

Data Infrastructure Update and FEL-II Validation Testing

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On behalf of Data Management Group

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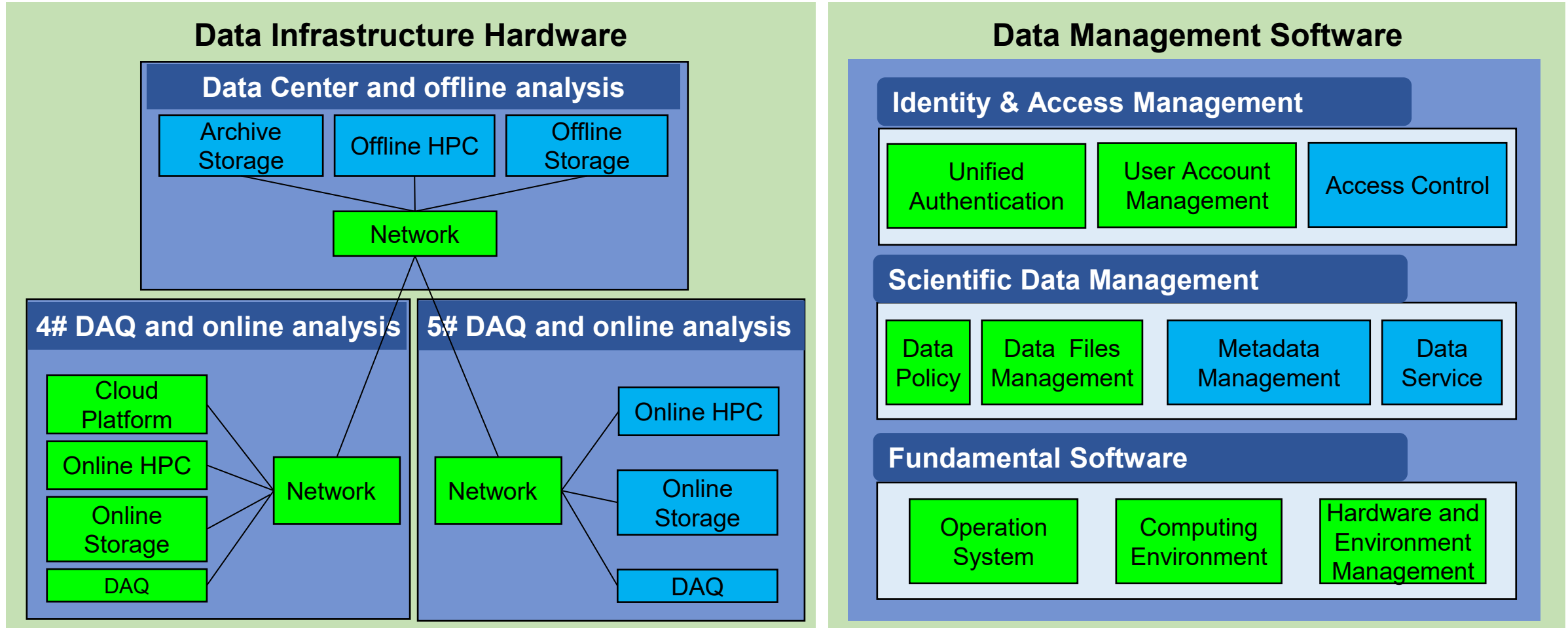
Outlines

- **Update of Data Infrastructure**
- **Validation Testing for FEL-II**
- **Plan**
- **Summary**

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Overview of the Data System



completed

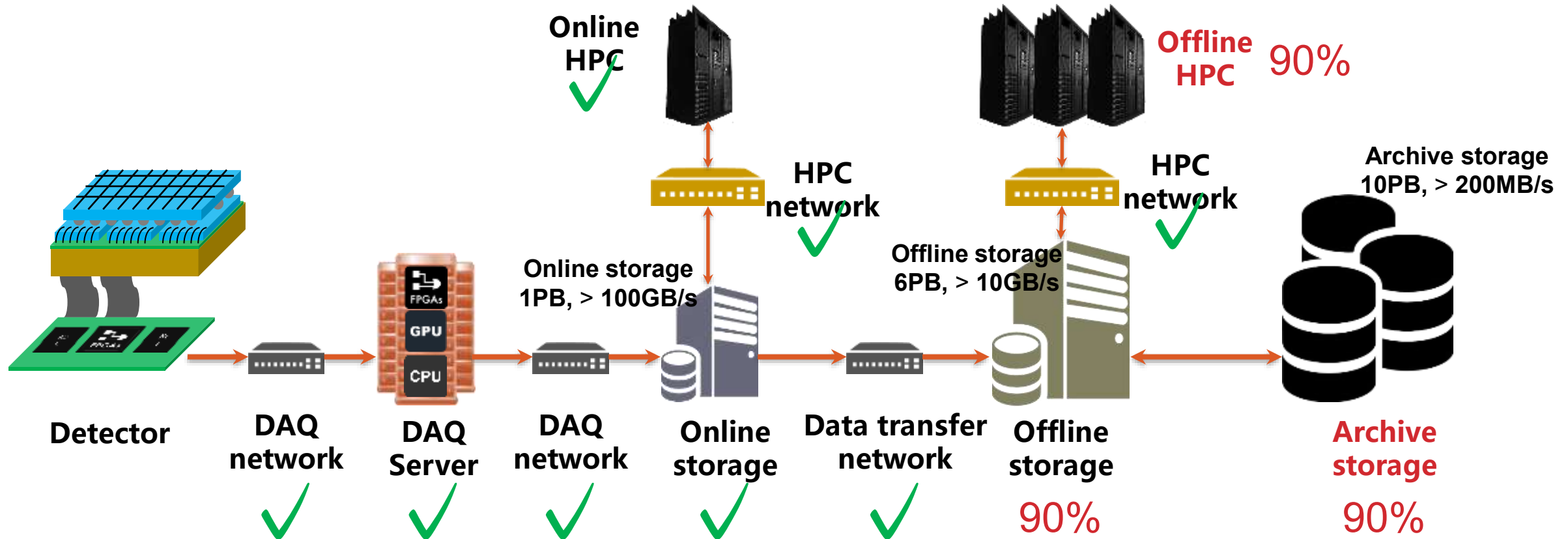
❑ Hardware: storage, computing resources, network.

Not completed

❑ Software: scientific data management, identify & access management, etc.

End-to-End Data Flow Readiness for FEL-II

The full life cycle of scientific data from the DAQ system → online storage → offline storage → archive storage for FEL-II will be ready by the end of 2026.

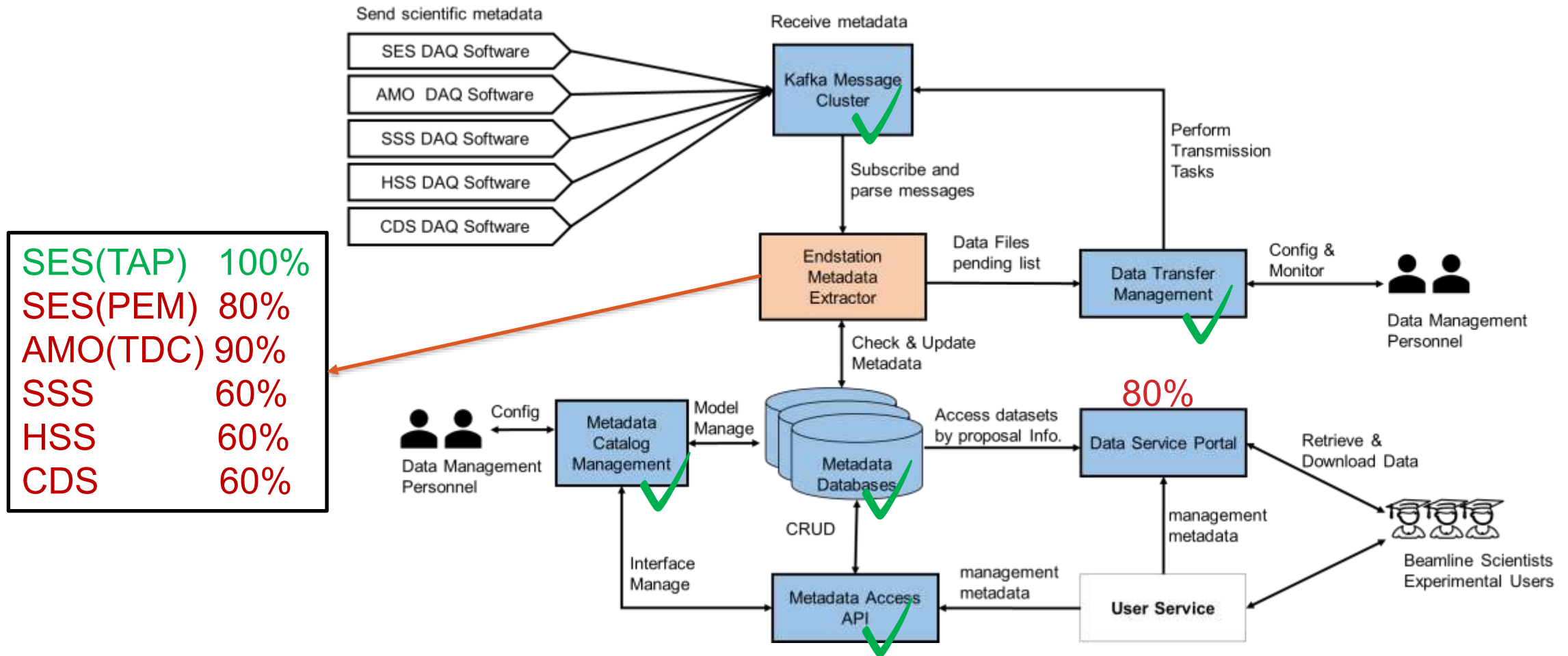


Update of the Data Infrastructure

	3rd TAC status	Current status	Progress	Integration?
Data Center	Completed	Completed	100%	NO
Network @T34	Ready for integration	Integrating and validation test	80% (FEL-II) 0% (FEL-I)	YES
Network @4#	Ready for integration	Integrating and validation test	80% (FEL-II) 20% (FEL-I)	YES
Online storage @4#	Ready for integration	Integrating and validation test	60% (FEL-II) 0% (FEL-I)	YES
Online HPC @4#	Completed	Completed	100%	NO
Network @T45	Delivered	Ready for integration	50%	YES
Network @5#	Delivered	Ready for integration	50%	YES
Network @DC	Delivered	Completed	100%	NO
Online storage @5#	In procurement	Offline commissioning and testing	50%	YES
Online HPC @5#	In procurement	Acceptance testing	90%	NO
Offline HPC @DC	In procurement	Acceptance testing	90%	NO
Offline storage @DC	In procurement	Acceptance testing	90%	NO
Archiving storage @DC	In procurement	Acceptance testing	90%	NO

Data Management Software Readiness

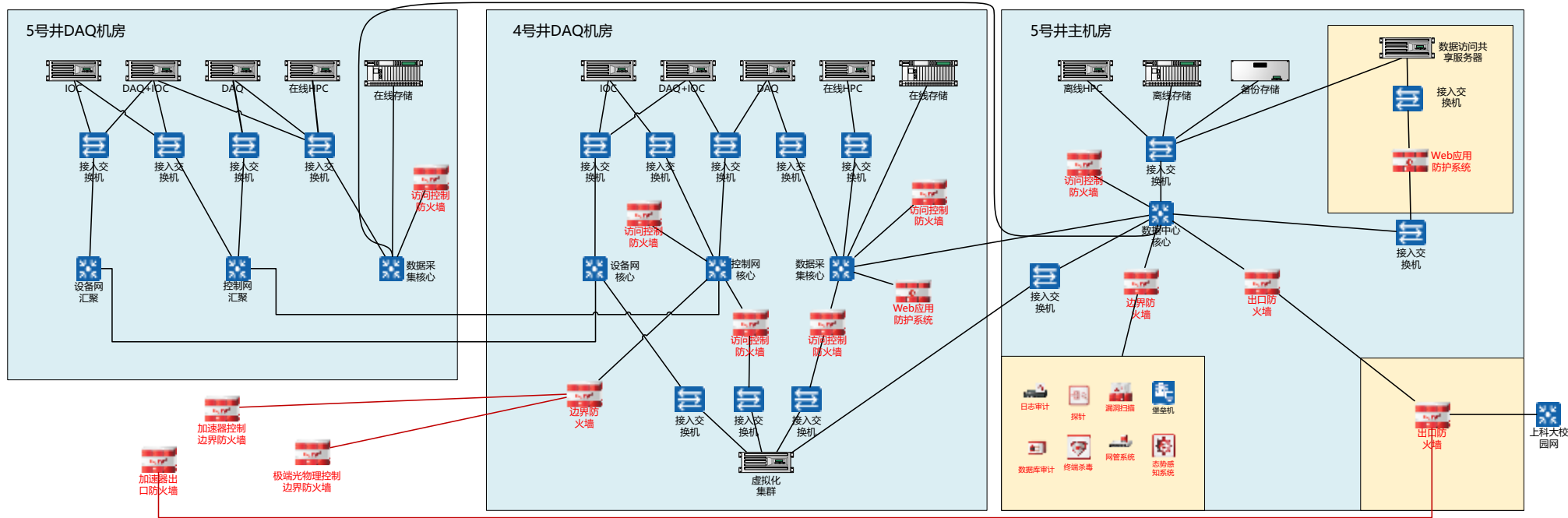
- ❑ Data Management software for endstations is ready for joint commissioning.
- ❑ Commissioning with SES TAP DAQ and functionality optimization have been done after last TAC.



Update of the Data Management software

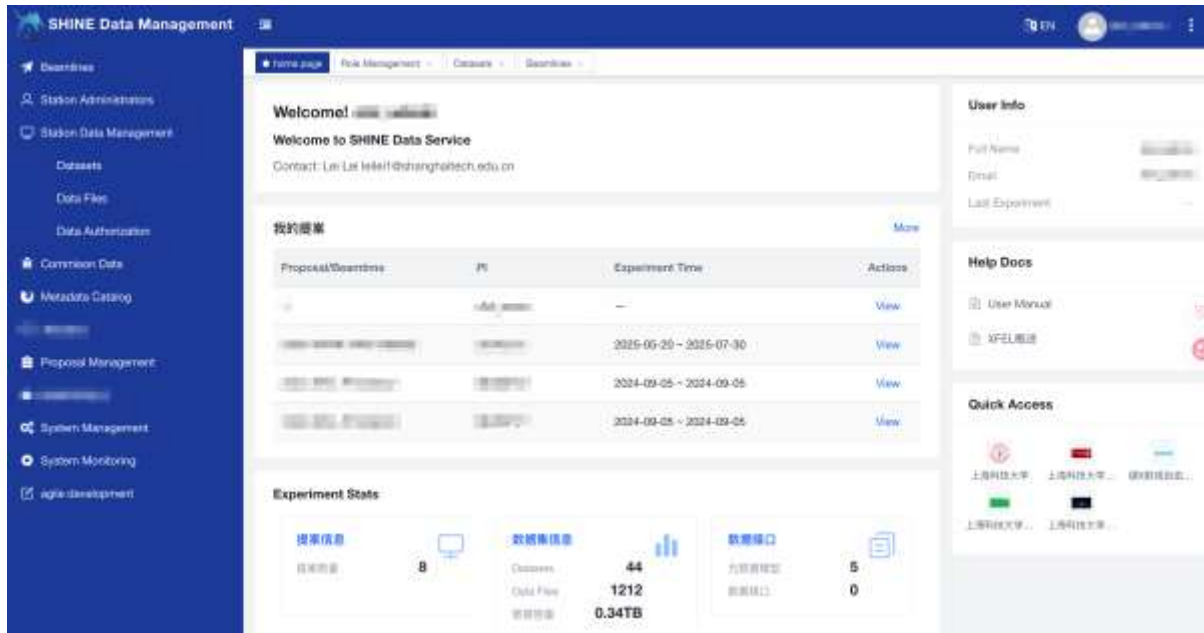
Software		3rd TAC status	Current status	Progress	Integration?
Overall framework		Completed	Completed	100%	YES
Message system		Completed	Completed	100%	YES
Metadata catalog management		Completed	Completed	100%	YES
Data transfer management		Completed	Completed	100%	YES
Data service portal		In constructing	Ready for joint commissioning while optimization	80%	YES
User management (unified identity authentication)		Completed	Completed	100%	YES
Metadata extractors	AMO (TDC)	Ready for joint commissioning	Ready for joint commissioning	90%	YES
	SES (TAP)	Ready for joint commissioning	Completed	100%	YES
	SES (PEM)	In constructing	Ready for joint commissioning	80%	YES
	SSS	In constructing	In constructing	60%	YES
	HSS	Designing	In constructing	60%	YES
	CDS	Designing	In constructing	60%	YES

Progress of Cyber Security



- ✓ The review of the cybersecurity design report is expected to be completed this month.
- ✓ Divided into several zones: the control zone, equipment management zone, DAQ zone, data center zone, data access and sharing zone, Internet access zone
- ✓ Zone-specific security policies are applied, while access controls and auditing at zone boundaries help protect the system.

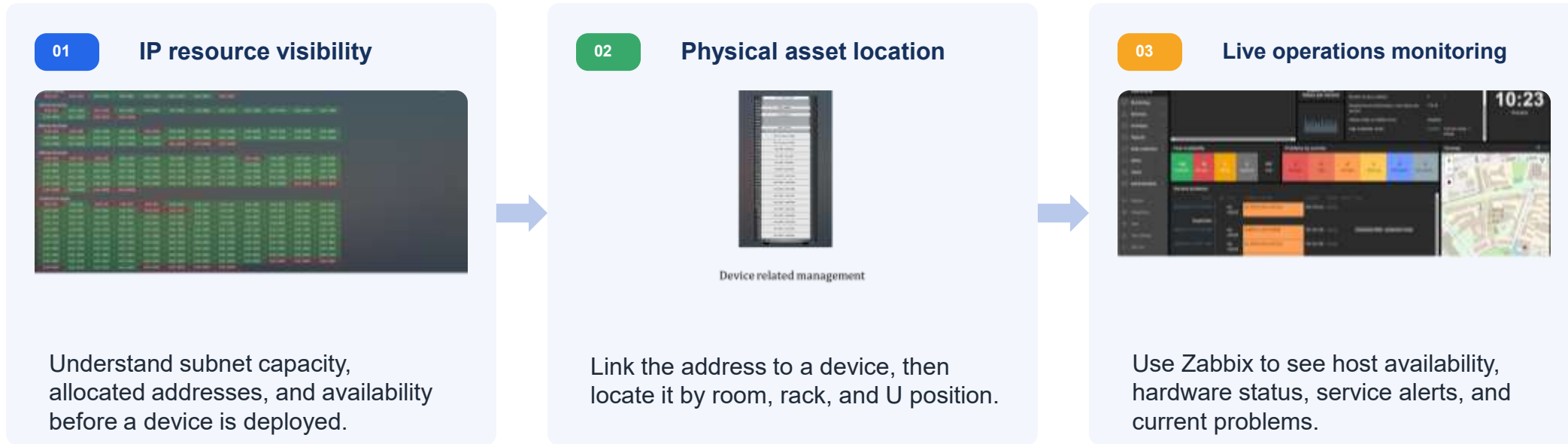
New features of data management software



- + Support HTTPS: <https://dataportal.be.shine.cn> via intranet
- + Beam tuning data management:
 - diagnostic data, vacuum and mechanical data
- + UI internationalization
- + Monitoring enhanced
 - data permission monitoring
 - message consumption and lag monitoring
- + Master Control Program tool integration:
 - exposing data services as MCP tools
 - retrieve and analysis data using LLMs and agents

Virtual Data Center

Objective: Establish integrated management of IP resources, hardware assets, and infrastructure monitoring.



COMPLETED

- 5 resource domains, 84 subnets, and 749 IP records
- 3 locations, 10 racks, 95 rack-mounted devices, and 11 device types
- 162 IP-to-device links established

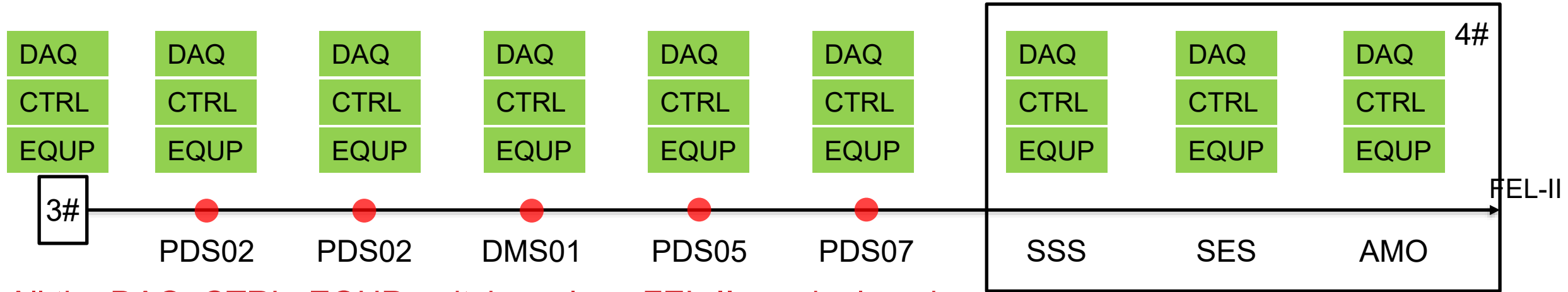
IN PROGRESS

- Complete management IP and device asset attributes
- Automate IP, device, and Zabbix host mapping
- Provide a unified view of resource, location, and live status

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Network integration and validation for FEL-II



All the DAQ, CTRL, EQUP switches along FEL-II are deployed.

Instruments Integration and validation --- over **50+** OPI/IOC for beamline and endstations.

- ✓ DAQ/Control/Equipment IP configuration and testing
- ✓ Active Directory domain integration
- ✓ Online storage integration

Completed:

- ❑ Integration with DAQ and control system of beamline @ FEL-II
- ❑ Integration with DAQ and control system of SES, AMO

In Progress:

- ❑ Integration with DAQ and control system of SSS

All integrated instruments
are functioning well.

Online storage integration and validation for FEL-II

- ❑ Over **20** DAQ/OPI/IOC have been integrated and tested with online storage through NFS/SMB.
- ❑ Over **15** DAQ/OPI/IOC have been integrated and tested with online storage through GPFS system.

Ready for use:

- ❑ beamline DIAG
- ❑ SES endstation

In Progress:

- ❑ The rest instruments at FEL-II

Plan:

- ❑ The instruments at FEL-I

```
[root@Q4-HPC-c04n04 gpfs-admin]# mmnfs export list
```

Path	Delegations	Clients
/shine_online4	NONE	10.25.118
/shine_online4	NONE	10.25.99.
/shine_online4	NONE	10.25.99.
/shine_online4	NONE	10.25.98.
/shine_online4	NONE	10.25.99.
/shine_online4	NONE	10.25.99.
/shine_online4	NONE	10.25.74.
/shine_online4	NONE	10.25.84.
/shine_online4	NONE	10.25.98.
/shine_online4	NONE	10.25.128
/shine_online4	NONE	10.25.74.
/shine_online4	NONE	10.25.74.
/shine_online4	NONE	10.25.74.
/shine_online4	NONE	10.25.99.
/shine_online4	NONE	10.25.84.
/shine_online4	NONE	10.25.74.
/shine_online4	NONE	10.25.74.

```
[root@Q4-HPC-c04n01 ~]# /usr/lpp/mmfs/bin/mmgetstate -a
```

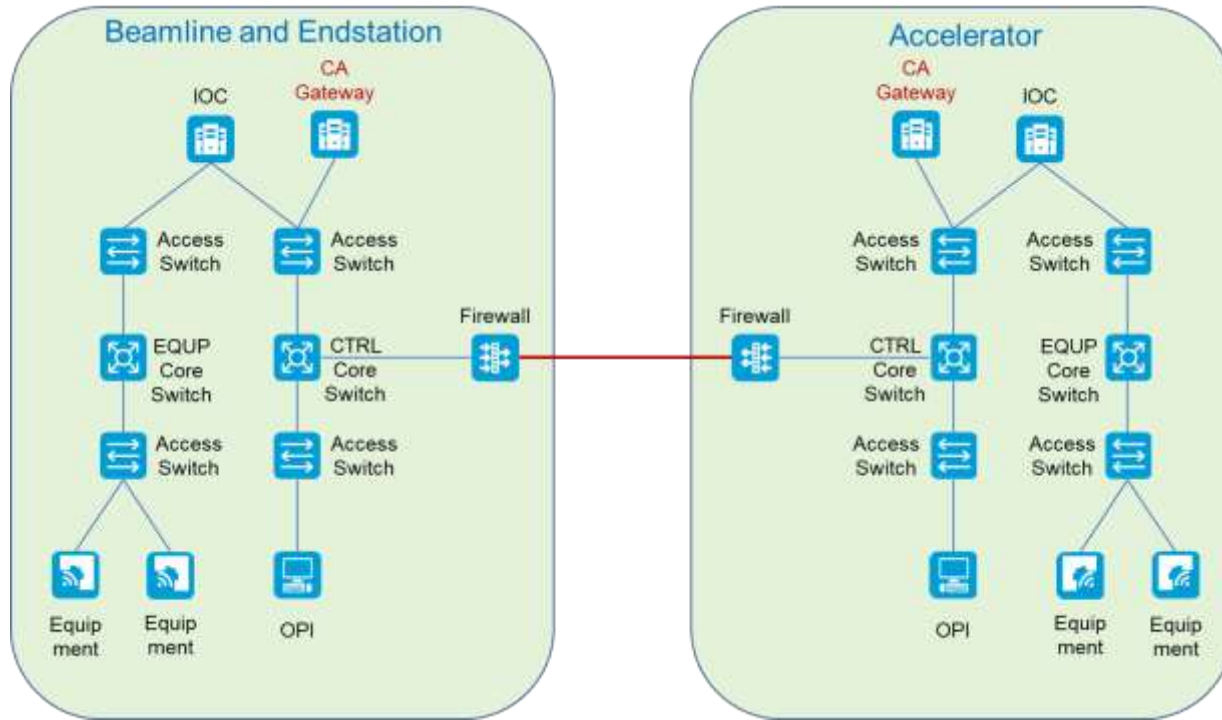
Node number	Node name	GPFS state
1	Q4-HPC-c04n01_100Gb	active
2	Q4-HPC-c04n02_100Gb	active
3	Q4-HPC-c04n03_100Gb	active
5	Q4-DAQ-DIAGBS_FS100	active
7	Q4-DAQ-VACBS_FS100	active
9	Q4-DAQ-SESPAM_FS100	active
10	Q4-DAQ-TAP_FS100	active
11	T34-DAQ-PES1_FS40	active
12	Q4-DM-WEB1_FSvm	active
13	Q4-WFS-ADI0C_FS100	active
14	Q4-DAQ-DIAGBS2_FS100	active
15	S4-PAMAM0-IOC_FS100	active
16	S4-DAQ-PES0PI2_FS40	active

```
[root@Q4-HPC-c04n01 ~]#
```

- ✓ In a representative test over a 100 GbE connection, a GPFS client without RDMA achieved a single-stream write throughput of approximately 5 GB/s.

All integrated instruments are functioning well.

Joint Commissioning with Accelerator



The OPIs at Beamline&Endstations and Accelerator can exchange the EPICS PV from the CA gateway via the firewall.

```
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on any, link-type LINUX_SLL (Linux cooked v1), capture size 262144 bytes
^C
0 packets captured
3 packets received by filter
0 packets dropped by kernel
[root@AC-GT-CN-CAGW1 ~]# ping 10.26.116.15
PING 10.26.116.15 (10.26.116.15) 56(84) bytes of data.
^C
--- 10.26.116.15 ping statistics ---
42 packets transmitted, 0 received, 100% packet loss, time 42009ms

[root@AC-GT-CN-CAGW1 ~]# tcpdump -i any host 10.26.116.5
dropped privs to tcpdump
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on any, link-type LINUX_SLL (Linux cooked v1), capture size 262144 bytes
16:29:29.058560 IP 10.26.116.5.57343 > AC-GT-CN-CAGW1.ca-1: UDP, length 64
16:29:29.090153 IP 10.26.116.5.57343 > AC-GT-CN-CAGW1.ca-1: UDP, length 64
16:29:29.154277 IP 10.26.116.5.57343 > AC-GT-CN-CAGW1.ca-1: UDP, length 64
16:29:29.282455 IP 10.26.116.5.57343 > AC-GT-CN-CAGW1.ca-1: UDP, length 64
16:29:29.538247 IP 10.26.116.5.57343 > AC-GT-CN-CAGW1.ca-1: UDP, length 64
```

The control system topology of accelerator and BE.

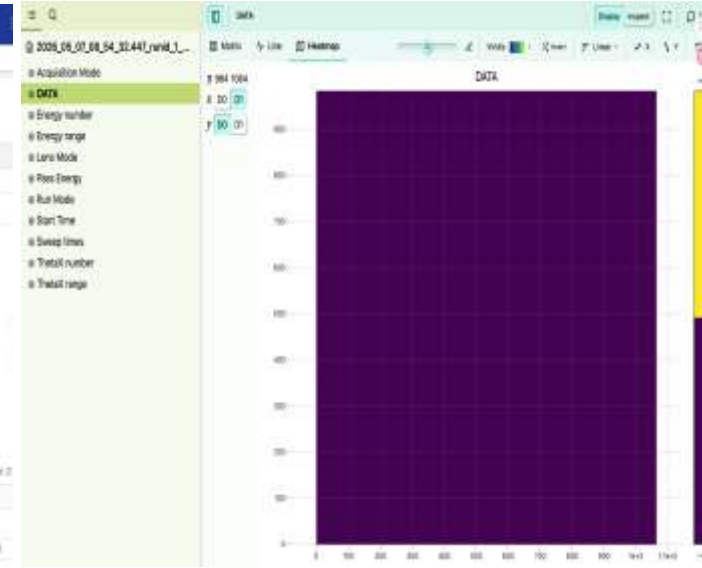
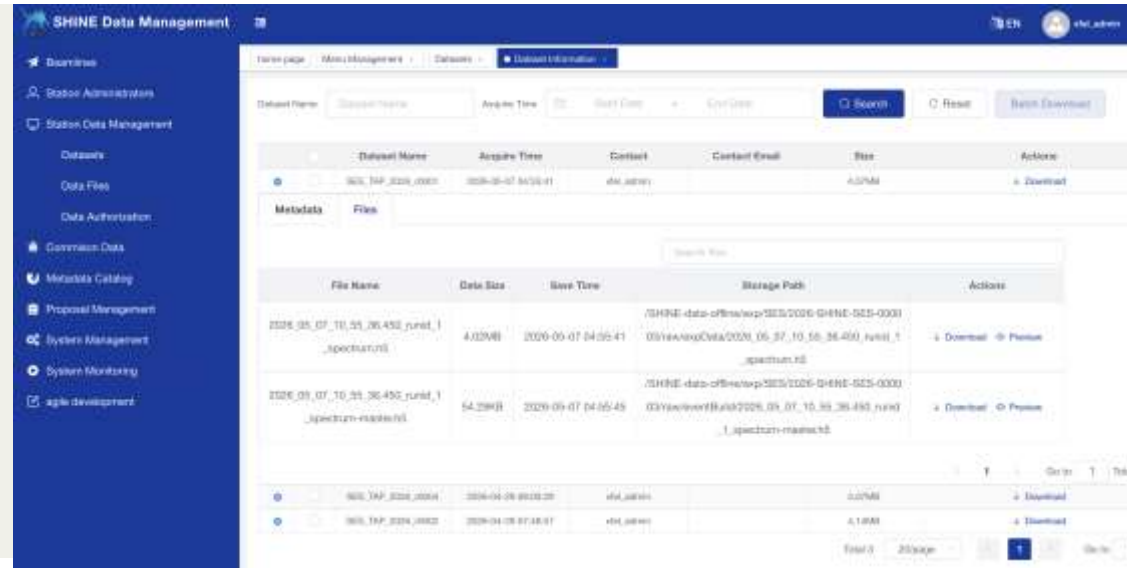
The access were controlled by the firewall at both sides.

Joint Commissioning with SES TAP DAQ

- Commissioning with SES TAP DAQ, offline event builder, online storage, and network has been completed at Shaft 4 in May.

Ready for use:

1. SES metadata extractor
2. Data transferring configuration
3. Kafka cluster
4. MongoDB cluster
5. Data Portal Services
6. Online Storage
7. Network



- SES TAP experimental data → Acquisition → Event building → Data transfer → Metadata registration and storage → Display and preview on the Data Portal web page
- Modules of the software run stably during commissioning and meet expectations.

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Plan

- All IT hardware for FEL-II beamline and endstations are ready for integration and validation testing.
- All IT hardware for FEL-I will be ready in November 2026.

		2026												2027																			
		1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12								
Hardware	Network @shaft 5	ready for integration																															
	DAQ server @shaft 5	in constructing and offline commsioning										ready for integration																					
	Online Storage @shaft 5	in constructing and offline commsioning										ready for integration																					
	Online HPC @shaft 5	in constructing and offline commsioning										completed																					
	Offline HPC	in constructing and offline commsioning										completed																					
	Offline Storage	in constructing and offline commsioning										completed																					
	Archive Storage	in constructing and offline commsioning										completed																					
Data management software	AMO	offline commsioning					ready for joint commissioning																										
	SES	in constructing			offline commsioning					ready for joint commissioning																							
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Cyber security	Cyber security	designing										in constructing		commsioning				completed															

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➤ **Hardware Integration and Validation Testing**

- Hardware validation testing with FEL-II has been successful.
- Hardware integration with FEL-I can begin in November 2026.

➤ **Software Development and Joint Commissioning**

- Joint commissioning of the DM software with the AMO and SES TAP DAQ systems has been completed.
- Joint commissioning of the DM software with the DAQ systems at the remaining endstations will begin once those endstations are ready.

➤ **Cybersecurity**

- The cybersecurity design will be completed soon. Procurement and construction are expected to begin.



Thank you for your attention!

