The Standards People

Conférence Internet des Objets et AI

Enriching the oneM2M platform with generic AI capabilities

A Proof-of-Concept

Presented by: **Emmanuel Darmois** For: **ETSI Specialist Task Force 584**

30.06.2020

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Outline

- ETSI / Specialist Task Force / 584
- An overview of oneM2M

- The STF 584 Approach
- Expected impact on oneM2M service layer capabilities
- The Proof-of-Concept and the selected Use Cases
- Initial conclusions and next steps

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A quick introduction to ETSI and STF 584

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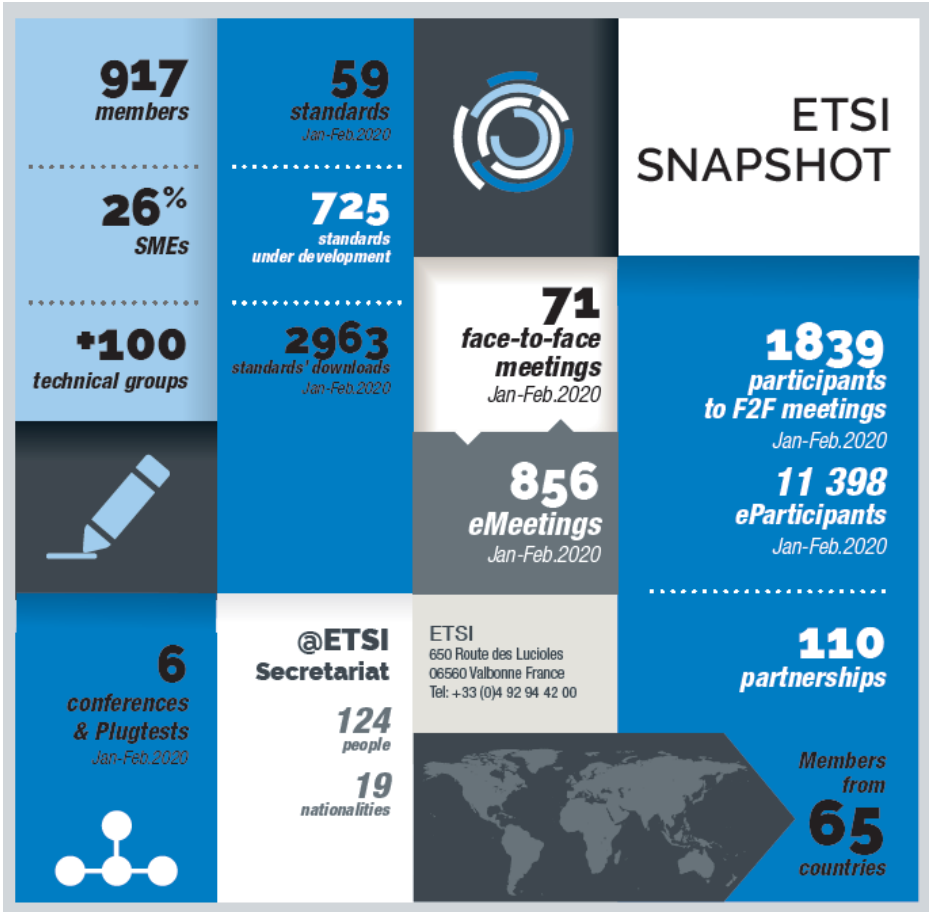
About ETSI - Bringing people together…

- Independent, non-profit standards organization
- Officially recognized by the European Union to support EU regulation
- **30** year track record of technical excellence in the ICT sector
- Founding Partner Member of both **3GPP** and **oneM2M**

- Over **910** members from **65** countries over **5** continents
- Diverse community: private companies, research and academia, governments, public bodies, societal stakeholders

- Over **48 000** standards published to date, **2 600** annually
- **17.5 million** downloads annually – All standards are free of charge

- Over **90** technical groups holding more than **4 000 (e)** meetings per year
- More than **50** conferences and interop events per year



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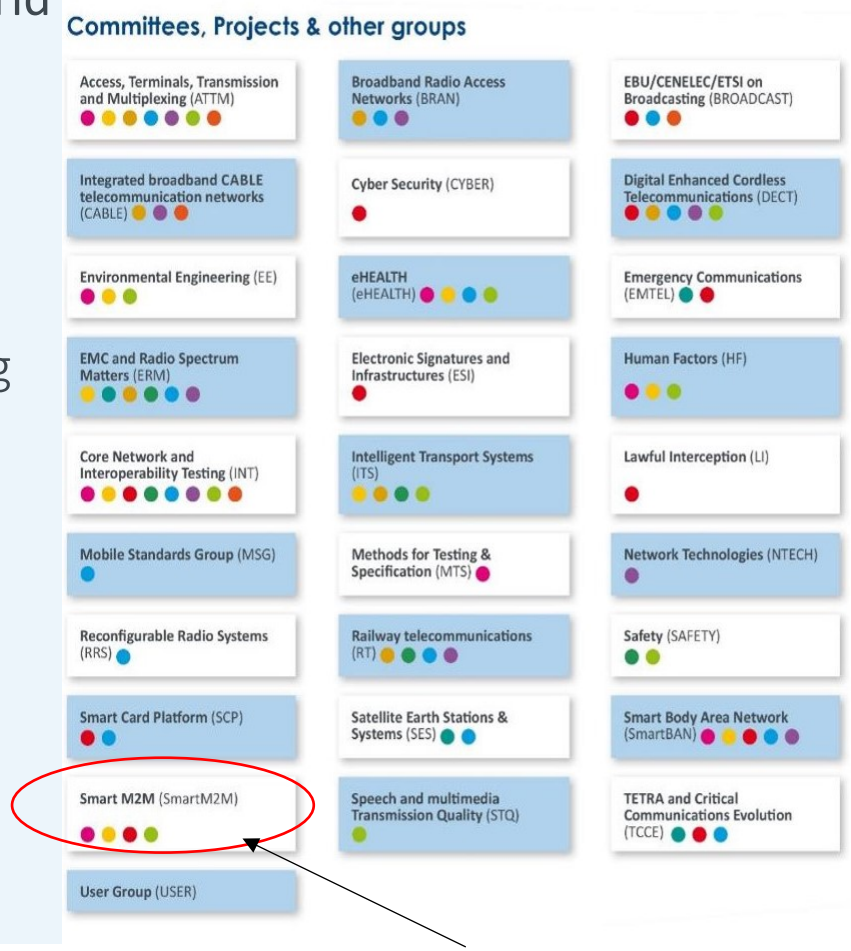
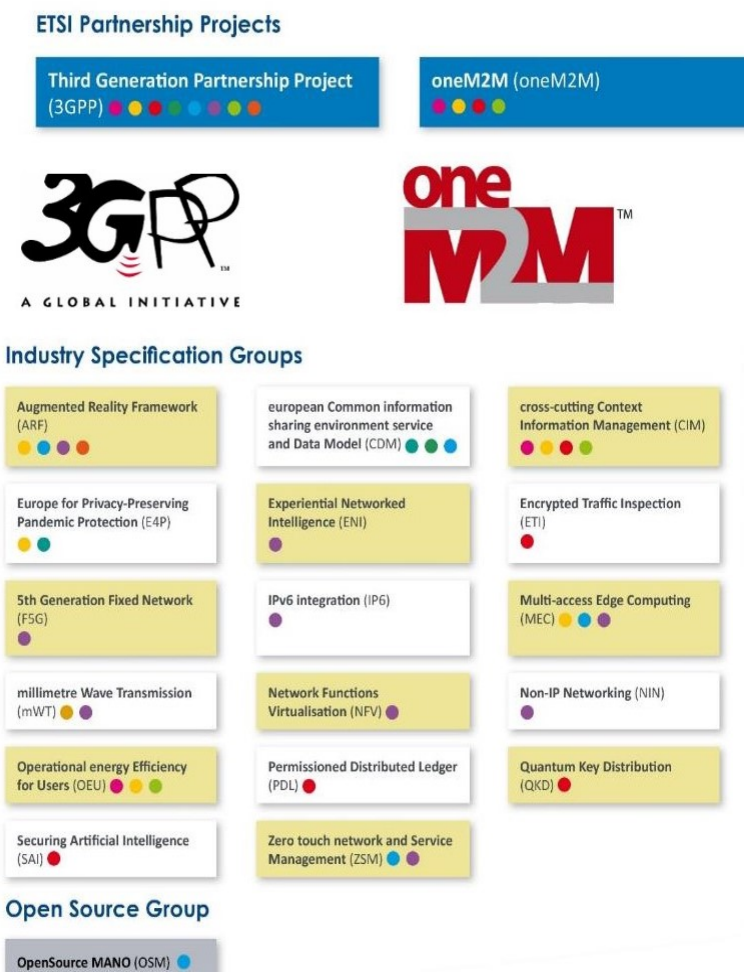
About ETSI - At the heart of digital…

To design tomorrow's digital world

- 5G
- IoT / M2M
- Cybersecurity
- Network Virtualization
- Multi-access Edge Computing
- Automated Network Management
- Artificial Intelligence
- Blockchain
- Quantum (Compute & Key)
- AR/VR/XR
- ..and many others





SmartM2M TC is the hosting TC for the STF

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ETSI Specialist Task Forces

What is an STF?

- Specialist Task Forces (STF) are teams established to support the ETSI Technical structure to accelerate the production of standards urgently required by the ETSI Members or the European Commission (EC) and the European Free Trade Association (EFTA).
- STFs give ETSI a competitive advantage by making readily available the technical competence to quickly develop standards needed by the market and/or to implement European Union policies.

Why use an STF?

- STFs can be requested by a Reference Body (Technical committee, ETSI Project, ETSI Partnership Project, Special Committee, Industry Specification Group), when the development of a standard requires specific technical competence not available in the Reference Body and/or the time scale cannot be achieved with the normal voluntary contribution of the delegates.

Who does the work?

- The Reference Body is responsible for the technical guidance of the STF. The ETSI Secretariat provides assistance for financing, recruitment of experts, establishment of contracts, project management, document editing, IT and logistic support
- The drafts produced by the STF will then be submitted to the normal approval process relevant to that type of standard.

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ETSI Specialist Task Force (STF) 584
Artificial Intelligence for IoT Systems

Objectives

- Provide an initially validated architecture that describes how IoT systems can make use of Artificial Intelligence (AI) and Machine Learning (ML) for the management and interpretation of IoT devices data
- Identify the requirements for the extension/adaptation of oneM2M in order to better integrate AI/ML techniques and ensure that the associated management of data is well handled by the IoT Service Layer

Tasks

- T2 Identification of Architecture Evolutions
- T3 Proof of Concept
- T4 Dissemination towards oneM2M and the IoT community

Deliverables

- ETSI TR 103 674: SmartM2M; Artificial Intelligence and the oneM2M architecture
- ETSI TR 103 675: SmartM2M; AI for IoT: A Proof of Concept

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ETSI STF 584
How it is done

Work started on January 2020 and to be finished by the end of December 2020.

Experts

- Mahdi Ben Alaya, Sensinov
- Ricardo Vitorino, Ubiwhere
- João Garcia, Ubiwhere
- Emmanuel Darmois, CommLedge
- Ken Figueredo, More with Mobile

Milestones

A	Detailed specification of use cases: early draft of ETSI TR 103 674	29 February 2020
B	Architecture evolutions: stable draft of ETSI TR 103 674	30 April 2020
C	Use cases for Proof of Concept: early draft of ETSI TR 103 675	29 May 2020
D	Architecture evolutions: final draft of ETSI TR 103 674 PoC architecture: stable draft of ETSI TR 103 675	18 June 2020
E	Final use cases implementation approved by ETSI/CTI	30 September 2020
F	Final use cases implementation presented and discussed with oneM2M Deliverables and Final report approved by TC SmartM2M	30 October 2020
G	Deliverables published and STF closed	31 December 2020

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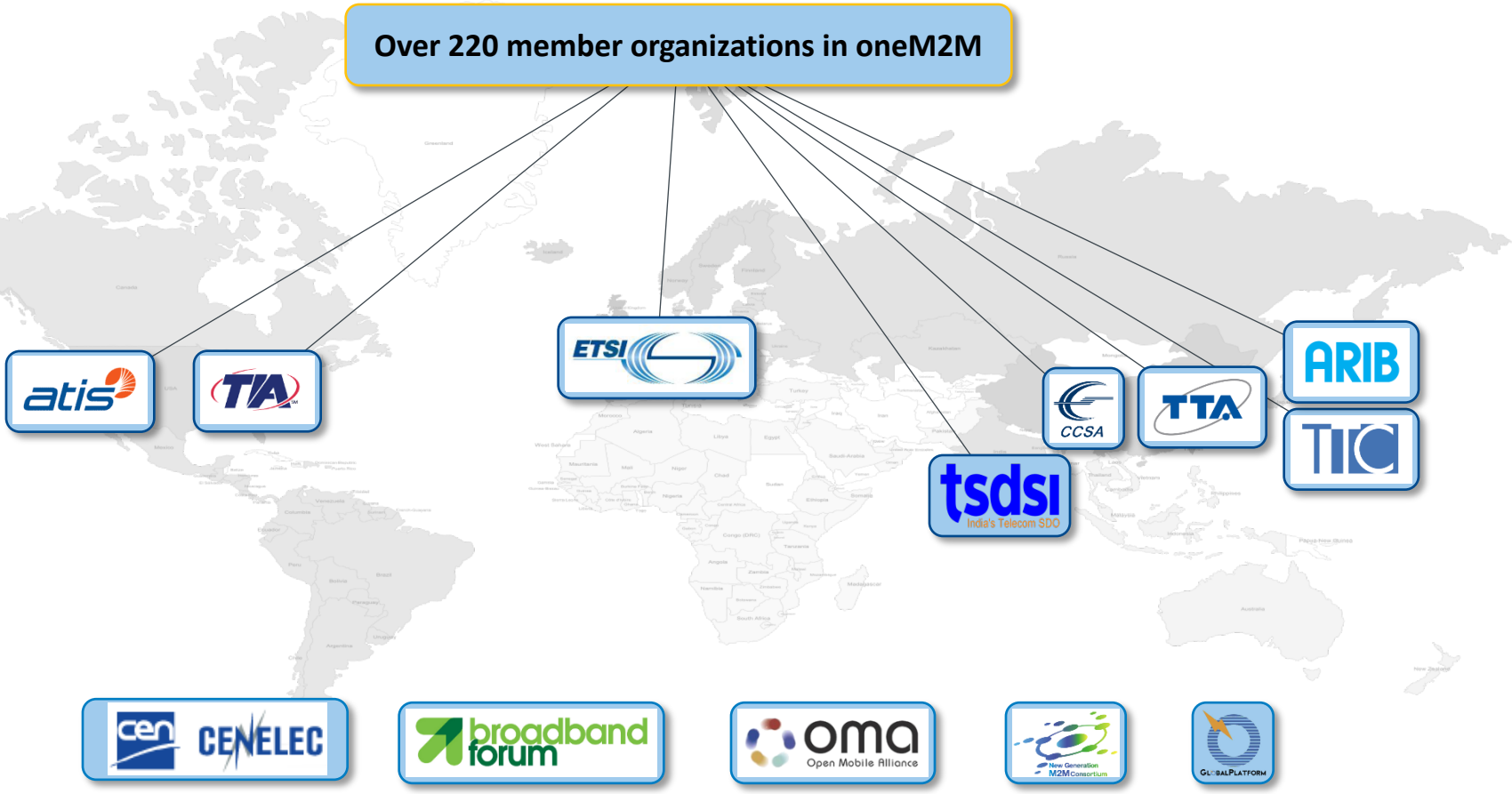
An overview of oneM2M

oneM2M Partnership Project



www.oneM2M.org

All document are publically available

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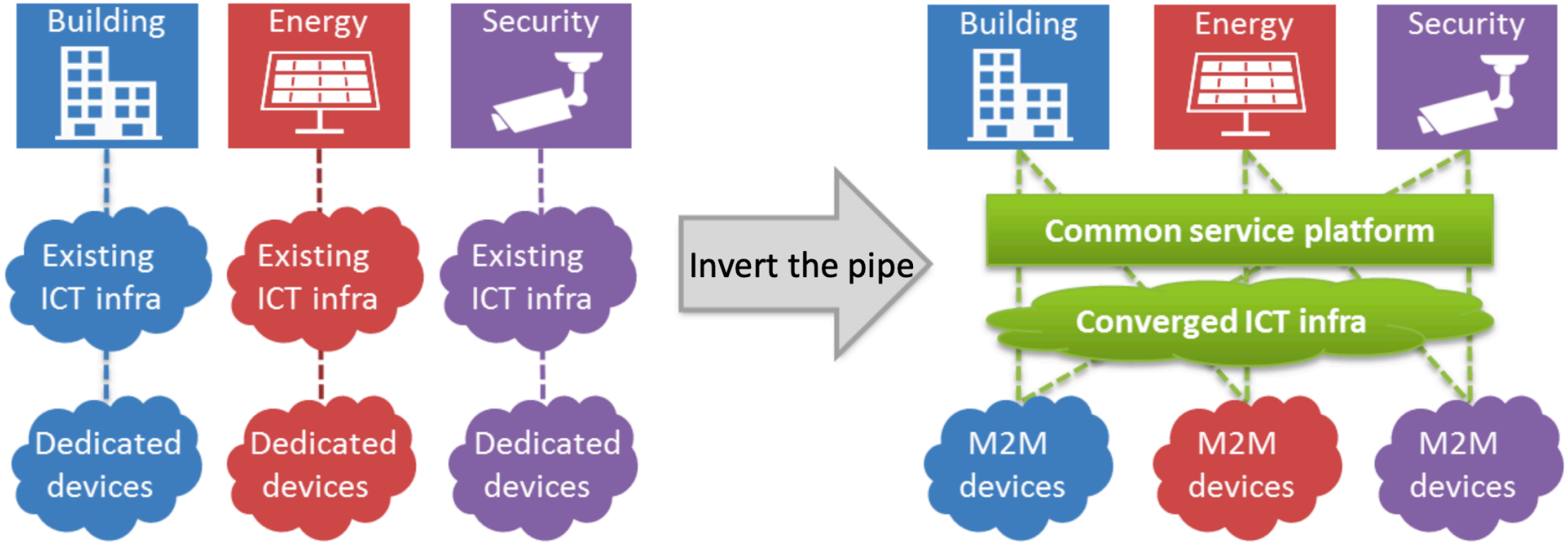
The oneM2M simplification approach

- Highly fragmented market with small vendor-specific applications.
- Reinventing the wheel: Same services developed again and again.
- Each silo contains its own technologies without interop.

- End-to-end platform: common service capabilities layer.
- Interoperability at the level of communications and data.
- Seamless interaction between heterogeneous applications and devices.



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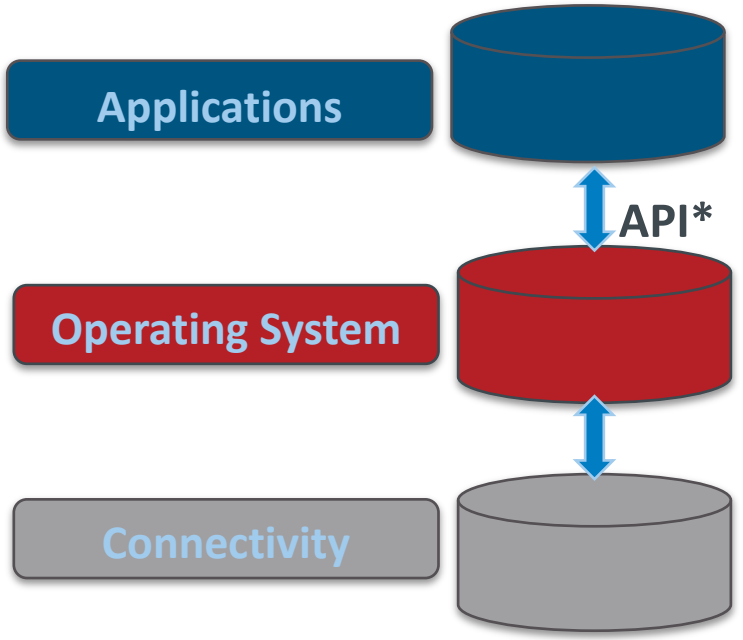
oneM2M Common Service Layer in a nutshell

A software “framework”

Located between the M2M applications and communication HW/SW that provide connectivity

Provides functions that M2M applications across different industry segments commonly need (eg. data transport, security/encryption, remote software update...)



Like an “Android” for the Internet of Things
But it sits both on the field devices/sensors and in servers
And it is a standard – not controlled by a single private company

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Common IoT key problems solved by oneM2M

Application area	• oneM2M provides globally standardized interfaces for the Application developers (device and cloud) • oneM2M enables Application portability
Data Interoperability	• oneM2M provides services towards the Application (Application –Registration & -Discovery, Subscription & Notifications Services, Secure Communication, Device Management etc… • oneM2M enables Device portability (a Device can be connected to any Infrastructure solution)
Connectivity	• oneM2M stores data in case of lack of connectivity • oneM2M can controls the devices usage of connectivity (When, how often communication happens)

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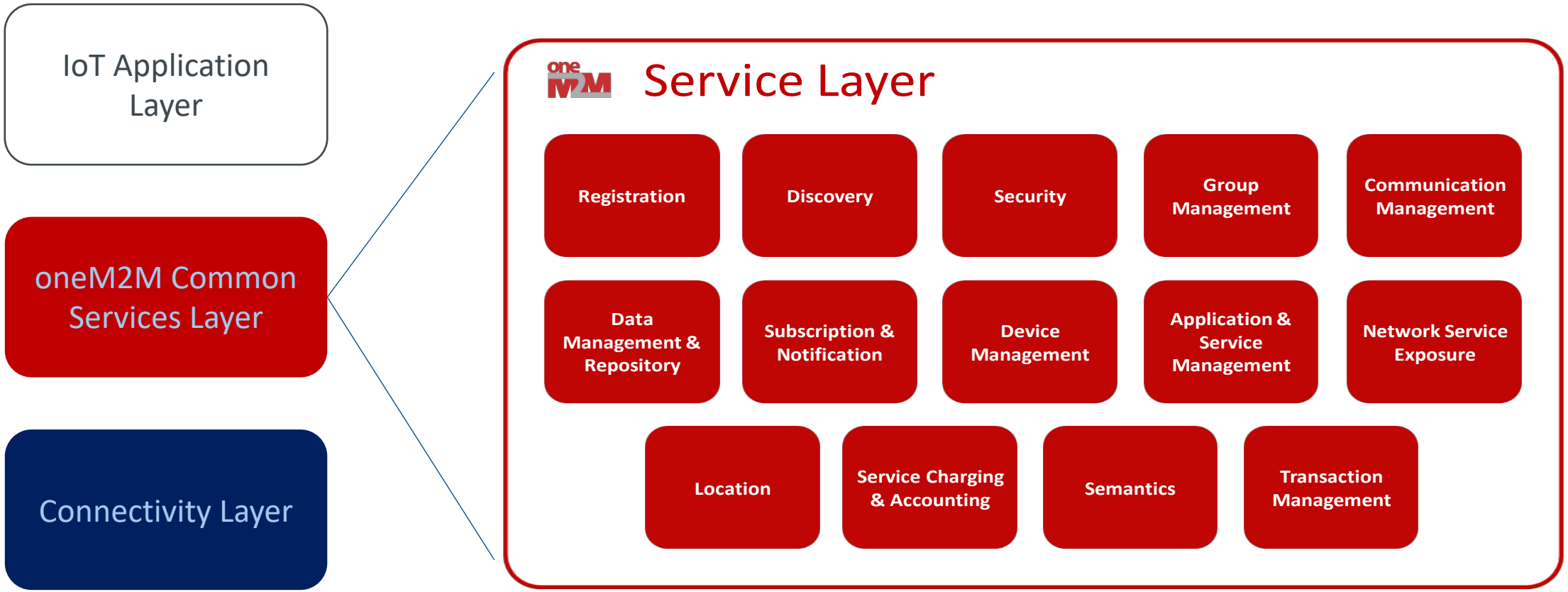
oneM2M Common Service Functions



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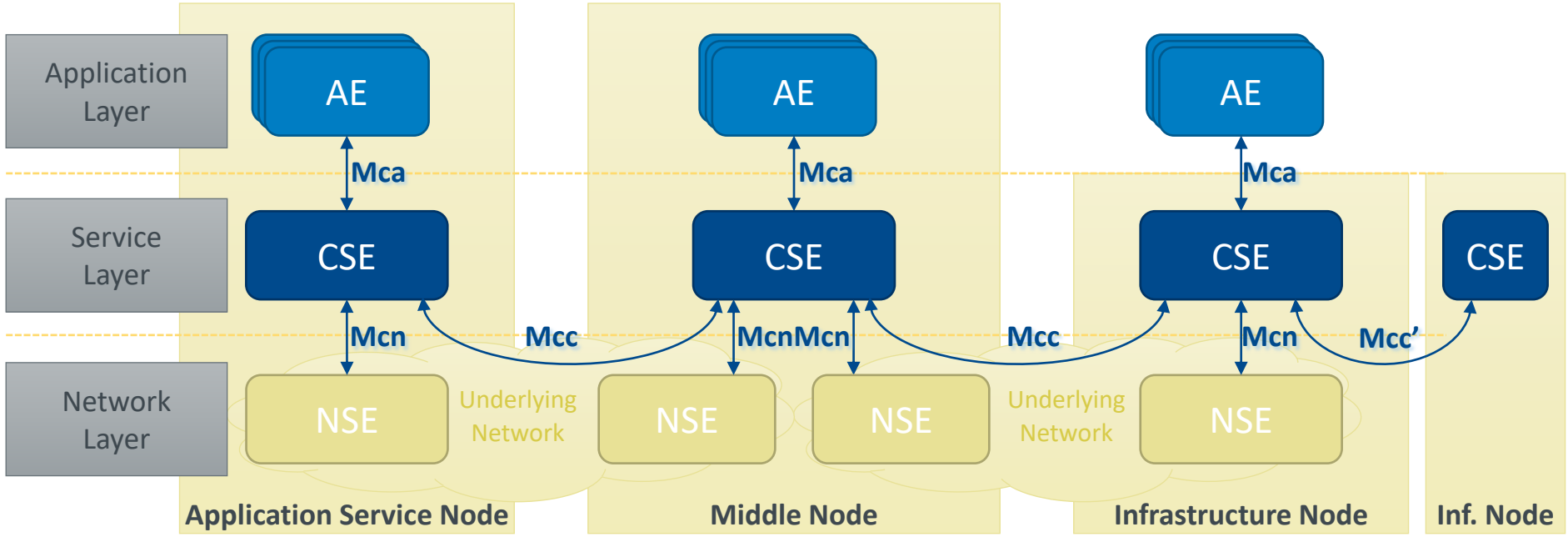
oneM2M Architecture

Reference Point	One or more interfaces - Mca, Mcn, Mcc and Mcc' (between 2 service providers)
Common Services Entity	Provides the set of "service functions" that are common to the M2M environments
Application Entity	Provides application logic for the end-to-end M2M solutions
Network Services Entity	Provides services to the CSEs besides the pure data transport
Node	Logical equivalent of a physical (or possibly virtualized, especially on the server side) device



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The STF 584 Work Approach

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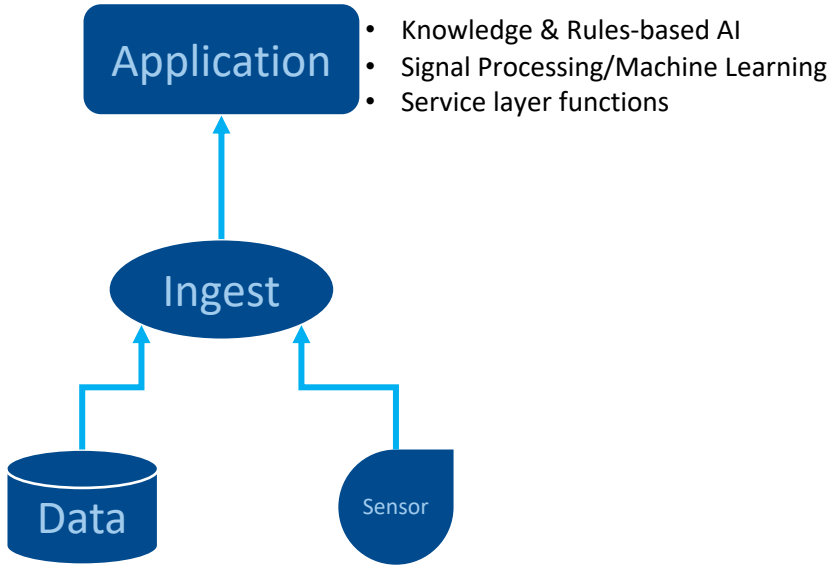
Challenge: enhance AI/ML performance, scalability and reusability through common service enablers

Traditional Approach

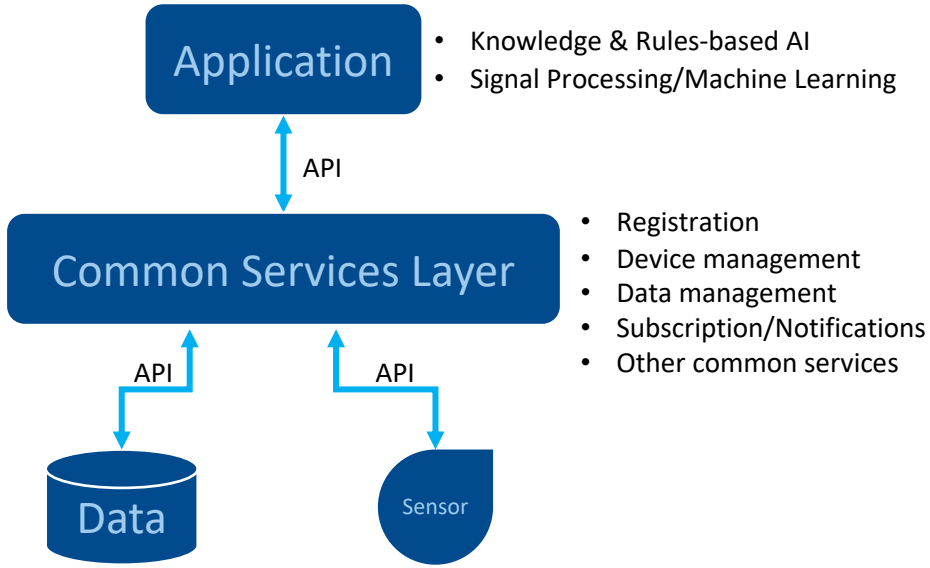
Concentrates all intelligence in the Application layer with limitations on replicability



Application has to ingest and store data

Scalable & Developer-friendly Approach

Creates a bi-directional abstraction layer between Applications and the underlying technologies for data and sensor management.



Developers can use a standard API in combination with a Subscription/Notification service to use data when notified of changes

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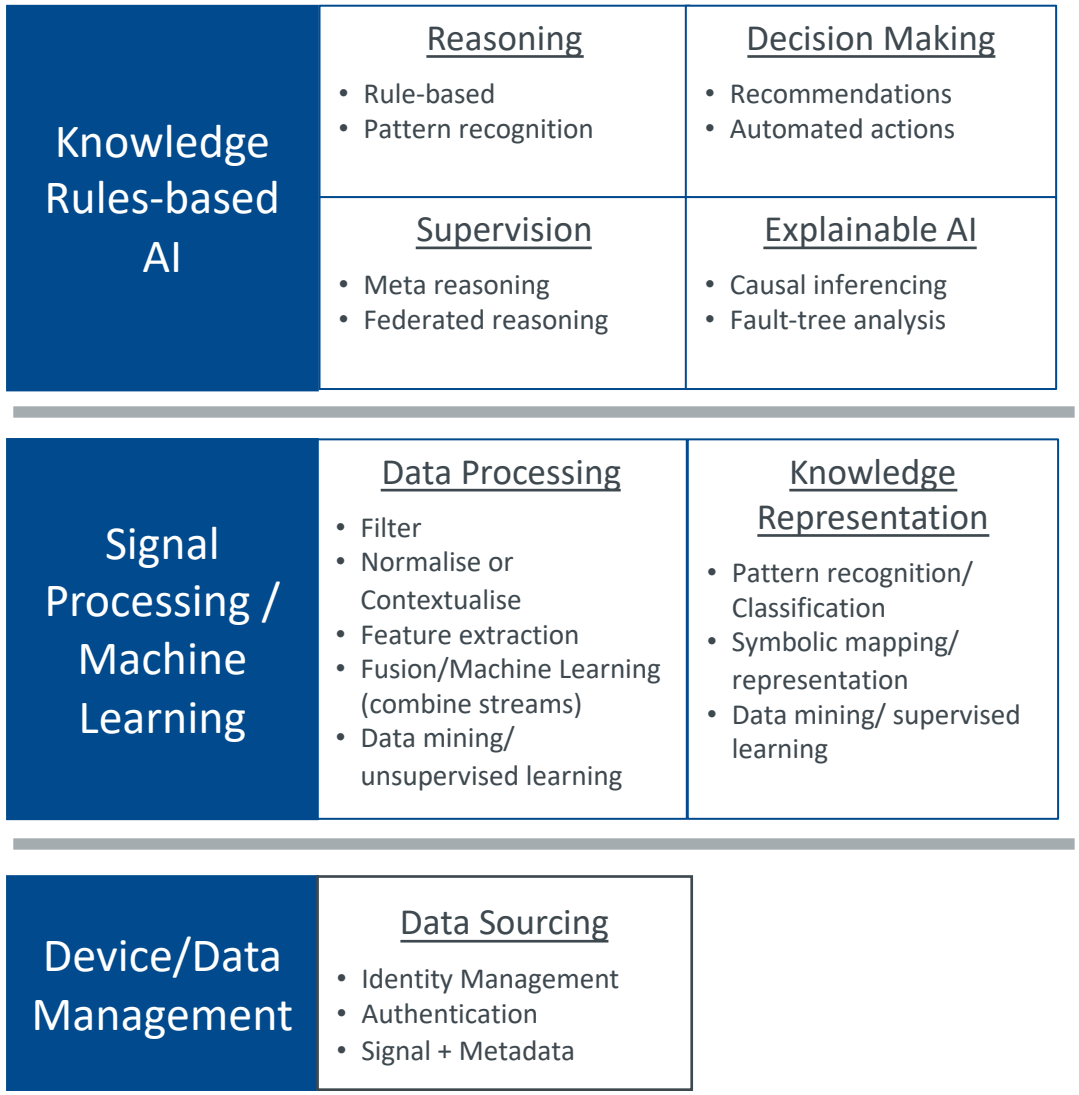
Impact on oneM2M Service Layer Capabilities



Opportunities for oneM2M Service Layer Capabilities

1. Convert AI/ML capabilities into CSF “as-a-service” capabilities in the CSL
2. Feed CSL data or resource-related information up to applications in order to improve AI/ML performance

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The Proof-of-Concept

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Some elements of the PoC

Three Use Cases to be implemented

- Use Case 1 on Fault detection will address more specifically measurements (implemented on oneM2M)
- Use Case 2 on Visual recognition will address more specifically images (implemented on oneM2M)
- Use Case 3 on tweets classification will address more specifically textual content (implemented on openMTC)

Some ideas to test

- AI/ML CSF “as-a-service” capabilities in the CSL
  - Configurable fault-detection functions (rule-based and ML based)
  - Configurable classifier CSF
- Applications of service-layer/CSF parameter data
  - Store and manage CSF performance data to establish trustworthiness profile in combination with static AE credentials (e.g. security maintenance history)
  - Combine semantic information with resource tree and discovery functions to create digital twins to enable explainable AI

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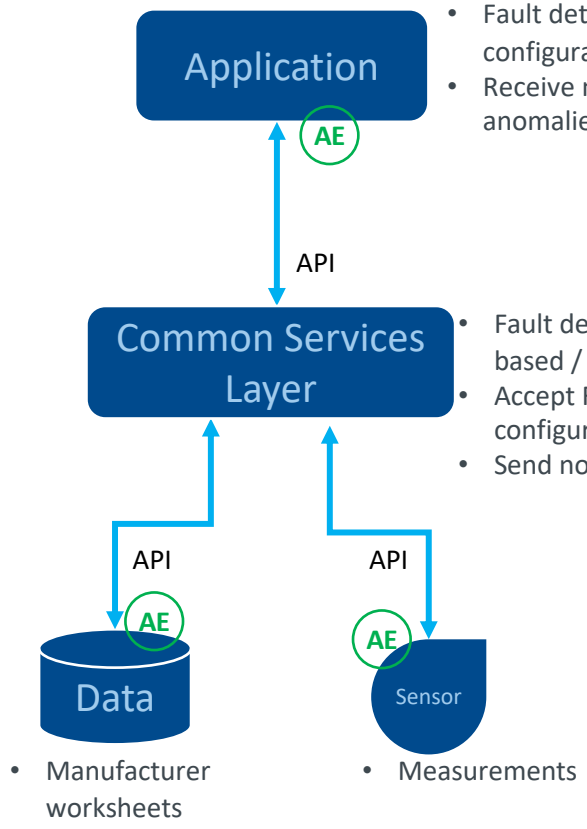
Use Case 1
Detailed description

In this use case, an IoT module will be prototyped for fault detection and isolation of IoT device data in a smart building environment using both a rule-based fault detection and a self-learning fault detection algorithm based on e.g. statistics sliding window approach. The rule-based approach would be based on available manufacturer datasheets including rules if available. The self-learning algorithm is based on determining trend vectors and comparing such vectors with longer term historic data.



- Fault detection configuration
- Receive notification when anomalies are detected

- Fault detection: Rule-based / ML-based
- Accept Fault detection configuration from AEs
- Send notification to AEs

- Manufacturer worksheets
- Measurements

oneM2M CSF DEPENDENCIES

- Data management: extend oneM2M resources (e.g. containers, flexContainers, etc.) with fault detection attributes.
- Application and Service Layer Management: Extend the oneM2M MCA interface to support configuration of fault detection parameters (CRUD)
- Discovery: Discover resources based on fault detection attributes (Extend filter criteria with fault detection attributes)
- Subscription and Notification: Notify an application when an anomaly is detected
- Security: Define dedicated access control policies related to fault detection, creation, configuration and notification.

NEW ML/AI CSF REQUIREMENTS

- Rule-based fault detection CSF: configurable service that detect faults based on predefined rules and notifies an application when it detects anomalies in the data (data loss, spikes, crossing of thresholds, etc.)
- ML-based fault detection CSF: configuration service that detect faults based on ML algorithms (e.g. exponential smoothing, auto-regressive Integrated Moving Average (ARIMA), etc.) and notify an application when it detects anomalies in the data.

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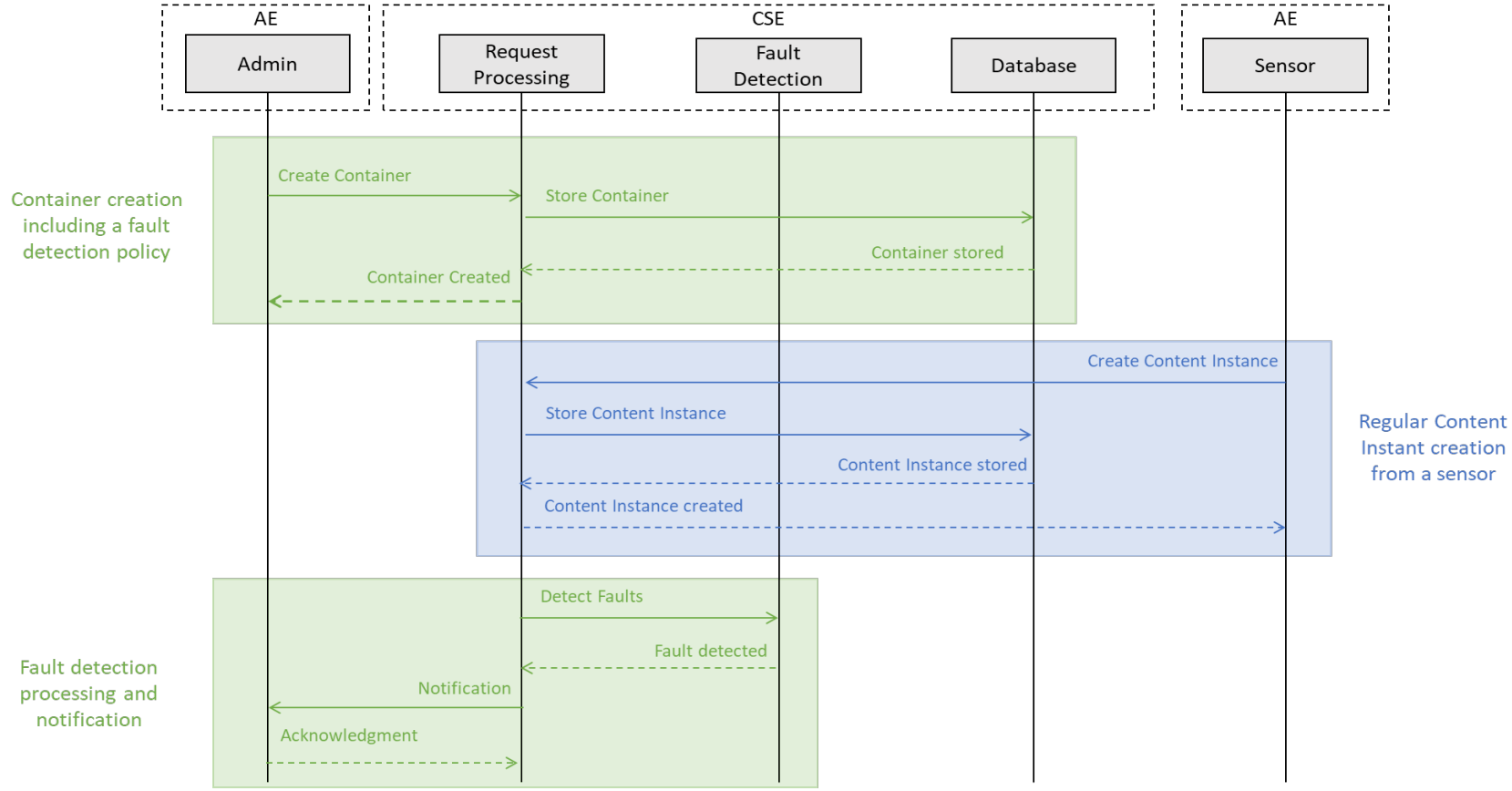
Entities and main components in Use Case 1

- Blue boxes show the interactions that are achievable with oneM2M platform without any changes
- Green boxes show new interactions that do not currently exist in oneM2M and need to be specified and implemented for this use case.



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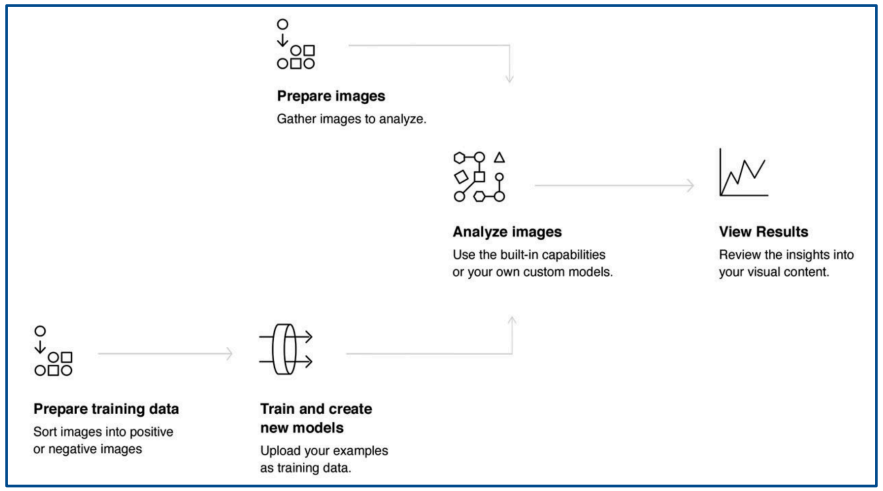
AI as a Service in oneM2M
A prior experiment with IBM Watson

An experiment by sensinov

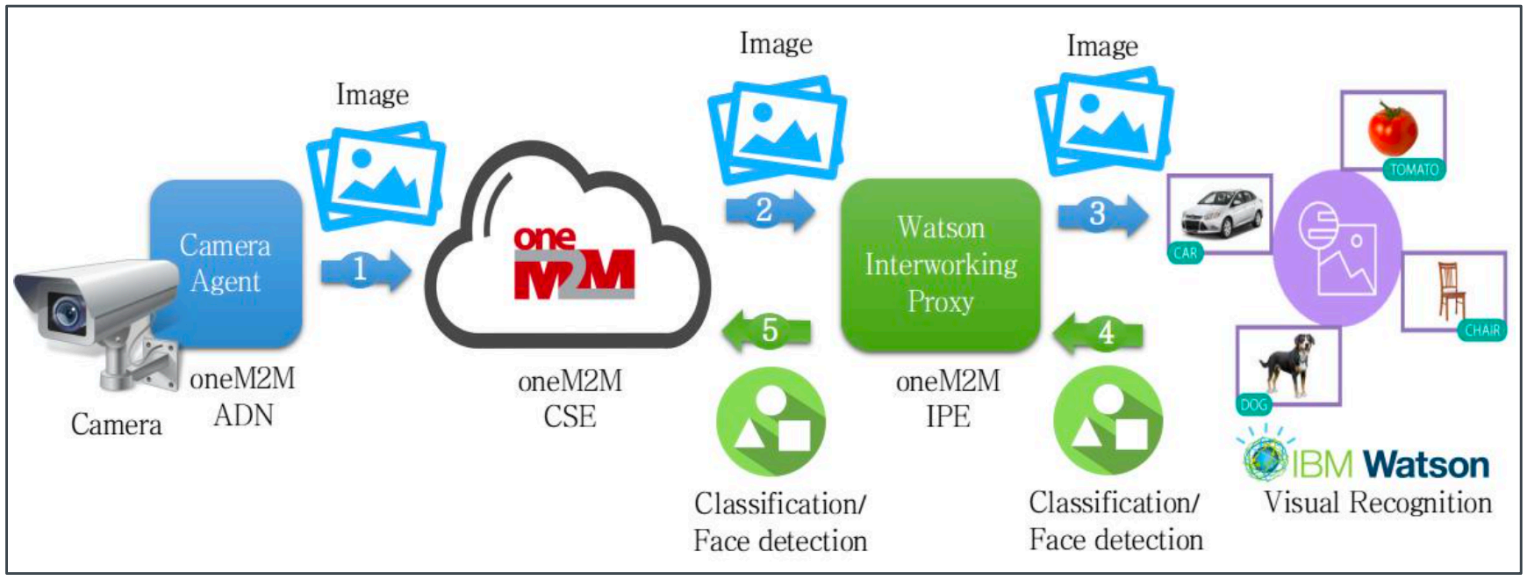
- A high-level architecture with an interworking proxy
- The interworking proxy supports multiple classifiers: predefined and custom models
- The Watson Visual Recognition Service is integrated with the oneM2M platform

An inspiration for the implementation of use case 1

- A more CSF-centric is a target of the PoC



Making use of IBM Watson Visual Recognition service



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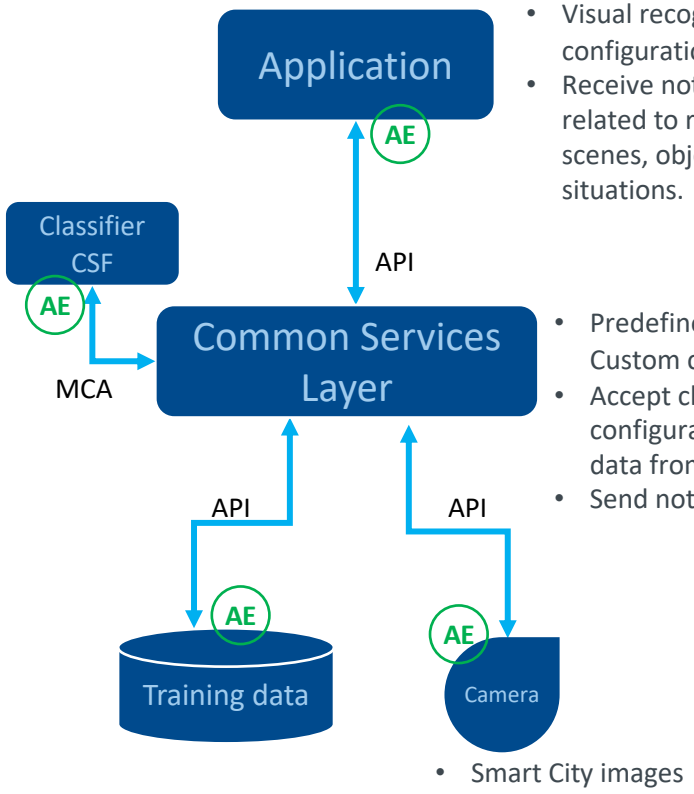
Use Case 2
Detailed description

Detection of patterns in video and camera streams enables users to identify scenes, objects, and situations in images uploaded to the service using aims visual recognition based on Artificial Intelligence and Machine learning. Subjects and objects contained in an image are automatically identified, organized and classified into logical categories in order to provide add high added value services in cities such as car vandalism and fire detection.



- Visual recognition configuration and training
- Receive notification related to relevant scenes, objects, and situations.

- Predefined-classification / Custom classification
- Accept classification configuration and training data from AEs
- Send notification to AEs

- Smart City images

oneM2M CSF DEPENDENCIES

- Data management: use existing oneM2M resources (e.g. containers, flexContainers, etc.) or create new ones to store training images, real images coming from cameras, and the result of the classification.
- Application and Service Layer Management: Extend the oneM2M MCA interface to support the configuration and train of the visual recognition service (CRUD).
- Discovery: Discover resources based on the visual recognition attributes (Extend filter criteria with image classification attributes, types, etc.)
- Subscription and Notification: Notify an application when a car vandalism is detected within the city
- Security: Define dedicated access control policies related to visual recognition creation configuration and notification.

NEW ML/AI CSF REQUIREMENTS

- Predefined-classifier CSF. The CSF comes with a predefined and pretrained classifier for Object detection, Object tracking, Semantic Segmentation, Instance Segmentation, etc.).
- Custom classifier CSF image classification CSF. Allow an application to create its own classifier and train it to implement specific visual recognition use cases.

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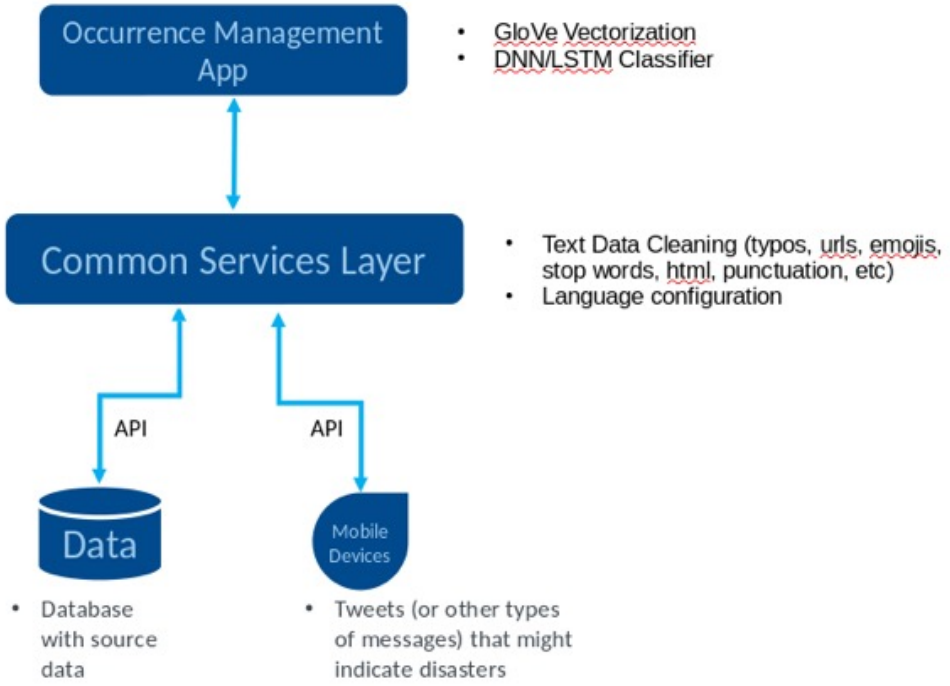
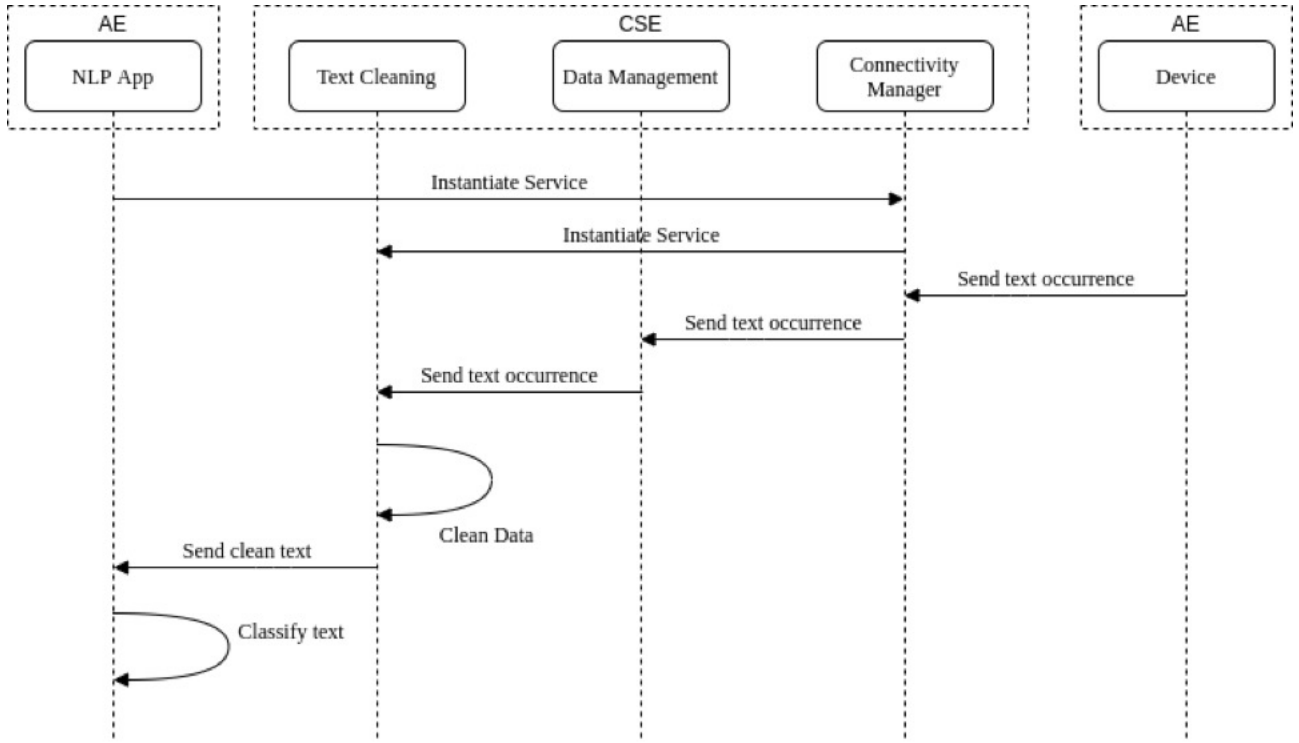
Use Case 3
Detailed description

Data will be obtained from a tweet dataset to train the model and from a mobile app where citizens can report occurrences and other incidents within the city. This text data will be cleaned by a custom-made Common Service Function before being fed to the application entity where the classification models reside. When an incoming occurrence is classified as reporting a disaster, an alert will be generated.





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Conclusions and next steps

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Next steps

Proof-of-Concept

- Implementation of the 3 Use Cases util end of September
- Source code available on the ETSI forge
- Experiment reported in ETSI TR 103 675

Feedback on the Architecture

- Description of generic AI-based CSFs with architecture implication
- Will be incorporated in ETSI TR 103 674

Validation/dissemination with oneM2M

- Proposed creation of new Work Items based on the results of the STF

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Thank you for your attention!

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