Personal Cloud
Self-Protecting Self-Encrypting Storage Devices

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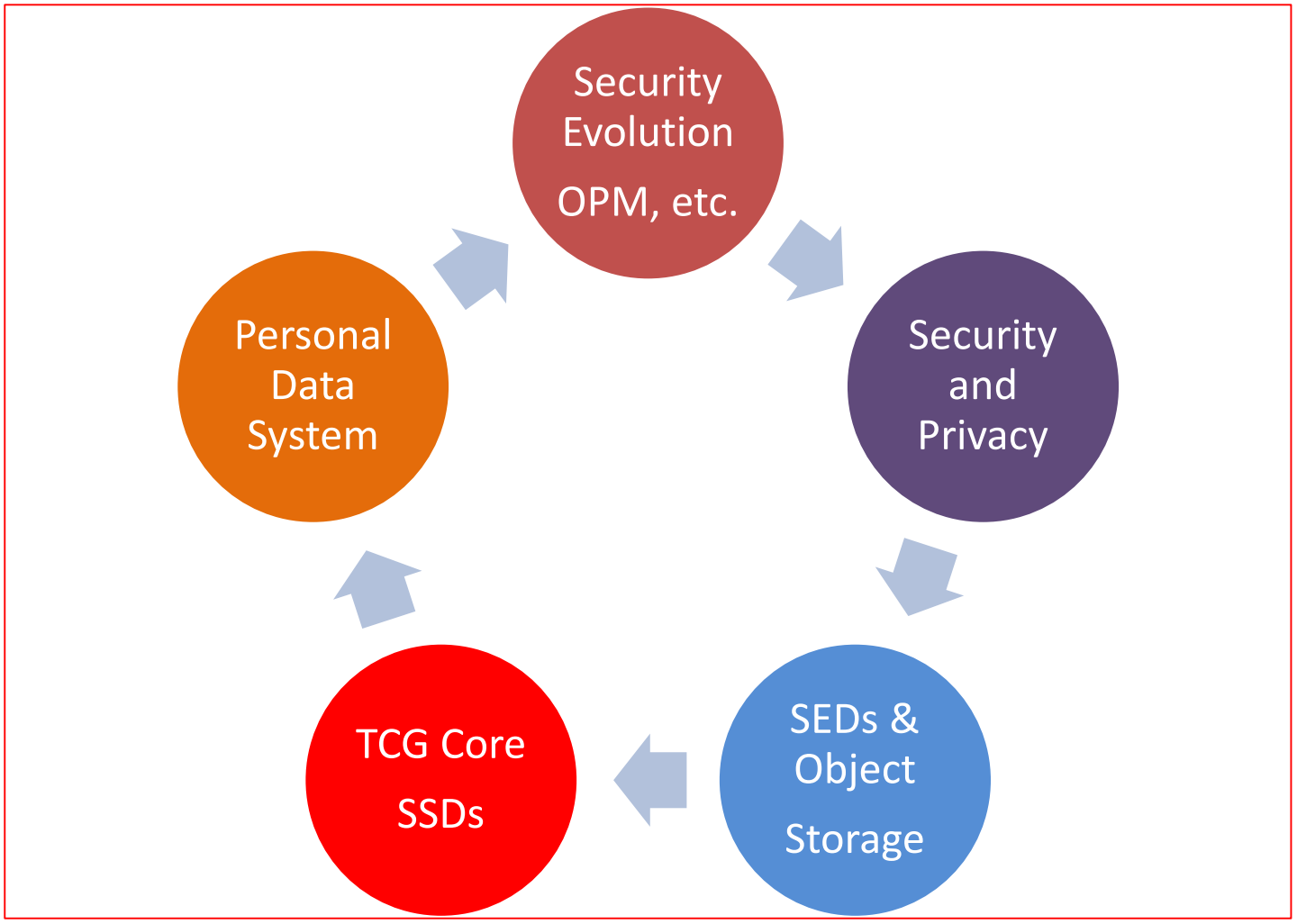
Takeaways

- This talk is about Personal non-volatile storage devices (in PCs, Pads, Phones, Cars, etc etc etc) – NOT Enterprise data-center storage
- 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

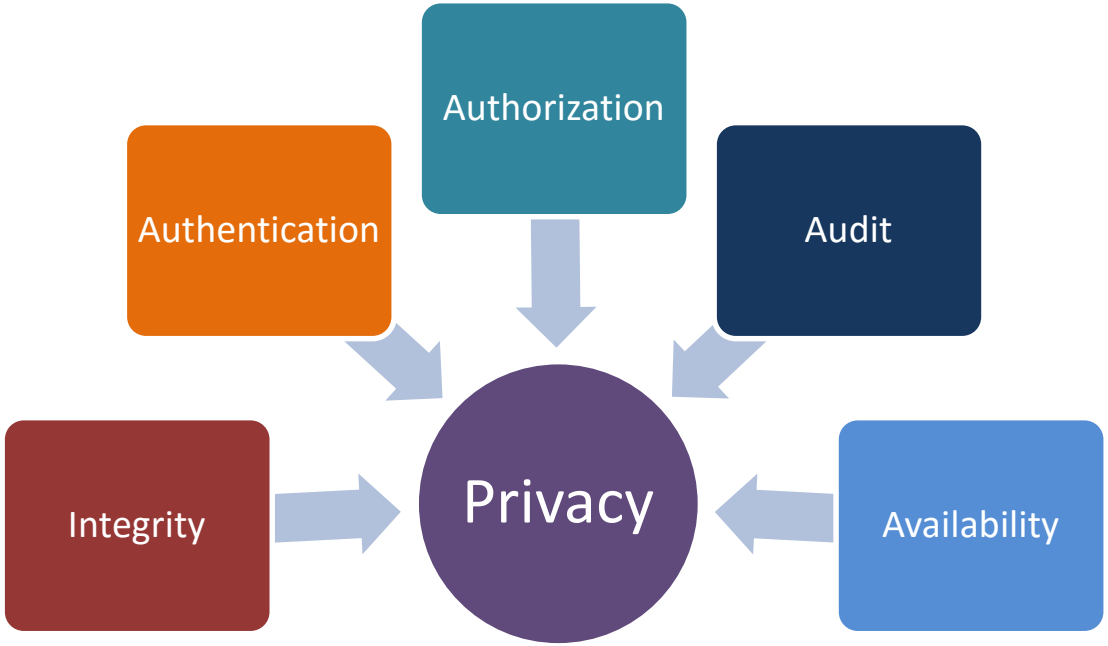
- Computer Forensics / Digital Evidence / Corporate Collections – Google, Yahoo, Microsoft, Amazon!
- NSA ANT Catalogue (USA)
- Ransomware (Russia)
- Sony (North Korea)
- OPM, US Office of Personnel Management hack (China)

All Phishing Initiated

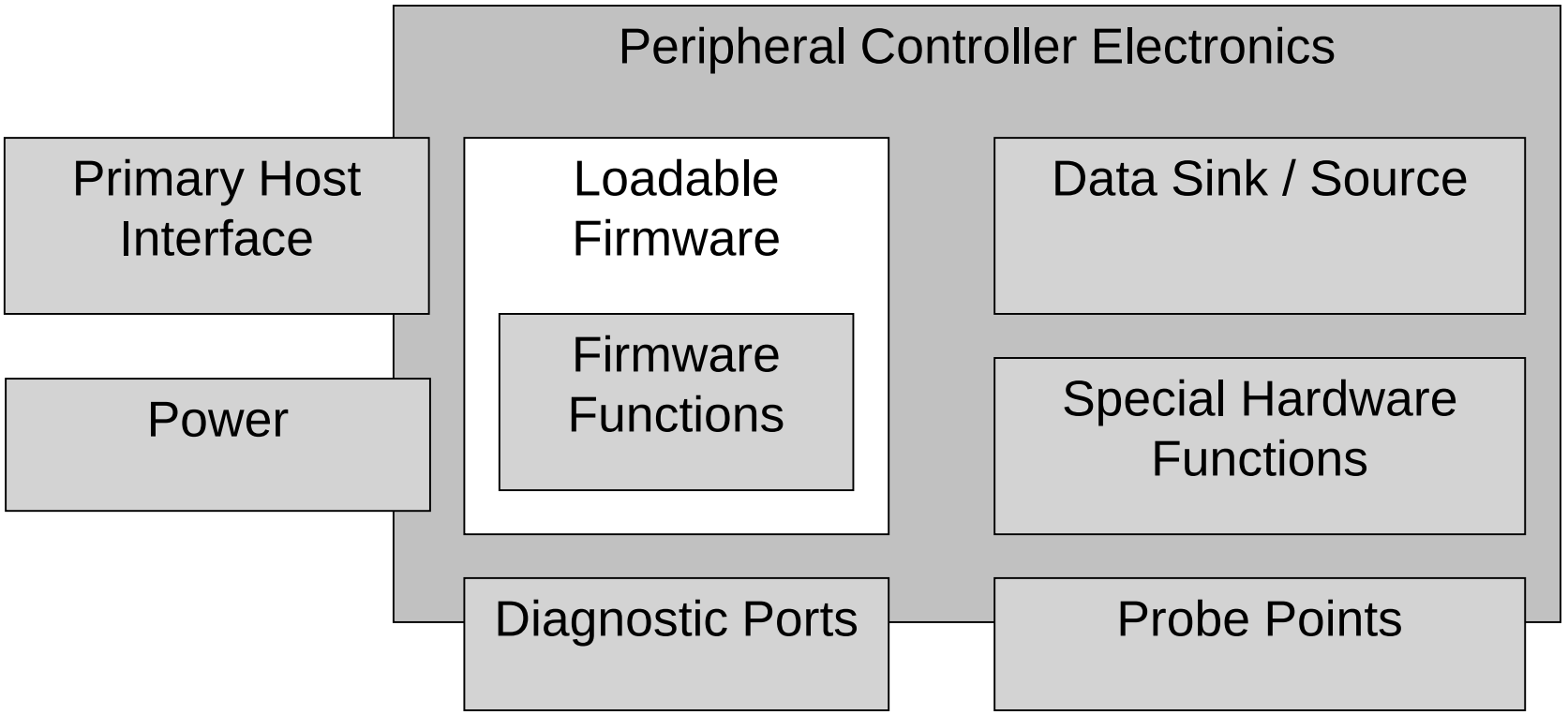
- Somebody else gets paid (or worse) for YOUR stuff! Just because you are using the Internet.

Security and Privacy 101

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



SP-SED Concept



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.

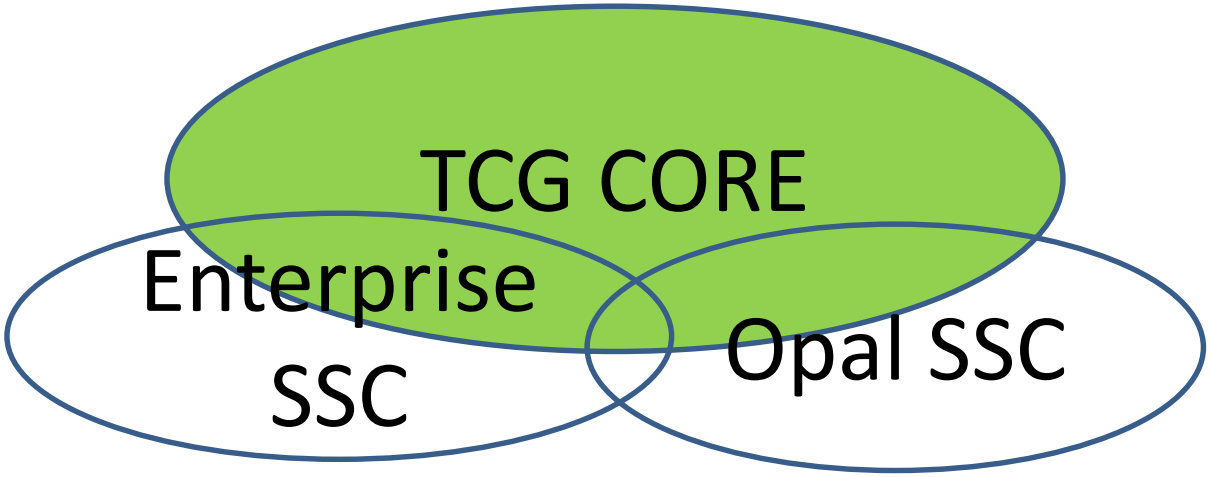
Drive Trust Alliance (DTA)

- 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

TCG Core Spec



- Core + Scripting
  - Core ~= Data Structures + Basic Operations
  - Scripting ~= Amazing Use Cases
- SPs: Admin, Locking, Clock, Forensic Logging, Crypto Services, and others.

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 1999
- 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

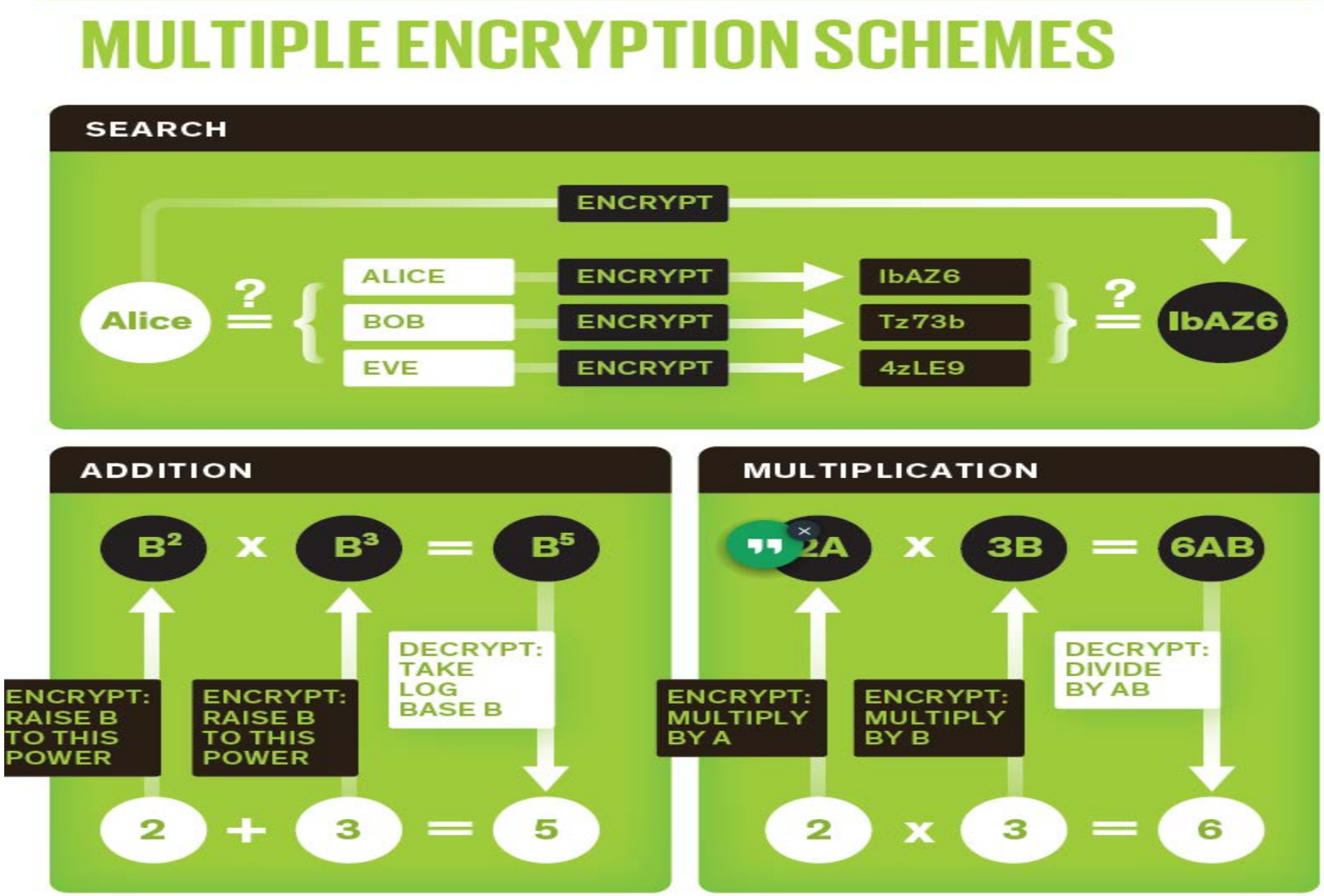
HE Cloud Model and SP-SED Model

ONLY ENCRYPTED DATA
Nothing Plain Text
Can only accept Authorized
Queries (PDS Style)

Private Container
ONLY ENCRYPTED DATA
Nothing Plain Text
Can only accept
Authorized
Queries (PDS Style)

Personal Client Has Keys

Solution for Homomorphic Encryption Examples – Several copies of Data



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

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