26th annual **FIRST** conference

BOSTON

MASSACHUSETTS

JUNE 22—27, 2014

Back to the ‘root’ of Incident Response

Boston Park Plaza Hotel | June 22-27, 2014

A New Security Mechanism Controlling the CPU and OS

～Back to “root” of computer structure～

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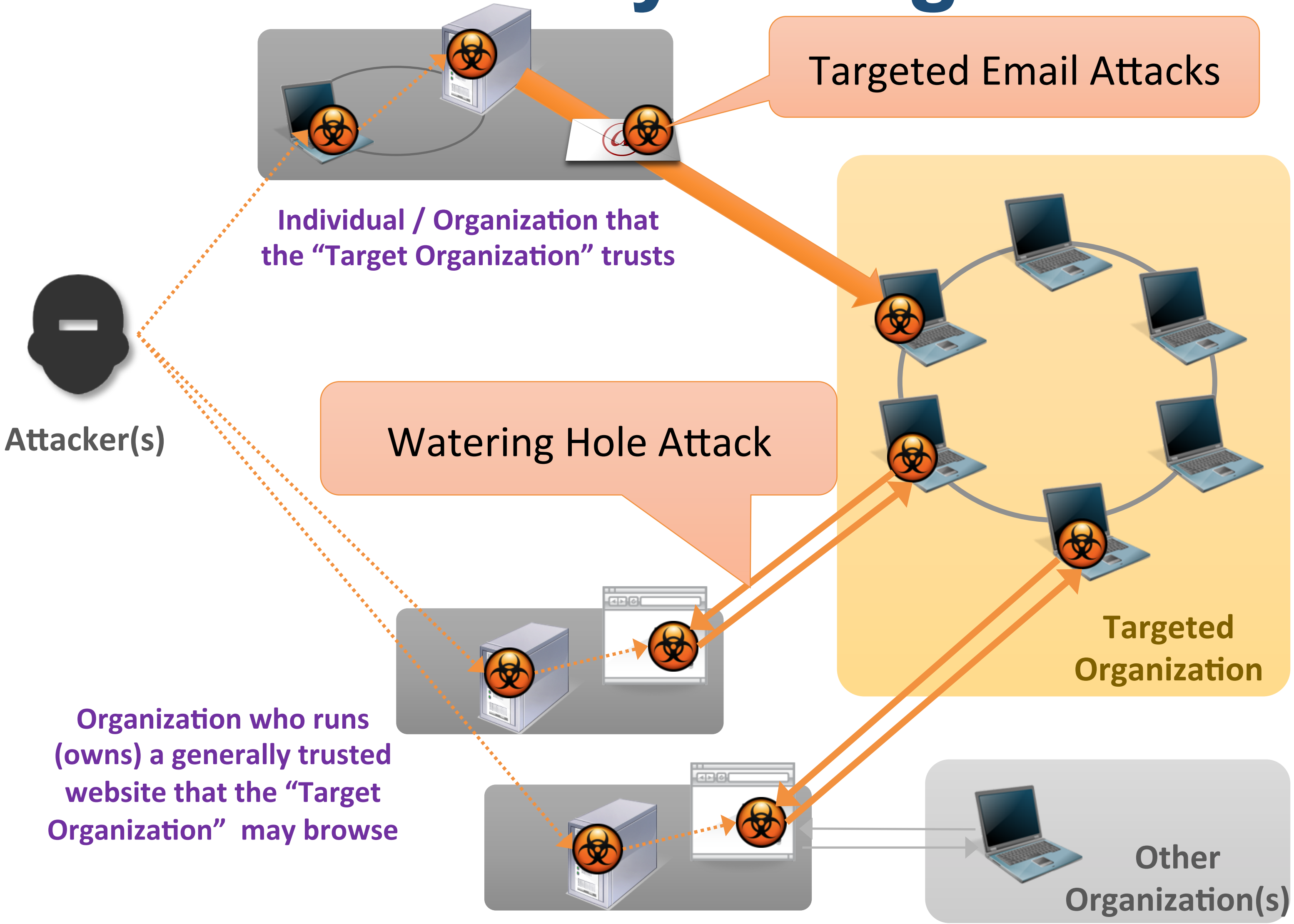
Who am I?

- **C**yber **D**efense **I**nstitute, Inc
  - Security Services
    - Penetration Tests
    - Digital Forensics
    - Malware Analysis
    - Incident Response
    - Research and Analysis
  - Cyber Threat Intelligence
  - (Ethical) Hacking Seminars

CyberDefense

What's Actually Going On



Targeted Email Attacks

Individual / Organization that the “Target Organization” trusts

Attacker(s)

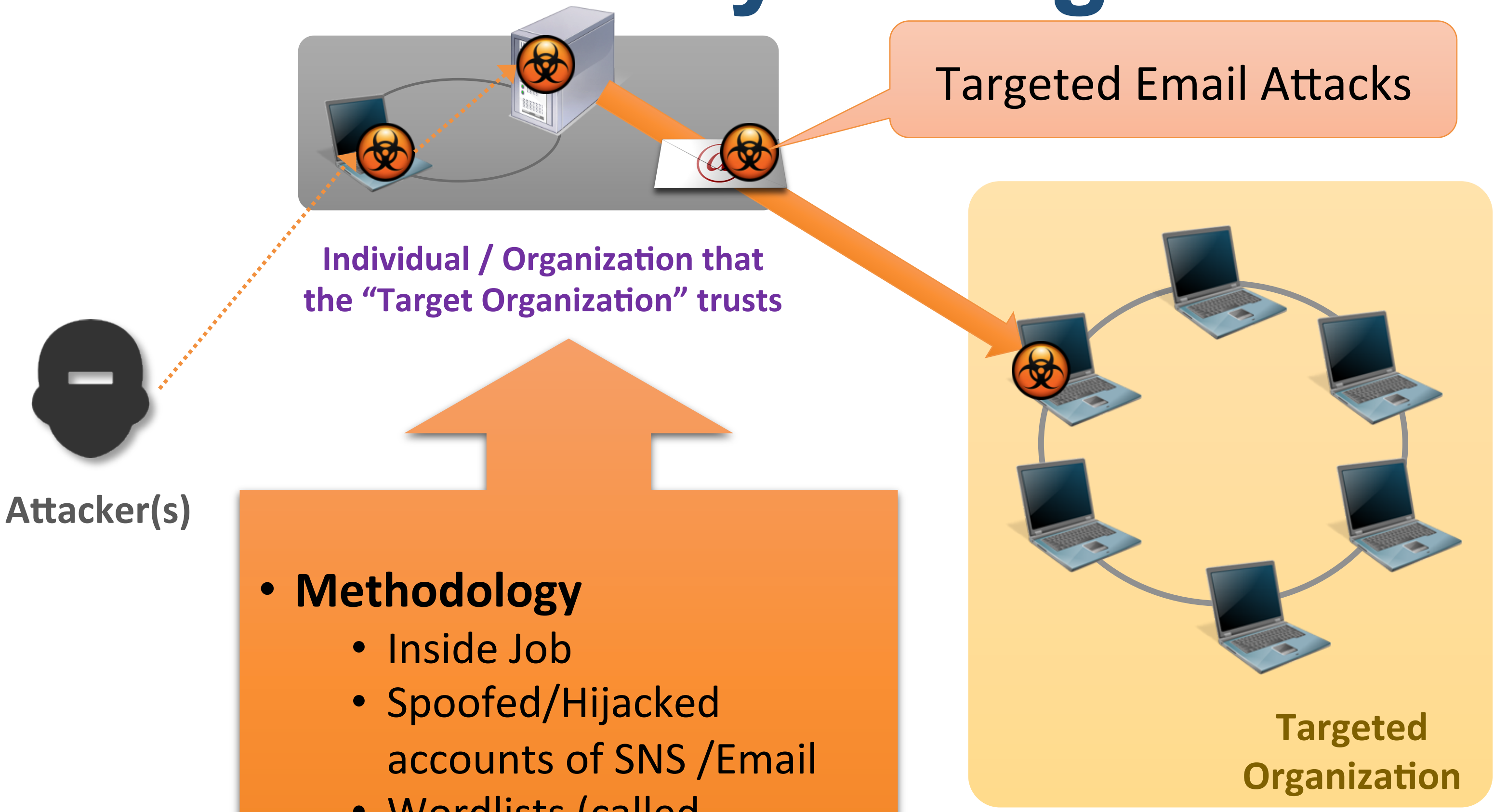
Watering Hole Attack

Targeted Organization

Organization who runs (owns) a generally trusted website that the “Target Organization” may browse

Other Organization(s)

What's Actually Going On



Targeted Email Attacks

Individual / Organization that the “Target Organization” trusts

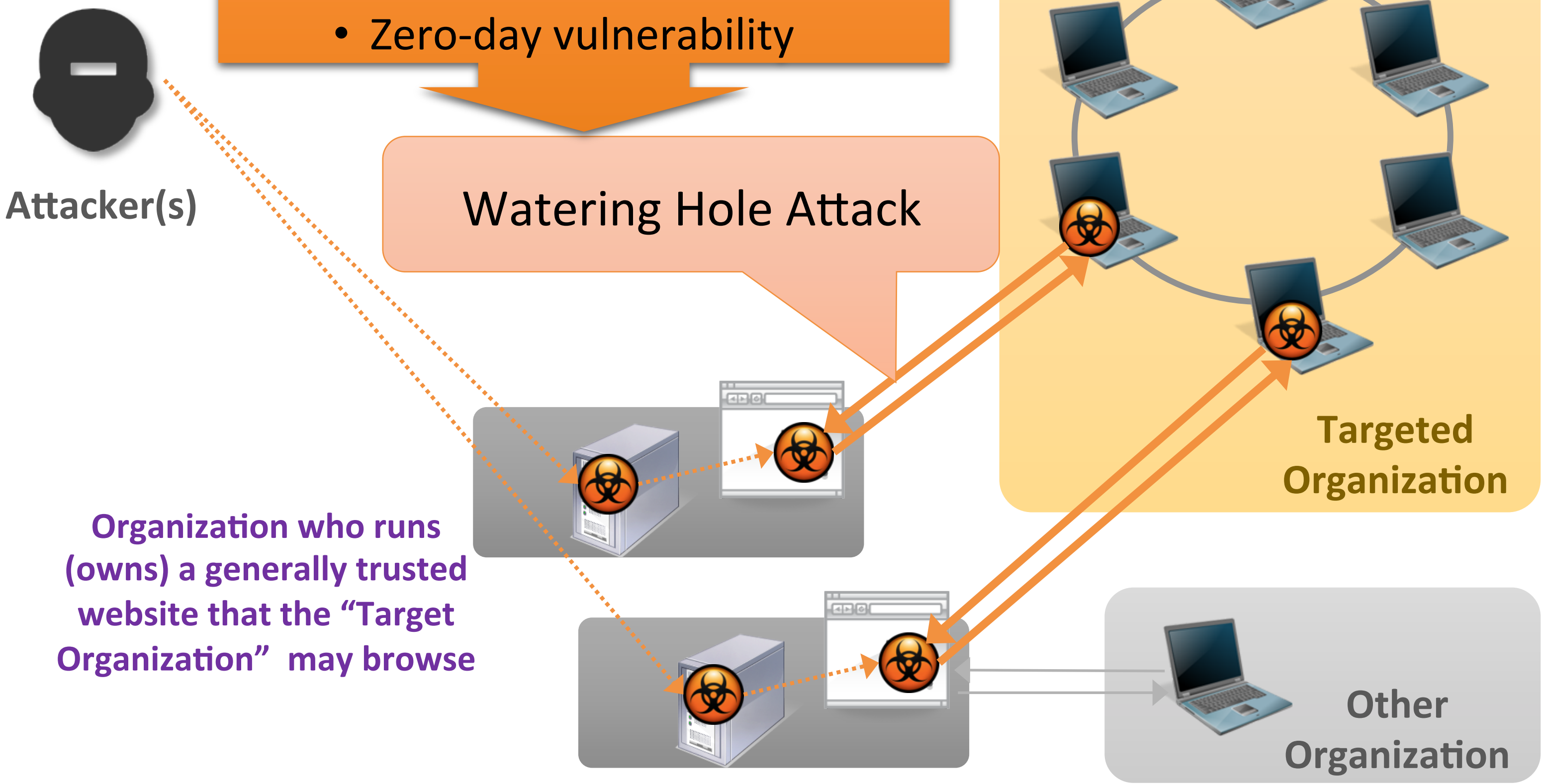
Attacker(s)

Targeted Organization

- **Methodology**
  - Inside Job
  - Spoofed/Hijacked accounts of SNS /Email
  - Wordlists (called “password lists” in Japan)
  - Zero-day vulnerability

What's Actually Going On

- **Methodology**
  - Penetrate update server (modified update modules)
  - Penetrate web server (Iframe injection)
  - Zero-day vulnerability

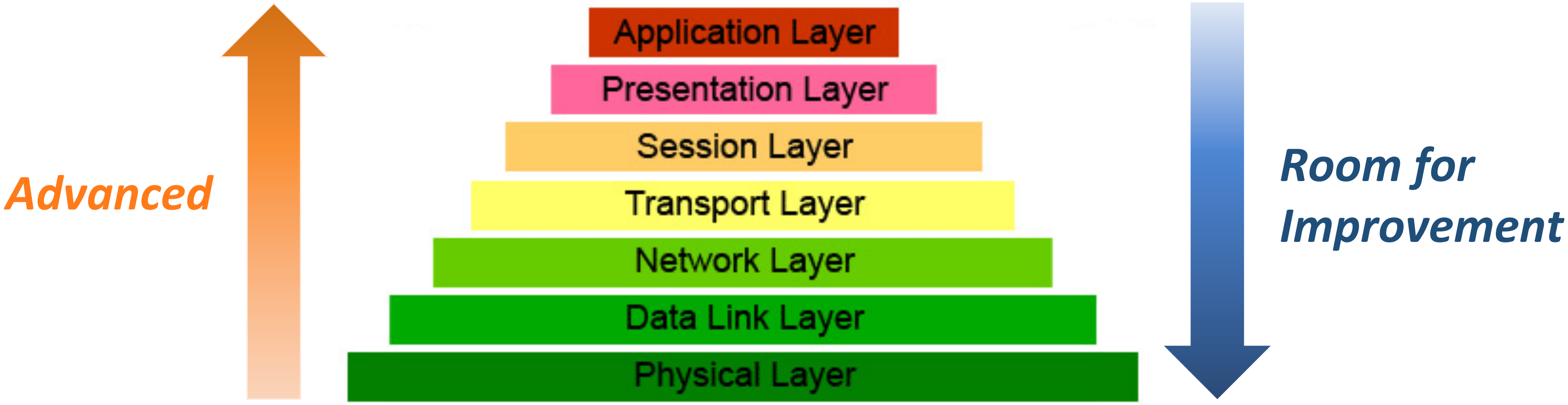


Watering Hole Attack

Organization who runs (owns) a generally trusted website that the "Target Organization" may browse

What We Learned

- We’ve reached the limit to “CAPABILITY-BASED SECURITY”
  - If you are unfamiliar with this concept, visit: http://en.wikipedia.org/wiki/Capability-based_security
- Upper layers in OSI model became advanced, but lower layers have remained at the former level.



F.TRON

- Founded in 2008
- From Tokyo, Japan
- Business
  - Computer security software
  - Consulting / Training
  - Intellectual property Management
- Core Product

  INTΦ (INT ZERO)

  : An endpoint security product with a whole new concept

Demo: Without our technology

- Heap Spray

  ⇒Application Layer

- Domain Hack

  ⇒Kernel Layer

DEMO1

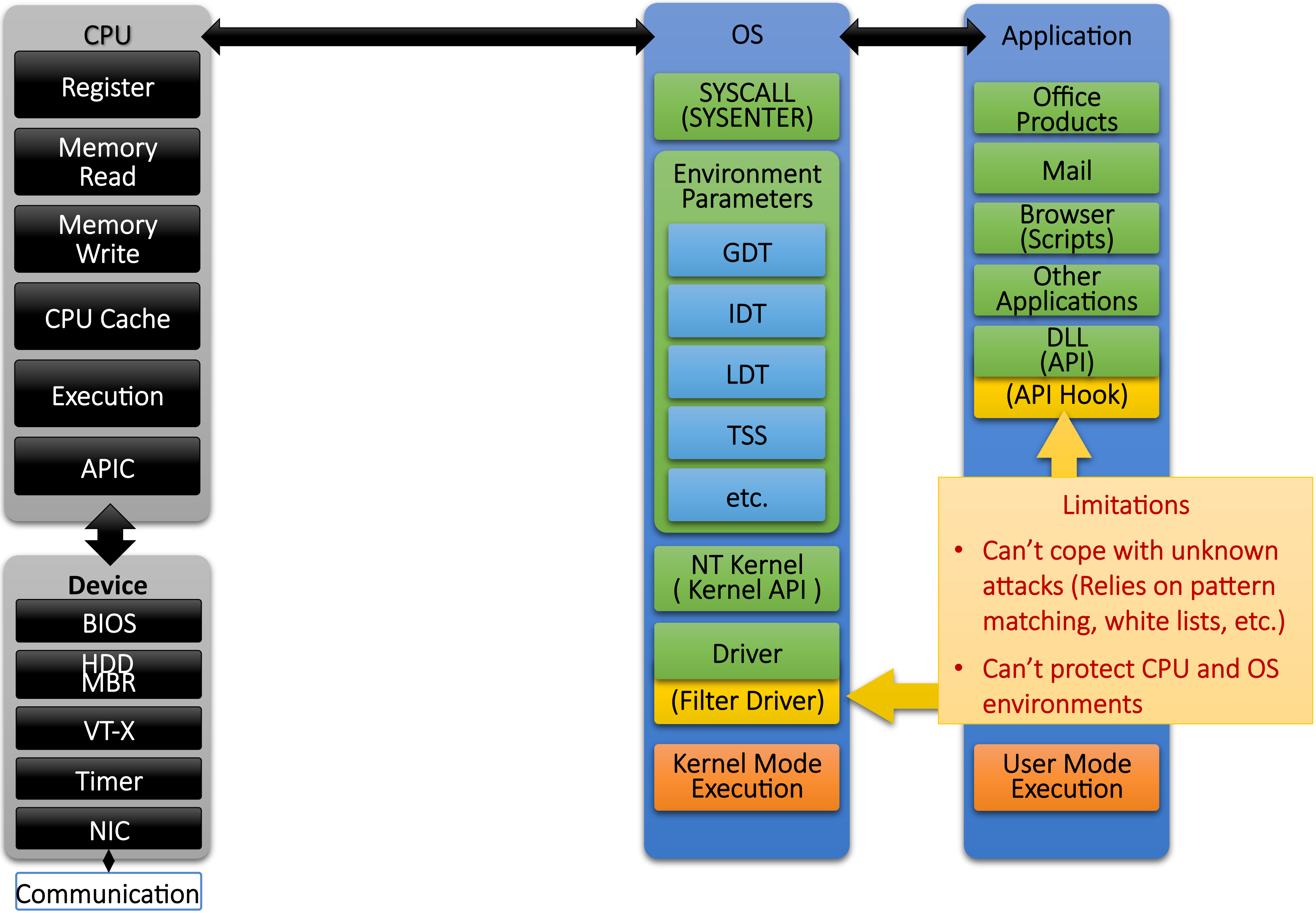
DEMO1

Demo: Summary

- OS checking mechanism doesn’t work
- CPU environment parameters can be modified even from user applications.
- Conventional technology can’t cope with these level of attacks

OS can be hacked – so easily!

Conventional Technologies



CPU

Register

Memory Read

Memory Write

CPU Cache

Execution

APIC

Device

BIOS

HDD MBR

VT-X

Timer

NIC

Communication

OS

SYSCALL (SYSENTER)

Environment Parameters

GDT

IDT

LDT

TSS

etc.

NT Kernel (Kernel API)

Driver

(Filter Driver)

Kernel Mode Execution

Application

Office Products

Mail

Browser (Scripts)

Other Applications

DLL (API)

(API Hook)

User Mode Execution

Limitations

- Can’t cope with unknown attacks (Relies on pattern matching, white lists, etc.)
- Can’t protect CPU and OS environments

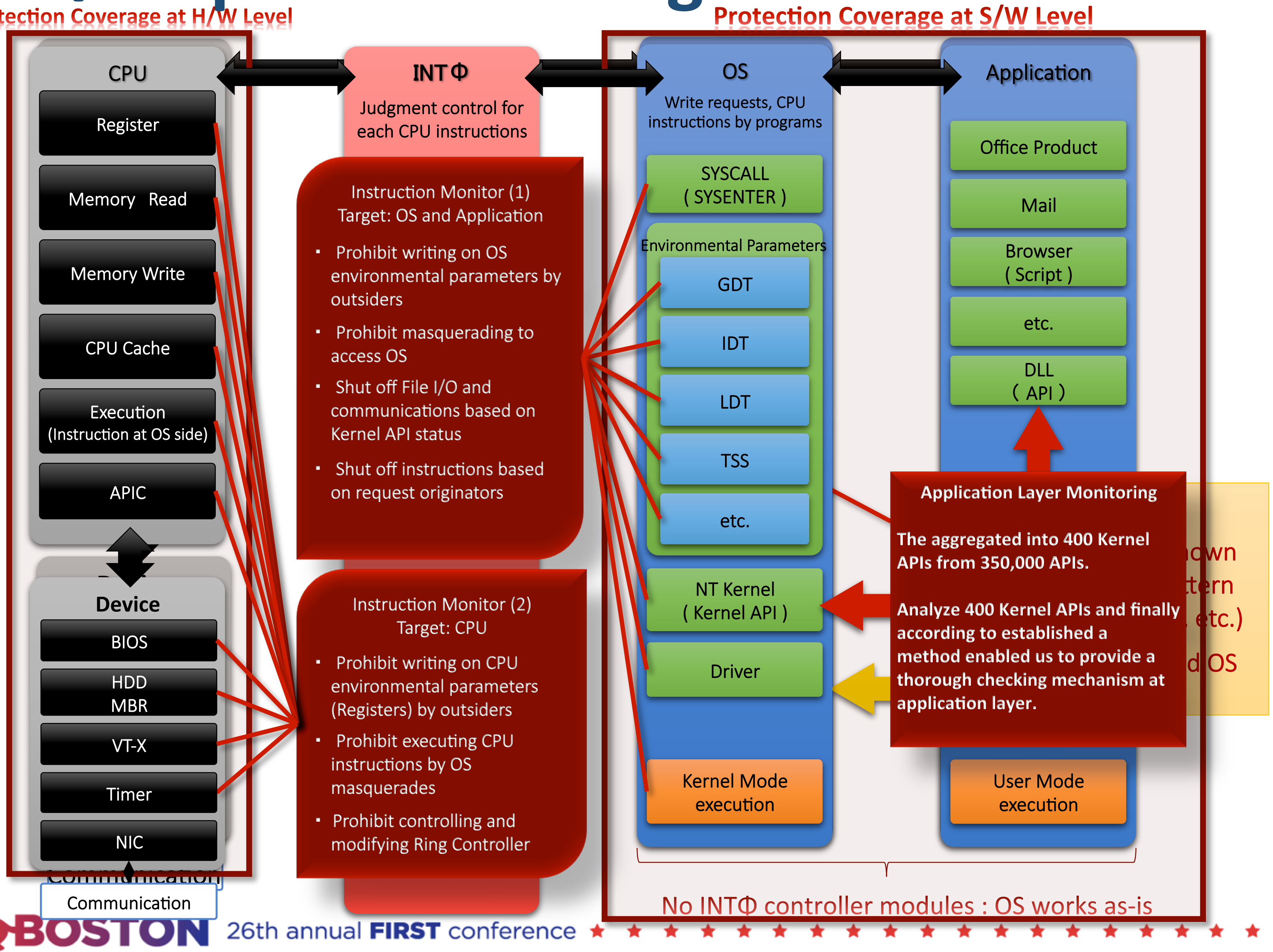
Introducing “INTΦ” (INT-ZERO)

Concept:

1. Protects the OS from outside
2. Takes full control of execution environment
3. Provides new intelligence to CPU instructions

INTΦ starts working first at boot process…
and keeps running until shutdown…
providing complete protection mechanism.

INTΦ Core Technologies



Protection Coverage at H/W Level

Protection Coverage at S/W Level

CPU

Register

Memory Read

Memory Write

CPU Cache

Execution
(Instruction at OS side)

APIC

Device

BIOS

HDD
MBR

VT-X

Timer

NIC

Communication

Communication

INTΦ

Judgment control for each CPU instructions

Instruction Monitor (1)
Target: OS and Application

- Prohibit writing on OS environmental parameters by outsiders
- Prohibit masquerading to access OS
- Shut off File I/O and communications based on Kernel API status
- Shut off instructions based on request originators

Instruction Monitor (2)
Target: CPU

- Prohibit writing on CPU environmental parameters (Registers) by outsiders
- Prohibit executing CPU instructions by OS masquerades
- Prohibit controlling and modifying Ring Controller

OS

Write requests, CPU instructions by programs

SYSCALL
(SYSENTER)

Environmental Parameters

GDT

IDT

LDT

TSS

etc.

NT Kernel
(Kernel API)

Driver

Kernel Mode execution

Application

Office Product

Mail

Browser
(Script)

etc.

DLL
(API)

User Mode execution

Application Layer Monitoring

The aggregated into 400 Kernel APIs from 350,000 APIs.

Analyze 400 Kernel APIs and finally according to established a method enabled us to provide a thorough checking mechanism at application layer.

own
tern
etc.)
d OS

No INTΦ controller modules : OS works as-is

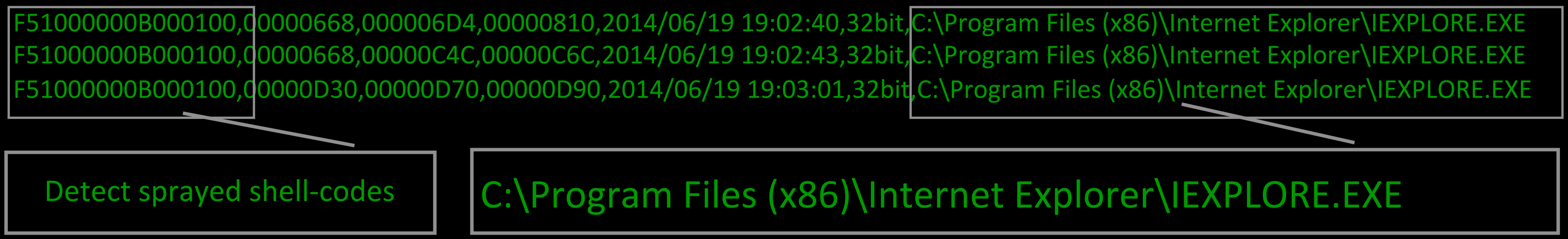
Instruction Monitor (1)　Target : OS and Applications

■Prohibits Illegal Accesses

- Prohibit writing on OS environment parameters by outsiders
- Prohibit masquerading to access OS
- Shut off File I/O and communications based on Kernel API status
- Shut off instructions based on request originators

Demo: With INTΦ (INT-ZERO)

INTΦ Log – “Heap Spray”



```
F51000000B000100,00000668,000006D4,00000810,2014/06/19 19:02:40,32bit,C:\Program Files (x86)\Internet Explorer\IEXPLORE.EXE
F51000000B000100,00000668,00000C4C,00000C6C,2014/06/19 19:02:43,32bit,C:\Program Files (x86)\Internet Explorer\IEXPLORE.EXE
F51000000B000100,00000D30,00000D70,00000D90,2014/06/19 19:03:01,32bit,C:\Program Files (x86)\Internet Explorer\IEXPLORE.EXE
```

Detect sprayed shell-codes

C:\Program Files (x86)\Internet Explorer\IEXPLORE.EXE

- How it works
  The SWF script   make new Allocated Memory, then spray shell-codes to those area.

- How INTΦ stops it
  Int ф check which contains the Shell-codes in the memory allocation that was repeated in the same thread.

Instruction Monitor (2)　Target: CPU

■Prohibits Illegal Accesses

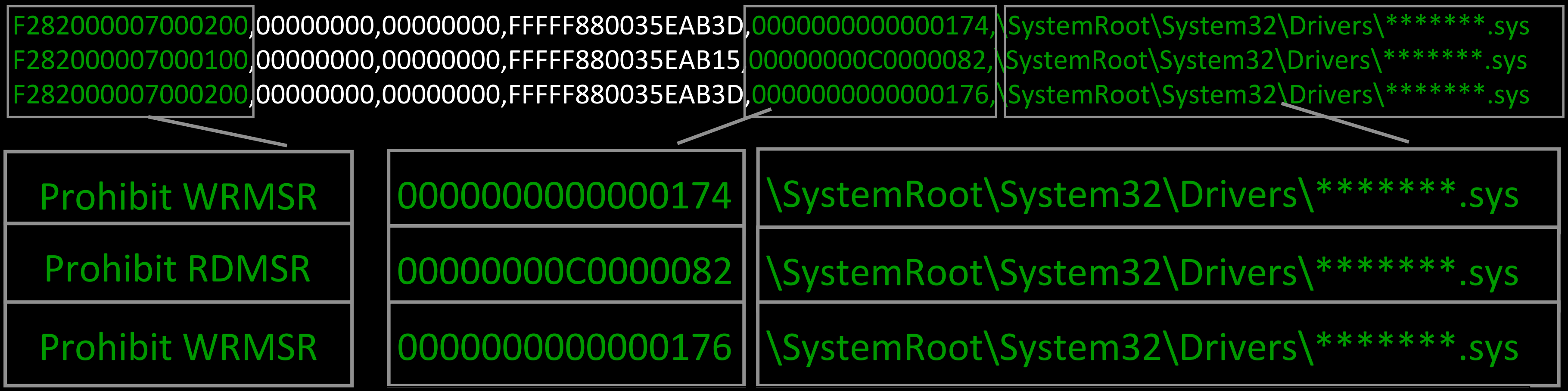
- Prohibit writing on CPU environmental parameters (Registers) by outsiders

- Prohibit executing CPU instructions by OS masquerades

- Prohibit controlling and modifying Ring Controller

Demo: With INTΦ (INT-ZERO)

INTΦ Log – “Domain Hack”



```
F282000007000200,00000000,00000000,FFFFF880035EAB3D,0000000000000174,\SystemRoot\System32\Drivers\*******.sys
F282000007000100,00000000,00000000,FFFFF880035EAB15,00000000C0000082,\SystemRoot\System32\Drivers\*******.sys
F282000007000200,00000000,00000000,FFFFF880035EAB3D,0000000000000176,\SystemRoot\System32\Drivers\*******.sys
```

Prohibit WRMSR	0000000000000174	\SystemRoot\System32\Drivers\*******.sys
Prohibit RDMSR	00000000C0000082	\SystemRoot\System32\Drivers\*******.sys
Prohibit WRMSR	0000000000000176	\SystemRoot\System32\Drivers\*******.sys

- How it works
  DNS resolution calls “Sendto”. You can overwrite buffer parameter that is passed on to Kernel API.

- How INTΦ stops it
  INTΦ prohibits overwriting MSR which is used to pass parameter to Kernel API.

Conclusion

Back to the root, starting over again from internal mechanism of computer…

INTΦ gives paradigm shift to computer security by:

1. Protecting the OS from outside

2. Taking full control of execution environment

3. Providing new intelligence to CPU instructions