Investigating the Customer Care based on Enhanced Telecom Operation Map Standard in Third Generation of Mobile Networks

Mustafa Boroumandzadeh¹, Mohammad Reza Mirsarraf² and Ali Movaghar³

¹Department of Computer Engineering and Information Technology, Payame Noor University, Iran; m.boroumandzadeh@chmail.ir
²Department of Information Technology, Iran Telecommunication Research Center, Tehran, Iran; mirsarraf@gmail.com
³Department of Computer Engineering, Sharif University of Technology, P.O. Box 11155-9517, Tehran - 14588-89694, Iran; movaghar@sharif.edu

Abstract

Objectives: This study takes the guaranteed quality of service for operators and service providers into consideration and challenges the discussions on service assurances such as mathematical and statistical analyses of quality indicators to achieve the significance of elements relevant to the services. Methods/Analysis: In order to ensure the process, Enhanced Telecom Operation Map (ETOM) framework has been applied, the procedure is tested on the Executive Network of Iran Telecommunication Research Center (mail services) due to the lack of a practical context of UMTS network (3G). Findings: The result was to achieve a practical and logical way characterizing coefficients of significance and dependence of the elements forming a parent service, and generally, elements of a large network in the form of statistical and mathematical methods by some calculations which vary depending on the context (small or large networks and referral services). Using these coefficients, the error or the range of the error can be determined when an error occurs while providing the service or in the general function of a larger network without spending time and naturally by lower cost. Novelty of the Study: This paper has applied eTOM framework for improvement of customer satisfaction and Customer care in third generation of mobile networks in Iran. Conclusion/Application: This paper indicates the applications, advantages, goals, service assurances and marketing of 3G technology and products under e-TOM standard.

Keywords: Coefficients of Significance, Constituent Elements, eTOM, Parent Service, Third Generation (3G), UMTS Network

1. Introduction

Due to technological advancements¹,² such as Third Generation (3G) on the mobile telecommunication industry (e.g. cellphone), a new perspective of e-commerce called as M-commerce is emerging. The structure of 3G based networks is based on two main principles: Mechanism of cellular mobile networks should increase network capacity; in addition, these networks well provide multimedia services independent of the location of the user.³ Although the GSM system successfully met needs and problems of customers of mobile systems during its peak years, there were problems which made it difficult to use GSM for applications. Its biggest problem was inflexibility of the airborne interface. For example, an application which generates bursty traffic with several multimedia components is not effectively used in GSM; however, UMTS Terrestrial Radio Access (UTRAN) variably allocates resources considering the immediate requirements of applications. Therefore, the use of resources for each radio frame (Ioms) is able to reset, which is not possible in GSM. Although General Packet Radio Service (GPRS) solves this problem⁴. Another reason related to the problem with convincing
customers to use the third generation mobile networks is that operators can provide wide services by their second-generation mobile networks, even more than the service provided by new 3G operator. This leads to other problems with proper marketing including new customer satisfaction techniques, quality, service assurance, security, reduced price etc.5

The Standard eTOM was first emerged in 1998 called as TOM Evolution, Version 1.0, by Tele Management Forum (TMF) in order to establish a framework and a globally integrated structure to manage all processes of a business operation. Then, the standard upgraded in 1999 to Version 1.1 and Version 1.2, in 2000 to Version 2.0 and Version 2.1 and in 2001 to Version 1.0e TOM and Version 2.0 and Version 2.5, in 2002 to Version 2.63, and finally at late 2002 to Version 3.06.

Richard et al.7, The Research Institute and Customer Service of Ericsson Microwave Group, studied Customer Relationship Management (CRM) as one of the eTOM Block processes and analyzed CRM in 3G market. Frederick Bentzer8, Research and Academic Institution of Linköping, studied Billing in end-to-end 3G applications.

John Bergstrom9, Numerical Analysis and Computer Science Institute, studied customer elements and customer value in 3G services; he challenged several parts of the eTOM process block.

The most popular standard has been the second-generation mobile telecommunications which works in two 900 and 1800 MHz frequency bands called as GSM900 and GSM1800. The system has an American mode ranging from 800 and 1900 MHz frequency. Bandwidth of each channel is 200kHz which is allocated to the eight users10.

Business Process of eTOM is a framework of organizational process for service providers. In general, organizational processes are classified into four main groups and twelve process groupings at organizational level.

Core capabilities of ETOM framework include:

- It provides a general business framework at organizational level for service providers.
- This process not only considers the operational aspects and maintenance, but also covers all the important areas of process.
- By identifying concepts such as customer loyalty, a new business interaction model, management of interactions with suppliers/partners, etc., it supports E-commerce.
- It not only covers network management, but also expands its scope to application management and computational resources and integrated management which is increasingly required.
- It separates life cycle management, involving development processes from operational processes and routines.
- It can provide both contextual approach (static) and process flow approach (dynamic); therefore, it contains high-level information requirements as well as business rules for a strong link to automation solutions11.

The current success and credit of eTOM is not only due to the fact that it promotes analysis and modeling of business processes, but also due to the participation of many service providers in continuation of its development, such as its application by service providers, retailers, integrators and developers. The eTOM model takes advantages of network management processes and services developed by TMF in processes, terms of services and standard service industry12.

Considering the fact that classified structure and business framework of eTOM can supervise all business operations in the world and manage various components of fast optimal service to customer from production, resources, partners, service quality etc., utilization of this standard in the market of mobile communications can be used by service providers to deliver these services to all customers as well as producers and suppliers13. The most important parameter is block diagram of FAB (overall vertical processes) of the standard eTOM, which is analyzed from different angles including horizontal elements of FAB framework14. The main point in any business management system is to determine the current status and performance of network resources. The eTOM model calls this process as resource performance management as a fundamental framework and a specific mechanism beyond processes related to Operation Support System (OSS)15-17. The eTOM considers performance management of the network and its resources as a part of resource management and functional layer of the resource, and divides it to a range of OSS processes and thus determines the flow of information within the performance management and other parts of OSS.

During the past 16 years, the increase in mobile phone subscribers and satisfaction of customer needs in terms of communication and various services delivered regardless of
a certain time and place draws a clear horizon of tendency to use advanced technologies of mobile telecommunications industry and consistency of this industry with IT and new customer services. This technology consists of an array of human resources, communications, software, hardware, information and management, which provides useful available information by collection, storage, retrieval, process and distribution of information in different ways or various efficient services. Thus, the trend toward high quality services based on customer service standards (e.g., e-TOM) and consumer demands plays an important role in dynamics and rapid return of capital in the mobile communication industry and paves the way for users of information to take advantages of information technology. Considering the achievements and standards analyzed in previous sections, this report will address the applications, advantages, goals, service assurances and marketing of 3G technology and products under the standard e-TOM.

2. Experiments

The studied network was the Computer Network of Iran Telecommunication Research Center (Tehran) including various sectors such as Data Center, Cable and Wireless Connections, DHCP and DNS servers, types of distributed, core and access switches, Internet, Dial up System (E1 and analog lines), Mail Service etc. Because of the consistency and transparency of logs and the values used in the presented statistical methods, mail service was selected among other available services.

The number of mail service subscribers was 987. The obtained log files (in the form of $X_i$'s) taken from different parts of the mail service are described as below. Samples were taken from $X_i$s at 30 days (one month). In fact, these numbers represent the number of errors for each child node. The rest are errorless, that is, direct operators of this service/sub-services have reported no failure for a long time. To define errors in the form of $X_i$s, the following definitions are used:

2.1 Hardware: $X_1$

This variable represents the number of computer systems which experienced hardware difficulties on the n-th day ($n = 1$ to 30). Optionally, the users were not able to use the mail service due to the hardware difficulties, or they did not tend to use the service in absence of these difficulties; this is discussed at following section.

2.2 Human being: $X_2$

This variable represents the number of human errors in a cycle of using hardware, software and login to the mail server on the n-th day. For example, wrongly typed U/P or functional errors during communication, and so on.

2.3 Account: $X_3$

This variable represents the number of individual errors in log into the mail server on the n-th day.

2.4 Web Browser: $X_4$

This variable represents the number of computer systems which experienced software difficulties on the n-th day ($n = 1$ to 30) and, optionally, they were not able to connect to the mail server and use the mail service due to these difficulties.

2.5 Outlook Express: $X_5$

This variable represents the number of computer systems which experienced software difficulties in Outlook Express on the n-th day ($n = 1$ to 30) and, optionally, they were not able to connect to the mail server and use the mail service due to these difficulties.

2.6 (U/P: $X_6$)

(relating to Dial Up) this variable represents the number of individual errors in inserting U/P to connect to the Dial Up system and, finally, connect to the Mail Server on the n-th day.

2.7 Time out: $X_7$

Variable $X_7$ represents the number of errors due to the end of a given time by the center to the subscriber to connect to the network from outside the company to use the services.

2.8 Others: $X_8$

This variable represents the number of errors, for various reasons, such as the lack of user with specifications given to the mail server error in connections, and so on.

2.9 W: Errors related to Mailserver

(Parent node) This variable represents the number of errors logged in the mail server. For example, $W = 50$ means 50 mail server subscribers are not able to use mail service for various reasons. Obviously, the $X_i$s defined above will considerably influence this parameter.
3. Results and Discussion

As noted earlier, X_i samples, values of which are listed in Table 1, were collected within a month (30 days).

3.1 Analysis of Samples by Statistical Relations and Mathematical Functions

Mail server errors are a function of errors in their child nodes, i.e. the end user, software and connections, each of which are functions of their child nodes. Assuming that all these functions are linear, then the error \( W \) (parent node, representing mail service) is a linear function of random variables \( x_1 \) to \( x_8 \); this dependence can be demonstrated as follows:

\[
W = a_0 + a_1 x_1 + \ldots + a_8 x_8 + b_0 u
\]  

(1)

where, \( u \) is an unknown random variable considered as noise and it can be eliminated from next equations. In equation (1), there are 9 unknowns, which need nine equations with non-random variables. For this purpose, the expected value of both sides can be calculated; however, an equation will exist again. To obtain the other eight equations, the both sides are multiplied by \( x_1 \) to \( x_8 \). That is:

\[
W x_1 = a_0 x_1 + a_1 x_1 x_1 + \ldots + a_8 x_1 x_8
\]

(2)

\[
W x_8 = a_0 x_8 + a_1 x_8 x_8 + \ldots + a_8 x_8 x_8
\]

(3)

takes the form of a matrix.

Let us obtain the expected value of both sides; we have:

\[
E\{X_i\}.V_1 = E\{C_i\}
\]

(4)

where, \( x_i \) is equal to:

\[
V_1 = [a_0 a_1 \ldots a_8]^T
\]

(5)

\[
C_i = [w_1 x_1 \ldots w_8 x_8]^T
\]

(6)

The \( T \) on top of the vectors \( v \) and \( C \) d represents the transposed of a vector or matrix. Let \( C, v \) and \( X \) represent the expected values of the matrix and the vectors; we have:

\[
X.v = C
\]

(7)

Assuming that \( X \) has an inverse, we have:

\[
v = X^{-1}.C \quad \text{or} \quad X^{-1}.X.v = X^{-1}.C
\]

(8)

where, the matrix of coefficients is obtained. The important thing here is accurate calculation, because we have approximate unknown distributions \( X_1 \) and \( X_8 \). Assuming approximately normal distributions \( X_1 \) to \( X_8 \), ranging from \( \mu_i \) to \( \mu_i \) and standard deviations \( \delta_i \) to \( \delta_i \), the mean sample distribution \( X \) is approximately normal in the range of \( \mu(\chi) = \mu \) and standard deviations \( \delta(\chi) = \delta \), where \( k \) is the number of samples selected to obtain and \( \mu_{\chi_i} \) and \( \delta_{\chi_i} \) matrices \( X \) and \( C \), as explained above.

In that case,

\[
Z_i = \frac{(X_i - \mu_1)}{\sigma_1}
\]

(9)

The normal variables will be the standard Z, we have:

\[
X_i = \delta_i . Z_i + \mu_i
\]

(10)

Substituting this formula in equation \( w \), we have:

\[
W = a_0 + a_1 x_1 + \ldots a_8 x_8 = a_0 + a_1(\delta_1 Z_1 + \mu_1) + \ldots + a_8(\delta_8 Z_8 + \mu_8)
\]

(11)

\[
\Rightarrow W = b_0 + b_1 z_1 + \ldots b_8 z_8
\]

(12)

where

\[
b_0 = a_0 + \sum_{i=1}^{8} a_i \mu_i, \quad b_i = a_i \delta_i
\]

(13)

In fact, equation (b) is a new equation obtained by substituting \( a_i \) by \( b_i \) and \( X_i \) by \( Z_i \). In this project, the variables \( X_1 \) to \( X_8 \) are normalized \( N(0,1) \) by a linear transformation (by finding \( \mu_i \) and \( \delta_i \) and their 95\% confidence interval using MATLAB). Using a linear conversion \( \gamma_i = (x_i - \mu_i)/\delta_i \), as argued above, an equation similar to (12) will be achieved, that is:

\[
W = d_0 + d_1 y_1 + \ldots + d_8 y_8
\]

(14)

\[
d_0 = a_0 + \sum_{i=1}^{8} a_i \mu_i, \quad d_i = a_i \delta_i
\]

(15)

To test our hypotheses, given that the original data -the number of points - was less than thirty and due to the excessive noise and the unknown distribution of variables, we do not expect a very good and accurate prediction. Thus, the tests were conducted by generating lower number of \( k \) points and a number of points more than thirty and adding normal noises in the same size of \( \rho N\left((\delta_i(2) - \delta_i(1)) \right)^{\rho} \rho = 0.5 \). The results are shown in the following figure.

In Figure 1(a) and 1(b), we used 19 points to find conversion parameters and the remaining 11 points to predict.
Figure 1. (a) Using the lower limit of the confidence interval, (b) Using the upper limit of the confidence interval, (c) Using the middle confidence interval, (d) Without software, (e) Without the conversion formula to the standard formula, (f) By noisy data and 19 training points, (h) By software, (i) Without the conversion formula to the standard formula, (j) By noisy data and 19 training points, (k) By synthetic noisy data and 150 training points.

In Figure 1(h), this was carried out by 150 and 30 points. Figure 1(b) is the result of converting and using μ and δ of the lower limit of the confidence interval for this parameter. We observe that the prediction is generally lower than the actual number and the predicted changes are smoother; that is, lower μ and δ (as a result of changes) will be smaller. Figure 1(c) is the result of converting and using μ and δ of the upper limit of μ and δ intervals, which are higher with steeper changes unlike the prediction made in Figure 1(b).

Figure 1(d) is the result of conversion using the original parameters of predictions; thus, this prediction is an intermediate between these two.

Figure 1(e) is the result from solving the problem by parameters μ and δ which are directly calculated without the software; that is:

$$\delta^2 = E[(x_i - x_j)^2] \quad E[X_i] = \frac{\sum X_i}{k} = x_i$$

I=1,…,8

Figure 1(f) is without the linear conversion and data is used directly in the V formula. Figure 1(e) and 1(f) are not different, except the changes in prediction which are smoother in Figure 1(f).

In Figure 1. and Table 1. indicating the confidence intervals of data, the output noise is high due to the relatively large intervals. In addition, the number of points (the sampling data) is low; therefore, no accurate prediction can be

| Table 1. Monthly sampling at the selected network |
|-----------------------------------------------|
| days  | 1    | 2    | 3    | 4    | 5    | 6    | 7    | 8    | 9    | 10   | 11   | 12   | 13   | 14   | 15   |
|-------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|------|
| X₁    | 4    | 5    | 6    | 9    | 3    | 4    | 2    | 5    | 6    | 2    | 4    | 3    | 7    | 7    | 6    |
| X₂    | 1    | 0    | 0    | 2    | 1    | 1    | 0    | 1    | 0    | 0    | 1    | 0    | 0    | 1    |     |
| X₃    | 0    | 0    | 1    | 2    | 0    | 3    | 1    | 0    | 1    | 1    | 0    | 0    | 1    | 0    |     |
| X₄    | 2    | 1    | 0    | 3    | 1    | 2    | 1    | 3    | 0    | 1    | 1    | 2    | 1    | 3    | 1    |
| X₅    | 1    | 2    | 0    | 0    | 3    | 2    | 2    | 1    | 0    | 1    | 1    | 0    | 0    | 1    |     |
| X₆    | 34   | 18   | 28   | 20   | 41   | 36   | 13   | 32   | 30   | 31   | 37   | 39   | 27   | 31   | 30   |
| X₇    | 15   | 12   | 11   | 12   | 18   | 18   | 16   | 17   | 12   | 10   | 11   | 20   | 19   | 17   |     |
| X₈    | 33   | 29   | 36   | 26   | 27   | 24   | 28   | 33   | 37   | 30   | 30   | 33   | 33   | 34   | 35   |
| W     | 60.71| 53.10| 41.21| 46.77| 49.11| 44.52| 59.86| 54.75| 65.65| 69.83| 66.31| 49.37| 44.62| 46.1 | 45.72|
| days  | 16   | 17   | 18   | 19   | 20   | 21   | 22   | 23   | 24   | 25   | 26   | 27   | 28   | 29   | 30   |
| X₁    | 6    | 4    | 9    | 0    | 1    | 2    | 0    | 0    | 3    | 5    | 4    | 1    | 2    | 0    | 7    |
| X₂    | 0    | 1    | 0    | 2    | 1    | 1    | 0    | 0    | 3    | 1    | 0    | 0    | 1    | 0    | 0    |
| X₃    | 1    | 0    | 1    | 2    | 3    | 1    | 1    | 2    | 0    | 1    | 0    | 1    | 0    | 2    |     |
| X₄    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    | 0    |     |
| X₅    | 3    | 1    | 2    | 1    | 1    | 1    | 2    | 3    | 0    | 1    | 1    | 1    | 1    | 0    | 0    |
| X₆    | 33   | 32   | 28   | 34   | 29   | 28   | 37   | 40   | 36   | 25   | 22   | 31   | 36   | 34   | 35   |
| X₇    | 26   | 15   | 14   | 17   | 14   | 13   | 23   | 22   | 27   | 24   | 29   | 29   | 24   | 19   | 15   |
| X₈    | 24   | 30   | 36   | 29   | 26   | 31   | 29   | 35   | 28   | 28   | 38   | 26   | 26   | 24   | 25   |
| W     | 55.77| 63.22| 74.27| 64.03| 68.59| 57.81| 54.57| 53.05| 46.58| 43.55| 44.90| 55.47| 63.50| 63.88| 74.88|
made. To prove this, we generated a prototype consisting of 180 points of the functions $Y_1$ to $Y_8$ with parameters ranging from $X_1$ to $X_n$, but normal distribution function (by normal noises equal to 25% the confidence interval for $\mu_s$ and 50% diffraction of the confidence interval for $\delta_s$); then, we added to original data $X_1$ to $X_n$. Next, we generated an input data by which we estimated parameters and predicted changes. Considering the high noise, we conclude that the implemented method performed well.

4. Conclusion

Assumption of linear dependence of $W$ to $x_5$ is approximately correct. Assumption of normal distribution of $x_5$ is approximately correct. Despite the large amount of noise, this method well responded. One of the reasons for systemic errors is that the number of sampling points is small. Synthetic data experiments confirm the above assumptions. In service assurance systems assuming linear dependencies, the proposed method performs well to find the dependency of service components (KPI’S) and ultimately to reduce time and cost when an error occurs until it resolves.

These results can be generalized to larger services and wider networks as well as the entire series of elements of a large network (although the main objective was to use it for UMTS network, the context and sampling were difficult). The results can encourage those interested in quality assurance in network services for future works.

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