Achieving Fault Tolerance In RAIN Network using Polling Scheme and Redundant Nodes

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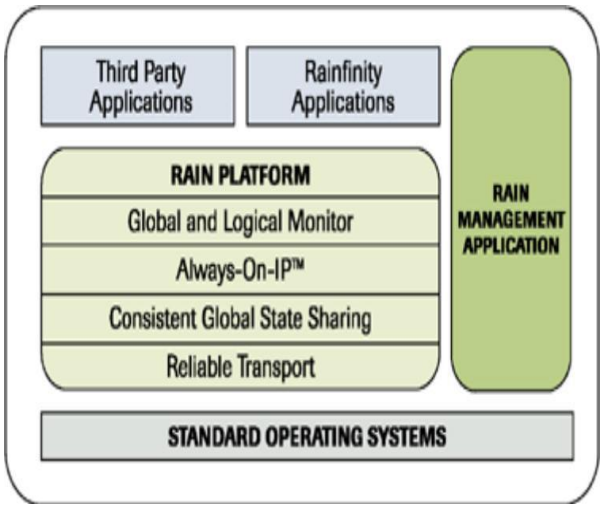
***Abstract*-**This paper is focused on evolution of RAIN technology, its requirement, architecture, components, its implementation on different topology and Fault tolerance in RAIN network.RAIN technology is depending on the concept of RAID. The focus of the research was on high performance, Traffic Management and fault-tolerant in distributed system. The largest systems in the world today already scale to hundreds of thousands of cores and it's continually increasing.A component that stores data across distributed processors and retrieves it even if some of the processors fail.Rain was developed to solve the problem of distributed system and some existing problemson internet. A communication component creates a redundant network between multiple processors and its work as a single processor.Whenever the system becomes distributed, the issue of fault tolerance becomes an important issue and we are trying to solve it in two approach.

Keywords-RAIN, RAID, Distribute system, Traffic Management, Topology, Redundant, Fault Tolerance, Cluster, SNOW.

I. INTRODUCTION

RAIN stands for ***Reliable Array of Inexpensive Node*** or ***Redundant Array of Independent Node*** or ***random array of independent nodes***. RAIN technology is originated in a research project at the ***California Institute of Technology*** (Caltech), in collaboration with NASA's ***Jet Propulsion Laboratory*** and ***The Defense Advanced Research Projects Agency*** (DARPA). The RAIN research team in 1998 formed a team called RAINFINITY. Basically Rain technology has come up with the different network solutions over the internet such as nodes failure, traffic congestion, link failure and 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. There is no limit to the number of nodes that can exist in a RAIN cluster. New nodes can be added and maintenance without affecting the existing network. Rain technology provides an efficient method for fault tolerance in different topologies. Rain technology makes the addition of new nodes in different type of topology much easy and without disturbing the existing structure. Whenever any two node communicate with each other, there are multiple nodes in between them, if any node fails in between them, the message still continues to travel and will reach the destination by using RAIN technology in distributed system. RAIN computing also helps those devices that do not have enough processing power to handle the amount of traffic they receives. Rain Technology provides feature of replacing a faulty node by a healthy node without breaking the information flow

II. ARCHITECTURE OF RAIN TECHNOLOGY



III. RAIN COMPONENTS

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

- Rain Nodes
- IP-Based Internetworking
- Rain Management Software
- Storage Component
- Communication Component
- Computing Component

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.

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.

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.

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.

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 affecting the existing structure. A communications component creates a redundant network between multiple processors and supports a single, uniform way of connecting to any of the processors.

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 ofnodes 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.

IV. CHARACTERISTICS OF RAIN

- Clustering
- Distributed
- Shared-Nothing
- Fault tolerant
- Reliance on software
- Use of inexpensive nodes
- Suitability for Network Applications
- Communication
- Scalability
- Group membership
- Data storage

Data Storage-

Fault tolerance in data storage across many disks is obtained using redundant storage schemes. Novel error-correcting codes have been developed for this purpose. These are array codes that encode and decode using simple XOR operations.

Group Membership-

The main function of group member is to tolerate the fault. Group member ensure that all processes maintain a consistent view of global membership. If any node is from a group is fail then the work immediately handled by the other node in this group.

V. GOALS OF RAIN TECHNOLOGY

- ✓ This Technology is able to offer the solution by minimizing number of nodes in the chain connecting the client and server.
- ✓ RAIN Technology is making the exiting nodes more robust and independent.
- ✓ RAIN Technology provides the features of replacing a faulty node by a good one easily.
- ✓ Tolerance the fault in RAIN network in very efficient method.

VI. ADVANTAGES OF RAIN TECHNOLOGY

- ➢ There is no limit on the size of a RAIN cluster.
- ➢ There is no concept of master-slave relation.
- ➢ A RAIN cluster can tolerate multiple node failure.
- ➢ This is highly efficiency in traffic management.
- ➢ New node can be added into the cluster to participate in load sharing.
- ➢ It work with many different intermit application RAIN Technology.

VII. FEATURES OF RAIN TECHNOLOGY

a. It includes scalability and high availability.
b. Many novel features in an attempt to deal with faults in nodes, network and data storage, Fault tolerant interconnect.
c. Group membership.
d. Data storage RAIN Technology.
e. Communication
  a. Bundled Interface
  b. Link Monitoring
  c. Fault Tolerance Interconnects topology.
f. Fault Tolerance.

Scalability –

Scalability is the ability of a system to provide throughput in proportion to and limited only by available hardware resources. A scalable system is one that can handle increasing numbers of requests without adversely affecting response time and throughput.

High Availability -

The availability of a system or any component in that system is defined by the percentage of time that it works normally. The formula for determining the availability for a system is: Availability = average time to failure / average time to failure + average time to recover.

Data Storage –

Fault tolerance in data storage across many disks is obtained using redundant storage schemes. Novel error-correcting codes have been developed for this purpose. These are array codes that encode and decode using simple XOR operations.

Communication -

Nodes communicate via interconnect topologies and reliable communication protocols. The nodes consist of multiple interface cards. For proper tracking and monitoring link state monitoring protocol is used and fault tolerant interconnect topologies are used.

Group membership -

Group membership is done via protocols that keep track of all the nodes in the cluster. An elemental part of fault management is to recognize which nodes are working and contributing in the cluster as well as the nodes that are faulty.

Fault Tolerance-

The ability of a system to respond gracefully to an unexpected hardware or software failure. There are many levels of fault tolerance, the lowest being the ability to continue operation in the event of a power failure

VIII. APPLICATIONS OF RAIN TECHNOLOGY

1) High availability of video server.
2) Strong Network of web server (SNOW).
3) Distributed check point mechanism.
4) Development of API (Application Programming Interface).
5) The implementation of real time distributed file system.

6) Development of Group Communication Protocol.
7) Development of Fault Tolerance Mechanism.

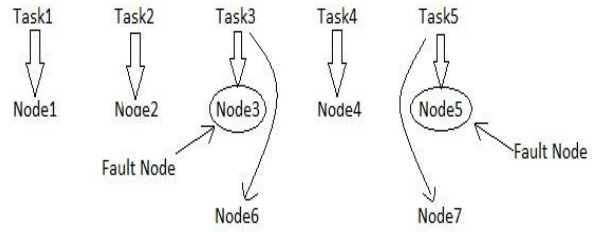
IX. PROPOSED ALGORITHM

Fault tolerance is the big issue in the distributed system as well as RAIN technology. Many scientist and researcher is doing work on this problem and found or invent many technique for tolerance this problem. In our paper use simply think on this problem and try to solve using our own concept. We found two approaches to solve the fault in RAIN technology. First approach is Expression Draw with using redundant node and second approach is Polling Scheme or it can call as Voting Scheme.

In our **first approach**, we take a simple expression and it divides into some small part of task and sends it to necessary nodes. All nodes are active and ready to handle the load. All nodes are not use at a time, keep some redundant node for feature use if any node is found fault. Main RAIN management system divides the original task and sends each part of task to each node. After perform the task the result is returns to the RAIN system. A fault detection system is parallel work with RAIN system, it detect the fault node in the system.The RAIN system replaces the detected fault node with a redundant node.

Conceptual Algorithm –

Step 1. RAIN system take the original task
Step 2. RAIN fault detection system check for faulty node in the RAIN system and return the number of fault node and healthy node.
Step 3. Keep one or more redundant nodes as inactive for later use
Step 4. RAIN system divide the original task
Step 5. Assign an independent part of task to each healthy node and keep a record of each part of task
Step 6. If later found an node fault or down, RAIN system replace it with inactive redundant node and reassign the task
Step 7. Each healthy node performs assign task and returns the result to RAIN system
Step 8. Repeat the step 4 to 7 if needed.

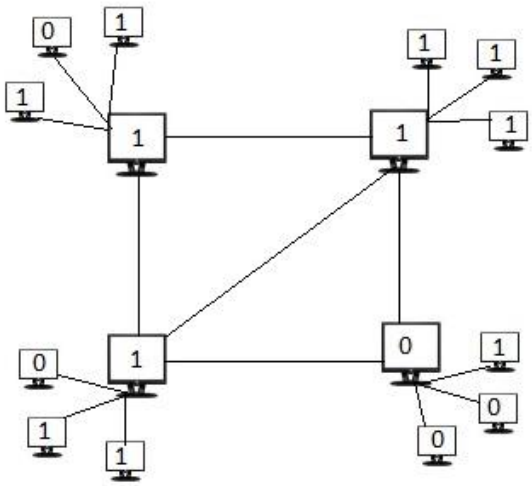


Here our main approach is keep redundant node. Node6 & Node7 is redundant node here. So faulty node3 &node5 is replace with redundant nodes.

In our **second approach**, we simply form some group with some nodefrom all the nodes. Each group contains more than one node. Each group contains same numbers of node.Main RAIN system divides the task and sends to the each group. In this approach no concept of redundant node. The nodes within a group perform the same task. If a node will fault or down or unable to work then others nodes are perform the task. Faulty node does not affect the others nodes.After perform the task nodes are returns their results. Now voting system is use within the returns results of a group. Take as the final result which is found major in this voting system.

Conceptual Algorithm –

Step 1. RAIN system Take the original task
Step 2. All nodes are dividing into some groups. A group contain more than one nodes
Step 3. RAIN system divide the original task into some small parts of task
Step 4. Each single part of task is send to each group
Step 5. Same task is performs by all the healthy nodes in a group
Step 6. The result which is similar to other's and counts more than others results, take as final result which is major in voting scheme
Step 7. The final result is send to RAIN system if needed



X. RESULT

In our ***first approach***, we use a fault detection protocol which checks the all nodes for faults. If we check manually all the nodes for faults then it will take too much time and its cost will also increase. It's reducing the time for manually checks for faults in a node. Here we kept some redundant nodes because if a node is fault during work the RAIN system switch the faulty node to a new healthy node that causes not so much time is waste, only the time which is taken to be detect the fault and switch to a new node is waste. We are trying to make a conceptual simulator and results of this are following.

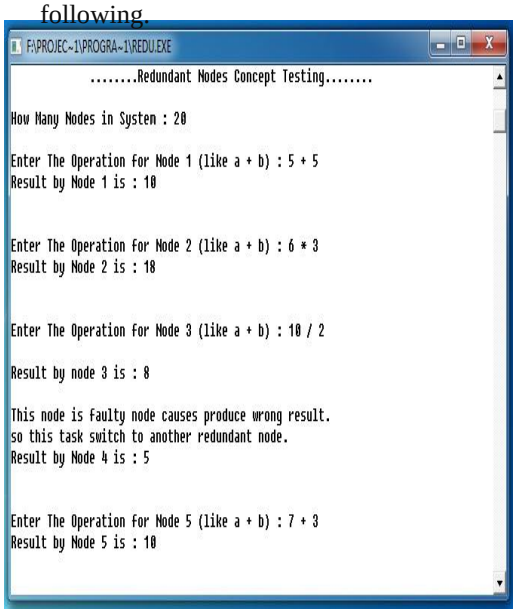


Fig. 1 shows that node 1, 2 and 5 perform different tasks and produce the right result. But node 3 perform a task and produce wrong results causes faulty node so that this task is switch to another redundant node 4 and this node produce right result.

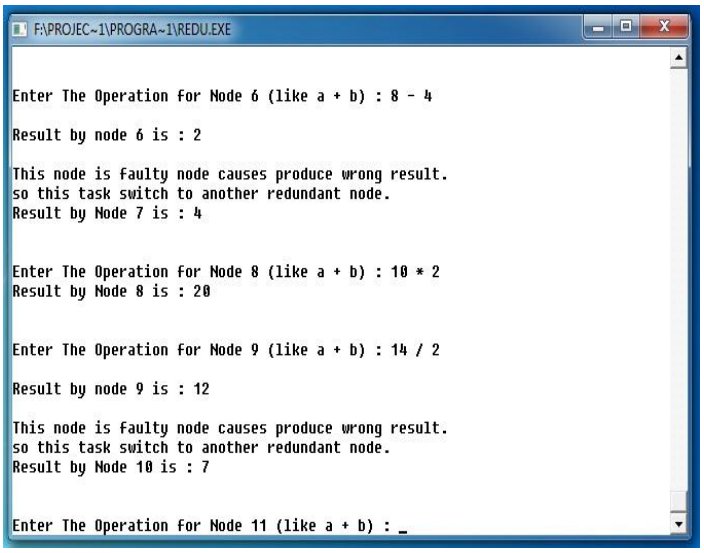
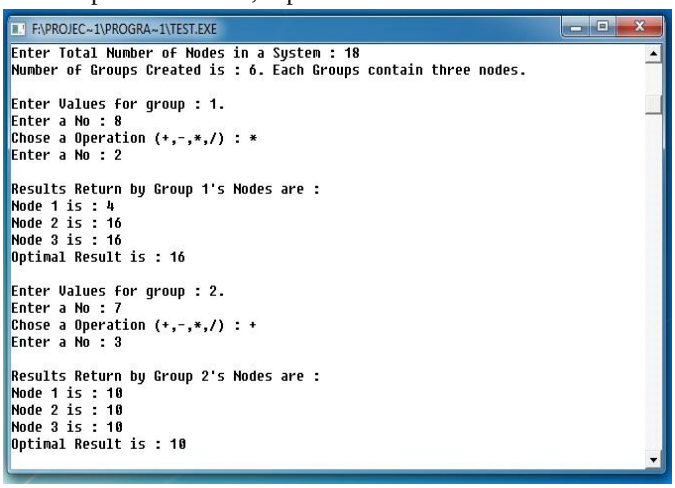


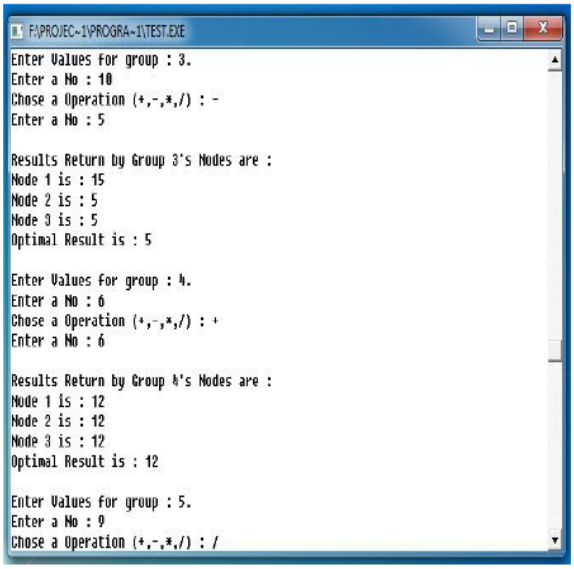
Fig. 2 shows that node 8 perform a single task and produce the right result. But nodes 6 and 9 perform different tasks and produce wrong results causes' faulty node so that this task is switch to another redundant nodes 7 and10 and this nodes produce right result.

In our ***second approach***, all nodes are same priority, all the nodes in a group is doing same task. If it is healthy then it'll produce right result otherwise wrong. Because of same task is performs by many nodes so results is also have to same conceptually. Within many results take as optimal this is major in numbers counts. Here we can say directly that the result produce by many node take as optimal value. If many nodes produce wrong then it'll be wrong obviously. We make a conceptual simulator, it produces results are follow.

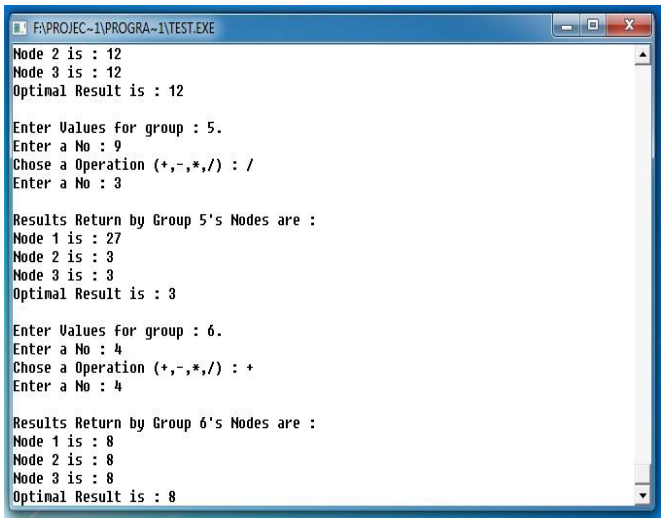


In Fig. 3 Group 1 perform a task and three nodes return their results. From those results node 1

produce wrong result and nodes 2 and 3 produce right result, so this result take as optimal result which is right. And then group 2 performs a task and all nodes are producing right results so it takes as optimal.



In Fig. 4 Group 3 perform a task and three nodes return their results. From those results node 1 produce wrong result and nodes 2 and 3 produce right result, so this result take as optimal result which is right. And then group 4 performs a task and all nodes are producing right results so it takes as optimal.



In Fig. 5 Group 5 perform a task and three nodes return their results. From those results node 1 produce wrong result and nodes 2 and 3 produce right result, so this result take as optimal result which is right. And then group 6 performs a task and all nodes are producing right results so it takes as optimal.

XI. CONCLUTION

By the end of our paper, it can be conclude that rain technology is a stronger then cloud computing and it efficiently overcome and solution for the disadvantages of Cloud Computing. The goal of our RAIN project has been to build process that address the fault and manage it with a consistent way. Communicate with a various nodes and store and retrieve the data in a distributed environment. The storage data is access from any redundant node. The creation of such building blocks is important for the development of a fully functional distributed computing system.In our two aboveapproaches fault can be tolerance in distributed RAIN system in very consistent way. If we use this RAIN system in the different topology in a consistent way then it increase the robustness and independent ability of the topology. If a part of cluster is taken down for maintains then others are continuing their work. All nodes are line same, no concept for master and slave. It is very efficient for load balancing and traffic control. We have discussed two approaches above. From the above two approach we can comprise with one another that which is best. We can say that polling scheme is best because same task is doing by many nodes (called group) so chances of taking optimal right result is major. In redundant node approach single node perform single task so chances of taking wrong result. In Polling mechanism its cost is high then second approach and its complexity is also low.

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