

# Strategies and New Technology for Long Term Preservation of Big Data

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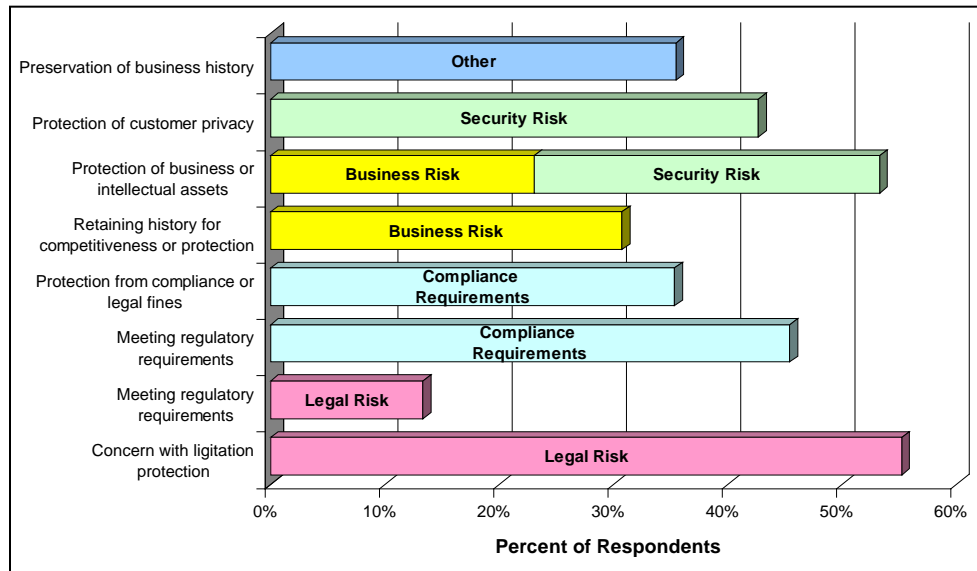
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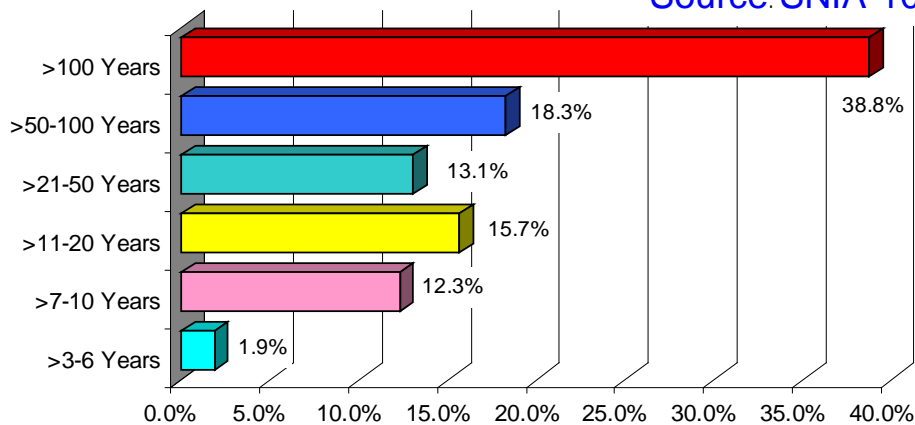
- ❑ Introduction
- ❑ What makes digital preservation of big data so hard?
- ❑ SNIA Long Term Retention technology for big data
  - ❑ Self-contained Information Retention Format (SIRF)
- ❑ SIRF serializations for cloud and tape
- ❑ SIRF status and summary

- ❑ Really is BIG.....
  - ❑ 2.5 quintillion ( $10^{18}$ ) bytes of new data created per day in 2012 (source IBM)
- ❑ And the move to the “Internet of Things” is only going to increase this volume
  - ❑ 19.8 Billion connected devices by 2020 (source McKinsey)
    - ❑ Only 4.2 billion smartphones and tablets, 3.4 billion PCs
- ❑ Data analytics is improving all the time
  - ❑ Therefore historical information has significant value
    - ❑ Apply new techniques and algorithms to gain new insights
    - ❑ Need to ensure ALL necessary information is captured to extract full value
- ❑ If storing big data is difficult today, how do we preserve it?
  - ❑ Over the short term? Over the long term?

**Top External Factors Driving Long-Term Retention Requirements:**  
**Legal Risk, Compliance Regulations, Business Risk, Security Risk**



Source: SNIA-100 Year Archive Requirements Survey, January 2007.



**What does Long-Term Mean?**  
**Retention of 20 years or more is required by 70% of responses.**

# The Need for Digital Preservation of Big Data

- ❑ Domains that have Big Data require preservation
- ❑ Regulatory compliance and legal issues
  - ❑ Sarbanes-Oxley, HIPAA, FRCP, intellectual property litigation
- ❑ Emerging web services and applications
  - ❑ Email, photo sharing, web site archives, social networks, blogs
- ❑ Many other fixed-content repositories
  - ❑ Scientific data, intelligence, libraries, movies, music


**Scientific and Cultural**



Satellite data is kept **for ever**

We would like to keep digital art **for ever**


**Healthcare**



X-rays are often stored for periods of **75 years**

Records of minors are needed until **20 to 43 years of age**

**M&E**



Film Masters, Outtakes. Related artifacts (e.g., games). **100 Years or more**

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# What makes digital preservation so hard?

## Data volume

- ❑ Digital content is generated at a much faster rate than analog
- ❑ “Big Data” (volume, velocity, variety) makes this even harder

## Technology issues

- ❑ Media obsolescence
- ❑ Media degradation/failure
- ❑ Format obsolescence
- ❑ Loss of context/metadata

## Human issues

- ❑ Large-scale disaster
- ❑ Human error
- ❑ Economic faults
- ❑ Attack
- ❑ Organizational faults

**Large scale & long time periods** → Even improbable events will have an effect

# Real Life Example Problem

2003

To: [roger.cummings@veritas.com](mailto:roger.cummings@veritas.com)  
From: [fred@nowhere.com](mailto:fred@nowhere.com)  
Subject: Something or other

2007

To: [roger\\_cummings@symantec.com](mailto:roger_cummings@symantec.com)  
From: [sue@somewhere.com](mailto:sue@somewhere.com)  
Subject: Something else

Same people?? Could you PROVE it 20 years on?

To: [gary.phillips@veritas.com](mailto:gary.phillips@veritas.com)  
From: [fred@nowhere.com](mailto:fred@nowhere.com)  
Subject: Something or other

To: [gary\\_phillips@symantec.com](mailto:gary_phillips@symantec.com)  
From: [sue@somewhere.com](mailto:sue@somewhere.com)  
Subject: Something else



# Goals of Digital Preservation

- ❑ Digital assets stored now should remain
  - ❑ Accessible
  - ❑ Undamaged
  - ❑ Usable
  
- ❑ For as long as desired – beyond the lifetime of
  - ❑ Any particular storage system
  - ❑ Any particular storage technology
  
- ❑ And at an *affordable cost*

- ❑ Can't predict what will change – only know it will
  
- ❑ This means processes are key
  - ❑ Must be evolvable
    - ❑ Current processes get us to the next step
    - ❑ At that point we will likely need new processes to take over
  - ❑ Must not destroy what we are trying to protect
  - ❑ Standards make evolution easier
  
- ❑ A good archive is almost always in motion
  - ❑ **Digital preservation is not a static activity!**

# Practices must vary by context

- ❑ What do we preserve?
  - ❑ Raw data? Analytical results? Context? etc.
  - ❑ Depends on customer needs and economics
    - ❑ Can we afford to keep the raw data?
    - ❑ Is it ever practical to re-analyze?
  - ❑ Can't always predict the eventual use
    - ❑ What insights will the data provide in 1 year, 5 years, 20 years, etc?
    - ❑ Trade off, based on predicted "business value"
- ❑ Many possible preservation techniques and strategies, which could vary over time

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- ❑ SIRF status and summary



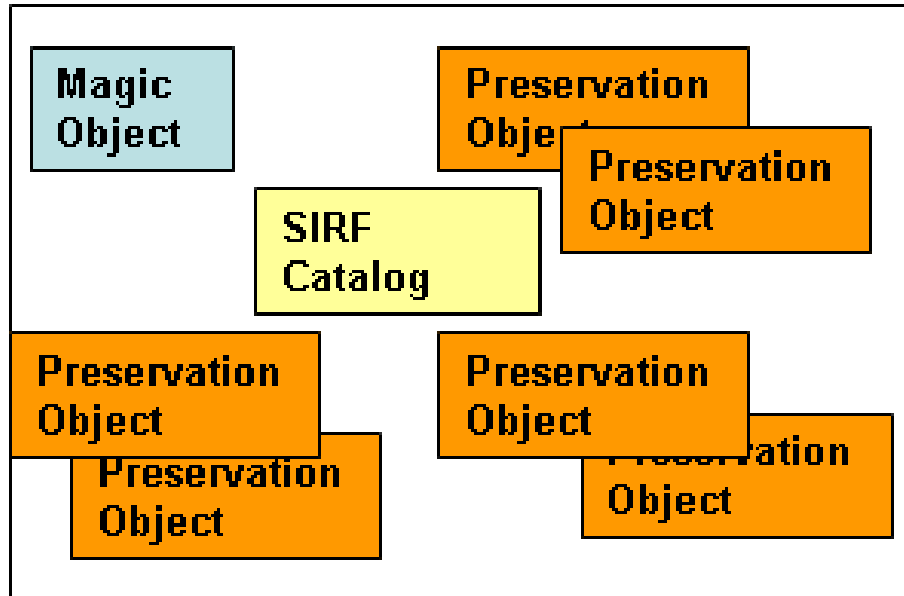
- ❑ SIRF is a logical data format of a storage container appropriate for long term storage of digital information
  - ❑ A storage container may comprise a logical or physical storage area considered as a unit.
  - ❑ Examples: a file system, a tape, a block device, a stream device, an object store, a data bucket in cloud storage
  
- ❑ Required Properties
  - ❑ Self-describing – can be interpreted by different systems
  - ❑ Self-contained – all data needed for the interpretation is in the container
  - ❑ Extensible – so it can meet future needs



# SIRF Components

A SIRF container includes:

- ❑ **Magic object**: identifies SIRF container and its version
- ❑ **Preservation objects** that are immutable
- ❑ **Catalog** that is
  - ❑ Updatable
  - ❑ Contains metadata to make container and preservation objects portable into the future without external functions



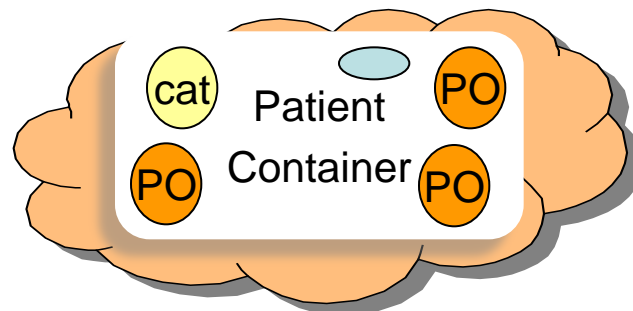
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- ❑ The TWG has developed serializations for CDMI and LTFS
  - ❑ specifies how a CDMI container or LTFS Tape also becomes SIRF-compliant
  - ❑ XML and JSON schemas for the SIRF catalog
- ❑ A SIRF-compliant CDMI container or LTFS Tape enables a future CDMI/LTFS client to “understand” containers created by today’s CDMI/LTFS client
  - ❑ The properties of the future client is unknown to us today
  - ❑ “understand” means identify the preservation objects in the container, the packaging format of each object, its fixities values, etc. (as defined in the SIRF catalog)

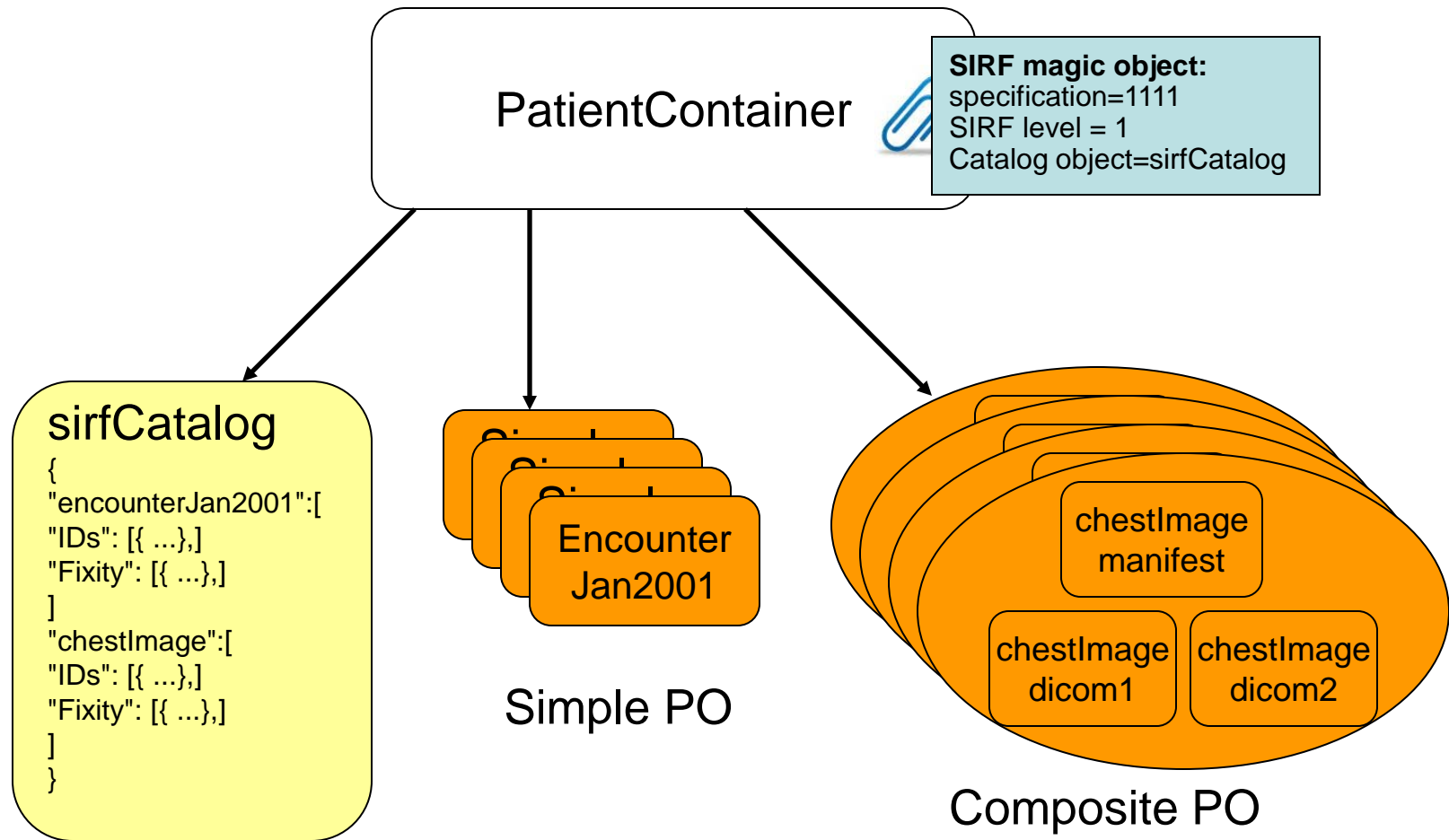
# SIRF Serialization for CDMI: Interface

- ❑ CDMI API can be used to access the various preservation objects and the catalog object in a SIRF-compliant CDMI container
- ❑ Example
  - ❑ Assume we have a cloud container named "PatientContainer" that is SIRF-compliant
    - ❑ the container has a catalog object
    - ❑ each encounter is a preservation object
    - ❑ each image is a preservation object

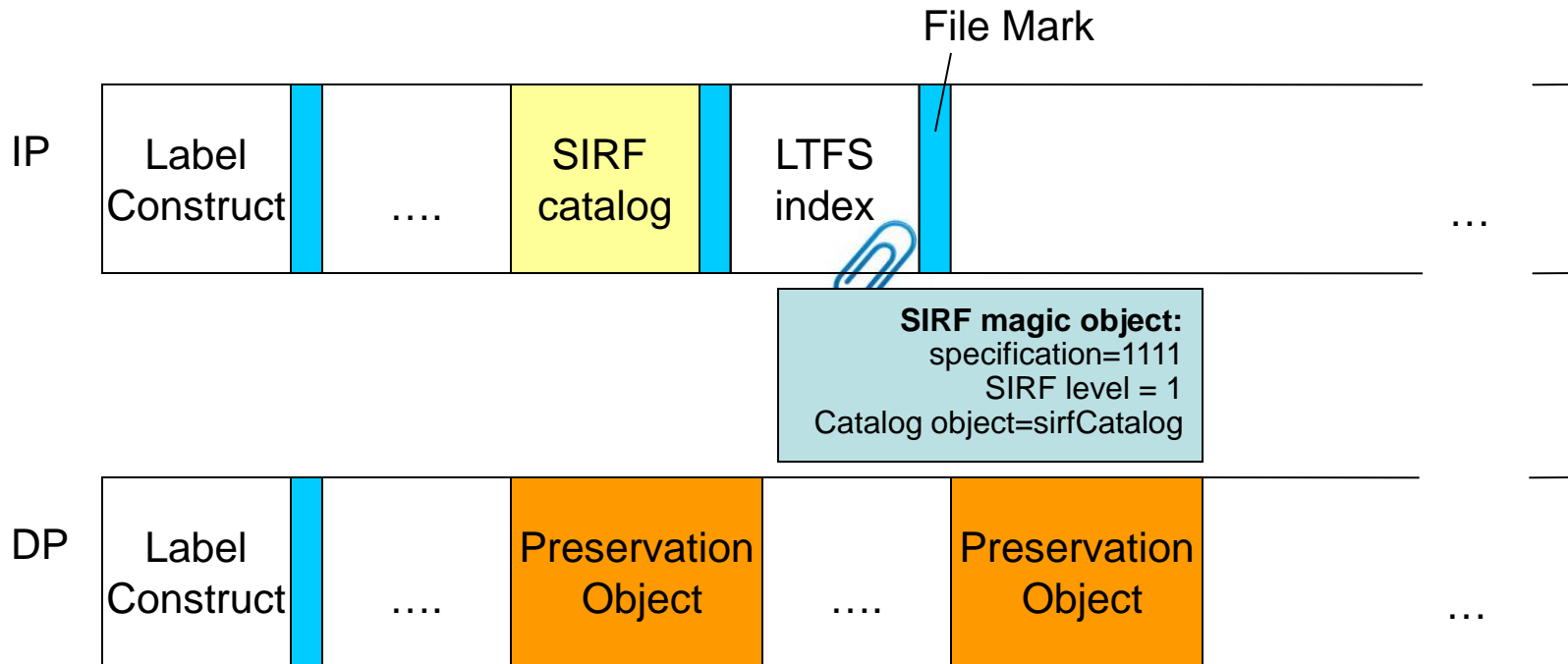


- ❑ We can read the various preservation objects and the catalog object via CDMI REST API as follows:
  - GET <root URI>/ PatientContainer>/sirfCatalog
  - GET <root URI>/<PatientContainer>/encounterJan2001
  - GET <root URI>/<PatientContainer>/chestImage

# SIRF Serialization for CDMI



# SIRF Serialization for LTFS



- ▣ The index partition of the tape is 2 wraps which is 37.5 GB in LTO-5 and probably larger in LTO-6.
  - ▣ The tape index partition is large enough to hold the LTFS index, the SIRF catalog, and even additional information e.g. thumbnails of images

# SIRF Serialization for LTFS: General

- ❑ A LTFS Tape can also be a SIRF Container when:
  - ❑ The SIRF magic object is mapped to extended attributes of the “LTFS index” root directory
    - ❑ The magic object includes, for example, specification ID and version, SIRF level, reference to SIRF catalog
  - ❑ The SIRF catalog resides in the index partition and formatted in XML
  - ❑ A SIRF preservation object (PO) that is a simple object (contains one element) is mapped to a LTFS file
  - ❑ A SIRF PO that is a composite object (contains several elements) is mapped to:
    - ❑ a set of LTFS files (one for each element) and a manifest file that its content includes the IDs and fixities of the element data objects

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- ❑ More information is available at [snia.org/ltr](http://snia.org/ltr)
- ❑ A SIRF draft is in development, and will be available for public review soon
- ❑ A reference implementation of SIRF is in development by the TWG

- ❑ Long Term Retention is hard
  - ❑ Volume, Velocity and Variety make it even harder
  - ❑ Need to retain not only information of immediate interest but ALL other information needed to make it fully usable in future
- ❑ SIRF Helps, providing a “digital box” for data and metadata
  - ❑ Includes self describing metadata to help “understand” the contents of the container in the future
- ❑ No single technology will be usable over the timespans mandated by current digital preservation needs
  - ❑ SNIA CDMI and LTFS technologies are among best current choices
    - ❑ Are good for perhaps 10-20 years
  - ❑ SIRF provides a vehicle for collecting all of the information that will be needed to transition to new technologies in the future