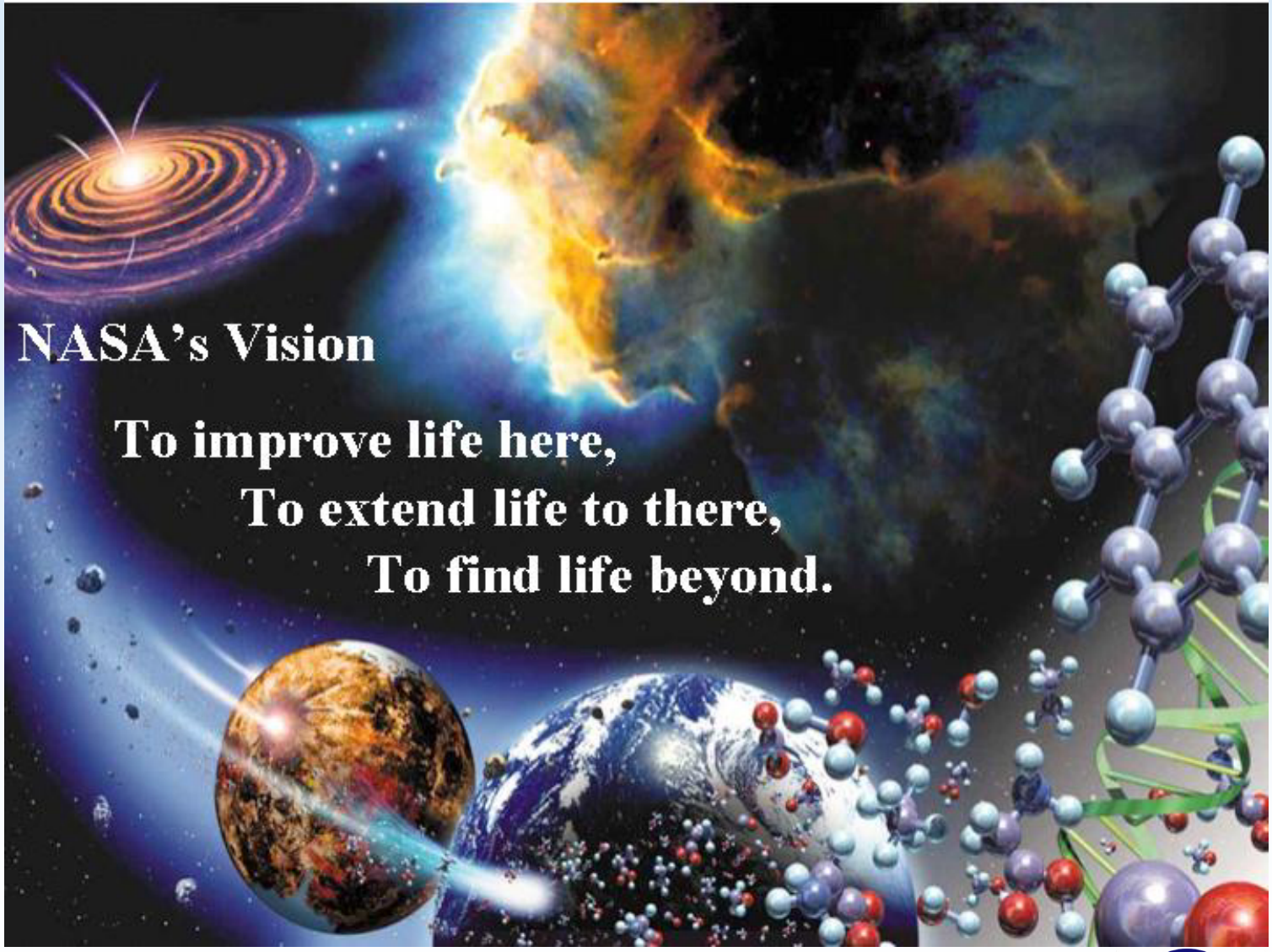
Woodrow Whitlow, Jr.
National Aeronautics and Space Administration
Glenn Research Center
Cleveland, Ohio

Outline

- NASA Vision and Mission
- Aeronautics Technology
- Space Technology
- Education Programs
- Conclusions



Glenn Research Center

at Lewis Field

The NASA Mission

To understand and protect our home planet

To explore the universe and search for life

To inspire the next generation of explorers

… as only NASA can.

To Understand and Protect Our Home Planet

- Understanding the Earth's system and its response to natural and human-induced changes
- **Enabling a safe, secure, efficient, and environmentally friendly air transportation system**
- **Investing in technologies and collaborating with others to improve the quality of life and to create a more secure world**

Glenn Research Center

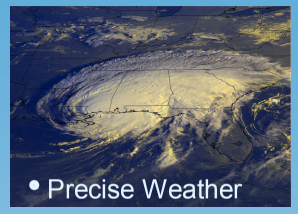
at Lewis Field

The Airspace System

Today's Challenges:

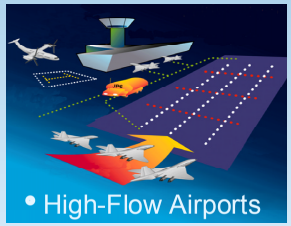
- **Overcome reduced throughput in bad weather**
- **Eliminate en route congestion and the "domino effect" throughout the system**
- **Keep pace with demand for arrival and departures at benchmark airports***
- **Increase situational awareness in the system**

Technology Solutions:

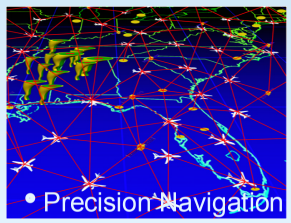


- **High-resolution weather**
  - **Precise forecasts**
  - **Precise wake vortex knowledge**

- **System-level traffic flows optimization**
  - **Separation assurance for complex traffic flows**



- **High-flow airports**
  - **No gaps in arrival and departure streams**
  - **Efficient surface movement and rapid reconfiguration**



- **Communication, navigation, and surveillance**
  - **High-bandwidth and reliable data transmission**
  - **Precision navigation**
  - **System wide coverage**

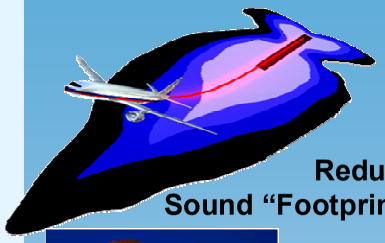
Airspace System of the Future

Revolutionary Vehicles

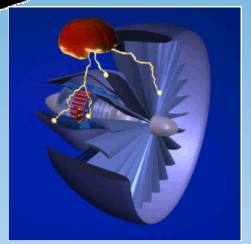
Today's Challenges:

- Reduce noise
  - Eliminate airport restrictions
- Lower emissions
  - Reduce greenhouse gases
  - Improve local air quality
- Improve safety
  - Reduce the accident rate
- Enhance capabilities–advance technology
  - Autonomous operation
  - Supersonic overland flight
  - Runway independence

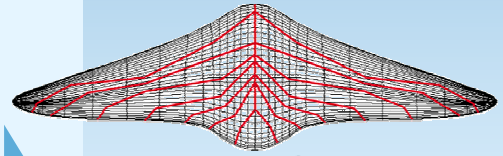
Technology Solutions:



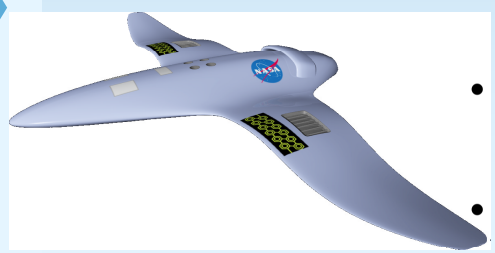
Reduce Sound "Footprint"



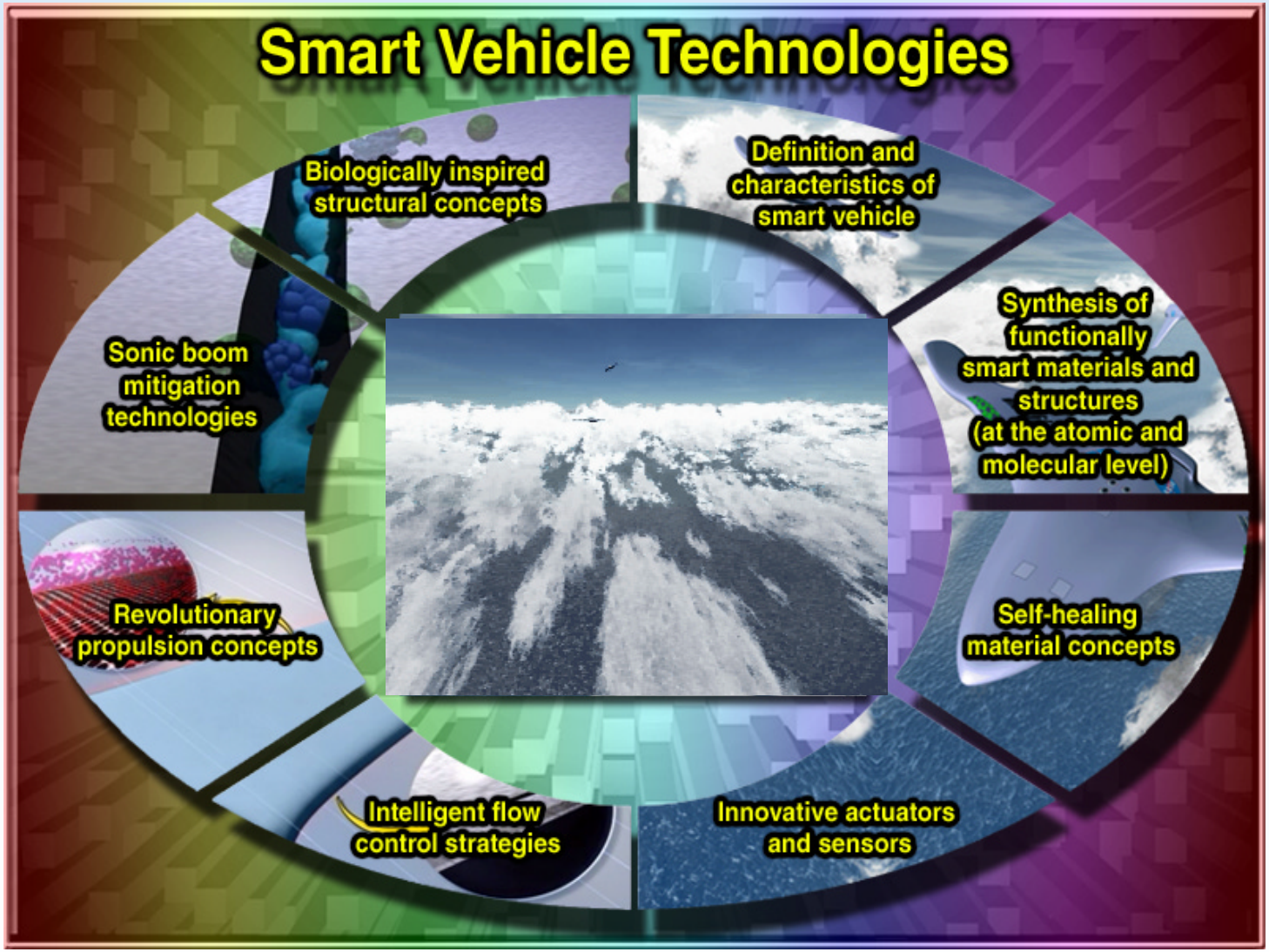
Intelligent Propulsion System



Intelligent Sensors



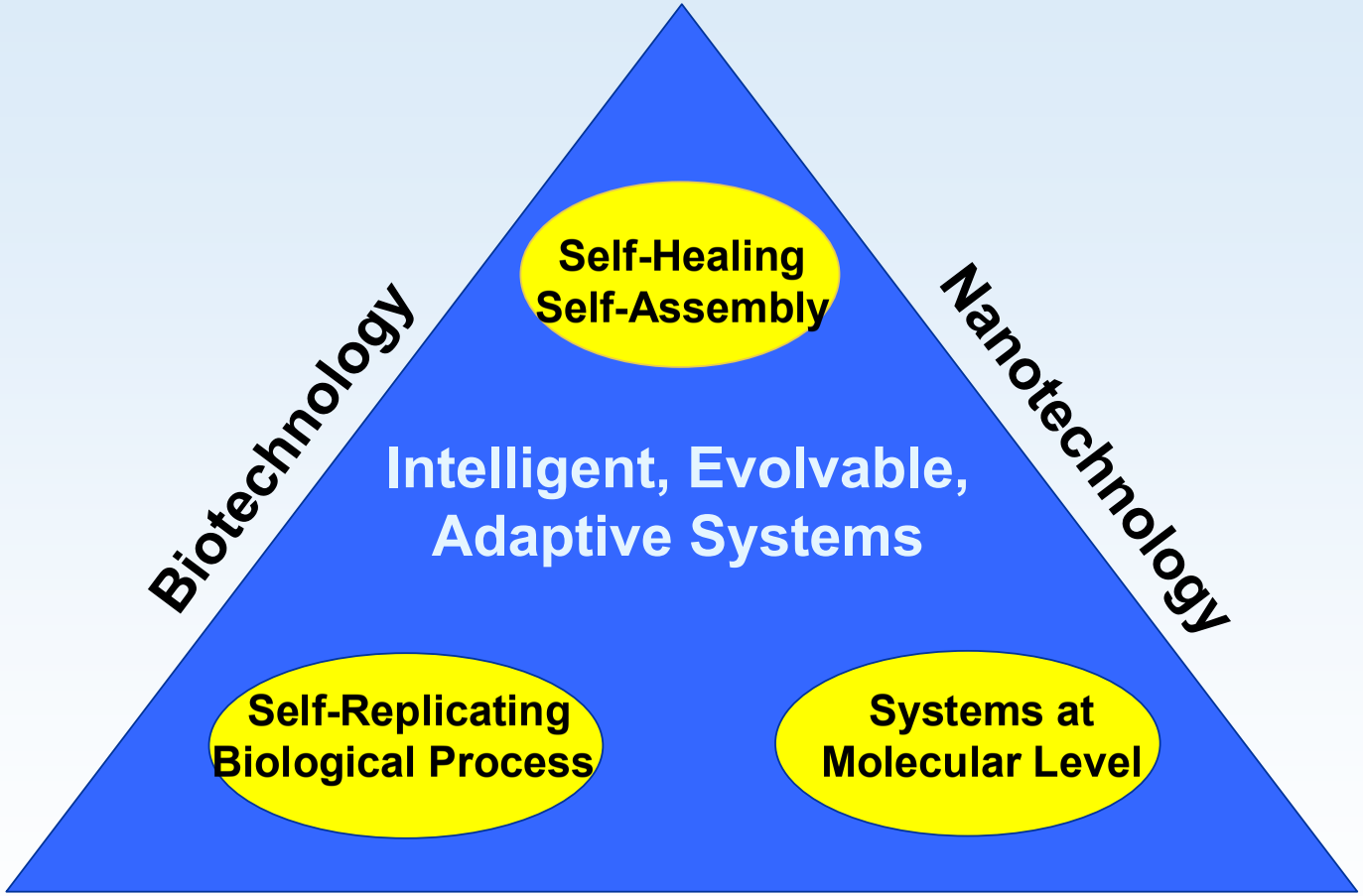
- Integrated airframe and propulsion systems
- Active flow and noise control
- Intelligent propulsion systems
- Fuel-efficient vehicles
- Robust flight control
  - Reconfigurable control laws
- Integrated vehicle health monitoring
- Automated decision aids
- Advanced vehicle concepts



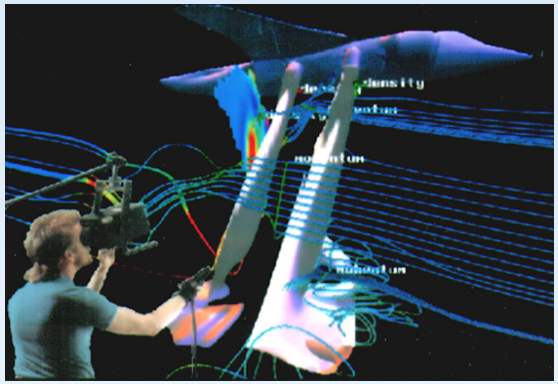
Glenn Research Center

at Lewis Field

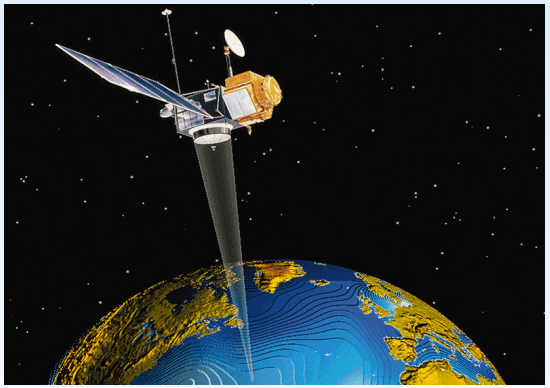
Revolutionary Technology Vision



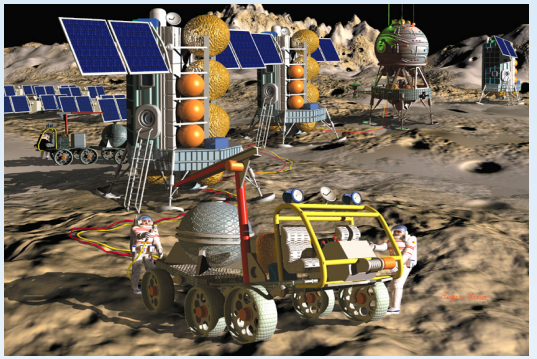
Information Technology



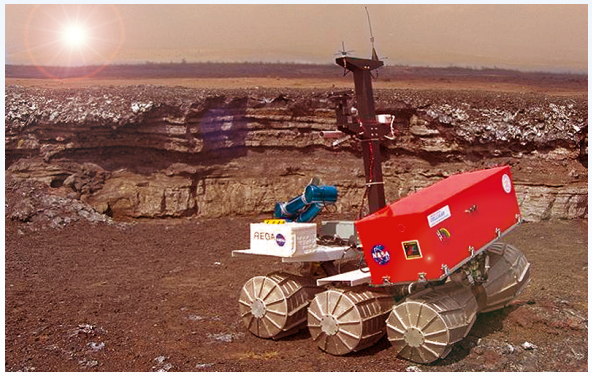
Intelligent Design Synthesis
In the Virtual Environment



Science Understanding



Human Exploration
of Space



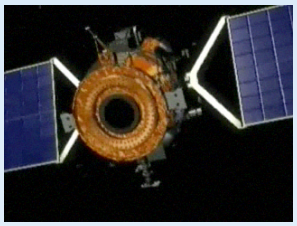
Robotic Exploration of Space

Aircraft Operations

Glenn Research Center

at Lewis Field

Intelligent Systems



Automated Reasoning

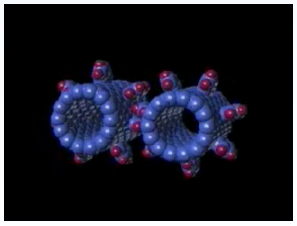
Systems that reliably make and execute decisions which traditionally require human intervention

Human Centered Computing

Tools that amplify both human and machine performance

Intelligent Data Understanding

Autonomous techniques that transform data into information, information into knowledge, and knowledge into understanding



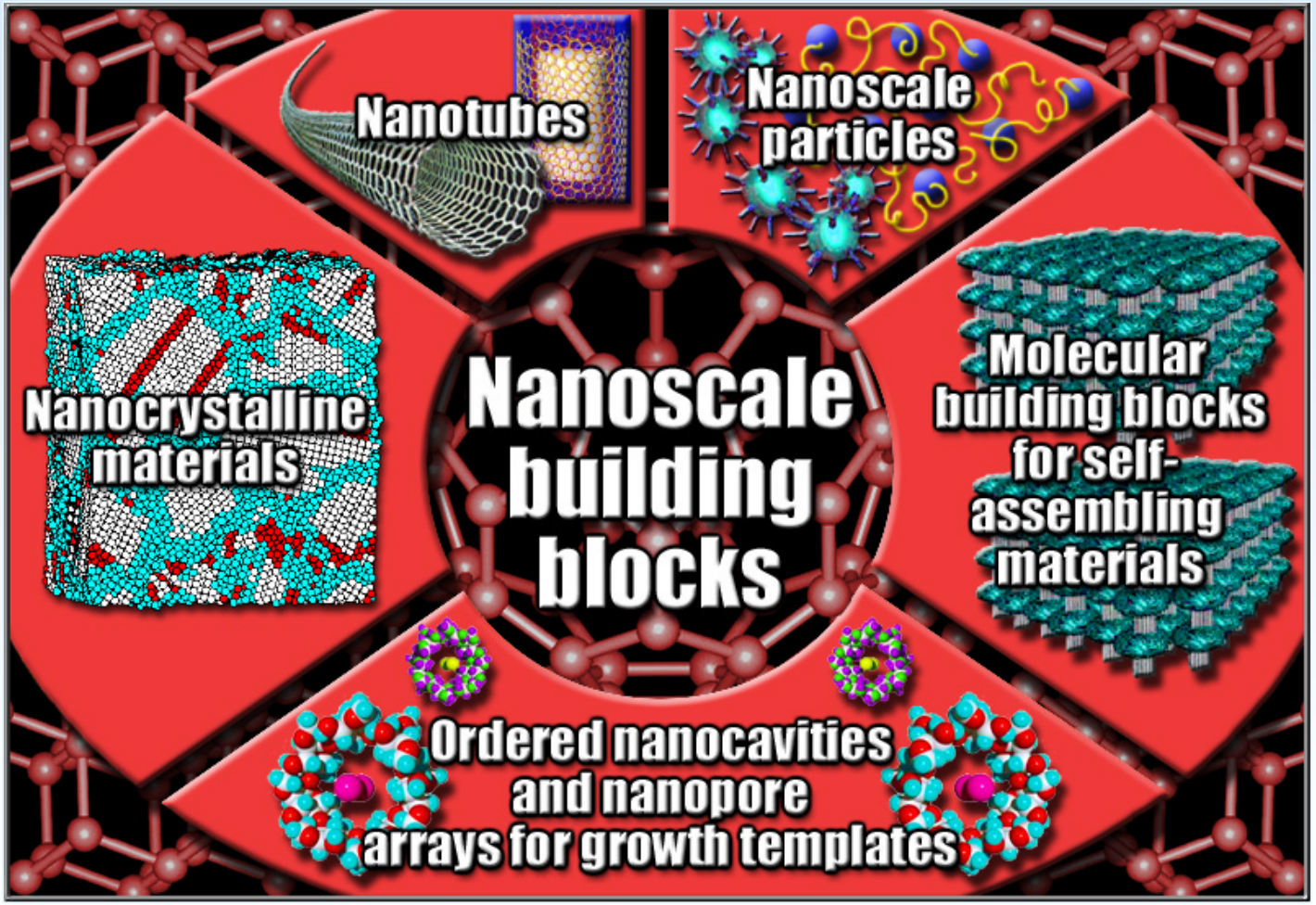
Revolutionary Computing

Advanced technologies that provide a platform for future Intelligent Systems

Glenn Research Center

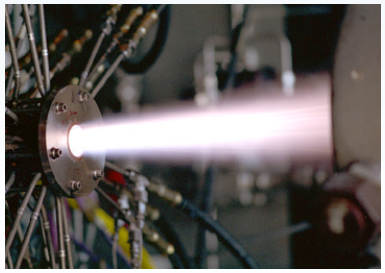
at Lewis Field

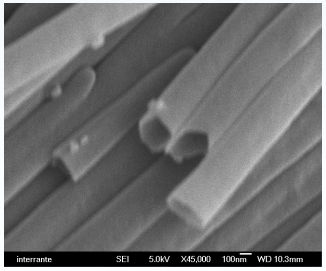
Nanoscale Technologies

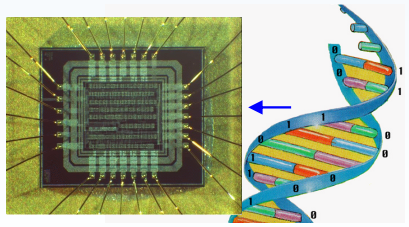


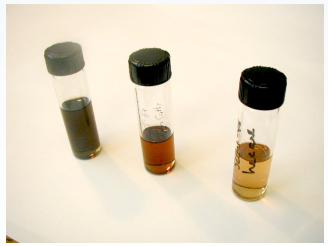
Nanotechnology Research for Propulsion & Power

- Materials 100x stronger than Steel
- Electronics processing 100x faster
- Fuel Cell with 10x greater power density
- In-vivo biosensors 1000X smaller







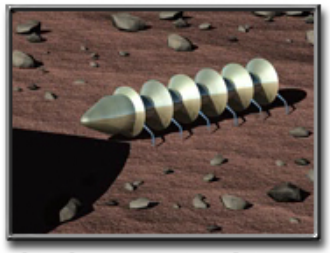


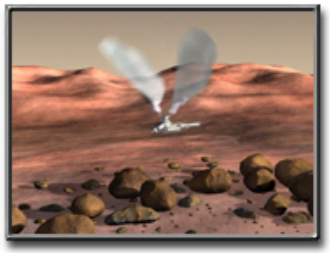
Glenn Research Center

at Lewis Field

Biotechnology Applications

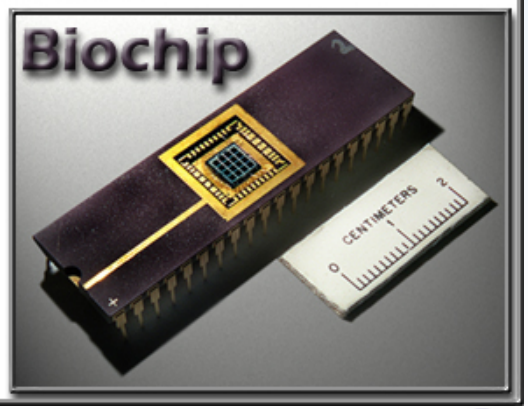
- Mimic biological systems





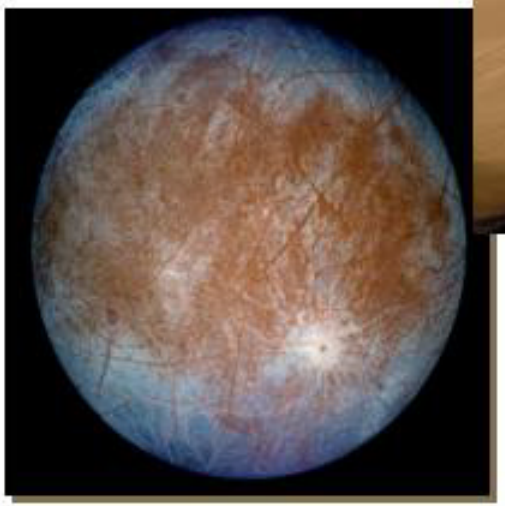
- Embed biological elements to create hybrid systems (e.g., hybrid nanomechanical devices - integration of biological motors with NEMS)

- Create fully biological and life-like systems. Examples:
  - Embryological electronics, with reproduction, adaptation and evolution
  - Highly intelligent structures that design themselves

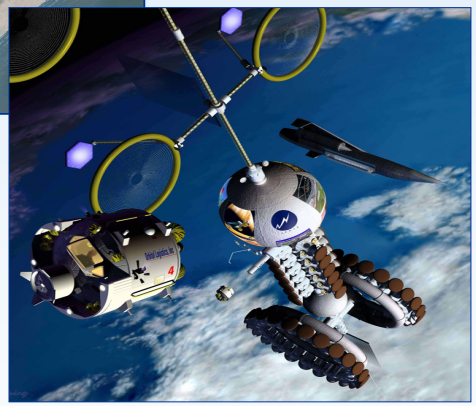


To Explore the Universe and Search for Life

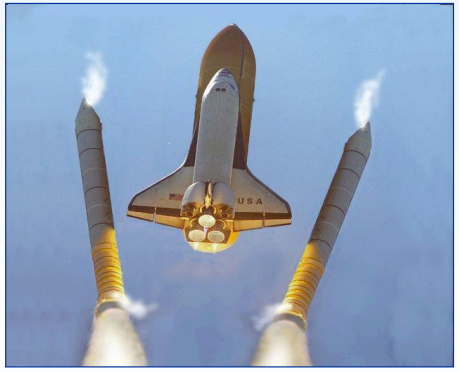
- Exploring the Universe and the life within it… enabled by technology, first with robotic trailblazers, and eventually humans… as driven by these compelling scientific questions:
  - How did we get here?
  - Where are we going?
  - Are we alone?



Integrated Space Transportation Plan



3rd Generation and In-Space Technologies



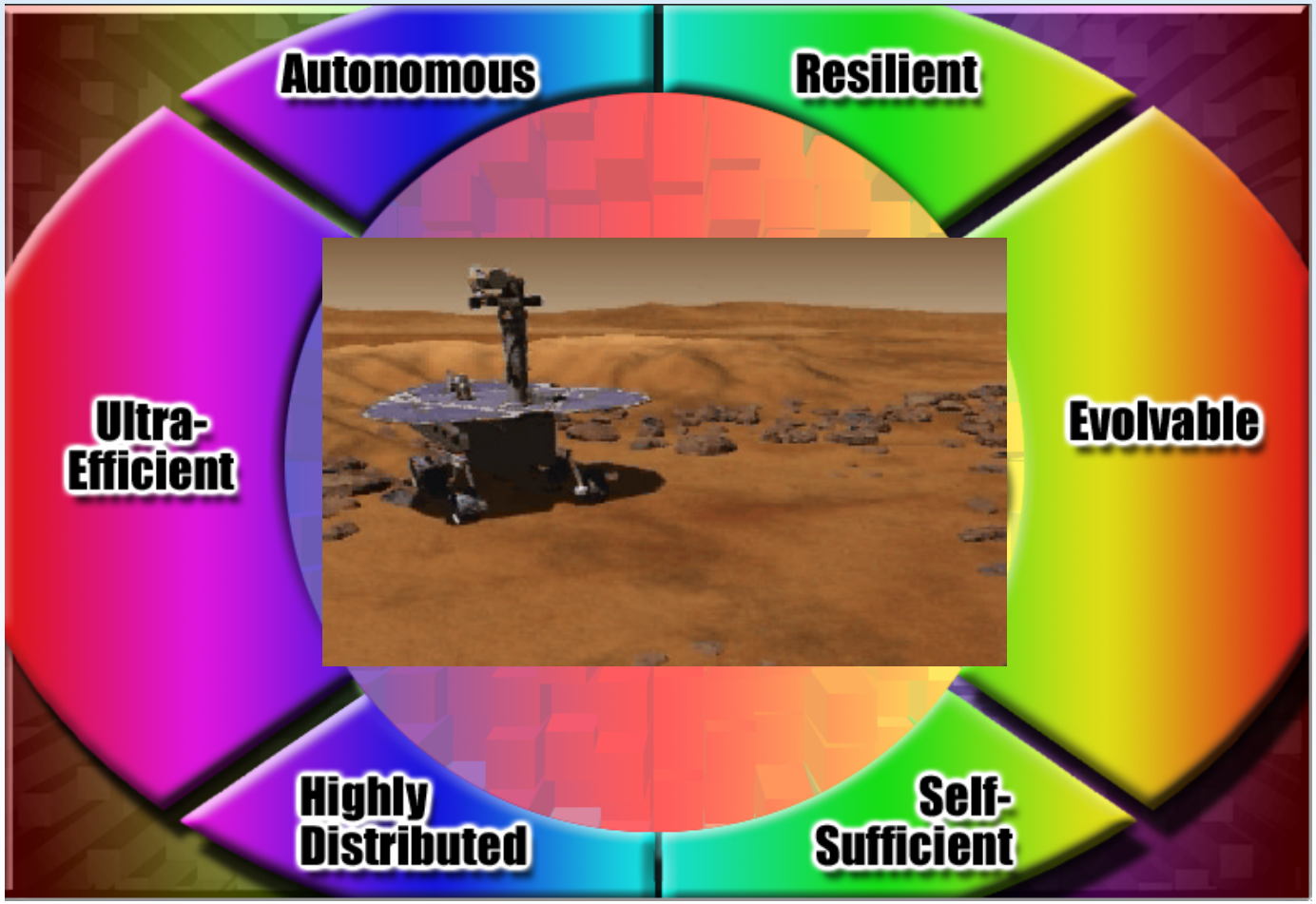
Risk Reduction for 2nd Generation RLV and NASA Unique Systems (Human-rated)

Space Shuttle Safety Upgrades (1st Generation RLV)

Glenn Research Center

at Lewis Field

Space Systems of the Future



To Inspire the Next Generation of Explorers

- Motivating students to pursue careers in science, math, and engineering
- Providing educators with unique teaching tools and compelling teaching experiences
- Improving our Nation's scientific literacy
- Engaging the public in shaping and sharing the experience of exploration and discovery

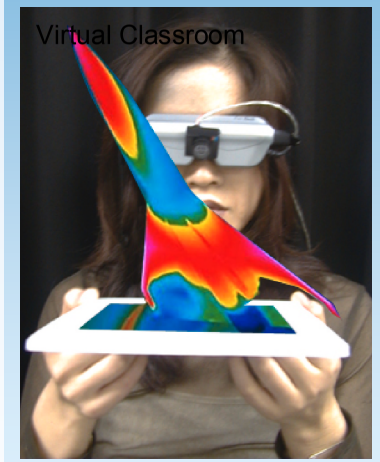
Educated Workforce–Approach to Education

Today's Challenges:

- Raise the interest in science and engineering in elementary, middle, and high schools.
- Prepare future graduates for a world of rapid technological change, complex systems, and advancements around the world.
- Maintain the high-tech workforce on par with the continuously advancing state of technology.

Technology Solutions:

- Foster interest and excitement in aerospace–establish an exciting vision for aeronautics



- Stimulate curriculum change and virtual and collaborative learning environments that will enhance educational relevance and scope

- Create life-long learning system that links classrooms to laboratories and on-the-job experiences

Glenn Research Center

at Lewis Field

Conclusions

- Advanced technology is essential to the Nation's future
- NASA has established very challenging technology goals for meeting future challenges
- Innovative research programs are in place to help obtain those goals
- NASA plays a significant role in ensuring a well-trained technology workforce and is increasing its emphasis in this area