4.6 Hot Potato Forwarding (HPF)

We analyze the hot potato broadcast routing scheme in which each packet maintains a hop count, and if this ever exceeds the discard threshold, DT, then the packet is discarded in order to prevent the subnet from flooding.

Since there is a discard threshold after which packets will be discarded, every packet transmitted from the broadcaster along the various links will be forwarded DT times. From the source, the packet will be transmitted D times, and then each node that receives a packet will forward it (D-1) times. Therefore, the total number of packets transmitted is:

$$NPT(N,D)_{HPF} = \sum_{j=1}^{DT} D*(D-1)^{j-1}.$$

This is the actual number of packet copies transmitted and not a bound. If the discard threshold was N-1, then the upper bound on NPT would be:

$$NPT(N,D)_{HPF}(upper) = D*\{(D-1)^{(N-1)} - 1\}/(D-2). \qquad (4.16)$$

This is illustrated in figure 4.13. Notice how quickly the number of packet copies transmitted per broadcast becomes very large for even a small sized network.

The smallest safe value of DT is equal to the diameter of the graph. The lower bound on the diameter of regular graphs is given by

$$NPT(N,D)_{HPF}(lower) = D*\{(D-1)^{DIA(N,D)} - 1\}/(D-2). \qquad (4.17)$$

This is illustrated in figure 4.14.

Since a packet is being forwarded along all links except the one on which it arrived, BDav and BDmax are identical to those for the multi-destination routing, or the source based forwarding case. Therefore

$$BDav(N,D)_{HPF} = SPLav(N,D) \qquad (4.18)$$

$$BDmax(N,D)_{HPF} = DIA(N,D) \qquad (4.19)$$

$$BC(N,D)_{HPF} = N*DIA(N,D). \qquad (4.20)$$

These dependencies are illustrated in figures 4.7, 4.5 and 4.12 respectively.

Note that in the determination of BDav, BDmax and BC, queueing delays arising from the interference of the extra packets were not taken into account. In all the other broadcast routing schemes discussed so far, BDmax was also a measure of the time during which packets of a particular broadcast message would remain in the network. This is so because extra packets were not generated by the network in an attempt to forward the packets to all the destinations. In the hot potato broadcast routing scheme BDmax is not a measure of how long packets for a particular broadcast will remain in the subnet. It is difficult to determine analytically what this time is. Intuitively, however, an estimate can be determined if queueing delays are neglected. A

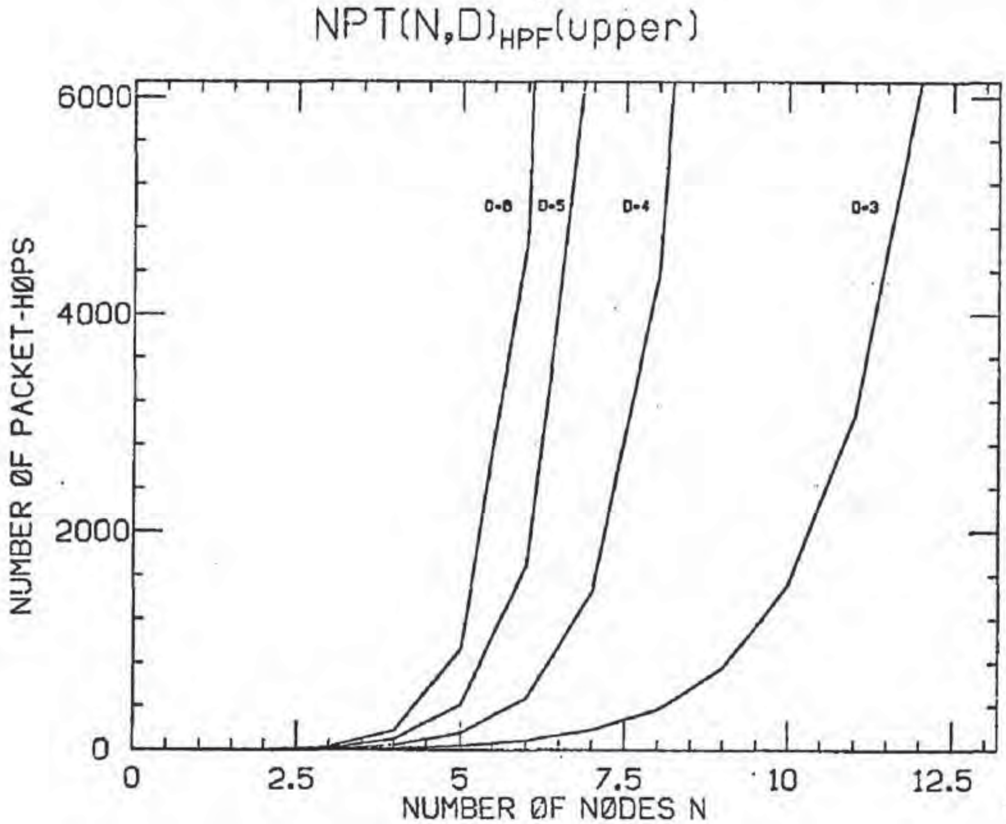

Figure 4.13. UPPER BOUND ON THE NUMBER OF PACKETS TRANSMITTED FOR HOT POTATO FORWARDING WITH DISCARD THRESHOLD.

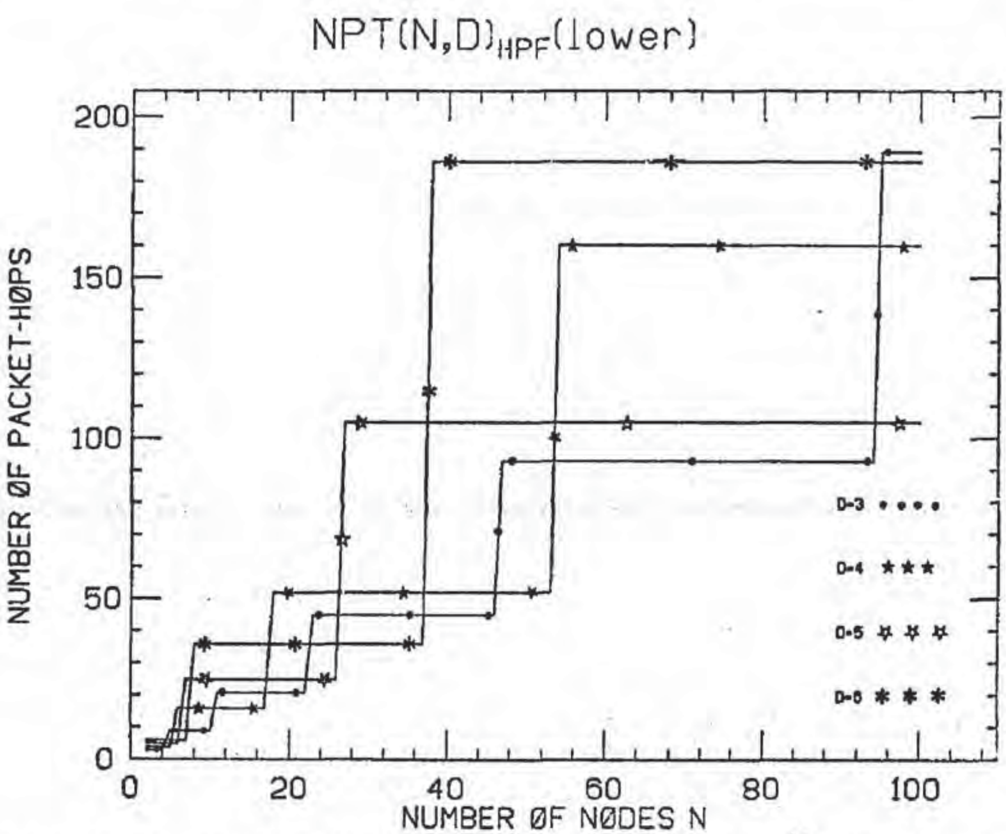

Figure 4.14. LOWER BOUND ON THE NUMBER OF PACKETS TRANSMITTED FOR

particular packet transmitted from the broadcasting node will keep giving rise to newer packets DT times. Hence a very low lower bound on the time for which broadcast packets will remain in the subnet is DT.

4.7 Reverse Path Forwarding (RPF)

We have shown in section 3.6.2, that if the simple reverse path forwarding scheme is used, then each node except the source forwards exactly one of the arriving broadcast packet along all links except the one on which it arrived. The source transmits the broadcast packet along all links incident to it.

$$\therefore NPT(N,D)_{RPF}(simple) = N*(D-1) + 1. \qquad (4.21)$$

This is illustrated in figure 4.15.

If the optimal version of the algorithm is used then broadcast packets are only forwarded along the branches of the reverse path tree and therefore

$$NPT(N,D)_{RPF}(optimal) = N-1. \qquad (4.22)$$

In determining the lower bound on delays, since all edge costs are same and equal to unity the reverse path tree from a source is isomorphic to the shortest path tree. Therefore

$$BDav(N,D)_{RPF} = SPLav(N,D) \qquad (4.23)$$

$$BDmax(N,D)_{RPF} = DIA(N,D) \qquad (4.24)$$

$$BC(N,D)_{RPF} = N*DIA(N,D). \qquad (4.25)$$

These dependencies are illustrated in figures 4.7, 4.5 and 4.12 respectively.

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