

# *IoT Information Model Interoperability*

## *An Open, Crowd-Sourced Approach in Three Parallel Parts*

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Consistent with the Call for Participation, the two authors believe the industry should enhance interoperability in the Internet of Things (IoT) at the application layer, specifically with today's inconsistent information models.

We see two key problems:

1. Information models need to converge. Many industry organizations e.g. OCF, UPnP, OIC, AllSeen (with Microsoft active participation in many of them), and in some situations individual companies define machine-readable information models (schemas) for various "Things". However, these are often closely coupled or influenced by the underlying communication architecture, e.g. RPC or RESTful designs. Further, some of the information models are still tied to specific protocols, e.g. protocol-specific auth, pairing and discovery mechanisms. We believe that a proper convergence of such discussions across the industry can and should occur pretty quickly. We believe this convergence can and should happen in a way that is open and protocol independent.
2. The industry needs widely adopted schemas, based on the converged information models. We believe this is where the real practical difficulty is for the industry, when it comes to scale. Thousands of new "Things" are being created at rapid pace. Many different "Lights", "Sensors", "Garage Door Openers" and combinations of such devices are being designed and manufactured by multiple vendors, due to ongoing market innovation and growth.

Let's consider a few market realities that can be informative on how to create "at scale" schemas covering a wide range of devices:

- a) Hardware vendors need the freedom to innovate at rapid pace, creating "Things" in existing categories (e.g. "Garage Door Openers") or jumpstarting entire new categories of Things. Industry pace is the keyword here.
- b) The majority of existing Things do not expose machine-readable schemas. Their capabilities are exposed in a wide range of ways, from low-level pin-out definitions to written-text documentation of non-machine readable high-level schemas.
- c) For the minority of existing Things that do expose machine-readable schemas, multiple information models and schema syntaxes are used today. As previously mentioned, many models are defined in a protocol-specific fashion.
- d) Open Source framework technologies are here today. Fast paced, cross platform, open source technologies such as Node, Boost and many others are widely adopted and maintained by thousands of developers. These technologies, for the most part, can access in a cross-platform

way, on the cloud or on devices, the different protocol buses used to communicate with “Things”.

We think that a bottom-up, open and crowd-sourced approach is a good way forward. We believe this can proceed in three parallel parts:

1. Schemas are created using existing mechanisms, e.g. Industry organizations can create schemas, top down or in a crowd-source manner (such as [oneloTa](#), [openDOF](#), [Haystack](#), [IoTDB](#) and many others). As discussed previously, syntax and information models should converge and be protocol independent and Microsoft is participating in industry discussions to help the necessary convergence, but the approach described in this proposal does not need to wait for this to happen as a few open schema syntaxes and models exist already.
2. Vendors/Manufacturers innovate and expose their device capabilities. It is obviously preferred that Vendors/Manufacturers adopt industry agreed-upon information models (schema syntax as well as actual schemas for existing classes of devices) but again our approach does not need to wait for this to happen. Our approach simply needs a vendor/manufacturer to expose programmatically, using the open protocol(s) supported by the device, a way to uniquely identify the device hardware model.
3. We think that crowd-sourcing the creation of open source bridges mapping existing schemas to diverse devices is a great path forward. For example, it would be extremely straightforward to map multiple Lightbulbs created by different vendors using different protocols. Open source developers will pick and choose between multiple schemas created in Part 1, adapt the best one to their needs and map multiple hardware devices to the same schema. Open source developers would “vote with their feet” by writing code and the schema that will get the most “bridges” to the most hardware devices will become the most usable schema in its category.

We think that such a bottom-up, open and crowd-sourced approach in three parallel parts has the potential to jumpstart the convergence of a set of common open schemas across many categories of Things.