IBM Storage Directions
Schwerpunkt SDS

Ralf Colbus
IBM Storage Platform
Member of WW CTO Office
colbus@de.ibm.com   Q1/2017
Muss ich alles selbst speichern?

- **Muss ich alles selbst speichern?**
- **Cloud**

Wie speichere ich günstiger on-prem?

- **Data Reduction & Cold Storage & Object Storage**

  - Warum habe ich etwas übersehen? Voraussehen?
  - **Analytics / BigData**

Wie erziele ich schnellere Ergebnisse?

- **Flash & Low-Latency protocols**

  - Und mein existierender Storage? Alles neu kaufen?
  - **SDS**

Meine Workload verändert sich- und Storage?

- **SDI: Framework für/in Container, Hadoop, Spark**

  - Weniger Management- Schnelles, einfaches Deployment?
  - **Integrated Stack und IT- as- Service**

Kann ich die Datenmenge überhaupt noch sichern?

- **CDM und neue Backup-Konzepte**
1. Flash Storage Media
   Storage Architecture
Directions in Storage Media

- HDD improvement rate slows to <20 % CGR or less
  - HDD becomes an ‘active archive’ media
  - 3.5” drives could reach 20TB by 2020

- Flash / SSD
  - Divides: high performance + reliability and low cost
  - New Technologies – e.g. 3D Xpoint, PCM etc.
  - 30/60 TB SSD in 2017

- Storage efficiency is key:
  - Technologies of efficiency: compression, dedup, lifecycle management
  - Cold Storage technologies with indexing, automated data placement and movement + Tape
IBM All-Flash Across the Portfolio

Flash for every workload

Based on IBM’s FlashCore Technology

Storwize „F“  |  FS900  |  V9000  |  A9000 R  |  A9000  |  DS8888  |  DeepFlash150
Upcoming: 3DXP - Phase Change Memory (PCM)

- A memory technology based on the resistance change of certain chalcogenide alloys upon application of heat (induced by application of current).
- Intel/Micron
PCM/SCM enables new a Architecture

- **1980**
  - Logic: CPU
  - Memory: RAM → DISK
  - Active Storage: TAPE

- **2014**
  - Logic: CPU
  - Memory: RAM → FLASH → DISK
  - Active Storage: TAPE

- **+2017**
  - Logic: CPU
  - Memory: RAM → PCM → FLASH → DISK
  - Active Storage: TAPE
  - Cloud: SCM
TLC - 3DXP

TLC – NAND (3DTLC)
- Samsung/Toshiba/Hynix
- Lower Cost
- High Dense
- High Capacity
- SECONDARY STORAGE

3DXP
- Intel- Micron
- Cheaper than DRAM
- Faster than NAND
- Low Latency
- PRIMARY STORAGE

DRAM
NVDIMM
- CACHE
2. Storage Networking Protocol for low latency
High-Seed – Low Latency: NVMe vs SAS/SATA

• NVMe Interface for SSD/flash attachment (high-performance, low latency)
• Replaces SAS/SATA SCSI IO-Path

SAS vs NVMe
CPU cycle reduction
• NVMe: 2.8µsec 9.100 cycles
• SAS: 6.0µsec 19.500 cycles

SATA vs NVMe:
• Read Throughput: +50%
• Write Throughput: 9x
• Write Latency: 5x
• SAN: - 50% latency

LINUX* STORAGE STACK

USER KERNAL

VFS/FILE SYSTEM

BLOCK LAYER

USER APPS

REQ QUEUE

SCSI XIAI

NVMe DRIVER

SAS DRIVER
NVMe Over Fabrics (NVMeF) enables NVMe over any RDMA (remote direct memory access)-enabled network (IB, RoCE / iWarp Ethernet, etc.) and also Fibre...
• Versuchsaufbau eines 220TB Tapes
• 123 Gb/in²
• R&D Zürich
• Next Gen Tape
• Internet-Provider - Exabyte
How Do You Store A Zettabyte? Microsoft And IBM Know...

Aaron Ogus – Microsoft Azure Storage, Development Manager Storage Architect

Ed Childers – STSM, Manager Tape Development

Edge 2016

The Premier IT Infrastructure Conference

Outthink status quo.

© 2016 IBM Corporation
2. SDS Objectstorage
Directions Storage Systems - SDS
Improved operation flexibility and efficiency through software based storage services

- **Storage services deployed** as software on standard hardware with standard for Block, File, and Object
- Improved ease of use, speed of deployment for applications
- Flexible infrastructure with management automation
- Foundation for hybrid-cloud
- Consistent storage design allows workload mobility and overcomes ‘data gravity’
- Adaptation layer for container
What is SDS: how to build storage out of... „PCs“?
SDS im Kontext:

- Policy Driven - SW to SW
- Runs on commodity hardware: no special hardware or components needed
- Full suite of storage services: equivalent to traditional systems
- Embraces multiple storage options: traditional, virtualized, software defined, cloud

Diagram:
- Software Defined Data Center
- Data Center Fabric
  - Compute
    - Software defined compute (compute hardware virtualization)
  - Storage
    - Software defined storage
  - Networking
    - Software defined networking
  - Environmental
    - Software defined facilities
Milestones in IBM Spectrum Storage

- **1998**: First “SDS” System-GPFS (Global Parallel File System)
- **2003**: First SVC on x86
- **2014**: IBM SDS initiative started
  - Design Thinking customer centric approach
- **Early 2015**: IBM Spectrum Storage announced
  - $1 Billion investment over five years
- **Late 2015**: Acquisition of Cleversafe (now IBM COS)
- **Early 2016**: IBM Spectrum Storage Suite unified licensing
- **Late 2016**: Hybrid Cloud support spreading across portfolio
- **2017 and beyond**: New models of IT and new ways to manage data with cognitive functions
Unser Portfolio 2017:

**IBM SDS und SDI**

- **Traditional Storage Products**
  - IBM Spectrum Accelerate
  - IBM Spectrum Virtualize

- **New-generation Storage Products**
  - IBM Spectrum Scale
  - IBM Cloud Object Storage

- **Data Management Products**
  - IBM Spectrum Protect
  - IBM Spectrum Control

- **SDI**
  - IBM Spectrum Conductor

**IBM Flash-Storage**

- Storwize „F“
- FS900
- V9000
- A9000 R
- A9000
- DS8888
- DeepFlash 150
- DeepFlash ESS

**Optimized Storage**

- Storwize
- SVC
- Tape
- VTL-Systems
- VersaStor

**New-generation Storage Products**

- Storwize
- SVC
- V9000
- A9000 R
- A9000
- DS8888
- DeepFlash 150
- DeepFlash ESS

**Data Management Products**

- IBM Spectrum Protect
- IBM Spectrum Control

**SDI**

- IBM Spectrum Conductor
IBM Software Defined Storage Architecture

**Traditional**
- Spectrum Virtualize
  - Node 1
  - Node n
- SAN
- iSCSI
- FlashSystem
- Existing Storage

**New Workload**
- Spectrum Scale
  - Scale Server
  - CES 1
  - CES n
- NAS
- SWIFT/ S3
- Container
- HDFS
- Native
- S3- Swift
- Cloud Object Storage
- Cloud
- Tape Libraries
- Spectum Protect Server
- Spectrum Control Server

- Application Server
- SAP HANA
- Application Server
- ESX
- Home Server
- Cloud Application
- Hadoop
- Application Server
- CES 1

**Workload**
- Traditional
- New
Einmalig: IBM SDS für jede Workload und Anforderung

IBM Spectrum Storage

IBM Spectrum Protect
IBM Spectrum Archive

IBM Spectrum Virtualize
IBM Spectrum Accelerate
IBM Spectrum Scale
IBM Cloud Object Storage

IBM storage
Non-IBM storage

Management
Copy Data Management
Backup
Archive

Backup & Archive

Infrastructure

Hybrid
Cloud
All-Flash
Tape / Virtual Tape

Computing

High-Performance Computing
High-Performance Analytics
New-Gen Workloads

IBM Spectrum Computing

IBM Cloud Object Storage
Scale-out Block Storage with SDS ("SAN Storage")

- ease of use
- resiliency
- quick rebuild
- predictive real-time compression
- Multi-Tenant & QoS
## Spectrum Accelerate Hardware Specifications

Capacity range: ~ 8 TB to 485 TB

<table>
<thead>
<tr>
<th>Item</th>
<th>Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>Servers (x86)</td>
<td>4-15</td>
</tr>
<tr>
<td>Each server is a converged infrastructure containing IBM Spectrum Accelerate as a Virtual Machine (VM) and other application VMs. Each server is configured as below:</td>
<td>(3 for PoCs only)</td>
</tr>
<tr>
<td>Physical (non-virtualized) cores</td>
<td>6-20</td>
</tr>
<tr>
<td>RAM (Must allocate extra RAM for the ESXi server)</td>
<td>48-128 GB</td>
</tr>
<tr>
<td>High Density Disk drives – Count</td>
<td>6-12</td>
</tr>
<tr>
<td>High Density Disk drives - Capacity</td>
<td>450 GB, 600 GB, 1 TB, 2 TB, 3 TB, 4 TB, 6 TB</td>
</tr>
<tr>
<td>(Must all be the same size)</td>
<td></td>
</tr>
<tr>
<td>Ports/ Network</td>
<td>4-6 x 10 GbE</td>
</tr>
<tr>
<td>SSDs as cache (400-800 GB)</td>
<td>1</td>
</tr>
</tbody>
</table>
SDS on Cloud (Bluemix):

All features included

• Two flavors for different needs
  • Capacity
  • Performance

• Base of 50 TB usable, increments of 20 TB
• New system of 4 nodes
• VLANs and VPN connectivity if needed

• Increments: Adds 1 node to the existing grid

Capacity flavor:
- Dual CPU 6 cores
- 32 GB RAM
- 11 x 4TB SATA drives
- 10GbE dual private links

Performance flavor:
- Dual CPU 8 cores
- 64 GB RAM
- 11 x 4TB SATA drives
- 800GB SSD
- 10GbE dual private links
Scale-out Block Storage with SDS over Four Consumption Models:

- **Performance**: Als Flash: IBM FlashSystem A9000
- **Consumption**
- **Optimized Capacity**: Als Disksystem: IBM XIV Storage
- **Ultra-flexible**: Als SDS: IBM Spectrum Accelerate on customer-choice

Managed by IBM Hyper-Scale Manager

- **In der Cloud**
- **On-premises**
- **Off-premises**
- Hybrid Cloud
Einmalig: IBM SDS für jede Workload und Anforderung
Optimizing Existing Storage with SDS:

- Storage Tiering
- Application Integration
- External Virtualization
- Data Protection

- FlashCopy
- Snapshot & Mirroring
- Thin Provisioning
- Compression
- Transparent Data Migration
- EasyTier

- HA statt DR

- Data to Cloud

- HITACHI
- IBM
- NetApp
- EMC
- NEXSAN
Spectrum Virtualize as Appliance or as Software Only

- Spectrum Virtualize as SW: Lenovo x3650 M5 oder Supermicro 2U Server SuperServer 2028U-TRTP+
- Disaster Recovery as a Service for virtually Any to Any Storage on Premises to an MSP Data Center
- Migration Services with Spectrum Virtualize Software Only – Global Mirror IP Replication
- Hybrid Cloud Data Mobility!
Einmalig: IBM SDS für jede Workload und Anforderung

IBM Spectrum Storage

Management
- Monitoring & Control
- Copy Data Management

Backup & Archive
- Backup
- Archive

Infrastructure
- Virtualized Block
- Scale-Out Block
- Scale-Out File
- Scale-Out Object

IBM storage
- Non-IBM storage

IBM Cloud Object Storage

IBM Spectrum Computing
- High-Performance Computing
- High-Performance Analytics
- New-Gen Workloads
“Workload 2.0”
Container
Data Ocean
Data Lake
Analytic-IoT-Mobile-Social
Webscale
Hadoop
Spark
Hortonworks
...
**Policies for Data Distribution, Tiering, Migration to the Cloud**

**Single Name Space**

- **NAS (NFS/SMB) Unterstützung**
- **Als SDS oder als Appliance ESS verfügbar**
- **Ein Filesystem über mehrere Niederlassungen**
- **Compliance Anforderungen KPMG Zertifikat**
- **Schnellste Filesystem Metadatenabfragen für Backup Scan TSM**
- **Policy basierte Tiering bringt die Dateien auf die optimale Tierstufe, Flash, SSD, SAS, SAS-NL, Tape**
- **Datenmigration auf kostengünstiges Tapes**
- **Verhindert Speicher Silos über alle Tierstufen**
- **Enterprise Funktionalitäten ersetzt Hadoops HDFS, kein Zeitaufwand für Datei Transfer**
- **Auslagerung in Cloud, on/off Prem. Cloud**
- **Objekt Storage (ICOS)**
- **Elastic Storage Server, schnellste Rebuildzeiten**
- **Hardware Appliance**
- **NativeRaid ESS**
- **Ein Filesystem über mehrere Niederlassungen**
- **Hadoop**
- **Cloud Storage**
- **Policy basierte Tiering bringt die Dateien auf die optimale Tierstufe, Flash, SSD, SAS, SAS-NL, Tape**
- **Schnellste Filesystem Metadatenabfragen für Backup Scan TSM**
- **Verhindert Speicher Silos über alle Tierstufen**
Einmalig: IBM SDS für jede Workload und Anforderung
Cloud Object Storage build with SDS:

- Cost efficient
- On site or Geo
- automatic rebuild
- S3-NFS-Swift

- For Enterprise Clouds, and Cloud Storage Services
- For geographically shared storage
- For Active Archive and Cold Storage

- Become the ‘third storage model’ next to file and block – and likely the largest
Object Storage – Use Cases

- Active Archive
- Enterprise Collaboration
- Business Continuity
- Back-up
- Content Repository
- Storage as Service
Raid and Replication vs Erasure Coding

RAID 6 + Replication

- Original 1.20 PB Raw
- Onsite mirror 1.20 PB Raw
- Remote copy 1.20 PB Raw

- 1 PB Usable Storage
- 3.6 PB Raw Storage
- 900 4TB Disks
- 3.6x Racks Required
- 3.6x Floor Space
- 3 FTE Ops Staffing
- Replication/backup

ICOS®

- 1 PB Usable Storage
- 1.7 PB Raw Storage
- 567 TB Raw Storage
- 432 4TB Disks
- 1.7x Racks Required
- 1.7x Floor Space
- .5 FTE Ops Staffing
- Extra Software None

$70% +
TCO Savings

IBM
Cloud Object Storage
IBM Hybrid Storage based on IBM COS

Backup

Local Backup

Spectrum Protect

Analytics, Hadoop etc

Spectrum Scale via TCT

S3 API

NAS/Filer

Robo/remote offices (sync/share)

Ctera SW

Offsite DR

Spectrum Virtualize via TCT

S3 API

Cloud Ready App

Native app support

Apps via NFS (S3 support)

IBM Cloud Object Storage

On-Prem und/oder Hybrid

FlashCopy

NFS

On-Prem und/oder Hybrid

IBM

Cloud Object Storage
Sync & Share + NAS mit Ctera

• Frontend

REMOTE OFFICES
- Servers
- Desktops

CTERA Gateways
- NAS File Servers
- Hybrid Cloud Backup

MOBIL USERS
- Laptops
- Mobile Devices

CTERA Endpoint Agents/Apps
- File Sync & Share
- Mobile Access

IN-CLOUD SERVICES
- Virtual Servers

CTERA Server Agents
- In-Cloud + Cross-Cloud

Secure & WAN Opt. Cloud Access
AES-256 + SSL
De-duplicated
Compressed
Bandwidth Control

Backend Storage
Multiple Device / Multiple Access / Sync&Share

Remote Office Access
Store Files Locally, Access via CTERA Cloud NAS Appliances

Browser Access
Access & Collaborate From Any System

Desktop Agents
Windows, Mac

Mobile Access
iOS, Android, Windows Phone

CTERA Agent

Browse Online
Share this file
Copy public link
Version History
4. Integrated Stack CS/HCS SDI
Converged Infrastructure

Cisco Joint Solutions: #1

Leading Converged Infrastructure leveraging Cisco UCS and IBM Storage
IBM Storage for VersaStack

- Storwize V5000/V5030F w/ Cisco UCS Mini
- Storwize V7000/V7000U V7000F w/ Cisco UCS
- FlashSystem V9000/900 w/ Cisco UCS
- SAN Volume Controller w/ Cisco UCS
- FlashSystem A9000 w/ Cisco UCS

- Entry to Mid-Size Business
- Medium to Large Enterprise
- Highest Levels of Performance
- Mixed storage environments
- VDI environments

Mixed storage environments include SAN Volume Controller w/ Cisco UCS and FlashSystem A9000 w/ Cisco UCS.

VDI environments include FlashSystem A9000 w/ Cisco UCS.
IBM/Cisco Joint Solutions: #2

Converged Infrastructure

Application Centric Hybrid Cloud

Leading Converged Infrastructure leveraging Cisco UCS and IBM Storage

VersaStack Private Cloud connected to Softlayer leveraging Cisco Cloud Center and Storage Automation for high ROI use cases
IBM/Cisco Joint Solutions: #3

**Converged Infrastructure**

Leading Converged Infrastructure leveraging Cisco UCS and IBM Storage

**Application Centric Hybrid Cloud**

VersaStack Private Cloud connected to Softlayer leveraging Cisco Cloud Center and Storage Automation for high ROI use cases

**Ultimate Software Defined Infrastructure**

VersaStack with Spectrum Suite of storage and storage management options

**Cloud Storage for the Enterprise**

IBM Cloud Object Storage deployed on scale out architecture, providing Exabyte Scale and Public Cloud Prices
Einmalig: IBM SDS für jede Workload und Anforderung

IBM Spectrum Storage

Management

Copy Data Management

Backup

Archive

IBM Spectrum Protect

IBM Spectrum Archive

IBM Spectrum LSF

IBM Spectrum Symphony

IBM Spectrum Conductor

Backup & Archive

Virtualized Block

Scale-Out Block

Scale-Out File

Scale-Out Object

IBM Spectrum Virtualize

IBM Spectrum Accelerate

IBM Spectrum Scale

IBM Cloud Object Storage

Infrastructure

IBM storage

Non-IBM storage

Computing

High-Performance Computing

High-Performance Analytics

New-Gen Workloads

Cloud

All-Flash

Hybrid

Tape / Virtual Tape

Monitoring & Control

IBM Spectrum Control

IBM Spectrum Copy Data Management
...wo Converged aufhört…. fängt SDI mit IBM an.

Workload Management / Deployment

Resource Management Server/CPU...

Data and Storage Management

Continuous optimization

Heterogeneous Infrastructure Support

On-premise, On-cloud, Hybrid Infrastructure
(heterogeneous distributed computing and storage environment)
IBM Spectrum Conductor for Containers

System Overview

- **Nodes**: 2
  - Active: 2
  - Inactive: 0
- **Shared Storage**: 0 GB
  - Available: 0 GB
  - Used: 0 GB
  - Released: 0 GB
  - Failed: 0 GB
- **Applications**: 2
  - Healthy: 2
  - Unhealthy: 0

Resource Allocation

- **CPU**: 13%
  - 1 of 8 Shares
- **Memory**: 6%
  - 796 MiB of 14 GiB
- **Local Disk**: 0%
  - 0 B of 171 GiB

Master Host: 192.168.122.149
Wrap up:

Modernize
- Effizienterer Betrieb- und Speicherung
- Flash-Technologien
- SDS
- Integrated Stack
- Data Management und DPR
- Cloud/Hybrid Cloud

Transform
- Bereitstellen und betreiben von neuen Applikations-Infrastrukturen
- Software-Defined Infrastructure (SDI & SDS)
- Flash-Technologien
- Cold Data/Tape
- Cloud-Objectstorage
Vielen Dank!