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Enabling the delivery and sustainment of secure and resilient capabilities to the warfighter and international partners quickly and cost-effectively

Better, Faster, Cheaper DoD Systems Through Commercial Electronics Design Best Practices

Leveraging the DoD Agile Electronic Hardware Emulation and Design Center and Tensilica To Realize The DoD AI Vision

J.S.B.Chew ***Senior Global Group Director***

Chair, NDIA S&ET Division

23 Mar 21

cadence®

Who Is Cadence

3,600+
R&D ENGINEERS

R&D INVESTMENT
$936M
(~40% of revenue)

1750+
FIELD ENGINEERING EXPERTS

PATENTS WORLDWIDE
1600+

US-based Company
HQ, San Jose
NASQ:CDNS
www.cadence.com
www.cadence.com/go/national-security

~$2.34B Revenue in 2019
~8100 Employees

26 GLOBAL DEVELOPMENT CENTERS

ONLY EDA Company Certified by DoD As A Trusted Supplier
https://www.dmea.osd.mil/otherdocs/AccreditedSuppliers.pdf

Making the World a Better Place Through Intelligent System Design
By Enabling First pass Success, Future Proofed Electronic Systems

Bottom Line Up Front

- **Cadence Design Systems (NASQ: CDNS) is an acknowledged leader in the Electronic Systems Design Enablement market**
  - Emulate Before You Fabricate
  - Intelligent Systems Design
  - We enable the Army's IVAS *(AI on the Edge)*

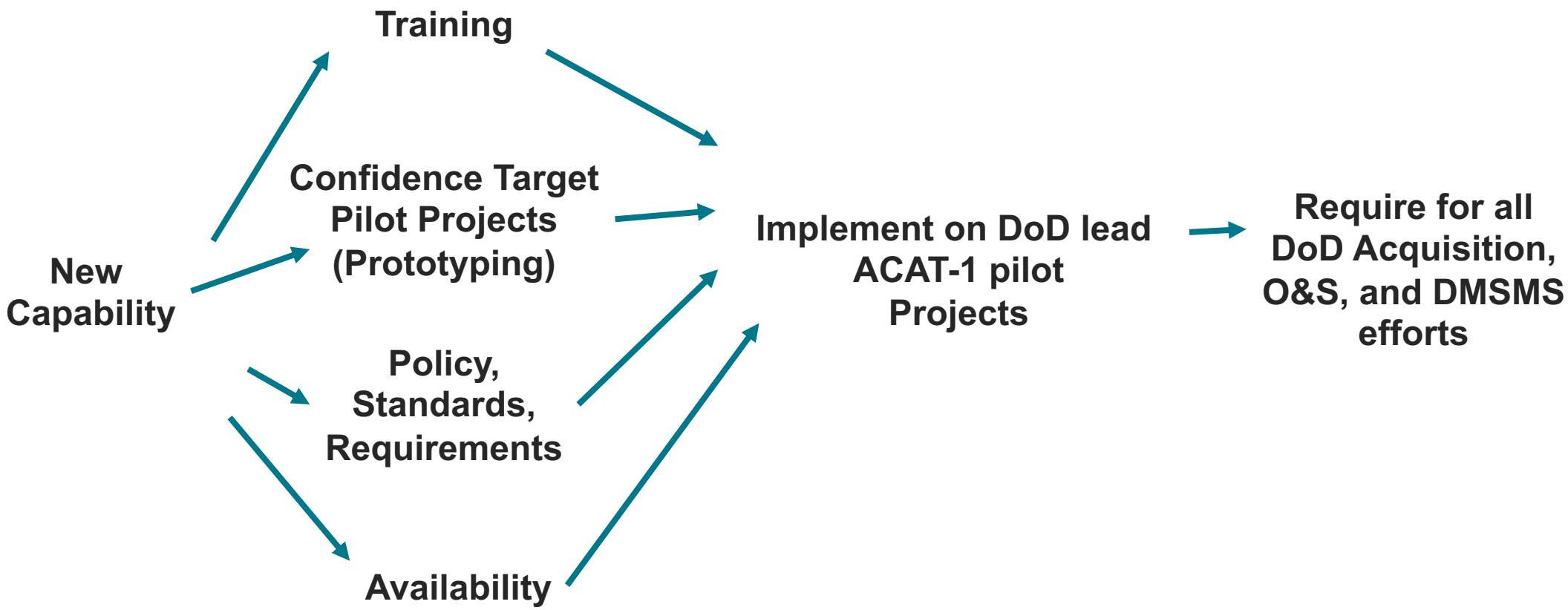
- **Since 2016, Cadence have been working to transition the Commercial Electronics Design Best practices to the DoD and Defense Industrial Base**
  - FY 17, FY 18 NDAA
  - National Defense Strategy
  - DoD funded pilot projects

- **DoD funded pilot projects has resulted in many "lessons learned"**
  - Identified deficiencies, challenges, and leverage points
  - Developed material to overcome and implement

- **If these "lessons learned" are leveraged, the DoD AI initiative can be accelerated and the quality of the finished product improved**
  - We want to help, in the appropriate fashion

Cadence brings a unique and exclusive insight in to this challenge

Process To Implement New Capability to DoD Acquisition



Anecdotal Observations on US AI Activity

- **Belief that AI/ML is a *Software* Solution Only**
  - AI/ML systems are a combination of customized HW and SW systems depending on application
    - How many DevSecOp Guys Does it take to change a lightbulb?
    - They don't – that's a hardware problem

- ***Most* US Electronic Manufacturers focus/core competency is in the communications aspect of the SOC/System; not in the AI/ML architectures**
  - Do not see an R&D Investment trend in AI for DoD

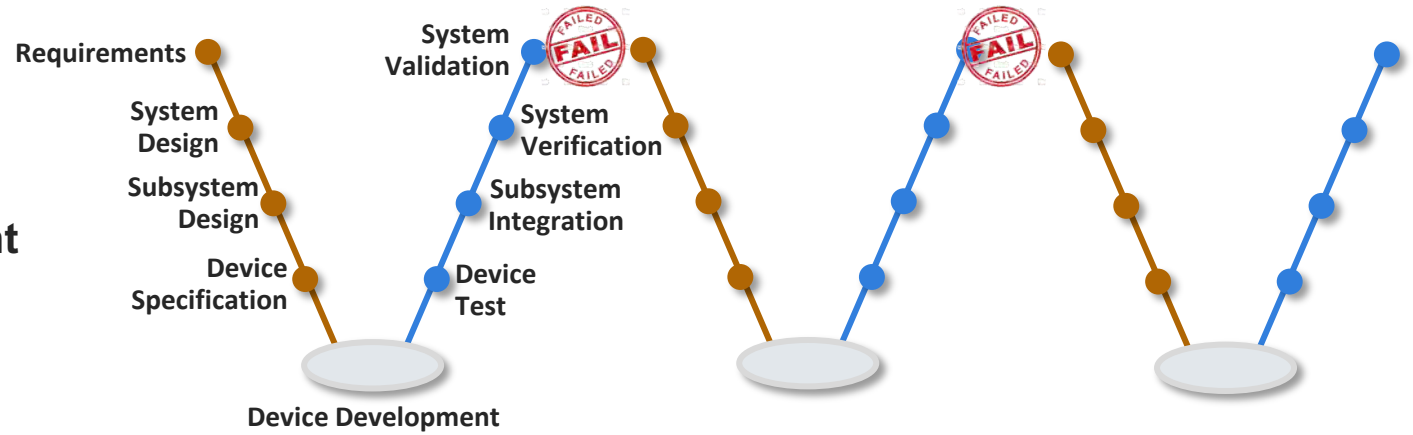
- **Lots of "R" funding, Not a lot of "D"**

- **Current *known* investment stems around Large/ Cloud based analytics/training applications**
  - Assuming huge platforms and data links

- ***Slim US focus on Edge based AI applications***
  - Will you have those data links during conflict?

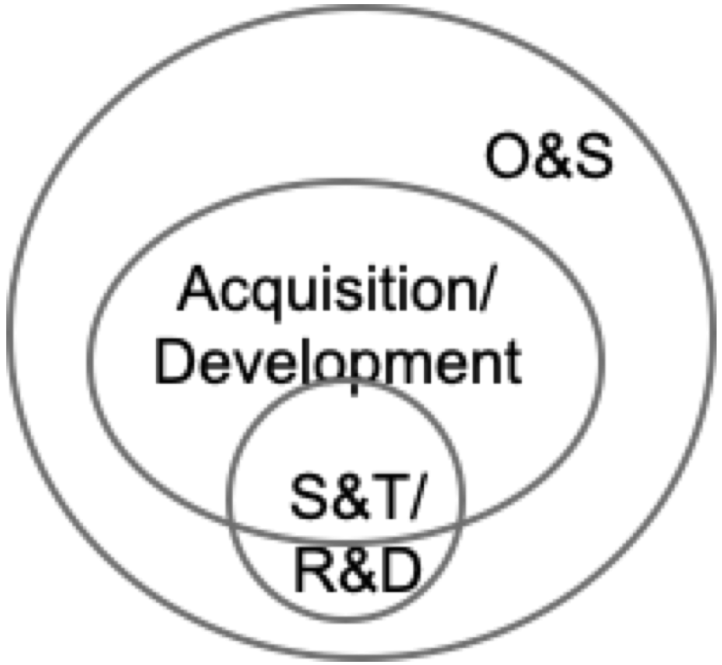
The DoD Acquisition/Development Culture
Cost Plus Fixed Fee

- **Build – Test – Rebuild - Test ...**
- **This process develops HARDWARE first , THEN SOFTWARE development starts**
- **Trainers developed after Prime Mission Equipment is built**
- **T&E performed AFTER Prototype Hardware/Prime Mission Equipment are Built**
- **Results in schedule slips and cost overruns**
- **Promotes performer culture of "Not Enough Time and Money To Do It Right, But Plenty Of Time and Money To Do It Over"**



Sustainment and Modernization NOT priority

The Commercial Electronic System Product Development Culture



- **Funded Internally**
- **Can’t Miss Christmas**
- **Emulate Before You Fabricate**
- **First Pass Success**
- **Sustainable and Modernizable at Launch**

“People who are really serious about software should make their own hardware”

- Alan Kay

How the Innovation Hub Can Advance the use of Edge Based AI To Ensure US Leadership

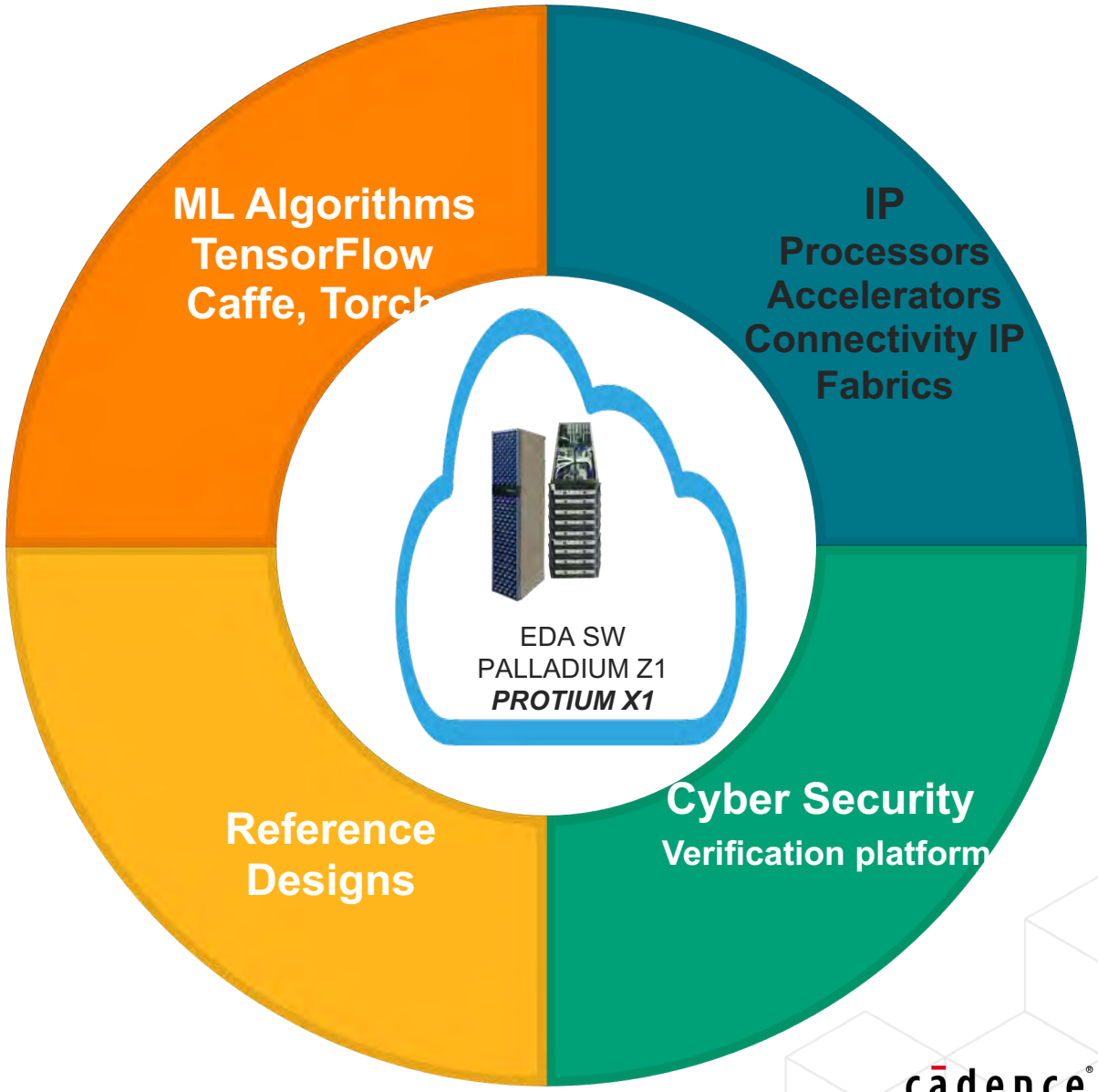
- **Provide an environment for both research and DEVELOPMENT of AI electronic systems and which address the needs of those Applications**
  - University (Research)
  - Start-ups (Development)
  - Govt Primes (Development)

- **Define key programs which can take advantage of AI Applications**
  - Target acquisition systems
  - Surveillance
  - Autonomous vehicles

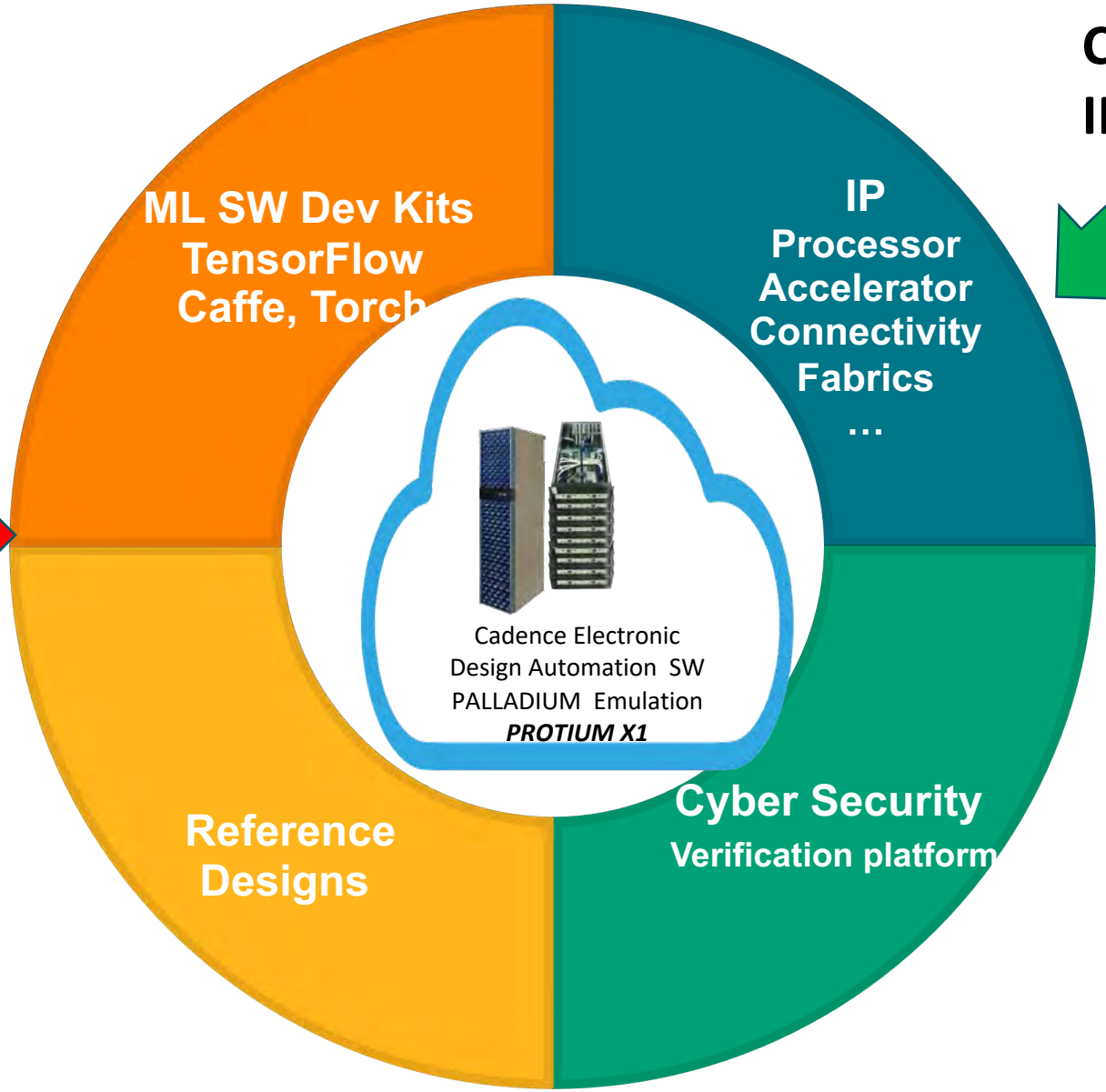
- **Provide Initial Funding to Seed the Development**

AI Innovation Hub for US AI Edge System Development (HW/SW)

- Cadence capabilities provide the Enabling technology blocks/methodologies for both Core and Edge Based Systems
  - EDA SW-Develop/Verify hardware
  - IP/Reference designs
  - HW/ SW Development and Co-verification environment
    - VALIDATE SYSTEM (HW and SW) WORKS BEFORE YOU BUILD IT.
    - Emulation and Configurable Prototyping
  - Cyber Security Verification Platform
- SW/Training algorithm development and test



NSCAI Innovation Hub for AI Cloud HW/SW R&D



Commercial IP

US Electronics Developers
- Current contractors
- US gov't funded Startups

Universities

What is Tensilica: Benchmark Edge-based computing

- **It is a RISC-based processor technology**
- **It is a Configurable and Extensible processor technology**
- **It is a design methodology**
- **It is an architecture design/analysis tool**
- **It is a set of software tools**
- **It is the "ARM of Audio"**
  - De facto standard for audio DSP

How Does it Work?

Electronic Specification

Configuration selection and custom-instruction description

Xtensa Processor Generator ("XPG")

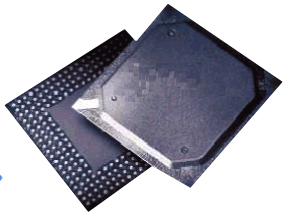
Complete Hardware Design

Source RTL, EDA scripts, test suite

Processor Extensions

Customized Software Tools

C/C++ compiler
Debuggers, Simulators
RTOSes



Use standard ASIC/COT design techniques and libraries for *any* IC fabrication process

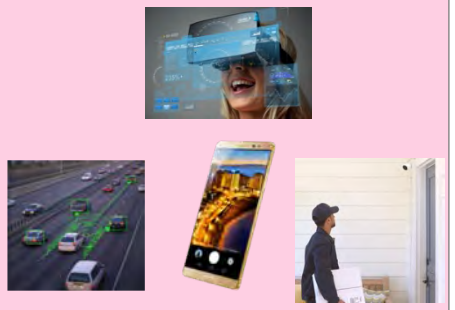
Tensilica® Products

DNA
Standalone AI processor for AI at the Edge inference
CNN, RNN, regression

HiFi

- Audio pre- and post-processing
- Voice trigger
- Noise reduction, Audio encode and decode

Vision



- Image and vision pre-/post-processing
- AI at the Edge
- SLAM, SGM

Fusion

- Auto radar
- Consumer radar
- Always-alert sensor processing

ConnX

- Narrow to wide band wireless
- LTE/LTE-A/5G
- Infrastructure and terminals

Controllers/ Custom ISAs

- High performance DSPs, NPUs, CPUs
- Application specific data types
- Custom ISA, Special functions

Broad Range of Application Specific DSPs | Custom

Automated User-Defined Customization (TIE)

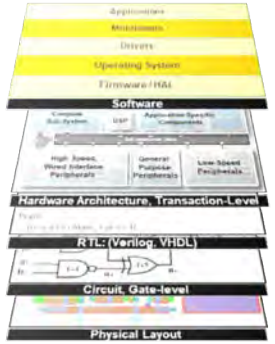
Xtensa® Processor

DoD Federated Emulation and Design Center (WPAFB, OH)

Located At Wright-Patterson AFB

Systems

Board & Package



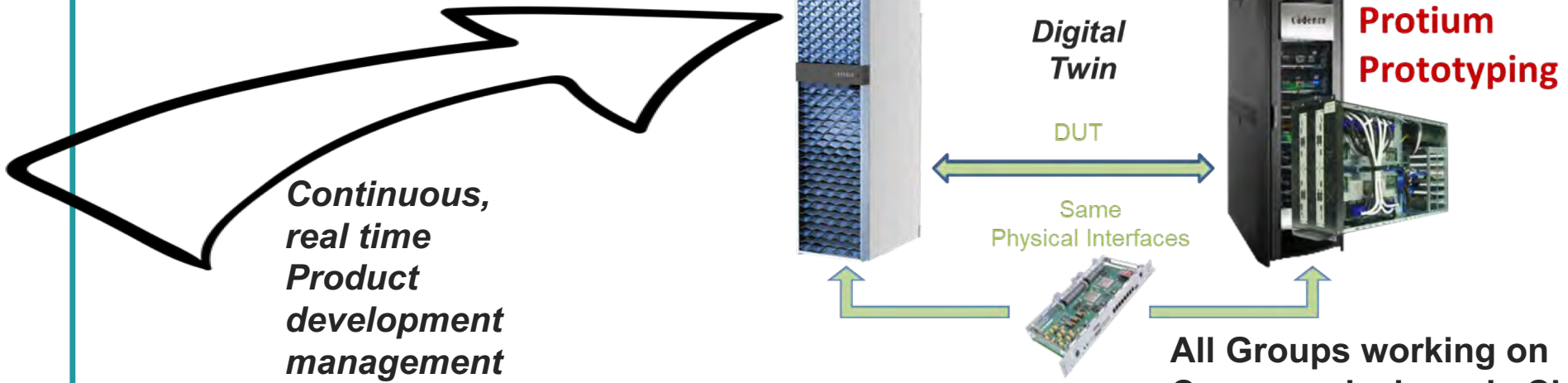
Hardware/Software Co-Design

IP & Subsystems

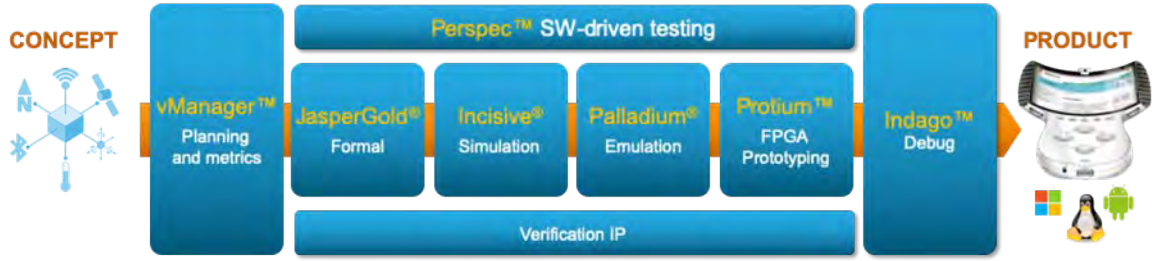
Emulate Before You Fabricate

- Hardware Development
- Systems Integration
- System/subsystem, Performance Analysis
- Thermal, EMI, Power systems analysis

- Software development
- *Digital Twin* for DevSecOps Development
- *Digital Twin* for system, subsystem developers
- *Digital Twin* for trainers, operators, maintainers



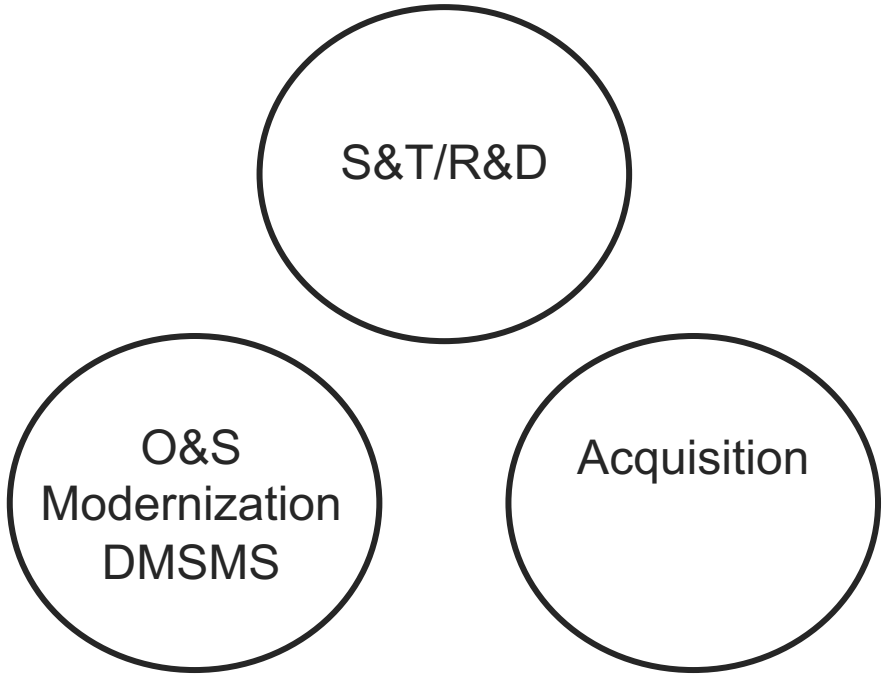
Continuous, real time Product development management



All Groups working on Common design, via Cloud, resulting in Trainers Developed and In Use Well Before Capability Is Fielded

Impact/Payoff To DoD
Continuous, Agile Improvement; No More Block Upgrades

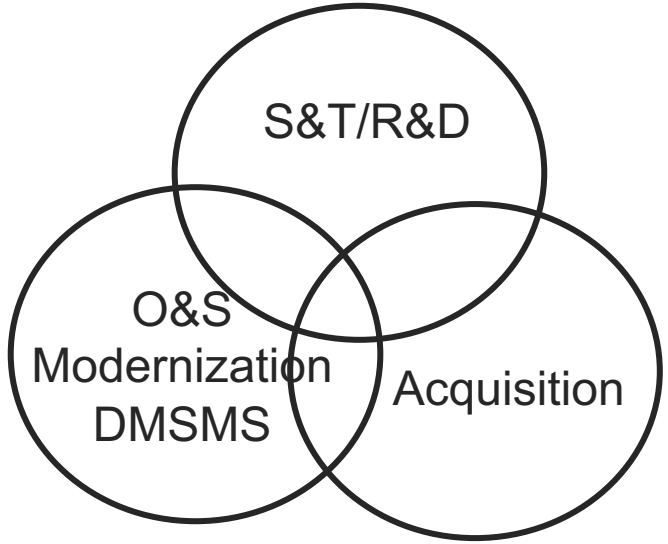
Current



Three separate activities

(Illustration Idea by CDR Jon Connelly)

Future



Continuous Improvement

All Groups working on Common design, via Cloud, resulting in Rapid Agile Fielding of New Capabilities on an "As Needed" Basis