PABX – a Specific Traffic Source

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Abstract: **Each PABX is connected to the PSTN trough trunk bundle and the quantity of the carried traffic depends on the quantity of the bundle. Good knowledge in the field of traffic distribution and processing is obligatory for the correct dimensioning and the definition of the quality parameters of the call processing. Some specific processes, described later, have lead to the idea to consider the traffic flows in the PABX and in the trunk bundles to the PSTN.**

The authors attempt to make wide consideration of the traffic flows between PABX and PSTN and based on this to recommend new, practical way to better dynamic dimensioning of the trunk bundles.

Keywords: **PABX, teletraffic theory, Internet traffic, traffic modeling**

I. Introduction

PABX's are relative small telephone exchanges. Their capacity can vary in wide ranges. Most of these exchanges are connected to the PSTN trough normal subscriber lines. For PABX with greater capacity it is necessary to connect them with PSTN trough analog or digital trunks. The obtaining the number of the lines in the trunk bundle is a serious optimization problem.

The dimensioning of the telephone network problem requires solving of wide range of problems, especially at the PABX – level, caused by:

a) great number of different places, where the PABX-s are installed – hotels, hospitals, administration buildings, schools, private offices etc.;

b) different characteristics of the incoming and outgoing traffic;

c) wide range of provided services;

d) different technologies – centralized or distributed control;

e) restrictions of service usage– by financial reasons.

The main differences between the traffic load in PSTN and PABX may be considered as follows:

a) different busy hour for the incoming and for the outgoing load;

b) the incoming traffic is much greater then the outgoing. This is caused by the following reason: all subscribers of the PABX may accept incoming calls and only a part of the subscribers have rights to make outgoing calls;

c) the usage of additional services (such as Internet or data communications) causes traffic load with different from the telephone traffic parameters – low number of calls with longer call duration;

d) tariffs policy of the telephone service provider.

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In order to obtain the traffic load of a PABX the following consideration is made: Incoming and outgoing traffic loads are measured on a switching system with 1800 extensions, 600 of them have permission to make outgoing calls to PSTN.

Figure 1.1 presents the average number of outgoing calls and their continuity. Figure 1.2 shows the same characteristics for the incoming calls. It is important to know that the data includes only effective calls (ended with conversation) but not seizures with no conversation end.

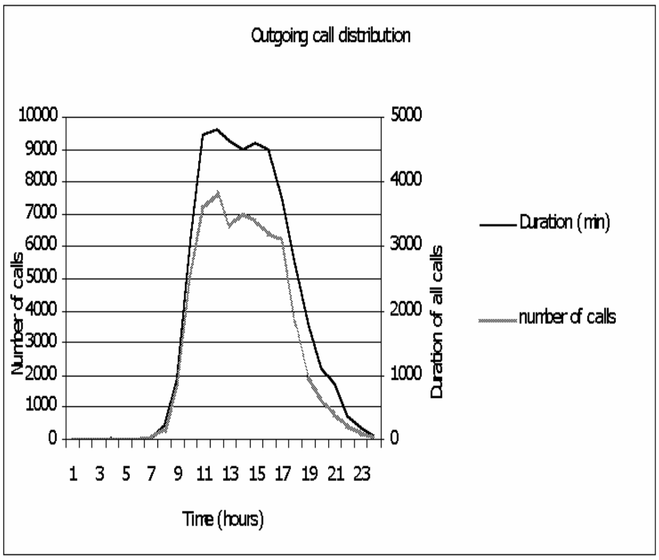


Figure 1.1 Statistical data for the outgoing calls of a PABX. The graphics show the average number of calls and the average duration of these calls for the whole consideration time – 6 months.

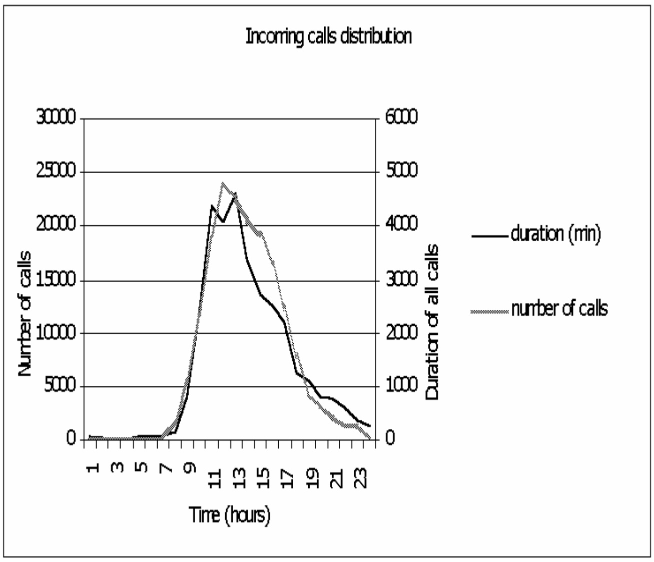


Figure 1.2 Statistical data for the incoming calls of a PABX. The graphics show the average number of calls and the average duration of these calls for the whole consideration time – 6 months.

II. DIMENSIONING OF TRUNK BUNDLES BETWEEN PABX AND PSTN

As mentioned before, The PABX with SPC (Stored Program Control) allows dynamic and with no restrictions changing of subscribers priorities, with defines the necessary capacity of the trunk bundle to the PSTN by keeping up the admissible loss level.

By the putting into operation of one exchange the capacity of a trunk bundle is to be defined – mostly arbitrary, in dependence of the resources of the network. Later, after setting up the configuration of the exchange, the administration of the PABX should reduce or increase the number of trunks in accordance with the traffic load.

The authors propound the following approach for determine the trunk bundle capacity:

1. After configuring the PABX following parameters are to be set up:

N – number of extensions;

N_{int} – number of extensions with permission for making international calls;

N_{nat} - number of extensions with permission for making national calls;

N_{loc} - number of extensions with permission for making local (city) calls;

$N_{out} = N_{int} + N_{nat} + N_{loc}$ - number of extensions initiating outgoing traffic load, where

2. The average outgoing traffic load per such an extension can be calculated using:

$$A_{out} = N_{int} \cdot a_1 + (N_{int} + N_{nat}).a_2 + N_{loc}.a_3, \qquad (2.1)$$

Where

a_1 – average international traffic per extension in busy hour;

a_2 – average national traffic per extension in busy hour;

a_3 – average local traffic per extension in busy hour;

The values are calculated due to statistical observation of calls from a PABX to PSTN and from PSTN to PABX (number of calls and duration of all calls – Figure1). The different duration of a dialing and the distribution, in percents, of calls ended with "no answer" or "busy" is taken in consideration.

In case of absence of statistical data it is possible to use the following values for a_1, a_2 and a_3:

a_1 = 0,0008 Erl,
a_2 = 0,0040 Erl,
a_3 = 0,0135 Erl.

The observation of the real operation of the PABX shows, that the conventional equalizing of the incoming and the outgoing traffic can not be accepted concerning the dimensioning of trunk lines between PABX and PSTN. This is so because in most cases all of the extensions of the PABX may accept incoming calls, and just part of them have permission to make outgoing calls.

Therefore the incoming traffic can be calculated:

$$A_{inc} = N.\ a3 \qquad (2.2)$$

with assumption that all extensions may accept calls.

Than the overall traffic is:

$$A = A_{inc} + A_{out} \qquad (2.3)$$

In most cases the busy hour for the incoming traffic differs from the busy hour for the outgoing traffic. This depends from

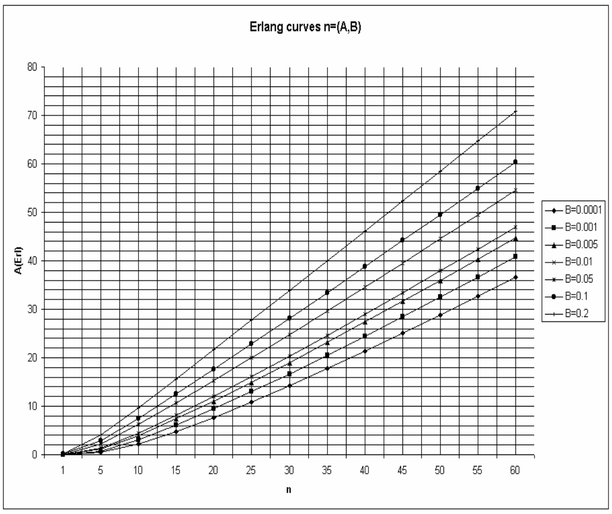


Figure 2.1 This is an example of the curves obtained by the first Erlang formula.

the working time of the most places where the PABX-s are being installed. This might be good concerning the losses in the trunk bundle.

3. The number of the necessary trunk lines (n) by given losses (B) and earlier calculated traffic A (2.3) can be obtain in two ways:

- using the curves shown on Figure 2.1;
- using the Erlang tables by N>300 or Engset by lower .

The applicability of the described method is being confirmed due a comparison of the statistical data of the observation and the values obtained using (2.1), (2.2) and (2.3). It is very important to know, that the observation was made on a trunk bundle with more then necessary trunk lines, witch works practically without losses.

The digital PABX-s are usually connected to the PSTN with PCM (2 Mbit/s) lines. In this case is important to consider the 30 - channel modularity of the line. The technical management of the PABX may define the number of lines by vary with the losses in admissible bounds. Figure 2.1 shows a curves family for losses between B = 0,001 and B = 0,02. In some cases it is possible to obtain higher level of losses.

III. INFLUENCE OF INTERNET TRAFFIC OVER THE TELEPHONE TRAFFIC

In order to obtain how the internet-traffic (by using dial-up connections) exerts an influence over the telephone traffic a real – time model was developed.

It is known that the internet-connections have a much longer duration then the telephone connections. The duration of these connections is a casual quantity.

To obtain the probability laws and the numeric characteristics of the quantity it is necessary to provide observation for a long time period. This is pot the case in this work

For the needs of modeling some hypotheses were accepted: the duration of the internet-calls is determined; the Internet calls occur rarely then the telephone calls.

The modeling is made as follows:

Step 1: When a call is made, a checkout is carried-out – whether this is an Internet call or a telephone call. The internet- calls occur within early defined number of telephone calls (there are two cases in the model: every 20-th or every 30-th call, independent of a call-flow intensity - λ).

Step 2: Generating of calls with various intensity: the intervals between calls have an exponent distribution law.

Step 3: Checking up – if there is a free serving device the call is being handled: for the telephone calls the handling time is exponential distributed, for the internet calls the handling time is determined – 30, 45 or 60 minutes. If there is no free device a loss is count off.

Step 4: When the observation time for each one experiment (according to Student's criterion) is up, the loss count is made.

Figures 3.1, 3.2, 3.3 and 3.4 show the modeling results by the following conditions:

- λ = 6.0, 7.0 and 9.0 calls/min;
- 5 % and 3 % of all calls are internet calls;
- number of calls – 1000000 ;
- duration of internet calls – 30, 40 and 60 minutes;
- for each one experiment the number of trunk lines decrease from 60 to 30.Figure 3.1 represents the losses in the trunk bundle having various numbers of lines by 5% internet calls with 30 minute duration.

Figures 3.2 represent the same but internet-calls are 3% of all calls in the bundle. There is a half of percent difference within the losses in these two cases.

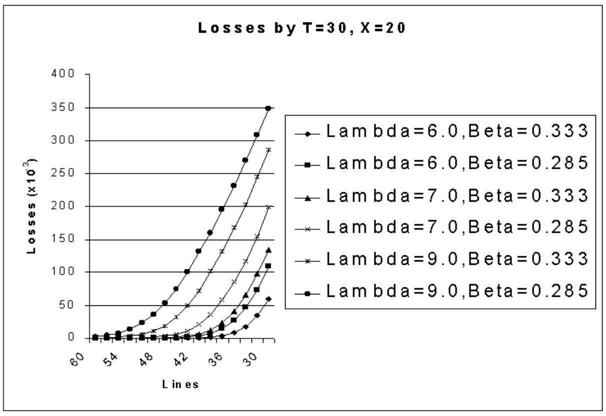


Figure 3.1 Losses in the bundle by 5 % internet-connections and duration of 30 minutes.

Figure 3.2 Losses in the bundle by 3 % internet-connections and duration of 30 minutes

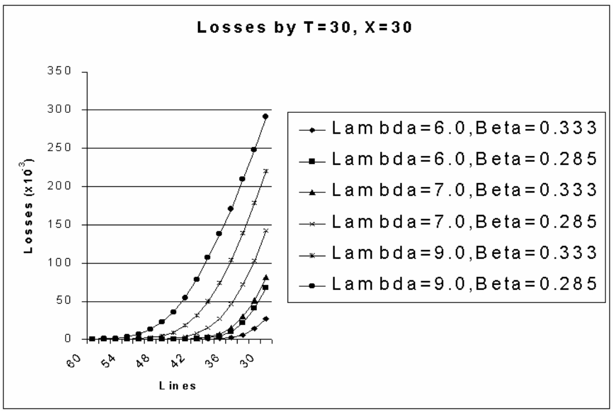
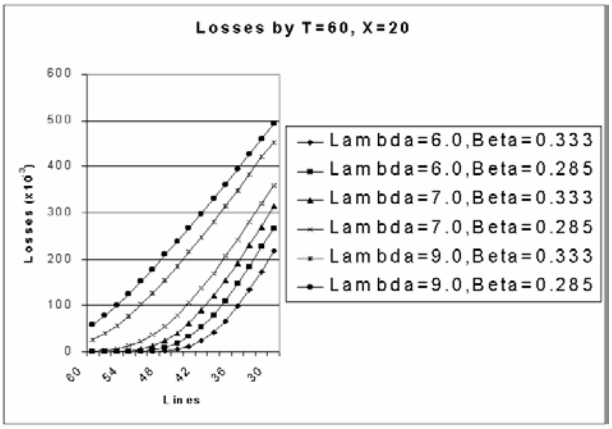


Figure 3.3 Losses in the bundle by 5 % internet-connections and duration of 60 minutes

From the Figures 3.3 and 3.4 is clear, that by higher



duration of the internet-calls (60 minutes), the losses increase dramatically.

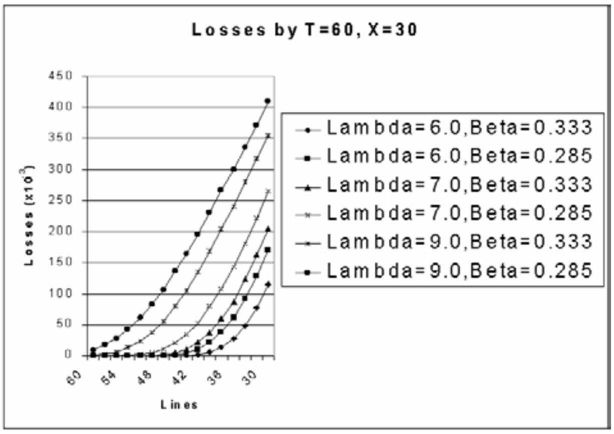


Figure 3.4 Losses in the bundle by 3 % internet-connections and duration of 60 minutes

For example: If the traffic obtain due to (2.3) is A = 18 Erl (that means call duration of connection 3 min by λ = 6.0 calls/min) and the number of lines in the bundle is V = 30, the losses have a value B = 0,0026. By the same value of λ, but if every 20-th call is an internet-call with 30 min duration, the losses increase 23 times – B = 0,0634!

To obtain the right dimension of the trunk bundle it is necessary to observe the internet-connections, to evaluate the number of these connections and the laws of the probability distribution of their duration.

This might be a future problem for the authors. The modeling results give a good basis for consequent research.

IV. CONCLUSION

As a conclusion, the correct obtaining of the traffic load on the trunk bundle between PABX and PSTN needs special efforts to be made and it is necessary a optimal dimensioning

In this work an appropriate method for this purpose is given. Also concrete trends for obtaining the influence of the to be provide concerning of the losses in the lines. So great economies for the owner of the PABX can be realized. internet-traffic over a normal telephone call handling are discussed.

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