A review on recent trends in mobile traffic offloading based on behavioural pattern of the offloading users

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Abstract: There is a need to find a specific answer to this question that how technically and in relation to market development, traffic off-loading will be evolving over time, and how does this evolution will influence the necessity for bandwidth? It is broadly acknowledged that remarkable adaption of Smartphone's and tablets has resulted into the rapid growth of traffic on the macro cellular network. In this paper we have reviewed Smartphone user's behaviour while offloading mobile traffic data from cellular network to Wi-Fi networks. This involves certain observations made on distributed mobile traffic management system and the relevant factor moving the amount of mobile data traffic on Smartphones. The model reviewed in this paper possibly will bear out constructively to analyze the behaviour of Smart device owner while offloading data and to predict the likelihood that a user with specified features will go down into a given data offloading category.

Keywords: Mobile data traffic offloading, Wi-Fi AP's

1. INTRODUCTION

In developed countries, mobile data traffic every month for each Smart phone will approach 25 GB by 2022. The traffic will skyrocket in just six years, rising by as much as 1000 per cent[1]. The cost of sustaining an acceptable performance is also growing dramatically as a result of this exponential rise. The expense is a huge user experience influencer [2]. And the major percentage of 95 of data will be generated by mobile networks, also static traffic is still much higher than mobile traffic, the mobile data flow expansion rate (66 percent) exceeds the static system data flow (21 percent) by a wide margin[3].

Table 1. percentage of internet users in regional population

Region	2018	2023
Global	51 percent	66 percent
Asia	51 perecnt	72 percent
Eastern Europe	65 percent	78 percent
America	60 percent	70 percent
Africa Middle East and	24 percent	35 percent
Northern America	90 percent	92 percent
Western parts of Europe	82 percent	87 percent

Mobile Data offloading is a solution which will use Wireless-Fidelity to minimize the rate of data being transmitted to the cellular network, there by opening bandwidth to other subscribers. The solution take into consideration the degree of coupling that is the interdependence between the cellular network and Wireless-Fidelity, that becomes higher when Wi-Fi access points are introduced by the mobile network operator itself and low vice-versa, because

there is no connection which is already pre-established between the two networks. The volume of traffic previously off-loaded, mainly to home Wi-Fi, already exceed in volume as compared to cellular network, and it's expected that it will increase in the near future. This is the result of the constant efforts done by service provider and standards bodies to develop both Wireless-Fidelity and cellular protocols in order to improve internal working among the two and to have the optimal use of the spectrum.

Cellular network providers are conscious that use of Wi-Fi networks is a vital component of the actions of Smartphone users. It is difficult to quantify this component due to the fragmented nature of Wi-Fi. Cellular network operators are therefore unable to fetch a detailed overlay of Smartphone connections with Wi-Fi AP's or Mobile data traffic offloading.

Hence, the pervasiveness of Wireless-Fidelity at home is vital indicators of data off-load over this network, and by this metric, chief countries in Europe are among the world leaders. The UK, France and Germany are amongst the world's highest Wi-Fi household penetration.

Table 2: Wireless-Fidelity penetration survey of domiciliary among 17 chosen countries in 2011 [5]

Wi-Fi Household access %	2011
South Korea	80.3%
United Kingdom	73.3%
Germany	71.7%
France	71.6%
Japan	68.4%
Canada	67.8%
Italy	61.8%
USA	61.0%
Spain	57.1%
Australia	53.8%
Czech Republic	31.6%
Mexico	31.5%
Poland	28.0%
Russia	22.9%
China	21.8%
Brazil	20.4%
India	2.5%

The major redirection of mobile device traffic over unlicensed spectrum to fixed networks is motivated not just by necessity but also by consumer preferences. Now that Wi-Fi is integrated into almost all mobile devices and available in a growing proportion of homes, offices and public spaces— consumers are actively choosing to use it as an alternative to the macro cell as their carrier network. It is shown in surveys that growing numbers of individual consumers as well as business users favours Wi-Fi for both cost and quality reasons.

In some abstract , the devices that are wireless or proxy devices either separated or in combination with the proxy server can differentiate the traffic as foreground traffic also known as interactive traffic or background traffic, different policies have been applied to various types of traffic flow , For background traffic and interactive traffic this means that it can function differently within. One of the example is like allowing interactive data transfer to reach the destination of network either in full transfer or in parts, and applying more stringent traffic control mechanism to background traffic;or the device side also allows a query to activate the radio if it receives any data or information from the server computer that the content of host has been modified or updated.

2. REVIEW OF PRIOR STUDIES

Several scholars studied the utilization of mobile devices in different context, but few explored the explanations for the major consumer variations concerning the volume of offloaded Smart device data traffic.

A. Behavioral categorization on the basis of volume of data generated through different application services

Several studies have considered data/information traffic generation which involves exclusively use of mobile networks and this study has principle association between smart phones, specific information communication services and particularly user behaviour. Sn'asel & Alwahaishi [6] analyzed Mobile user behaviours, their intentions behind mobile Internet use and certain specific characteristics. H. Falaki & D.Estrin.[7] examined comprehensive trends and volumes of smartphone-generated mobile data traffic through the implementation of various applications and through information-communication services, such as Internet search, navigation map and instantaneous messaging, Baghel and V. R. Manepalli.[8] analyzed the degree of data traffic Obtained using the different smart phone applications. A. Ghose and S. P. Han [9] closely examined a large section of users during the exploit of applications and information-communication services to obtain a detailed view of their conduct. Similarly, X. He et

al.[10] analyzed network data traffic patterns generated with various smart gadets, in this scenario with the aim of realizing desired level of performance in cellular network. J. Yang and Y. Qiao [11] have established a association between the, smartphone apps, volume of generated data traffic by them and mobility of the user.

B. Behavioral categorization on the basis of utilization perspective and duration of application services of smart devices

T. Soikkeli [12] analyzed mobile phone measurement based usage periods taken itself from the Mobile equipment. Traffic monitoring software was used to collect the data that was already installed on test user devices for capturing the context in which cellular phones were used, contributing to understand user behaviour. An app-based survey analyzed android /iOS-based data traffic distribution on mobile and Wireless-Fidelity networks during the different time duration of the day and on various days of the week[13], providing highlights into smartphone users ' behaviour patterns and their working habits.

C. Behavioral categorization on the basis of user preferences for future usage and the network type availability

Recent studies have explored how smart device owner use Wireless-Fidelity networks, how they can be used for future purposes, and what makes them choose to connect their smart system to Wi-Fi rather than the mobile network [14]. A new study [15] implemented Android OS and iOS application to analyze how smartly mobile device users navigate through access networks like 3rd Generation, 4G, & Wireless-Fidelity connectivity. Users select the network which is based on their access to the latest communicating technologies, data transfer rates as well as economy factor Smartphone user behaviour frequently changes based on the selected access network [16] and subscribers of mobile network with preferred Wi-Fi access.

D. Problems Encountered

This has led to the "blackhole" offload: once mobile active users shift from one network to Wi-Fi, most of the providers will not be able to monitor their activities, like proportion of data traffic, consistency of the data as well as the security of their network [17]. This blackhole is reflected in the consumer behaviour: As per study in [16] that shows the users boost their data traffic during context switching from a smartphone to Wireless-Fidelity network thus more users switch to the WI-FI than their respective network.

3. Existing Modal Framework and its relevant factors and variables to identify the Behavioral pattern of the mobile user

TABLE 3: The relevant factors and user preference that account to the existing modal framework for analysing user behaviour[20]

Relevant factors	User preferences
Size and resolution of smartphone display	Wi-Fi network speed
Mobile device operating system	Unlimited data traffic
Device and app settings	Low-cost access
Device capabilities depending on the mobile network	Quality of service/experience
Additional possibilities of applications	Wi-Fi availability in user devices
Mobile network communication technology	Widely deployed infrastructure
Software and applications updates	Quality of mobile network signal
Offload communication technologies	Automated login
Price plan	Security
Use of services and applications	Lower battery drain (when close to access point)
Context of use	International roaming
User personality profile and use of multiple devices	Improved indoor coverage

Analysis of suggested factors that can help user's classification by their offload behaviour. During the survey it is observed that Users who earn income, for example, are less likely to offload data than those who have no income. Those who have a smart income can afford high data packs with high data transfer than opting to wireless Fidelity. According to this idea, users with adequate data transfer benefits are not likely to belong in a high data offload category in their mobile plan. However, consumers who upgrade their apps solely on Wireless-Fidility networks are also ready to transfer data over cellular networks, as their lower probability for a high offloading section is evident.

Consumers who have access to WIFI connectivity at their premises are more interested to slide into upper categories of offloading, so these users have a default setting of running their application over WIFI settings . Ironically, subscribers with greater data limits are more attracted towards high data transfer rates with minimum buffering ..

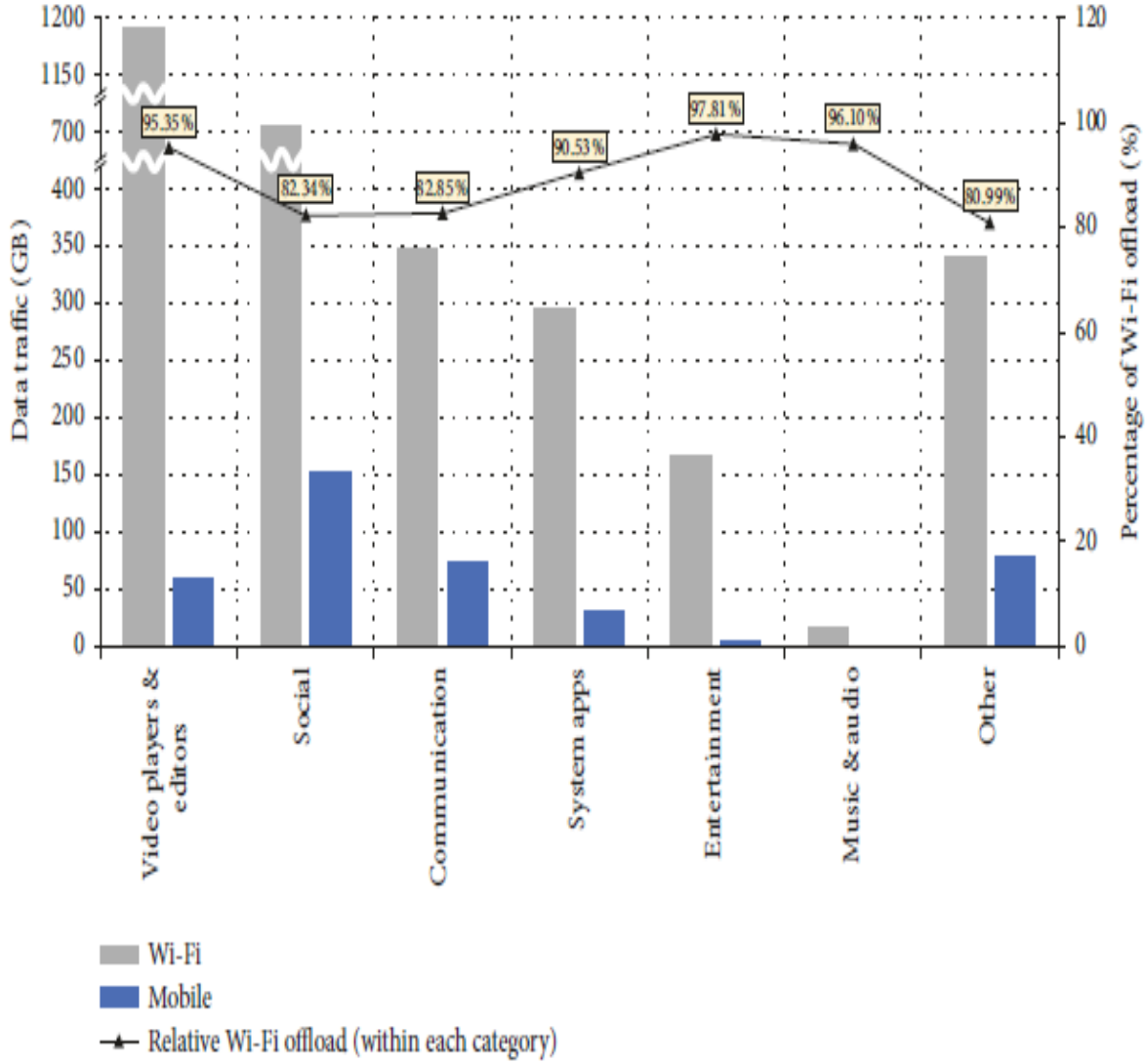

Figure 1: Comparison of amount of data offloading from cellular phone to Wi-Fi

Practical observations can be achieved by adding detailed data into the framework, like timeliness of data offloading and also what types of Wireless-FidilityAP's subscribers offloaded data to, as per some particular application which is installed on the device. An external platform that provides measurements of such phenomena that imposed as a necessary requirement to this, since the potentials of integrated application and platform used in this fieldwork are best utilized. This descends beyond the framework of the recent study on Wireless Communications and Mobile Computing, one that focused on the amount of data offloaded from cellular networks to Wi-Fi channels.

4. CONCLUSION

In this paper we reviewed, on the likelihood of using absolute value infrastructural divergence to equate user preferences as well as features with the likelihood of offloading varying amounts of cellular data from cellular phone to Wireless-Fidility networks. This paradigm we studied offers one of the most comprehensive analyzes of behavioral patterns of smartphone owners and how that behavior might relate to the quantity of data offloaded. This framework, together with the methodology of collecting information from subscribers surveys as well as apps deployed on their mobile device, may be beneficial for cellular network operators and service providers to comprehend customer behavior, segment their markets, and differentiate their market policies. Furthermore, the approach and results can be helpful for Wireless-Fidility connectivity as well as for service providers who regulate an incremental volume of data or information traffic but dearth market analysis to analyze, For instance, more important "blackhole" of offloading data transfer. Such offloading model described here will assist diverse stake holders far better leverage offloading market's revenue potential.

This framework provides help to mobile operators and service providers with special alternatives and distinct price schemes to benefit from some users ' tendency to use Wireless-Fidelity. For example, operators may also offer

special roaming facilities like email, data services that offers access to the various popular sites. Model represented here creates new possibilities for , rational service ,strategic initiatives and price plan optimization, and service personalization which can unambiguously be taken into consideration as extremely important ecosystem of the Wi-Fi network.

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