

ADVANTAGES OF TIMELINES FOR DEEP SPACE MISSION OPERATIONS

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Outline

- Context
 - Planning-intensive Deep-space Missions
 - Necessity for improved efficiency
- Mission Information
 - Pain Points
 - Timelines as solution
- MOS as Control System
- Synthesis

Context

- There are many ways to classify missions
- Useful distinctions
 - Deep-space vs. Near-Earth
 - Planning-intensive vs. straightforward conops
- Generalizations
 - Most planetary deep-space missions are planning-intensive
 - Most near-earth missions have more straightforward concepts of operations
 - ...of course, there are exceptions

Some Comparisons

Item	Deep-space Planning-intensive	Near-Earth Simpler Conops
Gnd Station Tracking time	Scarce	Abundant
Bandwidth	Scarce	Abundant
Anomaly response times	Hours to days	Minutes to hours
Currently operating missions	~25	~1000
Past missions	~40	~4000

- JPL has a history of planning-intensive, deep-space missions
- The world has order 100X more experience with other types of missions

Issue: Costs

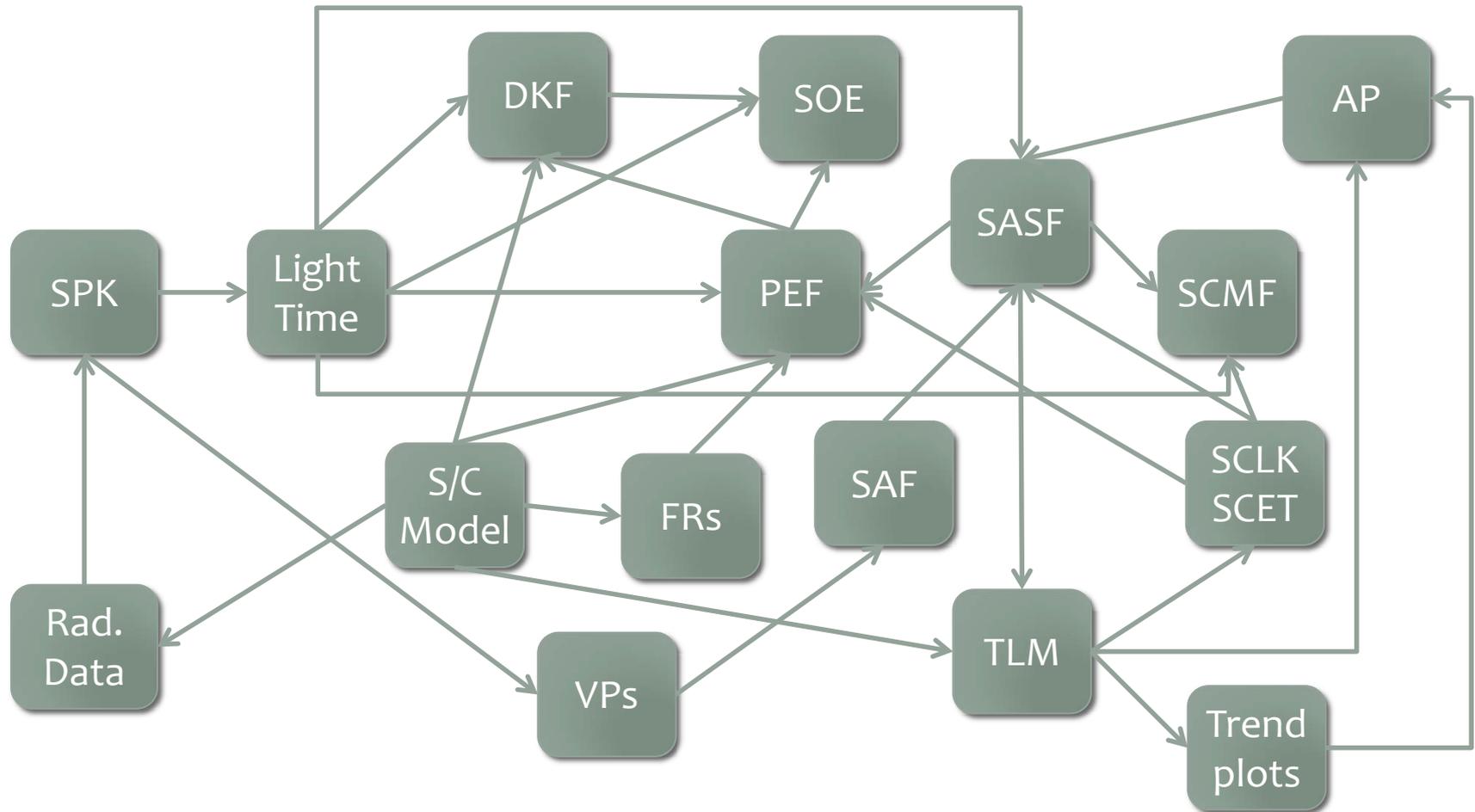
- Planning systems are expensive
 - To Build
 - To Operate
- Response:
 - Identify pain points in current MOS architecture
 - Find cost-effective solutions

MOS PERSPECTIVE ON TIMELINES

Timelines
Control System } Synthesis

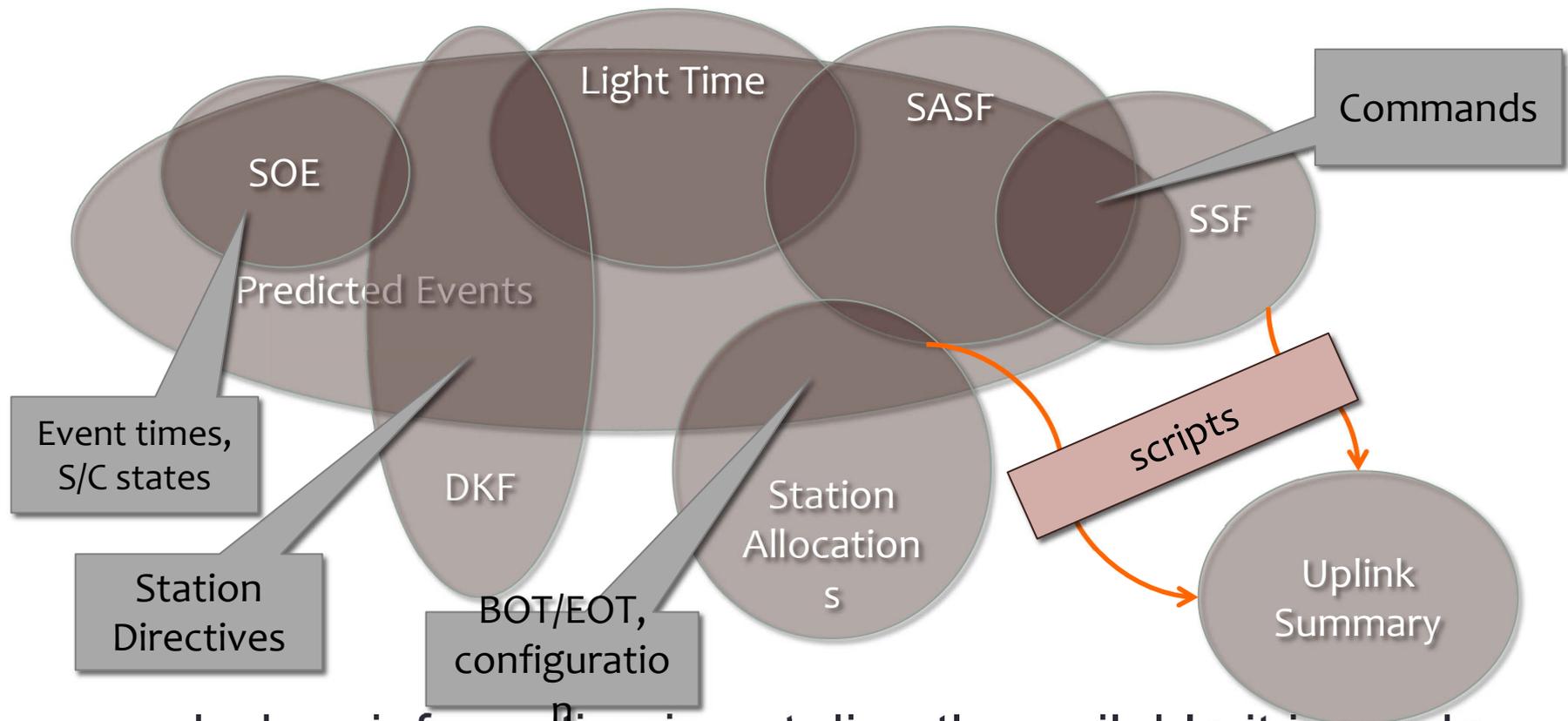


File-based Information



Information redundancy

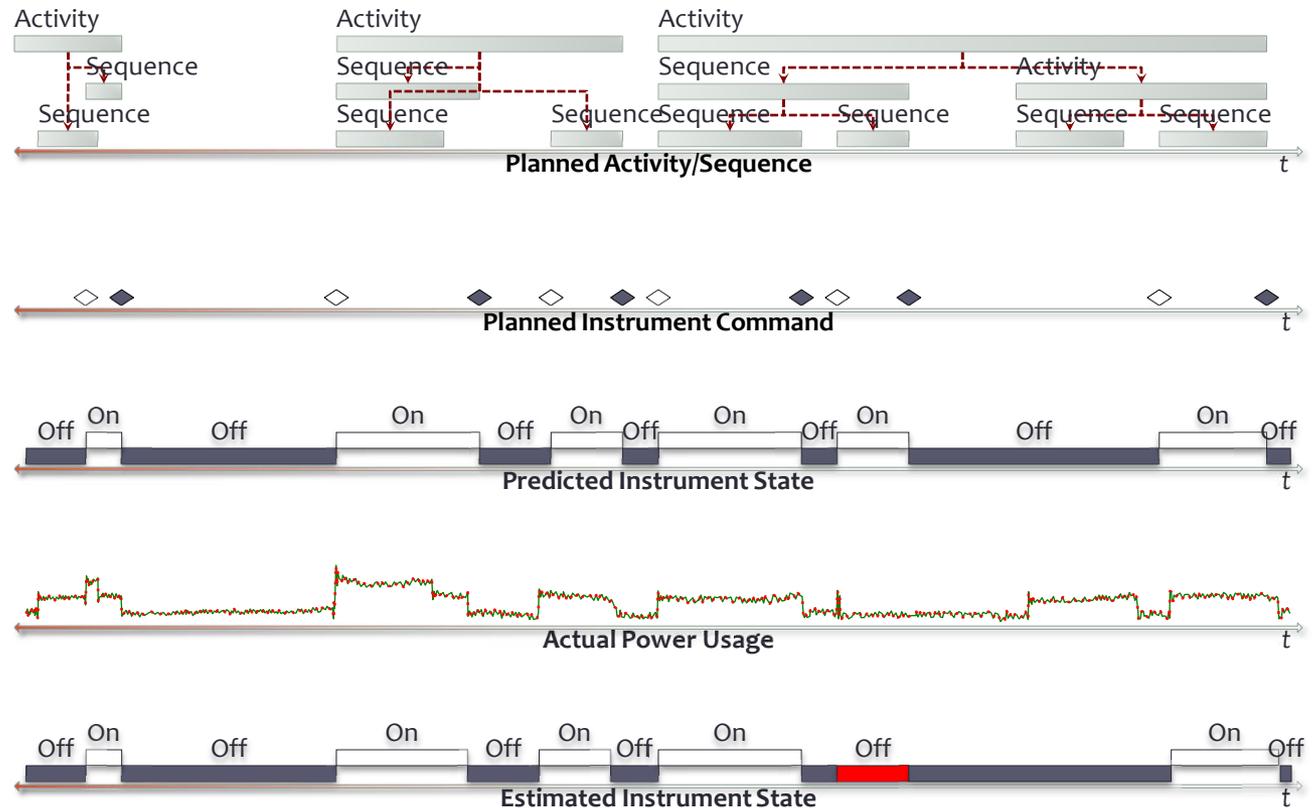
- Current MOS products have duplicate information



- ...and when information is not directly available it is made available via custom scripts

Timelines

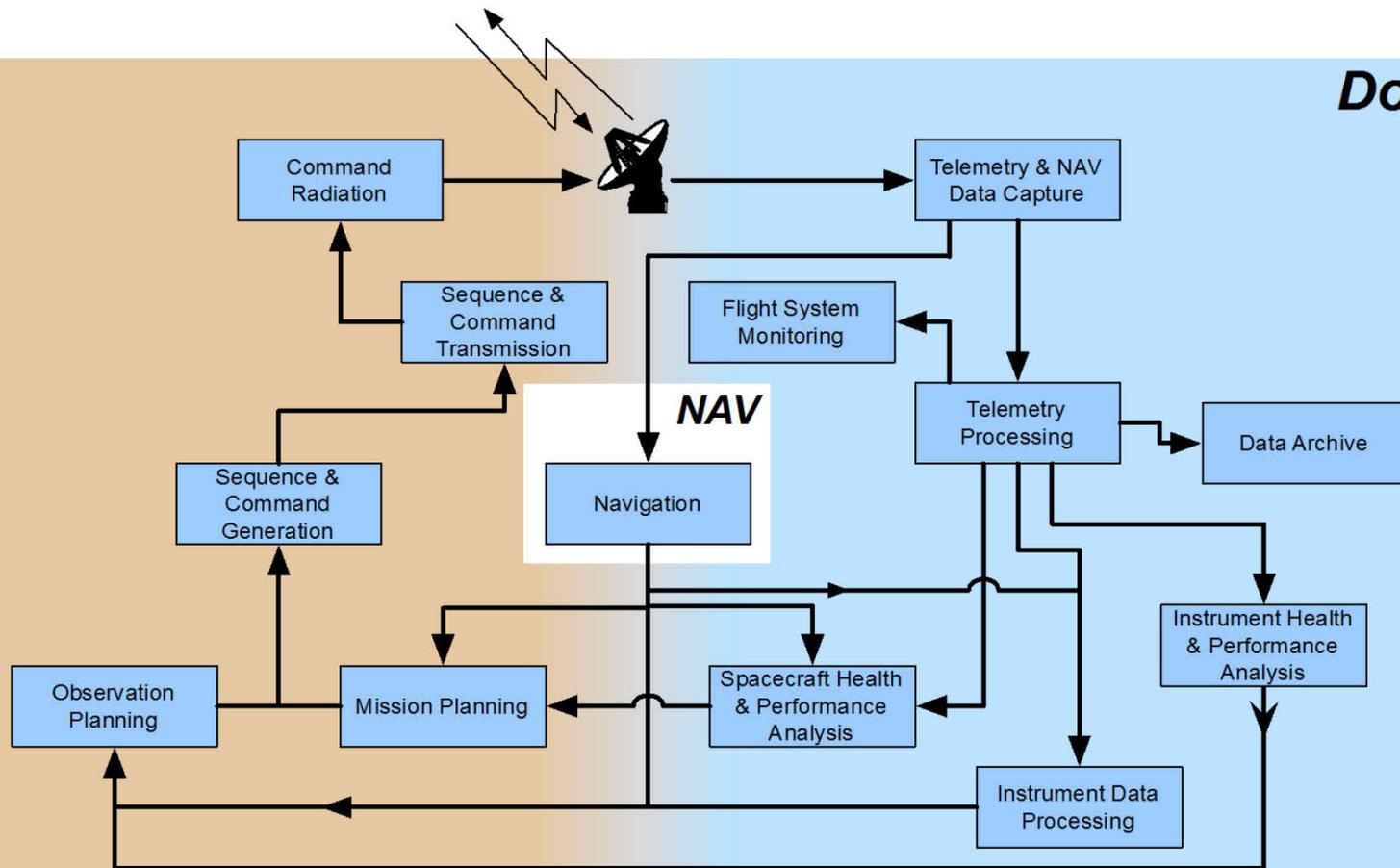
- Planned Activity Timelines
- Planned Command Timelines
- Predicted State Timelines
- Telemetry Timelines
- Inferred State Timelines
- ...



MOS does Uplink & Downlink

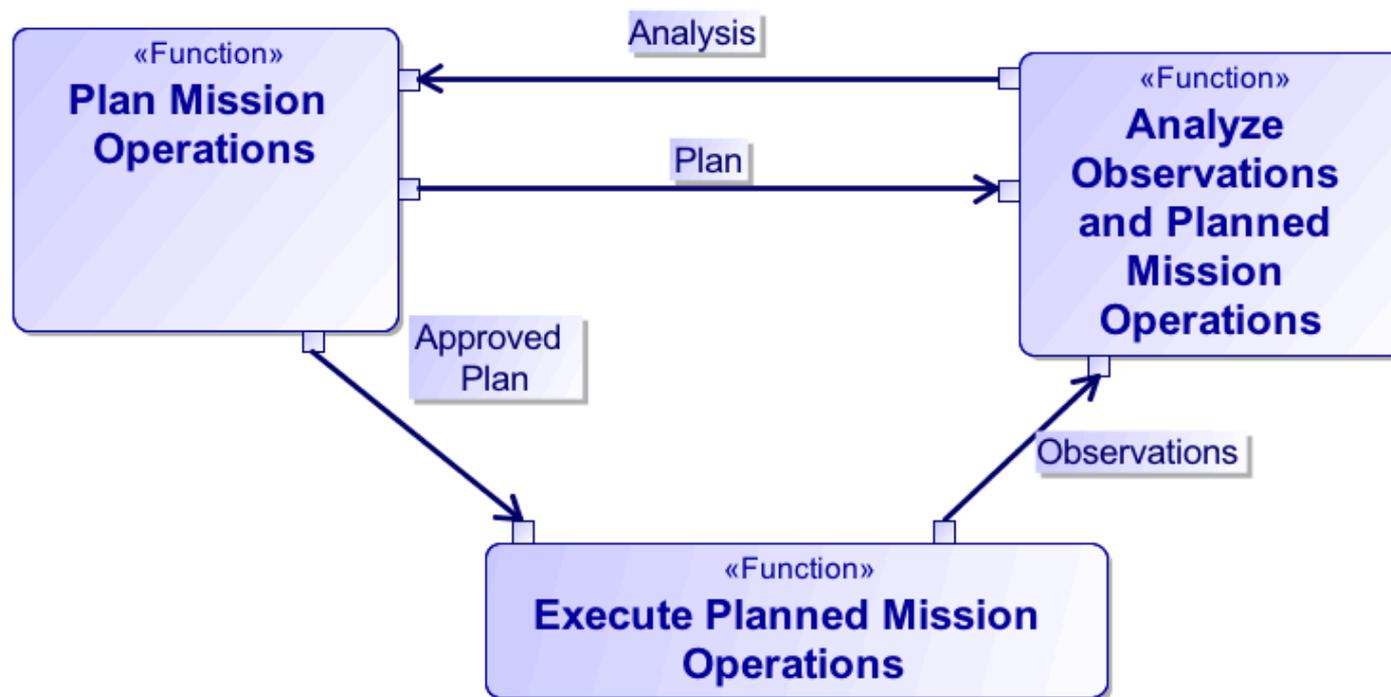
Uplink

Downlink



This is the current paradigm

MOS Controls the Mission



This is the “to-be” paradigm

Synthesis: Control Oriented Timelines

Flight System Engineering

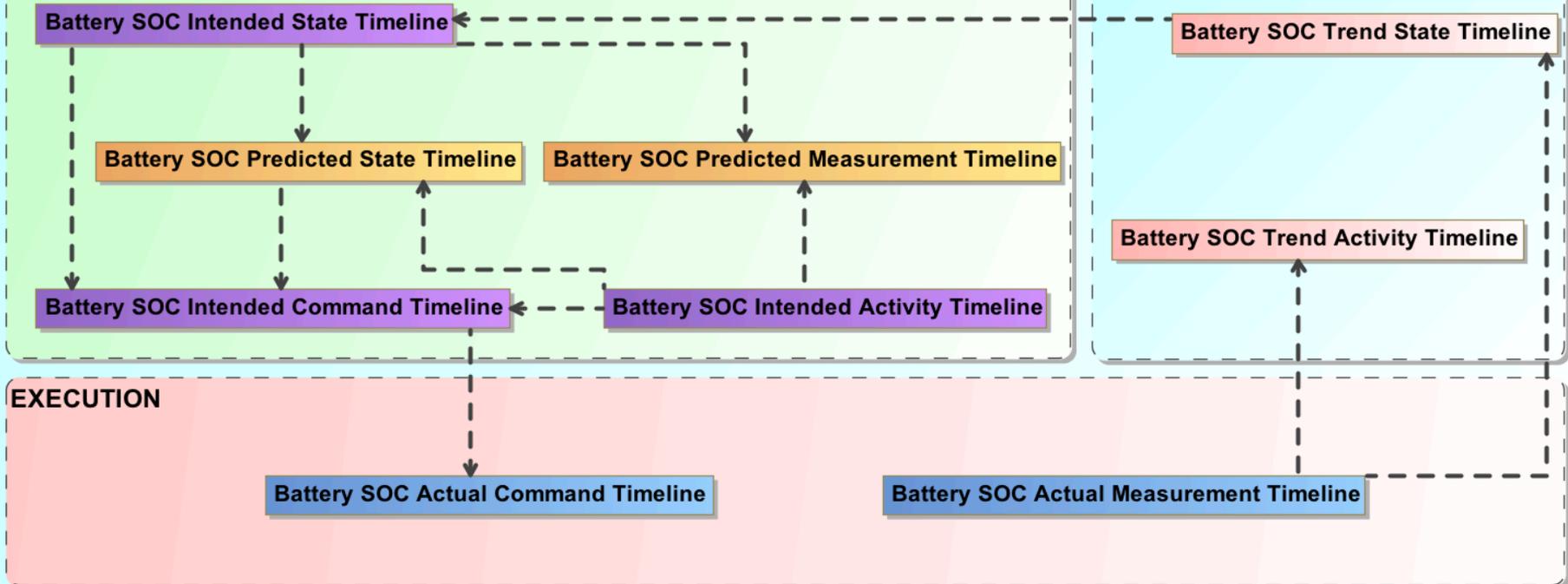
Power

ABSL Li-Ion Battery

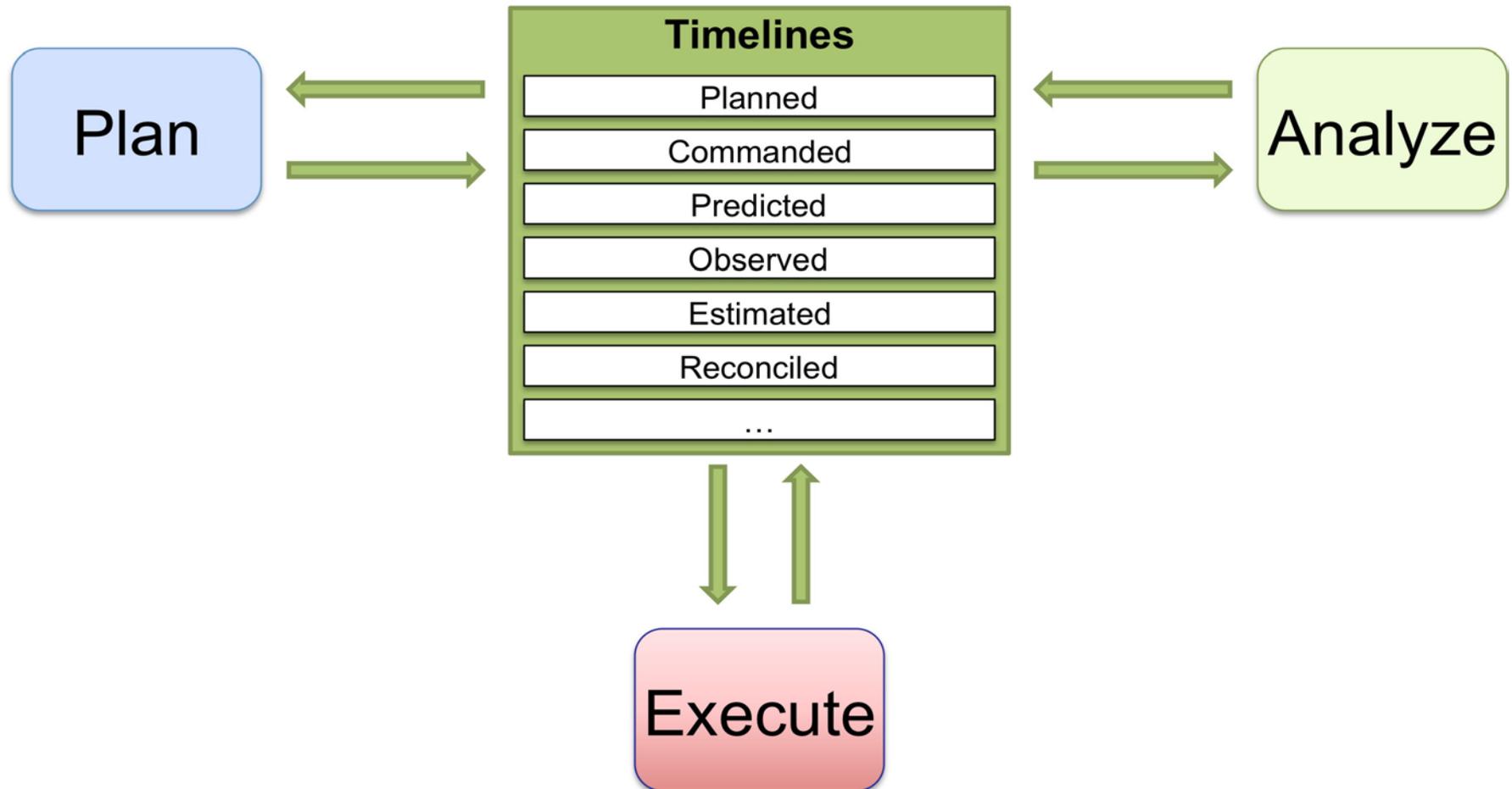
INTENTION PREDICTION ACTUAL TREND

PLANNING

ANALYSIS



Timeline-Based Control



Summary

- Timelines provide a common model for most MOS information
 - With attendant decrease in ambiguity and unneeded duplication
- Closed-loop control paradigm shows how Timelines can be used effectively
 - “Closing the loop” becomes a primary concern and a built-in characteristic of the MOS