**Challenges for Smart Cyberinfrastructure in Making Society 5.0 a Reality**

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1. Background

Japan’s vision for the future called “Society 5.0” is a super-smart society where technologies such as big data, IoT, AI/ML, and robots fuse into every industry and across all social segments. The concept of Society 5.0 is similar to Cyber Physical Systems (CPS) and there are many challenges to develop smart cyberinfrastructure for making Society 5.0 a reality. One of the biggest challenges is to design the entire edge-to-cloud cyberinfrastructure on which open innovation platforms could be built. These platforms would create an ecosystem of data collection, storage, sharing, and analysis for Society 5.0. In collaboration with universities, research laboratories, and private sectors in Japan and around the world, AIST is meeting this challenge using ABCI (AI Bridging Cloud Infrastructure) as a key resource. ABCI is the world’s first large-scale open AI computing infrastructure constructed and operated by AIST. The development of ABCI has the following two phases, (1) develop ABCI as a powerful shared computing infrastructure for AI and (2) develop ABCI as an open innovation platform. Phase 1 is underway since ABCI started its operation on August 2018, it has seen a steady increase in users both from industries and academia. ABCI’s software stack and tools provide easy-to-use interfaces for users and achieves highly efficient resource utilization for various types of AI jobs. To achieve Phase 2 of ABCI development, there are many challenges that must be solved through by collaborative research. As a step toward solving these research issues the Japanese government is supporting a data platform project named “mdx” which is being jointly designed by a broad consortium of national universities and institutions.

1. mdx: Data Platform Project

 The purpose of mdx is to leverage data utilization throughout Japan making full use of a high-performance research and education network called “SINET”. mdx aims to provide a rapid PoC environment for R&D data utilization activities including industry-academia collaboration projects. The infrastructure of the data platform is based on a cloud (IaaS) concept that is distributed over a wide geographical area. Network links connecting data and IoT devices can be provisioned with compute and storage resources securely. The platform provides virtual infrastructure “slices” to users in such a way that the users can use the “slice” as a dedicated secure infrastructure for their purpose. The design of the entire edge-to-cloud cyberinfrastructure is illustrated in Fig. 1. In order to build this data platform, we have to solve at least the following issues.

1. Data management

Managing data that enables cross-domain utilization is mandatory and challenging. Data management includes catalogue services and data access mechanisms with appropriate APIs and protocols with many aspects of scalability and high-performance.

1. Security

Security and privacy which enable the hosting of sensitive data such as medical and personal data is necessary.

1. Support of real time processing

The data platform will be connected to a huge number of IoT devices directly and must be capable of receiving all data and processing immediately without data loss or leakage.

1. Job scheduling

Batch scheduling cannot be used for nodes which receive/send real time data, but it is efficient for high machine utilization. The data platform needs to combine long term assigned nodes/VMs with batch scheduled nodes to support jobs.

1. Management software

IoT devices, wide area network, internal network, computing nodes, storage should be managed in a unified way. Existing cloud management software such as VMware, OpenStack, Kubernetes, etc. cannot satisfy all the requirements and we have to develop a novel management software.

By solving the above issues, mdx is expected to start its operation in January 2021.



Fig. 1. Infrastructure of the data platform (by courtesy of Prof. T. Kudoh @ U. Tokyo)

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