

Data Sharing to Improve Close Approach Monitoring and Safety of Flight



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Managing the Space Environment

- Space Environment becoming increasingly congested
- Protecting high value assets is a priority for government and commercial actors
- Better coordination between industry and government could:
 - Provide new awareness of the GEO orbit
 - Allow commercial fleets to be flown in a safer manner
 - Ensure sustainable use of key orbits
 - Reduce likelihood of an accidental crisis



Collision Monitoring History

- **Intelsat became active in collision monitoring in summer of 1999**
 - Contract with Aerospace Corporation – via Aerospace Corporation's Space Operations Support Office (SOPSO)
 - A highly automated probability-based collision risk assessment
 - Two-Tier monitoring with TLE and SP ephemeris data
- **Contract with Lincoln Lab in March 2003**
 - CRDA program via Geosynchronous Monitoring and Warning System (GMWS)
 - Semi automated collision risk assessment based on miss distance – operation capability limited to non-active and other CRDA partner satellites in GEO rings
 - Single-Tier monitoring with precision ephemeris based on data from deep space surveillance network

Collision Monitoring Today

- In-house collision monitoring program since Jan 2007
- Two Tier system relying on the Two Line Elements (TLE) via the Air Force Commercial and Foreign Entity (CFE) Program and support from the United State Joint Space Operations Center (JSpOC)
- Informal agreements exist that allow the routine exchange orbital element and maneuver information between operators
- During special operations, such as satellite relocations and transfer orbit operations, special notification is provided which typically includes:
 - Latest orbital information
 - Near-term maneuver plans
 - Frequency information
 - Company contact information



Shortcomings of Current Approach

- TLE does not have the required accuracy to provide reliable close approaches
- Maneuver information on active satellites are not available to make reliable predictions
- Inefficient and time consuming two-tier approach to identify potential threats
- No common protocols and format for exchanging orbital and maneuver information
- Not all operators participate in close approach monitoring



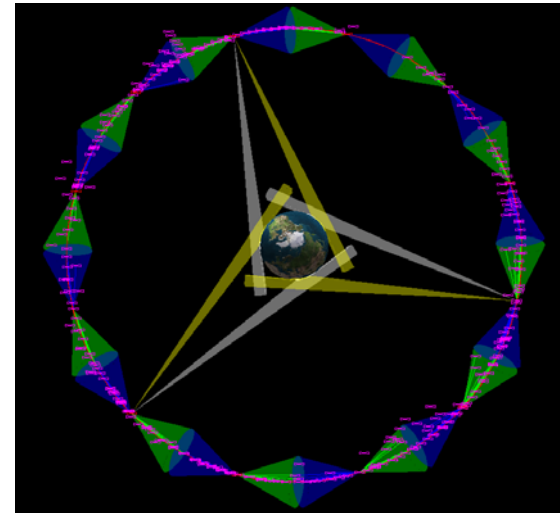
The Result?

- *Collision margins are increased*
- *A wider range of threats must be evaluated through inter-operator coordination*
- *Greater demands are place on government for information and assistance*



The Solution?

- Better cooperation between satellite operators
- Better cooperation between governments
- Better cooperation between satellite operators and governments



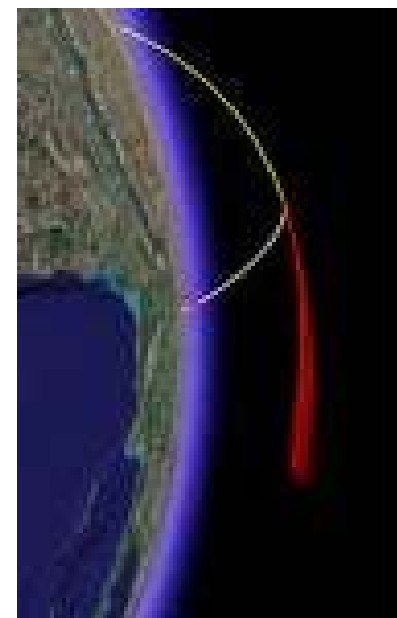
Cooperation Between Satellite Operators

- **Data center concept:**
 - Consortium supported by international satellite operators
 - Active processing center – conjunction monitoring and reporting
 - Focal point for data exchange – incoming and outgoing
 - Member data are protected and secured
 - Established rules and protocol based on different levels of conjunction alerts
 - Technical support available for close approach mitigation



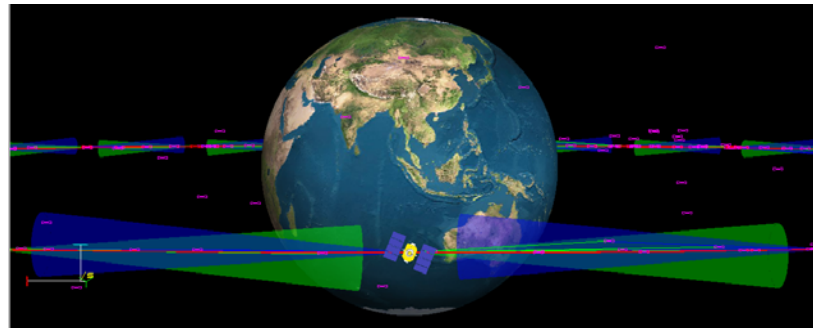
Goals of Data Center

- Enhance TLE data:
 - Augment TLE with operator precision orbit data and maneuver plans
 - Encourage data from other sources including radar, optical and other data from different academia institution, observatories and private/government agencies
- Enhancing communication:
 - Developed protocol for data exchange – from operators to data center and report from data center to operators
 - Standardized data exchange format and content
 - Common usage and definition of terminologies
 - Established operator contact list



Cooperation Between Industry and Governments

- Develop new space operations initiative
 - Formalize two-way regular communication process between operators and government to enable efficient data exchange.
 - Cooperate on the development of standard conjunction operational procedures
 - Provided ephemeris data and maneuver plans to government for routine and close approach analysis.
 - Government's commitment to provide conjunction monitoring and close-approach warning for participating commercial operators.



Initiatives

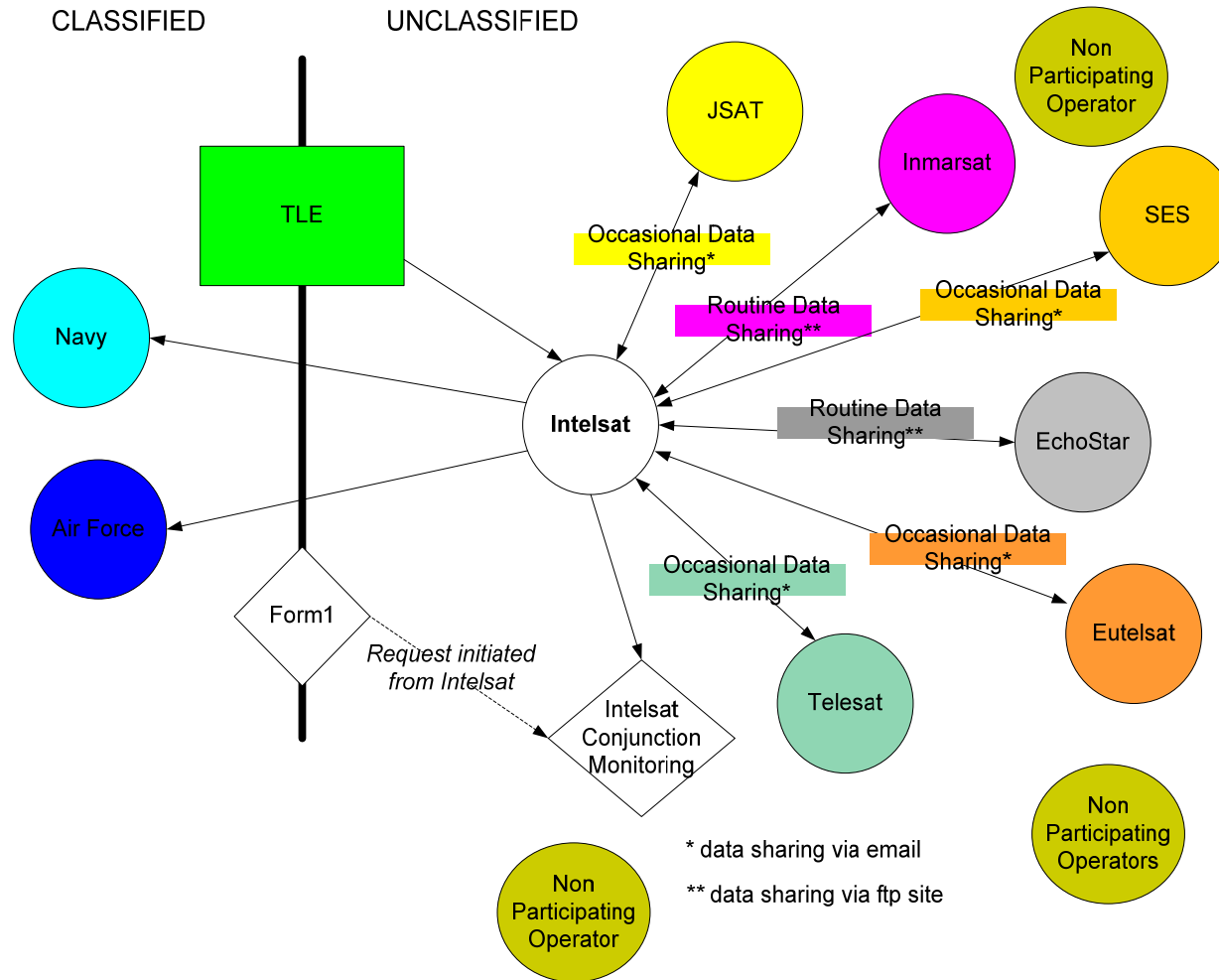
- **24th AIAA ICSSC Conference (Jun 2006, San Diego)**
 - Proposed the need for an International data warehouse
- **1st Improving Our Vision Conference (Sep 2006, Colorado Springs)**
 - Presented the detailed proposal on the concept for a global data warehouse
- **AGI User Conference (Oct 2006, Washington DC)**
 - Discussion with CSSI on the data center concept and collaboration on the prototype
- **Satellite Operators Round Table (Feb 2008, Washington DC)**
 - Workshop with commercial operators on data sharing and the data center initiatives

Owners/Operators workshop Feb 25, 2008

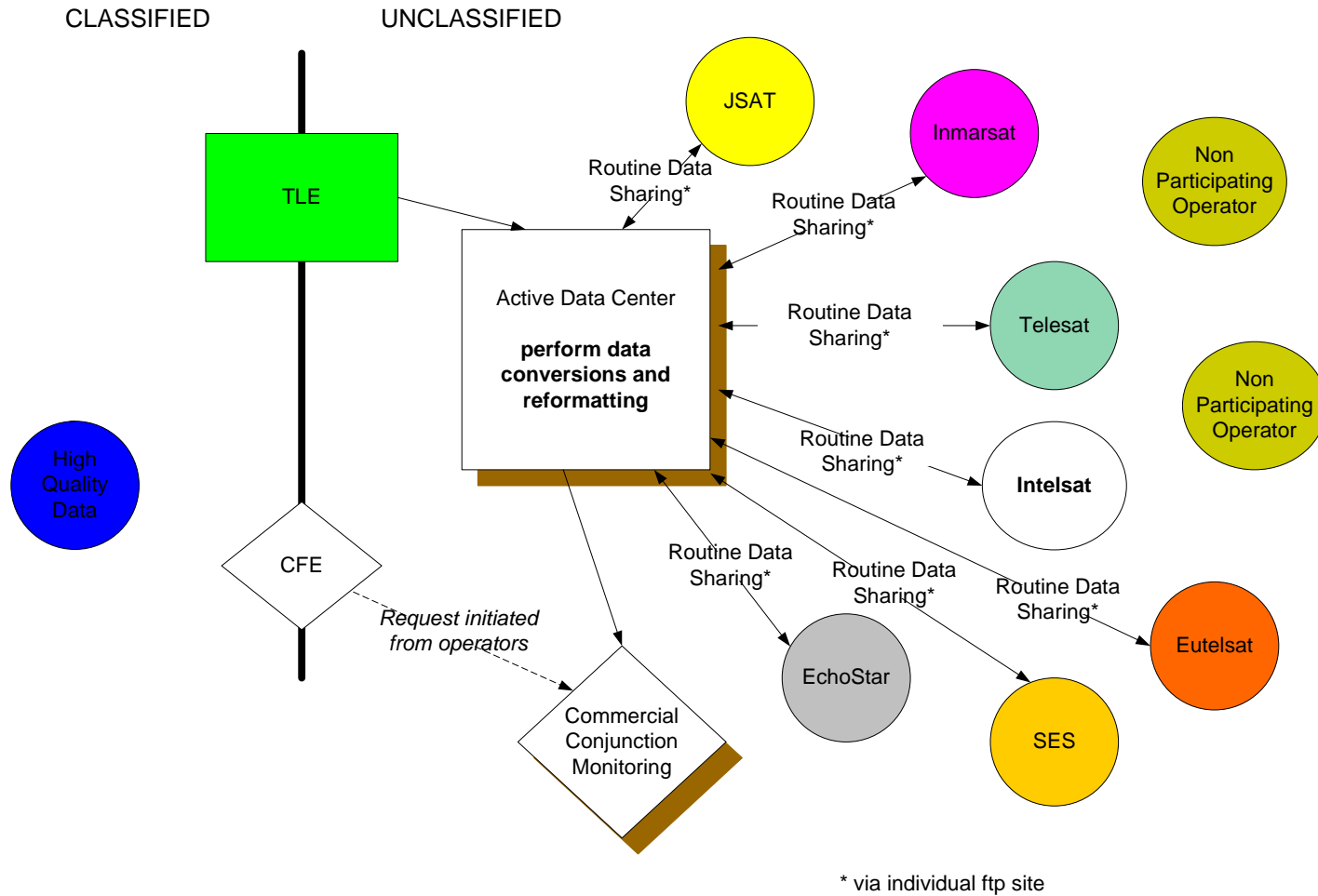
Washington, DC

- **Summary of Discussion Points**
 - Agreed the need to improve cooperation and coordination among owners/operators by means of data exchange to simplify conjunction monitoring and minimize risk.
 - Agreed to move towards creating owner/operator ftp sites and broadcast orbital information. Permission to access the information could be obtained from the owner/operator.
 - Agreed on data exchange content to include ICD, orbit elements, ephemeris data, and planned maneuvers.
 - Commercial operators and CSSI will work together to prototype an active data center for collision monitoring.

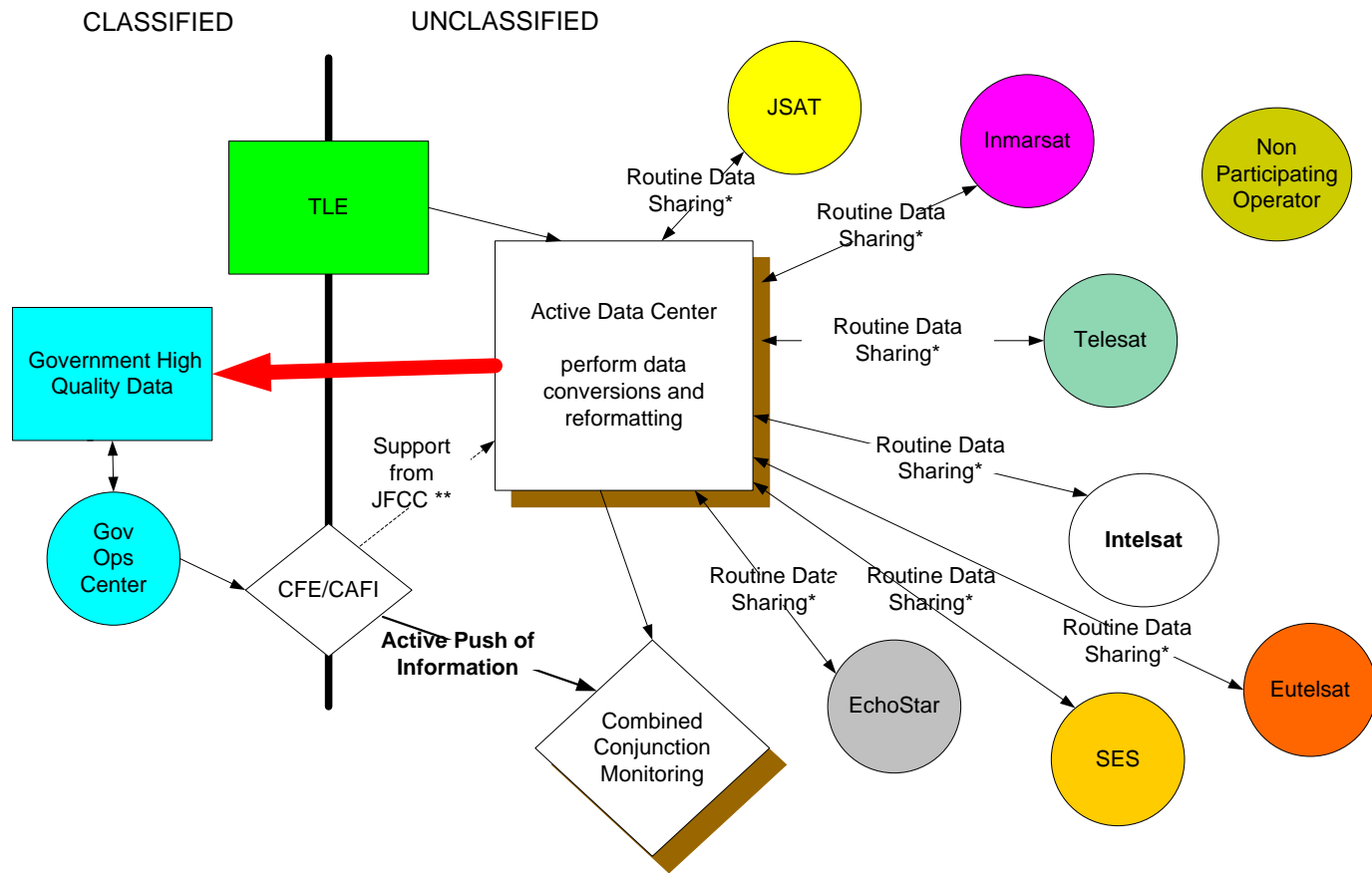
Our Vision (1/3)



Our Vision (2/3)



Our Vision (3/3)



* via individual ftp site

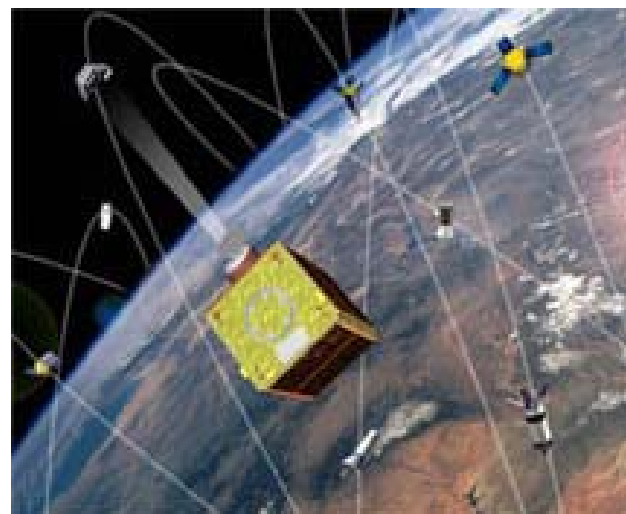
** To resolve close approach and avoidance maneuver planning

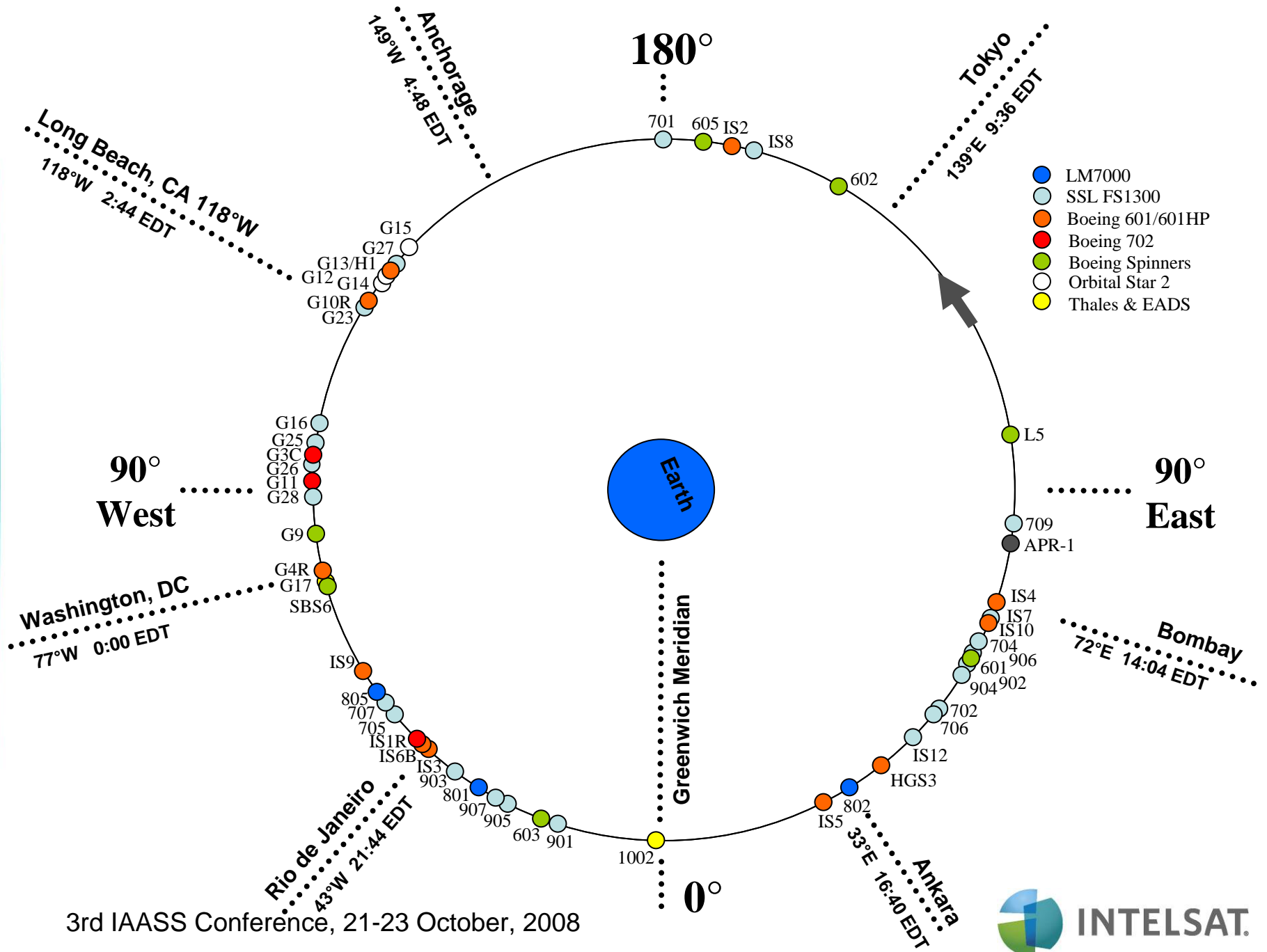
On-going Activities

- Working with US government to extended CFE to support routine close approach monitoring
- Continue data center prototype for proof of concept
 - Total 7 partners with data for 115 satellites (Intelsat, Inmarsat, EchoStar, SES, NOAA, Star One, Telesat)
 - Daily close approach alerts
 - Daily neighborhood watch
 - 2nd operator round table scheduled in December

Next Steps

- **Continue working group to:**
 - **Standardize data quality and exchange format – orbital reference frame definitions, data calibration, uncertainties/covariance, data time span, ...**
 - **Standardize close approach detection algorithm and process – conjunction box, probabilities and ...**
 - **Establish protocol to respond to close approaches – extension of current conjunction SOP.**
- **Reach out to government for support**





3rd IAASS Conference, 21-23 October, 2008

