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Title: Peer-to-Peer Voice-over-Internet Protocol Communications in Mobile Ad Hoc Networks

Abstract Text: Peer-to-Peer Voice-over-Internet Protocol Communications in Mobile Ad Hoc Networks Radhika R. Roy^1 and Wade K. Trappe^2 ^1 Army System Engineering Office, SEAMS, S&CTD, CERDEC, Aberdeen Proving Ground, MD ^2 Department of Electrical Engineering, WINLAB, Rutgers University, NJ Abstract Mobile ad hoc networks (MANETs) communicate in an autonomous peer-to-peer (P2P) environment, and this technology is becoming essential to the 21st century tactical warfighter. The routing protocols developed for use on MANETs work truly in a P2P mode, and thus there is an urgent need for carefully-designed, server-less P2P applications that can work over these P2P MANETs. In particular, it is desirable to ensure that we obtain the true benefits of “ad hoc” MANETs since the classical client-server applications are not suitable for MANETs. As an example, P2P voice-over-Internet protocol (VoIP) applications like P2P Session Initiation Protocol (P2PSIP) are being defined in standard organizations like the Internet Engineering Task Force (IETF). However, P2PSIP needs to be suitable for running on the MANET, and this is challenging since the topology of the network is dynamically created and broken due to the mobile conditions that arise in tactical scenarios. This paper describes how P2PSIP as well as network routing protocols can be extended to make them suitable for running on a tactical MANET. We have divided the MANET’s simple nodes (SN) into several groups under hierarchical cluster nodes (CNs). Further, a CN that controls other nodes that are not in the same level as this given CN is known as the cluster head (CH). In our approach, the lowest level of the CN controls one or more physical SNs. We have identified two layers of routing protocols for the MANET that will make it scalable for larger networks and which will support P2P VoIP application layer routing: (a) A key-based routing (KBR) protocol that is suitable for use over the MANET for logical routing is only used between the CNs of that particular level, and (b) A MANET physical routing protocol is used between the SNs that are controlled by a given CN of that level. Several candidate KBR protocols are examined for suitability over the MANET networks. The same KBR logical routing that is used over the MANET is also used by the P2P VoIP application for routing among the application layer peers. Distributed hash tables (DHTs) are a class of distributed database algorithms, and which KBR uses for implementation of its distributed database. The resource location and discovery (RELOAD) base protocol developed in the IETF P2PSIP working group (WG) is extended in our work so that it uses different DHTs with or without modifications. In the P2P VoIP application layer, the overlay topology of the all mobile nodes consists of a set of nodes arranged in a partly connected graph. Each node in the overlay is assigned a numeric node identity (Node-ID) which, together with the specific overlay algorithm that is specific to MANET in use, determines its position in the graph and the set of nodes it connects to. The P2P overlay network formed is not only a messaging network, but it is also a storage network, albeit one designed for small-scale storage, suitable enough 1000s of MANET nodes, rather than for bulk storage of large objects. Records are stored under numeric addresses which occupy the same space as node identifiers. Peers are responsible for storing the data associated with some set of addresses as determined by their Node-ID. The major components of a P2P VoIP application layer overlay architecture, like RELOAD, consists of Usage Layer, Message Transport, Storage, Message Transport, Topology Plug-In, and Forwarding and Link Management Layer. The Usage Layer has application usages - a set of data kinds and behaviors which describe how to use the services. A distributed algorithm is used to synchronize between the P2PSIP/VoIP KBR logical routing scheme, the P2P MANET KBR logical routing, and existing MANET physical routing. First, we have chosen the P2PSIP peers based on certain criteria. The criteria for selection of RT P2PSIP/VoIP peer in the application layer and the MANET network layer may complement each other, as well as potentially overlap each other. Hence, the integrated RT P2PSIP/VoIP KBR routing protocol is being developed to have the potential to meet the requirements of the P2PSIP/VoIP application layer, while complementing the P2P MANET network routing layer. The integrated algorithm for the scalable large-scale MANET-based RT P2PSIP/VoIP application networking combines all the requirements of the P2PSIP/VoIP application network, the P2P logical MANET network, and the physical MANET network in order as to meet the real-time conversational audio/video media performances subject to the resources constraints in all layers where all nodes are mobile.