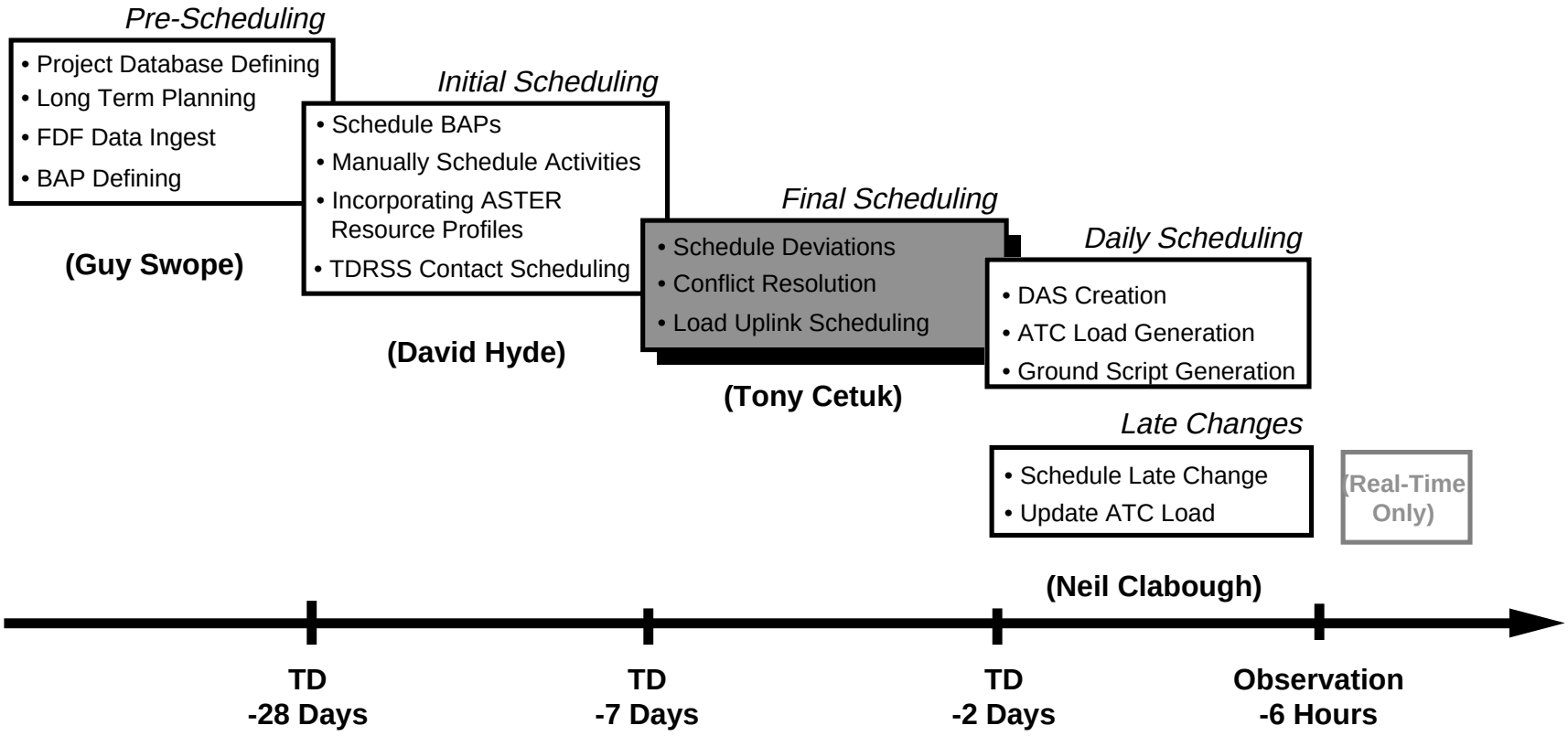
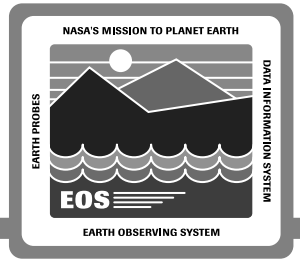
Final Scheduling



Final Scheduling Overview



Activity Deviation Scheduling

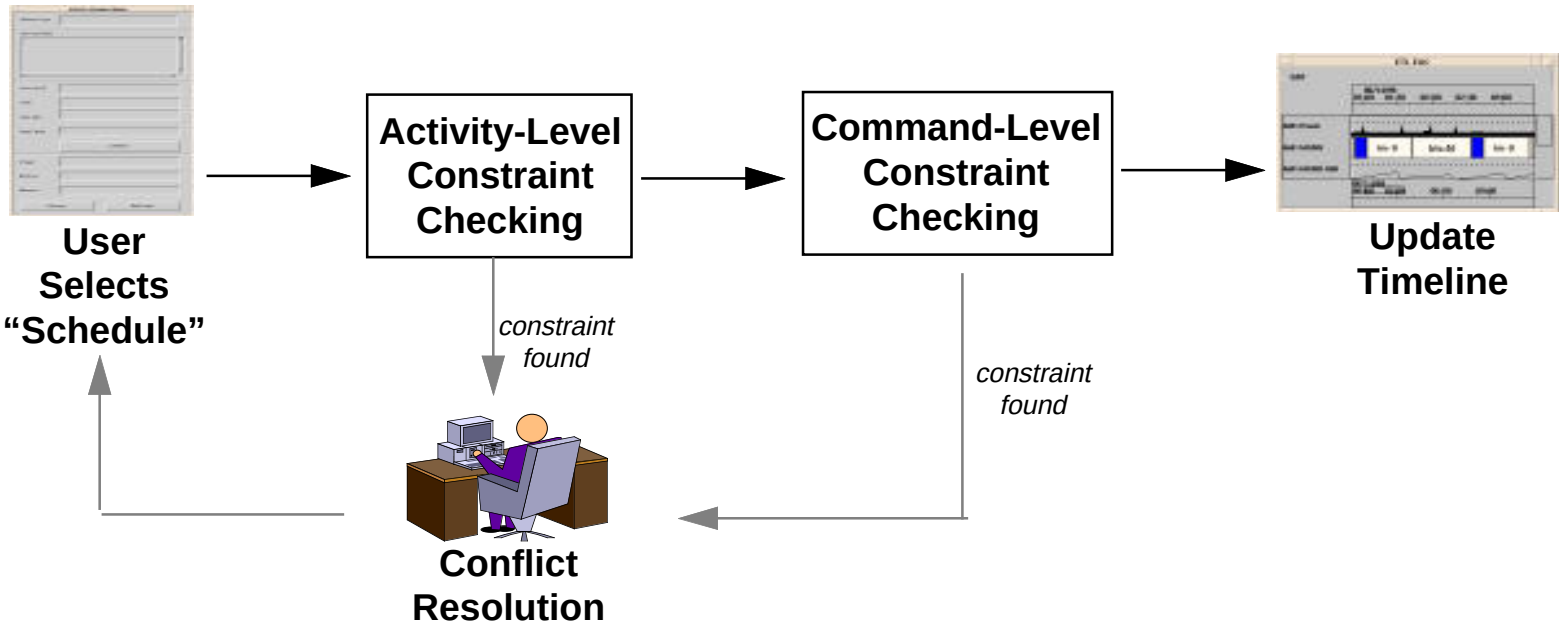
- **ISTs send activity deviation requests to EOC, if desired**
- **ASTER ICC sends activity list and deviations to EOC**
- **Spacecraft subsystem activity deviations incorporated by FOT, if necessary**
- **Conflict Resolution**
  - **Identification of scheduling conflicts**
  - **Analysis aids for resolution**

Load Uplink Scheduling

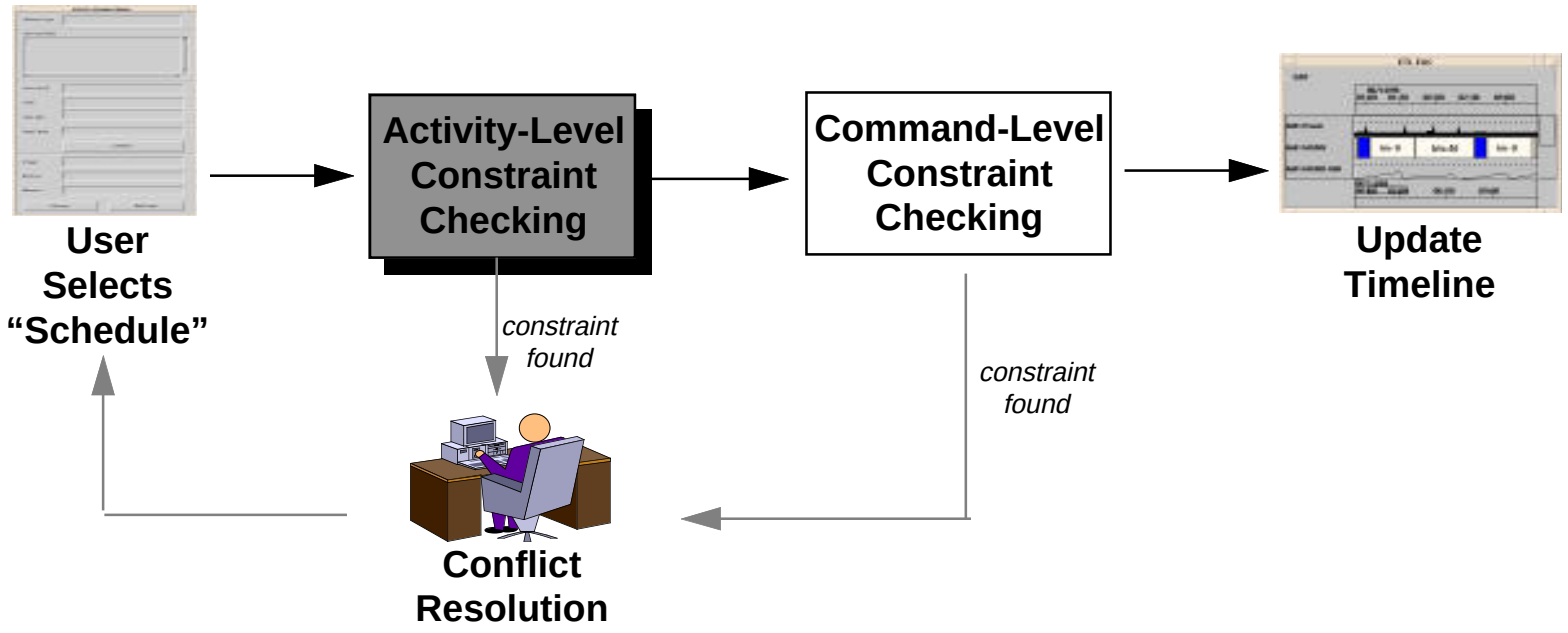
- **User created load contents submitted to EOC**
- **Uplink load generated from load contents**
- **FOT or IOTs schedule uplink time into mission schedule**

Activity Deviation Scheduling Overview

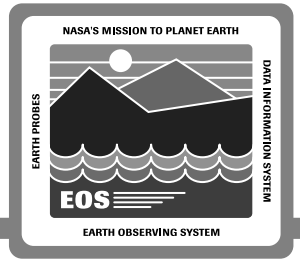
Functions Related To Activity Deviation Scheduling



Activity-Level Constraint Checking



Activity-Level Constraint Checking Description



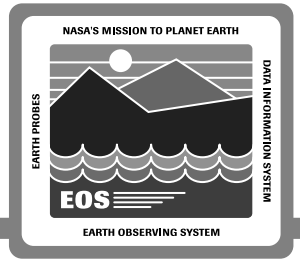
AM1 Activity-Level constraint checks include modeling related to:

- **Power and data volume consumption**
- **Valid Mode Transitions**
- **Timing Constraints**
- **Pointing Limitations (e.g. HGA gimbal limits)**
- **Field-Of-View Coverage (e.g. CERES avoiding sun intrusion)**

Hard constraints impact spacecraft health and are not allowed in conflict-free schedule used for command load generation (e.g. exceeding gimbal limitation)

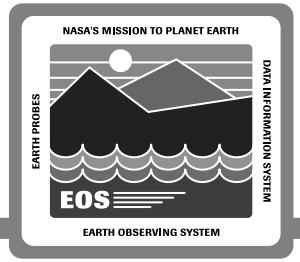
Soft constraints do not impact spacecraft health and are allowed in conflict-free schedule pending approval (e.g. exceeding data buffer storage limits)

Activity-Level Constraint Checking Design



See following page.

Activity-Level Constraint Checking Scenario



Pre-Conditions: Using Activity Scheduler Tool, the MODIS instrument scheduler sets start/stop time for a MODIS calibration activity and selects "Schedule"

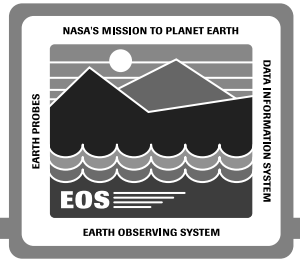
The MODIS Instrument checks following constraints:

- **Valid mode transition**
- **Timing constraints**
- **Sun does not enter instrument's field-of-view**

The Power Subsystem checks if it can allocate requested amount of wattage

The Recorder Buffer checks if its data volume exceeds storage limit

Activity-Level Constraint Checking Scenario (cont.)



If no constraints are found, the following states are updated:

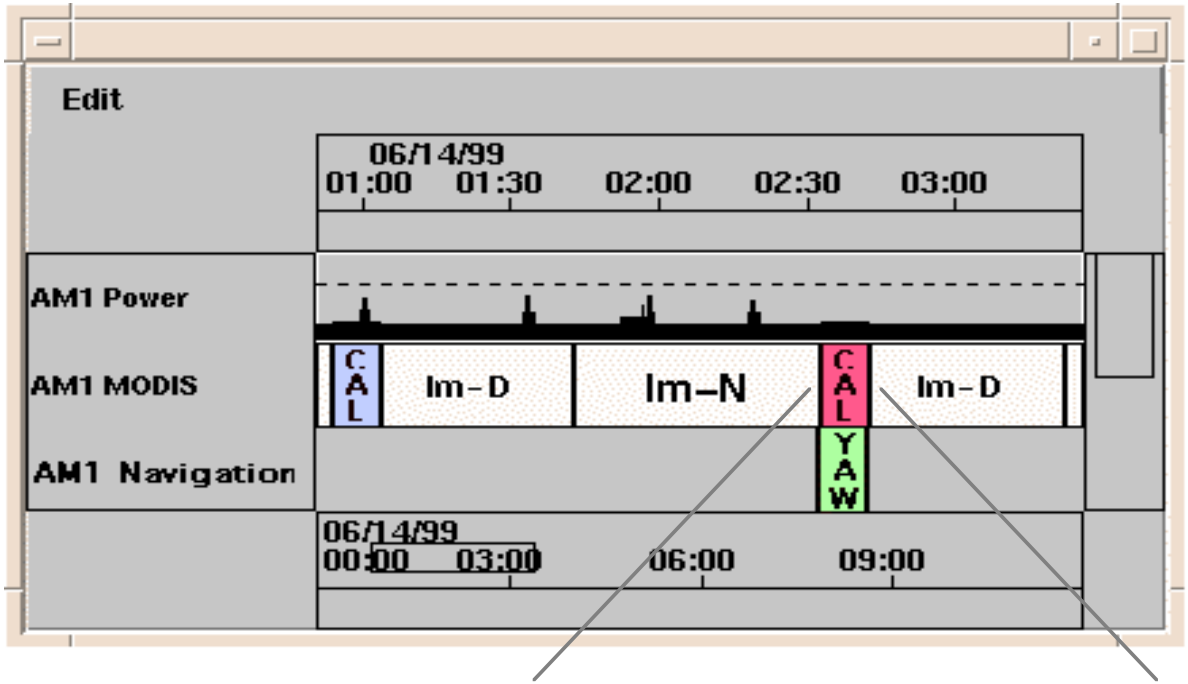
- **MODIS Instrument sets mode and data rate**
- **Power Subsystem updates wattage**
- **Recorder Buffer updates data volume**

If constraints are found, the MODIS instrument scheduler is notified:

- **Oversubscription turned on:**
  - **An event is sent to user describing constraint**
  - **MODIS calibration activity is incorporated into mission plan and displayed on timeline in a constraint state**
- **Oversubscription turned off:**
  - **An event is sent to user describing constraint**
  - **MODIS calibration activity is not incorporated into mission plan**

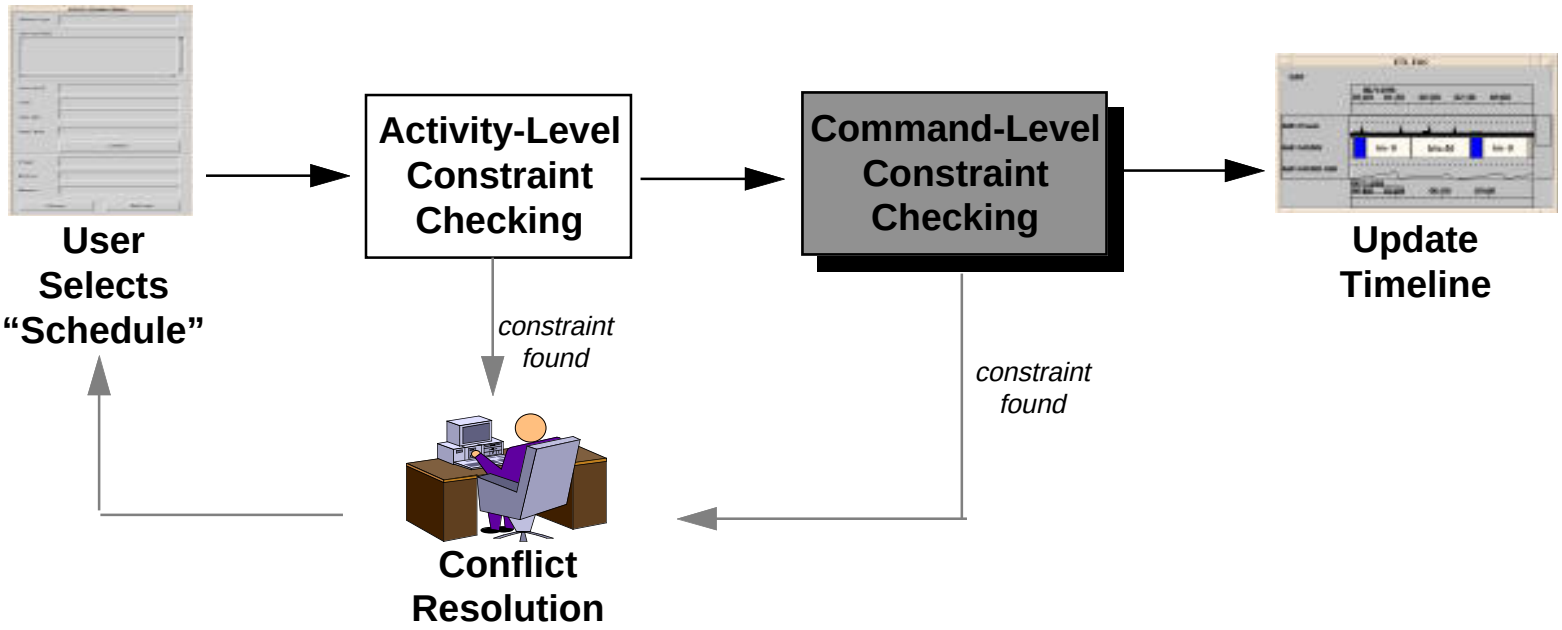
Activity-Level Constraint Checking Scenario (cont.)

Example of MODIS Calibration constrained by a yaw maneuver:

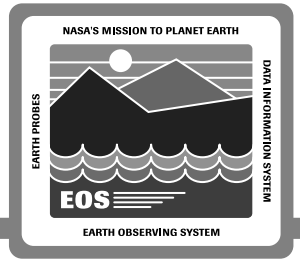


"MODIS CAL activity id #216745: Sun in sensor FOV"

Command-Level Constraint Checking



Command-Level Constraint Checking Description



Activities expanded into directives to allow command-level constraint checking to be performed

Directives represented with a time tag, keyword and optional parameters

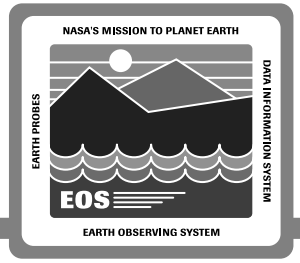
Directives merged into appropriate schedule(s):

- **Ground Schedule - Continuous time ordered list of ground commands (basis for generating Ground Script)**
- **ATC Schedule - Continuous time ordered list of absolute time commands (basis for generating ATC Load)**

Command level spacecraft constraints include:

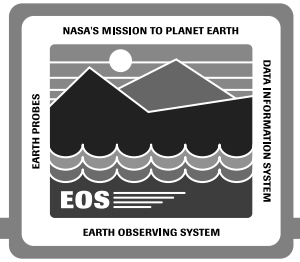
- **Number of commands per second**
- **Rule-based sequencing checks (e.g. If MODIS_IMAGE_ON, then MODIS_DOOR_OPEN)**

Command-Level Constraint Checking Design



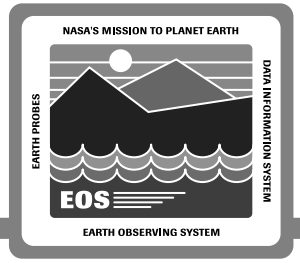
See following page.

Command Level Constraint Checking Design (cont.)



See following page.

Command-Level Constraint Checking Scenario



Pre-Conditions: The MODIS calibration activity has successfully passed activity-level constraint checking

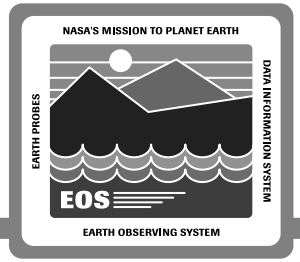
An Add Activity Request is received that specifies a MODIS calibration with corresponding start time and parameters

MODIS calibration activity expanded into its directive form

- **Activity name used to locate definition in activity database**
- **Start time of activity added to relative times in definition to obtain directive time tags**
- **Parameters applied to directives as specified in definition**

MODIS calibration directives merged into time ordered list of commands maintained in ATC Schedule

Command-Level Constraint Checking Scenario (cont.)



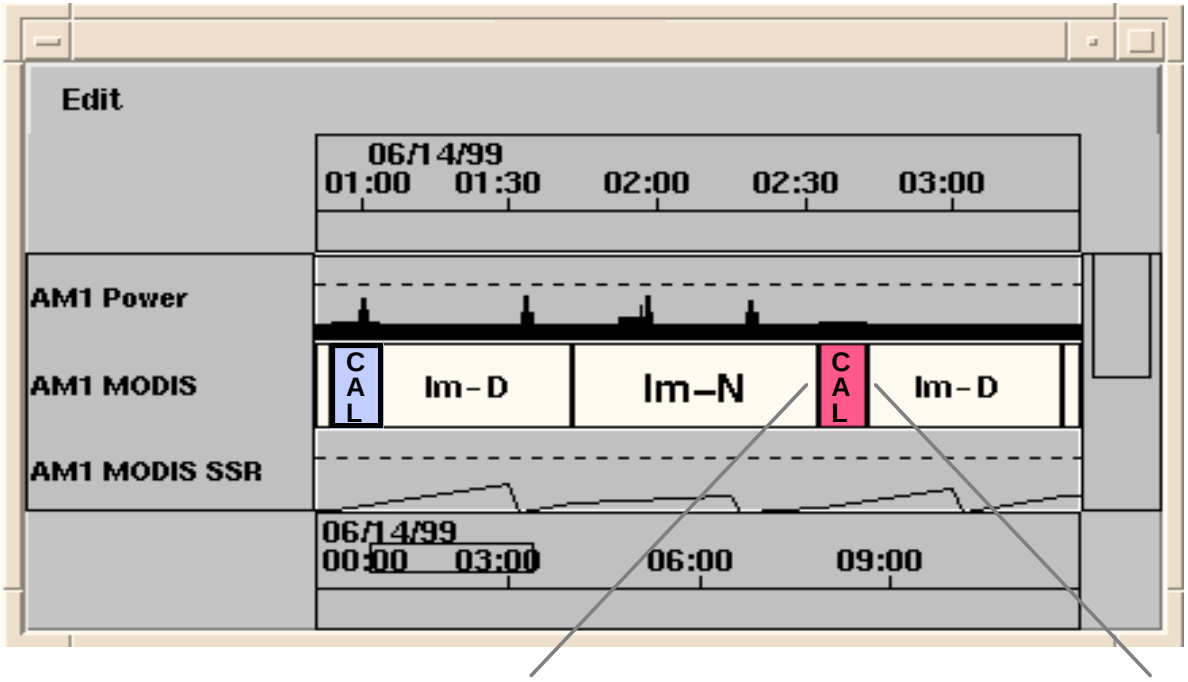
ATC schedule sends updated portion of its command list with a request to check constraints

- **ATC Buffer Model checks command timing constraints**
- **Command Model checks command sequencing constraints**
  - **Uses database defined rules**

Constraints notified to user through events and timeline display

Command-Level Constraint Checking Scenario (cont.)

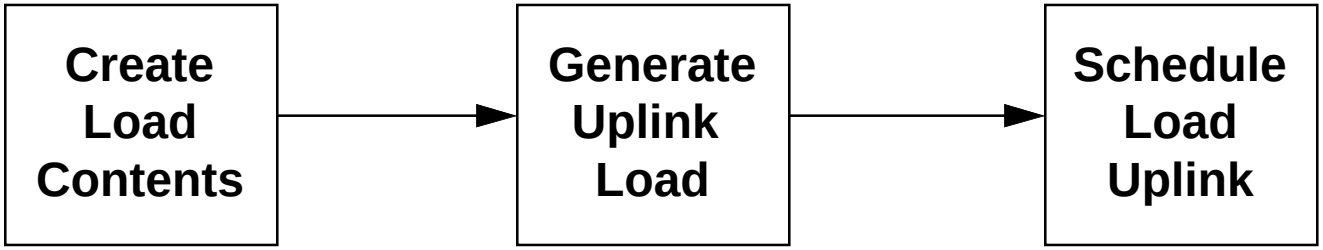
Example of MODIS Calibration command-level constraint notification:



"MODIS CAL activity id #216745: Number of simultaneous ATC commands exceeds 8"

Load Uplink Scheduling Overview

Four types of loads: Flight Software, Microprocessor, Table and RTS

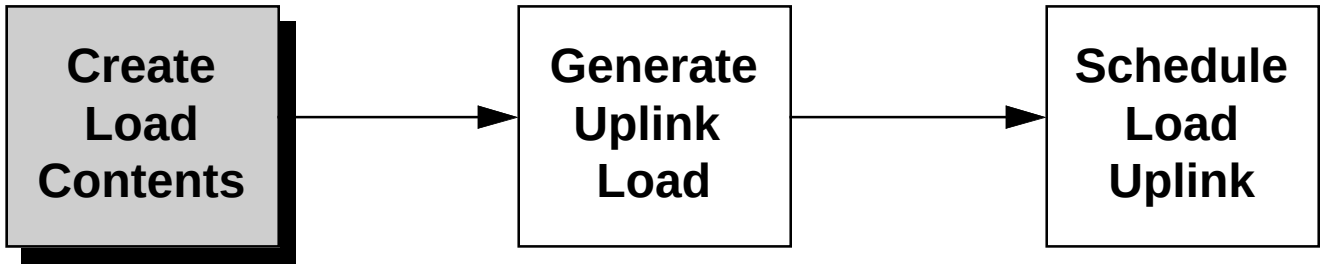


Load data created by FOS, SDF, SCF or FDF and sent to EOC

During load generation, EOC converts load data into proper uplink format

Scheduling tools provide users with capability to schedule desired uplink times for their load

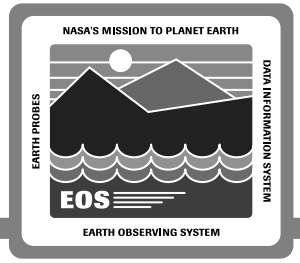
Create Load Contents Description



Method of load contents creation dependent on load type:

- ***RTS and Table Loads***
  - Created by EOC or IST using FOS tools
  - Created externally to FOS and transferred to EOC
- ***Microprocessor Load***
  - Created by Science Computing Facility and transferred to EOC
- ***Flight Software Load***
  - Created by Software Development Facility and transferred to EOC

Create Load Contents Tools



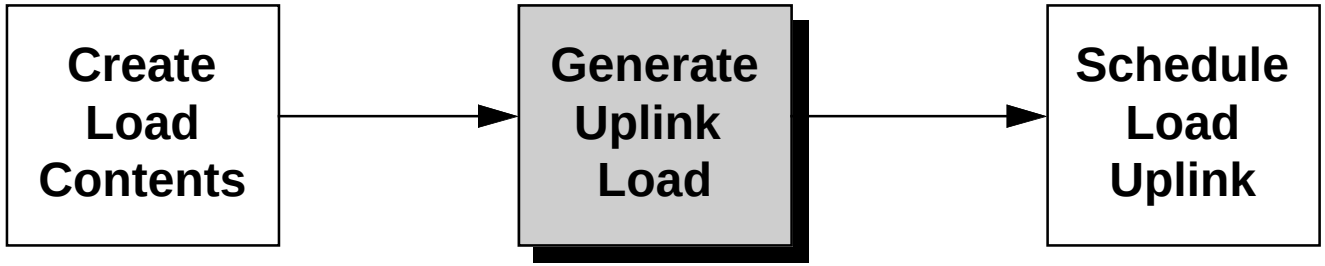
RTS Load Builder

- **Provides typical editor functions for entering command mnemonics and relative time tags**
- **Allows user to request uplink load generation**
  - **Contents validated when uplink load generation requested**

Table Load Builder

- **Allows user to enter table data following database defined template**
  - **Uses template to validate field contents during data entry**
- **FDF orbit data may be used as input**
- **Allows user to request uplink load generation**

Generate Uplink Load Description



Uplink load generation may be initiated by:

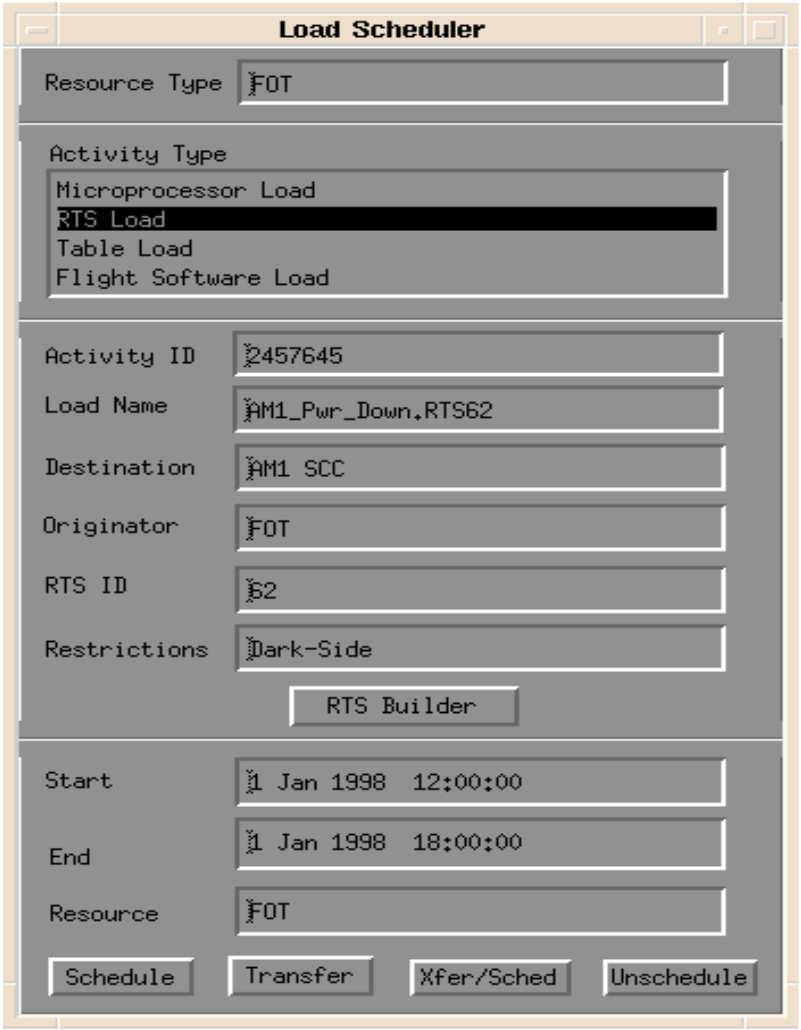
- **Load generation request from RTS Builder tool**
- **Load generation request from Table Builder tool**
- **Load transfer notification from Load Scheduler tool**

Uplink load generation process includes validation of load contents for:

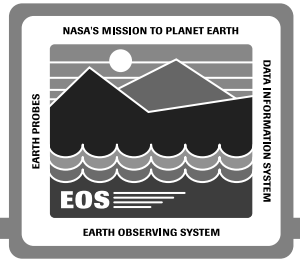
- **RTS loads**
- **Table loads**

Generate Uplink Load Description (cont.)

Example of Load Scheduler Display

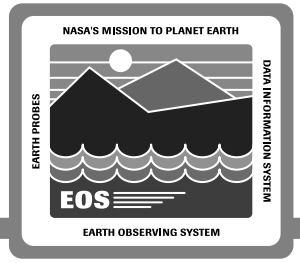


Generate Uplink Load Design



See following page.

Generate Uplink Load Scenario



MISR instrument scheduler submits MISR microprocessor load contents using Load Scheduler Tool

Load Catalog receives notification that a microprocessor load contents file has been submitted

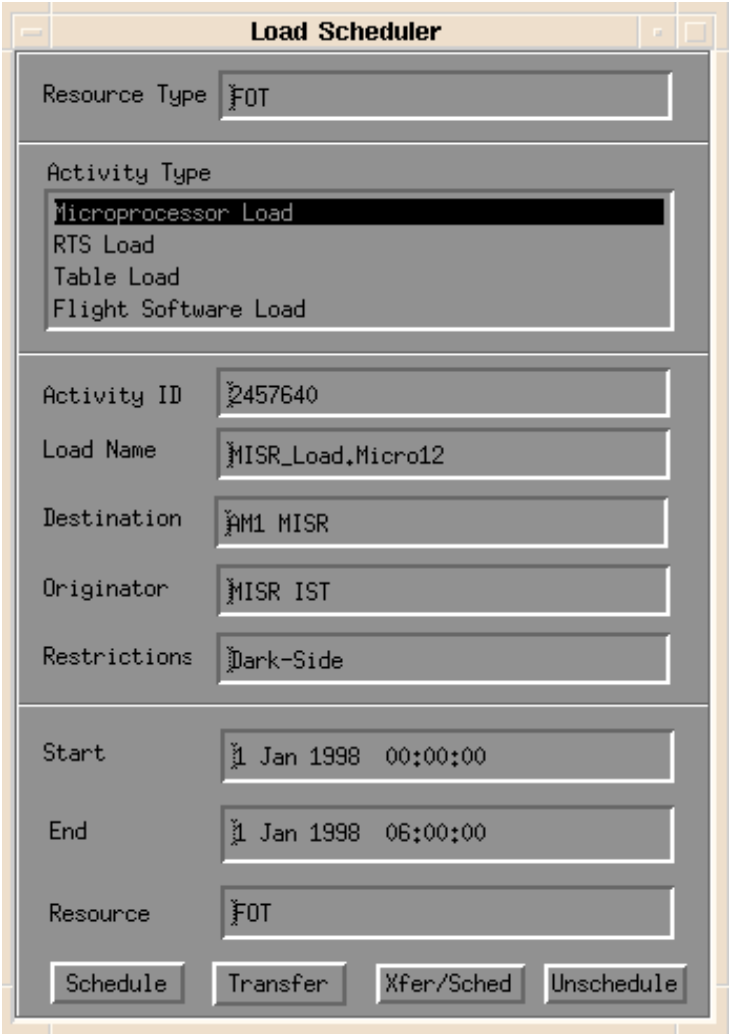
MISR uplink load generated from load contents

- **Appends load initiate command**
- **Formats for 1553 bus**
- **Appends CCSDS packet headers**

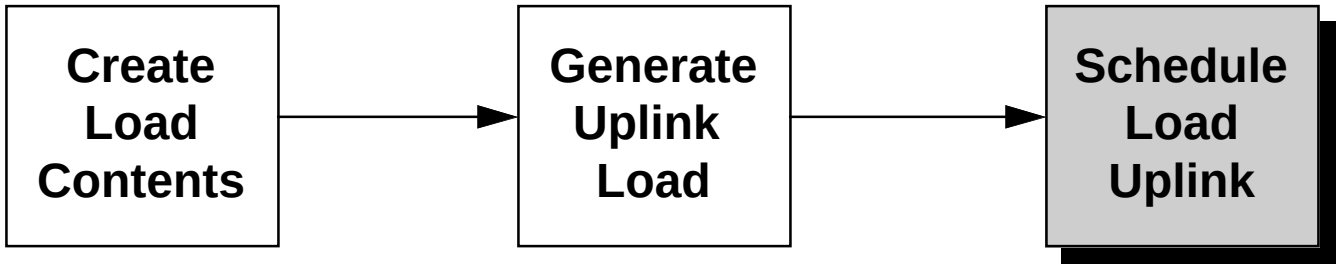
MISR uplink load stored in EOC local archive and a corresponding load report is generated

Generate Uplink Load Scenario (cont.)

Example of Submitting a MISR Microprocessor Load



Schedule Load Uplink Description



For each load, FOS will provide capability of scheduling an uplink window that indicates time period user requires load to be sent

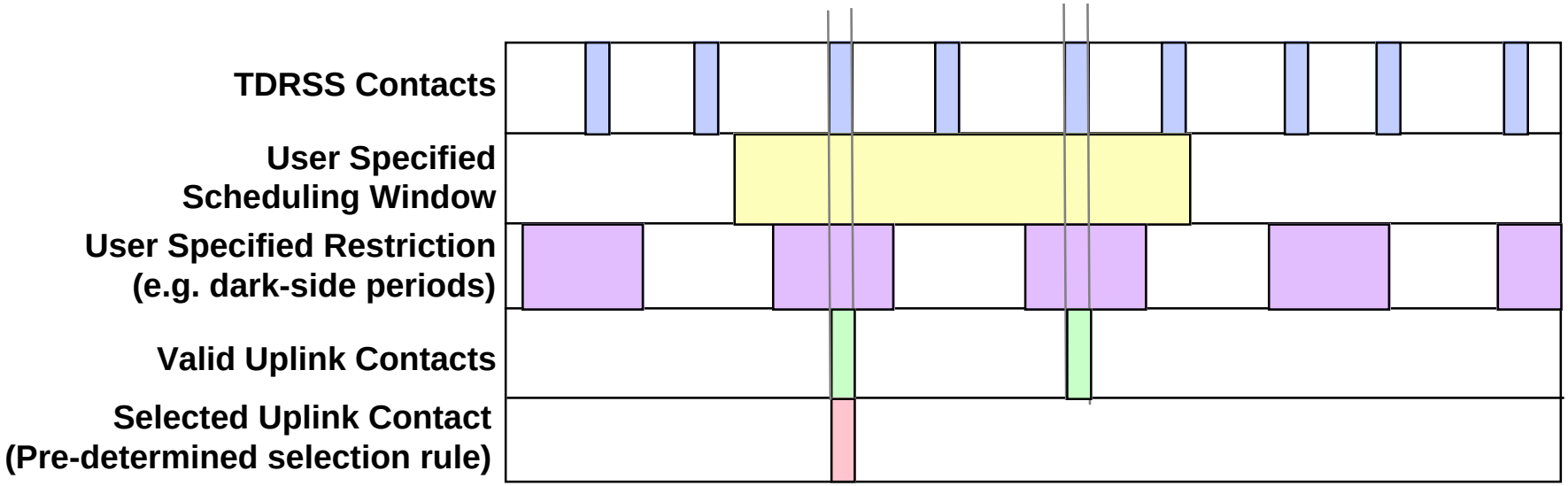
- **Time period may correspond to a specific communication contact (e.g. one TDRSS contact) or a longer time duration (e.g. a 6 hour time period)**

EOC uses uplink window for choosing a communication contact when FOT will send load

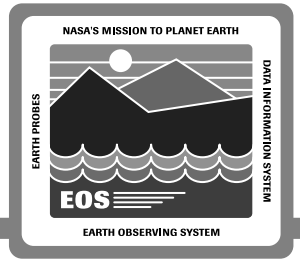
If a communication contact is not available that satisfies user request, user then notified

Schedule Load Uplink Description (cont.)

Uplink Scheduling Restrictions

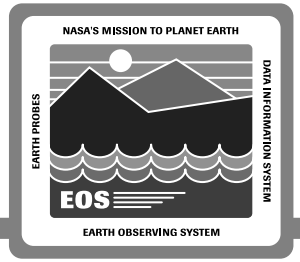


Schedule Load Uplink Design



See following page.

Schedule Load Uplink Scenario



Precondition: MISR instrument scheduler has submitted MISR microprocessor load to EOC

Using Load Scheduler Tool, MISR instrument scheduler specifies a 6 hour window for uplinking MISR microprocessor load

User specifies load name for uplink and a restriction to only uplink during dark-side TDRSS contacts

User selects "Schedule"

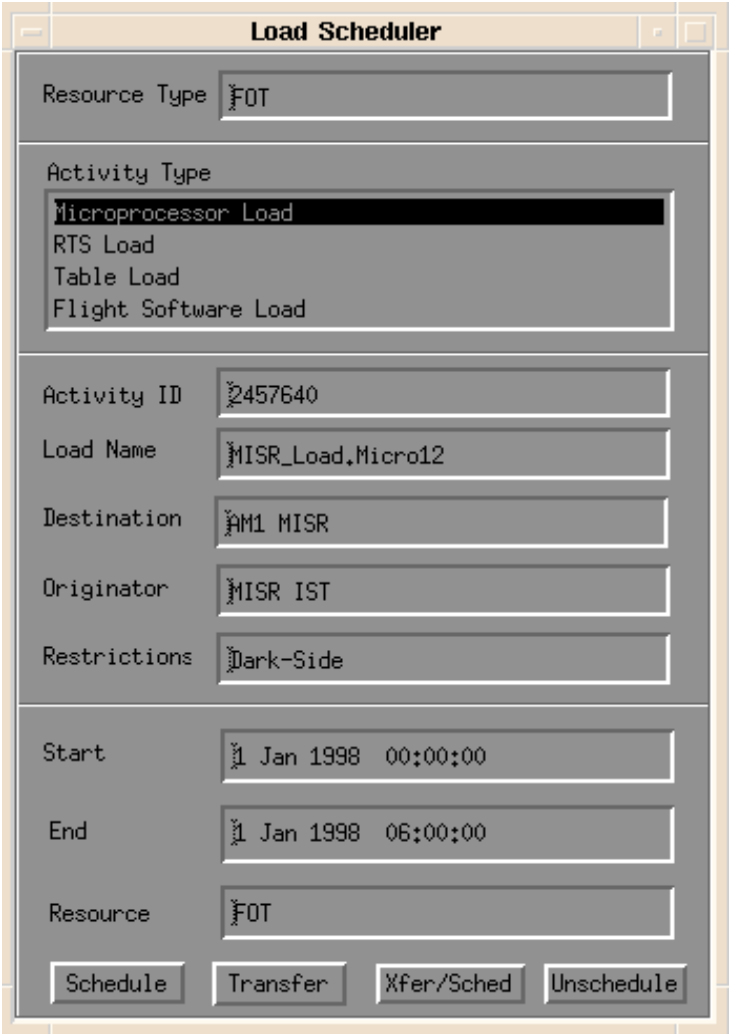
Requested window checked against following limitations:

- **Available TDRSS contacts**
- **Spacecraft dark-side periods**
- **Load existence**

MISR instrument scheduler notified of uplink status through timeline display and events

Schedule Load Uplink Overview (cont.)

Example of Scheduling Uplink Times for MISR Microprocessor Load



Schedule Load Uplink Scenario (cont.)

Example of Successfully Scheduled MISR Uplink Load