Scalable Internet with Local Identifiers and Locators

Dae Young KIM
CNU/Kyoto U
dykim@cnu.kr

Objectives

- Escape from gateway table explosion
- Minimal disturbance to legacy infra

Architecture

- HID/LOC separation
- Both HID and LOC local
- (ASN,HID) unique within a tier
- IDR based solely on ASN; no prefixes use
- Name Server (NameS) for (ASN,HID)
- Location Server (LocS) for LOC

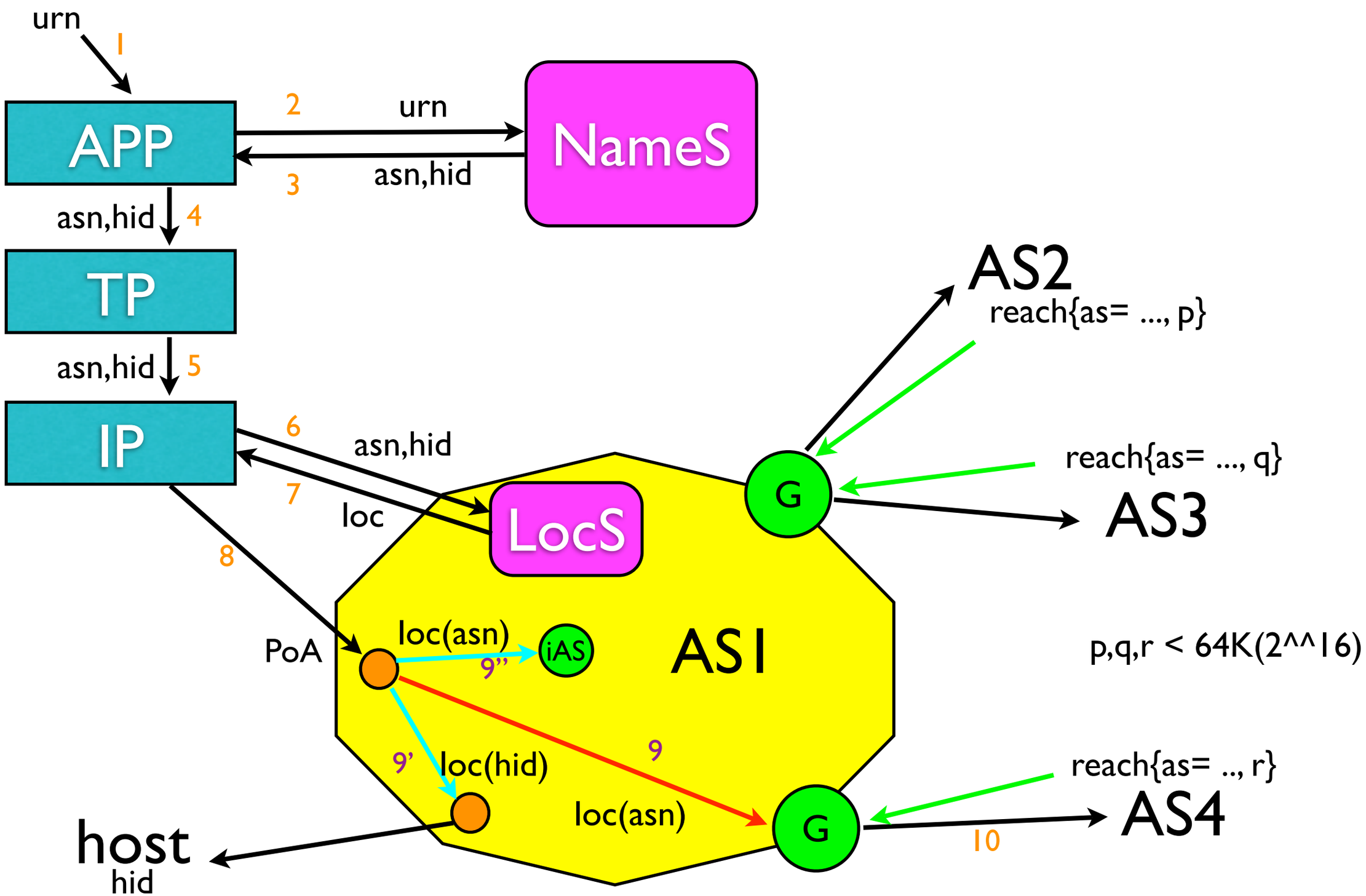
Implementation Choices

- Private IPvN addresses as LOCs
- Same IPvN number space for HID
- 16-bit ASN

Features

- IDR table size never exceeding 64K(2**16)
- Hierarchical AS recursion
  - Authority delegation to manageable size
- Global IPvN address infra not necessary
- DNS for NameS with a small change

Architecture Overview



Outgoing Scenario

1. Application(APP) takes URN of a peer.
2. APP consults NameS with URN.
3. NameS returns a (ASN,HID) pair for URN
4. APP requests Transport connection/ transmission with (ASN,HID).
5. Transport requests to IP transmission of segments with (ASN,HID).

Outgoing Scenario

6. IP consults LocS with (ASN,HID) for LOC.
7. LocS returns LOC.
   - If ASN is local, LOC points to a host.
   - If ASN is for an internal AS, LOC points to an internal ingress gateway.
   - If ASN is foreign, LOC points to an egress gateway.

Outgoing Scenario

8. IP injects a packet into the network.
9. Packet is delivered to a host or a gateway.
10. Packet exits the AS.

Incoming Scenario

- If the target AS of the incoming packet is local, the ingress gateway delivers the packet to the target implied by the HID imbedded in the packet.
    - The resultant target can be a local host or an ingress gateway into an internal AS one tier lower.

Incoming Scenario

- If the AS of the incoming packet is foreign for transit, it is redirected to a relevant outgoing gateway.

Consequences

No Table Explosion

- Gateways advertise only AS numbers reachable; no network prefixes.
- With 16-bit AS numbers, the maximum table size of gateways in a tier (in the recursive AS hierarchy) is limited to 64K(2^^16).

Recursion

- The scenario depicted in the Arch Overview diagram can be recursively repeated, both inwards and outwards, any number of times in the AS hierarchy.
  - An AS is a parent to child ASs of one tier deep.
- Only outer-most AS is advertised outwards.

Scalability

- With recursive AS hierarchy, the Internet can scale to infinity.

NAT a default

- Domain behind a NAT is a legitimate AS.
- Since address swapping takes place at every AS boundary, NAT is a default, not an evil.
- Address depletion, not an issue anymore

DNS Extension

- DNS can be used as NameS with only a small change
- DNS maintains (URN, ASN, HID) tuples.

Traffic Engineering

- If there are two exits for a AS, LocS returns two corresponding LOCs.
  - LocS concerts with a traffic manager.
- If there are multiple links to a neighbor AS, traffics are arbitrarily split over the links.
- If more traffic granularity is required, gateways deep inspects packets for HID.

Multi-homing / Mobility

- Inherent with HID/LOC separation
- Techniques can be borrowed from HIP, LISP, and Shim6 among others.

Acronyms

- APP application
- AS autonomous system
- ASN autonomous system number
- DNS domain name server
- HID host identifier
- HIP host identity protocol
- IDR inter-domain routing
- IPvN IPv4, IPv6
- LISP locator identifier separation protocol
- LOC locator
- LocS location server
- NameS name server
- NAT network address translator
- TP transport
- URN universal resource