PROBLEM STATEMENT : LEO Satellite Network Topology & Latency Optimization
TEAM NAME : NETWORK CARE
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Problem Description

Low Earth Orbit (LEO) satellite constellations are highly dynamic — their fast orbital motion constantly changes link availability between satellites and ground stations. This creates routing instability, congestion, and unpredictable latency in communication networks. Understanding and modeling these topological changes accurately is essential before implementing optimization techniques.

Solution Proposed

The team developed a **satellite tracking and topology modeling system** that predicts satellite positions using reduce latency and constructs a dynamic connectivity graph between satellites and ground stations. This allows real-time visualization of available inter-satellite links (ISLs) and communication paths. The model serves as the foundation for future AI-based routing and latency optimization.

Optimization Proposed by the Team

1. **Efficient Orbit Prediction:** Reduced computational overhead by updating positions only every 5–10 seconds using interpolation between edge.
2. **Modular Framework:** Designed the code to integrate easily with the upcoming AI routing .

Solution Architecture and Design

Architecture Flow:

Input: Model Satellites as Nodes

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Generate User Requests

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Serve Requests from Cache

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Pre-Processing

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Dynamic Topology Output

Timeline of Delivery

Task

Collect and parse pre-process data for chosen LEO constellation

Implement in Python

Build dynamic graph structure for satellites + ISLs

Visualize satellite network topology (Matplotlib / latency-aware caching algorithm).

References

1. Ground control ACLS group company(edge to reduce latency)
2. Starlink Constellation TLE Data – Celestrak.org
3. Driven data labs.

Conclusion

In this project, we explored methods to reduce communication latency in Low Earth Orbit (LEO) satellite networks through edge caching and onboard pre-processing. Traditional satellite systems suffer from high latency due to frequent round-trips between satellites and ground stations. Our proposed model brings computation and data storage closer to the user by enabling satellites to cache frequently accessed or predicted data and perform local data processing before transmission.

Simulation results and architectural analysis show that this technique reduces the average response time, minimizes bandwidth usage, and improves service reliability. The concept also opens new opportunities for real-time applications such as disaster monitoring, IoT data collection, and remote sensing analytics. Overall, edge-enabled LEO satellite networks present a scalable and efficient solution for next-generation low-latency global connectivity.