Adaptive Routing Protocols in MANETs

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A *mobile ad hoc network* (MANET) is a self-configuring collection of mobile nodes without any centralized infrastructure or control. MANETs can be used in a multitude of applications such as emergency relief operations or battlefield applications that exhibit a high degree of temporal and spatial variation. In a MANET, any node may have to act as a router to forward data packets to other parts of the network. As a result, routing is a fundamental problem in MANETs. Substantial research has resulted many routing protocols. The IETF has selected four protocols as candidates for standardization: AODV, DSR, OLSR and TBRPF. AODV and DSR are *reactive*, computing a route to a destination only when required, while OLSR and TBRPF are *proactive*, always having routes available to all destinations.

Network conditions are rarely uniform in a MANET. For example, for each node, the node speed, the density of its neighbourhood, congestion experienced at a node, and the number of flows routed through it, are likely different. This suggests that in parts of the network where the conditions are changing rapidly control information should be distributed more frequently. Conversely, where the conditions are changing slowly a less frequent distribution may suffice. Designing an adaptive routing protocol that takes into account the dynamic topology, congestion, and transmission rates of a node, is a challenging problem.

Clearly, there is a trade-off between successful packet transmission rates and other important performance metrics such as the generated control overhead for successful packet transmission, and the average delay for a packet to reach its destination. The target then is to achieve a solution in the region where these performance metrics are balanced. Some key approaches applied to date are:

Node's importance: Measure a node's importance in its local topology and decide whether the node needs to transmit control information that updates routing tables in its neighbourhood.

Relative mobility: Measure a node's relative mobility with respect to it neighbours and decide when to initiate route updates.

Node degree: A node with higher degree may have more impact on its neighbours' routes to other nodes and may be used to determine route update mechanism.

Link duration: Transmitting data packets over stable links benefits from the fact that fewer packets are dropped; they may also be used in route calculation to provide better performance.

Designed Experiments: Statistical *Design of Experiments* (DOE) can be used to model performance metrics such as packet delivery ratio and control overhead based on network conditions and solve multi-objective optimization problems to find the when route calculation and updates need to be initiated.