Access on Demand on Wi-Fi Networks: the Impact of Dynamic Switching of Providers for the Mobile User

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Abstract. *With the access on demand the mobile device manages the handovers and might not need to have a service contract for connecting to a network. These features may improve or worsen the user access experience and cause some impacts related to, for instance, the received throughput, paid price and number of handovers. This paper presents the performance evaluation results of an access on demand environment with Wi-Fi networks compared to the traditional access (not on demand), through simulation. It also shows how the application, the speed of the mobile and the traffic of other users can influence the number of handovers, paid price and the total of received bytes by a mobile. The mobile device can prioritize price, received signal strength or load on the access point.*

1. Introduction

The number of Wi-Fi access points (AP), also called hotspots, has increased in recent years, offering mobile users wider access coverage. But the short range of a Wi-Fi antenna makes it difficult for an ISP (Internet Service Provider) to offer a wider coverage to customers, such as in cellular networks. A possible solution is the access on demand, a feature of the Next Generation Networks (NGN) [NGN 2004].

Two basic features are present in the access on demand. Firstly, the handover management is user-centric, i.e., it is performed by the mobile device with network support taking context information and user preferences into account. Secondly, the user does not need to be a customer of the network he will connect to. To allow the mobile device to switch its network without losing communication with the application the Mobile IP protocol [Perkins 2002] may be used because it was designed to allow mobility.

The features of access on demand may improve or worsen the user access experience and cause some impacts related to, for instance, the received throughput, paid price, and number of handovers depending on the available networks and the handover management efficiency. The experimentation through a real on demand provisioning infrastructure with several antennas and networks belonging to different providers is difficult. So, it is necessary to use simulation.

This paper presents the performance evaluation results of an access on demand environment with Wi-Fi networks compared to the traditional access (as currently done, i.e., not on demand) in which we analyzed the number of handovers performed, the amount of received bytes by the mobile user, and how much the mobile user has spent with on access. In the traditional access, the user is a client of an access provider and connects only to antennas belonging to this provider. In the access on demand, the user will be able to connect to antennas belonging to other providers. In order to evaluate such environment and study some of the possible impacts, we modified the implementation of the Mobile IP module of NS2 [NS2 2012] (Network Simulator version 2.34) responsible for the handovers and used part of the methodology presented in [Augusto and Moreira 2009]. The simulations results show that not always an access on demand is beneficial and the results are not always predictable.

To better validate the results of this study, two scenarios were simulated, a less and a more populated scenario regarding antennas and users, along with variations in the speed of the mobile user, the application used and the traffic of the other users, totaling 144 different configurations of simulated scenario. About the handover decision policy for on demand access, the mobile user could prioritize the access as a function of the price, received signal strength (RSSI), or load (used bandwidth) on the access point.

At the most of the related work, there is just one scenario configuration, or no more than a few ones, and the networks usually belong to the same access provider, i.e., the mobile can connect with any antenna in the scenario. In our work we simulated 144 different configurations of the scenario and the antennas belong to different providers with different prices and characteristics, in a way that a real comparison between traditional and on demand accesses could be done.

Next Section describes some architectures to provide access on demand and other related issues. In Section III we present the changes made in the NS2 simulator. The simulated scenarios are presented in Section IV. Section V presents the simulation results and their analysis. The last Section presents conclusions and future work.

2. Related Work

In [Palazzi et al. 2007] the authors present a modified version of the Mobile IP module of NS2 which makes the handovers more seamless in overlapping wireless networks. The simulations with the new module show an increase in the TCP congestion window and an increase of the number of received packets. Although the authors did not report how many handovers were performed in the simulations, its reduction in quantity is clear. As a handover decision policy, the authors use only the amount of received advertisements from the access points.

There are several works related to handover decision policies. Rizvi et. al. [Rizvi et al. 2010] presents an intelligent vertical handover decision algorithm and points out other works. In [Kassar et al. 2008] the authors present an overview of the handover decision strategies, which are classified in five categories (cost functions, user centric, Fuzzy Logic and Neural Network-based, multi-criteria, and context-aware strategies) and present a new approach which considers context-aware and policies, aided by a Fuzzy Logic system. In [Wang et al. 1999] the authors present a cost function that can be applied to any network and in [Zhu and McNair 2006] the authors present a multiservice vertical handover decision algorithm (MUSE-VDA) and a general cost function used to choose a target network. In [Aust et al. 2003] the authors describe a policy based handover decision algorithm (POLIMAND) and point several link layer parameters in heterogeneous networks that can be used in the decision making. Handover trials were conducted between a Wi-Fi network and a GPRS network, which demonstrated its advantage in terms of throughput and packet loss. Because decision making is not the focus of our work, in our simulations we used simple algorithms described in Section 3.

In [Sharma et al. 2004] the authors propose a low-latency Mobile IP handover scheme that can reduce the handover latency of infrastructure mode wireless networks to less than 100 ms, minimizing the impacts of the network switching.

Some architectures, such as SOHand and Y-Comm, were proposed to provide access on demand to NGN. In both cases, the handover management is user-centric. The SOHand architecture [Moreira et al. 2007][Yokoyama et al. 2008] consists of three entities: client, access provider and a broker. On the client there are several context sources (from user environment and network). A context manager is responsible for processing and storing this information, and monitoring the conditions of the current network, device and user preferences. A negotiation module is responsible for negotiating access, based on pre-defined policies and context information. A handover decision module decides when and to which network a handover should be done. The access provider has a policy manager, which informs the mobile user of the access policies, and a local AAA, which is responsible for authentication, authorization and accounting. The broker is responsible for providing negotiation information from different providers.

The Y-Comm architecture [Mapp et al. 2006][Mapp et al. 2009] is divided into layers and splits the network into core and peripheral network. In the peripheral network, the vertical handover layer is responsible for, actually, performing the handover. The policy management layer evaluates the circumstances under which a handover should occur based on context information from the mobile device and access network. This layer can be configured with some rules related to handover decision. In the core, the (re)configuration layer will be used by the vertical handover layer to obtain network resources. The network management layer provides the AAA system and interacts with the policy management layer to inform about network available resources and negotiate the resources allocation to the client.

3. Changes in the Mobile IP Module

Originally the handover in NS2 occurs in two situations according to the Mobile IP specification [Perkins 2002]. The first situation occurs when a new advertisement (ADV) from a new Mobile IP agent (Foreign Agent) is received. This is an indication that the mobile user has reached the coverage area of a new antenna. Each received ADV is inserted (or updated) on a list maintained by the mobile, called *agent_list*.

The second situation occurs when the lifetime of the ADV belonging to the current AP (coa – Care Of Address) expires. A function called *timeout* often searches the agent list for ADVs with expired lifetime. Whenever one is found, the agent is removed from the list. If the removed agent is the AP the mobile is connected to, the mobile device does a handover to the first AP from its agent list, regardless of any context information. However, these two situations do not reflect what is expected on access on demand neither on traditional access.

SOHand and Y-Comm allows the mobile user to use context information such as cost, signal strength, load on AP, provider SSID, and others to decide if a handover should be done. The first three information items mentioned above were used in the access on demand simulations as a simple handover decision policy allowing the mobile to prioritize price, received signal strength, or load on AP.

For this purpose, a function was created that runs every 0.5 seconds, checks the agent list and decides if the mobile device should do a handover based on one of the decision policies mentioned above, in a such a way that the handover decision will occur differently of both situations defined in the Mobile IP specification. Also, SSID information was inserted into each antenna to identify the access provider. It was not implemented any new module to the simulator, basically, only the mode how the mobile decides the handover was changed.

To simulate the traditional access, in which the user only connects to APs that belong to its home access provider, the mobile device checks its agent list looking for antennas with the same SSID of its provider. If it finds another antenna with the same SSID and better signal strength, then a handover to this AP is done.

The signal strength is obtained from the *beacons* and the average of the last five ones is used to avoid the *ping-pong* effect. This effect occurs because the received signal strength by mobile varies even when the mobile is still. And when the mobile is in the middle between two access points, soon after a handover, the signal strength of the previous AP can become stronger again and the mobile reconnects to the previous AP.

The handover decision algorithms used in the access on demand simulations are described next.

3.1. Prioritizing price

For this policy, which aims at minimizing the spent value, if the mobile device finds any antenna, in its agent list, with lower price or with the same price but with a better signal strength, then a handover is done to this antenna. The access cost of each antenna would be provided by the broker of the SOHand and/or Y-Comm.

3.2. Prioritizing received signal strength

For this policy, which aims at maximizing throughput, the mobile device scrolls through its agent list and if it finds any antenna with a better received signal strength, then a handover is done to this antenna.

3.3. Prioritizing load on the access point

For this policy, the aim is also to maximize throughput through the choice of the access point with the smallest load. As all APs in the scenario have the same bandwidth of the edge router, the smaller the load, the higher the available bandwidth to a new user. In this policy, if the mobile device finds any antenna, in its agent list, with less load than the current antenna, then a handover is done to this antenna. This information would be provided by the broker, as required by SOHand and Y-Comm. In this case, the mobile does not consider the throughput being used by its application. Therefore, between one antenna with 1Mbps available and another one with 2Mbps, the mobile will choose the one that offers 2Mbps even if the application will only use 100Kbps, for instance. This approach can be reconsidered using a more complex decision policy taking into account the Quality of Service requirements for each application.

3.4. Other changes

Mobile IP specification [Perkins 2002] recommends the interval time between ADVs as one third of the ADV lifetime. However, the lifetime in NS2 is equal to the interval time between ADVs. Mobile IP also specifies that no more than one handover can be done per second, but this requirement is not respected in NS2. Therefore, these two features were modified to respect the specification.

Because handovers in NS2 do not have an elapsed time (related to association and authentication, for example), in our simulations we put an 100 ms time in each network switch, taking as example the handover time in [Sharma et al. 2004].

Considering the changes explained in this section, a mobile can hand over in two situations: if it finds a better antenna (taking into account each decision policy) or if the ADV expires and there exist another available antenna.

4. Simulated Scenarios

To evaluate the performance of access on demand in Wi-Fi networks, two scenarios were simulated, a less populated one in terms of Wi-Fi antennas (and thus connected users) and another one more populated. The less populated one is shown in Fig. 1. The more populated one differs in number of antennas and distance between them as shown in Table 1. There are three access providers (P1, P2, and P3), each one with APs along a 1200 meters avenue. P1net, P2net, and P3net represent web and other servers belonging to each provider. P1r, P2r, and P3r represent edge routers belonging to each provider. Access points are represented by PxAy (y-th Wi-Fi antenna that belongs to Px provider), and their positions can be observed along the avenue. Link speed is 20Mbps at the periphery (between antenna and edge router) and 100Mbps at the core and servers.

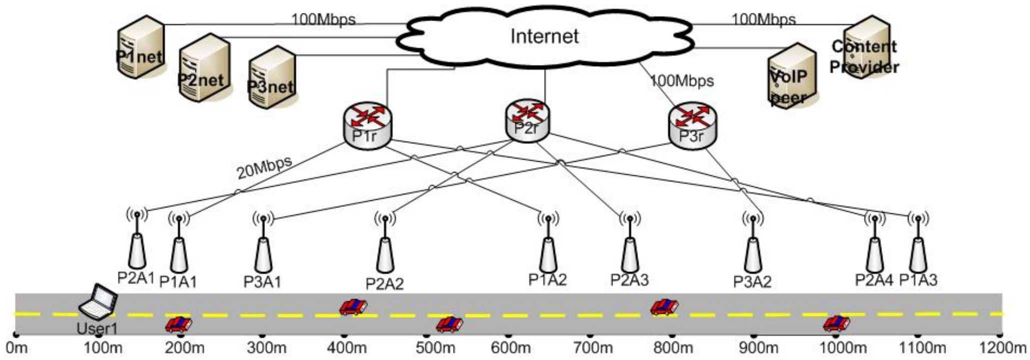

Figure 1. Less populated scenario

Table 1. Characteristics of the Access Providers

Scenario	**Less populated**			**More populated**		
Provider	**P1**	**P2**	**P3**	**P1**	**P2**	**P3**
Number of antennas	3	4	2	4	6	3
Distance (meters)	450	300	600	300	200	400
Users/antenna	3	2	5	3	2	5
Price/hour	$5	$7	$3	$5	$7	$3

In Fig. 1 mobile user User1 (P1 client) who will roam the avenue starting at 100m and stopping at 1050m performing several handovers according to a decision policy (as described in Section 3) is also illustrated. We simulated the mobile user moving at two different speeds: 36 km/h (10 m/s), characterizing a user inside a public bus; and 5 km/h (1.39 m/s), characterizing a user walking.

For each scenario and speed, three different applications run on the mobile device: a VoIP flow consisting of two UDP streams with a 64Kbps constant bit rate (G.711 codec) between mobile user and host VoIP peer; a 1.5Mbps MPEG1 video stream which server is the host Content Provider; and an FTP download whose server is the Content Provider host.

We also varied the traffic in the users connected to the other antennas. These users are not shown in Fig. 1. For each scenario, mobile user speed and application, we simulated the other users with 100Kbps, 200Kbps and 400Kbps UDP flows from the Content Provider host. These users are fixed, close to the antennas by at most 20 meters away.

The three providers have different profiles in terms of quality and price, according to characteristics in Table 1. Provider P1 has a medium infrastructure and price, offering a medium quality of access. Provider P2 is more expensive, has more antennas and fewer users connected per antenna, offering a better quality than P1. Provider P3 is cheaper, has more users per antenna and less available antennas. Although different providers can have different charging methods (per hour, per day, per MByte), in this work we used the same method for a better comparison, i. e., per hour.

The use of several quantities of antennas and, therefore, the distance between them, is aimed at differentiating the signal quality in terms of coverage and strength. The use of several quantities of users per antenna is aimed at differentiating the load on AP and available bandwidth for new accesses. The use of several prices is aimed at differentiating how much a user could spend choosing one or another provider. Thus, the mobile user may spend more or less, and download more or less bytes, depending on the handover decision policy.

The propagation model used was shadowing. The loss exponent and the shadowing deviation parameters were, respectively, 3.2 and 4, characterizing an external environment of an urban area, according to [NS2 2012]. The MAC layer (Mac/802_11Ext) was configured to the IEEE 802.11g standard by following the parameters used in [Medepalli et al. 2004] and [Symington and Kritzinger 2009]. The routing protocol used was NOAH [NOAH 2012], suitable for the infrastructure mode. The interval time between ADVs followed the recommended time of 1 second and the lifetime was set to 3 seconds.

5. Simulation Results

This section presents the performance results of paid value, received bytes and number of handovers done by the mobile user User1 in the simulations of traditional and on demand accesses in the less populated scenario.

The simulation results of the more populated scenario follow, in general, the same analysis of the less populated scenario and for space reasons, we will only comment the cases that do not follow the same analysis.

5.1. Traditional access

In the simulations of traditional access, the mobile user connected only to antennas belonging to his home access provider (P1), so the user spent the same value in all simulations of the same speed ($15.29 for 36km/h and $105.64 for 5km/h).

In both scenarios (less and more populated) and speed, the amount of received bytes decreased as the flow in the other users has increased, as shown in Table 2 (TRAD columns), due to more traffic competing in the same medium. Fig. 2 presents the throughput in the simulations at 36km/h with VoIP traffic, as an example. In that figure, it is possible to identify the two moments that handovers occurred (with 100kbps), at 36 and 79 seconds, when the throughput decreased. With 400kbps in the other users, the VoIP traffic is very injured.

Table 2. Received bytes in the less populated

Mobile Application	Traffic in the other users (bps)	36 km/h		5 km/h	
		TRAD (KBytes)	**PRICE** (KBytes)	**TRAD** (KBytes)	**PRICE** (KBytes)
VoIP	100k	847	821	5752	5872
	200k	786	810	5620	5871
	400k	605	772	3965	5663
MPEG1	100k	18601	19077	129189	137706
	200k	14159	18466	108724	131509
	400k	9110	14814	62632	106629
FTP	100k	34725	33493	234935	268815
	200k	21984	22148	146301	204782
	400k	3612	10002	48361	84349

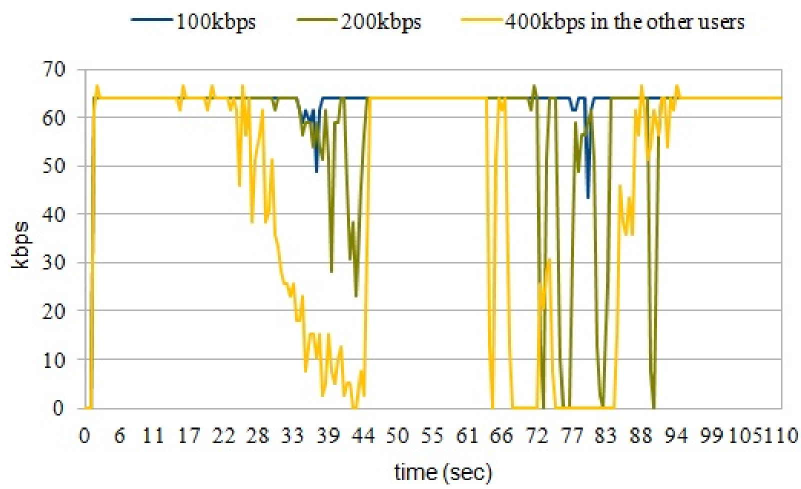

Figure 2. Throughput at 36km/h, VoIP traffic, traditional access

Table 3 (TRAD columns) shows the number of handovers done in the less populated scenario. In the simulations at 36 km/h, the mobile made one or two *ping-pong* handovers. At 5 km/h, the number of handovers increased significantly compared to the simulations at 36 km/h. This happened because the user, moving slowly, stayed longer near the middle between two APs, causing more *ping-pongs* due to the RSS variation.

When the traffic increased (200 and 400kbps), the mobile lost more beacons and ADVs, and the handovers began to occur more due to the ADV expiration and less because of the RSS variation. For instance, at 5km/h with VoIP and 100kbps in the other users, 28 handovers were caused by RSSI variation (77%) and 8 caused by ADV expiration, but with 400kbps in the other users, 1 handover was caused by RSSI variation (25%) and 3 caused by ADV expiration. The same has occurred with MPEG and FTP applications.

Table 3. Number of handovers in the less populated

Mobile Application	Traffic in the other users (bps)	36 km/h				5 km/h			
		TRAD	**PRICE**	**RSSI**	**LOAD**	**TRAD**	**PRICE**	**RSSI**	**LOAD**
VoIP	100k	2	4	8	3	36	5	18	7
	200k	4	4	8	4	24	5	14	14
	400k	2	8	8	6	4	8	18	13
MPEG1	100k	4	5	8	3	22	5	20	11
	200k	2	5	8	7	14	6	24	12
	400k	2	8	10	13	20	28	43	39
FTP	100k	4	5	8	3	18	5	25	11
	200k	2	7	8	7	24	10	24	11
	400k	2	5	8	7	14	24	30	21

5.2. Access on demand prioritizing price

In both scenarios, the mobile user spent less than the traditional approach, since the mobile connected to provider P3 antennas whenever possible. The most savings occurred in the more populated scenario where, with VoIP traffic and 100kbps stream in the other users, the mobile saved 37.67% when moving at 36 km/h and 35.16% when moving at 5 km/h. In the more populated scenario, the mobile saved more money because there was one more P3 antenna. Fig. 3 and 4 (TRAD, PRICE VoIP, PRICE MPEG1 and PRICE FTP) show the paid value prioritizing price compared to traditional access in the less populated scenario, at 36km/h and 5km/h, respectively. In all simulations, as the traffic in other users became higher, the mobile lost the signal of P3 antennas (ADV expired) more often and connected to other more expensive antennas, increasing the spent value.

For both scenarios and speed, the received bytes were close to the traditinal access with low traffic and also decreased with the increased traffic in the other users, as shown in Table 2 (columns PRICE), which presents the amount of received bytes in the less populated scenario. But the drop was smaller compared to traditional access, because there were more available antennas to connect to. For this reason, as the traffic in the other users became higher, the received bytes, in the simulations prioritizing price, became higher than the traditional access. Fig. 5 presents the throughput in the simulations at 36km/h with VoIP traffic, as an example. In that figure, with 100kbps in the other users (for instance), four handovers occurred at 11, 48, 71 and 103 seconds.

Column PRICE in Table 3 shows the number of handovers in the less populated scenario. In the simulations at 36 km/h, the number of handovers increased compared to the traditional access because there were more available antennas. At 5 km/h, with 100kbps and 200kbps in the other users, the number of handovers decreased, compared to

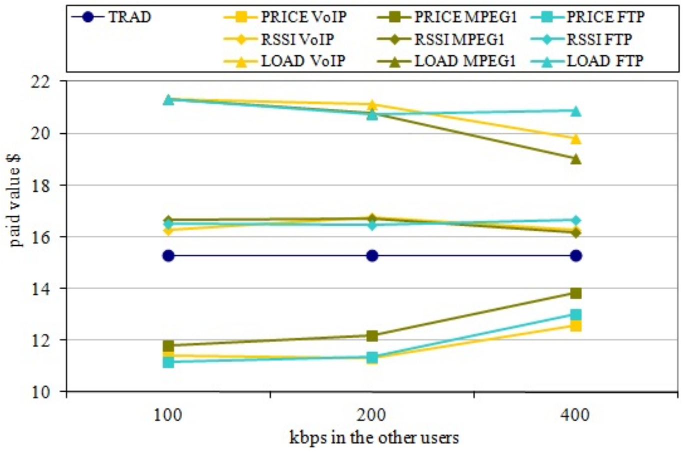

Figure 3. Paid value, less populated, 36km/h

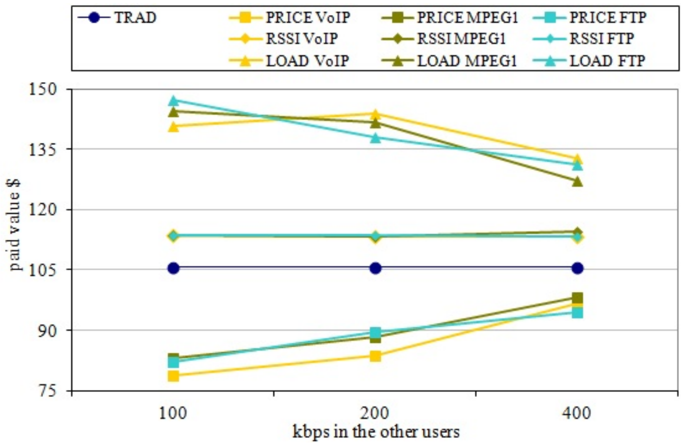

Figure 4. Paid value, less populated, 5km/h

traditional access, due to the algorithm which prioritized price and it became more stable to RSSI variation, and a few handovers were due to ADV expiration. But with 400kbps in the other users, the number of handovers increased, compared to traditional access, due to the increase in the number of ADV expirations and subsequent *ping-pong* handovers.

5.3. Access on demand prioritizing RSSI

The mobile connected with all antennas in the sequence in which they were along the avenue, when the signal of the next antenna became stronger than *coa*'s signal. For both scenarios and speed, the total of received bytes was greater than traditional access, except to simulations with VoIP traffic, at 36km/h, and 100kbps in the other users (in both scenarios: more and less populated). This exception was due to the low traffic in the mobile and in the other users, in which the mobile could stay longer connected to the same antenna without losing its throughput, what lead us to conclude that not always an access on demand is beneficial.

For both scenarios and speed, the received bytes also decreased with the increased traffic in the other users, as shown in Fig. 6 and 7, which presents the amount of received bytes (in logarithm scale) in the less populated scenario, compared to traditional access.

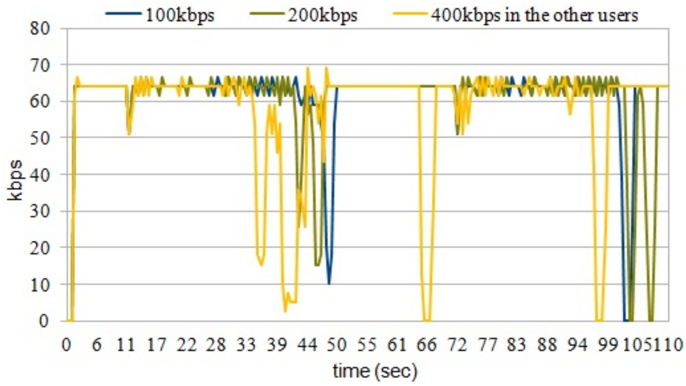

Figure 5. Throughput at 36km/h, VoIP traffic, prioritizing price

But the drop was smaller compared to traditional access, because there were more available antennas to connect to. In the less populated scenario, with FTP traffic and 400kbps in the other users, the mobile device downloaded 4.46 times more than traditional access at 36 km/h and 2.28 times more at 5 km/h.

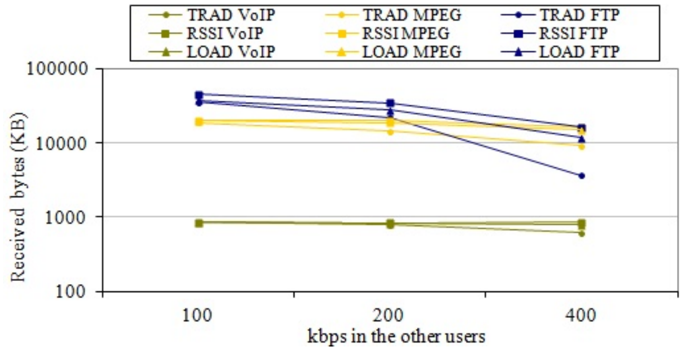

Figure 6. Received bytes, less populated, 36km/h

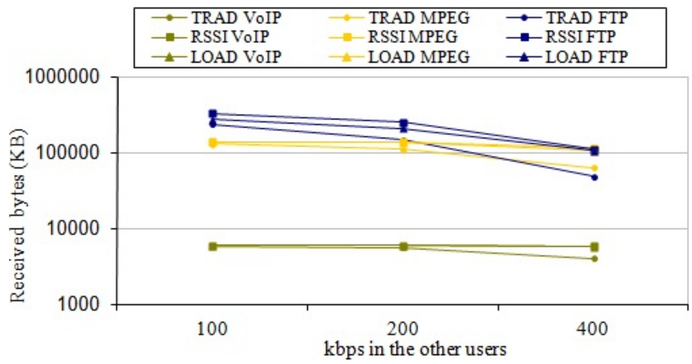

Figure 7. Received bytes, less populated, 5km/h

Fig. 8 presents the throughput in the simulations at 36km/h with VoIP traffic (less populated), as an example. It is clear to note the better throughput compared to traditional access and price prioritization.

At 36 km/h, in both scenarios, the number of handovers was greater than traditional access and occurred as a function of the number of antennas. A few or none

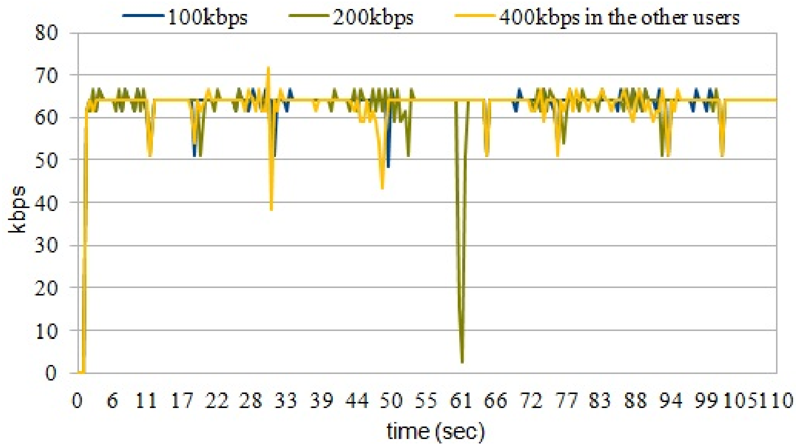

Figure 8. Throughput at 36km/h, VoIP traffic, prioritizing RSS

handovers occurred due to ADV expiration and/or RSS variation. In the Fig. 8, with 400kbps in the other users, it is clear to identify the moments that 8 handovers occurred. Table 3 (columns RSSI) shows the total of handovers done in the less populated scenario. At 5 km/h, more handovers occurred due to the RSS variation near the middle between two APs but the quantity was smaller than traditional access with low traffic and, with more traffic in the other users, more handovers due to ADV expiration occurred.

For both scenarios and speed, the spent value increased compared to the traditional access because, although the mobile connected to cheaper antennas (P3), it also connected to more expensive antennas that were available in greater quantity. Unlike the access on demand prioritizing price, the spent value remained stable, regardless of other traffics. Fig. 3 and 4 shows the spent value (RSSI VoIP, RSSI MPEG and RSSI FTP) for 36km/h and 5km/h, which is around $16 and $113, respectively.

5.4. Access on demand prioritizing load

In the simulations prioritizing load, the mobile connected, basically, to P2 antennas, in which there were less connected users and, consequently, lower load at the AP. For both scenarios and speed, the total of received bytes was greater than traditional access, except to simulations with VoIP traffic, at 36km/h, and 100kbps in the other users (both scenarios). It also happened to access on demand prioritizing RSSI and the reason was the same. The received bytes also decreased with the increased traffic in the other users, as shown in Fig. 6 and 7 (LOAD VoIP, LOAD MPEG and LOAD FTP), but the drop was also smaller than traditional access. In the less populated scenario, with FTP traffic and 400kbps in the other users, the mobile device downloaded 3.18 times more bytes than traditional access at 36 km/h and 2.15 times more bytes at 5 km/h.

The total of received bytes was smaller than access on demand prioritizing RSSI, what lead us to conclude that considering only load on AP is less efficient than RSSI prioritization, regarding to throughput. Fig. 9 presents the throughput in the simulations at 36km/h with VoIP traffic, in the less populated scenario, as an example. It is clear to note a better throughput compared to the traditional access but a worse throughput compared to the RSSI prioritization.

Columns LOAD in Table 3 show the number of handovers in the less populated

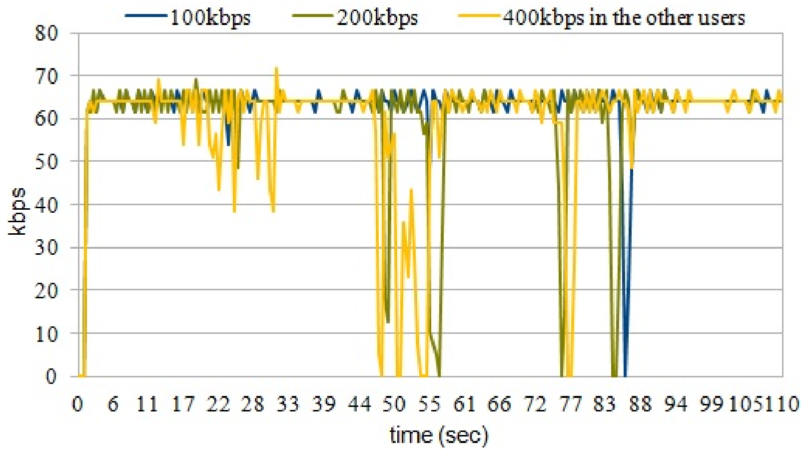

Figure 9. Throughput at 36km/h, VoIP traffic, prioritizing LOAD

scenario. The analysis is similar to access on demand prioritizing price, in which, in the simulations at 36 km/h, the number of handovers increased compared to the traditional access and, at 5 km/h with 100kbps and 200kbps in the other users, the number of handovers decreased, compared to traditional access, and with 400kbps in the other users, the number of handovers increased, due to the same reasons as price prioritization.

For both scenarios and speed, the spent value was much larger than in the traditional approach, and also larger than prioritizing RSSI, as show Fig. 3 and 4 (LOAD VoIP, LOAD MPEG and LOAD FTP), because the mobile stayed more time connected to antennas belonging to P2. The spent value decreased with more traffic due to ADV expiration from provider P2 and subsequent connection to cheaper antennas.

6. Conclusions and Future Work

The dynamic switching between access providers available in the Next Generation Network (NGN) may cause some impact to the mobile user. This paper presented some changes in the NS2 Mobile IP module to simulate access on demand, and some performance results of spent value on connection, amount of received bytes, and number of handovers done in simulations of a scenario with Wi-Fi networks and access on demand in which a mobile user might decide the handover prioritizing price, received signal strength, or load at the access network, compared to traditional access. The number of antennas, the application, mobile speed and traffic on other users were varied, totaling 144 different configurations of simulated scenario.

In the simulations in which price was prioritized, the paid value decreased compared to traditional access, saving up to 37.67% in the more populated scenario with low traffic and the user moving at 36 km/h. The paid value increased with more traffic in other users because the mobile lost the advertisements more often and performed handovers to more expensive access points. At 5 km/h, in which the number of handovers becomes critical because of the *ping-pong* effect, with low traffic, less handovers were done, compared to traditional access, because the decision policy became more stable to signal strength variation, but with high traffic, the number of handovers increased. The quantity of received bytes was similar to traditional access with low traffic in the other users and became higher than traditional access with higher traffic.

In the simulations in which the mobile prioritized signal strength, the total number of received bytes increased compared to the traditional approach, except to simulations with VoIP traffic, at 36km/h, and 100kbps in the other users, when the mobile could stay longer connected to the same antenna without losing its throughput, what lead us to conclude that not always an access on demand is beneficial and the results predictable. In the less populated scenario with high traffic, the mobile downloaded 4.46 times more bytes than traditional access at 36km/h. The number of handovers was greater than traditional approach at 36km/h and, when moving at 5km/h, it was smaller with low traffic and greater with high traffic. In all simulations, the mobile spent more than traditional access and this value remained stable regardless of the increase in the other traffics.

In the simulations in which the mobile prioritized load in the access network, the total number of received bytes also increased compared to traditional access, except to simulations with VoIP traffic, at 36km/h, and 100kbps in the other users, like in the RSSI prioritization. In the less populated scenario with high traffic, the mobile downloaded 3.18 times more bytes than traditional access at 36km/h. But the amount of received bytes was poor compared to RSSI prioritization, what lead us to conclude that considering only load is less efficient than RSSI prioritization. In general, compared to the traditional approach, less handovers were done when moving at 5km/h with low traffic, and more handovers were done when moving at 5km/h with high traffic or when moving at 36km/h (low and high traffic). Considering the paid value, this approach had the worst performance.

As future work, we propose the implementation of policy and access parameters negotiation between mobile and access network such as privacy, security and incentives. In addition, more complex decision policies can be implemented.

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