Towards self-management of distributed data-driven workflows with QoS guarantees

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Abstract

Data-driven application workflows that leverage compute capabilities and hosted services near the network edge can support latency-sensitive and critical applications in emerging areas such as Internet of Things (IoT) and smart infrastructure. However, distributed instantiation and execution of these workflows using resources across service providers and data centers can be challenging.

We present the formulation of a decentralized workflow management approach for the autonomous instantiation and execution of dynamic data-driven workflows based on the opportunistic discovery and composition of services on-demand. Given a workflow template specification, this approach allows us to decouple workflow stages, allowing the execution of different stages to be performed by individual services, which are discovered and instantiated dynamically, and can be independently scaled as needed. These services may be geographically distributed and may be offered by different service providers using various QoS levels and cost models. The design, implementation and experimental evaluation of a decentralized workflow management framework using a live media stream application in a multi-cloud infrastructure is presented. Evaluations using a sample topology shows up to 2.5 times increase in QoS-meeting throughput when using our dynamic multi-cloud approach instead of using a fixed centralized cloud of identical capacity.