FISH EYE ROUTING IN AD HOC NETWORKS

PRESENTED BY

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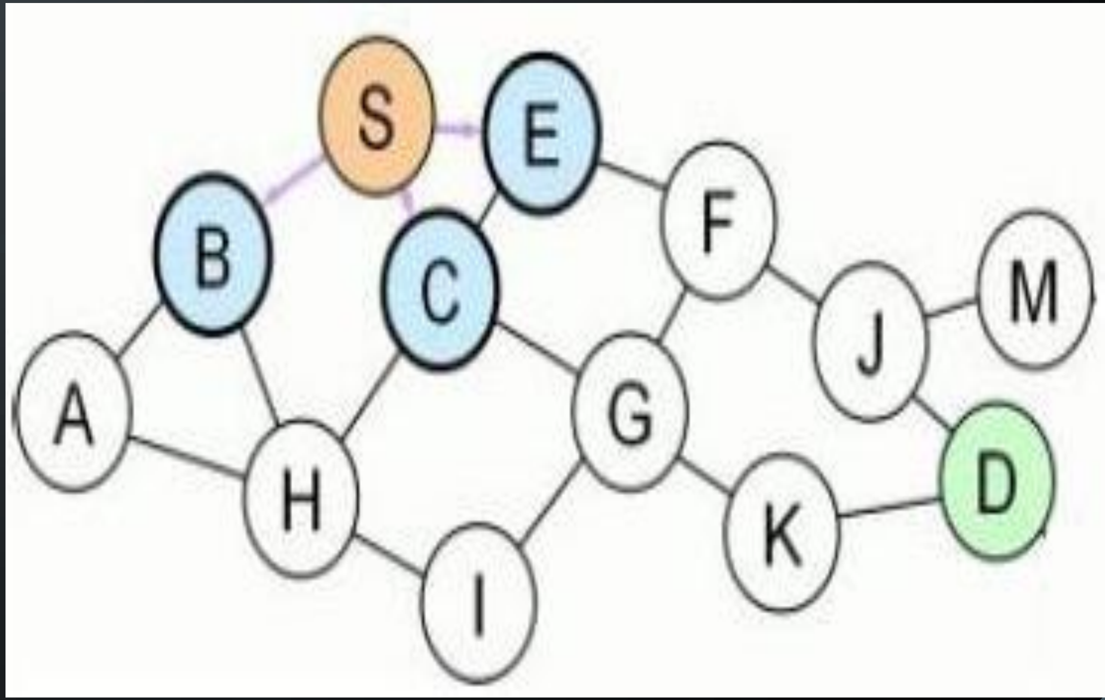
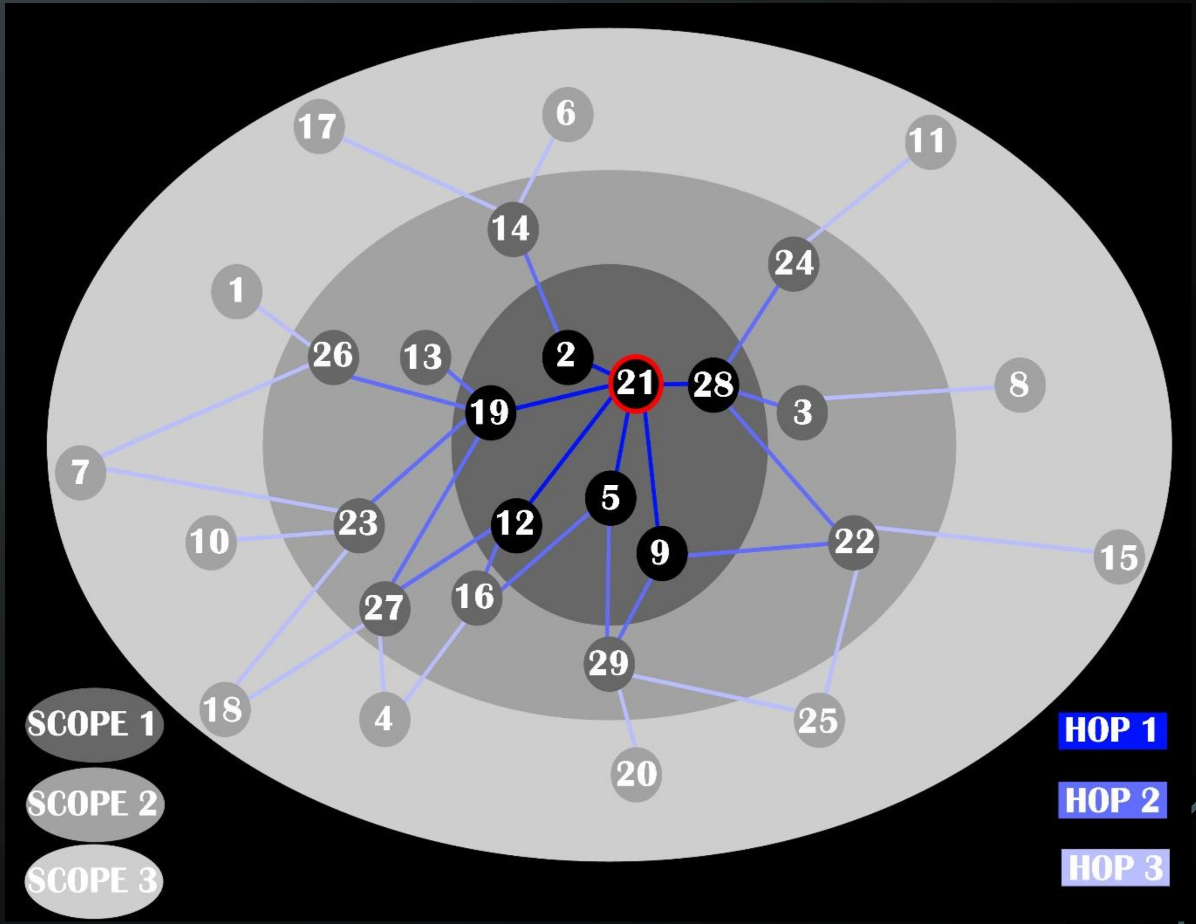
FISH EYE ROUTING

- Fisheye State Routing (FSR) is an hierarchical routing protocol based on link state routing.
- It has the ability to provide route information instantly by maintaining a topology map at each node.
- It relies on the concept of fish eye scope.



FISH EYE SCOPE

- In routing, the fisheye approach translates to maintaining accurate path information about the immediate neighborhood of a node, with progressively less detail as the distance increases.
- Hop count is used as a metric for defining the distance of a remote node, and hence for dividing the network into scopes.



ALGORITHM

FSR is based on a link-state foundation updating mechanism. It maintains a topology map at each node, which reduces the control overhead by disseminating topology information using the Fish Eye Technique.

The Update Mechanism is -

1. Node stores the Link State for every destination in the network.
2. Node periodically broadcast update messages to its neighbors.
3. Updates correspond to closer nodes propagate more frequently.

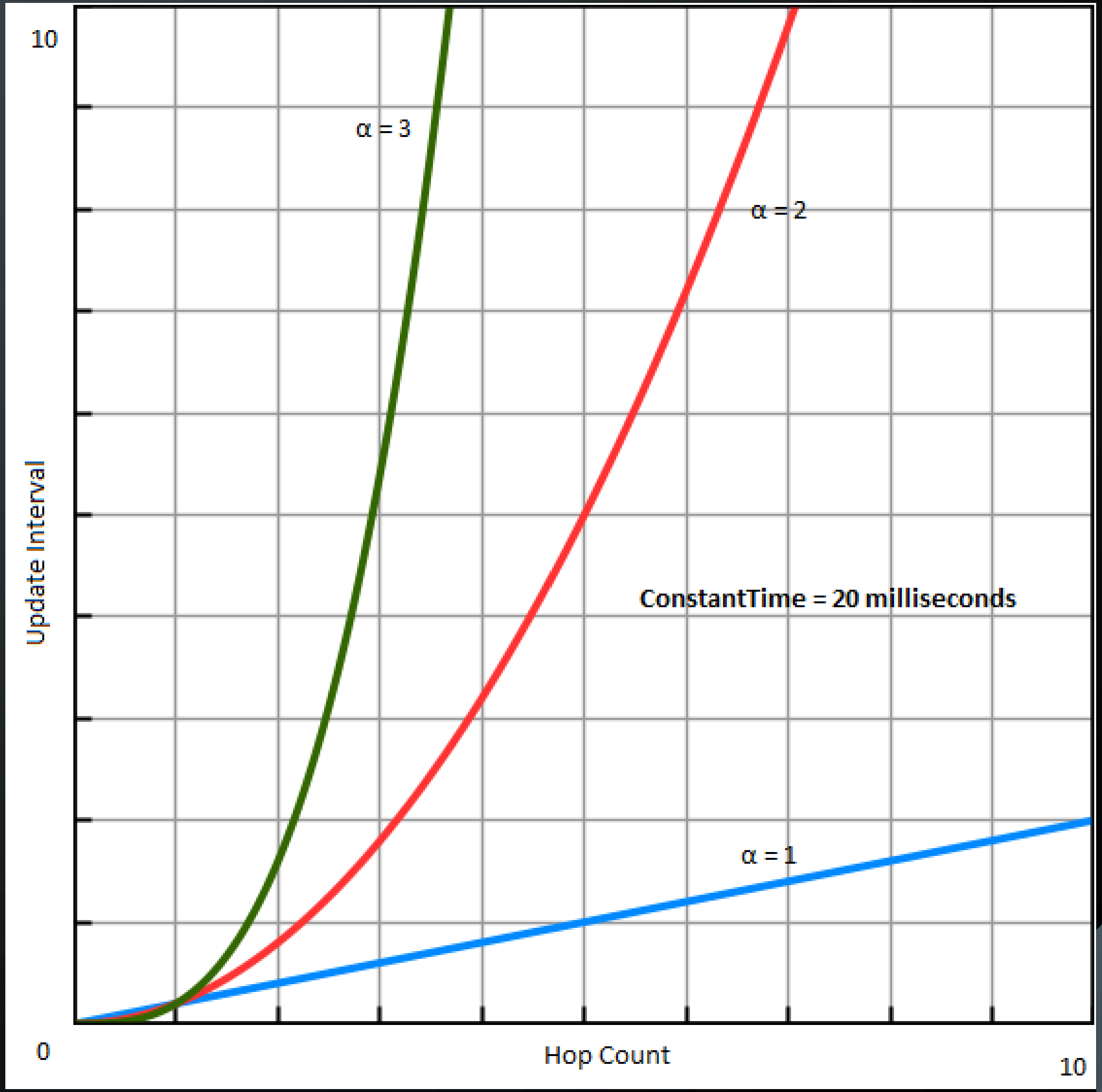
UPDATE INTERVAL

The reduction of routing messages is achieved by updating the network information for nearby nodes at a higher frequency and remote nodes at a lower frequency. When a node receives a LSP, it calculates a time to wait before sending out the LSP from the following equation:

$$UpdateInterval = ConstantTime * hopcount^{\propto}$$

UPDATE INTERVAL

- ConstantTime is the default period to send out LSPs (in the first scope)
- hopcount is the number of hops the LSP has to traverse
- alpha determines how much effect each scope has on UpdateInterval.



UPDATE TIMER

When a router accepts a LSP from a faraway node, and has not yet sent out the LSP in memory, the next time it will send out the LSP will be the minimum of the time left to wait in memory and the new calculated UpdateInterval based on the new LSP. This is to prevent a router from waiting indefinitely to send out a LSP when a new LSP arrives before the one in memory is sent out for that node.

UpdateInterval(new) = MIN(UpdateInterval(memory), UpdateInterval(LSP))

ADVANTAGES OF FISHEYE ROUTING

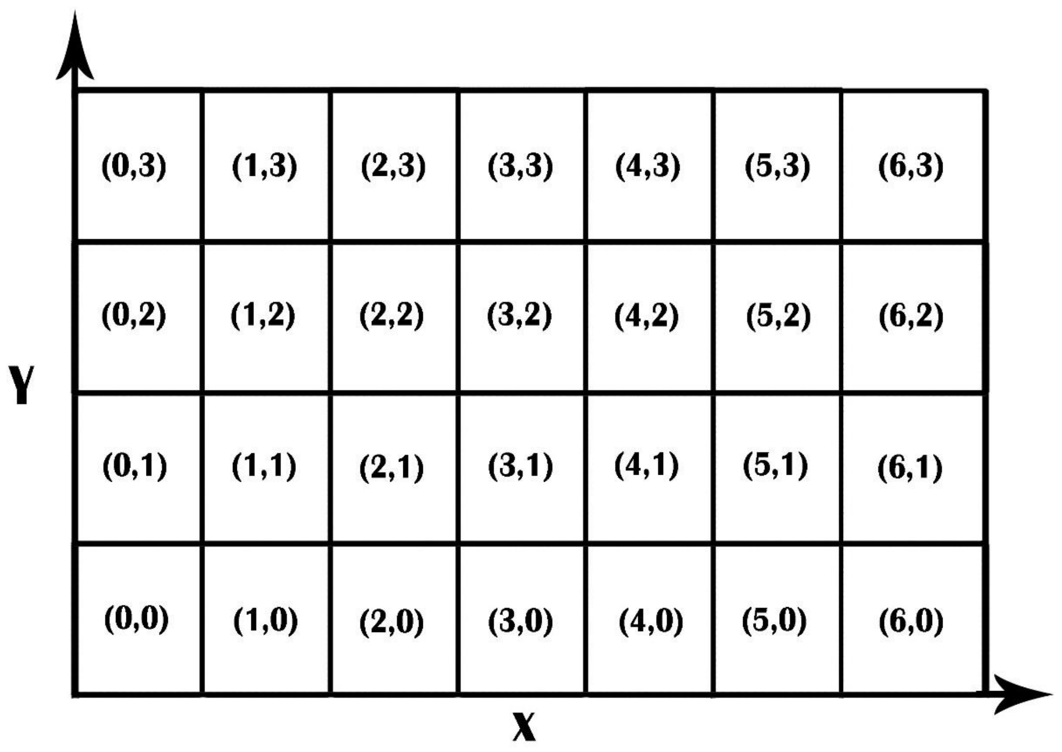
- Overhead - FSR allows major reduction in link overhead caused by routing updates, due to the update rate depending upon hop count.
- Latency - FSR show lowest end-to-end delay, when compared to other ad hoc routing protocols like DSR, AODV, ZRP, because routing paths are quickly available.
- Flood efficiency - Reduced flooding in routing traffic overhead and periodical propagation of link state in-formation makes Grid FSR suitable for dynamic network topologies.

ADVANTAGES OF FISHEYE ROUTING

- Scalability - As the number of nodes increases, delay tends to zero, as routes are available instantly, unlike AODV. The number of possible paths is increased, reducing the possibility of congestion at any point.
- Flexibility - By choosing the proper number of scope levels and radius size, FSR can be tailored to any network. The variable update delay is another parameter that can be tweaked to optimize performance.
- Robustness - The table-driven approach makes the protocol insensitive to traffic source and destination pair density.

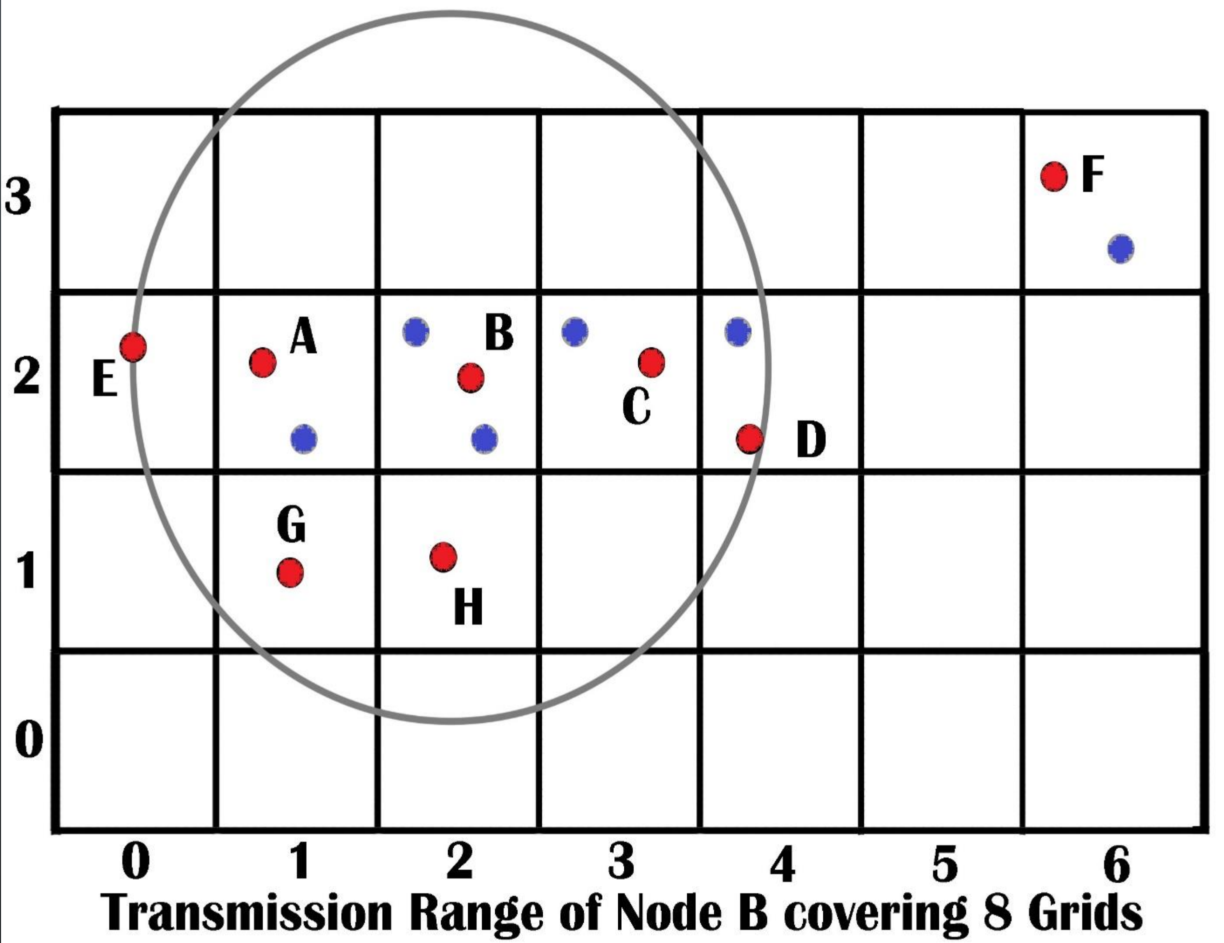
VIRTUAL GRID SYSTEM

- The virtual GRID system is an improvement over classical Ad-Hoc routing protocols.
- It takes into account the geographical locations of various nodes, and hence maps them into a grid.
- Each node is grid aware, having GPS triangulated coordinates.



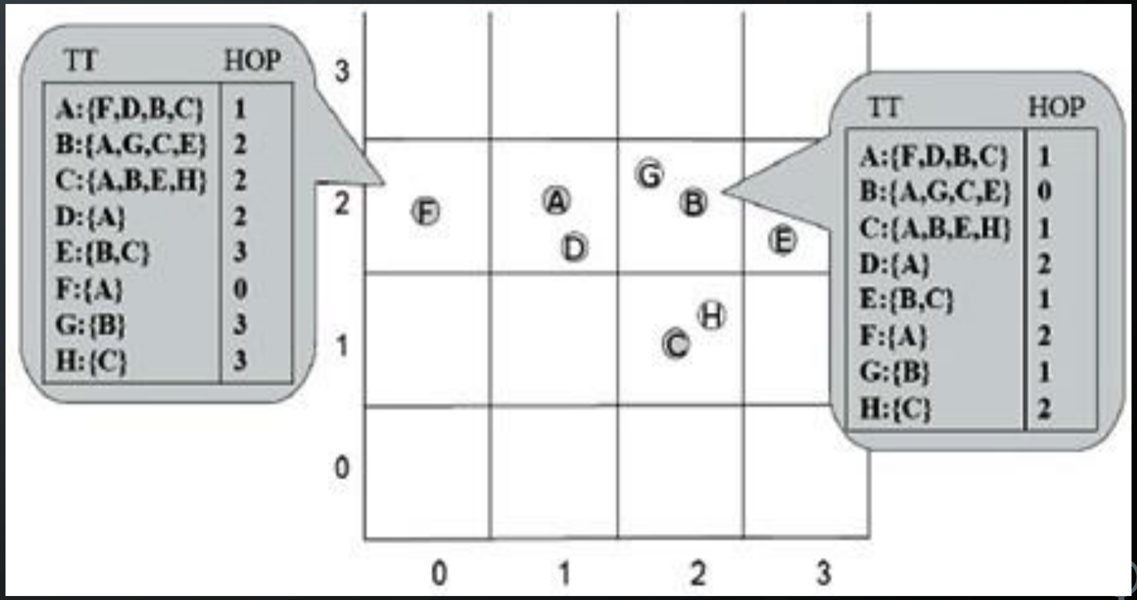
LOCATION AWARENESS

- The geographic area of an ad hoc network is partitioned into a two dimensional ordered virtual grid (x,y).
- Each node can calculate in which grid it currently dwells based on the physical location information derived from GPS.
- Based on routing updates, each node is also aware of the physical locations of other nodes.



GATEWAY ELECTION

- Initially, a gateway election is held in each grid, where a gateway is the node responsible for maintaining the routing table in its grid, and for exchanging routing information using fisheye state routing scheme.
- The grid size can be set in such a way that the transmission range of each gateway can effectively cover its eight neighbor grids.

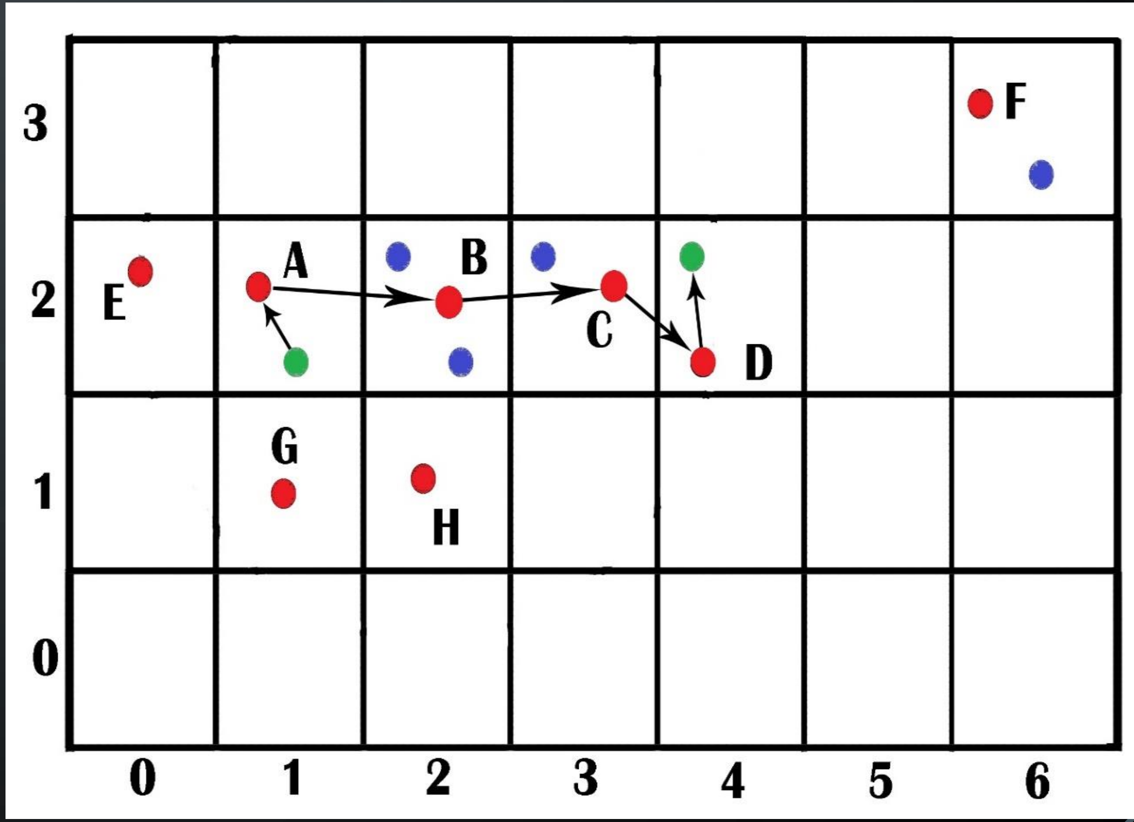


ELECTION CRITERIA

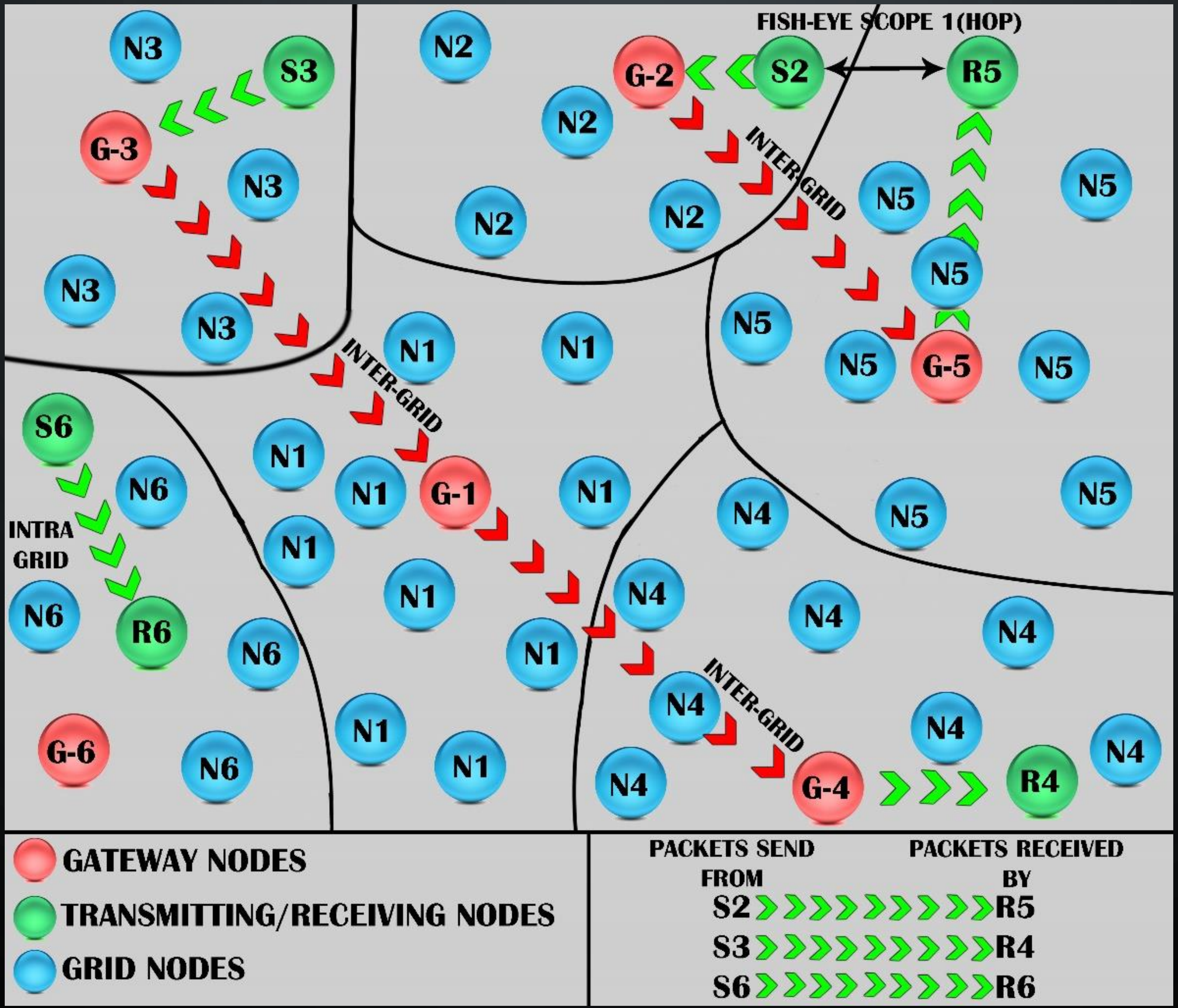
- Range
- Transmission Energy
- Available Power
- Bandwidth
- Mobility

ROUTING USING GRID

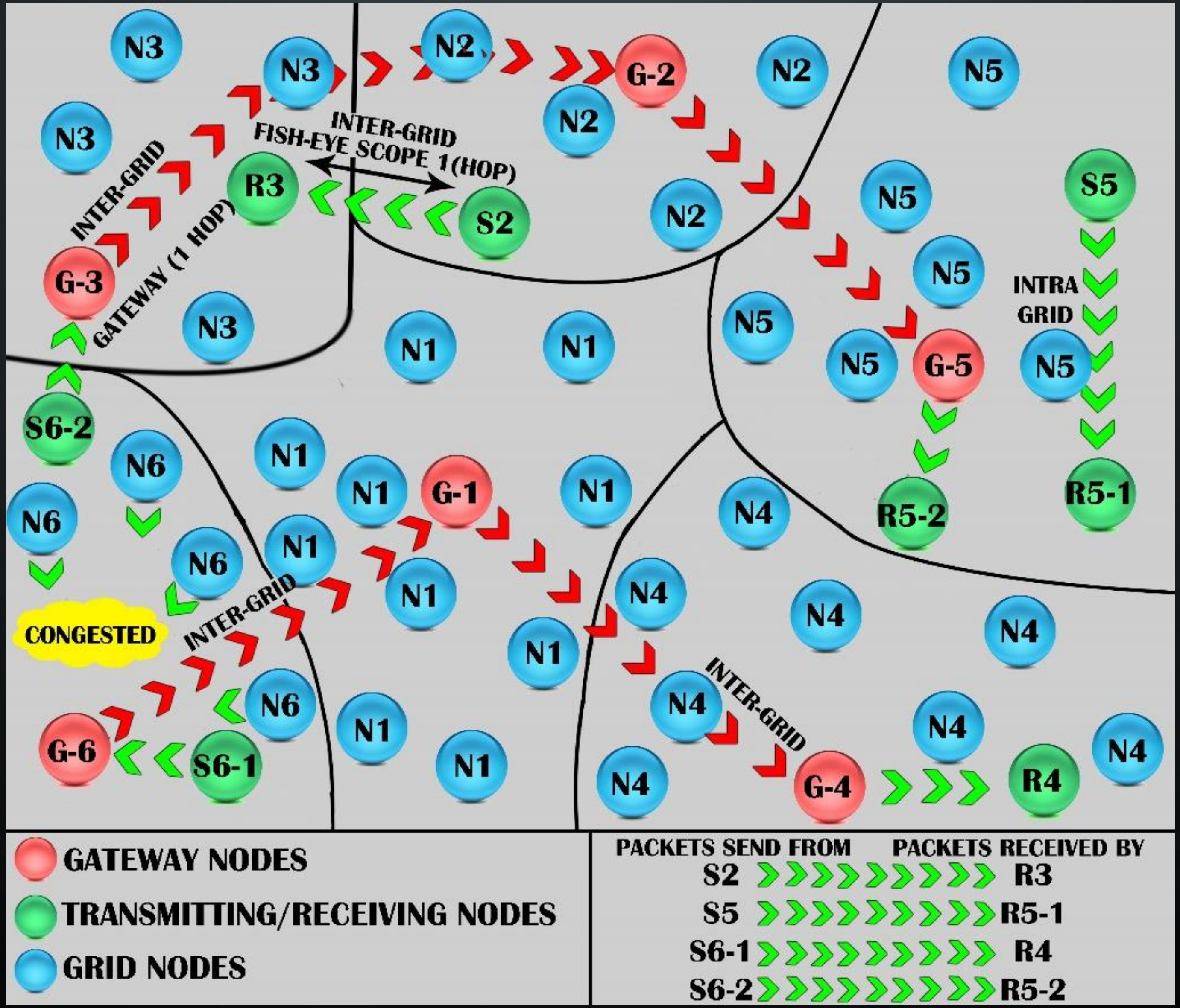
- If a node is a gateway, it transmits data to next hop by checking its routing table.
- If it is a non gateway node, it just sends data to its gateway, and then the gateway will take over to forward the message to next hop.



STRONG ALGORITHM



WEAK ALGORITHM



ALGORITHM ANALYSIS – STRONG FORM

Advantages

- System architecture is greatly simplified
- Only gateway nodes need to maintain complete grid awareness
- Network monitoring and performance measurement is simplified

Disadvantages

- If routing node fails, all nodes within that grid are cut off from the network
- Probability of congestion at gateway nodes

ALGORITHM ANALYSIS – WEAK FORM

Advantages

- Nodes are only forced to use gateways in case receiver is both outside grid and outside wireless range.
- Convergence is faster, in case of node failure

Disadvantages

- All nodes in the network must be location aware, and maintain complete routing information and a grid map
- A moving node has to update its entire table
- Does not solve most issues in Ad-Hoc networks

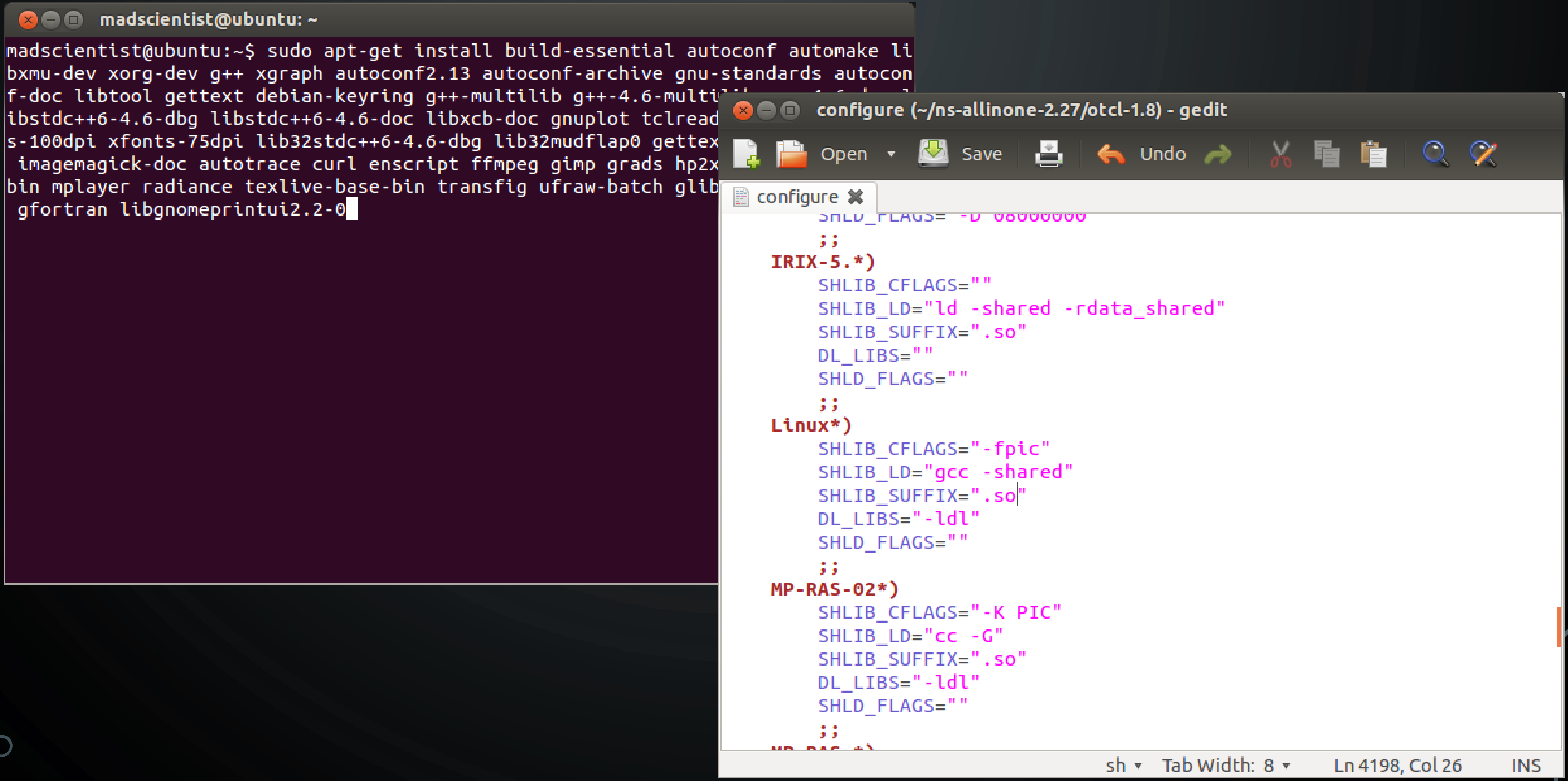
GRID SYSTEM ADVANTAGES

- Stabilizes routing paths
- Reduces routing update overheads
- Lowers net processing load
- Lowers net power consumption
- Improves throughput
- Reduces packet loss

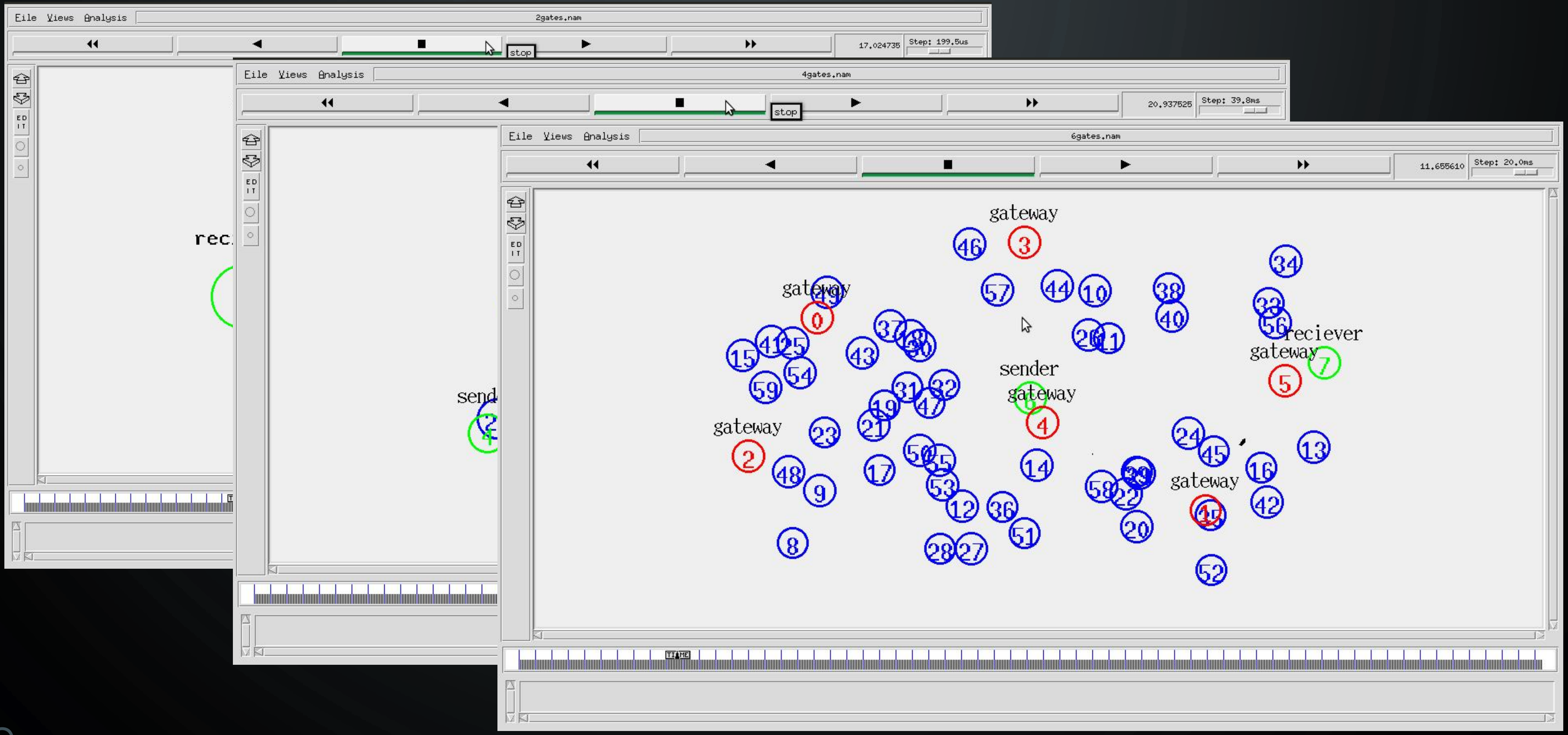
PLATFORM DETAILS

- Network Simulator – NS2 2.35
- Network Visualizer – NAM 1.15
- Scripting – oTCL 1.8.5
- Operating System – Ubuntu 12.04.5

DEPENDENCIES & CONFIGURATION



SIMULATION



File Views Analysis
2gates.nam
17.024735
Step: 199.5us
stop
rec
send
4gates.nam
20.937525
Step: 39.8ms
6gates.nam
11.655610
Step: 20.0ms
gateway
reciever
gateway
sender
gateway
gateway
gateway
gateway

PERFORMANCE VS DENSITY AND SCALABILITY

- Theoretically, more path choices resulting from greater density should raise reliability and throughput. It does in fact reduce the possibility of congestion at any one point.
- Greater density also makes the network less sensitive to node failure, as the failure of individual nodes has a lesser effect on the system.
- However, Ad-Hoc routing protocols do not inherently strive to maintain routing path stability, instead choosing whichever path is available at the time.
- In reality, the time consumed in evaluating a large number of potential paths is large enough to cause some packets to be dropped.

CONCLUSION

- The GRID algorithm offers significant advantages over classic ad-hoc routing algorithms, like reduction in latency and packet loss, and faster convergence.
- Processing overheads and the resulting increased power consumption are no longer critical factors due to more powerful modern SOCs.
- More research into this area of networking is sure to yield promising results.

THANK YOU

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