

Communication Network Parameters and Performance Measures: Jordanian Customer Loyalty as a Case Study

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Abstract

In this paper, we investigate the communication network performance and customer loyalty. A revision of performance parameters and measurement techniques is discussed. The main goal of this paper is to estimate the loyalty of Jordanian customers using questioner. Both mobile and Internet users were included in the case study. The results are useful for companies, who want to improve the provided Quality of Service (QoS) and also for users with different requirements to the communication networks.

Keywords: network parameters, network performance, Jordanian customer loyalty

1. Introduction

The intensive introduction of new technologies and standards allow communication network operators provide wide range of advanced services. Thus, a significant improvement of network infrastructure occurs. In the same time, the requirement for higher bandwidth is constantly increasing. Meeting these needs requires the use of large number of protocols and mechanisms for monitoring and management of communication network.

At first glance, it may seem that the introduction of multiple heterogeneous subsystems to the network complement each other and substantially improve the characteristics of the whole network, which can lead to the creation of high reliable communication network. The ability of observation the network state, control over working capacity of its individual elements, and early intervention in their operation in case of congestion or failure provides enough high reliability.

However, effective analysis of complex system functioning, to which belongs the modern communication network, shows a number of deficiencies in the management of network elements.

For example, the transmission of service signals in various protocols that used to manage network elements at different layers according to the Open System Interconnection (OSI) model occupies, in some networks, up to 20% of their capacity. Also, there are no mechanisms for automatic initialization/restart if a failure is detected in one element of the network that increases the delay of connection restoration.

If we add to this that the internal control system for the network elements covers only a specific list of errors and faults, and does not account for violations of the normal work that occurred through the fault of staff or due to external factors, then question that arises: what kind of statistics are needed to determine the actual performance reliability of communication network.

Literature searching and site browsing give the idea that data base of papers is lack of researches related to Jordan communication network; this makes this study more difficult but more important and actual.

In research paper (Samsudin, 2010), authors conclude that the implemented Customer Relationship Management (CRM) performance in the study to be considered as important grounds for formulating and implementing in assessing service providers to assign proportionate amount of resources to achieve sustainable customer loyalty. In addition, results of this research will also go a long way in minimizing the observed inconsistency between the service provider strategy and customers perspective, which enable service providers to compare their customer perception of their offering strategy in relation to other providers and their customers to adjust their offering strategy.

Reference (Farid, 2010) presents the experience of Orange Jordan, one of the communication companies providing both mobile and Internet services; it adopts excellence technology strategy to be able to launch innovative telecom solutions and services that serve all community segments. Using Innovation, research and development, technology resources, and technology exploitation can enhance the company's position in the market and also are positively related to securing and sustaining the company's competitive advantage.

Reference (Ohaneme, 2012) discussed the case in another growing country, Nigeria. This paper presents an insight into network performance evaluation and QoS improvement of mobile cellular systems in Nigeria. The paper also identifies the important key performance indicators for QoS evaluation which are used in evaluating the mobile networks. Two assessment parameters such as call completion ratio and answer seizure ratio for evaluating the traffic analysis of the networks in Nigeria are deployed. The parameters are applied on four mobile network systems. The result of the study shows that the QoS of mobile system in Nigeria still needs to be improved upon.

Increasing customer loyalty has been introduced as a key solution to guarantee the success of the mobile telecommunication companies. Several researchers have explored the customer satisfaction factors, which are essential to satisfy customers. Data rate, bandwidth, data error rate, delay and jitter are the most essentials. The study (Neda, 2006) introduces m-commerce as a new opportunity that causes more loyalty of customers.

In this paper, we apply a questionnaire, developed by authors for collecting data from users directly as initials for estimation the quality of Jordanian communication network.

The paper is organized as follows. In Section II, we summarize existing devices and methods for network quality measurements. The quality parameters are presented in Section III. In Section IV, we provide QoS estimation by questionnaire, case study. In section V, we show the results of questionnaire. Finally, Section VI concludes the paper.

2. Quality Estimation Measures

Quality estimation is categorized into direct and indirect methods (Michal, 2006; Ernst, 1993). The direct methods monitor the end-user quality metric of interest, including Bit Error Rate, Cyclic redundancy check (CRC) report, which indicates whether the sent frame is in error or not. However, CRC does not provide precise information on the actual quality if there was no block error.

Indirect methods incorporate the measurement of some other metrics, which are related to the actual link quality.

Direct and indirect methods are implemented by system protocol and standard technique. These methods provide adequate quality estimation in the case of normally operating system, transmitting and receiving. If the channel fails and block transmitting or receiving then CRC is useless.

Eye diagram and Optical Time Domain Reflectometer (OTDR) are examples of devices for quality estimation over communication system.

2.1 Eye Diagram

An eye pattern or diagram is an oscilloscope display in which a digital data signal is repetitively applied to the vertical input, while the data rate is used to trigger the horizontal input. For several types of modulation, the pattern looks like a human eye. If the eye is open, then system under test is operating normally, and the network providing the agreed upon QoS parameters to subscriber. Otherwise the eye is close and QoS degradation occurs.

Several system performance measures can be derived by analyzing the eye display. SNR, signal distortion, ISI, poor synchronization are examples of system performance measures that can be observed from the eye diagram.

The eye diagram provides visual information that can be useful in the evaluation and troubleshooting of digital transmission systems (Gary, 2005).

2.2 OTDR

OTDR is a measurement instrument used to characterize the performance parameters of an optical communication system using fiber. A series of optical pulses are injected into the fiber under test and extracted from the same end of the fiber after that light is reflected back from a point along the fiber. The plot on a screen is the attenuation of optical signal as a function of time and distance.

OTDR may be used to measure strain and optical loss distribution along optical fibers, by randomizing the polarization state of the reference lightwave for optical coherent detection (Kurashima, 1997).

In (Huttner & Gisin, 1999), a new method for the measurement of distributed polarization mode dispersion (PMD) in optical fibers is given. This method uses a polarization optical time-domain reflectometer (P-OTDR),

and is based on a measurement of the degree of polarization of the backscattered light as a function of distance in the fiber.

The eye diagram and OTDR techniques and other methods are used to measure a link or a system parameter, and usually implemented after installation or when a failure is detected. These methods are not suitable for network performance estimation because of their limitation and complexity.

3. Communication Networks Quality Parameters

Several quality parameters must be considered over the communication network for an estimation of functioning. Most important are Data Rate, Bit Error Rate (BER), Delay, Jitter, Crosstalk and Interference. These parameters are dependent each on other and related to some basic parameters such as the bandwidth of channel and used modulation technique.

In telecommunications, bit rate or data transfer rate (bit/s or bps) is the average number of bits per unit time (second) passing between two equipments (Tx and Rx) in a data transmission system.

In digital communication, the number of bit errors is the number of received bits of a data stream over a communication channel that have been changed due to noise, interference, distortion or bit synchronization errors.

BER is the number of bit errors divided by the total number of transferred bits during a connection time interval. BER, often expressed as a 10^{-x} , which indicates that one bit from 10^x transferred bits is probably changed.

An important performance characteristic of a telecommunications network is the delay that specifies how long it takes for a bit (or packet) of data to travel across the network from the transmitter to the receiver. Some applications as interactive voice (VOIP) and video (video on demand and video chatting) are delay sensitive. Special care of delay must be taken in design and measures of these services. Engineers divide the delay into several contributors:

$$\text{Average Delay} = \text{Delay}_{Tx} + \text{Delay}_{Router} + \text{Delay}_{Propagation} + \text{Delay}_{Rx}$$

In communication networking, a packet delay variation (PDV) is the difference in end-to-end one-way delay between successive packets in a flow. Jitter may be caused by electromagnetic interference (EMI) and crosstalk with carriers of other signals. As the delay, jitter has sufficient influence on QoS for interactive multimedia applications.

Crosstalk is a phenomenon by which a signal transmitted on one channel of a transmission system creates an undesired effect in another channel. Crosstalk is usually caused by undesired capacitive, inductive, or conductive coupling from one channel, to another.

In telephony, crosstalk is often distinguishable as pieces of speech or signaling tones leaking from other people's connections. Digital transmission is much less susceptible to crosstalk than analog.

In wireless communication, crosstalk is often denoted by co-channel interference, and is related to adjacent-channel interference.

Electromagnetic interference is a disturbance that affects an electrical circuit due to either electromagnetic induction or electromagnetic radiation emitted from an external source. The disturbance may degrade the performance of the transmitter or receiver circuit. These effects can range from a simple degradation of data to a total loss of data. The source may be any object, artificial or natural, that carries rapidly changing electrical currents, such as an electrical circuit or even the Sun.

4. Estimation by Questionnaire, Case Study

The loosely nature of wireless mobile communication and as a result the estimation of QoS parameters is an important issue (Liu, 2009). Research (Zhou & Guo, 2011) discussed the specifications of QoS-sensitive applications transmitted over wireless links, which require precise knowledge of the wireless environment. Link quality estimation for 3G wireless communication networks is formulated in (Gunreben, 2000).

Statistical information for the evaluation of QoS is collected from a real group of Jordanian users operating different communication networks via a questionnaire prepared by authors and multicast to mainly colleagues and students in Al-Huson University College. The analysis of the obtained information is used in the estimation of user loyalty. The results of the estimation study are useful and may be used in a way, which allows the prediction of the client reactions when the company-operator plans a particular action.

In addition, this form of assessment using the personal characteristics of the client, allow quantifying the user

behavior by equating to some probably response of customer to company-operator impact. For example, how to change customer loyalty, if the operator will lower the price of the outgoing calls.

The factor of customer income can be used, based on this factor it may be concluded about possible future payments of the client. For example, after analysis of a client it was received that with probability 0.6 clients will pay 100 conventional units per month, which permits the company attach them to a certain category of an internal scale. The complete analysis also allows companies based on the data of their subscribers to predict the loyalty of newly connected customers and determine them in some market segments.

We had divided the questionnaire into two parts: part 1 presents QoS in mobile service network while in part 2 presents the QoS in Internet, both are shown in appendix.

5. Results of the Provided Questionnaire

The results are presented below and had been divided into the following: figures group 1 are related to mobile communications and group 2 related to ISPs communications. Figures 1a to 1e show the percentage contribution of mobile companies in Jordanian market, the monthly bill for the mobile user, blocking time if any, no coverage signal and provided services.

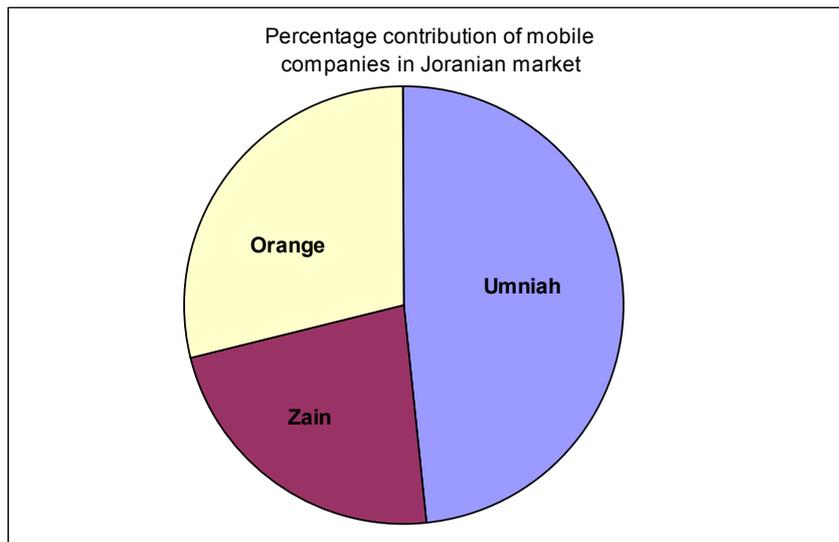


Figure 1a. The percentage contribution of mobile companies in Jordanian market

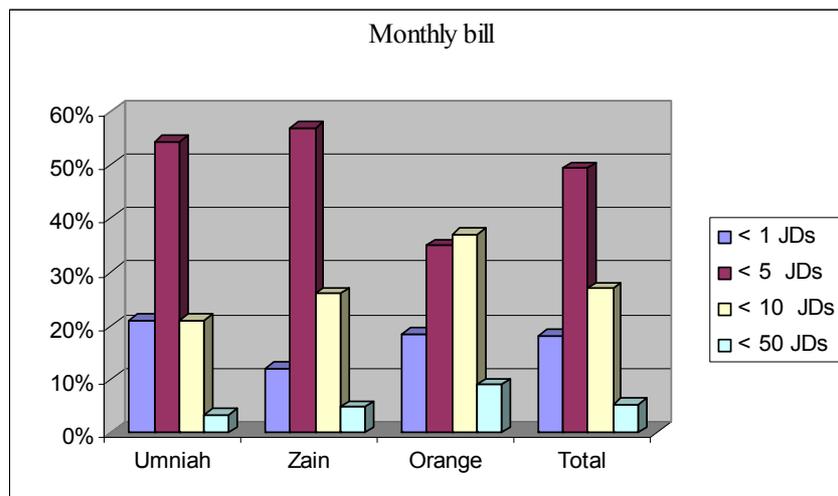


Figure 1b. The monthly bill for the mobile user

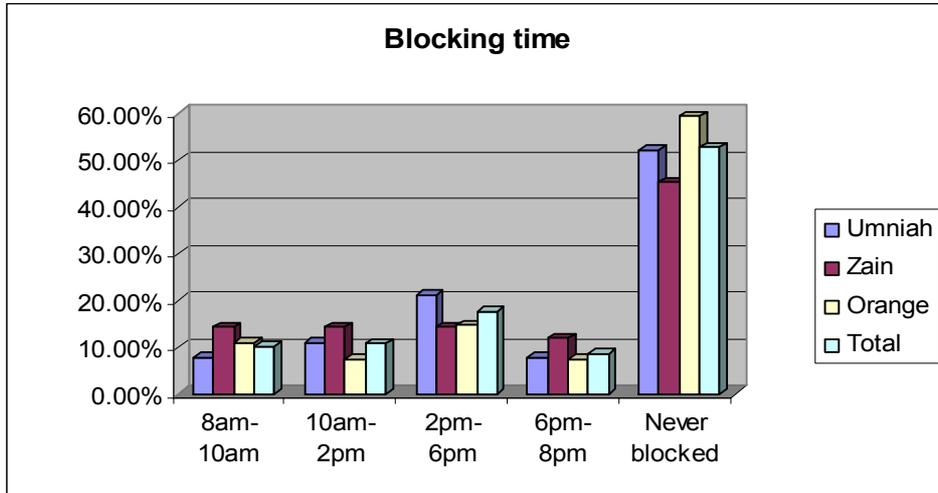


Figure 1c. The blocking time if any for the mobile user

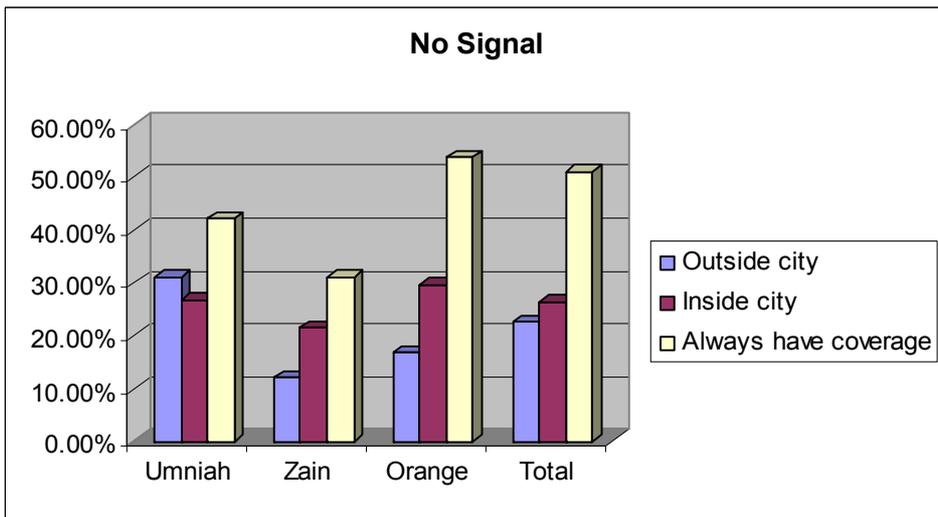


Figure 1d. No coverage signal for the mobile user

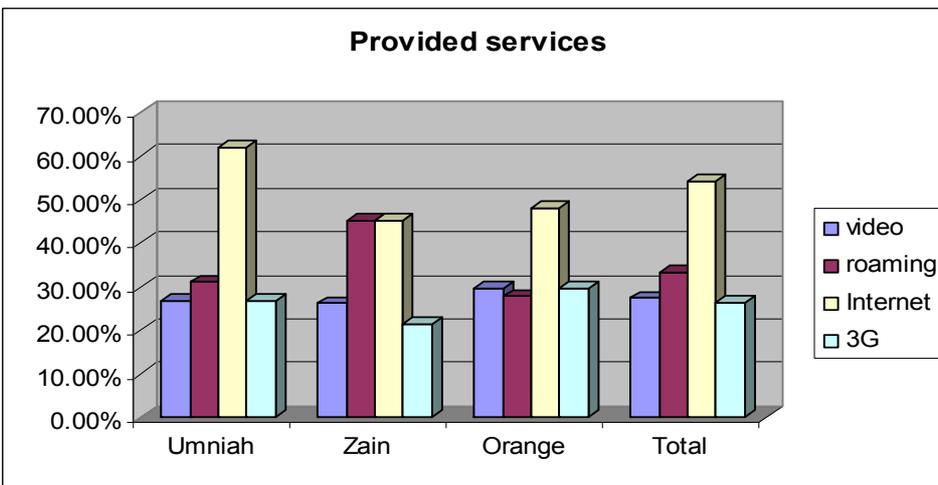


Figure 1e. The provided services for the mobile user

Figures 2a to 2f show the percentage contribution of ISPs companies in Internet Jordanian market, the connection speed for Internet user, the monthly bill for Internet user, the blocking if any, the blocking time, the provided security services.

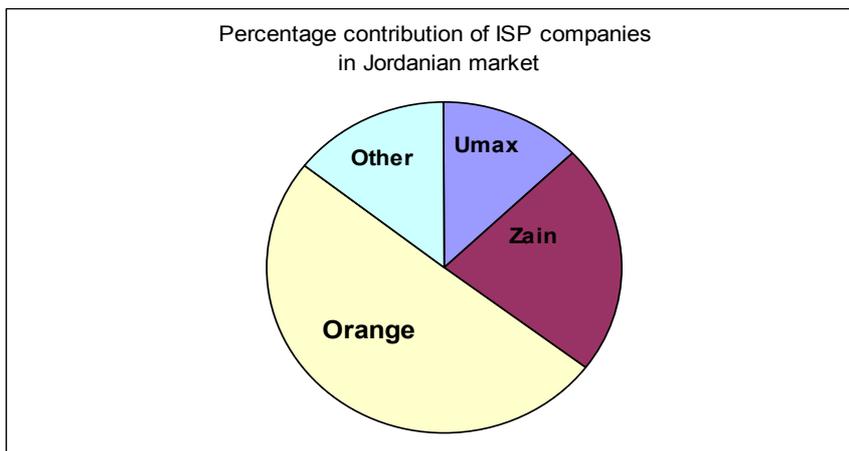


Figure 2a. The percentage contribution of ISPs companies in Internet Jordanian market

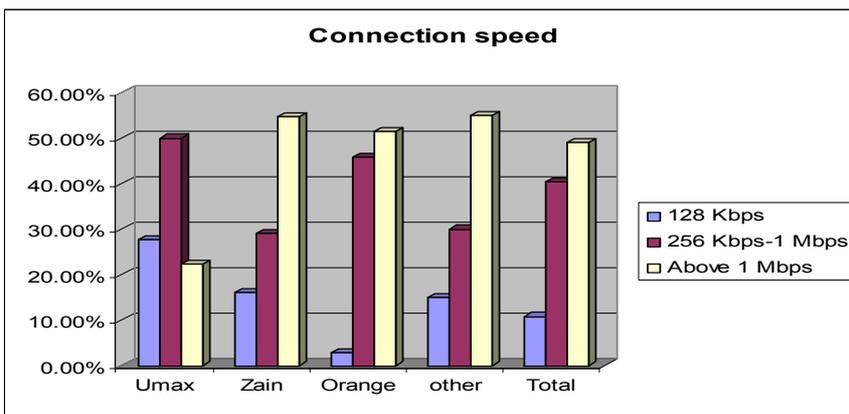


Figure 2b. The connection speed for Internet user

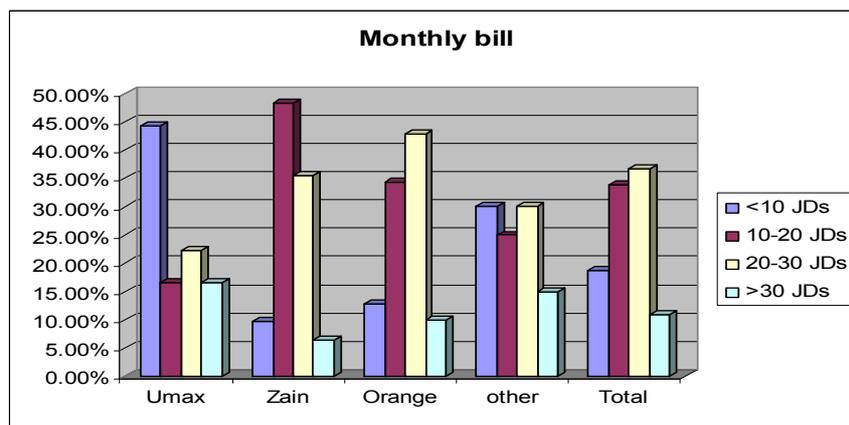


Figure 2c. The monthly bill for Internet user

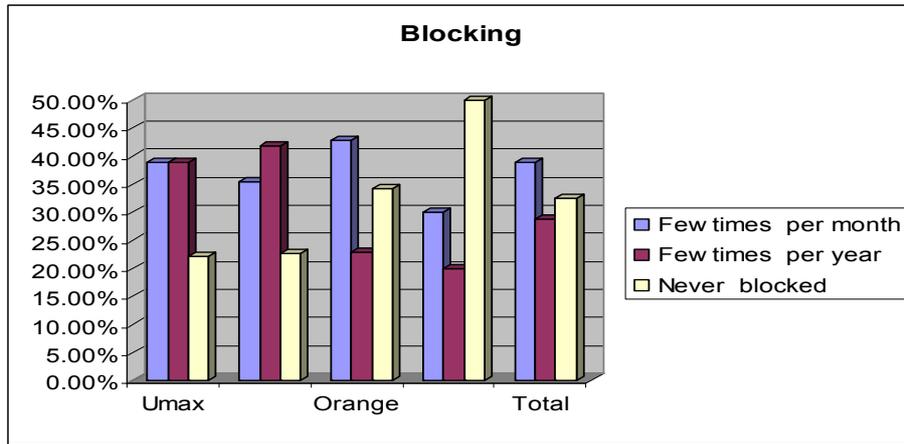


Figure 2d. The blocking if any for Internet user

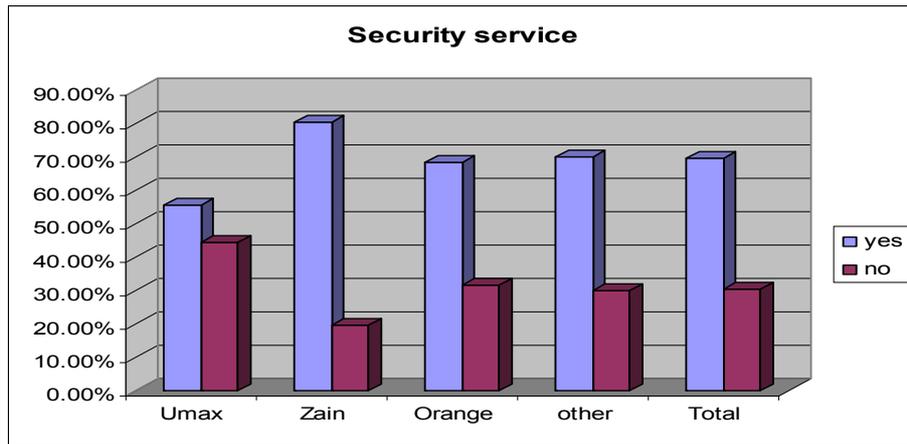


Figure 2e. The blocking time for Internet user

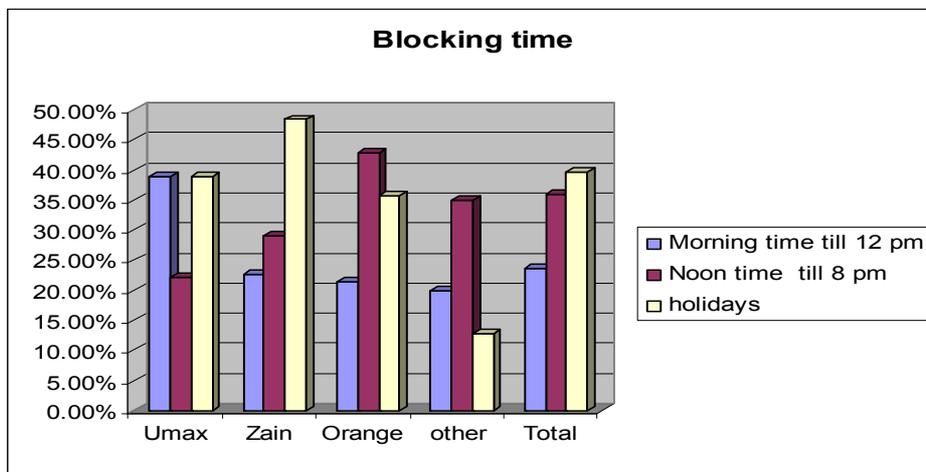


Figure 2f. The provided security services for Internet user

6. Discussion of the Results

From the presented above figures, any service provider, who is interested in approaching higher level of customer loyalty, can clearly see the weak points over which he must work. For example, Orange Internet service provider is the biggest ISP in Jordan as Figure 2a shows, probably because of the high connection speed, from Figure 2b, and relatively lower monthly bill, from Figure 2c.

All other factors are clearly shown in figures and a conclusion may be done simply by comparing the results for each company, mobile and Internet, for the desired factor.

On the other hand, the user can compare the QoS provided by each company in both types of communication, and then can make a choice depending on his requirements. For example, from Figure 1d, we see that Umniah mobile company suffers more than other from weak signal (no signal) outside city, this makes Umniah is not suitable choice for the truck drivers over Amman-Aqaba road.

We note that the presented results are satisfying reality. For example, Umax is wireless Internet and then has less connection speed and less monthly bill than Orange, which is wired ADSL.

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Appendix

Part 1. Mobile network QoS questionnaire
Do you have a mobile
<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
What Mobile company you subscribe to:
<input type="checkbox"/> UMNIAH <input type="checkbox"/> ZAIN <input type="checkbox"/> ORANGE
The monthly cost of your mobile recharging:
<input checked="" type="checkbox"/> >1 JDs <input type="checkbox"/> >5 JDs <input type="checkbox"/> >10 JDs <input type="checkbox"/> >50 JDs
The preferred time you make calls:
<input type="checkbox"/> 8 am-10 am <input type="checkbox"/> 10 am-2 pm <input type="checkbox"/> 2 pm-6 pm <input type="checkbox"/> 6 pm-8 am
You find that you are blocked from doing calls in the following time:
<input checked="" type="checkbox"/> 8 am-10 am <input type="checkbox"/> 10 am-2 pm <input type="checkbox"/> 2 pm-6 pm <input type="checkbox"/> 6 pm- 8 am <input type="checkbox"/> never blocked
No coverage signal in:
<input type="checkbox"/> Outside City <input type="checkbox"/> Inside City <input type="checkbox"/> Always have coverage
Does your Mobile Support any of these functions
Video calling <input type="text" value="Yes"/> Internet Access <input type="text" value="Yes"/>
Roaming (make calls outside Jordan) <input type="text" value="Yes"/> 3G <input type="text" value="Yes"/>

Part 2. Internet QoS questionnaire

Are you connect to the Internet at home:

Yes No

The company you are subscribed to:

Umniah Umax Zain Orange Other

Your connection speed:

128kbps 256 kbps - 1Mbps Above 1Mbps

Your bill cost (for Internet Only):

<10 JDs 10 -20 JDs 20 - 30 JDs >30 JDs

Blocking (no access to internet):

Few times per month few times per year Never blocked

blocking time:

Morning times (till 12 PM) Noon time (till 8 PM) Holidays and Celebrations

Is there any Security Services (over network), the company provide:

Yes No