# Developer Tutorial:
# Introducing the Cloud Data Management Interface – CDMI 1.1

SNIA – Cloud Storage Initiative
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Cloud Storage Initiative

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# Today's Presenters

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# Introducing CDMI 1.1:
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- "Follow Along" links
    - Specification: http://www.snia.org/sites/default/files/CDMI_Spec_v1.1.pdf
    - Extensions: http://www.snia.org/tech_activities/publicreview/cdmi
    - https://github.com/osaddon/cdmi

# A Quick Review of CDMI
# History of the standard

◆ **Technical Working Group founded in 2009**
  - Published TWG Charter and Use Cases

◆ **CDMI Timeline:**
  - 2010 - CDMI 1.0 Technical Architecture
  - 2011 - CDMI 1.0.1 Errata
  - 2012 - CDMI 1.0.2 Errata
  - 2013 - Adopted as ISO/IEC 17826
  - 2014 - CDMI 1.1.0 Technical Architecture

# A Quick Review of CDMI
# What is CDMI

◆ CDMI standardizes the following:
- How is data stored in the cloud
  - › Data objects, queues, metadata
- How is data stored in the cloud organized
  - › Containers, object IDs, query, snapshots
- How is data stored in the cloud transferred
  - › Client to cloud, cloud-to-cloud, exports, serialization, notifications
- How is data stored in the cloud secured

# A Quick Review of CDMI
# What is CDMI

- ◆ **CDMI works with existing protocols:**
  - ◆ File: NFS, CIFS, LTFS, etc.
  - ◆ Block: iSCSI, VMDKs, etc.
  - ◆ Object: S3, Swift, etc.
- ◆ **CDMI fills many gaps in the above protocols**
  - ◆ Unified storage management
  - ◆ Global and hierarchical namespaces
  - ◆ Query, notification and workflow

# A Quick Review of CDMI
# CDMI Adoption

- **22 publically announced CDMI servers**
    - Major vendors (NetApp, DDN,etc)
    - Startup companies
    - Open source projects
- **Widespread adoption in government**
    - USA DoD, UK, Italy, etc.
- **Supported in OpenStack Swift**

# CDMI 1.1 Changes
# Document Organization

◆ To improve readability, the CDMI specification has been split into five parts:

- ◆ Preamble pp 1 – 25 25
- ◆ Basic Cloud Storage pp 27 – 41 15
- ◆ CDMI Core pp 42 – 108 67
- ◆ CDMI Advanced pp 109 – 235 127
- ◆ CDMI Annexes pp 235 – 256 22

# CDMI 1.1 Changes
# Document Organization

◆ **Section 1 - Preamble**

   ◆ References and Terms

   ◆ Provides an overview of cloud storage

   ◆ Provides an overview of the CDMI standard

   ◆ Defines the CDMI model for cloud storage and metadata

   ◆ Introduces general CDMI concepts:

      › Object Types, Object IDs, Time, use of HTTP, Security, Backwards Compatibility

# CDMI 1.1 Changes
# Document Organization

◆ **Section 2 – Basic Cloud Storage**

  ◆ Formerly "Non-CDMI" operations

  ◆ Defines basic RESTful operations for data objects and containers

  ◆ Compatible subset of CDMI, S3, Swift, etc.

    › Provides guidance for multi-protocol support

    › Also see the Header-based Metadata Extension

  ◆ Minimal baseline for cloud storage

# CDMI 1.1 Changes
# Document Organization

◆ Section 3 – CDMI Core

  ◆ Defines operations for CDMI Data Objects

  ◆ Defines operations for CDMI Containers

  ◆ Minimal baseline for CDMI-based systems

    › Containers optional

    › By ID only objects optional

    › Etc.

# CDMI 1.1 Changes
# Document Organization

◆ **Section 4 – CDMI Advanced**

- Defines operations for CDMI Domain Objects

- Defines operations for CDMI Queue Objects

- Defines operations for CDMI Capabilities

- Advanced Features of CDMI

  › Exports, Snapshots, Serialization, Metadata, Retention and Hold, Logging, Notifications, Query

# CDMI 1.1 Changes
# Document Organization

◆ Section 5 – CDMI Annexes

- Extensions to the CDMI standard implemented by at least one vendor

- Includes:
  - Summary Metadata for Bandwidth
  - Expiring ACLs
  - Group Storage System Metadata
  - Versioning

# CDMI 1.1 Changes – Co-existence Clarification- #904, #907, #918, #919, #931

- ◆ **Clause 6 and 7 reworked**
  - ◆ Clarifies that Non-CDMI operations represent basic RESTful HTTP operations that are consistent with most object storage protocols

- ◆ **cdmi_authentication_methods**
  - ◆ Text added explaining how S3, Keystone, etc work with CDMI

# CDMI 1.1 Changes – Copy/Move Clarification - #440, #504, #815, #847

◆ Copy and Move

- Copying data to an existing or new object has been clarified.
  - › Behaviours are documented when fields in the source URI are omitted or specified
- Copying between and from queues have been clarified
  - › Added cdmi_copy_dataobject_from_queue
- Domain move capability missing

# CDMI 1.1 Changes – Container Fields Clarification - #476

◆ **childrenrange/children now optional on a container create**

  ◆ Eliminates an edge case where copying or deserializing a container could result in a large listing of children being returned

◆ **Servers: No change required**
◆ **Clients: No longer depend on these fields being returned**

# CDMI 1.1 Changes – Container Fields Clarification - #651

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◆ Clarified contents of parentURI and parentID for root containers

  ◆ Multiple vendors had chosen different approaches

  ◆ Selected approach was "best compromise"


◆ Servers: Changes may be required

◆ Clients: Changes if depend on these fields

# CDMI 1.1 Changes – Metadata Clarification - #517, #566, #833

◆ Metadata updates, additions and deletions have been clarified in a new section: 16.6

  ◆ Examples are already present in 1.0.2
  ◆ Additional examples added

◆ Mutability of storage and data system metadata

◆ Default values of storage system metadata

# CDMI 1.1 Changes – HTTP Headers Clarification - #536

◆ The Location header must be an absolute URI

    ◆ A close reading of RFC 2616 should have already confirmed this for implementers.

# CDMI 1.1 Changes – ACLs Clarification - #812, #817, #890

- Clarified field results when ACL deny access to specific parts of objects
  - CDMI 1.0.2 approach was viewed as standard and intuitive, but needed to be specified normatively.
- Now indicates which status code to return
- Clarified that hex and string forms are allowed
- Servers: Changes may be required
- Clients: Changes if depend on these fields

# CDMI 1.1 Changes – Retention and Hold Clarification - #894

◆ Additional examples added

# CDMI 1.1 Changes – Scopes New Functionality - #483, #508, #902

- CDMI Scopes have been enhanced to handle JSON arrays.
  - Required for querying against ACLs
- AND statements now use JSON arrays to avoid the use of duplicate keys
- Numeric query broken out

- Servers: Add new functionality if supported
- Clients: Changes required for numeric matching

# CDMI 1.1 Changes – Queues
# New Functionality - #515

- ◆ CDMI Queues now allow deletion by range
    - ◆ Allows idempotent deletes
- ◆ Servers: Add new functionality if supported
- ◆ Clients: No changes required

# CDMI 1.1 Changes – Data Object Updates New Functionality - #881

- Update range spec was unnecessarily restrictive
  - Now allows appends and sparse updates
- Servers: Add new functionality if supported
- Clients: No changes required

# CDMI 1.1 Changes – Extensions Multi-part MIME

◆ Allows the data object value to be sent as a separate MIME part, without requiring encoding

- Improves efficiency of binary transfers

# CDMI 1.1 Changes – Extensions Domain Authentication Methods

◆ Allows a client to discover which authentication methods a server supports

◆ Allows an administrator to restrict which authentication methods are supported for a given domain

# CDMI 1.1 Changes – Extensions
# Group Storage System Metadata

◆ Allows objects to have a specified "owner" that ACLs can refer to

◆ Allows broader compatibility with NFS and CIFS ACLs

# CDMI 1.1 Changes – Extensions
# Domain Summary Metadata

◆ Allows domain summaries to include information about bandwidth consumed

- Network bytes
- Reads & Writes
- Public and Private (Internal) I/O

# CDMI 1.1 Changes – Extensions Expiring ACEs

◆ Allows ACEs to have an expiration time, when the ACE will no longer be evaluated as part of the ACL

- Allows time-limited access
- Allows content to become public after a period of time

# CDMI 1.1 Changes – Extensions Versioning

◆ **Allows data objects to retain historical versions as changes are made**

- ◆ Historical versions are accessed by ID
- ◆ Historical versions are enumerated as a tree
- ◆ Enables multi-writer conflict resolution
- ◆ Simplifies federation, distributed storage and disconnected operation

# Guidance for CDMI 1.1 Adoption

- ◆ Review the CDMI 1.1 spec and errata, which is posted on the SNIA public review site
  - ◆ http://www.snia.org/tech_activities/publicreview
- ◆ Most vendors will be able to support 1.0.2 and 1.1 clients without changes.
  - ◆ Review error handling, data object update and container field behaviours
  - ◆ Consider adding support for Multi-part MIME

# Guidance for CDMI 1.1 Adoption

◆ Come visit us at the Cloud Plugfests

◆ Two closely coupled events are planned in December 2014:
   ◆ Virtual Cloud Plugfest Dec. 8-12, 2014
   ◆ Cloud Interoperability Demo Days Dec. 11-12, 2014 in London

◆ For more details, see http://www.cloudplugfest.org/

◆ "Follow Along" links
   ◆ Specification: http://www.snia.org/sites/default/files/CDMI_Spec_v1.1.pdf
   ◆ Extensions: http://www.snia.org/tech_activities/publicreview/cdmi
   ◆ https://github.com/osaddon/cdmi

# Questions and Answers

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# After This Webcast

- This webcast and a copy of the slides will be posted to the SNIA Cloud Storage Initiative (CSI) website and available on-demand
  - http://www.snia.org/forum/csi/knowledge/webcasts

- A full Q&A from this webcast, including answers to questions we couldn't get to today, will be posted to the SNIA-CSI blog
  - http://www.sniacloud.com/

# Conclusion

# Thank You