A Fault Tolerance Architecture: A Solution for Routing Protocols with Improved Convergence and Reduced Flooding

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***Abstract*—Certain network routing protocols behave in different ways in different scenarios. It is difficult to choose amongst them a suitable protocol for our implementation. Also certain protocols are susceptible to terms like flooding which can be advantageous and disadvantageous for different situations. There is also a possibility of network bandwidth consumption by the underlying network architecture such as flooding caused by major protocols, moreover learning specific protocols for their performances, manipulation, implementation consumes a lot of time and resources and could be problematic for a network designer to understand different routing algorithms and using large and complex hardware to simplify the task can be hazardous. This paper describes an alternate strategy that could be followed for a complex network. It includes a combination of advantageous protocols regarding functionality in the complex scenarios. Using this implementation technique we would also be able to minimize the flooding caused by certain protocols, thereby, providing network stability, scalability and removal of work load on single entities.**

***Index Terms*—Convergence of networks, flooding routing algorithms, routing protocols.**

I. Introduction

As we know a network is a group of inter-connected communicating devices such as computers, routers etc. and for proper communication between the devices we need efficient strategies. To control the communication process (multiple devices are connected simultaneously in a network and communication may happen through any device in a network, it is also possible to have only two communicating parties in the network and hence, path determination between the parties is very important as the network is, common for all the entities) so we need a governing party in terms of network communication, which we define as a protocol. Network could be of many types, depending on size, bandwidth etc. and therefore, a suitable strategy, more specifically termed as protocol, is chosen from a list of known protocols and implemented using a predefined structure format and is adopted in an ideal environment for its case. What we generally do is trying and associating our network with that ideal case and then carry our steps further. For a larger environment we also try to improve our protocols efficiency by switching to another protocol or by trying to implement multiple protocols in our network.

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II. Review

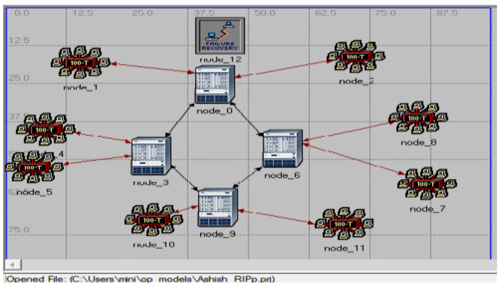
Having several protocols operating on our networks, depending on the network size etc we aimed for the most appropriate protocol available for our network. This part focuses on some of the basic protocols that have been implemented in our network. Apart from these, there are several other protocols available which are required to be understood for their underlying architecture and their basic functionality in the network [1]-[6].

A. RIP: Router Information Protocol

The Routing Information Protocol (RIP) is a distance vector routing protocol which employs hop count as a routing metric. Various problems faced by the RIP are:

1) VLSM were not supported by RIP version 1.
2) The hold down time is 180 seconds.
3) Max number of hops allowed is 15.

RIP has ‘slow convergence’ and ‘count to infinity’ problems. Figure below shows a scenario for RIP mechanism [5]-[8].



(a)

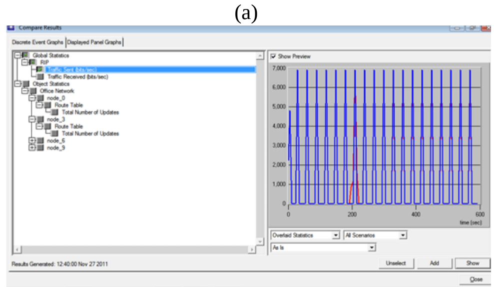


Fig. 1. (a),(b) Showing RIP functionality in OPNET IT GURU EDITION with its Traffic Generation

B. OSPF: Open Shortest Path First

Open shortest path first (OSPF) uses a link state routing algorithm and falls into the group of interior routing protocols, operating within a single Autonomous system (AS is the system of one or more networks falling under one entity

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control) [5], [7], [8].

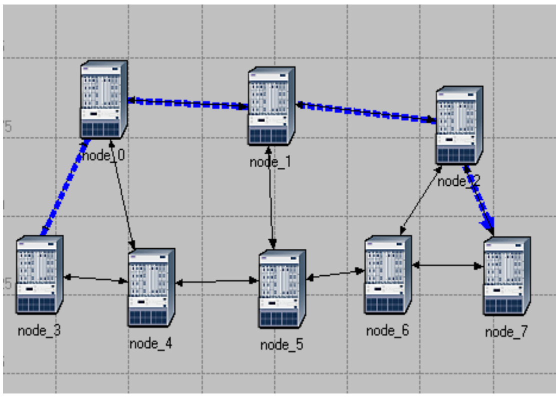

Fig. 2. Showing path determination in OSPF

TABLE I: COMPARISON OF SOME OF MAJOR PROTOCOLS [5]:

Characteristic	*OSPF*	*RIPv2*	*RIPv1*	*IS-IS*
Type of protocol	Link State	Distance vector	Distance Vector	Linked State
Classless Support	Yes	Yes	No	Yes
VLSM Support	Yes	Yes	No	Yes
Auto Summarization	No	Yes	Yes	No
Manual Summarization	Yes	No	No	Yes
Discontinuous Support	Yes	Yes	No	Yes
Route Propagation	Multicast on Change	Periodic multicast	Periodic Broadcast	Multicast on Change
Path metric	Bandwidth	Hops	Hops	Bandwidth
Hop Count	None	15	15	None
Convergence	Fast	Slow	Slow	Fast
Peer Authentication	Yes	Yes	No	Yes
Hierarchal Network	Yes(using Areas)	No(Flat only)	No(Flat only)	Yes(using Areas)
Updates	Event Triggered	Routing Table updates	Routing Table updates	Event Triggered
Route Computation	Dijkstra's	Bellman Ford	Bellman Ford	Dijkstra's
Designed Needs	Support for IPV4,build to route IP			IPV6 support

III. CONTRIBUTIONS

For a large and complex network which contains a combination of smaller and large networks, we can generally provide a mechanism of breaking a packet into smaller one to utilize bandwidth and provide flooding at initial state instead of emphasizing on specific protocols. Here we have divided our tasks into two parts, one is *Implementation* and the other is *Framing* [9]-[13].

A. *Implementation Process*

Initially, while trying to assign IP addresses to particular hosts in the network, we use the mechanism shown in the Fig. 3.

Fig. 3. depicts how a larger network can be broken into smaller networks and how the IP addresses could be assigned to the smaller network, keeping in mind that the smaller network remains associated with its parent network.

For example: In the Fig. 3. we can define the LHS of our diagram in the range of 10 which means the starting bit should be 10 (we have broken our network into 2 halves and assigned the IP addresses accordingly) and further while trying to break it further into smaller networks, we created a sub network (this contains the associatively of the nearby or parent network) Here the process of sub-netting can be applied too.

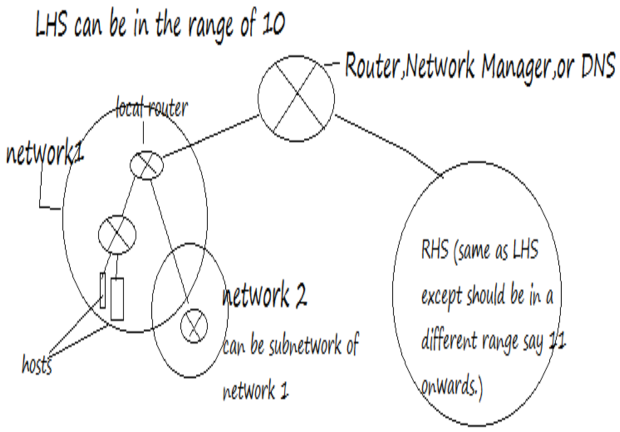

Fig. 3. Showing the implementation process.

B. *Framing Proces*

Initially at the startup of our network we make a large packet which contains all the information regarding the logical and physical address (as the network addresses is needed we can use DNS as best available resource) .The packet is broken into smaller pieces depending on the location. E.g. for the LHS we send all the packets whose ip address starts from 10 can be used to LHS and that starts from 11 To RHS and so on.

The packet to be sent by the sender to receiver through the network is decided by the host entity or the leader of a particular group (smaller network can together be combined to form a group and a leader or a server can be decided, If a router or a DNS is present which can act as a server) .

After sending the packet the time factor is considered the most and all the paths are been updated as shown below.

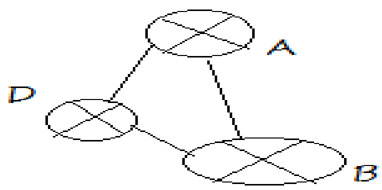

Fig. 4. Showing the alternate routes.

Suppose in Fig. 4 if a packet forwarding process is implied a packet path which is sent by router A or entity A, further is transmitted to two paths. Even if the hop count is more and packet reaches faster than the p path whose hop count is less than the hops with less time ,are been considered and the other path is to be kept as a alternate strategy in case something goes wrong for the path that is optimal which the path kept.

Then the time factor is included and HOP factor is discarded so we do need a timestamp with our packet for determining the time. The entities do maintain a routing table whose entries are updated accordingly. It keeps as the optimal path and alternate paths and time taken by the packet to reach destination accordingly. After the packet has reached the last host it then replies with an packet which contains an ok response from the receiving side and the logical and physical address again attached with a timestamp will be send to the sender, the whole process is repeated and for both the paths, time value gets updated to the routing table when (the packet is received).

C. Routing Table Structure

TABLE II: SHOWING THE PACKET FORMAT.

Optimal path	*Time taken By optimal path*	*Alternate path/paths from a to b*	*Time taken By alternate path*
A → B	.0002 sec	A→ D, D→B	.004 sec

A TCP packet could be modified as it is reliable and a resultant packet could be formulated. Remove the unnecessary fields in the top packet.

The sender then updates the routing table with the IP Address and the MAC Addresses and path in which its lying (whether its paced as optimal or alternate, occasionally an entity will be placed in both) and process is repeated until the final destination is reached(initially the starter of the packet frame). Hence the routing table gets updated. When both LHS and RHS get completed, the initiator shares the routing table between the two. Hence the packets are sent through optimal paths. IF the time should be optimal means the alternate path should have more time then the optimal one. Otherwise it should be zero if alternate path is not possible.

When the time exceeds the optimal time limit it is sent to the alternate path even if the acknowledgement doesn't come within the time limit. The negative acknowledgement is send to the server and certainly we do need a global logical clock for our system.

D. Updating for A New Node

Whenever a new node is encountered or added to our network then the new node sends an update to nearby node with packed containing the MAC and logical addresses. Again the optimal path and alternate paths are calculated

IV. CONCLUSION

Comparing the different protocols functionality we conclude that our defined mechanism.

- Removes problem of broadcasting timely as in RIP. There is no need for such criteria as we know we have to follow the optimal path or through the alternate paths if needed to be followed.
- Increases the reliability of the network as the entities taking part in communication have to take lesser decisions regarding the path determination and so they remain in idle state and are free to perform other actions.
- It contains a bidirectional flow. It may be possible that a node could posses a simpler path while traversing backward so if a packet is send by the end entity itself to the upper node its time will be reduced.

Hence continuing this way the process can be continued further and so excessive broadcasting and flooding can be removed from the network.

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