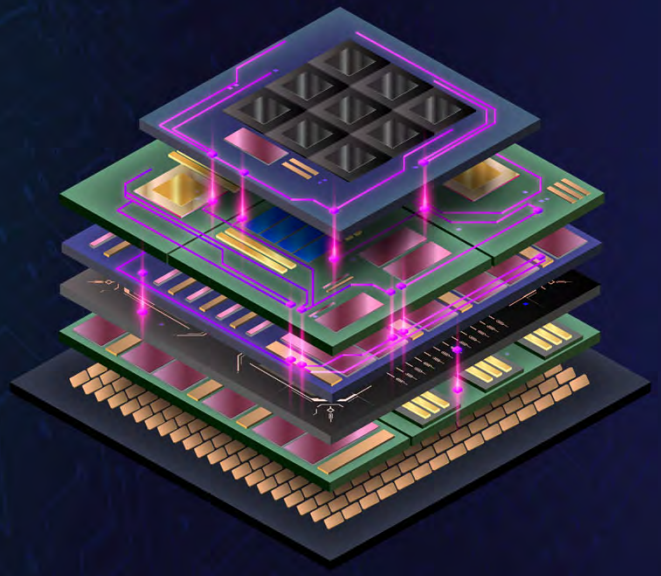
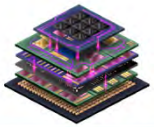
Engagement Opportunities

Michael Holmes
NGMM Managing Director, DARPA





TNC Baseline Process Capability Development Plan

PLANNED 3DHI LOW-VOLUME/HIGH-MIX FOUNDRY TECHNOLOGIES

1. Bonding

Die-To-Wafer	Die-To-Wafer & Wafer-to-Wafer
Thermocompression *Cu-Cu Cu-Sn*	Hybrid *Cu-Cu*

2. Through Substrate Via (TSV) and Advanced Substrates

Silicon	Glass
Compound Semiconductor	Polymer
Advanced Substrates	

3. Routing and Reconstitution

- Cu Routing Layers (200mm/300mm)
  Cu Damascene, RDL/Bump
- Sub-200mm Wafer Processing Enabled by Reconstitution
- Mixed-Material Reconstitution

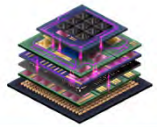
4. Thermal Solutions for Mixed-material 3DHI

- Engineered Thermal Materials & Systems
- Thermo-Mechanical Modeling & Reliability

5. Failure Analysis, Characterization, Test & Reliability

6. EDA and 3D Assembly Development Kit (3D-ADK)

- **Domestic State-of-the-Art 3DHI Foundry**
  - Pure play 3DHI services
  - ITAR/EAR compliant operations
- **Mixed-Materials Heterogeneous Integration (3DHI) Capability Built on a Silicon Advanced Packaging Baseline**
  - Support for many wafer sizes and formats
  - All bonding completed at 200mm/300mm using reconstitution or related methods
  - Standardized planar interface with Cu Damascene processing to enable diverse materials integration
- **3D Assembly Design Kit and Support of EDA Vendors**
  - Reference flows for prototype development
  - Digital Twin representation to support modeling
- **Strategic Domestic Partnerships**



NGMM Program Plan Summary

Phase 1
Establish Baseline Process

Phase 1 Deliverables
1. Initial Process Capability
2. Alpha ADK

Phase 2
Qualify / Operationalize

Phase 2 Deliverables
1. Qualified Process Capability
2. Beta ADK

End Goal
Ready for Customers

- **Facility Preparation and Equipment Installation**
  - Facility Refurbishment
  - Equipment Procurement and Installation
- **Process Development**
  - Initial Process Capability Development
- **Electronic Design Automation**
  - Workflows and Simulation
  - 3D-Assembly Design Kit (ADK)

- **3DHI Prototyping**
  - Exemplar Microsystems and Design Challenge Prototypes to Exercise Process Capability
- **Process Improvement**
  - Automation of Fabrication, Assembly, and Test Processes
- **Emulation/Digital Twin Capability Development**

- **3DHI Capability**
  - ✓**High Performance HI Microsystems**
  - ✓**Research, Rapid Prototyping, and Manufacturing**
  - ✓**Foundry Services**
  - ✓**ITAR/EAR Compliant**
  - ✓**Self-Sustaining**
  - ✓**Cost Effective**

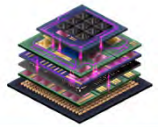
Phase 1: 30 months

Phase 2: 30 months

3DHI Foundry Capability

Design Challenge Solicitation

Design Challenge

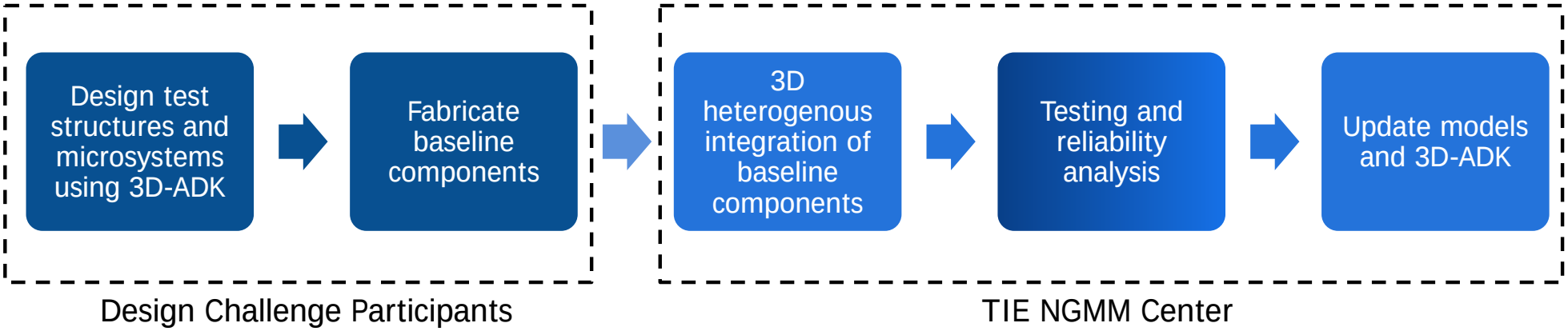


NGMM Design Challenge Program

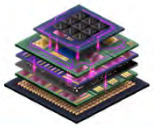
Goal

- Opportunity for early engagement with TNC to demonstrate novel next generation prototypes showcasing the unprecedented performance of 3DHI technology
- Support long term sustainability and technical roadmap of the TIE NGMM Center
  - Exercise business, design, and fabrication processes aligned with TIE's existing capability

Program Structure



The NGMM Design Challenge will Drive Innovation and Bolster TNC Capability in 3DHI

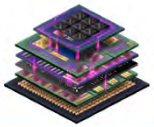


NGMM 3DHI Microsystems RFI

3DHI RFI Response Topic Areas

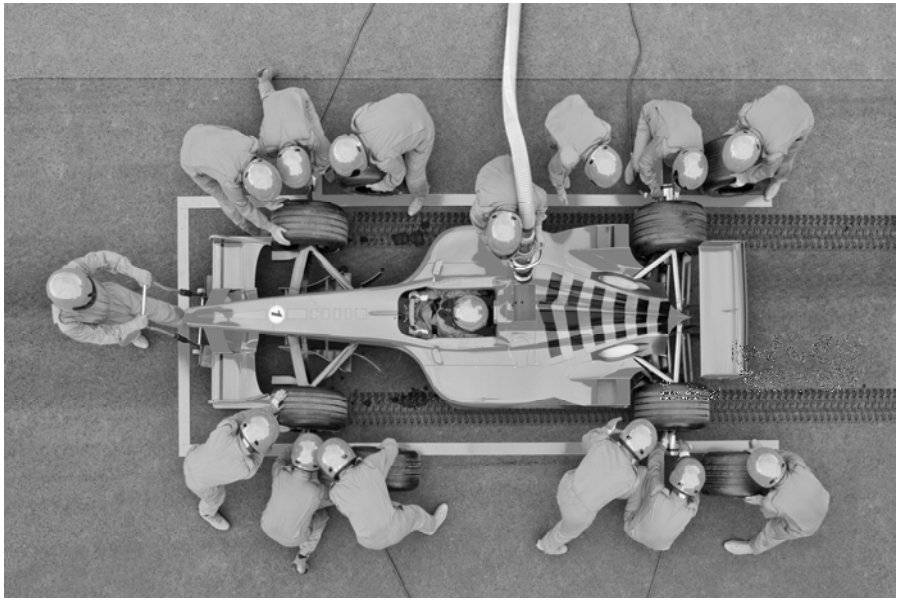
- RF Phased Array
- Focal Plane Array
- Power Converter
- RF Components
- Novel Sensors
- Compute Architectures

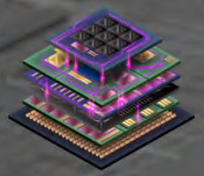
- **NGMM Request For Information (RFI): 7/25-8/25**
  - Thank you for great response!
  - **Goal:** Gain insight into community's innovative ideas to develop commercial and/or dual use 3DHI microsystems with TNC
- **Key Insights**
  - Significant interest in applications aligned with NGMM exemplars
  - High interest in RF device implementations
  - Interest aligned with NGMM 3DHI microsystem enablement
    - Thermal management technologies and EDA/3D-ADK
- **Additional Interest Areas**
  - Novel sensing
    - e.g, Architectures that incorporate MEMS or photonics
  - Compute architectures



Have an idea? Interested in getting involved?

- **Stay tuned** for additional opportunities to engage with TIE and NGMM
- **Connect with the DARPA team:** send your ideas to ngmm@darpa.mil
- **Monitor darpa.mil and sam.gov** for current and future DARPA opportunities





Thank you for joining us for the 2025 NGMM Summit!

We hope that you had a chance to...

- **Get an inside view** of the program and opportunities to get involved
- Gain insight into the **TNC Technology Roadmap** and design/development infrastructure
- Learn about our **progress** around facility, infrastructure, equipment, and key milestones in process development

And leave with a perspective on...

- How the **next generation of microelectronics performance** will be enabled by 3DHI
- Our focus on **developing the design enablement tools** required for TNC customers and partners to be successful
- The **importance of partnerships** in the success of not just NGMM, but of the larger domestic microelectronics community