The Global Language of Business

Hybrid Physical + Digital Identity

Insights, Opportunities, and Challenges from the GS1 US Fall Dinner Series in Palo Alto and San Francisco

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Executive Summary

- GS1 US® convened the Digital Convergence Forum to explore the business challenges and industry opportunities in a world where the physical and digital domains are blending at a rapid pace.
- Traditional concepts of identity—for individuals as well as items and entities like products, companies, and locations—are in the process of evolving to encompass not only the physical item, but also its digital counterpart, including attributes, history, metadata, and linkages to a variety of innovative digital services.
- The next phase of computing and network technologies, known as the Internet of Things (IoT), will involve connecting billions and potentially trillions of things to the Internet.
- Advances in sensors and networking protocols have made it conceivable that every physical product or item in the future will be linked with a rich digital data profile.
- Even "dumb" products can be tracked by their unique identifiers, and thereby they will have a digital history and will allow for dynamic services that engage with end consumers long after the product is purchased.
- IoT may transform consumer marketing completely by introducing new channels, new methods of brand building, and a new concept of ownership.
- The old notion of a left-to-right value chain is evolving into a continuous "cycle of consumption" that tracks the usage of a product beyond purchase through the entire lifecycle. The hybrid physical-digital identity plays a vital role in this process.
- IoT promises to yield great benefits in productivity, efficiency, superior data insights, sustainability, and consumer and patient engagement. But there are several obstacles to be surmounted before this vision will become a reality.
- Blockchain has been touted as a panacea that can, in theory, decentralize supply chains; but many of our panelists expressed skepticism that blockchain today offers greater value than existing, proven systems already in deployment.
- Blockchain technology may provide an infrastructure upon which a broader set of ecosystem participants can exchange real-time, transactional information across a number of varied business processes, including payments, SLAs, and physical event data essential to supply chain visibility.

This document sets forth some of the themes, insights, trends, and challenges discussed during the GS1 US Fall Dinner Series. The purpose of sharing this information is to precipitate further discussion, commentary, expansion, and clarification.

GS1's Role in a Hyper-Connected World

As the world's largest standards body focused on unique identification, GS1® has a well-defined role as a neutral authority at the forefront of establishing, managing, and promoting a System of Standards for global commerce. These standards are built upon three core concepts of identification, data capture, and information sharing, and they are among the most widely adopted and trusted standards ever created. The iconic U.P.C. barcode in the U.S. and its global counterpart, the EAN, are scanned more than 5 billion times a day.

Now, as the digital and physical domains begin to converge, conventional systems for identifying and managing items in the manufacturing supply chain must evolve to accommodate digital attributes and the associated metadata. Whereas standards for identification in the physical domain are well established, there are currently no equivalent standards for digital identification.

To address this need, GS1 US created the Digital Convergence Forum (DCF), an executive "think tank" designed to facilitate an open dialogue around the topic of technology and data standards that extend into the digital domain. As part of the DCF initiative, GS1 US invited leading technologists and executives to participate in a series of discussions intended to precipitate the exchange of ideas and insights and to identify problem areas and potential solutions. This report provides a summary of the ideas and insights that were explored in the 2017 GS1 US Fall Dinner Series.

In the converged physical and digital domain, the GS1 identifier is more than just a number—it will also serve as a pointer to the digital metadata associated with an identity.

Digital Convergence Goals for GS1 US

As a neutral governing body trusted by industry partners, GS1 US seeks to:

- Standardize digital identity by issuing unique, persistent, globally interoperable identifiers with a minimal amount of attributes for the purposes of authentication and verification.
- Reduce friction: make it easier and faster to issue identifiers at scale.
- Enable partners to issue single identifiers for long tail usage, such as online marketplaces like Alibaba, eBay, and Amazon.
- Dramatically expand the universe of items, parties, and locations that can be identified.
- Continue to advise manufacturers how to apply serialized identity at the level of the individual item.
- Support a series of pilot projects designed to put hybrid physical-digital identity concepts into practice with the goal of fostering the adoption of converged identity across a spectrum of real-world use cases.

1 Whatever Can Be Connected Will Be Connected

Computing is moving beyond the desktop into every facet of life. Between 2006 and 2016, there was a fundamental change: until 2006, personal computing primarily involved desktop computers with fixed-line broadband connections, but thereafter, personal computing increasingly happened on smartphones with wireless broadband connections that are linked to cloud-based services.

The companies that were best positioned to participate in the transition to mobile computing grew explosively as billions of consumers adopted smartphones. As 4G mobile broadband was deployed around the world, the internet giants grew to planetary scale as the number of internet users quadrupled from one to four billion.

That transformation is not finished; on the contrary, it is still gaining momentum. And it will continue to do so beyond the point when 90 percent of humanity has access to the internet.[1] With it comes an opportunity to reinvent industry and global trade.

The first phase of the internet (1968 to 1998) connected **computers to computers**. The second phase (1998 to 2016) expanded the network to connect **computers to smartphones**. And the next phase will connect **computers to everything**.

Whether we refer to this next phase as "machine-to-machine communication," "Internet of Things" (IoT), or "Industry 4.0," one central premise about the next era of the internet can be expressed simply this way: **Whatever Can Be Connected Will Be Connected.**

Throughout industries, government agencies, and civic institutions, technologists are devising new ways to connect existing systems to the network. In the process, they will rethink legacy workflow and reinvent long-established procedures from the industrial era for a new era of ubiquitous connectivity. Whether industrial companies and long-established institutions make the decision to do this for themselves, or whether feisty startup challengers disrupt them, we can be certain that, in one industry after another, whatever can be connected to the network will be. **And everything connected to the network will require a unique identity that spans both the physical and digital domains.**

2 Beyond Smart Devices: Towards "the Internet of Dumb Things"

The discussion about the Internet of Things often focuses on ***devices***, namely consumer or industrial electronics products equipped with a microprocessor and wireless connection.

These "smart" networked devices are sometimes embedded in other products, such as in the dashboard of a motor vehicle or in the walls of a building or in a city streetlight; sometimes they are sold as freestanding products like a Bluetooth speaker, a smart TV, or connected door locks.

What makes these products "smart" is the network connection that provides access to cloud-based servers that process usage data with machine learning, thereby augmenting the limited capabilities of the device itself.

Estimates for the total number of connected devices vary widely but they all range in the tens of billions. For instance, McKinsey projects that, by 2020, the number of smart non-PC, non-smartphone IoT devices connected to the internet will range from 20 to 30 billion. This figure is forecast to grow to 75 billion or more by 2025. What all such estimates have in common is that they all anticipate at least one order of magnitude more connected "things" than smartphones in use, and two orders of magnitude more than PCs in use. In other words, **the information technology sphere is expanding from *hundreds of millions of PCs* to *billions of smartphones* to *tens of billions of smart devices*.**

But the focus on smart devices obscures an even bigger potential transformation. **What about physical items that don't have a power supply or wireless connection?** Can those things be connected to the network, too? Probably, yes.

The integration of ever-smaller and cheaper sensors, such as RFID tags and ASICs, will soon make it possible to connect nearly every product and manufactured item to the network via a smart device or scanner. **Call it the "Internet of Dumb Things."**

It's early in this process, but consider the following predictions:

Tipping Points Expected to Occur by 2025

More than 75 percent of the respondents in this 2015 World Economic Forum survey expect the following to occur by 2025:[2]

- 10 percent of people wearing clothes will be connected to the internet
- 1 trillion sensors will be connected to the internet
- 10 percent of reading glasses will be connected to the internet
- The first implantable mobile phone will be commercially available
- 90 percent of the Earth's population will use smartphones
- 90 percent of the population will have regular access to the internet
- 10 percent of all cars on U.S. roads will be driverless

1 *Deep Shift—Technology Tipping Points and Societal Impact*, *Global Agenda Council on the Future of Software and Society, World Economic Forum*, September 2015.

2 Ibid.

These predictions by WEF members illustrate the widespread expectation that physical products, such as reading glasses, garments, and automobiles, will be routinely connected to the Internet in less than a decade.

How can anyone make a prediction with such certainty? Because the next wave of technology is already here in plain view.

Building Blocks of the Next Transformation

Technology comes in waves: every innovation is built upon the innovations that came before. After an initial period of diffusion followed by broad adoption, each new technology eventually serves as a foundation for the next phase of innovation.

The smartphone era was built upon a strong foundation of enabling network technologies and open standards that were introduced during the preceding era of fixed-line Internet, plus new advances in several key areas, such as: social networking and the social graph; mobile computing and mobile broadband; search and data analytics; and behavioral targeting and geo-location tracking.

The next round of technological progress will be built upon these foundations as well as a range of **new enabling technologies**, including the following:

- Computers everywhere
- Cloud computing
- Big data and artificial intelligence
- Robotics and automation
- Distributed trust/blockchain
- The proliferation of low-cost sensors
- New ways for machines to detect the real-world environment, including machine vision, image recognition, voice recognition, and natural language processing

The Benefits of Connecting Everything

Taken together, the technologies listed above offer the potential for a large-scale reinvention of the way that products are made, distributed, sold, and used. The Industrial Internet, a.k.a. Industry 4.0, promises to drive manufacturing to a new level of efficiency at a scale that was previously unobtainable. Analysts have heralded IoT as the next great phase of economic expansion, generating potentially hundreds of billions of dollars of investment in infrastructure and trillions of new growth.

It's a rosy forecast, but before we get there, we will need to solve some significant problems.

3 How IoT Will Transform Product Marketing

Brand Building in Turmoil

Here's a simple formula for building a mass brand: put the product onto the shelf in every store and saturate the airwaves with an advertising campaign. Today, those time-tested tactics are no longer sufficient. Fewer people are watching broadcast television each year, and visits to shopping centers have declined by more than 50 percent in the past five years.

Twenty years of digital transformation has weakened the two strongest channels of mass brand building:

- Advertising and mass media
- Physical retail and shopping center development

The **collapse of the broadcast television** audience has raised questions about the viability of traditional mass branding tactics. How can an advertiser build mass-scale brand awareness in a fragmented post-television world of personalized media feeds?

Meanwhile, the **weakening of physical retail** has caused a total reinvention of the brick-and-mortar shopping experience, and with it, a blurring of traditional roles of producers and retailers. As retailers expand their private-label lines, traditional consumer product brands are fearful of getting pushed off the shelf by their erstwhile retail partners.

These two changes have led to soul searching in the brand-building and advertising fields.

Relief might come via the Internet of Things. Specifically, the packaging around the product and the physical product itself might provide a new way to connect directly with consumers. Participants at the GS1 US Fall Dinner Series in San Francisco included several expert brand marketers who expressed enthusiasm for concepts like augmented-reality experiences that use the image of the product to connect interested customers to digital metadata such as product marketing information, instructions, tips, and guides and more. As one attendee said, **"Now the package is the new channel."**

The package itself may be the link to the digital identity. There is not enough space on the box to include all the information associated with the product, let alone the various snapcodes and barcodes. Instead, the image of the box can serve as a link that takes you to a directory of digital information.

(Some attendees pointed out that image recognition depends upon line-of-sight and for this reason, the image of the box might not be sufficient for all identification needs and may need to be supplemented by RFID).

As traditional channels collapse, every producer will attempt to build a direct link to consumers, but this has proven to be an exceptionally difficult challenge for many marketers. As one attendee said, "Everyone is trying to go D2C but not everyone is good at it." A standardized identity system that

unifies physical product ID with digital metadata will streamline the process of building a D2C channel, enabling new service providers to accommodate firms that lack digital expertise.

Other attendees pointed out that buyer values are shifting, too, and this will also reshape brand perception. "Today's consumer is buying authenticity and the promise of sustainability," one participant said. Again, the hybrid physical-digital identity could facilitate that quest. Consumers equipped with augmented-reality smartphone apps will have the option to explore detailed information about ethical sourcing, sustainable production methods, ingredients, and more.

Rethinking Brand Identity in a Hyper-Connected World

Every marketing executive is familiar with the axiom that "brand identity is a promise." A successful consumer product brand telegraphs to shoppers a guarantee of quality before they make the purchase. As Lisa Sullivan of Ketchum said at the GS1 meeting, "A good brand is a promise kept. And these promises are repeatable."

The classic way to build a brand identity is a process of construction. Marketers identify brand attributes and carefully construct memorable ways to express them: logos and marks, slogans and taglines, jingles and audio tags. Every brand element is designed to create a mnemonic link to the package. The goal is to train the consumer to recognize the package on a shelf and make the mental association to the promises expressed in a mass media advertising campaign. In this way, the iconic package design works like a hyperlink to data stored in consumer memory.

What's common in this classic "Mad Men" approach to brand building, whether the product is an automobile or a breakfast cereal, is that the process is a one-way, one-to-many style of communication that is optimized for broadcast media where the audience can passively absorb the message but cannot talk back.

With the advent of social media, micro-blogging, and visual messaging, the classic one-to-many broadcast approach is less effective. Today marketers seek to engage brand fans and their best consumers in a two-way dialogue, with the goal of stimulating viral breakout and peer-to-peer repetition of brand values and promises kept.

Lisa Sullivan said, "In the past, brand identity was something that you put out, but now it's reputation by permission. Brand value is something that is conferred upon you by third parties."

Upshot: marketers are in the process of rethinking **brand identity and promises** in an age of participatory media. And that's not all. We may also need to redefine what a product actually is in a hyper-connected world.

The Evolution from Static Products to Dynamic Services

The prospect of connecting everything heralds a shift away from standalone products to *products-as-services*. When everything is connected to the network, every product can be accompanied by a digital service that is tailored specifically to that item and its individual owner.

This shift to product-as-a-service demands a re-evaluation of legacy consumer product marketing, including:

- **Evolution of the product lifecycle** away from the classical left-to-right value chain towards a "cycle of consumption" that extends far beyond the retail checkout counter through usage by the first and subsequent owners, all the way to end of product life and eventual recycling. This cycle can be enabled by a persistent identity that links the physical product to a digital history.
- **Every smart product (and every connected dumb product) will be bundled with a cloud-based service** that provides information on demand and gathers contextual data about the usage and location of the physical item. This implies the deployment of a digital service infrastructure to accompany every physical product. For dumb products (i.e., those without connectivity), the connection may be "borrowed" from a nearby smart device such as a smartphone or handheld scanner. That's how every product will come with a client-side app. This app could take the familiar form of a smartphone app or an Alexa skill or a chatbot, or perhaps such apps will evolve into radically different form in the future that is linked to cloud servers and databases. This means that every manufacturer will also become, or need to partner with, a software company that manages integrated cloud-based digital services that track the product through its lifecycle. The upshot: as technology transforms the way products are consumed, the consumer marketing process itself will be defined by technology.
- **Every product now has a data shadow**, an unseen digital dimension that consists of information about the product. Ambient data from usage can be harvested and used productively to improve services. In the past, the only way to glean information about how and where a product was used was to conduct field research or consumer surveys. But with the advent of always-connected products, what was formerly overlooked as mere "data exhaust" or "data smog" can now be collected, stored, archived, analyzed and converted into useable insight. Continuous monitoring means continuous improvement. Just as Internet users can be defined by a social graph or their interest graph, connected products will be defined by their location graph and their proximity to other networked devices, whether or not they are connected. Again, this scenario depends upon a persistent identity that spans both the physical and digital domains, and it also introduces an absolute requirement to consider concepts of user privacy.

- **Evolution of ownership:** the way you "own" a smartphone is significantly different from the way you "own" a tool like a hammer or saw. With connected products like smartphones, the consumer might own the hardware but never own the software. The bundle of "ownership+access" implies there will be an ongoing relationship with the manufacturer after the purchase, a relationship that is typically governed by obligatory Terms of Use or conditional access to services via a software license agreement. If the nominal "owner" of the product breaches these terms, use of the product may be curtailed by the manufacturer. And when the consumer transfers ownership of the item to another person, these permissions and software access licenses will be transferred, too. Again, this scenario requires a persistent product ID that spans the physical and digital dimensions. In the hyper-connected future, many more products will be owned like smartphones.

Extending Product Identity to Include Digital Data

Historically, product identity in the GS1 context consisted of the standard U.P.C. number or GTIN® along with associated master data and a bit of logistics information that drove efficiencies in B2B supply chain operations. While serialized product identity is available, the value for the cost up to this point has been limited. This is changing. With the advent of IoT and digital commerce in general, more detailed information and metadata about individual items that connect to the "cloud half" of the item is required to meet consumer expectations, drive more efficient business processes, and compete in the digital age. Serialization offers the possibility of creating a unique identity issued for every individual item in the production line and unifying it with a digital identity which consists of an accumulation of attributes, attestations, and digital artifacts.

Digital metadata appended to the unique identity of an item might include:

- Product history: date/time/location of production, identity of source components, list of ingredients and sources, production methodology and equipment, instructions for proper shipping and handling and storage, logistics history in supply chain,
- Product documentation: instruction manual and troubleshooting guide, product warranty, legal disclaimers and regulatory documentation, certificate of authenticity, contact information for repairs and returns.
- Usage, ownership, and repair history.
- Ethical context: certificates for fair trade, organic or non-GMO, cruelty-free, etc.
- End-of-lifecycle data: instructions on how to return the product to a manufacturer for disposal and recycling of components

What Is Identity?

The discussion about the evolution of identity in a hyper-connected context, and the formulation of a hybrid physical-digital identity led to a lively discussion about what, exactly, an identity is and what it might become in the future.

Here is what we heard from attendees at the GS1 US Fall Dinner Series:

- **Identity as a brand is an expression of the core value**, something that a company (and its products) stand for: quality, authenticity, value. Increasingly, in the digital domain, brand values are expressed through actions or deeds. Consumers react negatively when a company (or its products) perform in ways that are not consistent with stated or perceived brand values. Identity is a sum of identifier(s) and attributes; interactions and transactions that occur; distributed ledgers may be a way to amass these attributes over time.
- **Identity is a claim.** Certificates and documentation (such as passport or driver's license) are issued by authorities to support and validate my claims.
- **Identity as a repository for history.** Identity is the gathering of what you've done over time. Identity gets richer as an item goes through its lifecycle. Identity is a collection of metadata that accumulates over time, and this is what makes it unique. Identity is formed by describers and attributes. Identity is the accumulation of attributes over time. Identity is a bundle consisting of identifier, control data, and associated metadata.
- **A global identifier is one that is unique, consistent, persistent, and brings together all elements of identity.** Identity is a stack, a container that holds many attributes and many different identifiers. Taken altogether, these many various attributes and attestations yield a cumulative identity that is more precise, more specific, and more accurate.

Multiple Interlocking Identities Create a Web of Trust

Beyond the discussion about the unique identity of a single item, some attendees also raised significant questions about the identity of the user/product owner/consumer. How do we know and trust this identity? Also, who is the person or entity that certifies the authenticity of an item or issues the document to verify a claim? Who verifies that person's identity? If all identity consists of an accumulation of attestations, then the problem shifts to: who is doing the attesting? How credible is that person or entity? (Refer to *The Origination Problem* below.)

Strategic Imperatives That Will Guide the Evolution of Hybrid Identity

Producer Benefits

- Accurate, machine-readable metadata to enable software automation and robotic handling, warehousing, shipping, and inventory management
- Ongoing stream of valid data to track product usage and optimize product performance
- Reduced errors and increased efficiency in shipping and order fulfillment
- Reduced fraud and counterfeiting
- Reduced overproduction and overstock

Consumer Benefit: New Experience of Brand Value

- Authenticity and trust
- Transparency: provable assertions about ethical sourcing
- Better utility and access to ever-improving companion services
- Ease of use and easier purchase decision

During the GS1 US Fall Dinner Series, we heard several anecdotes and examples that illustrate the way that consumer expectations have changed. Consumers now are concerned with blood diamonds and precious metals sourced in conflict zones; counterfeit parts, fake medications, and phony fashion accessories; products made with slave labor or unfair labor practices; and unverifiable claims made about organic produce, fair trade, or sustainable production methods.

4 Problems to Be Solved in Digital Identity

Part of every new undertaking is the process of surmounting the obstacles that block progress. This process begins with problem definition. There is a well-documented tendency in the technology field to leap ahead to finding solutions. But best practices from the field of industrial design would encourage a thorough examination of problems as a first step, before moving on to solution finding.

Obstacles: What's Preventing Us From Connecting Every Item?

- Not all identities (and not every aspect of identity) are machine readable.
- One identifier is sometimes appended to multiple product versions.
- No global identity system exists for most things: identities may be issued but they are not necessarily unique, standard, or interoperable. Some ad hoc or proprietary systems of identity are inconsistent, contradictory, duplicative, or non-interoperable with existing standards.
- No global standard exists for the formatting of metadata. Some retailers may resist such standardization because they seek to create a differentiated shopping experience.
- Every industry seems to require different kinds of metadata to describe its products. There is no simple baseline set of attributes or descriptors that apply to all products.
- Some manufacturers resist standardization. In the fashion industry, for example, some brands intentionally resist standardization of size and fit and color as a way to differentiate.
- The process of certifying claims is itself not standardized. There is no globally consistent way to verify claims about sourcing, sustainability, labor practices, product compatibility, etc.

Our panel of experts was prolific on the topic of *Problems to Be Solved*. The following observations were flagged as fundamental problems that must be solved in order to establish a durable and reliable digital identity system that corresponds to the physical identity of products.

The Origination Problem

A lively discussion was held on the topic of how to originate identity on a variety of products. Some attendees expressed concern about the authenticity of identity issued far upstream by producers and even farmers. "How do you originate the identity of this asparagus? Everything you do afterwards is irrelevant," said Rob Rekrutiak of Google Shopping. "The origination problem is a great challenge."

Rekrutiak offered the example of food traceability. In his view, tracing food may require a level of granularity and precision that is currently beyond the capacity of most sourcing operations. In the case of a food product recall, for instance, the disease might happen on a particular tree in or grove.

"If the Origination Problem isn't solved, the value and integrity of everything that comes after is lowered/compromised," Rekrutiak explained. "We have proof points supporting this today whereby GTINs are not as valuable as they could be because they are created/applied inconsistently."

As another attendee noted, "Identity is an accumulation of attestation. On top of attestation there is annotation. And we need the source of the attestation to be recorded—and that's another identity." This origination problem, then, is linked to the difficulty of verifying attestations. It is a recursive problem of interdependent but separate identities vouching for one another.

The Read/Write Permission Problem

Who has permission to read the data associated with an item? Who has permission to append new data or modify a record? Who decides?

In a classic supply chain situation, there's always a dominant party. The party of record controls the access to records and can permit or deny other parties to gain access to records. But in an extended lifecycle of consumption, it is no longer clear which entity should make the determination about read/write privileges after the consumer has purchased the product.

People—and automated systems—need to do two things:

1. Encode information into the profile
2. Query the information

However, the rules that govern how and when this may occur, and who might have access to do so, will vary greatly depending upon the type of product and the circumstances of use.

Some attendees proposed a scenario whereby anyone can read or query the information but only a few have permission to write new information. In some cases that arrangement may be eminently sensible. But it's not hard to envision certain other use cases where the rules might vary. For instance, in health care, regulations require that access to read records must be limited strictly to authorized users. Alternatively, in the case of automobile repairs and modifications, users or aftermarket body shops might need to add new data to the history of the product. All of this points to the need to carefully identify the problem to be solved, and construct a set of validated use cases, before implementing a technology solution.

The Inaccurate Data Problem

A data management executive at a leading retailer pointed out that inaccurate data is one of the primary reasons for returned merchandise in ecommerce. Google's Rob Rekrutiak posed the question: "Whose role is it to establish the integrity of the system?" He considers inaccurate product data to be the most difficult UX design challenge in the world.

Rob Rekrutiak breaks the problem into two parts: "The first is around creation/logging of the data—while we can create a globally unique number as an identifier, we need to 'tag' it on a product and that requires interaction with the physical world—how we address things like 'label' creation, application, granularity, collection of data, etc. given that this could be widely distributed across a wide range of contexts/capabilities ranging from highly automated factories to low-skill workers on a rural farm.

"The second is around the degree to which all downstream product experiences are impacted by the quality/completeness/accuracy of this data—the more sophisticated we want to get with an "experience" the more we must have quality/completeness/accuracy," Rekrutiak explained. "We have a hard enough time today creating a product page with accurate descriptions, attributes and variants because of the first problem—and that's just simple display, what if we want to support traceability a la our asparagus example or our use case demands something immersive like AR/VR? These can only exist with the data."

What do the biggest online retailers want? Findability, credibility, valid credentials, verifiable claims, and most importantly, accurate product descriptions.

The Standardized Description Problem

In general, everyone agrees that a GS1-issued identity should consist of more than just a number. Many attendees believe that the GS1-issued number should also serve as an address that points to a digital history or digital description of the product. This digital metadata is intrinsic to the concept of hybrid physical-digital identity: Ryan McManus of EVRYTHNG calls it "the cloud half" of every product.

Most attendees agreed that the best time to capture this metadata is when someone is applying for a GTIN. Anyone who wants to obtain a GTIN should be obliged to enter an agreed-upon set of attributes into GS1 US Data Hub® (which is free of charge).

But what are the common attributes? Nobody seems to agree. It is difficult to get consensus on even the most basic set of minimum-level attributes.

One complicating factor is that this minimum set of attributes will vary by industry and even by product type. Consider the immense diversity contained within this list of basic attributes if we attempted to unify the following fields across disparate product types, such as automotive, food, electronics, apparel, and appliances.

- Product photos: size, resolution, file format
- Text description: long and short description, word count, text format
- Physical dimensions of the product (see note about fashion below)
- Ingredients or components: ethical sourcing
- Compatibility with other products
- Compliance with government regulation
- Color

Amit Menipaz of Ebay noted that GS1 missed an opportunity to acquire accurate product descriptions. By issuing prefixes without requiring manufacturer to declare what product is assigned to it, GS1 missed the chance to compile accurate metadata.

"Physical world identity for all GS1 identifiers ever issued are complete," said Divyabh Mishra of CrowdANALYTIX, "What needs fixing is the virtual identity. To do so, we need to retrospectively add 8-10 product attributes representing the virtual product to the database of all GTINs ever issued and then continue the process of maintaining a virtual signature of all future products for which GTINs are issued. It's a daunting task but one that needs to be done before we think of any of the more futuristic stuff."

GS1 US Data Hub currently has descriptions for 17 million items. It may not be comprehensive, but it's a start. How might we increase the number of products with complete descriptions in this database? One way to greatly increase this number is for online marketplaces to require merchants and manufacturers to provide complete and accurate descriptions in Data Hub before accepting a new product listing.

In support of this idea, Amit spoke about a soft enforcement policy whereby a marketplace would not accept a new listing for an item unless it was "activated" by GS1, meaning that at least the fields for basic product attributes were completed. Of course, other marketplaces would still need to reach an agreement on those basic attributes before this approach could be widely adopted.

The Brand Differentiation Problem

There is a natural friction between building a unique brand identity and participating in a standards-based system of description and attribution. Consider the designer fashion industry where garment size and fit is frequently unique to a particular brand. For example, the "Calvin Klein" cut is part of the brand identity, and that brand would resist fiercely any attempt to standardize fit and size with other design labels. There's no way to compel a designer to conform to standard sizing or cut. The same is true of colors. Differentiated hue and tone is a distinct brand attribute, as are the words used to describe these colors.

The Fugitive GTIN Problem

Re-use of GTINs is also a problem. Today, there is no mandatory compliance procedure. A manufacturer who obtains a GS1 prefix is under no obligation to use the GTIN consistently or uniformly. In some cases, manufacturers re-use GTINs for multiple SKUs. This can create havoc further down the supply chain.

The Slotting Fee Problem

One goal might be to have a system that will dynamically update all trading partners every time a digital attribute is updated. This could be accomplished with an API to an online repository of data. But this approach would run headlong into *The Slotting Fee Problem*. One reason GTINs are recycled is that manufacturers occasionally need to alter the packaging, label, or ingredients on an existing SKU, but they don't want to pay an additional slotting fee to the retailer. Instead, they slipstream the altered product into the supply chain with the same GTIN instead of submitting it as a new SKU. The problem: if a manufacturer changes a food product ingredient, a customer with allergies might get the wrong metadata or wrong ingredient label.

The Friction Problem

Some attendees pointed out that there's too much friction in the GS1 system for issuing identity. Each prefix costs money. And the process itself may be cumbersome. These participants articulated the need to move towards a new system that enables an affiliate to issue a single-item GTIN.

The Serialization Problem

In the abstract, it's easy to get excited about a world where every item has a unique identity. But in practice, this may lead to extra cost and inefficiency. It's an economic question: how much is a producer willing to spend to serialize a can of soda that retails for $1.25? Serialization introduces a physical bottleneck in the printing process. If a firm is printing labels at scale, it may not be reasonable to expect the printing machines to serialize.

The "Garbage In, Garbage Out" Problem

"AI [artificial intelligence] only works well if we feed it good data," said Amit Menipaz.

Divyabh Mishra of CrowdANALYTIX explained: "Some of the supplier data is not as clean as the retailer would like. When you come to the search engine, you are relying on the data in order for that search to be successful. Inaccurate data is one of the biggest causes of product returns. Identity is only one aspect. A bundle of attributes can be an identifier. In some cases, the GTIN cannot be trusted (see "Fugitive GTIN" above). Cleaning it up manually doesn't scale. AI enables a speedup of the process."

In other words, CrowdANALYTIX is using AI to clean up inaccurate data so that it can be more useful for AI and automation.

The Workflow Problem

Menipaz offered a simplified version of the workflow problem: "Inside a company with a closed vertical supply chain, the product design team creates the product, and then the marketing team creates the metadata. But then the product is sent to the logistics department, where they don't care about the metadata. They just put a U.P.C. on it and now that product can be tracked through the supply chain. And the product identity resides in a legacy logistics system that has no place for rich metadata."

The Arbitrary Metadata Problem

Menipaz explained that there's an opportunity for manufacturers and wholesalers to self define their standards for product description and metadata. They need a standard way of definition. "The metadata can be totally arbitrary," he said, "but they need to tell us what it means."

The Future Partner Problem

Menipaz offered one more design criterion for the hybrid identity concept: "We need to come up with a system that can self-propagate across an ecosystem with parties that don't know in advance they'll be working together."

5 Blockchain: Ready for Primetime?

Blockchain, the distributed ledger technology that was originally developed as a mechanism to facilitate "trustless" e-cash exchanges between two anonymous parties using the digital currency Bitcoin, has found a new role beyond cryptocurrency. In 2013, blockchain was reconceived as the "missing trust protocol" that could facilitate exchanges of all sorts of goods and services, real or virtual. And thus, began a mad scramble as hundreds of startup firms attempted to apply blockchain to use cases far beyond the confines of cryptocurrency.

Hundreds of new startup ventures based on novel applications of blockchain have emerged in a wide range of industries, including: asset management; media and advertising; infrastructure and development; computing and storage; crowdfunding and lending; healthcare and insurance; payment and banking; and financial services.

CB Insights recently released a survey of industries where blockchain might be applied. Beyond the obvious cases, such as banking and payments, these include: cybersecurity, education, voting, car leasing and sales, networking, forecasting, content IP rights, ride sharing, stock trading, real estate, insurance, healthcare, supply chain management, cloud storage, energy management, sports management, loyalty programs, government and public records, gun tracking, wills and inheritance, retail, law enforcement, human resources, business and corporate governance, credit histories, 3D printing and manufacturing, and crowdfunding.

Some blockchain advocates define their mission in language that borders on utopian. "Through blockchains and cryptoeconomics, the time and complexity of developing trust is abstracted away, which allows a large number of people to collaborate and share in the profits of such collaboration without a hierarchical structure of a traditional firm." It may sound great in the abstract, but how does this apply to a traditional firm with a hierarchical structure in a mature industry?

Some proponents maintain that blockchain may ultimately displace neutral issuing authorities like GS1: "With blockchain and smart contracts, it's possible to implement a registration system for product identifiers without a trusted third party like GS1. The Ethereum Name Service (ENS) has already shown how this concept can work for domain names."[3]

But many of the attendees at the GS1 US meetings expressed skepticism about blockchain claims. Howard Lau of Crytopwerk complained about "blockchain hype about smart contracts." Susan Ramonat of Spiritus Partners believes that "Many blockchain applications are intended for a machine-to-machine world. That world is in the future, not today."

Daniel Buchner of Microsoft argued that "99 percent of what people think they can do with blockchain is wrong." In his view, "Blockchain is essentially a routing mechanism for trust. Blockchain has a core competency: it is a decentralized private key infrastructure." Buchner believes that blockchains can provide identifiers and DPKI better than any alternative. This informs his work at Microsoft's Decentralized Identity Foundation.

Buchner explains, "We are working on ways that will enable large scale public blockchains (including Bitcoin) to run at performance levels required for use in supply chain and other verticals. By using Layer 2 protocols, we can create virtual layers above the chain that operate just as fast as traditional systems. These Layer 2 techniques will preserve the unique attributes of high-immutability public blockchains, while serving the demands and requirements of downstream users/organizations.

The attributes of the first-generation blockchain are unsuitable for many supply-chain situations:

- 51 percent attack: Blockchain depends upon sufficient adoption to function properly. But this approach might not work in an industry ecosystem with few participants because the necessary scale might never be achieved.
- Transaction costs: Network speed slows significantly as more transactions per second are recorded.
- Irreversible: There is no way to reverse a mistaken trade. Immutability is not always desirable.
- Transparency: Public ledgers can create confidentiality problems in certain fields. If the identity of a trading partner is known, then one can see their other transactions in the past and in the future.
- Interoperability: Blockchain does not address semantic standardization within the transactions. Additionally, various Blockchain solutions will have to become interoperable for the technology to scale.
- Data storage: The limited block size of all conceivable blockchains makes it impossible to store whole medical images and similar large files. However, if the "data stays put, then it is not made immutable by a blockchain index, nor redundant, and thus the siloed and expensive current arrangements will persist. Blockchain doesn't even make records more accessible."[4]

3 "Barcodes on the Blockchain" Medium post by Rich McAteer, September 18, 2017.

4 "How Healthy is Blockchain Technology?" by Stephen Wilson and David Choe, September 13, 2017.

- Key management: The original incarnation of blockchain technology dispensed with key management. People were able to exchange digital currency reliably without needing to know anything about each other, and with no dependency upon administrators or regulators. “But when we do need to know who’s who in a health system (at the very least to be sure all the caregivers, researchers, insurers, and patients are properly authorized) then key management has to be part of the security system.”[5]

Many companies are currently working on modifications to blockchain that will address these concerns. However, as first-generation blockchain blends with conventional systems and legacy supply chains, some of the unique benefits of blockchain may be lost, such as immutability and decentralization.

As Wilson and Chou note in their whitepaper, “How Healthy is Blockchain Technology,” newer Synchronous Ledger Technologies, designed to improve upon these aspects of the original Bitcoin blockchain, offer solutions to some of these problems. R3 Corda, Microsoft’s Blockchain as a Service, Hyperledger Fabric, and IBM’s High Security Blockchain Network “involve orchestration of data streams being contributed by multiple parties (often in “coopetition”) with no one leader or umpire. Like the original blockchain, these ledgers are much more than storage media; their main benefit is that they create agreement about certain states of the data.”

The development of next-generation blockchain applications in the supply chain will continue to be a lively area of innovation and therefore will continue to be a focus of GS1 US.

5 Op.Cit. Wilson and Chou

About the Author

Robert Tercek is a consultant and an award-winning author. He provides strategic insight and advice on digital transformation to multinational firms and government agencies. Throughout his 25-year career, he supervised the design and deployment of several breakthrough digital services, including the world's first video on mobile phones, the largest live online learning programs, and the first online games and mobile games. He served in senior executive leadership at Oprah Winfrey Network, Sony Pictures Entertainment, and MTV. His book, "Vaporized: Solid Strategies for Success in a Dematerialized World," was selected as the 2016 International Book of the Year by GetAbstract.

Participants in the GS1 US Fall Dinner Series included:

- Chris Bailey, Bailey Brand Consulting
- Daniel Buchner, Microsoft
- Bob Carpenter, GS1 US
- David Frazee, 3M Company
- Rich Grant, Touchdown Ventures
- Howard Lau, Cryptowerk
- Ryan McManus, EVRYTHNG
- Amit Menipaz, eBay
- Andy Milburn, uNET
- Divyabh Mishra, CrowdANALYTIX
- Melanie Nuce, GS1 US
- Michael Okoroafor, McCormick & Company
- Susan Ramonat, Spiritus Partners
- Rob Rekrutiak, Google
- James Rowley, Gliffy
- Stacey Shulman, Intel
- Lisa Sullivan, Ketchum
- Alison Tirone, Pilot44 Labs

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