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Battelle Barricade™

Electronic Component Authentication Technology

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Battelle - Serving a Broad Range of Clients

- Consumer & Industrial

- Energy & Environment

- Health & Analytics

- Laboratory Management

- National Security

- Pharmaceutical & Medical Devices

- STEM Education

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National Security

- Advanced Manufacturing & Design
- CBRNE Defense
- Critical Infrastructure
- Cyber Innovations
- Data Analytics
- Demilitarization
- Identity Management
- Life Sciences Research
- Maritime Systems
- Medical Readiness & Response
- Tactical Systems

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Electronic Component Authentication as an Anti-counterfeiting Tool: Battelle Barricade™

The Problem

- Counterfeits in the supply chain: ranging from primitive chip harvesting to sophisticated cloning
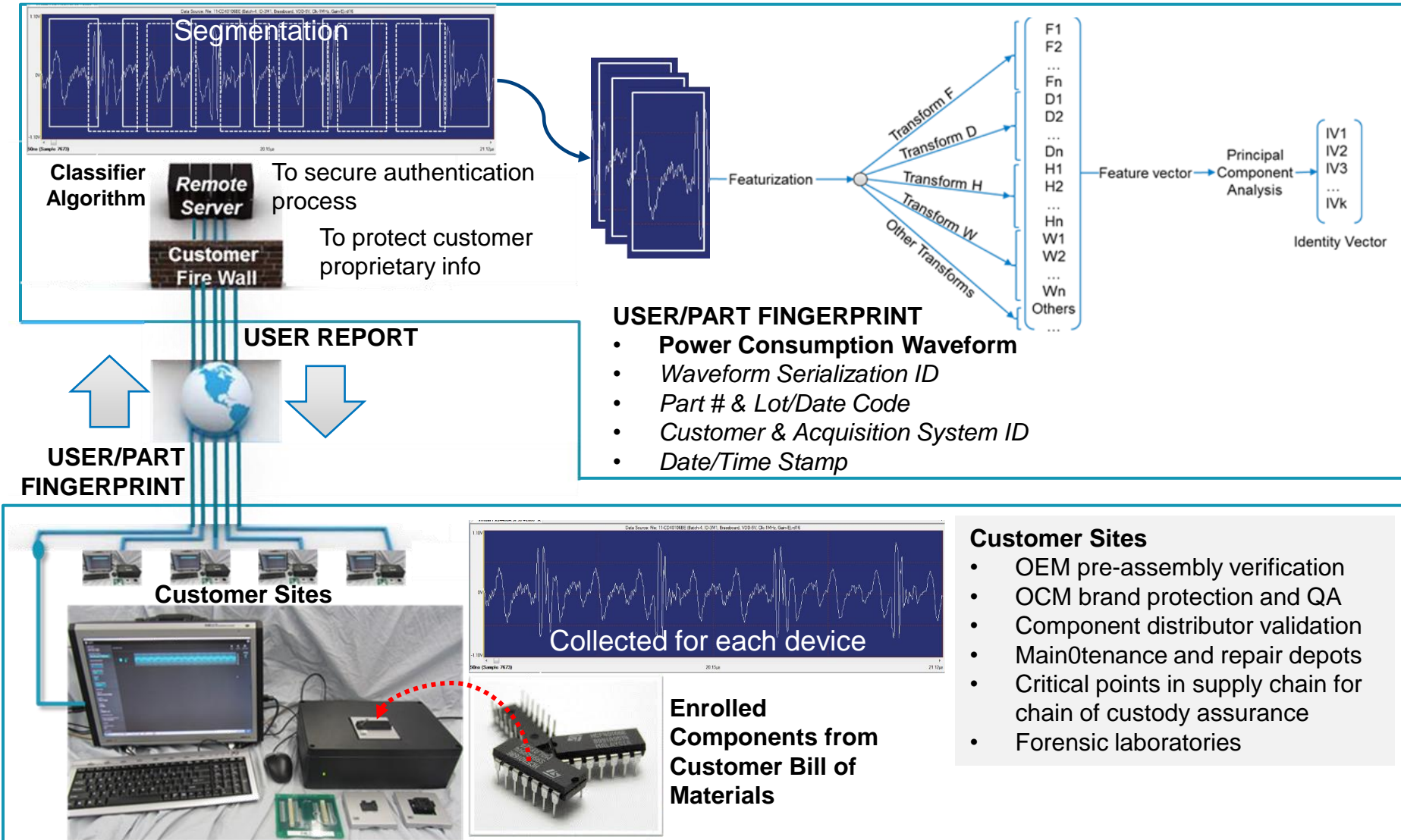
- Weaponized hardware
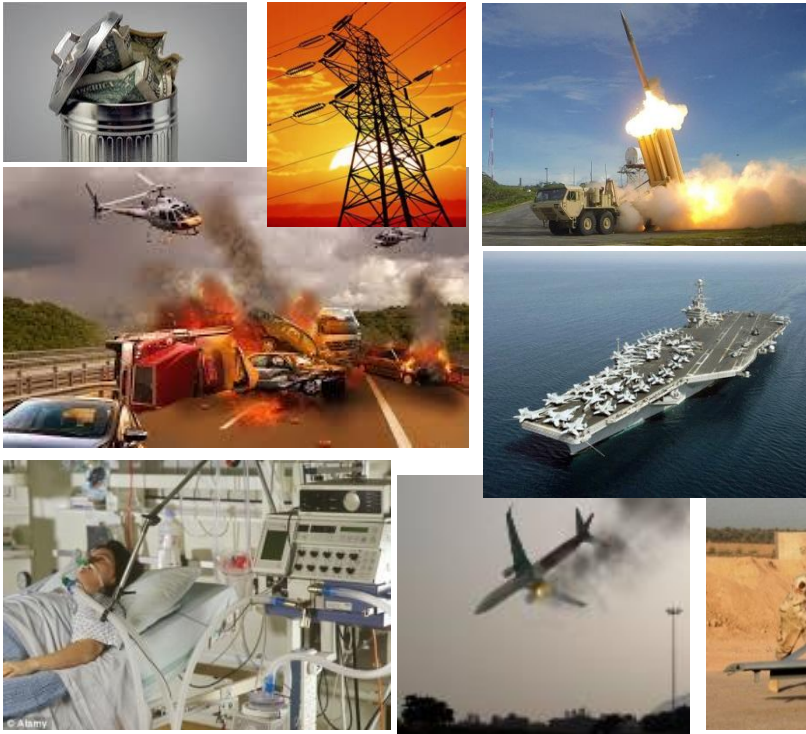
The Solution

- Nondestructive **classification** based on the effect environmental exposure and systematic manufacturing variations have on the electrical characteristics of components (<u>classifying on similarities and not anomalies</u>)
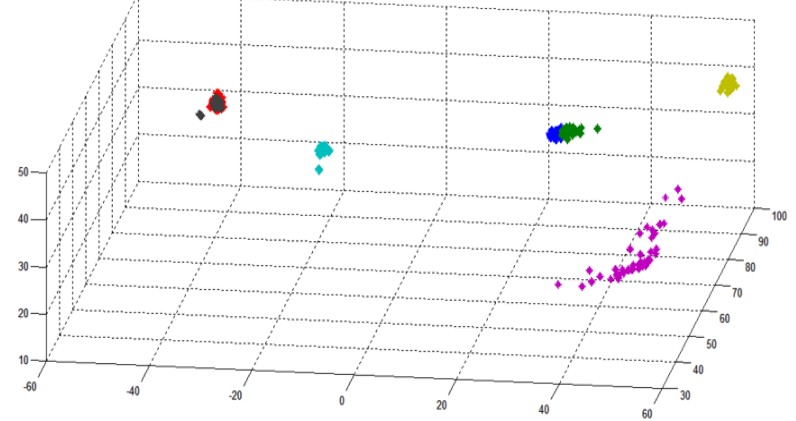
Why it matters

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What is Battelle Barricade™ and how does it work?

Segmentation

Classifier Algorithm

Remote Server

Customer Fire Wall

To secure authentication process

To protect customer proprietary info

Featurization

Transform F
Transform D
Transform H
Transform W
Other Transforms

F1, F2, …, Fn, D1, D2, …, Dn, H1, H2, …, Hn, W1, W2, …, Wn, Others, …

Feature vector

Principal Component Analysis

IV1, IV2, IV3, …, IVk

Identity Vector

USER REPORT

USER/PART FINGERPRINT

USER/PART FINGERPRINT
- **Power Consumption Waveform**
- *Waveform Serialization ID*
- *Part # & Lot/Date Code*
- *Customer & Acquisition System ID*
- *Date/Time Stamp*

Customer Sites

Collected for each device

Enrolled Components from Customer Bill of Materials

Customer Sites
- OEM pre-assembly verification
- OCM brand protection and QA
- Component distributor validation
- Main0tenance and repair depots
- Critical points in supply chain for chain of custody assurance
- Forensic laboratories

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How good are the results?

Part Number	Class (family)	Subclass (temp. grade)	ID	Notes
MC68HC908EY16ACFJE	EY16	C	AC	all same date codes
MC68HC908EY16AMFJE	EY16	M	AM	all same date codes
MC68HC908RF2CFA	RF2	C	CF	all same date codes
MC68HC908RF2MFA	RF2	M	MF	all same date codes
MC68HC908GR16CF	GR16		GR	all same date codes
MC68HC908JB16FAE	JB16		JB	all same date codes
MC68HC908JL16CFJE	JL16		JL	all same date codes

Power Consumption Waveform → Featurization → PCA → kNN

TP: true positive (classifies an authentic part as authentic)

FP: false positive (classifies a counterfeit part as authentic)

		k Nearest Neighbor Classifier Results using 5 training samples (99% confidence level)												
		AC	AM	CF	MF	GR	JB	JL	UNK	TP %	FP %	FN %	TP %	FP %	FN %
True Class Identity	AC	42	3	0	0	0	0	0	0	93	7	7	100	0	0
	AM	3	42	0	0	0	0	0	0	93	7	7			
	CF	0	0	26	19	0	0	0	0	58	7	42	100	0	0
	MF	0	0	3	42	0	0	0	0	93	42	7			
	GR	0	0	0	0	45	0	0	0	100	0	0			
	JB	0	0	0	0	0	45	0	0	100	0	0			
	JL	0	0	0	0	0	0	45	0	100	0	0			

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How good are the results? Tests performed on SMT supplied parts

Component		Test Description	Classifier Accuracy	
	3-bit decoder DM74LS138N (FAIRCHILD, NATIONAL) SN74LS138N (MOTOROLA, TI)	25 authentic samples from each of 4 different manufacturers having the same part number	95%	Discriminating manufacturers
	hex Schmidt inverter CD40106 (TI)	10 samples each of authentic and cloned components	100%	Discriminating authentic and cloned parts
	windowed EPROM M2732A-2F1 (ST MICRO)	10 samples each of authentic and counterfeit parts	100%	Discriminating authentic and counterfeit parts
	quad NAND gate SN74S00N (TI)	10 authentic samples each of 4 different date/lot codes from the same manufacturer	80%-90%	Discriminating date/lot codes
	8 bit shift register SN74HC164N (TI)	15 authentic samples and 16 clones	100%	Discriminating authentic and cloned parts
	multichannel transceiver MAX232CPE (Maxim)	4 authentic samples and 7 clones	100%	Discriminating authentic and cloned parts

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Battelle Barricade™ Summary

Attributes

- Nondestructive
  - Authenticate 100% of component inventory except for training samples if from an untrusted source

- Nonintrusive
  - No chip design modification or physical alteration
  - No insertion of technology into the manufacturing process of a trusted source

- High confidence/reliability
  - True positive (classifies an authentic part as authentic) goal of >95%
  - False positive (classifies a counterfeit part as authentic) goal of <1%

- Simple to use graphical user interface

- Low cost per part (pennies per part)

- High throughput rate (<< seconds per part)

Classifier Component Discrimination

- Authentic parts by part number, manufacturer, country of origin, temperature grade, date/lot code,…)

- Counterfeits
  - Die substitution
  - Age and environmental exposure
  - Temperature grade remarking
  - Clones

- Hardware Trojans

Authenticated Components and Counterfeits/Clones Data Repository

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