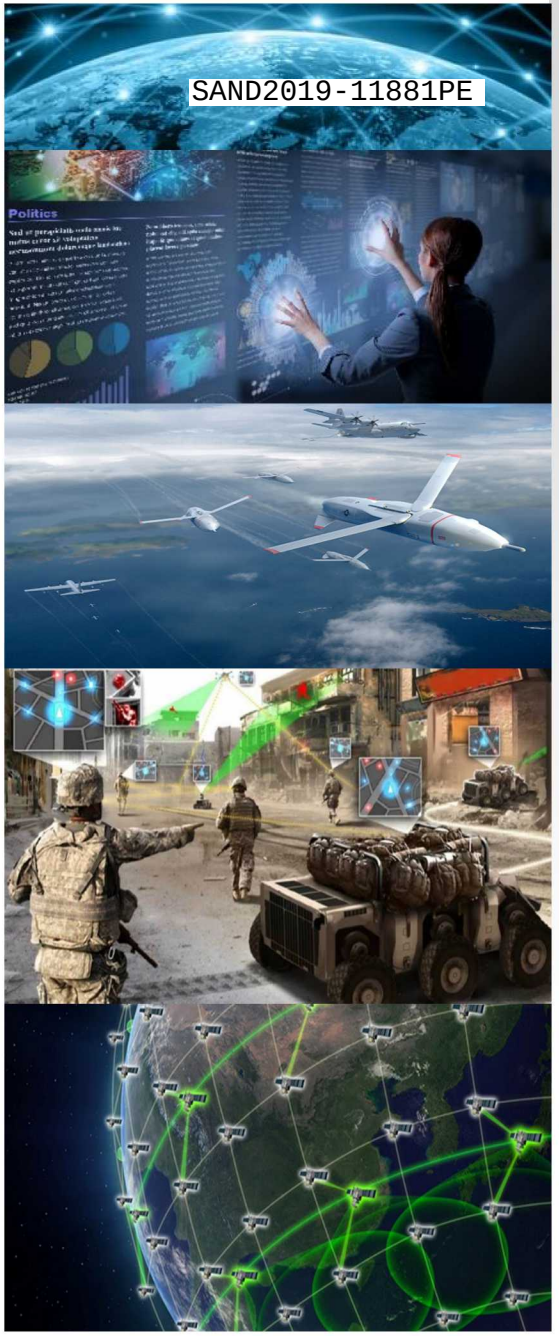

Quantifiable Assurance Workshop

Fabrication Data Sources for Rad Hard

Todd Bauer, Nick Pattengale, Nick Hilbert,
Vivian Kammler, MESA CIM Team
Sandia National Laboratories
Day 1

9 Oct 2019

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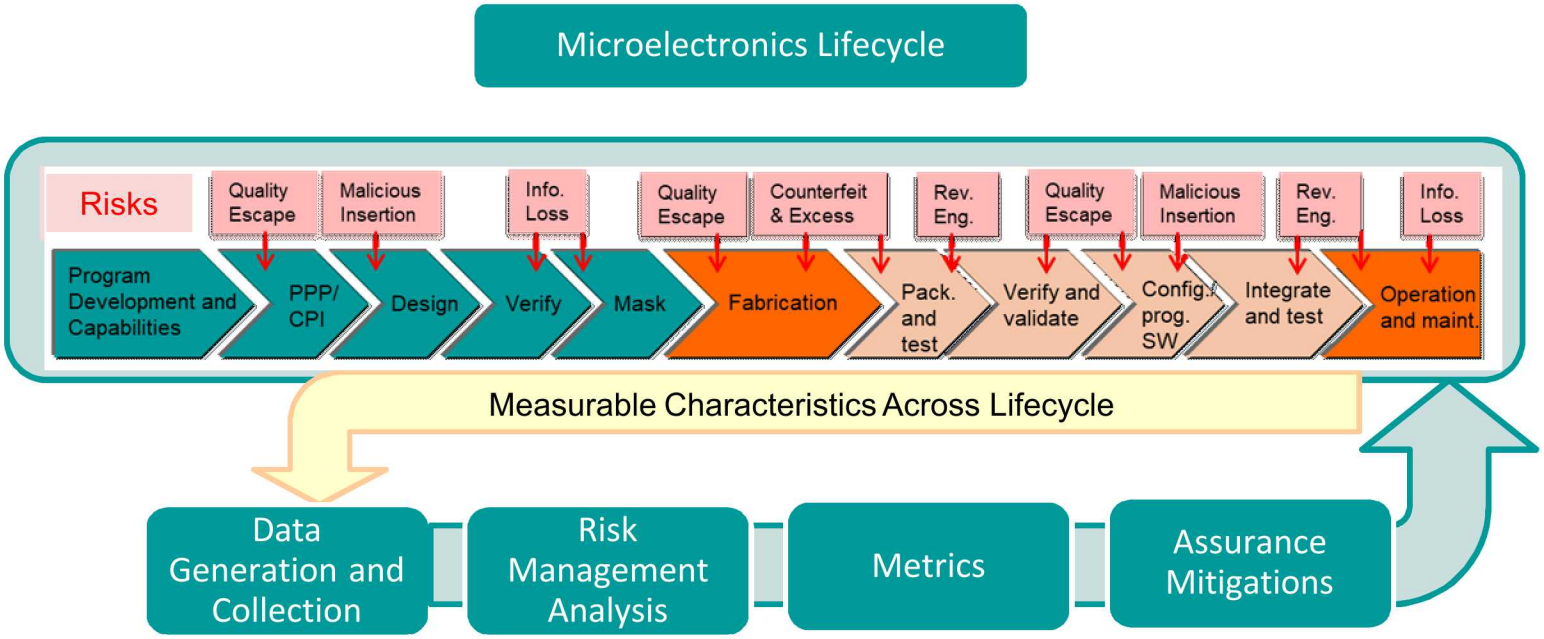
Data Driven Quantifiable Assurance



As a starting point, our focus is the application of Trust principles, Distributed Ledger and/or Blockchain to Fabrication.

The same approaches could be applied continuously across the entire lifecycle.

Introduction

- Who we are: Todd Bauer, Nick Pattengale, Nick Hilbert, Vivian Kammler, MESA Computer Integrated Manufacturing Team
  - Sandia National Laboratories
    - Microsystems Engineering, Science, and Applications (MESA) Center
    - Threat Intelligence Center
- What we do: design, fab, package, & test strategically radiation hardened microelectronics for National Security systems
  - Primary customer is NNSA
  - Full flow silicon CMOS, radiation hardened by process and by design
- In support of Assurance Enabled Manufacturing, can we increase stakeholder confidence in the integrity and reliability of our manufacturing flow?

Current State

- For MESAFAB, protection measures include robust physical security & cleared staff
- DMEA Trust certification
  - Relies on physical security and chain of custody of silicon and photomasks


ACCREDITATION OF TRUST

Microelectronics Trusted Source
CATEGORY 1A

By these presents the undersigned expresses the confidence of the Department of Defense, Defense Microelectronics Activity (DMEA) in the ability of the organization known as

Sandia National Labs

Microsystems Engineering, Science and Applications (MESA)

to deliver trusted foundry microelectronic goods and services to end users within the United States Government that correspond to Trusted Category 1A which meets Mission Assurance Category 1 as defined by Instruction 8500.2 of the Department of Defense Directives, effective this date.

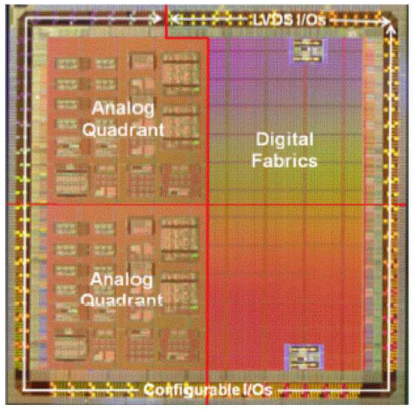
414 — Site Accreditation Number
14213 — Cage Code
2 Aug 2019 — Effective Date
28 Jun 2021 — Renewal Date
Kevin H. Rankin — Director (Acting), Defense Microelectronics Activity

- Extensive use of computing resources, controlled through internal restricted network and access control lists
  - All fabs generate data and the data is important!
  - Many sensitivities to manage
- Material tracking from lot starts to delivery
- What are we measuring?
  - Linear physical measurements, electrical parametrics, equipment settings, etc.
  - Compliance with operating procedures
  - Material tracking

Are We Measuring Assurance?

Future Directions

- Future state: Develop and demonstrate cryptographic blockchain and distributed ledger for provenance tracking of microelectronics
  - Establish a framework, not a point solution!
    - Use MESA as a model system
    - Note: Si CMOS that is RHBP looks a lot like standard Si CMOS
  - Complements existing DMEA Trusted flow



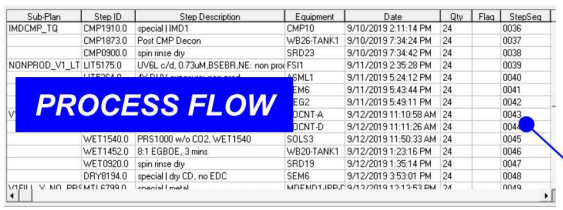
- If we 1) operate in a trusted environment, 2) verify compliance to requirements, and 3) document evidence of compliance in a blockchain, is that assurance?

Easy to Measure Compliance to Requirements

Can We Translate That To Assurance?

Future Directions

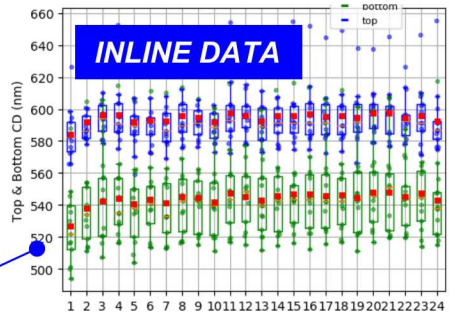
- Questions to be answered: Data from what sources? Incorporate sensitive information? How much distribution? Over what network?



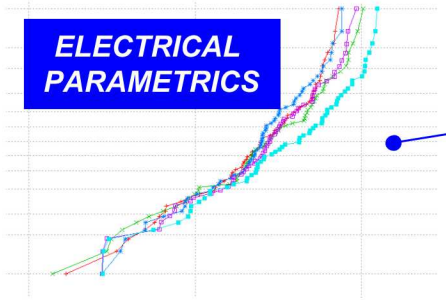
Reticle Information

SubPlan	Layer	Rev	Comments
			ocess on either scanner
			d targeting
			d targeting
			d targeting
NONPROD_PAD_LITHO_CVV	23		Std targeting

LITHO & MASK DATA



BLOCKCHAIN



DIE TRACKING?

– Bonus: Develop sanitized reference data for other researchers

Our Focus Is Fabrication But Concepts Are Applicable Across Full Lifecycle

Impact

- Compliance to Requirements Linked Through Blockchain
  - Immutability of Manufacturing Data
  - Verification of Manufacturing Conformance
- Robust Track & Trace Throughout Product Lifecycle
- Decentralization of Data Ownership and Data Storage
- Demonstrated in our fab but transferable to other fabs

Measure Compliance to Requirements & Link through Blockchain

Can We Quantify Assurance Value?

Status, Conclusions, Metrics

- Blockchain from *archived* data already demonstrated
- Studying trade space for *real-time* implementation of blockchain
  - High complexity!
  - Considering constrained implementation to start
- Studying trade space for distribution of ledger
  - For our specific implementation, thoughtful database design may be sufficient
- Transition: Engaging Colvin Run Networks

Easy to Measure Compliance, Harder to Measure Assurance