# Mobility Through Naming: Impact on DNS

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# Outline

# Research Question

**If DNS is used for ‘rendezvous’ in support of IP mobility, how might DNS be affected?**

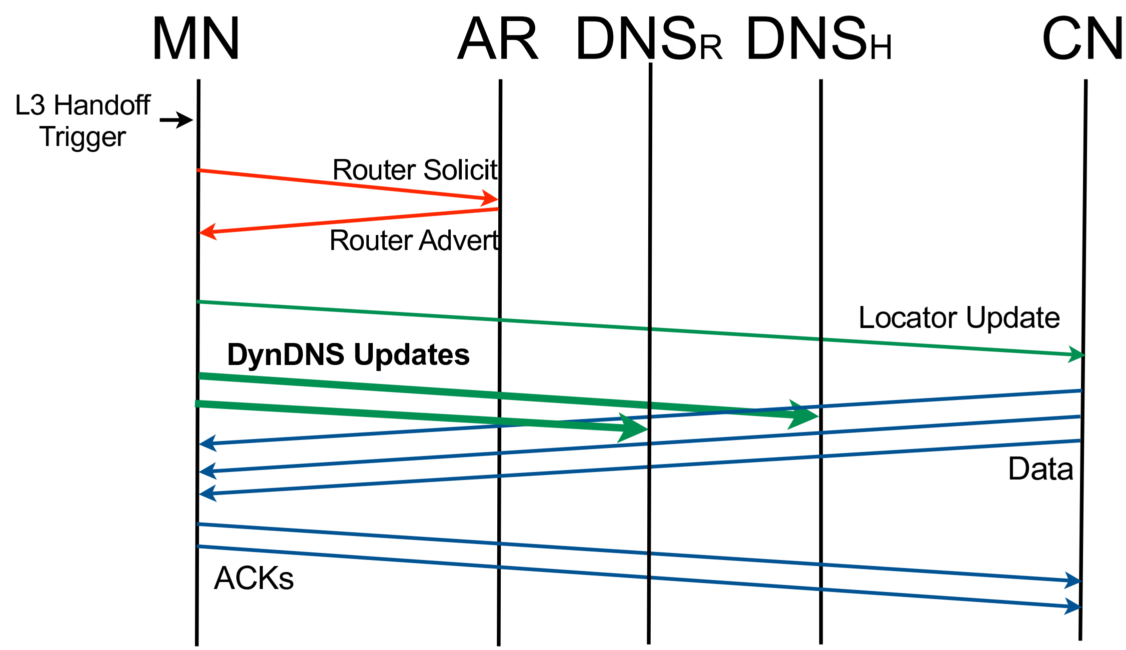
# Concept of Operation

- **DO NOT** name a Point of Attachment (PoA) (i.e an interface)
- **DO** name:
  - an IP (sub-)network – **Locator**
  - a node (host) – **Identifier**
- Applications and users use FQDNs.
- As movement occurs:
  - **Use DynDNS + DNSsec to update Locator value in DNS (‘rendezvous’ for new sessions)**.
  - Send Locator Update messages (LU) to correspondents (existing sessions, ala IPv6 Binding Update)

# ILNPv6 packet format

```
 0                   1                   2                   3
 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|Version| Traffic Class |           Flow Label                  |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|         Payload Length        |  Next Hdr     |   Hop Limit   |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                        Source Locator                         +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                      Source Identifier                        +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                      Destination Locator                      +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
|                                                               |
+                    Destination Identifier                     +
|                                                               |
+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
```

# Hand-off




| | |
|---|---|
| MN | mobile node |
| AR | router serving MN |
| $DNS_R$ | DNS Server (reverse) |
| $DNS_H$ | DNS Server (forward) |
| CN | correspondent node |

# New DNS records

| **Name** | **Description** | **Purpose** |
|---|---|---|
| *I* | Identifier Record | Identifier values for a host |
| *L* | Locator Record | Locator values for a host or network, including relative preference |
| *PTRI* | Reverse Identifier | permits reverse lookup of FQDN from Identifier value |
| *PTRL* | Reverse Locator | permits reverse lookup of FQDN from Locator value |
| *LP* | Pointer to Locator | names a network using an FQDN, resolves to an FQDN, which in turn resolves to an *L* record, containing the Locator value for a host or network |

# How might this affect use of DNS?

- Correspondents use DNS to look-up current (sub-)network name at which the host is located. That is, ‘rendezvous’ is through DNS, rather than via additional agent(s)/server(s).
- Hand-offs may be frequent ($\sim$ a few 10s of seconds), so DNS record changes need to reflect new location in a timely manner.
- DNS records need lower TTL:
  - Same as the likely interval between hand-offs.
  - Probably result in more DNS traffic overall.

# Mobile IP scenarios for ILNPv6

- Fixed hosts and networks
- Mobile client (no servers)
- **Mobile server**
- **Mobile network**

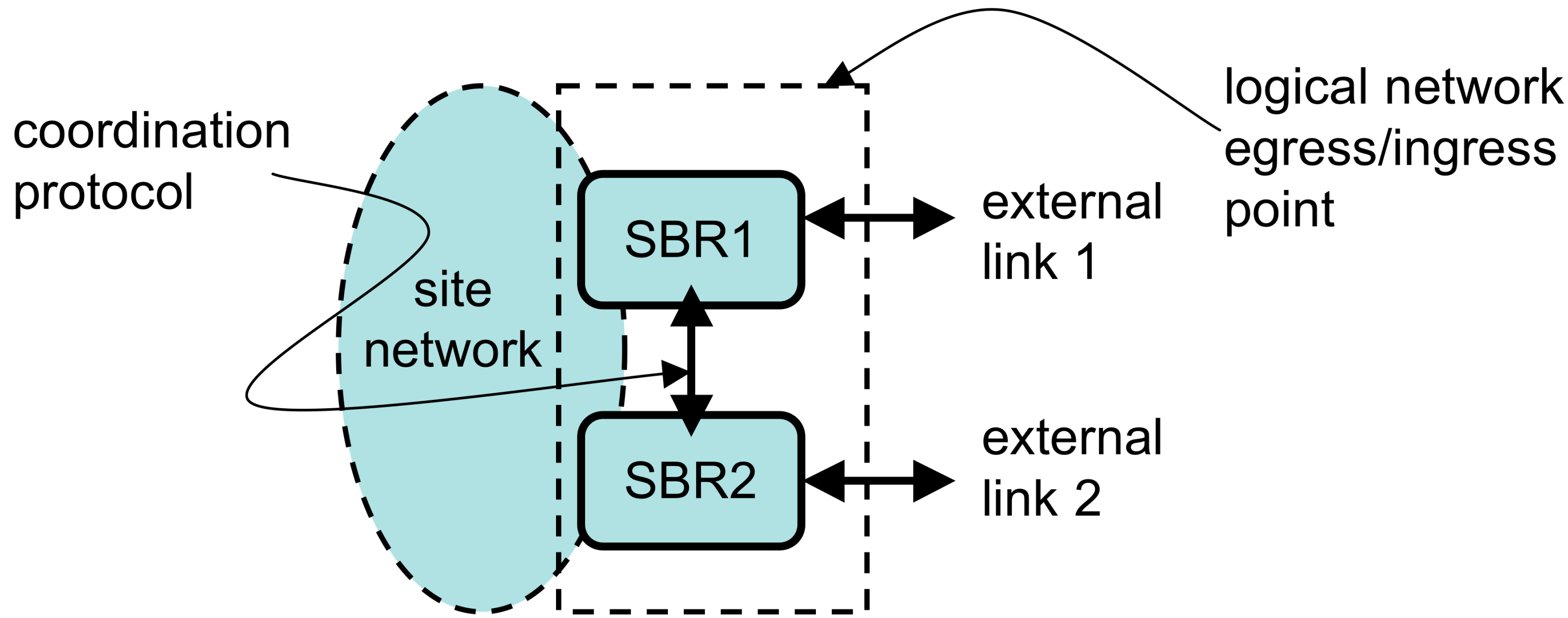
# Mobile server(s)

- Many connections from clients on single server.
- When a server moves:
  - Single L record update for server.
  - One Locator Update (LU) message per existing sessions.
- Many servers, many updates.
- Can be optimised for servers on the same network (mobile network scenario).

# Mobile network I

- Many connections to/from nodes in mobile network.
- Many servers: many DNS + LU updates may be required.
- Reduce DNS updates by using Site Border Router (SBR)[1] (ala MR in NEMO) + Locator Pointer (LP) record.
  - LP record 'points to' a L record – contains a FQDN which resolves to a L record.
  - (Still need LU messages to update existing sessions.)

# Mobile network II




SBR = site border router

[1] R. Atkinson, S. Bhatti, S. Hailes. ‘Harmonised Resilience, Security and Mobility Capability for IP’, to appear, IEEE MILCOM 2008, 17-19 Nov 2008, San Diego, CA, USA

| **Issue** | **Summary** |
|---|---|
| Traffic | DNS traffic little impact, but Locator Update traffic may be an issue |
| Robustness | Potentially improves system robustness |
| Deployability | Incremental deployability |
| Authentication | No impact |
| Scalability | Extra DNS traffic not likely to be significant and existing uses of DNS not impacted |
| Link mobility | ILNP supports multi-layer approach including soft-handoff without affecting DNS |
| Integration | ILNP easily integrated with other network functions |

# Summary

- ILNPv6:
  - Names a (sub-)network and a node.
  - Deployed IPv6 routers/backbones unchanged.
  - Host IPv6 implementations require updating.
  - Adds a few new DNS record types.
  - Backwards compatible & Incrementally deployable.
- ILNPv6 uses DNS for ‘rendezvous’:
  - Via widely available IETF standards:
  - Secure Dynamic DNS Update (RFC-3007)
  - DNS Security (RFC-4035)
- Main impact in Mobile Server and Mobile Network scenarios:
  - Increase in volume of DNS traffic when low TTL is used?

# Questions ...

**Thank you!**
**http://ilnp.cs.st-andrews.ac.uk/**

# Summary of DNS impact

| **Scenario** | **Extra DNS access** |
| --- | --- |
| Fixed | (correspondent: access for a multi-homed site) |
| Client | host: single access for update of *L* record(s) |
| Server | host: access for update of *L* record(s) |
| Network | host: extra access to update multiple *L* records, unless an *LP* records is used, and then only a single extra access to update of the *LP* record<br>correspondent: if *LP* record returned, extra access to resolve *L* record(s) |
| Simultaneous movement | same as Client scenario |

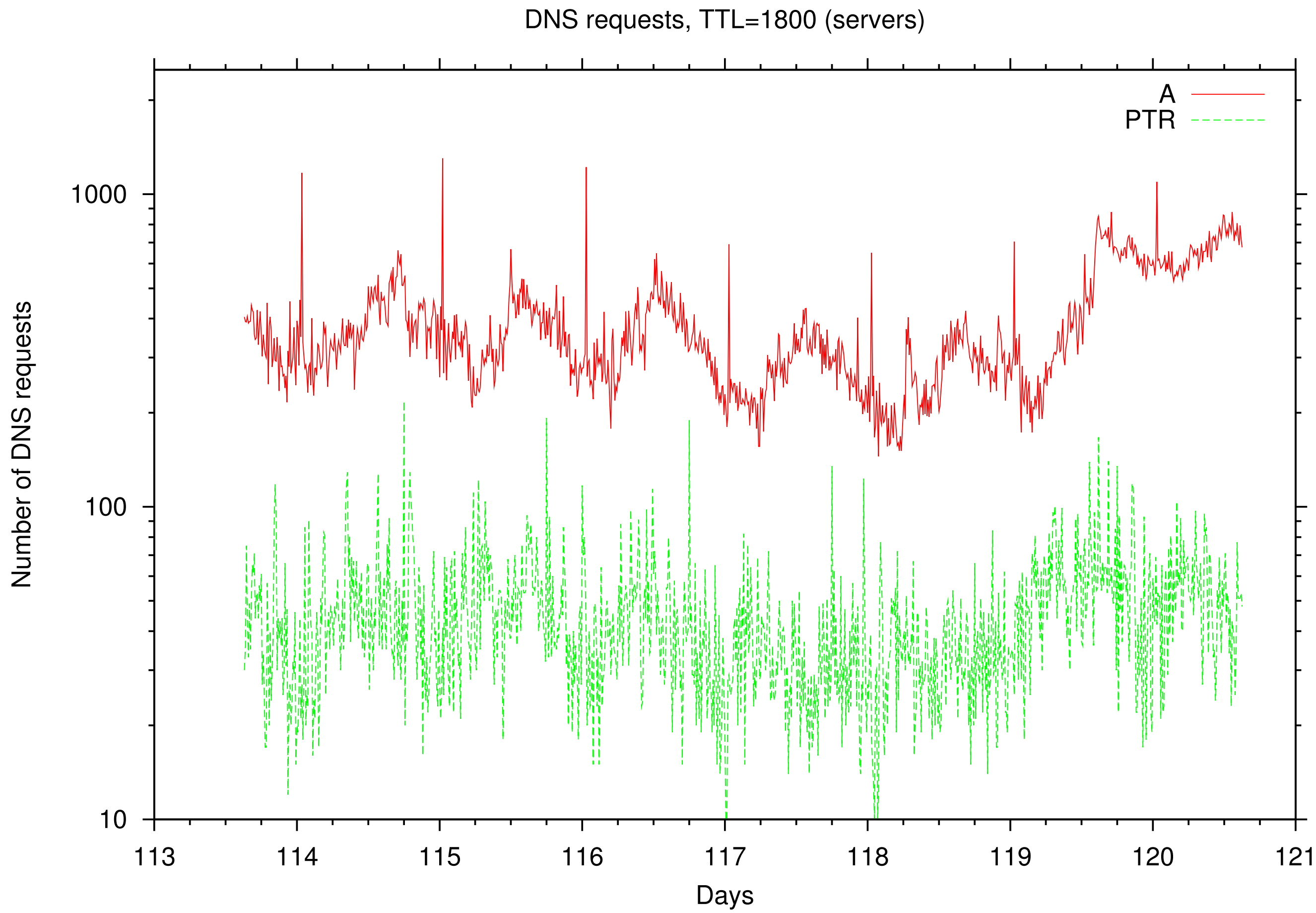
# Legacy applications

- Legacy IPv6 apps can be supported via Sockets API.
- Some legacy apps (e.g. FTP) might not work well and might need to fall back to ‘pure IPv6’.
- Legacy IPv6 apps might not be able to use all of the ILNPv6 features.
- Watch this space ... ;-)

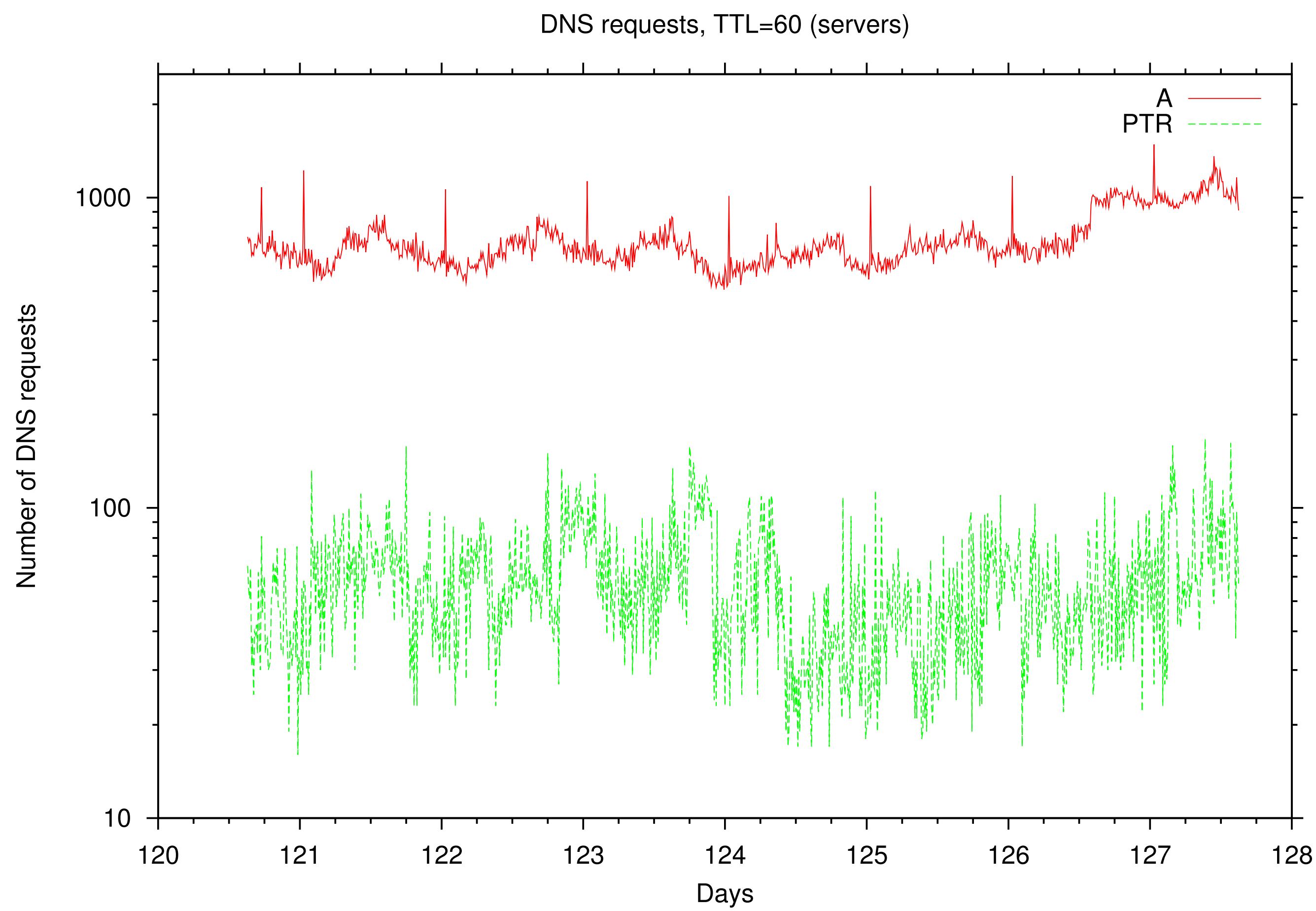
# Initial DNS graphs – very drafty :-) I

- DNS data collected at School of Computer Science, University of St Andrews.
- DNS requests for local targets only.
- 3 weeks, towards the end of semester 2 (i.e. busy):
  - Week 1: TTL = 1800s
  - Week 2: TTL = 60s
  - Week 3: TTL = 30s
- Linux *ncsd* turned off on lab machines.
- Graphs show:
  - *A* and *PTR* requests for **servers** only
  - 600s bins

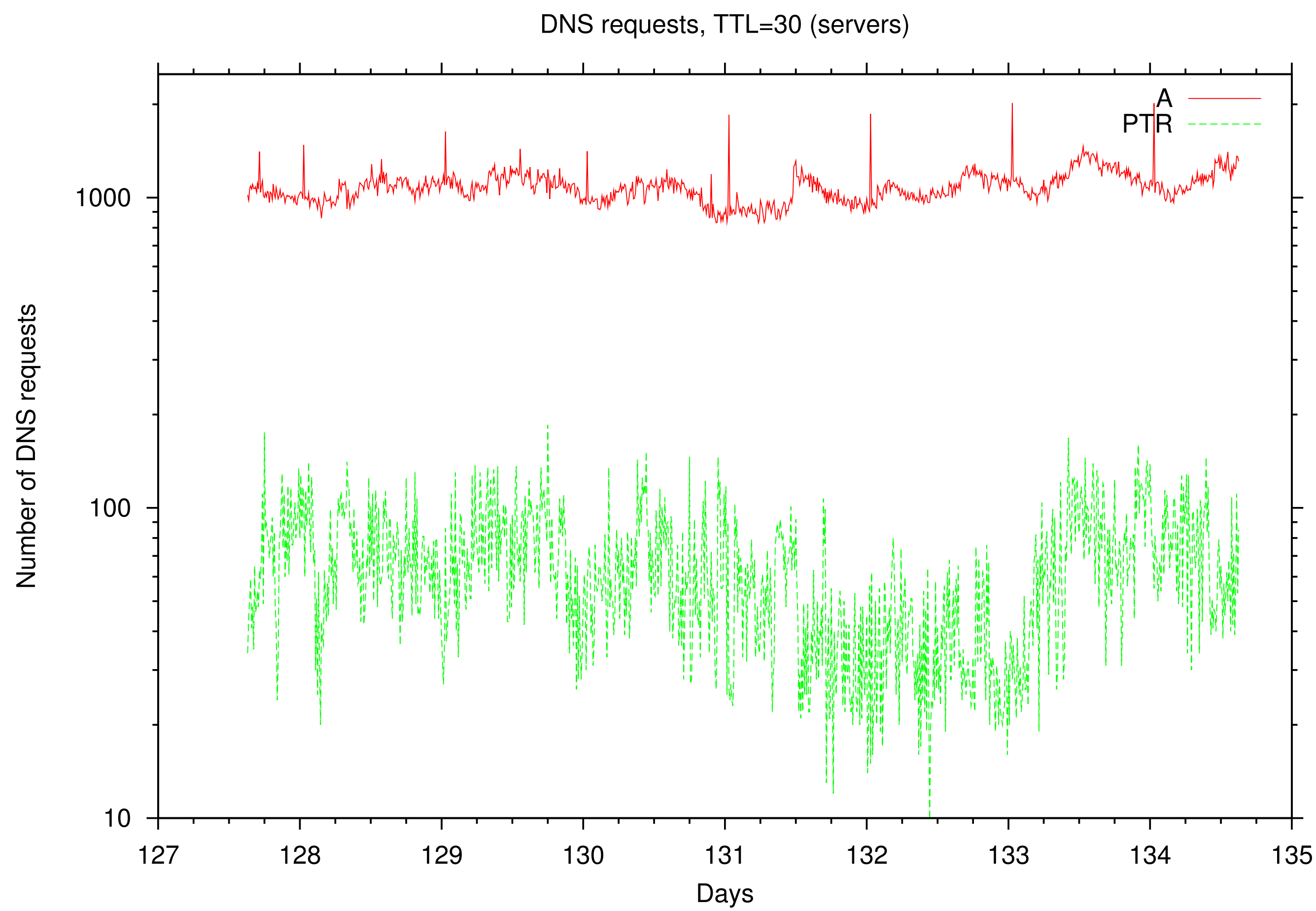
# Initial DNS graphs – very drafty :-) II



# Initial DNS graphs – very drafty :-) III



# Initial DNS graphs – very drafty :-) IV



# Simultaneous movement

- Assume:
  - 2 communicating hosts.
  - No soft-hand off.
  - Each host misses the other one's Locator Update.
- LU sent on new connectivity (hand-off succeeds).
- Worst case, after timeout, kernel checks DNS, and uses new Locator(s) found there.
  - Transport protocol could recover.

# Use and generation of I values

- I values needs to be unique in context of Locator.
  - This is required for ILNP to function.
- ILNPv6 does not **require** globally unique I values.
- ILNPv6 does not **preclude** globally unique I values.
  - Would be an advantage for mobility.
- I values always use the EUI-64 **syntax/format**
  - This follows existing IPv6 practices.
  - EUI-64 syntax has a Local/Global “scope bit”.
  - Default uses bits from MAC address of any host interface.
  - High probability of being globally unique.
  - Could use dynamically generated I values (local bit).
  - Could use cryptographically generated I values (local bit).