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### (12) United States Patent

Casas et al.

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## ) WIRELESS COMMUNICATION AND BEAM FORMING WITH PASSIVE BEAMFORMERS

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See application file for complete search history.

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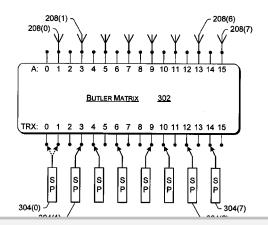
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#### (57) ABSTRACT

Wireless communication and beamforming is improved by depopulating one or more ports of a passive beamformer such as a Butler matrix and/or by increasing the order thereof. In an exemplary implementation, an access station includes: a Butler matrix having "M" antenna ports and "N" transmit and/or receive (TRX) ports; wherein at least a portion of the "M" antenna ports and/or at least a portion of the "N" TRX ports are depopulated. In another exemplary implementation, an access station includes: a Butler matrix that has multiple antenna ports and multiple TRX ports; a signal processor; and a signal selection device that is capable of coupling the signal processor to a subset of the multiple TRX ports responsive to a signal quality determination, the signal selection device adapted to switch the signal processor from a first TRX port to a second TRX port of the subset of TRX ports.

#### 39 Claims, 10 Drawing Sheets





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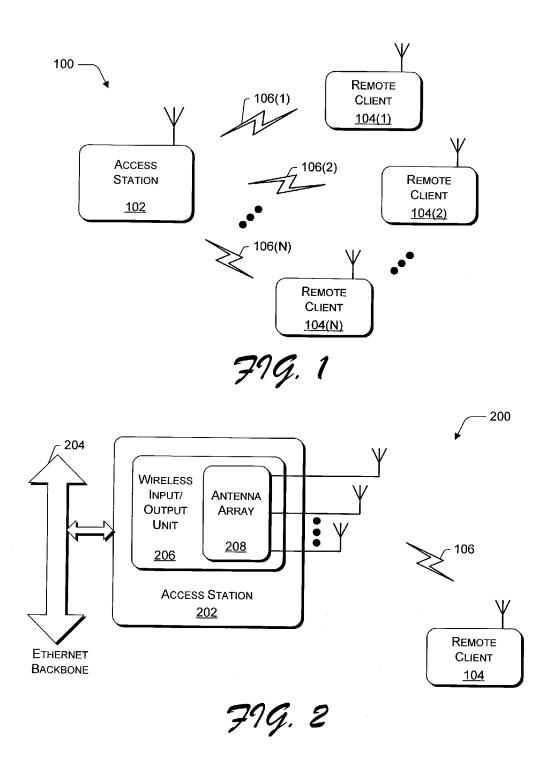
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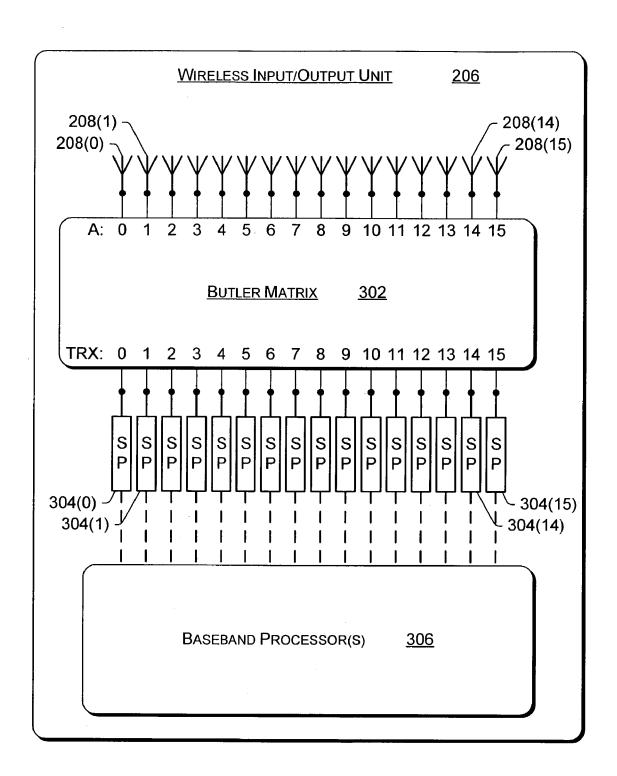
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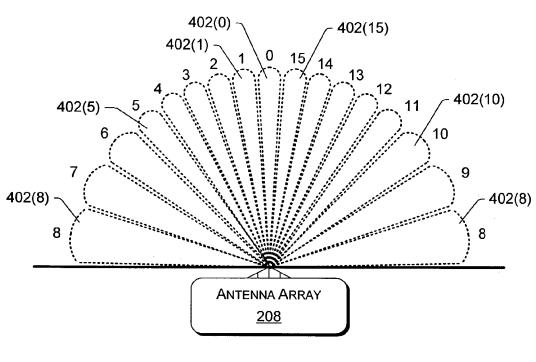




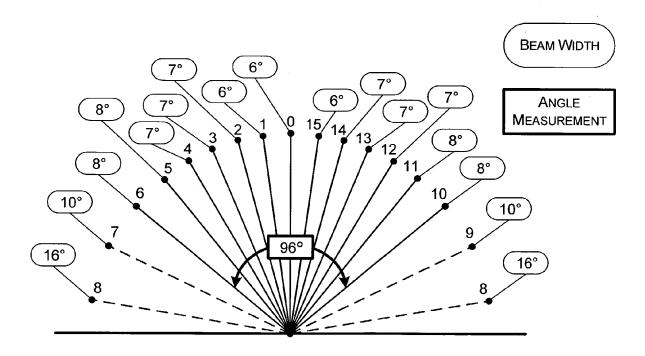


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