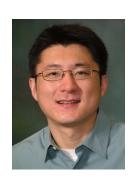
# SPARCHS: Hardware Support for Software Security











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# **SPARCHS\*** Guiding Principle

## Current Security

#### Reactive

"Show me a real-life incident"

## Top-down

Most attention to the most exposed layers

# Security as an add-on

- "Asserts" are removed
- AV/IDS shutdowns

## SPARCHS Security

#### Proactive

 Protect against known & unknown attacks

## Bottom-up

Hardware support for software security

## Security from get go

- Assume flaws exist
- Defend the defenses

<sup>\*</sup>Symbiotic, Polymorphic, Autotomic, Resilient, Clean-slate, Host Security

# **SPARCHS: Clean-slate security**

#### **Advances**

- Hardware support for dynamic diversity, protected execution, recovery & adaptive learning
- Challenge: Is this enough?

#### **Benefits**

- Cover common sources of insecurity
- Lack of security, buggy security or static security

#### Context

- Multi/Many-core architectures; serial and parallel codes
- Energy-efficiency and reliability constraints

# **Bio Security & Analogues**

#### Innate Immunity

- Body "knows" local and foreign organisms
- Better information flow tracking
- Track implicit flows with improved static analysis; and better performance

#### Adaptive Immunity

- Body learns from past attacks
- Support for Adaptive Learning
- Improve processor's ability to monitor software execution

#### Symbiotic Immunity

- A new type of immunity inspired by microbiomes
- Every program must have a security symbiote
- Symbiote encapsulates security function

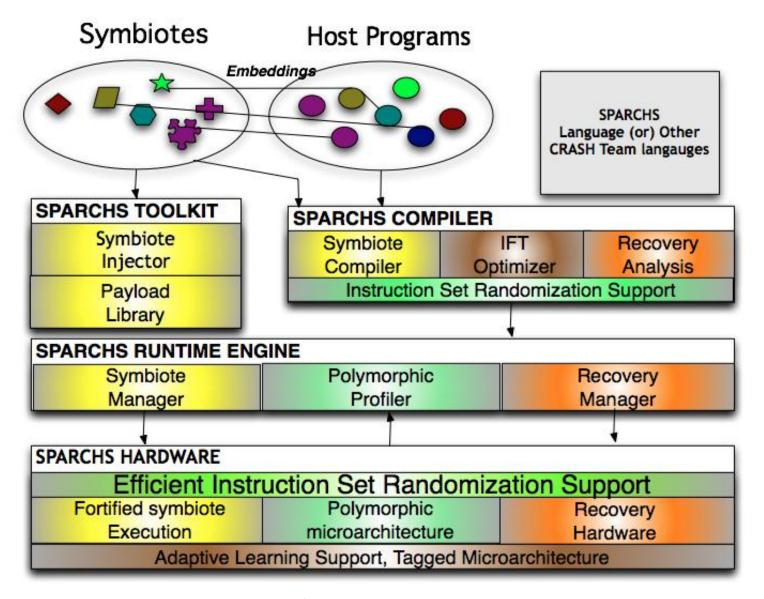
#### Defensive Polymorphism

- Shape-shifting hardware and software for diversity including ISR
- Inspired by shape-shifting viruses in nature (e.g., HIV, Cold)
- Protects against deterministic and non-deterministic bugs

#### Defensive Autotomy (not mispelled)

- Lose non-critical functions under attack
- Hardware and software for continued operation
- Expensive but useful e.g., lizards dropping tails

# Integrated SPARCHS System



# **Status**

- Four year, multi PI project, 2 quarters completed
  - Adaptive Immunity
    - Released a low-overhead tool that will allow x86 performance counters to be read. Useful for adaptive learning. [ISCA 11]
  - Dynamic Polymorphism
    - Released a software prototype of Instruction Set Randomization.
       Precursor to HW prototype.
  - Innate Immunity
    - Very fast IFT nearing release. Almost zero overhead
  - Symbiotic Immunity
    - Created embedded and system level attacks to demonstrate utility of software symbiotes
- We are looking for PhD students, Post Docs, Engineers and Collaborators. Much more exciting work to be done.
  - Contact: <u>simha@cs.columbia.edu</u>, <u>sal@cs.columbia.edu</u>
  - Learn more: http://castl.cs.columbia.edu/sparchs