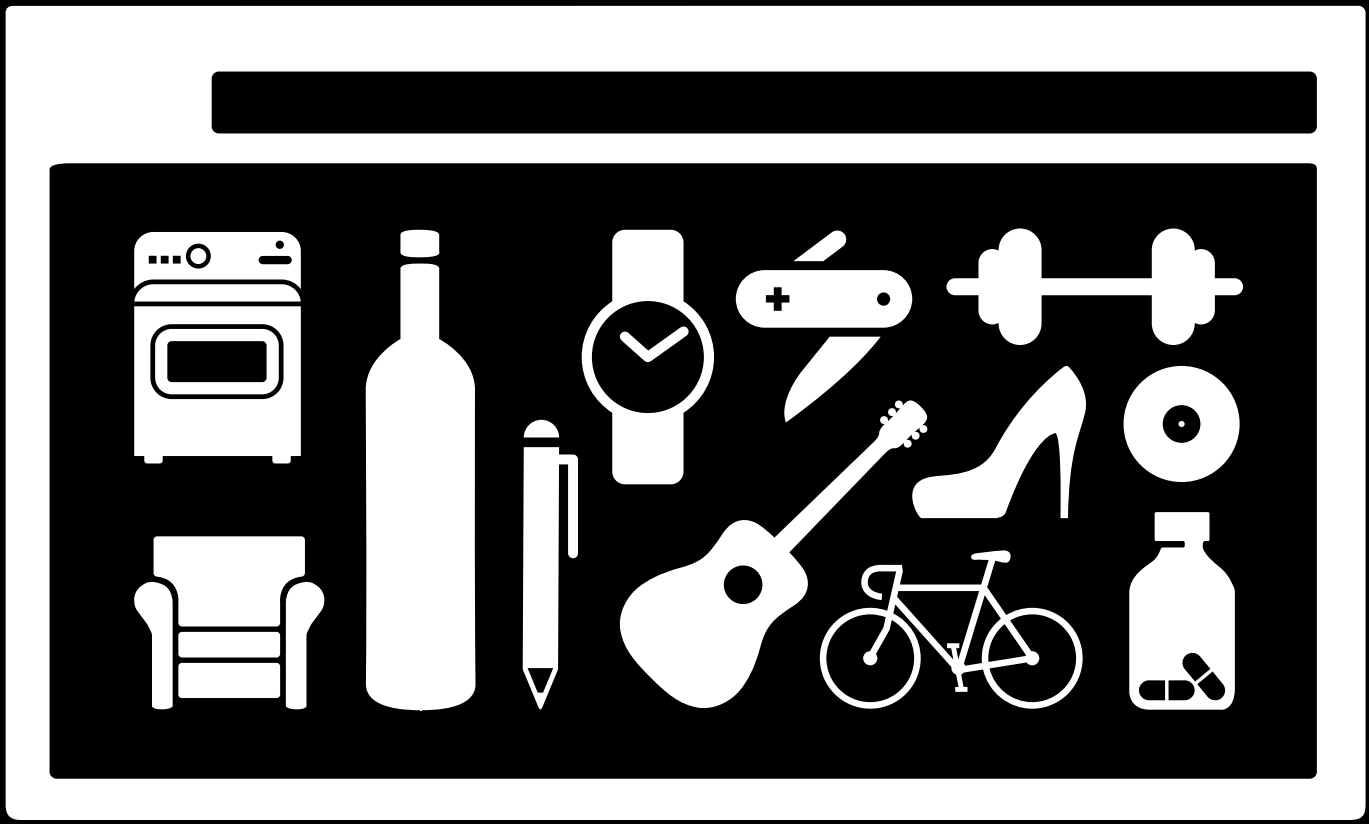
White Paper

EVRYTHNG™

MAKE PRODUCTS SMART

EVERY THING CONNECTED

How Web Object Technology Is Putting Every Physical Thing On The Web



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Every Thing Connected

The 'Internet of Things' – a term first used by technology visionaries at the AUTO-ID Labs at MIT in the 90s[1] – has received great attention in the past five years. Dramatic cost reduction and capability advances in embedded system, radio frequency tags and sensor devices, combined with increasingly pervasive and commoditizing mobile Internet access availability have at last made it a concrete possibility.

Intelligence that can now be built in to physical objects directly with embedded systems, or provided by proxy through tags and scanning devices – be they industrial or consumer mobile devices – makes it possible for physical objects to **sense** the world around them, **analyze** data in real-time, **share** data gathered and information derived and **action** their behavior based on information or instructions fed to them.

While the enabling technologies for physical object connectivity, computation and interactivity may be widely available, it is of course applications that create the real value. And it needs to be rapid and straight-forward to develop applications working with information flowing to, from and about a diverse set of physical objects, in a rich application environment.

Enterprise Web Services standards (known as WS-*) were developed with the objective of facilitating the design and deployment of interoperable, distributed applications. In practice the complex suite of well over fifty WS-* standards were a barrier to progress, leading to an environment where 'Intranets of Things' have emerged. These closed networks of physical objects dedicated to a single application or single enterprise's application portfolio, make the cost of interoperability with third parties and third party applications too high to make development scalable.

The Web As The Network for Things

In envisaging how the physical objects can more easily become part of the Internet, how their information can be networked, and how applications can be developed rapidly and flexibly, such requirements might be summarized as having to be:

- **Lightweight** – with an ability to be used on embedded devices with minimal memory and processing power available, and indeed with physical objects with no connectivity at all;
- **Flexible** – with support for a large set of interaction patterns and therefore able to maximize application creativity and diversity of data exchange;
- **Scalable** – with billions of objects talking to each other, sending millions of messages per second;

[1] Kevin Ashton:
'That 'Internet of Things' Thing.
In: RFID Journal, 22 July 2009.

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- **Loosely coupled** – so there is no impact on the system if nodes from the network disappear, and any element can talk to another with minimal or no prior knowledge; and
- **Standard** – to ensure maximum leverage of the tools, services, and best practices built by the community.

Simple technologies like HTTP have given birth to a very efficient and flexible application ecosystem in the Web, where a large variety of hardware and software platforms coexist and interact smoothly. Open access to data through services on the Web has enabled information to be reused across independent systems and therefore lowered the cost and barriers to application development. The 'Web 2.0[2]' application environment then focused on bringing together the diversity of user-generated content and a set of technologies (e.g. AJAX, RSS) that support highly interactive interfaces for rich user experiences.

The next step for the 'Internet of Things' is to bring physical objects online, extending the Web to reach into the real world and enabling physical objects to reach into the Web and become part of its application environment. In this Web of Things™, applications can be developed on top of the open and simple standards that made the Web so successful (REST, XML, HTTP, Atom), and physical objects can 'speak' the same language as other resources on the Web – making them as easy to integrate as any other Web content. By becoming connected, real-world objects become first class citizens on the Web, linkable, discoverable, searchable, and therefore usable.

Physical Things As Web Objects

The Web of Things™[3] sits above the transport layer of connectivity (e.g. TCP/IP) and at the application layer. It is concerned with what things say to each other and how to interpret the content of those communications. This abstraction removes issues of how objects are connected from consideration in how applications are designed and developed. In the Web of Things™, applications manipulate object data on the Web, using HTTP requests at various URLs and other Web standards.

In order to create the Web of Things™, data about physical objects must be accessible on the Web and behave in the same way as any other resource on the Web – be it a Web site in HTML or a Web API that returns JSON or XML data. Every physical object needs to have an active, individual presence on the Web to integrate with existing Web applications. This presence on the Web for a physical object can be provided through a **Web Object**.

[2] http://oreilly.com/web2/archive/what-is-web-20.html

[3] http://en.wikipedia.org/wiki/Web_of_Things

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To be of maximum valuable to other applications, the Web Object representing any physical object needs:

1. A URI that makes it accessible on the Web
2. A secure, RESTful Web API (HTTP) that makes it possible to read/write data to and from it
3. A semantic annotation format for machine-readable metadata
4. Capacity to store large amounts of historical data about itself
5. Computational capability to operate as an application service
6. Access Control, Authentication and Authorization to define who and how it can be interacted with

With these attributes, capabilities and functionalities, the Web Object is able to provide applications with an online interface to the physical object that it digitally represents. Applications can transact with Web Objects using standard Web application development technologies without worrying about how the physical object is actually connected to the Internet. The physical object itself may be connected to its corresponding Web Object - the avatar representing its physical existence online - by a variety of connector methods, including HTTP over TCP/IP, via scanning applications where the object is identified with a QR code or an NFC tag, or via gateways for devices connected via Bluetooth, Zigbee and similar protocols.

The Web Object now becomes a proxy acting on behalf of the physical object. Data from the object, which may be occasionally or intermittently connected, can be accessed consistently via the Web, while substantial amounts of data can be stored from and about the object – much more than the object may be able to store itself. Indeed, the Web Object can augment the physical object with active functionality substantially greater than could be accommodated on the object itself, benefiting from the economies of the Cloud[4].

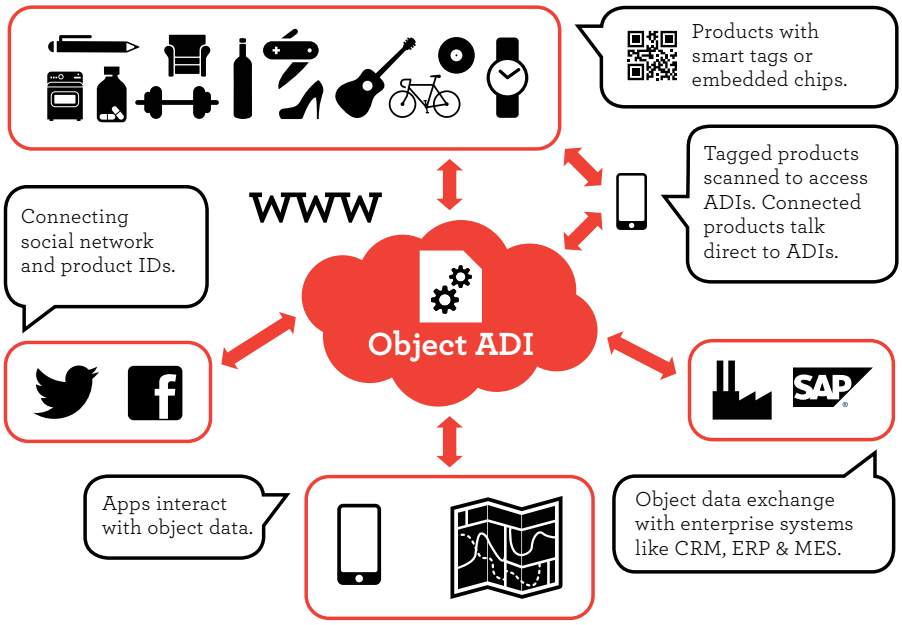
An Active Identity For Every Thing On The Web

With Web Objects making it possible for applications to interact with physical objects in the same way as other content resources on the Web, the next critical question is how to identify them. Identity, and uniqueness of identity, is vital for each physical object to be discoverable on the Web – it must be possible to distinguish one car from another, for example.

EVRYTHNG is a software company which provides Active Digital Identities™ – unique Web Objects associated with designated physical items, each with

[4] http://en.wikipedia.org/wiki/Cloud_computing

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its own global URL – and provided in a infrastructure on the Web through the EVRYTHNG Engine with computational and information storage capacity scalable to billions of objects.

Active Digital Identities™ realize the Web of Things™ vision, and make it straightforward for any physical object to instantiate a Web Object identity for itself, providing a persistent and unique presence on the Web available to any application authorized to access it.

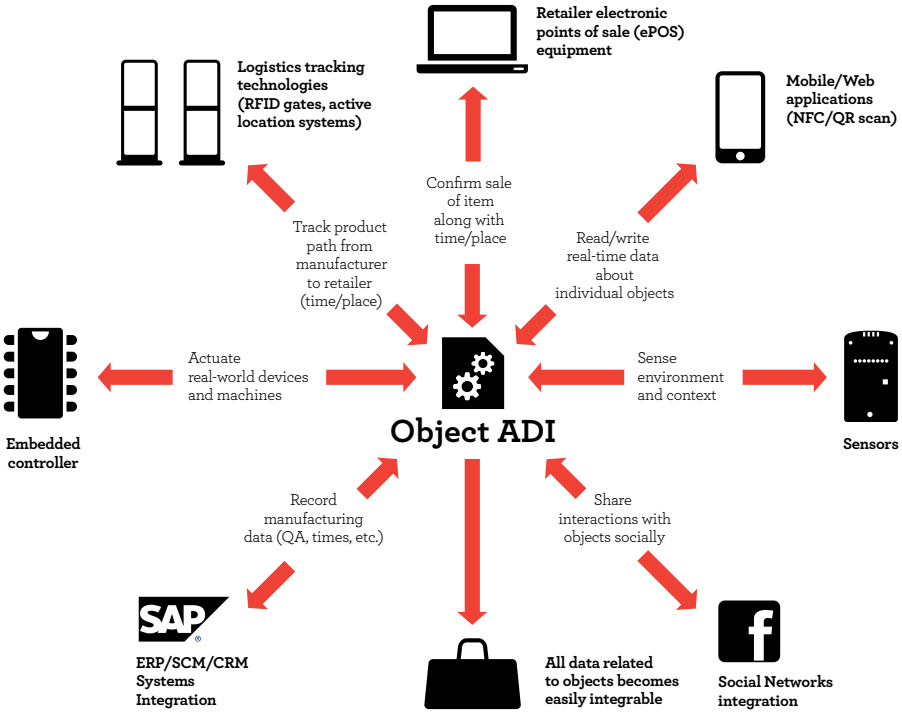
For unconnected objects to actually bind the digital identity of an object with the physical item, the URL of the object's ADI can be encrypted in a physical tag to uniquely identifying that object – for example, a unique QR code or NFC tag acting as a pointer to the ADI on the Web. The ADI can then manage application delivery to a user scanning the tag, subject to business rules encoded in the ADI. For connected objects, lightweight connector software running within embedded systems communicate directly with the object ADI using Web protocols.

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Rapid Application Development With Physical Mashups

With real-world objects as Web Objects, each with their own Active Digital Identity™ on the Web, applications can apply, link and integrate physical things as flexibly as any other content on the Web.



While traditional Enterprise Resource Planning (ERP) application development has involved complex systems design and development processes to produce special purposed applications, Web 2.0 application development technologies operate in an agile context where applications are formulated by linking variant, active data elements very dynamically, and very rapidly.

The Active Digital Identity™ for a physical object has semantic capabilities, and can deliver standard metadata descriptions that allow applications to understand and use the object data.

Managed as a Web Object in a software development process, physical objects can be readily linked to other Web resources and entities such as social network identities, CRM records, content assets, asset identities in ERP systems and soforth. Using tools such as visual editors, applications combining very diverse elements from the Web can be linked with relevant computational rules, algorithms and triggers to rapidly create powerful applications.

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Mashups, a new form of application development that combines diverse data resources on the Web like, say, images from Flickr, hashtags from Twitter, and geo-location tags from FourSquare, are combined to create visualizations with Google Maps or Wolfram Alpha, defined and demonstrated the potential of Web 2.0 technologies for rapid application development. Using Web Objects, in the form of Active Digital Identities™, to represent physical things online, means that real-world objects have now also become a part of this mashup development environment.

Making Products And Other Physical Objects Smart

Web Of Things™ and Web Object technology, provided through Active Digital Identities™ and the EVRYTHNG Engine make it possible to connect products and other objects – enterprise assets for example – with the Web. And by doing this, make it possible to augment them with digital services, capture analytics from them and how they're being used, and link these objects with other digital resources. By adding a tag, be it a QR code or an NFC tag encoding a simple URL for the objects online identity, any physical product or asset can become part of the Web of Things™.

The Web is the global integration platform, and open Web application development technologies make it possible to rapidly deliver innovative applications, be they for customer engagement, logistics, analytics or other purposes. EVRYTHNG's technology, platform and application services make this available today.

Use EVRYTHNG:

- Get started immediately, setting-up Active Digital Identities™ for physical objects with the EVRYTHNG Engine.
- Access EVRYTHNG's developer resources at **http://dev.evrythng.com**

Work with EVRYTHNG:

- Access application services, tools and support to create your application.
- Contact **sales@evrythng.com** and we'll be happy to help.

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Learn More About the Web Of Things™:

- Visit **http://WebOfThings.org** to join a community of academics and tinkerers.
- Learn about the REST Web protocol: **http://www.infoq.com/articles/rest-introduction** and **http://www.vs.inf.ethz.ch/publ/papers/dguinard-fromth-2010.pdf** and **http://www.vs.inf.ethz.ch/publ/papers/dguinard-things-2010.pdf**
- Other perspectives on the Web Of Things™: **http://discover.coverleaf.com/discovermagazine/20110708?pg=24** and **http://www.innovationexcellence.com/blog/2012/10/03/co-creation-and-the-new-web-of-things/** and **http://www.webofthings.org/publications/**

About EVRYTHNG.

EVRYTHNG is a Web of Things software company, making products smart by connecting them to the Web. Companies use EVRYTHNG's software-as-a-service to manage their connected products, make product operations smarter with real-time tracking analytics, and help their customers connect to products in a smarter way.

The EVRYTHNG Engine helps companies to manage billions of intelligent online identities in the cloud for their products. World-leading manufacturer and retail brands work with EVRYTHNG to operate applications linked to individual items as they are made, sold and used, making their supply chains smarter and connecting products more cleverly to people's lives.

To find out more about how EVRYTHNG is enabling the Web of Things today by powering the next revolution in product operations and customer interaction, please visit www.evrythng.com and follow @evrythng.

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