

Personal Cloud Self-Protecting Self-Encrypting Storage Devices

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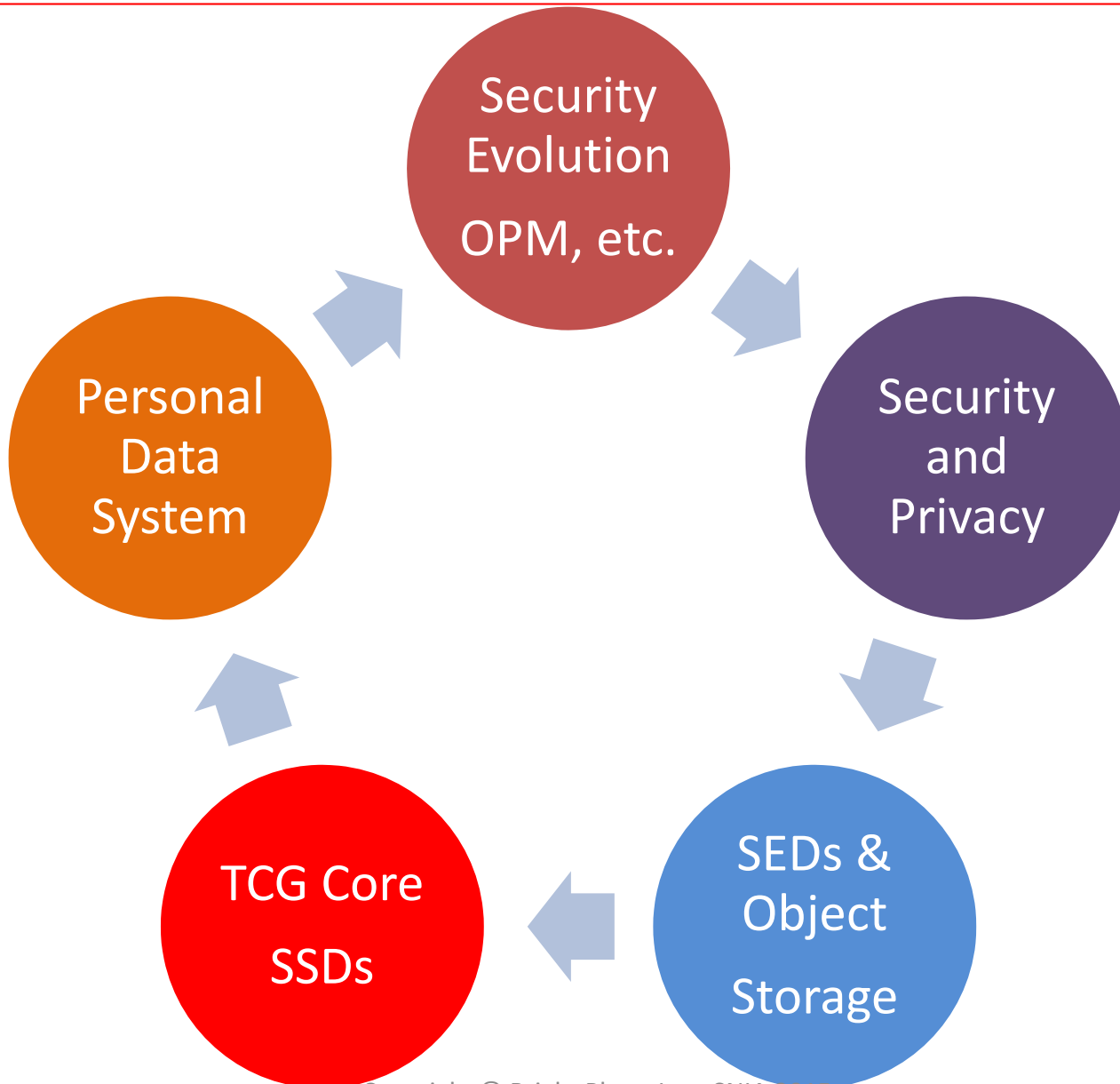
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Takeaways

- This talk: **Personal** non-volatile storage devices (in PCs, Pads, Phones, Cars, Homes, Businesses, etc etc etc) – NOT Enterprise data-center storage or Tutorial in TCG SEDs, see Willett's SNIA Tutorial Later Today
- Self-Encrypting Drives **fantastically successful** in technology and availability, but not in Personal adoption (Coughlin Assoc., 2015, see references)
- **Drive Trust Alliance** in association with Tom Coughlin Assoc. has opened-sourced TCG Opal (and Enterprise) code for clients (not devices) to facilitate personal adoption.
- **New Other Open Source** models for Self-Protection, and Personal Monetization of Private Data (TCG Core, PDS, Homomorphic Encryption), from MIT.

Agenda



The Age of Uncontrolled Data Leakage

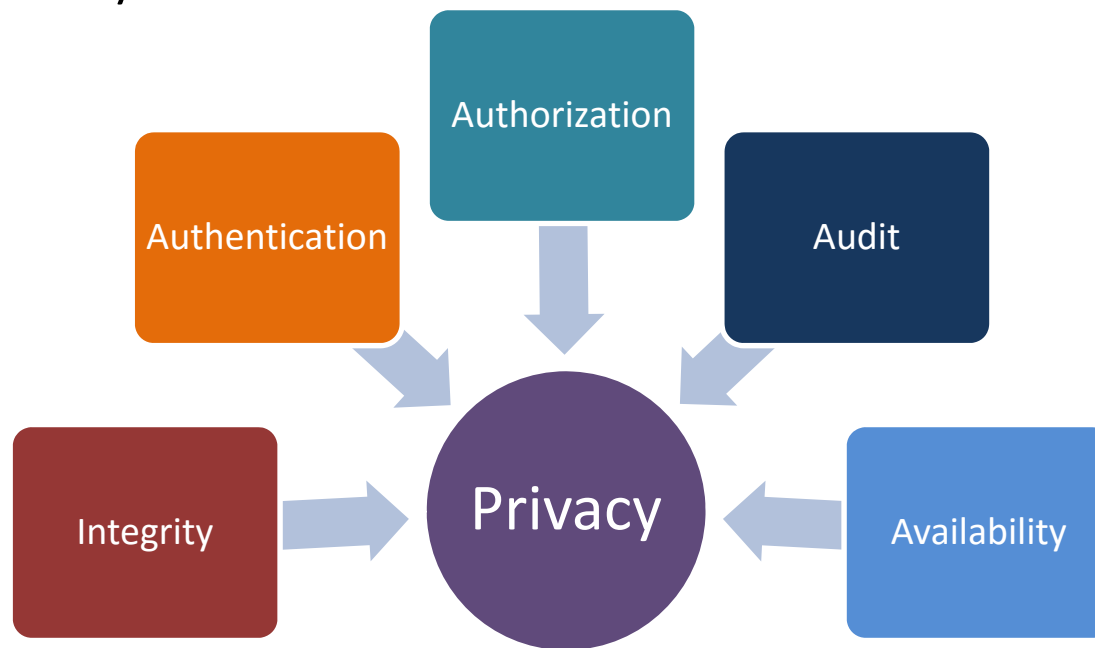
- Computer Forensics / Digital Evidence / Corporate Collections – Google, Yahoo, Microsoft, Amazon!
- NSA ANT Catalogue (USA)
- Ransomware (Russia)
- Sony (North Korea)
- OPM, US Office of Personnel Management hack (China)

All Phishing Initiated

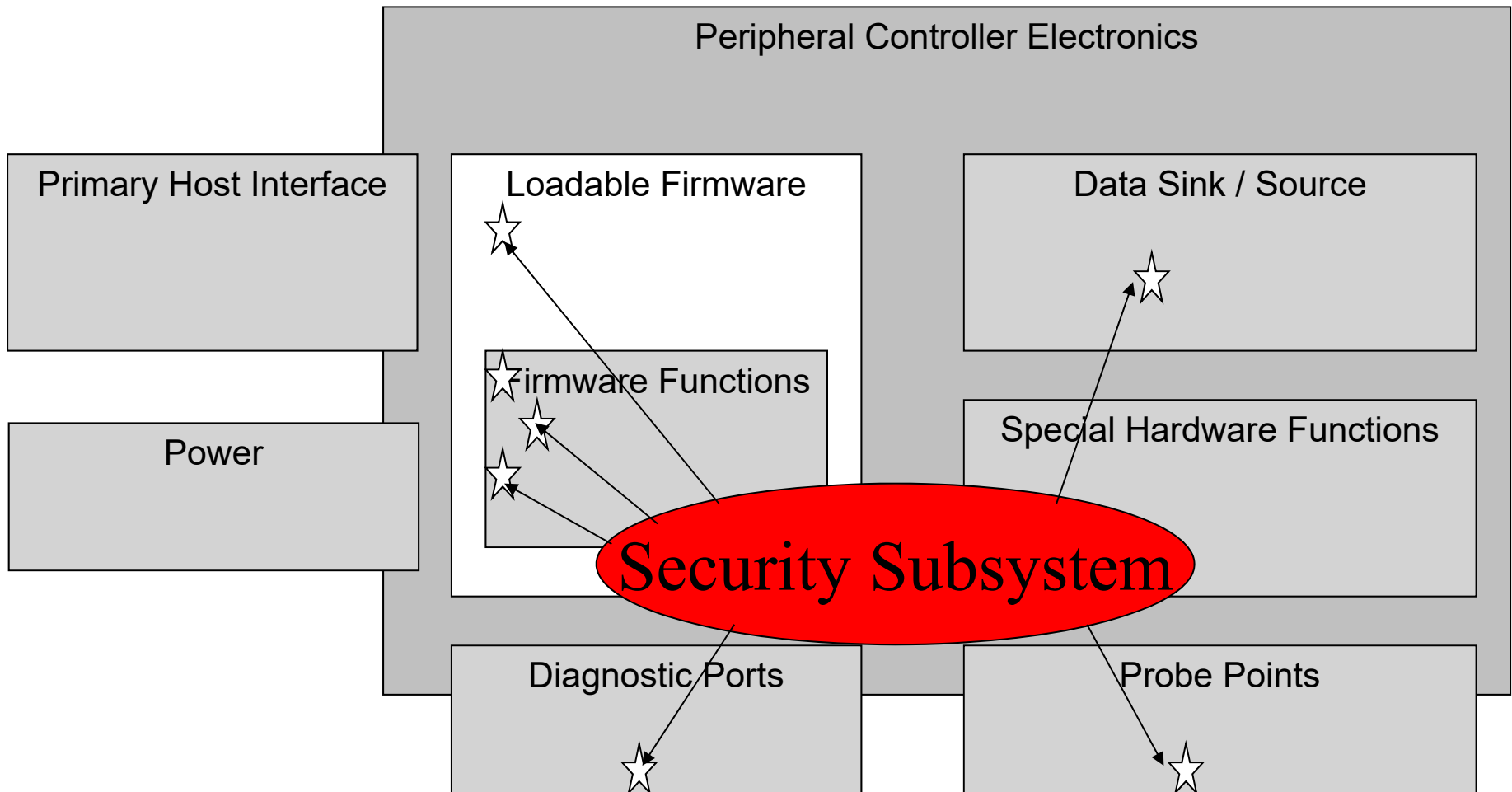
- Somebody else gets paid (or worse) for YOUR stuff! Just because you are using the Internet.

Security and Privacy 101

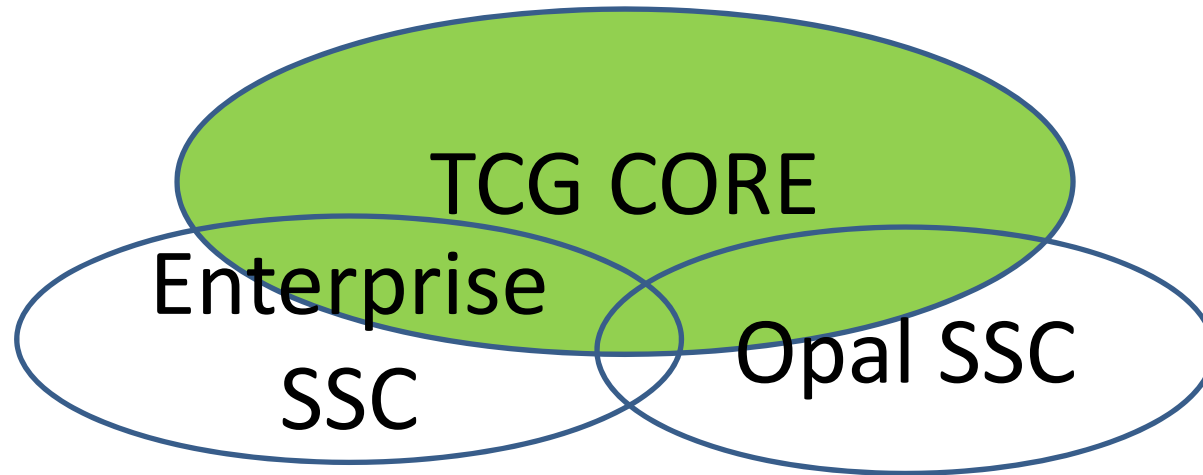
- Security \sim Access Control
- Security should *SERVE UP Privacy*
 - Computer Security \sim IPAAAA: Integrity, **Privacy**, Authentication, Authorization, Audit, Availability
 - Computer Security \sim CIA: Confidentiality (**Privacy**), Integrity, Availability



SP-SED Concept



TCG Core Spec



- Core + Scripting
 - Core \sim Data Structures + Basic Operations
 - Scripting \sim Amazing Use Cases
- Security Providers or **SPs**: Admin, **Locking**, Clock, Forensic Logging, Crypto Services, Internal Controls and others.

What is an SED?

Drive Trust Alliance Definition

- The device uses built in hardware encryption circuits to write and read data in and out of NV storage.
- At least one Medium Encryption Key (MEK) is protected by at least one Key Encryption Key (KEK, usually a “password”).
- If one or more KEKs have not decrypted the MEK, the data that the MEK protects is not available.
 - i.e., you cannot reverse engineer a locked SED without a valid KEK input from outside of the self-protecting SED.

Self-Encrypting Storage Personal Storage Landscape

- **~100% of all SSDs** are Opal
 - Due to Data Sanitization Problem for Flash
- **~100% of all Enterprise Storage** (SSD, HDD, etc) are TCG Enterprise
 - For fast safe and effective repurposing/disposal
- **100% of all Apple iOS devices** are hardware self-encrypting storage for user data if password is set
- **~100% Western Digital USB HDD Drives** are SEDs
- **Much smaller number of Personal HDDs** are **Opal or SED**
- **BUT MS Bitlocker** supports “eDrive” = Opal 2.0 Drives of all kinds
- **100% Opal Drive also supports the SATA Security Password** as a KEK in addition to TCG Opal Commands.
- **NVMe and other Personal storage devices** are being handled by the TCG Storage Workgroup right now.

Drive Trust Alliance (DTA)



- Sole purpose to facilitate adoption of Personal SEDs... to the mutual benefit of ...
 - Device Makers
 - ISVs
 - IT
 - Individual Use

A rising tide lifts all ships

- GPL Open Source for TCG Opal (and Enterprise) Clients (PCs, Pads, Phones, Cars, IoT, etc.), Windows, MAC, Linux
- Educational Services, Open Source Custom Software services

DTA Details



- DTA Web Site:

www.drivetrust.com

Full Service Web Site Opening is Oct 15

Today 9-24-2015
Announcing First Sponsor
of DTA!



SP-SED Rule 1

- When we talk about Cloud things, every Personal Device is actually “in the cloud” so...

Look in the Clouds for What
should be in
Personal Storage Devices

TCG SED Ranges

- Every partition (range of LBAs) can have a separate KEK and MEK and can be locked and unlocked independently.
- TCG Enterprise Drives use Ranges for VMs
- Bitlocker eDrive – 4 Ranges
- US Gov't uses DTA Open Source for Creating Resilient PCs using Ranges
- Personal: BYOD and Ransomware Protection Containers!

Personal Data Storage (PDS)

- All data you want to protect can be permitted to be queried under your control
- Classic example: You can ask if you are over 21 but not what your birthday is or how old you are, although that is what is in your PDS
- History: Pentland Started as cloud initiative, failed (distrusted), now Personal device initiative.
- MIT Media Lab, **OpenPDS** open source offered by the Kerberos Consortium at MIT

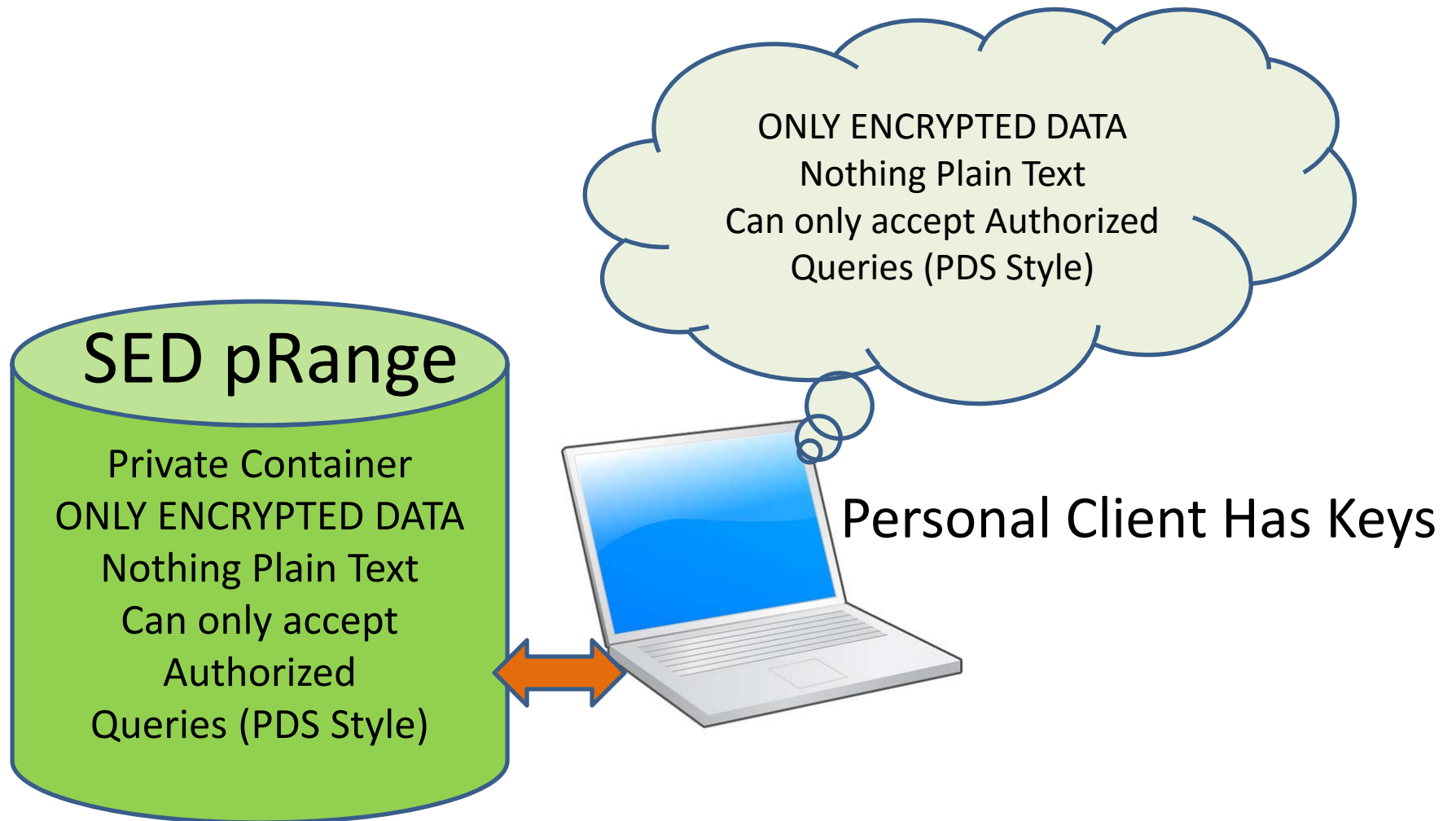
Homomorphic Encryption

- How can you do computing operations on encrypted data without ever decrypting the data?
- PDS: Ask questions without any possibility of getting at the data.

Homomorphic Encryption

- Idea around since early 80s, no idea how to do it until 1999ish
- General Solution was discovered but it is computationally infeasible (like Bitcoin 😊)
- Only in last few years (2011 or so) breakthrough in speed of computation
 - Divide and conquer (CryptDB, full SQL, from MIT)
 - Practical for SP-SEDs

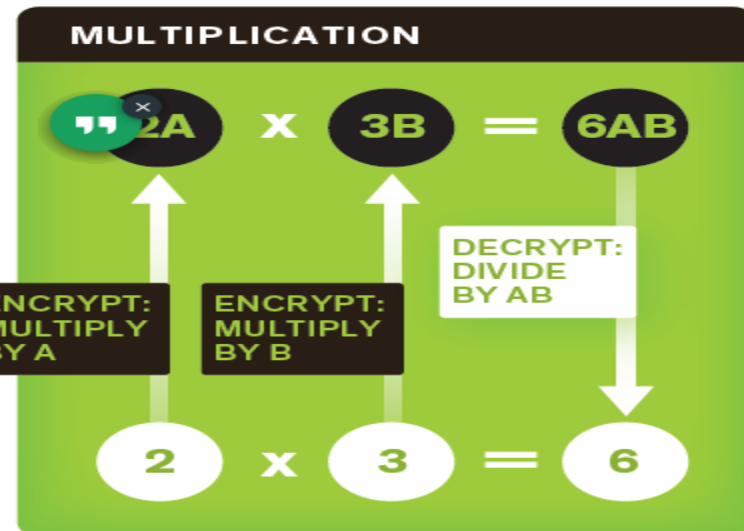
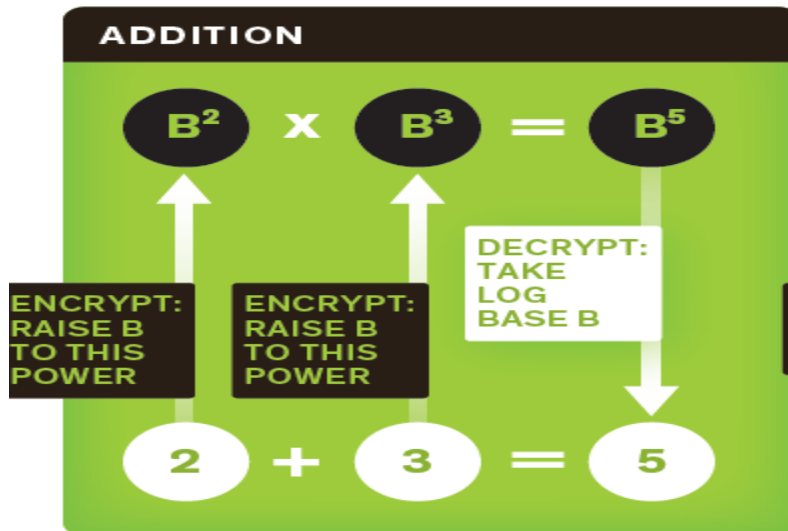
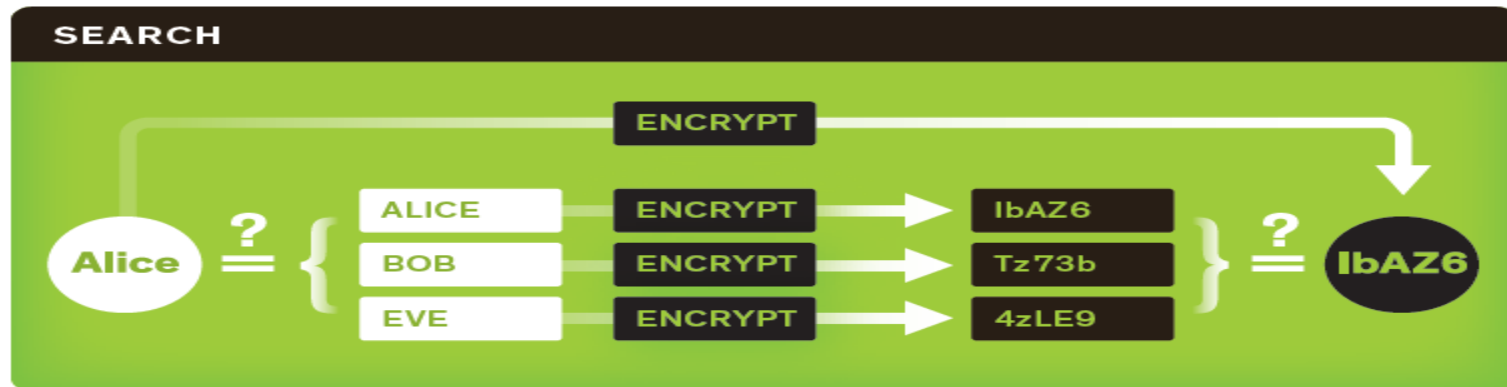
HE Cloud Model and SP-SED Model



Solution for Homomorphic Encryption

Examples – Several copies of Data

MULTIPLE ENCRYPTION SCHEMES



SP-SED Rule 2

- Like the Internet cloud: **If anybody can make money off an SP-SED, then people get really smart really fast...**

**SP-SEDs Should Charge \$\$
for Access to the Private Data They Protect**

- **The TCG Core Spec was written with this in mind.** PDS and Homomorphic Encryption provide a conceptual path that could be done with the TCG Core Spec.

Challenges to You

- *The TCG Core* was designed to provide services that are essentially identical to what Apple did with the App Store but in Self-Protecting Storage devices. It was largely operational by 2002, but storage device Execs didn't grasp how quickly a revolution could occur (Steve Jobs proved them wrong—several times over).
- *No kidding*, every Personal Storage Device should let *the owner of the device make money* off his private data on it. *It's up to you in this audience.*

Good References

- Sony, Inside the Hack of the Century, Fortune Magazine, 7-1-15, <http://fortune.com/sony-hack-part-1/>
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- TCG Storage Workgroup, Core, Opal, and Enterprise Specifications, www.trustedcomputinggroup.org
- TCG SED Successes and Challenges. The 2015 Self-Encrypting Drive Market and Technology Report, from Coughlin Associates <http://www.tomcoughlin.com/techpapers.htm>.
- Drive Trust Alliance, www.drivetrust.com
- Personal Data Service (Open PDS), <http://openpds.media.mit.edu/>
- Homomorphic Encryption, Google Scholar shows hundreds of wonderful papers., but for a great overview see <http://spectrum.ieee.org/computing/software/how-to-compute-with-data-you-cant-see> Here is a more public paper from MIT: <http://dspace.mit.edu/handle/1721.1/62241>