

## Appendix B: SBIR/STTR and the Space Technology Roadmaps

NASA's technology development activities expand the frontiers of knowledge and capabilities in aeronautics, science, and space, creating opportunities, markets, and products for U.S. industry and academia. The 2015 NASA Technology Roadmaps are a set of documents that consider a wide range of needed technology candidates and development pathways for the next 20 years (2015-2035). The roadmaps focused on applied research and development activities. Technologies that support NASA's missions may also support science and exploration missions conducted by the commercial space industry and other government agencies. In addition, NASA technology development results in applications for the general population including devices that improve health, medicine, transportation, public safety, and consumer goods.

The 2020 NASA Technology Taxonomy is an evolution of the technology roadmaps. The 2020 NASA Technology Taxonomy provides a structure for articulating the technology development disciplines needed to enable future space missions and support commercial air travel. The 2020 revision is comprised of 17 distinct technical discipline based Taxonomies (TX) that provide a breakdown structure for each technology area. The taxonomy uses a three-level hierarchy for grouping and organizing technology types. Level 1 represents the technology area, which is the title of that area (e.g. TX01: Propulsion Systems). Level 2 is a list of the subareas (e.g. TX01.1 Chemical Space Propulsion). Level 3 categorizes the types of technologies within the subareas (e.g. TX1.1.1 Integrated Systems and Ancillary Technologies). The taxonomy is a foundational element of NASA's technology management process. NASA's mission directorates reference the taxonomy to solicit proposals and to inform decisions on NASA's technology policy, prioritization, and strategic investments.

Subtopics in this solicitation still reference the Space Technology Roadmap Technology Areas (TAs) within the subtopic descriptions. They are cross-referenced to the new Technology Taxonomy in the table below. Details on the 2015 NASA Technology Roadmaps remain accessible here:

(<https://www.nasa.gov/offices/oct/home/roadmaps/index.html>), and information on the new 2020 NASA Technology Taxonomy can be found at:

([https://www.nasa.gov/sites/default/files/atoms/files/2020\\_nasa\\_technology\\_taxonomy\\_lowres.pdf](https://www.nasa.gov/sites/default/files/atoms/files/2020_nasa_technology_taxonomy_lowres.pdf)).

The research and technology subtopics for the SBIR Program are identified annually by Mission Directorates and Center Programs. The Directorates identify high priority research and technology needs for respective programs and projects. Research and technology subtopics for the STTR Program are aligned with needs associated with the research interest and core competencies across NASA Centers and aligned with the Space Technology Roadmaps. Both programs support a broad range of technologies defined by a list of subtopics that vary in content within each annual solicitation.

The table on the following pages relates the current SBIR/STTR subtopics to Technology Areas/Technology Taxonomy.

TA #	TA Mapping Level 1	TA Mapping Level 2	Subtopic #	Subtopic Title	2020 Technology Taxonomy
TA01	1.0.0 - Launch Propulsion Systems	1.3.0 - Air Breathing Propulsion Systems	A1.03	Low Emissions/Clean Power - Environmentally Responsible Propulsion	TX01 - Propulsion Systems
TA02	2.0.0 - In-Space Propulsion Technologies	2.1.0 - Chemical Propulsion	Z9.01	Small Launcher Lunar Transfer Stage Development	
			Z8.06	DragSails for Spacecraft Deorbit	
				Z10.03	
		Z10.04	Manufacturing Processes Enabling Lower-Cost, In-Space Electric Propulsion Thrusters		
			2.4.0 - Supporting Technologies	T2.05	
Z10.01	Cryogenic Fluid Management				
TA03	3.0.0 - Space Power and Energy Storage	3.1.0 - Power Generation	S3.02	Dynamic Power Conversion	TX03 - Aerospace Power and Energy Storage
			S3.01	Power Generation and Conversion	
			Z1.03	Kilowatt-Class Energy Conversion for Small Fission Reactors	
		3.2.0 - Energy Storage	S3.03	Energy Storage for Extreme Environments	
		3.3.0 - Power Management and Distribution	Z1.05	Lunar & Planetary Surface Power Management & Distribution	
			Z1.06	Radiation Tolerant High-Voltage, High-Power Electronics	
TA04	4.0.0 - Robotics, Telerobotics and Autonomous Systems	4.1.0 - Sensing & Perception	T4.01	Information Technologies for Intelligent and Adaptive Space Robotics	TX04 - Robotic Systems

			T13.01	Intelligent Sensor Systems	
		4.2.0 - Mobility	S4.04	Extreme Environments Technology	
			S3.05	Terrestrial Balloons and Planetary Aerial Vehicles	
			Z5.05	Lunar Rover Technologies for In-situ Resource Utilization and Exploration	
		4.3.0 - Manipulation	S4.02	Robotic Mobility, Manipulation and Sampling	
		4.5.0 - Autonomy	A2.02	Unmanned Aircraft Systems (UAS) Technologies	
			H10.02	Autonomous Operations Technologies for Ground and Launch Systems	
			S5.05	Fault Management Technologies	
			T4.03	Coordination and Control of Swarms of Space Vehicles	
			Z5.04	Technologies for Intra-Vehicular Activity Robotics	
		4.6.0 - Autonomous Rendezvous and Docking	Z3.05	Satellite Servicing Technologies	
		4.7.0 - RTA Systems Engineering	S4.05	Contamination Control and Planetary Protection	
TA05	5.0.0 - Communication and Navigation	5.1.0 - Optical Comm. And Navigation	H9.01	Long Range Optical Telecommunications	TX05 - Communications, Navigation, and Orbital Debris Tracking/ Characterization Systems
		5.2.0 - Radio Frequency Communications	T5.02	Electric Field Mapping and Prediction Methods within Spacecraft Enclosures	
			Z8.02	Communications and Navigation for Distributed Small Spacecraft Beyond LEO	

		5.3.0 - Internetworking	Z8.10	Wireless Communication for Avionics and Sensors for Space Applications	
		5.4.0 - Position, Navigation, and Timing	H9.03	Flight Dynamics and Navigation Technology	TX17 - Guidance, Navigation, and Control (GN&C)
			S3.04	Guidance, Navigation, and Control	
		5.5.0 - Integrated Technologies	H9.07	Cognitive Communication	TX05 - Communications, Navigation, and Orbital Debris Tracking/ Characterization Systems
		5.6.0 - Revolutionary Concepts	H9.05	Transformational Communications Technology	
				T5.04	Quantum Communications
TA06	6.0.0 - Human Health, Life Support and Habitation Systems	6.1.0 - Environmental Control Life Support & Habitation Systems	H3.02	Microbial Monitoring for Spacecraft Cabins	TX06 - Human Health, Life Support, and Habitation Systems
			H3.03	Lunar Dust Management Technology for Spacecraft Atmospheres and Spacesuits	
			H3.01	Advancements in Carbon Dioxide Reduction: Critical Subsystems and Solid Carbon Repurposing	
			T6.06	Spacecraft Water Sustainability through Nanotechnology	
		6.2.0 - Extravehicular Activity Systems	H4.05	Liquid Cooling and Ventilation Garment Connector Upgrade and Glove Humidity Reduction	
			H4.01	Exploration Portable Life Support System Component Challenges	
		6.3.0 - Human Health and Performance	H12.01	Radioprotectors and Mitigators of Space Radiation-induced Health Risks	

			H8.01	Utilization of the International Space Station (ISS) to Foster Commercial Development of Low-Earth Orbit (LEO)	
			H12.05	Autonomous Medical Operations	
		6.5.0 - Radiation	T6.05	Testing of COTS Systems in Space Radiation Environments	
TA07	7.0.0 - Human Exploration Destination Systems	7.1.0 - In-Situ Resource Utilization	Z12.01	Extraction of Oxygen from Lunar Regolith	TX07 - Exploration Destination Systems
		7.2.0 - Sustainability & Supportability	T6.07	Space Exploration Plant Growth	
		7.3.0 - Advanced Human Mobility Systems	Z13.02	Dust Tolerant Mechanisms	
		7.6.0 - Cross-Cutting Systems	Z13.01	Active and Passive Dust Mitigation Surfaces	
TA08	8.0.0 - Science Instruments, Observatories & Sensor Systems	8.1.0 - Science Instruments	S1.10	Atomic Interferometry	TX08 - Sensors and Instruments
			S1.11	In Situ Instruments/Technologies and Plume Sampling Systems for Ocean Worlds Life Detection	
			S1.12	In Situ Instruments/Technologies for Heliophysics	
			S1.07	In Situ Instruments/Technologies for Lunar and Planetary Science	
			S1.06	Particles and Fields Sensors & Instrument Enabling Technologies	
			S2.02	Precision Deployable Optical Structures and Metrology	

			S2.01	Proximity Glare Suppression for Astronomical Direct Detection of Exoplanets
			S1.04	Sensor and Detector Technologies for Visible, IR, Far-IR, and Submillimeter
			S1.02	Technologies for Active Microwave Remote Sensing
			S1.03	Technologies for Passive Microwave Remote Sensing
			S2.05	Technology for the Precision Radial Velocity Measurement Technique
			S2.04	X-Ray Mirror Systems Technology, Coating Technology for X-Ray-UV-OIR, and Free-Form Optics
			T8.06	Quantum Sensing and Measurement
			Z11.01	Nondestructive Evaluation (NDE) Sensors, Modeling, and Analysis
			Z8.08	Technologies to Enable Cost & Schedule Reductions for Ultra-Stable Normal Incidence Mirrors for CubeSats
		8.2.0 - Observations	S2.03	Advanced Optical Systems and Fabrication/Testing/Control Technologies for EUV/Optical and IR Telescope
		8.3.0 - Sensor Systems	S1.09	Cryogenic Systems for Sensors and Detectors
	S1.05		Detector Technologies for UV, X-Ray, Gamma-Ray Instruments	
	S1.01		Lidar Remote Sensing Technologies	

			S1.08	Suborbital Instruments and Sensor Systems for Earth Science Measurements	
			T8.04	Metamaterials and Metasurfaces Technology for Remote Sensing Applications	
TA09	9.0.0 - Entry, Descent and Landing Systems	9.1.0 - Aeroassist & Entry	Z7.05	3D Weaving Diagnostics	TX09 - Entry, Descent, and Landing
			Z7.06	Diagnostic Tools for High Enthalpy and High Temperature Materials Testing and Analysis	
			Z7.01	Entry Descent & Landing Sensors for Environment Characterization, Vehicle Performance, and Guidance, Navigation and Control	
		9.4.0 - Vehicle Systems Technology	Z7.03	Deployable Aerodynamic Decelerator Technology	
			Z7.04	Lander Systems Technologies	
TA11	11.0.0 - Modeling, Simulation, Information Technology and Processing	11.1.0 - Computing	H6.22	Deep Neural Net and Neuromorphic Processors for In-Space Autonomy and Cognition	TX11 - Software, Modeling, Simulation, and Information Processing
			S5.03	Accelerating NASA Science and Engineering through the Application of Artificial Intelligence	
			S3.08	Command, Data Handling, and Electronics	
			S5.01	Technologies for Large-Scale Numerical Simulation	
			Z6.01	High Performance Space Computing Technology	
		11.2.0 - Modeling	H6.04	Model Based Systems Engineering for Distributed Development	

			S5.04	Integrated Science Mission Modeling	
			S5.06	Space Weather R2O/O2R Technology Development	
		11.4.0 - Information Processing	T4.04	Autonomous Systems and Operations for the Lunar Orbital Platform-Gateway	
			T11.04	Digital Assistants for Science and Engineering	
			T11.03	Distributed Digital Ledger for Aerospace Applications	
TA12	12.0.0 - Materials, Structures, Mechanical Systems and Manufacturing	12.1.0 - Materials	T12.06	Extensible Modeling of Additive Manufacturing Processes	TX12 - Materials, Structures, Mechanical Systems, and Manufacturing
			T12.01	Thin-Ply Composite Technology and Applications	
		12.2.0 - Structures	H5.02	Hot Structure Technology for Aerospace Vehicles	
			H5.01	Lunar Surface Solar Array Structures	
			Z3.04	Autonomous Modular Assembly Technology for OSAM	
		12.4.0 - Manufacturing	T2.04	Advanced In-Space Propulsion	
			T12.05	Deposition and Curing of Thermoset Resin Mixtures for Thermal Protection	
			Z3.03	Development of Material Joining Technologies and Large-Scale Additive Manufacturing Processes for On-Orbit Manufacturing and Construction	



			Z4.04	Real Time Defect Detection, Identification and Correction in Wire-Feed Additive Manufacturing Processes	
TA13	13.0.0 - Ground and Launch Systems Processing	13.1.0 - Technologies to Optimize the Operational Life-Cycle	H10.01	Advanced Propulsion Systems Ground Test Technology	TX13 - Ground, Test, and Surface Systems
TA14	14.0.0 - Thermal Management Systems	14.2.0 - Thermal Control Systems	S3.06	Thermal Control Systems	TX14 - Thermal Management Systems
			Z2.01	Spacecraft Thermal Management	
TA15	15.0.0 - Aeronautics	15.1.0 - Safe, Efficient Growth in Global Aviation	A3.01	Advanced Air Traffic Management System Concepts	TX16 - Air Traffic Management and Range Tracking Systems
			A3.02	Increasing Autonomy in the National Airspace System (NAS)	
			A3.04	Non-Traditional Airspace Operations	
			A1.02	Quiet Performance - Aircraft Propulsion Noise	TA15 - Flight Vehicle Systems
		A1.09	Inflight Icing Hazard Mitigation Technology		
		A1.01	Aeroelasticity and Aeroservoelastic Control		
		15.3.0 - Ultra-Efficient Commercial Vehicles	A1.05	Computational Tools and Methods	
			A1.06	Vertical Lift Technology and Urban Air Mobility	
			A1.08	Aeronautics Ground Test and Measurement Technologies	
			A1.07	Propulsion Efficiency - Turbomachinery Technology for High Power Density Turbine-Engines	

			T15.04	Integration of Airframe with Distributed Electric Propulsion (DEP) System	
	15.4.0 - Transition to Low-Carbon Propulsion	A1.04		Electrified Aircraft Propulsion	
		T15.03		Electrified Aircraft Propulsion Energy Storage	
	15.5.0 - Real-Time System-Wide Safety Assurance	A3.03		Future Aviation Systems Safety	TX16 - Air Traffic Management and Range Tracking Systems
	15.7.0 - Other	A2.01		Flight Test and Measurement Technologies	TX15 - Flight Vehicle Systems
		A1.10		Hypersonic/High Speed Technology - Seals and Thermal Barriers	