ISS Trajectory Data
for ISS Payload Customers

Payload Operations Integration Working Group (POIWG)
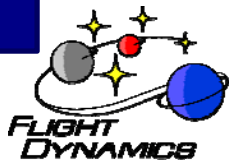
NASA MSFC

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Jatin V. Shah

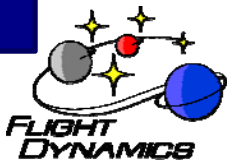NASA JSC - ISS Trajectory Operations and Planning Group

Agenda

- What is a TOPO?
- TOPO Products
- Request Process
- TOPO Points of Contact

What is a TOPO?

The **T**rajectory **O**perations and **P**lanning **O**fficer (**TOPO)** is the Flight Operations Directorate (FOD) team responsible for planning and maintaining a knowledge of where the International Space Station (ISS) and its supporting vehicles are, where they are going to be, and ensuring that they do not get hit by anything.
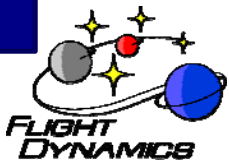
TOPO Products (ISS Ephemeris and Ancillary Data)

Name	Description	Accuracy	Format	Duration	Frequency
TOPO-01: **Reference Trajectory**	A long-term assessment of the ISS altitude strategy and reboost plan It is designed to support all long-look ISS trajectory customer product needs by providing high quality trajectory data on a 3 month delivery cycle	Accuracy is unknown due to in ability to predict the atmosphere changes over such a long duration Good for trends such as Beta Angle and Nodal Summary, not so much for in-track location	Format 13 ephemeris (5 min or 1 day dense) SAA, Sun lighting, Nodal Summary, Ground Sites, Beta Angle, Traj Summary	18-24 months	Quarterly Updated by: 01 February 01 May 01 August 01 November
TOPO-52: **Short Term Plan (STP)**	A short-term assessment of the ISS altitude strategy and reboost plan Its primary purpose is to provide data for the ISS TDRSS schedule planning process and the ISS crew onboard plan viewer	Goal is to be accurate within ±6 minutes AOS/LOS (or ~2700 km down track) after 4 weeks Typically, within ±3 minutes	Format 13 ephemeris (5 min or 12 hour dense) SAA, Sun lighting, Nodal Summary, Ground Sites	8 weeks	Weekly Typically updated every Monday

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TOPO Products (ISS Ephemeris and Ancillary Data)

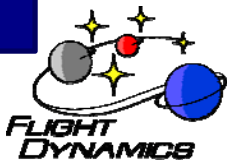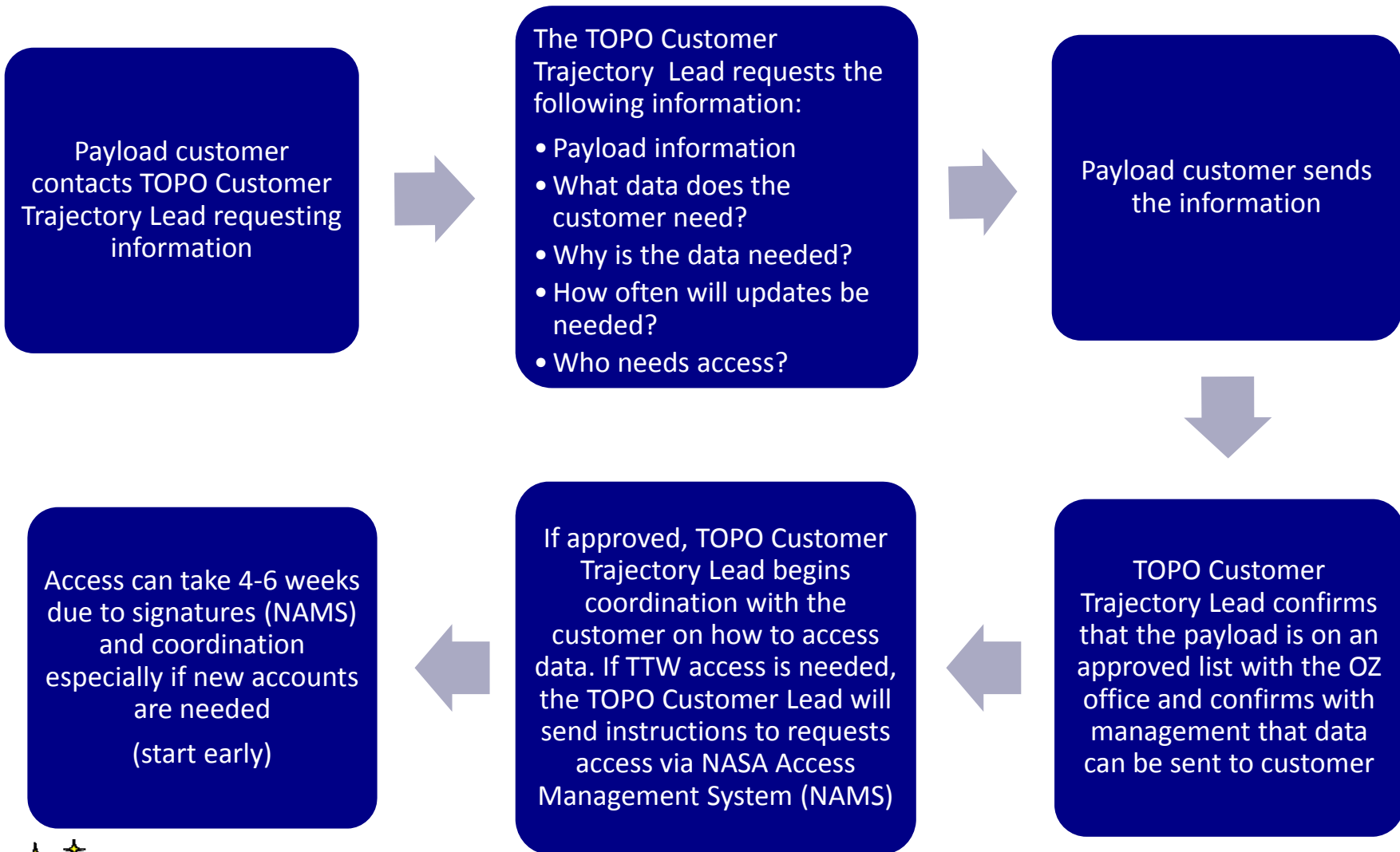| TOPO Products	Description	Accuracy	Format	Duration	Frequency
Mission Control Center (MCC) **ISS Ephemeris**	Ephemeris used on console by TOPO to model the ISS trajectory for real time products and analysis	Goal is to keep the ground's knowledge of ISS to within ±35 km of down-track position error at 72 hours Typically less than ±10 km in downtrack position after 72 hours	TSA Ephemeris (4 min dense) Ability to pull single vectors through JAVA App Sun, Moon, and Ground Site Acquisition info, Nodal info	15 days	Typically updated every Monday, Wednesday and Friday or as needed
Best Estimated Trajectory (BET)	The BET is an <u>estimate</u> of the as-flown ISS trajectory	Optimized to minimize downtrack errors after 1 week	Format 13 ephemeris (5 min dense) SAA, Sun Lighting, Nodal Summary	Historical data is broken into 1-week segments	Weekly Typically updated every Monday
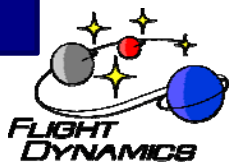
TOPO Products Availability

TOPO Products	Where is the Data Available?	How to requests access?
TOPO-01: Reference Trajectory	TOPO Homepage or specific files can be automatically emailed upon product delivery	Email the TOPO Customer Trajectory Lead to request data and required access, if applicable
TOPO-52: Short Term Plan (STP)	TOPO Homepage or specific files can be automatically emailed upon product delivery.	
Mission Control Center (MCC) ISS Ephemeris	TOPO Trajectory Web (TTW) via MCC-H Gateway (*)	
Best Estimated Trajectory (BET)	TOPO SharePoint website	

(*) – TOPO currently in the process of replacing all planning and real-time software tool suite. This location may change in the near future. The new format will be the Free Flyer version 2 ephemeris

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Request Process

Payload customer contacts TOPO Customer Trajectory Lead requesting information

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The TOPO Customer Trajectory Lead requests the following information:

- Payload information
- What data does the customer need?
- Why is the data needed?
- How often will updates be needed?
- Who needs access?

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Payload customer sends the information

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If approved, TOPO Customer Trajectory Lead begins coordination with the customer on how to access data. If TTW access is needed, the TOPO Customer Lead will send instructions to requests access via NASA Access Management System (NAMS)

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TOPO Customer Trajectory Lead confirms that the payload is on an approved list with the OZ office and confirms with management that data can be sent to customer

Access can take 4-6 weeks due to signatures (NAMS) and coordination especially if new accounts are needed

(start early)

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TOPO POCs

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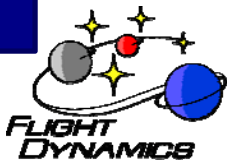
BACKUP
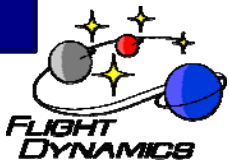
Format 13 definition

The file contains state vectors at a set interval and after every orbital adjust maneuver in the J2000 coordinate system. The file is an ASCII file. The first three (3) lines of the file are text header information. The first line contains the name of the file. The second line contains the number of fields in file. The third line lists the Data Field Titles in order. The state vector data starts on the fourth (4th) line. A single blank space occurs between each data field. Each line represents one vector. Subsequent vectors are printed in time order on consecutive lines. No non-vector lines occur between vectors or after the last vector. There are no duplicate vectors in the files.

The Mission Elapsed Time (MET) Base in the file is YYYY/001:00:00:00.000 GMT, where YYYY is the current year. End of year roll overs are not accounted for in the MET parameter. Therefore, the MET DDD component can be greater than 366 days for a given year.