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A Mechanism for Mobile Data Offloading to Wireless Mesh Networks

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Abstract- Wireless communications at its core is all about convenience – making it easy to apply a wide variety of network typologies quickly, easily, and cost-effectively. We often think of wireless in terms of a mobile device talking to a base station or access point – the point-to-multipoint topology, plus handoff between cells. And, normally, the interconnections between those cells use wire or perhaps a different form of point-to-point wireless. Suppose instead that the required interconnect was implemented as a form of relay, with one cell simply redirecting traffic wirelessly to the next, making it possible to implement almost any configuration; that's the domain of the wireless mesh. In this research a mechanism on mobile data offloading using wireless mesh networks is performed. In which one source node is connected with a sink node or we can say base station for communication. When there is a traffic in between the communication then the source node can change their base station or sink node. This mechanism is shown in further results.

Keyword- Mobile data offloading, HetNets, Queuing Theory, Incentive Schemes, Request Routing.

I. INTRODUCTION

As the growth of mobile data traffic places significant strain on cellular networks, plans for exploiting underutilized network resources become increasingly attractive. proposed design, and evaluate a data offloading architecture, where mobile users are offloaded to mesh networks, which are built and managed by residential users. It often known as Wi-Fioffloading is the use of complementary network technologies for delivering data originally targeted for cellular networks. Offloading reduces the amount of data being carried on the cellular bands, freeing bandwidth for other users. It is also used in situations where local cell reception may be poor, allowing the user to connect via wired services with better connectivity. Mobile data offload through Wi-Fi or Wi-Fi offload is one of the implementations of using small cell technologies like Wi-Fi to provide data services to cellular users in a more efficient and economically viable manner. Other small cell technologies like Femtocells etc. may also be employed for the same but Wi-Fi is garnering more attention from the cellular industry to cater to the rising data demand of the users. Smart devices today, are so designed that they prompt the user to log on to Wi-Fi networks for data transfer when one is in range as compared to cellular networks. But this kind of implementation is a very primitive one and is dependent on the user‟s choice to opt for Wi-Fi network or not. The standardization bodies like IETF, 3GPP, ITU etc. however, have been working to develop specifications for the implementation where the offload from cellular to Wi-Fi networks is more network-driven than user-driven. A typical implementation of Wi-Fi offload indicating selection and prioritization of different types of traffic between Wi-Fi and cellular network.

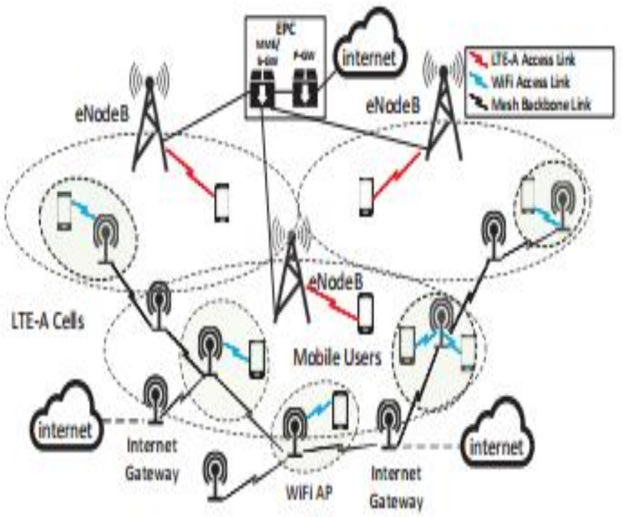

Fig 1: A multi-cellular LTE-A network serving mobile users that are partially covered by a WiFi mesh network.

II. WIRELESS MESH NETWORK

Multi-hop network built fromwireless routers More detailed: Multi-hop peer-to-peer wireless network in which nodes connect with redundant interconnections and cooperate with one another to route packets. Wireless mesh networks (WMNs) are the most efficient wireless technology when compared with the existing networks like ad-hoc, sensor networks etc. because of their advantages like automatic establishing and maintaining network connectivity, rapid deployment etc, it can be used in numerous applications. WMNs, are composed of mesh routers and mesh clients. Mesh routers have mobility and form the mesh backbone for mesh clients.

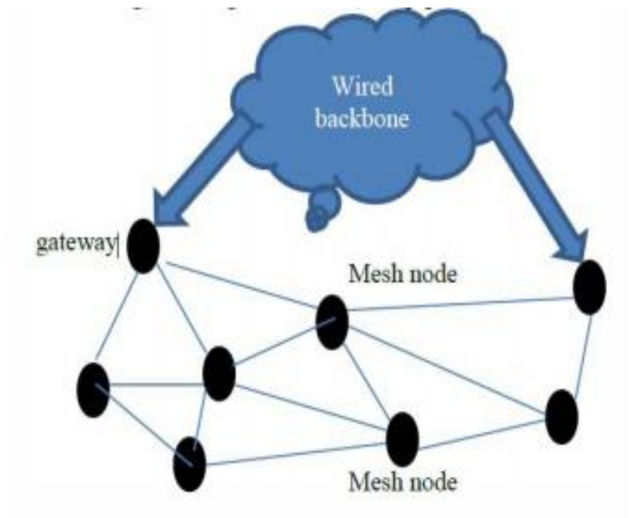

Fig 2: Wireless mesh network's

The characteristics of WMNs are explained as follows:

- Dynamic self-configuration and self-organization feature: The self-configuring feature provides easy and rapid deployment of WMNs and it also support self-organization.
- Adaptation: WMNs can adapt to the changes in the environment and it can reroute the data if any link failure occur.
- Fault tolerance and robustness: Mesh networks are redundant and hence it can provide a high level of fault tolerance and robustness.
- Multi-hop wireless network: WMNs will increase the coverage range of current networks without making any problem to channel capacity. It can provide non-line of sight connectivity within users without actual direct line of sight between them.
- WMNs have the capability of self-forming, self-healing, and self-organization and also support ad-hoc networking: WMNs increases the network performance, because of better network architecture, easy maintenance and configuration, fault tolerance, and robustness.
- Mobility dependence : Mesh routers have minimal mobility, while mesh clients can be stationary or mobile nodes.
- Multiple types of network access: WMNs support multiple types of network access. WMNs can be integrated with other wireless networks and providing services to end-users.
- Dependence of power-consumption constraints on the type of mesh nodes.
- With existing wireless networks it can provide Compatibility and interoperability.

III.LITERATURE REVIEW

Apostolos Apostolaras et.al in [1]studied cellular-to-mesh (C2M) data offloading for LTE-A cellular mobile users to WiFi mesh networks, which are built and managed collaboratively by users. Such networks are developed in the context of community networks or, recently, as commercial services among residential users. Mobile network operators can lease these mesh networks to offload their traffic and reduce their servicing cost. In this context, we introduce an analytical framework that determines which mobile users should be offloaded, based on the energy cost incurred to the cellular base stations (eNB) for serving their demands. Accordingly, we design a routing policy that the mesh network can employ so as to serve the offloaded traffic with the minimum possible cost. Moreover, the reimbursement offered by the operator should be dispensed to the different mesh users, according to their contribution and added-value significance. We address this issue by employing the Shapley value profit sharing rule, which ensures the participation of the mesh nodes in this joint task. We evaluate our work by simulating the operation of the LTE-A network, and conducting testbed experimentation for the mesh network. The results reveal significant savings for eNBs power consumption and compensation profits for mesh users.

Anusree Ajith et.al in [2] proposed an offloading algorithm which has low computational complexity. The proposed algorithm offloads data based on a balking function which is dependent on present network condition. Using extensive simulations, the authors demonstrate that the proposed algorithm achieves reduction in mean transmission delay without sacrificing much on the offloading efficiency. This technique is more efficient and applicable to real-time traffic, like live streaming video and audio, which has short and stringent delay requirements or deadlines.

Jeffrey G. Andrews et.al in [3] explained how several long-standing assumptions about cellular networks need to be rethought in the context of a load-balanced HetNet: we highlight these as three deeply entrenched myths that we then dispel. We survey and compare the primary technical approaches to HetNet load balancing: (centralized) optimization, game theory, Markov decision processes, and the newly popular cell range expansion (a.k.a. biasing), and draw design lessons for OFDMA-based cellular systems. We also identify several open areas for future exploration.

Yanjiao Chen et.al in [4] proposed a reverse auction framework for fair and efficient ACP transaction. Unlike strict outcome (the demand of bidder must be fully satisfied) in most of the existing works on auction design, the proposed auction model allows range outcome, in which WSP accepts partial demand fulfillment and Femtocell owners makes best-effort selling. We first propose a Vickery-Clarke-Grove (VCG) based mechanism to maximize social welfare. As the VCG mechanism is too time-consuming, we further propose an alternative truthful mechanism (referred to as suboptimal mechanism) with acceptable polynomial computational complexity. The simulation results have shown that the suboptimal mechanism generates almost the same social welfare and the cost for WSP as VCG mechanism.

George Iosifidis et.al in [5] considered a market where mobile network operators (MNOs) lease third-party deployed WiFi or femtocell access points (APs) to dynamically offload the traffic of their mobile users. We assume that each MNO can employ multiple APs and each AP can concurrently serve traffic from multiple MNOs. We design an iterative double auction mechanism that ensures the efficient operation of the market, where MNOs maximize their offloading benefits and APs minimize their offloading costs. Such a mechanism incorporates the special characteristics of the wireless network, such as the coupling of MNOs' offloading decisions and APs' capacity constraints. The proposed market scheme does not require full information about the MNOs and APs, incurs minimum communication overhead, and creates non-negative revenue for the market broker.

Oliver Arnold et.al in [6] developed such power models for macro and micro base stations relying on data sheets of several GSM and UMTS base stations with focus on component level, e.g., power amplifier and cooling equipment. In a first application of the model a traditional macro cell deployment and a heterogeneous deployment are compared.

Andrea Detti et.al in [7] proposed to integrate Software Defined Networking (SDN) principles in Wireless Mesh Networks (WMN) formed by OpenFlow switches. The use of a centralized network controller and the ability to setup arbitrary paths for data flows make SDN a handy tool to deploy fine-grained traffic engineering algorithms in WMNs. However, centralized control may be harmful in multi-hop radio networks formed by commodity devices (e.g. Wireless Community Networks), in which node isolation and network fragmentation are not rare events. To exploit the pros and mitigate the cons, our framework uses the traditional OpenFlow centralized controller to engineer the routing of data traffic, while it uses a distributed controller based on OLSR to route: i) OpenFlow control traffic, ii) data traffic, in case of central controller failure. We implemented and tested our Wireless Mesh Software Defined Network (wmSDN) showing its applicability to a traffic engineering use-case, in which the controller logic balances outgoing traffic among the Internet gateways of the mesh. Albeit simple, this use case allows showing a possible usage of SDN that improves user performance with respect to the case of a traditional mesh with IP forwarding and OLSR routing. The wmSDN software toolkit is formed by Open vSwitch, POX controller, OLSR daemon and our own Bash and Python scripts. The tests have been carried out in an emulation environment based on Linux Containers, NS3 and CORE tools.

Djohara Benyamina et.al in [8] surveyed different aspects of WMNs design and examine various methods that have been proposed either to improve the performance of an already deployed network or to improve its performance by a careful planning of its deployment.

D. Benyamina et.al in [9] proposed three multi-objective models for WMN planning problem, namely Load-Balanced Model, Interference Model, and Flow-Capacity Model. We devise an evolutionary swarm-based algorithm that is a hybrid combination of multi-objective Particle Swarm Optimization (MOPSO) and Genetic Algorithms (GAs) to solve the three models. We use realistic network sizes (up to 100 mesh nodes) to perform a thorough comparative experimental study on these three instance models with different key-parameter settings. Finally, we use the network simulator OMNET++ to evaluate the three models in terms of the actual performance (network throughput). The results presented in this paper show that Load-Balanced Model totally supersedes the Flow-Capacity Model and performs better than the Interference Model.

I.F. Akyildiz et.al in [10] presented a detailed investigation of current state-of-the-art protocols and algorithms for WMNs. Open research issues in all protocol layers are also discussed, with an objective to spark new research interests in this field.

IV. PROPOSED STUDY

In recent years, data traffic transmitted over cellular/mobile networks has seen a continuous exponential growth increasing by an order of magnitude every year. This unprecedented growth of data traffic can be attributed to a number of factors:-

1. Introduction of high-end devices such as smartphones, tablets, laptops, handheld gaming consoles, etc. that canmultiply traffic.
2. The growth in mobile network connection speeds that increase theaverage traffic per device(2G to 3G and 3G to 4G).
3. The rise of mobile video content which has higher bitrates than other mobile content types.
4. The availabilityof mobile broadband services at prices and speeds comparable to those of fixed broadband,together with the increasing trend towards ubiquitous mobility.
5. Thewidespread adoption of Machine-to-Machine (M2M) technologies across a range ofindustries is another contributing factor.

This increase indata traffic demand has led to a need for solutions to enhance capacity provision, wherebytraffic offloading to Wi-Fi is one means that can enhance realized capacity. Thoughoffloading to Wi-Fi networks has matured over the years, a number of challenges are stillbeing faced by operators to its realization.

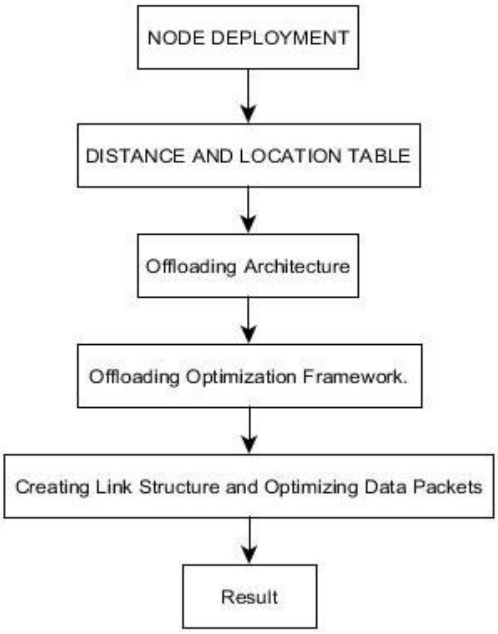

Fig 3: Flow Chart

As shown in flow chart first of all the nodes are deployed in a random manner. After deployment phase the distance and location table is generated so that the neighbor nodes and distance or positioning of neighboring nodes can be calculated. Now proposed architecture for minimum-cost servicing policyfor the mesh networks is applied on the network and which n turns provide link structure and optimal path using which the data packets can be moved from source to destination and using this propose architecture the strain on the WMN is reduced.

V. RESULTS AND DISCUSSION

Mobile data offloading, often known as Wi-Fi offloading, is the use of complementary network technologies for delivering data originally targeted for cellular networks. Offloading reduces the amount of data being carried on the cellular bands, freeing bandwidth for other users. It is also used in situations where local cell reception may be poor, allowing the user to connect via wired services with better connectivity.

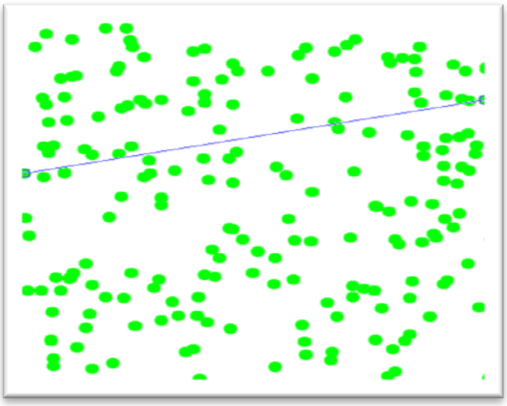

Fig 4: network area of source node and sink node

In these experiments, we use mobile data offloading techniques for wireless mesh network. In this technique mobile data offloading tells us about the traffic on the network. Firstly we define our source node and that source node defines his sink node or base station for new connection. If there is traffic in between the source node and the base station then source node can change his base station which has less traffic. In this fig 7.1 firstly we choose our source node and this source node then choose his base station or sink node for communication.

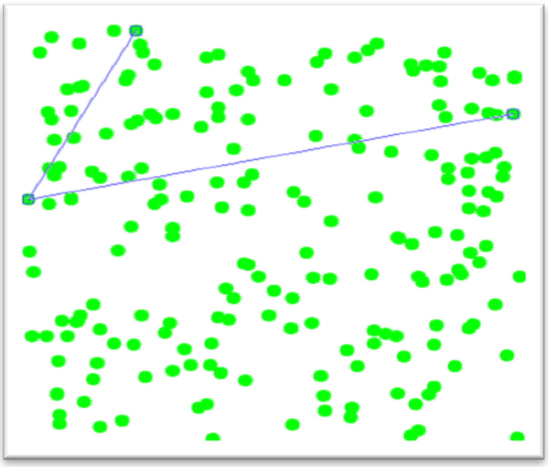

Fig 5 second sink node for the source node

In this fig 4 firstly we choose our source node and this source node then choose his base station or sink node for communication. If there should be traffic in between the communication then source node changed his base station as we shown in fig.

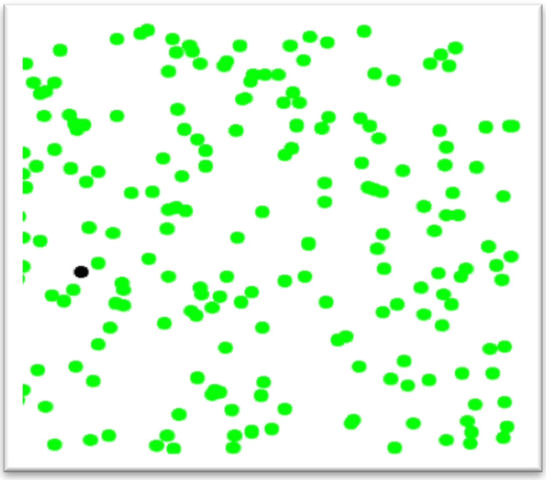

Fig 6: switch off mode of node or device

In this fig 6 it shows the disable mobile connection of any device. In this fig we can see node is in black color it means this node is in switch off mode when it switches on the color changes.

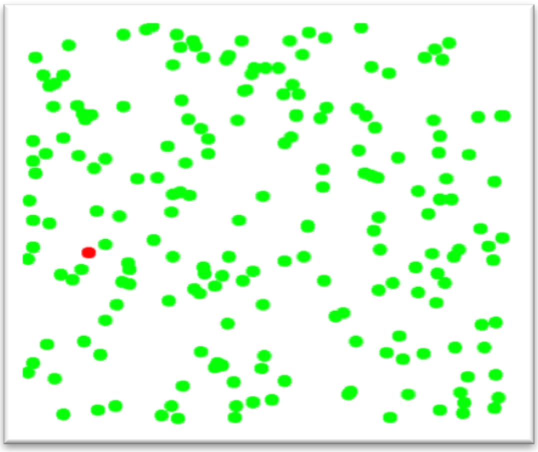

Fig 7: switch on mode of node

In this fig 7 it shows the enable mobile connection of any device. In this fig we can see node is in red color it means this node is in switch on mode.

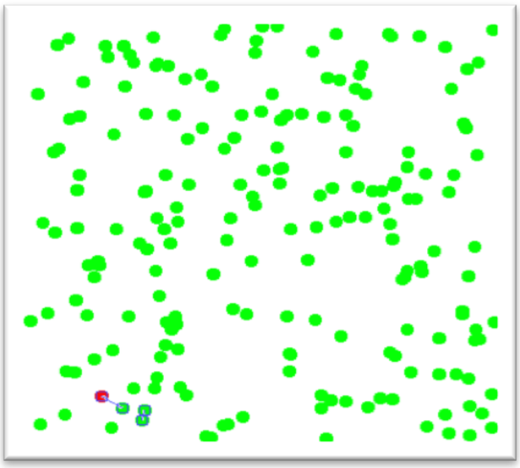

Fig 8: node connected with sink node

In this fig 8, it shows the source node connection with the nearest base station, when it turns switch on.

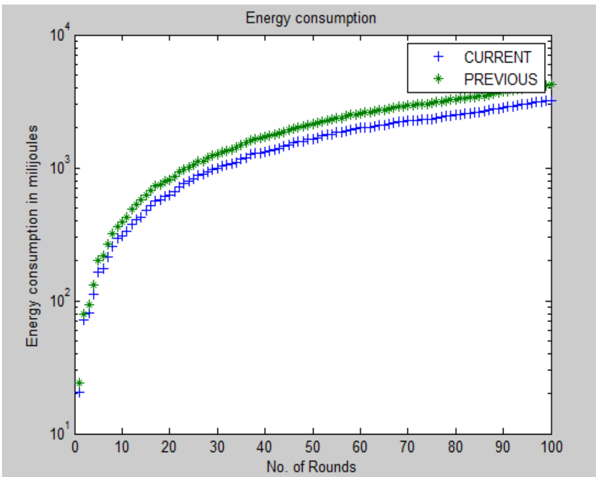

Fig 9 graph representation of energy consumption and no of rounds

In this fig 9, it shows the graph representation of energy consumption vs. numbers of nodes. As we can see in the graph the green color line shows the energy consumption of pervious method and the blue line shows the energy consumption of current method. The energy consumed by current method is less than previous method. So the current method is more useful than previous method.

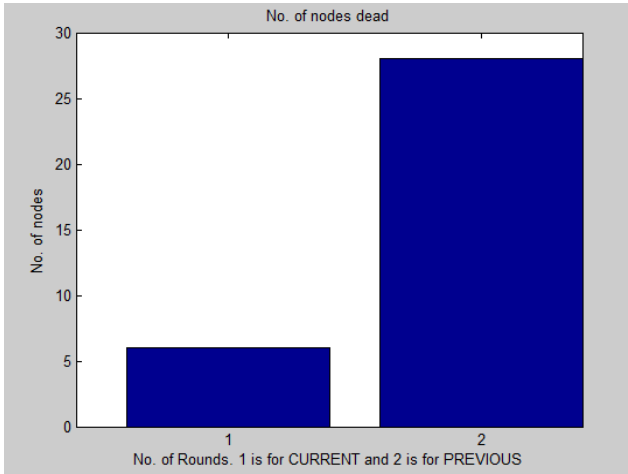

Fig 10: graph representation of no of nodes dead and no of rounds

In this fig 10, it shows the graph representation ofnumber of nodes deadvs. numbers of nodes. As we can see in the graph the dead nodes by current method is less than previous method. So the current method is more useful than previous method.

VI. CONCLUSION

Mobile data offloading is often known as Wi-Fi offloading is the use of complementary network technologies for delivering data originally targeted for cellular networks. Offloading reduces the amount of data being carried on the cellular bands, free bandwidth for other users. It is also used in situations where local cell reception may be poor, allowing the user to connect via wired services with better connectivity. In these results we can prove that our mechanism for mobile data offloading is better than all other previous mechanism. These results are shown in above results section.

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