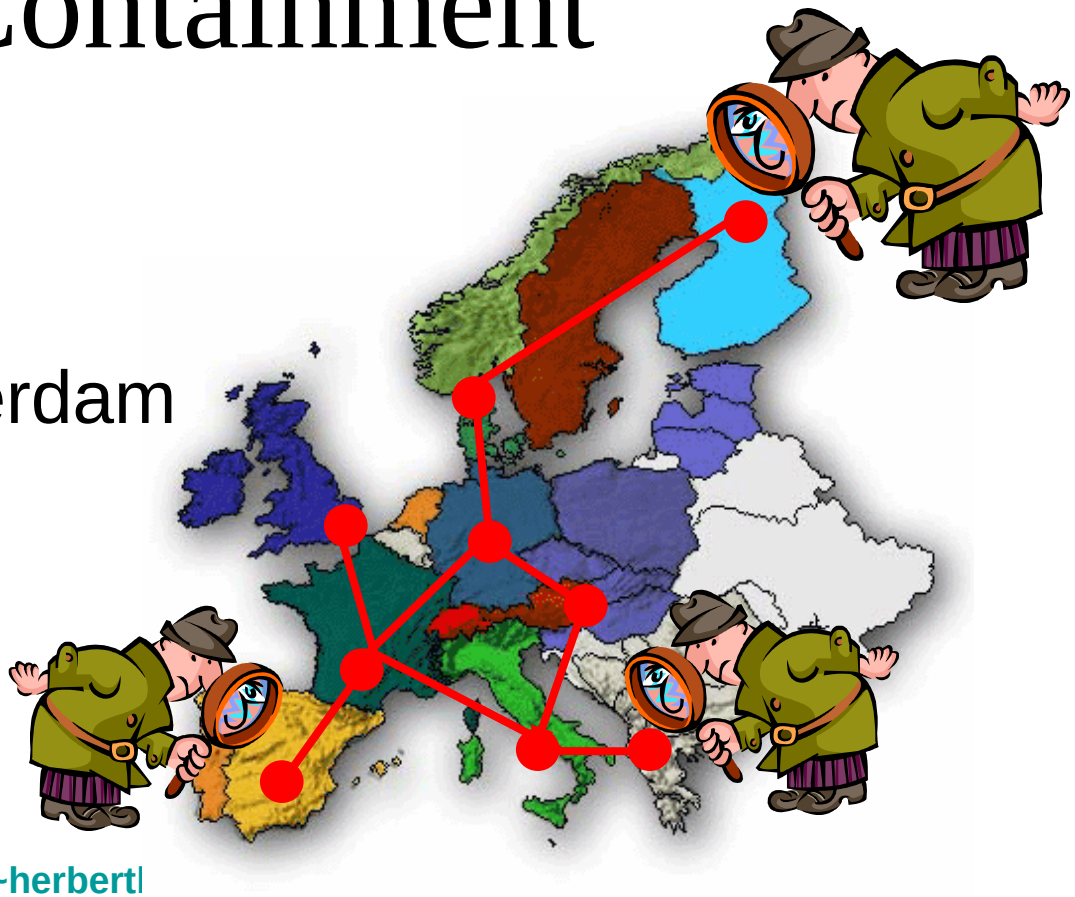
personal view on the future of

ero-day Worm Containment



Herbert Bos
Vrije Universiteit Amsterdam
herbertb _AT_ cs.vu.nl
http://www.ist-lobster.org/

What is LOBSTER?

lobster An IST Project

Information Society Technologies

http://www.ist-lobster.org/

- FP6 Specific Support Activity (SSA)
- Duration: 09/2004 – 12/06
- Partners
  - FORTH
  - Vrije Universiteit Amsterdam
  - TNO ICT
  - CESNET
  - UNINETT
  - FORTHnet
  - ALCATEL
  - TERENA
  - Symantec?

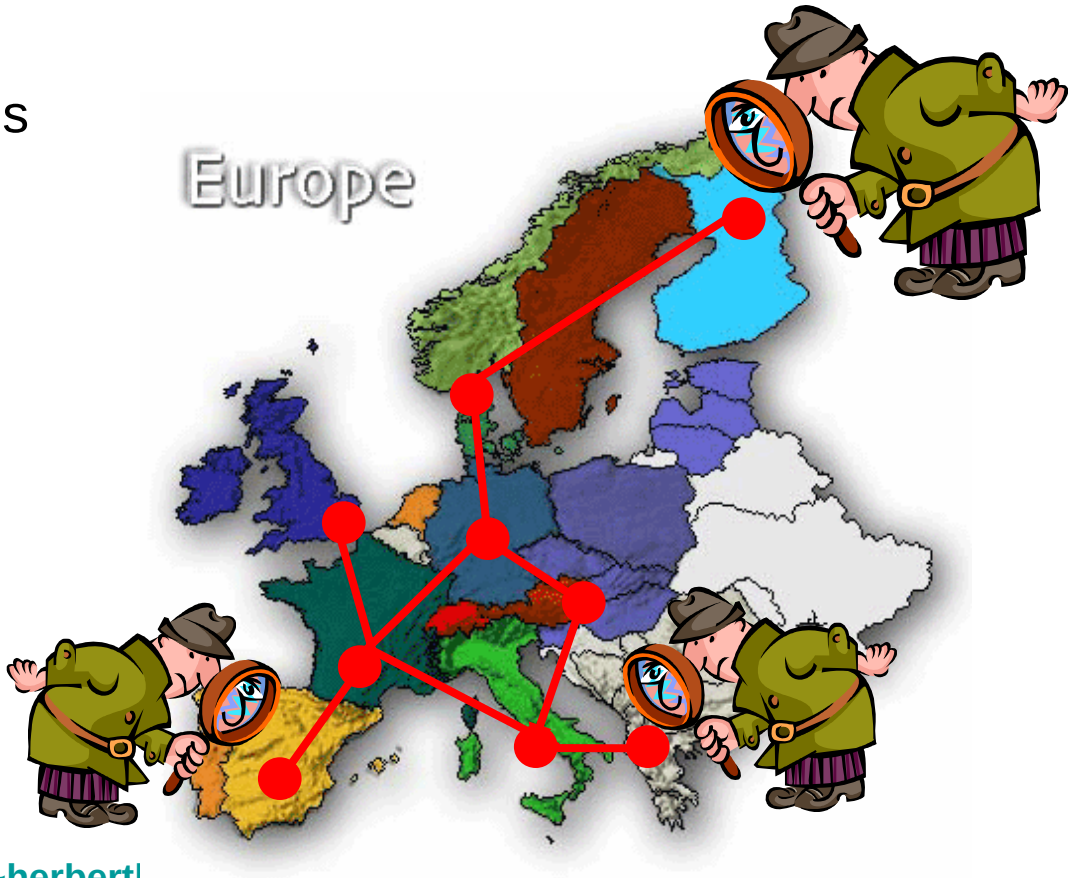
What is LOBSTER?

lobster An IST Project

Information Society Technologies

http://www.ist-lobster.org/

- European Infrastructure for accurate network monitoring
- Allows one to perform pan-European monitoring
  - across organisations
- High-speed
  - specialised network cards
  - also: common NICs
- Why?
  - traffic classification
  - security
    - worms
    - DDoS
  - performance
  - billing
  - management



Privacy

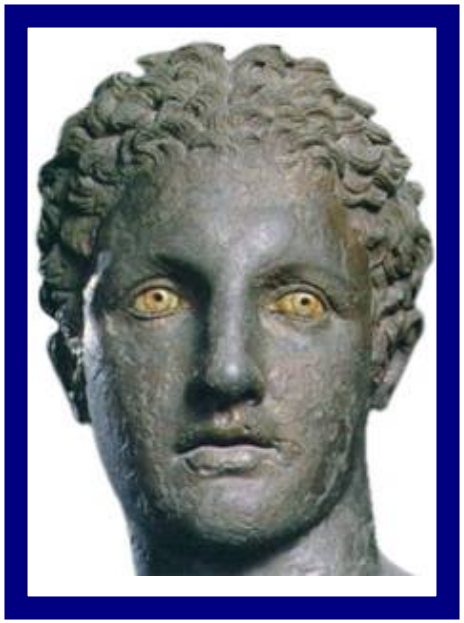
Information Society Technologies

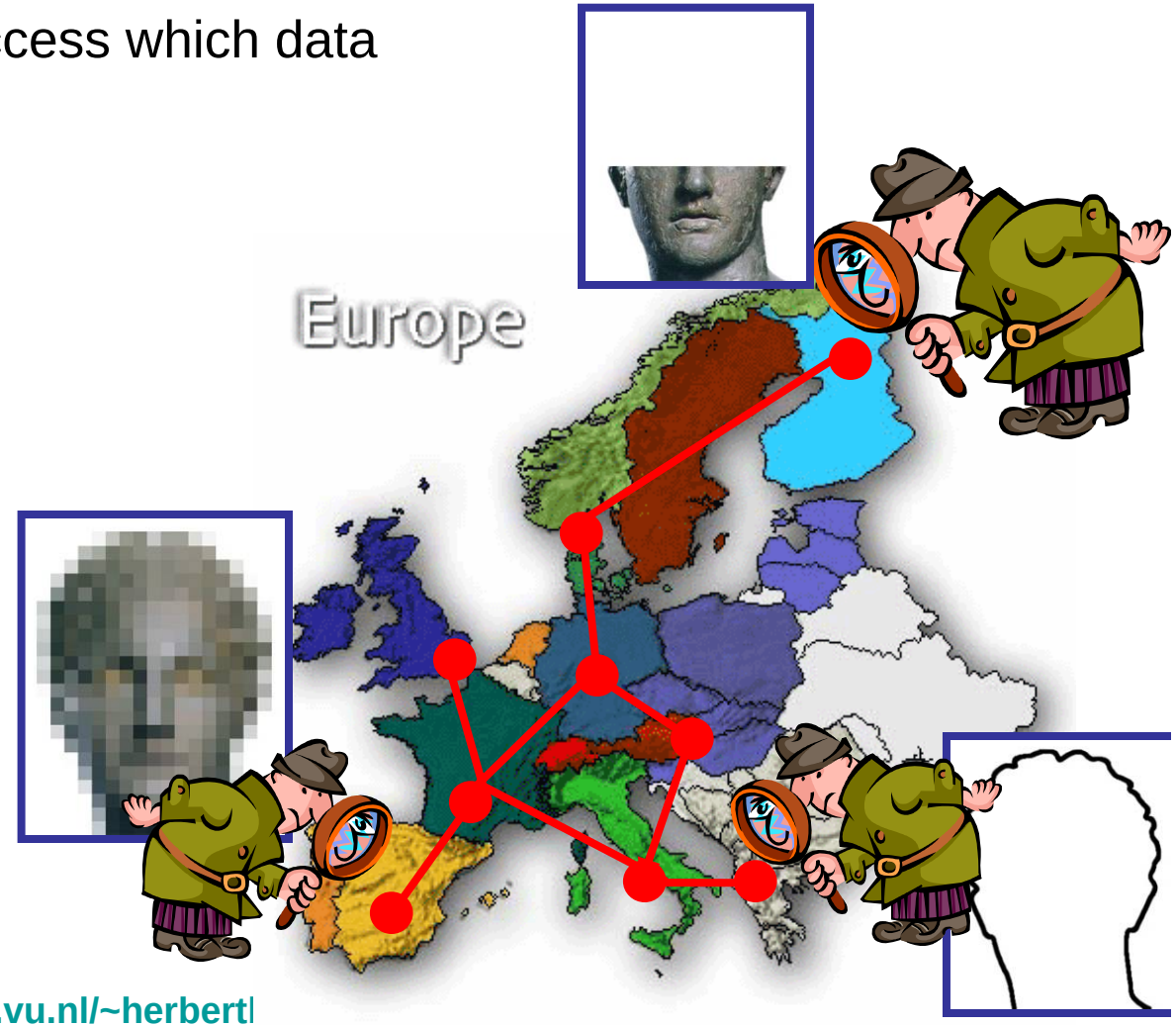
Anonymise!

- a shared monitoring infrastructure
  ➔ what about **privacy**?!

What is LOBSTER?

- Data owners control
  - which users may access which data
  - very flexible





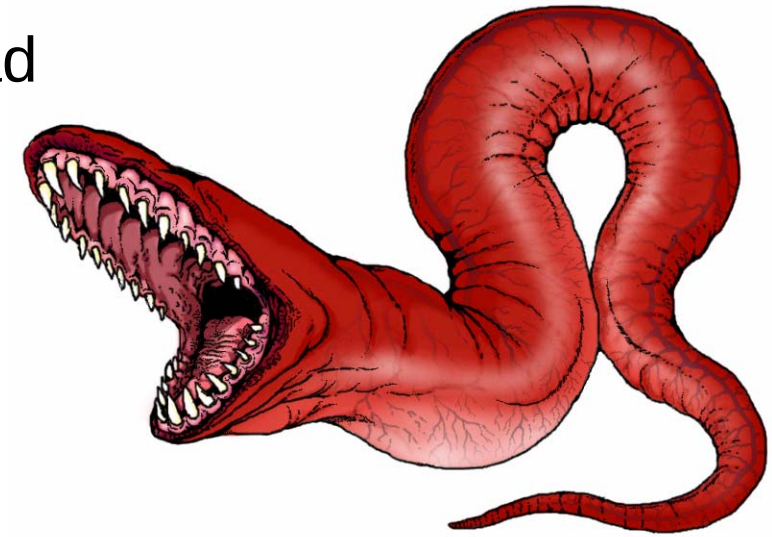
Passive Monitoring and Security

- Intrusion Detection
  - Are any of my computers compromised?
  - Is there any attacker trying to intrude into my network?
- Large-scale Attack Detection – Detection of Epidemics
  - DoS Attack detection (e.g., detect sharp increases in TCP/SYN packets)
  - Zero-day worm detection
    - e.g., detect lots of identical packets, never seen before, from several sources to several destinations
    - e.g., unusual no. of connections from a single port to unique destinations
    - e.g., detect worm characteristics
      - such as NOP sleds: long sequences of executable code
- Network Telescopes
  - monitor unused IP addresses
  - observe victims of DoS attacks
    - “back-scatter” traffic
  - observe infected hosts
  - port scans

Zero-day worm containment

- Why do we need it?
  - detect something new is on the loose
  - worms spread too fast for human intervention
- Different worms in different forms
  - fast ←→ slow
  - polymorphic ←→immutable
  - wide spread ←→ narrow spread
  - stealth ←→ plain
  - multi-vector ←→ uni-vector
- Worm structure

exploit	payload

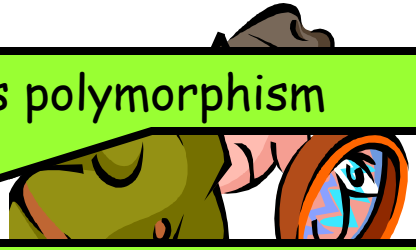


Two tasks

- Spot the bad guys
  - network-based
    - content-based: EarlyBird
    - flow-based: VirusThrottling
  - host-based
    - honeypots
    - end-users (systrace)
- Stop them!
  - filters for networks
    - snort
    - VirusThrottle
  - filters for hosts
    - Self-Certifying Alerts

- can be fast (certainly flow-based)
- protects many hosts

- handles polymorphism



- can be very accurate (no false positives)
- *may* handle polymorphism

- handles polymorphism

- protects many hosts

- polymorphism

- few false positives
- some polymorphism?

Two tasks

- Spot the bad guys
  - network-based
    - content-based: EarlyBird
    - flow-based: VirusThrottling
  - host-based
    - honeypots
    - end-users (systrace)
- Stop them!
  - filters for networks
    - snort
    - VirusThrottle
  - filters for hosts
    - Self-Certifying Alerts

- false positives
- what to do with encryption?

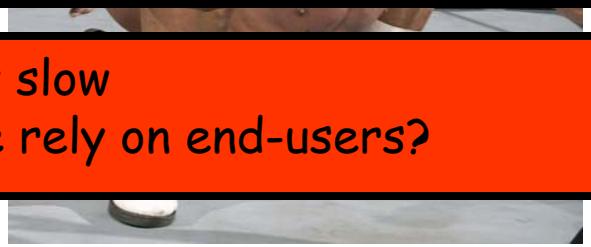
- false positives

- slow
- needs a certain amount of luck
- need real services for accuracy

- false positives

- encryption/polymorphism will kill us

- false positives



- pretty slow
- can we rely on end-users?

My conclusion (1/4)

- detection
  - network-based
    - behaviour-based
      - first indication
    - content-based:
      - weed out known and old threats
      - first indication for new threats
  - host-based
    - inaccurate behaviour based: first indication
    - accurate behaviour based:
      - zero-day detection
      - verification
    - should not handle full streams

My conclusion (2/4)

- blocking
  - network-based
    - behaviour-based:
      - no (unless exceptional circumstances)
    - content-based:
      - weed out known and old threats
      - first indication for new threats
  - host-based
    - good place for filtering, but scope of protection limited
    - end-host, so filtering should be fairly efficient

My conclusion (3/4)

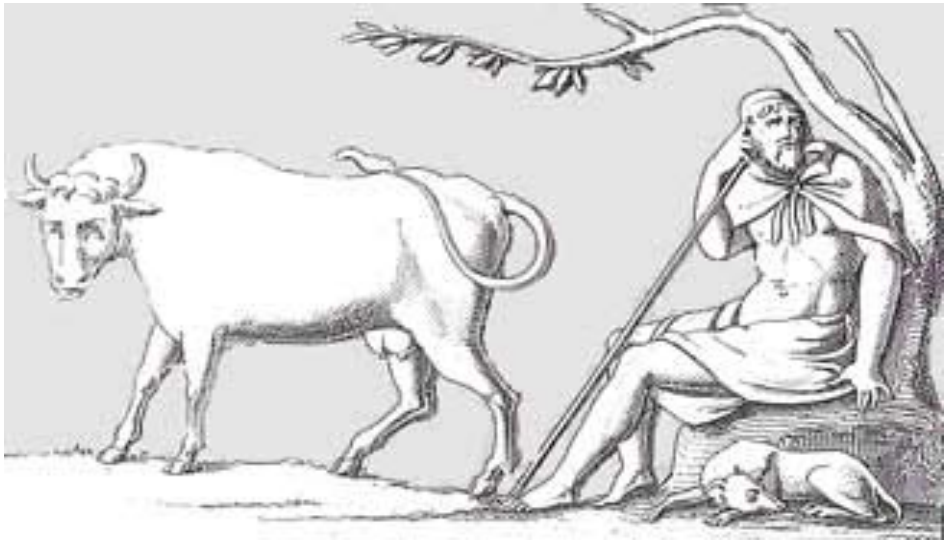
- future of network-based content inspection for zero-day worm detection

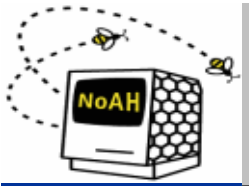
My conclusion (4/4)

- passive monitoring still needed, but role is changing
  - redirect traffic
  - sample traffic
  - first-pass detection
  - first-pass filtering
  - behaviour-based detection
- explore
  - multi-tier detection
  - multi-tier filtering
  - integrated approaches
  - cocktail-drugs for Internet diseases?

Fingerprinting zero-day attacks and using advertised honeypots

(or: guarding the heifer without falling asleep)





noah

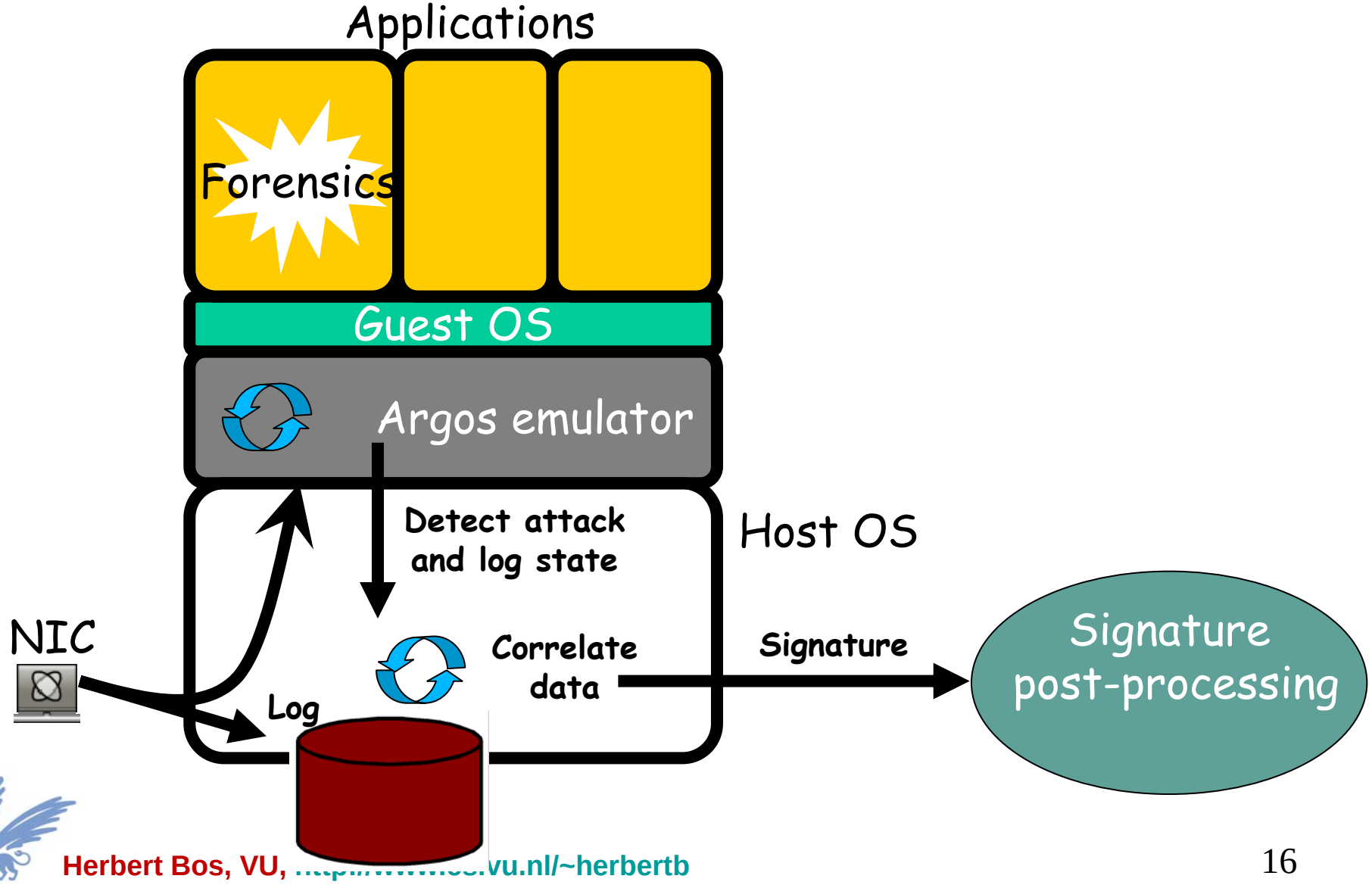
Argos Overview

Information Society Technologies

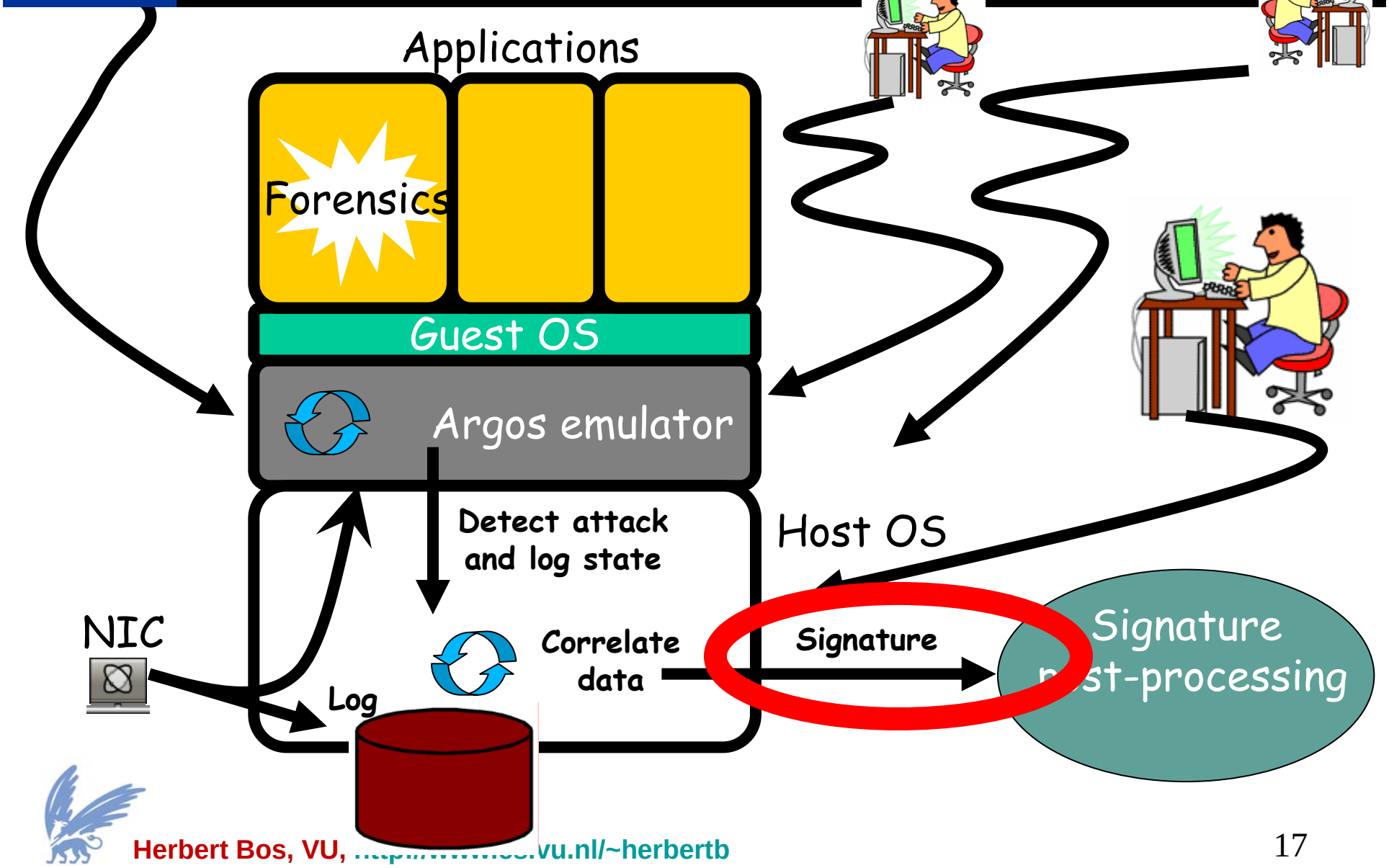
http://www.ist-lobster.org/

- Platform for next generation honeypots
  - High-interaction, advertised, safe
- Detection of most common vulnerabilities
  - Control, code injection, function argument attacks
- Emulate + protect entire PC systems
  - OS agnostic, run on commodity hardware
- Generate host and network intrusion prevention signatures
  - Protect even uncooperative users
- Joint development with Dutch DeWorm project (VU)

rgos Overview



rgos Overview



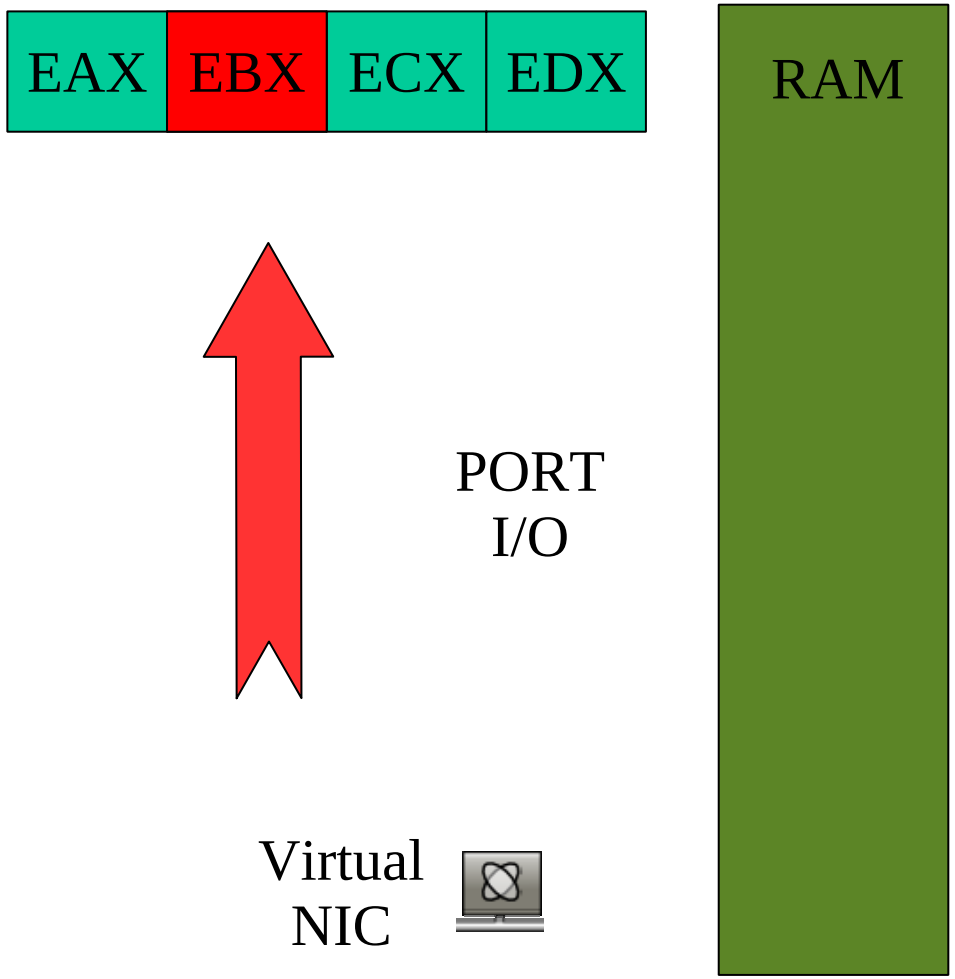
Development up to Present

- Based on the Qemu emulator
- Track network data throughout execution
- Detect illegal uses of network data
  - Jump targets, function pointers, instructions, system call arguments
- Forensics to generate signatures
  - Export emulator state, inject “forensics” shellcode

skip boring details

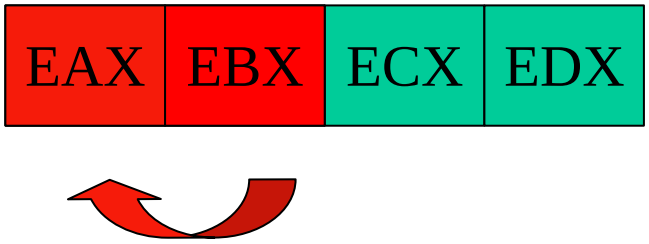
Network Data Tracking

- Tagging network data as “tainted”

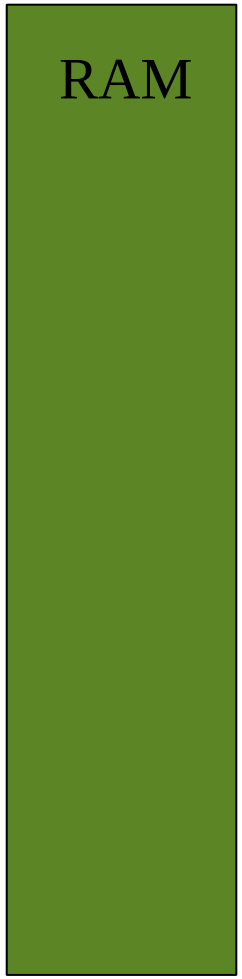


Network Data Tracking

- Tagging network data as “tainted”
- Tracking “tainted” data
  - ALU operations



ADD EAX, EBX



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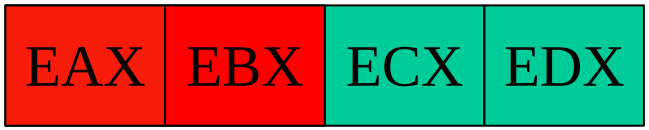
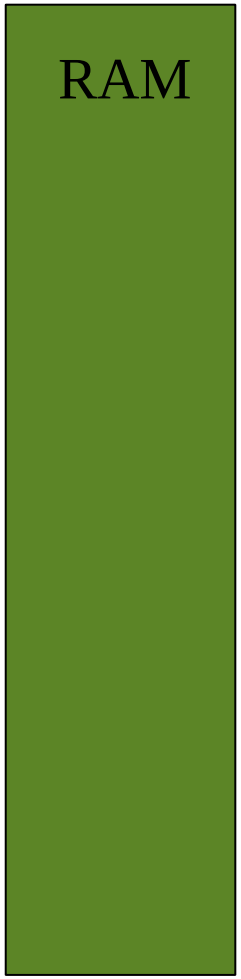


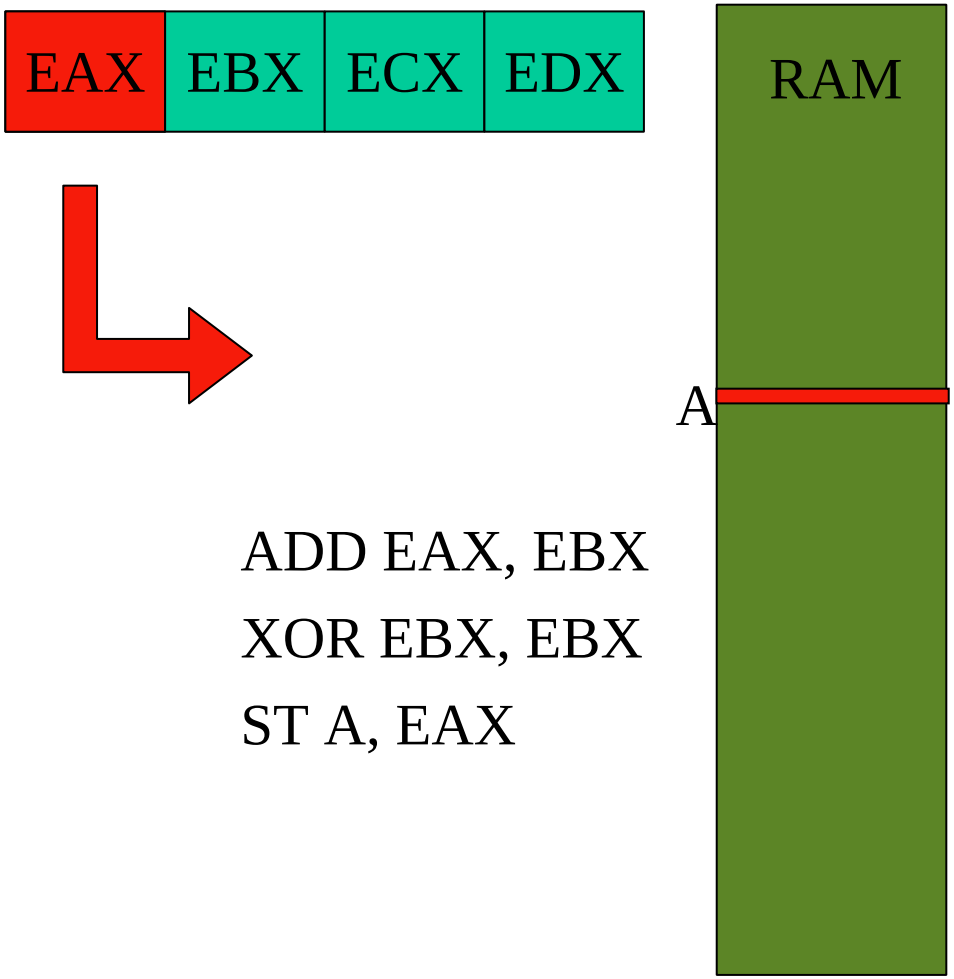


ADD EAX, EBX

XOR EBX, EBX

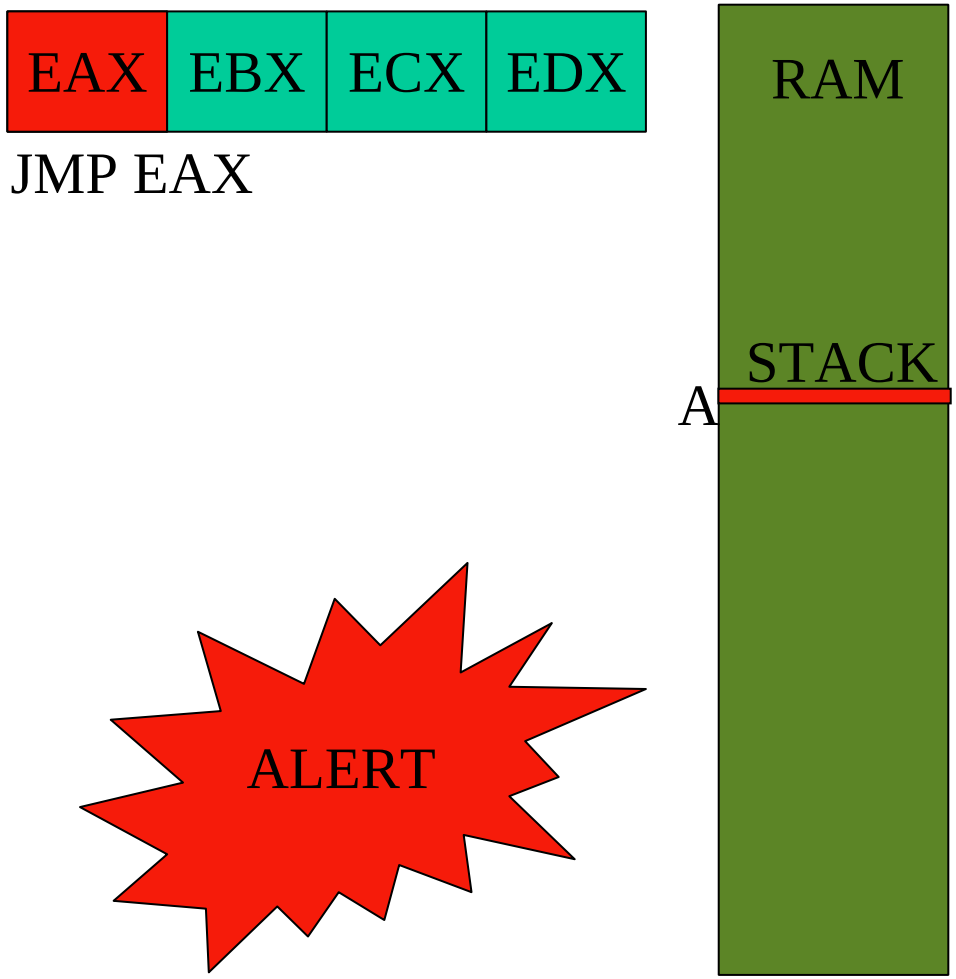
Network Data Tracking

- Tagging network data as “tainted”
- Tracking “tainted” data
  - ALU operations
  - MMU operations



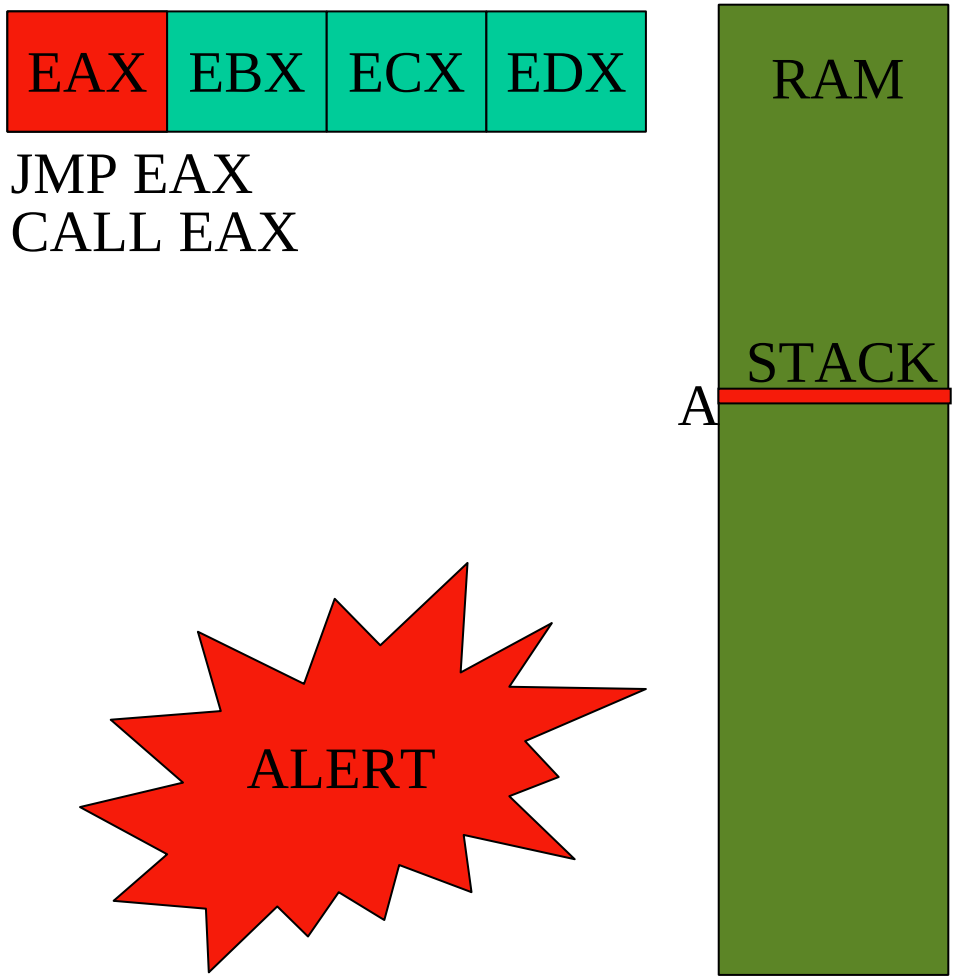
Identifying Attacks

- Jump targets



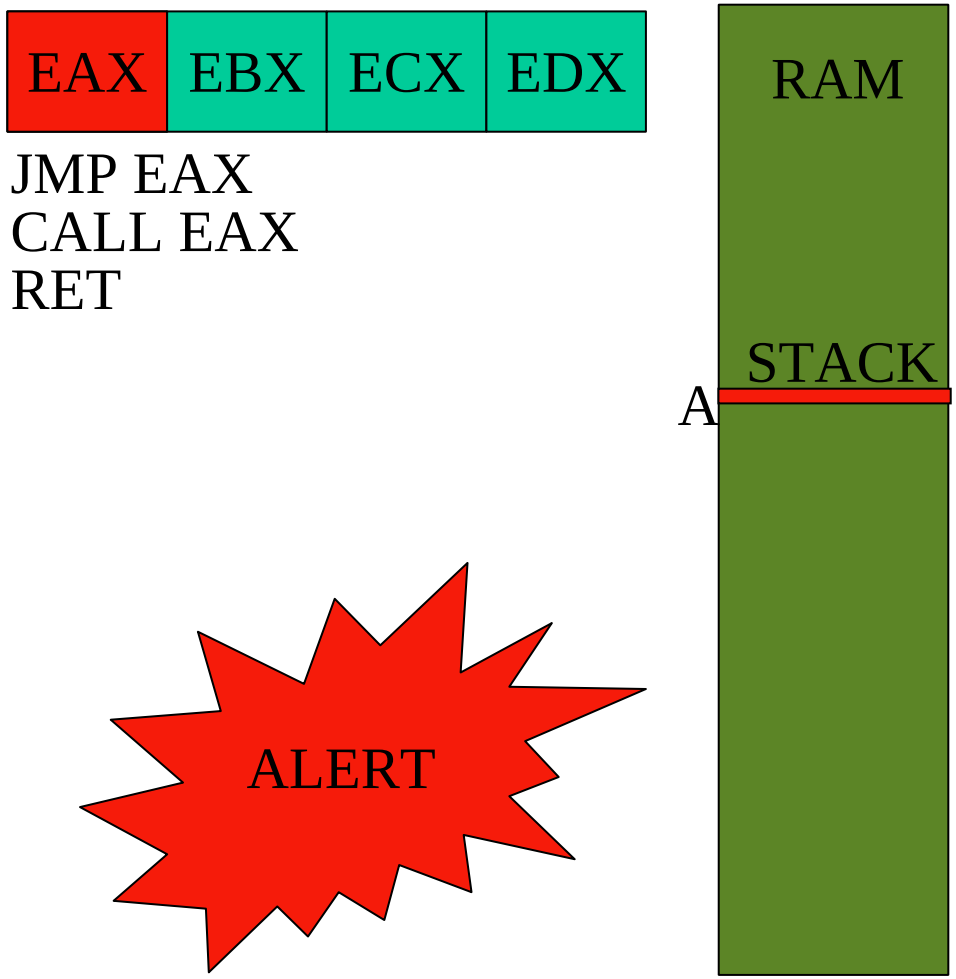
Identifying Attacks

- Jump targets
- Function calls



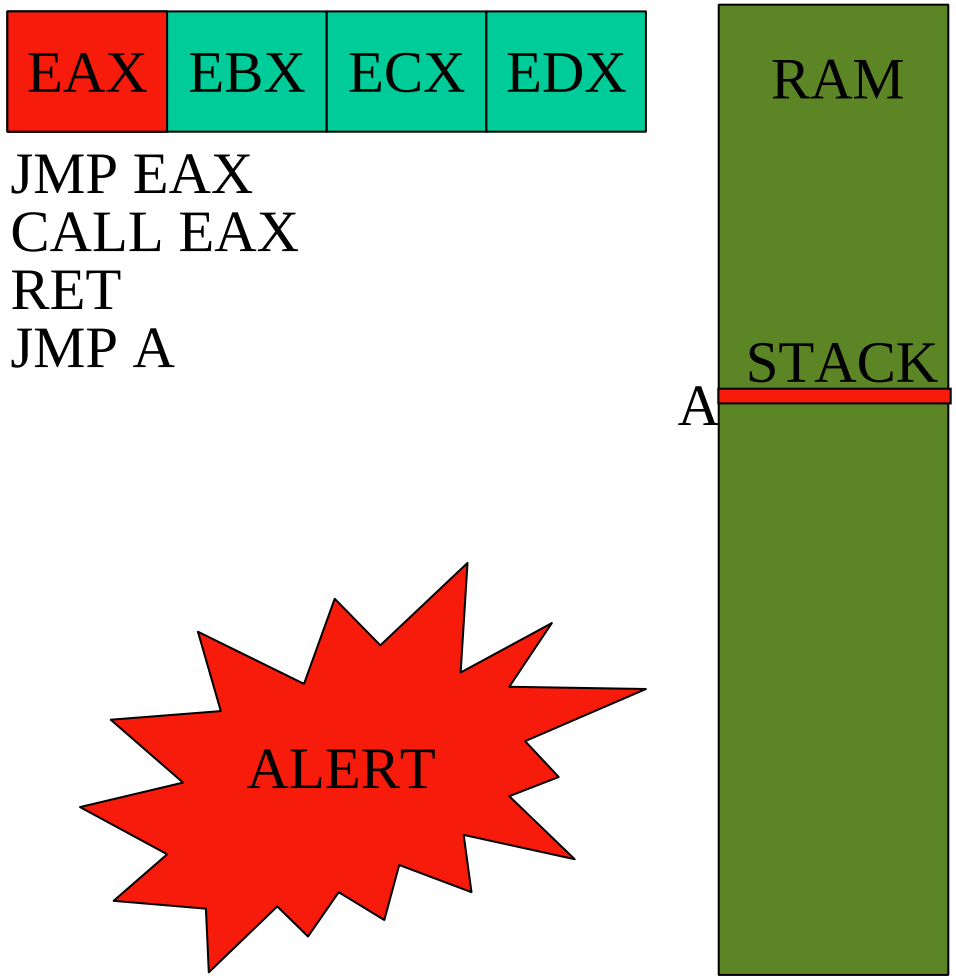
Identifying Attacks

- Jump targets
- Function calls
- Returns



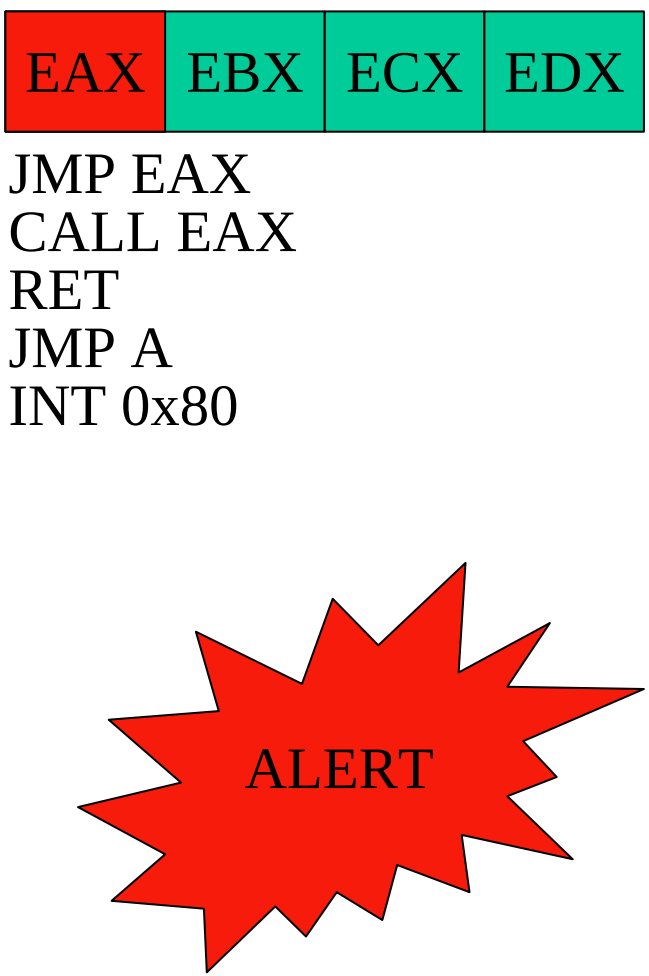
Identifying Attacks

- Jump targets
- Function calls
- Returns
- Code injection



Identifying Attacks

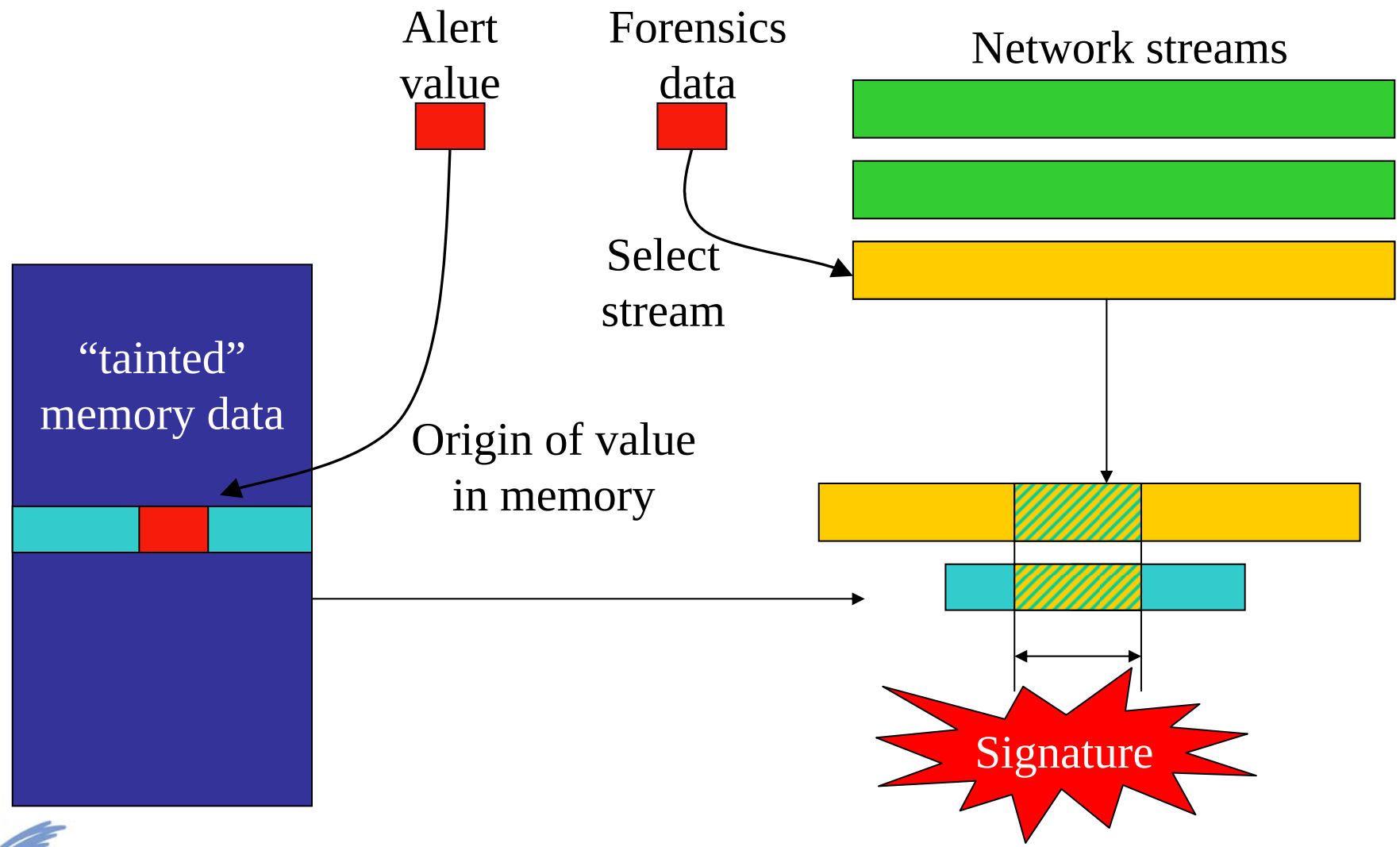
- Jump targets
- Function calls
- Returns
- Code injection
- System calls



Forensics

- Emulator state (registers, “tainted” memory)
- Injected shellcode data
  - Process information (e.g. PID)
  - Extraction of probable target port PID → Name → Port
- Network trace

Signature Generation



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Go qemu

Stumble! All I like it! Menu

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Argos: an Emulator for Capturing Zero-Day Attacks

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open source

NO ePATENTS

Argos is a full system emulator that implements secure extensions, which protect it from being compromised by most of the known vulnerabilities. It is based on the QEMU open source emulator, which employs dynamic translation to achieve attractive emulation speed.

The incentive behind Argos is to create a framework for honeypots that is both secure and robust, to identify zero-day attacks of worms and other similar malicious software. Eventually, we aim to produce a system that will automaticall produce remedies for such attacks by generating appropriate vaccines (e.g. intrusion prevention signatures).

To identify attacks we employ dynamic taint analysis. This involves tracking data originating from the network during execution, and raising an alarm whenever an illegal use os such data is detected. For example the use of network data as a jump target, instruction or critical system call argument.

Currently, Argos can be run in any little-endian CPU and any OS supported by QEMU. Emulated systems can be either x86 or x86_64. We are looking for people that would be interested in deploying Argos in their network, so if you are one of them do not hesitate to contact us.

http://www.few.vu.nl/argos

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