Open Source and Commercial Applications in a Java-based SELinux Cross Domain Solution

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Disclaimer

- We are not endorsing products, we are endorsing open standards.
  - The products chosen for CDCIE were those products that best suited our needs at the time the project started and they may be replaced in the future.
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Project Overview

Develop a standards based, non-proprietary, secure, scalable collaborative information environment (CIE) to enable cost-effective multinational information sharing (MNIS) in both single and cross domain environments.

- CDCIE 2.2 - Cross Domain Portal and Portal Applications
  - Provide a portal and suite of commonly used portal applications that are classification labeling aware
- CDCIE 2.2 - Cross Domain Document Management System
  - Provide an easy to use system for securely sharing documents with versioning and subscription support
  - Provide a method to automate much of the Reviewer/Releaser process
- CDCIE 2.1 & 2.3 - Cross Domain Collaborative Tool
  - Provide a secure and scalable collaboration tool for DOD that solves the tactical chat, cross domain, full function (minus video) collaboration requirements
- CDCIE 2.2 - Security Enhanced Office Automation Suite
  - Provide a method to safely redact documents for release to lower classification levels & external entities.
  - Improve the Reviewer/Release process
- Cross Domain Guards

Why we are building CDCIE

- Near-Term
  - Provide an integrated solution to identified MNIS problems:
    - Support DJC2 Baseline Requirements Document
    - Support COCOM cross domain information sharing requirements
    - GRIFFIN & CENTRIXS information sharing requirements
    - OIF Information Sharing Lessons Learned
  - Solve the Tactical Chat problem
  - Increase the efficiency of the Reviewer/Releaser process
  - Force policy and mindset changes in DoD
- Future
  - Work toward GIG/NCES vision
  - Promote next generation standards and develop new ones where they are lacking.
- Maximize Benefits of Open Source & Open Standards
  - Stimulate industry globally
  - Enable Coalition partners the ability to roll their own interoperable solution
  - Reduce the cost of collaboration in DoD

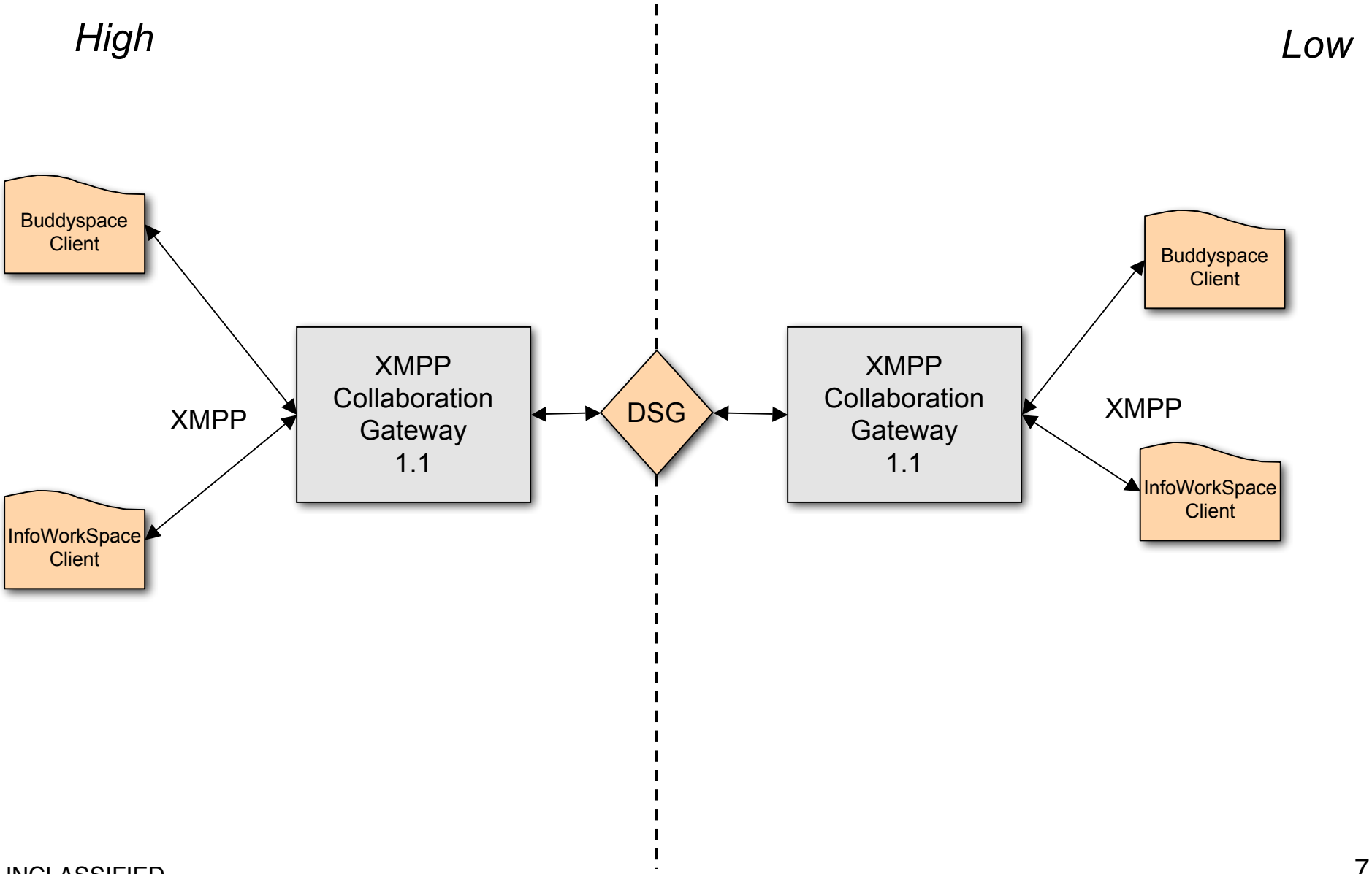
What is a Cross Domain Solution

- A device that acts as a trusted boundary between two or more networks of different security contexts (classifications)
- Typically has some additional goals such as:
  - Only permits data of a certain type to transit the boundary
  - Prevents inadvertent disclosure of information through the use of filters
    - Filters can include clean/dirty word scanning, schema validation, fixed message format validation, data skewing/transliteration, classification label checking, etc...
  - Prevents unauthorized users from transmitting data that crosses the domain boundary

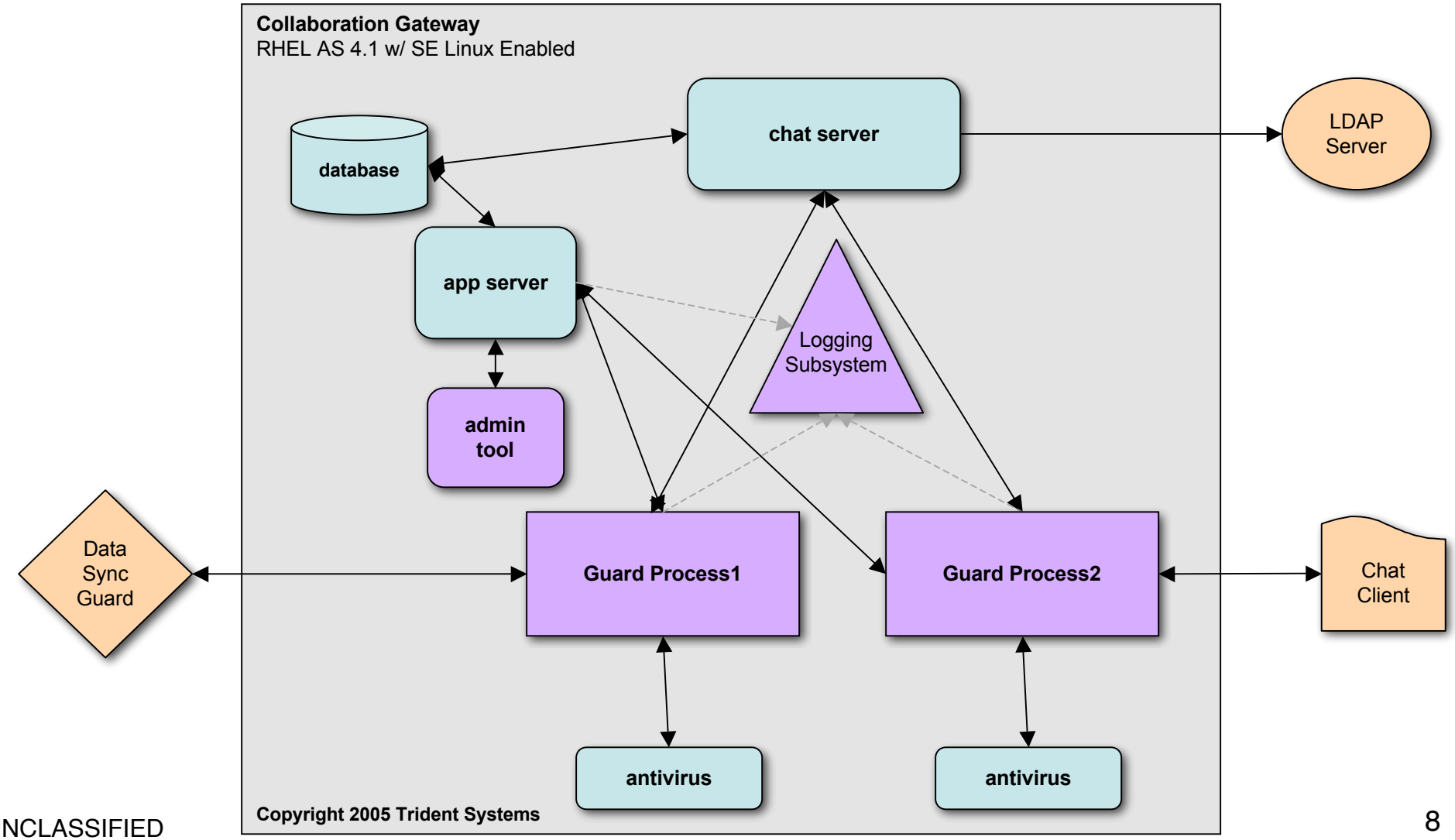
How does SE Linux help CDS Developers?

- Type Enforcement is a better CDS foundation
  - Provides mandatory access control
  - Reduces trust placed in guard applications
    - Security and accreditation burden shifted to architecture
    - Architecture defined and enforced in policy
  - Implemented in a powerful mainstream operating system
    - Including enterprise level support (e.g., RHEL 4.1)
- Type Enforcement simplifies CDS development
  - Ensures that data flows between applications only in the prescribed manner
  - Guard applications can be narrowly focused
    - Inspection/Filtering, logging, etc.
  - Simplified architecture by reducing security components to small discrete modules
    - Reduces development time/cost
    - Eases certification and accreditation

CDCIE Chat High Level Architecture



Collaboration Gateway 1.1 Process Interconnections



Java

- Java is used for most of the filters, application logging subsystem, guard interface, and applications developed for CDCIE
- JVM security manager complements SELinux access control
- Java was surprisingly well-behaved from the perspective of SE Linux policies
  - No extraneous access required
  - Memory protection permissions may be needed (execmem, execmod, etc)
- Well understood security model
- Low-level Linux IPC mechanisms can be used through Java To UniX (JTuX) library
  - Helpful in leveraging fine-grained access controls offered by SELinux on IPC
- Java's strong typing, resistance to buffer overflow attacks, stack smashing, automatic memory handling, and lack of pointers yields safer and more secure code
- Single Java executable
  - Separate domains required creative use of file labeling and entrypoints
- Disadvantages
  - Possibility of improperly handled exceptions

Closed Source Software

- Software used:
  - Jabber Inc's XCP Server, others
    - Supports XMPP (Jabber) protocol
    - Allowed developers to focus on other tasks rather than reimplementing support for Jabber
- Close Source Software & SELinux
  - Required most "loosely" written policy
    - SELinux policy still based on least privilege
  - Some extraneous access can be denied without impacting functionality
    - Reduced impact of programming flaws
      - Without access to source code

Open Source Software

- Software used:
  - JBoss, Log4j w/ Simple Socket Server, ClamAV, PostgreSQL, Linux
- This combination provided
  - Secure and flexible operating system (RHEL)
  - Flexible application level Logging (Log4j w/ Simple Socket Server)
    - A separate Simple Socket Server used for each application that is logging data.
  - Ability to do low latency high performance virus scanning using ClamAV with its Socket based interface
  - Leveraging this huge code base let the developers focus on other tasks (e.g. developing the trusted applications)
  - Existing policies could be modified and used (e.g., clamav and postgresql)

Open Source Software and SELinux

- Ability to fix flaws exposed through SELinux policy development
  - Changes contributed back to community
- Existing policies could be utilized
- Policy capable of describing access to complex filesystem layout used by JBoss
  - Deployment of applications requires write access to certain portions of the directory tree
  - This write access was confined at the “lowest” level in the tree

SE Linux Lessons Learned

- Modularity is key if using Type Enforcement for securing a filter pipeline
- Commercial applications are not always well behaved.
  - Required most “loosely” written policy
  - SELinux policy ultimately still grants this application access based on least privilege
  - Some extraneous access can be denied without impacting functionality
  - Reduced impact of programming flaws without access to the source code
  - Example: Jabber XCP – a XMPP Chat server.
- In a mixed environment of commercial and open source software, Java, and SELinux
  - SELinux can be used to enforce least privilege in individual applications
  - SELinux can be useful in exposing flaws in applications
  - SELinux can be used to deny extraneous access due to flaws in closed source applications
    - Prevent exploits from being leveraged or propagating to other parts of the system
  - The Java-based filters can focus on correctly processing the data
  - The collection of applications facilitates cross-domain chat while reducing development time and complexity (and costs!)

General Lessons Learned

- Avoid using the same instance of an internal server as this opens the possibility of creating untrusted paths through the device
- Leverage role separation for controlling access to the different functions in the guard.
- Leverage all aspects of Linux security when building cross domains solutions
  - SE Linux
  - Bind internal only servers (like AntiVirus) to only use Loopback addresses.
  - Use NSA, DISA & CIS security lockdowns.
    - Run the DISA Security Readiness Review (SRR) scripts
  - Script Everything
  - Use custom kickstart (ks.cfg) and customized installers to minimize amount of user level configuration.
    - We used Perl with Newt to create the custom installers
  - Use udev to control user level access to removable media (used for archiving logs and uploading antivirus definitions)
  - Use IP Tables to control inbound and outbound connections
- Insulate your users from command line – write GUI admin tools
  - We used JWM to provide users a familiar Windows like look-n-feel
  - We used Java Swing and Perl/Tk based applications

Future Ideas for the Community

- Trusted PostgreSQL – an SE Linux enhanced version of Postgres Database. This database will implement Role-Based Access Conrol (RBAC), Mandatory Access Control (MAC), and Label Security.
  - They are very few trusted databases on the market. They are expensive and/or do not support Java applications.
  - In order to achieve many of the goals of NCES and the GIG we need the ability to bind the database security (RBAC, MAC, LS) to the o/s capabilities.
- Security Enhanced Java #1 – Create a modified version of the Sun JDK 5.0 JVM's Security Manager so that its security services leverage the SE Linux policy framework.
  - This will allow the JVM to use SE Linux policies to enforce which systems calls are allowed. Currently we can use SE Linux to secure a JVM but this security lockdown is for the entire JVM process not to just the apps within the JVM. This is not a very elegant solution.
- Security Enhanced Java #2 – Implementation of the Mandatory Access Control in the JVM by leveraging "JSR-121: Application Isolation API Specification" and binding of the islets to the operating system's MAC layer.
- Security Enhanced Java #3 – Implementation of object level labeling, label security, the development of an API to manipulate operating system security labels.
- Security Enhanced Java #4 – Binding of the JVM class loader to the Trusted Platform Module (TPM). This capability will provide a potentially much higher level assurance in the execution of java applications on both guard and regular systems.

Questions?

Backup Slides

Cross Domain Guard

- Cross domain XML guard is the BAE Systems (formally DigitalNet) Data Sync Guard (DSG)
  - Supports TCP/IP Socket connections for fast low-latency data movement
  - Data movement within guard is via shared memory. Data regrading does not involve file system access.
  - Supports W3.org XML Schema Validation
  - Schema updates can be done directly on guard and do not require interaction with vendor.
    - NOTE: Schema updates on productions devices would not normally be allowed by policy
  - Supports IC Metadata Standard for Information Security Markings
  - Supports Unicode (UTF-8) compliant Clean and Dirty Word Search
  - Supports normalization (identity transformation) of XML messages
  - Lower cost compared to existing GOTS guards
    - Less than $100K per instance, installed with training
- Hardware:
  - XTS-400 is based on a 2.8 Ghz Intel Xeon based server
  - 3U Rack Mounted and Tower configurations available
  - Supports up to 8 standard connections at different system-high single-level networks
- Operating System:
  - EAL 5+ certified STOP/OS 6.1E
  - Has a Red Hat Linux 8 compatible API for developing applications
- Software:
  - DSG 2.0 software
  - Java based API for application development on guard interface
  - Apache Xerces 2.6 XML Parser (C/C++ Version)
    - Supports W3.org XML Schema Validation
    - Adding RelaxNG and Schematron support in CY06

Fielding and Schedule

- Version 1.0
  - Original CIE based on proprietary software
  - Proprietary. Temporary solution
  - Based on work from MC02 experiment
- Version 1.2
  - Fielded Portal and Document Management to Multinational Forces Iraq (MNF-I) in Feb/Mar 05
  - Standards based solution based on eXo and Xythos
- Version 2.1
  - Installing Portal and Document Management at JFCOM as enterprise solution in Aug/Sep 05
  - Cross Domain Chat started CT&E at Ft. Huachuca in Sep 05
- Versions 2.2 & 2.3
  - Portal, Cross Domain Collaboration, and Document Management to be delivered for CT&E in FY06

Version Table

CDCIE 2.1: Chat
CDCIE 2.3: Chat, Audio, AC, WB
CDCIE 2.2: Document Transfer/Portlet Data

CG = Collaboration Gateway
PFMG = Portlet Data & File Movement Gateway
SDG = Streaming Data Gateway