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A Collaborative Network Middleware Project by Lambda Station, TeraPaths, and Phoebus

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The TeraPaths, Lambda Station, and Phoebus projects were funded by the Department Of Energy's (DOE) network research program to support efficient, predictable, prioritized petascale data replication in modern high-speed networks, directly address the "last-mile" problem between local computing resources and WAN paths, and provide interfaces to modern, high performance hybrid networks with low entry barrier for users. Within the framework of the three projects, we successfully developed services that establish on-demand and manage true end-to-end, Quality-of-Service (QoS) aware, virtual network paths across multiple administrative network domains, select network paths and gracefully reroute traffic over these dynamic paths, and streamline traffic between packet and circuit networks using transparent gateways. These services function as "network middleware"and improve network QoS and performance for applications, playing a critical role in the effective use of emerging dynamic circuit network services. They provide interfaces to applications, such as dCache SRM, translate network service requests into network device configurations, and coordinate with each other to setup up end-to-end network paths.

Building upon the success of the three projects, which target the same user community, utilize compatible technologies, and have similar goals, we work together to research and develop the next generation of network middleware. We address challenges such as cross-domain control plane signaling and interoperability, authentication and authorization, topology discovery, and dynamic status tracking. Our roadmap is to co-design network models that ensure effective inter-domain topology discovery and network utilization, utilize the perfSONAR infrastructure to monitor dynamic circuit status and measure performance, enhance Grid authentication and authorization to support inter-domain trust, and integrate our joint work with the Inter-Domain Control plane efforts (IDC). The new network middleware will be deployed and fully vetted in the Large Hadron Collider data movement environment.

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