Ultra Density Optical technology

Tom Sas

Product Marketing Manager
Hewlett-Packard

Overview

Current 5.25” MO Technology

- Magneto-Optical uses hybrid of optical and magnetic technologies to reverse the polarity of magnetic domains
- CCW – Continuous Composite Worm
- Use 650nm red lasers and 0.6NA optics
- Maximum practical data density reached at 2.27 GB/sq in
- 14X (9.1GB) uses complex multi-layer MSR media
- Some 70% of applications are archival and use WORM media
- Media cost is relatively high at ~ $10/GB

UDO

- UDO is the next generation 5.25” professional optical storage technology
- Three generations of product will provide storage capacities of 30, 60 and 120GB
- Generation 1 began shipping in late 2004
- UDO is a convergent technology that provides the performance of 5.25” MO, the longevity of 12-inch WORM and the cost-effectiveness of DVD
- UDO sets new standards of capacity, performance and cost for optical storage technology
- UDO is the future standard in professional archival storage

Technology Fundamentals

- Standard half-height 5.25” format drives for library automation compatibility
- Media cartridge dimensionally identical to 5.25” MO for library automation compatibility
- No backwards compatibility with current MO technology
- Phase change WORM and rewritable media
- UDO employs far-field non-contact head media interface for robust recording performance.
- New dual shutter cartridge gives increased media protection
- First generation UDO will employ 0.7NA objective lens
  - Commercially available today as single element lens
  - Does not require active spherical aberration correction
  - Provides initial capacity of 30GB

Technology Fundamentals cont.

- 100µm (0.1mm) cover layer disk construction
- 405nm blue-violet laser and high NA optics give greatly increased data storage densities
    - 30GB - 7.4Gb/sq in
    - 60GB - 14.8Gb/sq in
    - 120GB - 29.6Gb/sq in
- Second and third generations of UDO drives and media will be backwards read compatible
- Lower cost media ~ $2/GB

5 1/4” MO/UDO Roadmap

Key Glossary Terms

Since UDO and MO technologies are not read/write compatible with each other it may be good to understand the basic differences:

- UDO technology
  - Uses the heat of the blue laser to alter the physical state of the disk during writes. Reads are low power laser reflecting off changed bits.
- MO technology
  - Combination of magnet and red laser changing the properties of the disk during writes. Reads use a low power laser to detect optical polarization shifts caused by the recorded magnetic properties

UDO Drive Technology

- First professional blue laser optical drive designed for long-term archival storage environments
- Multifunction drive
  - Supports read and write operations on both 30GB rewritable and write-once UDO media
- Records data using 8KB sectors
  - Maximizes media capacity and performance
  - Write pass followed by a verify pass

Blue Laser Technology

- A blue laser
  - Provide finer point than a red laser
  - Enables more data to be stored in a given space
  - Produces a stable recording surface
    - Does not degrade with use
    - Is insensitive to exposure to magnetic fields
    - Accommodates wider ranges of environmental conditions
    - Has a media life in excess of 50 years

UDO – MO Physical Differences

- Option Switches
  - UDO has no option switches
  - Functionality has been moved to the function connector, Mode Selector removed.
- SCSI Connector
  - MO 50 pin Ribbon(Narrow)
  - UDO 68 pin Micro-D (Wide)
- Media
  - UDO dual shutter (better for dust prevention/media protection)
  - Narrower shutter engage, notch at MO engage (prevents UDO media insertion into MO drive)
  - UDO longer detent (prevents loading MO media to UDO drive)

High Density Recording Comparison of Capacities

Comparison Table: 2x, 4x, 8x, 14x, UDO

	2X	4X	8X	14X	UDO
Capacity/Cartridge	1.3GB	2.6GB	5.2GB	9.1GB	30GB
LD Wavelength	785nm	685nm	→	660nm	405nm
Rec. Geometry	Land	→	Groove	Land &Groove	Land &Groove
User Area	30 to 60mm	→	30 to 62mm	→	28.9 to 62.5mm
Modified CAV	No	Yes	→	→	Yes
Modulation Code	RLL(2,7)	RLL(1,7)	→	→	RLL(1,7)
MSR	No	→	→	Yes	No (Phase Change)
ADRC	No	→	Yes	→	Yes
Max. Sector Size	1KB		2KB	4KB	8KB
Linear Density	0.86um/bit	0.50um/bit	0.40um/bit	0.3um/bit	0.11um/bit
Track Pitch	1.39um	1.15um	0.85um	0.65um	0.39um/bit

*um = micrometer

UDO Media

Media

- UDO Media is "**Automation Compatible**" with existing MO libraries:
  - Critical cartridge dimensions are the same (form factor compatible)
- UDO Media is NOT compatible with MO drives (Physical Interlock)
- MO Media is NOT compatible with UDO drives (Physical Interlock)

UDO Media Quick Specs

- 8MB/sec Read (outer zone)
- 4MB/sec Write (write and verify)
- 8KB sectors
- VAP
- 40MB/sec Wide Ultra 2 LVD SCSI interface
- 35 msec average seek time
- 750,000 load/unload cycles
- 100,000 hour MTBF

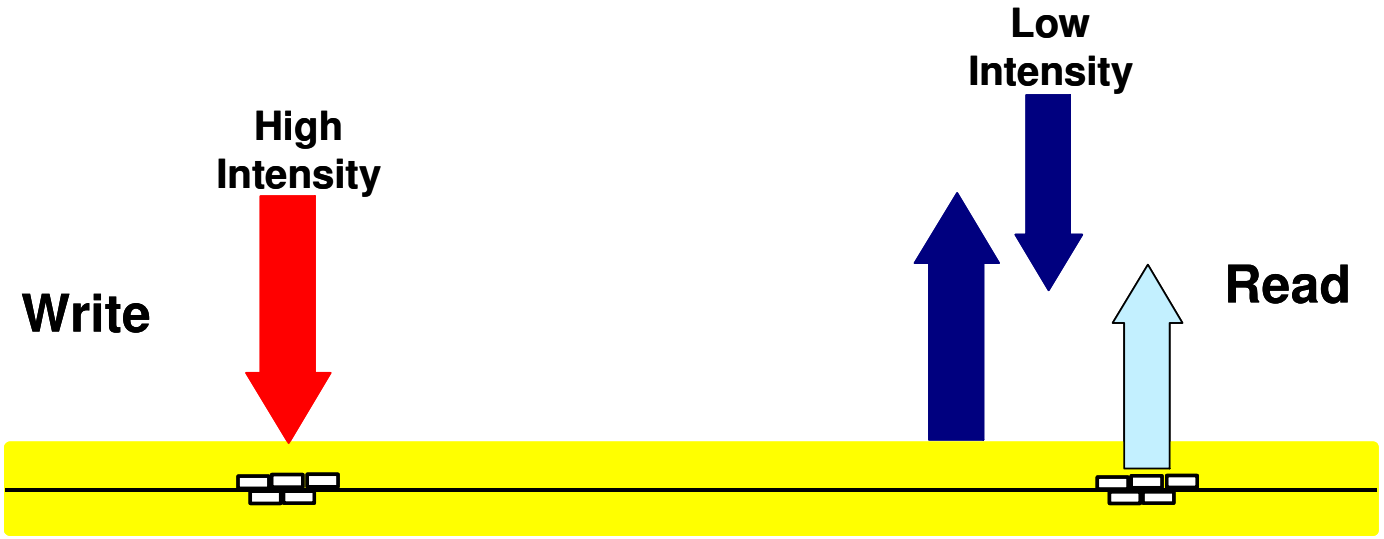
Media Comparison with MO

	MO 14x (4096 byte sectors)	UDO (8192 bytes sectors)
Media Types	RW Only CCW WORM	RW (Direct overwrite) WORM (Different media stack)
Write (RW)	Erase Pass Write Pass Verify Pass	Write Pass (Direct Overwrite) Verify Pass
Write (WO)	Blank Check Pass Write Pass Verify Pass	Write Pass (VAP overwrite protection) Verify Pass
Re-Write Cycles	Unlimited	10,000 Sector is relocated if rewrite cycles exceeded.
Max LBA	1,095,839	1,831,791
Spare Sectors	8191 (0.75%)	36,800 (2.0 %)
Writing	Requires Electromagnet	No Magnet Supports direct overwrite – no erase pass required.

Media Technical Specifications

Disk Diameter	**130mm**
Disk Thickness	**2.4mm**
Disk Size	**5.25-inch (ISO Standard 135 x 153 x 11mm)**
Capacity	**30GB**
Sector Size	**8KB**
Number of User Sectors /Side	**1,834,348**
Data Area	**27.0 to 62.5mm**
Recording Layer	**Phase change**
Recording Format	**Land and groove**
Recording Side	**Both sides**
Recording Density	**7.4GB/in^2**
Data Encoding	**RLL (1,7)**
Rewrite Cycles (Rewritable Media)	**10,000**
Media Life	**50+ years**
Archival Temperature	**5 to 55° C**
Archival Relative Humidity	**3 to 90 %**

Phase Change Technology

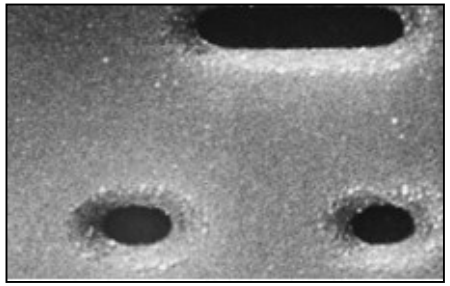


- Write:
  - High-intensity laser heat changes the special metal layer from **crystalline** to **amorphous**
- Read:
  - Different amounts of light are reflected from amorphous and crystalline areas:
    - High reflectivity (crystalline) = 1s
    - Low reflectivity (amorphous) = 0s

Optical Storage Technology Evolution

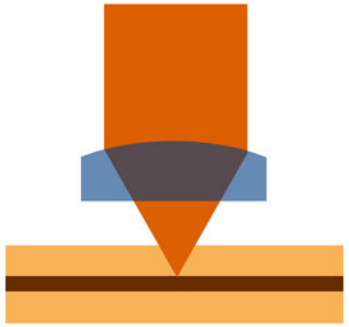
CD

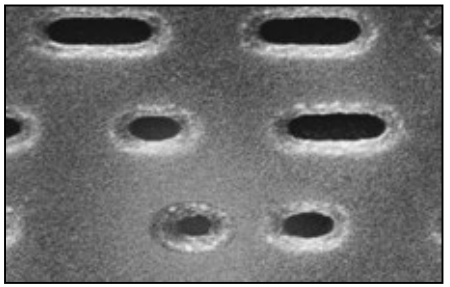
λ = 780 nm
NA = 0.45
1.2 mm substrate



DVD

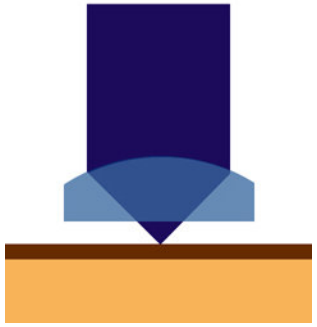
λ = 650 nm
NA = 0.6
0.6 mm substrate

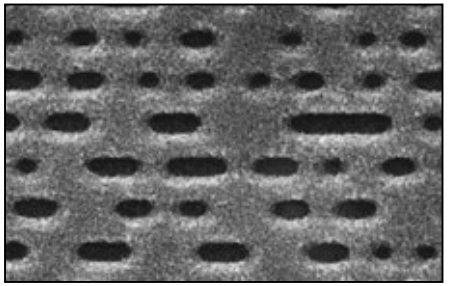




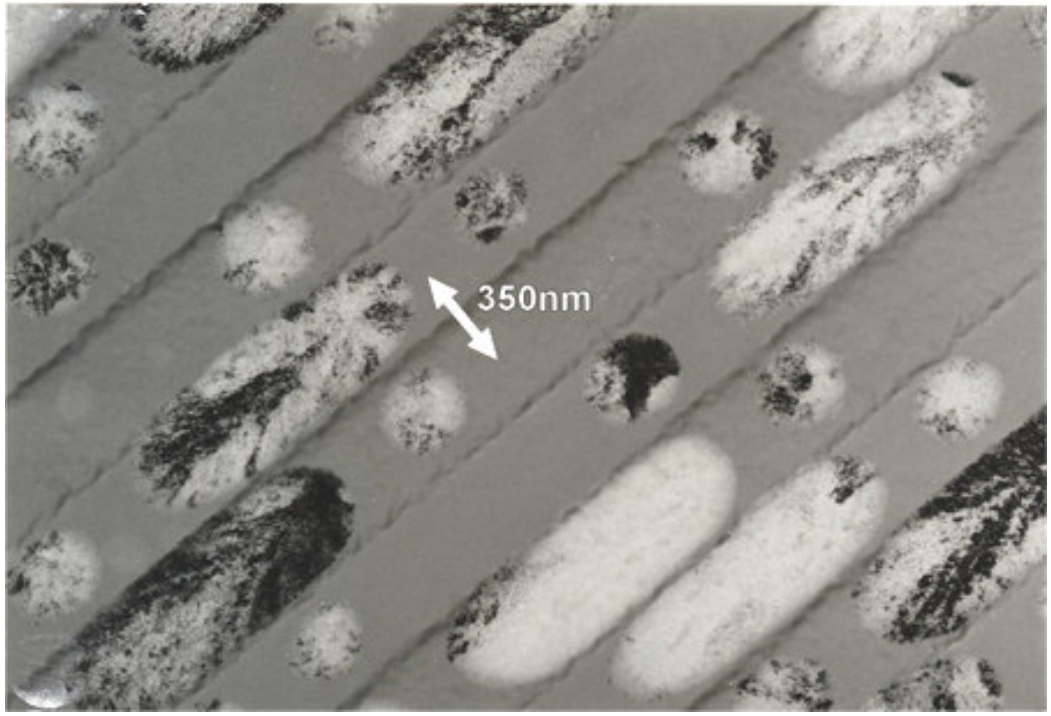
UDO/Blu-ray

λ = 405 nm
NA = 0.7/0.85
0.1 mm cover layer





TEM Image of UDO Write Once



UDO Drives

UDO Drive Specifications (1 of 2)

Performance	Media load time	5 seconds
	Media unload time	3 seconds
	Average seek time	35 msec
	Maximum sustained read transfer rate	8MB/s
	Maximum sustained write transfer rate	4MB/s (including verify)
	Drive buffer size	32MB
Drive operation	Error correction	Reed-Solomon
	Objective lens numerical aperture	0.7NA
	Laser wavelength	405nm
Certifications	Emissions	CISPR 22 Class B (1985) EN5502 Class B (1988) FCC 47 CFR Part 15 Class B
	Safety	UL 1950 IEC950 IEC825-1 CSA 950-93 21 CRF

UDO Drive Specifications (2 of 2)

Operating conditions	Operating temperature	10 to 35° C
	Operating humidity	5 to 90% relative humidity (non-condensing)
	Drive orientation	Horizontal or vertical
Dimensions and weight	Drive	H 41.1 x W 146 x D 203 mm
	Weight	1.5 kg
Reliability	MSBF	750K load/unload cycles
	MTBF	100,000 hours
Drive interface	Interface	Wide Ultra 2 LVD SCSI
	SCSI connector	Keyed 68 pin micro-D
	Maximum SCSI transfer rate	40MB/s

Drive Specs Comparison

	MO (14X)	UDO
Capacity	9.1 Gbytes (4.5 GB per side)	30 Gbytes (15 GB per side)
Sector Sizes	4KB, 2KB (1KB,512 Byte Emulation)	8 KB
SCSI Connector	50 pin Ribbon	68 pin Micro-D
SCSI Bus	Narrow Ultra SE (20 MB/s burst)	Wide Ultra 2 LVD/SE (40 MB/s burst)
Buffer Size	8 MB	32 MB
Disk Rotation Rate	3,000 RPM	2,010 Write Once (WO) 1,950 ReWriteable (RW)
Read Sustained Transfer Rate	6.14 MB/s OD	8.0 MB/s OD WO&RW 3.57 MB/s ID WO 3.73 MB/s ID RW
Load Time (typ)	5.5 s	5.0 s
Unload Time (typ)	3.5 s	3.0 s

Specifications by Generation

	Generation 1	Generation 2	Generation 3
Capacity	30 GB	60 GB	120 GB
Transfer Rate	8 MB/s	12 MB/s	18 MB/s
RPM	2000 RPM	3000 RPM	3600 RPM
Avg Seek Time	35 msec	35 msec	35 msec
Numerical Aperture	0.7	0.7	0.85
Media Layers	1	2	2
Encoding	1,7	1,7	ML
Sector Size	8KB	8KB	8KB
SCSI Transfer Rate	40 MB/s	80 MB/s	80 MB/s
Load Time	5 seconds	5 seconds	5 seconds
Unload Time	3 seconds	3 seconds	3 seconds
MSBF	750,000	750,000	750,000

Automation Changes

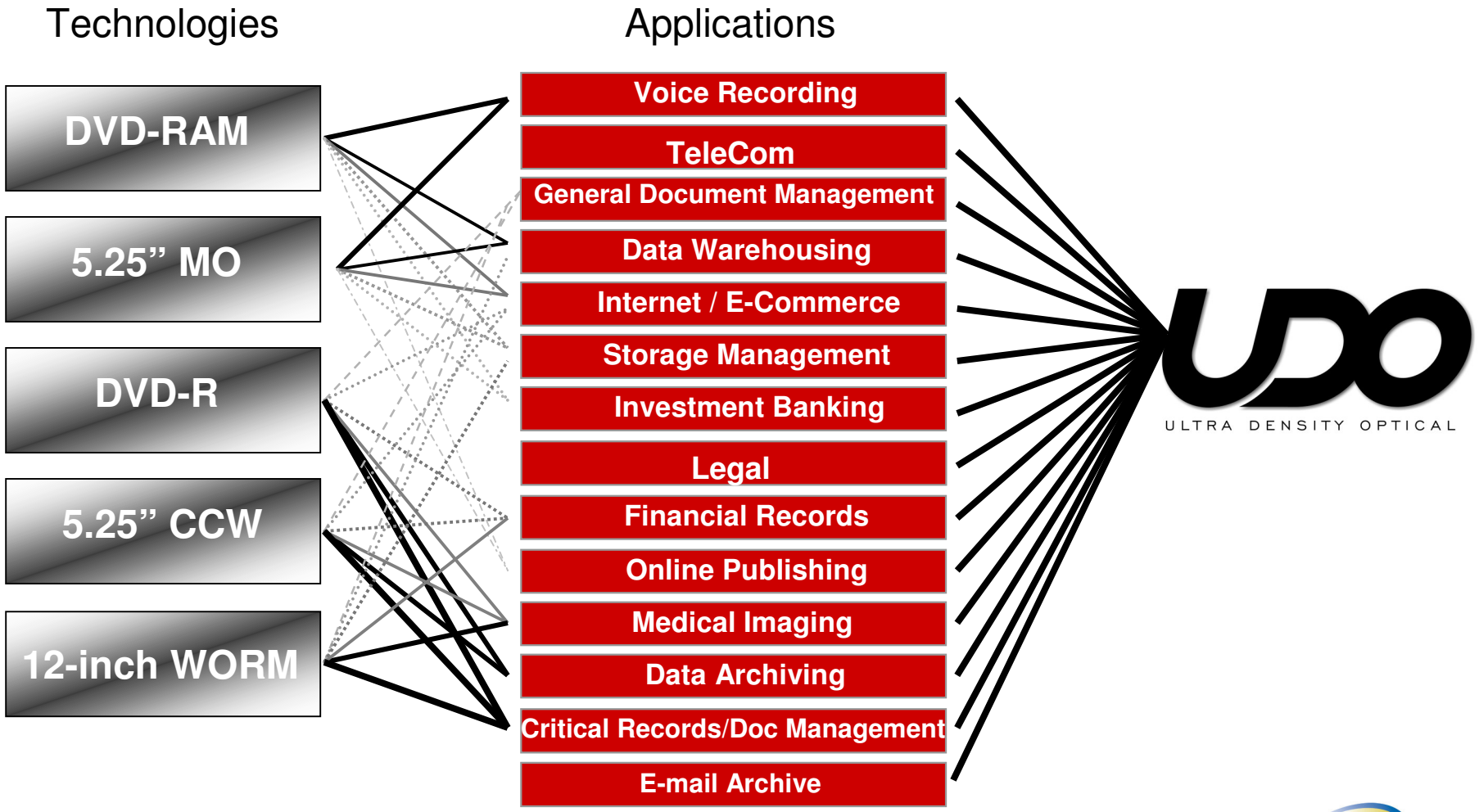
- I/O changes
  - LVD only (wide bus)
  - Lun mode is removed
    - Target ID's 0-15
    - Map scheme is same as current products
    - Mixed media MO drives limited to 0-7
  - New SCSI buffer board and cabling
  - Fibre support (via n1200, m2402)
  - No plans for multi-initiator support
- Firmware/SCSI changes
  - Minimal changes to overall command set
  - Currently, changes limited to Read Element Status functions
    - Slight changes to report drive compatibility information in a mixed media library.

Automation Features Removed

- Write Verify setting
  - Drive will be set w/ Write Verify ON
  - Option removed from Front Panel
- Lun Mode removed
  - Wide Bus allowing Target ID's 0-15
  - Option removed from Front Panel
  - Mapping scheme stays the same
  - Mixed media units requires MO drives at 0 - 7
- Online Drive Repair removed
  - Rarely implemented
  - Option removed from Front Panel
  - Associated R/W Buffer (128) removed

ISV Support

Optical Markets and Applications



ISV support

ISV	Expected support date (as of 8/9/04)	Mixed Drive Support	Fibre Channel Support
ADIC	October 2004	Not in 1st release	TBD
Comsquared	June 2004	No	No
DST	Launch + 180 days	TBD	TBD
EiStream	June 2004	Yes	No
FileNet	December 2004	Not in 1st release	No
IXOS	December 2004	Not in 1st release	Yes
KOM	June 2004	Yes	Yes
K-PAR	October 2004	Yes	No
KVS	Support via Qstar		
Legato (AX)	June 2004	Yes	No
Legato (DX/DXUL)	June 2004	Yes	Yes
Optika	June 2004	Yes	No
Pegasus	June 2004	Yes	Yes
PoINT	June 2004	Yes	Yes
Qstar	June 2004	Yes	Yes
Seven Ten	July 2004	Yes	Yes
Tivoli	Launch + 180 days	TBD	TBD
Unisys	Launch + 180 days	TBD	No
US Design	Launch + 180 days	TBD	No
VERITAS	Support via Pegasus		

Comsquared

- Support for UNIX environments
- Strong U.S. focus
- Focus on Document Imaging solutions
  - Content Manager
    - Image capture
    - Report management
    - Web viewing

EiStream

- Multiple OS support
  - Unix/AIX/Windows
- Good U.S. and European sales/support
  - Previous Wang and Kodak software components
- Enterprise Content Management
    - All encompassing product covering
      - DIM
      - Archiving
      - Email

KOM

- Products for Windows and Unix
  - Also OpenVMS
- Strong Canada/North American presence, just announced A/P capabilities
- File Management
  - Working to position in ILM territory
- Working with HP Strategic Alliances Group
  - Configuring MSA, DL380 and Optical for HIPPA compliance

K-Par

- Windows and Solaris OS support
- Americas and EMEA presence
- Archmedia product
  - Provides transparent archiving
    - Extensive use of caching for speed
    - Good off line media manager
    - Automatic media copy for DR capability

Legato

- Strong WW sales/support
- Strong integration with secondary storage
- EMC affiliation
  - XtenderSolutions family of software
    - AX – Archive Extender
      - Storage management
    - DX – Disk Extender
      - Content management
    - EX – Email Extender
      - Email management (support on UDO w/AX)
- ILM Partner

Optika

- Strong North American presence
- Focusing on ECM solutions
  - Specific targets
    - PeopleSoft & Oracle users
- Recent merger with Stellent
  - Brings larger Content Management suite
    - Employee portals and other line-of-business web sites

Pegasus

- Strong NT/Windows platform
- Seamless virtualization of multiple storage volumes (looks like one big disk)
  - Storage management
- Strong sales as OEM to other ISVs
  - Provides driver capability for VERITAS suite of products allowing easy optical integration with VERITAS
- Working towards non-windows versions
- HP ILM Partner

PoINT

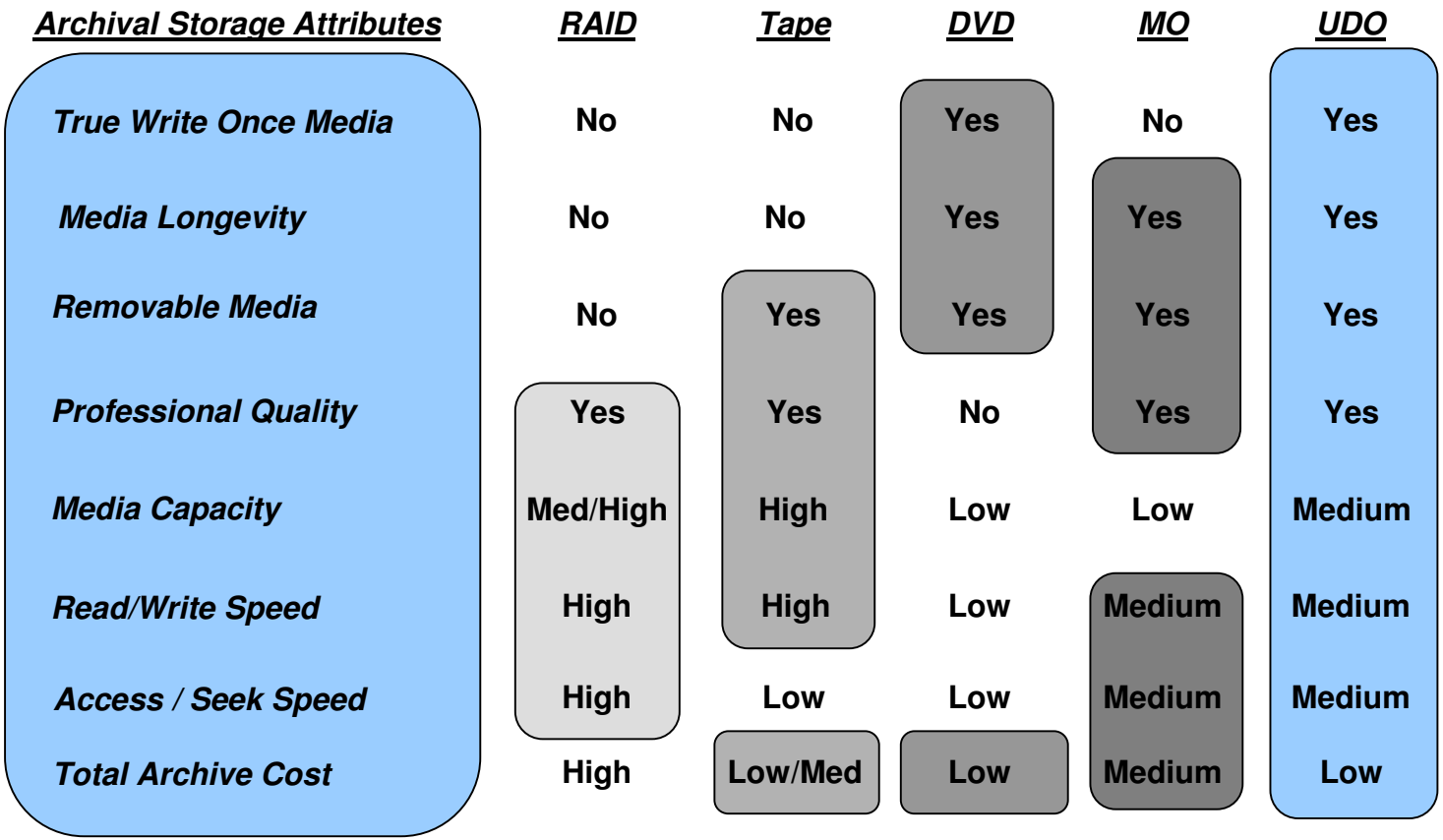
- Support on Windows platforms
- U.S. and European sales/support
- Optical first
  - Uses optical as the first storage medium
    - Then seamlessly migrated to other storage
- UDF file system format
- Large list of supported optical devices

Qstar

- Strong on Unix/Linux platforms
  - Also supports Windows
- Excellent U.S. and European sales/support
  - Works well with channel
  - Working on bringing back Asia/Pacific office
- HSM is their strength
  - Other products provide mirroring
- Provides driver capability for KVS and others
- HP ILM Partner

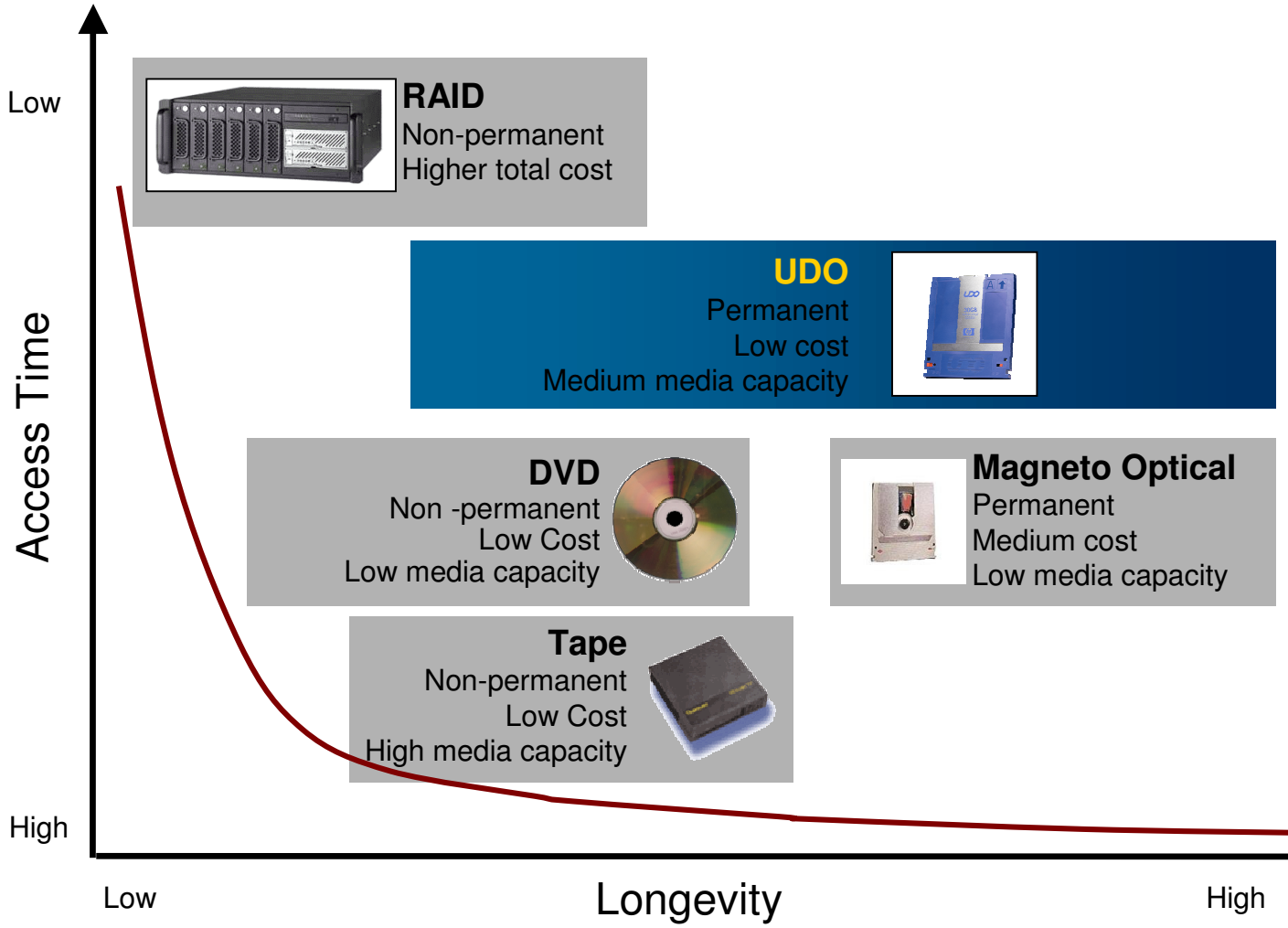
UDO compared to other storage technologies

Media Positioning for Long-term Data Archival Storage



Archival Storage Attributes	RAID	Tape	DVD	MO	UDO
True Write Once Media	No	No	Yes	No	Yes
Media Longevity	No	No	Yes	Yes	Yes
Removable Media	No	Yes	Yes	Yes	Yes
Professional Quality	Yes	Yes	No	Yes	Yes
Media Capacity	Med/High	High	Low	Low	Medium
Read/Write Speed	High	High	Low	Medium	Medium
Access / Seek Speed	High	Low	Low	Medium	Medium
Total Archive Cost	High	Low/Med	Low	Medium	Low

Storage Technology Positioning

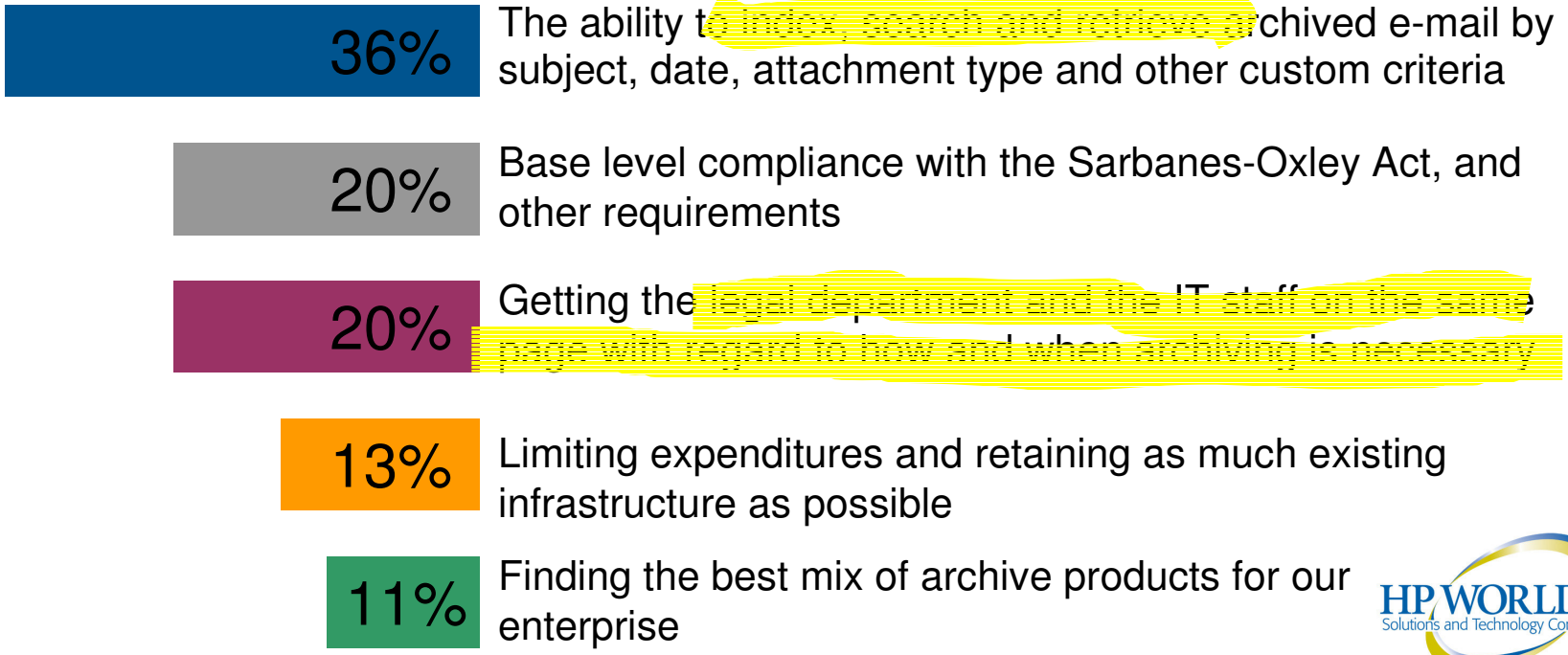


UDO as a part of ILM

Archiving as mean to gain control

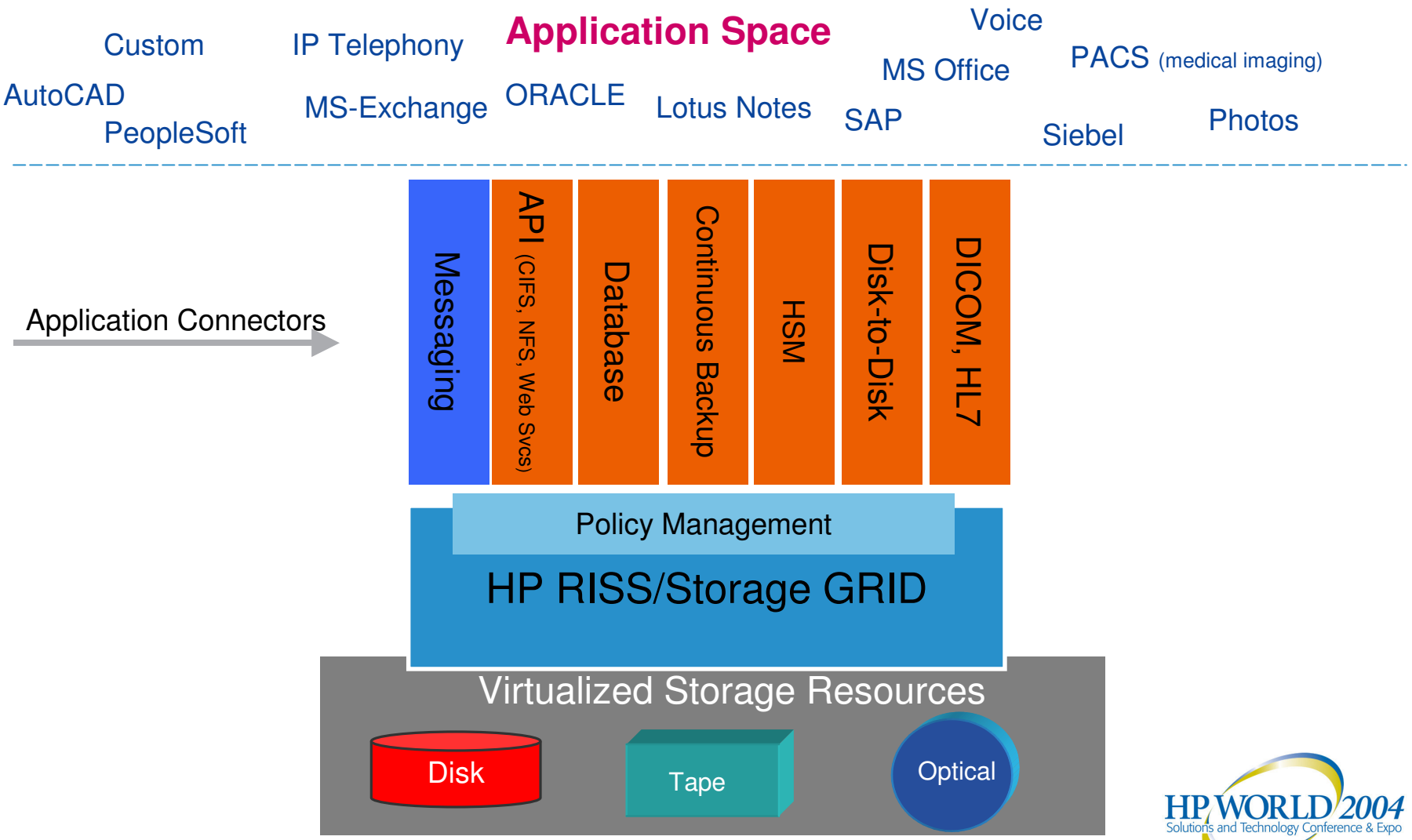
archive
1. A place or collection containing records, documents, or other materials of historical interest. Often used in the plural: old land deeds in the municipal archives.
2. A repository for stored memories or information: the archive of the mind.

Which statement best represents your biggest archiving challenge?



Source: CMP online survey www.storagepipline.com, March 23, 2004

HP Information Lifecycle Management Architecture



HP StorageWorks Optical Jukeboxes

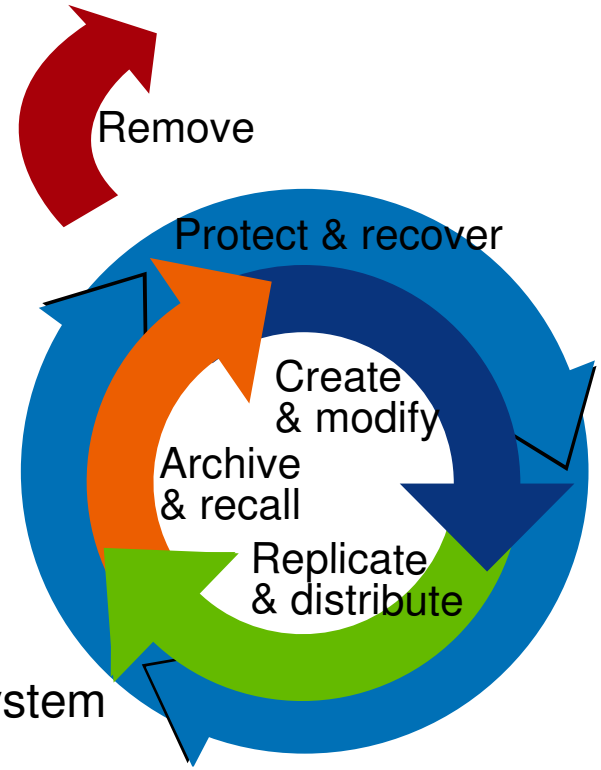
Create & modify
- Online disk arrays HP StorageWorks XP, EVA and MSA1000
- HP StorageWorks NAS portfolio

Replicate & distribute
- Replication: - array, host and network based
- Local and remote replication

Protect & recover
- HP OpenView Storage Data Protector
- HP StorageWorks tape libraries and drives

Archive & recall
- HP StorageWorks MO Jukeboxes
- HP StorageWorks Reference Information Storage System

– Services at every stage
– Partnerships to augment our offering in key vertical markets



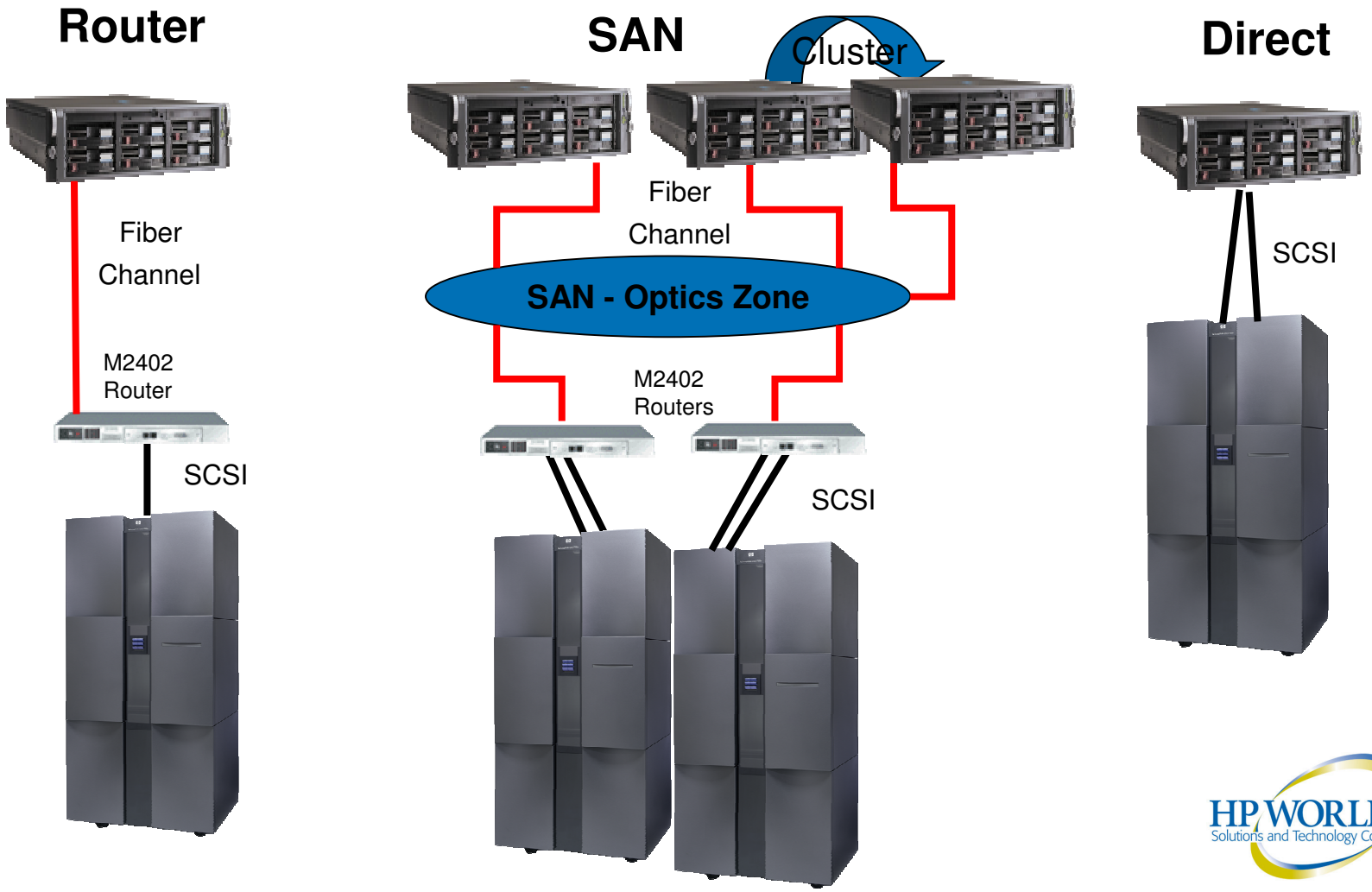
ILM solutions today:
Archive and recall

- There are over 20 orderable HP partnered archive and HSM solutions today with HP StorageWorks MO Jukeboxes
- Solutions include HSM, COLD (computer output to laser disk), email archiving, and document image management solutions
- Designed for customers who value removable media, who are driven by regulatory requirements for WORM functionality and want a proven, tested solution
- Partners include Legato, Pegasus, QStar, IXOS, Veritas, ADIC/AMASS, and KVS
- Majority of ISVs to be certified with UDO

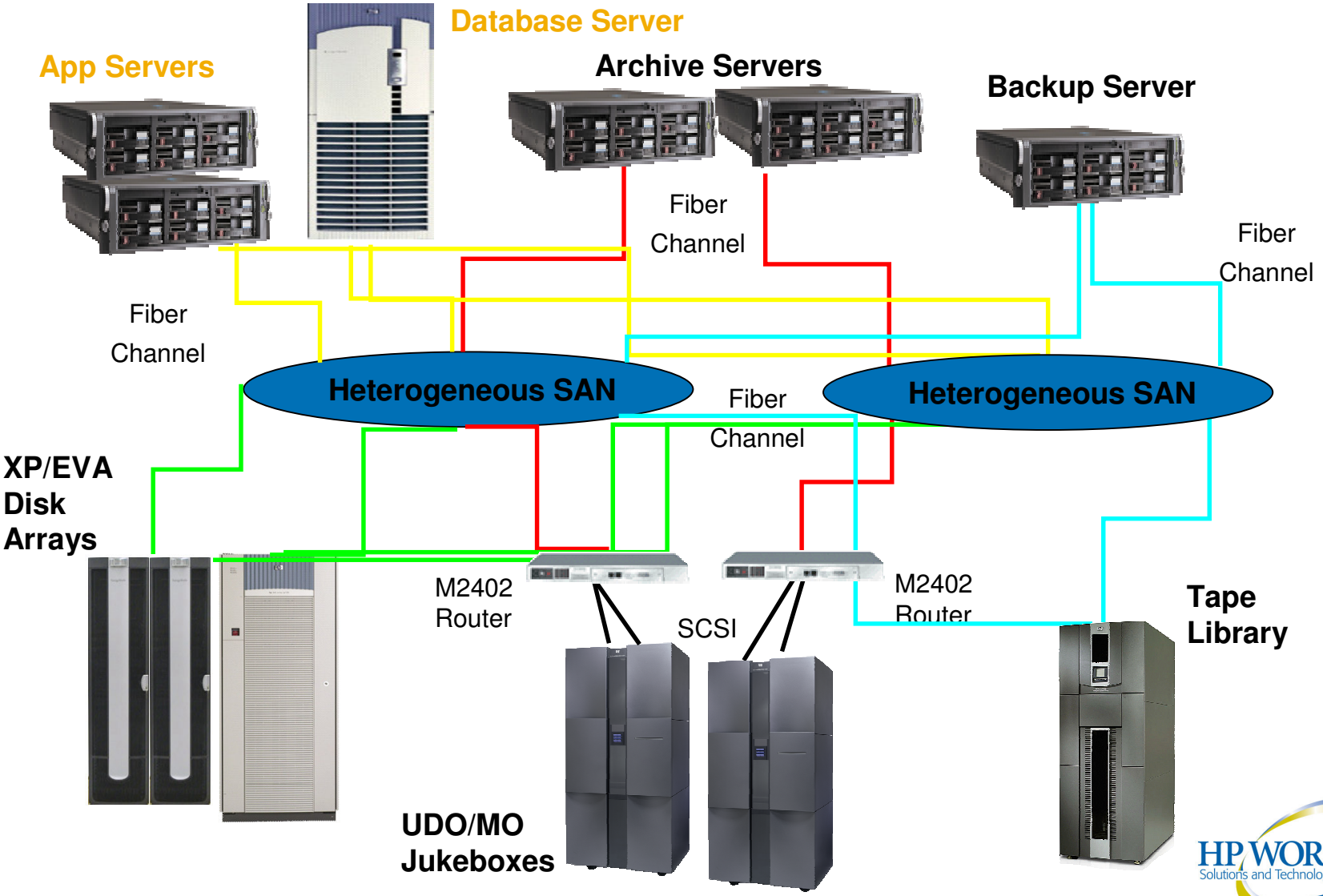
HP StorageWorks Optical Jukeboxes

Sample UDO system configurations

Connectivity Types



Data Center Approach



Summary

UDO

- UDO leverages next generation optical technology
- proven blue-violet laser/phase change recording
  - High NA optics with aberration correction
  - 0.1mm cover layer disk manufacturing process/equipment
- Quantum leap to 30GB with roadmap to 120GB
- Robust drives and media specifically designed for the professional data archival market
- Media level WORM archival storage
- 5 fold decrease in storage cost over current MO systems
- UDO is the future of professional optical storage

Resources

HP Links

- www.hp.com/go/optical
- www.hp.com/go/udo
- www.hp.com/go/ilm
- www.hp.com/go/storagemedia

UDO Technology Forum
  - http://www.udo.com

Cohasset Records Management
  - http://www.cohasset.com

Searchstorage.com
  - http://www.searchstorage.com

Optical Storage Technology Association
  - http://www.osta.org


hp
invent

HP WORLD 2004

Solutions and Technology Conference & Expo

Co-produced by:

interex

shared knowledge • shared power

encompass

AN HP USER GROUP

RECOMMENDED TRAINING VENUE FOR THE

HP Certified Professional