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PIONEERS IN COLLABORATIVE RESEARCH®

Panel 1: Motivation for Action

Benjamin Jun / Cryptography Research, Moderator

Mark Tehranipoor / UConn CHASE

Serge Leef / Mentor Graphics

Saverio Fazzari / Booz Allen Hamilton

Bruce Newgard / Xilinx

Bob Bell / Cisco

Paul England / Microsoft Research

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Mark Tehranipoor

Charles Knapp Associate Professor in Engineering Innovation

Center for Hardware Assurance, Security, and Engineering (CHASE)
Comcast Center of Excellence for Security Innovation (CSI)

CHASE

UCONN

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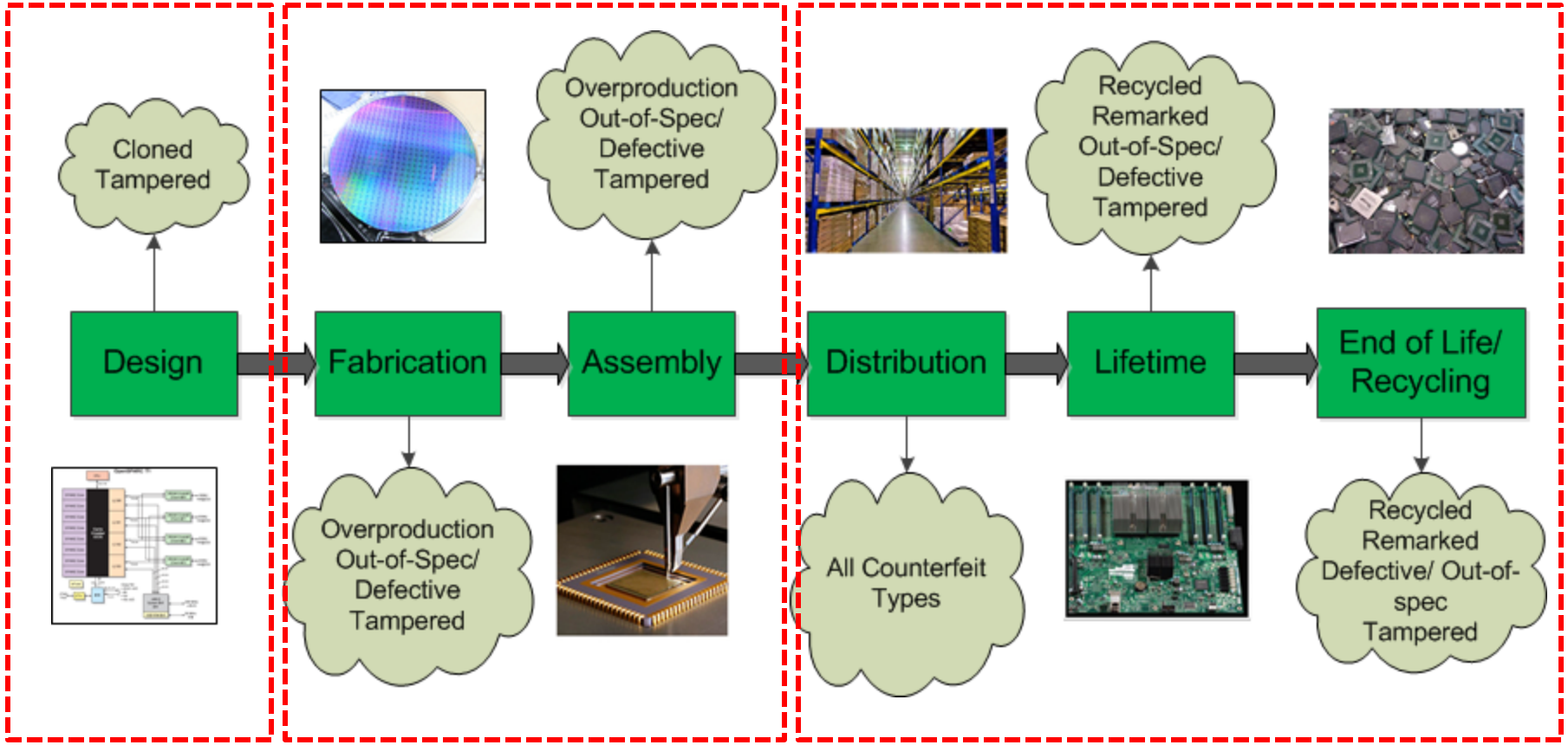
www.chase.uconn.edu

Supply Chain Vulnerability



Untrusted IP Vendor & Sys. Integ.

Untrusted Foundry & Assembly

In the Field & Recycling

Maximum Flexibility ← → **Minimum Flexibility**

Grand Challenges

Immediate Needs

- Security at the low levels of abstraction should NOT be an after thought anymore
- Improve supply chain security
  - Untrusted foundry and assembly
    - IP, design flow, and IC
  - More effective chip/device identification and authentication

3-5 Years

- Metrics for security assessment
- Development of robust security primitives
  - Anti-reverse engineering
  - Anti-tampering
  - Anti-counterfeit
  - More …
- Advanced track & trace
- Development of standards

5-10 Years

- Development of innovative silicon authentication platform
  - To reduce area and power
  - Offers solutions such as PUF, TRNG, sensing capability, COA, anti-tampering, cloning, anti-Trojan, etc.

Continuous Attack Analysis and Understanding of Vulnerabilities

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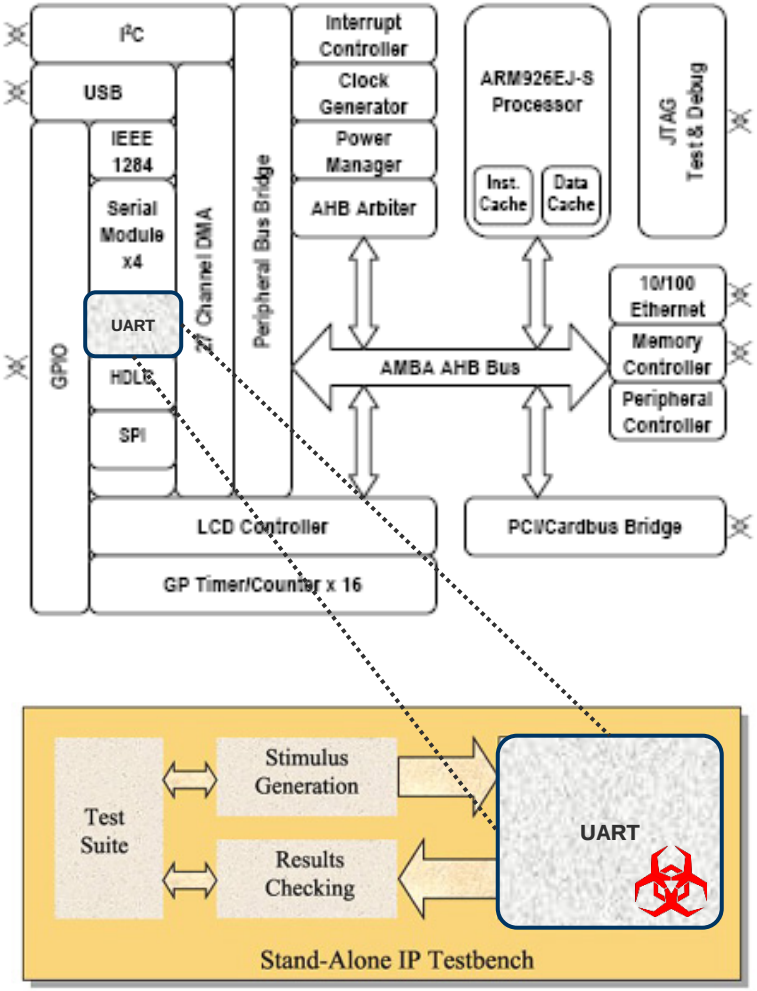
Serge Leef

VP, New Ventures

GM, System Level Engineering Division

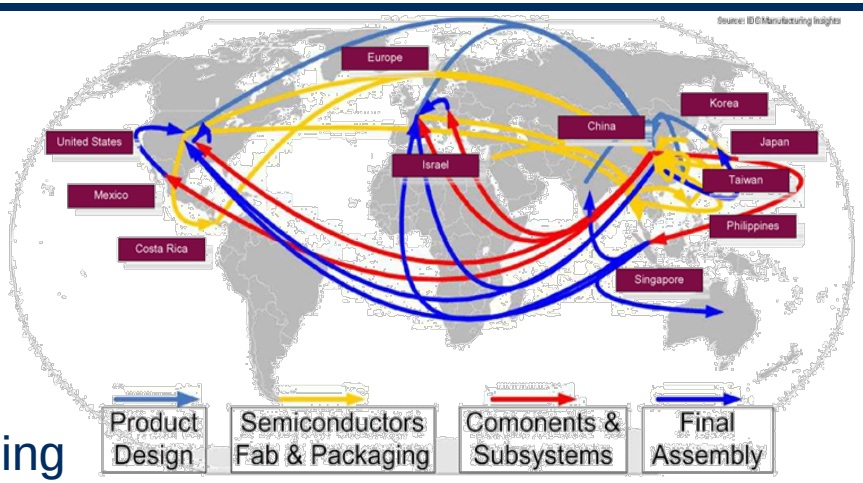
Mentor Graphics Corporation

Threat: IP as a Trojan carrier



- In a typical IP-based design, each block can originate from different sources
- Incoming IP blocks are verified to confirm promised functionality
- Additional verification may be done to confirm proper interaction with other IP blocks operating in the system context
- A key question that does NOT get asked in this process is: “does this block do anything ELSE?”

Risk: “Chain of custody” no longer workable



Mitigation Strategies:

Authentication circuits

- Embedded ID + Crypto engine
- Challenge/response dialog

On-chip odometers to address recycling

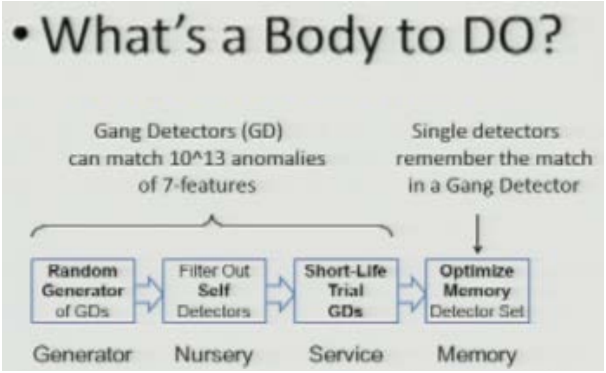
- On chip structures that count some physical events like power cycles, memory accesses or other inexpensively measurable values
- Data in the odometer is encrypted; reset to ‘0’ indicates an attack
- Can be accessed at the authentication time

Activation – chips do not work as manufactured

- Only the IP rights holder would have the keys needed to activate chips
- Different degrees of activation need to be offered to enable the customer to make trade-offs between security and costs
- Pre-existing test methods should be accommodated
- Power-up, event-based or periodic activation offers highest security

Grand Challenges

- Near term: Recognition of the problem
  - Skepticism in the hardware design community
  - Change can be driven by crisis or strong top-down requirements
- Medium term: Industry/Government collaboration
  - Handed down policies are ineffective & quickly obsolete
  - Ambiguous economic incentives for compliance
  - Partnership with technological countermeasure vendors
- Long term: Methods for finding Unknown Unknowns
  - Proactive anomaly detection:
    - Mimicking biological systems
    - Search for zero-day bugs
    - Very large number of varieties
    - Most are first time encounters
    - Use immune system as a model*



*Source: Rick Dove, Paradigm Shift International, COFES 2014
http://cofes.com/ADMIN-STUFF/Video/Video-Player/VideoId/295/MP2-Rick-Dove-Paradigm-Shift-International.aspx

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Saverio Fazzari

Booz Allen Hamilton

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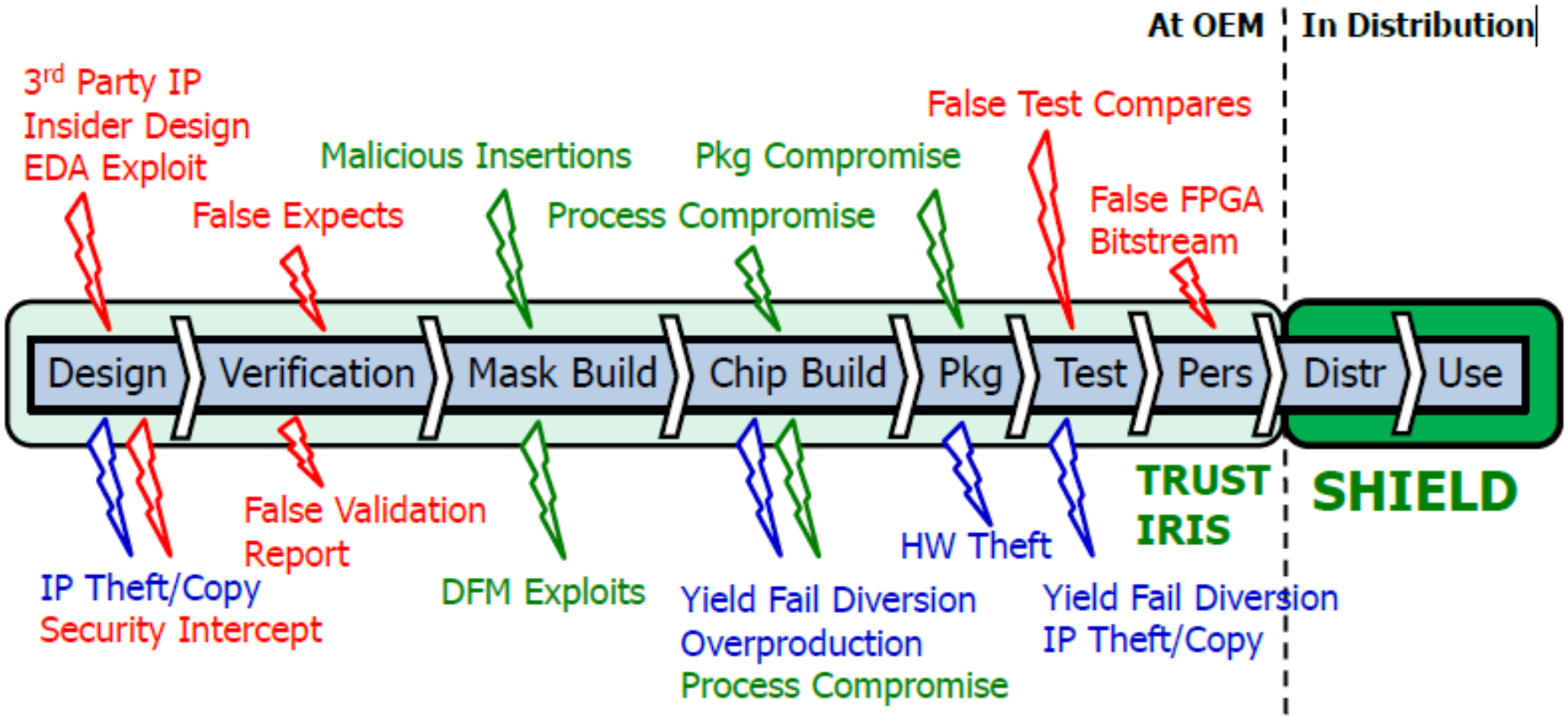
TRUST, IRIS Programs Validated Design Preceding Distribution:
- SHIELD Will Take it From There

LEGEND: Design Attack - Hardware Attack - Logistics Attack



DARPA TRUST and IRIS Programs developed techniques for validating the design and process integrity before distribution.

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Bruce Newgard

Director, Product Planning

Xilinx, Inc.

XILINX

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Today's World

- I rob banks because that's where the money is
  - Attributed to **Willie Sutton**

- Systems are attacked today because the information (IP, User data, etc.) is valuable
  - Economically
  - Militarily

View From the Foundation (H/W)

- Threats (not exhaustive)
  - Side channel attacks such as DPA & EMI
  - Environmental Attacks (e.g. Temp, Voltage)
  - Counterfeit Si (reclaiming, re-marking, up-screening)
  - Focused Ion Beam (FIB)
  - Memory Imprinting
  - IP protection - copying & modification
- System & H/W designers must understand and mitigate all or most of most of the attack vectors

Basic Requirements

- Security MUST be designed in early
  - Difficult & costly to add security after design stage
- For system to be secure, the H/W MUST be trusted and boot securely
  - Solid foundation which to build on
- Trust and authentication must be established BEFORE the system can process data

Si Grand Challenges

- Near term
  - Low to zero penalty to invoke security features
  - Trusted Si & IP
  - Resistance to attack vectors (e.g. DPA)
- Medium term
  - Si, Tools & IP- correct by design, no “extra” or dead code
  - Counterfeit-proof
- Long term
  - Supply Chain – manufactured anywhere in world – trusted and secure by design
  - Life cycle management – cradle to grave tracking and authentication

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Bob Bell

Senior Product Security Architect, TRIAD

Cisco Systems

CISCO

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View from the Trenches

- Hack and Shack attacks becoming better with low-cost access to better tools
- Lab attacks becoming better through outsourced tools and expertise
- Nation State attacks are confirmed not theoretical any more!
- Customers are not DEMANDING security and integrity in the products
  - At least that is what Product Marketing keeps saying
  - This drives adoption into products

Grand Challenges

- Near term –
  - Overcome reluctance to add security and integrity functions into products
  - Increase accountability of manufacturing partners
- Medium term –
  - Raise the bar to tampering and modifying of equipment by several orders of magnitude
  - Build in stronger IP Protection measures all along the supply chain
- Long term –
  - Develop new and stronger methods to detect hardware and software “Trojans” which are commercially usable

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Paul England

Software Architect

Microsoft

The View from Above

Secure and Trustworthy Hardware from an OS & Service Perspective

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A Decade of New/Improved Security Tools

The Cloud	Data Centers: Your life in the cloud
Appliances	Phones, Tablets, Game consoles...
App Model	Better App-containers, White-Lists, App-Stores
OS-Lockdown	Kernel-Lockdown, Measured Boot
Hypervisor-Security	Hypervisors for Security Isolation + Invariants
New CPU Modes	ARM-TrustZone, SGX, VT, Security Processors
Secure Boot	TPM-Based Measured Boot, UEFI Secure Boot
TPM	Key Storage, root-of-trust

Grand Challenges

- Near term
  - Use the tools!
  - Executing well
    - Certainly a “grand challenge”
  - Security usability:
    - make it hard for users to make poor choices
- Long term
  - Coexistence of security and openness
  - Supporting both strong identity and anonymity
    - On the Internet nobody knows you’re a dog
  - Secure by construction or proof:
    - hardware, runtimes, languages...