



US006289054B1

(12) **United States Patent**
Rhee

(10) **Patent No.:** **US 6,289,054 B1**
(45) **Date of Patent:** **Sep. 11, 2001**

(54) **METHOD AND SYSTEMS FOR DYNAMIC HYBRID PACKET LOSS RECOVERY FOR VIDEO TRANSMISSION OVER LOSSY PACKET-BASED NETWORK**

(75) Inventor: **Injong Rhee**, Raleigh, NC (US)

(73) Assignee: **North Carolina University**, Raleigh, NC (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/560,409**

(22) Filed: **Apr. 27, 2000**

Related U.S. Application Data

(63) Continuation-in-part of application No. 09/079,621, filed on May 15, 1998, now Pat. No. 6,104,757.

(51) **Int. Cl.**⁷ **H04N 7/64; H04N 7/36**

(52) **U.S. Cl.** **375/240.27; 375/240.12; 714/18; 714/48**

(58) **Field of Search** **375/240, 240.27, 375/240.12; 714/18, 48; H04N 7/36, 7/64**

(56) **References Cited**

U.S. PATENT DOCUMENTS

- 5,680,322 * 10/1997 Shinoda 714/18
- 5,767,907 * 6/1998 Pearlstein 348/407 X
- 5,794,018 * 8/1998 Vrvilo et al. 713/400
- 6,104,757 * 8/2000 Rhee 375/240.12

OTHER PUBLICATIONS

RHEE ET AL., "FEC-Based Loss Recovery for Interactive Video Transmission," Proceedings of IEEE International Conference on Multimedia Computing and Systems, vol. 1, p. 205-256, Florence, Italy, (Jun. 1999).

RHEE, "Error Control Techniques for Interactive Low-Bit Rate Video Transmission Over the Internet," Proceeding of the ACM SIGCOMM '98, pp. 290-301, (Sep. 1998).

RHEE, "Retransmission-Based Error Control for Interactive Video Applications Over the Internet," Proceedings of International Conference on Multimedia Computing and Systems, pp. 118-127, (Jun. 1998).

TALLURI, "Error-Resilient Video Coding in ISO MPEG-4 Standard," IEEE Communication Magazine, vol. 36 (No. 6), pp. 112-119, (Jun. 1998).

PODOLSKY ET AL., "Simulation of FEC-Based Error Control for Packet Audio on the Internet," Proceedings of the ACM SIGMETRIC/PERFORMANCE, pp. 505-515, (Jun. 1998).

CARLE ET AL., "Survey of Error Recovery Techniques for IP-Based Audio Visual Multicast Applications," IEEE Network, pp. 24-36, (Dec. 1997).

MCCANNE ET AL., "Low-Complexity Video Coding for Receiver-Driven Layered Multicast," IEEE Journal on Selected Areas in Communications, vol. 16 (No. 6), pp. 983-1001, (Aug. 1997).

(List continued on next page.)

Primary Examiner—Howard Britton

(74) *Attorney, Agent, or Firm*—Jenkins & Wilson, P.A.

(57) **ABSTRACT**

Methods and systems for performing packet loss recovery when transmitting compressed video over a lossy packet-based network include transmitting packets of compressed video data from a sender to a receiver. In response to detecting lost or erroneously received packets, the receiver transmits a retransmission request to the sender. In response to receiving the retransmission request, the sender changes the periodic temporal dependency distance of a frame to be transmitted such that the frame depends on the frame associated with the retransmitted packets. The receiver receives the retransmitted packets and restores the frame corresponding the retransmitted packets in a frame buffer. The receiver uses the restored frame to decode a frame transmitted after the retransmitted packets.

37 Claims, 12 Drawing Sheets

