TOM BECKLEY

SENIOR VICE PRESIDENT
CADENCE DESIGN SYSTEMS

New Commercial DoD Partnership Models

Cadence System Design Enablement

Tom Beckley, Senior VP – R&D, Custom IC, IC packaging and PCB

DARPA ERI Summit

July 2018

A long history with US Government: DoD, DARPA, NASA, …

Not secure:
Employee ID #

1978 — GM

1981 — HARRIS SEMICONDUCTOR

1990 — XYNETIX

1998 — Avant!

2000 — neolinear®

2004 — cadence

Recent — DARPA

CRAFT
CHIPS
ERI

cadence®

Tough enough?

Try it without the driver.


Boeing
Phantom Works
intel
CAT
Chevron
Duke
HARRIS
TTech
TTControl
PHILIPS
RedTeamRacing.org
Carnegie Mellon
RED TEAM
NAVTECH

Cadence Overview
Commitment to Innovation

FORTUNE 100 BEST COMPANIES TO WORK FOR 2018

#38

7,200+ employees

4,400+ R&D engineers
1,500+ field engineers

26 global development centers

Broad portfolio of solutions-based products

20 new products in the past 3 years;
50+ new IP products

40% of revenue invested in R&D

1686 patents worldwide

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Industry 4.0 ←→ Smart Product World ← → Fourth Technology Revolution

With its Highest Growth Rate in 14 Years, the Global Semiconductor Industry Topped $429 Billion in 2017, IHS Markit Says

Samsung edged out Intel, to become the new semiconductor industry leader ***BusinessWire 3/28/18***

Non-Traditional Chips Gaining Steam

Flexible hybrid electronics are showing up in a variety of markets where electronics never existed before.

MARCH 15TH, 2018 - BY: **JEFF DORSCH** ***SEMICONDUCTOR ENGINEERING***

Chipmakers bet on the 'big bang' of artificial intelligence

Tim Bradshaw in Los Angeles NOVEMBER 19, 2017 ***Financial Times***

Engineering in the Twilight of Moore's Law

It's all about finding and riding the big waves

By Robert W. Lucky 15 Feb 2018 ***IEEESpectrum***

Moore's Law Is Dying -- So Where Are Its Heirs?

By Radoslav Danilak 9 Mar 2018 ***Forbes Magazine***

The first real 5G wireless standard is official

The final technical details of the 5G NR will be available later this week when the full standard specifications are released (the documents will be available on the 3GPP portal). For now, we know it will cover wireless bands from 600MHz all the way up to millimeter wave signals in the 50GHz range. Sprint is making sure everyone knows its 2.5GHz band is included in 5G NR, which makes it the largest holder of sub-6GHz 5G spectrum.

12/21/17 Ryan Whitwam ***Android Police sourcing Qualcomm***

DARPA lays out cash-splash to defibrillate Moore's Law

Electronics resurgence program gets US$75 million more for 2018

By Richard Chirgwin 14 Sep 2017 ***The Register***

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New Technology Revolution Unfolds
Impacting DoD, IC and System Companies

- Fusion of electrical, mechanical, sensors, RF, software, and Cloud
- Leverage research into commercial solutions using unique partnerships
- Mining deep data using machine learning and AI
- Security, safety, reliability paramount
- Semi/Systems boundaries morphing; China aggressively investing

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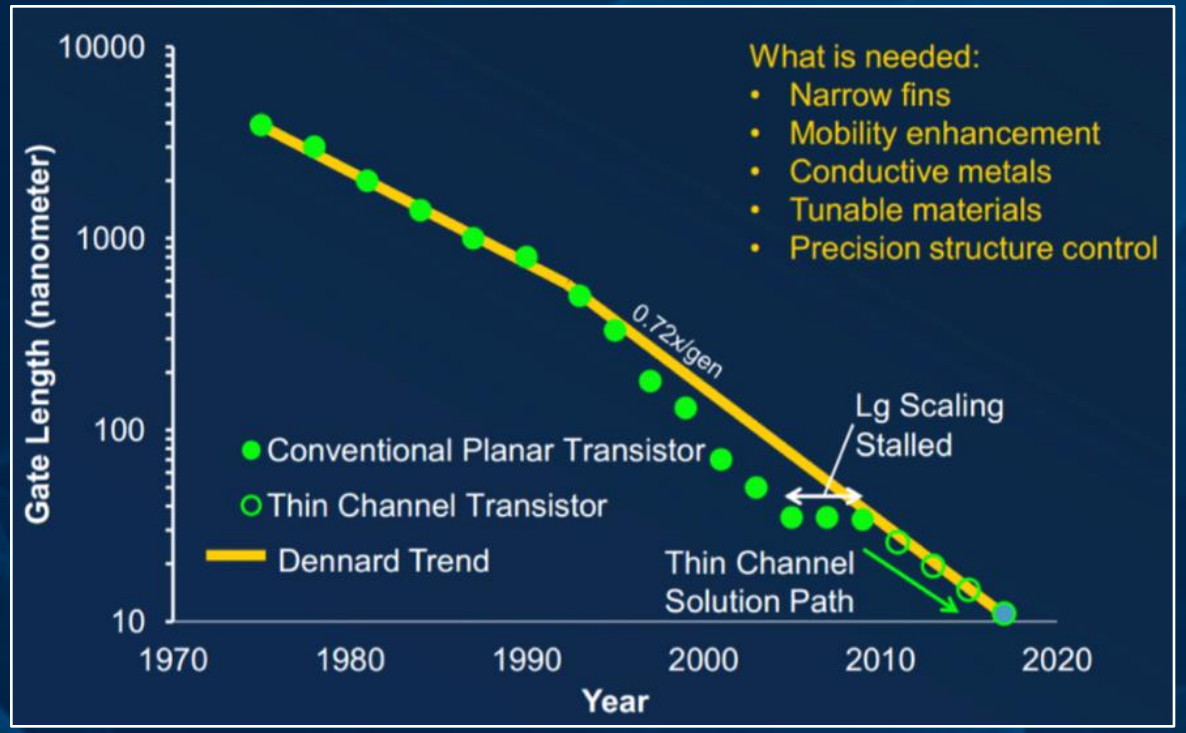
Amidst Continuous Technology Disruption



Beyond Moore's Law

3D Printing of Customized PCBs

Courtesy of Nano Dimension

Additive Manufacturing & Robotics

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System Design Enablement & Industry 4.0

Intellectual Property

Systems Integration

System analysis * Hardware/Software verification * Software applications

Package and Board

PCB design * Package design * Analysis * Mechanical/PLM integration

Chip/IC

Design and implementation * IP/SoC verification * Software drivers

Security

Expanding Collaborations

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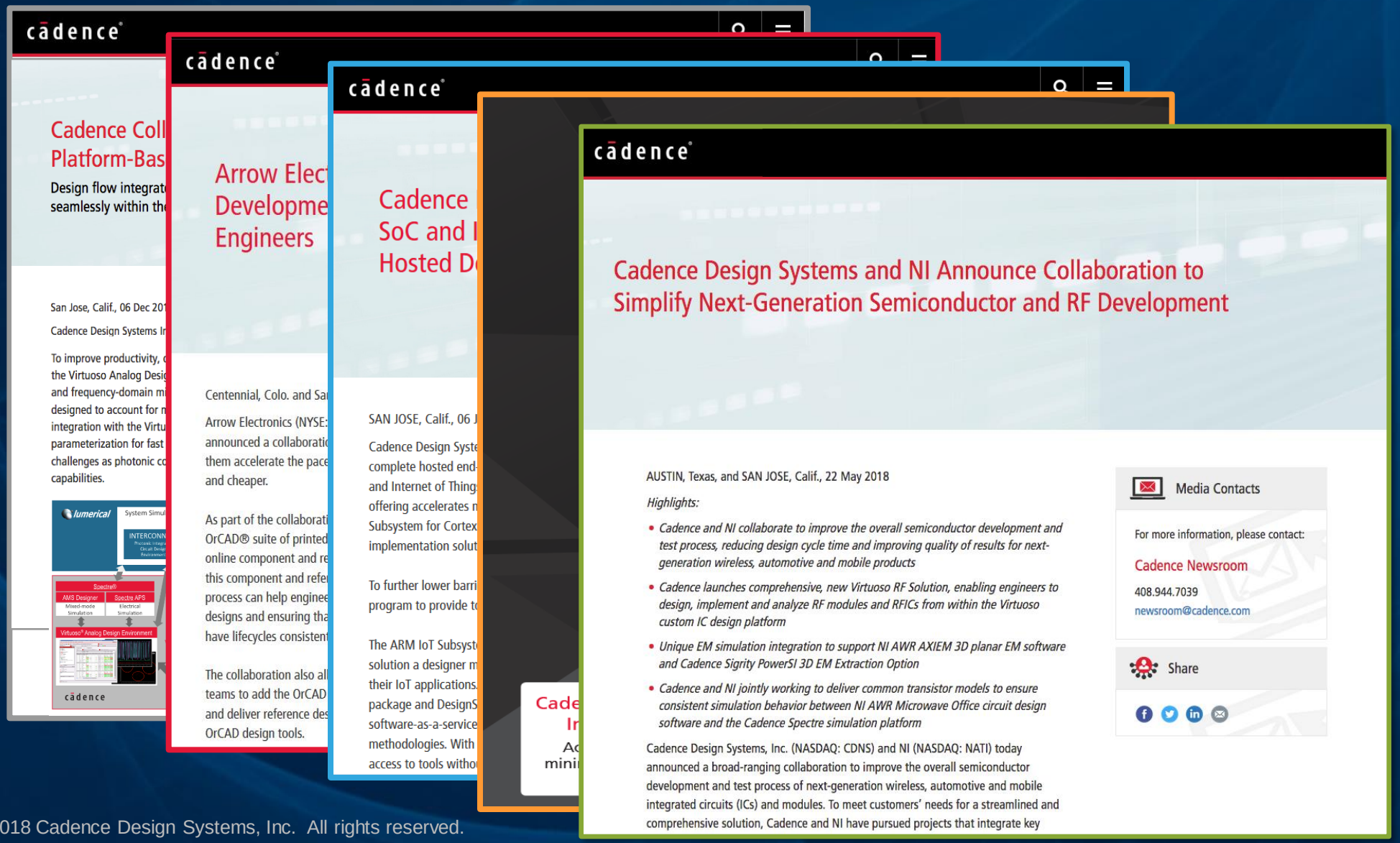
Partnering for System Design Enablement



lumerical

ARROW

arm

MathWorks

NATIONAL INSTRUMENTS

More to come…

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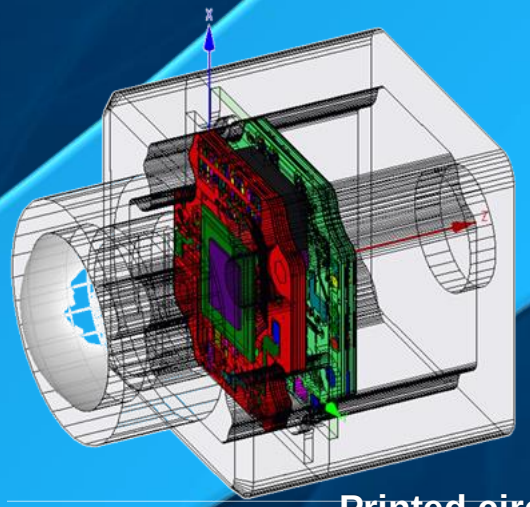
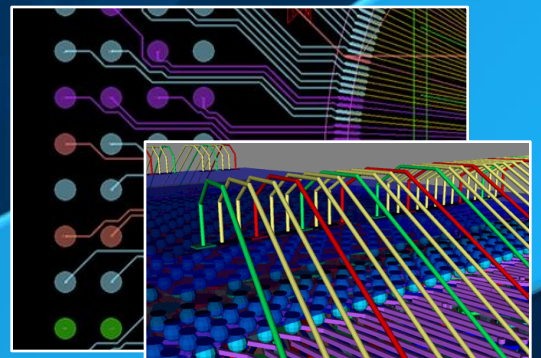
Enabling complex system design

Integrating IP, IC, package, PCB, and analysis

- “More than Moore” transforming
- Designing, analyzing, and verifying multi-die, multi-technology, complex systems
- Automating design using Machine Learning/AI

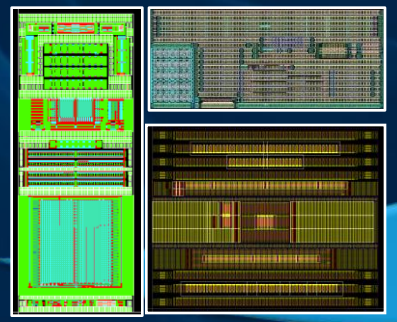


Printed circuit board

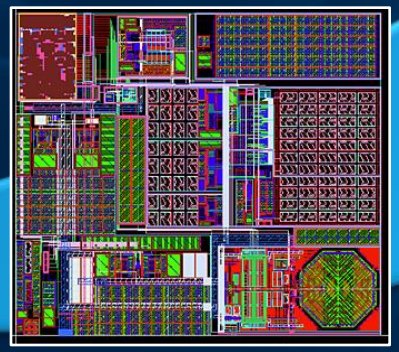


Chip packaging

IP



Integrated circuit



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5G Changes Everything

- Intersection of cloud computing, big data analytics, and AI
- Backbone of information systems
- Capacity, connectivity, latency, long battery life, security, and reliability
- 5G RF system complexity is exponentially increasing

40X faster than 4G, with up to 1M connections per m^2

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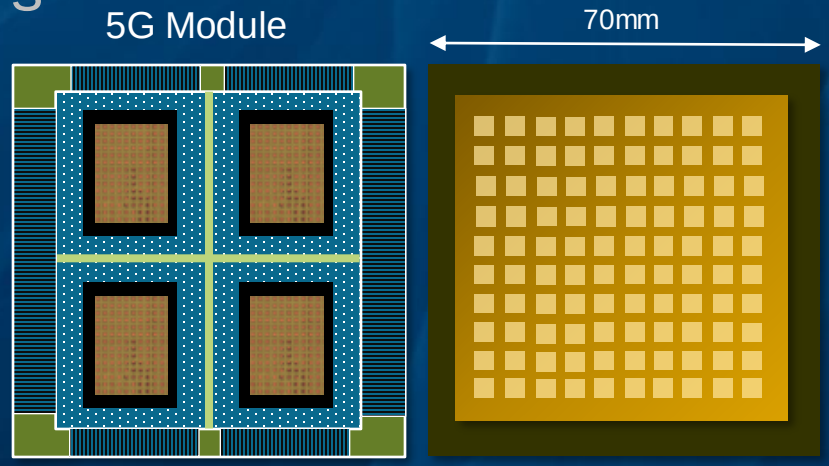
5G “New Radio” / Wireless Design Technologies

Wireless is a rapidly emerging opportunity for suppliers

5G

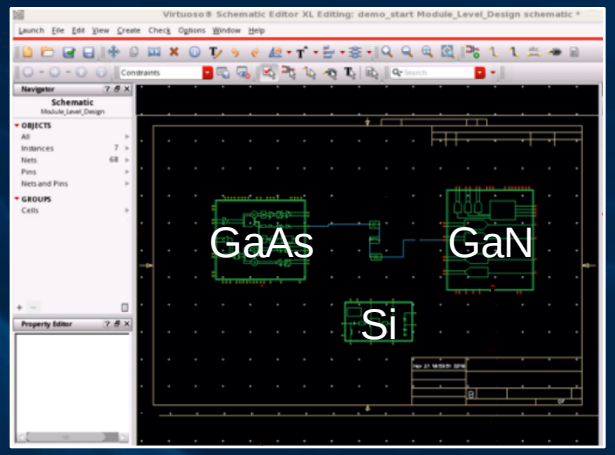
- Must integrate analog, RF, optical, and advanced packaging – including wafer level
- Exponential design complexity
- Complex RF and microwave systems

5G Module

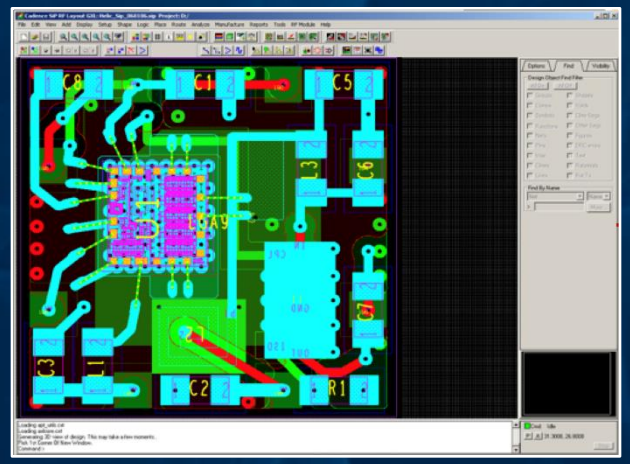


4 monolithic silicon ICs on the bottom of the module

Dual-polarized antennas on the top of the module



Single schematic – ICs & package mixed process technologies



Allegro® module / package

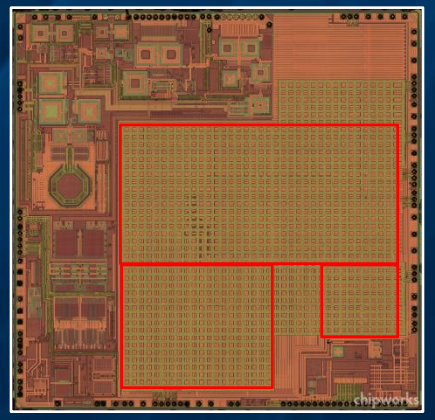
GaN

WiFi or Bluetooth IC

Analog

5mm

Digital



Radio + MAC + Baseband

Low-Noise Amplifier (Rx)

Power Management Unit

Power Amplifier (Tx)

Low-Energy Processor

On-Chip Memory

Digital Baseband

Sensor I/O: UART, SPI, I2C, 26 GPIO

Picture ©Chipworks

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Robotic Systems

Robotics

	Industrial robots/100 workers	Labor-cost savings (%, 2025)
Korea	7	33%
Singapore	5	25%
Japan	3	25%
Germany	3	21%
USA	2	22%
Taiwan	2	22%
	World Average 0.75	World Average 16%

Global market industrial and non-industrial robots from 2016 to 2022 ($B)

Source World Robotics 2017 Source Boston Consulting Group

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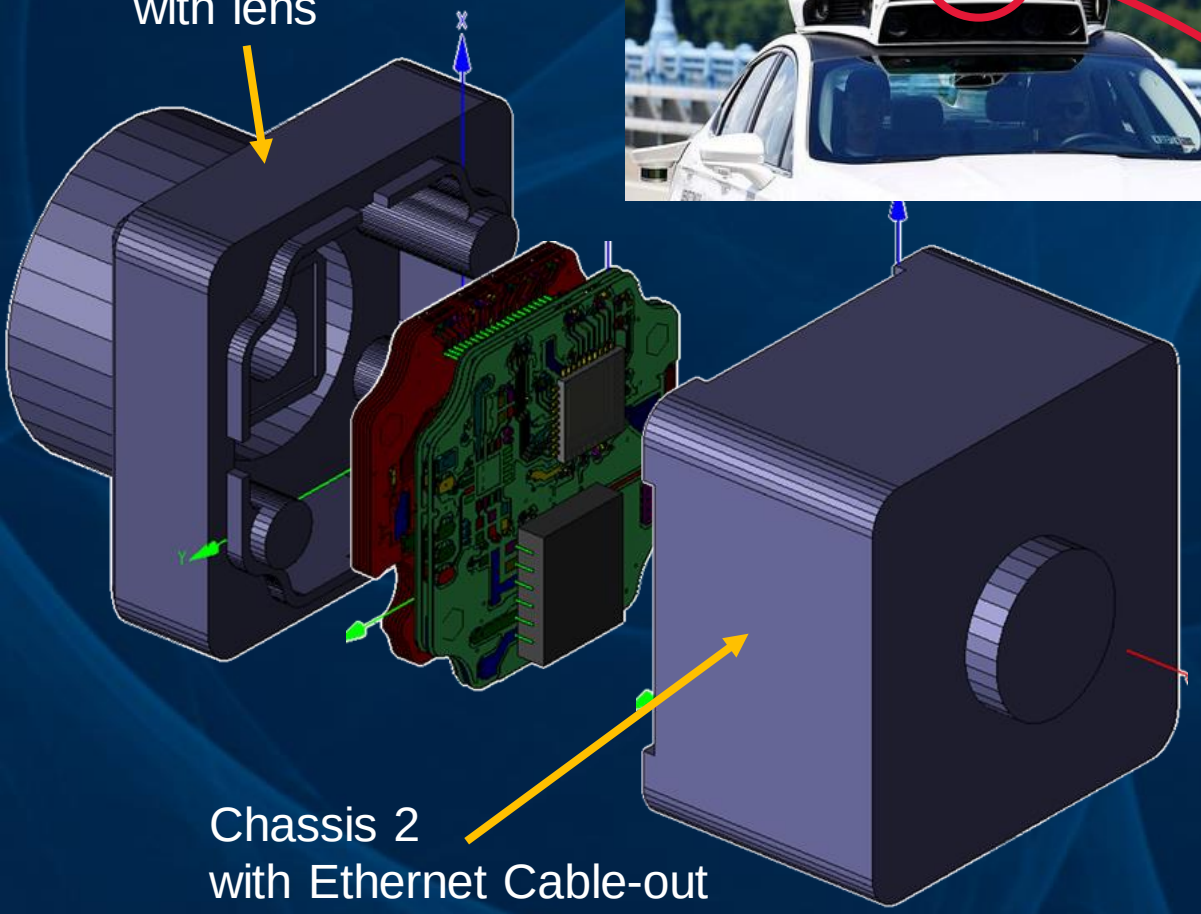
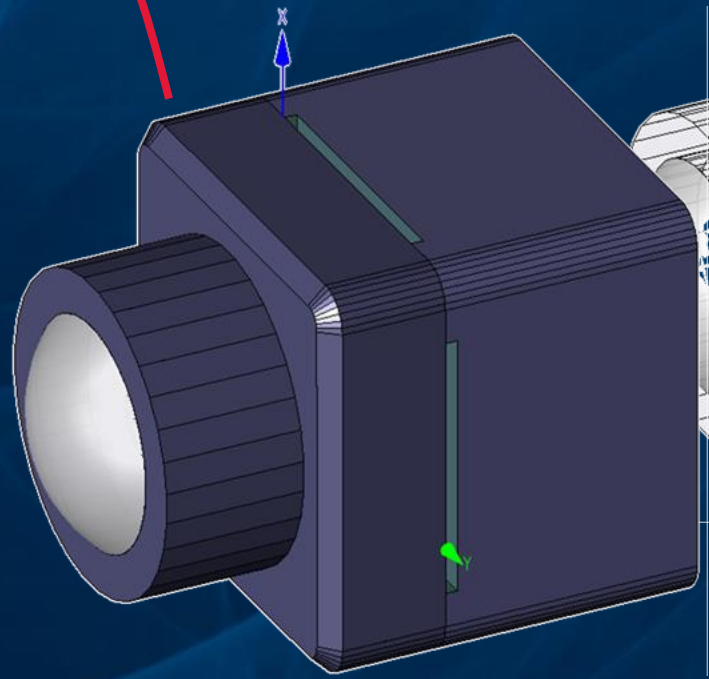
Spatial Perception
Camera Module

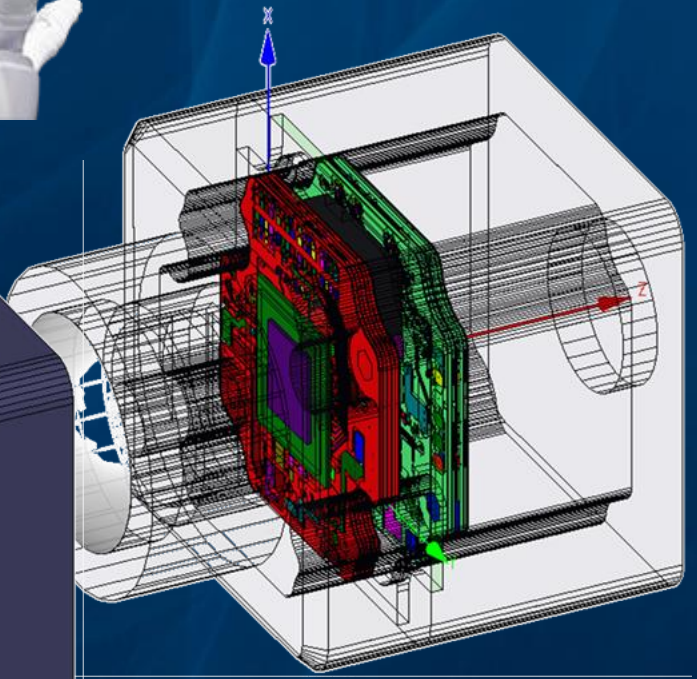
Automotive

Robotics

Chassis 1
with lens







Chassis 2
with Ethernet Cable-out

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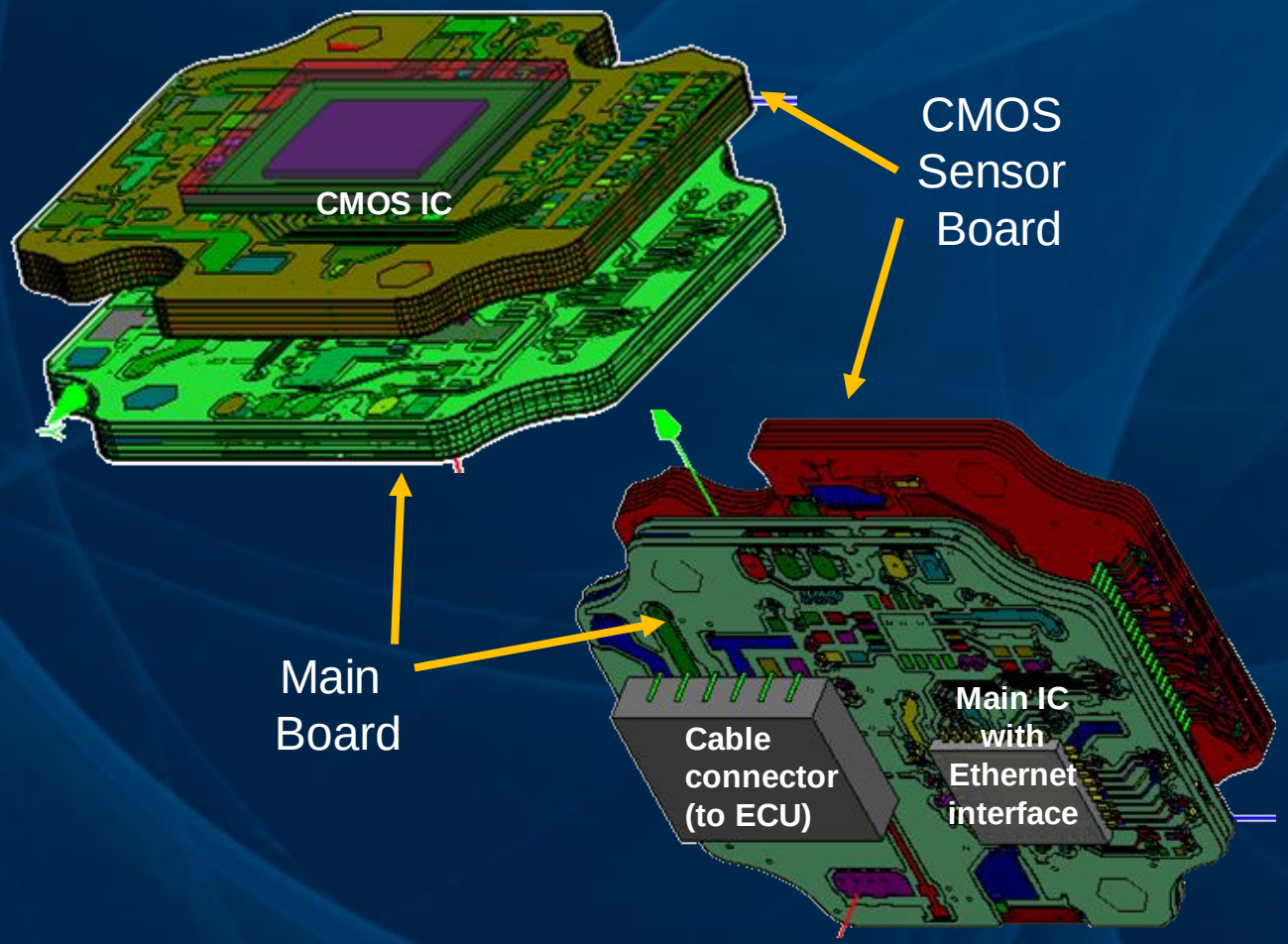
Image Sensor
Design, analysis, integrity

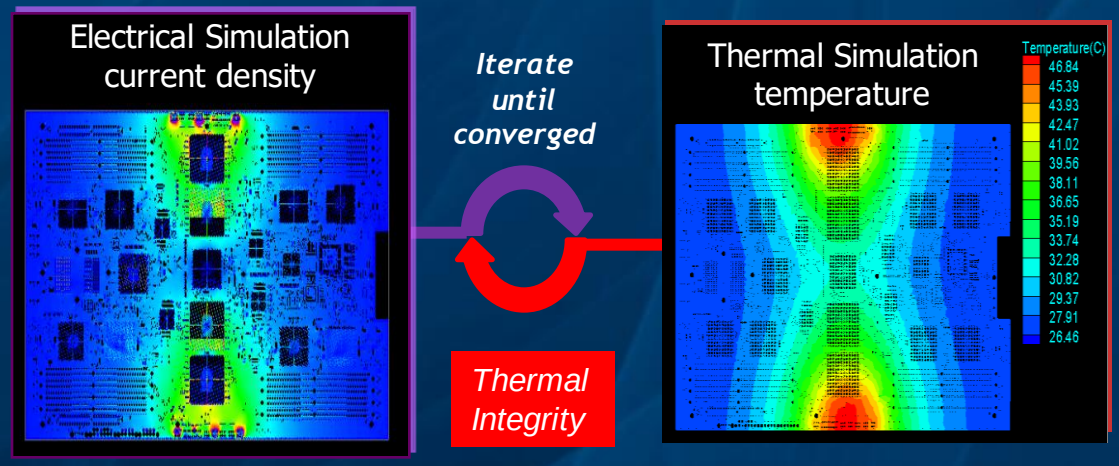
Automotive

Robotics

Allegro® PCB Designer

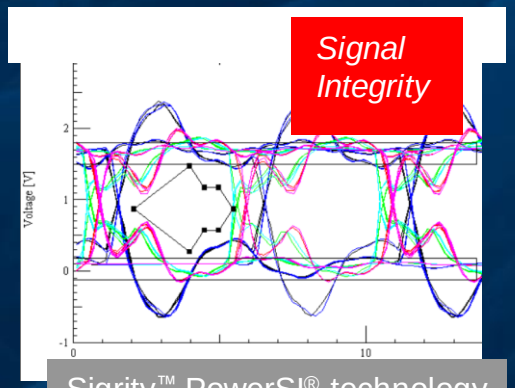


Sigrity PowerDC™ technology

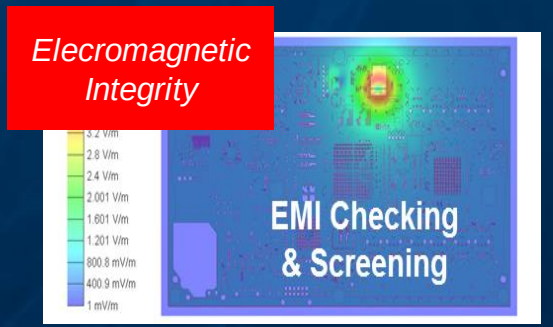


- Resistance increases with temperature
- Component leakage power dissipation increases with temperature

- Copper (Joule) heating
- Component heating



Sigrity™ PowerSI® technology



Sigrity PowerDC™ technology

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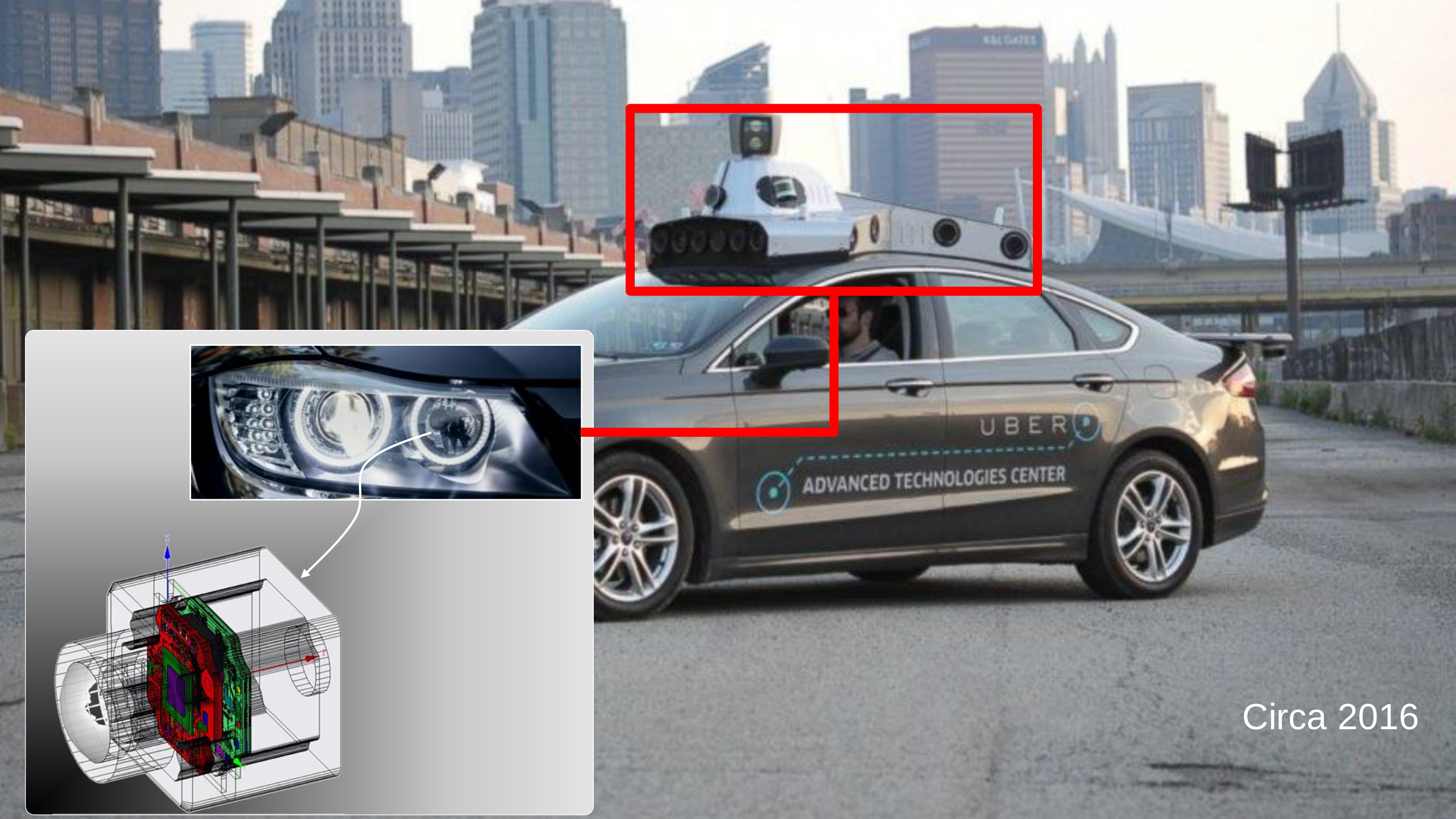


Circa 2016

Autonomous Vehicles
Pulsed time-of-flight Lidar system

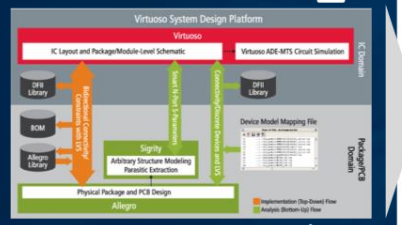
Automotive

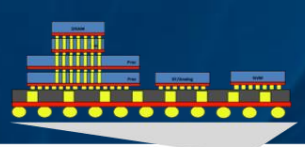
MathWorks cadence system design including beamforming algorithm toolkit

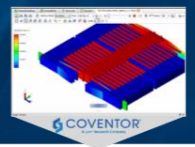
System design

Allegro Package, SiP, Board

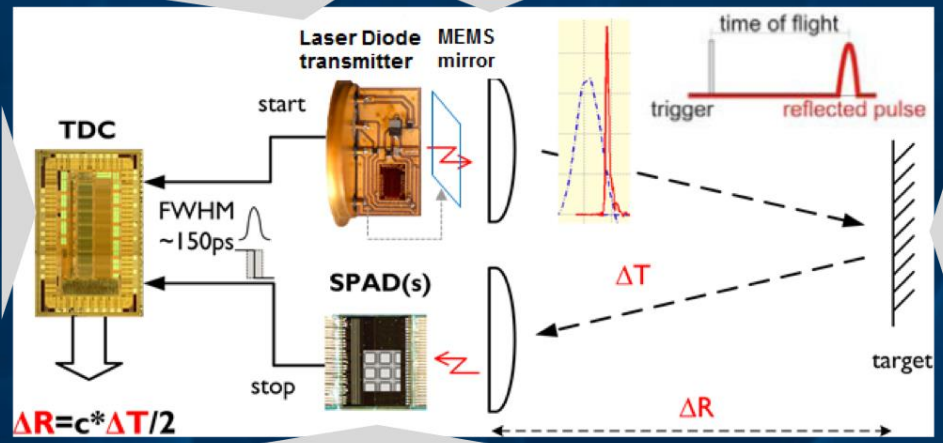
Virtuoso System Design Platform



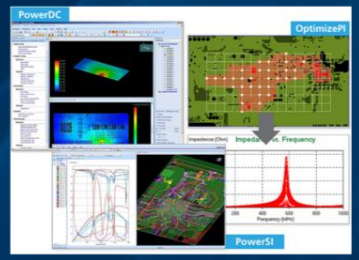




Cosim with Spectre
Co-design with Virtuoso



Sigrity Power Analysis and optimization of PCB



Cosim with Spectre
Co-design with Virtuoso

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Transforming Aerospace / Defense

2018 National Defense Strategy

"Platform electronics and software 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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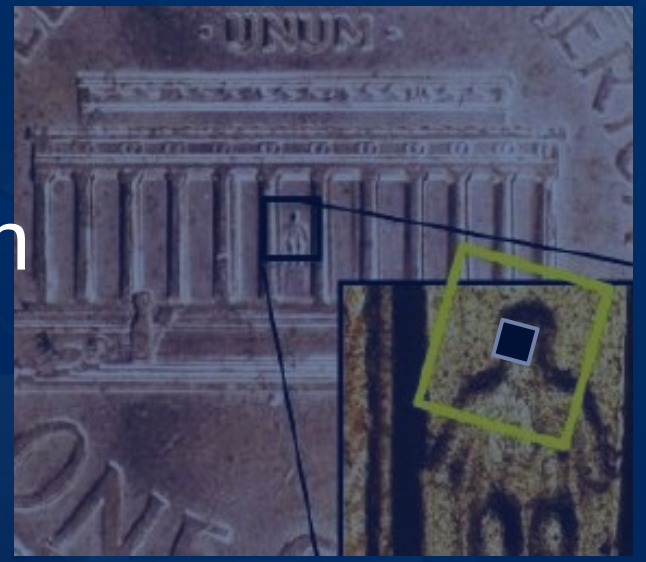
Recent Cadence DARPA Collaborations

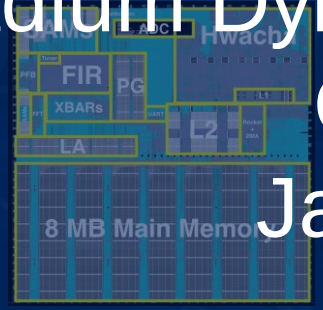
CHIPS

– IP reuse through 2.5D Modular Design



SHIELD

– Worlds smallest IC



ACT

– Achieved 4x reduction in Power and Area over prior generation

CRAFT

– Collaboration aimed at reducing DoD SOC design and verification time by **10x**

SPADE

– Advanced security techniques focused on DoD system requirements

Virtuoso Liberate

Modus

Virtuoso Schematic Editor

Sigrity

Tempus Timing Signoff Solution

Innovus

Virtuoso Layout Suite

Genus

Palladium Dynamic Power Analysis

Quantus

JasperGold

Xcelium

Virtuoso ADE Assembler

Palladium Z1

Berkeley UNIVERSITY OF CALIFORNIA

cadence

NORTHROP GRUMMAN

BAE SYSTEMS

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Commercial DoD Partnership Model

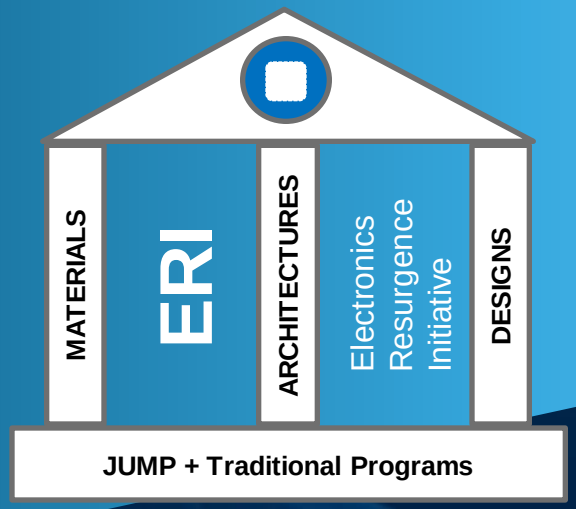
Collaboration across government, academia and technology leaders

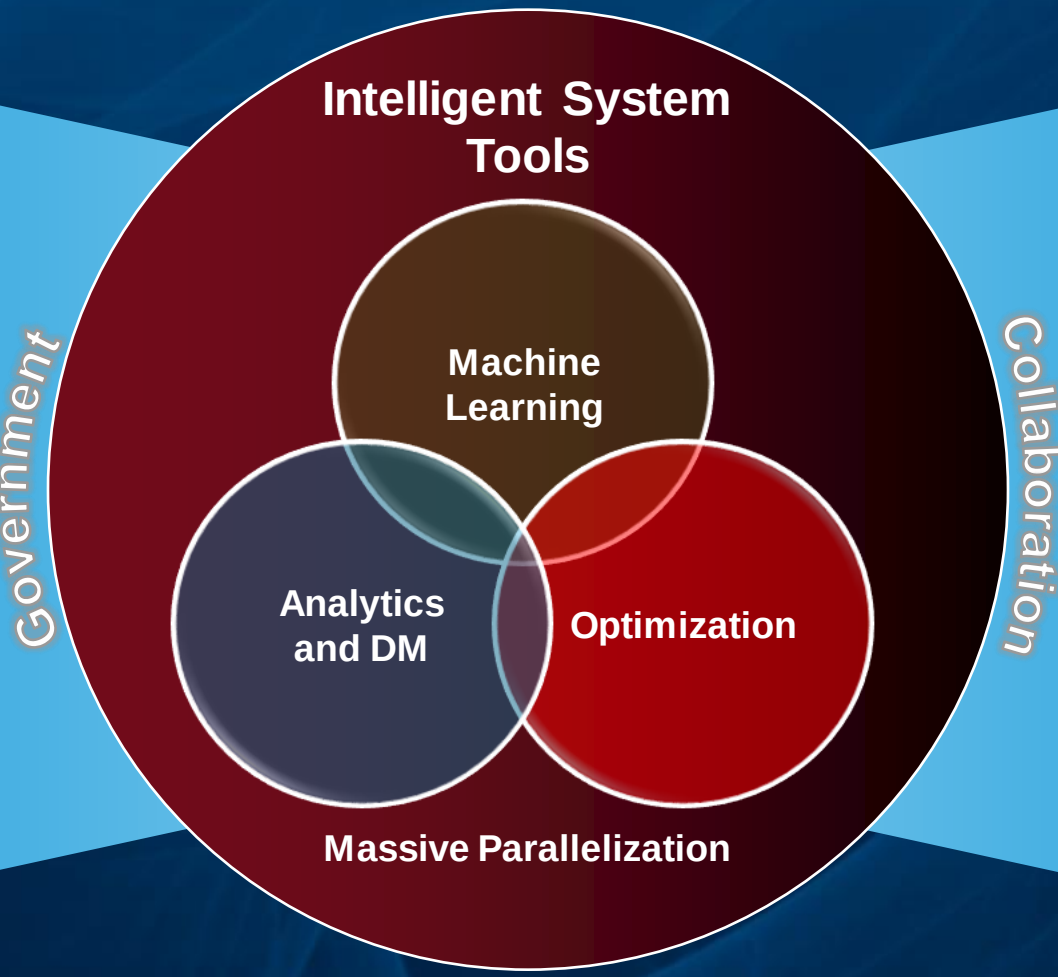
DARPA

ERI Proposal

(intelligent chip, package and board design)

2025-2030
NATIONAL ELECTRONICS CAPABILITY





Carnegie Mellon University

+

cadence®

+

NVIDIA

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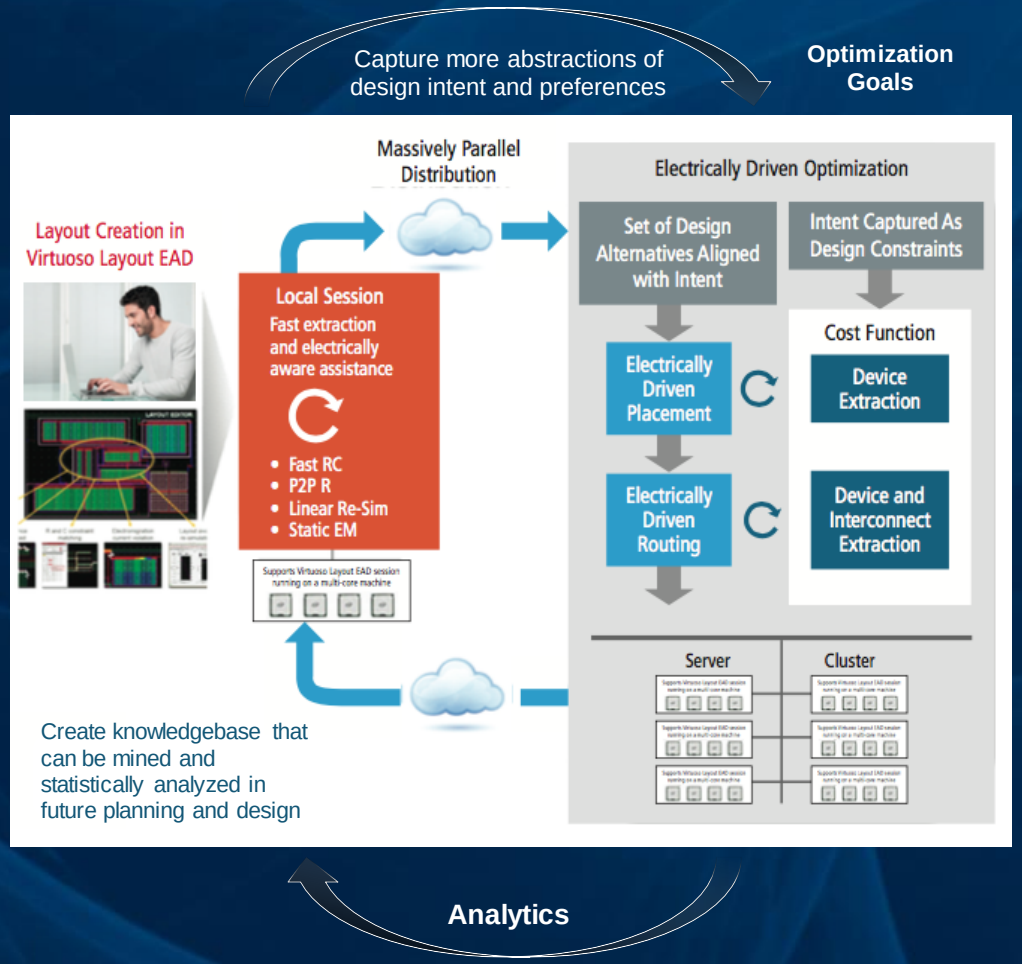
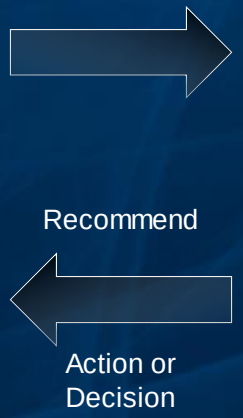
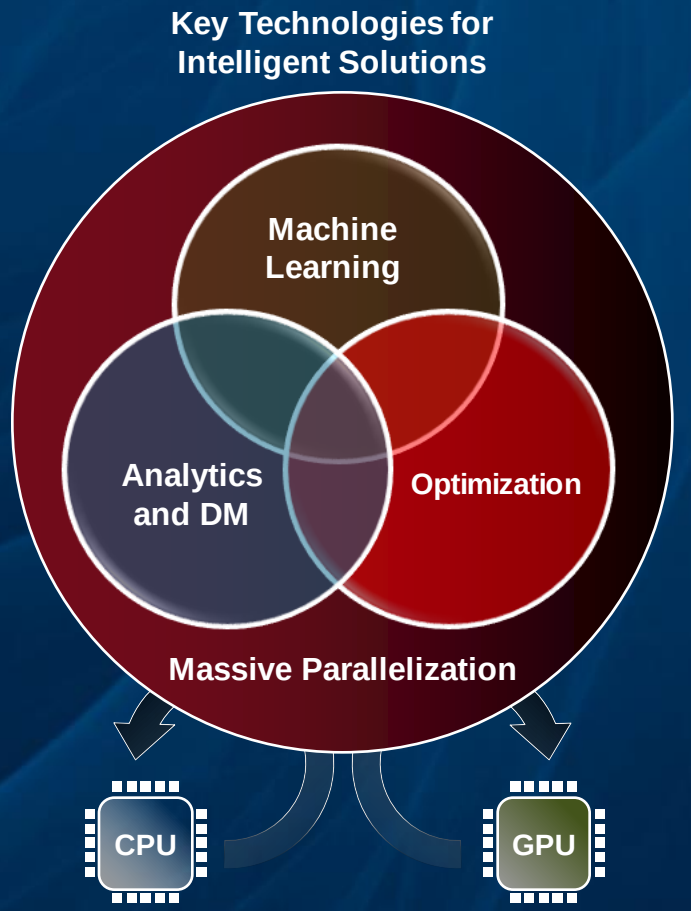
Intelligent Design and Optimization
Addressing the Uncertainty of Design Intent







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MAGESTIC: Analog Block/SoC/Pkg/PCB Automation

ERI
ELECTRONICS RESURGENCE INITIATIVE

DESIGN ENTRY AND ELECTRICAL CHARACTERIZATION

- Schematic design
- Analog design
- Simulation & analysis
- Die abstract, parts library, package/board outline

PHYSICAL DESIGN

Optimization

Virtuoso, OrbitIO, Allegro

- Placement
- Routing
- Extraction

Machine Learning Algorithms

Analytics and DM algorithms

PHYSICAL CHARACTERIZATION

Verification → GDSII Gerber

MAGESTIC

Machine learning-driven Automatic Generation of Electronic Systems Through Intelligent Collaborations

Partner Deliverables

Machine learning libraries, flows, tool chain adaptive decision making processes in traditional EDA tool flows

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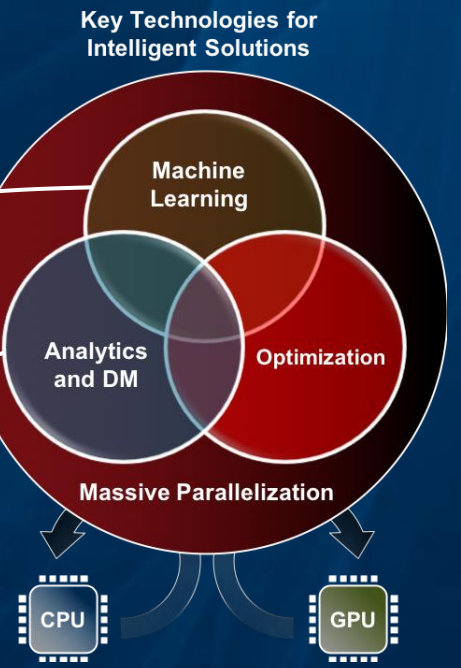

Training Data → Layout DB and ML model parameters

Owned by customers/users

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Industry 4.0 Teaming / Innovating: Govt, Industry & Academia

Advanced Research Projects

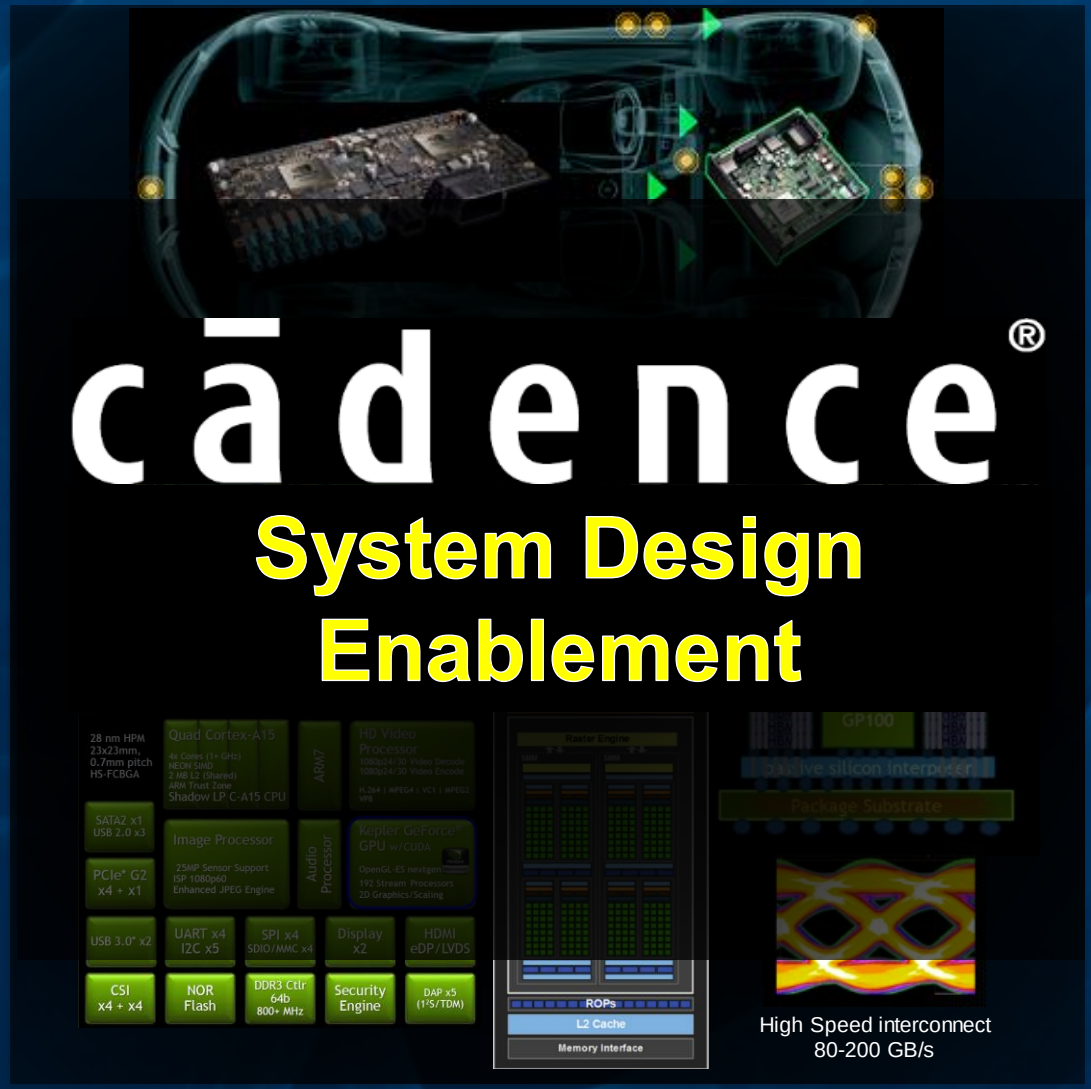
CRAFT, ACT, CHIPS, SPADE, SHIELD, REIMAGINE,

ERI
ELECTRONICS RESURGENCE INITIATIVE

DARPA

NVIDIA

Carnegie Mellon University



Integrated chip, package, PCB, and system

System modeling and analysis

RF / photonics / mixed-signal

SI/PI, fault simulation & thermal analysis

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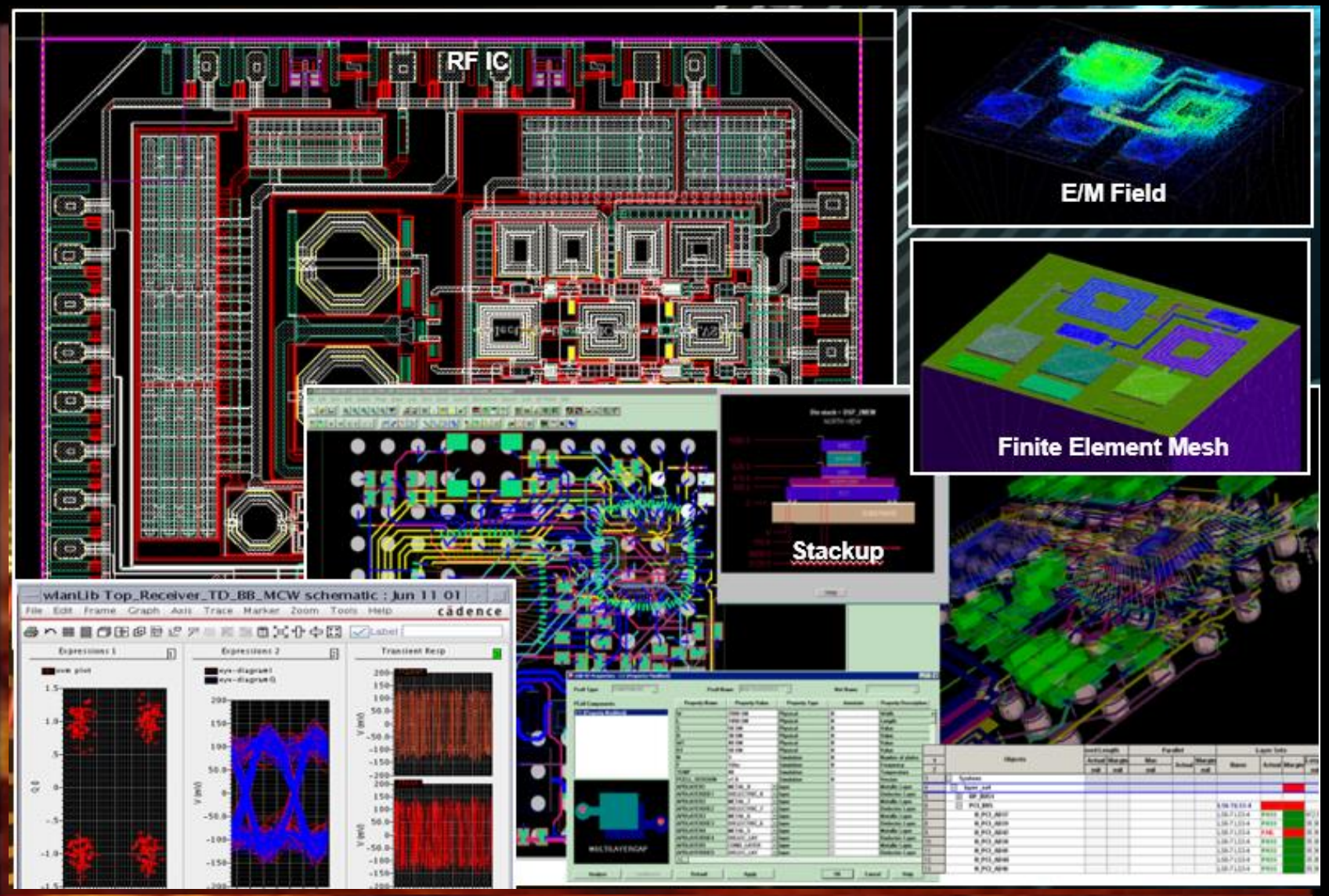
Tough enough?

Try it without the engineer.



DARPA ERI GRAND CHALLENGE 2018

Thanks!

ERI ELECTRONICS RESURGENCE INITIATIVE

SUMMIT

2018 | SAN FRANCISCO, CA | **JULY 23-25**