NAC TECHNOLOGY & INNOVATION COMMITTEE MEETING

ESMD/OCT TECHNOLOGY COORDINATION

James Reuther, OCT Director for Strategic Integration
Jet Propulsion Laboratory
Von Karman Auditorium
Pasadena, CA
August 3, 2010

Outline

- Interrelationship Example Between OCT and MD Tech Programs
- Aero-Space Technology Area Roadmap (A-STAR)
- NASA Technology Development Framework
- Examples:
  - Optical Comm Strategy
  - EDL Strategy
  - SOMD's ISS Utilization Plan & Potential OCT Involvement

Office of Chief Technologist Roles/ Responsibilities

- **OCT established in February 2010**

- **OCT has six main goals and responsibilities:**
  1) Principal NASA advisor and advocate on matters concerning Agency-wide technology policy and programs.
  2) Up and out advocacy for NASA research and technology programs. Communication and integration with other Agency technology efforts.
  3) Direct management of Space Technology Programs.
  4) Coordination of technology investments across the Agency, including the mission-focused investments made by the NASA mission directorates. Perform strategic technology integration.
  5) Change culture towards creativity and innovation at NASA Centers, particularly in regard to workforce development.
  6) Document/demonstrate/communicate societal impact of NASA technology investments. Lead technology transfer and commercialization opportunities across Agency.

- Mission Directorates manage the mission-focused technology programs for directorate missions and future needs
- Beginning in FY 2011, activities associated with the Innovative Partnerships Program are integrated into the Office of the Chief Technologist

NASA Technology Integration Governance

NASA Technology Executive Council

- The NASA Technology Executive Council (NTEC) is organized and chaired by the NASA Office of the Chief Technologist.
- Council membership includes the Mission Directorate AAs (or their designees), and the NASA Chief Engineer (or designee).
- The function of NTEC is to perform Agency-level technology integration, coordination and strategic planning
- 2 Meetings completed: June 10th, July 28th

Center Technology Council

- The Center Technology Council (CTC) is organized and chaired by the NASA Office of the Chief Technologist.
- Council membership includes the Center Chief Technologist (CCT) from each NASA Center, and a representative from OCE.
- The CTC will focus upon institutionally funded activities and development of OCT programs.
- 2 Meetings completed: June 22nd, July 29th
- Center CTs:
  - **John Hines (ARC)**
  - **David Voracek (DFRC)**
  - **George Schmidt (GRC)**
  - **Peter Hughes (GSFC)**
  - **Thomas Twik (JPL)**
  - **John Saiz (JSC)**
  - **Karen Thompson (KSC)**
  - **Rich Antcliff (LaRC)**
  - **Andrew Keys (MSFC)**
  - **Ramona Travis (SSC)**

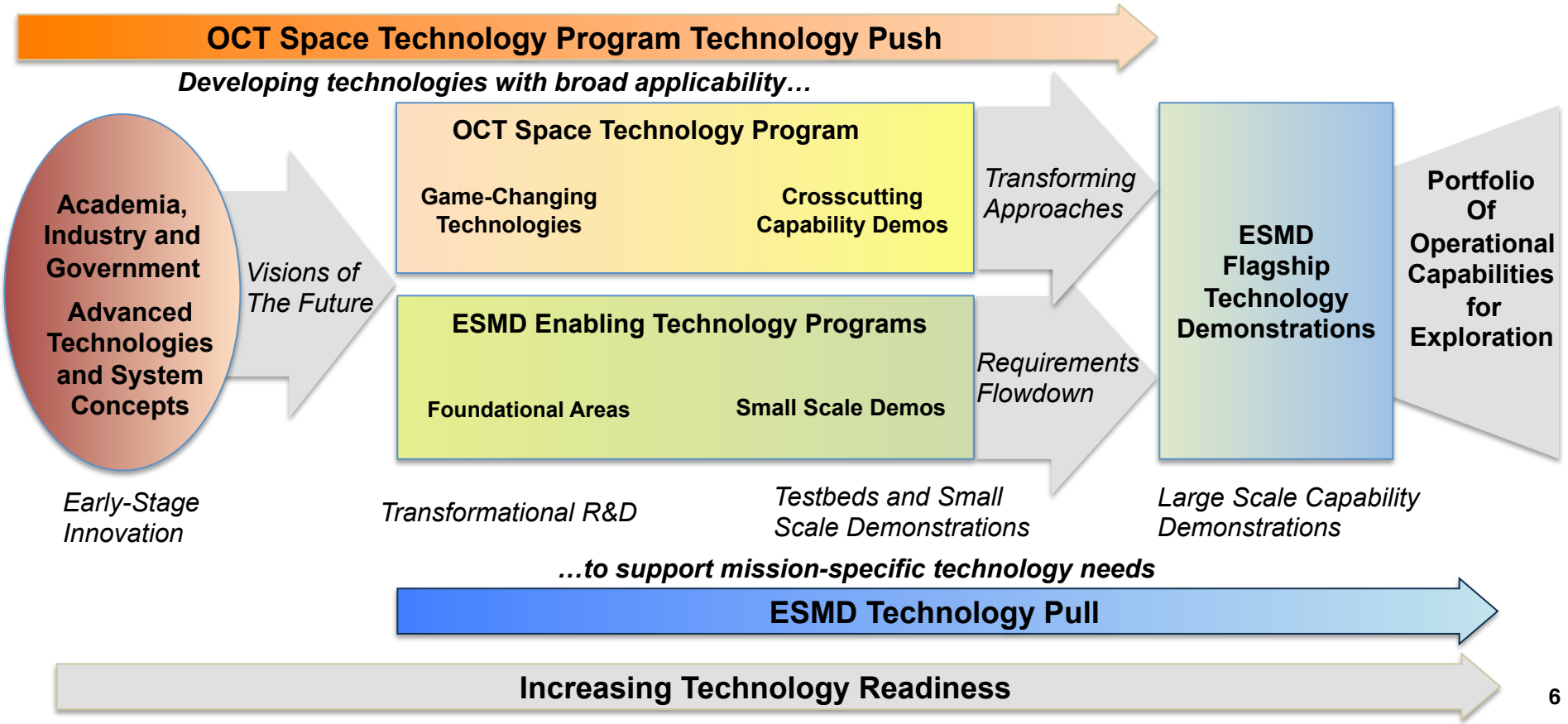
Governance model approved in May 2010

Center Chief Technologists

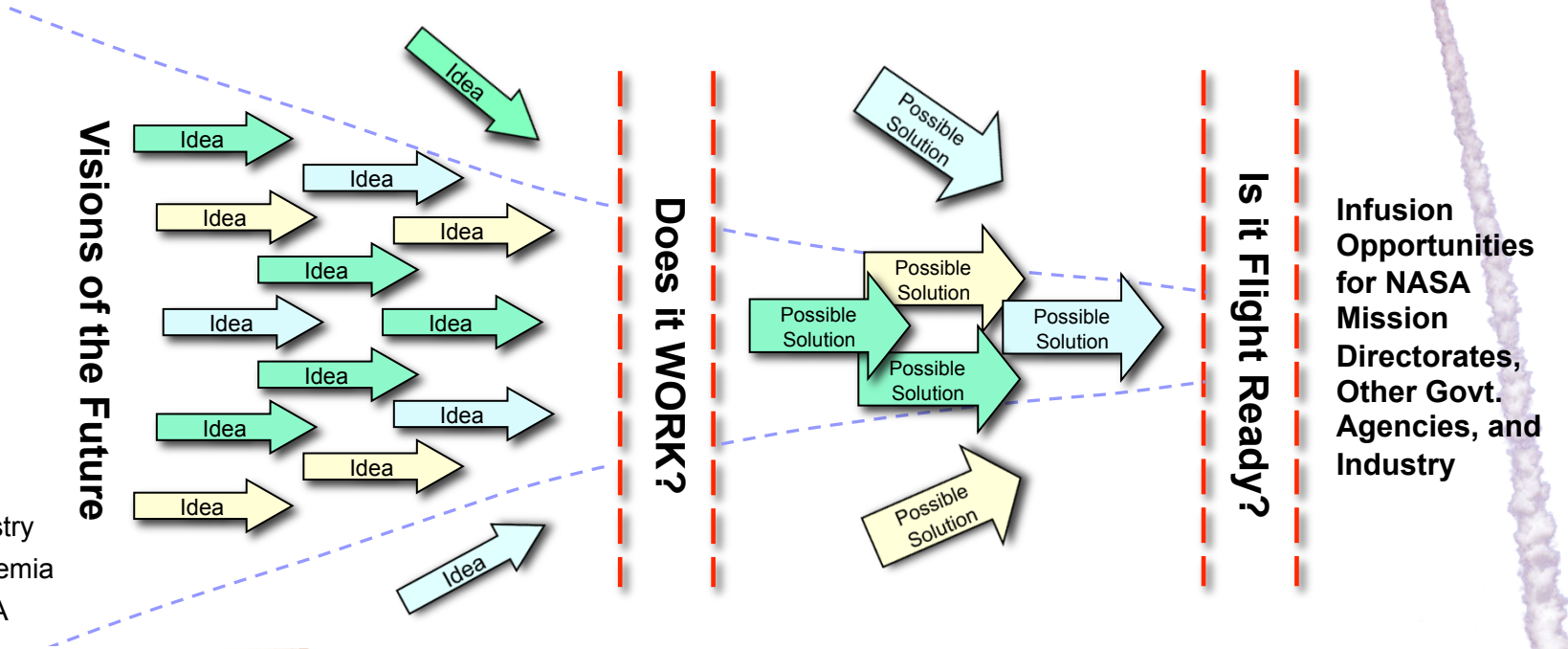
- **A Center Chief Technologist has been appointed at each NASA Center by the Center Director**
- **Center Chief Technologists responsibilities**:
  - Report to Center management. Serve as the principal advisor to Center leadership on matters concerning Center-wide technology development and leverage.
  - Communicate Center technology capabilities through representation on Center Technology Council.
  - Serve as Center POC for the NASA Center Innovation Fund. Responsible for reporting and programmatic management of the Center Innovation Fund at the Center level.
  - Serve as Center focal point for Space Technology Research Fellowships.
  - Lead technology transfer, SBIR/STTR and commercialization opportunities across the center, including activities of solicitation, evaluation, and selection.
  - Serve as Center change agent, particularly regarding the workforce's capacity to innovate.
  - Document, demonstrate and communicate societal impact of Center technology accomplishments.
  - Serve to encourage partnerships and inter-Center collaborations
- **Center Chief Technologists have significant technical experience within the core competencies of their Center and also technical experience at other NASA Centers, within industry or academia.**
- **Center Chief Technologists not only have significant technical depth, but also the ability to think at a system-level and apply technical knowledge to significant societal challenges.**

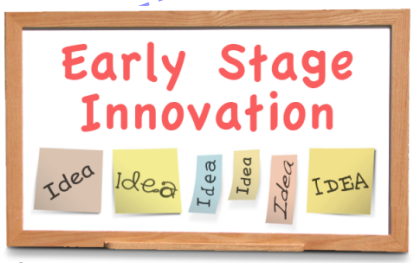
NASA's Integrated Technology Programs

- OCT in partnership with the Mission Directorates including ARMD, SMD, SOMD and ESMD will invest in a portfolio of technology investments enabling new approaches to NASA's current mission set, and allowing the Agency to pursue entirely new missions of science and exploration.
  - the example below shows how OCT will partner with ESMD
  - similar partnerships are planned for SMD, SOMD and ARMD



OCT Space Technology Development Approach



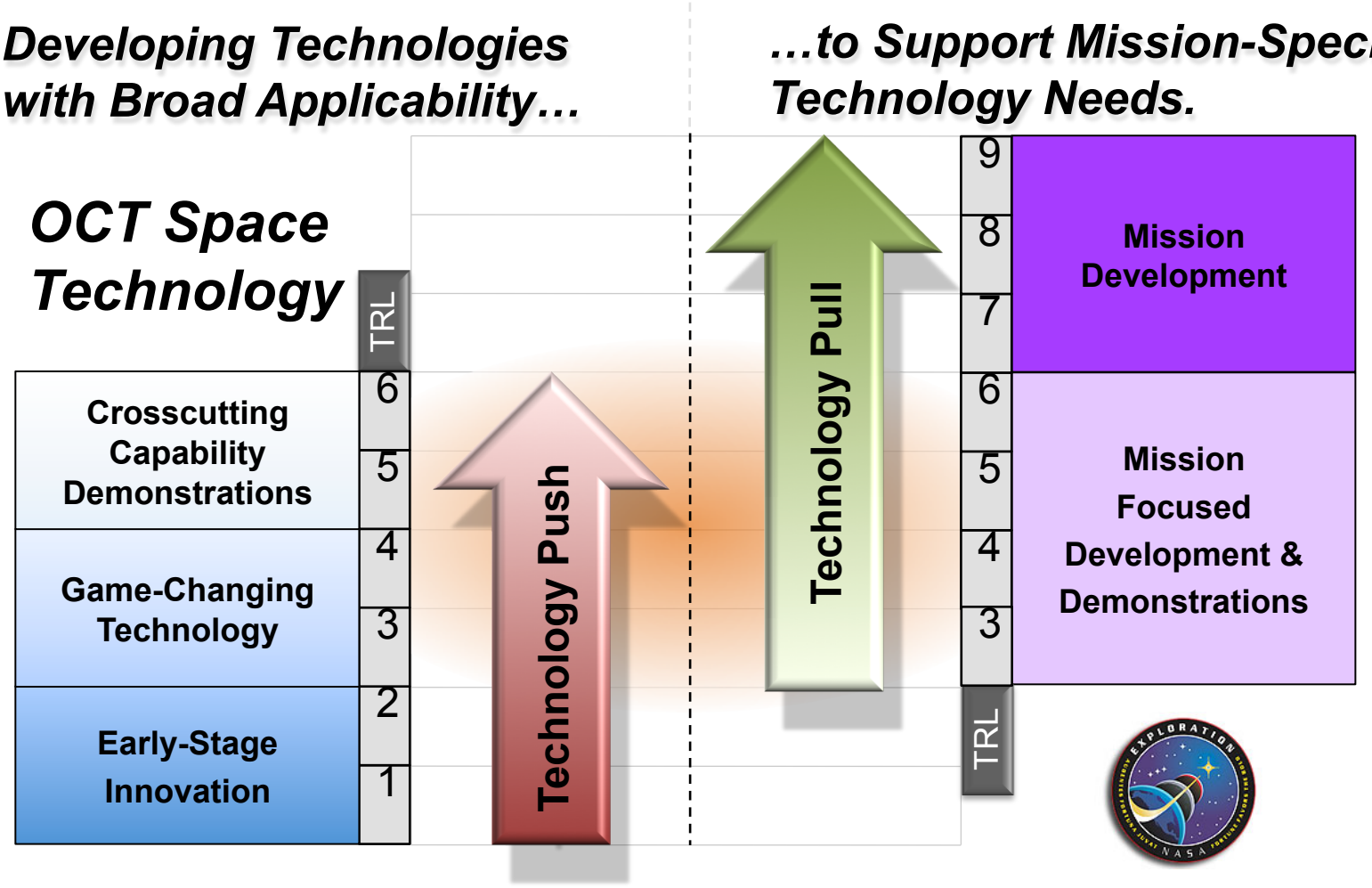


Creative ideas regarding future NASA systems or solutions to national needs.

Prove feasibility of novel, early-stage ideas with potential to revolutionize a future NASA mission and/or fulfill national need.

Mature crosscutting capabilities that advance multiple future space missions to flight readiness status

Relationship with Mission Directorate Technology Programs (e.g., ESMD)



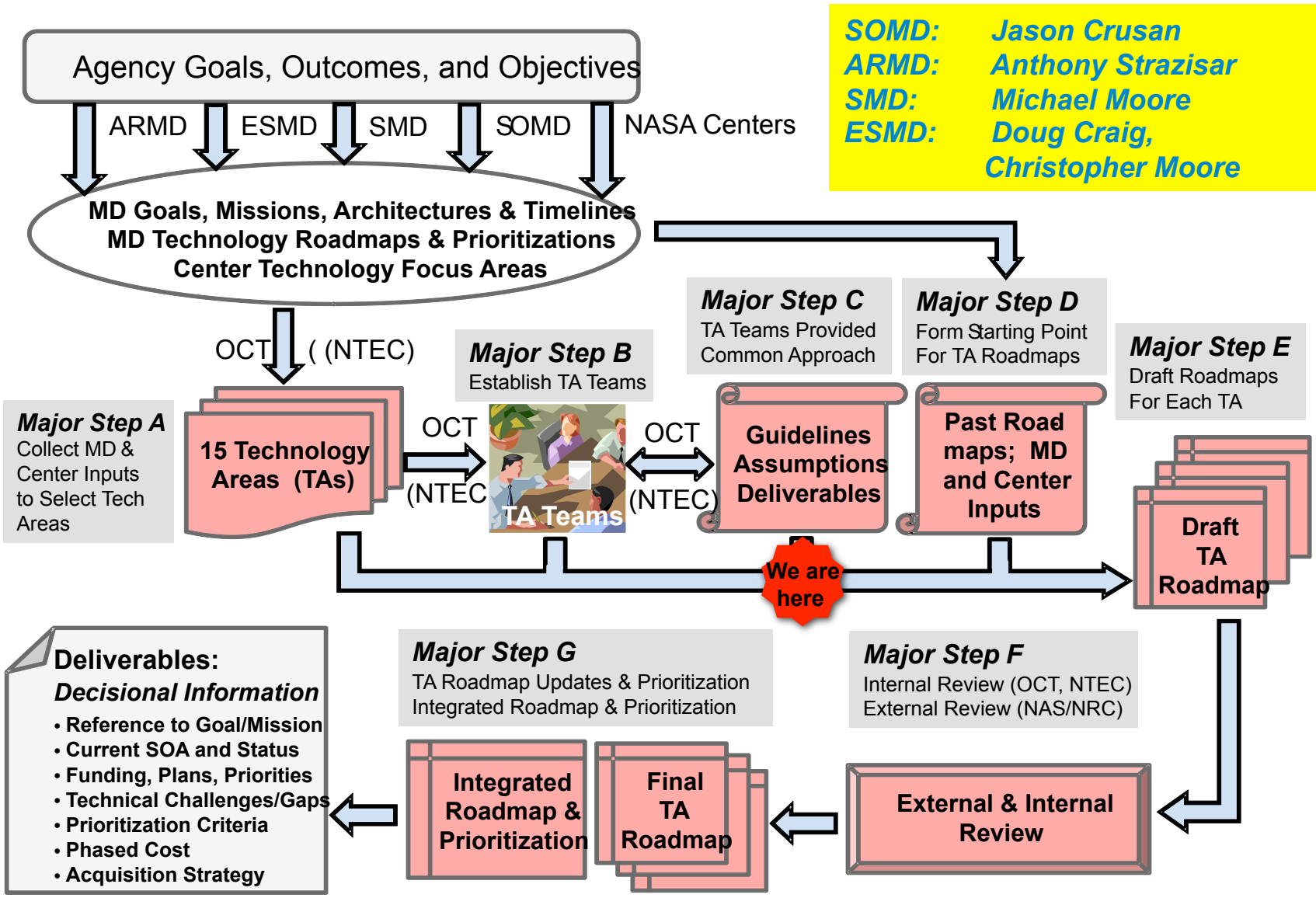
Roadmapping Background

- OCT documented and received Agency-level concurrence on the "Process to Create and Maintain NASA's Aero-Space Technology Area Roadmap (A-STAR)" – *released version posted with OCT policy documents at www.nasa.gov/OCT*
- A-STAR performs a Decadal Survey:
  - Creating a set of 15 cross-cutting Technology Area (TA) roadmaps and links them to an integrated strategic roadmap to show the overall technology strategy and priorities across all of NASA's technology investments
    - ✓ Responds to the OCT charter to provide "Coordination of technology investments across the Agency, including the mission-focused investments made by the NASA Mission Directorates, and perform strategic technology integration."
  - Calls for thorough internal and external roadmap content development and review processes
    - ✓ Establishes a deliberative panel of internal and external stakeholders to review and advise on technology development priorities for the Space Technology Programs through a transparent and balanced process
- OCT's Office of Strategic Integration (OCT/SI) was charged with executing the A-STAR process

A-STAR Benefits

- ✓ Provides clear Agency-level technology investment recommendations
- ✓ Provides external credibility and transparency for NASA technology programs by performing a decadal survey to gather broad-based inputs from non-government parties and independent reviews provided by the NRC
- ✓ Provides internally-defensible and transparent process to ensure all Mission Directorate (MD) and Agency Office priorities are included
- ✓ Identifies the interrelationships, linkages and synergies between the technologies and the associated investments from the different NASA MDs and Offices, as well as other Gov't Agencies and internationals
- ✓ Includes emerging technology ideas and innovations from the Centers and externals to enable alternate technology paths

A-STAR Process



Roadmap Technology Areas

1	LAUNCH PROPULSION SYSTEMS
2	IN-SPACE PROPULSION SYSTEMS
3	SPACE POWER AND ENERGY STORAGE SYSTEMS
4	ROBOTICS, TELE-ROBOTICS, AND AUTONOMOUS SYSTEMS
5	COMMUNICATION AND NAVIGATION SYSTEMS
6	HUMAN HEALTH, LIFE SUPPORT AND HABITATION SYSTEMS
7	HUMAN EXPLORATION SURFACE SYSTEMS
8	SCIENTIFIC INSTRUMENTS, OBSERVATORIES, AND SENSOR SYSTEMS
9	ENTRY, DESCENT, AND LANDING SYSTEMS
10	NANOTECHNOLOGY
11	MODELING, SIMULATION, INFORMATION TECHNOLOGY AND PROCESSING
12	MATERIALS, STRUCTURAL AND THERMAL SYSTEMS, AND MANUFACTURING
13	GROUND AND LAUNCH SYSTEMS PROCESSING
14	THERMAL MANAGEMENT SYSTEMS
15	AERONAUTICS

NASA Technology Development Framework

Purpose

- Describe the various strategies that NASA will employ to develop technologies
- Identify how these strategies are embodied within NASA technology programs and functional offices
- Clarify how technology programs and functional offices fit together and interact to form overall Agency vision for technologies
- Identify the types of innovation and technology developments within the Mission Directorates (MDs) and under the OCT Programs
- Provide NASA Stakeholders, the NASA workforce, and potential technology partners (other government Agencies, industry, academia and internationals) with a clear understanding of
  - Purview of each NASA technology program
  - TRL pathways across them
  - Coherent overarching vision that integrates them
- Provide approaches for collaboration between NASA Offices and Mission Directorates
- Provide methods that will be employed to eliminate overlaps and close gaps

NASA Technology Development Framework

Example Parameters

- Technology Push vs. Pull
- Game-changing/Transformational vs. Evolutionary/Incremental
- Mission Specificity vs. Cross-Cutting
- National needs vs. NASA strategic goals, outcomes, objectives
- Mix of Technology Areas vs. Technology Area-Focused
- Competed vs. Directed
  - Selection/Award and Acquisition strategy
  - Review Processes
- Management Structure
- Collaborations and Handoffs/Transfers between Programs, Offices & MDs
- External Partnering Strategies
- Student Involvement

Space Optical Communications

Optical Space Communications technology is ready in the lab today. Large differences in requirements for Near-Earth Optical Comm and Deep Space Optical Comm lead to two track qualification process. First near-Earth demonstration will be conducted on the Lunar Atmosphere and Dust Environment Explorer (LADEE).

Space Optical Comm Advantages:

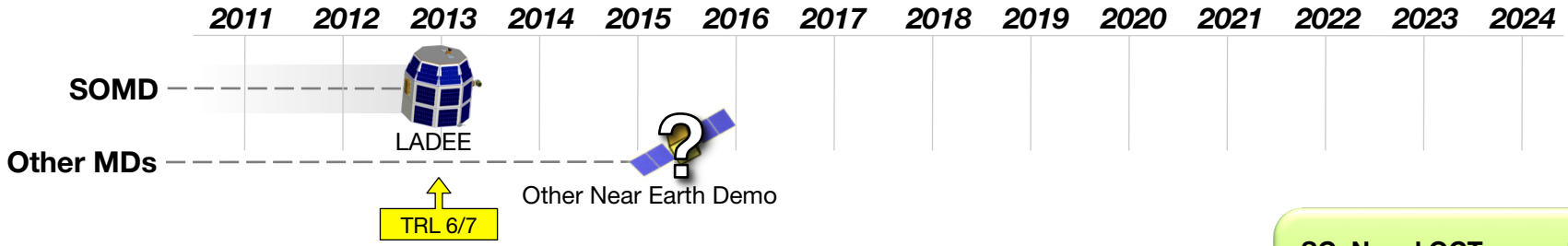
Higher Data Rates

- Order of magnitude higher than RF
- Enables use of Earth Sensing-class instruments at the Moon and Mars and beyond
- More productivity from science spacecraft

Lower Size, Weight, and Power Burden on Spacecraft Compared to RF Systems

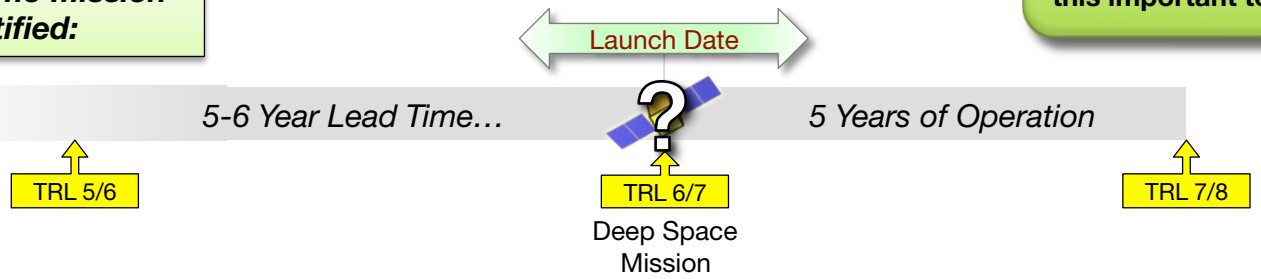
- More spacecraft resources available for science instruments / extended missions

Near Earth Tech Demo Missions:



SCaN and OCT are actively seeking partners to support continued development of this important technology.

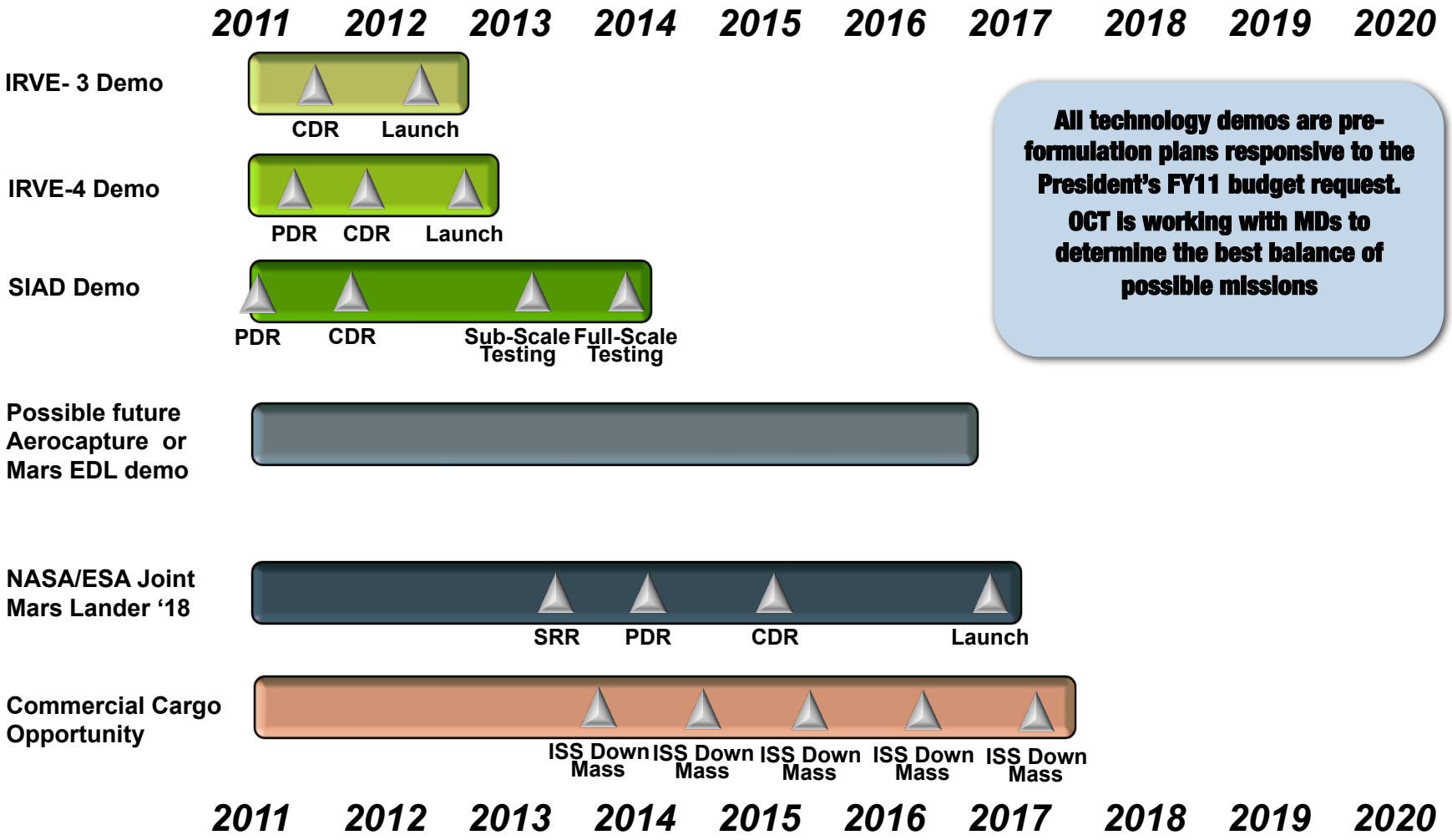
A Deep Space Tech Demo Mission Has Not Yet Been Identified:



Integration of Entry, Descent, and Landing (EDL) Investments

- EDL is a cross-cutting technology for both robotic and human exploration elements
  - Core need of many Mission Directorates (SMD, ESMD, ARMD) and potentially others (Industry, DOD, etc.)
- A number of programs will undertake EDL technology development
  - OCT: Technology Demonstrations Mission Program
  - ESMD: Exploration Technology Development & Demonstrations Program, Robotic Precursor Technology Demonstrations Program, Flagship Technology Demonstrations Program
  - SMD: Planetary Science Division's specific mission investments
- Strategic Integration within OCT coordinates the technology investments between all MDs to ensure sufficient resources are allocated to advance EDL technologies with minimal overlap
  - Long term EDL roadmap development efforts are defined and negotiated with the MDs
- EDL investments decisions are vetted through NTEC to ensure a proper overall portfolio is established and acted upon with firm agreements

Possible EDL Technology Development and Demonstration Missions



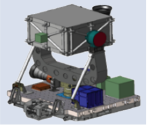
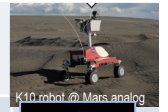
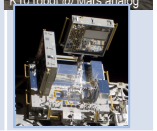
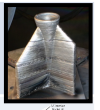
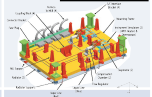
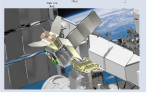
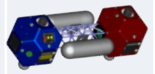
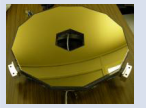
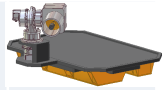
All technology demos are pre-formulation plans responsive to the President's FY11 budget request.

OCT is working with MDs to determine the best balance of possible missions

NASA SOMD - ISS Utilization Background

- NASA's Space Operations Mission Directorate (SOMD) requested proposals for technologies, which could be developed or tested on the International Space Station
- Some of these proposals include crosscutting technologies
- Some of the proposals may have possible co-funding from OCT
- Depending on the technology, the TRL, and the study scope, these could fall under
  - The Game Changing Development Program within OCT's Game Changing Technology Division, or
  - The Technology Demonstration Mission Program within the Crosscutting Capability Demonstration Division

SOMD ISS Utilization Proposals to Validate Crosscutting Technology

Proposed Demo	
X-ray Navigation Demonstrator (GSFC & ARC): Validate real-time XNAV (X-ray pulsar-based navigation, with onboard nav solution processing, to TRL 7) and XCOM (comm over X-rays) concepts. Pathfinder for breakthrough timing solutions: navigation anywhere in the Solar system.	
Tele-robotic Operations of Rovers from ISS (ARC & GRC): From orbit, the ISS crew would remotely operate a rover to scout/survey a planetary analog site on Earth, to demo human-robotic interaction for improved exploration.	
Materials on ISS Experiment-X (MISSE-X) (LaRC, GRC, JSC, ARC, JPL, MSFC): MISSE-X is a follow-on ISS external experiment suitcase/platform with a plug & play interface designed to expand ISS utilization by providing experimenters with low cost and ease of access to space environments.	
Segmented PrimAry RoboTic Assembly experimeNt (SPARTAN) (GSFC): End-to-end low cost demo of autonomously-assembled instruments in space (e.g., modular optical space telescopes) to validate in-space application of wavefront sensing and control technologies.	
In-Space Electron Beam Freeform Fabrication (LaRC & MSFC): Electron beam fabrication provides on-demand, manufacturing to mitigate spares mass / volume reqs and enables repair and assembly of large structures on orbit.	
Thermal Loop Experiment (GSFC): Tech demo of a small-scale, passive, self regulating, thermal control system, consisting of a miniature loop heat pipe (MLHP) with multiple heat-acquisition / rejection sites & unique evaporators.	
Joint NASA-Commercial ISS Electric Propulsion & Power Testbed (GRC, JSC, MSFC): Demonstrate operation of the Ad Astra VASIMR engine, and provide an in-space facility to test new power and EP thruster systems.	
Acquisition of Low-Gravity Slosh Data in Simulated Propellant Tanks (KSC): Acquire data on liquid position (slosh) & tank response for known forces to calibrate CFD models of coupled fluid-vehicle behavior.	
ISS Observatory and Telescope Testbed (JPL): Demonstrates telescope architecture technology for in-space assembly that is an enabler for in-space human/robotic assembly of future space telescopes: Cosmic Origins, Exoplanet Detection, Earth Science and DOD.	
10 Gb/sec LEO LASERCOM Testbed (JPL): Demonstrate high-rate LEO-to-Earth laser communication: 10 Gb/s lasercom terminal on ISS w/ associated mobile ground terminal.	

Summary

- Technology coordination and integration governance across the Agency is addressed through NASA Technology Executive Council (NTEC)
- Integration of technology development across the NASA Centers is addressed through the establishment of Center Chief Technologist (CCTs) and the Center technology Council (CTC)
- The OCT's Strategic Integration Office addresses technology related coordination and integration between OCT and the Mission Directorates and other NASA Offices
  - Coordinating an Agency level technology roadmapping activity, e.g., A-STAR, to create decadal recommendation of NASA technology investments
  - Developing a technology framework document to provide guidance and explanation of the NASA technology programs and the strategic plan that brings them together
  - Coordinating with MDs to develop integrated plans for strategic technology investment plans involving more than one Office or MD.