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Next Generation Networks (NGN) Billing and Charging System

Amir Ahmed Omer Yousif
e-mail: ameer_ahamd@yahoo.com
Dr. Hamid Abbas Ali
Prof. Sami M. Sharif
Faculty of Electrical Engineering, University of Khartoum, Khartoum – SUDAN

ABSTRACT:

This paper reviews the private next generation networks (NGN) , billing and charging system and clarify the billing and charging system and compared with traditional telecommunications billing system. The paper also contains the NGN billing and charging system mathematical model so as to understand the NGN billing process.

***KEYWORDS*:** NGN, Billing, Charging

1- INTRODUCTION:

Historically the telecommunication networks have evolved from a simple telephone network into a multi-service field, with new services implemented either as add-on to existing networks or by creating separate service specific networks. This hierarchical structure till now facilitates simple planning, operation and management. However different networks with one-to-one mapping of services (IP, ATM, PSTN & Internet) costs a lot to service providers [1]. Today, the telecommunications industry is expecting to shift to a new, revolutionary type of networks generally referred to as Next-Generation Networks (NGN). NGN is the new buzzword in the telecommunications community since 1998. It implies the convergence of traditionally separate telephone and data networks into a single multiservice IP (Internet Protocol) based network. NGNs will carry voice, data and multimedia traffic over common transmission links and routers using a packet-based transport method [2]. Telecommunications billing is the group of processes of communications service providers that are responsible to collect consumption data, calculate charging and billing information, produce bills to customers, process their payments and manage debt collection [1]. Telecommunications billing system is an enterprise application software designed to support the telecommunications billing processes.

The figure bellow (Figure 1) shows the NGN architecture model that consist of a service creation environment and applications server layer which includes software programs to execute the available services content and interface [7].

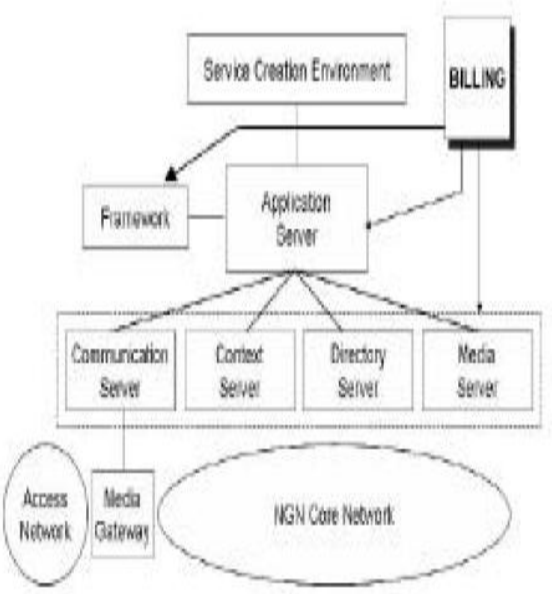

Figure 1: NGN - Reference architecture

2- OBJECTIVES and BACKGROUND:

Telecommunications Network Operators have traditionally billed their customers on a strict usage basis, charging for service on a per-minute basis. But as wireless penetration slows and average revenue per user begins to lag, carriers are looking for ways to recoup the cost of their network upgrades to 2.5G and 3G [3]. So in order to make any money, carriers need to upgrade their billing systems to support content-based services. Mediation technology collects usage information from the network and presents it to the billing system, allowing carriers more flexible billing options, such as billing for Web sites, emails, applications such as streaming media, etc [3].

A billing system is a system that tracks customer usage of services, and calculates the impact on a customer's account, based on the price of the services [2].

The widely used billing and charging types are:

- Pre-pay Billing: A billing mechanism where customer pays in advance and after that starts using a service.
- Post-pay Billing: This is the conventional billing which is coming for many years.
- Interconnect Billing: The network operator is usually financially responsible for services provided to its customers by other networks regardless of whether or not the customer pays for the service.
- Roaming Charging: When a customer goes from one network operator's coverage area to another operator's coverage area, first operator would pay marginal charges to second operator to provide services to their customers.
- Convergent Billing: Convergent billing is the integration of all service charges onto a single customer invoice. Convergent billing means creating a unified view of the customer and all services (Mobile, Fixed, IP etc) provided to that customer.

3- NGN BILLING and CHARGING SYSTEM:

NGN networks like GPRS and UMTS networks; the gateway support node plays a significant role in the rollout of next generation networks [3]. It provides a primary interface between the carrier's cellular network and the IP services layer. The gateway support node is capable of offering enhanced service creation, billing, and IP traffic management by using its full visibility of the sessions' bearer traffic. These functionalities enable the collection of data and the billing of newly launched services, making it possible for the operator to measure the rate of adoption. The Content Based Billing feature offered by Content gateway support node enables differentiation between the various data flows, allowing different billing models to be applied. Content Based Billing solution provides key functionality including support of per-subscriber personalized IP packet filtering and IP flow based recording and reporting [3].

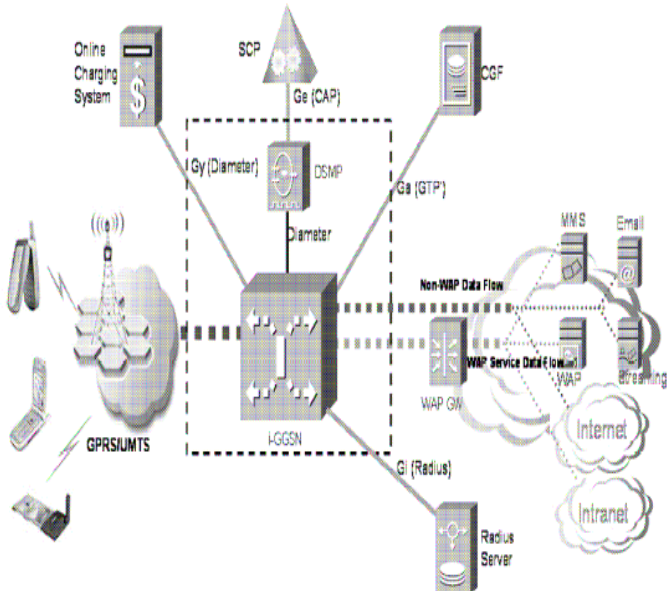

Figure 2: Content Based Service delivery architecture over NGN

Figure 2 shows the Content Based Service delivery architecture over NGN, the services of content-based billing include Websites, individual files, Multimedia Message Service (MMS), and lots more. The gateway support node (GGSN) can report billing records or information over different interfaces [3]:

- GTP (Ga-interface) as in GTP accounting to Charging Gateway function (CGF),
- IETF RADIUS messaging (Gi-interface) as in RADIUS accounting to AAA servers
- TCP/IP based Diameter protocol (Gy-interface) as in real-time Prepaid. Together with a Prepaid Server, which could be an SCP and/or an online Charging System, the GGSN offers an integrated real-time pre paid solution that facilitates roaming.

4- MATHMETICAL MODEL for NGN BILLING and CHARGING SYSTEM:

In order to get a simplified general model for NGN billing process, a study of the traditional billing process is seemed to be helpful. In traditional billing systems, the billing value (charge) (C) can be expressed in the following form [7]:

$$C = f(Q,u,T,P) \qquad (4.1)$$

Where Q is quantity of data to be transported, u is the pricing unit, T is the duration of the connection and P is the operator policy. The unit price u is also a function of the data rate R, the quantity Q, the duration T, the distanced and the strategy (policy) of the operator P. Therefore Equation (4.1) can be written as follows:

$$C = f(Q,u,T,P) \qquad (4.2a)$$

with

$$u = g(R,Q,T,d,P) \qquad (4.2b)$$

Traditional communication systems have two separate general switching technologies; circuit switching and packet switching. In case of circuit switching, that is highly dedicated for telephony services:

- R is fixed, so it has no effect in Equation (4.2).
- Also Q becomes meaningless parameter in the billing model when R is fixed. So, Equation (4.2) becomes:
-

$$C = f(u,T,P) \qquad (4.3a)$$

with

$$u = g(T,d,P) \qquad (4.3b)$$

The depending of the charge on policy can be put in the following piecewise form:

$$c = \begin{cases} f_1(u_1,T); & P = P_1 \\ f_2(u_2,T); & P = P_2 \\ \vdots & \\ f_n(u_n,T); & P = P_n \end{cases} \qquad (4.4a)$$

with

$u_i = g_i (T,d)$ (4.4b)

Where n is the number of policies of the operator. As an example, assume that some operator has the following charging policies:

1. Fixed charging unit per distance per time – P1.
2. Flat rate time for period t (between h1& h 2) – P2.
3. For the 1st strategy:

C = u(T,d)T

and

u (T,d) = u_od

Therefore:

C = u_odT;

Where u_o is a constant unit price.

The 2nd strategy has fixed unit price Uo for a given time period. The overall charging system of such an operator may be formed as:

$$c = \begin{cases} u_0 dT & P = P_1 \\ U_0 \quad h_1 \le t \le h_2 & P = P_1 \end{cases} \quad (4.5)$$

In case packet switched mode:

R is represented as bps (bandwidth).
Q is considered in terms of data volume (Bytes).
So, Equation (4.2) becomes:

$$c = \begin{cases} f_1(Q, u_1, T) & P = P_1 \\ f_2(Q, u_2, T) & P = P_2 \\ \vdots & \\ f_n(Q, u_n, T) & P = P_n \end{cases} \quad (4.6a)$$

with

ui = g_i (R,Q,T,d) 1 < = i <= n (4.6b)

Now if the service needed is performed through more than one operator, the total charge value can be computed as:

$$C_r = \sum_{k-1}^{K} f_k (Q, u_k, T), \quad P = P_k \quad (4.7a)$$

with

$u_k = g_k$ (R,Q,T,d) 1 < = i <= n (4.7b)

Where, K is the number of operators. In this equation the charging policy depends on the agreement between the operator (i) and the operator (i + l). As an example, assume that for a telephone service all the operators are agreed on charging policy of unit price per distance per time, then the total charge C_T becomes:

$$\cup_T = T \sum_{k-1}^{K} u_k d_k \quad (4.8)$$

Considering the case of NGN, two additional new parameters affect the charging value of service. These parameters are the service content C_S and the bundling options O_B Therefore the charging value $\mathbf{C_{NGN}}$ for next generation network can be represented by the following form:

$$C_{NGN} = f_I(Q, u, T, C_S, 0_B, P) \quad (4.9)$$

Here also, the unit price u still depends on the data rate, quantity, duration, distance and operator's policy. It will also depend on some new parameters, which are; the quality of service QoS, the location (l), the network (N), the content (C_S) and the bundling options (O_B), i.e.:

$$u = f_2(R, Q, T, d, QoS, l, NC_s, 0_B, P) \quad (4.10)$$

Finally, the charging policy is also a function depends on the type of service (S), the timing considerations (t), the payment options (O_P) and the marginal profit expected (G), i.e.:

$$P = f_3(S, t, O_p, G) \quad (4.11)$$

5- CONCLUSION and RECOMMENDATIONS:

This paper has reviewed the limitations of current billing systems and billing standards with regard to NGN billing, charging, fraud detection and evaluated the traditional networks billing system. A NGN is a based network able to provide telecommunication services and able to make use of, transport technologies and in which related functions are from underlying transport transport related technology related technologies [5]. It enables unfettered acc fettered accesses for users to networks and to competing service providers and/or services of their choice. It supports general generalized mobilized mobility which will allow consistent and ubiquitous provision of services to users [5].

Further work in this area should include the simulation of mathematical modelling of the various charging models on simulated mobile network or telecom network data covering both voice and Internet data services. This should include examining the combining of charging models and the resultant effect on the income for the telecommunications network provider and also the cost impact on the different types of subscribers using the telecommunications networks [6].

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