Economic Period of Provisioning

Planning of Fiber Optics Cable

Solution of Case Study

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1. Calculation of circuits required between transit exchanges

From Table 1 providing the trunks needed for the next three years, we get:

877 + 888 = 1765 trunks.

2. Calculation of demand growth

The annual demand growth for PCM systems is found:

- annual demand growth for circuits:

  1765/3 = 588,3 circuits/year

- annual demand growth for transmission systems of 1920 channels:

  λ *= 588,3/1920 =* *0.3064* *system/year*

3. Calculation of cable parameters

- Calculation of *pvf* μ_c

$$\mu_c = 1 + \frac{1}{(1+i)^T - 1} + \frac{u}{i}$$

For i = o.1, T = 18 years, and u = 0.035, we get:

$$\mu_c = 1 + \frac{1}{1.1^{18} - 1} + \frac{0.035}{0.1} = 1.57$$

- Calculation of capital basic cost. Let

$$\hat{\mu}_c = 1 + \frac{1}{(1+i)^T - 1} = 1.22$$

be the *pvf*, taking into account only the replacement of cable. Then, we have

$$a = \text{purchasing cost} \times \mu_c + (\text{taxes} + \text{digging cost} + \text{placement of cable}) \times \mu_c$$
$$a = 600 \cdot 1.57 + (600 \cdot 0.2 + 750 + 80)\ 1.22 = 2100\, MU / km$$

- Calculation of capital incremental cost *b*

$$b = \text{purchasing cost} \times \mu_c + (\text{taxes} + \text{jointing and testing}) \times \mu_c$$

$$b = 720 \cdot 1.57 + (720 \cdot 0.2 + 15)\ 1.22 = 1324\, MU / pair / km$$

4. Economic period of provisioning

The provisioning period is given by

$$t = \frac{1}{r} ln(1 + p + 2p)\ ,\ \ p = ar / (b\lambda) = 0.492$$

$$t = ln\left(1 + 0.492 + \sqrt{2 \cdot 0.492}\right) = 9.57 \quad years$$

5. Optimal size of cable

$$s = \lambda t = 9.57 \cdot 0.3064 = 2.94 = 3\ pairs$$

Thus, the optimal size of cable should be *6 fibers*.

6. Calculation of present worth of expenditure to implement the fiber optics *Link*

$$PW = \frac{a + bs}{1 - e^{-rs/\lambda}}\lambda = \frac{2100 + 1324 \cdot 3}{1 - e^{-0.095 \cdot 3 / 0.3064}} 170 = 1{,}704{,}750\ MU$$

7. Calculation of annual charges (AC)

$$(AC) = PW.\ i = 1704750 \cdot 0.1 = 170.475\ MU\ /\ year$$

8. Present worth of expenditures for double size cable

$$PW_{25} = \frac{a + b2S}{1 - e^{-r2s/\lambda}}\lambda = \frac{2100 + 2 \cdot 1324 \cdot 3}{1 - e^{-0 \cdot 095 \cdot 6 / 0 \cdot 3064}} \cdot 170 = 2{,}022{,}179\ MU$$

Percentage variation with respect to minimum cost variation

$$= \frac{2022179 - 1704750}{1704750} \cdot 100 = 18.6\%$$