



Secure, Reliable, Recoverable?

Building data recovery into SSD

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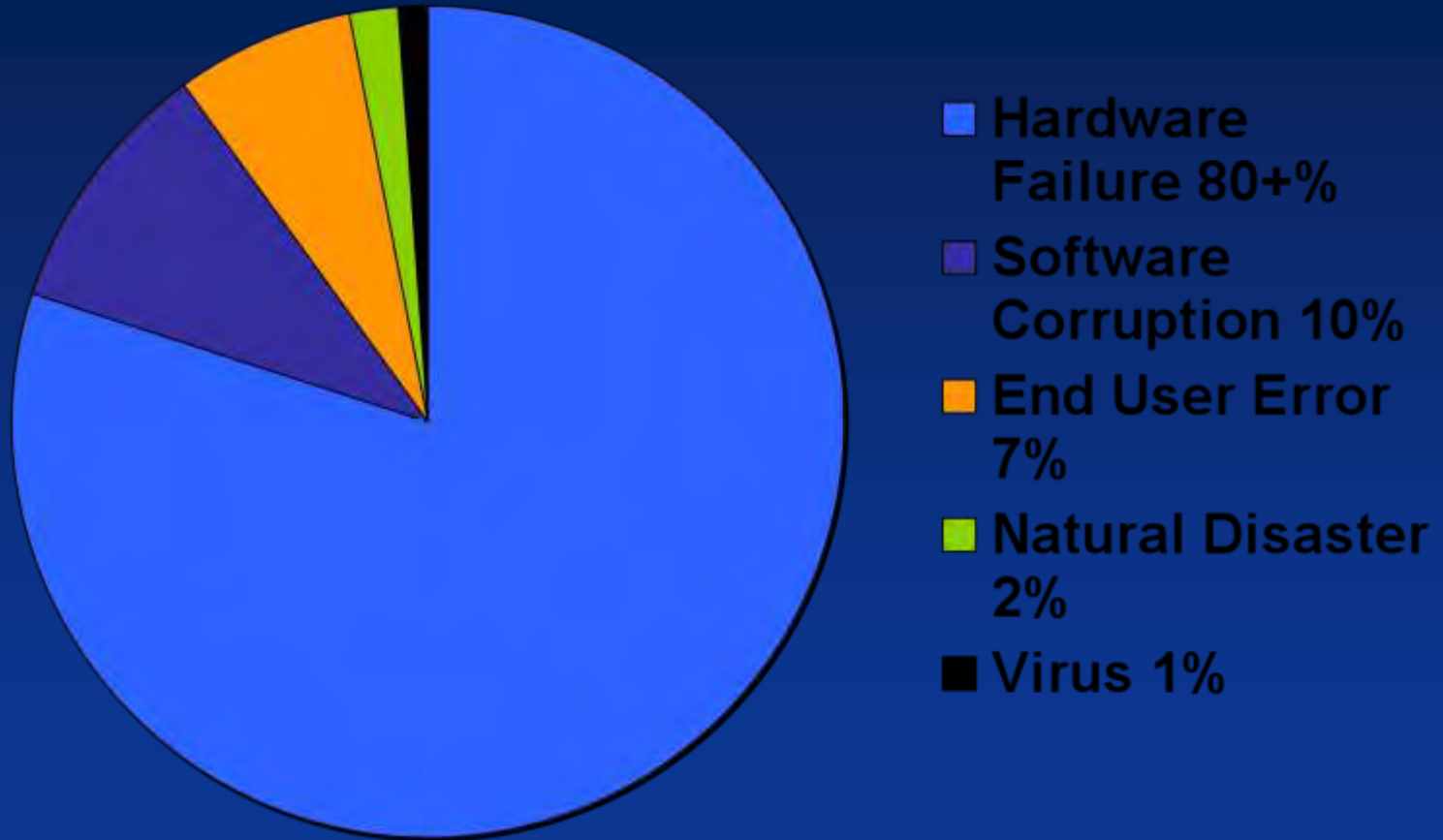
DriveSavers Data Recovery

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Goals...

- Recognize the gains & challenges in SSD reliability and data recovery
- Raise awareness about user data loss
- Motivate the discussion of enabling data recovery opportunities in SSD
 - The value of data recovery in the design equation

All Storage Devices Fail





So Where is the Backup?

- Only 57% of consumers back up their data; 33% “don’t even think about backups”; 24% have lost data in the past 6 months*₂
- Over 50% of company employees tasked with backing up data will misconfigure the backup software and render the data unrecoverable*₃
- Success rates of virtual server backups are under 60%; tape backup systems have a 50% failure rate*₄
- Google reports thousands of hard drive failures annually within every cluster of 1,800 servers *₅
- Data center professionals report that 81% experienced power failures in the last five years; 20% suffered at least five failures*₆



Data at Risk

- What is the Value of Lost Data?
 - Intellectual property
 - Photos & Video
 - Financial records
 - Databases
 - Accounting files
 - Intellectual property
 - Email
 - Medical Records
 - ...



Impact on Business

- 43% of surveyed companies estimate downtime costs at \$10K to \$100K per hour; 7% assess it at more than \$1 million per hour*₇
 - Recovery costs
 - Revenue loss
 - Productivity loss
 - Loss of confidence
 - Loss of employment

- 93% of companies that lost their data center to a disaster filed for bankruptcy within one year. 50% of those businesses filed immediately.*₈



Data Must Be Maintained by Law

- Data Loss is No Longer an Option
- Data Privacy/Security Laws, Regs & Standards:
 - HIPAA (*Health Insurance Portability and Accountability Act*)
 - SAS (*Statement on Auditing Standards*)
 - ISO (*International Organization for Standardization*)
 - PCI (*Payment Card Industry*)
 - GLB (*Gramm-Leach Bliley Act*)
 - DAR (*Data at Rest*) Mandate
- Data Breach on the Rise
 - New government regulations state that businesses, corporations, financial institutions, government agencies and healthcare providers are responsible for any breach in data security/privacy when confidential data leaves their facility (*Data Leakage*)
 - TJ Maxx settlement: \$40.9M for security breach

The Reality of Reliability

- It's Not a Question of "If", but "When"
 - All electronic components have a failure rate
 - When you least expect it...expect it!

- SSD Reliability Advantages
 - Better than HDD, but good enough?
 - Consumer, Professional, Enterprise variables

- AFR vs. Field Replacement Rates
 - .25-1+% Annualized Failure Rates
 - Field replacement rate even higher
 - More units shipped, more data stored, more data lost

Reliability Via the Controller

- NAND Inherent Challenges
 - Data Retention
 - Endurance limits
 - Disturb Errors
 - Bad Blocks / media failure
 - Shrinking die size

- Intelligent SOC Defines the Device
 - Utilizing MLC in SLC applications
 - ECC, Wear Leveling, Compression
 - Endurance solutions
 - Security via Encryption

Non-Secure Flash Applications

- Mobile Consumer applications
 - USB drives
 - Easy too lose, seldom protected
 - Real issue for IT security
 - Digital Camera Media
 - Most valuable data to home user
 - Pro photographers \$

- Early SSD products
 - No encryption via controller
 - NAND media readily accessible
 - User data recoverable
 - TRIM not implemented
 - Deleted files not erased at block level
 - User data recoverable

Data Security via Encryption

- Mobile Consumer Applications
 - USB drives
 - New secure products
 - Some allowance in corp and govt environments

- Current and Future SSD Designs
 - Self encrypting devices
 - 256bit AES encryption via controller
 - No performance degradation
 - User data secure
 - Efficient use of NAND media
 - Encryption provides balanced write distribution of random bit patterns
 - Compression, De-Dup, other technologies

Data Security via Data Sanitation

- Permanent Deletion of User Data
 - Unprotected devices
 - Secure deletion via software
 - Encrypted Devices
 - Just throw away the key?

- Permanent Destruction
 - Shred, Crush, Incinerate

Why Data Recovery on SSD?

- NAND most probable source
 - Individual package or die failure
- Controller as the Culprit
 - Firmware locked in a panic
 - Defect tables or translators corrupt
- Electrical / ESD damage
- Environmental damage
 - Fire, flood, impact
- Endurance limits

Data Recovery Challenges

- The Good News is...
 - Traditional failure of mechanical issues are gone
- The Bad News Is...
 - Many potential issues yet to be discovered!
- Encryption
 - Controllers now encrypting data
 - Individual package or die recovery futile
- TRIM & Garbage Collection
 - Undelete still possible?
 - Depending when the cleanup occurs

Data Recovery Solutions

- Advanced Technology Required in Lab
 - Fewer opportunities than with HDD
 - Competing technologies advancing quickly
 - Current data recovery solutions become obsolete
 - New tools and techniques being developed

- Technological Alliances Critical
 - Each OEM has proprietary implementations
 - Lab must work with industry leaders
 - Providing FA back to the dev teams
 - Identifying unique and new failures
 - Helping to prevent future issues in the field

Data Recovery & Future SSD

- Enable Data Recovery on SSD
 - Possible future design implementations
 - Security will be of primary concern
 - Non-destructive diagnostics
 - Safety mechanisms to prevent catastrophic failure

- Consider an Industry Standard
 - JEDEC or other?

- Realize the Real Value of User Data