

Transparent expansion of WLCG compute sites using HPC resources

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FIDIUM Collaboration Meeting 2022

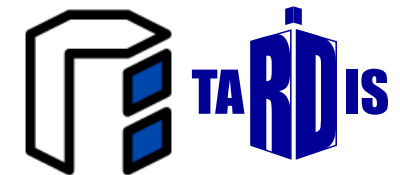
Computing in German HEP

- “Official” WLCG sites provide compute resources for user analysis and production jobs of the LHC experiments
- As of the [newest prediction](#) CMS does not expect a major shortfall in computing power
- However, situation in Germany complex:
 - WLCG resources, research HPC clusters, institutes resources

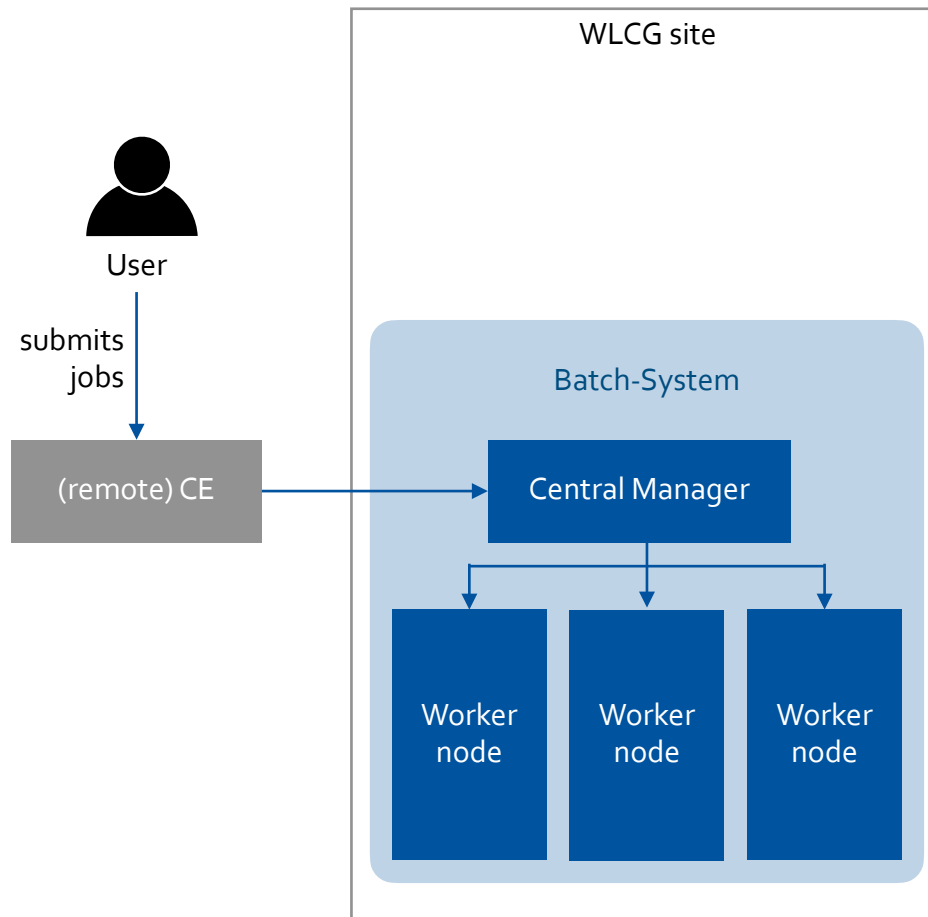
Diverse landscape for experiments
→ Consolidate resources for streamlined access

COBaID / TARDIS

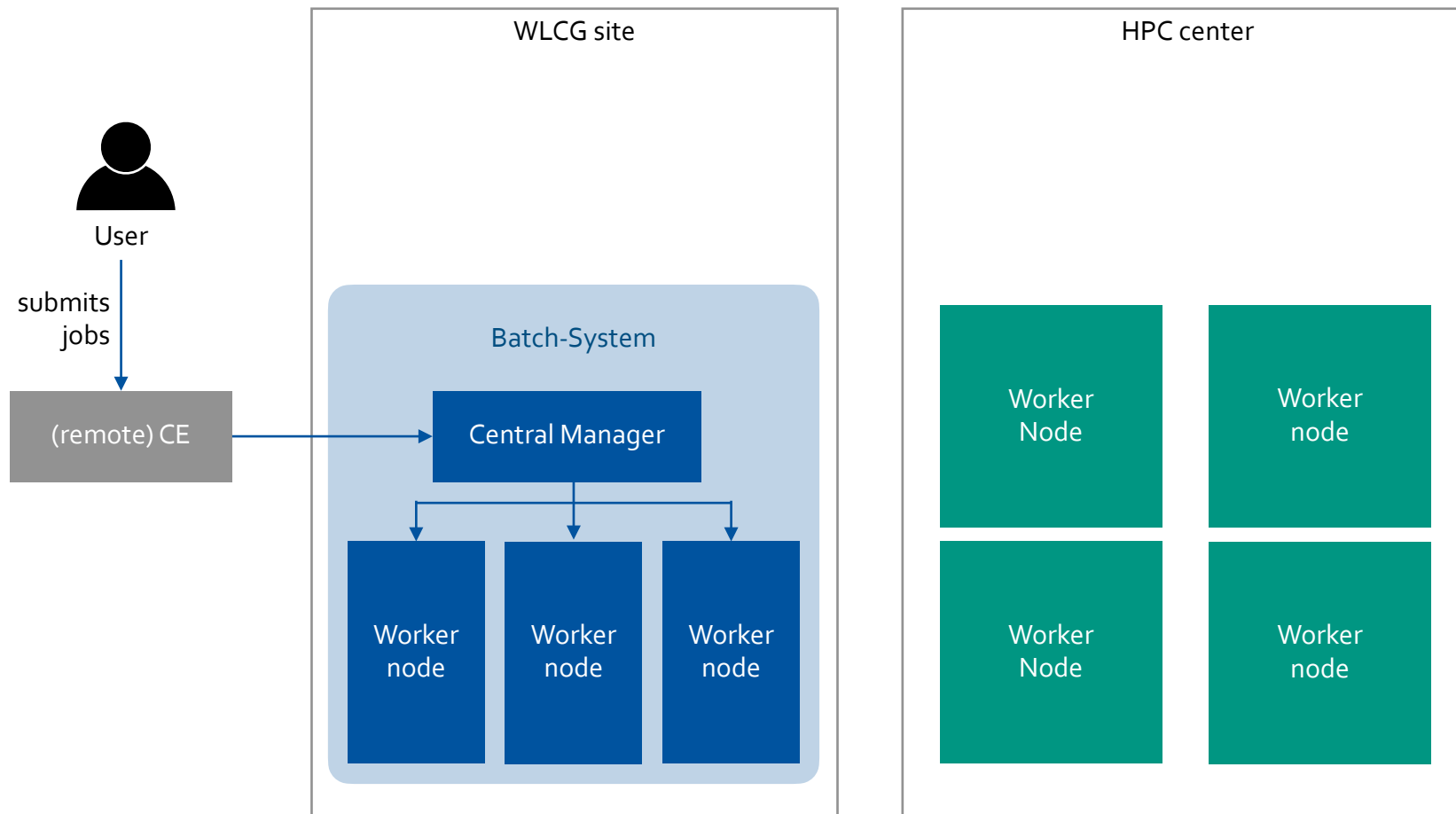
- COBaID/TARDIS are tools for dynamic resource scheduling developed at KIT and contributions from our partners in Freiburg and Bonn
- For transparent use, resources are integrated into common overlay batch system
- Compute elements (CE), established in the grid-context, act as single points of entry
 - Also perform authentication and authorisation
- Schedule resources based on current demand through proxy user
- Provide WLCG/experiment software through container layers



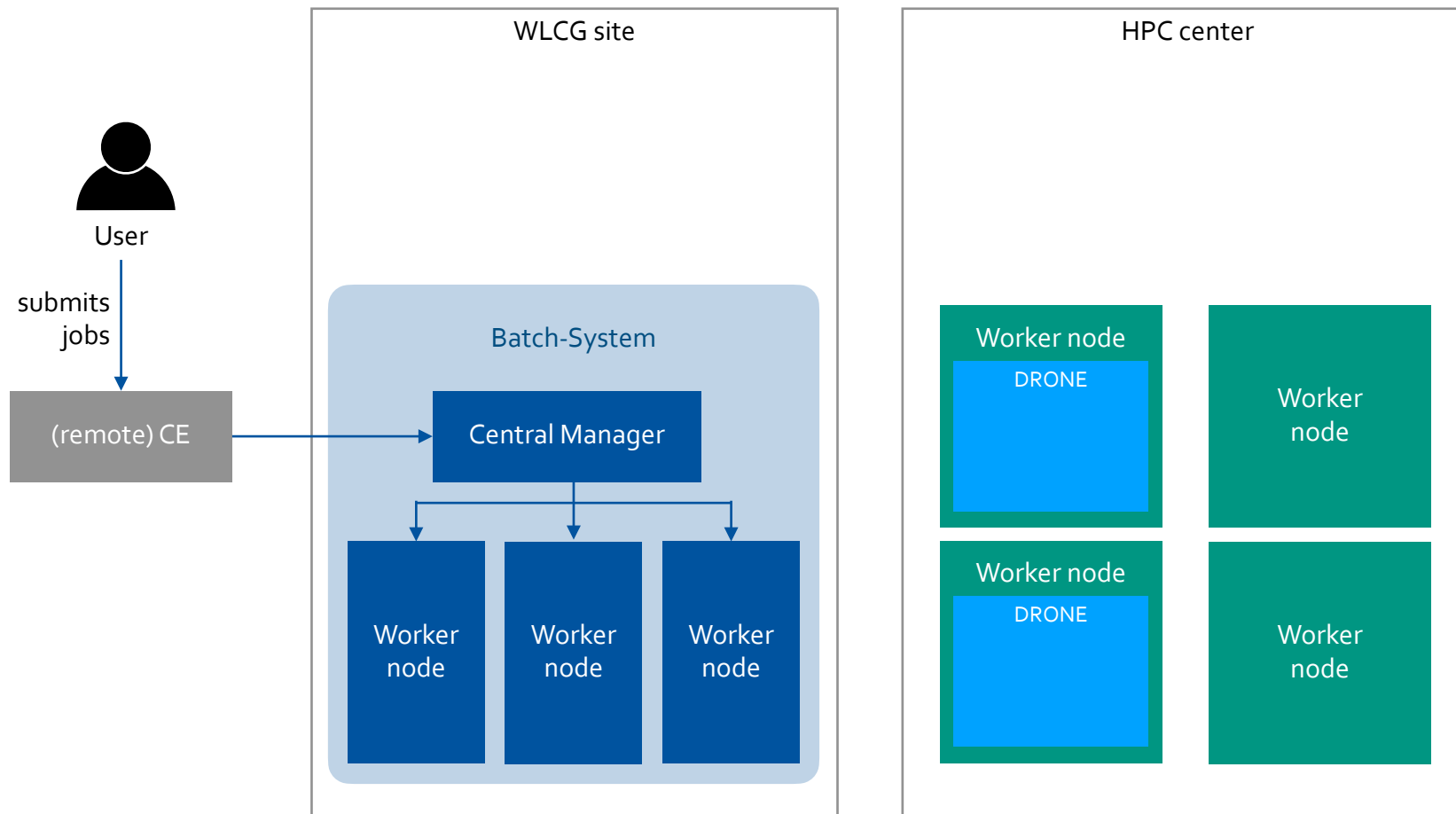
Ressource Integration using COBaID/TARDIS



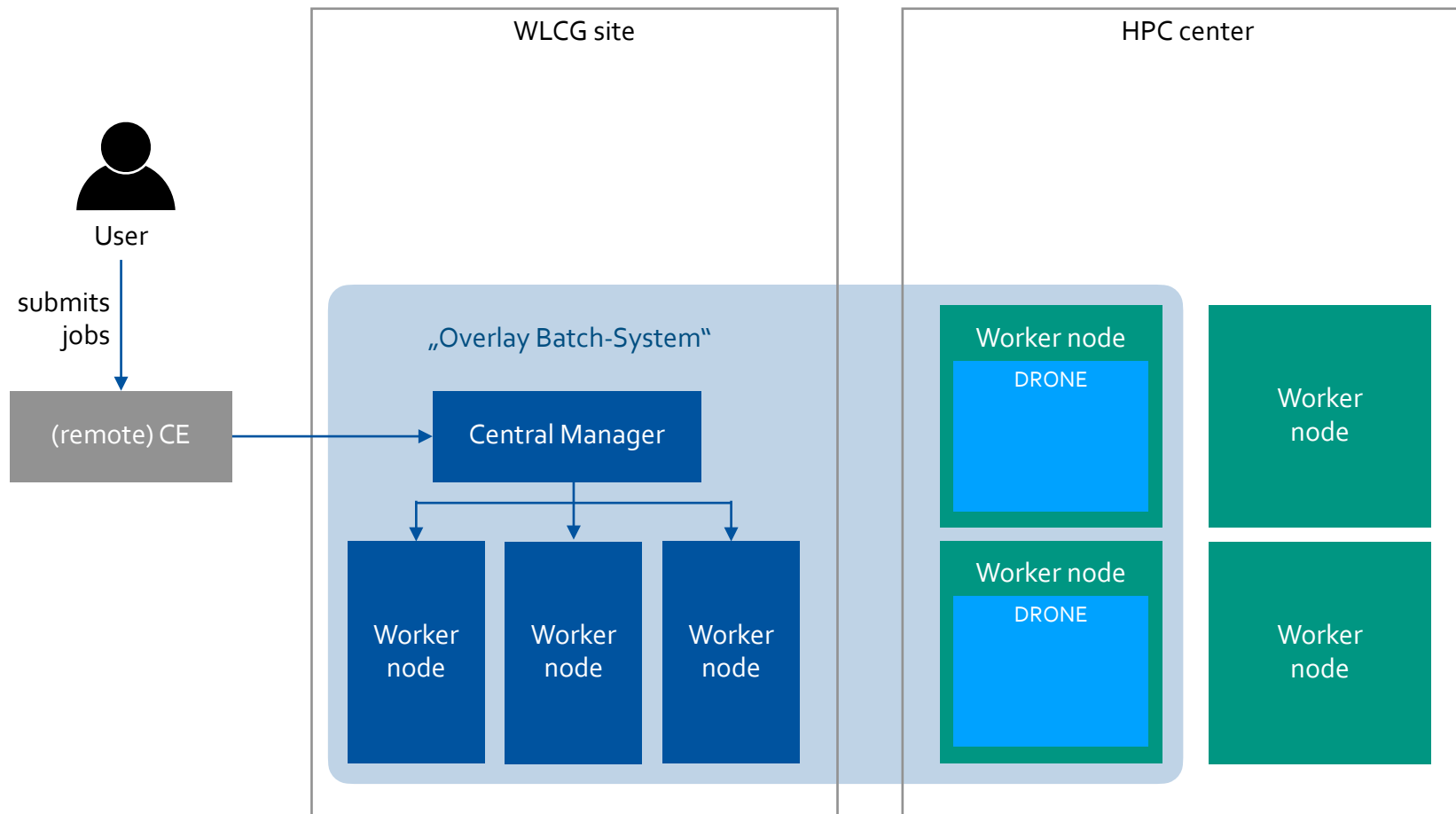
Ressource Integration using COBaID/TARDIS



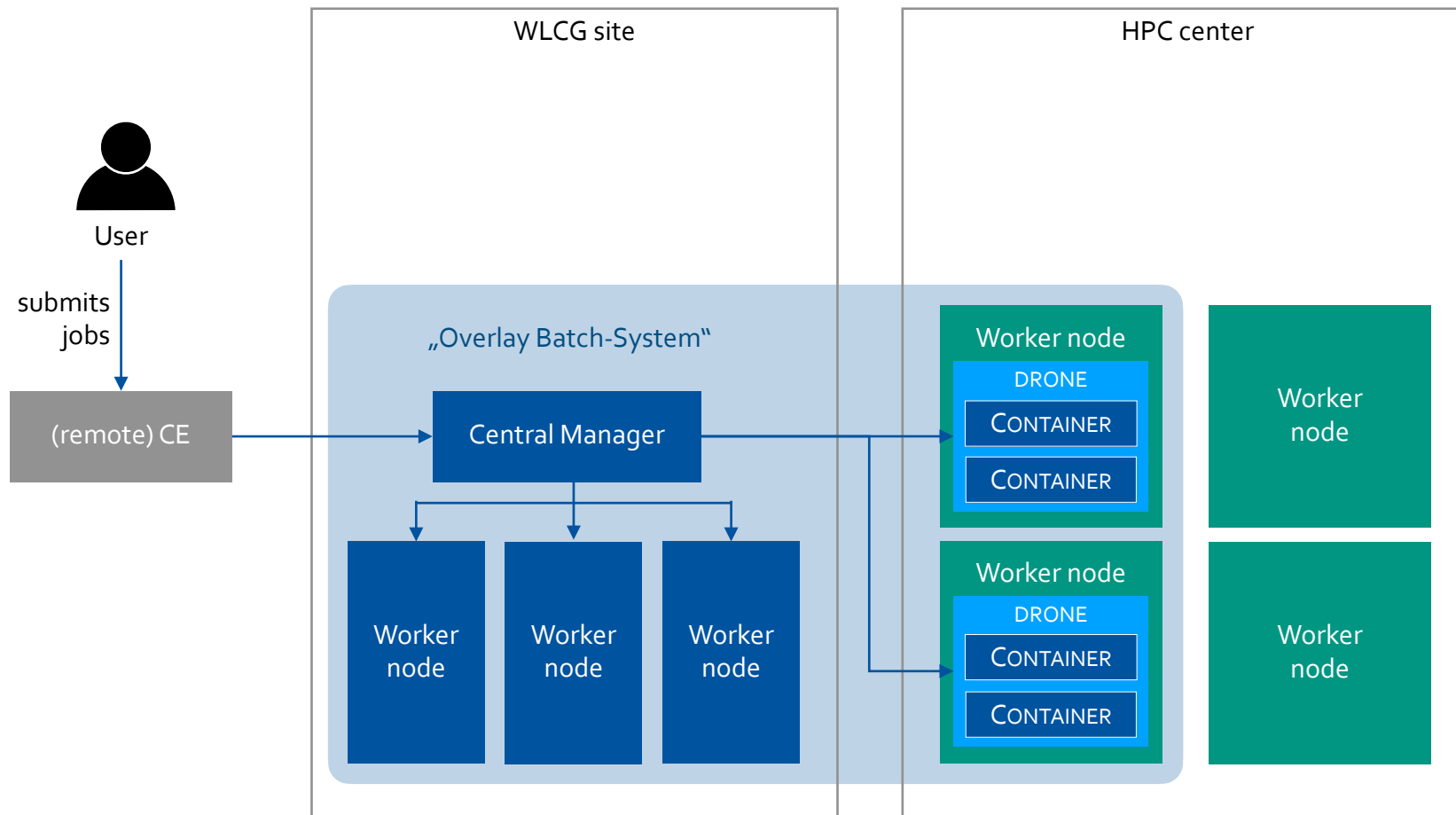
Ressource Integration using COBaID/TARDIS



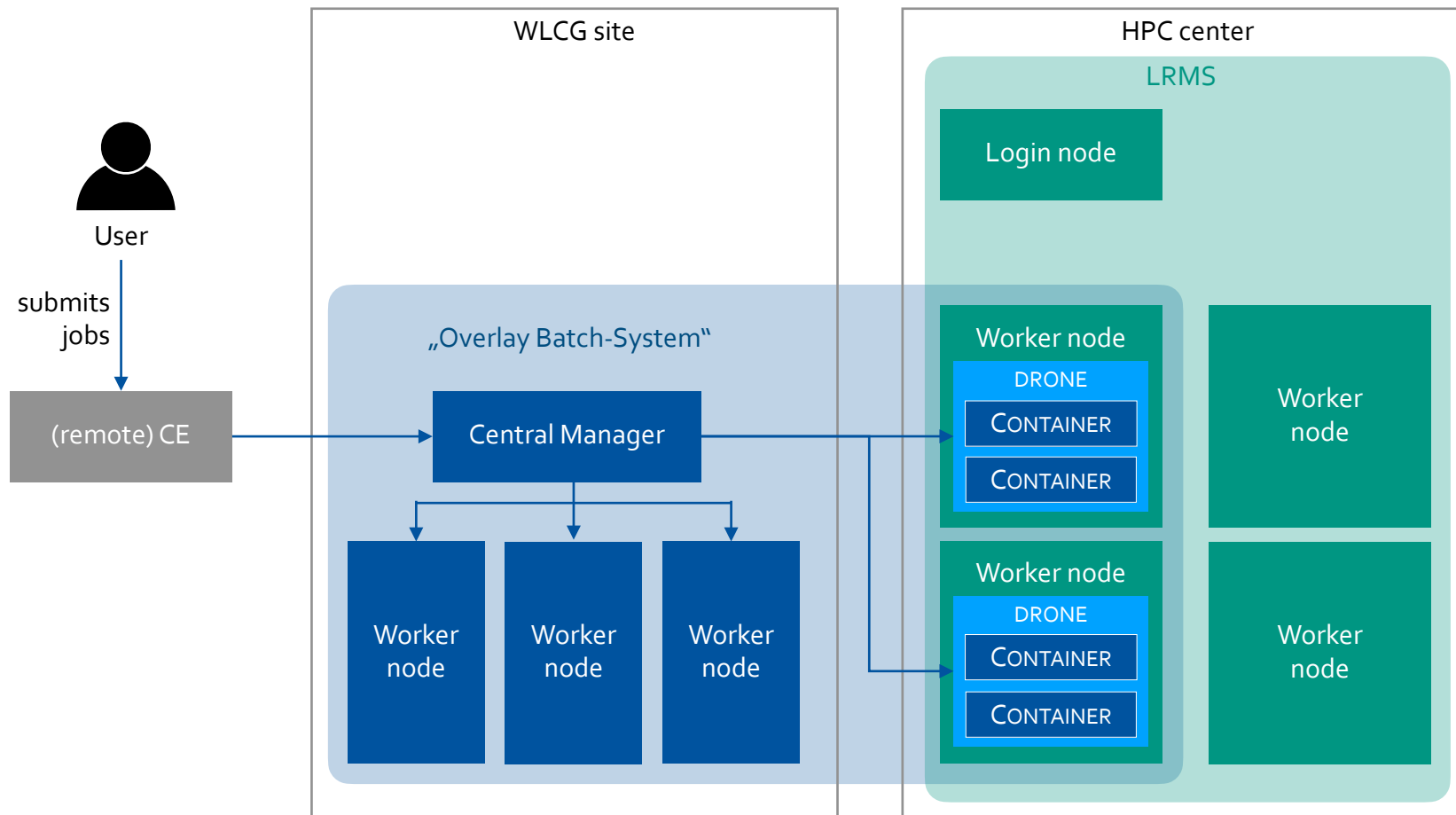
Ressource Integration using COBaID/TARDIS



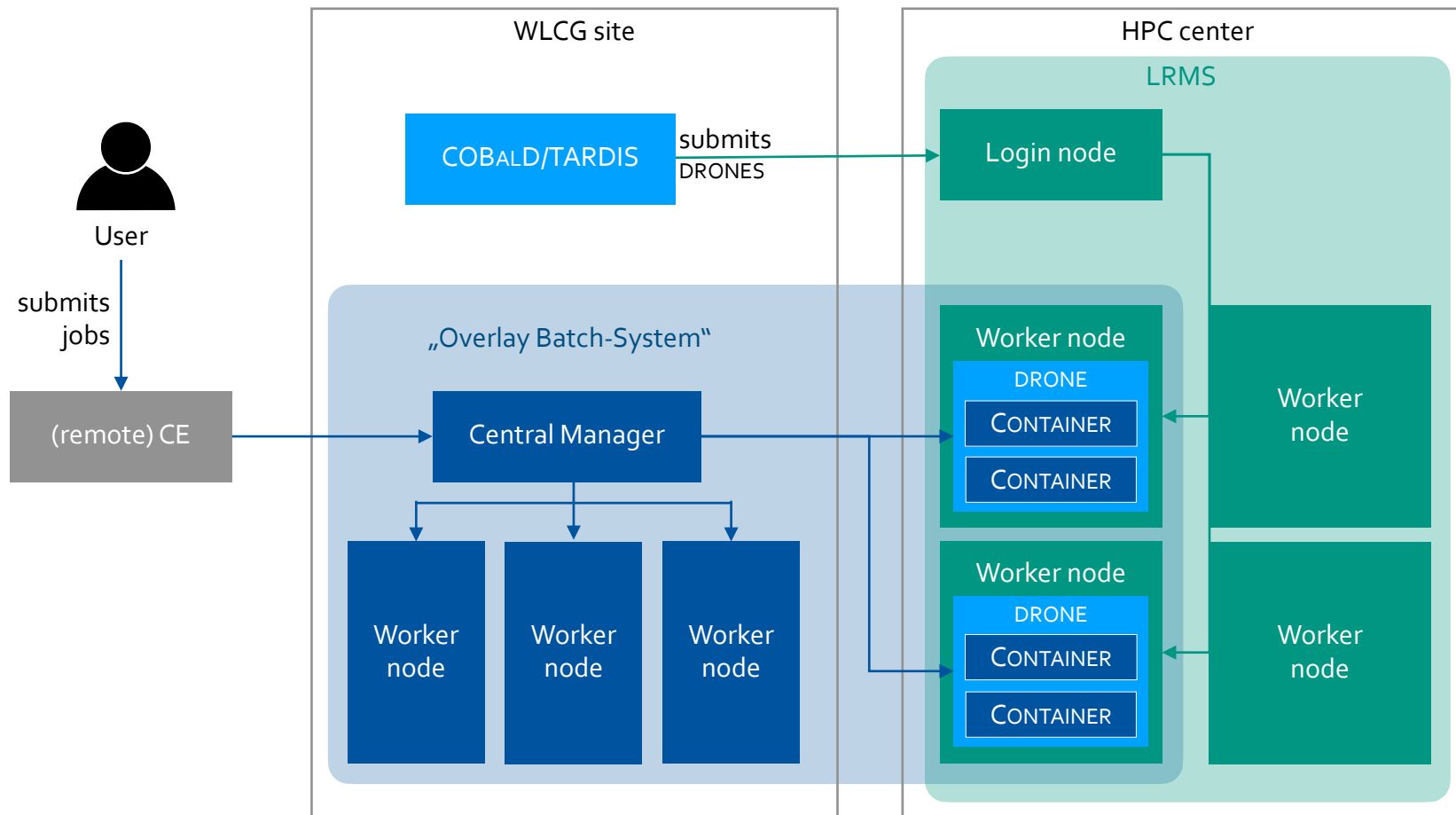
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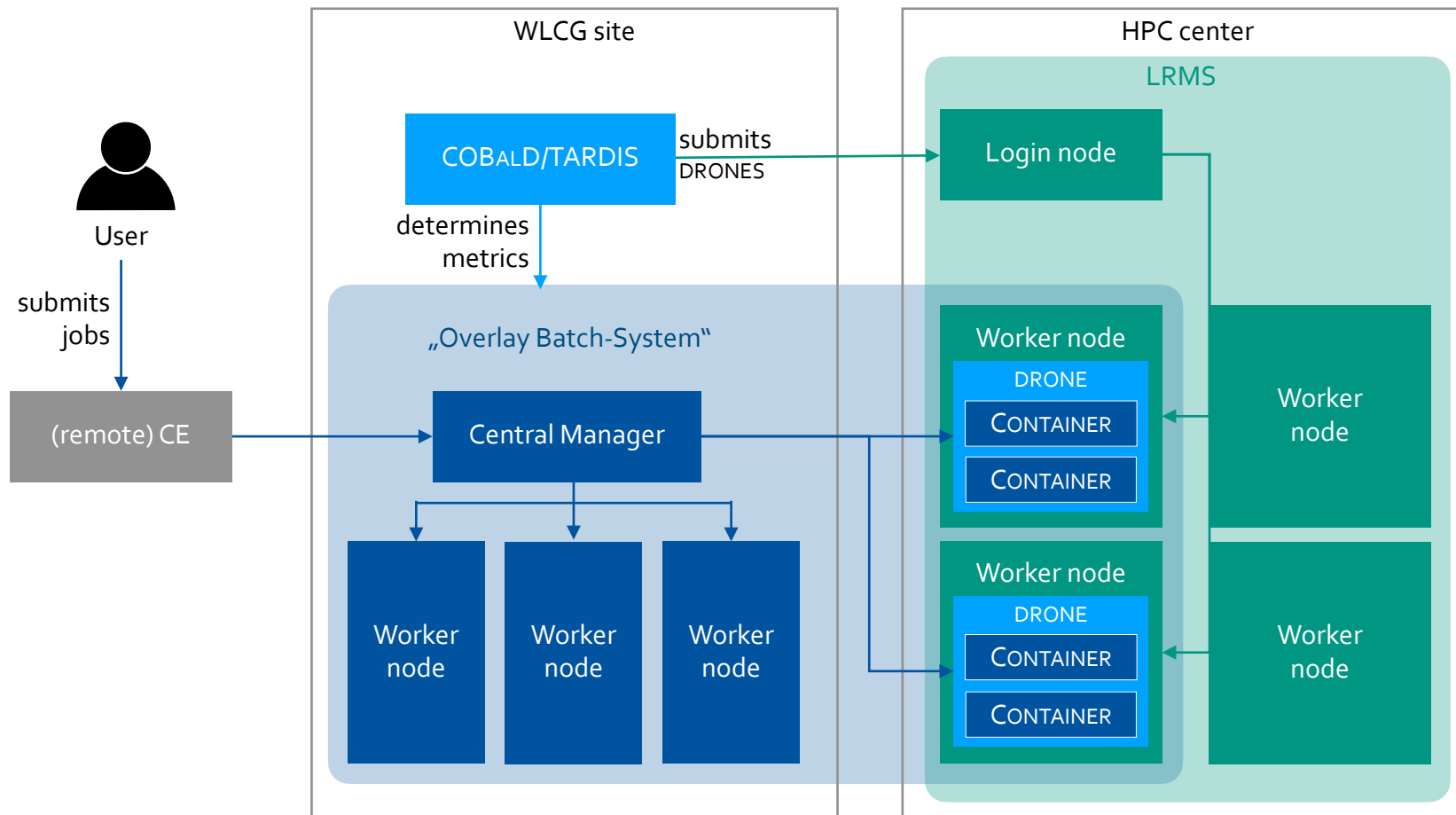
Ressource Integration using COBaID/TARDIS



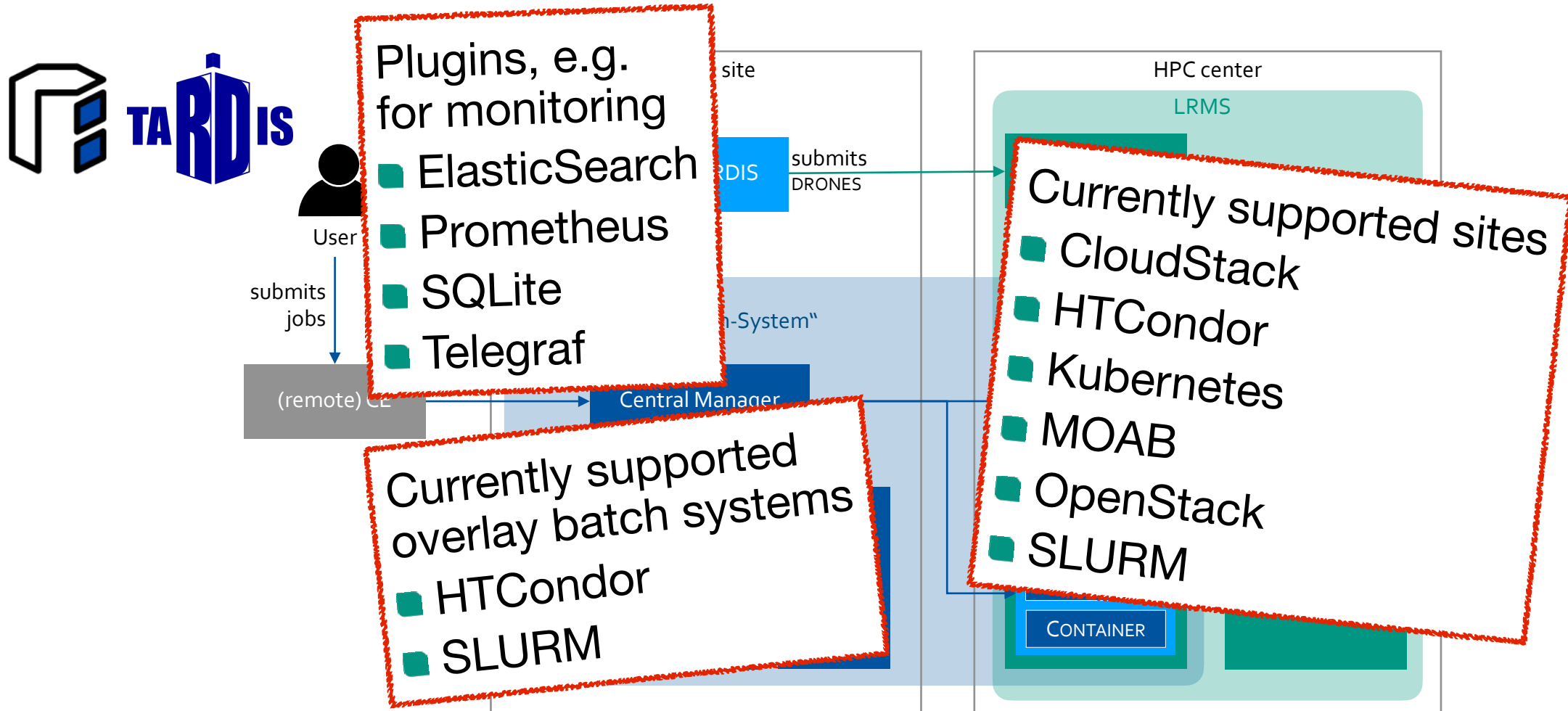
Ressource Integration using COBaID/TARDIS



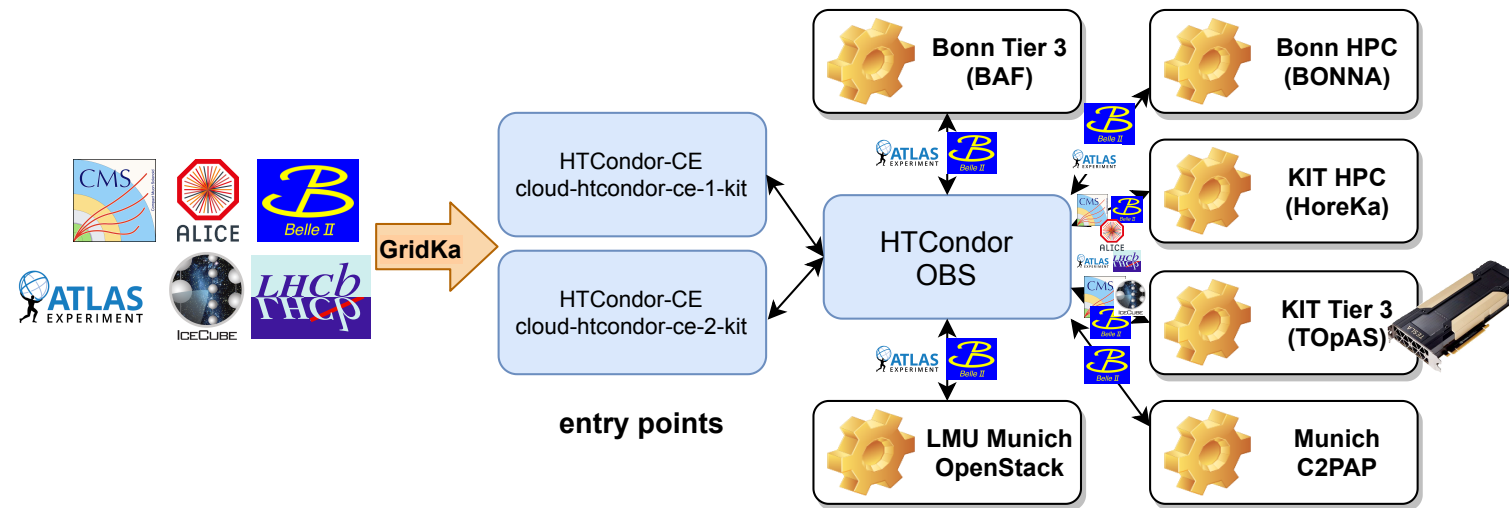
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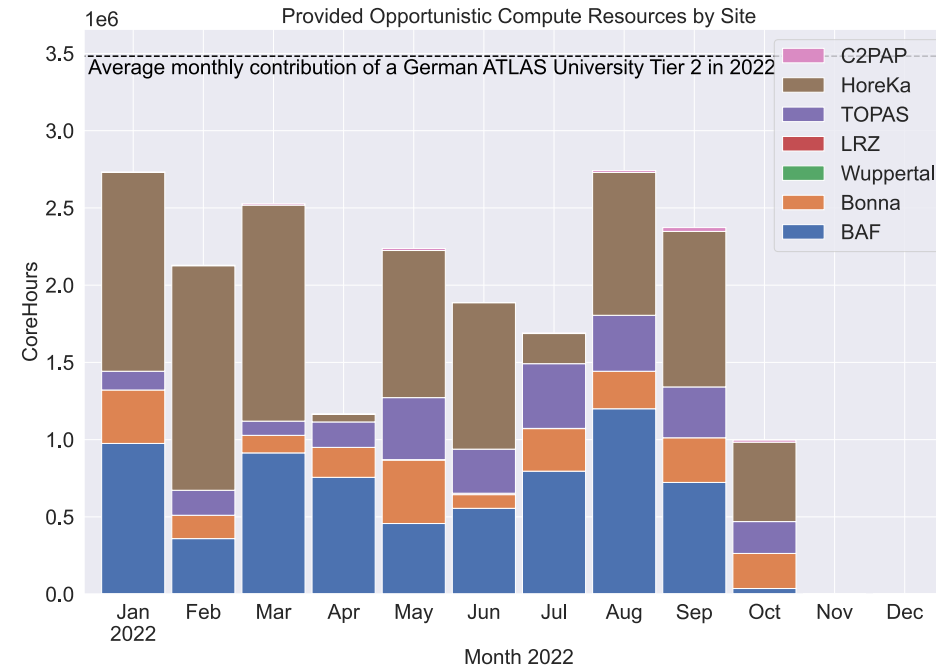
Federated Opportunistic Computing Infrastructure



- Opportunistic resources across Germany consolidated in setup at GridKa
- Provides VO-specific access to several resources through WLCG Tier 1 infrastructure
- Allows the use of specific hardware, eg. GPUs

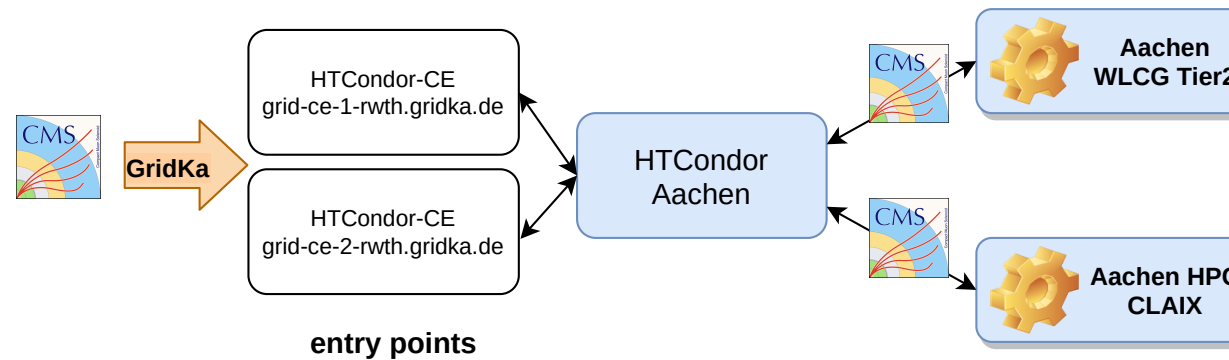
Federated Opportunistic Computing Infrastructure

Provided CPU Hours per Month in 2021



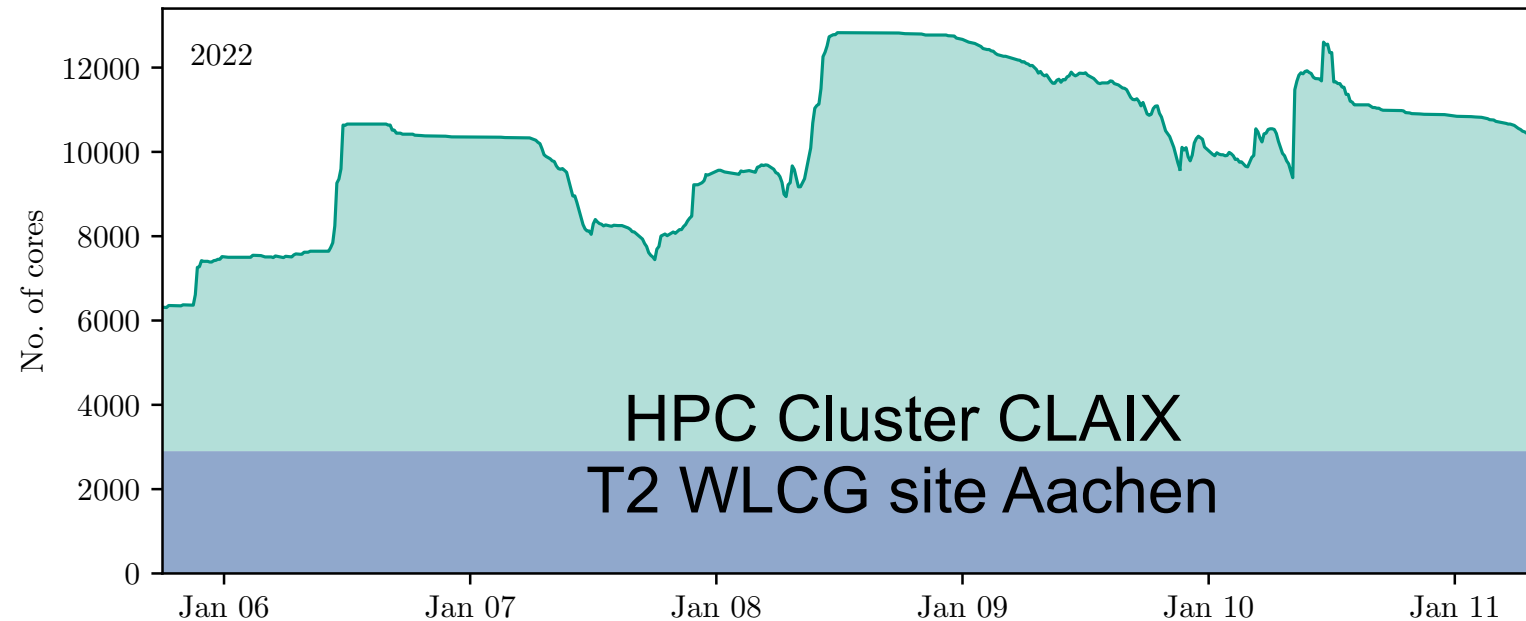
- The setup already provided more than 20 million additional core hours to the experiments this year

Lightweight Grid Operations



- COBaID/TARDIS also used in Aachen for integration of local HPC center into existing tier 2 infrastructure
- CE as access point to grid resource located in Aachen is operated at GridKa in Karlsruhe
- Modularising grid resources allows for lightweight operations
- “Remote CE” possible for other sites

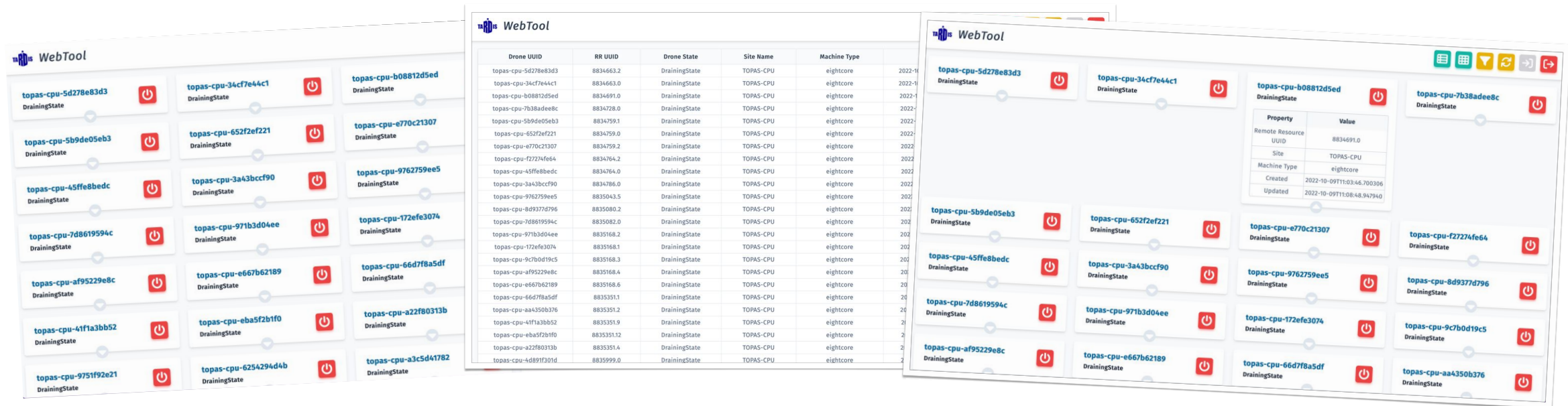
Aachen: Number of integrated cores



- The setup already delivered more than 10 million core-h to the CMS experiment in 2022 (and continues to do so...)

Web tool for resource management

- TARDIS now also ships with a web tool for resource management



The WebTool interface provides a comprehensive overview of drone resources. The left panel displays a grid of drone status cards, each showing a unique ID (e.g., topas-cpu-5d278e83d3) and a red power button icon. The middle panel is a table listing all drones with their respective UUIDs, states, site names, machine types, and creation dates. The right panel offers a detailed view of a specific drone's properties, including its remote resource UUID, site, machine type, and timestamps for creation and updates.

Drone UUID	RR UUID	Drone State	Site Name	Machine Type	
topas-cpu-5d278e83d3	8834663.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-34cf7e44c1	8834663.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-b08812d5ed	8834691.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-7b38adee8c	8834728.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-5b9de05eb3	8834759.1	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-652f2ef221	8834759.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-e770c21307	8834759.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-f2724fe64	8834764.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-45ffe8bedc	8834764.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-3a43bccf90	8834786.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-9762759ee5	8835043.5	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-8d9377d796	8835080.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-7d8619594c	8835082.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-971b3d04ee	8835168.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-172efe3074	8835168.1	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-9c7b0d19c5	8835168.3	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-af95229e8c	8835168.4	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-e667b62189	8835168.6	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-66d7f8a5df	8835351.1	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-aa4350b376	8835351.2	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-41f1a3bb52	8835351.9	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-eba5f2b1f0	8835351.12	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-a22f80313b	8835351.4	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-a3c5d41782	8835999.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306
topas-cpu-4d891f301d	8835999.0	DrainingState	TOPAS-CPU	eightcore	2022-10-09T11:03:46.700306

- Allows for quick assessment of drone statuses and to shut them down

Broad Adaption and Support

- Suitable for all experiments and most resources
- Adaptable to specific setups:
 - E.g. ATLAS cache setup can be incorporated with additional ARC-CE
- Working with Göttingen on integrating the HLRN-HPC cluster into the local WLCG tier 2
- Working with Wuppertal on integrating the university HPC cluster into the WLCG through GridKa CEs
- Several other groups also on board



**If interested, contact us:
We are available for kick-off workshops**

Accounting on Heterogeneous Resources

- New accounting software needed for use with opportunistic resources: AUDITOR
- Finalising first version of AUDITOR HTCCondor collector using python client provided by AUDITOR
 - Uses condor_history to collect data
- Agreed on recurring accounting meeting with AUDITOR developers

See next talk by
Stefan Kroboth
on accounting

Summary and Outlook

- COBaID/TARDIS allow for dynamic integration of heterogeneous resources through single point of entry
- Developing HTCondor AUDITOR collector for aggregating accounting data
- In production at several location, already provided substantial amount of computing resources to HEP experiments
- Development open to everyone:
 <https://github.com/MatterMiners>  <https://chat.eudat.eu/matterminers/>