Center for Satellite and Hybrid Communication Networks

A Commercial Communications System for the ISS

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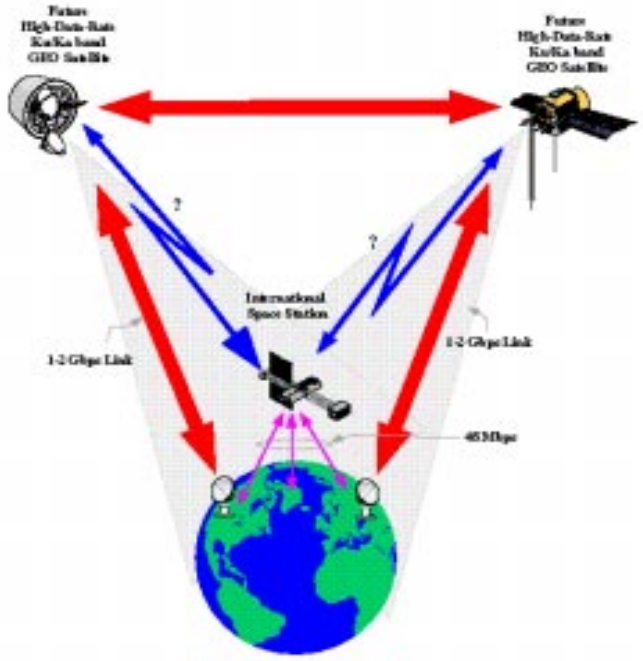
High Data Rate Communications from Spacecraft and Space Missions

- **Commercial Space needs high data rate and high quality communications**
  - Experiments with Shuttle
  - Experiments with ISS
  - Spacecraft linkage
  - Future space habitats and planetary missions
- **NASA networks, spacecraft, instruments on the Internet**
- **Needed:**
  - Efficient and cost effective communications from spacecraft to commercial satellite constellations
  - Experiments to validate such systems

HDR Commercial Communication Services to the ISS



- **Initiated interactive modeling and simulation of HDR telecomm services between the ISS and future HDR satellite constellations**

Support for NASA Missions: Objectives and Significance

- **Objectives:**
  - Provide high quality broadband communications connectivity to the ISS from commercial satellite networks
  - Facilitate broadband Internet services throughout NASA missions
  - Provide performance evaluation of space communication systems
- **Significance:**
  - International Space Station (ISS) is the NASA Mission with the highest priority
  - National Space Policy mandate for NASA to commercialize its space communications operations
  - Reduction in cost for NASA broadband communication needs
  - Better and easier dissemination of NASA mission and experiments data

Development of Simulation Testbed

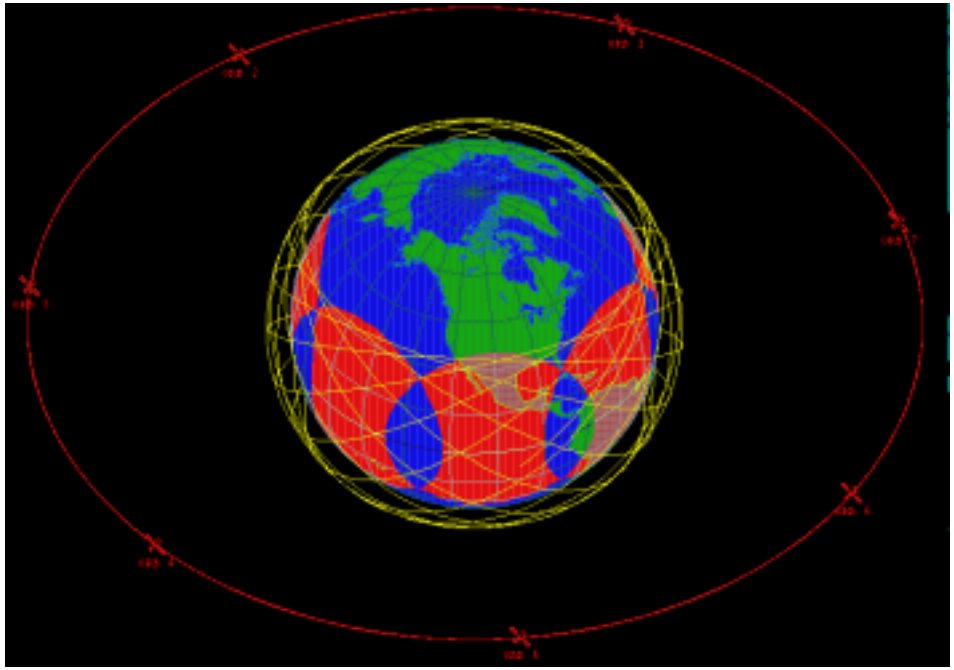
- **Modular simulation testbed under development includes:**
  - Realistic traffic source models for broadband services
  - Protocol enhancements for Internet (TCP/IP) and ATM service provision via satellite
  - Orbital/coverage models of candidate satellite constellations
  - Satellite Gateway Model (Link Enhancements (Coding), Framing)
- **Further enhancements will include:**
  - Network topology architectures (including Inter Satellite Links)
  - Antenna & channel RF (Ka and V Band cases) characteristics
  - On-board switching models
  - Phase arrays and tracking

Project Plans

- **OBJECTIVE: Investigate the use of commercial GEO and LEO/MEO satellite constellations for the communication needs of various NASA missions and in particular the International Space Station (ISS).**
- **Phase I:**
  1. Determine, in cooperation with NASA LeRC particular traffic scenarios, QoS service requirements for initial analysis scenario
  2. Identify potential commercial systems as candidate for investigation, starting from simple GEO (existing) Ku/Ka-band systems and moving to Ka/V band MEO/LEO systems
- **Phase II:**
  1. Where necessary apply analytical tools for traffic modeling, handoff analysis, fast end-to-end performance evaluation
  2. Develop simulation model that includes network architecture & topology of Hybrid Network, including:
     - **ISS (treated as an extremely LEO satellite) & NASA ground network.**
     - **Candidate Commercial Systems (constellation orbit model, ground network topology, information on routing options through constellation, ISLs if any)**

Project Plans

- **Phase III:**
  - Using analysis & simulation perform detailed studies to quantify the performance of candidate satellite systems for specific services, protocols & traffic scenarios and recommend potential design modifications to ensure NASA's QoS requirements are met



& MEO Constellation - Orbit Model

Performance Parameters for NASA Missions

- **Performance parameters that need to be addressed include:**
  - COVERAGE: Percent of time that data could be transmitted to the ISS via the commercial satellite system (this includes Static & Dynamic coverage and the effect of Inter Satellite Links)
  - THROUGHPUT: Maximum amount of information that can be exchanged between constellation & ISS, based on service availability and the per channel data rate
  - QUALITY-OF-SERVICE: Level of confidence for the reliable delivery of information to NASA users: Link quality (BER), Link Availability, Connectivity
  - ANTENNAS & TERMINALS: Antenna & earth terminal characteristics wrt required link quality. It would be necessary to have an antenna design well suited for covering both LEO vehicles and terrestrial traffic