Cost Comparison of
Voice Frequency Cable vs. PCM System

Case Study

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1. The problem

Two analogue exchanges in a metropolitan area are linked by a voice frequency cable which is completely used up. There are two alternatives to provide facilities: either to use PCM systems equipped with the appropriate signalling interface units on existing cable or to lay another voice frequency cable to expand the existing facilities.

The problem is to determine the "break-even distance" between the two alternatives.

To set up a PCM link, two voice-frequency pairs are needed which are ensured from the existing facilities. The average regenerator interval is 1.81 km.

The average interest rate is 10 %.

2. Data

2.1	*Voice frequency cable*	
2.1.1	Basic purchasing cost	95 *MU / km*
2.1.2	Incremental purchasing cost	5.8 *MU / pair / km*
2.1.3	Placement (jointing + digging)	600 *MU / km*
2.1.4	Service life	40 years
2.1.5	Maintenance + Operating cost	2 %
2.1.6	Scrap value	0
2.1.7	Cable sizes	
	10, 20, 30, 40, 50, 60, 70, 80, 100, 120, 150, 170, 200, 220 250, 280, 300, 320, 350, 370, 400, 450, 500, 600, 700, 750	
2.2	*Relay sets*	
2.2.1	Purchasing cost	16 *MU / piece*
2.2.2	Installation cost	5 *MU / piece*
2.2.3	Maintenance + Operating cost	7 %
2.2.4	Service life	20 years
2.2.5	Scrap value	0

2.3 PCM Systems

2.3.1	Purchasing of two terminals equipped with the appropriate signalling units and line terminating equipment	2200 *MU*
2.3.2	Installation	900 *MU*
2.3.3	Regenerator cost	100 *MU*
2.3.4	Regenerator housing	20 *MU / reg.*

2.3.5	Installation of regenerators with associated housing	20 *MU / reg.*
2.3.6	PCM system capacity	30 *Ch*
2.3.7	Service life	20 years
2.3.8	Maintenance + Operating cost	5 %
2.3.9	Scrap value	0

The break-even distance is evaluated from the following relationship:

$$l_o = \frac{C_P - Y(\lambda)X(\lambda)}{Z(\lambda)X(\lambda) - C_{LE}}$$

where: $X(\lambda) = 1 - e^{-rk'/\lambda}$

$$Y(\lambda) = \frac{2\lambda \quad C_R}{1 - e^{-r}}$$

$$Z(\lambda) = \frac{a + b \quad S}{1 - e^{-rS/\lambda}}$$

Calculations are facilitated if you fill in the following table.

Table 1

No.	λ	t	S	X(λ)	Y(λ)	Z(λ)	l_o
1	5						
2	10						
3	15						
4	20						
5	25						
6	30						
7	35						
8	40						
9	45						
10	50						