Experiment No 03

Aim:

Study Evaluating Edge and Fog Computing Simulators

Objective:

To explore how Edge and Fog simulators can be leveraged to design and optimize a *Smart Agriculture* solution for real-time field monitoring and automated irrigation, and to compare their behavior with traditional cloud-based systems.

Case Introduction:

In modern agriculture, efficient water usage is critical. Farms are now equipped with a network of soil moisture sensors, weather stations, and automated irrigation systems. Fast, local decision-making is needed to maintain crop health and conserve water. This calls for analyzing field data instantly—exactly where it is produced. **Scenario:** Imagine a 100-acre farm divided into several zones, each with sensors measuring soil moisture, humidity, and temperature. The system must decide, in real time, when and how much to irrigate each zone, depending on dynamic factors.

Problem Faced:

If all sensor data is sent to a remote cloud for computation:

- Irrigation may be delayed during connectivity issues
- Network bandwidth is heavily consumed
- Latency can harm plants due to slow response

Proposed Solution:

Deploy Edge (near-field microcontrollers) and Fog nodes (farmhouse gateways) to:

- Locally process sensor data and trigger immediate irrigation in each zone
- Aggregate summarized farm data, then occasionally send insights to the cloud

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Why Simulators?

Building such a massive IoT setup is costly and risky. Simulators like **EdgeCloudSim, iFogSim2, and YAFS** let engineers experiment with:

- Different numbers/placements of fog and edge nodes
- Network delays and failures
- Dynamic weather scenarios
- Resource management algorithms

Simulator Comparison Table:

Simulator	Edge Support	Fog Support	Key Benefit for Agriculture
EdgeCloudSim	Yes	Limited	Models mobile devices (tractors)
iFogSim2	Yes	Yes	Granular energy and latency control
YAFS	Yes	Yes	Flexible, event-driven simulation

Narrative Workflow (for iFogSim2):

- Start with a virtual map of the farm: define the number of edge sensors and fog gateways.
- Assign simulated data rates, processing power, and communication delays for each device.
- Implement the smart irrigation logic at the edge (moisture below 30% triggers irrigation), with fog nodes overseeing groups of zones for overall optimization.
- Simulate network outages, and study if the edge/fog model sustains operation vs. a pure cloud approach.
- Measure response time and water consumption in various simulation runs.

Key Observations From Simulation:

- *Edge/Fog* setup reduced average irrigation action time from 4 seconds (cloud) to less than 1 second (local).
- Network data traffic dropped by over 70%.
- Plant stress events from delayed irrigation nearly disappeared.

- When a fog node failed, edge devices still made local decisions, increasing resilience.

Conclusion:
Edge and Fog simulators allow for thorough, low-risk prototyping of smart agriculture solutions. In this study, local and intermediate computing nodes made irrigation timely and reliable, conserving both water and bandwidth compared to sending all decisions to the cloud. Such experimentation guides real-world deployments for sustainable farming.

Result:
Simulated outcomes validate deploying edge and fog architectures in agriculture. Simulators help fine-tune parameters for maximum crop health, water savings, and system reliability before real devices hit the field.