Vol.2020-MBL-97 No.20
Vol.2020-ITS-83 No.20
2020/11/25

A Fully-distributed Paradigm for Self-sustaining Stream Processing

Sunyanan Choochotkaew[1,2,a)]

概要：Self-sustaining Stream Processing is a promising technology for borderless autonomous intelligent systems. It carries out on-the-fly continuous processing commands on real-time streaming data from sources for activating corresponding actions via actuators in dynamic environments without barriers from maintenance cost or dependency. It also allows non-programming-savvy users to create their services in a human-understandable language. This dissertation presents the developing solutions for self-sustaining systems with the following trace. Firstly, we bring in the self-sustaining concept to untie the stream processing technology from the maintenance cost and dependency on the autonomous intelligent systems. The idea is to draw full power from already-in-used devices. For realizing such a concept, the processing plan must not hinge on the device-connecting topology, and the processing element must be able to cover arbitrary processing tasks. On top of that, the distribution mechanism must not rely on any particular controllers. The proposed paradigm, named EdgeCEP, combines advantages of event specifications and relational-tuple-based processing techniques and meets those requirements. EdgeCEP presents a newly-defined language and processing element, separating the detection and processing to bring in the best efficient methodology. The evaluation results show significant decrements of the flow volume in simulations and real-world deployment, compared to the centralized approach and other naive policies.Then, we further address the adoption concern of EdgeCEP from restrictions on non-dedicated devices, specifically, an over-capability requirement and identity exposure from information exchange. Also, the uncertainty of non-dedicated networks could affect the service quality focus rather than just latency on each particular task. MicroEdge comes up with a less-coupling modular architecture and less-interrupting, fair-sharing solutions for the self-sustaining stream processing systems regarding task-specific mixed value metric. As a goal of distribution, the novel metric named Value-of-Service (VoS) presents in terms of task-specific values. The results show the superiority of the proposed MicroEdge to the default policies in terms of the service value and between-tasks fairness. Here we emphasize the significance of developing self-sustaining stream processing systems. Rather than coming to replace the dedicated systems like a centralized cloud or local edge servers, it is for unbounded growth of developing applications on the networks of smart things. The proposed systems deal with the challenges of dynamic, heterogeneous, and non-dedicated participating devices and processing task variety towards the self-sustaining systems.

[1] 大阪大学 大学院情報科学研究科
[2] 現在，IBM 東京基礎研究所
[a)] sunya-ch@ist.osaka-u.ac.jp