Volume 3, Issue 9, September 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

Rain Technology and its Implementation

Suman R. Tiwari, Jigar A. Patel, Hardik N. Talsania
R.C. Technical Institute, Ahmadabad
India

Abstract*— This review paper is focused on evolution of RAIN technology, its requirement,, architecture, components and its implementation on different topology. Rain was developed to overcome the problem of cloud computing and current existing problem on accessing internet. Rain technology provide an efficient method for fault tolerance in different topologies which is not covered by cloud computing. Rain says that nodes are always available on networks, and they use different mechanism to identify faulty nodes and replace them with healthy node .we have described how fault tolerance, load sharing, always availability of node is possible in RAIN technology by implementing them on different topology.

Keywords*—RAID,SATA,,hot-swap, SNOW , Cluster computitng , Data storage , cloud computing ,1U Sever,Gnutella, eDonkey.

I. INTRODUCTION

Rain technology has evolved over the disadvantages of cloud computing and was developed by the California Institute of technology, in collaboration NASA's Jet Propulsion laboratory and the DARPA. The name of the original research project was RAIN, which stands for Reliable Array of Independent Nodes. The RAIN research team in 1998 formed a company called Rainfinity. Rainfinity is a company that primarily deals with creating clustered solutions for enhancing the performance and availability of Internet data centers.RAIN is also called channel bonding, redundant array of independent nodes, reliable array of independent nodes, or random array of independent nodes.[1]

Basically Rain technology has come up with the different network solutions over the internet such as nodes failure, traffic congestion, link failure, data lost. It is a cluster of nodes linked in a network topology with multiple interfaces and redundant storage. It is an implementation of RAID across nodes instead of across disk arrays. RAIN is used to increase fault tolerance .RAIN can provide fully automated data recovery in a local area network or wide area network even if multiple nodes fail[1].Many of the distributed file sharing services such as Gnutella and eDonkey are similar to RAIN systems, but they do not provide adequate redundancy by design—if none of the sharing users online have a copy of some part of a file, the file becomes inaccessible[7].The RAIN technology concentrates on developing high-performance, fault-tolerant, portable clustering technology[5], and overcome the problem of eDonkey and Gnutella. Current Existing system of networking has major drawback of single point of failure ,client and server architecture and bottlenecks .If some node fails then there is no backup of that node in current existing system, Similarly they do not have enough processing power to handle the traffic they receive .RAIN technology is capable to provide the solution of all the problem of networking which is currently exist . Rain Technology does this by reducing the number of nodes.

II. RAIN COMPONENT

RAIN is an open architecture approach that combines standard, off-the-shelf computing and networking hardware with highly intelligent management software.RAIN-based storage and protection systems consist of following component:

A. Rain Nodes

These hardware components are 1U servers that provide about 1 terabyte of serial ATA disk storage capacity, standard Ethernet networking and CPU processing power to run RAIN and data management software. Data is stored and protected reliably among multiple RAIN nodes instead of within a single storage subsystem with its own redundant power, cooling and hot-swap disk-drive hardware.

B. IP-based Internetworking

RAIN nodes are physically interconnected using standard IP-based LANs, metropolitan-area networks (MAN) and/or WANs. This lets administrators create an integrated storage and protection grid of RAIN nodes across multiple data centers. With MAN and WAN connectivity, RAIN nodes can protect local data while offering off-site protection for data created at other data centers.

C. Rain Management Software

This software lets RAIN nodes continuously communicate their assets, capacity, performance and health among themselves. RAIN management software can detect the presence of new RAIN nodes on a new network automatically, and these nodes are self-configuring.

D. Storage Component

In a RAIN-based storage system, each RAIN node regularly checks all its own files. The combination of hundreds of RAIN nodes forms a powerful parallel data-management grid. When file corruption is detected, the associated RAIN node initiates a replication request to all other RAIN nodes, which verify their own replicas and work collectively to replace the defective file

E. Communication Component

There is no limit to the number of nodes that can exist in a RAIN cluster. New nodes can be added, and maintenance conducted, without incurring network downtime, A communications component that creates a redundant network between multiple processors and supports a single, uniform way of connecting to any of the processors.

F. Computing Component

A computing component that automatically recovers and restarts applications if a processor fails. RAIN technology was able to offer the solution by minimizing the number of nodes in the chain connecting the client and server, RAIN technology provides the novel feature of replacing a faulty node by a healthy one thereby avoiding the break in information flow.

III. ARCHITECHURE

Rain Technology incorporates following core modules shown in figure -1:

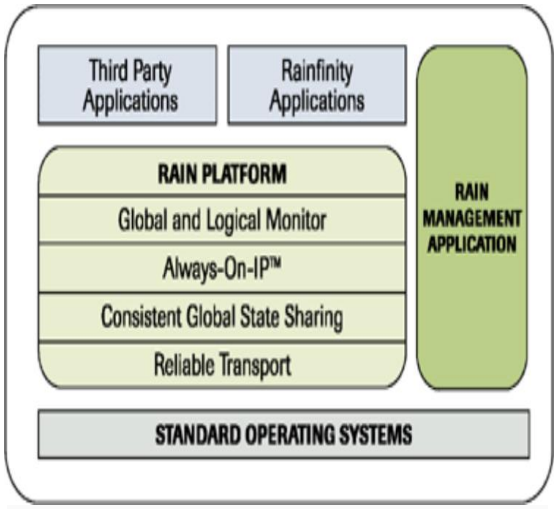

Figure 1 :Architectures of RAIN Technology[1]

A. Reliable transport

Reliable transport ensures the reliable communication between the nodes in the cluster. This transport has a built-in acknowledgement scheme that ensures reliable packet delivery. It transparently uses all available network links to reach the destination. When it fails to do so, it alerts the upper layer, therefore functioning as a failure detector. This module is portable to different computer platforms, operating systems and Networking environments.

B. Consistent global state sharing protocol

This protocol provides consistent group membership, optimized information distribution and distributed group-decision making for a RAIN cluster. This module is at the core of a RAIN cluster. It enables efficient group communication among the computing nodes, and ensures that they operate together without conflict.

C. Always-On-IP

This module maintains pools of "always-available" virtual IPs. This virtual IPs is logical addresses that can move from one node to another for load sharing or fail-over. Usually a pool of virtual IPs is created for each subnet that the RAIN cluster is connected to. A pool can consist of one or more virtual IPs. Always-On-IP guarantees that all virtual IP addresses representing the cluster are available as long as at least one node in the cluster is operational. In other words, when a physical node fails in the cluster, its virtual IP will be taken over by another Healthy node in the cluster.

D. Local and Global Fault Monitors

Fault monitors track . the critical resources within and around the cluster: network connections, on a continuous or event-driven basis. They are an integral part of the RAIN technology, guaranteeing the healthy operation of the cluster

E. Secure and Central Management

This module of Rain Technology offers a browser-based management GUI for centralized monitoring and configuration of all nodes in the RAIN clusters. The central management GUI connects to any node in the cluster to obtain a single-system view of the entire cluster. It actively monitors the status, and can send operation and configuration commands to the entire cluster.

IV. FEATURS

A. Communication

As the network is frequently a single point of failure, RAIN provides fault tolerance in the network through the following mechanisms

1) Bundled Interfaces: Nodes are permitted to have multiple interface cards. This not only adds fault tolerance to the network, but also gives improved bandwidth.

2) Link Monitoring: To correctly use multiple paths between nodes in the presence of faults, link- state monitoring protocol is used that provides a consistent history of the link state at each endpoint.

3) Fault-tolerant Interconnects Topologies: Network partitioning is always a problem when a cluster of computers must act as a whole. We have designed network topologies that are resistant to partitioning as network elements fail.

B. Group membership

A fundamental part of fault management is identifying which nodes are healthy and participating in the cluster.If any node from group fails, its work is immediately handled by another member from group. Strong group management of Rain Technology gives the different feature of load sharing, handle network congestion and efficiently handle node or link failure.

C. Data Storage

Fault tolerance in data storage over multiple disks is achieved through redundant storage schemes like RAID (Redundant array of independent disk). If any node or disk fails then redundant data stored at another node provide the information of failed node.

V. TOPOLOGY USING RAIN

Rain technology helps in building the structure of topology in such a manner that it minimizes the number of nodes and removes the extra nodes. It is able to provide the solution by minimizing the total number of nodes in network between client and server. As the total number of nodes is minimum, so the data transmission time will also be reduced from source node to destination node. Secondly, delay factor will also be reduced and data can be transmitted within less period of time.

A.Star Topology

In star topology all the nodes are attached to Central HUB or switch. All the nodes in network communicate with one another via Central HUB as shown in following figure 2:

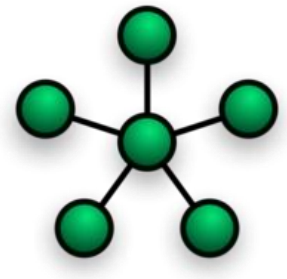

Figure:2 Star Toplogy

Main Problem in Star topology is that if Central HUB fails then whole network goes down and no node can communicate with one another in network.

1) Star Topology Using Rain: We can place switch at each Node of network and Each node can be connected with few another node in network as shown in Figure 3 apart from central node so if central node fails then node can communicate with rest of node of network by using another path available. If central node fails then node-2 can communicate with another path with node-1 and node-3. Suppose further any one link of node-2 fails even then node-2 can communicate with with rest of network. Node-2 will be disconnected if both outgoing link and central hub fails

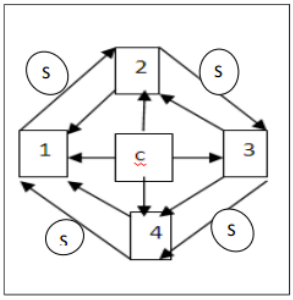

Figure3 : Star topology using Rain

B. Ring Topology

In Ring Topology one node is connected with another node and forms a ring like network as shown in Figure-4.

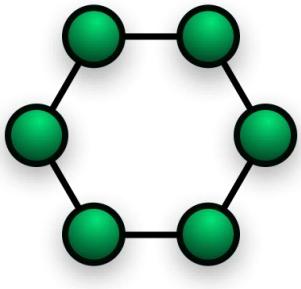

Figure 4 : Ring Topology

There are two Main problem of ring network :

- If one node of network fails then whole network fails.
- Scalability : if we add more nodes in network then token needs more time to reach at destination node, thus delay time increase**.**

*1) Ring Topology Using Rain :*Using Rain technology nodes are attached with another nodes of network using diameter method[3] such that in case of node or link failure can communicate with one another. Nodes are connected with other node which is on longest distance, which helps to reduce delay to transfer token.

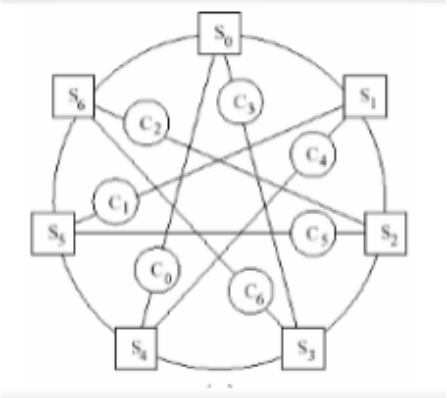

Figure 5 : Solution of Ring Topology using RAIN

As shown in above Figure-5 every nodes are connected with another node which are far from them and they can suffer upto 2 -3 link failure. If any link in above ring topology fails then via another duplicate path node can communicate with another node in network.

C. BUS Topology

In Bus topology backbone cable is used on which all the nodes of network are connected .Every node of network communicate with each other via backbone cable.

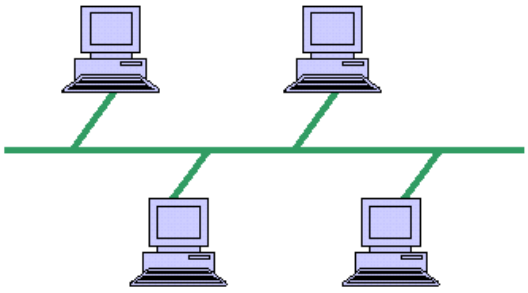

Figure 6 : Bus Topology

Main problem with bus topology is that if backbone cable fails then whole network goes down.

1) BUS Topology Using Rain: Nodes of Bus topology are connected through Backbone cable as well as switch, as shown in following in figure 7. So each node in bus topology can communicate with rest of network by using either switch or backbone cable. Node are connected with different switch so that they can reach to all node of network as in figure-7.

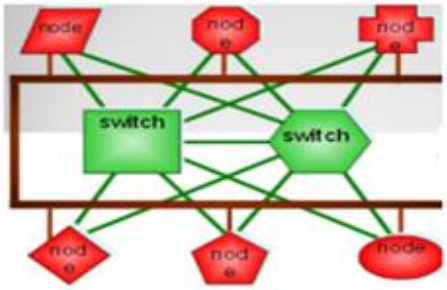

Figure 7 : Bus topology Using Rain[1]

If backbone cable fails then also nodes can communicate with one another using switch and another node of network. Network will goes down when backbone cable as well as both switch will fail.

D. Mesh Topology

In Mesh Topology every node of network has a dedicated point to point link to every other device. A fully connected mesh network therefore has n (n-1)/2 physical channels to link n devices. To accommodate that many links, every device on the network has n-1 input/output ports. Figure -8 shows representation of mesh topology.

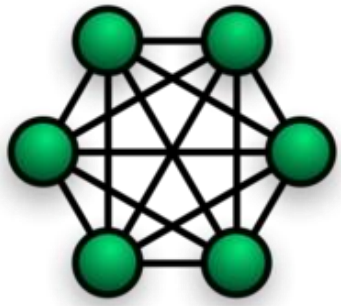

Figure 8 : Mesh Topology

Main problem in Mesh topology is that if there is n nodes then all nodes should have n-1 input/output ports, therefore large number of cables are required.

*1) Mesh topology Using RAIN :*The problem in the mesh topology can be solved by the diameter solution[3] of RAIN. The nodes are kept distance apart and the link is established at minimum distance. Using diameter solution we can avoid the dedicated link among nodes , so there is no requirement of (n-1) port at each node.

VI. ADVANTAGE & DISADVANTAGE OF RAIN

A. Advantage

Rain technology is very powerful and efficient to handle the networking problem. Advantage of Rain is summerize over here.

1. This technology when applied in the different topologies will increase the robustness of each topology. All nodes will be active throughout the topologies and can handle the load balancing.
3. RAIN Technology is the most scalable software cluster technology . There is no limit on the size of RAIN cluster. Adding new node in Rain technology does not increase delay.
4. Another advantage of RAIN is its continuous availability. Eg as in case of Rainwall ,it detects failures in software and hardware components in real time, shifting traffic from failing gateways to functioning ones without interrupting existing connections[1].
5. This software technology is open software and highly portable.
6. Rain Technology supports Hot -Swap mechanism i.e. part of the cluster can be taken down for repair whereas the others can continue working.
7. There is no concept of master-slave or client server relationship in Rain technology. In Client server architecture client send request to server for web page and if server is down then communication between them fails. So this problem does not arise in network which used rain concept.
9. It is highly efficient in load balancing and traffic congestion control due to its strong group membership management.

B. Disadvantage

Rain technology suffers with some drawback as specified below:

1. As the rain technology requires placement of switches in between of structure, so it becomes little expensive.

2. Secondly, Installation and configuration is time consuming and requires maintenance also.
3. Although if the node of the topology fails, it will not disturb the topology completely as mentioned above but if the switch fails, it affects the network partially and switch has to be repaired as early as possible.

VII. CONCLUSION

By the end of this paper, it can be concluded that rain technology is solution for the disadvantages of Cloud Computing, Rain Technology proven to be the stronger technology when compared to Cloud computing[5] .Secondly Rain technology can be embedded into various layer of OSI model which will definitely removes the problem occurring at different layers such as link break up, point to point failure, traffic congestion, load balancing. Rain technology at data link layer will help in sequencing and time to time delivery of data packets. Although there are some disadvantage of Rain technology which can be overcome by SNOW technology. SNOW (Strong network of web server) is scalable Web server cluster that was developed as part of the RAIN project [1].

REFERENCES

[1] www.ijcsmr.org/vol1issue4/paper143.pdf
[2] HarinderKaur, "Cloud Computing: Rain Cloud Computing: Rain Cloud System", International Journal of Emerging Technology and Advanced Engineering, Volume 2, Issue 10, October 2012.
[3] V. Bohossian et al., "Computing in the RAIN: Reliable Array of Independent Nodes," IEEE Trans. Parallel and Distributed Systems, vol. 12, no. 2, Feb. 2001, pp. 99-114 .
[4] Computing in the RAIN:A Reliable Array of Independent Nodes,VaskenBohossian, IEEE TRANSACTIONS ON PARALLEL AND DISTRIBUTED SYSTEMS, VOL. 12, NO. 2, FEBRUARY 2001.
[5] Reliable array of independent nodes by MeghaR.Sisode, World Journal of Science and Technology 2012, 2(3):79-84 ISSN: 2231 – 2587.
[6] http://www.computerworld.com.au/article/120893/rain_architecture_scales_storage
[7] http://en.wikipedia.org/wiki/Reliable_array_ofindependent_nodes.
[8] http://www.paradise.caltech.edu/papers/etr029.pdf

