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Fast Data Collection in Multipath Routing With Independent Directed Acyclic Graphs

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Abstract— in this paper, we introduce the concept of Independent Directed Acyclic Graphs (IDAGs) to achieve resilient multipath routing. The algorithm developed in this paper: (1) achieves multipath routing; (2) guarantees recovery from single link failure. The multipath routing scheme consists of an algorithm to determine a set of multiple disjoint or partially disjoint paths and a mechanism for distributing traffic over a multipath route to reduce the traffic load on a congested link. Multipath routing is capable of aggregating the resources of multiple paths and reducing the blocking capabilities in QoS oriented networks, allowing data transfer at higher rate when compared to single path. To improve the failure resiliency without jeopardizing the routing stability, we propose a local rerouting based approach called failure insensitive routing. Under this approach, upon a link failure, adjacent router suppresses global updating and instead initiates local rerouting. We demonstrate that the proposed approach provides higher service availability than the existing routing schemes.

I. INTRODUCTION

The unprecedented growth of the Internet has lead to a growing challenge among the ISPs to provide a good quality of service, achieve operational efficiencies and differentiate their service offerings. Multipath routing is a technique that exploits the underlying physical network resources by utilizing multiple source- destination paths. Traffic engineering has been used to imply a range of objectives, including load- balancing, constraint-based routing, multi-path routing, fast re-routing, protection switching etc. In data network the idea of using multiple paths for end-to-end transport first appeared in. The use of multipath routing is to minimize the overall delay in the network. The Internet today provides only a single path between any pair of hosts that fundamentally limits the throughput achievable between them. Multipath routing can be effectively used for maximum utilization of network resources. It gives the node a choice of next hops for the same destination. Multipath routing is capable of aggregating the resources of multiple paths and reducing the blocking capabilities in QoS oriented networks, allowing data transfer at higher rate when compared to single path. It also increases the reliability of delivery. Techniques developed for multipath routing are often based on employing multiple spanning trees or directed acyclic graphs. One approach that offers resiliency from single link failure and provides multipath routing to some degree is the "colored trees". The colored tree approach allows every node to split its traffic between the two trees, thus offering disjoint multipath routing. In this approach, two trees are constructed per destination node such that the paths from any node to the destination on the two trees are disjoint. Multipath routing is a promising routing scheme to accommodate these requirements by using multiple pairs of routes between a source and a destination. When multiple routing tables are employed, a packet has to carry in its header the routing table to be used for forwarding. Figure 1 shows an example network where red and blue trees, rooted at node A, are constructed. This tree construction enables recovery from a single link failure by switching from one tree to another. For example, consider a packet that is forwarded from node F to node A on the blue tree. When there are no failures, the packet would take the path F–C–B– A. If link C–B fails, then node C would re-route the packet on the red tree, thus the packet will follow the path: F–C– F–I–H–G–D–A.

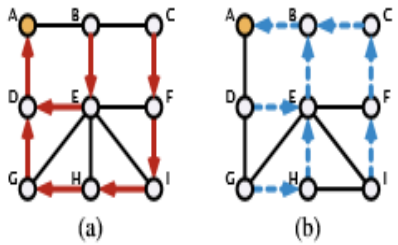


Fig. 1. Illustration of node-independent Trees for the example network. (a) Red Tree. (b) Blue Tree. Node A is the root (destination) node.

II. RELATEDWOK

The nature of link failures in a network and their impact on the traffic has received a great deal of attention recently. The multipath routing protocols described above, which are based on source routing,

allow the source node to compute multiple node or edge-disjoint paths.

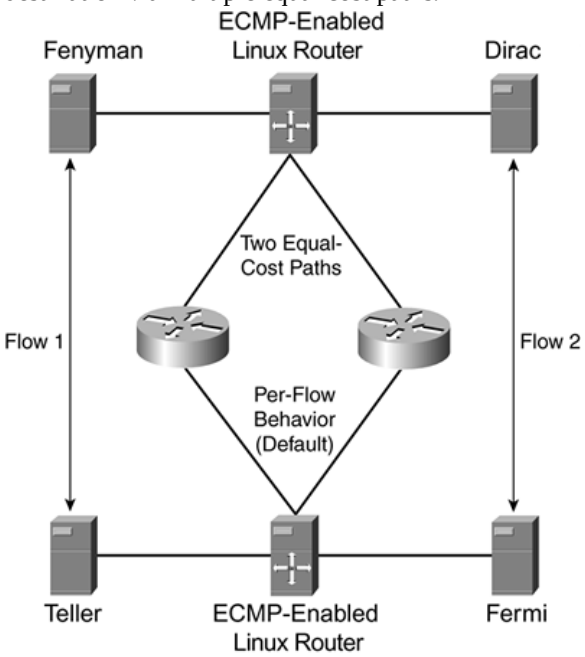
Basic concepts:

A network can be represented by a directed graph G = (V, E) with node set V and link or edge set E. The number of nodes and links in the network are denoted by |V | and |E|, respectively. A path p is a sequence of nodes such that from each node in the path, there is a link to the next node in the sequence. As an example, the path *p = {s, i1, i2, ⋯, in, d}.*

The Equal-Cost Multipath (ECMP) protocol

ECMP is a routing strategy where next-hop packet forwarding to a single destination can occur over multiple "best paths" which tie for top place in routing metric calculations. Multipath routing can be used in conjunction with most routing protocols, since it is a per-hop decision that is limited to a single router. With ECMP, a router potentially has several available next hops towards a given destination.

A new gateway is chosen for each new source/destination IP pair. The ECMP routes can be created by routing protocols (RIP or OSPF), or by adding a static route with multiple gateways, separated by a comma (e.g., /ip route add gateway=192.168.0.1, 192.168.1.1). The below is architecture of ECMP. Thus with ECMP, OSPF can route packets in a round robin fashion to the destination via multiple equal cost paths.



In ECMP, a node implements multipath routing when it discovers two or more shortest paths (of equal length) to a destination node. This is a multi- path routing extension for Internet routing protocols such as OSPF and RIP. There are several drawbacks of this approach:

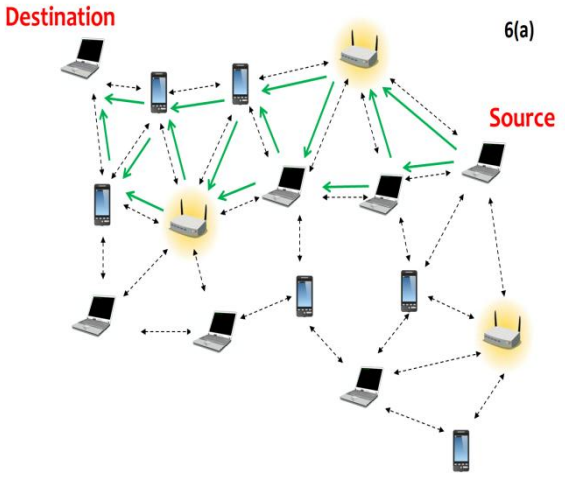
(1) ECMP is not guaranteed to determine a multipath route for each source-destination pair.

(2) The characteristics of the multipath route are not taken into account.

(3) Packets are forwarded in equal proportion, on a packet-by-packet basis.

Over view of Multipath Routing:

Multipath routing has been explored in several different contexts. Traditional circuit switched telephone networks used a type of multipath routing called alternate path routing. Multiple paths can also provide load balancing and route failure protection by distributing traffic among a set of disjoint paths. The below is example diagram of multipath routing.



Multipath routing has also been addressed in data networks which are intended to support connection-oriented service with QoS. Alternate or multipath routing has typically lent itself to be of more obvious use to connection-oriented networks; call blocking probability is only relevant to connection oriented networks.

Benefits of Multipath Routing:

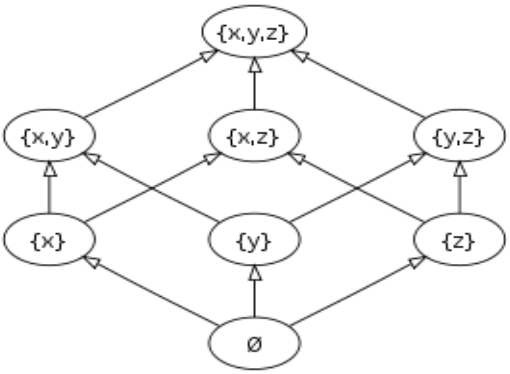
- As mentioned before, multiple paths can provide load balancing, fault-tolerance, and higher aggregate bandwidth.
- Load balancing can be achieved by spreading the traffic along multiple routes. From a fault tolerance perspective, multipath routing can provide route resilience.

III. INDEPENDENT DIRECTED ACYCLIC GRAPHS

In order to achieve resilient multipath routing, we introduce the concept of independent directed acyclic graphs (IDAGs) in this paper. Link-independent (node-independent) DAGs satisfy the property that any path from a source to the root on one DAG is link-disjoint (node-disjoint) with any path from the source to the root on the other DAG. Given a network, we develop polynomial-time algorithms to compute link-independent and node-independent DAGs. The algorithm developed in this paper:

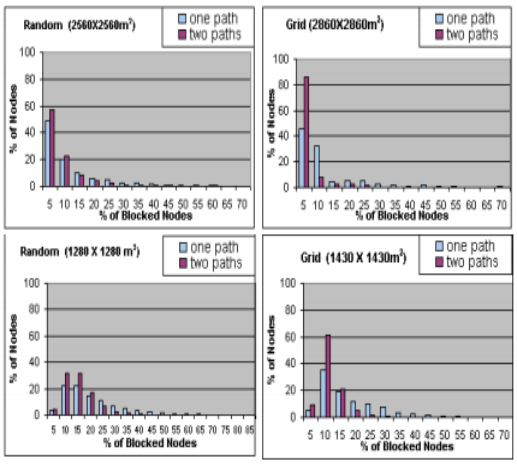
1) Provides multipath routing.

2) Utilizes all possible edges
3) Guarantees recovery from single link failure
We show the effectiveness of the proposed IDAGs approach by comparing key performance indices to that of the independent trees and multiple pairs of independent trees techniques through extensive simulations.



IV. PERFORMANCE EVALUATION OF INDEPENDENT DIRECT ACYCLIC GRAPHS

A graph-based modeling technique has been developed for the stochastic analysis of systems containing concurrency. The basis of the technique is the use of directed acyclic graphs. These graphs represent event-precedence networks where activities may occur serially, probabilistically, or concurrently. When a set of activities occurs concurrently, the condition for the set of activities to complete is that a specified number of the activities must complete. We consider four performance metrics:
(1) Average path length
(2) Number of paths
(4) Average link load. Multipath routing mechanism creates more overheads but provides better performance in congestion and capacity provided that the route length is within a certain upper bound which is derivable.



V. CONCLUSION

In this paper, we introduced the concept of independent directed acyclic graphs (IDAGs) and developed a methodology for resilient multipath routing using two IDAGs. Through simulations, we showed that the IDAGs approach performs significantly better than the independent trees approach in terms of increasing number of paths offered. We proposed a *failure insensitive routing* approach where routers infer link failures from the packet's flight and pre compute interface specific forwarding tables avoiding the potentially failed links. We also provide descriptions of a number of multipath routing schemes proposed for wireless ad hoc networks, aiming at showing various strategies of utilizing multiple routings in wireless networks. However, the method is impractical since it needs many overhead bits in the packet header.

REFERENCES

[1] S. Cho, T. Elhourani,and S. Ramasubramanian, "Resilient multipath routing with independent directed acyclic graphs," in Proc. IEEE Int. Conf. Commun., Cape Town, South Africa, May 2010, pp. 1–5.
[2] Z. Ye, S. V. Krishnamurthy, and S. K. Tripathi, "A framework for reliable routing in mobile ad hoc networks," in Proc. IEEE INFOCOM, Apr. 2003, pp. 270–280.
[3] P. P. Pham and S. Perreau, "Performance analysis of reactive shortest path and multi-path routing mechanism with load balance," in Proc. IEEE INFOCOM, 2003, pp. 251–259.
[4] J. Tsai and T. Moors, "A review of multipath routing protocols: From wireless ad hoc to mesh networks," in Proc. ACoRN Early Career Res. Workshop Wireless Multihop Netw., Jul. 17–18, 2006, pp. 17–22.
[5] S. Murthy and J. Garcia-Luna-Aceves, "Congestion-oriented shortest multipath routing," in Proc. IEEE INFOCOM, Mar. 1996, vol. 3, pp.1028–1036.
[6] W. Lou, W. Liu, and Y. Fang, "A simulation study of security performance using multipath routing in ad hoc networks," in Proc. IEEE Veh. Technol. Conf., Oct. 2003, vol. 3, pp.