

**Key Technology Capability Roadmaps:  
Performance, Products, and Using Missions vs. Time (continued)**

Time Horizon	Now	5 Years	10 Years	25 Years
Spacecraft Systems and Intelligence	<ul style="list-style-type: none"> <li>• Single spacecraft at 180kg</li> <li>• 0.5μ feature size with 5V rad hard</li> <li>• Card-based, backplane architecture</li> <li>• Subsystem boxes and cabling</li> <li>• 100kg avionics</li> <li>• Preprogrammed sequences</li> </ul>	<ul style="list-style-type: none"> <li>• Formation of S/C (virtual S/C) at 190kg</li> <li>• 0.35μ feature size with 3.3V rad hard</li> <li>• Reconfigurable and programmable logic gates</li> <li>• Multichip modules and multifunctional modules for power, comm., data</li> <li>• 3-D flex interconnects</li> <li>• 35kg avionics subsystem</li> <li>• Semi-autonomous planning and operations [Benefits all missions]</li> <li>• Data Acquisition System, &lt;125μ 100MHz enabling for GLAST</li> </ul>	<ul style="list-style-type: none"> <li>• Precision constellations of 40kg S/C over hundreds of km, with cm precision</li> <li>• 0.18μ feature size with 1V rad hard</li> <li>• Fault-tolerant, reconfigurable and programmable logic gates</li> <li>• 3-D stacked chips and multichip module systems</li> <li>• Avionics systems on a chip</li> <li>• 10–15kg avionics</li> <li>• Fully autonomous operations with decision making and fault tolerance</li> <li>• Benefits all missions</li> </ul>	<ul style="list-style-type: none"> <li>• Massive 3-D swarms of 1–10kg S/C (virtual presence throughout solar system)</li> <li>• &lt;20nm single electron quantum devices</li> <li>• Molecular nanotechnology</li> <li>• Biological computing</li> <li>• Bio-electro-optical hybrid tech.</li> <li>• Integrated, intelligent, multifunctional, reconfigurable, ultra-low power microsystems</li> <li>• &lt;1kg integrated avionics</li> <li>• Thinking systems with onboard scientific and operational expertise</li> <li>• Benefits all missions</li> </ul>
Transportation and Mobility	<ul style="list-style-type: none"> <li>• ΔV of 2.1km/s for Cassini</li> <li>• Tens of meters range for Sojourner with 11.5kg mass</li> <li>• High-altitude, short-lived Venus balloons on Venus</li> <li>• Stereo HDTV on Pathfinder for science analysis</li> <li>• Real-time public image dissemination</li> </ul>	<ul style="list-style-type: none"> <li>• ΔV of 10–15km/s from multimission SEP</li> <li>• Solar sail of 20g/m²</li> <li>• Tens of km with 50% science payload for Mars rovers</li> <li>• 0.9kg nanorovers for comets, asteroids, or local Mars surface</li> <li>• Home broadcast of HDTV space images</li> <li>• Automatic real-time space images via Internet</li> <li>• Stereo HDTV for operations, sample arm, navigation</li> <li>• Lighter (TBD) high-temperature atmospheric entry systems</li> <li>• Beneficial to Mars, outer planet missions</li> </ul>	<ul style="list-style-type: none"> <li>• ΔV of 30km/s with advanced SEP</li> <li>• ΔV of 50km/s with 5g/m² solar sail</li> <li>• Enables multibody sample return</li> <li>• Megawatt EP to support piloted Mars missions</li> <li>• Mars mobile science labs with hundreds of km range</li> <li>• Subsurface explorers to several km depth on Mars, Europa</li> <li>• Scalable mass from 0.1 to 100kg</li> <li>• Aerobots circumnavigating Mars, Venus, Titan</li> <li>• Stereo IMAX-quality images for operations and science</li> <li>• Stereo HDTV to homes</li> <li>• Lighter (TBD) high-temperature atmospheric entry systems</li> <li>• Beneficial to Mars, outer planet missions</li> </ul>	<ul style="list-style-type: none"> <li>• 100km/s SEP</li> <li>• 1gm² solar sail</li> <li>• ΔV of 500km/s using antiproton-catalyzed microdiamond fusion</li> <li>• Interstellar robotic missions and piloted exploration of solar system</li> <li>• Autonomous labs circumnavigating Mars and interacting with humans</li> <li>• Nanorover swarms with hundreds of km range</li> <li>• Europa ocean exploration</li> <li>• 4X resolution of home digital video</li> <li>• IMAX-quality stereo panoramas in home without viewing aids</li> <li>• Real-time "virtual" roaming on planetary and satellite surfaces</li> <li>• Lighter (TBD) high-temperature atmospheric entry systems</li> <li>• Beneficial to Mars, outer planet missions</li> </ul>