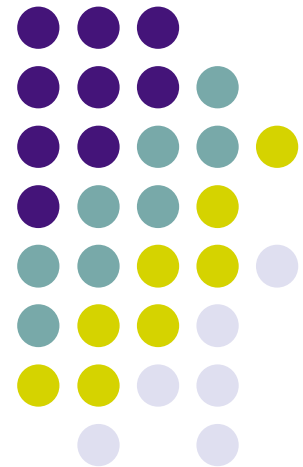


# Locator Identifier Split

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# Overview



- A bit of inter-domain history
- The problem
- Loc/ID split
- Mapping systems

# A bit of inter-domain history



- In the late 80s one started worrying about exponential growth of global routing table size
- CIDR reduced the growth significantly (92/93)
- IETF started IPng work (93)
- Many proposals
  - TUBA (UDP/TCP over CLNP) (92)
  - PIP (Separates host identifier and provider assigned addresses for routing) (94)
  - SIPP (kind of IPv6 with 64 bit addresses) (94)
  - ENCAPS (routing of ADs (Adm.Domains) using encapsulation between domains with IP addresses of ADs) (96)
  - 8+8/GSE (addresses with 8-byte end host identifier and 8-byte locator (97)
  - IPv6 (95)

# The problem (1/2)



- Recently people have realised that the current Internet routing has to change
- Routing table growth is too large
  - Multihoming is one reason, no provider aggregation
- Increasing number of BGP updates
  - Partly due to lack of aggregation and number of prefixes
  - Also traffic engineering (load balancing with BGP etc)
- The cost of the specialised hardware needed by routers is growing quicker than Moore's Law
  - Also issues with power/heating

# The problem (2/2)



- We more or less have the same problems as in the early 90's that triggered CIDR and IPng work
- IPv6 is no solution, enterprises are not willing to just use provider assigned addresses and host multi-addressing
  - Also want to change providers without renumbering
- Large scale deployment of IPv6 with provider independent addresses might make things worse
- NAT is kind of Id/Loc split
  - A single provider assigned aggregateable address is used for the NAT device (e.g. customer router) and is used as a locator
  - Private addresses are used as identifiers and are independent of location and provider

# The goal



- Find a new way to do routing and/or addressing for the Internet that can scale well into the future
- Multihoming and traffic engineering should be possible
  - Do it near the edge without exposing the Internet core to all details?
- Some degree of mobility?
- Allow enterprises to have provider independent addressing?
- Needs to work with IPv6 and preferably IPv4
- There should be a simple transition path
  - No flag day
  - Change only parts of the system?
- There is ongoing work in the IETF, in particular in the Routing Research Group in the IRTF
- We will present some of the ideas and proposals

# Locators and identifiers



- There is a general agreement that the main problem is IP addresses used as both identifiers and locators
  - An identifier is used to address one specific host
    - Used by transport and application layers
    - A pure identifier should be fixed independent of the location (which network, which provider etc)
    - A multihomed host should still have just one identifier
  - A locator specifies a location, which network, which provider etc
  - You might say that hosts, stack and apps care about IDs while routers care about locators

# Loc/ID examples



- A typical postal address is e.g. **John Smith**, High Street, **London**, **UK**
- The red part (if unique) would be an identifier
  - The person might move or somehow have two post boxes in two different locations
- The blue part is a locator and can be aggregated (hierarchical)
  - The postal service around the world treats all post to UK the same way, sending it to the same next-hop
  - The postal service in UK can send all London post to the same next-hop etc
- When one were looking at IPng (now IPv6) there were proposals like GSE/8+8 for having IP addresses containing prefix and identifier
  - With IPv6 stateless address autoconfig we almost have this
    - **2001:db8:10c:2:1234:56ff:fe78:9abc**
  - However the host treats the entire address as an identifier
  - Many people want the prefix part to be provider independent



# Loc/ID alternatives



- Split handled by end hosts
  - The ID may be in lower bits of the address (ref prev slide)
  - The IP address (in packet header) may be locator only
    - Identifiers in e.g. extension header (HIP)
- Split handled by routers
  - First/last-hop routers can rewrite the locator parts of the addresses as needed (e.g. with GSE/8+8)
  - First-hop router may encapsulate the packet with a locator specifying the last-hop router in the outer header
    - Last-hop decapsulates the packet, forwarding the payload to the local host
  - Alternatively do the same at e.g. site border routers where the identifiers are routeable within the site
    - Not quite Id/loc, more hierarchical addressing...

# Identifier considerations



- What name space to use
  - Could be e.g. domain names but want it to work with current applications/transport so 32/128 bit (IP addresses)
- Flat or hierarchical?
  - Hierarchical requires change of ID when moving in the hierarchy?
- Derived from, or bound to, locators (Six/One)
- Aggregation may be important for scalable mapping
  - Aligned delegation hierarchy and mapping service topology
- Routeable identifiers at the edges or in overlay?
- Allowing routable identifiers might help transition
- Distinguishable from locators?
  - If all 32 bit numbers are used for locators, one cannot simply inject 32 bit identifiers in the same routing system

# ID/Locator considerations



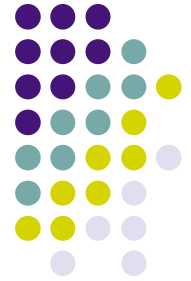
- Who provides the mapping service? Can an enterprise own its identifiers? Dependency on identifier or mapping service providers?
- Flat or hierarchical locators? Independent of topology?
  - E.g. if a locator were a source route it would need to change if the path changed
- Can locators sometimes be used as identifiers?
  - E.g. for routers

# Mapping considerations



- Push or pull?
- Trade-off of size (amount of state), refresh times and latency
- Can end system or edge router have full knowledge? How to maintain the information?
- Can it be requested when needed?
  - Delay or drop data packets until known?
  - Some kind of default forwarder or overlay?
  - Caching may be of some help
  - How quickly may mappings change to provide traffic engineering or some degree of mobility?
- Security
  - How to know that the locator is correct? Can traffic be hijacked?

# Further reading



- Problem statement
  - From IAB routing workshop Amsterdam Oct 2006
    - <http://tools.ietf.org/html/draft-iab-raws-report-02>
- IRTF RRG
  - <http://www.irtf.org/charter?gtype=rg&group=rrg>
- IRTF RRG Proposals and presentations
  - <http://www3.tools.ietf.org/group/irtf/trac/wiki/RoutingResearchGroup>