IPv6 vs EPC

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What’s the beef?
RFID overview
EPC specification
IPv6 overview
IPv6 & EPC comparison
Final thoughts
What’s the Beef?

IF

the EPC is not adopted as a global standard for unique item identification

THEN

IPv6 is an ideal alternative candidate

ASSERTION

- Can IPv6 replace EPC as a unique (physical) item identifier?
- And (just for fun), can the EPC be used as a network interface address?
- And, are there other ways to skin the cat?
Standards-based RFID

- Item (pallet, case, container, product)
- Passive RFID tag with unique electronic product code (EPC)
- Reader system
- EPC + sensor data
- Applications: Savant, ONS, EPCIS

NOT limited to supply-chain market
Electronic Product Code (EPC)

- The EPC is a unique number to identify physical objects
- The EPC has a particular form and structure that facilitates uniqueness, number management and information referencing
## EPC 1.0 Specification

### GENERAL
- Two EPC versions - 64-bit and 96-bit
- 64-bit is proper subset of 96-bit but with series of compromises
- Focus on 96-bit version here

### HEADER (8 bits = 256 unique combinations)
- Identifies the length, type and structure of the EPC
- EPC specifies a generic **Universal Identifier** and a set of **Domain Identifiers** to accommodate existing numbering systems
- EPC 1.0 specifies one Domain Identifier - the EAN.UCC.GTIN number

### MANAGER (28 bits >268m)
- Company, manager or organization (entity) responsible for maintaining the numbers in subsequent partitions (class and serial#)
- The MANAGER numbers assigned by EPCGlobal to entity and ensures it is unique

### CLASS (24 bits >16m)
- Used to identify a unique CLASS of things

### SERIAL# (36 bits >68bn)
- Non-repeating serial numbers for every instance within each object class code

\[
\text{= 1.1 \times 10^{18} unique items per entity}
\]

Source: EPCGlobal, Inc.
### 96-bit EPC UNIVERSAL IDENTIFIER

<table>
<thead>
<tr>
<th>Field</th>
<th>Length</th>
<th>Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>header</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>manager</td>
<td>28</td>
<td>28</td>
</tr>
<tr>
<td>class</td>
<td>24</td>
<td>24</td>
</tr>
<tr>
<td>serial#</td>
<td>36</td>
<td>36</td>
</tr>
</tbody>
</table>

### 96-bit EPC EAN.UCC.GTIN DOMAIN IDENTIFIER

<table>
<thead>
<tr>
<th>Field</th>
<th>Length</th>
<th>Bits</th>
</tr>
</thead>
<tbody>
<tr>
<td>filter value</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>partition</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>header</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>company prefix</td>
<td>37 - 20</td>
<td>37 - 20</td>
</tr>
<tr>
<td>item reference</td>
<td>7 - 24</td>
<td>7 - 24</td>
</tr>
<tr>
<td>serial#</td>
<td>38</td>
<td>38</td>
</tr>
</tbody>
</table>

*Source: EPCGlobal, Inc.*
IP version 6 (IPv6) is a new version of the Internet Protocol

Changes from IPv4 to IPv6 fall into the following categories:
  - Expanded Addressing Capabilities, Header Format Simplification, Improved Support for Extensions and Options, Flow Labeling Capability, Authentication and Privacy Capabilities

IPv6 addresses are 128-bit identifiers for interfaces and sets of interfaces

Source: RFC 2460
From IPv4 with ~4 billion (4 \times 10^9) addresses to IPv6 with ~3.4 \times 10^{38} addresses
How It Works

Applications

- **API**: Savant
  - EPC readers
  - EPC + sensor data
  - EPCs to URL addresses
  - Filter, transform, and aggregate EPCs

- **API**: Object Name Service (ONS)
  - EPCs -> w.x.y.z
  - Resolve EPC to URL address

- **API**: EPC Information Service (EPCIS)
  - goto w.x.y.z
  - Read/write EPCs and item data

- **API**: read/write EPCs
**Resolve EPC to a URL**

1. A sequence of bits containing an EPC is read from an RFID tag
   
   0100001000001110000000000000000011111000000000000011010000000000000000110101000000000001

2. The RFID tag reader sends that sequence of bits to a local server
   
   0100001000001110000000000000000011111000000000000011010000000000000000110101000000000001

3. The local server converts the bit sequence into the URI form and sends it to the local ONS Resolver
   
   Urn:epc:1.2.24.400

4. The resolver converts the URI form into a domain-name and issues a DNS query for NAPTR records for that domain
   
   24.2.1.onsroot.org

5. The DNS infrastructure returns a series of answers that contain URLs that point to one or more services (eg. an EPCIS service)

6. The local resolver strips the URL from the DNS record and presents it back to the local server
   
   http://pml.example.com/pml-wsdl.xml

7. The local server contacts the correct PML server found in the URL for the EPC in question

*Source: EPCGlobal, Inc.*
## IPv6 vs EPC Comparison

<table>
<thead>
<tr>
<th>Feature</th>
<th>IPv6</th>
<th>EPC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Objects to identify</td>
<td>Network interfaces</td>
<td>Physical objects</td>
</tr>
<tr>
<td>Primary application</td>
<td>Routing address</td>
<td>Pointer to information</td>
</tr>
<tr>
<td>Address allocated by</td>
<td>Network manager</td>
<td>Item manufacturer</td>
</tr>
<tr>
<td>Unique identifier</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Identifier length (bits)</td>
<td>128</td>
<td>64, 96, other</td>
</tr>
<tr>
<td>Can identifier change?</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Area of difficulty</td>
<td>Mobility</td>
<td>No location information</td>
</tr>
</tbody>
</table>

*Source: Auto-ID Center*
Final Analysis

- IPv6 cannot be used as both unique item identifier and routing address
- EPC cannot be used as both routing address and unique item identifier
- Need both EPC and IP address for item level identification and communication
Some Thoughts

**DOES MATTER**
- EPC rules, okay!
- RFID tag costs are going to come way down especially with non-silicon based tags
- Reader system costs are going to come down too

**PROBABLY DOESN’T MATTER**
- Savant will disappear into vendors middleware
- ONS - a shame it all went to Verisign!
- EPCIS (aka PML) - essentially an XML interface to product databases/catalogs
Tag It!

Think of application/markets outside of the supply-chain

- Is it a physical object?
- If yes, does it have value?
- If yes, does it move?
- If yes, then tag it!
Evolving Web Could Turn Into The Everynet – Investor’s Business Daily

- Coming soon: really high-tech houses, smarter cell phones and everyday objects linked to the Internet.

- What's paving the way? Next Generation Internet (IPv6) … Broadband … Wireless … and …

- RFID: As RFID tags come down in price toward pennies each, it's possible they'll pop up en masse, such as in the care tags on new clothes. That could create a market for washing machines with built-in ID readers.
Next Generation Internet (IPv6) is Happening

The Coming of Internet 6.0 -- MIT Technology Review

- Code for IPv6-enabled network is already built into the current versions of Windows XP, MacOS, Linux, and many forms of Unix.
- Every router made by Cisco Systems Inc. comes ready to run IPv6.
- So does every Nokia Corp. mobile phone.
- The whole world is getting dressed up for the IPv6 party.
IPv6 quadruples the size of the Internet address field from 32 bits to 128 bits, resulting in a massive increase in space.

IPv4 could never supply enough addresses for every human being or objects on the planet.

Asian nations not happy with IPv4. China and South Korea -- with a combined population of more than 1.3 billion -- have been allocated only 38.5 million and 23.6 million respectively.

IPv6 could provide roughly 60 thousand trillion trillion addresses.
Military's RFID Alternative: IPv6

A white paper by ODIN Technologies suggests the U.S. military could use the new Internet Protocol to track items. [http://www.odintechnologies.com/epc_whitepaper.pdf](http://www.odintechnologies.com/epc_whitepaper.pdf)

- If industry does not adopt the EPC system, a potential substitute is to use address space from IPv6.
- Military’s Unique Identification (UID) .. Mapped to IP addresses just as EPC ... Could be less expensive.
- Or, companies could write tag IDs to RFID chip from their IPv6 assignments, which will be managed in a similar method to current IPv4 address assignments.
Neutral and trusted non-profit third parties already manage IPv6 address space at global and regional levels.

The address space is inexpensive.


Military’s Unique Identification (UID) .. Mapped to IP addresses just as EPC ... Could be less expensive.
IPv6 References

   ❖ “Sensors and e-tags on IPv6 platform”. Home Networking technology and Sensor Networking technology - Itaru Mimura
   ❖ “IPv6 enabled portable RFID scanner”. Business to Business and IPv6 - Yurie Rich

❖ Internet of Things – RFID or burnt in IPv6 addresses – Peter Sevcik.
   www.netforecast.com/Articles/BCR%20C29%20Who%20Will%20Control%20Tomorrow.pdf


❖ Tracking via GPS and Geospatial addressing via IPv6.

IPv6 vs EPC

THANK-YOU

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