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Ochiai laboratory studies IT systems for the new age. The year 2010s were the age of Big Data -- whereas the research demand for the new age is raising toward (1) Distributed AI, and (2) IoT/LAN security which contribute to the protection of users against the abuse of data. As for the digital transformation of energy systems which we have worked for decades, we study as (3) energy control and management system for the year 2050s.

1. Distributed AI (From 2021 -)

Machine learning originally used the user data collected at a central server and trained a model, which is now getting possible to train a global model without extracting data from the local devices of users, as federated learning does. Ochiai laboratory has successfully made it fully decentralized as a peer-to-peer distributed AI. There are many machine learning models, which should be targeted for decentralization in our laboratory, in the future.

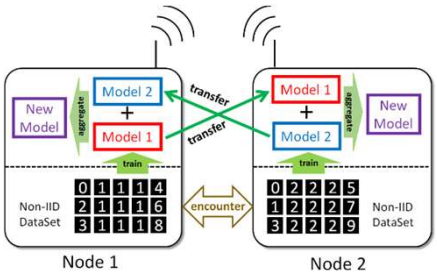

Fig. 1: The Most Basic Peer-to-Peer Federated Learning

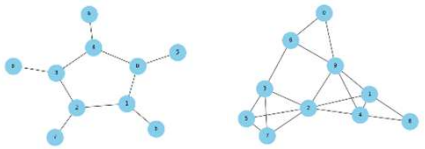

Fig. 2: Topologies for Peer-to-Peer Federated Learning

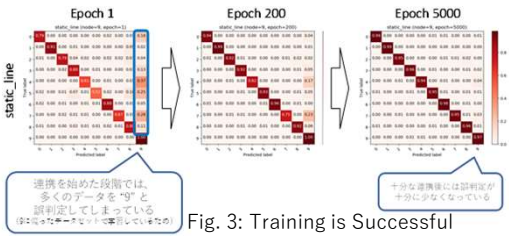

Fig. 3: Training is Successful

2. IoT/LAN Security (From 2018 -)

A local area network (LAN), an edge of computer networks, has varieties of connected devices including IoT devices. We have seen suspicious activities in LANs caused by sophisticated cyber attacks dwell in the complex computer systems. By constructing a collaboration scheme with the universities around ASEAN-region from 2018s, we collect such suspicious activities made in LANs, and develop a taxonomy of suspicious device-to-device communications inside a LAN. We also develop a detection system against the attacks to operational technology (OT) systems.

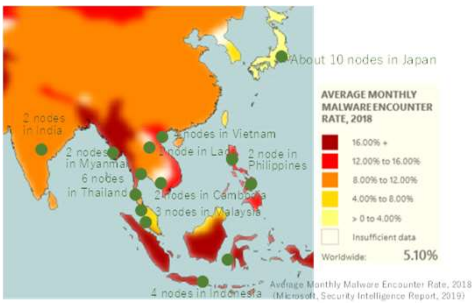

Fig. 4: Security Observatory Network Developed in ASEAN-Region

3. Energy Control System for 2050s (From 2021-)

Energy is a very important topic for our sustainable development society, and we will rely on “digital transformed energy system” in the future. Assuming energy related facilities in 2050s, we simulate 1 million buildings with privacy-friendly federated reinforcement learning.

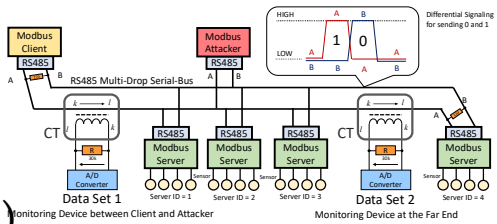

Fig. 5: OT-Security Management System

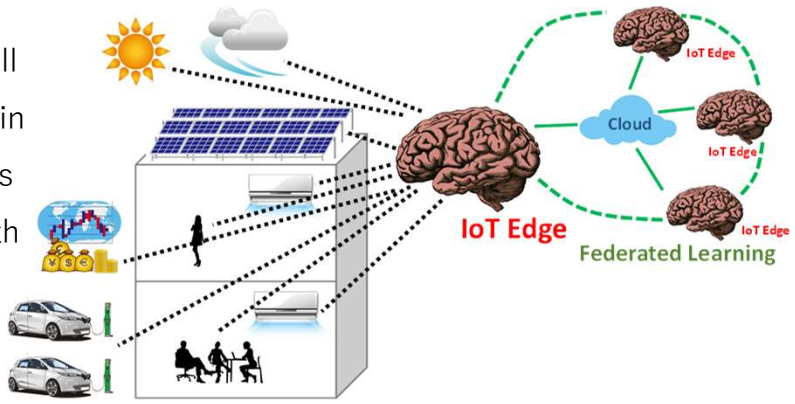

Fig. 6: Energy Control and Management System for 2050s