RENATER Network-Delivery of IPv6 services through **Cisco IOS Software**: A Successful Deployment from Pilot to Production

Renater

> "After a year of running the Cisco IOS Software implementation of IPv6, which is available on the Cisco 7200 and 12000 Series routers, we are confident about configuring and providing the IPv6 connectivity on the operational network."
>
> – Bernard Tuy, RENATER IPv6 and IP Multicast Project Manager

The government-funded National Telecommunications Network for Technology, Education, and Research (RENATER) of France provides a compelling case for the features and value of the evolving IP version 6 (IPv6), available with Cisco IOS® Software Releases 12.2T and 12.0ST. The advanced functions available with IPv6—including expanded IP addressing, hierarchical addressing, integrated auto-configuration, quality of service (QoS), mobility, and security—will serve the billions of new users and connected devices expected to access the Internet in coming years.

RENATER is a national research and education production network, affiliated to 6REN (http://www.6ren.net), that is similar to CANARIE in Canada, CERNET in China, JGN in Japan, SURFNET in The Netherlands and Internet 2 in the United States. It serves more than 650 universities, research organizations, and government agencies throughout France and its dominions.

RENATER's pilot IPv6 service follows experiments conducted since 1995 as part of the G6 Group, a French outgrowth of the Internet Engineering Task Force (IETF) IPv6 Project Working Group that develops the IPv6 protocols. RENATER has overlaid a virtual private network called the G6-bone on its IPv4 network to interconnect the organizations that are ready to test IPv6 features. See Figure 1.

A Native IPv6 Pilot Network

The native IPv6 pilot service has replaced the former G6-bone-tunneled Topology, where up to 40 sites were connected to five regional points-of-presence (POPs). The IPv6 pilot is deployed on RENATER's ATM infrastructure using dedicated ATM virtual circuits.

"After a year of running the Cisco IOS Software implementation of IPv6, which is available on the Cisco 7200 Series routers, we are confident about configuring and providing the IPv6 connectivity on the operational network," said Bernard Tuy, RENATER IPv6 and IP Multicast Project Manager who is responsible for RENATER's IPv6 project.

RENATER2 consists of 26 POPs located in the main cities in France where regional networks are aggregated. These POPs are built with Cisco Catalyst® 8540 MSR ATM switches and Cisco 12008 Series core routers deployed for ATM and IP services. The IPv6 network is built on Cisco 7200 Series routers attached to the Cisco Catalyst 8540 MSR (ATM) switches, running native IPv6.

RENATER also provides IPv6 service on a Cisco 12008 Series Router in its Internet peering exchange point (IX) called SFINX (http://www.sfinx.tm.fr). This enables IPv6 peering capability for more than 70 Internet service providers already present at the

SFINX and exchanging IPv4 traffic. Another Cisco 12008 Series Router is dedicated to IPv6 international circuits including the Geant Test Programme for IPv6 (GTPv6)—the pan-European IPv6 backbone 6Net access, and Asia: ETRI, South Korea and WIDE, Japan. Native IPv6 connectivity is provided through the TEIN link (www.transeurasia.org), which is funded jointly by France (RENATER) and Korea (KISDI). This represents the first step towards a global interconnect between Europe and Asia.

Lastly, RENATER provides native IPv6 connectivity to the 6TAP, an IPv6 IX located at STAR-TAP in Chicago. This allows the IPv6 communities spread across Europe to collaborate with their U.S.-based partners from other research networks and companies. To complete its international IPv6 activities portfolio, RENATER—as well as Cisco—is one of the seven work package leaders of the Pan-European IPv6 project, 6NET(http://www.6net.org). See Figure 2.

Benefits of IPv6

The expanded addressing space and auto-configuration features of IPv6 appeal to early-adopter customers in the wireless, gaming, and home networking industries; national research networks like RENATER around the globe; and military and government bodies. Third Generation (3G) of Mobile Services and Wireless Service Provider planning for it, IX, and regional Internet service providers worldwide are also considering IPv6. Cisco industry partner—Hewlett-Packard, IBM, Microsoft, Motorola, and Sun—are implementing IPv6 in hardware, software, and operating systems to allow business applications to run IPv6-enabled networks in support of growing customer adoption. At RENATER, various services benefit from running IPv6.

EXECUTIVE SUMMARY

Background

RENATER is an acronym for Réseau National de Telecommunications pour la Technologie, l'Enseignement et la Recherche (National Telecommunications Network for Technology, Education, and Research) in France. Funded by the French ministries of education and research, RENATER uses SDH, ATM, and IP technologies to provide 155-Mbps to 2.5-Gbps backbone services to more than 650 French universities, research centers, and government agencies. RENATER is at the forefront of piloting new internetworking technology and solutions and will evolve to OC-192 and Gigabit Ethernet in 2003.

Challenge

To deploy IPv6 on a large-scale operational network and to understand the challenges of IPv6 integration over the Internet, RENATER identified the need to experiment with the new IP version, and to deploy it early, both nationwide and internationally. This must be done before the end-user community becomes involved in this technology. The first step in this process was to provide IPv6 connectivity to enable the launch of various research projects including National, RNRT (http://www.telecom.gouv.fr/rnrt) and European, IST (http://www.cordis.lu/ist/ka4/mobile/projects/iprelatedproj.htm).

Cisco Solution

For several years, Cisco Systems has partnered with RENATER, providing early field-trial version of Cisco IOS IPv6 and supporting its hardware infrastructure. Today, RENATER implements IPv6 through commercial Cisco IOS Software Releases 12.2T and 12.0ST. The next step is to integrate native IPv6 in the dual-stacked operational network, starting with RENATER3. This will be achieved through Cisco 12400 Routers series, demonstrating its Best-in-Class IPv6 forwarding capabilities. After more than a year into the IPv6 pilot service, RENATER has demonstrated that the IPv6 protocol is mature enough to be deployed in operational context, allowing applications to benefit from the enhanced IPv6 feature set.

"The built-in auto- configuration feature allows IPv6 clients to auto-configure their addresses," said Tuy. "This will save a lot of time and effort as client devices become more mobile."

Cisco routers configured for IPv6 advertise their IPv6 prefix or prefixes on one or more interface. This allows IPv6 clients to auto configure or renumber their IP addresses using an interface ID—derived from the built-in IEEE MAC address—and a network prefix from the local router. Industry experts anticipate that this feature will eventually replace or complement the labor-intensive administration of Dynamic Host Configuration Protocol (DHCP) services now required for IPv4 address management.

"With IPv6 auto-discovery, a workstation or wireless device can be moved to different physical data link layers or locations and then easily reconnected to an IPv6 network, still remaining known by its home address when running mobile IPv6," Tuy explained. RENATER and other partners in the European 6Net Project are testing IPv6 applications over wireless (IEEE 802.11b) that rely on auto configuration.

Expanded addressing is an important feature among IPv6 adopters. To accommodate the huge growth of devices connected to the Internet and to meet anticipated future demand, the IP address length in IPv6 has quadrupled to 128 bits. Additionally, to reduce the size of Internet routing tables, a hierarchical addressing structure and associated policies from the Regional Registries have been defined.

"The hierarchical approach of IPv6 addressing makes it possible to decrease the size in the Internet routing table," said Tuy. "This can greatly improve operation of the routers and overall network efficiency."

IPv6 multicast service is also being tested through the IPv6 pilot at RENATER, which provides an operational IPv4 native multicast service as well. IPv6 multicast—a future Cisco IOS IPv6 feature—offers enhancements to IPv4, including a 'scope' feature to prevent the propagation of multicast traffic outside of a delimited zone. IPv6 multicast also helps avoid collisions between different IP addresses that share a single MAC multicast address.

IPv6 protocol specifications define IPv6 option headers to add extended capabilities such as support for authentication, encryption, and source routing. Combined with QoS and IP Security (IPSec), these features, which are equivalent to their IPv4 counterpart, will allow RENATER to more easily implement new services.

Gradual Transition with IPv4 and IPv6 Overlap

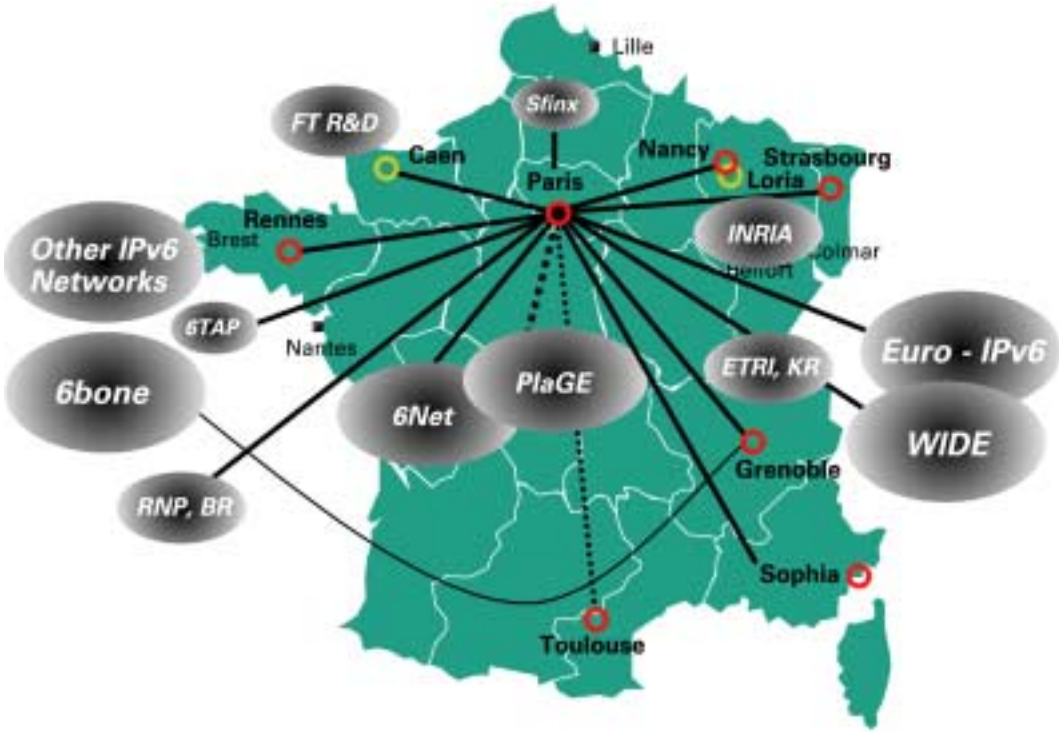
The move to native IPv6 across entire enterprises will be a gradual transition. RENATER will move to 2.4 Gbits/sec SDH interface (OC-48) and 10 Gbits/sec SDH interface (OC-192) in 2003. RENATER provides a good example of how the transition can take place moving from tunneling to a dual-stack network (IPv6 and IPv4).

Bernard Tuy looks forward to adding more applications and services, including Mobile IPv6 transition mechanisms. "The upgrade of RENATER infrastructure to OC-48 in August 2003, then OC-192 in 2003 using Cisco 12400 series Routers represents an opportunity for both RENATER and Cisco to demonstrate that IPv6 is now ready for Production".

In the meantime, RENATER meets periodically with other G6 hardware and software vendors to benchmark and compare their IPv6 solutions, promising an end-to-end, global addressing architecture and simplified gateways for a new generation of always-on devices, integrated telephony applications, and wireless devices.

Figure 1. RENATER & G6-bone IPv6 Tunnels Topology

Figure 2. National & International Native IPv6 Connectivity



For more information go to the following links:

RENATER: http://www.renater.fr

The G6 Group: http://www.ipv6.pps.jussieu.fr/

SFINX: http://www.sfinx.tm.fr

The 6Net Project: http://www.6net.org

RNRT: http://www.telecom.gouv.fr/rnrt

Information Society Technologies (IST): http://www.cordis.lu/ist/ka4/mobile/projects/iprelatedproj.htm

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

European Headquarters
Cisco Systems Europe
11, Rue Camille Desmoulins
92782 Issy-les-Moulineaux
Cedex 9
France
www-europe.cisco.com
Tel: 33 1 58 04 60 00
Fax: 33 1 58 04 61 00

Americas Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
www.cisco.com
Tel: 408 526-7660
Fax: 408 527-0883

Asia Pacific Headquarters
Cisco Systems, Inc.
Capital Tower
168 Robinson Road
#22-01 to #29-01
Singapore 068912
www.cisco.com
Tel: 65 317 7777
Fax: 65 317 7799

Cisco Systems has more than 200 offices in the following countries and regions. Addresses, phone numbers, and fax numbers are listed on the
Cisco Web site at www.cisco.com/go/offices

Argentina • Australia • Austria • Belgium • Brazil • Bulgaria • Canada • Chile • China PRC • Colombia • Costa Rica • Croatia
Czech Republic • Denmark • Dubai, UAE • Finland • France • Germany • Greece • Hong Kong SAR • Hungary • India • Indonesia • Ireland
Israel • Italy • Japan • Korea • Luxembourg • Malaysia • Mexico • The Netherlands • New Zealand • Norway • Peru • Philippines • Poland
Portugal • Puerto Rico • Romania • Russia • Saudi Arabia • Scotland • Singapore • Slovakia • Slovenia • South Africa • Spain • Sweden
Switzerland • Taiwan • Thailand • Turkey • Ukraine • United Kingdom • United States • Venezuela • Vietnam • Zimbabwe