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Bandwidth Assurance Using Energetic Fusion Channel In Ad-Hoc Networks

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Abstract: *Wireless mesh networks (WMNs) have been proposed to provide cheap, easily deployable and vigorous Internet access. Improving user throughput is a primary objective in a WMN. The system focus on wireless networks with inactive nodes, such as community wireless networks. The goal of the metric is to choose a high-output path between a source and a destination. Metric assigns weights to individual links based on the Expected Transmission Time (ETT) of a packet over the link using many to many communications. In such networks, most of the nodes are either stationary or minimally mobile and do not rely on batteries. Hence, the effort of routing algorithms is on improving the network capacity or the performance of individual transfers for this, the system use Ad-hoc On-Demand Multi Path Distance Vector (AOMDV) for selecting and Demanding Shortest Path for transmission with Bandwidth Assurances. One of the main problems facing such networks is the reduction in total capacity due to interference between multiple simultaneous transmissions.*

Index Terms*: Ad-hoc On-Demand Multi Path Distance Vector, Bandwidth Assurances, Quality of Service, high-throughput, topology control.*

I. INTRODUCTION

An effective energetic fusion channel methodology is discussed and it also focuses on route-maintenance and loop-freeness requirements. In existing system the conventional method was discussed. In proposed system AOMDV approach and its limitations was explained. To attain Self Recoverable, Demanding shortest Path, Bandwidth Assurance also focuses on Route-Maintenance and loop-freeness requirements.

A. Wireless Mesh Network

A Wireless Mesh Network is a communications network made up of radio nodes organized in a mesh topology. Wireless mesh networks frequently consist of complement clients, mesh routers and gateways. The mesh clients are often laptops, cell phones and other wireless devices complement the mesh routers forward traffic to and from the gateways which may, but need not, connect to the cyberspace. The exposure area of the radio nodes working as a single network is sometimes called a mesh cloud. Approach to this mesh cloud is dependent on the radio nodes working in harmony with each other to create a radio network. A mesh network is trustworthy and offers redundancy. When single node can no longer operate, the time out of the nodes can still communicate with each other, absolutely or through one or more intermediate nodes.

B. Wireless Mesh Network Architecture

Wireless mesh network architecture is illustrated in Fig.1, consisting of mesh routers, clients, and gateway nodes. Mesh routers communicate with peers in a multi hop fashion such that packets are mostly transmitted over multiple wireless links (hops). Therefore, nodes forward packets to other nodes that are on the route but may not be within direct transmission range of each other. Routers which are connected to the independent world are called gateway nodes. These GWNs carry traffic in and out of the mesh network. The group of such routers and gateway nodes connected together in a multi hop fashion form the basis for an infrastructure WMN (also called backbone mesh). Additionally, the multi hop packet transmission in an infrastructure WMN extends the area of wireless broadband coverage without wiring the network; thus WMNs can be used as extensions to cellular networks, ad hoc networks (MANET), sensor and vehicular networks, IEEE 802.11 WLANs (Wi-Fi), and IEEE 802.16 based broadband wireless (WiMax) networks.

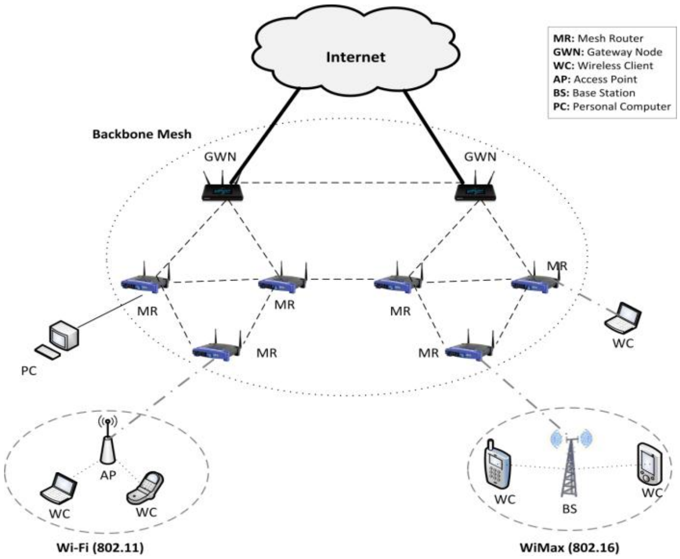

Fig. 1. Typical Wireless Mesh Network Architecture

Wireless Mesh Network using two types of nodes there are Wireless Mesh Router, Mesh Clients. Wireless Mesh Router contains additional routing functions to support mesh networking. It usually equipped with multiple wireless interfaces built on either the same or different wireless access technologies. It improves the flexibility of mesh networking. Mesh Clients can also work as routers since they also have necessary functions for mesh networking. It gateway and bridge functions do not exist in these nodes.

II. HELPFUL HINTS

A. Opportunities and Challenges of WMN

Mihail L. Sichitiu et al (2006) [4] says, an introduction to wireless mesh networks and also deals with the main hurdles that have to be overcome. The main drawback of the technology is its complexity. The foremost source of this complexity is a combination between wireless technology (with its flexibility and drawbacks) and the unusual role of each wireless node (as simultaneously router and host).

The challenges are in large part unique to WMNs and considerable research has yet to be completed before WMNs can reach their full potential. Especially if multiple gateways are used, all distinct point-of-failures are eliminated. A responsive routing protocol can quickly route around failed links or nodes.

Adding a new client to an existing WMN can take several hours instead of several months, the typical delay for installing new wires for cable or DSL. The wireless links used to connect the mobile clients can be of the same type as the intra-mesh wireless links or can be a completely different technology. Many implementations allow mobile nodes to connect to the WMN while in its range; their packets are forwarded in the same multi-hop manner as the ones of the stationary nodes (and in their turn, although not always preferable, the mobile nodes can forward packets on behalf of other nodes). Not all nodes have to support client nodes.

B. Routing Metrics for Wireless Mesh Networks

Merkourios Karaliopoulos, Rainer Baumann, and Thrasyvoulos Spyropoulos, et al (2009) [6] had represent a detailed survey and taxonomy of routing metrics. A routing metric is a value assigned by a routing algorithm and used to determine whether one route performs better than another.

These metrics can have generally different optimization objectives, different methods to collect the required information to produce metric values, and different ways to derive the end-to-end route quality out of the individual link quality metrics.

Currently the 802.11x suite of standards does not provide much information to higher layers. The only channel quality measure reported from commodity wireless adapters is the "Received Signal Strength Indicator" (RSSI) value which is also vendor-dependent. However, standardization efforts within IEEE 802.11 are preparing standards (802.11k for wireless LANs and 802.11s for wireless mesh networks), which will enable higher layers to obtain detailed channel condition information from the PHY and the MAC layers and provide additional flexibility with respect to transmit power control.

These standards will include signal strength measurements and neighbour reports containing information on neighbouring nodes as well as link quality metrics such as the Airtime metric. The use of this information to develop more sophisticated and efficient routing metrics is expected to be an area for future research.

C. QUORUM – Quality of Service in WMN

Vinod Kone, Sudipto Das, Ben Y. Zhao and Haitao Zheng, et al (2008) [12] had proposed a routing protocol for wireless mesh networks that provides QoS guarantees to applications based on metrics of minimum bandwidth (Bmin) and maximum end-to-end delay (Tmax).

They have developed QUORUM, a novel QoS aware routing protocol for wireless mesh networks. Specifically, QUORUM takes three QoS metrics into account: bandwidth, end to end delay and route robustness but there is no bandwidth guarantees. To optimize QUORUM for wireless mesh networks, several mechanisms including topology-aware route discovery that drastically reduce the control overhead and network congestion from route discovery. Some researchers advocate for a stateless approach, while others have advocated maintaining state at intermediate nodes.

Providing a stateless solution in, they describe a way to achieve QoS routing without using explicit reservation mechanisms and give new distributed solution to oscillation and collision of flows. Other approaches include use of channel switching where APs use multiple channels and Mobile Hosts (MHs), upon detection of a QoS violation, switch channels to connect to another AP. Another approach proposes clustering of end hosts and use of orthogonal channels to reduce the effect of interference.

D. Multi-Radio and Multi-Hop Routing

Richard Draves, Jitendra Padhye, and Brian Zill, et al (2004) [8] says, the goal of using inexpensive, commodity hardware to build and deploy multi-hop wireless networks. Several researchers have studied the problem of capacity reduction in multi-hop wireless networks from a theoretical perspective.

They shows that observed capacity is far below the theoretical optimum, using evidence from deployed multi-hop 802.11 wireless meshes. They observe that throughput degrades quickly as the number of hops increases. One reason is that the 802.11 MAC is inherently unfair and it can stall the flow of packets over multiple hops. Another reason is that these networks use only a small portion of the spectrum and a single radio for transmitting and receiving packets. The ETX metric measures the expected number of transmissions, including retransmissions, essential to send a unicast packet across a link.

The derivation of ETX starts with measurements of the underlying packet loss probability in both the forward and reverse directions; denoted by pf and pr, respectively; and then calculates the expected number of transmissions. They begin by calculating the probability that a packet transmission is not successful.

The 802.11 protocol requires that for a transmission to be successful, the packet must be successfully acknowledged.

A link-state protocol consists of four components:

1. A component that discovers the neighbors of a node.
2. A component that assigns weights to the links a node has with its neighbors.
3. A component to propagate this information to other nodes in the network.
4. A component that uses the link weights to find a good path for a given destination. In other words, the link weights are combined to form a path metric.

E. Multihop Mac

Debora and Otto, et al (2008) [7] focused on path selection mechanisms and new frame formats, since these features are the most closely related to multi-hop forwarding at the MAC level. They also deals IEEE 802.11s emerging standard proposals, focusing on path selection mechanisms, and discuss and compare both layer-two and layer-three approaches for building WMNs.

The recent emergence of handheld communication devices, constrained in many ways (power, processing, memory), demands a solution that may be easily embedded in Network Interface Cards and in systems-on-chip.

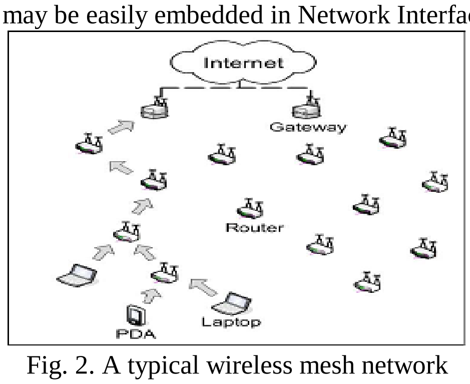

Fig. 2. A typical wireless mesh network

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F. Interference-Aware Channel

Krishna N. Ramachandran, Elizabeth M. Belding and Kevin C. Almeroth, et al (2006) [2] presented a centralized, nosiness-aware channel assignment algorithm and a corresponding channel assignment protocol aimed at improving the capacity of wireless mesh networks by making use of all available non-overlapping channels.

Several proposals focus on improving the IEEE 802.11 MAC protocol to support multiple channels. The key advantage of such schemes is that only a single radio is required to support multiple channels. The disadvantage is that they require changes to the MAC layer and the hardware in order to support per-packet channel switching.

To the best of our knowledge, such hardware is still not available. One potential pitfall of dynamic channel assignment is that it can result in a change in the network topology. Topology changes can lead to sub-optimal routing and even network partitioning in case of node failures.

The proposed solution, therefore, ensures that channel assignment does not alter the network topology by mandating that one radio on each mesh router operate on a default channel. A second potential pitfall is that channel assignment can result in disruption of flows when the mesh radios are reconfigured to different frequencies.

G. Characterizing Achievable Rates

Murali Kodialam and Thyaga Nandagopal, et al (2005) [5] deals with the problem of determining the achievable rates in multi-hop wireless mesh networks with orthogonal channels.

The paper characterized the achievable scheduling space under various communication models for multi-hop wireless networks with orthogonal channels and also address the problem of determining if a given set of source to destination rates are achievable or not and, if achievable, we derive efficient, simple to implement algorithms to compute the end-to-end routes and the per-link flows.

They provide efficient polynomial-time graph edge-coloring algorithms for computing schedules for any given set of achievable source-destination rates.

They consider a multi-hop wireless network with nodes. The nodes communicate with each other via wireless links. Every node in the network can communicate directly with a subset of the other nodes in a network. If node can transmit directly to node, they represent this fact by a directed edge (link), from node to node. Also assume that there are links in the network. They represent the nodes in the network and possible communication with a directed graph where represents the set of nodes in the network and the set of directed edges (links) in the network.

They do not assume that links are bi-directional to transmission. This problem is analogous to the multi-commodity flow problem, and is nontrivial due to the fact that this problem involves jointly solving a routing and scheduling problem. I characterize the achievable scheduling space first, and then solve the routing problem over the achievable scheduling space. We studied algorithms for routing flows and scheduling transmissions in multi-hop wireless mesh networks.

H. Securing VOIP Services

Yi Xian and Chin-Tser Huang, et al (2005) [14] had present a new protocol for securing the voice traffic over the wireless mesh network, including the client verification, intermediate mesh nodes authentication to ensure secure multi-hop communication, voice traffic privacy and secure optimal routing selection by using the probing packets.

Voices over Internet Protocol (VoIP) services have gained widespread popularity and still keep growing steadily. However, ease of access to the medium makes VoIP over wireless mesh networks vulnerable to unauthenticated access and malicious misuse.

Such vulnerability makes providing security guarantees a big challenge, which has not gained enough attention so far. Possible attacks on VoIP over wireless mesh networks include traffic eavesdropping, Denial of Service attacks, mesh node impersonation, and unauthorized mesh node access.

Traffic encryption is needed if data confidentiality is a requirement. A lightweight and efficient encryption algorithm can improve the network performance. Unfortunately, existing standards are not sufficient for these security requirements. For example, current protocols lack mesh node access control and mutual authentication of intermediate mesh nodes.

I. Understanding Congestion Control

Sumit Rangwala, Apoorva Jindal and Ramesh Govindan, et al (2005) [10] had presents mechanisms for achieving fair and efficient congestion control for multi-hop wireless mesh networks.

In multi-hop topologies with RTS/CTS enabled, both RTS and DATA packets can be lost due to collision. For coordinated stations and near hidden links, an RTS collision takes position if the two links start transmitting at the same time. For near hidden links, an RTS collision can also take position if a node starts transmitting an RTS while an RTS transmission is ongoing on the other link.

For asymmetric topologies where transmitters have an incomplete view of the channel, and for distant hidden links, the receiver of the link will not send back a CTS whenever there is a transmission ongoing at the other link. By similar cases, it is easy to see that, for DATA packets, collisions cannot happen in coordinated stations or near hidden links, but can occurs for asymmetric topologies and distant hidden links.

J. Estimating Wireless Link Capacity

Apoorva Jindal, Mingyan Liu and Konstantinos Psounis, et al (2005) [1] had proposed a mechanism to estimate link capacity in a wireless network. He proposed a simple yet accurate and model-independent, capacity-based approach to estimating link capacity in a wireless network.

However, estimating residual link capacity in a wireless network, especially a multi-hop network, is a hard problem because the available capacity is a function of not only the current arrival rate at the link under consideration, but also of the arrival rates at links which interfere with that link and the underlying topology.

Models which accurately represent this dependence are very complex, as input, require the complete topology information including which pair of links interfere with each other, the capture and deferral probabilities between each pair of links, the loss probability at each link, etc. Simpler models make simplifying assumptions which diminish their accuracy in real networks.

Model-based capacity estimation techniques work only for the specific MAC/PHY layer for which they were designed and extending them to a new MAC/PHY layer requires building a new model from scratch. Finally, none of these methods work with auto-rate adaptation at the MAC layer, which makes them inapplicable to any real network.

III. EXISTING SYSTEM

A wireless mesh network consists of a large number of wireless nodes. The nodes form a wireless connection to cover the service area while a few nodes are wired to the Internet. Wireless mesh networks often consist of mesh clients, mesh routers and gateways. Wireless Mesh Network has to support diversified multimedia applications for its users either its wired or wireless increments hop-count in overlay networks. It is essential to provide efficient Quality-of-Service support in this kind of networks. Searching the path with the maximum available bandwidth is one of the fundamental issues for supporting Quality-of-Service in the wireless mesh networks. The available path bandwidth is well-defined as the maximum additional rate a flow can push before saturating its path using many to single.

***Disadvantage*:**

- The traffic rate of a new stream on a path is no greater than the available bandwidth of this route, accepting the new traffic will not violate the Bandwidth assurance of the existing flows.
- The problem of classifying the maximum available bandwidth path from a source to a destination, which is also known as the Maximum Bandwidth Problem.
- Maximum Bandwidth Problem is a sub-problem of the Bandwidth-Constrained Routing Problem, the problem of identifying a path with at least a given amount of available bandwidth.
- Maximum available bandwidth path is also known as widest path it won’t give bandwidth assurances from source to destination.

IV. PROPOSED SYSTEM

Designing routing metrics is critical for performance in wireless mesh networks for bandwidth Performance using Adhoc On-Demand Multipath Distance Vector. The rare characteristics of mesh networks, such as Dynamic nodes and the shared nature of the wireless medium, not validate existing solutions from both wired and wireless networks and impose unique requirements on designing routing metrics for mesh networks. The system focus on identifying these requirements. System first analyzes the possible types of routing protocols that can be used and show that proactive hop-by-hop routing protocols are the most appropriate for mesh networks. Then, the system examines the requirements for designing routing metrics according to the characteristics of mesh networks and the type of routing protocols used.

System Architecture

System architecture is the conceptual model that defines the structure, performance, and more views of a system. An architecture explanation is a proper description and representation of a system, organized in a method that supports reasoning about the structures of the system. System architecture can contain system components, the externally obvious properties of those components, the relationships (e.g. the behavior) between them. It can offer a scheme from which products can be obtained, and systems developed, that will work collected to implement the complete system.

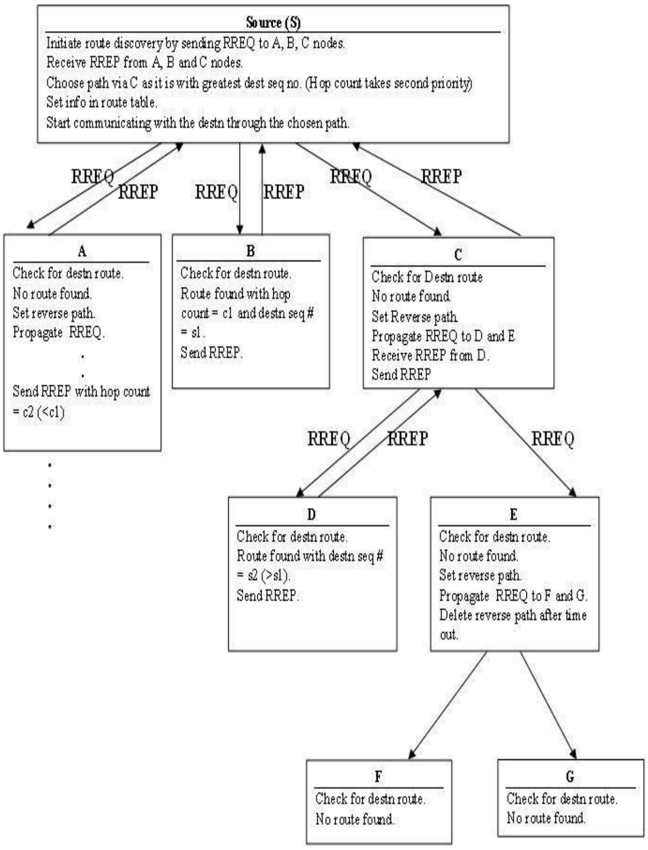

Fig. 3. Architecture of Complete System

Steps

1. Source 'S' has to send data to destination.
2. S sends RREQ to its next A, B, C.
3. B finds the path in its routing table (with destination seq-number s1 and hop count c1) and sends RREP to S.
4. C sets up reverse path.
5. C forwards RREQ to its neighbors D and E.
6. E sets up reverse path.
7. E forwards RREQ to its neighbors F and G.
8. E deletes the reverse path after a time out period as it does not receive any RREPs from F and G.
9. D finds the path (with dest seq-number s2 which is greater than s1 and hop count c1) in its routing table and sends RREP to C.
10. C receives RREP from D and sets up forward path and onward RREP to S.
11. A sets reverse path; forwards RREQ to its neighbors; receives RREP (with path of hop count c2 which is greater than c1); sets forward path; and forwards this RREP to S.
12. S receives a path info from C (with destn seq-number s2 and hop count c1), another path info from B (with destn seq-number s1 and hop count c1), and another path info from A (with destn seq-number x which is less than s1 and s2 and hop count c2 which is less than c1).
13. S chooses path info from C (which was originated from D), giving importance to the path with greatest destination sequence number and then second priority to the path with smallest hop count. Though route given by A is of smallest hop count, it is unnoticed because the destination sequence number is greater than the path from C.

Module Description

A. Topology Control
B. Protocol Design
C. Hop by hop routing in WSN

A. Topology Control

Topology control is a technique used in distributed computing to alter the underlying network (modeled as a graph) in order to reduce the cost of distributed algorithms if ran over the new resulting graphs. It is a basic terminology in distributed algorithm. For example, a minimum spanning tree is used as a backbone to reduce the cost of broadcast from m to n, where m and n are the number of edges and vertices in the graph respectively. The term topology control is consumed mostly by the wireless ad hoc and sensor networks research community.

The main aim of topology control in this domain is to save energy, reduce obstacle between nodes and extend lifetime of the network. Topology management refers to the inspect mechanisms required to autonomously organize a variable number of nodes into a connected network. In a tactical environment, it is important that the network be rapidly deployable to ensure connectivity among nodes in the shortest amount of time. It is also important that the network be rapidly reconfigurable to provide timely reactions to changes in the topology caused by node destruction and/or jamming of links.

Topology controls have been divided into two sub problems, Topology construction, in charge of the initial decrease, and topology maintenance, in amount of the maintenance of the reduced topology so characteristics like connectivity and coverage are preserved. This is the first step of a topology control protocol. Once the initial topology is deployed, especially when the location of the nodes is unplanned, the administrator has no controlled over the design of the network. For example, some zones may be very dense, showing a high number of unnecessary nodes, which will improve the number of message collisions and will provide several copies of the same information from similarly located nodes.

However, the administrator has control over some parameters of the network transmission power of the nodes, state of the nodes active or sleeping, that role of the nodes (Cluster head, gateway), etc. By modifying these parameters, the topology of the network can change. Upon the same time a topology is reduced and the network starts serving its resolution, the selected nodes start using the energy. The "optimal" reduced topology stops being it at the first second of full activity.

After some time being active, some nodes will start to pass out of energy. Particularly in wireless sensor networks with multi hoping, it is a fact that nodes that are closer to the sink spend higher amounts of energy that those farther away due to packet forwarding.

The network must restore the reduce network periodically in order to preserve connectivity, coverage, concentration, and any other metric that the application requires. A network design that takes into account the relative mobility of its nodes is better positioned to yield higher efficiency (responsiveness) and stability (adaptability) to highly dynamic topological changes by detecting correct and nearest neighboring nodes. The relative mobility of a node can be used to characterize the capabilities of the node in question with respect to its peer nodes over the resulting peer links.

Algorithm for neighboring broadcast,

1: initialize Grng $\leftarrow$ Ggg
2: for each I $\in$ V
3: for each j $\in$ N(i)
4: for each k $\in$ N(i)
5: if max (d(i, k), d(j, k)) < d(i, j)
6: remove j from N(i)
7: remove [i $\rightarrow$ j] from NL(i)

B. Protocol Design

MAC protocol design is an important aspect of meeting QoS, as a key contributor to latency in a wireless network is the contention occurring when accessing the shared medium. Access can be combined with channel assignment for meshes using multiple channels. If the number of transceivers on a node is smaller than the number of channels employed in the mesh, access can be combined with scheduling radio and channel use on different links. Several MAC protocols exist for both single channel and multi-channel meshes.

Prioritized access increases the probability of high-priority traffic transmitting before lower priority traffic. However, that alone is not sufficient to meet the latency restrictions for QoS. Wireless mesh networks present MAC design challenges beyond those of WLANs. Plentiful hidden nodes increasing the number of collisions. This, syndicate with the related approach needed when forwarding a multi-hop flow, reduced Quality of Service.

MAC enhancements for meshes are presented that reduces latency for mesh traffic while promoting co-existence with nearby WLANs. Wider contention windows for back off lower the risk of repeated unknown node collisions, a spatial expansion of the TXOP concept called 'express forwarding' clears multi-hop flows sooner, and a new mechanism called 'express retransmission' reduces collisions on retransmitted. Simulation results show the possible valve of the proposed enhancements. The subject of objectivity is reported, as well as conservation of QoS in close by WLANs.

The end-to-end delay experienced in a mesh multi-hop path may be longer than a simple multiple of the delay experienced for a single hop in a non-mesh environment. The prevalence of hidden nodes and the interaction of contention-based access with multi-hop flows increases collision rates and retransmissions, and lead to higher channel utilization per attempted transmission and ultimately to dropped frames and/or latency increases in Networks. These following equation shows protocol designed for number packets to be transferred to sink without any congestion in network.

Suppose burst size = M (k=M) and initially when the connection starts the $a_0^1 = q_0^1 = 0$

Average queue

$$a_n^k = a_n^M = a_5^{15} = w \times \sum_{i=1}^{n-2} i \times (1-w)^{nk-2-i} + w \times \sum_{j=1}^{k-1} \sum_{l=0}^{n-1} [j(n-1)-1+l] \times (1-w)^{nk-nj-l} = 4.17 \qquad (1)$$

Number of packets in the buffer will be

$$q_n^k = q_n^M = q_1^1 + k \times (n-1) = \qquad (2)$$

C. Hop by hop Routing in WSN

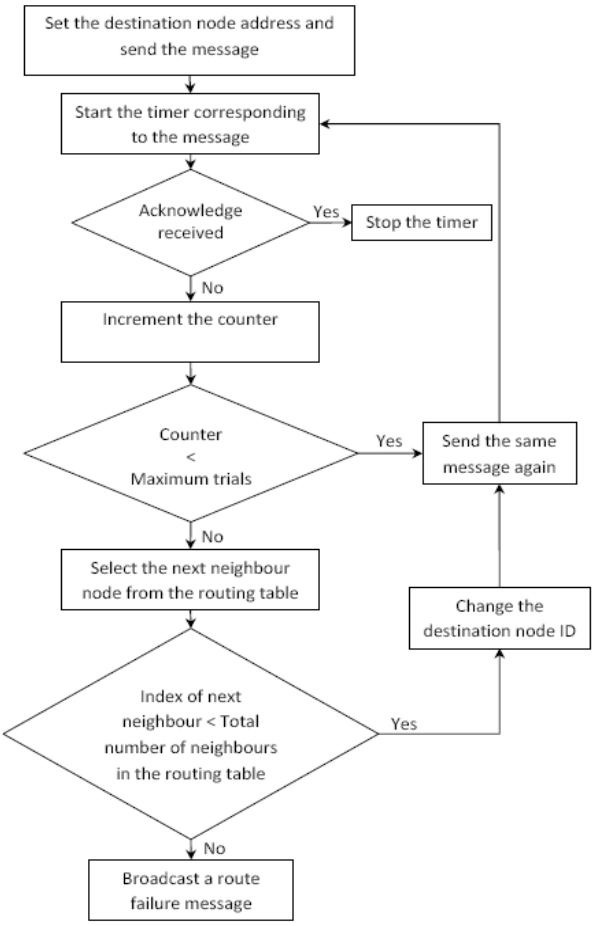

Fig. 4. Flowchart for Hop-count in WSN

The most significant obstacle to multi-hop communications in wireless sensor networks is high link error rate. This is an efficient hop-by-hop consistency support scheme is highly required. To identify the characteristics of two typical communication patterns in wireless sensor networks and address the problems of previous end-to-end sequence based hop-by-hop error recovery protocols, which cannot working correctly with route variation events and have a scalability problem with multiple senders. It uses hop-by-hop sequence numbers for hop-by-hop error recovery and operates in two separate modes depending on communication patterns and monitors for bandwidth assurances.

$$R = \frac{s}{T_{RTT}\sqrt{\frac{2}{3}p} + \mathrm{T}_{RTO}.3\sqrt{\frac{2}{3}p}.p(1+32p^2)} \quad (3)$$

Where,

R is the achieved rate,

s is the segment size,

p is the loss probability,

TRTT is the round-trip-time,

TRTO is the retransmit time-out (which can be approximated as 4*TRTT)

V. CONCLUSION & FUTURE WORK

Hop-count based localization algorithms offer a feasible solution despite these network constraints. Positioning based on hop-count is simple and distributed. In multihop sensor networks, the distance progressed by a broadcast is almost equivalent to the transmission range of the transmitting node. Thus, counting the minimum number of packet broadcast, i.e., hop-counts, between two nodes can be used to approximate the distance between the two communicating nodes. Besides, sensors usually have low mobility. During the period between hop-counts are disseminated and hop-counts are obtained by each node, the node positions do not change considerably with Bandwidth Guarantees. Thus, the linear relationship between hop-count and distance is consistent over time. Therefore, hop-count technique is suitable for localization in multi-hop and low-mobility wireless sensor networks.

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