DRTM on AMD Server Platforms

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Agenda

• Dynamic Root of Trust Measurement (DRTM)
• DRTM present status
• DRTM: Intel vs AMD
• DRTM with AMD’s ASP
• GRUB
• Secure Kernel Loader (SKL)
• Secure Launch Kernel
• Linux Upstream Status
• Questions
Dynamic Root of Trust Measurement (D-RTM)
TCG Specification

• Trusted Computing Group (TCG) defines the broad requirements for D-RTM
• “A platform-dependent function that initializes the state of the platform and provides a new instance of a root of trust for measurement without rebooting the platform. The initial state establishes a minimal Trusted Computing Base.”

• The Gap, a period in time where we haven't validated the Computed Base.
• Dynamic Launch Event: DRTM starts recording measurements into the PCR after the **DL Event**
• If successful, DRTM presents the user with a Dynamically Launched Measured Environment (DLME).
Dynamic Root of Trust Measurement (DRTM)

- The location of the ROT is dynamic in DRTM; it is flexible, and the security architecture can choose where ROT lies.

- In the AMD platforms, the ROT starts with executing the **SKINIT** instruction.

- For TrenchBoot project on AMD, GRUB launches the DRTM sequence by executing the SKINIT instruction.

- The SKINIT instruction verifies the Signature of the SKL.
Dynamic Root of Trust Measurement (DRTM)

TrenchBoot

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SKL: Secure Kernel Loader
MLE: Measured Launch Environment
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**TrenchBoot with AMD’s HW**

**SKL**: Secure Kernel Loader

**MLE**: Measured Launch Environment
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DRTM present status

• DRTM comprises two phases: **Power-On** and **Relaunch**.

• The Power-on phase interfaces with AMD’s **ASP** hardware; it authenticates and measures software modules.

• The Relaunch phase involves saving and restoring the user state and vectoring back to the GRUB. **Ross Philipson** is working on it.

• The Power-on phase is now available.

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**TrenchBoot with AMD’s HW**

- BIOS
- GRUB
- SKL
- MLE
- OS

SKL: Secure Kernel Loader

MLE: Measured Launch Environment
ACM: Authenticated Code Module

MLE: Measured Launch Environment

SKL: Secure Kernel Loader
DRTM with AMD’s ASP

Relaunch

- BIOS
- GRUB
- SKL
- SKINIT
- ROT event
- MLE (OL8)
- uroot
- APP
- APP
- OS
- BSP (CPU 0)
- ALL CPUs
- CPU
- MMIO
- PCR BANK
- TPM
- DRTM UAPP
- ASP
- DRAM
- IO DEVICES
- DMA
DRTM with AMD’s ASP

- BIOS
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DRTM with AMD’s ASP

- BIOS
- GRUB
- SKL
- MLE (OL8)
- APP
- APP
- OS
- BSP (CPU 0)
- ALL CPUs
- CPU
- PCR BANK
- DRTM UAPP
- DRAM
- IO DEVICES
- TPM
- ASP
- DRAM
- TMR
- DEV_EN

Relaunch

SKINIT ROT event
DRTM with AMD’s ASP

- BIOS
- GRUB
- SKL
- SKINIT
- ROT event
- MLE (OL8)
- APP
- APP
- SKL
- uroot
- APP
- ALL CPUs
- BSP (CPU 0)
- CPU
- PCR BANK
- TPM
- DRTM UAPP
- ASP
- DRAM
- IO DEVICES
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- DEV_EN
DRTM with AMD’s ASP

- BIOS
- GRUB
- SKL
- SKNIT ROT event
- MLE (OL8)
- APP
- OS
- APP
- BSP (CPU 0)
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Relaunch
DRTM with AMD’s ASP

- BIOS
- GRUB
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Relaunch

BSP (CPU 0) -> ALL CPUs

CPU

Rot event

UEK
uroot

APP

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• Check CPU supports SKINIT

• Set ICR, CPU control registers, and fill SKL tags with bootloader data

• Setup DRTM service through ASP
  • DRTM Service Initialization
  • DRTM Get Capability
  • DRTM Setup Trusted Memory Region

• Runs the SKINIT instruction by passing the physical address of the SKL binary to it via the EAX register
Secure Kernel Loader (SKL)

• Executes with SL_DEV protection

• Kicks off the state machine in the DRTM UAPP

• Measures the MLE kernel and extends the measurements to PCRs

• ASP validates the signature embedded in SKL before vectoring into it.

• AMD allows vendors to sign SKL. Oracle developed a tool to sign and package SKL.
Secure Launch Kernel (a.k.a MLE / DLME)

- Runs on the Bootstrap Processor (BSP)
- Enables DMA by releasing TMRs
- Locks TPM locality 2 and ends the DRTM state machine in the ASP
- Clears INIT_REDIRECTION in VM_CR MSR
- Wakes up the Application Processors (APs) using the startup IPI
- U-root makes policy decisions
- Two flavors: Provisioning & SecureLaunch
Linux Upstream Status

- Current Secure Launch patch set for Linux submission is Intel/TXT only.

- Version 7 of the patch set was posted to LKML in November 2023.

- Primarily contained AP startup changes using MWAIT/MONITOR per Thomas Gleixner’s suggestion.

- The UEFI/Dynamic Launch stub support was removed in v7 because of substantial changes to the EFI startup code in the setup kernel.

- An effort is underway with the UEFI Linux kernel maintainers to redesign a new solution.

- These changes will be posted to LKML in patch set version 8 in the next few months.
Thank you