National Aeronautics and Space Administration

OFFICE OF THE CHIEF TECHNOLOGIST

Take-up of SBIR Technologies in NASA Missions

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Objectives for this presentation

- Provide a brief overview of the NASA Office of the Chief Technologist (OCT)
- Describe the process by which NASA infuses SBIR/STTR-developed technologies into its missions
- Identify key challenges and make recommendations to strengthen technology infusion to NASA and other markets

Overview of
NASA Office of the Chief Technologist

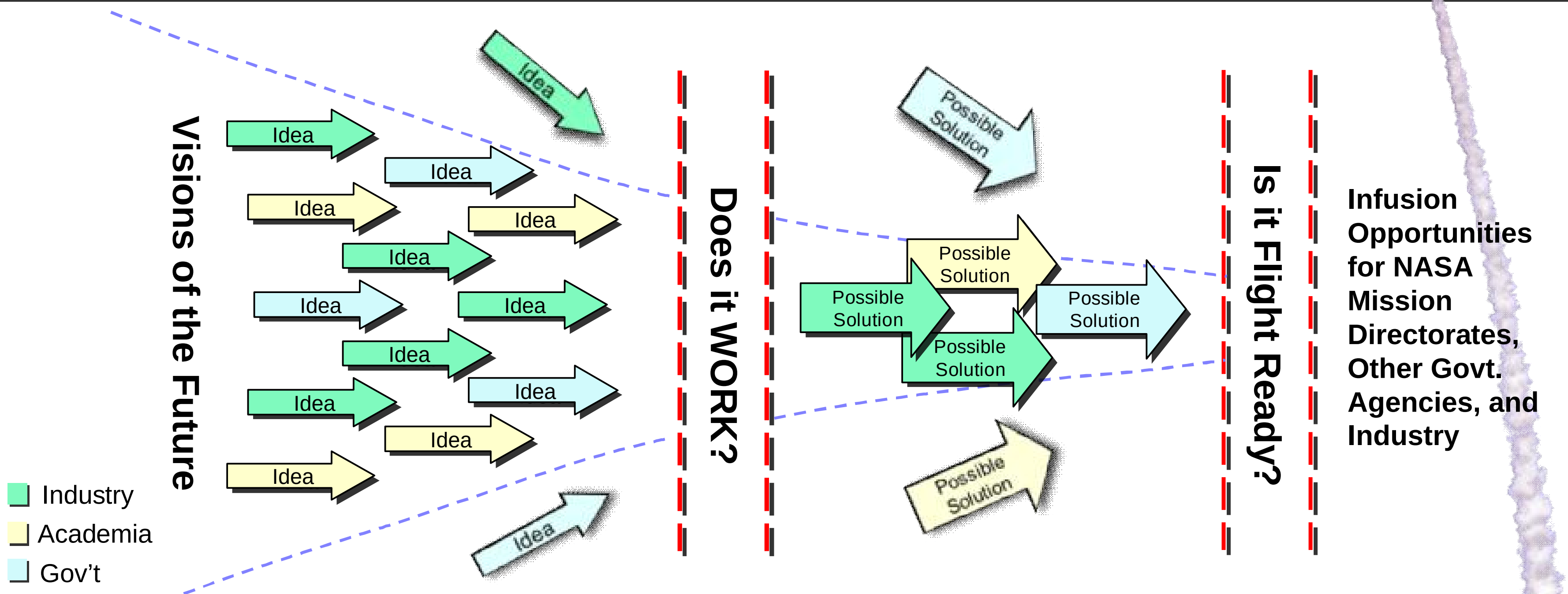
Office of Chief Technologist Roles/Responsibilities

- **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

Space Technology Development Approach

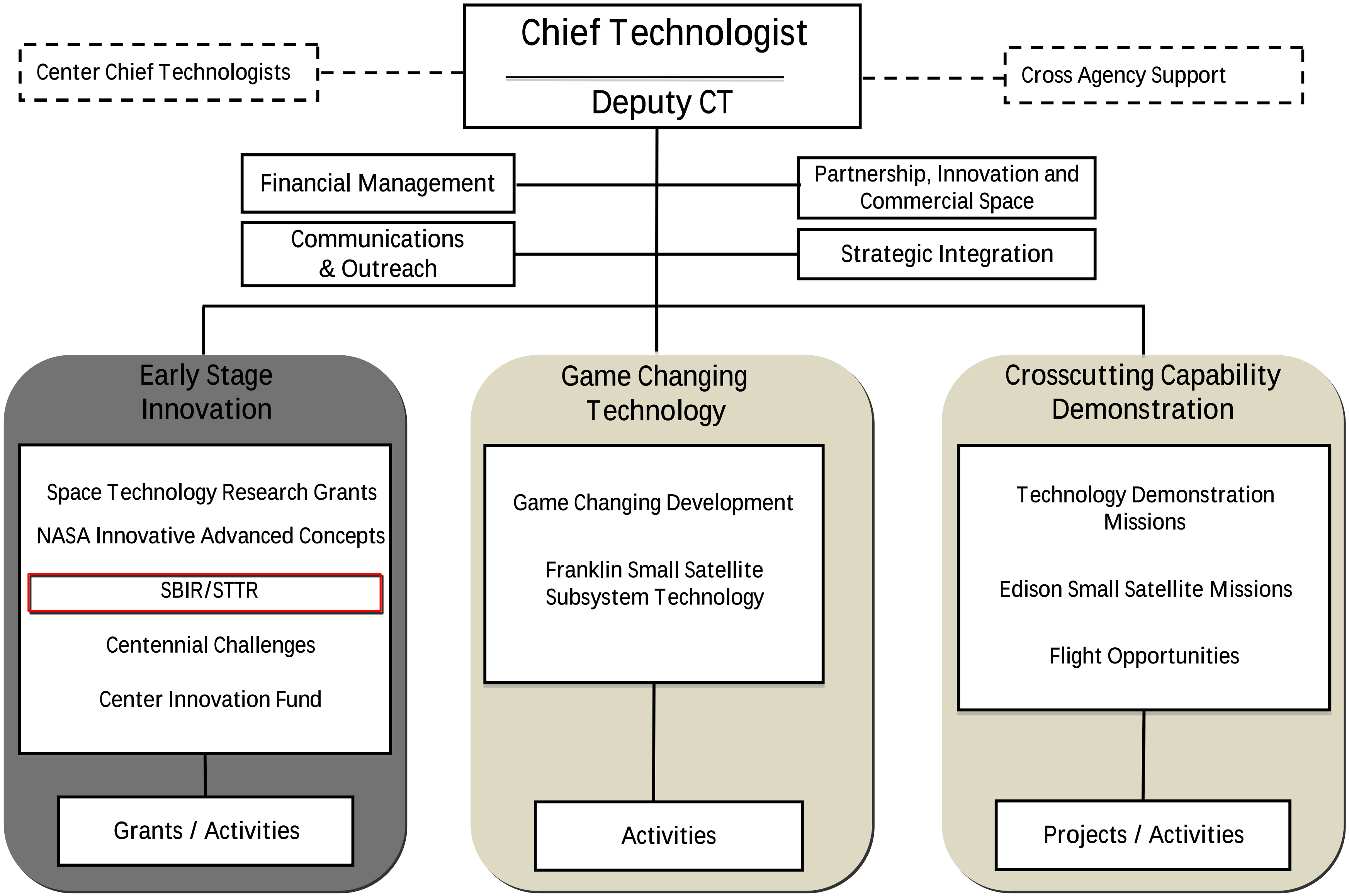


Creative ideas regarding future NASA systems or solutions to national needs.

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

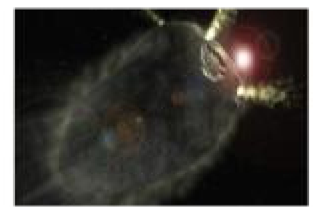
Office of the Chief Technologist Organization



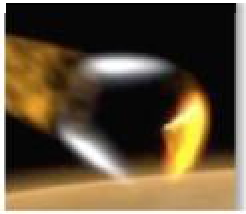
OCT Space Technology Divisions

	Early-Stage Innovation	Game-Changing Technology	Crosscutting Capability Demos
Development Stage	Concept Validation (TRL 1-2)	Tech Demonstration (TRL 3-4/5)	System Qualification (TRL 6)
Programs	Space Tech Research Grants NIAC Center Innovation Fund SBIR/STTR Centennial Challenges	Game Changing Development Small Satellite Subsystem Technology	Technology Demonstration Missions Edison Small Satellite Missions Flight Opportunities
Number of Projects	100+	10-20	TDM: 3-8 ESSM: 1-3 FO: 20-40
Typical Project Cost	$50K-$800K	GCD: Large: $25M; Small: $6M SSST: $6M	TDM: $150M from OCT ESSM: $10M FO: < $5M
Project Duration	6 months – 2 years	2 yrs w/potential 1 yr extension	TDM: < 3 years ESSM: < 2 years FO: 6 months – 2 years
Performer Selection	100% Competed	> 70% Competed	> 70% Competed
Typical Performers	Academia, NASA, Industry	NASA, Fed Labs, Industry, Academia	Industry, NASA
Acquisition Strategy	Grants, Contracts, Cooperative Agreements, Prize Competitions	BAAs, Contracts	Contracts, Space Act Agreements
Cost-Sharing	Encouraged	Preferred	Required, 25% min for TDM
Partners	Academia Federal: NASA MDs, DARPA, DOD, DOE, NOAA, NSF, Other Industry: Aerospace, Non-Aerospace International Partners		

Space Technology Grand Challenges

Space Technology Grand Challenges			
Expand Human Presence in Space			
			
Economical Space Access Provide economical, reliable and safe access to space, opening the door for robust and frequent space research, exploration and commercialization.	**Space Health and Medicine** Eliminate or mitigate the negative effects of the space environments on human physical and behavioral health, optimize human performance in space and expand the scope of space based medical care to match terrestrial care.	**Telepresence in Space** Create seamless user-friendly virtual telepresence environments allowing people to have real-time, remote interactive participation in space research and exploration.	**Space Colonization** Create self-sustaining and reliable human environments and habitats that enable the permanent colonization of space and other planetary surfaces.
Manage In-Space Resources			
			
Affordable Abundant Power Provide abundant, reliable and affordable energy generation, storage and distribution for space exploration and scientific discovery.	**Space Way Station** Develop pre-stationed and in-situ resource capabilities, along with in-space manufacturing, storage and repair to replenish the resources for sustaining life and mobility in space.	**Space Debris Hazard Mitigation** Significantly reduce the threat to spacecraft from natural and human-made space debris.	**Near-Earth Object Detection and Mitigation** Develop capabilities to detect and mitigate the risk of space objects that pose a catastrophic threat to Earth.

Space Technology Grand Challenges

Enable Transformational Space Exploration and Scientific Discovery				
				
Efficient In-Space Transportation Develop systems that provide rapid, efficient and affordable transportation to, from and around space destinations.	**High-Mass Planetary Surface Access** Develop entry, descent and landing systems with the ability to deliver large-mass, human and robotic systems, to planetary surfaces.	**All Access Mobility** Create mobility systems that allow humans and robots to travel and explore on, over or under any destination surface.	**Surviving Extreme Space Environments** Enable robotic operations and survival, to conduct science research and exploration in the most extreme environments of our solar system.	**New Tools of Discovery** Develop novel technologies to investigate the origin, phenomena, structures and processes of all elements of the solar system and of the universe.

NASA Space Technology Roadmaps

Roadmap Technical Areas (TAs)

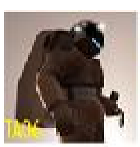
TA01 
- LAUNCH PROPULSION SYSTEMS

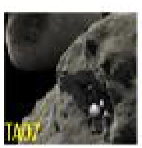
TA02 
- IN-SPACE PROPULSION TECHNOLOGIES

TA03 
- SPACE POWER & ENERGY STORAGE

TA04 
- ROBOTICS, TELE-ROBOTICS & AUTONOMOUS SYSTEMS

TA05 
- COMMUNICATION & NAVIGATION

TA06 
- HUMAN HEALTH, LIFE SUPPORT & HABITATION SYSTEMS

TA07 
- HUMAN EXPLORATION DESTINATION SYSTEMS

TA08 
- SCIENCE INSTRUMENTS, OBSERVATORIES & SENSOR SYSTEMS

TA09 
- ENTRY, DESCENT & LANDING SYSTEMS

TA10 
- NANOTECHNOLOGY

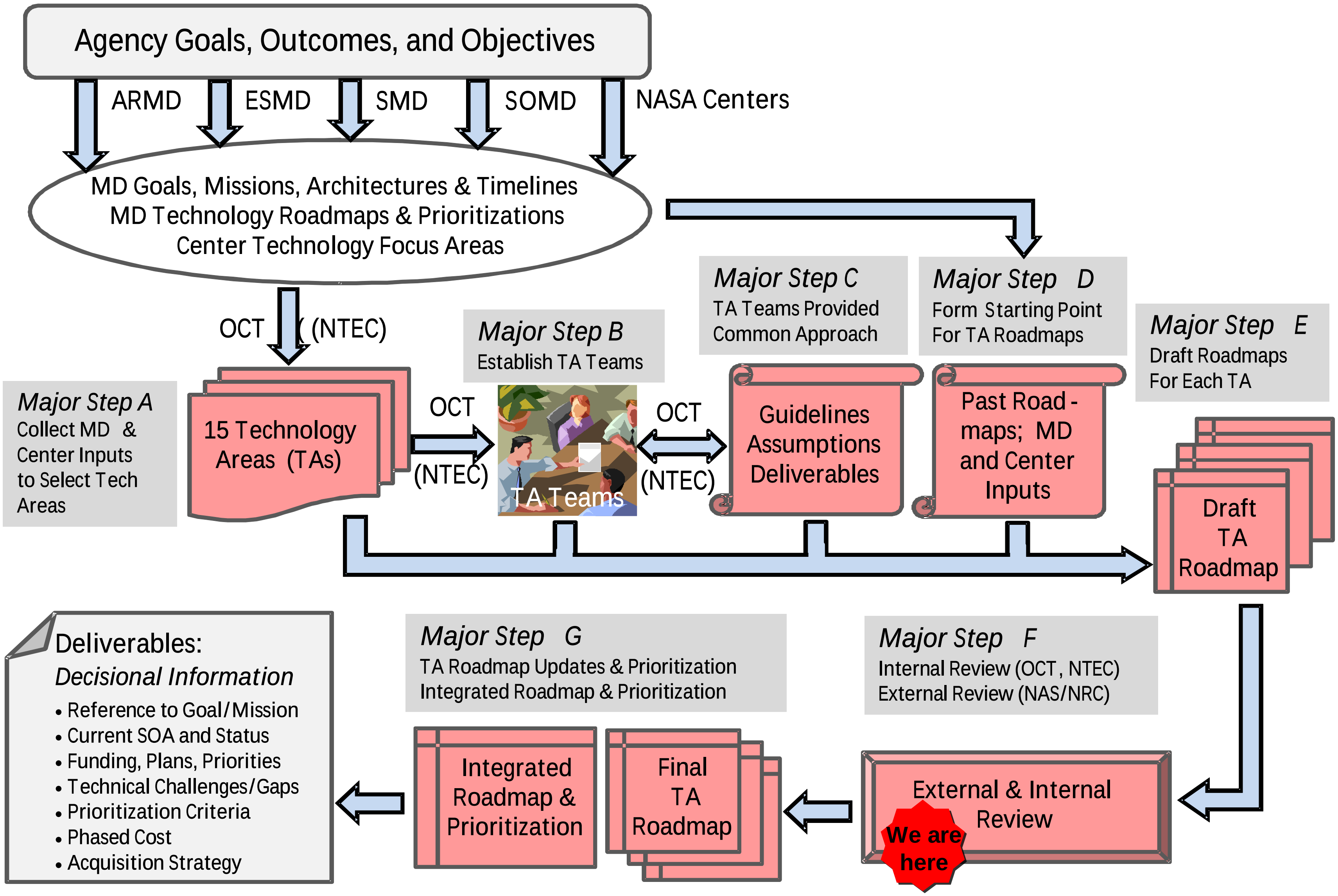
TA11 
- MODELING, SIMULATION, INFORMATION TECHNOLOGY & PROCESSING

TA12 
- MATERIALS, STRUCTURES, MECHANICAL SYSTEMS & MANUFACTURING

TA13 
- GROUND & LAUNCH SYSTEMS PROCESSING

TA14 
- THERMAL MANAGEMENT SYSTEMS

STR Process



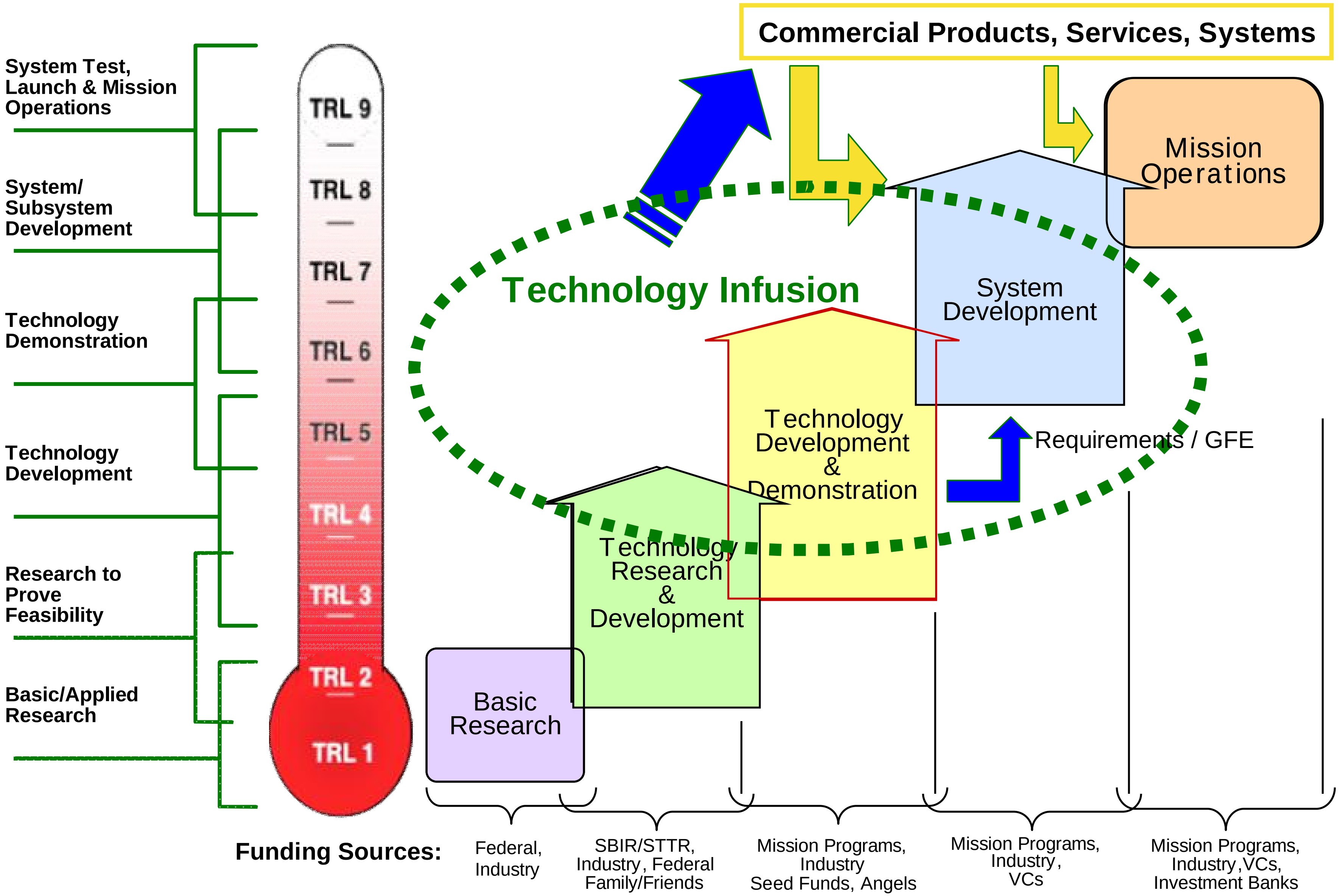
Agency Goals, Outcomes, and Objectives
ARMD
ESMD
SMD
SOMD
NASA Centers
MD Goals, Missions, Architectures & Timelines
MD Technology Roadmaps & Prioritizations
Center Technology Focus Areas
OCT
(NTEC)
Major Step A
Collect MD & Center Inputs to Select Tech Areas
15 Technology Areas (TAs)
OCT
(NTEC)
Major Step B
Establish TA Teams
TA Teams
OCT
(NTEC)
Major Step C
TA Teams Provided Common Approach
Guidelines Assumptions Deliverables
Major Step D
Form Starting Point For TA Roadmaps
Past Road - maps; MD and Center Inputs
Major Step E
Draft Roadmaps For Each TA
Draft TA Roadmap
Major Step F
Internal Review (OCT, NTEC)
External Review (NAS/NRC)
External & Internal Review
We are here
Major Step G
TA Roadmap Updates & Prioritization
Integrated Roadmap & Prioritization
Final TA Roadmap
Integrated Roadmap & Prioritization
Deliverables:
Decisional Information
• Reference to Goal/Mission
• Current SOA and Status
• Funding, Plans, Priorities
• Technical Challenges/Gaps
• Prioritization Criteria
• Phased Cost
• Acquisition Strategy

STR Schedule

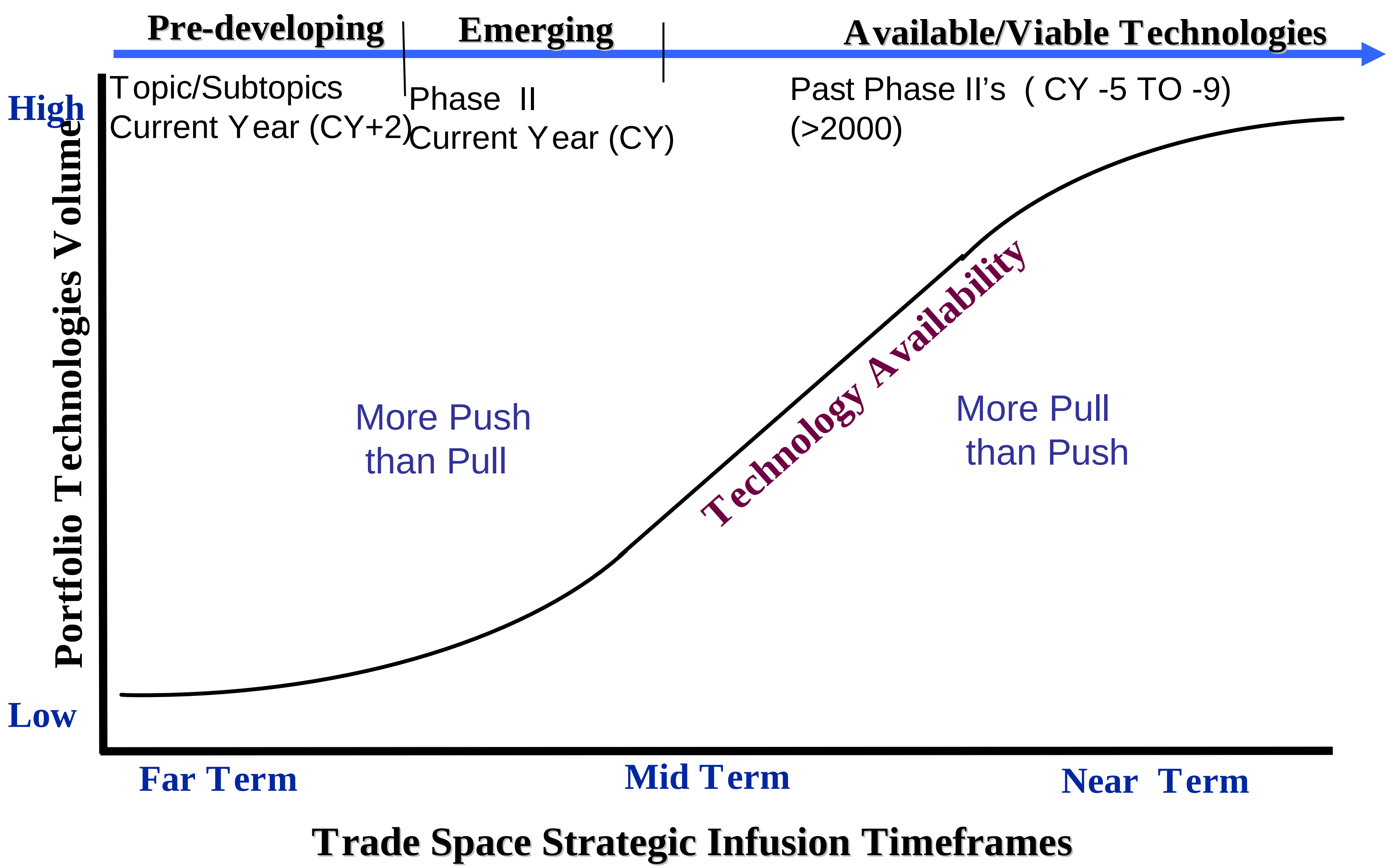
ü Roadmapping Kickoff meeting with TA chairs	7/28/10
ü First cut, 1-pg TABS and TASRs provided by each TA	8/13/10
ü Presentation of Rev 1 Draft Roadmaps for NASA Review	9/15-16/10
ü Draft Roadmap Review comments due to OCT	9/27/10
ü TA team disposition of comments and report revisions	10/22/10
ü OCT approval of final “draft” TA roadmap reports	11/10/10
ü Draft NASA Roadmaps sent to NRC & widely distributed	12/2/10
• NRC kick-off meeting	1/25-27/11
• NRC panel meetings and workshops	2-4/11
• NRC Interim Report	8/11
• NRC Final Report	1/12

Process for Infusion of NASA SBIR/STTR Technologies

NASA Technology Infusion

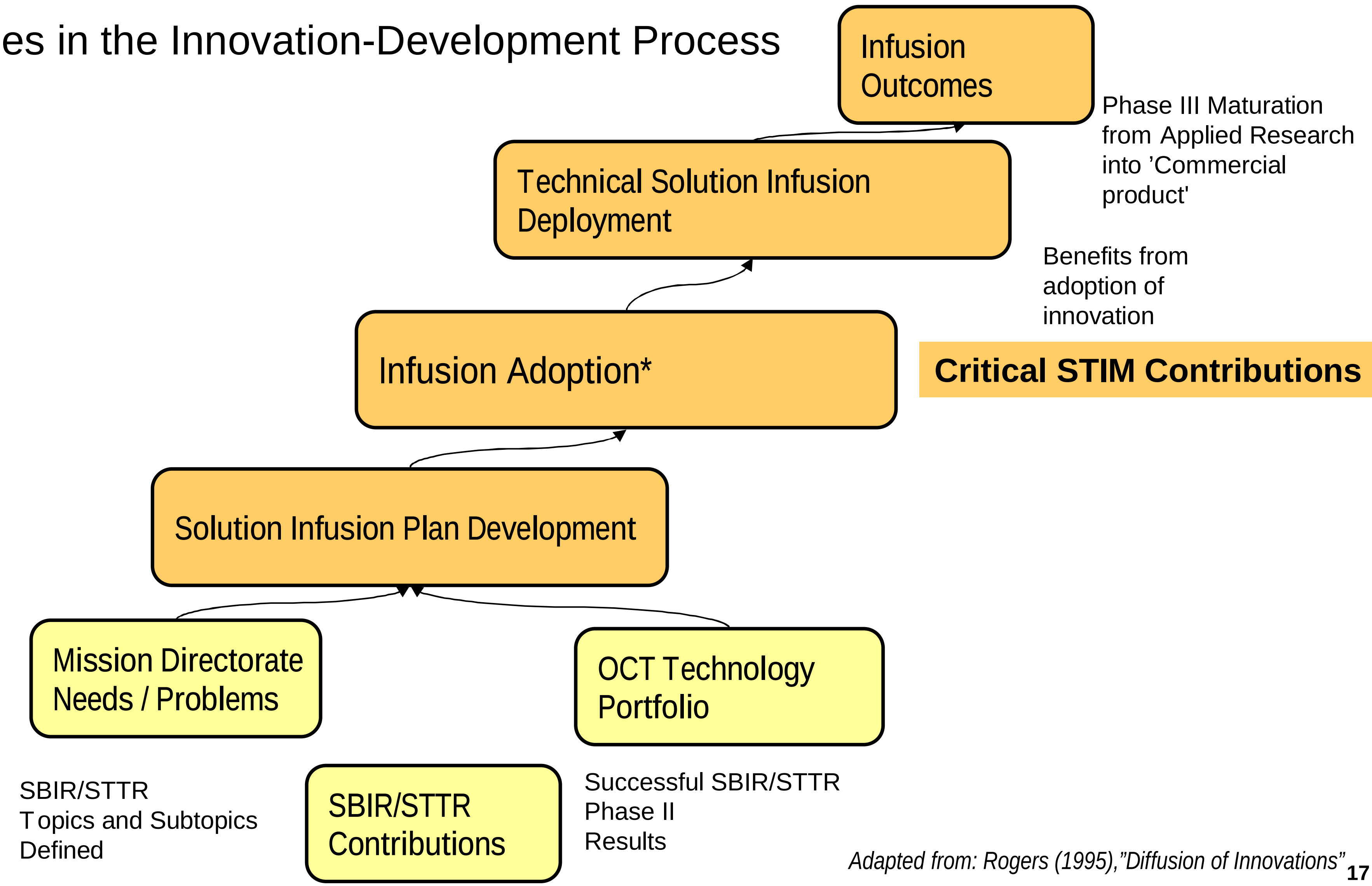


SBIR/STTR Portfolio Landscape



Infusion as Part of the Innovation Process

Phases in the Innovation-Development Process



Adapted from: Rogers (1995),”Diffusion of Innovations”

Infusion Interfaces

How does NASA define infusion success?

At NASA, SBIR infusion success is measured in several ways:

- Technology directly picked up by a flight project, mission or instrument – This is the ultimate prize, but not the only one.
- Technology targeted for further specific development, under an advanced technology program which a flight project, mission or instrument supports.
- Technology significantly benefits direction of overall portfolio.
- Small business either (a) sells their technology to a larger company, or (b) is bought out by a larger company, which in turn incorporates the technology into one of their product lines and/or uses it on a flight program.

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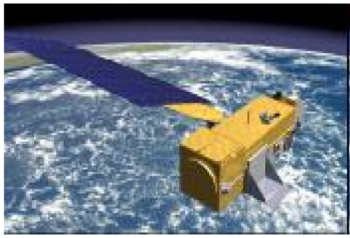
Some NASA SBIR Mission Technologies



Aura

Phoenix

Hubble

Rosetta

Xionetics
Deformable Mirror Technology

Spaceborne, Inc.
Correlator Chip for Radio Astronomy

Yardney Technical Products
Lithium-Ion Batteries

SpaceDev
Wet Chemistry Analysis

Honeybee Robotics, Inc.
Icy Soil Acquisition Device

Starsys Research
Heat Switch Control Radiator

IA Tech
Planning Collaboration Software

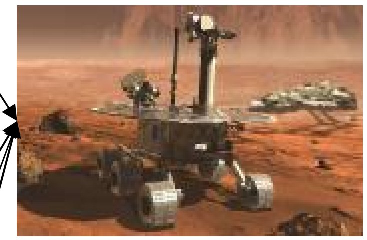
Maxwell Technologies
Electronics

Advanced Optical Systems
Video Guidance Sensor

Surface Optics Corporation
Mirror Coating Process

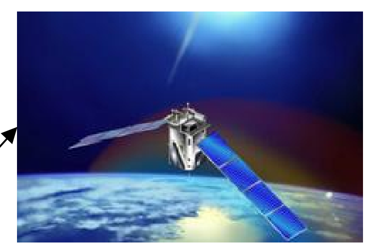
Sensor Sciences, LLC
UV Detectors

Palomar



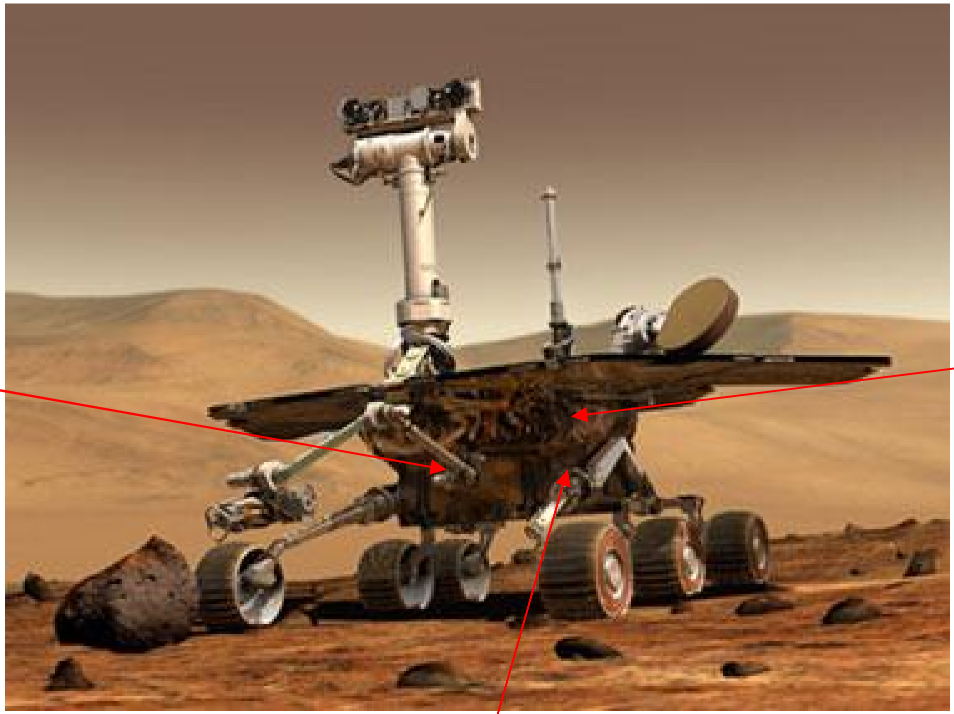
MER

Kepler



TIMED

Mars Exploration Rovers Operate Using SBIR-Developed Technology



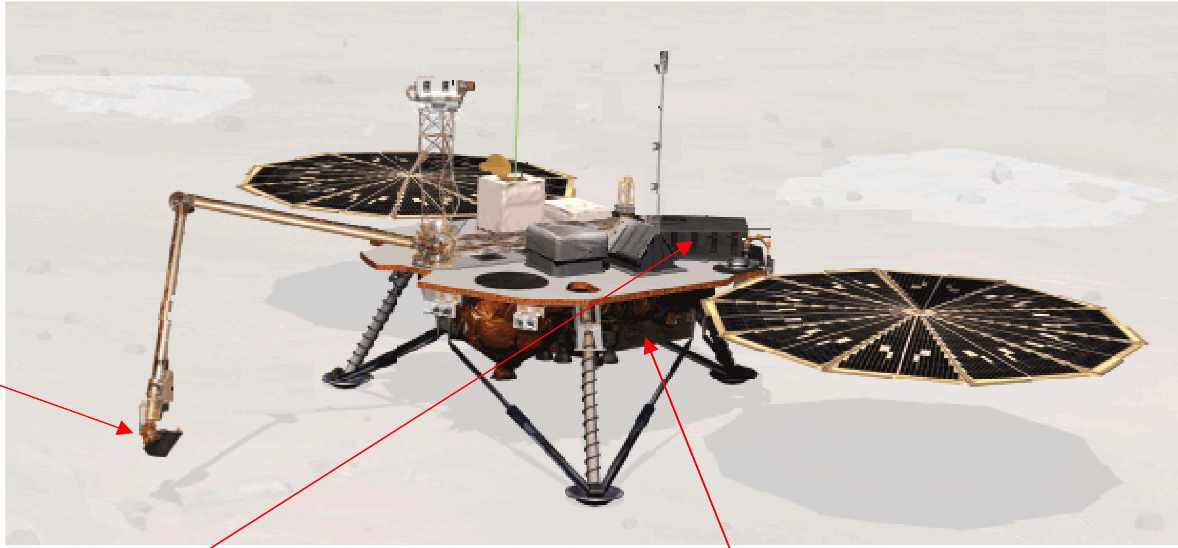
Starsys Research Developed several paraffin based heat switches that function autonomously. Heat switches control radiator for electronics package on Mars 2003 Rovers.

Yardney Technical Products Developed lithium ion batteries with specific energy of >100Wh/kg and energy density of 240 Wh/l and long cycle life. Subsequently, they won a large Air Force/NASA contract to develop batteries for space applications. They are supplying the batteries for the 2003 Mars Rovers.

Maxwell Technologies Fabricated and tested an ASCII chip with single event latch up protection technology. Innovation enables the use of commercial chip technology in space missions, providing higher performance at a lower cost. Supplying A to D converter for Mars 03 Rovers.

SBIR Contributions to the Phoenix Mission to Mars

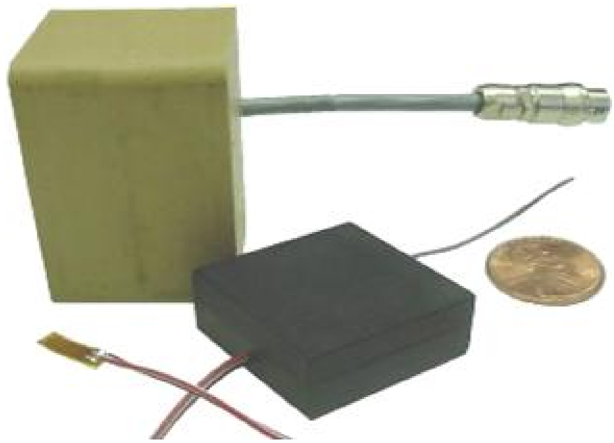
Icy Soil Acquisition Device supplied by Honeybee Robotics, Inc.



SpaceDev contributed wet chemistry elements of the Microscopy Electrochemistry and Conductivity Analyzer (MECA)

Lithium ion batteries supplied by Yardney Technical Products, Inc.

SBIR-Developed Miniature Wireless Instrument System Flying on Space Shuttle



INNOVATION

- Invocon MicroWIS-*XG* systems transmit data to receivers attached to a standard RS-232 port on a PC
- Remote units capable of interfacing with any type of resistive strain, temperature, pressure, humidity sensors

ACCOMPLISHMENTS

- Successfully Flown on STS-101 as a Development Test Object and acquired temperature data from several key locations in and around the Shuttle Crew Compartment and avionics equipment
- Technology Applicable to the NASA Exploration program

COMMERCIALIZATION

- The system is used to monitor external grout pressure during construction of two tunnels in the Netherlands
- The system was used to monitor the induced fatigue due to stresses on a bridge during the construction and testing phases in 2002

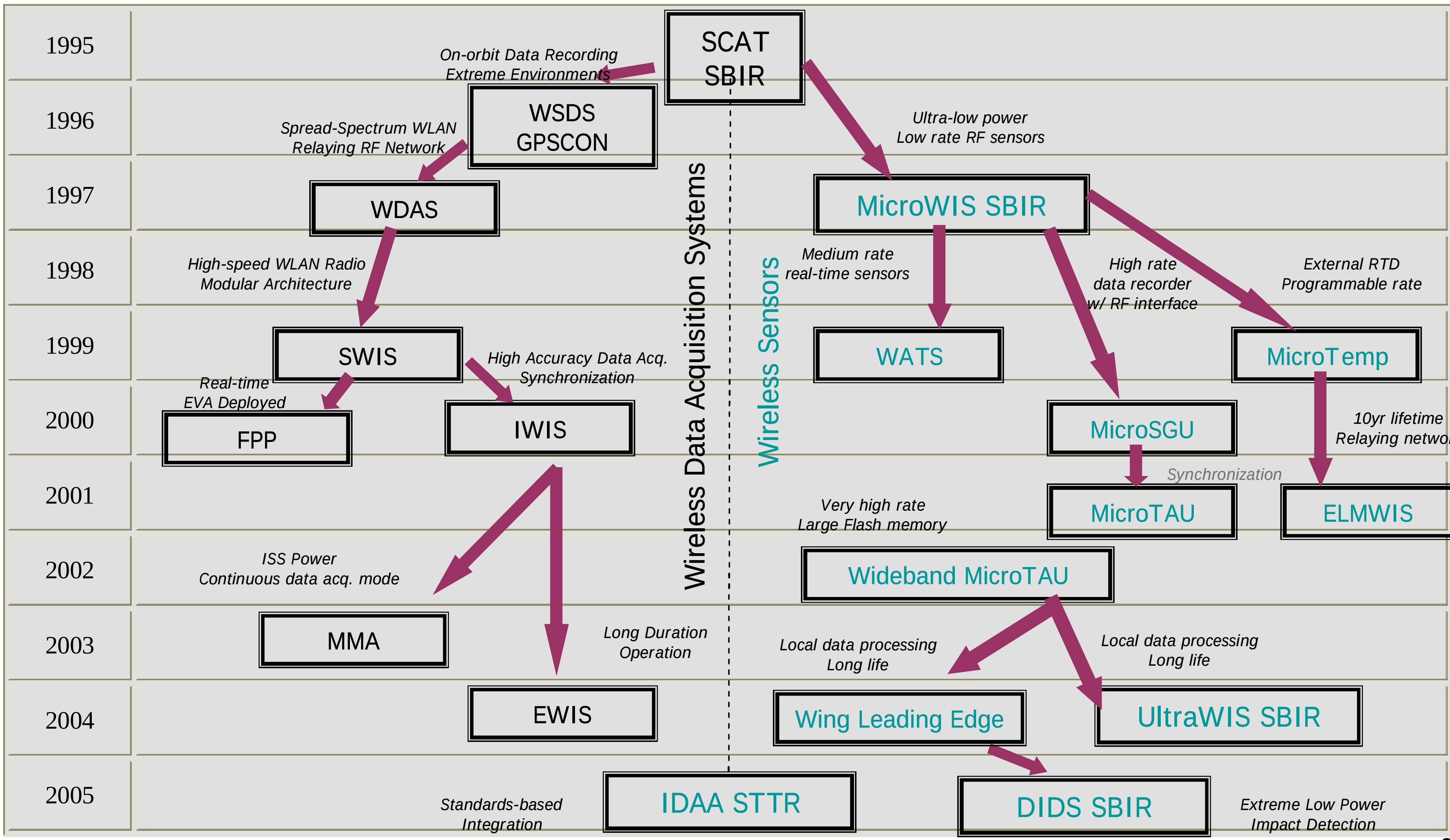
GOVERNMENT/ SCIENCE APPLICATIONS

- MicroWIS-*XG* system is enhanced version of original Invocon MicroWIS system developed for NASA in 1998. MicroWIS can operate in conjunction with both the MITE WIS™ and the ELMWIS™ systems.
- The system successfully flown and operated on STS-92, STS-96, STS-97, STS-100, STS-101, STS-104, STS-106, STS-114, and STS-108
- Four types of Invocon systems where flown On STS-114, the return to flight mission

Johnson Space Center 03/20/2006
Electronic Systems/ Components, Sensors, Test & Measurement
www.invocon.com

SBIR 1997 Phase I NAS 9 98077
NASA Contact: chieger@ems.jsc.nasa.gov
Company Contact: 281-292-9903

NASA SBIR/STTR Technology Development Tree for Wireless Data Acquisition



Challenges to SBIR/STTR Technology Commercialization at NASA

Technology infusion challenges that are unique to NASA – or are they?

- Small market size for highly specialized technologies
  - Often developed for a particular application, with unique interfaces
  - Makes for narrow pathways to the Federal and commercial markets
  - Even within NASA, there are challenges in creating production flows for repetitive development or manufacturing

- NASA not immune to a challenge that faces all SBIR participants — helping firms connect internally to NASA programs and other federal acquisition opportunities
  - NASA has taken steps to improve these opportunities through Technology Infusion Managers (TIMs) at all NASA centers
  - TIMs act as internal advocates, matchmakers, and advisors to strengthen follow-on opportunities