Huawei & InterDigital Demonstrate Open-Standard, IoT-Platform Interoperability

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This article provides information and insights captured in an interview conducted by Joseph Fontaine, Vice President, Testbed Programs at the Industrial Internet Consortium (IIC) with Amar Deol, Senior Standards Manager at Huawei, and Ken Figueredo, IoT Strategy Advisor at InterDigital Communications.

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PROFILE

Since there are several components in any industrial IoT (IIoT) application, it is useful to think of these using a stack model that applies to a complete solution. The bottom of the stack consists of connectivity and communications protocols, of which there are many. Next up the stack are functions relating to device management, security and those that support the ability to mix-and-match sensors and applications from a variety of vendors. Further up the stack, there are components that enable the exchanging of data between separate IIoT applications in a semantic way (semantic interoperability). The design challenge for any IIoT application involves a set of individual choices up the stack, from the lower levels of connectivity and communications protocols all the way up to semantic interoperability[1].

The intention of the Huawei-InterDigital IoT-Platform initiative was to demonstrate interoperability using the oneM2M™ open-standard. This standard provides application developers with the tools necessary to design applications coherently up that very stack. An example of what this means is that a sensor attached to an application in one stack might be discoverable and accessible by an application linked to a completely separate stack.

The oneM2M standard starts by permitting application developers to combine devices that use different protocols. This is useful for heterogeneous device populations. Once that first step is overcome, developers can continue up the stack and mix devices from different vendors. Eventually, developers can exchange data semantically, without worrying about configuration tasks taking place in the lower levels because oneM2M service-functions take care of that complexity.

Interoperability can be applied to all the different layers of the stack. At the very lowest layer, designers may be working with devices that communicate using the Constrained Application Protocol (CoAP). However, there may be a deployment requiring some CoAP devices, some Message Queuing Telemetry Transport (MQTT) devices and maybe even some devices relying on WebSocket. Designing a custom solution would entail building connectors that can accommodate each of these

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[1] oneM2M's Value Proposition for IoT Application Developers (2017), https://sites.atis.org/insights/onem2ms-value-proposition-iot-application-developers/

protocols; oneM2M handles these in a standardized manner that is also extendable to additional protocols as needs arise in the future.

A foundational aspect of the oneM2M standard is its architecture which provides a way for different parties to collaborate on the basis of a common representation scheme and associated terminology. As

Huawei-InterDigital testbed focused on demonstrating the following:

o Interworking between platforms belonging to two vendors.
o Multiple devices/applications interworking to an IoT platform.
o Distributed, multi-hop communication spanning network applications, cloud, gateways and devices.
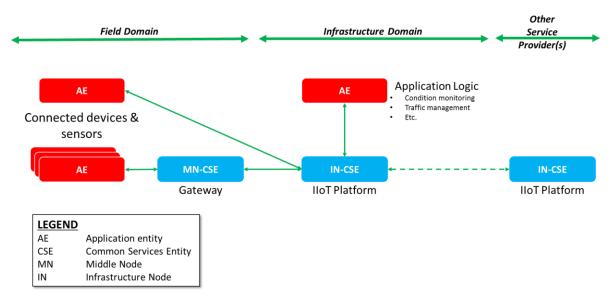

Figure 1 Overview of oneM2M Architecture and Terminology

illustrated in Figure 1, a representative IoT application involves the collection of data from a connected device or sensor (AE), which may pass via a gateway (MN-CSE), to an IoT platform (IN-CSE) and then onto an application (AE) that embodies some form of application logic (e.g. quality control, predictive analysis, etc.). Decision outcomes from the application logic might then trigger some form of remote device actuation (AE).

Within the standard, the oneM2M architecture includes an extension that allows separate IoT environments to interact, e.g. IN-CSE#1 to IN-CSE#2 and IN-CSE#2 to AE#1, etc. The objectives of the

From a use case perspective, testing focused on the following:

o Interworking various types of sensor and actuator devices to the multi-vendor platform and making these sensors/actuators discoverable and usable by various types of applications. This shows the horizontal nature of the testbed and how it can be easily applied to other use cases.

Some of the key technologies showcased include:

o Device and application registration (authentication + authorization).

- o Publishing of sensor device readings to the platform and discovery of these readings by applications.
- o Issuing commands to actuator devices.
- o Subscribing to the platform to receive notifications if/when devices publish new sensor readings.
- o Securing access to devices and data via authorization (i.e., access controls) enforced by the platform
- o Interworking between multiple transport protocols (e.g. HTTP, CoAP, MQTT)
- o Interworking between multiple content serialization formats (XML and JSON)

The physical configuration for the testbed involved Huawei hosting its IoT platform in China while InterDigital's platform was hosted in the United States. Testing is being carried out across the globe, depending on the availability of individual testers. Some devices are physically located in Huawei's facilities in China, while others are physically located in InterDigital's labs in the United States.

In the initial stages of the testing, there were some challenges due to slightly different interpretation of the specifications and an issue of access control to corporate networks. These were minor issues so there was no need to feed anything back to the oneM2M standard.

PLANNING AND MANAGEMENT FRAMEWORK

This testbed was the result of Huawei's and InterDigital's existing relationships as well as the ecosystem partnering opportunities offered within the IIC. The IIC's Open-

Horizontal Testbed Program (OHTP), which addresses the need for re-usable platform capabilities, seemed a natural venue to test IoT platforms based on the oneM2M standard and to leverage the IIC's aims of encouraging member companies to use horizontal platform capabilities.

The IIC's Testbed Working Group forum acted as a catalyst when InterDigital introduced its horizontal platform ideas. Huawei and other companies immediately recognized the opportunity to demonstrate that oneM2M is a good fit for industrial use cases and multi-vendor operating environments.

Huawei and InterDigital representatives agreed on a three-phase plan, covering a period of one year, with progressively more demanding test cases. The progress reporting cycle mapped onto IIC's quarterly member meetings which became a venue to bring additional IIC members into this work. This endeavor still represents one of the team's primary aims.

IIC INTERACTIONS

The oneM2M architecture maps quite well to the Industrial Internet Reference Architecture (IIRA) and the testing team confirmed that the two are consistent with one another.

oneM2M is also referenced in the Industrial Internet Connectivity Framework. Huawei plans to build on this early reference by contributing to both the IIC's Interoperability and the Distributed Data Interoperability Management Task Groups. This work will demonstrate how oneM2M's existing capabilities and the new features in its future release plan can help application

developers in the areas of semantic interoperability.

The IIC's Business Strategy and Innovation Framework deals with strategic and commercial aspects of how organizations deploy IIoT applications. An example might be an organization that needs multiple IIoT applications within its manufacturing facilities and supply chains. It is not sustainable to build individual 'stacks' and use separate platforms for each of those applications. Companies will eventually have to address the issue of scaling up, which triggers the need for horizontal platforms that can support multiple applications, share common services (e.g. device management) and enable data-sharing across application silos, as enabled by oneM2M.

ROLE OF STANDARDS AND STANDARDIZATION

Huawei and InterDigital have been involved in the oneM2M standard since its inception in 2012 and count among its early adopters.

oneM2M is a relatively young standard that addresses new challenges specific to the IoT market. oneM2M release 1 and 2 specifications are already available [2] and release 3 is being developed. In addition to being supported by eight national standardization bodies (from China - CCSA, Europe - ETSI, India - TSDSI, Japan - ARIB, TTC, North America - ATIS, TIA, S. Korea - TTA), oneM2M's functional architecture is the first to enter the International Telecommunication Union's (ITU) standards

approval process [3] from an international perspective.

In progressing from standardization to market adoption, one of the aims of this test bed is to demonstrate the value of oneM2M by raising awareness of the capabilities it offers application developers and service providers.

As a horizontal standard, oneM2M is not constrained to a single industry vertical. It is currently being used in utilities, telecommunications, smart cities, event management, intelligent transport, manufacturing, & energy sectors.

To address future industry needs, oneM2M currently has initiated collaborative work with OSGi, OCF, OPCUA, Modbus and DDS. These initiatives are in addition to the core standardization of oneM2M service enablers (e.g. in Release 3 and roadmap plan for Release 4) along the IIoT application stack.

OUTCOMES

The testing process involved Huawei (OceanConnect) and InterDigital (Chordant) IoT platforms, gateways and applications, and was conducted in phases. During the first phase, the focus was on establishing communications between InterDigital's platform and Huawei's gateway, devices and applications. The second phase involved Huawei's platform with InterDigital's devices, gateway and applications. The first two phases were focused on demonstrating interoperability between Huawei and InterDigital platforms using oneM2M

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[2] oneM2M Published Standards - http://www.onem2m.org/technical/published-documents

[3] ITU Recommendation Y.4500.1: oneM2M- Functional architecture https://www.itu.int/rec/T-REC-Y.4500.1/en

standards. During the third phase, Huawei introduced interworking functions, between OSGi and oneM2M, into the scope of work. Test cases demonstrated interworking between the InterDigital system and Huawei's OSGi gateway.

During testing, one should always make sure that things operate seamlessly in all situations. The idea is that one should be able to pick up devices that conform to a specified standard from various vendors and make them work together seamlessly.
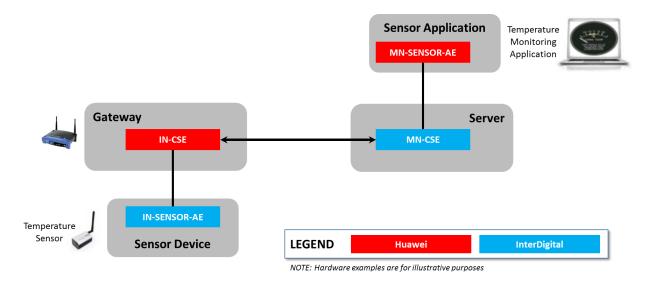

Figure 2 Example test-case: prepare a sensor to publish data to a subscriber application

Exposure of the testing project with the IIC has laid the foundations for more intensive testing along the lines of the third phase and involving other companies with their oneM2M-compliant devices.

There were not many bottlenecks or challenges encountered during testing, apart from time-zone differences for China and USA-based team members. It was mostly straightforward other than some issues with interpretation of the specification and provisioning. However, those issues were sorted out via configurations.

One of the key lessons learned was that although we followed and conformed to the same standard there was still the issue of arriving at slightly different interpretations of the specifications.

IN CLOSING

In the context of the IIC's testbed program, the focus on this testbed has always been on interoperability, between platforms and between applications. It is important to strike a balance as to where to invest efforts. For example, one can invest a lot of time building an algorithm to optimize an industrial operation and not spend nearly enough time on the technology or the platform that enables the application. The latter is important because whenever an organization needs to replicate something or add to it, it is all too easy to fall into the trap of re-inventing the wheel. A standardized solution eliminates this.

While there are many standards for connectivity and proximity networks in

specific verticals, oneM2M is the key standard that addresses new challenges in the emerging IIoT market. Example issues include cross-domain and hybrid-cloud communications as well as vendor-neutral solutions for devices and gateway nodes.

This IIC-enabled collaboration has been a great opportunity for Huawei and InterDigital to build stronger ties and working relationships. There were no unexpected surprises along the way, and none of the interoperability testing would have been possible without the IIC's OHTP venue. Having an OHTP venue within IIC to demonstrate a standards solution and the importance of scalable thinking as distinct from proprietary/silo approaches has been

very useful, and hopefully other IIC members will get involved in future phases.

This work has also led to building a stronger ties between oneM2M and IIC. oneM2M had an event in July 2017 which IIC members attended and presented. An IIC-oneM2M Joint Workshop[4] was held on February 8, 2018 in Reston, Virginia and it represented the first formal gathering between members from oneM2M and the IIC to talk about overlaps and common areas of interest, which may trigger some work in the future.

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[4] Presentation materials from IIC-oneM2M Workshop - http://www.iiconsortium.org/liaison-workshop.htm