Orchestrating a brighter world

NEC

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Internet-of-Things Standards

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Imagine a Digital Skin on our Planet

A real INTERNET of Things

Smart Shelf: Display Contextualized Advertisment

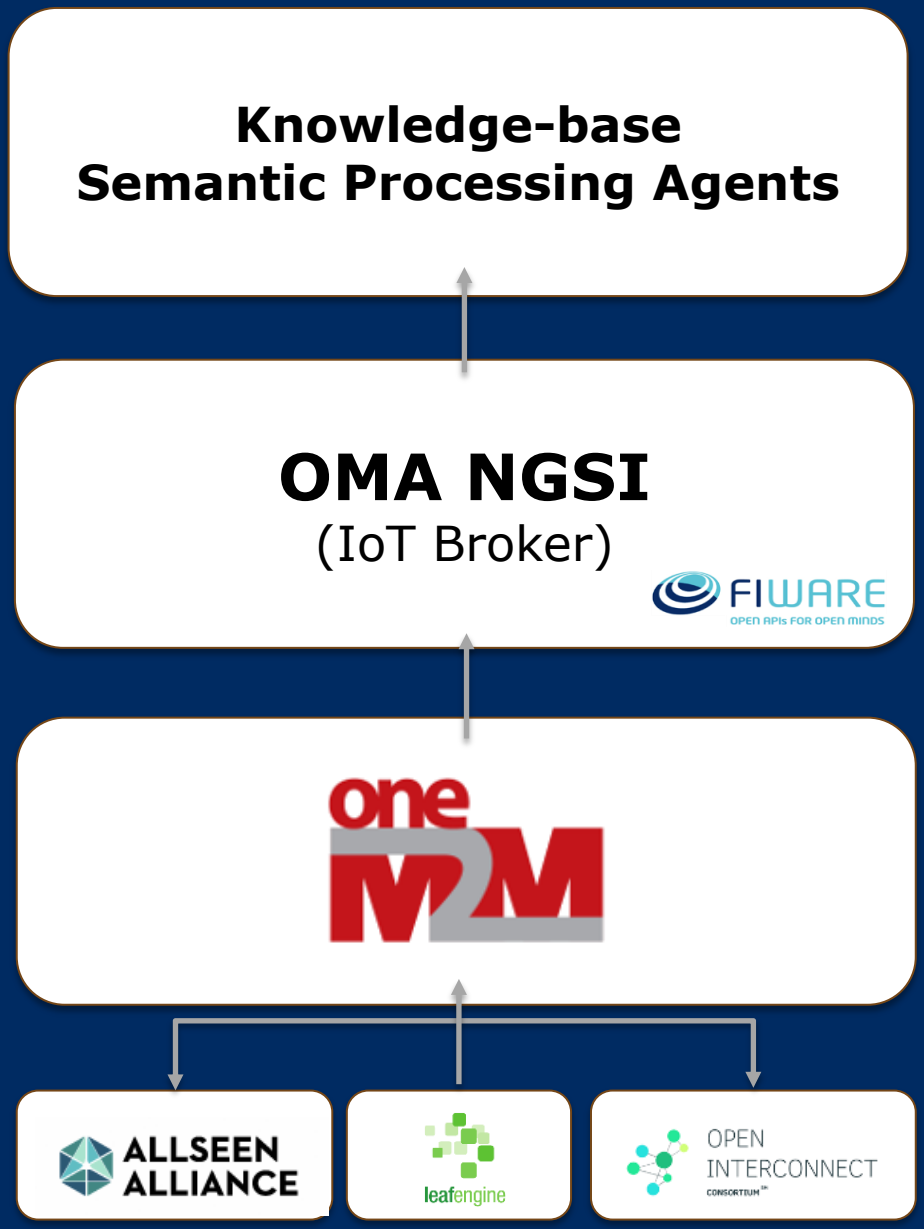
It‘s hot out there, Public Transport is full...

EuroShop

„I have plenty of more time to shop“

Global IoT Services

Emerging IoT Protocol Stack



Data Integration
- across many systems
- Semantic Representation
- Semantic Mediation

IoT Entities
- Contextualized Information
- Content-based Queries
- Pub / Sub

IoT Integration Layer
- IoT Resources: Black Box Container
- REST-based Access

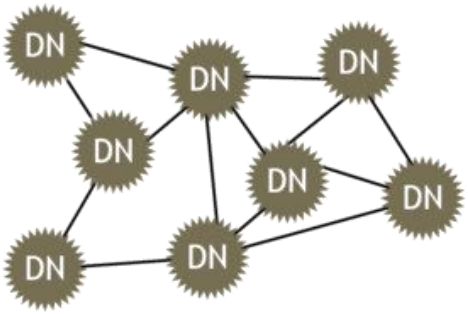
IoT Development System
- SDK
- OS Integration
- IoT Hardware

Local Area IoT

IoT Edge Communication

Meshed Networks

- Digimesh – fuill meshed networks
- Used by NEC NZ



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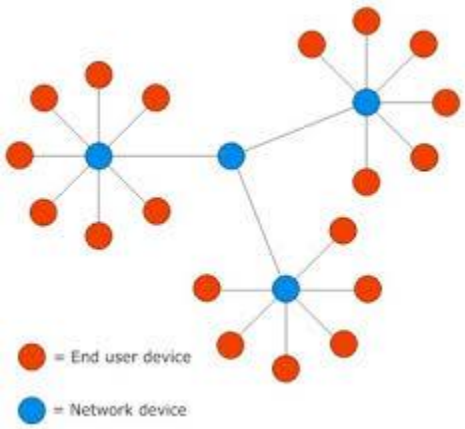
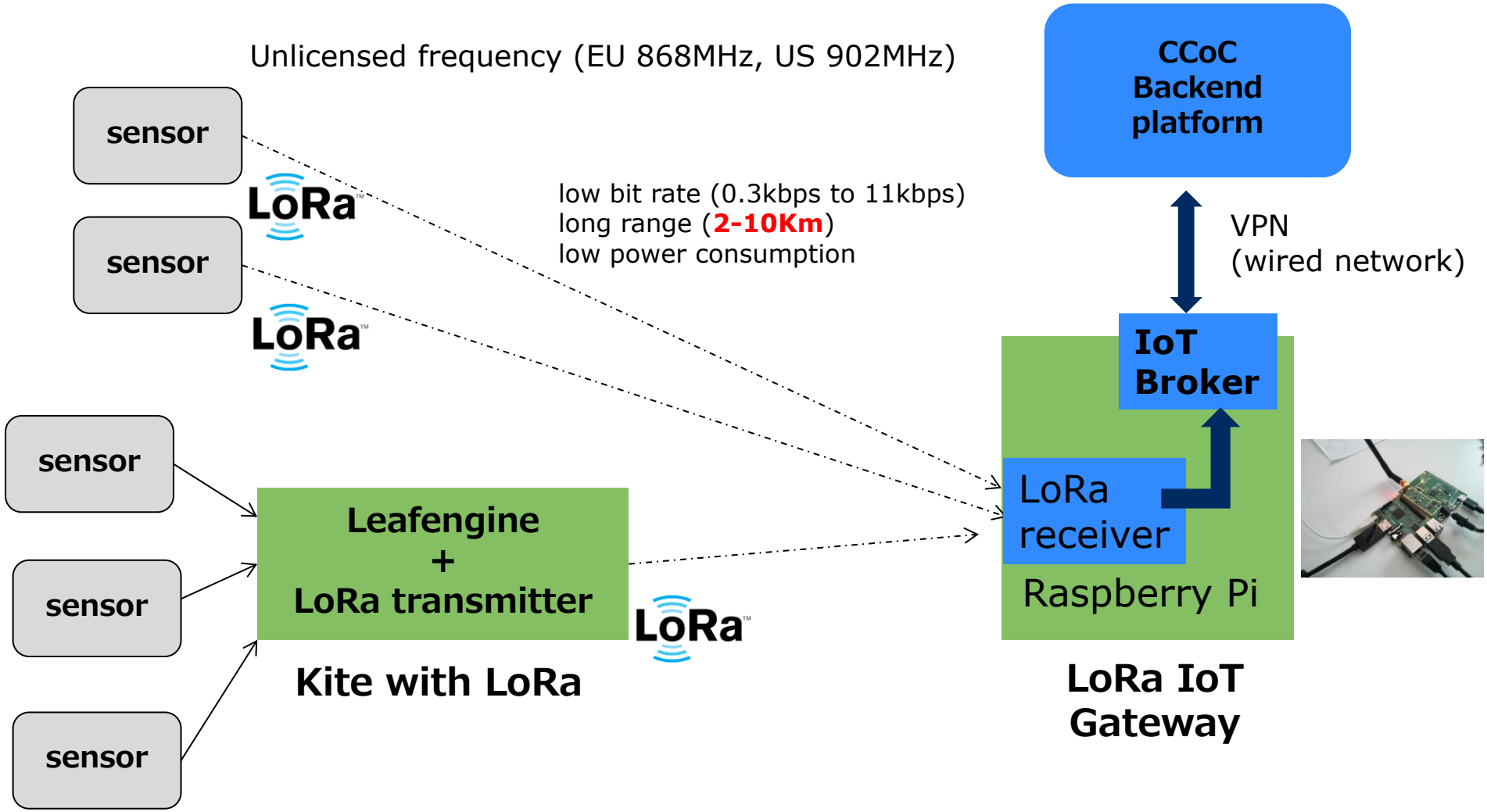


LoRa Networks

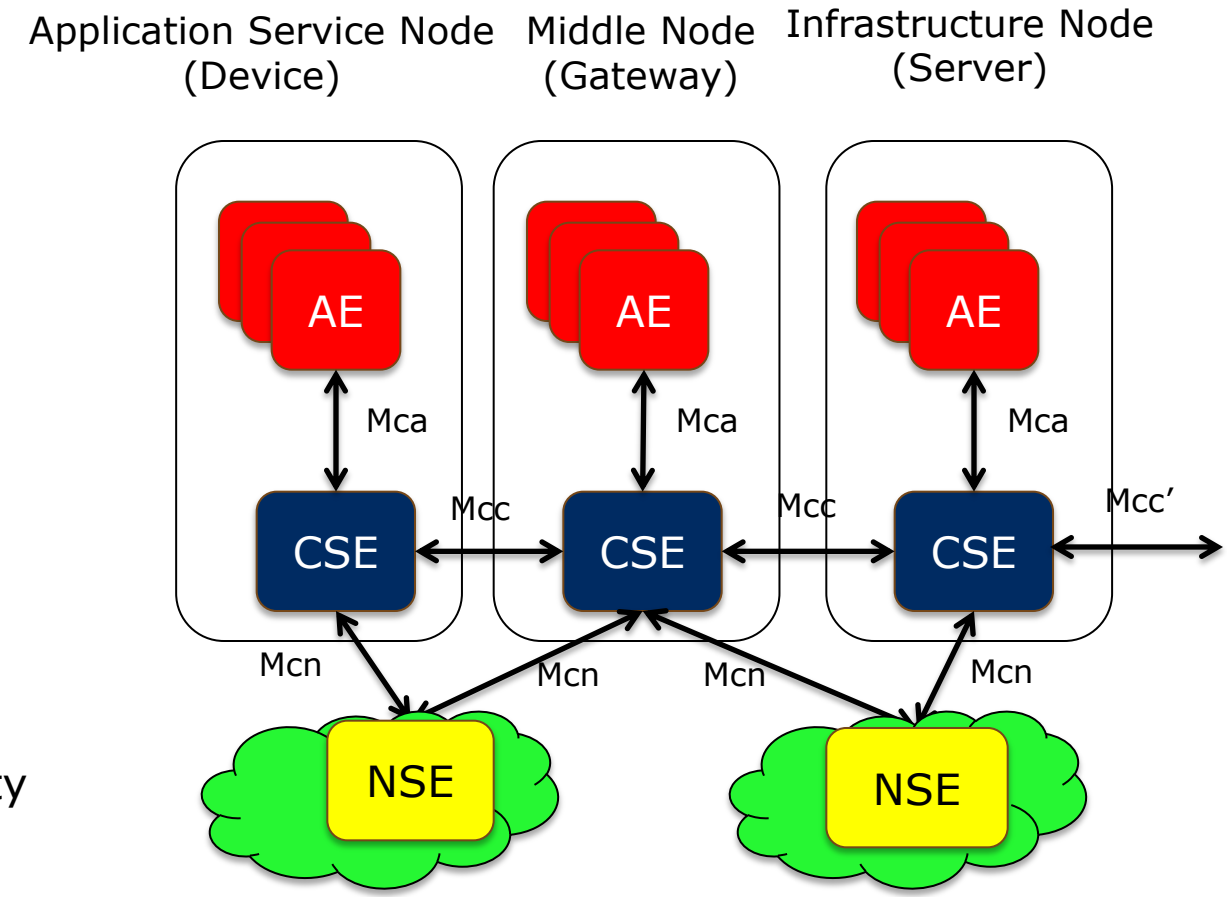
[1] Meshed network at the edge
[2] LoRaWAN – IoT Gateway for LoRa networks

NEC IoT Platform with LoRa Network



oneM2M Introduction

oneM2M ***Architecture*** (simplified)



AE: Application Entity
CSE: Common Services Entity
NSE: Network Services Entity

Mca, Mcc, Mcc':

- Reference points of oneM2M
- specified API + protocol bindings

OMA NGSI Introduction

FIWARE NGSI data model

NGSI = Next Generation Service Interface
(Standard originally from Open Mobile Alliance)

NGSI Context Information
=
Information about Entities and their attribute values

Entity
name: my_house
type: house

Attribute
name: indoor temperature
value: 21 ° C

Attribute
name: PowerConsumption
value: 5000 W

Metadata
name: accuracy
value: +- 5%

Metadata
name: timestamp
value: 14:34:57

Attribute
name: speed
value: 112 km/h

Entity
name: my_car
type: car

Person
name: alice
type: person

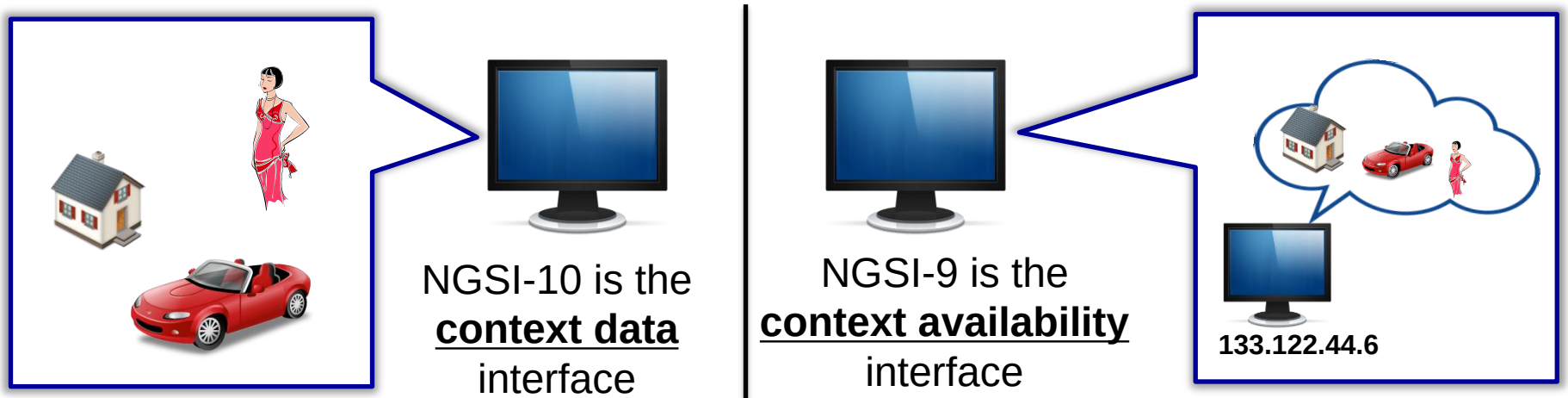
Attribute
name: age
value: 27 years

Attribute
name: location
value: +34 40 50.12

data consumer

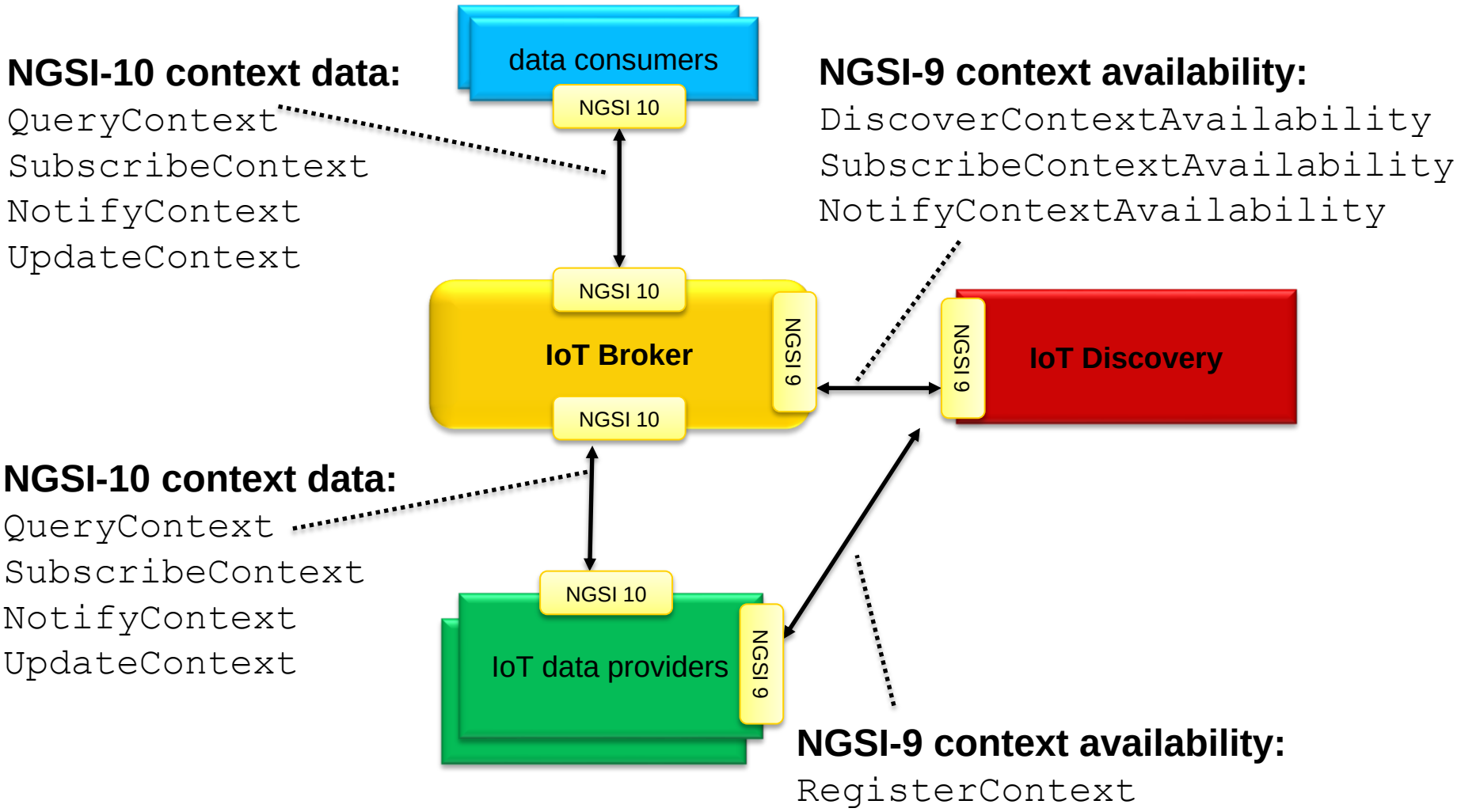
IoT Broker

FIWARE NGSI interfaces

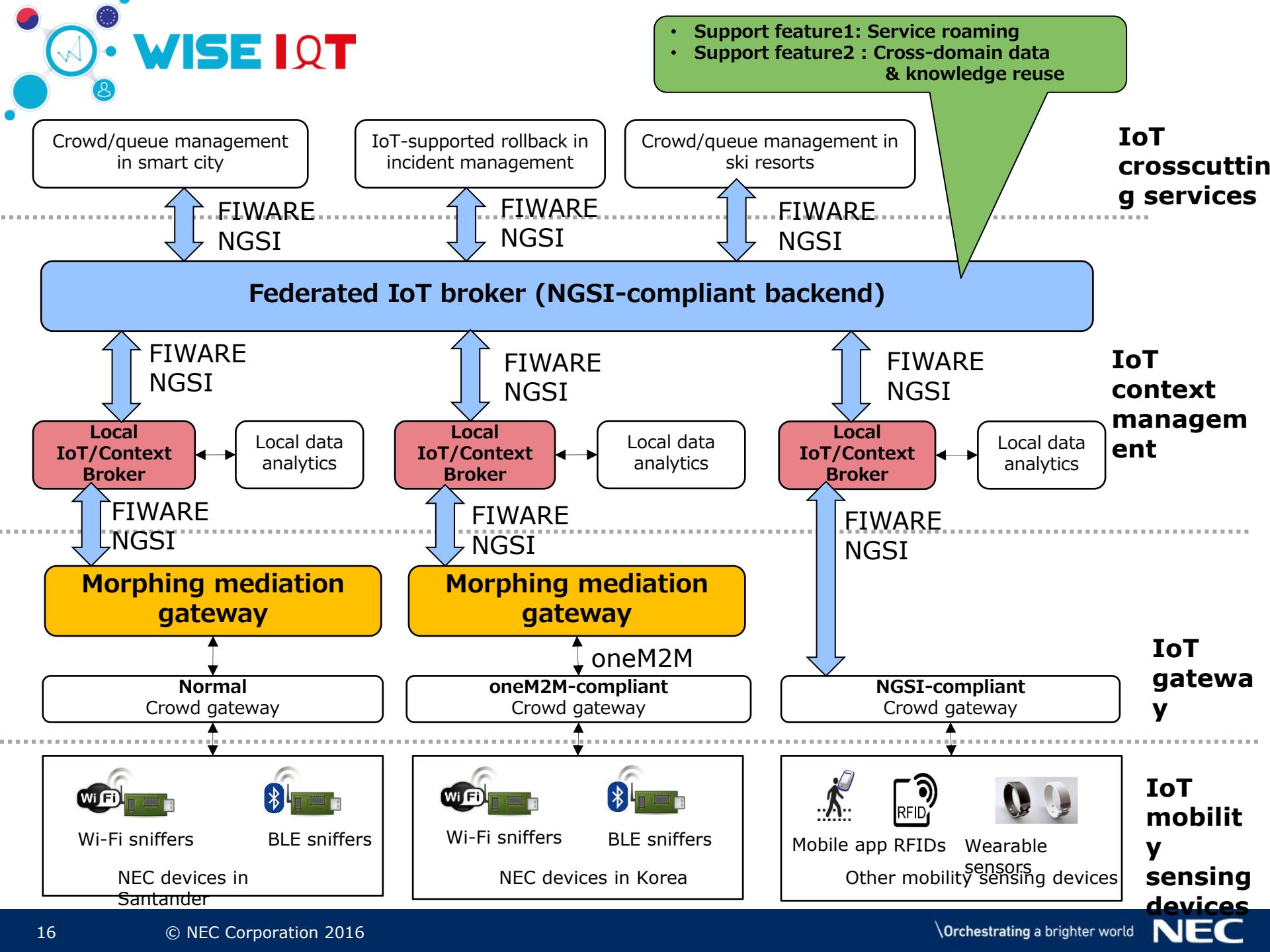


synchronous retrieval	`queryContext` → get data now	`discoverContextAvailability` → get data providers now
asynchronous retrieval	`subscribeContext`, `notifyContext` → get data regularly	`subscribeContextAvailability`, `notifyContextAvailability` → get regular updates on data providers
push-mode interaction	`updateContext` → send (“push”) data	`registerContext` → announce data providers

FIWARE NGSI interactions of IoT Broker



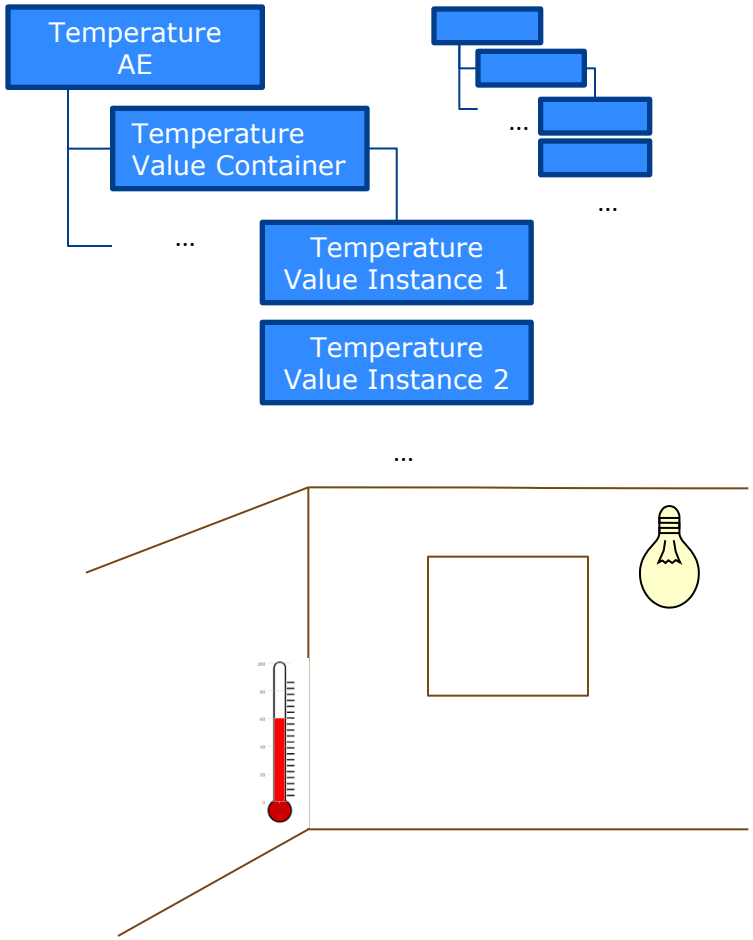
Interworking



Semantic in oneM2M

oneM2M today (rel. 1)

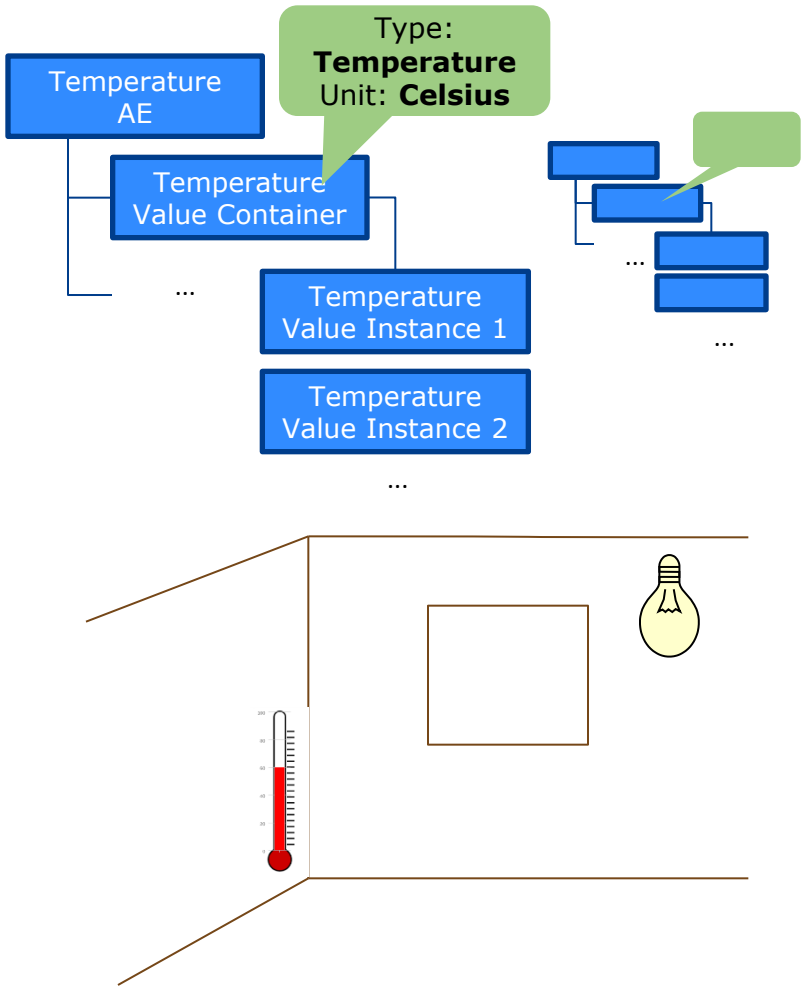
Building Management Application



- oneM2M provides resource structure for sensor applications to provide their information
- Syntax and semantics of information not visible to the platform
  - At best limited support for discovery (explicit tags)
  - No support for efficient access to structured information, creation of mash-ups, support for analytics
- Applications using the information have to a-priori know
  - Resources provided by each sensor applications
  - Syntax and semantics of information
- Explicit configuration step for every change in available sensors

oneM2M with Semantics

Building Management Application



- oneM2M provides resource structure for sensor applications to provide their information
- oneM2M provides semantic information about resource contents and functionalities making use of it
- Functionalities that can be provided or enhanced using semantics
  - Queries/Discovery based on semantic descriptions
  - Support for analytics (e.g. efficient access to information, deployment of analytics within the platform)
  - Support for creation of mash-ups (e.g. enabling IoT scenarios)
- Applications using the information can
  - Specify what information they are interested in → be notified in case of relevant changes
  - Syntax and semantics of information is made explicit, so applications can decide whether they can handle it, what module is needed for processing etc.

Automatic configuration for every change in available sensors

Semantic Functionalities for oneM2M

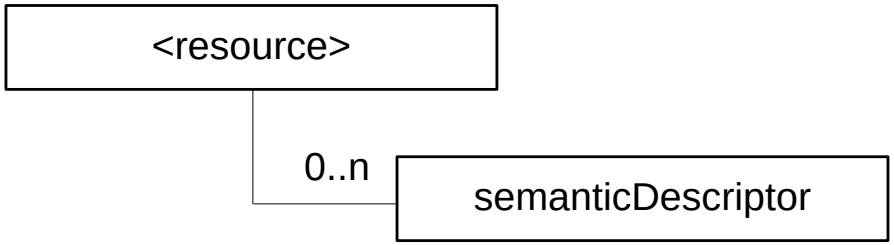
Requirements on Semantics have been identified for the following aspects:

- Functionalities
  - Semantic Queries (e.g. Discovery)
  - Support for Data Analytics
  - Support for Semantic Mash-ups
  - Use of semantics to support generic interworking (→ see separate section)
- Required Foundations
  - Semantic Annotation
  - Ontology
  - Semantic Reasoning

The focus areas for Release 2 are shown in red.

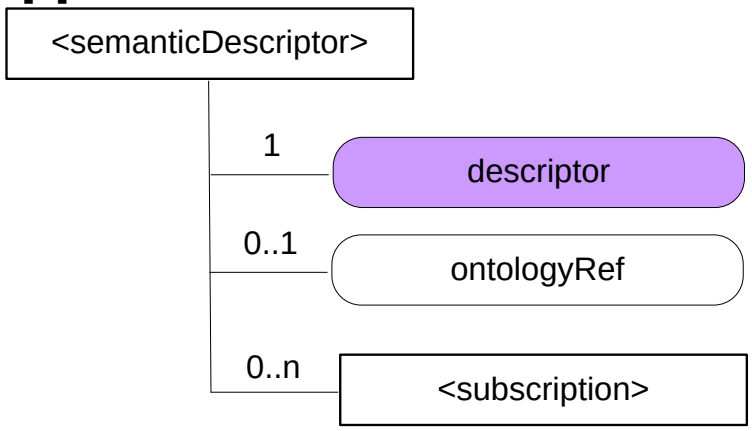
Semantic Annotation

- *Application Entity*, *Container* and *Content Instance* resources optionally can have one or more ***Semantic Descriptor* resources** that semantically annotate the respective resource.



- The case that there are multiple semantic descriptors can be used if the same resource is to be semantically described according to multiple different ontologies.

- The *Semantic Descriptor* resource is used to store a **semantic description** pertaining to a **resource** and potentially sub-resources (in ***descriptor* attribute**) as **semantic triples** (subject, predicate , object).
The semantic information is used by the **semantic function-alities of the oneM2M system** and is also available to **applications**.

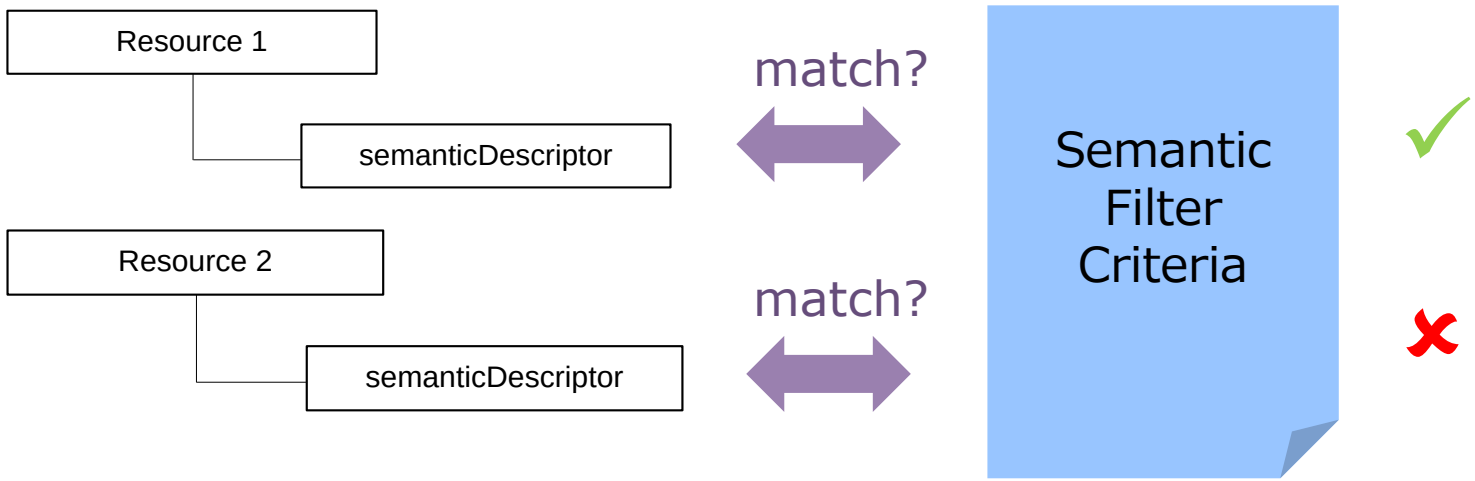


Semantic Filtering and Discovery

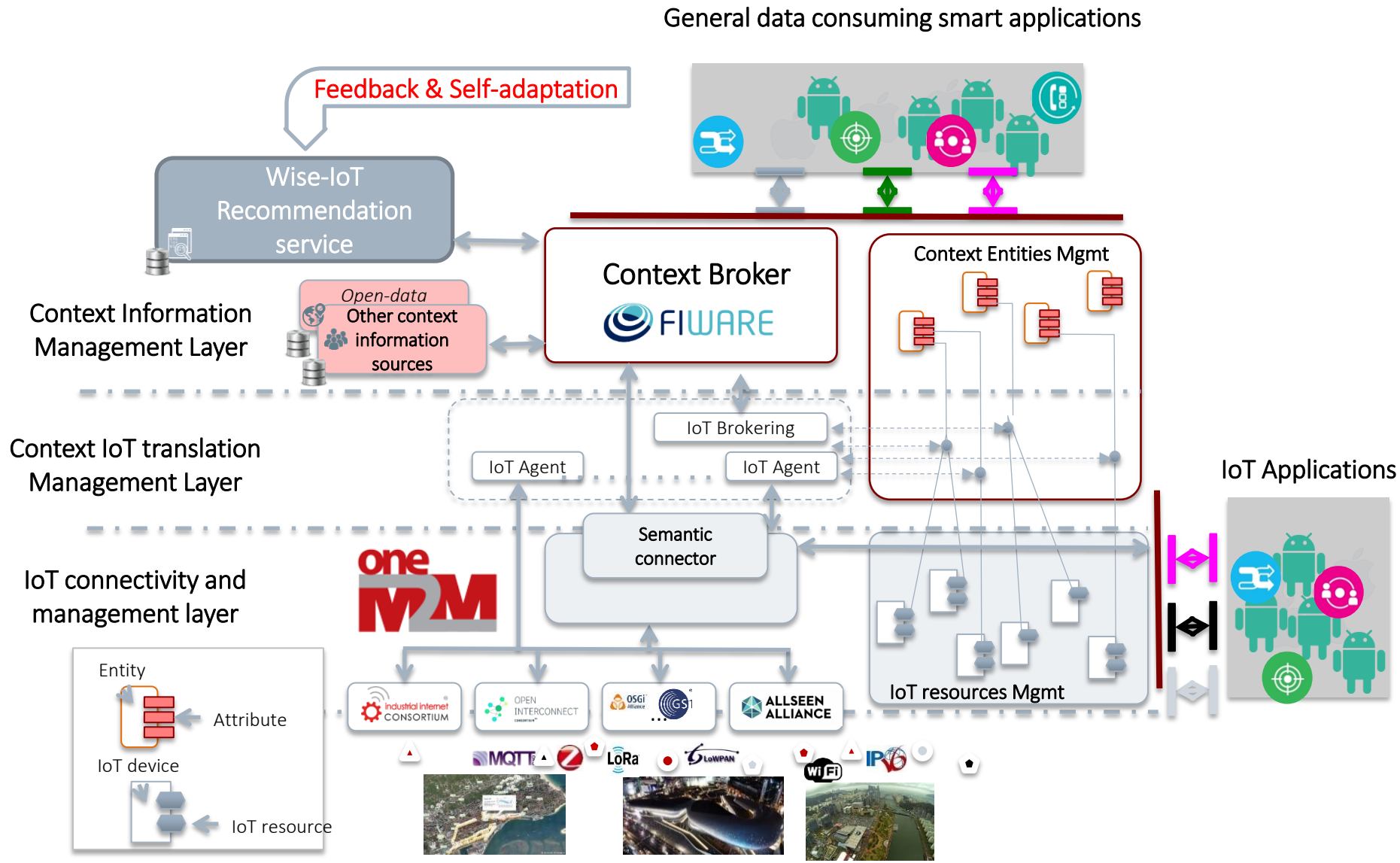
- Resources can be selected / discovered in oneM2M based on filter criteria
- A new filter criteria on semantics has been added

semantics	0..n	The semantic description contained in one of the <semanticDescriptor> child resources matches the specified semantic filter.

- The filter criteria will be applied to the respective semantic description contained in the descriptor attribute of each of the semantic descriptor resource instances
- If the semantic filter criteria match the semantic descriptor, the parent resource is included in the result set, otherwise it is not

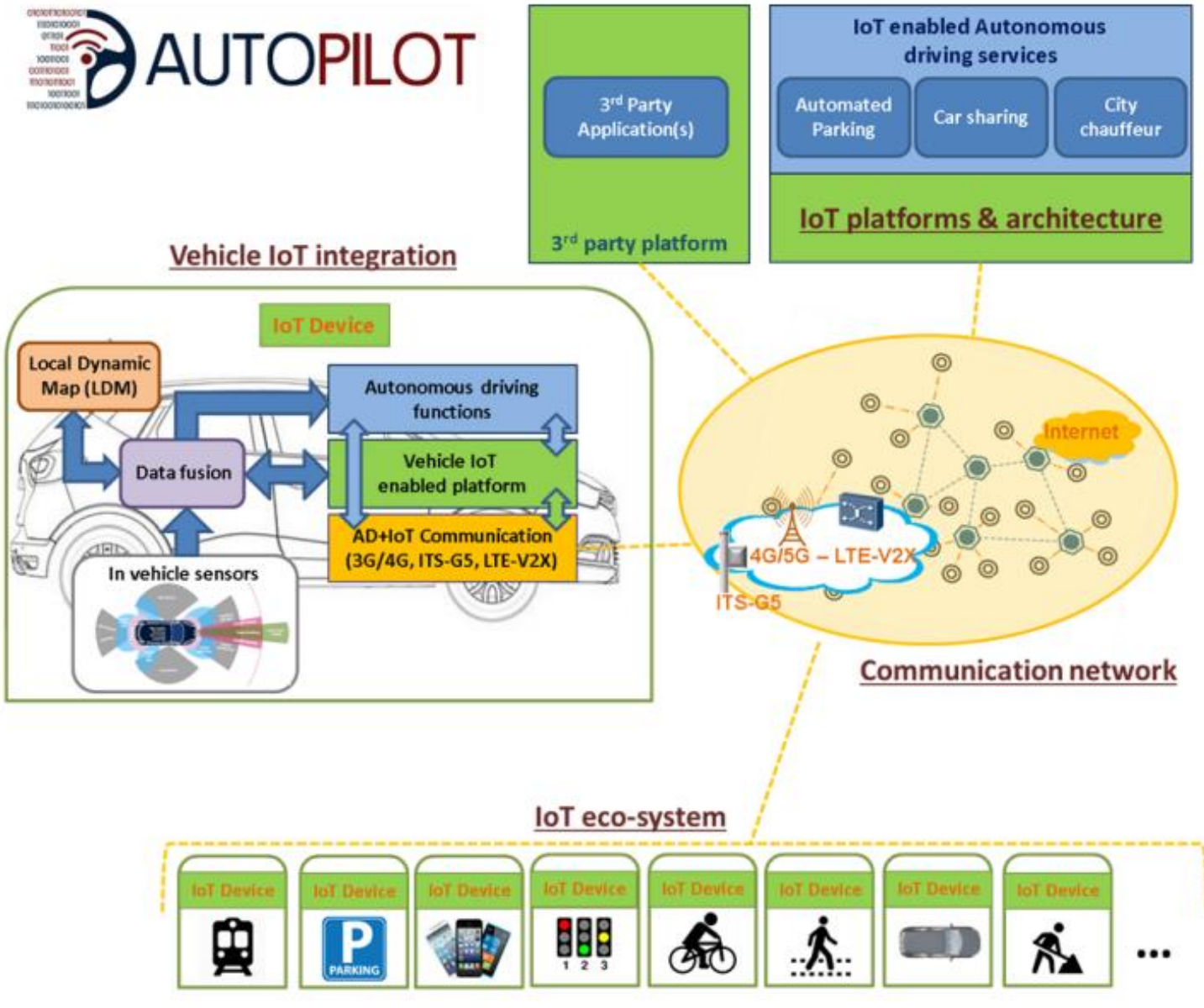


Initial architecture



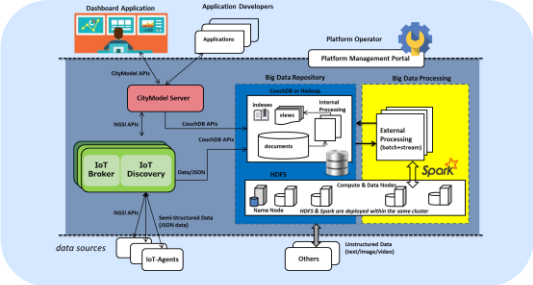
IoT and Autonomic Driving

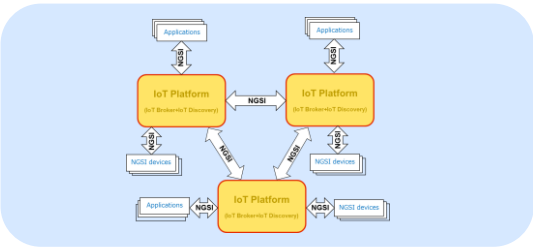
AUTOPILOT – Large Scale Pilot on „IoT for Autonomous Driving“

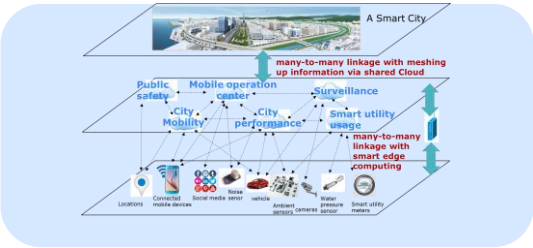


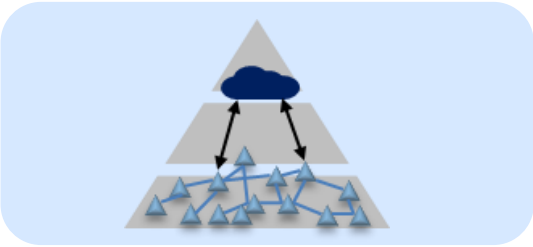
- **Brainport Helmond/ Eindhoven**
- **Tampere**
- **Versailles**
- **Florence-Livorno**
- **Vigo**

Outlook: Future Technology Trends









IoT Clouds [today state-of-the-art] — Today

- Cloud-based provisioning of IoT services
- NEC product: Cloud City Operation Center

Elastic IoT [emerging] — 1-3 year

- From central cloud to federation & brokering: Cloud-of-Cloud, System-of-System
- Edge Computing & automated functional distribution, devops
- IoT network re-configuration

Hyperconnected IoT [Next Gen Discussion] — 2-5 year

- Business mode: many-to-many data sharing
- semantic interoperability, multi-source data analysis, semantic context, sharing of control
- massive orchestration

Extreme IoT [R&D starting] — 4-6 year

- Massive use: „100-10K IoT objects **per room**“
- IoT & 5G: IoT into every (!) object
  → network impact , advance discovery & contextualized orchestration, tactile control

Summary

- An Advance IoT protocol stack is emerging...
- … connecting everything to everything means to understand everything.
- We need automated ways of connecting systems together and understand the meaning.
- Semantic Mediation Gateways

Orchestrating a brighter world

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