ABSTRACT

In the analysis and design of any communication system one of the fundamental considerations is the possibility of successful communication between various pairs of nodes in the network. This obviously depends both on the topological layout of the communication links and the reliability of the constituent communication centres and the connecting links. Based on the definitions of acceptable network operation, two most meaningful measures of the reliability of a communication network are the 'terminal reliability' between a given pair of communication centres and the 'overall reliability' or the 'global availability'. The terminal or s-t reliability is defined as the probability that there exists at least one path between two extrema of the network. The overall reliability is defined as the probability that the network is at least simply connected.

There are several available algorithms for the evaluation of the terminal reliability. All these methods become prohibitive with the increasing size of the communication systems or the computer networks. Therefore, some work is reported in the recent years on suitable decomposition strategies. The existing methods suffer from many serious drawbacks, which have been eliminated in the method proposed in this thesis. The suggested method is computerizable and the examples are given in support of the method.
In the existing methods for the derivation of the symbolic reliability expression, it has been assumed that a successful operation of all elements of any path is necessary as well as sufficient for system success. In actual practice, however, every communication link can offer only a limited amount of channel capacity. Also normally there is a constraint on the total amount of information which may be required to be transmitted from source node to the terminal node in a communication system. In the method proposed in this thesis, we consider the communication system reliable only if it is possible to successfully transmit the required amount of information from the source to the sink node, thus rendering the proposed reliability analysis much more realistic and useful. Since the number of cutsets is smaller than the number of paths for several practical networks having vertices of average degree more than four, an attempt has also been made to suggest another reliability evaluation algorithm based on cutset approach.

Large scale computer communication networks are now coming into more extensive use primarily because of the economy achieved through resource sharing. Two fundamental considerations in the design of a CCN are the reliability between any pair of nodes and the maximum permissible cost. Having the knowledge of the locations of the various computer centres (nodes) and the possible position of links which can be connected between various node pairs, an optimal network topology is suggested which gives us the maximum s-t
reliability, when the maximum permissible cost of establishing the links is specified. Another heuristic method is proposed for the design of a CCN to maximize the overall reliability, if maximum permissible cost for establishing the total number of links is specified. This method requires the enumeration of the spanning trees of the possible network topology. Therefore a method for the generation of all the spanning trees of the network is also proposed.