Rural Network Planning

Solution of Case Study

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SOLUTION PROPOSED FOR RURAL NETWORK PLANNING. CASE STUDY

EXCHANGES

At least one digital exchange must be introduced. A is an evident location. E2 is a candidate, mainly because of future replacement of analogue exchange. The start-up cost of digital exchange is however too high to motivate a second exchange in the area.

LOCATIONS B1 - B4

Equipment in B1

Alt. 1	RSS, 2 x 128 subsc.:	300 + 2 x 70	=	440
	Termination, GSS	2 x 10	=	20
	60 channels to A:			x
				>460
Alt. 2	RSM, 5 x 30 subsc.:	5 x 50	=	= 250
	Termination, SSS:	2 x 100	=	=200
	150 channels to A:			y
				>450

RSS is chosen for location B1

Equipment in B2 and B4

RSM is compared with RSS. In the RSM case, traffic is concentrated in B1 RSS. Cost of connection in RSS is divided between at least locations B2 and B4. Calculation is therefore carried out in one step for both locations.

Transmission costs B2-B1 and B4-B1 are the same in both alternatives and therefore not included.

Alt. 1	RSS 128 subsc. in B2 and B4			
	RSS:	2 x (100 + 70)	=	340
	Termination in GSS:	2 x 10	=	20
	60 additional channels B1-A:			x
				>360
Alt. 2	RSM:	2 x 50	=	100
	Termination in B1 RSS:			100
	if radio, 2 initial line syst:	2x2x4	=	16
	if radio, TUKA:	(16-7) x 0.5	=	5
				221

RSM is chosen for locations B2 and B4.

Equipment in B3

Alt. 1	RSS, 128 subs:	100 + 70	=	170
	Termination in GSS:			10
	30 additional channels B1 to A:			x
				>180
Alt. 2	RSM, 2 x 30 subs:	2 x 50	=	100
	30 additional channels B3-B1:			y
				>100

We assume that x > y, since B1 - A is the longest distance. ***The choice for location B3 is RSM***.

Transmission channels requirements

After the choice of RSS and RSM, requirement of transmission channels is as follows:

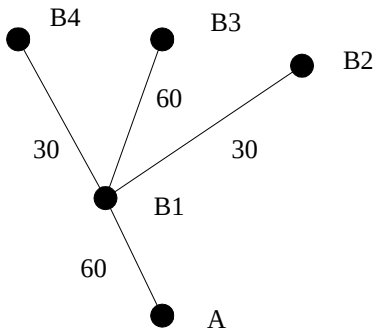

Figure 1

We continue with planning of transmission equipment.

Transmission A - B1

Radio is compared to new pole line and TUKA cable.

Alt. 1	Radio, 8Mb/s:	2 x 90	=	180
	Dig mux 2/8:	2 x 25	=	50
	Init. line system, B1:	2 x (4+4)	=	16
	TUKA:	0.5 x 11.5	=	6
	Power:			70
				322
Alt. 2	Pole line:			340
	+ cable, repeaters			x
				> 340

The choice is 8Mb/s digital radio.

Branch D1 - D2

Alt. 1	Radio, 2Mb:	2 x 70	=	140
	Mast:			40
				180
Alt. 2	Pole line:	18 x 20	=	360
				360

Radio is chosen.

Equipment in D3

D3 can be connected to A either by passing D1 or by passing radio repeater. If RSM is chosen, an additional 2Mb system must be added either between D2 and D1 or between D3 and radio link repeater.

Alt. 1	RSS:	100 + 70	=	170
	Termination			10
				180
Alt. 2	RSM:	2 x 50	=	100
	additional radio:	2 x 70	=	140
				240

RSS is chosen for position D3.

Transmission from D1 to A

Radio, 8Mb is chosen with an initial line system from RSS in D1.

Transmission from D3, D4 to A

Alt. 1	Connection over D1		=	
	Radio, 2Mb D4-D3:	2 x 70	=	140
	Masts D4, D3:	2 x 40	=	80
	Pole line D3-D2:	20 x 19	=	380
	TUKA:	19 x 11.5	=	219
	Rep.	(19-2.2) x 8	=	64
	Radio D2-D1:	2 x 2 x 70	=	280
				1163

Transmission, B4 - B1

Alt. 1	Radio:	2 x 70	=	140
	Mast			40
	Init. line system, B1:	4 + 4	=	8
	TUKA:	0.5 x (16 - 11.5)	=	2
				190
Alt. 2	Pole line:	11 x 20	=	220
	+ cable, repeaters			y
				> 220

The choice is digital radio, 2Mb/s

Transmission, B2, B3 to B1

Because of the road structure, some costs are common for the cable solution. Transmission is therefore planned in one step for both locations.

Alt. 1	Radio, hop B2 - B1:			
	Radio, 2Mb:	2 x 70	=	140
	Mast:			40
	Init. line sy:	4 + 4	=	8
	TUKA (additional):	0.5 x 4.5	=	2
	Radio, hop B3 - B1:			
	Radio, 2Mb:	2 x 2 x 70	=	280
	Mast:			40
	Init. line system:	2 x (4 + 4)	=	16
	TUKA:	2 x 0.5 x 4.5		5
				531
Alt. 2	Cable line system			
	Pole line:	(5 + 4 + 3) x 20	=	240
	TUKA:	5 x 16 + 3 x 11.5 + 4 x 7	=	143
	Line term.:	2 x 3 x 4	=	24
	Repeaters:	2 x 13 + 1 x 8 + 1 x 6	=	40
				447

The choice is cable line systems for connection of B2, B3 to B1. Cost of transmission capacity extension is lower for the cable alternative.

Comment: 8Mb/s radio cannot be chosen from B3 to B1 since there is no space in the cabinets for a 2/8 digital multiplexor.

LOCATIONS C1, C2

The choice is RSS with container in C1 and RSS with cabinet in C2.

LOCATIONS D1 - D4

Equipment in D1-D4

RSS mounted in cabinet is chosen for location D1. RSM is chosen for D2 and D4. RSM is connected to SSS in A.

Alt. 2	Connection over radio repeater			
	Radio; D3-REP:	2 x 70	=	140
	Mast, D3			40
	Radio, D4-REP:	2 x 70	=	140
	Mast, D4			40
	Repeater:			
	Mast			40
	Feeder			20
	Power			70
	Accommodation			80
	Civil work			150
	Dig. mux 2/8:	2 x 25	=	50
	Radio, 8Mb/s:	2 x 120	=	240
				1010

Radio with repeater is chosen. It has lower cost and spare capacity on 8Mb/s radio systems both from D1 to A and from repeater to A.

LOCATIONS E1 - E7

Equipment in E1, E2, E3, E4

Calculation of costs of RSS and RSM shows that RSS is the most economical choice for all locations. Digital transmission, 2Mb/s, on existing pair cable, is used from E1, E2 to A. Radio is not economic on route E2-E4. New TUKA on existing pole line is used.

Branch from E1

Alt. 1	Pair cable, 10p:	5 x 12	=	60
Alt. 2	Subsc. carrier:	5 x 2	=	10
	TUKA:	5 x 7	=	35
	ET:			16
				61

Pair cable is chosen because of capacity for 10 subscribers and testing possibility of subscriber line and telephone set.

Branch from E2.

Subscribers without existing pole line can be connected using one-channel analogue radio to a cost of (10 + 10) / sub. + cost of common mast in location E2 or E3. New pole lines to E3 are not economic.

Connection of subscribers in E3 and along the road can be made either by using subscriber carrier and TUKA or by using RSM and pair cable.

Alt. 1:	Subscriber carrier:	23 x 2	=	46
	ET :	3 x 16	=	48
	TUKA:	10 x 11.5	=	115
	Repeaters:	3 x 3	=	9
				218
Alt. 2:	RSM:	50+ 100	=	150
	Pair cable, 10p:	10 x 12	=	120
	Line term:	2 x 4	=	8
	Repeaters:	5 x 6	=	30
				308

RSM is chosen because of higher ultimate capacity and testing possibility of subscriber line.

Branch from E4 to E6

Three alternatives are studied. In all alternatives, subscribers are connected using carrier equipment.

Alt. 1: E5 is connected using pair cable, E6 using carrier.

Pair cable; 50p:	4 x 23	=	92
TUKA:	22 x 11.5	=	253
Repeaters:	2 x 3 x 3	=	18
Subscr. carrier:	22 x 2	=	44
ET:	3 x 16	=	48
RSS, 128			70
			525

Alt. 2: E5 is connected using pair cable, RSM is used in E6

Pair cable; 50p:	4 x 23	=	92
TUKA:	12 x 11.5 + 6 x 7	=	180
Repeater, carrier:			3
Subscr. carrier:	2 x 2	=	4
ET:			16
Repeater, 2Mb/s:	(3 + 8) x 6	=	66
LT:	2 x 4	=	8
RSM			50
Termination in RSS			100
			519

Alt. 3: E5 and E6 are connected using RSM

TUKA:	4 x 12 + 18 x 11.5	=	255
Repeater, carrier			3
Carrier:	2 x 2	=	4
ET:			16
Repeaters, 2Mb:	2 x 13 + 9 x	=	80
RSM, 90 subscr:	3 x 50	=	150
Termination in RSS			100
LT:	3 x 2 x 4	=	24
			632

In Alt. 2, there is a possibility of connecting up to 30 subscribers in E6. Moreover, other RSM can be terminated in E4 without extra costs. Testing of the subscriber line is not possible if the carrier is used. ***Alternative 2 is therefore chosen.***

Branch from E4 to E7

Subscribers cannot be connected physically because of transmission requirements. ***Subscriber carrier is therefore applied for subscribers along the road E4-E7 and in E7.***

Fig. 2 - DIGITAL RURAL NETWORK

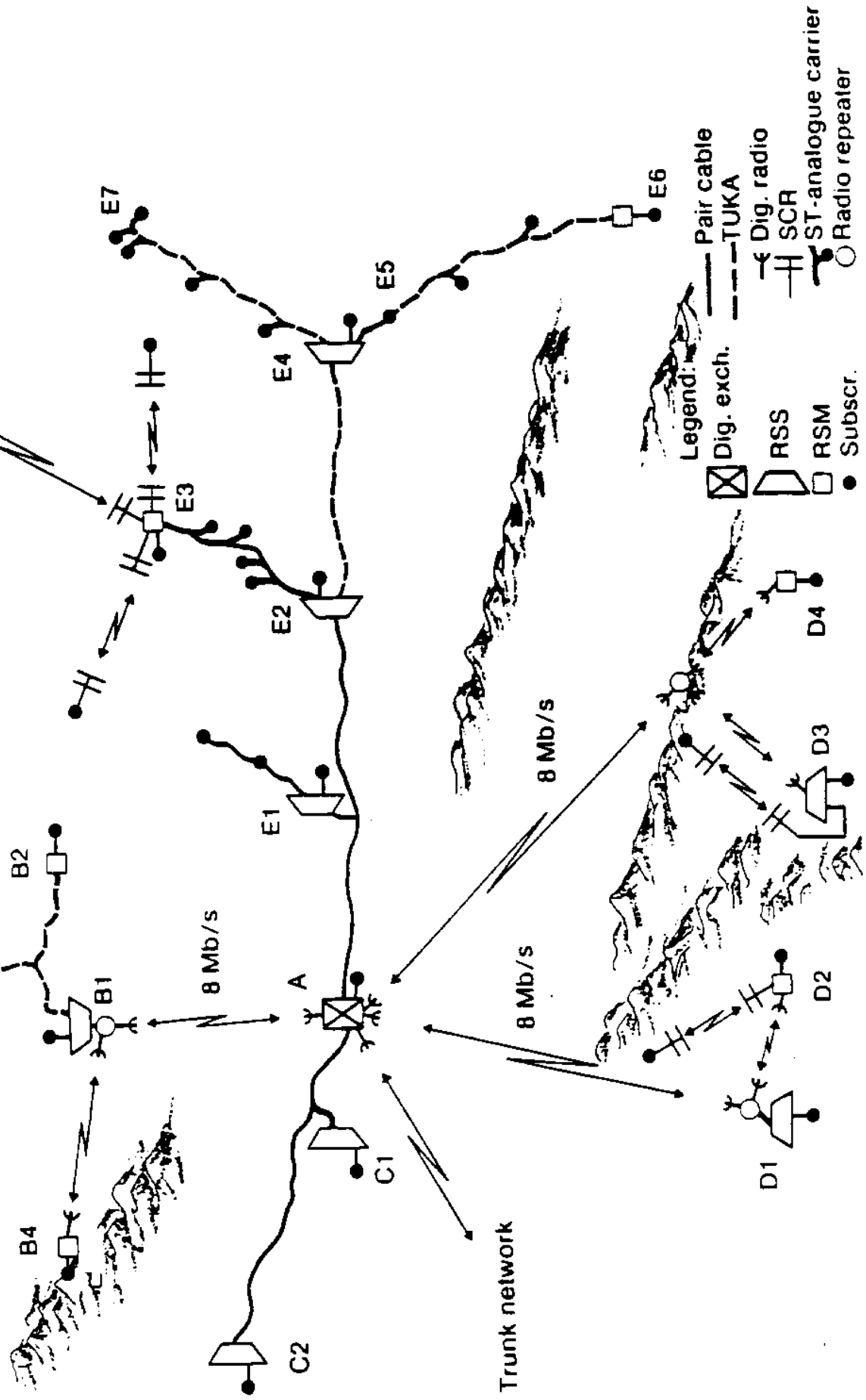

Figure 3 - EQUIPMENT FOR LOCATIONS E2-E3

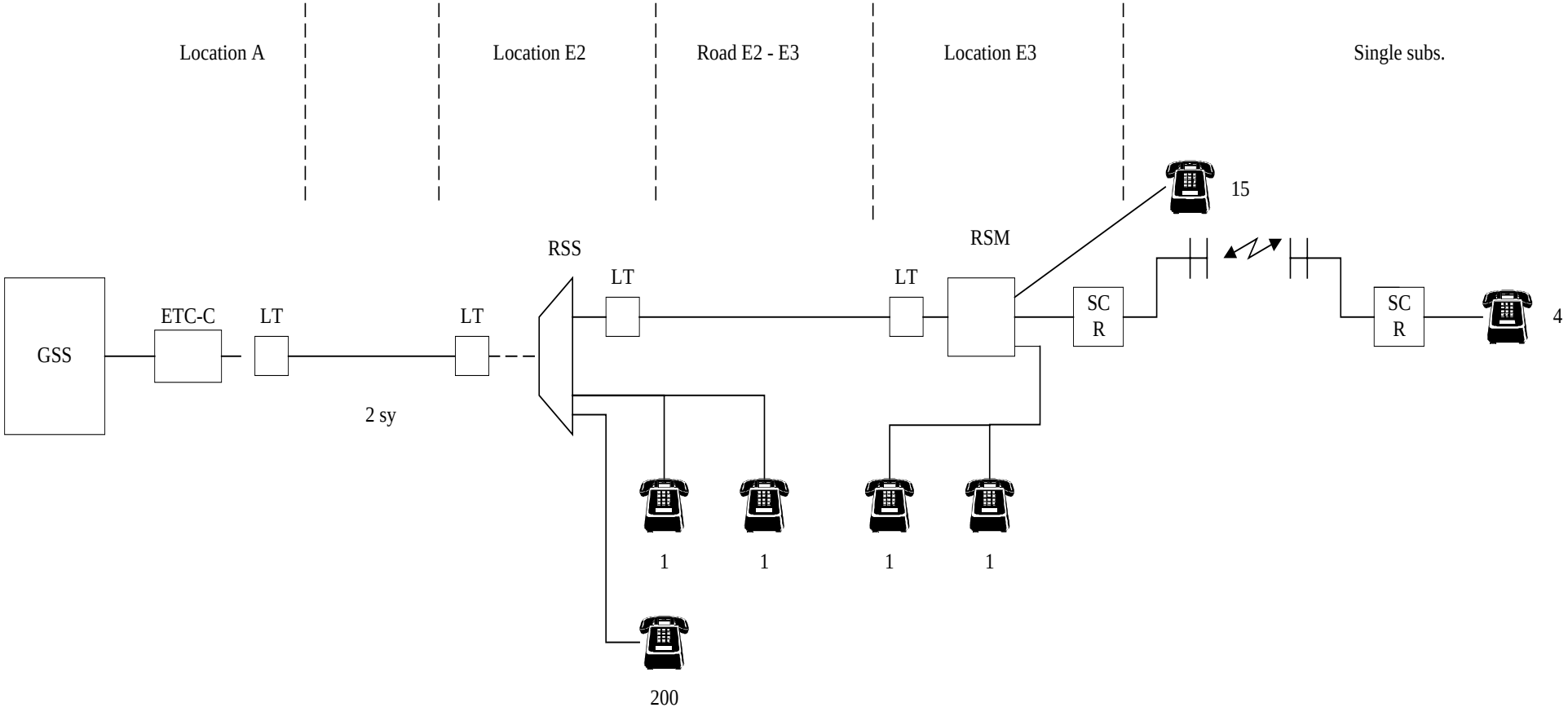

Figure 4 - EQUIPMENT FOR LOCATIONS B1 TO B4