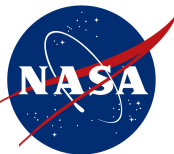


**2011 INCOSE Conference
Denver, CO 20-23 June 2011**

MANAGING RISK FOR NASA'S DEEP SPACE NETWORK

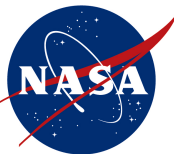
(Paper by: Mona M. Witkowski, John Q. Todd & John Dokken)

**Presented by
Mona M. Witkowski & John Q. Todd
21 June 2011**



Agenda

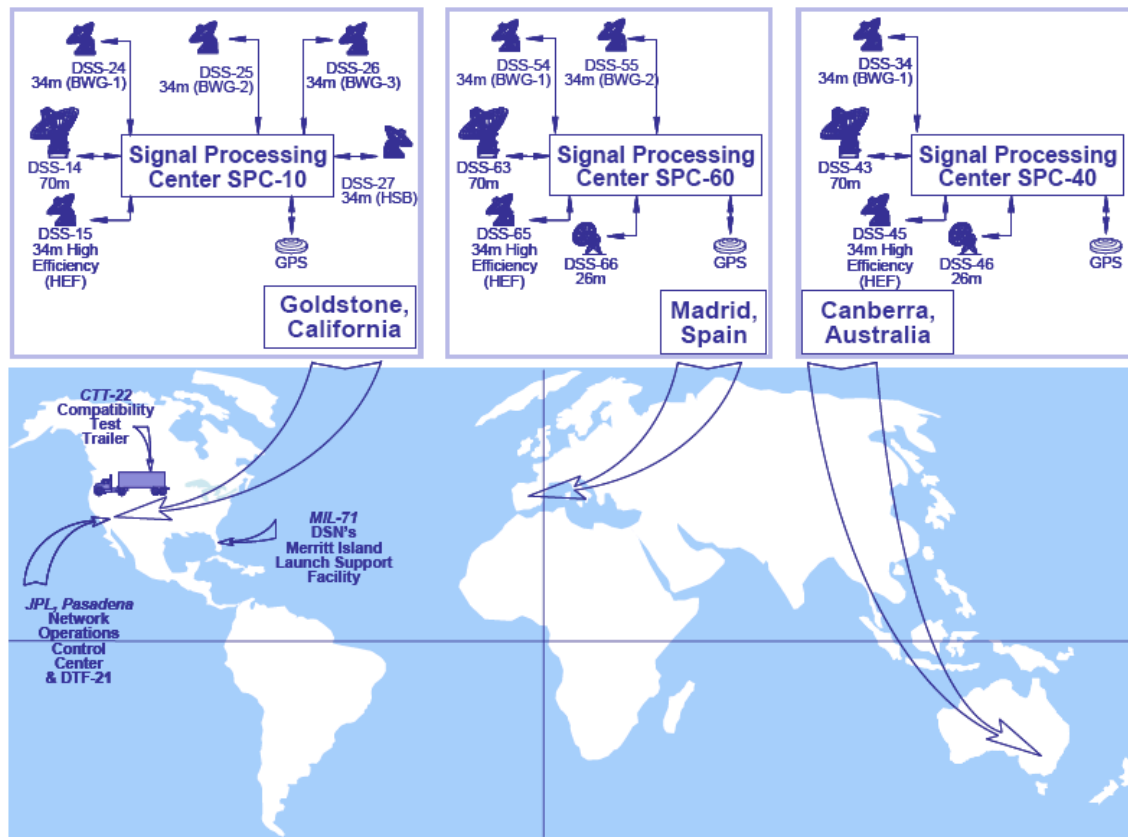
- **Deep Space Network**
- **Organizational Complexities**
- **Risk Management Challenges**
- **Risk Management Implementation**
- **Mission Services Risk Management**
- **Risk Board Meetings**
- **Reviews & Reporting**
- **Summary**



Deep Space Network



- Directed and operated for NASA by the Jet Propulsion Laboratory
- Spaceflight Communications and Operations Facility
- Deep Space Communications Complexes (DSCC)
 - California, USA
 - Madrid, Spain
 - Canberra Australia



World leader in the development of low-noise receivers, tracking, telemetry and command systems, digital signal processing and deep space navigation

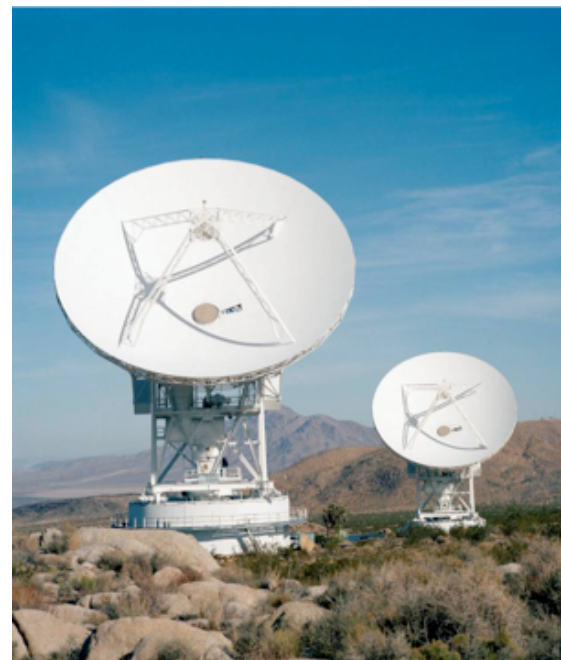
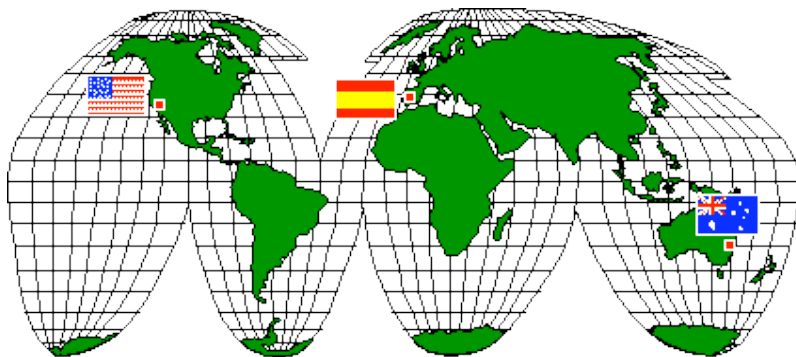


Deep Space Network

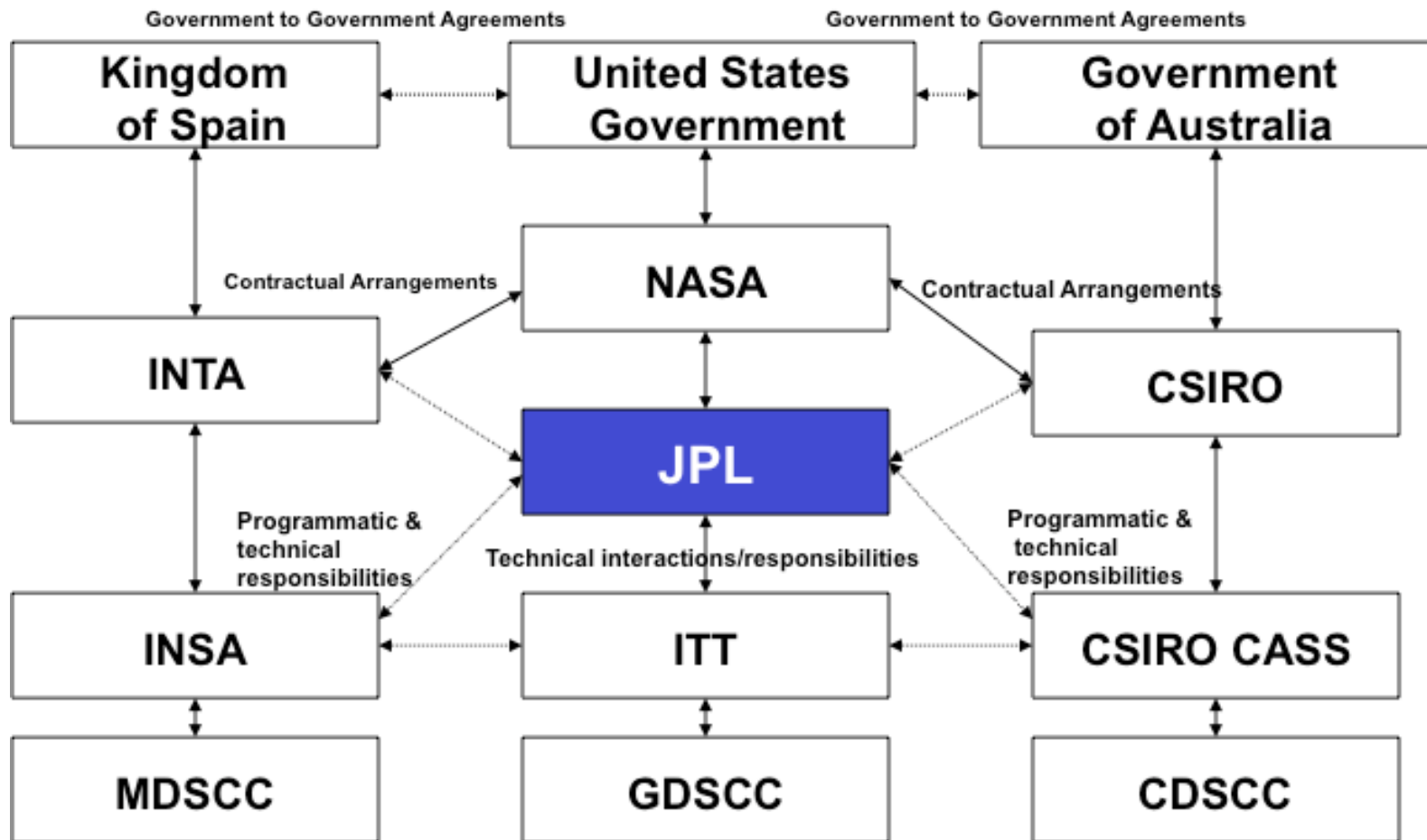
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- Global configuration enables continuous two-way communication with spacecraft
- Flagship 70 Meter Antennas
- Capturing Whispers from Outer Space



Organizational Complexities



Risk Management Challenges

Traditionally focused on robotic missions

- Mission Risks have a definite and finite lifetime
- Predetermined schedule for mitigation
- Risks retired / mitigated prior to launch

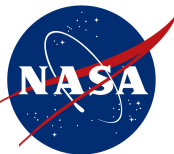


The DSN is a service provider

- Risk is interruption of DSN services
- Permanent loss of critical mission data
- Assets are aging and are at or beyond their lifetime
- Spans three continents and countries

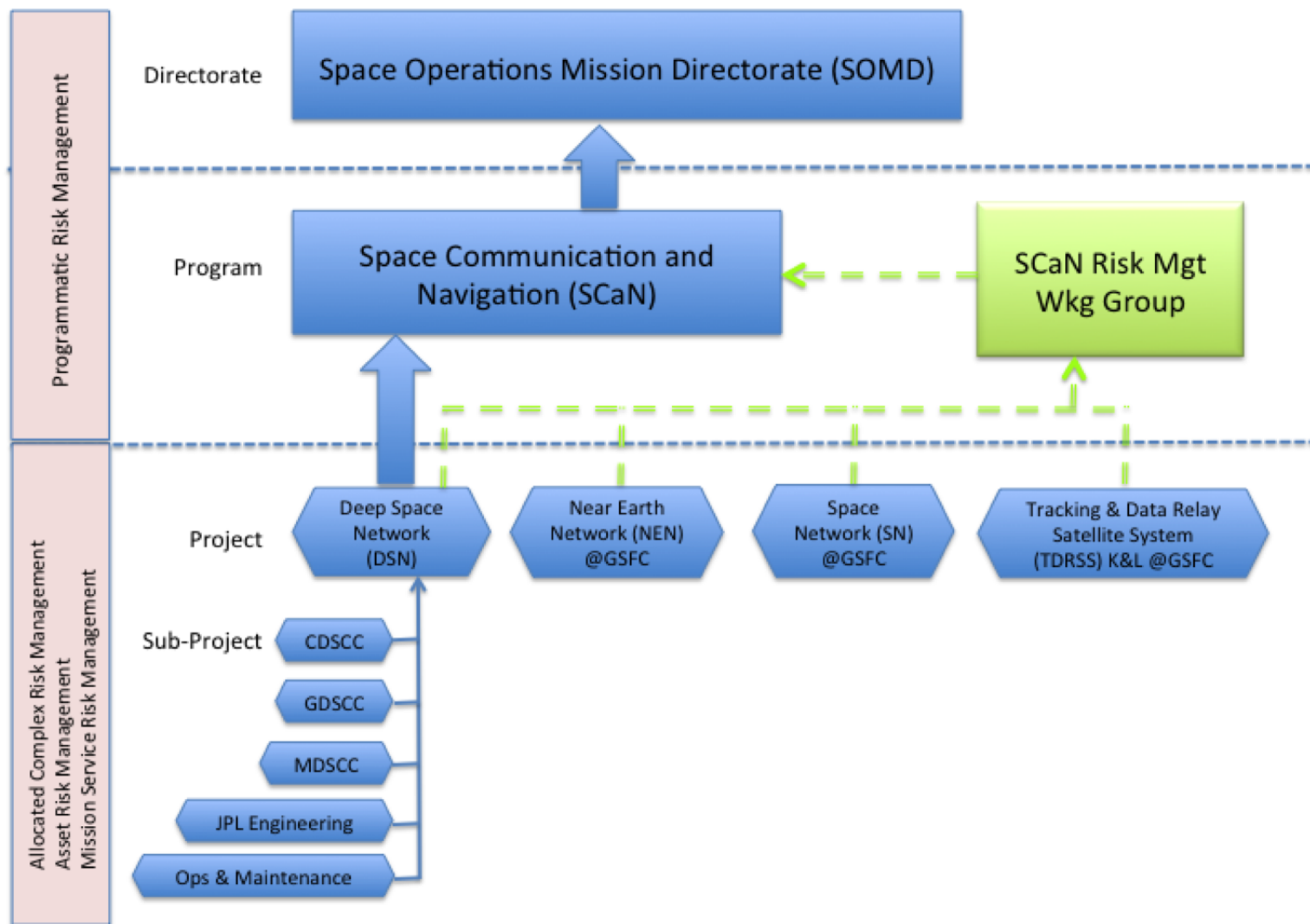


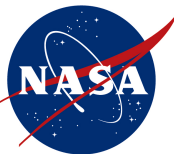
Global Collaboration is Key



Risk Management Implementation

DSN Risk Mgt Plan | NPR 8000.4a





Risk Management Implementation

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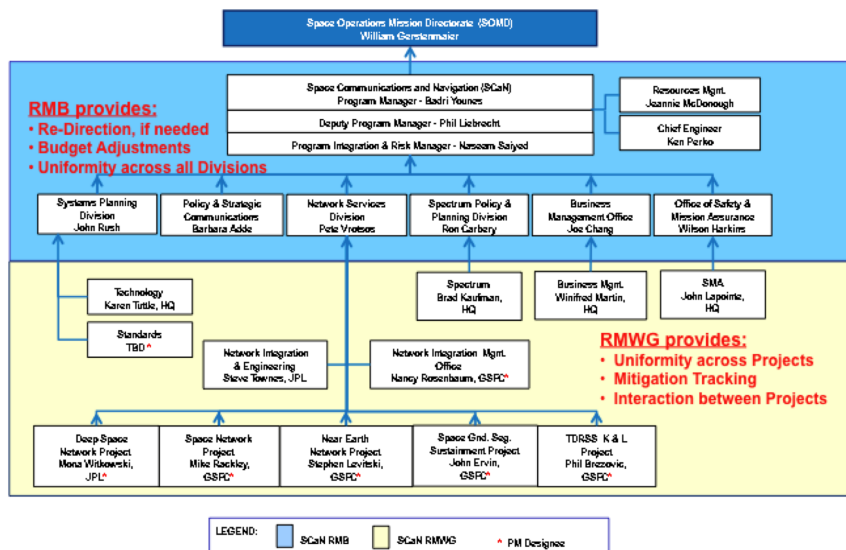
Programmatic Risk Management

- NASA Space Operations and Mission Directorate
- Spacecraft Communications and Navigation Program
 - **Deep Space Network (DSN)** →
 - Near Earth Network (NEN)
 - Space Network (SN)
 - Space Ground Segment Sustainment (SSGS)
 - Tracking and Data Relay Satellites (TDRSS)

- DSCC Risk Management
 - Canberra, Australia (CDSCC)
 - Goldstone, California (GDSCC)
 - Madrid, Spain (MDSCC)

- Asset Risk Management
 - Reliability Centered Maintenance
 - Depot Level Maintenance
 - Antenna Life Extension

- Mission Services Risk Management
 - Probabilistic Risk Assessment
 - DSN Implementation
 - Fault Trees



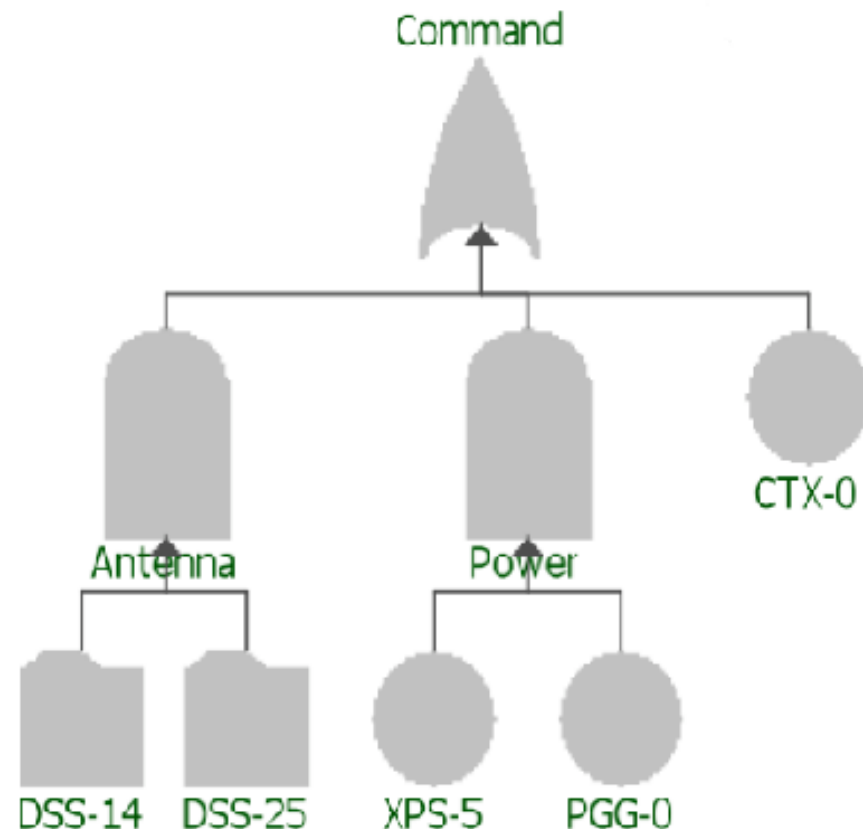
Mission Services Risk Management

Probabilistic Risk Assessment

- Risk statements focused on interruption of delivered data services
- Specific to mission critical events
- Quantifies risk assessment
- Facilitates communication to missions

Fault Trees

- Specific to asset configuration
- Quantifies failure events
 - Use of field and/or mission failure and repair data
 - Mean time to fail/ repair
- Quantifies likelihood assessment
- Facilitates rank / placement on 5X5 risk matrix



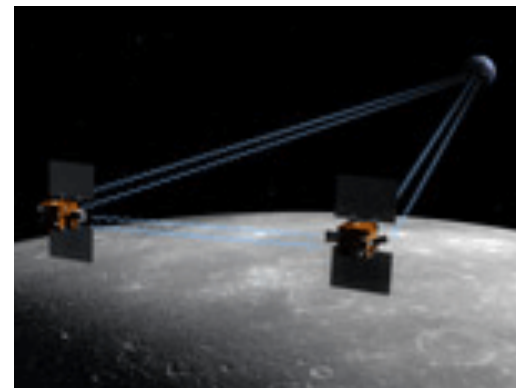
Challenge – Quantifying Risk for Missions

Mission Services Risk Management

(Continued)

Affected Data Minutes

- Potential data minutes lost represented by mean, median and modes
- Quantifies the consequence assessment
 - Utilizes data from discrepancy reporting system
 - Provides assessment of the length of an interruption
- Mission has final call on consequence assessment

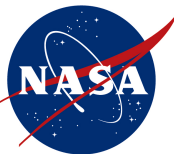


TELEMETRY Overall	
Mean	75
Median	65
Mode	60

TRACKING Overall	
Mean	85
Median	75
Mode	65

COMMAND Overall	
Mean	90
Median	75
Mode	35

Quantifying Affected Data Minutes



Mission Services Risk Management

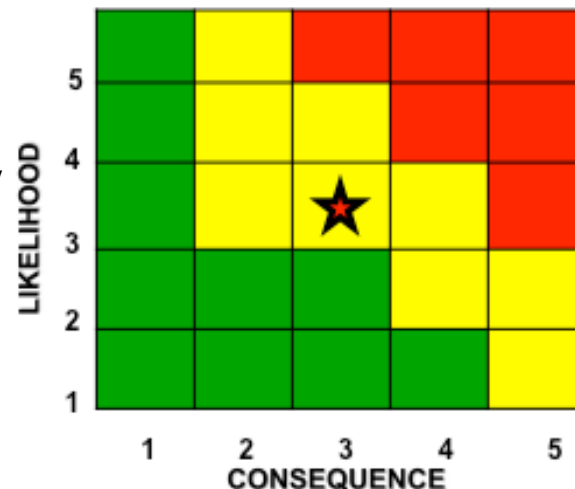
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Risk Determination

- Mission services – Command, Tracking and Telemetry
- Each service is characterized as a risk

Risk Matrix Representation

- Likelihood determination = Fault Trees
- Consequence determination = Affected Data Minutes



Likelihood of Occurrence

The best estimate of the probability that the undesirable event will occur.

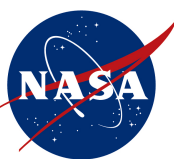
Level	Likelihood	Probability
5	Very High	>70%
4	High	>50%
3	Moderate	>30%
2	Low	>=1%
1	Very Low	<1%

Consequence of Occurrence

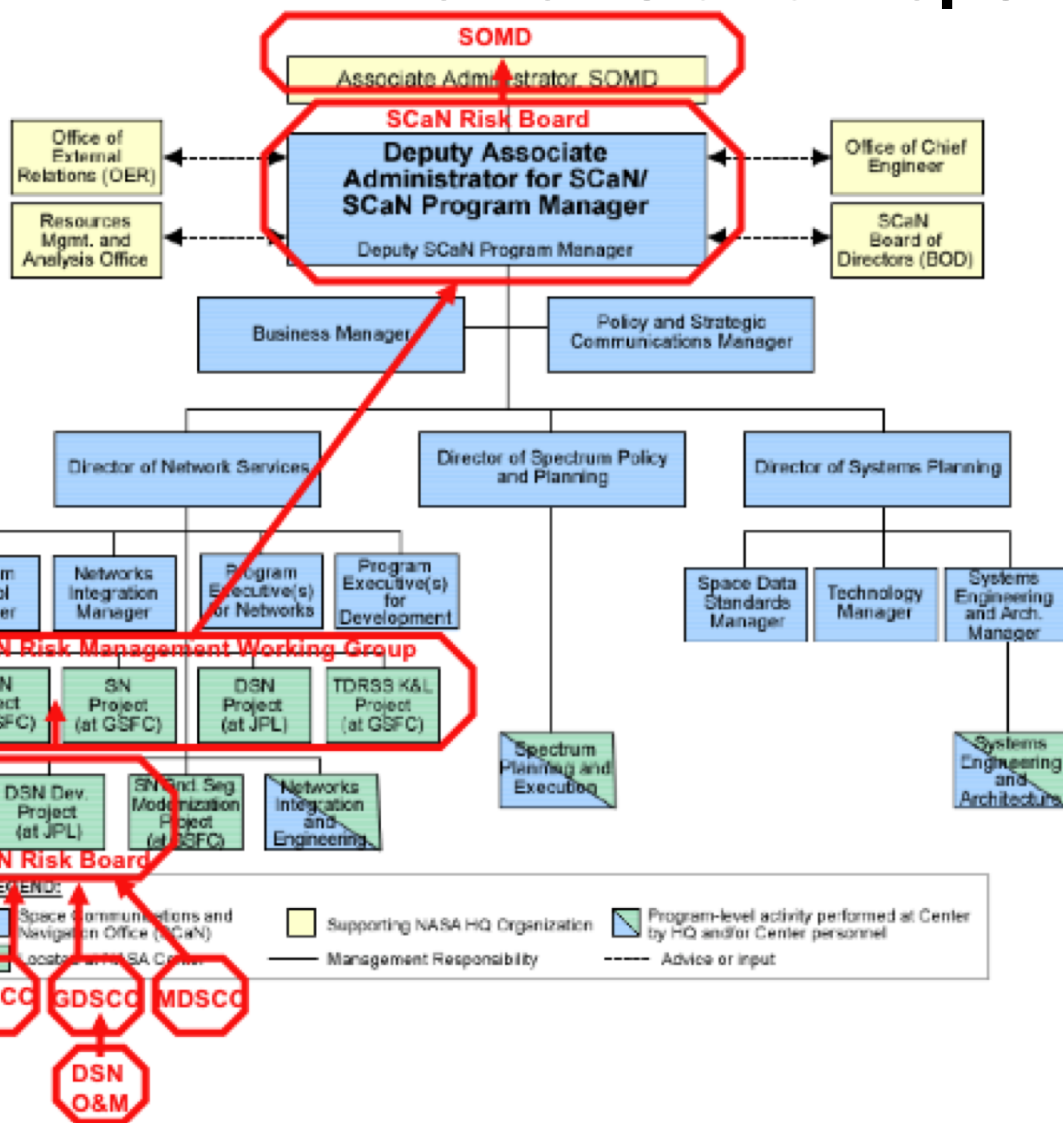
Estimated severity of the consequence that will be realized

Level	Mission Impact
5	Mission success criteria unachievable
4	Mission success criteria partially unachievable
3	Mission success criteria threatened
2	Mission success criteria achievable
1	Mission success criteria fully achievable

Mission Risk Assessments Streamlined



Reviews and Reporting



Monthly Reviews

- SCA/N Program
- JPL Project Status
- DSN Project
- DSCC Status

Mission Reviews

- Mission Risk
- Mission Event Readiness

Risk Board Meetings

SCaN Risk Management Board

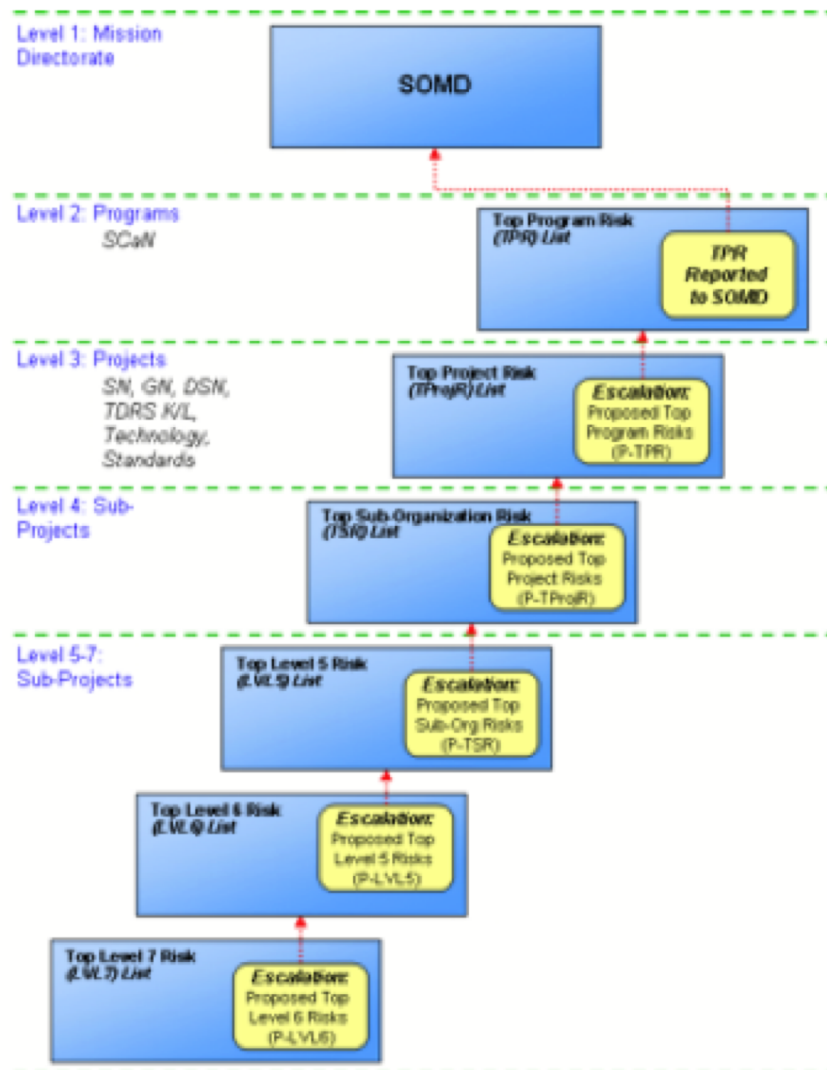
- Meets monthly
- Risks escalated from lower levels
- Funds mitigation efforts
- Reports to NASA SOMD

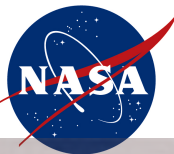
SCaN Risk Management Working Group

- Meets Monthly
- Participation of all networks
- Independent avenue to escalate risks
- Risks escalated to SCaN

DSN Risk Management Board

- Meets monthly
- Quarterly meetings include DSCCs
- Risk escalated to SCaN





Summary

- **Deep Space Network has been supporting missions for over 40 years**
 - Risks were managed informally by engineers and managers
 - Retirements and equipment aging/obsolescence began to emerge
 - A more robust risk management process was needed
 - Risk Management process for the DSN began in the fall of 2005
- **Fall of 2005: Core team formed to formalize the DSN Risk Management Process**
 - Expanded quickly to the complexes and then to O&M contractor (ITT)
 - Risks are vetted horizontally and vertically
 - Interaction with SCA_N Program Office at NASA Headquarters and Risk Management Working Group solidified risk communication
 - Risks are captured, well understood, managed and retired in a repeatable manner
- **Process has grown in acceptance and level of detail and has good momentum!**