A Review: Mobile Data Offloading By LTE Offloading Scheme

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Abstract

Wi-Fi offloading is regarded as one of the most promising techniques for dealing with the explosive data increase in cellular networks due to its high data transmission rate and low requirement on devices. In this thesis, we investigate the mobile data offloading problem through a third-party Wi-Fi access point (AP) for a cellular mobile system. In particular, we consider three scenarios:

1) Successive interference cancellation (SIC) available at both the base station (BS) and the AP. According to base paper utility of operator is 10 Mbps when the numbers of users are maximum by threshold -based distributed data offloading scheme.

2) SIC available at neither the BS nor the AP. Base paper proposed threshold -based distributed data offloading scheme. When the SIC decoder is available at BS (base station) and AP(Access point ) then the utility of the operator is near about 7-8 Mbps .

3) SIC available at only the BS.

In this paper, we suggest LTE offloading scheme improves the performance of the cellular operator maximize its utility. According to the proposed methodology, LTE offloading scheme utility of the operator will increase for all the three scenarios.

Keywords- Access point, Base station, Long Term Evolution.

Introduction

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 [1].

Rules triggering the mobile offloading action can be set by either an end-user (mobile subscriber) or an operator. The code operating on the rules resides in an end-user device, in a server, or is divided between the two. End users do data offloading for data service cost control and the availability of higher bandwidth. The main complementary network technologies used for mobile data offloading are Wi-Fi, femtocell and Integrated Mobile Broadcast. It is predicted that mobile data offloading will become a new industry segment due to the surge of mobile data traffic [2].

Mobile Data Surge

Increasing need for offloading solutions is caused by the explosion of Internet data traffic, especially the growing portion of traffic going through mobile networks. This has been enabled by smart phone devices possessing Wi-Fi capabilities together with large screens and different Internet applications, from browsers to video and audio streaming applications. In addition to smart phones, laptops with 3G access capabilities are also seen as a major source of mobile data traffic. Additionally, Wi-Fi is typically much less costly to build than cellular networks. It has been estimated that the total Internet traffic would pass the 500
exabytes/year milestone in 2013 [1]. Annual growth rate of 50% is expected to continue and it will keep out phasing the respected revenue growth.

Wi-Fi and femtocell technologies are the primary offload technologies used by the industry. In addition, Wi Max and terrestrial networks (LAN) are also candidates for offloading of 3G mobile data. Femtocell use standard cellular radio technologies, thus any mobile device is capable of participating in the data offloading process, though some modification is needed to accommodate the different backhaul connection. On the other hand, cellular radio technologies are founded on the ability to do network planning within licensed spectrum. Hence, it may turn out to be difficult, both technically and business wise, to mass deploy femtocell access points. Self-Organizing Network (SON) is an emerging technology for tackling unplanned femtocell deployment (among other applications). Wi-Fi technology is different radio technology than cellular, but most Internet capable mobile devices now come with Wi-Fi capability. There are already millions of installed Wi-Fi networks mainly in congested areas such as airports, hotels and city centres and the number is growing rapidly. Wi-Fi networks are very fragmented but recently there have been efforts to consolidate them. The consolidation of Wi-Fi networks is proceeding both through a community approach, FON as the prime example, and by the consolidation of Wi-Fi network operators [1] [2].

Wi-Fi offloading is an emerging business domain with multiple companies entering to the market with proprietary solutions. As standardization has focused on degree of coupling between the cellular and Wi-Fi networks. The competing solutions can be classified based on the minimum needed level of network interworking. A further classification criterion is the initiator of the offloading procedure [1].

Cellular and Wi-Fi Network Interworking

Depending on the services to be offloaded and the business model there may be a need for interworking standardization. Standardization efforts have focused on specifying tightly or loose coupling between the cellular and the Wi-Fi networks. 3GPP based Enhanced Generic Access Network architecture applies tight coupling as it specifies rerouting of cellular network signalling through Wi-Fi access networks. This makes Wi-Fi a de facto 3GPP RAN. 3GPP has also specified an alternative loosely coupled solution for Wi-Fi. The approach is called Interworking Wireless LAN (IWLAN) architecture and it is a solution to transfer IP data between a mobile device and operator’s core network through a Wi-Fi access. In the IWLAN architecture, a mobile device opens a VPN/IPsec tunnel from the device to the dedicated IWLAN server in the operator’s core network to provide the user either an access to the operator’s walled-garden services or to a gateway to the public Internet. With loose coupling between the networks the only integration and interworking point is the common authentication architecture.

The most straightforward way to offload data to the Wi-Fi networks is to have a direct connection to the public Internet. This no coupling alternative omits the need for interworking standardization. For majority of the web traffic there is no added value to route the data through the operator core network. In this case the offloading can simply be carried out by switching the IP traffic to use the Wi-Fi connection in mobile client instead of the cellular data connection. In this approach the two networks are in practice totally separated and network selection is done by a client application. Studies show that significant amount of data can be offloaded in this manner to Wi-Fi networks even when users are mobile.

However, offloading does not always mean reduction of resource consumption (required system capacity) in the network of the operator. Under certain conditions and due to an increase of the burstiness of the non-offloaded traffic (i.e. traffic that eventually reaches the network of the operator in a regular way), the amount of network resources to offer a given level of QOS is increased. In this context, the distribution of offloading periods turns out to be the main design parameter to deploy effective offloading strategies in the network of MNOs making non-offloaded traffic less heavy-tailed, hence reducing the resources needed in the network of the operator [1].

SIC

Successive interference cancellation (SIC) is a well-known physical layer technique [3]. Briefly, SIC is the ability of a receiver to receive two or more signals concurrently (that otherwise cause a collision in today’s systems). Successive interference cancellation (SIC) is a physical layer capability that
allows a receiver to decode packets that arrive simultaneously. SIC is possible because the receiver may be able to decode the stronger signal, subtract it from the combined signal, and extract the weaker one from the residue. Emerging software radio platforms, such as GNU radios, are making practical implementations of SIC feasible [3].

**Problem Statement**

Wi-Fi offloading is regarded as one of the most promising techniques for dealing with the explosive data increase in cellular networks due to its high data transmission rate and low requirement on devices. Utility of the operator is the main issue in the cellular network. Base paper is working at threshold-based distributed data offloading scheme [4] [5]. They find three possible conditions and give the solution for that. Conditions are

1) Successive interference cancellation (SIC) available at both the base station (BS) and the AP. According to base paper utility of operator is 10 Mbps when the number of users is maximum by threshold-based distributed data offloading scheme.

2) SIC available at neither the BS nor the AP. Base paper proposed threshold-based distributed data offloading scheme. When the SIC decoder is available at BS (base station) and AP (Access point) then the utility of the operator is near about 7-8 Mbps.

3) SIC available at only the BS. Utility of the operator goes from 6-9 Mbps [4] [5].

In the base paper utility of the operator is increasing by SIC decoder. But it can be further improved. Utility of the operator can be increase. So in this thesis we will improve the performance of utility of the operator.

**Proposed Methodology**

**LTE**

LTE, an abbreviation for Long-Term Evolution, commonly marketed as 4G LTE, is a standard for wireless communication of high-speed data for mobile phones and data terminals. It is based on the GSM/EDGE and UMTS/HSPA network technologies, increasing the capacity and speed using a different radio interface together with core network improvements.[26][27] The standard is developed by the 3GPP (3rd Generation Partnership Project).

LTE is the natural upgrade path for carriers with both GSM/UMTS networks and CDMA2000 networks. The different LTE frequencies and bands used in different countries will mean that only multi-band phones will be able to use LTE in all countries where it is supported.

The packets are initially sent over LTE. Once the Wi-Fi coverage is available, the data is offloaded to the Wi-Fi air interface. Due to the created congestion on the Wi-Fi, we have developed an acknowledgment mechanism that allows the UE (user equipment's) to transmit back to the small cell either a positive acknowledgment (ACK) or a negative acknowledgment (NACK) for each received packet. A NACK is declared if a particular packet index is missing. Once a NACK is declared, the erroneous packet is retransmitted over the LTE interface. The LTE is utilized to guarantee a congestion-free retransmission. As for the next new packet, the Wi-Fi is activated again and it carries the upcoming packet. Hence, the description in the name “Retransmit-Once.” This procedure continues until the data frame is successfully received.

**Conclusion**

We have investigated the mobile data offloading problem through a third-party Wi-Fi AP for a cellular mobile system. From the cellular operator’s perspective, we have formulated the problem as a utility maximization problem. By considering whether SIC decoders are available at the BS and/or the Wi-Fi AP, different cases are considered. When the SIC decoders are available at both the BS and the Wi-Fi AP, the utility maximization problem can be solved by LTE offloading scheme. For above all three possible conditions they are checking the utility of the operator (in Mbs). For improvement and research work we suggest a LTE based offloading scheme by which utility of the operator for all three possible conditions just get increase.

**References**

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Urban Environments" ISBN 978-3-901882-68-5 c 2015 IFIP.


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