LQWHURS 4784

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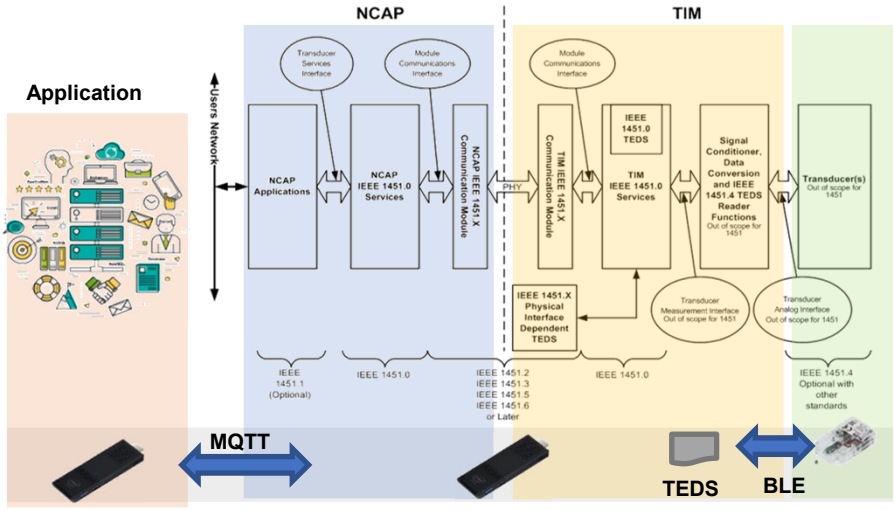
Keio University / Waseda University / NARO

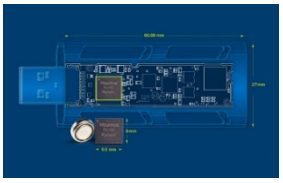
IEEE1451-1-6 pilot implementation and interoperable demos

- Sensor
  - Multiple sensor modules with BLE of ALPS Electric Inc are used. The module has temp., humid., pressure., illuminance, UV, and 6-axis acceleration / geomagnetic sensors.
- TIM: Transducer Interface Module
  - The demo system is designed with Python on CentOS8.2 and Intel Computing Stick. TIM manages sensor modules and exchanges sensory data and Transducer Electronic Data Sheet (TEDS), including sensor specifications with external application servers via NCAP.
- NCAP: Network Capable Application Processor
  - Application Processor for connecting with other networks, especially with the Internet, is used. IEEE21451-1-6 uses MQTT for distributing sampled data and TEDS. In this demo, TIM and NCAP are implemented in one stick style PC.



- Request-Response style communication
  - In addition to the conventional MQTT publish-subscribe style messaging, request-response style messaging like HTTP, which sends messages in response to the received messages, is supported. MQTTv5 allows this style of communication by supporting key-value message format. In this style, the requested client indicates the destination topic of the response message.
- Time Synchronization
  - For achieving time synchronization, timestamps must be sent when requested. MQTTv5 fulfills the requirement by allowing to send key-value style timestamps on the request-response communication.

- MQTTv5 Broker
  - MQTT is a simple and popular protocol for IoT devices. While general communication protocol uses peer-to-peer and server-and-client based communication, MQTT supports publish-and-subscribe style communication through MQTT broker. MQTT uses a topic to index communication like a socket.
  - mosquitto >1.6 supports MQTT v5, and it enables request-response style MQTT message, and 1451-1-6 supports this feature for sensor data distribution, TEDS distribution, and new time-synchronization function. MQTTv5 advanced in security, authorization, and usability. MQTT v5 Request-Response feature was used for TEDS distribution.
- Protocol Conversation system on Edge for IoT protocols
  - IoT systems use various application protocols, such as MQTT, XMPP, and CoAP. The contention of communication protocols raises interoperability problems. For maximizing the use of IoT systems, protocol conversion is indispensable. Application protocol conversion methods for supporting various IoT protocols was proposed and demonstrated. It supports various protocols simply but has enough conversion function was prepared. It supports high-throughput processing and high flexibility in its conversion rule description. The special intermediate description eliminates the conversion design cost.
- Edge AI
  - Intel Neural Computing Stick 2 is an application-specific hardware accelerator as a neural computing engine. It has 16 powerful processing SHAVE Core and high-throughput memory fabric. Intel OpenVINO fully supports this hardware accelerator. The result is also handled as sensor data, and some super parameters can be given and controlled by TEDS and NCAP operators, respectively.



1451 + MQTTv5 + IoT + Edge + AI
for
Cyber-Physical System Platform + Smart Agriculture

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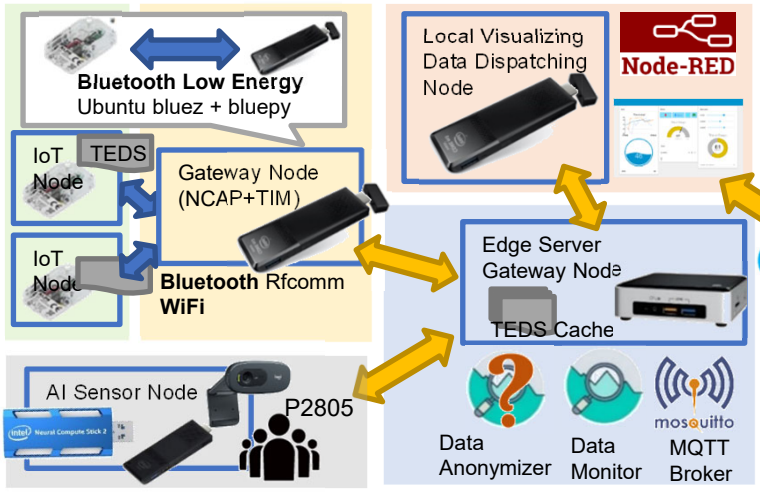
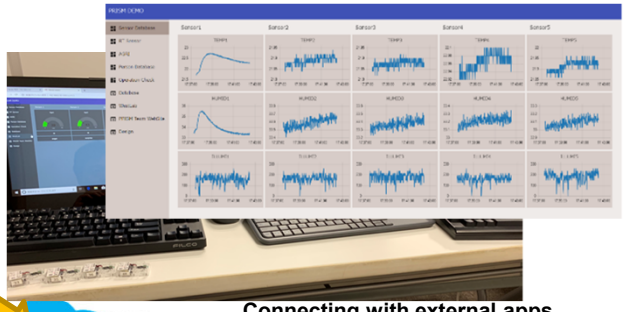
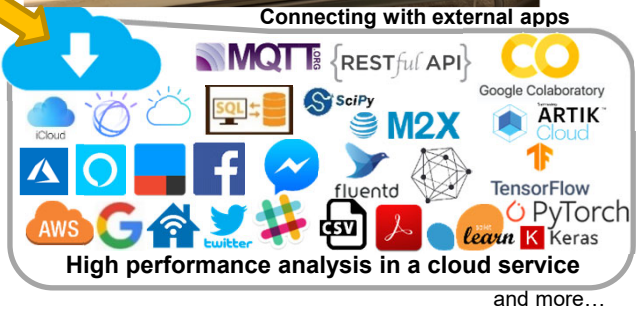
West Lab Computing and Networking

IEEE1451-1-6 pilot implementation and interoperable demos





Connecting with external apps



and more…

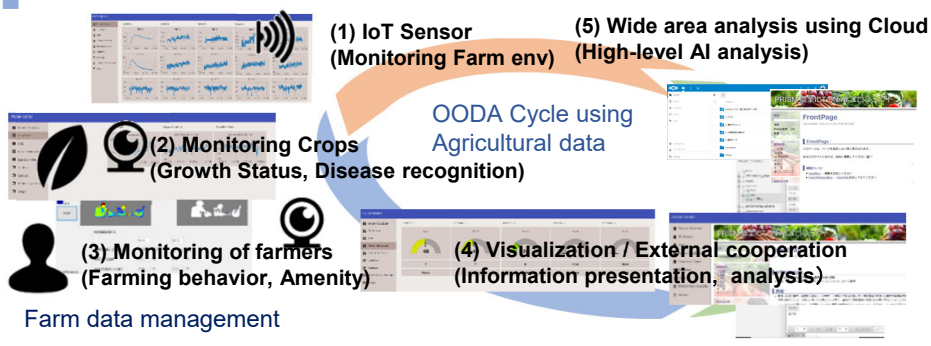
Cross-ministerial Strategic Innovation Promotion Program, Japan

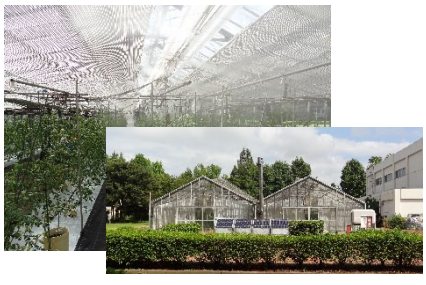
Intelligent Processing Infrastructure of Cyber and Physical Systems

SIP

- For establishing Physical Space Digital Data Processing Platform
  - A highly sophisticated cyber-physical system, which is the key to establish Society 5.0, is required to collect, process, and use the data from physical space. This platform gives a solution to technical problems for establishing a cyber-physical system. It also gives a common platform to provide solutions for those who are not familiar with IT technologies. The penetration and use of this platform give a solution to social problems, achieve economic development, and bridge technological gaps. We provide the technologies, such as collection and process of required data from anywhere, battery-less IoT devices using energy harvesting, digital data sampling and processing from physical spaces, wireless communication, even in the extreme environments, providing scalability in the increase of data transaction and the number of nodes, QoS guaranteeing of communication, real-time control, physical AI processing, and low-power IC processes. These technologies enable highly integrated and sophisticated service provisioning, especially for real-time systems in a physical space.
  - The establishing technology for building a physical space digital data processing infrastructure will bridge these gaps and realize Society 5.0. One of the key technologies for filling the gaps is to use and collaborate with the newest sensor, actuator (IEE 1451 family), and edge computing (IEEE P2805 family) standards.

Use Case for Smart Farm





Farm data management

- Cost down / Harvesting yield, quality / Growth control / EMS
- Abstraction: Anonymization, Labeling using AI
- Crystallization: Ultimate improvement of farming

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