# Optimization Model and Their Applications of Linking Assignments of Terminal Reliability of Computer Communication Network

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**Abstract**

Probabilistic network whose connections are vulnerable to failure have been studied widely in literature, their reliability is seen as the network capacity to keep on functioning after failures have happened. We take into consideration all terminal measure of reliability, which is defined as the probability that the network will be connected after failures. Existing work on this model assumes equal failure probabilities all links. We discuss in this paper the design issue of allocating the provided distinct probabilities of the links of a network to maximize the system's reliability.

**Keywords:** LAN, WAN, MAN Network, Reliability**.**

## INTRODUCTION:

To begin with, the installed base of various networks is vast and increasing.ATM systems are frequently employed on satellite, cellular and 4 infrared networks, second of computer and networks get chapter, the spot where decision get made moves downward.

Many companies have a policy to the effect than purchasing costing over a million dollars have to be approved by top management.

Third different networks (e.g. ATM and wireless) have radically different technology,

so it should not be a shock that with new hard were developments there will be new software developed to light the new hardware.

For instance : the typical home row resembles the typical office a decade earlier: full of computers which do not communicate with each other in the future, it will be ubiquitous for the telephone, the TV set and other application all to be networked together, so they can be controlled recently.

The new technology will certainly bring new protocols.

As an illustration of how various networks, interact, take this illustration: At most universities, the computer science and electrical engineering department each have their own LANS usually different. Besides, the university computer outer tends to have a mainframe and a super computer, the former for the faculty members of the humanities who do not want to enter into the computer maintains business, and the letter for the physicists who need cruel numbers.

1. LAN-WAN: A computer scientist downloading a file to engineering.
2. LAN-WAN: A computer scientist sending most to a distant physicist.
3. WAN-LAN: Two poets exchange.
4. LAN- WAN-LAND: Engineers at different universities.

Following are illustrates these four types of connection as dotted lines.

In both situations, one needs to insert a 'black box' in the function between two networks, to deal with the required conversions as packets traverses from the network to others.

The name assigned to the black box between two networks is based on what layer does the work.

Some names are listed below (though there isn't much consensus on terminology in this space)

Layer 1: Repeaters duplicate single bites from one cable segment to another.

Layer 2: Bridges buffer and relay data link frames between LANs.

Layer 3: Multi protocol routers relay packets between heterogeneous networks.

Layer 4: Transport gateways link byte streams at the transport layer.

Above 4: Application gate ways aloe inter-working above Layer 4.

For brevity, we shall at times refer to any device that bridges two or more different networks as simply "gateway".

Common place for the telephone, the television set and other application all to be networked together, so they can controlled recently.

This new technology will certainly introduce new protocols.

To illustrate how various networks, interact, imagine the following example:

At most schools, the electrical engineering and computer science department each have their own LANS usually different. Besides, the university computer exterior usually contains a mainframe and super computer, the latter to the faculty of the humanities who do not want to delve into the computer maintains business, and the letter to physicists who wish to cruel

numbers .
1. LAN-WAN: A computer scientist downloading a file to engineering.
2. LAN-WAN: Most from a computer scientist to a far-off physicist.
3. WAN-LAN: Two poets communicating with each other.
4. LAN- WAN-LAND: Different engineering universities.

Following are represent these four kinds of connection as dashed lines. In either case, one needs to inset a 'black box' at the function between two networks, to perform the required conversions as packets transfers from the network to others, The name given to the black box between two networks is based on the layer does the job.
Some standard names are listed below (albeit little consensus exists regarding names in this domain)
Layer 1: Repeaters replicate single bites between segments of cable.
Layer 2: Bridges cache and transmit data link frames between LANs.
Layer 3: Multi protocol routers route packets between different networks.
Layer 4: Transport gateways link byte streams at the transport layer.

Above 4: Application gate ways aloe inter-working above Layer 4. For convenience, we will occasionally refer to the terms "gateway" as any piece of equipment that links two or more unlike networks. The idea of a shortest path is worth explaining.
Once way of measuring path length is the number of hops. Using this metric, another metric is the geographic distance in kilometers. However, many other metrics are also possible besides hope and physical distance. For instance, each of them might be marked with the mean queuing and transmission delay for some typical test packet from the results of hourly test runs. With graph marking as such, the shortest is the path with shorter than the path with fewer are or kilometers.

**Reliability Preserving Reductions –**
In this section we describe a few combinational tools that are useful in computing the Reliability of a network with given assignment. To lighten notation, we write px instead of py(x).
**(a)** The Factoring Theorem: The factoring theorem evaluates the Reliability of a network G by considering the operating status of an edge. For this, we need to define the deletion and contraction of an edge x of G.If x is an edge from μ to v, then G-x is the sub graph obtained from G be deleting the edge x: note that deletion of x does not imply deletion of μ, v. In G, contracting an edge x involves deleting x and merging its end vertices μ, v into a "super-vertex" that is given the adjacency of both μ, v in G.
The graph obtained from G by contracting x is denoted as G/x. A state of the network is a collection of edge and therefore its operating probability is a 'compound' event. It consists of more elementary events, the survival or failure each individual edge.Thus, the operating status of an edge x partition the status of G into two set and the terminal Reliability of G can be written as:
R(G)= pxR (G: x is functional)+(1-px_R (G: x is not functional)

The above formula is referred to as the key decomposition [1, 2],Perhaps one of the earliest such to this equation was derived by Moskowitz in [6]; it is applied there to obtain the following elementary but important topological transformation for graph

R(G)= pxR (G-x)+(1-px) R (G/x)-------------------(1)

This is also referred to as the factoring theorem and has played a crucial role in designing recursive algorithm for calculating (G), See [8]. The following there reduction rules are confirmed by the factoring theorem.

**(b) Parallel Reduction:** Let x ={u, v} and y ={u, v} be two parallel edges in a graph G.A direct connection between u, v exists if at least one of the two edges operates; thus a parallel reduction replaces x and y with a single edge z = {u, v } such that p.
Z= px +py-px
Py (=1-qxqy, where q= 1-p)
If G is graph obtained from G, them R (G) =R (G)

**(c) Series Reduction:** Let x ={u, v} and y={v, w} two edges of G adjacent at a degree -2 vertex v. Then a series reduction replaces x and y by a single edge z= {u, v} such that pz =if G is the graph obtained from g than

r(G) =(1-qxqy) R(G).

Note that this reduction also referred to as a degree two reduction in [7] is different from the standard series reduction , since in this model three are no vertex failures.

**(d) End - Reduction:** Let x= {u, v} be an edge of G, and u an end- point .Clearly, any operating state of G must including x. Thus, an end-reduction deletes Vertex u an edge x producing a new graph G. Than R(G)= pxR(G).

**Optimal Link Assignments:**
We now introduce a class of sparse graph that includes unicyclic graphs . A connected graph G is an multi - ring network if all edges of G lie on at most one cycle. Thus, we require cycle to be edge-disjoint but not necessarily vertex disjoint. One can determine in liner time whether a graph G is a multi ring network, using the following recognition algorithm.
**Step 1:** Decompose the graph into its disconnected components B1........,Bi,E.
**Step 2:** For each of these components, test if either [$B_i$]=1or if the sub graph
Induced by $B_i$.
**Step 3:** Return "yes" if all biconnected components pass the test and "No" otherwise. Note that the algorithm can easily be modified to produce a list 5 of all the edge disjoint cycle in the graph, if the graph is indeed a multi ring. This
PEf:{m} --->E □ {• }
f(i) • , $C_i$ □ {□}
i=1,........, mrf
(i) which can be rewritten as the sum of products in line 3 above.
Hence, we have essentially established the following theorem.

**Theorem 1** Given a multi ring network G, a probability vector P and edge assignment y, we can compute the Reliability of G under y in a linear number of arithmetic operations, and in polynomial time overall.
**Proof.** From the previous remarks, we can compute the edge disjoint cycles of G in linear time. Hence, we can compute the sums. x• C• {• }r x in a linear number of arithmetic operations.

Likewise, we can determine R(G,P,y) by computing a product of these sums in a linear number of arithmetic operations. It is easy to check that number of bits needed to represent the numbers that occur during the computation is O (n(log n+a))where is a the maximum number of bits in the input data. Hence, the overall computation is still polynomial time.

In order to determine an optimal link assignment, first note that certain edges such as bridges or end edges are part of each operating state. Thus, it is intuitively clear that these edges should be assigned the highest available probabilities. To make this 7percise, define the set 1 of essential edges for G. For example for the bi-cycle.
**Definition:** A set of edges E={E is assignment invariant if fir any two assignment Y,Y for G and P that differ at most on E,R (G,PY) =R (G,P,Y).
The next proposition is obvious from the definition.

**Proposition 1:** I is an assignment- invariant set. The next claim established the fact that essential edges are more important for the Reliability of the network.

**Propsition.2:** If y is an optimal link assignment for G, x is an essential edge and y fails to be essential, then py (x) 4.2: if y is an optimal link assignment for G, x is essential edge and y and y fails to be essential then py (x) > py (y).

**Proof .** Let y be a optimal link assignment for G and obtain a new assignment y
switching the values of x and y. Since $R(G, y) \geq R(G, y)$
we can write
: $\Theta□(G)u□py(u)v/□\Theta(1-py(v))-py(v)) \geq \Theta□\Omega(G)\ u\ □\Theta\ py(u)\ v/□\Theta\ (1-py(v))$

Note that in the above expression the only Θ terms that do not cancel out, are those for which x□ Θ and y Θ .Therefore we have
py(x) (1-py(y))(...) $\geq$ py (x) (1-py(y)) (...),
py(x) (1-py(y)) $\geq$ (y) (1-py(x)),
py (x) $\geq$ py(y), as required.

Using the last two propositions, we can immediately determine optimal link assignments in unicycle. Note that for a unicycle G, the edges are partitioned into I and C=E-1, the essential edges and the cycle edges.

**Proposition 3:** An optimal link assignment for a unicycle G assigns the [1] many highest probabilities to the essential edges and the remaining probabilities to the cycle edges , in any order.
**Proof:** it is clear that the non- cycle edges of G are its essential set I. From proposition (4.1) and (4.2), any optimal assignment must attach higher probabilities to the edges I than to the cycle edges C.

We claim that both I and C are assignment-invariant, so that any permutation of values within I and C does not affect the

Reliability of the network. But by theorem 4.1 or, equivalently, by applying the reduction of section 3, the Reliability of the network is and this terms is clearly invariant with respect to the permutation under consideration.

Complexity consideration from the previous section, we know that the Reliability associated with an assignment for a multi ring network is always computable in polynomial time. Moreover, if there is at most one cycle in the network, then we can actually compute an optimal assignment, essentially be sorting the probabilities. By contrast, we will now show that already for two cycles it becomes NP-hard to determine optimal assignments.

To see this, let us write the two cycle as A, B• E. Using the same notation as above, we have from the theorem:

Set S:= si
And T:= si

Consider a graph consisting of two edge-disjoint cycles. A and B of length t and t-t, respectively, and probability vector $P=P_1,\ldots\ldots\ldots P_t$ given by $p_i=1(1+S_i$ ). Then G together with P and bound c is a yes-instance of BCOLA Iff (a Asa) (b Bsb) $\geq$ c/T-S-1. Now choose the bound c to be C= T (S2/4+S+1)

Then we have a yes instance if A sa=b B sb=S/2.

But that means that S1,…….S is a yes instance of partition. Then opposite direction is entirely similar. Moreover, the BCOLA instance G, P and C can be constructed from the Partition instance in polynomial time, Hence, BCOLA is NP hard and we are done.

**REFERENCE:**


1. Batcher,K.E." Sorting Networks and their applications".
2. Adans, N., Gold, R. Schilit, B.N. Tso, M.H. and Want, R., "An Infrared Network for Mobile Computers".
3. AT & T and Belclke, " Observation or error characteristics of fiber topic Transmission systems".
4. Chervenar,A.L., Tertirary Storage:An Evaluation of new application, Ph.D. thesis.CSD, Univ. of California at Berkelay (1994).
5. Demers A…, Keshav,S. and Shenker,S., "Analysis and simulation of a fair queuing algorithm".
6. Mishra,P.P. and Kanakia,H.,"A Hop by Hop rate Based Congestion Control Scheme.
7. Otway,D., and Ress, O., "Efficient and Timely mutual Authentication.
8. Shannon, C., "A Mathematical Theory of Communication".
9. Walrand,J., Communication Networks.
10. Waston, R.W., "Timer Based Mechanisms in Reliable Transport Protocol Connection Management".
11. Ziv., J. and Lempel, Z., " A universal algorithm for sequential Data Compression".