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Implement DUMBO as a Network Based on Mobile Ad hoc Network (MANETs)

Fredrik Sanat

ISB School of Computer, Norway

*Corresponding author's E-mail: *Fredrik.san@gmail.com*

Abstract

Nowadays there are a large variety of wireless access networks. One of these networks is Digital Ubiquitous Mobile Broadband OLSR (DUMBO) which has been strongly motivated by the fact that large scale natural disasters can wipe out terrestrial communication infrastructure. DUMBO routers can automatically form one or more self-configuring, self-healing networks called Mobile Ad hoc Networks (MANET). Vehicle Ad hoc Network (VANETs) is an advanced version of MANETs. VANETs is offered to be used by network service providers for managing connection to get a high performance at real time, high bandwidth and high availability in networks such as WLAN, UMTS, Wi-MAX and etc. In this paper surveying DUMBONET Routers with relevant algorithm, approaches and solutions from the literature, will be consider.

Keywords: DUMBO, VANET, MANET and Routing Protocols.

1. Introduction

Mobile Ad hoc Network MANETs consist of mobile/semi mobile nodes with no existing pre-established infrastructure. They can connect themselves in a decentralized, self-organizing manner and also establish multi hop routes. If the mobile nodes are vehicles then this type of network is called vehicular ad-hoc network (VANETs) [6]. VANET is an advanced version of MANETs. Therefore, the protocols used in the MANET are applicable to the VANET also. The earlier VANET models discussed only the communication among vehicles through the RSU. Most of the researchers used

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standard 802.11 for VANET model. Without using the RSUs, each vehicle in the network is treated as a router to communicate with the neighboring vehicles. With the use of the latest VANET technology, the 802.11p are used to study the performance of routing protocols [2].

MANET topology can dynamically change. In MANETs, each node is equipped with a wireless transmitter and receiver and is typically free to move around in an arbitrary fashion. The self-configuration ability of MANETs makes them suitable for a wide variety of applications [4].There are hundreds of routing protocols which have been proposed for ad hoc networks. In MANET no fixed network topology is used. Therefore, mobile nodes adopt any runtime topology due to their own dynamic behavior. In addition, there exists not even single method for routing in MANET, as network is created at runtime [7].

The common underlying MANET routing protocol that is adopted, (OLSR protocol), continuously senses the change in network topology and updates the routing table at every participating router. To being a proactive protocol, OLSR must regularly sense if someone (Something) in MANET is disappearing or if someone (Something) joins the MANET – a useful feature when dealing with emergency situations [12].Using portable mobile nodes routers can be carried by people, vehicles, or even animals, into disaster-affected areas to expand MANET coverage. These kind of routers also provide a mean to interconnect two or more disaster emergency MANETs (e.g. at two or more locations) via satellite or some other remaining terrestrial links. Rescuers can communicate by using P2P video streaming, P2P voice over IP (VoIP) and P2P short instant text messages [11].

2. Routing Technology

To send the data packets from source to destination, MANET routing protocols are categorized to:

- Proactive routing
- Reactive routing
- Hybrid routing

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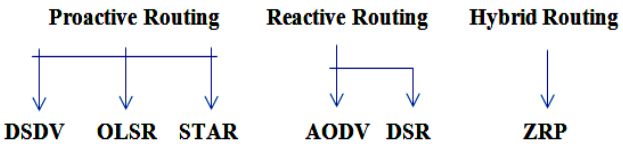

Figure 1. Topology Based Routing.

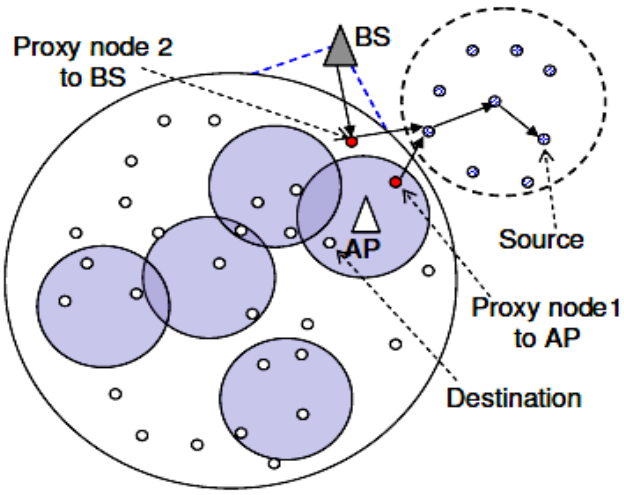

Figure 2. Network topology with ad hoc mode [9].

2.1. Proactive Routing

These protocols are table based, so they keep information of all connected nodes in shared form of tables with neighbors. By changing the network topology, nodes will update its routing table. Strategies implemented in proactive algorithms are Link-state routing (as shown in Fig. 1).

DSDV

Destination Sequence Distance Vector Routing (DSDV) use Distance Vector shortest path routing algorithm, it provides loop free single path to the destination. DSDV sends two types of packets "*full dump" and "incremental"*. In full dump packets, all the routing information is send while in incremental only updates are send. It decreases bandwidth

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utilization by sending only updates instead of complete routing information. The incremental still increases the overhead in the network, because these incremental packets are so frequent that makes it unsuitable for large scale networks [8].

OLSR

Optimized link state routing (OLSR) maintains routing information by sending link state information. After each change in the topology every node sends updates to selective nodes. By doing so, every node in the network receive updates only once. Unselected packets cannot retransmit updates; they can only read updated information [7].

STAR

Source-Tree Adaptive Routing (STAR) is another link State protocol. In STAR, preferred routes to every destination are saved in each router. It reduces overhead on the network by eliminating periodic updates. There is no need of sending updates unless any event occurs. This protocol can be suitable for large scale networks but it needs large memory and processing because it has to maintain large trees for whole network [4].

2.2. Reactive Routing

On demand or reactive routing protocols were designed in such a manner to overcome the overhead that was created by proactive routing protocols. This is overcome by maintaining only those routes that are currently active. Routes are discovered and maintained for only those nodes that are currently being used to send data packets from source to destination [2]. Route discovery in reactive routing can be done by sending RREQ (Route Request) from a node when it requires a route to send the data to a particular destination. After sending RREQ, node then waits for the RREP (Route Reply) and if it does not receive any RREP within a given time period, source node assumes that either route is not available or route expired. When RREQ reaches the particular destination and if source node receives RREP then by using unicasting, information is forwarded to the source node in order to ensure that route is available for communication [9].

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AODV

Ad Hoc on Demand Distance Vector Routing (AODV) is an example of pure reactive routing protocol. AODV belongs to multi-hop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other. AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node [9]. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. Routing table management in AODV is needed to avoid those entries of nodes that do not exist in the route from source to destination. Managing routing table information in AODV is handled with the destination sequence numbers. The need for routing table management is important to make communication loop free. The following are characteristics to maintain the route table for each node [3].

DSR

Dynamic Source Routing protocol (DSR), designed for multi-hop wireless ad hoc networks. This protocol consists of two operations "*Route Discovery"* and "*Route Maintenance"* that makes it self-configuring and self-organizing. DSR routing protocol manage the network without any centralized administrator or infrastructure. In route discovery this protocol discovers for the routes from source node to destination. In DSR, data packets stored the routing information of all intermediate nodes in its header to reach at a particular destination. Routing information for every source node can be change at any time in the network and DSR updates it after each change occur [8]. Intermediate routers don´t need to have routing information to route the passing traffic, but they save routing information for their future use. Basic purpose to develop DSR was to reduce the overhead on the network and designing self organizing and self configuring protocol to support MANET [5].

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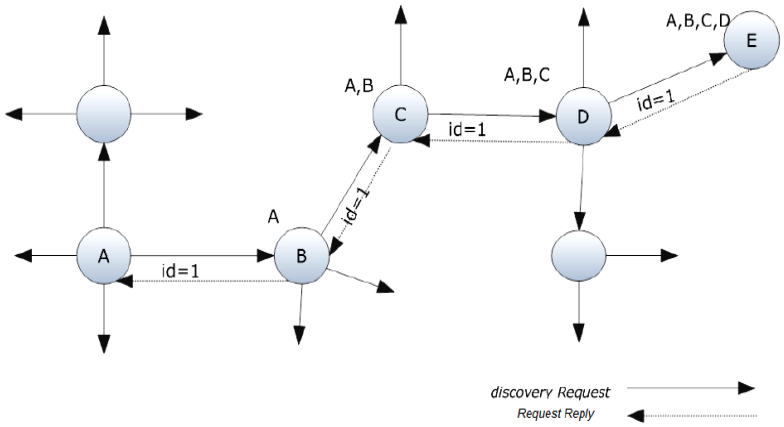

Figure 3. DSR Route Discovery [5].

2.3. Hybrid Routing

Hybrid routing combines characteristics of both reactive and proactive routing protocols to make routing more scalable and efficient. Mostly hybrid routing protocols are zone based; it means the number of nodes is divided into different zones to make route discovery and maintenance more reliable for MANET [2]. Haas and Pearlman proposed a hybrid routing protocol and named it as ZRP (Zone routing protocol). The need of these protocols arises with the deficiencies of proactive and reactive routing and there is demand of such protocol that can resolve on demand route discovery with a limited number of route searches. ZRP limits the range of proactive routing methods to neighboring nodes locally; however ZRP uses reactive routing to search the desired nodes by querying the selective network nodes globally instead of sending the query to all the nodes in network. ZRP uses "*Intrazone*" and "*Interzone*" routing to provide flexible route discovery and route maintenance in the multiple ad hoc environments [3].

3. DUMBO Routers

Digital Ubiquitous Mobile Broadband OLSR (DUMBO) is an emergency network which is based on Mobile Ad hoc Network (MANETs). The aim of DUMBO is to

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provide a multimedia communication network without any pre-exist network infrastructure within least possible time [4].

Dumbo Objective

- Interconnectivity between Mobile Ad-hoc Network and Fixed infrastructure.
- Vehicle-to-Vehicle (V2V) communications with mixed vehicle types.
- Vehicle-to-Infrastructure (V2I) Internet-like Gateway
- A newly revised Emergency Response Multimedia Communication Applications (P2P SIP) [12].

MANEMO

MANEMO is the combination of MANET and Network Mobility (NEMO) Basic Support protocol where NEMO provides session connectivity and Tree Discovery (TD) and Network In Node Advertisement (NINA) provide routing information [6].

OLSR

OLSR is a single Mobile Ad hoc Network comprising with a variety of mobile nodes and almost similar network condition [1]. A node can communicate with other neighbor node and with the distant command center situated anywhere in the internet. Headquarter has some special application to visualize the real-time position and movement of the individual nodes and can send broadcast message to all the nodes [9].

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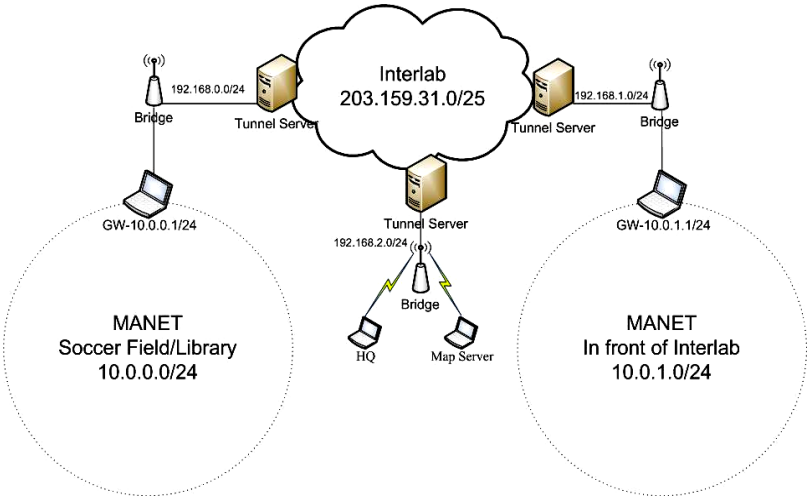

Figure 4. The used topology for the training.

The concept of P2P communication is built into DUMBO routers [11]. The P2P paradigm is decentralized and distributed framework designed to tolerate hardware and software failure. If one mobile router fails, the other remaining mobile router can take over. Rescuers can communicate by using P2P video streaming, P2P voice over IP (VoIP) and P2P short instant text messages. There can be one or more optional command centers. But the command centers are just special peers that may have extra processing power. Conventionally the command centers may be located far away from the disaster site. They are connected to the DUMBO emergency networks in the affected fields via satellite internet or other high speed internet link. An optional facial recognition module can be installed at any DUMBO mobile routers or at the command centers [10].

The facial recognition module helps matching between any unknown person's face photo taken from the field and a collection of known face images. In addition, sensors can be deployed to measure such environmental data as temperature and humidity. Sensor data can be sent to any mobile router or passed onto the command centers [13]. DUMBO focuses on Disruption Tolerant Networking (DTN) and Social Networking (SN) services in OLSR MANET/VANET. Disruptions are very common and inevitable in MANET/VANET emergency networks. Radio propagation range, mobility, terrain are among some factors that cause network disruptions. The result is that a path

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between a source node and a destination node may not always be available [14]. Most DTN routing algorithms employ variations of store-and-forward techniques to deliver each individual information unit called a DTN bundle from its source to one or more destinations. The bundle can be a short text message or a file of any type. One key enabling technology is the Structured Mesh Overlay Network (SMON), provides overlay construction capabilities – allowing a subset of nodes in the physical network to discover each other and to communicate as peers. The topology of an overlay network can be significantly different from that of the underlying network. Overlay networks can be used for service and resource discoveries [10].

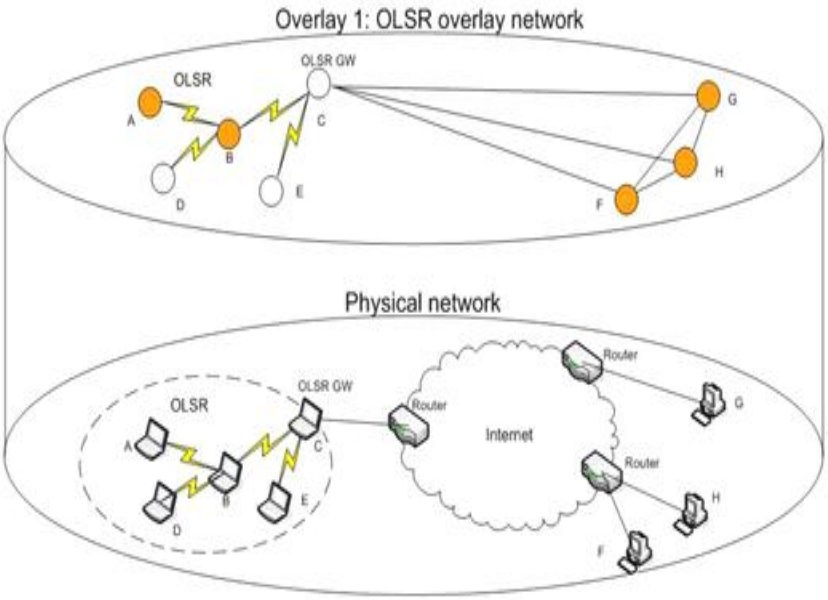

Figure 5. OLSR Overlay Network [9].

4. Conclusion

DTN routing protocol utilizing OLSR overlay, called Delay Tolerant Structured Overlay Link State Routing (DTS-OLSR), was developed. DTS-OLSR utilizes SMON to form DTN overlay in OLSR MANET/VANET. DTS-OLSR provides DTN routing capabilities among OLSR MANET/VANET network partitions (intERLab

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2011). Likewise, a Social Networking (SN) service utilizing SMON was also developed. We field tested both DTS-OLSR and SN in laboratory and in high mobility VANET situations. DTS-OLSR and SN services have become an integral part of our DUMBO mobile router since.

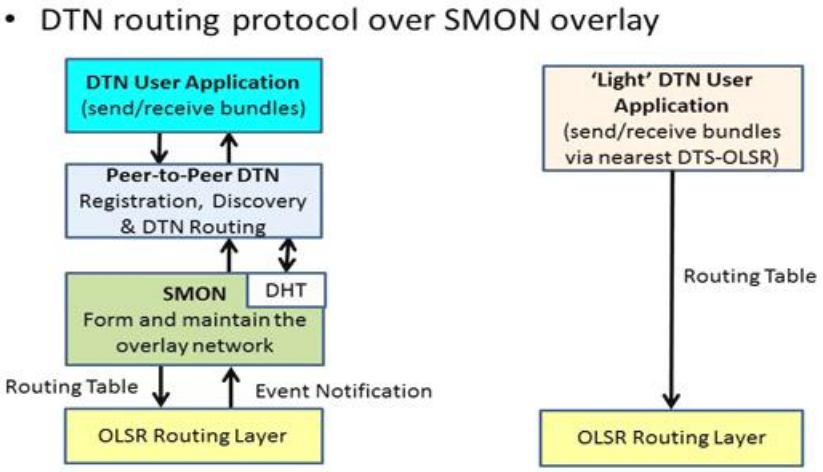

Figure 6. Delay-Tolerant /structured Overlay Link State Routing (DTSOLSR) [7].

With the DTN delivery capabilities, rescuers may transmit information in the form of short text or bulk file (e.g. map, inventory, situation report) from a source to a destination in the situation where the path between them is disruptive (i.e. not always-on) (ait. asia 2008).

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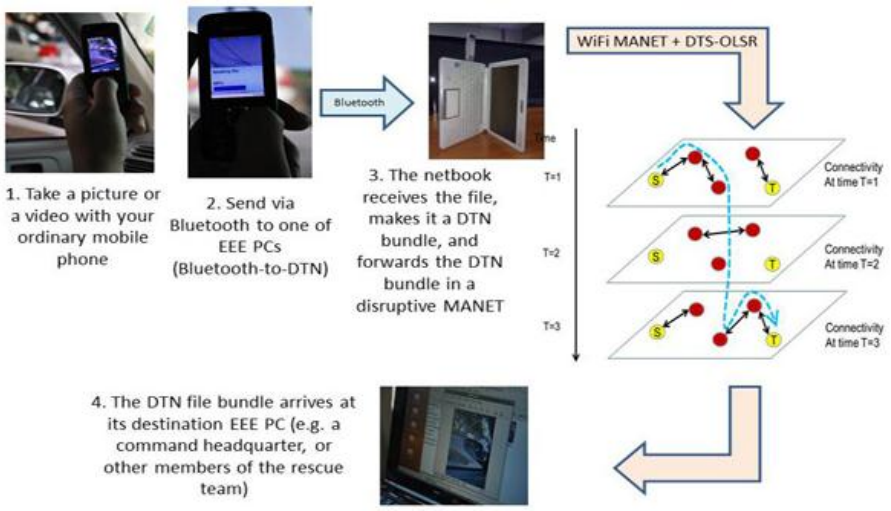

Figure 7. DTS file transfer in a disruptive MANET.

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