Chapter I

INTRODUCTION

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1.1 Scope of document

The principal purpose of this document, now incorporated under its present title as part of the Buenos Aires Action Plan (Programme No. 3), is to provide the Administrations of developing countries with concise and practical guidelines for the preparation of their development plans. The long-term objective of the programme is to enable planning engineers from national Administrations to produce and up-date these plans.

In the case of developing countries, the telecommunication networks are characterised by, among other factors, low telephone penetration rates and often inferior quality of service, in contrast to developed networks in which the telephone penetration is almost at the saturation level and the Administrations are concentrating on the provision and management of new services. Much of the content of this manual is therefore directed to the type of planning required by Administrations which aim to improve the penetration rate and quality of service of their telephone networks and, at the same time, need to plan for the introduction of new services. For the foreseeable future, the telephone service is likely to dominate the requirements of this type of Administration, this priority being reflected in the texts. Nevertheless, it is recognised that in view of the rapid progress in technology, and in particular the convergence between telecommunications and information technology (IT), as well as an increasingly competitive environment, Administrations need to envisage the implementation of radically new systems and enhanced services. For these reasons, and in addition to the chapters devoted to 'traditional' planning, the introduction of new services and operating methods is also considered in some detail, in particular in the chapters on "Scenarios for future development" and "Target Networks", which are directed to the preparation of business oriented strategic plans..

The assumption is made that the common long-term objective of all Administrations is the implementation of a fully digital network - in some cases a type of integrated services digital network - and strategies for digitalisation are included in the texts.

1.2 Summary of contents

1.2.1 Background information required for planning and implementation

A significant quantity of background information has to be collected, and documented, before any planning activity can be started.

This information is required, not only to support the planning itself, but also, and in particular in the case of developing countries, to provide a background for both potential donors and financial agencies as well as any external assistance personnel who may be required.

In Chapter 2, the background information required is summarised in two categories:

- that required for financing institutions;
- that required for planning activities and for the information of external assistance personnel.

In the first category, the importance of realistic analyses of the telecommunication sector (invariably required by financing institutions) is emphasised.

The background information for planning activities in addition to inventories of existing systems, consists essentially of the statistics which have to be collected, and entered into a data base, for forecasting purposes.

1.2.2 Policies and strategies

In this chapter, the importance of defining both the business concepts and overall strategy of the Administration is emphasised.

Guidelines are provided in the form of a summary of current trends in sector re-structuring together with some examples of modern sectoral policies, etc. The guidelines include the basic principles involved in changing from the traditional, hierarchical, technology-based structure to the service-centred, market-driven and customer-oriented organisational structure which is necessary in the current environment.

To implement such radical changes it is necessary to make realistic assessments of the present performance of the Administration, to have access to market information and forecasts and to formulate scenarios on the possible future roles of the organisation in the broadest terms.

1.2.3 Scenarios for future development

As part of the recommendations on the formulation of a strategic plan, Chapter 4 considers some scenarios which can be envisaged by Administrations.

Recommendations are included on the following topics:

- assessment of the need for existing and new telecommunication services;
- analysis of the possible impact of any future new services, including cost, profitability and risks;
- evaluation of alternative solutions for the future network development;
- preparation of a digitalisation strategy;
- assessment of the use of new techniques for network operation, in terms of centralised versus distributed service provision, and of alternative roles for network operators, service providers and end users.

1.2.4 Target network

To facilitate the evaluation of possible strategies for network development and the introduction of new services, the concept of a target network has been found to be a useful device. As already mentioned, the long-term objective of most Administrations is a fully integrated digital network, either for telephony and traditional narrow band services or for a multiplicity of services, including wide-band services. In broad terms this future all-digital network is the 'target' network. In practical terms it is necessary to:

- design the target network structure, or physical network model;
- consider the flexibility, simplicity and cost effectiveness aspects, for example, the ability of the network to respond successfully to large variations in demand and traffic patterns, to facilitate the easy implementation of new services, to respond safely to fault conditions etc.;
- identify all problems which could be encountered and propose solutions to these problems.

A target network defined according to the above is effectively a framework for detailed network planning. These principles are considered in Chapter 5.

1.2.5 Forecasts

All planning, whether strategic or shorter term, relies heavily on forecasting-which obviously will become more accurate the shorter the study period.

The basis for all forecasting is the prediction of the subscriber, or end user, demand for the various services to be offered - at present predominantly the telephony service. Ideally, a subscriber demand forecast for each exchange area of the present and future network should be made. In practice, this means the collection, and organisation, of vast quantities of data which can only be effectively manipulated using computerised methods. The formation of a suitable data base, its up-dating and manipulation are discussed in Chapter 7.

The demand forecasts form an essential input to traffic forecasting, on which the network optimisation and subsequent provisioning of equipment are based.

As far as forecasting (demand and traffic) is concerned, the following are considered in some detail in Chapter 6:

- the purpose of each type of forecast and its relation to other subjects;
- the inputs required; background information, data collection and scrutiny, formation of a data base;
- outputs of forecasts; time scale, variables of interest, required precision, etc.;
- forecast process; evaluation of various models;
- choice of methods, improvement of forecast quality, digitalisation and use of non-numerical information.

1.2.6 Network dimensioning and configuration

In the section on network dimensioning and configuration (Chapter 7), recommendations are included on the computerised tools available for this complex operation, in particular the PLANITU programme available from the ITU. The importance of carrying out systematic traffic measurements is also emphasised, with an example of the measurements which could be carried out on a digital exchange.

1.2.7 Fundamental technical plans

These plans effectively define the technical standards which are to be achieved over the long-term planning period and are therefore closely related to the strategic plan of the Administration. In Chapter 8, all the technical plans, together with their preparation, are described. For all these plans, the assumption is made that the network development is towards a fully digital configuration over a more or less long period depending on the current state of the network. In those cases where fundamental technical plans exist for an analogue network, revisions will obviously have to be made for the gradual transition to a digital configuration. These are considered in each relevant sub-section of Chapter 8.

a) Numbering plan

The numbering plan, of necessity, has to be valid for a long period - typically 50 years - as, until the advent of SPC exchanges, it was extremely difficult to change. Although the flexibility of modern switching systems enables the numbering plan to be modified more or less on demand, the administrative inconvenience to both the operators and subscribers makes it desirable that the long-term validity is retained.

The formulation of conventional numbering plans is considered in Chapter 8, together with the allocation of numbering capacity to any new services which could be introduced. Examples of numbering changes which have to be introduced on the implementation of digital switching, and of a closed numbering system are included.

b) Routing and switching plan

The principles of preparing a routing and switching plan are presented, taking account of the inevitable introduction of SPC switching systems, digital remote switching units, etc. which significantly change the traditional philosophy. For example, the use of combined local/transit exchanges can radically change the configuration of local networks and the introduction of digital transit exchanges and digital transmission in the long-distance network can facilitate direct routes using a larger number of links.

The concept of non-hierarchical networks, using dynamic or adaptive routing, is introduced together with that of network nodes - which are replacing exchange switching points.

c) Transmission plan

The purpose of a transmission plan is to define the losses and other impairments which can be tolerated over each part of any subscriber connection and which will ensure satisfactory communication between those subscribers irrespective of their location on either the national or international network. In addition, the methods by means of which the transmission standards are to be achieved over the long-term planning period have to be specified, as well as the time-scales involved.

In Chapter 8, a review of the above, together with a summary of the many CCITT Recommendations on the subject, is given.

d) Network synchronisation plan

Full synchronisation is required once non-voice services are introduced into the digital telephony network. Until these services are introduced, a plesiochronous network, i.e. using independent exchange clocks of moderate frequency stability, could be sufficient.

In Chapter 8, the slip-rate objectives and the methods of network synchronisation to achieve these objectives are considered together with a review and interpretation of the relevant CCITT Recommendations on this subject.

e) Signalling plan

The two fundamental types of signalling, subscriber to exchange and inter-exchange, are considered in this chapter with particular emphasis on the desirability, or otherwise, of implementing the CCITT Signalling System No. 7 which was specifically designed for the ISDN.

As far as subscriber signalling is concerned, it is likely that conventional signalling will remain in service for many years in the future so that digital local exchanges have to be provided with suitable line interfaces.

The signalling plan has to define any proposals for the introduction of new systems according to the digitalisation strategy and aim for standardisation whenever possible.

f) Charging plan

The charging plan, which is also considered in Chapter 8 as a fundamental technical plan, has to ensure:

- adequate revenue for the Administration;
- an adequate return on investment;
- the efficient use of the network;
- relation of charges to defined parameters;
- subscriber satisfaction.

The charging philosophies which are used, together with the relation to other technical plans are considered.

g) Network security plan

This includes the so-called availability plan which aims to maintain a specified quality of service. The security plan itself defines the practical measures proposed to minimise the effects of equipment and system failures on the availability. The relationship between these two aspects, as well as the influence of the routing plan and the provision of transmission links is considered in this sub-section.

The security plan has an obvious relation with network management and the facilities for the latter are also considered.

1.2.8 Equipment and networks

The sub-sections of Chapter 9 provide mainly technical information on all the equipment likely to be used in the network development, together with recommendations on its provision and deployment during the planning period.

a) Subscriber terminal equipment

A review of all types of subscriber terminal equipment likely to be used during the planning period is given. This equipment includes special network terminals as well as the conventional telephone sets, PABXs, etc.

Recommendations are made concerning technical standards, type approval and procurement policies for this equipment - which is often owned by the subscriber.

b) Local networks

The provision, and maintenance, of local networks, in particular the multi-exchange networks in metropolitan centres, absorbs a significant portion of the total investment in telecommunications.

Both the investment and maintenance costs can be reduced by effective network planning at the outset and this sub-section includes recommendations on basic local network planning, construction methods and maintenance procedures.

With the exception of the junction networks, the external plant in the local exchange areas, in particular the subscriber distribution networks, is envisaged to remain largely in its conventional (metallic) form in the foreseeable future - at least in the developing countries - but the increasing introduction of digital local exchanges means that the quality of the subscriber distribution networks will have to be drastically improved in many cases. Possible future scenarios, including the provision of optical fibre in the distribution network and radio access in the network are briefly considered.

c) Switching equipment

This section covers the technical characteristics and other practical requirements of the switching systems to be used over the planning period, as well as the general policy concerning the procurement and implementation of these systems.

The questions of standardisation and limited number of manufacturers etc. are included in the recommended policy.

In addition, the infrastructure required (power, buildings, environment, etc.) is briefly considered.

d) Transmission networks

The available transmission media for use on the different types of network are described to provide a background for planning staff, and recommendations are made for its optimum deployment. These include the introduction of the synchronous digital hierarchy (SDH) which is expected to offer the possibility of more flexible, and more easily managed, digital networks as well as providing the basic transmission infrastructure for the next generation of network, the broadband ISDN.

Developments in the international transmission network, including satellite systems and submarine cable systems, are reviewed.

The solutions proposed complement the theoretical aspects of the transmission plan discussed in Chapter 9.

e) Rural networks

A significant proportion of the world population lives in small villages, isolated both from each other and the nearest large city. Due to this remoteness, the telecommunication needs of this (rural) population cannot usually be met by conventional systems and, in this sub-section, the less conventional transmission media, usually radio systems, are reviewed for their suitability in rural applications.

Both cellular and satellite radio techniques are now being advocated as solutions to the rural telecommunication problem - as well as the now commonly used point-to-multipoint radio. These are included in the review of transmission media, together with their integration into the national network.

The case of high-density rural populations in developing countries is also considered, the initial solutions being based on the planned provision of public call offices (PCOs) in strategic locations.

f) Non-voice networks

Although telephony is envisaged to remain the dominant telecommunication service offered by network operators, there is now a significant demand for non-voice services, to be provided over either the telephone network itself or over other specialised networks. These are reviewed in this section of Chapter 9.

g) Introduction of cellular radio systems

Cellular radio has shown a remarkable growth in the industrialised world over the last decade, during which all demand forecasts have been exceeded by a considerable margin.

The structure and principles of these systems are reviewed in this section together with recommendations on the policy to be adopted by Administrations wishing to introduce this service in their national networks. Their extension into the so-called PCN radio access systems is also considered.

A future development is likely to be the introduction of low earth orbit (LEO) satellite systems which, once the formidable political and administrative problems have been solved, could provide a global mobile radio system complementing (or replacing) some of the existing cellular systems.

Although not normally an integral part of the national network, the so-called trunked radio systems also fall into the category of mobile cellular radio. These systems have emerged as a result of the release of frequencies formerly used for TV broadcasting, typically the 160 MHz band. Due to the low radio frequency the coverage per cell is high and the systems can be set up as closed networks in remote areas as well as the more usual application for private companies (taxi, transport, etc.). As the operators of these systems have to be licensed by the Administration, or relevant Ministry, they are briefly mentioned in this sub-section.

h) Note on maritime radiocommunication services

The planning of these systems has already been covered in a separate ITU document published in 1991. This note is therefore confined to a brief reference to this document and the proposals made for programme 4 of the Buenos Aires Action Plan which is intended to provide assistance for the development of these services.

1.2.9 Operation and maintenance

The previously mentioned technical plans have to be supplemented by a network operating plan, the principal objective of which is to ensure that the network quality of service objectives are met in a cost-effective manner.

This subject is now to be considered by the new Study Group 2, under Programme No. 7 (Improvement of Maintenance) of the Buenos Aires Action Plan and Chapter 10 is simply an explanatory note on this development.

1.2.10 Organisational structures and management

The ultimate success of the development plan depends on the capability of the network operator to provide the organisation and management expertise to market and provide the services envisaged in the plan.

This is the principal reason for the inclusion of organisation and management aspects in the development plan, the other reason being that a demonstration of plans to improve operational efficiency is essential to attract investment.

In Chapter 11, a summary of current trends in organisation development and management principles is given, together with some examples of modern trends in these aspects.

1.2.11 Manpower planning and training requirements

Chapter 12 covers human resources strategy which includes performance appraisal, manpower planning and forecasting, job classification, remuneration policies, etc. as well as the associated training requirements, policies and methods.

1.2.12 Tariff reforms

Obviously the tariff structure is one of the key elements of the telecommunication development plan -in particular a business oriented plan- as it defines the means by which the plan will be financed.

After a review of the traditional tariff structure and its application, the concepts of future tariff structures are considered in Chapter 13. It is shown that the three traditional factors on which tariffs are normally based; distance, duration and volume, are becoming less significant. The factors which will take their place will no doubt be more closely related to the market value of a service rather than the cost of producing it.

Included in this chapter are a checklist of the steps to be taken when setting or changing a tariff structure and a list of alternative social and policy objectives with their probable impact on the structure.

Finally, information on the role of ITU in establishing international tariffs is explained.

1.2.13 Financing network investment

In Chapter 14, the broad issue of financing the development of the network is considered. While it is desirable that this development is financed internally, i.e. from revenue generation, this is rarely possible -and certainly not in those countries in which it is necessary to maintain a high rate of growth to match the demand.

A review of the investment indicators which are necessary for assessing requirements, and formulating a business plan, is given followed by considerations on traditional and non-traditional methods of financing.

Finally, it is concluded that the best strategy for growth would appear to be increased investment -provided that this investment is carried out in a rational way. This applies in all the different ideological, economic and organisational environments in which the telecommunication authorities have to operate.

1.14 Strategic business plan

1.3 Presentation of contents

An attempt has been made to present the contents of this document in more or less the order which would be followed for an actual set of development plans. Thus Chapters 1 to 8 provide guidelines for the preparation of strategic and other long-term plans, which define the long-term objectives and the technical standards which are to be achieved, Chapter 9 concentrates on providing descriptive material on equipment and network standards, including procurement policy, choice of suitable equipment, etc. and the remaining Chapters give information on the operation and organisation of the management of the network.

The chapters, and paragraphs where appropriate, are individually page-numbered to facilitate later modifications if these are required.

All the contents rely heavily on other ITU publications, in particular the GAS manuals and ITU-T/ITU-R (formerly CCITT/CCIR) Recommendations to which references are made in the text. Those topics which are not subject to ITU or other Recommendations necessarily reflect the views of the authors but are nevertheless representative of 'good practice' as used by telecommunication Administrations.

As is well known, telecommunication technology is, to say the least, rapidly changing so that it is inevitable that some of the text could become obsolete in a more or less short time. However, it is considered that the underlying principles described should remain valid in spite of this pace of change. In this respect, it is to be noted that ITU-T and ITU-R Recommendations are now published separately, as are revisions to these recommendations. ITU-T publishes, free of charge, a catalogue of its Recommendations at regular intervals.

Consistent with ITU practice, the term 'Administration', when used in this document, denotes either a telecommunication administration or a recognised private operating agency. However, as agencies other than the national Administrations are now frequently in competition the term Public Telecommunication Operator (PTO) is also used in the text as a general designation.