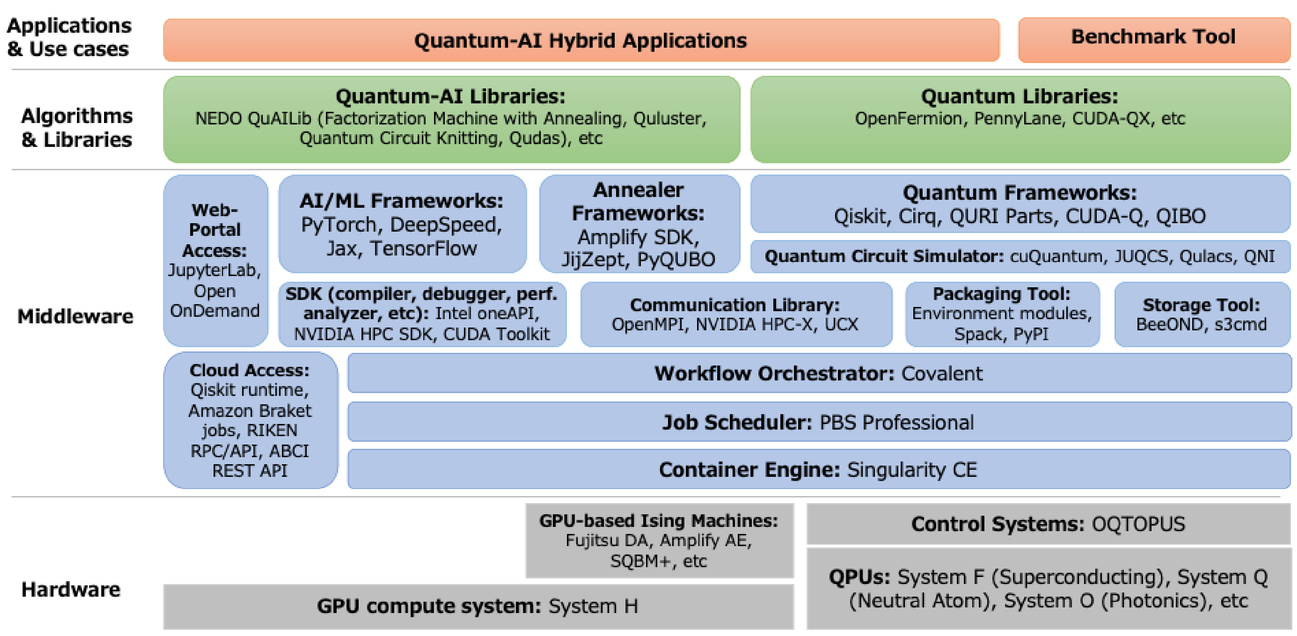
ABCI-Q Software Environment for Quantum-Classical Hybrid Computing

Software Stack

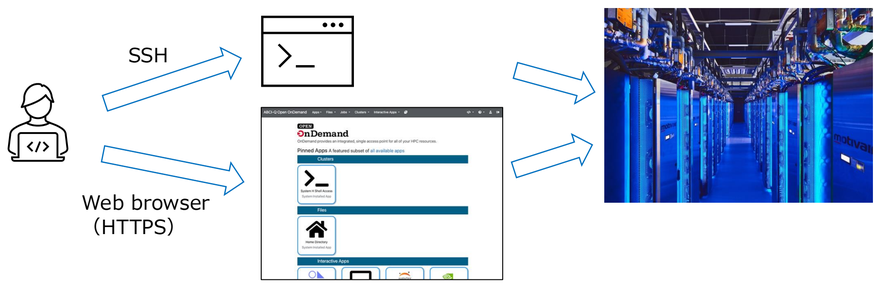


- System H builds on a well-established HPC software stack, extending its middleware to support hybrid quantum-AI workloads
- Users can install custom software to create tailored R&D environments
- The system offers access to multiple GPU-enabled quantum circuit simulators and Ising machines:
  - NVIDIA cuQuantum Appliance
  - Fujitsu Digital Annealer
  - Toshiba SQBM+
  - Fixstars Amplify Engine

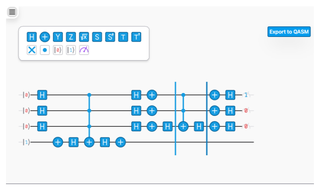
User Environment

System H enables ABCI-Q users to effectively leverage cutting-edge computing resources for hybrid HPC and quantum workloads. With a web browser-based interface powered by Open OnDemand, we provide an intuitive environment that lowers the barrier to advanced computation—supporting industrial applications and fostering innovation

Open OnDemand



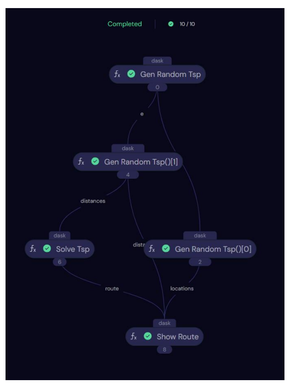
- Web Console
- File browser
- Job management
- Jupyter Lab
- Web applications for quantum computing (Qni, etc)



https://qniapp.net/

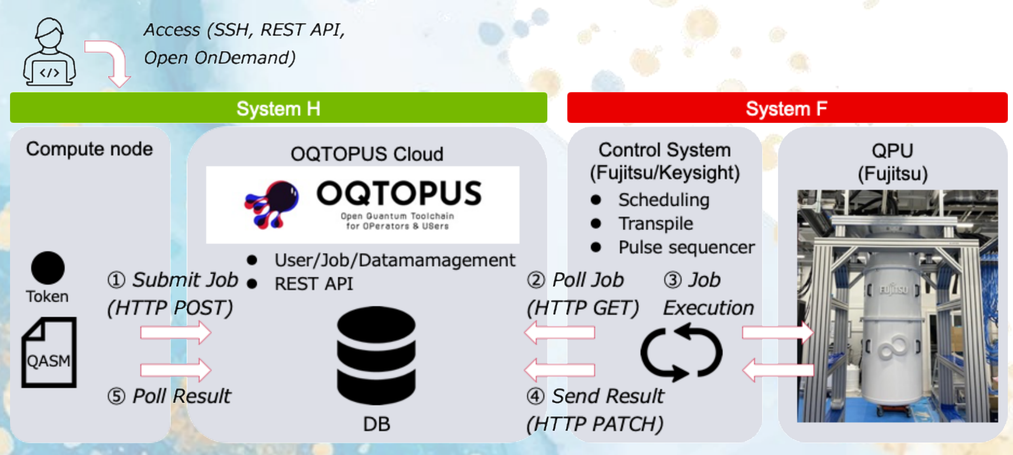
Covalent: Quantum-Classical Application Workflow

- A workflow orchestration platform for developing quantum-classical hybrid applications, led by DataRobot Inc
- ABCI-Q provides a web application that launches Covalent services and JupyterLab on System H compute nodes
- We developed Covalent job scheduler plugins for ABCI serices
  - Altair Grid Engine
  - Altair PBS Professional
    - https://github.com/QuAILib/covalent-gridengine-plugin
    - https://github.com/QuAILib/covalent-pbs-plugin



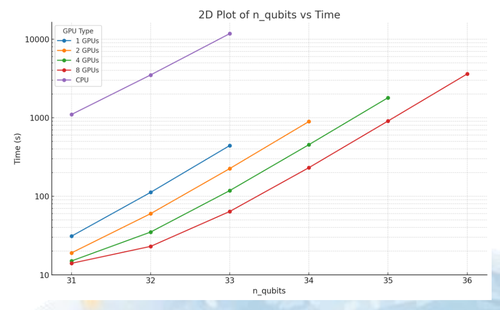
OQTOPUS: Quantum-HPC Hybrid Job Execution

- Support for hybrid job execution through integration between OQTOPUS middleware and job scheduler
- https://oqtopus-team.github.io/

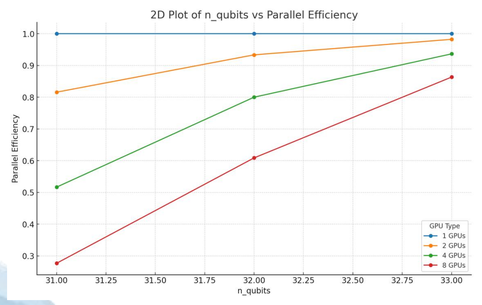


QURI Parts: GPU-accelerated Open Source Library

- An SDK for creating and executing quantum algorithms on various quantum platforms, led by QunaSys Inc
- We developed a simulation platform for QURI Parts that uses cuQuantum to leverage multiple GPUs
  - https://github.com/QunaSys/quri-parts-cuquantum



Simulation Time



Parallel Efficiency

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AIST SC25 Website