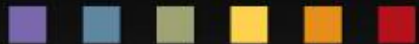# Archive Forever

SPECTRA

Steve Mackey
VP EMEA

spectralogic.com

Drivers for Persistent High Volume Archives

- Explosive growth of content
  - Constantly increasing resolution and frequency
  - Increasing generators
  - Increasing analytical output
- Retention
  - Compliance
  - Preservation
- Never throw away culture
  - No analogue backup
  - Indeterminate future value
  - Cost of recreation
  - Unique content

Oil & Gas
Seismic
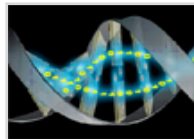
Communications
Teleco, Internet, Cable

Medical Imaging
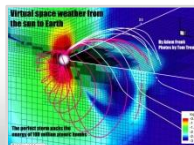Radiology, Cardiology, MRIs, Ultrasound

Media & Entertainment
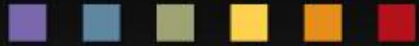Film, TV, Music, Broadcasting, Publishing

Life Sciences
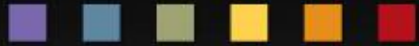BioIT, Genomics, Pharma

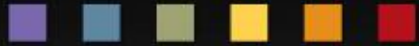**High Performance Computing**
Academics, Research, Manufacturing

Issues to Overcome

- Cost
- Energy/space
- Protection - disaster, human, corruption
- Persistence – technology lifecycle, degradation
- Retrieval – find, read

Indexing and Retrieval

- Archive has no value if content cannot be found

- File system metadata has limited value

- Traditional file system focus on "location" vs. "content"

- Limitations on scaling, indexing and searching

- Index on ingest
  - Collect as much metadata as possible on ingest
- Metadata is nearly free
  - Metadata is in kb, compared GB for the real data
- Keep the metadata format open
  - Metadata also needs to migrate forward
- Create searchable metadata DB
- Store metadata with data set (DR, portability)
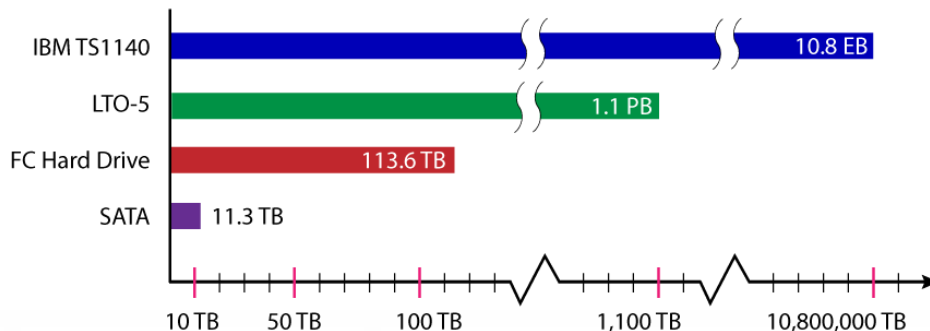- Use object methodology not file systems
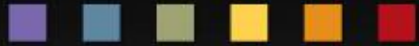
Persistence – Technology Change

- Formats change
  - 8" floppy?
- Operating systems change
  - Windows 2.11?
- Applications change
  - Foxpro?
- Interconnects change

- Storage media migration
- Open format interfaces and protocols
- Open format self describing media

Persistence – Data Integrity Verification

- Know which copy is right?

- Current disk ECC is 10^{-15}

- Current tape ECC is 10^{-20}

- Create a digital signature of the original content

- Check digital signature on a regular basis

- Regular data integrity verification

Number of TB per Error

Device	TB per Error
IBM TS1140	10.8 EB
LTO-5	1.1 PB
FC Hard Drive	113.6 TB
SATA	11.3 TB

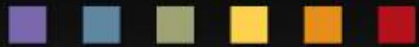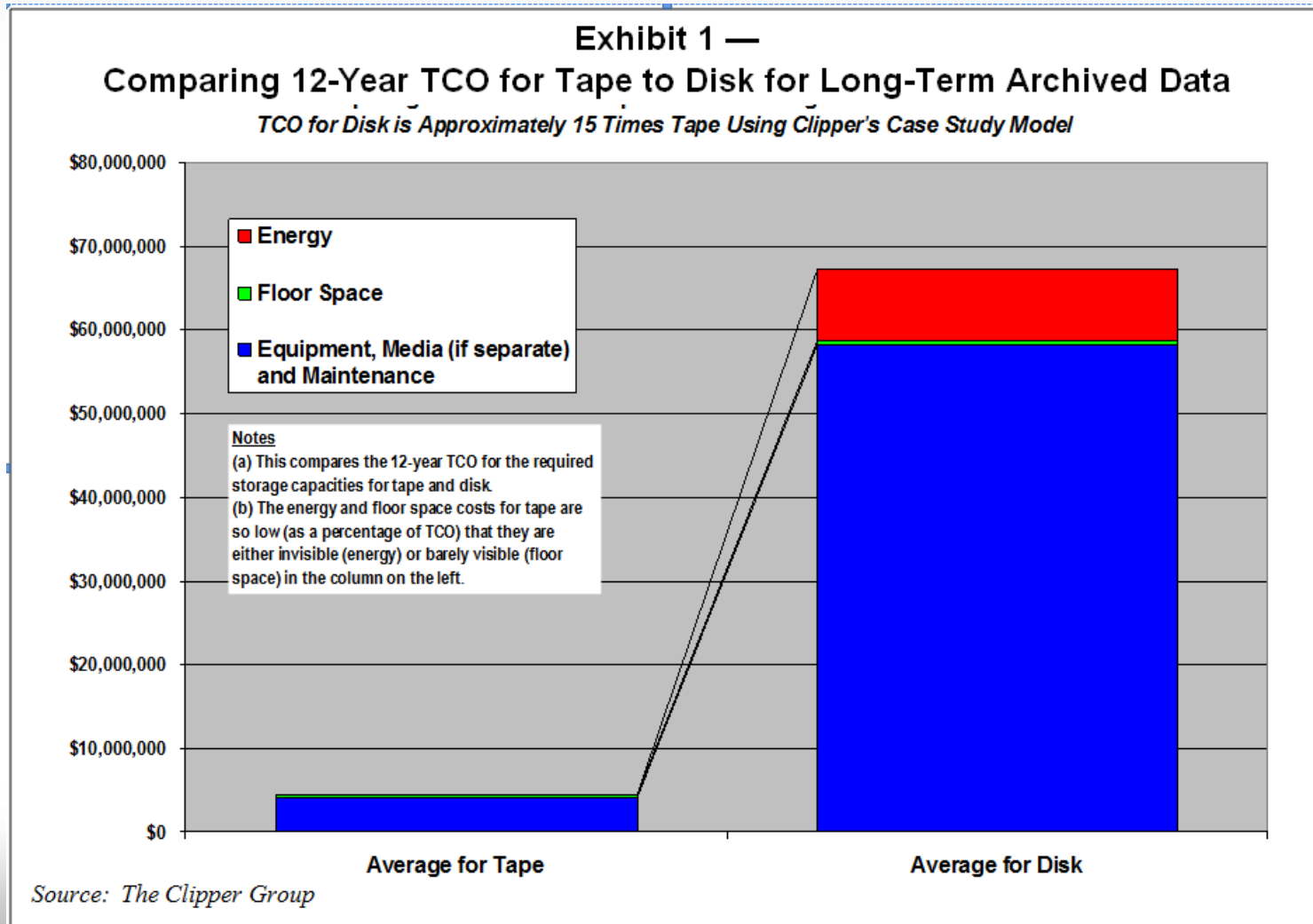Scale: 10 TB, 50 TB, 100 TB, 1,100 TB, 10,800,000 TB
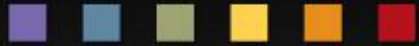
Protection - how many copies?

- RAID/RAIT does not make up for dual copy on tape

- Dual* copy allows separation
- Dual* copy allows differing technology
  - Two Genome System
  - Do not allow a firmware or hardware issue destroy data
- Dual* copy decreases possibility of loss

* By Dual copy, meaning more than 1. i.e 2x, 3x..

Energy

Exhibit 1 —
Comparing 12-Year TCO for Tape to Disk for Long-Term Archived Data
TCO for Disk is Approximately 15 Times Tape Using Clipper's Case Study Model

Legend:
- ■ Energy
- ■ Floor Space
- ■ Equipment, Media (if separate) and Maintenance

Notes
(a) This compares the 12-year TCO for the required storage capacities for tape and disk.
(b) The energy and floor space costs for tape are so low (as a percentage of TCO) that they are either invisible (energy) or barely visible (floor space) in the column on the left.

Y-axis values: $0, $10,000,000, $20,000,000, $30,000,000, $40,000,000, $50,000,000, $60,000,000, $70,000,000, $80,000,000

X-axis: Average for Tape, Average for Disk
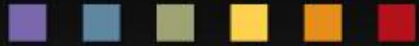
Source: The Clipper Group

Deep Storage will be required to keep pace with the Digital Revolution:

- Deep storage is extremely low-cost, power efficient and dense storage for data that does not need immediate access.

- Deep storage is accessed over open interfaces such as REST interfaces and web protocols.

- Data in deep storage is stored as objects that are self-describing and written in an open file format.

- Deep storage has the ability to migrate data over time between technologies
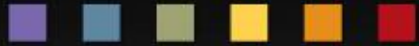
REST (Representational State Transfer)

- REST is the primary set of principles used on the Web

- Cloud architectures are RESTful

- A REST architecture uses a client and server model

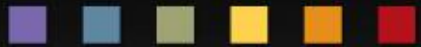- REST architectures use simple commands to offer high value services
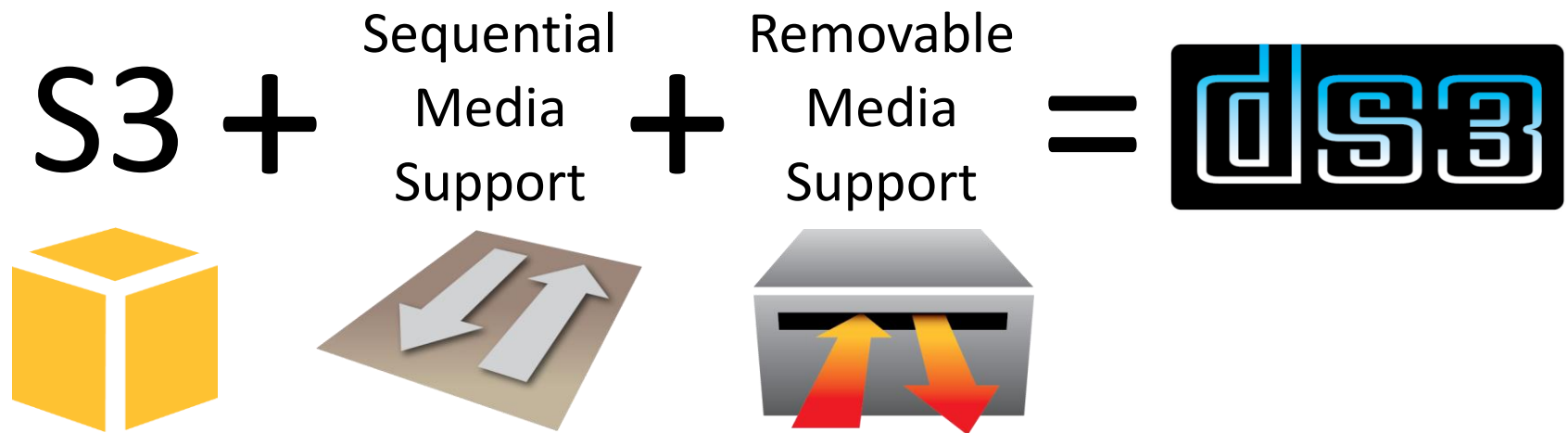
S3 (Simple Storage Service)

Created by Amazon, S3 simplifies web-scale storage and computing development.
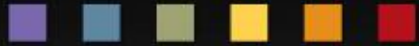
- Defines a cloud storage web service
- Proven technology and wide adoption (2+ trillion objects)
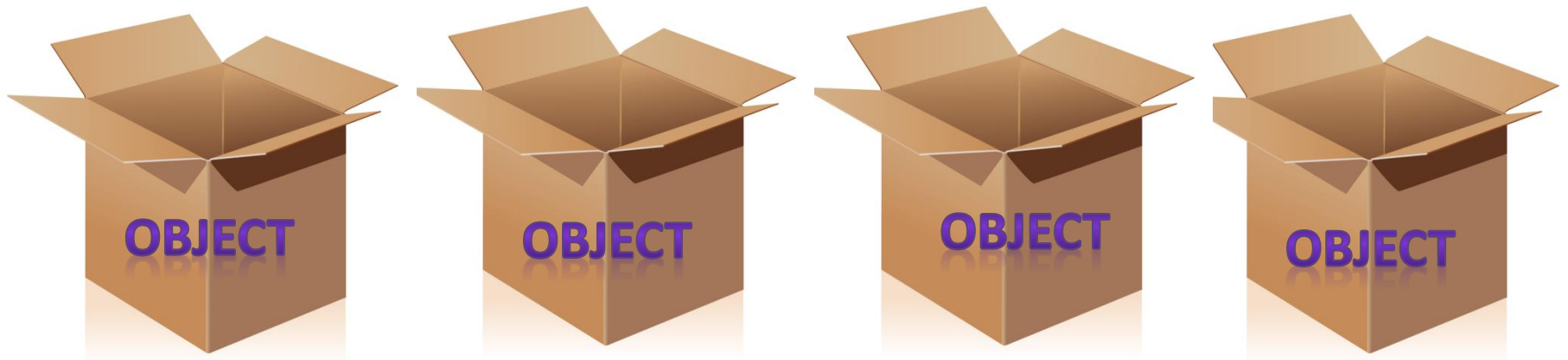- Many clients and client developers

What is DS3?
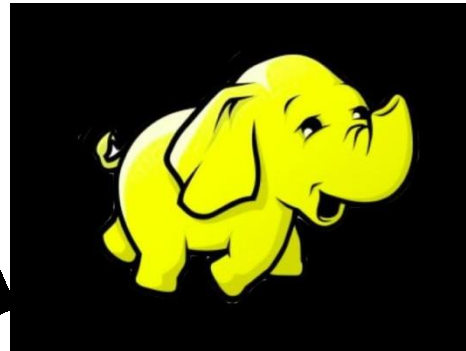
S3 + Sequential Media Support + Removable Media Support = ds3

What is an Object Store?

Object Stores are "Flat" vs. Hierarchical
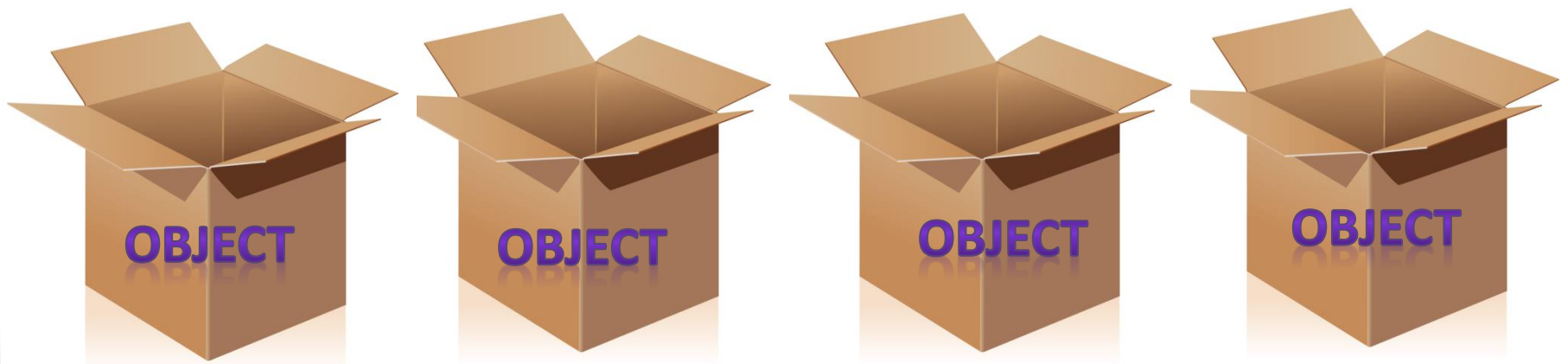**Unlike files, objects are not stored in hierarchy**
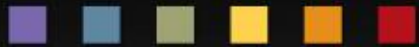**Like files, objects contain data**

# Each object has a unique object ID

- Physical location of the data no longer matters
- Objects can be moved across the storage pools among one or multiple tiers
- Data can be stored or copied within an Object Store thus eliminating the need to continually back it up
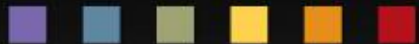
Metadata and physical data are separated

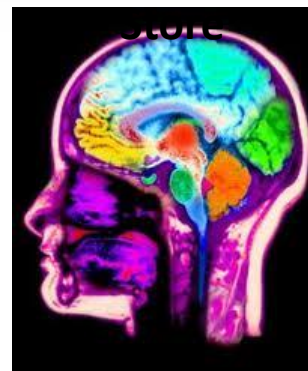- Enables search, mining, and analytics of billions of objects without touching physical media
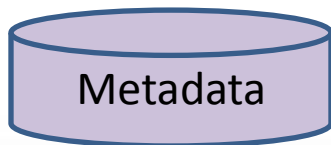
Metadata

Enriched Metadata

File Store

Object Store

VS.

File Name: CATSCANRLSMITH
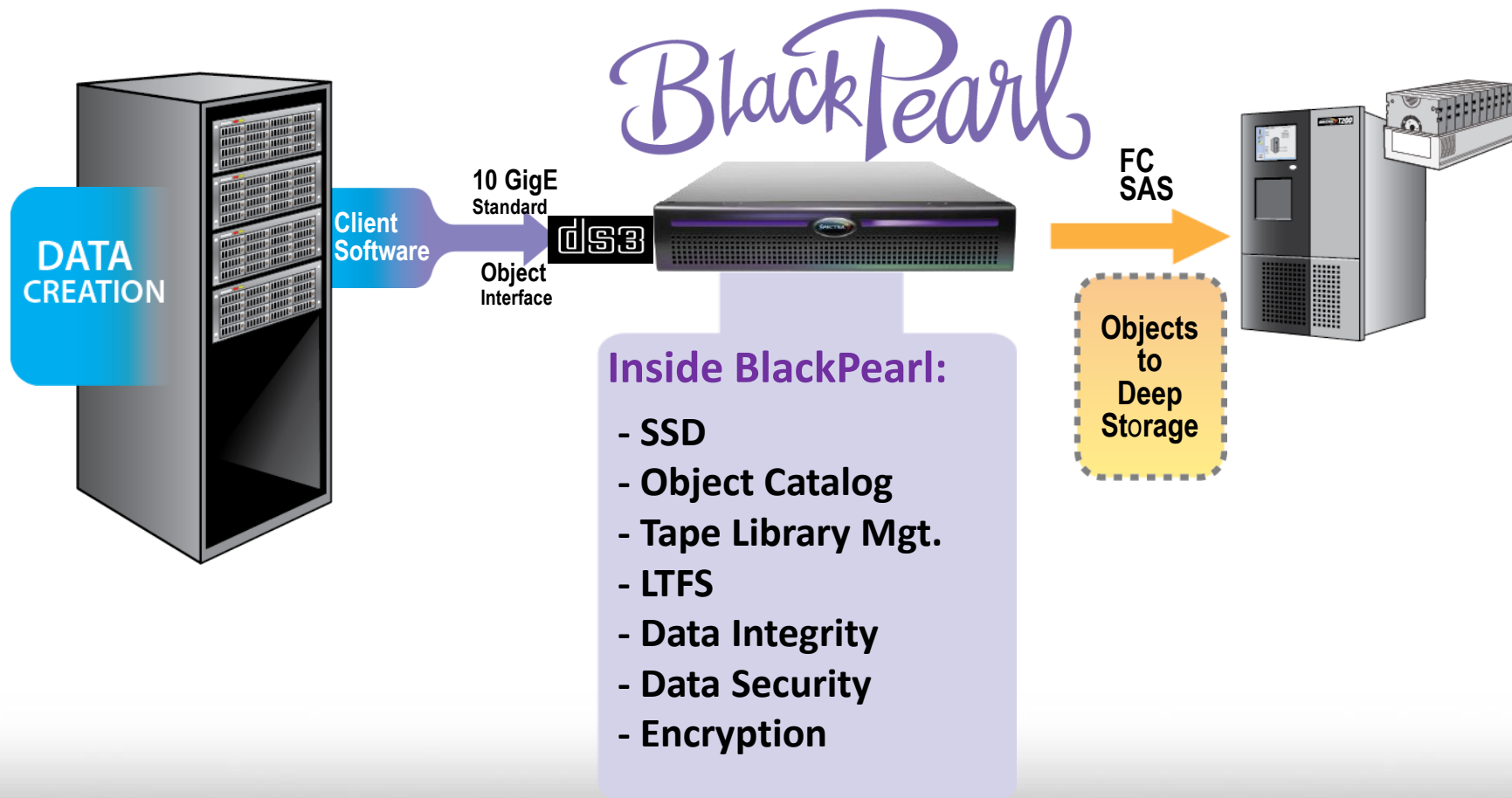Created by: Technician_BC
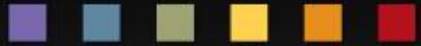Created on: 03-14-2013
File Type: .SCAN

Object ID: 24356
File Type: .SCAN
Patient Name: Ron L. Smith
Physician Name: Dr. Ling
Physician Notes: xxx.MP3
Procedure Date: 03-14-2013
Prior XRAYS: 00768, 00456
Prior SCANS: 24355, 24354
Retention Period: 50 years
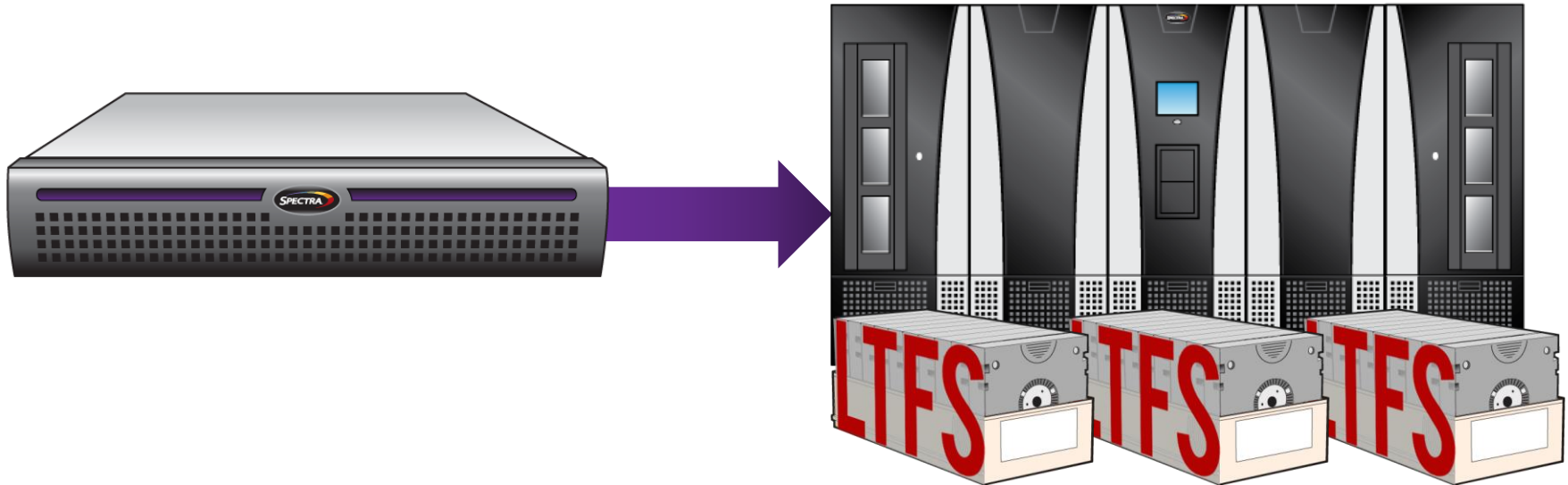Prognosis: Concussion
Custom Metadata: XXX
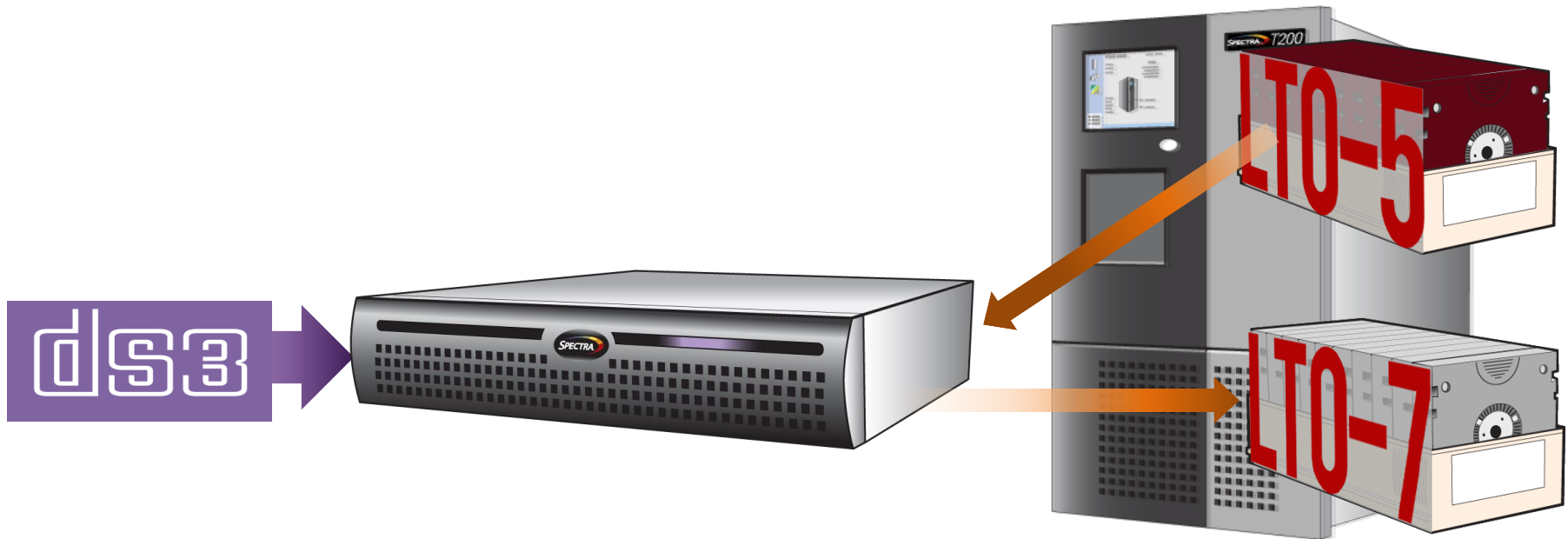
Easiest Way to Persistently Store Bulk Data

SPECTRA

DATA CREATION

Client Software

10 GigE Standard

Object Interface

ds3

BlackPearl

FC SAS

Objects to Deep Storage

Inside BlackPearl:

- SSD
- Object Catalog
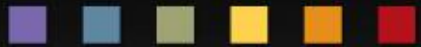- Tape Library Mgt.
- LTFS
- Data Integrity
- Data Security
- Encryption

Open Format - LTFS Support

Media Migration

Media Migration to Future Storage Mediums

Absolute Lowest Cost Way to Store Data

SPECTRA

nTier Verde
Archive Grade NAS Disk

= 1.4 PB uncompressed
@ $0.45/GB

Spectra **BlackPearl** plus **T950** with **TS1140** drives

6.4 PB uncompressed
@ $0.09/GB

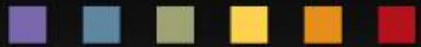Spectra **BlackPearl** plus **T950** with **LTO** drives

2.4 PB uncompressed
@ $0.10/GB

Spectra **BlackPearl** plus **T380** with **LTO** drives

1.9 PB uncompressed
@ $0.14/GB

Thank You