20 Years of Storage Innovation
…and Predictions for the Next 20 Years

Michael Oros
Executive Director
How did we get here…

- Cave paintings…40,000 years ago
- Pictograms…9,000 years ago
- Writing…5,000 years ago
- Paper data storage…300 years ago
- Commercial electricity generation…~140 years ago
How did we get here…

- Transistor…70 years ago
- Hard disk drive…63 years ago
- Networked storage…34 years ago
- Flash memory…33 years ago
- Storage area networks…23 years ago
- SNIA…20 years ago
Why standards are important: Electricity as an example

- AC / DC – the battle of the currents
- AC voltage and frequency
  - 220-240V and 100-127V are the standard for commercial power
  - 14 frequencies were initially commercialized
  - 50 and 60 Hz are the dominant world frequencies today
  - 4-combination of voltage and frequency today…and 15 plugs
Why standards are important: Electricity as an example

**Impact:**
- Electronics industry has to account for all permutations
- Electric machinery/motors has to be customized for each voltage/frequency combination
- Higher costs for manufacturers and customers

**Examples and consequences:**
- Los Angeles power grid
- Japan’s incompatible power grids
Remembering how far we’ve come…
Who remembers dialup?

5 years ago: NO: Pokemon Go, Apple Watch, Microsoft Surface, Amazon Echo

10 years ago: NO: iPhone, Android, Instagram, Uber, iPad, Wii, Nest, WhatsApp, Fitbit, Pinterest, Waze, Kindle, AirBNB, Macbook Air, Snapchat, Lyft, Minecraft

15 years ago: NO: Facebook, Twitter, Google Maps, WiFi, Bluray, XBox, Spotify, YouTube, Hulu, Kayak, Sonos, Skype, iPod

20 years ago: NO: Google, DVRs, USB, Bluetooth, Netflix, Tencent, BlackBerry, Alibaba, Salesforce.com, Mailchimp, Jive
Data Center Dependent

5 years ago

NO: Pokemon Go, Apple Watch, Microsoft Surface, Amazon Echo

10 years ago

NO: iPhone, Android, Instagram, Uber, iPad, Wii, Nest, WhatsApp, Fitbit, Pinterest, Waze, Kindle, AirBNB, Macbook Air, Snapchat, Lyft, Minecraft

15 years ago

NO: Facebook, Twitter, Google Maps, WiFi, Bluray, XBox, Spotify, YouTube, Hulu, Kayak, Sonos, Skype, iPod

20 years ago

NO: Google, DVRs, USB, Bluetooth, Netflix, Tencent, Blackberry, Alibaba, Salesforce.com, Mailchimp, Jive
SNIA in Action

**STORAGE MANAGEMENT**
Enabling interoperable, deployable and verifiable solutions

**CLOUD**
Multi-Cloud environments becoming the norm

**FLASH**
Mainstream for mixed workloads

**PERSISTENT MEMORY**
Non-Volatile Memory (NVM) becoming less like storage, more like memory

**GREEN**
U.S.A. EPA drives ENERGY STAR® Program

**OBJECT DRIVES**
Standardizing points of physical and logical interoperability

**SECURITY**
Storage Security and Data Protection get real, new industry privacy regulations take hold
SNIA-at-a-Glance

160 unique member companies

2,500 active contributing members

50,000 IT end users & storage pros worldwide
Standards Development

20 YEARS of Standards Development

- ISO & ANSI Standards
- Storage Standards
- Best Practices & Security
- Interoperability & Conformance Testing

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Standards Development – Past 20 Years

- IP-Based Drive Management Specification 1.0
- Self-contained Information Retention Format (SIRF) Specification 1.0
- Storage Management Initiative Specification (SMI-S) 1.7
- SNIA Emerald™ Power Efficiency Measurement Specification 2.1
- Storage Management Initiative Specification (SMI-S) 1.6.1
- NVM Programming Model 1.0
- TLS Specification for Storage Systems 1.0
- SSS PTS Enterprise 1.1
- Linear Tape File System (LTFS) Format Specification 2.2
- SNIA Emerald™ Power Efficiency Measurement Specification 2.0
- SSS PTS Client 1.0
- SNIA Emerald™ Power Efficiency Measurement Specification 1.0
- SSS PTS Enterprise 1.1
- Multipath Management API 1.1
- XAM SDK 1.0.1
- Common RAID Disk Data Format (DDF) 2.0
- Storage Management Initiative Specification (SMI-S) 1.3
- Storage Management Initiative Specification (SMI-S) 1.1
- Storage Management Initiative Specification (SMI-S) 1.0
- NVM Programming Model v1.2
- Swordfish Scalable Storage Management API Specification 1.0
- LTFS Bulk Transfer 1.0
- SFF TA TWG
- SSS PTS Client 1.2
- Linear Tape File System (LTFS) Format Specification 2.3
- SSS PTS Client 1.1
- Cloud Data Management Interface (CDMI) 1.1
- Storage Management Initiative Specification (SMI-S) 1.6
- SSS PTS Client 1.1
- Cloud Data Management Interface (CDMI) 1.0
- Storage Management Initiative Specification (SMI-S) 1.5
- Storage Management Initiative Specification (SMI-S) 1.4
- Storage Management Initiative Specification (SMI-S) 1.3
- XAM Specification 1.0
- Cloud Data Management Interface (CDMI) 1.0
- NVM Programming Model 1.1
- Cloud Data Management Interface (CDMI) 1.0
- NDMPv4 Release 1.0
- iSCSI Management API 2.0
- Storage Management Initiative Specification (SMI-S) 1.2
- Common RAID Disk Data Format (DDF) 1.2
- ISCSI Management API 1.1
- Storage Management Initiative Specification (SMI-S) 1.1
- Multipath Management API 1.0
SFF TA TWG: since creation in July 2016

- SFF-8071 Specification for SFP+ 1X 0.8mm Card Edge Connector Rev 1.8
- SFF-8351 3.5" Form Factor Drive with High Density Connector Rev 1.0
- SFF-8449 Specification for Management Interface for SAS Shielded Cables Rev 2.1
- SFF-8617 Specification for Mini Multilane 12X Shielded Cage/Connector (CXP) Rev 1.7
- SFF-8642 Specification for Mini Multilane 12X 10 Gb/s Shielded Connector (CXP10) Rev 3.2
- SFF-8636 Specification for Management Interface for Cabled Environments Rev 2.9
- SFF-8024 Specification for SFF Cross Reference to Industry Products Rev 4.2
- SFF-9402 Reference Guide for Multi-Protocol Internal Cables for SAS and/or PCIe Rev 0.7

17 Active Projects
From Idea to New ISO Standard

- Do you have an idea for a new technical standard or a proprietary standard you would like to standardize?
- As a SNIA Member, find two other SNIA companies that agree with you
  - Statements of support from at least three active SNIA members are a prerequisite for TWG approval. “Support” includes intent to actively participate in the TWG
- Create a proposal and present to the Technical Council for review/approval
  - Prepare a draft charter and proposed Program of Work
- For additional information send an email to tcmd@snia.org
SNIA Technical Work Groups Drive Important Storage Specifications

- Non-Volatile Memory Programming Model (NVM)
- Object Drive IP-Based Management Specification
- SNIA Emerald™ Power Efficiency Measurement Specification
- Storage Management Specification (SMI-S)
- Transport Layer Security (TLS) Specification for Storage Systems
- Solid State Storage Performance Test Specification (PTS)
- Linear Tape File System (LTFS) Format Specification
- LTFS Bulk Transfer Technical Position
- Self-contained Information Retention Format (SIRF)
- Device level connectors, interfaces, and form factors (SFF)
SNIA TWG Projects - Specifications

- Cloud Data Management Interface (CDMI)
- IP-Based Drive Management
- Key Value API
- Linear Tape File System (LTFS) Format
- NVM Programming Model (NPM)
SNIA TWG Projects - Specifications

- Self-contained Information Retention Format (SIRF)
- SNIA Emerald™ Power Efficiency Measurement
- Solid State Storage (SSS) Performance Test Specification (PTS)
- Storage Management Initiative Specification (SMI-S)
- Swordfish Scalable Storage Management API
Specifications for:

- Connectors
- Transceivers
- Form Factors

17 Active Projects
SNIA TWG Projects – Open Source Software

- API emulator for Swordfish
  - Extends Redfish emulator
- Swordfish client reference implementations
  - Basic Swordfish web client
  - PowerBI sample client
  - DataDog sample client
- CDMI Reference Implementation
Participation in Software projects for SNIA is not limited to just members

- Any individual may now sign the Contributors License Agreement

Projects such as the CDMI Reference Implementation exist due to volunteer contributions, now both member and non-member

The Horizon 2020 project Indigo Data Cloud has taken the RI and used it for their project, creating a “fork”

- Signed the CLA and contributed back their changes
- SNIA benefits from the improved code
Success Story: CDMI and Philips Research

Philips HealthSuite imaging and monitoring systems

Problem: Moving medical records to other countries and hospitals thru commercial cloud technologies
- How to do securely and with correct permissions/consents

Decided to use SNIA’s CDMI standard and do joint development with CDMI Technical Working Group
- CDMI Encrypted Object Extension
  - Makes a cloud object storage server “encryption -aware”
  - Server or client can do in-place encryption and decryption
- CDMI Delegated Access Control extension
  - Gives control of access decisions back to data owner and can be client or server side
SNIA Projects

- I/O Traces, Tools & Analysis (IOTTA) Repository
- DPCO: 100 year archive
- Workload (Provisional TWG)
SNIA Public Review Drafts

http://www.snia.org/publicreview

- SNIA Emerald™ Power Efficiency Measurement Specification v3.0 rev 55
- Storage Management Initiative Specification (SMI-S) v1.8.0r1
- Swordfish Scalable Storage Management API v1.0.4
- Simple IP Based Drive Mockup-4
- IP Based Drive Array Mockup-2
- Persistent Memory Security DRAFT
- CDMI Test Specification v1.0a DRAFT
- CDMI Reference Implementation v1.0e DRAFT
- DRAFT CDMI Extensions and Profiles

Check them out! - Provide Feedback!
Participate in their development!
The Need for Speed and Capacity

500 Hours of Video Uploaded Per Minute, Feb 2017
(Source: Smart Insights)

DoD Drones Capable of Capturing 430 PB/Day

Estimated 20.4B Connected Devices by 2020
(Source: Gartner)

Surveillance Cameras Capture 2.5 EB/Day in 2019
(Source: IHS Inc.)
What’s Next?

- **Data:** Efficient management, movement and security of information
  - Industry: Growth, higher scrutiny and liability for collected private data

- **Physical Storage:** Persistent Memory over Fabrics, Hyperscaler Storage
  - Industry: High density/lower cost media, persistent media, new interfaces

- **Storage Management:** Device/System management, SNIA Swordfish™
  - Industry: Automation, self-management and healing

- **Object Storage:** IP Drive Management Specification, Object Storage API
  - Industry: Classification/categorization of data will become overwhelming

- **Cloud Storage:** Data into and out of Cloud Storage
  - Industry: Physical transport of data
Join the community!  snia.org/join
Startup Membership Category Launched

CELEBRATING 20 YEARS OF STANDARDS DEVELOPMENT

STORAGE NETWORKING INDUSTRY ASSOCIATION

STORAGE DEVELOPER CONFERENCE
SEPTEMBER 11-14, 2017
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