# Report on Temporary TD-LTE Small Cell Demo Deployment

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Hong Kong Applied Science and Technology Research Institute Company Limited (ASTRI)

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## Executive Summary

The Hong Kong Applied Science and Technology Research Institute (ASTRI) was founded by the Government of Hong Kong SAR in 2000 with a mission of enhancing Hong Kong's competitiveness in technology-based industries through applied research.

The ASTRI Communications Technologies Division deployed a TD-LTE small cell demo system from 21 October 2014 to 28 February 2015 for technology promotion. This report summarizes the demo system's network architecture, hardware specifications, and experimental results.

# 1 Introduction and Background

## 1.1 Purposes of the TD-LTE Small Cell Demo Deployment

The purposes of the TD-LTE small cell demo deployment include:

- To promote TD-LTE technologies.
- To demonstrate small cell deployment scenarios.
- To showcase the R&D and network planning capabilities of ASTRI.

## 1.2 Schedule

The demonstration was held from 21 October 2014 to 28 February 2015.

## 1.3 Concerned Parties

- ASTRI
- OFCA
- 21ViaNet

## 1.4 Non-Revenue Generating

ASTRI used the demo system's network, equipment, and services solely for technology promotion. ASTRI did not open the demo system for public access and did not generate revenue by operating the demo system.

# 2 TD-LTE Small Cell Demo System Specifications

## 2.1 Radio Design and Considerations

### 2.1.1 RF Equipment and Antenna Compliance

The RF equipment and antennas used in the demo system comply with 3GPP TD-LTE requirements.

### 2.1.2 RF Power

Small cell base station: The maximum EIRP (equivalent isotropically radiated power) per antenna port was 38 dBm.

User equipment: The maximum EIPR per antenna port was 23 dBm.

### 2.1.3 Class of Emission

The demo system employed TDD mode, 20 MHz bandwidth, and various modulation techniques (such as QPSK, 16QAM, and 64QAM) according to 3GPP TD-LTE specifications.

### 2.1.4 RF Spectrum

ASTRI used the 2300 MHz – 2330 MHz spectrum under a memorandum of understanding with 21ViaNet.

### 2.1.5 Interferences to Other Equipment

The TD-LTE demo systems operated at the 2300 MHz – 2330 MHz spectrum, as licensed by OFCA, and did not cause interference to existing mobile phone network or other RF equipment at the installation locations.

## 2.2 Equipment

### 2.2.1 TD-LTE Small Cell Base Station

The small cell base station used is shown in Fig. 1 and the specifications are as follows:

- Brand: Fujian Sunnada
- Model: LNC-2000E Nanocell
- Compliant with 3GPP TD-LTE Release 9 standard;
- 2 transmit antennas and 2 receive antennas;
- Maximum 23 dBm transmit power per antenna port;
- Adaptive modulation scheme including QPSK, 16QAM and 64QAM; and
- Support user equipment category 1 to 4.

**Figure 1: TD-LTE small cell base station.**

### 2.2.2 Base Station Antenna

Typical outdoor antennas were used. The specifications are listed below.

- Frequency range: 2300 MHz – 2700 MHz
- Gain/Horizonal Beamwidth/Vertical Beamwidth: 16 dBi/$120^0$/$9^0$
- Input impedance: 50Ω

### 2.2.3 TD-LTE User Equipment

The TD-LTE user equipment used is shown in Fig. 2 and the specifications are as follows:

- Brand: Huawei;
- Model: E392u-92;
- 1 transmit antennas and 2 receive antennas;
- Maximum 23 dBm transmit power;
- Adaptive modulation scheme including QPSK and 16QAM; and
- LTE user equipment category 3.

**Figure 2: TD-LTE user equipment.**

### 2.2.4 LTE Evolved Packet Core

ASTRI's LTE EPC (evolved packet core) software implemented on a x86 server was used and the key features are as follows:

- Mobility Management Entity (MME);
- Packet Gateways (SGW and PGW); and
- System Management interfaces including CLI/Telnet management console and HTTP web interface System Management.

**Figure 3: ASTRI's EPC.**

## 2.3 Demo System Overview

The demo system included two base stations which were deployed at two locations in the Hong Kong Science Park (HKSP) (see Fig. 4) including the roof top of Photonics Centre and the roof top of Lakeside 2.


**Figure 4: Base station sites in HKSP.**

## 2.4 Network Topology Overview

The demo system network topology is illustrated in Fig. 5. The base station carrier center frequency is 2320MHz and TD-LTE uplink-downlink configuration 2 is adopted (i.e., each radio frame consists of 2 uplink subframes, 6 downlink subframes, and 2 special subframes).

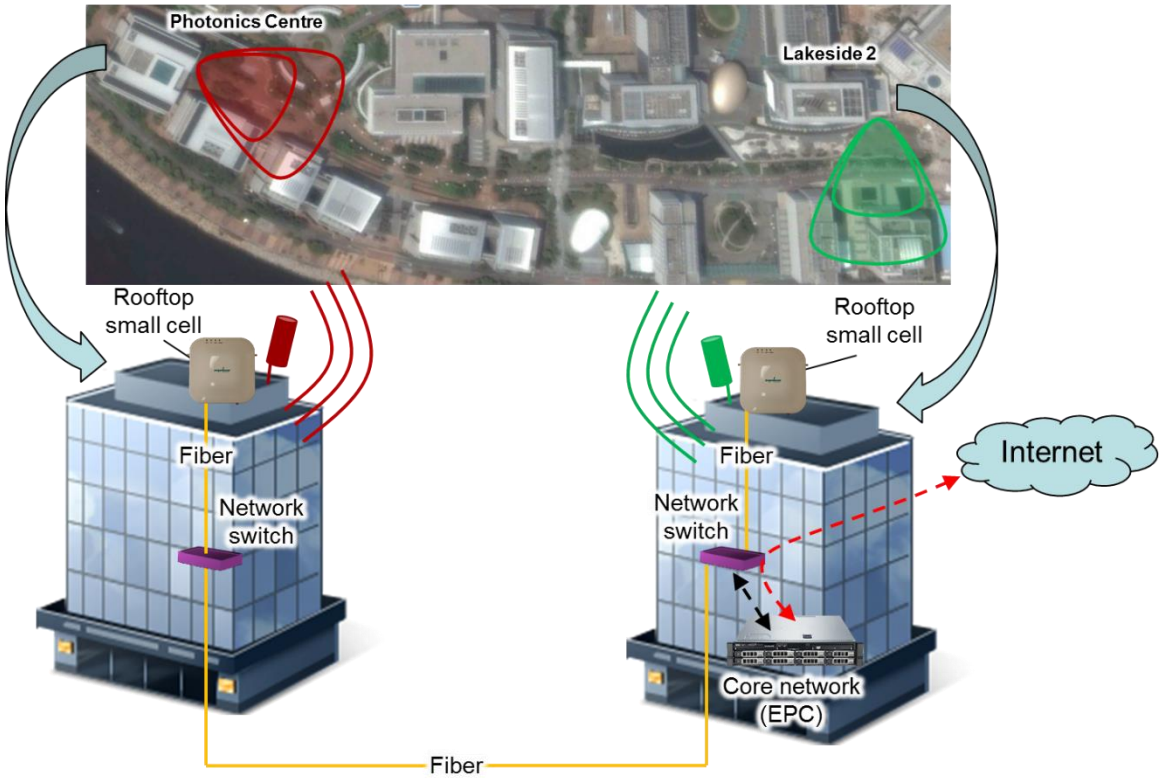
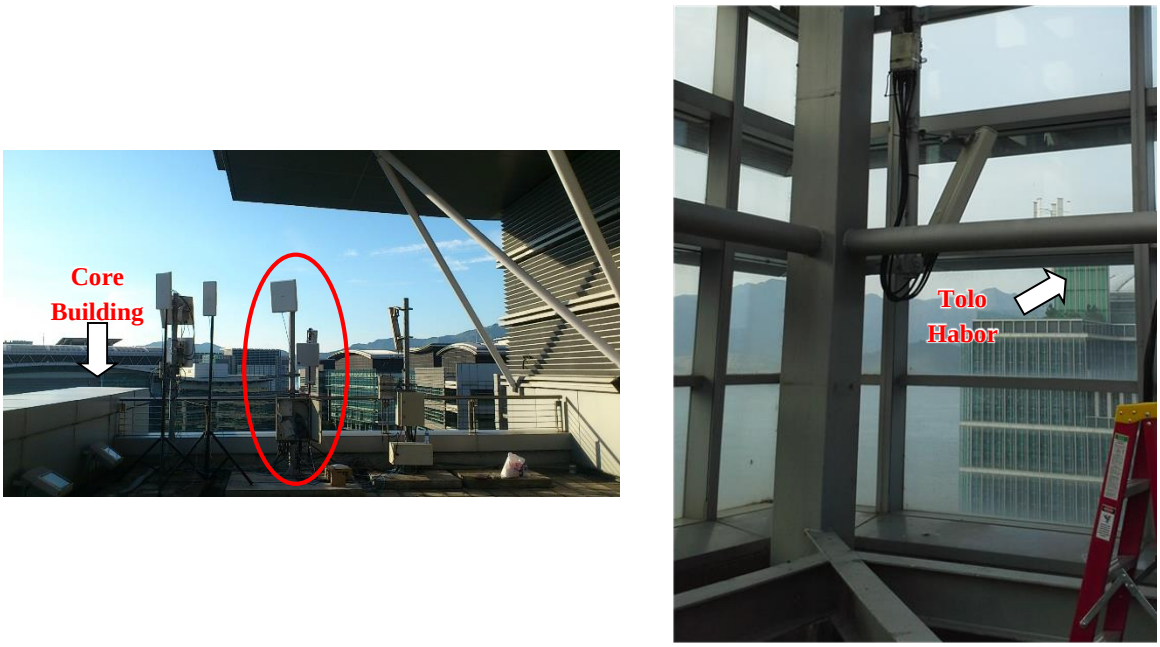



**Figure 5: Demo system network topology.**

## 2.5 Base Station Sites

The base station sites are illustrated in Fig. 6. At the Photonics Center, the antenna faced the Core Building (see Fig. 6a). At Lakeside 2, the antenna faced the Tolo Harbor (see Fig. 6b).




(a) (b)

**Figure 6: Base station sites. (a) Photonics Center. (b) Lakeside 2.**

# 3 Experimental Results

## 3.1 Coverage Measurements

The coverage of the demo system was measured using the R&S TSMW Universal Radio Network Analyzer (see Fig. 7) which is a measurement equipment for network drive tests. The key features of the TSMW for LTE network rollout and optimization include:

- Automatic detection and measurement of all available cells;
- Narrowband and wideband measurements; and
- Automatic channel detection.


**Figure 7: The R&S TSMW.**

The coverage of the demo system was measured by strolling through HKSP (see Fig. 8) and coverage results are shown in Fig. 9 to Fig. 14. The measurements metrics included the RSSI (received signal strength indicator) in dBm, the SINR (signal to interference plus noise ratio) in dB, and the RSRP (reference signal received power) in dBm. In particular, the coverage areas of the cells are shown in Fig. 11 and Fig. 14 at which the RSRP is above approximately -110dBm.


**Figure 8: Coverage measurement setup.**

**Figure 9: RSSI measurement results (in dBm) for Photonics Center base station.**

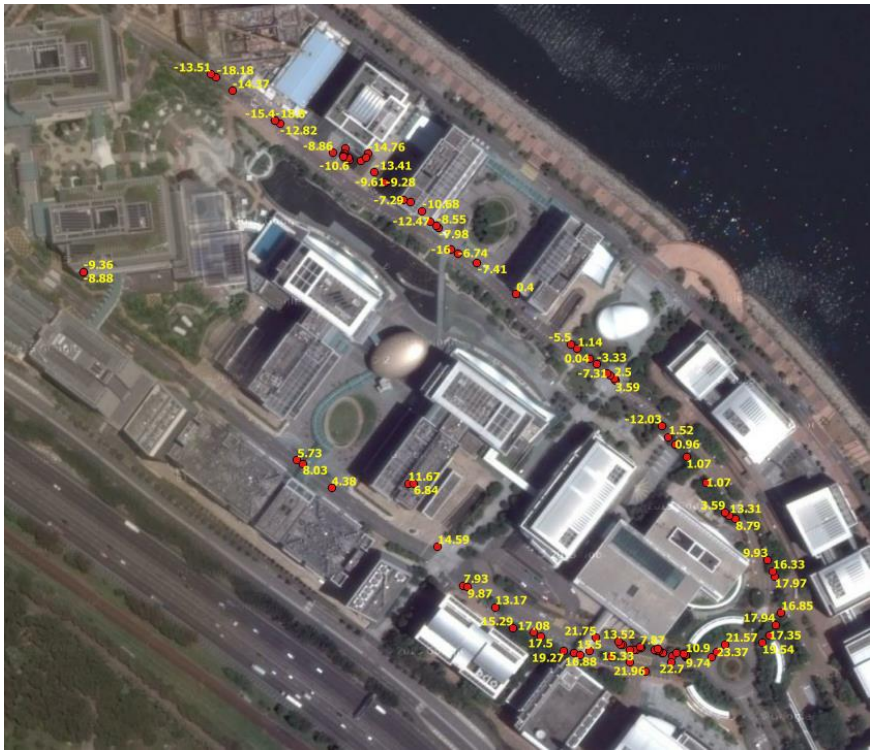



**Figure 10: SINR measurement results (in dB) for Photonics Center base station.**


**Figure 11: RSRP measurement results (in dBm) for Photonics Center base station.**

**Figure 12: RSSI measurement results (in dBm) for Lakeside 2 base station.**

**Figure 13: SINR measurement results (in dB) for Lakeside 2 base station.**

**Figure 14: RSRP measurement results (in dBm) for Lakeside 2 base station.**