

THE EFFECT OF NIGERIAN FACTORS ON GSM NETWORK TRAFFIC LOADING

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Abstract

Network resource allocation techniques are mostly based on the network user traffic intensities. In Nigerian environment 'flashing' (unproductive calls) and erection of GSM call-booths are the order of the day. The unanticipated high intensity of traffic from GSM booths and flashings may overwhelm the designed network resources. Therefore, effective and efficient network performance management strategy requires an accurate appraisal of GSM network traffic loading. This paper, therefore, presents the influence of flashings and presents a model that could be employed in the determination of the traffic loading on a given GSM network that operates in Nigerian environment. The model was based on the census of GSM users' activities conducted in 12 national tertiary institutions.

Key words: flashing, user traffic, call-booths.

1.0 Introduction

The issue of network performance management is very topical with telecommunication network providers. It has severally been stated that no matter how accurate a network may be designed and implemented the operation may not be effective and efficient without appropriate network management [1]. Precisely, how well resources are managed in a network brings about the clear differences in the performances that exist among network providers - GSM providers.

Several researches have been dedicated to network performance management - specifically resource allocation. Quite good number of results has been implemented [1]. This notwithstanding, till now telecommunication networks still suffer from traffic congestions that are caused by the imprecision in resource allocation. Network traffic is comprised of user and signaling traffic [2, 3, 4]. GSM networks are noted for being signaling traffic intensive [4, 5, 6, 7] and therefore, in order to develop appropriate performance management strategy the precise network traffic (signaling and user) intensity needs to be defined. It may be pertinent to note that increase in the user traffic intensity corresponds to a relative increase in the signaling intensity. Generally, from the start, a given capacity of resources

is designed into GSM network to support the traffic while the network providers are expected to manage the network performance on the basis of user specifics.

In the Nigerian environment, GSM call-booths are proliferating. Consequently, GSM networks are inundated with call arrivals that are generated by the call intensive GSM call-booths. In Nigeria, there is a popular practice referred to as 'flashing' that greatly influences call arrivals and the resultant traffic intensity. Flashing may be considered as the act of placing a call through a network without the intention to actually communicate. Connection is established and immediately disconnected in order to avoid billing since user message is not intended to be transmitted over such connection. The objectives of 'flashing' may include transferring the cost of communication to the called. In some other cases, it could merely serve as a coded message to the called. Such calls generate complete signaling messages that occupy network resources unproductively. Therefore, flashings and the proliferation of call-booths cause the resultant network traffic to overwhelm the designed traffic intensity and consequently network resources. The existence of GSM call-booths and the flashings are rarely observed in developed countries and

therefore may not have been provided for in the initial network plan.

The effect of flashing may be very pronounced at the network access points where a blocked call may give rise to repeated call requests. The flashings occur randomly and independent of traffic situation at the node. It swells the arriving traffic volume and the extent to which this is done is the objective of this paper.

This paper, therefore, presents the analysis of the effect of Nigeria factor on normal GSM traffic load. The extent of GSM call-booth proliferation and the level of mobile user's involvement in flashing were investigated. Effects of flashings and GSM call-booths on network traffic were defined. This paper presents a model that may be employed in the determination of the traffic load on a given GSM network operating in Nigerian environment. The model was based on the census of GSM users' activities conducted in 12 national tertiary institutions in 12 Nigerian states. It is intended that the knowledge of the fact that there is Nigerian factor attached to GSM system operation in the country would go a long way to correct some management decision errors hitherto made. Therefore, the effect of flashings and call-booths were quantified and built into a model.

2.0 Determination of Traffic

In this work, traffic was defined on the basis of traffic generated by a group of people in the nation since a nation can be regarded as a multiplicity of groups of people. This approach is in consonance with the definition of traffic that has always been limited to a single node as networks may also be regarded as a multiplicity of nodes. Therefore, any analysis reached on a node may be extrapolated for an entire network [1]. Network traffic is comprised of signaling and user traffic [8]. One of the objectives of this work is to determine the percentage of calls that generate both user and signaling traffic that emanate from call booths and those from subscribers as flashings.

The realization of the above objective was approached by conducting a nation-wide census of mobile users' activities in these regards. This was done using questionnaire. Four GSM service providers (Visa, MTN, Glo and Zain) were randomly selected for study. The activities of the subscribers to these networks were investigated using twelve states, as listed in table 1. The states and consequently the institutions listed for investigation were also randomly selected. The choice of tertiary institutions as object of study was based on the fact that majority of the community members may be most willing and can respond appropriately to questionnaires. Students may be considered as the most active group of people in the nation with respect to information and communication technology (ICT).

Table 1 presents the result of the investigation as extracted from the questionnaires. In each of the institutions the average of 284 subscribers was randomly sampled and the average of 254 responses was received in each of the 12 institutions. The responses show that average of 40 subscribers is attached to more than one network simultaneously. Also it was shown that the average of 24 subscribers use mobile stations (MS) for public purposes (call-booths) while the average of 224 subscribers uses them for private purposes in each of the institutions. The average of 194 private MS users occasionally patronizes the call-booths. The average of 115 subscribers engages in flashing while 109 subscribers do not engage in flashing. Among those that engage in flashing, average of 30 subscribers flash once, 53 flash two times, 27 and 7 subscribers flash three times and more than three times respectively in each of the 12 institutions every day.

Analysis of table 1 shows that 9.6% of the mobile stations served belong to the public user group that employs the mobile stations for commercial purpose in call-booths. It is shown that 82.9% of private users occasionally patronize call-booths. Each call-booth records the average of 2707 call units patronization per day. The call holding times were averaged to two minutes. In the same

way, it was observed that 51.3% of the private mobile users engage in flashing.

2.1 Network user traffic

Arriving user traffic at the network interface is comprised of local and trunk traffic including blocked traffic as illustrated in figure 1. Numbers of calls for a given area (a tertiary institution) may be measured. The analysis of such traffic was presented for a given area in the author's earlier work [8]. In the same vein, the total GSM user traffic, $F(x)$, may be expressed as in equation (1).

$$F(x) = F_1(x) + F_2(x) \quad (1)$$

Where,

$F_1(x)$ – traffic from private MS users, and

$F_2(x)$ – traffic from public MS users.

Therefore the total average number of calls, x , per second and within the institution may be given by equation (2) and illustrated by figure 1.

$$x = \rho_1 + \rho_2 + \rho_3 \quad (2)$$

Where,

ρ_1 – local calls

ρ_2 – trunk calls

ρ_3 – blocked calls

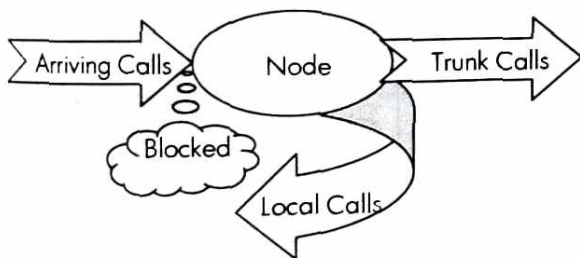


Figure 1: Originating node traffic

2.2 Flashing traffic

All flashings arrive at the network as call requests and network nodes recognize them genuinely as calls by allocating adequate resources to them. The only difference is that in the case of flashings, resources are occupied unproductively. Such unproductive calls are not different from the productive ones signaling wise. As a result, the total call arrival intensity in the network increases above the projected level for a given number of mobile users. The effect of flashing on mobile traffic was modeled into the traffic from private MS user employing equation (3).

$$F_1(x) = x(1 + \delta) \quad (3)$$

Where,

x = traffic value as defined in the earlier work by the author [8]. The traffic designed into the network, and

δ = flashing factor.

51.3% of private MS users engage in flashing activity. 90.4% of the entire mobile users are private users. Therefore, 46.4% of the entire mobile users engage in flashing and so flashing factor (δ) may be given as 0.464.

2.3 Call-booth traffic

It was observed that calls from the booths may be comprised of calls from individuals that do not own MS and those that have MS but occasionally patronize call-booths. The implication is that call intensity that emanate from call-booths (MSs for public use) overwhelm the designed level. The effect of call-booths on traffic was modeled using equation (4).

$$F_2(x) = x\alpha + \varepsilon \quad (4)$$

Where,

α – call-booth coefficient, and

ε – call-booth patronage coefficient.

9.6% of the total MSs belong to public user group and 82.9% of private MS users patronize the booths occasionally. So, call-booth coefficient (α) may be given as 0.096 while the call-booth patronage coefficient (ε) may be given as 0.75.

2.4 Total traffic

Therefore, total traffic may be given as in equation (5).

$$F(x) = x(1 + \delta) + x\alpha + \varepsilon = x + [x(\delta + \alpha) + \varepsilon] \quad (5)$$

Equation (4) implies that $x(\delta + \alpha) + \varepsilon$ is the Nigerian factor in the GSM traffic. This factor adds to the projected traffic. In our environment, management decisions can only be precise if and only if this factor is recognized.

3.0 Conclusion

In Nigerian environment 'flashing' (unproductive calls) and erection of GSM call-booths are reality. An unanticipated volume of traffic from GSM booths and

flashings was observed as an excess on network monitored traffic.

Table 1: Census of mobile users' activities on four GSM networks

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State (Tertiary Institution)			Rivers	Delta	Enugu	Anambra	Lagos	Ogun	Borno	Adamawa	Abuja	Plateau	Sokoto	Kaduna
Number of Users Sampled			300	260	295	260	250	302	310	252	323	275	287	287
Number of Responses			261	253	270	232	242	260	287	204	298	244	251	215
Network User is Attached	Visa		28	30	29	15	20	12	17	09	12	32	07	22
	Mtn		160	180	138	167	149	176	150	132	170	154	131	143
	Glo		80	72	98	98	121	93	143	67	99	87	102	79
	Zain		40	50	37	26	31	38	27	28	42	39	44	34
Number of Users attached to more than one network			52	63	32	38	26	70	30	43	35	51	19	17
User Group	Public MS (Booths)	Nos of bths	15	19	30	28	40	15	20	22	23	27	21	25
		Ave call unit sold	3015	2793	2445	3230	3524	2351	2024	1875	2754	3050	2205	3213
	Private MS		239	233	236	200	196	240	265	180	265	211	230	187
Number of Private Users that Occasionally Visit the Phone-Booth			209	200	198	174	181	214	231	158	218	169	204	162
Average Number of Flashings Per Call per Day	0		103	111	113	94	91	118	131	99	143	97	129	76
	1		30	20	40	32	30	22	41	21	24	42	27	24
	2		56	47	57	41	47	74	68	42	77	31	47	49
	3		30	20	26	30	28	17	25	18	21	40	23	35
	>3		20	35	0	3	0	9	0	0	0	1	4	3

This excess is capable of overwhelming the designed network resources when ever the exact network traffic is offered. The implication is that resource allocation technique that ignores this excess in traffic would not work well for Nigeria.

An analytical model and the modeling approach that could be employed in the determination of the exact traffic load on a

given GSM network that operates in Nigerian environment was presented. The census of GSM users' activities conducted in 12 national tertiary institutions was presented.

It was found that 9.6% of the mobile stations belong to the public user group that employs the mobile stations for commercial purpose in call-booths. 82.9% of private users

occasionally patronize call-booths. Each call-booth records the average of 2707 call units patronization per day. The call holding times were averaged to two minutes. In the same way, it was observed that 51.3% of the private mobile users engage in flashing. These data can be greatly improved on by increasing the extent and detail to which MS users activities are observed using the same approach.

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