Performance Evolution of Routing Protocols for MANETS Based on CBR and FTP Application Agents

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Abstract: ***In wireless communication networks Ad-hoc networks are plays dominant role, Mobile Ad-hoc network (MANET) is a collection of wireless mobile nodes that dynamically form a network temporarily without any central administration. The primary objective of this research work is to study and investigate the performance of Dynamic source routing (DSR) protocol and Minimum Maximum Battery Cost Routing (MMBCR).Energy efficient routing is one of the important design criterions for MANET since mobile nodes are battery powered with limited capacity and which cannot be recharged whenever needed. So the MANET routing is challenged by power and bandwidth constraints. We use Constant bit Rate (CBR) application with TCP agent and File transfer protocol (FTP) application with UDP agent to analyse the performance of routing protocols based on the parameters Energy Consumption and Node Analysis. We have used NS-2 Simulator for simulation.***

Keywords: communication. CBR, TCP, protocols, MANET, information, networks

1. Introduction

Mobile Ad-hoc networks (MANETs) are combination of mobile nodes without existence of any centralized control or pre-existing infrastructure. Such kind of networks generally use multi-hop paths and wireless radio communication channel. Thus, communication between nodes is established by multi-hop routing. Also, new nodes join or leave at any time. Owing to the dynamic nature, topology is often changing. Therefore performance of network deteriorates rapidly. Ad hoc is a kind of special wireless network mode. An ad hoc wireless network is a collection of two or more devices quipped with wireless communications and networking capability. Such devices can communicate with another device that is immediately within their radio range or one that is outside their radio range not relying on access point. A wireless ad hoc network is self-organizing, self-disciplining, and self-adaptive.

A mobile ad-hoc network consists of mobile hosts equipped with wireless communication devices. The transmission of a mobile host is received by all hosts within its transmission range due to the broadcast nature of wireless communication and Omni-directional antenna. If two wireless hosts are out of their transmission ranges in the ad hoc networks, other mobile hosts located between them can forward their messages, which effectively build connected networks among the mobile hosts in the deployed area. Due to the mobility of wireless hosts, each host needs to be equipped with the capability of an autonomous system, or a routing function without any statically established infrastructure or centralized administration. The mobile hosts can move arbitrarily and can be turned on or off without notifying other hosts. The mobility and autonomy introduces a dynamic topology of the networks not only because end-hosts are transient but also because intermediate hosts on a communication path are transient. The communication between the nodes in a packet data network must be defined to ensure correct interpretation of the packets by receiving intermediate and end systems. Packet exchange between the nodes is called protocols. And the routing involves two things: Firstly determining optimal routing paths, secondly transferring the information groups (called packets) through an internetwork. Routing protocols use several metrics to calculate the best path for routing the packets to its destination. Unsurprisingly, designing good protocols with few packets collision will reduce power consumption. At the network layer, the routing protocols can be designed such that there is an increase in the network life time by distributes the forwarding load over multiple different paths. The main objective of this paper to investigate the performance of routing in ad-hoc network and Energy Management. A group of mobile devices called as nodes, without any centralized network, communicates with each other over multi-hop links is called as an Ad-hoc Network (MANET). A MANET is a collection of self-organized mobile users which are free to act independently that communicate over relatively bandwidth constrained wireless links. Since the nodes are mobile, the network topology may change quickly and cannot be predicted over time. The main characteristics of ad hoc networks are as follows:

Dynamic topology: Because nodes in the network can move arbitrarily, the topology of the network also changes.

The bandwidth of the link: it is unstrained, and the capacity of the network is also tremendously variable. Because of the dynamic topology, the output of each relay node will vary with the time, and then the link capacity will change with the link change. At the same time, compete-collision and interference make the actual bandwidth of ad hoc networks smaller than their bandwidth in theory.

Power limitation: it is in mobile devices is a serious factor. Because of the mobility characteristics of the network, devices use batteries as their power supply. As a result, advanced power conservation techniques are very necessary in designing a system.

The Safety: it is limited in a physical aspect. The mobile network is more easily attacked than the fixed network. Overcoming the weakness in safety and the new safety trouble in wireless networks are on demand. Each and every node has limited life spam. To maximize the life time of nodes in a network, the energy consumption rate of each node must be evenly distributed. Section II describes the Routing Protocols, Section III Theoretical Analysis of routing protocols, and Section IV presents Simulation Environment. Section V describes about the experimental results and lastly section VI gives the conclusion.

2. Routing protocols

MANET routing protocols are having the responsibility to find and maintain routes between nodes in a dynamic topology by using minimum resources. They are classified into three main groups such as

1. Proactive routing protocols
2. Reactive routing protocols
3. Hybrid routing Protocols

Routing protocol has two significant functions:

- Selecting the routes for various source-destination pairs and among those choose the best path (least cost/ minimum distance/ more bandwidth).
- Routing each messages through that best path to their correct destination.

The second function is implemented by a variety of protocols with the help of routing tables. Ad-hoc routing protocols can be classified based on different criteria. Based on the routing mechanism used by a given protocol, it may fall under more than one class. Routing protocols for Ad-hoc networking can be classified into four categories.

- Based on routing information which are updated by anyone of the routing mechanism (proactive or table-driven, reactive or on-demand and hybrid routing protocols).
- Based on that instantaneous time information (Both Past and Future time information) for routing
- Based on routing topology (Flat Topology, Hierarchical Topology)
- Based on the use of particular resources (Power Aware Routing and Geographical

Each node in these routing protocols in Mobile Ad hoc networks operates on constrained battery power. The power will start decreases with time even though the node is idle. Power management is an important concept which concentrates how to reduce the energy consumed in the wireless interface of battery-operated mobile devices. So Energy Conservation is taken as a prime factor since all wireless devices usually rely on portable power sources such as batteries to provide the necessary power.

Routing is important in MANET due to the following reasons:

- Host mobility: It is due to the dynamic topology that changes over time. The routing protocol must be capable of managing link failure/repair due to mobility.
- Distributed Environment: Minimum control overhead as there is no any centralized control
- Bandwidth constrained: Total bandwidth is shared.
- Energy constrained: Battery resource is constrained

An efficient routing protocol should maximize network throughput and lifetime, while minimizing delay in transmission. Routing protocols coming under energy awareness must balance delay constraints, battery lifetime and routing efficiency in order to achieve a better route discovery. The common means of energy consumption in routing occurs during exchange of route information. In case of route with small number of hops, energy is consumed significantly compared to a route with large number of hops. The lifetime of a node is degraded as it is used more frequently.

3. Theoretical Analysis

Performance analysis between routing protocols for mobile ad-hoc networks we are considering different routing protocols like DSR-Dynamic Source Routing, MBCR-Minimum Battery Cost Routing, and MMBCR-Minimum Maximum Battery Cost Routing.

3.1 Dynamic Source Routing (DSR) Protocol

The Dynamic Source Routing (DSR) protocol is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad-hoc networks of mobile nodes. Using DSR, the network is completely self-organizing and self-configuring, requires no existing network infrastructure or administration. Network nodes co-operate to forward packets for each other to allow communication over multiple "hops" between nodes which are out of wireless transmission range from one another. As nodes in the network move about or join or leave the network, all routing is automatically determined and maintained by the DSR routing protocol.

Since the number or sequence of intermediate nodes needed to reach any destination may change at any time, the resulting network topology may be quite rich and rapidly changing. In DSR protocol overheads are very low and able to react very quickly to changes in the network. The DSR protocol provides highly reactive service in order to help ensure successful delivery of data packets in spite of node movement or other changes in network conditions. The DSR protocol is composed of two main mechanisms that work together to allow the discovery and maintenance of source routes in an ad-hoc network:

Route Discovery: It is the mechanism by which a node S wishing to send a packet to a destination node D obtains a source route to D. Route Discovery is used only when S attempts to send a packet to D and does not already know a route to D.

Route Maintenance: It is the mechanism by which node S is able to detect, while using a source route to D, if the network topology has changed such that it can no longer use

its route to D because a link along the route no longer works. When Route Maintenance indicates a source route is broken, Scan attempt to use any other route it happens to know to D, or it can invoke Route Discovery again to find a new route for subsequent packets to D. Route Maintenance for this route is used only when S is actually sending packets to D.

In DSR, Route Discovery and Route Maintenance each operate entirely "on demand". In particular, unlike other protocols, DSR requires no periodic packets of any kind. For example, DSR does not use any periodic routing advertisement, link status sensing, or neighbour detection packets. This entirely on-demand behaviour and lack of periodic activity allows the number of overhead packets caused by DSR to scale all the way down to zero, when all nodes are approximately stationary with respect to each other and all routes needed for current communication have already been discovered. As nodes begin to move more or as communication patterns change, the routing packet overhead of DSR automatically scales to only what is needed to track the routes currently in use.

In response to a single Route Discovery, a node may learn and cache multiple routes to any destination. This support for multiple routes allows the reaction to routing changes to be much more rapid, since a node with multiple routes to a destination can try another cached route if the one it has been using should fail. This caching of multiple routes also avoids the overhead of needing to perform a new Route Discovery each time a route in use breaks. The sender of a packet selects and controls the route used for its own packets, which, together will support for multiple routes.

3.2. The min-max battery cost routing (MMBCR):

This protocol was proposed in at first, in each possible route from source to destination, the maximum battery **cost** will be selected from Equation (3.3.1). Among this set of maximum battery costs, the minimum battery cost will be selected according to Equation (3.3.2). The battery of each host will be used more fairly than in previous schemes.

Battery cost R_j for route j is redefined as

$$R_j = \max_{i \in route\_j} f_i\left(c_i^t\right) \quad \text{..... (3.3.1)}$$

Similarly, the desired route i can be obtained from the equation

$$R_j = \min\{R_j | j \in A\} \quad \text{..... (3.3.2)}$$

Advantage: Since this metric always tries to avoid the route with nodes having the least battery capacity among all nodes in all possible routes, the battery of each host will be used.

Disadvantage*:* The disadvantage is that since the minimum total transmission power is not considered in MMBCR, the power consumption may be more to transmit user traffic from a source to a destination, which actually reduces the lifetime of all nodes.

In MMBCR (Min-Max Battery Cost Routing) we first find the node having minimum battery capacity in each node of the possible routes and select the route having the maximum value among the selected routes. That means the route having maximum life time is selected. But the main demerit of MMBCR is that it does not consider the transmission powers of the nodes. In MMBCR, the updated information is not considered for route selection. So, two mechanisms are proposed to overcome this disadvantage. The first is MMBCR-route reply, where the cost function is calculated in route reply phase instead of in route request phase for selecting the route.

And the other is MMBCR with periodic route discovery to get more updated information about the routes. In this method periodically the route discovery process is done. If there are any changes in the route, the route information is updated. Because of this method, different routes are used for transmission of data packets and periodic shifting between the routes which avoids the over usage of nodes and node exhaustion leading to the increase of the life time of the network.

4. Simulation Environment

The Proposed protocols are implementing with the object oriented discrete event simulator. In our simulation, 10 mobile nodes move in a 500 mx 500 m square region for 200 seconds simulation time. The Simulator Environment is created by using TCL Script with the help of following parameters included in the table. In the TCL script use the two types of Applications those are FTP (File Transfer Protocol) with TCP Agent and CBR (Constant Bit Rate) with UDP agent.

4.1 CBR Analysis

Constant Bit Rate is an encoding method that keeps the bit rate same as opposed to VBR which varies the bit rate. CBR processes audio faster than VBR due to its fixed bit rate value. The downside to a fixed bit rate is that the files that are produced are not as optimized for quality vs. storage as VBR. For example, if there is a quiet section in a music track that does not require the full bit rate to produce good quality sound then CBR will still use the same value thus wasting storage space. The same is true for a complex sounds, if the bit rate is too low then quality will suffer.

4.2 FTP Analysis

File Transfer Protocol (FTP) is a standard Internet protocol for transmitting files between computers on the Internet. Like the Hypertext Transfer Protocol (HTTP), which transfers displayable Web pages and related files, and the Simple Mail Transfer Protocol (SMTP), which transfers e-mail, FTP is an application protocol that uses the Internet's TCP/IP protocols. FTP is commonly used to transfer Web page files from their creator to the computer that acts as their server for everyone on the Internet. It's also commonly used to download programs and other files to your computer from other servers. The Table 4.1 shows the Simulation Environment parameters.

Table 4.1: Simulation Environment table

Propagation	*Two Ray Ground Propagation*
No. of Nodes	10
Area Size	500x500 m^2
MAC	802.11
Simulation Time	200 Sec
Traffic Source	CBR and FTP
Packet Size	512 bytes (CBR)
Antenna type	Omni directional
Packet Transmission Power	0.4 mw
Packet Receiving Power	0.1mw
Routing Protocols	DSR, MMBCR
Initial Energy of nodes	X joules (Different Energies)

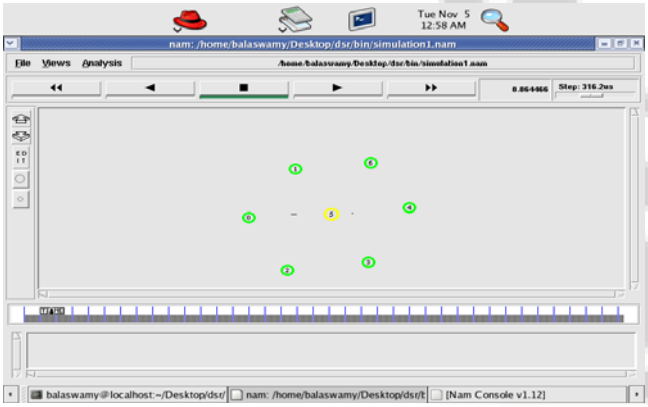

Figure 4.1: file transfer and Acknowledgment in DSR

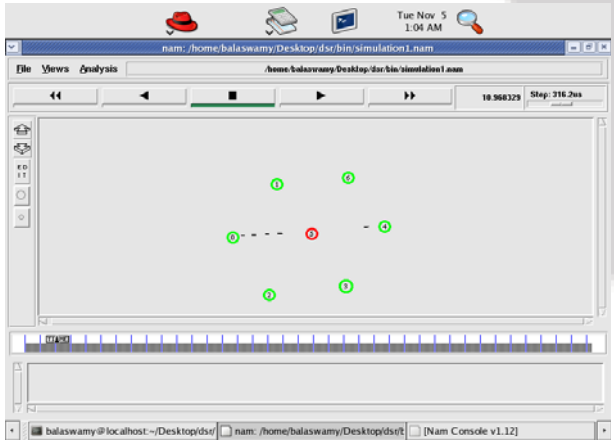

Figure 4.2: Packets transfer in DSR

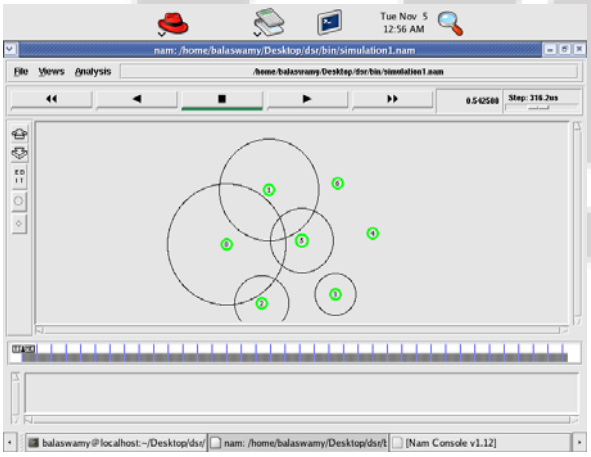

Figure 4.3: Route Discovery in DSR

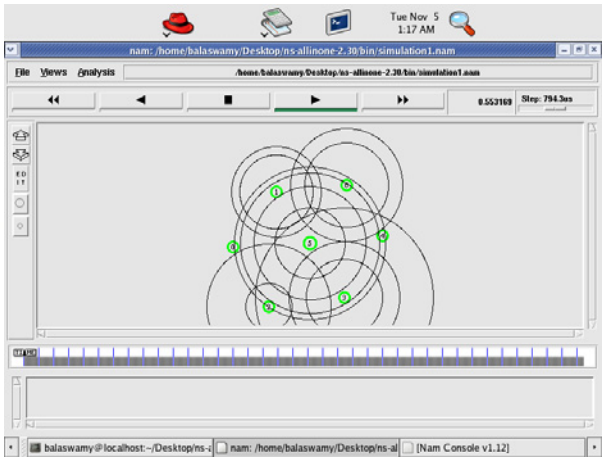

Figure 4.4: Broadcasting in MMBCR

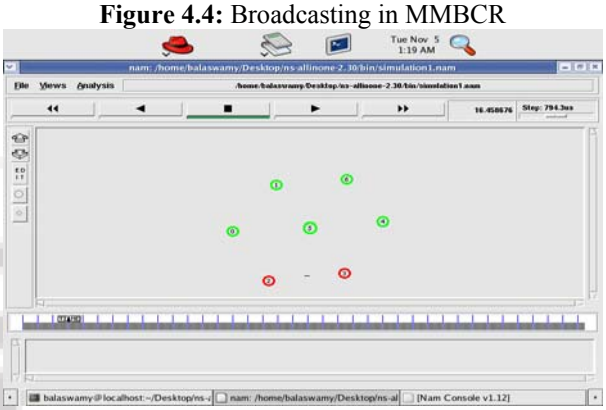

Figure 4.5: File Transfer in MMBCR

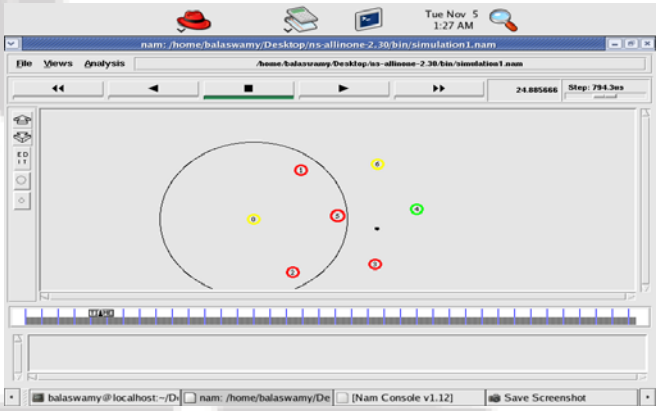

Figure.4.6: Dropped Packet in MMBCR

5. Experimental Results

The results are taken experimentally comparison of Routing Protocols both DSR and MMBCR Based on the parameters First node failure, Energy Consumption Analysis of a node.

5.1 FTP Practical Analysis

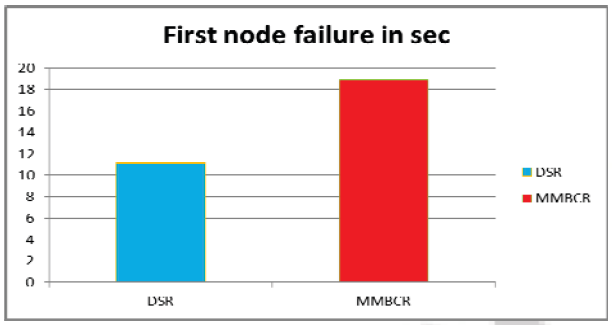

Figure 5.1: First node Failure

The above Diagaram representation shows the first node failure time in sec consider protocols DSR and MMBCR. X-axis shows protocol name and Y-axis shows time in sec.

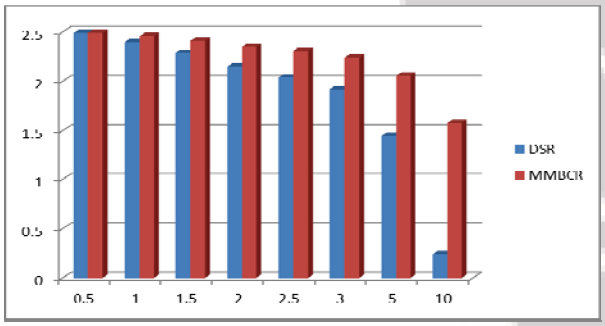

Figure 5.2: Energy Consumption Analysis of Node 5

The above Diagaram representation shows the Energy Consumption Anaysis of node 5 in Joules consider protocols DSR and MMBCR. X-axis shows time in seconds and Y-axis shows Energy Consumption Analysis in Joules.

The diagram Blue bars indicates the Energy Consumption of node 5 using DSR routing Protocol.

The diagram Red bars indicates the Energy Consumption of node 5 using MMBCR routing Protocol.

5.2 CBR Analysis

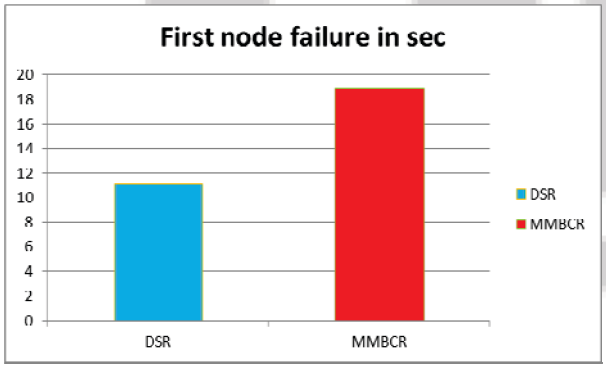

Figure 5.3:.First node failure time in Sec

The above Diagaram representation shows the first node failure time in sec consider protocols DSR and MMBCR. X-axis shows protocol name and Y-axis shows time in sec.

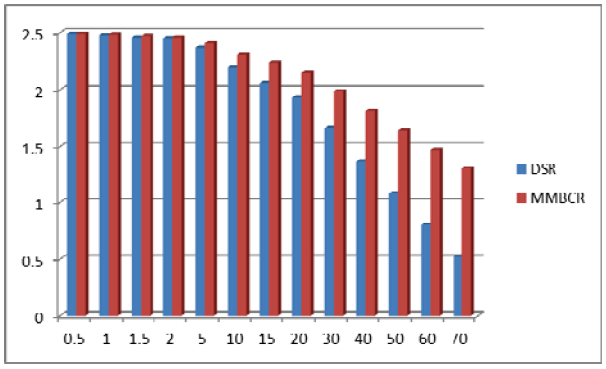

Figure 5.4: Energy Consumption Analysis of node 5

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The diagram Blue bars indicates the Energy Consumption of node 5 using DSR routing Protocol.

The diagram Red bars indicates the Energy Consumption of node 5 using MMBCR routing Protocol.

6. Conclusion

Generally in MANET the design of Routing protocols are very important criteria because the performance of network depends on the design of routing protocols. In this paper, we are using ad-hoc routing protocols like dynamic source routing protocol (DSR),minimum-maximum battery cost routing protocol (MMBCR) MMBCR is the Energy Efficient routing Protocol considering the performance metrics First node failure time and Energy Consumption of node analysed the performance of the Mobile Ad-hoc Network with the help of CBR traffic and FTP application Agents. The simulation results shows that MMBCR performs better in case of node failure time and Energy Efficiency of the Network is investigated for MMBCR to get higher node failure time by using the Network Simulator Software.

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