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U.S. Patent No. 10,447,450

U.S. Patent No. 10,447,450 ("*Neo Wireless LLC*" or the "patent-at-issue") was filed on August 14, 2017, and claims an earliest priority date of September 28, 2005. Claim 1 of the patent-at-issue is generally directed to an operating method for a wireless network employing a frame structure of multiple frames for transmission, comprising a plurality of time intervals, orthogonal frequency division multiplexing (OFDM) symbols, and frequency subcarriers. The time-frequency resource is divided into segments where signals containing information can be transmitted from the base station to a mobile station. Each segment has a starting time-frequency coordinate where each segment is composed of N (equal to 2, 4, or 8) time-frequency resource units within a time interval. Each unit contains a set of frequency subcarriers in a group of OFDM symbols. The mobile station receives the signal and recovers the information from the signal based on the starting time-frequency coordinate, N and an identifier assigned to the mobile station.

The primary reference, U.S. Patent No. 8,111,653 ("*NEC*"), was filed on July 27, 2005, and claims an earliest priority date of July 28, 2004 on the basis of a prior application. The patent is directed to a wireless transmission system that includes a plurality of mobile stations in a cell area, and a base station. The base station divides each of an uplink frame and a downlink frame into a plurality of blocks, assigns a specific one to each mobile stations, assigns a specific frequency channel to the mobile station, and notifies the specific block and the specific frequency channel to the mobile station. The length of each of the plurality of blocks is optional, and a sum of the lengths of the plurality of blocks is equal to the length of the frame.

The secondary reference, U.S. Patent No. 7,058,367 ("*Sony*"), was filed on January 31, 2003 and claims priority on the same date. The patent is directed to a rate-adaptive method of communicating over a multipath wireless communication system using multiple links such that each end of a link uses multiple transmit and receive antennas. Several independent streams that are to be transmitted for each link is determined based on an overall system performance measure. In OFDM systems, the number of independent streams, as well as the modulation, coding, and power control, may be determined on a tone-by-tone basis based on an overall system performance measure

A sample claim chart comparing claim 1 of *Neo Wireless LLC* to *NEC*, and *SONY* is provided below.

US10447450 ("*Neo Wireless LLC*")	**A. US8111653** (*"NEC"*) **B. US7058367** (*"Sony"*)
1. An **operating method for a wireless network comprising at least a base station and a mobile station**, the wireless network employing **a frame structure of multiple frames for transmission**, each frame comprising **a plurality of time intervals**, each time interval comprising **a plurality of orthogonal frequency division multiplexing (OFDM) symbols**, and each OFDM symbol containing **a plurality of frequency subcarriers**, the method comprising:	**A. US8111653** "As shown in FIG. 2, in the **wireless transmission system** according to the present invention, **an uplink is used for communication from the mobile station to the base station while a down link is used for communication from the base station to the mobile station**." *NEC* at col. 5:12-17 "As shown in FIGS. 3A and 3B, the base station is arranged in the vicinity of the center of each of cell areas A to G. Each of the cell areas is divided into a plurality of areas. In examples shown in FIGS. 3A and 3B, each of the cell areas is divided into two areas. **The area is divided based on blocks of the uplink frame and the downlink frame**." *NEC* at col. 5:18-24 "As described above, **the uplink frame and the downlink frame are divided into a plurality of blocks**, and these blocks correspond to the plurality of areas in each of the cell areas. **Time of each of the blocks is optional and a total time in each of the blocks is equal to time in the link frame**. The uplink frame and the downlink frame have a same block configuration." *NEC* at col. 5:48-54 "As shown in FIG. 4, **the base station divides the frame into a first block from a time t1 to a time t2 and a second block from the time t2 and a time t3**." *NEC* at col. 5:57-60 "In the second embodiment, communication between the mobile station 1 and the base station 2 is carried out by using an **OFDM (orthogonal frequency division multiplexing)**." *NEC* at col. 11:47-50 "A subcarrier to be used may also be determined as follows. For example, if W is the number of frequency repetition and T is an integer divisible by W, **(T/W) subcarriers are in the (y+W*z)-th (Z=0, 1, . . . , T/W) positions among the total T of subcarriers in one OFDM symbol**." *NEC* at col. 15:63-67 **B. US7058367** "The present invention can be implemented using an exemplary system, which is shown in FIG. 1. FIG. 1 shows an

1. An **operating method for a wireless network comprising at least a base station and a mobile station**, the wireless network employing **a frame structure of multiple frames for transmission**, each frame comprising **a plurality of time intervals**, each time interval comprising **a plurality of orthogonal frequency division multiplexing (OFDM) symbols**, and each OFDM symbol containing **a plurality of frequency subcarriers**, the method comprising:	**exemplary cellular network** 100 **that employs a rate-adaptive MIMO communications technique** according to the present invention. **Cellular network** 100 **includes many cells. In, for example, cell** 101, **there is a base station** 102 **and a number of mobile stations**, of which only one is shown and is denoted as 103." *Sony* at col. 8:13-19 "**Each signal transmitted between base station** 102 **and mobile station** 103 **adopts an exemplary frame structure**, such as shown in FIG. 2 (**the frame structure applies to both uplink and downlink frames**), in which one time slot 240 of signal 200 contains a training sequence 201, a payload sequence 202, a CRC sequence 203, and a control sequence 204." *Sony* at col. 8:28-34 "FIG. 7 shows **an exemplary MIMO system architecture** 700 **according to the present invention that uses space-time coding and OFDM techniques**" *Sony* at col. 11:45-47
assigning an identifier to the mobile station;	**A. US8111653** "**A mobile ID is given to the mobile station** 1 **in advance for individual identification**. The mobile station ID generating section 82 generates **an ID signal to identify each of the plurality of the mobile stations** 1." *NEC* at col. 14:66-67 through col. 15:1-2
transmitting a signal containing information from the base station to the mobile station over a segment of time-frequency resource, the segment having **a starting time-frequency coordinate** and the segment comprising **N time-frequency resource units within a time interval**, each unit containing **a set of frequency subcarriers in a group of OFDM symbols, where N=2, 4, or 8**; and	**A. US8111653** "FIG. 16 is a block diagram showing the configuration of the **transmitting section** 6 **in the base station** according to the second embodiment of the present invention. As shown in FIG. 16, the **transmitting section** 6 in the second embodiment includes **a frequency determining section** 80, a data signal generating section 81, a mobile station ID generating section 82, **a first subcarrier assigning section** 83 a, **a second subcarrier assigning section** 83 b, a first IFFT section 84 a, a second IFFT section 84 b, a first GI adding section 85 a, a second GI adding section 85 b, **and a multiplexing section** 86." *NEC* at col. 14:35-44 "**The first subcarrier assigning section** 83 **a specifies a subcarrier corresponding to the data signal** S61 supplied from the data signal generating section 81 **on the basis of a frequency channel and a block number contained in the block assignment data** S70 outputted from the frequency determining section 80." *NEC* at col. 15:6-11

transmitting a signal containing information from the base station to the mobile station over a segment of time-frequency resource, the segment having **a starting time-frequency coordinate** and the segment comprising **N time-frequency resource units within a time interval,** each unit containing **a set of frequency subcarriers in a group of OFDM symbols, where N=2, 4, or 8**; and	"FIG. 17A shows the configuration of **the subcarrier in case of mapping each of frequency channels in order in accordance with the elapse of time**." *NEC* at col. 15:53-55 "A subcarrier to be used may also be determined as follows. For example, if **W is the number of frequency repetition and T is an integer divisible by W, (T/W) subcarriers are in the (y+W*z)-th (Z=0, 1, . . . , T/W) positions among the total T of subcarriers in one OFDM symbol**." *NEC* at col. 15:63-67 **B. US7058367** "Each signal is identified by an index number starting from 0. For example, if **base station** 102 **uses all M antennas for transmitting M different signals** (data streams), **the respective indices of these signals are 0, 1, 2, . . . , M−1**." *Sony* at col. 8:56-60
receiving by the mobile station the transmitted signal; and	**A. US8111653** "FIG. 12 is a block diagram showing the configuration of the **receiving section** 3 **in the mobile station** 1 according to the second embodiment of the present invention." *NEC* at col. 11:51-53 **B. US7058367** "(1) At transmission onset, base station 102 preferably transmits only **one signal (data stream) in a downlink frame to mobile station** 103 using a proper modulation method. . . ." *Sony* at col. 9:4-6 "(2) **After receiving the downlink frame, mobile station** 103 computes the best weight for each receive antenna and generates a composite signal that is the weighted summation of the signals received from each antenna, such that the mean-squared error (MSE) of the training sequence 201 is minimized." *Sony* at col. 9:14-19
recovering by the mobile station the **information from the received signal based on the starting time-frequency coordinate and N** in conjunction with the **identifier assigned to the mobile station**.	**A. US8111653** "As shown in FIG. 12, the **receiving section** 3 **includes a separating section** 51, **a first GI (guard interval) removing section** 52 a, **a second GI removing section** 52 b, a first FFT section 53 a, a second FFT section 53 b, an assignment specifying section 54, **a subcarrier extracting section** 55, and a data reproducing section 56." *NEC* at col. 11:53-59

recovering by the mobile station the **information from the received signal** **based on** **the starting time-frequency coordinate** **and** **N** in conjunction with the **identifier assigned to the mobile station**.	"The **separating section** 51 **separates** **a reception signal** S31 **received by an antenna into a data signal and an** **ID signal** **in the frame**. The separating section 51 supplies a reception data signal S32 to the first GI removing section 52 a on the basis of the separated data signal. Similarly, **the separating section** 51 **supplies a reception ID signal** S33 **to the second GI removing section** 52 b **on the basis of the separated ID signal**." *NEC* at col. 12:3-9 "The **subcarrier extracting section** 55 **specifies a subcarrier corresponding to the frequency channel indicated by the assignment data** S39, extracts a subcarrier assigned to the mobile station 1 **in accordance with the subcarrier and the block number**, and outputs a reception data S38 on the basis of the subcarrier. The data reproducing section 56 performs a symbol determination to the reception data signal S38 supplied from the subcarrier extracting section 55, and outputs data series S40." *NEC* at col. 12:32-40 **B. US7058367** "(7) **After receiving the downlink frame, which includes N signals (data streams),** mobile station 103 computes the best weight for each receive antenna and generates a composite signal that is the weighted summation of the **signals received from each antenna as an estimate of the ith signal**, denoted as Si(t), such that the MSE(i) of training sequence 201 for the transmitted signal Si(t) is minimized." *Sony* at col. 10:1-7 "(8) Based on the composite signal for the transmitted signal Si(t), **mobile station** 103 **decodes the payload sequence**, the CRC sequence, and the control sequence. If the detected CRC sequence matches the CRC sequence computed from the decoded payload sequence, which means the payload sequence is decoded correctly, the ARQ instruction corresponding to the transmitted signal Si(t) in the control sequence 204 in the next uplink frame is thus set to signal "transmit next downlink frame." Otherwise, the ARQ instruction signals "retransmit Si(t) in the next downlink frame." Mobile station 103 repeats step (7) and (8) for **every i=1, 2, . . . , N**. **After this is done, mobile station** 103 **can obtain an N×N matrix channel response H(N) for the MIMO channel.**" *Sony* at col. 10:8-21 "On the receive side (the right-most side) of FIG. 7, M antennas 720 a–720 p detect/receive the M transmitted signals and forward the detected/received signals to fast Fourier transformers (FFT) 725 a–725 p. The multiple

recovering by the mobile station the **information from the received signal** **based on** **the starting time-frequency coordinate** **and** **N** in conjunction with the **identifier assigned to the mobile station**.	detected/received signals are then forwarded to a space-time processor 730 and to a channel parameter estimator 735. **Upon completion of the space-time processing, the processed detected/received signals are space-time decoded by space-time decoders** 740 a **and** 740 b." *Sony* at col. 11:55-64