Microelectronics Innovation for Next Generation System Advancement and Validation (MINSAV) Industry Day

Dr. Brian Dupaix, Principal Engineer

AFRL Sensors Directorate (AFRL/RYDT) October 9th, 2019

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Agenda

- MINSAV Overview / Technical Objectives..... Dr. Brian Dupaix, Technical Lead (30 min)
- Motivation……... Mr. Jeffrey Stanley, Deputy Assistant Secretary Air Force SAF/AQR (30 min)
- Contracting Overview……Dawn Dalhamer, MINSAV Contracting Officer (10 min)
- Question and Answer…….....…(15 min)
- Break
- OSD R&E Microelectronics Roadmap……Dr. Matt Casto, OSD R&E (15 min)
- MINSAV First Call Overview / Technical Objectives…… Dr. Brian Dupaix, Technical Lead (30 min)
- Secure cloud computing / enterprise licensing.....P. Len Orlando, AF HW Assurance Lead (30min)
- MINSAV First Call Contracting Overview……Dawn Dalhamer, MINSAV Contracting Officer (10 min)
- Question and Answer…….....…(15 min)

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MINSAV

an opportunity to enhance the U.S. commercial microelectronics ecosystem and to align commercial development with DoD needs to maintain U.S. technological superiority in warfighting capability

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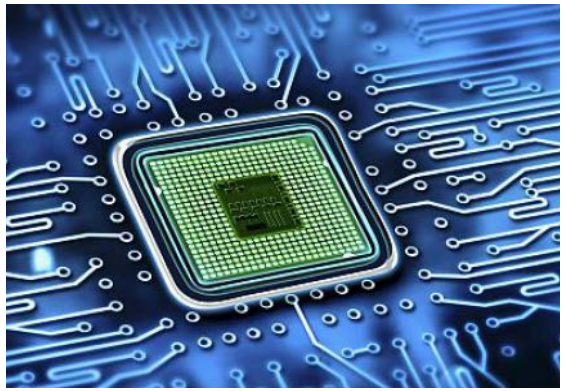
PROGRAM INFORMATION



- **Program Name:** Microelectronics Innovation for Next-generation System Advancement and Validation (MINSAV)

- **Estimated Program Value:** $800M

- **Program Summary:** The objective of the MINSAV effort is to acquire the design and fabrication of commercial and government developed sensor (signal) generation and processing technologies to enhance the US commercial microelectronics ecosystem and align commercial development with DoD needs to maintain US technological superiority in warfighting capability.

Experimentation under the MINSAV ARA will construct prototype systems that demonstrate microelectronics capabilities that yield technical offset for DoD related autonomous, artificial intelligence, position navigation and timing, electronic warfare, data processing, spatial / spectrally agile, and strategic applications.

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PROGRAM INFORMATION

Advanced Research Announcement (ARA) w/ Calls

- **ARA Open Period**: 60 months (5 years)
- **AFRL MINSAV Program Awards Periods of Performance (PoP):**
  - PoPs to be determined on each call/award; expected to range from 12 months to 60 months.
- **Deliverables:**
  - **Final Report**: To be delivered under each award
  - **Hardware**: Anticipated, including design and prototype procurement. TBD for each award
  - **Software**: Anticipated, including design and prototype procurement. TBD for each award
  - **Other**: None anticipated
  - **Significant End Items Being Delivered**: Not anticipated. TBD for each award
- **Military Equipment Valuation**: Not applicable. No items potentially capable of entering active inventory will be developed under this program.
- **Security Classification:** Unclassified.
- **Export Control:** determined for each call / award.

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MINSAV

the best microelectronic supplies for the warfighter

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Microelectronics – a technical edge in warfighting capability

Unstable Flight Systems

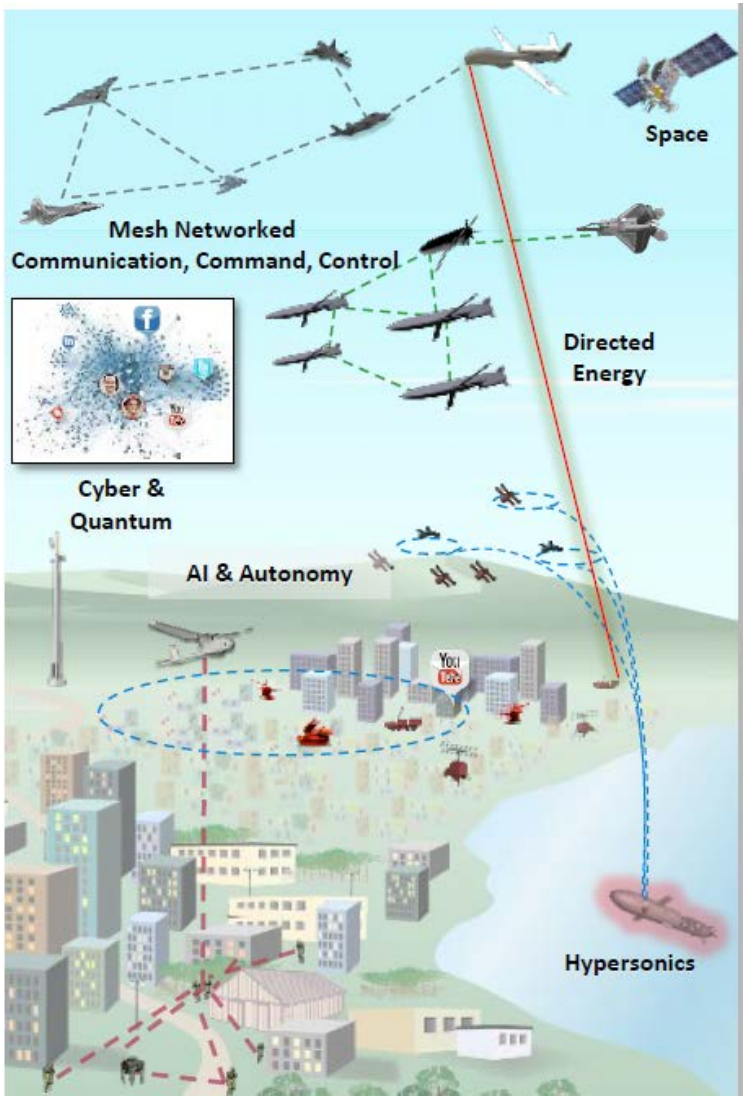
"Highly stealth aircraft like the F-117 Nighthawk are aerodynamically unstable … and require constant flight corrections from the flight system to maintain controlled flight" – *Skunk Works*, B. Rich and L. Janos

Remotely Piloted Systems

"Utilizing state-of-the-art equipment… these experts perform surveillance and reconnaissance…" – airforce.com

2018 National Defense Strategy

"Platform electronics… must be designed for routine replacement instead of static configurations that last more than a decade… deliver performance at the speed of relevance."



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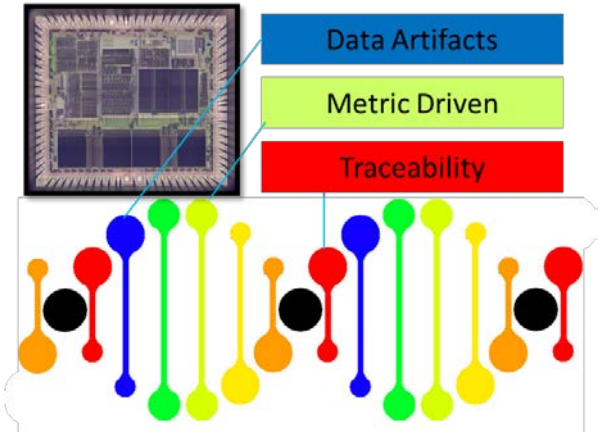
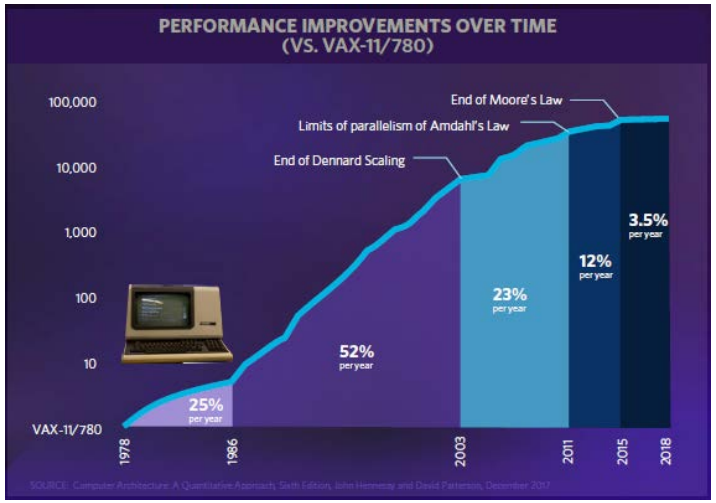
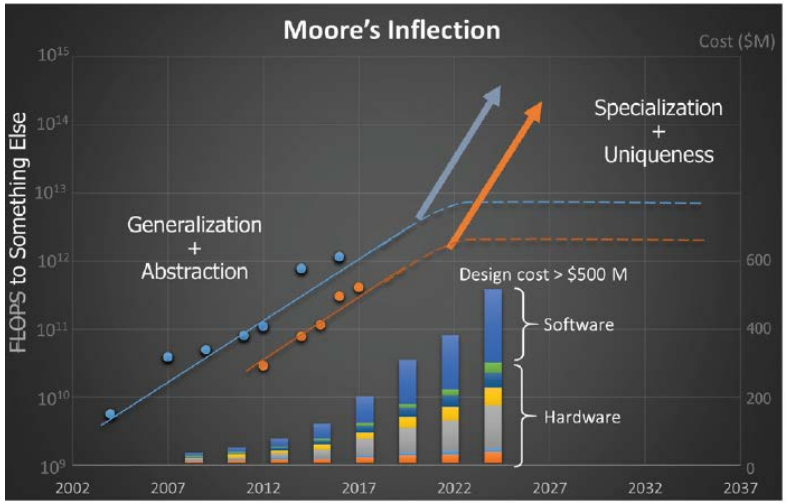
Best Microelectronics Supplies

- State of the Art Computation
- Power / Performance advantage (GOPS/W)
- ***Built In Assurance (part of design)***



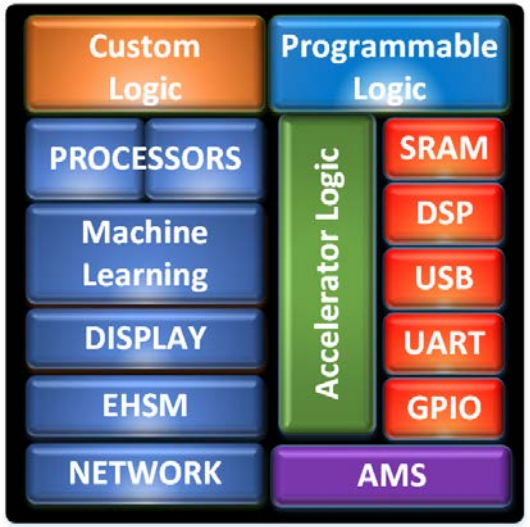


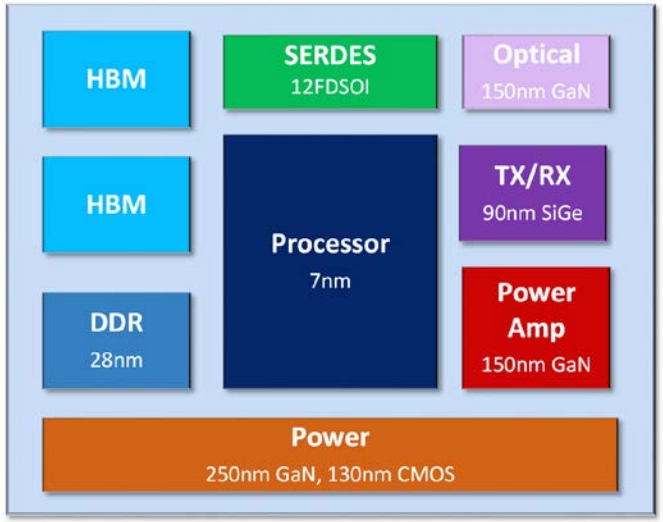
Source: DARPA



Source: DARPA

- ***Domain Specific Architectures and Accelerators***
- ***Wide range of fabrication nodes / technologies***





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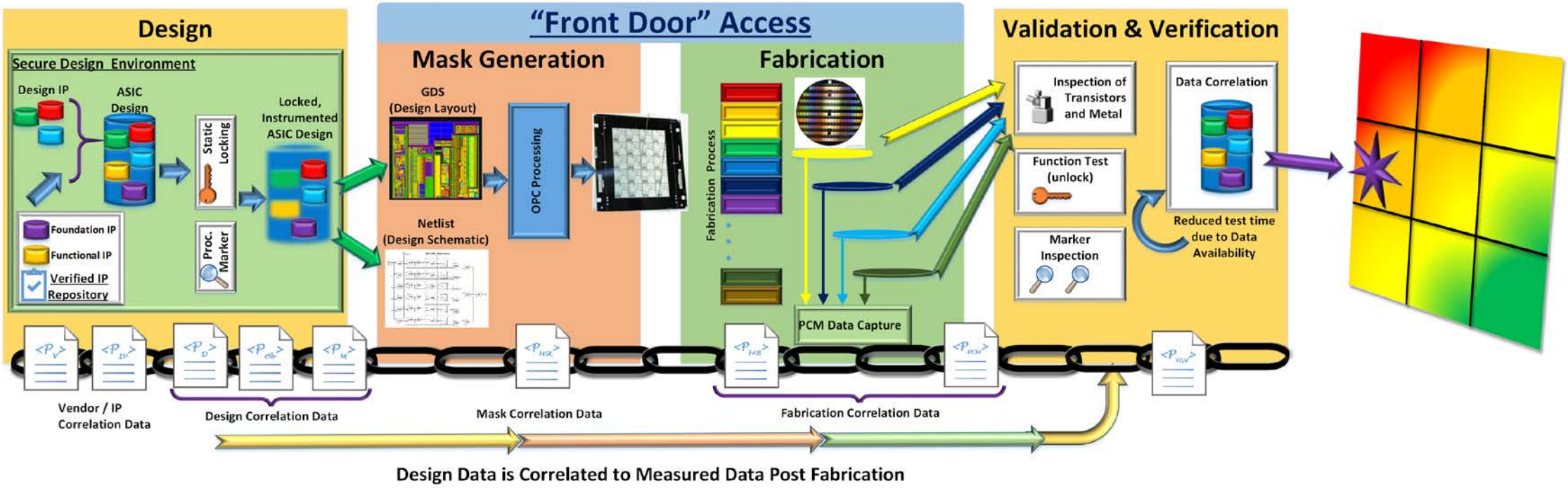
Facilitating Assured Access to State-of-the Art Microelectronics

- Quantified Assurance: data-driven approach to quantify risk associated with implementing microelectronics components across the lifecycle



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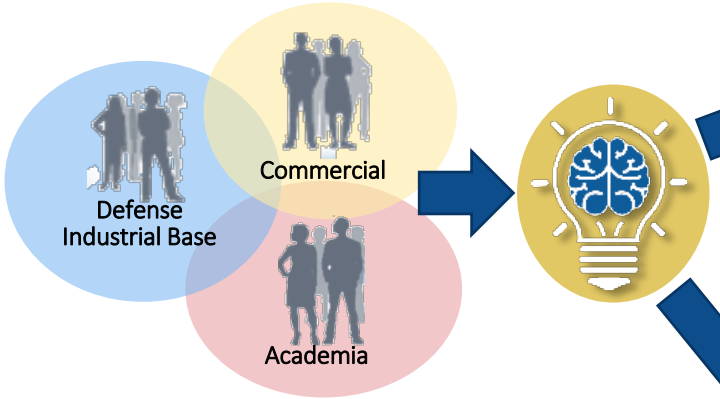
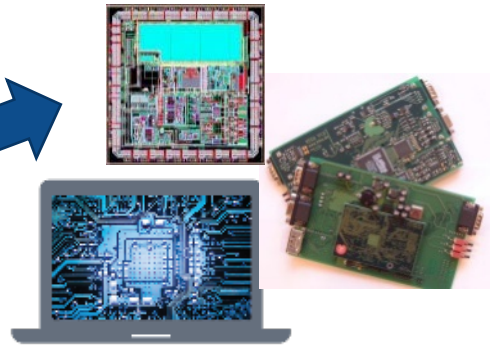
MINSAV Scope

Link commercial, academia, and Defense Industrial Base partners



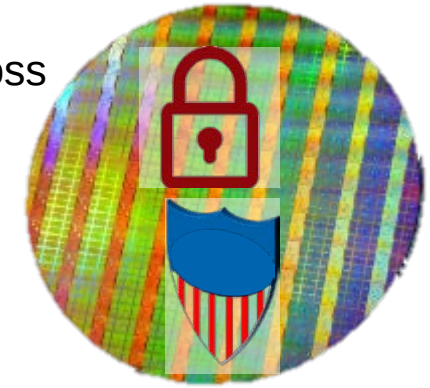
Construct prototype systems



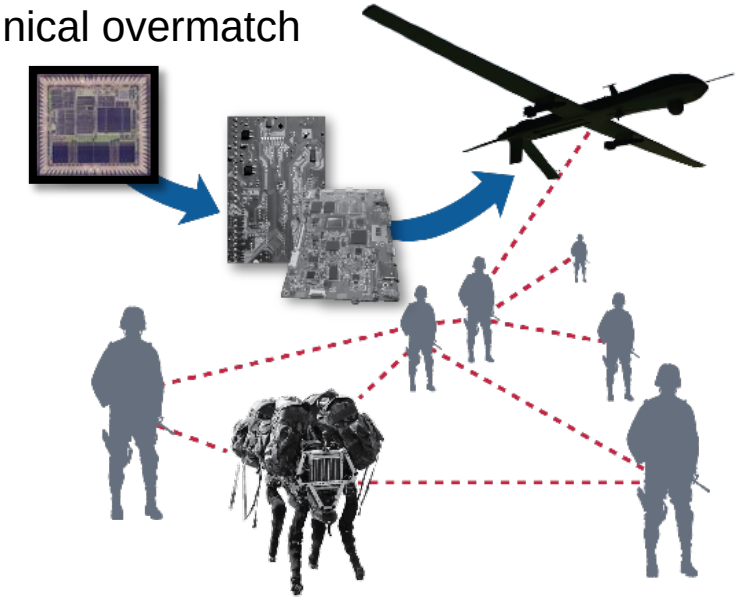
Demonstrate technical offset

Protect from technology loss

Protect from modification



Rapid system modernization for continued technical overmatch



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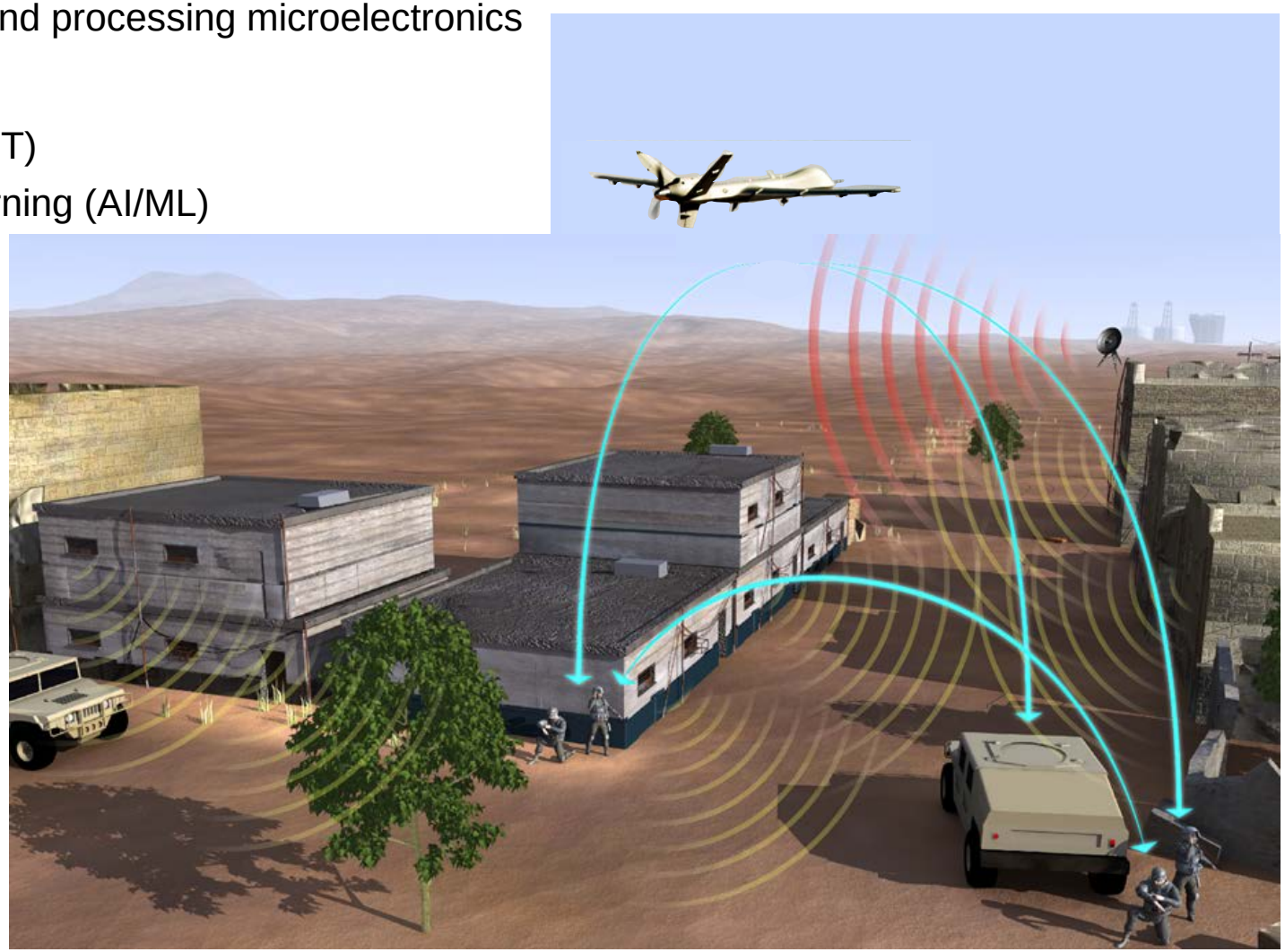
MINSAV – Objectives

- Design and fabricate signal generation and processing microelectronics
- Demonstrate offset in:
  - Position Navigation and Timing (PNT)
  - Artificial Intelligence / Machine Learning (AI/ML)
  - Autonomy
  - Communications
  - Electronic Warfare
  - Data Processing
  - Spatial / Spectral Agility (SSA)



Source: DARPA

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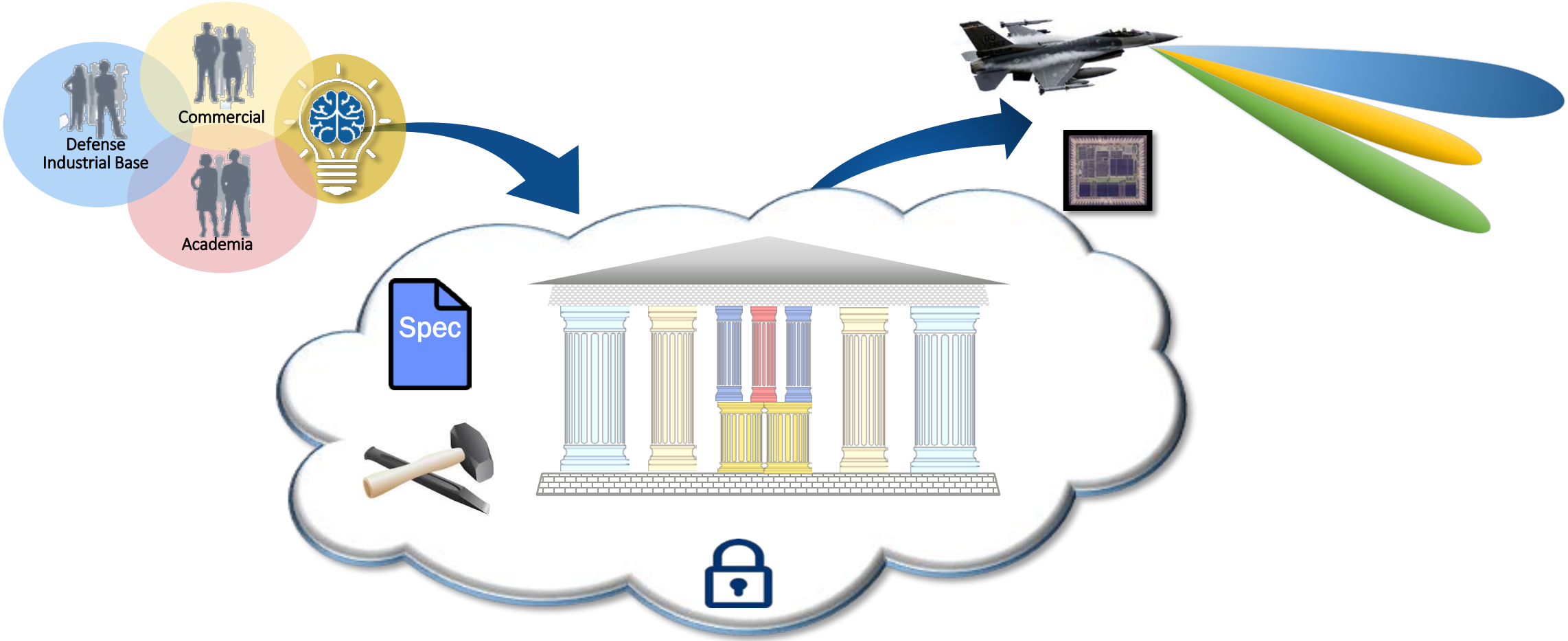
MINSAV – TASK 1

- Develop, Demonstrate and Prototype specialized next-generation disruptive microelectronics technologies



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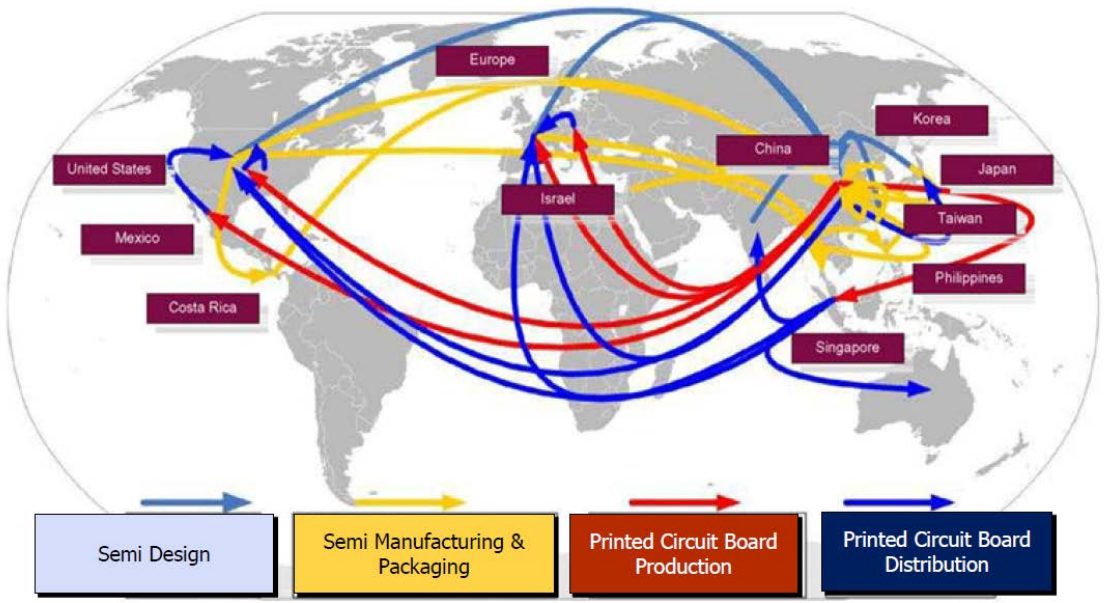
MINSAV – TASK 2

- Capture and secure microelectronics R&D and prototyping in a U.S. ecosystem with provenance and traceability



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MINSAV – TASK 2

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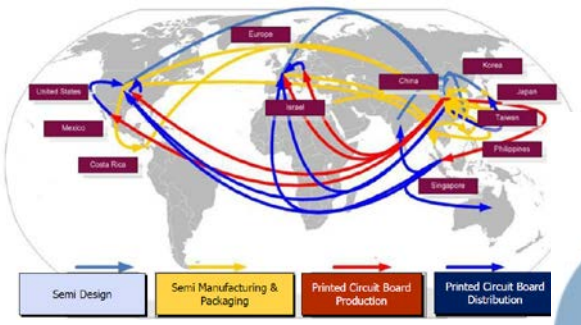

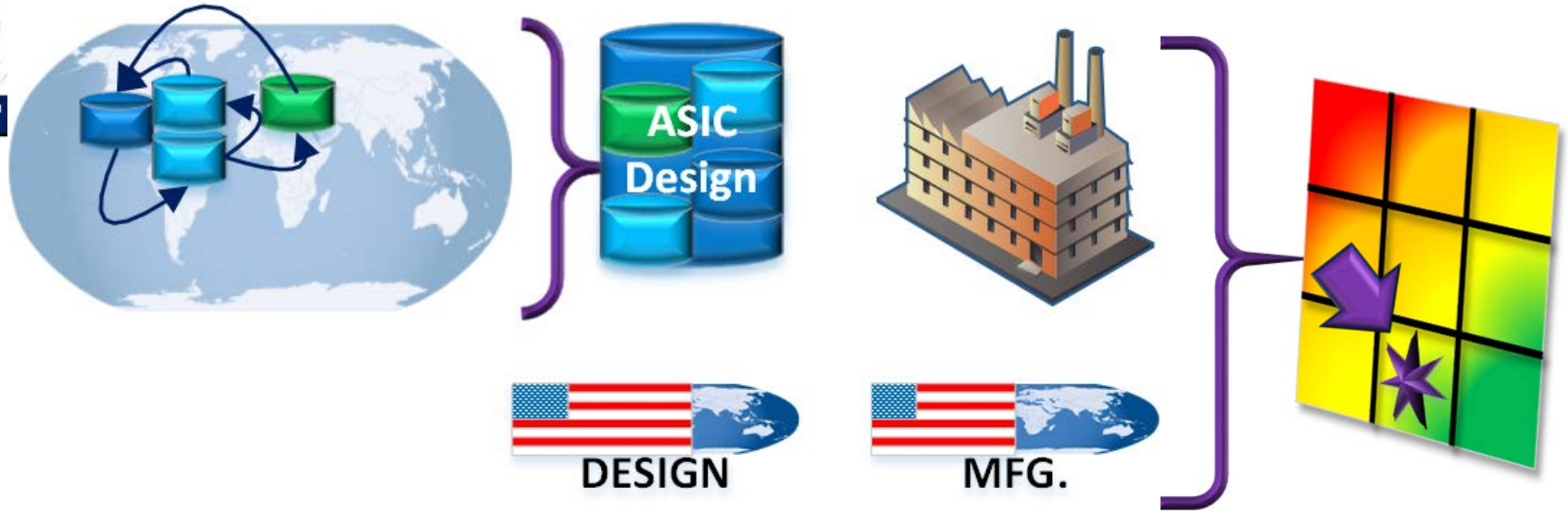

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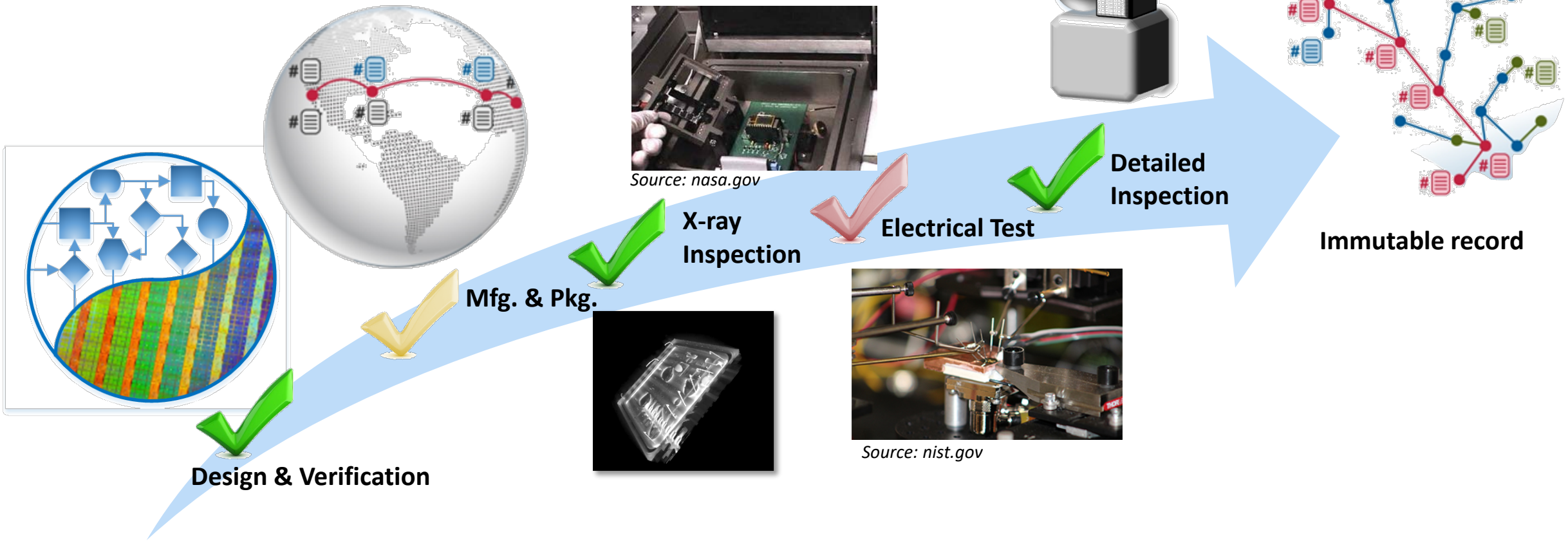
MINSAV – TASK 3

- Develop, Demonstrate, Prototype and Insert new microelectronics capabilities with assurance as a market differentiator
- Commercially realizable assurance solutions provided to the DoD



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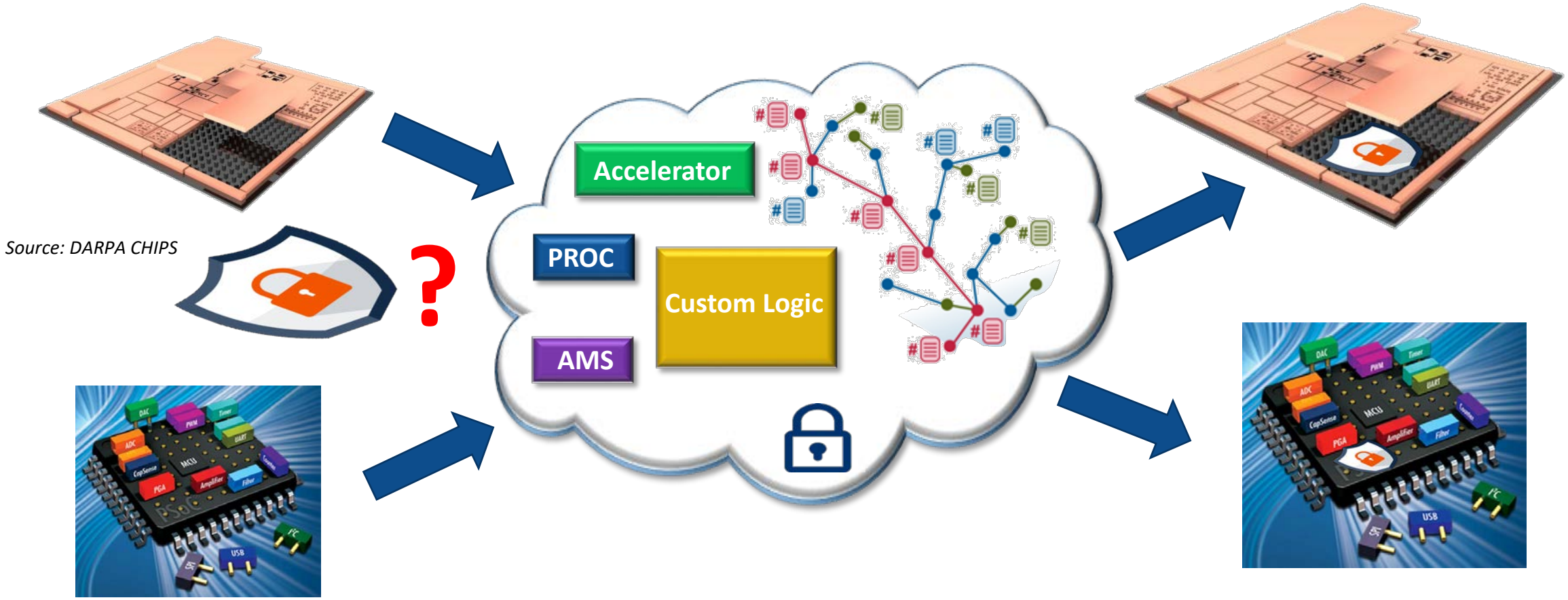
MINSAV – TASK 4

- Co-develop and prototype Commercial Off The Shelf (COTS) programmable Integrated Circuits (IC) and Intellectual Property (IP)



Source: DARPA CHIPS

Source: Cypress Semiconductor

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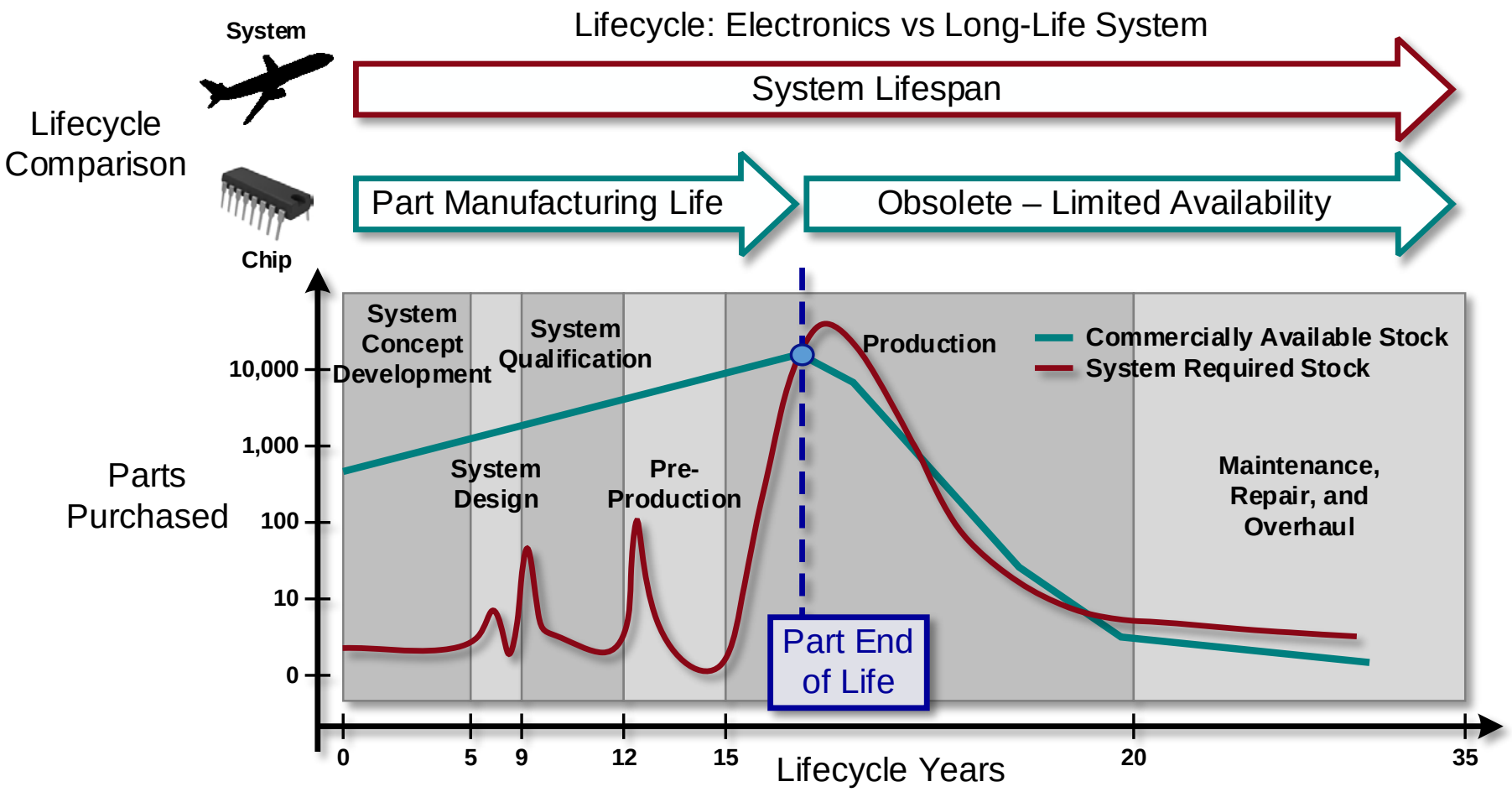
MINSAV – TASK 5

- Microelectronics Modernization: Replace obsolete microelectronics using State-of-the-Art designs to reduce lifecycle cost and risk



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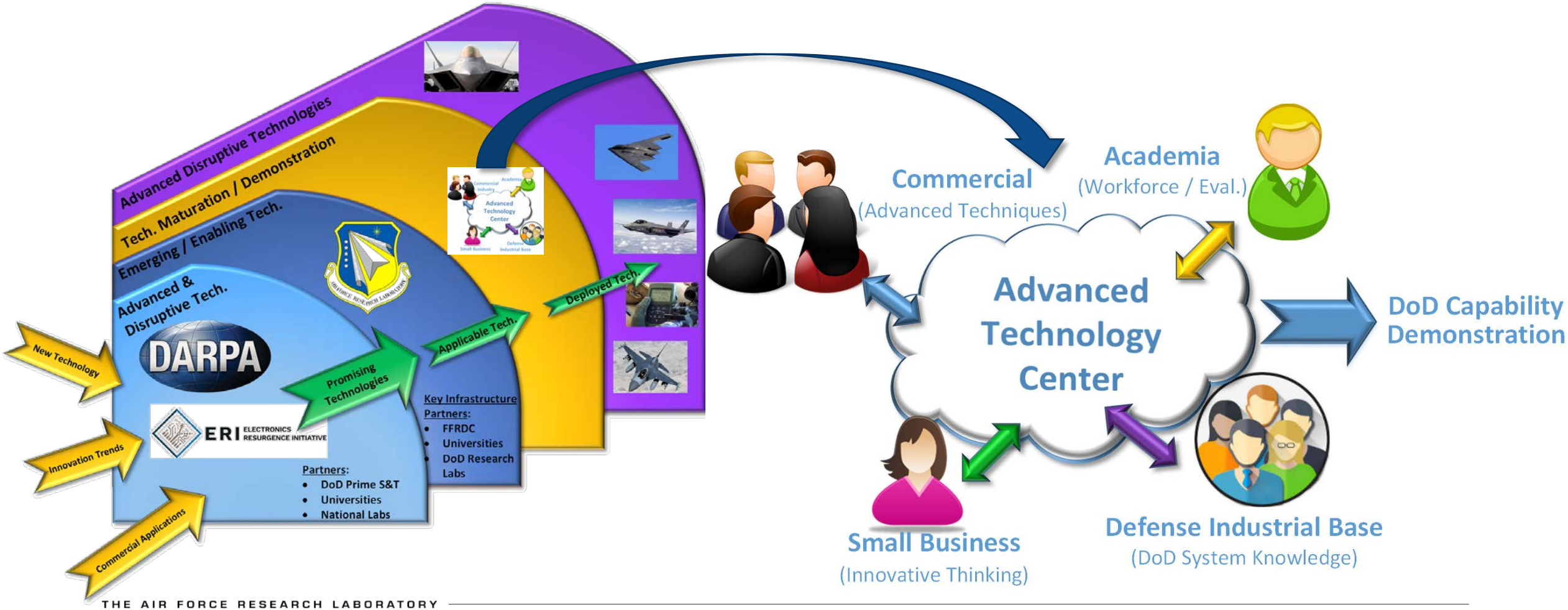
MINSAV – TASK 6

- Innovation hubs and Advanced Technology Centers (ATCs) for rapid development and prototype demonstration of advanced microelectronics technologies for defense systems



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MINSAV
Contracting Overview

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Contracting Overview

Advanced Research Announcement (ARA) vs. Broad Agency Announcement (BAA)

ARA

- 10 USC 2373 (Non-FAR)
- Budget Activity (BA) 6.4 and above
- No Assistance Awards
- Can be used to award FAR-based contracts and Other Transactions (OT) pursuant to 10 USC 2373 or 10 USC 2371(b))
- Technology Readiness Level (TRL) 6 and above
- Authority extends beyond AFRL programs of past
- Design/Prototyping* and Test/Experimentation to develop best supplies needed for national defense

BAA

- FAR 35
- Budget Activities 6.1 - 6.3
- Assistance Awards Allowed
- Up to TRL Level 5

* Prototypes should be acquired in the minimum quantities necessary for experimentation, evaluations, and assessment.

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Contracting Overview

MINSAV ARA with Calls

- Total estimated program value is $800M.
- Multiple awards anticipated, ranging from $10M to $200M.
- Program is unclassified.
- Foreign participation is not anticipated, however, will be determined for each call.
- Soliciting white papers/proposals through One-Step or Two-Step calls until 01 October 2024.
- All requirements listed within the basic ARA announcement are considered applicable to each call, unless otherwise indicated.
- No limits on the number of white papers/proposals an offeror may submit.
- Government reserves the right to award some, all, or none of the proposals.
- **No classified submissions!**

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Contracting Overview

MINSAV ARA with Calls

- White Papers (Two Step) will be reviewed to address whether they have the potential to meet the AF's needs based on criteria detailed in the ARA Solicitation/Call. Requests for Proposals (RFP) will be issued to those that have been determined to meet.
- Proposals (One Step/Request for Proposal) will be reviewed through Peer or Scientific Review, using criteria detailed in the ARA Solicitation/Call, and categorized* as Selectable or Not Selectable.
- Other Transactions (OT), Cost Plus Fixed Fee (CPFF) contracts, or other cost type contracts are anticipated under this ARA.

* When the Government elects to award only a part of a proposal, the selected part may be categorized as Selectable, though the proposal as a whole may not merit such a categorization.

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Contracting Overview

Other Transactions (OT)

- Under certain circumstances, OTs may be used as the acquisition instrument for prototype projects directly relevant to accomplish mission effectiveness of military personnel and the supporting platforms, systems, components, or materials proposed to be acquired or developed by the DoD, or improvements of platforms, systems, components, or materials in use by the armed forces.
- Generally, not subject to the federal laws and regulations governing procurement contracts.

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Contracting Overview

Perceptions of OT

- Removes rigidity of traditional Government procurement
- Commercial-like in nature - both parties write and negotiate* terms vs. use of the FAR
- Allows performer to negotiate more-favorable intellectual property rights
- Attractive to contractors looking for elasticity in their agreements
- Nimble where traditional Government contracts are not
- Allows performers to use their own accounting systems (GAAP)
- No cost or pricing data requirement

* negotiations can be time consuming

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Contracting Overview

MINSAV ARA with Calls

REMINDERS

- ✓ **Cost Proposal must include**:
  - All direct costs as well as indirect costs by contractor fiscal year and in summary for the entire effort
  - Further cost breakdown and summary by individual task area to allow for partial awards
  - Subcontractor proposals and detailed subcontractor analyses (IAW FAR 15.404-3(b)).
  - Any current rate agreements/recommendations
  - All supporting pricing backup for material, travel, etc.
  - Small Business Subcontracting Plan (if applicable)
- ✓ **Deliverables are anticipated on calls to include:**
  - Hardware (including prototypes), Software, and Data (See Model Contract CDRLs)
- ✓ **Data Rights:**
  - Unlimited are desired but will be negotiated on a call-by-call basis
  - Must include desired assertions in detail within proposals

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Contracting Overview

MINSAV POCs

- **Technical Questions:**
  Stacie Smith-Turner (Program Manager) stacie.smithturner@us.af.mil

- **Contracting Questions:**
  Dawn Dalhamer (Contracting Officer) dawn.dalhamer@us.af.mil and
  Jennifer Skalski (Contract Specialist) jennifer.skalski@us.af.mil

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Questions?

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Advanced Technology Center for Data Processing (ATC-DP)

CALL 1

Processing Sensor Data at the speed of relevance

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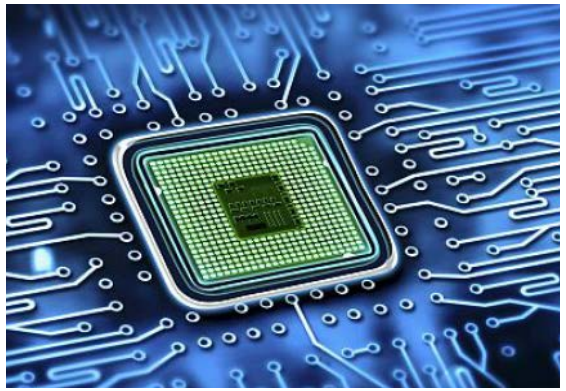
CALL 1 INFORMATION



- **Call Name:** Advanced Technology Center for Data Processing (ATC-DP)
- **Estimated Call Value:** $150M
- **Call Summary:** ATC-DP creates an advanced microelectronics technology center that leverages state-of-the-art microelectronics to process the large streams of sensor data produced in modern weapons systems. The center will support demonstration and experimentation projects for advanced microelectronics in military-relevant systems. The goals are:
    - The center designs and procures the best microelectronics supply via teaming between commercial experts, members of the Defense Industrial Base (DIB), government, and academic researchers.
    - Design and evaluate experimental prototypes of military-relevant sensor systems that illustrate differentiation achieved through use of advanced microelectronics.
    - Enable defense system application of the best microelectronics technologies through protection technologies that prevent exposure of sensitive design information during the fabrication process
    - Demonstrate monitoring structures for experimental assessment of the integrity of microelectronic device post fabrication
    - Develop US-based state-of-the-art microelectronics expertise

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Advanced Technology Center for Data Processing (ATC-DP)

CALL1

State-of-the-Art microelectronics based military-relevant prototype demonstrators

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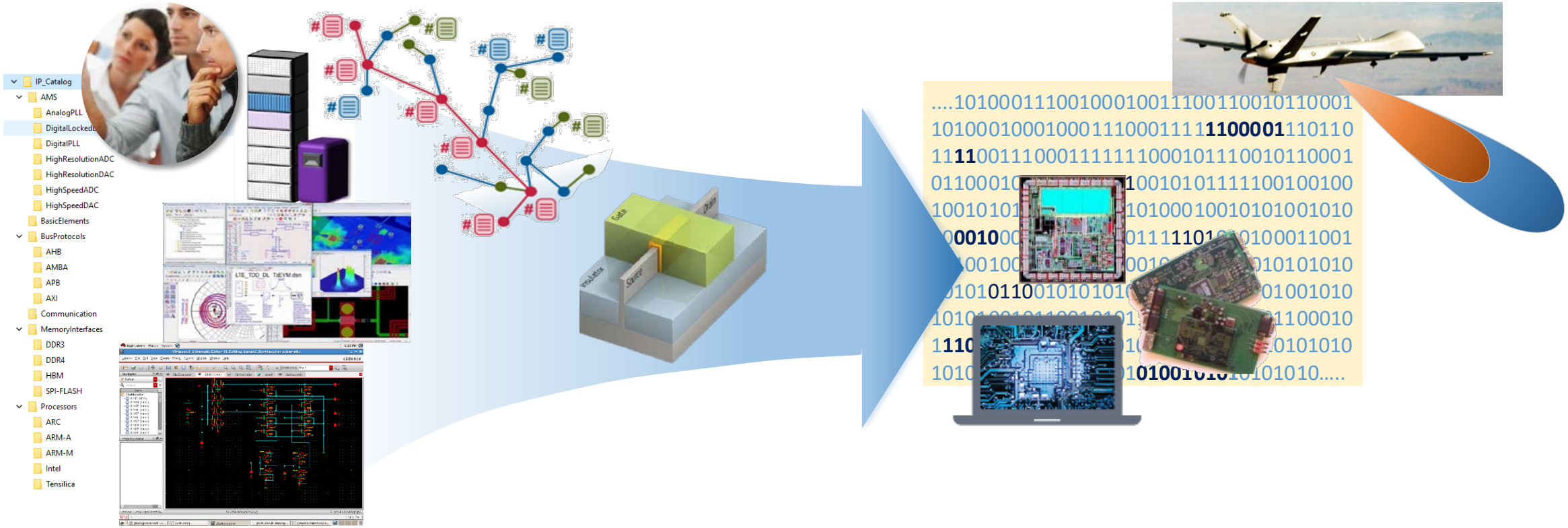
Overview

- Enable **assured access** to advanced and **future semiconductor technologies**, developing and demonstrating commercial and DoD developed **novel processing accelerators**, and providing DoD programs and the DIB with the infrastructure, tools, and Intellectual Property (IP) to construct **prototype systems**



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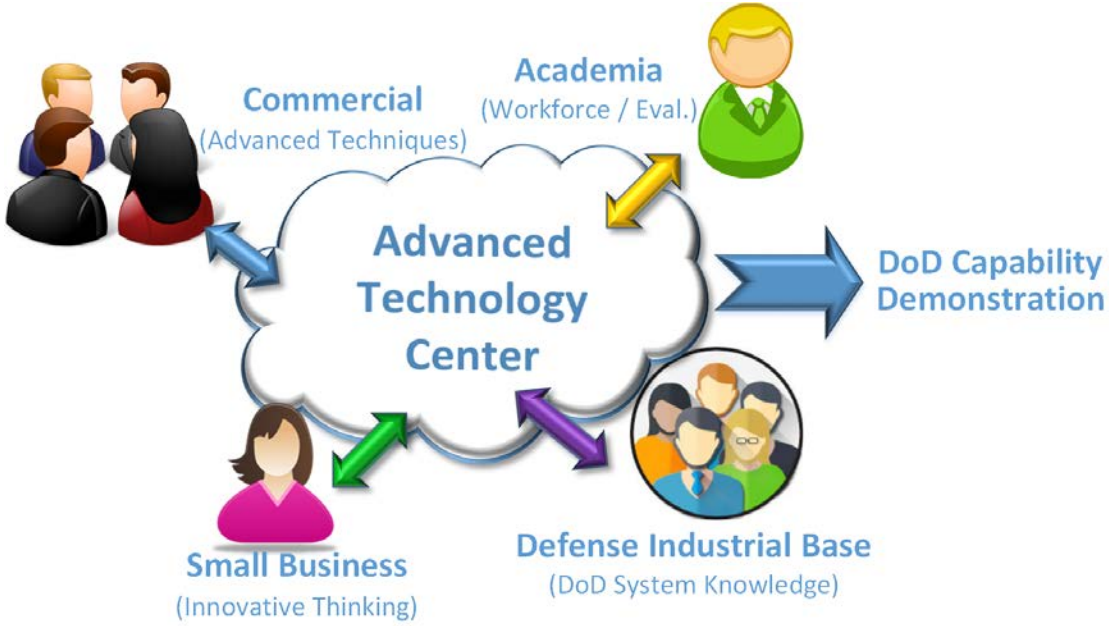
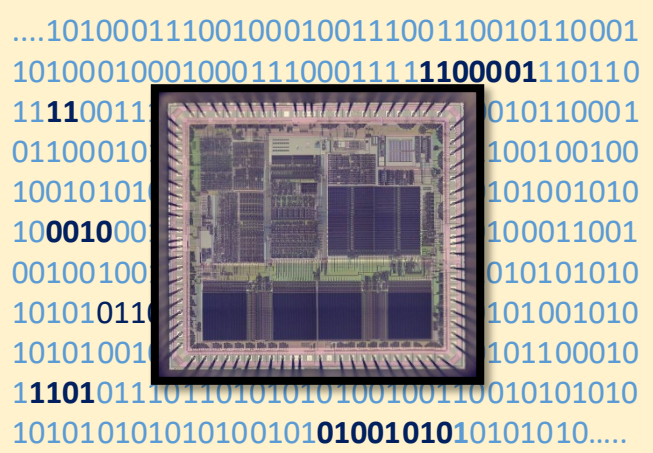
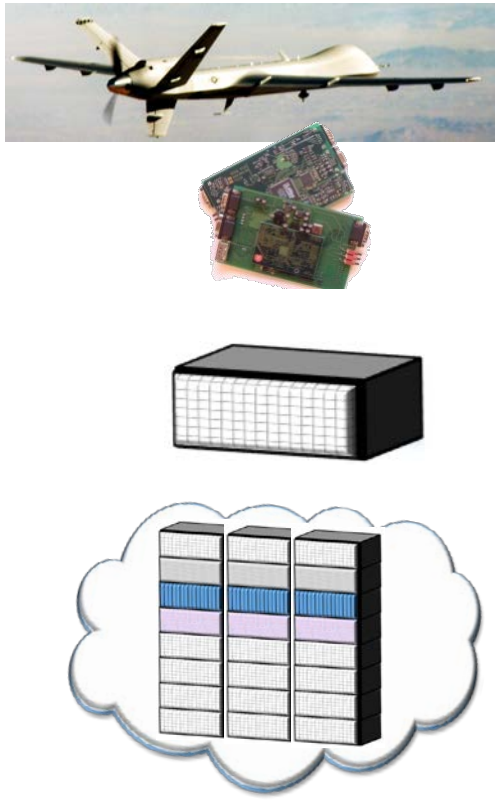
Objective

The objective of the Advanced Technology Center for **Data Processing** (ATC-DP) effort is to design new **military-relevant prototype demonstrators** that leverage **state-of-the-art microelectronics** to provide differentiating capability for DoD applications. These demonstrators express data processing algorithms in SOTA microelectronics to provide **computational offset** at the sensor edge, data aggregation, and cloud processing nodes.







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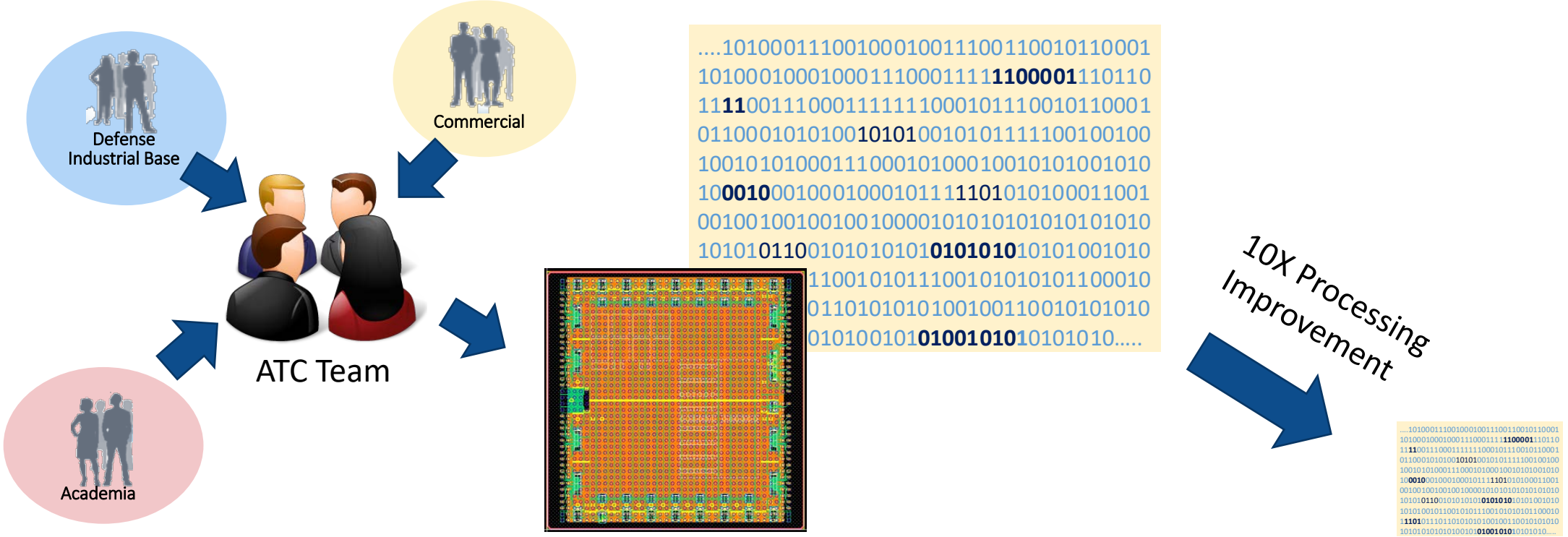
Task 1 – Develop Prototype SOTA Microelectronic Components

- The contractor shall design, develop, and implement **military-relevant prototype component designs** using state-of-the-art microelectronics technology (i.e. ≤ 22nm technology node) that highlight the differentiating capability of the use of advanced microelectronics. The contractor shall construct **advanced microelectronics development teams** consisting of commercial, DIB, government, and academic partners.



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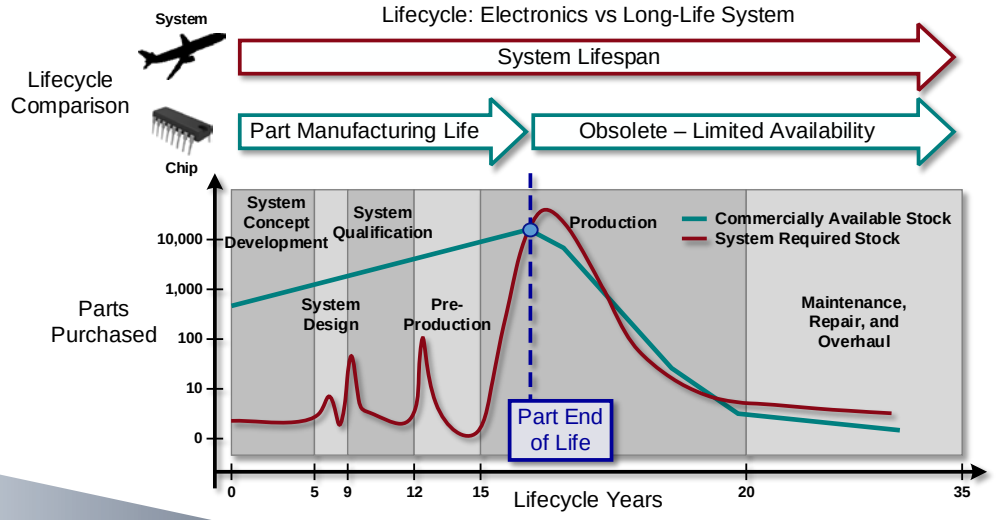
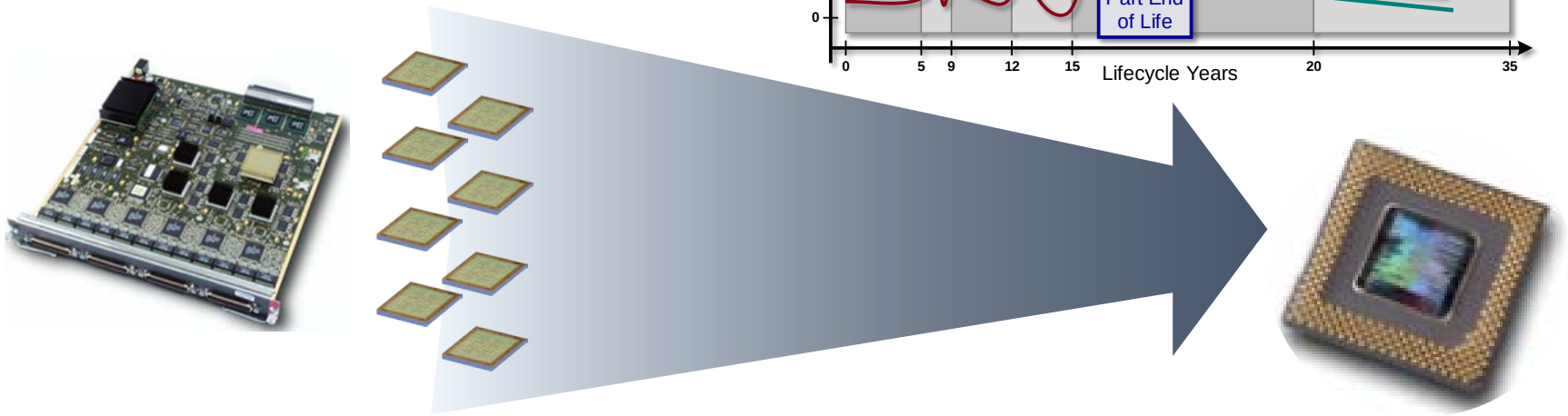
Task 2 – Develop Prototype SOTA Microelectronics for Obsolescence Mitigation

- The contractor shall design, develop, and implement component designs using **SOTA microelectronics technology to mitigate component obsolescence** for DoD systems. The contractor shall construct designs to modernize obsolete components or specialize Commercial off the Shelf (COTS) components for economics, performance, or assurance.



Legacy/Obsolete (Multiple) Boards and Components



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Modernization Opportunities – Aircraft in service

A-10 – 47 yrs (1972)

B-1B – 45 yrs (1974)

B-2 – 28 yrs (1989)

B-52 – 67 yrs (1952)

C-130 – 65 yrs (1954)

C-5 – 51 yrs (1968)

E-3A – 47 yrs (1972)

F-4 – 61 yrs (1958)

F-15 – 47 yrs (1972)

F-16 – 45 yrs (1974)

KC-135 – 63 yrs (1956)

F-5/T-38 – 60 yrs (1959)

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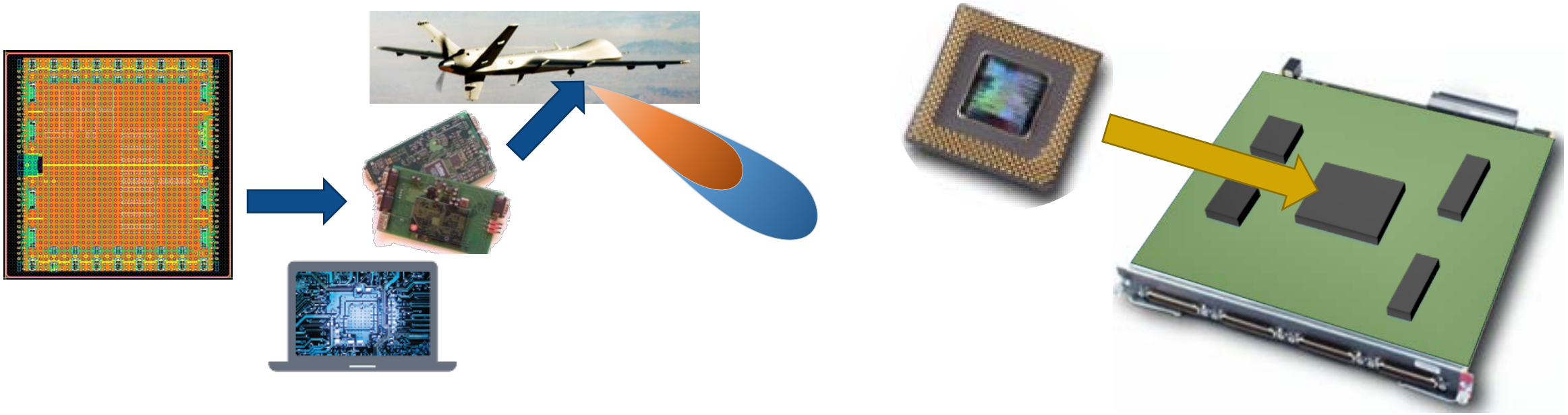
Task 3 – Construct System Demonstrators for Rapid Insertion

- The contractor shall construct military system demonstration prototypes that implement designed SOTA microelectronics. The contractor shall demonstrate 10x differentiation achieved in one or more figures of merit (i.e. power, performance, area) in the system based on the application of SOTA microelectronics to an existing system.
- Create Exemplars of Use of SOTA Electronics in Systems Used by Programs of Record
- Construct Demonstrators that Mitigate Obsolescence Supply Chain Risk for Sustainment



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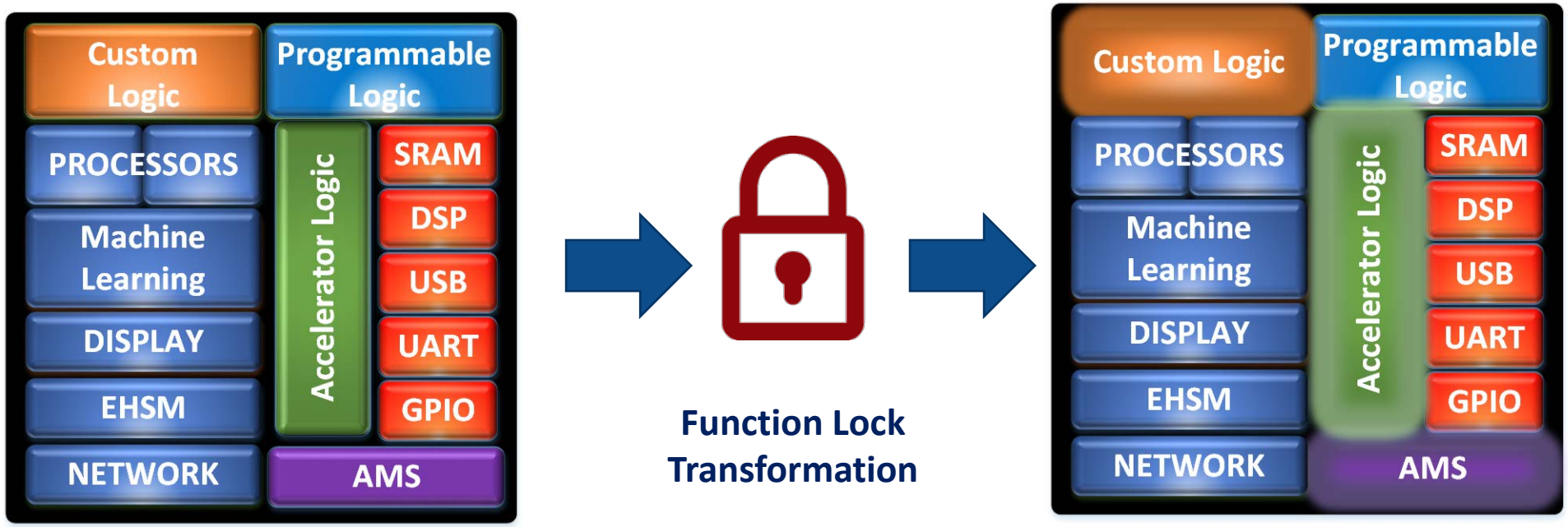
Task 4 – Develop and Evaluate Function Locking Technologies

- The contractor shall construct and implement protection techniques that **lock design function** to **prevent exposure of sensitive information** during the fabrication process. The contractor shall implement protection techniques to significant portions of a range of design types and **produce netlists and layout databases for evaluation**. The contractor shall **evaluate the protection** achieved and provide an analysis for the design types that quantifies the level of protection.



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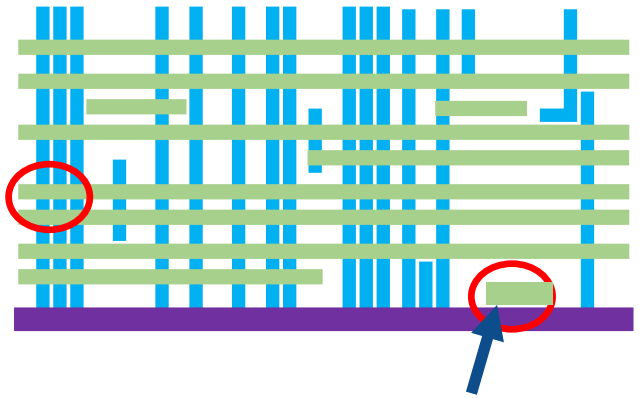
Task 5 – Demonstrate and Evaluate Fabrication Integrity Structures

- The contractor shall create, design, and implement a range of **inspection structures** that provide **assessment of the integrity** of both the **front end and back end of microelectronic fabrication**. The contractor shall devise means of testing these structures by probing and by on-chip test infrastructure and create quantified correlation measures that define the **resolution and accuracy of each integrity assessment method**. The contractor will fabricate the structures, test and evaluate the resolution, and analyze and quantify the resolution and accuracy provided by the test structures.

Design



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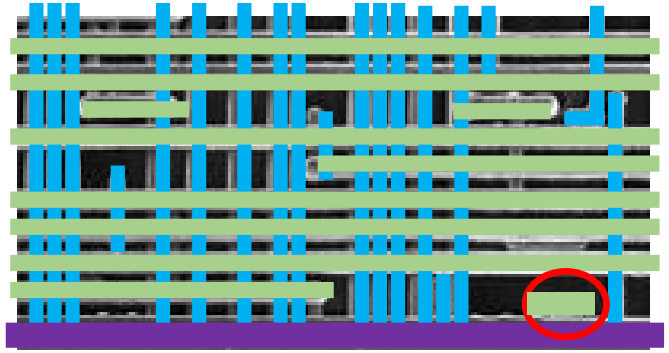
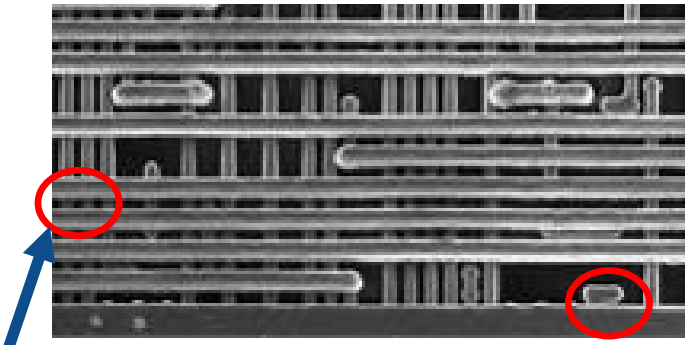


As Fabricated



Is spacing what it should be?

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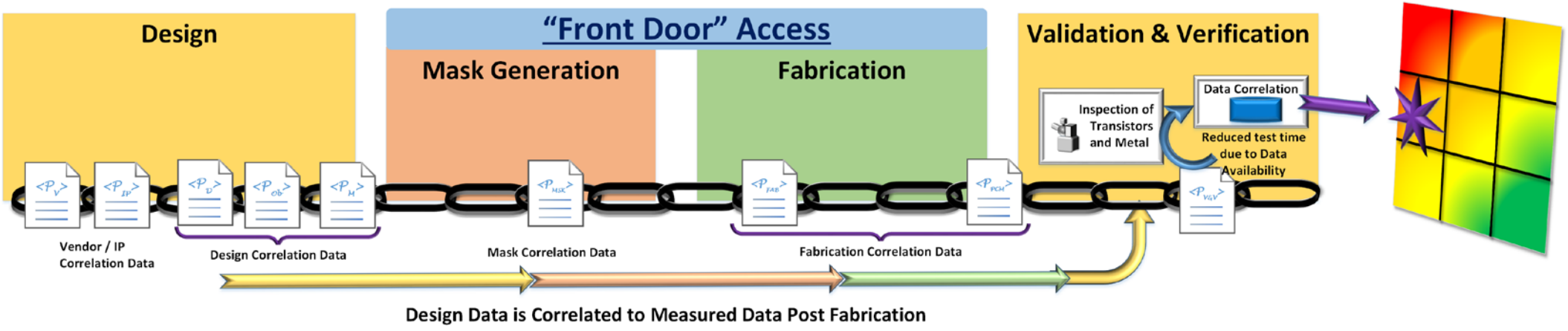
Task 6 – Construct Component Lifecycle System with Full Traceability and Provenance

- The contractor shall construct a **component lifecycle system** that provides full traceability and provenance through the design, manufacture, package, test, provisioning, and validation and verification stages of component life. The contractor shall implement a system that maximizes the use of **economically feasible commercial assurance practices** that are enhanced to support DoD needs and **show a relevant business purpose outside of the DoD**. The contractor shall implement a system that supports multi-classification component development and provides data access infrastructure for generation of assessments, metrics, and quantification of supply chain risk.



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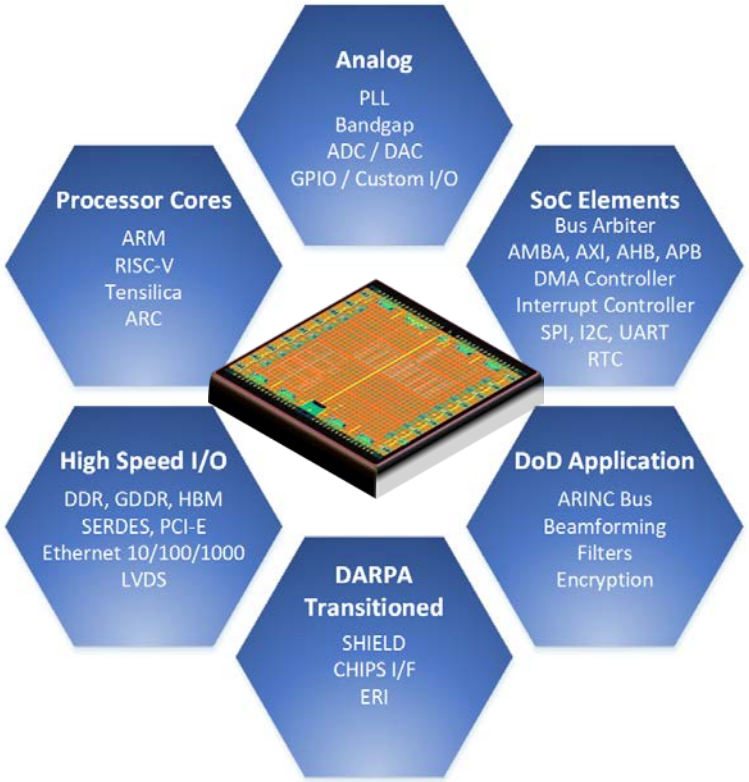
Task 7 – Produce Vetted and Qualified Libraries of Design IP

- The contractor shall produce and capture in a repository **functionally vetted and silicon qualified libraries of design Intellectual Property** (IP). The contractor shall capture the software, scripts, Hardware Description Language (HDL) files, and configuration settings for the IP verification, design, physical implementation, and the test and validation infrastructure for **IP designs in at least three (3) SOTA technology nodes**.



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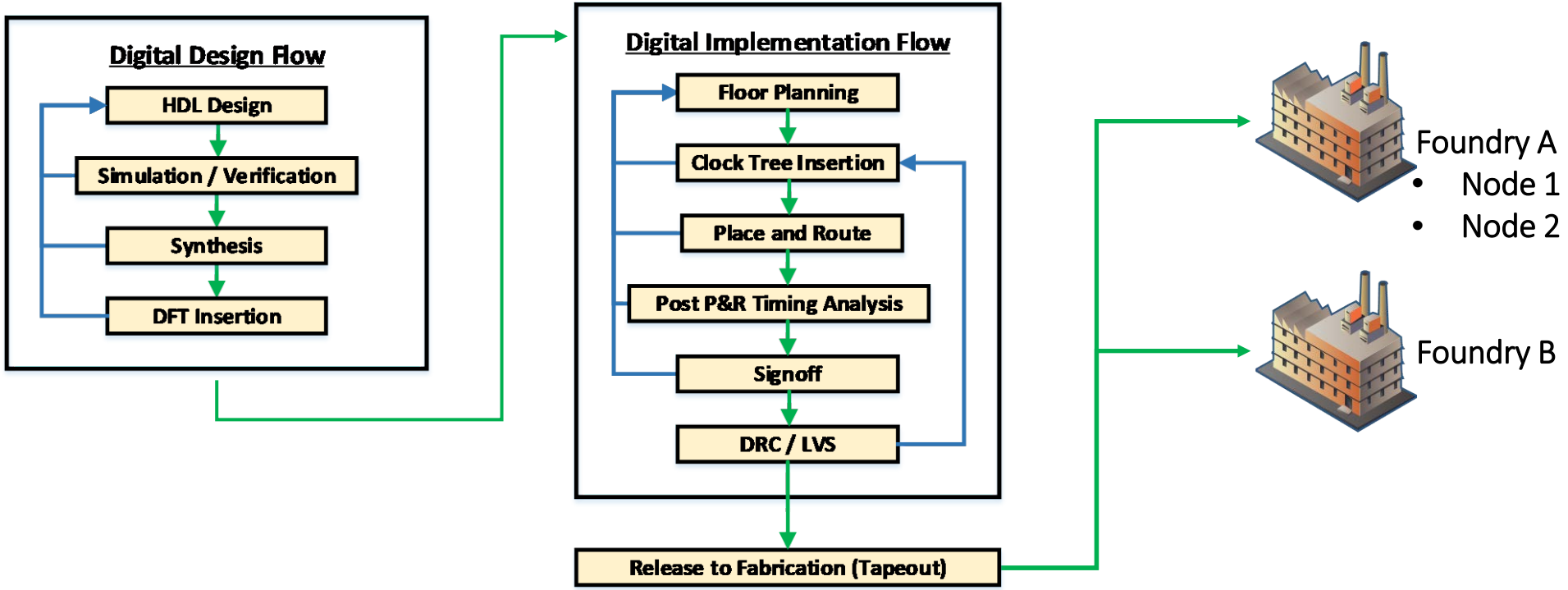
Task 8 – Construct SOTA Foundry Design and Implementation Flows

- The contractor shall construct foundry design and implementation flows for **at least three (3) SOTA technologies in at least two (2) different US-based foundries**. The contractor developed flow shall make Electronic Design Automation (EDA) tools, design platforms, and IP portable between foundries. The contractor shall **capture flow software, scripts, and methodology documentation** in a repository that can be made widely available to DoD microelectronics developers.



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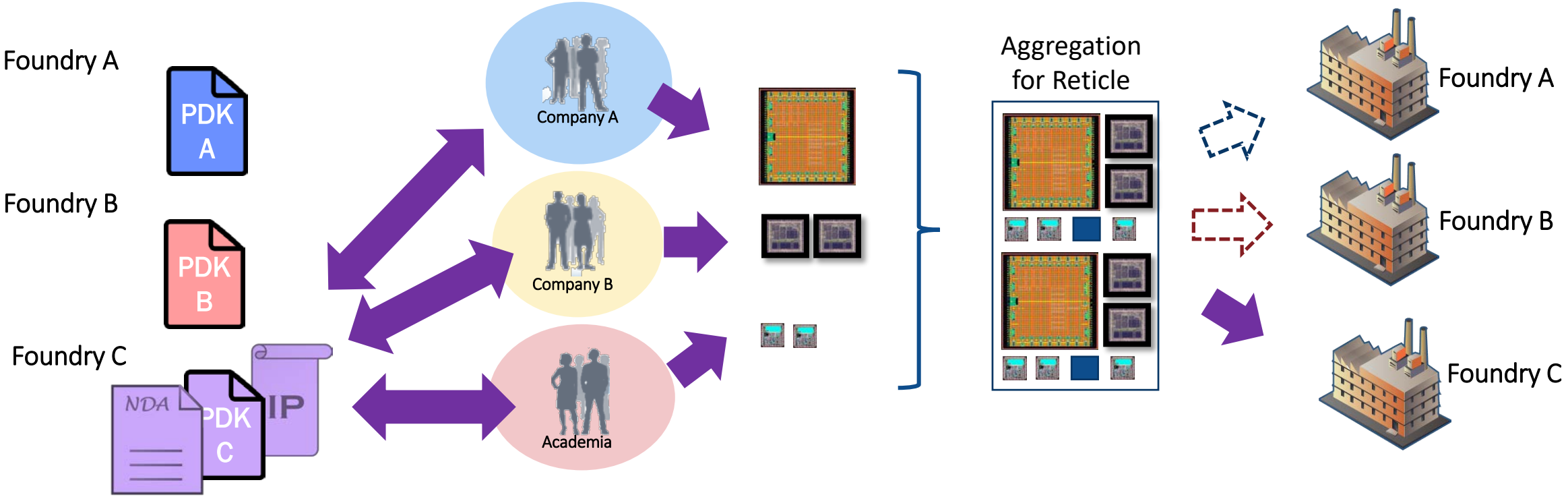
Task 9 – Construct a Multi-Foundry SOTA Access Model

- The contractor shall develop a front-door, multi-foundry access model for SOTA US-based microelectronic fabrication services. The contractor shall construct a model that provides Multi Project Wafer (MPW) fabrication runs and pre-negotiated Non-Disclosure Agreements (NDAs) for access to foundational digital Intellectual Property (IP) and Process Design Kits (PDKs). The contractor shall provide a model that enables aggregation of designs for MPW fabrication with all associated backend design capabilities.



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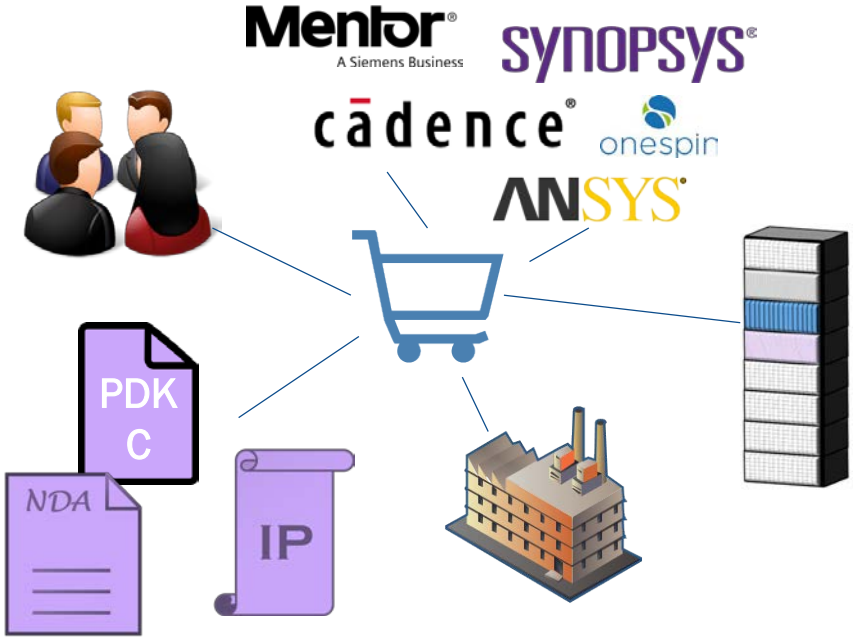
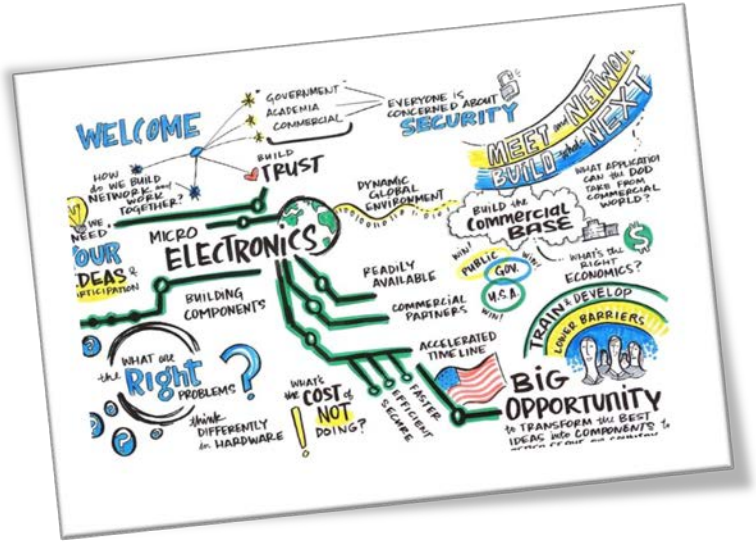
Task 10 – Instantiate Microelectronics Development Marketplace

- The contractor shall instantiate a **development marketplace** that serves as a pipeline to implement innovative ideas and novel technologies in SOTA microelectronic nodes by traditional DoD and non-traditional performers. The contractor shall **develop and implement business models for access to facilities, infrastructure, tools, services, and expertise required to express ideas** in SOTA microelectronics. The contractor shall establish models for sharing assurance and protection tools and techniques to facilitate wide adoption. The contractor shall develop prototype standards for assurance and protections





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Task 11 – Develop US-Based SOTA Microelectronics Persistent Expertise

- The contractor shall develop and implement a **plan to develop a U.S. Citizen-based persistent expertise in SOTA microelectronics**. The contractor shall develop relationships with university participants in the ATC-DP that **increase the number of U.S. students** participating at the university in microelectronics-related disciplines. The contractor shall provide metrics demonstrating the increase in U.S. persons participating in microelectronics due to the imp

Source: fbi.gov

"The knowledge worker … is the key to economic growth and economic performance in todays society."
– Peter Drucker

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Advanced Technology Center for Data Processing (ATC-DP)

Contracting Overview

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Contracting Overview

CALL 01 – ATC-DP

- Two-Step Solicitation
  - First Step: White Papers (10 page limit) are due **31 October 2019, 5:00pm EST**.
  - Second Step: Proposal due date and time will be provided in resulting Request for Proposals.
- One (1) award is anticipated; Other Transaction (OT), Cost Plus Fixed Fee (CPFF) contract, or other cost type contract.
- Estimated award value is $150M.
- Anticipated award date is 30 May 2020.
- Call is subject to Export Contract (International Traffic Arms Regulation (ITAR)).
- Base support is not anticipated.
- Network access will be required for call.
- Unlimited data rights are desired.
- **No classified submissions!**

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Questions?

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