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Adapting the LHCb High-Level Trigger Farm as a WLCG Tier-2D Site: Optimizing computing resources usage

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The Large Hadron Collider beauty (LHCb) experiment at CERN has successfully optimized the usage of its High-Level Trigger (HLT) farm by integrating the tools that make its usage transparent as a Worldwide LHC Computing Grid (WLCG) Tier-2D site, used opportunistically when the HLT needs are reduced. This innovative transformation leverages the power of XRootD for data access, HTCondor for workload management, and WinCC Open Architecture (OA) for overall system control and monitoring as well as integration with the global LHCb Experiment operation. This abstract presents the motivations, implementation details, and preliminary results of this initiative.

The LHCb HLT farm is normally dedicated to physics event selection during data-taking periods. By integrating it into the WLCG as a Tier-2D site, we significantly enhance the experiment's computing capabilities during periods of lower computing requirements for HLT, maximizing resource utilization and contributing to the broader WLCG community.

XRootD, a high-performance, scalable file access solution, forms the backbone of our data management strategy. It enables efficient, low-latency access to distributed data across the farm, facilitating seamless integration with the WLCG data ecosystem. The XRootD deployment supports both local and remote data access, ensuring optimal performance for various workloads.

HTCondor, a flexible and powerful workload management system, orchestrates job scheduling and resource allocation across the HLT farm. Its ability to handle diverse workloads, from high-throughput computing to more complex, multi-node jobs, makes it an ideal choice for our heterogeneous computing environment. HTCondor's integration with the WLCG job submission framework ensures smooth interoperability with the wider grid infrastructure.

At the heart of this transformation lies WinCC OA, a versatile supervisory control and data acquisition (SCADA) system, which is used to control the whole LHCb experiment. WinCC OA provides a unified interface for managing and monitoring the entire infrastructure, from individual nodes to overall farm performance, and allows for the leveraging of resources between the online (data-taking) requirements and resources availability for offline (WLCG) usage.

This document will delve into the technical challenges encountered during the integration process, including network reconfiguration, security considerations, and performance optimization. We will discuss the synergies achieved by combining XRootD, HTCondor, and WinCC OA, highlighting how this integrated approach enhances overall system efficiency and reliability.

In conclusion, the successful adaption of the LHCb HLT farm into a WLCG Tier-2D site represents a novel approach to maximizing resource utilization in high-energy physics computing. This initiative not only optimizes LHCb's computing resources but also serves as a model for other experiments seeking to optimize their computing infrastructure.

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