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Casas et al.

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(54) **WIRELESS COMMUNICATION AND BEAM FORMING WITH PASSIVE BEAMFORMERS**

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(51) **Int. Cl.**
H01Q 3/24 (2006.01)

(52) **U.S. Cl.** **342/373; 342/374**

(58) **Field of Classification Search** **342/373, 342/374**

See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

3,295,134	A *	12/1966	Lowe	.....	342/368
3,836,970	A *	9/1974	Reitzig	.....	342/373
3,858,218	A *	12/1974	Masak et al.	.....	342/406
4,231,040	A *	10/1980	Walker	.....	342/373
4,639,732	A *	1/1987	Acoraci et al.	.....	342/371
5,115,248	A *	5/1992	Roederer	.....	342/373
5,162,804	A *	11/1992	Uyeda	.....	342/373
5,610,617	A *	3/1997	Gans et al.	.....	342/373
5,666,123	A *	9/1997	Chrystie	.....	342/373
6,104,935	A *	8/2000	Smith et al.	.....	455/562.1
6,167,036	A *	12/2000	Beven	.....	455/440
6,252,544	B1	6/2001	Hoffberg	.....
6,340,948	B1	1/2002	Munoz-Garcia et al.	.....
6,353,410	B1 *	3/2002	Powell	.....	342/373
6,397,082	B1 *	5/2002	Searle	.....	455/562.1
6,429,812	B1	8/2002	Hoffberg	.....

6,470,192	B1 *	10/2002	Karlsson et al.	.....	455/562.1
2001/0016504	A1 *	8/2001	Dam et al.	.....	455/562
2002/0163478	A1 *	11/2002	Pleva et al.	.....	343/853

OTHER PUBLICATIONS

P. Lehne et al., An Overview of Smart Antenna Technology for Mobile Communications Systems, IEEE Communications Surveys, vol. 2(4), p. 2-13, 1999.*

K. Uehara et al., A planar sector antenna for indoor high-speed wireless communication terminals, IEEE Antennas and Propagation Society International Symposium Digest, vol. 2, p. 1352-1355, Jul. 1997.*

F. Caldwell Jr. et al., Design and implementation of a switched-beam smart antenna for an 802.11b wireless access point, IEEE Radio and Wireless Conference, p. 55-58, Aug. 2002.*

(Continued)

Primary Examiner—Thomas H. Tarcza

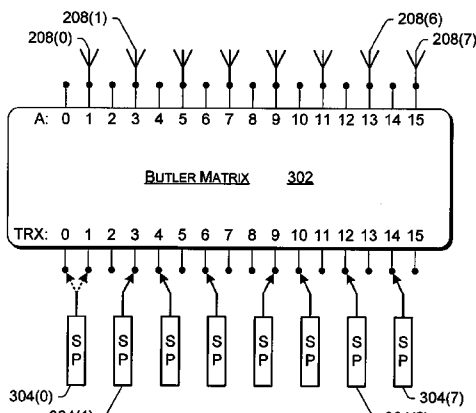
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(57) **ABSTRACT**

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



OTHER PUBLICATIONS

W.X. Sheng et al., Super-resolution DOA estimation in switch beam smart antenna, Proceedings of the 5th International Symposium on Antennas, Propagation and EM Theory, p. 603-606, Aug. 2000.*

M.V. Clark et al., Outdoor IEEE 802.11 cellular networks: radio link performance, IEEE International Conference on Communication, vol. 1, p. 512-516, 2002.*

* cited by examiner

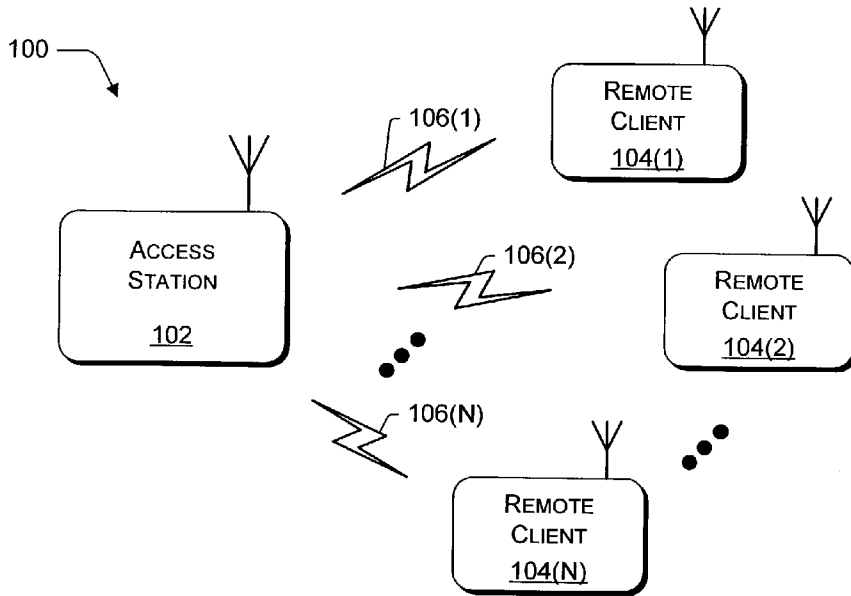


FIG. 1

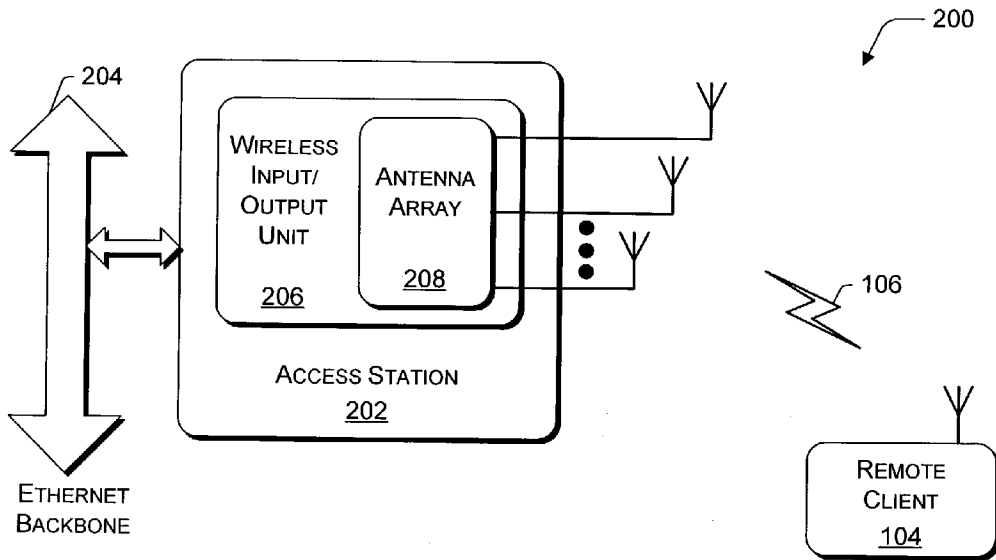


FIG. 2

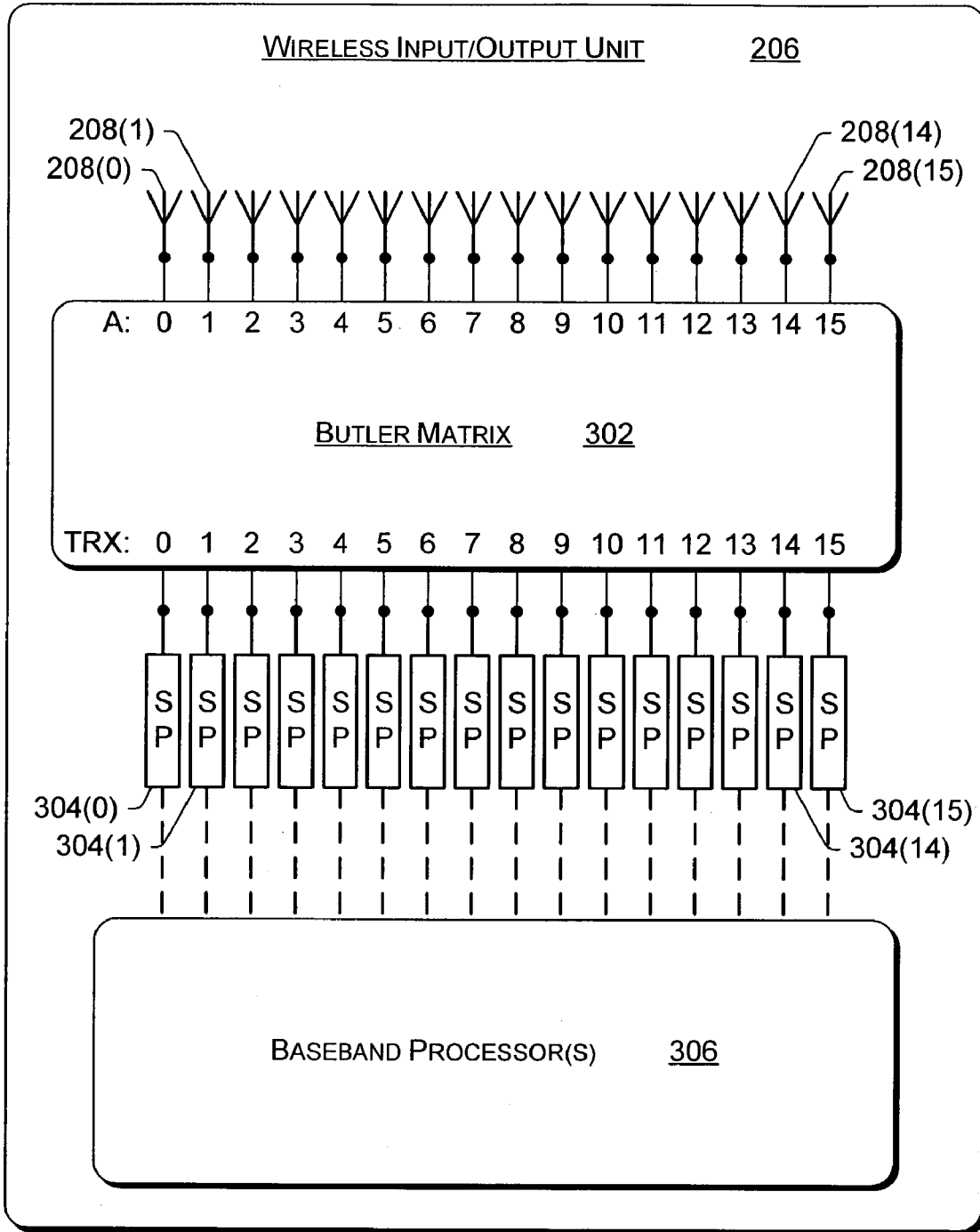


FIG. 3

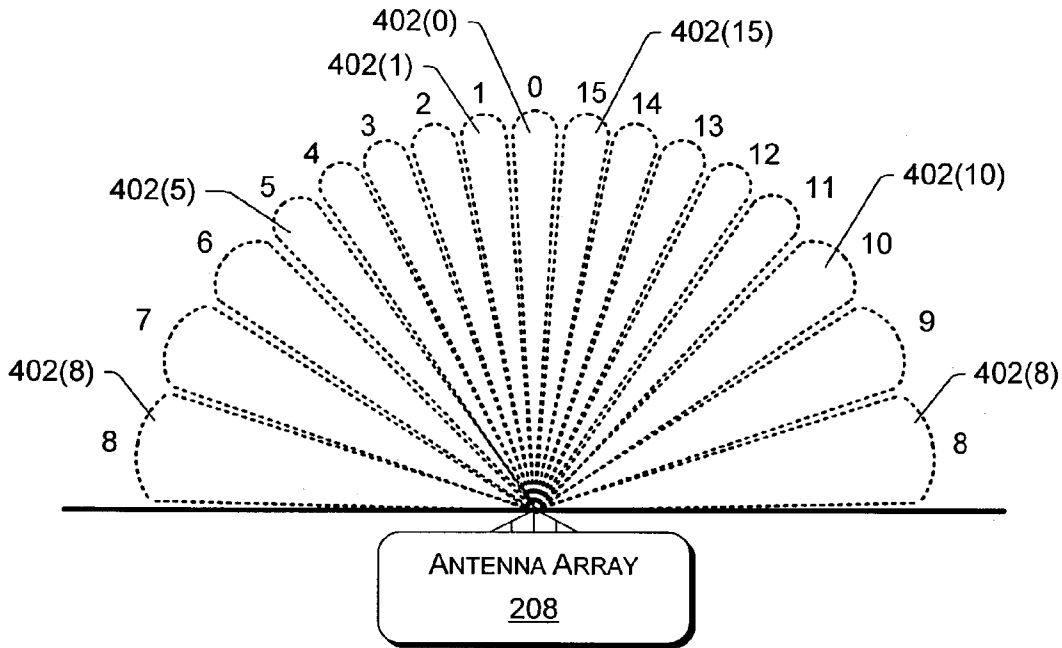


FIG. 4

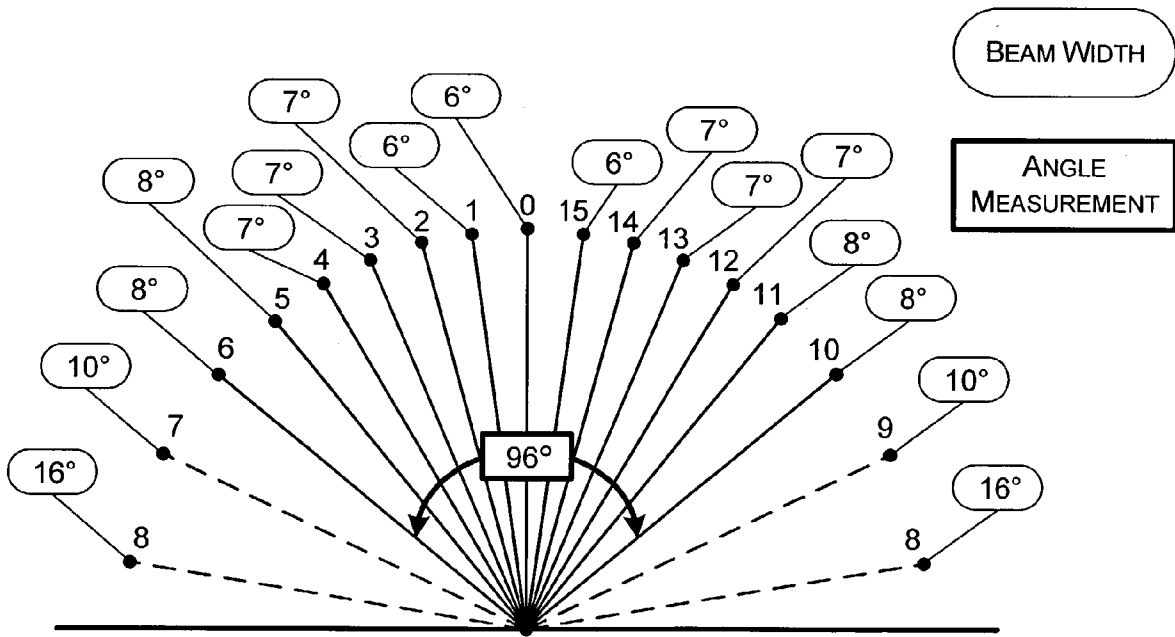


FIG. 5

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