

## 5.5 Development Scenario

## 5.5.1 Service Provision

## (1) Basic Telecommunications Services

<u>Type of Services</u>	<u>Present</u>	<u>Year</u>			
		<u>1994/95</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
Telephone/Fax					
- Manual switching	Yes	Yes	-	-	-
- Automatic switching	Yes	Yes	Yes	Yes	Yes
- Various functions	Yes(50%)	Yes	Yes	Yes	Yes
Telegraph					
- Through P.O.Box	Yes	Yes	Yes	Yes	Yes
- Delivery to house	-	-	Yes	Yes	Yes
Telex	Yes	Yes	Yes	Yes	Yes
Leased circuits					
- Analog	Yes	Yes	Yes	Yes	Yes
- Digital (for data communication)	-	Yes	Yes	Yes	Yes

Note: Various functions mean the special functions on switching system for telephone services, such as temporary transfer and call waiting services, etc.

## (2) Advanced Telecommunications Services

<u>Type of Services</u>	<u>Present</u>	<u>Year</u>			
		<u>1994/95</u>	<u>2000</u>	<u>2005</u>	<u>2010</u>
ISDN					
- Narrow band	-	-	Yes	Yes	Yes
- Broad band	-	-	-	-	?
Mobile communication					
- Telephone	-	Yes	Yes	Yes	Yes
- Paging	-	Yes	Yes	Yes	Yes
- Trunk mobile radio (MCA)	-	-	Yes	Yes	Yes
- Maritime radio comm.	-	-	Yes	Yes	Yes

## 5.5.2 Supply Volume

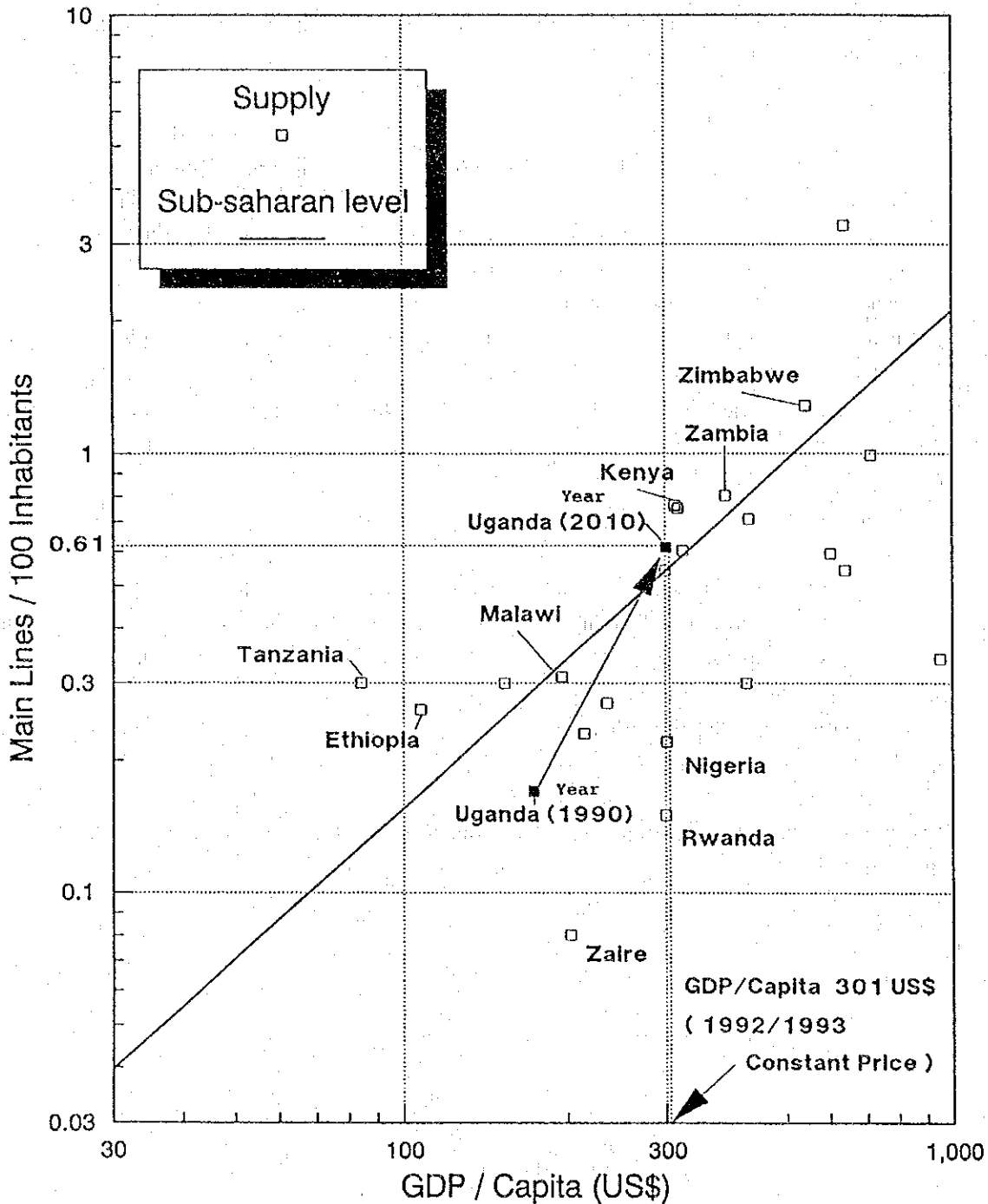
## (1) Telephone Service

Based on the above-mentioned policies, the following supply targets are proposed for telephone service:

	(Unit:1000 subscribers)					
	Rehabilitation		Development			
	Year	1993	Phase-1 1995	Phase-2 2000	Phase-3 2005	2010
1. Demand (5% GDP growth)						
1) By ITU-model		87	98	126	167	224
2) By sample survey		73	-	-	-	-
3) By Uganda-model		73	84	118	164	227
2. Supply						
1) On-going		25	35	-	-	-
2) Guideline						
a) Sub-Saharan level		53	59	78	105	142
b) 70% supply to demand		-	59	83	115	159
c) 0.5% investment/GDP		-	-	71	109	160
3) Targets in Master Plan						
			35	65	105	160

For reference, the telephone service status of sub-Saharan countries in 1990 is shown in Figure 5-5-1.

**TELEPHONE SERVICE SUPPLY**  
 ( Data in 1990 )  
 JICA Master Plan Study



Source:  
 Yearbook of Common Carrier by ITU in 1993  
 World Development Report by World Bank in 1992

Figure 5-5-1 Telephone Service Status in 1990

In each county, the supply ratio will be increased, phase by phase. Here, the supply ratio is the ratio of supply volume to demand.

Figure 5-5-2 shows present supply ratio of each county.

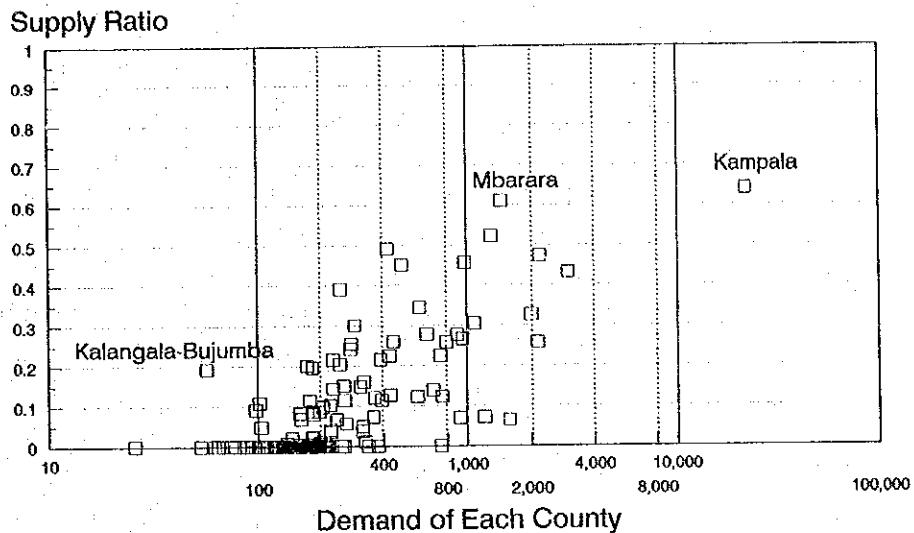


Figure 5-5-2 Present Supply Ratio of Each County (Year 1993)

Considering the above mentioned development policy, supply policy and supply target, the basic supply volume is decided as follows:

Phase - 1 (1995/96 - 1999/2000)	Supply Ratio at the phase end	Counties
	90%	Kampala and other 13 municipalities
	80%	Counties having large demand (2,000 -) at the phase end.
	30%	Counties having medium demand (800 - 2,000) at the phase end.
	-	There will be no supply for counties having small demand (- 800) at the phase end. Supply ratio will be lower than the present ratio, with demand growth.

Phase - 2 (2000/01 - 2004/05)	Supply Ratio at the phase end	Counties
	90%	Kampala and other 13 municipalities
	80%	Counties having large demand (2,000 -) at the phase end.
	50%	Counties having medium demand (400 - 2,000) at the phase end.
	-	There will be no supply for counties having small demand (- 400) at the phase end. Supply ratio will be lower than the present ratio, with demand growth.
Phase - 3 (2005/06 - 2009/10)	Supply Ratio as the phase end	Counties
	90%	Kampala and other 13 municipalities
	80%	Counties having large demand (2,000 -) at the phase end.
	50%	Counties having medium demand (400 - 2,000) at the phase end.
	10%	Counties having small demand (- 400) at the phase end.

Figure 5-5-3 shows development of these supply ratios with phase. Detailed supply plan by county is shown in Table 5-5-1 through Table 5-5-4, and proposed actual supply ratio at each phase end is shown in Figure 5-5-4 through Figure 5-5-6.

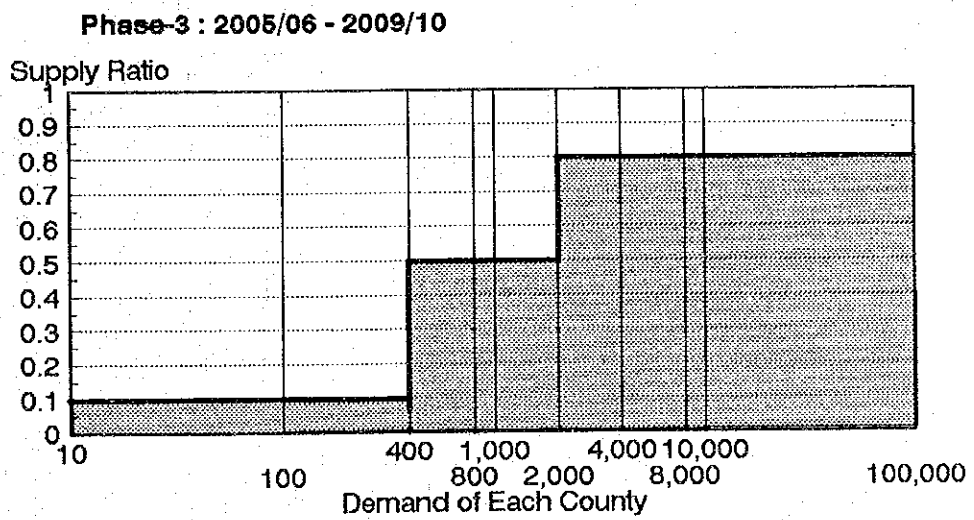
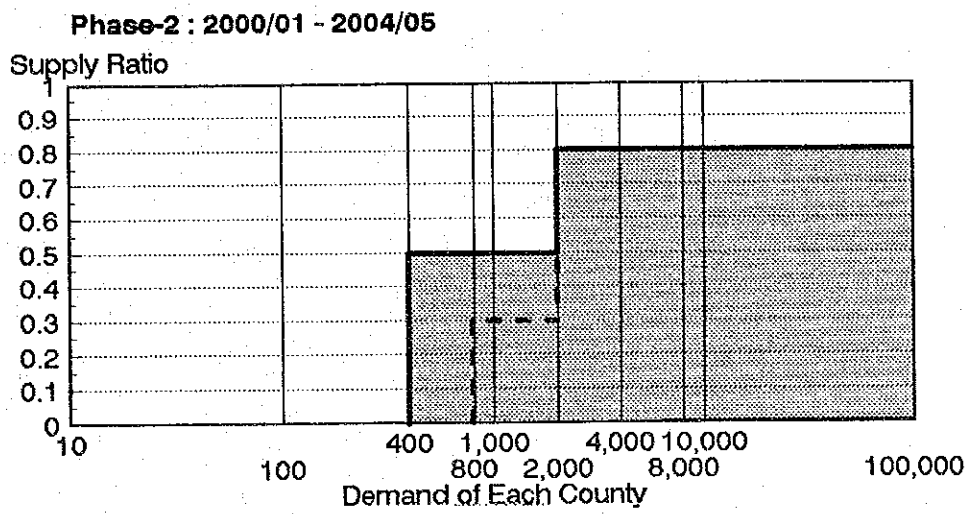
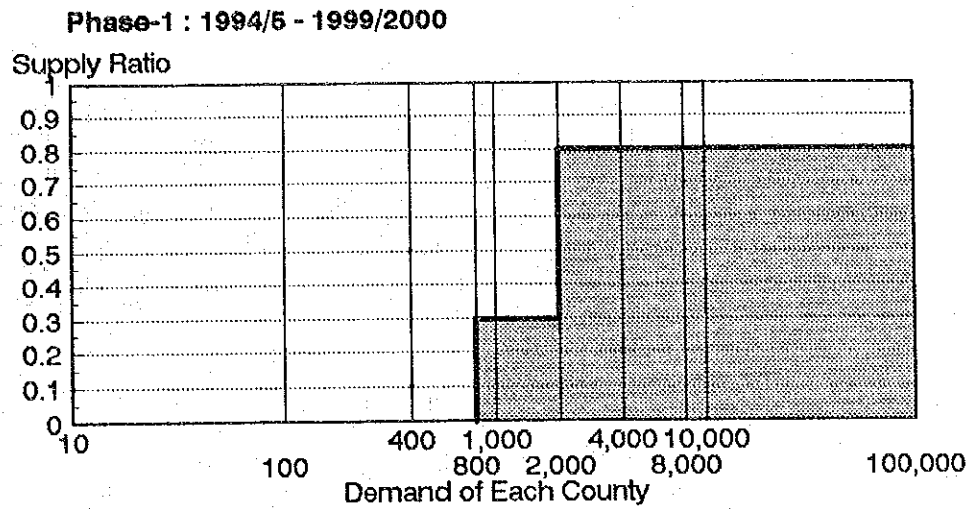


Figure 5-5-3 Supply Plan for Each Phase

Table 5-5-1 Supply Volume in Each Phase (1/4: Central Region)

District	NO.	County	Exchange (***)... Not Work	E.C.s (1993)	Walters (1993)	E.C.s + Walters	2000		2005		2010	
							Demand	Supply	Demand	Supply	Demand	Supply
Kalangala	1	Bujumba	Kalangala	11	20	31	89	27	122	37	170	51
	2	Kyamuswa					40	12	56	17	78	23
		(TOTAL)			11	20	31	129	39	178	54	248
Kampala	3	Kampala C.C.	Kampala Central	10,298	4,321	14,619	18,234	16,411	26,481	23,833	38,059	34,253
			Makerere	870	92	962	4,513	4,061	6,553	5,898	9,419	8,477
			Kawempe (RLU)	268	112	380	2,491	2,242	3,618	3,256	5,200	4,680
			Mengo (XB)	411	70	481	4,697	4,227	6,821	6,139	9,803	8,823
			Nsambya (FLU)	1,065	150	1,215	2,299	2,070	3,339	3,005	4,800	4,320
			Lubowa (FLU)	117	45	162	815	734	1,184	1,066	1,702	1,532
			Kyambogo (XB)	215	20	235	2,191	1,971	3,181	2,863	4,572	4,115
			Mbuya (RLU)	849	41	890	2,337	2,103	3,394	3,055	4,878	4,390
		(Total)	14,093	4,851	18,944	37,573	33,816	54,566	49,109	78,424	70,582	
Kiboga	4	Kiboga	Kiboga	50	30	80	458	50	707	354	1,057	529
		(TOTAL)		50	30	80	458	50	707	354	1,057	529
Luwero	5	Buruli	Nakasonkola	33	30	63	360	33	501	250	699	350
	6	Kalikamu	Bombo	22	35	57	257	77	358	179	500	400
			Luwero	42	28	68	290	87	405	203	565	452
			Wobulenzi	29	13	42	340	102	474	237	661	529
			(Sub-Total)	93	74	167	887	266	1,237	619	1,726	1,381
	7	Nakasoke	Ssemulo	8	15	23	102	8	142	8	199	99
Nakasoke			5	28	33	146	5	204	5	285	143	
		(Sub-Total)	13	43	56	249	13	346	13	483	242	
8	Wabusana (Bamunanka)					275	0	383	0	535	268	
	(TOTAL)			139	147	286	1,770	312	2,467	882	3,444	2,241
Masaka	9	Bukomansimbi	Byoga (PCO)	1	20	21	257	1	341	1	460	230
	10	Bukoto	Bukoto	4	7	11	467	4	621	311	838	503
	11	Kalungu	Lukaya	15	17	32	209	15	278	139	374	187
			Kalungu	1	14	15	248	1	327	163	440	220
			(Sub-Total)	16	31	47	454	16	604	302	814	407
	12	Lwemiyaga					97	0	130	0	175	17
13	Masaka Municipality	Masaka	557	355	912	3,081	2,773	4,098	3,688	5,524	4,972	
14	Mawogola					272	0	362	0	488	244	
	(TOTAL)			578	413	991	4,629	2,794	6,156	4,302	8,299	6,373
Mpigi	15	Entebbe Municipality	Entebbe	1,048	85	1,133	2,984	2,686	3,829	3,446	5,014	4,513
	16	Busiro	(Naddangira)				1,013	0	1,299	650	1,702	851
	17	Bulambala					194	0	249	0	327	33
	18	Gomba					255	0	327	0	429	214
	19	Kyadondo	Kasangati	81	15	96	988	296	1,268	1,015	1,661	1,329
			Namulonge	5	40	45	223	67	286	229	375	300
			(Maluga)				530	0	680	544	891	713
			(Sub-Total)	86	55	141	1,741	363	2,234	1,788	2,927	2,342
20	Mawokota	Mpigi	52	81	133	951	285	1,223	611	1,600	800	
		(Milara Maria)	52	81	133	76	0	98	49	128	64	
		(Sub-Total)	104	162	266	1,027	285	1,321	660	1,728	864	
	(TOTAL)			1,186	221	1,407	7,214	3,334	9,260	6,544	12,126	8,817
Mubende	21	Busujju					208	0	288	0	424	212
	22	Buwekula	Mubende	88		88	786	236	1,124	592	1,600	800
	23	Kassanda					321	0	459	229	653	326
	24	Mityana	Mityana	180	95	275	931	279	1,332	666	1,895	1,516
			Busimbi	1	40	41	139	42	199	99	283	226
		(Sub-Total)	181	135	316	1,069	321	1,530	765	2,178	1,742	
	(TOTAL)			269	135	404	2,384	557	3,411	1,556	4,855	3,080
Mukono	25	Bbaake					222	0	336	0	500	250
	26	Buikwe	Lugazi	75	57	132	452	226	687	550	1,018	814
			Buikwe	4	12	16	244	4	371	297	550	440
			Ngogwe	0	17	17	116	0	177	142	262	210
			Nkokonjeru	4	30	34	184	4	280	224	415	332
			Nyenga	19	21	40	258	129	393	315	583	466
			(Sub-Total)	102	137	239	1,254	363	1,908	1,527	2,828	2,262
	27	Buvuma Island					102	0	155	0	229	23
	28	Mukono	Mukono (RSU)	222	10	232	738	222	1,122	561	1,663	1,331
			(Seta)				204	0	310	155	459	367
		(Sub-Total)	222	10	232	941	222	1,432	716	2,122	1,698	
29	Nakifuma	Kasawo	12	20	32	149	12	227	114	336	168	
		(Nagalama)				155	0	236	118	350	175	
		(Sub-Total)	12	20	32	304	12	463	232	686	343	
30	Ntenjeru	Kayunga	72	15	87	719	216	1,094	547	1,620	810	
		(Kangulumira)				134	0	203	102	301	151	
		(Sub-Total)	72	15	87	853	216	1,297	649	1,921	961	
	(TOTAL)			408	182	590	3,675	813	5,593	3,124	8,286	5,537
Rakai	31	Kabula	Lyantonde	0	85	85	344	0	511	255	744	372
	32	Kakuuto	(Kakuuto)				231	0	343	172	500	250
	33	Kooki	Rakai	4	15	19	330	88	489	123	713	178
	34	Kyotera	Kyotera	39	30	69	232	39	344	172	501	250
			Kalisizo	33	32	65	272	33	403	202	588	294
		(Sub-Total)	72	62	134	504	72	747	374	1,089	544	
	(TOTAL)			76	162	238	1,410	160	2,090	924	3,045	1,344
Central Total				16,810	6,161	22,971	59,243	41,875	84,428	66,848	119,784	98,576

Table 5-5-2 Supply Volume in Each Phase (2/4: Eastern Region)

## Eastern Region

District	NO.	County	Exchange (***)... Not Work	E.C.s (1993)	Walters (1993)	E.C.s + Walters	2000		2005		2010		
							Demand	Supply	Demand	Supply	Demand	Supply	
Iganga	35	Bugweri	Busesa	15	28	43	317	15	448	224	624	312	
	36	Bukooli	Bugiri	46	40	86	531	46	751	376	1,045	523	
	37	Bunya	Mayuge	15	13	28	454	15	642	161	893	224	
	38	Busiki	Busembatya	20	18	38	303	20	429	214	597	298	
	39	Kigulu	Iganga (Namungalwe)	207	120	327	1,258	378	1,781	890	2,478	1,983	
			(Sub-Total)		207	120	327	1,363	409	1,928	964	2,684	2,147
	40	Luuka	Kiyunga	4	30	34	310	4	439	219	610	305	
		(TOTAL)		307	249	556	3,277	509	4,637	2,158	6,453	3,809	
Jinja	41	Bulembe	Kakira	44	34	78	693	44	1,022	511	1,461	731	
	42	Jinja Municipal	Jinja	1,305	292	1,597	5,754	5,178	8,488	7,639	12,137	10,923	
	43	Kagoma	Buwenge	9	26	35	427	9	631	158	902	226	
			(TOTAL)		1,358	352	1,710	6,874	5,231	10,140	8,308	14,500	11,880
Kamuli	44	Budope					354	0	526	88	755	126	
	45	Bugabuk	Bulopa	4	11	15	75	4	112	56	161	80	
			Kamuli	34	45	79	395	119	587	294	843	421	
			Namwendwa	1	7	8	31	1	46	23	66	33	
			(Sub-Total)		39	63	102	502	39	745	373	1,070	535
	46	Bulamogi	Kaliro	35	25	60	337	35	500	250	717	359	
	47	Buzaaya				300	0	445	74	639	106		
		(TOTAL)		74	88	162	1,492	74	2,215	785	3,181	1,126	
Kapchorwa	48	Kongasis					119	0	180	0	216	20	
	49	Kween					136	0	183	0	247	20	
	50	Tingey	Kapchorwa	36	13	49	282	226	381	305	513	410	
		(TOTAL)		36	13	49	536	226	725	305	976	450	
Kumi	51	Buke dea	(Buke dea)				206	0	276	0	370	37	
	52	Kumi	Kumi	45	30	75	475	143	637	318	853	427	
	53	Ngora	(Ngora)				179	0	240	0	321	32	
			(TOTAL)		45	30	75	860	143	1,153	318	1,544	496
Mbale	54	Bubulo	Myenze	20	25	45	302	20	398	20	527	264	
	55	Budadiri	Budadiri	13	10	23	263	13	348	174	460	230	
			Sironko	13	10	23	263	13	348	174	460	230	
			(Sub-Total)		26	20	46	527	26	695	348	920	460
	56	Bulambuli					184	0	243	0	321	32	
	57	Bungokho	Nakaloke	5	21	26	227	5	300	150	397	198	
			Manafwa	3	8	11	103	3	136	68	179	90	
			(Sub-Total)		8	29	37	330	8	435	218	576	288
	58	Manjiya	Bududa	11	15	26	202	11	267	133	353	177	
			Bulucheke	5	12	17	149	5	197	99	261	130	
(Sub-Total)				16	27	43	352	16	464	232	614	307	
59	Mbale Municipal	Mbale (2 Units)	685	70	755	1,925	1,733	2,541	2,287	3,363	3,027		
		(TOTAL)		755	171	926	3,619	1,803	4,777	3,105	6,322	4,378	
Pallisa	60	Budaka	Kamankoli	1	7	8	306	1	453	227	648	324	
	61	Butebo					235	0	348	0	498	249	
	62	Kibuku					291	0	430	215	615	308	
	63	Pallisa		16	15	31	350	105	518	259	741	371	
			(TOTAL)		17	22	39	1,182	106	1,749	701	2,502	1,252
Soroti	64	Amuria	(Amuria)				282	0	366	0	476	238	
	65	Kaberamaido	(Kaberamaido)				312	0	402	201	524	262	
	66	Kalaki	(Otsubo)				266	0	344	0	448	224	
	67	Kapelebyong					182	0	234	0	304	30	
	68	Kasilo					212	0	274	0	358	36	
	69	Serere	(Serere)				340	0	438	219	572	286	
	70	Soroti					380	0	490	245	638	319	
	71	Soroti Municipal	Soroti	207	120	327	846	761	1,094	984	1,424	1,282	
	72	Usuk	(Kalakwi)				245	0	316	0	412	206	
			(TOTAL)		207	120	327	3,065	761	3,958	1,649	5,156	2,883
Tororo	73	Bunyole					232	0	291	0	368	37	
	74	Kisoko (W. Budama)					263	0	329	0	417	209	
	75	Samia-Bugwe	Busia	62	30	92	890	267	1,113	557	1,411	705	
			Lumino	3	15	18	343	103	429	214	543	272	
			(Sub-Total)		65	45	110	1,232	370	1,541	771	1,954	977
76	Tororo	Malaba	30	25	55	347	104	434	217	550	440		
77	Tororo Municipal	Tororo	331	70	401	1,446	1,301	1,809	1,628	2,293	2,064		
		(TOTAL)		426	140	566	3,521	1,775	4,404	2,616	5,583	3,727	
Eastern Total				3,225	1,185	4,410	24,426	10,627	33,758	19,945	46,217	30,001	



Table 5-5-3 Supply Volume in Each Phase (3/4: Northern Region)

District	NO.	County	Exchange (***)... Not Work	E.C.s (1993)	Walters (1993)	E.C.s + Walters	2000		2005		2010	
							Demand	Supply	Demand	Supply	Demand	Supply
Apac	78	Kole					321	0	464	232	650	325
	79	Kwana	Aduku	3	11	14	274	82	396	198	555	277
	80	Maruzi	Apac	23	15	38	418	125	606	303	848	424
	81	Oyam					385	0	557	139	779	195
		(TOTAL)			26	26	52	1,398	208	2,023	872	2,832
Arua	82	Aringa					246	0	329	0	436	218
	83	Arua Municipali	Arua	98	27	123	1,066	959	1,426	1,283	1,891	1,702
	84	Ayivu					259	0	347	0	461	230
	85	Koboko	(Koboko)				287	86	384	115	510	255
	86	Madi-Okollo	(Rhino Camp)				204	0	273	0	362	36
	87	Maracha					256	0	343	0	455	228
	88	Terego					246	0	329	0	436	218
	89	Vurra					193	0	258	0	343	34
		(TOTAL)			96	27	123	2,757	1,045	3,688	1,398	4,893
Gulu	90	Aswa					180	0	222	0	277	28
	91	Gulu Municipali	Gulu	250	75	325	1,460	1,314	2,190	1,971	3,285	2,957
	92	Kilak					199	0	247	0	308	31
	93	Nwoya					118	0	146	0	183	18
	94	Omoro					211	0	262	0	327	33
	(TOTAL)			250	75	325	2,169	1,314	3,067	1,971	4,380	3,067
Kitgum	95	Agago					274	0	369	0	493	246
	96	Aruu					223	0	300	0	400	40
	97	Chua	Kitgum	55	35	90	677	203	912	456	1,216	608
	98	Lamwo					207	0	279	0	372	37
	(TOTAL)			55	35	90	1,381	203	1,860	456	2,480	931
Kotido	99	Dodoth					163	0	217	0	287	144
	100	Jie	(Kotido)	0	25	25	281	84	374	112	495	247
	101	Labwor					157	0	210	0	277	28
	(TOTAL)			0	25	25	601	84	801	112	1,058	419
Lira	102	Dokolo	(Dokolo)				235	0	320	0	430	215
	103	Erute	Aboke	2	20	22	320	2	436	218	585	293
	104	Kloga					207	0	282	0	380	38
	105	Lira Municipality	Lira	117	150	267	722	649	983	885	1,321	1,189
	106	Moroto	(Aloi)				272	0	370	0	497	249
	107	Oluke					156	0	212	0	285	29
	(TOTAL)			119	170	289	1,911	651	2,603	1,103	3,498	2,013
Moroto	108	Bokora					119	0	149	0	187	19
	109	Kadam (Chekw)					143	0	179	0	226	23
	110	Matheniko	(Nakapiripirik)				141	0	176	0	221	22
	111	Moroto Municip	Moroto	98	45	143	338	304	423	380	532	479
	112	Pian					92	0	115	0	145	14
	113	Upe					72	0	90	0	113	11
	(TOTAL)			98	45	143	905	304	1,131	380	1,424	568
Moyo	114	East Moyo					252	0	332	0	435	218
	115	Obongi					93	0	122	0	160	16
	116	West Moyo	Moyo	51	30	81	370	111	487	244	639	319
	(TOTAL)			51	30	81	715	111	941	244	1,234	553
Nebbi	117	Jonam	(Pakwach)				314	94	417	209	552	276
	118	Okoro					577	0	767	192	1,015	254
	119	Padyere	(Nebbi)				395	119	525	263	694	347
		(TOTAL)			0	25	25	1,285	213	1,710	664	2,261
Northern Total				695	458	1,153	13,122	4,133	17,824	7,201	24,061	12,570

Table 5-5-4 Supply Volume in Each Phase (4/4: Western Region)

## Western Region

District	NO.	County	Exchange (***)... Not Work	E.C.s (1993)	Walters (1993)	E.C.s + Walters	2000		2005		2010	
							Demand	Supply	Demand	Supply	Demand	Supply
Bundibugyo	120	Bwamba					371	111	484	242	632	316
	121	Ntoroko					156	0	204	0	268	27
		(TOTAL)		0	25	25	527	111	688	242	898	343
Bushenyi	122	Buhweju					209	0	301	0	419	210
	123	Bunyuruguru					252	0	361	0	504	252
	124	Igara	Bushenyi	97	154	251	788	394	1,132	566	1,579	1,263
	125	Ruhinda					338	0	485	243	677	339
	126	Sheema	Kabwohe (PCO)	1	35	36	356	107	512	258	714	357
		(TOTAL)	98	189	287	1,943	501	2,791	1,065	3,893	2,421	
Hoima	127	Bugahya	Hoima	169	21	190	986	493	1,214	607	1,510	1,208
	128	Buhaguzi					178	0	219	0	273	27
		(TOTAL)		169	21	190	1,164	493	1,433	607	1,783	1,235
Kabale	129	Kabale Municip	Kabale	659	87	746	2,476	2,229	2,923	2,631	3,504	3,153
	130	Ndorwa					239	0	282	0	338	34
	131	Rubanda					235	0	278	0	333	33
	132	Rukiga					182	0	215	0	258	26
		(TOTAL)	659	87	746	3,133	2,229	3,698	2,631	4,433	3,246	
Kabarole	133	Bunyungabu					288	0	388	0	513	257
	134	Burahya					289	0	388	0	516	258
	135	Fort Portal Municip	Fort Portal	446	109	555	1,515	1,364	2,033	1,829	2,705	2,435
	136	Kibale					280	0	375	0	499	250
	137	Kilagwenda					222	0	298	0	397	40
	138	Kyaka					191	0	256	0	341	34
	139	Mwenge	(Buliil, Kyenjojo)	0	42	42	328	164	440	220	585	293
		(TOTAL)	446	151	597	3,113	1,528	4,176	2,049	5,558	3,567	
Kasese	140	Bukorjo					480	0	618	155	796	199
	141	Busongora	Kasese Kilembe (-Hilma) (L. Katwe)	236 19 0 0	120 25 15 30	356 44 15 30	1,562 136 100 177	781 41 30 53	2,080 175 129 228	1,664 140 103 182	2,498 225 166 294	1,998 180 133 235
		Busongora	(Sub-Total)	255	190	445	1,975	905	2,612	2,089	3,183	2,546
			(TOTAL)	255	190	445	2,455	905	3,230	2,244	3,979	2,745
	142	Bugangalzi	Kakumiro	11	30	41	186	11	267	11	372	37
Kibale	143	Buyaga	Kagadi	0	25	25	358	107	513	257	715	357
	144	Buyanja					170	51	244	122	339	170
		(TOTAL)		11	55	66	714	169	1,024	390	1,426	564
Kisoro	145	Bufumbira	Kisoro	68	40	108	546	164	802	401	1,134	567
		(TOTAL)		68	40	108	546	164	802	401	1,134	567
Masindi	146	Mujenje	Bulindi (Budongo) (Sub-Total)	9 9	5 5	14 14	96 200 296	29 60 89	126 250 376	38 75 113	166 330 496	50 99 149
	147	Bulisa	Bulisa	5	25	30	153	5	201	5	263	26
	148	Buruli	Masindi	207	80	287	1,040	520	1,364	682	1,787	1,430
	149	Kibanda	Kigumba	11	25	36	239	11	314	11	411	205
			(TOTAL)	232	135	367	1,728	625	2,255	811	2,957	1,809
Mbarara	150	Bukanga					205	0	267	0	347	35
	151	Ibanda	Ibanda (PCO)	1		1	306	92	398	199	518	259
	152	Isingiro					279	0	364	0	473	237
	153	Kashari					257	0	335	0	436	218
	154	Kazo					183	0	238	0	310	31
	155	Mbarara Municip	Mbarara	894		894	2,139	1,925	2,786	2,507	3,626	3,264
	156	Nyabushozi	Rushere (PCO)	1		1	202	61	263	79	342	103
157	Rwampara	Kinoni (PCO)	1		1	256	77	333	100	434	217	
		(TOTAL)	897	0	897	3,827	2,154	4,983	2,885	6,487	4,364	
Ntungamo	158	Kajara	(Rwashamare)				406	0	573	286	790	395
	159	Rushenyi					380	0	537	268	740	370
	160	Ruhaama	Ntungamo	17		17	555	167	783	392	1,080	540
		(TOTAL)		17	0	17	1,341	167	1,893	946	2,610	1,305
Rukungiri	161	Kinkizi					258	0	375	0	528	264
	162	Rubabo					192	0	280	0	394	39
	163	Rujunbura	Rukungiri	84		84	463	232	674	337	949	474
		(TOTAL)	84	0	84	912	232	1,329	337	1,871	777	
Western Total				2,936	893	3,829	21,403	9,277	28,302	14,607	37,029	22,943
(Grand Total)				23,666	8,697	32,363	118,195	65,912	164,312	108,601	227,091	164,090

NOTE: Indicator (\*) shows the supply volume has been modified through the Team-UPTC discussion.

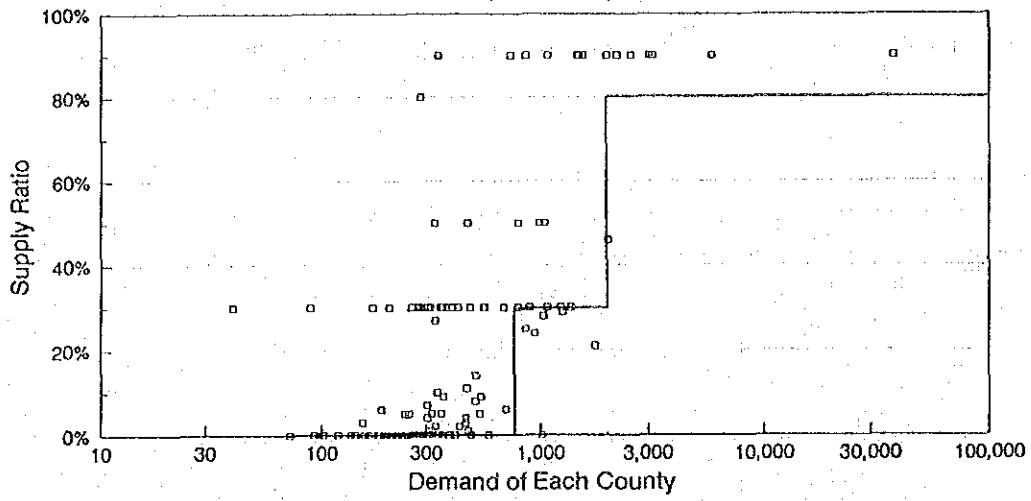


Figure 5-5-4 Demand and Supply Ratio (Year 2000)

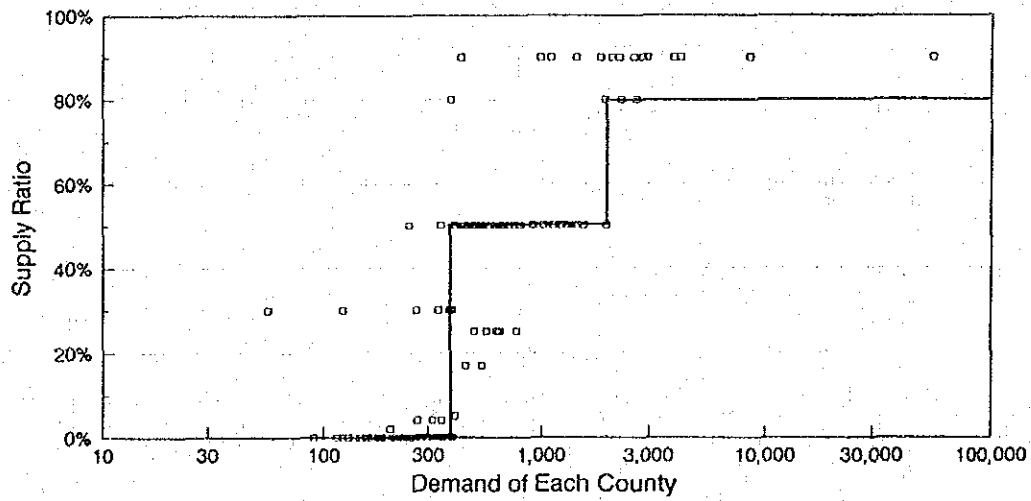


Figure 5-5-5 Demand and Supply Ratio (Year 2005)

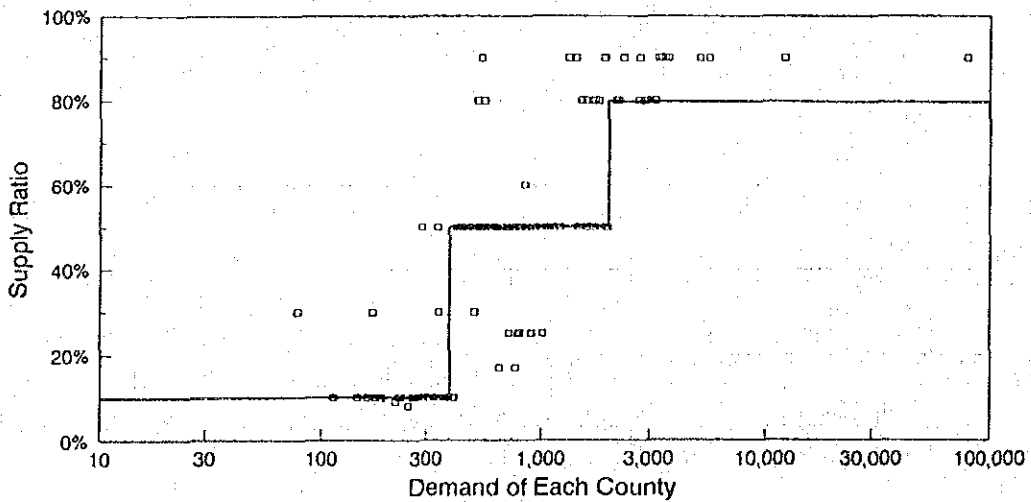


Figure 5-5-6 Demand and Supply Ratio (Year 2010)

## (2) Telegraph Service

Telegraph offices are to be provided "in all county centers" by the year 2010 to provide the basic telecommunication service to the people.

## (3) ISDN Services

The data communication services can be effectively provided by ISDN. These services are to be supplied in major towns considering demand as shown in Table 5-5-5.

Table 5-5-5 Supply Plan for ISDN Services

Year	2000	2005	2010	
Demand (Data Comm.)	910	1,446	2,268	
Supply (N-ISDN lines)	800	1,300	2,000	
Towns	Kampala Entebbe	Kampala Entebbe Jinja Masaka	Kampala Jinja Mbala Gulu Soroti Lira Masindi	Entebbe Masaka Mbarara Fort Portal Moroto Arua Kabale

## (4) Mobile Communication Services

The mobile communication services will be provided by private companies. These services are to be supplied in major towns considering demand as shown in Table 5-5-6.

Table 5-5-6 Supply Plan for Mobile Comm. Services

Year	2000	2005	2010	
Demand (Mobile Tel.)	999	1,810	2,958	
Supply (Mobile Tel.)	800	1,600	2,700	
Towns	Kampala Entebbe	Kampala Entebbe Jinja Masaka	Kampala Jinja Mbala Gulu Soroti Lira Masindi	Entebbe Masaka Mbarara Fort Portal Moroto Arua Kabale

### 5.5.3 Network Expansion

#### (1) Priority

To solve the current problems in the telecommunications services, the network must be rehabilitated and expanded giving priority to the following subjects:

- a) Replacement of old equipment
- b) Network expansion to remote corners (isolated districts)
- c) Network expansion to semi-urban (middle size towns)

For item a), the old switching and transmission systems in major towns, for example in Kampala, Jinja and Entebbe, must be urgently replaced by new systems.

For item b), a new transmission link to the isolated district centers, especially to Arua town, must be constructed in Phase-1 (1995-2000).

For item c), the network must be expanded to the middle size towns like county centers in Phase-2 (2000-2005).

#### (2) Rural Telecommunications

To improve telecommunications services in rural areas, telephone exchanges or public call offices (PCOs) be provided in "all county centers" in the year 2010. By this provision, everybody can get access to telephones within 20 km (about 1.5 hour by bicycle).

According to the ITU guideline for rural telecommunications, telephones should be accessible by everybody within one hour by walk (about 5 km). To realize this guideline, the huge costs (about US\$ 125 million) will be required for UPTC to construct a total of 2,500 locations of DMARS for all sub-counties. This plan is not so feasible in Uganda.

### 5.5.4 Financial Projection

#### (1) Fund for Investment

The investment costs must be covered by the following funds:

- a) Grant aid : For priority or un-profitable projects.
- b) Foreign loan : For large scale profitable projects.
- c) Own budget : For small scale projects.

(2) Government Contribution

To provide the basic telecommunications services for the people in the whole nation, UPTC must expand the telecommunications network to rural areas even though the revenue from subscribers will not be large enough. For the realization of normal financial management with such conditions, UPTC may require the following contributions from the Government:

- a) Financial assistance to cover unexpected foreign exchange loss.
- b) Tax exemption for imported equipment.

(3) Operation Revenue

To solve current financial problems, the following actions must be taken:

- a) Urgent introduction of a new billing system.
- b) Special actions for cash collection.

#### 5.5.5 Privatization of UPTC

The basic telecommunication services, such as telephone, telegraph and telex, are to be provided by UPTC until the network will be expanded to rural areas. If UPTC is privatized now, the telecommunication services will not be provided in such unprofitable areas.

The specific telecommunication services, such as data communication and mobile communication services, can be provided by the private investors under the control of the Ministry or UPTC.



## **CHAPTER 6**

### **NATIONAL NETWORK EXPANSION PLAN**





## CHAPTER 6 National Network Expansion Plan

### 6.1 Fundamental Technical Plan

The development objective of this master plan covers the period 1995/1996 to 2009/2010. A considerable expansion of the Uganda telephone network is foreseen over the next 15 years. However, it is necessary to update it to match the digital technology innovation which is changing fast.

The ultimate object of the future telephone network in Uganda is the establishment of an integrated digital network (IDN). Analog and digital technologies in the network will, however, continue to co-exist for the time being. Analogue and digital networks will first be integrated at the group switching center (GSC) level interface points where analogue to digital conversion will take place for long distance switching and transmission.

To improve the present network efficiently, it is imperative to balance the factors among the various technical plans, such as traffic, routing, signalling, transmission, synchronization, numbering and charging plans. This chapter gives the present technical plans in use and the proposal for modifications to be applied for the future telecommunications network in Uganda.

#### 6.1.1 Routing Plan

##### (1) Network Hierarchy

The basic network structure consists of seven switching areas. All switching points are ranked from the viewpoint of the star network and shall have trunks to upper and lower ranked switching points and, further, high usage routes are allowed where necessary. Figure 6-1-1 shows the present hierarchical network configuration of Uganda.

In consequence of the realization of national digitalization, the current 3-step hierarchy of the telephone switching network is to be modified to the 2-step hierarchy, eliminating group switching centers. Figure 6-1-2 shows the network configuration in future.

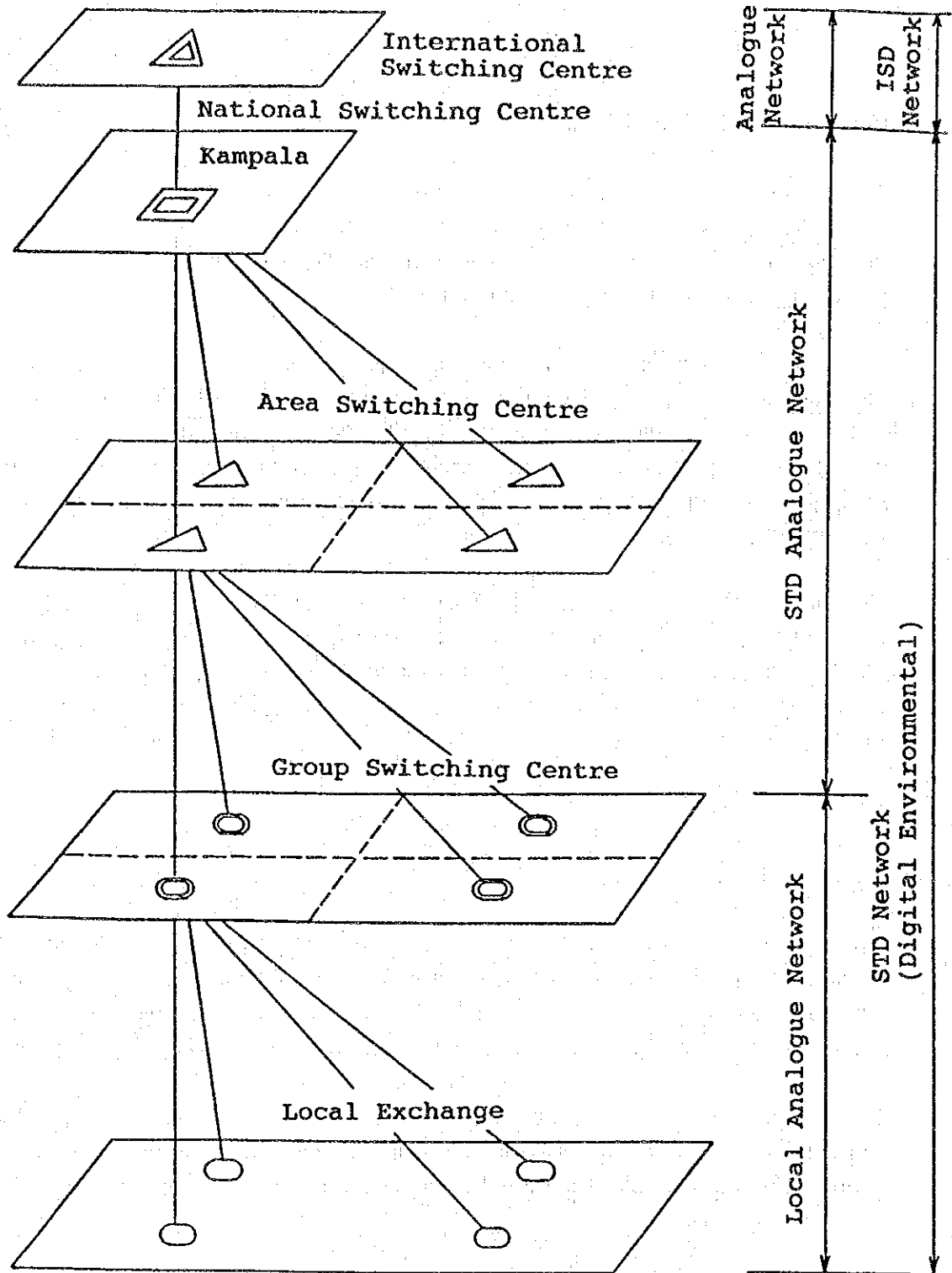


Figure 6-1-1 Telephone Network Configuration of Uganda

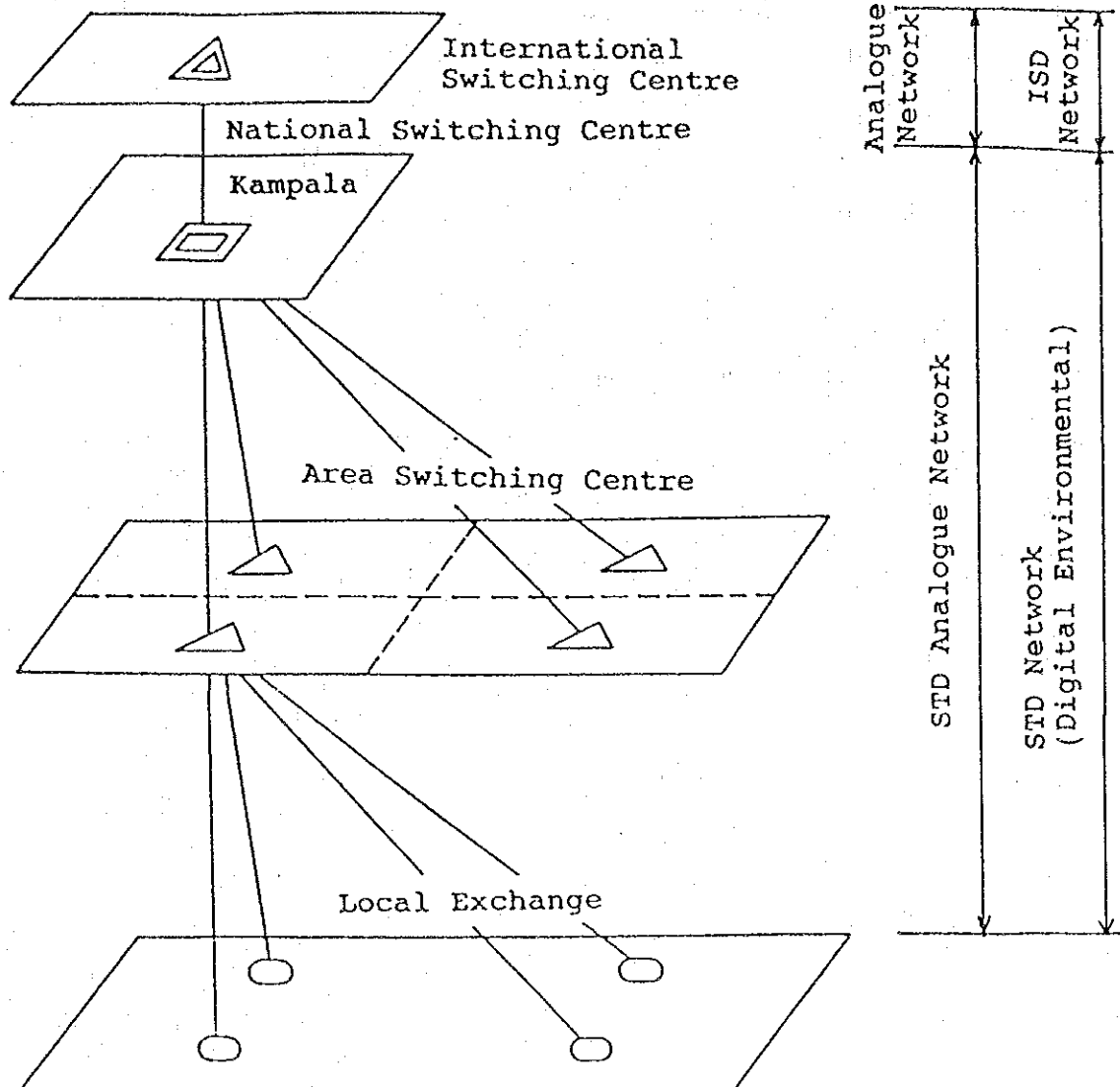


Figure 6-1-2 Telephone Network Configuration in Future

(2) Routing Details

- a) International Transit Exchanges (ITE)
  - trunking international traffic to NSC
  
- b) National Switching Center (NSC)
  - trunking traffic from/to all ASCs
  - trunking international traffic from/to all ASCs
  - trunking by operator assistance
  
- c) Area Switching Center (ASC)
  - trunking traffic in own local area
  - trunking traffic between EOs under ASC
  - trunking by operator assistance
  - operating center for exchanges in own area
  
- d) End Office (EO)
  - processing traffic from/to local subscribers
  - trunking by operator assistance
  - controlling RSUs under EO
  
- e) Remote Switching Unit
  - processing traffic from/to local subscribers

Figure 6-1-3 shows ASC boundaries.

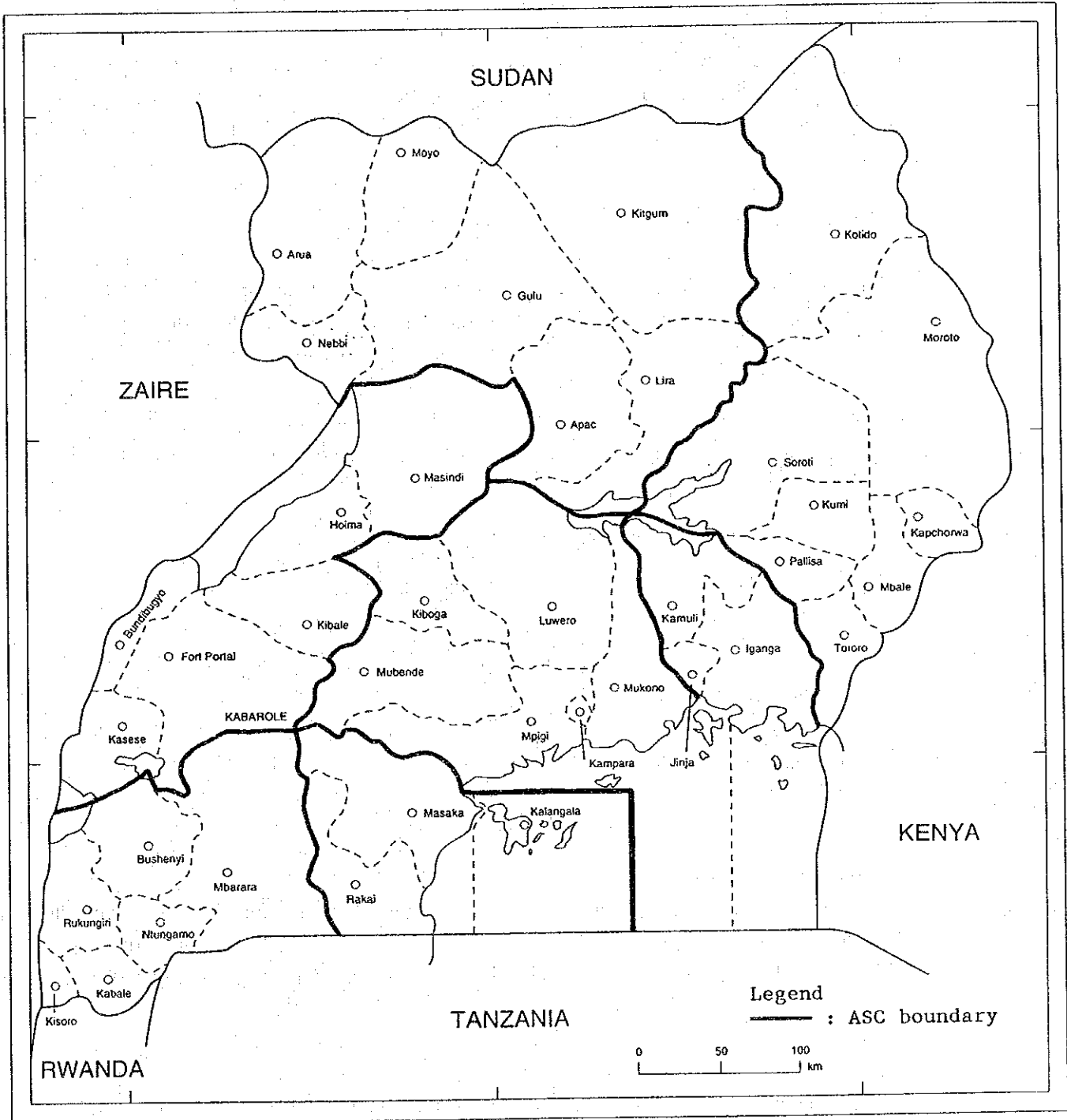


Figure 6-1-3 Switching Area Plan

### 6.1.2 Signalling Plan

#### (1) Current Signalling System in STD Network

In the national network of Uganda, Group Switching Centers are equipped with national MFC R2 registers and senders, and for bearers, out-band carrier systems or digital systems are adopted. MFC R2 (East Africa) are still used for cross bar exchanges.

##### a) Line Signalling

The line signalling in the STD network is of the out-band low level continuous type with tone-on-idle signalling, based on a link-by-link system. Various types of signalling are available: E+M (DP), E+M (MF), generator signalling (ring-down) for the existing Manual Board without automatic dialling facility.

##### b) Line Conditions

Signalling conditions correspond to six operating conditions of lines shown in the Table 6-1-1.

Table 6-1-1 Line Signalling Conditions

Operating Condition of Circuit	Signalling Condition	
	Forward	Backward
1. Idle	Tone on	Tone on
2. Seized	Tone off	Tone on
3. Answered	Tone off	Tone off
4. Clear-forward (Backward)	Tone on	Tone off
5. Release	Tone on	Tone off
6. Block	Tone on	Tone off

##### c) Register Signalling

Inter-register Signalling System R2 (IRSS-MFC-R2) in Uganda is a compelled multi-frequency signalling system and has been standardized for use in STD-network. Operation of MFC-R2 in Uganda complies with the Recommendations by ITU-T (former CCITT).

##### d) Frequencies

Multi-frequency signals used in Uganda are of frequency combinations in a 2-out-of-6 code using six frequencies in the forward direction and six different frequencies in the backward direction.

## (2) New Signalling System in STD Network

In the course of telephone network digitalization, a new signalling system shall be applied in Uganda. It is proposed to apply the common signalling system between digital switching units.

## 6.1.3 Transmission Plan

## (1) Transmission Systems

At present, the following transmission systems are used in Uganda:

- Voice-frequency transmission on open-wire lines
- Carrier systems on open-wire lines (3ch and 12ch)
- Coaxial cable (Analog)
- Cable PCM (Digital)
- Fiber optic transmission system (Digital)
- VHF radio system (Analog)
- UHF radio system (Analog)
- Microwave system (Analog and Digital)

In future, analog transmission systems will be replaced by digital systems.

## (2) Hierarchical Structure

## a) FDM System

Table 6-1-2 shows the hierarchical structure of FDM system.

Table 6-1-2 Hierarchical Structure of FDM System

Level	Group name	Composition	Basic Frequency Range	No. of Telephone Channels
1	Group	-	60-108 kHz (48 kHz band)	12
2	Supergroup (SG)	5 G	312-552 kHz (240 kHz band)	60
3	Mastergroup (MG)	5 SG	812-2,044 kHz (1,232 kHz band)	300



## b) TDM System

Table 6-1-3 shows the hierarchical structure of TDM system.

Table 6-1-3 Hierarchical Structure of TDM System

Level	Bit Rate (kbps)	Nominal Rate (Mbps)	No. of Telephone Channels
1	2,048	2	30
2	8,448	8	120
3	34,368	34	480
4	139,264	140	1,920

The Synchronous Digital Hierarchy (SDH) has been recommended by ITU-T (former CCITT) for spreading B-ISDN services over the world. In this hierarchy, the bit rate of 155,520 kbps is considered to be the first level (STM-1) of the hierarchy.

## (3) Radio Frequency Plan

Radio-frequency channel arrangements are provided in ITU-R (former CCIR) recommendations Section 9B1. Table 6-1-4 shows the existing and available frequency allocation plans for Uganda.

Table 6-1-4 Existing and Available Frequency Plans

A n n o g	Maximum Telephone Channels	Frequency Band										
		160 MHz	400 MHz	800 MHz	1.5 GHz	2 GHz	4 GHz	6 GHz /L	6 GHz /U	7 GHz	8 GHz	
D i g i t a l	Single	***										
	12 CH		***									
	60 CH		***			*** 283			***	*** 385	***	
	120 CH					*** 283			***	*** 385	*** 386	
	300 CH					*** 283				*** 385		
	960 CH/ TV					*** 283 382	*** 382	*** 2833 83	*** 384			
D i g i t a l	6/12 CH		***		*** 283							
	2M bps (30 CH)			***	***	*** 283						
	8M bps (120 CH)					*** 283				***	***	
	17M bps (240 CH)					*** 283				***	***	
	34M bps (480 CH)					*** 283	*** 382	***	***	***	***	
	34M bps x 2 (960 CH)					*** 283	*** 382	***	***			
	140M bps (1,920 CH)						*** 382	*** 383	*** 384			***
	DMARS				*** 701	*** 701						

LEGEND: \*\*\*... existing/available system  
283... ITU-R Rec. No. 283

(4) Transmission Performance

The telephone circuits will cause undesirable phenomena, such as singing, near-singing and echo, in case transmission loss is too low. To avoid such phenomena, circuits should be so designed that they have the minimum necessary transmission loss.

Factors which dominate transmission performance are as follows:

Analog System:

- transmission loss (Loudness Rating)
- stability
- attenuation distortion
- circuit noise
- singing, near-singing
- echo
- crosstalk
- propagation time

Digital System:

- error (bit error rate)
- slip
- jitter, wander
- propagation time
- quantizing distortion
- quantizing noise
- echo

(5) Translation of RE into LR

The maximum normal Reference Equivalent (RE) for Uganda is translated into Loudness Rating (LR) values as follows:

$$SLR = CSRE - 5 = 21 - 5 = 16 \text{ (dB)}$$

$$RLR = CRRE - 5 = 12 - 5 = 7 \text{ (dB)}$$

(ITU-T Rec. G.111)

ITU-T recommends LR values for international and national networks as follows:

Table 6-1-5 LR values for Network

	SLR (Send LR)	CLR (Circuit LR)	RLR (Receive LR)	OLR (Overall LR)
Traffic-weighted mean values:				
long term	7-9	0-0.5	1-3	8-12
short term	7-15	0-0.5	1-6	8-21
Maximum values for an average-sized country	16.5		13	
Minimum value	-1.5			

(Source: ITU-T Rec. G.111)

(6) Bit Error Ratio (BER)

Error performance on an ISDN network and a digital international network is arranged according to ITU-T Rec. G.821. The following BERs and intervals are referred to the recommendation as the objectives to be achieved.

- (a) a BER of less than  $1 \times 10^{-6}$  for  $T_0 = 1$  minute;
- (b) a BER of less than  $1 \times 10^{-3}$  for  $T_0 = 1$  second;
- (c) zero errors for  $T_0 = 1$  second (equivalent to the concept of error free seconds EFS).  
( $T_0$ ... time interval)

(7) Other Impairments of Transmission

Group-delay distortion and circuit noise should be considered as other transmission impairments. Limits to these impairments are recommended in ITU-T Rec. G.133 and G.123.

#### 6.1.4 Synchronization Plan

Synchronization in bit timing is required of switching systems and transmission systems. The network synchronization system should be so designed that slip rates encountered can be negligible for transmission quality of the telephone traffic. The switching system proposed should be capable of acting as a node in the synchronization system of the digital network, and if required, acting as the primary source (master) for timing and synchronization.

Since the digital network will develop and a number of separated digital areas will be integrated into a complete digital network, it can be said that the master slave method will be the most convenient synchronization method for the network in Uganda. The national master clock with an extremely high accuracy and stability is to be used as the reference for network synchronization at the ISC.

Presently, the highest level - NSC - is being equipped with cesium clock. Its frequency will not be affected by surrounding exchanges. For example, NSC is synchronized according to the pre-synchronous concept.

On the next lower hierarchical level, all transit exchanges such as ASC should be mutually synchronized with the single-ended control, connected to the NSC with unilateral link. In the case of failure of the master clock or the link from it, the ASC's level remains mutually synchronized. In the areas where there is a meshed network, it should be possible to introduce mutual synchronization with the single-ended control.

### 6.1.5 Numbering Plan

In any numbering system for a telecommunications network, each subscriber line must be given a number which is unique to that line. This subscriber number usually consists of a limited number of digits for practical reasons, e.g., a long number is not easily remembered and, therefore, often results in dialling error.

Basically a complete national telephone number consists of two parts.

- an individual number which identifies a subscriber in a numbering plan area (NPA) and
- a national code number which identifies the particular NPA in which a subscriber is located.

#### (1) Present Numbering Plan

By the present numbering plan in Uganda, national numbers are composed of trunk prefix "0" + trunk code + subscriber number, and is of 6, 7 or 8 digits form depending on area.

- **Trunk prefix:** The digit required to be dialled by a calling subscriber, when making a trunk call from outside of his number plan area. This provides access to the automatic trunk equipment. Digit "0" is used.
- **Trunk code:** The digits which identify the called number plan area within a country composed of 2 or 3 digits. First digit "4" indicates Uganda within East African countries and second digit "1"- "9" indicate ASC area.
- **Subscriber number:** The number required to be dialled to reach a subscriber in the same NPA.

Present numbering plans for the existing automatic exchanges are listed in Table 6-1-6, and special service numbers in Kampala, Jinja and Mbale exchanges are listed in Table 6-1-7.

Table 6-1-6 Present Trunk Codes and Local Numbers in Uganda  
(As of October 1993)

ASC Area	Trunk Code	Local Exchange	Local Number	Capacity	Total* Dialed Digits
Kampala	41	Kampala Central (E10B)	23XXXX-25XXXX	15,000	8
Kampala	41	Kampala Central (C400)**	330XXX-334XXX	5,000	8
Kampala	41	Lubowa	200XXX	600	8
Kampala	41	Mbuya	22XXXX	3,000	8
Kampala	41	Nsambya	26XXXX	3,000	8
Kampala	41	Mukono	290XXX	600	8
Kampala	41	Mengo	27XXXX	3,600	8
Kampala	41	Makerere	53XXXX-55XXXX	5,000	8
Kampala	41	Kawempe	56XXXX	1,500	8
Kampala	41	Kymbogo	28XXXX	1,000	8
Kampala	44	Lugazi	48XXXX	100	7
Kampala	46	Mityana	2XXX	1,000	6
Kampala	464	Mubende	4XXX	1,000	7
Kampala	42	Entebbe	20XXX-21XXX	1,200	7
Jinja	43	Jinja	20XXX-22XXX	2,400	7
Jinja	43	Kakira	41XXX	100	7
Jinja	495	Iganga	2XXX	800	7
Mbala	45	Mbale (SXS)	2XXX	800	6
Mbala	45	Mbale (C23)	3XXX	780	6
Mbala	45	Tororo	4XXX	1,000	6
Mbala	45	Nakaloke	82XXX	100	7
Masaka	481	Masaka	20XXX-21XXX	2,000	8
Mbarara	485	Mbarara	20XXX-21XXX	2,000	8
Mbarara	485	Bushenyi	42XXX	1,000	8
Mbarara	486	Kabale	22XXX-24XXX	3,000	8
Mbarara	486	Rukungiri	42XXX	1,000	8
F.Portal	493	F.Portal	2XXX	600	7
F.Portal	493	Kasese	4XXX	1,000	7

Table 6-1-7 Present Special Service Numbers in Uganda

Service	Kampala City	Jinja	Mbale
Directory Enquiry	901	991	91
Time - English	903	---	---
Time - Swahili	904	---	---
Telegram	990	990	90
Enquiries about Telephone Call	992	992	92
Fault	997	997	97
Enquiries about Post Office Service	256151	992	92
Fire, Police, Ambulance	---	997	---
Enquiries about STD Dialling Code	900	900	0

## (2) Modified Numbering Plan

The UPTC has modified its national numbering plan since 1986 without considering the plans adopted in neighboring countries (East African countries). The modified plan has omitted the digit "4" between the area code and the national access code. This plan was to be introduced by the end of 1992, but not yet realized due to the regulation of neighboring countries.

An outline of the modified plan is as follows:

- The national number is composed of Access Code "0" + Area Code + Subscriber Number(include Exchange Code).
- The Area Code appears in Table 6-1-8.
- The Subscriber Number is composed of 6 digits, including Exchange Code of 2 digits.
- Special Service Codes are composed of 3 digits as "9XX" and international service codes are "09XX". The special service code appears in Table 6-1-9.

Table 6-1-8 Modified Area Codes in Uganda (in future)

Area Code	ASC
1	Kampala
2	----
3	Jinja
4	Masaka, Mbarara
5	Mbale
6	Fort Portal
7	Gulu
8	Neighboring Country
9	International Operator

Table 6-1-9 Modified Special Service Numbers (in future)

Service	Codes	Charge
<b>National:</b>		
Assistance Operator	900	Free
Directory Enquiry	901	Free
Enquiries about Telephone call	902	Free
----	991	
----	992	
Time (English)	993	Local
Time (Swahili)	994	Local
Announcement (General)	995	Local
Faultman's Test Desk	996	Free
Fault Report	997	Free
Faultman's Ring Back	998	Free
Emergency (Fire, Police, Ambulance)	999	Free
Telegram	990	Local
<b>International:</b>		
Booking ISD Call	0900	Free
Operator for Call Progress or Enquiry	0901	STD
Directory Enquiry	0902	Free
----	0903	
----	0904	
Booking Not ISD Call	0905	Free

## (3) TELEX Numbering Plan

The present TELEX numbering plan in Uganda is based on 5 digits form. First digit "6" indicates Uganda within East African countries and second digit "0"--"9" indicates ASC area or Region. Present TELEX numbering plan appears in Table 6-1-10.

Table 6-1-10 TELEX Numbering Plan

"AB" Code*	Area
61	Kampala, TASS**
62	----
63	----
64	Jinja
65	----
66	Mbale
67	----
68	Masaka
69	North Region
60	West Region

\* National Numbering: "ABXXX"

\*\* TASS: Telegraph Automatic Switching System



### 6.1.6 Charging Plan

The called number and the duration of a call are indispensable information to determine the relevant charge to be applied. A simple relationship between the numbering scheme and the charging system to be employed is required.

#### (1) STD Call Charging

The periodic pulse metering system is employed throughout the Uganda Telecommunications Network for both local and trunk calls. This will also apply to the calls to neighboring countries, except originating call from manual boards. To all international destinations, other than the specified neighboring countries, detailed billing will be applied.

The duration system is employed depending on the distance between two exchanges concerned; each metering unit fee is Shs 50 and unit fee for a coin box call is Shs 100, effective from June 1992 to-date. The STD calls charge appears in Table 6-1-11.

Table 6-1-11 STD Call Charge (as of December 1993)

Distance Between Exchange	Charge Letter	Period for Unit Fee	
		Full	Cheap
Up to 30 km	L *	6 Mins.	12 Mins.
30 - 60 km	A	30 Secs.	60 Secs.
60 - 150 km	B	15 Secs.	30 Secs.
150 - 230 km	C	10 Secs.	20 Secs.
230 - 350 km	D	7.5 Secs.	15 Secs.
350 - 510 km	E	6 Secs.	12 Secs.
510 - 700 km	F	5 Secs.	10 Secs.
Over 700 km	G	4.28 Secs.	8.56 Secs.
Semi-International	I	3 Secs.	6 Secs.

\* : Including Local Calls

- Note :
- Full Rate Period ... Monday to Friday 7.00 to 18.00  
Saturday 7.00 to 14.00
  - Cheap Rate Period ... Exclusive of Full Rate Period
  - Unit Fee of Ordinary Line ... Shs 50
  - Unit Fee of Coin Box ... Shs 100

## (2) Operator Controlled Call Charging

The Local Call charge is Shs 50 for each 6 minutes. The charge of a manual trunk call excluding Charge Letter "L" (distance is up to 30 Km) is based on the 3 minutes duration and is also dependent on the distance between exchanges. The operator toll ticketing system is employed for operator controlled calls. Table 6-1-12 presents the existing manual call charging per each period of 3 minutes and every additional 1 minute. The charges of coin box calls are twice these values.

Table 6-1-12 Operator Controlled Call Charge  
(as of December 1993)

Distance Between Exchange	Charge Letter	3 Minutes		Additional 1 Minutes	
		Full Rate	Cheap	Full Rate	Cheap
Up to 30 km	L *				
30 - 60 km	A	300	150	100	50
60 - 150 km	B	600	300	200	100
150 - 230 km	C	900	450	300	150
230 - 350 km	D	1,200	600	400	200
350 - 510 km	E	1,500	750	500	250
510 - 700 km	F	1,800	900	600	300
Over 700 km	G	2,100	1,050	700	350
Semi- International	I	2,400	1,200	800	400

Note : - Full Rate Period ----- Monday to Friday 7.00 to 18.00  
Saturday 7.00 to 13.00  
- Cheap Rate Period ----- Exclusive of Full Rate Period  
\* : - Charge for Local Call (include up to 30 km) is Shs 50 for each 6 minutes.  
- Coin Box Call is Shs 100 for each 6 minutes.

## (3) Other Charges

The telephone connection charges, telephone rental charges and special facilities charges are shown in Table 6-1-13 and Table 6-1-14.

Table 6-1-13 Telephone Connection and Rental Charges  
(as of December 1993)

(Unit : Shs)

Distance from the Exchange (km)	Connection Charge		Rental Charge (per month)		
	Automatic Exchange	Manual Exchange	Exclusive Line	Additional and Auxil.	Shared & Two Party
Basic Charge (less than 5.2)	21,250	11,050	800	665	400
5.2 - 5.6	21,765	13,725	865	865	505
5.6 - 6.0	25,490	16,300	845	845	525
6.0 - 6.4	29,245	18,870	975	975	540
6.4 - 6.8	33,315	21,445	1,025	1,025	560
6.8 - 7.2	37,405	24,020	1,070	1,070	575
7.2 - 7.6	41,855	26,595	1,135	1,135	595
7.6 - 8.0	45,985	29,165	1,190	1,190	620
8.0 - 8.4	50,095	31,740	1,245	1,245	635
8.4 - 8.8	54,225	34,315	1,300	1,300	655
8.8 - 9.2	58,335	36,885	1,350	1,350	670
9.2 - 9.6	62,445	38,460	1,410	1,410	685
9.6 - 10.0	66,575	42,035	1,465	1,465	705
Over 10.0 (each 400 m)	7,720	4,805	185	185	95

Table 6-1-14 Special Facilities Charge by Exchanges  
(as of December 1993)

(per Month)

Service	Charge (equivalent of US\$)	Applied Exchanges *
Hotline	4.00	DI1
Detailed Billing	4.00	DI1
Temporary Transfer	Free	DI1
Abbreviated Dialling	6.00	DI1
Alarm Call Charge	1.00	DI1
Conference Call	6.00	DI1
Registered Call	4.00	DI1
Do Not Disturb	Free	DI1
Malicious Call Tracing	2.00	DI1
Home Location Meter	1.00	DI1, DI2
Priority Line Rental	4.00	DI1
Out-going Calls	2.00	DI1, DI2, XB1
In-coming Calls	2.00	DI1, DI2, XB1
Restriction on Trunk and IDD Calls	Free	DI1, DI2

- \* DI1... Kampala central, Makerere, Mukono, Mbuya, Nsambya, Lubowa, Kawempe and Kabale  
 DI2... Masaka and Mbarara  
 XB1... All Cross Bar (C400 and C23)

- (4) **TELEX Charging:** The present TELEX Service charge is shown in Table 6-1-15. Operator position for TELEX Service is Kampala.

Table 6-1-15 TELEX Service Charge (as of December 1993)

Type	Unit		Charge (Shs)
Automatic Call		Within 3 minutes	120
		Additional 1 minute	40
Operator Controlled Call	0-60 km from Kampala Central	Each 1 minute (Charge Letter A)	80
	61-230 km from Kampala Central	Each 1 minute (Charge Letter B)	160
	231-530 km from Kampala Central	Each 1 minute (Charge Letter C)	230
Connection Charge	Within 5.2 km		75,000
	Extra charge for each 400 m exceeding 5.2 km		2,500
Rental Charge per Month	Per month		15,000
Deposit for Teleprinter	Ordinary		500,000
	Model T1200 BS		750,000
	Model T1200 SD		500,000

- (5) **Telegraph Charging:** The telegraph charge is shown in Table 6-1-16.

Table 6-1-16 Telegraph Services Charge

Class of Telegram	Unit	Charge (Shs)
Ordinary Telegram	Word	20
Urgent telegram	Word	40
Deluxe Service	Sheet	140
Press (Ordinary I)	40 Words	40
Press (Ordinary II)	Extra 10 Words	20
Press (Urgent)	First 10 Words	80
Radio Telegram (I)	First 10 Words	240
Radio Telegram (II)	Extra 1 Word	40

## 6.2 Telephone Traffic Forecast

### 6.2.1 Traffic Forecast Method

A traffic forecasting is one of the most essential processes in the network planning. Accurate estimates of traffic are required to dimension the optimum capacity of switching and transmission systems. The traffic forecast methods vary depending on requirements of accuracy on planning stages.

#### (1) General Method for Detail Design

The most accurate estimate is required in the detail design for project implementation. The popular method for this purpose is founded in the GAS 10 Handbook "Planning Data and Forecasting Methods" by ITU-T. The basic flow of this forecasting method is shown in Figure 6-2-1 below.

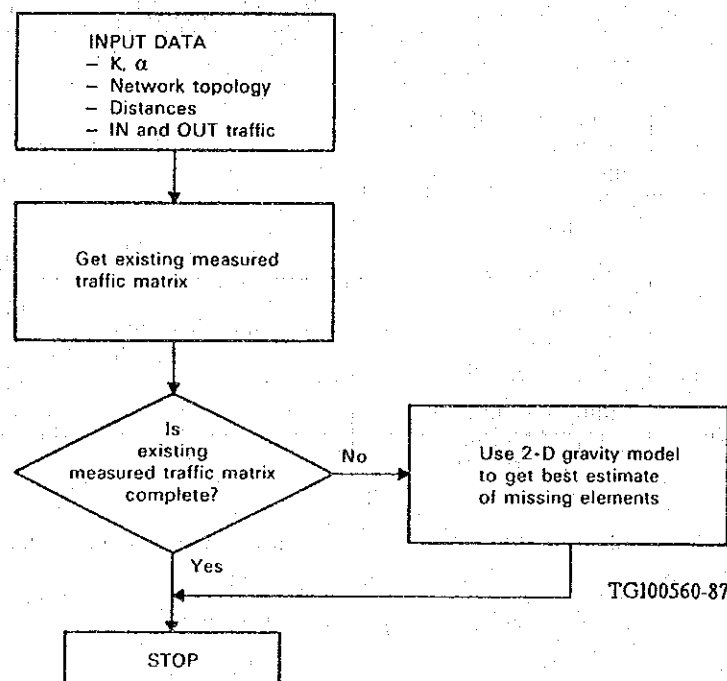


Figure 6-2-1 Traffic Forecast Flow in Detail Design

For the traffic forecast by this method, the complicate process is required using the actual traffic data in each town. The estimated results will not be so useful in the long term planning because traffic characteristics may change with the network expansion in future.

## (2) Specific Method for Master Plan

In this Master Plan Study, the simplified traffic forecast method was applied. This specific method consists of the following:

- a) Estimate of traffic between GSAs (group switching areas) by the "regression model" based on the traffic data between major exchanges.
- b) Estimate of traffic within GSAs by the "classified calling rate" based on UPTC standard.

This method will present the telephone traffic on a sufficient level to plan the capacity of trunk/junction transmission links in future. The general flow of this method is shown in Figure 6-2-2.

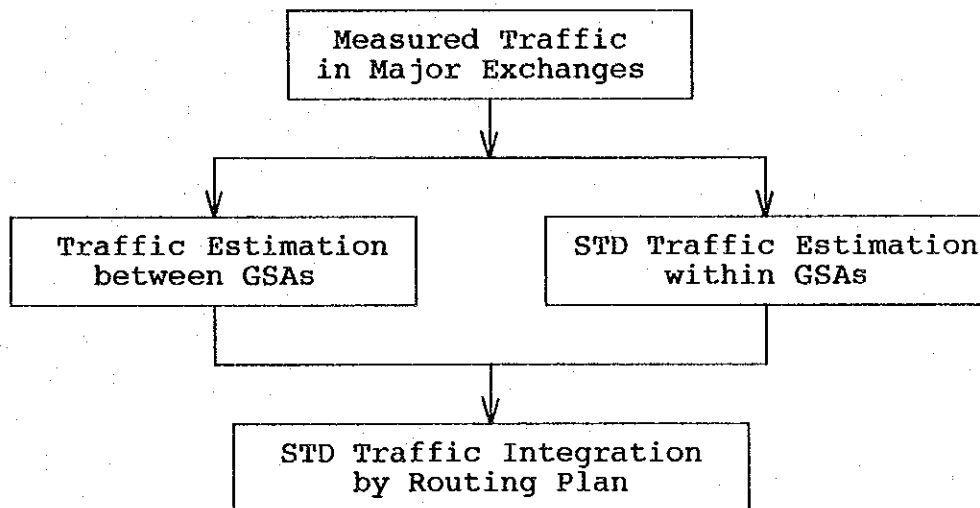


Figure 6-2-2 Traffic Forecast Flow for Master Plan

## 6.2.2 Existing Telephone Traffic

### (1) 24-hour Traffic Profiles

The average evolution of a traffic load depending on the time of a day is called "24-hour traffic profile". For national traffic, the traffic profile depends on characteristics of the subscribers (business/residential) and the exchanges (size of a town, etc.). International traffic profile is different from national traffic profile. Figure 6-2-3 shows the traffic profile at Kampala TSU (national/international) in 1992.

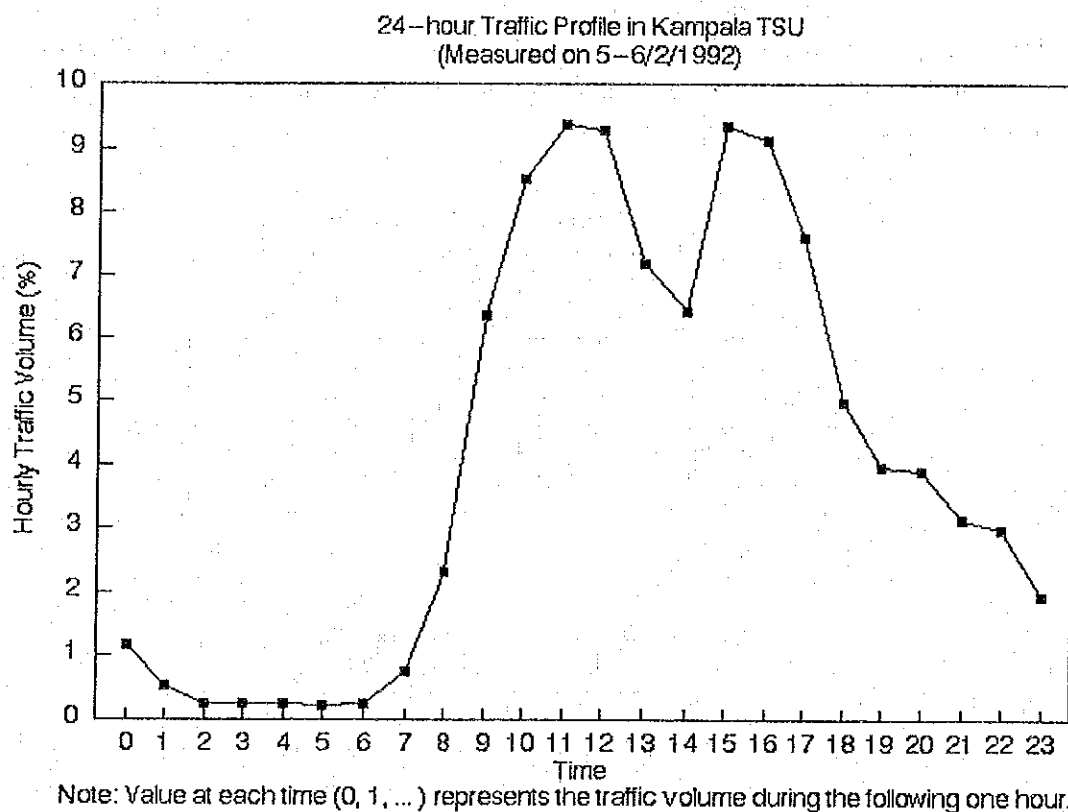


Figure 6-2-3 24-hour Traffic Profile at Kampala TSU  
(Total of National and International)

The busy hour is at around 11 o'clock in the morning and 3 o'clock in the afternoon. The traffic volume in each busy hour is 9.5% of the daily total. This profile is similar to other countries where telecommunications network is underway.

## (2) Busy Hour Traffic

The originating and incoming traffic per subscriber in the busy hour at 10 existing automatic exchanges is shown in Table 6-2-1.

Table 6-2-1 Traffic (OG+IC) per Subscriber at Existing Exchanges

Exchange Name	Type of Switch	Switch Capacity (lines)	Working Subs. (lines)	Traffic/sub (OG+IC) (Erl)
Kampala GSC	E10B	15,000	9,225	0.080
Makerere GSC	E10B	5,000	687	0.085
Masaka GSC	HDX10	2,000	553	0.084
Mbarara GSC	HDX10	2,000	885	0.050
Mbale GSC	C23	780	417	0.054
	SxS	800	261	0.060
Kasese	C23	1,000	230	0.070
Fort-Portal	C23	600	443	0.060
Mityana	C23	1,000	178	0.030
Iganga	C22	800	202	0.076
Tororo	C23	1,000	331	0.050

Depending on the growth of economic activities in Uganda, the traffic per subscriber will increase during the master plan period. It is proposed to adopt the figures shown in Table 6-2-2 for the network design .

Table 6-2-2 Traffic per Subscriber for Planning

Exchange	Traffic (OG+IC) at Present (Erl/Sub)	Traffic (OG+IC) in Future (Erl/Sub)
Kampala	0.08	0.14
Others	0.06	0.12



## (3) STD Traffic Share

The STD traffic share at the existing automatic exchanges is listed in Table 6-2-3 below.

Table 6-2-3 STD Traffic Share at Existing Exchanges

Exchange	Local Call (%)	STD Call (%)
Kampala E10B GSC	66.9	33.1
Makerere E10B	82.3	17.7
Entebbe C400	43.8	56.2
Mbarara HDX10	39.3	60.7
Masaka HDX10	26.3	73.7
Fort Portal C23	48.1	51.9
Mbale C23	24.5	75.5
Kabale FETEX 150	41.2	58.8
Tororo C23	44.1	55.9
Kasese C23	27.4	72.6
Iganga C22	24.5	75.5
Mityana C23	45.8	54.2

Considering growth of subscribers in each exchange, the traffic mix will change during the master plan period. It is proposed to adopt uniform figures for network design as shown in Table 6-2-4.

Table 6-2-4 Traffic Mix for Planning

Area	Traffic Mix (%)			
	Local Call		STD Call	
	Current	Future	Current	Future
Kampala Area	70	80	30	20
Major 16 Ex. Area (6 ASC & 10 EO)	40	65	60	35
Other Local Exchange	35	40	65	60

### 6.2.3 Traffic Estimation for Master Plan

#### (1) Traffic between Major Exchanges

The long distance telephone traffic volume between major exchanges (all MSUs excluded Mukono and Luwero) is basically related to three factors, such as, the numbers of subscribers in both areas and the distance between both areas as shown below.

$$T_{ij} = k \times S_i^a \times S_j^b \times D_{ij}^c$$

$T_{ij}$ : Traffic between area-i and area-j (Erl)

k: Constant

$S_i$ : Number of subscribers in area-i

$S_j$ : Number of subscribers in area-j

$D_{ij}$ : Distance between area-i and area-j (km)

a, b, c: Coefficient for each factor

Based on the traffic data between major automatic exchanges, the following regression models were obtained:

$$T_{ij} = k \times S_i^{0.492} \times S_j^{0.485} \times D_{ij}^{0.124} + \text{Adj}$$

R square = 0.75

k: 0.0072 for Kampala in/out

0.003 for other areas

Adj: Adjustment for specific sections

This regression is illustrated in Figure 6-2-4. Example of the estimated results is shown in Table 6-2-5 for year 2009/2010. The result for each development phase is presented in the SUPPORTING DOCUMENT.

(Automatic, Apr - Sep 1993)

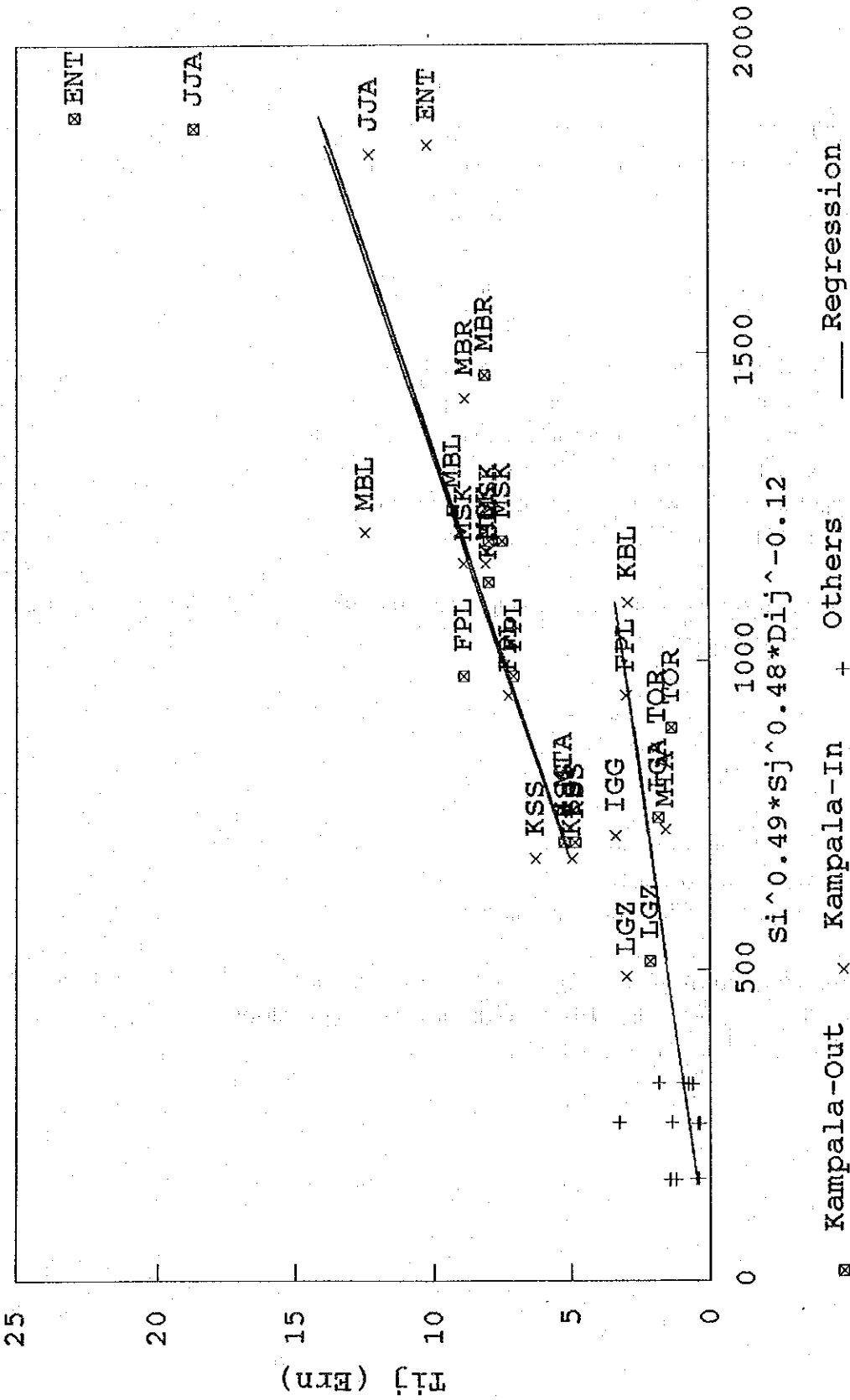


Figure 6-2-4 Long Distance Telephone Call Traffic

No. To	No. From	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	Traffic /Sub	
No. To	No. From	KLA	ENT	MTA	MSK	JJA	IGA	MBL	SRI	MOT	TOR	GLU	LRA	AUA	FPL	MDI	MBR	KBA	Total	Traffic /Sub	
1	Kampala	79,276	5,913	3,609	8,102	14,991	4,168	6,576	2,883	987	3,727	3,067	4,165	4,351	7,219	3,045	8,090	4,590	164,099	0.010	
2	Entebbe	86.7	---	6.5	9.2	12.4	6.4	7.5	5.0	2.8	5.7	4.9	5.9	5.7	7.7	5.2	8.3	6.0	185.6	0.035	
3	Mityana	59.1	6.5	---	7.7	9.9	5.1	6.1	4.1	2.3	4.6	4.1	4.9	4.8	6.5	4.4	6.9	5.0	142.2	0.039	
4	Masaka	80.4	9.2	7.6	---	13.9	7.3	8.7	5.8	3.3	6.7	5.9	7.0	7.0	9.7	6.2	10.8	7.7	197.1	0.024	
5	Jinja	119.4	12.3	9.8	13.9	---	12.4	13.1	8.6	4.7	10.1	8.2	9.9	9.4	12.2	8.4	13.0	9.5	275.0	0.018	
6	Iganga	59.4	6.4	5.1	7.3	12.5	---	7.4	4.7	2.6	5.7	4.4	5.4	5.0	6.5	4.5	6.9	5.1	149.1	0.036	
7	Mbale	68.3	7.5	6.1	8.7	13.2	7.4	---	6.1	3.4	7.7	5.5	6.7	6.2	7.9	5.5	8.4	6.2	174.8	0.027	
8	Soroti	19.2	5.0	4.1	5.9	8.7	4.8	6.2	---	2.3	4.5	3.9	4.9	4.3	5.4	3.8	5.7	4.2	92.6	0.032	
9	Moroto	10.6	2.8	2.3	3.3	4.8	2.6	3.4	2.3	---	2.5	2.2	2.7	2.5	3.1	2.1	3.2	2.4	52.9	0.054	
10	Tororo	21.9	5.7	4.6	6.7	10.2	5.7	7.7	4.5	2.5	---	4.1	5.0	4.7	6.0	4.1	6.4	4.7	104.6	0.028	
11	Gulu	18.8	4.9	4.2	5.9	8.3	4.4	5.5	3.9	2.2	4.1	---	5.1	4.9	5.7	4.1	5.8	4.3	92.2	0.030	
12	Lira	22.6	5.9	4.9	7.0	10.0	5.4	6.7	4.9	2.6	5.0	5.1	---	5.4	6.6	4.8	6.8	5.0	108.6	0.026	
13	Arua	21.7	5.7	4.8	7.0	9.5	5.0	6.2	4.3	2.5	4.7	4.8	5.4	---	6.9	4.8	6.9	5.1	105.4	0.024	
14	F.Portal	68.9	7.7	6.5	9.7	12.3	6.5	7.9	5.4	3.1	6.0	5.6	6.5	6.9	---	6.0	10.0	7.3	176.2	0.024	
15	Masindi	19.8	5.2	4.5	6.3	8.5	4.5	5.5	3.8	2.1	4.1	4.1	4.8	4.8	6.0	---	6.1	4.5	94.7	0.031	
16	Mbarara	75.9	8.2	6.9	10.8	13.1	6.9	8.4	5.6	3.2	6.4	5.8	6.8	6.9	10.0	6.1	---	8.4	189.4	0.023	
17	Kabale	53.8	6.0	5.0	7.7	9.6	5.1	6.2	4.2	2.4	4.7	4.3	5.0	5.1	7.3	4.4	8.4	---	139.2	0.030	
Total Traffic		806.6	171.7	140.7	196.2	288.9	147.7	177.2	91.9	52.1	103.9	91.5	108.0	104.8	175.3	94.0	189.4	138.1	3,057.9		
Total/Subs.		0.010	0.032	0.039	0.024	0.018	0.035	0.027	0.032	0.053	0.028	0.030	0.026	0.024	0.024	0.031	0.023	0.023	0.030	0.019	

## (2) STD Traffic from/to Lower Hierarchy Exchange

Traffic Estimations of RSU - MSU and some MSU (Mukono, Luwero) - ASC are calculated using basic data (Traffic per Subscriber for planning, mix for planning) shown in Paragraph 6.2.2.

STD (Subscriber Trunk Dialling) traffic from/to lower hierarchy exchange all flow to/from the closest higher ranking exchange, so the following formula leads the traffic estimation.

Traffic = Traffic per subs. x STD call ratio x subs. No. of lower exchanges

The result of estimation is shown in Table 6-2-6.

## (3) Junction Traffic in Kampala Multi-Exchange Area

Junction traffic in Kampala multi-exchange area is calculated by distributing out-going and in-coming traffic with subscribers ratio as below:

$$T_{ij} = T_i \times \frac{S_j}{\Sigma S} = T_k \times M_l \times S_i \times \frac{S_j}{\Sigma S}$$

where,

- $T_{ij}$  : Traffic between area-i to area-j (OG + IC) (Erlang)
- $S_i$  : Number of Subscribers in area-j
- $S_j$  : Number of Subscribers in area-j
- $\Sigma S$  : Whole Number of Subscribers in Kampala MEA
- $T_i$  : Whole Traffic from/to area-i
- $T_k$  : Traffic per Subscriber for planning (OG + IC) (Erlang)
- $M_l$  : Local call ratio

The result of estimation is shown in Table 6-2-7.

Table 6-2-6 STD Traffic from/to MSUs and RSUs

ASC	No.	Major 17 MSU	Other MSU/RSU	OG/IC Traffic Per Sub.	Year 2000		Year 2005		Year 2010				
					Covered Subs. No.	OG/IC Traffic	Covered Subs. No.	OG/IC Traffic	Covered Subs. No.	OG/IC Traffic			
Kampala	1	Kampala C.	Lubowa	A	734	20.6	1,066	29.8	1,532	42.9			
			Kyambogo	A	1,971	55.2	2,863	80.2	4,115	115.2			
			Mbuya	A	2,103	58.9	3,055	85.5	4,390	122.9			
			Nsambya	A	2,070	58.0	3,005	84.1	4,320	121.0			
			Mengo	A	4,227	118.4	6,139	171.9	8,823	247.0			
			Makerere	A	4,061	113.7	5,898	165.1	8,477	237.4			
			Kawempe	A	2,242	62.8	3,256	91.2	4,680	131.0			
			Kasangati	C	363	26.1	1,244	89.6	1,629	117.3			
			Matuga	C	0	0.0	544	39.2	713	51.3			
			Naddangira	C	0	0.0	650	46.8	851	61.3			
			Mukono	C	222	16.0	834	60.0	1,873	134.9			
			Kayunga	C	228	16.4	763	54.9	1,379	99.3			
			Luwero	C	87	6.3	203	14.6	720	51.8			
			Bombo	C	85	6.1	187	13.5	499	35.9			
			Nakasongola	C	33	2.4	250	18.0	350	25.2			
Wobulenzi	C	107	7.7	242	17.4	672	48.4						
Kampala	2	Mityana	Kiboga	C	50	3.6	354	25.5	529	38.1			
			Mubende	C	236	17.0	562	40.5	800	57.6			
Kampala	3	Entebbe	Mpigi	C	285	20.5	611	44.0	800	57.6			
Jinja	4	Jinja	Bulkwe	C	4	0.3	439	31.6	673	48.5			
			Kakira	C	44	3.2	511	36.8	731	52.6			
			Kamuli	C	124	8.9	535	38.5	766	55.2			
			Lugazi	C	226	16.3	550	39.6	814	58.6			
			Nikokonjeru	C	4	0.3	224	16.1	332	23.9			
			Nyenga	C	129	9.3	315	22.7	466	33.6			
			Jinja	5	Iganga	Bugiri	C	46	3.3	376	27.1	523	37.7
						Kaliro	C	35	2.5	250	18.0	359	25.8
			Mbale	6	Mbale	Kapchorwa	C	226	16.3	305	22.0	450	32.4
						Kumi	C	143	10.3	318	22.9	496	35.7
Pallisa	C	105				7.6	259	18.6	371	26.7			
Mbale	7	Tororo		Busia	C	370	26.6	771	55.5	977	70.3		
				Malaba	C	104	7.5	217	15.6	440	31.7		
Mbale	8	Moroto		Kotido	C	84	6.0	112	8.1	419	30.2		
Mbale	9	Soroti											
Masaka	10	Masaka	Kalisizo	C	33	2.4	202	14.5	294	21.2			
			Kyotera	C	39	2.8	344	24.8	500	36.0			
			Lukaya	C	15	1.1	139	10.0	187	13.5			
			Lyantonde	C	0	0.0	255	18.4	372	26.8			
			Nabusanké	C	0	0.0	49	3.5	311	22.4			
			Rakai	C	88	6.3	123	8.9	178	12.8			
Mbarara	11	Mbarara	Bushenyi	C	394	28.4	809	58.2	2,064	148.6			
			Kabwohe	C	107	7.7	256	18.4	357	25.7			
			Ntungamo	C	167	12.0	392	28.2	540	38.9			
			Rubaare	C	0	0.0	268	19.3	370	26.6			
			Rwashamiré	C	0	0.0	286	20.6	395	28.4			
	Mbarara	12	Kabale	Kisoro	C	164	11.8	401	28.9	567	40.8		
				Rukungiri	C	232	16.7	337	24.3	777	55.9		
Fort Portal	13	Fort Portal	Kagadi	C	169	12.2	390	28.1	564	40.6			
			Kasese	C	905	65.2	2,244	161.6	2,745	197.6			
Fort Portal	14	Masindi	Holima	C	493	35.5	607	43.7	1,235	88.9			
Gulu	15	Gulu											
	16	Arua	Moyo	C	111	8.0	244	17.6	553	39.8			
			Nebbi	C	213	15.3	664	47.8	877	63.1			
			Aboke	C	2	0.1	589	42.4	813	58.5			
17	Lira	Apac	C	207	14.9	501	36.1	701	50.5				
		Kitgum	C	203	14.6	456	32.8	931	67.0				
Total													

Note : OG/IC Traffic per Sub. ...A : 0.028 Erl/Sub.

B : 0.042 Erl/Subs.

C : 0.072 Erl/Subs.

Table 6-2-7 Junction Traffic in Kampala Multi Exchange Area

(0.056 ent./Sub)

(2000)

Subs.	16,411	734	1,971	2,103	4,227	2,070	2,242	4,061	33,819
	Kampala C.	Lubowa	Kyambogo	Mbuya	Mengo	Nsambya	Kawempe	Makerere	Total
Kampala C.	446.0	19.9	53.6	57.1	114.9	56.3	60.9	110.4	919.0
Lubowa	19.9	0.9	2.4	2.6	5.1	2.5	2.7	4.9	41.1
Kyambogo	53.6	2.4	6.4	6.9	13.8	6.8	7.3	13.3	110.4
Mbuya	57.1	2.6	6.9	7.3	14.7	7.2	7.8	14.1	117.8
Mengo	114.9	5.1	13.8	14.7	29.6	14.5	15.7	28.4	236.7
Nsambya	56.3	2.5	6.8	7.2	14.5	7.1	7.7	13.9	115.9
Kawempe	60.9	2.7	7.3	7.8	15.7	7.7	8.3	15.1	125.6
Makerere	110.4	4.9	13.3	14.1	28.4	13.9	15.1	27.3	227.4
Total	919.0	41.1	110.4	117.8	236.7	115.9	125.6	227.4	1893.9

(2005)

Subs.	23,833	1,066	2,863	3,055	6,139	3,005	3,256	5,898	49,115
	Kampala C.	Lubowa	Kyambogo	Mbuya	Mengo	Nsambya	Kawempe	Makerere	Total
Kampala C.	647.6	29.0	77.8	83.0	166.8	81.7	88.5	160.3	1334.6
Lubowa	29.0	1.3	3.5	3.7	7.5	3.7	4.0	7.2	59.7
Kyambogo	77.8	3.5	9.3	10.0	20.0	9.8	10.6	19.3	160.3
Mbuya	83.0	3.7	10.0	10.6	21.4	10.5	11.3	20.5	171.1
Mengo	166.8	7.5	20.0	21.4	43.0	21.0	22.8	41.3	343.8
Nsambya	81.7	3.7	9.8	10.5	21.0	10.3	11.2	20.2	168.3
Kawempe	88.5	4.0	10.6	11.3	22.8	11.2	12.1	21.9	182.3
Makerere	160.3	7.2	19.3	20.5	41.3	20.2	21.9	39.7	330.3
Total	1334.6	59.7	160.3	171.1	343.8	168.3	182.3	330.3	2750.4

(2010)

Subs.	34,253	1,532	4,115	4,390	8,823	4,320	4,680	8,477	70,590
	Kampala C.	Lubowa	Kyambogo	Mbuya	Mengo	Nsambya	Kawempe	Makerere	Total
Kampala C.	930.8	41.6	111.8	119.3	239.8	117.4	127.2	230.3	1918.2
Lubowa	41.6	1.9	5.0	5.3	10.7	5.3	5.7	10.3	85.8
Kyambogo	111.8	5.0	13.4	14.3	28.8	14.1	15.3	27.7	230.4
Mbuya	119.3	5.3	14.3	15.3	30.7	15.0	16.3	29.5	245.8
Mengo	239.8	10.7	28.8	30.7	61.8	30.2	32.8	59.3	494.1
Nsambya	117.4	5.3	14.1	15.0	30.2	14.8	16.0	29.1	241.9
Kawempe	127.2	5.7	15.3	16.3	32.8	16.0	17.4	31.5	262.1
Makerere	230.3	10.3	27.7	29.5	59.3	29.1	31.5	57.0	474.7
Total	1918.2	85.8	230.4	245.8	494.1	241.9	262.1	474.7	3953.0

## (4) Regional Traffic from/to Neighboring Countries

Estimation of regional traffic from/to neighboring countries (Kenya, Tanzania) has been done using regression method. It is assumed that regional traffic is represented by Kampala-Nairobi and Kampala-Dar es Salam traffic. The following formula have been obtained based on recent traffic data, the number of subscribers and the distance between respective areas. Basic data for the calculation is shown in SUPPORTING DOCUMENTS.

$$T_{ij} = 0.000198 \times S_i + 0.000329 \times S_j - 0.00851 \times D_{ij}$$

(R square = 0.997)

where,

- $T_{ij}$  : Traffic Between area-i and area-j (Erlang)  
 $S_i$  : Number of subscribers in area-i  
 $S_j$  : Number of subscribers in area-j  
 $D_{ij}$  : Distance between area-i and area-j (km)

The result of estimation is shown in Table 6-2-8.

Table 6-2-8 Regional Telephone Call Traffic Estimation

No.	Year	Section Out	Section In		Subs (Out) $S_i$	Subs (In) $S_j$	Section Distance $D_{ij}$ (km)	Estimated $T_{ij}$ (Erl)
1	1993	Kampala	KPL Nairobi	NAR	12,782	118,383	500	37.18
1	2000	Kampala	KPL Nairobi	NAR	33,819	307,796	500	103.60
1	2005	Kampala	KPL Nairobi	NAR	49,115	461,694	500	157.21
1	2010	Kampala	KPL Nairobi	NAR	70,590	646,371	500	222.16
2	1993	Kampala	KPL D'Salaam	DAR	12,782	40,915	1,100	6.61
2	2000	Kampala	KPL D'Salaam	DAR	33,819	106,379	1,100	32.29
2	2005	Kampala	KPL D'Salaam	DAR	49,115	159,569	1,100	52.80
2	2010	Kampala	KPL D'Salaam	DAR	70,590	223,396	1,100	78.02
3	1993	Nairobi	NAR Kampala	KPL	118,383	12,782	500	23.35
3	2000	Nairobi	NAR Kampala	KPL	307,796	33,819	500	67.70
3	2005	Nairobi	NAR Kampala	KPL	461,694	49,115	500	103.15
3	2010	Nairobi	NAR Kampala	KPL	646,371	70,590	500	146.72
4	1993	D'Salaam	DAR Kampala	KPL	40,915	12,782	1,100	2.93
4	2000	D'Salaam	DAR Kampala	KPL	106,379	33,819	1,100	22.78
4	2005	D'Salaam	DAR Kampala	KPL	159,569	49,115	1,100	38.32
4	2010	D'Salaam	DAR Kampala	KPL	223,396	70,590	1,100	58.00



## 6.3 Trunk Circuit Calculation

### 6.3.1 Circuit Calculation Method

Calculation of the necessary number of trunk circuits is based on the estimated traffic in Chapter 6.2. The whole country area is divided into 17 exchange areas (present GSAs and some EO areas), and the number of circuits between respective exchange areas is calculated. The calculation procedure is as follows:

- a) A direct route is established for each route of which estimated traffic volume exceeds 20 erlang.
- b) 90% of the whole traffic over such route is allotted to the said route itself, while 10% is allotted to the final route.
- c) The necessary number of channels of each direct route is calculated, based on the traffic volume thus allotted, by applying Erlang-B formula (G.O.S.  $B=0.01$ ).
- d) A unit for the digital transmission line is 30 channels (2M bps x 1) and, therefore, the odd number of channels are rounded off. Then the traffic corresponding to the number of channels rounded off is allotted to the final route.
- e) Traffic for the final route, i.e., 10% of the whole traffic and the traffic mentioned in d) above is combined at seven ASCs (Area Switching Centers).
- f) For the traffic matrix among the seven ASCs, the above procedures a) through e) are taken again. Then traffic of ASCs for the final route is allotted via Kampala NSC (National Switching Center).

For exchanges which are lower in hierarchy than the above 17 exchanges, no direct route to connect them with each other is considered. All the traffic of these exchanges is allotted to the final routes and the odd number of channels are rounded up to 30 channels (2M bps x 1).

For the routes between exchanges in the Kampala multi exchange area, the number of channels is calculated, based on STD traffic and local traffic from/to other exchanges, by applying Erlang-B formula.

6.3.2 Circuit Calculation for 17 Exchange Areas

The number of circuits between each two exchanges in year 2009/2010 is calculated, adopting the above mentioned procedures based on the estimated traffic volume in Chapter 6.2. The calculated result is shown in Table 6-3-1.

Contents of each cell is as below:

Legend:

		4 MSK 8,102	
1. Kampala		(A)159.5	
		(B)143.6	(C)15.9
		(D)163	
		(E)150	
		(F)130.6	(G)28.9

- (A) Whole traffic (OG + IC) between Kampala MSU and Masaka MSU (Erlang)
- (B) 90% volume of above (A) (Erlang)
- (C) 10% volume of above (B) (Erlang)
- (D) The number of circuits corresponding to (B) traffic (Erlang-B formula) (Channels)
- (E) The number of circuits rounded by 30 Channels unit (Channels)
- (F) Traffic volume corresponding to above (B) Channels (Erlang) ... Direct route traffic
- (G) (A) - (F) traffic volume (Erlang) ... Final route traffic

Figure 6-3-1 Legend for Table 6-3-1 and Table 6-3-2

Then, above final route traffic (G) is combined at ASCs and traffic matrix between ASC areas is shown in Table 6-3-2. Contents in each cell is the same as above. Figure 6-3-2 shows proposal of transmission network configuration based on the above calculation in year 2010.





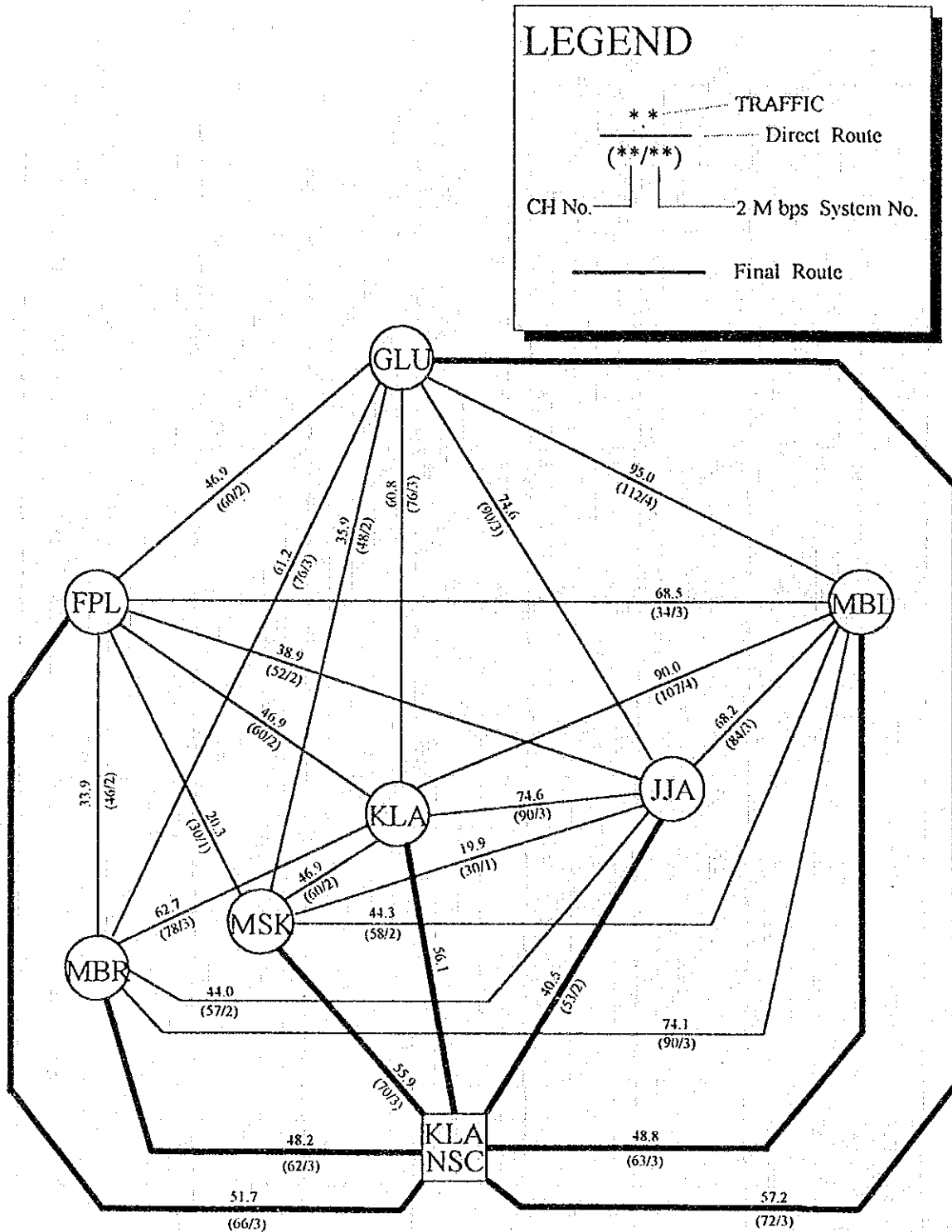


Figure 6-3-2 Traffic and the Number of Circuits Between Each ASC (Year 2010)

### 6.3.3 Circuit Calculation for Lower Hierarchy Exchanges

Trunk circuits from/to lower hierarchy exchanges than 17 exchanges are all via final routes, and the routes are all to/from higher hierarchy exchanges. Number of the circuits are summarized in Table 6-3-3.

There will be three (3) main switching units in the Kampala multi exchange area: Kampala central, Makerere and Mengo. Eight (8) exchanges (3 MSUs and 5 RSUs) be connected by star type network configuration basically. The required number of circuits is shown in Table 6-3-4 and Figure 6-3-3.

Table 6-3-3 STD Traffic and the Number of Circuits in Major 17 MSU areas

ASC	No.	Major 17 MSU	Other MSU/RSU	OG/IC Traffic Per Sub.	Year 2010		CH No. (Erl-B: B-0.01)	2Mbps (30CH) System No.						
					Covered Subs. No.	OG/IC Traffic								
Kampala	1	Kampala C.	Lubowa	A	1,532	42.9	Consider in another table							
			Kyambogo	A	4,115	115.2								
			Mbuya	A	4,390	122.9								
			Nsambya	A	4,320	121.0								
			Mengo	A	8,823	247.0								
			Makerere	A	8,477	237.4								
			Kawempe	A	4,680	131.0								
			Kasangati	C	1,629	117.3			140	5				
			Matuga	C	713	51.3			65	3				
			Naddangira	C	851	61.3			76	3				
			Mukono	C	1,873	231.9*			254	9				
			Kayunga	C	1,379	99.3			120	5				
			Luwero	C	720	159.7*			180	6				
			Bombo	C	499	35.9			48	2				
			Nakasongola	C	350	25.2			36	2				
Wobulenzi	C	672	48.4	62	3									
Kampala	2	Mityana	Kiboga	C	529	38.1	51	2						
			Mubende	C	800	57.6	72	3						
			Entebbe	C	800	57.6	72	3						
Jinja	4	Jinja	Bulkwe	C	673	48.5	62	3						
			Kakira	C	731	52.6	67	3						
			Kamuli	C	766	55.2	70	3						
			Lugazi	C	814	58.6	73	3						
			Nikokonjeru	C	332	23.9	35	2						
			Nyenga	C	466	33.6	46	2						
			Jinja	5	Iganga	Bugiri	C	523	37.7	50	2			
						Kaliro	C	359	25.8	37	2			
						Mbale	6	Mbale	Kapchorwa	C	450	32.4	44	2
									Kumi	C	496	35.7	48	2
Pallisa	C	371	26.7	38	2									
Mbale	7	Tororo	Busia	C	977	70.3	86	3						
			Malaba	C	440	31.7	44	2						
			Moroto	C	419	30.2	42	2						
Mbale	9	Soroti												
Masaka	10	Masaka	Kalisizo	C	294	21.2	32	2						
			Kyotera	C	500	36.0	48	2						
			Lukaya	C	187	13.5	22	1						
			Lyantonde	C	372	26.8	38	2						
			Nabusanke	C	311	22.4	33	2						
			Rakai	C	178	12.8	21	1						
Mbarara	11	Mbarara	Bushenyi	C	2,064	148.6	170	6						
			Kabwohe	C	357	25.7	37	2						
			Ntungamo	C	540	38.9	52	2						
			Rubaare	C	370	26.6	38	2						
			Rwashamalre	C	395	28.4	40	2						
			Mbarara	12	Kabale	Kisoro	C	567	40.8	54	2			
						Rukungiri	C	777	55.9	70	3			
Fort Portal	13	Fort Portal	Kagadi	C	564	40.6	53	2						
			Kasese	C	2,745	197.6	219	8						
Fort Portal	14	Masindi	Hoima	C	1,235	88.9	110	4						
Gulu	15	Gulu												
			Gulu	16	Arua	Moyo	C	553	39.8	53	2			
						Nebbi	C	877	63.1	78	3			
			Gulu	17	Lira	Aboke	C	813	58.5	73	3			
						Apac	C	701	50.5	64	3			
Kitgum	C	931				67.0	82	3						
Total														

Note: OG/IC Traffic per Sub. ...A : 0.028 Erl/Sub.

B : 0.042 Erl/Subs.

C ; 0.072 Erl/Subs.

(\*) ... STD Traffic from/to RSU Is Combined.

Table 6-3-4 STD/Local Traffic and the Number of Circuits in Kampala Multi Exchange Area

Exchange Name		STD/Sub (OG+IC) (Eri)	Local/Sub (OG+IC) (Eri)	Number of Subs			STD Traffic (OG+IC) (Eri)			Local Traffic (OG+IC) (Eri)			Y-2010 Local + STD OG/IC Traffic (Eri) (*1)		Y-2010 Circuit Number	2Mbps (30Ch) System Number
MSU	RSU	(Eri)	(Eri)	2000	2005	2010	2000	2005	2010	2000	2005	2010	KLA C.-MSU	MSU-RSU		
Kampala C.		0.028	0.112	16,411	23,833	34,253	459.5	667.3	959.1	1,838.0	2,669.3	3,838.3				
	Kyambogo	0.028	0.112	1,971	2,863	4,115	55.2	80.2	115.2	220.8	320.7	460.9	-	549.2	576	20
	Lubowa	0.028	0.112	734	1,066	1,532	20.6	29.8	42.9	82.2	119.4	171.6	-	210.8	233	8
	Mbuya	0.028	0.112	2,103	3,055	4,390	58.9	85.5	122.9	235.5	342.2	491.7	-	584.0	612	21
	Nsanbya	0.028	0.112	2,070	3,005	4,320	58.0	84.1	121.0	231.8	336.6	483.8	-	575.2	603	21
Makerere		0.028	0.112	4,061	5,898	8,477	113.7	165.1	237.4	454.8	660.6	949.4	1,567.3	-	1596	54
	Kawempe	0.028	0.112	2,242	3,256	4,680	62.6	91.2	131.0	251.1	364.7	524.2	-	620.4	648	22
Mengo		0.028	0.112	4,227	6,139	8,823	118.4	171.9	247.0	473.4	687.6	988.2	1,111.7	-	1141	39
Total				23,289	33,822	70,590	652.2	946.9	1,361.1	2,608.3	3,788.2	5,444.8				

<KLA--TRF.WK3>

NOTE : Local = 0.14(E)x80% = 0.112 (E/Subs)  
 STD = 0.14(E)x20% = 0.028 (E/Subs)  
 (\*1) These traffic exclude local traffic within own exchanges.

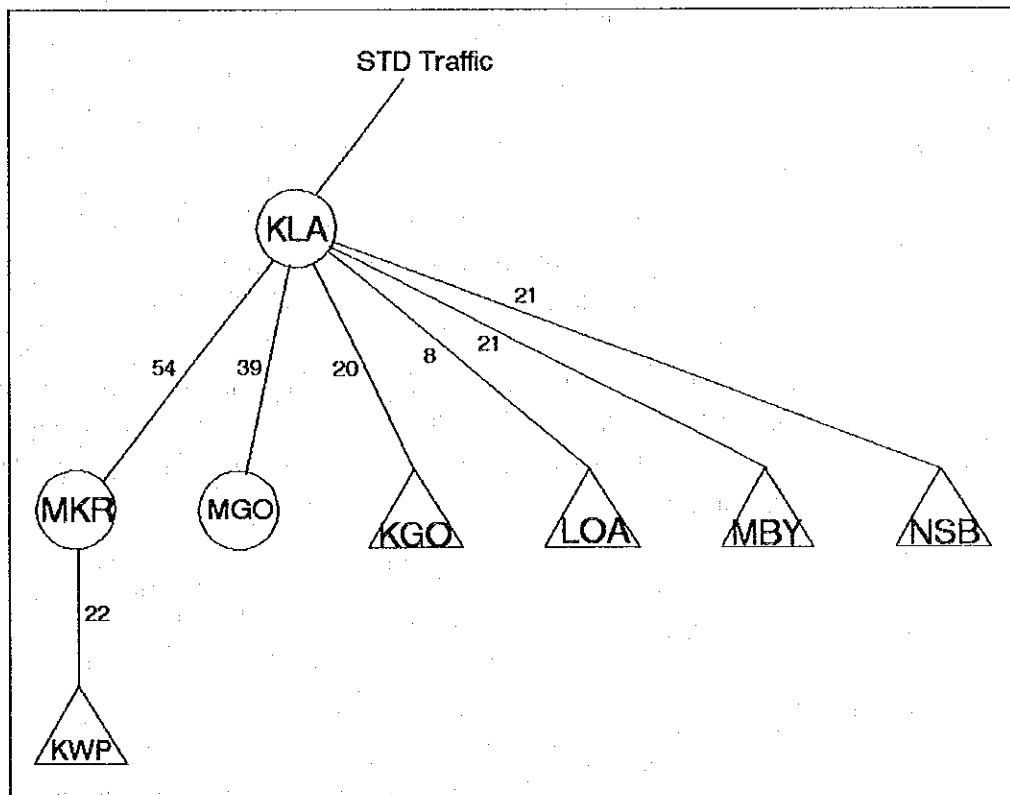


Figure 6-3-3 Required Number of 2M bps Systems in Kampala Multi Exchange Area in Year 2010.



## 6.4 National Network Expansion

### 6.4.1 Telephone Network

#### (1) Whole Network

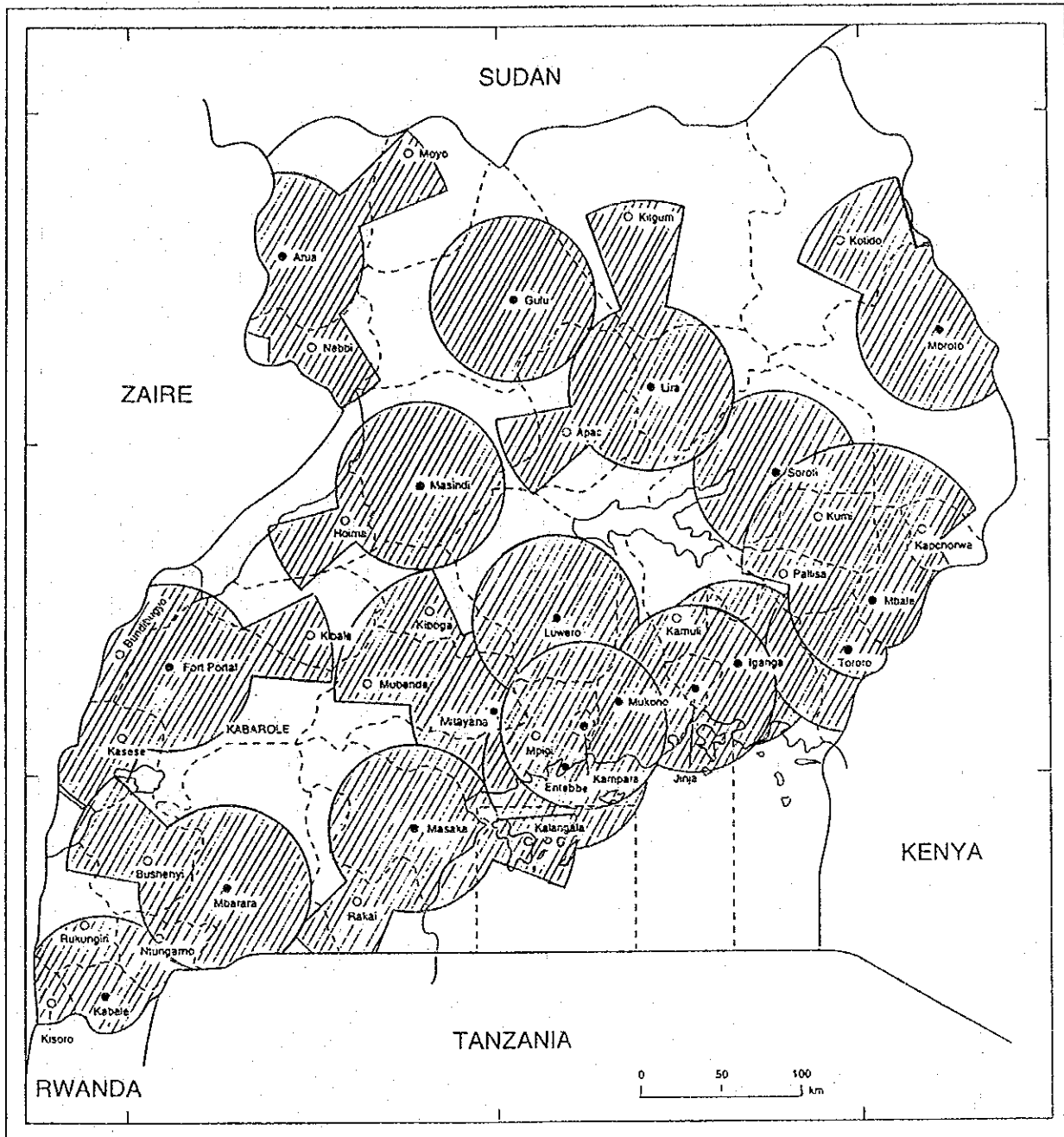
To improve the telephone service in Uganda, many automatic exchanges must be constructed throughout the whole country by year 2010. However, in rural areas, the number of subscribers will not be so large. If the MSU (Main Switching Unit) is installed in such small towns, it will prove to be overinvestment in view of its installation and maintenance costs. Therefore, MSU and RSU locations have been determined with the following concept:

- (a) The whole nation has been divided into 163 sections (Municipalities and counties), and the supply volumes for each section in 2000, 2005 and 2010 have been determined.
- (b) The 163 sections are grouped into 64 areas, centering round relevant district centers and major towns, each to be covered by an exchange or remote unit.
- (c) The type of exchanges to be installed in each covering area is determined, in principle, as follows:
  - a) For each covering area which has more than 2,000 subscribers, an MSU will be installed.
  - b) For each covering area which has more than 1,000 subscribers and is more than 50 Km distant from the nearby MSU, an MSU will be installed. In case the distance from the nearby MSU is less than 50 Km, an RSU will be installed.
  - c) For each covering area which has more than 350 subscribers and is more than 100 Km distant from the nearby MSU, an MSU will be installed. In case the distance from the nearby MSU is less than 100 Km, an RSU will be installed.

Figure 6-4-1 presents location of 39 district centers and coverage by MSUs in 2010 under the above concept.

#### (2) Area Network

Details of the proposed telephone network are presented by district in the SUPPORTING DOCUMENTS.



**LEGEND:**

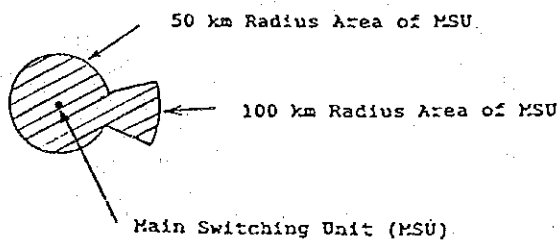


Figure 6-4-1 Location and Coverage of MSUs in 2010

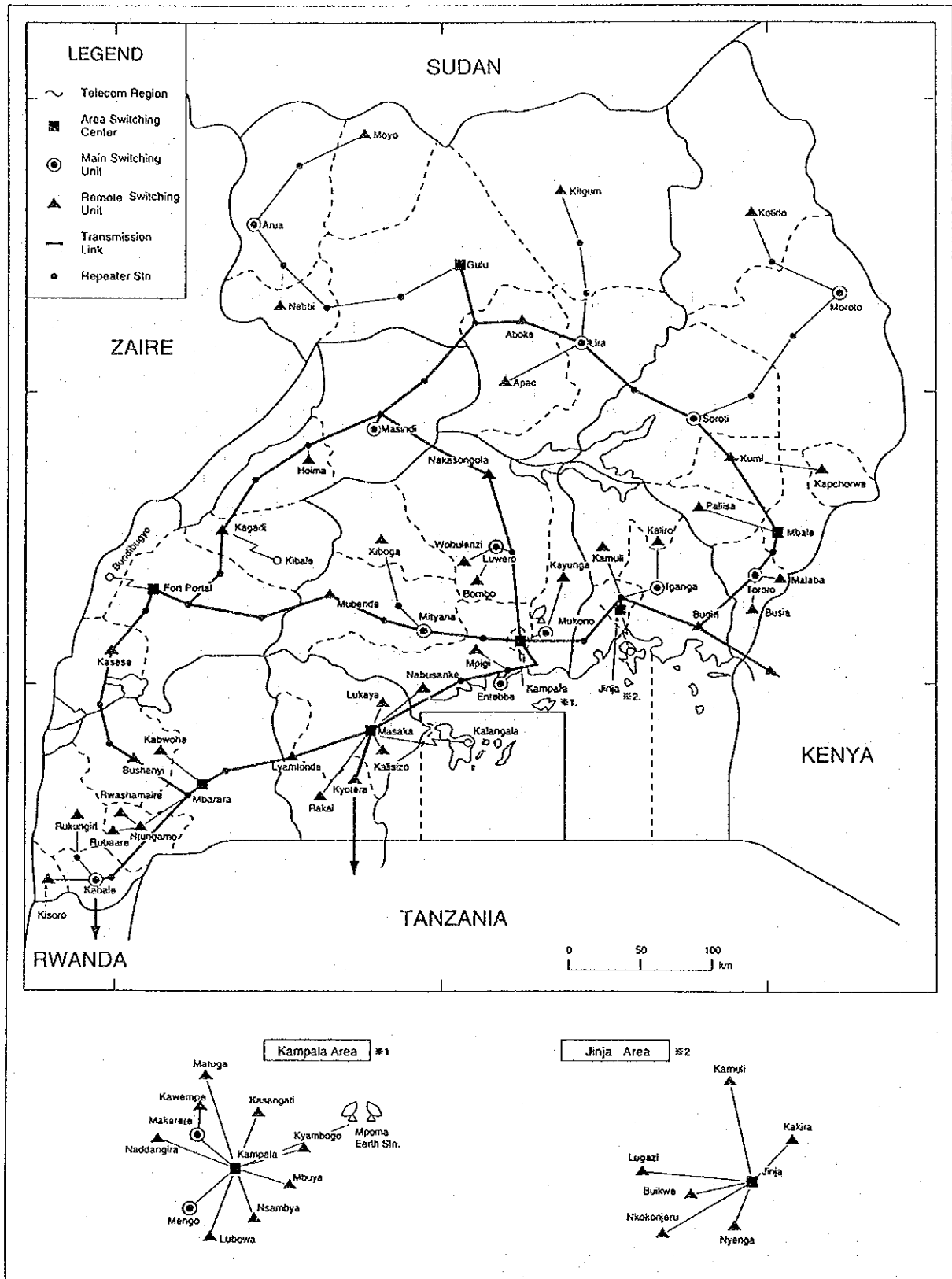


Figure 6-4-2 Telephone Network Plan in 2010

## **CHAPTER 7**

### **NATIONAL NETWORK FACILITIES PLAN**



## CHAPTER 7 NATIONAL NETWORK FACILITIES PLAN

### 7.1 Switching system

A switching system expansion plan is outlined in Figure 7-1-1. Basic concept underlying this expansion plan is that telephone demand which will remain at a level of 84,204 in 1994/1995 will grow to the forecasted 226,841 nearly 2.7 times in 2010 and that the objective fulfillment rate will attain 72% in that year.

At present, five types of automatic switches, i.e., E10B, C400, C23, HDX10 and SxS are operated.

Existing manual exchanges (70 exchanges) will be completely withdrawn and replaced or absorbed by digital switches. Automatization progress in each work phase is shown in Tables 7-1-1 and 7-1-2.

For expansion in the future, it is advisable the same type of switches should be installed in the same area from the viewpoint of spare parts and measuring equipment interchangeability, as well as easy maintenance and standardization.

The expansion plan is presented in the Table 7-1-3.

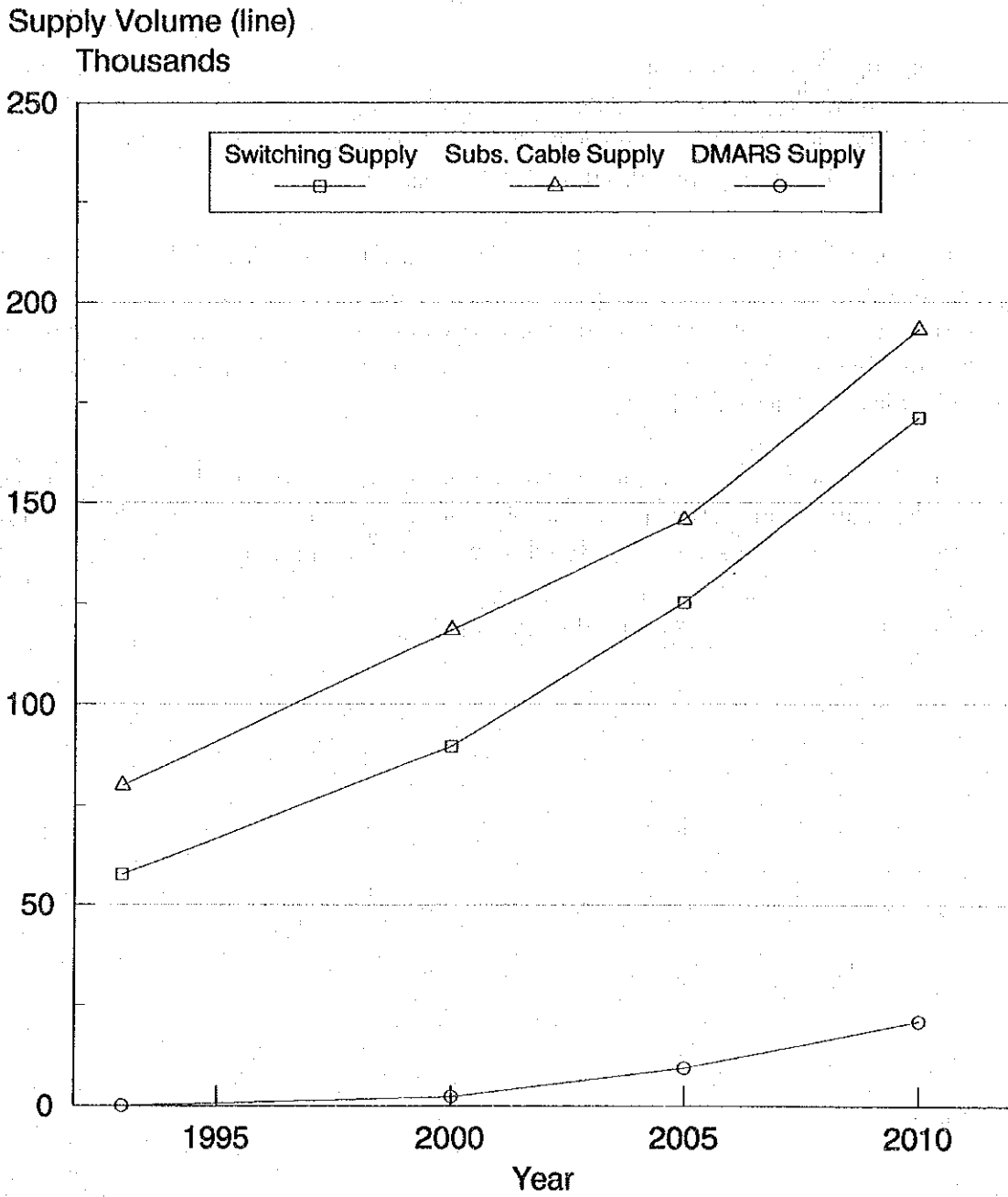


Fig. 7-1-1 Outline of SW system Expansion

Table 7-1-1 Automatized Exchange in Each Phase

ASC	Phase I		Phase II		Phase III	
	Auto (ESS,RSU)	Manual	Auto (ESS,RSU)	Manual	Auto (ESS,RSU)	Manual
Kampala	12	12	23	0	24	0
Jinja	3	9	13	0	13	0
Masaka	1	2	4	0	4	0
Mbarara	5	1	9	0	9	0
Fort Portal	3	0	4	0	4	0
Gulu	10	3	14	0	14	0
Mbale	8	2	10	0	10	0
Total	42	29	77	0	78	0

Table 7-1-2 No. of Exchanges to be automatized and newly established

ASC	Phase I		Phase II		Phase III	
	Automati- zation	Newly Estab- lished	Automati- zation	Newly Estab- lished	Automati- zation	Newly Estab- lished
Kampala	1	1	11			1
Jinja			9	1		
Masaka			2	1		
Mbarara	1		1	3		
Fort Portal	1			1		
Gulu	4		2	2		
Mbale	2		2			
Total	9	1	27	8		1



Table 7-1-3 Summary of Switching System Expansion Plan

ASC	Existing	Phase-I		Phase-II		Phase-III		Total	
		Replace	New	Replace	New	Replace	New	Year 2010	No. of Subs.
Kampala	37,210	(34,940)	47,100	(1,270)	20,400	(1,000)	24,000	91,500	88,198
Jinja	3,970	(3,500)	7,900	(370)	5,900		6,100	19,900	19,099
Mbale	3,640	(3,640)	8,750		2,050		3,800	14,600	14,173
Masaka	2,341			(2,341)	6,500		2,000	8,500	8,102
Mbarara	7,131			(3,031)	5,800	(4,100)	7,900	13,700	12,680
Fort Portal	2,200	(2,200)	6,600		600		3,600	10,800	10,264
Gulu	1,140	(1,010)	7,000	(130)	1,500		3,500	12,000	11,583
Total	57,632	(45,390)	77,350	(7,142)	42,750	(5,100)	50,900	171,000	164,099

Phase-I : 1994/1995 - 1999/2000

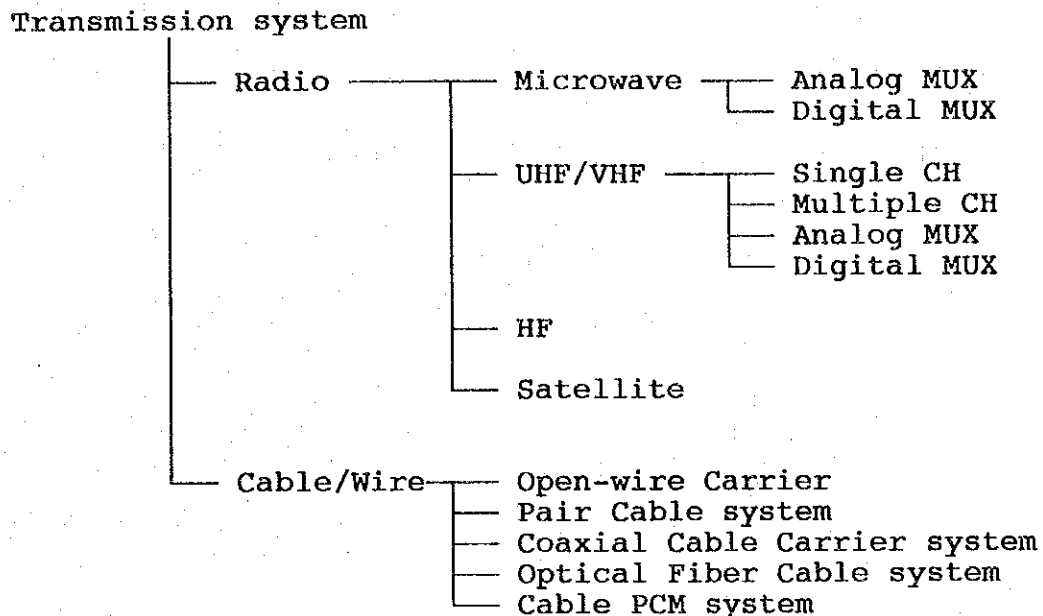
Phase-II : 2000/2001 - 2004/2005

Phase-III : 2005/2006 - 2009/2010

## 7.2 Transmission System

### 7.2.1 Planning Criteria

Transmission systems are generally classified as follows:



Of the above, microwave radio systems, UHF radio systems and Fiber Optic transmission systems are regarded as suitable for trunk transmission links and junction transmission links in view of the transmission capacity, route length and stability.

At present, many analog transmission systems are used. But the future systems should be digital systems which can meet the future demand for ISDN. Existing analog systems will be replaced with digital systems one by one.

For subscribers lines, the following three systems are considered suitable.

- 1) Pair cable systems for urban areas,
- 2) RSU and pair cable systems for the concentrated demand areas, and
- 3) DMARS systems for the dotted demand areas.

An outline of these three systems is shown in Figure 7-2-1.



The development target for the transmission system up to year 2009/2010 is as follows:

- Establishment of a national trunk loop network.
- Realization of a complete digital transmission network.
- Provision of a rural telecommunications network.

### 7.2.2 Radio system

Radio relay transmission systems are adopted for the national trunk network and the junction network.

Microwave radio relay transmission systems which have 140 Mbps, 34 Mbps, 17 Mbps and 8 Mbps capacities are available for backbone links, spur links and junction links.

UHF digital radio transmission systems (6CH/12CH) are available for the small capacity point-to-point radio sections.

Digital Multiple Access Radio Systems (DMARS) are a solution to rural telecommunications problems. The system using the demand assigned multiple access method is suitable to realize telecommunications networks in dotted and few demand areas with the lowest investment cost.

These radio transmission systems are advantageous because they can utilize the existing radio stations and antenna towers.

### 7.2.3 Cable System

140 Mbps/34 Mbps Fiber Optic Transmission Systems (FOTS) and cable PCM systems have been employed for junction links in Kampala. Like this, cable systems should be used for large capacity, short distance transmission links.

### 7.2.4 Trunk Network

A trunk network expansion plan is formulated in consideration of the exchanges provision plan. The studied items are as follows:

- a) Calculation of the required number of trunk circuits in future,
- b) Study of the trunk network structure, and
- c) Study of the suitable transmission systems.

Considering the calculated circuit number, on-going projects and operation and maintenance simplicity, the small- to medium-size capacity microwave radio systems are decided to be employed for the trunk networks in principle.

(1) Backbone Links

The following six backbone links will be required in the near future. These are considered based on the existing transmission routes, future traffic trend and a rough map study.

- a) Kampala - Jinja - Mbale link
- b) Kampala - Masaka - Mbarara link
- c) Mbarara - Kabale - Kigali(Rwanda) link
- d) Kampala - Masindi - Gulu - Lira - Mbale link
- e) Kampala - Mityana - Fort Portal - Kasese - Mbarara link
- f) Masindi - Fort Portal link

Of the above six links, three links of a), b) and c) are existing links. The link a) has been operated for over 20 years and must be replaced urgently. Only the link c) is already digitalized.

Result of the circuit distribution which is calculated in Chapter 6-3 for these six backbone route configurations are shown in Figure 7-2-2 and Table 7-2-1 through Table 7-2-4.

Route diversity will be applied for final route transmission links between Kampala NSC and each ASC. This adds circuit redundancy and in case a transmission link be obstructed, provide a alternative route.

For realizing this network form, at least one of 2 Mbps system (30CH) of transmission links between Kampala NSC and each ASC should be provided with an alternative route.

But, two ASC exchanges of Jinja and Gulu will be linked to the backbone network via spur links as shown in Figure 7-2-2, so they will not be able to set alternative transmission routes like other ASCs. Furthermore, both of Kampala - Mbale link and Kampala - Gulu link will be set through Kololo repeater, and therefore Kampala will also be a bottleneck in Kampala - Mbale - Lira - Gulu - Kampala great loop.



Table 7-2-1 Transmission Route and Required Number of 2 Mbps System (1/4)

(1) KLA-JJA-MBL Route

NSC/ASC Final Route	KLA	Mwiri Rep.						TOR	MBL
		(A)	(B)	(C)	(D)	(E)	(F)		
KLA-NRB		14			14				NRB (Kenya)
KLA-DAR		6			6				DAR (Tanzania)
KLA-JJA		1	1						
KLA-JJA *			1		1	1	1		KLA
KLA-MBL		2			2	2	2		
KLA-GLU *		1			1	1	1		GLU
ASC/ASC Direct Route									
KLA-JJA		3	3						
MSK-JJA	MSK	1	1						
MBR-JJA	MBR	2	2						
GLU-JJA	GLU	3	3						
FPL-JJA	FPL	2	2						
JJA-MBL			3		3	3	3		
KLA-MBL		4			4	4	4		
MSK-MBL	MSK	2			2	2	2		
MBR-MBL	MBR	3			3	3	3		
FPL-MBL	FPL	3			3	3	3		
ASC/EO Final & Direct Route									
JJA-IGA			7	7					
TOR-MBL							6		
KLA-JJA		8	8						
EBB-JJA	EBB	1	1						
MSK-JJA	MSK	1	1						
FPL-JJA	FPL	1	1						
MBR-JJA	MBR	1	1						
JJA-IGA			1	1					
JJA-MBL			1		1	1	1		
JJA-TOR			1		1	1			
KLA-IGA		4		4					
KLA-MBL		5			5	5	5		
KLA-TOR		2			2	2			
KLA-SRI		2			2	2	2		SRI
KLA-MOT		1			1	1	1		MOT
Total Sys. No.		73	38	12	51	31	34		

Note: \_\_\_\_\_ Final Route (A)... KLA-Mwiri Rep. (F)... TOR-MBL  
 \_\_\_\_\_ Direct Route (B)... Mwiri Rep.-JJA  
 \*... Alternative Route (C)... Mwiri Rep.-IGA  
 (D)... Mwiri Rep.-Bugiri Rep.  
 (E)... Bugiri Rep.-TOR

Table 7-2-2 Transmission Route and Required Number of 2 Mbps System (2/4)

(2) KLA-MSK-MBR-KBL Route

		Kyebe Rep. -(C)-		EBB -(E)-			
		KBL -(A)-	MBR -(B)-	MSK -(D)-	Dundu(F)-	KLA	
				Rep.		Rep.	
NSC/ASC Final Route	KGL-KLA	Kigali (Rwanda)	3		3		3
	BKB-KLA	Bukoba (Tanzania)		2	2		2
	MSK-KLA				2		2
	MSK-KLA *	KLA	1				
	MBR-KLA		2		2		2
	FPL-KLA *	FPL	1		1		1
ASC/ASC Direct Route	MSK-KLA				2		2
	MSK-JJA				1		1 JJA
	MSK-MBL				2		2 MBL
	MSK-GLU				2		2 GLU
	MBR-KLA		3		3		3
	MBR-JJA		2		2		2 JJA
	MBR-MBL		3		3		3 MBL
	FPL-MSK	FPL	1				
ASC/EO Final & Direct Route	EBB-KLA					7	7
	KBL-MBR	7					
	EBB-KLA					5	5
	EBB-JJA					1	1 JJA
	MBR-MSK		1				
	MSK-KLA				5		5
	MSK-JJA				1		1 JJA
	MBR-KLA		5		5		5
	MBR-JJA		1		1		1 JJA
	KBA-KLA	4	4		4		4
Total Sys. No.		11	27	2	41	13	54

Note:        Final Route (A)... KBA-MBR (F)... Dundu Rep.-KLA  
       Direct Route (B)... MBR-MSK  
\*... Alternative Route (C)... Kyebe Rep.-MSK (D)... MSK-Dundu Rep.  
(E)... EBB-Dundu Rep.



Table 7-2-3 Transmission Route and Required Number of 2 Mbps System (3/4)

(3) KLA-GLU-MBL Route

		(A) Kigulya Rep.	(B) MDI	(C) Minakulu Rep.	(D) GLU	(E) AUA	(F) LRA	(G) SRI	(H) MOT	(I) MBL	
NSC/ASC Final Route	KLA-GLU	2		2	2						
	KLA-GLU *				1		1	1		1	KLA
	KLA-JJA *	1		1			1	1		1	JJA
	KLA-MBL *	1		1			1	1		1	
ASC/ASC Direct Route	KLA-GLU	3		3	3						
	MSK-GLU	2		2	2						MSK
	JJA-GLU	3		3	3						JJA
	GLU-MBL				4		4	4		4	
	MBR-GLU		MBR	3	3						
	FPL-GLU		FPL	2	2						
ASC/EO Final & Direct Route	AUA-GLU					7					
	GLU-LRA				7		7				
	FPL-MDI		FPL	6							
	SRI-MBL									6	
	MOT-MBL								4	4	
	KLA-MDI	2	2								
	KLA-AUA	2		2	2	2					
	KLA-GLU	2		2	2						
	KLA-LRA	2		2			2				
	SRI-KLA										2
	MOT-KLA									1	1
	Total Sys. No.		20	8	23	31	9	16	7	5	20

Note:        Final Route (A)... KLA-Kigulya Rep. (F)... Minakulu Rep.-LRA  
       Direct Route (B)... Kigulya Rep.-MDI (G)... LRA-SRI  
 \*... Alternative Route (C)... Kigulya Rep.-Minakulu Rep. (H)... SRI-MOT  
 (D)... Minakulu Rep.-GLU (I)... SRI-MBL  
 (E)... GLU-AUA

Table 7-2-4 Transmission Route and Required Number of 2 Mbps System (4/4)

(4) KLA-FPL-MBR Route

		Kigulya				
		MBR - (A)	FPL - (B)	Oruha Rep. - (C)	MTA - (D)	KLA - (E)
NSC/ASC Final Route	FPL-KLA		2		2	2
	FPL-KLA * KLA	1				
	MBR-KLA * KLA	1	1		1	1
	MSK-KLA * MSK	1	1		1	1
ASC/ASC Direct Route	FPL-KLA		2		2	2
	FPL-MBL		3		3	3
	FPL-JJA		2		2	2
	MBR-GLU	3	3	3	GLU	
	FPL-GLU		2	2	GLU	
	MBR-FPL	2				
	MSK-FPL	MSK	1			
	ASC/EO Final & Direct Route	FPL-MDI		6	6	MDI
MTA-KLA					7	
MBR-FPL	1					
FPL-KLA		5		5	5	
FPL-JJA		1		1	1	
MTA-KLA					4	
Total Sys. No.		10	28	11	17	28

Note:   
 Final Route (A)... MBR-FPL  
 Direct Route (B)... FPL-Oruha Rep.  
 (C)... Oruha Rep.-Kigulya Rep.  
 (D)... Oruha Rep.-MTA  
 \*... Alternative Route (E)... MTA-KLA

Here, we study the case of Kampala - Jinja link. To find better solution for this link having the highest trunk call traffic, the following route plans are considered:

- (A) New microwave route under planning:  
Kampala - Kololo rep. - Luyanzi rep. - Mwiri rep. -(spur)- Jinja
- (B) Existing microwave route:  
Kampala - Konge rep. - Ngogwe rep. - Jinja - Mwiri rep. -
- (C) New fiber optic cable route:  
Kampala - Mukono - Lugazi - Jinja
- (D) Adoption of above (A) and (C): (traffic allocation to these two routes)

A comparison study was made for the above four plans from the viewpoints of costs, reliability and problems involved. These plans are ranked in the order of (C), (B), (A) and (D) as summarized in Table 7-2-5. Details of cost estimation are given in the SUPPORTING DOCUMENTS.

The solution for linking to Gulu also be studied in the project implementation stage.

Table 7-2-5 Comparison of the Applications for Kampala-Jinja Transmission Link

	Plan-A	Plan-B	Plan-C	Plan-D
Microwave New route Exist. route Fiber Optic	*	*	*	*
Invest cost (x 1,000 US\$)	3,752	3,238	2,850	5,930
Maint. cost (x 1,000 US\$)	50	50	10	50
Notes	KLA-Kololo F.O. excluded.	KLA-Konge F.O. in- cluded.		Micro - 2 Sys. F.O. - 3 Sys.
Reliability	Poor?	Good	Good	Excellent
Problems involved	No alternative route for Kampala and Jinja.	Access roads to Konge and Ngogwe are poor.	Cable maint. is difficult at a Nile River crossing point.	Expensive in total cost.
Evaluation	3rd	2nd	1st	4th

(2) Spur Links

Microwave radio systems with the capacity of 2, 4 or 8 Mbps and UHF systems with the capacity of 6, 12CH are applied to the spur links.

The route and capacity of major spur links are also shown in Figure 7-2-2 and Table 7-2-1 through Table 7-2-4.

(3) Junction Links

Junction links in Kampala multi exchange area are all FO and cable PCM transmission systems installed recently. Considering the existing numbers of systems and future traffic trend, the number of systems for the existing cable PCM link shall be increased after year 2000. Existing number of systems is illustrated in DATA BOOK, and the required number of systems in year 2010 is shown in Figure 7-2-3.

(4) Other Trunk Links

Other trunk links inside each RTM region should be realized with small capacity radio systems. Trunk link of each MSU-RSU and some MSU-MSU fall under this category. Required link configurations and the numbers of systems are shown in Figure 7-2-3 through Figure 7-2-5. The numbers of systems shown correspond to telephone circuits only and do not include circuits for MSU-RSU control.

Links mentioned in (1) through (4) above are the trunk network links to be required in year 2010.

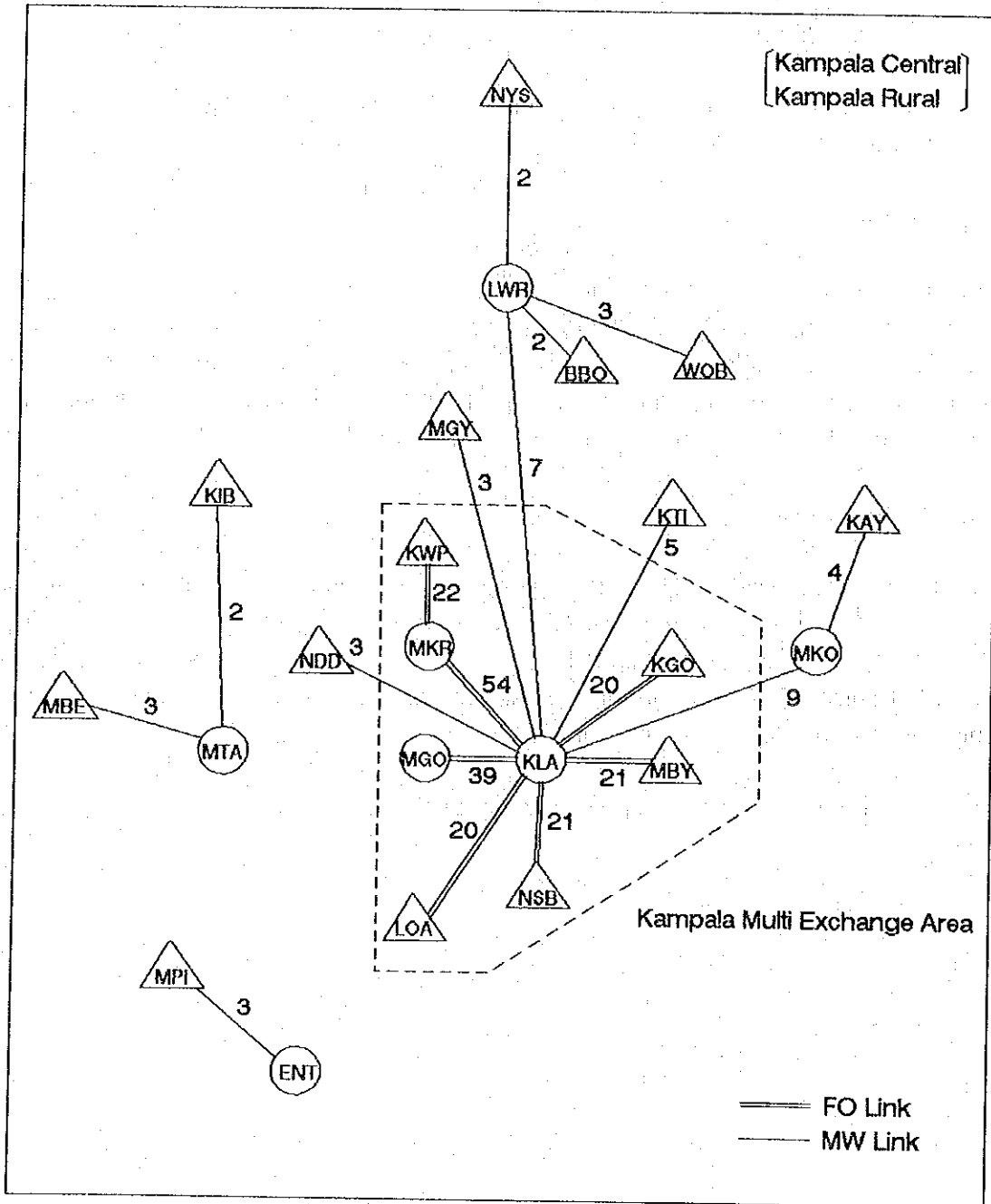


Figure 7-2-3 Required Number of 2 Mbps Systems in Each RTM Area in Year 2010 (1/3)

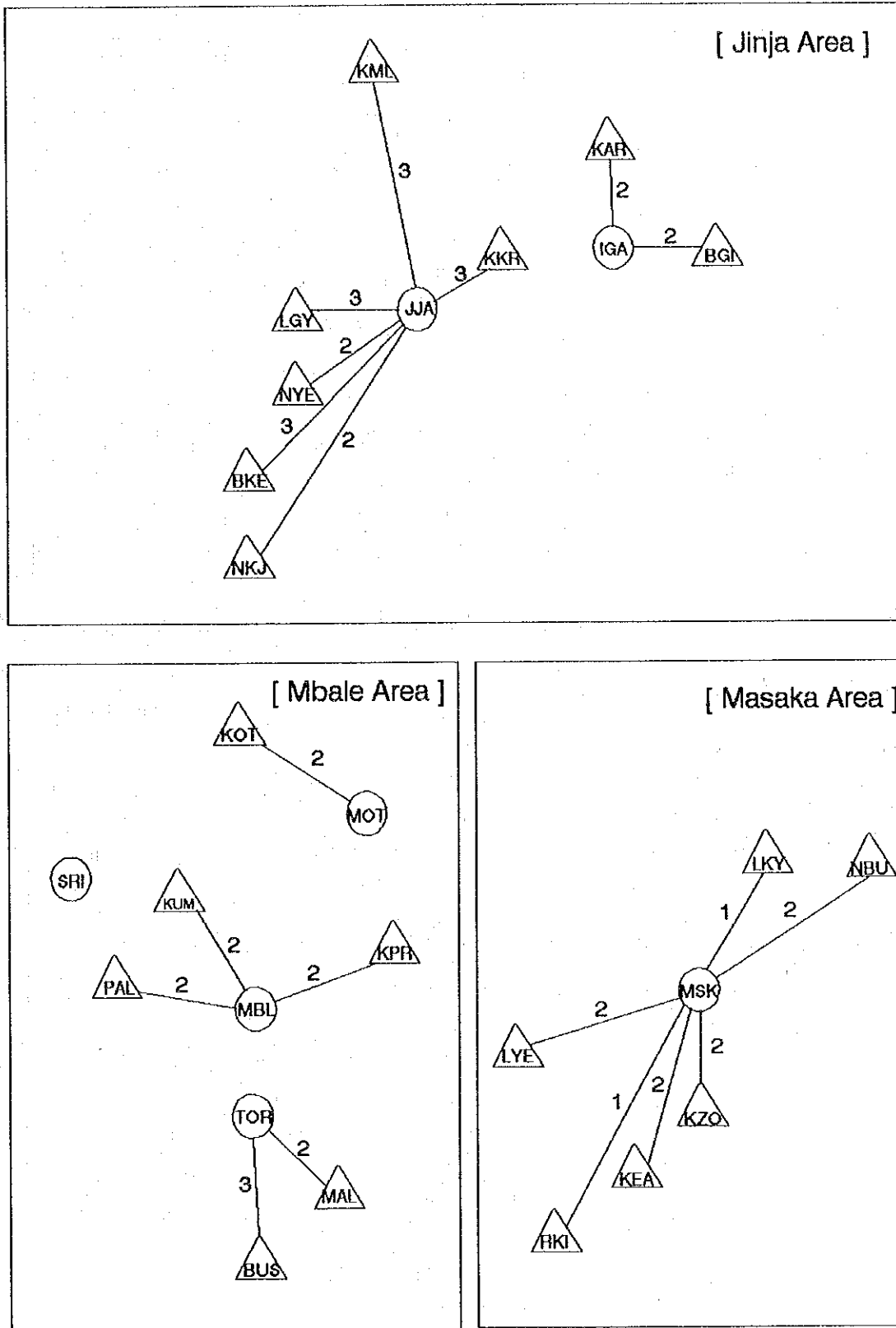


Figure 7-2-4 Required Number of 2 Mbps Systems in Each RTM Area in Year 2010 (2/3)

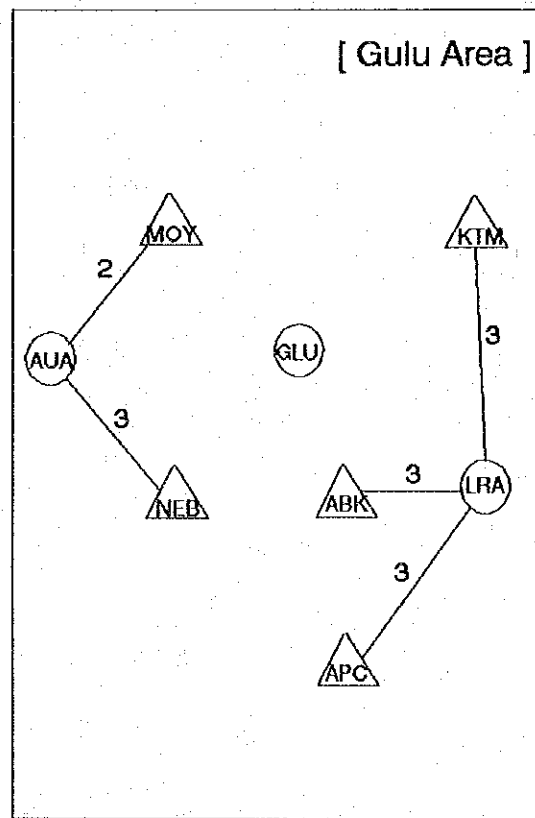
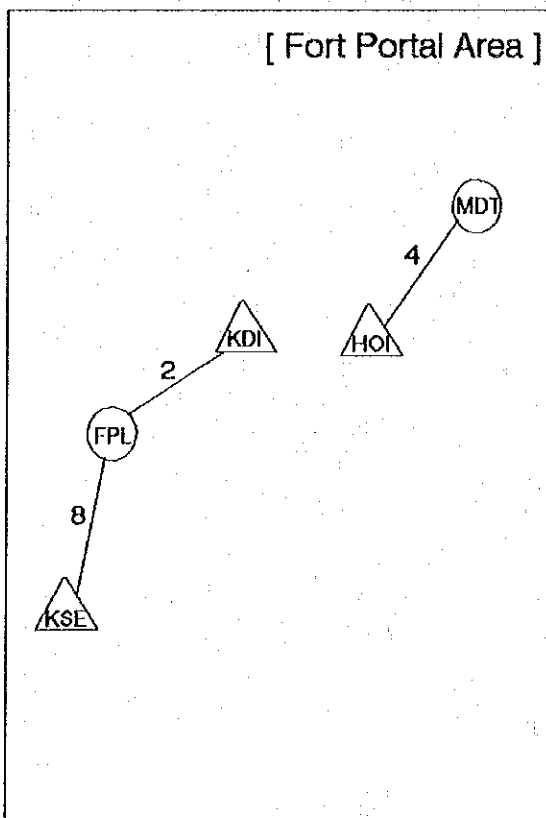
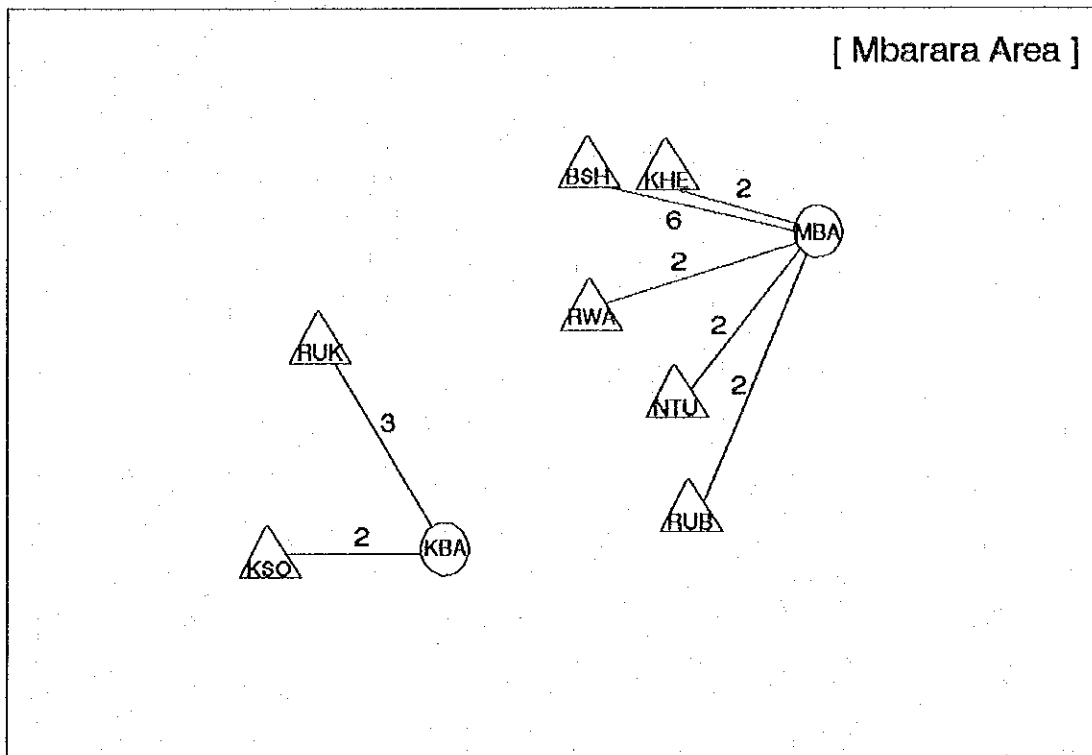


Figure 7-2-5 Required Number of 2 Mbps Systems in Each RTM Area in Year 2010 (3/3)