World Academy of Science, Engineering and Technology
International Journal of Electrical and Computer Engineering
Vol:3, No:3, 2009

Analysis of Equal cost Adaptive Routing Algorithms using Connection-Oriented and Connectionless Protocols

ER. Yashpaul Singh, and A. Swarup

***Abstract*—**This research paper evaluates and compares the performance of equal cost adaptive multi-path routing algorithms taking the transport protocols TCP (Transmission Control Protocol) and UDP (User Datagram Protocol) using network simulator ns2 and concludes which one is better.

***Keywords*—**Multi-path routing algorithm, Datagram, Virtual Circuit, Throughput, Network services.

I. Introduction

ROUTING of data employs routing algorithms. The performance of routing [1][6] depends on the routing algorithms adopted. The routing algorithms may be single path adaptive or multi-path adaptive. The multi-path adaptive routing algorithm used in this research paper is equal-cost multi-path, because it gives the better performance than single path routing algorithm. The Performance of routing algorithm is influenced by many aspects like bandwidth of link, buffer capacities used at the bottleneck links, type of routing algorithm used i.e. single path or multi-path etc. but in this paper the issue of transport protocols is also discussed in routing traffic Engg. Techniques used because the simulation results obtained helps in deciding the situation in the Internet where the equal cost multi-path adaptive routing techniques algorithm is best suitable. The performance of routing algorithm also depends on the transport protocol used i.e. TCP (Transmission Control Protocol) and UDP (User datagram Protocol). The performance of equal-cost multi-path adaptive routing algorithm is evaluated using TCP and UDP protocols with the help of simulations (Network Simulator-2). The paper is divided into sections as under. Section II gives the brief description of network services. Section III gives the overview of connection-oriented and connection-less protocols. Section IV gives the comparison of connection oriented and connectionless protocols. Section V gives the simulation comparison of TCP and UDP protocols. Section VI concludes the paper. Section VII gives the acknowledgement.

ER. Yashpaul Singh is Ph.D. Scholar, Life Member ISTE, IAENG with N.I.T. Kurukshetra, India.

A. Swarup, Sr. Member IEEE, Prof.&Chairman Electrical Engineering. Department is with N.I.T. Kurukshetra, India.

II. Network Services [3][4]

Network services are also termed as Traffic Engineering techniques. The Network services are classified into two types:-

A. Connectionless (Datagram)
B. Connection –Oriented (Virtual Circuit)

A. Connectionless Service [9]

In this approach the node transmits each piece of data called packet along with the address of the destination independently. Every packet is independently routed, so the network cannot guarantee that all the packets will reach the destination in the transmitting order since the packet delivered through more than one path. Even if one packet is just a piece of a multi-packet transmission, the network treats it as, it existed alone. Packets in this approach are referred to as datagrams. The Internet has chosen this type of service at the network layer. The deliveries of packets are ensured in order if the delay of each outgoing path delivery of a router is same.

The reason for this decision is that the Internet is made up of so many heterogeneous networks that it is almost impossible to create a connection from the source to the destination without knowing the nature of the networks in advance.

B. Connection-Oriented Service

In a connection-oriented service, the source node first makes a connection with the destination node before sending a packet. When the connection is established, a sequence of packets from the same source to the same destination can be sent one after another.

In this case, Packets are sent on the same path in sequential order. When all packets of a message have been delivered, the connection is terminated. In connection-oriented protocol, the decision about the route of a sequence of packets with the same source and destination addresses can be made only once, when the connection is established. Switches do not recalculate the route for each individual packet. This type of service is used in a virtual circuit approach such as Frame Relay and ATM. This type of service is also known as reliable network service.

III. Connection-Oriented and Connection-Less Protocols [5][7]

A. Connection-oriented Protocols

The protocol can be either connection-oriented or connectionless in nature. In connection oriented protocols, corresponding entities maintain state information about the dialogue they are engaged in. This connection state information supports error, sequence and flow control between the corresponding entities.

Connection- Oriented protocols operate in three phases. The first phase is the connection setup phase. The Second phase is the data transfer phase. The third phase is the connection release phase. An everyday example of a connection-oriented protocol is a telephone call. TCP/IP has two main protocols that operate at the transport layer of the OSI reference model. One is the transport Control Protocol (TCP) which is connection-oriented, the other (IP) is the Connectionless protocol.

B. Connectionless Protocols

Connectionless protocols differ markedly from connection-oriented protocols in that they do not provide the capability for error, sequence and flow control. Nor do they have any connection state maintenance requirement. Each message is considered to be independent of all others in a connectionless protocol. Connectionless protocols are always in the data transfer phase, with no explicit setup or release phases as in connection-oriented protocols. Connectionless means that no effort is made to setup a dedicated end to end connection. IP, UDP, ICMP, DNS, TFTP and SNMP are examples of connectionless protocols in use on the Internet. UDP (User datagram protocol) is a communications protocol that offers a limited amount of service when messages are exchanged between computers in a network that uses the Internet protocol (IP). UDP is an alternative to the TCP and together with IP is sometimes referred to as UDP/IP. UDP provides two services not provided by IP layer. It provides port numbers to help distinguish different user requests and optionally a checksum capability to verify that the data arrived intact.

IV. Comparison of Connection-Oriented and Connection-Less Protocols [2]

The usability of the protocol depends on the application is use. Each protocol whether connection-oriented or connectionless as their own benefits for which that are used. The Connection -oriented protocol has the following characteristics.

1. The Network guarantees that the packets will be delivered in order without loss or duplication of data.
2. Only a single path is established for the calls and all the data follows that path.
3. Network guarantees a minimal amount of bandwidth and this bandwidth is reserved for the duration of the call.
4. If the network becomes over utilized, future call requests are rejected.

TCP is used for application that require the establishment of connections such as FTP, it works using a set of rules by which a logical connection is negotiated prior to sending data. UDP is used by applications that do not need connections or other features but need the faster performance that UDP can offer by not needing to make such connections for sending data. There are different protocols used at different layers.

In connectionless approach the failure of communication link can be easily compensated whereas in connection-oriented approach it is fatal. In virtual circuits enough resources are allocated in advance so provides quality of service and avoids congestion control whereas these two things are difficult to achieve in data-grams.

For short messages (Packets) the packet switching data-grams approach is better whereas for long messages virtual circuit approach is better.

V. Simulation Comparison of TCP and UDP Protocols

The simulation work is performed by using the network simulator NS-2 which is discrete event simulator and helps in assessing the performance of routing.

TABLE I
Routing for TCP Protocols

No. of Nodes	Throughput
4	775
6	773
8	770

Table I show the throughput w.r.t. no. of nodes in the network, when TCP transport protocol is used for routing the data using topology of Fig. 1(a),(b),(c).

Topologies used are given here:-

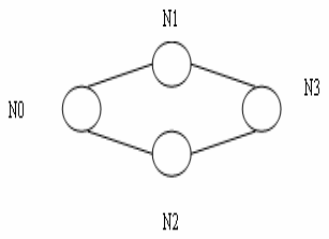

Fig. 1 (a): 4 nodes

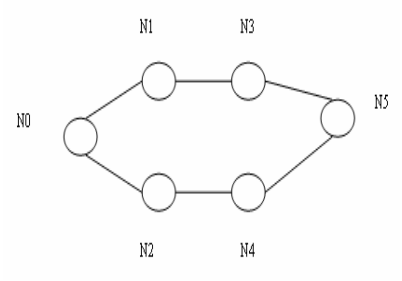

Fig. 1(b): 6 nodes

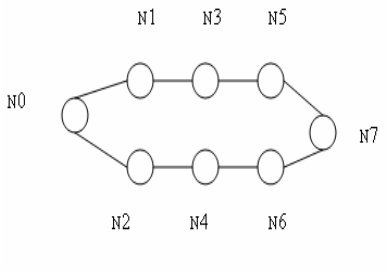

Fig. 1 (c): 8 nodes

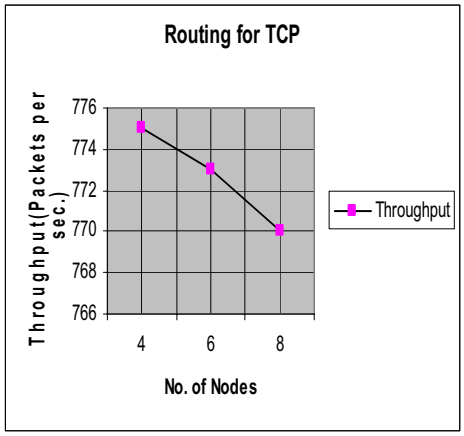

Fig. 2 The throughput decreases as the no. of nodes in the network increases

TABLE II
ROUTING FOR UDP

No. of Nodes	Throughput
4	1034
6	1035
8	1035

Table II shows the throughput w.r.t. no. of nodes when UDP transport protocol is used for routing the data using topology of Fig. 1 (a),(b),(c).

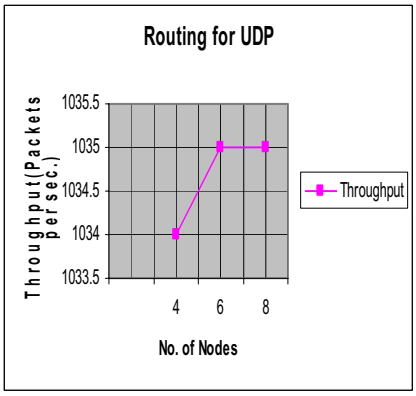

Fig. 3 The throughput increases as the no. of nodes in the network increases

Routing for UDP and TCP

The Source node in the topology used in fig.1 is n0 and the destination node in 4 node topology is n3, in 6 node topology is n5 and in 8 node topology is n7.

TABLE III
ROUTING FOR UDP AND TCP

No. of Nodes	Time taken by a packet from S to D by using UDP(ms)	Time taken by a packet from S to D by using TCP(ms)
4	0.0025	0.00266
6	0.005	0.00532
8	0.0075	0.00798

Table III shows the time taken by a packet to reach from source node to destination node w.r.t. no. of nodes for a particular transport protocol i..e. UDP and TCP.

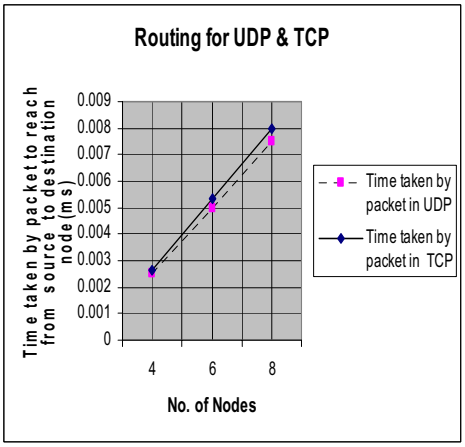

Fig. 4 Time Taken by a packet from source to destination node for UDP & TCP Protocols w.r.t. no. of nodes

VI. Conclusion

The answer of the question that one type of routing protocol i.e. connection-oriented or connectionless is better than the other is very difficult, because it depends on the requirements of applications. File transfer and remote terminal protocols (RTPs) will not tolerate loss of data and require the packets to remain in order, so this kind of application requires connection-oriented service. Electronic mail does not require that packets remain ordered. In video conferencing the main requirement is fast data transmission i.e. delayed packets are not recommended so as per Table III & Fig. 4 connectionless routing protocol is recommended solution for video conferencing. Fig. 2 concludes that throughput decreases as the no. of nodes increases in the network, whereas Fig. 3 concludes that throughput increases as the no. of nodes increases in the network. Throughput in case of UDP protocols is more as compared to TCP protocols in routing the data being faster as shown in Fig. 4.

Acknowledgment

The Simulation work has been done by Er. YashPaul Singh under the guidance of Dr.A.Swarup.

References

[1] Alberto Leon-Garcia, Indra Widjaja, "Communication Networks, Fundamental Concepts and Key Architectures", TATA MCGRAW-HILL Edition second.
[2] "Comparison of TCP and UDP", available at http://www.atlasindia.com/ multicast.htm.
[3] "Network Service Types", available at http://www. raduniversity .com /networks /1996/ x25/ netserty.html.
[4] Behrouz A. Foruzan, "Data Communication and Networking" TATA MCGRAW-HILL Third Edition.
[5] "TCP/IP Guide", available at http: /www. tcpipguide. com/free/ t_connection oriented and connectionless.
[6] William Stalings, "Data and computer Communication", 7th Edition.
[7] "Virtual Circuit versus Datagram simulation" available at http:/www2.rad.com/networks/1998/packet/sim.htm.
[8] The Network Simulator NS-2, http://www.isi.edu/ ns nam/ns/ns-documentation
[9] Prof. Raj Jain, "Packet Switching", Ohio state university Columbus.
[10] "Packet Switching", available at http: www.erg.abdn.ac.hk /users/gorry/course/intro-pages/psht

Er. Yashpaul Singh is working as Principal Technical Education Department, Haryana, India. He did his B.E. on Computer Engg. in 1990, M.E. Computer Technology and Applications in 2000 from Delhi College of Engg. Delhi and now pursuing Ph.D. on Computer Networking Specialization in Routing algorithms and Protocols from NIT Kurukshetra, Haryana, India. He got National Award of ISTE (Indian Society of Technical Education), New Delhi in December 2007. His research interests are routing algorithms and protocols, traffic engg., network security.

A. Swarup, Sr. Member IEEE, ISTE received his Ph.D. in 1993 from IIT (Indian Institute of Technology) Delhi. Dr. Swarup is presently working as Professor & Chairman in Electrical Engg. Deptt., NIT (National Institute of Technology) Kurukshetra, Haryana, India. His research interests are Robotics and Artificial Intelligence, System Identification, Computer Networking.