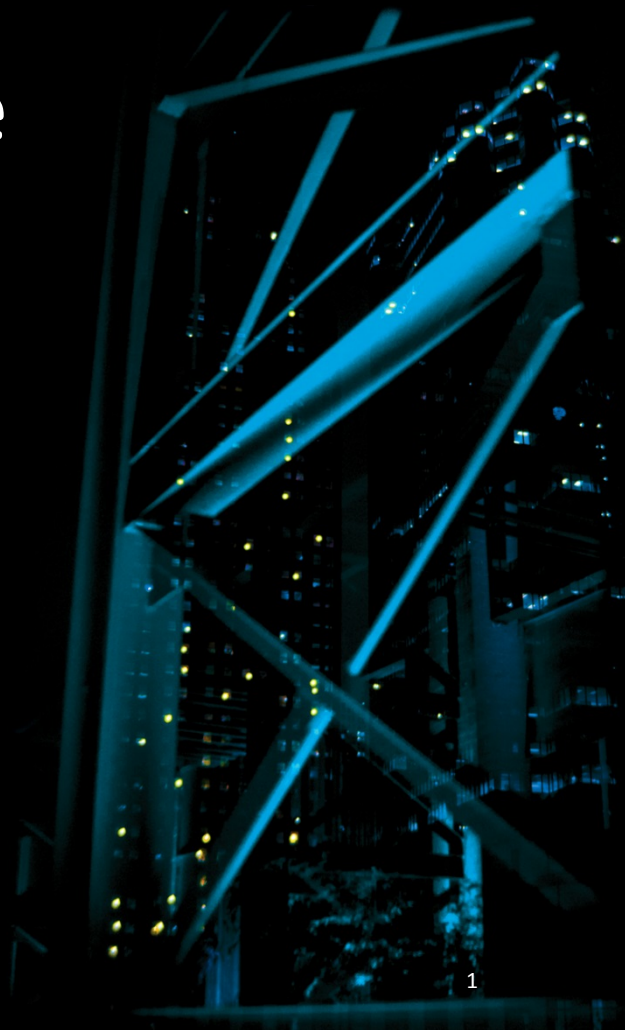
oneM2M – A Common Service Platform for IoT

Paul L. Russell, Jr.
InterDigital Communications
Conshohocken, PA

June 10, 2016



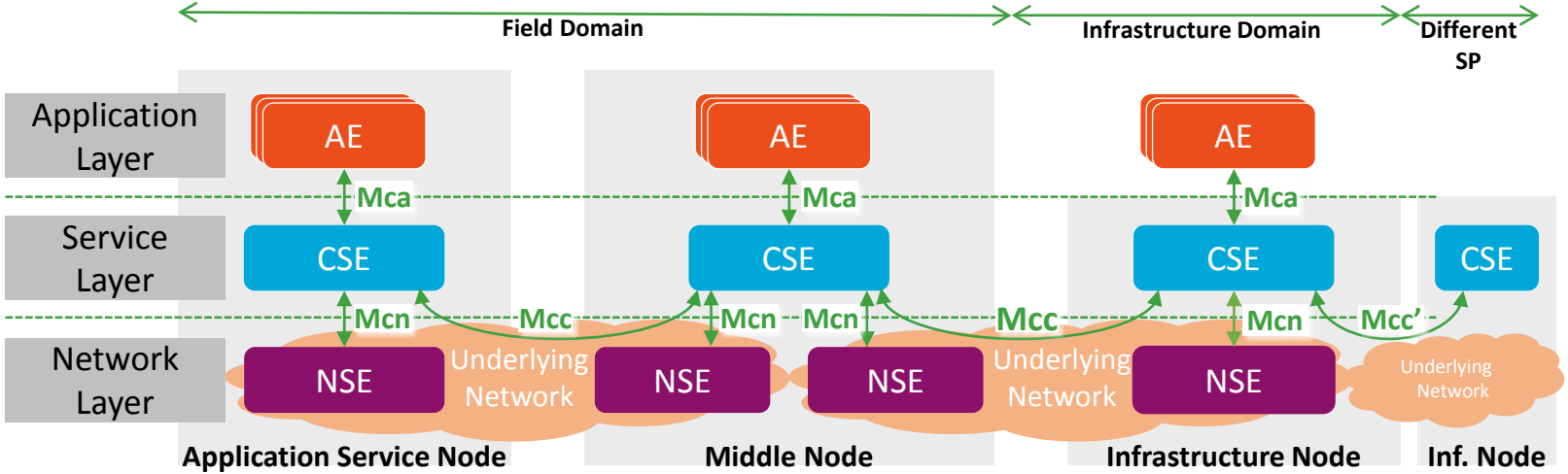
INTERDIGITAL.

Outline

- Overview of oneM2M Activities
  - Interoperability
  - Semantics
- Overview of 3GPP Activities
  - MTC, SCEF, CIoT
- Conclusion
- Additional Resources

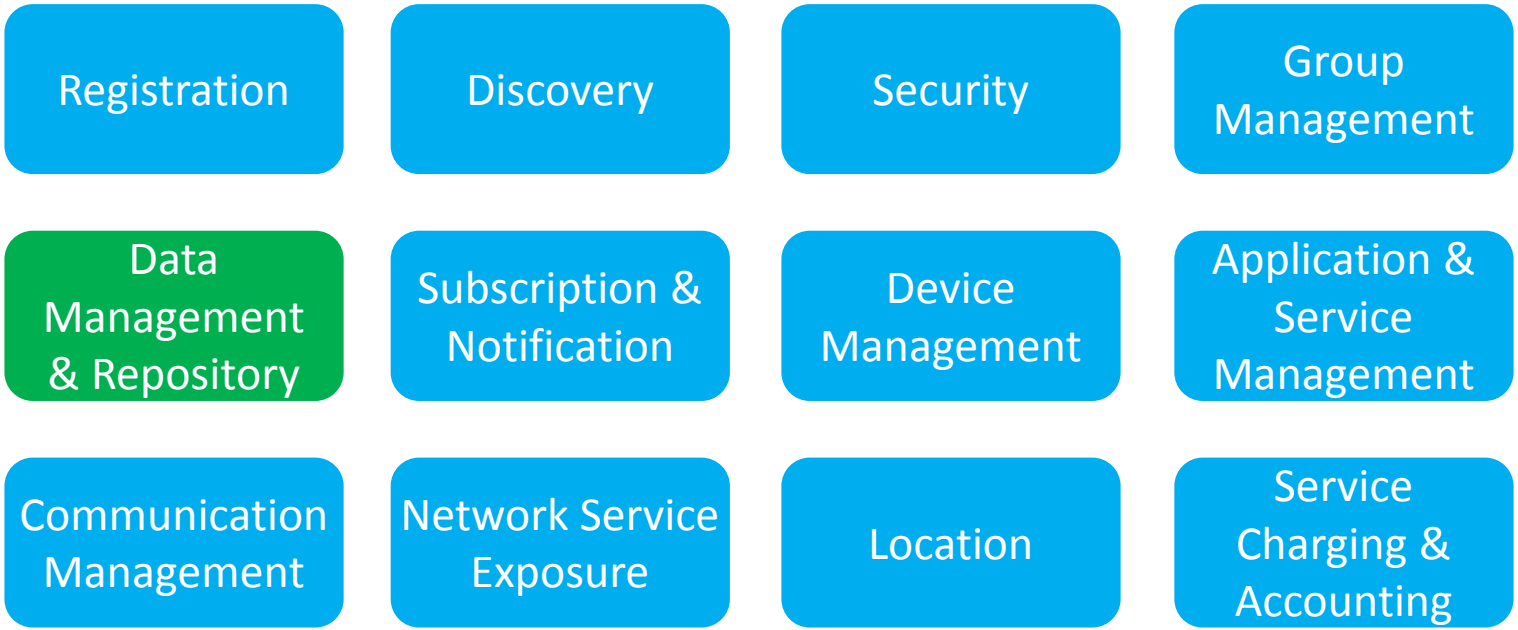
Overview of oneM2M Activities

Overview of oneM2M Service Layer Architecture

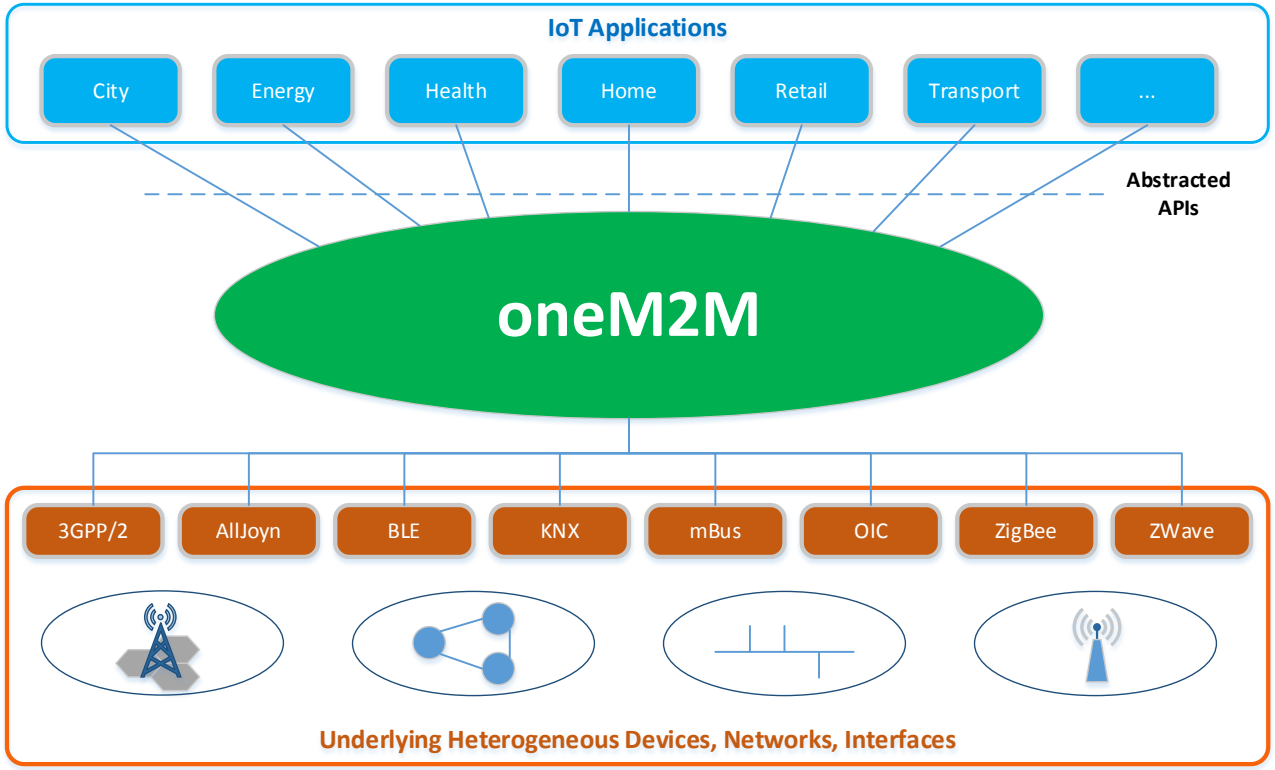


- Reference Point One or more interfaces - Mca, Mcn, Mcc and Mcc' (between 2 service providers).
- Common Services Entity (CSE) Represents an instantiation of a set of "common service functions" of the M2M environments.

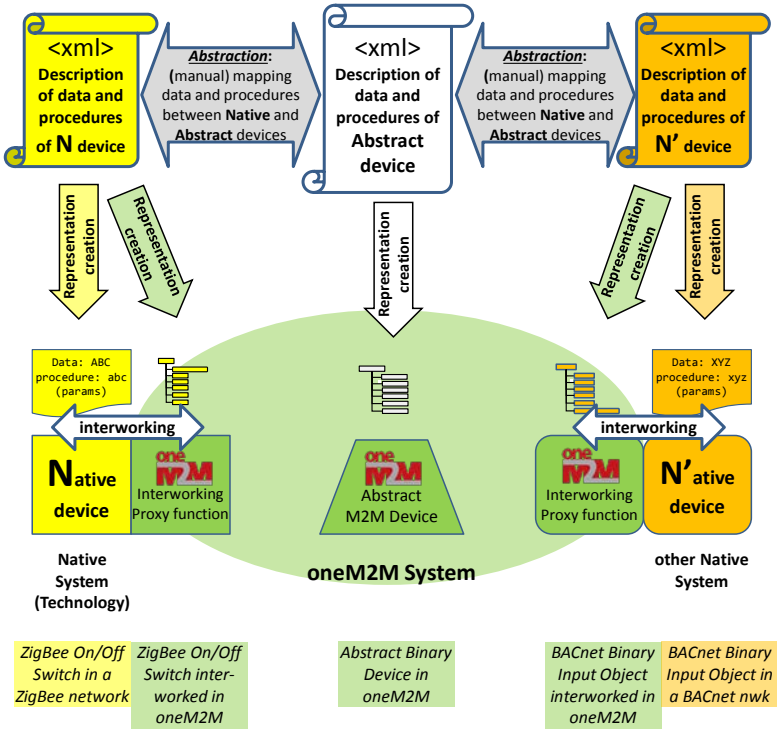
Overview of oneM2M Common Service Functions (CSF)



oneM2M Interworking and Abstraction



Interworking, Abstraction and Semantics



Holistic View on Interworking, Abstraction and Semantics

Interworking: mapping between two specific technologies to enable the information exchange between heterogeneous systems. However, applications may still need to understand the native information model (e.g. Zigbee profile)

Help here

Abstraction: generalizing the information model to hide the complexity of the specific technologies by providing a single format to represent devices and unified methods directly usable by the applications. However, certain data meaning diversities is lost due to abstraction.

Help here

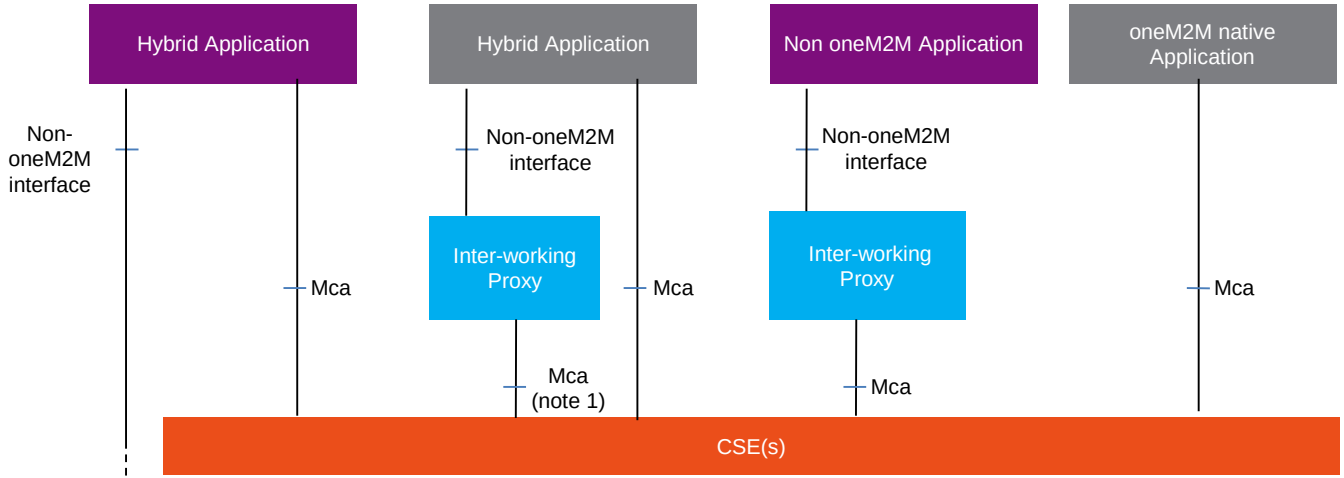
Semantics: adding additional information to data so that applications can understand the meaning of data.

Source: oneM2M TR-0007 (Abstraction and Semantics Enablement)

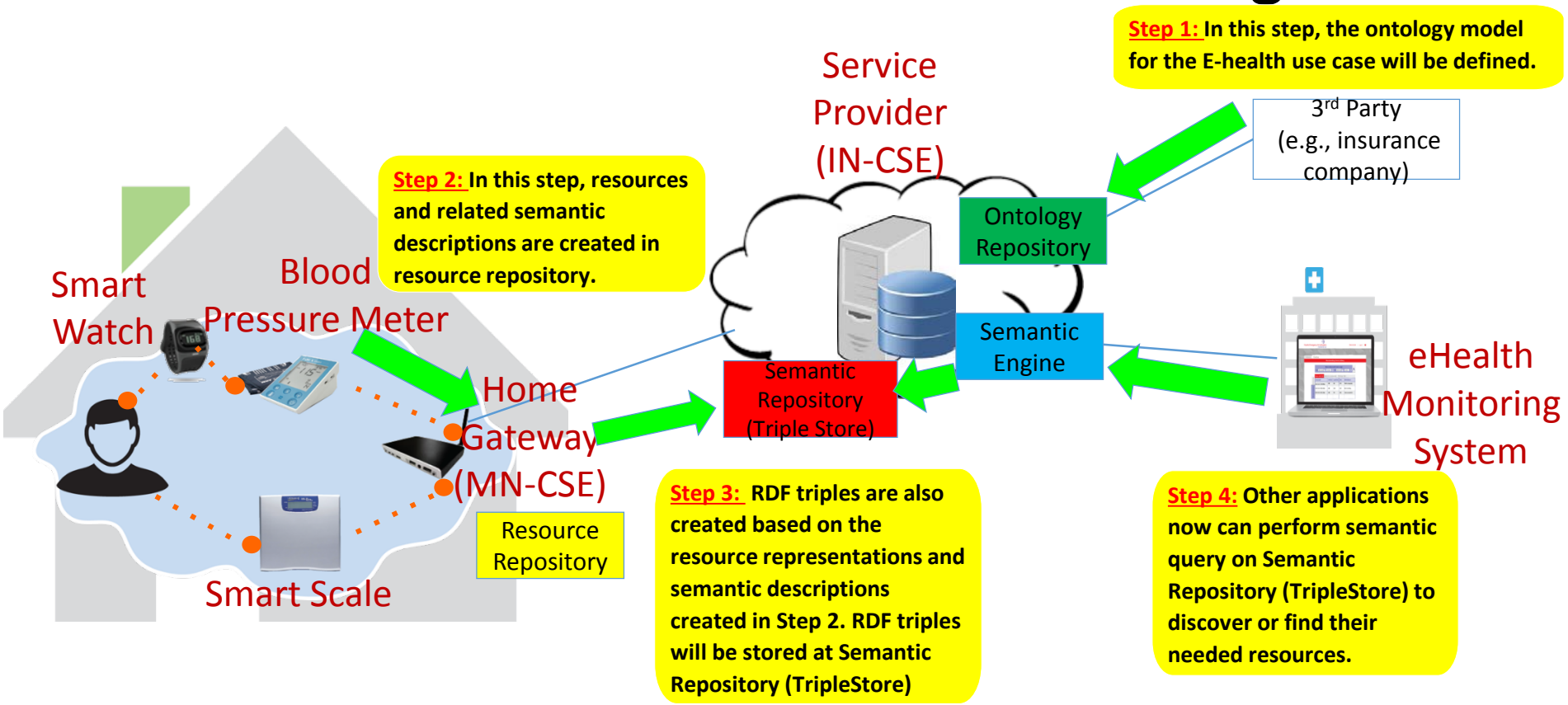
Interworking Proxy Application Entity– IPE

The **Interworking Proxy Application Entity (IPE)** abstracts and maps the non-oneM2M data model to the oneM2M resources exposed via the Mca reference point.

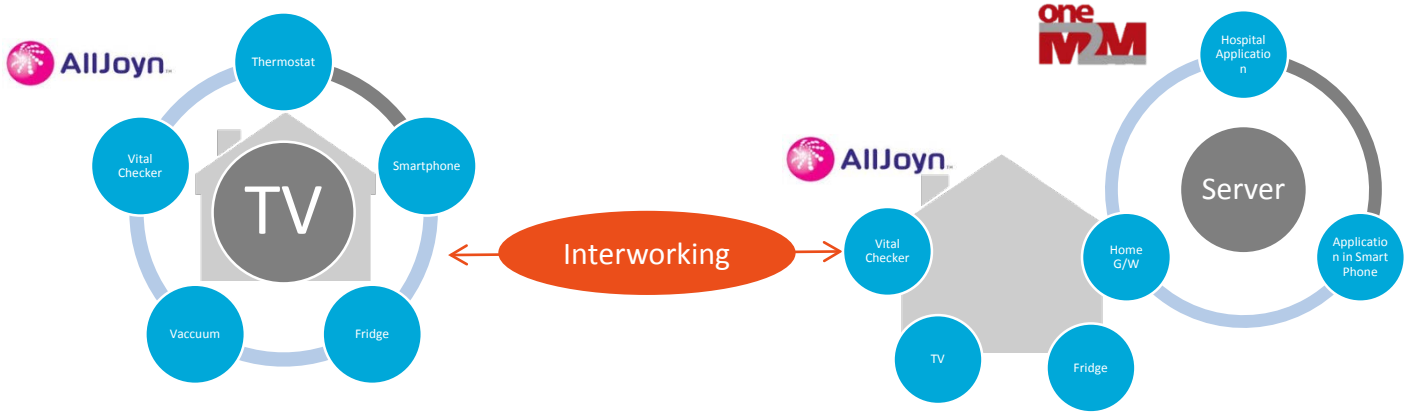
- This is typically supported via a full semantic inter-working of the data model used by the non oneM2M and a related protocol inter-working logic, either by a complex set of resources built via the basic oneM2M ones or a simple direct mapping of the communication via the containers.
- This enables communications among different protocols, catering for different level of inter-working including protocol inter-working, semantic information exchange, data sharing among the different solution and deployments.



eHealth Use Case – Blood Pressure Reading

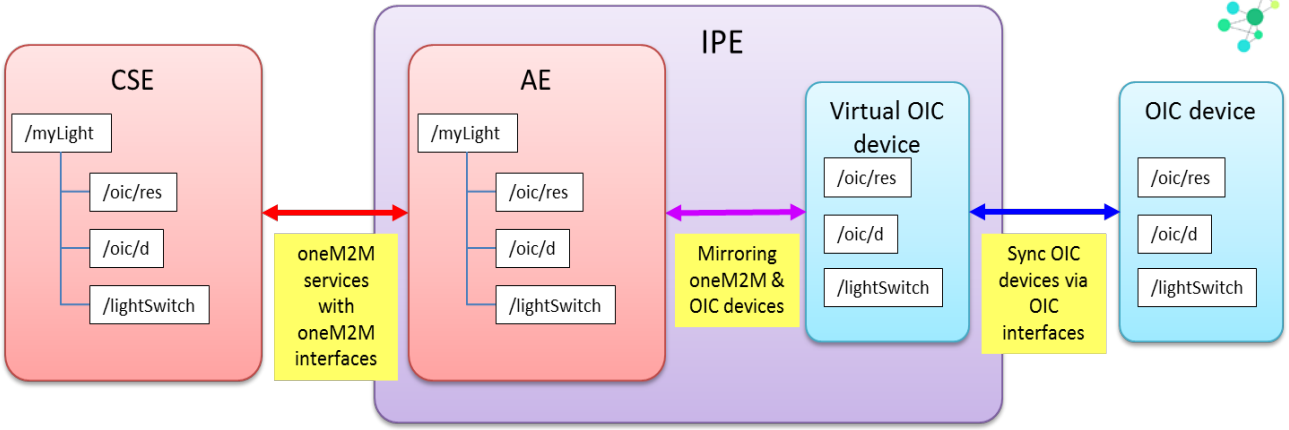


Interworking with Non-oneM2M Service Layer– AllJoyn



Features	AllJoyn	oneM2M
Network Architecture	Peer-to-Peer in LAN	Server-to-Client in WAN
API Style	RPC(RMI) API	Resource-based API
Discovery Style	Proactive Discovery	Passive Discovery

Interworking with Non-oneM2M Service Layer– OIC



Features	OIC	oneM2M
Resource	For Device Specific Characteristic	For Common Service Functionalities
Communication Model	Peer-to-Peer and Remote Access	Registration-Oriented Data Delivery
Device Management	Native	BBF TR-069 and OMA DM

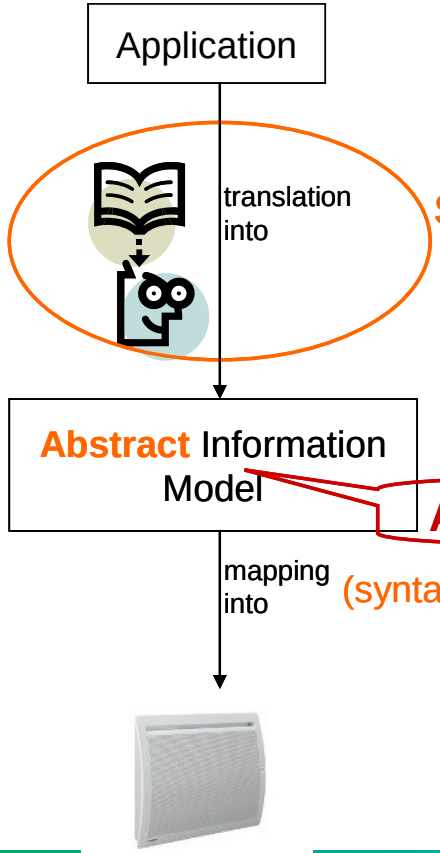
Source: oneM2M ARC-2015-2118 and ARC-2015-2139

Why oneM2M Needs Semantics

- Applications need to agree beforehand on a common definition of exchanged data, the data flowing through or stored within M2M Service Layer is treated as opaque information.
  - The data sensed or generated by the device applications, e.g. temperature, humidity in the gym sensed by ambient sensor, training recorded by treadmill, blood pressure data measured by blood pressure monitor, are treated opaquely, and cannot be understood by the Service Layer or other applications.
  - Any semantic-aware services cannot be provided by M2M systems without understanding the semantics of the data, e.g. data aggregation, data sharing, data analytics.
- Resource discovery is very limited by searchStrings.
  - searchStrings are tokens used as keys for discovering resources. The resources that match to the searchStrings literally are returned as discovery result.
- However, more advanced resource query is needed, for example, a gym user wants to discover the treadmill with particular model, and available in certain time frame.
  - searchStrings based discovery is not able to achieve the advanced resource query.
  - But Semantics-based discovery can provide a full set of analytic query operations such as JOIN, SORT, AGGREGATE, FILTER for data whose schema is intrinsically part of the data.

M2M System needs semantics support/capability

Abstraction vs Semantics for oneM2M



1. Application-level command
e.g. “lower the living room temperature”

Semantic support
helps understanding the original data,
and the relationships between things, data,…

2. Abstract device-level command
e.g. "switch off the radiator with ID=00007“

Abstraction of the specific technologies

(syntactic support)

3. Techno-specific device-level command
e.g. "send the command <ZigBee Specific Command> to endpoint ID=<ZigBee specific ID>"

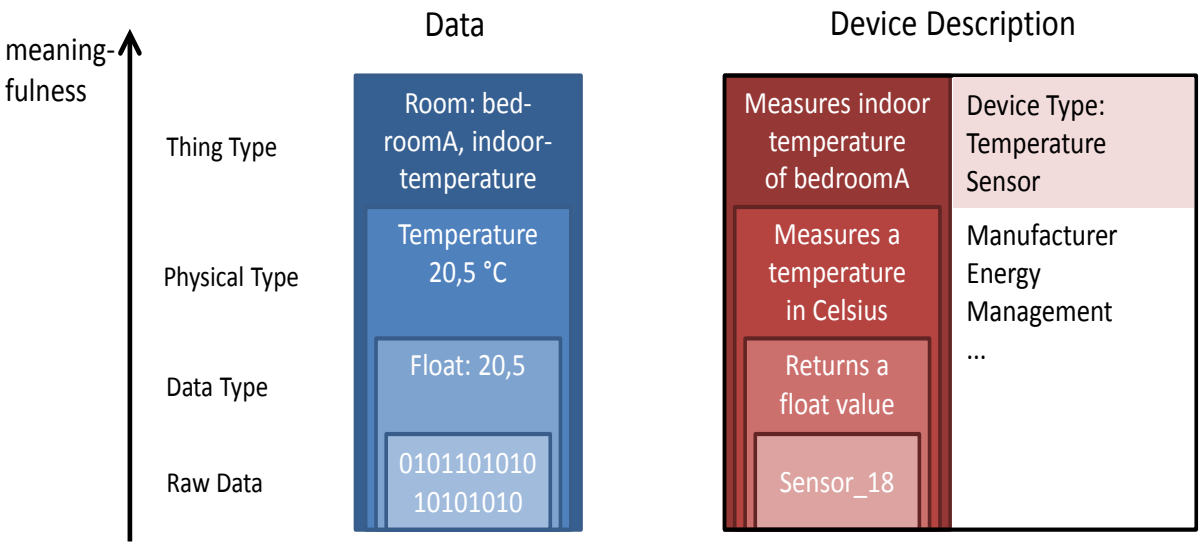
Source: oneM2M TR-0007 (Abstraction and Semantics Enablement)

Levels of Meaningfulness in oneM2M

Thing Type: identifies the real-world thing and the aspect represented by the value, e.g. the indoor temperature of the room “bedroom”.

Physical Type: provides the meaning of the float value, e.g. the float value 20.5 represents a temperature in °C.

Data Type: how the raw data has to be interpreted to determine its value, e.g. float point value 20.5.

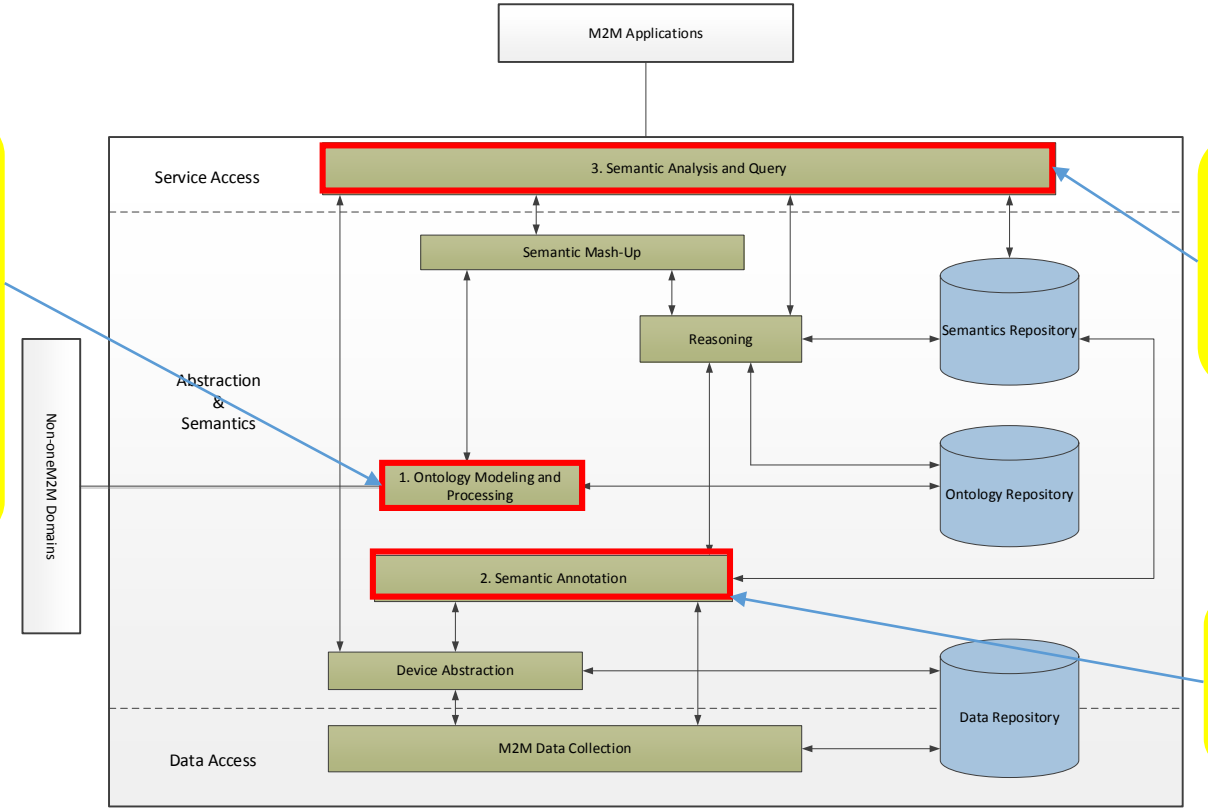


Source: oneM2M TR-0007 (Abstraction and Semantics Enablement)

Devices can also be semantically described.

- If a device produces data, the semantic description of the output directly corresponds to the semantic description of the data.
- In addition, other aspects can be semantically described, e.g. the device type, the manufacturer, the energy consumption, management information.

InterDigital's Semantics Architecture for oneM2M

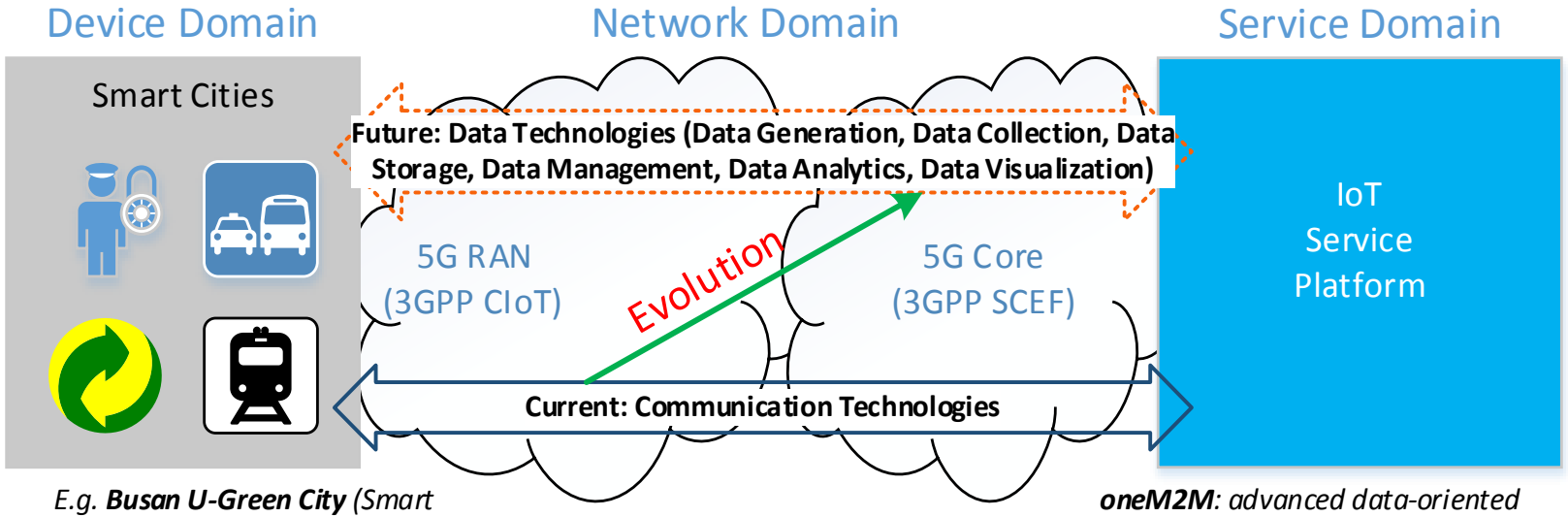


1. Ontology Modelling: Ontology modelling is the process for building an ontology which is used to model a domain.

3. Semantic Analysis/Query: M2M applications' requests can be semantically analysed and then certain semantic queries can be conducted on e.g., semantics repository to answer external applications' requests.

2. Semantic Annotation: Semantic annotation is a method for adding semantic information to oneM2M resources.

Communication Technologies -> Data Technologies



E.g. ***Busan U-Green City*** *(Smart Community, Smart Energy/Resource Recycling, Smart Safety and Security, Smart Green Logistics)*

oneM2M*: advanced data-oriented services such as semantics (semantic discovery, semantic ontology, semantic reasoning, semantic mash-up)*

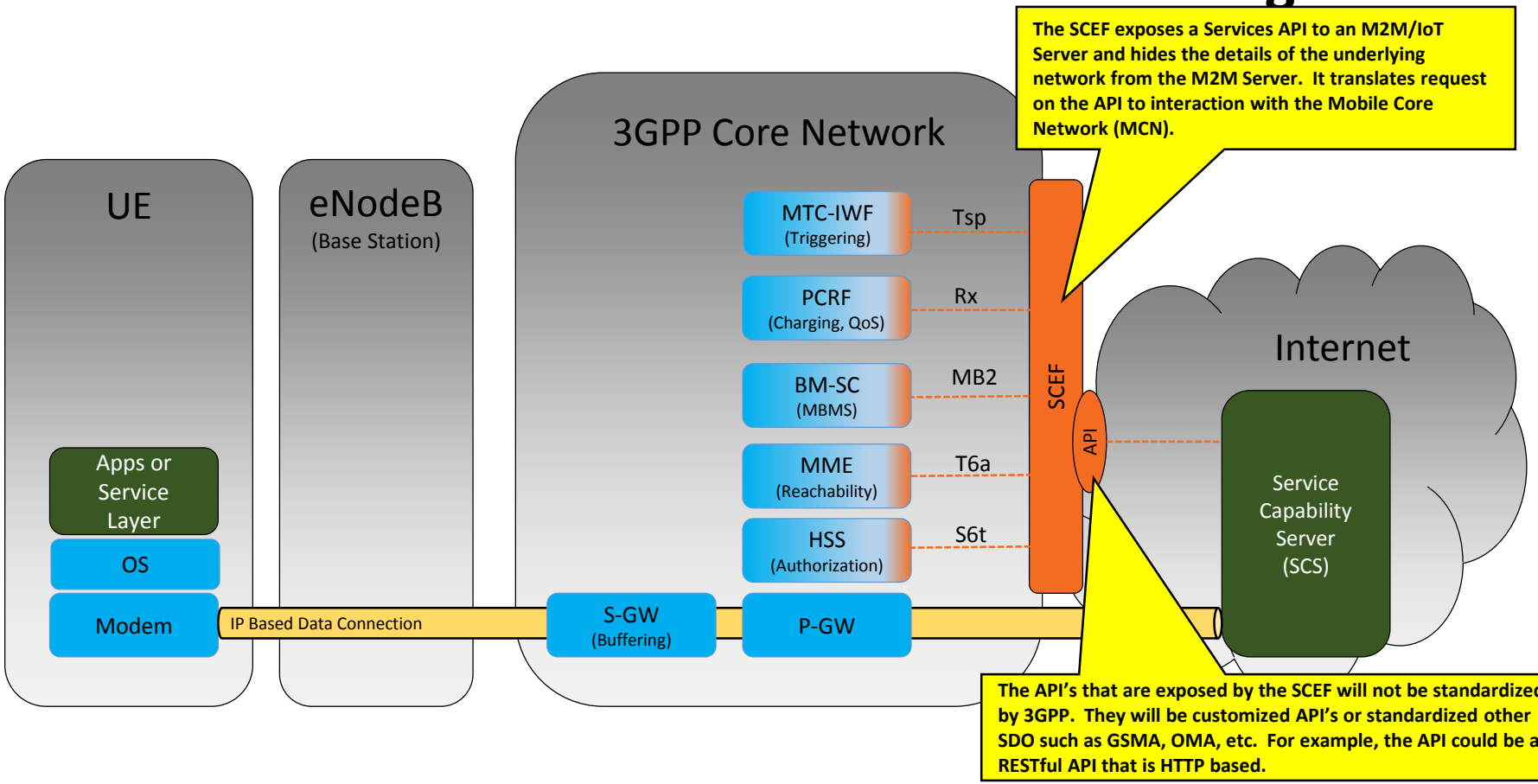
Cellular Network Interworking

Cellular Network Interworking

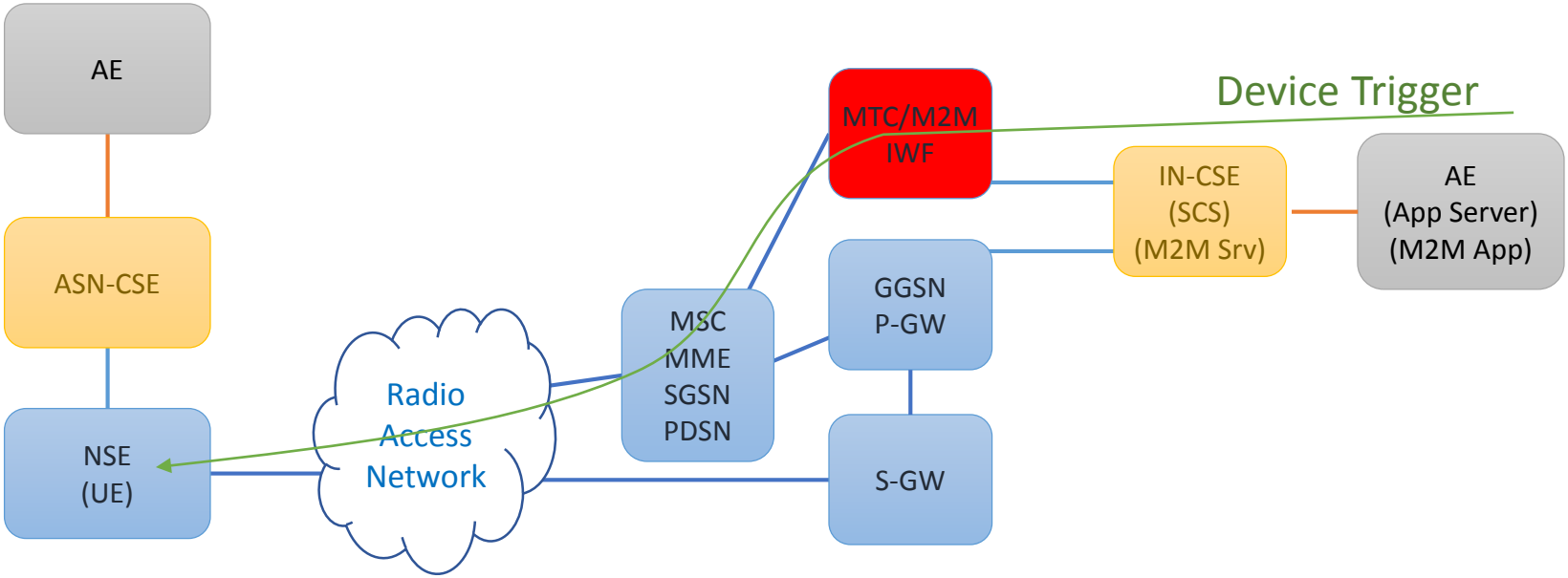
- The 3GPP Core Network Infrastructure has “built-in” services that are useful for IoT Applications.
  - Group Comminutions (i.e. MBMS)
  - Connectivity Awareness (i.e. Reachability)
  - SMS
  - Session Based QoS
  - Scheduling
  - Location Services
  - Security
  - Buffering

- In Release 13,
  - 3GPP created a new “Service Capability Exposure Function (SCEF)”
    - that uses 3GPP defined interfaces to allow Applications & Services (e.g. M2M/IoT Servers) to leverage the services that are “built-in” to the Core Network.

3GPP Architecture: Cellular Network Interworking



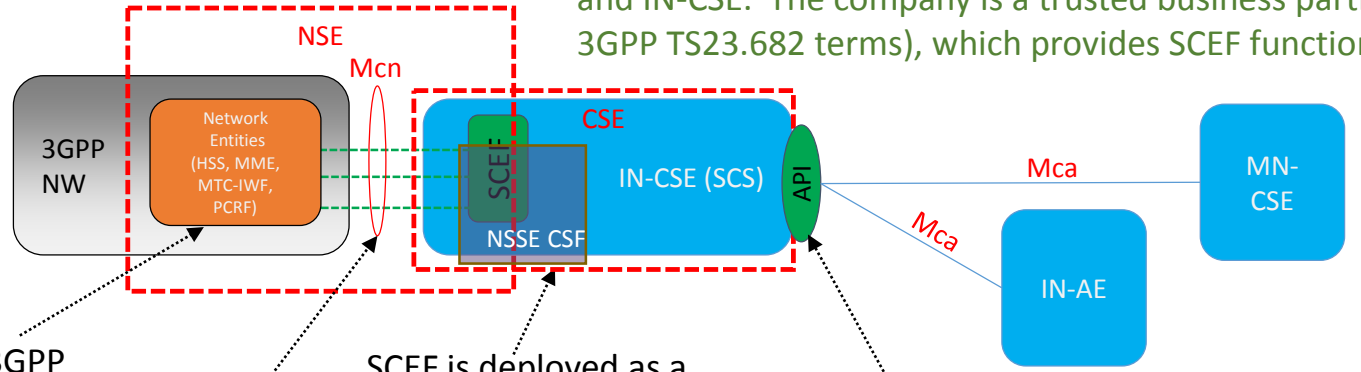
Interworking with 3GPP/3GPP2 MTC



MTC: Machine-Type Communications

3GPP & oneM2M Interworking Architecture Scenario #1

In this scenario, a single company operates both the SCEF and IN-CSE. The company is a trusted business partner (in 3GPP TS23.682 terms), which provides SCEF functionality.



Functions in 3GPP Network are **NSEs**

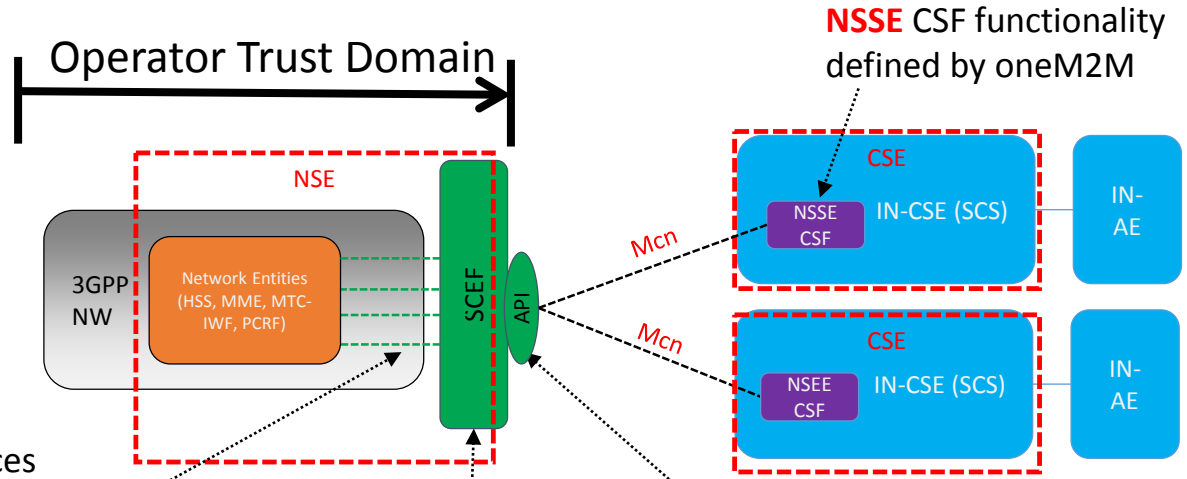
SCEF's southbound interface is a oneM2M **Mcn** reference point & is bound to 3GPP defined interfaces (e.g. Rx, Tsp, etc.)

SCEF is deployed as a oneM2M **NSSE** CSF within the IN-CSE

SCEF's northbound interface API is made available to other CSFs and AEs as well as for internal CSE's SCFs

3GPP & oneM2M Interworking Architecture Scenario #2

In this scenario, the SCEF is owned by the operator or by the trusted business partner and is in a Trust Domain. From CSE's point of view, they can be collectively considered as a NSE.



NSSE CSF functionality defined by oneM2M

Multiple IN-CSEs could interface to a single SCEF

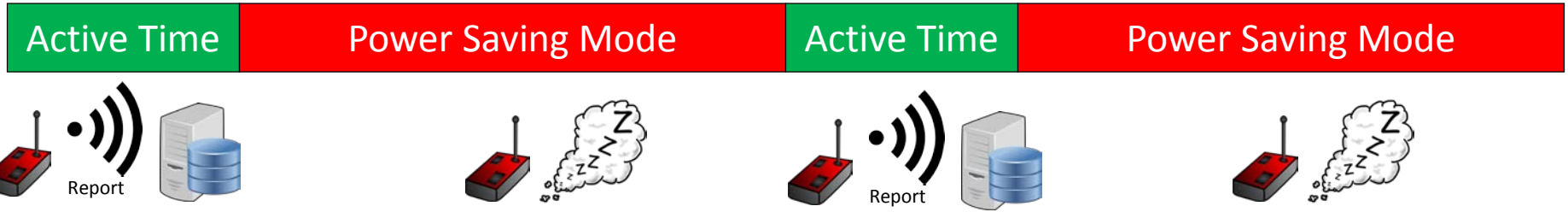
SCEF southbound interfaces are made up of 3GPP defined interfaces (e.g. Rx, Tsp, etc.) and out of scope of oneM2M

SCEF northbound interface API (e.g. OMA APIs) is bound to oneM2M's **Mcn** reference point.

SCEF may be deployed in a standalone manner. In this scenario, the SCEF may be owned & operated by an MNO or a trusted party. The trusted party may be the IN-CSE service provider or some other 3rd party. From the CSE's view, the SCEF and the network entities that it connects to can collectively be consider as an **NSE**.

Cellular Network Low Power Considerations

- 3GPP introduced Power Savings Mode (PSM) in Release 12.
- PSM allows a UE to stay attached to the network but got into a “sleep” state where it is not listening to the network.
- The UE can indicate to the network how long it wants to be in PSM and the network can override the UE’s request. For example, a UE can stay “active” for 5 minutes and use PSM for 1 hour.
- PSM is particularly useful for IoT applications such as sensors, vending machines, etc. The IoT Device can report its measurement or inventory, and then go into PSM until its next report time.
- In Release 13, SCEF is able to notify the M2M Server when a device is active and the S-GW is able to buffer data while the device is sleeping.



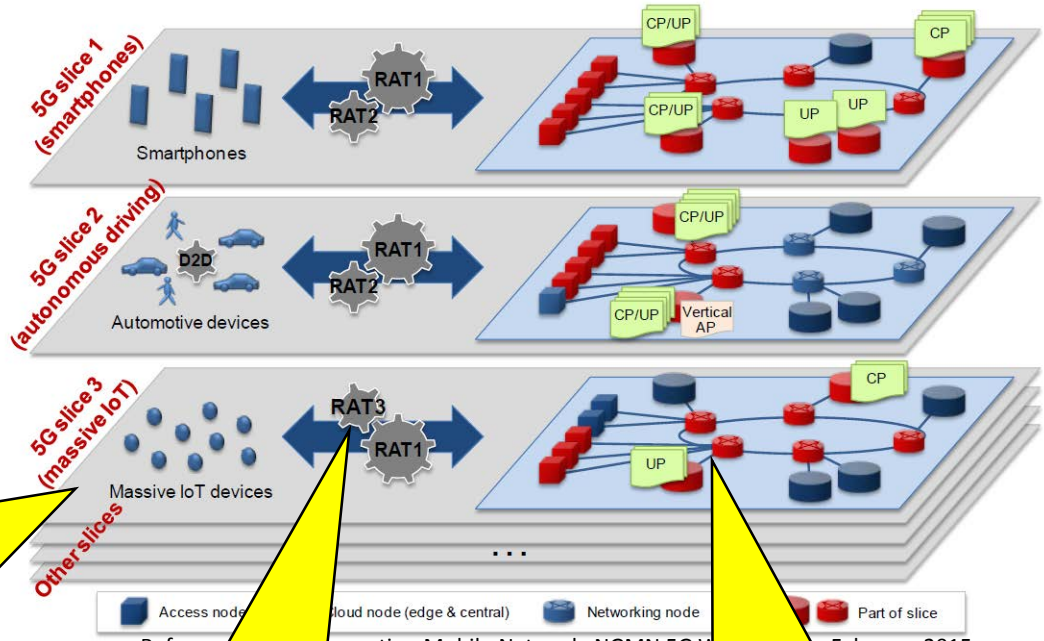
What's Next? - Cellular IoT

The use of cellular is expanding and evolving. From smartphones, to connected vehicles, to massive numbers of IoT Devices.

Think Cellular Connected Home. We need…….

- Ultra-Low Data Rates (160 bps)
- 20 dB extended coverage
- 10 year battery life
- Lower cost & reduced complexity
- Improved Indoor coverage
- Massive numbers of devices (40 per home)
- Improved power efficiency,
- Delay tolerant

What is required to get there……



Specialized RATs for IoT

Specialized Core Network Nodes for IoT

Conclusion

- The IoT needs full-fledged Data Technologies for the entire data lifecycle.
  - oneM2M as a common service layer can run on top of 5G connectivity to provide advanced data-oriented IoT services including data storage, data access, semantics, etc.
- 5G will provide more efficient Cellular Connectivity to the IoT via the development of SCEF and CIoT Technologies.
  - But the SCEF and CIoT Technologies are Communication Technologies, which helps to collect data.
- Future directions and challenges
  - Scalable data management in oneM2M and other service platforms
  - Efficient data analytics in oneM2M and other service platforms
  - Efficient data visualization in oneM2M and other service platforms
  - Efficient data preservation in oneM2M and other service platforms
  - Efficient data security and privacy in oneM2M and other service platforms

Additional Resources

- oneM2M White Paper
  - http://www.onem2m.org/images/files/oneM2M-whitepaper-January-2015.pdf

- oneM2M Webinars – Slide Share
  1. http://www.slideshare.net/onem2m/onem2m-how-standardization-enables-the-next-internet-evolution
  2. http://www.slideshare.net/onem2m/onem2m-taking-a-look-inside
  3. http://www.slideshare.net/onem2m/onem2m-release-1-primer
  4. http://www.slideshare.net/onem2m/onem2m-management-abstraction-and-semantics
  5. http://www.slideshare.net/onem2m/onem2m-personal-connected-healthcare
  6. http://www.slideshare.net/onem2m/onem2m-facing-the-challenges-of-m2m-security-and-privacy
  7. http://www.slideshare.net/onem2m/iot-service-layer-evolution

- 3GPP 5G Presentations
  1. http://www.3gpp.org/news-events/3gpp-news/1734-ran_5g
  2. ftp://ftp.3gpp.org/workshop/2015-09-17_18_RAN_5G/Docs/RWS-150030.zip
  3. Many more… see link #1 above…

- InterDigital Career Opportunities
  - https://workforcenow.adp.com/jobs/apply/posting.html?client=interdigit

Backup

INTERDIGITAL.