

Advanced Infrastructure for Science

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Cybermedia Center, Osaka University, Japan

THE 4th GLOBAL RESEARCH PLATFORM WORKSHOP
at eScience2023

Cybermedia Center, Osaka University



CMC main building



IT core as data center

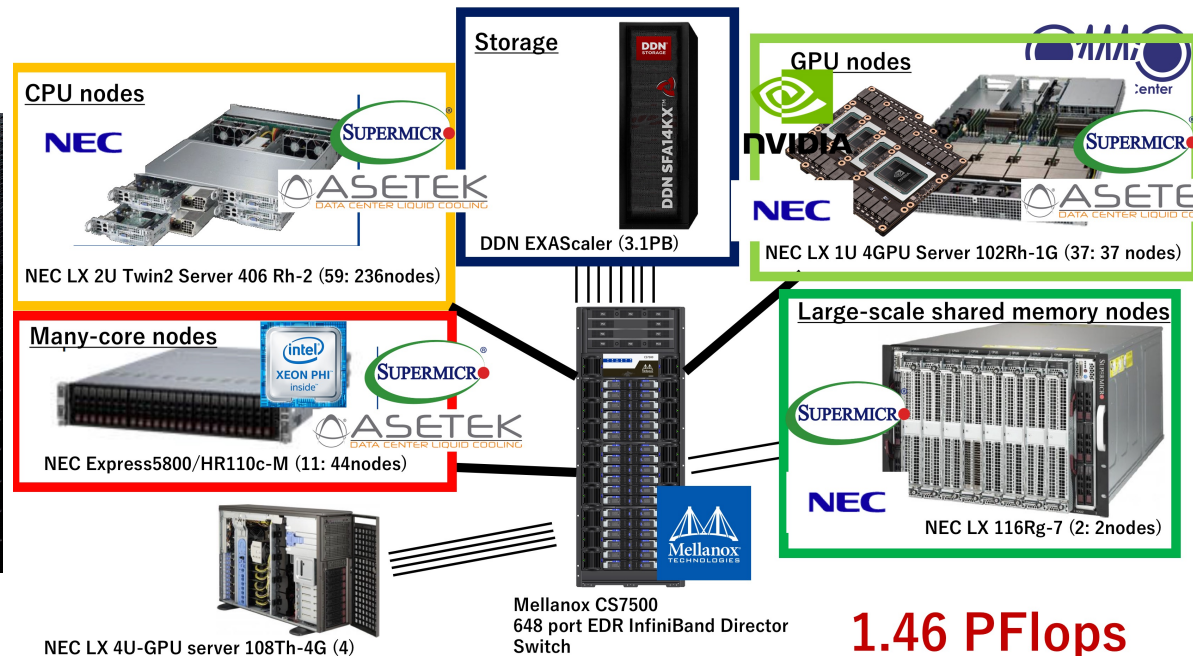
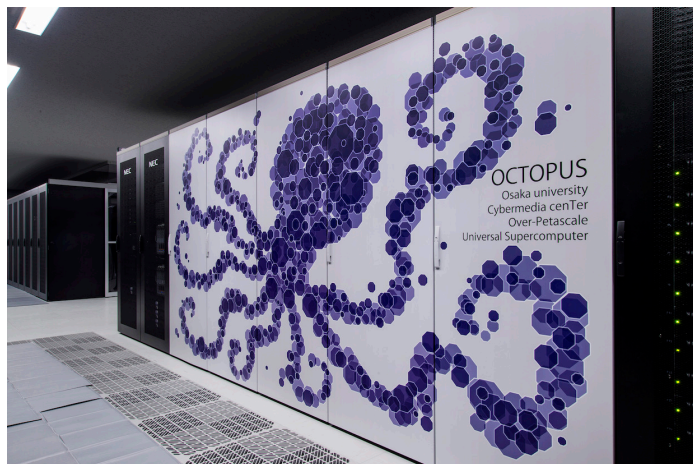
- Supercomputing center at Osaka University
 - has a responsibility of providing a powerful high-performance computing environment for university researchers across Japan as a national joint-use facility.

OCTOPUS since 2017



➤ OCTOPUS (Osaka university Cybermedia cenTer Over-Petascale Universal Supercomputer (Dec. 2017 ~))

- ❑ Peak Performance 1.46 PetaFlops
- ❑ DLC Hybrid Supercomputer systems



➤ Development of new computing needs (“Reclamation”)

Support for computing demands and need in medical, dental and healthcare scientific areas
 Expectation of DL, ML, and AI using supercomputing systems from academic research

SQUID since May 2021



Supercomputer for Quest to Unsolved Interdisciplinary Datascience



SQUID システム構成

- **Cloud-linked High Performance Computing and High Performance Data Analysis Supercomputer System (Supercomputer for Quest to Unsolved Interdisciplinary Datascience)**
 - **Peak Performance 16.591 PFlops**



CPU nodes	
1520 nodes x peak perf. 5.837 TFlops 8.871 PFLOPS	
プロセッサ	Intel Xeon Platinum 8368 (Ice Lake / 2.40 GHz 38コア) 2基
主記憶容量	256 GB
GPU nodes	
42 nodes x peak perf. 161.836 TFlops 6.797 PFLOPS	
プロセッサ	Intel Xeon Platinum 8368 (Ice Lake / 2.40 GHz コア) 2基
主記憶容量	512 GB
GPU	NVIDIA HGX A100 8 GPU ボード (Delta)
Vector nodes	
36 nodes x peak perf. 25.611 TFlops 0.922 PFLOPS	
プロセッサ	AMD EPYC 7402P (2.8 GHz 24コア) 1基
主記憶容量	128 GB
Vector Engine	NEC SX-Aurora TSUBASA Type 20A 8基
Interconnect	
ノード間接続	Mellanox InfiniBand HDR (200 Gbps)
ONION data aggregation Infra.	
S3-compatible Parallel File System 21.2PB	
ファイルシステム	DDN EXAScaler (Lustre)
HDD	20.0 PB
SSD	1.2 PB
S3-compatible Object Storage 500TB	
オブジェクトストレージ	CLOUDIAN HyperStore
HDD	500 TB

Date, S., Kido, Y., Katsuura, Y., Teramae, Y., Kigoshi, S. (2023). Supercomputer for Quest to Unsolved Interdisciplinary Datascience (SQUID) and its Five Challenges. In: Resch, M.M., Gebert, J., Kobayashi, H., Bez, W. (eds) Sustained Simulation Performance 2021. WSSP 2021. Springer, Cham. https://doi.org/10.1007/978-3-031-18046-0_1

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My Current Research Motivation



- To develop and provide a research platform where researchers and scientists can perform data-intensive research using our supercomputing systems (at the Cybermedia Center).
 - because I am in charge of the administration and management of supercomputing systems as associate professor of the center.
- The research platform should be the environment that allows researchers and scientists to exchange large amount of scientific data and perform large-scale computation among collaborators in the world.
 - I hope to provide a research platform that can improve research productivity of researchers who perform data intensive science using supercomputing systems.

How should we as a supercomputing center can support researchers who work on data-intensive science in this globalized research scene?

First encounter (experience)

History of our DTN project with Jim Chen/StarLight



- In PRAGMA, CENTRA, SEAIP, and GRP held around 2018 and 2019 (before COVID-19), we discussed about the possibility of research collaboration and Jim asked the possibility of setting up a DTN node at Osaka University.
 - I guess, the trigger was for SCAsia Data Mover Challenge 2019.
- Jim shipped a DTN node to Osaka University and we connected the node to JGN 10G network thanks to NICT.



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Intel® NUC 8 Mainstream-G mini PC with QNAP QNA-T310G1S

Result of performance measurement in SC19

- CMC to SC venue -



Memory to Memory

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NVMe to NVMe



ONION: Data Aggregation Infrastructure in Osaka University

SQUID since May 2021



Supercomputer for Quest to Unsolved Interdisciplinary Datascience



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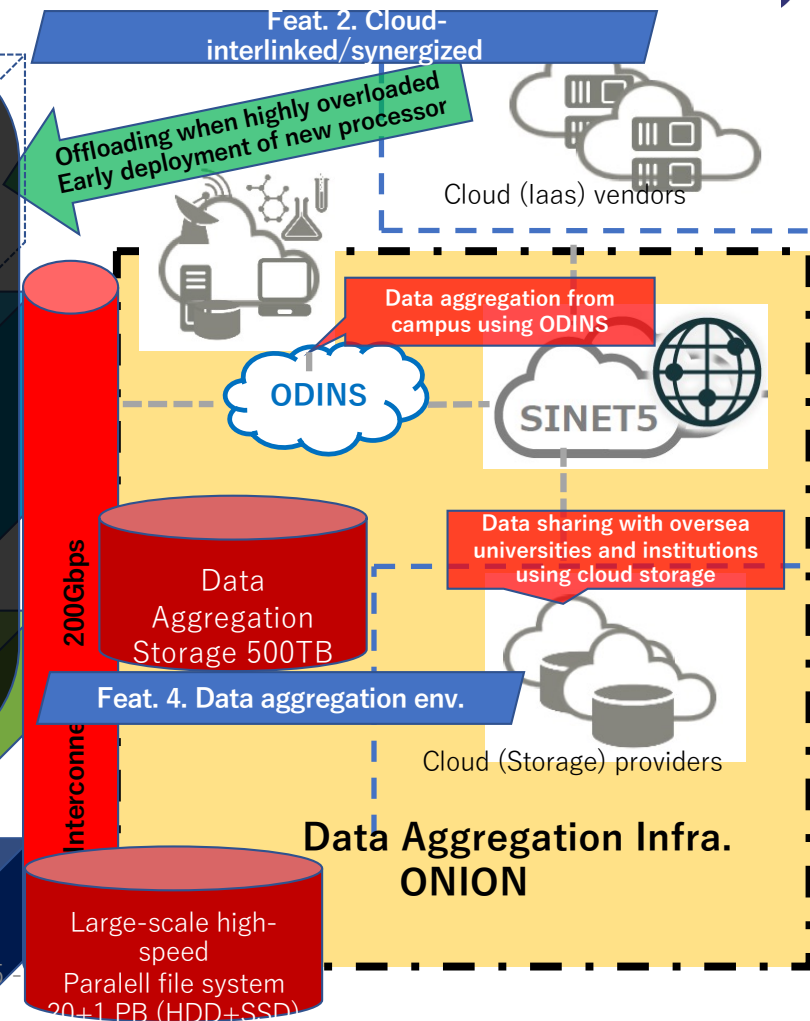
Five Features in SQUID



ONION, data aggregation infrastructure

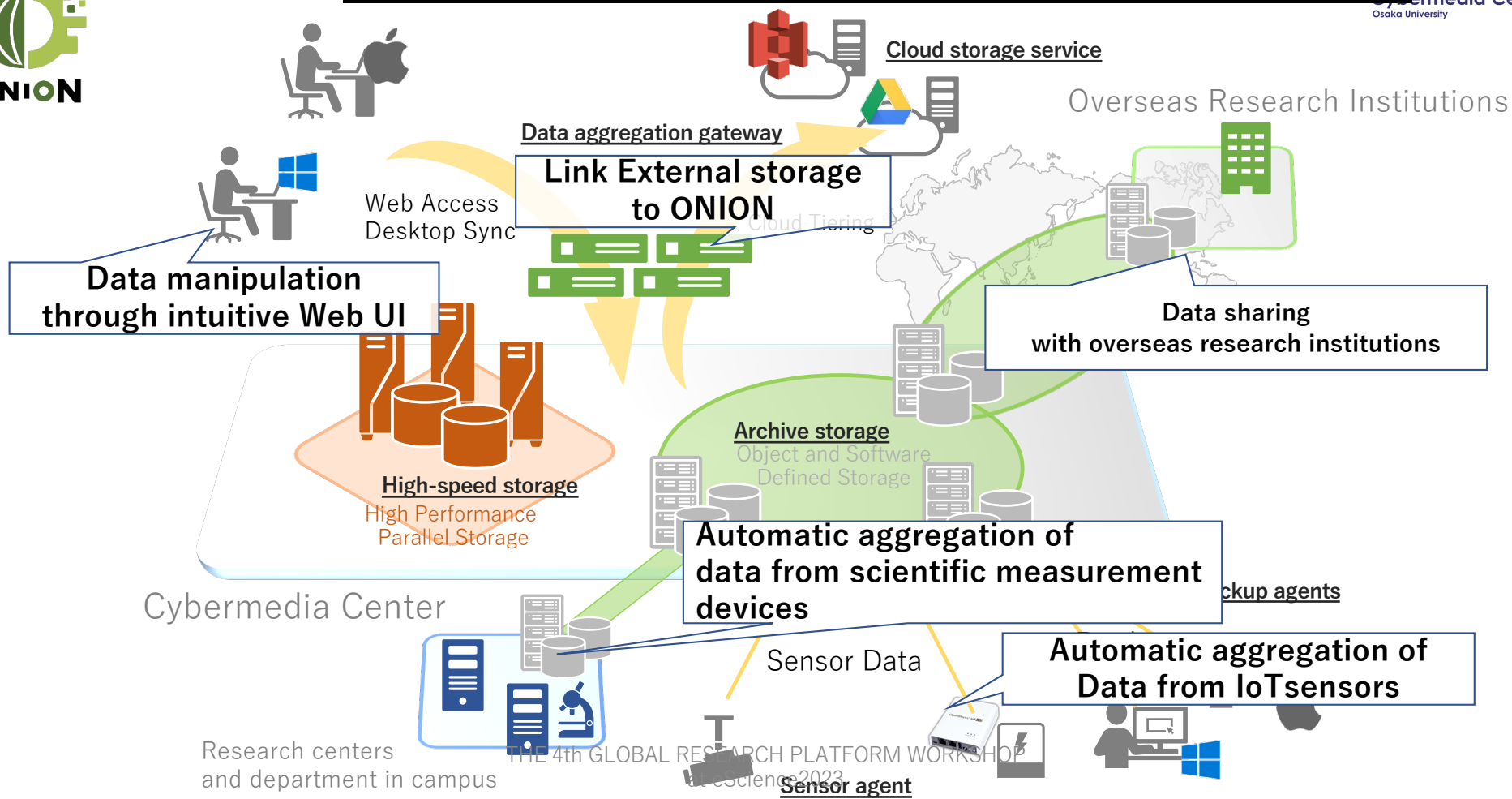
- Osaka university Next-generation Infrastructure for Open research and open innovation
- Data aggregation infrastructure that not only enables the sustainable handling of "super big data" generated in Osaka University in a responsible manner while ensuring the sustainability of such data into the future but also facilitates utilization of research data for "co-creation between academia and industries" and "international research collaboration".
- introduce as PoC (Proof-of Concept) implementation in the procurement of SQUID on a trial basis.

- The primary purpose of procurement is supercomputing system, not for data storage.
- Our designed ONION might not be useful and thus not be used.



Overview of ONION

3 storage solutions are seamlessly combined in a synergic manner



Cybermedia Center

Research centers and department in campus

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Sensor agent

Sensor Data

Automatic aggregation of Data from IoT sensors

Backup agents

Automatic aggregation of data from scientific measurement devices

Archive storage

Object and Software Defined Storage

High-speed storage
High Performance Parallel Storage

Data sharing with overseas research institutions

Overseas Research Institutions

Cloud storage service

Data aggregation gateway

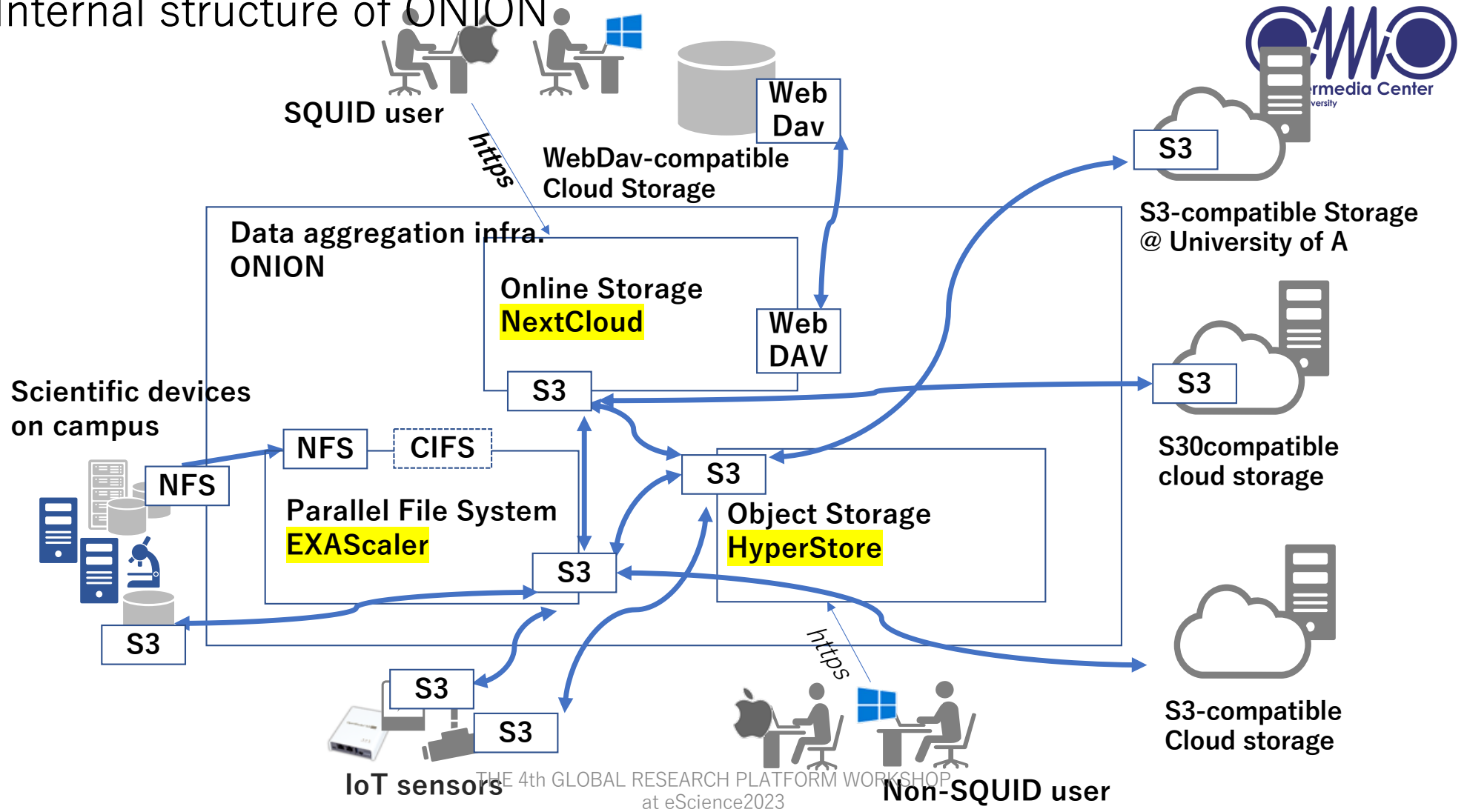
Link External storage to ONION

Cloud Tiering

Web Access
Desktop Sync

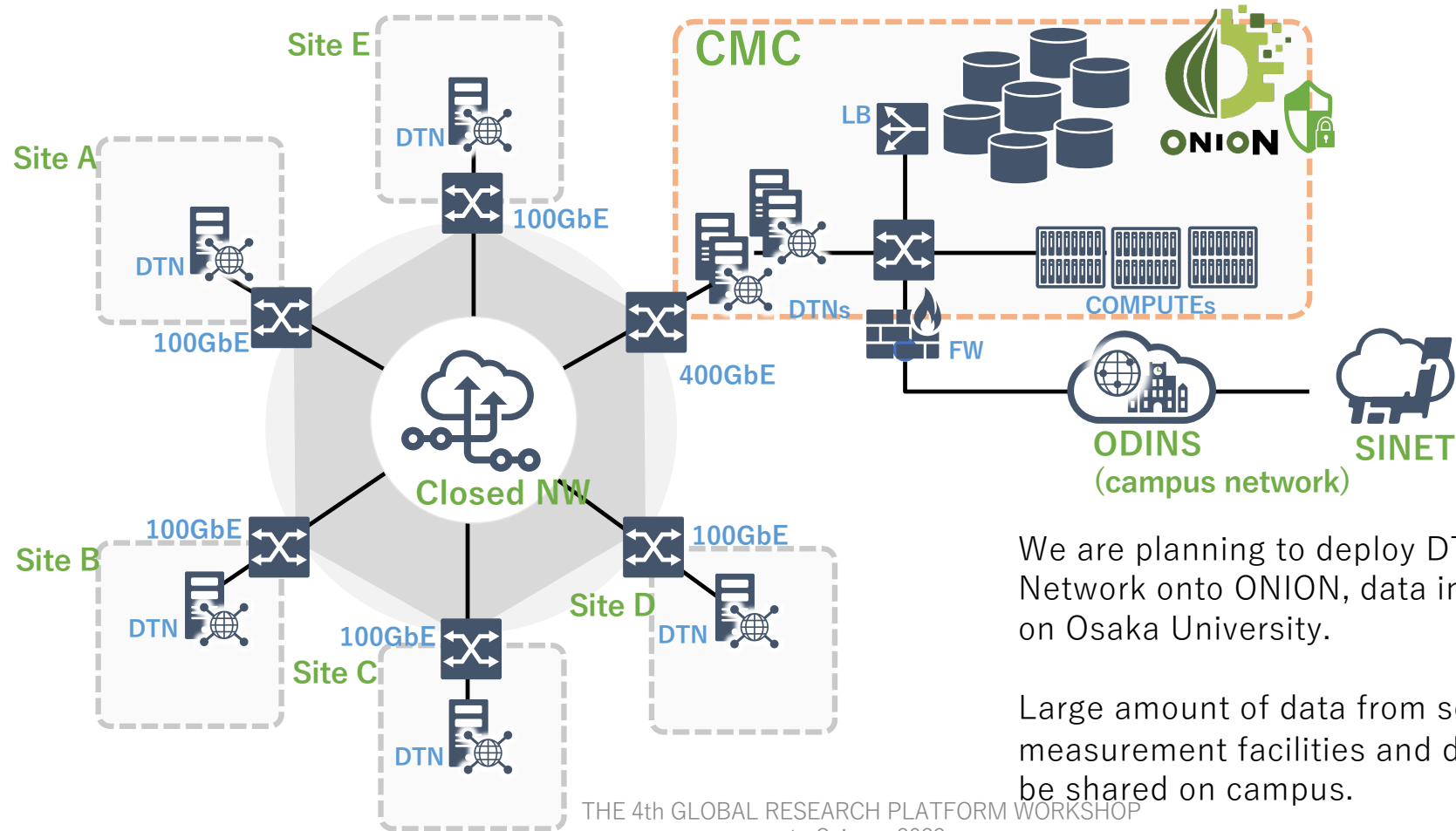
Data manipulation through intuitive Web UI

Internal structure of ONION



ONION+DTN = RED ONION

RED (Research-EnhanceD) ONION (towards Science DMZ)



We are planning to deploy DTN and high-speed Network onto ONION, data infrastructure on Osaka University.

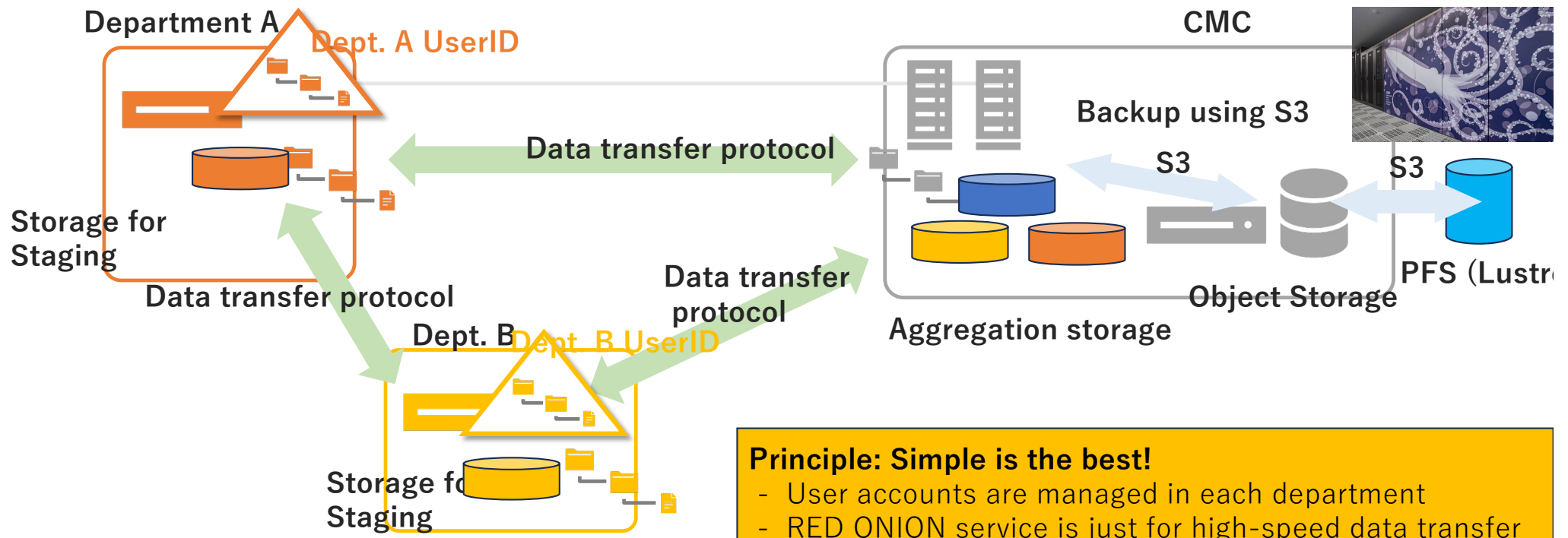
Large amount of data from scientific measurement facilities and devices can be shared on campus.

On-going work



1. Designing RED ONION from actual operation perspective
2. Performance Evaluation of DTN solutions in LAN/domestic network/SC2023

1. Designing RED ONION from actual operation perspective

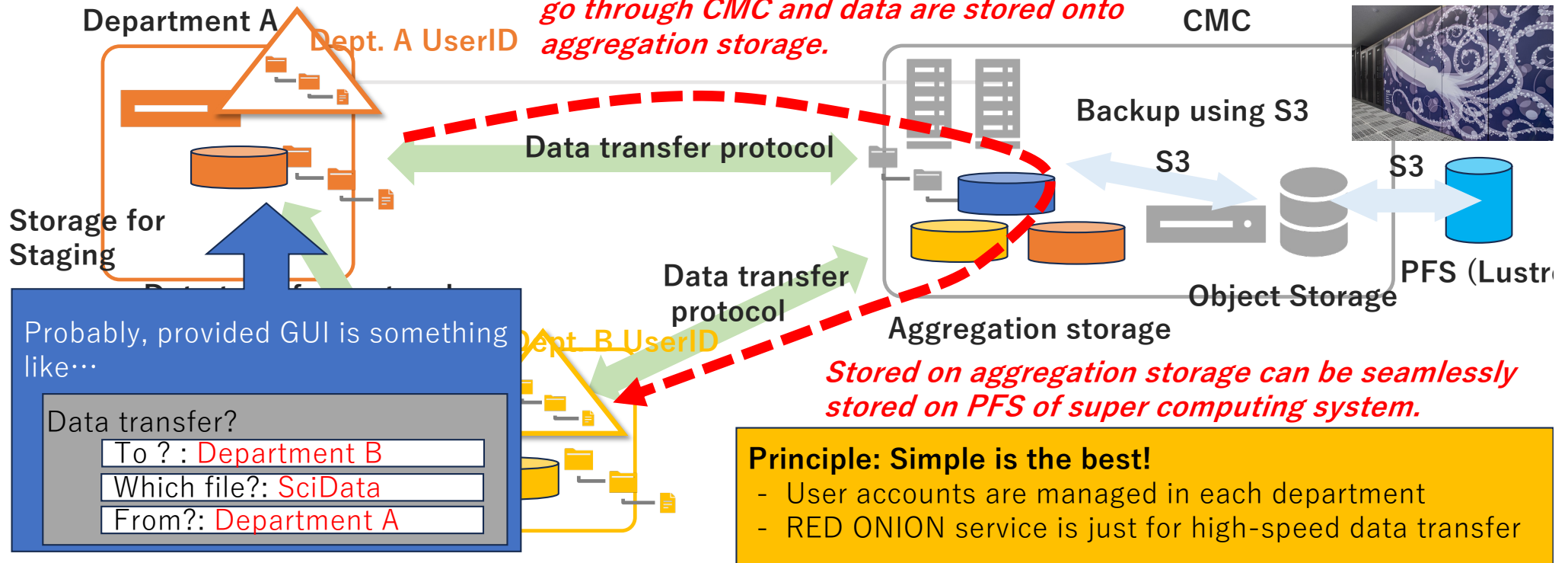


Principle: Simple is the best!

- User accounts are managed in each department
- RED ONION service is just for high-speed data transfer

1. Designing RED ONION from actual operation perspective

Data traffic on RED ONION always go through CMC and data are stored onto aggregation storage.



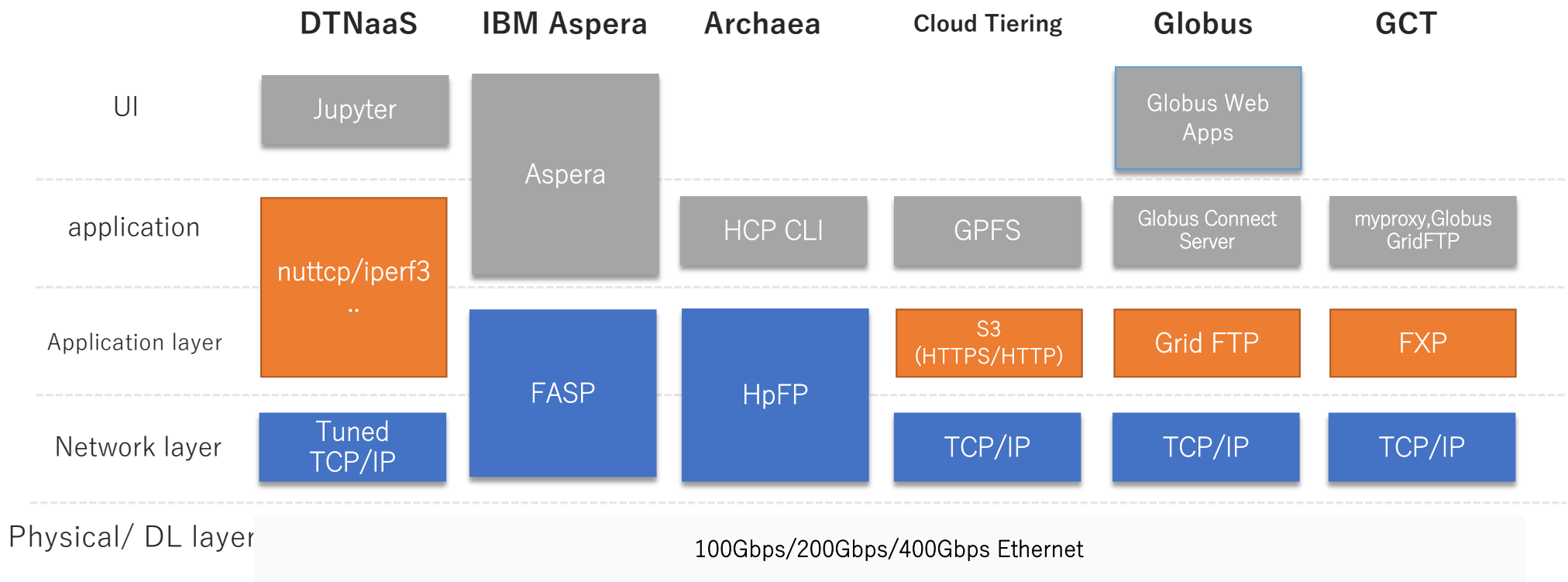
2. Performance Evaluation of DTN solutions in L



- Performance of DTN is the most important. The Second importance is easiness in administration, operation and maintenance of DTN.
- In our case, university does not have operation team enough to manage and administer RED ONION service in addition to supercomputing systems. Therefore, we currently need technical support from IT companies for daily operation.

We are now preparing a performance evaluation experiment of several DTN solutions in Osaka U LAN environment.

Several options for data transfer protocol from our perspective



Planning: performance evaluation in SC2022



- We are now working together with NICT (National Institute of Information and Communications Technology), Japan for performance evaluation / demonstration of RED ONION project in SC2023 Denver.
 - Before SC2023, we did pre-test it between Osaka U and NICT in Japan.
- For the purpose, 100Gbps network is established between Osaka U and NICT research booth in SC2023 and we plan to investigate whether our RED ONION environment is feasible in terms of performance and administration.

SC23 Network Research Exhibition: Demonstration Preliminary Abstract

[Performance Evaluation of DTNs Towards Research-Enhanced ONION (RED ONION)]



Susumu DATE, Cybermedia Center, Osaka University, date@cmc.osaka-u.ac.jp

Abstract

The Cybermedia Center (CMC) is a supercomputing center in Osaka University, Japan. The CMC is in charge of providing a high-performance computing environment for Japanese researchers in both academia and industries. From the perspectives of the rising demand on high performance data analysis characterized AI (artificial intelligence), ML (machine learning) and DL (deep learning) and the necessity of research reproducibility, the CMC has been working on data aggregation infrastructure named ONION (Osaka university Next-generation Infrastructure for Open research and open innovation) in campus, so that researchers can perform HPC and HPDA immediately after obtaining scientific data from scientific measurement devices and research data including computation results are managed in a proper way. In the future vision, we are exploring the development of RED ONION, which allows research institutions and departments in campus to transfer large amount of research data through the use of Data Transfer Nodes on high-speed campus networks. For the purpose, we are planning to use this SC2023 demonstration opportunity to learn the performance characteristics of candidate DTN technologies over a wide-area network between US and Japan for our RED ONION concept.

Goals

Also, we need 100Gbps network between Osaka University and NICT booth in SC2023. We would like to have a L2 connection between them. Also, it would be greatly helpful if we can use the network even in a time-shared manner. This is because we plan to have direct connection from the CMC to each department or research institute on Campus on the basis of 100G ethernet. Also, we would like to verify the performance of DTNs on a wide-area network because we personally would like to apply this data transfer solution to the network with our partner universities.

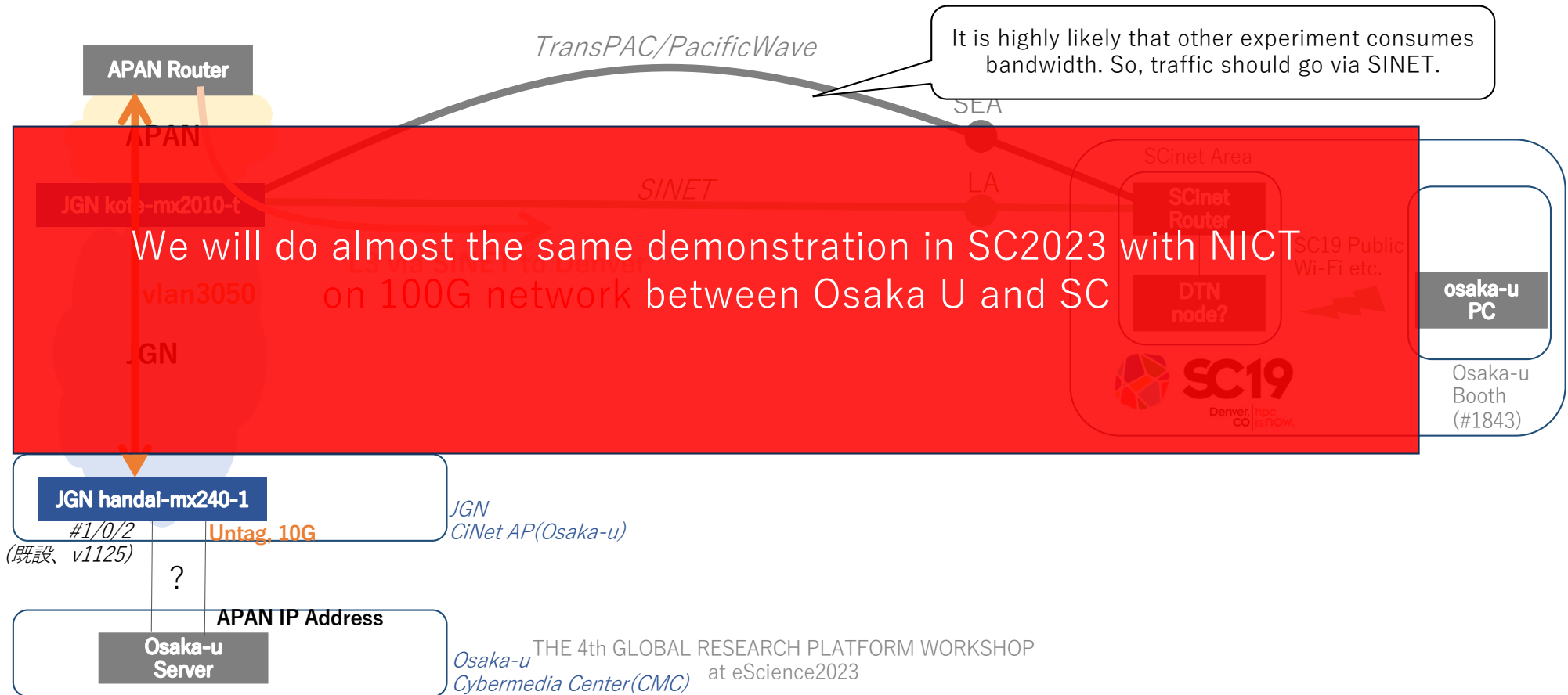
Involved Parties

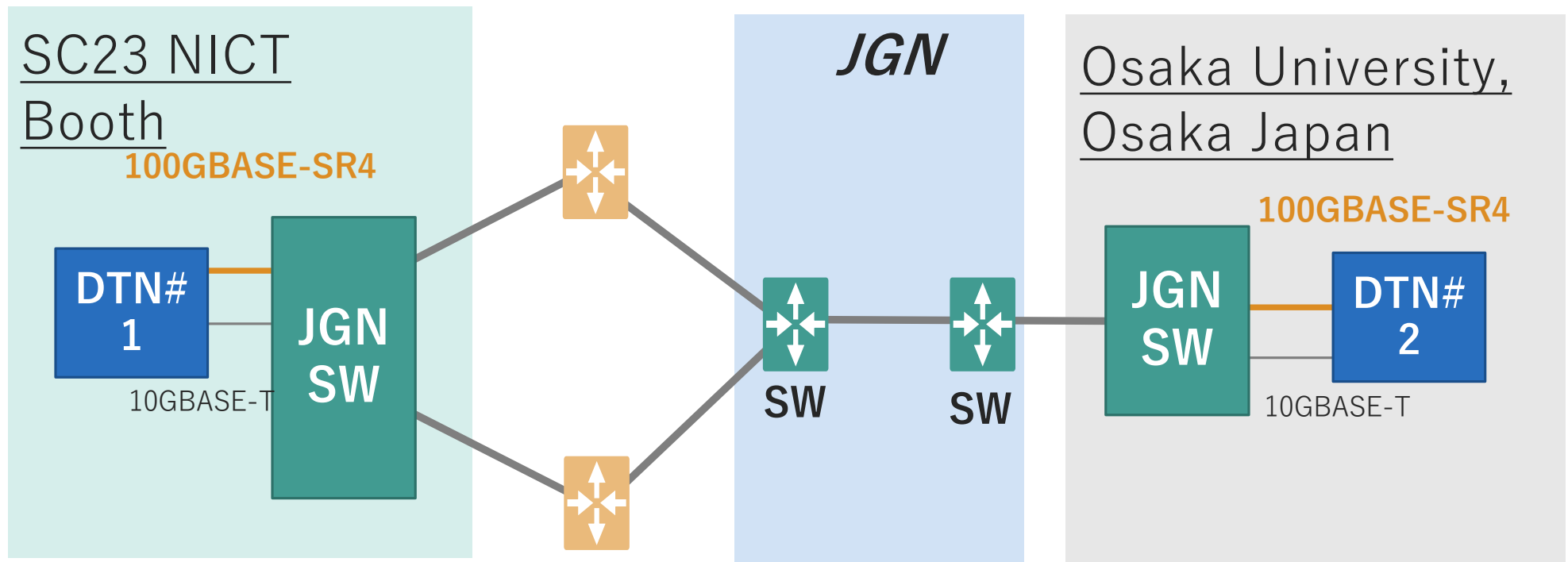
[List of other institutions, researchers and entities involved in the planning and execution of this demonstration. This should include names and contact information]

- Susumu Date, Osaka University, date@cmc.osaka-u.ac.jp
- Kenji Ohira, Osaka University, ohira@cmc.osaka-u.ac.jp
- Kodai Fukuda, Osaka University, fukuda.kodai@ais.cmc.osaka-u.ac.jp
- Hideyuki Tanushi, Osaka University, htanushi.cmc@osaka-u.ac.jp

History2 of our DTN project with Jim Chen/StarLight

- **SC19** Experiment conducted between Osaka University and SC venue.





Result of performance measurement in SC19

- CMC to SC venue -



Memory to Memory

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NVMe to NVMe

Scientific devices on campus

Researchers on campus

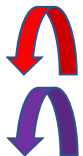
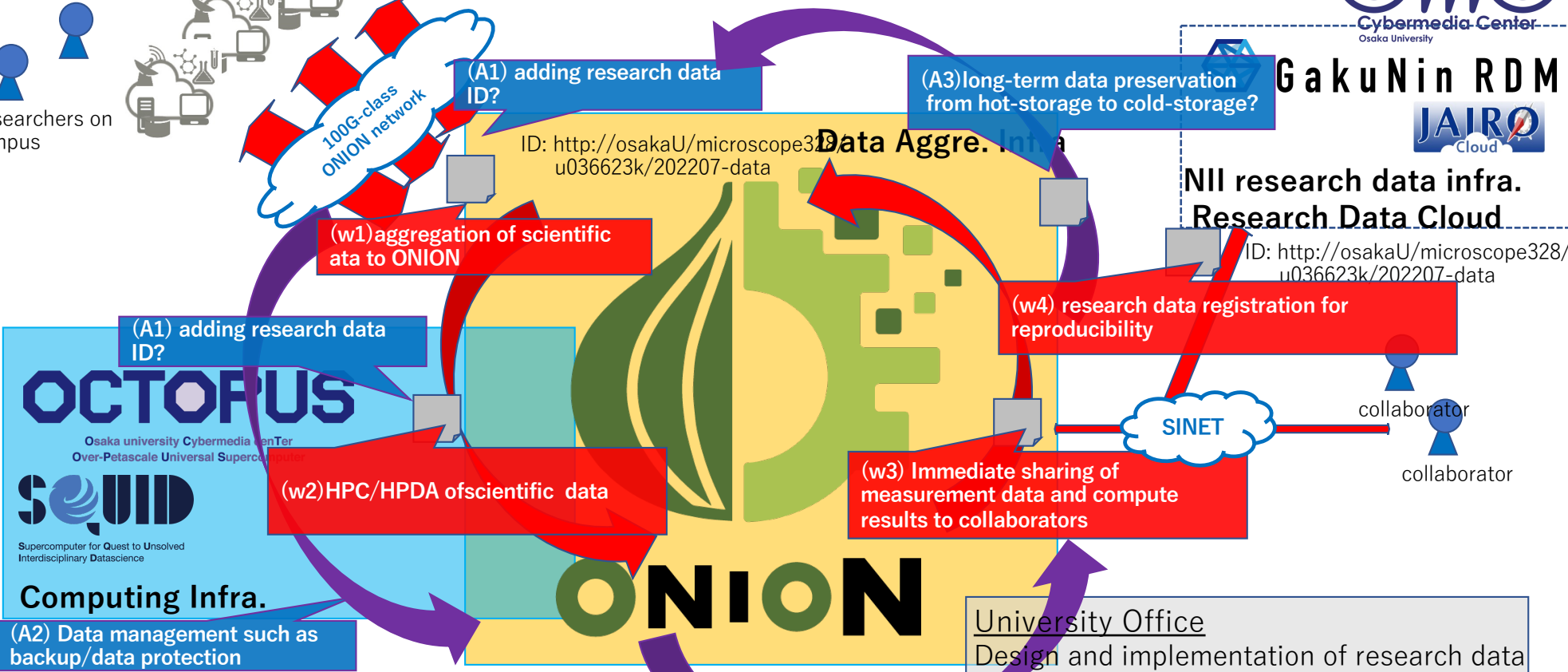
Towards research data management infrastructure at Osaka University (Personal view)



GakuNin RDM



NII research data infra. Research Data Cloud



Researcher's data utilization flow
Research data management flow

CMC ONION admin office?
Design and implementation of data Administration policy at eScience2023

University Office
Design and implementation of research data Administration policy
* Reserch data(measurement data, compuing result, papers, etc)
* How to use GakuNinRDM for proper data utilization

Summary



- Cybermedia Center at Osaka University currently has been operating a data aggregation infrastructure named ONION.
- To facilitate scientists to move data on campus, we have been working on the realization of RED ONION.
- For the purpose, the performance of DTN solutions is the most important. Also, for stable operation and administration of RED ONION, the easiness is also being evaluated.
- In SC2023, we plan to investigate the performance profile of DTN in a 100Gbps network between Osaka and Denver in addition to pre-test in a domestic network thanks to NICT, Japan.