ORGANISATION FOR ECONOMIC CO-OPERATION AND DEVELOPMENT

Measuring deployment of IPv6

Paris, 6 April 2010

Karine Perset, OECD

OECD reports:

- "*Measuring Deployment of IPv6*", April 2010
- "*Economic Considerations in the Management of IPv4 and in the Deployment of IPv6*", June 2008

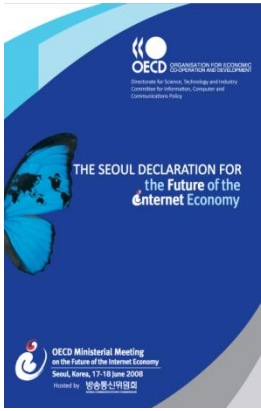
www.oecd.org/STI/ICT/IPv6 (available 7 April 2010)

Introduction

- IPv4 addresses nearing full allocation (8% remain in April 2009). Projected run out of previously unallocated IPv4 addresses in 2011-2012.

↳ Timely deployment of IPv6 increasing priority for ***all*** Internet stakeholders.

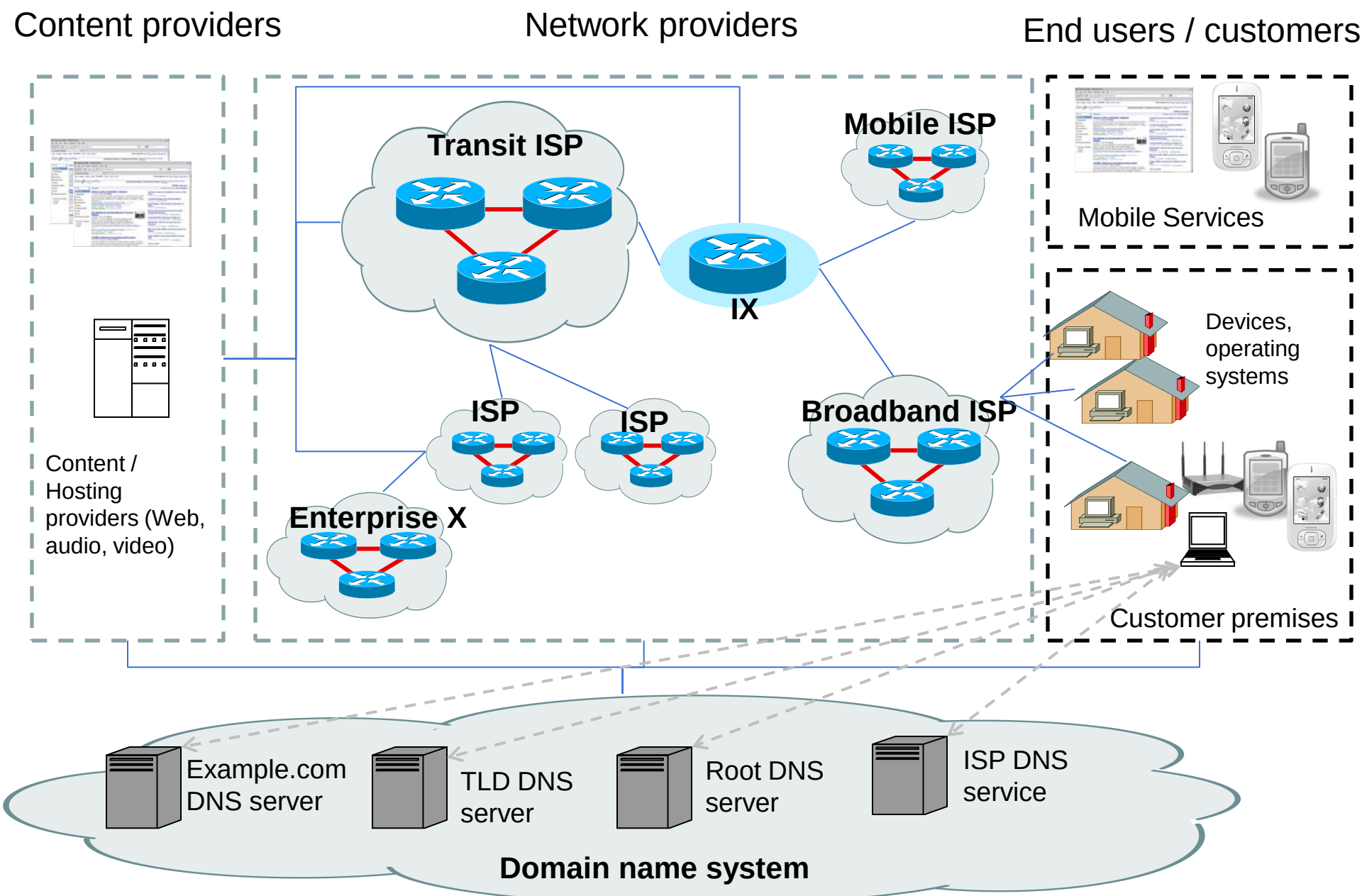
- *Seoul Declaration* of June 2008, Ministers highlighted importance of "encouraging IPv6 adoption, in particular through its deployment by the private sector and by governments."



- To this end, necessity of benchmarking IPv6 deployment

- **Objective**: present various data sets being used to monitor IPv6 deployment alongside IPv4 (dual stack)

Stylized view of the Internet

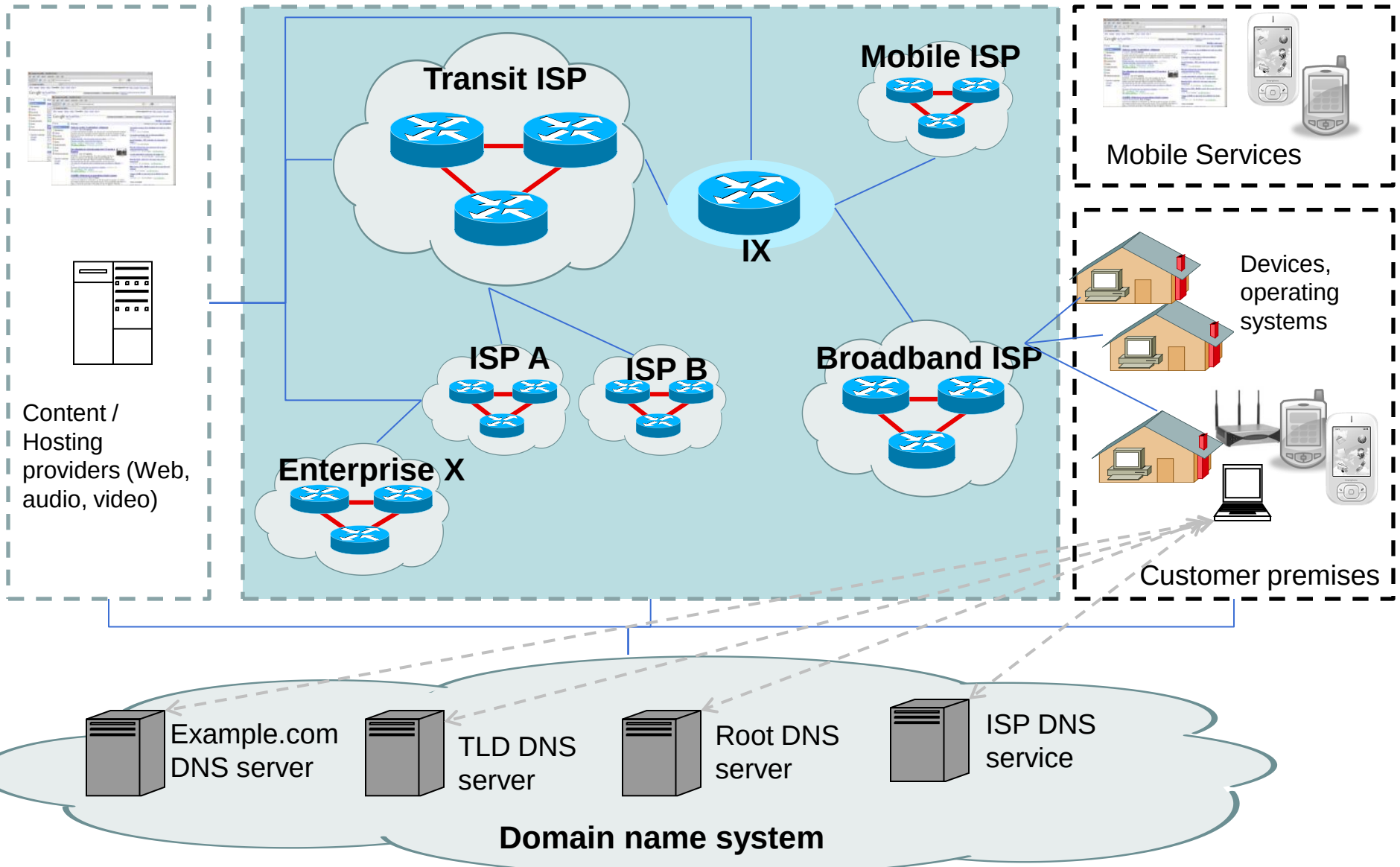


Zoom on **network providers**

Content providers

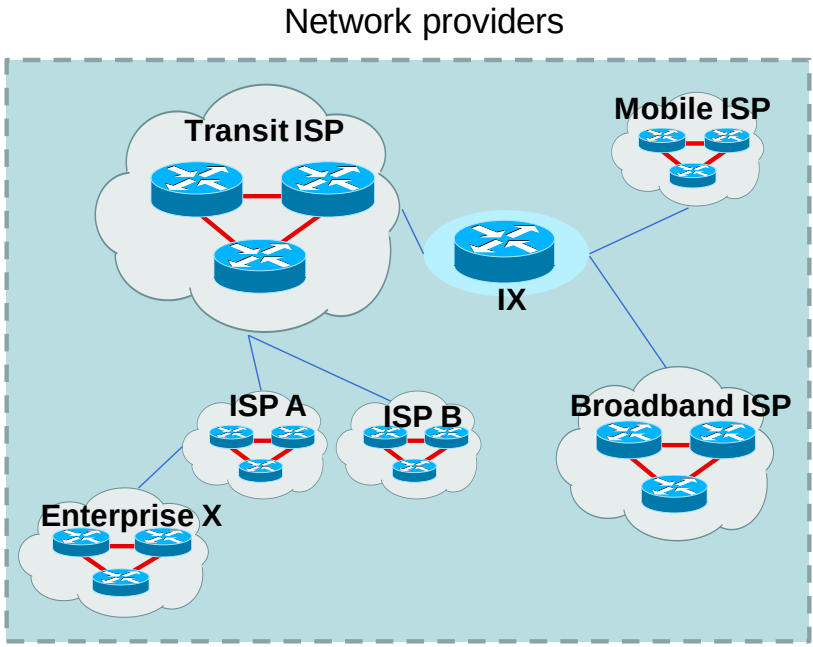
Network providers

End users / customers



Infrastructure readiness: networks running IPv6

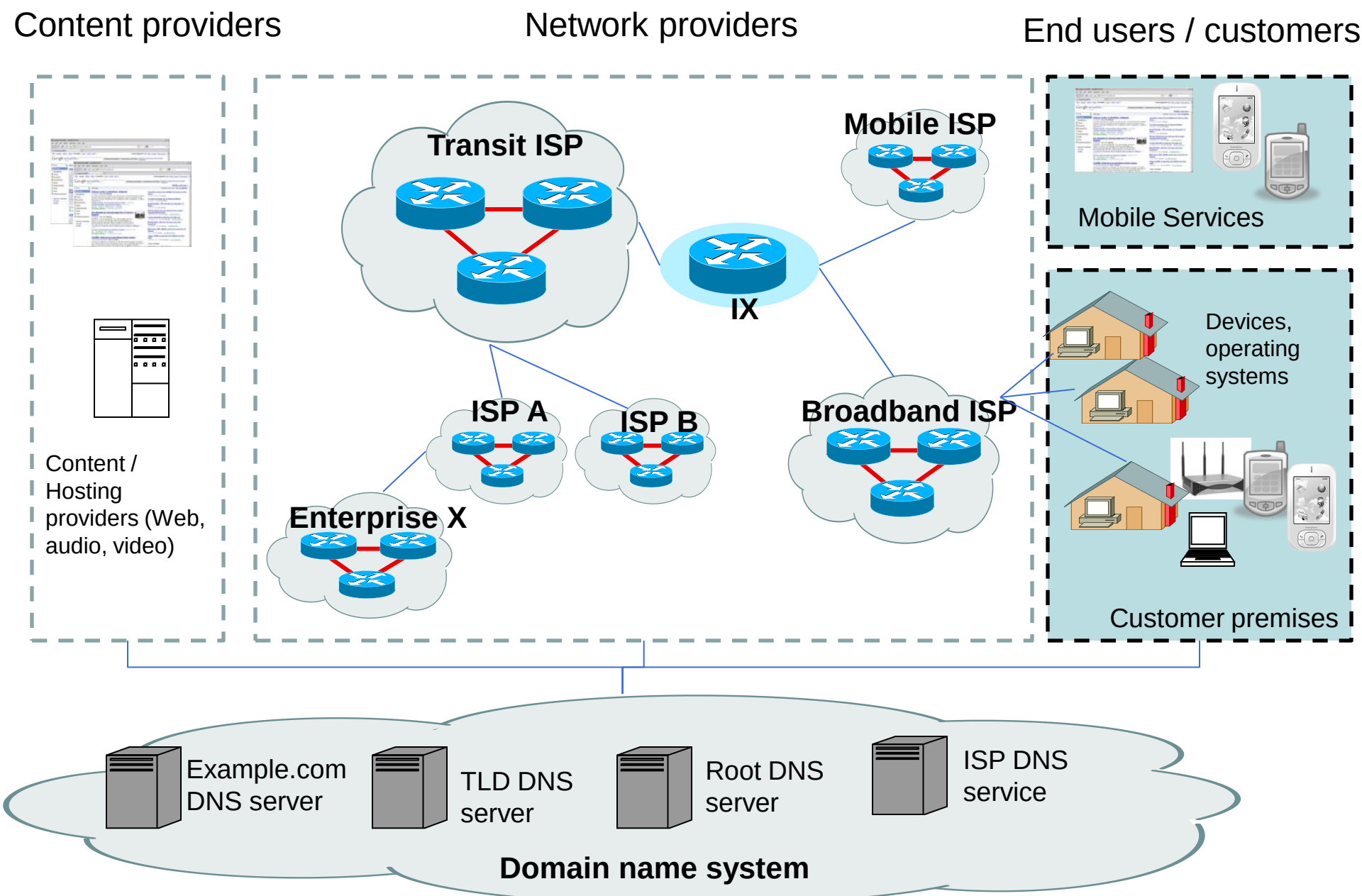
Networks that can run IPv6 & that propose IPv6 services are critical to IPv6 deployment.



- Over **5% of networks on the Internet** (1 800 networks) can handle IPv6 traffic. IPv6 networks have grown faster than IPv4-only since mid-2007.
- But **1 out of 5 of Internet infrastructure providers** (networks that provide connections through themselves to other networks) handle IPv6… this is encouraging!

- Top IPv6 networks different from IPv4 networks at this stage.
- Presence of **IPv6 peers**: top countries **DE**, **NL**, **US**, **CN**, **UK**.
- Number of **ISPs** offering native IPv6 service: top countries **DE**, **US**, **JP**, **UK**, **FR**.
- Native IPv6 **transit providers** services **:** top countries **DE, NL**, **UK**, **FR**, **US**.

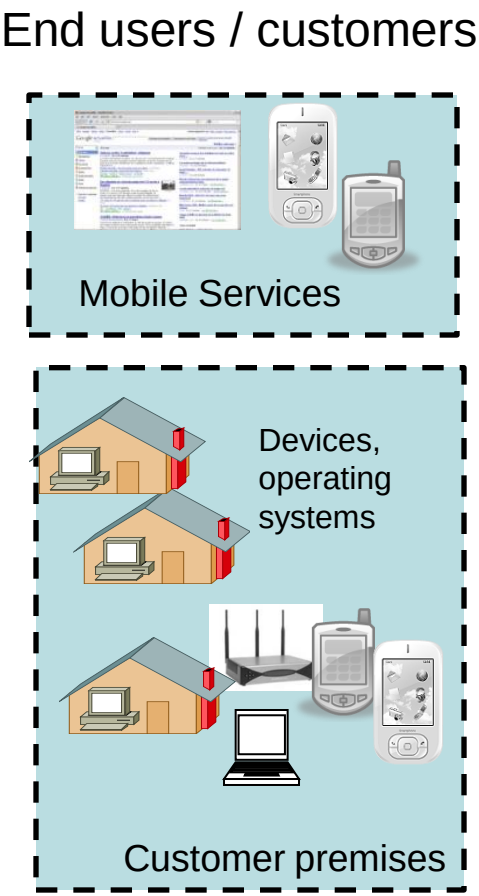
Zoom on **end users**



Infrastructure readiness: end user equipment

The penetration of operating systems that support IPv6 indicates the number of Internet computers/ devices ("end-hosts") that can run IPv6 if IPv6 connectivity is available.

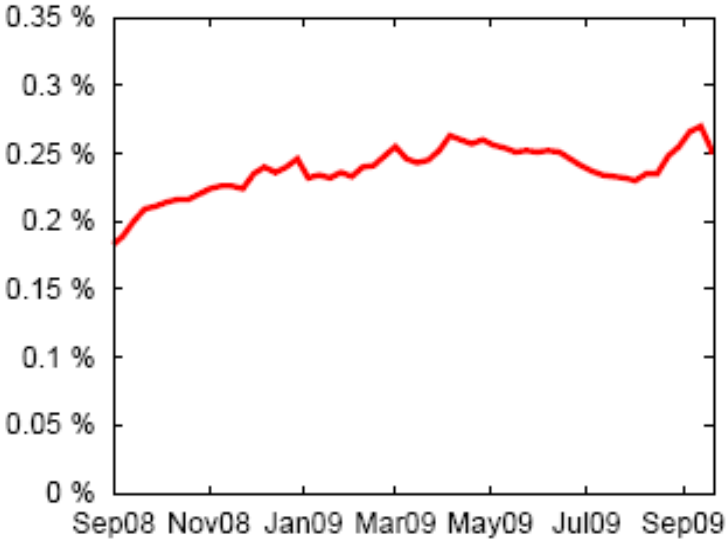
- Over **90%** of the installed base of operating systems is IPv6-ready, but often requires extra configuration.
- Roughly **25%** of end users run an operating system that **supports IPv6 by default**, in particular Windows Vista or Mac OS X.



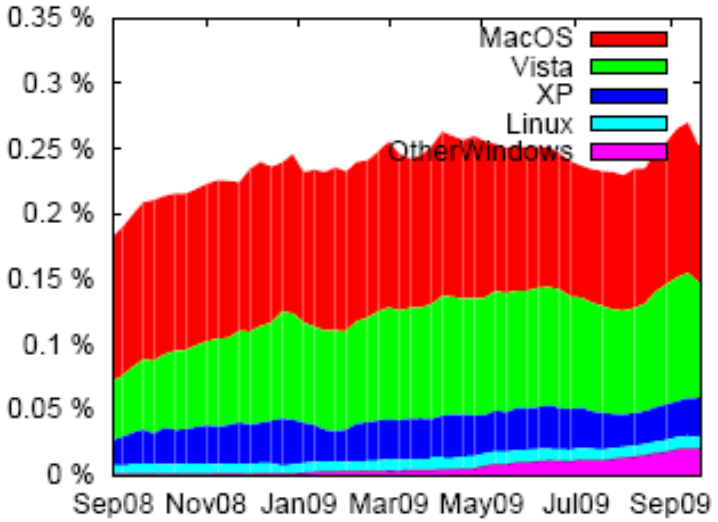
Actual use: end user systems (1/1)

End-user systems that chose IPv6 when given the choice (dual-stack) and have IPv6 connectivity is a very important indication of IPv6 uptake by users.

Working IPv6 over time.



Working IPv6 by operating system.

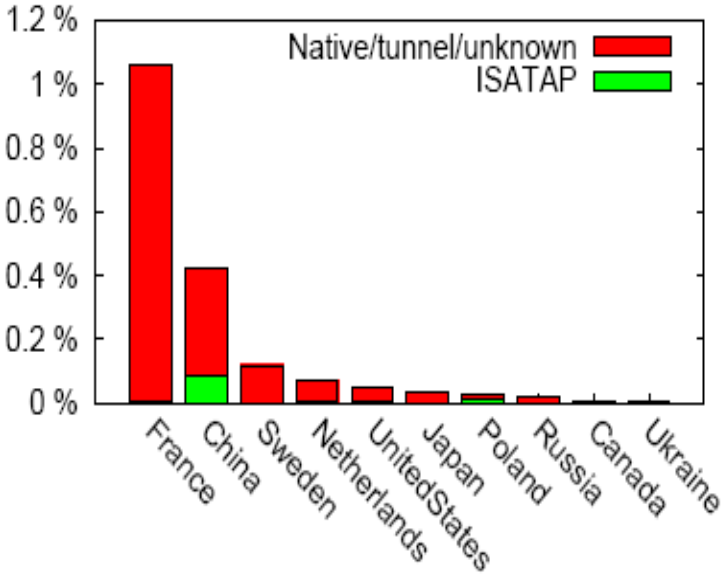


Source: Evaluating IPv6 Adoption in the Internet, April 2010, Lorenzo Colitti, Steinar H. Gunderson, Erik Kline, Tiziana Refice, under submission at PAM 2010.

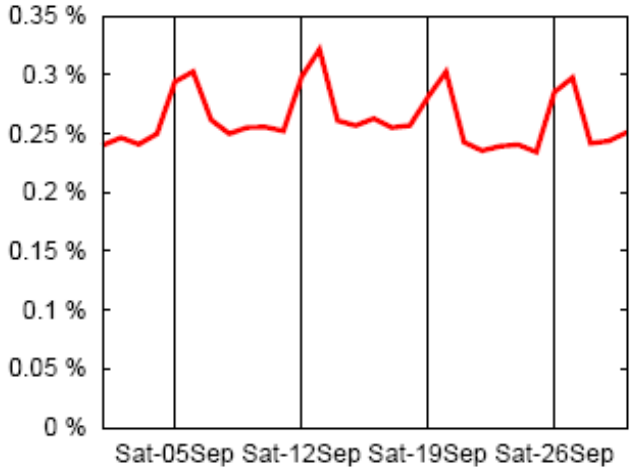
- One year experiment by Google: **0.25% of users were IPv6 capable by September 2009, up from less than 0.2% one year before**. (more technically-oriented web sites find that about 1% of end-users connect via IPv6 when possible).
- Mostly Mac OS X and Windows Vista operating systems enable IPv6 by default.

Actual use: end user systems (2/2)

Working IPv6 ratio for top-10 countries, non-relayed only.



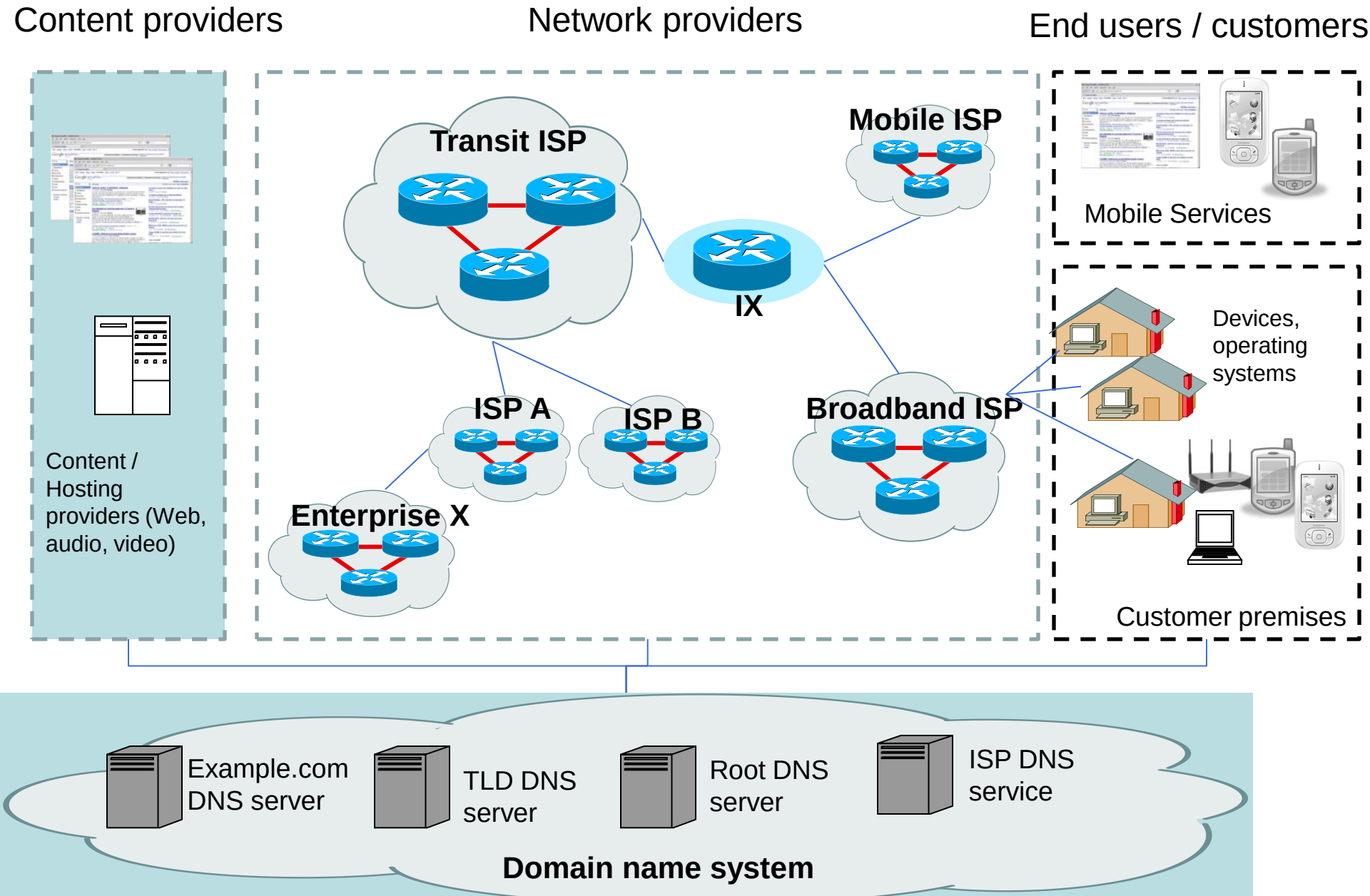
Daily working IPv6 in August 2009.



Source: Evaluating IPv6 Adoption in the Internet, April 2010, Lorenzo Colitti, Steinar H. Gunderson, Erik Kline, Tiziana Refice, under submission at PAM 2010.

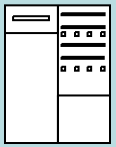
- Google's experiment finds the networks originating most IPv6 traffic are universities or research institutions. Notable exception of free.fr in France.

Zoom on the **domain name system & content providers**



Infrastructure readiness: **Content providers**

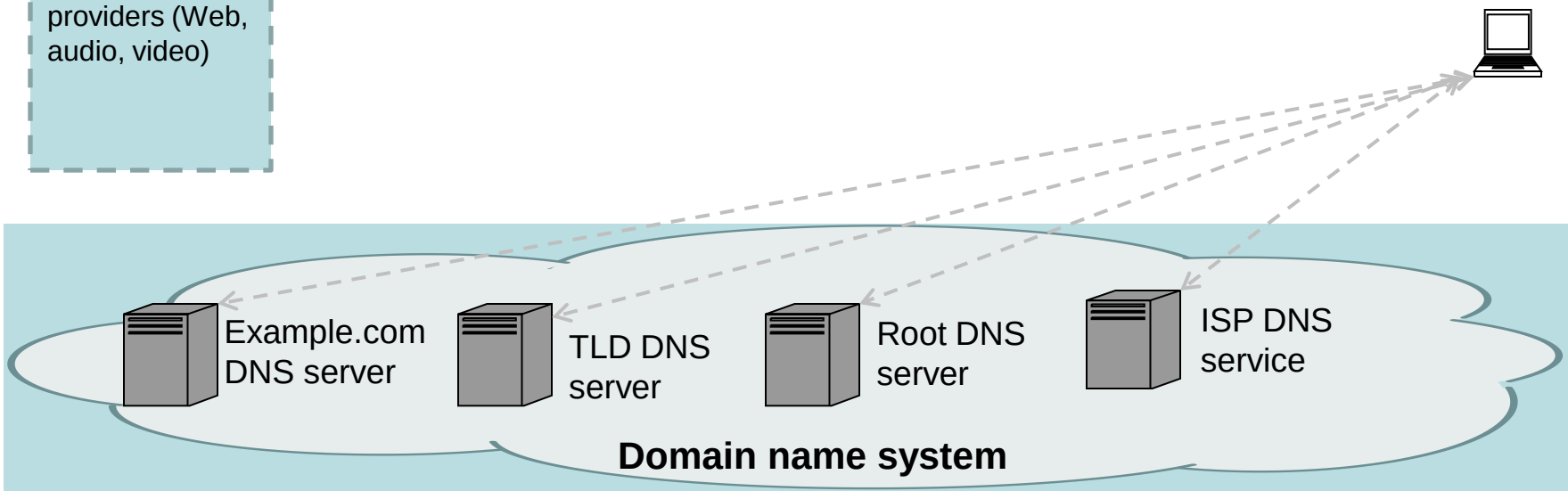
IPv6 support by content providers and latency of IPv6 websites.



Content / Hosting providers (Web, audio, video)

- **1.45% of top 1000 websites have an IPv6 website**. Only 0.15% of the top 1 M do.

- **Native IPv6 latency** similar to IPv4. Latency of non-native/relayed IPv6 content > IPv4



Main points

- The Internet is in the early stages of a transition to IPv6 whereby end hosts, networks, services and middleware are shifting from IPv4-only to support both IPv4 and IPv6 (dual-stack).

- IPv6 still a small proportion of the Internet. Nonetheless, positive signs:
  - The use of IPv6 is increasing ***slighly faster*** than the (continuing) use of IPv4.
  - Some ***large-scale deployments /plans*** (*e.g.* Google, Free.fr, Verizon LTE…)
  - ***Increasing awareness*** of future addressing needs

- Need for significant increase in adoption of IPv6 to satisfy foreseeable demand for Internet deployment.

⇩ Actors will face significant pressure as the IPv4 address pool depletes.

⇩ Deployment of IPv6 a priority for ***all*** Internet stakeholders, including governments.

ADDITIONAL SLIDES

WHY IS THE IPV4/IPV6 ISSUE RELEVANT TO PUBLIC POLICY MAKERS?

1. Public institutions rely on Internet as others

2. Internet as platform for innovation & growth requires IPv6

- IPv6 necessary for Internet economy growth LT the alternatives entail unacceptable risks
  - Limitations on scalability (dense NAT without IPv6)
  - Hurried/unstable IPv6 deployment (wait and rush).
- Need to promote interoperability where possible
- As IPv6 becomes norm, IPv6 expertise key for economic competitivity.

3. Competition concerns regarding IPv4:

- New entrants will need IPv4 resources to interoperate with IPv6.
- Need ability to transfer addresses between parties.

ALL STAKEHOLDERS, INCLUDING GOVERNMENTS, HAVE A ROLE TO PLAY…

Government's role is not about regulation, but about working with technical experts and business to:

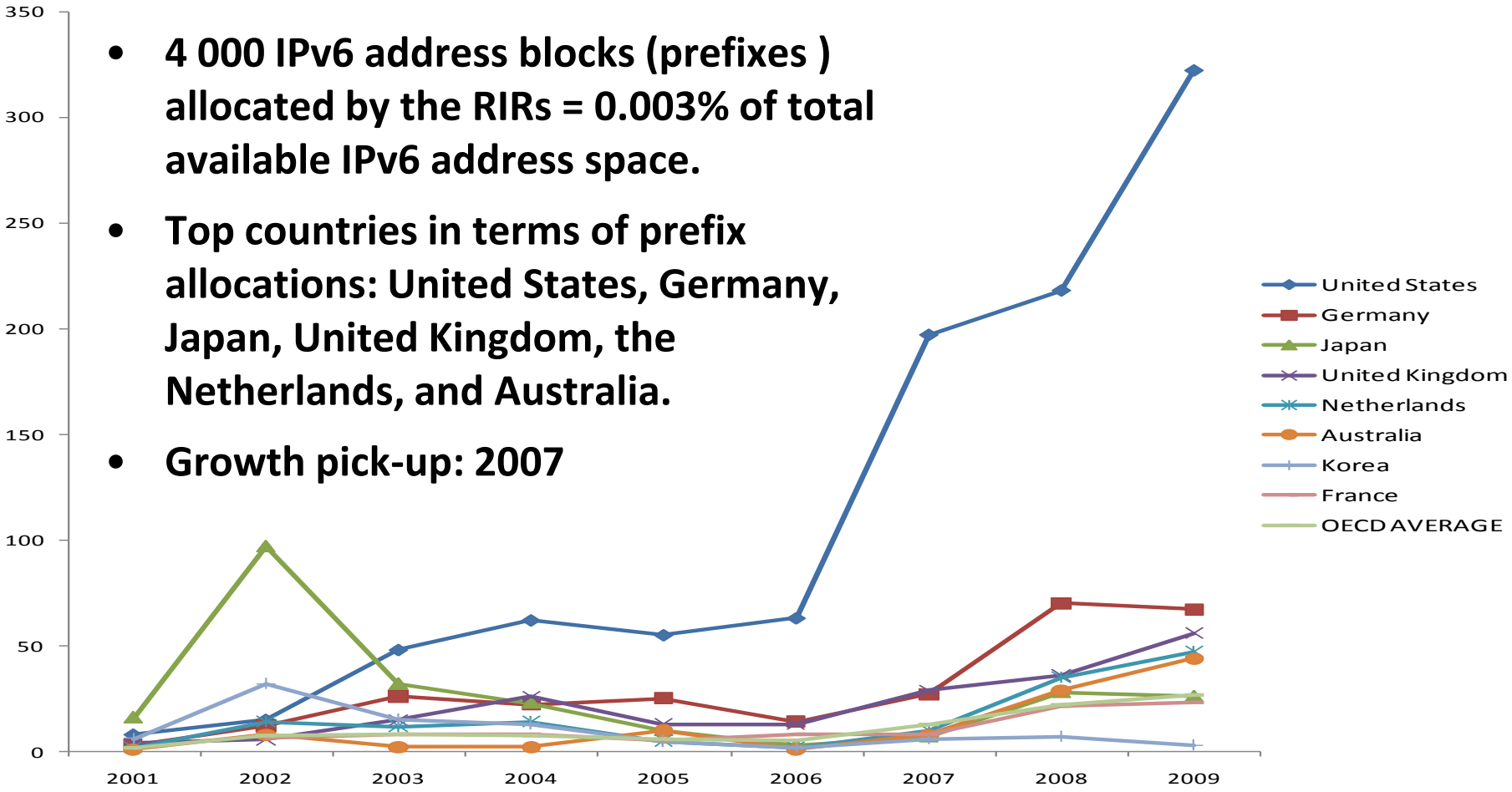
- Role 1: Build awareness of issue & help to ease bottlenecks through multi-stakeholder co-operation.
- Role 2: Being early adopters.
- Role 3: International co-operation and helping to monitor progress of deployment.

Need for multi-stakeholder co-operation.

Infrastructure readiness: RIR allocations of IPv6 address blocks

RIR allocations of IPv6 address space shows interest in potential IPv6 deployment, since obtaining IPv6 address space is a first step in deploying IPv6.

- **4 000 IPv6 address blocks (prefixes) allocated by the RIRs = 0.003% of total available IPv6 address space.**
- **Top countries in terms of prefix allocations: United States, Germany, Japan, United Kingdom, the Netherlands, and Australia.**
- **Growth pick-up: 2007**



Numbers of IPv6 allocations per year, top 8 OECD countries, 1999-2009

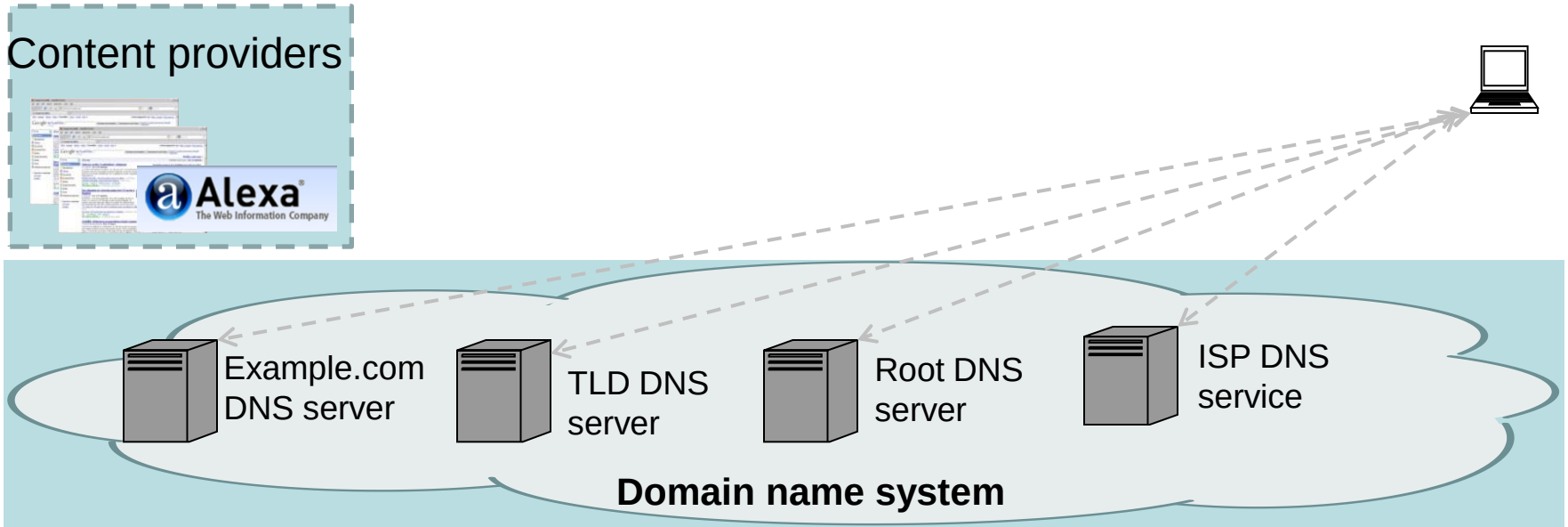
Infrastructure readiness: **the domain name system**

IPv6 support in the Domain Name System (DNS) enables IPv6-enabled computers ("hosts") to reach other IPv6-enabled computers.

- **Root DNS servers***:* 7 out of 13 have IPv6 records.
- **Top-Level Domains (TLDs):** 65% have IPv6 records in the root zone. 80% have IPv6 name servers.
- > 1.5 million **domain names** ± 1% of domain names registered have IPv6 records.

DNS data also indicates IPv6 support by content providers and latency of IPv6 websites.

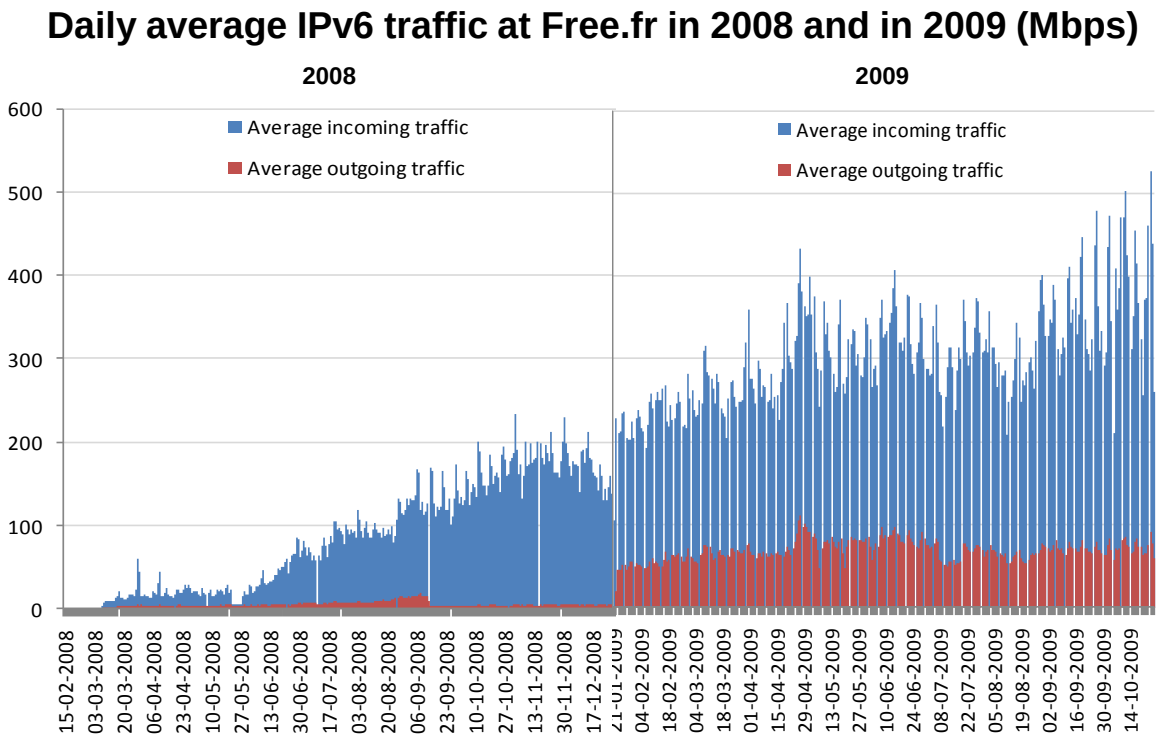
- 1.45% of **top 1000 websites** have an IPv6 website. Only 0.15% of the top 1 M do.
- **Native IPv6 latency** similar to IPv4. Latency of non-native/relayed IPv6 content > IPv4.



2) Actual use: external IPv6 traffic

The percentage of traffic that uses IPv6 on the Internet is a general indication of uptake of IPv6, although there are numerous caveats.

- At free.fr, a French IPv6-enabled ISP, IPv6 traffic per opt-in customer represented on average some 3% of each customer's **external** traffic in October 2009.
- 400 000, or 10% of subscribers, opted in.

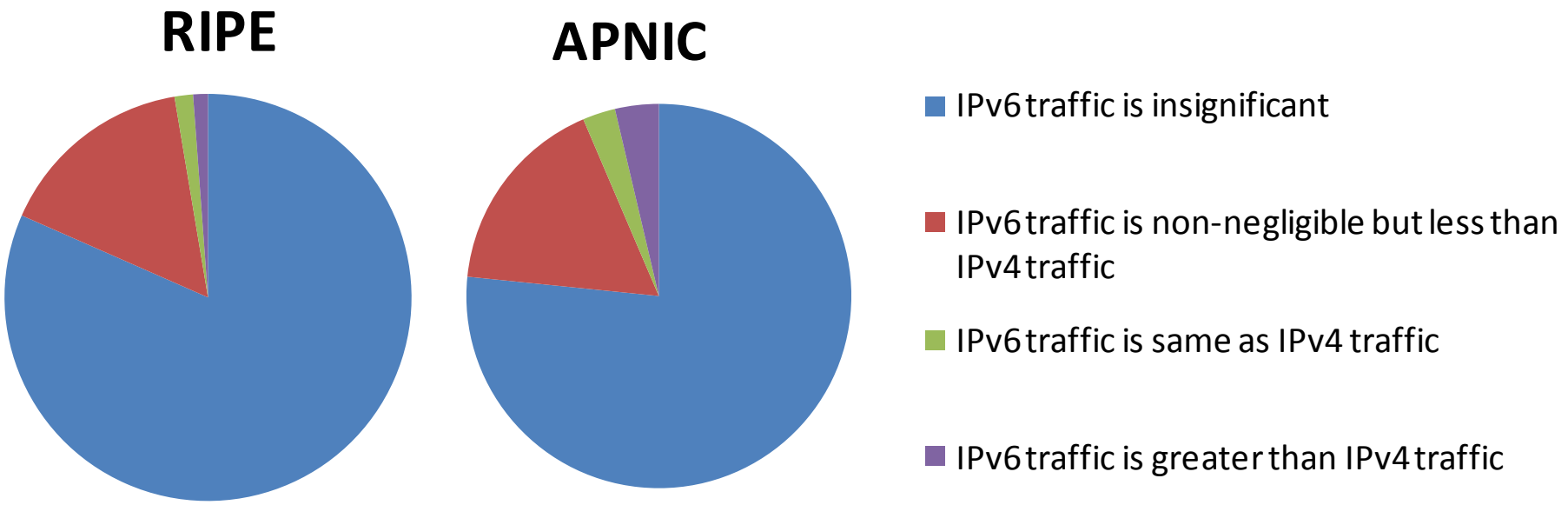


- At one of the largest IXPs, AMS-IX, 0.3% of the total traffic exchanged was IPv6.

3) Survey data from RIPE and APNIC service areas

Survey data provides some insight on network operators' planned IPv6 deployments and perceived barriers. Overall, levels of deployment seem similar in the Asia-Pacific region and the Europe, the Middle East and parts of Central Asia.

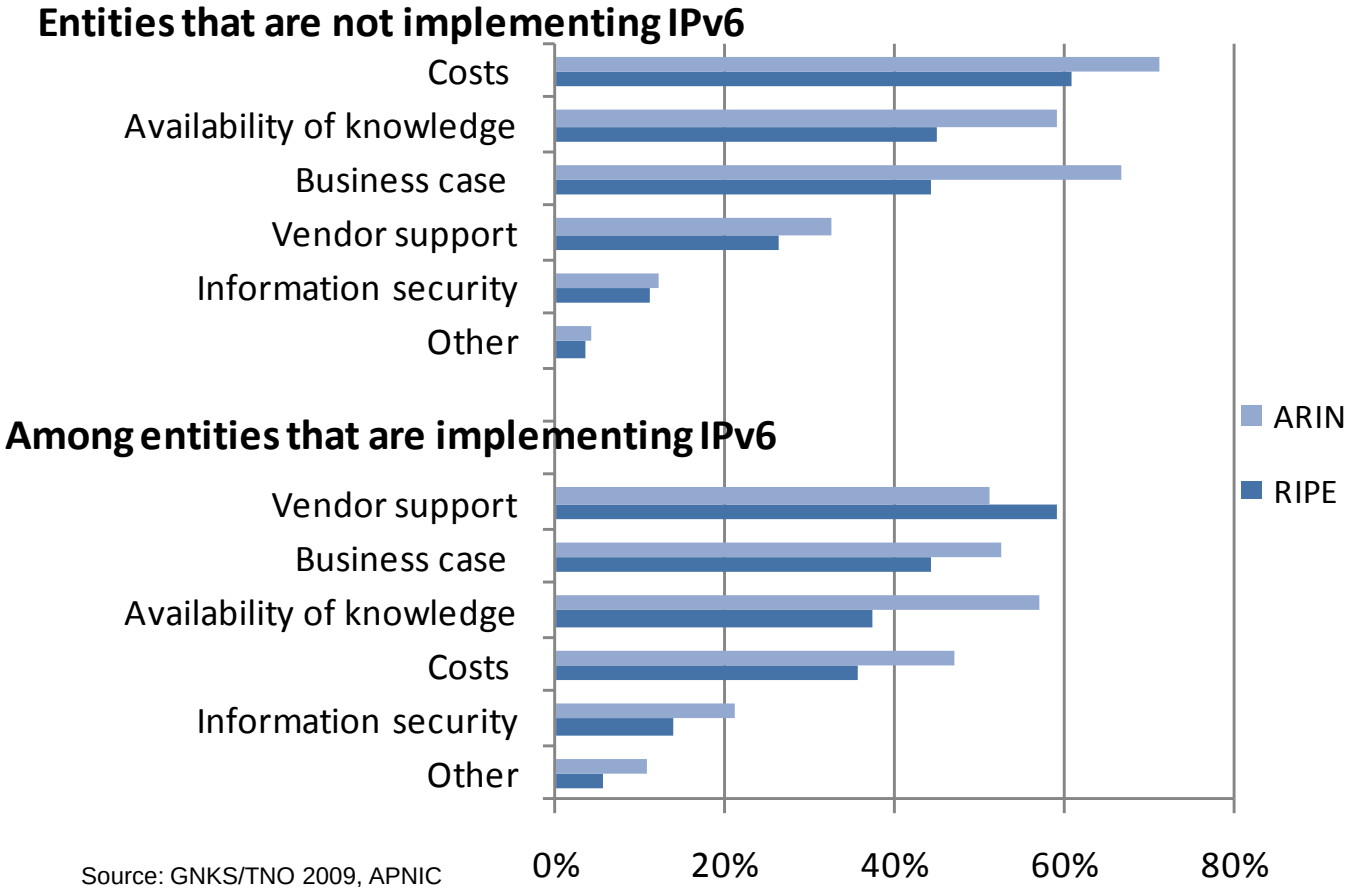
IPv6 traffic compared to IPv4 traffic for institutions that have implemented IPv6



Source: GNKS/TNO 2009, APNIC

3) Survey data from RIPE and APNIC service areas

Expected largest hurdle(s) for organizations to deploy IPv6



Source: GNKS/TNO 2009, APNIC

Lack of vendor support remains a barrier to IPv6 deployment as does the lack of business models.