AVOIDING CONGESTION AND IMPROVING QOS BY IMPLEMENTING WI-FI TECHNIQUE FOR MOBILE DATA OFFLOADING

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ABSTRACT

Mobile data traffic rate increasing gradually in recent years which causes so many problems in the Network such as Congestion as well as Quality of Services provided to the customer is very poor due to this heavy traffic. A recent analysis show how the data traffic is raised in the past decade i.e. the percentage of data traffic growth in 2013 is around 81 % globally. Global Mobile data traffic reached 1.5 Exabyte's per month at the end of 2013, from 820 petabytes per month at the end of 2012, this much of data moving in the network with these smart phone technologies or with 3g/4g mobile technologies. Smart devices occupies 21 % of the total mobile devices and connections in 2013,along with text content people also accessing the audio, video, image data through their smart devices. In this paper we are proposing Wi-Fi technology which provides solutions for the following problems "How to reduce the traffic generated by smart devices in the network" and "How it improves the Quality of Services to the customers".

Keywords: WiFi offloading, QoS, congestion

I. INTRODUCTION

Globally data traffic generated from smart or mobile devices rapidly due to the access features provided by these devices, in general when we want to access the network we need a personal Computer that is having the connection of internet, when we want to access the network it took around few minutes and there is no mobility but smart phones offers mobility as well as we can connect to the network in a few seconds whenever we want. Instantly we can log in to a particular site, browse so many web pages ,download the audio/video content, we can also attend some video conferences as well as. Smart phone usage grew globally 50 percentage in 2013,the average amount of traffic per smart phone in 2013 was 529MB per-month, up from 353 MB per month in 2012.some of the interesting facts shows that only 27 percentage of total global handsets in use in 2013,but resented 95 percent of total global handset traffic. In 2013, the typical smart phones generated 48 times more mobile data traffic than the typical basic-feature cell phones. According to Cisco study report on mobile data traffic there were nearly 22 million wearable devices in 2013 generating 1.7 petabytes of monthly traffic. The following table gives an overall view of the mobile data traffic in all over countries as well as Rapid growth of smart phone devices forecasting by the year 2018.

TABLE 1.OVER VIEW OF MOBILE DATA-TRAFFIC AND SMART PHONE DEVICES GROWTH

Device Type	Growth in Devices, 2013–2018 CAGR	Growth in Mobile Data Traffic, 2013–2018 CAGR
Smartphone	18%	63%
Tablet	41%	87%
Laptop	13%	30%
M2M Module	43%	113%

From the above table we can conclude that to facilitate that much of traffic we need to develop some measure to control the congestions and How to improve the Quality of Services, we can achieve this by mobile data offloading. Mobile Data Offload also called "offloading" is a group of techniques used to move traffic from mobile/cellular networks to other networks, in order to alleviate congestion and allow better use of available mobile network resources. The strategy is often talked about as one of the solutions to the "capacity crunch". The aim is to maintain QoS and a good customer experience, while also reducing both the cost and impact of carry capacity-hungry and QoS-sensitive services such as video on the mobile network. Statistics shows that how much importance the offloading has, so most of the people choosing their carrier in providing offloading services.

The networks can either build denser networks with new masts closer together, or offload the data to wired networks. Of course, they are doing both. However, it takes a long time to build out cellular networks. This is driving carriers to offload data to their own and other people's Wi-Fi networks, and to "small cell networks" such as micro-, pico- and femtocells. The "small cell" networks allow the carriers to provide mobile services that are not currently possible with Wi-Fi. So that, Offloading is an effective network congestion reduction strategy to solve the overload issue compared to scaling and optimization. It enables network operators to reduce the congestion in the cellular networks, while for the end-user it provides cost savings on data services and higher bandwidth availability. Wi-Fi is the one of the most small cell technologies which is having a feature of Cost-Effective mean of offloading large amount of mobile data traffic while delivering a variety of services. Wi-Fi uses a local wireless network to transfer information. Its coverage is therefore limited to a building or a public space. To surf on your phone, you must have a Wi-Fi device. Downloading data on your smart phone is faster than the uploading the data. Wi-Fi is more efficient and uses less battery in mobile phones than the 3G radio while associated with an access point. It will use less power than the 2G technology.

II. WI-FI NETWORK ARCHITECTURE

When we are using Wi-Fi network for Mobile data offloading, we need to take care of the following things:

A. Authentication
B. Policy and Charging Control
C. IP Persistence
D. WLAN Access Gateway
E. Packet Data Gateway

A. Authentication: Authentication is used for ensuring that only authorized subscribers can access the network. To control who can access the Wi-Fi network various authentication methods are used and these authentication methods also helps to determine the subscribers as well as device types that can be addressed in a particular network. The authentication methods are Portal Based Authentication and EAP authentication.

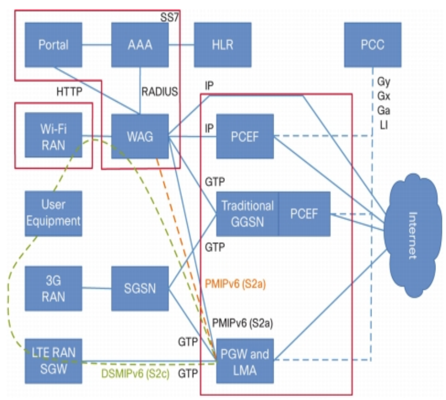

Fig.1 Network Architecture

1) Portal-Based Authentication: Portal-based authentication depends on Layer 3 connectivity to the network and HTTP communication before granting access to the subscriber. The Wireless Internet Service Provider Roaming (WISPr) standard also uses HTTP communication with the portal for automatic authentication, with the user device launching HTTP communication in the background without user intervention.

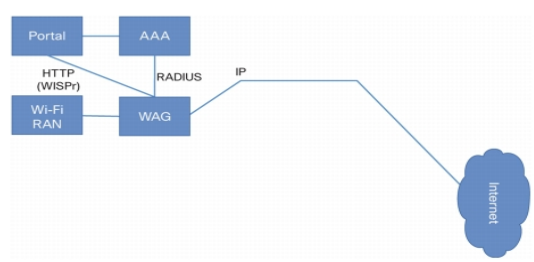

Fig. 2 Portal-Based Authentication Architecture

In the above figure we have WAG which block all IP communication for the unknown subscribers and redirects the HTTP connection to a captive portal. Captive portal authentication supports:

- Users that have login id and password
- Guest users can only need to supply mail-id
- A simple accept policy button
- A splash page

Fig. 3 Default Captive Portal Page

When user login into the captive portal successfully with valid details WAG will signaled by the AAA server. From this moment subscriber will be known in the AAA cache and WAG allows subscriber to send and receive data, it also stores the Users MAC address is also cached in the AAA server, together with the user data and granted service. When the subscriber leaves from Wi-Fi coverage area and then returns, the subscriber device will be recognized by the WAG based on the MAC address and authenticated automatically against records stored in AAA server, so the subscriber is not repeatedly redirected to the portal after losing Wi-Fi coverage.

2) EAP Based Authentication: In this authentication method Devices with SIM cards encapsulate the SIM application information exchange into the EAP message and these are proxied by the AAP server to the Home Location Register (HLR) for authentication. So that, there is a definite need of connection between the AAA server and HLR. The architecture of EAP based authentication is shown in the below figure.

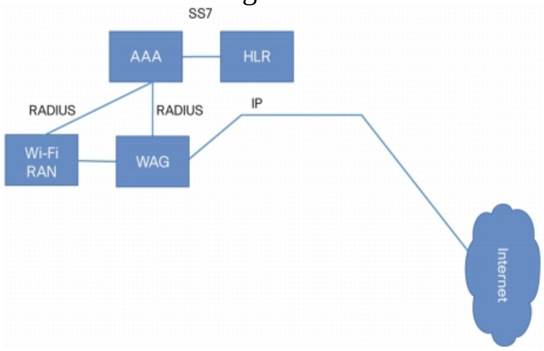

Fig. 4 EAP authentication Architecture

B. Policy and Charging Control: An important concern from the mobile operators is the availability of similar or identical policy enforcement and charging rules for the subscriber, regardless of the RAN being used. Therefore, the design of PCC integration is a crucial part of Wi-Fi offload. An efficient PCC integration is method follows reuse of the elements deployed for the 3GPP services.

C. IP Persistence: There are 2 types of persistence's i.e. 1. Destination Address Affinity Persistence- it's also called as sticky persistence which supports TCP& UDP protocols, and directs session requests to the same server solely based on the destination IP address of a packet. 2. Source Address Affinity Persistence- it's also called as simple persistence, which supports TCP & UDP protocols and directs session requests to the same server solely based on the source IP address of a packet. We can describe how to handle mobile data traffic using traditional 3G communication and Wi-Fi access network to off-load traffic from the 3G access network by using the following diagram. From the above figure on the left side we have shown a mobile device and two wireless access networks, a Wi-Fi access network and a 3G access network. Generally mobile users use Wi-Fi access network to communicate with the internet because it offers a higher band width and it's also beneficial to the mobile operator because traffic is offloaded from 3G network that has limited resources. The middle part of the diagram depicts the mobile operator infrastructure that is required to integrate the access network with the backend system. 3G infrastructure contains SGSN and GGSN nodes along with I-WLAN nodes that allow the mobile operator to establish a controlled communication channels between the Wi-Fi user and the content provider. Controlling the channel allows the operator to offer better services but also to charge for these services.

D. WLAN Access Gateway: The WLAN access gateway is responsible for routing the data to/from the WLAN access network and the data gate way. It is the first node that interacts with the Wi-Fi network. The following are functions of the WLAN:

- Makes sure that packets are routed to the PDG.
- Supports QoS mechanism if they are applied.
- Discards data Packets that shall not be forwarded to the PDG.

E. *Packet Data Gateway (PDG):* It is responsible for authentication of a mobile device and the authorization of to select devices.PDG will take care of assigning IP address for the mobile devices and maintains routing information for the mobile devices. It applies QoS mechanisms that allow operators to provide quality for different users and traffic types.

In the below diagram we have shown two different networks are used to content or data providers. Internet provide a best effort communication service and High-Quality-Network is used to provide guaranteed bandwidth for services like HD videos, high-speed backup services etc.

III. PERFORMANCE MEASURES

The performance of mobile offloading is highly depends on user mobility and Wi-Fi coverage. To find out Wi-Fi signals and for trouble shooting the Wi-Fi network problems we are using InSSIDer tool. It contains a network table that displays nearby access points, the information associated with network tables.

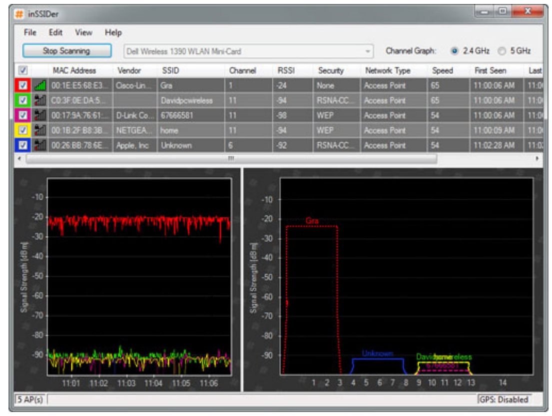

Fig. 5 InSSIDer Tool

- ✓ MAC address
- ✓ Service Set Identifier
- ✓ Received Signal Strength Identification
- ✓ Channel
- ✓ Security
- ✓ Network Type
- ✓ Vendor

MAC address is unique a wireless network. In an infrastructure network this will be the radio`s MAC address. In ad-hoc network it will be pseudo randomly generated MAC address. Service Set Identifier which is the name an 802.11 wireless network uses to identify itself. The received Signal Strength Identification which is the amplitude level of the wireless network as seen by a computers wireless card. Each wireless network operates on a specific channel; channels 1-14 are operated on 2.4 GHz frequency range and channel 30-160 are in the 5GHz range. Vendor contains the information relating to hardware vendor of an access point and also the maximum rate that each access point is capable of. Security options available are open, WEP, WPA personal, WPA-Enterprise, Wi-Fi protected setup etc.

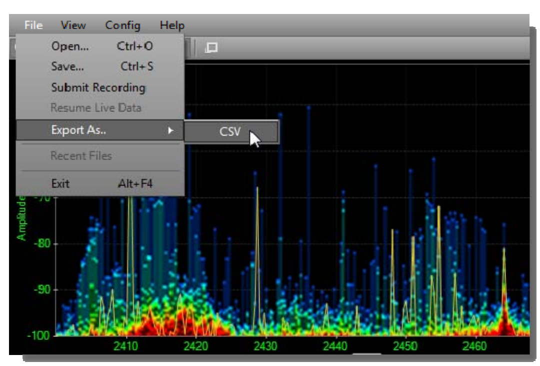

Fig.6 Extracting the Data

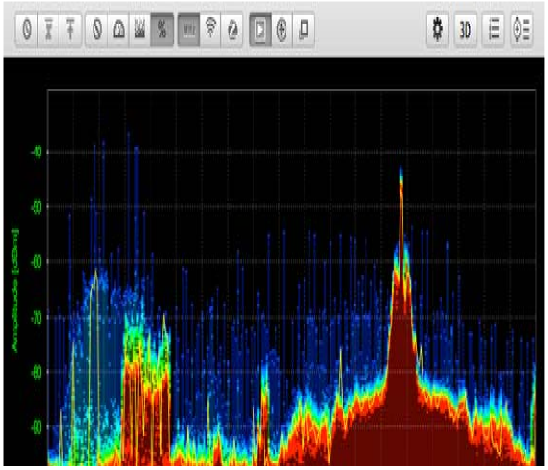

Fig. 7 Recognizing best Wi-Fi channel

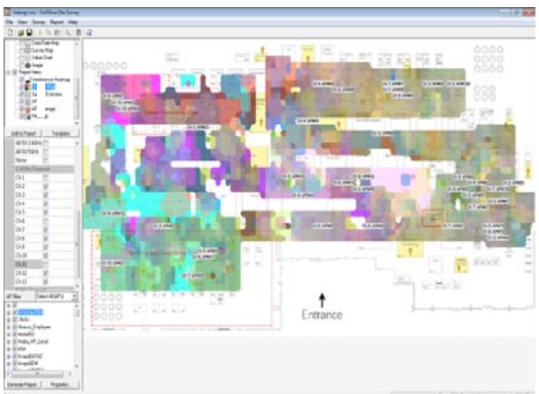

Fig. 8 Report Data

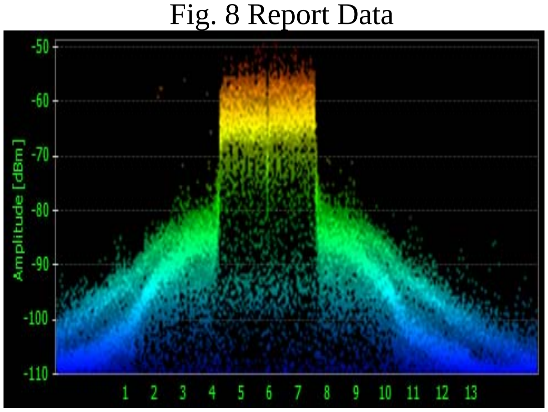

Fig. 9 Density View

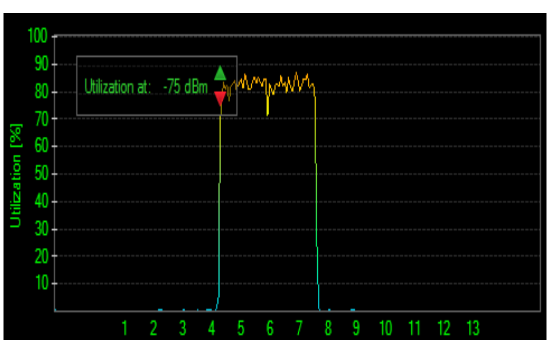

Fig. 10 Utilization View in 75-dBm

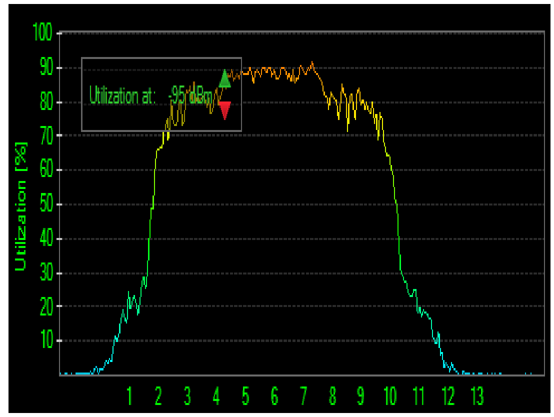

Fig. 11Utilization View in 95-dBm

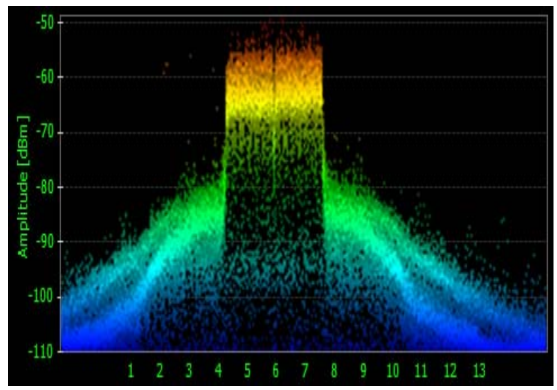

Fig. 12 Density View

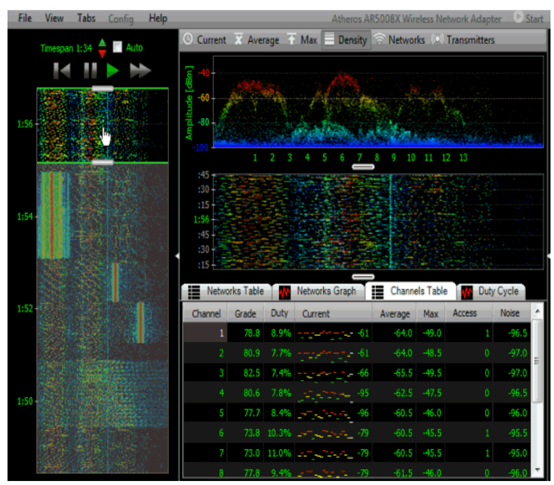

Fig. 13 Time Segment Analysis

IV. Conclusion

Wi-Fi offloading provides a number of benefits for users, carriers, and their Wi-Fi network partners. At the same time Wi-Fi offloading is complex and demands that carriers thoroughly test it to ensure a transparent, high-quality experience for customers. To improve the success of Wi-Fi offloading leaders of mobile carriers, NEMs, and Wi-Fi partners must be familiar with the unique challenges of Wi-Fi offload. So that we can conclude that Wi-Fi offload will improve the QoS provided to the customer also reduces the major problem of congestion in the network, so therefore increased reliability, speed and performance can be achieved.

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