HDD-based Security
SMR Recorded HDDs

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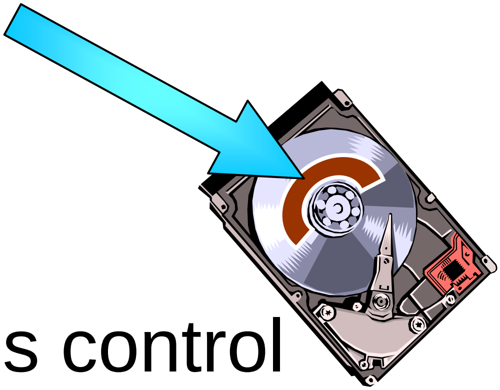
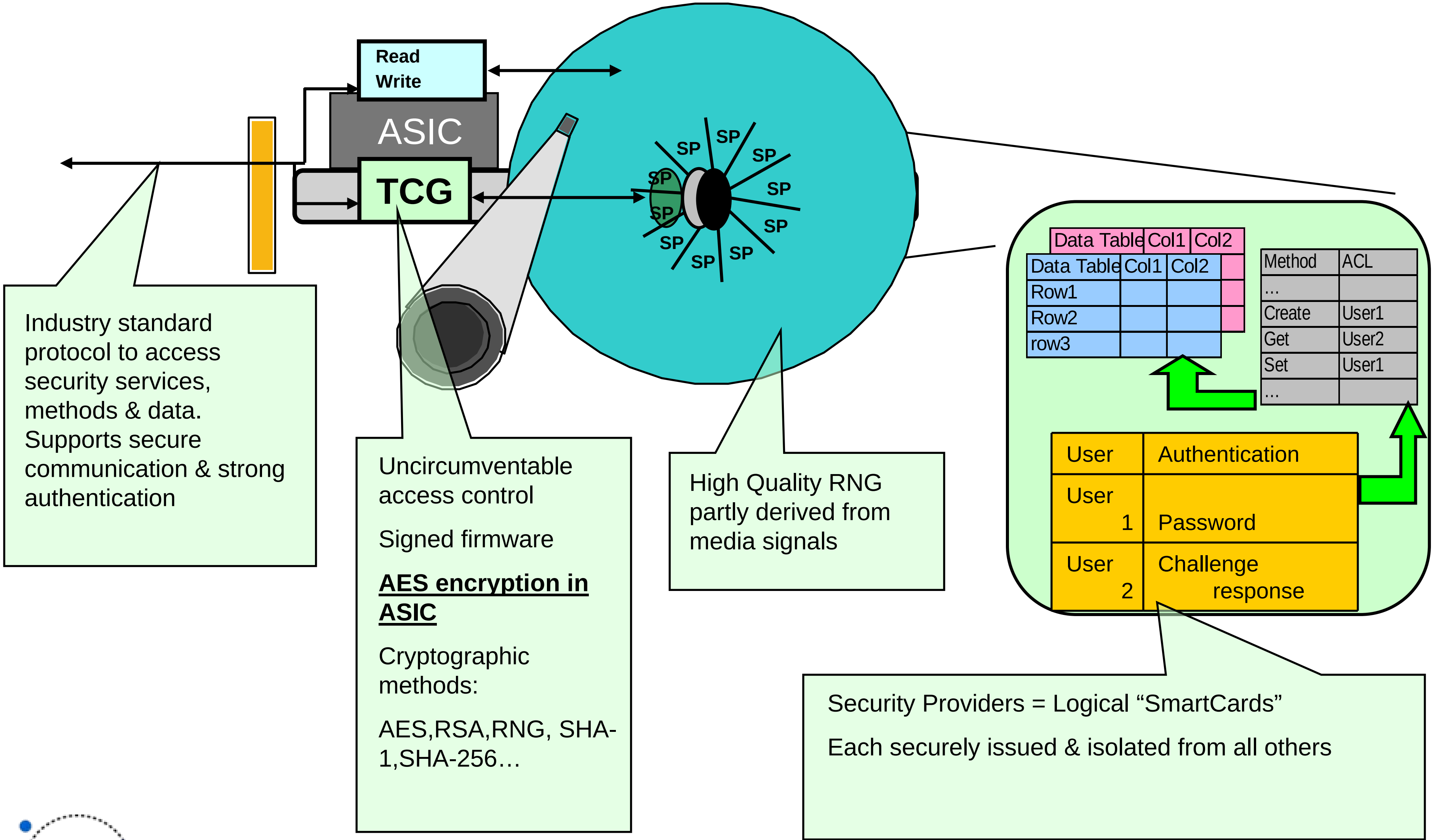
Why Security in the HDD



3 Simple reasons

- Storage for secrets with strong access control
  - Inaccessible using traditional storage access
  - Arbitrarily large
  - Uncircumventable gate to access
- Unobservable cryptographic processing of secrets
  - Processing unit united to storage
  - Secrets can be cryptographically processed in secret
- Custom logic for faster, more secure operations
  - Inexpensive implementation of modern cryptographic functions
  - Makes feasible complex security operations

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

Data Table	Col1	Col2

Data Table	Col1	Col2
Row1		
Row2		
row3		

Method	ACL
…	
Create	User1
Get	User2
Set	User1
…	

User	Authentication
User 1	Password
User 2	Challenge response

Security Providers = Logical “SmartCards”

Each securely issued & isolated from all others

Cryptography

Asymmetric encryption

- RSA 1024 => 2048
- EC under consideration

Symmetric encryption

- Done in hardware for full interface performance, zero latency
- FC, SAS will have dual crypto engines, one for each interface
- AES-128 & AES-256
- =>Block chaining, LBA seeding
- Support for non-512 multiple block sizes & Protection Information (PI)

Hashing

- SHA-1 & SHA-256

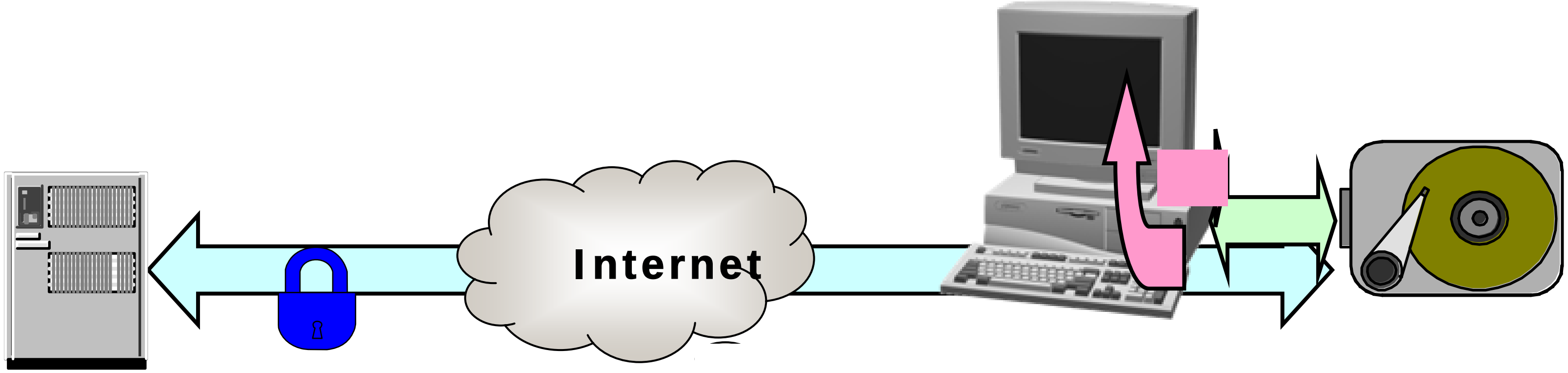
Random number generation

- Head noise-based RNG
- Adding hardware RNG

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 X509 certificates for authentication

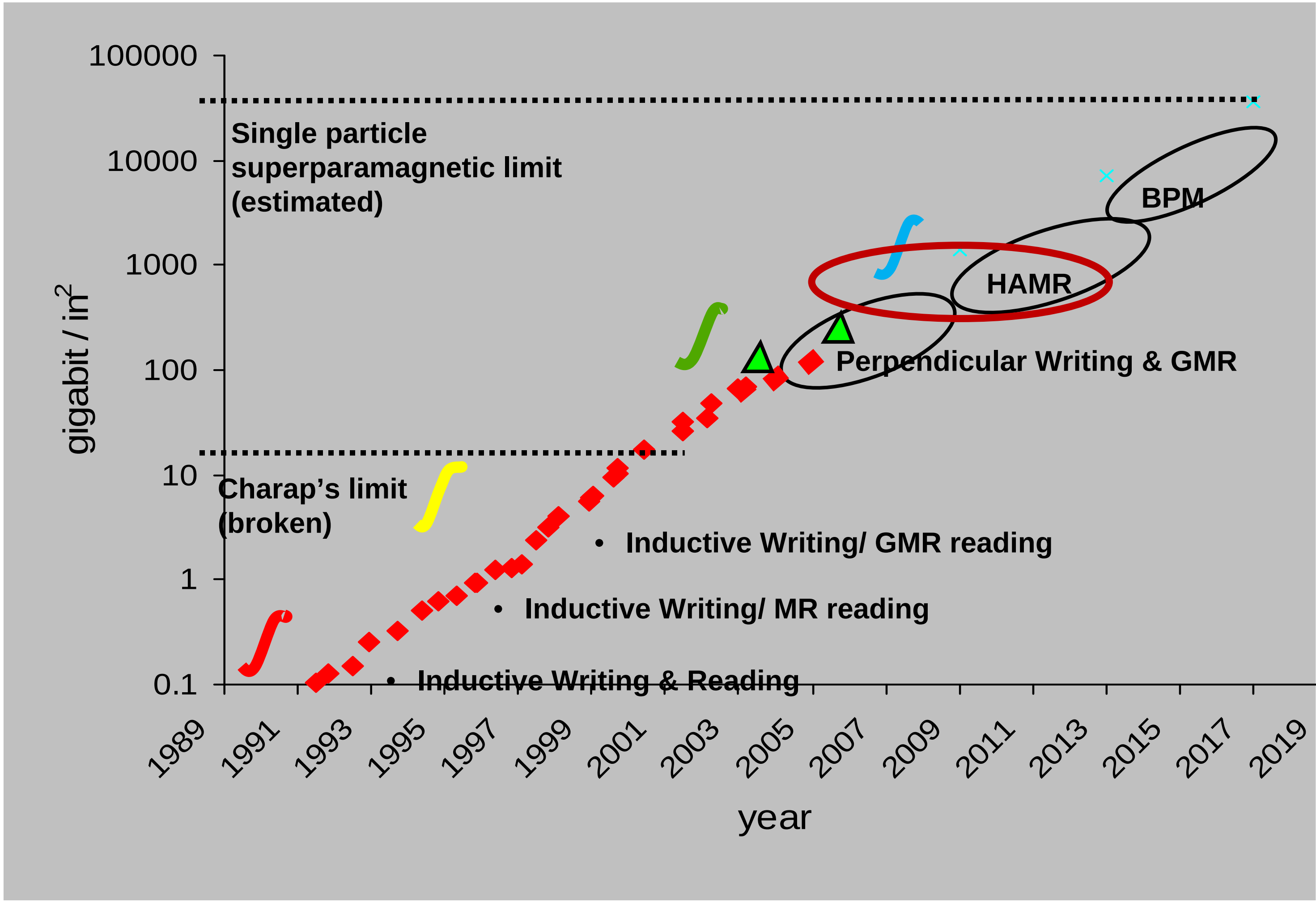


Shingled Magnetic Recording(SMR)

Areal Density Growth

- Areal Density CAGR 40%
- Transfer Rate CAGR 20%

- Late 1990s – super paramagnetic limit demonstrated through modeling
- Perpendicular expected to extend to ~1 Tb/in^2
- Additional innovations required at that point
  - heat-assisted recording
  - bit patterned media recording

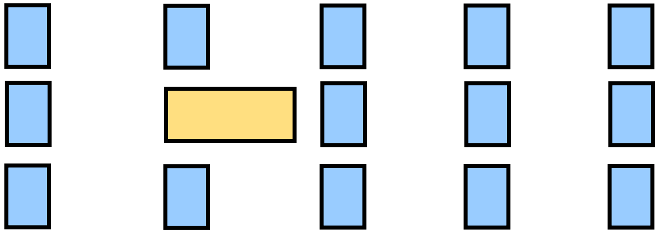


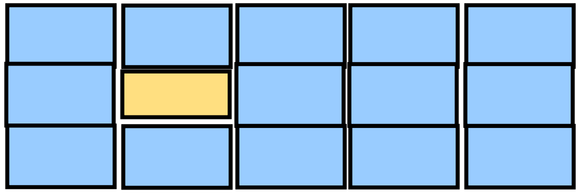
Challenge: Increasing Capacity

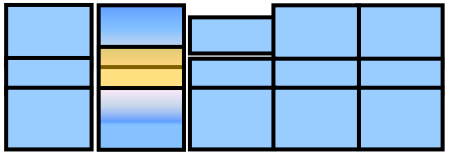
Higher capacity comes from higher areal density

- Blocks smaller, more susceptible to errors
- Spacing tighter, raising risk of fringing effects
- New technology to enable higher areal density:
    - Patterned media
    - Heat assisted magnetic recording
    - Great technical difficulty and risk to implement
    - Capacity growth will slow significantly until at least one is in place

Enter Shingled Magnetic Recording (SMR)



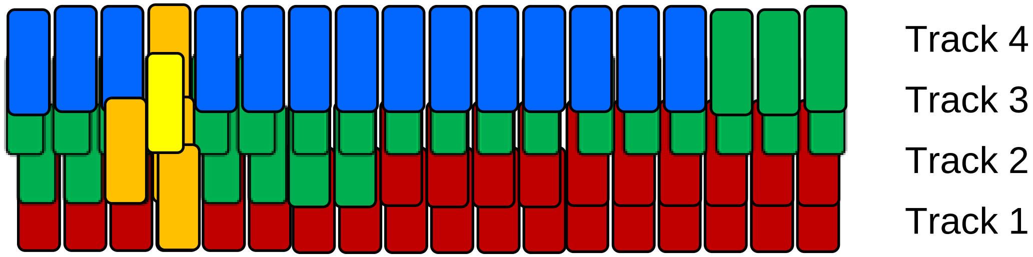




SMR: A New Hope for AD Growth

SMR: Shingled Magnetic Recording - band(s) of disk with:

- Within a band only sequential write forward capability
- Blocks in these areas cannot be updated
- Full random read support
- Could be multiple or lots of such bands per drive
- Some area of the disk may be organized with traditional random Read/Write capability



SMR- Some Advantages & Questions

Advantages

- An obvious candidate path for AD growth
- SMR - relief for the head manufacturing variation issues

Questions

- What applications can use SMR?
- What system changes will be needed?
  - How should bands be sized?
  - What is relation between SMR bands and traditional R/W area?
- Will those result in a storage device with sufficient application?