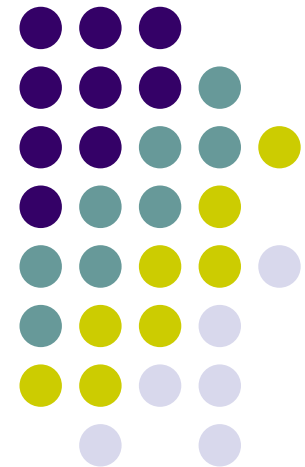


# Practical IPv6 experiences in the Nordic and Europe(6NET), current problems and challenges

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*Stig Venaas*  
*venaas@uninett.no*



# IPv6 in Nordic academic networks

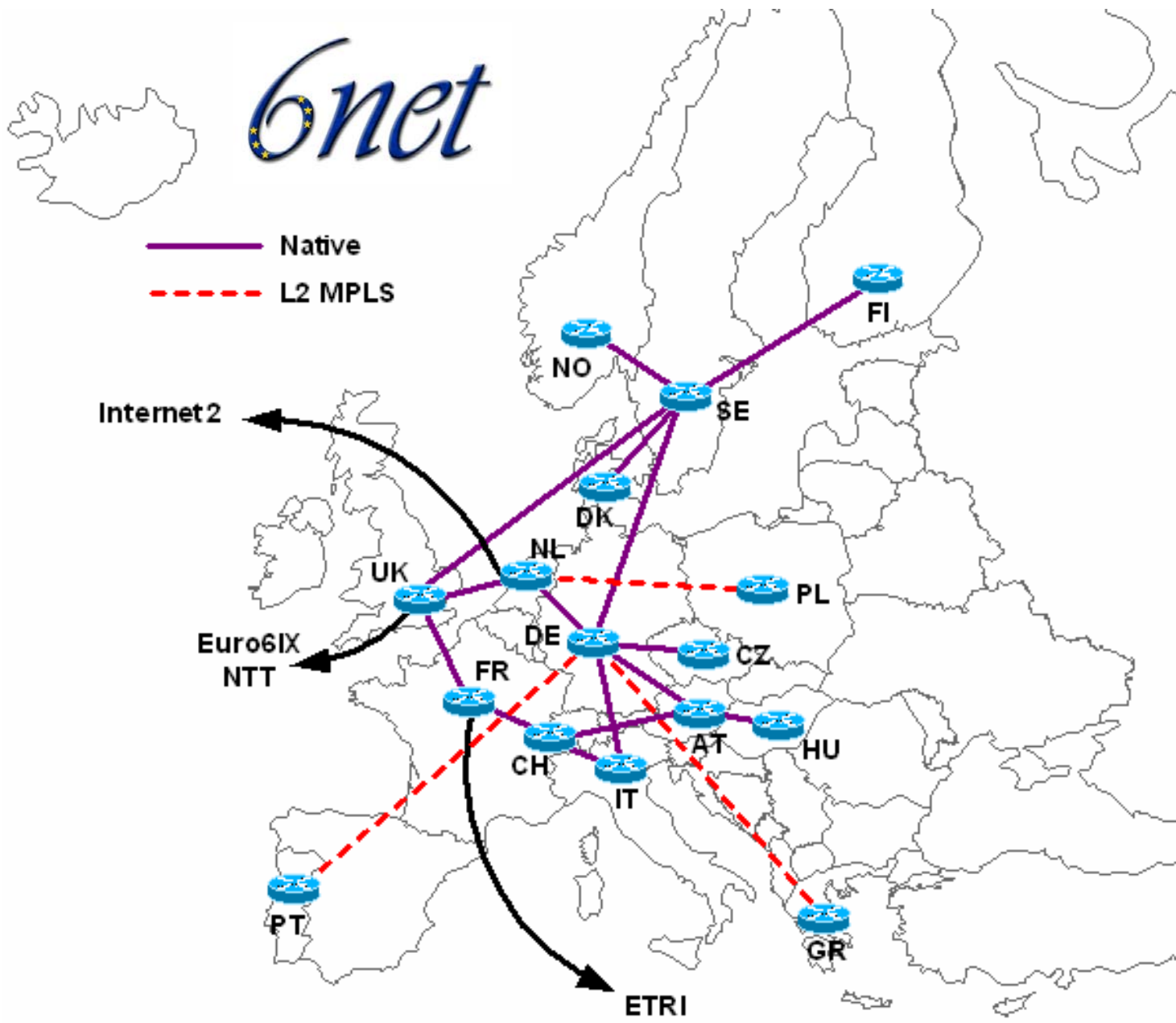


- Nordic academic networks started working on IPv6 in 1998
  - some 1-2 years later
- The academic networks in the Nordic countries all support IPv6
  - Generally separate test infrastructure at first, later in the backbone
  - FUNET got IPv6 throughout the back-bone in 2002
  - UNINETT in 2003
  - There are several universities with native IPv6 connectivity
- NORDUnet started enabling IPv6 in the production network in 2002
  - Native peering with Abilene autumn 2002
  - The NORDUnet backbone now provides native IPv6 connectivity between academic networks in Nordic countries, rest of Europe, Abilene and also some commercial peerings
- All the networks go for dual-stack strategy
  - All routers and links doing both IPv4 and IPv6

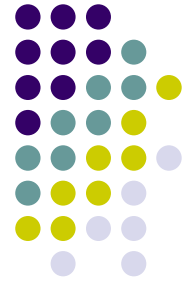
# 6NET overview



- A large European project involving many European countries, including the Nordic ones
- January 2002 – June 2005
- National research networks, universities and industry partners
- Quickly built native IPv6-only network
  - Later services like Multicast and Quality of Service
- This was used for experiments, research, developing application and management tools, learning how to manage IPv6-only network
- Tests of transition mechanisms, Mobile IPv6
- Contribution to IETF IPv6 standards



# 6NET activities



- Deploying and managing native IPv6 network
- IPv6 transition (IPv4 – IPv6 co-existence)
- Routing, DNS, multicast, security
- QoS, mobility, multi-homing
- Applications
- Management
- Dissemination
  - Many documents available at <http://www.6net.org/>

# 6NET experiences



- Deploying IPv6 is generally easy
  - Provided routers support it
- QoS with diffserv like IPv4
  - Routers only used DSCP, flow label not used yet
- Main issue is network management
- Need more applications
  - 6NET ported several applications to IPv6
  - Found several application issues
    - One example is whether application falls back to IPv4 if cannot connect with IPv6
- How to do inter-domain IPv6 multicast

# 6NET and network management



- Few tools for managing IPv6 networks
- Almost no tools for IPv6-only networks
- Need more IPv6 MIBs
  - In dual-stack networks it may be hard to measure amount of IPv6 traffic
- Routers did not support IPv6 SNMP transport
- No IPv6 Netflow
- IPv6-only network, but used IPv4 connectivity to routers for some management functions
- Many of the partners had their own home made tools, some were ported to IPv6

# 6NET and multicast



- Deployed IPv6 multicast in 2003
- We used PIM Sparse Mode
- SSM worked fine, but few edge routers supported MLDv2, and practically no hosts and no applications
  - Some applications ported. Situation better now
- We did tests with one central RP (Rendezvous Point), but does not scale
- For IPv4, MSDP allows each domain to have their own RP for all groups. MSDP is not available for IPv6
- This means everyone must use the same RP for the same group
- We came up with embedded-RP
  - RP address encoded into multicast group address
  - Allows each domain to have their own RP for their own range of groups. They use these groups for multicast sessions they host
  - Others throughout the Internet (depending on scope) can join the sessions, using the host's RP
- Multicast transition, deployed IPv4 – IPv6 multicast gateway

# Some IPv6 issues today



- Still many management tools not supporting IPv6
- SNMP IPv6 transport more common, still missing MIBs
  - RFC 4293 IP MIB just came out (both IPv4 and IPv6 support), now we need this to be supported on routers
- Netflow v9/IPFIX available on some routers, need more support and tools
- Host configuration, few DHCPv6 implementations
  - How to configure dual-stack hosts, both DHCPv4 and v6?
- How to efficiently manage dual-stack networks/hosts
  - Ideally not more work than single stack ...
- Limited Mobile IPv6 support
- Still need more applications
- Multihoming
- IPv6 deployment proceeding very slowly, too much work on NAT workarounds. Users are starting to think that NAT is just the way Internet works

# IPv6 deployment strategy



- Basically dual-stack everywhere
  - Deploying IPv6 alongside IPv4
  - Both in the network, hosts and services
  - Also trying to deploy IPv6 multicast in parallel with IPv4 multicast
- Hopefully we will get some new IPv6-only services
- At some point in the future, start removing IPv4
  - Hard to predict when and how this might happen
- We now have dual-stack in the core networks, now we are trying to push it to our customers
  - For campus networks there are issues with some routers not supporting IPv6, and also management tool
- Most hosts can easily do IPv6 now
- Some services support IPv6, but many to go
  - Application support is one of the issues

# University/college deployment



- We have had IPv6 in the core for some years, the issue now is deployment by universities and colleges
  - Some have started, but many to go
- Perhaps the main “problem” we have right now, is that they can get the IPv4 addresses they need
  - The question is how long this lasts
- There are not that many short term incentives right now
  - They should deploy IPv6 for research and teaching
  - Should have end-to-end connectivity with others that have IPv6 and only NATted IPv4
- But there are long term reasons to think of IPv6 now
  - New equipment should support IPv6, and network administrators should learn IPv6
  - There might soon be new IPv6 services, or IPv6 improved services
  - It will become harder to get IPv4 addresses

# Some questions



- Do you already have problems getting enough IPv4 addresses for your universities/customers?
  - Are you forced to use NAT/private addresses today?
- What other incentives than lack of IPv4 addresses do we have for deploying IPv6 now?
  - How do we convince people that they should deploy IPv6 now?
- Can you think of new applications that will require IPv6?