“Address Ownership” Considered Fatal

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March 31, 1995

Acknowledgements

This talk borrows heavily from various postings on various mailing list.

This talk quotes from messages posted by Noel Chiappa, Eric Fleischman, Geoff Huston, Jon Postel.

Thanks to Noel Chiappa for review and constructive comments.

Motivations

- Motivated by recent discussions on various mailing lists about current address allocation/management policies

- Discussion can't be pursued in a vacuum – need to understand technical issues/implications associated with address allocation/management

Non-goal: formulate address allocation/management policies.

Goal: articulate to the parties involved in formulating address allocation/management policies relevant **fundamental technical issues**.

Note: one may choose to ignore the fundamental technical issues, but this doesn't change the fundamental property of these issues.

Address allocation/management policies

Broad set of issues:

- Who formulates policies ?
- Who executes policies ?
- What roles do Registries play in address allocation/management ?
  - execute, but don't formulate policies
  - is there a need for consistent and coordinated policies across registries ?
- What roles do various government bodies play in address allocation/management ?
- What roles do ISOC, IAB, IESG, IETF, IEPG play in address allocation/management ?

Address allocation/management policies (cont.)

- Address allocation/management and the ability of the Internet routing system to scale are not independent issues – only **certain** address allocation/management policies yield scalable routing

- "Address ownership" – an important component of address allocation/management policies

- Need to examine relationship between "address ownership" and the ability of the Internet routing system to scale (i.e., have controlled routing overhead growth)

Relation between addressing and routing (overview)

Discussion about address allocation/management policies need to understand its subject – "IP address".

- What is an IP address ?
- What is the value of an IP address ?
- What is the role of an IP address ?

IP address

- An IP address is an element of a discrete set of numbers range 0 - 2^{32}

- There are many discrete sets of numbers range 0 - 2^{32} – the IP address space is one such set

Question: What makes this set different from all other sets ?

IP address (cont.)

What makes this set different from all other sets ?

- The set of IP addresses is functionally defined by its ability to gain access to the routing service:
  - The set of IP addresses has a coherent address structure
  - IP address is used for Network Layer routing
  - IP address acquires its value as the information about where this address is gets injected into the routing system – the ability to be reachable brings the value to the address

IP address (cont.)

Corollary 1: it is the service environment (the Internet) and its continued operation which provides the address with any intrinsic value, rather than inverse.

Corollary 2: if routing system cease to be operational, the service disappears, and the addresses cease to have any intrinsic value.

Postulate: there is not too much consolation, or utility, in "owning" an address that doesn't enable access to the service.

Corollary 3: if the addresses cease to have any intrinsic value, the concepts of address allocation/management, including "address ownership" part, are rendered meaningless.

Hierarchical routing

- Need to accommodate routing in the growing Internet requires to perform routing information aggregation/abstraction

- Both the current routing technology and the proposals on the table for new routing technologies (Nimrod, Unified) assume that hierarchical routing will be used as **the fundamental** technique to deal with the growth in the overhead costs of operating the routing system

Hierarchical routing and its implications on address allocation/management policies

Hierarchical routing places certain constraints on address allocation/management policies:

- Addresses are unique within an internet
- Addresses reflect topology – addresses reflect **where** in the network you are:
  - changing network topology means you change where you are, which in turn means you may need to change your address
- Hierarchical addressing is an essential part of hierarchical routing

Address ownership (background)

The issue of "address ownership" is an important component of any address allocation/management policy.

Claim: "our traditional system assumes the concept of "address ownership" on the part of the entity to which the address block has been delegated"

Fact: "Address ownership" had never been explicit – the words used were "assignment", "allocation", "delegation"

Observation: while the current allocation procedures may be consistent with the concept of "address ownership", this does not mean that "address ownership" is the current policy.

Address ownership and its implications on hierarchical routing

Observation 1: "address ownership" assumes that addresses don't change.

Observation 2: hierarchical routing assumes that addresses reflect network topology.

Corollary 1: "address ownership" and hierarchical routing can work together only if the network topology never changes

Corollary 2: if the network topology is allowed to change, "address ownership" becomes **fatal** to hierarchical routing (as it leads to violation of one of the hierarchical routing fundamental assumptions).

Corollary 3: in presence of hierarchical routing addresses can't be "owned" – they can only be "leased".

Implications of “address leasing”

What are the practical implications of replacing “address ownership” with “address leasing” ?

- Large and some medium size subscribers (e.g. a subscriber that can inject /16 prefix into the Internet routing) – no impact

- Small and some medium subscribers (longer than /16 prefix):
  - renumber when changing providers, or
  - don’t renumber, but have limited IP connectivity
    - limited IP connectivity may be augmented by application layer gateways and/or NAT boxes
    - NAT technology allows “to have your cake and eat it too” – don’t have to renumber, and no extra burden on the routing system

- The Internet routing system stays alive

Conclusions

- Any address allocation/management policy for the addresses used for the Internet-wide connectivity has to take into account its impact on the scalability of the Internet routing system

- Only address allocation/management policies that yield scalable routing system are feasible

- With certain address allocation/management policies the Internet routers will "run out of gas" before we'll run out of IPv4 addresses

- We have a choice between moving the concept of "address ownership" to Historic, or witness how the Internet itself would become a historic concept