



National Aeronautics and Space
Administration
Jet Propulsion Laboratory
California Institute of Technology

DSN/Mission Briefing - 2012

Deep Space Network (DSN) Mission Interface Overview

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DSN MISSION STATUS BACKGROUND



DSN Mission Set, 2012

HEO, LEO, Lunar, L1,L2

- CHANDRA
- JWST
- GEOTAIL
- WIND
- SOHO
- ACE
- CLUSTER
- MMS-1,2,3,4
- ARTEMIS B & C
- TDRS

- LRO
- GRAIL A & B
- LADEE

DEEP SPACE

- CASSINI
- MARS ODYSSEY 01
- MARS EXPRESS
- ROSETTA
- MESSENGER
- MARS RECONN ORBITER
- VENUS EXPRESS
- NEW HORIZONS
- DAWN
- EPOXI (DI)
- MER OPPORTUNITY
- SPITZER SPACE TELESCOPE
- KEPLER
- VOYAGERS 1 & 2
- STEREO A & B
- Solar Probe Plus

- MSL: CURIOSITY
- JUNO
- PLANET-C
- MAVEN
- ExoMars 2016, 2018
- OSIRIS-Rex

DSN Science:

- EGS/VLBI, ATOT
- GBRA, GAVRT
- GSSR, GODR
- SPACE GEODESY
- REF FRAME CAL

KEY

- Astrophysics
- Heliophysics
- Planetary Science



Mission Set Perspective

- 34 Flight Missions:
 - 10 GSFC Missions
 - 1 MSFC Mission
 - 2 ARC Missions
 - 11 JPL Missions
 - 2 JAXA Missions
 - 4 ESA Missions
 - 4 APL Missions
- 7 ground based science missions

- 45 Spacecraft for Nominal Support
- 7 TDRS Spacecraft for Emergency Only
- Spacecraft with:
 - 18 S-band
 - 5 Ka-band
 - 25 x-band



Past & Future Cross-Support Missions

DSN Supported Partner Missions

CLUSTER (ESA)
MARS EXPRESS (ESA)
GEOTAIL (JAXA)
PLANET-C (JAXA)
ROSETTA (ESA)
VENUS EXPRESS (ESA)
SELENE (JAXA)
Hayabusa (JAXA)
INTEGRAL (ESA)
Chandrayaan-1 (ISRO)
XMM-Newton Emergency Recovery
Support (ESA)
Phobos-Grunt Emergency Recovery (RUS)

Partner Supported NASA Deep Space Missions

ACE
JUNO
DAWN
JWST
Kepler
MARS RECONNAISSANCE ORBITER
MAVEN
MER: SPIRIT & OPPORTUNITY
MSL CURIOSITY
PHX
SOHO
STEREO
Ulysses (ESA/NASA)

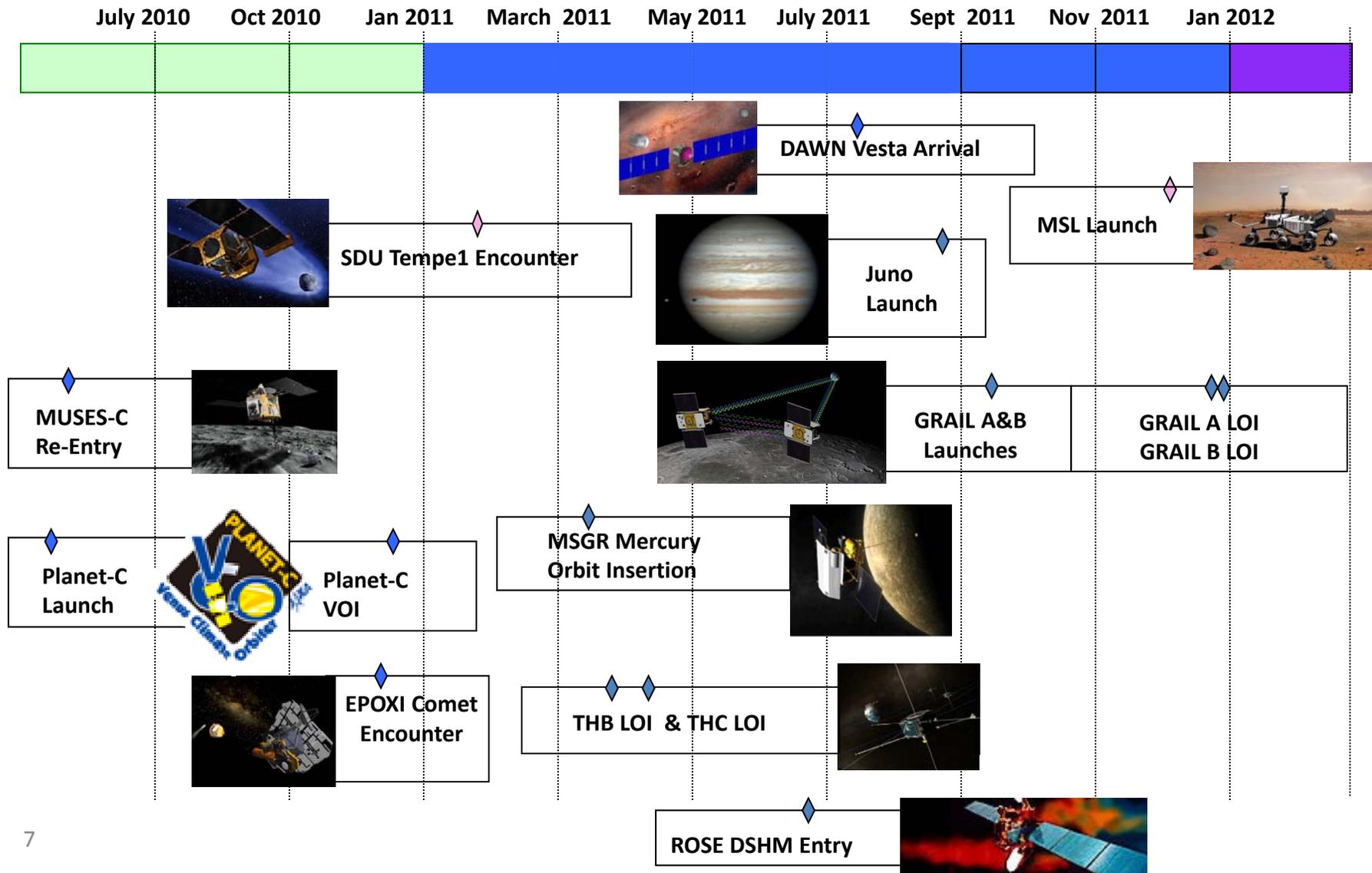


Upcoming Mission Critical Events

JPL MSL Landing @ Gale Crater	August 6, 2012
JPL Juno Deep Space Maneuver	Aug 30 and Sept 4, 2012
JPL Juno Earth FlyBy	October 9, 2013
ARC LADEE Launch	NET July 14, 2013
ARC LADEE Lunar Orbit Insertion	NET August 11, 2013
GSFC MAVEN Launch	Nov 18 – Dec 7, 2013
ESA ROSETTA Hibernation Exit	January 2014
GSFC MAVEN MOI	Sept 22 - 28, 2014
GSFC MMS-1,2,3,4 Launch	October 15, 2014
ESA ROSETTA Landing on a Comet	November 2014
JPL Dawn Arrival at Ceres	February 2015
APL NHPC Pluto Encounter	July 14, 2015
JAXA Planet-C VOI	TBD, 2015
ESA ExoMars 2016	January, 2016
JPL Juno Jupiter Orbit Insertion	July 5, 2016
GSFC OSIRIS REx Launch	September 2016
GSFC/APL SPP Launch	July 2018
GSFC JWST Launch	October 2018

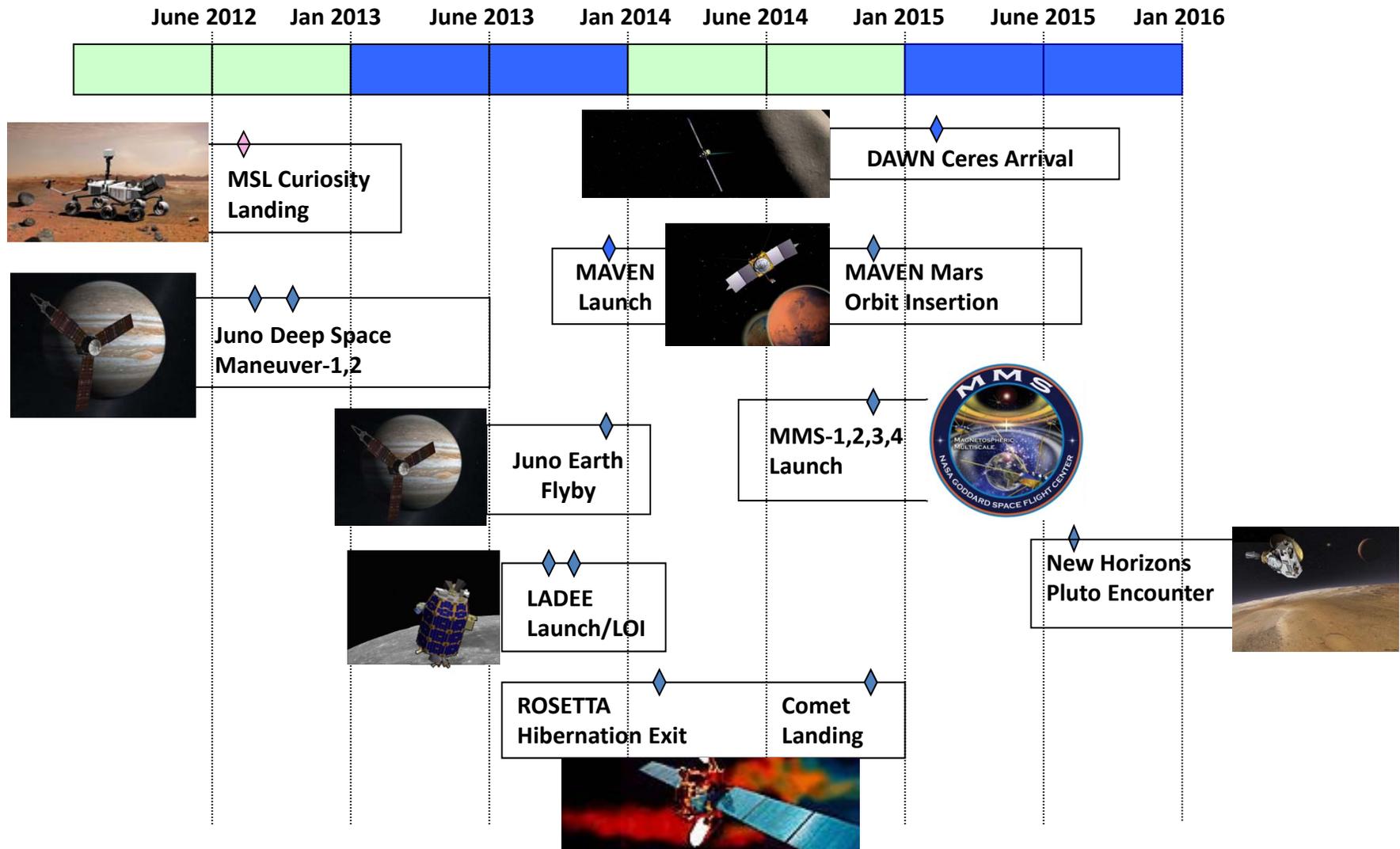


Mission Critical Events Timeline, May 2010 - 2012





Mission Critical Events Timeline, Aug 2012 - 2015





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DSN-MISSION INTERFACE MANAGEMENT



Mission Interface Change Process

- Changes to the DSN services and its interfaces have a significant impact on projects
- Process is needed for communication and feedback on changes to the mission interface and for transition planning
- First step is to baseline mission service interfaces, policies, and practices in new document (done)
- Next step is to develop processes and tools to notify missions and get feedback on changes and plan transitions to new mission interfaces

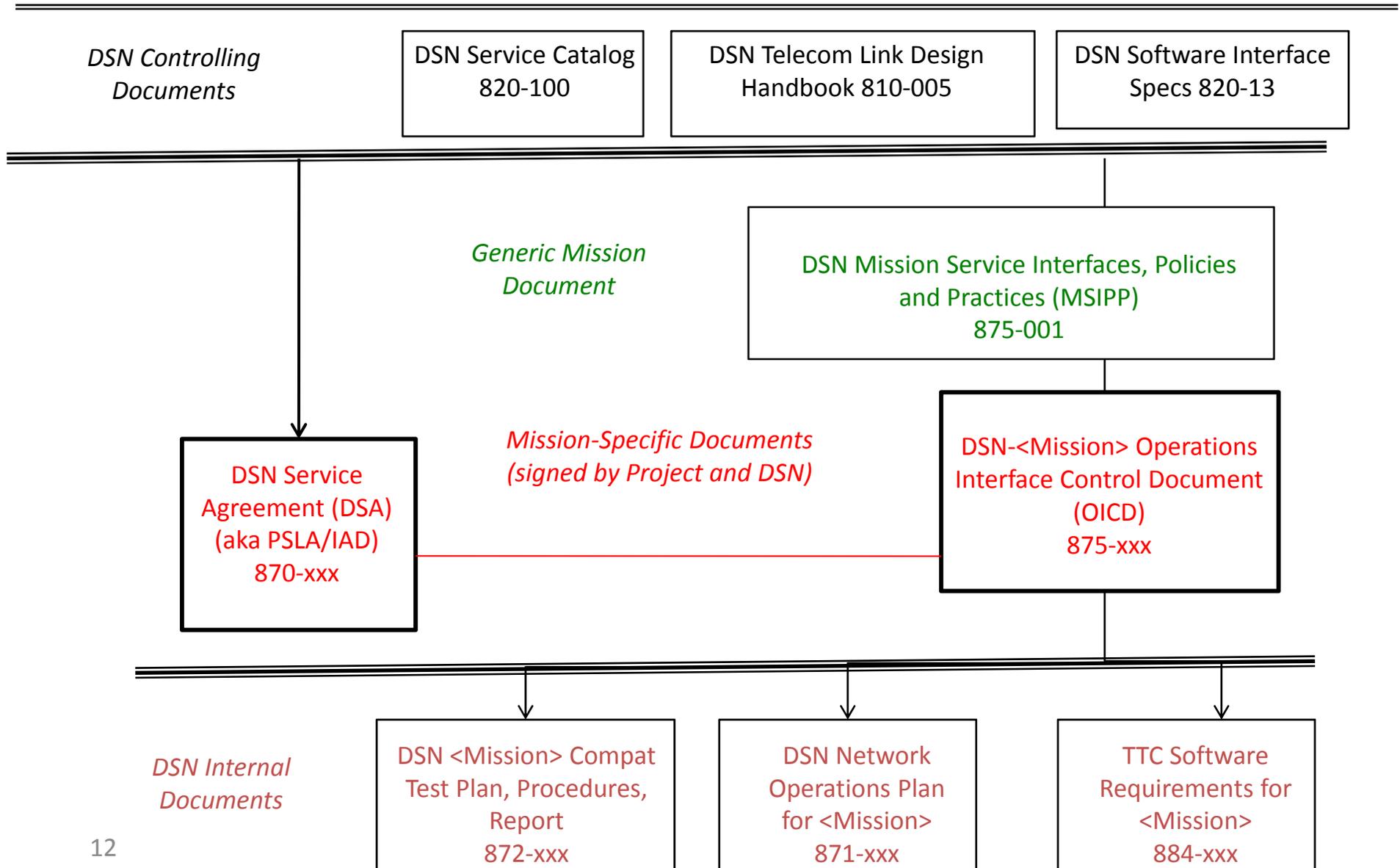


DSN-Mission Commitment Documentation

- DSN Service Agreement (DSA) – specifies service-level commitment for DSN support through end of approved mission
- DSN-<Mission> Operations Interface Control Document (OICD) – specifies the mission-specific telecommunication parameters and service interfaces with the DSN (dynamic throughout life of mission)
- (2012) DSN Generic Mission Service Interfaces, Policies and Practices (MSIPP) - specifies standard policies & practices applicable to all mission interfaces



DSN Mission Interface Document Tree





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DSN UPGRADE PLANS



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DSN of the Future

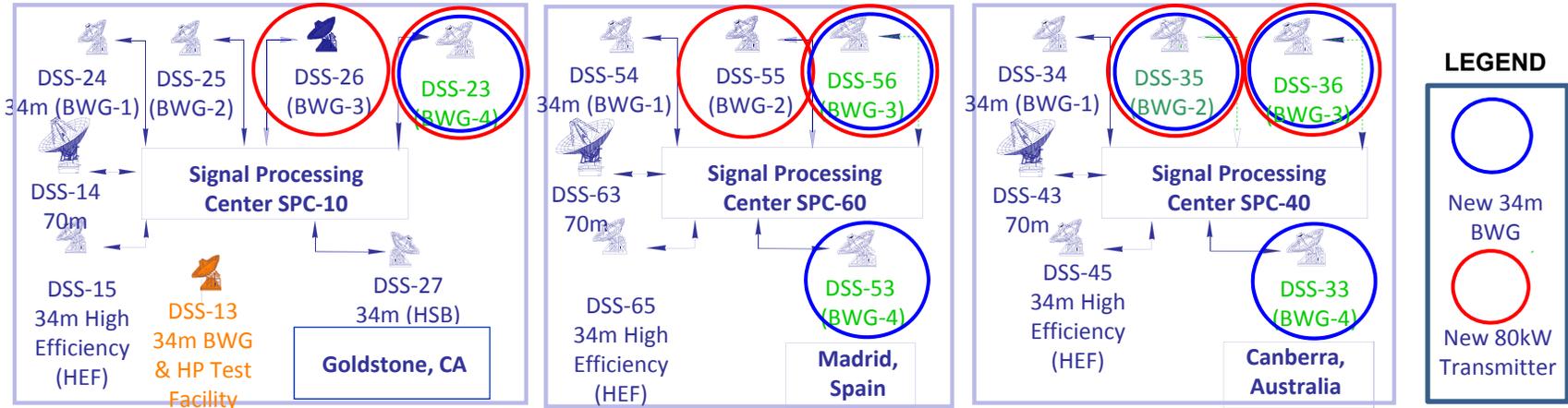




(Future) DSN Station Overview

DSN Circa 2025

Under construction
 10/2014 → 10/2016





DSN Station Upgrade for Strong Signals

- Plans in place to install a bypass switch in most BWGs for handling strong, near-Earth signal levels
 - Will not need to operate with reverse polarization to avoid receiver saturation and equipment damage
 - By-pass Switches in the X-band and Ka-band paths of the BWG antennas will be installed in 2013



DSN-ESA VLBI Quasar Catalog Upgrade

- Existing DSN VLBI catalogs (810-005) are missing high quality measurements of southern sky sources
- Measurements from two Southern Hemisphere sites will enable unprecedented update to shared ESA-DSN radio catalog for Navigation and Delta-DOR uses
- Quasar astrophysics has shown that Ka-band is better than X-band
- DSN and ESA each have a Southern site with Ka-band capabilities:
 - DSN Canberra and ESA Malargue are Southern sites where mixed baseline measurements have potential for full sky coverage of the Quasar Catalog with sub-nano-radian accuracy
- Benefits to ESA and DSN collaboration:
 - Δ DOR: increased accuracy and long term stability
 - Ties ESA-DSN reference frames for inter-operability
 - Increased weather immunity for critical events



Over the Next 5 Years

- The next five years will be focused on catching up on maintenance
 - Few new driving requirements
 - Incremental changes mostly
- Budget remains tight
 - Must deal with continued challenges, such as exchange rate fluctuations, NASA budget issues
 - Looking at additional areas for operational efficiencies
- Few major new developments
 - Data Capture and Delivery (DCD)
 - Service Scheduling Software (SSS)
 - Network Monitor & Control (NMC) System upgrades
 - Goldstone Emergency Control Center (ECC) upgrades
- Refurbishment continues to be the main priority
 - Antennas
 - Power
 - Facilities
 - Environmental, Health, and Safety



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DSN MISSION INTERFACE CHANGES



Radiometric Data Services

- DSN delivery of Tracking Data Files in the new CCSDS Tracking Data Message (TDM) format (0212-Telecomm-TDM) and in the existing DSN Archive TRK-2-34 format
 - DSN offers auto-push SFTP delivery of TDM/TRK-2-34 data files post-pass and UDP stream delivery of TRK-2-34 data
 - Plans to retire TRK-2-18 by end of 2017 (not available for new missions)
- DSN improvements to ranging capabilities
 - 3-way Ranging Product is under test (New Horizons demonstration was successful)
 - Pseudo-Noise (PN) ranging capabilities
 - Increased performance over sequential, advantage can be used to get more range points or less variance
 - DSN standard pattern successfully demonstrated with spacecraft
 - CCSDS PN Ranging is a future capability
 - PN ranging allows spacecraft to implement onboard regenerative ranging systems, for improved ranging SNR



Data Delivery Service Interface

- R/T UDP (Multicast) Data Delivery Protocol
 - Monitor data delivery (0158-Monitor)
 - Tracking data delivery (TRK-2-34)
 - R/T Telemetry SFDU frame delivery via SFG will be decommissioned
 - Currently implemented via Special Function Gateway (SFG) hardware and software
 - SFG hardware/software is being replaced
 - No changes in the UDP protocol and mission interface
 - Test and transition plans will be worked with projects, currently planned to be tested in late 2012 and deployed in early 2013

- SLE Protocol for Telemetry/Command Services
 - All new missions must implement CCSDS Blue Book version
 - Future plan to transition all missions to Blue Book (TBD)



DSN Emergency Control Center (ECC)

- Goldstone ECC Status and plans to be presented by Pat Beyer
- DSN Goldstone ECC
 - Emergency DSN services in the event JPL DSOC is no longer operational, within 12 hours of decision to evacuate
 - DSN is adding a RIONET node and SLE Gateway at ECC (2013)
 - Missions can fund dedicated line to GDSCC (such as LM Denver)
- ECC capabilities will be expanded incrementally over time, including:
 - SPS Portal
 - TTC Data Services
 - All TLM data stored, engineering telemetry data delivered to mission
 - Monitor data (best effort)



Service Preparation Subsystem (SPS)

- SPS Portal represents the single point of interface between the missions and the DSN for Service Management
- New RESTful web service web service (HTTP) interface for access to SPS information. The following REST services will be available:
 - Get Scheduled Tracks
 - <https://spsweb.fltops.jpl.nasa.gov/rest/ops/info/activity/STA/2012-07-01T00:00:00/2012-09-01T00:00:00/>
 - Get Support Data Products
 - Get Ephemerides
- Generic Telecom Models for all spacecraft
 - DSN will be requesting telecom information to allow DSN to generate mission-specific models to enable use of telemetry predicts for DSN tracks
- New approach for selecting Receiver-Telemetry tables has been implemented
 - Receiver-Telemetry tables will now be selected more accurately, using additional information available in the predicts
- 0211-ServMgmt (Mission Sequence Of Events) for station automation (Future)
 - First step is an internal evaluation within DSN on performance improvements
 - Depending on results, future demonstrations will be planned for DKF Replacement (FY2015)



Network Comm Interface

- JPL Remote Partner Gateway (RPG) will be added to DSN external comm interface
 - RPG is the Mission Network gateway infrastructure for data and voice connectivity to remote partners
 - Key change is the addition of a new firewall between JPL and its remote partners
 - Primary driver for this change is in response to GAO audit finding
 - Two phase implementation:
 - Phase 1 is deployment of RPG firewall hardware (done)
 - Phase 2 is mission test and transition
 - Missions with dedicated T1s will be transitioned individually
 - Missions that share interfaces (e.g. RIONET) will be transitioned together
 - Some non-DSN comm interfaces have already been transitioned
 - DSN mission transitions will start in FY13 (test and transition schedule will be coordinated by MIM and missions)



DSN Real-Time Ops Efficiency

- Ops Efficiency plans and status to be presented by Michael Levesque
- DSN Real-Time Operations Efficiency Task Goals:
 - Increase automation of pre-pass setup and pass operations, relying on accurate Sequence Of Events (SOE) input from the missions
 - Reduce manual interventions such as operator type-ins, real-time changes in SOE, and unnecessary voice communication between mission and link controller