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K8TRE and FRIDGE: Bridging Kubernetes-native Trusted Research Environments with High-Performance Computing for Sensitive Data

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Trusted Research Environments (TREs) have become the established way of making sensitive data available to researchers while maintaining public trust. Most TREs have developed organically over the past decade with limited collaboration, confined to single sectors, and provide constrained computational resources. In contrast, high-performance computing (HPC) environments offer significant compute capacity but lack the robust governance capabilities that TREs require. The DARE UK TREvolution programme addresses these limitations by developing foundational technologies that enable federated multi-sector analyses across TREs and HPC infrastructures. K8TRE is an open-source, Kubernetes-native TRE supporting multiple compute infrastructures including public/private clouds. It provides a foundational platform catering for diverse organisational and disciplinary needs whilst enabling easy entry to standardised federated networks. K8TRE also allows efficient cross-sectoral collaboration on platform

engineering through its modular, microservices-based architecture and ephemeral development environments. It is being deployed in production at multiple institutions on different host infrastructures. FRIDGE (Federated Research Infrastructure by Data Governance Extension) enables TREs to extend into national HPC facilities, previously unfeasible due to specific data isolation and governance requirements. Through careful mapping of information governance requirements to infrastructure controls – including encryption, network isolation, and identity management, all influenced by public engagement—researchers conducting AI and computationally intensive research are no longer limited to local TRE compute capacity. FRIDGE defines secure tenancy without prescribing what runs within it allowing K8TRE to extend its computational capacity into HPC infrastructure. Together, these technologies deliver enhanced data governance and interoperability and improved support and scalability for compute-intensive research.

