Trusted Secure Isolation

For Resource-Constrained Embedded Linux

ELC Europe 2007

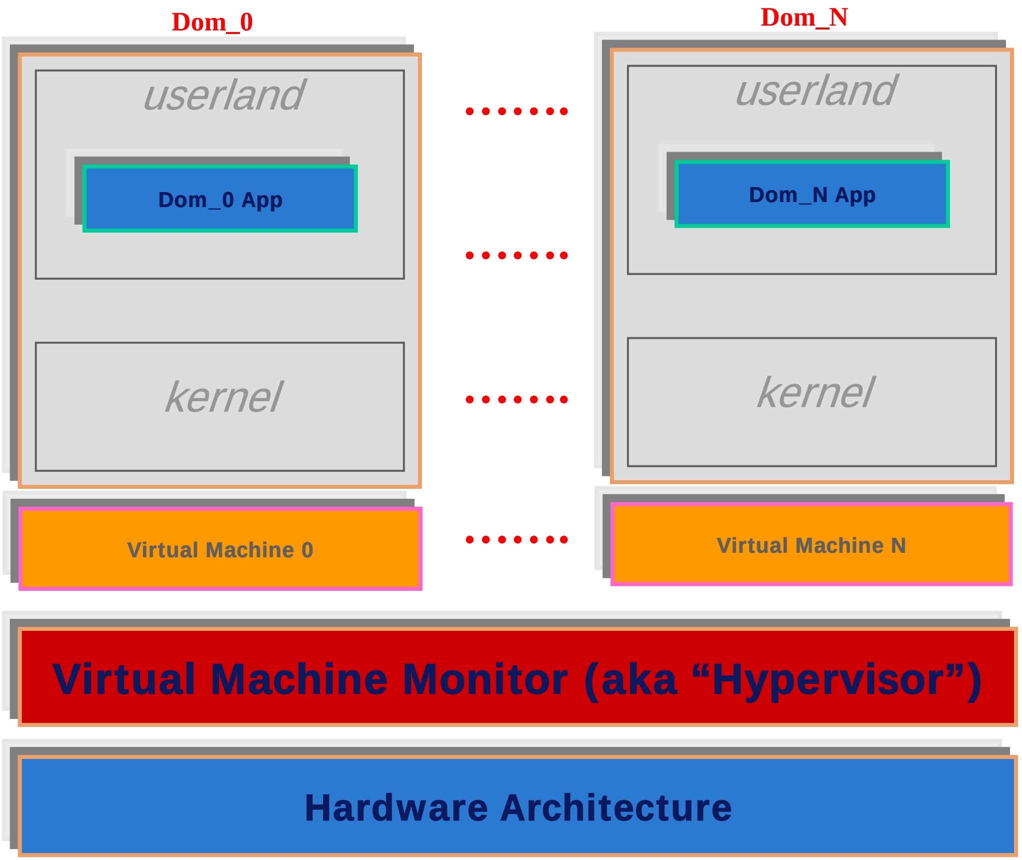
Nov. 2nd and 3rd, 2007
Johannes Kepler University
Linz, Austria

Hadi Nahari
Chief Security Architect

Agenda

- Isolation Overview
- Isolation vs. Separation
- Isolation Requirements
  - What's Missing
- What's *Secure* Isolation?
- MontaVista Xen-ARM Project
- Future Enhancements
- References, Announcements

Current Isolation Solutions High-Level Design



- Minimal Security: Only MMU
- Secure Isolation?
- VMM Access Control?
- Secure Communication?
- Secure Services?
- VM Mediated Sharing?
- Attestations by VM?
- Integrity Guarantees?

Secure Isolation Requirements

Isolation Technologies Should Provide

- Execution Segregation: Running Trusted Code
  - *Along With* Or *Inside* Untrusted Environment
- Work Across Different ARM Cores
  - With Or Without TrustZone HW
- Provide Security Controls *Within* Hypervisor
  - Fine Grained Enough To Guarantee Isolation
  - Coarse Grained Enough To Guarantee Performance
- GPL Jailhouse: No GPL Contamination For IP Code

Current Isolation Solutions (cont'd)

- **Access Control Granularity Is Important**
- **IBM's sHype**
  - A Step In The Right Direction
  - Available On Xen
  - VMWare ESX & MS Viridian Likely To Adopt Same Style
  - Not Fine-grained Enough
  - More Work Needed: (Mainline?)
- **XSM (Xen Security Modules)**
  - NSA & NIARL Working on it
  - Includes: FLASK, ACM (sHype), dummy (default)
  - FLASK Module: Fine-grained, SELinux-like MAC
  - Interesting Approach, More Work Needed.

Secure Isolation: What's Missing?

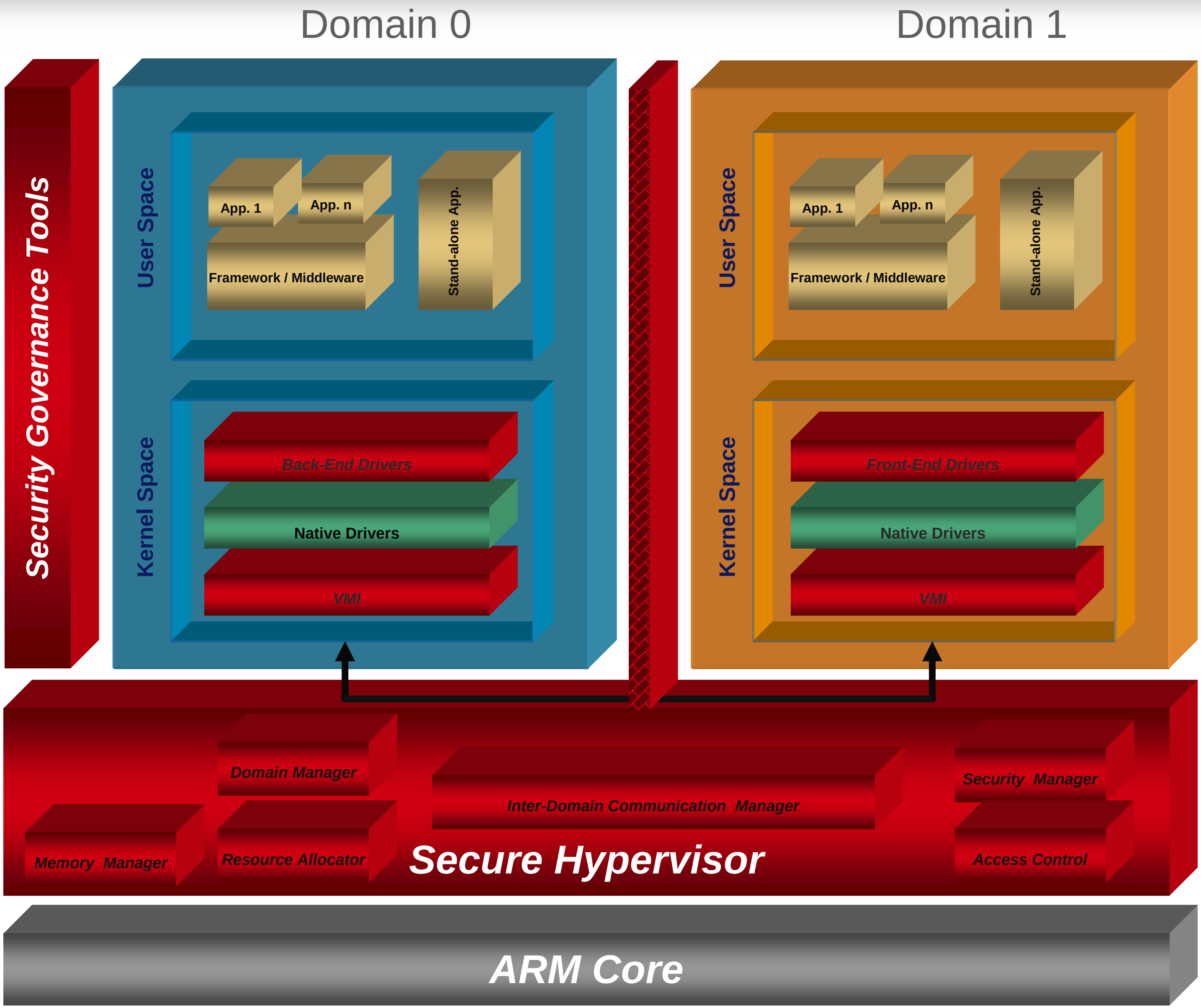
The Notion of Identity

- ***security_context(Dom_n_id)***
  - Lacks Individual Application Identification Within a Domain
- ***security_context(Dom_n_id, App_m_id)***
  - Individual Applications Within a Domain Identified
  - But Who Handles
    - Identity Management?
    - Access Control Definition & Enforcement?
  - What's The Mediation Mechanism Across Domains??
  - Who Arbitrates & Attests The Identities?
    - Hypervisor? Could It Still Be Considered "thin layer"?

MontaVista Xen-ARM Project

- High-Level Architecture
- Design Objectives
- Unique Consumer Benefits
- Further Enhancements

High-level Design



MontaVista Xen-ARM Design Objectives

1. Delivers a unique and timely implementation of Secure Isolation Technology for ARM Architecture, targeting the emergent Linux-based ARM cores

2. Comprises A Complete, Optimal And Linux-centric Secure Isolation Technology

3. Designed For Tight, Efficient Integration With MontaVista Mobilinux 5.x Edition On ARM Cores

4. To Be The Premier Linux-Based Secure Isolation From The Leading Embedded Linux Company.

MontaVista XEN-ARM: Unique Consumer Benefits

- Provides A Secure Isolation Solution for ARM Cores That:
  - Provides Guest Domains With TCB
    - Hypervisor Proper Small & Verifiable
    - Includes MAC (*Work In Progress*)
  - Is Optimized For
    - MontaVista Mobilinux 5.x
  - Is Linux-Centric
    - Easy To Integrate, And Efficient
  - Is Robust & Extensible
    - Is Based On Active, Advanced And Open Source Technologies
    - Has A Secure, Layered, Pluggable And Extensible Architecture
    - Paravirtualization Independent Of VT-Enabled Hardware
    - Dom0 Can Run Even During Guest Upgrade (e.g. FOTA)
  - Has A Light-Weight Implementation
    - Memory Footprint: ~2M (Hypervisor)
  - Includes Non-GPL Environment To Enforce IP Segregation

Status: What's Already Completed

- Low-level Serial Console Debug
- Initial MMU Setup Hardwired For Xen Start-of-day
- ARM Exception Handlers
- ARM Interrupts
- ARM Timer Interrupts
- Xen Scheduler
- Xen Idle Domain
- Mini-OS Builds For ARM
- Common Hypercalls
- Memory Allocation
- Pseudo-Physical Memory

Wish List & Enhancements

- STIP API Implementation
- Trusted Interpreter
- Power Management
- Secure Native Services
  - Secure E2E OTA (End to End Over The Air) Update Infrastructure
  - Remote Destruction of Sensitive Data Mechanism
  - Remote Enablement/Disablement Infrastructure
  - SecureVault Functionality
  - Cryptographic Key Management Infrastructure
  - Backup & Restore Mechanism
- Addition of Crypto, Flash, and Legacy HAL to Secure kernel

References & Announcements

- Debut: XEN-ARM ML On Oct. 29, 2007
- http://lists.xensource.com/cgi-bin/mailman/listinfo/xen-arm

Thank You

- ***Questions***
- ***Comments***
- ***Contact: hnahari [at] mvista [dot] com***