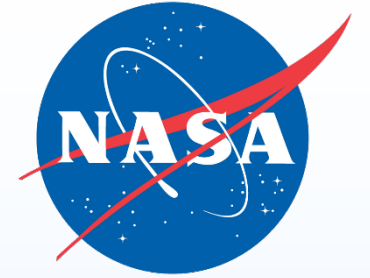


National Aeronautics and Space Administration



NASA Electronic Parts and Packaging (NEPP) Program Focus, Strategic Collaborations, and Our Path to the Future

Responsive Technology Assurance for Civil Space

Jonathan Pellish
Program Manager (Acting)
jonathan.pellish@nasa.gov

Peter Majewicz
Deputy Program Manager (Acting)
peter.majewicz@nasa.gov

Michael Sampson
NEPAG Manager
michael.j.sampson@nasa.gov

www.nasa.gov

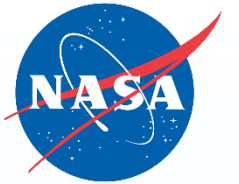
This work was sponsored by NASA Office of Safety & Mission Assurance



Acronyms

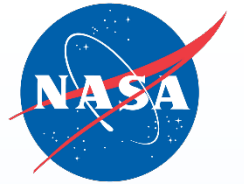
Abbreviation	Definition
AF	Air Force
BoK	Body of Knowledge
BYU	Brigham Young University
CLT	Capability Leadership Team
CMOS	Complementary Metal Oxide Semiconductor
DLA	Defense Logistics Agency
DMEA	Defense Microelectronics Activity
DoD	Department of Defense
EEE	Electrical, Electronic, and Electromechanical
ESA	European Space Agency
ETW	Electronics Technology Workshop
FPGA	Field Programmable Gate Array
GaN	Gallium Nitride
GIDEP	Government Industry Data Exchange Program
GPU	Graphics Processing Unit
GRC	Glenn Research Center
GSFC	Goddard Space Flight Center
IC	Integrated Circuit(s)
IEEE	Institute of Electrical and Electronics Engineers
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
LANL	Los Alamos National Laboratory
LaRC	Langley Research Center
MAPLD	Military and Aerospace Programmable Logic Devices (Workshop)

Abbreviation	Definition
MBMA	Model-Based Mission Assurance
MRAM	Magnetic Random Access Memory
MSFC	Marshall Space Flight Center
NEPAG	NASA Electronic Parts Assurance Group
NEPP	NASA Electronic Parts and Packaging (Program)
NESC	NASA Engineering and Safety Center
NPD	NASA Policy Directive
NRO	National Reconnaissance Office
NSREC	Nuclear and Space Radiation Effects Conference
NSWC	Naval Surface Warfare Center
OCE	(NASA) Office of the Chief Engineer
OGA	Other Government Agency
OSMA	(NASA) Office of Safety and Mission Assurance
POC	Point of Contact
RH	Radiation-hardened
RHA	Radiation Hardness Assurance
SAPP	Space Asset Protection Program
SEE	Single-Event Effects
SiC	Silicon Carbide
SMC	Space and Missile Systems Center
SoC	System on a Chip
STMD	(NASA) Space Technology Mission Directorate
STT	Spin-Transfer Torque
TOR	Technical Operating Report



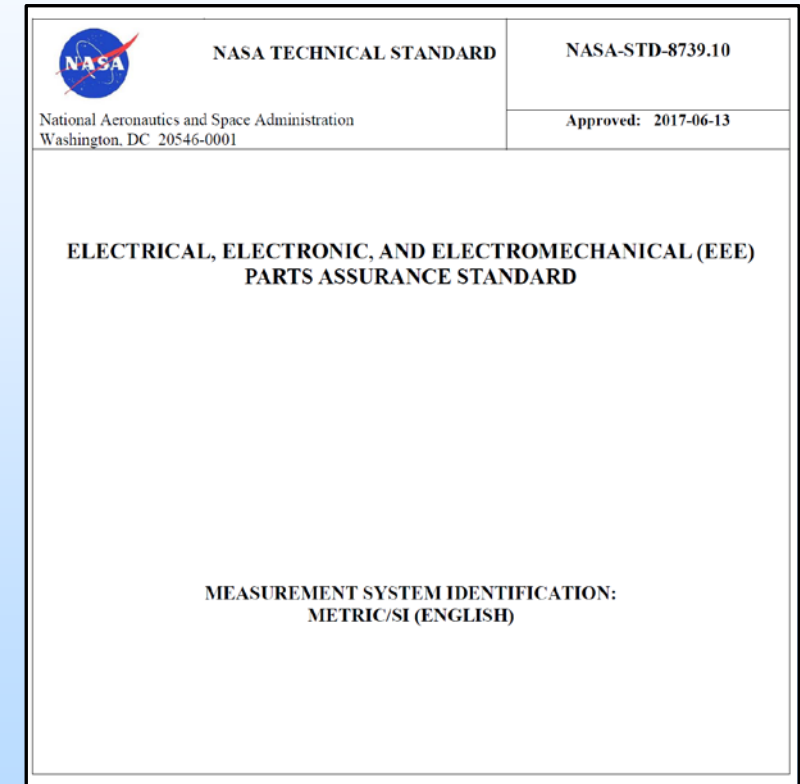
Outline

- **Continued evolution of NASA Electrical, Electronic, and Electromechanical (EEE) parts management**
 - EEE Parts Manager: an evolving role in the Agency
 - NEPP Program structure
 - General NASA EEE parts interfaces
- **NEPP Program overview for 2019**
 - What's new in 2019?
 - Key efforts, concerns, and status
- **NASA Electronics Parts Assurance Group (NEPAG)**
 - Standards development
- **Summary**



NASA EEE Parts – Evolving Structure

- **NASA EEE parts consolidation:**
 - Primary Agency test and analysis activities will be at the Goddard Space Flight Center (lead Center) and the Jet Propulsion Laboratory
 - **Jonathan Pellish**, the Agency EEE Parts Manager, will lead
- **NEPP remains virtually the same:**
 - Owns the EEE parts assurance processes and related technical efforts
 - NEPP management evolution
- **New NASA-wide documents activities**
 - NASA Standard 8739.10, released
 - First NASA-wide EEE parts standard since MIL-STD-975 was canceled in May 1998
 - “EEE-INST-003” / NASA-STD-8739.11 unification underway



<https://standards.nasa.gov/>



NASA EEE Parts Manager – *A Recent and Evolving Role*

- **Manage EEE parts workforce at the Agency level**
 - Radiation effects on EEE parts are in scope, as is management of the Agency radiation facility block buy
 - GSFC is lead Center, supported by JPL
- **Provide resources for Centers to acquire EEE parts workforce expertise and a forum to coordinate activities with stakeholders (e.g., OCE, OSMA, etc.) and customers**
- **Track the state of the Agency EEE parts workforce, including Center expertise, demand, and capacity**
- **Support Agency policy and technical decision-making processes**
- **Evolve management functions as needed**



NASA EEE Parts – Interfaces

Agency EEE Parts

Assurance

Office of Safety & Mission Assurance

- **NEPP**
- Quality
- Reliability
- Workmanship

Development

Office of the Chief Engineer

Capability Leadership
NESC

Flight Projects

Field Centers
Mission Directorates

Facilities

Mission Support

Space Environments Testing Management Office

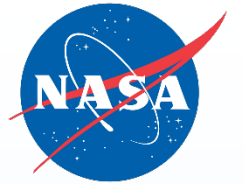


NEPP Overview – Mission Statement

Provide NASA's leadership for developing and maintaining guidance for the screening, qualification, test, and reliable use of EEE parts by NASA, in collaboration with other government agencies and industry.

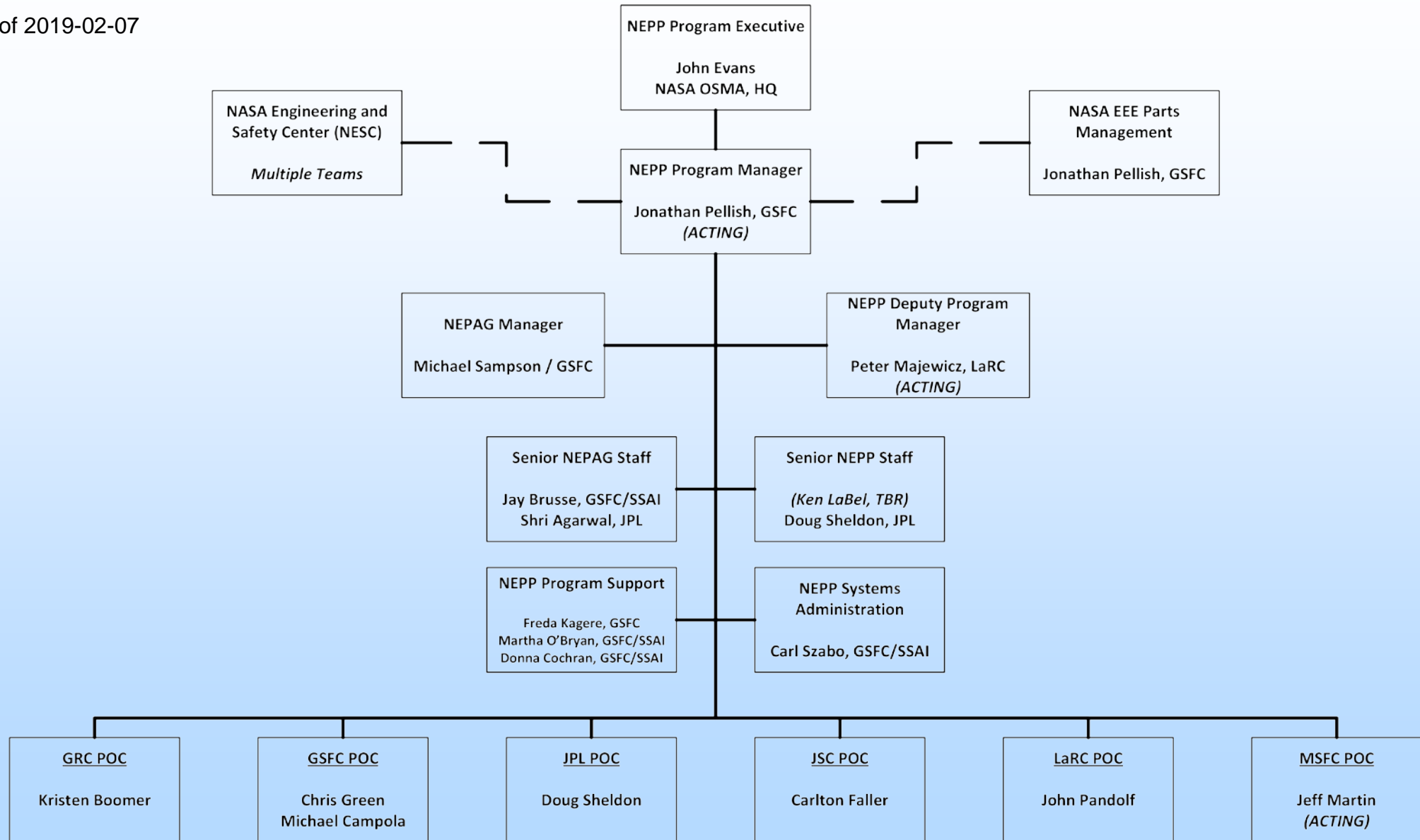
Accessible & Product-Oriented

Note: the NASA Electronic Parts Assurance Group (NEPAG) is a core portion of NEPP



NEPP Program – Organization Chart*

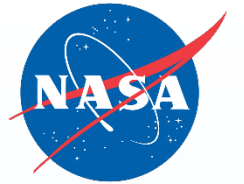
*as of 2019-02-07



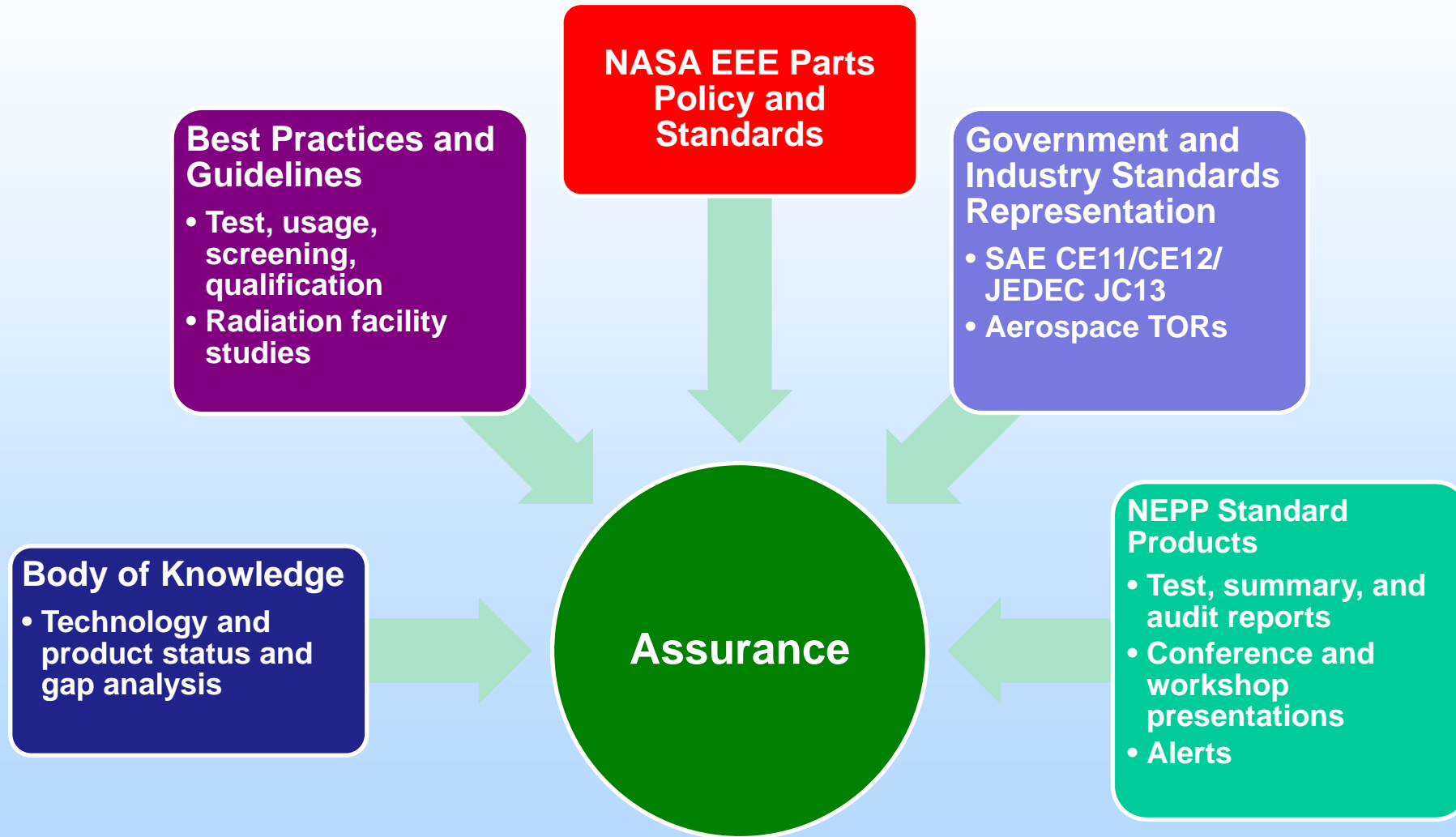


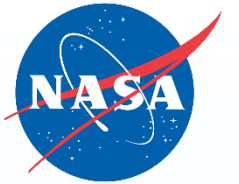
NEPP Charter





NEPP Product Delivery

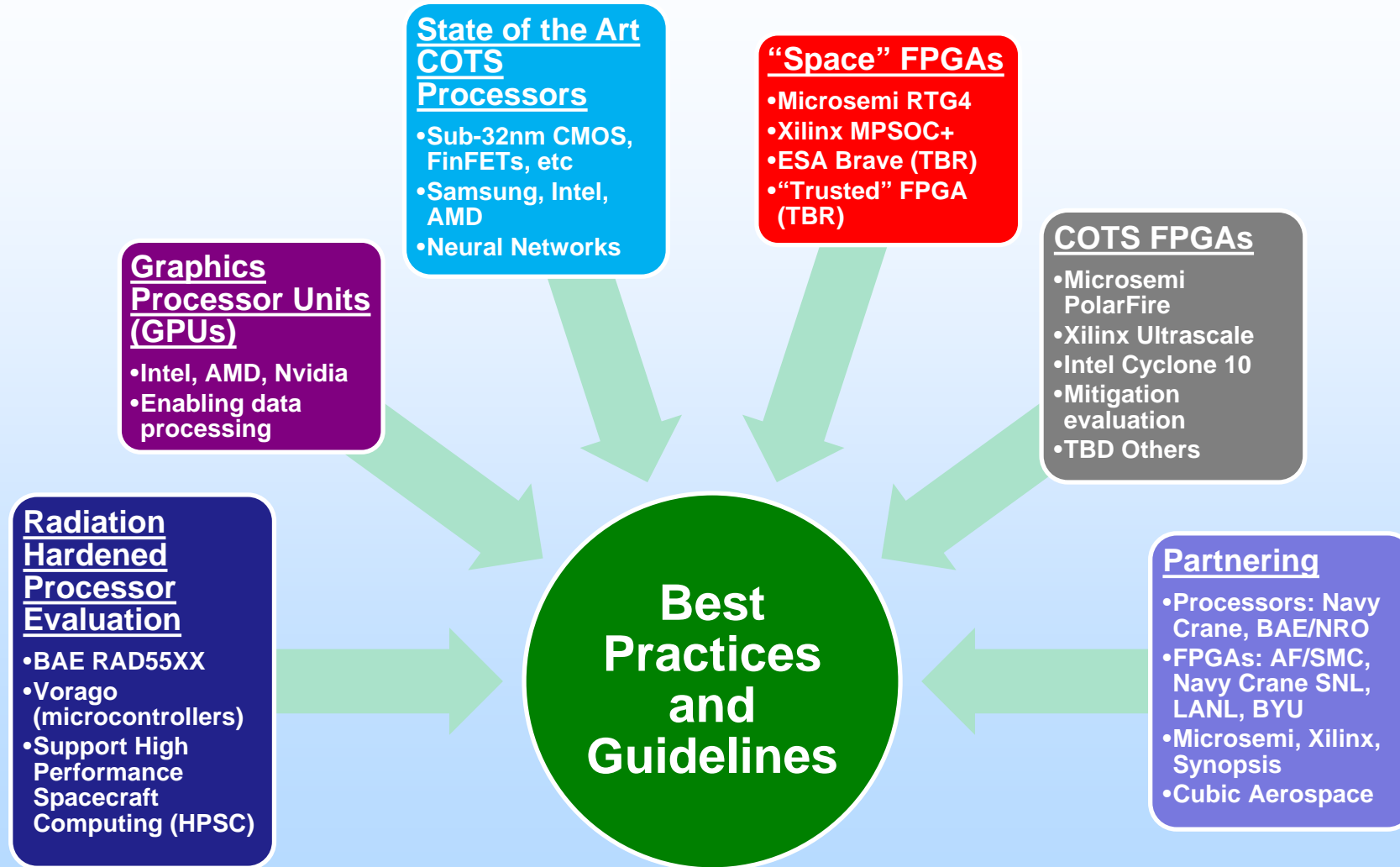




New for NEPP in FY2019

- Released [GPU BoK](#) (E. Wyrwas et al.)
- Kicked off SmallSat industrial base assessment (major support from AF/SMC)
 - Components and systems; production and procurement
- Increasing focus on advanced packaging
- Radiation Hardness Assurance
 - Building board-level proton test guideline
 - Developing proton electronics testing best practices at medical facilities
 - Examining best practices for test planning and data collection / sharing
 - Planning to release GaN and SiC RHA testing best practices
 - Starting non-volatile FPGA and STT-MRAM radiation evaluation via interagency agreement between NASA and DoD/NSWC Crane
- Examining opportunities for more significant integration of NEPP documentation into future community-consensus products/standards
- Continuing delivery of assurance products (lots more going on here)
 - BoKs, guidelines, tools, information sharing, and training
 - Unification of NASA documentation (NEPAG)

Field Programmable Gate Arrays (FPGAs), Processors, Systems on a Chip (SOC)



Potential task areas: artificial intelligence (AI) hardware, Intel Stratix-10, Xilinx Versal



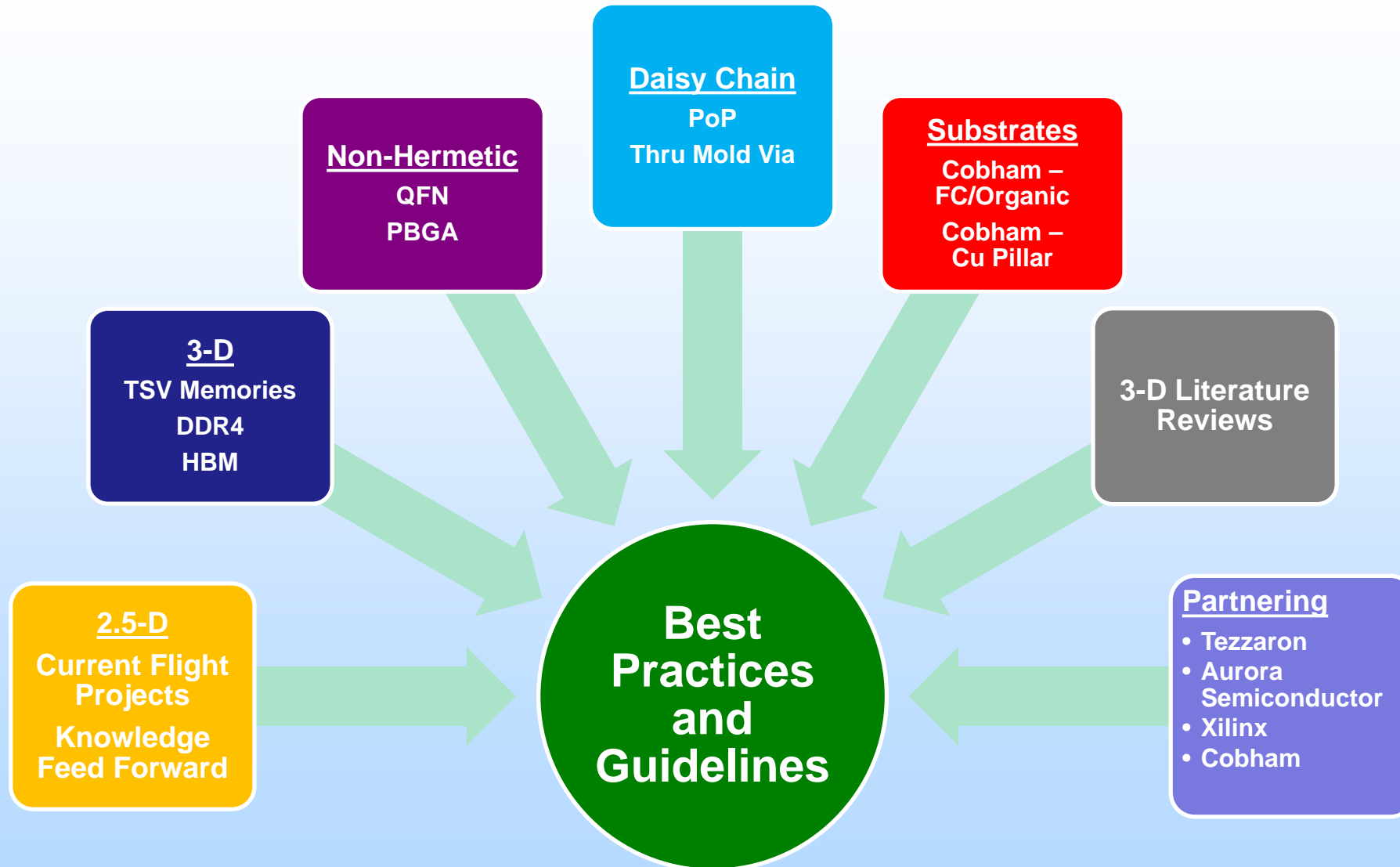
Memory Devices



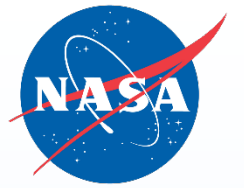
Related task areas: deprocessing for single event testing (also w/processors, FPGAs,...)



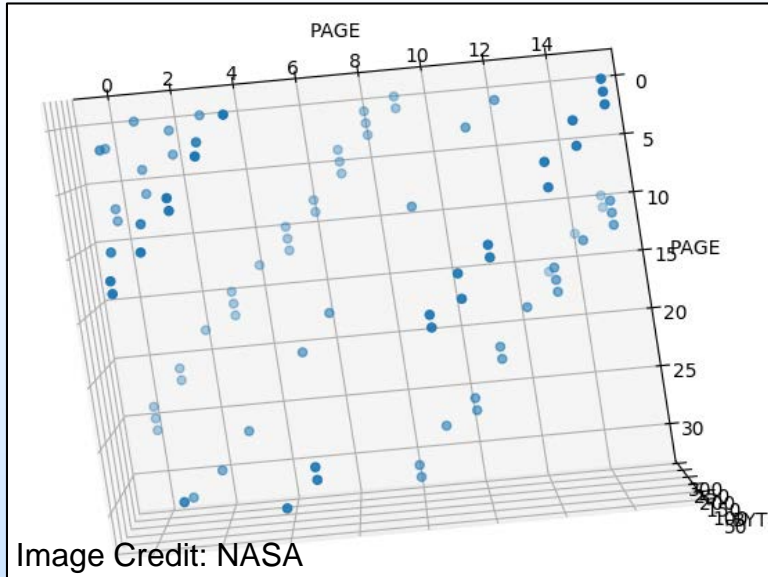
Packaging



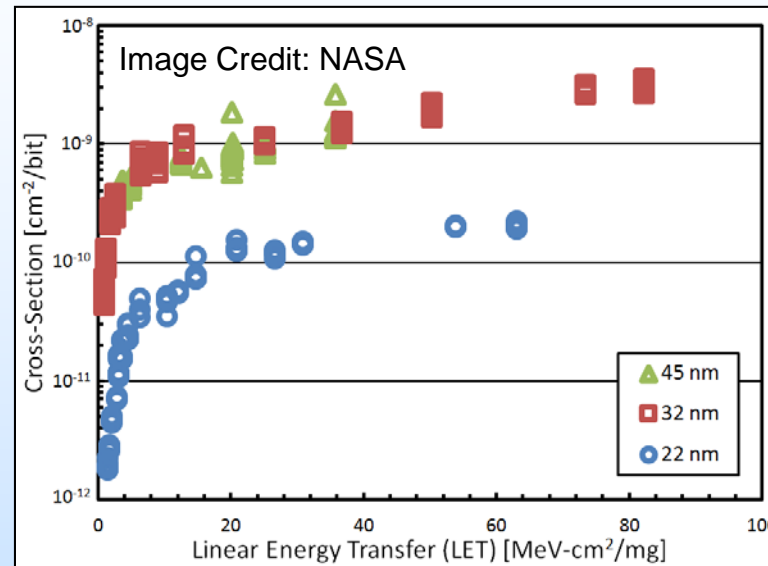
A NEPP Program task area that will see increased attention in FY19+



Advanced Technology Evaluation Examples



Angled heavy ion tracks in 3-D NAND Flash
Micron MT29F1T08CMHBB
256Gb die, MLC, 32 layers, piece-part testing
 T. Wilcox et al., SEE/MAPLD 2018.



Heavy ion cross sections
GlobalFoundries 45 & 32 nm PDSOI, 22 FDSOI
Static Random Access Memories (SRAMs)
 M. Casey et al., IEEE NSREC 2018.
 Collaboration with DMEA, Sandia, and GlobalFoundries

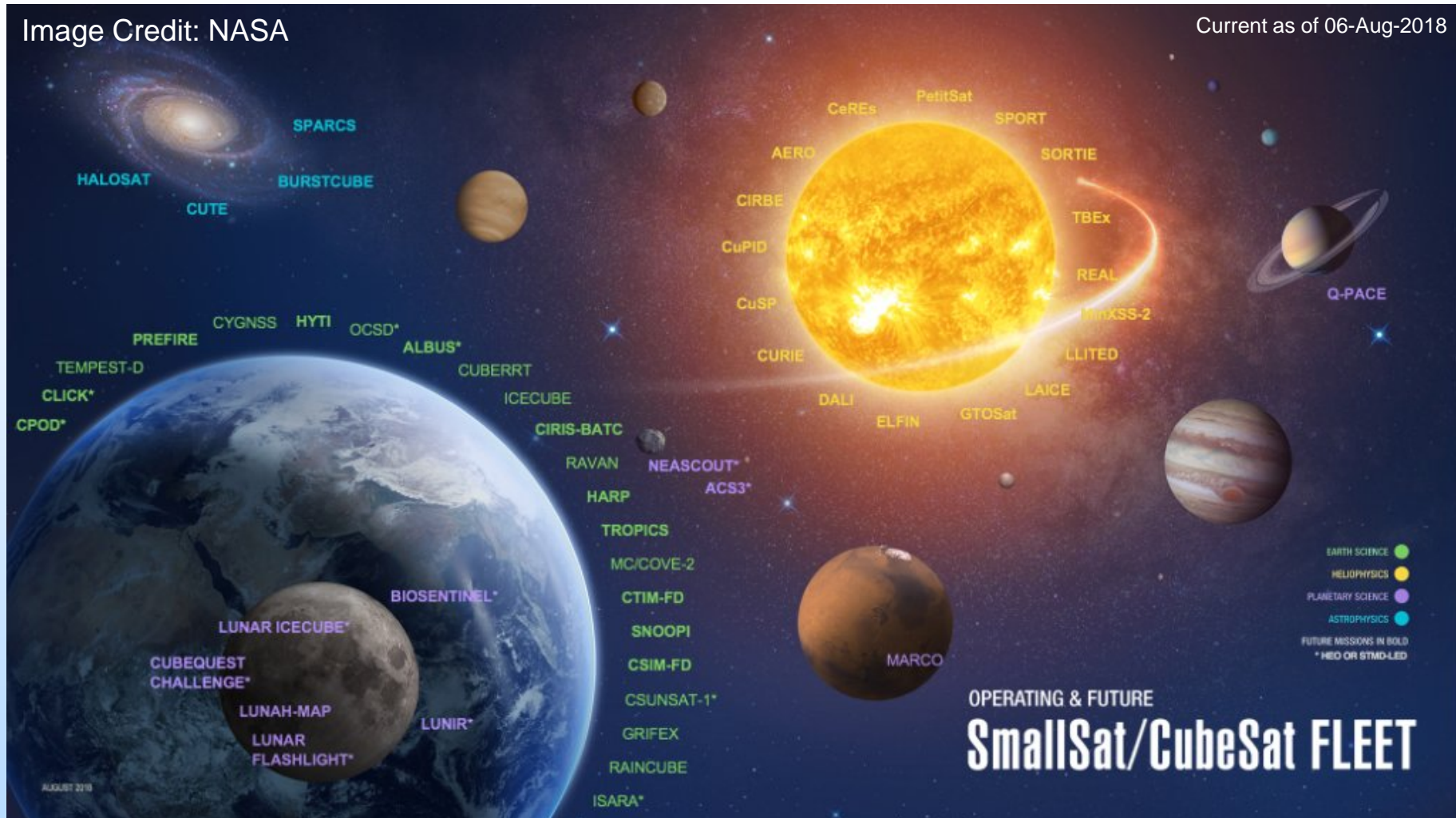


400 W cooling on bare NVIDIA GTX 1050
 E. Wyrwas, [2018 NEPP GPU BOK](#).

Pace of technology evolution and growth of evaluation requirements continue to generate new demands:
1) diversified subject matter expertise; 2) more access to a wider variety of radiation test facilities



NASA Bolsters SmallSat Science Programs



NASA SMD 06-Aug-2018: SmallSats are the focus of a new initiative that'll grant \$100M/yr to targeted science, tech developments & educational opportunities to enrich the already impressive NASA science SmallSat mission portfolio.

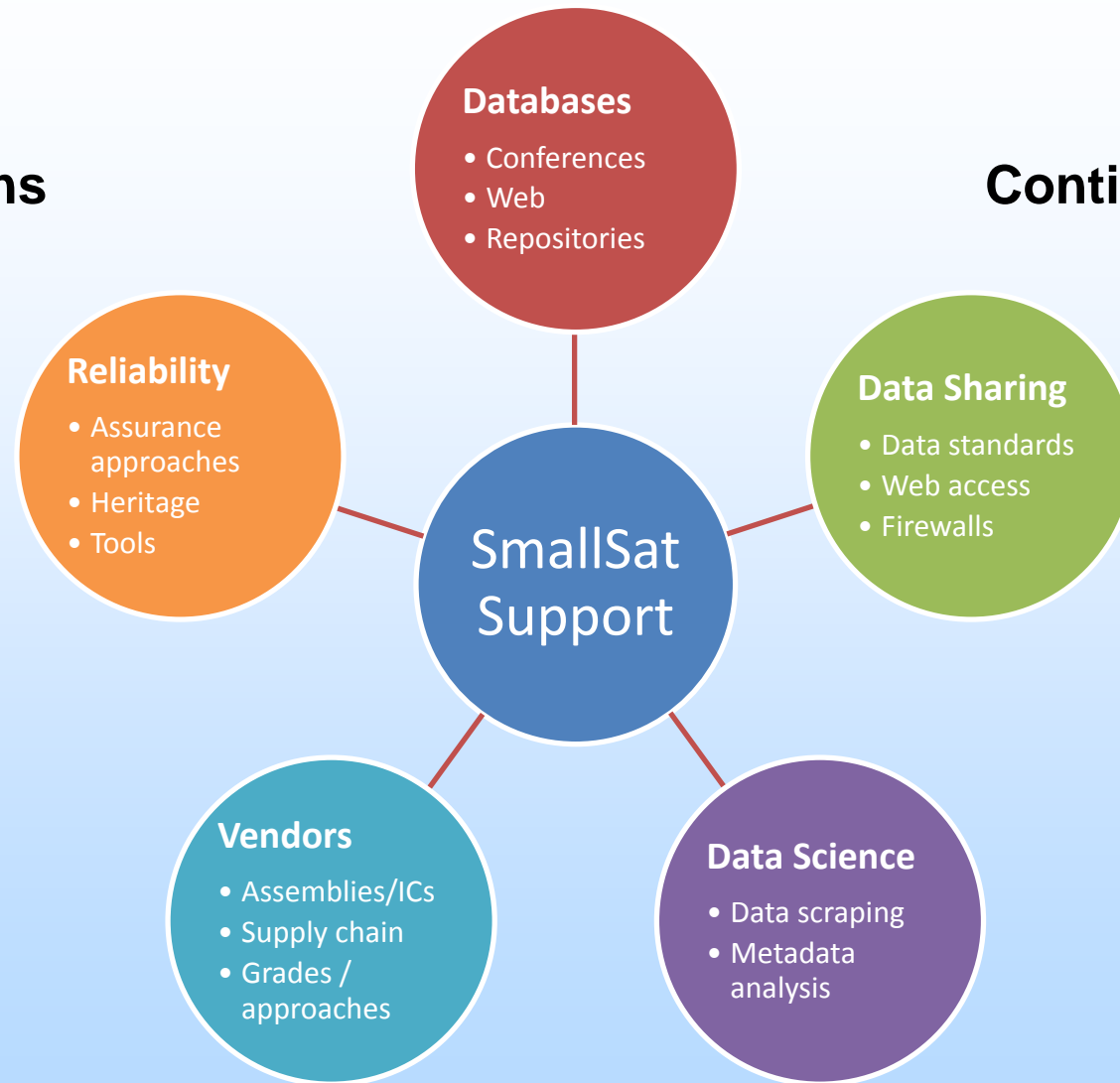


Evolving Landscape for SmallSat Assurance Support

Multiple Collaborations

- Academia
- Industry
- OGAs

Continued focus on Model-Based Mission Assurance (MBMA)



Accessibility

Product Delivery

Linking Program Tasks to Community Focus Areas / Needs

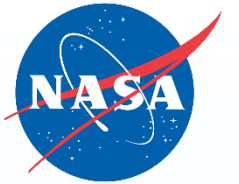


NEPP Program / NEPAG Standards & Policy Development

- **Released NASA-STD-8739.10**
 - *NASA EEE Parts Assurance Standard*
- **Updating EEE-INST-002**
 - *Instructions for EEE Parts Selection, Screening, Qualification, and Derating*
 - Will become new Agency standard, NASA-STD-8739.11
 - Goal is to modernize and synthesize existing Agency documents
 - Ongoing throughout FY19
- **Updating NPR-8705.4**
 - *Risk Classification for NASA Payloads*
 - Appendix C – Recommended SMA-Related Program Requirements for NASA Class A-D Payloads
 - Goal for EEE Parts is a mapping that recommends parts with respect to payload class (A-D), mission criticality (critical/noncritical) and part grade level (space, military, industrial, COTS, etc.)

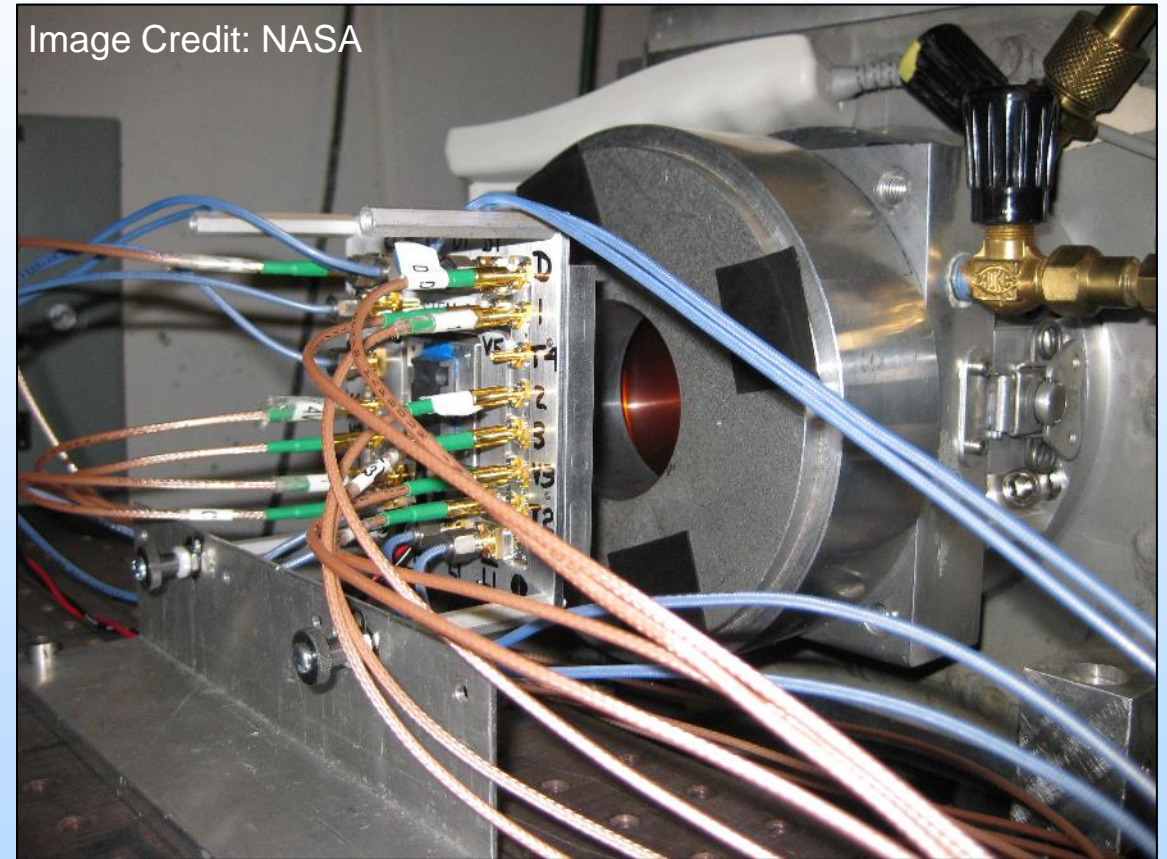
NASA Technical Standards: <https://standards.nasa.gov/>

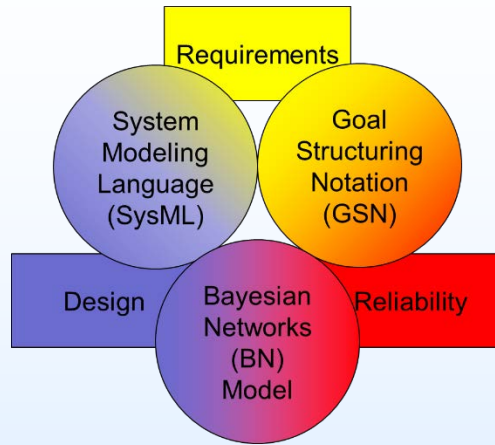
NASA Online Directives Information System (NODIS): <https://nodis3.gsfc.nasa.gov/>



As Always, Partnering is Essential

- **Within:**
 - **NASA**
- **With:**
 - **Academia**
 - **Government agencies**
 - **Ex.: Strategic Radiation-Hardened Electronics Council Working Groups**
 - **Test & Evaluation (member)**
 - **Workforce Development (lead)**
 - **Industry**
 - **International**





Emerging Assurance Methods
(Witulski, Vanderbilt University, NEPP ETW 2017)

Image credit: Vanderbilt / NASA

10th Annual NEPP Electronics Technology Workshop (ETW)

Scheduled dates:
June 17-20, 2019
NASA/GSFC and on-line

<https://nepp.nasa.gov/>

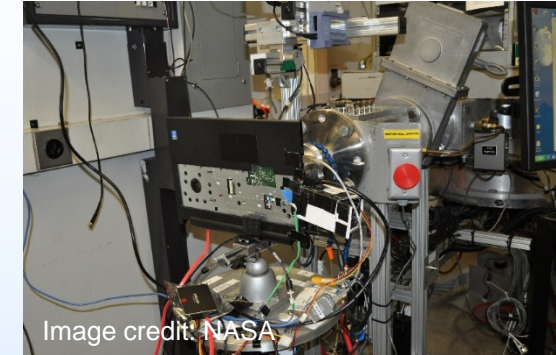


Image credit: NASA

Radiation Testing



Image credit: NASA

Advanced Technology Reliability

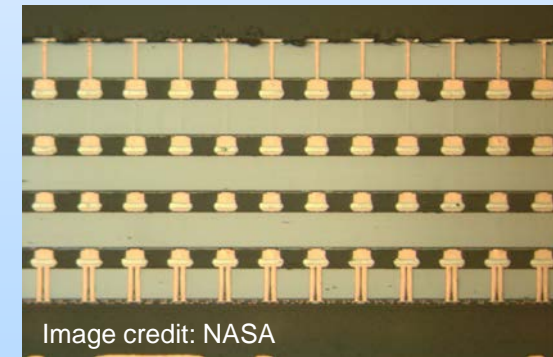


Image credit: NASA

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