Deploying IPv6 in IPv4 networks

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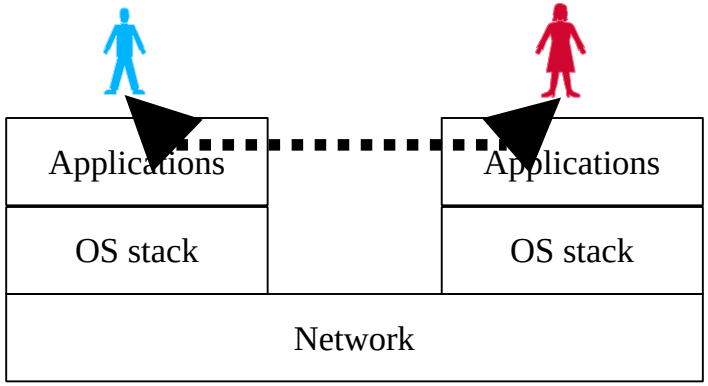
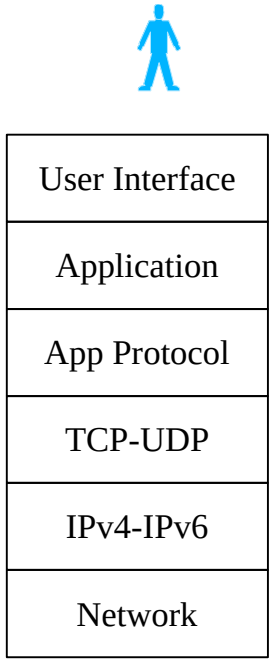
Plan

- Application
- IP stack
- Network
  - IPv6 transition mechanisms

User-app to User-app

- Three pieces
  - Application
  - IP stack
  - Network





User Interface

- Nothing to do except:

Porting Application to IPv6

- Few changes to socket calls
  - ex: gethostbyname() -> getaddrinfo()
- If user may enter/view an IP address
  - Address: 192.0.2.1
  - with IPv6: 3ffe:b00:1:1::1
  - URL: http://192.0.2.1:81/intro.html
  - with IPv6: http://[3ffe:b00:1:1::1]:81/intro.htmlfor most applications, code is localized and small
- After porting, the application becomes IP version independent
- Application chooses the IP version based on DNS answers

Application Protocol

- IP address processing inside the application protocol
  - New revision of the protocol
  - Possible signaling needs to be done
- Broadcast use -> Multicast
  - Need to register a multicast address
  - Some logic to change

Applications

- Applications need to be ported
  - Usually small changes for porting
  - Then deployed
- New applications
- One by one application

IP stack

- Integrated (or add-on) to operating system
- Manage the upgrading to a new version of the operating system that supports IPv6
- Features needed?
  - Default address selection
  - Mobility
  - IP security
  - etc.

IP stack and DNS

- Resolver/Default address selection
  - Typical rule is to prefer IPv6 over IPv4
  - Connections start using IPv6 transport
  - IPv6 must be at the same level of support than IPv4:
    - network wide
    - infrastructure wide
    - help desk

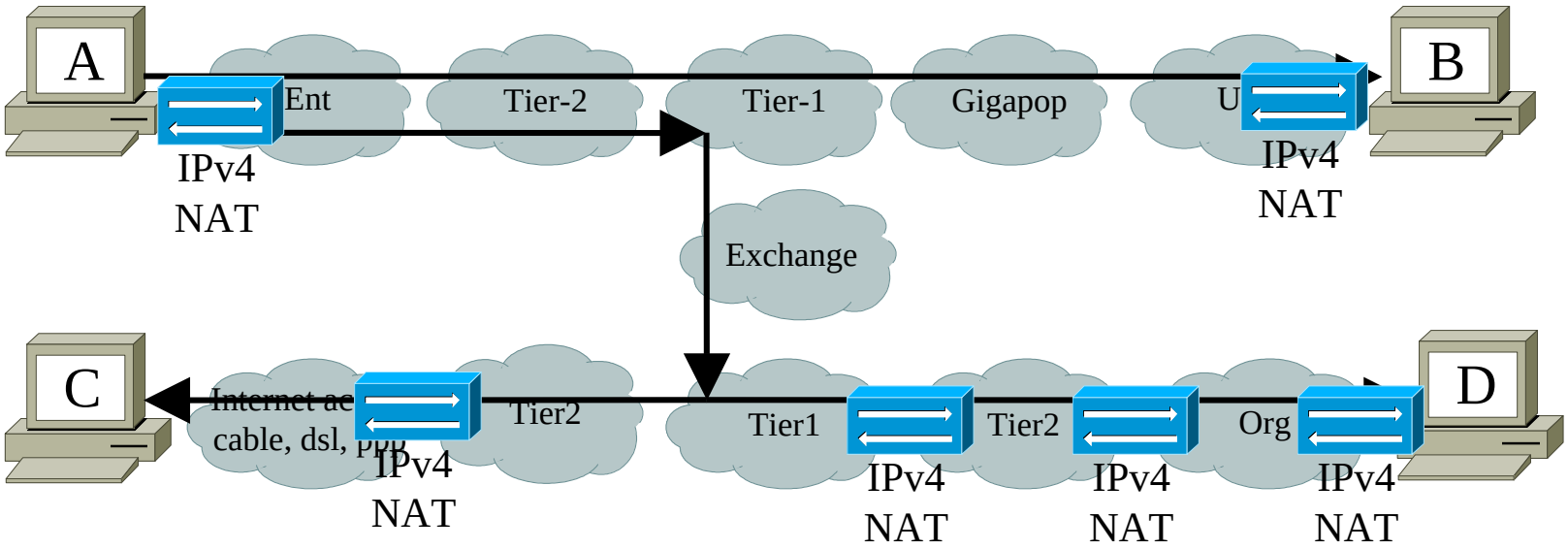
Users/Applications are IP agnostic

- Need ubiquitous IPv4 _and_ IPv6 connectivity, where all cases are handled
  - IPv4-only network access
  - IPv4-only network access with NAT in the path
  - Dual stack (IPv4,IPv6) network access
  - IPv6-only network access (not yet for most cases…)
  - Users are mobile: laptop/pda/cell phones/wearable/ in office, dorms, starbucks, home (with high-speed nat…), wifi hotspots…
- Need of a technology to handle all these cases “transparently” for the user

Network

- IPv6 native from source to destination:
  - Best
  - But not easy:
    - still in an IPv4 dominant network
    - parts you can not control: Internet, providers, public servers
    - parts you can not easily upgrade: “old” routers, firewalls, printers, etc.
    - non-availability of some solutions

From end to end



End to end reachability using IPv6.
Core to node: IPv6 last mile.

IPv4 Dominant Networks

- Tunneling techniques used as overlay over the IPv4 network
  - 6to4, ISATAP, Teredo, Tunnel broker/TSP, etc.
- Important considerations for tunneling
  - NAT in the path
    - you might not know if one is in the path
    - one might appear: if you are mobile
  - Security policies
  - MTU
  - Operational management

6to4

- Site solution
- Embedding the IPv4 external address in the IPv6 prefix
- Automated tunneling between 6to4 sites
- Need a 6to4 relay for non 6to4 sites
- One entry/exit point
- Does not traverse IPv4 NAT
- RFC 3056

ISATAP

- Site solution
- Makes a virtual link-layer over the IPv4 network
- Does not traverse IPv4 NAT

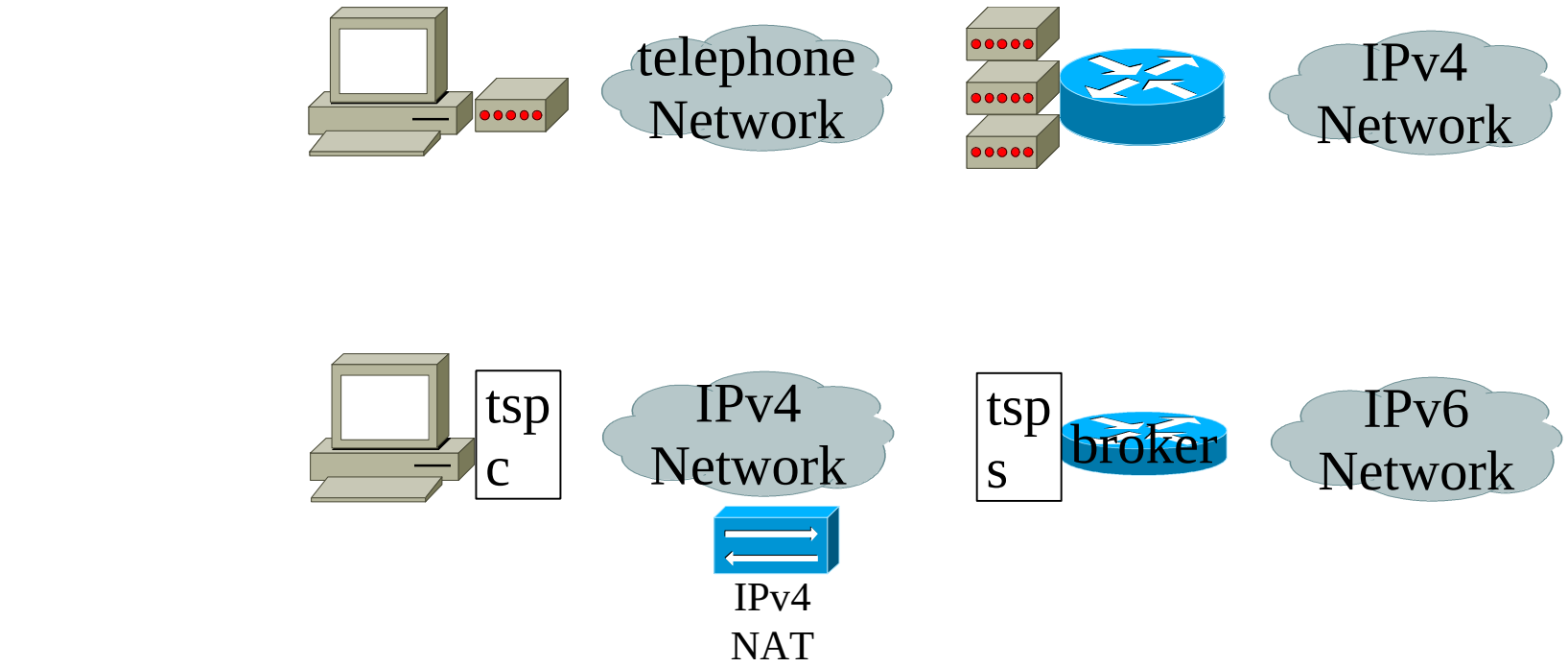
Teredo

- Host solution
- Traverse NAT
- Needs Teredo server and relay

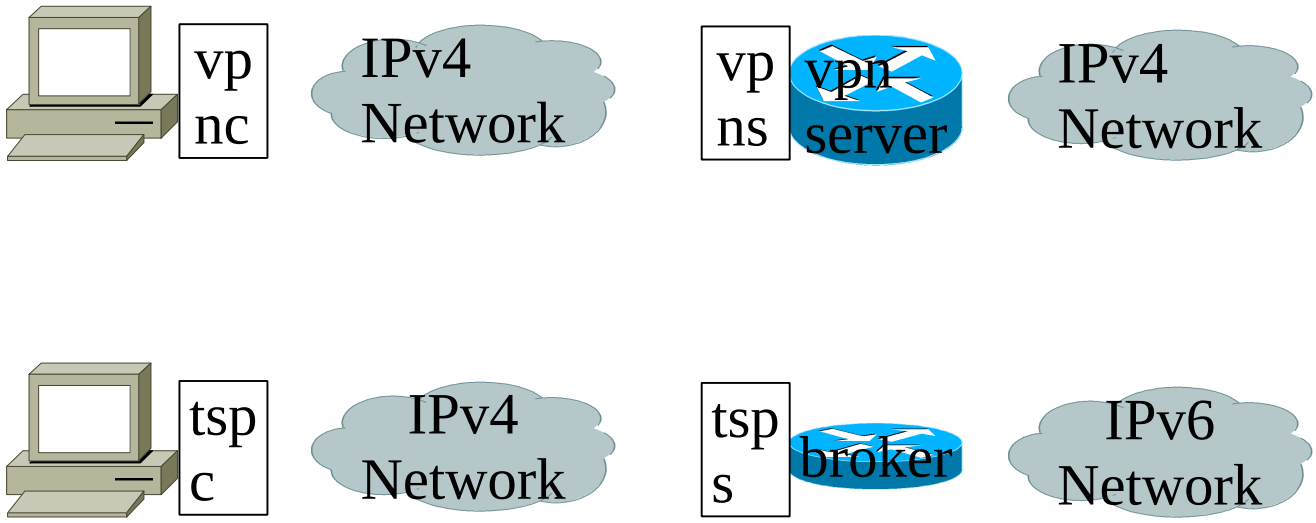
Tunnel Broker with TSP

- Site, small network and host solution; deployed in enterprise and provider networks
- Reaches the end node/app/user without an end to end upgrade of the network
  - Additional services without large upgrade upfront costs
- Has AAA policies, where
  - Authentication: security and no open relay
  - Accounting: billing
- Traverse NAT
- Stable/permanent IPv6 address and prefix
- RFC3053 + enhancements

Tunnel Broker as an IPv6 Access Server



Tunnel Broker as a VPN Server



Hexago

- Spin-off of Viagénie, a consulting and R&D firm
  - 7 years old, specialized in security and IP networking
  - Heavily involved in IPv6 deployment since 1996:
    - designed the first IPv6 exchange in the world (6tap) with ESnet,
    - provide services to the IPv6 community: NTPv6, ipv6 route registry, Quake-v6, freenet6.net
    - IETF contributions, such as: IPv6 address plan method RFC (RFC3531)
    - IPv6Forum, Nav6tf
- Hexago product: Migration Broker: tunnel broker. Shipping now. Enterprise and provider customers.

Conclusion

- Applications need to be updated
- Network goal: provide end-to-end reachability
- Applications using IPv6 need a network
- IPv6 networks need applications to be deployed
- Devices are connected to:
  - IPv4-only, IPv4-only with NAT, IPv4-IPv6, IPv6
  - mobile, using wifi/wired/2.5G, 3G/...
- Need a cheap-to-deploy technology to provide ubiquitous access to applications and services, agnostic of IP version.
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