State of the Practice of Software Anti-Tamper

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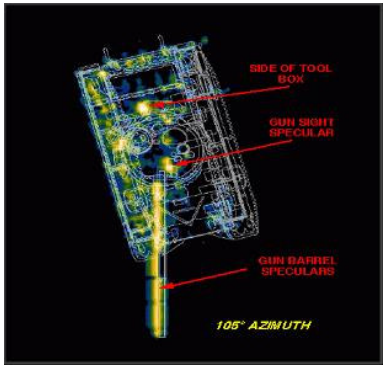
Introduction

- AT-SPI Background
- Understanding the RE Threat
- Software Protection Techniques
- Protection Case Studies
- Software Protection Vendors
- Conclusion

Software Protection Initiative (SPI)

- Goal: Protect critical DoD application software (running on general purpose computers) from piracy and exploitation
- Lead: DUSD(S&T)
  - **Office of Primary Responsibility (OPR): AFRL AT-SPI Technology Office**



Scientific & Engineering/Modeling & Simulation Software

Mission Support Software

Enterprise Software containing critical personnel, pay, or medical information

Mission

Anti-Tamper Software Protection Office

- To deter the reverse engineering (RE) and exploitation of our military's critical technology…..

- AC130U
  - ~609,000 source lines of code (SLOC)
- F-22
  - ~2 million SLOC
- JSF
  - ~19 million SLOC

Cutting the pilot out of the locked cockpit of an F-22.

Reverse Engineering

```
:0000015A 833E00                cmp dword ptr [esi], 00000000
:0000015D 0F8412FFFFFF          je 00000075
:00000163 83C604                add esi, 00000004
:00000166 813E20646147          cmp dword ptr [esi], 47616420
:0000016C 7419                  je 00000187
:0000016E 3906                  cmp dword ptr [esi], eax
:00000170 740A                  je 0000017C
:00000172 391E                  cmp dword ptr [esi], ebx
:00000174 0F84FBFEFFFF          je 00000075
:0000017A EBE7                  jmp 00000163
```

$$TMF = \left\{ \frac{\int_0^5 f^3 A(f)\,df}{\int_0^5 A(f)\,df} \right\}^{\frac{1}{3}}$$

Intellectual Property

Commercial Piracy

- Business Software Alliance (BSA) – 2006 Global Software Piracy Study
  - 35% of software installed worldwide illegal
  - $34 billion in pirated software
- Commercial companies seek to limit initial piracy/reverse engineering

Commercial Piracy
Consumer Education

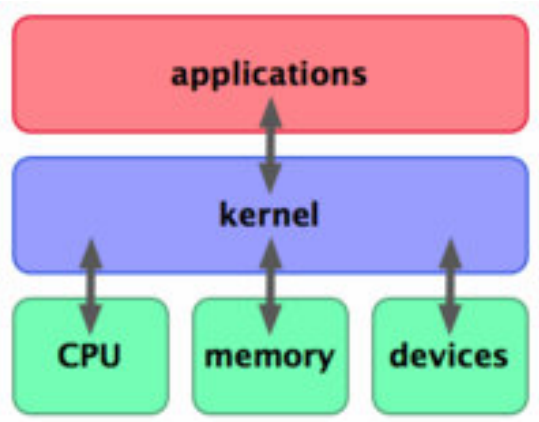
Garret the Ferret

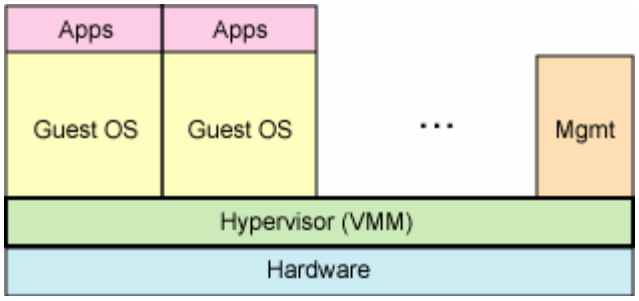
-Copyright Crusader

Source: http://www.playitcybersafe.com/pdfs/Curriculum-CC-2005.pdf

RE Threat

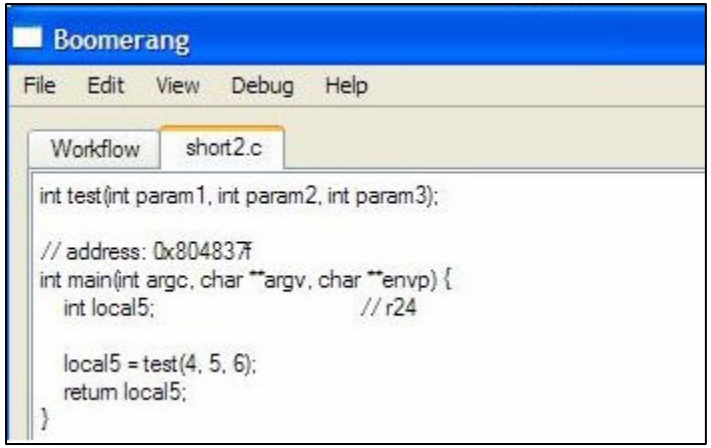
- Access
- Analysis
- Understanding



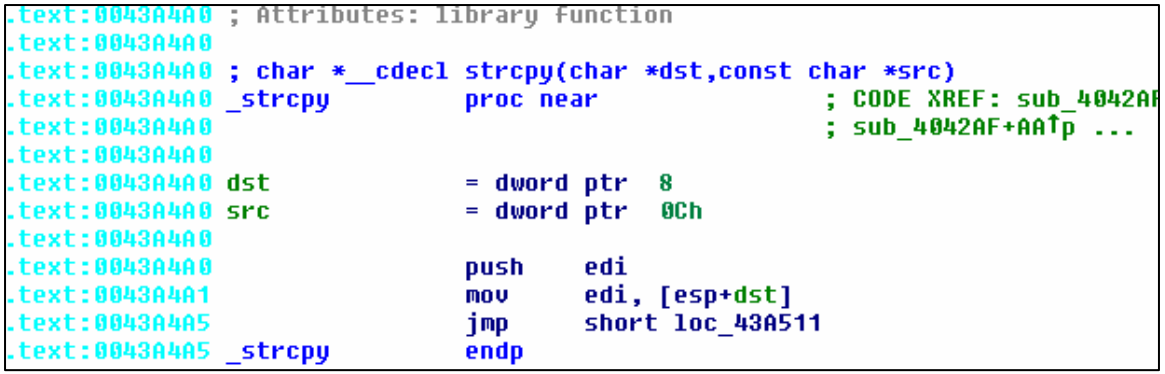


Tools of the Trade
Static Analysis

- Decompilers
  - Boomerang
  - IDAPro beta plugin



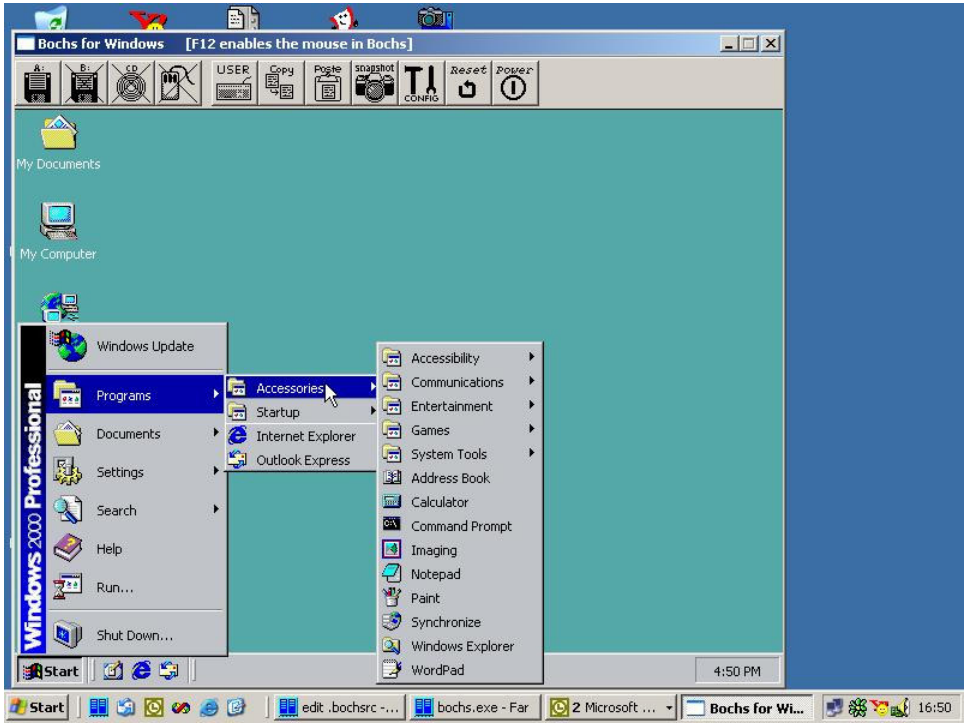
- Disassemblers
  - IDAPro



Tools of the Trade
Dynamic Analysis

- Debuggers
  - Ollydbg
  - WinDbg
  - VAMPiRE
  - Hardware ICE

- Emulators
  - Bochs
  - Custom Virtualizers



Software Protection Techniques

- Hardware Storage/Processing
- Obfuscation
- Anti-debugging
- Encryption
- Checksums
- Diversity

Software Anti-Tamper (AT)

- Two major types in industry
  - Encryption wrappers
  - Integrated protections

Source: http://www.slane.co.nz/cartoons.html

Source: www.6seconds.org/anabel/map.html

Protections: Why they Fail

- Causes problems for the end user
- Negatively impacts performance
- Opens security holes
- Tedious to apply
- Easily broken
  - BORE attacks

Starforce
Case Study

- $5 Million dollar lawsuit claiming software DRM was insecure
- Users claimed StarForce causes computer instability and crashes

Ubisoft officially dumps Starforce

Citing "complaints," the publisher ends its relationship with the copyright-protection provider.

By Tor Thorsen, *GameSpot*
Posted Apr 13, 2006 5:56 pm PT

Following several days of rumors, Ubisoft has officially confirmed that it will no longer use the controversial digital-rights software from Starforce.

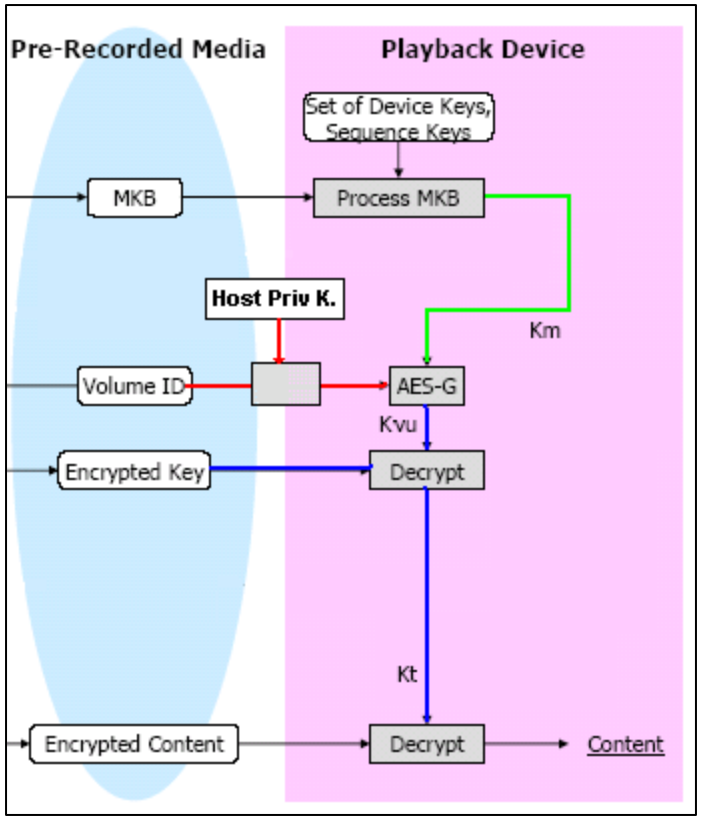
Source: http://www.gamespot.com/news/6147655.html

Sony XCP
Case Study

- Sony BMG music CDs shipped with copy protection scheme
- Protection installs system driver that hides any file or process that begins with sys
- Protection device driver left system open to privilege escalation attack

AACS
Case Study

- Advanced Access Content System
  - Copy protection
  - Modification/Decryption protection
  - Renewability and revocation
- Encryption only protects data at rest
  - Code (e.g., keys) visible upon execution



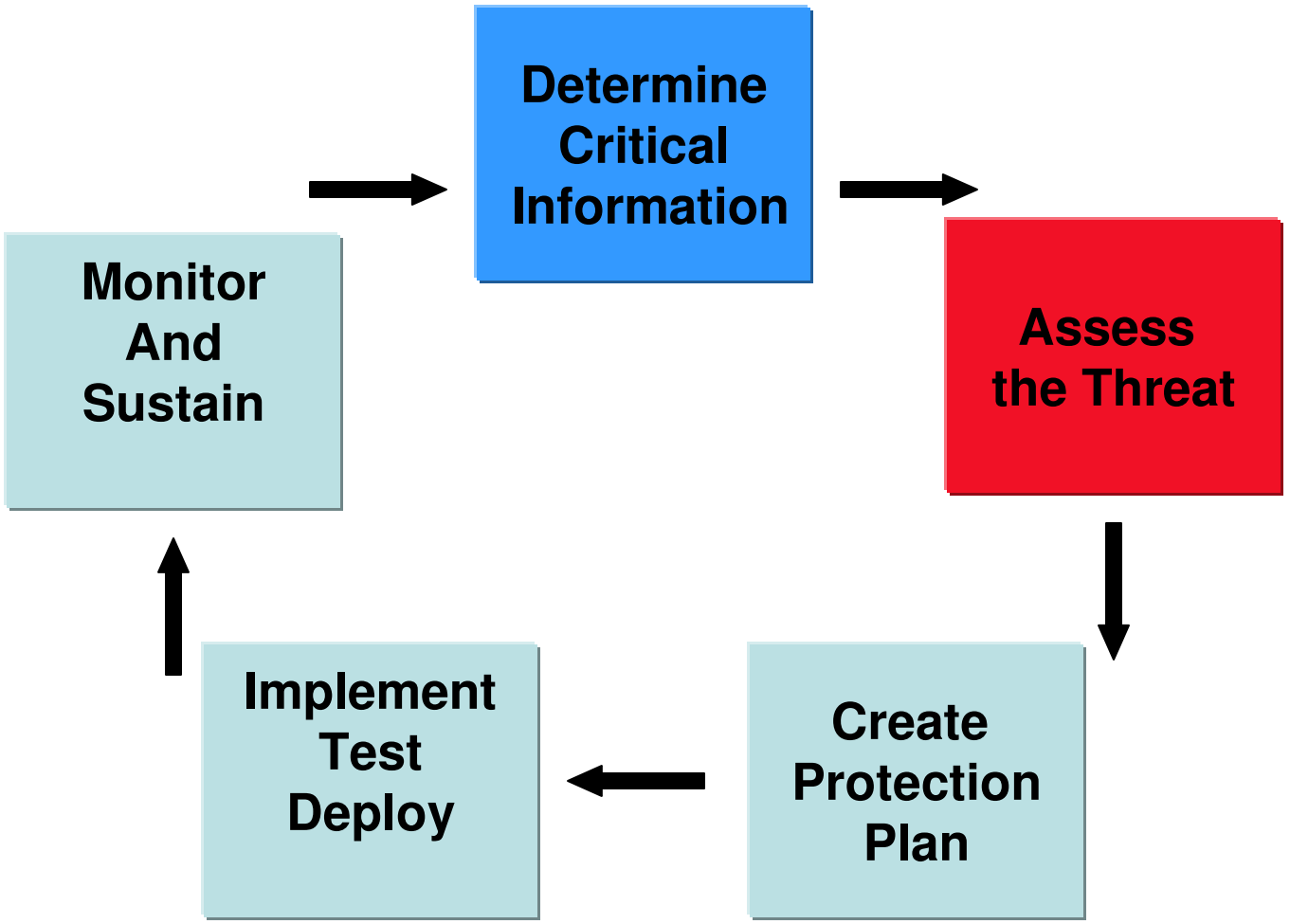
XProtector
Case Study

- Software protection focused on kernel mode driver
- Discontinued due to repeated published breaks
- Updated product renamed as Themida
- Protection transitioned from kernel module to Virtual Machine

Ideal Software Protection

- High level of security against best attackers
- Low performance impact
- Resistant to repeat/automated attacks
- Protects against all forms of runtime analysis
- Securely locks to hardware
- Easy to apply

Protection Process



Metrics

- Difficult questions
  - How much protection is enough?
  - How long will it last?
- Determining metrics
  - Blackhat assessments
  - Red teams
  - Markets
  - Formal modeling

Sample of Protection Vendors

- Arxan
  - http://www.arxan.com/solutions.html
- Pikewerks
  - http://www.pikewerks.com/research.htm
- Cloakware
  - http://www.cloakware.com/products_services/security_suite/
- Luna
  - http://www.lunainnovations.com/research/secure.htm

Conclusion

- Software Protection (AT) is still very much in its infancy
- Significant research into formalizing protection techniques and assessment metrics
- Autonomous and dynamic/polymorphic protections will improve and become more prevalent
- Increased support from hardware (e.g., TPM) and software (e.g., Microsoft) vendors for secure systems

Questions?

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Acronyms

- AACS - Advanced Access Content System
- AFRL – Air Force Research Labs
- AT – Anti Tamper
- BORE – Break Once Run Everywhere
- DRM – Digital Rights Management
- DUSD(S&T) – Deputy Undersecretary of Defense (Science and Technology)
- OPR – Office of Primary Responsibility
- RE – Reverse Engineering
- SLOC – Source Lines of Code
- SPI – Software Protection Initiative
- TPM – Trusted Platform Module