HARDWARE BASED AUTHENTICATION AND TRUSTED PLATFORM MODULE FUNCTIONS(HAT) FOR IOTS

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Outline

- Security challenges in IoTs.
- Hardware security attacks and countermeasures
- Research overview
- Q&A

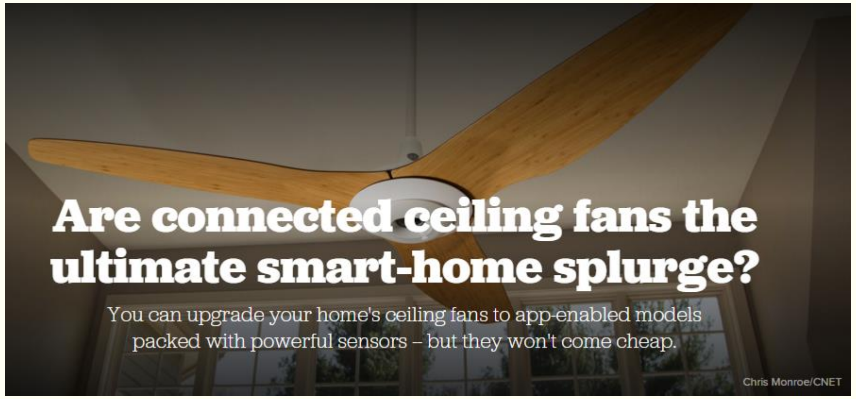
Era of “Smartness”

Smart Thermostat

Google Home

CUJO: Smart firewall

Smart Talkies



Are connected ceiling fans the ultimate smart-home splurge?

You can upgrade your home's ceiling fans to app-enabled models packed with powerful sensors – but they won't come cheap.

Chris Monroe/CNET

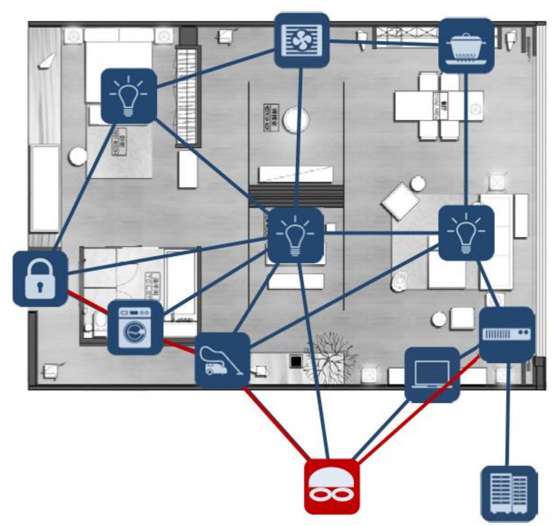
with motion & climate sensors…automatically adjust as you come and go, or as the temp. rises.

Virtual Reality Headset

4-in-1 Smart Connect™ Cradle ’n Swing
“… Baby, that’s genius.”

Internet of Things (IoTs) Charactristics

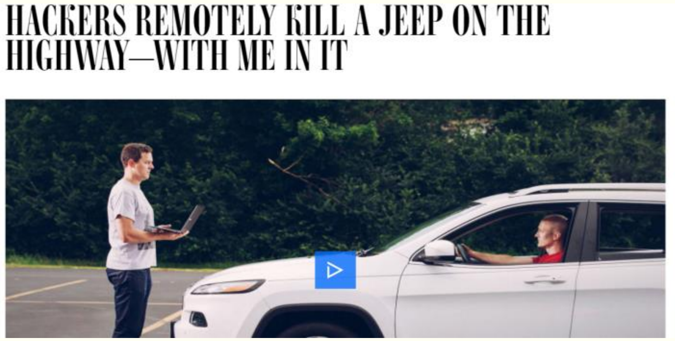
- **Unique requirements for IoT security**
  - Long, complex life cycles
  - Never intended to be connected
  - Machine-to-Machine interactions
  - Mass produced in same configuration (“Hardware Homogeneity”)



- **Changing environment for security assurance**
  - Increasingly globalized supply chain
  - Increasingly stringent time-to-market
  - Increasingly connected world

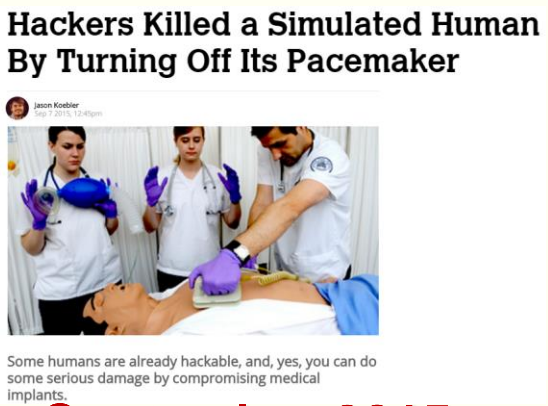
How can we protect diverse, connected, and highly complex modern computing systems against malicious attacks?

IoTs: Security and Trust Threats and Attacks



HACKERS REMOTELY KILL A JEEP ON THE HIGHWAY—WITH ME IN IT

July 2015

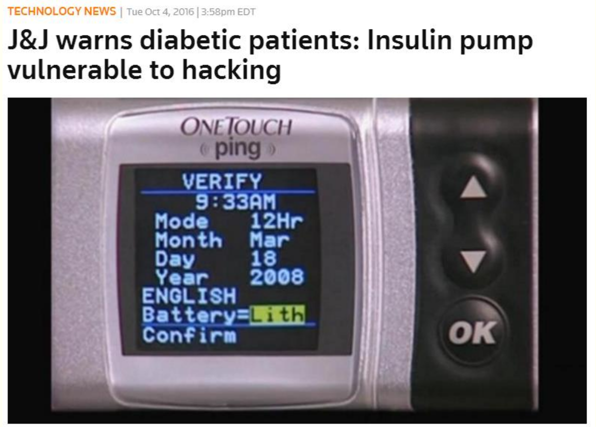


Hackers Killed a Simulated Human By Turning Off Its Pacemaker

Jason Koebler
Sep 7 2015, 12:45pm

Some humans are already hackable, and, yes, you can do some serious damage by compromising medical implants.

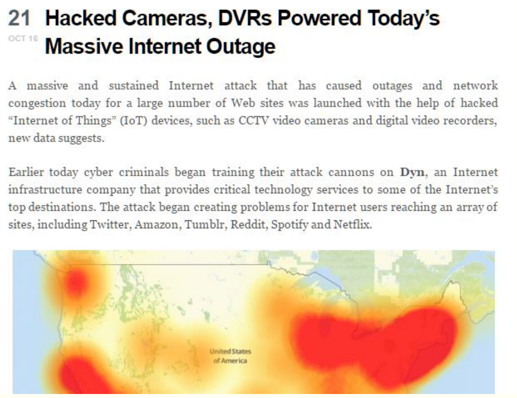
September 2015



TECHNOLOGY NEWS | Tue Oct 4, 2016 | 3:58pm EDT

J&J warns diabetic patients: Insulin pump vulnerable to hacking

October 2016

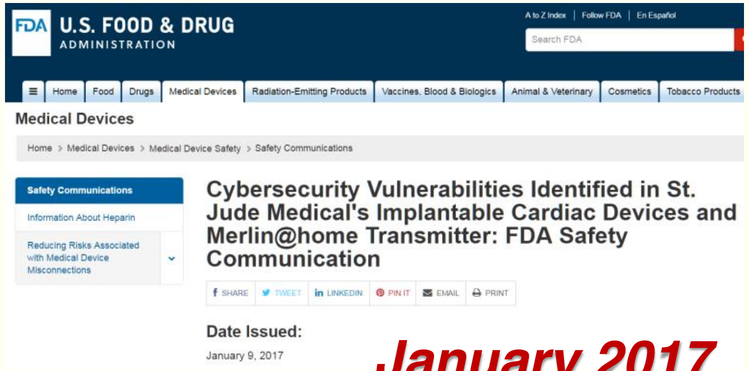


21 OCT 16 Hacked Cameras, DVRs Powered Today's Massive Internet Outage

A massive and sustained Internet attack that has caused outages and network congestion today for a large number of Web sites was launched with the help of hacked "Internet of Things" (IoT) devices, such as CCTV video cameras and digital video recorders, new data suggests.

Earlier today cyber criminals began training their attack cannons on **Dyn**, an Internet infrastructure company that provides critical technology services to some of the Internet's top destinations. The attack began creating problems for Internet users reaching an array of sites, including Twitter, Amazon, Tumblr, Reddit, Spotify and Netflix.

October 2016



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Reducing Risks Associated with Medical Device Misconnections
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Medical Devices

Cybersecurity Vulnerabilities Identified in St. Jude Medical's Implantable Cardiac Devices and Merlin@home Transmitter: FDA Safety Communication

Date Issued:

January 9, 2017

January 2017

MICHAEL CALORE GEAR 03.07.17 3:28 PM

WORRIED THE CIA HACKED YOUR SAMSUNG TV? HERE'S HOW TO TELL

March 2017

https://www.wired.com/2015/07/hackers-remotely-kill-jeep-highway/
https://motherboard.vice.com/en_us/article/hackers-killed-a-simulated-human-by-turning-off-its-pacemaker
https://krebsonsecurity.com/2016/10/hacked-cameras-dvrs-powered-todays-massive-internet-outage /
http://www.reuters.com/article/us-johnson-johnson-cyber-insulin-pumps-e-idUSKCN12411L
http://www.fda.gov/MedicalDevices/Safety/AlertsandNotices/ucm535843.htm
https://www.wired.com/2017/03/worried-cia-hacked-samsung-tv-heres-tell/

Internet of things needs to be redefined as securely connecting devices, exchanging trusted data and delivering value through analytics and smart decisions

Cyber security: Where and Why it is important

Cloud and distributed system security

IoT Security

Network Security

Biometrics and Security

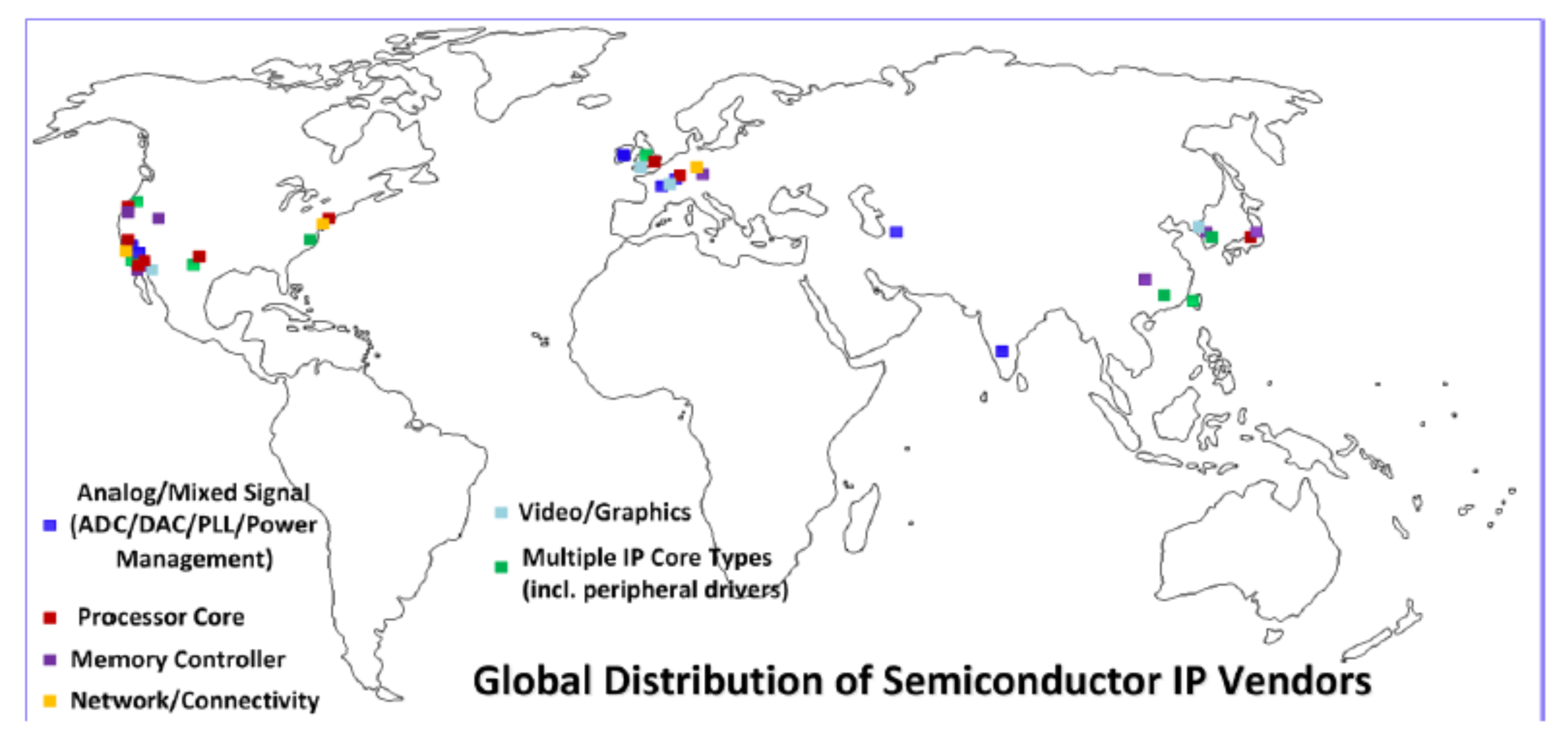
Supply Chain Security

Nanoscale Security

Hardware Security

Cyber security traditionally meant software, network and data security considering hardware as root of trust. This assumption is no longer true with evolving semiconductor business landscape .

IP Vendors Distributed Across the Globe


🟦 Analog/Mixed Signal (ADC/DAC/PLL/Power Management)
🟥 Processor Core
🟪 Memory Controller
🟨 Network/Connectivity
Video/Graphics
🟩 Multiple IP Core Types (incl. peripheral drivers)

Global Distribution of Semiconductor IP Vendors

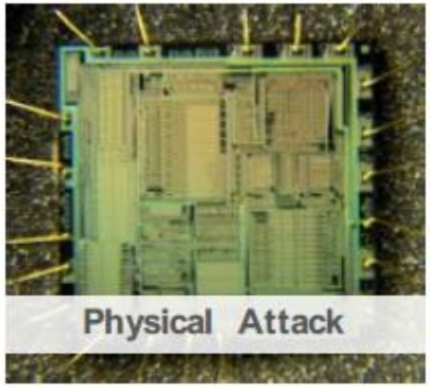
Long and globally distributed supply chain of hardware IPs makes SoC design increasingly vulnerable to diverse trust/integrity issues.

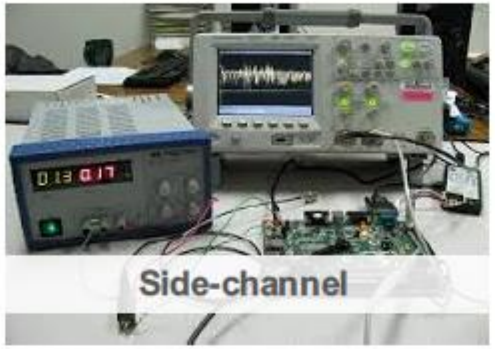
Security Attacks on Hardware

Trojans

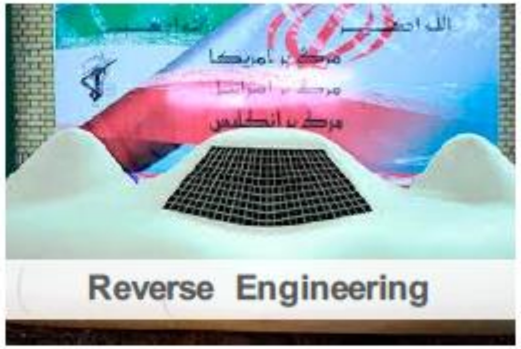
Untrusted Foundry

Counterfeit ICs


Physical Attack


Side-channel

Fault Injection


Reverse Engineering

Fake Parts

Research Projects

- **Hardware-Oriented Security and Trust (HOST)**
  - Physical Unclonable Functions
  - Authentication and Encryption
  - Differential power analysis countermeasures
  - Hardware Trojan Detection
  - Obfuscation of chip functionality
  - Secure Automotive ECU Design

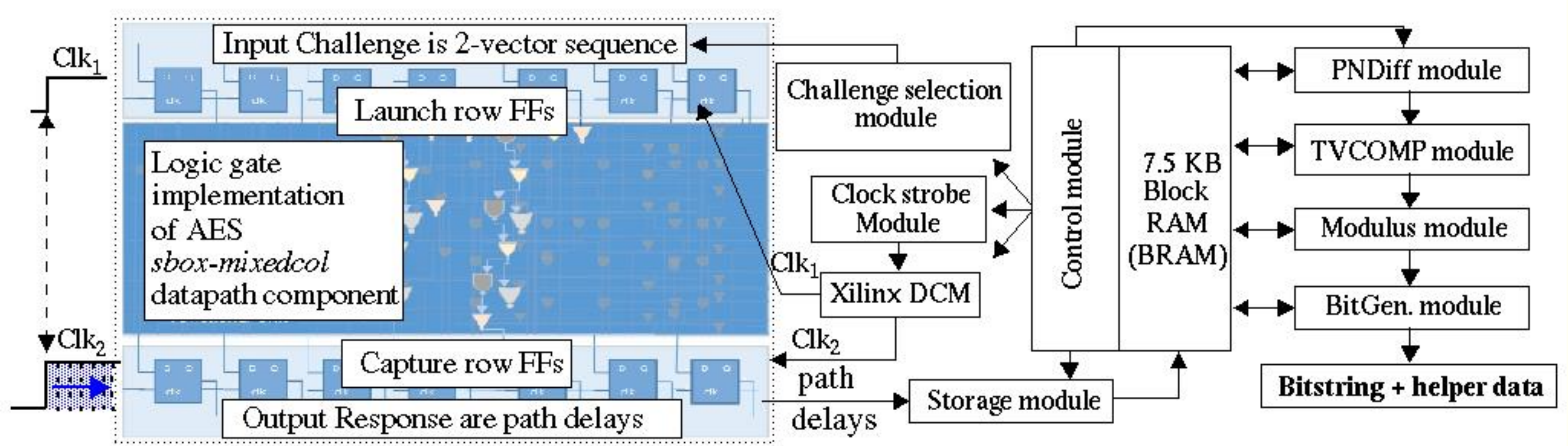
- **Embedded Systems**
  - TrustZone based hardware isolation
  - FPGA-based embedded systems
  - Hardware acceleration

THE INTERNET OF EVERYTHING
I TOLD YOU TO PICK UP MILK ON THE WAY HOME. DON'T YOU LISTEN TO ANYTHING I SAY?!!
BING
© D Fletcher for CloudTweaks.com

Security Research: PUFs

HELP entropy is path delays of existing functional units.

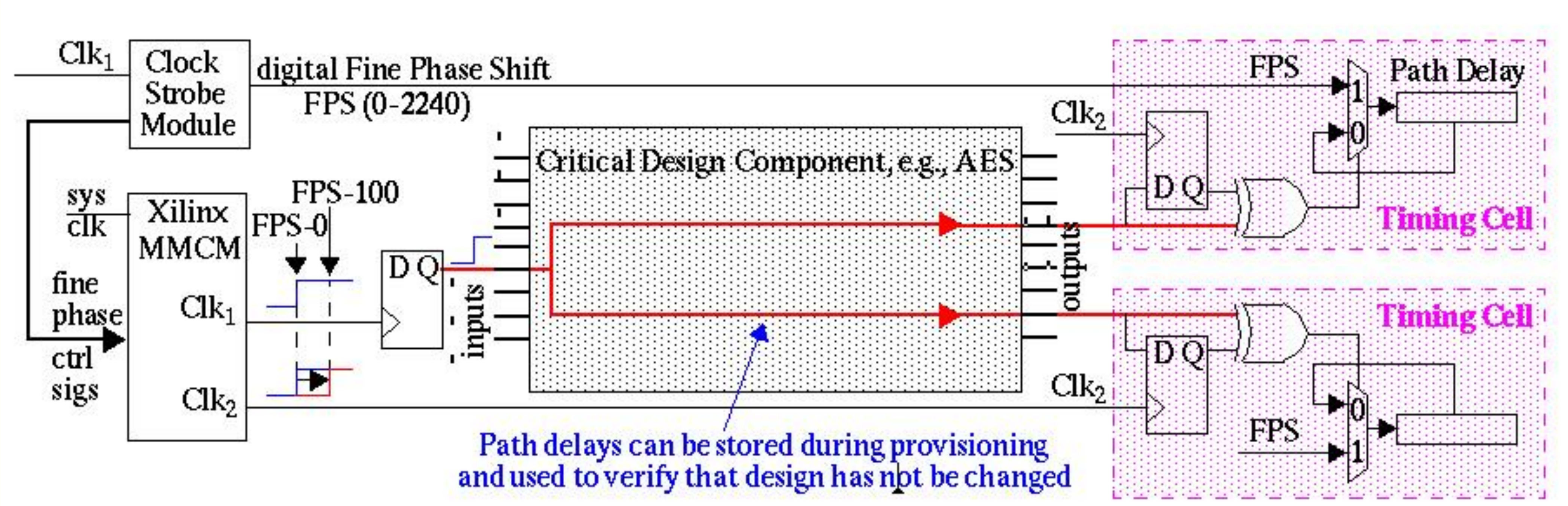
On-chip bitstring generation provides real-time identification.



Trust Research: Tamper Detection

Devise a water-marking mechanism by profiling path delays

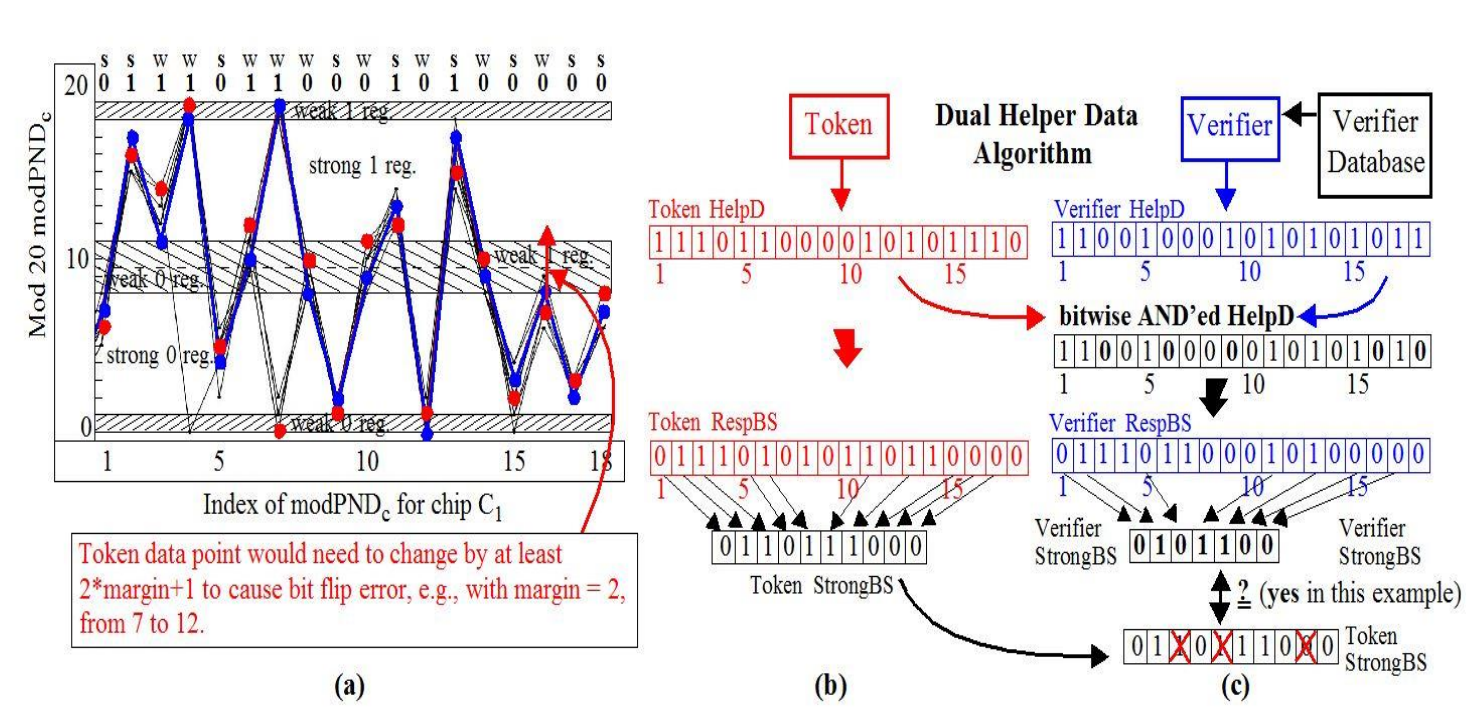
In-field chips compared with the time 0 to detect tamper



Path delays can be stored during provisioning and used to verify that design has not be changed

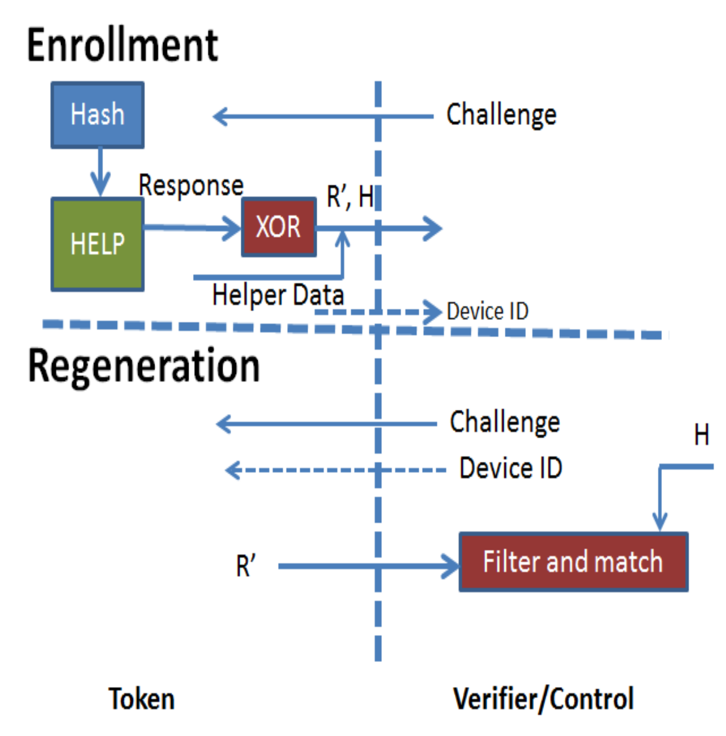
Privacy Preserved Authentication in Distributed Environment

A privacy-preserving, mutual authentication protocol using dual helper data



Token data point would need to change by at least 2*margin+1 to cause bit flip error, e.g., with margin = 2, from 7 to 12.

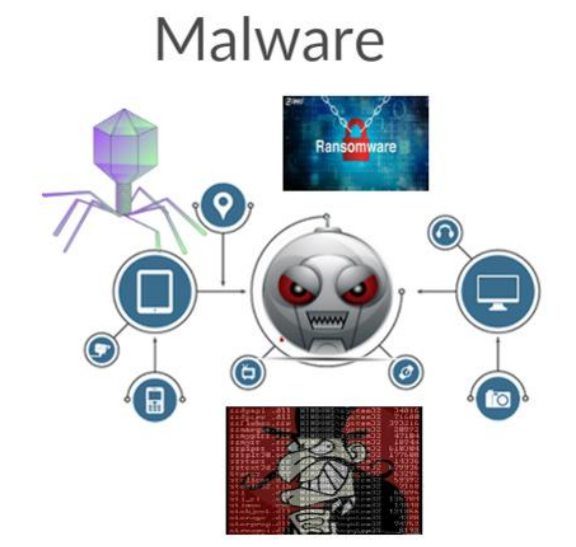
(a) (b) (c)

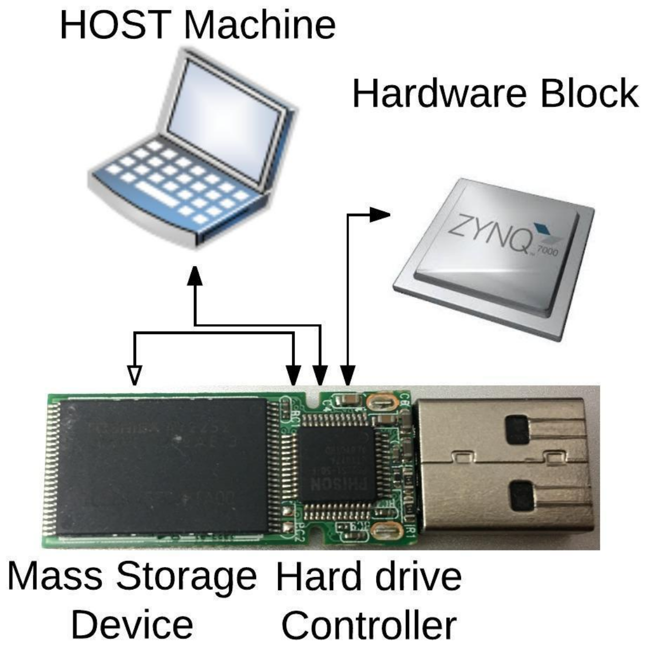


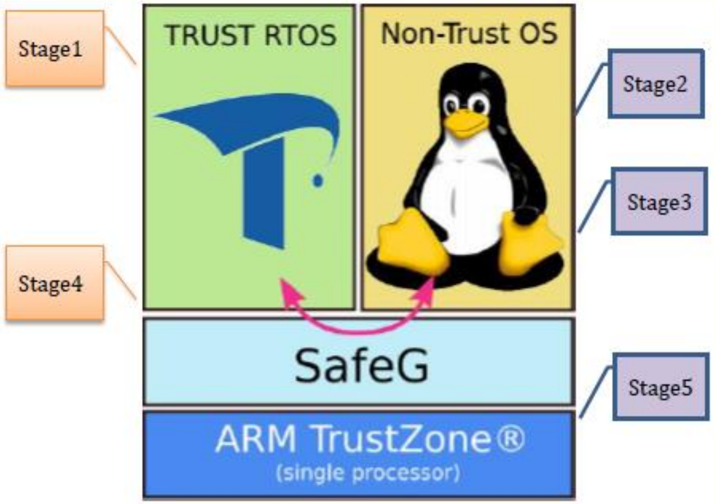
- Sponsored by NSF

Security based hardware isolation and Access Control

Techniques to mitigate malwares such as Rootkits and Bootkits







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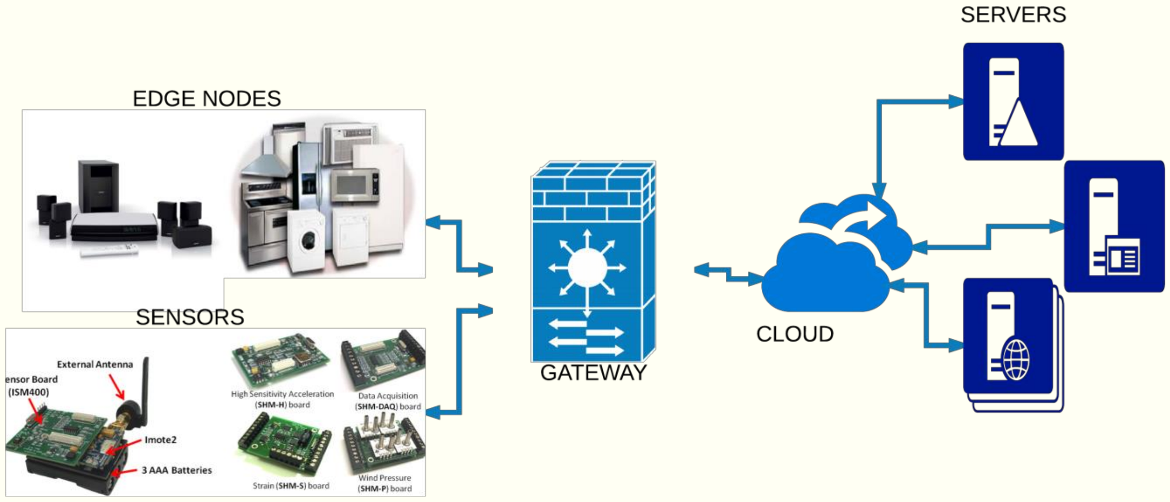
IoT Security Issues

- Provisioning keys and key management life cycle
- Security assessment of equipment connected via gateways, that were never intended to be connected.
- Device identification for device-to-device communication
- Availability and system resilience.
- Scalability



Requires holistic view of device to gateway to cloud and the communication between them.

Questions