Characteristics and Statistics of The International Traffic In The Sudan Telephone Network

Sami M Sharif and Awatif M Ismail
Electrical Engineering Department, University of Khartoum, Khartoum, Sudan

Abstract

Traffic characteristics and parameters are determined in the international routes of the Sudan Telephone Network. The distribution and mean values of the holding time, carried traffic and Seizure rates are determined and discussed. The daily traffic profiles are measured and the traffic busy hours are determined. The time distribution of the number of seizure calls blocked is measured and found to have a high value.

I. Introduction

Generally, the management and planning of communication network, depend completely on the traffic offered and carried by that network. Traffic is a random process[1,2], with random parameters that depend on a large number of factors that include the end users behaviour, time, day, season and socio-economical factors. Thus investigation of traffic behaviour is carried out on statistical basis, and defined by statistical parameters. The statistical quantities that are generally used to study the behaviour of traffic in networks may include[1,2], the call arrival rates, holding time, profiles, etc. In Sudan, the largest install communications network is the telephone network, which is used to provide communications on the national and international levels. As in many other developing countries, the characteristics of the traffic carried by and/or offered to the network are not well documented. At the present, planning and management of the network are carried out on assumed values for the traffic parameters, which may led to a poor grade of service (g.o.s) or uneconomical network operation. The aim of this paper is to investigate the traffic carried by Sudan Telephone Network (STN) at the international level and determine its statistical parameters. The network configuration and routing plans are discussed in section II. In section III, the techniques used for data collection and measurement are considered. The traffic profiles

are given in section IV; while the traffic parameters, i.e. the holding time and seizure rate, are discussed in sections V and VI respectively. In section VII the blocking of seizure calls is discussed. Conclusions are given in section VII.

II. Network Configuration

The international exchange at Khartoum (i.e. international/national transit, CTX/CTN) is of type DTN1.I, supplied by Telettra, Italy; installed in 1983, the full description of the exchange is given in ref.[3]. The exchange is equipped with 3750 national and international trunks, expandable to 1440 trunks and fully controlled by stored program. Electronic manual board (IBM) is used for manual and semi-automatic operation. In international trunks, R2I and CCITT No. 5 signalling are used, while in the national side of the exchange the R2Y and PHUV signalling are used. The traffic investigated in fourteen routes; the circuits associated with these routes are shown in Table 1. Some of these routes holding transient traffic e.g. UAE, Italy, swaziland and USA route.

Table 1 : Routing Plane In Khartoum International Exchange[3]

Destination	Incoming Circuits	Outgoing Circuits	Both Ways
Libya	00	00	12
Bahrain	00	00	03
UAE	12	04	24
Qatar	00	00	05
Italy	04	00	04
Egypt	05	05	00
USA	00	00	06
Swaziland	00	00	03
UK	02	00	03
Saudi 1	00	08	36
Saudi 2	24	24	00
Jordan	00	00	02
Oman	00	00	02
Yemen	00	00	02

III. Data Collection and Measurement

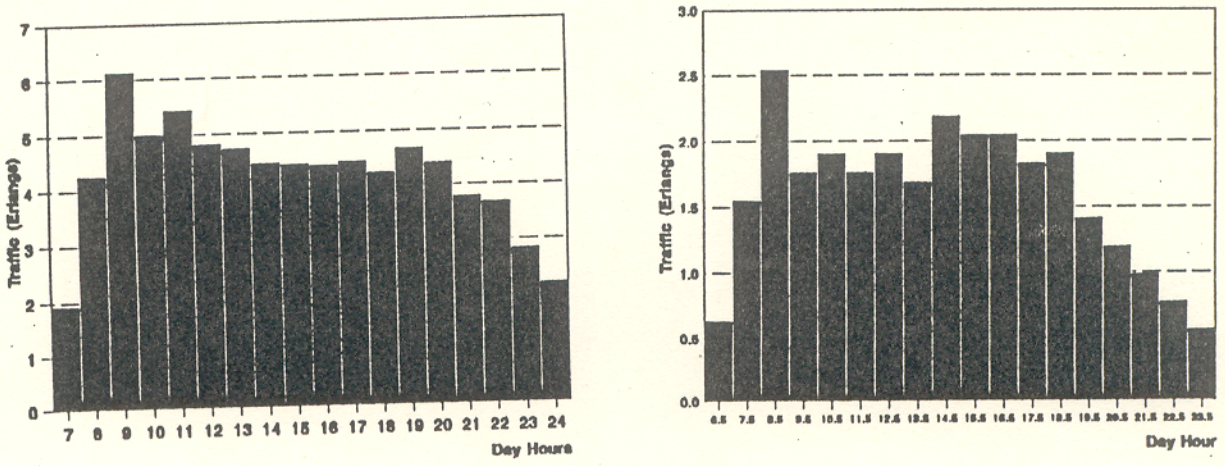
Data from three sources are used in the investigations of the traffic in the international routes of the Sudan Telephone Network. The first source of data was the billing information used by the

Sudan Telecommunication Co-operation. Two sets of data were considered for incoming and outgoing traffics; one for the traffic that is handled by the semiautomatic dialling and the other for the direct dialling. The data was collected from different areas in Khartoum, that include residential and commercial areas. A sample of 11,200 calls was considered from the total calls carried out during a period of 1 month. This sample represents about 20% of the total calls carried out during that period; which is seen to be a reasonable and accurate sample for the present study[4]. The sample consists of 5447 calls for the semi-automatic dialling and 5755 calls for the direct dialling. The analysis was carried out using standard statistical methods for the holding time for the different destinations and routes. The second source of data is the information available in the STC accounting department for the total number of call and duration carried in each route for the years 1990 and 1991; this information were used to determine the average holding time of the traffic in the different routes. The third source of data is direct measurement; counters were used to count the number of seizing and conversation every half an hour for 6 working days. The measured data were used to determine the daily traffic profile i.e., circuits occupancy and percentage of seized calls blocked. The results are discussed in details in the following sections.

IV. Daily Traffic Profiles

The daily traffic profiles give the occupancies of the international links (trunks). The profiles are determined for the incoming and outgoing traffics from the measured data, mentioned in section III above, for both outgoing and incoming routes. The profiles of the total carried traffics in all routes are given in Fig 1a and 1b respectively from time 6:00 to time 24:00. It is noticed that traffic carried in the period from time 00:00 to 6:00 is small and not considered. During the day the carried traffic is always within the range form 3.60 E to 1.30 E for the incoming traffic and in the range from 2.54 E to 0.66 E for the outgoing traffic. For the incoming and outgoing traffics the busy hour is the hour 8:00 a.m. to 9:00 a.m.; the average busy hour carried traffic is 4.79 E for the incoming traffic and 2.69 E for the outgoing traffic. The busy hours and busy hour traffic of the different destinations (routes) are given in Table 2.

The average of daily incoming and outgoing traffics are determined from the measured data, and found to be 3.63 and 1.61 respectively. The different routes, (destinations), daily traffic averages are shown in Table 2. These results do not agree with the data published by ITU team[5]; however, the ITU team was carried out a limited number of measurements; and it is clear from our experience that the published traffic matrix does not reflect the actual traffic behaviour.



(a) (b)

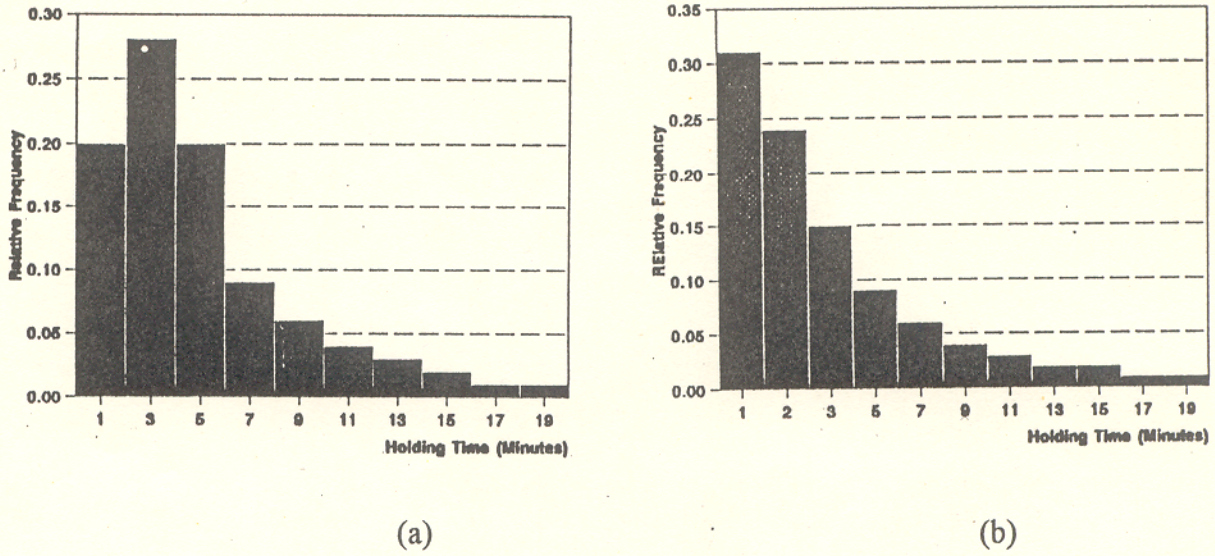
Fig 1: Daily Traffic Profile (a) Incoming Traffic, (b) Outgoing traffic

Table 2 : Busy Hours and busy hours traffic for the different Destination

	Incoming Traffic			Outgoing Traffic			
Destination	**Busy Hour**	**Busy Hour traffic Erlang**	**Mean of Daily Traffic Erlang**	**Busy Hours**	**Busy Hour Traffic Erlang**	**Mean of Daily Traffic Erlang**	**Percentage of carried Traffic**
Libya	09:00-10:00	00.78	00.59	09:00-10:00	00.96	00.59	01.7
Bahrain	11:00-12:00	00.80	00.50	11:00-12:00	00.20	00.12	00.95
UAE	09:00-10:00	25.71	16.46	08:00-09:00	06.60	03.82	30.82
Qatar	08:00-09:00	03.22	02.05	08:00-09:00	00.90	00.58	03.93
Italy	09:00-10:00	02.76	01.79	11:00-12:00	00.39	00.21	03.01
Egypt	08:00-09:00	02.19	01.55	08:00-09:00	03.69	02.72	05.60
USA	08:00-09:00	04.32	02.68	15:00-16:00	03.33	01.79	07.30
Swaziland	08:00-09:00	01.56	01.12	08:00-09:00	00.52	00.19	01.98
UK	13:00-14:00	03.42	02.50	13:00-14:00	00.23	00.14	03.48
Saudi 1	08:00-09:00	19.78	15.51	08:00-09:00	09.81	06.02	28,23
Saudi 2	08:00-09:00	00.00	00.00	08:00-09:00	09.25	05.10	8.83
Jordan	14:00-15:00	00.82	00.98	15:00-16:00	00.91	00.51	01.64
Oman	09:00-10:00	00.71	00.47	08:00-09:00	00.66	00.50	0130
Yemen	08:00-09:00	01.10	00.56	08:99-09:00	00.21	00.16	01.25

V. Holding Time Distribution

The holding time probability distributions are determined from the billing information as mentioned in section III above. The distribution are given in Figures 2a and 2b for the outgoing traffic through the semi-automatic and directly dialling respectively. The average holding time was



(a) (b)

Fig. 2: Holding Time distribution (a) Semi-automatic dialling, (b) Direct dialling

found to be 7.06 minutes. In the residential areas the average holding time was determined to be 10.89 minutes while in the business areas it is 6.54 minutes. The mean holding time of the traffic carried in the different routes (i.e. to different destination) were determined from the information in the Accounting Department in the STC, and the values are given in Table 3 for semi-automatic and direct dialling. There are some diversity in average the holding time values for the different routes; the average values is found to be the range from 4.87 to 13.19 minutes.

Table 3 : Traffic parameters in the different routes

	Incoming Traffic		Outgoing Traffic	
Destination	**Average Holding Time Semiautomatic Dialling Minutes**	**Average Holding Time Direct Dialling Minutes**	**Maximum Seizure Rate Incoming routes Calls/Minutes**	**Maximum Seizure Rate Outgoing Traffic Calls/minutes**
Libya	05.65	05.50	02.23	01.02
Bahrain	06.54	05.07	01.87	00.08
UAE	04.96	04.43	55.47	05.30
Qatar	04.94	04.34	03.95	00.82
Italy	05.56	06.40	02.90	00.53
Egypt	06.47	06.94	02.73	01.67
USA	10.39	05.91	02.87	01.13
Swaziland	07.44	08.66	01.38	02.70
UK	07.60	07.86	02.08	00.17
Saudi	05.54	05.16	46.35	02.79
Jordan	07.56	03.51	01.45	00.28
Oman	13.19	04.48	01.12	00.12
Yemen	07.10	06.93	01.77	00.17

VI. Seizure Rate Distribution

The probability distribution of the seizure rate in the international circuits are determined from the measured data (section III). These distributions are given in Figures 3a and 3b for the incoming and outgoing traffics respectively. The maximum seizure rate was observed to occur in the hour 08:00 t0 09:00 with the values 8.47 and 0.96 calls/minutes in the incoming and outgoing routes respectively; with the corresponding average values of 4.99 and 0.67 calls/minutes respectively. It is worth to noticed that, only few percent of these calls success to conversate as will be discussed in the next section.

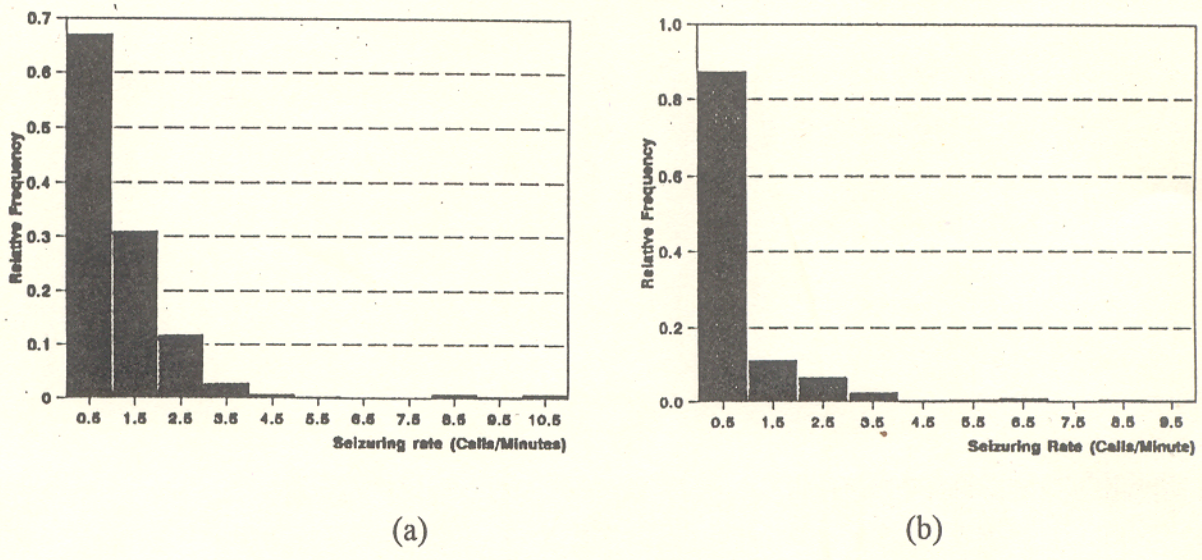
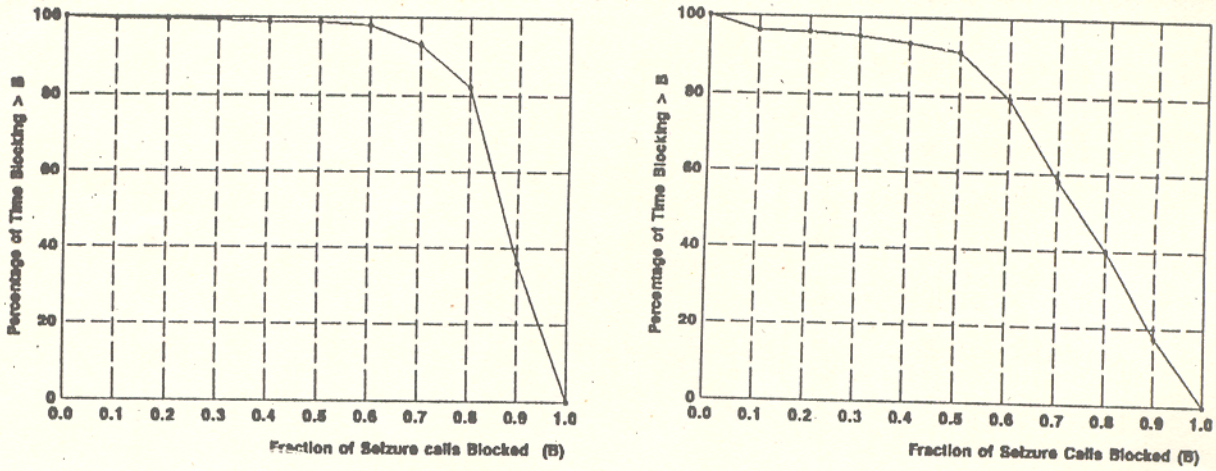


Fig. 3 : Seizure Rate Probability Distribution, (a) Incoming Traffic, (b) Outgoing Traffic

VII. Lost Calls

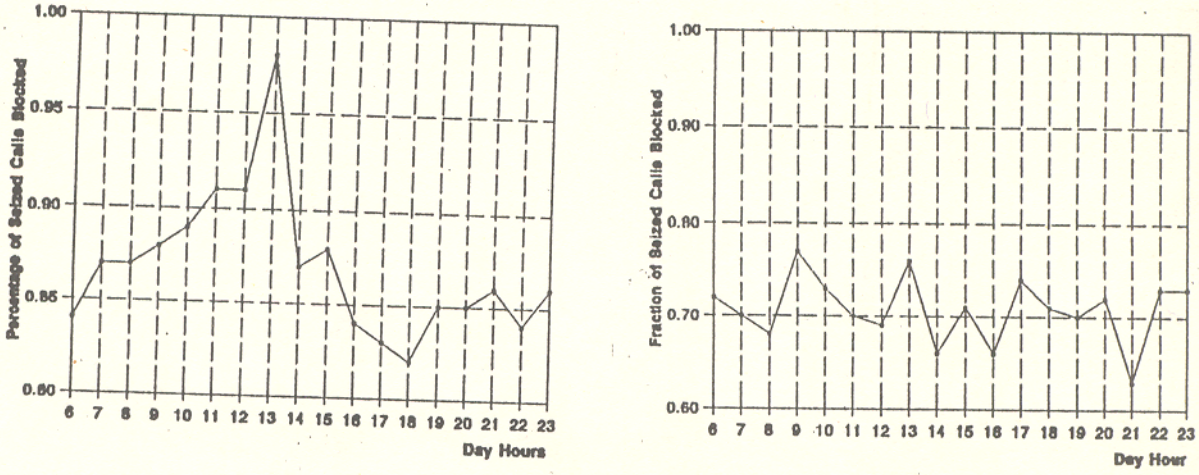
The measured data, mentioned in section III above, give the total number of the sized and converseded calls every half an hours. This data set is used to determine the percentage of calls blocked due to the unavailability of resources at the end terminals. Figures 4a and 4b give the time versus the percentage of calls blocked for both incoming and outgoing traffics respectively. It is worthy to note that, the blocking in the network for incoming and outgoing traffics respectively, are greater than 80% and 40% for 80% of the time. The daily profiles of the percentage of the blocked calls are measured and given in Figure 5a and 5b, for the incoming and outgoing traffic respectively. It has been noticed that the percentage of the calls blocked due to the lack of resources is always within the range from 85% to 98% for incoming traffic and 63% to 79% for outgoing traffic. The percentage of blocked calls is greater for the incoming traffic. It is believed

that, this is due to (i) the grater volume of incoming traffic and (ii) the poor g.o.s. offered by the national network.



(a) (b)

Fig. 4 : Percentage of seizure calls blocked (a) Incoming Traffic, (b) Outgoing Traffic



(a) (b)

Fig 5 : Daily Profile: Fraction of seized calls blocked (a) Incoming Traffic, (b) Outgoing Traffic

VII. Conclusions

Measurements were carried to investigate the traffic characteristics and behaviour in the international routes of the Sudan Telephone Network. The average holding time was found to be 7.06 minutes. The daily traffic profiles were determined and the busy hour was found to be the hour 8:00 to 9:00. The night traffic is small and not considered in this study. The average rates of seizure were determined, and found to be 8.47 and 0.96 calls/minutes for the incoming and outgoing traffic respectively. A high blocking rate was observed during the day that exceeds 70% and 50% for the incoming and outgoing traffic respectively for 90% of the annual time.

References

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