

QoS-aware Fault-tolerant Routing in MANETs based on Segment-backup Paths

by

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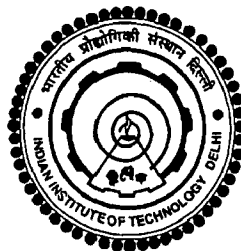
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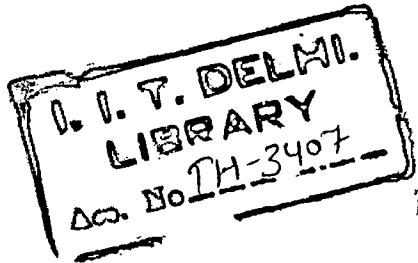
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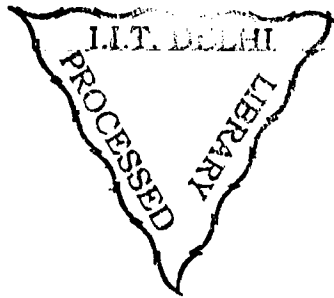
1. Mobile adhoc networks



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The results contained in this thesis have not been submitted to any other university or institute for the award of any degree or diploma.



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To my family,
for their unwavering love and support

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Abstract

In the context of mobile ad hoc networks (MANETs), we consider the problem of identifying (a) an optimal primary path which satisfies the required QoS constraints, and (b) a set of alternate paths that may be used in case a link or a node on the primary path fails. The alternate paths are also required to satisfy the same set of QoS constraints as is the case with the primary path. In the thesis, we have proposed that the traffic be re-routed along a sub-path that by-passes a segment (portion) of the primary path that contains the failed link or node. The segments are determined based on (a) availability of alternate paths, and (b) so that QoS constraints are met. This flexibility in identifying the segments can also be used to ensure that the delay in switching traffic over to an alternate path, and the resulting packet loss, are bounded.

It is proved that for a given (a) source-destination pair of nodes in a network, and (b) any primary path between them, the nodes on the primary path can be divided into a collection of segments such that for each segment there exists an alternate path which completely by-passes the segment *if and only if* there exist two or more node-disjoint paths between the source and destination nodes. This implies that if there exists a solution consisting of a set of alternate backup paths *for a given primary path* then such a solution can always be found for *any* primary path.

We present a *centralized* algorithm to compute a primary path π_0 between a given pair of nodes and a corresponding set of *QoS-constrained* alternate paths each of which bypasses a segment of π_0 . The set of such alternate paths is referred as a complete set of segment-backup paths. Such an algorithm may be used in case when the network topology is known a-priori. But, since the topology of a MANET is not fixed and therefore unknown a-priori, we have proposed a heuristic to identify a significant fraction of available paths between the source and destination nodes.

As the centralized algorithm is compute-intensive, we also propose a *distributed* DSR-like Segment-Backup Routing (DSBR) protocol. The protocol helps distribute computation over the nodes in the MANET and, in the process, it simultaneously discovers a primary path and the corresponding complete set of segment-backup paths each of which satisfies the QoS constraints viz., maximum permissible one way end-to-end delay, minimum required bandwidth, minimum required path reliability. Together, they satisfy maximum permissible one way switch-over delay. Suitable structures of routing tables are also developed to enable data packets to use *any* form of IP routing mechanism (viz. strict source routing, loose source routing, or otherwise).

To speed-up identification and establishment of a primary path and the corresponding complete set of segment-backup paths between a source S and destination D, we establish a result which takes advantage of an existing primary path and the corresponding complete set of segment-backup paths from an *intermediate* node to the same destination D.

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