



# DoD Trusted and Assured Microelectronics Summary

Dr. Jeremy Muldavin  
Strategic Technology Protection and  
Exploitation (STP&E), OUSD(R&E)

NDIA Electronics Division Meeting  
February 7, 2019

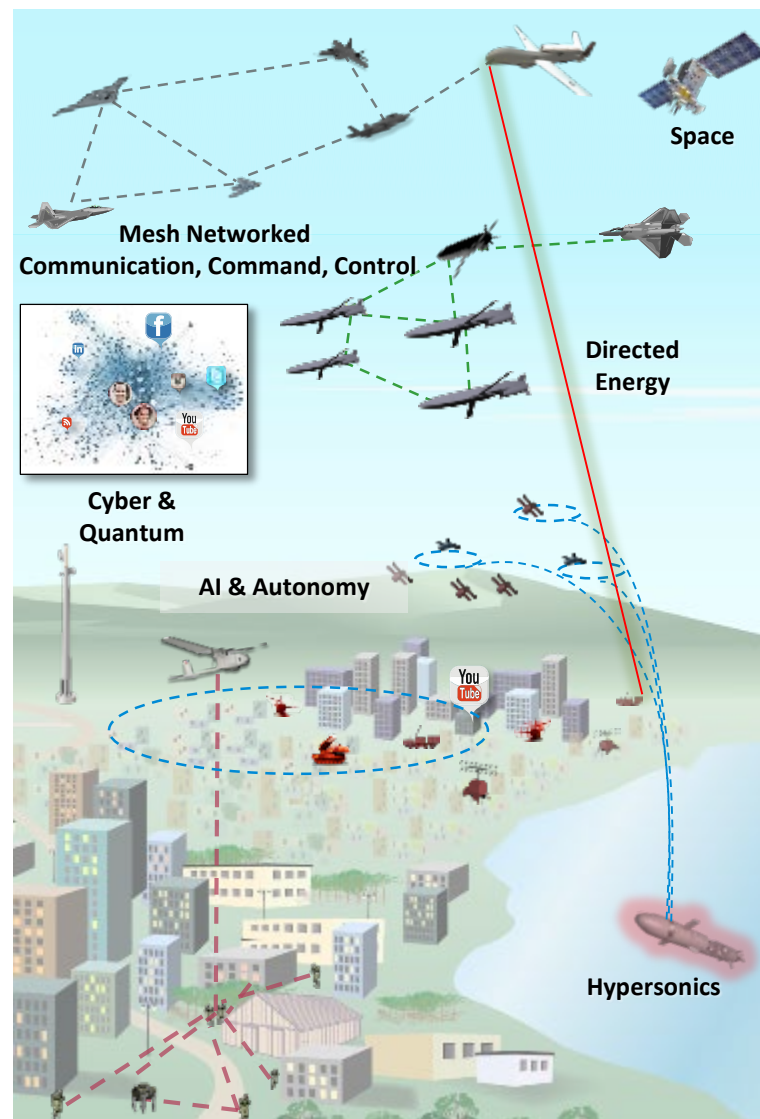


# Future Warfighting Needs

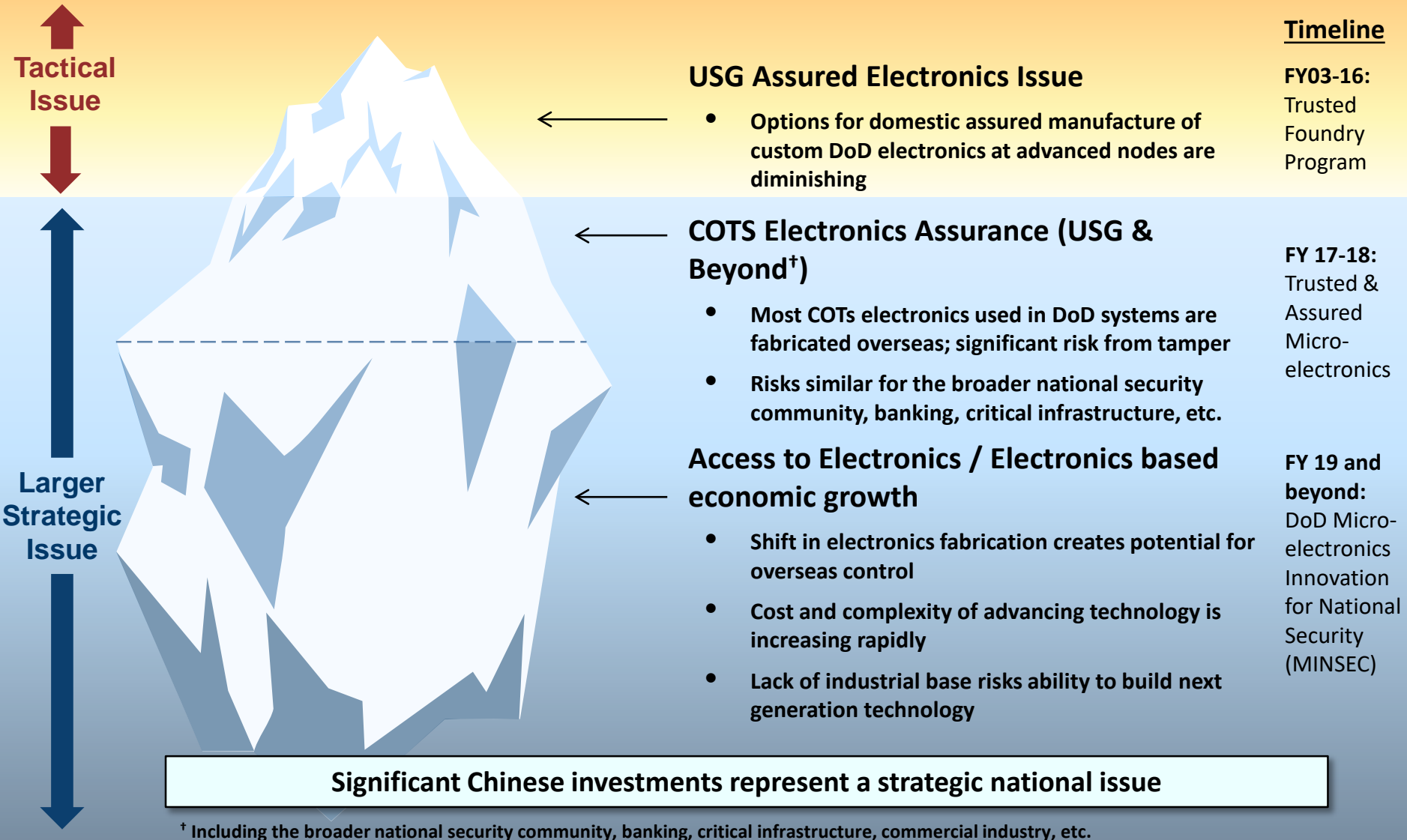


## Dependency on Advanced Microelectronics Technology

- **Cyber & Quantum**
  - >1000x performance enhancement and efficiency for real-time ID/processing/response/security
- **Mesh Networked C3**
  - Open and distributed architecture to enable local processing of raw data on the battlefield
  - Adaptive processing for multi-antennas and frequencies for robust comm. and radar systems
- **Artificial Intelligence and Autonomy**
  - Need vision, semantic, and navigation processing for high-performance imagers and navigation
- **Directed Energy**
  - Advanced Imagers, optoelectronic technology, signal processing and control systems, spectral awareness
- **Space & Hypersonics**
  - Significant increases in rad-hard on-board sensor processing, communications, targeting, controls



# Strategic Microelectronics Issue



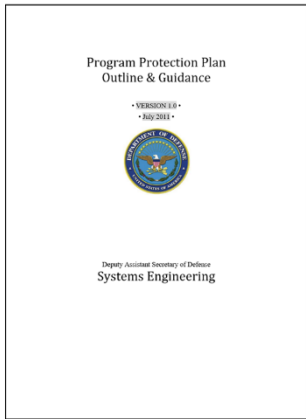
<sup>†</sup> Including the broader national security community, banking, critical infrastructure, commercial industry, etc.

# Key Elements of DoD's Implementation Plan



- **Revised microelectronics assurance policy and guidance** to address state-of-the-art (SOTA) technology applications, use of commercial parts in DoD systems, and full life cycle vulnerability protection, beginning with secure design and protection of intellectual property (IP)
- **Robust microelectronics verification and validation (V&V) capability**
- **Access to DoD/Government-unique needs**, radiation-hardened by process and radiation-hardened by design technologies, in support of space and nuclear modernization, including Diminishing Manufacturing Sources and Material Shortages (DMSMS) foundry-of-last-resort capability
- **Cultivation of workforce expertise and proactive engagement** with academia, Defense Industrial Base (DIB), and DoD user communities in prototyping, and development activities to build a domestic knowledge base for design and manufacturing of advanced microelectronics
- **Disruptive Research and Development (R&D) investment** to lead development of the next generation microelectronics and protect domestic leadership
- **Modernization of Defense Systems** through advanced microelectronics technology and systems-on-chips (SOCs), improving performance while reducing reliance on legacy parts and obsolete systems. Acquisition policies that promote rapid modernization, standards and best practices to facilitate V&V, supply chain risk assessment, and counterfeit detection
- **Availability, Access and Assurance at multiple domestic SOTA Foundries** through business models that sustain growth and commercial competitiveness

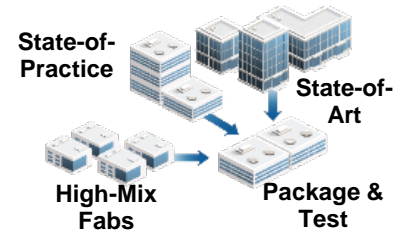
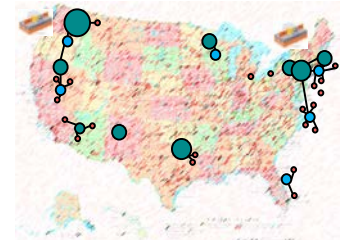
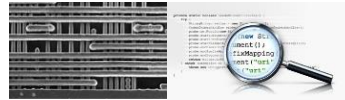
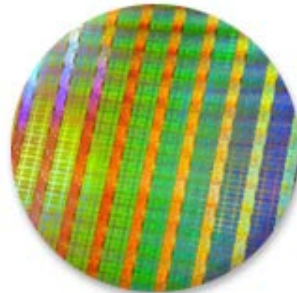
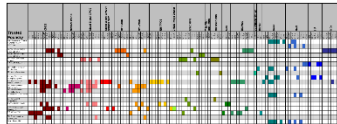
# DoD Strategy and Actions



## Trusted Supplier Accreditation



## TAPO



## Policy

- Program Protection Plan (PPP), 5200.44, ITAR, DPA Title III updates
- Strategy/Directive for Assured Microelectronics
- National Security Strategy priority



## DMEA

- Maintain and expand the number of trusted suppliers
- Provide access to state-of-the-art trusted flow (TAPO)
- Support sensitive needs and operations

## Trusted & Assured Microelectronics

- Assured Access to state-of-the-art foundries through modern trust and assurance methods and demonstration
- Industrial standards for assurance
- Joint Federated Assurance Center enhancements

## DoD MINSEC

- Next generation R&D DARPA (ERI) captured in US
- Modernization & assurance for DoD & nation through Innovation ecosystems
- Radiation hardened micro-electronics for nuclear and space

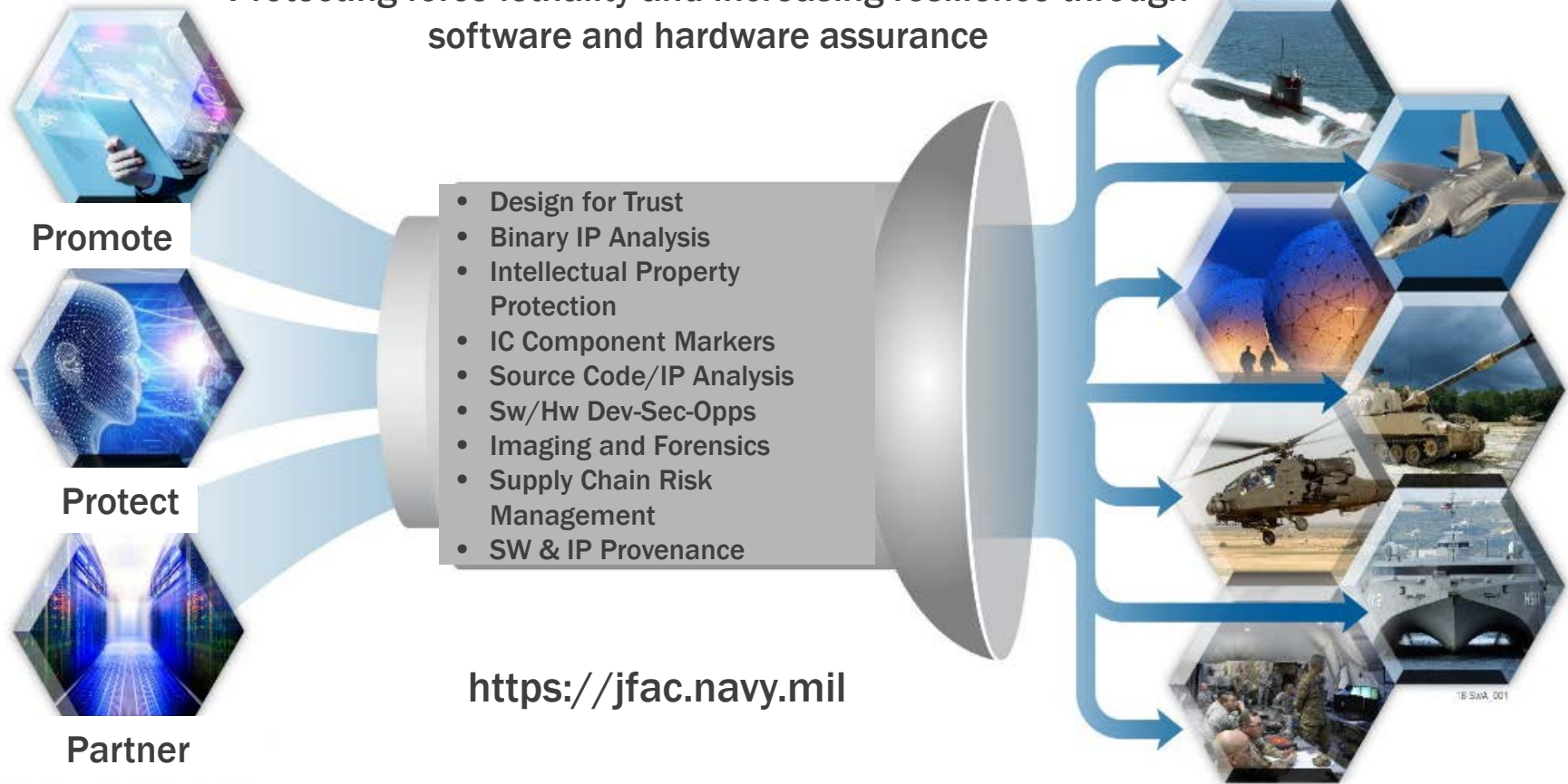
## Domestic Foundry & Packaging

- Multiple competitive State of the Art Foundries on shore
- Leadership in R&D and production
- Strong commercial business models
- Government business model for innovation & assurance

# Joint Federated Assurance Center (JFAC)



Protecting force lethality and increasing resilience through software and hardware assurance



- **Federated Stakeholders** - Army, Navy, Air Force, National Security Agency (NSA), Defense Microelectronics Activity (DMEA), Office of the Under Secretary (OUSD) of Defense (Research & Engineering), DoD Chief Information Officer, Defense Information Systems Agency (DISA), National Reconnaissance Office (NRO), Missile Defense Agency (MDA), OUSD (Acquisition & Sustainment), Department of Energy (DOE/NNSA)

# T&AM Baseline Projects FY19



## Trusted Mask Trust Approach

- Secure trusted photomasks required for leading-edge designs
- Engage and support DoD programs to determine trusted photo-mask needs
- Leverages DPA Title III



## Verification & Validation (V&V) Capabilities and Standards for Trust

- Improve throughput and capability to analyze commercial parts using tools/techniques for leading-edge processes
- Provide destructive and non-destructive equipment, analysis tools, imaging software and highly skilled tradecraft
- Engage vendors to improve their device and IP security; acquire government access to specific proprietary designs, software, development and quality assurance processes and test procedures



## New Trust Approach Development and Demonstration

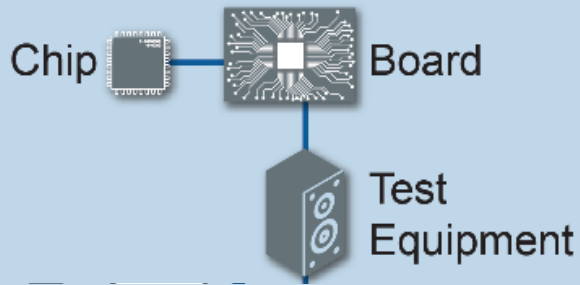
- S&T program of work to advance technologies and implement an alternative to the trusted foundry model
- Technologies include:
  - design for trust techniques;
  - IP partitioning and concealment;
  - split manufacturing;
  - cost-effective low-volume manufacturing;
  - tagging technologies to track chain of custody;
  - advanced imaging and forensics to evaluate dense components



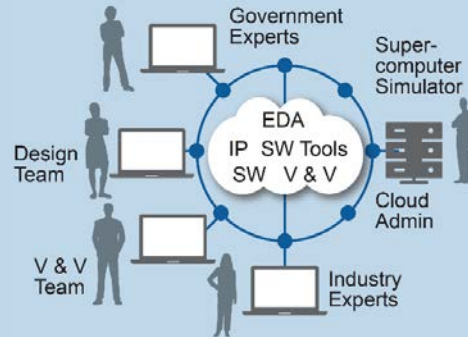
# T&AM Baseline Focus Areas



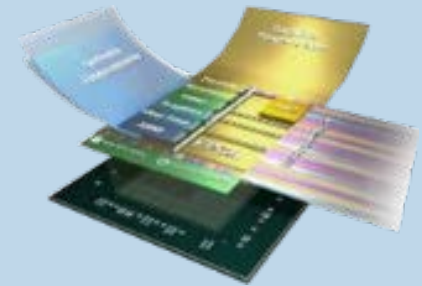
## Verification & Validation



## Design Assurance



## FPGA Assurance



## Enhanced Manufacturing



## Rad-Hard Microelectronics



## Outreach & Standards





# Microelectronics Innovation for National Security and Economic Competitiveness (MINSEC)



## Strategic National Security Applications



Secure IoT



Financial & Data Analytics



Autonomous Systems + AI



Robust + Agile Communicators



Commercial Space



Biomedical

## Strategic National Economic Competitiveness Applications

**Proactive Awareness & Security**

- Supply Chain track
- Proactive Authorities
- Intelligence & CI
- Standards

**Access & Assurance**

- Secure Design
- IP, EDA, experts
- Foundry assured Access 
- Modernization & co-development

**Enhanced Manufacturing**

- SOTP Back-end parity with SOTA
- SOTA on 200mm tools at SOTP
- High-mix low vol. fabrication

**Incentives & Market Growth**

- Acquisition reform and incentives
- Tax, policy, regulation reform
- R&D and domestic fab incentives

**Strategic Alliances**

- Cooperative R&D
- Trade and Foreign Military Sales (FMS)
- Americas
- Europe
- Asia partners

## Disruptive Research & Development

Experts, Infrastructure, Innovation, Venture Capital, Industrial Base, Academia

# FY19 T&AM MINSEC Activities



Enhancements	Description
<b>Capture and Secure Microelectronics R&amp;D</b>	Supports secure design and capture of IP and architectures; IP sharing and re-use; and keeps DARPA ERI IP secure within the domestic ecosystem using secure design environments and domestic foundry capabilities.
<b>New Microelectronics Development, Demonstration, and Capability Insertion</b>	Supports public/private development of system-on-chip (SoC), hardware assurance, emulation and virtual verification and validation (V&V) to enable assured and secure IP; fabrication and packaging at SOTP government and merchant foundries; and design, packaging, testing, and integration of SoCs into a capability.
<b>COTS programmable IC co-development</b>	Pilots secure co-design capabilities and supply chain tools using commercially-available cloud-based services with/at commercial co-development partners to secure commercial IP and develop and promote security features and software and hardware assurance tools, and capabilities that meet future DoD needs.
<b>Radiation-Hardened by Process (RHBP)/ Radiation-Hardened by Design (RHBD)</b>	Provides for secure design and development of strategic radiation-hardened (SRH) IP and microelectronics test articles for JFAC and National Nuclear Safety Administration (NNSA) evaluation and qualification using RHBP techniques and SOTP foundry access.
<b>Radio Frequency (RF) and Optoelectronic (OE)</b>	Provides for secure design and development of radio frequency and optoelectronic IP and test articles, to include strategic designs, for JFAC and NNSA evaluation and qualification using SOTP and SOTA foundry access.
<b>Microelectronics Obsolescence and Replacement</b>	Supports critical process IP installation at two USG and/or a merchant foundry for USG use. This IP is required to ensure the continued availability of these critical technologies by providing for second sources.
<b>Microelectronics-focused Workforce Development</b>	Provide access to university, DoD, and small businesses for training and skill development; SOTA processes for test articles and training; and limited funding to promote design challenges and hacks around hardware IP development and assurance.

# DoD MINSEC Highlights (POM 19)

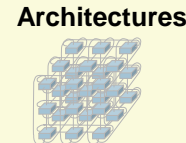


R&D & Security

**Develop the Next Generation Technology**  
DARPA Electronic Resurgence Initiative R&D Programs with matching from industry

**Capture & Secure R&D in US Ecosystem**  
Secure design environments, foundry access and enhancement, security support

## Results & Deliverables



Secure design environments



Intelligence & counter intelligence



Domestic enhanced R&D fabs

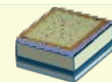
Modernization & Security

**New Capability Development w/ Assurance & Insertion into DoD, dual use products (1000x COTS)**

**Assured COTS Programmable Co-Development**

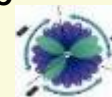
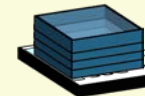
**Obsolescence & Replacement**

**Workforce Development**



Most Advanced Digital Imagers

EW Array SoC



Secure PNT SoC



EW resistant



Assured FPGA from 2 vendors



ML/AI SoC

2 Chips = 8 Peta FLOPS  
400,000 FPS,  
240W

10k X GPU

Preserve access to legacy IP and processes

Future obsolescence replacement of boards by SoCs

100 STEM scholarships including microelectronics specialization

Specialty Needs

**Rad-Hard Microelectronics**  
Deliver future nuclear and space modernization

**RF & Optical Technologies**  
Deliver unique RF and optical technologies for DoD systems



- Domestic USG fab enhanced from 90nm AL to 65nm copper back-end process developed in partnership with NNSA
- Rad-hard by design developed for 1-2 SOTA foundry offerings with limited testing and qualification (strat-RH)
- Secure design and development of radio frequency and optoelectronic IP and test articles
- JFAC and NSA evaluation and qualification using SOTP and SOTA foundries

# DoD MINSEC Highlights (FY 19 Omnibus)



## Results & Deliverables

R&D & Security

**Develop the Next Generation Technology**  
DARPA Electronic Resurgence Initiative R&D Programs with matching from industry




**Materials**




**Devices**

**+MTO Tech Dev**




**Design tools**



**Architectures**


**Capture & Secure R&D in US Ecosystem**  
Secure design environments, foundry access and enhancement, security support



**+Secure design environments**

**+Pilot Innovation Hub with Industry**

**+SOTA Foundry Access**



**+E-Beam litho**

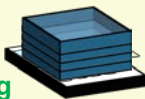
**Domestic enhanced R&D fabs**

Modernization & Security

**New Capability Development w/ Assurance & Insertion into DoD, dual use products (1000x COTS)**

**+ATC Tech Pipeline for Assured SOTA & AI**


**+3D Packaging**





**+Pilot Secure SoC**

**+Pilot Reference ASIC Dev**

**+Promote SwA & HwA tools (JFAC)**



**Assured COTS Programmable Co-Development**

**+Promote security features and Secure Design Assurance for COTS**

**Obsolescence & Replacement**



- Preserve access to legacy IP and processes
- + Future obsolescence replacement of boards by SoCs**

**Workforce Development**

**+SOTA Access, Test articles, Training , Design Challenges, scholarships**

Specialty Needs


**Rad-Hard Microelectronics**  
Deliver future nuclear and space modernization

**+ Rad-hard reliability Eval (strat-RH)**

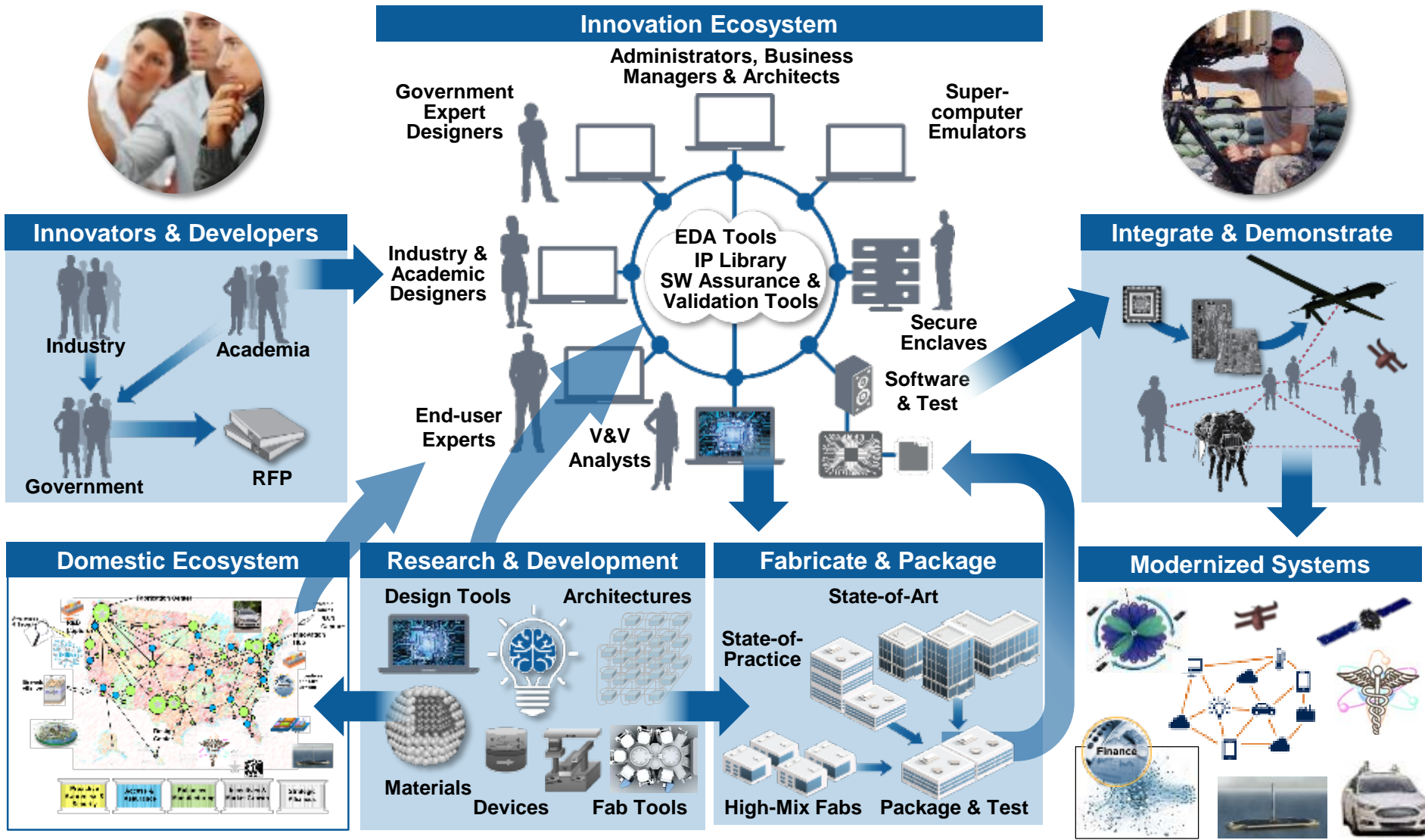
**+ Strat-RH test facility**

**RF & Optical Technologies**  
Deliver unique RF and optical technologies for DoD systems



- JFAC and NSA evaluation and qualification using SOTP and SOTA foundries
- + Enhance SOTP Process Capabilities for DoD and Commercial**

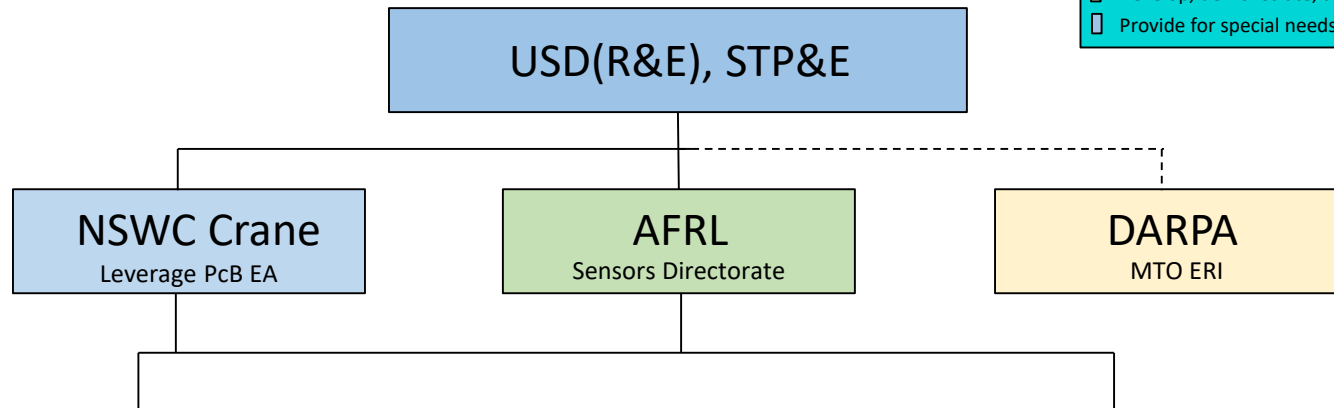
# New Capability Development Operational View



# T&AM & DoD MINSEC Execution Management



- Next-generation disruptive R&D
- Develop, demonstrate, and insert new capabilities
- Provide for special needs, awareness & security



## T&AM

<b>V&amp;V</b> Lead: NSWC Crane*	<b>Design Assurance</b> Lead: AFRL*
<b>Strat Radiation Hard</b> Lead: NSWC Crane	<b>Outreach &amp; Stds</b> Lead: IDA
<b>FPGA Assurance</b> Lead: NSA*	<b>Enhanced Fabrication</b> Lead: AMRDEC*/DMEA*

## DoD MINSEC

<b>Rad-Hard</b> Lead: NSWC Crane	<b>Capture &amp; Secure ERI</b> Lead: AFRL	<b>ERI</b> Lead: DARPA MTO
<b>RF &amp; OE</b> Lead: NSWC Crane	<b>New Capabilities</b> Lead: AFRL	<b>Obsolescence</b> Lead: DMEA
<b>Awareness &amp; Security</b> Lead: NSWC Crane	<b>COTS Co-dev</b> Lead: AFRL	<b>TAPO Access</b> Lead: DMEA

\* JFAC Federated Organizations, which include the Army, Navy, Air Force, National Security Agency (NSA), Defense MicroElectronics Activity (DMEA), Defense Information Systems Agency (DISA), National Reconnaissance Office (NRO), and Missile Defense Agency (MDA) laboratories and engineering support organizations; Intelligence Community and Department of Energy



# Summary

- **Maintaining Technology Dominance is critical to economic and national security:**
  - Promote and protect our critical missions, programs, and technologies
  - Combat adversary effectiveness and abilities to challenge our dominance
- **Goals for Microelectronics Dominance and Semiconductor Leadership:**
  - Revised trust and assurance standards that result in a competitive advantage for US/partners to deliver secure and reliable microelectronics
  - Maintain U.S. leadership in innovation and technology enabled by strong public/private partnerships to deliver next generation technology and capabilities
  - Maintain competitive domestic advanced microelectronics ecosystem and modern infrastructure (5G, smart cities, AI/autonomy, finance, IoT, etc.)

***The DoD has been given an opportunity to take action towards these Goals in alignment with the whole government***