A ROBUST ACKNOWLEDGEMENT SCHEME FOR UNRELIABLE FLOWS

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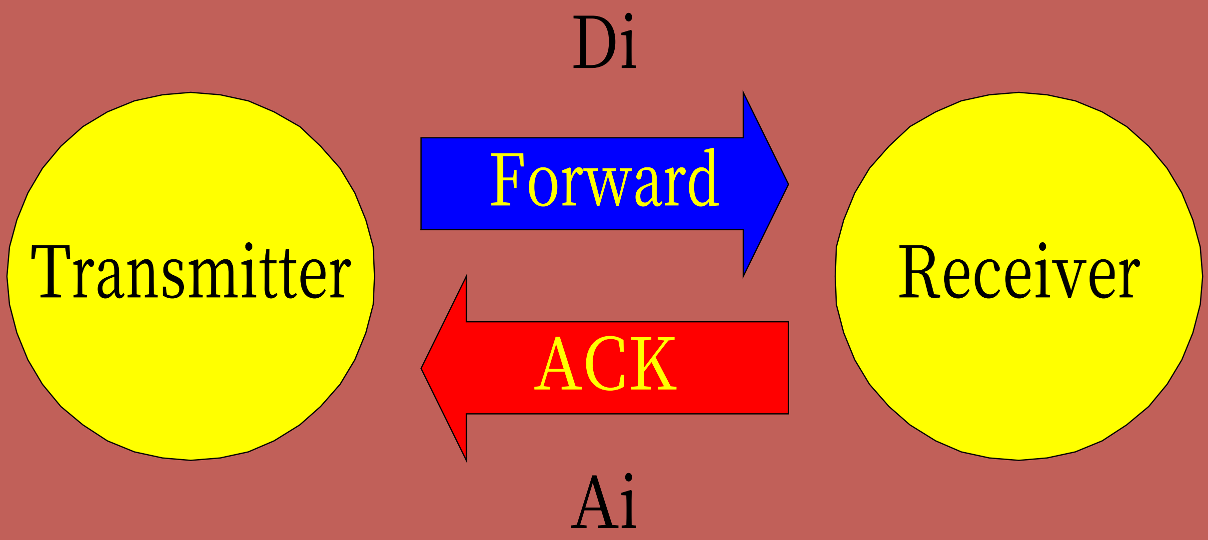
OUTLINE

- Motivations
- Problem Definition
- Evaluation of Different Variants of the Model
- Conclusions

MOTIVATIONS

- Multimedia streaming applications (e.g. a MPEG video player) and monitoring applications can benefit from selective retransmissions of some but not all lost packets.
- The authors propose a bit-vector-based ack (BACK) scheme. It uses very few control bits and is robust against losses.

PROBLEM DEFINITION

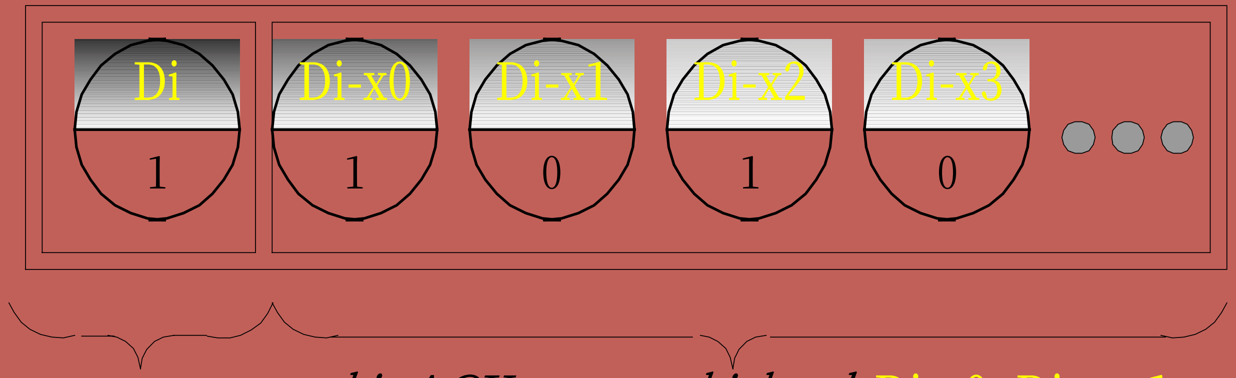


- The sender sends an infinite number of packets to the receiver.
- The forward link and reverse link are lossy paths.

PROBLEM DEFINITION

- Each ACK Ai is composed of：
  - An ACK number i
  - A n-bit ACK vector
- The j-th bit of the ACK vector is set to 1 if and only if Di-xj has been received.
- X0~Xn-1 are the distances between the elements of the vector.

The format of Ai *is like that*



n-bit ACK vector which ack Di-x0~Di-xn-1

PROBLEM DEFINITION

- We focus on three types of ACK vector placement scheme：
  - Consecutive placement (CP)
    - i.e. X0=0, X1=1,X2=2,……Xn-1=n-1
  - Uniform placement (UP)
    - m is the vector spread, (65536) k=(65536-1)/(n-1), X0=0, X1=k, X2=2k,……Xn-1=65536-1
  - Exponential placement (EP)
    - m is the vector spread, (65536) X0=0 and

    Xn-1=65536-1, the interval of consecutive points increase exponentially.

PROBLEM DEFINITION

- CP is chosen because of its simplicity.
- UP is chosen because of that it often achieves a high accuracy.
- EP is robust scheme that achieves both excellent accuracy and good average ACK delay.

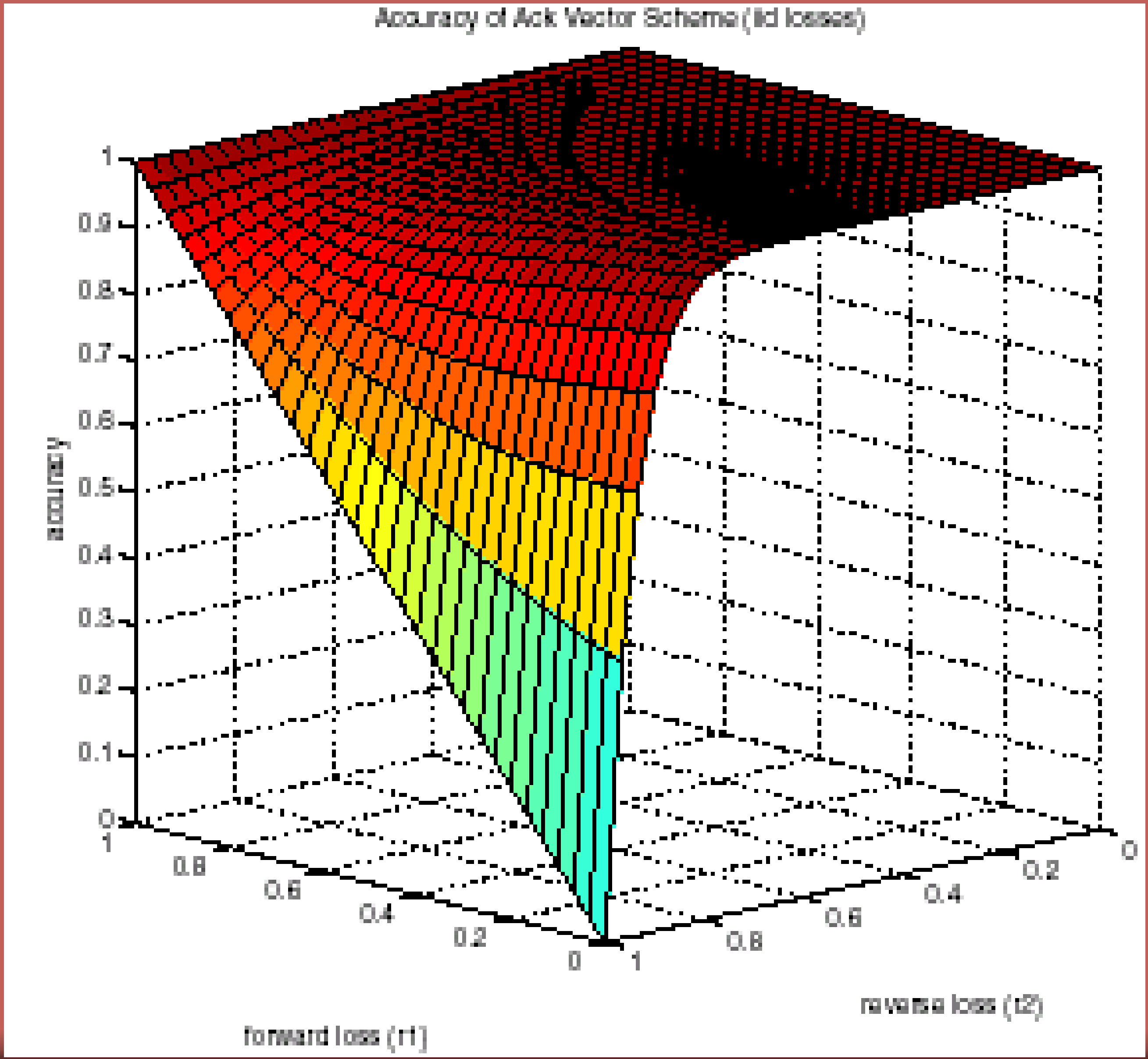
PROBLEM DEFINITION

- Accuracy **α** is defined to be：

  α=1-Pr[a packet is received but never acknowledged]

- ACK delay for packet I is defined to be the length of the period after the packet is sent and just before an ACK for it is first received.

PROBLEM DEFINITION



Evaluation of Different Variants of the Model

- Network loss Model1
  - Discrete-time 2-state Markov process, in the GOOD state the data is transmitted of received correctly, in the BAD state the packet is loss.
- Network loss Model2
  - The same as Model1, but in the GOOD state, the packets are dropped with probability P_{lo}, in the BAD state P_{hi}.
- Network loss Model3
  - This model emulate networks that occasionally experience very long bursts of losses.

Evaluation of Different Variants of the Model

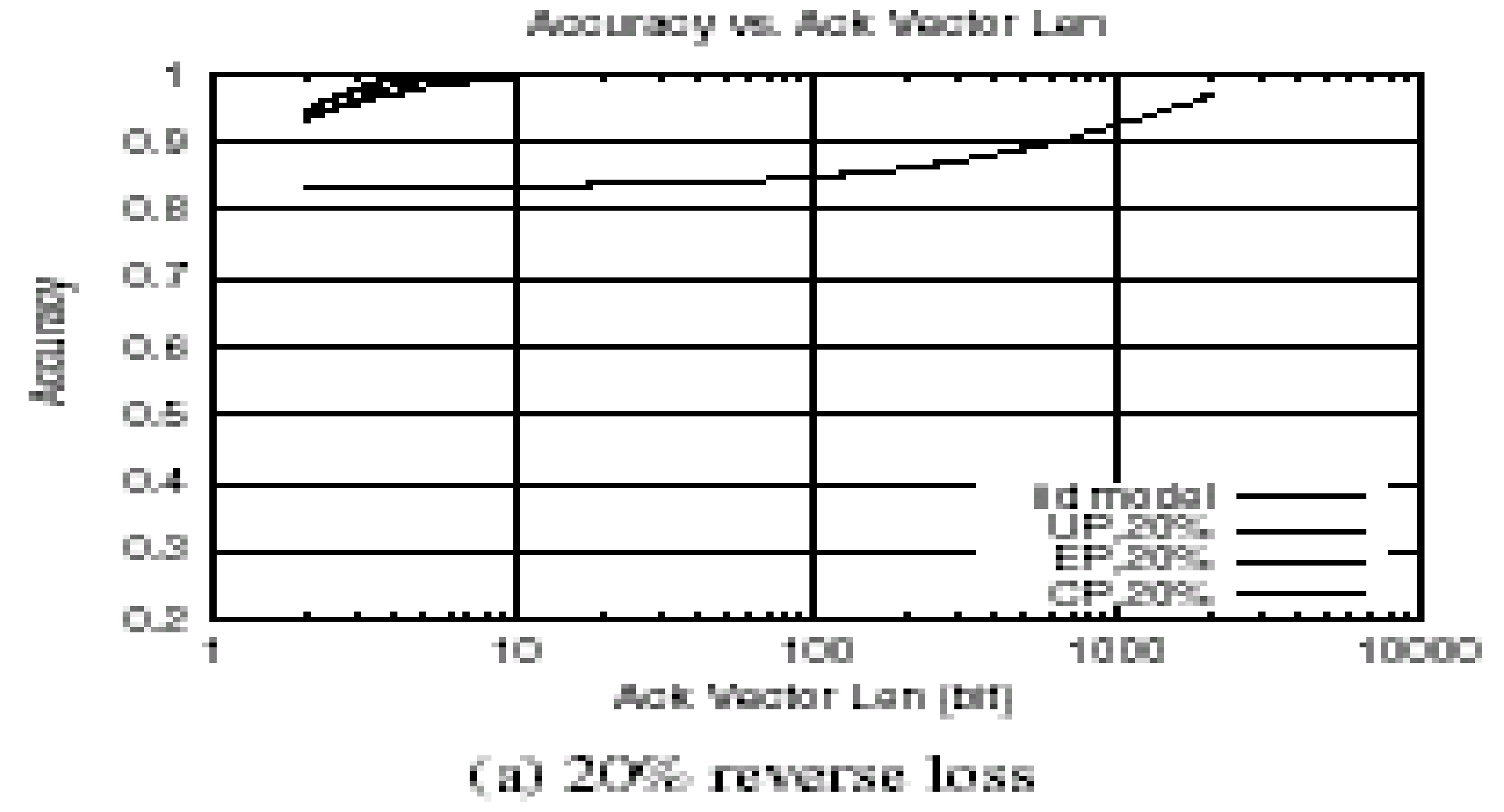
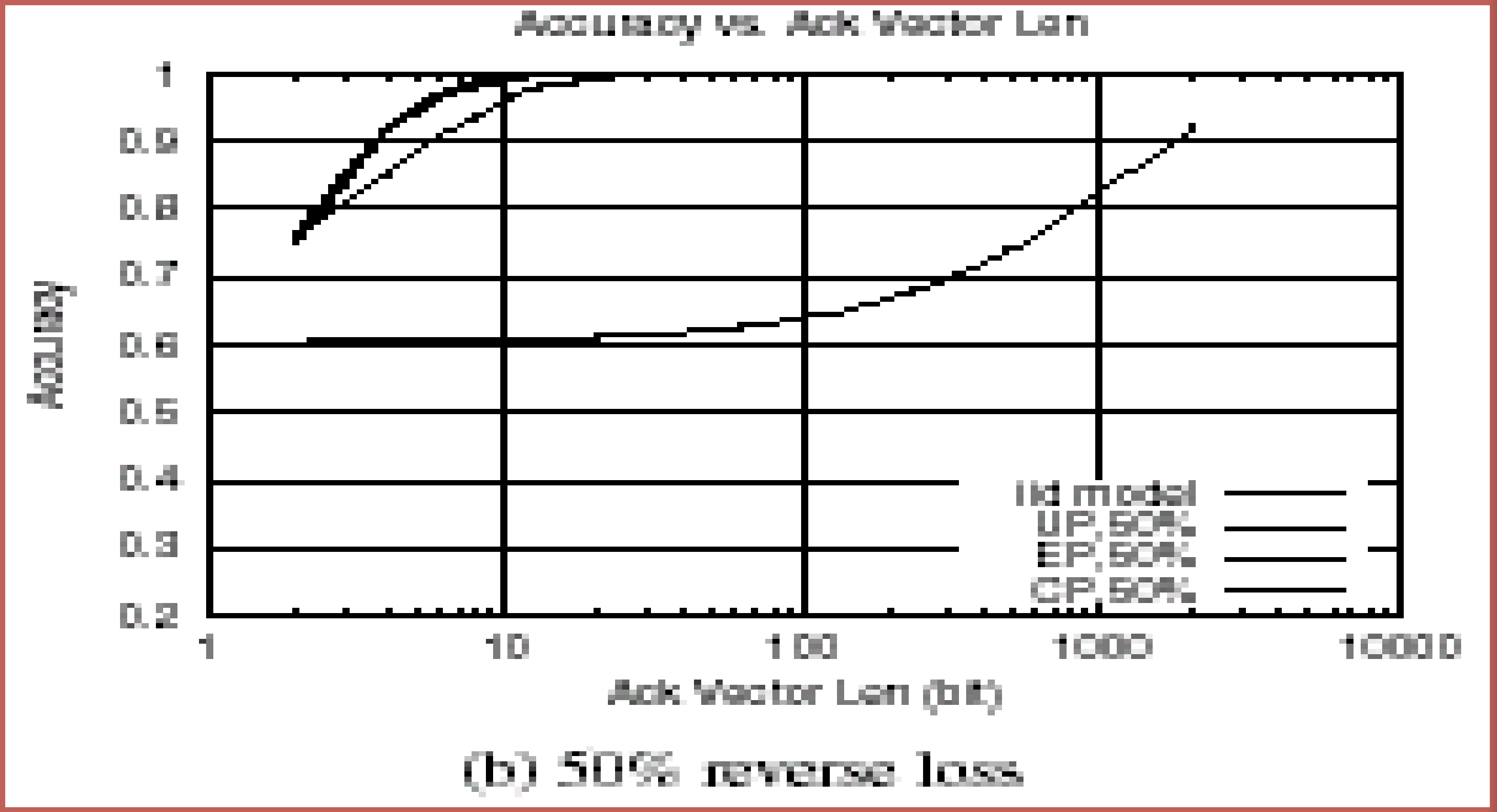


Fig4 Effects of number of ACK bits on accuracy under model 1

Evaluation of Different Variants of the Model



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Evaluation of Different Variants of the Model

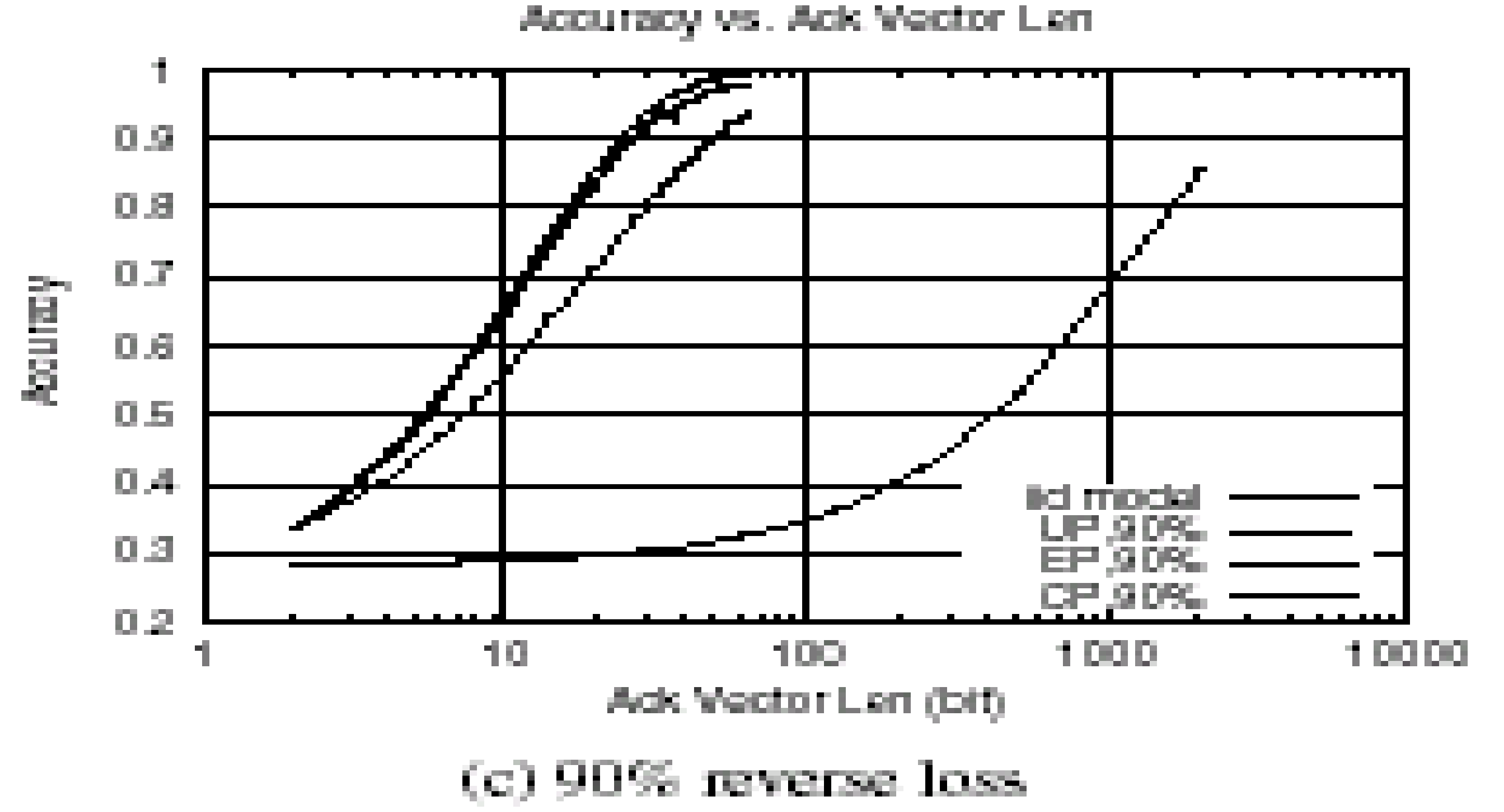
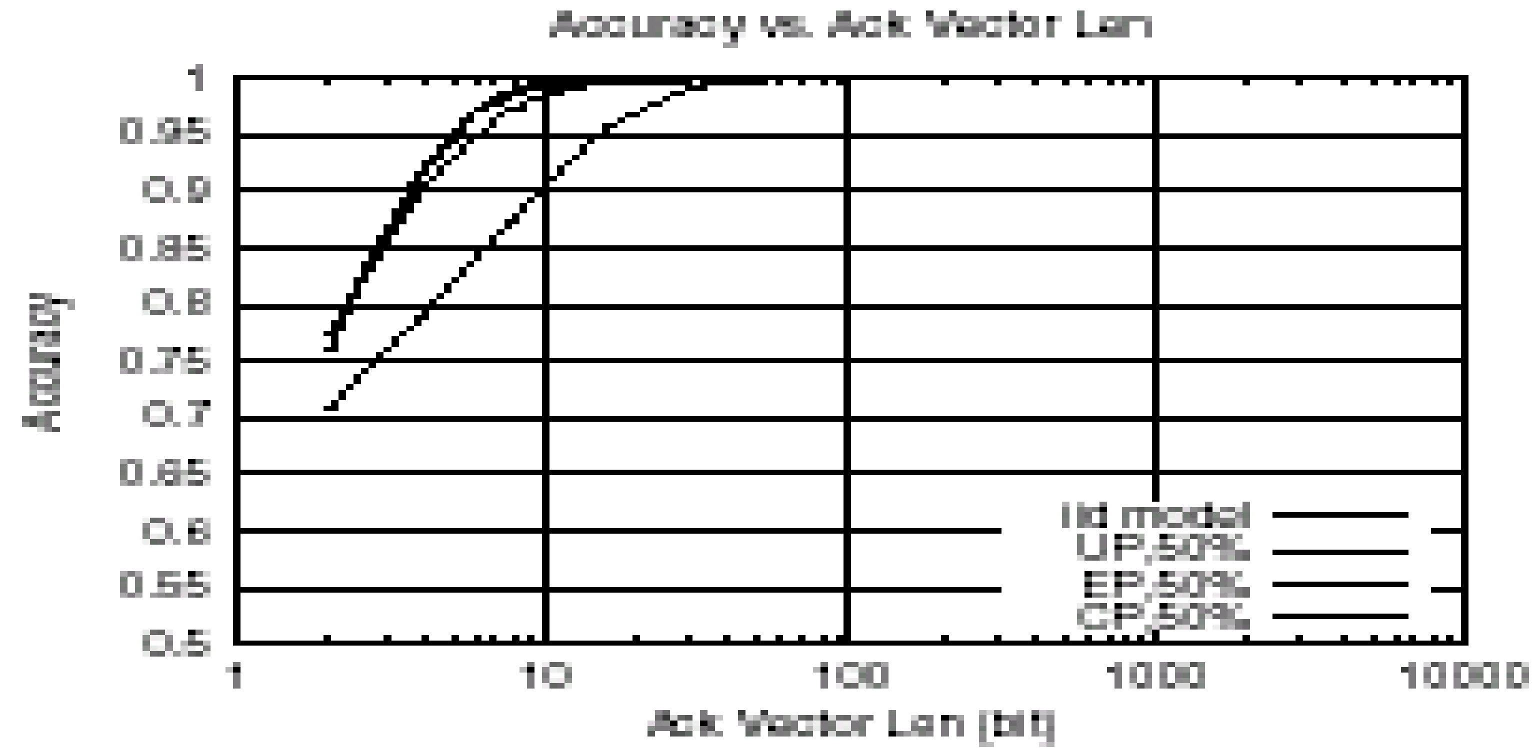


Fig4 Effects of number of ACK bits on accuracy under model 1

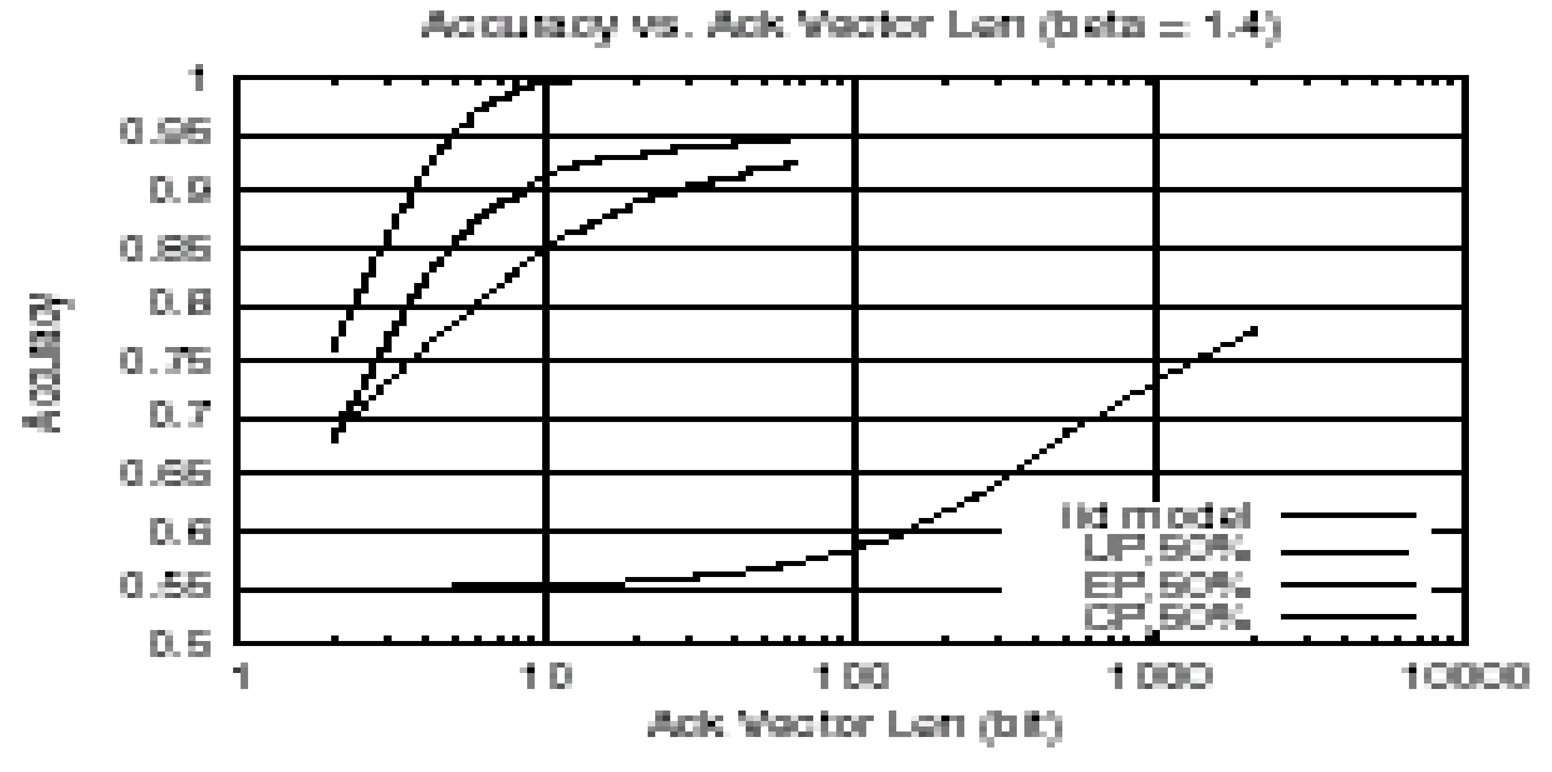
Evaluation of Different Variants of the Model



(a) 50% reverse loss, Markov-Modulated

Fig5 Effects of number of ACK bits on accuracy under model 2

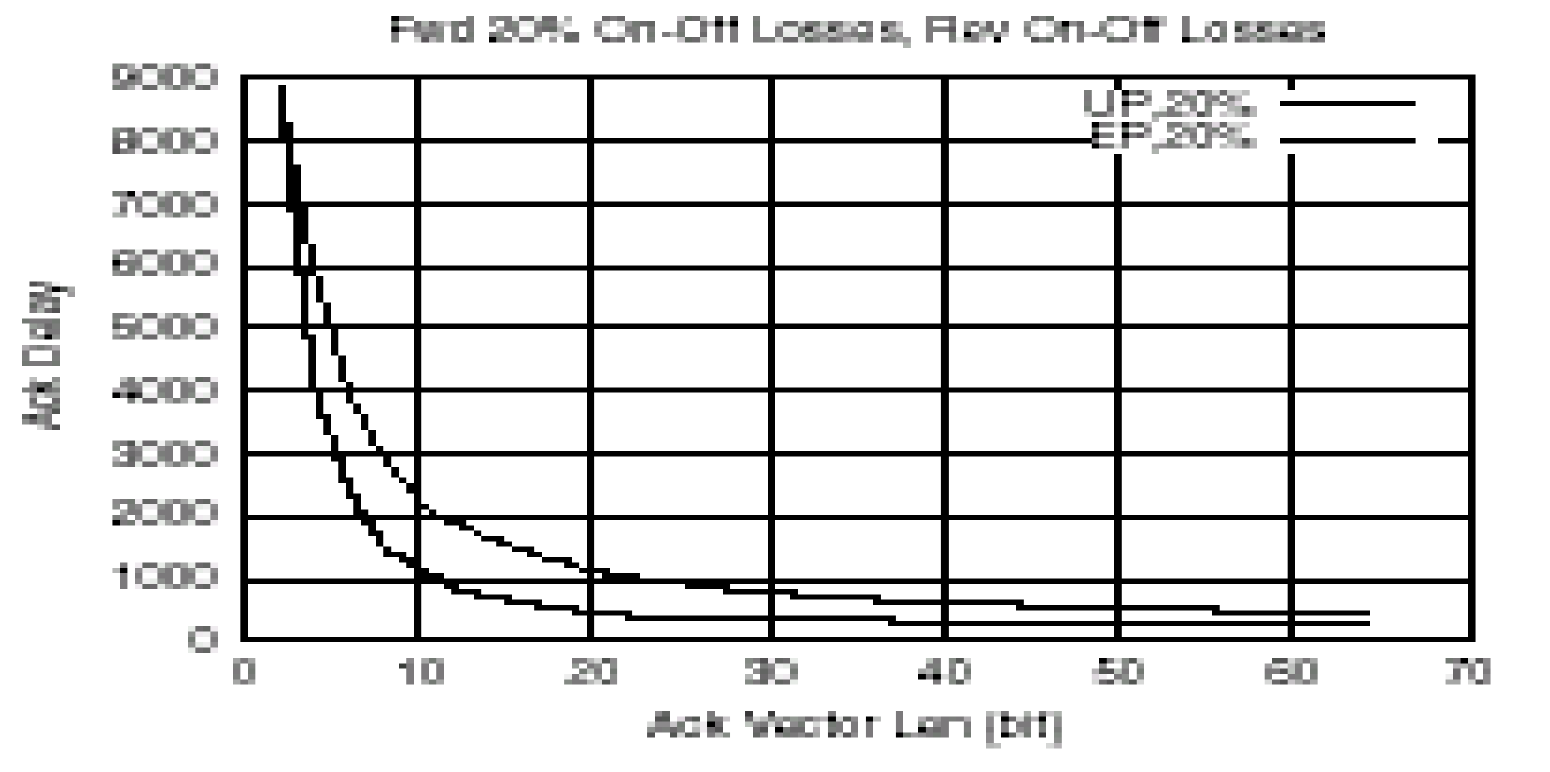
Evaluation of Different Variants of the Model



(b) 50% reverse loss, Pareto

Fig5 Effects of number of ACK bits on accuracy under model 3

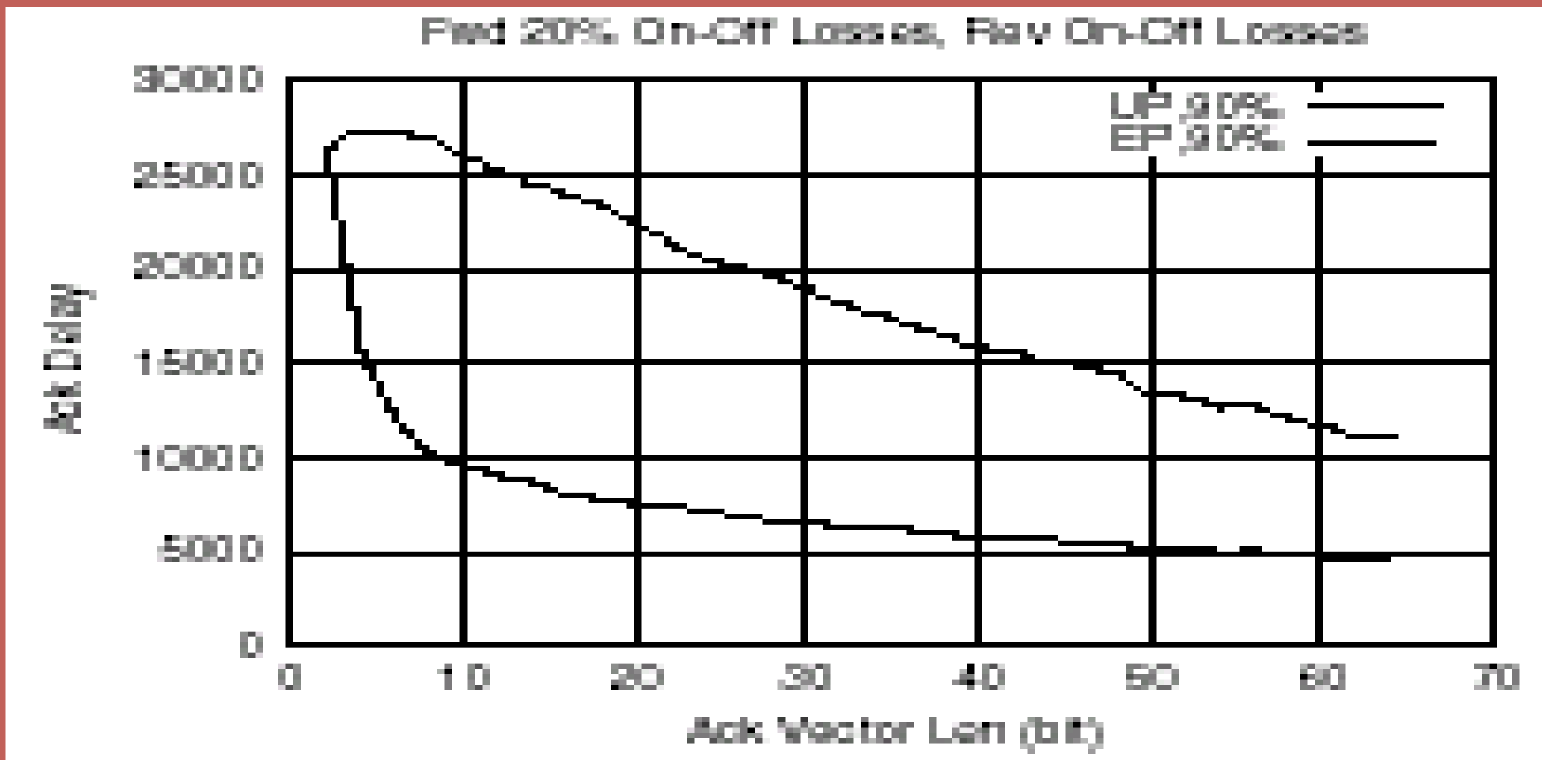
Evaluation of Different Variants of the Model



(a) 20% reverse loss

Fig6 Effects of number of ACK bits on ACK delay under model 1

Evaluation of Different Variants of the Model



(c) 90% reverse loss

Fig6 Effects of number of ACK bits on ACK delay under model 1

Evaluation of Different Variants of the Model

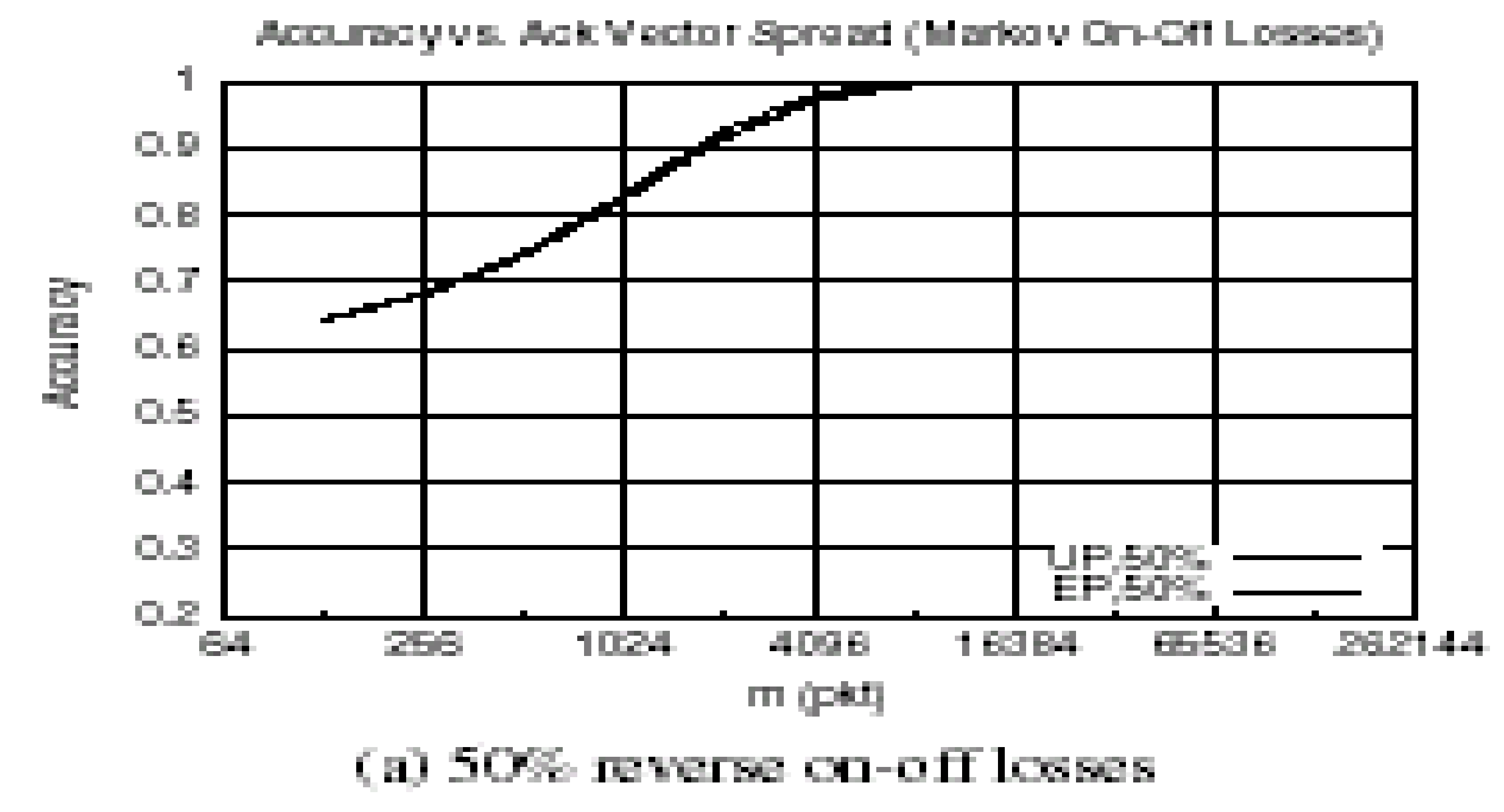


Fig8 Effects of ACK vector spread on accuracy under model 1

Evaluation of Different Variants of the Model

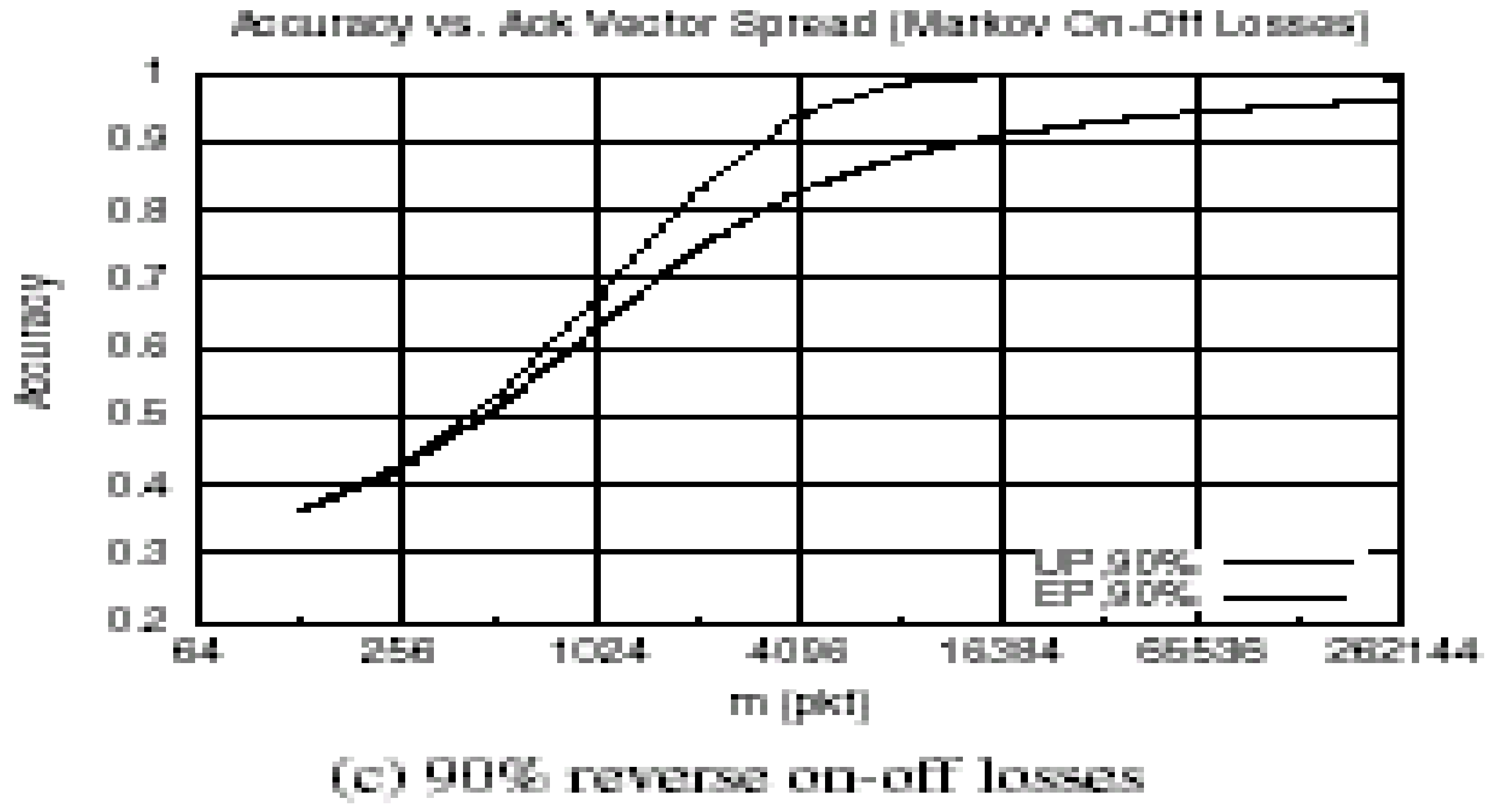


Fig8 Effects of ACK vector spread on accuracy under model 1

Evaluation of Different Variants of the Model

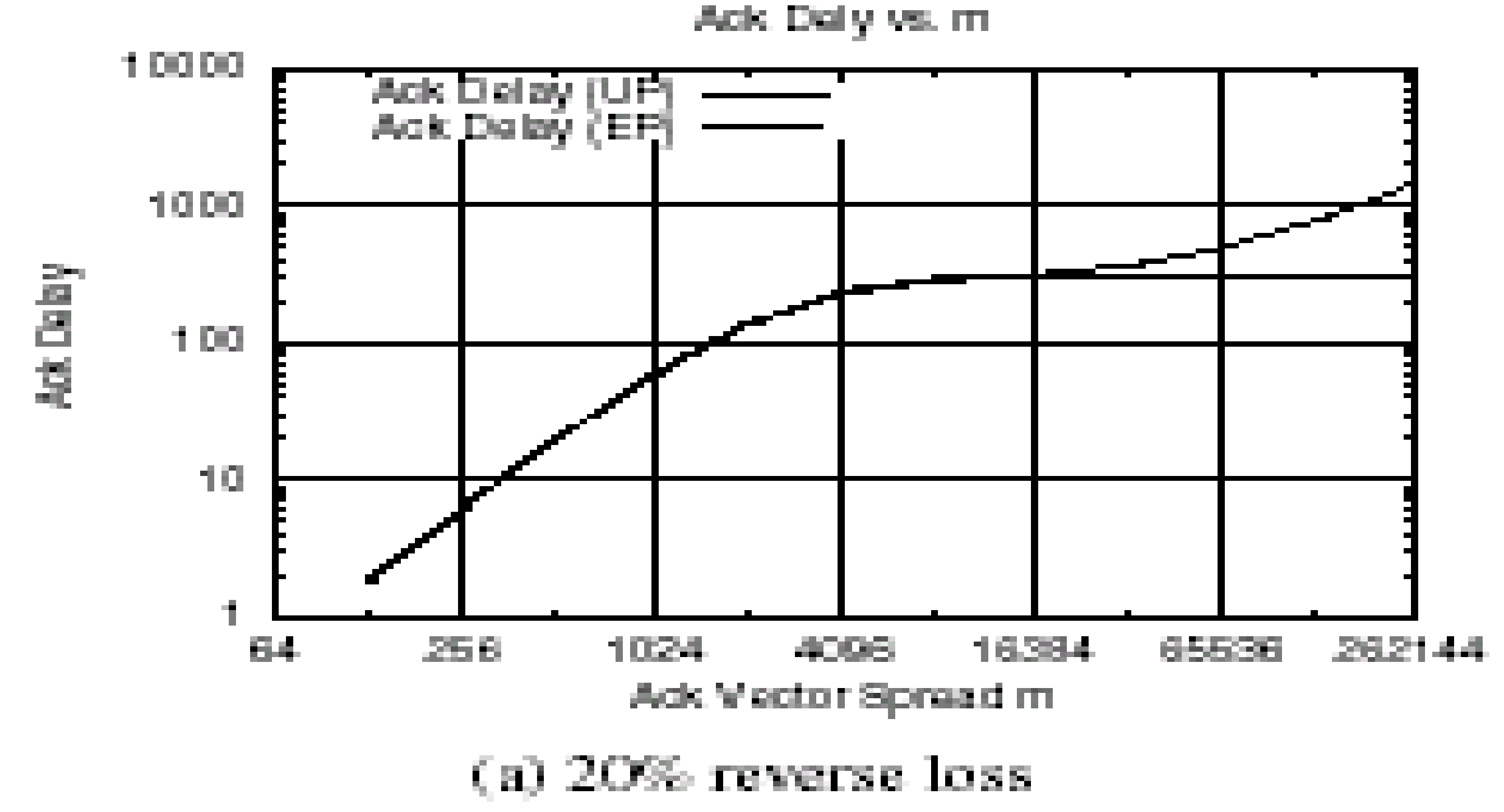


Fig9 Effects of ACK vector spread on ACK delay under model 1

Evaluation of Different Variants of the Model

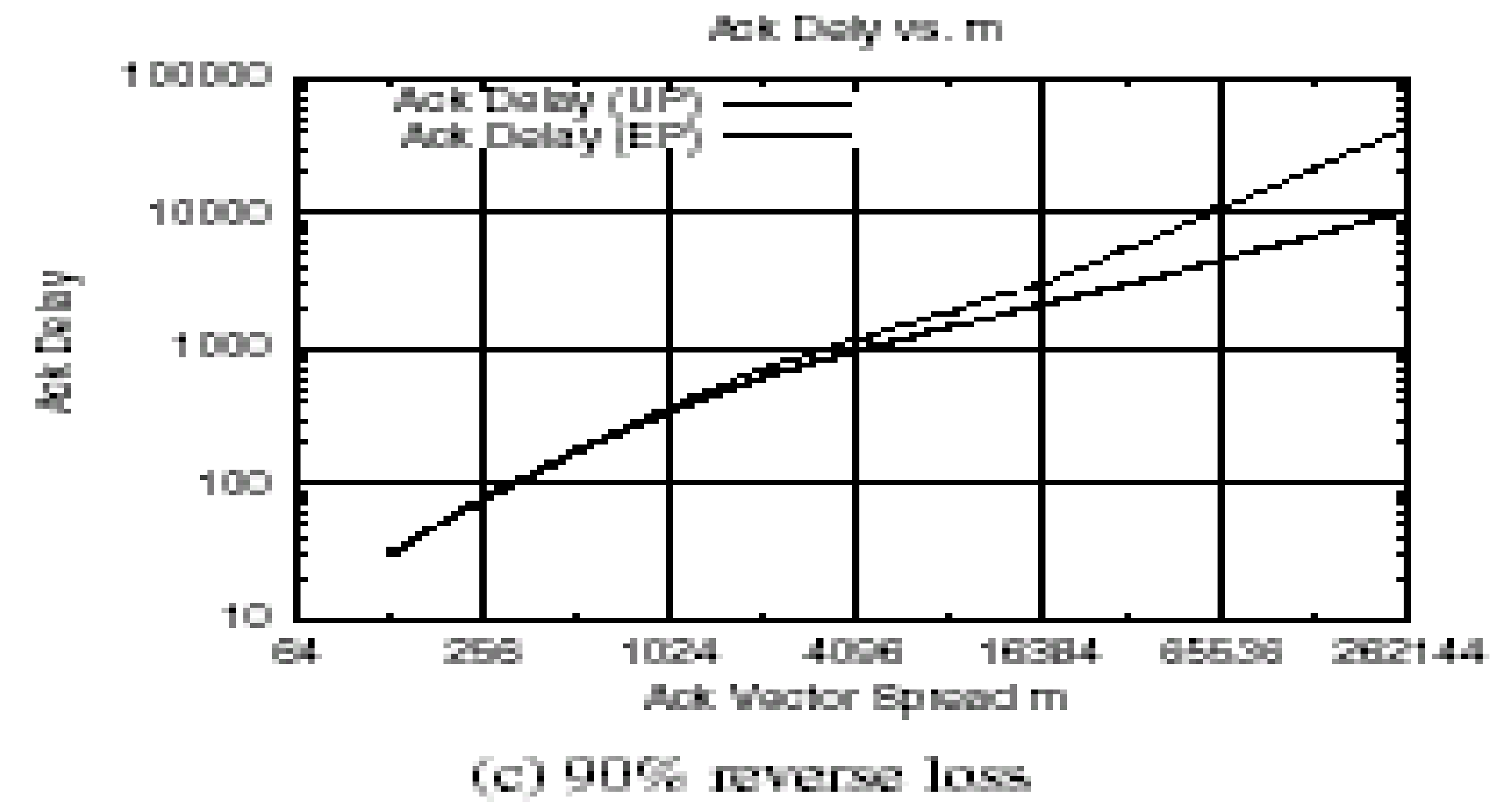
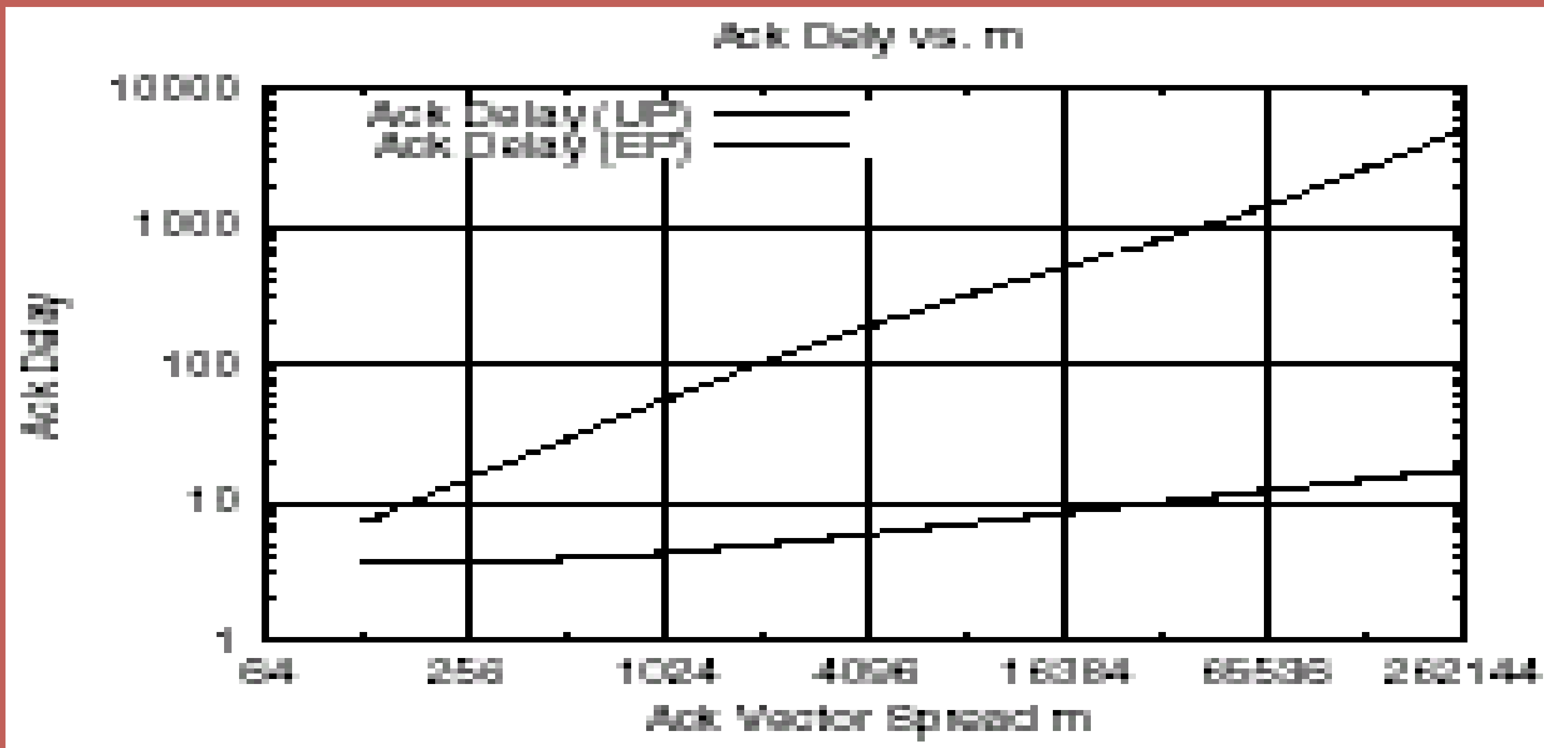


Fig9 Effects of ACK vector spread on ACK delay under model 1

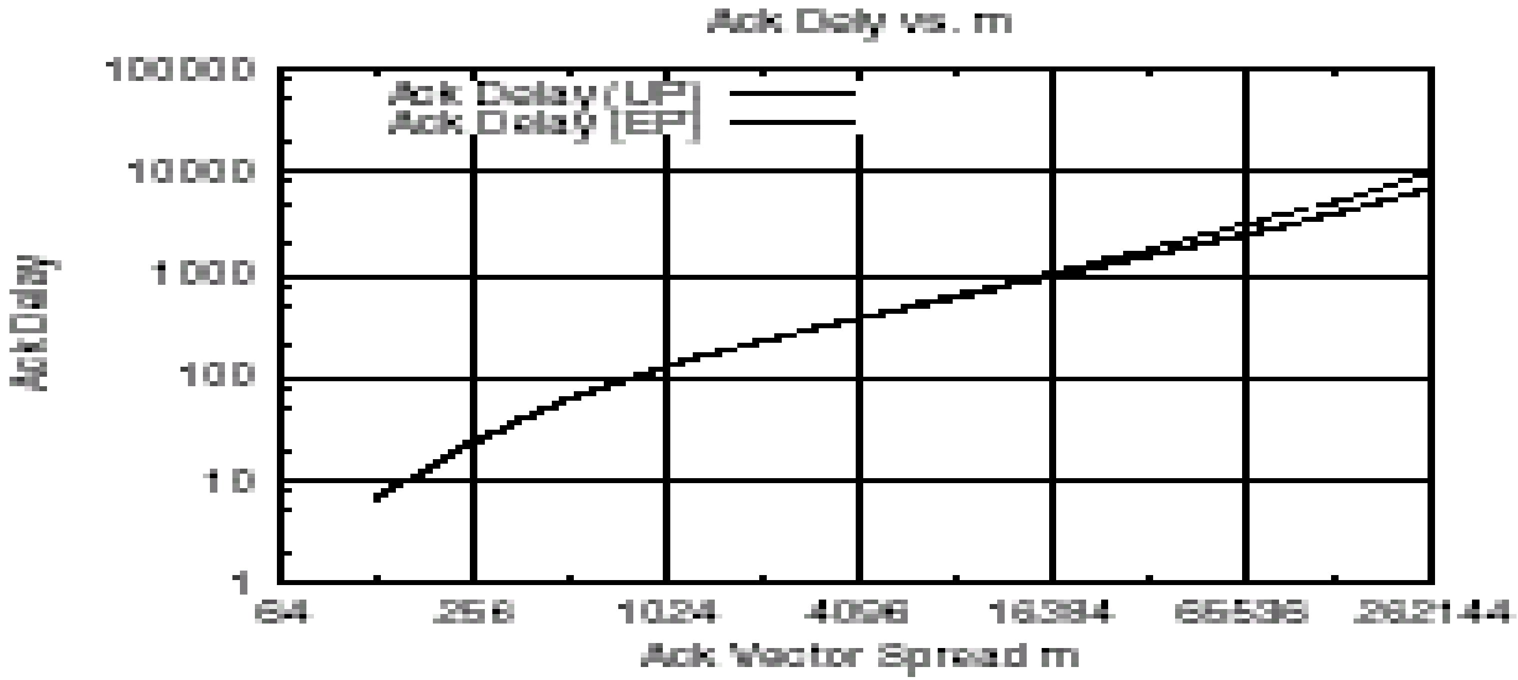
Evaluation of Different Variants of the Model



(a) 50% reverse loss, Markov-modulated

Fig10 Effects of ACK vector spread on ACK delay under model 2

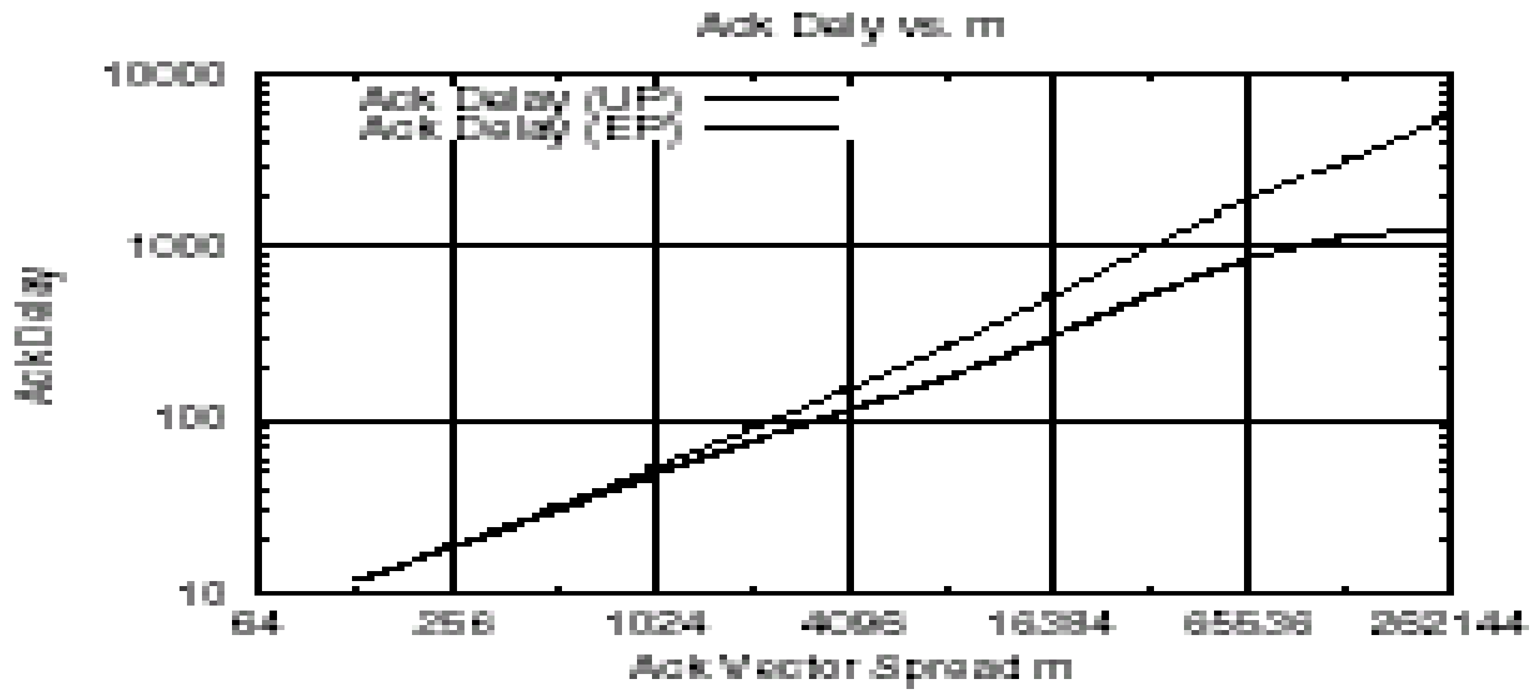
Evaluation of Different Variants of the Model



(b) 50% reverse loss, Pareto, avg. loss bursts of 1000 packets

Fig10 Effects of ACK vector spread on ACK delay under model 3

Evaluation of Different Variants of the Model



(c) 50% reverse loss, Pareto, avg. loss bursts of 50 packets

Fig10 Effects of ACK vector spread on ACK delay under model 3

Conclusions

- This study shows that an ACK vector with Exponential Placement (EP) has several advantages：it is simple, robust, scalable, and incurs low delay.
- An EP ACK vector is simple because it is fully specified using only two parameters.
- To achieve a high accuracy the ACK vector spread has to be much larger than the actual burst loss length. Consequently, choosing m is very difficult. Fortunately, the major benefit of EP is ACK delay is not sensitive to m.

Conclusions

- EP is also scalable in that it achieves a high accuracy while per packet overhead is relatively small (compared with SACK) ,and the number of per packet overhead changes only by a few bits even though the networks have orders of magnitude difference in throughput and delay.