6.11 Local Networks

6.11.1 Technology Trends in Local Networks

The routing in the local switches superimposes a logical local network structure on the local transmission network. The choice of a local network structure is dependent on several technological and technical frame conditions, which have dramatically changed with the introduction of the digital technology:

Unlike the older electro mechanical switching systems (e.g. the EMD system), which had very limited routing capabilities, modern digital SPC type switching systems do not have any practical limitations concerning their routing capabilities. They provide a digit analyzing capability of up to 8 or even more digits and alternate routing with several subsequent overflow possibilities. Consequently, direct circuit groups have become possible wherever they are desirable and economically feasible.

Modern digital switching systems allow any combination of functionality in any exchange. Thus, combined local / local transit exchanges and combined local / (STD) transit exchanges have become feasible.

Digital transmission and digital switching have full 4-wire characteristics. Consequently the 4-wire chain has been extended to the local exchanges. As a result, the old limitations imposed by the analog 2-wire technology, i.e. attenuation and resistance (dominating the maximum distance allowance between local exchanges as well as between local exchanges and their associated trunk exchange), do not exist any more.

The remaining limitation is the maximum length of the analog subscriber line, which depends on the maximum attenuation and the maximum loop resistance, and which determined the maximum size of a local exchange area. However, modern digital switching systems allow the deployment of remote units (RU), connected to their host exchange by digital transmission systems (i.e. without additional attenuation), at any place in the local exchange area. This can be understood as the possibility to distribute the local switching function in a local exchange area at will, with all the limitations reduced to the economic ones. In conjunction with the increased processing power of the local (host) switches, which allows for far more than 100,000 subscribers being connected to a single exchange, this leads to a maximum flexibility in the planning of local networks.

The maximum size of local exchanges has become less a subject to capacity constraints and technical limitations, and more a subject to security and availability considerations. Security and availability considerations finally result in the question: which percentage of the total amount of subscribers in an local area is acceptable to be affected by a disaster or calamity with long term consequences (such as fire, flooding and intrusion) which may hit a single exchange.

The use of Signalling System No.7 ISDN User Part (SS7 ISUP) enables the operation of bothway circuit groups. This allows to handle both traffic directions between any two local exchanges as one traffic stream and thus to exploit the bundling gain phenomena inherent to the traffic theory. As a consequence, much better use of the transmission resources can be made and the number of switch ports required for junction lines can be reduced. Beyond that, direct circuit groups become economically feasible much earlier, when bothway operation of the circuit groups is applied.

The introduction of the Synchronous Digital Hierarchy (SDH) transmission technology, which allows the economic extraction and insertion of 2MBit/s systems even into the largest multiplexed systems, promotes the application of direct circuit groups between local exchanges. Consequently, the economic feasibility threshold for direct circuit groups, which is strongly associated with the 2MBit/s (30 channels) modularity, becomes lower.

Summarizing, it can be stated that

- very large local exchanges have become technically and economically feasible,
- deployment of remote units allows to extend the local exchange area sizes,
- bothway operation with SS7 ISUP promotes the feasibility of direct circuit groups,
- SDH transmission application increases the feasibility of direct circuit groups,
- technical constraints in the traffic routing do not exist any more for digital exchanges,

in the long term, this will lead to

- less but larger local exchanges also in the multi exchange areas (e.g. Damascus),
- more direct circuit groups between local exchanges,
- flatter network structures with less hierarchical levels.

6.11.2 Basic Considerations on the Choice of Local Network Structures

The prime objective of local network optimization is to make optimum use of a minimum of switch ports for junction lines and a minimum of transmission resources. However, both minimization contradict each other, so that the real optimization process searches for the network with the lowest cost.

If this process were executed without any frame conditions, this would regularly lead to an unstructured hierarchical network, which would be optimized exactly and only to the traffic streams and patterns assumed as basis of this optimization.. Any traffic flow would be routed via any resource which still has capacity reserves. However, such unstructured local networks are practically not plannable in the long term and may need full re-optimization whenever an additional larger exchange is inserted in that network or even in the case that traffic patterns change or develop differently than predicted. In both cases an excessive planning overhead is regularly required, which is not acceptable in economic terms.

The application of alternate routing with traffic overflow to other circuit groups in unstructured networks results in a high danger of circular routing.

Furthermore, the behavior of such unstructured networks in case of failure of a transit switch or a larger transmission system is almost unpredictable. The same problem appears in cases of overload.

The considerations before show clearly that unstructured hierarchical networks are hardly plannable and hazardous

Consequently, pre-given network structures have to be imposed in the optimization process with the aim:

- to ease future network planning for expansion,
- to avoid major restructuring in the traffic routing in future,
- to avoid circular routing,
- to enable a prediction of the network behavior in case of failure and overload.

For the choice of the appropriate local network structures, there are three different types of local networks are to be distinguished in STE's PSTN / ISDN:

- Single exchange local networks,
- Small multi-exchange local networks,
- Large multi-exchange local networks.

6.11.3 Proposed Future Local Network Structures

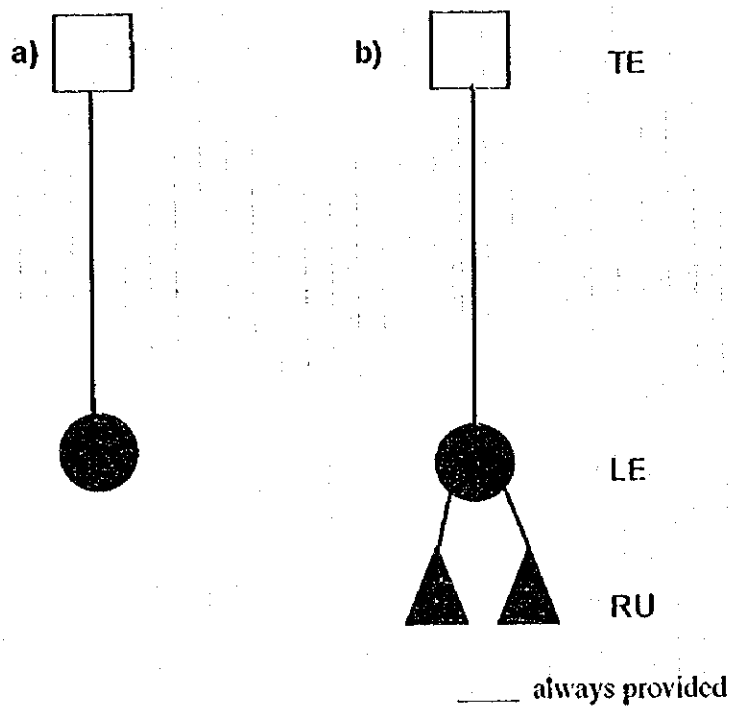
In the following, local network structures are recommended for the three different types of local networks in STE's PSTN / ISDN, which allow for optimization in accordance with the criteria established above. Subsequently, the traffic routing rules and the engineering rules for the different types of circuit groups are given. Finally, a comparison with the existing local network structures showing their disadvantages is made, and the necessary course of action is proposed.

6.11.3.1 Single Exchange Local Networks

A single exchange local network consists of only one local exchange (LE). This exchange may serve as well as host exchange for several remote units (RU)

(1) Proposed Structure

The single local exchange (LE) is connected only to the homing transit exchange (TE) (in Syria also called STD exchange). Possibly existing remote units (RU) are directly connected to the Host (local exchange).



(2) Routing

The routing is very simple. All local calls are exchange internal calls. All long distance calls are routed directly to the transit exchange (TE).

(3) Dimensioning

An local exchange in a single exchange local network should (for security reasons) serve not more than 40 000 subscribers. If this limit is exceeded a second local exchange should be inserted with the consequence that the area changes into a small multi-exchange area.

Extensive use of remote units should be made to provide service in suburbs an neighboring villages.

All circuit groups between digital exchanges where SS7 ISUP is applied should be operated as bothway groups.

The circuit group(s) from and to the transit exchange (TE) are to be dimensioned as fully provided circuit groups. The umbilical links between the host and the remote units are to be dimensioned in the course of the switch engineering in accordance with the dimensioning rules given by the switch supplier.

(4) Present Situation

Very limited use has been made of remote units. Instead, rather expensive small local exchanges have been deployed at a large scale especially in the rural areas.

Even when SS7 ISUP is used as signalling system, the circuit groups seem to be operated in uni-directional mode.

Often the circuit groups from and to the transit exchange are not routed directly but through another local exchange. This is primarily caused by a presently applied extreme optimization to 8 MBit/s transmission systems or multiples thereof, and has caused excessive occupation of switch ports for junction lines.

(5) Actions Proposed

First of all, the deployment strategy for small local exchanges should be revised, and intensive use of remote units hosted by already existing local exchanges should be made. New local exchanges should be deployed only, if the potential host exchange is near to exceed the security limit given above.

When SS7 ISUP is used as signalling system, the circuit groups should be operated in bothway mode. This will remarkably contribute to better utilization of the transmission resources and switch ports for junction lines.

The accesses to the transit (STD) exchanges should be re-arranged in accordance with the structure described above, whenever sufficient transmission capacity is or becomes available.

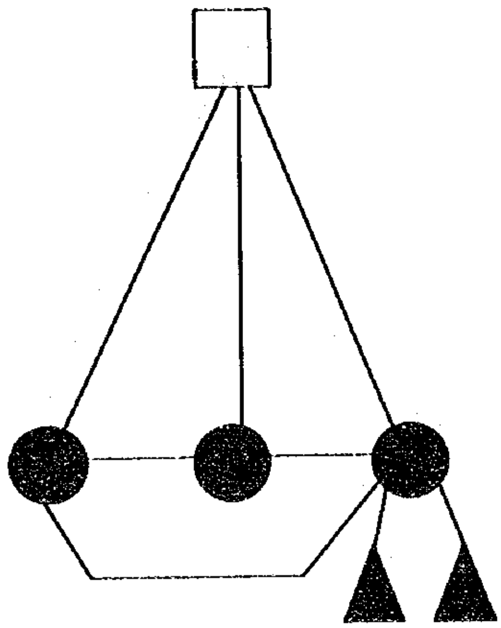
Direct circuit groups to neighboring local exchanges, which already exist to a certain extent, can be implemented, whenever the traffic justifies it. 12 Erlang as the sum for both directions, should be the threshold for such direct circuit groups (to be operated as bothway circuit groups).

6.11.3.2 Small Multi-Exchange Local Networks

A small multi-exchange local network consists of a minimum of two local exchanges and may contain as much as up to ten local exchanges. Presently, the larger communities in Syria (e.g. Aleppo, Homs, Hama and Lattakia) are examples for small multi-exchange local networks.

(1) Proposed Structure

In a small multi-exchange local network all local exchanges are fully intermeshed amongst each other by direct circuit groups, and each of them is connected to the homing transit (STD) exchange by a direct circuit group.



(2) Routing

All local calls, which are not exchange internal calls, are routed on the respective direct route to the target local exchange (LE). All long distance calls are routed directly to the transit exchange (TE). Overflow is not foreseen.

(3) Dimensioning

Any local exchange in a small multi-exchange local network should (for security reasons) serve not more than 50,000 to 70,000 subscribers, dependent on the total amount of subscribers in that multi-exchange area. The more subscribers are situated in the entire area, the larger the particular exchanges may become. If the limit is exceeded an additional local exchange should be inserted.

Furthermore, extensive use of remote units should be made to provide service even inside the city (substitution of the cross connecting cabinets and the primary cables by remote units, see also section 6.12), as well as in suburbs, in neighboring villages and in the surrounding rural areas.

All circuit groups between digital exchanges where SS7 ISUP is applied should be operated as bothway groups.

All circuit groups (i.e. the direct circuit groups between the local exchanges (LE) and those from and to the transit exchange (TE) are to be dimensioned as fully provided circuit groups.

(4) Present Situation

Presently, the final capacity of the local exchanges in small multi-exchange local networks is set (by the planning) to 30,000 subscribers.

Very limited use has been made of remote units in the larger cities, in their suburbs and in the surrounding rural areas. Instead, rather expensive small local exchanges have been deployed at a large scale especially in the rural areas.

In the presently existing small multi-exchange local networks, most of the new digital inner-city exchanges are fully intermeshed. For the sub-urban and the rural exchanges, often the circuit groups from and to the transit exchange are not routed directly but through another local exchange. This has caused excessive occupation of switch ports for junction lines.

Even when SS7 ISUP is used as signalling system, the circuit groups seem to be operated in uni-directional mode.

(5) Actions Proposed

First of all, the planning limit for the final capacity of the local (host) exchanges should be revised in accordance with the new security limit given in section (3).

The deployment strategy for small local exchanges should be revised, and more use of remote units hosted by already existing local exchanges should be made. No new digital exchanges should be deployed as long as the security limit given above is not exceeded. An exception may be made when large older type exchanges are to be replaced.

When SS7 ISUP is used as signalling system, the circuit groups should be operated in bothway mode.

The accesses to the transit (STD) exchanges should be re-arranged in accordance with the structure described above, whenever sufficient transmission capacity is or becomes available. Direct circuit groups between the sub-urban and rural exchanges and the inner-city exchanges should be introduced whenever economically feasible

6.11.3.3 Large Multi-Exchange Local Networks

A large multi-exchange local network consists of more than ten local exchanges. Presently, Damascus is the only example in STE's network for a large multi-exchange local network.

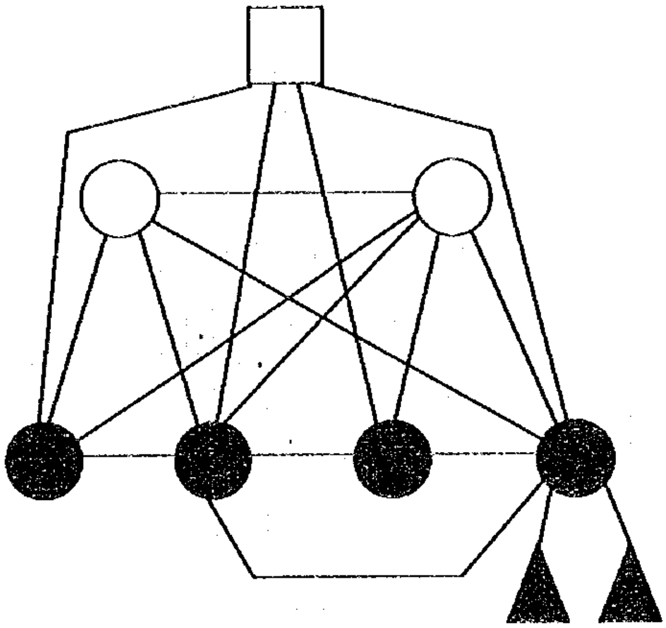
(1) Proposed Structure

In a large multi-exchange local network an additional level of local transit exchanges (LT), which forwards local traffic exclusively, is inserted on top of the level of local exchanges (LE). The large multi-exchange local network is sub-divided into as much local transit areas as local transit exchanges are provided. Each local exchange (LE) is allocated to one of the local transit areas and thus to a (homing) local transit exchange (LE).

Circuit groups are systematically provided between each local exchange (LE) and its homing local transit exchange (LT). Furthermore, the local transit exchanges are fully intermeshed amongst each other. Thus, a local backbone network is provided.

In addition to the local backbone network, direct circuit groups between any pair of local exchanges (LE), and direct circuit groups between any local exchange (LE) and any distant local transit exchange (LT) are provided, as soon as the amount of traffic between the respective two exchanges justifies it.

For the long distance traffic, each local exchange (LE) has (a) direct circuit group(s) from / to the transit exchange (TE).



____ always provided ___ provided when justified by traffic

The local transit function may be implemented as stand alone local transit exchange (LT) or combined with a local exchange function as combined local transit / local exchange (LT/LE). The determining factor for the decision should be the amount of transit traffic to be handled. If intensive use of direct circuit groups between the local exchanges is made, the remaining transit traffic will be rather small, and consequently, the combined solution should be favored.

(2) Routing

The following routing patterns should be applied in a large multi-exchange local network:

- Local calls

  - 1st choice: direct route to terminating local exchange (LE) (if existing),
  - 2nd choice: direct route to distant local transit exchange (LT) (if existing),
  - Last choice: route to own local transit exchange (LT).

Overflow is arranged in a systematic way following the choices as indicated above and dependent on which circuit groups are existing.

- Long distance calls

All long distance calls are routed directly to the transit exchange (TE). Overflow is not foreseen.

(3) Dimensioning

Any local exchange in a large multi-exchange local network should (for security reasons) serve not more than 60,000 to 90,000 subscribers, dependent on the total amount of subscribers in that multi-exchange area. The more subscribers are situated in the entire area, the larger the particular exchanges may become. If the limit is exceeded additional local exchanges should be inserted.

If an exchange serves as combined local transit / local exchange (LT/LE) the capacity limit should be set at the lower limit to reserve processing power for the local transit function.

A local transit exchange (LT) should serve as homing exchange for approximately 10 local exchanges (LE). However, this figure should be considered as a guideline and not as strict limit, and may be exceeded as long as the resulting traffic load for the LT remains acceptable and manageable.

Extensive use of remote units should be made to provide service even inside the city (substitution of the cross connecting cabinets and the primary cables by remote units, see also section 6.12), as well as in suburbs, in neighboring villages and in the surrounding rural areas.

All circuit groups between digital exchanges where SS7 ISUP is applied should be operated as bothway groups.

The direct circuit groups between the local exchanges (LE) and the circuit groups between local exchange (LE) and distant local transit exchange (LT) are to be dimensioned as high usage circuit groups. However, 12 Erlang as the sum for both directions, should be the threshold for such direct circuit groups (to be operated as bothway circuit groups).

The circuit groups between a local exchange (LE) and the own (homing) local transit exchange, the intermeshing circuit groups between the local transit exchanges (LT), and the circuit groups between the local exchanges (LE) and the transit exchange (TE) are to be dimensioned as fully provided circuit groups.

(4) Present Situation

Since Damascus is presently - and is most likely to remain for a rather long time - STE's only large multi-exchange local network, all following statements are directly related to the Damascus local network.

Presently, the final capacity of the local exchanges in the Damascus local network is set (by the planning) to 30,000 subscribers.

Very limited use has been made of remote units inside Damascus, in the suburbs and in the surrounding rural area. Instead, rather expensive small local exchanges have been deployed at a large scale especially in the rural areas.

The present Damascus local network must be classified as an unstructured network:

- at least half of the approximately 40 new digital exchanges fulfill local transit functions,
- no regular homing pattern of the LE to the LT is recognizable,
- no regular traffic routing pattern is recognizable,
- the routing seems to be organized on opportunity,
- rather large traffic streams are unnecessarily routed via other exchanges,

Furthermore, for the sub-urban and the rural exchanges, often even the circuit groups from and to the transit exchange are not routed directly but through several other local exchanges.

Even when SS7 ISUP is used as signalling system, the circuit groups seem to be operated in uni-directional mode.

This all together has caused excessive occupation of switch ports for junction lines and unnecessary transit traffic load on most of the Damascus local exchanges.

The real reason for all the shortcomings described above is most likely a presently applied extreme optimization to 8 MBit/s transmission systems or multiples thereof, even on the expense large amounts of switch ports for junction lines, which is clearly recognizable in the Damascus local network.

It should be noted here, that 8 MBit/s transmission systems (120 channels) never really had and never will have a future. The transmission system of the future will be the STM 1 in the SDH (155 MBit/s, 1920 channels), which allows by means of Add-Drop Multiplexes (ADM) economic extraction and insertion of 2MBit/s streams (30 channels) and any multiple thereof.

Summarizing, it must be stated that the presently unstructured Damascus local network:

- is not really optimized in a way which also accommodates for the future development,
- is hardly plannable for future expansions, and

- is most likely to behave unpredictable in case of major failure or overload.

(5) Actions Proposed

Considering the present state of the Damascus local network it appears of utmost importance, to restructure it towards a target structure as proposed in section (1). However, this restructuring process will require sustained activities over a rather long period. Furthermore the restructuring should be done in alignment with the introduction of the SDH transmission technology. This requires profound detailed planning. In the following only an overview on the course of action can be given as guidance for that planning process.

However, the earlier the restructuring process is started, the less is the amount of traffic and circuits concerned, and the easier is the task to be fulfilled.

First of all, the planning limit for the final capacity of the local (host) exchanges should be revised in accordance with the new security limit given in section (3).

The deployment strategy for small local exchanges should be revised, and more use of remote units hosted by already existing local exchanges should be made. No new digital exchanges should be deployed as long as the security limit given above is not exceeded. An exception may be made when large older type exchanges are to be replaced. However when two different systems in the same building are to be replaced (as in the Baghdad Street exchange) this should be done by one single new exchange.

Both measures together will result in larger local (host) exchanges and larger traffic streams between the particular exchanges.

As a preparing step for the restructuring itself, real knowledge must be obtained of the traffic structure in the Damascus network. Preferably, the originating traffic of each local exchange must be measured with respect to all local destinations and the trunk network, so that a detailed traffic pattern for the originating traffic of each local exchange can be established. Assumptions based on common models may be misleading.

Five exchanges should be selected to serve as the only local transit exchanges in future. Prime candidates would be Al Jallaa, Kefr Souseh, Barzeh, Bab Sharki, Mezzeh D2 (and Al Nasser, first for the older exchanges).

With priority, direct circuit groups should be implemented and utilized, whenever justified in accordance with the dimensioning guidelines given in (3), with the aim to unload the present local transit exchanges from transit traffic.

When SS7 ISUP is used as signalling system, the circuit groups should be operated in bothway mode.

The accesses to the transit (STD) exchange should be re-arranged in accordance with the structure described above, whenever sufficient transmission capacity is or becomes available.

Subsequently, direct circuit groups to the distant (future) local transit exchanges should be implemented and utilized whenever the traffic justifies it and the transmission systems are available.

As the next step, the intermeshing between the five designated local transit exchanges should be dimensioned and implemented.

Finally, the circuit groups to the own local transit exchange will be dimensioned and implemented.

It must be borne in mind, that each of the restructuring steps described before involves major re-arrangements in the routing tables which are recommended to be executed carefully step by step, since they are changing the way of non-negligible traffic stream portions in the network. Strict monitoring of the consequence of each step taken is advised.

6.12 Subscriber Networks

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

6.12.1 Metallic Cable Network

In the metallic cable network, any subscriber is connected to the exchange by means of a pair of metallic wires. The junction to the subscriber will be established by connections in the terminal blocks with:

- jumper wires in the Main Distribution Frame (MDF) and Cross Connection Cabinet (CCC),
- drop wires at the Distribution Point (DP).

The size of the exchange area to be covered is limited by the following influential factors:

- maximum subscriber line attenuation in accordance with the transmission plan
- maximum loop resistance (subscriber line signalling limit) as determined by the switching system
- economical limitations, e.g. subscriber density in the area.

The metallic cable network structure can be classified into two general categories:

- Rigid Cable Network
- Flexible cabinet work

6.12.1.1 Rigid Cable Network

In the rigid cable network, all conductors are electrically extended from one cable section to another by joints, i.e. the conductors are firmly jointed together and all pairs are thus taken through rigidly from the MDF to the DP. This results in a simple star network.

The advantages of the rigid cable network are as follows:

- non expenditure on CCC

- less likelihood of faults
- simple setting up of the subscriber line (no jumper wire in CCC)
- subscriber line records are simple.

The configuration of a rigid cable network is shown in Figure 6.12.1.1-1.

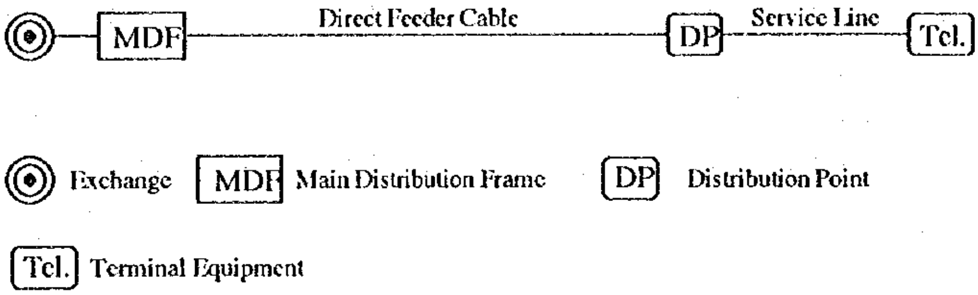


Figure 6.12.1.1-1 Configuration of Rigid Cable Network

6.12.1.2 Flexible Cable Network

In the flexible network, the subscriber line between MDF and DP is divided into two separate sections, i.e. main cable or primary cable and distribution cable or secondary cable sections, by use of cross-connection cabinets. In this way, a hierarchical star network is obtained.

The main advantage of the flexible network is that any pair of the secondary cable can be connected to any pair of the primary cable. In this way, all smaller pair groups from DP's can be combined to form a larger pair group to the exchange. Therefore cable pairs are saved so that less space is required at the MDF.

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

The configuration of a flexible cable network is shown in Figure 6.12.1.2-1.

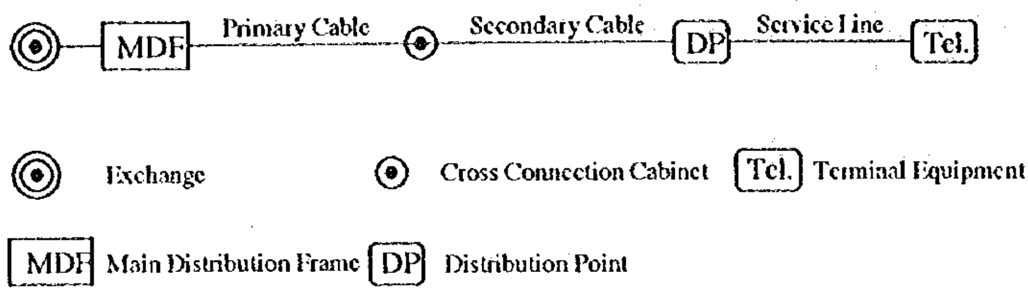


Figure 6.12.1.2-1 Configuration of Flexible Cable Network

6.12.1.3 Semi-rigid network

The above mentioned network system, rigid and flexible cable networks, are more or less of theoretical nature. Both of the cable networks are combined in the practical implementation and it is called Semi-rigid cable network.

This structure combines the advantages of the rigid and the flexible cable networks, which will be able to compensate for the disadvantages each other. Since this network structure has been introduced in Syria, the advantages offered by this system should be used in areas where the metallic cable network structure has to be applied for any reason. However, it is recommended to enable a transition to a state of the art network considering the new structures mentioned in Section 6.12.2.

6.12.2 Hybrid Subscriber Network

The technological development, especially the feasibility of remote units (distantly placed subscriber stages controlled by a host switch) and the decreasing costs for transmission systems with optical fiber allows for new subscriber network structures.

In order to save metallic cable pairs, to avoid faults caused from connection points and to enable a high speed transmission connection to certain customers (e.g. for leased lines), the latest subscriber network structures deploy optical fiber cables much closer to subscribers' premises.

In addition, to meet the customers' actual and future demand, the subscriber network must be considered the requirements of the initial implementation and of the subsequent system as well. The latter aspect is of significant commercial interest as the effort required for expansion of the system by rearranging and supplementing elements of infrastructure can be minimized, if the corresponding growth in traffic demand is taken into account in time.

Figure 6.12.2 - 1 illustrates the principal structure of a hybrid subscriber network.

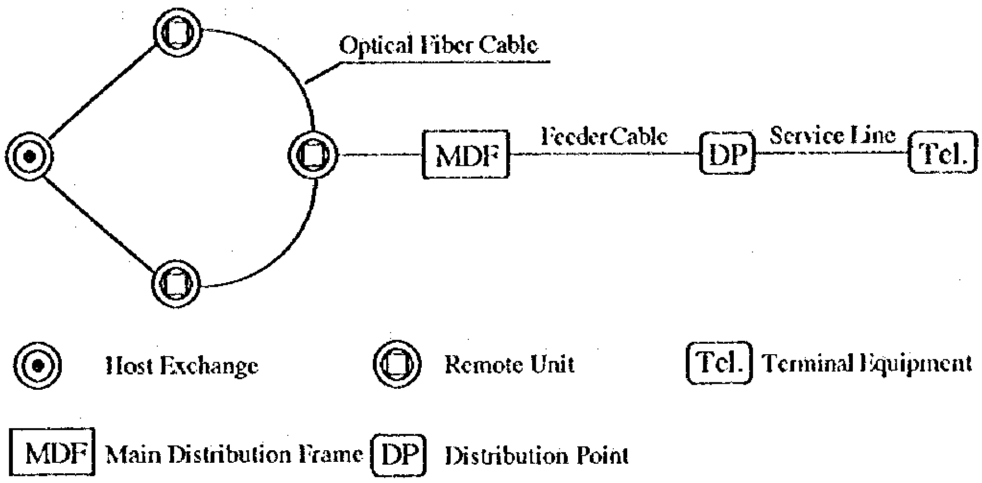


Figure 6.12.2-1 Configuration of Hybrid Subscriber Network

Advantages of the Hybrid Subscriber Network

- due to optical fiber cable deployment between a host exchange and remote units, a much more flexible determination of the exchange areas' sizes becomes possible,
- all presently known services are available,
- future oriented technological innovations are considered,
- economical operation and installation,
- short implementation time,
- less operation and maintenance costs.

Disadvantages:

- additional costs for transmission components and operating,
- additional costs for power supply,
- skilled and highly qualified staff is necessary.

The additional costs for the transmission components and power supply will almost be compensated by saving on expenditures for primary copper cables, cross connection cabinets and due to saving for smaller duct systems.
Considering the cost trends in optical fiber cables and SDH transmission equipment, the advantages will outweigh the disadvantages in the long term.

6.12.2.1 SDH Transmission Ring

In the final stage, the RU is connected to the host exchange by an optical fiber ring employing synchronous digital hierarchy (SDH) transmission technology.

The SDH transmission ring:

- allows for easy configuration and reconfiguration in conjunction with the inherent management capabilities of the SDH transmission technology,
- guaranties high security in case of physical destruction at one point,
- indicates 2 way feeding (1+1),
- provides the possibility to monitor the availability of both directions,
- provides double capacity.

The feasibility of the Hybrid Subscriber Network is determined by the following:

- transmission of all presently known services,
- 1 + 1 feeder system,
- regenerators are normally not required in the SDH transmission ring.

The Hybrid Subscriber Network consists of:

- a ring of optical fiber cables connecting the RUs with the host exchange,
- a feeder cable network (secondary network);
  The service area (area of metallic cable deployment) is determined by the demand density. High density areas will have a very short subscriber line length in average; however, the total length is limited by the transmission plan.

- Service line (drop wire) area,
- Active transmission devices;
  - Terminal Multiplexer (TM) in the host exchange
  - Add/Drop Multiplexer (ADM) in the remote unit (RU)

- Conduit system;
  - standardized manholes
  - PVC pipes for copper cables
  - pipe separators,- protection pipes
  - PVC sub-pipes for optical fiber cables

- Telecommunication cable;
  - optical fiber cable (single mode)
  - metallic cable

- Connection points;
  - MDF
  - DP
  - in-house connection boxes
  - subscriber outlet.

6.12.2.2 Components of Hybrid Subscriber Network

(1) Host exchange

The host exchange controls several RUs which are distributed over the exchange area. The host Exchange will be integrated in the SDH Network Management.

(2) SDH Transmission Ring

The optical fiber ring is deployed instead of the primary cable lines. Using optical fiber cable transmission system, no practical length limits exists between the host exchange and a remote unit (transmission loss = 0 dB), while the feeder cable line (secondary cable line) is limited in length by transmission parameters.

The transmission medium in the SDH transmission ring is the single mode optical fiber cable. All services and high transmission streams demanded are available.

(3) Add/Drop Multiplexer / Terminal Multiplexer

The Add/Drop Multiplexer (ADM) / Terminal Multiplexer (TM) extracts and inserts the umbilical links connecting the remote units with their host exchange from and into the SDH transmission system. The ADM allows also to extract and insert high bit rate streams, e.g. for 2 Mbit/s leased lines.

(4) Remote Unit (RU)

The Remote Unit (RU) is a distantly placed subscriber stage controlled by a host switch and provides all subscriber interfaces like a normal exchange. A remote unit can strategically be placed in the exchange area close to centers of demand. They may be housed in a small building owned by STE, in a container 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 easily be installed if the demand arises in particular areas like in industrial zones or business districts.

The SDH transmission ring can provide two way feeding. Taking into account the redundant nature of this system, all channels can be switched to the alternative route in case of an interruption or disturbance.

(5) Feeder Cable Line (Secondary Cable Line)

The feeder cable lines within the Hybrid Subscriber Network will normally be a rigid network where the DP's are directly connected to the RU.

In conjunction with the new flexibility gained by the deployment of remote units, the existent secondary cable lines can be optimized in accordance with the demand structure in the feeder cable service area to be planned. The size of the service area under consideration can be adapted to the type of area to be covered (urban area, suburban area or rural area).

6.12.2.3 General Considerations

The strategy for implementation of the network development is designed to optimize commercial and operational aspects in order to meet customers demand as rapidly as possible.

The implementation of the Hybrid Subscriber Network is dependent on economic considerations and the provision of services required in Syria.

Economic aspects have to be considered at any time when planning work is performed. It can be expected that the price for fibers and transmission devices will plummet in future. In line with the decreasing prices of components, the implementation of the Hybrid Subscriber Network will be expedited.

Hybrid Subscriber Network implementation will need some time and will be deployed step by step. Where ever planning work is in progress, Hybrid Subscriber Network structure has to be taken into account in the planning.

6.12.3 Wireless Local Loop

6.12.3.1 Technology

Wireless local loop (WLL) systems are used to set up radio connections between local exchanges and non-mobile telephone subscribers. This approach gives access to the public telephone network and even to the ISDN service without delay. The subscribers are largely offered the same service features 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.

Today, there are various wireless local loop systems in use. State of the art wireless local loop systems with digital technology use the Digital European Cordless Telecommunication standard (DECT).

The following basic services are possible by all cellular wireless local loop systems:

- telephony,
- telefax (fax group 3),
- data transmission by means of a modem.

ISDN access is possible with new wireless local loop systems designed according to the DECT standard. The DECT standard was especially established for the support of analog and ISDN services as well as for the handling of high traffic rates. A substantial advantage of systems based on the DECT standard is the fast call set-up and the flexibility in speech and data applications.

To provide a high quality, the signal is continuously monitored at the handset. When the call is set up, a permanent search is being made for a channel with a better transmission quality. The change-over to another channel is performed without interruption or noise. Another advantage of the DECT standard is the protection against tapping.

The fast and flexible possibility to provide telephone facilities in wireless local loop systems is offered by the use of mobile radio elements. A cellular wireless local loop system consists of three 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. Its task is the control and management of 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 1000 subscribers via several radio base stations.

The wireless local loop subscriber equipment consists either of 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.

Figure 6.12.3-1 shows the principle architecture of a wireless local loop.

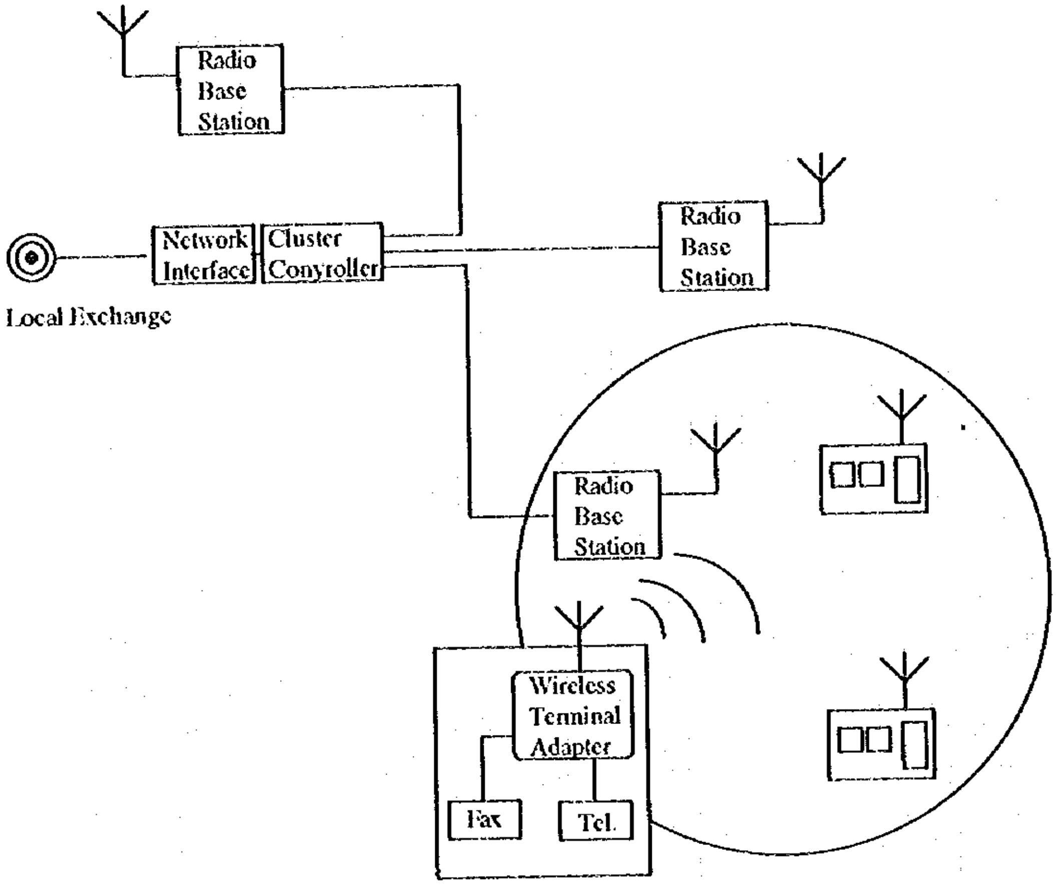


Figure 6.12.3.1-1 Configuration of Wireless Local Loop

6.12.3.2 Cost Comparison

The costs for connecting subscribers by cable to the local exchange depend on the location of the subscriber. In urban areas, a local line is generally cheaper than in rural areas because of the high density of subscribers and the short distance to the local exchange. Rural areas are characterized by widely scattered communities. Economic activity is generally dispersed and the existing telecommunication infrastructure is far away, requiring long transmission lines for telephone access. Therefore, the provision of wired networks in rural areas leads to relatively height 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 exchange.

In urban areas, it is very easy to build up wireless local loop systems. All subscribers are within easy reach by the radio base stations which are located on the site of a local exchange. As microwave towers are constructed at most of the exchanges in Syria, a rapid access to the local network is possible. However, in urban areas, the costs for a subscriber line via wireless local loop are much higher than the costs for an access by cable.

6.12.3.3 Application Possibilities

Rapid service provision is made easy by the use of wireless local loop radio systems. Since no additional infrastructure is required between the subscribers' premises and the public telephone network, a large number of subscriber stations can be implemented without loss of time. This should be borne in plans for rural and suburban areas.

6.12.4 Implementation Strategy

The long term target is to enable STE for an economical and fast construction of subscriber networks. In addition, the provisioning of high bit rate leased lines to the customer (n x 64 kbit/s, 2 Mbit/s and n x 2 Mbit/s) shall be facilitated.

The long term strategy is to construct the subscriber network by means of the hybrid subscriber network, especially in suburban and rural areas.

For the implementation of any technology, it should be distinguished between the following kind of areas depending on the subscriber density:

- Metropolitan/City area
- Urban/Suburban area
- Rural area.

The overall implementation strategy is considered as follows.

- the existing network (Metallic Cable Network) should remain as it is now. An early replacement is economically not feasible. An exception may be, if bottlenecks in duct availability surface. In such exceptional cases, the replacement of an existing CCC by a RU and the replacement of primary cables by optical fiber cable may be considered in order to avoid or to postpone duct expansion.

- New projects, especially in suburban and rural areas, should be executed by means of introducing a Hybrid Subscriber Network.

- In rural areas, the WLL technology shall be applied, if the costs for the construction of a Metallic Cable Network or a Hybrid Subscriber Network exceed the costs for the WLL installation.

6.13 Intelligent Network Infrastructure

The Intelligent Network (IN) can be understood as an overlay infrastructure of data processing capabilities in conjunction with a centralized data base function and an associated management entity, which supports and complements the call control function in the switches.

Figure 6.13-1 shows the functional architecture of the IN

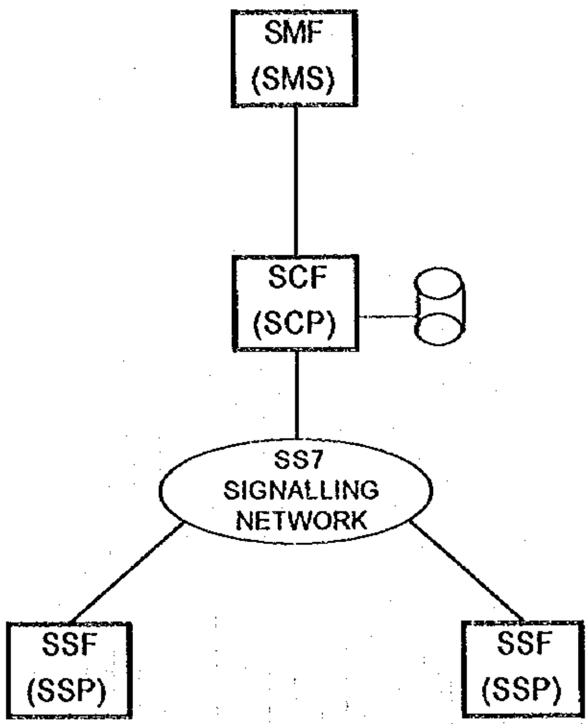


Figure 6.13-1: INTELLIGENT NETWORK ARCHITECTURE

6.13.1 Functional Components

The Intelligent Network architecture contains the following components shown in Figure 6.5-1:

- Service Switching Function (SSF)

The Service Switching Function is embedded in the call control function of a switch, and supplements the call control by a trigger recognition function and a communication function for interaction with the Service Control Function (SCF). For the communication the Signalling System No.7 (SS7) signalling network is used. A special application part in SS7, the Intelligent Network Application Part (INAP), which utilizes TC, SCCP and MTP as transport functions, serves for the communication. A switch, which contains the SSF is called Service Switching Point (SSP). Finally all local exchanges in a network will become SSPs.

- Service Control Function (SCF)

The Service Control Function can be understood as an extended call control function with a large data base placed centrally in the network, which can be accessed on demand by the Service Switching Functions. The Service Control Function analyzes the data received from a Service Switching Function by means of its so called Service Logic and sends instructions and data back to the originating Service Switching Function to enable it to continue with the call set up. The Service Control Function resides in a powerful fault-tolerant On-Line Transaction Processing (OLTP) computer named Service Control Point (SCP).

- Service Management Function (SMF)

The Service Management Function is thought to be a means and a filter for manipulations of the Service Control Function. Such manipulations will be needed to add data to or to modify data in the data base in the SCP, or to create a new IN service. The Service Management Function resides on a normal commercial computer called Service Management System (SMS). The inter-face between the SMS and the SCP is not standardized. Normally a X.25 interface with a proprietary higher level protocol is applied. On the long term the SMF is most likely to migrate into the Telecommunications Management Network (TMN) (see also chapter 10).

- Service Creation Environment (SCE)

The Service Creation Environment is a set of software tools normally to be run on a work station or a PC which provides a user friendly interface for service creation and data base manipulation. It also includes pre-testing and filtering so that it can be directly connected to the SCP.

6.13.2 Objectives of the IN Principle

Basically, the IN principle has two major objectives. The first one, which has already been achieved by present IN implementations, is optimized and/or ad-ministratively easier utilization of the network. The second one, which is in the long term of even more importance, is rapid service creation and deployment by the network operator without direct involvement of the switch supplier.

- Optimized and / or administratively easier utilization of the network

All new services involving virtual numbering (numbers which are not real network addresses), flexible charging and flexible routing can in principle be handled by today's switching systems either by routing such calls to centralized and specialized exchanges with the necessary data bases high up in the network or by having the required data stored in every local exchange in the network.

The first solution leads to an unnecessary occupation of network resources e.g. when a call is routed first to the special exchange and than in the extreme case back to the local network f origin. The second solution would require very frequent up-dating of all local data bases, which is administratively not.

The capability of the IN infrastructure, to provide access to a centralized data base via the SS7 signalling network without occupying speech circuits, overcomes the shortfalls of both solutions discussed before. The full advantage of this IN feature can only be exploited when the Service Switching Function is deployed as close to the subscriber as possible, which means in all local exchanges.

- Rapid service creation and deployment

Today's Digital SPC switching systems are very flexible and allow any up-grading for new services. However, the process of defining, specifying, implementing and testing in conjunction with deploying the new functionality in all exchanges throughout network takes normally at least two years. Furthermore, an adding of new services one by one, would require very frequent software changes and consequently, would result in a fairly instable software. Under this frame conditions, it is usual practice to bundle new services and service features and to execute the required software change in the network only in intervals of two to three years.

However, with liberalization and consequently increasing competition this rather long interval is not acceptable any more. New ways for faster service deployment without software de-stabilization were needed.

The IN capability of placing a part of the call control function outside the switch at a centralized point in the network, where it can be manipulated in a standardized way (the principle of Service Independent Building Blocks, SIBs), and where it can be accessed by the switch via the SS7 signalling network, allows for rapid service creation by the network operator without direct involvement of the switch supplier.

6.13.3 Intelligent Network Deployment Strategy for STE

An Intelligent Network infrastructure should be deployed in STE's PSTN/ISDN starting during the Eighth Five Year Plan. The Strategy should aim at reaching full network covering already in the early stage of the deployment, so that IN services can be marketed throughout the country.

As a final target the Service Switching Function should be available in every local exchange.

Never the less, there are still local switching systems operational in the STE network for which the integration of the Service Switching Function is either technically not possible (system EMD) or economically not feasible (systems E10A / E10B and NEAX 61). For these switches, the associated transit exchange must serve temporarily as Service Switching Point until they will be replaced finally.

The integration of the Service Switching Function into the EWSD exchanges should preferably be performed in the course of a regular expansion project associated with a software version up-grading, and not especially for that purpose only.

It may happen that in some small (rural) exchanges neither a regular expansion nor a software version up-grade is scheduled for the visible future. In this case, it must be decided whether the up-grade to the Service Switching Function separately or to rely on the transit exchange as a SSP (as for the older switching systems). The latter is the more preferable the smaller the exchange under consideration is. However, if there is a general software version up-grade throughout the network all local exchanges of that system should become SSPs.

A general out-line for STE's Intelligent Network introduction strategy could be as follows:

- initially deploy a Service Control Point (SCP) and the Service Creation Environment (SCE), and integrate the Service Switching Function (SSF) at least in all the transit (STD) exchanges,
- integrate the SSF into the local exchanges, preferably in the large city exchanges and those in densely populated areas first,
- continue to deploy the SSF in all local exchanges throughout the country,
- if obsolete switching systems are replaced at local level make sure that the new exchange system contains the SSF right from the beginning.

CHAPTER 7 LONG TERM FACILITY PLAN

7.1 Transmission

Based on the circuit-matrixes which forecast numbers of circuits between telephone switches at the end of 2010, shortages of transmission facilities have been checked, comparing existing digital circuits with the forecast circuits in number. For areas where shortages are anticipated, new facilities are planned that consider suitable network configurations. Taking into account of re-usage of replaced equipment, new facilities are not planned for some areas. Then each of the facility plans are assigned to one of the three long terms (1996-2000, 2001-2005 and 2005-2010), according to the levels of urgency (see sections 5.2.4.1, 5.2.4.2, and 5.2.4.3).

7.1.1 Long Line Network

(1) Areas ranging from Damascus to Aleppo, including West Coast

Capacity surplus for digital circuits at the end of 2010 are summarized in Table 7.1.1-1, where figures with minus signs indicate shortages.

Table 7.1.1-1 Capacity Surplus [2MBPS]

Station	Station	Surplus	Note
DAMASCUS	NABEK	-9	
DAMASCUS	ZABADANI	-12	under construction
DAMASCUS	QUNEITRA	10	
DAMASCUS	DARAA	4	
DAMASCUS	SWEDA	-4	
DAMASCUS	ALEPPO	-17	
DAMASCUS	HOMS	7	
DAMASCUS	HAMA	1	
DAMASCUS	LATTAKIA	-6	
DAMAS(INTN.)	ALEPPO	10	
DAMAS(INTN.)	HOMS	6	
DAMAS(INTN.)	HAMA	-4	
DAMAS(INTN.)	LATTAKIA	0	
ALLEPO	MUNBIJ	0	
ALLEPO	IDLEB	-20	
ALLEPO	HOMS	15	
ALLEPO	HAMA	6	
ALLEPO	LATTAKIA	2	
HOMS	HAMA	16	
HOMS	LATTAKIA	14	
HAMA	LATTAKIA	-2	
LATTAKIA	TARTOUS	-15	
TARTOUS	DAMAS	11	existing circuits
TARTOUS	HOMS	8	existing circuits
DEIR ELZOR	DAMASCUS	-8	
DEIR ELZOR	HOMS	-2	
DEIR ELZOR	DAMAS(INTN.)	-2	
TOTAL		9	

The table above indicates that a significant shortage is not anticipated for the year 2010 as a whole. However, if circuit transfer from the obsolete analog microwave systems and analog/digital coaxial systems is considered, line usage will become close to capacity. TV circuits and dedicated circuits used by governmental sectors and private sectors now run on the obsolete systems.

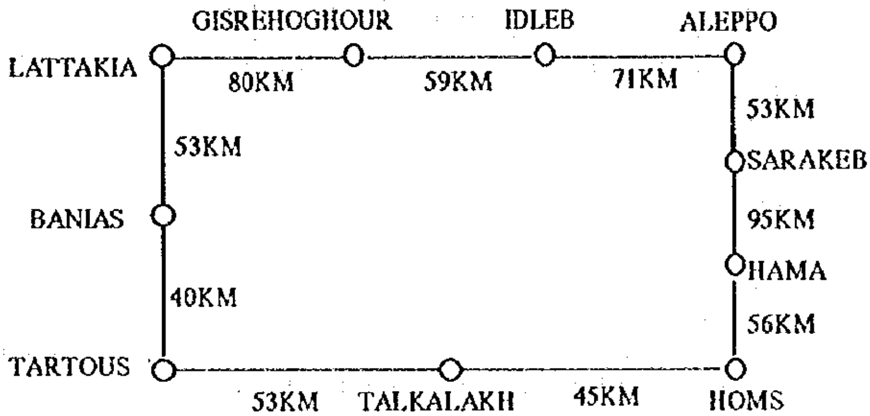
It is proposed here to introduce SDH-4 systems for circuits between main transits switches to relieve shortages in capacity and at the same time to increase security up to 100% for the most important circuits. SDH switching functions are utilized for 100% circuit restoration (protection). Circuits for main transits switches will be transferred from the existing 140Mbit/s systems to the SDH-4 systems to make free circuits in the existing 140Mbit/s systems, and the free circuits can be used for the TV circuits, the dedicated circuits, circuits linking Aleppo and Idleb, and other circuits.

Circuits covered in the SDH-4 systems are shown in Table 7.1.1-2 which is made from the Long Line Network Circuit Matrix of 2010.

Table 7.1.1-2 Circuits On Main Transit Switches, 2010

	AREANAME	1.DAMA	7.ALEP	14.HOMS	15.HAMA	16.LATT	18.INTE	TOTAL outg.
1	DAMASCUS		960	480	210	420		2070
7	ALEPPO	960		180	150	270	120	1680
14	HOMS	480	180		90	90	90	930
15	HAMA	210	150	90		60	60	570
16	LATTAKIA	420	270	90	60		90	930
18	INTERNATIONAL		210	90	60	90		450
	TOTAL incom.	2070	1770	930	570	930	360	6630
	TOTAL outgo.	2070	1680	930	570	930	450	6630
	TOTAL	4140	3450	1860	1140	1860	810	13260
	2MBPS	138	115	62	38	62	27	442
	STM-1	2.19048	1.8254	0.98413	0.60317	0.98413	0.42857	7

Figure 7.1.1-1 shows SDH network configurations for the main transit switches.



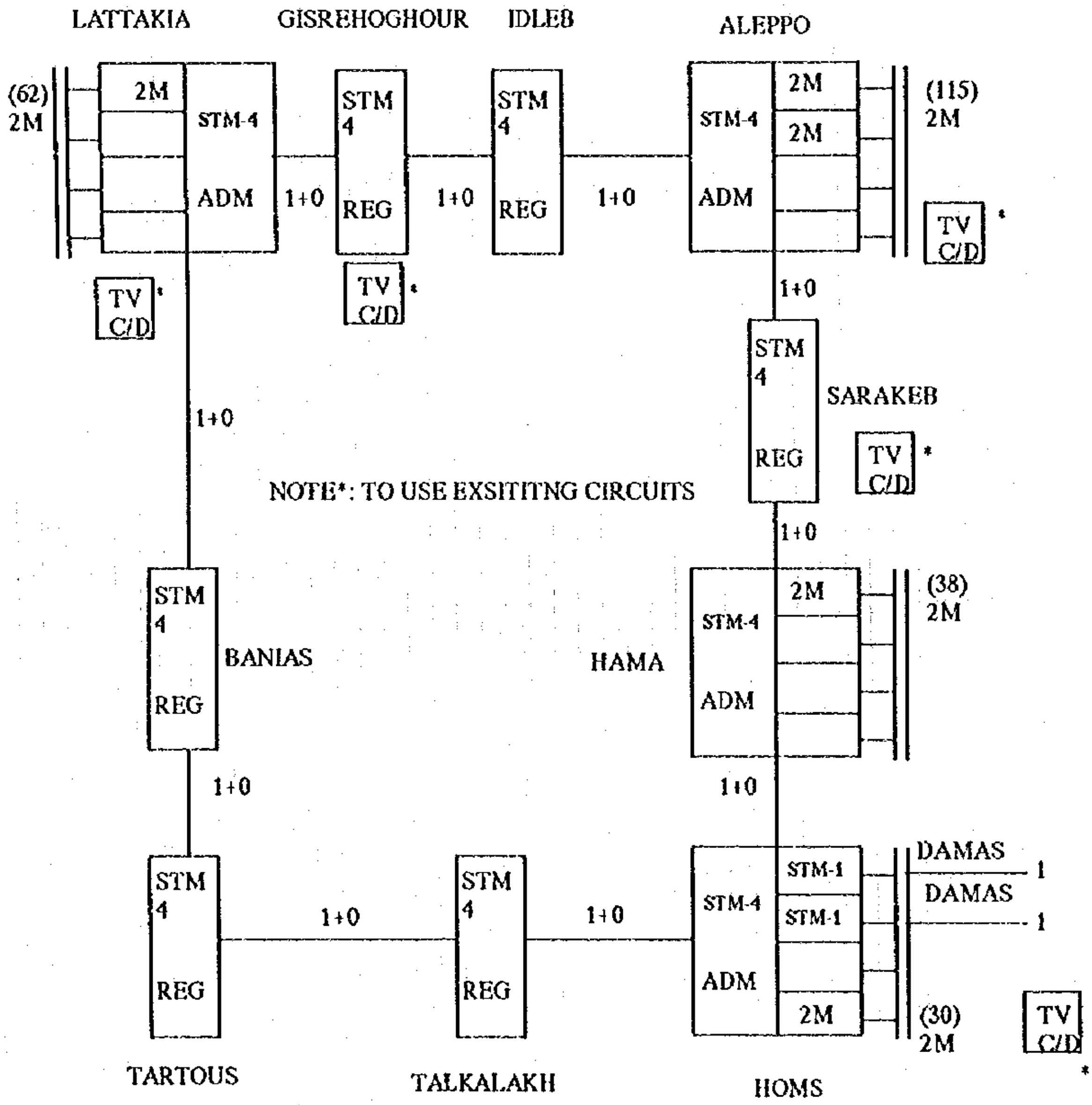
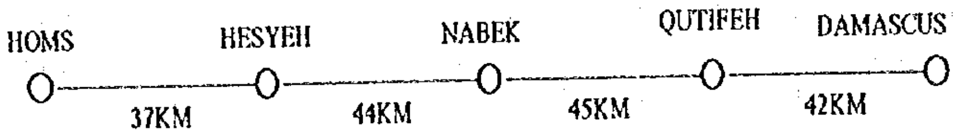
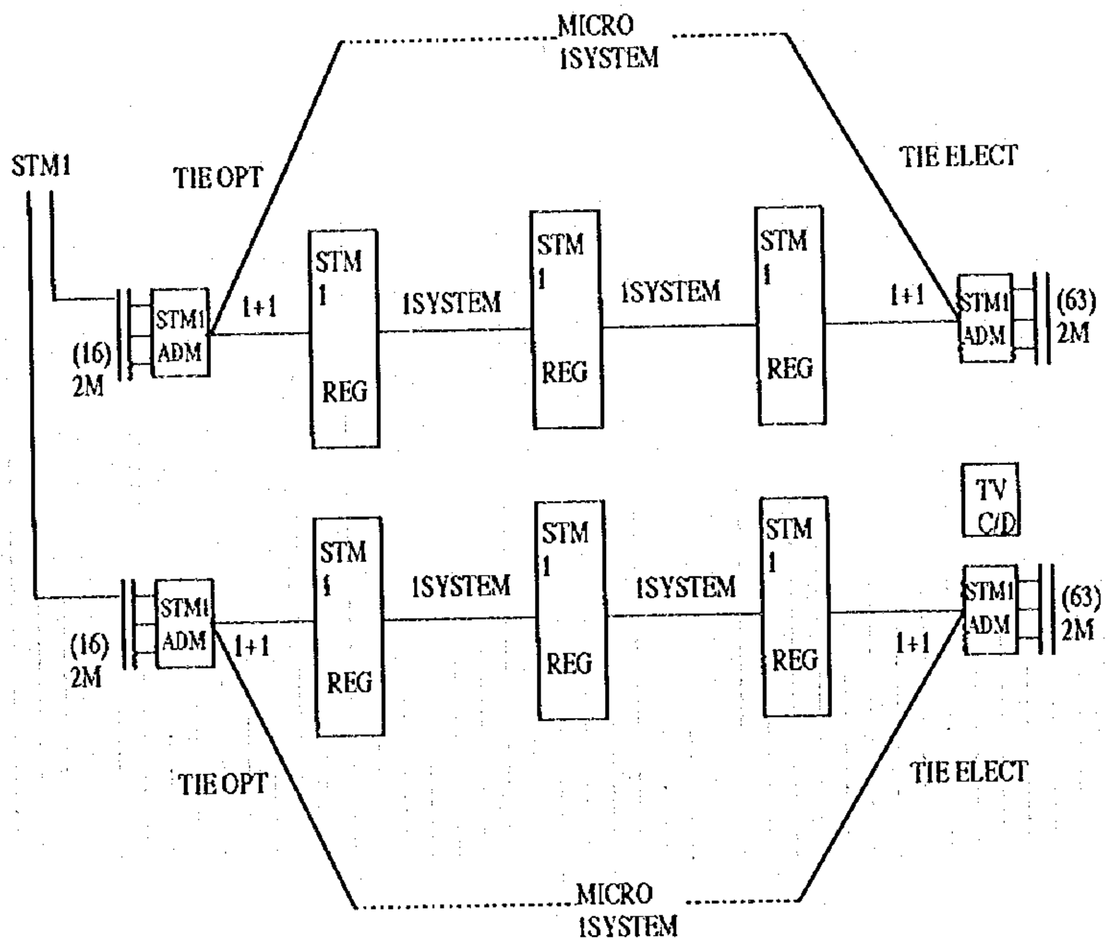


Figure 7.1.1-1 Network Configuration for Main Transit Switches (1/2)





MICRO: Micro Wave (2+1) Systems with 3 repeator stataions, new towers, and new antennas

Figure 7.1.1-1 Network Configuration for Main Transit Switches (2/2)

(2) Areas ranging from Aleppo to Deir Elzor, and Kamichly

There are no digital transmission systems for these areas, so digitization is an urgent requirement for this part of the Long Line Network. SDH-4 (1+1) fiber-optic systems are proposed, as, in the interim, existing analog microwave systems can be relied on as back up systems for the fiber-optic systems. Both wire and wireless systems could be used to complement each other to strengthen circuit security. New digital microwave systems would have to be installed when traffic levels require them, perhaps after the year 2010.

Figure 7.1.1-2 shows the number of circuits that will be required. In addition to TV circuits, the numbers of telephone circuits for each section are increased by 20% for dedicated circuits. Figure 7.1.1-3 shows the transmission network configuration for these areas.

(3) Areas ranging from Damascus to Sweda , and Daraa

No significant digital circuit shortage is anticipated at the end of 2010, though circuit rearrangement may be required. Therefore, any new facilities plans for these areas have not been drawn up.

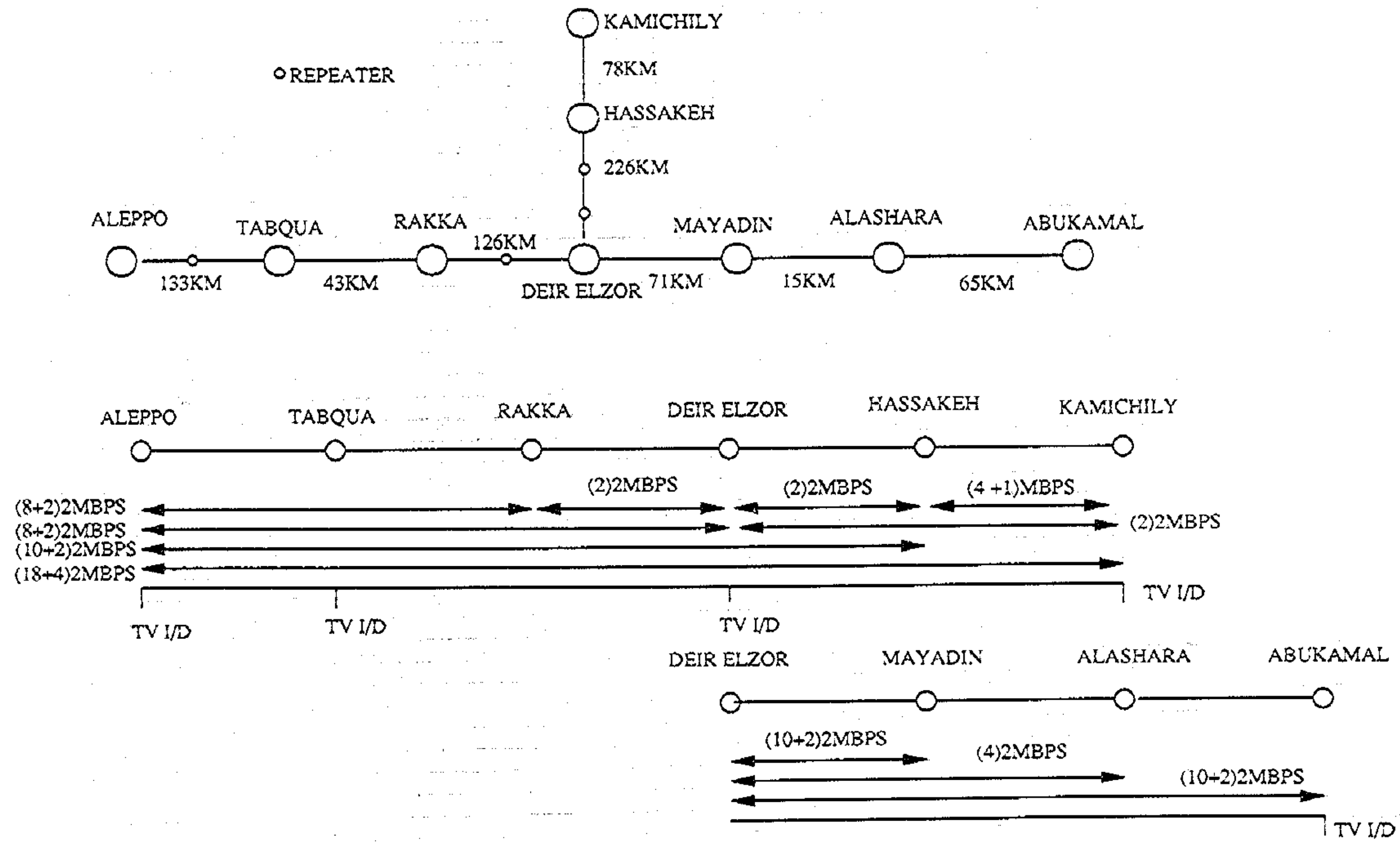


Figure 7.1.1-2 Required Cicuits for Areas East of Aleppo (in 2010)

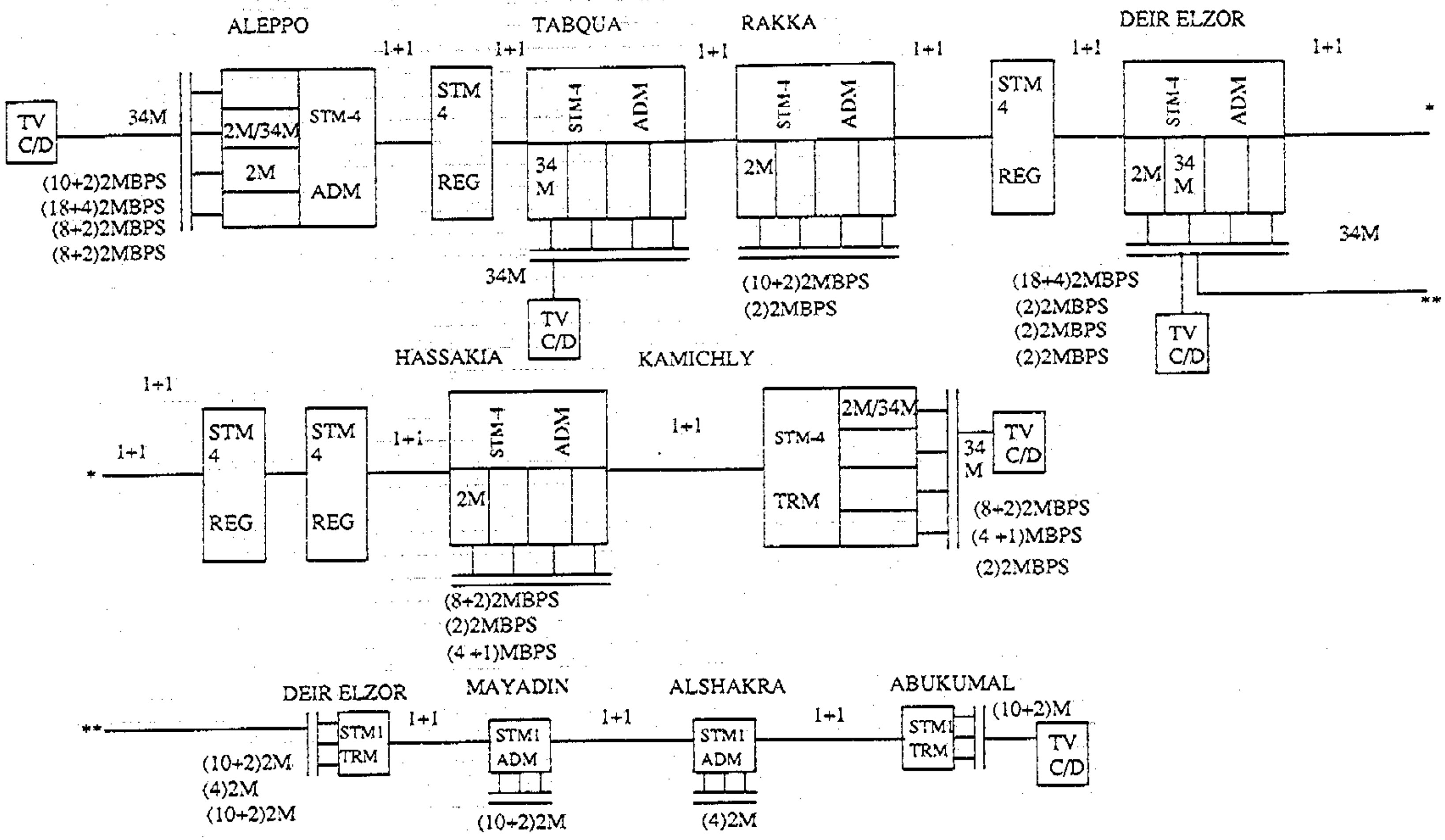


Figure 7.1.1-3 Network Configuration for Areas East of Aleppo

7.1.2 Junction Networks

(1) Aleppo Junction Network

Sections with circuit shortages are shown in Figure 7.1.2-1. The proposed strategy for this area is to make a SDH-4 loop (Ring) in the central part of Aleppo to provide additional circuits and better security. The ring will secure more than 50% protection with route diversity. Figure 7.1.2-2 shows the ring Network configuration.

Some existing 140Mbit/s systems will be transferred to the two new Hananow-C and "NEW AREA"-A sections, where new fiber-optic cables are required by the plan.

(2) Damascus Junction Network

Sections with circuit shortages are shown in Figure 7.1.2-3. The eight SDH-4 loops (Rings) shown in Figure 7.1.2-4 are planned to cover these circuits shortages. The most urgent is LOOP1, and the least is LOOP8 which supplements shortage in the LOOP1 capacity. LOOP2 is related to new switch A2, and LOOP3 is indirectly related to the switch A2 They also serve to cover the lack of LOOP1 capacity. LOOP1, LOOP2 and LOOP3 are all urgently needed.

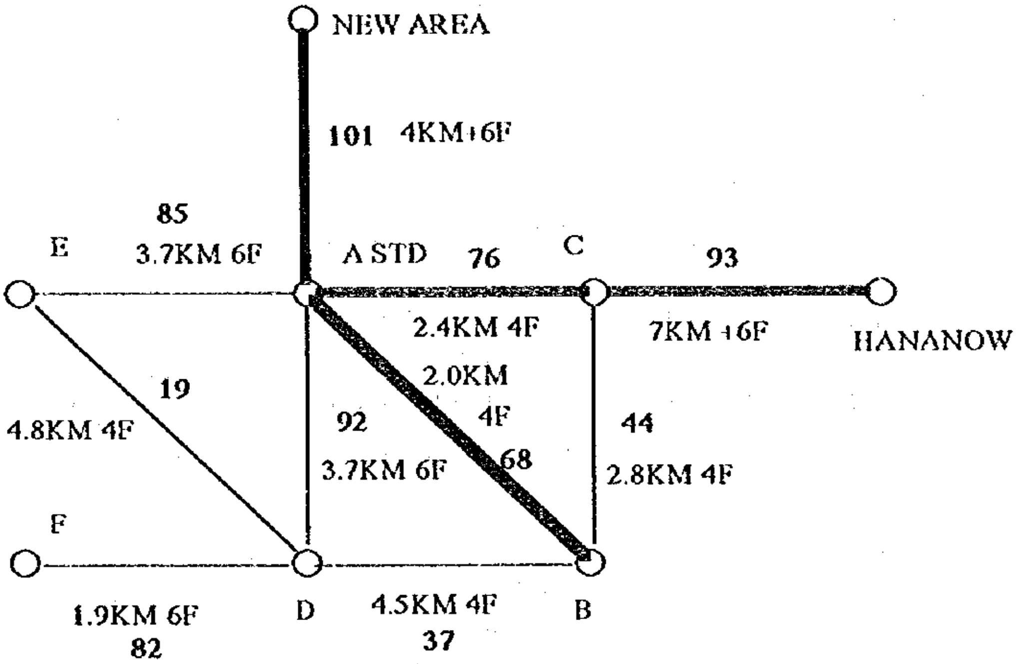
LOOP5 is related to a switch in "NEW TOWN". Location of "NEW TOWN" is presumed to be as shown in the figures, just for cost estimation. When any actual "NEW TOWN" become feasible, loop configuration must be re-considered.

50%-50% route diversities are used for all loops to ensure a minimum 50% protection.

An example of LOOP configuration is shown in Figure 7.1.2-5. Some existing 140Mbit/s systems will be replaced with SDH-4 systems and transferred outside the loops where new fiber-optic cables are planned. In addition to new fiber-optic cables for the A2-C, and A2-A1 sections, new fiber-optic cables will be installed for the M-I, N1-N2, N2-J, "NEW TOWN"-L1, "NEW TOWN"-K, P-D2, and Milehaa-H sections.

(3) Homs, Lattakia areas

Since circuit shortages are anticipated at the end of 2010, new SDH-4 systems will be installed for Homs STD - Homs E, and Lattakia STD - Lattakia D, as shown in Figure 7.1.2-6. The existing 140Mbit/s systems will be replaced with the SDH-4 systems.



NOTE: Bold figures show the number of 2MBPS circuits required at the end of 2010.

: Sections with circuit shortage

Figure 7.1.2-1 Circuits required in Aleppo Junction Network (in 2010)

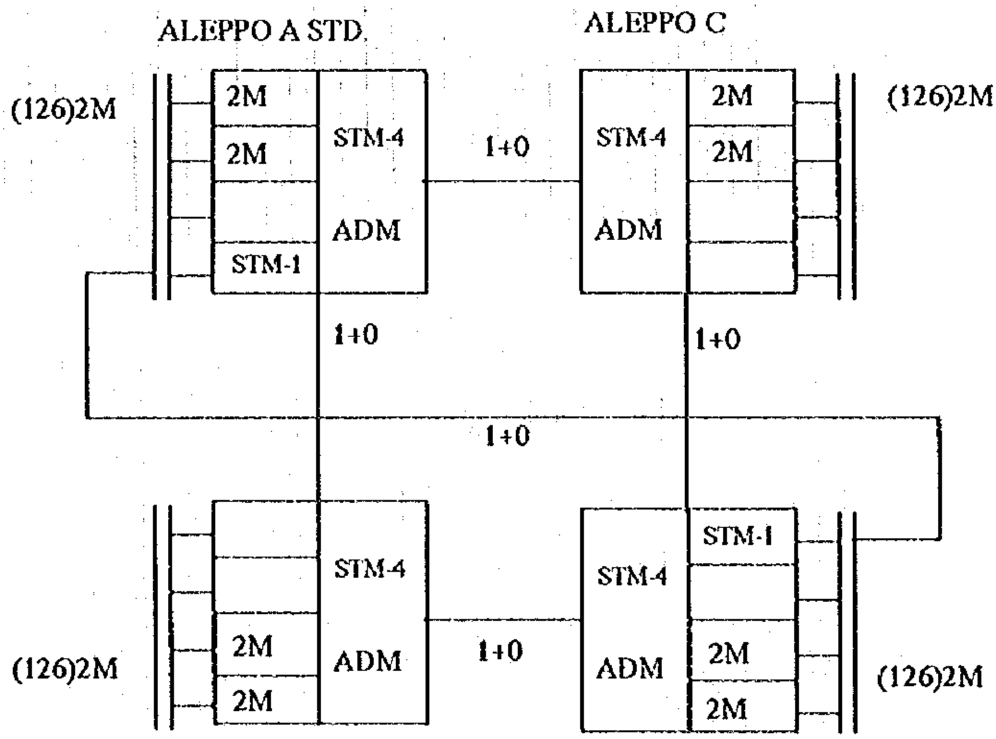
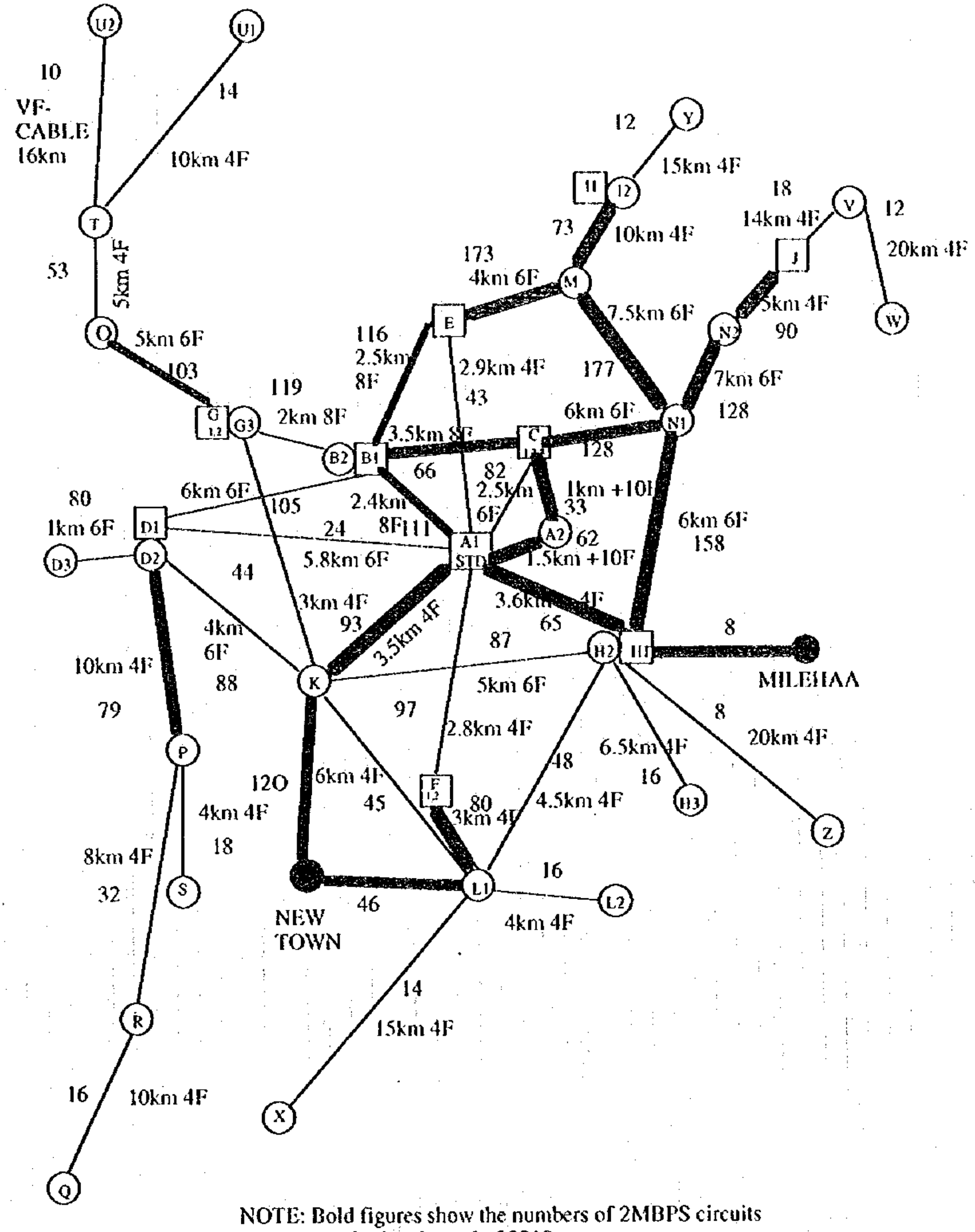


Figure 7.1.2-2 Aleppo Junction Network Configuration



NOTE: Bold figures show the numbers of 2MBPS circuits required at the end of 2010.

: Sections with sircuit shortage

: Sections approaching circuit shortage

Figure 7.1.2-3 Circuits required in Damascus Junction Network (in 2010)

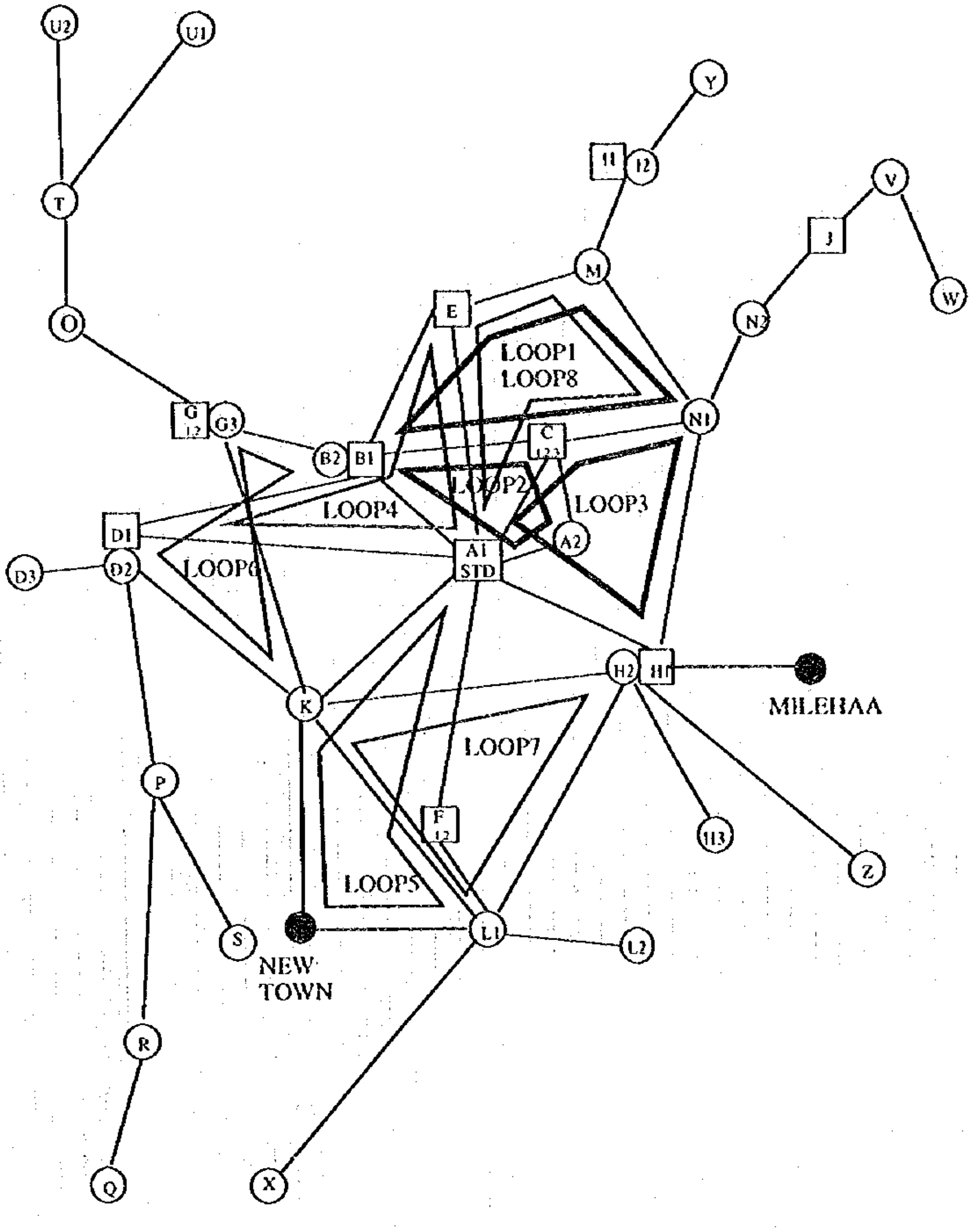
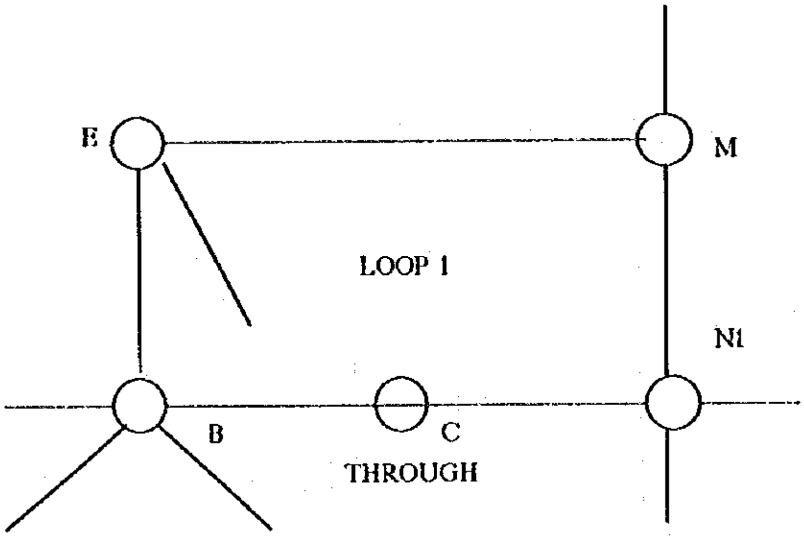


Figure 7.1.2-4 Damascus Loops



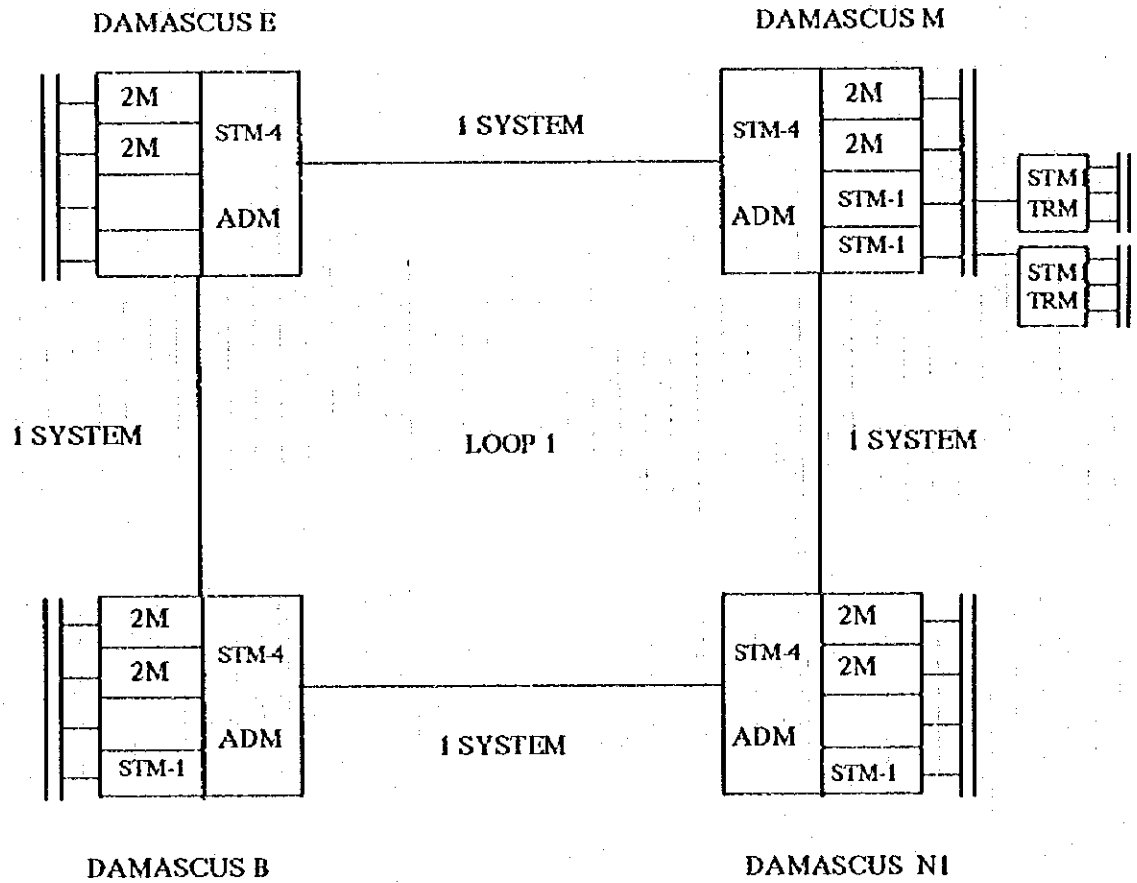
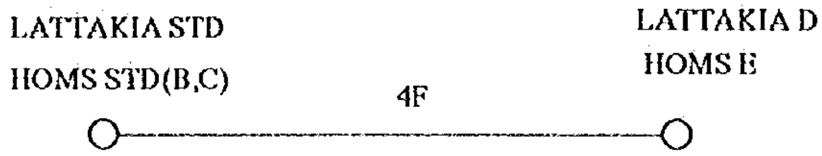


Figure 7.1.2-5 Example of Damascus Loop Network Configuration



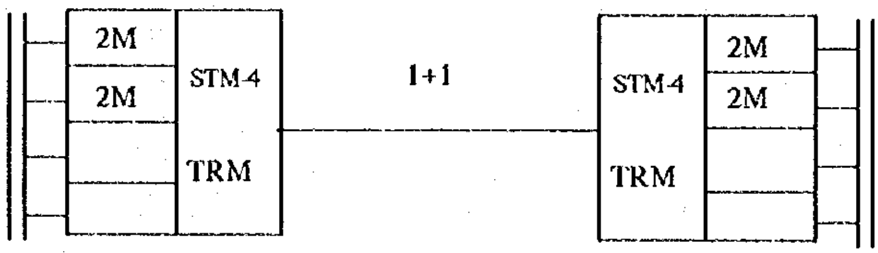


Figure 7.1.2-6 Network Configuration for Homs and Lattakia

7.1.3 Long Local Sections

The following three long sections are ones that have not been digitized, but are required to be in the plan.

(1) Tartous - Safita 50km (see Figure 7.1.3-1)
(2) Deir Elzor - Myadin - Abukumal 151km (see Figure 7.1.1.-2, Figure 7.1.1-3)
(3) Homs - Tadmore 150km (see Figure 7.1.3-2)

They all use new fiber-optic SDH-1 (1+1) systems. As for the Homs - Tadmor section, the alternative section, Damascus - Tadmor would be better, from the point of view of the security described in section 6.3.1. However, the small capacity requirement for the section could not justify the more expensive alternative. The plan adopts the more economical route. The Homs - Tadmore will be the last of the sections to be digitized. In the lead up, all replaced analog micro wave systems should be accumulated to here to be used as spare parts.

7.1.4 Local Sections

A look at the circuit matrix tables reveals some sections which have not been digitized yet or which do not have enough circuits. Table 7.1.4-1 lists such sections. Transmission systems for these sections are not specified in the plan. Use of 34Mbit/s microwave systems is assumed for the purposes of cost estimation.

7.1.5 Manual Switch Sections

Circuit demand on manually switched sections are listed in Table 7.1.5-1, based on the circuit matrix tables. Transmission systems for these sections are not specified in the plan. Use of 34Mbit/s microwave systems is assumed for cost estimation purposes. One 34Mbit/s microwave system is used for every ten 2Mbit/s circuits.

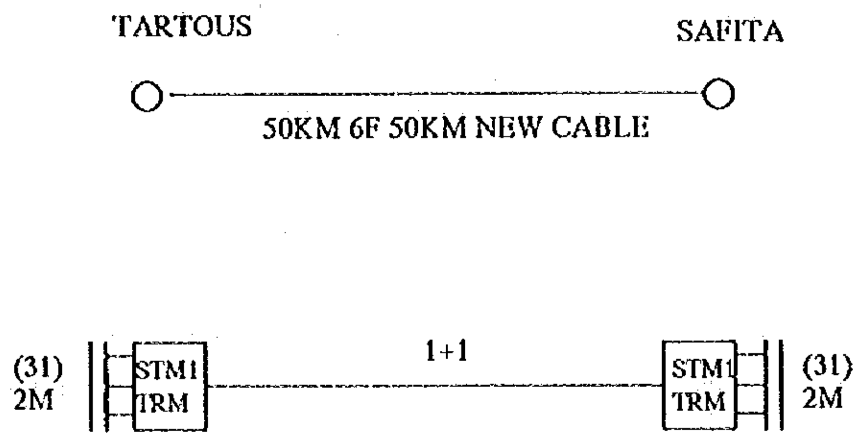


Figure 7.1.3-1 Network Configuration for Tartous and Safita

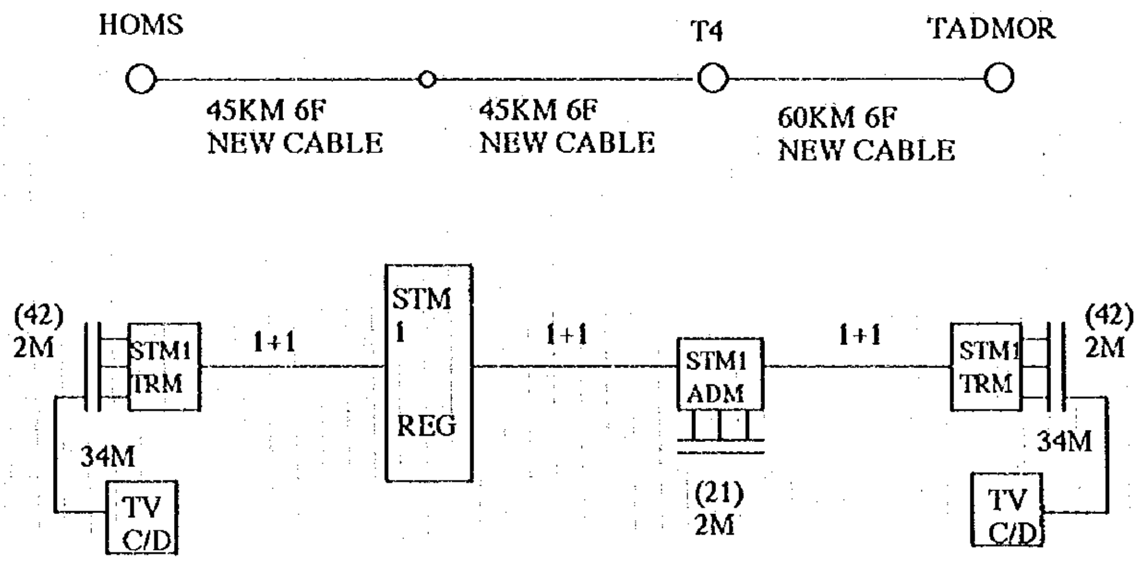


Figure 7.1.3-2 Network Configuration for Homs and Tadmor

Table 7.1.4-1 Local Digital Circuit Demand (in 2010)

station1	station2	2MBPS	NOTE	PLAN
NABEK	YABROD	18		1996-2000 2005-2010
	DERATTIAH	16		1996-2000
	JEROD	16		1996-2000
	EINTENEH	2		2001-2005
KARRA	DERATTIAH	10		1996-2000
MALLOLA	JEROD	4		2001-2005
DERALZOR	ALASHARA	4		2001-2005
HOMS	TALBESHE	8		2001-2005
	KATTENA	4		2001-2005
	ALSOQNEH	4		2001-2005
IDLEB	ARIEHA	20	existing system	2005-2010
	MAERT MISRIEN	14	existing system	2005-2010
	SRAKEB	14		1996-2000
	SELKEIN	8		2001-2005
	BENSH	12		1996-2000
KAMESJLE	AMODAH	10	existing system	2005-2010
MANBEG	JARABLOS	12	existing system	2006-2010
	EIN ALARAB	10	existing system	2006-2010
QUENNENTRA	JOBATTA	4		2001-2005
RAKKA	ALTHAOWRAH	6	trans MUX	2001-2005
TARTOUS	MASHTA	12		1966-2000
ZABADANI	UNKOWN1	6		2001-2005
	UNKOWN2	8		2001-2005
	UNKOWN3	4		2001-2005

Table 7.1.5-1 Digital Circuit Demand

on Manaual Switches (in 2010)

area	CCT1	CCT2	total	2MBPS	34MBPS*
ALEPPO	630	630	1260	42	5
NABEK	720	720	1440	48	5
DARAA	630	630	1260	42	5
DERALZOR	150	150	300	10	1
HAMA	810	810	1620	54	6
HASAKIA	150	150	300	10	1
HOMS	480	480	960	32	4
IDLEB	600	600	1200	40	4
KAMIESJELE	210	120	330	11	2
LATTAKIA	450	450	900	30	3
MANBEG	120	120	240	8	1
QUENNERTA	120	120	240	8	1
RAKKAH	90	90	180	6	1
SWEDA	480	510	990	33	4
TARTOUS	570	570	1140	38	4
ZABADANI	120	150	270	9	1
TOTAL			12630	421	48

Note*: One 34MBPS MICRO SYSTEM is assigned

for every ten 2MBPS circuits.

7.1.6 Summarization of Transmission Plans

The following are summaries of transmission plans for the individual long term plans.

(1) The Eighth Five-Year Plan (1996-2000)

(1-1) Aleppo-Tabquq-Rakka-Deir Elzor-Hassakeh-Kamichily

New 606km fiber-optic cable.

SDH STM-4 (1+1)system.

TV coder/ decoder.

(1-2) Damascus-Homs

5GHz micro system (2+1) system new tower new antenna diversity.

Two SDH STM-1 systems on an existing fiber-optic cable.

TV coder/ decoder.

(1-3) Damascus SDH Loop 1-3

One SDH STM-4 system Ring for each loop on existing fiber-optic cables.

(1-4) Aleppo-Hama-Homs-Lattakia

One SDH STM-4 system Ring on existing optical fiber cables.

TV coder/ decoder.

(1-5) Tartous-Safita

New 50km fiber-optic cable.

SDH STM-1 (1+1) system.

(1-6) Aleppo Loop

One SDH STM-4 system Ring on existing optical fiber cables.

(1-7) Sections on Manual switches

34Mbit/s micro (24+24) systems.

(1-8) Local Sections

34Mbit/s micro (7+7) systems.

(2) The Ninth Five-Year Plan (2001-2005)

(2-1) Dier Elzor-Mayadin-Alshakera-Abukumal

New 151km fiber-optic cable.

SDH STM-1 (1+1) system.

TV coder/ decoder.

(2-2) Damascus Loop 4 and 5

One SDH STM-4 system Ring for each loop on existing fiber-optic cables.

(2-3) Sections on Manual switches

34Mbit/s micro (24+24) systems.

(2-4) Local Sections

34Mbit/s micro (12+12) systems.

(2-5) New cables for Aleppo and Damascus Junction Networks

(3) The Tenth Five-Year Plan (2006-2010)

(3-1) Homs-Tadmor

New 150km fiber-optic cable.

SDH STM-1 (1+1) system.

(3-2) Homs STD-Homs E

STM-1 (1+1) system on existing fiber-optic cables.

(3-3) Lattakia STD-Lattakia D

STM-1 (1+1) system on existing fiber-optic cables.

(3-4) Damascus Loop 6-8

One SDH STM-4 system Ring for each loop on existing fiber-optic cables.

(3-5) Local Sections

34Mbit/s micro (6+6) systems

7.2 Switching for the PSTN / ISDN

This part of the facilities plan outlines the amount of switching equipment and the number of junction and trunk lines to be deployed in STE's network during the next 15 years. Basically, it represents:

- the long term planning for provision in the switching sector,
- the basic data for transmission network planning, and
- should allow the estimation of the investment needed in switching during this period.

The facilities plan for switching shall not and can not substitute for detailed planning, which has to be performed at regular intervals as preparation for project implementation.

7.2.1 Relation with the Fulfillment Plan

The facilities plan for switching is based on the fulfillment plan and the traffic forecast as lined out in chapter 5.

The fulfillment plan shall guide STE's network development by setting targets for the number of subscriber lines to be in service in each of the next 15 years. Thus, the fulfillment plan is the co-ordinating instrument for provision of the particular telecommunications components (transmission facilities, switching facilities and subscriber network).

The fulfillment plan foresees two phases:

- during the Eighth Five-Year Plan (1996 - 2000) a concentrated effort to catch up with the demand and to eliminate the waiting list, and
- during the Ninth and Tenth Five-Year Plan (2001 - 2005 and 2006 - 2010) sustained efforts to provide telecommunications in accordance with the increasing demand.

This facilities plan for switching strictly follows the fulfillment plan.

However, the present bottleneck in provision are the subscriber networks, with an actually widening lag of approximately 800,000 subscriber lines behind the deployment of switching facilities.

One of the key elements in the fulfillment plan is to close this gap during the Eighth Five-Year Plan (1996 - 2000). If indications surface that closing the gap will not succeed to the extent planned, the fulfillment plan must be revised.

As a consequence, also this facilities plan for switching must than be revised accordingly. The revision in this case must first of all slow down the regular expansion and deployment of switching equipment, since this would be an investment without return for a rather long period. Whether instead modernization of the network, i.e. the replacement of older automatic switching equipment and the replacement of manual equipment, should be speeded up, must be decided based STE's financial situation at that point of time.

7.2.2 Regular Switching Equipment Expansion and Deployment

With the deployment of switching equipment in STE's network already at an advanced level, it is proposed to shift the expansion and deployment strategy from large project implementation to continuous provision based on demand-oriented continuous planning.

Continuous provision involves the introduction of a so-called "planning period" of n years. This means that in the year x provision for demand of the year x+n has to be implemented. The planning and commissioning of equipment, therefore has to be done in the year x-1.

To equalize planning, commissioning and implementation work load, the expansion for 1/n th of the exchanges is done each year in turn, so that after n years, the planning and provision cycle starts again.

The planning period is a compromise between planning and implementation overhead costs and interest costs for advance investment. In networks growing with normal speed a planning period of n = 2 years is usual.

However, the planning period for very slowly growing exchanges may be superseded by minimum provision requirements, which reflect the fact that if an expansion project becomes to small, the planning and commissioning overhead becomes unacceptably high. In such cases the minimum amount is provided and the planning period is expanded accordingly for these exchanges. The minimum provision requirements are given in the respective sub-sections in the following.

7.2.2.1 Local Exchanges

Strategically, the currently-valid final capacities for local exchanges should first of all be revised in accordance with the proposals in section 6.11, and greater use of remote units (RU) should be made.

The exchange and remote unit sizes for the next 15 years in accordance with the fulfillment plan are shown in S1-7-1 in the Supporting Report.

The frame conditions have been set as follows:

- Planning period **2** years,
- Minimum expansion for local (host) exchanges **1,000** line units,
- Minimum expansion for remote units (RU) **100** line units,

Note: The 1996 and 1997 figures do not yet reflect the remote unit project (125,000 line units planned and commissioned for implementation in 1996) and the small digital exchange project (125,000 line units planned for implementation in 1997) since sufficiently detailed data on sites and amounts per site could not yet be obtained.

7.2.2.2 Junction Lines

An overview on the expected development of the junction networks in five year intervals is given for each local and regional network in S1-7-2 in the Supporting Report.

The junction network are the lines between the local exchanges and between the local exchanges and their associated transit (STD) exchanges.

No planning period has been imposed, since the junction lines are normally connected on demand at yearly intervals. Necessary junction line ports in the exchanges must be provided with the regular expansions of the respective exchanges, and the necessary transmission systems are provided in accordance with the provision of transmission.

However, the Figures in S1-7-2 in the Supporting Report provide the basis for local and regional transmission planning.

7.2.2.3 Long-Distance Exchanges

The long-distance (STD) exchange sizes for the next 15 years in accordance with the fulfillment plan are shown in S1-7-3 in the Supporting Report.

The frame conditions have been set as follows:

- Planning period **2** years,
- Minimum expansion for dedicated long distance (STD) exchanges **120** ports,
- Minimum expansion for combined local / long distance exchanges **30** ports,
- The expansion of the long distance portion of a combined exchange is always implemented together with the expansion of the subscriber portion of that exchange.

It should be noted that the position "INTERNATIONAL" includes only the national side of the International Gateway Exchanges (IGE). Furthermore, the national parts of both the International Gateway Exchanges, Damascus and Aleppo, are still shown together since an exact in-service date for Aleppo could not yet be obtained.

From S1-7-3 in the Supporting Report, it can clearly be seen that the growth in the long distance network is rather slow (which is mainly caused by the present over-provision), and that no additional long distance exchanges are needed for the visible future.

7.2.2.4 Long Distance Lines

An overview on the expected development of long-distance lines in five year intervals is given in S1-7-4 in the Supporting Report.

No planning period has been imposed, since long-distance lines are normally connected on demand at yearly intervals. The necessary long-distance line ports in the long distance exchanges must be provided with the regular expansions of the respective exchange, and the necessary transmission systems are provided in accordance with the provision of transmission.

However, the figures in S1-7-4 in the Supporting Report provide the basis for long distance transmission planning.

7.2.3 Replacement of Older Automatic Switching Systems

Since this plan is looking ahead for 15 years, a strategy how to cope with the older systems must not be neglected.

Three older types of automatic switching systems are operational in STE's PSTN:

- 221 000 line units of the EMD system, an electrically marked electro-mechanical analog system, installed mainly between 1968 and 1974, including 4 containerized exchanges with together 4,000 line units deployed in 1986.
- 58,000 line units of the systems E10A and E10B, a first generation digital switching system family.
- 100,000 line units of NEAX 61, a first generation digital switching system, installed in 1982 as three large units in Damascus (Al Nasser and Baghdad street) and Aleppo.

All the three older automatic switching systems have in common that

- up-grading to ITU-T Signalling System No.7 (SS7) is technically not possible or economically not feasible,
- up-grading to Integrated Services Digital Network (ISDN) is technically not possible or economically not feasible,
- up-grading to Intelligent Network functionality (Service Switching Point (SSP) functionality) is technically not possible or economically not feasible,
- Integration into the planned traffic management system and into a future Telecommunications Management Network (TMN) is technically not possible or economically not feasible.

A clear indication for these systems being obsolete already or becoming obsolete in the foreseeable future is, that all three systems are not marketed actively any more by their suppliers, but have been succeeded by more advanced systems.

Beyond that, the usual problems with aging systems at the end of their economic life span are to be expected:

- for the EMD exchanges, faults caused by mechanical wear and tear will surface with accelerating frequency. It must be considered that the majority of the EMD exchanges by the year 2000 will be older than 25 years and a considerable part will even be older than 30 years. In addition, the procurement of spare parts will become more and more difficult.

- for the E10A, the E10B and the NEAX 61 exchanges, the end of their economic life span can be expected short time after the year 2000. On the one hand the usual effect of strongly increasing electronic component fault rates at the end of the life span will turn up. On the other hand it will become more and more difficult to obtain spares for these electronic components, especially for the integrated circuits, since nobody will produce these out of technology electronic components any more.

Based on the above considerations, the following strategy to cope with the older systems is proposed:

- The present status for all the older systems should be frozen. Expansion of the older systems should not take place any more. Modern second generation digital systems should be co-located at the same site with priority unless not yet existing.

- All EMD exchanges should be replaced during the Eighth Five Year Plan (1995 - 2000). The equipment should be scrapped, relocation to other sites should not be considered. The replacement should be started with priority in the Damascus local network to support the restructuring as proposed in section 6.11.

- All E10A, E10B and NEAX61 exchanges should be replaced during the Ninth Five-Year Plan (2001 - 2005), beginning with the E10 exchanges. The equipment should be scrapped, relocation to other sites should not be considered.

Detailed replacement plans for EMD, E10A, E10B and NEAX61 can be found in S1-7-5 to S1-7-7 in the Supporting Report.

7.2.4 Replacement of Manual Systems

There are approximately 120,000 line units still operational at manual exchanges / switchboards in STE's network. Most of them are connected to rather small manual exchanges with less than 200 subscribers.

All manual exchanges / switchboards should be replaced during the Eighth and the Ninth Five-Year Plan (1996 - 2000 and 2001 - 2005). Typically, they should be replaced by remote units (RU) homing to already existing digital second generation exchanges.

7.2.5 Intelligent Network Infrastructure

During the Eighth Five-Year Plan (1996 - 2000) an Intelligent Network (IN) infrastructure should be introduced in STE's PSTN as described in Section 6.13. This IN infrastructure should consist of:

- The Service Switching Point (SSP) function in all second generation digital local exchanges, which should be inserted - for cost reasons - with one of the next regular software version up-grades, but not in a separate up-grade,
- The Service Switching Point (SSP) function in all transit exchanges where older systems are connected to,
- One centralized Service Control Point (SCP) function,
- One Service Management System (SMS) / Service Creation Environment (SCE).

7.2.6 Five Year Plan Overview

As an extract from the facilities plan for switching the following Table gives a comprehensive overview for the next 3 five year plans.

	2000	2005	2010
Regular network expansion (Line Units)	574,339	158,300	146,600
Replacement of EMD (Line Units)	221,000	-	-
Replacement of E10A/E10B (Line Units)	-	58,000	-
Replacement of NEAX61 (Line Units)	-	100,000	-
Replacement of manual exch. (Line Units)	60,000	60,000	-
Subscriber Line Units to be procured	855,339	376,300	146,600
Trunk Line Units to be procured	8,500	1,530	3,180

7.3 Subscriber Network

The following Facilities Plan for subscriber lines gives the total number of lines to be available in the network on a year-by-year basis and on a per-exchange area basis. In addition, the number of subscriber lines to be installed every year are calculated on a per-exchange area basis to allow for an estimation of the investment needed.

The number of lines is shown separately in primary cable pairs and in secondary cable pairs since different flexibility factors are applied for the respective cable lines, i.e. primary and secondary cable lines.

Paragraph 6.4 describes a change in the subscriber network systems, which is mainly from subscriber metallic cable networks with primary cables and Cross Connection Cabinets (CCCs) to hybrid subscriber networks with Remote Units (RUs) which are connected to the host exchange by optical fiber cables. Owing to the large number of Switching LUs already provided or ordered but not yet supplemented by associated subscriber networks, it is not exactly predictable at what point in time the transition in construction from subscriber metallic cable networks to hybrid subscriber networks will take place. Furthermore it may appear that this transition could be at very different points in time for each exchange area.

In fact, new primary cables will not be installed in the areas where hybrid subscriber network is introduced.

However, the tables shown hereunder still show primary cable pairs throughout all the time under consideration. Since the main purpose of this Facility Plan is to estimate the investments needed for the subscriber network installation and since it can be assumed that the investment cost needed for each subscriber line in the hybrid subscriber network will not be higher than the cost needed for each subscriber line in the subscriber metallic cable network on condition that the hybrid subscriber network is introduced in suburban and rural areas, the calculation is still based on primary pairs even for the time beyond the transition.

7.3.1 Determination of the Total Number of Subscriber Lines

The tables shown hereunder will reflect the capacities of primary pairs as well as secondary pairs per exchange area based on the "Demand Fulfillment Plan" in chapter 5.

The actual layout of primary and secondary cable lines, i.e. type and capacity of the cables, has to be decided on each case in the detailed design.

7.3.1.1 Determination of Primary Cable Pairs

The amount of demand (subscribers) per exchange area depicted in the demand fulfillment plan represents the minimum number of primary cable pairs required for each service year in the exchange.

The number of primary cable pairs to be distributed in each exchange service area is calculated based on the demand fulfillment value for the year Tx-5 to be provided actually in the year Tx. Moreover, in order to provide sufficient flexibility in the network, an average distribution factor of 1.35, 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 the primary cable pairs to be distributed actually in each exchange.

S1-7-8 in the Supporting Report is showing the figures of primary pairs per exchange area, which have to be installed according to the demand fulfillment plan considering a provision period of five years. In this way, as a example, the value for the year 1996 shows the total number of primary cable pairs required for that year plus the additional primary cable pairs which are shared by 1/5th the primary cable pairs required for the year 2001. The result is rounded by one digit.

This calculation is based on the consideration that the expansion of the subscriber network in an exchange area is split into five different groups of cabinet areas, and the individual groups will be extended in turn every five years.

7.3.1.2 Determination of Secondary Cable Pairs

For the calculation of the required secondary cable pairs, an average distribution factor of 1.3 which is the ratio between primary cable pairs and secondary cable pairs is applied to provide the necessary flexibility in network arrangements. This factor already includes the deduction of direct feed cables, which are included in the calculation of primary cable pairs.

S1-7-9 in the Supporting Report shows the figures of secondary cable pairs per exchange area, which have to be installed according to the implementation plan.

7.3.2 Determination of Installation Volume for Subscriber Lines

The objective of the following calculations is to estimate the total number of subscriber lines in order to determine the required investment.

The number of necessary additional primary cable and secondary cable pairs are calculated based on the S1-7-8 and S1-7-9 in the Supporting Report on an exchange service area basis.

However, it must be assumed that several subscriber network construction projects are underway to be completed 1995, 1996 and 1997. Since no data can yet be obtained on these projects, the figures for the years 1996 and 1997 are not adjusted in accordance with the ongoing projects. For the determination of the actual figures for the respective years, the adjustment has to be done by STE as soon as accurate data on the ongoing projects is available.

S1-7-10 in the Supporting Report shows the figures of primary cable pairs per region to be installed additionally every year, which is the difference of the total amount between two adjacent years as per S1-7-8 in the Supporting Report.

S1-7-11 in the Supporting Report shows the figures of secondary cable pairs per region to be installed additionally every year, which is the difference of the total amount between two adjacent years as per S1-7-9 in the Supporting Report.

7.3.3 Five-Year Plans

A summary of the additional numbers of primary cable pairs and secondary cable pairs respectively to be installed in five-year steps is shown in the table below:

Year	2000	2005	2010
Primary Cable Pairs	1,066,930	224,940	242,800
Secondary Cable Pairs	1,385,900	292,270	315,720

7.4 Mobile Services

7.4.1 Current Mobile Services Facilities Plans of STE

STE now has a plan to launch both GSM and Paging Services in the western region of Syria at the beginning of 1998. The numbers of subscribers are estimated to be approximately 50,000 and 10,000, respectively.
In general, it must be stated that the approach adopted by STE in minimizing costs through sensible planning of the Base Station network by maximizing the use of existing STE facilities, is an approach that can be fully supported and is assumed to apply also in the expanded Facility Plan. In addition, values for design parameters such as the traffic per subscriber and the grade of service to be achieved, as contained in STE's specification, have been discussed with STE's management and are accepted as reasonable and appropriate for the Syrian market and are therefore re-used in this facility plan.

7.4.2 Scope and Purpose

First of all it has to be stated that, for the development of a facility plan for Mobile Services networks, a major effort is needed in the design and cost optimization of the Base Radio Station network to achieve the required coverage. This requires a detailed field survey of the proposal coverage areas. Such a survey must establish a precise prediction of radio coverage to enable the design of a network of Base Stations that will achieve the coverage. The network design must then be cost-optimized in order to remain within the investment constraints of the business plan for the phases of the project.

Therefore, clearly it is not possible within the time constraints of this study, and more importantly, not desirable, to specify a detailed long-term facility plan in this Report.

a) *not possible within the time constraints*, because the task involves a complete field survey of thirteen cities / large towns and the surrounding territory along a corridor west of the line stretching from Al Sweida, in the South, to Aleppo in the North to Al-Hassakeh in the East, including a detailed inventory of existing STE buildings, radio tower facilities, tower heights and loading capabilities, power and other facilities, that may be used to support mobile services infrastructure;

b) *not desirable*, because the design of the BS network is one of the key issues that suppliers of Mobile Services networks must fully address in competitive bidding for the network and therefore should not be pre-emptied with a pre-defined plan that precludes innovative use to different suppliers design tools and different system architecture.

The scope of this facility plan is therefore limited to developing estimations, based on a set of assumptions from experience in other countries and adapted for Syria, of the quantities of the different components and elements of the Syrian Mobile Services networks to meet the demand forecast (Chapter 4, Section 4.3.2 and 4.3.3) For example, this plan will not specify the locations where Base Radio Stations should be erected which, as stated earlier, would require a detailed radio survey, however, the total number of Base Radio Stations are required as well as the ancillary facilities required, are estimated.

7.4.3 General Assumptions in Developing the Mobile Services Facilities Plan

The basis for this facility plan is the service strategy developed in Chapter 3, Section 3.4. and the demand forecast developed in Chapter 4, Section 4.3.2 and 4.3.3 of this Report.

The underlying business plan assumption must be to minimize investment, to maximize revenue and therefore to minimize the pay-back period. This strategy will be possible at least as long as STE has a total monopoly on service provision. (In competitive market conditions, coverage becomes a key competitive issue and competing network operators usually have to scramble to maximize their coverage at the early stages of their investment in order to capture and retain market share.)

7.4.3.1 Use of STE's Infrastructure

This service strategy (Chapter 3, Section 3.4) recommends that:

a) A functionally separate management structure be established within STE for the purposes of handling all aspects of the establishment and operation of the Mobile Services in Syria

b) STE procures the services of an external agency or company that is experienced in all aspects of the successful provision of mobile telephone services to support the new management structure for a period of at least two years and longer, if necessary

These recommendations have some specific facility and cost implications that will be addressed later. However, the most important overall cost implication is that STE's existing and planned infrastructure for the fixed telephone network will be fully available and utilized to the maximum extent to support the Mobile Services infrastructure. This will enable very significant cost savings to be achieved.

7.4.3.2 Coverage

The coverage will include

a) Thirteen urban areas: Damascus, Homs, Hama, Aleppo, Idleb, Lattakia, Tartous, Darra, Al-Sweida, Quneitra, Al-Rakka, Deir-el-Zor, Al-Hasakeh.

b) The Damascus rural area, which includes the areas around and to the south, south west and west of Damascus up to the borders with Jordan, Palestine and Lebanon.

c) Only the main roads between the cities will be covered.

7.4.3.3 Traffic and Grade of Service Assumptions (GSM)

For the purposes of network design, the traffic (I/C + O/G) per mobile station is assumed to be 0.04 erlang. While this figure may appear a little optimistic, it has to be borne in mind that PSTN Substitution, with its associated higher calling rates, is expected to play a significant role in the developing GSM market. The design Grade of Service is assumed to be 2%.

7.4.4 GSM Facilities Plan

7.4.4.1 Mobile Switching Systems

The basic network design is based on the demand forecast as contained in Chapter 4, Figure 4.3.2-2 of this Report and on the demand, broken down by covered areas, as contained in Chapter 4, Table 4.3.2-3 of this Report.
STE has planned to install a Mobile Switching Center in Damascus at first, then the second MSC will be installed in Aleppo during the next Five-Year Plan.
Both MSCs will be required to interface with the PSTN and will be expanded in accordance with the increasing number of subscribers.

7.4.4.2 Base Transceiver Stations (BTS) and Base Station Controllers (BSCs)

The total covered area and number of Base Transceiver Stations is estimated in Table 7.4.4.2-1

Table 7.4.4.2-1: Coverage Areas and Numbers of Cells/BTSs

Name	Urban (Sq.Kms)	Suburban (Sq.Kms)	Rural (Sq.Kms)	Main Roads (Kms)
Damascus	50	300		
Rural Damascus	0	0	10,000	
Homs	15	100		
Hama	12	50		
Aleppo	50	300		
Idleb	10	50		
Lattakia	12	50		
Tartous	10	50		
Al-Rakka	10	100		
Deir-el-Zor	10	100		
Al-Hasakeh	10	100		
Darra	10	0		
Al-Sweida	6	0		
Quneitra	10	0		
Total	215	1,200	10,000	3,600
	Urban	Suburban	Rural	Main Roads
Number of Cells	63	18	8	90

The total required number of BTS is therefore estimated to be 179. The number of Base Station Controllers (BSC) is estimated to be 20 in total for the entire network.

7.4.4.3 GSM Network Facilities Plan

Based on the above assumptions and analysis, the total infrastructure requirements for the GSM network to meet the demand for mobile telephone service has been calculated. The results are presented in Table 7.4.4.3-1 in accordance with the future five-year plans.

Table 7.4.4.3-1: GSM Infrastructure Requirements to Meet the Demand

Ref.NO.	GSM Infrastructure to be provided in the five year periods: Description	2000 Quantity	2005 Quantity	2010 Quantity
1	Base Transceiver Station(BTS)	92	87	0
2	BTS Expansion	0	54	35
3	Number of BTS Sites	92	87	0
4	Base Station Controller(BSC)	10	10	0
5	Mobile Switching Center(MSC)	1	1	0
6	MSC Expansion	0	1	2
7	OMC/NMC	1	0	0
8	Billing System	1	0	0
9	Microwave(BTS-BSC)	92	87	0
10	2Mbits/sec(BSC-MSC)	44	49	21
11	2Mbits/sec(MSC-MSC)	0	25	5
12	2Mbits/sec(MSC-PSTN)	147	146	0
13	BTS Site Infrastructure	92	87	0
14	BSC Site Infrastructure	5	5	0
15	MSC Site Infrastructure	1	1	0

The following notes are provided to explain Table 7.4.4.3-1:

General Note 1: The information contained within this table has been calculated based on a demand forecast for more than 210,000 mobile subscribers by the year 2010. The calculations have been made without the benefit of a field survey and should therefore be understood as indicative of the scale of the infrastructure required. This table should not be used as the basis of a procurement specification. Detailed field surveys will be required as part of any network procurement process.

General Note 2: The quantities shown in the columns give the quantities to be provided in each of the five-year plans.

Note (Ref. No. 3): The number of BTS sites is estimated based on the assumption that there will be one BTS per site.

Note (Ref. No. 8): It is recommended that the Mobile Telephone Service should have a separate billing system from that of the fixed network, in line with the recommendation that the Mobile

Telephone Service be managed with a "functionally separate management structure". In addition, there are known to be setbacks in the billing system for the fixed network that STE is in the process of sorting out. This is not the time to add an additional burden on the existing billing system.

Note (Ref. Nos. 10, 11, 12): It is assumed that BSC and MSC sites may be selected in order to optimize the use of existing/planned transmission network facilities of STE's PSTN and therefore to minimize costs.

Note (Ref. Nos. 13, 14): It is assumed that STE's existing site infrastructure (buildings, towers, power, etc.) may be used to a significant extent, particularly in the start-up phase of the project so that the network construction time is minimized.

7.4.5 Paging Services Facilities Plan

7.4.5.1 Paging Processor System

The basic network deign based on demand forecasts will be conducted as well as that of GSM. Generally speaking, there would be two types of designing so as to cover all of Syria. One is a nationwide coverage type and the other is a separate coverage type. It is recommended that the nationwide coverage type be employed for the following reasons.

a) Only one paging processor will be needed.
b) Paging anywhere provided it is within coverage areas in Syria.

However, transmission line costs will increase compared with those of the other type.

7.4.5.2 Base stations

The total covered area and number of Base Stations is estimated in Table 7.4.5.2-1.

Table 7.4.5.2-1: Coverage Areas and Number of Base Stations

Name	Urban (Sq.Kms)	Suburban (Sq.Kms)	Rural (Sq.Kms)	Main Roads (Kms)
Damascus	50	300		
Rural Damascus	0	0	10,000	
Homs	15	100		
Hama	12	50		
Aleppo	50	300		
Idleb	10	50		
Lattakia	12	50		
Tartous	10	50		
Al-Rakka	10	100		
Deir-el-Zor	10	100		
Al-Hasakeh	10	100		
Darra	10	0		
Al-Sweida	6	0		
Quneitra	10	0		
Total	215	1,200	10,000	3,600
	Urban	Suburban	Rural	Main Roads
Number of Base Stations	13	14	10	69

7.4.5.3 Paging Services Facilities Plan

Based on the above assumptions and analysis, the total infrastructure requirements for the Paging Services network to meet the demand for the Paging Services have been calculated. The results are presented in Table 7.4.5.3-1.

Table 7.4.5.3-1: Paging Services Infrastructure Requirements to Meet the Demand

Ref.No.	Paging Infrastructure to be provided in the five year periods: Description	2000 Quantity	2005 Quantity	2010 Quantity
1	Base Station	40	66	0
2	Base Station Expansion	0	11	11
3	Number of B.S Sites	20	35	0
4	Paging Processor	1	0	0
5	Paging Processor Expansion	0	1	1
6	OMC/NMC	1	0	0
7	Billing System	1	0	0
8	Transmission Lines(B.S-Paging Processor)	80	278	212
9	2Mbits/sec(PSTN-Paging Processor)	11	5	2
10	B.S Site Infrastructure	20	35	0
11	Paging Processor Site Infrastructure	1	0	0

General Note 1: The information contained within this table has been calculated based on demand forecast for more than 100,000 paging services subscribers by the end of 2010. The calculations have been made without the benefit of a field survey and should therefore be understood as indicative of the scale of the infrastructure required. This table should not be used as the basis of a procurement specification. Detailed field surveys will be required as part of any network procurement process.

General Note 2: The quantities shown in the columns give the quantities to be provided by the end of each year.

Note(Ref.Nos .6.7):At present it is not certain whether the Paging Services should be managed with a functionally separate management structure from the fixed network. It is also assumed that there is one Billing system and one OMC/NMC for all mobile services. Further discussions will be required to settle the management structure.

Note(Ref. No.8.9): It is assumed that Base Station sites may be selected in order to optimize the use of existing/planned transmission network facilities of STE's PSTN and therefore to minimize costs.

Note(Ref.No.10): It is assumed that STE's existing site infrastructure(buildings, towers, power,etc) may be used to a significant extent, particularly in the start-up phase of the project , so that network construction time is minimized.

7.5 Packet Switched Data Network (PSDN)

7.5.1 Introduction

Forecast figures for Packet Switched Services have to be developed within a broader concept for data communication. In particular data communication on ISDN and Leased Line Platforms have to be taken into account as well as new services and technologies such as Frame Relay (FR) and ATM.

In chapter 7.5.4 some forecast figures are given for related technologies and services. However the relationships between the various services and platforms (networks) and their impact on demand figures have to be worked in more detail in a feasibility study.

As recommended in the service strategy, Chapter 3, Section 3.6.2.3, the Packet Switched Data Network (PSDN) should form one of the main infrastructures upon which data communications will be supported in Syria. (STE is running a PSDN service in Syria at the moment based on a small-scale PSDN network.) The service strategy recommends that the PSDN should be developed to cater for:

- the expected growth in demand for the service from the Government / industry / service sectors for dedicated and dial-up access

- expected growth in demand from small enterprises, PC users, etc. who wish to access the service using dial-up access via the PSTN

- STE's own requirements for PSDN services in the future coming from:
  - the large-scale computerization of the customer service order system, first with the expected 14 centers in Damascus (and later with the establishment of centers throughout Syria) which, it is understood, are planned to be linked with the main customer services host systems using X25 packet switching
  - the large-scale computerization of the billing system and the reliable transfer of call charging data from the digital telephone exchanges / OMCs directly to the Billing System host computer
  - the installation of a network management system which could require very frequent transfer of traffic and other data from the digital telephone exchanges and other network components possibly via the packet switched network if a sufficiently robust PSDN would be available

- interworking with ISDN to provide service support for field trials and pilot services to be launched for ISDN

It is due to the role foreseen for the PSDN, in the support of data communications in Syria, in the support of new Value Added Services introduction and in the support of the internal data communications needs associated with the management of the public telecommunications services that the PSDN has been proposed as a priority project for the Eighth five-year planning period.

7.5.2 Estimate of Required Capacity for Public Packet Data Services

The current PSDN being run by STE is still in a relatively early stage, considering that the service is entirely new, both to the business community and to the STE staff. Bearing this in mind, it must be stated that the number and types of customers already connected or planning to connect to the service looks promising.

It must be stated that in general, markets where PSDN services have been introduced (e.g. all developed and many developing economies) have not experienced the same difficulties as have been experienced by ISDN. The main reason for this is that customer premises equipment, such as modems, for connection to the PSDN are readily available in most markets, are relatively inexpensive and provide a straight forward function that the customer can understand. The market in Syria should be no different, although it is recommended that a relaxation of the restrictions on the sale and use of Customer Premises Equipment would help matters considerably. The other difficulty faced in Syria is the relatively low level of computerization. However, as demonstrated by the market studies carried out earlier organizations have real plans to introduce computers and it is expected that many of these customers will want wide area data communications services, of which the PSDN presents one of the most cost effective and reliable solutions.

Based on information provided by STE, the total number of customers connected, or in an advanced stage of planning to be connected, to the PSDN service in 1995 was close to 50. This customer base represents a reasonable spread of organizations, such as Government bodies, Banks, Embassies, Oil industry, etc. The total number of access ports involved (as per end of 1995) is given in Table 7.5.2-1.

Table 7.5.2-1 PSDN Capacity in 1995:

Access Port Type	Quantity (Field Trial)
Dedicated Subscriber Access	90
Dedicated ports for trunk and admin. lines	94
Dial-Up Access	10

It would be preferable to re-evaluate the capacity requirements when the PSDN service is at a more advanced stage. It is recommended therefore that this facility plan be reviewed during the feasibility study phase so that estimates can be revised based on the latest information.

The main demand is in Damascus, but there are also reasonable levels of demand in Aleppo, Homs and Lattakia, and the distribution of organizations such as the branch networks of the major banks, ministries like those of Agriculture and Irrigation and Oil exploration companies means that there is potential demand in most large towns throughout Syria. The flexibility of X25 networks means that the geographical distribution of demand is not as critical as for circuit switched networks. However, like all networks, connections to remote sites (e.g. an oil drilling platform) presents particular challenges (and cost). It should be pointed out at this stage that there exist other means, besides using X25 packet switching, to support the data communications needs of these organizations.

The projected capacity requirements to meet the demand for public packet data services are estimated based on the following assumptions. For dial-up access, it is assumed that the market for on-line services will emerge soon and develop quickly. Since demand for dedicated accesses will be restricted to medium and large organizations only, growth rates will be more modest and consistent through the planning period. It is assumed that PSDN based services will decrease some years after 2000 (possibly between year 2002 and 2003) as ISDN will become the dominant network for narrowband data communication and also broadband integrated services become available in Syria.

From a network design point of view it s irrelevant whether the users of the network are STE's customers or whether STE itself is the user. Hence the forecast figures for both user groups have been combined in the facility plan (chapter 7.5.4).

7.5.3 Estimate of Required Capacity to meet STE's Requirements for Data Communications

As stated earlier, STE's internal requirements for data communications will place significant additional demand on the PSDN, particularly in terms of performance and reliability. These requirements arise from the computerization and automation of the processes for operation and management of telecommunications services that is already partly underway in STE and that is proposed to be further developed in this Interim Report, leading ultimately towards a fully fledged Telecommunications Management Network (TMN). The main requirements will arise as a result of:

The capacity requirements to meet the internal data communications needs of STE are estimated to be as follows:

Customer Service Centers

It is assumed that the total number of Customer Service Centers will be expanded from the current 14, planned for Damascus, to a total of 34 centers for the entire country during the Eighth Five-Year plan. The average number of service positions per center is assumed to be 4. Each center should be connected to the PSDN via a dedicated access.

Transfer of Call Charging Data to Billing Center

All local (main) switching centers as well as any centers where toll ticketing is performed, such as transit switching centers with operators, will require access to the Billing Center host computers via the packet network. This could be arranged initially using dial-up access, using X32 for example. Later dedicated access will be required anyway for traffic management, therefore it is assumed that dedicated access will be implemented.

Transfer of Traffic and other Data for Network Management

All main switching centers in the network will be connected to the Network Management Center for down-loading of traffic data in near-real time and for receiving instructions from the NMC. This will require a dedicated access from each switching node. The total number of switching nodes is assumed to be 200 by the year 2010.

As stated earlier there exist other methods, such as the extensive use of leased lines or, via the circuit switched network, to transfer data of the types indicated above. In some cases FR connections may be more efficient. It is therefore assumed that STE will use other communication platforms in addition to the PSDN.

7.5.4 Facilities Plan for the PSDN

Combining the capacity requirements from the "public" packet service and STE's internal data communications, the total projected capacity requirements of the PSDN are provided in Table 7.5.4-1.

Table 7.5.4-1 Projected Capacity Requirements of the PSDN

Access Type	1995	2000	2005	2010
Dedicated Accesses	90	270	250	80
Dial-Up Accesses	15	350*	1,700*	700*

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

The point must be stressed again that these forecast figures are made under the assumption that ISDN will be introduced soon with aggressive marketing concepts.

Clearly these projections must be reviewed frequently (at least every two years), as more information on the trend in the market for data communications in Syria becomes available.

There are at least two possible basic design approaches to facility planning for the PSDN:

- one, based on the use of multiple meshed packet nodes, each node with a switching performance range of about 1,000 packets per second. The existing PSDN packet network in Syria is designed according to this approach. The approach is used in large private packet networks and small-scale public network.
- a second, based on the use of a small number of powerful packet switches, in the range up to 20,000 packets per second, usually employed in public packet switching networks

A third approach is a network design that incorporates elements of both basic approaches.

A feasibility study has to examine whether the existing PSDN is appropriate for PSDN based services and possible alternatives and network structures have to be investigated.

7.5.5 Forecast Figures for Related Services and Technologies

Developments in at least 4 areas may influence the importance of the PSDN, i.e. the demand for services based on the PSDN:

- an early introduction of ISDN
- the introduction of platforms for high bandwidth communication
    - ATM/B-ISDN
    - FR and
- a competitive leased line service.

The most important area is without any doubts the introduction of ISDN. However forecast figures for data communication on ISDN are not relevant from an ISDN point of view because data communication in ISDN will only play a minor role compared with voice services on ISDN. Also data communication on ISDN is transparent for the service/network provider if no interworking with other networks (e.g. the PSDN) is involved.

FR and ATM (B-ISDN) are not important competitors from a PSDN point of view because both services and technologies aim at high bandwidth users whereas traditional PSDNs aim on small bandwidth users (max. 64 kbit/s but mainly subrates).

Nevertheless the new services will become important very soon and hence it is absolutely necessary to plan an early introduction and to develop consistent concept for data communication. A feasibility study should develop some first ideas and strategies.

Forecast figures in table 7.5.5-1 and 2 are at this point in time very vague but they are necessary for medium term strategies.

Table 7.5.5-1 Forecast for FR

	1995	2000	2005	2010
n*64 kbit/s up to 2 Mbit/s	-	50	200	n. predi.

Table 7.5.5-2 Forecast for ATM (native interfaces)

	1995	2000	2005	2010
>= 2 Mbit/s	-	5	60	200

7.6 Network Management

The following facility plan gives an overview on the amount of Transmission Facilities Management Centers and the Traffic Management Centers to be provided in accordance with chapter 8.4 in the particular five plans.

Year	2000	2005	2010
Transmission Management Center	3	-	-
Traffic Management Center	-	1	-

CHAPTER 8 OPERATIONS AND MAINTENANCE

8.1 Switching

The considerations in this section are not strictly limited to operations and maintenance of the switching equipment, but include to a certain extent also the supporting equipment such as power supply and air-conditioning.

8.1.1 Definitions

- Operations

Operations in switching comprises the day to day tasks associated with service provisioning general (such setting up of new trunk and junction lines, routing modifications, etc.) and to particular subscribers (such as setting up of new subscribers, changes for existing subscribers, changing of subscriber service profiles, etc.).

- Maintenance

Maintenance in switching comprises all tasks required to sustain service (such as hardware and software fault localization and clearing). Three different types of maintenance philosophies co-exist, and are applied dependent on the type of equipment to be maintained:

- Preventive Maintenance tries to reduce failures of equipment by preventive actions such as mechanical checks and overhauling performed at regular intervals, before failures surface. Preventive maintenance, if performed properly and in due time, shows good results for equipment being subject to wear and tear such as electro-mechanical switching systems, tape units, air-conditioning units, back-up diesel generators and batteries.

- Corrective Maintenance responds on failures as they appear. This requires that the equipment is designed in such a way that the impact of a failure on the service is kept to a minimum e.g. by means of duplicated key elements and / or by very small down units. Modern digital SPC switching systems are typically designed for corrective maintenance.

- Controlled Maintenance tries to recognize surfacing problems in an very early stage or the real reasons for sporadically appearing failures by means of statistical methods applied to irregularities in the equipment functioning. Basically, controlled maintenance has its field of application in modern transmission equipment maintenance, but is also applied in software maintenance.

8.1.2 Present Organization of Operations and Maintenance

8.1.2.1 Operations

Operations in switching are performed locally at each switch. The larger medium sized exchanges are manned between 8:00 and 20:00 hours at normal working days (Saturday to Thursday). O&M staff travels to the smaller exchanges on demand.

The operation and maintenance centers (OMC) described in the following section are normally not involved in the operations tasks (see also 8.1.3).

8.1.2.2 Maintenance

Maintenance for the systems NEAX 61 and EMD is performed locally in the respective exchanges.

For EMD exchanges, preventive maintenance (i.e. overhauling of the selectors and the relay sets) is performed in regular intervals.

Maintenance for E 10 A and E 10 B systems is performed locally and is supported by an dedicated OMC situated in Damascus.

Maintenance for EWSD is directed by five regional OMC:

PLACE	CODE	LU SERVED	INSTALLATION
Damascus	DAOM	426,000	1993
Aleppo	ALOM	176,000	1994
Deir Elzor	DEOM	102,000	1994
Homs	HOOM	165,000	1994
Lattakia	LAOM	136,000	1995

The maintenance tasks themselves are performed by the local operations and maintenance staff. The local operation and maintenance staff is supported by three technical assistance levels (TAC1 - TAC3), which can be called in for help:

- TAC1 is represented by the five regional OMC;
- TAC2 is represented by the supplier in Syria;
- TAC3 is represented by the supplier in Germany.

Supervision of the unattended EWSD exchanges is performed by the responsible regional OMC. Outside the normal working hours, this applies to the other EWSD exchanges as well.

For the supporting systems:

- Air-conditioning equipment,
- Emergency back-up diesel generators,
- Batteries,

preventive maintenance is scheduled to be performed by STE staff at the usual intervals.

As far as the maintenance of air-conditioning equipment is concerned, some indications have been received, that STE's skilled staff may be overloaded by installing new air-conditioning equipment in new exchanges and handling the regular overhauling of the operational air-conditioning equipment at the same time. However, such a situation must not be solved on the expense of the regular air-conditioning equipment overhauling. It must be borne in mind that an air-conditioning failure will cause total exchange failure soon after.

Another fact, which gives reason to concern, is the insufficient stability of the public power supply which results in unusual long cumulative running times for at least some of the emergency back-up power generators. This will result in rather frequent major overhauling activities for the diesels. This leads to the question, how to tackle a power down or degradation during such a major overhauling activity. One solution could be to connect a mobile emergency back-up diesel generator to an "high risk" exchange before the overhauling is started and keep it connected as long as the overhauling goes on.

8.1.3 Comments on the Organization of Operation and Maintenance

The organization of operations and maintenance as described in section 8.1.2 appears to be out of line with the usual organizations as applied by other network operators. Considering that

- OMC generally are used to centralize operations work with the aim to save staff costs,
- digital exchanges are designed for corrective maintenance and unattended operation,

no real exploitation of these advantages is made by STE.

As a matter of fact, STE's operations and maintenance organization is ruled by the dominating Government policy to create job opportunities to the extent possible, and thus, presently not changeable.

However, as soon as the Government policy changes, STE should revise their operations and maintenance organization and should start to exploit the existing operations and maintenance infrastructure.

8.1.4 Spare Parts and Circuit Board Repair

For the EMD system, which is an electro-mechanical motor selector system, the repair work is performed locally in the exchanges. Spare parts are provided by the supplier and held at stock at STE.

For the systems E 10 A, E 10 B and EWSD, spare part stocks are kept at each OMC. For NEAX 61 a spare part stock is kept partly at the repair center and partly in the exchanges.

For the systems EWSD, NEAX 61, E 10 A and E 10 B, repair centers have been established in Damascus for repair of the most commonly used circuit board types. Those board types, which cannot be handled there, are sent back to the supplier for repair.

Presently, circuit board circulation and repair seem to work properly, and the sizes of the spare circuit board stocks seem to be sufficient. No hints for cannibalization of yet unused equipment were found.

However, the repair center for EWSD presently has a work load of approximately 85% to 90% the total capacity caused by SLMA boards with damaged hybrids due to over voltage at the subscriber lines. Considering that only a minor portion of the newly installed subscriber line units are really connected, it becomes obvious that the EWSD repair center will be heavily overloaded very soon, if the original problem is not taken care of in due time.

8.2 Transmission

8.2.1 Current Situation

8.2.1.1 Organization

The following three departments, under the Directorate of Operation and Maintenance, are responsible for transmission system operation and maintenance.

(1) The "Maintenance Dept. for Networks" is responsible for maintenance of symmetrical links and fiber-optic cable links in cities, and the national networks which use fiber-optic cables, and also responsible for maintenance of subscriber cables

(2) The "Maintenance Dept. for Microwave Transmission" is responsible for maintenance of microwave and satellite systems.

(3) The "Maintenance Dept. for Coaxial Cable Transmission " is responsible for maintenance of coaxial cable transmission systems.

There are 14 regional directorates and one international area directorate that handle the operation and maintenance duties for each region. They compile periodical reports for and receive instruction from the Maintenance Departments , as required. The directorates are Damascus, Damascus Rural, Homs, Hama, Idleb, Aleppo, Lattakia, Tartous, Rakka, Deir Elzor, Hassakeh, Daraa, Sweda, Quneitra, and International Regions.

8.2.1.2 Shift Rotation

For each site where transmission equipment is installed, maintenance staff are on duty 24 hours, 365 days of the year. The standard shift rotation system in Syria is shown below.

8:00 - 14:00	5, 6 or 7 technicians/ engineers, including a manager
14:00 - 20:00	2 technicians / engineers (minimum)
20:00 - 8:00	2 technicians (minimum)

As a rule, each site is manned by maintenance staff, except for in uninhabited areas such as the T4. As for the 34Mbit/s microwave sites on the 50/A contract project, only the main stations are manned.

Maintenance staff are sometimes divided into specific transmission areas such as microwave, fiber-optic, coaxial and other types of systems, even if they are in the same room. When two separate rooms for transmission equipment are available in a building, each of the rooms usually has their own staff shift.

Customer complaints are submitted to the neighboring station, where staff tackle the problem in coordination with other stations. When the problems are difficult to solve, engineers are dispatched during the 14:00 - 20:00. In the case of the 20:00 - 8:00, shift solution of the problem is delayed until the following morning. In the event of major problems such as cable failure, the chief of the station must go and try to solve the problems whenever they occur.

8.2.1.3 Centralized Supervisory Systems

The following centralized supervisory systems have been deployed for 140 Mbit/s optical fiber systems on the contract 50/A project.

Master station: Damascus STD

Slave stations: Tartous, Talkalalh, Homs, Alnabek, Quteifeh, Int. Airport, Keswh(Damascus X), Sanamein, Cheikh Meskeen, Daraa, Sweda

Master station: Aleppo STD

Slave stations: Banyas, Lattakia, Gisr Eshoughour, Edleb, Hama, Tartous

The 34 Mbit/s digital microwave network for contract 50/A project has centralized supervisory systems for each of the following master station areas.

Master stations: Homs, Aleppo, Tartous, Latakia, Edleb, Kamishly

The 140 Mbit/s fiber-optic systems for local networks of the contract 40/A project have the following centralized supervisory systems for each area.

Master stations: Damascus STD, Lattakia TR, Aleppo STD, Tartous STD, Hama TR, Homs A, Idleb A, Deir Elzor, Rakka A

However, the 34 Mbit/s optical systems for the contract 50/A project, which have no centralized supervisory systems, are only monitored locally.

As the centralized supervisory systems above have been only recently introduced, and the STE has a number of other systems which must be monitored locally, it can be said that, at present, maintenance work for transmission is mainly based on local monitoring. Exceptions are the unmanned stations of the 34Mbit/s microwave systems.

8.2.2 Future Trends in Transmission Operation and Maintenance

Along with economic development, the following problems will appear in Syria and in other countries.

(1) Private companies and individuals will come to rely heavily on telephone circuits and leased circuits as their activities increase in society. Failures will result in many complaints and strong criticism from users and from governmental sectors.

(2) At the same time, it will be very difficult to secure good operation and maintenance staff.

Leased circuits are not that popular in Syria, but they will definitely gain in popularity, as frequent users always find telephone costs expensive and try to shift their traffic to leased circuits. Leased circuit users are very strict about its reliability, as their business activities rely on leased circuits, in some cases round the clock. Therefore 24-hour maintenance and quick response to customer complaints are essential for any telephone companies. Customer complaints cannot be ignored, because they sometimes have the power to mount the privatization campaigns, even against the wishes of telephone operators.

The following are steps to cope with the problems mentioned above.

(1) Discard Obsolete transmission systems as soon as possible, to free the STE's operation and maintenance staff.

(2) Gradually increase unmanned stations for night time, and even for day time operation in some cases. Maintain 24-hour maintenance on an on-call basis.

(3) Carry out monitoring activities at central stations, first at night, and then round the clock.

(4) Provide and test 2Mbit/s paths remotely from central stations.

(5) Functions of the STE contact points for receiving customer complaints must be strengthen in line with increase of leased circuits. Some telephone operators have customer centers.

(6) Who controls fault clearing operations up until the fault is actually cleared, and who carries out tests for each circuit, for each path and for each transmission system must be clearly defined.

SDH systems will help the STE to carry out the steps listed above, and to simplify circuit management by focusing on 2Mbit/s paths.

8.3 Subscriber Network

8.3.1 Operation of Subscriber Lines

Operation of subscriber lines comprises provision and subscriber line installation. Both tasks are allocated to STE.
A new subscriber will be connected to the network by;

- connection of jumper wires in the MDF,
- connection of jumper wires in the CCC,
- installation of the service line between DP and subscribers premises,
- installation of the in-house wire, and
- installation of the telephone plug socket and the terminal equipment.

In the final stage of a Hybrid Subscriber Network with its rigid structure, the connection of jumper wires in the CCC will not exist.

With regard to the unacceptable present practices on the installation of aerial cables, drop wires and in-house wiring, it is, as a first step, recommended to prepare technical standards and technical guidelines for:

- aerial cable installation,
- drop wire installation,
- in-house installation.

In order to expedite the installation, especially considering the gap between the number of Line Units (Switching) already installed or ordered and the number of existing or contracted subscriber lines, it should be considered to out-source this task.

In case of out-sourcing, it is indispensable that a formal acceptance procedure is introduced and sound acceptance tests are made before the subscriber line is integrated in the network in order to avoid deficiencies, resulting from a lack of quality in provision and installation, which may impose problems on maintenance later on.

8.3.2 Maintenance of Subscriber Lines

8.3.2.1 General Considerations

The maintenance philosophy for subscriber lines must be customer-oriented. Basically, a combination of controlled and corrective maintenance should be applied:

- Subscriber line faults should be detected to the extent possible (but limited to the extent economically feasible) before the customers get aware of the faults. An acceptable performance in this area is possible with a combination of simple tests and regular routine tests run at regular intervals (e.g. once a week). The faults not detected or not detected early enough by the network operator will be indicated by the subscribers via the complaint service.

- Fast clearing of faults is essential for two reasons:

  - Subscriber lines out of service do not generate revenues
  - Subscriber lines out of service for long time dissatisfy the customers and gives the network operator a negative image.

Therefore, 90% of the faults surfacing should be repaired within 36 hours (in the larger cities within 24 hours) and 95% within 7 days. The performance in this field must be monitored continuously.

For faults which require a rather long repair time, such as cable faults, temporary provisional repair should be considered to bring the customer back to service as early as possible, on condition that the provisionally repaired lines are restored in a right repair method.

- Fault clearing should regularly be done only during normal working hours.

- Fault clearing outside normal working hours should be limited to very important lines such as police, emergency services and fire brigade in principle. It may be offered as well to customers who are willing to pay extra charges for this service.

In the long term, subscriber line maintenance should be accommodated to the framework of a Syrian Telecommunication Management Network (TMN). This plan can only put up an initial idea and can give some overall guidelines for this way. It is recommended that much more detailed definition, specification and organization work is invested in this area by STE.

8.3.2.2 Technical Arrangements for Subscriber Line Maintenance

To support the maintenance philosophy outlined before, the following technical arrangements are needed:

- The exchanges shall run a set of simple tests on a call attempt basis originating from and directed to the subscriber. The set should involve:

  - test for external (AC and DC) voltage (a-wire against b-wire; a-wire, b-wire against ground),
  - insulation resistance test (a-wire against b-wire; a-wire, b-wire against ground).

- Test equipment to perform routine subscriber line tests and measurements at regular intervals should be available in every exchange or should have remote access to the exchange. The equipment may be exchange-system integrated or exchange-system independent. The same equipment should be used for tests and measurement of single subscriber lines in case of complaints. Therefore, this test equipment must have the capability to be accessed and directed remotely from the complaint and fault clearing center.

Automatic answering, test/measuring and ring back equipment must be connected to each exchange for support of the line men. Preferably, this equipment shall have a uniform number throughout the network. This equipment must be capable of performing all tests and measurements required before a subscriber line can be activated for service.

The complaint and fault clearing center must have access to the subscriber line administration system. If such a system is newly defined or redefined, the interests of the complaint and fault clearing service must be considered.

A long-term goal for subscriber line maintenance must be to accommodate the complaint service system, the subscriber line test equipment, the remote access to it and the subscriber line administration system inside the TMN.

8.3.2.3 Maintenance Organization for Subscriber Lines

Every Operation and Maintenance Center (OMC) should have one complaint center. This complaint center provides:

- Complaint response and registration for customer complaints on the basis of 24 hours per day,

- Initial testing, fault verification and general fault localization including provision of subscriber line data (from the subscriber line administration system) for the line men.

As long as remote access to the subscriber line test and measuring system is not yet available at some places, initial testing, fault verification and general fault localization can be done from the local test access by the line men.

- Initiation and supervision of fault clearing during normal working hours,

- Co-ordination of work and allocation of work to the line men,

- Initiation and supervision of fault clearing outside normal working hours,

- Detailed fault record keeping and regular fault analysis with regard to frequently appearing and re-appearing faults. These faults should be reported to a central entity for quality assurance.

Line men for the actual physical fault clearing in the respective service area of an exchange or Remote Unit should be stationed at every Main Distribution Frame (MDF) site during normal working hours.
The work orders including the initial test results and the subscriber data needed for the line men should be generated by the complaint service operation system (triggered by the operator in the complaint center) and transferred directly to the respective sites.

At the MDF site, the line men also need access to the subscriber line test and measuring system.
Outside normal working hours one experienced line man must always be on call, provided that there are important lines or customers paying for fault clearance outside normal working hours situated in that area.

8.4 Network Management

8.4.1 Scope

8.4.1.1 Scope of the Network Management Function

The Network Management function is primarily concerned with the real-time behavior of the PSTN under abnormal conditions. Typical causes of abnormal conditions are :

- predictable events such as
  - high subscriber calling rates associated with predictable peak traffic days in the year, (around national festivals, for example)
  - high subscriber calling rates to specific destinations associated with some national or local event
  - 'en mass off-hook' caused by popular TV/Radio phone-in shows
  - repeat dialing due to network congestion caused by the above.
- unpredictable events such as
  - high subscriber calling rates associated with unpredictable peak traffic days in the year
  - high subscriber calling rates to specific destinations associated with the occurrence of some large scale disaster
  - temporary outage of a major route during the busy hours caused by a fault in a switching or transmission sub- system
  - temporary outage of a switching node (excluding planned outages which anyway should be scheduled during low traffic periods)
  - temporary outage of a transmission system (excluding planned outages which anyway should be scheduled during low traffic periods)
  - permanent system outages (caused by fire damage, flooding or other disaster)

The objective of Network Management is to ensure that as many calls as possible are successfully completed by maximizing the use of all available network resources under all abnormal network conditions.

Since in most instances where abnormal network conditions develop, the cause and the effect may be short lived (e.g. a few hours) the Network Management function, to be effective, must be capable of taking appropriate remedial action within the shortest possible time from the occurrence of the event that causes the abnormal conditions to develop. Therefore the Network Management function must involve some or all (depending on the target performance level of the Network Management function) of the following:

- well tried and tested procedures to be followed by the Network Management team;
- excellent communication with staff of other functions such as transmission and exchange O&M staff, and clearly established lines of authority to facilitate fast decision making;
- detailed advance planning for, including preventative actions to minimize the affects of, predictable disturbances;
- detailed advance planning for, including preventative actions to minimize the affects of, unpredictable disturbances (i.e. planning based on 'what if' analysis);
- centralized reporting of real-time (or near real-time) supervision, monitoring and measurement data on the current network status and performance;
- centralized access to the capabilities to rapidly reconfigure the network and/or control the traffic flow;
- a Network Management team consisting of members who are high caliber specialists in the different network systems and/or technical disciplines, have the skills to operate the Network Management systems and accurately interpret a range of supervision data quickly, have the experience to identify, and implement if instructed, possible remedial actions, and can accurately communicate a proposed course of action to the other team members/Network Manager;
- a Network Manager who has a profound understanding of telephone traffic engineering, a broad knowledge and experience of modem telecommunications networks, the mental capability to analyze a complex set of parameters and data on network status quickly, the necessary leadership qualities to build and mold a small but effective Network Management team, the capacity to shoulder the responsibility that goes with the authority to take decisions that may impact the entire network.

So, from the above it can be deduced that there is more involved with the Network Management function than perhaps is initially perceived.

However, the Network Management function should not be interpreted in too broad a sense either. This can happen due to the fact that there exists no internationally well defined definition of the function. Too broad a definition for Network Management should be avoided, particularly in the context of a developing network scenario such as Syria, because the primary aims of Network Management would be in danger of becoming diluted and the entire effort to establish a Network Management function, which is not insignificant, would likely stray out of focus very quickly and have little or no beneficial impact.

Therefore, before examining the techniques of Network Management it is necessary to confront and hopefully clarify some of the terminology associated with Network Management so that the definition can be maintained within controllable limits.

In order to avoid confusion as to the precise scope of Network Management being considered herein, there is a need to distinguish the traditional "Network Management" function, as described above, from other functions, which for the purposes of this scope statement may be called "Network management" or "network management". The need to distinguish these terms from the traditional Network Management function is explained as follows:

Due to developments in the use of computerized operating systems in all aspects of telecommunications networks and services provision and operation, there has been a tendency to centralize activities/functions associated with the management of telecommunications networks and services. The term 'network management' is now frequently used by network operators to encompass a broader function, reflecting a "blurring" of the boundaries between the traditional function of Network Management and Operation and Maintenance, for example. This has resulted partly from the fact that different network operators have approached the problem of managing the network in different ways, depending on factors such as the scale of the network, the level of digitalization, their network's inherent stability, and partly from the development of a new concept for the management of telecommunication networks & services called TMN which has approached the broad subject of managing the telecommunication network/services in a radical new way. The proposed long term strategy regarding Network Management for Syria contained herein is rooted in the TMN concept.

Therefore it needs to be emphasized that the scope of the consideration within this chapter is limited to the traditional Network Management function, especially since some of the considerations will center on the TMN approach, in which there is a high risk of interpreting Network Management in a broader sense. (The exception to this general rule involves Transmission Facilities Management, the available systems for which, will also support normal transmission O&M activities. Therefore this has been taken into consideration in proposals for the Transmission Facilities Management system in Paragraph 8.4.3(2)).

8.4.1.2 Network Management and Telecommunications Management Network (TMN)

TMN is a concept that addresses the problem, faced by the network operator, of how to support the efficient management of the totality of telecommunications network(s) and service(s). A TMN is intended to support a wide variety of management areas covering planning, installation, operations, administration, maintenance and provisioning of telecommunications networks and services.

Up to now, ITU-T has identified five management functional areas : performance management, fault management, configuration management, accounting management, and security management, which are modeled in relationship to typical hierarchical management layers (business management, services management, network management, network element management) to enable the definition of TMN Management Services (TMN-MS). A TMN Management Service is an area of management activity that supports some aspect of Operations, Administration, or Maintenance of the network being managed. TMN Management Services are described in section 8.5.

TMN Management Services that may be relevant in the context of Network Management are :

- Traffic management
- Transport network management
- Switching management
- Common Channel Signalling System management

TMN Management Services rely on the use of TMN Management Service components. One of the keys to the TMN strategy is that TMN Management Service components may be used by several TMN Management Services. A good example of a TMN Management Service component is alarm surveillance. The alarm surveillance Management Service component will be utilized by several Management Services, including all of the Management Services listed above.

Taking, for example, a disturbance like the failure of a switching module which causes a major route to go down. Alarm surveillance may cause status information on the disturbance to be presented via several Management Services, e.g.

- the Switch Management service will inform the switch management staff that a module has failed. This should put in motion the necessary procedure to repair the faulty module;
- the Common Channel Signalling System Management service may, depending on the route affected, detect a loss of a signalling link and automatically cause a reconfiguration of the affected part of the signalling network and present information/report to the signalling network management staff; alternatively some manual intervention may be necessary;
- the Traffic Management service will detect the loss of the route and the resultant traffic disturbance, as traffic congestion spreads from the source of the disturbance, and will

(visually) present the escalating problem to the traffic management staff who should take corrective action to control or divert the traffic flow in the area of the disturbance.

The question which immediately poses itself is: are all of the above activities part of the traditional "Network Management" function?

In fact it is clear that the action of the Switch Management service falls fully within the remit of what is currently described as switch O&M functions. In TMN terminology, this corresponds to "network element management", where in this case the Network Element is a digital exchange that supports the switch function. The module is referred to in TMN terms as an "Object" and the functional area concerned is "fault management".

Signalling may be considered as a function of an exchange, and the function of automatic reconfiguration of the signalling links is part of network element management, where again the Network Element is a digital exchange. However, it is also possible that the loss of a signalling link may require reconfiguration of the signalling network on a network-wide rather than a local scale and in this case the function of reconfiguration is clearly part of network management (in TMN terms) and the traditional Network Management function.

Traffic Management is unambiguously associated with network management (in TMN terminology) and the traditional Network Management function.

In fact the Traffic Management service, as described in the latest issues of ITU-T Recommendations on the TMN (reference ITU-T M 3000 Series), corresponds very closely with the Network Management function as described earlier in that it is concerned with the management of traffic associated with circuit switched networks (PSTN) and transmission networks (such as the SDH network). The objective is to enable as many calls as possible to be successfully completed and this is intended to be achieved by maximizing the use of all available equipment and facilities in any traffic situation. So, in the TMN concept, Traffic Management clearly encompasses elements of switching facilities management and transmission facilities to achieve the stated objective, which essentially is the same objective as the traditional Network Management function.

Therefore, in conclusion, a basic interpretation of the relationship between the traditional Network Management function and the current definition of TMN is that it corresponds closely with the TMN defined Management Service called Traffic Management, the objective of which is to control traffic flow by manipulating switching and/or transmission resources in order to maximize the number of completed calls. The only missing element in this interpretation is the management of the common channel signalling network. However, this is considered to be a lower priority consideration given that Signalling System No. 7 networks can be specified and designed to be effectively self-managing.

Figure 8.4.1.2-1 illustrates the relationship between traditional Network Management function and TMN functional areas.

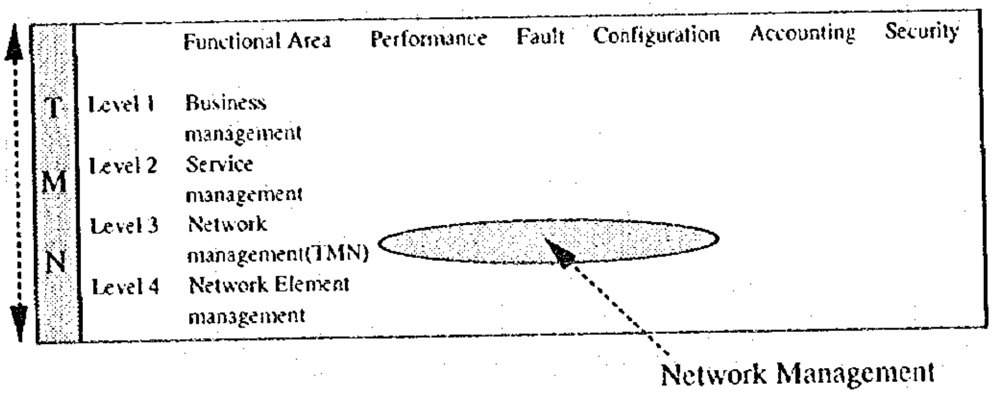


Figure 8.4.1.2-1 Relationship between Traditional Network Management and TMN

Figure 8.4.1.2-1 also helps to give some idea of the scale and magnitude of TMN.

In conclusion, TMN is already well established and accepted globally as the future direction and framework upon which to base the development of systems for the management of telecommunications networks/services. Therefore it is important to align the long term Network Management strategy for Syria with TMN concepts at the earliest possible point. However, a lot of work over the coming years is still foreseen to further develop the TMN concepts and associated interfaces/communication protocols, therefore the approach for Syria in the short to medium term should be based on realistic and achievable objectives which can have real benefits in the short term, while ensuring that the timing of investments and the selection of systems in the future are made taking into account the latest stage of development of the TMN standards.

8.4.2 Simple Functional Model of the Network

A digital telecommunications network can be viewed as consisting of a number of separately manageable functional layers:

- The *physical network* of transmission resources, which consists of the transmission media (coaxial cables, optical fibers, micro-wave links and satellite links), the transmission systems, the transmission nodes and the repeater stations.

- The *logical network* of switches and circuit groups, which utilizes the physical resources by means of the routing capabilities and the routing data base in the exchanges. In abstract terms, the routing function in the switches super-imposes the logical network structure on top of the physical network structure.
- The *common channel signalling network*, a supporting network for the logical network. It should be borne in mind, that SS7 already includes a considerable amount of signalling network management functions in its signalling network level specification (ITU-T Rec. Q.704) and therefore the need for external management should not be an urgent issue.

As a consequence, network management has to cope with at least two layers, the "transmission network" and the "switching network" and since these functional layers are entirely different, it is clear that

- Management activities must be structured in accordance with the characteristics of the respective layer they should apply to;
- Management activities at the different layers must be specified and executed in a fully co-ordinated way in order to achieve optimum use of the network resources, instead of possibly worsening an already poor situation with uncoordinated actions.

8.4.3 An Approach to Network Management Implementation in Syria

In the light of the above, it is recommended to tackle the implementation of network management from two directions and in phases, as follows:

- *Transmission Facilities Management*, which should be understood as the management of the transmission network, to be established in Syria during the Eighth five year plan
- *Traffic Management*, which should be understood as the management of the switched network, to be established in Syria during the 9th five year plan

While the time scales for these implementations are quite different, the basic planning for their introduction should be centralized in a single planning unit in order to ensure that the requirements for co-ordination between the two are fully understood and planned for, and that both activities will be accommodated inside the same planning framework for the future Syrian TMN and are required to strictly adhere to TMN definitions and TMN standards. This will leave the door open for a future integration if this is desired.

(1) Basic Strategic Principles

For the definition, the specification and the implementation of both Transmission Facilities management and Traffic management, it is recommended that STE establishes a TMN network management planning group to take prime responsibility for these ongoing tasks.

For Transmission Facilities management implementation as well as for Traffic management implementation in Syria, strict adherence to the following strategic principles is recommended:

- All arrangements for network management must be in accordance with the TMN framework.
- All transmission and switching equipment (network elements) procured from now on must have TMN-defined management interfaces (Q3 or Qx-type interfaces). If this is not possible (e.g. if definitions or specifications are not yet available), the supplier must make a commitment to implement interfaces on request from STE as soon as definitions and specifications become available.
- All transmission and switching equipment (network elements) procured from now on must have supervision intelligence and control capabilities. If this is not possible to the full extent (e.g. if definitions or specifications are not yet available), the supplier must make a commitment to upgrade, on request from STE, as soon as definitions and specifications become available.
- All existing digital equipment (network elements) installed in the network must be classified according to planned in-service lifetime.
- If the envisaged service lifetime extends to 3 or more years beyond the introduction year of the relevant network management system, implementation of TMN-type interfaces should be initiated, under the precondition that the existing management intelligence is sufficient or can be upgraded at acceptable costs. Existing management interfaces of non-TMN type should be assessed for possible adaptation to TMN-type interfaces.
- If the envisaged remaining life time is less than 3 years beyond the year in which the relevant network management system is planned to be in service, then no actions are required. If the existing built-in management intelligence is insufficient and cannot be upgraded at acceptable costs, the equipment should remain outside the managed network until its life time expires or until it is replaced.

(2) Transmission Facilities Management

Three main areas can be identified in transmission facilities management:

- *Configuration management* is mainly directed towards provisioning (setting up and cancellation of transmission links for the switched network and for other purposes such as leased lines). Another major activity in configuration management is transmission network reconfiguration for optimization purposes. Configuration management in the transmission network may also be used to support fault management at the traffic management level (e.g. a permanent outage at a transit switch caused by fire, flooding, etc.) However, this needs close co-ordination with the traffic manager.
- *Performance Management* is the basis for controlled maintenance. Performance data, collected real-time, are used to evaluate network performance. Based on this evaluation, maintenance actions targeted to performance and quality improvement are initiated.
- *Fault Management* is targeted to initiate corrective maintenance actions for clearing of equipment faults and to help neutralizing major fault situations in the transmission network (e.g. when transmission systems or even complete physical resources such as optical fibers or microwave links are down). This starts with the switching-in of protection resources (automatically or initiated by the network manager). A major reconfiguration of the remaining transmission resources, depending on the impact of the fault, may follow. A re-configuration of this kind must be performed -

  - always in close co-ordination with the Traffic manager
  - only after a sound analysis of the possible consequences and
  - never in a hurried decision
  - and must always be based on the network manager's final decision and never based on automated execution.

a. Functionality of a Transmission Facilities Management System

A Transmission Facilities management system needs the following basic functionality:

- Management "intelligence" at network element (transmission equipment) level consisting of:
  - data collection capabilities
  - supervision capabilities and
  - control (execution) capabilities
- Open TMN (Q-type) interfaces at the network element level and at the transmission management operation system level
- Reliable access capabilities (data communication) between all components of the system (by means of a DCN)
- Central management "intelligence" (a management operation system) capable of:

- data analysis and storage
- proposing appropriate actions based on the data analysis, stored data and pre-imposed patterns of action

In an advanced stage, the management operation system may be upgraded into a so-called expert system, capable of learning by accumulating experience from former management actions. However, the definition and development of such systems will still require considerable efforts and considerable time.
As far as the Transmission Facilities management operation system is concerned, the platform should be of continuous availability (fault tolerant).

A visual display should give a comprehensive overview on the current situation in the transmission network being managed.

b. Organization of Transmission Facilities Management

In the long term, three transmission network management centers should be established. Since TMN standardization work is most advanced for the field of transmission, particularly in the area of SDH, and since SDH transmission systems will be deployed during the Eighth five year plan, there would appear to be no reason why the deployment of the Transmission management centers should not be scheduled for the Eighth five year planning period. Therefore, during the Eighth five year plan it is proposed that Transmission Facilities management centers be installed at three locations, as follows

- Damascus, covering the Damascus Metropolitan and Rural Areas, which should serve as transmission facilities management center for all regional and local transmission routes in the south west;
- Alleppo, covering the Alleppo Metropolitan and Rural Areas which should serve as transmission facilities management center for all regional and local transmission routes in the north west region, and the eastern region;
- Damascus, covering the long distance transmission network. This center will be
  - the master control center for transmission facilities management for the entire country, thus supervising all other transmission facilities management centers and controlling their authorization
  - transmission facilities management center for all national transmission backbone routes.

In the long term, the allocation of the transmission facilities management areas of responsibility (and thus, the areas of authorization) to specific Transmission Facilities management centers should be based on (software) network maps.
In the introduction phase, this allocation may be done based on physical systems.

The network managers must have full authorization and also full responsibility in their areas of control. When they make a decision, they may consult specialist advisors from certain areas. However, after the decision has been made, execution must take place right away on their instruction only. Execution must not be dependent on any approval of any other manager in the administration hierarchy.

c. Implementation Plan

Implementation of Transmission Facilities management should start with the introduction of the Synchronous Digital Hierarchy (SDH) during the Eighth Five-Year Plan.

Since even then, full TMN solutions capable of managing transmission equipment from different suppliers may not yet be available on the market, the following start-up arrangements should be made:

- Each new (SDH) transmission equipment (network element) should have built-in management intelligence (supervision capabilities, data collection capabilities and control capabilities) accessible from TMN (Q-type) interfaces.
- Each new (SDH) transmission system should have an element manager / system control station, which allows management of the system from this station.
- The element managers / system control stations should be placed at those locations which are planned to serve as Transmission Facilities management centers.

The suppliers must make the commitment to upgrade the SDH equipment to full TMN management capabilities as soon as definitions and specifications are available and the network operator requests it.

In a second step the existing PDH transmission equipment must be examined in accordance with the basic strategic principles outlined before. Upgrading should be initiated as indicated there.
In a final step, full integration into a TMN (national) management system should take place.

(3) Traffic Management

The ITU-T E. 41x - Series of Recommendations are aimed at international traffic management. However, the basic principles established in ITU-T Rec. E.410 are valid for national traffic management as well. In addition, the management controls defined in ITU-T Rec. E.412 are also applicable in national traffic management.

ITU-T Rec. E.410 defines traffic management as the function of supervising the traffic flow in a network and taking actions when necessary to control the flow of traffic.

Four main areas can be identified for traffic management:

- Overload handling should protect the network against traffic overload in cases of:
  - predictable traffic peaks
  - unpredictable traffic peaks

- Fault handling should, during major fault situations (e.g. a major resource in the network is down):
  - reorganize the remaining resources in such a way that maximum throughput in terms of traffic is possible (see also configuration management);
  - protect the remaining network against spreading of traffic overload conditions resulting from the loss of resources, in order to avoid the situation becoming even worse.

- Configuration management should allow for reconfiguration at the logical network (circuit group) level (i.e. setting up, expanding, contracting and cancellation of logical routes including the dynamic manipulation of the routing tables) in order to compensate (at least partly) for major network faults. As a very advanced form of configuration management, the application of load-dependent routing, controlled by the traffic management center, is to be considered.

- Performance management should in the long term
  - support real-time grade of service evaluation by collecting and analyzing information on the current traffic situation
  - keep records of the performance data
  - support data collection for network planning

a. Principles of Traffic Management

The following principles should apply for the definition and specification of traffic management:

- Maintain maximum revenue from the network by ensuring that
  - as many circuits as possible are in service
  - all available circuits are utilized
  - all available circuits are kept filled with successful traffic
  - switching congestion is inhibited and its spread is prevented
  - traffic with high success probability is given priority over traffic with lower success probability
  - traffic with poor success probability is blocked at or near the source

- Ensure that the customers obtain the best possible service from the network resources available

- Make the most effective use of the network under
  - heavy load conditions
  - plant failure conditions
  - national disaster conditions
  - unpredictable traffic patterns

b. Traffic Levels

The traffic being managed can be classified/prioritized based on the revenues it generates as follows:

- International traffic consisting of:
  - incoming international traffic including its distribution in the national network
  - outgoing international traffic including its collection in the national network

- National traffic consisting of:
  - long distance traffic
  - regional traffic
  - local traffic

Under heavy load conditions, different handling strategies for these different traffic categories in accordance with their priority (revenue they generate) may be considered and applied.

c. Basic Functionality of a Traffic Management System

A traffic management system needs the following basic functionality:

- Management "intelligence" at network element (switch) level consisting of:
  - data collection capabilities
  - supervision capabilities incl. thresholding and
  - control (execution) capabilities

- Open TMN (Q-type) interfaces at the switches and at the traffic management operation system level

- Access capabilities (data communication) between all components of the system (by means of a DCN)

- Central management "intelligence" (a management operation system) capable of:
  - data analysis and storage;
  - proposing appropriate actions based on the data analysis, stored data and pre-imposed patterns of action.

In an advanced stage, the management operation system may be upgraded into a so-called expert system capable of learning by accumulating experience from former management actions. However, the definition and development of such systems will still require considerable efforts and considerable time.

As far as the traffic management operation system is concerned, the platform should be of continuous availability (fault tolerant).

A visual display should give a comprehensive overview on the current situation in the switched network.

d. Technical Arrangements for Traffic Management

First of all, the switching systems in the network must have efficient built-in automatic overload protection mechanisms, which ensure maximum traffic throughput in case of overload. Such mechanisms are necessarily dependent on the different architecture of the switching systems. However, as part of the selection process to buy a switching system, it is of prime importance to thoroughly examine and compare the overload protection philosophy and the overload protection mechanisms of the offered systems.

The Automatic Congestion Control (ACC) procedure shall be specified as mandatory for Signalling System No 7.

As far as technical arrangements for external traffic management are concerned, the exchanges (being NE's according to the TMN definition) must contain built-in management intelligence (supervision capabilities, data collection capabilities and control capabilities) to provide the means for:

- real-time monitoring of traffic on the particular traffic carrying entities (circuit groups, control elements, etc.), e.g. based on pre-set (and adjustable) thresholds;
- dynamic adjustment of these thresholds on-line;
- the execution of the preventive and expansive management controls defined in ITU-T Rec. E.412, the applications of which are explained in the ITU-T Handbook on Quality of Service, Network Management and Network Maintenance;
- communication with the traffic management operations system (Q3 interfaces).

For management access (DCN) any existing network (e.g. the existing packet switched public data network or the packet-mode service in the ISDN when implemented) could be used, provided they are appropriate for the data transfer rate envisaged.

The traffic management application system must be defined to make the best use of the management intelligence in the switches.

e. Organization of Traffic Management

It is recommended that, in the first instance, one National Traffic Management Center be established to control the long distance traffic flow in Syria. To ensure effective co-ordination, the Traffic management center should be co-located with the national backbone transmission center already proposed for Damascus.

The Traffic Management center shall be the

- master control center for traffic management for the entire country;
- traffic management center for all inter-regional traffic routes;

- traffic management center for all traffic routes and all exchanges in the city and region of Damascus.

The Traffic manager must have full authorization and also full responsibility in his area of control. When he makes a decision, he may consult specialist advisors from certain areas. However, after the decision has been made, execution must take place right away on his instruction only. Execution must not be dependent on any approval of any other manager in the administration hierarchy.

f. Phased Implementation

In a preparation phase, management intelligence to be located in the switches and protocol stacks for the Q3 interfaces must be defined and specified in detail. In parallel the traffic management application functions must be defined and specified. Both actions must include continuous co-ordination with the switch suppliers.

It is recommended that the National Traffic Management Center be scheduled for deployment during the 9th five year planning period. An earlier implementation is too ambitious and not likely to bring substantial benefits as long as the required basic skills have not been developed and advance planning not performed.

(4) Co-ordination of Transmission Facilities Management and Traffic Management

In general, the Transmission Facilities manager(s) should inform the Traffic manager(s) (and vice versa) on all actions they intend to take. For more sophisticated actions direct consultation is recommended.

Major failures in the network (e.g. a main transmission cable cut or a transit exchange damaged by fire) which cannot be repaired in a short time, may result in the remaining resources being unable to handle the total traffic and thus, the network being affected possibly for a long time.

In this case, co-ordinated actions of the Transmission Facilities management and the Traffic management will be needed to ensure maximum utilization of the remaining resources and maximum traffic throughput in the affected network.

For these cases, co-ordination and advisory groups, consisting of specialists from the technical disciplines involved, are recommended to be established.

It shall be possible to convene such a group at very short notice, given either by the Traffic manager or the Transmission Facilities manager. The group should be activated immediately on the occurrence of such faults to support the Transmission Facilities managers and Traffic managers in the decision making.