RELIABILITY IN COMPUTER ENGINEERING

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Abstract

Incorporating network reliability parameter in the design of reliable computer communication network makes the computations prohibitive. Interdependence among network topological parameters dose not permit the design of a maximally reliable network using any one of the parameters and thus, there arises a real need for a composite reliability index whicph gives a more realistic assessment of network reliability .In this paper the topology parameters which from the basis of the existing reliability measure and also the reliability indices which is formulated in [3] are calculated for some networks.

1.Introduction

A computer communication networks (CCN) is either a set of many interconnected computers or a set of terminals connected to one or more computer, it is represented by reliability block (Logic) diagram in which nodes correspond to the computer centers in the network and edges correspond to the communication links .See [2],[4].

An essential consideration in the design of a (CCN) is the reliability of the communication paths between all pairs of nodes.

These depend upon the links in addition to the reliability of the individual computer systems and communication facilities . It is assumed that the communication is desired between the sours rode and terminal node. Having Knowledge of the possible locations of different computer centers and communication links i.e , between nodes and edges which can be connected between any two nodes.

In a graph theory, a network can be described topologically by its parameters like number of nodes number of links ,minimum node connectivity, network radius, network diameter ,network girth, and network articulation level, for more detail see[1][5].Many research workers suggested different reliability measures based on these parameters above in their attempts to realize maximally reliable computer network topology like Frank & Frisch (1971),Wilkov (1972),and others. See [2],[6].

2.Some Definitions and Concepts

Overall reliability: Is the probability that each node in the network is able to communicate successfully with all other nodes.

Connectivity: Is the minimum number of edges or nodes which must be removed from a network in order to break all paths between any pair of nodes.

Cohesion: Is the minimum number of edges or nodes which must be removed from a graph in order to isolate any sub graph of m nodes from the next of the graph.

Diameter: Is the maximum length of any shortest path in a graph.

Girth: A circuit in a graph G is a path in which the initial and terminal nodes winced, the length of any circuit in G is the number of edges on the corresponding closed path. The minimum length of any circuit in a graph represents the girth of the graph .

Node Articulation Level :Is the fewest number of nodes (edges) which if deleted would break the network into at least two non communicating

sub nets, articulation of level m is that minimum set of m nodes (edges) which if deleted would break the network in to at least two non communicating subsets Based on the concepts of network articulation level Soi. suggested prime node (edge) cut sets of size m with respect to any pair of nodes define as follows :

$$X^n(m)=\max_{i,j}\{X^n_{(i,j)}(m)\} \quad \ldots\ldots\ldots 1$$

$$X^e(m)=\max_{i,j}\{X^e_{(i,j)}(m)\} \quad \ldots\ldots\ldots 2$$

For more detail .See [1],[4].

3. Notation

$$K(G)=\max_{i,j}\{d_{(i,j)}\} \quad \ldots\ldots\ldots 3$$

Where $d_{(i,j)}$ denote the distance between nodes i,j in a graph G .

The indices p_0 and p_1 which have been formulated by taking into account all the topological parameters.p_0,p_1 are formulated in [3] as follows:-

e	number of edges.
n	number of nodes.
d	connectivity.
t	girth .
k	diameter.
$X^n(m)$	network nod articulation level.
$X^e(m)$	network edges articulation level.
δ	cohesion.
p_α	reliability index.

$$P_\alpha=\frac{t+\delta+\alpha\, d}{K+X^e(m)+X^n(m)}+\frac{2e}{n} \qquad \alpha=0 \text{ or } =1 \qquad \ldots\ldots\ldots\ \ldots\ldots\ldots\ .4$$

4.An illustrative Example

In the section above briefly described the existing reliability measures based on the network topology, in this section the topological parameters are calculated for the problem which is taken from [3] to four different networks, also p_o,p_1 are measured for the same networks which is shown in Fig.(1) below.

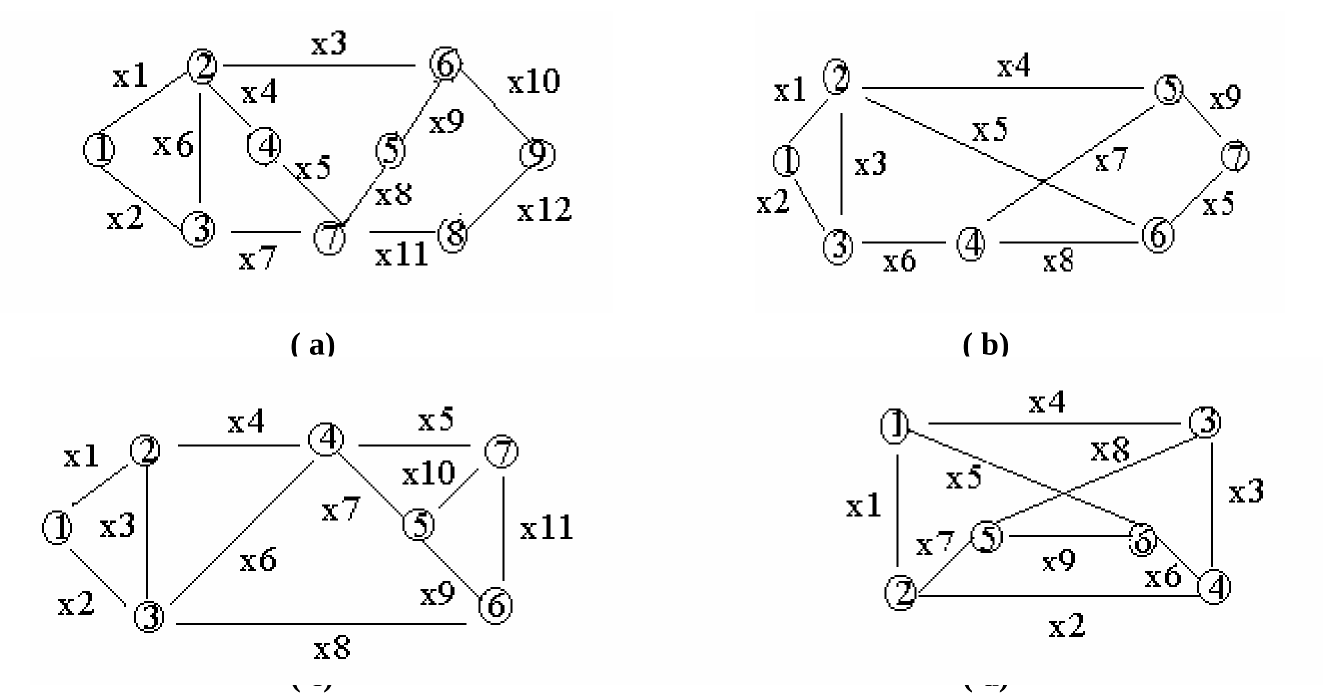

Fig.(1)

For the networks shown in Fig. (1) ,the topology parameters and the reliability indices p_0,p_1 are calculated and tabulated in table (1)below.

Table (1)

Fig.(1)	(n,e)	Topology Parameters						Reliability Indices	
		d	k	t	δ	$X^e(m)$	$X^n(m)$	p_o	p_1
a	(9,12)	2	3	3	2	3	4	3.17	3.37
b	(7,10)	2	3	3	3	2	4	3.53	3.75
c	(7,11)	2	3	3	3	1	3	4.00	4.28
d	(6,9)	3	2	4	4	0	0	7.00	8.50

Table (2)

Fig.(1)	Overall Reliability			
	p=0.6	p=0.7	p=0.8	p=0.9
a	0.349	0.551	0.801	0.958
b	0.449	0.677	0.866	0.972
c	0.525	0.745	0.904	0.983
d	0.626	0.821	0.944	0.993

5. Conclusions

1.In the analysis of CCN it is customary to measure the parameters describing the network topology and to have a qualitative idea of the overall reliability of the network.

2.The evaluation of the p_o,p_1 from the topological parameters by using eq.(4) is quite simple and does not need too much computation , thus measuring p_o,p_1 to get a qualitative idea of network overall reliability is far more economical and simple from computational point of view as compared to evaluating the overall reliability of a network .

3. In comparing between the results in table (1)and the overall reliability which is taken from[3] in table (2) ,the overall reliability increase with an increase in p_o,p_1 for all networks in Fig.(1) .

4.p_o,p_1 can also compare with overall reliability of different network topologies without actually solving for the overall reliability .

5.Results confirm that none of the reliability measures based on a single network topology parameter is suitable for designing computer networks with maximum overall reliability, since the failure to meet the design requirements probably results from very high interdependence among these parameters , thus the combination of these parameters is needed in the design of maximally reliable networks.

References

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