A New Architectural Approach for P1451.99 Binding to P1451.0: a First Proposal for P1451.99.0

Riccardo Brama
IEEE P1451.99 Chair
Cortus S.r.l.
Lecce (IT)
0000-0003-4270-1828

Peter Waher
R&D
Trust Anchor Group Chile SpA
Concon, Chile
peter.waher@ieee.org

***Abstract*—This demo demonstrates both a new proposal for aligning P1451.99 with the newly introduced 1451 standard family architecture and casts the basis for a JSON based generalized binding interface, P1451.99.0, to make arbitrary IoT verticals fully compliant with IEEE P1451.0 ecosystem.**

Introduction

Never as in these days the harmonization of different verticals of Internet of Things (IoT) and IIoT (Industrial Internet of Things) is becoming of critical importance. Gathering information from different devices using a uniform approach, while easing the adoption of a common interface to systems yet deployed on the field, allows to minimize the need for systems duplication thus minimizing both costs and the impact of human activities on the environment. The first proposal for P1451.99 has been designed to become a distributed, privacy and security enforcing IoT common ground whose network architecture is reliable and fault tolerant.

After the revision of P1451.0, introducing an in-depth reshaping of the overall 1451 Standards Family, it became evident how the P1451.99 architecture needs to be backed by a set of ancillary interfaces allowing the various P1451.1.X communication stack flavors to fully take advantage of P1451.99 harmonized things.

Standard Overview

At the beginning of its development path, the IEEE P1451.99 IoT Harmonization was designed to provide a series of services and features to ease the creation of an open, interoperable, and secure network ecosystem for things. The basis for this harmonization layer has been identified in the XMPP protocol, originally standardized by the Internet Engineering Task Force [1] for Instant Messaging, and on the IEEE P1451.1.4 communication stack as the gateway for reaching P1451.99 harmonized network [2]. The P1451.99 has been kept as agnostic as possible with respect to underlying technologies to be harmonized. This to make it neutral and cross-domain. It is interesting to note that the first P1451.99 proposal is purposely agnostic of both the 1451.0 messaging and insights. This because the P1451.1.4 had to provide mechanisms and resources allowing to bridge the 1451.0 ecosystem with the P1451.99. The new 1451 standards family asset proposed by the P1451.0, on the other hand, suggest P1451.1.4 to be an independent XMPP implementation, urging the need to reshape the P1451.99 aligning it with this new vision.

To bind the P1451.0 ecosystem with the P1451.99 it has been proposed an architecture in which the P1451.99 ecosystem is the center around which both 1451 enabled devices and non-1451 enabled networks can join. Binding is realized by means of IP enabled gateways that from one side can interface with any of the P1451.1.X standards and, on the other, implement the entire P1451.99 protocol stack to reach the harmonized IoT level. These gateways will provide the following features:

- Realize binding between JIDs identified Concentrators/Nodes and IEEE P1451.0 UUIDs;
- Real time generation of TEDS for non-1451 enabled IoT verticals, possibly with proxying capability;
- Translation of non-1451 messages towards P1451.99;
- Adaptation of P1451.99 messages towards the corresponding P1451.1.X layer.

Implementing this set of features for each P1451.1.X member is a straightforward work due to the perfect knowledge of the P1451.1.X insights. At the same time, it is easy to integrate other well-known technologies, such as the newborn Matter [3], in an harmonized P1451.99 ecosystem. On the other hand, it is more challenging to address arbitrary non-1451 verticals. This can be done only abstracting completely implementation details focusing only on data and its informative content.

A two layers abstraction proposal for the P1451.99.0 general binding is shown in Fig. 1.

The first layer, the Specific Gateway Interface (SGI) provides a set of primitives defining a common interface that developers must implement to interface with an arbitrary networking technology. This layer abstracts all communication details while keeping information about addressing needs, devices and users' identity (where applicable), and devices capabilities. In other terms it provides a uniform interface for arbitrary non-1451 IoT verticals.

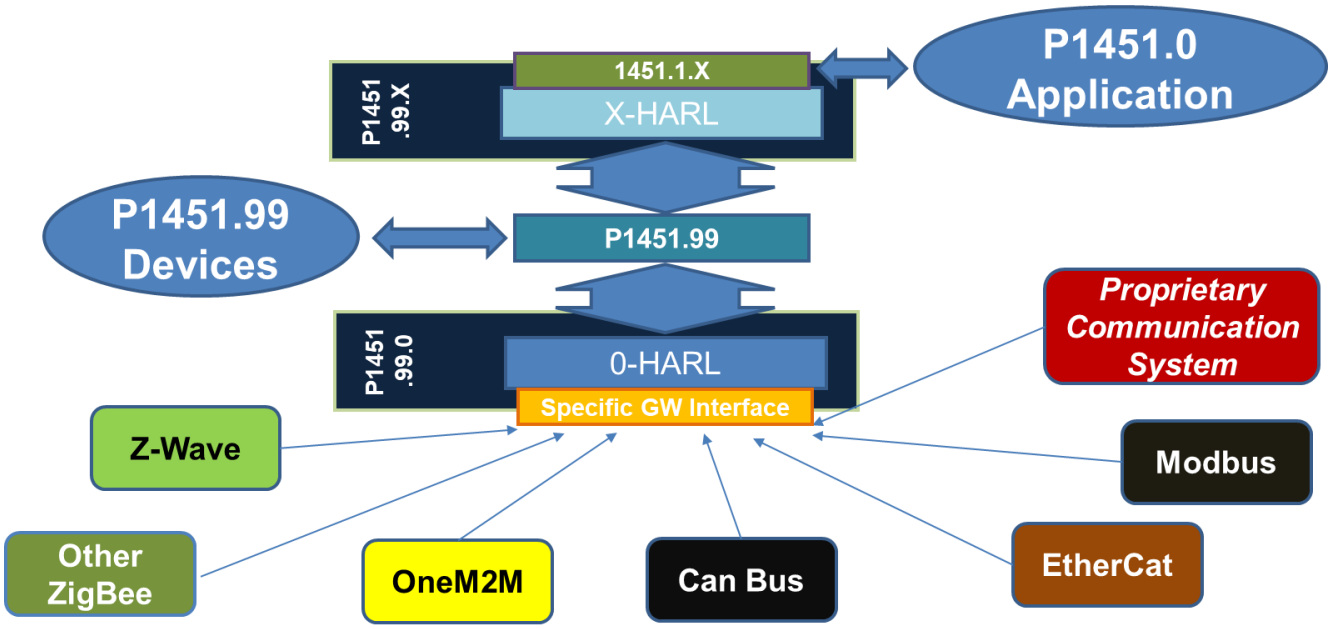

Figure 1 The proposed P1451.99 Centric Binding Approach

The second layer, the Harmonization Layer (HARL), is the one in charge of both message translation and of TEDS generation and proxying service.

To realize such a goal the HARL needs to be aware of a set of information that shall be provided from the SGI abstracted network. In the 0-HARL, i.e. the HARL of the P1451.99.0 binding, this is realized by means of a JSON based information representation [4]. Each device of the SGI abstracted interface is described with a proper JSON object whose methods are well known and documented. It will be beyond the scope of the P1451.99.0 taking care of security and privacy details within the premises of the SGI abstracted network.

Collecting information on SGI network device capabilities the 0-HARL can compile TEDS in an appropriate P1451.0 format. These TEDS are then used to describe in a fully compliant 1451.0 way the non-1451 devices.

In the same way JSON objects, together with primitives, can be used to provide a representation of actions and their informative content needed to interface the P1451.99 harmonized network towards the SGI network.

Material and Equipment

The demonstration can be carried out by means of a personal computer as a way to mimic both the non-1451 side and the P1451.99.0 gateway.

Demo Structure

The demonstration will limit to show how it is possible to compile a TEDS from an abstracted JSON description of an arbitrary object in a non-1451 SGI abstracted network as shown in Fig. 2. The non-1451 side of the communication symbolizes an arbitrary gateway implementing, at least the SGI abstraction layer. The P1451.99.0 binding provides initialization, JID generation, TEDS completion and caching allowing to produce a full 1451.0 compliant TEDS that can be retrieved from another P1451.99.X binding through the P1451.99 network.

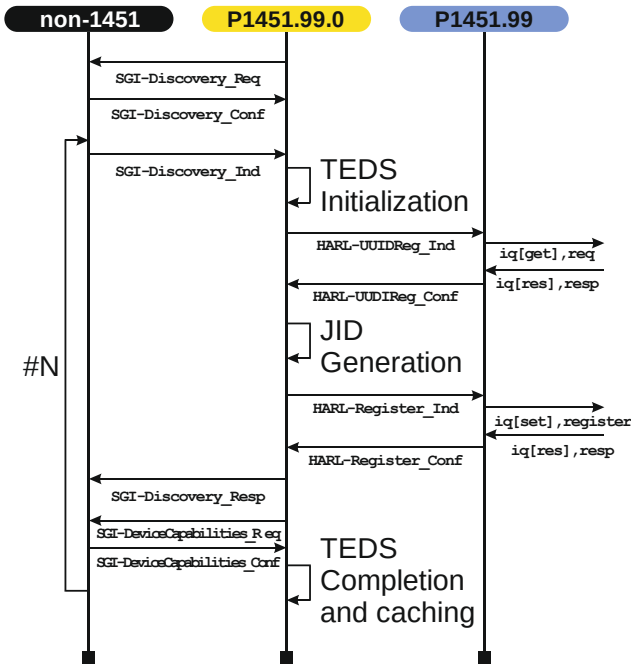

Figure 2 TEDS Caching Service

References

[1] P. Saint-Andre, "Extensible Messaging and Presence Protocol (XMPP): Core", RFC 6120, "Instant Messaging and Presence", RFC 6121, "Address Format", RFC 6122, Internet Engineering Task Force (IETF).

[2] IEEE 1451.99 WG Open Source Repository for XMPP IoT Interfaces: https://gitlab.com/IEEE-SA/XMPPI/IoT, retrieved Sept 2022.

[3] Connectivity Standards Alliance, "Matter", https://csa-iot.org/

[4] T. Bray, "The JavaScript Object Notation (JSON) Data Interchange Format", RFC 8259, Internet Engineering Task Force (IETF)