

Mastering Opportunistic Computing Resources for HEP

Matthias Jochen Schnepf, Christoph Heidecker, Max Fischer, Manuel Giffels, Andreas Heiss, Eileen Kuehn,
Andreas Petzold, Günter Quast

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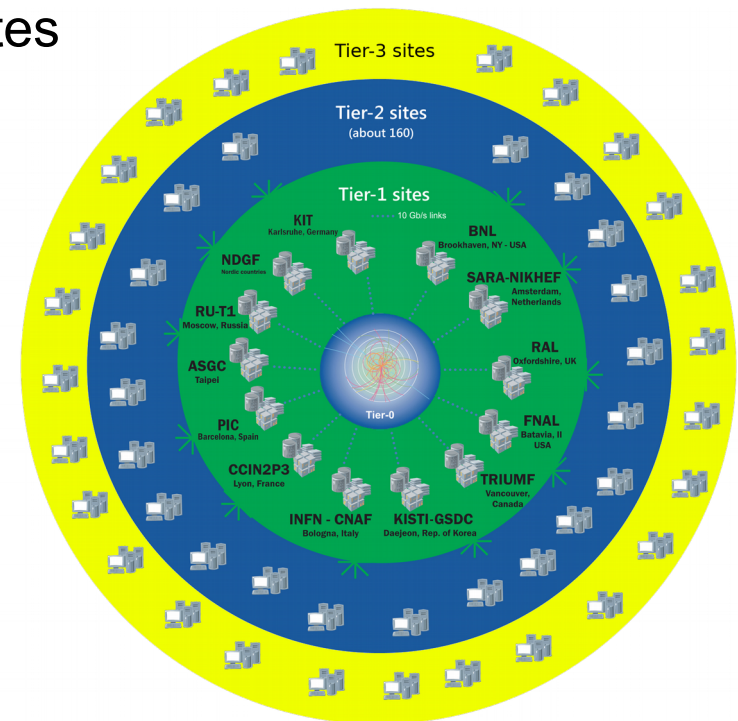
SCC / ETP



HEP Computing Infrastructure

■ HEP Resources

- Tiered structure
- HEP specific software environment
- Dedicated network to other HEP sites
- Persistent Grid Storage



Based on https://espace2013.cern.ch/WLCG-document-repository/images1/WLCG/WLCG-TiersJun14_v9.png

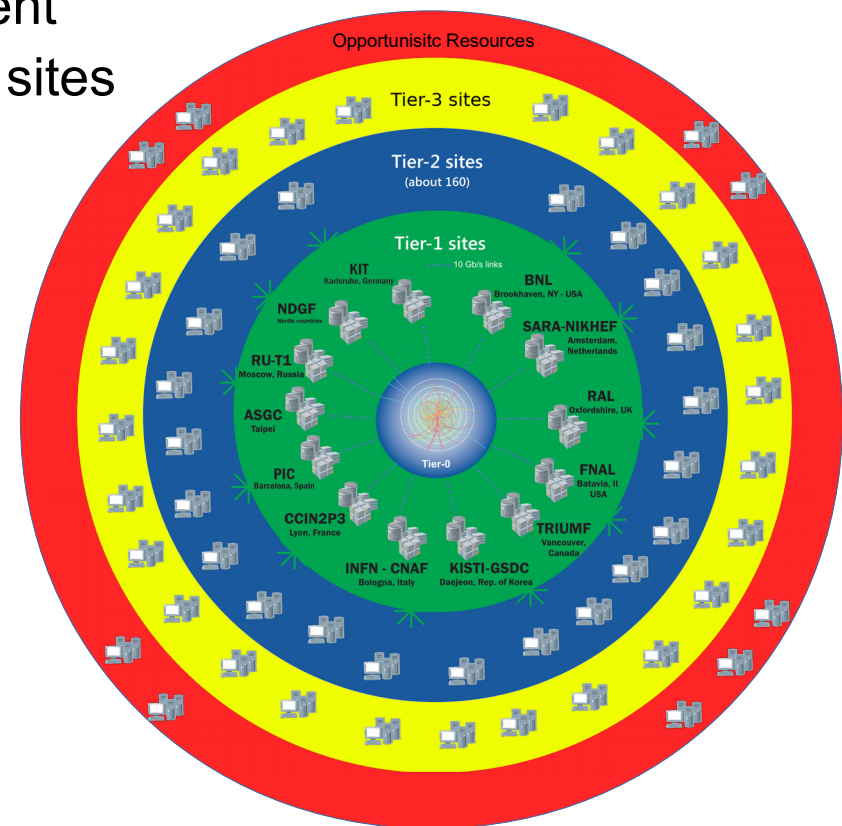
HEP Computing Infrastructure

■ HEP Resources

- Tiered structure
- HEP specific software environment
- Dedicated network to other HEP sites
- Persistent Grid Storage

■ Opportunistic Resources

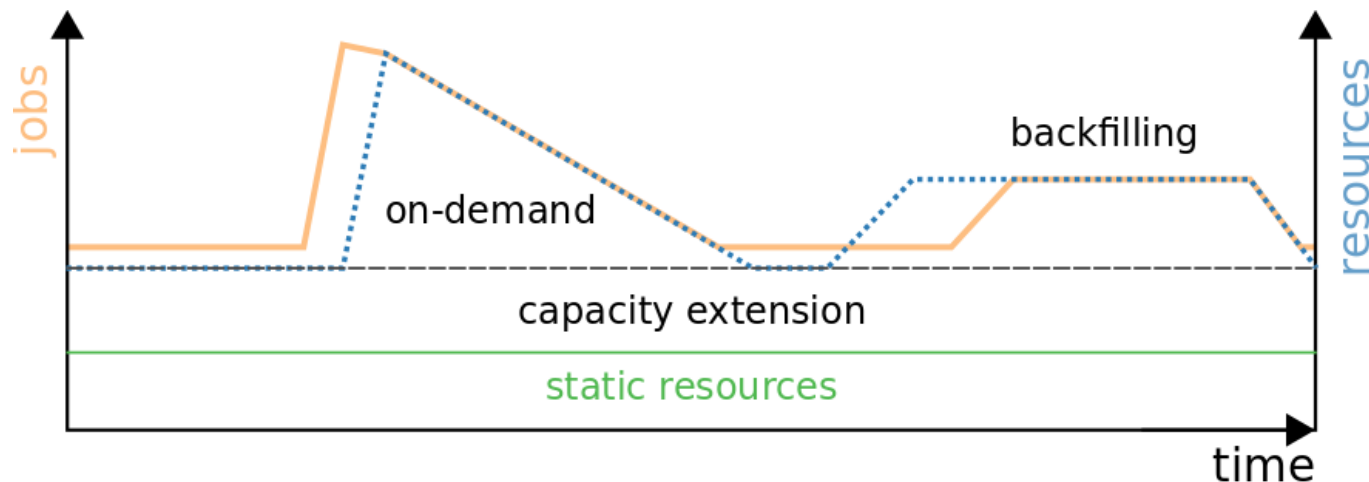
- Extension of existing sites
- Diverse software environment
- Non-dedicated network to other HEP sites
- Temporal availability of local storage



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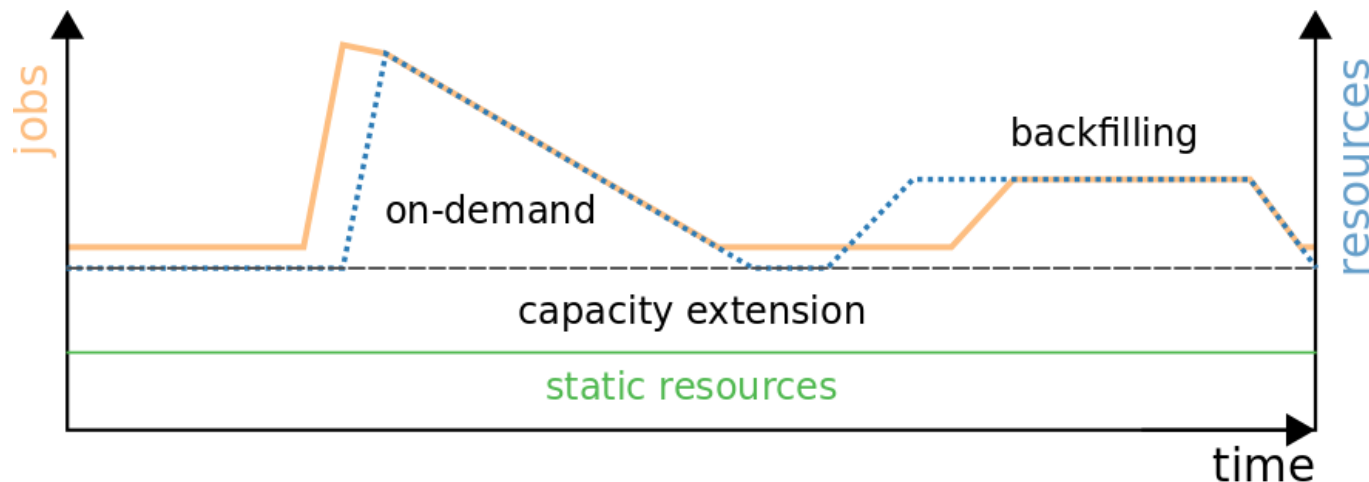
Provisioning Types

- Resource dependent provisioning of opportunistic resources
 - Backfilling of unused resources (cycle stealing)
 - On-demand booking for job peak loads
 - Constant capacity extension



Provisioning Types

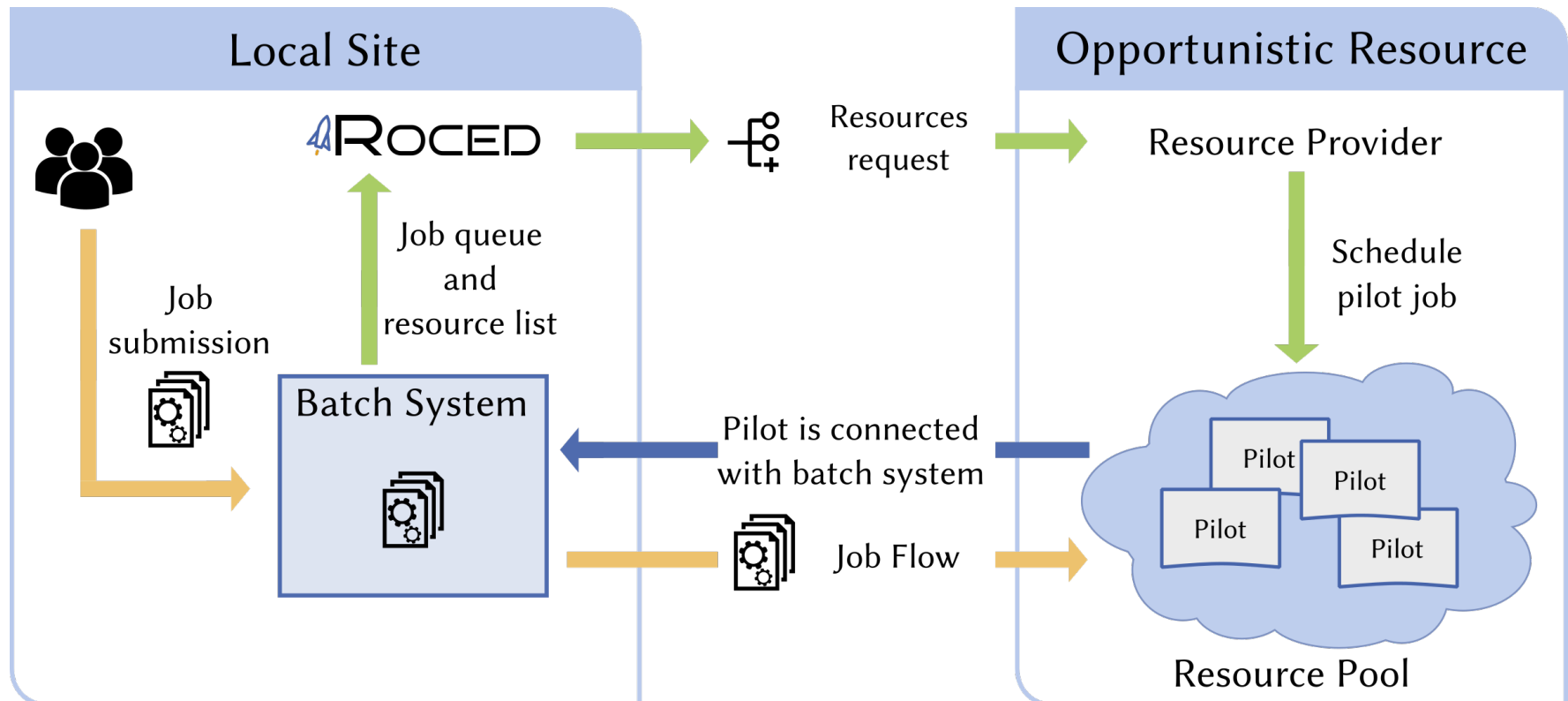
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- Resource scheduler to enable dynamic resource provisioning and controlling

Resource Scheduler: ROCED

- Lightweight management solution developed at KIT
- Support for multiple batch systems and resource providers
- <https://github.com/roced-scheduler/ROCED>



Example of Opportunistic Resources

■ KIT Desktop Cloud

- Local desktop PCs
- Provisioning of HEP software environment via docker
- Backfilling to utilize unused resources (cycle stealing)
- Accessible for local users



■ Helix Nebula Science Cloud

- EU research project to provide computing resources
- On-demand provisioning of VMs
- Accessible for different scientific communities in the EU



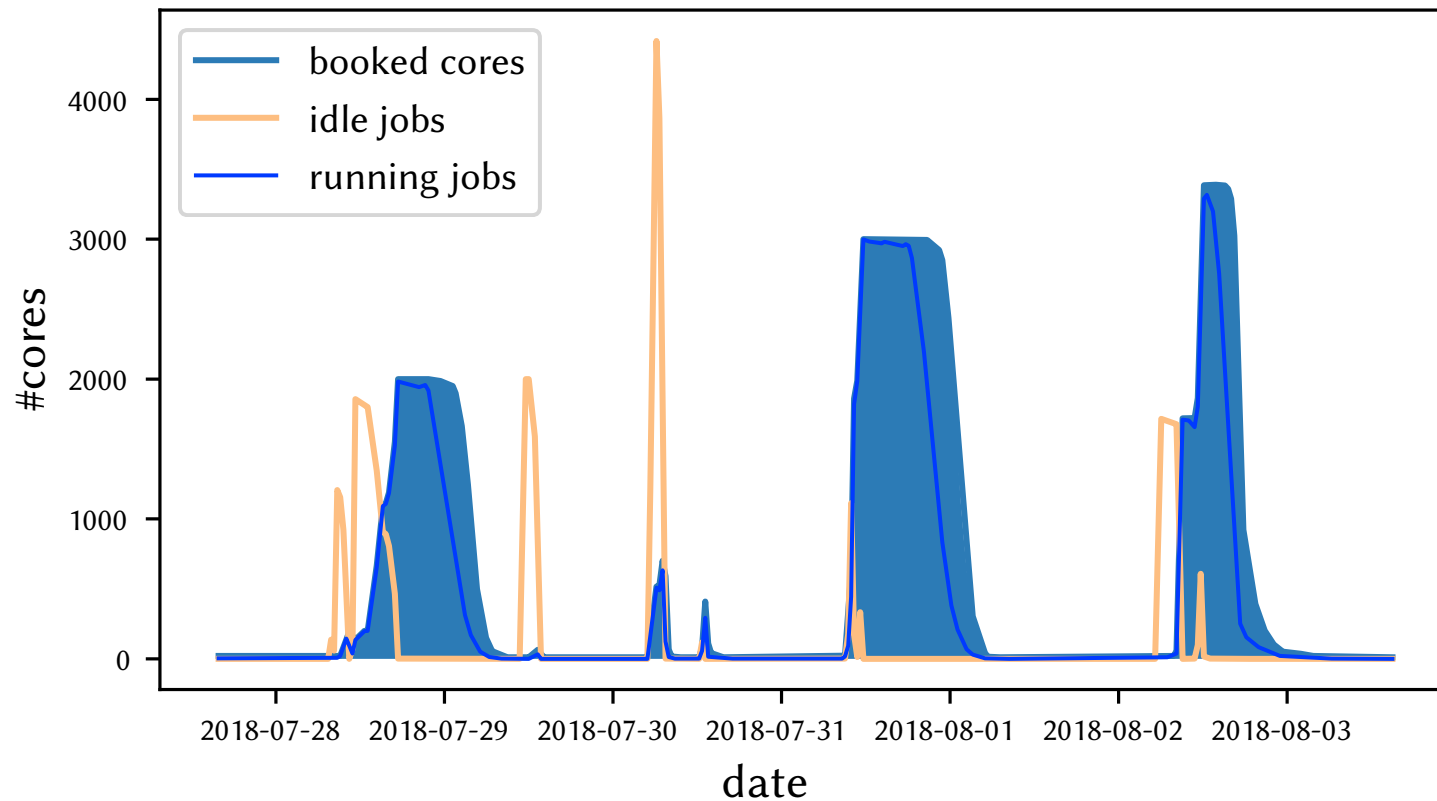
■ HPC NEMO

- Shared HPC centre with additional virtualization functionality
- On-demand capacity extension allocated via fair share
- Accessible for very diverse scientific communities in state of BW



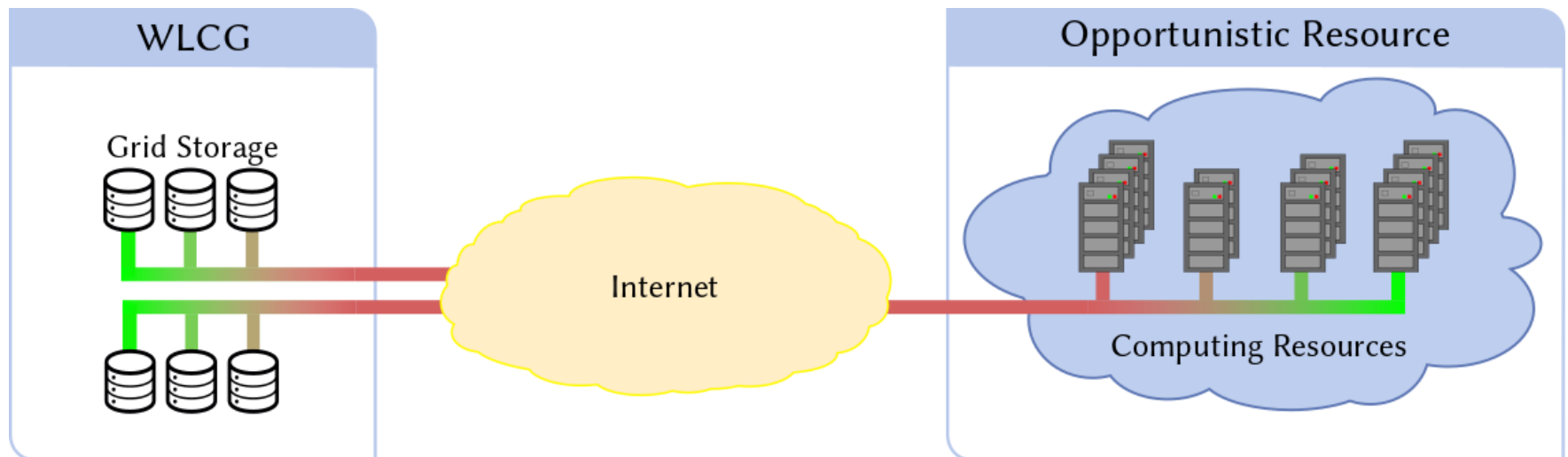
HPC NEMO Usage

- Dynamic on-demand provisioning of VMs
- Integration into local batch system
- Scalability up to 11k Cores proven



Challenges of Opportunistic Resources

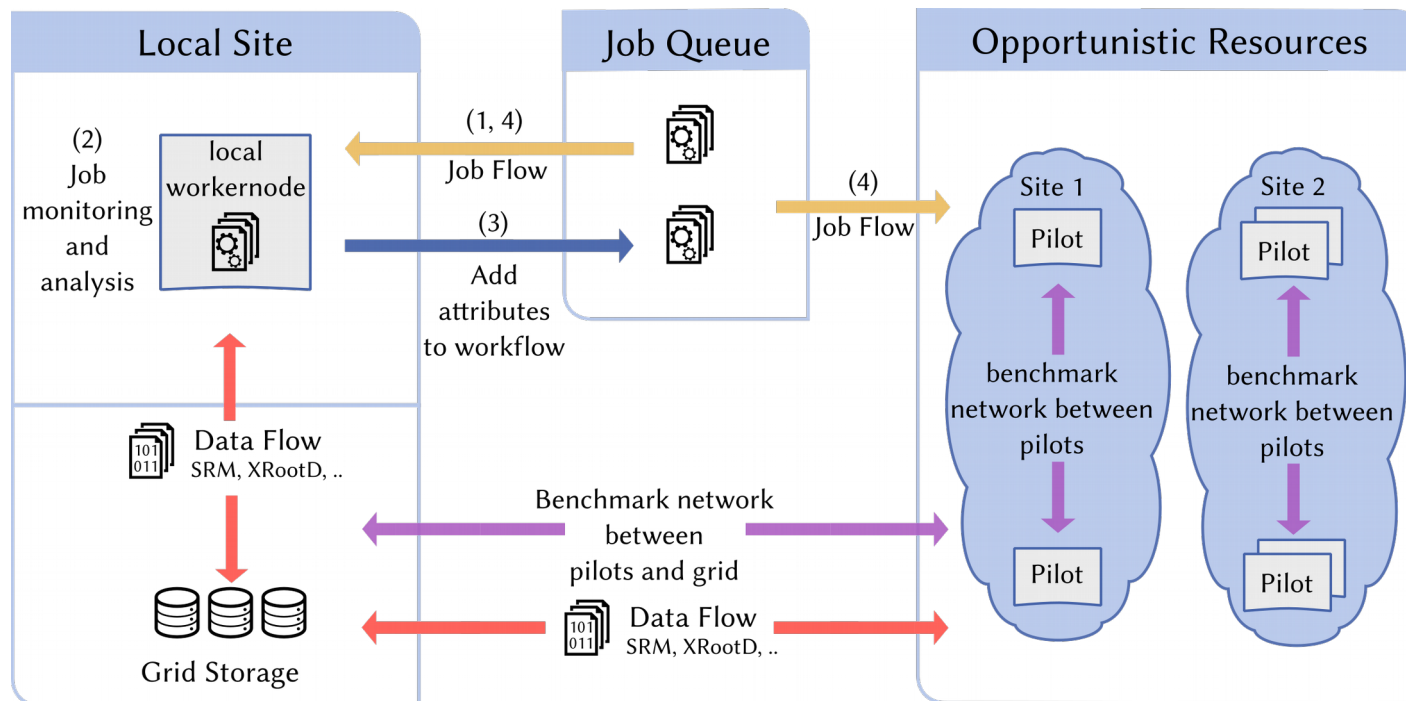
- Persistent storage only located at HEP sites
- Storage performance usually designated for one Grid site
- Network shared at opportunistic resource
- Varying utilization of storage and network



Outlook

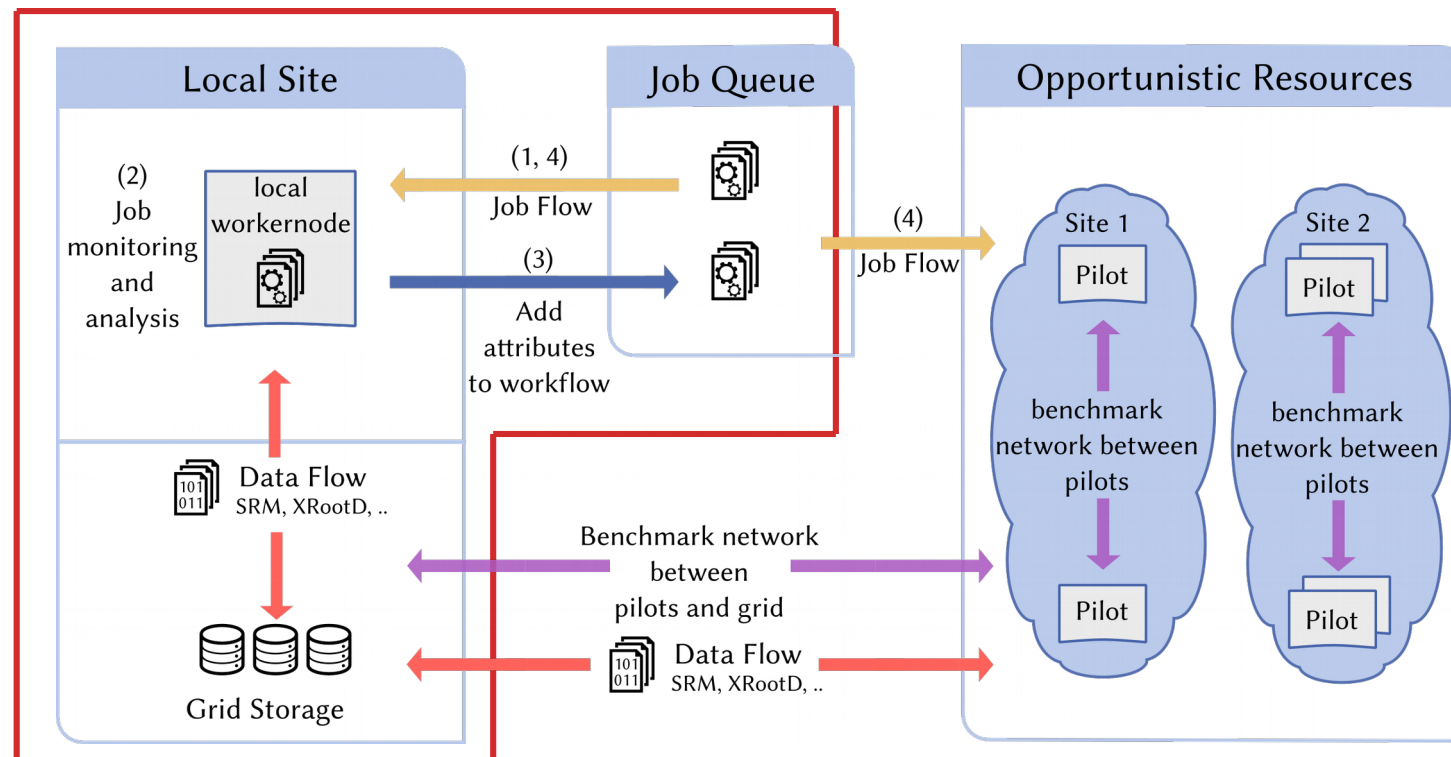
■ Tackle the challenges with

- Analysis of workflows
- Benchmarking of resources



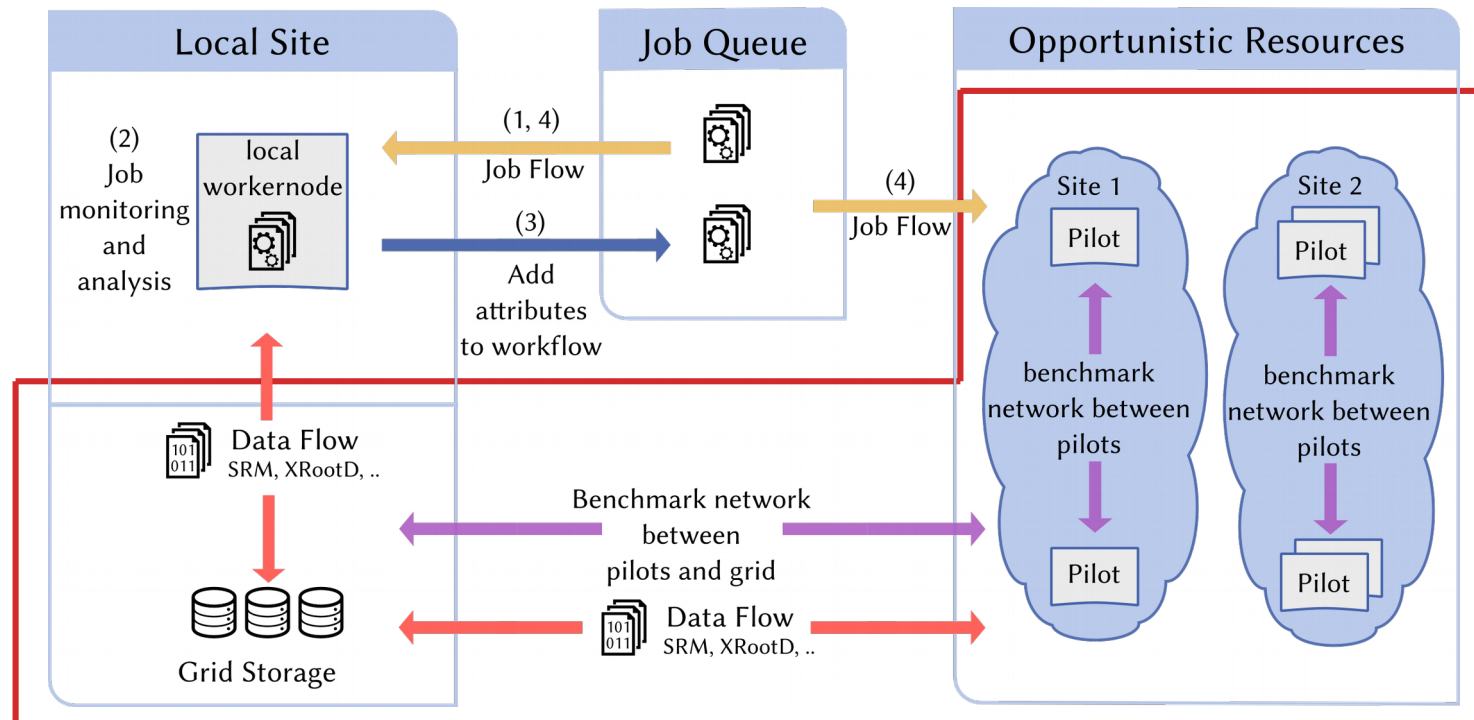
Outlook: Workflow analysis

- Deploy sample jobs of one workflow to local resources
- Monitor traffic, walltime, memory, etc. of job
- Assign attributes to all jobs corresponding to the analyzed workflow



Outlook: Resource Benchmark

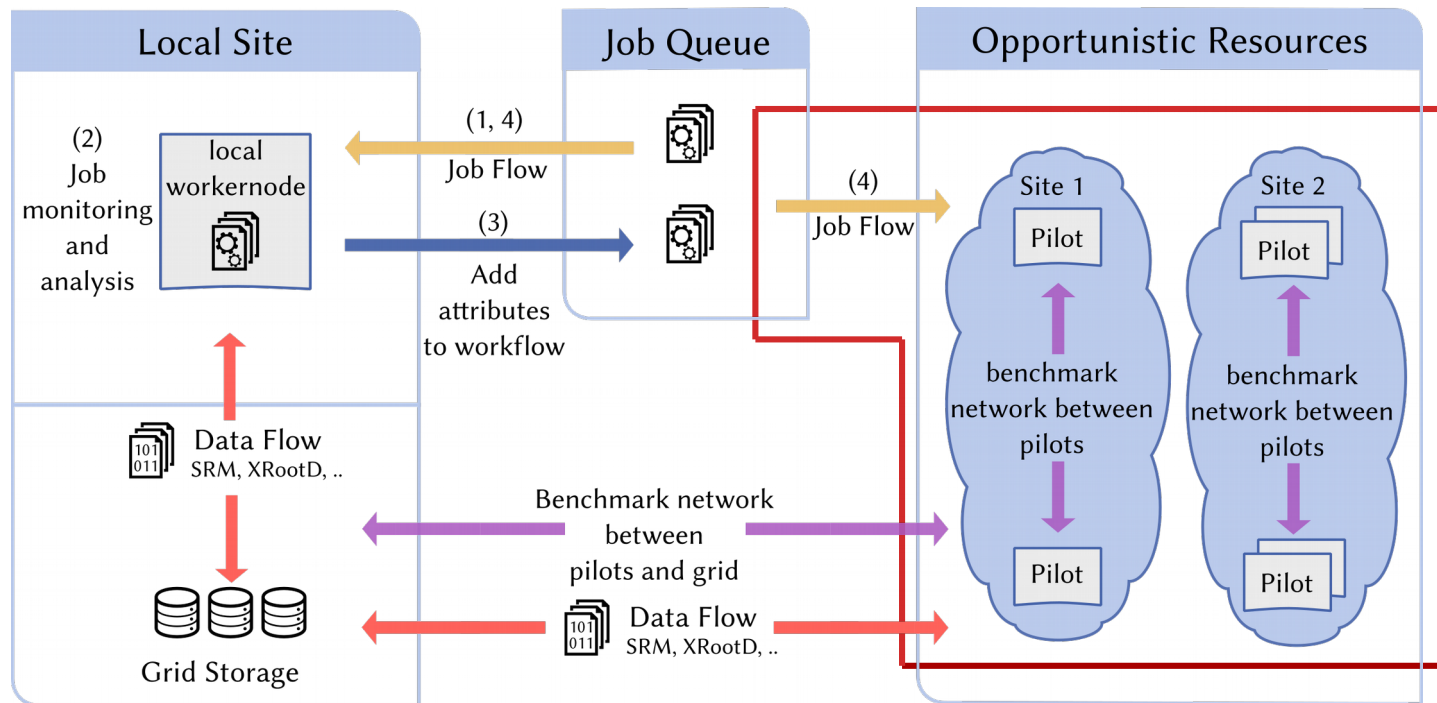
- Pilots benchmark network bandwidth periodically and coordinated
- Benchmark network capacity between
 - Pilots (WN network capacity)
 - Pilots and Grid storage (site network capacity)



Outlook: Bandwidth Scheduling

■ Advanced and optimized scheduling

- Schedule jobs based on pilot resources and bandwidth
- Schedule pilots based on site resources and bandwidth



Conclusion

- Productive usage of
 - Opportunistic resources utilizing VMs and container technologies
 - On-demand provisioning of resources using ROCED
- Faced challenges caused by dynamic and shared resources
- Future research
 - Assignment of workflow attributes based on job monitoring
 - Smart pilots to map the network resources over time via coordinated benchmarks
 - Advanced scheduling of opportunistic resources and jobs

Backup

