PATROLL Winning Submission

U.S. Patent No. 10,771,302

U.S. Patent No. 10,771,302 (“*Neo Wireless*” or the “patent-at-issue”) was filed on April 16, 2018 and claims priority on January 29, 2004. Claim 1 of the patent-at-issue discloses a communication method for a mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) system. The method involves receiving a request for a probing signal from a base station, and in response to that request, transmitting a probing signal with a modulated code sequence in the frequency domain. The probing signal is designed to overlap with uplink signals from other mobile devices in the time domain and occupies a portion of spectrum not designated for uplink control signals in the system base station.

The primary reference, U.S. Patent No. 7,242,720 (“*Sugiyama*”), was filed on April 5, 2002, and claims priority on April 9, 2001. The patent involves an OFDM signal communication system used in broadband mobile communication that transmits signals over the same radio frequency from N transmitting antennas. It uses an inverse matrix computer to compute an NxN inverse matrix, which is made up of propagation coefficients for each propagation path between each of the N transmitting antennas and each of the N receiving antennas. This allows the subcarrier demodulator to separate the signals of each propagation path based on the obtained inverse matrix, leading to stable operation under severe frequency selective fading environments, providing high quality communication.

A sample claim chart comparing claim 1 of *Neo Wireless* to *Sugiyama* is provided below.

US10771302 ("*Neo Wireless*")	**US7242720** (*"Sugiyama"*)
1.pre. A communication method for a **mobile device in an Orthogonal Frequency Division Multiplexing (OFDM) communication system**, the method comprising:	"The present invention relates to **an orthogonal frequency division multiplexing (OFDM) signal communication system used in broadband mobile communication** and the like, which divides transmission signals into subcarrier groups orthogonal to each other to perform multi-carrier transmission. More specifically, the invention relates to an OFDM signal communication system which achieves substantial frequency utilization efficiency under a multipath fading environment, using a plurality of transmitting antennas and a plurality of receiving antennas, and which uses a space division multiplexing (SDM) method or polarization division multiplexing (PDM) that can achieve signal transmission with high quality, high capacity, and high speed." *Sugiyama* at col. 1:9-21
1.a. **receiving a request for a probing signal from a base station in the system**; and	". . . an OFDM **signal receiving device** which includes N receiving antennas **for receiving signals** transmitted from the N transmitting antennas . . ." *Sugiyama* at col. 4:9-11 "The present embodiment can be widely applied not only to wide band mobile communication systems, but also to **wireless systems where many user wireless stations are connected to a base station using the OFDM method**, as with the point-to-multipoint fixed wireless access system." *Sugiyama* at col. 28:57-60
1.b. **transmitting**, in response to the received request, **the probing signal with a code sequence modulated in the frequency domain**, wherein:	"Moreover, the present invention is an OFDM signal receiving device used in an OFDM signal communication system for **transmitting OFDM signals over the same radio frequency from an OFDM signal transmitting device** comprising a plurality of N transmitting antennas to an OFDM signal receiving device comprising N receiving antennas, wherein the OFDM signal communication system comprises: an inverse matrix computer for computing each of inverse matrices of N-dimensional square matrices for each subcarrier constituted by the propagation coefficients for the respective propagation paths between the respective transmitting antennas and the respective receiving antennas . . ." *Sugiyama* at col. 4:42-53

(cont.) 1.b. **transmitting**, in response to the received request, **the probing signal with a code sequence modulated in the frequency domain**, wherein:	8. The OFDM signal communication system according to claim 1, wherein the **OFDM signal transmitting device further comprises: a forward error correction encoder for forward error correction encoding the transmission information signals**; an interleaver which rearranges the output from the forward error correction encoder and outputs to the combiner; and a **first switch for selecting to send signals obtained by serial-parallel conversion of the transmission information signals to the combiner, or to send the same transmission information signals to the combiner**. . . *Sugiyama* at Claim 8 "In FIG. 3, **the transmission information signals T1 to TN are subjected to be encoded for forward error correction in forward error correction encoders 15-1 to 15-N, and are then subjected to be interleaved in interleavers 16-1 to 16-N in the subcarrier domain, that is in the frequency domain**. This is performed in order to avoid successive errors due to depression of the level (notching) in a certain frequency neighborhood, and obtain large performance improvement by forward error correction." *Sugiyama* at col. 11:59-67 "A configuration example of a conventional transmitter-receiver for this MIMO channel is shown in FIG. 37. This is a configuration example of a transmitter-receiver which performs time-space equalization using N transmitting antennas 1110-1 to 1110-N, and N receiving antennas 1111-1 to 1111-N. **On the transmitter, the transmission information is coded in encoders 1101-1 to 1101-N, interleaved by interleavers 1102-1 to 1102-N, and distributed to N modulators 1103-1 to 1103-N, and then transmitted**." *Sugiyama* at col. 2:1-9 "**The OFDM signals received by the antennas 51 (1) to 51 (N) pass through the respective frequency converters** 52 (1) to 52 (N) **and are frequency converted to OFDM signals in a relatively low frequency band suitable for signal processing**. A common local oscillator frequency from the local oscillator 55 is supplied to the frequency converters 52 (1) to 52 (N)." *Sugiyama* at col. 17:28-34

1.c. **the probing signal is configured to overlap, in the time domain**, with **uplink signals transmitted over an uplink frequency band by other mobile devices in the system**; and	"On the other hand, **the OFDM signals which have been modulated by the transmission information signals T1 to TN are transmitted so as to overlap on the time domain**." *Sugiyama* at col. 8:37-39 "**Transmission information signals T1 to TN are combined on respective time domains by combiners 7-1 to 7-N, with pilot signals P1 to PN input from pilot signal generators 6-1 to 6-N which generate known pilot signals P1, P2, PN corresponding to the respective OFDM modulators 1-1 to 1-N**. These combined signals are respectively input to each of the OFDM modulators 1-1 to 1-N." *Sugiyama* at col. 7:42-48 "Due to the above operation, respective data signals can be separated and received as with the embodiment of FIG. 1, without providing elements for interference canceling on the OFDM signal receiving device 50 side, although **the N OFDM signals are transmitted at the same time using the same frequency band**." *Sugiyama* at col. 20:50-55 33. An OFDM signal receiving device used in an OFDM signal communication system for **transmitting OFDM signals over the same radio frequency from an OFDM signal transmitting device** **comprising a plurality of N transmitting antennas to the OFDM signal receiving device comprising N receiving antennas**, the receiving antennas are transmitting/receiving antennas further provided with a transmission function, and the OFDM signal receiving device further comprises . . . *Sugiyama* at Claim 33
1.d. the **probing signal is configured to occupy a portion of spectrum in the uplink frequency band** **not designated for transmission of uplink control signals in the system**.	. . . a pilot signal generator for generating pilot signals of N kinds for use in corn win an inverse matrix in order that an inverse matrix computer provided in the OFDM signal transmission device compute each of inverse matrices of N-dimensional square matrices for each subcarrier constituted by the propagation coefficients for the respective propagation paths between the respective transmitting antennas and the respective receiving antennas, and that an **interference canceller provided in the OFDM signal transmitting device cancel interference components which occur between the OFDM signal transmitting device and the OFDM signal receiving device** . . . . *Sugiyama* at Claim 33