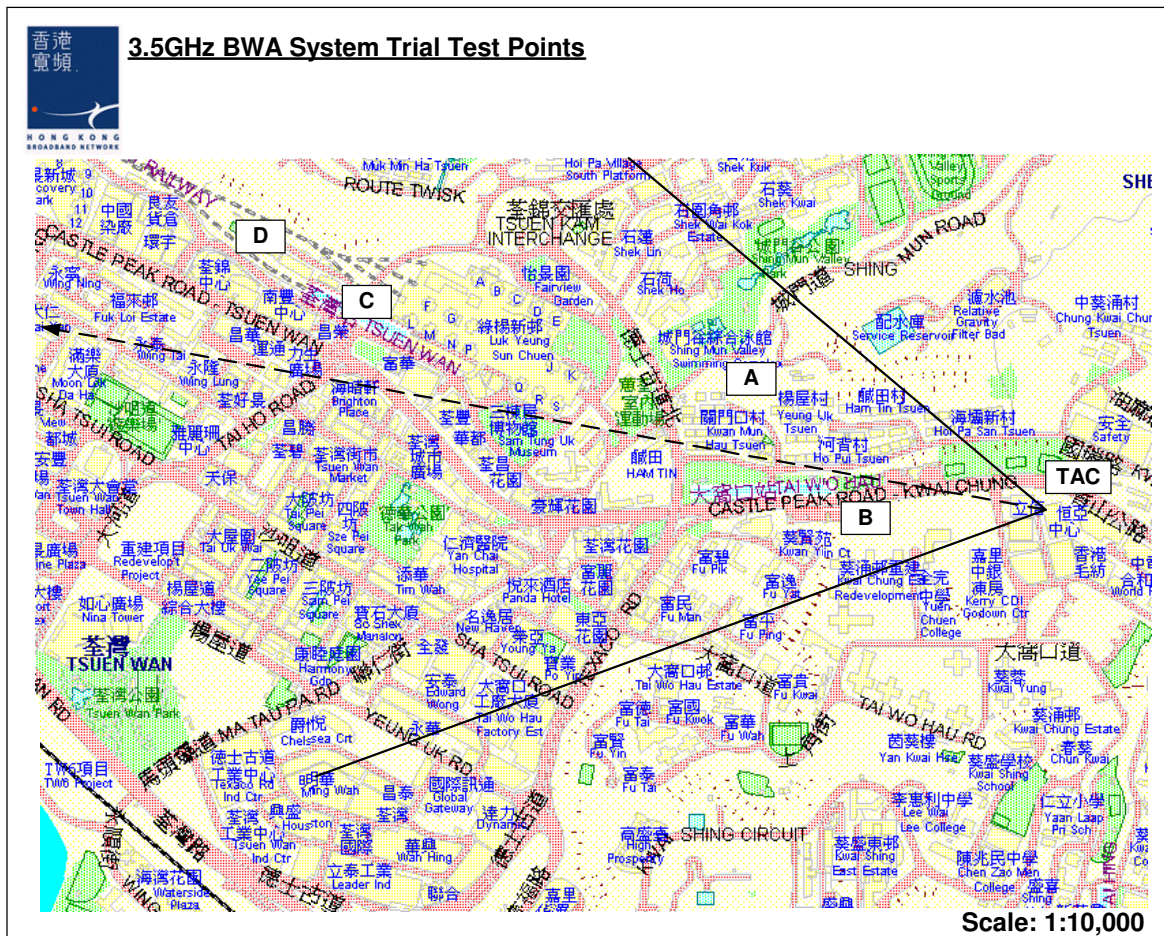


Figure 1 – Selected trial test points

3.2 Radio Air Interface Configuration

The system employs TDD and the uplink/downlink is transported over the same RF channel. In this test, there are 4 timeslots are assigned for uplink and 8 timeslots are assigned for downlink per frame.

3.3 System set up and configuration

A. Outdoor Test

A network was established as shown in Figure 2 to evaluate the throughput performance under different signal strength. First, a sector at TAC was set up and point towards four authorized locations at Tsuen Wan Area (namely A, B, C and D) and the throughput performance test was carried-out one-by-one.

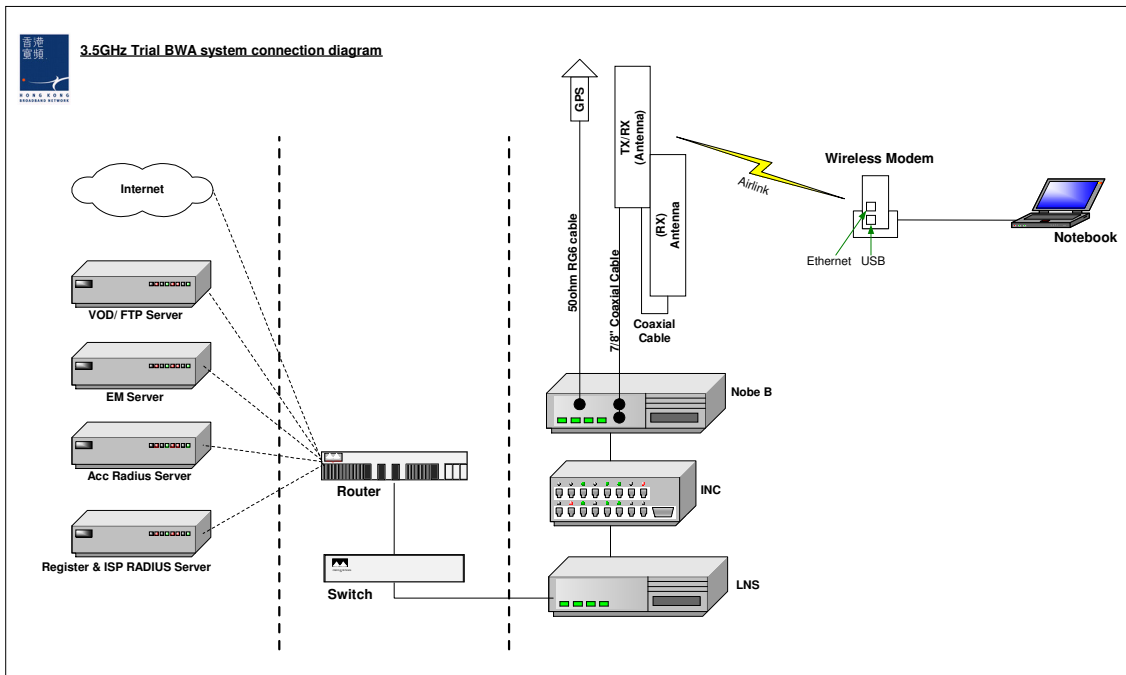


Figure 2 – General Test Configuration

Since the system supports spatial and polarization receiver diversity. It means two antennas per sectors will be used. The advantage for diversity is to increase the sensitivity. A GPS timing signal is used for the TDD frame timing that all sectors in the



network are synchronized. Several servers such as FTP server, which located in HKBN's core network, were connected to the base station at TAC and it transfer data to the remote clients to perform the throughput test. A notebook PC was used as the remote client.

For the outdoor trial test, only one client was connected to the base station during the test.

B. Indoor Test

For indoor test, a similar system had set up in TAC both for the base station and the remote clients. Several clients performed the throughput test at the same time to evaluate the loading performance. In the trial, the following five application tests had been completed.

- (1) VoIP Test
- (2) Tier of Service Test
- (3) Web Browsing Test
- (4) VPN Test
- (5) Email (POP3 and SMTP) Test

4. Trail Results Summary

4.1 Outdoor Field test results

4.1.1 Download Throughput test results:

Location	LOS/NLOS to TAC	Signal Strength	Test Results (Mbps)
A	LOS	Good	2.2
B	NLOS	Fair	2.1
C	NLOS	Fair	1.7
D	NLOS	Marginal	0.7

4.1.2 Upload Throughput test results:

Location	LOS/NLOS to TAC	Signal Strength	Test Results (Mbps)
A	LOS	Good	0.9
B	NLOS	Fair	0.82
C	NLOS	Fair	0.23
D	NLOS	Marginal	0.1

4.1.3 Mixed Download and Upload throughput test results:

Location	LOS/NLOS to TAC	Signal Strength	Download Test Results (Mbps)	Upload Test Results (Mbps)
A	LOS	Good	2.16	0.928
B	NLOS	Fair	1.7	0.54
C	NLOS	Fair	1.28	0.215
D	NLOS	Marginal	1.35	0.102

Remarks: Location B was tested inside the MDF room and locations without LOS to TAC.

4.2 Indoor Tests Results

The following test results were got under good radio signal strength condition.

4.2.1 Downlink Throughput test results with 2-4 clients connected to the network

# of Clients connected	Test Results (Mbps)			
	Client 1	Client 2	Client 3	Client 4
2	2.21	1.92	/	/
3	1.69	1.7	1.56	/
4	1.41	1.27	1.25	1.11

4.2.2 Uplink Throughput test results with 2-4 clients connected to the network

# of Clients connected	Test Results (kbps)			
	Client 1	Client 2	Client 3	Client 4
2	379	333	/	/
3	288	268	281	/
4	230	222.72	225	216

4.2.3 Mixed downlink & uplink throughput test results with 4 clients connected to the network

Client	Download Test Results (Mbps)	Upload Test Results (Mbps)
1	1.27	0.234
2	1.158	0.237
3	1.228	0.221
4	1.27	0.214

4.2.4 Internet Platform Application Tests Results

The following five application tests were completed.

- (1) VoIP Test
- (2) Tier of Service Test
- (3) Web Browsing Test
- (4) VPN Test
- (5) Email (POP3 and SMTP) Test

(1) VoIP test results

The objective was to verify the system can support the packet of VoIP and its performance.

The result is that the system can support VoIP but the quality is not as good as fixed line.

(2) Tier of Service test results

The system offers different tier of data rates (business, gold, silver and bronze) and this test was to assess the ability of the system limit the user data rate

according to different service plans. Assigning different class of service or rate limiting to each client, we can observe that all clients (under the test) will be shared the sector capacity regarding to their tier setting. Also, the final throughput for all clients would not be greater than the limitation set for the corresponding tier of service.

(3), (4) & (5) Web browsing, VPN and Email (POP3 & SMTP) tests results

Test Item	Results
Web Browsing	Functional
VPN Connection	Functional
Email (POP3 & SMTP)	Functional

5. Conclusion

In the trial with 10MHz spectrum bandwidth, it was observed that the TD-CDMA system provided an average of 2Mbps downlink data rates to outdoor users and 1Mbps to indoors users at strong signal locations. The system can deliver the optimum data rate to the user with its adaptive rates. Under poor radio coverage conditions, the downlink throughput had fallen to 700kbps.

The BWA system also demonstrated the NLOS characteristic, which is a significant advantage in the provision of wireless telecommunication services in Hong Kong. First, clients with wireless modem can receive radio signal and make connections to access the Internet services without connecting to the in-building block-wiring system or installing external antenna. Second, Internet service providers need not to deploy in-building wiring system in the heavily congested trunkings. Through the BWA system, subscribers can enjoy high-speed Internet access whenever and wherever it's needed – around the house, in the office, at meetings or even outdoors. Although, in the mean time the mobility of this kind of product is limited by the handover technology, it is also valuable to study and apply this technology in the urban environment in Hong Kong.

6. Appendix

The followings are extracted from the Permit Issued under Section 7E of the Telecommunications Ordinance by OFTA for the trial.

電台細節 Station particulars			
設備詳情 Equipment Particulars	頻率及最大頻 差容限(兆赫) Frequency and Maximum Frequency Tolerance (in MHz)	發射 類別 Class of Emission	最大等效全向輻 射功率(瓦特) Maximum Equivalent Isotropically Radiated Power (in Wats)
Point to multi-point wireless system	Subscriber Station transmit: 3485 - 3495 MHz \pm 0.05 ppm Central Station transmit: 3485 - 3495 MHz \pm 0.05 ppm	5M00G7W or 10M00G7W	Subscriber Station transmit: 2 W Central Station transmit: 100W