# Satellite Network

## IETF 115 Hackathon

**Huawei & Nanjing University**

**November 5-11, 2022**

# Hackathon Plan

## Hypatia Platform:

- Generation of satellite network topology and routing.
- Traffic Generation and Simulation of Traffic Transmission over Satellite Networks.
- Visualization of Constellation, Display the dynamic topology of satellite network.

## UltraStar Platform:

- Configuration of satellite network parameters.
- Topology management of Large-scale satellite network.

# Hackathon Development

**Build Enviroment:**

- **OS**
  - Windows10
- **Hyper-v**
  - 10.0
- **Virtual Machine OS**
  - Ubuntu 20.04


- **Python**
  - 3.8
- **G++/Gcc**
  - 9.4


# Hypatia Introduction

Hypatia is a low earth orbit (LEO) satellite network simulation framework.

## Capabilities:

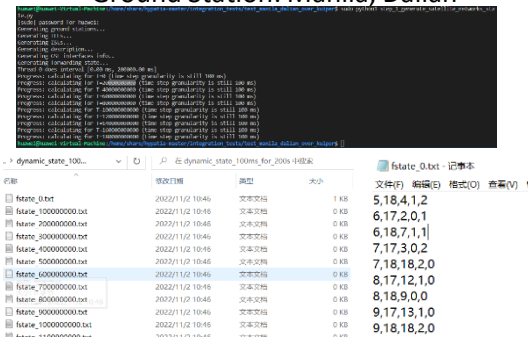
- Control of ISL/GSL connection setup
- NS3 packet-level simulation
- Visualization of link utilization
- Generation of time slice “fstate”

## Available Research:

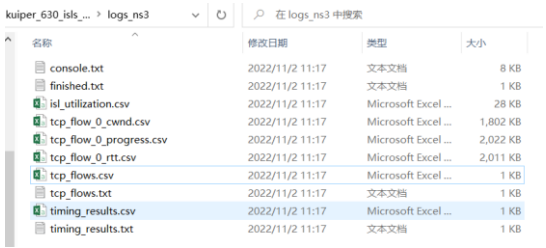
- Orbital dynamics
- Evaluation of constellation performance
- Simulation of RTT delay and path switching, and TCP performance
- Research on Load Balancing
- Research on Routing Algorithms, such as “virtual topology”

# Demo & Result

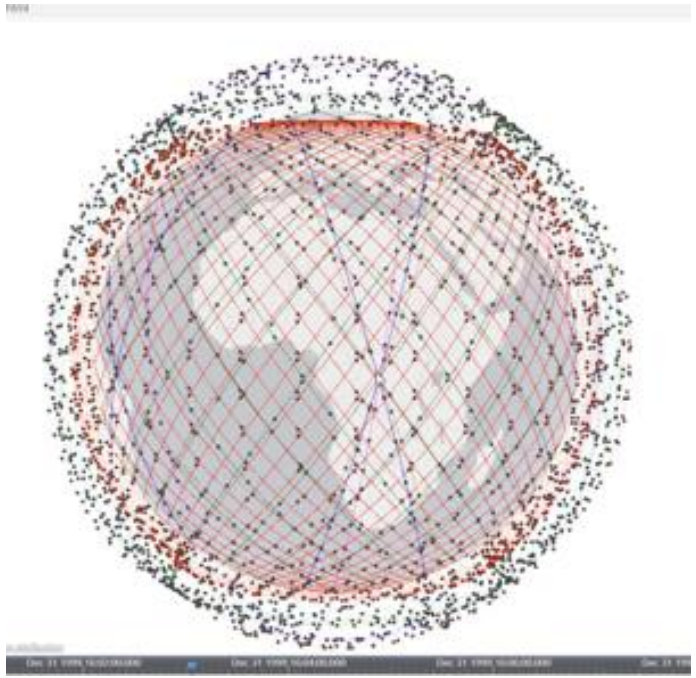
- Step1: Generation of topology and Routing Table.
  - Constellation: Kuiper;
  - Ground Station: Manila, Dalian




- Step2: Generation of TCP traffic configuration
- Step3: Simulation of Traffic Transmission over Satellite Networks.




- Step4: Visualization of Constellation



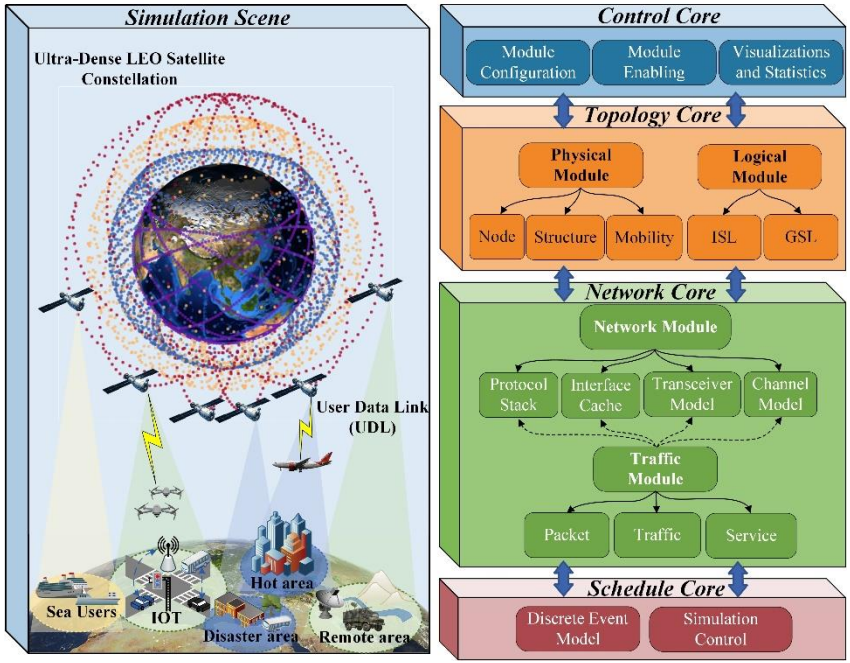
# UltraStar: A Lightweight Simulator of Ultra-Dense LEO Satellite Constellation Networking

**UltraStar** is a discrete event based simulator, designed as a platform to test protocols and management methods in ultra-dense LEO constellations.

- Topology Management
  - Dynamic topology for any constellation configuration.
  - Maintenance and update of satellite link status.

- Networking Simulation
  - Protocol-level network simulation.
  - Tests new protocols and management methods.

- Visualization and Statistics
  - Topology visualization, simulation information statistics.



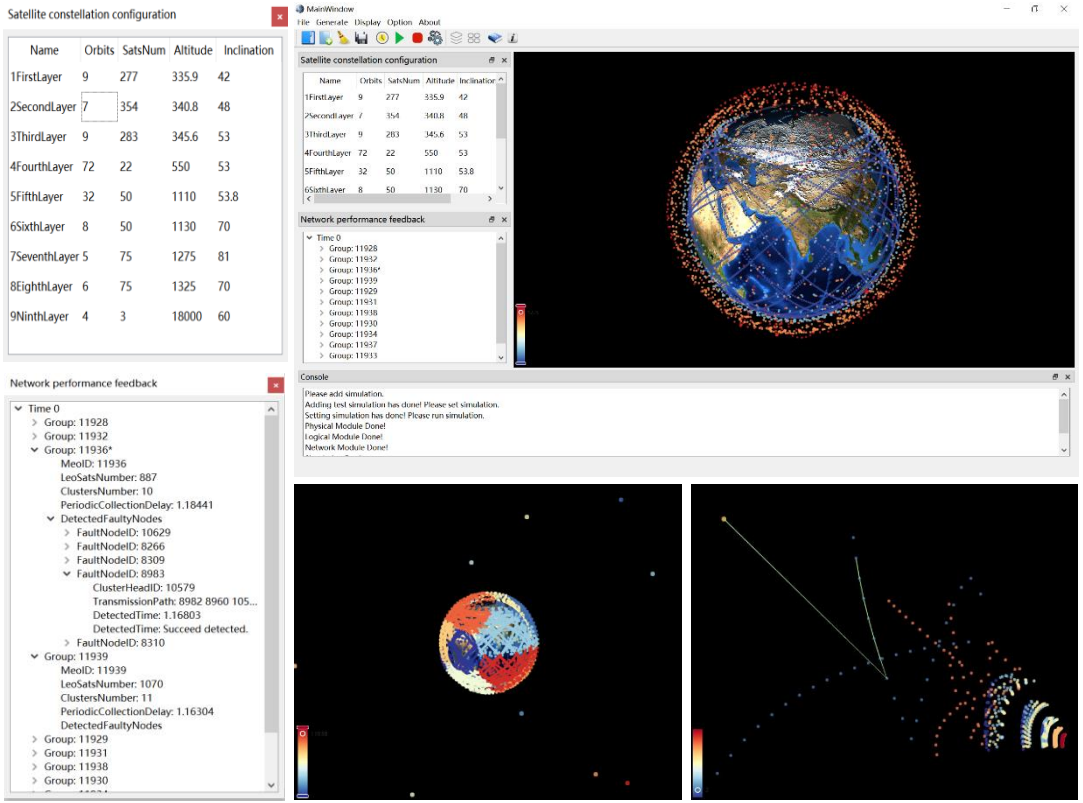
# Demo & Result

## Two-layer topology management architecture

- Each MEO centrally manages LEO satellites in its line of sight, which form one **group**.
- Each group is divided into clusters according to the adjacency principle.
- Each cluster head (CH) manages satellites in its cluster and reports the intra-cluster information to the manager MEO.

## Real-time satellite fault information management

- Each LEO satellite periodically collects the status information of neighboring LEO satellites, which is further reported to the CH.
- Once receiving the intra-cluster status information, CH reports it to the manager MEO, the MEO then sends fault responses to the confirmed faulty satellites.



# What we learned

- Simulation platform is very helpful to the research of satellite network, it provides a low cost method to study satellite network.

**In the future:**

- Adapting more routing protocols to the satellite network.
- Like discussing in TVR group, How does the satellite use the planed changes to the topology for routing?
- Cooperate with partners who interest in satellite network, join us to improve it together!

# Thank you :)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Open Communities: https://github.com/Satellite-Routing