Scenarios for Flexible Address Structure

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Overview

Gap Analysis

• **IPv6** becomes the **core protocol** of the entire communication system
• Increasingly network scenarios long for **TCP/IP** for **global reachability**.
• IP address is designed to hold the **topology semantics** only (RFC0791)
• New network scenarios may prefer a **flexible address structure** for advanced features and routing capabilities.

Main Purpose:

• A flexible address structure is expected to be adaptive to futuristic scenarios requirements
• unleash more network abilities and possibilities
Address Flexibility

- Include multiple semantics
- Length variable

Physical location

- Edge network / Limited domain (RFC8799)

Logical Position

- A supplementary of the IPv6 address, not replacement
Scenario-1: Internet of Things (IoTs)

GAP Analysis

- IoTs is expected to use IPv6 for global end-to-end reachability
  - Myriad address space is huge enough to accommodate various IoT devices
- Energy consumption of standard IPv6 is unaffordable for constrained devices.
  - E.g., power requirements, computation requirements, memory requirements
- 6LowPan is a feasible but suboptimal solution
  - The compression and decompression still introduce extra energy and resource consumption
  - The (de)compression action at every forwarding node leads to network delay

Potentials under a flexible address structure

- A shorter address (and packet header) could contribute to energy saving
- A appropriate gateway can restore the global IPv6 address when packet flow into Internet backbone, and vice versa.
Scenario-2: Satellite Network

GAP Analysis

• The space-based Internet is expected to provide global Internet reachability
  • E.g., SpaceX Starlink
  • Be conductive to cruise ships, flights, or vehicles in deserts.

• The high dynamics of satellite network lead to low communication performance
  • Layer 3 routing protocol is designed for terrestrial network and statics topology
  • Bubble protocol (DTN WG) is an overlay solution, thus subject to drawbacks of the underlay.

Potentials under a flexible address structure

• Geolocation could be encoded in IP address (semantics refer to geolocation)
• Then satellite can forward packet by geolocation rather than table lookup
• Improve the underlay routing reliability and performance
Scenario-3: Dynamic Service and Resource

GAP Analysis

• Delay exist for mapping between resource/service and their IP address
  • E.g., DHCP service → IP, Google search service → IP

• Inflexible network forwarding for different resource/service
  • Routers can not offer differentiated service quality based on IP
  • QoS field is easy for spoofing

Potentials under a flexible address structure

• service/resource identifier can be embedded and marked by a fixed address, without mapping and its delay.

• In-network routers can offer differentiated network quality based on the identifiers that located in the address
Scenario-4: Policy-based Traffic Control

GAP Analysis

• Network itself is hard to directly conduct traffic control
  • End-to-end policy: network should not intervene upper layer business
  • Access allow/deny action is usually conducted at the end

• Policy-based traffic control can be indirectly conducted by sub-net partition
  • E.g., VLAN, VxLAN

• Too much human cost: manual configuration and maintenance
  • small changes in reality could lead to a huge manual efforts

Potentials under a flexible address structure

• Address can explicitly depict objects identifier (users, devices)

• In-network routers can thus directly allow/deny traffic according to the identity that depicted in address
Scenario-5: Robust Trust and Security

GAP Analysis

• IP protocol itself cannot offer any authentication capability
  • IP address is easy to spoofing
  • Packets is easy to be detoured to anyone else
• IPsec offers authentication, but it is hard for keys distribution
• Specific address/protocol construction can contribute to authentication
  • E.g., Cryptographically Generated Addresses (CGA) [RFC3972], Host Identity Protocol (HIP) [RFC7401]
  • Keys can only be used by a truncated sequence due to the limited space of IPv6

Potentials under a flexible address structure

• any secure-related keys could be integrally included inside the address
• Integrally key could contribute to authentication and security without key distribution.
Recap.

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Logical Position
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Discuss

Are these scenarios **reasonable** for a **flexible** address structure?
THANKS!

Questions / Comments?

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