Exhibit G

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Additional inventors are being named on the 1 separately numbered sheets attached hereto

TITLE OF THE INVENTION (500 characters max)

METHODS AND APPARATUS FOR MULTI-CARRIER, MULTI-CELL WIRELESS COMMUNICATION NETWORKS

Direct all correspondence to: **CORRESPONDENCE ADDRESS**

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ENCLOSED APPLICATION PARTS (check all that apply)

☒ Specification Number of Pages 9 ☐ CD(s), Number

☐ Drawing(s) Number of Sheets 13 ☐ Other (specify)

☐ Application Data Sheet. See 37 CFR 1.76

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Respectfully submitted,

SIGNATURE

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Date 1/28/2004

REGISTRATION NO. (if appropriate)

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Number 2 of 2

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Methods and Apparatus for Multi-Carrier, Multi-Cell Wireless Communication Networks

1 Background of the Invention

In multi-carrier wireless communications, many essential system functions such as frequency synchronization and channel estimation are carried out with the facilitation of network information provided by a portion of total subcarriers such as pilot subcarriers (Figure 1). The level of the fidelity of received version of these subcarriers directly dictates how well these functions can be achieved, which in turn affects the performance of the entire network in terms of efficiency and capacity. In a wireless network, there are a number of base stations, each of which provides coverage to its designated area, normally called a cell. If a cell is divided in to sectors, from system engineering point of view each sector can be considered as a cell. In this context, the terms "cell" and "sector" are interchangeable. The network information can be categorized into two types: the cell-specific information that is unique to a particular cell and the common information that is common to the entire network or to a portion of the entire networks (e.g., a group of cells). In a multi-cell environment, for example, the base station transmitter of each cell transmits its own pilot subcarriers, in addition to data carriers, for the use by the receivers within the cell. In such an environment, carrying out the pilot-dependent functions becomes a challenging task in that, in addition to the degradation due to multipath propagation channel, signals originated from the base stations at different cells interfere with each other. One approach to deal with the interference problem is that each cell will transmit a particular pattern of pilot subcarriers based on a certain type of cell-dependent random process, which, to a certain degree, is able to mitigate impact of the mutual interference between the pilot subcarriers from adjacent cells [1]. However, in this approach or alike, there is no careful and systematic consideration of the unique requirements for pilot subcarriers of different functionalities. While it is necessary to manage the mutual interference between those subcarriers that are used for the functionalities unique to individual cells, it is desirable and constructive to design those subcarriers that are used to carry common information in such a way that signals from other cells are treated as contributing factors rather than interfering factor.

2 Summary of the Invention

In this invention, a design process is devised to divide pilot subcarriers into two different groups according to their functionalities and hence their distinct requirements. Each group of pilot subcarriers will be designed to have such a transmit format that the essential system functions such as frequency synchronization and channel estimation can be performed in the optimal way. The first group is called cell-specific pilot subcarriers (Figure 5), which will be used for the receiver to extract information unique to each individual cell. For example, these cell-specific pilot subcarriers can be used in the channel estimation process where it is necessary for a particular receiver to be able to differentiate the pilot subcarriers that are intended for its use

from those that are from other cells. For these pilot subcarriers, counter-interference methods are necessary. The second group is termed the common pilots subcarriers (Figure 5), which are designed to possess a set of characteristics common to all the base stations of the system. Thus, every receiver within the system is able to exploit these common pilot subcarriers to perform the necessary functions without interference problem. For instance, these common pilot subcarriers can be used in the frequency synchronization process, where it is not necessary to discriminate pilot subcarriers from one cell to others but it is desirable for the receiver to combine coherently the energy of common pilot subcarriers with the same carrier index from different cells so as to achieve relatively accurate frequency estimation.

This invention provides methods to define the transmission formats of the cell-specific and common pilot subcarriers that enable a receiver to perform different essential system functions. In particular, a set of design criteria are provided for pilot subcarriers.

This invention further provides the apparatus or means to implement the aforesaid design process and methods. In particular, signal reception can be improved by manipulating phase values of the pilot subcarriers and by the use of power control The methods and process provided by this invention can also be extended to cases, such as the one where multiple antennas are used within an individual sector and where some subcarriers are used to carry common network/system information. Base stations can be synchronized in frequency and time by sharing a common frequency oscillator or a common frequency reference signal, such as the one generated from the signals provided by the Global Positioning System (GPS).

3 Brief Description of the Drawings

Figure 1: A basic multi-carrier wireless communication system consists of a transmitter and a receiver. A functional block, called Pilot generation and insertion, at the transmitter generates the necessary pilot subcarriers and inserts them into the predetermined locations in frequency. These pilot subcarriers are used by the receiver to carry out some essential functions.

Figure 2: The basic structure of a multi-carrier signal in the frequency domain is made up of subcarriers. Data subcarriers can be grouped into subchannels in a particular way. The pilot subcarriers are also distributed over the entire channel in a particular way.

Figure 3: The radio resource is divided into small units in both the frequency and time domains: subchannels and time slots. The basic structure of a multi-carrier signal in the time domain is made up of time slots.

Figure 4: A cellular wireless network is comprised of a plurality of cells, in each of which the coverage is provided by a base station (BS). Within each coverage area, there are distributed mobile stations. A base station is connected to the backbone of the network via a dedicated link and also provides radio links to the mobile stations within its coverage.

Figure 5: The pilot subcarriers are divided into two groups: cell-specific pilot subcarriers and common pilot subcarriers. The cell-specific pilot subcarriers for different cells are not necessarily aligned in frequency. They can be used for the receiver to extract the cell-specific information. The common pilot subcarriers for different cells are normally

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