MDA University Outreach
QS Radiation Hardness Assurance for Parts and Materials (QSR) Division

By: Dr. Jon Ahlbin
Division Chief, QSR
Missile Defense Agency
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BLUF

(U) MDA is constantly focusing on improving the capabilities of our systems to operate in radiation environments

Areas of Focus:

1. (U) Performance Goal: Using AI and Machine Learning to improve the ability of our interceptors

- (U) Requires RadHard technology breakthroughs in high speed imaging, discrimination, and comms to support on-board processing
  - *(U) FPAs, ROICs, FPGAs, Memories, Processors, Power and RF devices that can survive hostile environments*

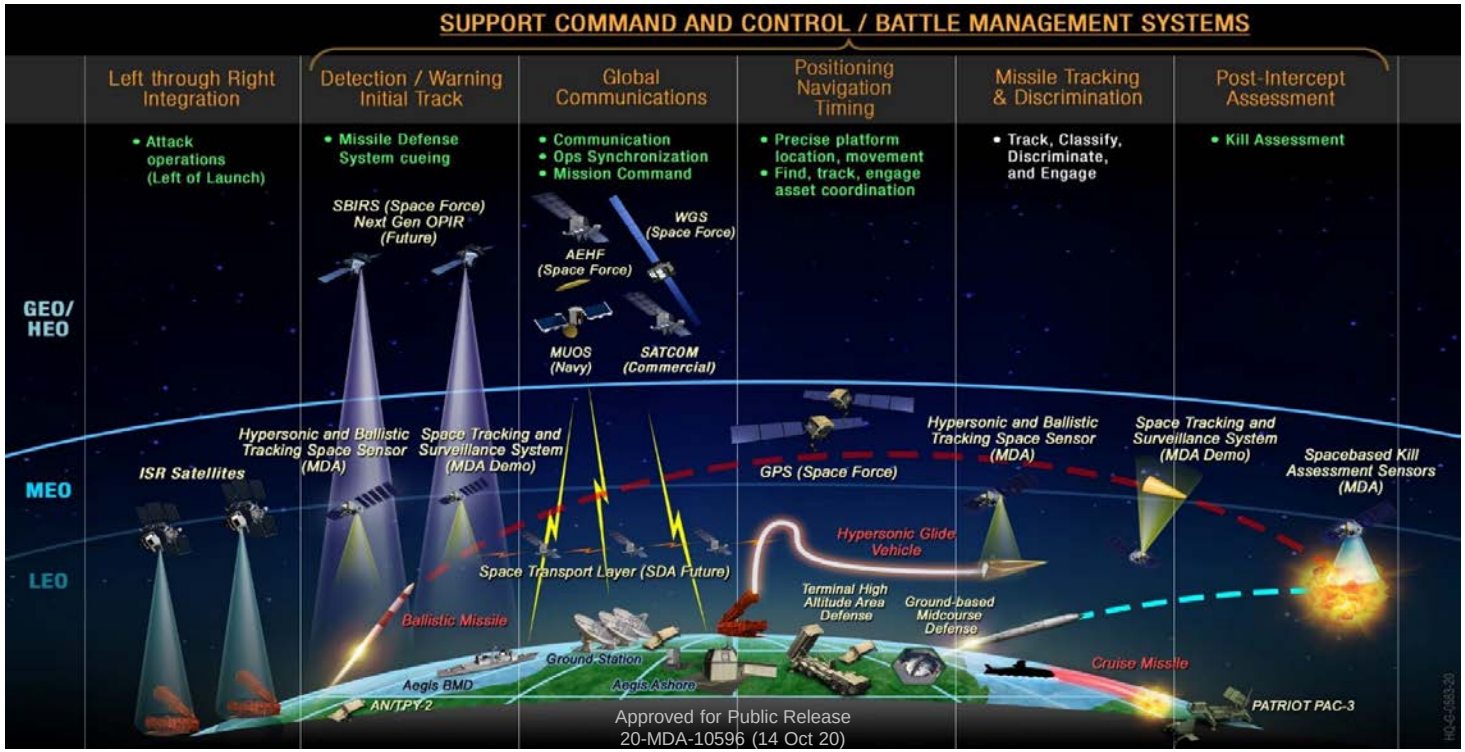
2. (U) Technical Challenge: Leveraging available COTS technologies for use in NSE or HE to meet performance requirements while minimizing the need for custom, RadHard parts

- (U) Post-procurement hardening techniques that can make a previously unviable or cost-prohibitive technology more viable: Novel Advanced Re-packaging techniques, thinning of substrates, etc.?

3. (U) Technical Challenge across OSD: Complex, digital state of the art (22nm and below) parts hardened for Neutron Single Event Effects (nSEE) for performance in HE, including related modeling and simulation tools.

- (U) Complex phenomenology and device physics problem that is not well understood in emerging technologies, has minimal standards or testing facilities, and needs modeling and sim

Designing & Engineering Space Capabilities for Missile Defense Operations



- **A Ballistic Missile Intercept may encounter multiple, complex radiation phenomenologies**
- **Comprehensive cradle-to-grave approach for radiation hardness includes**
  - **piece parts selection**
  - **radiation testing of parts and sub-system**
  - **Modeling & Simulation**
  - **part and design hardening techniques (shielding, EDAC, etc.)**

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RadHard Part Technology Focus Areas

Generic Focus Technology Areas	Generic Natural Space Environment Assessment	Generic Hostile Environment Assessment
Sensor Systems: FPA/ROICs and Optics/Coatings	• Modern COTS risks in NSE (radiation hardness, noise sensitivity)	• HE survivability needs to be better understood for current COTS
IMU	• Performance and design constraints well understood in NSE	• HE survivability requires custom designs
Power Electronics	• Space qualified power exists	• HE survivability needs to be better understood for space-grade COTS power technologies; likely requires custom designs
Microelectronics (FPGA, SOC, Processors, Memories, and other complex ICs)	• NSE operation with COTS requires mitigations that impact data throughput and power consumption per operation	• HE survivability needs to be better understood for current technology offerings
RF/Communications Rad Hard parts	• Space qualified RF/communications exists; robust designs may be required to operate through solar storm environments.	• HE survivability needs to be better understood for space-grade COTS RF/Communication technologies requires

- **COTS parts may not be viable options for every design but custom RadHard parts are $$**
- **Reliability of any part in these categories combined with test margins, part performance, and part application are critical to overall survivability and reliability of any system**

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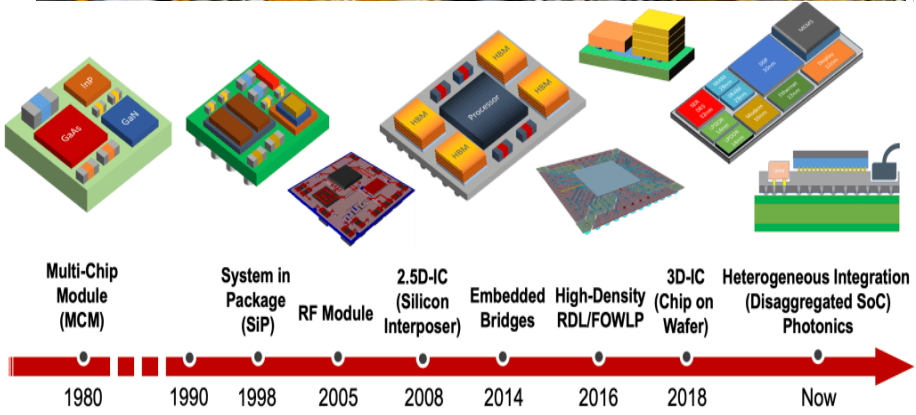
Technology Challenge Examples

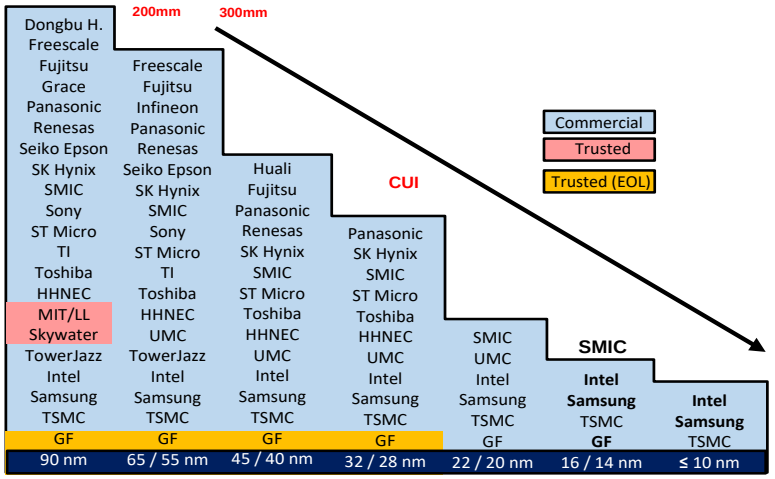
- **Dual-Use Commercial Space Technologies**
  - **Some inherent radiation hardness**
  - **High performance, SWaP-C, etc.**
  - **Consider advanced materials and manufacturing opportunities**
  - **Consider advanced packaging**
- **Cybersecurity**
- **Autonomy / Machine Learning**



Current RadHard Landscape

Industrial Base

- Industry demand for low-cost, high performance, power and quantity results in parts that struggle to meet radiation requirements
  - Commercial consolidation has led to declining sources of microelectronics
- RadHard microelectronic SOTA technology (<22 nm) in development in all radiation environments



Derived from a chart originally from the General Services Administration (GSA)

NSE Testing

- Only 3 CONUS-based Heavy Ion facilities to accommodate all Single Event Effects (SEE) Testing for commercial, space, defense and military applications
- SRHEC performed an Analysis of Alternatives (AoA) on projected testing needs vs SEE test facility availability and upgrades needed
  - Working with OSD to determine a path forward to improve accessibility
- Plenty of Proton facilities available

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Industrial Base Agnostic Solutions Needed

- **(U) Every time a supplier/vendor/performer changes their product offerings, immediate risks and mitigations are initiated**
  - **(U) Lifetime-Buys, wafer purchases, hardness assurance assessment of alternate parts/design, increased Radiation Lot Acceptance testing**
  - **(U) IMPACT – New or Increased program risk, increased testing costs for verification & validation, potential delays in deployment and support to the warfighter**
- **(U) GF RH45nm/12SOI closure will drive reliance on older technology, or un-proven in HE SOTA technology**
- **(U) RH technology, testing or Modeling & Sim advancements, especially in hostile environments, need to be AGNOSTIC to industrial-base volatility**
  - **(U) Cannot solely rely on one supplier, fabrication house, or performer for a particular RH approach**
  - **(U) Example: RHBD techniques, 3D shielding, etc. are applicable regardless of the vendor**

RadHard capabilities require adaptability to meet evolving threats while (ideally) being agnostic to industrial base volatility.

MDA Initiatives: Testing

Heavy Ion (HI) Testing Facilities

- **MDA purchased block buys of time at NSRL and LBNL to ensure access for program requirements as well as the Common Parts Testing Program**
- **Supporting the publicly available SRHEC AoA HI facility recommendations to address projected shortfalls in testing resources**
  - **Discussed at the JEDEC/SAE JC-13.1 meeting that efforts are underway with MSU to implement new HI capability = ~2,000 hrs of capacity**

Common Parts Testing Program

- **Open application process for RadHard community to request use of MDA HI test time with agreement to provide government purpose data rights on final data and analysis**
  - **Public announcement coming out shortly**
- **Objectives and Benefits:**
  - **Minimize duplicate testing on parts with common applications to multiple platforms that need characterization data**
    - Reduces constraints on test facilities and testing resources
  - **Leverage the test data to determine early part candidates in different radiation environments and application needs**
    - Early program planning = less programmatic risk, cost savings, schedule savings
  - **Visibility for vendors of their parts' SEE performance across multiple platforms, designers and performers**
  - **Build a part selection list of parts with proven HI data**

MDA Initiatives: Database & Tech Development

- **Multiple tech development efforts in work**
  - **Novel RadHard designs**
  - **Part agnostic mitigation techniques**
  - **Combined environments test facilities for FPAs in conjunction with AFRL**

- **MDA is pursuing a comprehensive radiation database that will**
  - **Standardize radiation data attributes for commonality across the agency**
  - **Track parts and associated test plans, reports, and reference materials**
  - **Provide Complex search capability**
  - **Interface with SRHEC common parts library (where feasible) to promote collaboration across the DoD in opening up availability of radiation data to the community**

MDA Initiatives: Workforce Development

Survivability Seminar Series

- **Developed a Survivability Seminar Series with Survivability and Hardness Assurance Subject Matter Experts to begin educating a broader audience on survivability and hardness assurance topics for any program**
  - **Basic environments → requirement development → system design → hardness assurance → part selection → testing and verification efforts**
- **Currently available to MDA, SETA contractors, NASA and OGAs**
- **Long term – open to universities, primes, etc.**

SCALE, H4D, and other University Initiatives

- **Provide mentoring, radiation based problems and project ideas to various partner universities to get students and faculty excited about the challenges facing the hardness assurance community**
  - **Several successful projects resulting in products that MDA is implementing**
- **Mentoring students interested in the radiation field**

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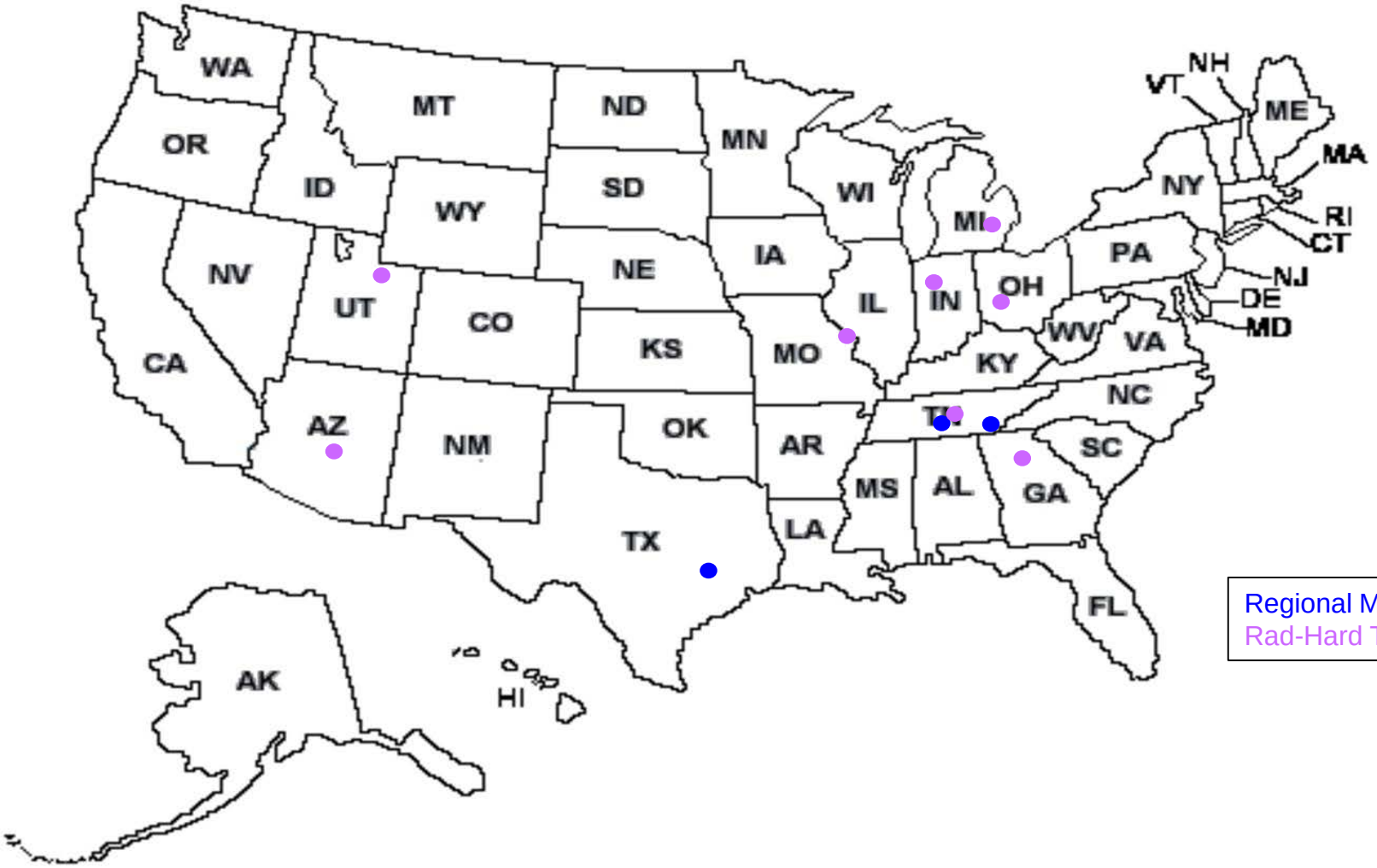
Workforce Development Initiative



Summary

- MDA has a broad range of both natural and hostile radiation environments that require a variety of hardness assurance techniques and RadHard technologies
- Constantly collaborating across the DoD, industry, and the testing community to better understand emerging problems, solutions, and opportunities
- Numerous internal and external efforts to improve technical knowledge in radiation hardness assurance and overall survivability,
- Common Parts Testing Program established to improve access to valuable HI SEE data across programs while minimizing impacts on testing infrastructure

Multiple challenges exist that can be solved by innovative solutions!