The Dimensioning of Trunk Groups for Standard Gradings of the German GPO in Case of Finite Number of Traffic Sources

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1. Introduction

The dimensioning outlines of the German GPO include loss tables for the dimensioning of trunk groups with limited accessibility for offered PCT 1 (infinite number of traffic sources). With prescribed values of the probability of loss \( B \), the offered traffic \( A \) and the accessibility \( k \) the corresponding number of trunks \( n \) can be read off the tables. These tables are valid for trunk groups for standard gradings of the German GPO.

If the traffic is offered to these trunk groups from a finite number \( s \) of traffic sources (PCT 2) the admissible offered traffic increases by an amount \( d = f(s, n, k, B) \) with constant values \( n, k \) and \( B \).

In section 2, gradings with offered PCT 1 are regarded. Subsequently, offered PCT 2 is considered in section 3. In this section, a simple formula for the calculation of \( d \) is introduced. Therewith, the PCT 1 — tables are also usable for PCT 2. Examples for the application of this \( d \)-formula are given in section 4. In section 5, results achieved by this \( d \)-formula are compared with artificial traffic trials performed on a digital computer.

2. Offered PCT 1

(Infinite Number of Traffic Sources)

2.1. High Efficiency Gradings

Trunk groups for high efficiency gradings (see Fig. 1) with skipping and slipping, i.e. with good traffic balance, can be calculated very accurately by means of the Modified Palm Jacobaeus Loss Formula (MPJ Formula) [1, 2, 3].

2.2. Standard Gradings

Standard gradings (see Fig. 2), as generally used by the German GPO since many years, have a simplified structure which facilitates automated design of gradings and remarkably less expenditure of work for the implementation and for eventual extensions [4].

The admissible offered PCT 1-traffic for prescribed parameters \( n \), \( k \) and \( B \) is slightly smaller than for high efficiency gradings. The difference \( \Delta A \) can be calculated according to [5, 6]. The above mentioned loss tables of the German GPO [7, 8] already take this difference \( \Delta A \) into account.

3. Offered PCT 2

(Finite Number \( s \) of Traffic Sources)

If PCT 2 is offered to an one-stage connecting array with fixed parameters \( n \), \( k \) and \( B \), the admissible offered traffic \( A_{\text{PCT 2}} \) is greater than the corresponding tabulated value \( A_{\text{PCT 1}} \) [2, 3]. In [9] loss formulae for this case are derived.

The difference

\[
d = A_{\text{PCT 2}} - A_{\text{PCT 1}} = f(s, n, k, B)
\]  

(1)

\( d \) can, however, for standard gradings of the German GPO, easily be calculated directly by means of the following formula

\[
d = 0.3 \left[ n - 0.77 \cdot A_{\text{PCT 1}}(1 - B) \right] \frac{n}{(s + n)}
\]  

(2)

which is valid for \( k \geq 3 \), \( s \geq 6 \) and \( A_{\text{PCT 1}} \geq 2.5 \) Erlang.

In Eqn. (2) the accessibility \( k \) is implicitly regarded by the values \( n \), \( A_{\text{PCT 1}} \) and \( B \).

Fig. 1.
High efficiency grading with skipping and good traffic balance for the accessibility \( k = 10 \) and \( n = 110 \) trunks.

Fig. 2.
Standard grading of the German GPO for the accessibility \( k = 10 \) and \( n = 110 \) trunks.

The corresponding admissible offered PCT 2-traffic is according to Eqn. (1):

\[
A_{\text{PCT 2}} = A_{\text{PCT 1}} + d
\]  

(3)

Furthermore, we get the corresponding call rate per idle source (mean holding time \( h = 1 \)):

\[
\lambda = \frac{A_{\text{PCT 2}}}{s - A_{\text{PCT 2}}(1 - B)}
\]  

(4)
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4. Examples for the Application of the d-Formula

4.1. Example 1

Be given a standard grading with $k = 10$, $n = 30$, $s = 120$ and prescribed loss $B = 0.5\%$. The admissible offered traffic $A_{PCT2}$ is wanted.

a) From the tables for PCT 1 [7, 8] we get for $k = 10$, $n = 30$ and $B = 0.5\%$ the offered PCT 1-traffic (see Fig. 3): $A_{PCT1} = 15.0$ Erlang.

b) By means of Eqn. (2) we get

$$d = 0.3 [30 - 0.77 \cdot 15.0 (1 - 0.005)] = 1.11\text{ Erlang}.$$
Considering the finite number of sources the calculation yields in this example a saving of three trunks, in contrary to a dimensioning of the trunk group for the standard grading with the PCT 1-tables, only.

5. Comparison between Calculation and Artificial Traffic Trials

The function $B = f(s, n, k, A_{PCT})$ for trunk groups with limited accessibility and with standard gradings was simulated on a digital computer checking the accuracy of the calculated $A_{PCT}$-values. The results are shown in Fig. 5 to 8 (grading schemes see e.g. in [6]).

6. Summary

A formula is presented which allows to calculate very easily trunk groups for standard gradings with offered PCT 2-traffic by means of the new dimensioning outlines of the German GPO.

References


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