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A Brief Survey of Routing Methods in Computer Network

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***Abstract*: When the given sets of machines are interconnected by wired or wireless means, it forms a network. Computer networks are generally formed in order to assist in data sharing, resource sharing, complex computations etc [1]. When it comes to communication through a network, routing is a concept of finding the efficient path from source machine to destination machine through which data is sent. Between the gives set of nodes, there might exist multiple paths of different costs. Selecting the efficient path is one of the crucial aspects of computer networking [2]. Various routing algorithms exist in literature which differs from each other from various perspectives. This paper provides a brief survey and comparison of various types of routing algorithms.**

***Keywords*: adaptive, broadcasting, hierarchy, non-adaptive, routing.**

1. Introduction

Routing algorithms can be broadly classified into two categories, Static and Dynamic. Static routing algorithms also known as Non-adaptive algorithms, works on the basis of static/fixed routing tables which doesn't adapt themselves in accordance with the changes in network topology or a load factor in the network. Dynamic routing algorithms which are also called as Adaptive routing algorithms takes into consideration the load factor in the network and the topological changes, and adjusts its routing decisions accordingly. Adaptive algorithms are employed in the scenarios where the network traffic is unpredictable and the network is subjected to frequent changes in its topology. Correctness, simplicity, robustness, stability and efficiency are some of the desirable properties of routing algorithms. Correctness means the path computed by the algorithms should be correct. Simplicity says that, algorithm should be easy to understand and implement. Algorithm should be robust in the sense that it should be able to cope up with hardware failure or high traffic. Stability means algorithm should converge quickly to equilibrium/stable state and stay over there. And finally, efficiency deals with the cost factor of estimated path [2].

2. Routing Algorithms

A. Flooding

Flooding [2] is one of the simplest routing algorithms which do not involve any computational steps in order to find the path from source to destination. A node/router after getting a packet, forwards the packet to all its outgoing links except the one onto which the packet arrived. In Selective flooding, packet is sent only on those output lines which are approximately going in the right direction.

Advantages:

- Robust. Even if some routers are blown-off, flooding will find the alternative path if it exist. Hence, used in military applications.
- Simple and easy to implement.

Disadvantages:

- Flooding generates large number of duplicate packets in the network which leads to network congestion. Hop-counter method is used to reduce the duplication of packets in the network.
- Consumes lot of bandwidth hence not suitable for sending large number of packets.

B. Dijkstras Shortest Path routing

This iterative algorithm [2] computes the least cost (shortest) path from one source node to all other nodes in the given network. This algorithm is said to be global/centralized because the source node needs to have the global knowledge of all other nodes in the network in order to compute the shortest path.

Advantages:

- Computes the shortest path from one source to all other destinations. Used in Google maps.

Disadvantages:

- It does a blind search there by consuming a lot of time, leading to waste of necessary resources.
- Due to its inability to handle negative edges, acyclic graphs are obtained from which right shortest paths cannot be computed.

C. Distance Vector Routing

Also known as Bellman Ford or Routing Information Protocol [2], which was originally used in ARPANET. It is dynamic algorithm and is more efficient because it computes the shortest path by taking current topology into consideration. Each router maintains a routing table containing one entry for each router in the network. Each entry has two parts; preferred outgoing line to use for that destination and an estimate of the distance to that destination. Distance metric can be either number of hops or delay. Each router takes some information (in the form of vector) from each of its neighbor and constructs its neighbor and constructs its own routing table by making use of these received vectors. It is decentralized algorithm in which a node needs to have knowledge only of its neighbors and not of entire network.

Advantages:

- Bandwidth requirement negligible for typical LAN environment.

Disadvantages:

- It suffers from count-to-infinity problem which deals with routing loops.

D. *Link State Routing*

Distance Vector routing which was initially used in ARPANETs suffered from count-to-infinity problems. Hence it was later replaced by Link State routing algorithm [2]. Link state routing is also a dynamic (adaptive) algorithm which takes into consideration load factor in the network and accordingly computes the paths.

Link state routing can be summarized as follows:

Each router must do the following:

a) Find the list of its neighbors and get their addresses.
b) Compute the delay or cost to each of its neighbors.
c) Construct a packet telling all it has just learned.
d) Forward this packet to all other routers.
e) Using this received packets, compute the shortest path to every other router using Dijkstras algorithm.

Advantages:

- Lower convergence time. Link state-based routing protocols have a much lower convergence time and the internetwork is converged without routing loops.

Disadvantages:

- Complex. Link state-based routing protocols are much more complex and difficult to understand and troubleshoot than distance vector-based routing protocols.
- More difficult to configure. A link state-based routing protocol implementation requires additional planning and configuration.

E. *Hierarchical Routing*

When size of the network increase dramatically, it becomes difficult to manage the network. Also, as the number of systems increases, size of the routing table also increases. This results in more space requirements and also, more time in scanning the routing table. Hence, the possible solution is to divide the entire network into multiple regions. Each router in a region has the complete knowledge of routing in its own region but has no idea of routing in other regions. For a given node, other regions are just as single nodes. In cases where 2level hierarchies is not sufficient, then following multilevel hierarchy can be followed.

Network→Regions→Clusters→Zones→Groups.

Advantages:

- Maintenance of network becomes easy.
- Lower router table space requirements.

Disadvantages:

- By using hierarchical routing, route computation can be simplified but in some cases it may lead to longer paths.

F. *Broadcast Routing*

When one node in a network wants to send a packet to all other nodes in the same network, then it is called as Limited broadcasting. If a node in a network wants to send a packet to all the nodes in some other network, then it is called as Directed broadcasting. Various methods which can be used for broadcasting [2] are, n-way unicasting, multi-destination routing, sink tree method, reverse path forwarding and flooding.

In n-way unicasting, if a node wants to send a packet to n nodes, then it constructs n different packets with same data but different addresses, one for each of the n node. It then sends the packet to each of the node using simple unicast method.

In multi-destination routing, a single packet consists of list of addresses of all the nodes. As a node gets a packet, it accepts it, removes its address from the packet and forwards it to other nodes. Hence, after sufficient number of hops, a packet behaves as a normal packet having only one address.

In sink tree method, a sink tree/spanning is constructed for the given network, and packets are forwarded only through the edges present in a sink tree thus preventing a packet from looping in the network.

In reverse path forwarding, a node forwards the packet to its outgoing link if and only is, it received the packet from the source through the link, which falls on the shortest path from that node to the source. Else, it doesn’t forwards the packet.

3. Conclusion

Routing algorithms can be broadly classified as adaptive and non-adaptive. Various routing algorithms are studied and discussed in this paper along-with their advantages and disadvantages.

References

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