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**Johansson et al.**

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(54) **BATCHED FAIR EXHAUSTIVE POLLING SCHEDULER**

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(52) **U.S. Cl.** ..... **370/449; 370/329**

(58) **Field of Search** ..... 370/431, 449, 370/329, 346; 455/450

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

5,051,984	A	9/1991	Mostafa et al.
5,056,085	A	10/1991	Vu
5,065,399	A	11/1991	Hasegawa et al.
5,173,689	A	12/1992	Kusano
5,235,599	A	8/1993	Nishimura et al.
5,719,861	A	2/1998	Okanoue
5,740,366	A	4/1998	Mahany et al.
5,748,611	A	5/1998	Allen et al.

**FOREIGN PATENT DOCUMENTS**

EP	0 294233	A2	12/1988
EP	0599764		6/1994
EP	0 715 478	A2	11/1995
EP	0883265		12/1998
EP	0913965		5/1999
GB	2 229 895	A	2/1990
WO	9911025		3/1999
WO	9923799		5/1999

**OTHER PUBLICATIONS**

Takagi, Hideaki, "Queuing Analysis of Polling Models", ACM Computing Surveys, vol. 20, No. 1, Mar. 1988.  
Johansson, Per, et al., "Short Range Radio Based Ad-hoc Networking: Performance and Properties", Proceedings of International Conference on Communications (ICC '99), Jun. 6-10, 1999.

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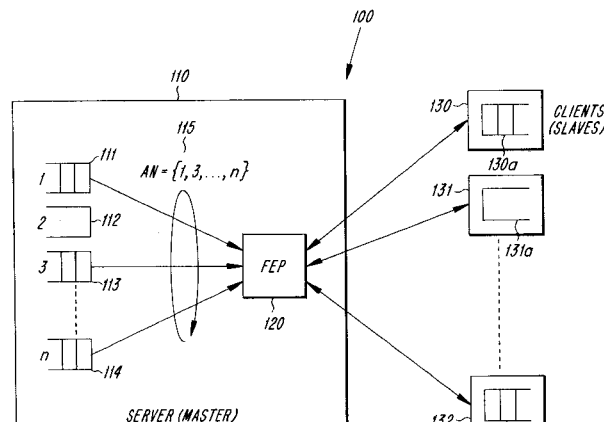
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(57) **ABSTRACT**

A method and apparatus for improving channel utilization and throughput in an ad-hoc wireless communication system is provided. A master unit and one or more slave units are coupled to a shared communication channel having at least an uplink (UL) channel and a downlink channel (DL) for each master unit-slave unit pair. A group of active nodes is established corresponding to slave units having UL and/or DL data associated therewith for transfer. The group of active nodes may be polled according to Fair Exhaustive Polling (FEP) and information alternately transferred on a TDD. Accumulated information may be transferred in a batch and feedback information collected and used to adjust polling. One or more links may be identified as lossy links due to increased Bit Error Rate (BER) and accompanying information loss resulting in lower throughput. Virtual active nodes added to the group of active nodes to compensate therefor. A transmission parameter such as number of retransmissions may be evaluated against a predetermined threshold to identify lossy links. If lossy links improve, virtual active nodes may be removed from the group of active nodes. Information associated with the one or more slaves units may be circuit switched synchronous information or non-circuit switched asynchronous information. Feedback information such as timeout information associated with the slave units may be evaluated. If a time out signal associated with a slave unit is received the slave unit may be scheduled for polling responsive to the time out signal.

**18 Claims, 4 Drawing Sheets**



OTHER PUBLICATIONS

“Specification of the Bluetooth System”, Bluetooth SIG, vol. 0, Jul. 24, 1999; pp. 35–40 and pp. 121–122.

Albrecht, M., et al., “IP Services over Bluetooth: Leading the Way to a New Mobility”, Proceedings of the Conference on Local Computer Networks, Oct. 1999.

Tode, H., et al., “A Routing Method Using a Tunable Cost Function to Obtain Required Communication Quality and

Performance”, Electronics and Communications in Japan, Part 1. vol, 81, No. 5, 1998.

Haartsen, J., “Bluetooth—The Universal Radio Interface for Ad Hoc, Wireless Connectivity”, Ericsson Review No. 3 (1998), pp. 110–117.

Copy of European Search Report issued on Jun. 5, 2000.

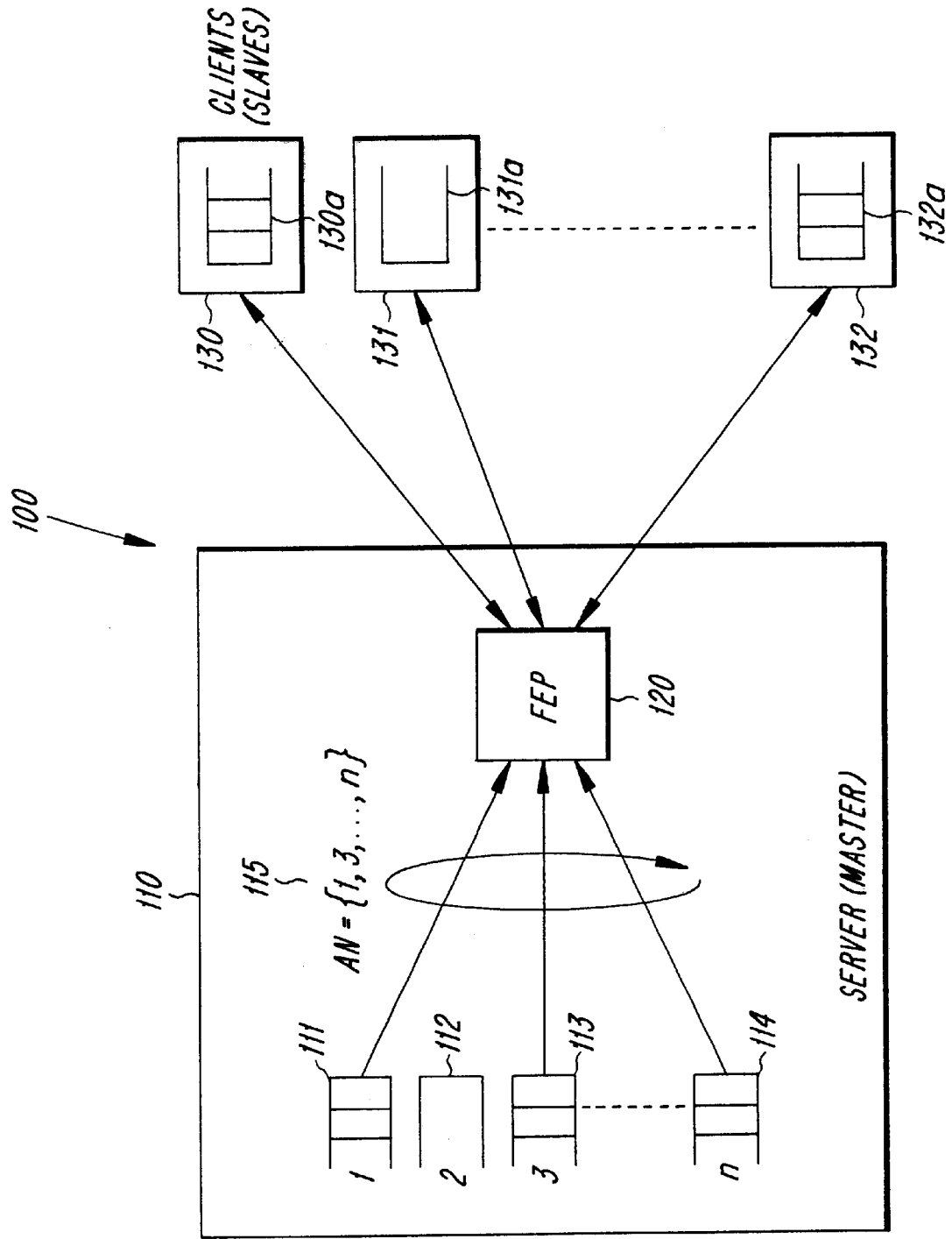


FIG. 1

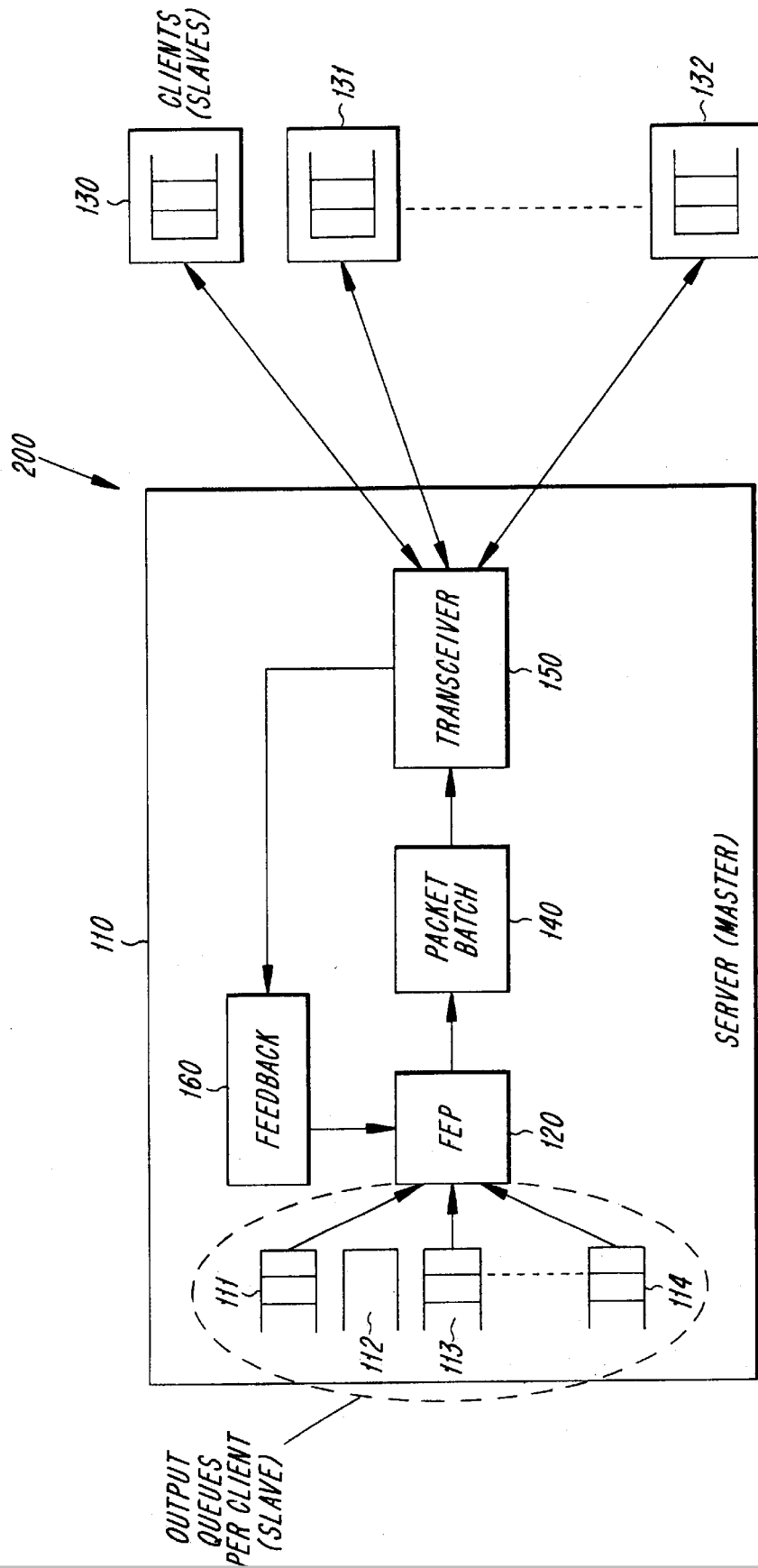


FIG. 2

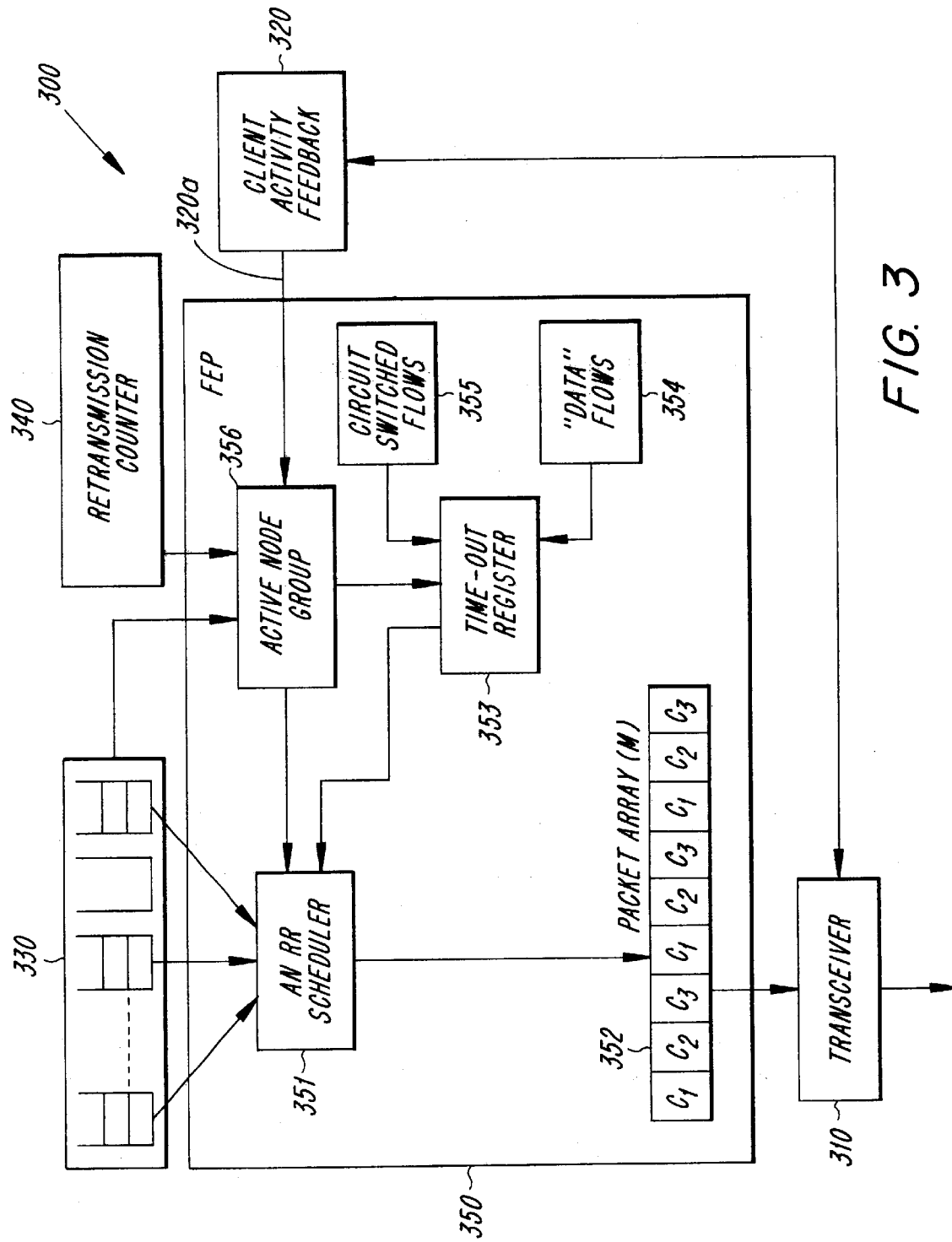


FIG. 3

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