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Improved Hybrid Routing Protocol for Circular Area Routing in WSN

Jatinder Singh[1] & Kamaljit Kaur[2]
[1]M.Tech Scholar , [2]Assistant Professor
Department of Computer Science and Engineering
Sri Guru Granth Sahib World University, Fatehgarh Sahib

Abstract*: The research makes a first endeavor to give a far reaching audit on atypical Multi level routing. The research offer a grouping of atypical various leveled routing of WSNs, and give point by point examination of various sensible topologies. The most illustrative atypical progressive routing conventions are depicted, examined, and subjectively analyzed. Specifically, the points of interest and disservices of various atypical progressive routing conventions are very important. After studying and analyzing every aspect the research proposes a hybrid mechanism on the bases of chain and area based routing in a circular area. In this paper the simulation result of the hybrid mechanism are presented which is working on the Chain-Area based Hybrid routing.*

1. INTRODUCTION

A wireless sensor network is a group of transducers with a communications infrastructure for monitoring and recording conditions at diverse locations. Commonly monitored parameters are temperature, humidity, pressure, wind direction and speed, vibration intensity, sound intensity, power-line voltage, chemical concentrations, pollutant levels and vital body functions. A sensor network consists of multiple detection stations called sensor nodes, each of which is small, lightweight and portable. Every sensor node is equipped with a transducer, microcomputer, transceiver and power source. The transducer generates electrical signals based on sensed physical effects and phenomena. The microcomputer processes and stores the sensor output. The transceiver receives commands from a central computer and transmits data to that computer. The power for each sensor node is derived from a battery.

2. ROUTING IN WIRELESS SENSOR NETWORK

Routing in wireless sensor network is the technique in which several nodes are connected with each other. There is a one sink node means Base Station and all other are the sensor nodes. These sensor nodes sense the data or signal and send it to the base station in the form of packets. Each and every sensor node can send the data to the sink node. There packets are send through the route. The nodes in routing finds the shortest route and then send packets.

2.1 Hierarchical Routing Protocols In WSN

Hierarchical routing in WSN is a very important topic that has been attracting the research community in the last decade. Hierarchical routing protocols are categorized into two parts. These are defined below:

2.1.1 Typical Hierarchical Routing is called clustering routing, in which the network is divided into multiple clusters. They are only based on Clustering in which clustering methods are included.

2.2.2 Atypical Hierarchical Routing is also same as typical hierarchical routing but it is some part of different than typical hierarchical routing is that it add the different techniques into clustering to the way the hierarchy is made like chain-based, tree-based, grid-based and area-based routing.

3. CLASSIFICATION OF ATYPICAL HIERARCHICAL ROUTING

Atypical Hierarchical Routing is divided into four categories: chain-based, tree-based, grid-based, and area-based according to routing.

3.1 Chain-Based Routing Protocols

In chain-based routing, one or more chains are constructed to connect the deployed sensor nodes for data transmission. In a chain, a leader is selected to perform the task of data collecting, like a sink. Data is delivered along the chain, and ultimately to the leader node. Data aggregation is performed during the process of transmission.

3.2. Tree-Based Routing

In tree-based routing, a logical tree is constructed by all sensor nodes. Data is delivered from leaf nodes to their parent ones severally. In turn, the parent nodes send the received data to their parent nodes towards to root nodes. Data aggregation is possibly performed in each node.

3.3. Grid-Based Routing

In a grid-based topology, the network is divided into various grids by geography approach. Thus, grid-based routing generally belongs to location-aware routing. The distinct characteristic of the type of routing is that the routing operation is performed without any routing table. Once the position of the destination is achieved by the source, all routing operations are locally performed.

3.4. Area-Based Routing Protocols

Area-based topology is an up-to-date structure, in which some sensor nodes are designated in a specific area and act as high-tier nodes. Generally, such nodes perform the task of data collection and data transmission to the sink. The size of the area can be adjusted according to the load balancing requirements. Such topology is always used in mobile WSNs.

4. PROTOCOLS IN ATYPICAL HIERARCHICAL ROUTING

There are many different routing protocols of atypical hierarchical routing are categorized into given Table 1.

Table 1. Atypical Hierarchical Routing Protocols

Atypical Hierarchical Routing	***Protocols***
Chain Based Routing	*LEACH,PEGASIS, CHIRON*
Tree Based Routing	*EADAT, BATR, PEDAP*
Grid Based Routing	*TTDM, PANEL, HGMR*
Area Based Routing	*LBDD, Railroad, Ring Routing*

But the emphasis of this paper is only on chain based(CHIRON) and area based routing(Ring Routing) protocols.

4.1 CHIRON

CHIRON (Chain-Based Hierarchical Routing Protocol) [1] is a chain-based routing protocol with the goal of alleviating several flaws such as data propagation delay.

The operation of CHIRON protocol consists of four phases:[16]

i) Group Construction Phase

The main purpose of this phase is ready to divide the sensing field into a number of smaller areas so that the CHIRON can create multiple shorter chains to reduce the data
propagation delay.

ii) Chain Formation Phase

In this phase, the nodes within each group will be linked together to form a chain. The chain formation process is same as that in PEGASIS scheme.

iii)Leader Node Election Phase

For data transmission, a leader node in each group chain must be selected for collecting and forwarding the aggregated data to the BS. Unlike the PEGASIS scheme, in which the leader in each chain is elected in a round-robin manner, CHIRON chooses the chain leader based on the maximum value of group nodes. Initially, in each group, the node farthest away from the BS is assigned to be the group chain leader.

iv) Data Collection and Transmission Phase

After completed the previous three phases, the data collection and transmission phase begins. The data transmission procedure in CHIRON is similar to that in PEGASIS scheme. Firstly, the normal nodes in each group transmit their collected data, by passing through their nearest nodes, to the chain leader. And then, starting from the farthest groups, the chain leaders collaboratively relay their aggregated sensing information to the BS, in a multi-hop, leader-by-leader transmission manner.

4.2 RING ROUTING

Ring Routing [1] proposes a ring topology in which the ring consists of a one-node-width, closed strip of nodes that are called the ring nodes. After the formation of the ring, neighbor discovery is performed to determine the neighboring ring nodes. The ring acts as a rendezvous for the events and queries. The sink communicates with the ring by forwarding packets of its location information towards the network center by a follow-up manner, and the ring nodes conserve the current information of the sink at all times. The source nodes query the ring by a similar communication way. Moreover, the ring structure can be changed to prevent the ring nodes from dying quickly. So, the ring nodes must switch roles with regular nodes from time to time.

The operation of Ring Routing protocol consists of four phases:[23]

i) Ring construction

The ring consists of a one-node-width, closed strip of nodes that are called the ring nodes. As long as the ring encapsulates the pre-determined network center, it can change. The shape of the ring might be imperfect as long as it forms a closed loop. After the deployment of the WSN, the ring is initially constructed by the following mechanism: An
initial ring radius is determined. The nodes closer to the ring, which is defined by this radius and the network center, by a certain threshold are determined to be ring node candidates. Starting from a certain node (e.g. the node closest to the leftmost point on the ring) by geographic forwarding in a certain direction (clockwise/counterclockwise), the ring nodes are selected in a greedy manner until the

starting node is reached and the closed loop is complete.

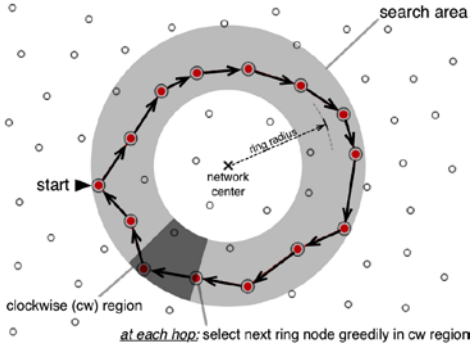

Figure 1. Ring construction [23]

ii) Advertisement of sink position

As the sink moves, it selects anchor nodes (ANs) among its neighbors. The AN serves as a delegate managing the communications between the sink and the sensor nodes. Initially, the sink selects the closest node (e.g., the node with the greatest SNR value) as its AN, and broadcasts an AN Selection (ANS) packet. Before the sink leaves the communication range of the AN, it selects a new AN and informs the old AN of the position and the MAC address of the new AN by another ANS packet. Since now the old AN knows about the new AN, it can relay any data which is destined for it to the new AN. The current AN relays data packets directly to the sink.

iii) Obtaining the sink position from the ring

A source node, that has data available, has to obtain the position of the AN before disseminating data to the sink. The fresh position of the AN is stored in the ring. The source node sends an AN Position Information REQuest (ANPIREQ) packet towards the ring (towards the network center if the node is outside the ring, away from the network center if it is inside the ring). The source node's position is also included in the ANPIREQ packet. Even though these packets and the information contained within them are destined for their ultimate target, the intermediate nodes relaying these packets may obtain the AN position information.

iv) Data dissemination

Once a source node receives a response (ANPIRESP) to its request (ANPIREQ), it learns the position of the AN and can now send its data directly to it by geographic forwarding. If data reaches an old AN, meaning that the AN has already changed by the time data has arrived at the destined AN, the follow-up mechanism is used to disseminate data to the current AN.

5. EXISTING WORK

Ibriq et.al [1] this work describes sheer, secure hierarchical energy-efficient routing protocol, which provides secure communication at the network layer. Sheer uses a probabilistic broadcast mechanism and a three-level hierarchical clustering architecture to improve the network energy performance and its lifetime. To secure the routing mechanism from the inception of the network, sheer implements hikes, a hierarchical key management and authentication scheme. Simulation studies compare sheer and a secure version of leach using hikes. The simulation results showed that sheer is more energy-efficient than the secure LEACH and has better scalability.

Huang et.al [2] In this research, a new cluster-based optimization algorithm is set up which optimizes clustering process, to effectively avoid the low-energy and long-distance nodes as the cluster head. Considering sink node, the object cluster head routing protocol was proposed, it ensured that only the object cluster head send overall data to sink node, which can balance energy depletion among the cluster heads in WSN. The simulation results showed that the optimization strategy significantly prolongs survival time of the network, the object cluster head routing protocol reduces the unbalance of cluster heads energy dissipation caused by different distance from sink node and maximizes the network lifetime.

Jan et.al [3] this work, aimed to improve the lifetime of sensor network by using leach based protocols and efficiently utilizing the limited energy available in these sensor nodes. In sensor network, the amount of data delivered at the base station is not important but it is the quality of the data which is of utmost importance. Their proposed approach significantly improves the life time and quality of data being delivered at the base station in sensor network. They have evaluated proposed approach using different sets of node energy levels and in each case our approach shows significant improvement over existing cluster-based hierarchical routing protocols. They evaluate our scheme in terms of energy consumption, life time and quality of data delivered at the base station.

Amini et.al [4] the author has proposed a hierarchical routing protocol for wireless sensor networks is introduced that aims at reducing the energy imbalance among sensor nodes by integrating the distance of the nodes from the base station into clustering policies. Moreover, the proposed routing protocol does not need any centralized support from a certain node which is at odds with aiming to establish a scalable routing protocol. Mobility management is a salient feature of this protocol that guarantees reliable communications between mobile and static nodes. A simulator was developed in the MATLAB environment to evaluate the performance of this protocol. Simulations on two different network configurations are used to validate their analysis of the proposed protocol.

Chen et.al [5] in this research, they proposed an energy efficient chain-based hierarchical routing protocol, named as CHIRON, to alleviate such deficiencies. Based on the BEAMSTAR concept, the

main idea of CHIRON is to split the sensing field into a number of smaller areas, so that it can create multiple shorter chains to reduce the data transmission delay and redundant path, and therefore effectively conserve the node energy and prolong the network lifetime. Simulation results show that, in contrast to enhanced PEGASIS and PEGASIS protocols, the proposed CHIRON can achieve about 15% and 168% improvements on average data propagation delay, 30% and 65% improvements on redundant transmission path, respectively. By these contributions, the network lifetime can also be extended to about 14%~7% and 50%~23%, under various small and large simulation areas, respectively.

Nesrine et.al [6] this research proposes a new routing mechanism to reduce energy consumption in WSNs, and subsequently increasing their lifetime. In particular, we describe a new routing protocol named: hierarchical energy efficient routing protocol (HEERP). Using computer simulations, we show that HEERP outperforms leach, is the most existing popular routing pool. Wireless sensors networks (WSN) are increasingly used in various applications such as environment tracking, health monitoring, industrial control and intrusion detection applications. WSN consists of small-sized nodes, deployed generally in inaccessible environment to the human, in order to collect information about it. These motes are autonomous and work with battery. The critical characteristic of these networks is energy, which was their main design constraint to increase their lifetime. Energy consumption had a major impact on all levels: application software, motes (software and hardware) routing and communication channel.

6. IMPROVED HYBRID ROUTING PROTOCOL

In this proposed work, the Hybrid Routing Protocol is proposed in which the concept of CHIRON (Chain Based Routing Protocol) and Ring Routing (Area Based Routing Protocol) is merged. Hybrid Routing Protocol is proposed to remove the limitations of these both existing protocols . While Area-based systems are highly scalable, they have very large delays. To solve this problem, implement a concept of minimum hop with energy efficient optimization for area-based routing. In this concept, implement the area-based routing where will compute the minimum number of hops required to transmit the data from source to sink. Then will compute the minimum energy that is required to transmit the packet from source to sink. Then find the intersection where the energy and hop have optimal value and then transmit the packet .Also will make the good load balancing in network and make the more scalable network.

6.1 Algorithm for Hybrid Routing

ALGO: HYBRID ROUTING[X,Y]
INPUT VARIABLES

- X = {length of region}
- Y= {Breadth of region}
- Nodes={Number of nodes}
- Store =Deploy Nodes (Nodes, X, Y)
- [cX,cY]=Computer center(X,Y)

OUTPUT

- Draw circles ([cX,cY],{number of circles})
- Usage=calculation(nodes)Findpath=node(2,X,Y,Usage)

PROCESS

1. Start rounds
2. Src=select source ()
3. SNo=Select sink (sinks,src);
4. path =find path(src,sinks (SNo));
5. metrics=sendpacket (path)
6. save metrics (materics)
7. Findpathagain=findpath(src,sinks (sNo, usage));
8. metrics=sendpacket (path)
9. save metrics (materics)
10. end

OUTPUT

- Plot metrics (global metric)

Figure 2. Algorithm for Hybrid Routing

7. PARAMETERS USED

In this research different scenarios are taken into consideration with varying number of nodes against constant simulation time. Comparison is drawn between Ring Routing and Hybrid Routing Protocols on the basis of Delay, Energy, Load and Scalability.

1. Delay: Delay caused in the packet transmission over the selected path. Delay of the network specified how long it takes for miliiseconds of data to travel across the network from one node to another.

Formulas for calculate the delay: The formula with the use of delay is calculated is given below:

1. v1=imline(gca,[h2 var(indx22,2)],[k2 var(indx22,1)]);
2. dis2=dis2+((var(indx22,2)-h2)^2+(var(indx22,1)-k2)^2)^0.5;
3. tt4=toc;
4. tt1=[tt1 tt2 tt3 tt4];
5. TT(1)=sum(tt);

```
TT(2)=sum(tt1);
Figure
bar(TT)
title('Delay');
xlabel('Ring Routing  Hybrid Routing');
```

Figure 3. Calculate the delay

2. Energy: Energy used by packet in transmission over the calculated distance. Energy of the network specified as how much packects are consumed during the transmission from one node to another node. . It is expressed as millijoule.

Formulas for calculate the Energy: The formula with the use of energy is calculated is given below:

```
tt3=toc;
%dis1=((var(indx3,2)-180)^2+(var(indx3,1)-180)^2)^0.5;
%dis2=((var(indx3,2)-220)^2+(var(indx3,1)-220)^2)^0.5;
if (indx2==indx22)
else
v4=imline(gca,[var(indx32,2) 200],[var(indx32,1) 200]);
dis2=dis2+((var(indx32,2)-200)^2+(var(indx32,1)-200)^2)^0.5;
end
figure
bar([dis1 dis2])
title('Energy');
xlabel('Ring Routing Hybrid Routing');
packets=10;
```

Figure 4. Calculate the Energy

3. Load: The number of packets transmitted cause the network to experience consumption of availability of paths. It refers to the amount of data that is carried by a network. It is expressed as computational cycles.

Formulas for calculate the Load: The formula with the use of load is calculated is given below:

```
tt3=toc;
%dis1=((var(indx3,2)-180)^2+(var(indx3,1)-180)^2)^0.5;
%dis2=((var(indx3,2)-220)^2+(var(indx3,1)-220)^2)^0.5;
if (indx2==indx22)
else
v4=imline(gca,[var(indx32,2) 200],[var(indx32,1) 200]);
dis2=dis2+((var(indx32,2)-200)^2+(var(indx32,1)-200)^2)^0.5;
end
Load1=packets*(1/dis1/TT(1));
Load2=packets*(1/dis2/TT(2));
Loadp(1:100)=0;
Loadc(1:100)=0;
for i=1:100
Loadp(i)=i*Load1;
Loadc(i)=i*Load2;
end
figure
plot(1:100,Loadp,1:100,Loadc);
xlabel('Rounds');
ylabel('Load');
```

Figure 5. Calculate the Load

4. Scalability: The ability of the network to adapt changes like number of nodes in this case.

7.1 Simulation Environment

The simulation of the system on the basis of the pseudo code is done in MATLAB. The network parameters used as follows:

Table 2. Simulation parameters

Simulation Parameter	**Value**
Simulator	MATLAB
No. of nodes	200, 250
Network area	400X400
Routing Protocols	CHIRON, RING ROUTING

Initial energy	100 mJ
Range type	Fixed

9. COMPARISION

In this step compare the Ring Routing Protocol with new Hybrid Routing Protocol on the basis of delay, energy and load.

9.1 Comparison of Ring Routing and Hybrid Routing on the basis of Delay

Delay: It is caused in the packet transmission over the selected path. Delay of the network specified how long it takes for milliseconds of data to travel across the network from one node to another.

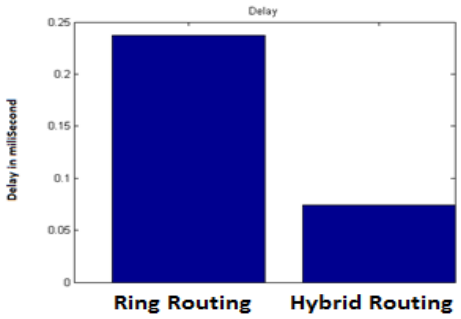

Figure 6. When no. of nodes are 200 for delay calculation

In the Figure 6 shown that when the no. of nodes are 200 deployed on the wireless sensor network area , the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of delay.

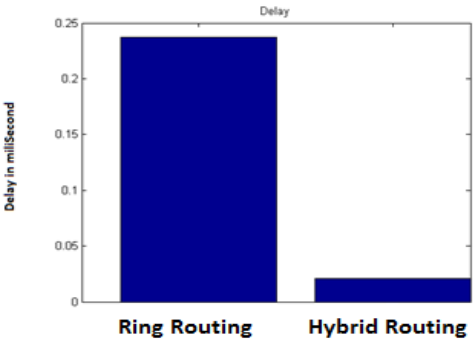

Figure 7 When no. of nodes are 250 for delay calculation

In this Figure 7 shown that when the no. of nodes are 250 deployed on the wireless sensor network area, the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of delay.

9.2 Comparison of Ring Routing and Hybrid Routing on the basis of energy

Energy: Energy used by packet in transmission over the calculated distance. Energy of the network specified as how much packets are consumed during the transmission from one node to another node.

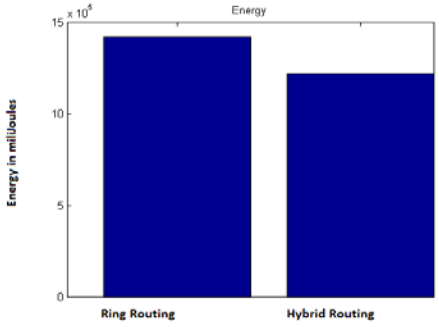

Figure 8. When no. of nodes are 200 for energy calculation

In the Figure 8 shown that when the no. of nodes are 200 deployed on the wireless sensor network area ,the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of energy.

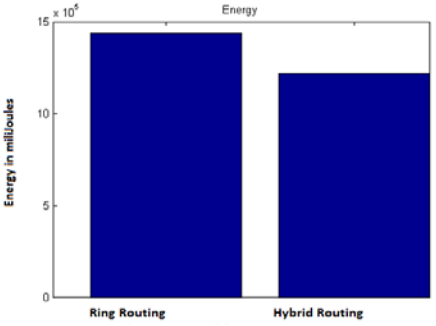

Figure 9. When no. of nodes are 250 for energy calculation

In this Figure 9 shown that when the no. of nodes are 250 deployed on the wireless sensor network area ,the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of energy.

9.3 Comparison of Ring Routing and Hybrid Routing on the basis of load

Load: The number of packets transmitted cause the network to experience consumption of availability of paths. It refers to the amount of data that is carried by a network. It is expressed as computational cycles.

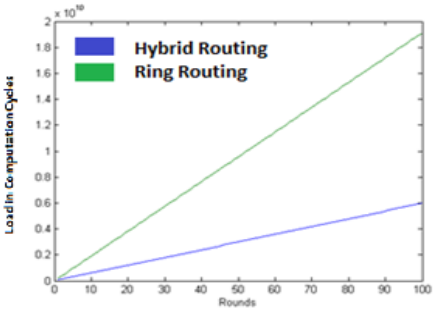

Figure 10. When no. of nodes are 200 for load calculation

In this above Figure 10 shown that when the no. of nodes are 200 deployed on the wireless sensor network area, the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of load.

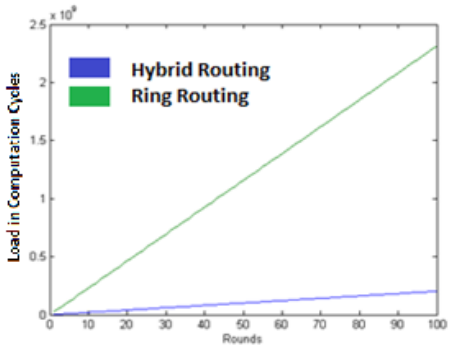

Figure 11. When no. of nodes are 250 for load calculation

In this Figure 11 shown that when the no. of nodes are 250 deployed on the wireless sensor network area, the Ring Routing Protocol and Hybrid Routing Protocol are compared on the basis of load.

9.4 Scalability: The ability of the network to adapt to changes like number of nodes in this case. Comparisons of Ring Routing and Hybrid Routing Protocols for 200 and 250 nodes on the basis of delay, energy and load which proves the scalability of the mechanism.

9.5 Comparison of Ring Routing and Hybrid Routing Protocols on the basis of delay, energy and load.

Ring Routing and Hybrid Routing Protocols are compared on the basis of delay, energy and delay into the below given table.

Table 3. Comparisons of ring routing and hybrid routing

Para-meters	**Delay** (millisec)		**Energy** (milliJoules)		**Load Balancing** (Computation Cycles)	
No. of nodes	**200**	**250**	**200**	**250**	**200**	**250**
Ring Routing	0.23	0.24	13	14	1.9	2.3
Hybrid Routing	0.07	0.02	11.5	12.5	0.6	0.2

10. RESULT & DISCUSSION

The result generated of the comparison between the Ring Routing and the current scenarios i.e. the Hybrid Routing Protocol show that the Hybrid Routing performs better than the Ring Routing mechanism in terms of System load, delay and energy.

11. CONCLUSION & FUTURE WORK

WSNs have pulled in expanding consideration as of late for their broad applications. Because of the constrained assets, routing is loaded with difficulties in WSNs and intelligent topology assumes a urgent part in directing outline of asset limitation systems. Previously, much stress has been made in outlining possible progressive steering conventions for WSNs taking into account distinctive sensible topologies. In this report, an overview of sensible topologies and progressive directing is given. All the more particularly, Atypical Routing for WSNs is separated into five classifications, including cluster based, chain-based, tree-based, matrix based, and range based topologies. Additionally, diverse legitimate topologies for various leveled WSNs have been investigated by coherent topologies, including their qualities, focal points also, weaknesses. In the end we have simulated the ring routing and the chain based ring routing mechanisms and compared them on the bases of Delay, Energy and Load on the system. The conclusion from the results is that Hybrid chain and ring based routing performs better than the [21] ring based routing.

FUTURE WORK

In the future that can be done on this work, the researcher can merge different protocols for hybrid mechanism like tree based routing and will try to enhance this mechanism by making multiple chains in the network.

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