Asian Journal of Information Technology 7 (1): 15-18, 2008
ISSN: 1682-3915

Determination of Some Key Performance Indicators in Public Telephone Switches in Calabar, Nigeria

[1]J.C. Ogbulezie, [1]M.U. Onuu and [2]D.E. Bassey
[1]Department of Physics, University of Calabar, Calabar, Nigeria
[2]NITEL Headquarters, Abuja, Nigeria

Abstract: The performance of any equipment or network is of great importance. Key performance indicators are the indices for finding out how well the telephone switches in Calabar Nigeria are performing. Measurements and analyses were taken at the Nigerian Telecommunications Limited (NITEL), Calabar exchange using Electronic Digital Switching system (EWSD) equipment. It was found that not up to 50 calls out of a 100 were effectively carried even though the call completion rates were very high. Key teletraffic performance and key traffic events have indicators been determined for the public telephone switches in Calabar, Nigeria.

Key words: Key performance indicators, telephone switches, traffic events

INTRODUCTION

Telecommunication is a fascinating fast paced industry that influences every aspect of our daily life like normal voice phone calls, connectivity to the internet, satellite communication, surfing the web, fax transmission, video conferencing, high speed data communication and cable television. The field of telecommunication is no doubt one of the most exciting occupation fields that modern society has to offer.

In any Public Switched Telephone Network (PSTN), it basic mechanism of planning is to ensure that the right size of equipment is provided to meet the needs of the customer in a most economical way. It is therefore necessary to know the measure of service given to customers. This research is aimed at finding how well the public telephone switch in Calabar, Nigeria is. This was done by calculating the key performance indicators.

The Public Switch Telephone Network (PSTN) is a telecommunications network that was developed to provide two-way voice communication to many users. This network provides a means of interconnection between users (Calhoun, 1988). By connecting all users to a central switch and providing a switch to connect any other user, the number of required links can be greatly reduced. The size of any switch is dependent on the number of telephone users in the area. The Calabar switch has the capacity to carry 10,000 subscribers (Bassey, 2005).

The switching centers in Nigeria have four-level hierarchy. The local switches (local exchange) form the lowest-level. Each local switch within a given area is connected to a central switch called primary centre using a star network. Within a large area, each primary centre is connected to a central location called a secondary switch. The fourth hierarchy involves International Direct Dialing (IDD) linking subscribers to international telephone switching centre. The Calabar exchange is a primary centre (Bassey, 2005).

The term telephone traffic when used in telephone exchange or group of trunk circuits is determined by both the rate at which telephone calls arrive and the length of time for which they are held. These two key qualities account for the term "traffic" (Bear, 1976). If a circuit carries one call continuously for one hour, it is said to carry one erlang of traffic. Key performance indicators are the parameters that determine how effective and efficient a PSTN is.

This research is aimed at finding how well the public telephone switches in Calabar, Nigeria is by determining its performance indicators as well as show the quality of service given to customers.

Theory: The traffic carried can never exceed the numbers of channels (lines). A channel can at most carry one erlang. In theoretical models the concept offered traffic is used; this is the traffic which would be carried if no calls were rejected due to lack of capacity, i.e., if the number of servers were unlimited. Theoretically, there are two parameters, namely, call intensity, λ (mean number of calls offered per unit time) and mean service times (Iversen, 2006).

Offered traffic A is given by

$$A = \lambda.s \quad (1)$$

Corresponding Author: M.U. Onuu, Department of Physics, University Calabar, Calabar, Nigeria

According to Asouzu (2004), key traffic events include:

- Trunks provided to carry traffic.
- Trunks available at the time of traffic (trunks provided-faulty trunks).
- Bid (call initiation by lifting hand set).
- Seizures (seizing of switching signaling path).
- Switch through (seizing of speech path).
- Answer (successful call answered by the called subscriber).
- Busy/no reply (unanswered call that has successfully seized a speech path).
- Traffic carried (as measured by the system).

The key performance indicators are as follows (Asouzu, 2004).

Bids per Circuit per Hour (BCH): This is a measure of the demand or calling pressure on a route during a particular period; it is an indication of traffic volume.

$$BCH = \frac{Bids}{Available\ circuits} \quad (2)$$

Seizure per Circuit per Hour (SCH): This is a measure of the ability to seize an idle circuit in a route. And it is expressed as:

$$SCH = \frac{Seizure}{Available\ circuits} \quad (3)$$

Mean Holding Time per Seizure (MHTS): This is the total holding time divided by the number of seizures.

$$MHTS = \frac{Total\ holding\ time}{Total\ seizure} \quad (4)$$

Answer Seizure Ratio (ASR): This is the direct measure of traffic offered and is denoted by:

$$ASR = \frac{Answered\ calls}{Total\ seizure} \times 100\% \quad (5)$$

Call Completion Rate (CCR): This indicates the effectiveness of call completion up to switching level

$$CCR = \frac{Answered+No\ reply+Busy+No.\ unobtainable}{Total\ seizure} = \frac{Switch\ through}{seizure} \quad (6)$$

Answer Bid Ratio (ABR): This is the percentage ratio of answered calls to totals bids. It is expressed as:

$$ABR = \frac{Answered\ calls}{Total\ bids} \times 100\% \quad (7)$$

Percentage overflow: It a measure of difficulty being encountered by a bid on securing an idle circuit in a route

$$= \frac{Seizure}{Bids} \times 100\% \quad (8)$$

Total Traffic (TC): Carried in Erlang

$$= \frac{Total\ traffic\ carried}{10} \times 100\% \quad (9)$$

Total traffic per circuit in Erlang during the busy hour

$$= \frac{Total\ traffic\ carried\ in\ Erlang}{Total\ number\ of\ available\ trunks} \quad (10)$$

$$Switch\ through = Answered+No\ reply+Subscriber\ busy \quad (11)$$

MATERIALS AND METHODS

The Calabar exchange of Nigeria Telecommunications Limited (NITEL) uses 10,000 subscriber's digital electronic switching system (EWSD) model, 12,000 analogue and external plant network, 144 megabits/sec, digital carrier network and computerized Operation and Maintenance Terminal (OMT). Data from six routes were collated and analyzed.

Teletraffic on the Calabar switch was carried out for a period of 24 h 30 min interval using teletraffic commands. This was done continuously for 7 days to determine the busy hour of the routes. Busy hour is the period of 60 consecutive minutes during which the traffic on the exchange is greatest. For 8 weeks (June 12, 2006 to August 15, 2006) data for calculating key performance indicators was collected.

RESULTS AND DISCUSSION

Table 1 shows busy hour key traffic events at Calabar-Uyo primary centre, while Table 2 shows calculated busy hour key teletraffic performance indicator for this primary center using the formula specified above. Similarly Table 3 and 4 show the busy hour key traffic events at Calabar-Aba primary center and busy

Table 1: Busy hour key teletraffic performance indicators at Calabar-Uyo primary centre

Key traffic event measurements	Outgoing traffic scanning time (19.30-20.30 h)	Incoming traffic scanning time (14.30-15.30 h)
Trunks provided	75	75
Trunks available	75	75
Bids	879	625
Seizures	810	619
Switch-through	629	609
Answered	172	296
Busy/No reply	457	313
Traffic carried (DERL)	11	8.3

Table 2: Busy hour key teletraffic performance indicators at Calabar -Uyo primary centre

Key teletraffic performance indicators	Outgoing teletraffic	Incoming teletraffic
Traffic carried in Erlang	10.70	8.30
Traffic per circuit in Erlang	14.30	11.10
Answer Bid Ratio (ABR)	19.60	47.40
Answer Seizure Ratio (ASR)	21.00	47.80
Call Completion Rate (CCR)	77.70	98.40
Mean Holding Time per Seizure (MHTS)	47.60	48.30
Bids per circuit per hour	11.72	8.30
Seizure per circuit per hour	10.80	8.30
Per centage over flow	7.90	1.00

Table 3: Busy hour key traffic events at Calabar-Aba primary centre

Key traffic event measurements	Outgoing traffic scanning time (20.30-21.30 h)	Incoming traffic scanning time (20.00-21.00 h)
Trunks provided	150	150
Trunks available	122	122
Bids	1,014	1,563
Seizures	987	1,498
Switch-through	987	1498
Answered	235	151
Busy/No reply	643	1158
Congestion	109	189

hour key teletraffic performance indicators for the same centre respectively. Table 5 and 6 similarly show busy hour key traffic events and busy hour key performance indicators at Calabar-Port Harcourt primary centre.

The key performance indicators such as call completion rate, answer-bids ratio, answer-seizure ratio, bids per circuit, seizure per circuit, etc are quality of service indicators. From the table showing key performance indicators of the Calabar-Uyo primary centre, it is seen that the percentage of answered calls to bids were 19.60 and 47.40% for outgoing and incoming traffic. These gave a call completion rate of 77.70 and 98.40% for outgoing traffic, respectively. The high rate of call failures revealed that the local loop network was in a poor state. Majority of calls could not get to the called subscribers as a result of bad terminating cable. Similarly, Table 4 shows that for the Calabar-Aba route the ABR was 9.23 and 9.70% for outgoing and incoming traffic, respectively.

Table 4: Busy hour key teletraffic performance indicators at Calabar-Aba Primary centre

Key teletraffic performance indicators	Outgoing teletraffic	Incoming teletraffic
Traffic carried in Erlang	15.60	12.70
Traffic per circuit in Erlang	12.80	10.40
Answer Bid Ratio (ABR)	0.23	9.70
Answer Seizure Ratio (ASR)	23.80	10.10
Call Completion Rate (CCR)	100.00	100.00
Mean Holding Time per Seizure (MHTS)		
Bids per circuit per hour	8.30	12.80
Seizure per circuit per hour	8.10	12.30
per centage over flow	2.70	4.20

Table 5: Busy hour key traffic events at Calabar-Port Harcourt primary centre

Key traffic event measurements	Outgoing traffic scanning time (12.30-13.30 h)	Incoming traffic scanning time (19.00-20.00 h)
Trunks provided	402	402
Trunks available	402	402
Bids	2,987	1,796
Seizures	2,152	1,783
Switch-through	2,149	1783
Answered	513	451
Busy/No reply	1,179	1261
Congestion	448	71

Table 6: Busy hour key teletraffic performance indicators at Calabar-Port Harcourt primary centre

Key teletraffic performance indicators	Outgoing teletraffic	Incoming teletraffic
Traffic carried in Erlang	27.60	25.40
Traffic per circuit in Erlang		
Answer Bid Ratio (ABR)	17.20	25.10
Answer Seizure Ratio (ASR)	23.80	25.30
Call Completion Rate (CCR)	99.90	100.00
Mean Holding Time per Seizure (MHTS)		
Bids per circuit per hour	7.40	4.50
Seizure per circuit per hour	5.40	4.40
per centage over flow	28.00	0.70

The switching system had very good call completion ratio of 100% for outgoing and incoming traffic. For the Port-Harcourt primary centre, the answer-bid ratio of 17.20 and 25.10% for outgoing and incoming traffic were recorded. Interestingly, the interconnection point achieved 99.90% call completion rate for outgoing and 100% for incoming traffic.

CONCLUSION

Real time teletraffic measurement and analyses are very important. These help the operator's technical department to know their traffic indicators in order to attain network optimization. It also helps in knowing how service usage impacts on networks and other trends. Though these analyses the operator is able to know real-time call traffic statistics, network elements, cause of breakdown failures, destination analysis, failure rate, circuit dimensioning and teletraffic load shedding. These monitors will prevent failure and revenue losses.

Through these measurements, NITEL can tackle a problem before it alters customers satisfaction and network performance. This measurement and analytical approach give a uniform view of traffic trend and services rendered regardless of the technology used.

REFERENCES

Asouzu, C., 2004. Guidelines for Trunk Traffic Management. NITEL Operational Publications, Nigeria Telecommunications Limited.

Bassey, D.E., 2005. Computer Aided Measurements and Analysis of Real-Time Teletraffic Signals in Some Parts of South Eastern Nigeria. Ph.D Thesis, Department of Physics, University of Calabar, Nigeria.

Bear, D., 1976. Telecommunications Traffic Engineering. London: Peter Peregrinus Sa1.

Calhoun, G., 1988. Digital cellular radio. Norwoods Artech house incorporation.

Iversen, V.B., 2006. Teletraffic Engineering and network Planning. http://www.com.dtu.dk.