IDF13

UEFI Secure Boot in Linux*

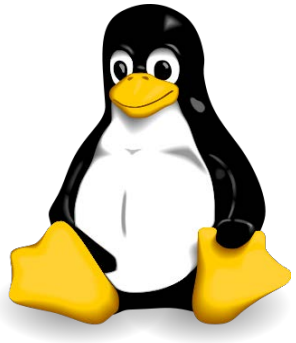
Vincent Zimmer – Principal Engineer, Intel Corporation
Philip Oswald – Project Manager, SUSE
Gary Lin – Software Engineer, SUSE

STTS002

intel Look Inside.

Agenda

- Problem Statement
- What is UEFI Secure Boot
- Introduction to Machine Owner Key
- Secure Boot in SUSE Linux
- Demo



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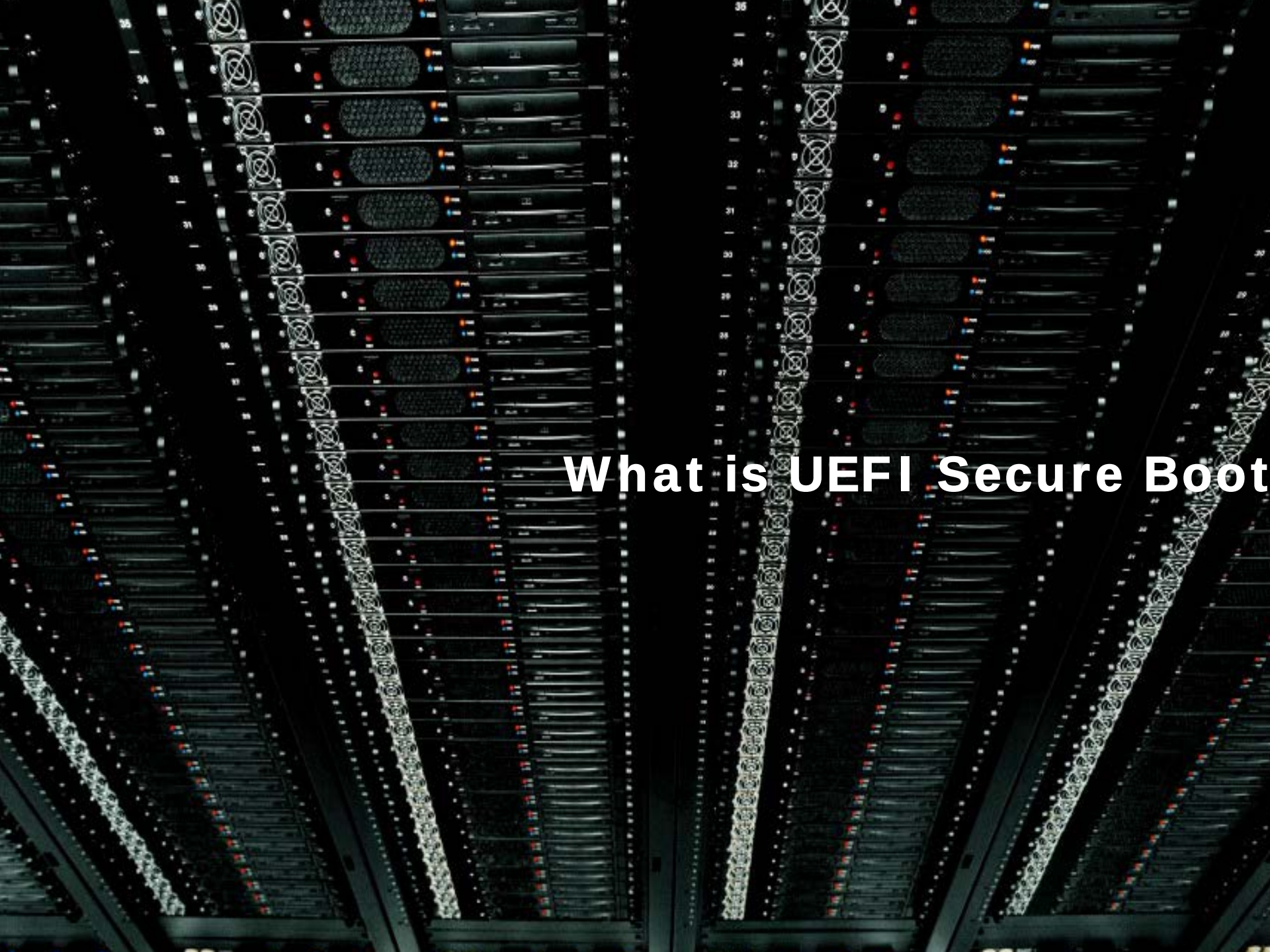
Problem Statement

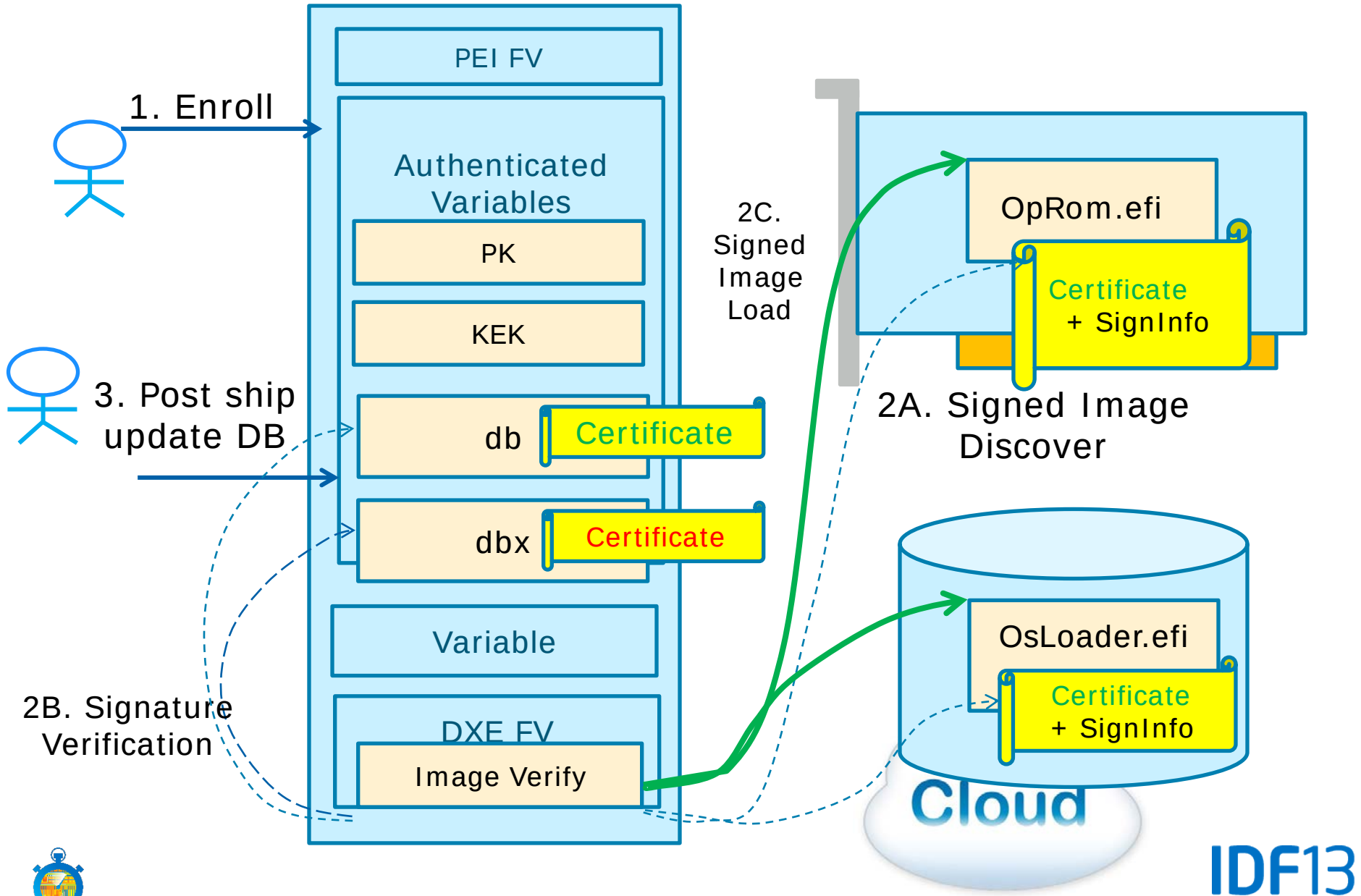
Secure Boot Problem

- Malware moving more into the platform
- UEFI extensibility can be exploited by unauthorized parties
- Attacks increasingly targeting the platform firmware
  - Black Hat 2007, 2009, 2013, CanSecWest 2013…
- Need to balance UEFI code loading controls and maintain platform owner and user choice
- For platform integrity and user flexibility:
  - Maintain ability to have several operating systems on the platform
  - Provide platform owner a choice for software



What is UEFI Secure Boot

UEFI Secure Boot



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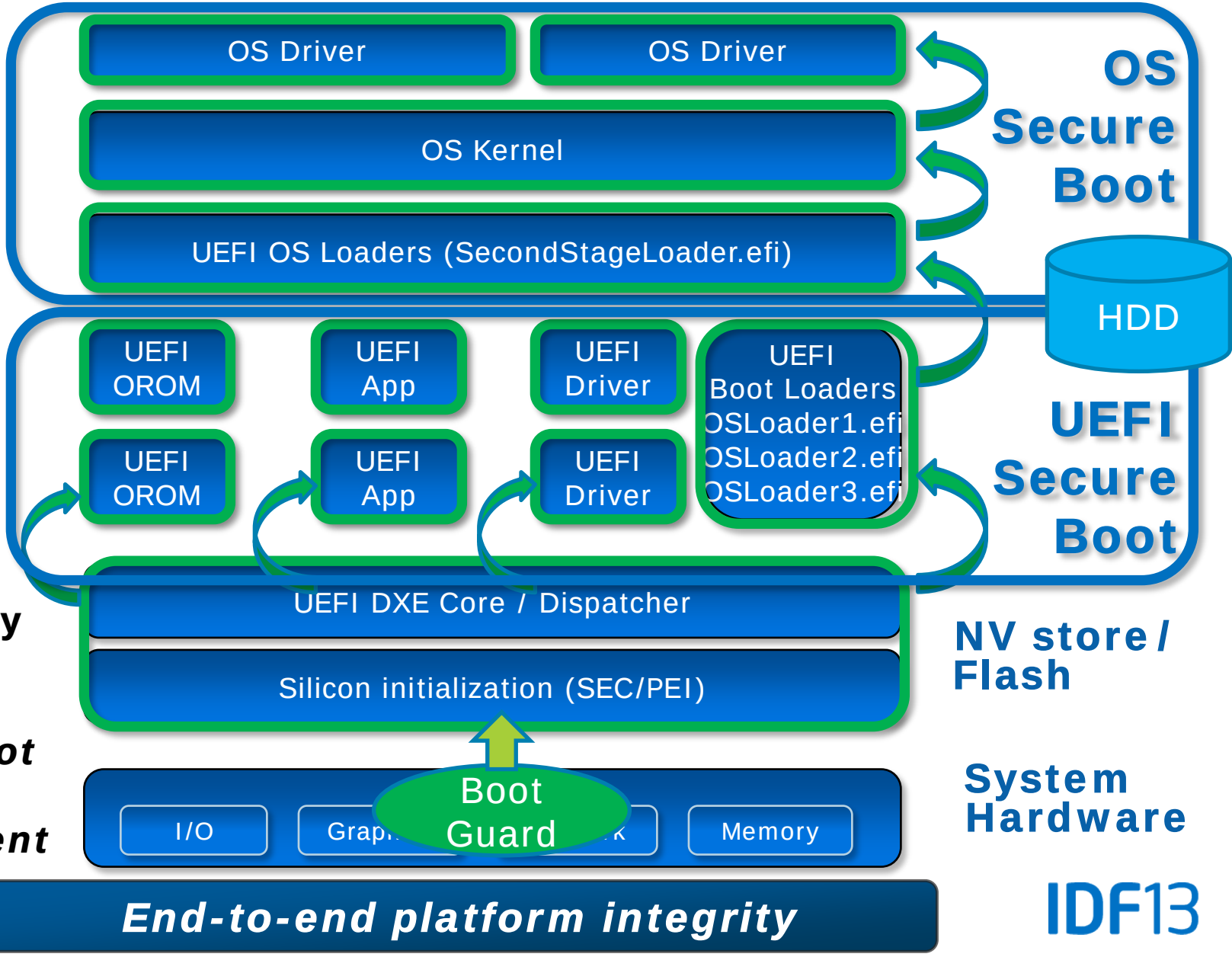
The Full Solution

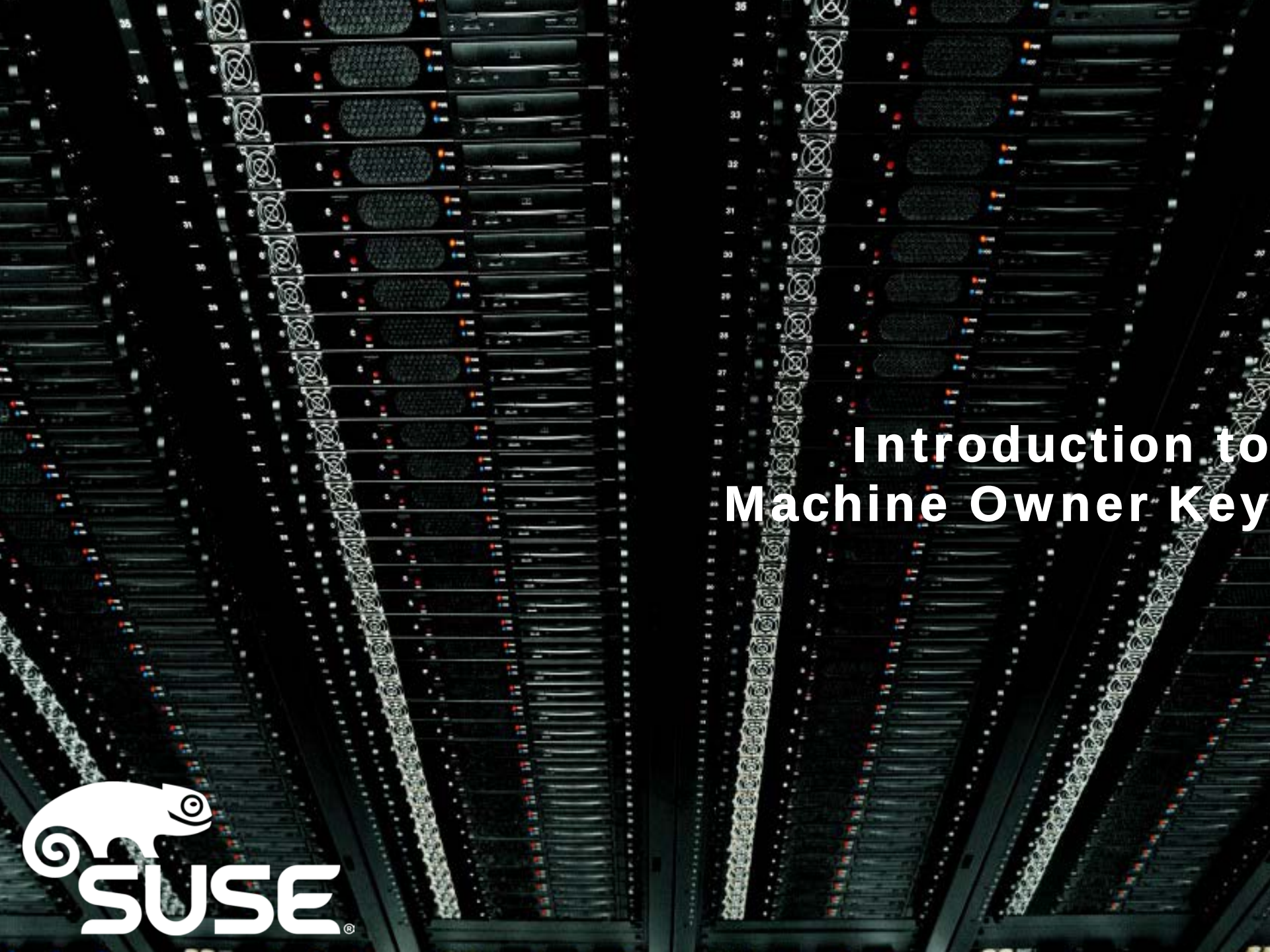


Intel® Device Protection Technology with Boot Guard – Secure *Boot Policy Enforcement*

Secure Boot Challenges for Linux*

- Dual OS deployment challenge
  - Users can disable UEFI Secure Boot to install Linux* but this isn't the best deployment plan
  - Users must have an option to install Linux alongside an OS, even when UEFI Secure Boot is enabled
- Linux can benefit from UEFI Secure Boot, if…
  - Customers can install Linux without disabling the feature
  - Platform owner can set security policy and customize system
- Different roles interact with UEFI Secure Boot
  - Kernel hacker – disable or enroll own keys w/firmware screens
  - Consumer – just want it to work, seamless boot of live images
  - Managed IT machine – IT is the 'owner.' Control end user actions.

Linux distributions have several options to implement secure boot


Introduction to
Machine Owner Key
SUSE

Machine Owner Key (MOK)

- To support UEFI Secure Boot in Linux*, there are two challenges to overcome
  - Coexist with other operating systems
  - Avoid the potential General Public License (GPL) copyright issues caused by the UEFI image signature
- MOK gives back the key management control to users or security admin

SUSE Solution

MOK comprised of 4 parts

shim

grub2, kernel, and kernel drivers

- A BSD licensed preloader of the OS loader(grub2) signed with the db key
- All involved components are signed

MOKList

MOK database - The key database implemented in a UEFI nvram variable, MOKList

MokManager

The UEFI program to manipulate the MOK database

mokutil

The Linux* utility program to issue requests to MokManager

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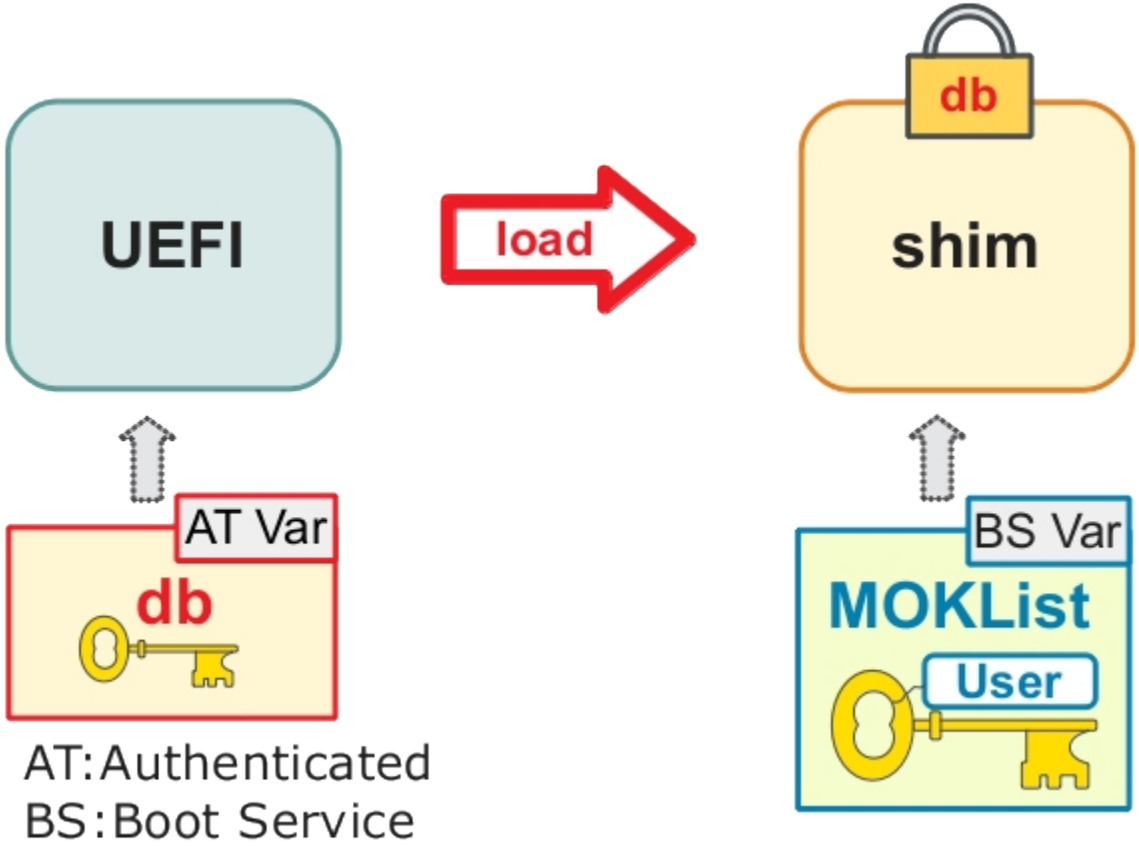
MOK Database

- The MOK database is used as a boot service non-volatile variable
- UEFI Boot Service non-volatile variables are immune from threats from OS
- MOKList is not the db and does not need to be controlled by KEK

	Boot Service	Runtime Service	Authenticated
UEFI - Read	Yes	Yes	Yes
UEFI - Write	Yes	Yes	Restricted
OS - Read	**No**	Yes	Yes
OS - Write	**No**	Yes	Restricted
	BS Var	RT Var	AT Var

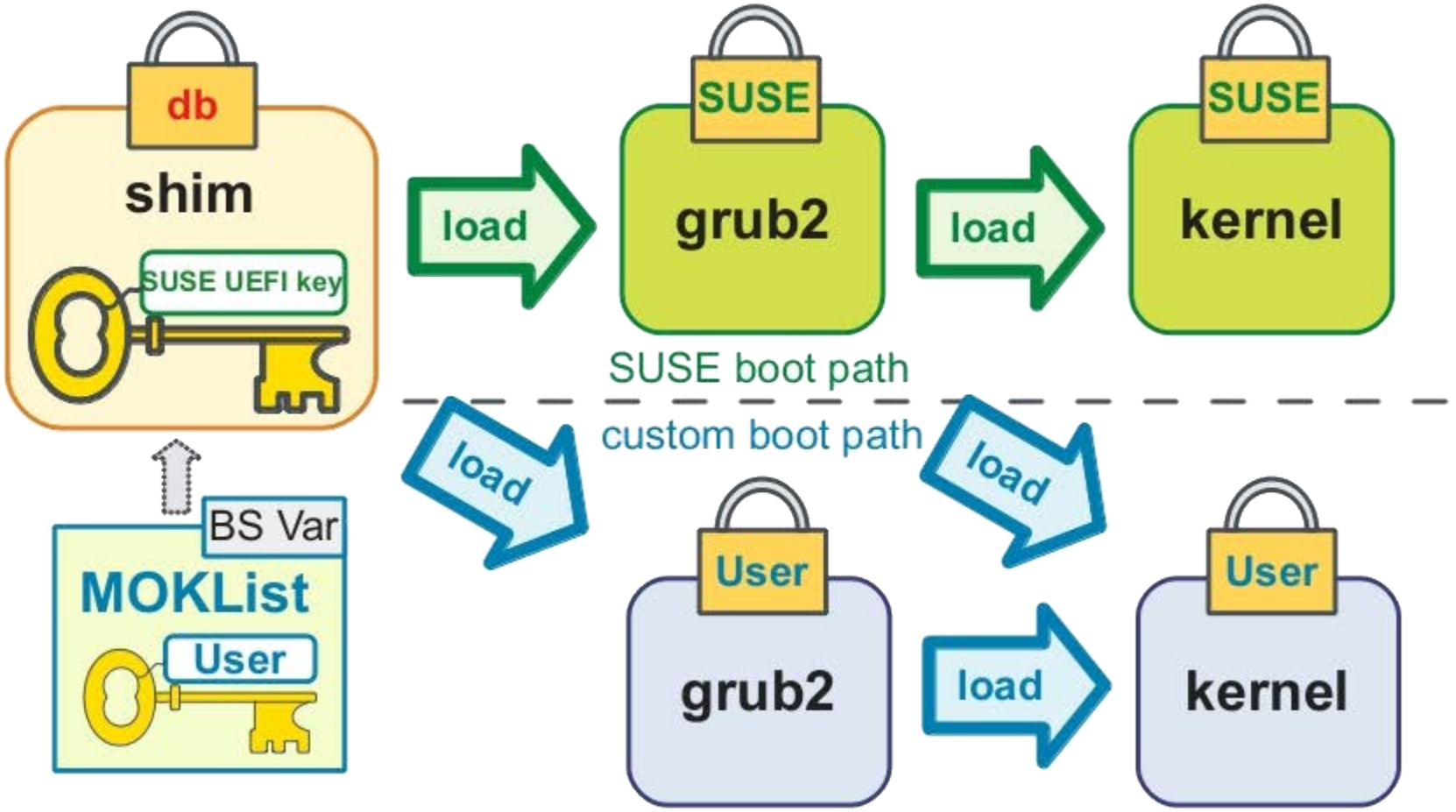
MOKList is not accessible at OS runtime

UEFI Secure Boot With MOK



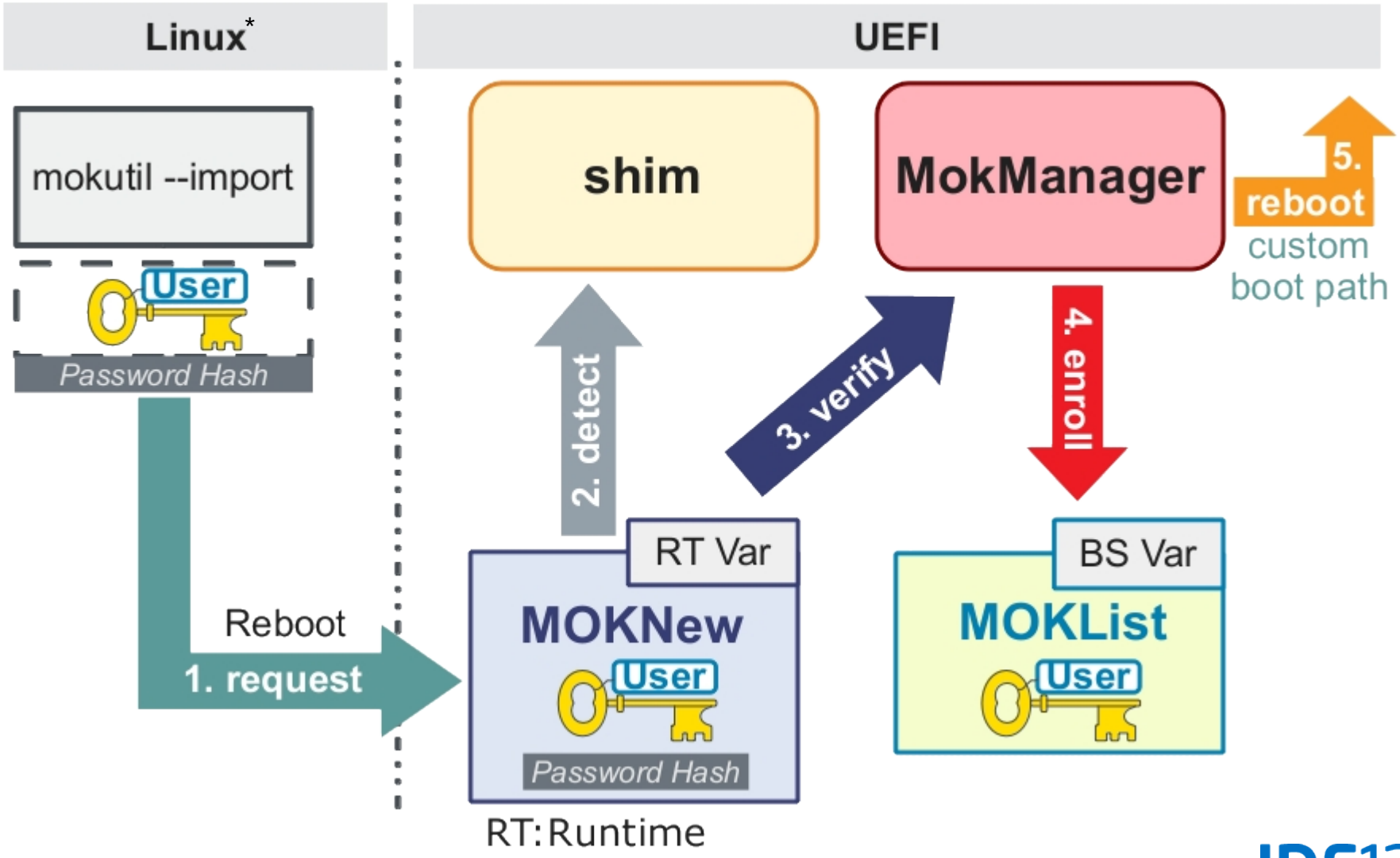
shim is loaded before other UEFI images

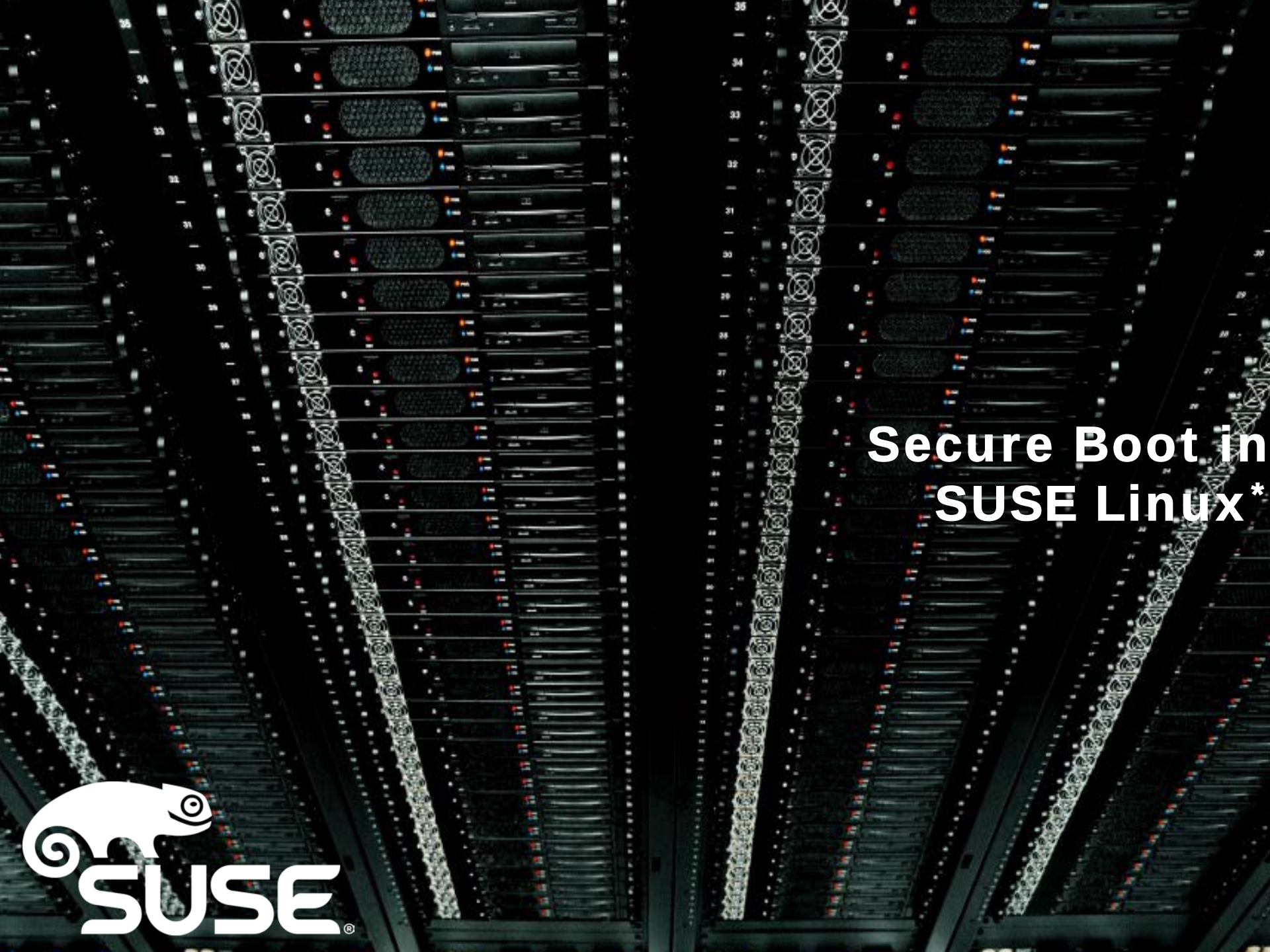
Multi-boot with MOK



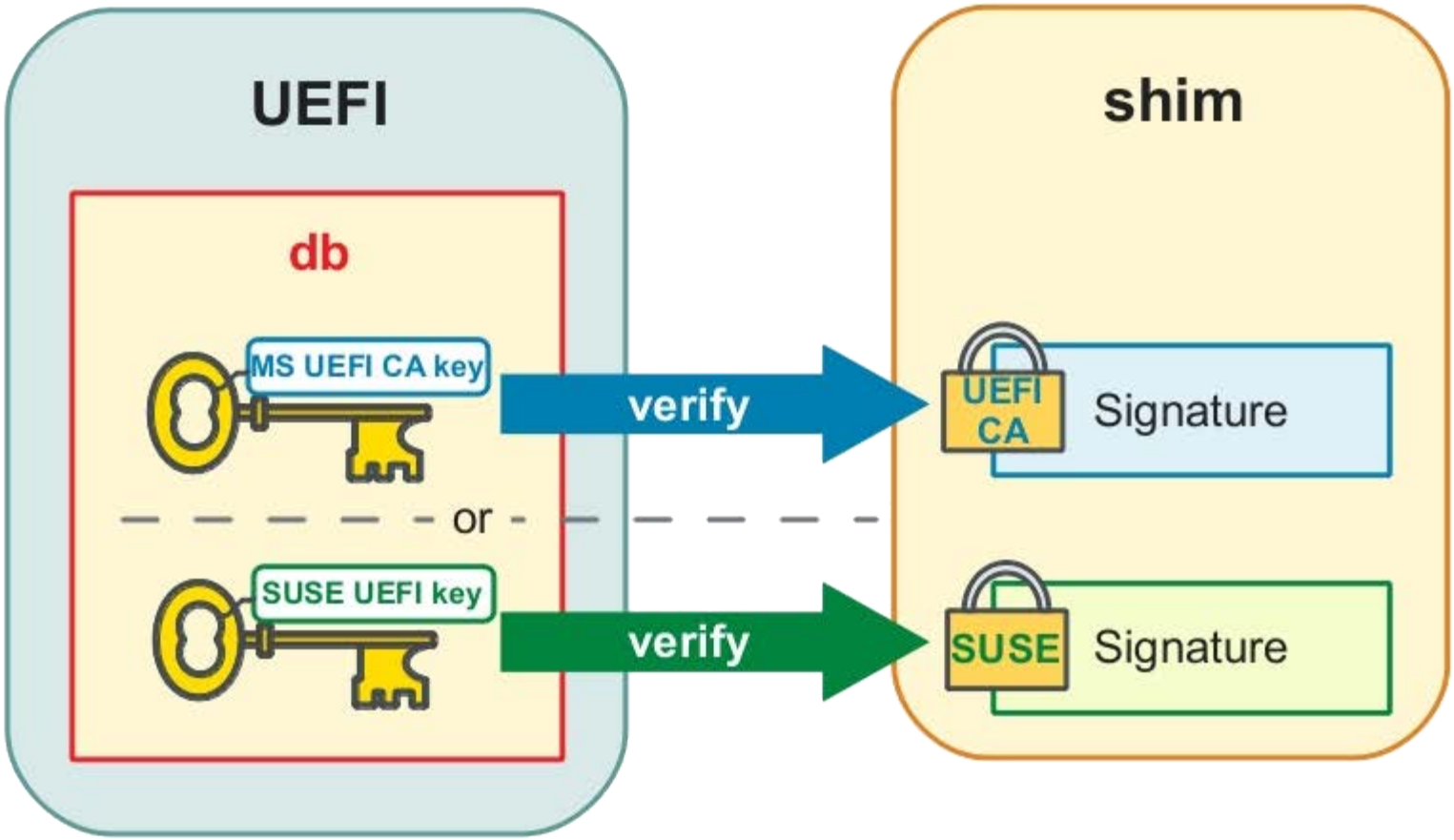
Load the UEFI image as long as it is trusted

Enroll A New MOK Key




Secure Boot in
SUSE Linux*
SUSE

Multisigned shim



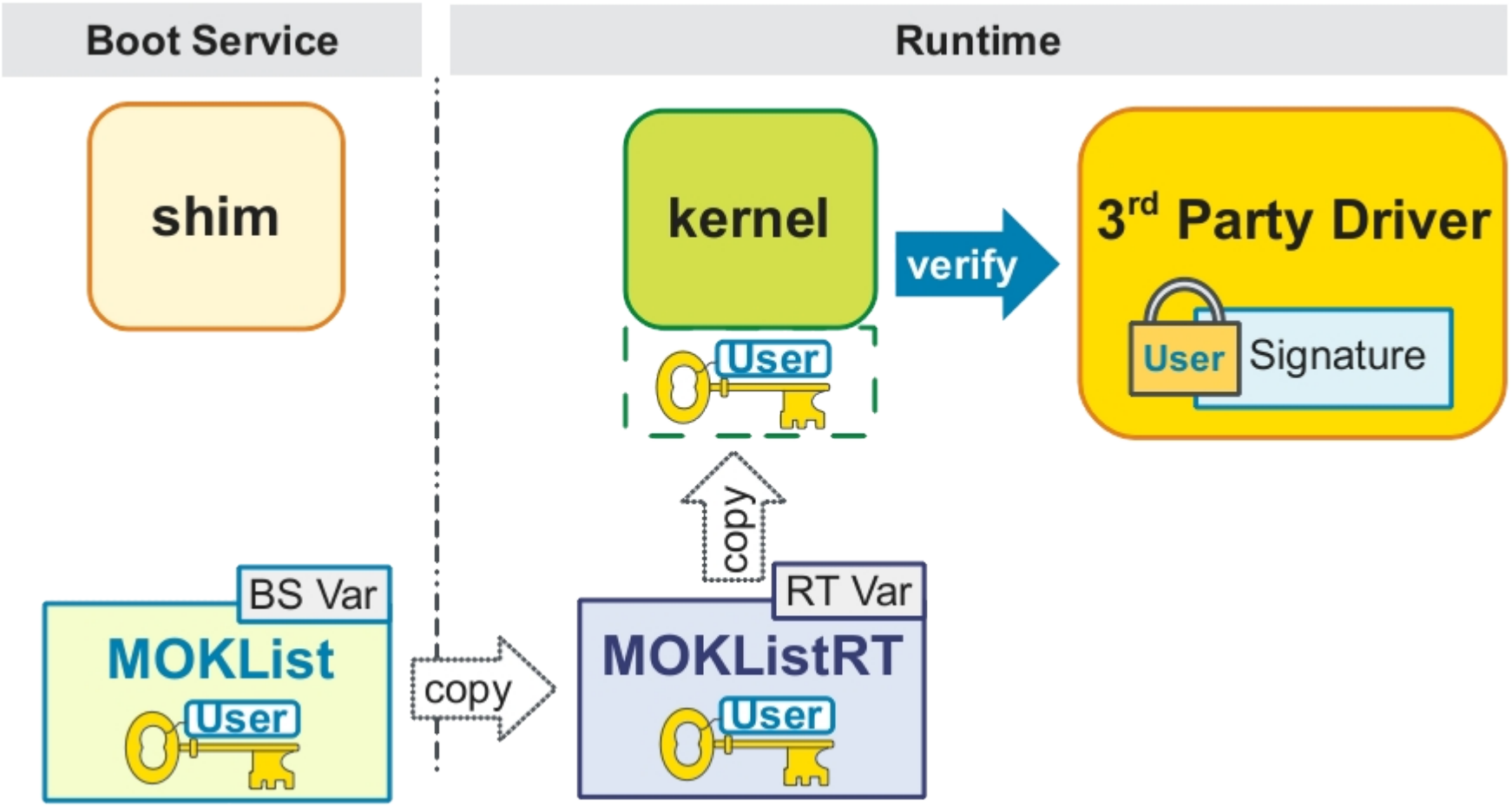
Either the UEFI CA key or SUSE key will let the shim boot with UEFI secure boot

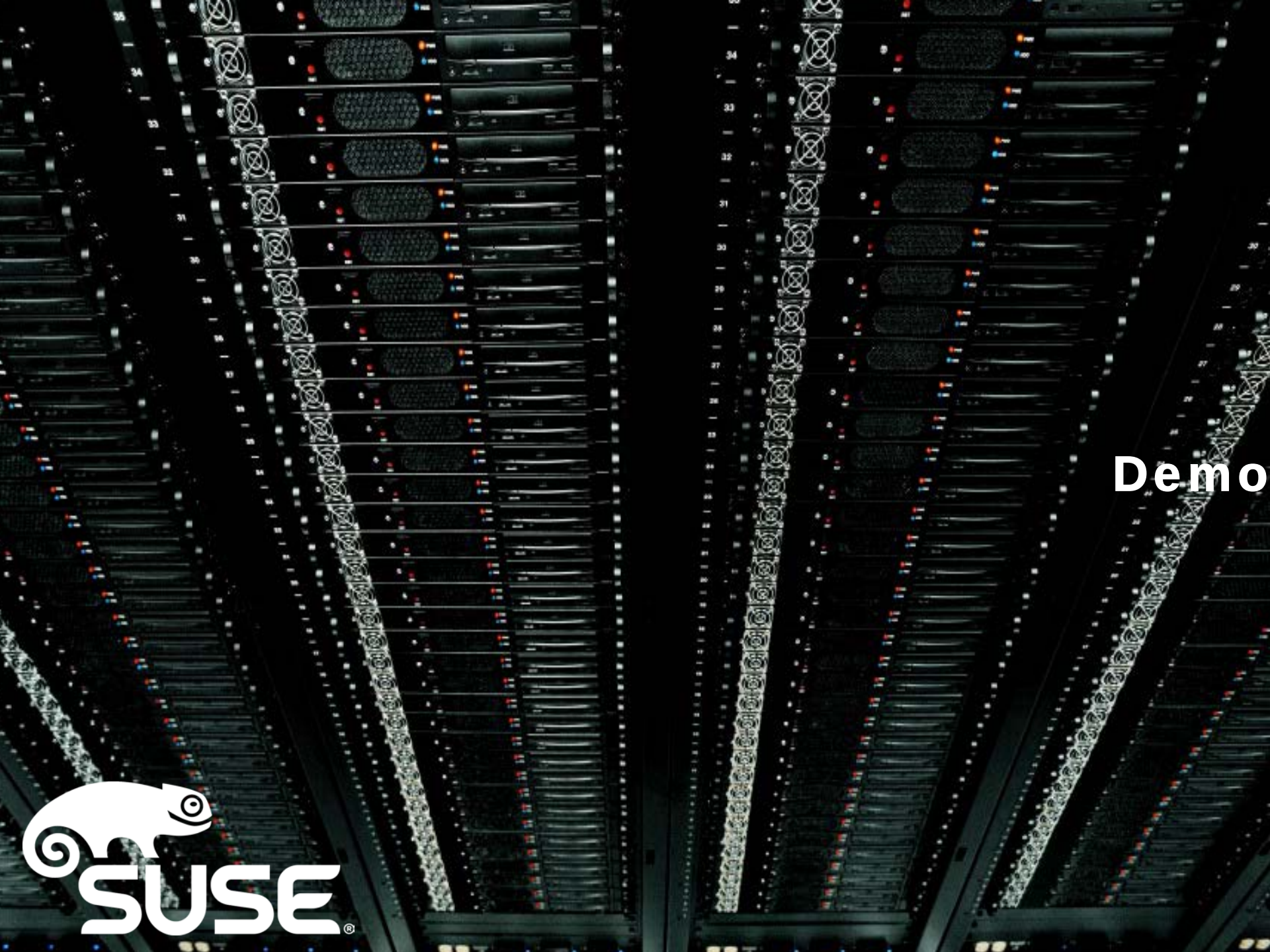
Linux* Driver Verification

- All kernel drivers have to be signed with the SUSE key
- Linux* kernel verifies drivers with the built-in SUSE key or MOK keys
- SUSE will NOT sign any binary driver that is incompatible with GPLv2
- The user is free to enroll the key for the third party binary driver
- SUSE's Partner Linux Driver Program (PLDP) - simplifies MOK implementation

Users can get their 3rd party drivers included in the secure boot with MOK

Third Party Driver Verification




Demo
SUSE

SUSE Summary and Call to Action

- UEFI Secure Boot no longer an issue to the Linux* World
- With MOK, users select the keys they trust
- Linux systems benefit from MOK to ensure the integrity of the drivers

Call to action:

- Use MOK in your Linux deployments
- Put SUSE key in UEFI database to test multi-signed shim
- Utilize SUSE's Partner Linux Driver Program for delivering kernel drivers compatible with SUSE Linux Enterprise and Secure Boot
  - https://www.suse.com/partners/linux-driver-program/

Summary

- Attacks against the platform will most likely continue
- Deploy UEFI Secure Boot to address pre-OS malware
- Design a robust platform implementation
- Avoid ‘restricted boot’ & continue to enable platform owner choice of UEFI Secure Booted code
- Emergent tools for choice include multi-signed images, the Shim Loader, and Machine Owner Key
- Machine Owner Key provides practical solution for implementing key management

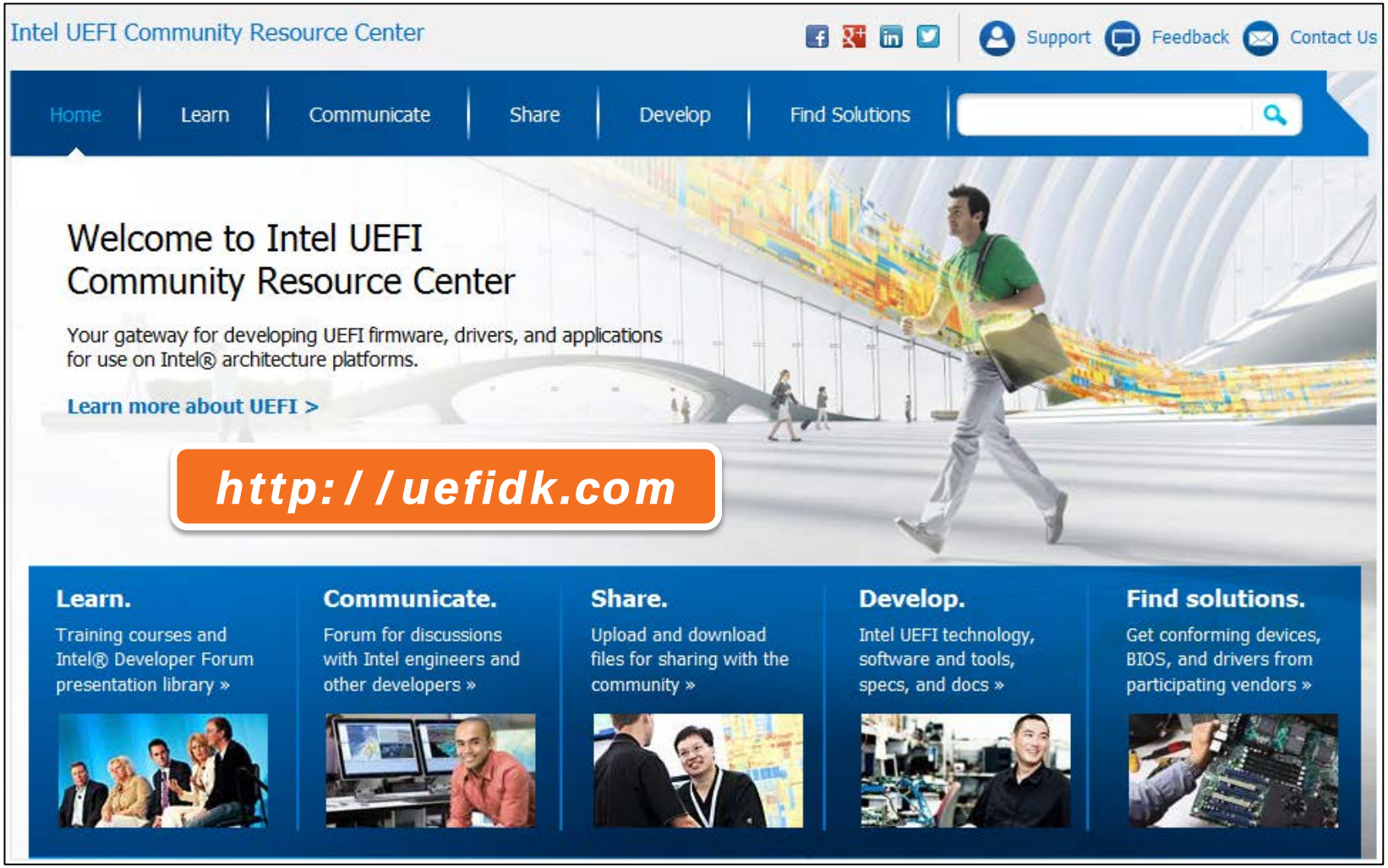
Updates from Linux* Distributions

- **Ubuntu* 12.10** – 64-bit version of Ubuntu 12.10 shipped with Shim to support secure boot
- **Fedora* 19** – included Shim with MOK (Machine Owned Key) functionality
- **OpenSUSE* 12.3** release supports MOK manager and multisigned Shim loader
- **SUSE SLES 11 SP3*** - included multisigned Shim with MOK functionality and runtime Mokutil
- **Linux* Foundation** Secure Boot System Released
- UEFI Technology Adopted by Linux Community†

Linux distro implementation with MOK 3rd party manager signing list implemented already

† http://www.businesswire.com/news/home/20130319006268/en/UEFI-Technology-Adopted-Linux-Community

Intel UEFI Community Resource Center



Central resource for UEFI on Intel® Architecture

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Additional Sources of Information

PDF of this presentation is available is available from our Technical Session Catalog: www.intel.com/idfsessionsSF.
The URL is on top of Session Agenda Pages in Pocket Guide.

Visit the Unified EFI Forum for the latest specifications.

The EDK II project is hosted at http://tianocore.org.

Latest updates to SUSE* UEFI secure boot:

OpenSUSE tools UEFI:

http://download.opensuse.org/repositories/home:/jejb1:/UEFI/
http://build.opensuse.org/project/show/home:jejb1:UEFI

Related Articles/Whitepapers at tianocore.org:

- "A Tour Beyond BIOS into UEFI Secure Boot"
- Images with Multiple Signatures

Other Sessions at IDF
Wednesday, Sept 11, Moscone Room 2008

ID	Title	Time
✓ STTS001	Creating UEFI Solutions Optimized for Mobile Devices	11:00
✓ STTS002	UEFI Secure Boot in Linux*	13:00
STTS003	Using UEFI for Secure Firmware Update of Expansion Cards	14:15
STTS004	Predicting Performance of Hadoop* and Data Center Clusters with Intel® CoFluent™ Studio	15:45
STTS005	Accelerating Software Development on Next Generation Intel® Architecture Microservers and Tablets with Wind River Simics*	17:00

See also

Technical Showcase Booths 408, 409, 410

"Intel® Device Protection Technology with Boot Guard - Secure *Boot Policy Enforcement*, booth #318"

✓ = DONE

Software Developers: *Network & Have Fun!*

Don't miss out on some great IDF networking and social activities hosted by Intel Software & Services Group (SSG):

- Day 1, Tuesday, Sept 10th, 7pm-10:30pm
  - **Software Developer Networking Party**
    - **Pick up your Software VIP lanyard at the Software and Services Pavilion Info Counter to get party access!**
- Day 2, Wednesday, Sept 11
  - **SSG Inspiration Through Innovation Hour**
    - Location: Showcase Networking Plaza, 11am-12pm & 5pm-6pm
    - SSG/guests discuss how innovation has inspired their products
  - **Doug Fisher (Intel VP, GM SSG) Meet & Greet**
    - Software & Services Pavilion, 5-7pm

- Watch out for SSG Mobile lunch food and dessert carts outside Moscone throughout the conference
- Visit SSG Pavilion Showcase for great demos and games!

Additional Linux Resources

IDF 2012 – Developing UEFI Support for Linux*

https://intel.activeevents.com/sf12/scheduler/catalog/catalog.jsp?sy=42

For more information on Ubuntu* …

Ubuntu ODM Portal - http://odm.ubuntu.com/

Secure Boot Tools - git://kernel.ubuntu.com/jk/sbsigntool
https://github.com/vathpela/pesign

Summary of secure bootloaders

http://www.rodsbooks.com/efi-bootloaders/secureboot.html

Matthew Garrett http://mjg59.dreamwidth.org/

Shim https://github.com/mjg59/

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Backup

Authenticated Variables

Authenticated Variables (AT):
Small signed named data containers
- Managed, protected by the system BIOS
- Read by BIOS, OS.
- Modified by BIOS, OS only if signature verifies (or local user on Intel® Architecture platforms)

Signed PE/COFF executables
- Op ROMs
- Boot loaders
- Applications

Authenticode signing format

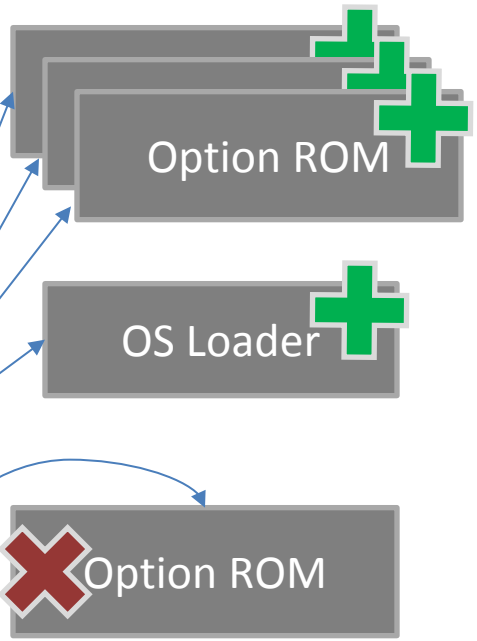
Relationships

PK: Platform Key: AT containing OEM's keys.
Party who can edit the KEK via s/w

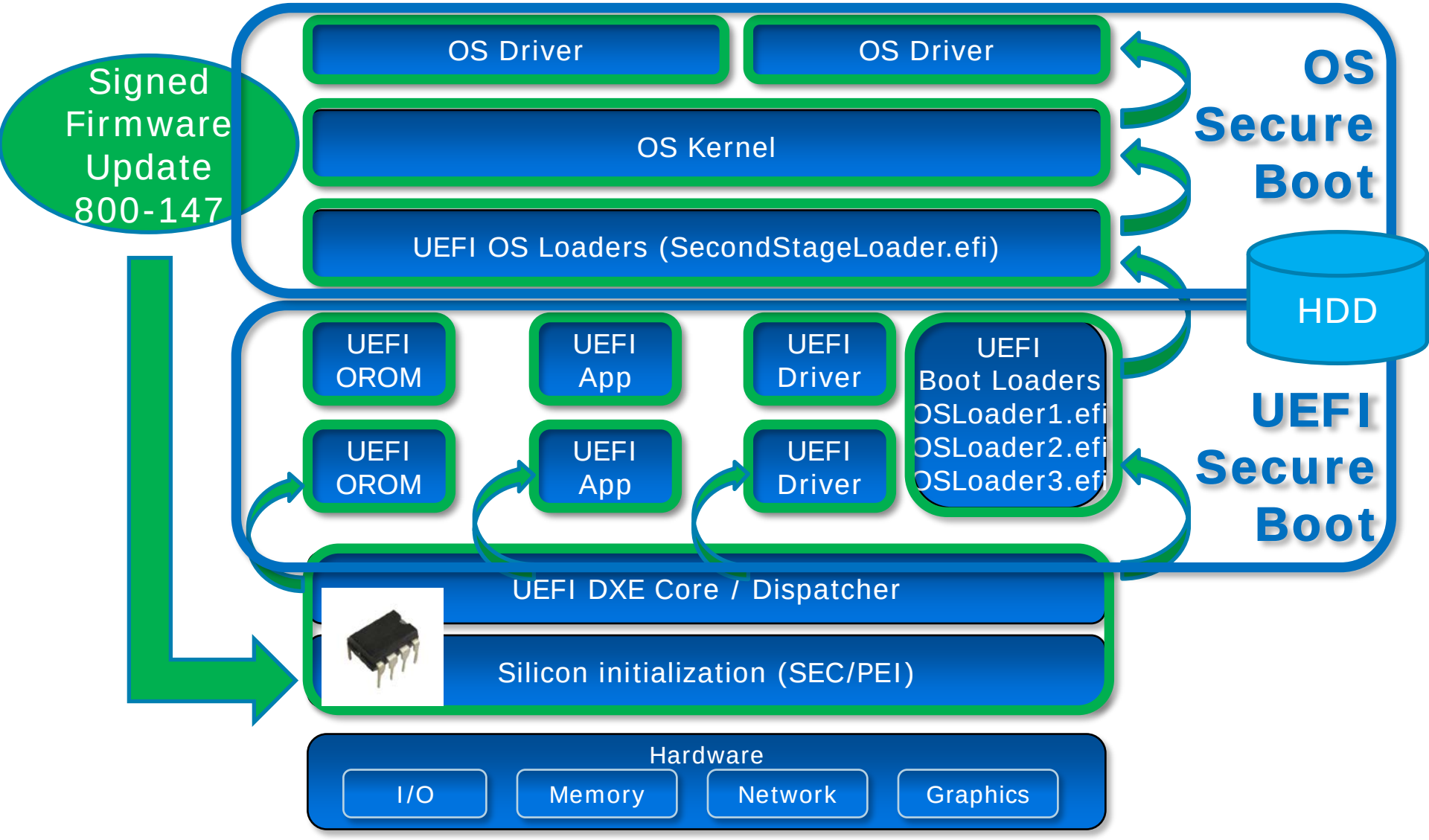
KEK: Key Exchange Key: List of certificates of owners allowed to update white list (db), black list (dbx)

db: Authorization Database: AT containing authorized certs / hashes

dbx: Exclusion Database: AT containing excluded certs / hashes



The Full Solution



End to end platform integrity