Modulating Signal Description for ATK's experiment at SOCOM TE 15-1.

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1.0 OVERVIEW

The latest Physical Layer Description for LTE is contained in “Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description” 3GPP TS 36.201 V12.0.0 dated 09/2014. The ATK SOCOM TE-15 test system is compliant within “Evolved Universal Terrestrial Radio Access (E-UTRA); LTE physical layer; General description” 3GPP TS 36.201 V8.3.0 dated 03/2009. (Included for completeness). This document describes that subset of the LTE Physical Layer we will be limited to during the test period at the SOCOM TE-15 event 10/20-10/25/2014 at Camp Blanding, FL.

2.0 MODULATING SIGNAL DESCRIPTION

The LTE Specification supports many Frequency and Bandwidths. The ATK TE-15 demonstration will be limited to band 3. Specifically we will be transmitting concurrently at frequencies 1725 MHz and 1820 MHz a 10 MHz wideband signal with effective isotropic radiated power (EIRP) of 23 dBm and 33 dBm, respectively. The modulation schemes supported in the downlink and uplink are QPSK, 16QAM and 64QAM. The modulation scheme is based on Orthogonal Frequency Division Multiplexing (OFDM) with a cyclic prefix (CP) in the downlink, and on Single-Carrier Frequency Division Multiple Access (SC-FDMA) with a cyclic prefix in the uplink. To support transmission in paired and unpaired spectrum, two duplex modes are supported: Frequency Division Duplex (FDD), supporting full duplex and half duplex operation, and Time Division Duplex (TDD). The radio frame structure type 1 used for FDD (for both full duplex and half duplex operation) has a duration of 10ms and consists of 20 slots with a slot duration of 0.5ms. Two adjacent slots form one sub-frame of length 1ms. The radio frame structure type 2 used for TDD consists of two half-frames with a duration of 5ms each and containing each 8 slots of length 0.5ms and three special fields (DwPTS, GP and UpPTS) which have configurable individual lengths and a total length of 1ms. A sub-frame consists of two adjacent slots, except for sub-frames 1 and 6, which consist of DwPTS, GP and UpPTS. Both 5ms and 10ms switch-point periodicity are supported.

While Multimedia Broadcast and Multicast Service (MBMS) is supported by LTE over a Single Frequency Network (MBSFN), this experiment will not utilize that capability.

LTE also supports transmission with multiple input and multiple output antennas (MIMO) with configurations in the downlink with up to eight transmit antennas and eight receive antennas, which allow for multi-layer downlink transmissions with up to eight

streams. This experiment will utilize only 2 antennas for MIMO demonstration for both uplink and downlink.

3.0 PHYSICAL CHANNEL DESCRIPTIONS

3.1.1 Downlink:

- Physical Downlink Shared Channel (PDSCH),
- Physical Multicast Channel (PMCH),
- Physical Downlink Control Channel (PDCCH),
- Enhanced Physical Downlink Control Channel (EPDCCH),
- Relay Physical Downlink Control Channel (R-PDCCH),
- Physical Broadcast Channel (PBCH),
- Physical Control Format Indicator Channel (PCFICH)
- Physical Hybrid ARQ Indicator Channel (PHICH).

3.1.2 Uplink:

- Physical Random Access Channel (PRACH),
- Physical Uplink Shared Channel (PUSCH),
- Physical Uplink Control Channel (PUCCH).

4.0 CHANNEL CODING

The channel coding scheme for transport blocks in LTE is Turbo Coding with a coding rate of R=1/3, two 8-state constituent encoders and a contention-free quadratic permutation polynomial (QPP) turbo code internal interleaver. Trellis termination is used for the turbo coding. Before the turbo coding, transport blocks are segmented into byte aligned segments with a maximum information block size of 6144 bits. Error detection is supported by the use of 24 bit CRC.