

Exchange Locations and Boundaries

Case Studies

Mr. T. Fried, ITU



UNION INTERNATIONALE DES TELECOMMUNICATIONS
INTERNATIONAL TELECOMMUNICATION UNION
UNION INTERNACIONAL DE TELECOMUNICACIONES



CASE STUDY : Exchange Locations and Boundaries

Definition of Problem

An urban area is served at present by one local exchange: 20000 lines installed, 80% of them in service; building capacity: 30000 lines. In ten years the number of subscribers will be more than double and a forecast of the subscriber distribution has been made for this time. The forecast is given in Figures 1-4. The size of the grid element is 250m x 250m and the total number of subscribers in year 10 is 47831.

A peculiarity of the subscriber growth is that the area is growing away from the present town center, towards the north-east. The location and present service area of the existing exchange are shown in Figure 4.

The problem of defining the expansion plan for the local network is to determine where a new local exchange should be installed, where it should be located, and what should be its capacity and service area. In order to have the background to take a decision on the above, it is necessary to investigate different solutions.

The following alternative solutions satisfy the forecast :

- 1) to **extend the existing building** and serve the area from the existing location;
- 2) to open a **new local exchange** in an available building, shown in Figure 1 and 2; the new exchange can be analog or digital;
- 3) to **close the existing exchange** and to serve the area with one new exchange, placed in the **optimum location**;
- 4) to open a **new local exchange in the optimum location**, i.e. to serve the area with **two exchanges**.

For alternative 2) it is necessary to determine the optimum service area for each exchange, i.e. to find the optimum exchange boundaries.

For alternative 3) it is necessary to determine the optimum location for one single exchange.

For alternative 4) it is necessary to determine the optimum location and the service area of the second exchange.

CASE STUDY 1

EXCHANGE BOUNDARIES

Determine the optimum exchange boundaries for the exchanges in Figure 1.

Use simplified method for boundary optimization, disregarding the influence of the exchange, building, and junction network costs, as well as the different transmission media costs in the subscriber network.

Measure the distance with the cathetic method.

0	0	0	0	0	0	0	0	0	81	326	81	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	122	407	163	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	81	366	204	0	0	0	0	0	0
0	0	0	0	0	0	117	156	40	323	284	122	0	0	0	0	0	0
0	0	0	0	0	0	195	391	236	323	323	326	41	43	43	72	43	0
0	0	0	0	0	43	121	234	235	194	150	132	190	222	188	148	72	0
0	0	0	0	0	175	218	38	208	326	310	240	283	317	317	101	72	0
0	0	0	0	0	190	263	263	125	332	155	141	36	61	69	62	66	0
0	0	0	0	76	381	264	224	0	133	142	84	74	77	87	84	53	0
0	0	0	0	229	381	305	300	270	57	192	47	74	35	60	88	40	0
0	0	0	17	140	267	341	271	203	0	112	51	55	61	88	100	26	0
0	0	0	102	339	170	226	86	164	0	187	96	69	61	87	106	26	0
0	0	0	106	203	204	427	192	204	0	201	192	190	51	83	129	23	0
0	0	20	356	267	79	400	192	204	0	328	235	338	99	142	71	0	0
0	0	88	212	356	267	253	97	85	0	178	200	338	99	142	28	0	0
0	0	300	300	257	264	528	190	213	0	322	177	169	113	140	28	0	0
0	0	300	344	300	131	276	189	213	0	402	215	234	112	112	0	0	0
0	110	173	172	344	172	417	184	268	0	299	183	84	142	28	0	0	0
0	115	376	290	133	155	417	261	304	0	392	56	142	56	0	0	0	0
0	150	303	361	193	306	200	217	77	246	238	142	70	0	0	0	0	0
0	340	365	170	163	307	278	186	172	163	98	84	0	0	0	0	0	0
0	150	365	277	436	182	215	34	258	118	98	0	0	0	0	0	0	0
0	0	87	420	242	298	112	190	166	142	56	0	0	0	0	0	0	0
0	0	0	20	186	220	162	404	144	93	0	0	0	0	0	0	0	0
0	0	0	0	0	0	323	404	133	19	0	0	0	0	0	0	0	0
0	0	0	0	0	0	81	121	21	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0	0	0

Figure 1 :



location of existing exchange (OLD)



location of new exchange (NEW)

CASE STUDY 2

EXCHANGE BOUNDARIES

Determine the optimum exchange boundaries for the exchanges in Figure 2.

Use a simplified method for boundary optimization, taking into account the subscriber network cost only.

The NEW exchange is a digital exchange. The subscribers are connected to the exchange through remote subscriber units, RSU.

Use Table 1 for transmission media costs.

Measure the distance with the cathetic method.

Compare with the result for Case study 1.

Table 1

TRANSMISSION MEDIA FOR SUBSCRIBER NETWORK

Type	Cost	Cost / km	max. distance (km)	Exchange
0.4 mm	0	2.4	2.5	OLD
0.5 mm	0	2.8	4.0	OLD
RSU	1.3	0.4	-	NEW

0	0	0	0	0	0	0	0	0	81	326	81	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	122	407	163	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	81	366	204	0	0	0	0	0	0
0	0	0	0	0	0	117	156	40	323	284	122	0	0	0	0	0	0
0	0	0	0	0	0	195	391	236	323	323	326	41	43	43	72	43	0
0	0	0	0	0	43	121	234	235	194	150	132	190	222	188	148	72	0
0	0	0	0	0	175	218	38	208	326	310	240	283	317	317	101	72	0
0	0	0	0	0	190	263	263	125	332	155	141	36	61	69	62	66	0
0	0	0	0	76	381	264	224	0	133	142	84	74	77	87	84	53	0
0	0	0	0	229	381	305	300	270	57	192	47	74	35	60	88	40	0
0	0	0	17	140	267	341	271	203	0	112	51	55	61	88	100	26	0
0	0	0	102	339	170	226	86	164	0	187	96	69	61	87	106	26	0
0	0	0	106	203	204	427	192	204	0	201	192	190	51	83	129	23	0
0	0	20	356	267	79	400	192	204	0	328	235	338	99	142	71	0	0
0	0	88	212	356	267	253	97	85	0	178	200	338	99	142	28	0	0
0	0	300	300	257	264	528	190	213	0	322	177	169	113	140	28	0	0
0	0	300	344	300	131	276	189	213	0	402	215	234	112	112	0	0	0
0	110	173	172	344	172	417	184	268	0	299	183	84	142	28	0	0	0
0	115	376	290	133	155	417	261	304	0	392	56	142	56	0	0	0	0
0	150	303	361	193	306	200	217	77	246	238	142	70	0	0	0	0	0
0	340	365	170	163	307	278	186	172	163	98	84	0	0	0	0	0	0
0	150	365	277	436	182	215	34	258	118	98	0	0	0	0	0	0	0
0	0	87	420	242	298	112	190	166	142	56	0	0	0	0	0	0	0
0	0	0	20	186	220	162	404	144	93	0	0	0	0	0	0	0	0
0	0	0	0	0	0	323	404	133	19	0	0	0	0	0	0	0	0
0	0	0	0	0	0	81	121	21	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0	0	0

Figure 2 :



location of existing exchange (OLD)



location of new exchange (NEW)

CASE STUDY 3

EXCHANGE LOCATION

Determine the optimum exchange location for one single exchange.

Use the simplified cathetic method for exchange location optimization, disregarding the influence of the junction network costs and the different transmission media costs in the subscriber network.

Use Figure 3 for subscriber distribution in year 10.

Compare the result with the location of the existing exchange in Figure 4.

0	0	0	0	0	0	0	0	0	81	326	81	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	122	407	163	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	81	366	204	0	0	0	0	0	0
0	0	0	0	0	0	117	156	40	323	284	122	0	0	0	0	0	0
0	0	0	0	0	0	195	391	236	323	323	326	41	43	43	72	43	0
0	0	0	0	0	43	121	234	235	194	150	132	190	222	188	148	72	0
0	0	0	0	0	175	218	38	208	326	310	240	283	317	317	101	72	0
0	0	0	0	0	190	263	263	125	332	155	141	36	61	69	62	66	0
0	0	0	0	76	381	264	224	0	133	142	84	74	77	87	84	53	0
0	0	0	0	229	381	305	300	270	57	192	47	74	35	60	88	40	0
0	0	0	17	140	267	341	271	203	0	112	51	55	61	88	100	26	0
0	0	0	102	339	170	226	86	164	0	187	96	69	61	87	106	26	0
0	0	0	106	203	204	427	192	204	0	201	192	190	51	83	129	23	0
0	0	20	356	267	79	400	192	204	0	328	235	338	99	142	71	0	0
0	0	88	212	356	267	253	97	85	0	178	200	338	99	142	28	0	0
0	0	300	300	257	264	528	190	213	0	322	177	169	113	140	28	0	0
0	0	300	344	300	131	276	189	213	0	402	215	234	112	112	0	0	0
0	110	173	172	344	172	417	184	268	0	299	183	84	142	28	0	0	0
0	115	376	290	133	155	417	261	304	0	392	56	142	56	0	0	0	0
0	150	303	361	193	306	200	217	77	246	238	142	70	0	0	0	0	0
0	340	365	170	163	307	278	186	172	163	98	84	0	0	0	0	0	0
0	150	365	277	436	182	215	34	258	118	98	0	0	0	0	0	0	0
0	0	87	420	242	298	112	190	166	142	56	0	0	0	0	0	0	0
0	0	0	20	186	220	162	404	144	93	0	0	0	0	0	0	0	0
0	0	0	0	0	0	323	404	133	19	0	0	0	0	0	0	0	0
0	0	0	0	0	0	81	121	21	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0	0	0

Figure 3

CASE STUDY 4

INTRODUCTION OF A NEW EXCHANGE

Determine the optimum location and service area of one new exchange in Figure 4.

Use the following iterative procedure :

- a) find a first location of the new exchange, assuming the boundaries of existing exchange remain unchanged; use the method from Case study 3;
- b) assuming the new exchange is in its first location, find its service area; use the method from Case study 1;
- c) repeat steps a) and b) for the second location, third location and so on, until no changes are required in the service area boundaries.

Compare the result with this for Case study 1.

0	0	0	0	0	0	0	0	0	81	326	81	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	122	407	163	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	81	366	204	0	0	0	0	0	0
0	0	0	0	0	0	117	156	40	323	284	122	0	0	0	0	0	0
0	0	0	0	0	0	195	391	236	323	323	326	41	43	43	72	43	0
0	0	0	0	0	43	121	234	235	194	150	132	190	222	188	148	72	0
0	0	0	0	0	175	218	38	208	326	310	240	283	317	317	101	72	0
0	0	0	0	0	190	263	263	125	332	155	141	36	61	69	62	66	0
0	0	0	0	76	381	264	224	0	133	142	84	74	77	87	84	53	0
0	0	0	0	229	381	305	300	270	57	192	47	74	35	60	88	40	0
0	0	0	17	140	267	341	271	203	0	112	51	55	61	88	100	26	0
0	0	0	102	339	170	226	86	164	0	187	96	69	61	87	106	26	0
0	0	0	106	203	204	427	192	204	0	201	192	190	51	83	129	23	0
0	0	20	356	267	79	400	192	204	0	328	235	338	99	142	71	0	0
0	0	88	212	356	267	253	97	85	0	178	200	338	99	142	28	0	0
0	0	300	300	257	264	528	190	213	0	322	177	169	113	140	28	0	0
0	0	300	344	300	131	276	189	213	0	402	215	234	112	112	0	0	0
0	110	173	172	344	172	417	184	268	0	299	183	84	142	28	0	0	0
0	115	376	290	133	155	417	261	304	0	392	56	142	56	0	0	0	0
0	150	303	361	193	306	200	217	77	246	238	142	70	0	0	0	0	0
0	340	365	170	163	307	278	186	172	163	98	84	0	0	0	0	0	0
0	150	365	277	436	182	215	34	258	118	98	0	0	0	0	0	0	0
0	0	87	420	242	298	112	190	166	142	56	0	0	0	0	0	0	0
0	0	0	20	186	220	162	404	144	93	0	0	0	0	0	0	0	0
0	0	0	0	0	0	323	404	133	19	0	0	0	0	0	0	0	0
0	0	0	0	0	0	81	121	21	15	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	6	9	0	0	0	0	0	0	0	0

Figure 4 :



location of existing exchange (OLD)



present boundary of existing exchange