글로벌 ICT 표준 컨퍼런스 2023

Global ICT Standards Conference 2023

(세션2) ICT 표준 R&D 우수성과 발표회

AI/ML enabled IoT platform and standards

Prof. Kim Jaeho (Presenter)/ Prof. JaeSeung Song, Sejong University

주최 과학기술정보통신부 Ministry of Science and ICT
특허청 Korean Intellectual Property Office
주관 국립전파연구원 National Radio Research Agency
TTA IITP KEA kista ETRI

Index

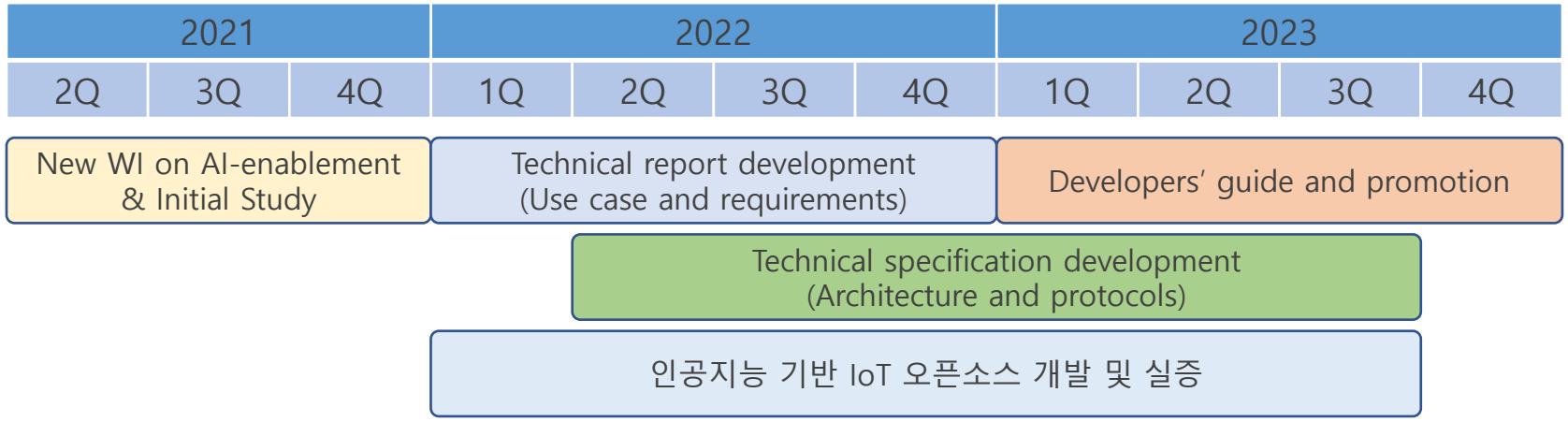
01. Introduction to the AIStar project

AIStar Project

과제 특징	정책지정( ), 혁신도약형( ), 경쟁형( ), 표준화 연계(O), SW자산뱅크 등록대상( ), 공개SW( ), 기술료 비
총괄 과제명	AI 기능 지원 프레임워크 기반의 이기종 IoT 플랫폼 연동 오픈소스 및 국제 표준 개발
연구책임자	송재승 교수 (세종대학교)
총 개발기간	2021.04 ~ 2023.12 (31개월)
총 연구개발비/ 당해년도 연구개발비	1,525,596 천원 (정부 : 1,375,000 천원, 민간 : 150,596 천원)/ 415,508 천원 (정부 : 375,000 천원, 민간 : 40,508 천원)
TRL	
참여 기관 및 책임자	세종대학교 SEJONG UNIVERSITY — 송재승 교수, 김재호 교수 제주대학교 JEJU NATIONAL UNIVERSITY — 김도현 교수 대전대학교 DAEJEON UNIVERSITY — 홍용근 교수

01-1. Open Source and Standards

- **주요 기능:**
  - oneM2M 기본 구조가 인공지능 서비스를 지원하기 위한 기능 및 리소스 제안
  - 이기종 플랫폼간 인공지능 서비스 지원 기능 제안
- **주요 성과 활동:**
  - 신규 워크 아이템 (New Work Item) 제안 및 승인
  - 기술 보고서 (Technical report) 및 기술 표준 (Technical specification) 개발
  - 개발자 가이드 (Developer's guide) 개발을 통한 개발자 지원
  - 인공지능 지원 Mobius 오픈소스 개발 및 오픈소스 반영
  - 세종대학교 캠퍼스를 테스트베드로 인공지능 기반 IoT 서비스 구축 및 데모



01-2. AIStar 표준화 실적 (1/5)

oneM2M

- 신규 워크 아이템 제안 WI-0015 “System enhancements to support AI capabilities”
  - Rapporteur: Song JaeSeung (Sejong University)
  - Supporting members: KETI, Hyundai Motors, Exacta GSS, Deutsche Telekom, SBS, Nokia, Orange, Convida Wireless, Hansung University
- 신규 Technical Report 표준 개발 및 제정
  - TR-0068 : AI enablement to oneM2M
  - Current version: 15.0.0
  - Statistics: Total 15 contributions / 6 use cases / 13 potential requirements / 20 input use cases from ETSI
- 오픈소스 OCEAN (https://github.com/AISL-Sejong/AI4IoT)
  - Develop Metaverse use case
  - Apply AI features
  - Become a committer
- 오픈소스 OM2M (가. https://gitlab.eclipse.org/eclipse/om2m/om2m)
  - Bug fixes
  - Add new features on flexContainerInstances
  - Become a committer

01-2. AIStar 표준화 실적 (2/5)

IETF

- IoT 통신 관련 표준 개발 주도
  - 표준 문서 : RFC 9428(IPv6 over NFC), RFC 9354(IPv6 over NFC), RFC 9453(6lo use cases)
  - PLC, NFC, BLE, Z-wave 같은 자원 제약적인 IoT 환경에서 효율적인 IPv6 패킷 전송을 위한 네트워크 기법 및 use cases 기술
- IoT Edge computing 관련 표준 개발 주도
  - 표준 문서 : IoT Edge Challenges and Functions (draft-irtf-t2trg-iot-edge)
  - Edge computing 중심의 IoT 서비스 제공을 위한 핵심 기능과 함께 Edge 환경에서 AI 서비스를 제공하기 위한 네트워크 구조 기술
- 분산 협력으로 AI 서비스를 구축하기 위한 표준화 논의 주도
  - 표준 문서 : Considerations of deploying AI services in a distributed approach (draft-hong-nmrg-ai-deploy), AI-Based Distributed Processing Automation in Digital Twin Network(draft-oh-nmrg-ai-adp)
  - IoT 환경에서 AI 서비스를 도입하는데 필요한 네트워크 구조, AI 모델의 정확도, 추론 지연시간, 통신 방식, 모델의 종류, 서빙 프레임워크 등을 기술

ITU-T

- ITU-T SG20에서 AIoT 관련 2건의 권고안 개발
  - 표준문서 : ITU-T Y.SF-prediction (Service framework of prediction for intelligent IoT), ITU-T Y.IoT-CRE-fr (Framework of Common rule enablement for intelligent IoT services in heterogeneous IoT platform environments)

01-2. AIStar 표준화 실적 (3/5)

oneM2M TR-0068 Release 5 표준 제정

ONEM2M TECHNICAL REPORT	
Document Number	TR-0068-V5.0.1
Document Name:	AI enablement to oneM2M
Date:	2023-08-18
Abstract:	The document is analysing existing AI/ML technologies that can be resourced into oneM2M architecture. The document is also investigating potential AI/ML service use cases that use data collected in the oneM2M system. The study on existing AI/ML technologies and use cases are further analysed in this document to understand what features are supported and unsupported by the oneM2M system. Based on the result of this technical report, it will identify potential requirements and key features to enable AI/ML in the oneM2M system.
'Template Version: January 2019 (do not modify)	

History

Publication history		
V5.0.1	August 2023	Partners pre-processing done by editHelp! e-mail: mailto:edithelp@etsi.org

Draft history (to be removed on publication)		
V0.0.1	2021-07-07	Skeleton of the TR.
V0.1.0	2021-10-20	Agreed contributions from TP#51 are added - RDM-2021-0053R01 - RDM-2021-0054R02 - RDM-2021-0055R02 - RDM-2021-0056R01 - RDM-2021-0057R02
V0.2.0	2021-11-16	Agreed contribution from RDM#51.1 is added - RDM-2021-0072R01

01-2. AIStar 표준화 실적 (4/5)

IETF : IoT 환경에서 통신 및 AI 서비스 제공 관련 표준화

NO.	표준화 기구	구분	단계	성과명 (표준명)	문서번호	시기
1	IETF 6lo WG	제정	개발	IPv6 over Constrained Node Networks (6lo) Applicability & Use cases	draft-ietf-6lo-use-cases-15	2023.03
2	IETF 6lo WG	제정	개발	IPv6 over Constrained Node Networks (6lo) Applicability & Use cases	draft-ietf-6lo-use-cases-16	2023.09
3	IETF 6lo WG	제정	승인	IPv6 over Constrained Node Networks (6lo) Applicability & Use cases	RFC 9453	2023.09
4	IETF 6lo WG	제정	승인	Transmission of IPv6 Packets over PLC Networks	RFC 9354	2023.01
5	IETF 6lo WG	제정	개발	Transmission of IPv6 Packets over NFC	draft-ietf-6lo-nfc-19	2023.01
6	IETF 6lo WG	제정	개발	Transmission of IPv6 Packets over NFC	draft-ietf-6lo-nfc-20	2023.01
7	IETF 6lo WG	제정	개발	Transmission of IPv6 Packets over NFC	draft-ietf-6lo-nfc-21	2023.02
8	IETF 6lo WG	제정	개발	Transmission of IPv6 Packets over NFC	draft-ietf-6lo-nfc-22	2023.07
9	IETF 6lo WG	제정	승인	Transmission of IPv6 Packets over NFC	RFC 9428	2023.07
10	IETF NMRG	제정	개발	Considerations of deploying AI services in a distributed approach	draft-hong-nmrg-ai-deploy-03	2023.03
11	IETF NMRG	제정	개발	Considerations of deploying AI services in a distributed approach	draft-hong-nmrg-ai-deploy-04	2023.07
12	IETF NMRG	제정	개발	Considerations of deploying AI services in a distributed method	draft-hong-nmrg-ai-deploy-05	2023.10
13	IETF NMRG	제정	개발	Network management by automating distributed processing based on artificial intelligence	draft-oh-nmrg-ai-adp-00	2023.07
14	IETF NMRG	제정	개발	AI-Based Distributed Processing Automation in Digital Twin Network	draft-oh-nmrg-ai-adp-01	2023.10
15	IETF T2TRG	제정	개발	IoT Edge Challenges and Functions	draft-irtf-t2trg-iot-edge-08	2023.01
16	IETF T2TRG	제정	개발	IoT Edge Challenges and Functions	draft-irtf-t2trg-iot-edge-09	2023.07
17	IETF T2TRG	제정	개발	IoT Edge Challenges and Functions	draft-irtf-t2trg-iot-edge-10	2023.09

01-2. AIStar 표준화 실적 (5/5)

ITU-T : AIoT를 위한 서비스 및 Common Rule Enablement 기술 관련 표준화

NO.	표준화 기구	구분	단계	성과명 (표준명)	문서번호	시기
1	ITU-T SG 20	제정	개발	Update text of Y.SF-prediction	T22-SG20-C-0217R1	2023.01
2	ITU-T SG 20	제정	개발	Update text of Y.IoT-CRE-fr	T22-SG20-C-0218R1	2023.01
3	ITU-T SG 20	제정	개발	Output text for draft Recommendation ITU-T Y.SF-prediction "Service framework of prediction for intelligent IoT", Q4/20 meeting (Geneva, 30 January – 10 February 2023)	T22-SG20-230130-TD-GEN-0660	2023.02
4	ITU-T SG 20	제정	개발	Output text of draft Recommendation ITU-T Y.IoT-CRE-fr "Framework of common rule enablement for intelligent IoT services in heterogeneous IoT platform environments", Q4/20 meeting (Geneva, 30 January - 10 February 2023)	T22-SG20-230130-TD-GEN-0661R1	2023.01
5	ITU-T SG 20	제정	개발	Proposed text updates for draft Recommendation ITU-T Y.SF-prediction "Service framework of prediction for intelligent IoT"	T22-SG20-C-0357	2023.09
6	ITU-T SG 20	제정	개발	Proposed text updates for draft Recommendation ITU-T Y.IoT-CRE-fr "Framework of common rule enablement for intelligent IoT services in heterogeneous IoT platform environments"	T22-SG20-C-0358	2023.09
7	ITU-T SG 20	제정	개발	Output text for draft Recommendation ITU-T Y.SF-prediction "Service framework of prediction for intelligent IoT", Q4/20 meeting (Arusha, 13-22 September 2023)	T22-SG20-230913-TD-GEN-1007	2023.09
8	ITU-T SG 20	제정	개발	Output text for draft Recommendation ITU-T Y.IoT-CRE-fr "Framework of common rule enablement for intelligent IoT services in heterogeneous IoT platform environments", Q4/20 meeting (Arusha, 13-22 September 2023	T22-SG20-230913-TD-GEN-1008R1	2023.09

01-3. AI and IoT

AI enabled IoT?

"AI can make IoT smarter"

"IoT can make AI smarter"

02. Motivation and Background

- Many Artificial Intelligence (AI) and Machine Learning (ML) applications use data collected in IoT platforms to train their model.
- Depending on the quality and quantity of collected dataset for model training, the performance of AI models are different.
- IoT platform (including oneM2M) is a place holder to collect and manage various data (image, text, sensory, etc.)
- In order to build a good model, it is very important to have good data management.
- As AI technologies are now being used in many network systems (such as telco core network, smart factory platform, including IoT platforms), it is good to consider providing necessary AI enablement features to IoT platforms.
- If AI applications use IoT platforms that support proper AI data management, the applications can provide various intelligent services more easily.

03. How to support common AI/ML features via IoT service layer platform?

Steps of Machine Learning (ML)

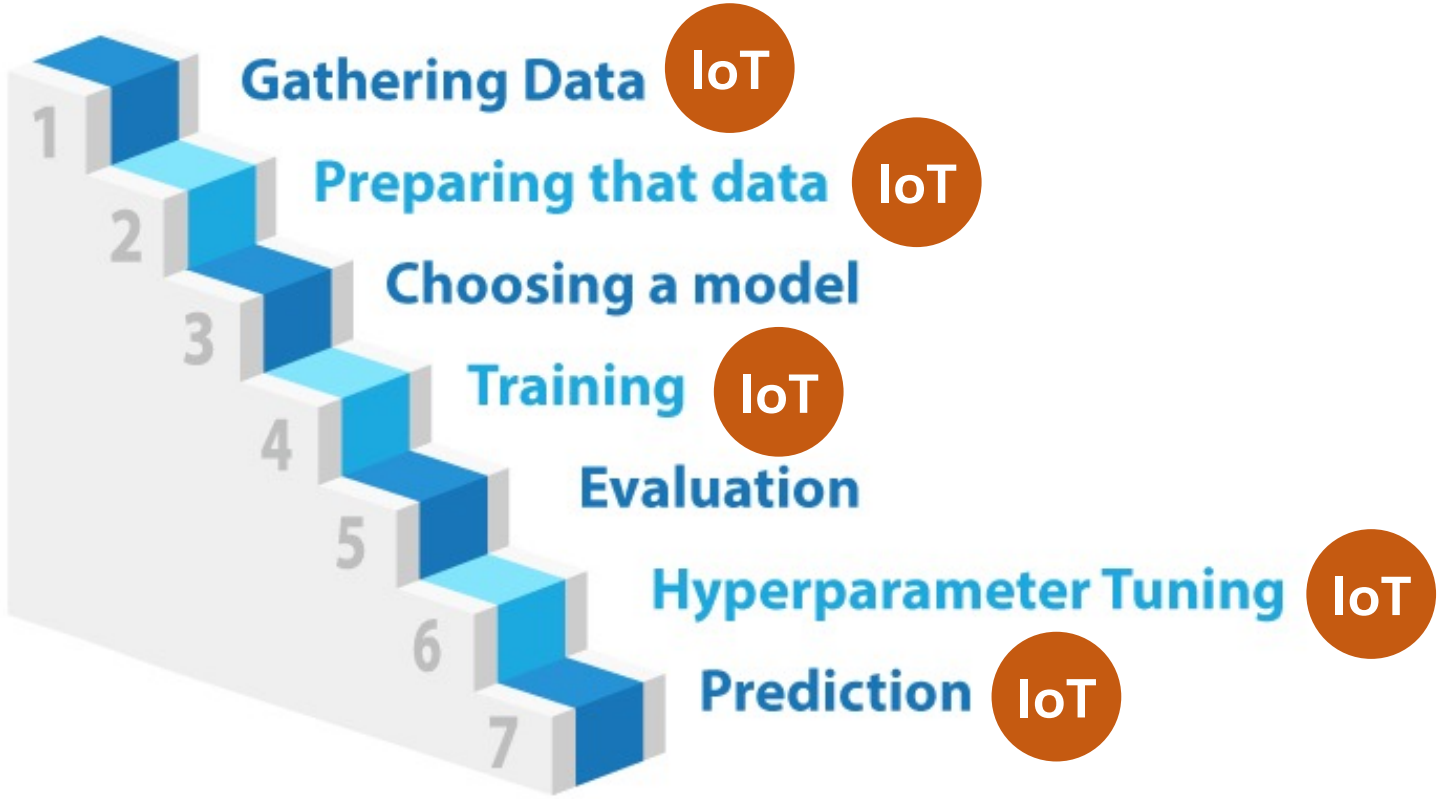


Image from https://www.mygreatlearning.com/blog/what-is-machine-learning/

04. Introduction to AI enabled oneM2M system

What oneM2M can do?

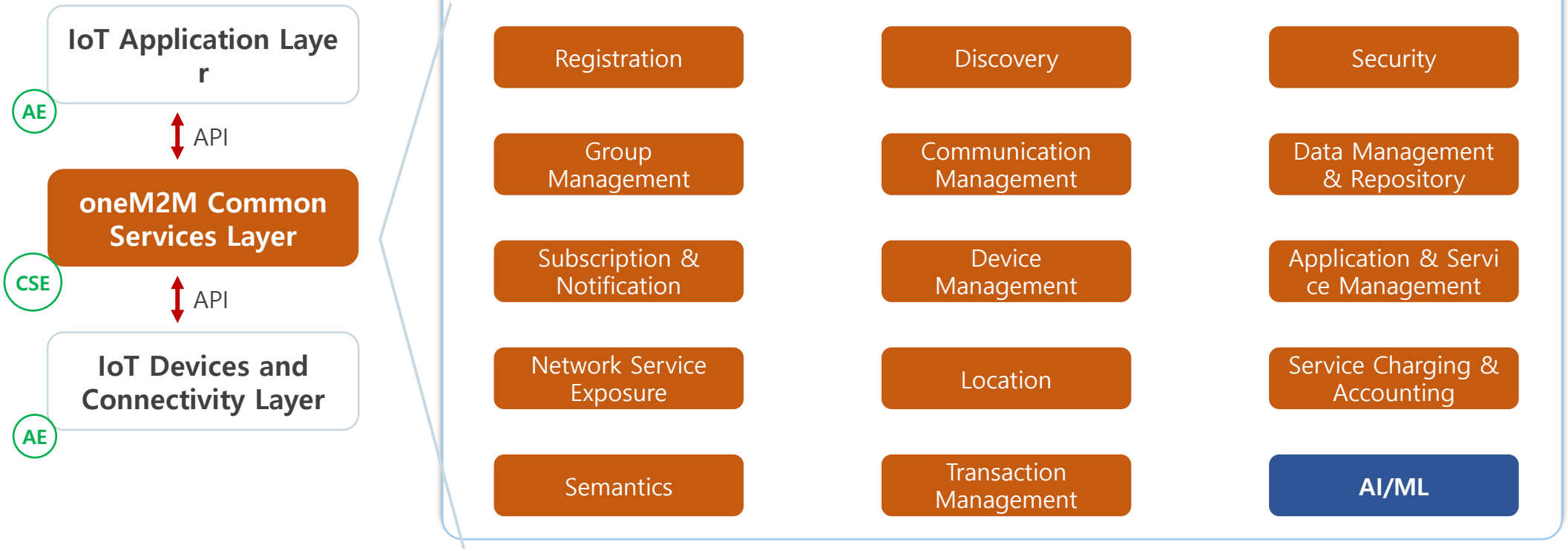
- oneM2M can consider to support data management for AI/ML

- For example,
  - A resource for AI/ML algorithms?
  - Classification and management of ML dataset stored in oneM2M?
  - A new CSF for various AI/ML models?
  - Management of parameters for AI/ML models?
  - Management of trained AI/ML models?

- A new WID for the enablement of AI/ML features to oneM2M?

Image from https://www.mygreatlearning.com/blog/what-is-machine-learning/

04-1. AI/ML as a common service



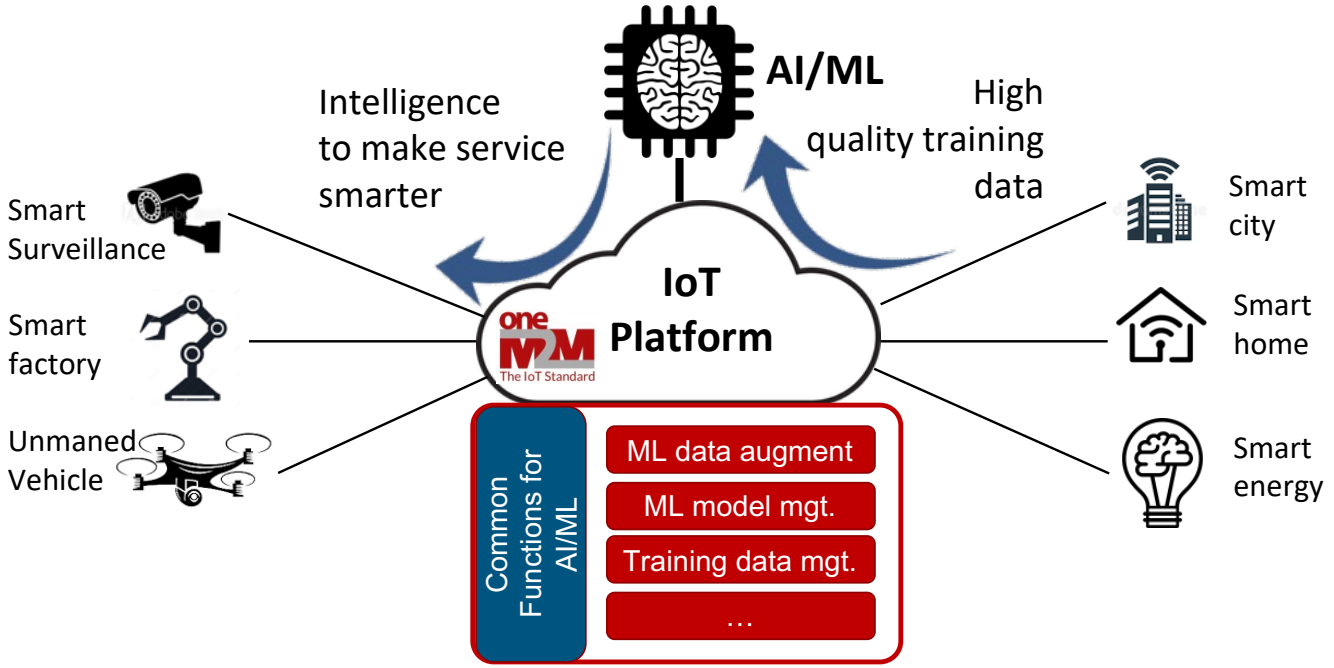
AE In oneM2M terminology, an AE represents an Application Entity

CSE In oneM2M terminology, an CSE represents a Common Services Entity

04-2. High-level concept

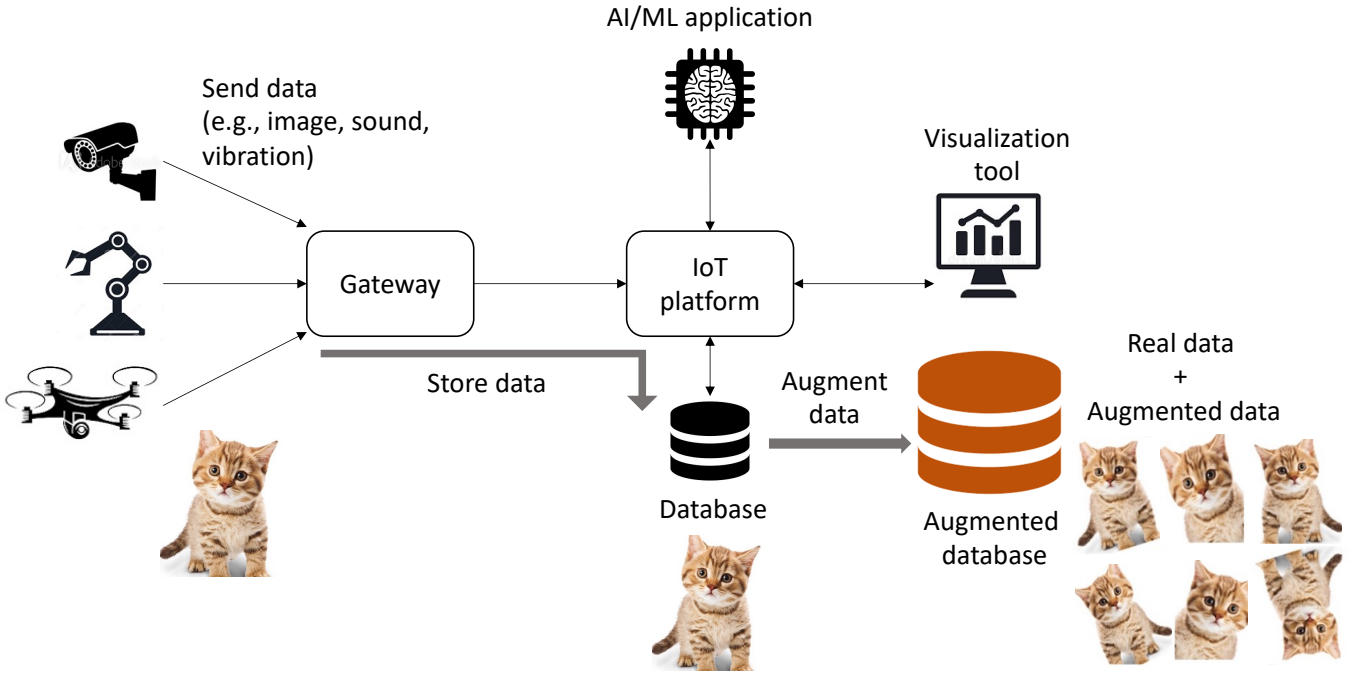
oneM2M system should be enhanced with

- A new common service function (CSF) to support AI capabilities
- A set of new resources
- Various AI/ML use cases



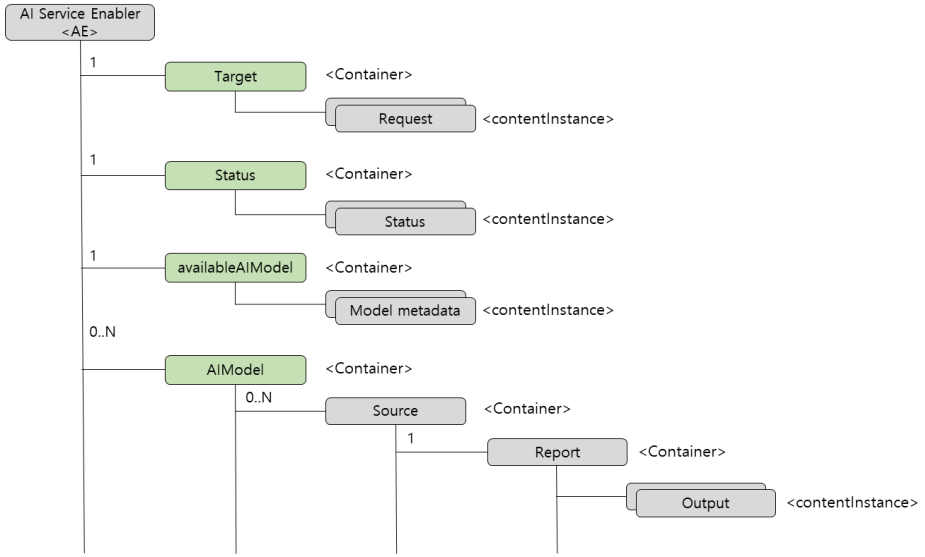
04-3. Use case #1. Data Augmentation

- Introduce a new resource to oneM2M for data augmentation
- AI/ML developers simply request data augmentation to oneM2M platform
- Larger training dataset is given to AI/ML developers for training and build a model
- Augmented dataset can be reused by others

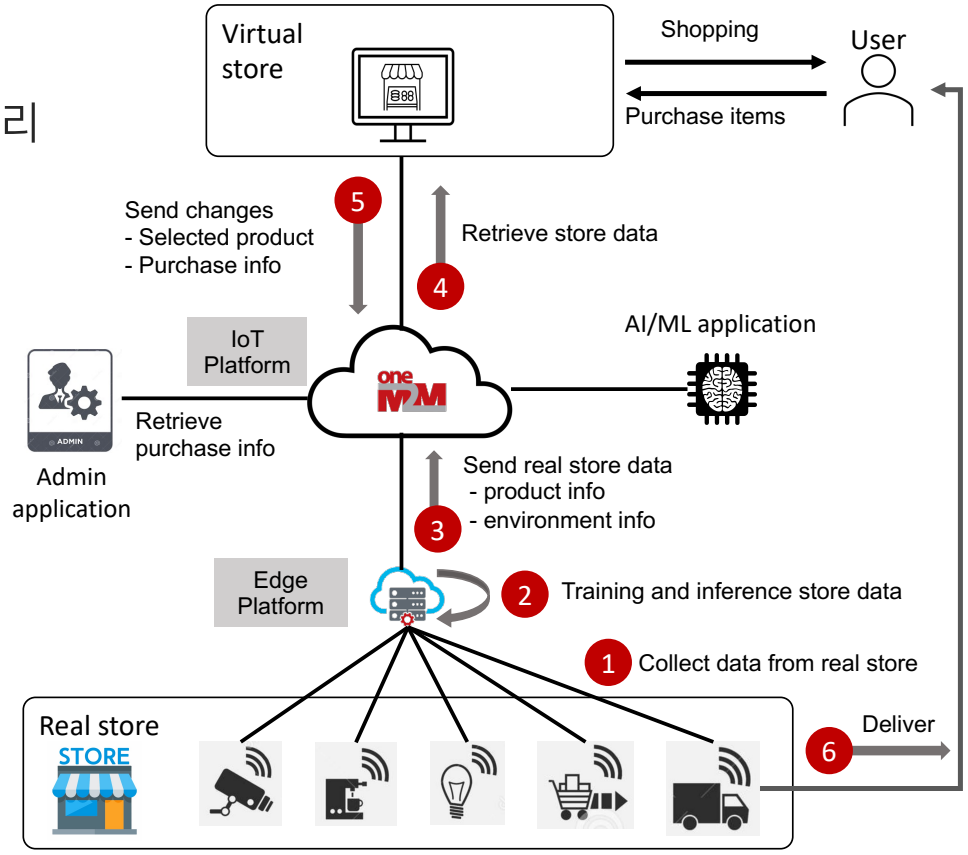


04-4. Use case #2. 메타버스 Virtual Store

- 가상의 공간인 Metaverse Virtual Store와 실제 사물을 연동하는 유스케이스 제안
- 지속적인 인공지능 학습 모델 관리 지원
- 다중 AI/ML 모델을 지원하는 리소스 구조 제안
- 인공지능 개발자는 oneM2M 플랫폼을 통해 모델 및 데이터 관리

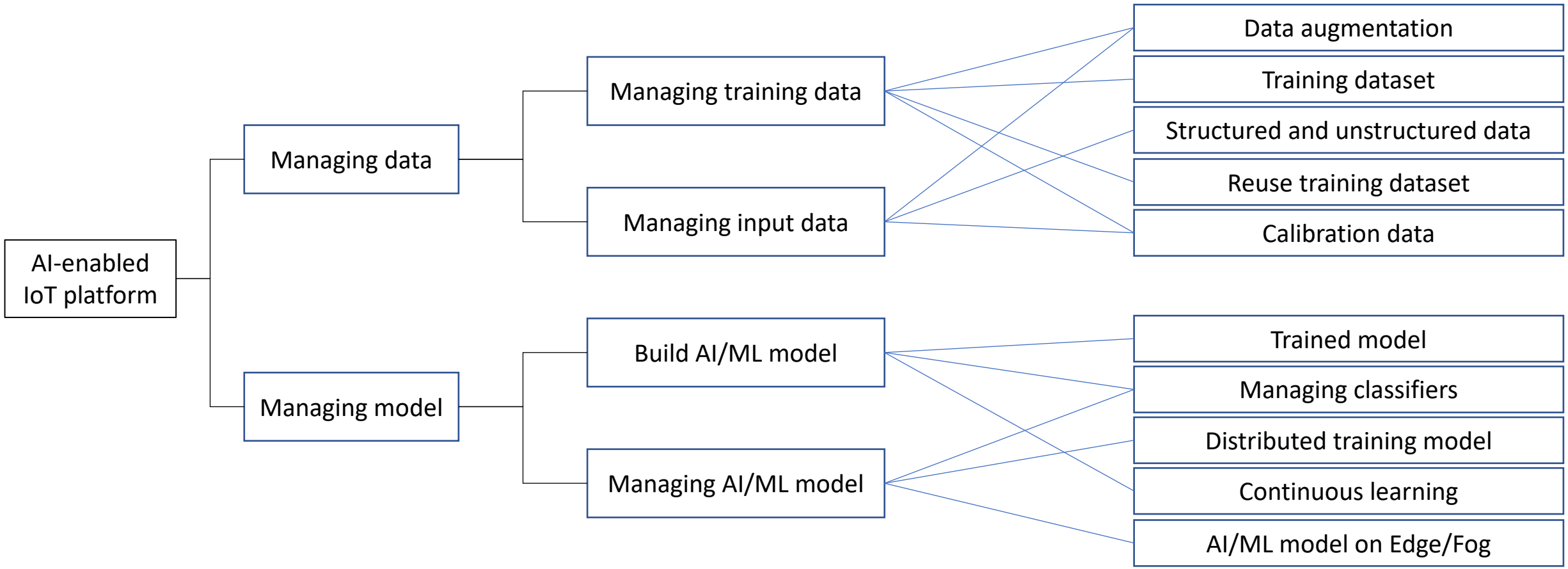


[다중 AI/ML 모델 지원 리소스 트리]



[메타버스 가상 상점 지원 지능형 IoT 플랫폼]

04-5. Potential Requirements to Support AI/ML



04-6. Demo at Taipei AIoT 2023 Exhibition

AI-Enabled IoT
based on the oneM2M Standards
using Mobius Open Source

(Sejong University & KETI)

04-7. AIStar 표준화 실적 (표준 기관 협력)

"Enabling Multi-access Edge Computing in Internet-of- Things: how to deploy ETSI MEC and oneM2M" White Paper 발간

- oneM2M과 ETSI ISG MEC 협업 및 세종대학교 선도 결과물
- 엣지 컴퓨팅을 기반으로 두 표준의 아키텍처를 연동하여 안정적인 상호 연동 프레임워크 설계 방법을 가이드
- 참여기관: 세종대학교, Intel, Telecom Italia, Deutsche Telekom, InterDigital 등

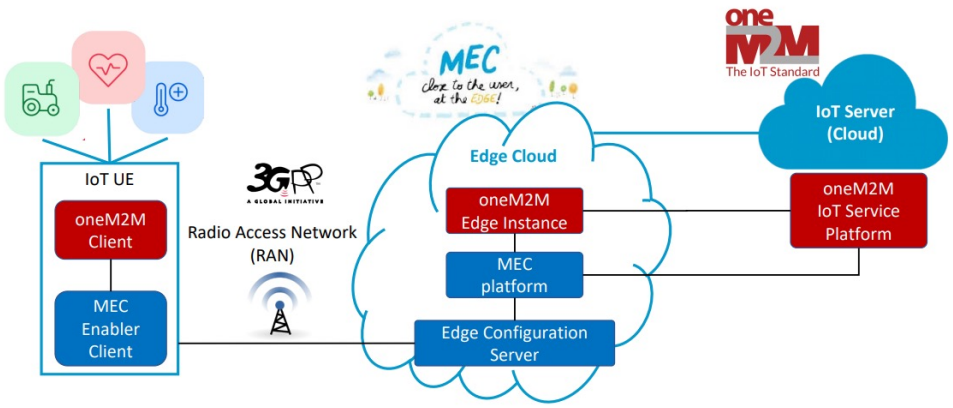


Figure 14: High-level conceptual architecture with MEC and oneM2M

ETSI White Paper No. #59

Enabling Multi-access Edge Computing in Internet-of-Things: how to deploy ETSI MEC and oneM2M

1st edition – June 2023

Authors:
Dario Sabella, Roland Hechwartner, Enrico Scarrone, Samar Shailendra, JaeSeung Song, Bob Flynn, Arif Ishaq, Laurent Velez, Robert Gazda, Lee Jieun

ETSI
06921 Sophia Antipolis CEDEX, France
Tel +33 4 92 94 42 00
info@etsi.org
www.etsi.org

05. New oneM2M Features led by Sejong University

Make oneM2M platform to support data management for AI and provide AI/ML capabilities

WORK ITEM	
Work Item Title:	System enhancements to support AI capabilities
Document Number	WI-0105
Supporting Members or Partner type 2	KETI, Hyundai Motors, Exacta GSS, Deutsche Telekom, SBS, Nokia, Hansung University, Orange, Convida Wireless
Date:	2023-04-21
Abstract:	This work item aims to enable oneM2M to utilize Artificial Intelligence models and data management for AI services.
Template Version:23 February 2015 (Do not modify)	

05. New oneM2M Features led by Sejong University

Allow oneM2M to manage data license so support

- **Linked Open Smart City Data**
- **License-based discovery**

WORK ITEM	
Work Item Title:	System enhancements to support Data License Management
Document Number	WI-0102
Supporting Members or Partner type 2	Hyundai Motors, KETI, Deutsche Telecom, Telecom Italia, Convida Wireless, BT, Orange
Date:	2020-05-29
Abstract:	Proposes a work item to study oneM2M system enhancement to support data license management.
Template Version:23 February 2015 (Do not modify)	

05. New oneM2M Features led by Sejong University

Make oneM2M platform to be compliant with Data Protection Regulations such as GDPR and PIPA

WORK ITEM	
Work Item Title:	System enhancements to support Data Protection Regulations
Document Number	WI-0095
Supporting Members or Partner type 2	Hyundai Motor, KETI, BT, SyncTechno Inc., Hansung University, EGM, Sejong University
Date:	2022-11-30
Abstract:	Proposes a work item to study oneM2M system enhancement to support data protection regulations such as General Data Protection Regulation from EU.
Template Version:23 February 2015 (Do not modify)	

05. New oneM2M Features led by Sejong University

Make oneM2M platform to support Metaverse services

WORK ITEM	
Work Item Title:	Enablement of IoT in the metaverse (MetaIoT)
Document Number	WI-0110
Supporting Members or Partner type 2	Hansung University, Nokia, KETI, Sejong University
Date:	2022-09-28
Abstract:	Propose a Work Item for enabling Metaverse services on IoT

'Template Version: January 2020 (do not modify)

감사합니다.

Prof. Kim Jaeho (Presenter)/ Prof. JaeSeung Song, Sejong University
kimjh@sejong.ac.kr / jssong@sejong.ac.kr