



LTE Patent for Standard Analysis Sample

1Q. 2010

1. 1 Down Link Reference Signals Standard (1)



3GPP LTE standard TS36.211 specifies the down link reference signals (DL RSs) in section 6.10. The specification defines the DL RSs in three types: Cell-specific reference signals, UE-specific reference signals, and MBSFN reference signals. DL RSs are needed to carry out coherent demodulation at UE through DL channel estimation.

The cell-specific RSs are available to all UEs in a cell and span the entire cell bandwidth. The structure and characteristics of the cell-specific RSs are as follows (Ref. Figure 1.1):

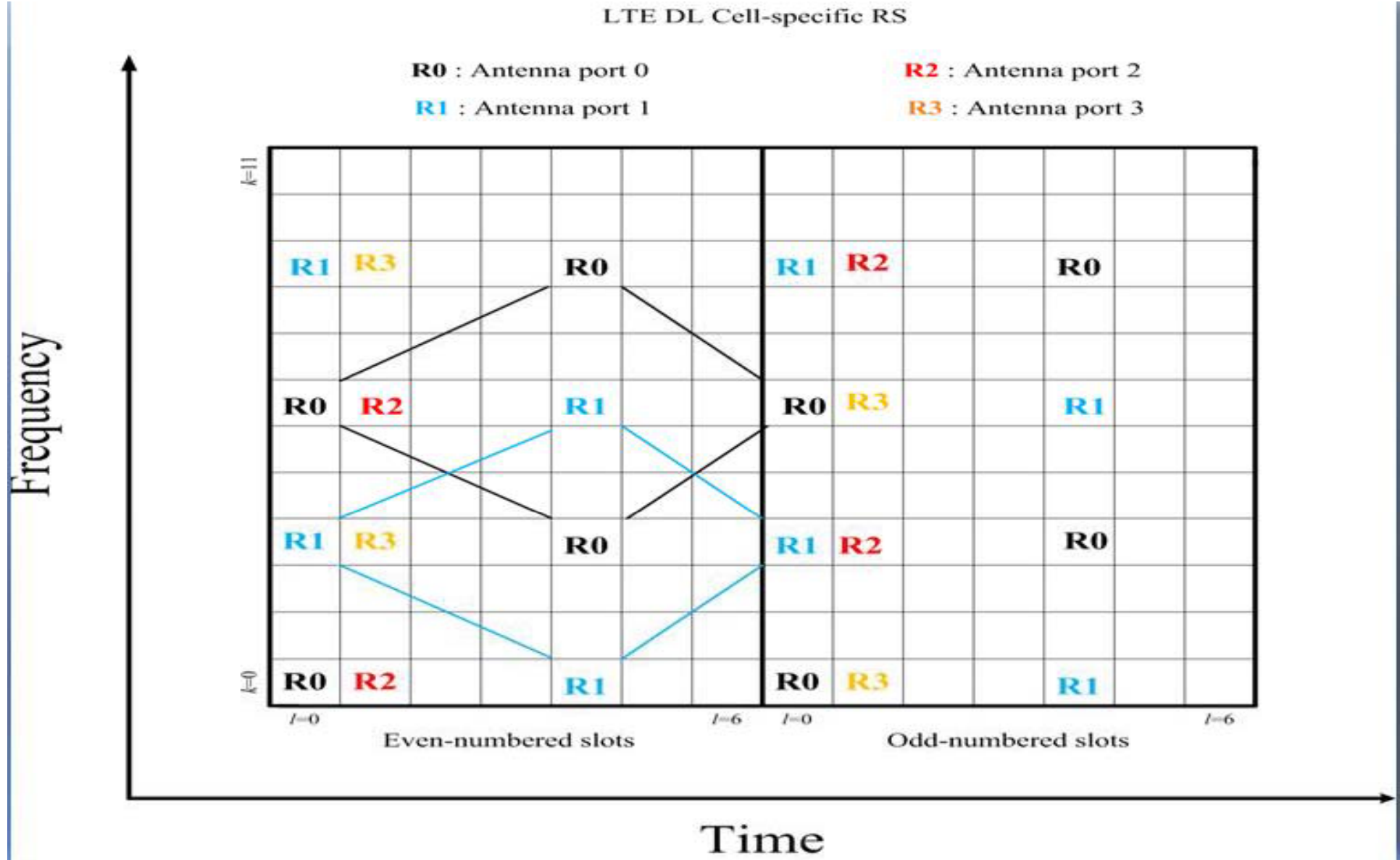
1. The OFDM symbols form a two-dimensional sequence (corresponds to one of 504 different cell identities, NID_{cell}) and are arranged in a 'diamond shape' lattice structure to achieve the minimum interpolation errors for the channel estimation.
2. Considering the case of high channel frequency selectivity and high UE velocity, there are four reference symbols per RB (Resource Block) for optimal channel estimation.

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3. There are six frequency shifts of the reference symbols corresponds to 84 different cell identities (the reference symbols are inserted within the first and the third from the last OFDM symbol for a given slot of RBs and staggered by three subcarriers relative to each other).
4. For the case of four antenna ports, the reference symbols of the second antenna port are shifted by three subcarriers with respect to the reference symbols of the first antenna port in each OFDM symbols. The reference symbols for the third and fourth antenna ports are located within the second OFDM symbols of each slot (two reference symbols per RB) to reduce the overhead in multiple channel estimations.
5. DL RSs are generated using QPSK modulation for low PAPR (Peak-to Average Power Ratio).

Fig. 1.1 Cell-specific DL RSs structure



1. 2 Down Link Reference Signals Essential Patent (1)



3GPP Patent application publication US20060285484, entitled Pilot Design and Channel Estimation, is a candidate for LTE DL RSs essential patent.

BACKGROUND

In an OFDM (Orthogonal Frequency Division Multiplexing) based communication system, pilot symbols are transmitted in addition to data symbols to provide a reference for the receiver to estimate the channel medium and accordingly demodulate the received signal. OFDM systems periodically insert reference (or pilot) symbols that are known a priori, into the transmission signal. The receiver can thus estimate the channel response based on the received pilot symbols and the known transmitted pilot symbols. A pilot signal also referred to as reference signal is composed of the pilot symbols.

PRIOR ART

Channel estimation is based on time and frequency interpolation among pilot sub-carriers in order to obtain the channel estimates at the position corresponding to data sub-carriers. In order to be able to perform frequency interpolation, the pilot sub-carrier spacing in the frequency domain should be smaller than the 50% correlation coherence bandwidth of the channel for all channels of interest. Similarly, in order to be able to perform time interpolation, the pilot sub-carrier spacing in the time domain should be smaller than the 50% coherence time of the channel at the operating carrier frequency for all UE speeds of interest.

There is a need for an improved pilot structure design in the prior arts in order to achieve accurate channel estimates for high user equipment (UE) speeds in mobile operations while also achieve the ability to use substantial pilot energy from succeeding TTI (Transmission Time Interval) with minimum latency.

INVENTION

Embodiments of the invention provide method and apparatus for generating a structure in a OFDM communication system having a transmitter with a least one transmitting antenna to achieve accurate channel estimates for high UE speeds and high channel frequency selectivity in mobile operations.

CLAIM

2. The method of claim 1 wherein the transmission time interval comprises of seven orthogonal frequency division multiplexing symbols and wherein the pilot signal from at least one transmitting antenna is located in the first and fifth OFDM symbols of a transmission time interval:

DL RSs specification for single antenna port in 3GPP TS36.211, V890, Section 6.10.12 & Figs 6.101.2-1

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3. The method of claim 2, wherein the transmitter has at least two antennas, said method further comprising: locating a pilot signal from a second antenna into two orthogonal frequency division multiplexing symbols of said frame such that the pilot power of the pilot signal from the second antenna is in the first and fifth orthogonal frequency division multiplexing symbols of the transmission time interval:

DL RSs specification for two antenna ports in 3GPP TS36.211, V890, Section 6.10.12 & Figs 6.10.1.2-1

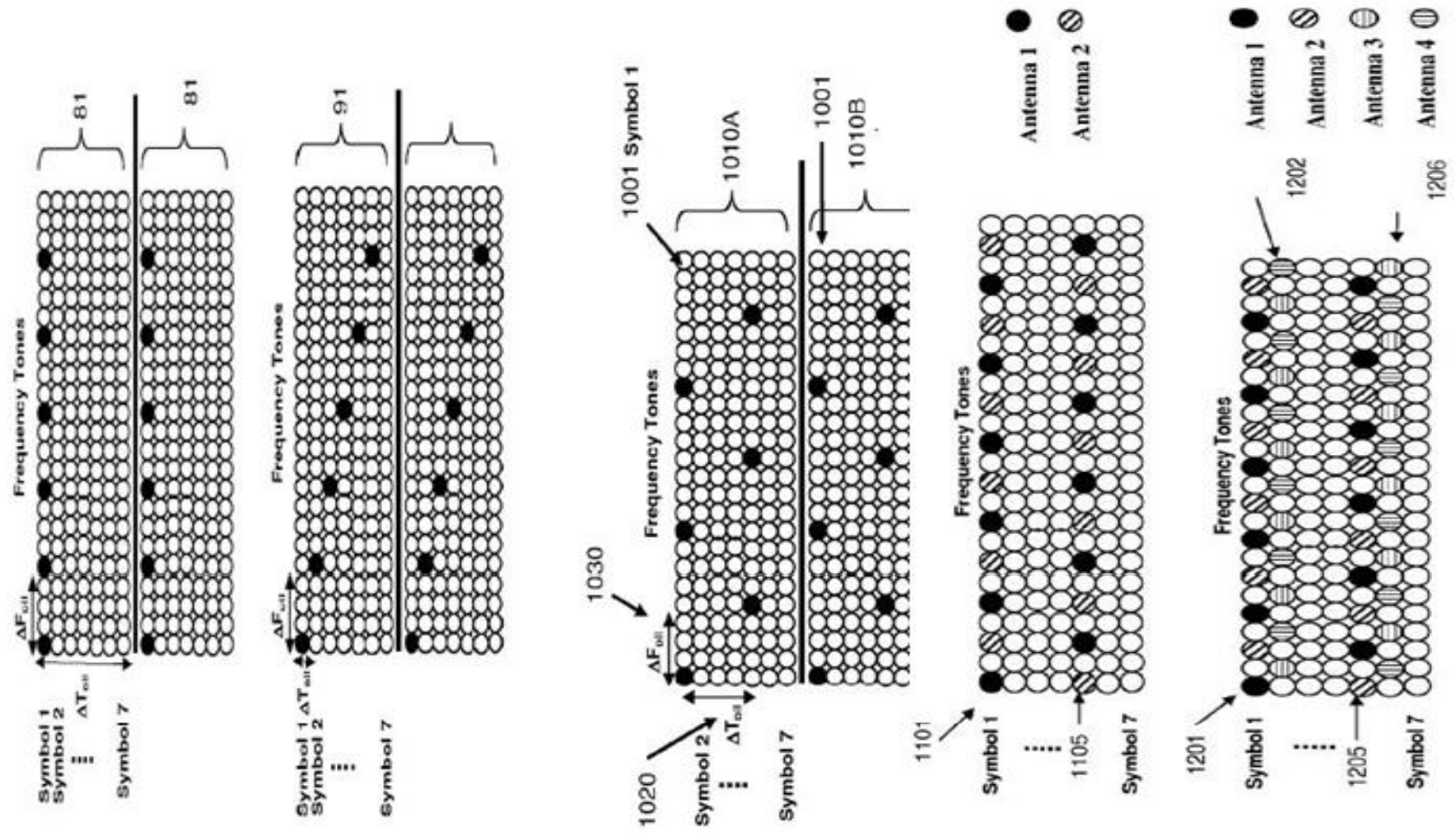
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The method of claim 3, wherein the transmitter has at least four antennas, said method further comprising: locating a pilot signal from a third antenna into two orthogonal frequency division multiplexing symbols of said frame such that the pilot power of the pilot signal from the third antenna is in the second and sixth orthogonal frequency division multiplexing symbols of the transmission time interval; and locating a pilot signal from a fourth antenna into two orthogonal frequency division multiplexing symbols of said frame such that the pilot power of the pilot signal from the fourth antenna is in the second and sixth orthogonal frequency division multiplexing symbols of the transmission time interval:

DL RSs specification for four antenna ports in 3GPP TS36.211, V890, Section 6.10.12 & Figs 6.101.2-1

Fig. 1.2 US20060285484



Prior Art

US 20060285484

LTE Down Link Synchronization Signals Standard & Essential Patent:

http://techipm-innovationfrontline.blogspot.com/2010/02/lte-innovation-mining-down-link_23.html

http://techipm-innovationfrontline.blogspot.com/2010/02/lte-innovation-mining-down-link_24.html

LTE Down Link MIMO Standard & Essential Patent:

<http://techipm-innovationfrontline.blogspot.com/2010/02/lte-innovation-mining-down-link-mimo.html>

http://techipm-innovationfrontline.blogspot.com/2010/02/lte-innovation-mining-down-link-mimo_25.html

http://techipm-innovationfrontline.blogspot.com/2010/02/lte-innovation-mining-down-link-mimo_1717.html

Thank you!



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