Cygnus
Broadband, Inc.

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Contents

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REVISION HISTORY

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Overview

Cygnus Broadband is committed to develop an outdoor, metro-picocell eNB. The development is focusing on the eQeE component that stands out Cygnus Broadband's eNodeB from its competitors. Field trial is one of the development phases required to be completed before launching the products

Initial field trial for Cygnus LTE eNB

Cygnus field test trial is to measure the performance of its LTE eNodeB product in the field using different drive routes and radio channel environments. Among other things, system bandwidths, UDP and TCP throughput shall be measured.

The trials include measurements of 10-Mhz bandwidths, FDD and of SISO (Single-In Single-Out) antenna configuration. The test frequencies are ranging from 2500-2570 MHz for Uplink and 2620-2690 MHz for downlink transmission. The eNB peak power output shall be 100mW max. The test also presents the layer-1, UDP and TCP throughput using the various commercial 4G handheld terminals.

LTE (Long Term Evolution)

The LTE standard is being developed in two 3GPP work items: The LTE work item targets the evolution of the radio network; and the SAE (System Architecture Evolution) work item targets the evolution of the packet core network. In contrast to previous standards, the LTE standard solely specifies a packet-switched (PS) domain for LTE and SAE. Output from the work items is embodied in the Evolved UTRAN (E-UTRAN) and the Evolved Packet Core (EPC) standards. Together, they form the Evolved Packet System (EPS)

The E-UTRAN standard employs orthogonal frequency-division multiplexing (OFDM) technology for downlink operation and single carrier frequency-division multiple access (SC-FDMA) technology for uplink operation. This approach yields excellent flexibility in terms of deploying and allocating spectrum from 1.4 MHz up to 20 MHz. In addition, the LTE standard supports FDD (frequency-division duplex) as well as TDD (time-division duplex) modes of operation.

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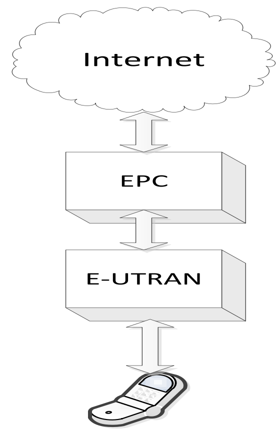

Figure 1. Evolved Packet System (EPS)

Cygnus LTE eNB Test bed

The hardware architecture of Cygnus' eNB LTE test bed is a one-sector; one-cell system designed for 4G LTE market. It supports a variety of configurations, antenna setups, and system bandwidths; and measurements of layer-1, layer-2 and application-level performance.

The upper layer (application) and the lower layer (MAC/PHY) software is based on a common platform T4000, but different versions of the code are used for different hardware configurations in order to match the current antenna configuration. Cygnus LTE eNB development has taken place in parallel with the 3GPP standardization process. Therefore, the LTE test bed does not exactly mirror the most recent release 3GPP LTE specification.

The MIMO scheme in the test bed, for example, employs selective per-antenna rate control (S-PARC), which means streams can be individually encoded and modulated and a single data stream is always mapped to a single transmit antenna. The latter shall be used for initial field trial.

Cygnus Field Trial Setup

The Cygnus eNB Field trial test setup is shown in figure 2.

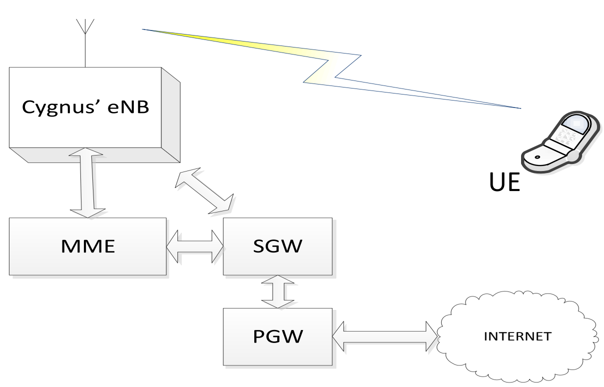

Figure 2. Field test set up

The LTE network architecture uses a modular system design called the system architecture evolution - SAE, which is composed of separate components that may be added, removed, or connected together to evolve or improve the capabilities of an existing system. The LTE system uses an SAE to transition from a voice centric switched network to a universal broadband communications access system.

This figure-2 shows the basic architecture of the LTE system. This diagram shows that key network elements for Cygnus field test setup.

The field test equipment includes commercial user equipment (UE), Cygnus base stations (eNBs) (Figure 3), serving gateway (S-GW), a mobile management entity (MME), and a packet gateway (P-GW). UEs communicate with eNBs (base stations) through the Uu radio interface. The MME sets up and manages mobile connections using information from a configuration file.

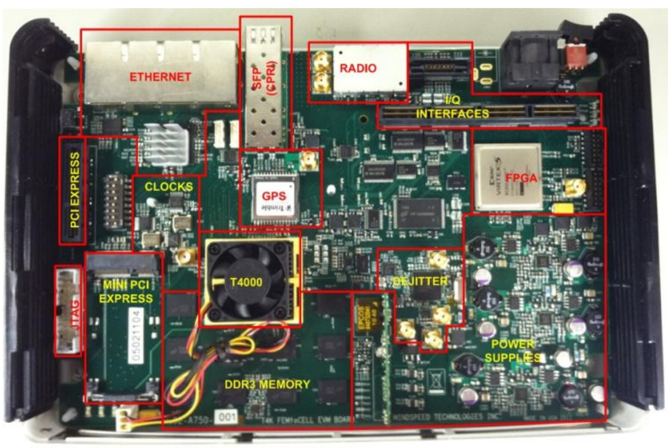

Figure 3. Cygnus eNB

Experimental

The test results shall be obtained using the Cygnus test bed in the laboratory and in extensive outdoor field tests. For the field trials, an LTE test site shall be installed on the roof at Cygnus' headquarters in San Diego (Figure 4).

Figure 4. Field test site

Commercially available antennas for the 2.6 GHz band were used at the base station (Figure 5). To evaluate the use of spatially separated and dual polarized antennas, the testers used different antenna setups and benchmarked them against each other for different MIMO configurations.

Figure 5. LTE Diversity Panel Antenna

The UE terminal shall be installed in a measurement van with antennas mounted on the roof. A GPS receiver was also used to make it possible to associate logged performance with the position of the terminal. The field tests shall be performed in one sector which is quite sparsely settled and dominated by low-rise buildings (compared to the site installation height) – line-of-sight (LOS) conditions were thus fairly common.

The majority of the field tests were performed within a radius of 1km from the test site (Figure 6). During most parts of the field tests, the speed of the terminal was between 5 and 40km per hour.

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Figure 6.

Tests cases

The following test cases shall be conducted during field trial.

- Attach
- Detach
- Reattach
- Iperf (Thru-put) both uplink and Downlink
- Stream Video
- File transfer
- Multi UEs

Measurements

The measurements shall be evaluated with 10 MHz bandwidth and application level performance, measurements using UDP and TCP traffic over a SISO. UDP is a best-effort transmission technique without acknowledgements from the terminal to the base station. It is thus insensitive to uplink performance and IP-related issues, such as system buffer sizes. TCP, on the other hand, transmits acknowledgements in the uplink. The results shall indicate if the test system has a well-tuned and reliable uplink.