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Performance Measurement of QOS Parameters of through put enhanced Wireless in Local Loop Architecture

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Abstract: *The number of subscribers in Wireless Networks such as Wireless in Local Loop (WiLL) is increasing thereby it becomes beneficial to use spectrum reusability techniques. To improve the capability of WiLL systems, multihop relaying is used. In the existing WiLL system, number of subscribers that can be simultaneously served is limited, with increase in subscriber density. It is to develop Throughput Enhanced Wireless in Local Loop (TWiLL) architecture that uses multi-hop relaying and shortcut relaying to reuse bandwidth of the system.In the existing WiLL system, the Throughput(30 Mbps) decreases with increase in time, Packet drop(20 kbps) increases with increase in time, Packet Delay (5 kbps) increases with increase in time.The technological challenges faced by the system are its performance output obtained by analyzing the Throughput, Packet Drop and Packet Delay of WiLLsystem is 25 Mbps less as compared to the performance output obtained by analyzing the Throughput, Packet Drop, Packet Delay of TWiLL system. The research focuses on designing a TWiLL system with a Throughput of about 56Mbps, Packet Drop of 18 kbps and Packet Delay of 3.2 kbps*
Keywords -*Multi-hop relaying, Single hop relaying, Shortcut relaying, Wireless in Local Loop*

I. Introduction

A Wireless in Local Loop (WiLL) system comprises of a set of fixed subscribers connected to the PSTN through a radio link as shown in Fig.1. The geographical region is separated into a number of cells and at center of each cell a Base Transceiver Station (BTS) is assigned. The BTS communicated with the fixed subscribers over the wireless link and PSTN over a wired link. The equipment which is used for communication with the BTS, at the subscriber premises is known as the Fixed Subscriber Unit (FSU).

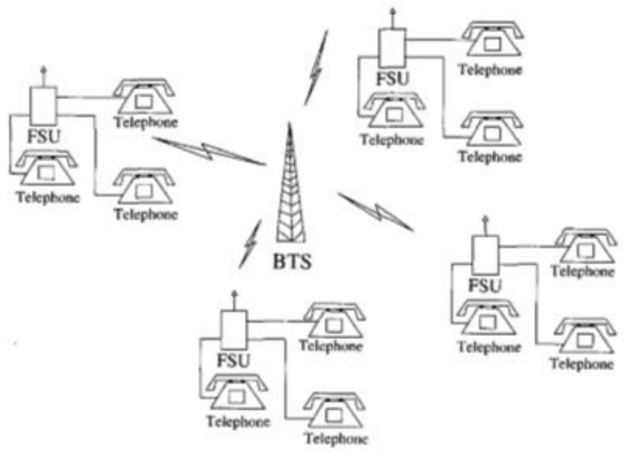

Fig 1 : Wireless in Local Loop System

WiLL systems offers many advantages like ease and low cost of deployment and maintenance. While the amount of subscribers in WiLL systems keep on increasing, the electromagnetic spectrum's capacity remains the same. Hence the number of subscribers that can be simultaneously served is limited. To overcome this limited usability Throughput Enhanced Wireless in Local Loop (TWiLL) systems are used. TWiLL is an architecture which uses methods like multi-hop relaying and single hop relaying to reuse system bandwidth. [1]

II. Literature Survey

The Performance measurement of qos parameters of throughput enhanced wireless in local loop architecture is evolved from various standard technical papers as mentioned below. These papers along with certain research work over the internet has enlightenmethods and techniques which are used towards the proposed approach presented in this paper.

In the papers,

[1] "Performance of the Throughput Enhanced Wireless in Local Loop Architecture Using Multi-dimensional Markov Chains", published in April 2005 by the authors, V Mythili, B. S. Manoj, and C. Siva Ram Murthy,

[2] "On Using Multidimensional Markov Chains for Performance Evaluation of Hybrid Wireless Networks", published in December 2006 by the authors, B.S.Manoj, V. MythiliRanganath, and C. Siva Ram Murthy, and

[3] "A Wireless in Local Loop Architecture Utilizing Directional Multihop Relaying", published in September 2004 by the authors, V. Mythili Ranganath, B. **S.** Manoj, and C. Siva Ram Murthy,the authors have explained aboutWireless in local loop (WiLL) systems that faces the limitation that with the increase in amount of subscribers in WiLL systems, the electromagnetic spectrum's capacity remains same. As a result the number of subscribers that can be simultaneously served is limited. This limitation can be overcome by using Throughput Enhanced Wireless in Local Loop (TWiLL) systems which makes use of multi hop relaying and shortcut relaying to reuse system bandwidth.

[4] In the paper, "Multihop Cellular: A New Architecture forWireless Communications", published in March 2000 by the authors, Ying-Dar Lin and Yu-Ching Hsu, authors state the limitations faced bynetworks with Single hop channels (SCN) about path vulnerability encountered in ad hoc networks and how it can be overcome by using multi hop channels (MCN) where multiple hops among bases are allowed which improve the throughput performance of the network.

[5] In the paper, "Integrated Cellular and *Ad Hoc* Relaying Systems:iCAR" published in October 2001, by the authors, Hongyi Wu, ChunmingQiao, Swades De, and OzanTonguz, the authors explain the limitations about the congestion problem due to unbalanced traffic faced by the conventional cellular networks and how it can be overcome by using the Integrated Cellular and Ad hoc Relaying Systems (iCAR) which improves the call blocking/dropping probability, throughput and signalling overhead of the system.

[6] In the paper, "Multi-hop Cellular Networks: The Architecture andRouting Protocols" published in October 2001, by the authors, Ananthapadmanabha R., B. S. Manojand C. Siva Ram Murthy, the authors extend the research work carried out by Ying-Dar Lin and Yu-Ching Hsu, and explain how the performance of MCNs is better than the SCNs under various load conditions (both TCP and UDP).

III. Problem Definition

- To design a TWiLL Network with 300 nodes, spread over a terrain of dimensions 2.01 km x 2.61 km.
- To implement basic communication in Mobile Network using AODV protocol having multiple communications channel.
- To implement Cluster Formation and Cluster Head Selection, a master node is selected in each cluster and rest of the nodes are taken as slave.
- To implement node communication in the form of Intra-cluster and Inter-cluster. In Intra-cluster nodes from the same cluster communicate with each other, whereas in Inter-cluster nodes from different clusters communicate with each other.
- To measure the performance evaluation, the analysis calculations of packet delivery ratio, throughput, End to End Delay, packet drop etc. is to be done

IV. Twill Architecture

TWiLL Architecture is as shown in Fig. 2. In TWiLL, every radio channel is selected as a multi-hop channel (MC) or a single-hop channel (SC).

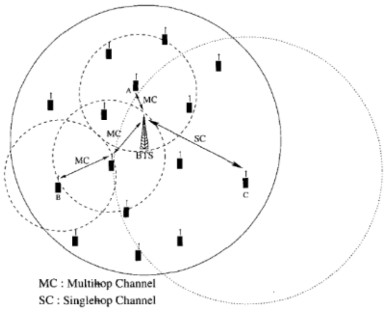

Fig.2 : The TwiLL Architecture

A node is also known as a Fixed Subscriber Unit (FSU) is used to transmit radio signals in a WLL system. Every node transmits a Single Hop Channel (SC) with a range of R which is cell radius, and multi hop channel (MC) with a range of r = R/2. Node A and node B are connected to the Base Transceiver Station (BTS) through multi-hop paths. Node A can reach the BTS over a one hop while Node B can reach the BTs with two hops. Node C cannot reach the BTS with multi-hops, hence it uses a single-hop channel (SC) to communicate with the BTS.[7]

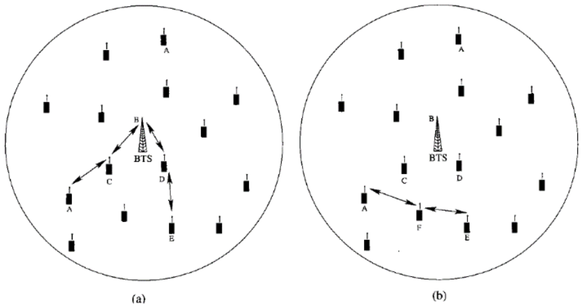

Fig. 3 : Call setup in TwiLL for local calls (locality = 1) (a) Normal relaying (b) Shortcut relaying

The locality (L) of the system can be defined as the probability that a calls destination is within a same cell as the calls source. In TWiLL, a technique called shortcut relaying uses the locality of the system to improve the throughput of the system. Fig. 3 (b) shows shortcut relaying while Fig.3 (a) shows normal relaying. In shortcut relaying, Node A sets up a call to Node E which is present in the same cell as node A. Under a normal WiLL system it does not need to go to node C and BTS, and from there establish a connection to node D and node E. Thus shortcut relaying improves the efficiency of the system as the node E is directly connected to node A, and it avoids the path to go from node C to BTS and then node D to node E. This path setup is coordinated by the BTS, as node A does not have the knowledge of the network topology.[8]

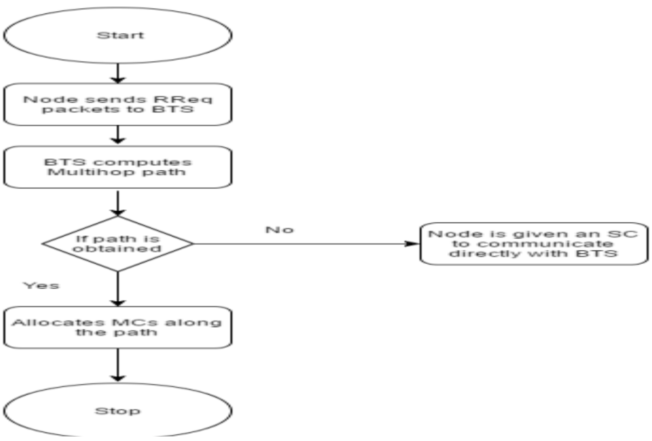

Fig.4 : Flowchart of Proposed TwiLL system with Normal Relaying

The flowchart is as shown in Fig. 4.

1. To start a call over the control channel, a node sends a Route Request (RReq) packet to the BTS.
2. The BTS computes a multihop path (MC) from the node to itself.
3. If a path is obtained, it allocates MCs along the path.
4. If such a path cannot be found, then the node assigns single hop channel (SC) to communicate directly with the BTS.

V. Simulation Results

To evaluate the performance of the TWiLL system, a network with 15 nodes is simulated in Network Simulator 2. The communication between the various nodes is analyzed and the Throughput and Packet Loss of the network is measured in the system.

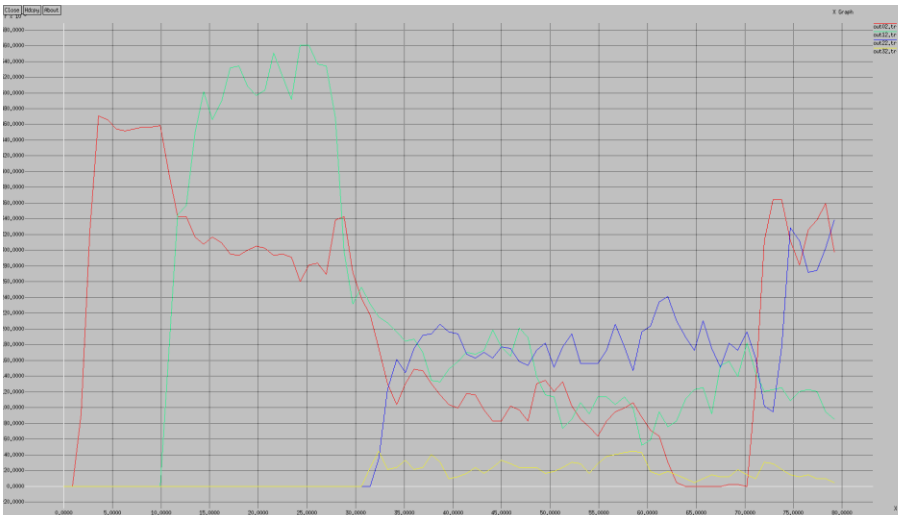

Fig.5 : Graph of Throughput between nodes

In Fig.5, the graph of throughput of the network is shown. Here the throughput of the network is analyzed. The throughput between the nodes 0 and 1 is shown through the red segment, between nodes 2 and 3 is shown through Green segment, between nodes 4 and 5 is shown through Blue segment and between nodes 6 and 7 is shown through yellow segment. It can be seen from the graph that all the nodes achieve a maximum throughput in the early stages but then the throughput decreases gradually, the nodes 0 and 1 achieve a throughput of 47 Mbps max, nodes 1 and 2 achieve a throughput of 56 Mbps, nodes 3 and 4 achieve a throughput of 32 Mbps and nodes 6 and 7 achieve a throughput of 40 kbps.

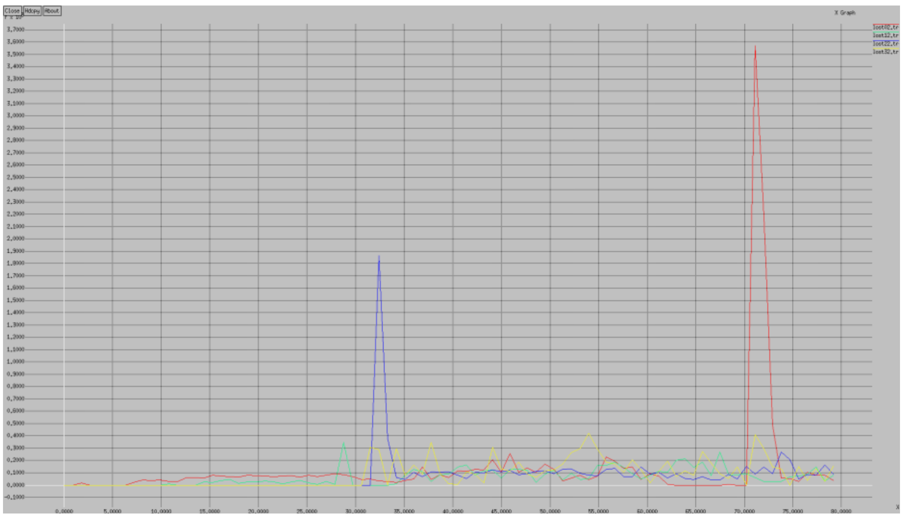

Fig.6 : Graph of Packet Drop between nodes

Fig. 6 shows a graph of Packet drop in the network. The packet drop between nodes 0 and 1 is shown by the red segment, the packet drop between nodes 2 and 3 is shown by the green segment, the packet drop between nodes 4 and 5 is shown by the blue segment, the packet drop between nodes 6 and 7 is shown by the yellow segment. It can be seen from the graph that there is no packet drop in the initial stages but later the packet drop increases. The packet drop between node 0 and 1 is maximum at 36 kbps, between nodes 2 and 3 is 3 kbps, between nodes 4 and 5 is 19 kbps and between nodes 6 and 7 is 4 kbps.

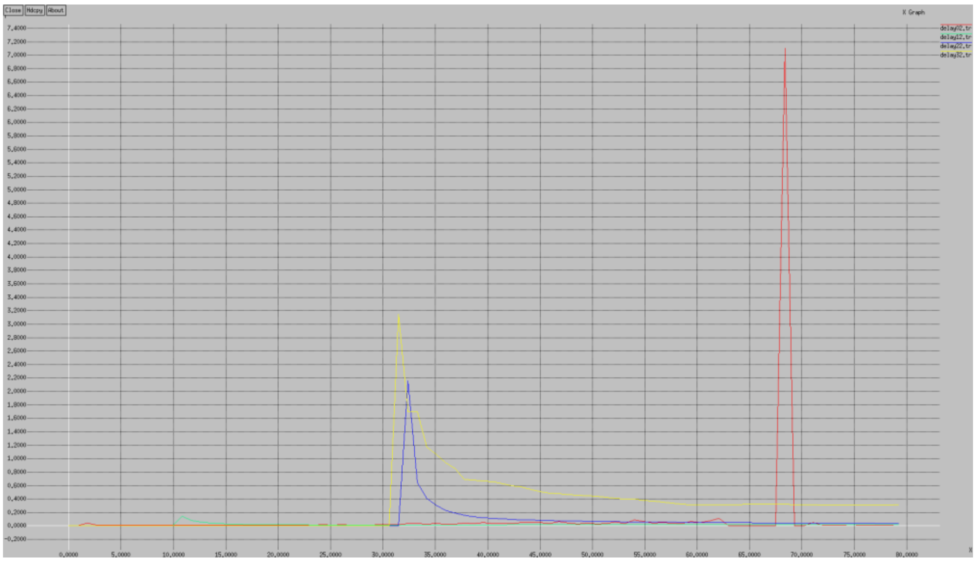

Fig.7 : Graph of Packet Delay between nodes

Fig. 7 shows a graph of Packet delay in the network. The packet delay between nodes 0 and 1 is shown by the red segment, the packet delay between nodes 2 and 3 is shown by the green segment, the packet delay between nodes 4 and 5 is shown by the blue segment, the packet delay between nodes 6 and 7 is shown by the yellow segment. It can be seen from the graph that there is no packet delay in the initial stages but later the packet delay increases. The packet delay between node 0 and 1 is maximum at 72 kbps, between nodes 2 and 3 is 2 kbps, between nodes 4 and 5 is 22 kbps and between nodes 6 and 7 is 32 kbps.

VI. Conclusion

Multihop relaying results in significant bandwidth reuse in WiLL architecture and thereforeTWiLL system performs steadily better than the traditional WiLL systems. It is observed that the TWiLL architecture provides a maximum throughput of 56 Mbps, Packet Drop of36 kbps and Packet Delay of 72 kbps. We have validated our analysis with experimental values from simulations and thus verified the correctness of our model.

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