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U.S. Patent 7,742,388

U.S. Patent 7,742,388 ("*Fleet Connect*" or the "patent-at-issue") was filed on July 20, 2005. According to the paragraph in the specification entitled "Cross-Reference to Related Applications", the patent-at-issue claims priority to U.S. provisional application having Ser. No. 60/589,158, filed on July 20, 2004. Claim 1 of the patent-at-issue involves creating a packet for network transmission that includes a preamble containing initial training symbols. The packet is then expanded by adding subcarriers specifically to the second training symbol, resulting in an extended packet where the second symbol contains more subcarriers than the first. Finally, this extended packet is sent out via an antenna for transmission over the network.

The primary reference, U.S. Patent 8,077,592 ("*Webster*"), was filed on July 21, 2005, and claims an earliest priority date on June 22, 2004. The patent is directed to a legacy-compatible spatial multiplexing (SM) systems, referred to as LCSM systems, within multiple-input multiple-output (MIMO) orthogonal frequency division multiplexing (OFDM) communication contexts. These systems utilize transmit modules with waveshape logic to generate transmit waveforms, forming two-part packets. The first part contains a legacy preamble for compatibility with legacy receivers, while the second part includes a cyclic shifted, inverted long training symbol for SM MIMO receivers. To maintain coherence, implementations adjust subcarrier counts, ensuring continuity between the legacy and MIMO portions of the preamble, preventing wasted packet overhead. The waveshape logic extends the long training symbol by adding subcarriers to both ends without altering its duration, enabling MIMO-compatible processing without disregarding the legacy preamble.

A secondary reference, U.S. Pat. App. 2005/0180386 ("*Avago*"), was filed on February 14, 2005, and claims an earliest priority date on February 13, 2004. The patent application describes a method and device for wireless communication preamble transmission within a frame. The method involves creating a first training sequence for the frame's preamble and embedding a frequency domain window within this sequence, particularly stimulating a set of subcarriers during long training. Another method entails receiving a training sequence, identifying it as a first sequence, and integrating a frequency domain window into it. The device comprises a signal generator to create the preamble, a multiplexer for inserting a frequency domain window into the first training sequence, an IFFT module for converting the frame with the preamble to a time domain signal, and multiple antennas for transmitting the frame.

A secondary reference, U.S. Pat. App. 2005/0233709 ("*Qualcomm*"), was filed on April 5, 2004, and claims an earliest priority date on April 10, 2003. The patent application describes the utilization of a modified preamble in extended devices operating at higher rates or employing multiple antenna and multi-channel techniques beyond standard 802.11a compliance. These extensions involve spatial multiplexing (MIMO) or transmitting across multiple 802.11a channels simultaneously. This modified preamble serves multiple purposes, signaling both legacy and extended devices to convey capabilities and manage interference on the communication channel. It also aids in obtaining channel estimates for MIMO and multi-channel operations. Importantly,

the modified preamble is designed to enable mode detection, allowing coexistence with legacy 802.11a devices while maintaining interoperability and facilitating detection of conventional and extended modes.

A sample claim chart comparing claim 1 of *Fleet Connect* to *Webster*, *Avago*, and *Qualcomm* is provided below.

US7742388 ("*Fleet Connect*")	**A. US8077592** (*"Webster"*) **B. US20050180386** (*"Avago"*) **C. US20050233709** (*"Qualcomm"*)
1.pre. A method comprising: 1.a. **generating a packet with a size corresponding to a protocol used for a network transmission**, wherein **the packet comprises a preamble having a first training symbol and a second training symbol**;	**A. US8077592** "In one embodiment, an LCSM system comprises one or more transmit modules that include waveshape logic configured to **generate transmit waveforms (e.g., packet segments)** that enable a receiver to implement channel estimate processing corresponding to signals emitted from multiple transmit antennas. **The waveshape logic generates**, in one embodiment, **a two-part packet that is employed in both MIMO spatial multiplexed packet transmission and reception and legacy transmission and reception**. That is, **a first portion of a packet includes a legacy preamble that is compatible for use with legacy receivers (e.g., 801.11a/g receivers)**. Legacy receivers recognize the first portion as a normal legacy preamble, and thus process the corresponding packet in a conventional manner. **A second portion of the packet includes a cyclic shifted, inverted long training symbol that is used to enable successful processing by a SM MIMO receiver (e.g., 802.11n compatible receiver)**." *Webster* at col. 4:57-67 through col. 5:1-6 "FIG. 4A is a block diagram that illustrates an embodiment of the module 334 of FIG. 3. The module 334 comprises the transmit processor 306, radio 310, and first transmit antenna 314. **The transmit processor** 306 **comprises a waveshape logic** 350 a **that generates the packet structure**. The **waveshape logic comprises a legacy preamble/signal field (SF) generator** 319. The **legacy preamble/SF generator** 319 **comprises a short training symbol (STS) generator** 301, **a long training symbol (LTS) generator** 303 a, a SF1 generator 305, and a switch 311. The STS generator 301 and LTS generator 303 a are configured to generate segments of a legacy preamble. The LTS generator 303 a also includes functionality to insert additional subcarriers to a standard, 52-subcarrier legacy LTS symbol. The STS generator 301 generates a STS segment and **the LTS generator** 303 a **generates a LTS segment in conformity to 802.11 standards**. The SF1 generator 305 generates a signal field segment." *Webster* at col. 7:27-43

1.pre. A method comprising: 1.a. **generating a packet with a size corresponding to a protocol used for a network transmission**, wherein **the packet comprises a preamble having a first training symbol and a second training symbol**;	**B. US20050180386** "1. A method for transmitting a preamble for a frame of a wireless communication, the method comprising: **generating a first training sequence for a preamble of a frame**; . . . ." *Avago* at claim 1 "2. The method of claim 1, further comprising **generating a second training sequence for said preamble**." *Avago* at claim 2 **C. US20050233709** "The use of modified preambles is described herein. Such **modified preambles can be used in packets sent over a wireless network, such as an 802.11a compliant wireless network**." *Qualcomm* at par. 0021
1.b. **increasing the size of the packet by adding subcarriers to the second training symbol of the packet to produce an extended packet**, wherein **a quantity of subcarriers of the second training symbol is greater than a quantity of subcarriers of the first training symbol**; and	**A. US8077592** "In one implementation, **52 subcarriers are used for the MIMO portion of a preamble and the legacy portion of the preamble at the transmit side**. In another implementation, **56 or more subcarriers are used for the MIMO portion of a preamble**. **Such an implementation in conventional systems would represent a discontinuity in bandwidth between the legacy preamble portion (having 52 subcarriers) and the MIMO portion (having 56 or more subcarriers)**. Such a discontinuity also results in conventional systems ignoring the legacy portion of the preamble in training or estimating the channel corresponding to the MIMO signal, which wastes packet overhead. Thus, one embodiment of **the waveshape logic processes the long training symbol in a manner that adds subcarriers to each end of a symbol to provide an extended long training symbol (ELTS) having 56 or more subcarriers**. It is noted that although the width of the long training symbol is extended, the duration preferably remains unchanged." *Webster* at col. 5:7-23 "**By adding extra subcarriers, the data portion of the packet can be increased by as much as 10% or more**." *Webster* at col. 16:37-39 **B. US20050180386** "1. A method for transmitting a preamble for a frame of a wireless communication, the method comprising: . . .

(cont.) 1.b. **increasing the size of the packet by adding subcarriers to the second training symbol of the packet to produce an extended packet**, wherein **a quantity of subcarriers of the second training symbol is greater than a quantity of subcarriers of the first training symbol**; and	**inserting a frequency domain window into said first training sequence**; and **stimulating a set of subcarriers with said frequency domain window during long training**." *Avago* at claim 1 "3. The method of claim 2, further comprising determining said **second training sequence is different than said first training sequence, wherein said frequency domain window is inserted into said first training sequence of said preamble**." *Avago* at claim 3 "4. The method of claim 2, further comprising **stimulating another set of subcarriers with said second training sequence, wherein said another set of subcarriers is smaller than said set of subcarriers**." *Avago* at claim 4 **C. US20050233709** "3. The method of claim 1, wherein **the modified preamble comprises a modified long training pattern distinct from a conventional 802.11a long training pattern**." *Qualcomm* at claim 3 "25. The method of claim 24, wherein **the fields of the extended mode preamble include a modified short training sequence**." *Qualcomm* at claim 25 "26. The method of claim 24, wherein **the fields of the extended mode preamble include a modified long training sequence**." *Qualcomm* at claim 26
1.c. **transmitting the extended packet from an antenna**.	**A. US8077592** "29. A system, comprising: . . . **generate long training symbols (LTSs) in each legacy portion of packets corresponding to a plurality of transmit antennas**, . . . **a radio, configured to transmit the packet structure**." *Webster* at claim 29 **B. US20050180386** "8. The method of claim 1, further comprising **transmitting said preamble over a plurality of transmitters**." *Avago* at claim 8

1.c. **transmitting the extended packet from an antenna**.	**C. US20050233709** "1. A method of transmitting signals using a plurality of transmit antennas, the method comprising: . . . **transmitting a modified preamble from each of the plurality of transmit antennas**, wherein **the modified preamble is distinguishable at a receiver from a conventional 802.11a preamble**." *Qualcomm* at claim 1