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N-HUB Routing with Bandwidth and Energy based QOS and Link Optimization in Wireless Networks

Priyanka[1], Shameem Akthar[2]

[1]M.Tech CSE, Khaja Banda Nawaz College of Engineering, Gulbarga. Affiliated to VTU Belgaum, Karnataka, India

[2]Professor, Department of Computer Science and Engineering, Khaja Banda Nawaz College of Engineering, Gulbarga
Affiliated to VTU Belgaum, Karnataka, India

Abstract: ***In this paper, we simulate effectiveness of "N-hub Shortest-Path Routing" in wireless static topology networks. N-hub Shortest-Path Routing allows the ingress node of a routing domain to determine up to N intermediate nodes ("hubs") through which a packet will pass before reaching its final destination. This facilitates better utilization of the network resources, while allowing the network routers to continue to employ the simple and well-known shortest-path routing paradigm. The concept is being used in several different ways. We explore the concept of N-hub routing in the context of Wireless Network. By using the technique the system can detect overall number of Incoming and outgoing connections and based on the parameters like delay and energy can determine the optimum number of nodes ideal for current transmission. Further the system is simulated with node failure and congestion errors. It is demonstrated that the proposed system performs better than present shortest path routing.***

Keywords: Load balancing, routing

1. Introduction

The shortest-path routing paradigm is known to be simple and efficient. It does not place a heavy processing burden on the routers and usually requires at most one entry per destination network in every router. However, while this scheme finds the shortest path for each pair of nodes and thus minimizes the bandwidth consumed by every packet, it does not guarantee full utilization of the network resources under high traffic loads. When the network load is not uniformly distributed, some of the routers introduce an excessive delay while others are under-utilized. In some cases, this non optimized use of network resources may introduce not only excessive delays but also incur a high packet loss rate.

N- Hub routing is an Improved routing scheme of Shortest path Routing where any Ingress router decided if it can participate in the routing based on Number of Hubs or Domains the Request packet have traversed. Therefore here we introduce the fundamentals of Shortest path and it's Adaptation in wireless network i.e., AODV.

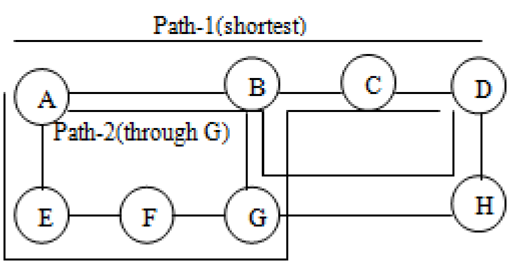

Figure 1: Example of N-hub routing

It is important to note the practical benefits of N-hub Shortest-Path Routing over virtual-circuit routing. First, N-hub routing can be implemented in networks that usually do not employ virtual-circuit routing technologies. In particular, it can be implemented in sensor networks and *ad hoc* (mobile) networks. Second, when virtual-circuit routing is used, only one or two routes are usually established between every two routers. Therefore, it is not possible to react to changes in the traffic pattern before the time-consuming and labor-intensive building of new routes. In contrast, an N-hub route can be changed immediately according to changes in the link loads, without having to set up additional routes in advance. Third, N-hub routing imposes additional processing and memory burden on the hubs and the source edge routers only, while the other nodes employ regular shortest-path routing. In virtual-circuit routing this burden is imposed on all the nodes along the path. This is especially significant when each node has to maintain several thousands of explicit routes.

The ingress router of a routing domain should be responsible for determining the intermediate router(s) through which the packets of each flow will be routed. To this end, the router may use information it acquires regarding the load distribution in the network by means of a link-state flooding protocol like OSPF-TE[6]. If N-hub routing is not supported, the router has no option but to forward the packet along the default (shortest) path or to drop it. With N-hub routing support, however, the edge router uses information about the load distribution in the entire domain, as can be obtained using OSPF-TE, in order to determine the hub(s) that define the least congested route. This list of hub(s) is added to the packet, and is also kept in the router's local flow table. When subsequent packets of the same flow are received by this router, it identifies them as belonging to the same flow, e.g., using the flow label of IPv6[11], and fetches from its table the list of hub(s) associated with this flow. Once every time-out period, the router checks if there is a better N-hub route that can be used by the considered flow.

2. Literature Survey

N-hub routing can be implemented using several existing mechanisms. A straightforward way is to take advantage of the IPv4 Loose Source-Routing option in IP network. But as

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Wireless network are well suited to AODV, we extend the same with AODV protocol. When this option is used, the AODV header is extended by a list of the addresses of the intermediate node(s) the packet must traverse. However, this option, much like any other AODV option, is rarely used, mainly because of the heavy processing burden imposed on the general purpose CPU of the router when an AODV header contains any optional field.

Though AODV is tough to modify to N-Hub routing, there are certain “built-in” support for N-hub routing. The primary header of an AODV packet can be followed by flexible extension headers with Information about Hubs, Bandwidth and Power. These headers can, for example, indicate the addresses of the network routers the packet should traverse en route to its destination.

Another way to implement N-hub routing in AODV is to use Self decision in nodes which is adopted here. In this case, an AODV header indicating the final destination is encapsulated in the payload of another header. The latter header contains, in its destination address field, the address of an intermediate router. The total number of headers is therefore equal to the number of hubs plus 1.

N-hub routing can also be implemented through an overlay network [13],where nodes takes the advantage of other intermediate nodes to route the packets. In an overlay network, the source sends a packet to the first hub, while adding to its payload information that identifies the next hubs and the final destination. Each hub uses this information to route the packet to the next hub.

In a network, intermediate node can select shortest path or over an explicit path to an egress node. An explicit path contains a list of intermediate nodes. The route between two consecutive nodes in the list is either strict or loose. A loose route may contain other nodes. Therefore, N-hub shortest path routing can be viewed as a special case of the AODV route option.

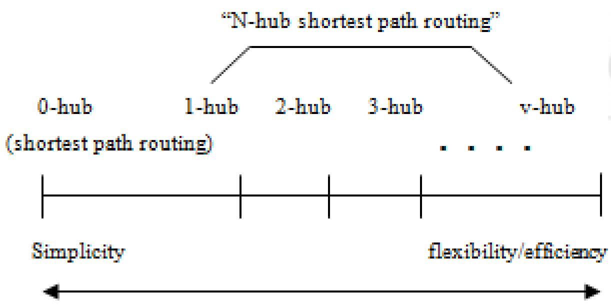

Figure 2: N-hub routing as a compromise between efficiency and simplicity

3. Methods/Approach

The main objective of the proposed technique is minimizing the maximum load imposed on a single link was addressed in the past mainly in the context of the multicommodity flow problem[21], and the Virtual Circuit Routing problem. Maximizing the load on a single link does not always guarantee perfect load balancing and minimum average delay. However, it was shown in the past to yield good performance because the delay on a link grows exponentially with the load. Moreover, this objective is easier to analyze from a theoretical point of view. As a counterexample, consider the topology in Fig. 3 and suppose there are three flows as follows.

1) A flow from node A to node E, with a bandwidth demand of 1.
2) A flow from node A to node B, with a bandwidth demand of 2.
3) A flow from node B to node E, with a bandwidth demand of 1.

An algorithm that minimizes the maximum load may produce a solution that routes flows 1 and 3 via node C.This solution yields a greater delay of the packets of flow 1 and flow 3 than a solution obtained by an algorithm that tries to minimize the average delay. The latter solution might route flow 1 through router C and flow 3 through router D.

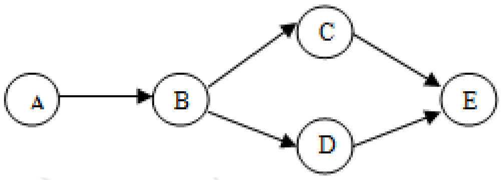

Figure 3: Example of a network topology

One may consider the average load over all of the edges in the graph as a better objective for minimizing the average delay of the packets. However, this objective is achieved with static shortest-path routing which, as mentioned above, is known to be inefficient for non uniform traffic patterns in which some areas in the AS are more congested than others. Another possible objective is minimizing the variance of the loads on the network links. However, this objective does not take into account the actual load on the links. It may therefore yield very long and possibly non simple routes in order to ensure that all of the links will be equally utilized.

4. Results

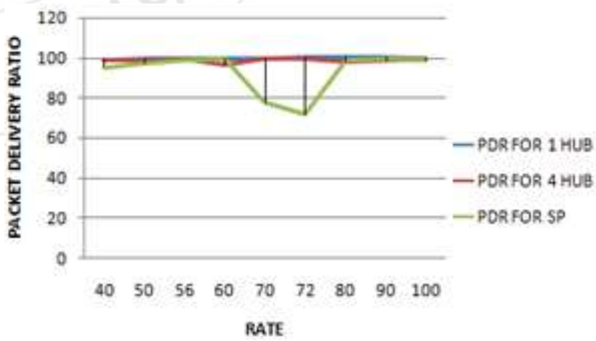

Figure 4: Rate v/s PDR

The graph Clearly shows that N-hub routing produces better result than both shortest path and 1 Hub Routing.

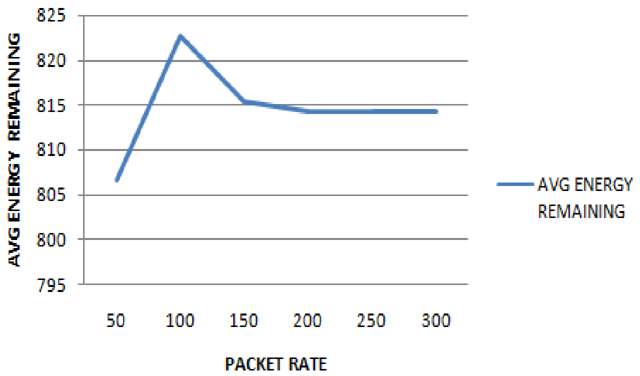

Figure 5: Packet rate v/s Avg Energy remaining

Consumption of energy does not depend on packet rate.

5. Conclusion

N hub routing is one of the preferred upcoming routing techniques for IP network. In this work, we have analyzed the routing for Wireless network and have proved that the system is viable even for wireless networks.

In N hub routing, nodes receiving Route request determines if it wants to be part of the path based on number of criteria which includes Hubs and bandwidth. The system provides multiple backup paths for the source which can choose the appropriate paths.

6. Future Scope

Simulation study reveals that the performance of the system is better than shortest path or AODV. One of the finding however is that under severe mobility, performance of the proposed system is not very good which is understandable as the system is originally developed for IP network. More optimization schemes can be adopted in future work to improve the performance of the system under mobility.

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Author Profile

Ms. Priyanka, M. Tech CSE from Khaja Banda Nawaz College of Engineering, Gulbarga. Affiliated to VTU Belgaum, Karnataka, India.