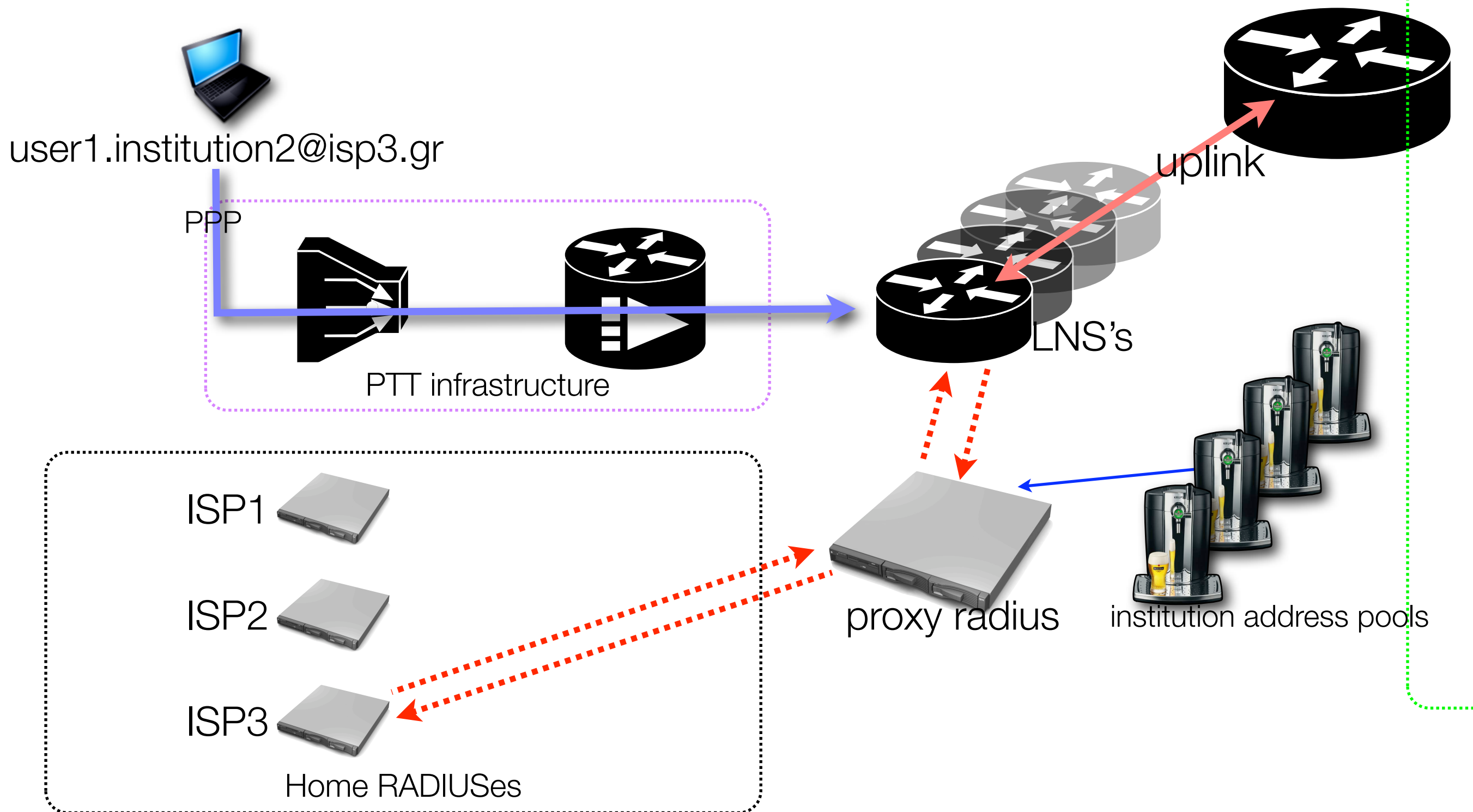


IPv6 deployment on a broadband access network

Athanasios Douitsis

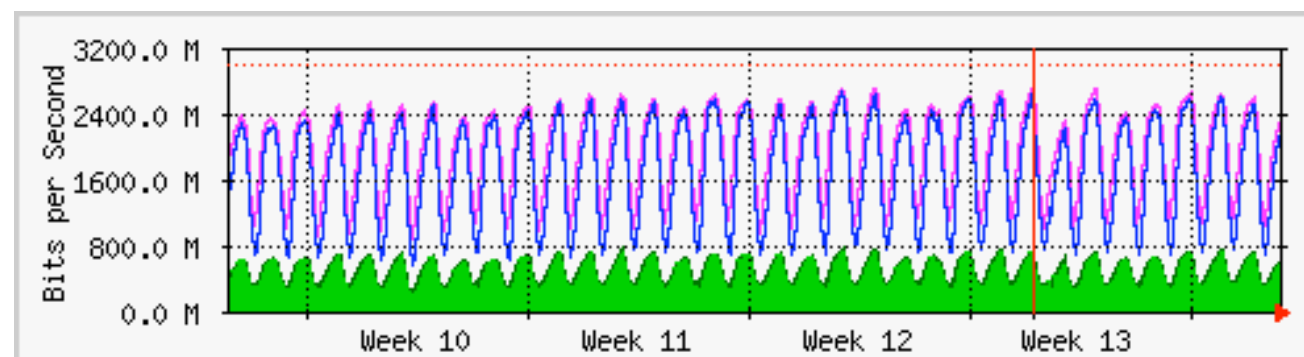
National Technical University of Athens / Greek Research Network

EduDSL in a nutshell



Present Status

- 50 institutions - provisioning of IP addresses
- 30,000 users - assignment of IP to each user according to affiliated institution
- 3 commercial ISPs - user account management, billing, accounting
- Greek Research Network - connectivity, administration, equipment
- 9 LNS's, 3 Gigabit uplinks, 2 Proxy RADIUSes



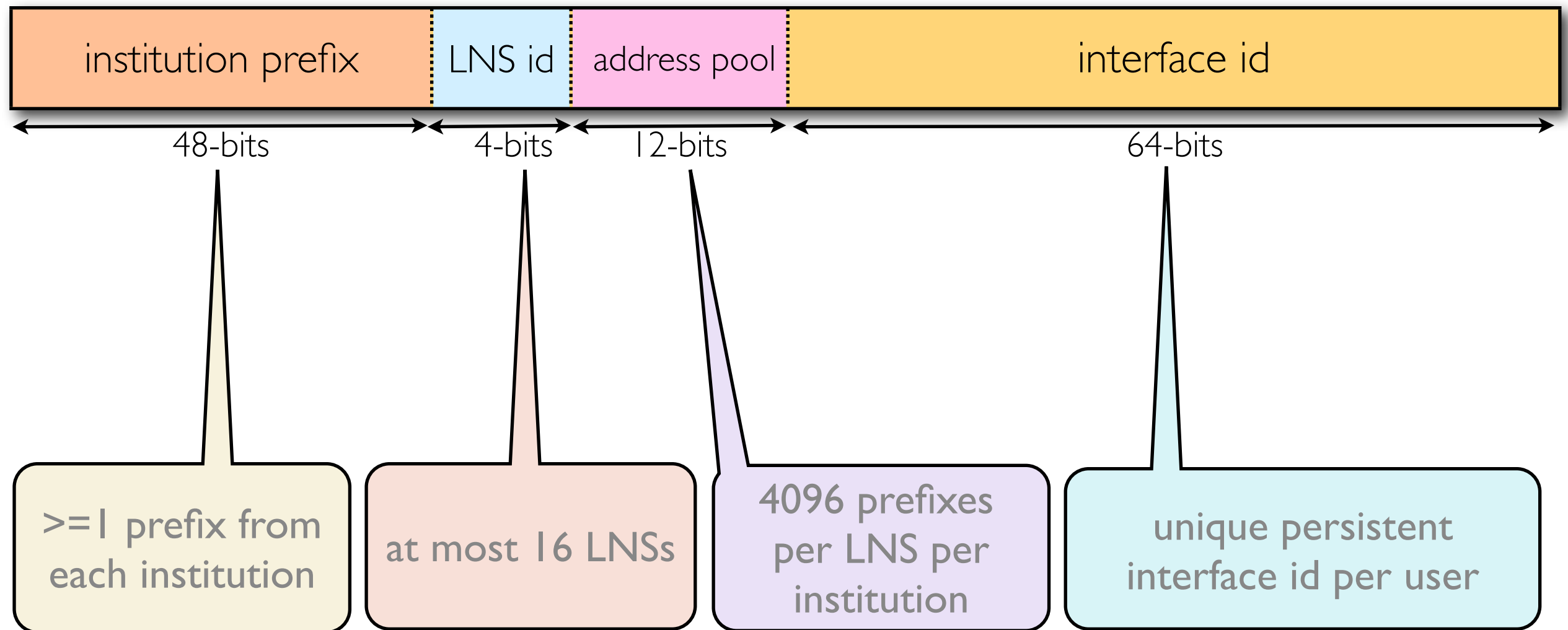
A. Douitsis - IPv6 deployment on a broadband access network

Objective: Native IPv6 over PPP (PPPo6)

- IPv6-enabled PPP connections
- IPv6-enabled home LAN support (behind CPE)
- IPv6 accounting
- No user action necessary
- EduDSL-specific: IPv6 addresses per institution
- EduDSL-specific: ISP RADIUSes unaffected
- CPE: Windows Vista, MacOSX, GNU/Linux, FreeBSD, other vendors

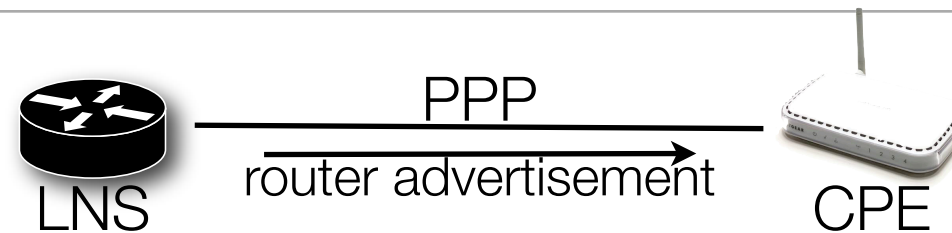
Addressing Scheme

- **2 /64** prefixes for each user (1 PPP, 1 Home LAN).



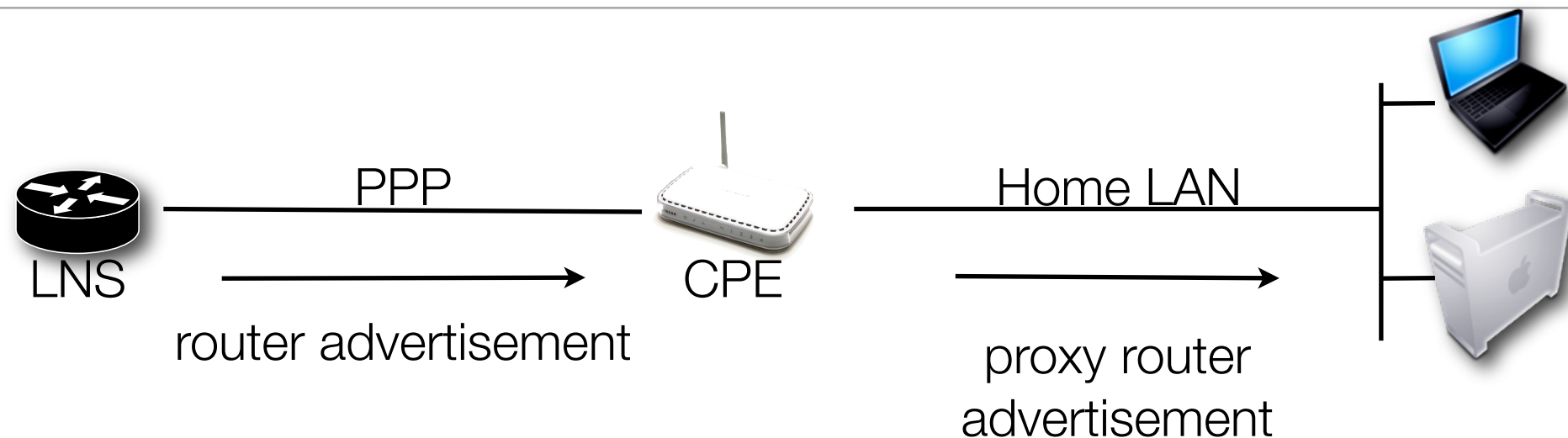
- **ipv6 local pool inst2-pool 2001:648:2001::/52 64**

IPv6 over PPP (RFC 2472)



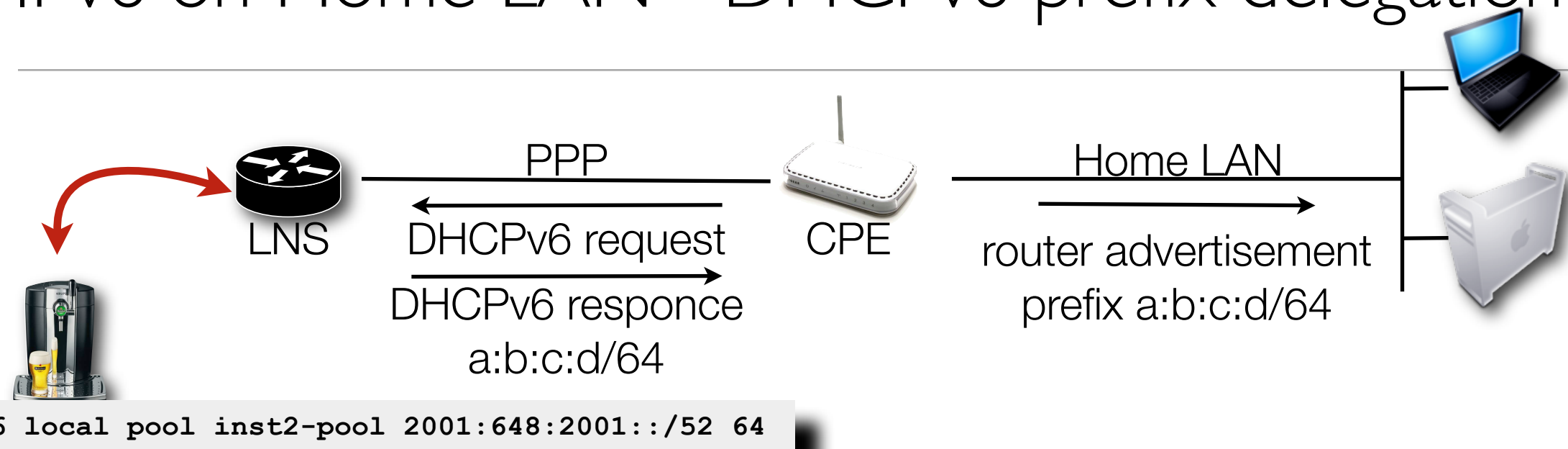
- LCP unchanged
- IPv6CP
 - (Optional) Interface ID - lower 64 bits settable by the LNS
- IPv6 Address auto-configuration over established link after PPP start
- Recommendation for /64 prefixes

IPv6 on Home LAN - Neighbor Discovery Proxies



- RFC 4389
- Proxying of ICMPv6 ND messages to the Home LAN
- Only 1 /64 prefix needed per user for both PPP and Home LAN
- No known implementations at this point - adoption postponed

IPv6 on Home LAN - DHCPv6 prefix delegation



- Request of additional prefix by the CPE
- DHCPv6 requests and responses over the PPP link
- delegation of IPv6 /64 prefix to the CPE by the LNS
- Home LAN enumerated using address auto-configuration and the delegated /64 prefix

RADIUS attributes for IPv6



RADIUS

← access request

→

access accept

Framed-IPv6-Pool = inst2

Framed-Interface-Id = aaaa:bbbb:cccc:dddd

←

accounting (start/stop)

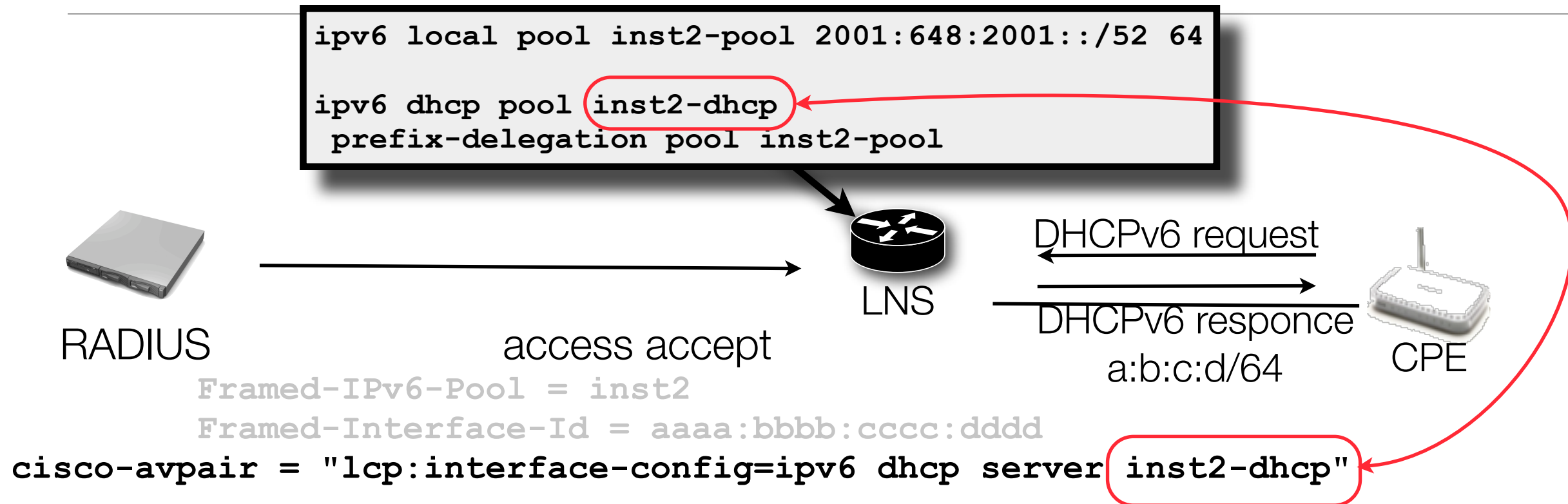
Framed-Interface-Id = aaaa:bbbb:cccc:dddd



LNS

- Framed-IPv6-Pool
- Framed-Interface-ID

RADIUS attributes for IPv6 Prefix Delegation



- EduDSL: Usage of the same prefix pool for PPP and Home LAN
 - Simpler configuration
 - Uniformity
 - Efficient Usage

IPv6 DNS *(see RFC 4339)*

- RFC 5006: IPv6 Router Advertisement Option for DNS Configuration -- not available
- Anycast DNS -- to be evaluated later
- DHCPv6 stateless mode - used for EduDSL
- “Other” options flag in LNS RA
- Ability to include other options in the future: SNTP server etc.
- Works harmoniously with IPCP-defined DNS settings for IPv4

```
ipv6 dhcp pool inst2-dhcp  
prefix-delegation pool inst2-pool  
dns-server 2001:648:2FFC:100::2211
```

IPv6 accounting

- Based on Framed-Interface-ID (== lower 64-bits of PPP IPv6 Address)
- 1 unique Framed-Interface-ID per unique user
 - Generation of Framed-Int-ID by hashing '*user1.inst2@isp3.gr*' to 64-bits
 - Other option: Storage of IDs into DB
- Optional adoption by ISP Home RADIUSes

Problems & Workarounds

- Cisco IOS: IPv4+IPv6 ACL name clash on dual stack virtual templates -- serious
 - kill ACLs from virtual template (d'oh!)
- DHCPv6: Crazy, buggy or malevolent clients -- address exhaustion, need for resource controls
 - Critical
- Accounting: Missing of some IPv6-* RADIUS attributes from Acct. messages
 - Usage of Frame-Interface-ID

Problems & Workarounds - 2

- DHCPv6 prefix delegation: No way to configure using IETF RADIUS attributes
 - Use VSA pairs (IOS virtual profile cloning disabled?)
- DHCPv6 accounting
 - Critical

Why not static IPv6 prefixes per user?

✓ Simplified RADIUS configuration

✓ easy setup of DHCPv6 prefix delegation

✓ decoupling from LNS implementation

- But: random destination LNS for each PPP session -- very bad for routing
 - Tens of thousands of IGP routes constantly changing

Current Status

- IPv6 enabled test accounts to selected individuals
 - Native IPv6 CPEs
 - PPPoE and Vista
- Proxy RADIUS changes readily available
- Windows Vista
 - Seamless home LAN enumeration by Internet Connection Sharing Agent

Future Directions

- Fixing of current problems (Accounting, DHCPv6)
- Investigation of a tunnel switch possibility
- IPv6-enabling of one institution
 - monitoring and fixing of problems
- Testing of a Juniper E-Series 320

Addendum -- JunOSel 0.1

- Framed-IPv6-Prefix required for NDRA over PPP link (cannot use Framed-IPv6-Pool yet)
- Framed-IPv6-Pool usable only for DHCPv6 Prefix Delegation
- Delegated-IPv6-Prefix (IETF) for DHCPv6 Prefix Delegation

Approaches:

- Use Framed-IPv6-Prefix and Delegated-IPv6-Prefix (RADIUS-centric)
- Use Framed-IPv6-Pool for DHCPv6 **and** Framed-IPv6-Prefix for PPP (awkward)

Thank You! Any Questions?

Many thanks to:

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GRNet NOC

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