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EVERYTHING

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The Web of all the other Things

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When the Internet of Things (IoT) came out of the Auto-ID Labs in 1999 in a presentation for P&G, the term was coined to describe a future in which all of their products would have RFID tags somehow connected to information systems on the Internet. Today, the Internet of Things, as a field, has a lot more focus on bigger, smarter things such as smart cities, factories or homes.

The W3C WoT standardization effort to date also primarily focuses on this side of the Internet of Things. However, other efforts and in particular work within the GS1 standard organization are looking at bringing “all the other Things” to the Web. Indeed, standards such as

the GS1 Digital Link [1] or the upcoming GS1 EPCIS 2.0 [2] have a strong focus on bringing Consumer Packaged Goods (CPG), fresh food, apparel and pharma products to the Web. It seems as if the IoT has come full circle.

After briefly introducing the current work on the Digital Link and EPCIS 2.0 standard, we will discuss how bridges could be built between the W3C WoT work and these new standards.

THE GS1 DIGITAL LINK STANDARD

Over five billion barcodes are scanned daily around the world – that’s more transactions than there are Google searches every day. The new “GS1 Digital Link” standard [1] upgrades this 40+ year-old technology for a connected world. Let us look at how it works. Each code contains a Global Trade Item Number (GTIN) that identifies the product Stock Keeping Unit (SKU), optional unique identifier and most importantly, a URL that links to the product’s digital identity on the Web. Linking the unique symbology on the product with an intelligent digital identity in the cloud means that consumers can get dynamic access to product provenance and other product information, brand content and digital services when they scan the item. Because it is a GS1 standard, point of sale systems and supply chain readers can identify the product via the same code too. Furthermore, it means that all kinds of consumer applications can understand what the product is and use this information (e.g., an allergy information application, a fitness tracking application, etc.). On top of this, brands can add data intelligence to every product to tackle challenges that physical product packaging just cannot deal with by itself, such as complex regulatory requirements, real-time tracking for supply chain integrity or authentication to detect counterfeits.

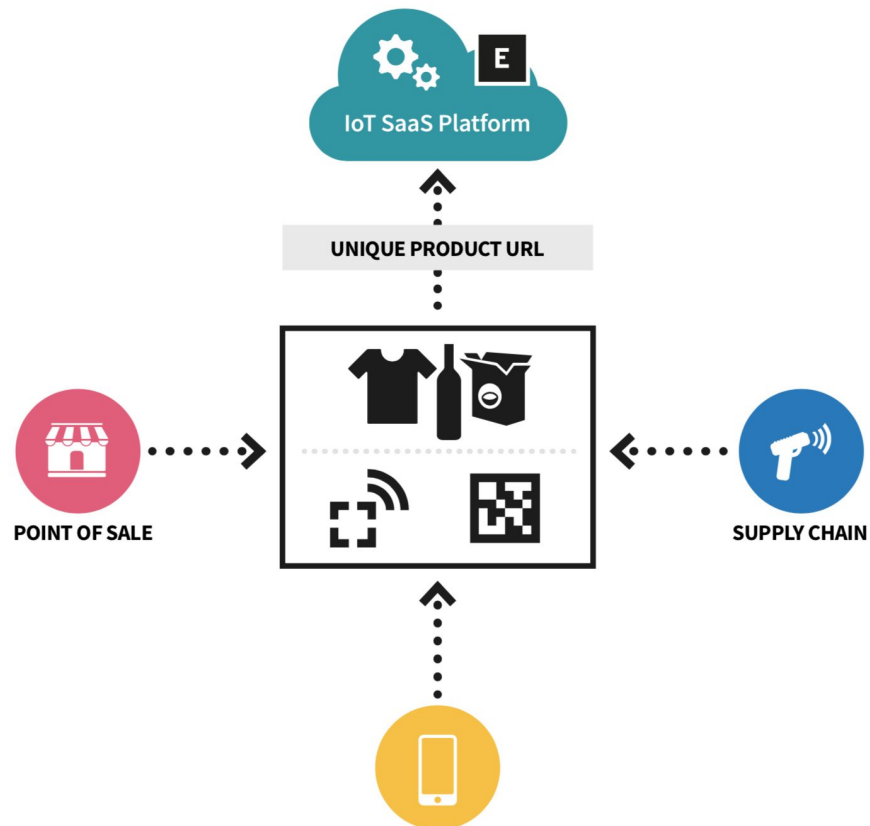


Figure 1: Digital Link can be used to drive a number of applications in the supply chain and for consumers.

THE GS1 WEB URI STRUCTURE

The standard underlying the GS1 Digital Link is the “GS1 Web URI Structure” standard. It was introduced because until now there has been no standard way for consumers to interface with GS1 identifiers or data carriers such as 1 dimensional barcodes. It enables every single product to get a unique and resolvable identity on the Web. It provides a unique and standard way of converting GS1 identifiers, also known as GS1 Application Identifiers or AI, into a Web address that can be understood by the majority of mobile platforms and applications. Finally, it can be

used on the Web, describing products and items in a language that Web crawlers and other applications can read.

The structure of a GS1 Digital Link is as follows:

[https://{{domain}}/{{identifierKey}}/{{value}}/{{keyQualifier}}/{{value}}\)*?\({{dataAttribute}}={value}\)*](https://{{domain}}/{{identifierKey}}/{{value}}/{{keyQualifier}}/{{value}})*?({{dataAttribute}}={value})*)

()*	Repeat this section several times with different key value pairs
identifierKey	GS1 Identifier Keys, e.g., GTIN, SSCC, GLN as string or numeric identifier
keyQualifier	GS1 Key Qualifiers, e.g., CPV, batch, serial as string or numeric identifier
value	GS1 compliant identifier value, leading 0 removed, e.g., for a GTIN: 9507000009060 data
dataAttribute	GS1 data attributes as numeric identifiers, e.g., for Best Before Date: 15=220420. This space is also available for any (non GS1) extension as query parameters, e.g., sec=12iu7 for a platform specific security parameter

As an example, the following web address is a URI representation of a serialized GTIN in the numeric short form:

<https://dfnr.tn.gg/01/860080001300/22/323/21/445?15=220131&sec=12iu7>

An alternative representation in an alphanumeric form is shown in Figure 2.

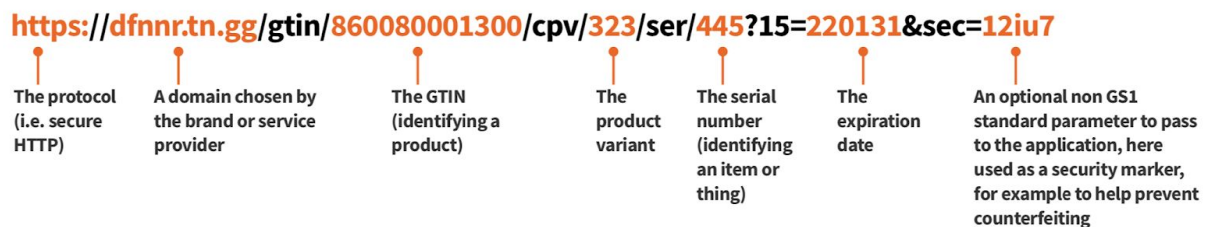


Figure 2: A Digital Link in an alphanumeric form.

DIGITAL LINKS AND THE SEMANTIC WEB

GS1 Digital Links have one more powerful use: they can be used as unique identifiers for the semantic Web. This allows you to create authoritative links to a product from another page (e.g., a review page). Furthermore, it is possible to describe relationships to a “Digital Link identified product” using machine-readable Linked Data. As a concrete example, a Web page with a cleaning manual for a pair of hiking shoes can reference the shoes in a machine-readable way i.e., explaining to applications that this page is about these particular hiking shoes. This is very useful to allow the automatic discovery all kinds of relevant content around a product on the Web.



Figure 3: Digital Link as a semantic Web identifier, allowing to link to all kinds of related Web resources.

THE DIGITAL LINK STANDARD VERSION 1.1

Beyond the ratified standard to describe the syntax of a product URL, the Digital Link Working Group at GS1 is now working on a compression algorithm for Digital Links URLs as well as describing the standard API (called Resolver) to fetch specific results (e.g., a recipe for a food product) from the Web. Effectively, the effort is to create a standard API for products and hence bridges to the W3C WoT standard could be built at this level.

THE UPCOMING GS1 EPCIS 2.0 STANDARD

The EPCIS standard and the current development of a version 2.0 are also of interest to the Web of Things. Indeed, since its ratification in April 2007, Electronic Product Code Information Services (EPCIS) is a global GS1 standard for creating and sharing visibility event data, both within and across enterprises, to enable users to gain a shared view of physical objects and their associated events such as movements within the supply chain.

A PRIMER ON THE EPCIS MODEL

The EPCIS model itself defines the basic building blocks of a supply chain information system. In essence it proposes the following constructs to capture:

- What
- When
- Where
- Why

of events within the supply chain. The EPCIS model is basically as follows:

- **What:** Events of type Object (e.g., scan of a pallet), Aggregations (e.g., putting Objects on a Pallet) and Transformations.
- **Why:** Each of these events then has an action: Add, Observe or Delete.
- **Where:** It also specifies Business Locations which are essentially places.

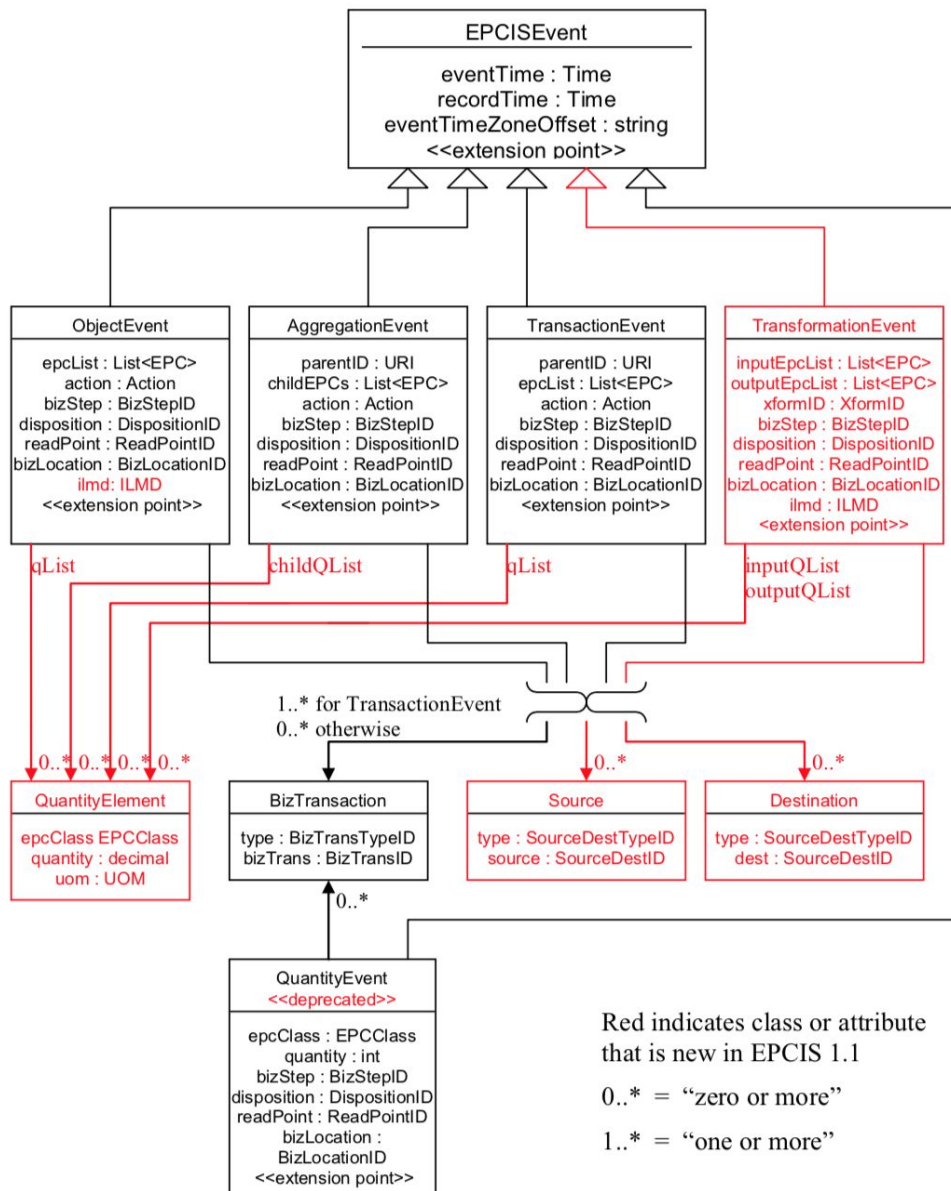


Figure 4: The EPCIS 1.2 Model, source [3].

EPCIS 1.2 IS NOT WEB

In its current form, the EPCIS standard defines query and capture interfaces with WS-* Web services (SOAP, WSDL, etc.). This current interface is poorly compatible with the Web and hence limits the application space. Phase 2.0 of the standard will improve this by creating a REST binding inspired by the one proposed in [4]. Furthermore, the EPCIS 2.0 standard will

allow for resources to be represented in JSON(LD) additionally to the current standard XML representation.

CONCLUSION: AN OPPORTUNITY FOR ALL THINGS TO SPEAK THE SAME LANGUAGE

While addressing different types of things, the W3C and GS1 efforts could be brought together to create bridges between the two standards, allowing smart devices to communicate with tagged things. This would unlock a number of interesting and futuristic use cases such as appliances “understanding” the things they are dealing with. For example, a washing machine could know what type of clothing it is loaded with, an industrial machine could know what type of material it has to deal with or an oven what type of food it has to heat, a truck could know the types of fresh food it is transporting and adapt its temperature and air quality.

With this position paper, we would like to report the state of the nation in tagged things describing these two standards. In particular, we would like to take the opportunity to discuss how the Web of Things and the work that was done within the W3C WoT WG could be used to positively influence these upcoming standards and work towards a Web of Things that truly covers all things: from the simplest CPG products to the most complex smart cities.

Works Cited

[1] *GS1 Digital Link standard* <https://www.gs1.org/standards/gsl-digital-link>

[2] *GS1 EPCIS 2.0 standard charter*

https://www.gs1.org/sites/default/files/docs/gsm/epcis_2.0_cta_final.pdf

[3] *GS1 EPCIS 1.1 standard*

https://www.gs1.org/sites/default/files/docs/epc/epcis_1_1-standard-20140520.pdf

[4] *Giving RFID a REST: Building a Web-Enabled EPCIS*

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