



(12) **United States Patent**  
**Mao et al.**

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(45) **Date of Patent:** **Dec. 25, 2007**

(54) **ADAPTIVE BEAM-FORMING SYSTEM USING HIERARCHICAL WEIGHT BANKS FOR ANTENNA ARRAY IN WIRELESS COMMUNICATION SYSTEM** 7,088,288 B1 \* 8/2006 Margolese et al. .... 342/377  
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EP 1394966 A2 3/2004

(73) Assignee: **Comware, Inc.**, Rockville, MD (US)

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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 300 days.

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(21) Appl. No.: **11/071,249**

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(22) Filed: **Mar. 4, 2005**

(65) **Prior Publication Data**

US 2005/0206564 A1 Sep. 22, 2005

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**Related U.S. Application Data**

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(60) Provisional application No. 60/554,408, filed on Mar. 19, 2004.

(57) **ABSTRACT**

(51) **Int. Cl.**

**H01Q 3/22** (2006.01)  
**H01Q 3/26** (2006.01)

An adaptive beam-forming system using hierarchical weight banks for antenna arrays in wireless communication systems is disclosed. The present invention can be applied for both reception and transmission beam-forming. The hierarchical weight banks contain weights that are pre-calculated based on pre-set beam look directions. By comparing measurements of chosen signal quality metrics for pre-set look directions, the best weights, and thus the best beam look direction, can be selected from the weight banks.

(52) **U.S. Cl.** ..... **342/377; 342/373**

(58) **Field of Classification Search** ..... **342/367, 342/373, 377, 378, 383; 455/69, 101, 562.1**  
See application file for complete search history.

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**41 Claims, 10 Drawing Sheets**

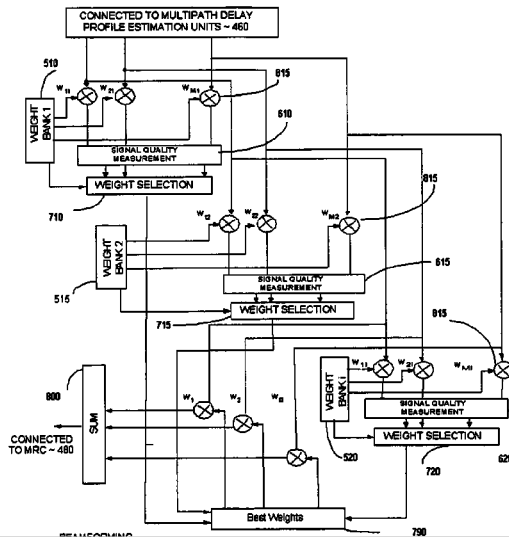


FIG. 1

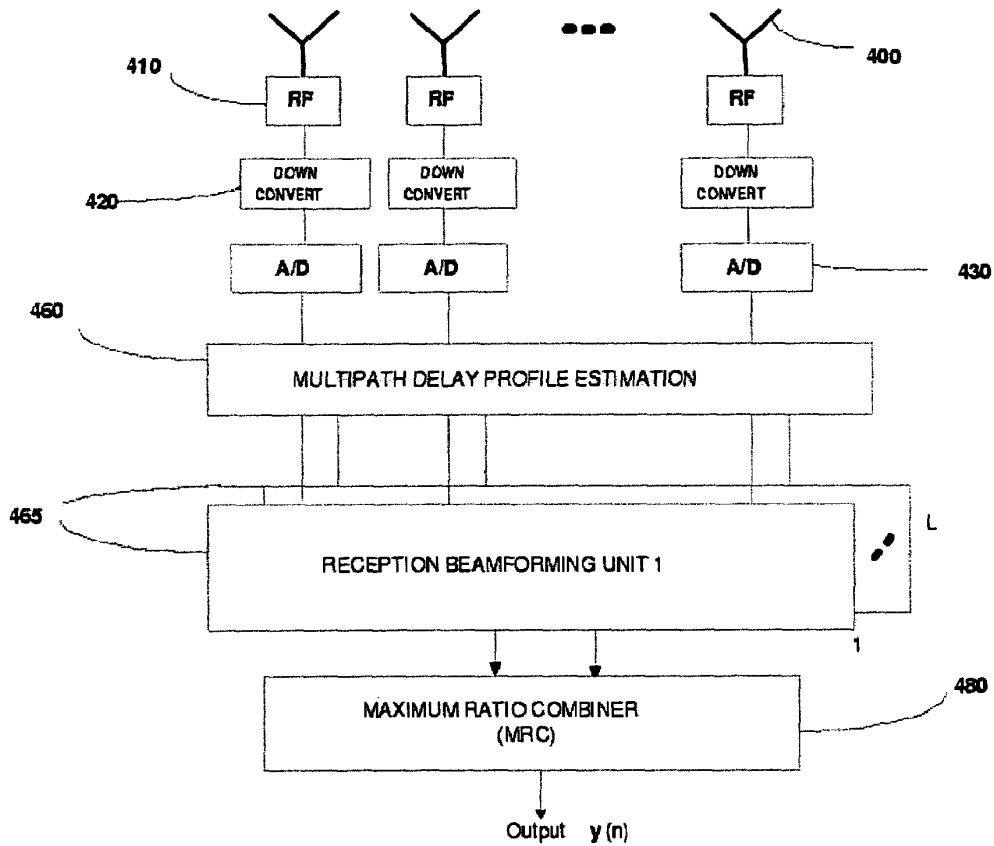


FIG. 2

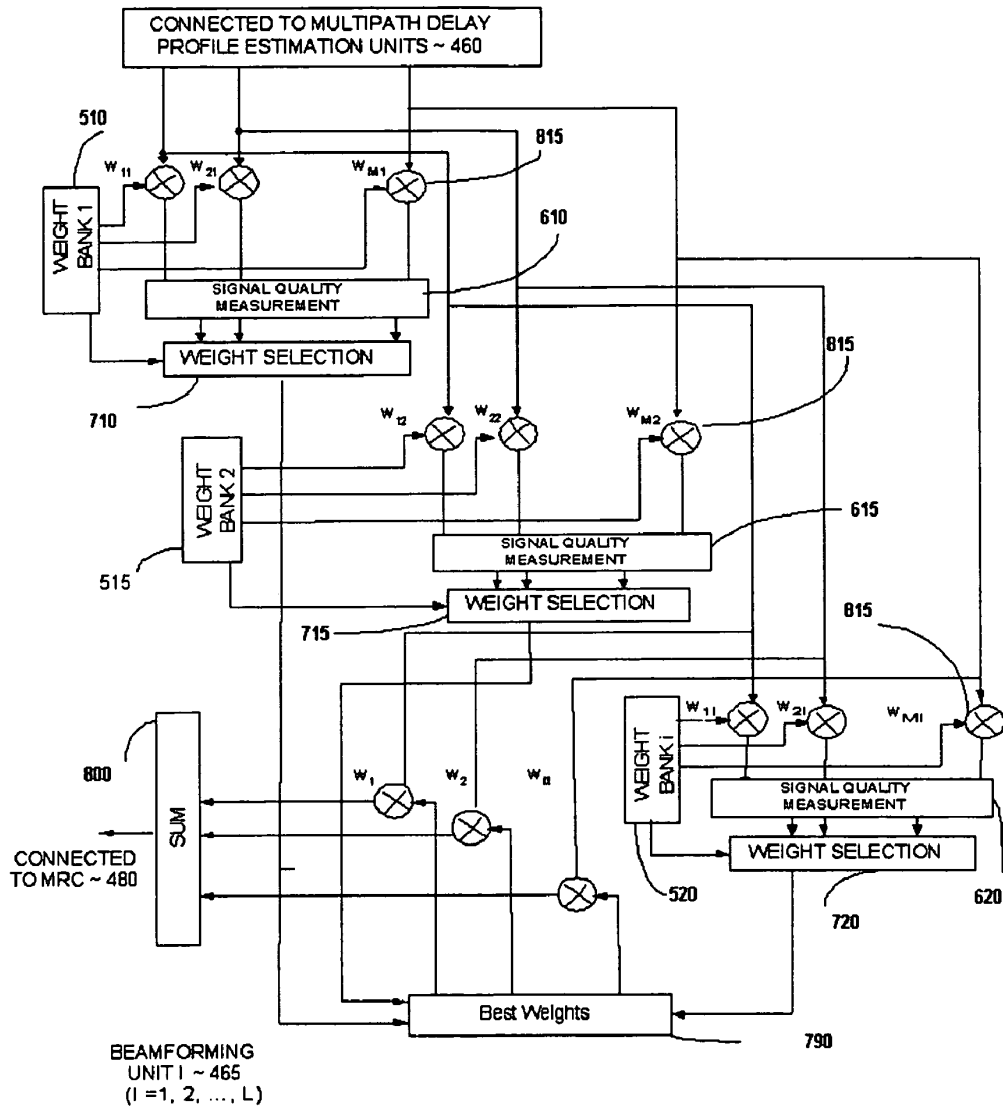


FIG. 3

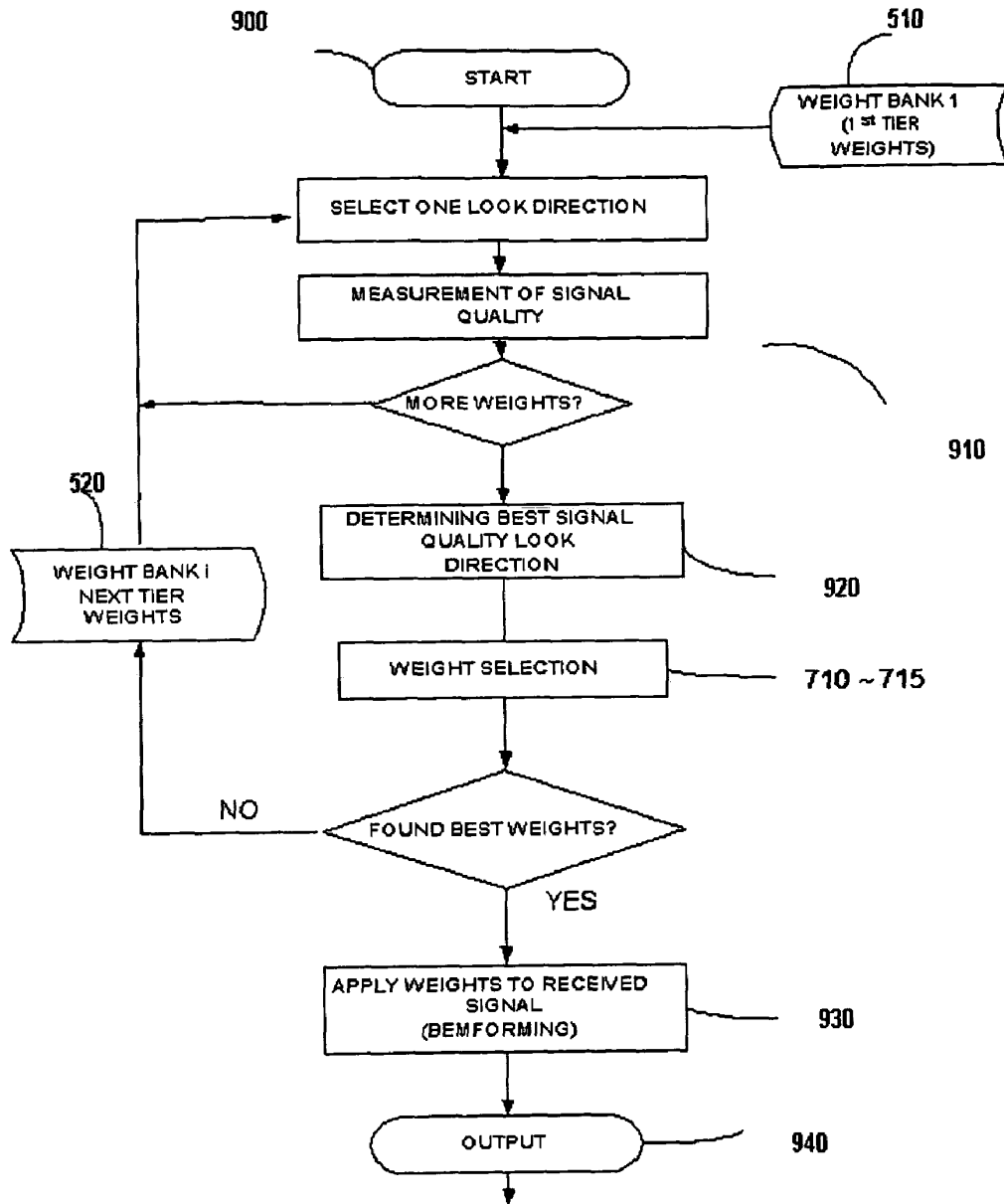
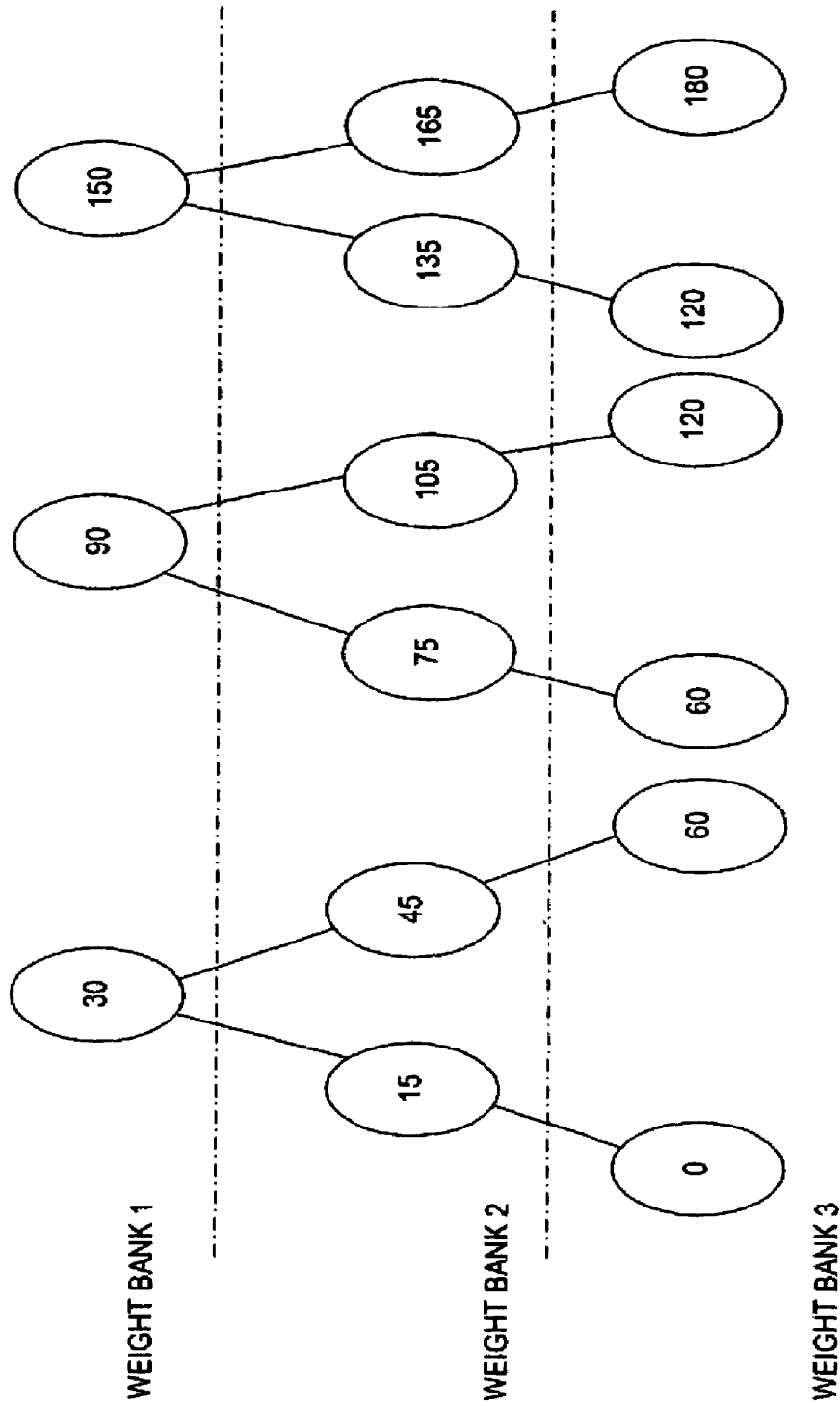


FIG. 4



The beam direction search resolution = 15°

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