IPv6 vs EPC

Silicon Valley World Internet Center
February 12, 2004

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What's the beef?

RFID overview

EPC specification

IPv6 overview

IPv6 & EPC comparison

Final thoughts

What's the Beef?

ASSERTION

IF

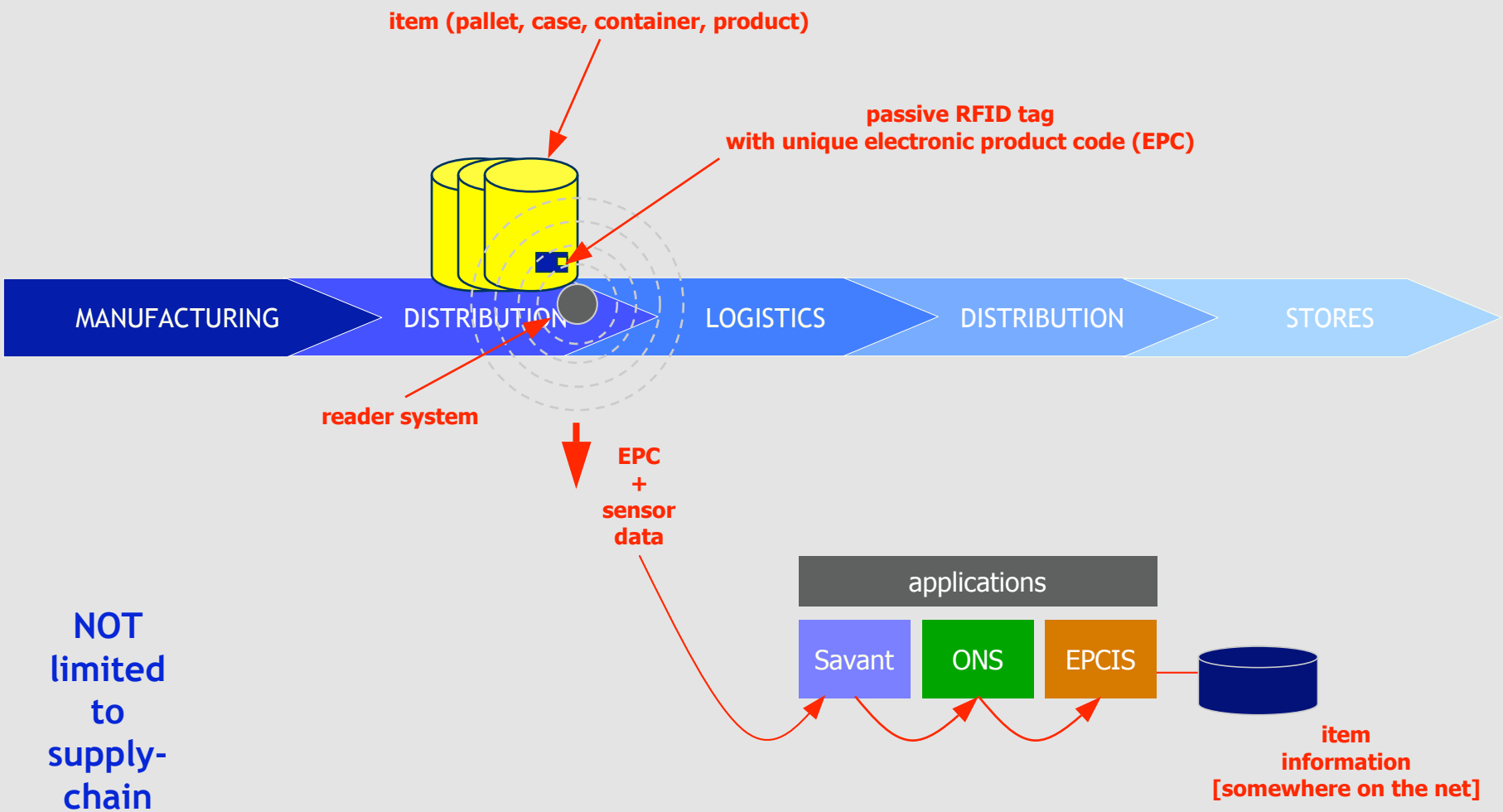
the EPC is not adopted as a global standard for unique item identification

THEN

IPv6 is an ideal alternative candidate

- 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

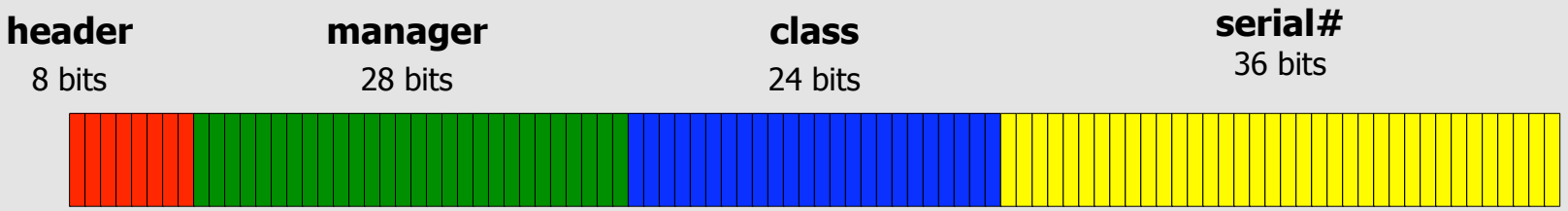


NOT limited to supply-chain market

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 EPCGloabl to entity and ensures it is unique

CLASS (24 bits >16m)

- Used to identify a unique CLASS of things

SERIAL# (36 bits >68bn)

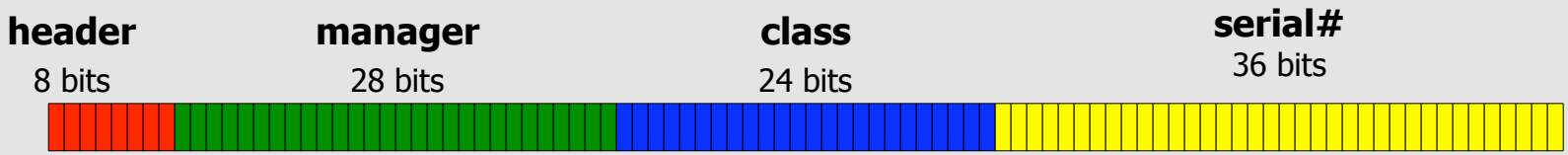
- Non-repeating serial numbers for every instance within each object class code

= 1.1 x 10^{18} unique items per entity

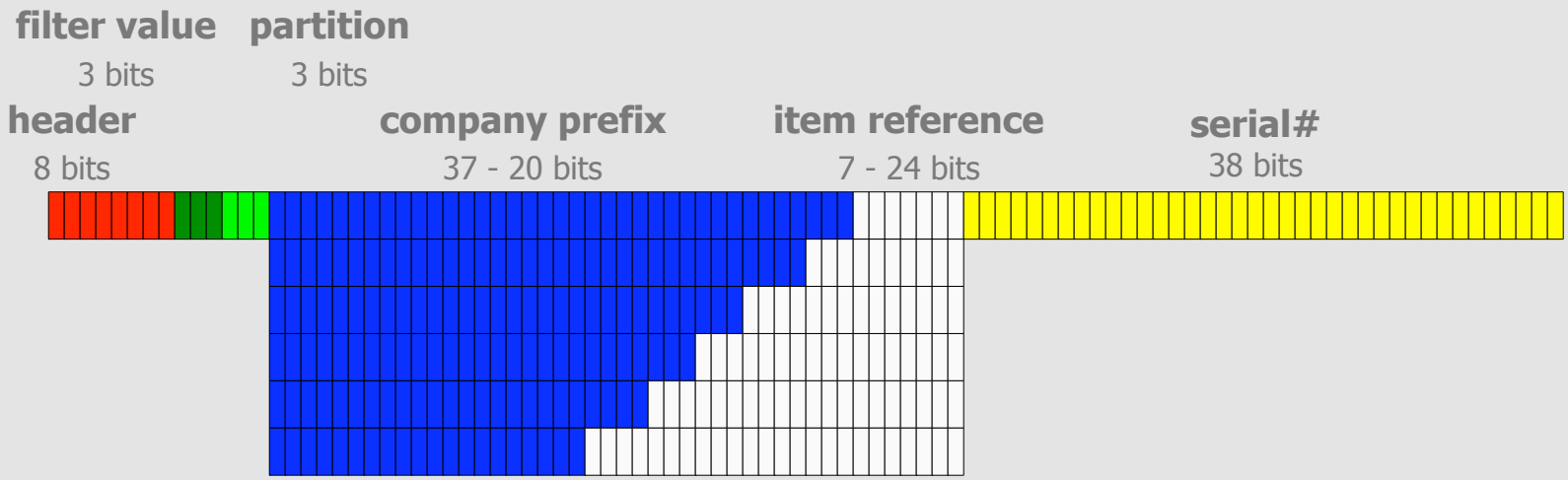
Source: EPCGlobal, Inc.

96-bit EAN.UCC.GTIN Domain Identifier

96-bit EPC UNIVERSAL IDENTIFIER



96-bit EPC EAN.UCC.GTIN DOMAIN IDENTIFIER



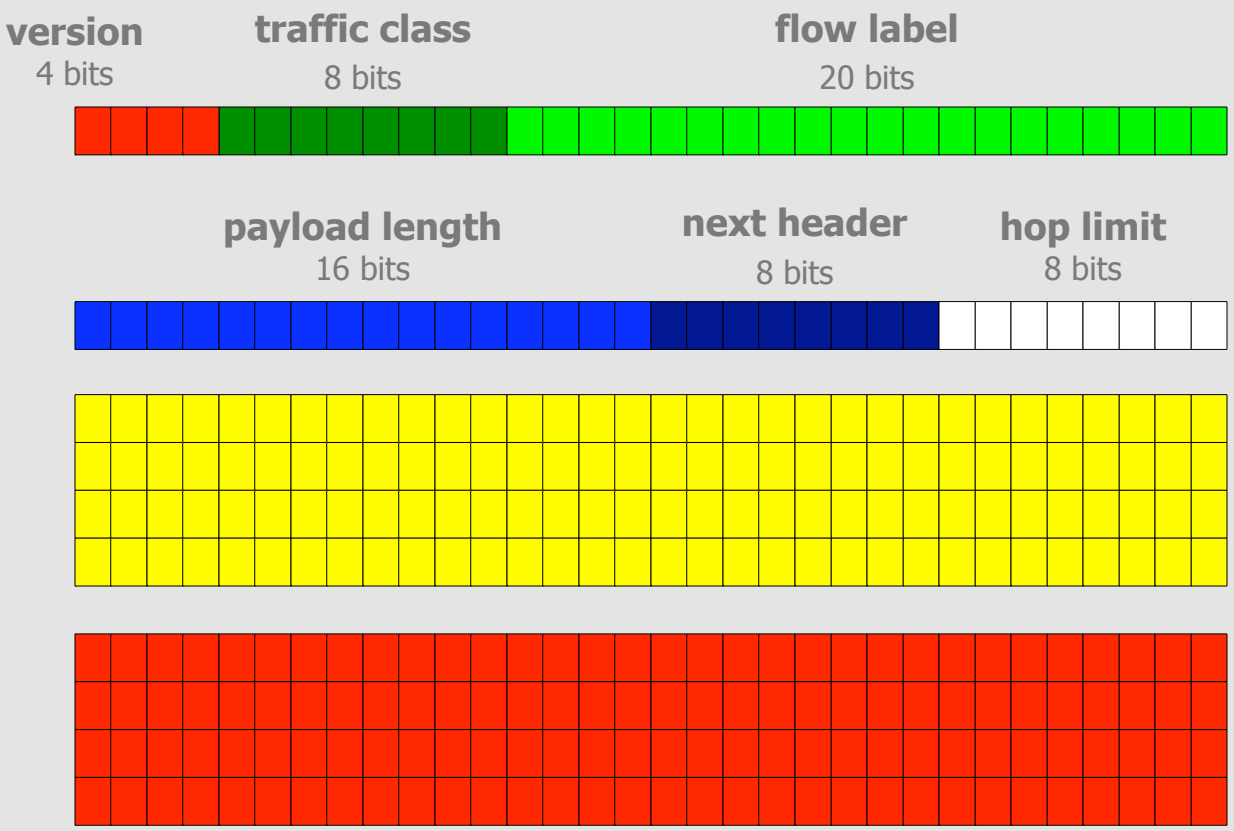
Source: EPCGlobal, Inc.

Internet Protocol v6 (IPv6)

- 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**

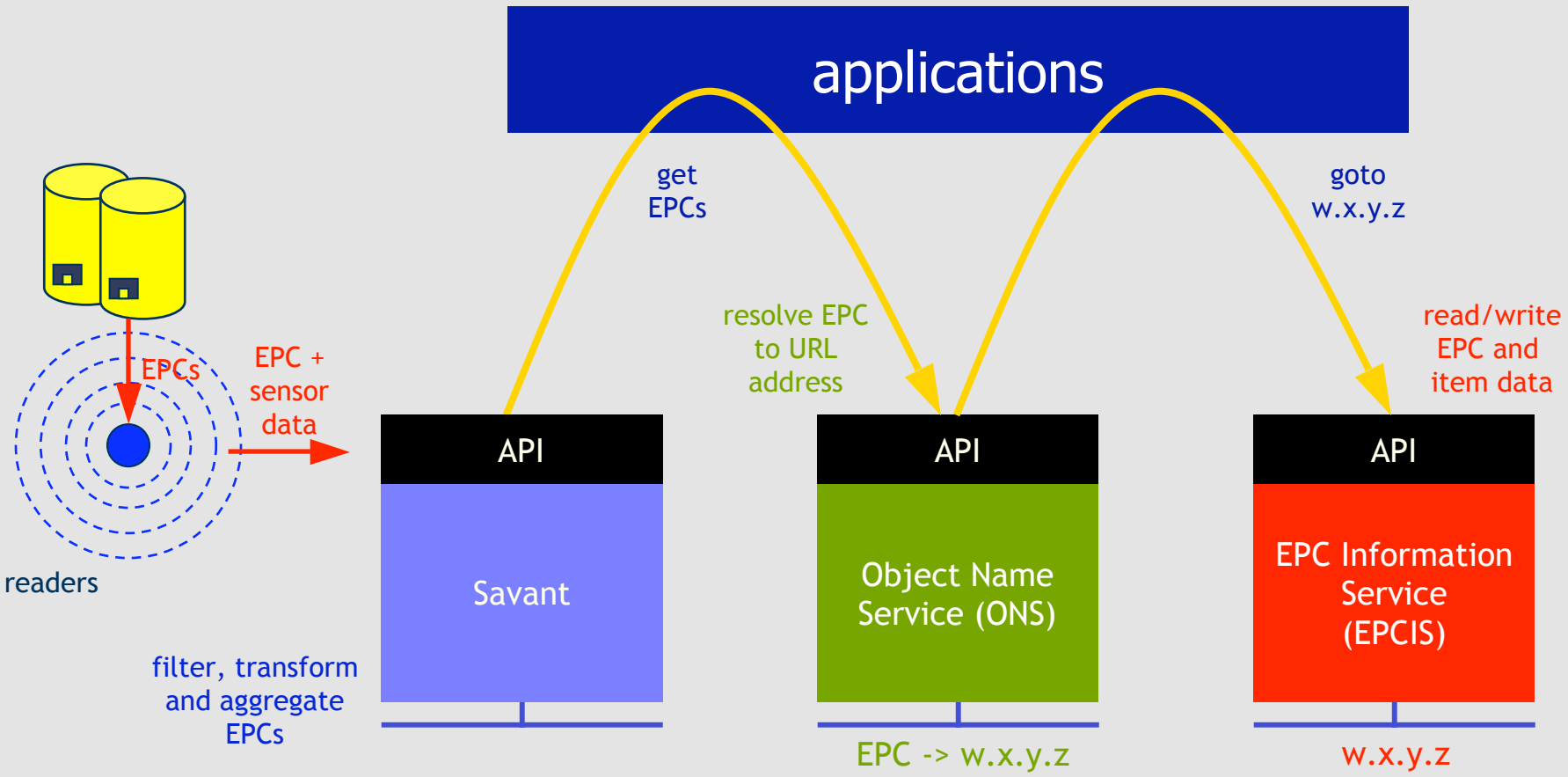
Source: RFC 2460

IPv6 Specification



from IPv4 with ~4 billion ($4 \_ 10^9$) addresses to IPv6 with ~$3.4 \_ 10^{38}$ addresses

How It Works


applications
get
EPCs
goto
w.x.y.z
resolve EPC
to URL
address
read/write
EPC and
item data
EPCs
EPC +
sensor
data
readers
API
Savant
API
Object Name
Service (ONS)
API
EPC Information
Service
(EPCIS)
filter, transform
and aggregate
EPCs
EPC -> w.x.y.z
w.x.y.z

Resolve EPC to a URL

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

   01000001000001100000000000000000000000001111100000000000001101000000000000000011010100000000001

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

   01000001000001100000000000000000000000001111100000000000001101000000000000000011010100000000001

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

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

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!

Internet of Things

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

Next Generation Internet (IPv6): Why?

- 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.

Marketplace Controversy: IPv6 vs. EPC??

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

- 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.

Marketplace Controversy: IPv6 vs. EPC??

- Neutral and trusted non-profit third parties already manage IPv6 address space at global and regional levels.
- The address space is inexpensive.
- Mandates will push IPv6: US DOD's systems to be fully IPv6 compliant by Q4, 2006. Japanese government want Japan-based businesses to be fully IPv6 compliant by Q4, 2005.
- Military's Unique Identification (UID) .. Mapped to IP addresses just as EPC ... Could be less expensive.

IPv6 References

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- Internet of Things – RFID or burnt in IPv6 addresses – Peter Sevcik.
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- ABCs of IPv6 by Cisco. http://www.cisco.com/go/abc
- Tracking via GPS and Geospatial addressing via IPv6.
  www.isr.uci.edu/events/twist/twist99/presentations/gorlick/gorlick.pdf
- PDA with a link to RF-ID tag containing unique IPv6 address by Nokia Japan Co. and Nokia Research Center. http://www.ipv6style.jp/en/apps/20030318/index.shtml

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THANK-YOU

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