

**A Digital Transmission Network**

Case Study

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Case Study:

### **A DIGITAL TRANSMISSION NETWORK**

A digital transmission network for a medium sized city with 16 exchanges has been planned. The planning was based on the forecasted need for channels between the exchanges (see Table 1). The network was planned with 2 Mb/s digital systems (see Figure 2). The number of parallel 2 Mb/s systems will, however, be quite large on certain links. You are therefore requested to carry out a study of the network based on the idea of "highways" in the network, i.e. the use of higher order PCM- systems on certain of the links. Of course, such a central, high capacity part of the network will attract traffic, so the 2 Mb/s systems will then, to a great extent, be used as entrances to the higher order systems.

Two cases should be investigated:

2 Mb/s + 34 Mb/s and 2 Mb/s + 140 Mb/s.

An optional case to investigate may be 2 Mb/s + 34 Mb/s + 140 Mb/s.

The network structure, the number of different multiplexors, line terminals, etc., and the costs should be investigated.

It is more important that all items be covered rather than doing very exact calculations.

Compare also quality of the different solutions which concerns:

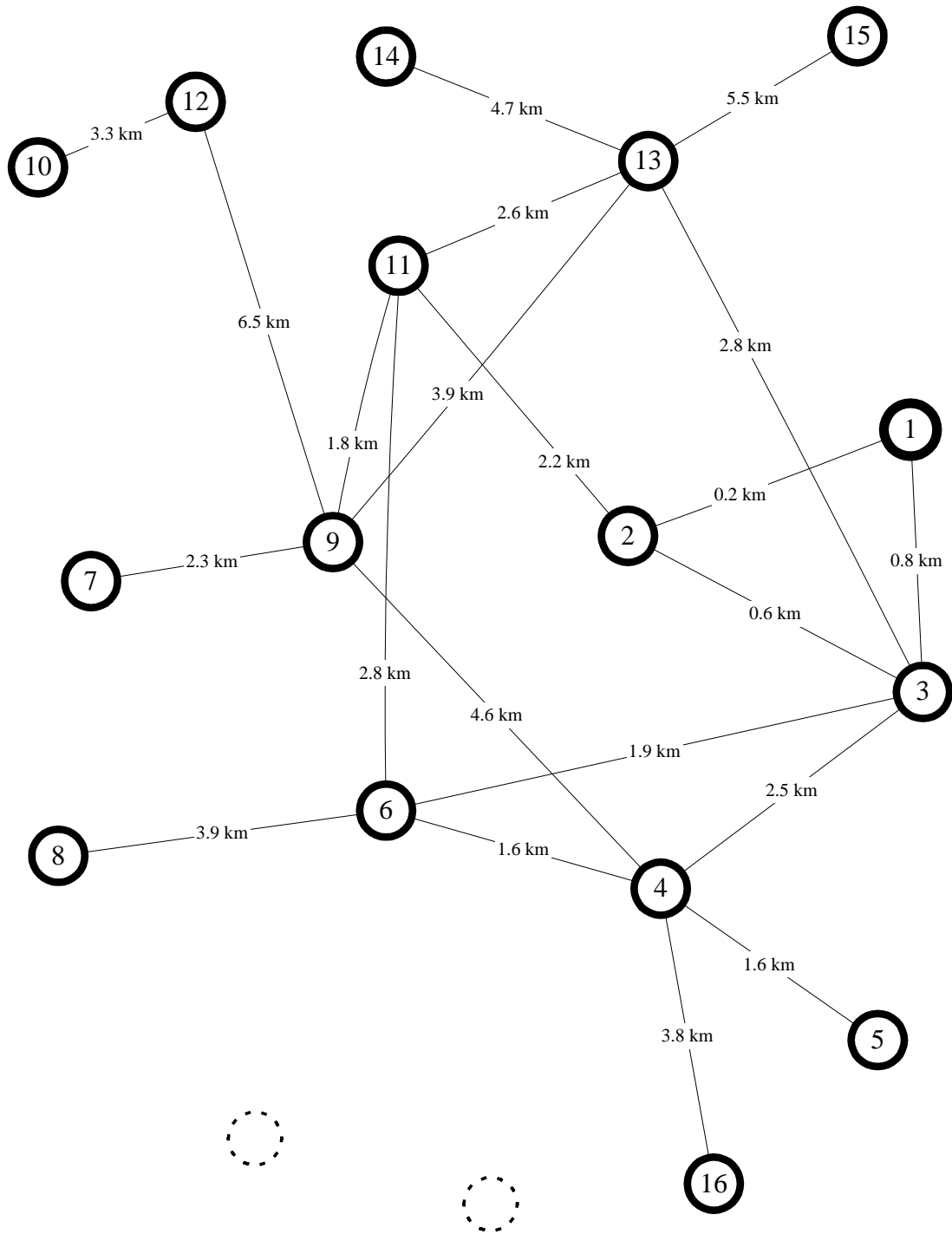
- Maintenance;
- Rerouting possibilities in case of faults;
- Reliability;
- Costs.

Appendices:

- Table 1 No. of 30-groups required between the exchanges
- Figure 1 Distances between the exchanges
- Figure 2 Digital 2 Mb/s network, present proposal
- Table 2 Digital system properties, repeaters
- Table 3 Multiplexor properties
- Table 4 Digital system properties, line terminals
- Table 5 Cable properties
- Work sheets 1-4

↗	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1		4	4	3	3	3	3	2	4	3	3	3	5	3	3	4
2	4		18	7	3	7	2	2	7	2	5	4	9	3	3	7
3	4	18		12	4	14	4	3	14	4	11	7	16	6	5	12
4	3	7	12		3	7	2	2	5	1	3	2	5	2	2	7
5	3	3	4	3		3	1	1	2	1	2	1	3	1	1	4
6	3	7	14	7	3		3	3	6	2	6	3	6	3	3	7
7	3	2	4	2	1	3		1	3	1	2	1	2	1	1	3
8	2	2	3	2	1	3	1		2	1	1	1	2	1	1	3
9	4	7	14	5	2	6	3	2		3	8	6	9	4	3	6
10	3	2	4	1	1	2	1	1	3		2	4	3	2	1	2
11	3	5	11	3	2	6	2	1	8	2		4	7	3	3	4
12	3	4	7	2	1	3	1	1	6	4	4		6	3	2	3
13	5	9	16	5	3	6	2	2	9	3	7	6		6	5	6
14	3	3	6	2	1	3	1	1	4	2	3	3	6		3	2
15	3	3	5	2	1	3	1	1	3	1	3	2	5	3		3
16	4	7	12	7	4	7	3	3	6	2	4	3	6	2	3	
Σ	50	83	134	63	33	76	30	26	82	32	64	50	90	43	39	73

Table 1 - No. of 30-Groups Required Between Exchanges 1-16  
*Note that the lower part of the matrix is just a repetition of the upper part*



**Figure 1 - Distances Between Exchanges**



<b>SYSTEM</b>	<b>Cost per repeater, MU</b>	<b>Repeater distance, km</b>	<b>Cost per repeater box, MU</b>	<b>No. of systems per box</b>
<b>2Mb/s on pair cable</b>	<b>1</b>	<b>1.8</b>	<b>6</b>	<b>24</b>
<b>8Mb/s on special pair cable</b>	<b>7</b>	<b>3.6</b>	<b>13</b>	<b>10</b>
<b>34 Mb/s on optical fibre</b>	<b>48</b>	<b>10</b>	<b>15</b>	<b>4</b>
<b>140 Mb/s on small coax.</b>	<b>25</b>	<b>2</b>	<b>10 / 15</b>	<b>3 / 6</b>
<b>140 Mb/s on optical fibre</b>	<b>80</b>	<b>8</b>	<b>15</b>	<b>4</b>

**Table 2.**

<b>DIGITAL MUX</b>	<b>Channels</b>	<b>Cost per unit, MU</b>
<b>M<sub>2</sub></b>	<b>30 / 120</b>	<b>16</b>
<b>M<sub>3</sub></b>	<b>120 / 480</b>	<b>18</b>
<b>M<sub>4</sub></b>	<b>480 / 1920</b>	<b>50</b>

**Table 3.**

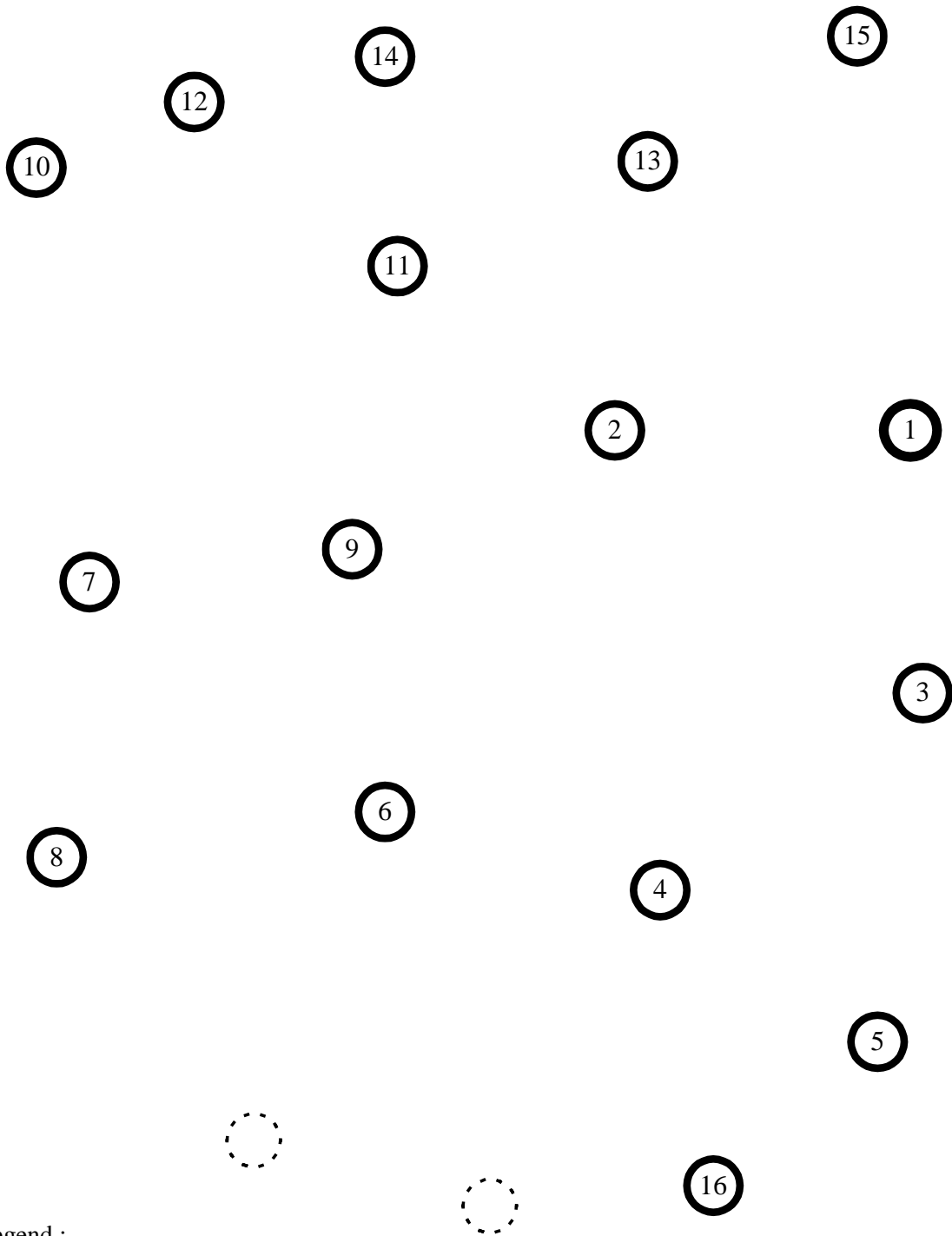
SYSTEM	Cost per line terminal excl. power supply, MU	Distance without power, km	Cost per power supply unit, MU
2Mb/s on pair cable	2	1.2	-
8Mb/s on special pair cable	6	3.3	1
34 Mb/s on optical fibre	32	10	12
140 Mb/s on small coax.	62	2	12
140 Mb/s on optical fibre	64	8	12

Table 4

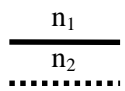
CABLE TYPE (SYSTEM)	Cost for cable, MU / km, for these capacities (speech channels)				
	480	960	1920	3840	7680
Pair cable (2 Mb/s)	12.5	25	50	100	200
Special pair cable (8Mb/s)	16	16	30	60	120
Optical fibre (34 Mb/s)	18	26	42	74	140
Small coax. (140 Mb/s)	20	20	20	30	50
Optical fibre (140Bb/s)	20	20	20	30	50

Table 5 - Add 20 MU/km for Installation!

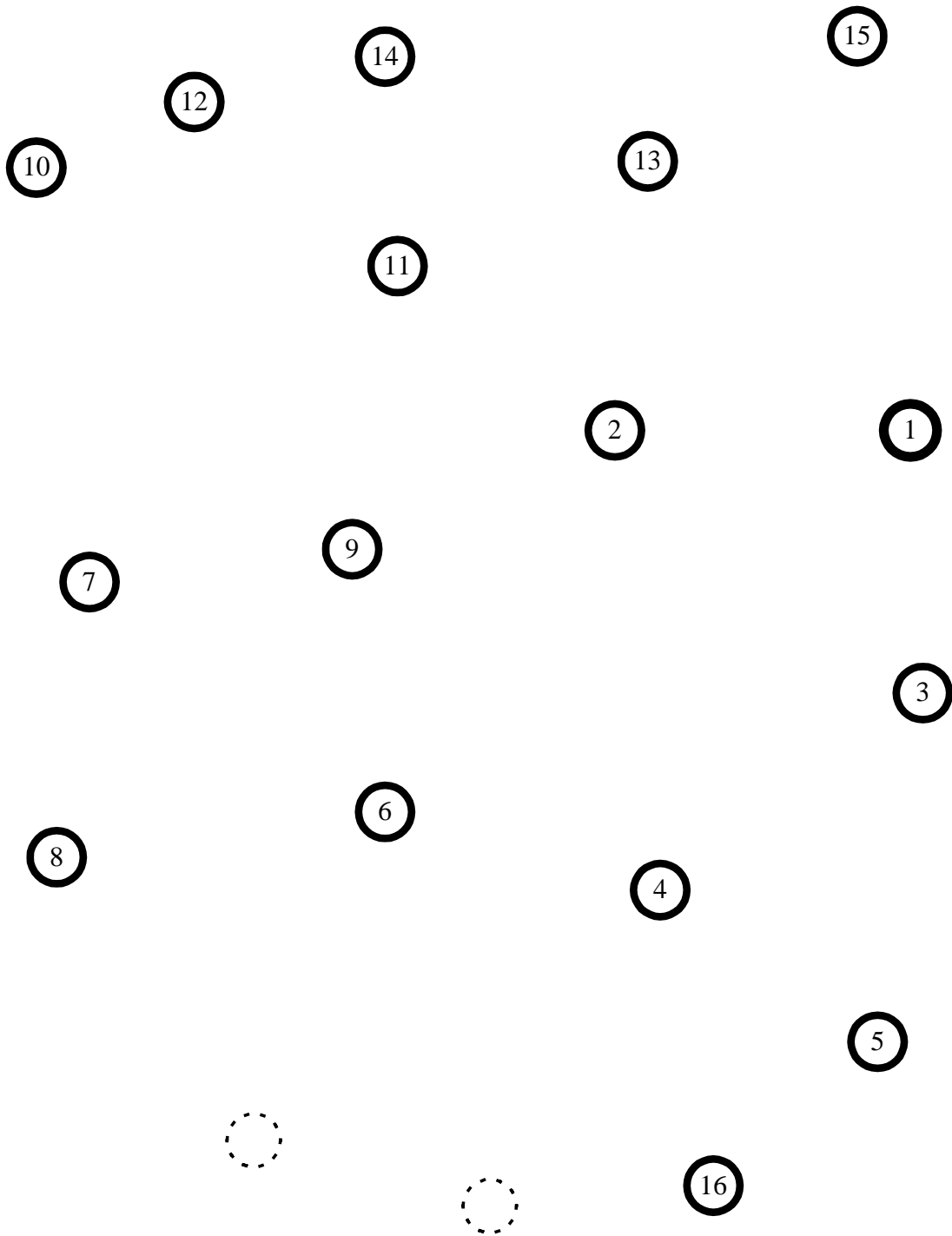




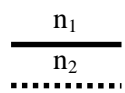
Legend :



$n_1$  = no. of 30-ch. systems (2Mb/s)  
 $n_2$  = no. of 480-ch. systems (34Mb/s)

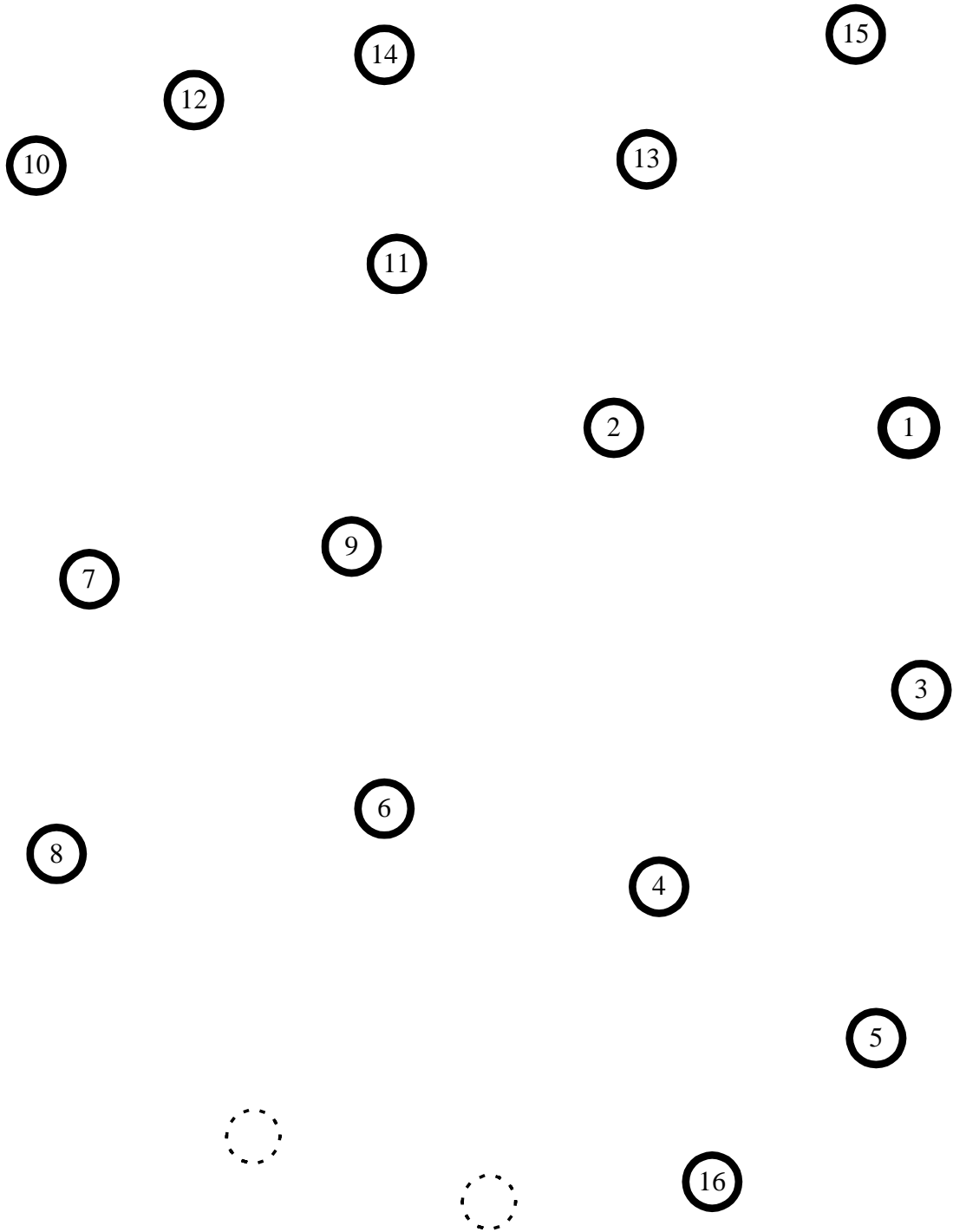


Legend :



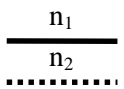
$n_1$  = no. of 30-ch. systems (2Mb/s)

$n_2$  = no. of 1920-ch. systems (140Mb/s)



Work Sheet 3

Legend :



Equipment		2 Mb / s	2 Mb/s + 140 Mb/s Throughconnection:		2 Mb/s + 34 Mb/s Throughconnection:	
			alt. 1	alt. 2	alt. 1	alt. 2
Line Terminals	LT <sub>1</sub>					
	LT <sub>3</sub>					
	LT <sub>4</sub>					
Digital MUX	M <sub>2</sub>					
	M <sub>3</sub>					
	M <sub>4</sub>					
Repeaters	R <sub>1</sub>					
	R <sub>3</sub>					
	R <sub>4</sub>					
Repeater Boxes	B <sub>1</sub>					
	B <sub>3</sub>					
	B <sub>4</sub>					

Alt. 1 : Throughconnection based on 30-groups

Alt. 2 : Throughconnection on highest possible level, ie. a mixture of 480-, 120- and 30-groups.

Work Sheet 4