Certifying Linux on all IBM Platforms
- Achievements, Roadmap & Experience

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Agenda

• CC Overview
• Achievements/Roadmap
• Challenges for CAPP/EAL4+
• Challenges for LSPP/EAL4+
• Open Sourcing Evaluation Material
• What’s different about Open Source?
• Certification Valve
• Futures
• Summary
Common Criteria

• Multinational security evaluation criteria
• Defines seven Evaluation Assurance Levels EAL1-EAL7
• Mutual recognition up to EAL4
• CC defines functional and assurance requirements

• Protection Profiles
  – Predefined set of functional and assurance requirements
  – Controlled Access Protection Profile applies to DAC based access
  – Label Security Protection Profile applies to MAC based access
  – New profiles evolving

• Common Criteria certified products required for national security systems
Linux and Common Criteria

- Until 2003, many people believed that Linux would not be able to get CC certified
- Now, three years later, no other operating system has got more Common Criteria certificates than Linux®
  - Two distributions (Novell SUSE and Red Hat)
  - Two different kernel versions (2.4 and 2.6)
  - Many different hardware platforms
    - IBM® Pentium, XEON, and Opteron systems
    - IBM pSeries®, iSeries™, and zSeries® systems
    - HP Pentium, XEON, and Itanium systems
    - SGI Itanium systems
  - Two certifying agencies (BSI & NIAP)
  - Assurance levels up to EAL4 augmented by ALC_FLR.3
## Evaluation Achievements/Roadmap

<table>
<thead>
<tr>
<th>Product</th>
<th>Hardware</th>
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<tbody>
<tr>
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<td>xSeries® 335</td>
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<td>SLES 8</td>
<td>xSeries 335, pSeries® 630, iSeries™ 825, zSeries® 900, eServer™ 325</td>
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<tr>
<td>RHEL 3</td>
<td>Dell PowerEdge 6650 (AS) HP Proliant ML 570 (AS) Dell PowerEdge 2650 (ES) HP Proliant ML 570 (ES) Dell Precision 650 (WS) HP d350 (WS)</td>
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<td>SLES 9</td>
<td>SGI Altix 350 SGI Altix 3700</td>
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<td>RHEL 3</td>
<td>Unisys ES7000</td>
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<td>RHEL 4</td>
<td>Unisys ES7000</td>
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<td>RHEL4 UP1</td>
<td>xSeries model x336 machine type 8837 (AS/WS) pSeries model 550 machine type 9124 with pSeries LPAR (AS only) iSeries model 550 machine type 9406 with OS/400 v5R3 LPAR (AS only) zSeries z/VM 5.1 Logical Partition (AS only) eServer model 326 based on the AMD 64 (Opteron) processor machine type 8848 (AS only)</td>
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<tr>
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<td>xSeries model x346 machine type xxxx &amp; model HS20 Blade (AS/WS) zSeries z/VM 5.1 Logical Partition – includes z800, z890, z990, z9 (AS only) eServer model 327 based on the AMD 64 (Opteron) processor machine type xxxx &amp; model LS 20 Blade (AS only)</td>
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<td>CAPP LSPP RBAC</td>
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Parties involved in the evaluations  
(Sponsored by IBM)

• IBM:
  – Sponsor the project, project management, and coordination
  – Codevelop the audit subsystem
  – Develop design documentation (FS, HLD, LLD)
  – Develop test cases and test plan
  – Conduct developer testing
  – Document development/security procedures (i.e. Configuration Management for test suits, document control, and test results)
  – Produce Vulnerability Assessment Report

• Distributors – SUSE & Red Hat:
  – Codevelop the audit subsystem
  – Update development and security procedures documentation

• atsec:
  – Codevelop the evaluation strategy
  – Provide guidance documents and a configuration script
  – Perform the evaluation

• Certifying Bodies - BSI & NIAP:
  – Supervise the evaluation and issue the certificate
Challenges for CAPP/EAL4

• New functionality
  – Now kernel version 2.6 (was 2.4 in the previous evaluations)
  – New design of the kernel audit functions

• Low-level design
  – Required for the kernel and all trusted processes
  – Large documents focusing on the security functions
  – Describing the details of the 2.6 kernel and trusted processes

• Additional vulnerability analysis
  – More in-depth analysis
  – Penetration testing
  – Crypto/Keygen/RNG/Primality tests

• Impacts on the distro development processes
  – Enhancements in flaw remediation
  – Acceptance procedures
Reuse from Previous Evaluations

• Security Target mainly re-used from CAPP/EAL3+
• High level design required only minor changes:
  – Impact of changes made from 2.4 kernel to 2.6 kernel
  – New kernel part of audit subsystem
• Functional specification partly re-used (required some changes):
  – New and modified system calls
  – Complete parameter description of system calls (not just libc wrapper functions)
• Testing mostly reused:
  – Required some changes and some additional tests
• distro processes did not change significantly:
  – Most documents could be re-used
Security Target

• TOE: SLES 9 & RHEL 4 UP1 with fixes and additional functions (audit, self-test)

• Security Functions selected for server system:
  – Password based Identification and Authentication using PAM Framework
  – Discretionary Access Control using the POSIX ACLs for the ext3 file system (permission bits for other file systems).
  – Discretionary Access Control for Inter-Process Communication (including access control for sockets).
  – Configurable audit for security relevant actions.
  – VSFTP, Stunnel, and SSH as the only trusted network applications
  – Trusted processes for security management.
  – Focusing on the ability of the kernel to protect itself.

• Assurance level achieved is higher than required by CAPP:
  – EAL 4 augmented by ALC_FLR.3 (CAPP requires only EAL 3)
Problems Identified

• Several security flaws have been identified by the evaluation team during the evaluation and have been fixed.

• Other security flaws identified by the Open Source Community during the time of the evaluation also have been fixed.
  – Race Conditions
  – Memory Leaks
  – Overflows
  – Parameter Validation
  – Kernel Hangs
  – Missing DAC Checks
Towards LSPP Compliance

• A true open source effort - challenging
• IBM sponsors a weekly teleconference
  – 40 participants from 9 organizations on the invitation
    • IBM, Red Hat, NSA, @sec, HP, TCS, Tresys, OSDL, and PSU +
    • various individuals
  – All development takes place on open mailing lists
• Development goes upstream and is collected in rawhide
  – Fedora Rawhide provides daily builds for xSeries and pSeries.
  – Red Hat hosts test kernels for features pending kernel maintainer
    acceptance.
• Schedule
  – In Evaluation (09/05)
  – Development Complete (03/06)
  – Certification Complete (03/07)
Towards LSPP Compliance (Contd.)

• Major Enhancements
  – Kernel
    • SELinux MLS Support
    • IPsec labelled networking
    • Audit augmentation
    • VFS polyinstantiation
  – User Space
    • MLS Policy using reference policy
    • Enhanced user management
    • Audit filtering
    • Browsing augmentation
    • Device allocation
    • Labelled print
    • Multilevel network services
    • Multilevel cron
Towards LSPP Compliance (Contd.)

- Work remaining
  - Complete MLS development
  - Get it upstream
  - Ensure MLS work is incorporated into RHEL5
  - Augment exiting test suite
  - Enhance design documentation
    - Functional Specification
    - High Level Design
    - Low Level Design
  - Run tests and produce documentation
  - Undergo evaluation by lab.
  - Obtain certificate from NIAP
  - Open source documentation
Evaluation evidence open sourced

• Functional Specification*
  – Man pages existed, but not for all system calls and configuration files.
    • Additional man pages have been developed.

• High Level Design*
  – Very good general material and books exists, but partly not up-to-date and not
    focused on security
    • a new security focused High Level Design has been developed

• User Documentation*
  – Some very good security related documents and books exist, but they are
    generic and not dedicated to a specific distribution.
    • An additional Security Guide has been developed.

• Test Documentation**
  – Test cases for security functions didn‘t exist, so a comprehensive set of tests
    were developed for each assurance level.

Linux® now has a good starting point for further evaluations, and for the evaluation of other distributions.

** http://ltp.sourceforge.net/EAL3.html
What’s different about open source?

- Sponsor vs Vendor
  - IBM & distros
  - Less control
  - Process IP
- Multiple Platforms
  - Across all IBM eServers including opetron
  - VM, LPAR
  - Blades, Clusters,…
- Open Source Community
  - Acceptance (OLS paper, OLS BOF)
  - Changes into standard kernel (Audit, MAC)
- Open sourced evidence material
  - FS, HLD, User Docs, Security Guide, Test cases
- Site Visit/Site Security
What’s different about open source?

- Design Documentation
  - Available in public domain with varying detail
  - Functional Specs. used man pages as a basis
  - HLD/LLD referred to public documentation – e.g. Linux VMM book (Mel Gorman)
    - Use of scripts
      - Reading a document with numerous links is cumbersome
      - Collate relevant pieces into a common html format
      - Evaluator executes a script & then uses a browser
- Vulnerability Analysis
  - Vulnerability descriptions in public domain, e.g.
    http://www.novell.com/linux/security/advisories/
  - Task was simpler
- Evidence Reuse
  - SUSE/RH
  - HP
  - SGI
  - Unisys
- Distro Release/Schedule – alignment of priorities
- Open Question - How long do we want to sponsor?
Certification Value

• Business Value
  – 3rd party trust
  – Competition
  – Mandatory for DoD market
  – Other government agencies to follow
  – Reuse of evaluation material
  – Towards high assurance/robust Linux

• Technical Value
  – Audit capability
  – MLS capability
  – Hardware testing utility
  – Inline with the “many eyes” philosophy
  – Several security flaws identified
Futures

- LSPP Compliance (in progress)
- MLOSPP Compliance
- EAL5 Linux
- HA Linux (EAL7) – Separation kernels
- Integration with other Linux security projects—eCryptfs, TPM
- Integration with middleware
- More security functions as part of the TSF:
  - Additional authentication methods
  - Directory integration
  - VPN functions
  - Linux for desktop systems
- User space policy management server
- Policy development framework
- Enhancing the security of existing functions:
  - SAMBA
  - Trusted X-Windows
  - NFS®
Summary

• First Linux evaluation at EAL2+ performed in less than six months!
  – Started in February and finished in June of 2003.
• Evaluation at EAL3+ with CAPP compliance achieved in less than one year!
  – Including the development of a new auditing subsystem.
• Evaluation at EAL4+ with CAPP compliance achieved one year later.
  – This was based on the latest version of the kernel.
• Total of 10 Linux evaluations; 4 in progress
• First operating system evaluated on a variety of hardware platforms!
• Open Sourced Evaluation Evidence – has been reused
• Working towards LSPP compliance
Conclusion

- Linux has much to offer in terms of security
- Linux has a bright future ahead
- IBM is committed to elevating Linux as a secure operating system of choice in today’s business environment
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