
Kepler Mission
Operations
Scheduling
—
Resource
Optimization
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# Kepler Mission Overview

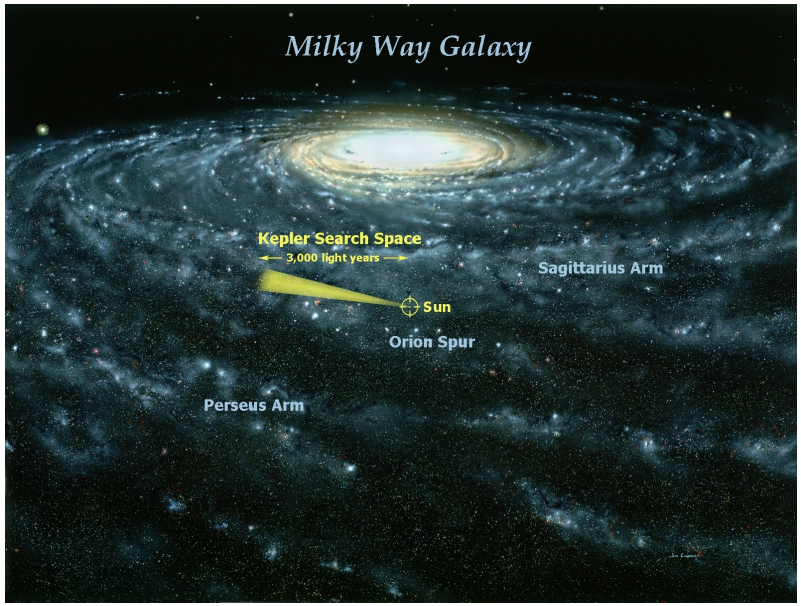
**Mission Objectives** - Explore the diversity of extrasolar planetary systems and determine:

- The frequency of terrestrial and larger planets in or near the habitable zone of a wide variety of stellar spectral types
- The distribution of sizes and semi-major axes of these planets
- If there are additional members of each planetary system using other techniques
- Determine the distributions of semi-major axis, albedo, size, and density of short-period giant planets
- The percentage and orbital distribution of planets orbiting multiple star systems
- The characteristics of those stars that harbor planetary systems

**Mission Design**

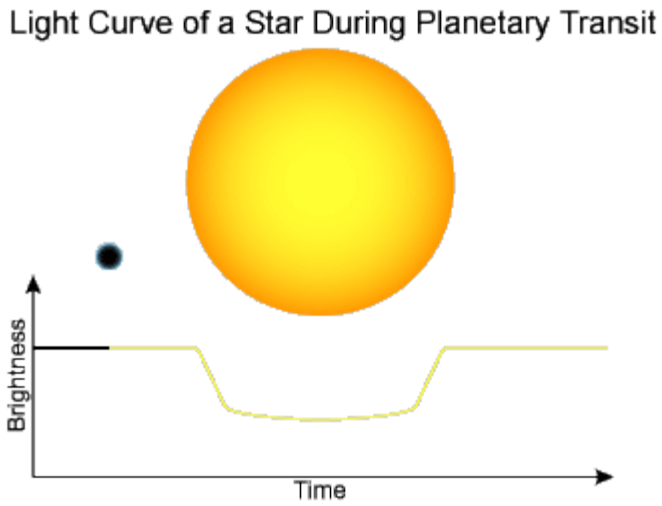
3.5-year flight (>6 years consumables)
Earth-trailing heliocentric orbit
Single instrument
Single field-of-view
170,000 targets
⇨ Monthly data downlinks
⇨ Quarterly rotations about the line-of-sight

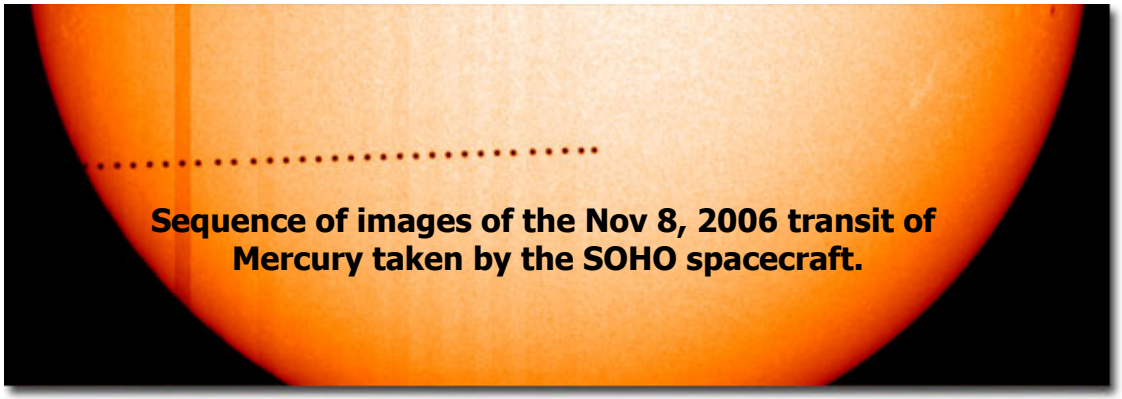
Launched March 6, 2009



# Transit Detection Method

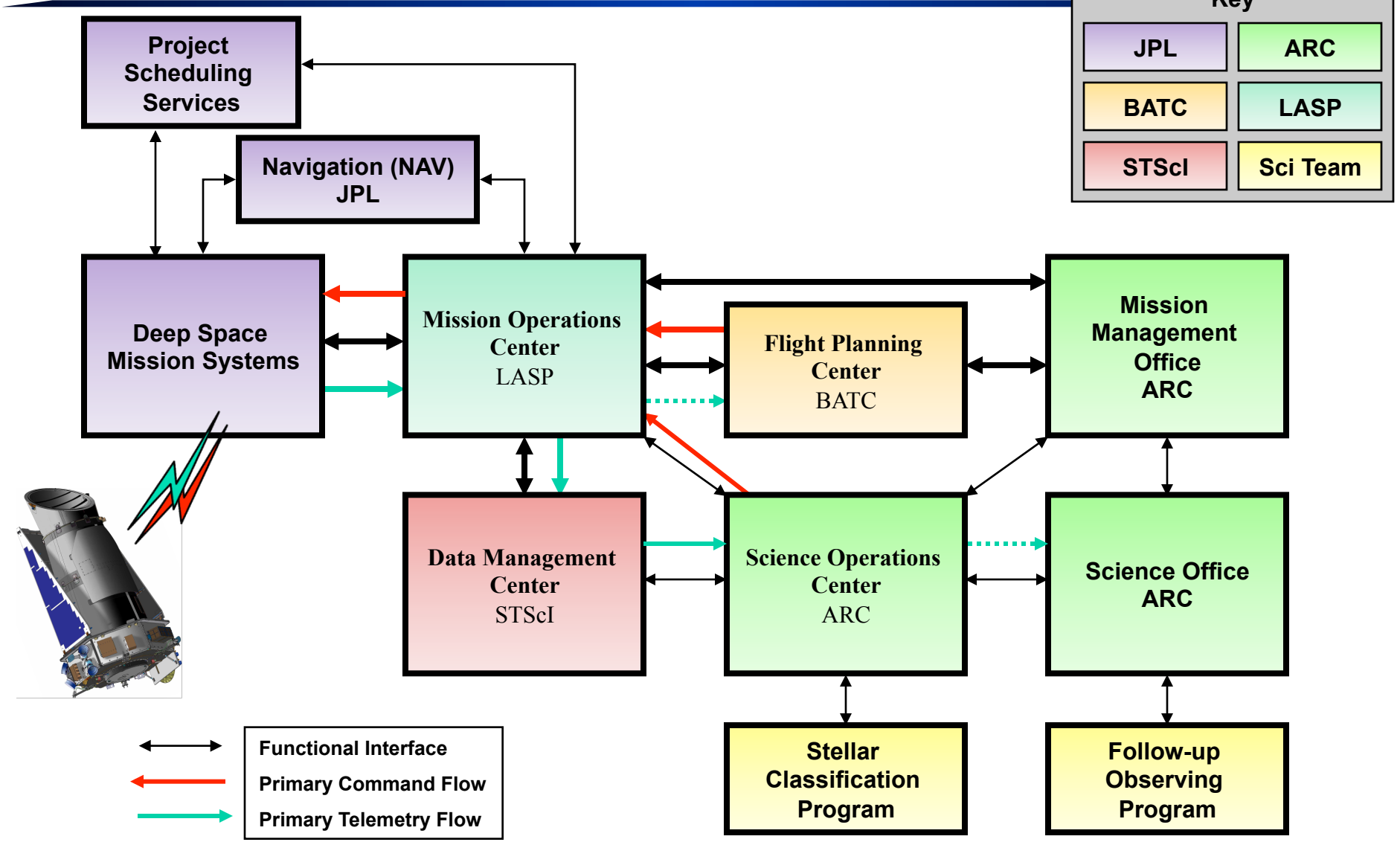
- Kepler will discover planets around other stars by observing transits
- A transit occurs when a planet passes in front of its star and blocks part of the star's light.
  - Jupiter would block 1% of the sun's disk
  - Earth (or Venus) would block 0.01% of sun's disk
  - Mercury blocks 0.001% of sun's disk



**Sequence of images of the Nov 8, 2006 transit of Mercury taken by the SOHO spacecraft.**

# Distributed Team



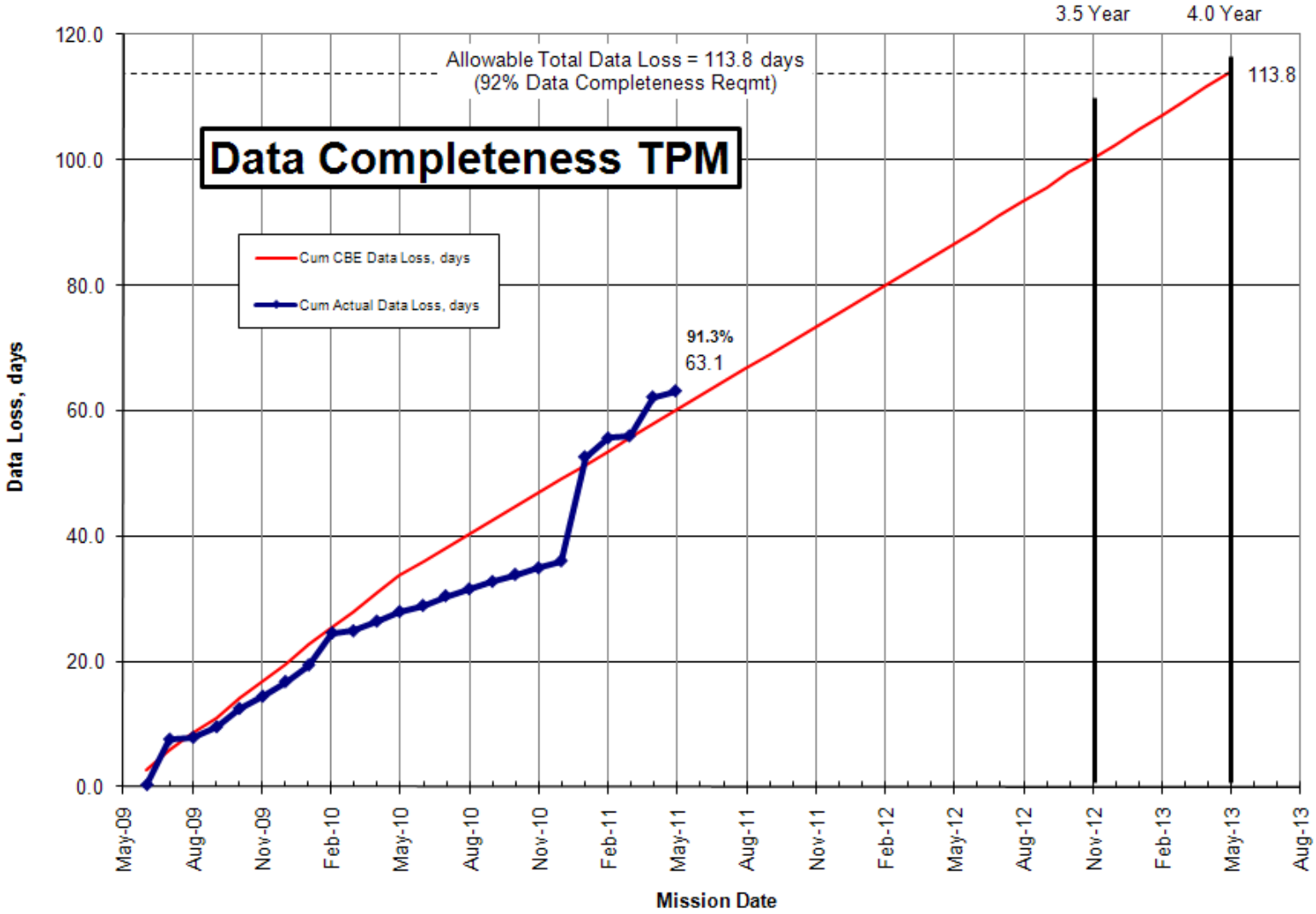

# Operations
# Time Management & Scheduling


**Key Requirement** –Data Completeness

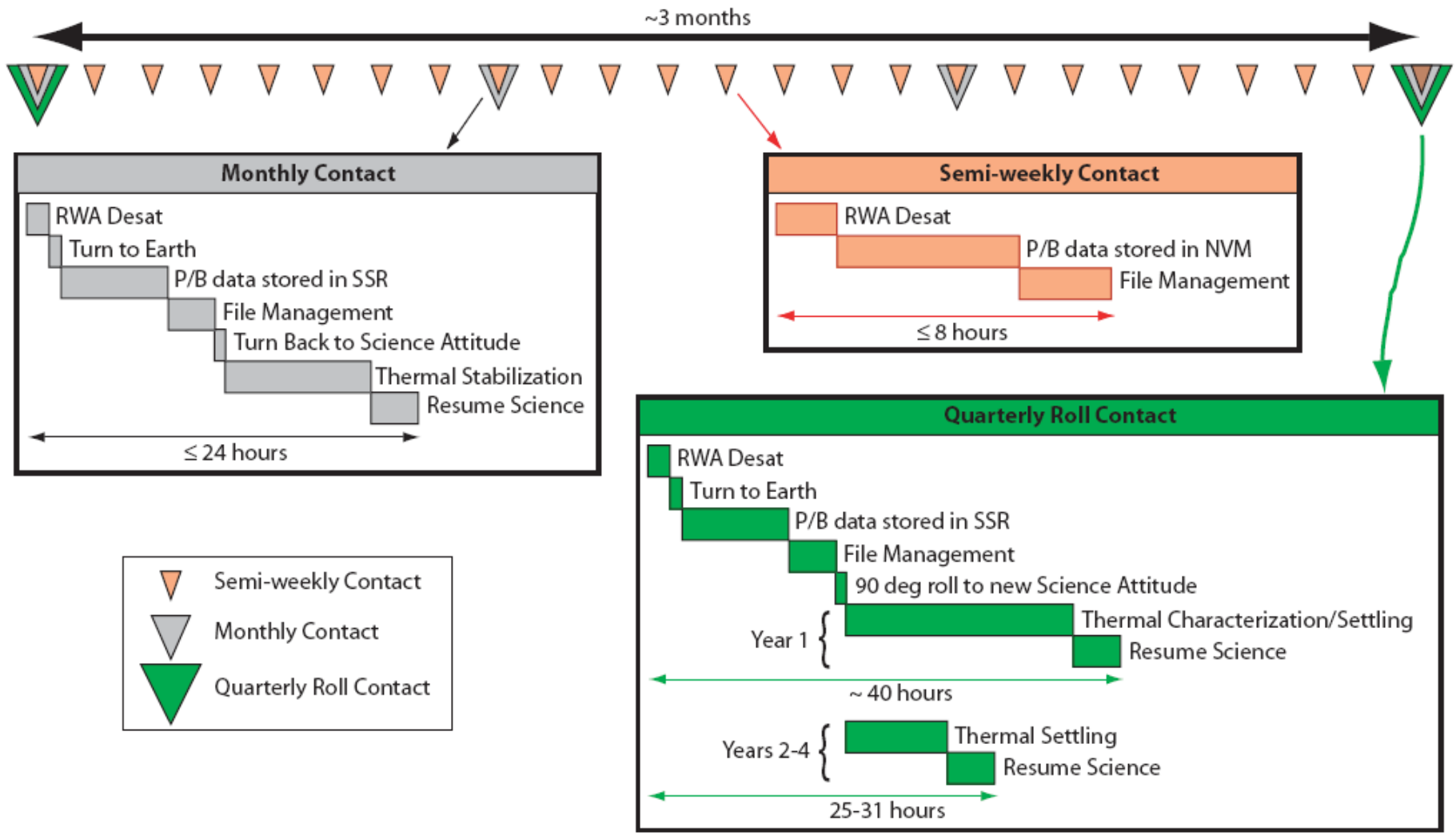
- ✓ Transits are 5 – 20 hours in duration
- ✓ Don't know where or when a transit will occur
- ✓ Telescope requirement is to gather data 92% of the time
- ✓ Data breaks occur due to:
  - Monthly/Quarterly downlinks
  - Reaction wheel desaturation
  - Cosmic rays
  - Anomalies
  - Others…

# Data Completeness

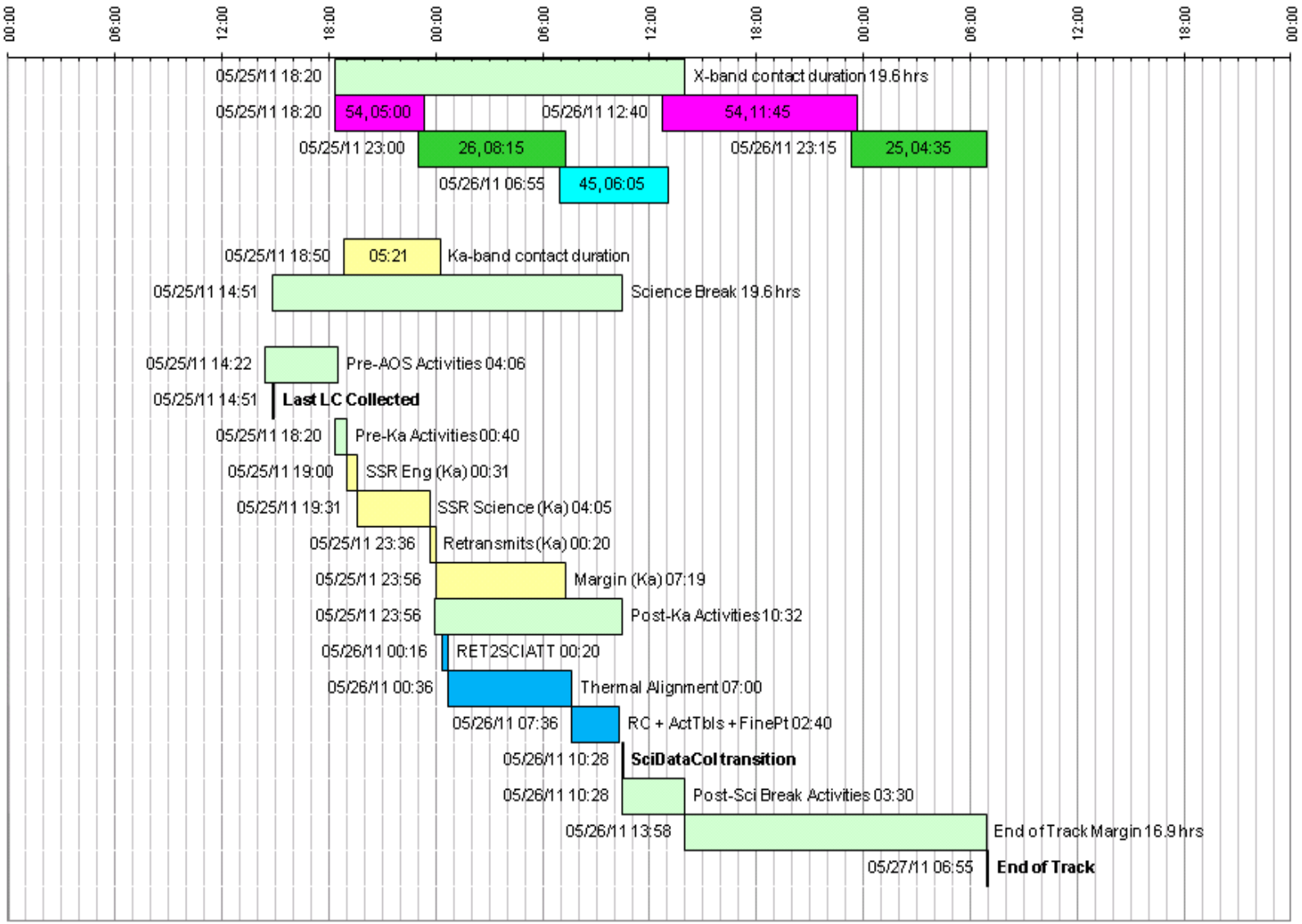
- April Monthly Contact was 16.7 hrs



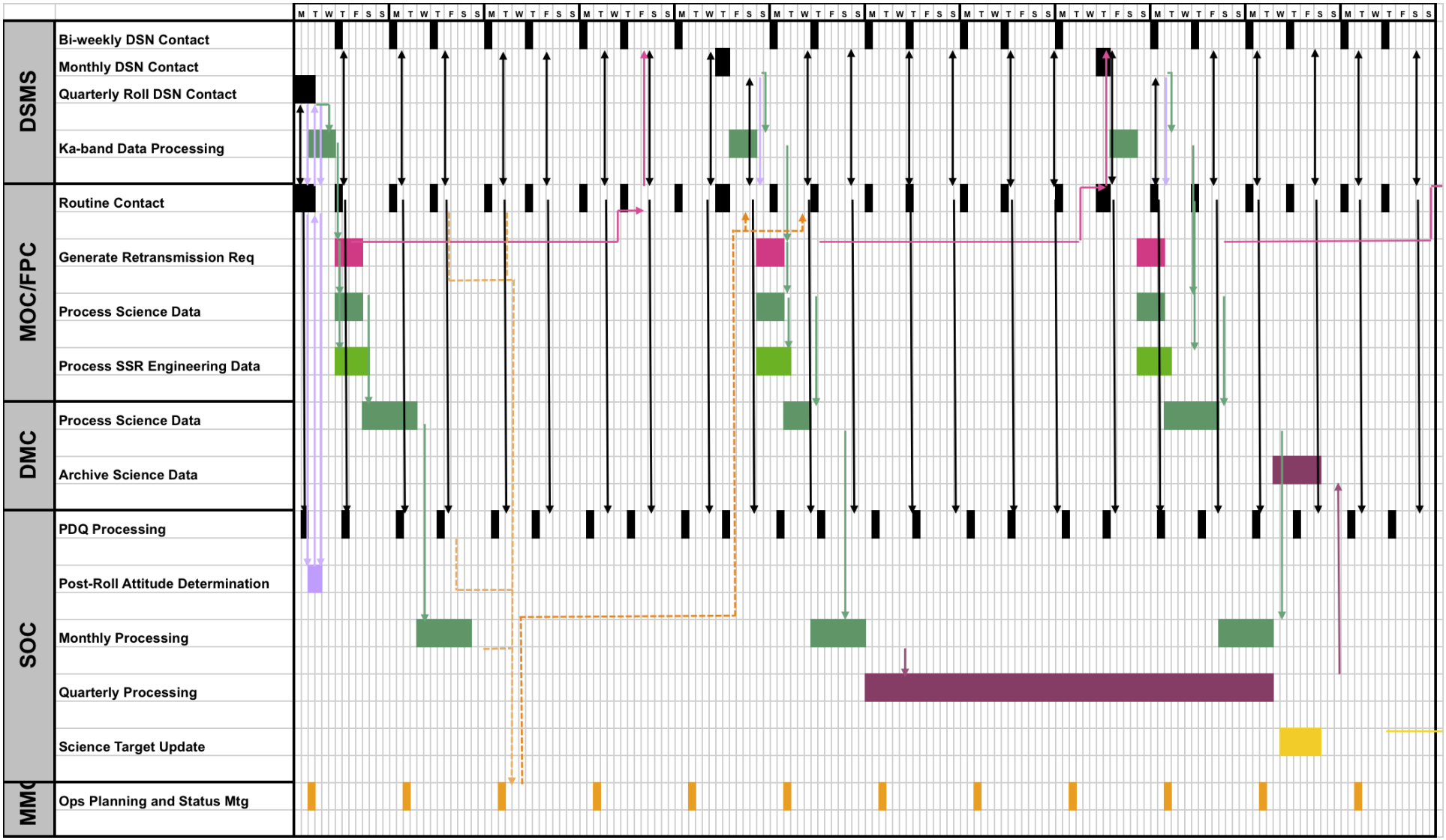
# Operational Cadences



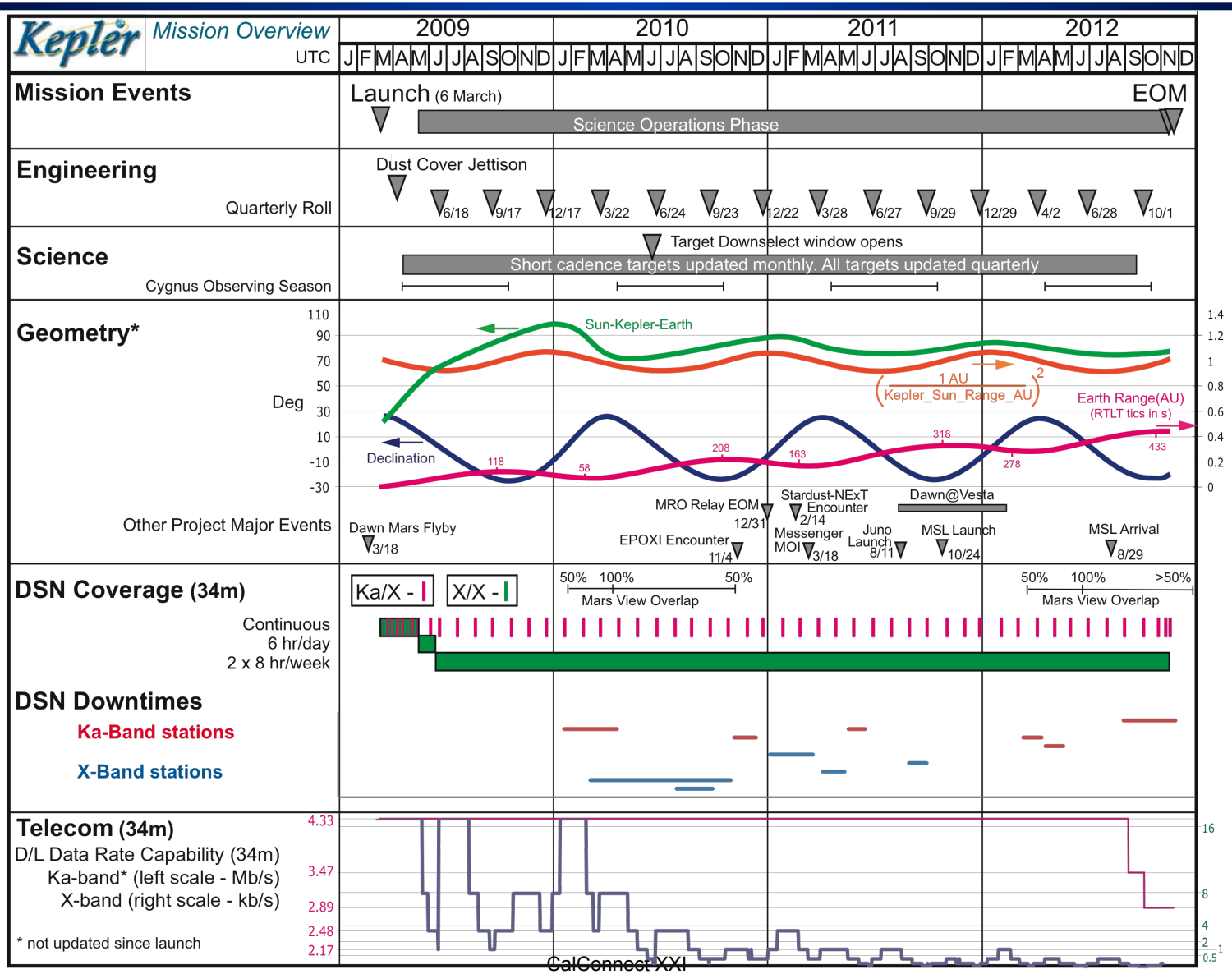
# May Monthly Timeline



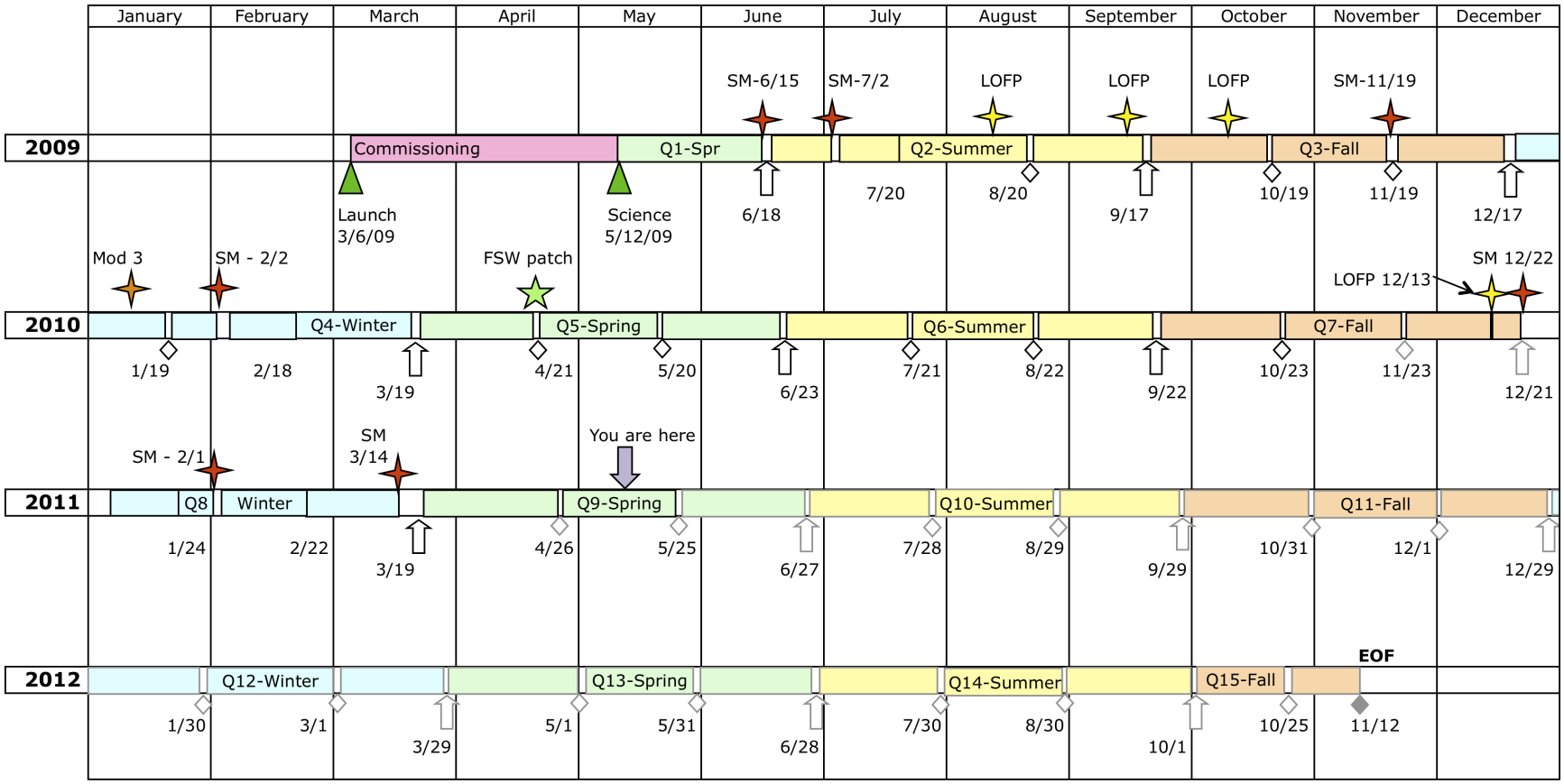
# Cadence Data Flow



# Downlink Resources



# Mission Timeline




**Symbol Key**

| | |
|---|---|
| Quarterly roll | Monthly |
| Safe Mode Event | Module 3 anomaly |
| Loss of Fine-Point | Chart update date |

# Other Scheduling Challenges

## Follow-up Observing

- ✓ Kepler has identified thousands of interesting signals that require follow-up by other ground and space-based telescopes
  - Medium and high resolution spectra
  - High resolution imaging
  - Differing band passes
- ✓ Involves many different observers, instruments and telescopes

## Data Processing, Release & Publication

- ✓ Updated analysis software requires reprocessing of the data set
  - When should data be released internally to the team? To the public?
- ✓ At what point should we slow the analysis in order to publish results?

## Target Management?