Manual Calculation of Break-Even Point

for the Use of Remote Subscriber Switches

Solution of Case study

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SOLUTION

CASE STUDY, MANUAL CALCULATION OF ECONOMICAL BREAK-EVEN POINT FOR THE USE OF REMOTE SUBSCRIBER SWITCHES

a Traffic, Case 1 and Case 3, 500 subscribers, 0.1 E

$500 \times 0.1\ E = 50\ E$
$50\ E,\ 0.1\ \%$ congestion => 71 circuits

Traffic, Case 2 and Case 4, 2 000 subsc., 0.1 E

$2\ 000 \times 0.1\ E = 200\ E$
$200\ E,\ 0.1\ \%$ congestion => 238 circuits

b Number of PCM systems

71 circuits => 3 PCM systems
238 circuits => 8 PCM systems

CASE 1

Check that transmission plan is not violated!

Loss B-C (maximum) 2 km, 0.5 mm cable: $2 \times 1.21 = 2.42\ dB$

Remains for A-B: $8 - 2.42 = 5.58\ dB$

if 0.4 mm cable corresponding to $\frac{5.58}{1.60} = 3.48\ km$

if 0.5 mm cable corresponding to $\frac{5.58}{1.21} = 4.61$ km

if 0.7 mm cable corresponding to $\frac{5.58}{0.79} = 7.06\ km$

Suppose that X is in the interval $3.48 < X < 4.61\ km$ and calculate with 0.5 mm cable (for VF) between A and B!

Suppose that Y intermediate PCM repeater points are required.

=> Cost of (RSS + PCM) alternative:

$$2 \times 16\ 000 \times X + 350\ 000 + 16\ 000 \times Y + 3 \times 1\ 500 \times Y + 20\ 000 + 8\ 000 + 12\ 000\ /\ 3 + 4\ 000 \times Y$$

=> Cost of (SS + cabinet) alternative: $5\ 000 + 113\ 000 \times X$

To find the economical break-even distance, set the two costs equal.

$$(113\ 000 - 32\ 000)\ X = 350\ 000 + 32\ 000 - 5\ 000 + (16\ 000 + 4\ 500 + 4\ 000) \times Y$$
$$81\ 000 \times X = 377\ 000 + 24\ 500 \times Y$$
$$X = \frac{377000}{81000} + \frac{24500 \times Y}{81000} = 4.65 + 0.30Y$$
$Y = 1 \Rightarrow 4.95\ km > 4.61\ km$ (PCM signal loss = 12 dB/km, max. loss = 35 dB => Y = 1)

Thus, 0.7 mm cable is necessary for determining X. Try again:

$$5000 + 166000\,X = 2\times 16000\,X + 350000 + 16000\times Y + 3\times 1500\,Y + 20000 + 8000 + 4000 + 4000\,Y$$

$$(166000 - 32000)\,X = 350000 + 32000 + (16000 + 4500 + 4000)\,Y$$

$$134\,000\,X = 382\,000 + 24\,500\,Y$$

$$X = \frac{382\,000}{134\,000} + \frac{24\,500}{134\,000}Y$$

$$X = 2.85 + 0.18\,Y$$

Attenuation 12 dB/km, maximum loss 35 dB $\Rightarrow$ $Y = 1$ => $X = 2.85 + 0.18 = 3.03\ km$

Conclusion

Up to 4.61 km SS with main cable, 0.5 mm is used because:

- it is cheaper than a solution with RSS
- it is permitted with regard to the transmission plan

Above 4.61 km, the RSS alternative is used. This alternative is cheaper than SSS + 0.7 mm main cable already above 3.03 km.

CASE 2

$$2\times 16000\times X + 350\,000 + 16\,000\times Y + 8\times 1\,500\times \mathrm{Y} + 20\,000 + 7\times 4\,000 + 4000 + 4\,000\times \mathrm{Y} = 20\,000 + 300\,000\times \mathrm{X}$$

$$268\,000\times \mathrm{X} = 350\,000 + 52\,000 - 20\,000 + (16\,000 + 12\,000 + 4\,000)\times \mathrm{Y} = 382\,000 + 32\,000\ \mathrm{Y}$$

$$X = \frac{382\,000}{268\,000} + \frac{32\,000}{268\,000}Y = 1.43 + 0.1\,Y \Rightarrow Y = 0$$

$X = \underline{1.43\ km}$

CASE 3

$$350\,000 + 16\,000\times Y + 3\times 1\,500\times Y + 20\,000 + 8\,000 + 4\,000 + 4\,000\times Y = 5\,000 + 96\,000\times X + 96\,000\times X$$

(assume 0.4 mm cable, add 100 % for new duct)

$$192\,000\times X = 350\,000 + 32\,000 - 5\,000 + (16\,000 + 4\,500 + 4\,000)\,Y = 377\,000 + 24\,500\times Y$$

$$X = 1.96 + 0.128\,Y \Rightarrow Y = 1$$

$X = \underline{2.09\ km}$

CASE 4

$$350\,000 + 16\,000\times Y + 8\times 1\,500\times Y + 20\,000 + 7\times 4\,000 + 4\,000 + 4\,000\times Y = 20\,000 + 300\,000\times X + 300\,000\times X$$

$$600\,000\times X = 350\,000 + 52\,000 - 20\,000 + (16\,000 + 12\,000 + 4\,000)\times Y = 382\,000 + 32\,000\times Y$$

$$X = 0.64 + 0.053\,Y \Rightarrow Y = 0$$

$X = \underline{0.64\ km}$