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**Logothetis et al.**

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(54) **METHOD AND APPARATUS FOR A MULTI-BEAM ANTENNA SYSTEM**

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(\* ) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 498 days.

International Search Report and Written Opinion mailed Feb. 16, 2005 in corresponding PCT Application PCT/SE2004/001551.

(Continued)

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(57) **ABSTRACT**

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**H04M 1/00** (2006.01)

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342/368

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455/562.1, 101, 134, 135, 137, 276.1, 226.3,  
455/63.1, 67.11, 25.63, 63.4, 67.16, 91; 375/144,  
375/147, 148; 342/372, 378, 81, 82, 350,  
342/354, 367, 368; 343/751, 757

See application file for complete search history.

An antenna array in a radio node includes multiple antenna elements for transmitting a wider beam covering a majority of a sector cell that includes a common signal and a narrower beam covering only a part of the sector cell that includes a mobile user-specific signal. Transmitting circuitry is coupled to the antenna array, and processing circuitry is coupled to the transmitting circuitry. The processing circuitry ensures the user-specific signal and the common signal in a mixed beam embodiment are in-phase and time-aligned at the antenna array. In a steered beam embodiment, the processing circuitry ensures the user-specific signal and the common signal are time-aligned and have a controlled phase difference when received at mobile stations in the sector cell. In both embodiments, distortions in the common signal and the user-specific signal associated with their conversion from baseband frequency to radio frequency are also compensated. And in the steered beam embodiment, beam forming weights are used not only to radiate a narrower beam to the desired mobile user but also to direct a wider common signal beam to reach all mobile users in the cell.

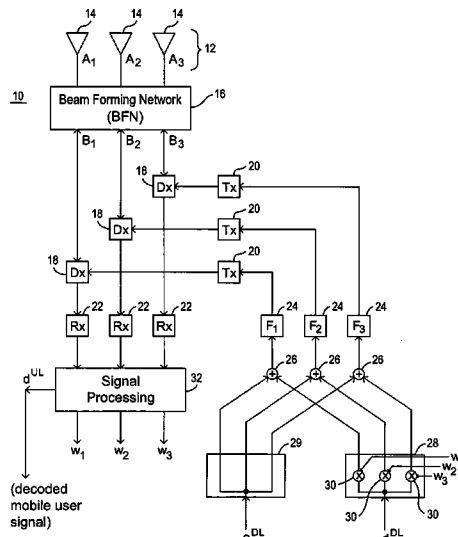
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**58 Claims, 13 Drawing Sheets**



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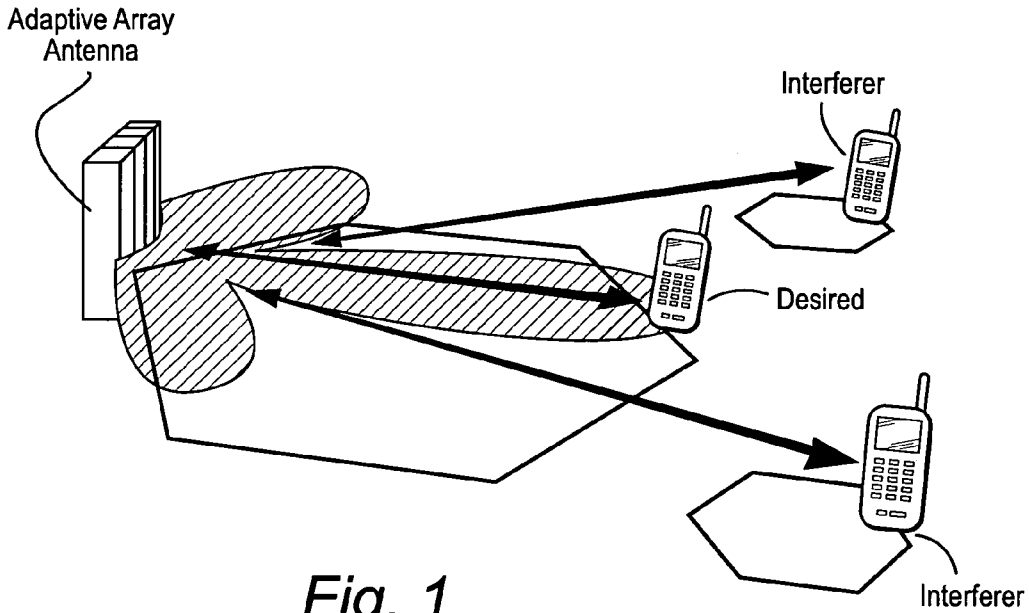


Fig. 1

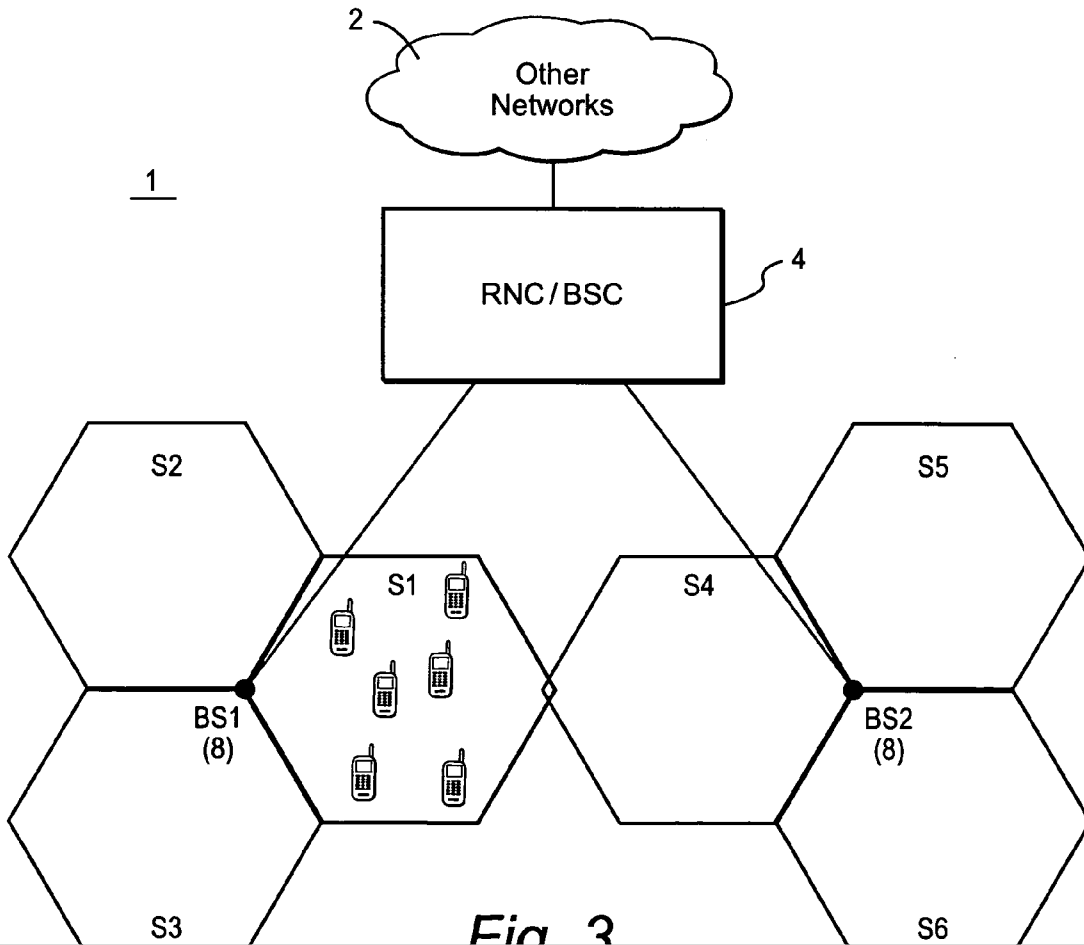


Fig. 3

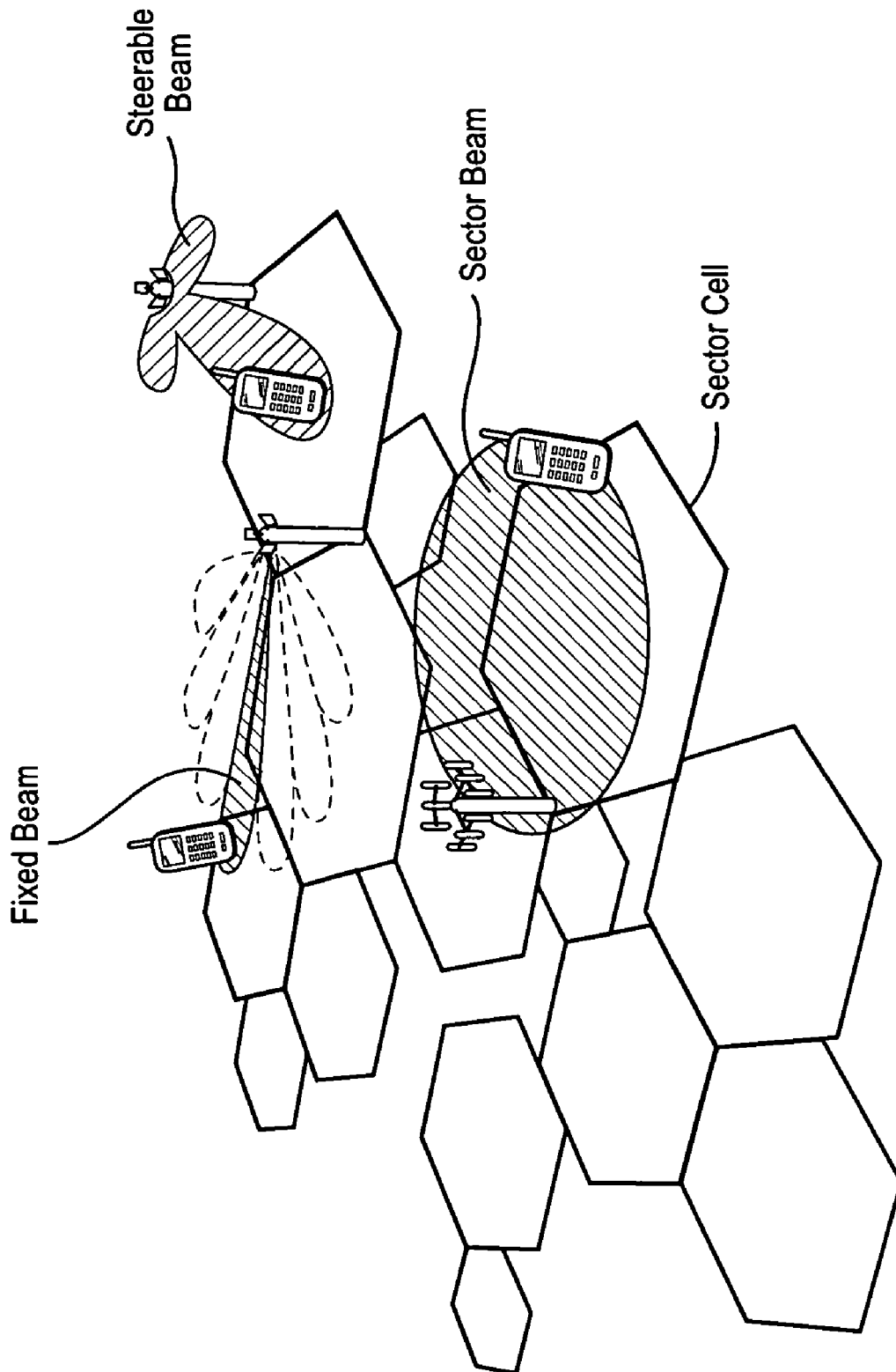


Fig. 2

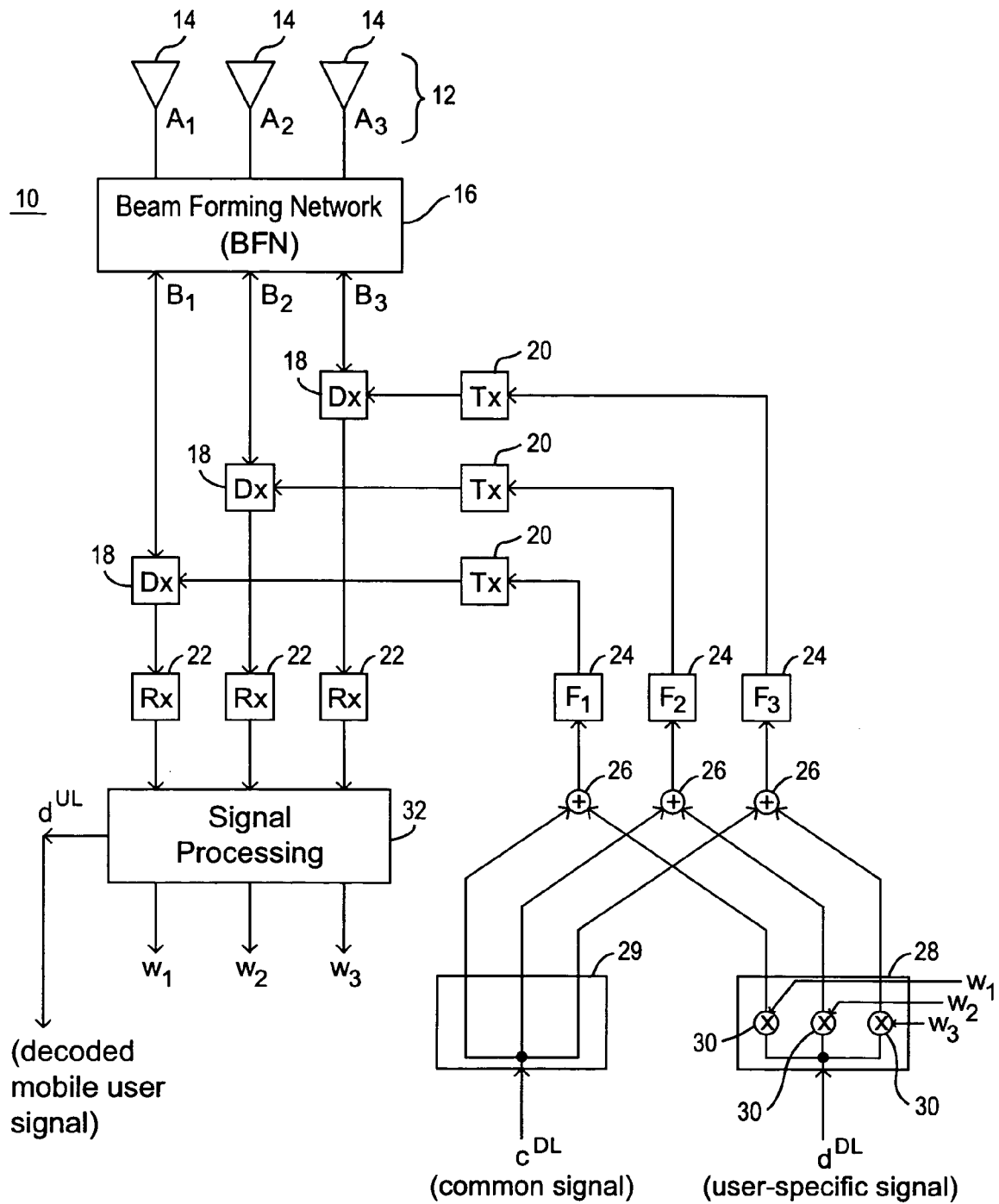


Fig. 4

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