ETH Zurich

Speicherumgebung an der ETH Zürich – Lösungen und Herausforderungen

Johan Verstrepen, Dr. Tilo Steiger

ETH Zurich at a glance

Founded in 1855

- Driving force of industrialisation in Switzerland

ETH Zurich today

- One of the world's leading universities for technology and the natural sciences
- Place of study, research and employment for 30,000 people from over 120 different countries

Reasons for success

- Excellent education
- Groundbreaking fundamental research
- Knowledge transfer that benefits society

Agenda

Short portrait ETH Zürich

ETH IT Services / Facts & Figures / Challenges

Storage Services

Service solutions

Security Measures

Challenges (HW, protocols, tape, SW)

Locations

Campus City Center

Two main locations in Zürich
- *In the city center:* historical main building, built by Gottfried Semper
- *On the Hönggerberg:* Modernern Campus, that exemplifies science, business and the public

Other locations in Switzerland
- *Basel:* Departement of Biosystems
- *Lugano:* Swiss High Performance Computing Center (CSCS)
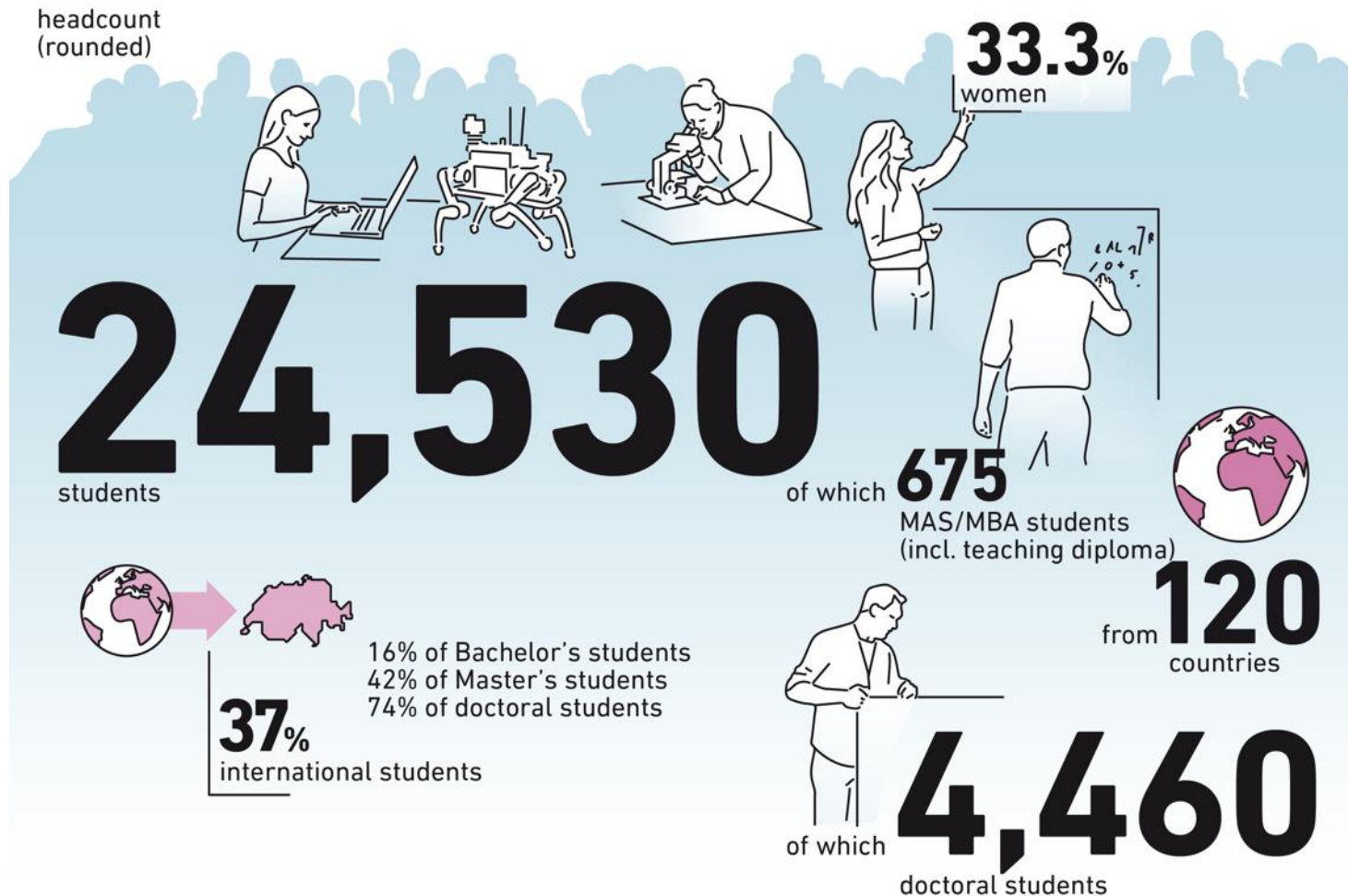
Other decentralized units
- *Research location in Singapore:* Singapore-ETH Centre (SEC)

Campus Science City, Hönggerberg

ETH zürich

ETH Zurich in figures – students

headcount (rounded)

24,530 students

33.3% women

of which **675** MAS/MBA students (incl. teaching diploma)

from **120** countries

16% of Bachelor's students
42% of Master's students
74% of doctoral students

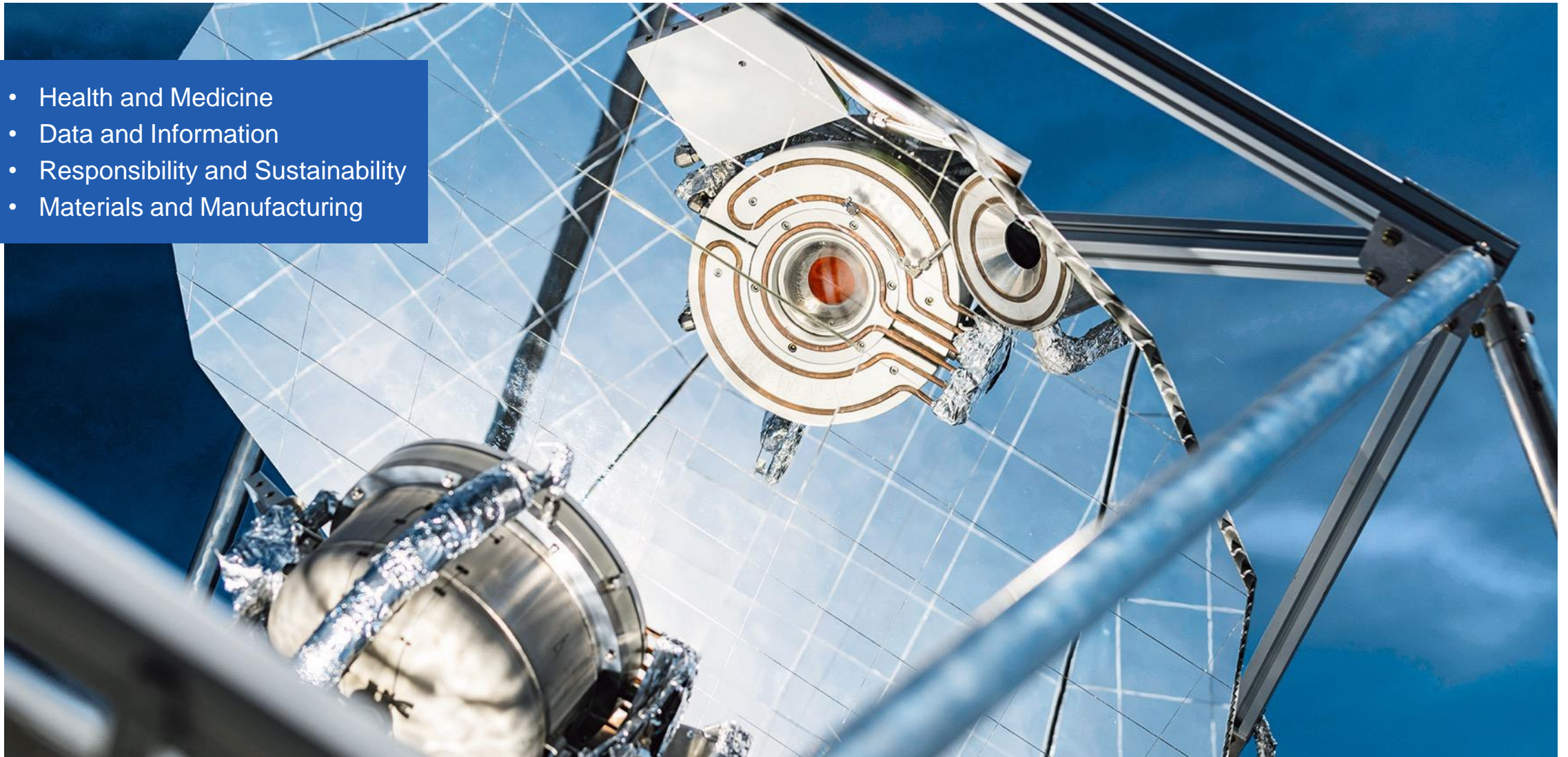**37%** international students

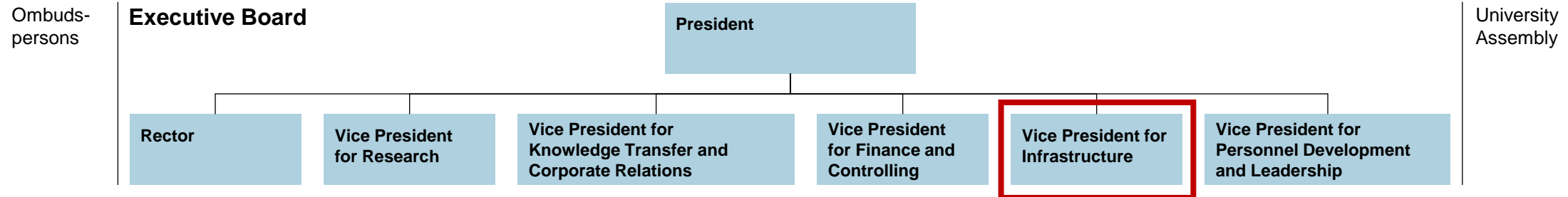of which **4,460** doctoral students

Stimulating the economy

Spin-offs
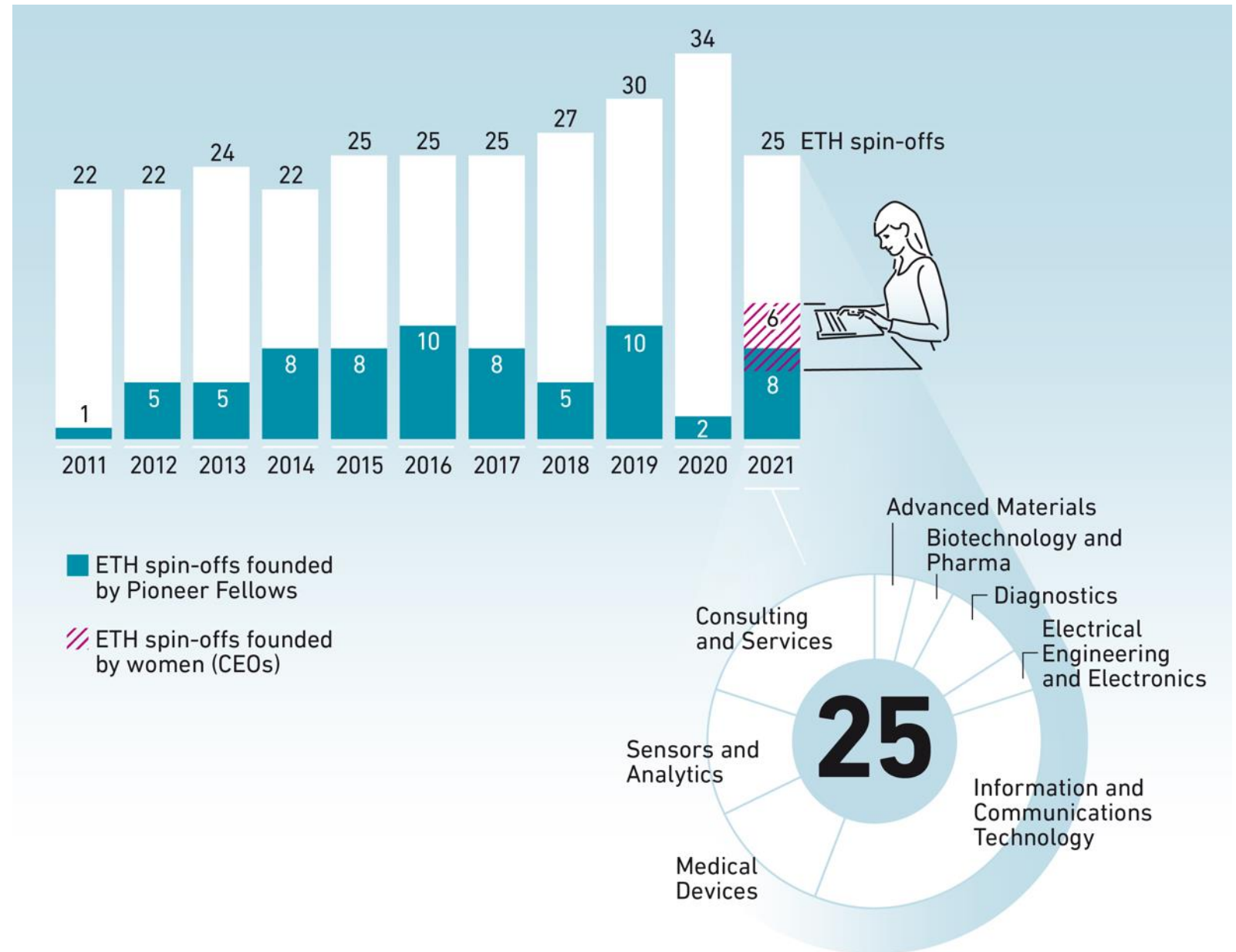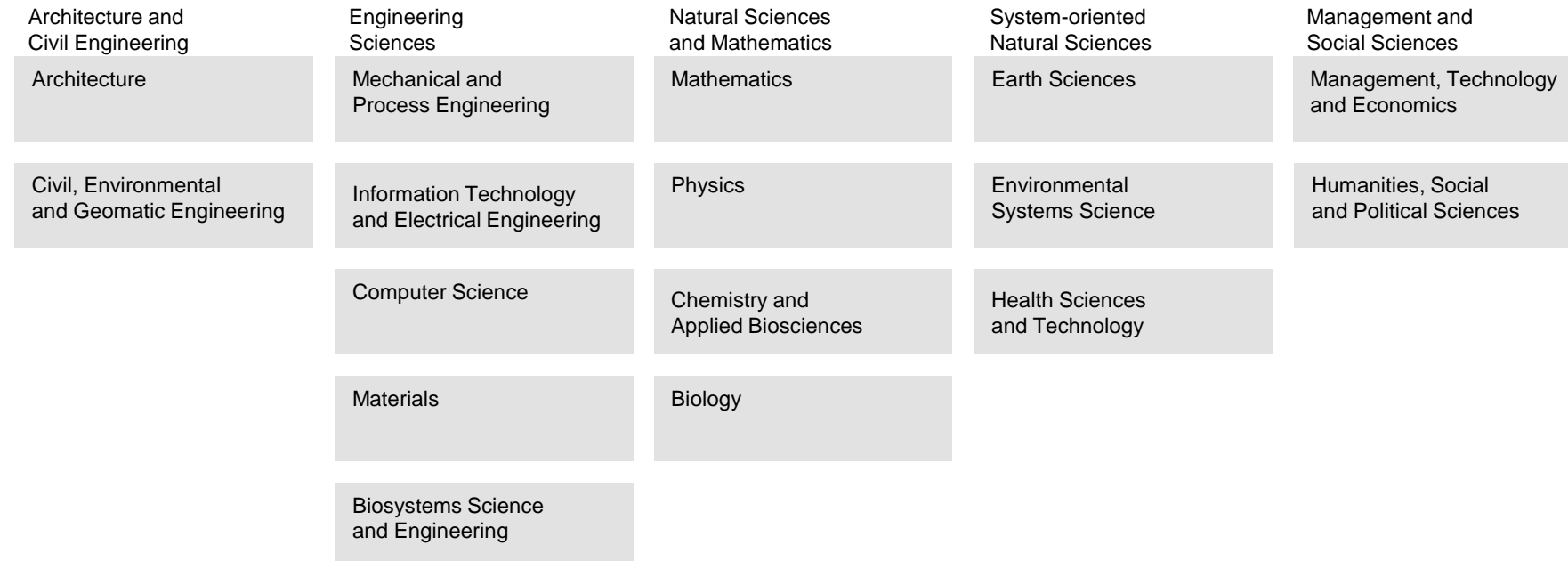
Strategic action areas

- Health and Medicine
- Data and Information
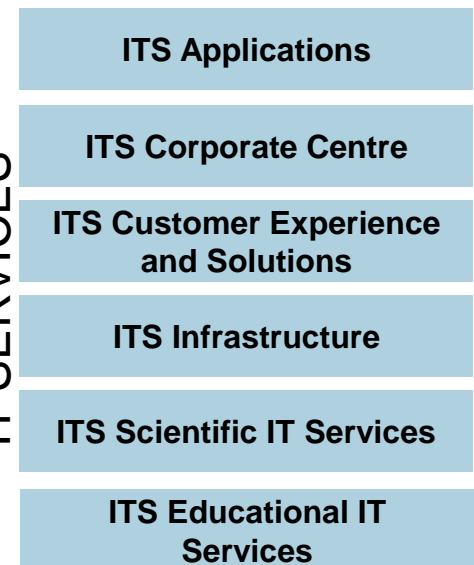- Responsibility and Sustainability
- Materials and Manufacturing

ETH *zürich*

Organisational chart ETH 2024

Ombuds-persons

Executive Board

President

University Assembly

Rector

Vice President for Research

Vice President for Knowledge Transfer and Corporate Relations

Vice President for Finance and Controlling

Vice President for Infrastructure

Vice President for Personnel Development and Leadership

16 academic departments

Architecture and Civil Engineering

Engineering Sciences

Natural Sciences and Mathematics

System-oriented Natural Sciences

Management and Social Sciences

| Architecture | Mechanical and Process Engineering | Mathematics | Earth Sciences | Management, Technology and Economics |

| Civil, Environmental and Geomatic Engineering | Information Technology and Electrical Engineering | Physics | Environmental Systems Science | Humanities, Social and Political Sciences |

| | Computer Science | Chemistry and Applied Biosciences | Health Sciences and Technology | |

| | Materials | Biology | | |

| | Biosystems Science and Engineering | | | |

IT SERVICES

ITS Applications

ITS Corporate Centre

ITS Customer Experience and Solutions

ITS Infrastructure

ITS Scientific IT Services

ITS Educational IT Services

Facts & Figures
Selection

IAM

~60'000 Identities

~90'000 user accounts

Managed Clients

~15'000 Windows

~3'000 macOS

2'200 Linux

166 Mill. Emails

~1'300 procurement requests

~170'000 invoices processed

~31'

60'000 recordings (lectures, events)

~1'000'000 Zoom meetings

~33'000 Zoom users

442 Webinars

298 FTE at 19 locations

~60'000 access points

~21'000 parallel WiFi users

~5'000 VMs on 121 hosts

1'700 compute nodes with 155'000 cores

2,100 GPUs w/ 8 million CUDA cores

12.5 PB of high-performance storage

IT support and workplace management for

~170 professors and their teams in all departments,

all students,

all admin staff

298 FTE at 19 locations

1'700 compute nodes with 155'000 cores

2,100 GPUs w/ 8 million CUDA cores

12.5 PB of high-performance storage

Challenges we are facing
Selection

Cost Pressure

Cybersecurity

Challenges

Labor market

Heterogeneous Technology

ETH Storage Services Overview

Disk Only

NAS *(IBM Spectrum Scale)*
➢ High throughput
➢ Fully managed
➢ Backed up

CDS
➢ **Cheap**
➢ **Not backed** up

SERVER BACKUP
CLIENT BACKUP

POLYBOX

Tape Only

DBR - Backup & Restore
(Spectrum Protect)
➢ Free
➢ Redundant

LTS - Archive & Retrieve
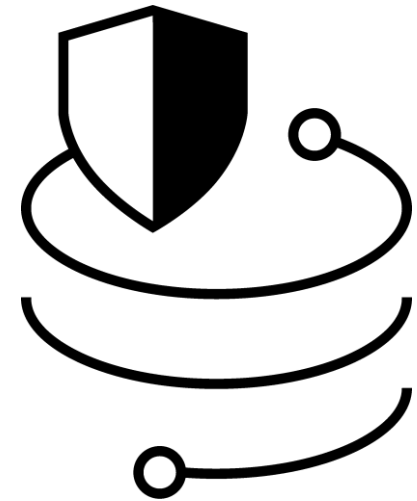*(StrongLink or SP)*
➢ Free
➢ Redundant

Disk / Tape Hybrid

HSM - Migrate & Recall
(Spectrum Protect)
➢ Free
➢ Could be redundant
➢ *Mostly migrated to LTS*

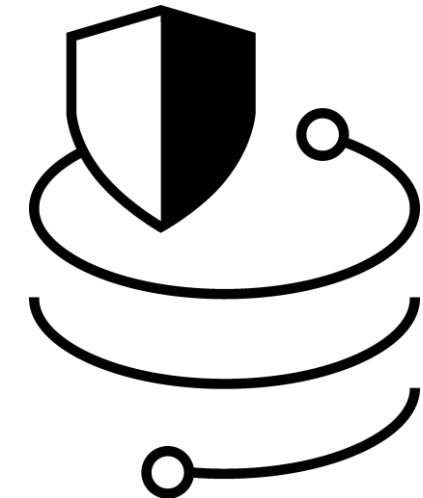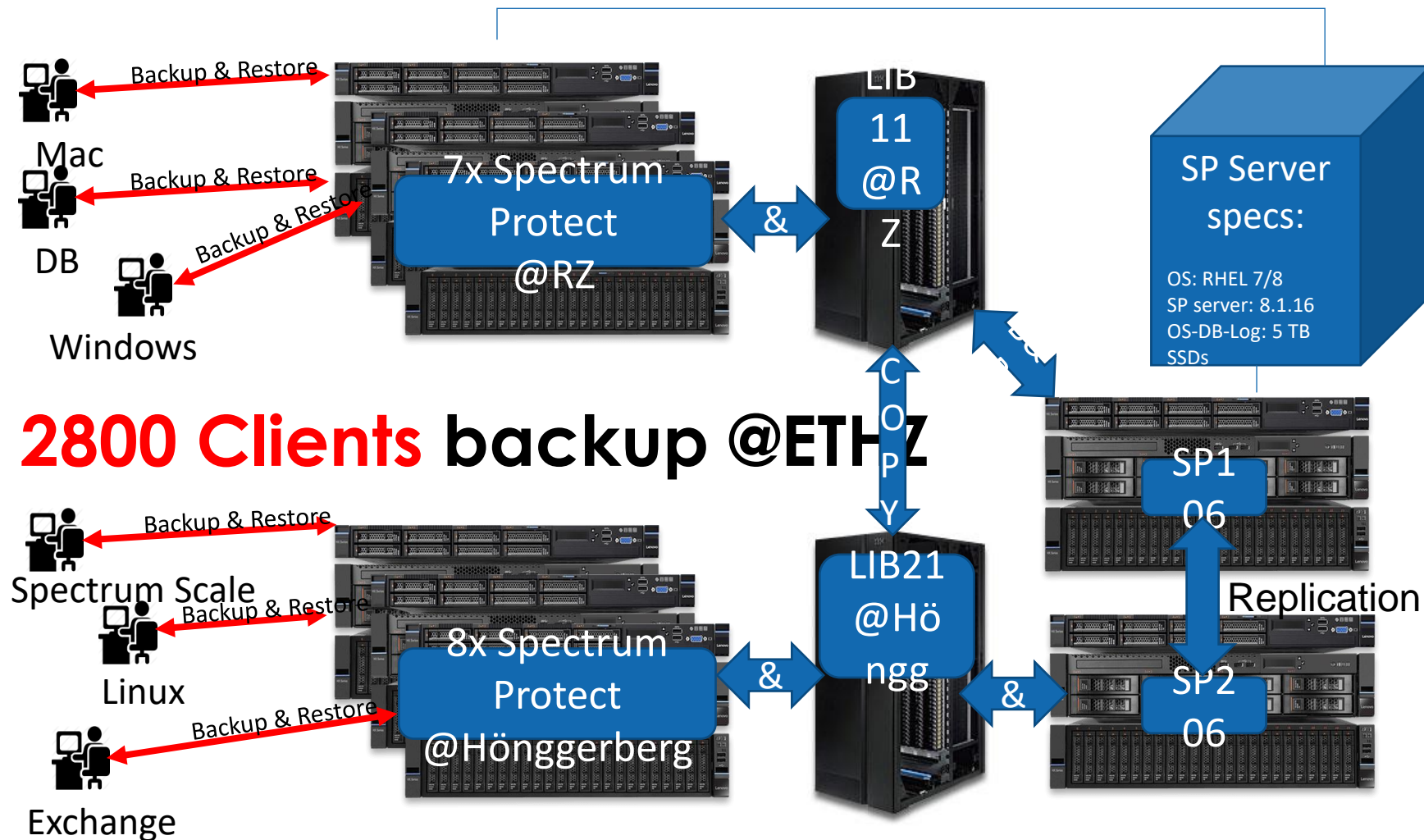# ETH Storage Services Overview – some numbers

- ~100 PB of tape-only backup (Spectrum Protect)

- ~400 TB of disk-only backup (IBM/Cohesity)

- ~20 PB of disk-only online data (Spectrum Scale/CDS)

- **~24 PB of tape-only archive (StrongLink)**

ETH Storage Vendors

ETH Data Backup and Restore Service Solution

Mac

DB

Windows

Backup & Restore

Backup & Restore

Backup & Restore

Backup & Restore

7x Spectrum Protect @RZ

LIB 11 @RZ

&

SP Server specs:

OS: RHEL 7/8
SP server: 8.1.16
OS-DB-Log: 5 TB SSDs

COPY

2800 Clients backup @ETHZ

Spectrum Scale

Linux

Exchange

Backup & Restore

Backup & Restore

Backup & Restore

8x Spectrum Protect @Hönggerberg

LIB21 @Höngg

&

&

SP1 06

SP2 06

Replication

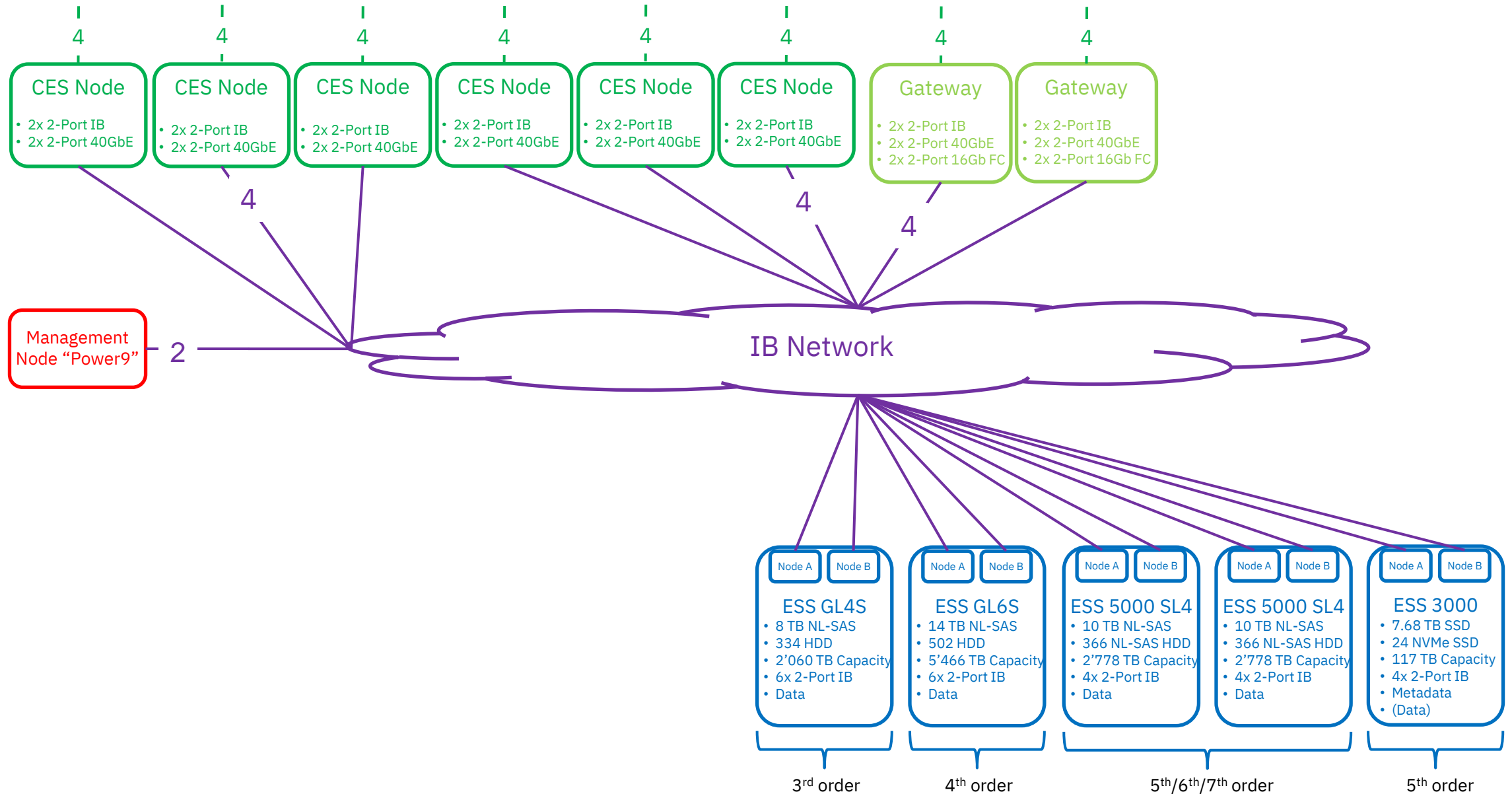IBM | COHESITY

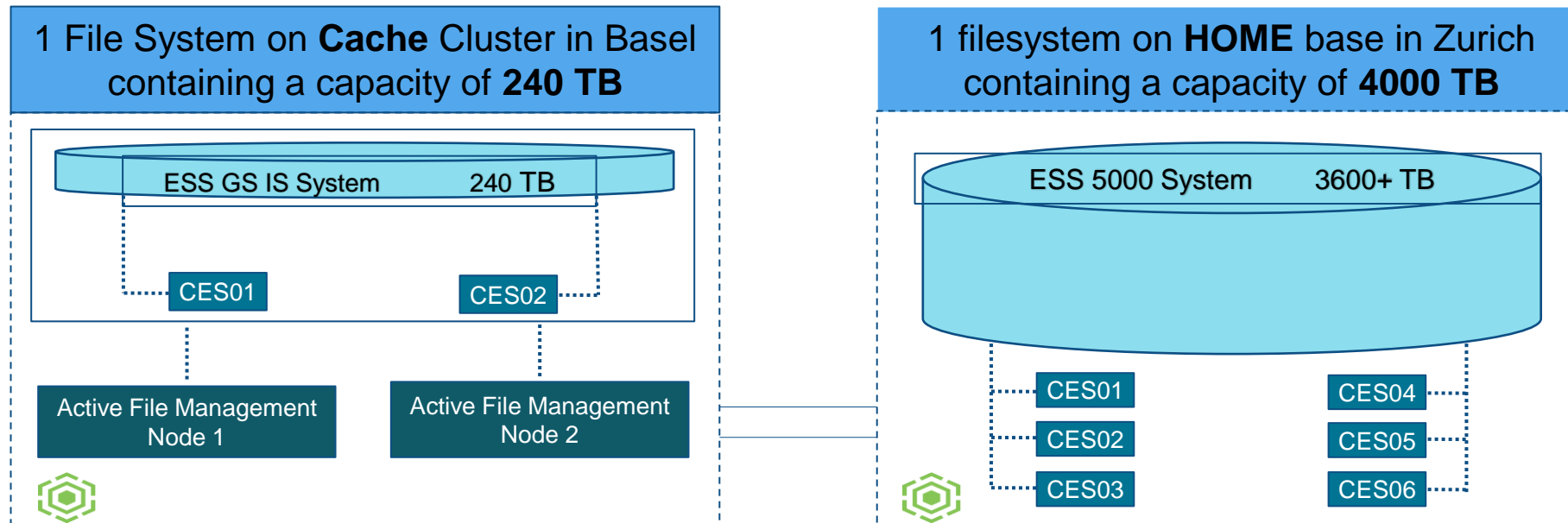# Tape archive numbers (Long Term Storage) – Sevice Solution

- Around 24 PB on tape *(dual copy)* – 12 PB native

- 2 copies on separate locations of every single file

- 40 shares (NFS & SMB)– one for each department

- ½ million files archived

- File sizes usually between 100 MB to 1.5 TB
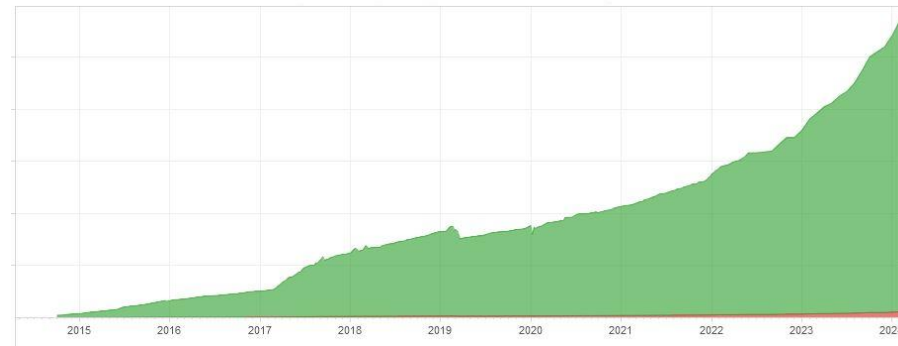
Spectrum Scale Service Solution at one of two campus locations

| 4 | 4 | 4 | 4 | 4 | 4 | 4 | 4 |

CES Node
- 2x 2-Port IB
- 2x 2-Port 40GbE

CES Node
- 2x 2-Port IB
- 2x 2-Port 40GbE

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CES Node
- 2x 2-Port IB
- 2x 2-Port 40GbE

CES Node
- 2x 2-Port IB
- 2x 2-Port 40GbE

Gateway
- 2x 2-Port IB
- 2x 2-Port 40GbE
- 2x 2-Port 16Gb FC

Gateway
- 2x 2-Port IB
- 2x 2-Port 40GbE
- 2x 2-Port 16Gb FC

4   4   4

Management Node "Power9"

2

IB Network

Node A Node B

ESS GL4S
- 8 TB NL-SAS
- 334 HDD
- 2'060 TB Capacity
- 6x 2-Port IB
- Data

ESS GL6S
- 14 TB NL-SAS
- 502 HDD
- 5'466 TB Capacity
- 6x 2-Port IB
- Data

ESS 5000 SL4
- 10 TB NL-SAS
- 366 NL-SAS HDD
- 2'778 TB Capacity
- 4x 2-Port IB
- Data

ESS 5000 SL4
- 10 TB NL-SAS
- 366 NL-SAS HDD
- 2'778 TB Capacity
- 4x 2-Port IB
- Data

ESS 3000
- 7.68 TB SSD
- 24 NVMe SSD
- 117 TB Capacity
- 4x 2-Port IB
- Metadata
- (Data)

3rd order   4th order   5th/6th/7th order   5th order

AFM Cache and Home Systems Service Solution

1 File System on Cache Cluster in Basel containing a capacity of 240 TB

ESS GS IS System   240 TB

CES01   CES02

Active File Management Node 1

Active File Management Node 2

1 filesystem on HOME base in Zurich containing a capacity of 4000 TB

ESS 5000 System   3600+ TB

CES01   CES04

CES02   CES05

CES03   CES06

Spanning a distance of 120 KM, 2 AFM nodes enable the transfer of data via a CACHE cluster at 40 GB per second each. To leverage Spectrum Protect servers, Tape-based backup runs against HOME filesets. Six CES docking points for end users enable remote access of the copied data, generating a central storage network with high scalability and at low cost
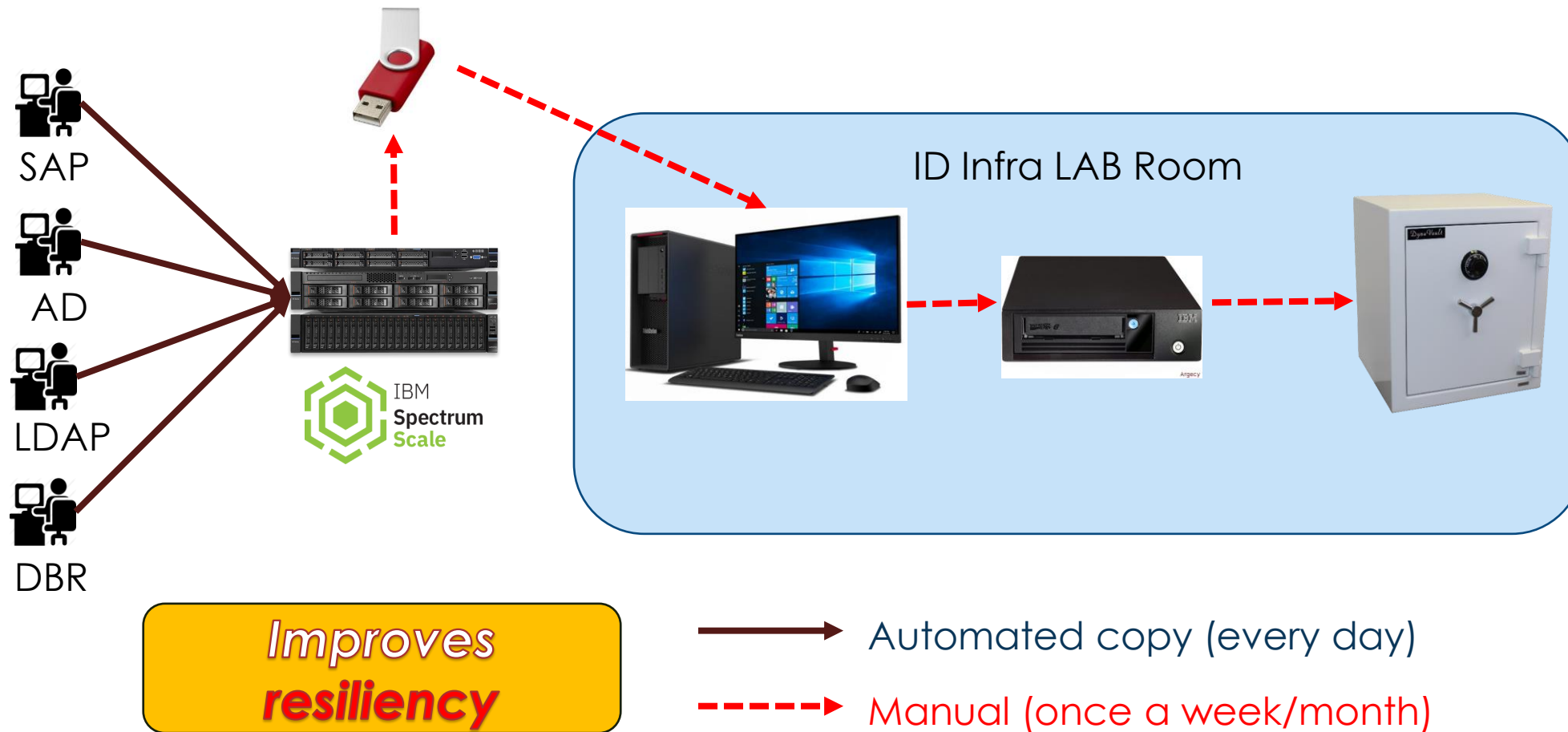
Security Measures – Tiered Backup

- **Tier 4.** – Common user data with *dual tape copy*

- **Tier 3. ~ 1 PB** – Important data with *fast restore* required

- **Tier 2. ~ 200 TB** – Critical data with logical airgap & mirror

- **Tier 1. ~ 20 TB** – Vital data with physical airgapped mirror

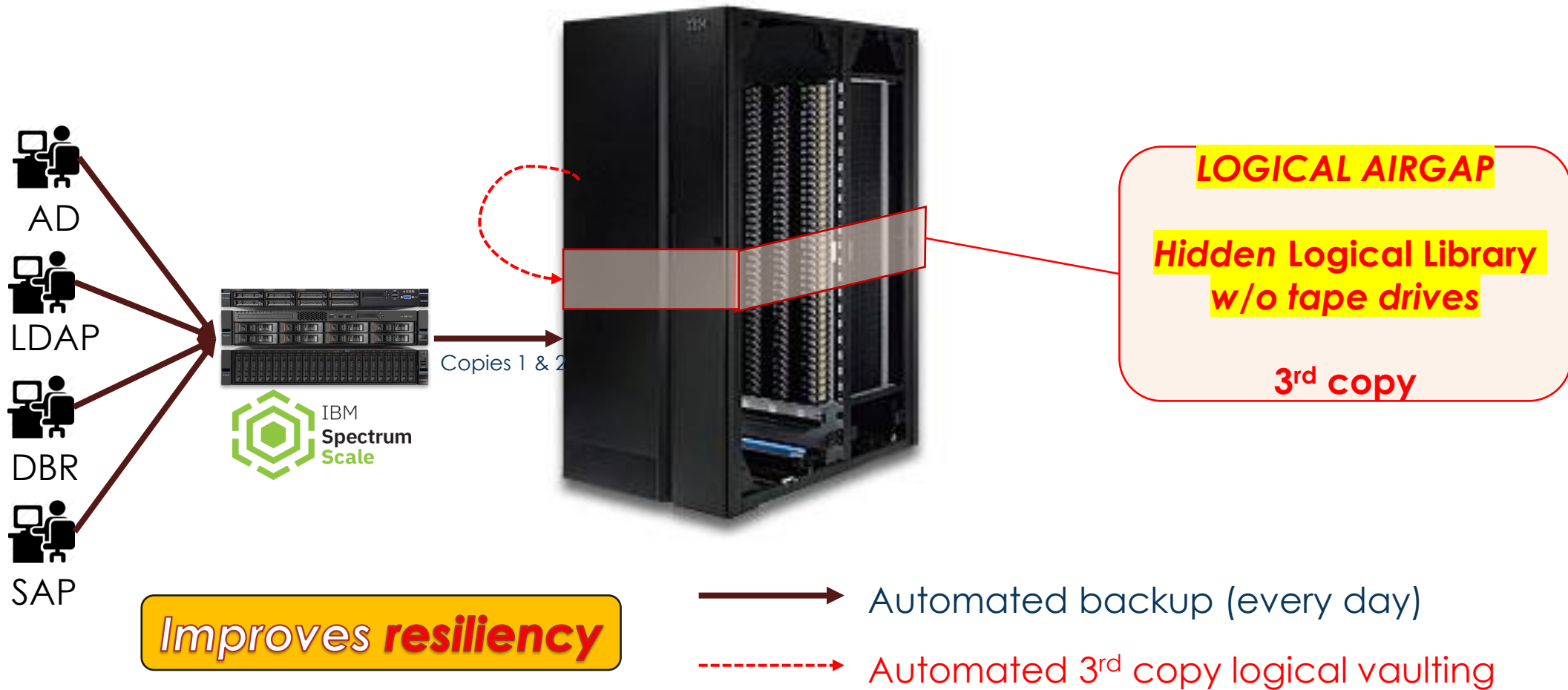*Can be done **ONLY** if we **first classify data** based on importance, urgency and requirements!*
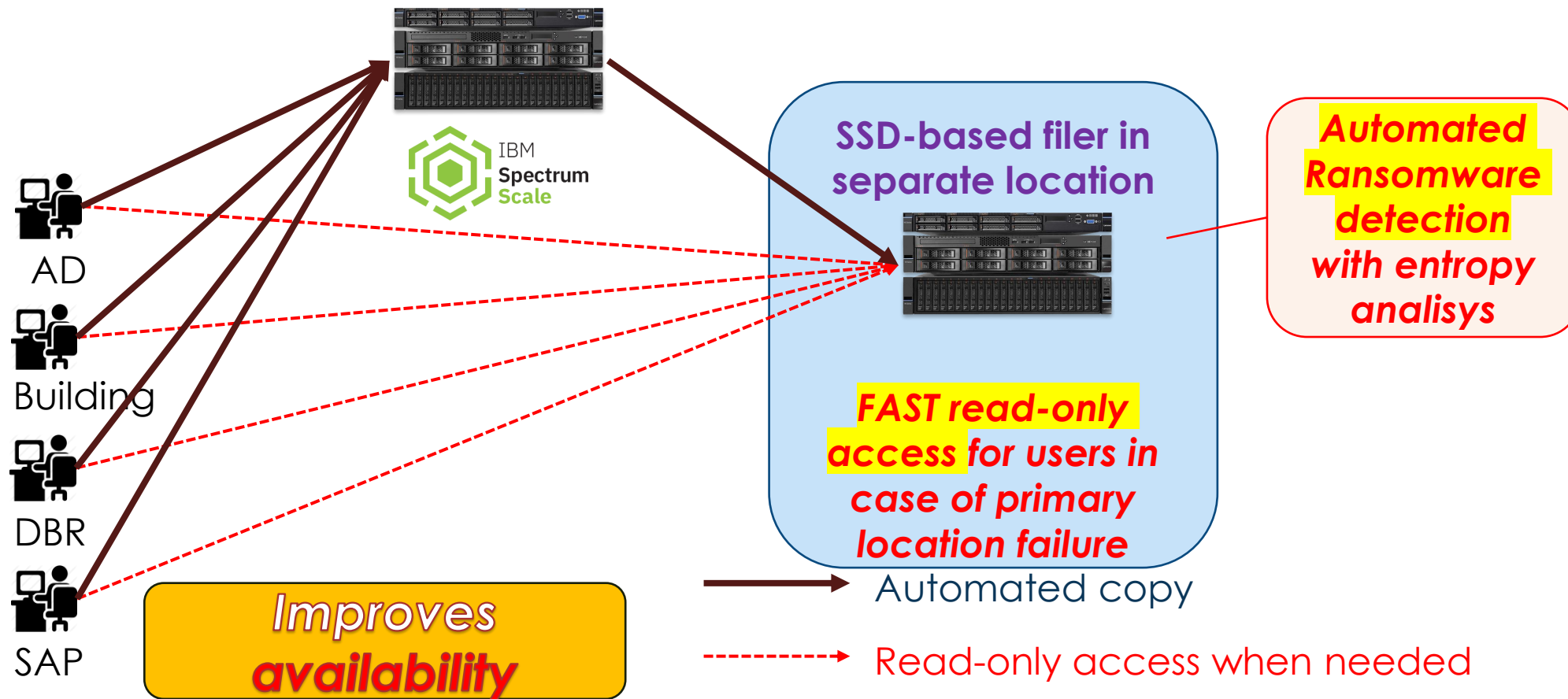
Crown Jewels

Security Measures – the physical air gap vault

SAP

AD

LDAP

DBR

IBM Spectrum Scale

ID Infra LAB Room

Improves resiliency

→ Automated copy (every day)

⇢ Manual (once a week/month)

Security Measures – the offline backup copy

AD

LDAP

DBR

SAP

IBM Spectrum Scale

Copies 1 & 2

LOGICAL AIRGAP

Hidden Logical Library w/o tape drives

3rd copy

Improves resiliency

→ Automated backup (every day)

⇢ Automated 3rd copy logical vaulting

Security Measures – the online mirror for Tier 1 and Tier 2

SSD-based filer in separate location

Automated Ransomware detection with entropy analisys

FAST read-only access for users in case of primary location failure

Improves availability

IBM Spectrum Scale

AD

Building

DBR

SAP

→ Automated copy

⇢ Read-only access when needed

Challenges

- Huge daily growth vs. limited budgets

  Disk space & network throughput

  Tape drives & FC throughput

- Protocols (NFS, SMB, S3 all within the SDS layer)

- HW Renewals

- Future of tape

  will it be tailored for hyper scalers?

- Cyber attacks

Challenges, challenges *and more challenges!*

Answers to your questions …

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Open position: **Linux and Spectrum Scale admin**