Matthew Kay, Ph.D.

DoD Unique Needs Project Lead
SRHEC Executive Secretariat
OUSD(R&E)

Trusted & Assured Microelectronics Program

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Workshop Ground Rules

- All conversations must remain at Distribution A level (No classified, FOUO, CUI, etc.)
- Microphones will be muted and videos turned off except for Moderators and Panelists
- If you have a question for the speaker, please use the “Q&A Feature”.
  - Submit through the Q&A button 

  - The Panel Moderators will address your questions during the Audience Q&A portion of the panels
- If you have dialed into the Workshop with a separate phone line, please link your audio line with your zoom participant ID so that we may better address participants during the workshop
  - The participant id is 6 numbers seen by clicking on the  in the upper left of the zoom screen
  - On your phone press #, enter the participant id, #
- Logistical/connection issue
  - Zoom Troubleshooting Guidance: https://support.zoom.us/hc/en-us/sections/200305593-Troubleshooting
  - Wireless Connection Issues: https://support.zoom.us/hc/en-us/articles/201362463-Wireless-WiFi-Connection-Issues
  - Connect with the ERI Team desk via the 6Connex platform
- Workshop facilitators: Garrett Storaska & Tammy Walker

Agenda

1415-1425	***Unique DoD Needs Intro*** *Matt Kay* Office Secretary of Defense, Project Lead
1425-1505	***Radiation Hardened Microelectronics Needs and Opportunities Panel***
• 1425-1430	• Introduction -Matt Gadlage, Naval Surface Weapons Center
• 1430-1455	• Panel Discussion: o Moderator Question: "What Rad Hard technologies do you see transitioning into production for the Defense Industrial Base in the next five years?" o Panelists: - Skywater – Brad Ferguson - MITLL – Pascale Gouker - Draper – Paul Melanson - NRL – Dale McMorrow - Vanderbilt University – Lloyd Massengill
• 1455-1505	• Audience Q&A –Matt Gadlage
1505-1545	***Radio Frequency and Optoelectronic Needs and Opportunities Panel***
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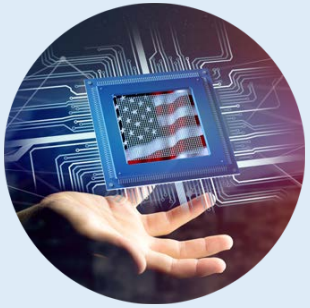
Trusted and Assured Microelectronics

Microelectronics - DoD's Top Modernization Priority

We cannot expect success fighting tomorrow's conflicts with yesterday's weapons or equipment.
-National Defense Strategy



	Access to State of the Art (SOTA) Commercial Technology	Data Driven Quantifiable Assurance	Address DoD Unique Needs	Create a Resilient and Robust Pipeline
Gaps:	DoD lags commercial CMOS[1] ecosystem/ infrastructure	Threats to design and manufacturing in global supply chain	Increased sources for national strategic defense	Domestic and Allied Ecosystem to rapidly and securely mature emerging advanced technology
Approach:	Establish best practices for secure design, assembly, packaging, and test capabilities to support Defense Industrial Base and co-development of dual use electronics	Secure full lifecycle confidentiality, Integrity, verification & validation, and supply chain for assured warfighters electronics	Develop sustainable sources of mission essential niche rad-hard electronics capabilities, and specialized radio frequency and electro-optic components	Invigorate secure pipeline for disruptive R&D transition, supply chain aware technology development, education and workforce.

1. Complimentary Metal Oxide Semiconductor

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T&AM Rad-Hard Microelectronics Focus Areas

- **Rad-hard by process (RHBP) State of the Practice (SOTP) microelectronics**
  - Develop alternative sources for RH microelectronics
- **Rad-hard by design (RHBD) in State of the Art (SOTA) technologies**
  - Efforts focused in commercial technologies
  - Develop rad-hard memories with 100X higher density than currently available
  - Demonstrate IP for advanced rad-hard System on Chips (SoC)
- **Modernized DoD lab capability**
  - Covers several functions including: new radiation test sources, SRHEC (Strategic Rad Hard Electronics Council) activities, workforce development, radiation testing/modelling of RHBD & RHBP silicon, and overall program support

SOTP - Rad-Hard by Process

Developing Alternative Sources for SOTP Strategic RH Electronics

NRL MIT-LL

SKYWATER

Partners and Performers

Technical Execution Strategy:

- Transferring a strategic rad-hard (SRH) FDSOI process from MITLL to Skywater
  - Adding Cu BEOL to Skywater
- Support process hardening at trusted fabs (NRL)

US Department of Defense to Invest up to $170M in SkyWater's Domestic Technology Foundry

- Broadens SkyWater's production capabilities for Strategic Rad-Hard electronics
- Enables Cu (copper) interconnect process for enhanced mixed-signal device performance and interposers for advanced packaging technologies
- SkyWater to expand facility and clean room to support new technology capabilities

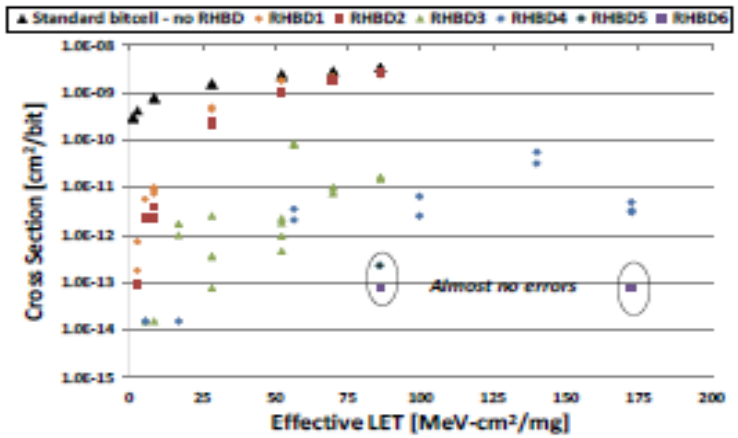
https://www.skywatertechnology.com/press-releases/skywater-licenses-key-fdsoi-technology-from-mit-lincoln-laboratory-moves-up-availability-of-its-90-nm-strategic-rad-hard-by-process-offering/

Demonstration of a Strategic Rad-Hard 90-nm Fully Depleted SOI Process

Pascale M. Gouker, Dominick Pipitone, Domenic Terranova, Matthew Guyton, Richard D'Onofrio, MIT Lincoln Laboratory

Matthew J. Gadlage, Aaron M. Williams, David Bruce, and J. David Ingalls, NSWC Crane

Nathaniel Dodds, Marty Shaneyfelt, Sandia National Laboratories



SOTA - Rad-Hard by Design

Developing and Demonstrating RH Electronics in SOTA Technology Nodes

AFRL BAE Systems
Honeywell Infineon
Micro RDC

AFRL RH Memory BAA Efforts

Technical Execution Strategy:

- Develop, demonstrate, and apply radiation hardening design techniques in key technology nodes
- Leverage RHBD to develop SOTA RH memories and intellectual property for rad-hard SoCs

RHBD Tasks

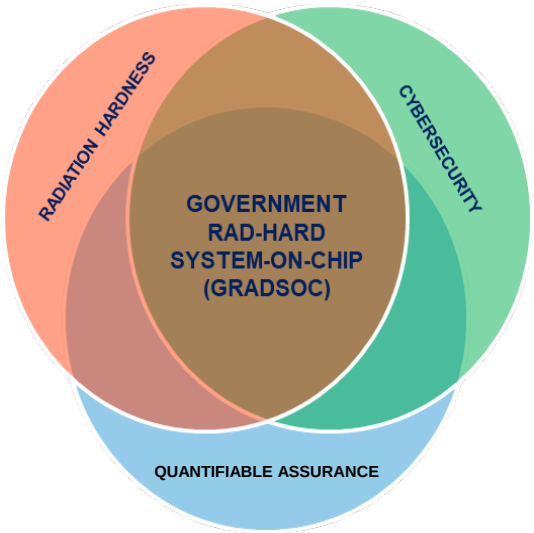
Vanderbilt University ISDE
22FDX

Naval Information Warfare Center PACIFIC
HV Analog RHBD

MILANOWSKI and Associates, INC.
AFRL SBIR – Analog RH PDK

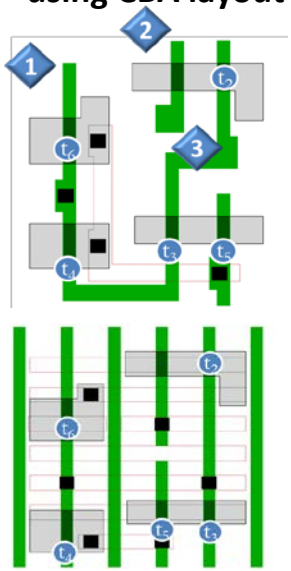
Sandia National Laboratories
Reliable MicroSystems
Strategic RHBD

DRAPER



GRADSoC – Rad Hard SoC

Silicon Technologies, Inc.
Analog RHBD Development using CBA layout



Alphacore
Arizona State University

"**Radiation and Reliability Characterization Chips (RAREChips)**"

Alphacore, in collaboration with **Arizona State University (ASU)**, is developing **test characterization vehicles (TCV)** in the following advanced CMOS technologies:

- **22nm FD-SOI (22FDX)**
- **45nm PD-SOI (45RFSOI)**
- **14/12nm bulk FinFET (14LPP/12LP)**

Radiation Hardened Executive Summary

- DoD programs have requirements for varying performance specifications for rad-hard electronics

- In order to ensure access to radiation-hardened microelectronics for these applications, investments across a range of technologies is being made that include:
  - SOTP strategic rad-hard by process
  - SOTA strategic rad-hard by design
  - Enhanced DoD lab capability

Through SRHEC, a data driven investment strategy to ensure program access to radiation-hardened microelectronics is being executed.

RH Panel Discussion

"What Rad Hard technologies do you see transitioning into production for the Defense Industrial Base in the next five years?"

- **Panelists**
  - Skywater – Brad Ferguson
  - MITLL – Pascale Gouker
  - Draper – Paul Melanson
  - NRL – Dale McMorrow
  - Vanderbilt University – Lloyd Massengill

- **Audience Q&A**

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Radio Frequency & Optoelectronics

Technical Execution Area

DoD Unique Needs Program Area

OUSD(R&E) TAM/MINSEC

Joshua Hawke, Ph.D.

Naval Surface Warfare Center, Crane Division

July 2020

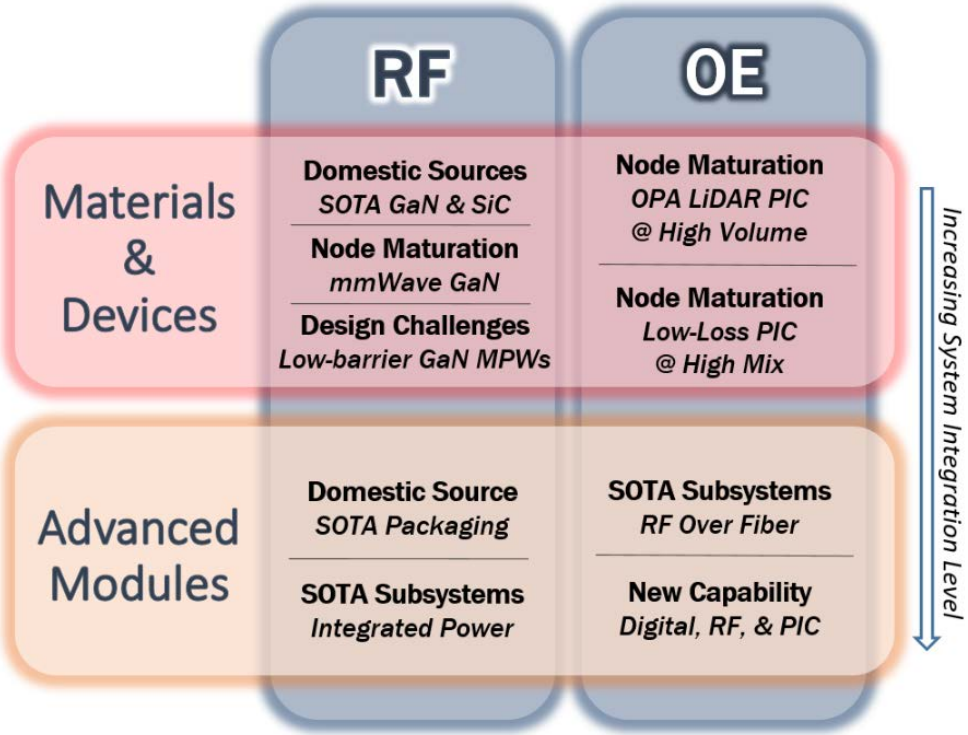
https://www.CTO.mil *@DoDCTO*

The RF & Optoelectronics Technical Execution Area is funded by the OUSD(R&E) Trusted & Assured Microelectronics Program.

Radio Frequency & Optoelectronics

Goals

- Develop secure access to SOTA RF/OE foundries, designs, and IP, which enables next generation sensors and communications.
- Demonstrate SOTA RF/OE designs and IP, which targets transition to DoD programs and the Defense Industrial Base.



Warfighter Benefits

- Maximize power and efficiency across the electromagnetic spectrum
- Secure, affordable access to SOTA RF & mmWave devices
- Enable cross-service overmatch capabilities in Spectrum & Information Dominance

Objectives

- Establish domestic sources of advanced materials
- Provide secure program access to SOTA prototypes and IP
- Lower access barriers for pure play GaN and Photonic ICs
- Leverage RF/OE Community of Interest to accelerate technology development, demonstration, and transition

Partners

- DoD/USG – OUSD(R&E) TAM/MINSEC (sponsor), Navy Crane (lead), DARPA, AFRL, ONR, NRL, Army AMRDEC, GTRI
- Industry – Transphorm, II-VI, Qorvo, BAE, GlobalFoundries, AIM Photonics, Radiance, BRIDG, 3M/Ceradyne, EO Space, Tagore Technology, New Edge Signal Solutions, Northrop Grumman, Raytheon

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RF/OE Panel Session

"What RF/OE technologies do you see transitioning into production for the Defense Industrial Base in the next five years?"

AIM Photonics – David Harame

David Harame worked for IBM 1984 – 2014 where he was an IBM Fellow and worked on SiGe BiCMOS technology and Enablement. In 2005 he was awarded the IEEE Daniel E Noble Award "For the development of manufacturable Silicon Germanium, HBT Bipolar and BiCMOS technologies. In 2014 David joined GLOBALFOUNDRIES as a GF Fellow and CTO for RF technologies where he worked on the qualification of 22nm RF FD SOI technology. In 2019 David joined the Research Foundation State University of New York where he is the Director of EPDA, Photonics and Test Assembly & Packaging Process development in Albany/Rochester NY. He is an IEEE Fellow.

GlobalFoundries – Ezra Hall

Mr. Ezra Hall is the Director of GLOBALFOUNDRIES' Aerospace and Defense Business Unit, where he specializes in creating novel solutions to technical, legal, security, and business challenges for clients, as he leads GLOBALFOUNDRIES' strategy in this important sector for his company and national security. Mr. Hall is a founding member of the National Defense Industry Association (NDIA) Electronics Division, and is a recognized industry leader in the Trust and Assurance domain. Mr. Hall was selected by IBM as Master Inventor in 2015, holds 19 US Patents (additional pending), and applies a high degree of innovation in his results driven approach to simultaneously satisfy his companies' business goals and this nations' needs for secure and available microelectronics

Northrop Grumman – Aaron Oki

Aaron is an NG Fellow and manager of the Electronics & Sensors Technology organization. He has been with Northrop Grumman for 35 years supporting both advanced microelectronics technology development as well as supporting several major Northrop Grumman programs for the DoD and other U.S. government organizations. Recently he served on an Air Force Study Board with the National Academy of Science for Trusted and Secure Microelectronics.

Qorvo – Elias Reese

Elias Reese serves as Technical Director of Engineering for Qorvo's Infrastructure and Defense business unit. Mr. Reese served in engineering technical staff and engineering management positions as Qorvo's Texas based organization evolved from Texas Instruments' Microwave Laboratory & GaAs operations, acquired by TriQuint in 1998 and subsequently reformed as Qorvo in 2015. During that time Mr. Reese has focused on micro- and millimeter-wave integrated circuits and III-V compound semiconductor devices. Prior to joining Texas Instruments in 1985, he worked in electro-magnetic field modeling and application. Mr. Reese received his B.S.E.E degree from The University of Texas at Austin, and M.S.E.E degree from Stanford University.

Raytheon – Matt Tyhach

Matt Tyhach is a RTN Engineering Fellow and the Advanced Technology Mission Area Director for next generation sensors and microelectronics for Raytheon Missiles and Defense. He responsible for developing new DoD sensor technology and transitioning it to create new capabilities for our warfighters. Matt has supported advanced microelectronics along with DARPA for many years including the first GaN MMIC power amplifiers and is now developing next generation semiconductors, packaging, and integrated RF/Digital front ends.

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