4.5 Outside Plant

4.5.1 Present State of Existing Telecommunications Cable Network

The telecommunications cable network consists of three (3) elements: subscriber cable networks, service lines including subscriber terminal equipment and trunk/junction cable networks needed to operate and maintain the telecommunication cable network, which is in the responsibility of STE to provide the complete outside plant from the Main Distribution Frame (MDF) to the subscriber's terminal equipment.

4.5.1.1 Subscriber Cable Network

The existing subscriber cable network installed in the study area is basically a flexible network which is composed of primary cables, secondary cables, Cross Connection Cabinets (CCCs), Distribution Points (DPs), and service lines, as illustrated in Figure 4.5.1.1-1.

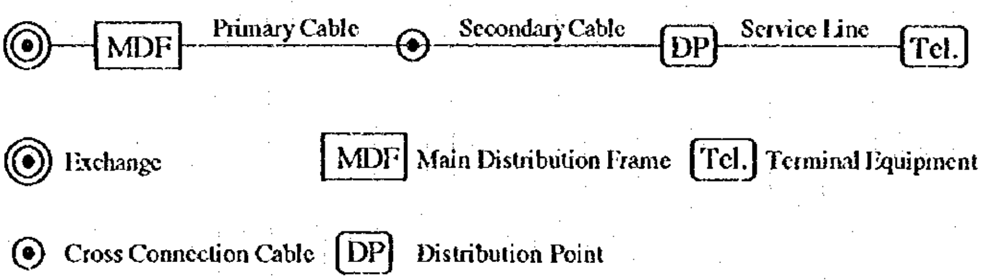


Figure 4.5.1.1-1 Existing Subscriber Cable Network

(1) Main Distribution Frame (MDF)

In the new exchanges, the MDF will be provided together with the switching equipment and placed above the cable vault room. Insulation displacement connector technology will be used for the terminal blocks where primary cable pairs are connected.

In the existing exchanges, soldering type of terminal blocks with tags is used to connect the tie cables installed between the terminal blocks, and to connect the jumper wires to the vertical terminal blocks on the switching side. The lightning arrester for subscriber lines is installed at the MDF.

Table 4.5.1.1-1 shows the present distribution factor, which is the ratio between the number of primary cable pairs and the number of switching line units. It also shows the present occupation rate, which is the ratio between the number of primary cable pairs and the number of connected subscribers.

Table 4.5.1.1-1 Distribution Factor and Occupation Rate

Exchange Name	No. of Line Units (1)	No. of Connected Subscribers (2)	No. of Primary Cable pairs (3)	Distribution Factor (3)÷(1)	Occupation Rate (2)÷(3)
Al Nasser	40,000	39,580	64,000	1.60	61.8 %
Al Thawra	15,000	—	25,800	1.72	—
Kefr Souseh	25,000	8,937	30,500	1.22	29.3 %
Domar	15,000	8,662	16,000	1.07	54.1 %
Al Mohajrin	21,000	13,598	28,000	1.33	48.6 %
Jallaa	30,000	23,785	38,000	1.27	62.6 %
Bab Sharki	30,000	24,099	36,000	1.20	66.9 %
Mezzeh[D1,2]	25,000	19,491	27,200	1.09	71.7 %
Mezzeh[D3]	25,000	—	47,000	1.88	—
Al Miedan	17,000	17,000	24,000	1.41	70.8 %
Al Yarmouk	30,000	25,813	63,000	2.10	41.0 %
Rokn Al Dien	10,000	10,000	16,200	1.62	61.7 %
Barzeh	30,000	17,527	46,000	1.53	38.1 %
Bagdad	40,000	39,930	85,400	2.14	46.8 %
Total	353,000	248,422	547,100	1.55	45.4 %

(2) Cable Line Structure

Most of the existing primary cables placed between MDFs and CCCs in the exchange service areas are installed in duct systems to enhance the reliability of the primary cable network; the primary cables are directly buried underground where subscribers are directly accommodated to exchanges. Each of the primary cables is led to the MDF in the exchange by tie cables with a capacity of 300 or 600 pairs.

Most of the existing secondary cables placed between CCCs and DPs in the exchange service areas are directly buried underground, while aerial cable line structure is also applied to secondary cable lines in the suburban area of Damascus.

Drop wires as well as separate wires have been used for the service lines placed between DPs and subscriber premises.

(3) Type and Capacity of Cables

The duct cables installed in duct systems are of polyethylene (PE) sheathed, polyethylene (PE) insulated and jelly filled type. The older lead-sheathed, paper-insulated and air-pressurized type of cables still in use in some exchange service areas are gradually being replaced by STE.

The direct buried cables are of PE sheathed, PE insulated, jelly filled and armoured type. This type of cables is protected with additional galvanized steel tapes in different layers depending on the size of the cable.

The aerial cables installed on pole lines are of PE sheathed, PE insulated, non-jelly filled and self-supporting type.

All of the primary and secondary cables now being installed underground in the exchange service areas are the jelly-filled type. The conductors in the cable are twisted in pairs, which are stranded in sub-units for forming a unit.

The tie cables installed for leading the primary cable pairs to the MDF are of PVC sheathed, PE insulated and air-core type. The capacity is either 300 or 600 pairs with wire diameters of 0.5 mm.

The capacities of the duct cables are 50, 100, 150, 300, 600, 900, 1,200 and 1,800 pairs with wire diameters of 0.4, 0.5, 0.6, or 0.9 mm. The direct buried cables are 10, 20, 30, 50, 75, 100, 150, 200 and 300 pairs with wire diameters of 0.4, 0.5, 0.6, or 0.9 mm.

The capacities of the aerial cables are 5, 10, 15, 20, 25, 50, 75, 100, 150, or 200 pairs with wire diameters of 0.4, 0.5, 0.6, or 0.9 mm.

(4) Cross Connection Cabinet (CCC)

Old and new types of Cross Connection Cabinets (CCCs) are used for the subscriber cable network in the study area. The older CCCs manufactured in Germany were constructed of metallic materials; newer CCCs were fabricated in Bulgaria. According to

STE Technical Specifications, the case of the new CCCs is supposed to be fabricated using reinforced plastic material. However, new CCCs with metallic housing have been found during site surveys.

The terminal blocks use soldering tags to terminate the primary and secondary cable pairs on the backside and nickeled brass screws to connect with the jumper wires. Grounding clips are fixed at the bottom of the terminal blocks to ground the metallic sheaths of the cables. In addition, terminal blocks with prefabricated tail cables are not specified by STE.

Regarding the installation of CCCs, the restoration of the surrounding ground surfaces has been found in proper condition in the surveyed areas. The CCCs are firmly attached to their bases, and the cable entry holes are sealed with heat shrinkable sleeves, while the vacant ducts are covered with rubber caps. However, regarding the installation of the terminal blocks, it has been reported that the base material has a tendency to crack when torsion force is applied during the screwing in process.

The capacities of the terminal blocks installed in the CCCs are 50, 100 or 150 pairs each, while the capacities of the CCCs are as shown in Table 4.5.1.1-2.

Table 4.5.1.1-2 Capacity of CCC

Capacity	Number of Terminals for Primary Cable pairs	Number of Terminals for Secondary Cable Pairs	Remarks
600	150 + (100)	250 + (100)	
900	300 + (100)	400 + (100)	
1200	450 + (100)	550 + (100)	

(5) Distribution Point (DP)

The distribution Points (DPs) are mounted vertically on walls and wooden poles. According to STE Technical Specifications, the DPs are supposed to be made of robust reinforced plastic materials.

The housings of the DPs are not grounded and a system for displaying the distributed secondary cable pair numbers has not been adopted. The capacities of the DPs are 10 , 20 , 30, or 50 pairs each.

4.5.1.2 Junction Cable Network

STE has digitized its network on a large scale with microwave, optical fiber cable and metallic PCM cable transmission systems installed under the 50/A, 40/A, and 3/A projects.

Table 4.5.1.2-1 shows the optical fiber junction cable routes installed in the city area of Damascus under these three projects.

Table 4.5.1.2-1 List of Optical Fiber Junction Cable Routes (1/2)

Section	Distance	No. of Cores	System	Project
Al Nasser - Al Jallaa	2.4 Km	8 Fiber	140M (4+0S)	3/A
Al Nasser - Al Miedan	2.9 Km	6 Fiber	140M (2+0S)	3/A
Al Nasser - Al Thawra	1.5 Km	10 Fiber	140M (1+0S)	40/A
Al Nasser - Bab Sharki	3.6 Km	4 Fiber	140M (2+0S)	3/A
Al Nasser - Bagdad	2.5 Km	6 Fiber	140M (3+0S)	3/A
Al Nasser - Kefr Sousch	2.8 Km	4 Fiber	140M (2+0S)	40/A
Al Nasser - Mezzeh [1,2]	5.8 Km	6 Fiber	140M (3+0S)	3/A
Al Nasser - Rokn Al Dien	3.5 Km	4 Fiber	140M (2+0S)	3/A
Al Jallaa - Al Mohajrin	2.0 Km	8 Fiber	140M (4+0S)	3/A
Al Jallaa - Al Thawra	2.5 Km	6 Fiber	140M (1+0S)	40/A
Al Jallaa - Bagdad	1.7 Km	4 Fiber	140M (1+0S)	3/A
Al Jallaa - Mezzeh [1,2]	6.0 Km	6 Fiber	140M (3+0S)	3/A
Al Jallaa - Rokn Al Dien	2.5 Km	6 + 8Fiber	140M (4+0S)	3/A
Al Thawra - Bagdad	1.0 Km	10 Fiber	140M (2+0S)	40/A
Al Thawra - Kefr Sousch	5.0 Km	6 Fiber	140M (1+0S)	40/A
Bab Sharki - Al Yarmouk	4.5 Km	4 Fiber	140M (2+0S)	40/A
Bab Sharki - Bagdad	3.5 Km	6 Fiber	140M (2+0S)	40/A
Bab Sharki - Jaramana	3.8 Km	4 Fiber	140M (1+0S)	40/A
Bab Sharki - Kefr Sousch	4.4 Km	6 Fiber	140M (3+0S)	40/A
Bab Sharki - nashabieh	18.4 Km	4 Fiber	140M (1+0S)	40/A
Bab Sharki - Zamalka	6.8 Km	6 Fiber	140M (3+0S)	40/A
Kefr Sousch - Al Mohajrin	4.4 km	4 Fiber	140M (1+0S)	40/A
Kefr Sousch - Al Yarmouk	6.0 Km	4 Fiber	140M (2+0S)	40/A
Kefr Sousch - Mezzeh [1,2]	3.9 Km	6 Fiber	140M (3+0S)	40/A
Al Mohajrin - Domar	6.0 Km	6 Fiber	140M (3+0S)	40/A
Al Yarmouk - Al Miedan	2.8 Km	4 Fiber	140M (1+0S)	40/A

Table 4.5.1.2-1 List of Optical Fiber Junction Cable Routes (2/2)

Section	Distance	No. of Cores	System	Project
Al Yarmouk - Bebila	3.8 Km	4 Fiber	140M (1+0S)	40/A
Al Yarmouk - Kessweh	16.4 Km	4 Fiber	140M (1+0S)	40/A
Bagdad - Zamalka	5.8 Km	6 Fiber	140M (3+0S)	40/A
Mezzeh [1,2] - Mezzeh [3]	1.6 Km	6 Fiber	140M (2+0S)	40/A
Mezzeh [1,2] - Daraya	10.4 Km	4 Fiber	140M (2+0S)	40/A
Rokn Al Dien - Barzeh	3.6 Km	6 + 8 Fiber	140M (5+0S)	40/A
Barzeh - Al Tall	9.1 Km	4 Fiber	140M (1+0S)	40/A
Barzeh - Zamalka	7.8 Km	6 Fiber	140M (3+0S)	40/A
Domar - Al Hameh	5.0 Km	4 Fiber	140M (2+0S)	40/A
Al Hameh - Al Fijeh	13.3 Km	4 Fiber	140M (1+0S)	40/A
Al Tall - Seidnaya	14.8 Km	4 Fiber	140M (1+0S)	40/A
Zamalka - Harasta	5.1 Km	6 Fiber	140M (3+0S)	40/A
Harasta - Douma	4.4 Km	4 Fiber	140M (1+0S)	40/A
Douma - Aadra	13.4 Km	4 Fiber	140M (1+0S)	40/A
Aadra - Dmeir	16.8 Km	4 Fiber	140M (1+0S)	40/A
Daraya - Suhnaya	6.5 Km	4 Fiber	140M (1+0S)	40/A
Daraya - J.Artouz	8.9 Km	4 Fiber	140M (1+0S)	40/A
J.Artouz - Katana	10.0 Km	4 Fiber	140M (1+0S)	40/A

Table 4.5.1.2-2 shows the symmetrical metallic PCM junction cable routes which have been installed in the city area of Damascus

Table 4.5.1.2-2 List of Symmetrical Metallic PCM Junction Cable Routes

Section	Distance	No. of Repeater	System	Remark
Al Nasser - Bagdad	2.2 Km	1	74 sys	
Al Nasser - Al Miedan	2.8 Km	1	32 sys	
Al Nasser - Mezzeh [1,2]	5.8 Km	3	19 sys	
Al Nasser - Rokn Al Dien	3.0 Km	2	24 sys	
Al Nasser - Bab Sharki	4.0 Km	2	1 sys	
Bagdad - Al Mohajrin	4.0 Km	3	4 sys	
Bagdad - Rokn Al Dien	2.5 Km	1	4 sys	
Bagdad - Bab Sharki	5.0 Km	3	4 sys	

(1) Junction Cable Line Structure

Most of the junction cables placed between exchanges in the city area of Damascus are installed in duct routes to improve the reliability of the cable transmission system. Cable lines are directly buried in the suburban areas where the duct routes are not available.

(2) Type and Capacity of Junction Cable

The optical fiber junction cables installed in duct routes are of Polyethylene (PE) sheathed and jelly filled type, while the optical fiber cables directly installed underground are of PE sheathed, jelly filled and armoured type. The capacities of the optical fiber junction routes installed in the study area are shown in Table 4.5.1.2-1.

The symmetrical metallic PCM cables installed in the study area are of PE sheathed, paper insulated and air-pressurized. Their capacities of the cables are individually 100, 200, 300 and 600 pairs with wire diameter of 0.6 or 0.9 mm.

4.5.1.3 Duct System

The dust system is completely constructed locally in the study area. However, road restoration after installation of manholes and ducts has been found lacking: the road surfaces have subsided along duct routes in the surveyed areas, and some of the manhole covers have cracked due to heavy traffic and the use of insufficiently strong material.

(1) Manhole

Two types of manhole have been specified by the STE: Those for use in roadways and driveways and those for use in sidewalks. Table 4.5.1.3-1 lists the standardized types of manholes used by STE.

Table 4.5.1.3-1 Types of Manholes

Application	Roadways/Driveways				Sidewalks				
Type	T1	T2	T3	T5	T1	T2	T3	T5	C2
No. of Ducts	6-12	13-20	21-30	21-40	6-12	13-20	21-30	21-30	Spec. for CCC
No. of covers	2	2	2	2	2	2	2	2	1
Cable bearer	4	6	6	6	4	6	6	4	2
Length (cm)									
Out	470	570	670	620	470	570	670	520	220
In	390	500	590	550	400	500	600	450	180
Width (cm)									
Out	240	250	270	540	240	250	270	320	210
In	160	180	170	430	170	180	200	250	170
Depth (cm)									
Out	257	257	257	260	257	257	257	257	232
In	200	200	200	200	200	200	200	200	192
Direction	2	2	2	3	2	2	2	3	2

(2) Duct (Pipe)

Three types of pipes (asbestos pipes, PVC pipes and steel pipes), exist in the study area. The PVC pipes are mainly used for duct routes being installed in the exchange service areas, while the steel pipes are applied to special sections, such as bridge attachment sand, road crossing. Although asbestos pipes exist in the old duct routes, they are no longer applied to duct routes.

The pipe dimensions are shown in Table 4.5.1.3-2.

Table 4.5.1.3-2 Pipe Dimensions (mm)

Pipe Type	Nominal Internal Diameter	Nominal Wall Thickness
Asbestos Pipe	100	—
PVC Pipe	100	3.2
Steel Pipe	100 and 120	3.2

The distance between manholes in straight lines is in a range between 100 m and 250 m, while the distance between manholes in curved lines is less than 100 m. According to the material obtained from STE, the average distance between manholes is approximately 140 m in the city area of Damascus, and moreover, the clearance between the ground surface and the top of pipes installed underground is 60 cm or more, except for special sections.

4.5.1.4 Survey Result

As a result of survey in the study area, the following problems as mentioned in Table 4.5.1.4-1 have been found on the subscriber cable network. These problems seem to have caused a great number of faults which impose a heavy repair work load on the staff of the maintenance centers.

Table 4.5.1.4-1 Survey Result of Existing Cable Network (1/2)

Category of Facilities	Problem Points Found in Investigation
1. Cable Vault	• Existing cables have been congested in cable vaults and the state have complicated to maintain and replace those cables, especially in the cable vaults of old exchanges. • Existing cables have overlapped each other, and many cables have been damaged on the overlapped parts of cables.
2. Duct Route	• Inspected manholes have not been sealed at the duct entries, and some of the manhole covers have cracked. The existing cables, therefore, have been placed in the water and soil which penetrated from the duct entries and manhole covers. • The road reinstatement after installation of manholes and ducts is not so good. Therefore, the road surfaces have subsided along the existing duct routes in the inspected areas.
3. Primary Cable	• Old type of lead sheathed, paper insulated and air-pressurized cables is still in use as primary cables, especially in the service areas of old exchanges. • Existing cables have not arranged in the proper position by using cable brackets in inspected manholes and cable vaults. • Existing cables have not the name plates to distinguish each individual cable in manholes.
4. Secondary Cable	• Aerial cables has been installed on poles without using cable attaching hardware and accessories. • Some sections of direct buried cable lines, cables have become exposed on the ground and the sheaths of the exposed cables have been damaged and torn. • The clearance between aerial cables and power wires is not enough to prevent the contact accidents with power wires.

Table 4.5.1.4-1 Survey Result of Existing Cable Network (2/2)

Category of Facilities	Problem Points Found in Investigation
5. Cross Connection Cabinet (CCC)	• Some of the housings of inspected CCCs have been broken partially, which have exposed the terminal blocks to humidity. • In the inspected CCCs, nicked brass screws of terminal blocks have been corrosive, and installed jumper wires have been congested, and • The state have complicated to maintain and replace those jumper wires.
6. Distribution Point	• There have been many DPs without terminal blocks and without covers. • In the DPs without terminal blocks, the distributed secondary cable pairs have been connected to drop wires directly, and the connected pairs have been exposed outside the DPs. • The display system of distributed secondary cable pair numbers has not been adopted.
7. Subscriber Service Line	• Service lines (drop wires) installed on poles without hardware /accessories have been congested between poles, and between DPs and subscriber premises. It seems to have complicated to distinguish and maintain each of the drop wires. • The clearance between service lines and power wires is not enough to prevent the contact accidents with power wires.

4.5.1.5 Quality of Subscriber Network

As a result of analyzing statistical data obtained in eight (8) out of fourteen (14) exchanges, the quarterly number of complaints against the telephone services from subscribers and the quarterly number of faults based on repair orders issued to the maintenance centers are shown in Figure 4.5.1.5-1.

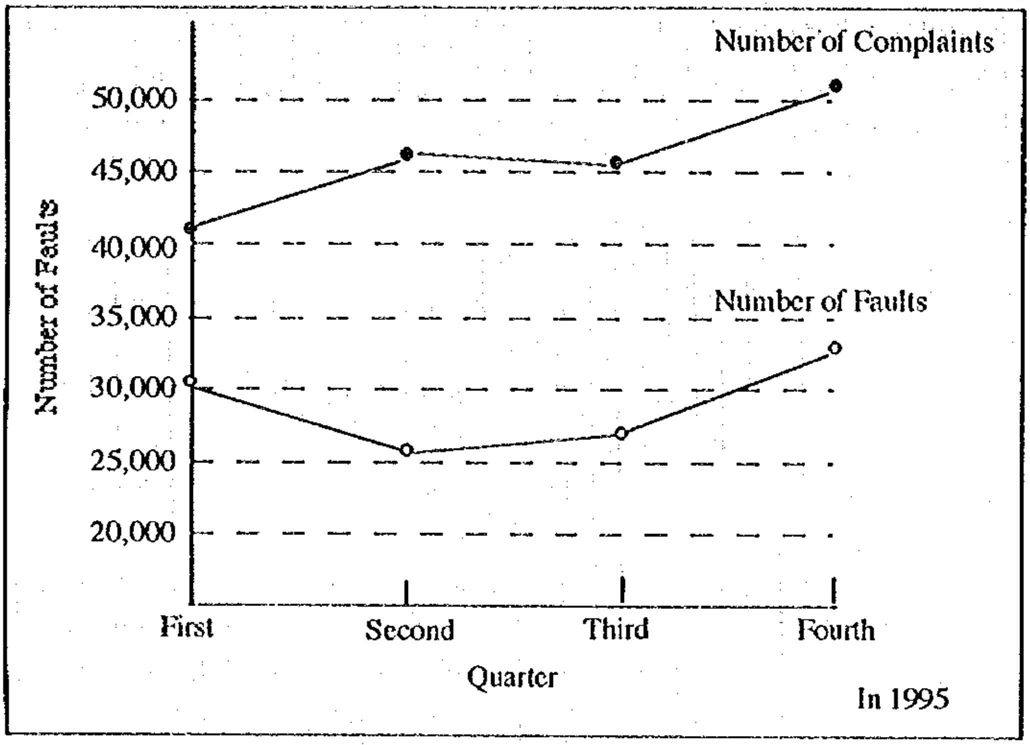


Figure 4.5.1.5-1 Number of Subscriber Line Faults

The fault rate of the subscriber network facilities in the exchange service areas concerned, which is calculated by using the data obtained from STE was approximately 5.20 faults/month/100 subscribers in 1995. In Japan, the fault rate value is approximately 0.12 faults/month/100 subscribers. This extreme difference of the faults rates compared between both countries seems to come from the existent subscriber cable networks being in the state as mentioned in Paragraph 4.5.1.4. Therefore, the inferior facilities and obsolete cables and service lines in existent subscriber cable networks should be improved in the feasible project to be implemented in this study area.

4.5.2 Subscriber Network Plan

The purpose of the subscriber network is to provide a physical connection between the Main Distribution Frame (MDF) installed in an exchange and the subscriber terminal equipment.

4.5.2.1 Feasible Subscriber Network Structure

In the worldwide trend, there are some kinds of subscriber network structures, which have been applied to exchange service areas to establish the most appropriate network in consideration of the state of the areas concerned.

The following subscriber network structures as mentioned in Table 4.5.2.1-1 are considered in order to select the most appropriate subscriber network to be planned in this study area.

Table 4.5.2.1-1 Subscriber Network Structures

Category	Division	Sub-division	Remark
Cable Network Structure	Metallic Cable Network	Rigid Cable Network	This system has been utilized generally for a basic telephone service, and especially applied to areas with stable telephone demand in the future
		Flexible Cable Network	This system has been utilized widely for a basic telephone service, and especially applied to areas with rapidly increasing telephone demand.
		Hybrid Cable Network	This system has been utilized recently for a basic telephone service, and especially applied to remote areas in a wide exchange service area.
	Fiber Optic Cable Network	Fiber Optic Cable Network	This system has been utilized to offer a wide-band digital transmission service to specific subscribers.
Radio Network Structure	Fixed Radio Network	Wireless Local Loop Network	This system is the most effective in rural areas with sparsely scattered demand or in areas with low demand density.

Among the subscriber network structures mentioned above, the optical fiber cable network is excluded from the selection of subscriber network structures in consideration of the objectives of the Project to be implemented in this study area. This is because this network system is generally applied to specific subscribers which require a wide-band digital transmission service, such as data and video transmitting.

4.5.2.2 Conception of Subscriber Network Structures

The potential subscriber network structures which may be introduced in this study area are conceptually expressed as follows, regarding the network components, characteristics, advantages and so forth.

(1) Rigid Cable Network

In a rigid cable network, any subscriber is connected to the exchange basically by means of a pair of copper wires. All conductors are electrically extended from one cable section to other section by joints, i.e. the conductors are firmly jointed together and all pairs are thus connected rigidly through the Main Distribution Frame (MDF) to the Distribution Points (DPs). A configuration of this rigid cable network is shown in Figure 4.5.2.2-1.

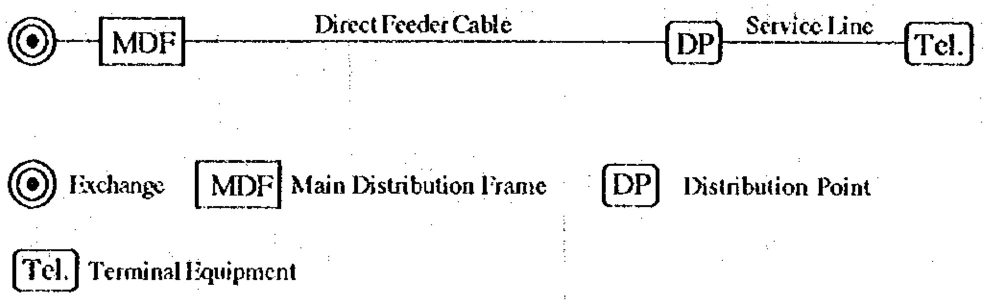


Figure 4.5.2.2-1 Configuration of Rigid Cable Network

In considering the advantages of the rigid cable network, this system is very convenient, and generally applied to certain areas or office buildings which have a stable telephone demand in an exchange service area.

The advantages of the rigid cable network are as follows.

- The costs relating to CCCs are omissible.
- It is possible to decrease the number of line faults by non-use of CCCs.
- Subscriber lines are simply set up.
- Subscriber line records are simple.

The disadvantages of the rigid cable network are as follows.

- Sudden demand or rapidly increased demand is difficult to cope with.
- The size of the exchange area is limited by the maximum line attenuation in compliance with the transmission plan and maximum loop resistance (signaling limit) required by the switching system.

(2) Flexible Cable Network

In a flexible cable network, the subscriber line between the Main Distribution Frame (MDF) and the Distribution Point (DP) is divided into two (2) separate sections, i.e. main cable (primary cable) and distribution cable (secondary cable) sections, by use of a Cross Connection Cabinet (CCC). In this way, a hierarchical star network is obtained. A configuration of this flexible cable network is shown in Figure 4.5.2.2-2.

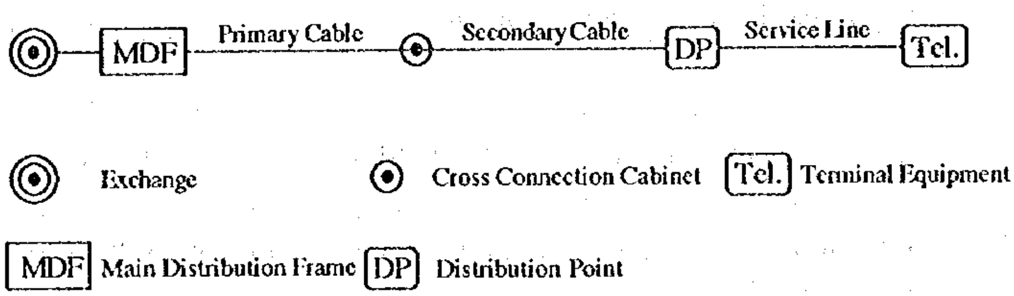


Figure 4.5.2.2-2 Configuration of Flexible Cable Network

The main advantages of the flexible cable network is that any pair of the secondary cable can be connected to any pair of the primary cable. In this way, at first, all smaller pair groups from DPs can be combined to form larger pair groups to the CCC, and next, all larger pair groups which are combined in each individual CCC are further combined to form much larger pair groups to the exchange, according to the capacities of primary cables to be used for the subscriber cable network. Therefore, the primary cable pairs can be saved in order to decrease not only project costs but also the space for the MDF to be installed in each exchange.

Another economic advantage is that the sections of the network can be developed independently to cope with the rapidly increased demand at a certain location (unexpected situations). Furthermore, the cable fault location is facilitated by testing the conductors at the CCC.

As a disadvantage of this network system, the size of the exchange area is limited by the maximum line attenuation in compliance with the transmission plan and maximum loop resistance (signaling limit) required by the switching system.

In considering the advantages mentioned above, this flexible cable network system is very economical, and can be widely applied to exchange service areas with rapidly increased telephone demand.

(3) Hybrid Subscriber Network

In a hybrid subscriber network, a host exchange controls several Remote Units (RUs) which are distributed over the exchange area. The ring structural optical fiber cable network is deployed instead of the conventional primary copper cable network. No practical length limit exists between the host exchange and a RU, while the feeder cable section is limited in length by transmission parameters.

The RU is a distantly placed subscriber stage controlled by a host switch and provides all subscriber interfaces like a normal exchange. The RUs can be strategically placed close to the centers of the demand in each remote area of an exchange service area. They may be housed in a container or in a small building owned by STE, or on rented space in a large building.

The number of RUs to be connected to the host exchange is flexible and depends on the demand to be satisfied. Additional RUs can be installed easily whenever the demand arises in particular areas like industrial zones or business districts.

The subscriber network within the hybrid subscriber network structure will be a rigid network basically, i.e. the DPs are directly connected to the MDF.

In conjunction with the new flexibility gained by the deployment of RUs, the cable network can be optimized in accordance with the demand structure in the feeder cable service area to be planned.

A configuration of this hybrid subscriber network is shown in Figure 4.5.2.2-3.

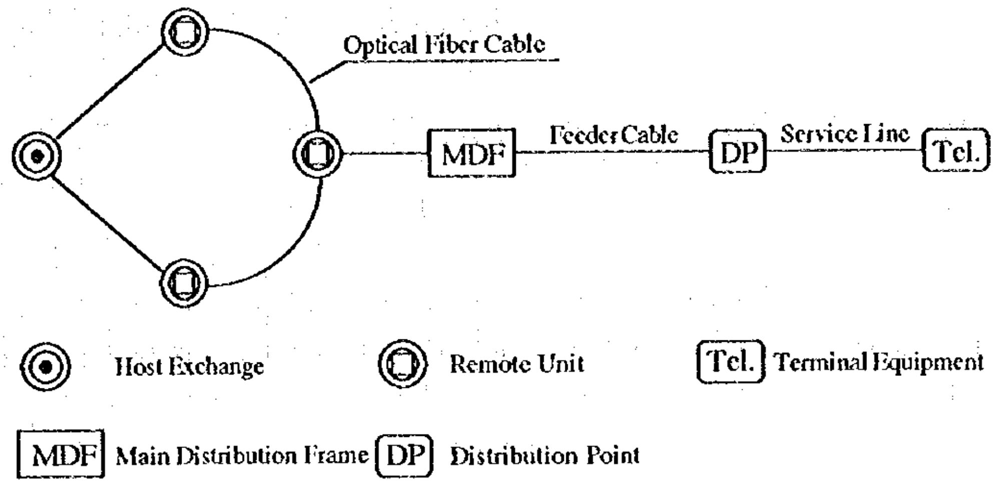


Figure 4.5.2.2-3 Configuration of Hybrid Subscriber Network

The advantages of the hybrid subscriber network are as follows.

- More flexible determination of the exchange service areas' sizes becomes feasible according to optical fiber cable deployment between the host exchange and the remote units.
- All presently known services are available.
- Future technological innovations are considered.
- Short implementation period.
- Lower operation and maintenance costs.

The disadvantages of the hybrid subscriber network are as follows:

- Additional costs for transmission components and operating are necessary.
- Additional costs for power supply are necessary.
- Skilled and highly qualified staff are necessary.

In the hybrid subscriber network, however, the additional costs for the transmission components and the power supply will be almost compensated by saving expenditures for primary copper cables, cross connection cabinets and duct system construction if this network system is introduced into an exchange which covers the widely expanded service area like a rural area, or into particular areas like industrial zones or business districts.

(4) Wireless Local Loop Network

Wire local loop (WLL) systems are used to set up radio connections between local exchanges and non-mobile telephone subscribers. This approach offers access to the public telephone network and even to the Integrated Services Digital Network (ISDN) without delay. The subscribers are largely offered the same services as provided by a wire connection to the public telephone network.

The wireless local loop systems can be easily integrated into an existing infrastructure and they are sufficiently flexible to support the extension of the overall network. The following basic services are possible for all cellular wireless local loop systems:

- Telephony service.
- Telefax service
- Data transmission service by means of a modem.

A fast and flexible possibility to provide telephone facilities in wireless local loop systems is offered by use of mobile radio elements. A cellular wireless local loop system consists of three (3) basic functional units:

- Cluster Controller, Central Station or Switching Center (depending on the architecture),
- Radio Base Station, and
- Wireless Local Loop Terminal.

The cluster controller (or central station or switching center) is the interface between the wireless local loop and the public telephone network, and its task is to control and manage the system. Several radio base stations are connected to the controller via 2 Mbit/s systems. Hence, it is possible to operate the controller and the radio base stations in different places. Depending on the system, the controller is capable of serving a maximum of 1,000 subscribers via several radio stations.

The wireless local loop subscriber equipment consists of either an adapted mobile-radio telephone or a wireless local loop adapter with a two-wire interface to which all types of conventional telephones may be connected.

The principle architecture of the wireless local loop network is shown in Figure 4.5.2.2-4.

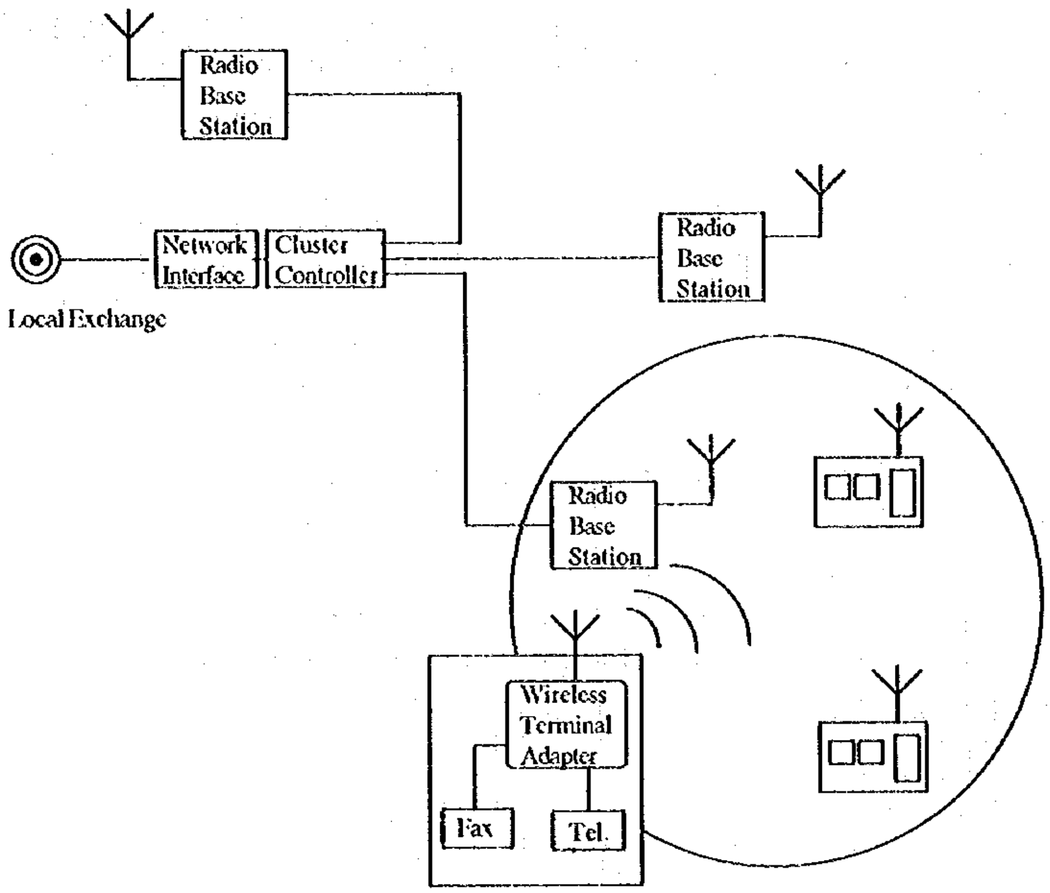


Figure 4.5.2.2-4 Configuration of Wireless Local Loop

In considering the costs for connecting subscribers to the local exchange by a cable network, the costs depend on the location of the subscriber. In urban districts, local line installation costs are normally cheaper than those in rural areas because of the high demand density and the short distance to the local exchange. Rural areas are characterized by widely scattered communities. Economic activity is generally dispersed and the existing telecommunications infrastructure is far away, requiring long transmission lines for telephone access. Therefore, the provision of cable networks in rural areas leads to relatively high costs per subscriber line. In rural areas, the costs per subscriber in a wireless local loop system are less than the costs for a cable link to the local exchange. However, in urban districts, the costs for a subscriber line via the wireless local loop are much higher than the costs for an access line of the cable network.

Consequently, the wireless local loop systems should be borne in plans for rural and suburban areas or for special areas, such as particularly isolated zones in urban district.

4.5.2.3 Selection of Subscriber Network Structure

When subscriber network planning work is performed, existent facilities aspects and economic aspects have to be considered at any time. The subscriber network to be applied in the study area is selected from among the subscriber networks as mentioned in Paragraph 4.5.2.1 in consideration of the following conditions.

(1) Application Conditions

The states of the study area and existent subscriber cable networks are as follows.

- The study area is a metropolitan area with high demand density.
- There are fourteen (14) exchanges which have approximately 248,400 subscribers in sum total as of the end of 1995.
- The flexible cable network has applied to all of the exchange service areas, while the rigid cable network has been applied to areas which are near to each exchange.
- The furthest subscriber from the exchange in each exchange service area is within 3.5 km on average.

(2) Objective and Required Service Menu

The main objective of the Project to be implemented in this study area is to establish an appropriate subscriber network to satisfy the rapidly increasing telephone demand, and the established subscriber network has to offer a basic telephone service menu, such as general telephone services, facsimile communications.

(3) Optimization of Existent Subscriber Network

In considering the costs of the Project to be implemented in this study area, it is significant to consider that the existent subscriber network should be optimized as much as possible in order to decrease the implementation costs. Moreover, the selected subscriber network system should match well with the existent subscriber network in order to maintain the integrated subscriber network after completion of the Project in the study area.

As a conclusion of the terms mentioned above, the Flexible Subscriber Cable Network system is fundamentally selected for the study area, and also the Rigid Subscriber Network system is selected. Because the combination of both subscriber network systems will be much more flexible to expand the subscriber cable networks in the study area and this combination will be available to obtain the advantages of both network systems.

4.5.2.4 Subscriber Network Expansion Plan

The facilities provision plan for the expansion of the subscriber cable networks is formulated based on the facilities provisioning policy mentioned hereunder in order to meet the demand fulfillment plan of the Project to be implemented in the study area.

(1) Subscriber Cable Network System

The combination of both cable networks, i.e. the Flexible Cable Network and the Rigid Cable Network, is applied to the subscriber cable networks to be implemented in the study area. This will provide cable pairs effectively for subscribers, and will cope with fluctuating and rapidly increasing telephone demand. Moreover, this subscriber network system has been applied to the existent subscriber networks in the study area, and therefore, the staff of the maintenance centers will be able to easily maintain the subscriber cable networks installed under the Project.

The configurations of the Flexible Cable Network and the Rigid Cable network are referred to Paragraph 4.5.2.2 in this Chapter.

(2) Cable Line Structure

The primary cables placed between Main Distribution Frame (MDF) and Cross Connection Cabinets (CCCs) in the exchange service area are installed in duct routes in consideration of the importance and reliability of the primary cable network.

The secondary cables placed between CCCs and Distribution Points (DPs) in the exchange service area are directly buried underground in general, but the secondary cables may be installed in duct routes where the number of ducts in existent duct routes is superabundant in the same route. In addition, an aerial cable line structure is not applied to the secondary cable lines, except for the service lines in the study area.

(3) Type and Capacity of Cables

The diameter of conductors is calculated based on the maximum line attenuation loss allocated to the subscriber cable network in compliance with the transmission plan and based on the maximum Direct Current (DC) loop resistance (signaling limit) required by the switching system. In considering the topographical terms of each exchange service area in the study area, the conductor gauges of the cables to be used for this Project will be 0.4 and 0.5 mm in diameter.

The duct use cables installed in duct routes are of polyethylene (PE) sheathed, polyethylene (PE) insulated and jelly filled type, while its capacities will be 50, 100, 150, 300, 600, 900, 1,200 or 1,800 pairs in line with the STE Technical Standard.

The direct buried cables are of PE sheathed, PE insulated, jelly filled and armoured type, while its capacities will be 10, 20, 30, 50, 75, 100, 200 and 300 pairs in line with the STE Technical Standard.

The tie cables installed for leading primary cable pairs to the MDF are of PVC sheathed, PE insulated and air-core type, while its capacity will be either 300 pairs or 600 pairs with 0.5 mm in diameter in line with the STE Technical Standard.

The electrical characteristics of the cables to be applied to the subscriber cable network are as shown in Table 4.5.2.4-1.

Table 4.5.2.4-1 Electrical Characteristics of Cables

Conductor Gauge (mm)	DC Loop Resistance (Ω/km)	Attenuation Loss (dB/km) at 800 Hz
0.4	300	1.85
0.5	188	1.50

(4) Determination of Primary Cable Pairs

The capacity of primary cable pairs to be distributed to each exchange service area is estimated based on the "Demand Fulfillment Plan" described in Paragraph 4-1 in Chapter 4. The amount of demand in each exchange service area depicted in the demand fulfillment plan represents the minimum number of primary cable pairs required in the exchange for each service year. The number of primary cable pairs to be distributed in each exchange service area is calculated based on the demand fulfillment plan for the year Tx+5 (2005) to be provided in the year Tx (2000). Moreover, in order to provide sufficient flexibility in the network, an average distribution factor of 1.5 which is the ratio between the number of primary cable pairs to be terminated at the MDF and the demand fulfillment value estimated for the year Tx+5 is applied to the calculation of primary cable pairs to be actually distributed in each exchange. Tx is herein defined as the completion date for the installation of the outside plant network, according to the Implementation Plan.

(5) Determination of Secondary Cable Pairs

The capacity of secondary cable pairs to be distributed in each exchange service area is also estimated based on the "Demand Fulfillment Plan". For the practical calculation of the required secondary cable pairs, however, an average distribution factor of 1.5, which is ratio between primary cable pairs and secondary cable pairs, is assumed to provide the necessary flexibility in network arrangements. This factor has already considered the deduction of direct feed cable pairs, which are included in the calculation of primary cable pairs.

(6) Accessory

Regarding the accessories, the new types of Cross Connection Cabinet (CCC) and Distribution Point (DP) which have been used for the subscriber cable networks by STE will be basically applied to the Project to be implemented in this study area, and those capacities are referred to Paragraph 4.5.1.1 in this Chapter.

(7) Duct Network

The duct network will be designed in order to sufficiently meet the underground cable installations including primary cables, junction cables and trunk cables envisaged not only in the planned year (Tx+5) but also in the future in order to avoid digging up roads frequently. In addition, spare ducts for maintenance (replacement of damaged cables) are added to the calculation.

The types of manholes stipulated by STE will be basically applied to constituting the duct network in the study area. The type and duct attachment capacity are referred to Paragraph 4.5.1.3.

Two (2) types of pipes, PVC pipes and steel pipes, will be used in the duct network. The PVC pipe with 100 mm in nominal inside diameter is mostly applied to the main duct routes installed along roads. The steel pipe with 100 mm in nominal inside diameter is used in specific sections, such as bridge attachments, road crossings, while the steel pipe with 120 mm in nominal inside diameter is used to protect the PVC pipe installed in specific sections.

4.5.2.5 Installation Volume of Subscriber Network

The installation volume of the main items of the subscriber network to be newly installed in the study area is calculated on the basis of the facilities provisioning policy mentioned in Paragraph 4.5.2.4 of this Chapter. The objective of the calculations is to estimate the investment costs necessary for the Project.

Table 4.5.2.5-1 shows individual total numbers of primary cable pairs and secondary cable pairs necessary for the year Tx+5 (2005) actually to be provided in the year Tx (2000).

Table 4.5.2.5-1 Total Numbers of Primary Pairs and Secondary Pairs

Cable Line Category	Total Number of Pairs
Primary Cable	731,550
Secondary Cable	1,097,325

Table 4.5.2.5-2 shows the number of primary cable pairs in individual exchange service areas in each situation. The number of added primary cable pairs means the number of primary cable pairs which will be installed under the Project to be implemented in the study area.

Table 4.5.2.5-2 Number of Primary Cable Pairs in Each Situation

Exchange Name	Demand Fulfillment Plan (Tx-5, 2005)	Necessary No. of Primary Pairs	No. of Existing Primary Pairs	No. of Added Primary Pairs
Al Nasser	39,200	58,800	64,000	-
Al Thawra	24,500	36,750	25,800	10,950
Kefr Souseh	24,500	36,750	30,500	6,250
Domar	20,500	30,750	16,000	14,750
Al Mohajrin	25,300	37,950	28,000	9,950
Jallaa	29,200	43,800	38,000	5,800
Bab Sharki	23,000	34.500	36,000	-
(Dewelaah)	23,000	34,500	0	34,500
Mazzeh[D1,2]	24,500	36,750	27,200	9,550
Mazzeh[D3]	20,500	30,750	47,000	-
Al Miedan	24,500	36,750	24,000	12,750
Al Yarmouk	24,500	36,750	63,000	-
(Al Kadam)	20,500	30,750	0	30,750
(Al Sebeyneh)	20,500	30,750	0	30,750
Rokn Al Dien	16,500	24,750	16,200	8,550
Barzeh	24,500	36,750	46,000	-
(Ibn Alamied)	12,500	18,750	0	18,750
Bagdad	42,800	64,200	85,400	-
(Al Abbaseyen)	23,600	35,400	0	35,400
(Jobar)	23,600	35,400	0	35,400
Total	487,700	731,550	547,100	264,100

The work volume mentioned in Table 4.5.2.5-3 is based on a result of analyzing the statistical data on the outside plant obtained from STE and based on our experience. The work volume is roughly calculated as a reference to know the summary of the Project. Therefore it will be reviewed and detailed in the subsequent detailed design study.

Table 4.5.2.5-3 Work Volume

Work Item	Work Volume (km)	Remarks
Primary Cable Length	251	
Secondary Cable Length	1,295	
Duct route Length	76	Including duct routes necessary for optical fiber Junction cables

4.5.3 Junction Cable Network Plan

The purpose of the junction cable network is to provide a physical connection between exchanges placed in a certain service area defined to offer telecommunications services. The junction cable network is established between exchanges, based on the requirements from the transmission system plan.

4.5.3.1 Feasible Junction Cable Network System

There are two (2) sorts of transmission mediums, i.e. the Symmetrical Metallic Pulse Code Modulation (PCM) Cable and the Optical Fiber Cable. However, in the worldwide trend, the optical fiber cable is mostly applied to the junction routes to be newly installed, while the symmetrical metallic PCM cable is applied very little at present. Therefore, the optical fiber cable is applied to the junction cable network system to be installed in the study area.

4.5.3.2 Junction Cable Network Expansion Plan

The facilities provision plan for the expansion of the junction cable network is formulated based on the facilities provisioning policy mentioned hereunder in order to meet the requirements from the transmission system plan.

(1) Cable Line Structure

The optical fiber cable is placed in duct routes to ensure high reliability of the junction cable network. In the route selection, the newly planned optical fiber cables should not be placed in the same routes as existent optical fiber cables have already occupied, as far as possible, in order to avoid that these optical fiber cables are disconnected at the same time by an unexpected accident.

(2) Type of Cable

The optical fiber cable to be used for the junction cable network system is a polyethylene (PE) sheathed and jelly filled type, and its fiber cores are Single Mode (SM).

(3) Characteristics of Single Mode (SM) Optical Fiber Core

The characteristics of the SM optical fiber core to be used in the Project should conform to ITU-T Recommendation G.652, as follows:

- Mode field diameter

  The nominal value of the mode field diameter at 1,300 nano-meter wavelength shall lie within the range of 9 to 10 micro-meter, and the mode field diameter deviation should not exceed the limits of ±10 % of the nominal value, in accordance with item 1.1 of ITU-T Recommendation G.652.

- Cladding diameter

  The nominal value of the cladding diameter is of 125 micro-meter, and the cladding deviation should not exceed the limits of ±2.4%, in accordance with item 1.2 of ITU-T Recommendation G.652.

- Mode field concentricity error

  The mode field concentricity error at 1,300 nano-meter should not exceed 1 micro-meter in accordance with item 1.3 of ITU-T Recommendation G.652. (for some particular jointing techniques and joint loss requirements, tolerances up to 3 micro-meter may be appropriate)

- Cut-off wavelength

  The cut-off wavelength is within the range of 1,100 to 1,260 nano-meter in accordance with item 1.5 of ITU-T Recommendation G.652.

(4) Number of Optical Fiber Cores

The number of optical fiber cores to be considered in each junction cable route is generally determined based on the formula mentioned below.

- N = 2 x A + 2 (for spare system, if necessary) + 2 (for spare cores)

  Where;

  N : Number of optical fiber cores

  A : Number of transmission systems required for ordinary telephone and various new services.

4.5.3.3 Planned Cable Routes

Based on the facilities provisioning policy mentioned above, newly planned junction cable routes between exchanges in the study area are installed in order to satisfy the requirements from the transmission system plan. The list of the newly planned junction cable routes is shown in Table 4.5.3.3-1.

Table 4.5.3.3-1 List of Planned Junction Cable Routes

Section	Distance	No. of Cores	System	Remark
Bagdad - Al Abbaseyen	4.3 Km	6 Fiber	140M (2+0S)	
Bagdad - Jobar	2.8 Km	6 Fiber	600M (1+0S)	
Bab Sharki - Dewelaah	0.8 Km	6 Fiber	600M (1+0S)	
Barzeh - Ibn Alamied	1.5 Km	4 Fiber	140M (1+0S)	
Kefr Souseh - Al Kadam	5.7 Km	6 Fiber	600M (1+0S)	
Al Yarmouk - Al Kadam	4.1 Km	6 Fiber	600M (1+0S)	
Al Yarmouk - Al Sebeyneh	7.2 Km	6 Fiber	140M (2+0S)	
Dewelaah - Jobar	3.0 Km	6 Fiber	600M (1+0S)	

4.5.4 Public Payphone

At present, two (2) types of modern public payphones, i.e. Coin Operated Payphones and Card Operated payphones, have been installed in the study area. The coin operated payphones are providing local call service only, while the card operated payphones are providing local, long distance and international access. In addition, Prepaid Cards are used for the card operated payphones.

4.5.4.1 Public Payphone Service Plan

STE has planned a project for expanding public payphone services. The project includes the purchase and installation of 1,000 card operated payphones, 500 coin/card operated payphones including 1,000,000 cards, and the construction of a management center in the whole of Syria, all of which is to be completed by the year 2000.

The number of public payphones installed in the study area will be as shown in Table 4.5.4.1-1 on completion of the project mentioned above.

Table 4.5.4.1-1 Number of Public Payphones in Each Phase

	Existing Payphone		Additional Payphone	Total
	Coin Type	Card Type	Card or Coin/Card Type	
Damascus (City area)	221	83	300	604
Damascus (Rural area)	55	15	-	70
Total	276	98	300	674

However, the installed public payphones will be short in number by the year 2000. The number of public payphones necessary to offer sufficient services will be 850 based on the "Demand Fulfillment Plan" described in Paragraph 4.1 in Chapter 4. It is therefore recommended that 246 additional public payphones be installed in the study area by the year 2000.

4.5.4.2 Deployment of Public Payphone

In general, it has to be considered that all isolated communities with little telephone service should have access to public payphones and that popular places which gather many persons should have public payphones sufficient in number to offer easy access to telecommunications services.

In consideration of the above, it is recommended that the following places have public payphones. In addition, it is recommended that the required public payphones should be installed not only in telephone booth but also in business buildings mentioned below.

- Community Centers
- Hospitals
- City halls
- Bus Terminals
- Railway Stations
- Airports
- Big Markets and Hotels

4.5.4.3 Facilities Provisioning Demarcation

In general, the facilities provisioning plan for terminal equipment and public payphones including the service lines is formulated sepatately from the subscriber network development plan.

In considering the condition that STE has planned to establish private companies to operate and maintain public payphone facilities, it is desirable for STE to formulate the facilities provisioning plan for the public payphones to be added in the study area.

In this point of view, the service lines necessary between exchanges and public payphones will be provided by the Project to be implemented in this study area; however, the public payphones including telephone booths should be prepared and installed by STE.

CHAPTER 5 MOBILE TELEPHONE SYSTEM

5.1 Introduction

In the "Master Plan," the demand for mobile telephone service is forecasted for longer period, until the year 2010. Here the demand foredast in the Master Plan is used as the basis of a detailed implementation of the mobile service
Development of telecommunication infrastructure is an essential driving force to facilitate industrial and commercial activities of a country. It is not long since the mobile telephone service emerged to the telecommunication realm, but the number of subscribers of the mobile telephone shows robust increment recent years. There are several reasons: A mobile telephone will enhance the convenience of communication: An applicant for the communication does not need to wait for much time before getting a mobile phone set. In a country where there are many who have long been waiting for the telephone service will apply the mobile telephone service, there will be many so-called substitutors.

The number of subscribers is expected to grow rapidly also in Syria once the service will start. The mobile communication will facilitate economic activities. STE wants the mobile telephone service be launched urgently, and it already started the study of introducing mobile telephone service based on the GSM standard.

In this study, observing the Master Plan and admitting the idea of the shorter preparation period until the implementation, the implementation schedule of the mobile telephone service is set differently from other projects. The service is presumed to start in 1998 and the system is to be designed to have enough capacity for the demand of the year 2000.

The coverage of the mobile telephone system in this study, which is shown in the Figure 5.1-1 in the next page, is Damascus area that includes rural area of Damascus, Aleppo city, and main roads (the road between Damascus and Aleppo). However, the capacity of the mobile service switching center (MSC) is designed to cover the demand of Lattakia and Tartous as well.

5.2 Demand Forecast

For designing the system the demand of each area should be estimated. Therefore, based on the demand forecast in the Master Plan, the demand of each area in the year 2000 is estimated as shown in Table 5.2-1.

In this study, BTSs are to be designed to cover 52,393 subscribers of the year 2000, in which the demand of Idleb, Lattakia, and Tartous is deducted from the total demand. But the central equipment of the system, such as the mobile switching center (MSC) and traffic is to be designed to cover 69,857 subscribers, the total demand of the year 2000.

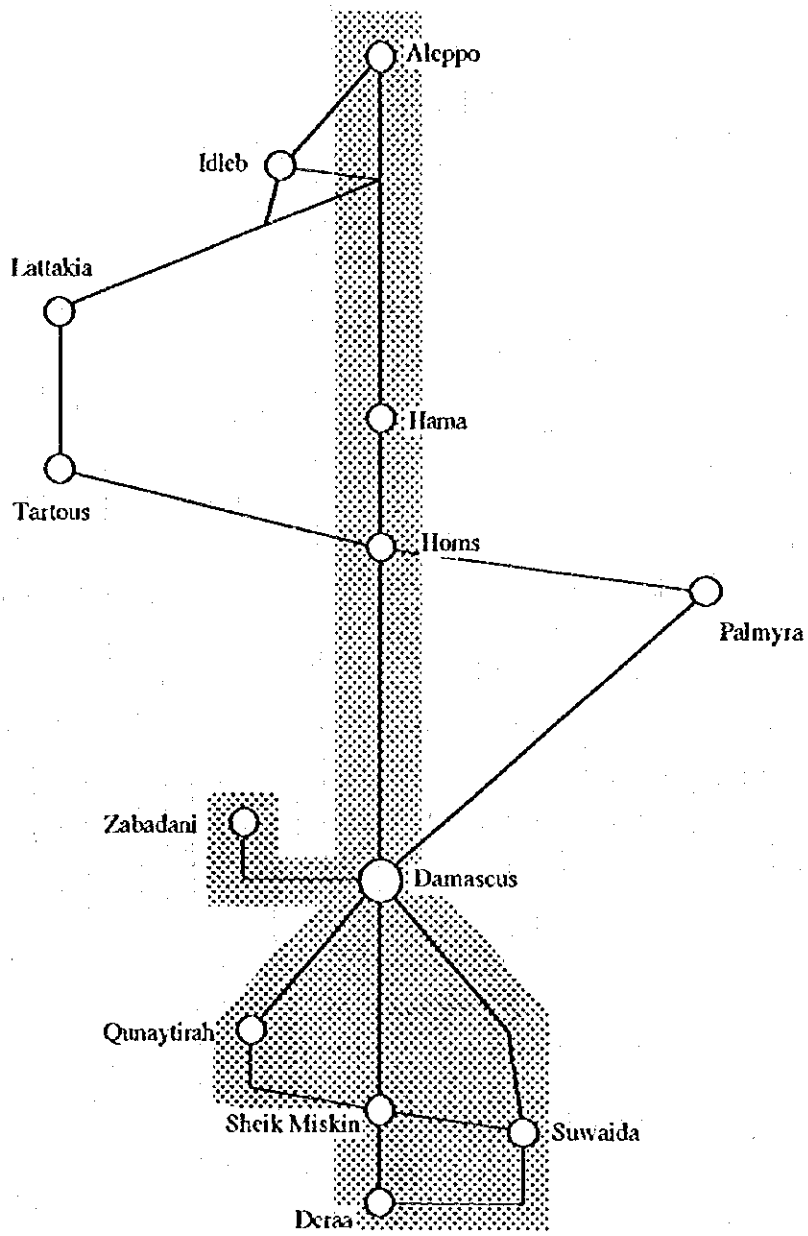


Fig 5.1-1 Coverage Area of Mobile Telephone Service in this Study

Table 5.2.1 Demand Forecast of the Mobile Service

		1998	1999	2000
1.	Damascus	12,000	14,320	16,766
2.	Rural Damascus	9,200	10,978	12,854
3.	Homs	3,500	4,177	4,890
4.	Hama	2,500	2,983	3,493
5.	Aleppo	6,500	7,756	9,081
6.	Daraa	1,700	2,029	2,375
7.	Al-Sweida	1,500	1,790	2,096
8.	Qunaytirah	600	716	838
	Subtotal	37,500	44,749	52,393
9.	Idleb	2,500	2,983	3,493
10.	Lattakia	6,500	7,756	9,081
11.	Tartous	3,500	4,177	4,890
	Total	50,000	59,665	69,857

5.3 System Plan

5.3.1 Network Configuration

As a conclusion of the intensive discussions with STE counterparts, the fundamental network aspects and the configuration of the network is decided as shown in Figure 5.3.1-1.

The fundamental network aspects are as follows:

1) The network has one mobile service switching center (MSC) until the mobile telephone service starts in the eastern region. The MSC is installed at Al Thawra Telephone Office.

2) The MSC has connection to PSTN switches at STD stage and it is decided to connect to STDs at both Al Thawra and Al Nasser from the view points of network security, and the two STDs shall share the traffic load equally.

3) Billing Center System of exclusive use for this Network should be introduced at Al Thawra. However, it should be recommended that this system and the Telephone Center System (see chapter 7) interworking has to be supported, e.g. all the terminals installed at each telephone center should be able to access this Billing Center System.

4) An operation and maintenance center should be also located at Al Thawra Telephone Office and some branch offices shall be located in some remote major

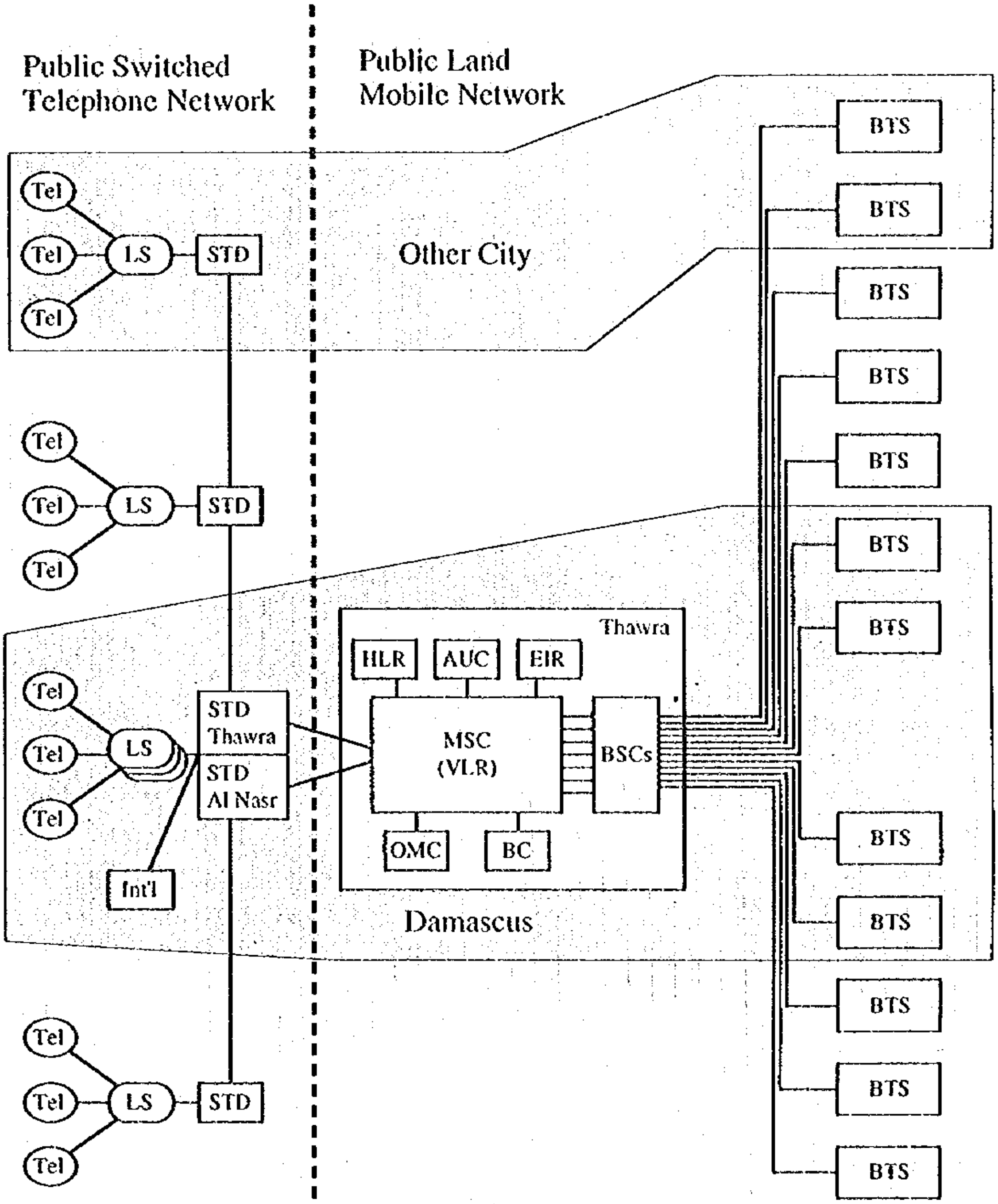
cities.

5) On considering the quantity of the circuits, it should be taken into consideration that any call from/to a mobile station (MS) will go through the MSC at Al Thawra. For example, even when a MS in Aleppo makes a local call to a PSTN subscriber in Aleppo, the traffic goes through Damascus.

6) In relation to the above 5), transcoders are employed to reduce the number of lines required.

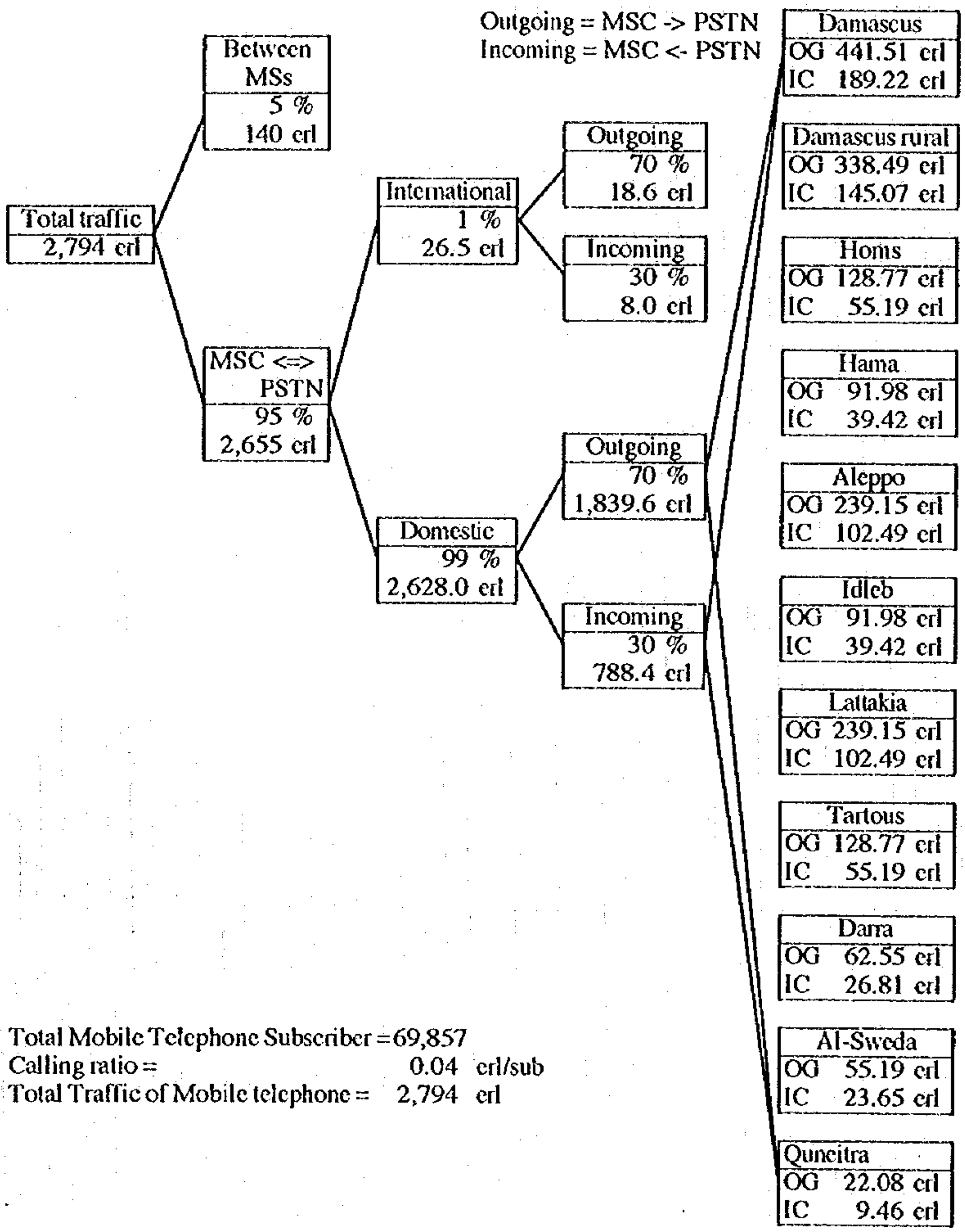
7) The radio link budget assumes that the nominal power of each MS is 0.8W and that the coverage probability within each cell is at least 90% . The indoor loss is not taken into consideration.

Figure 5.3.1-2 shows the estimated traffic flow between MSC and PSTN in the year 2000, on the assumption that calling ratio of 0.04 erlang each subscriber, following the Master Plan, and that ninety-five (95) percent of the total traffic will flow into PSTN. The rest, five (5) percent, is between mobile terminals. The PSTN is required to have sufficient capacity to carry the traffic occurred in the mobile network.



Legend
MSC: mobile service switching center
HLR: home location register
AUC: authentication center
EIR: equipment identity register
VLR: visitor location register
BSC: base station controller
BTS: base transceiver station
BC: billing center

Figure 5.3.1-1 Mobile Telephone Network Configuration



Total Mobile Telephone Subscriber = 69,857
Calling ratio = 0.04 erl/sub
Total Traffic of Mobile telephone = 2,794 erl

Figure 5.3.1-2 Traffic Distribution between MSC and PSTN

5.3.2 Cell Designing

(1) Basic Parameters

On designing the cells the basic parameters are set as follows:

• Center Frequency	:	Down link	:	942.5 MHz
		Up link	:	897.5 MHz
• Mobile Station Height	:	1.5 m		
• Receiver Sensitivity	:	BTS	:	-104 dBm
		Hand-held type	:	-102 dBm
		Car-mount type	:	-104 dBm
• BTS TX Power	:	2 Watt - 10 Watt		
• MS TX Power	:	0.8 Watt - 5 Watt		
• Type of cells	:	3 - sectored and 2 - directional		
• Cell size	:	1.5 km, 3 km, 6 km, 12 km, 24 km (The smallest cell size was decided by taking into consideration of propagation loss in large cities. The propagation loss is estimated by using the formula of Hata Model in GSM 03.03, "Radio Network Planning Aspects.")		

The samples of link budget calculation of the above cells are shown in S2-5-1 in the Supporting Report.

(2) Location of Stations and Size of Cells

There may be alternatives to design the cell configuration of Mobile Telephone Network of Syria. An ideal method is to locate the base transceiver stations (BTSs) at the center of each cell. This method would request many new stations and as a result STE will has to prepare new towers, power equipment, security guard, etc. On the contrary, if STE use its own building, it would save the cost and time and provide better security.

On considering the above, in this study we design the configuration of the cell and the locations of BTSs by using as many STE offices as possible.

In Damascus city, as large increase of the subscribers is assumed, the cells shall be designed considering future cell configuration that covers the whole Damascus city. The centers of the future cells shall be so designed that as many telephone offices as possible are close to them. A result of the future cell design is shown in Figure 5.3.2-1. The radius of the cells is 1.5 km. The figure also shows the location of telephone offices (existing and planned).

However, it is not efficient to install all the 1.5 km cells from the beginning. Suburban area can be covered by cells with double size, i.e., 3 km radius. The cell centers of larger cells shall be located at a cell center of a 1.5 km cell. In the future when the demand increases, the 3 km cells can be divided into 1.5 km cells without relocation of BTSs.

Figure 5.3.2-2 shows a cell design with larger cells of 3 km radius in suburban area and 1.5 km cells in the central area of the city. Eleven (11) BTSs are planned to cover the Damascus city area properly. Among them nine (9) stations are to be installed at STE's buildings. Two (2) stations may be located in the rented space in a building or in a new building of STE. The Kassioun station is located about 300 m higher than the city level and is planned to cover the far area.

In Aleppo city, the central part is covered by two 1.5 km cells and suburban area by three 3 km cells. The centers of the cells also are so designed that the large cell can be divided in to small cells without relocation of BTSs. The cell design is shown in the Figure 5.3.2-3. The BTS at TV station covers 24 km.

In Homs there is a hill in the middle of the city. Therefore two BTS with 3 km cells located on the opposite side of the hill are planned to cover the city and a BTS is planned at the TV station on the top of the hill to cover 24 km. Figure 5.3.2-4 shows the cell design of the northern area. Cells with two-directional antenna are planned along the main road. Figure 5.3.2-5 shows the cell design of the southern area. Cells with two-directional antenna are planned along the main road.

The site of BTSs and cell radius is listed in Table 5.3.2-2 in the next section.

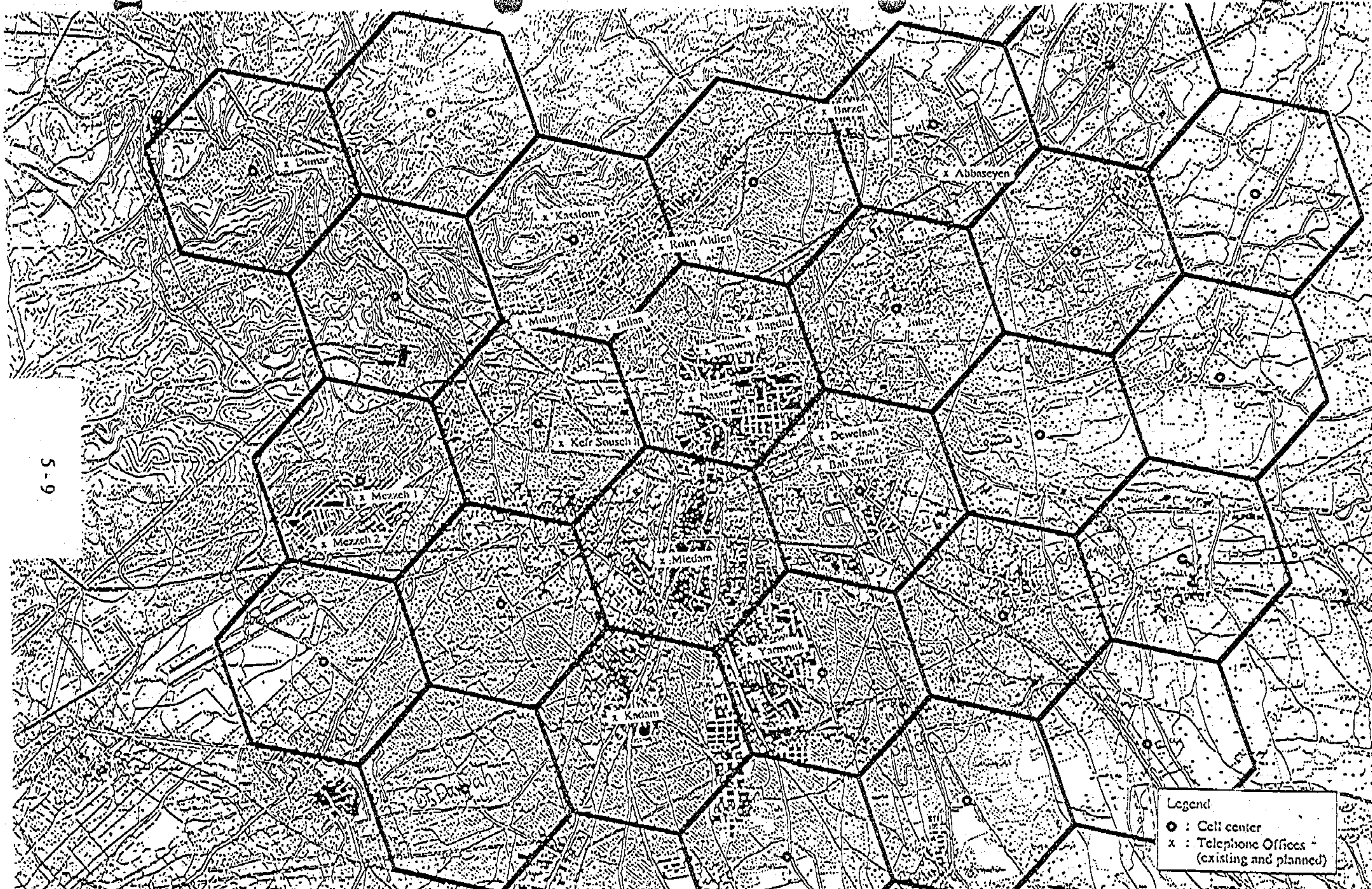


Figure 5.3.2-1 Futrue Cell Structure of Damascus City

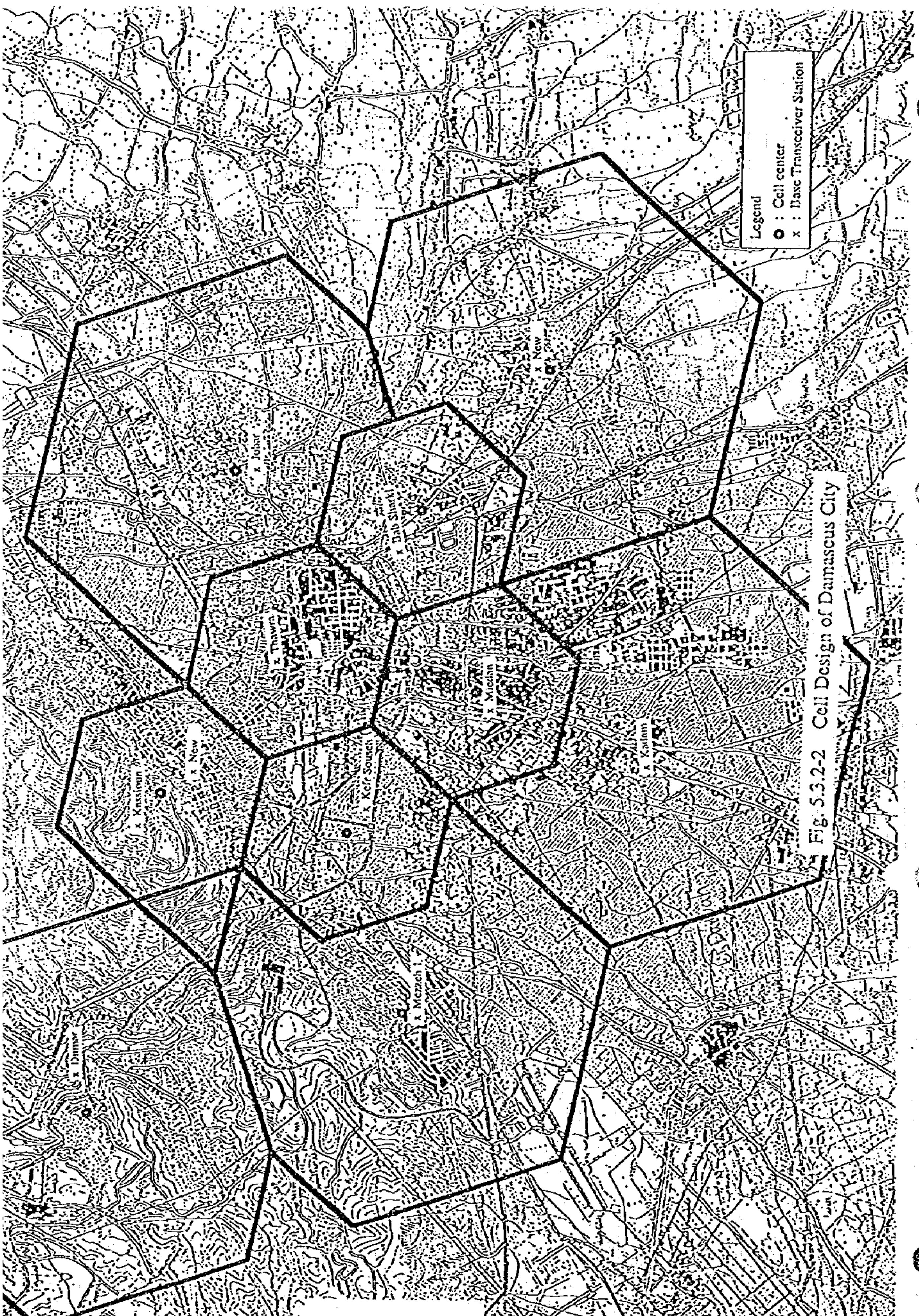


Fig. 5.3.2-2 Cell Design of Damascus City

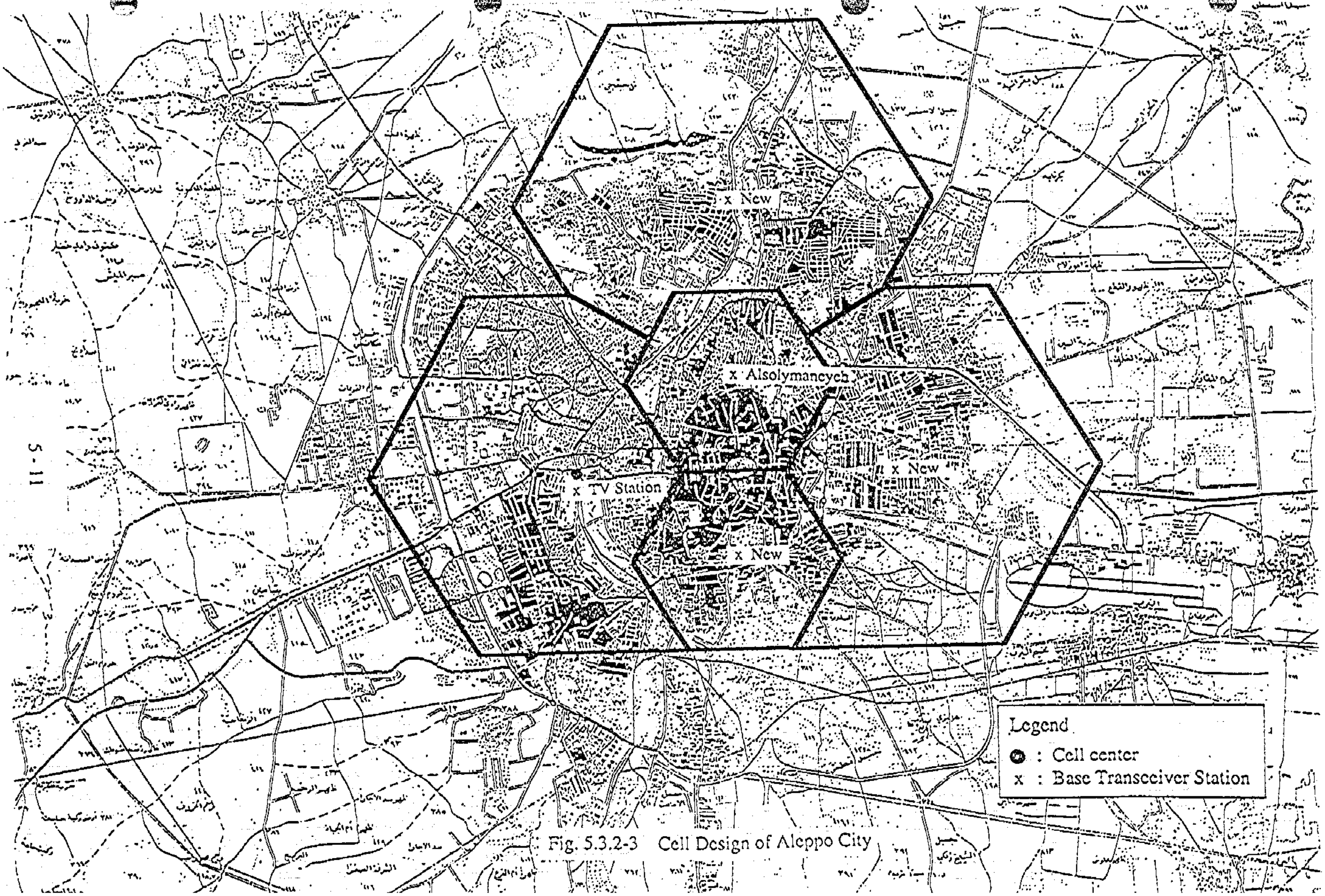


Fig. 5.3.2-3 Cell Design of Aleppo City

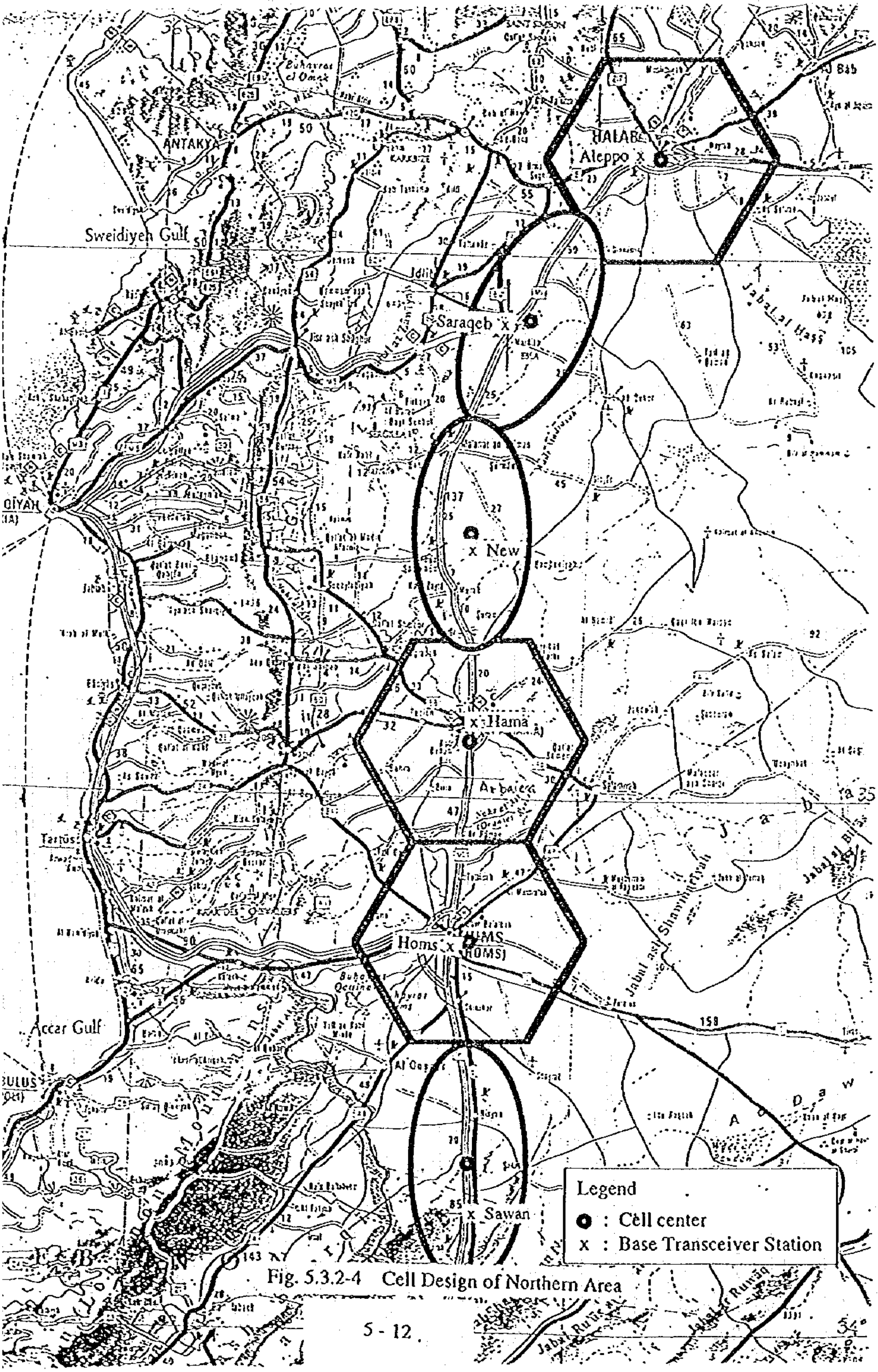


Fig. 5.3.2-4 Cell Design of Northern Area

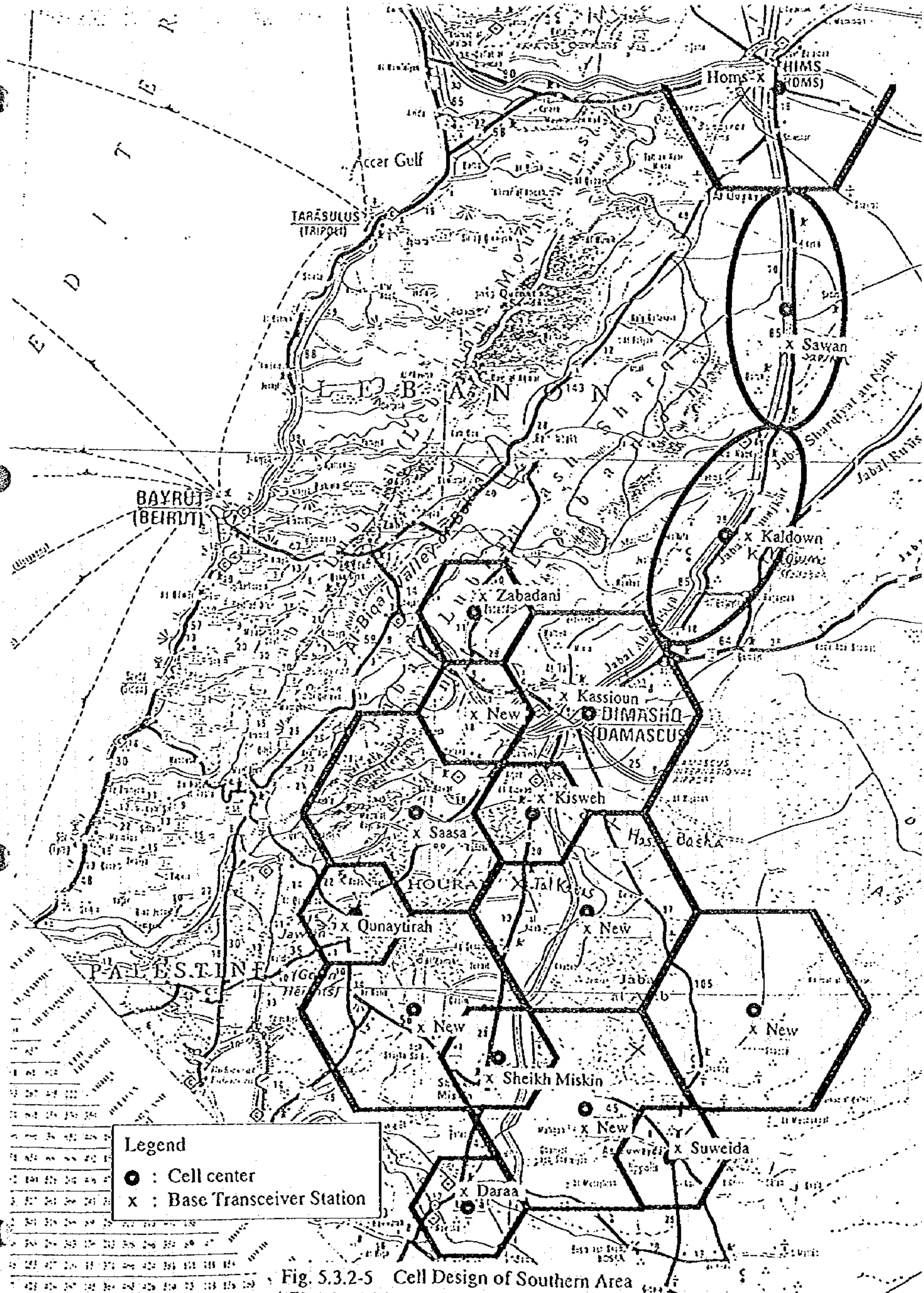


Fig. 5.3.2-5 Cell Design of Southern Area

(3) Designing Number of Transceivers

In GSM system a radio frequency (RF) channel, which is transmitted by transceiver (TRX), has eight channels. They are used for traffic channels (TCHs) and control channels (CCHs). Based on the condition of 2 % of grade of service and 0.04 erlang per subscriber of calling ratio, the capacity of a set of transceiver is assumed as shown in the Table 5.3.2-1.

The number of transceivers (TRXs), which is shown in the Table 5.3.2-2, is designed to be sufficient for the estimated subscribers.

Table 5.3.2-1 The number of subscribers that can be handled by a set of TRXs

No. of TRX	No. of Subscribers
1	62
2	183
3	320
4	465
5	615
6	769
7	925
8	1,083
9	1,242
10	1,402
11	1,564
12	1,726

5.3.3 Entrance Link between BSC and BTSs

The traffic channels (TCHs) and the control channels at each BTS shall be connected to the base station controller (BSC). For this purpose 2 Mbps circuits between BSC and BTSs, the entrance link, shall be designed. Figure 5.3.3-1 shows the configuration of the designed entrance link network for nation wide. The entrance link within Damascus is shown in Figure 5.3.3-2.

Table 5.3.2-2 The number of RF channels and subscriber capacity of the Stations

No.	Area	Name of the Station	Cell radius (km)	Type of cell*	RF ch / Sector A	RF ch / Sector B	RF ch / Sector C	Subs. capa-city	No of ch	2 Mbps (30ch)
1	Damascus	Al Thawra	1.5	3-sec	4	4	4	1,512	84	2
2		Kefr Souseh	1.5	3-sec	4	4	4	1,512	84	2
3		Bab Sharki	1.5	3-sec	4	4	4	1,512	84	2
4		Miedan	1.5	3-sec	4	4	4	1,512	84	2
5		New	1.5	3-sec	4	4	4	1,512	84	2
6		Mezzeh 1	3	3-sec	4	4	4	1,512	84	2
7		Kadam	3	3-sec	4	4	4	1,512	84	2
8		Jobar	3	3-sec	4	4	4	1,512	84	2
9		Dumar	3	3-sec	4	4	4	1,512	84	2
10		New	3	3-sec	4	4	4	1,512	84	2
11		Kassioun	24	3-sec	5	5	5	1,983	105	2
12	Aleppo	Alsolymaneyeh	1.5	3-sec	5	5	5	1,983	105	2
13		New	1.5	3-sec	5	5	5	1,983	105	2
14		New	3	3-sec	4	4	5	1,669	91	2
15		New	3	3-sec	4	4	4	1,512	84	2
16		TV Station	24	3-sec	5	5	5	1,983	105	2
17	Highway	Saraqeb	24	2-dir	3	3		702	42	1
18		New	24	2-dir	3	3		702	42	1
19	Hama	Hama	3	3-sec	9	8	8	3606	175	3
20	Homs	City Center	3	3-sec	4	4	4	1,512	84	2
21		Wadi Al Thahab	3	3-sec	4	4	4	1,512	84	2
22		TV Station	24	3-sec	5	5	5	1,983	105	2
23	Highway	Sawan	24	2-dir	3	3		702	42	1
24		Kaldown	24	2-dir	3	3		702	42	1
25	Zabadani	Zabadani	12	3-sec	3	3	3	1,053	63	1
26		New	12	3-sec	3	3	3	1,053	63	1
27	Southern Region	Kisweh	12	3-sec	3	3	3	1,053	63	1
28		Saasa	24	3-sec	3	3	3	1,053	63	1
29		New	24	3-sec	3	3	3	1,053	63	1
30		New	24	3-sec	3	3	3	1,053	63	1
31		New	24	3-sec	3	3	3	1,053	63	1
32		New	24	3-sec	3	3	3	1,053	63	1
33		Shaykh Miskin	12	3-sec	3	3	3	1,053	63	1
34	Suweida	Suweida	12	3-sec	6	5	5	2,143	112	2
35	Daraa	Daraa	12	3-sec	6	6	6	2,463	126	2
36	Qunaytirah	Qunaytirah	12	3-sec	3	3	2	907	56	1
		Total						52,533		

*Note) 3-sec: three sectored antenna
2-dir: two directional antenna

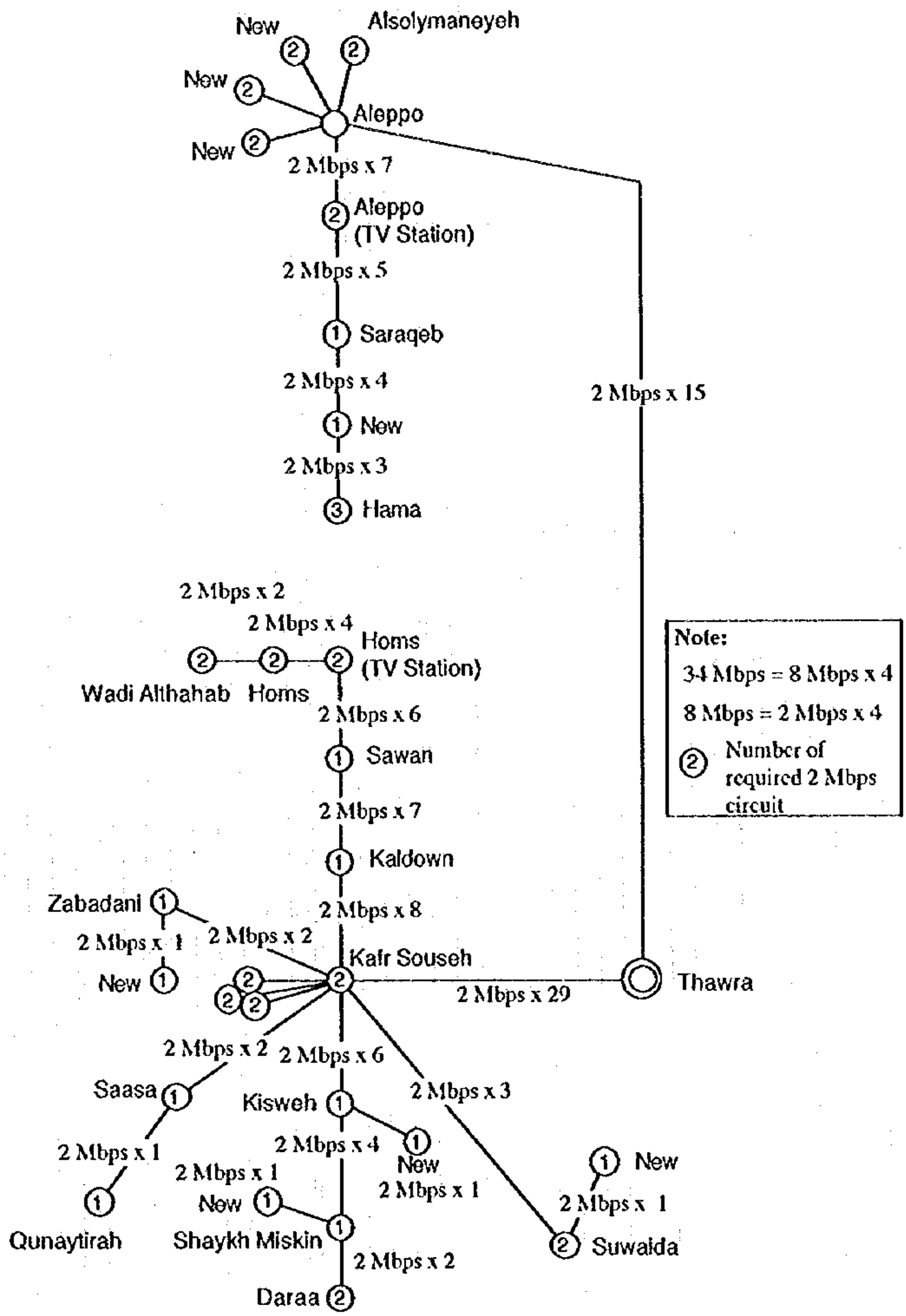


Figure 5.3.3-1 Entrance Link Network

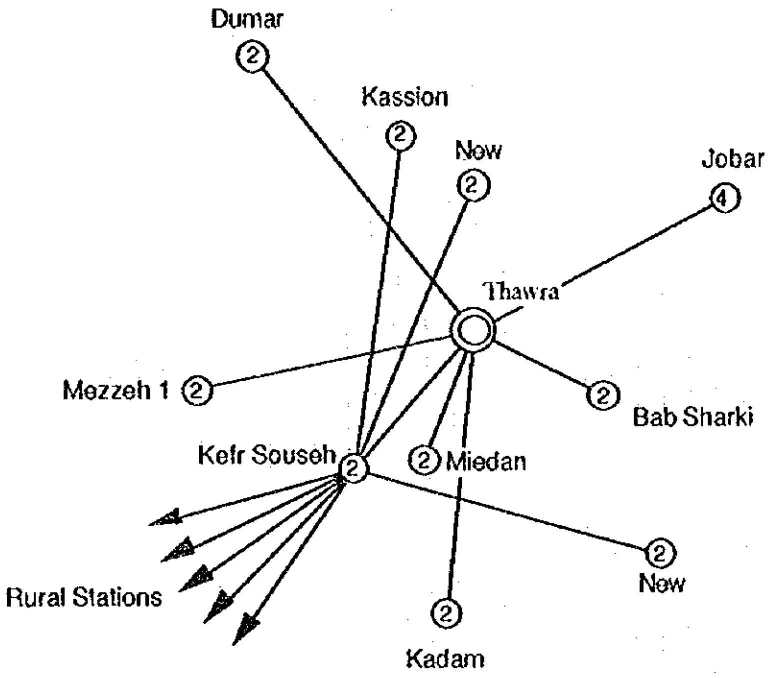


Figure 5.3.3-2 Entrance Link Network for Damascus City

Based on the design of the entrance link network shown in Figure 5.3.3-1 and Figure 5.3.3-2, the system configuration that explains required multiplexers and transmission media shall be designed. An example of design is shown in Figure 5.3.3-3, "Configuration of Transmission Network (1) - (3)."

As Figure 5.3.3-3 shows the number and type of transmission equipment at each station, the cost of the transmission network can be estimated based on it.

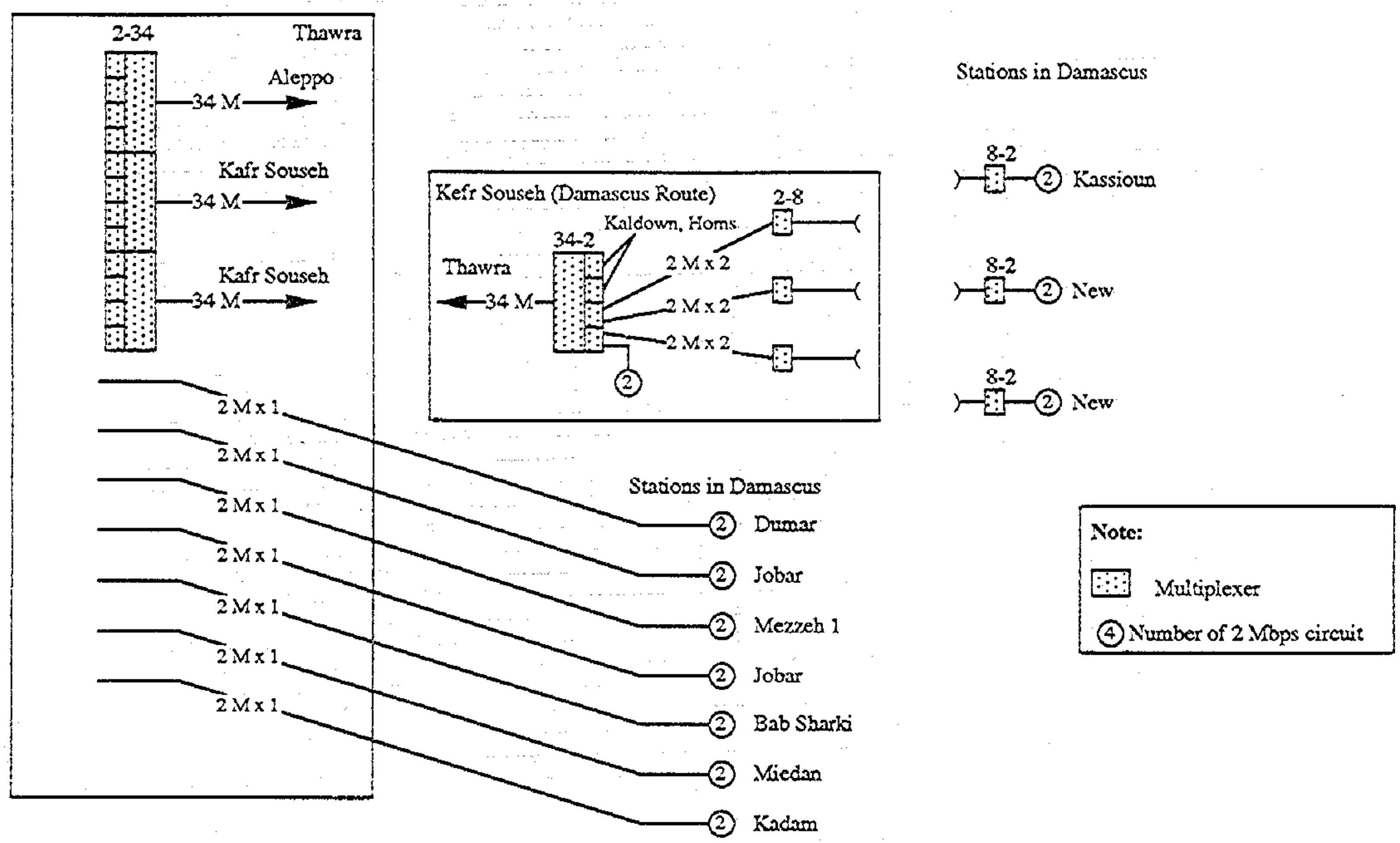


Figure 5.3.3-3 Configuration of Transmission Network (1)

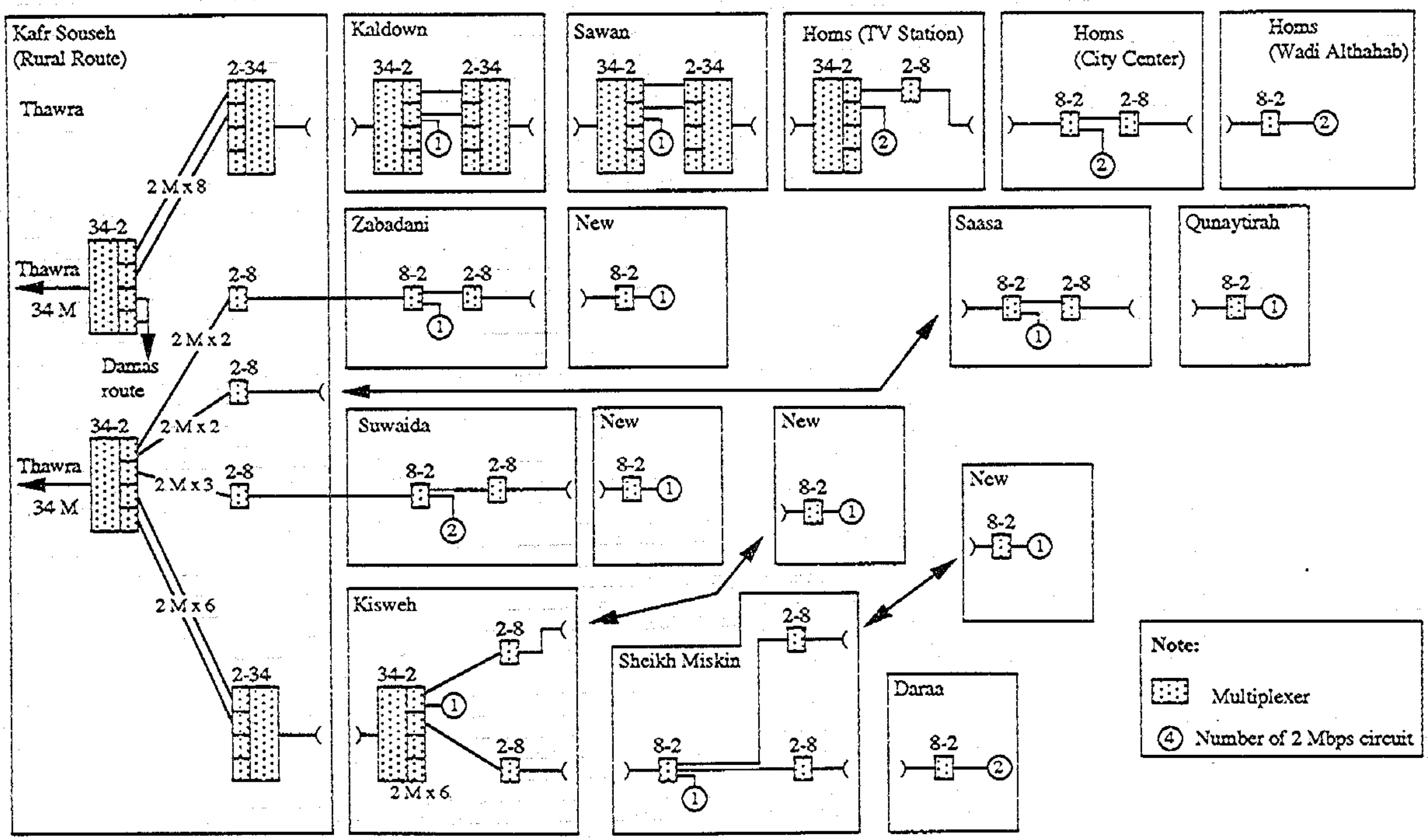


Figure 5.3.3-3 Configuration of Transmission Network (2)

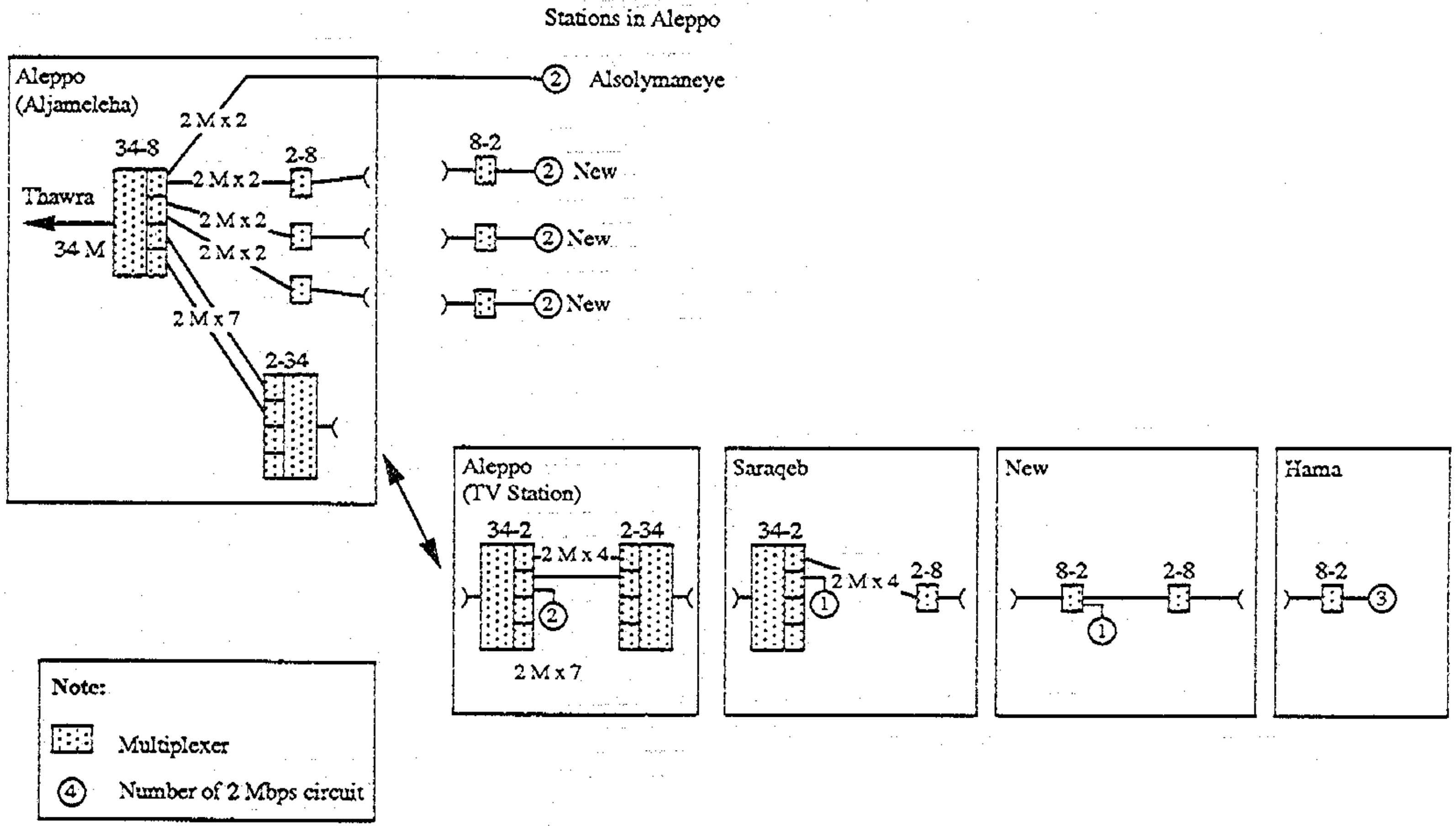


Figure 5.3.3-3 Configuration of Transmission Network (3)

5.4 Numbering Plan

The telephone number is one of limited resources. Therefore the numbering of mobile telephone shall be sufficient to cover the number of subscribers in the long future, and at the same time it should be planned not to exceed more than the sufficient.

For accessing mobile network, the access number shall be "090," and the number from "091" until "099" shall be reserved for future new services, as is stated in Paragraph 3.4.1.

The estimated number of subscribers in whole Syria in the year 2000 is 69,857, as is shown in Table 5.2-1. Although five digit number looks enough for the subscribers of the year 2000, at least six digit number shall be assigned for the expected mobile telephone service. In the future when the number of subscribers increases near to 1,000,000, seven digit number shall be adopted.

As a result, the telephone number of the call to a mobile subscriber is planned as follows:

Access Code	Subscriber Code
090	XXXXXX

The above mentioned subscriber code should better contain the area identifier for administration purpose.

The numbering plan of the mobile telephone service is described in Paragraph 3.4.1.

5.5 Building and Power

MSC and other central equipment, such as Home Location Register (HLR) and Equipment Identity Register (EIR), is planned to be installed in Al Thawra station. The billing center is also planned in the same building.

Most of BTSs are located at the existing STE building, i.e., telephone offices and microwave stations. To give appropriate coverage of the mobile telephone service, some BTSs are planned at the place where there is no STE building.

The positions of the planned new stations in Damascus are shown in Figure 5.3.2-2, "Cell Design of Damascus City," and ones in Aleppo are shown in Figure 5.3.2-3, "Cell Design of Aleppo City." As these planned new stations are in populous area, BTSs are assumed to be located in rented spaces.

On the other hand, the new stations in rural area are assumed to be located in buildings newly built by STE.

The required size of space at each station can be estimated based on the BTS equipment designed in Table 5.3.2-2, "The number of RF channels and subscriber capacity of the Stations" and transmission equipment designed in Figure 5.3.3-3, "Configuration of Transmission Network." The final result of the required space is shown in Paragraph 8.2.

The cost of the space is estimated based on following conditions. In the case that the mobile system occupies space in an existing STE telephone office, the cost is calculated by 8,500 Syrian Pound/sq m. In the case that the mobile system occupies space in a microwave station, the cost is calculated by 10,000 Syrian Pound/sq m. The final result of the cost calculation is shown in Table 11.2.2-1, "Cost for Mobile Telephone System," in Paragraph 11.2.2.

The required amount of power at each station also can be estimated based on the BTS equipment designed in Table 5.3.2-2, "The number of RF channels and subscriber capacity of the Stations" and the transmission equipment designed in Figure 5.3.3-3, "Configuration of Transmission Network." The required power equipment at each station is designed based on the required amount of power at each station. Then the cost of power system can be estimated. The final cost estimation in Table 11.2.2-1 includes the cost of the power system calculated in said manner.

5.6 Billing plan

The tariff is the base of billing for the mobile service. The tariff is related to the prosperity of the service and it influences the growth of it, as well. There are varieties of the tariff structure. Here we show some examples of tariff structure for the reference purpose.

(1) Price of a Mobile Terminal

Normally the selling price of goods are decided by adding reasonable margin to the purchased price. The price of a mobile terminal can be decided in this way, which will be from several hundreds U.S. dollars to about one thousand U.S. dollars. If the price is reasonable the number of subscriber will increase soon.

There is another way to decide the price. On the assumption that the subscribers of the mobile telephone service can afford high price, the price can be set high politically to cover a part of cost of the mobile system. The price of a terminal may be several thousands U.S. dollars. The operator may get return of investment soon, if the number of subscribers keep on increasing. However, high price prevent increase of subscribers.

The third method is mix of the above two. The price is set high at the beginning and it is gradually reduced later on.

The price of the mobile terminal shall be decided cautiously, considering the social economic condition of the society and the profit condition of STE.

(2) Subscription Fee

Subscription fee is an initial and one-time charge at subscribing the mobile telephone service. It shall cover a part of cost of the whole mobile system and the cost of registration procedure of the terminal. In a country where the mobile telephone service is popular, the subscription fee is several tens of U.S. dollar.

There may be an idea that subscription fee shall be set high so that the operator shall get early return of investment. However, the relation between the price and increase speed of the subscriber shall be considered on deciding the subscription fee.

(3) Monthly Fee

Monthly fee is a fixed monthly charge, and it is usually 20 - 30 U.S. dollars in a country where the mobile telephone service is popular.

(4) Air-time Fee

Air-time fee is the charge proportional to the usage of the mobile service. The charge can be set in several categories:

- depending on the distance of destination,
- depending on the day time when the call is made, such as day-time, not-busy hours, and on holiday.
- depending on the type of the call, i.e., originating call or receiving call.

In some countries the mobile subscribers are charged only for originating calls, on the other hand in the other countries they are charged for receiving calls as well.

(5) Special Features Charge

There are many supplementary services in GSM besides basic services, such as

- Call Offering,
- Call completion, and
- Call restriction

The monthly charge of each service is normally from two to three U.S. dollars.

5.7 Customer Service and Management

As is stated in Master Plan and also in Paragraph 5.3.1 of this document (Network Configuration), a billing system for the mobile telephone network should be installed separately from one for PSTN in order not to add an additional burden on the existing one.

It is needless to say that there should be an organization in STE for providing the mobile telephone service. It is preferable that the organization is established solely for mobile telephone service independent of the organization of the PSTN, because the service is new and needs unique procedures.

To provide a good service and to maintain the quality of the service, the persons newly assigned to the organization of the mobile telephone service need to be trained.

Here we show a sample of the organization of the mobile telephone service and their functions. Although this organization plan stated here is an example, we itemize almost all the necessary functions. Some functions can be rearranged among the sections.

(1) Administration section

This section handles the administrating matters of the mobile telephone organization, such as, personnel matters, account and finance matters, and contract matters.

(2) Engineering section

Here in this study the implementation is planned in 1998, but the system needs more expansion and it should expand according to the demand. In other words, the mobile system is ever expanding system.

The function of the engineering section is to analyze the existing condition of the system and the demand for the mobile telephone service, to make plans of expansion, and to execute the implementation plan.

The section shall analyze the traffic data and assess whether the present facilities at each station are enough or not. It shall analyze the sales condition and the demand for mobile service at each region/area. Based on the analysis it shall make a expansion plan, considering also the financial condition. Then it shall prepare for a tender and carry out the tender. After the conclusion of the tender, it supervise the installation work.

The section carries out the above jobs cyclically.

(3) Marketing/Sales section

The function of the marketing and sales section is to sell the mobile telephone terminals as much as possible to make the service profitable. It can be said that the profitability of the mobile telephone service depends on the number of terminals sold.

The mobile terminal can be sold not only by STE but also by the third parties consigned by STE. There are countries where the terminals are sold freely.

However, different from a normal telephone set, which does not have an identity, the mobile telephone system does not allow the terminal that is not registered in the system to make a call to prevent an unauthorized call. Therefore a new mobile terminal, or its subscriber identity module (SIM) that is mounted in the mobile terminal should have their identity registered in the central equipment of the mobile telephone system so that the terminal can be identified as an authorized subscriber of the system.

Either the retail counters have to sell the mobile terminal with the subscriber's identification, or the new subscribers have to come to a registration office, which will be operated by customer service section, to have SIM registered in the system. One of methods would be that each retail counter has a data input terminal to register the identity on the mobile terminal, but it would cost much. Another method is to have a data input terminal in the registration office at each major city, such as Damascus, Aleppo and Homs. The retail counter that does not have the data terminal shall communicate with the registration office.

(4) Customer service and billing section

The function of the customer service billing section is to maintaining the information of the subscribers and their terminals (or subscriber identity module: SIM), working together with the marketing/sales section, and to bill the subscribers.

The section receives information of the new terminals and of the new subscribers from the sales section, and inputs the data into MSC, because the terminal cannot be recognized as an authorized one unless its identity is registered in the central equipment. If in the future a customer changed their service condition, the section shall revise the data.

The section shall be in charge of billing. The billing is essential for getting income of the mobile telephone service. The subscribers should be accurately charged based on the type and the amount of usage and the invoice bill should be issued on schedule.

The section is also in charge of delivering the invoice bill printed by the billing center to the customers and of collecting fee from them. They shall monitor the payment of them and shall take warning action or penalty action to the subscribers who delay the payment exceeding to certain limit of time.

(5) Operation and maintenance section

The function of the operation and maintenance section is to monitor the system and to take necessary action at the necessary moment. Their function consists mainly of following five issues:

Equipment management	It includes to monitor the equipment, to maintain the equipment, to recognize malfunctioning and to record it, to diagnose it and to locate the cause of it, to restore the function, and to execute periodical check up as preventive activity.
Network configuration management	It includes to set up the connection among equipment and to set parameters, in order to maintain the equipment at the best condition
Billing management	It includes to manage the data of subscribers regarding charging and billing.
Service quality management	It includes to monitor the quality of the service, and to reconfigure the system in order to improve the quality.
Security management	It includes to manage the parameters and algorithm in order to prevent unauthorized accesses to the mobile telephone network or unauthorized use of it.

The operation maintenance center (OMC) for the mobile telephone service should be established in Al Thawra telephone office, and a branch office shall be established at Aleppo for quick recovery from the failure at remote stations. . The working condition of OMC is 24 hours a day, 7 days a week, 365 days a year, in shift working scheme. Thirty-five (35) staffs are estimated to be required including for the branch office.

CHAPTER 6 PACKET SWITCHED DATA NETWORK (PSDN)

6.1 Introduction

The scope of the Feasibility Study (F/S) on Packet Switched Data Networks covers;

- the evaluation of forecast figures for PSDN based and related services,
- the evaluation of the present PSDN,
- the development of a rough overall concept for data communications,
- concrete steps to provide for PSDN based services and
- a proposal for various tasks and projects to meet new requirements in data communication.

The F/S on PSDN can only be developed within a consistent concept (framework) for satisfying the up-coming demand in data communications considering all data services and platforms and their role in such a concept. Services and platforms that have to be considered beside the PSDN are at least Leased Lines (LL) platform and ISDN. Also new technologies, services and interfaces such as FR, B-ISDN and ATM have to be considered.

The main factor that drives the development of a consistent concept for data communication is of course the demand forecast for data communications services.

However, reliable forecast figures are almost impossible. These figures not only depend on customers need for data communication (to connect computers and LANs, to have access to computers and services such as Internet and E-mail etc.) but also depend on regulations and tariffs. A concept must therefore be flexible enough to cater for various services and growth rates as demand requires.

A concept must also take into account international trends in data communication but always keep in mind the national environment (national specifics).

The F/S for Data Networks in general and for PSDN in particular may be very different to other parts of the F/S (e.g. the PSTN part). There are a number of reasons for this fact:

- Demand forecast is less precise
- Demand is depending on many legal and administrative factors
- Technology is changing more rapidly
- There are normally a number of alternatives for data communication

- Time for provisioning can be kept relatively short (existing infrastructure will normally be used (e.g. existing Transmission Network))

As a consequence a F/S should not and can not deal with all details of network configurations, installations and expansions for a long period. Many activities are "on demand" activities. In addition it may not necessary to deal with all technical and operational aspect because a PSDN has already been introduced by STE and operational and technical procedures have already been defined and established. These aspects will be explained in more detail later.

6.2 International Trends in Data Communications

Today packet switching is still the most accepted technology for data communication. PSDNs are in operation in all developed countries and many of the developing countries. They are based on well defined and accepted standards (e.g. X.25, X.75) and hence provide for the most common platform for international data communication.

However, trends to higher bandwidth (up to nx64 kbit/s and higher, e.g. for LAN interconnections) can be observed. Technologies for high bandwidth in WANs are available now for broadband applications (FR, MAN (SMDS), ATM (B-ISDN)).

In addition for many applications there are now alternatives to PSDNs available. In countries where ISDN has been deployed a considerable portion of data communication has moved or will move from PSDN to ISDN. ISDN is used and will be used for many reasons and applications, e.g.

- as a platform to supports end-to-end data communication transparently up to nx64 kbit/s,
- as back-up for leased lines,
- as access network to a PSDN,
- others.

On ISDN, data can be conveyed using the B-channel and/or the D-channel. Interconnections between ISDN and PSDN have been standardized, e.g. the Packet Handler Interface.
In particular the usage of the D-channel for data communication is very economic because it means the usage of free capacity of existing access lines. (It should be kept in mind that dedicated access lines (local loops) for data communication are very often the dominating cost factor.)

These trends and new means for data communication have changed the demand for services based on packet switching technologies, i.e. the service based on PSDNs. As a result, there is a

- decrease of demand for bitrates < 19.2 kbit/s,
- increase of demand for bitrates >= 64 kbit/s,
- decrease of importance of PSDN,
- increase of demand for data communication in ISDN
- demand for ISDN-PSDN interworking.
- increase of demand for FR
- increase of demand for ATM (many carriers have started in 94/95/96 with commercial services based on ATM)

Typical applications for data communication in a PSTN are those requiring access to one or several destinations for short periods of time with very low bandwidth requirements. With ISDN the bandwidth limits will be relaxed to some extent. Typical applications for data communication in a PSDN are those requiring access to one or several destinations for lengthy periods of time with low bandwidth. Leased lines are suitable for those applications requiring access to one destination for lengthy periods of time with medium to high bandwidth requirements.

Some services which do not belong to the traditional "PSDN" services have been added to some PSDNs in the meantime, e.g. FR. Also some effort is under way to enhance PSDNs towards higher bandwidth. But in general it is said that the importance of PSDNs will decrease.

6.3 Demand Forecast for Syria

The international trends can not be applied to Syria without taking into account the special situation in Syria concerning data communications. However international trends will help to better forecast the medium and long term demand.

Demand forecast for Syria should be based mainly on

- STE's experience since the introduction of the PSDN (demand over the past 2 years),
- the forecasts of economy development,
- forecasts in the area of computer penetration (PCs, LANs, Workstations etc.) and
- forecasts of STE's internal demand (STE is probably the largest user of the service).

Beside the input mentioned above there are other factors which may influence demand for data communication in general and the demand for services based on a specific platform (here the PSDN). Some of these factors are:

- Regulatory constraints
- Tariffs
- Existence of alternative means

It is assumed that the trend in Syria will in principal follow the trend which can be observed in developed countries. Time gap may be up to 4-5 years.

The anticipated trend in Syria is depicted in Figure 6.3-1.

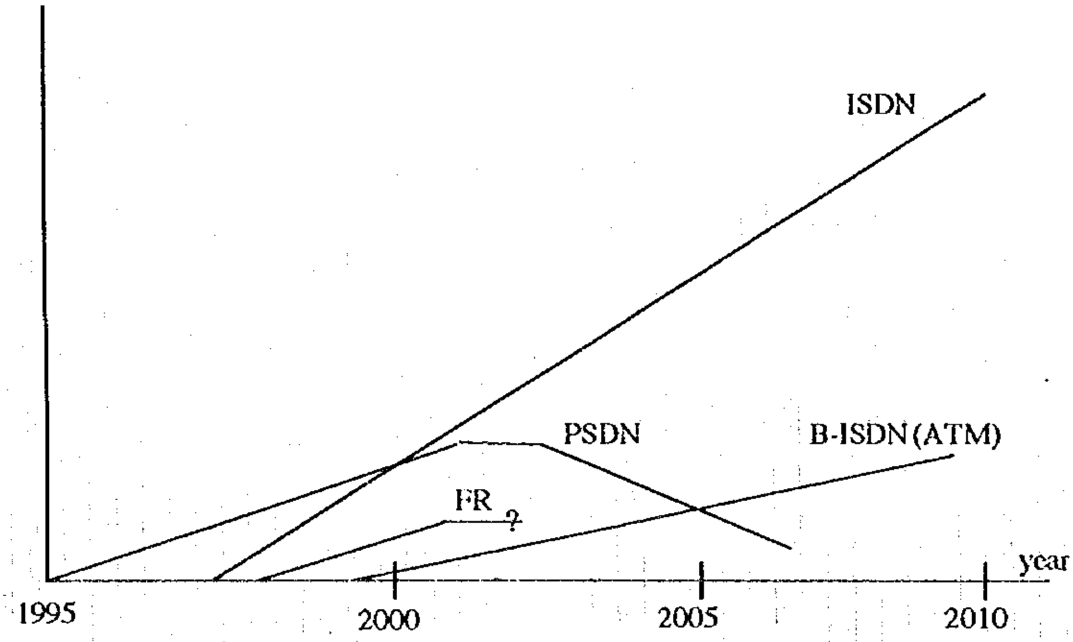


Figure 6.3-1: Possible Trend in Data Communication in Syria

Notes:

- Trend for ISDN does not take into account pure telephone service.
- Trend for FR is not clear
- LL services are not included

It must be clear that forecast figures (in particular the long term figures (>5 years) are not reliable and may deviate by several 100% from real demand. Hence these forecast figures can only be used for strategic planning (new technologies, new services) and long term budget allocation. For concrete network (capacity) expansions the concrete increase of demand and traffic has to be observed as on ongoing planning process. Expansions will in principal not cover more than a 2 years period.

This short period is feasible and reasonable because lead time for provisioning can be kept very short if expansions are within certain physical limitations of the network. This point will be elaborated later in this section.

Forecast Figures

The forecasted figures of the Master Plan (MP) have been evaluated. In principal, the figures are still valid (Table 6.3-1) and the Study Team has herein classified according to Bandwidth and Access Type, as is shown in Table 6.3 - 2.

Based on the international trends and the anticipated trend for Syria it is assumed that the peak traffic in the PSDN with bandwidth < 64 Kbit/s will be reached after year 2000 but before year 2005. That means that the usage of the PSDN will decrease (perhaps slowly) sometimes after year 2000. Other networks will more and more take over data communication.

Table 6.3-1 PSDN, Forecasts according to Master Plan (including STE's requirements, internal demand)

Port type	1995	2000
Dedicated access:	90	270
Dial-up access:	15	350*

Notes:

- * D-channel access (B-channel access) included

Table 6.3-2 PSDN, Forecast according to bandwidth and Access Type

Bandwidth, Synch./Asynch., Rec.	Dial-up/Leased Lines	1995	2000
1.2 to 19.2 kbit/s, asynch., X.28			
	Dial-up customer	15	250*
	LL ports	68	200
2.4 to 19.2, synch., X25			
	Dial-up cust., X.32	0	45
	LL ports	22	50
64 kbit/s, synch., X25			
	Dial-up cust., X.32	0	50*
	LL ports	0	15
nx 64 kbit/s, synch., X.25			
	Dial-up cust., X.32	0	5*
	LL ports	0	5

Notes:

- * Access and interworking from and with ISDN included
- Figures are only valid if access from and interworking with ISDN and access types will be supported

Table 6.3-3 Forecast for FR

	1995	2000
nx 64 kbit/s up to 2 Mbit/s	-	50

Demand forecasts for ATM-based services are very vague at this time because they are still under development and even the standardization process has not been finished. However many trends can be observed and also many carriers have already started to offer ATM-based services. The trends can be illustrated by some statements and figures:

- ATM is the telecoms technology of the future
- ATM will dominate the market in 10 years
- The number of ATM edge switches will increase from about 140 in the year 1995 to more than 4000 in the year 2000 in Europe (growth rate of about 100%)

Main service areas are:

- Native end-to-end ATM services at the speed from (2 Mbit/s) 34 Mbit/s to 155 Mbit/s (e.g. for Multimedia applications)
- PBX and LAN interconnections
- Frame Relay

- Managed Bandwidth Service (explained in more detail later)
- Internet gateway access
- Video on demand (may not be within the portfolio of every carrier)

Table 6.3-4 gives forecasted figures for the first service area (native end-to-end service).

Table 6.3-4 Forecast for ATM (native interfaces)

	1995	2000
>= 2 Mbit/s	—	5

Leased Line services can be divided into "simple LL" and "value added LL" services. The latter are known by various service names such as "Managed Bandwidth Service (MBS)." The former are normally only based on existing transmission infrastructures, the latter normally require a dedicated platform because they offer value added features such as permanent end-to-end supervision, rerouting in case of failures etc. Table 6.3-5 gives forecast figures for a MBS, the table does not include "simple LL" service.

Table 6.3-5 Forecast for Leased Lines (Managed Bandwidth Service only)

	1995	2000
< 64 kbit/	*220**	150
>= 64 kbit/s	—	220

Notes:

- * For information only (analog LL according M.1020, not MBS)
- From year 2000 only digital LL

6.4 Present PSDN, Network Structure and Configuration (as of March 1996)

Name:	SYRIAPAC
Network in operation for trial:	End of 1993
Network in operation for service:	End of 1994
Contractor:	Gandalf
Manufacturer:	OST

6.4.1 Network Configuration

Type of devices, locations and quantity:

Primary and Secondary Nodes:	ECOM25M, ECOM25L and APX76
Multiplexer (concentrator)	XMUX and 1 Access Server
Modems:	Baseband, 2w (64 kbit/s)
	Baseband, 2w, (19.2 kbit/s)
	V32, 2w, (9.6 kbit/s)
	V32bis, 2+4w, (9.6 kbit/s)
	V22bis, 2w, (2.4 kbit/s)
	V29, 4w, (9.6 kbit/s)

Locations:

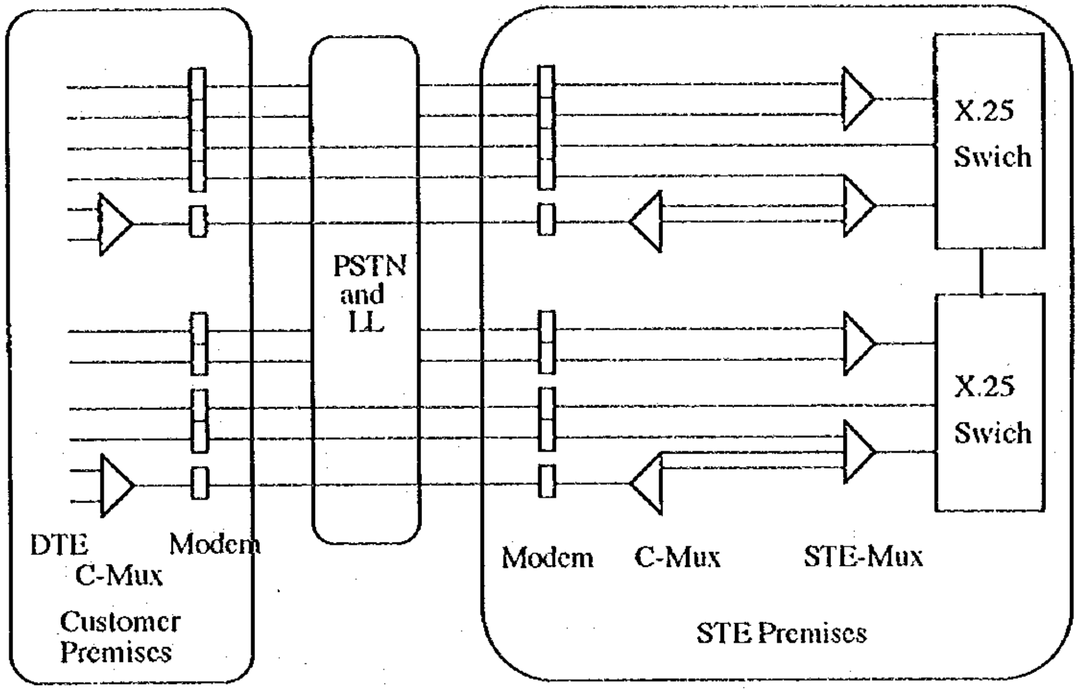
Switches nodes/sites:

Damas00:	1 ECOM25M (40 ports), 1 APX76
	1 ECOM25L (co-located and connected with/to Damas00)
Damas01:	1 ECOM25M (40 ports), 2 APX76
Damas00 and 01 co-located	
SSRC	1 ECOM25L (connected to Damas01), 1 AccessServer
Aleppo:	ECOM25M (40 ports), 2 APX76

Damas switches are connected with each other via 64 kbit/s leased lines,
Aleppo switch is connected to both Damas switches via 9.6 kbit/s leased lines.
16 XMUX connected to switches mainly via 9.6 kbit/s leased lines. Nearly all of them are installed at STE's premises in 13 cities.

Beside the multiplexer (concentrators) mentioned above there are also some multiplexers in the network which are owned and provided by the customer. These concentrators avoid the otherwise necessary higher number of access lines. Any type of concentrator may be provided by the customer. Figure 6.4-1 shows possible access means.

From a maintenance and quality of service point of view it is nor advisable to use equipment that is provided by the customer because it results in a decrease of quality of service (availability). It is therefore recommended that STE deploys only equipment which is under its full control/responsibility (supervision, maintenance, spare parts etc.).



STE-Mux: Mux (concentrator) owned by STE (e.g. XMUX)

C-Mux: Mux (concentrator) owned and provided by customer

Figure 6.4-1 PSDN Access Network Configuration

6.4.2 Port Profile (switches and concentrators)

Table 6.4-1 gives a summary of port allocations (March 1996). Ports are classified according to their

- usage (customer ports or other ports),
- type (dial-up or leased line),
- and speed (1.2 up to 64 kbit/s).

Table 6.4-1 Port Profile (March 1996)

Number of customers:	~50	
Customer/user ports (lines)		
Dial-up, X.28, ports	10 (15 subscriber)	2.4 kbit/s
Dial-up, X.25	0	
Leased Line ports, X.28	11	1.2 kbit/s
"	45	2.4 kbit/s
"	6	4.8 kbit/s
"	6	9.6 kbit/s
Leased line ports, X.25 "	1	2.4 kbit/s
"	1	4.8 kbit/s
"	5	9.6 kbit/s
"	15	14.4 kbit/s
"	0	64 kbit/s
LL X.25/X.75 trunk and admin. ports		
Leased line X.25, X.75 ...	2	2.4 kbit/s
"	2	4.8 kbit/s
"	33	9.6 kbit/s
"	1	56 kbit/s
"	19	64 kbit/s
LL, X.28, admin	7	9.6 kbit/s
Dial-up, X.28	19	2.4 kbit/s

Notes: X.25 ports for customers are mainly configured for 16 channels.
X.25 trunk lines between Mux and switches mainly for 8 to 16 channels.
All figures may be inaccurate but they are sufficiently precise for further calculations.

6.4.3 Numbering Plan

X.121:

DCC: "417"

NTN: 5 digits

Network-Id:	"1"
Area/switch code:	2 digits
Device/line code:	2 digits

The numbering plan (although not very flexible) is appropriate for small networks.

6.4.4 Power Supply

220 V~, backed-up.
Not all equipment (although installed in STE premises) have backed-up power supply.

Recommendation: To increase the availability of the service, all network equipment installed at STE's premises should be provided with backed-up power supply.

6.4.5 PSDN Evaluation Summary

The installed PSDN equipment (switches, multiplexer etc.) is adequate for small networks. The anticipated increase in demand can be met by moderate network upgrades.

The reliability of the equipment itself is sufficient. However service reliability is not sufficient and should be improved at least in 3 areas:

- All PSDN equipment which is installed in STE's premises where back-up power supply is available should be provided with back-up power-supply.
- All equipment in particular modems and multiplexer should be provided by STE. They should be an integral part of STE's supervision and maintenance procedures. Currently, the customers are allowed to provide equipment of their own choice.
- Operation and maintenance procedures should be improved. Hot line and help desks functions should be also installed or improved.

6.5 Network and Migration Concepts

There are basically two options for how to proceed with implementing data networks in general and PSDN in particular.

- Replace existing PSDN ("Gandalf" technology) as soon as possible by new technology which allows for additional services, e.g. higher performance, higher bandwidth (>= 64 kbit/s), FR access etc. This network may also include LL requirements.

- Operate existing PSDN ("Gandalf" technology) for some more years (maybe even after year 2003) but prepare for a new Digital Data Network (new generation network NGN) which will meet the demand of the future (including new services), this network may also serve as the "LL platform." Existing PSDN will remain for some time as an access network for low bit rates (1200, 2400, 4800 and 9600 bit/s, Dial-up and leased line access). The preparation for new generation network should start in 96 or 97 but installation should not start until the need (demand) can be seen clearly. Of course a trial network can be installed before to gain experience in new technologies.

An evaluation of the present PSDN and the demand forecast has shown that the network can satisfy the demand for data communication services up to bit rates of 64 kbit/s for this five-year period and most likely thereafter. The network can be extended according to demand.

It is therefore recommended to select the second option with the advantage that

- the investments can be used further
- the expertise is available,
- there is more time to develop plans for a new generation network and to deploy that network thereafter,
- the NGN can concentrate on new services. The present PSDN serves as an access network.

Beside the dedicated PSDN, ISDN may play a significant role in data communication. Therefore ISDN-PSDN interworking has to be taken into account (as part of the ISDN or the PSDN project). Interworking should follow ITU Recommendation X.31 (Case A and/or B).

ISDN-PSDN interworking will be dealt with in more detail in a later clause.

6.6 Expansion of Present PSDN

The existing PSDN should be extended as required to meet customer demand because the lead time for provisioning can be kept very short (from a new weeks to several months at the maximum). However, two things are needed to keep the lead time short:

- Enough spare parts (not only for replacement of faulty parts but also for possible quick network expansions).
- A well introduced procedure to quickly order new parts (e.g. Modems, XMUX, FEPs etc.). A special contract with Gandalf to ensure Gandalf's quick delivery on STE's demand is helpful. This contract should cover a certain period (e.g. 4 years).

The upgrading of switches, installation of new switches, upgrading of concentrators, new concentrators, new or additional trunk capacity etc. will be dictated by

- customer demand,
- the necessity to improve the quality of service (e.g. reliability, throughput) and
- optimization requirements.

The expansion of the network is an ongoing planning process. Input for planning is mainly derived from customer demand (including the demand for new services) and the operation and maintenance activities.

Although it is foreseen that switches will be installed in the major 5 cities (in addition to Damascus and Aleppo in Homs, Hama and Lattakia), concrete actions have to follow the guidelines mentioned above. The decision whether or not a switch or a concentrator has to be installed is mainly dictated by some basic calculations, cost for a switch compared to costs for more leased lines. The same rule applies for the decision concentrator versus several access lines. There are also other aspects which may influence the decision such as perfomance, availability and network management (or operational) aspects.

Each switch should have trunk connections to 2 other switches. The trunk lines should, if possible, be routed on different transmission links.

For budget planning the following configuration expansion is assumed to meet the forecasted requirements:

3 ECOM 25L including FEPs, interface cards and software
1 ECOM 25M including FEPs, interface cards and software
8 XMUX (8 channels) including software

8 XMUX (16 channels) including software
10 additional FEPs and interface cards
600 Modems
All equipment including racks, cables etc.

Test Network

In a growing network with an increasing number of users it very often not possible to perform certain tests without the potential danger of disrupting the service (decrease quality of service, e.g. the availability). Tests include

- testing of new software (new releases),
- testing of new hardware components (devices) and
- interoperability test.

It is therefore desirable to install a separate small network beside the production network, a test network. However this has also an economic aspect. To limit the expenditures for a test network, it an be combined with the pool for spare parts (both spare parts for defect units and spare parts to react quickly on customer demands).

6.7 PSDN-ISDN Interworking

Data communication via ISDN can play an important role if the ISDN services are offered on a broad basis. The ISDN situation in Syria at the beginning of 1996 was as follows:

- 5 of 114 switches (all EWSD switches from Siemens AG) in 4 cities were equipped with ISDN ports (450 total ISDN ports)
- all new switches will support ISDN
- additional switches in business centers will be equipped with ISDN lines.

These ISDN figures and plans clearly show that ISDN will be available on a broader basis and hence ISDN has to be taken into consideration for data communication. In fact, as mentioned before, it is assumed that ISDN (B-ISDN) will totally change the data communication landscape at least for bitrates up to 64 kbit/s.

Data communication which is purely within ISDN (originating at an ISDN subscriber and terminating at an ISDN subscriber) is not of concern of any PSDN. All a subscriber needs, is an ISDN interface for his terminal to access his ISDN subscriber line (e.g. an ISDN card in his PC). Data communication is transparent for the ISDN and normally it is not necessary for a carrier to provide for extra ISDN resources. Also no specific technical enhancements are necessary in this case for STE to support data communication on ISDN unless STE wants to supply customers with ISDN interfaces such as terminal adapters.

Interworking between ISDN and PSDN is different to the scenario described above. Interworking

- allows an ISDN customer with an X.25 DTE (and a terminal adapter) to access the PSDN trough an ISDN
- allows communication between customers of the ISDN with customers of the PSDN
- allows an ISDN subscriber to use D-channel and/or B-channel for data communication

ISDN-PSDN interworking (interfaces and procedures) are defined in ITU Recommendations X.31 and X.32 (see Figure 6.7-1).

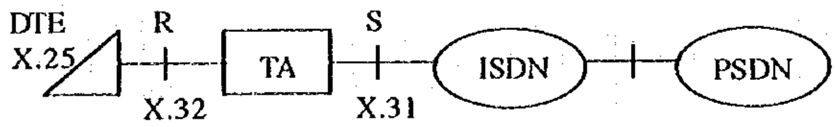


Figure 6.7-1 ISDN Reference Points

In principal 2 cases of interworking (A and B) have been defined in X31:

In case A, which is depicted in figure 6.7-2, only the B-channel can be used to access the packet switched service whereas in case B both B- and D-channels can be used.

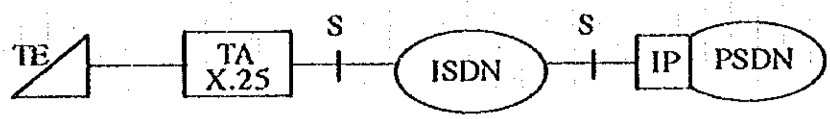
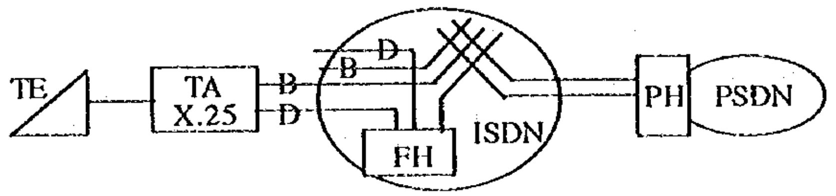


Figure 6.7-2 Minimum Integration of Packet Mode Services (Case A)

In case A (also called the "minimum integration" solution) ISDN offers a transparent 64 kbit/s channel as an access line to the existing PSDN. The connection is established in two steps. In the first step a circuit switched connection is established between the terminal adapter and the interworking port at the packet switch. After this step the ordinary X.25 connection set-up procedure follows.

Case B (or the "maximum integration") is depicted in figure 6.7-3. All services are offered under the ISDN number. User data may be transferred via either the B-channel or the D-channel (which was initially designed for transfer of signalling information between the terminal and the network).



FH: Frame Handler
PH: Packet Handler

Figure 6.7-3 Maximum Integration of Packet Services (Case B)

To support ISDN-PSDN interworking, additional network equipment has to be installed (e.g. Interworking Ports/Units (IP) and/or Frame Handler (FH) and Packet Handler (PH)). The FH is normally part of the ISDN switch, IP and PH are more separate units but very often part of a PSDN switch. Concrete solutions depend on the kind of interworking and the products available for the networks involved.

The number of ISDN-PSDN interworking products is today limited. But there are some products available suitable for STE's environment, e.g. FH and PH from Siemens AG.

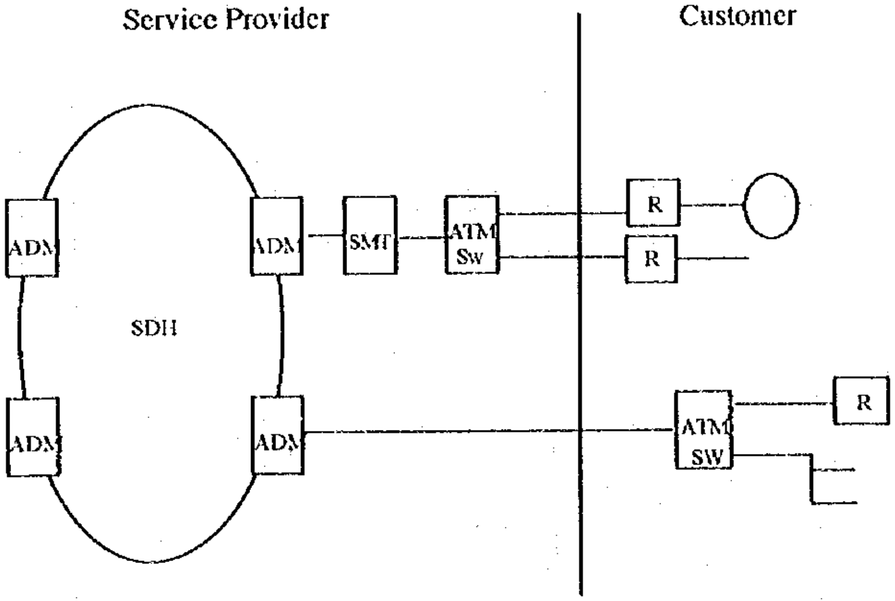
It is proposed to study ISDN-PSDN interworking in more detail and to launch a project on the subject matter with the aim to upgrade the networks accordingly.

6.8 New Generation Network (NGN)

The demand forecast shows that there is a requirement to support higher bandwidth and also additional interfaces such as FR. However demand forecast in this area is very vague and also no demand can be foreseen for at least the next 2 to 3 years. However it will take some time (possibly 18 to 24 month) to build up a new platform (network) and to put it into commercial operation. It is therefore proposed to start work on a new generation network in `96 or `97 at the latest. But any major investments should be avoided until the need for the new generation network (that means the demand for the new service) becomes more obvious. For high-level planning, including budget planning, it is assumed that demand will become obvious by 1998.

In a first step the ATM service could link government offices, universities and research facilities in Damascus, i.e. to install the platform for a "city information highway (CIH)." The CIH can be based on existing SDH structures. After this first step the trial should include some selected companies.

Figure 6.8-1 shows an example of a CIH configuration. Of course a concrete configuration will be more complex. It will also depend on the services that will be supported.



ATM Sw: ATM Switch
SMT: Synchronous Terminal Multiplexer
ADM: Add and Drop Multiplexer
R: Router

Figure 6.8-1: A CIH configuration example

Table 6.8-1 summarizes ATM services which should be included in the ATM trial.

Table 6.8-1 Native and Legacy ATM-Services

Services	Interface	Service-Characteristics
Legacy Services		
Transparent Connections	G.703/2.048 Kbit/s	
LAN-Bridging for 802.5 TR	802.3	Remote Bridging
LAN-Bridging for 802.3 Ethernet	802.5	Remote Bridging
LAN-Bridging for FDDI	FDDI	Remote Bridging
Frame Relay, FR	X.21/ 64K - 2 Mbit/s G.703/G.704	CIR 1024 Kbit/s and more
ATM-Services		
2 Mbit/s ATM	2 Mbit/s G.703/G.804	
34 Mbit/s ATM	34 Mbit/s G.703/G.804	
155 Mbit/s ATM	155 Mbit/s STM-1 electr./opt	
Service Classes as defined by ATM Forum		
CBR-Service		Peak cell rate, point-to-point, point-to-multipoint., asymmetric
VBR-Service		Peak- and sustainable cell rate, point-to-point, point-to-multipoint., asymmetric
ABR- and UBR-Services		Later, not in a first step
PVC-Service		
SVC-Service		Signalling according ATMF UNI 3.1, UNI 4.0 or ITU Q.2931

The work on NGN should follow the normal procedures beginning with more detailed studies on services and concepts. This approach also gives STE the chance to become familiar with new services and technologies at an early stage. A small test network (two or three small nodes with only a small number of ports) would help to gain necessary experiences with new technologies.

6.9 Platform for "Value Added" LL Services

A dedicated platform for "value added" leased line services is currently not available. STE is considering to launch a LL project (beginning with a small trial network).

"Value added" LL services (there are a number of different service names, e.g. "Managed Bandwidth Service, MBS") may include functions like

- automatic re-routing in case of failures (to increase availability)
- bandwidth on demand (quick response to customer requirements on bandwidth)
- end-to-end management
- Customer Network Management (CNM) services
- variety of interfaces (X.21, V.35, V.36, G.703, E1, T1, HDSL etc.)
- voice support
- protocol support (e.g. HDLC flag suppression)

These functions require a dedicated platform (a special network) based on Digital Cross Connectors (DXC) or similar switches.

The concrete scope of a MBS has to be studied.

Demand forecast may or may not justify to install a dedicated platform for leased line services. From a pure economic point of view a MBS might not be profitable but STE should be interested to extent its product range (service offers) and to gain experience in this area.

In principal the LL platform could be part of the new generation platform and hence these 2 projects can be combined.

However there might be some conditions to carry out the 2 projects separately, e.g.:

- A different time frame (MBS platform more urgently needed than new generation platform)
- MBS platform is often based on TDM technology, new generation platform will be based on cell/frame oriented technology

The risks to invest in non profitable platforms is relatively low because a small MBS platform is not expensive (depending on size about 200,000 $)

Later on the new generation platform may be used as backbone network for the LL platform.

6.10 Summary of Actions Items

This section summarizes the main actions identified in this chapter.

A possible rough schedule of the action areas is depicted in figure 6.10-1.

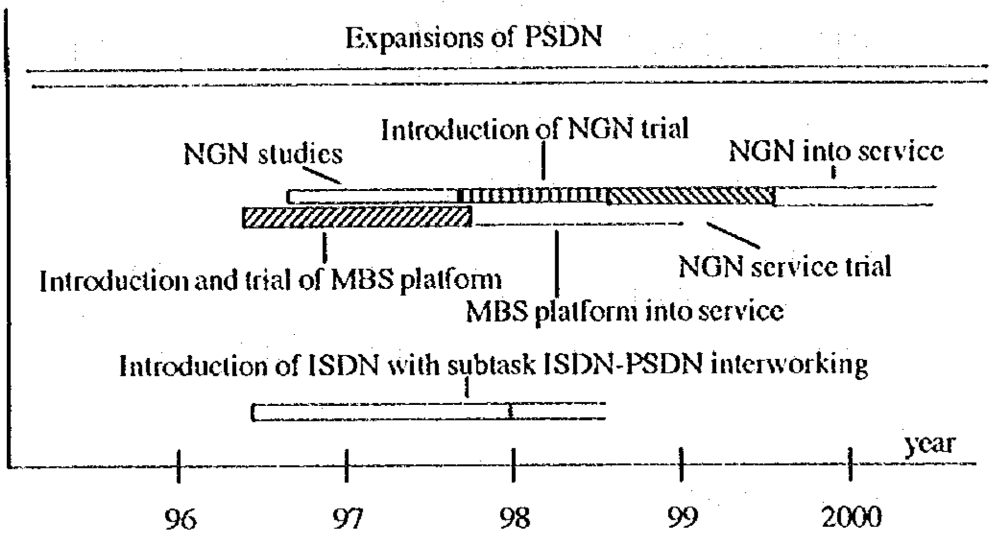


Figure 6.10-1 Projects and Tasks Schedule

The expansion of the existing PSDN is an ongoing routine task and should be carried out within the existing responsible organizational unit. The other tasks involve several organizational units and hence it is preferable to carry out this work in project organization.

6.10.1 Expansion of Existing PSDN

- Expansion of the network is based on a permanent supervision and planning process to keep track with demand
- All expansions activities are triggered by this process, expansions should not be based on forecast
- A small test network should be installed (1 ECOM, 1 APX, 2 XMUX, all devices with limited port (FEP) numbers. The test network should be combined with the pool for spare parts.

6.10.2 PSDN-ISDN Interworking

- ISDN project should be set up as soon as possible
- PSDN-ISDN interworking should be part of this project (sub-project)
- Sub-project should evaluate interworking cases, write a specification, evaluate tenders etc.
- Project should not only deal with technical issues but also with issues such as tariffs and marketing

6.10.3 NGN and MBS Platform

- Definition of services to be supported by the platform(s)
- Development of a consistent concept
- Specification and tendering process
- Development of marketing and tariff concept
- Introduction of platform (for trial)
- Introduction of service

CHAPTER 7 COMPUTER SYSTEM

7.1 Introduction

Based upon the Master Plan, we carry out the feasibility study of the 3 computer systems. The outline of the study is as follows,

- Required hardware and software
- Computer system configuration
- Development plan

7.2 Target Area

Based on the targets projects described in chapter 2 and the demand fulfillment plan in the Master Plan, we decided the target area as follows.

Table 7.2-1 Target area for Computer system

Computer system	Target area
Billing-center system	Billing processing for all Syria New billing-center in Aleppo (In Damascus, new billing-center system has been already installed)
Telephone-center system	Telephone centers in 5 big cities* with more than 10,000 subscribers in the year of 2002(refer to Table 7.2-2) (In Damascus, new telephone-center system has been already installed)
Management information system (MIS)	Headquarters and 5 big cities*

Note* : Damascus Rural, Aleppo, Homs, Hama, Lattakia

7.3 Computer System Configuration

In this section the configuration of the computerized system is discussed.

The necessity of computerization regarding service-order system including subscriber line management, and billing system in Master plan have been analyzed. It is more appropriate, however, that the telephone-center system be distinguished from the billing-center system in examining computer system configuration and implementation. Because some part of billing function (mainly calculation of bills) is done in a billing center and the other part (mainly collecting bills) is done in a telephone center.

Table 7.3-1 Examined System for Implementation

Examined system for implementation	Main function
Telephone-center system	Service order
	Subscriber line management
	Collecting bills
Billing-center System	Calculating bills

In addition, management information system (MIS) should be also examined and implemented.

Presently, STE is striving to introduce computerized systems that contain billing and telephone-center systems.

Regarding to a telephone-center system and a billing-center system, the systems that STE is developing are practically almost the same as those proposed here from the viewpoint of the objectives, the target, and the scale. It is therefore decided to utilize the similar system configuration. Here the system configuration is described after minor modifications. Besides, the system configuration of MIS is also described.

7.3.1 Telephone-center System Configuration

(1) Overview

In this study, 25 telephone-centers are selected, that will have more than 10,000 subscribers for the installation of new telephone-center system installation from 1996 to 2000.(Table 7.3.1-1)
The installations of the telephone-center systems require many system engineers and much training for the system operators, therefore it is practical to divide the installation into 2 phases (1997 and 1998). System installation is proposed for the areas of Damascus Rural and Aleppo in 1997, and the areas of Homs, Hama and Lattkia in 1998.

Table 7.3.1-1 Selected Telephone-center for the Computerization

Damascus Rural area	Aleppo area	Homs area	Hama area	Lattakia area
Tall	Aljameleha	Alkwatli	Hama	Lattakia
Doma	Alsabele	Almahtta	Kowatlle	Tishreen
Harsta	Kan-Alwazeer	Alwaer	Salammeh	Kerdaha
Daryah	Alsolymaneyeh			Jableh
Alhamah	Hananow			
Alnabek	Alansari			
Zamalka	Alhamadaneyeh			
Zabadani				

(2) System configuration

Terminals are available for each telephone center's contract section, technical section, construction section, exchange section, testing section, cable section, complaints section, and directory section. Furthermore, a chief of each telephone center uses one to manage the whole of work or service of the center. Moreover, another terminal is needed for a system administrator for system administration, operation, and maintenance. Cash registers similar to these terminals are available for cashiers and staff who can cash for bills with them.
These terminals including cash registers must mutually communicate and thus are connected by a LAN (Local Area Network) and a file server. The customer information for each telephone center is utilized in a billing center, too. Accordingly, the file server in each telephone center is connected to a billing center by public network (X.25).

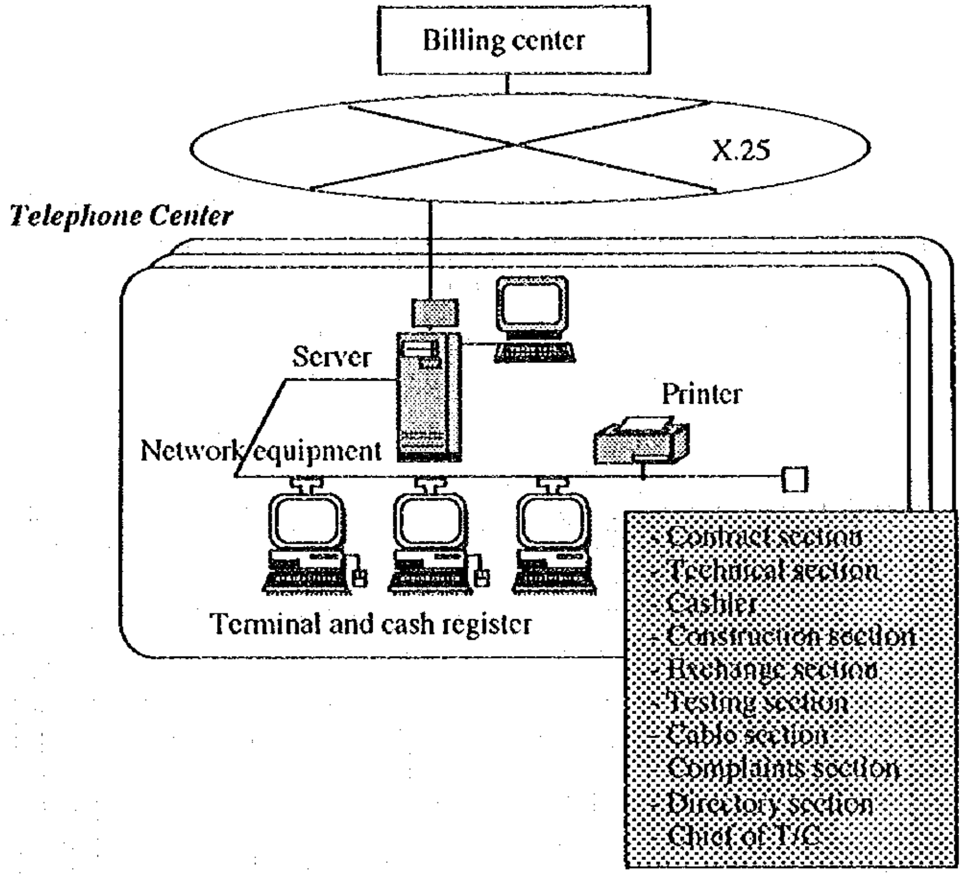


Figure 7.3.1-1 Telephone-center System Overview

(3) Hardware

A server, terminals, network equipment and other devices are necessary for each telephone center.

The necessary quantity of terminals differs for each telephone center. The calculation method is as follows:

$$\text{Formula A} = \frac{15 \times \text{Number of transactions of each center}}{6 \times 60}$$

Average job processing time = 15 minutes
Working hours = 6 hours

$$\text{Formula B} = \frac{\text{Number of subscribers of each center}}{10{,}000}$$

$$\text{Formula C} = \frac{\text{Number of devices connected to LAN} - 1}{7}$$

The necessary quantity of devices are decided as follows.

Table 7.3.1-2 Necessary Quantity of Devices for a Single Telephone Center

Device		Section	Quantity
Server	CPU Ethernet adapter Floppy drive Hard disk Streamer CD-ROM drive		1
Terminal	CPU Ethernet adapter Floppy drive Hard disk	Chief of T/C	1
		System admi.	1
		Contract	Depend on formula A
		Technical	1
		Construction	1
		Exchange	1
		Testing	1
		Cable	1
		Complaints	1
		Directory	1
Cash register	(Same with terminal)	cashier	Depend on formula B
Laser printer		each section	11
Printer	(Printing bills)	cashier	Depend on formula B
Router			1
MODEM			1
Hub			Depend on formula C
UPS			1

The quantity of devices for each telephone center is outlined in detail in S2-7-1 in the Supporting Report.
The needed quantity of devices for all telephone centers (25) targeted computerization are as follows:

Table 7.3.1-3 Total Quantity of Devices for All Telephone Centers

Device	Quantity
Server	25
Terminal	282
Cash register	75
Laser printer	275
Printer	75
Router	25
MODEM	25
Hub	73
UPS	25

(3) Software

Necessary software for telephone-center systems is indicated below.

Table 7.3.1-4 Telephone-center Software

Kind of software	
Operating system for server (inc. network software)	UNIX
Database software	RDBMS
Operating system for terminal	DOS, Windows
Network software for terminal	(for DB manipulation)
Application software*	Packaged software customized for STE

7.3.2 Billing-center System Configuration

(1) System configuration

In considering the configuration of billing-center system, the processing type should be decided (concentrated or distributed type). The distributed type should be recommended for the following reasons:

- Damage caused by system shutdown or other trouble is less in case of distributed type than in case of concentrated type.
- Most of packaged software for billing application have the limit of the processing capability and it may be difficult to expand it.

Table 7.3.2-1 Comparison of Concentrated and Distributed Types

Type	Merits	Demerits
Concentrated type	- Concentrated management of customer information - To be able to reduce the number of technical staff for maintenance and operations	- Much manpower and machine power in one billing center - All of technical staff is necessary in one place. - Damage caused by system shutdown or other trouble is very large. - Possible difficulty of expanding the processing capabilily of billing application software
Distributed type	- To be able to reduce the load in one billing center - To be able to utilize the rural area staff - Less damage caused by system shutdown or other trouble - Free from the limit of processing capacity of billing application software	- Total technical staff must be increased. - Retrieval or management of all customers is difficult.

↓

Distribeted type is recommended (= plural billing centers).

Considering the present number of subscribers, increment of subscribers from now on, the location of big cities and so on, distributed billing system centers are installed as indicated below.

Table 7.3.2-2 Distributed Billing System Centers and the Divided Area for Each Center

Center	Area (Provinces)	Expected number of subscriber in 2000
South (Damascus)	Damascus(city) Damascus(rural) Quennetra Darra Sweda	808,000
North (Aleppo)	Aleppo Homs Hama Idleb Der Alzor Alhasaka Rakkah Lattakia Tartous	1,046,200

The number of subscribers in the area of Damascus City, Damascus Rural, Quennetra, Darra and Sweda is estimated as 0.8 million in 2000, and there is no necessary for the expansion of the billing-center system in Damascus till 2000.

The number of subscribers in the area of Aleppo, Rakka, Idleb, Al Hasaka, Der Alzor, Homs, Tartous, Hama and Lattakia will reach to 1.05 million in 2000 and will exceeds the processing capacity of the Billing-center in Aleppo(about 1 million). Therefore, the expansion of hard disk capacity for the billing-center system will be required.

The billing-center system configuration is as follows:

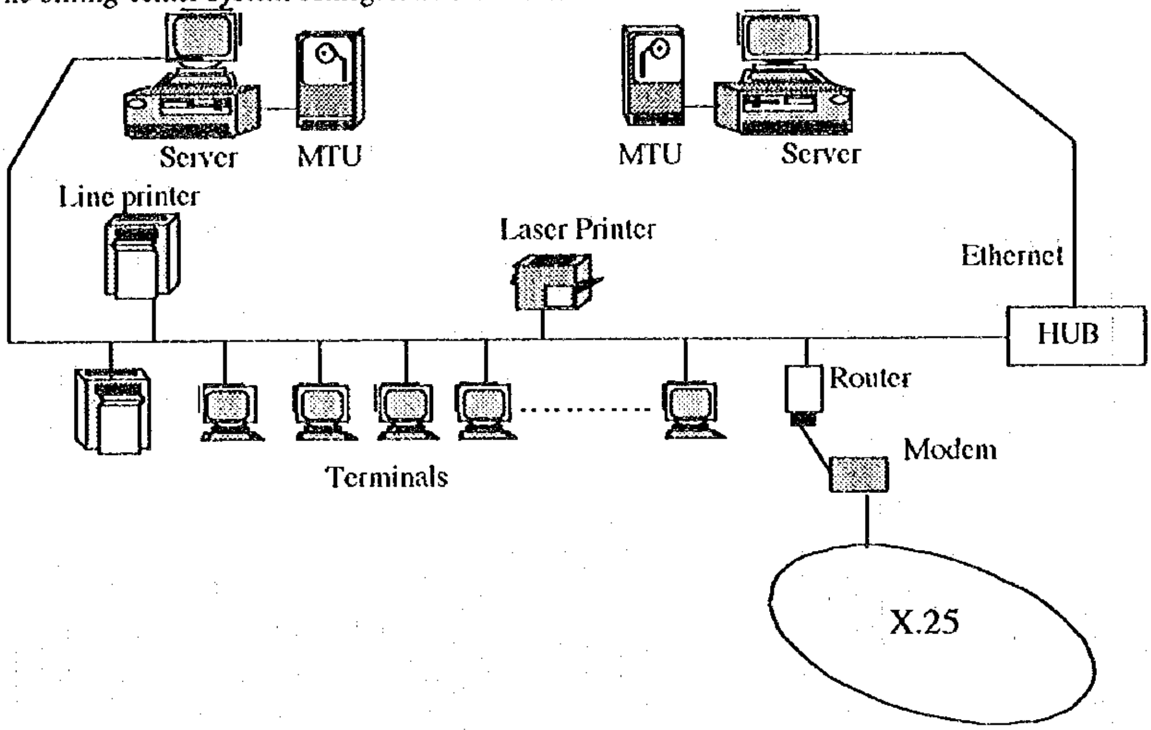


Figure 7.3.2-1 Billing-center System Overview

(2) Hardware

A server, terminals, network equipment and other devices are necessary for the billing center; the same as in telephone centers.

The billing-center system requires high reliability, especially in the server that calculates and issues bill. If the server shuts down, damage could be severe. A duplex system is thus vital.
Aleppo billing-center system needs 32 terminals chiefly for data input of the photo counter, receipts and data of other services (telegrams, etc.).

Table 7.3.2-3 Necessary Quantity of Aleppo Billing Center Devices

Device		Quantity	Remarks
Billing computer	CPU X.25 adapter Ethernet adapter Floppy drive Hard disk Streamer CD-ROM drive	2	Duplex system
Line printer		2	
Laser printer		1	
Magnetic tape unit		2	
Terminal		32	
Hub		6	Depend on formula D
Router		1	
MODEM		1	
UPS		2	

During the Eighth National Five-Year Plan, the number of subscribers treated in Aleppo billing center is expected to increase, therefore hard disk should be added for enough capacity.

(3) Software

Necessary software for the billing-center system is indicated below.

Table 7.3.2-4 Billing-center Software

Kind of software	
Operating system for server (Inc. network software)	UNIX
Database software	RDBMS
Operating system for terminal	DOS, Windows
Compiler	C compiler
Application software	Packaged software customized for STE billing

7.3.3 Management Information System (MIS)

(1) Overview

The information in the billing-center system and telephone-center system is useful for the directors in the STE's headquarters and provinces to make management decisions. Therefore, the management information system which stores this useful information from the billing system and telephone system should be introduced.

By using this system, it is possible for directors in the STE to get and analyze the following data quickly by area and time (month and year).

- number of subscribers by telephone center
- volume of telephone usage (number of calls and total duration of calls)
- amount of issued bills
- amount of paid bills
- number of proposed telephone installations
- numbers on the waiting list for telephone installation

Gathering the summarized data from the billing-center system and telephone-center systems should be carried out each month.

(2) System configuration

An MIS server is installed in the headquarters of STE and it is connected to telephone center systems and billing center systems to gather customer information and billing information owned by the centers. Client terminals for directors use are installed in headquarters and each province connected by the public network (X.25).

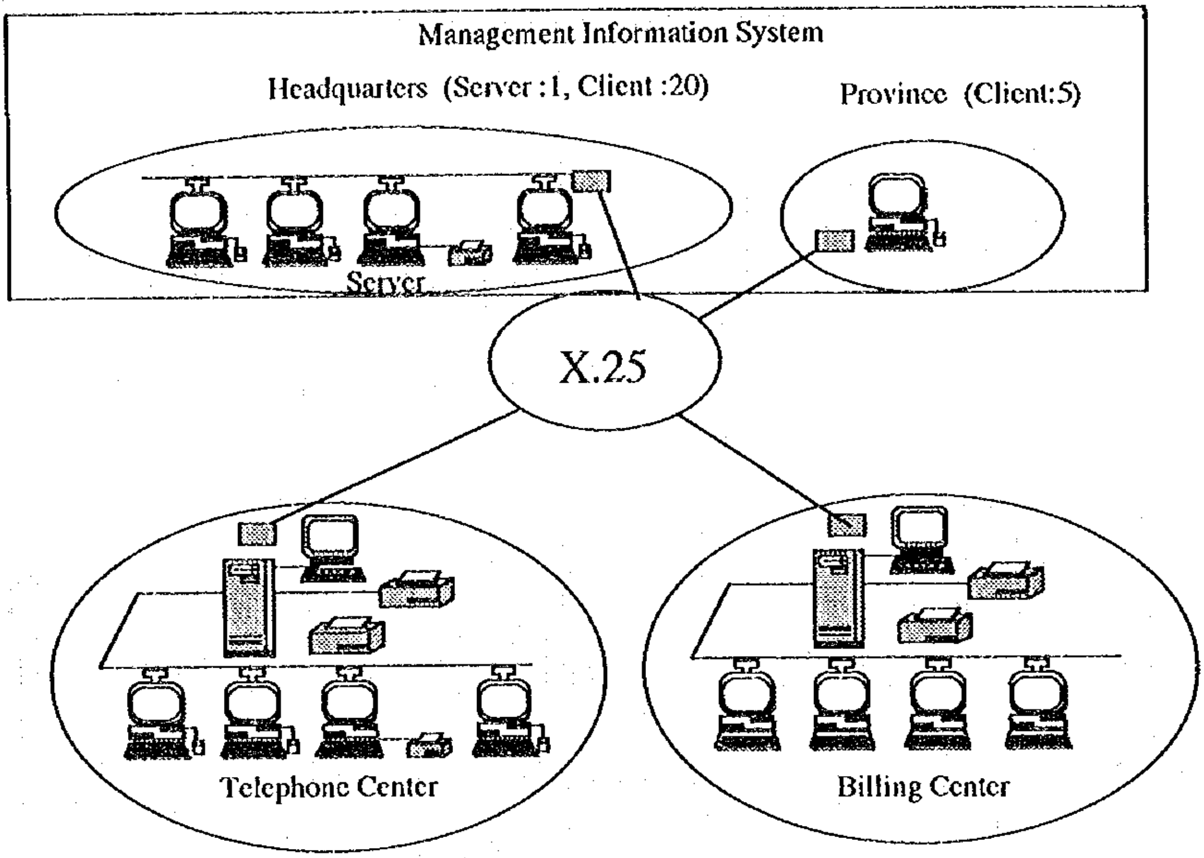


Figure 7.3.3-1 Management Information System Overview

(2) Hardware

The needed quantity of devices for MIS is indicated below.

Table 7.3.3-1 Total Quantity of Devices for MIS

Device		Quantity	Remarks
Server	CPU X.25 adapter Ethernet adapter Floppy drive Hard disk Streamer CD-ROM drive	1	installed in headquarters
Terminal		25	20 for headquarters 5 for provinces
Laser printer		26	for a server and each terminal
Hub		3	Depend on formula D
Router		1	for headquarters
MODEM		6	1 for headquarters 5 for provinces
UPS		1	

(3) Software

Necessary software for MIS is indicated below.

Table 7.3.3-2 MIS Software

Kind of software	
Operating system for server (inc. network software)	UNIX
Database software (Server)	RDBMS
Database software (Client)	
Operating system for terminal	DOS, Windows
Application software	