Routing scalability

Summary of WP1 of the FI program

Nokia Siemens Networks

WP1: Routing scalability activities

- Background:
  - The complexity of the Internet routing system increases faster than the Internet itself is growing.
    - Routing the size growth: multi-homing and IPv4 depletion
    - The original design criteria of the routing machinery not meeting the future needs
    - IRTF/IETF activities in the area
  - Research question for the WP1 of FI Program:
    - How would the routing system of the Future Internet servicing several billions of mobile users running real time applications look like?

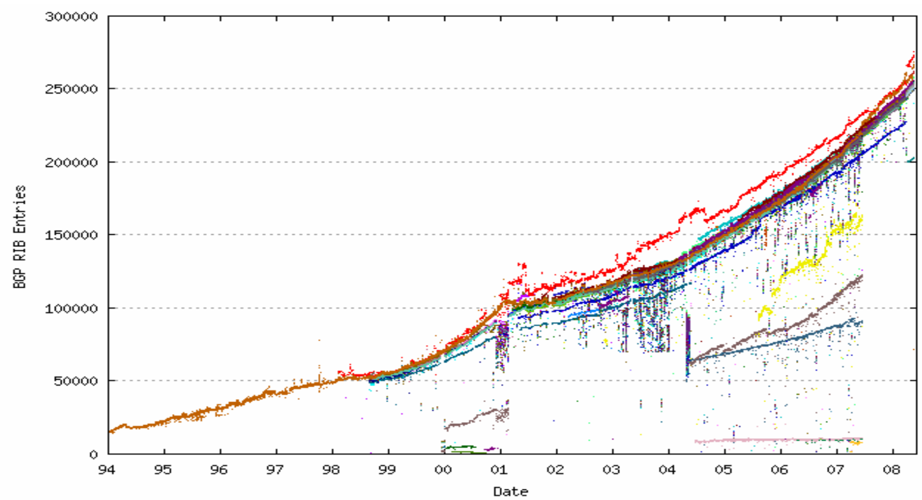
Scaling of the routing and addressing system

Old problem becoming acute:

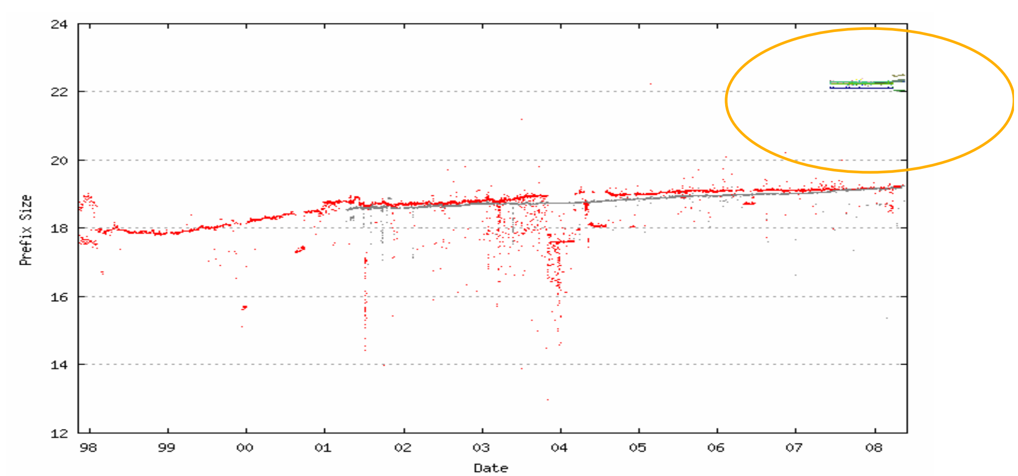
- IAB Workshop on Routing & Addressing, Oct 2006 resulting into RAWS report
- Triggered IRTF/ RRG work with active participation of major players. (Not only universities)

- RAWS report statements
  - Multihoming,
  - Traffic engineering,
  - Non-aggregatable address allocations
  - Business events such as mergers and acquisition
- De-aggregation leads to an increased number of BGP UPDATE messages injected into the DFZ

FIB size



Average prefix size

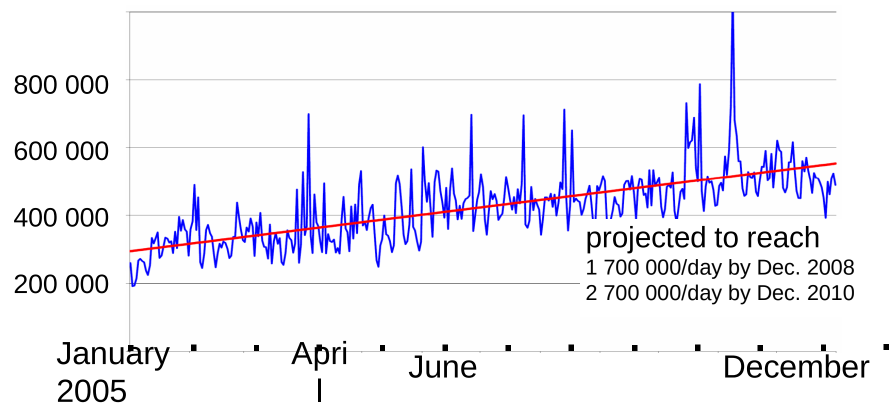


Source: Geoff Huston, http://www.potaroo.net/

Why is this an issue?

- Table sizes grow 2 * faster that the real growth
- IPv6 will accelerate the growth
- Frequent BGP routing table updates cause service disruptions noticeable to VoIP/SIP

- Cost of an announced prefix in DFZ $6200 per year (ref. B. Herring



IPv4 BGP updates per day in 2005

- Utility function:

update rate * size of the table

WP1 activities

- Activity 1.1 Routing problem validation
- Activity 1.2 Indirection layer
- Activity 1.3 Address aggregation and the Mapping system
- Activity 1.4 Routing in the Network of Future

Activity 1.1 – Routing problem validation

Task 1: Survey of current routing methodologies

- Collecting the observed real-life routing problems and the remedies used for them (e.g., route flapping – route flap damping)
- Understanding the theoretical limitations of various routing methodologies (e.g., instabilities of link-state protocols, BGP rule-set convergence)
- Studying unused routing features and why they are avoided (stability, scalability etc. issues)
- Identifying missing or suboptimal functions in current systems (e.g., inter-domain routing information exchange, QoS routing)
- Understanding how business needs and models relate to interdomain routing requirements and how adequate current solutions are for that

Activity 1.1 – Routing problem validation (cont.)

Task 2: Definition of common criteria for evaluating routing and addressing systems

- Defining evaluation criteria (e.g., functions, scalability, reactiveness, stability, technical feasibility)
- Creating a common framework for designing test cases

Task3: Routing system service support

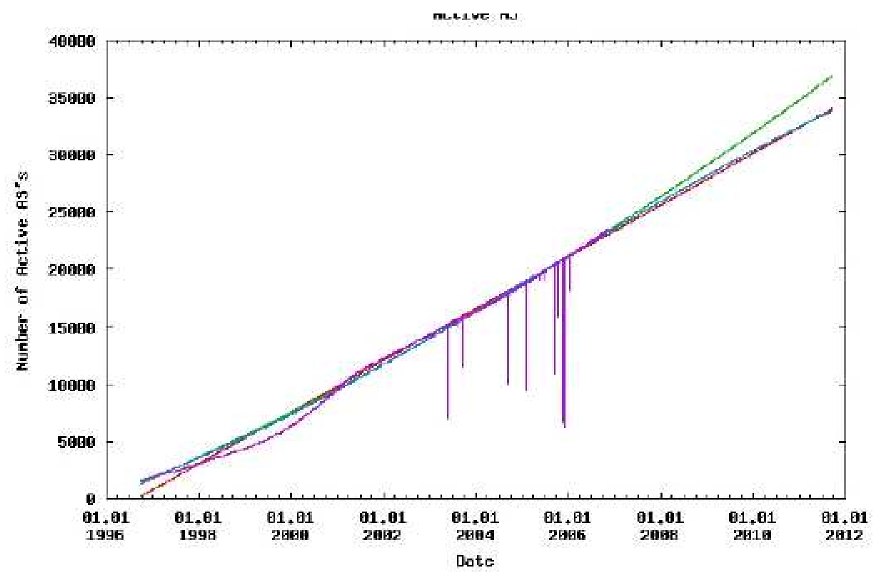
- Studying what kind support is required by various VPN technologies
- Secure routing and other overlay issues
- Interactions between routing layer and various L2/L2.5 connection oriented and connectionless schemes

Some Routing problem constraints

- Currently some 250 k + advertised prefixes in the Default Free Zone (DFZ)
- Internet topology is becoming flatter
  - AS:s becoming more connected
  - Average AS-hop distance (is btw 3.1 – 3.7) grows slowly
  - Max AS path length 13 based on routing policies

- Big content providers running their of WANs bypassing Tier1s

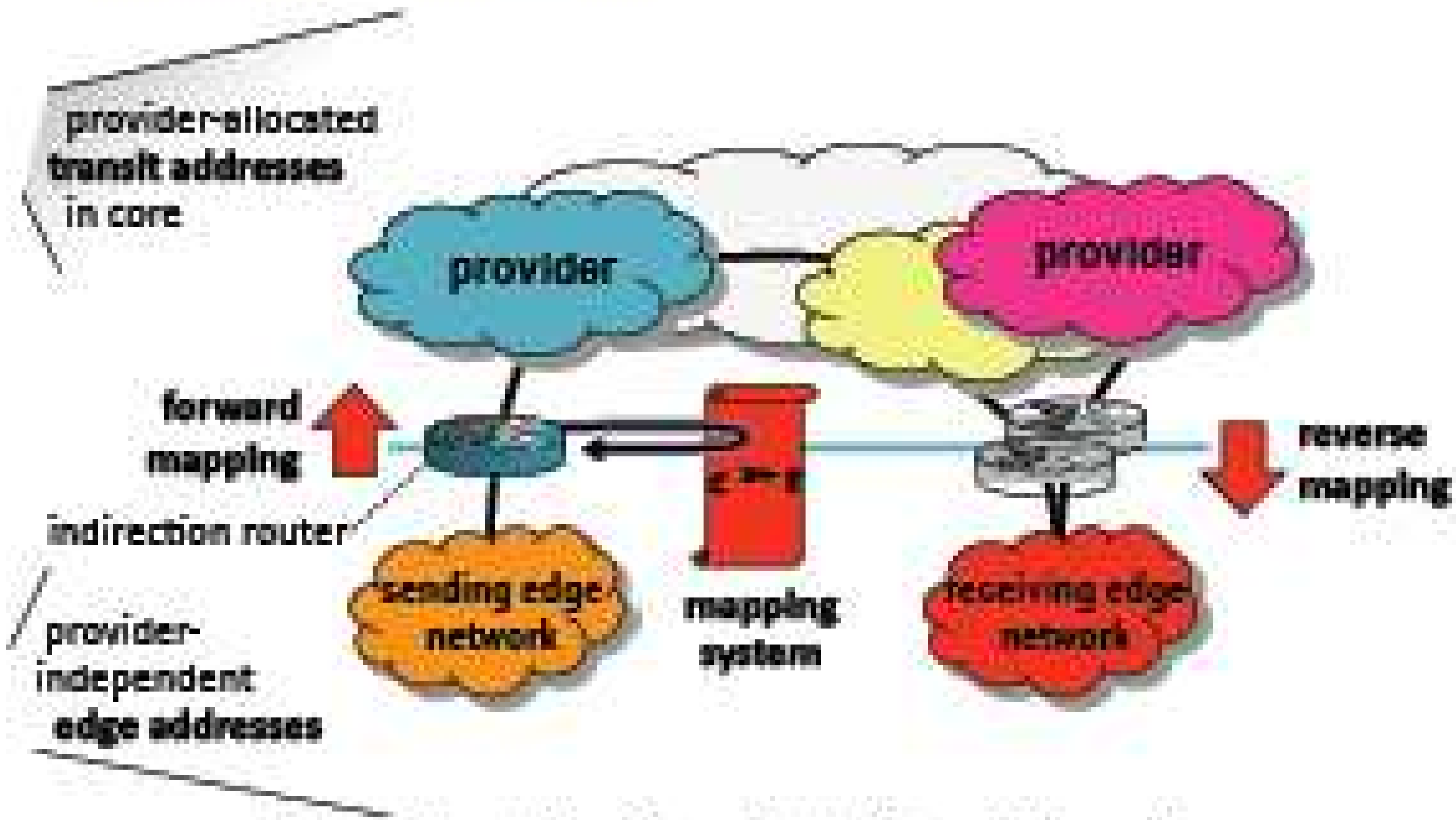
Active ASs



Activity 1.2 - Indirection layer

- Increase the flexibility of the routing system in a scalable manner, facilitating provider independency and traffic-engineering-compatible multi-homing
- Solutions will be based on a separation of the currently overloaded functions of IP addresses as host identifiers and packet-forwarding directives.
- Contribute solutions to the Internet Research and Engineering Task Forces (IRTF, IETF), and back up the solutions with prototypes.

Address Indirection

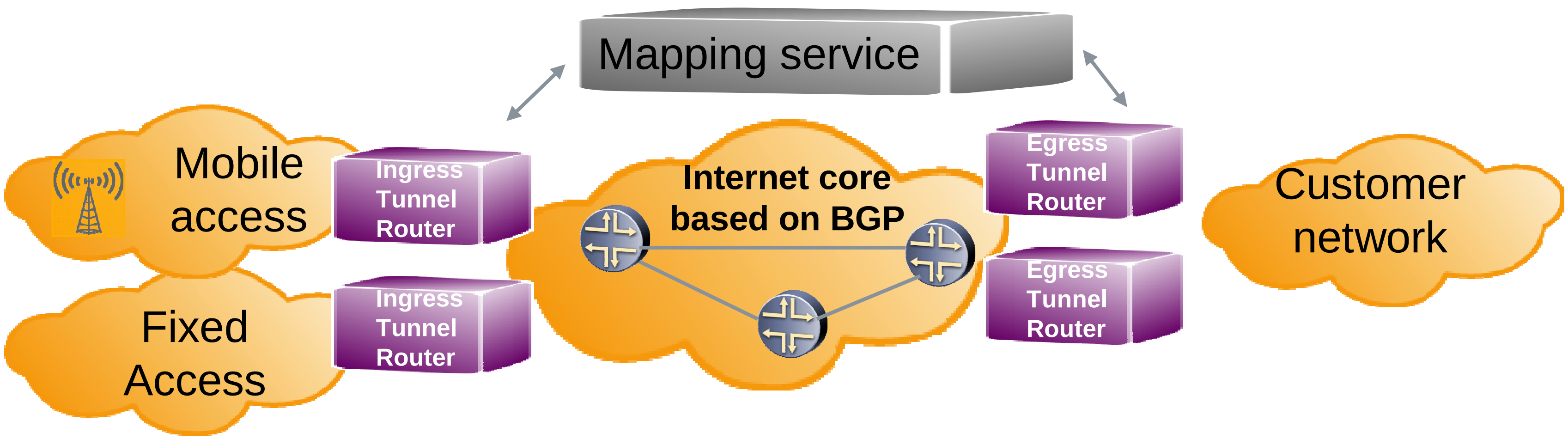


- decouples addressing at edge from Internet core
- global mapping system for remote edge addresses

Source: C. Vogt/Ericsson

Indirection by tunneling - LISP

- Ingress Tunnel Router
  - Encapsulates
  - Caches Mapping information
  - Located in Customer network
- Egress Tunnel Router
  - Decapsulates, advertises EID -> RLOC bindings to the mapping service
- End point and locator address spaces are bound together with mapping infrastructure



Host based Multi-homing approach

- Use of DNS “hints” and SCTP to deal with multi-homing
- FQND has several A and/or AAAA records
- Applications should try to initiate connections to more than one address
- No need for Provider Independent Addressing (eliminates PI need)

Activity 1.3 - Address aggregation and Mapping Systems

- Create new ways of aggregating routing information possibly with an evolution path from the current prefix and BGP based system
- Study Mapping System alternatives:
  - Push: full mappings are pushed (similar to BGP routing table distribution)
  - Pull, Hybrid Push-Pull
  - DNS
  - DHT

- Impact of peering relationships between the IPS and roaming agreements that are the basis for GRX and IPX

WP 1.4: Routing in the Network of Future

Task 1: Routing in power-law random graphs.

Power-law random graphs have no built-in structure like hierarchy, but an architecture with a ’softly hierarchical core’ and loglog *N* distances emerges spontaneously. These features make them relevant for Future Internet routing studies: a routing scheme that works on this topology will almost certainly work on the future Internet as well.

’Compact routing’ provides a starting point.

The work in this task focuses on identifying possible routing schemes and characterizing their performance and robustness.

References:

Norros, Reittu: Network models with a ’soft hierarchy’: a random graph construction with loglog scalability. *IEEE Network 22:2, 2008.*

Krioukov, Fall, Yang: Compact routing on Internet-like graphs. *Infocom 2004.*

WP 1.4: Routing in the Network of Future

Task 2: Scalable wire-speed routing

The objective is to create comprehensive understanding of routing in future networks and to study, develop and analyze alternative wire-speed routing and forwarding mechanisms. The emphasis is on layer 2 mechanisms complemented with layer 3 functionality.

People involved in WP1

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