SNIA

Education

SELF-ENCRYPTING DRIVES (SEDs):

SIMPLE, YET POWERFUL

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Abstract

SELF-ENCRYPTING DRIVES: SIMPLE, YET POWERFUL

Data security is top of mind for most businesses trying to respond to the constant barrage of news highlighting data theft and security breaches. Combined with litigation risks, compliance issues and pending legislation, companies face a myriad of technology and products that all claim to protect data-at-rest on storage devices.

The disk drive industry has standardized and is now deploying innovative, simple and powerful technology intended to secure data where it lives – in storage. This tutorial will give storage users and managers a look at emerging **drive-level self-encryption technology (both HDD and SSD) from notebook PCs to the data center** that provide a more secure storage foundation and compare that technology with alternate storage encryption methods, including: host-based, appliance, network fabric, and controller-based.

The Problem…

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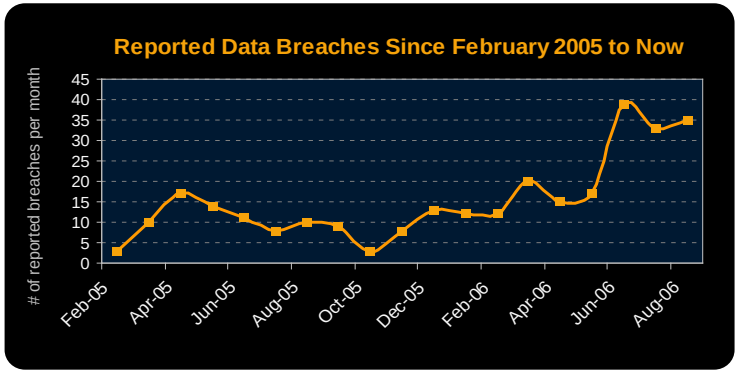
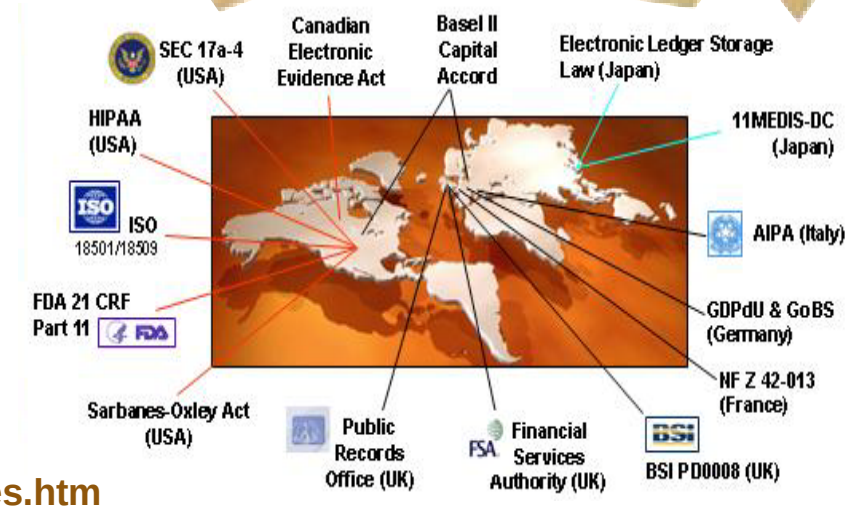
Since 2005, over 345,124,400 records containing sensitive personal information have been involved in security breaches



In 2008, the average cost of a data breach was $6.65 million per affected corporation ($202 per record)

$6.65 Million Per Incident



http://www.privacyrights.org/ar/ChronDataBreaches.htm

The Problem…

Since 2005, over 345,124,400 records containing sensitive personal information have been involved in security breaches

Legal

Financial

Reputation

reach was $6.65 million per affected corporation ($202 per record)

ncident

http://www.privacyrights.org/ar/ChronDataBreaches.htm

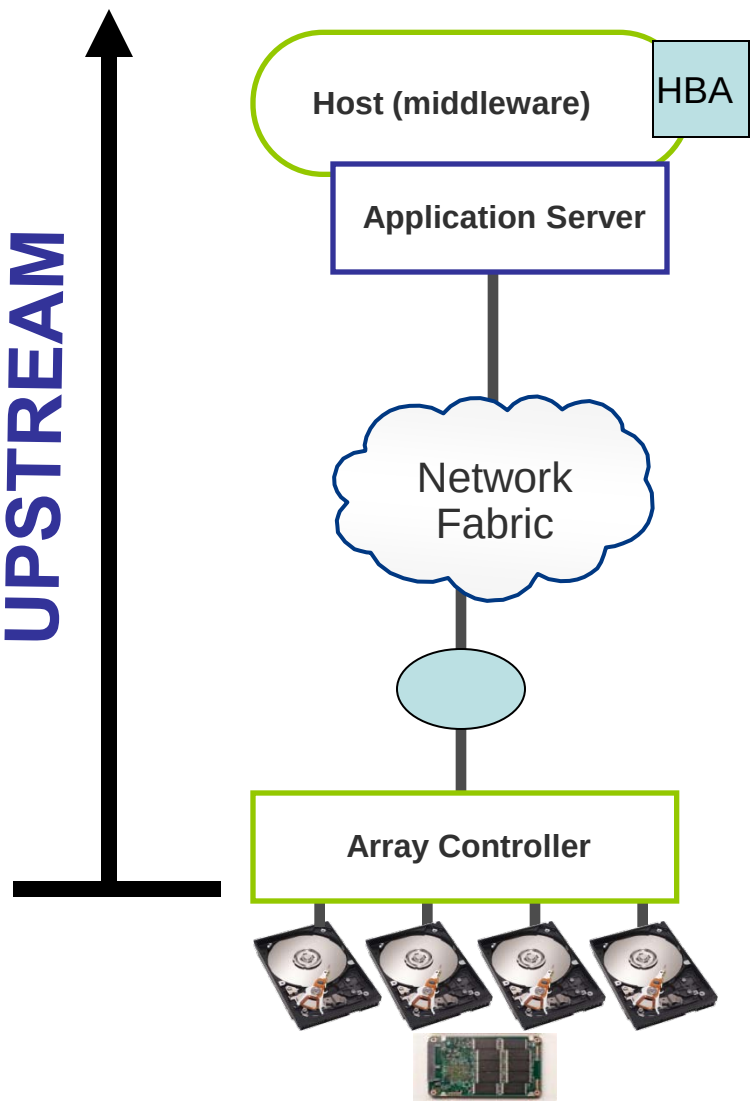
Why Encrypt Data-At-Rest?

- Compliance
  - **46+ states have data privacy laws with encryption "safe harbors", which exempt encrypted data from breach notification[1]**
- Data center and laptop drives are portable (HDD, SSD)
- Exposure of data loss is expensive ($6.65 Million on average per incident[2])
- Obsolete, Failed, Stolen, Misplaced…
  - **Nearly ALL drives leave the security of the data center**
  - **The vast majority of decommissioned drives are still readable**

Threat scenario: stored data leaves the owner's control – lost, stolen, re-purposed, repaired, end-of-life, …

1. http://www.ncsl.org/IssuesResearch/TelecommunicationsInformationTechnology/SecurityBreachNotificationLaws/tabid/13489/Default.aspx
2. Ponemon Institute, Fourth Annual US Cost of Data Breach Study – Jan 2009 www.ponemon.org

Encryption can be done in a number of places…



Host middleware

Host HBA (h/w adapter)

Application

Switch

"Bump in the wire" appliance

Array controller

Drive (HDD, SSD)

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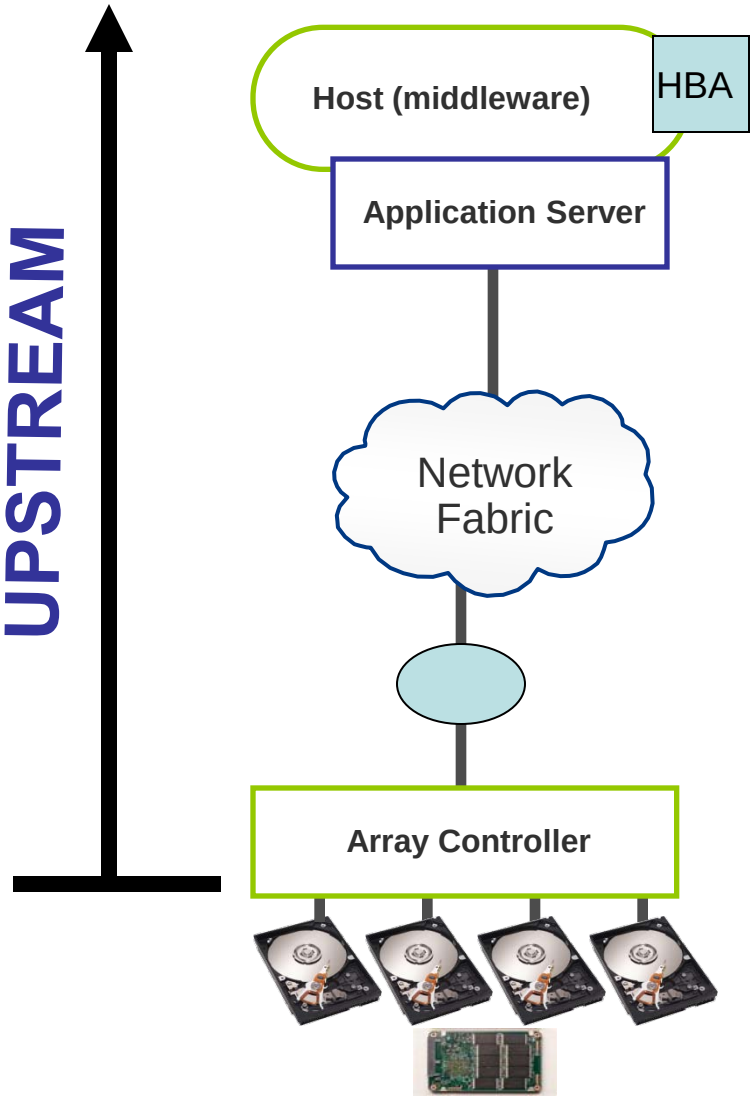

Host middleware

Host HBA (h/w adapter)

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Switch

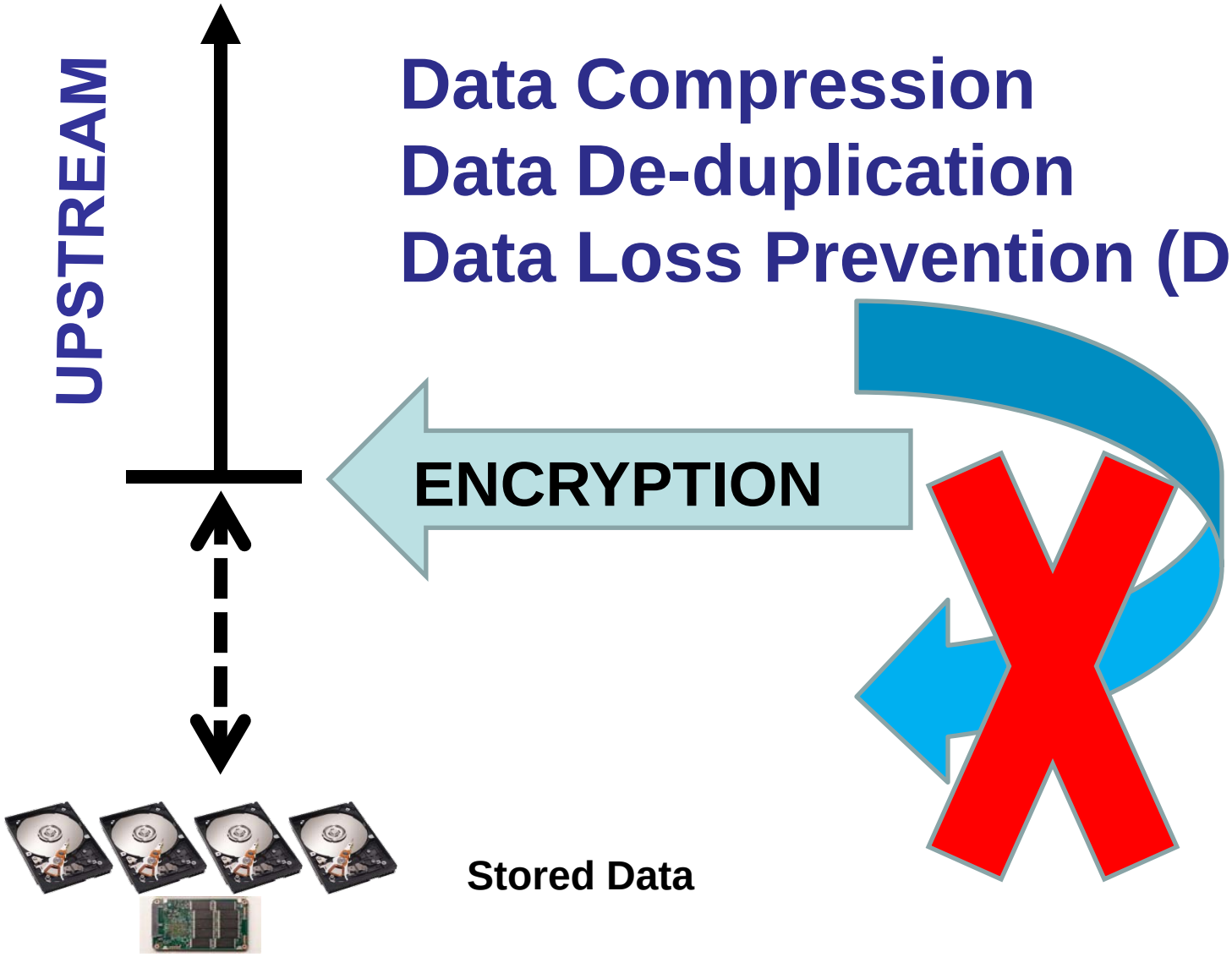
"Bump in the wire" appliance

Array controller

Drive (HDD, SSD)

DIFFERENT THREAT SCENARIOS

Encryption upstream can affect other processes



Self-Encrypting Drives

- **Simplified Management**
- **Robust Security**
- **Compliance "Safe Harbor"**
- **Cuts Disposal Costs**
- **Scalable**
- **Interoperable**
- **Integrated**
- **Transparent**

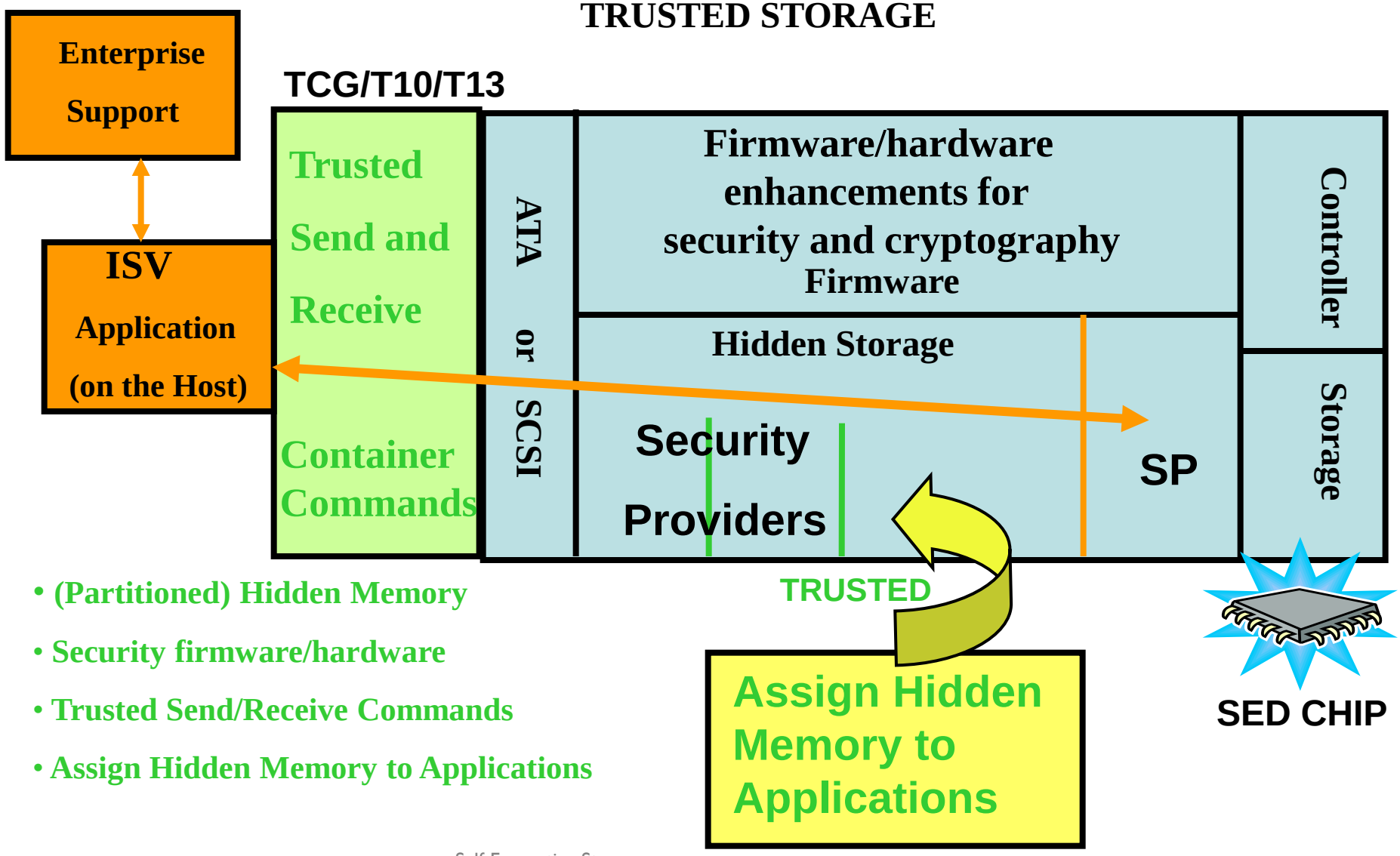
"Many organizations are considering **drive-level security for its simplicity** in helping secure sensitive data through the hardware lifecycle from initial setup, to upgrade transitions and disposal"

Eric Ouellet
Research Vice President
Gartner

Trusted Storage Standardization

Published Storage Specifications

Implementation Overview



- (Partitioned) Hidden Memory
- Security firmware/hardware
- Trusted Send/Receive Commands
- Assign Hidden Memory to Applications

Trusted Storage with Trusted Platform

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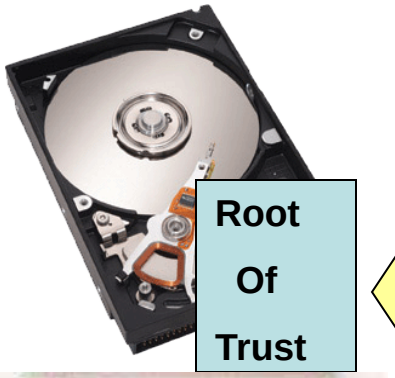
Trusted Storage



Root Of Trust

Secure Communications

Trusted Platform

TPM

OR

Trusted Element

Life Cycle: **Manufacture, Own, Enroll, PowerUp, Connect, Use, …**

Trusted Storage with Trusted Platform

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Trusted Storage

Root Of Trust

Secure Communications

Trusted Platform

TPM

OR

Trusted Element

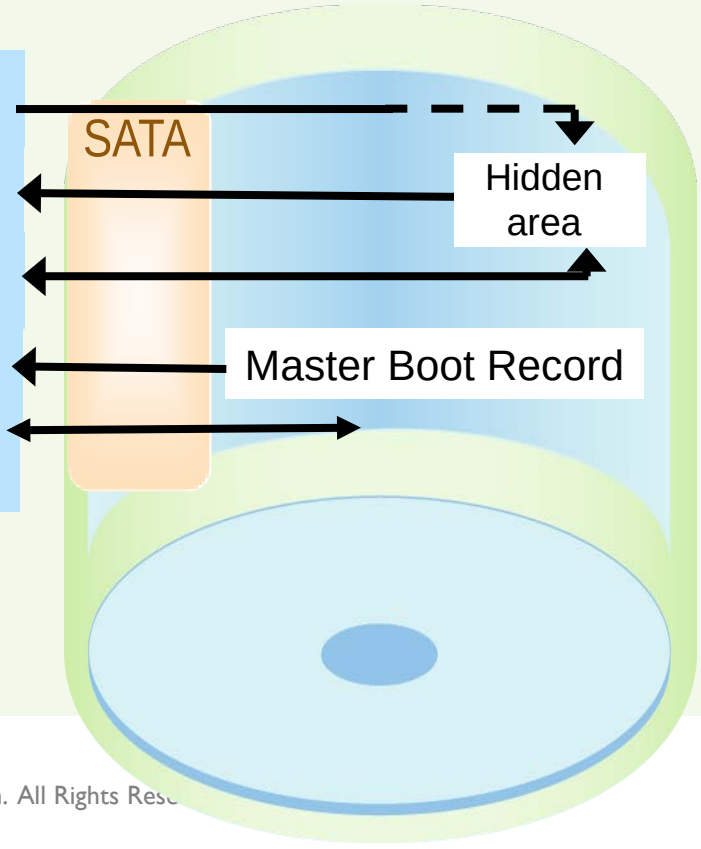
Manage Trusted Storage (ISV Software)

Life Cycle: Manufacture, Own, Enroll, PowerUp, Connect, Use, …

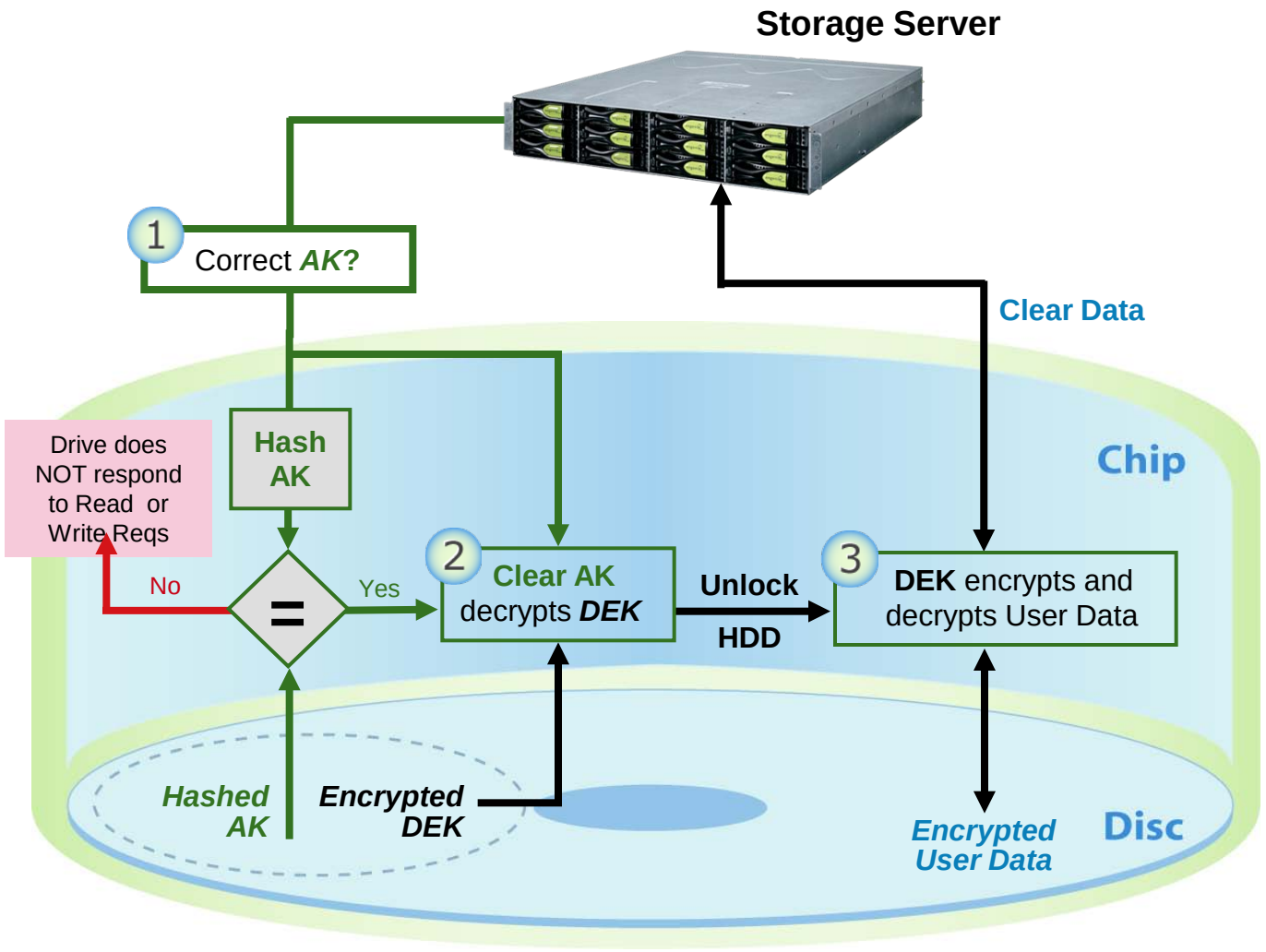
Client Security: Pre-Boot Authentication

- **Transparency: Master boot record and OS are unmodified**
- **Protected from malicious software: Authentication occurs before OS (and any malicious software) is loaded**
- **The master boot record can't be corrupted: The entire drive, including the master boot record, is encrypted**

1. BIOS attempts MBR read; drive redirects to pre-boot area
2. Drive loads pre-boot OS
3. User enters authentication credentials for drive to verify
4. If authentication successful, drive loads original MBR
5. Normal operation commences



Authentication in the Drive



AK
Authentication Key

DEK
Data Encryption Key

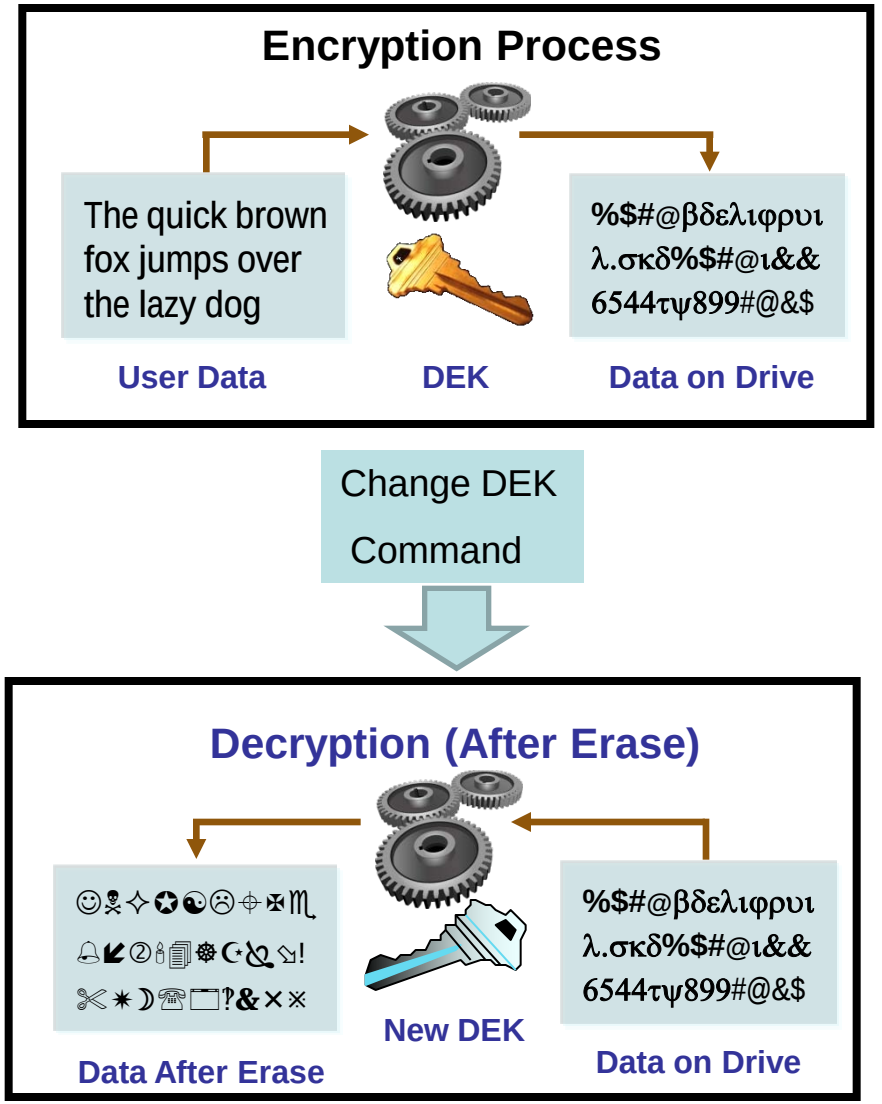
Cryptographic Erase

Description

- Cryptographic erase changes the drive encryption key
- Data encrypted with previous key, unintelligible when **DEcrypted** with new key

Benefits

- Instantaneous "rapid" erase for secure disposal or re-purposing



‘Hurdles’ to Implementing Encryption…

Key management / data loss	• Tracking and managing encryption keys • Tracking and managing authentication keys (passwords for unlocking drives)
Complexity	• Data classification • Impact on OS, applications, databases • Interoperability
Performance	• Performance degradation; scalability
Cost	• Initial acquisition costs • Deployment costs

No Performance Degradation

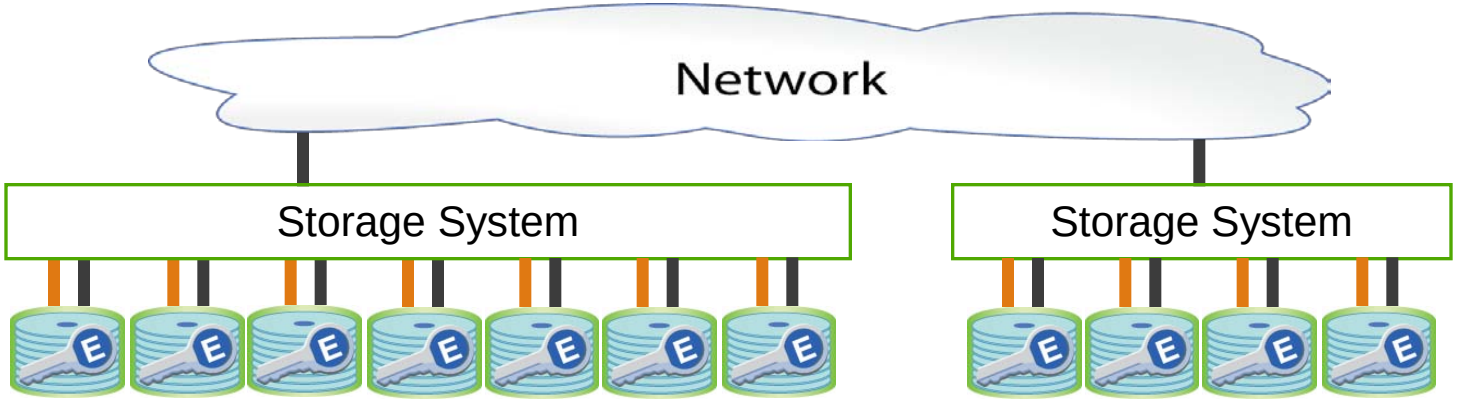
Encryption engine speed

Matches

Port's max speed

The encryption engine is in the drive electronics

Scales Linearly, Automatically



All data will be encrypted, with no performance degradation

IT Retires Drives Constantly

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- All Drives are Eventually Retired
  - End of Life
  - Returned for Expired Lease
  - Returned for Repair / Warranty
  - Repurposed

- 50,000 drives leave data centers daily
- Exposure of data is expensive - $6.65 million on average
- 90% of retired drives are still readable

(IBM study[1])

Needed: A simple, efficient, secure way to make retired drive data unreadable

1: http://www.redbooks.ibm.com/redpapers/pdfs/redp4529.pdf

How the Drive Retirement Process Works

Retire Drive

- Replace
- Repair
- Repurpose

Remove ALL drives

Send even "dead" drives through

Queue in Secure Area

Transport Offsite

Queue in secure area

Retirement Options

Overwriting takes days and there is no notification of completion from drive

Hard to ensure degauss strength matched drive type

Shredding is environmentally hazardous

Not always as secure as shredding, but more fun

SECURE?

People make mistakes

"Because of the volume of information we handle and **the fact people are involved, we have occasionally made mistakes.**"

IRON MOUNTAIN

which lost a tape with 150,000 Social Security numbers stored at an Iron Mountain warehouse, October 2007[1]

99% of Shuttle Columbia's hard drive data recovered from crash site

Data recovery specialists at Kroll Ontrack Inc. retrieved 99% of the information stored on the charred Seagate hard drive's platters over a two day period.

- May 7, 2008 (Computerworld)

1. http://www.usatoday.com/tech/news/computersecurity/2008-01-18-penney-data-breach_

How the Drive Retirement Process Works

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Retirement Options

Retire Drive

- Replace
- Repair
- Repurpose

Overwriting takes
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S E C U R E ?

Drive Retirement is:

Expensive

Time-consuming

Error-prone

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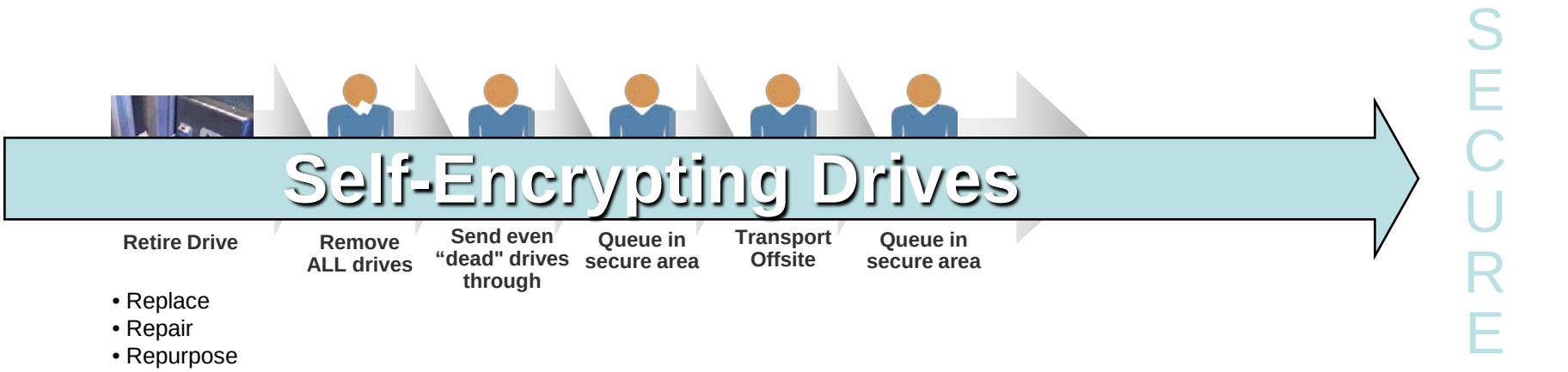
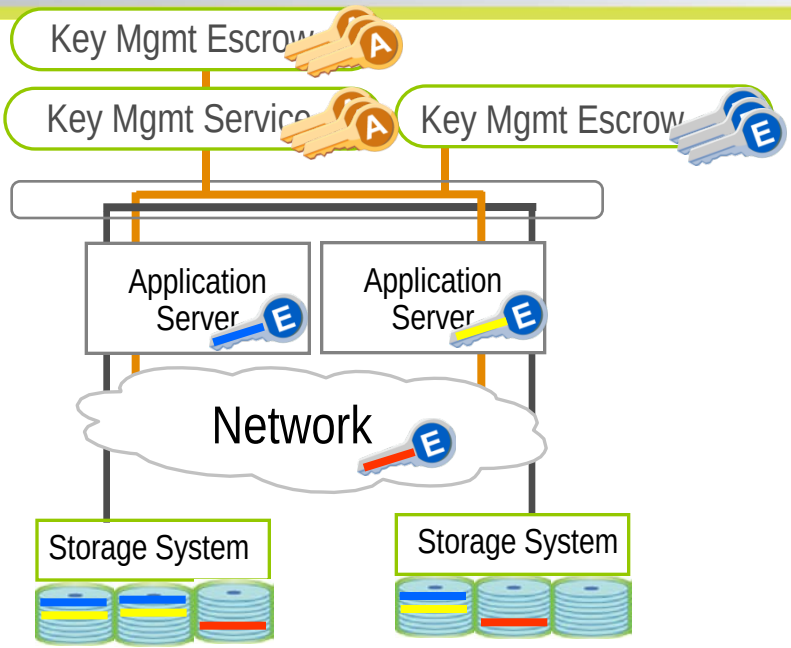
Drive Retirement: Self-Encrypting Drives



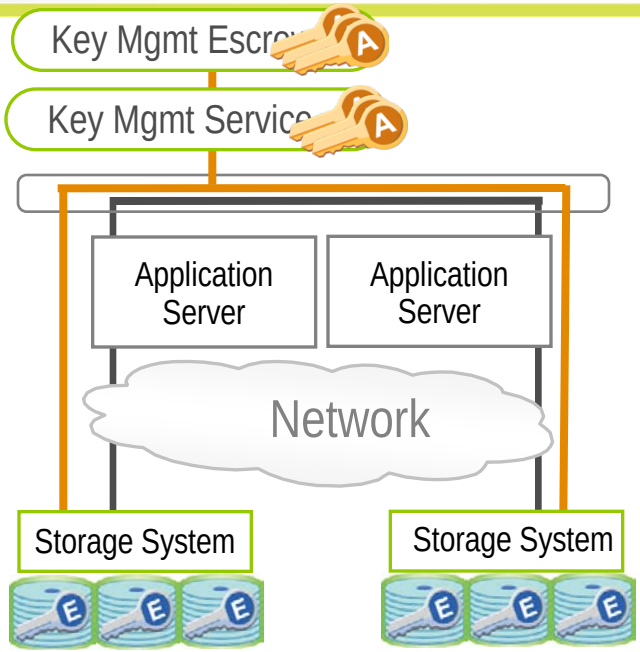
Power Off = Locked and Encrypted = Secure

- Reduces IT operating expense
  - Eliminates the need to overwrite or destroy drive
  - Secures warranty and expired lease returns
  - Enables drives to be repurposed securely
- Provides safe harbor for most data privacy laws

Key Management Simplification



Encrypting outside the drive



Encrypting in the drive

Encryption key never leaves the drive. No need to track or manage …
BUT, YOU STILL MANAGE THE AUTHENTICATION KEYS (drive locking),
to protect against loss or theft (for just crypto erase, no authentication key needed)

- **To recover data from a drive:**
  - ***Only need the Authentication Key and the drive***
  - Don't need to escrow the encryption key to maintain data recoverability
  - Don't need to track encryption key storage separate from data storage
  - Don't need to be concerned with interoperability of encryption key storage and data

Reducing Security Costs

- **Initial acquisition costs:**
  - Integrated into standard products
  - Implemented per regular storage upgrade schedule
  - Standards-based, and all drive vendors are participating in TCG
  - The drive industry has long demonstrated standards promote competition which drives cost
  - Economies of scale enable incremental logic in the ASICs to remain a small portion of drive material costs
- **Reduce drive decommissioning and insurance costs**
- **Maintain ability to compress and de-duplicate data**
- **Preserve drive hardware value**
  - Service, warranty, expired lease returns enabled
  - Drive repurposing enabled

Hardware-Based Self-Encryption versus Software Encryption

-**Transparency:** SEDs come from factory with encryption key already generated

- **Ease of management:** No encrypting key to manage

- **Life-cycle costs:** The cost of an SED is pro-rated into the initial drive cost; software has continuing life cycle costs

- **Disposal or re-purposing cost:** With an SED, erase on-board encryption key

- **Re-encryption:** With SED, there is no need to ever re-encrypt the data

- **Performance:** No degradation in SED performance

- **Standardization:** Whole drive industry is building to the TCG/SED Specs

- **No interference** with upstream processes

ISSUE: Hardware acquisition (part of normal replacement cycle)

Performance Comparisons: HDD and SSD, software versus SED

MB/Sec	HDD: no encryption	HDD: S/W encryption	HDD: SED	SSD: no encryption	SSD: S/W encryption	SDD: SED
Startup	7.90	6.97	7.99	82.50	47.90	95.33
App Loading	7.03	5.77	5.71	48.33	30.77	60.37
Modest size file test	6.13	5.00	5.28	41.13	26.77	50.40
Large Scale Data Read	84.67	52.88	82.75	178.00	70.23	169.33
Large Scale Data Write	79.60	49.50	50.31	170.80	63.60	164.50

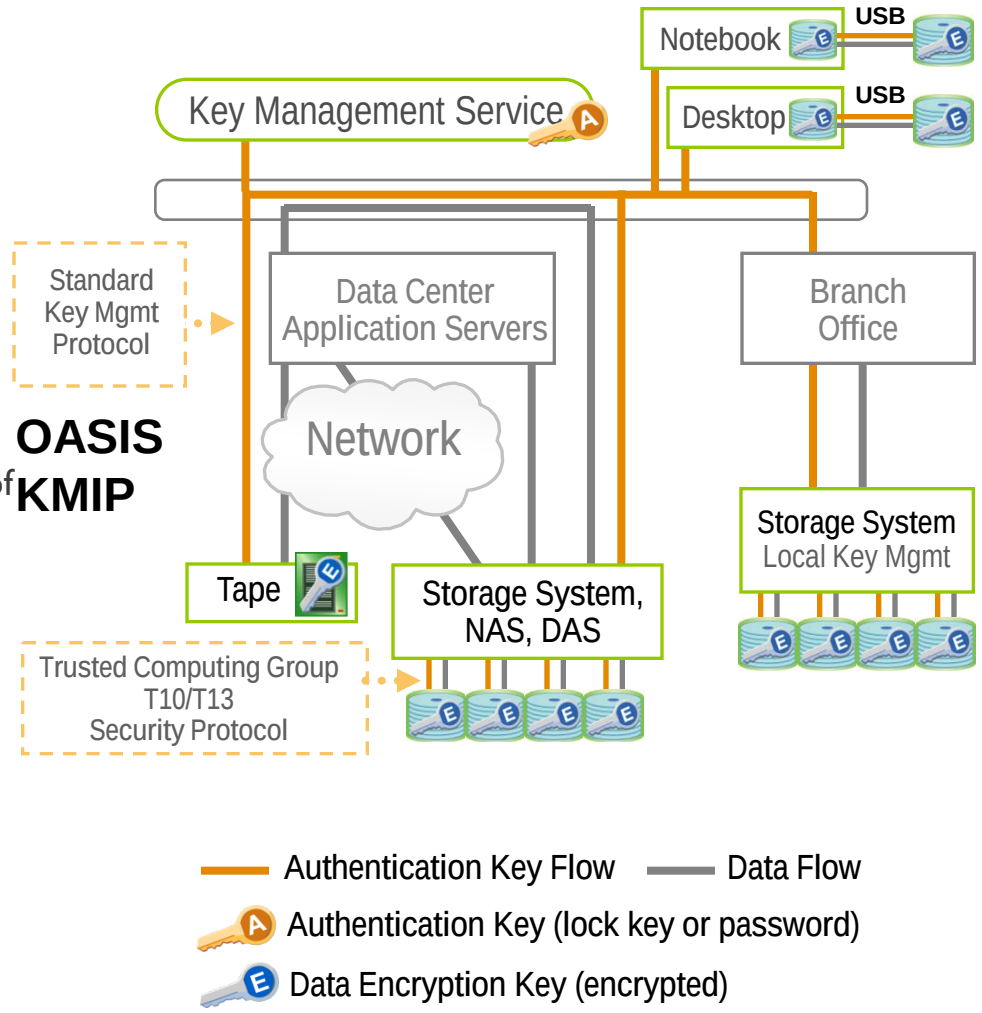
http://www.trustedstrategies.com/

Addressing the Hurdles…

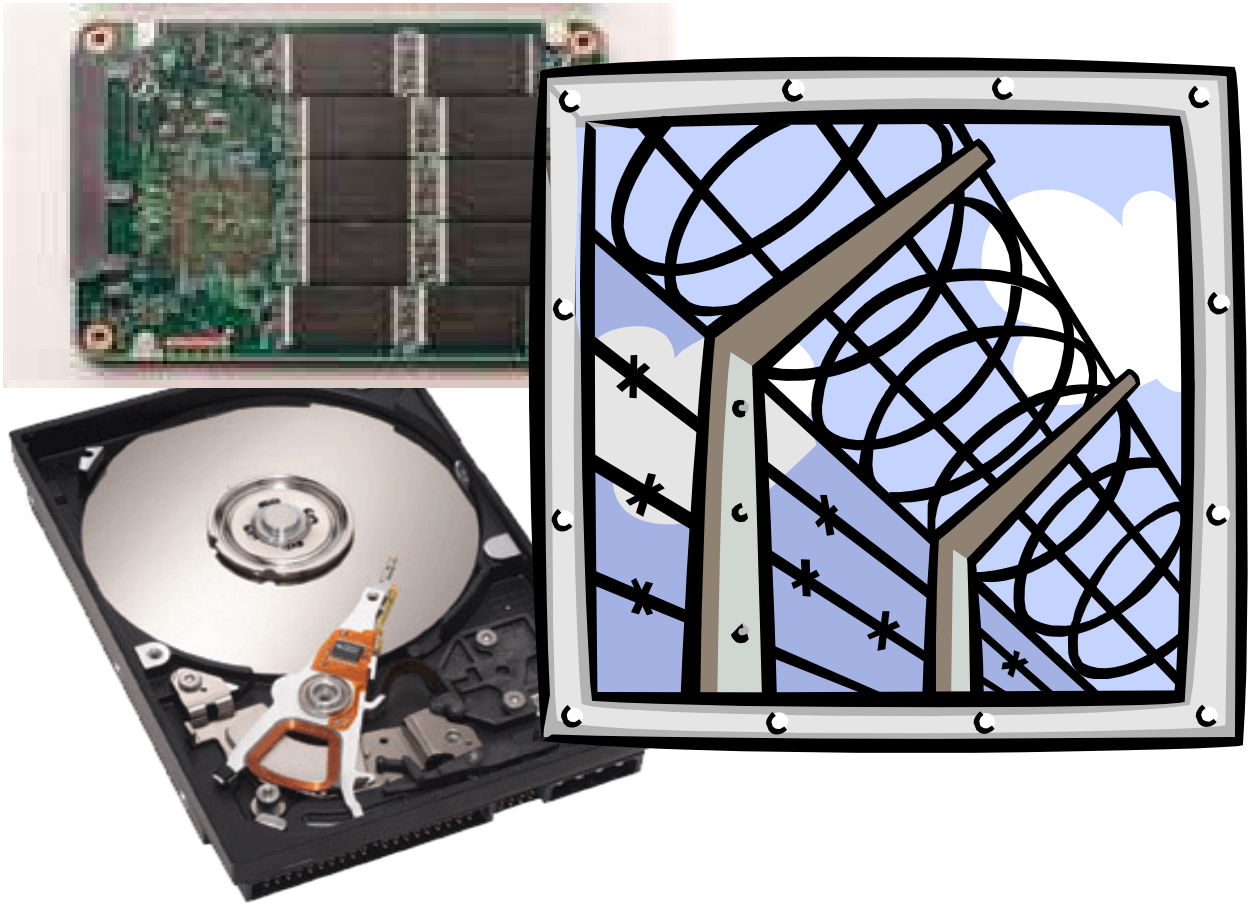
Simplifies key management to prevent data loss	✓ Encryption key does not leave the drive; it does not need to be escrowed, tracked, or managed
Simplifies Planning and Management	✓ Standards-based for optimal manageability and interoperability ✓ Transparent to application developers and database administrators. No change to OS, applications, databases ✓ Data classification not needed to maintain performance
Solves Performance	✓ No performance degradation ✓ Automatically scales linearly ✓ Can change keys without re-encrypting data
Reduces Cost	✓ Standards enables competition and drive cost down ✓ Compression and de-duplication maintained ✓ Simplifies decommissioning and preserves hardware value for returns, repurposing

The Future: Self-Encrypting Drives

- **Encryption everywhere!**
  - Data center/branch office to the USB drive
- **Standards-based**
  - Multiple vendors; interoperability
- **Unified key management**
  - Authentication key management handles all forms of storage
- **Simplified key management**
  - Encryption keys never leave the drive. No need to track or manage.
- **Transparent**
  - Transparent to OS, applications, application developers, databases, database administrators
- **Automatic performance scaling**
  - Granular data classification not needed



Thank You!



SNIA Security: Get Involved!

- SNIA Security Technical Work Group (TWG)
  - Focus: Requirements, architectures, interfaces, practices, technology, educational materials, and terminology for storage networking.
  - http://www.snia.org/tech_activities/workgroups
- Storage Security Industry Forum (SSIF)
  - Focus: Marketing collateral, educational materials, customer needs, whitepapers including the BCPs & Encryption of Data At-Rest (a Step-by-Step Checklist)
  - http://www.snia.org/forums/ssif

Visit the Hands-On Lab

Hands-On LAB COMPUTERWORLD SNIA SNW

Check out the Hands-On Lab:

Solid State Storage in the Enterprise

Q&A / Feedback

- Please send any questions or comments on this presentation to SNIA: tracksecurity@snia.org

Many thanks to the following individuals for their contributions to this tutorial.

- SNIA Education Committee

Gianna DaGiau
Michael Willett