

Addressing in Future Internet: Problems, Issues, and Approaches

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19 June, 2008

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- Introduction
- Problems of current Internet Addressing
 - Semantic overloading of IP address
 - Routing scalability
- Big picture of addressing architecture
 - Identifier / Locator split
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- Research issues in addressing
- Conclusion

Introduction

- **Challenges of current Internet**
 - Name space shortage
 - Mobile endpoints growth
 - Break of End-to-End paradigm
 - ◆ Peer-to-Peer applications
 - ◆ NATs and ALGs
 - ...
- **Current Internet is not designed for commercial use**
 - Hard to provide QoS
 - No mechanisms for accounting or authentication
 - Weak for network management
 - ...
- **Time to rethink about the fundamental design of Internet!**
 - **Addressing is essential elements to design a network**
 - ◆ **Problems of current Internet addressing**
 - ◆ **Basic approach to resolve these problems**
 - ◆ **Major research issues related with addressing of Future Internet**

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Semantic overloading of IP address

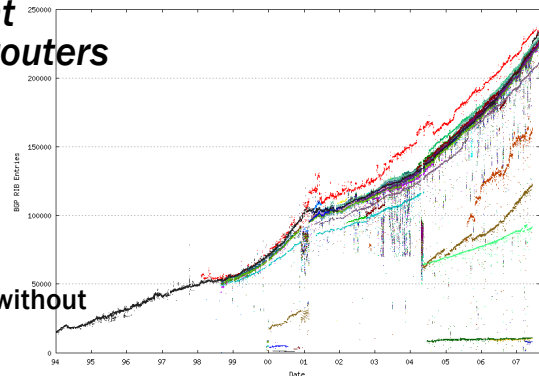
- **Semantic overloading of IP address**
 - Used by a means of uniquely identifying a device interface that is attached to a network
 - ◆ **Endpoint identifier**
 - Used to identify where a device is located within a network
 - ◆ **Location identifier**
 - Used as a lookup key into a forwarding table to make local switching decisions
 - ◆ **Forwarding identifier**
- Cause mobility, multi-homing, and routing scalability problems

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Routing Scalability

- *“Increasing rate of unaggregatable routing entries is so fast that the development speed of high-end hardware for core routers will not meet the requirements...”*
 - IETF IAB workshop on routing and addressing, 2007
- Hierarchical aggregation is broken
 - Provider-Independent addressing
 - ◆ Sites want to be able to change providers without renumbering
 - Site Multi-homing
 - ◆ Even if PI addressing is not used, multi-homing injects more-specific routes from one provider to another
 - Traffic Engineering
 - ◆ Providers inject more-specific routes to influence the behavior of the routing system, in order to control various traffic patterns

<http://bgp.potaroo.net/>



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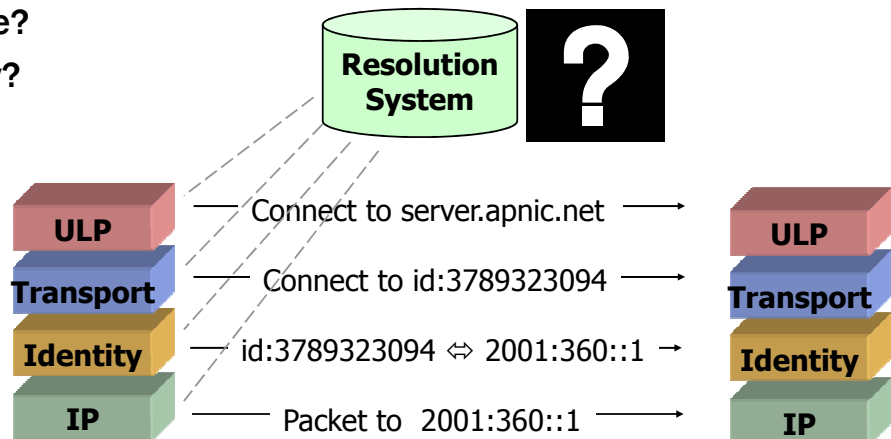
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Identifier / Locator split [1/1]

- Let's decouple the overloaded semantic of address
 - can prevent the architectural limitations about mobility, multi-homing, routing scalability
- Remaining issues after split
 - How identifier and locator will look like?
 - How to resolve?
 - How to deploy?

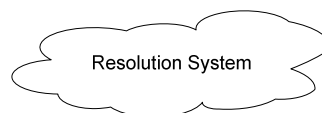


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Identifier / Locator split [2/2]

- Candidates for identifier
 - Coexist?
- Candidates for locator
 - Competing?

Identifier:



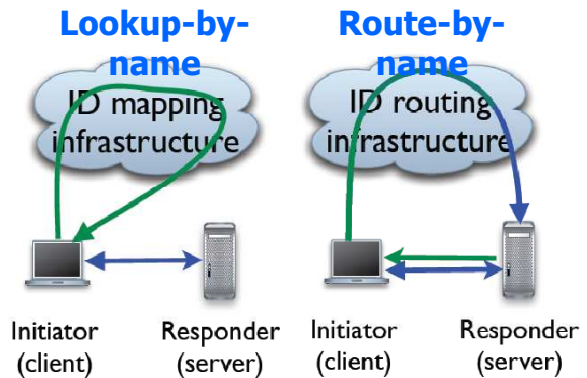
Locator:

- Resolution
 - After split, the resolution between id and loc will be more dynamic because of mobility
 - ◆ DNS can support the resolution between id and loc???

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Route-by-name Paradigm

- Resolution between identifier and locator
- Resolution Models
 - Lookup-by-name
 - maintain a distributed database to response a query to find a locator
 - DNS
 - Route-by-name
 - find a locator with name while routing
 - DONA (TRIAD)
- Resolution based on **route-by-name** approach can be more appropriate for Future Internet



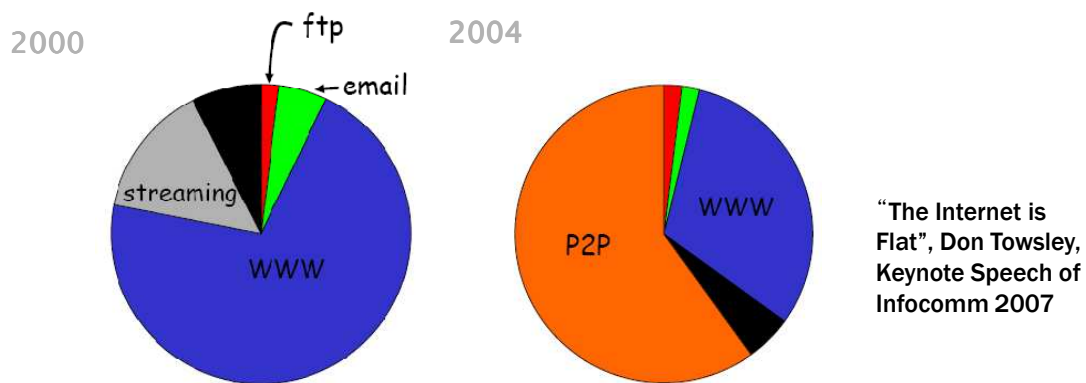
	Lookup-by-name	Route-by-name
Extensibility	Bad	Good
Routing Efficiency	Good	Poor
Robustness	Poor (single POF)	Good

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Content-oriented Network [1/2]

- Current **addressing** of Internet is **Host-centric**
 - designed to identify Hosts
- Current **usage** of Internet is **Data-centric**
 - Overwhelming use of today's networks is for a machine to acquire named chunks of data



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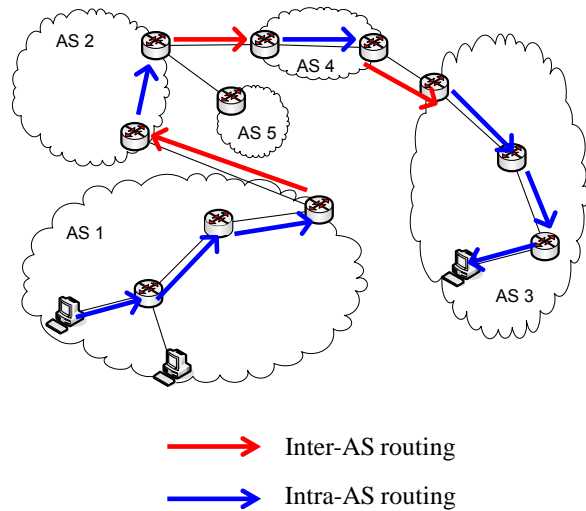
Content-oriented network [2/2]

- Content-oriented network
 - A network whose messages are driven **by the content of the messages**, rather than **by explicit addresses assigned by senders**
- Basic identifying elements for communication
 - Current Internet
 - ◆ Sender Hosts
 - ◆ Receive Hosts
 - Content-oriented Network
 - ◆ Content of data
 - ◆ (Providers publishing the content)
- *“Content-oriented Networking as a Future Internet Infrastructure: Concepts, Strengths, and Application scenarios”*
 - Technical session 7: “Data Oriented Architecture”, 6/20

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Location-based addressing

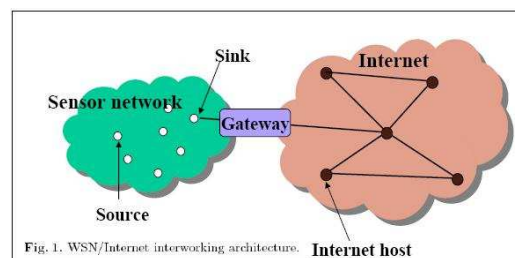
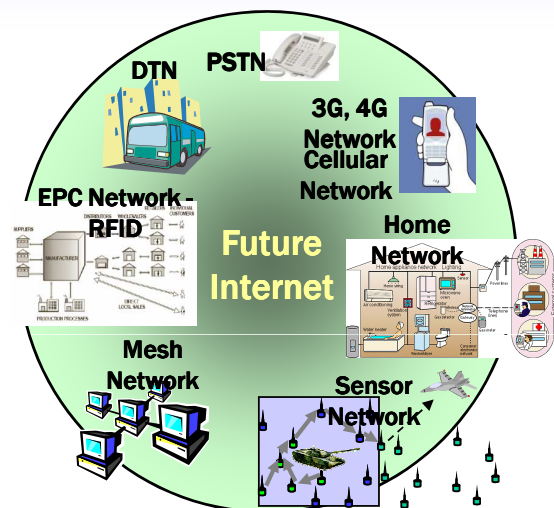
- Use Geographical information for the locator
 - Example of locator
 - ◆ (Longitude, Latitude, Attitude from sea level)
 - ◆ (Horizontal / Vertical distance from a reference point, Attitude)
- Pros
 - Can resolve the routing scalability problem with greedy routing
- Cons
 - Hard to support policy-based routing (BGP)
 - Dead end problem can be severe in wired network



AS number	Geographical information	Random part
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Access network integration

- Emerging access network
 - Sensor Network, DTN, Vehicular Network, WPAN, RFID, ...
- How to integrate these networks into Future Internet?
 - Is global address needed for emerging network?
 - ◆ Each network has its own requirements
 - Possible scenarios
 - ◆ Absorption into the Future Internet
 - ◆ Interworking through the Gateways



Conclusion

- Research of addressing scheme for Future Internet is needed
 - Routing Scalability
 - Meeting the new requirements
 - ◆ Mobility, Multi-homing, QoS provision, security...
- Basic approach
 - Id / Loc split + route-by-name resolution model
- Addressing research is **not standalone!**
 - Addressing research should be proceeded with related researches
 - ◆ Content-oriented Networking (Data-oriented Network)
 - ◆ Location-based addressing
 - ◆ Semantic-aware service architecture
 - ◆ Resolution architecture supporting mobility (under id/loc split)
 - ◆ Security mechanism

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Thank you



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