

Preliminary Report of Technical Trial of Wireless FTNS in Hong Kong (10 January 2000)

1. Purpose

The aim of this trial was to have an in-depth technical field study of the Hong Kong unique environment in order to expedite the implementation and roll-out of wireless FTNS. The scope mainly covered the environmental factors such as rain fade and the technical characteristics of existing in-building coaxial distribution system.

2. Field Trial Period

The field trial was commenced on 18 September 1999, the next day after Ofta's approval of the trial was granted. We expected that we could conclude the study by March 2000.

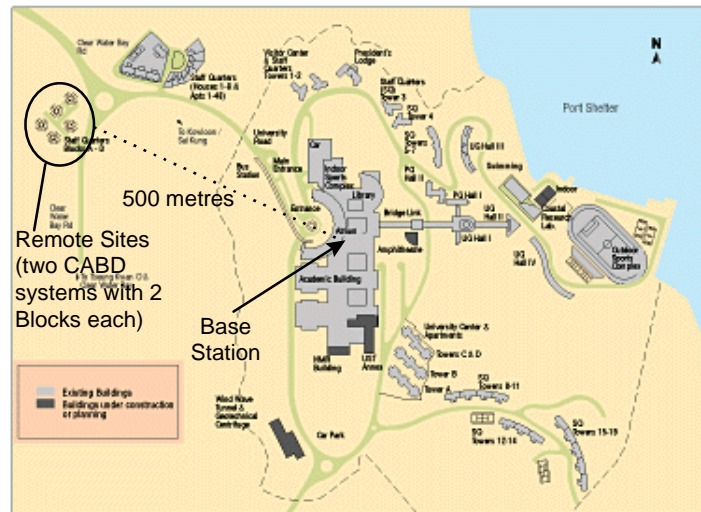
3. Trial Sites

There were two main trial sites. The first one was located at the Hong Kong University of Science and Technology (HKUST). The primary objective of this site was on the environment study. The second site was situated in Mong Kok. Our aim for this site was mainly the study of network deployment for commercial buildings and old residential buildings.

The total number of customers were limited to 100 in the Ofta's approval of our field trials. Such a quota was equally split amongst these two trial sites. There were around 50 customers in each trial site. Together with our own test traffic, the trial system was fully loaded during the test.

(a) Trial Site at HKUST

The address of trial site at HKUST was at Clear Water Bay, Kowloon. It was a typical humid area in Hong Kong. Foggy weather was expected in Spring. It would also be quite windy during the typhoon as the university was located at a hill on the east side of the Kowloon Peninsula. The diagram below gave an overview of the trial site at HKUST.



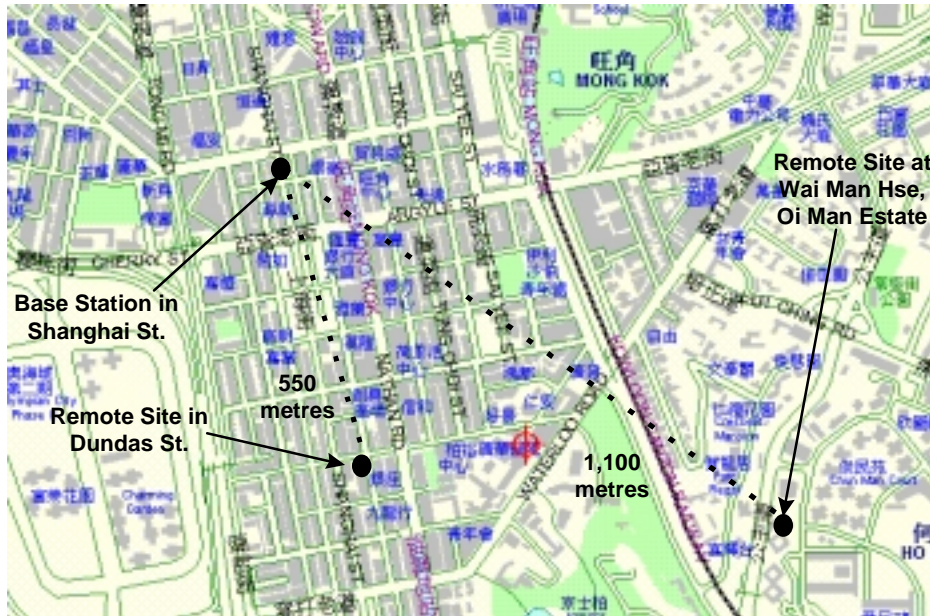
The base station was set up within the main campus. The antenna outdoor unit was put at the roof top of academic building while the indoor equipment was installed at the second floor within the Information Technology Services Centre (ITSC). The RF cable length between the outdoor and indoor units was over 35 metres.

The remote customer sites were located at the Junior Staff Quarters (JSQ). It was approximately 500 metres away from the base station. This site was a perfect model of typical estate arrangement in Hong Kong. There were four blocks of 5-storey building with 8 units on each floor. As these buildings were developed in two phases, there were two Communal Aerial Broadcasting Distribution (CABD) systems, one for blocks A and B and the other for blocks C and D. Each have been providing the TV broadcasting service to the occupants since they moved in around six years

The remote antennae were installed at the roof top of two of blocks A and C while the indoor equipment was put within the meter room. No air-conditioning nor ventilation was available in this meter room. The cable run from the outdoor unit to indoor unit was approximately 15 metres.

(b) Trial Site in Mong Kok

The second trial site was located in the densely populated area at the west of Kowloon Peninsula as shown in the following map. The setup was basically the same as the HKUST trial site. There were one base station and two remote stations. Unlike the HKUST trial site, the two remote sites were around 850 apart in the same 90° sector. In addition, one remote site was commercial building and the other remote site was an 25-year old building, owned and managed by the Housing Authority.



The base station was strategically located in Mong Kok, one of the typical concrete forest in Hong Kong. It had a clear line-of-sight to most of the buildings in this area. The two remote sites were respectively 550 and 1,100 metres away from the base station, across of a number of buildings in-between.

Our intelligent building approach, with the use of fibre and Cat-5 technologies, was testified in the commercial building remote site. For the residential remote site, the prime objective was to testify the implementation of our wireless FTNS technologies in a typical noisy CABD system that was considered by a number of people as technically not viable. The building chosen in our trial test was an 25-year old building. It was a typical 24-storey public house with around 600 units.

4. Trial System

(a) Radio System

So far, we have tested four radio systems in our field trial. The operating frequency covered the spectrum designated by Ofta for the implementation of wireless FTNS. In addition, other operating frequency was also explored for comparison and functional test purposes. They were summarised in the table below.

	Ofta's Approval	System	Operating Frequency	Maximum Power	Frequency Stability	Antenna Gain
Radio 1	17 Sep 99	ATM	28 GHz	< 1 watt	± 4 ppm	15 & 36 dBi
Radio 2	13 Oct 99	IP	2.6 GHz	14 dBm	± 1 KHz	24 dBi
Radio 3	13 Oct 99	TDM	23 GHz	17 dBm	± 10 ppm	34 dBi
Radio 4	13 Oct 99	TDM	26 GHz	17 dBm	± 10 ppm	34 dBi

(b) In-Building System

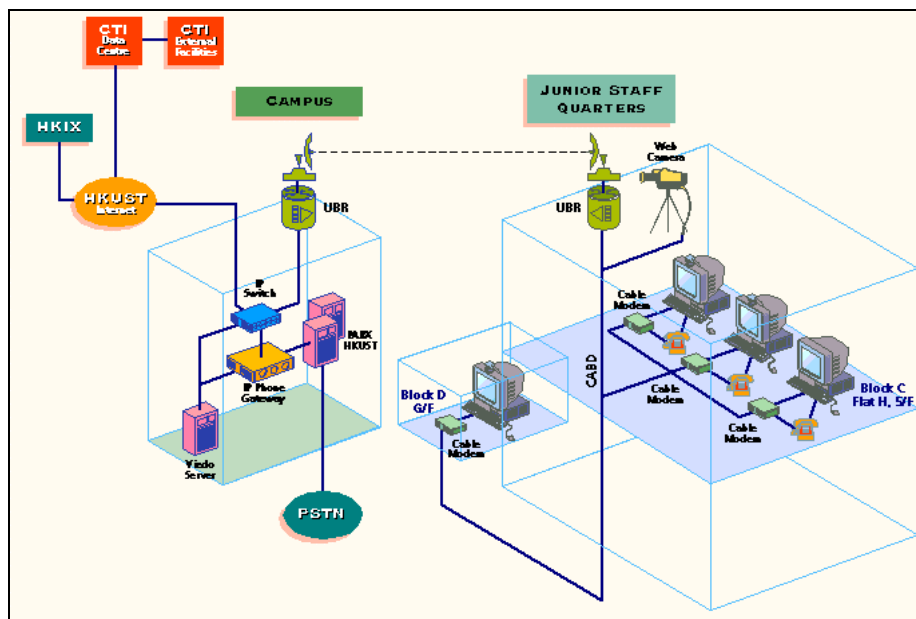
Our technical field trial on the in-building system was mainly focused on the implementation of DOCSIS technology in the in-building CABD system. Approval from Ofta was given for the use of the following frequencies. Variety Cable Modem Termination System (CMTS) and cable modem were used in the test but all conformed to the DOCSIS specification.

Upstream: 22.4 - 25.6 MHz for HKUST and 36 - 39.2 MHz for Mong Kok

Downstream: 718 - 726 MHz

5. Test Configuration

A number of systems were tested at our trial sites but the equipment set up was basically the same. The following was a typical configuration with reference to the HKUST trial site.



6. Preliminary Findings

With extensive laboratory tests conducted in the nine months before the field trial, we experienced no major difficulties in conducting the field test. The following were the salient points of our findings.

- The noise level of CABD system was much lower than the expectation. The signal-to-noise ratio was at least 32 dB. It was around four times better than the DOCSIS minimum requirement. This was not only applicable to the HKUST trial site but the trial site at Oi Man Estate, an 25-year old building. It was mainly because of the short distance. Unlike the Hybrid Fibre Coaxial (HFC) system, the CABD network in

Hong Kong covered only one estate within an area of less than 500 metres in Hong Kong.

- We experienced no technical difficulties in putting our upstream and downstream channels in the existing CABD system. There was no degrade in the TV reception quality after our DOCSIS system was in place. Our system was transparent to other occupants who did not involve in the field trial.
- The net information rate achieved at the customer end could be 3 - 4 Mbit/s.
- With the real time traffic generated from the customers, the trial platform successfully supported the following multimedia applications to be run on it. Over 800 visitors, including government officials, telecommunications analysts, reporters, incorporate owners, owner committees, management offices and property developers, have witnessed this during their visit to our trial site.
 - Broadband Internet at 3 Mbit/s
 - Video on demand at 2 Mbit/s
 - Video Broadcast at 2 Mbit/s
 - Video Conference at 512 Kbit/s
 - Home Security at 512 Kbit/s
 - Voice over IP
- With the proper design of radio link budget and the Automatic Gain Control (AGC) built in the radio system, all our field trial radio systems could immunise from the weather condition during the trial period. The following was a summary of the major key meteorological data from September to December 1999. The most severe weather in Hong Kong last year was on 16 September 1999, unfortunately one day before the Ofta's approval of our trial was granted. The maximum instantaneous rate of rainfall was 180 mm per hour at 5:04pm while the maximum gust peak speed was 234 km/hour at 5:14pm. This was the highest record since 1983.

Month	Mean Pressure	Mean Air Temperature	Mean Relative Humidity	Total Rainfall
Sep 1999	1,007 hPa	28 °C	78%	366 mm
Oct 1999	1,014 hPa	26 °C	73%	39 mm
Nov 1999	1,017 hPa	22 °C	70%	16 mm
Dec 1999	1,021 hPa	17 °C	60%	33 mm

- The radio system integrated perfectly with our DOCSIS system. The overall connection efficiency depended on the radio link protocol. For IP or TDM radio link, we could achieve 70 - 80% efficiency but it was only 50% for ATM radio link.

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