INTRODUCTION AND SCOPE OF THE WORK

1.1 INTRODUCTION

Today we are living in a world in which telecommunications have reached a degree of sophistication which is not only surprising but also have far-reaching social and economic implications. It causes us little or no surprise when we see on the TV screen in our living room, in real time, remote events such as a lunar landing. New developments in microelectronics - notably microprocessors - are bringing about other revolutionary changes in our domestic and industrial communication environment.

The office of the future will make increasing use of text creation (word processors), the storage, manipulation and retrieval of information (data processing) and new methods of communication (electronic mail). Such an electronic office will utilise the convergence of computer and telecommunication technology to provide a single paperless integrated system for the storing and manipulation of information in electronic form to handle all office functions. Powerful micro-processor systems using the TV as a display can also be expected to penetrate into the home, paving the way for a wide variety of services, interactive entertainment, electronic mail and information retrieval. It can therefore be seen that the balance of person to person communication will progressively shift from the traditional face-to-face and postal mail methods to telecommunications, and such a move will become intensified by the need for saving time and energy spent in transportation.

Underlying all these changes are the new developments in telecommunication which are progressively getting interwoven into the economic and industrial fabric of society. New methods of signal transmission have shrunk the world
today, making Madrid or New York as easily accessible as Madras or New Delhi.

In a competitive world, any technological breakthrough attaining new heights in efficiency and productivity cannot be ignored by other countries, developed or developing. India as such cannot remain unconcerned about such changes but has to incorporate them into her own system as far as possible, commensurate with her own needs and available resources.

The Indian telecommunications network in near future will need to handle a wide variety of voice, data and visual services. New dimensions will be required to plan the network of the future to cater for the complexity of high technology plant and the need to interwork during the transitional period. It will no longer be possible to predict the future by extrapolation of the past and there is a need to provide for the unpredictability of the social environment and speed of technical innovation. Our seventh plan for Telecommunication Development provides for a huge investment involving thousands of crores of rupees to bridge the gap between the demand and the supply of telecommunications facilities and to introduce modern technologies, particularly digitalisation, which is of prime concern to this thesis. Before we consider it in greater detail it will be useful to examine the existing background.

1.2 THE CALCUTTA TELECOM NETWORK

The Calcutta network is typical of major Indian cities. At present the junction network consists of nearly 2000 Kms. cable route connecting 49 telephone exchanges. In the local network, connecting nearly 2,50,000 subscribers, the cable route runs into some 25,000 Kms.

Calcutta network is dominated by electro-mechanical and X-Bar switching systems. By today's standards they are slow, noisy, fault-prone and limited in capability to provide the facilities which can be seen as potential requirements
for future. Also, they are dependent on semi-precision mechanical production which is highly labour intensive, sensitive to cost inflation and therefore expansive. Thus there is a clear need to introduce new technology systems in the networks of the future. The most promising of these is the digital system.

Since the digitalisation of an existing network cannot be accomplished at one stroke, the reasons being both practical as well as financial. It must be introduced gradually in the network. The choice of the appropriate degree or extent of digitalisation is guided by the following considerations:

- Need for exchange replacement.
- Need for introduction of new exchanges.
- Improvement of transmission quality.
- Need to increase traffic carrying capacity.
- Need for introduction of modern signalling system.
- Introduction of other digital services.

Advantages of digitalisation are likely to materialise only when the network becomes fully digital. In the intervening period there are distinct possibilities of a deterioration in the quality of service, which may be coupled with the higher costs particularly if the transmissions are not planned and implemented with adequate care.

As a first step to make the transition less difficult, junction networks in Calcutta are being digitalised. This will be followed by large scale introduction of digital switching into the network. About 30% of transmission systems installed in the 6th plan period and 75% in the 7th plan period are expected to be of the digital type. Beyond that period (1990) no more analogue transmission systems are likely to be introduced into the network.
1.3 Scope of the work

The author of the present thesis, now a Deputy General Manager of Calcutta Telephones, was entrusted with the arduous task of introducing PGM systems into the junctions network of the Calcutta Telephone District about seven years ago. This was a maiden venture. Very little was known about what might be the best way of introducing the changes, and often through experiments designed by himself, the author had to find answers to the questions that faced him.

The first step in this programme was the selection of some junction routes for PGM working. The configuration of Calcutta Telephones is such that the distances between peripheral exchanges are sometimes of the order of 50 to 60 Km., requiring provision of high grade junctions. A major planning like this always involves a number of conflicting requirements and a balance has to be made by careful judgement. The junction plant network in our telephone system involves about 30% of the total capital invested and the undertaking of investments in a complex junction network like ours without evolving proper strategy may lead to serious errors and financial imbalances. It was therefore of particular importance to carry out economic studies before arriving at decisions.

In Calcutta it is experienced that due to the large-scale developmental projects undertaken by various organisations, numerous physical damages are inflicted on underground junction cables and consequently these are subjected to high incidence of breakdowns. Each junction breakdown is found to result in a loss of about Rs.32,500/- by way of loss of revenue and repair cost. There are junction routes in which the number of breakdowns every year is of the order of 12. This colossal financial loss, which is in addition to the irreparable damage done to the image and credibility of the department in the
public eye, was an important factor to make us think about PCM routes on Microwave systems. This is peculiar to Calcutta, for no other metropolitan city in India has this disadvantage. The most arduous part was the engineering and execution phase of the work. Since 30-channel PCM systems were selected for our use it was necessary that in all cable routes any loading coils provided in the pairs must be removed to facilitate the high Mb rate working associated with PCM-30 signals. As our organisation has no past history of high frequency working in audio cables of all sizes, capacities, constructions and ages, formulation of certain rules for PCM regenerator spacing, power feeding section etc. were needed. Although PCM transmission is widely used in a number of countries, in its inter-exchange applications, PCM planning and engineering have to be local rather than national or international.

This study is the first of its kind in our country and engineering rules were developed to ensure a very high degree of success. All measurements were taken in a very conservative way. During four years (1978-1982) the author headed this project nearly 10% of audio junctions could be digitalised. These routes comprise of 2,048 Mb/s working on cable as well as 34 Mb/s working on 13 GHz microwave systems. Demand for voice band data communication is also growing in our network. An attempt to evaluate the capabilities of this network for the same was also made by the author while studying the characteristics of the junction network for PCM working.

The present dissertation describes how the author was able to introduce PCM-30 systems in the Calcutta network for the first time - the problems he faced and how eventually be solved them. The work may be divided into three parts, namely (i) planning for introducing PCM, (ii) engineering aspects of the work : the problems faced and the solutions evolved and (iii) the economics of PCM i.e., how on the basis of above experience one can make realistic cost estimates
about introducing PCM in any network in our country.

This dissertation has eight chapters. Chapters I and II are introductory. The former describes the scope of the work, while the latter gives a general introduction to PCM systems. The planning aspects of primary PCM routes are discussed in chapter III.

Chapter IV deals with the engineering aspects. The criteria for selecting suitable cable pairs for PCM working are discussed. Some engineering rules are suggested for Repeater spacing and Power-feeding section. These are based on data collected by actual cross-talk measurements on a large number of different types and sizes of junction cables in the different routes of Calcutta telephone district. Capability of any junction cable for PCM systems has also been discussed and average penetration or fill of junction cable has been suggested. Average value of PCM fill is very useful to the planners, particularly when total digitalisation of junction network is under consideration.

The economic aspects are discussed in chapters V and VI. Chapter V is based on detailed techno-economic studies of the junction routes and discusses what may be the most economic sizes of span of junction links for physical cables, cable-based PCM systems and radio-based PCM systems. Trade off sizes of the span are also indicated. The economic considerations and other constraints underlying the choice of Nodal Digital Microwave network in our telephone district are reviewed in chapter VI. The problem of intra-system interference in a practical nodal distribution network is discussed and suggestions are made for transmitter power regulations.
In course of the present study the potentiality of our telephone network for voice band data communication came up by the way. The results obtained are presented in chapter VII.

Chapter VIII gives the summary and the major conclusions.