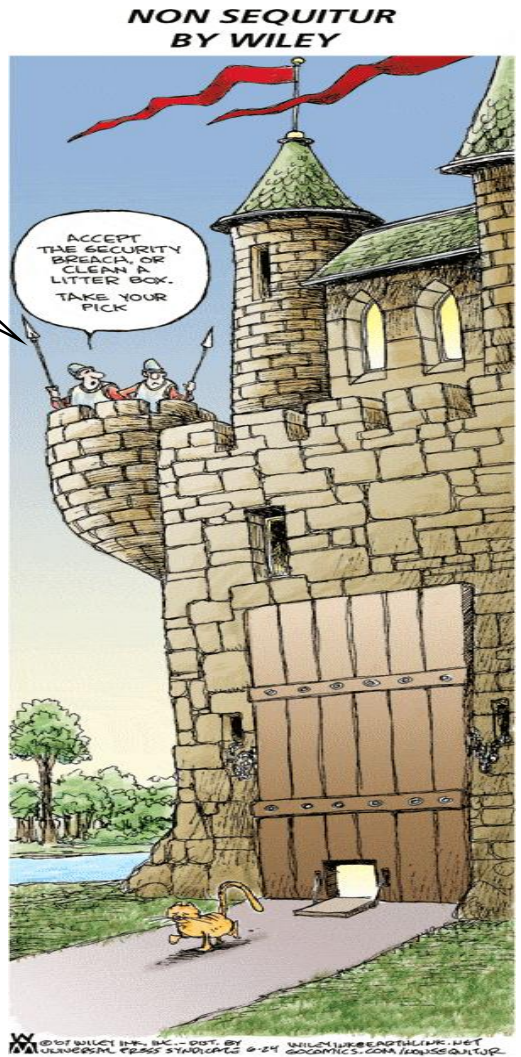
# Seagate

# Drive Firmware Security Overview

Dave Anderson, Enterprise Storage

“Accept the security breach or clean a litter box.
Take your pick…”




# Security is a Trade-Off …!

# Topics

1. Problem Statement:
   Mitigate Firmware and Diagnostics related HDD attacks

2. Self Encrypting Drive Basics

3. Mitigating Methods

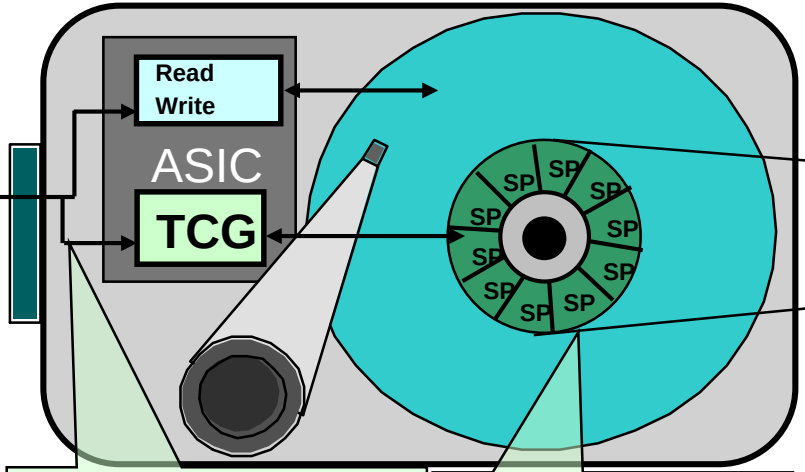
4. Parting Thoughts

# SED Cryptography and Completeness

- Self Encrypting Drive development brought clear recognition of need
  - Encrypting data is useless unless back doors into drive were locked
    - **Firmware must be protected**
    - **Diagnostics must be controlled**

- Self Encrypting Drives brought needed tools
  - Using standardized crypto techniques & algorithms enabled superior protection of firmware
  - Eventually retrofitted into all non-SED drives

# What's Inside One of These Drives:




Industry standard protocol to access security services, methods & data. Supports secure communication & strong authentication

Uncircumventable access control

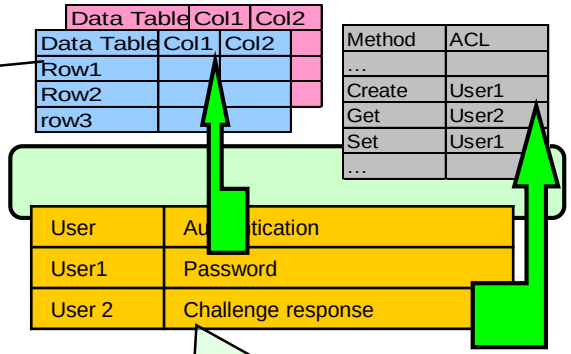
Signed firmware

**AES encryption in ASIC**

Cryptographic methods:

AES,RSA,RNG, SHA-1, SHA-256…

High Quality RNG partly derived from media signals




Security Providers = Logical "SmartCards"

Isolated from all others & to be securely issued

# Self-Encrypting Drive Basics

Locking + encryption = security

- Locking only is easily hacked (ATA has had this for years)
- Encryption only does not prevent prevent access to data

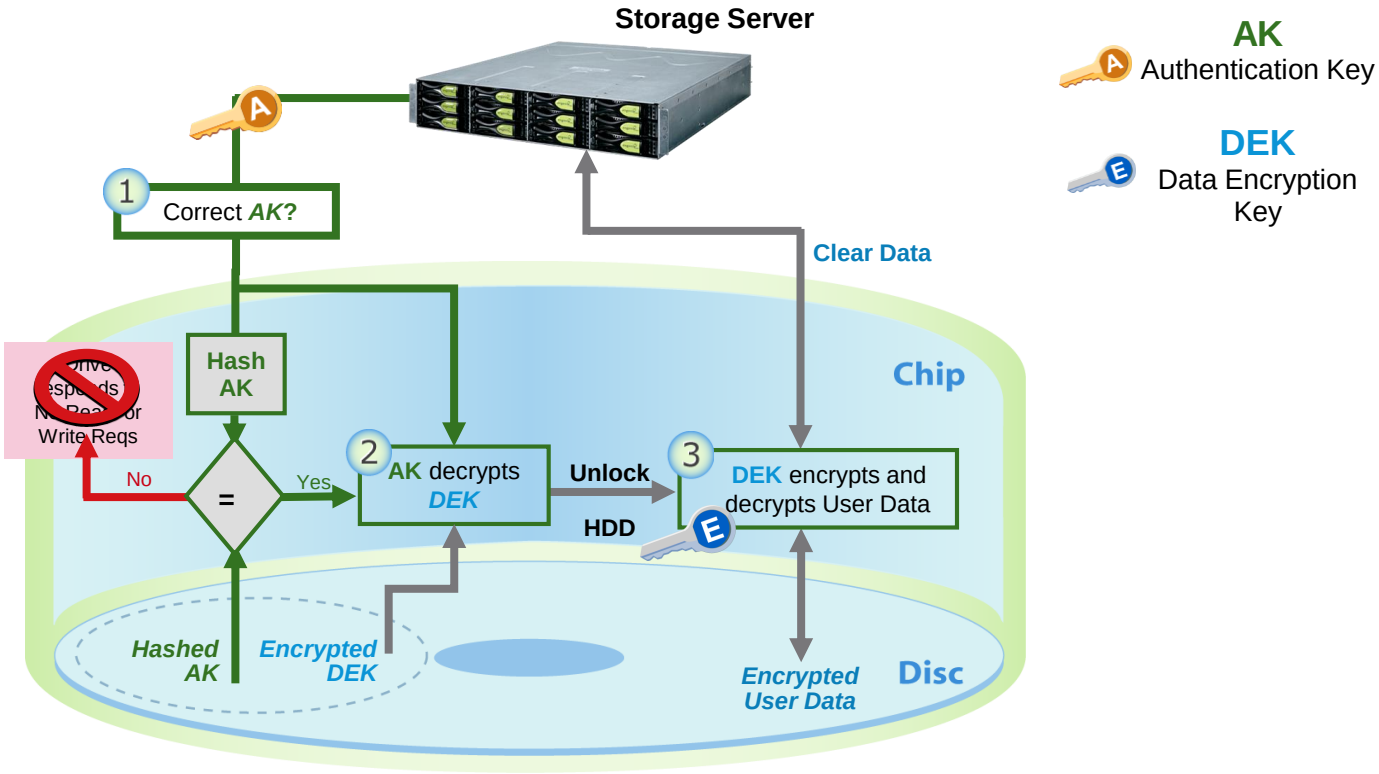
Power OFF: SED LOCKS automatically

Power ON: SED remains LOCKED

Authentication Key (Password) Unlocks the drive

Write and Read data allowed

# Authentication in the Drive



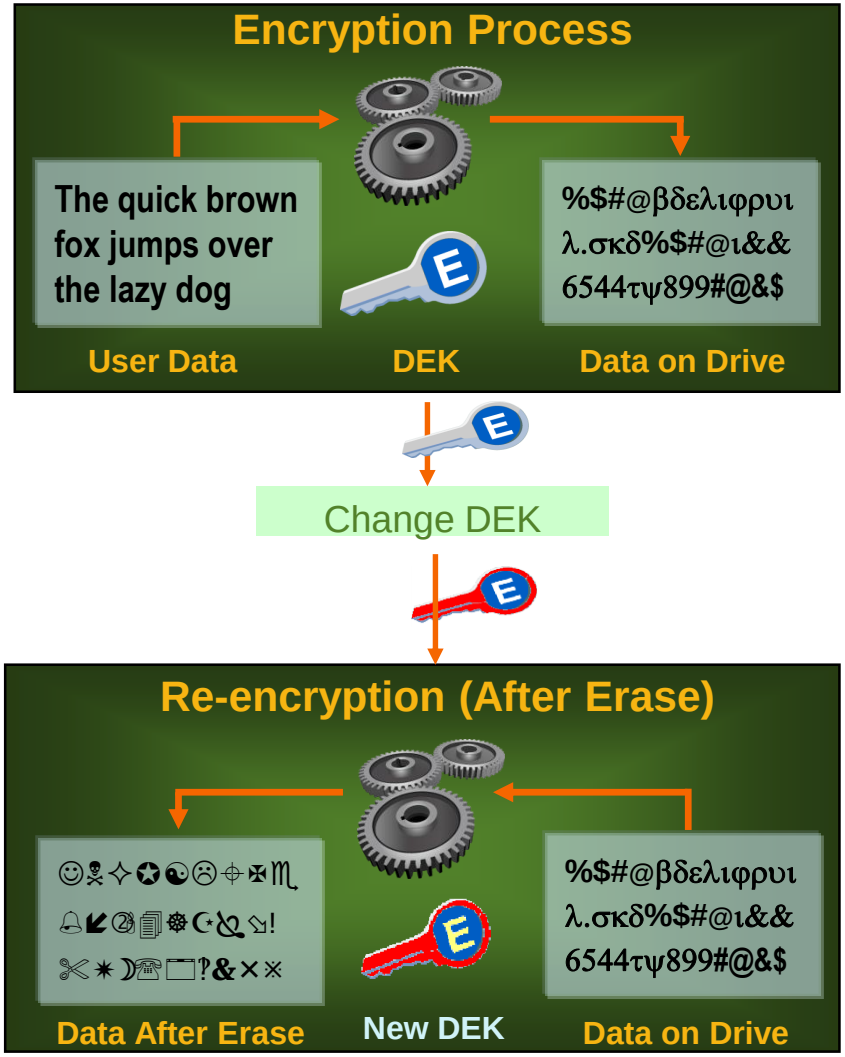
# Seagate Instant Secure Erase

## Description

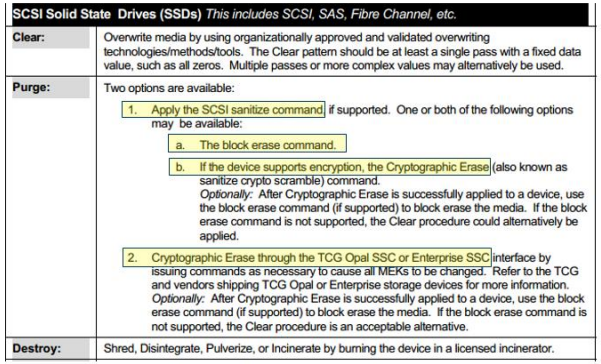
- Instant Secure Erase changes the drive's Data Encryption Key (DEK).
- Data encrypted with previous key is unintelligible when "decrypted" with new key

## Benefits

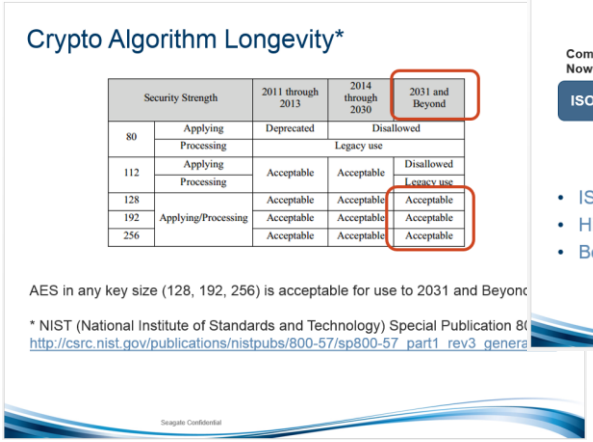
- Instantaneous erase for secure disposal or repurposing
- All spares, all virtual copies, ***Everything*** written with the original Key is instantly securely erased!



# Media Sanitization Standards

| SCSI Solid State Drives (SSDs) *This includes SCSI, SAS, Fibre Channel, etc.* | |
|---|---|
| **Clear:** | Overwrite media by using organizationally approved and validated overwriting technologies/methods/tools. The Clear pattern should be at least a single pass with a fixed data value, such as all zeros. Multiple passes or more complex values may alternatively be used. |
| **Purge:** | Two options are available:<br>1. Apply the SCSI sanitize command if supported. One or both of the following options may be available:<br>a. The block erase command.<br>b. If the device supports encryption, the Cryptographic Erase (also known as sanitize crypto scramble) command.<br>*Optionally:* After Cryptographic Erase is successfully applied to a device, use the block erase command (if supported) to block erase the media. If the block erase command is not supported, the Clear procedure could alternatively be applied.<br>2. Cryptographic Erase through the TCG Opal SSC or Enterprise SSC interface by issuing commands as necessary to cause all MEKs to be changed. Refer to the TCG and vendors shipping TCG Opal or Enterprise storage devices for more information.<br>*Optionally:* After Cryptographic Erase is successfully applied to a device, use the block erase command (if supported) to block erase the media. If the block erase command is not supported, the Clear procedure is an acceptable alternative. |
| **Destroy:** | Shred, Disintegrate, Pulverize, or Incinerate by burning the device in a licensed incinerator. |





**Seagate led the industry with Media Sanitization Standards for Crypto Erase**

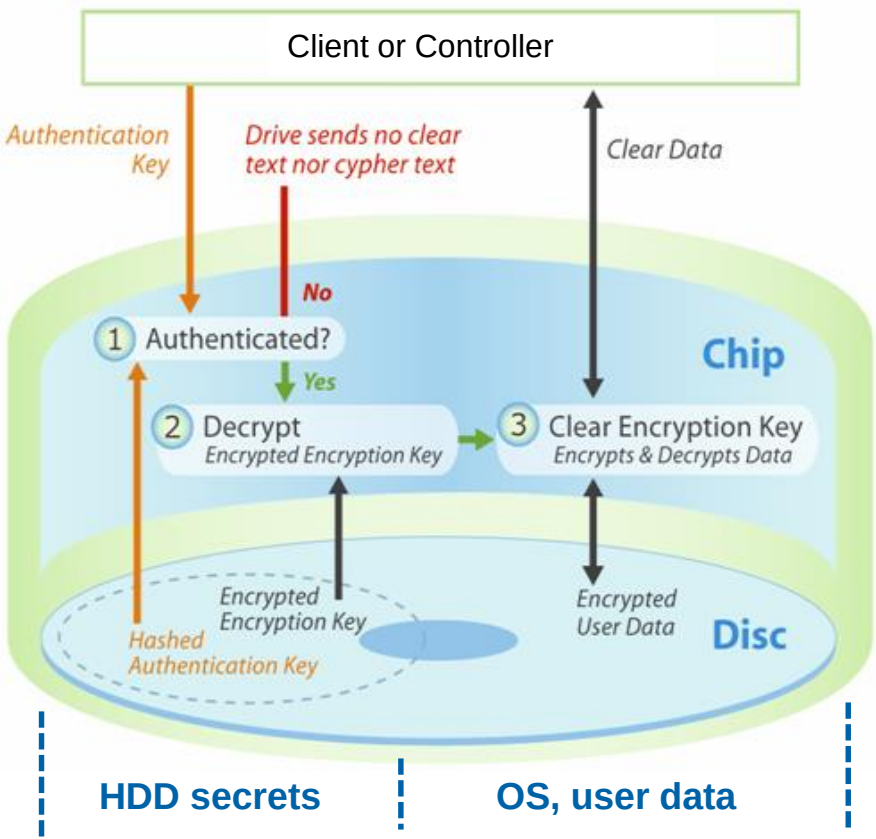
**Federal and International Standards now released**

**NIST 800-88 is the unified Federal Standard**

**ISO 27040 is the international standard.**

**NIST 800-57 defines algorithm longevity.**

# Encryption and Authentication Basics

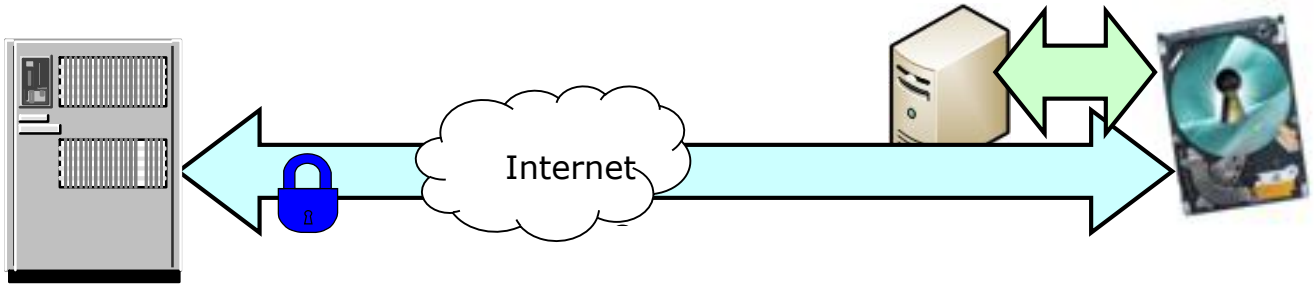



- No clear text secrets on the drive.
- Cipher text is never revealed.
- Authentication blocking after X attempts – Power Cycle required.
- Access control credentials are separated from the encryption key
- Additional credential wrap with HW Root Key.

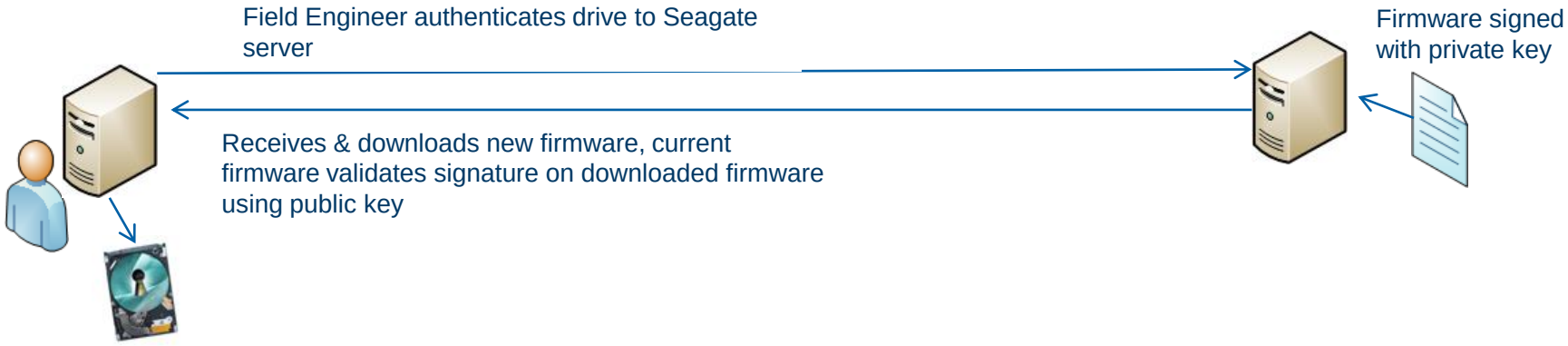
# Root of Trust & Secure Communications

## HDD security services can establish secure channel

- Can pass through untrusted BIOS, OS, app, WWW
- Can create session keys & secure sessions
- Can issue and respond to challenge/response sequences
- Supports PKI signing and verification
- Supports MAC & HMAC
- Has X.509 certificates for authentication



# Secure Firmware Download



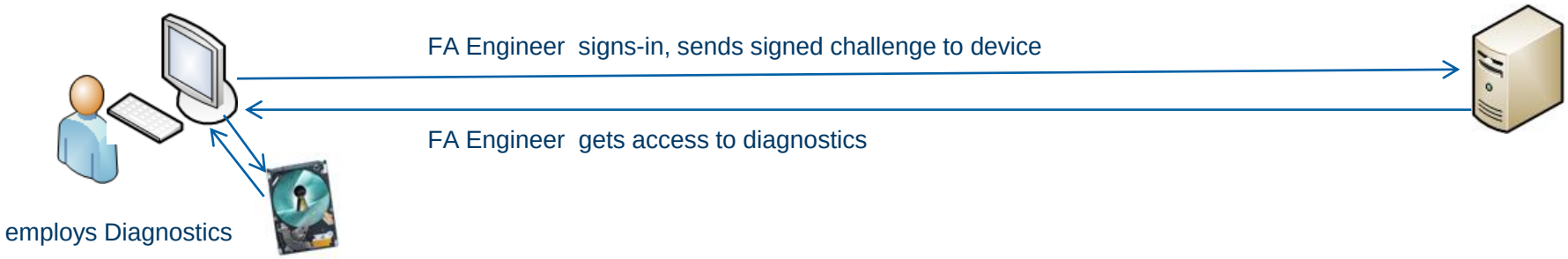

**Requires cooperation of drive owner: Drive must be unlocked!**

Firmware download allows only Seagate signed (using RSA2048 and SHA-256) firmware.

To load new controller firmware onto the drive, the drive verifies the integrity and authenticity of the firmware, using a replay resistant protocol exchange, before activating it.

ROM boot code verifies firmware on each power on.

# Authenticated Diagnostics Command Access




**Requires cooperation of drive owner: Drive must be unlocked!**

Each drive is assigned an unchanging, unique security ID at manufacturing time.

Drives ship with the Diagnostic Port locked and with no Diagnostic commands. Diagnostics Port unlock via authentication through a Seagate Secure Server.

All drive protection related information is cryptographically protected on the media.

Non-repudiation log maintained for all security management activities

# My Thoughts on Protecting Firmware: Key to Drive Business

## You cannot outsmart the world

- Secrets are eventually found out
- See Brian Williams, Gary Hart, etc
- Obviously NSA cannot keep a secret (Snowden)
- Thinking you can is clearly no basis for intelligent action

## Seagate led industry to drive encryption

- Compromised firmware would threaten our leadership
- Would waste millions of dollars of technical & market development
- Might open the door for a competitor to leapfrog us in SED business

## Our whole business depends on our firmware

- If it were untrustworthy, our very existence would be threatened
- Too much to risk for allowing any compromise whatsoever