IPv6 Broadband Access to University Students in Greece: The *DIODOS* project

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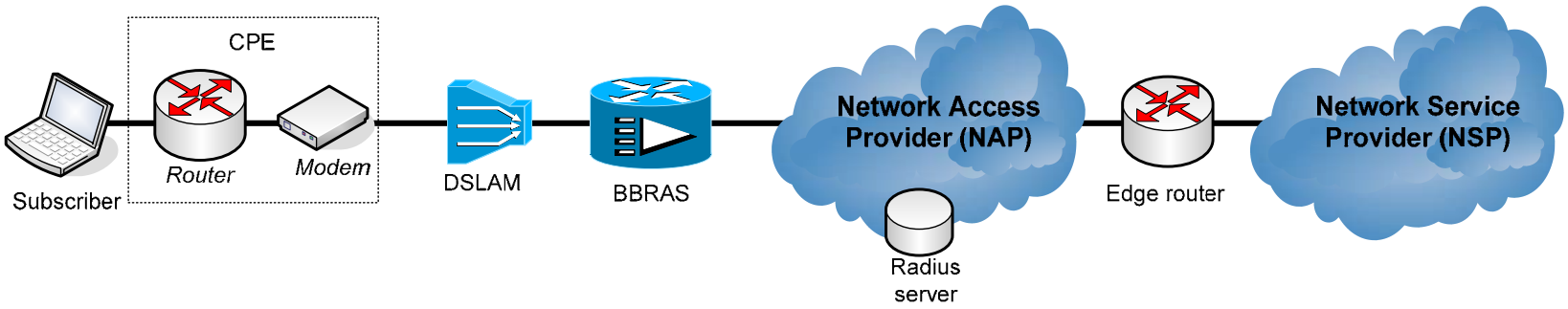
Outline

- Introduction to xDSL access networks
- IPv6 interconnection services over xDSL
- The *DIODOS* project: Objectives & Architecture
- Why enabling IPv6 in DIODOS?
- Current status & Future plans

Entities involved in an xDSL environment

- Subscriber (xDSL User)
  - PCs, modem, bridge/router
- Network Access Provider (NAP)
  - Responsible for the management of the copper local loop.
  - DSLAM, BBRAS, radius server*
- Network Service Provider
  - Responsible for providing interconnection with the Internet. May offer other added-value services.
  - Edge router, radius server*

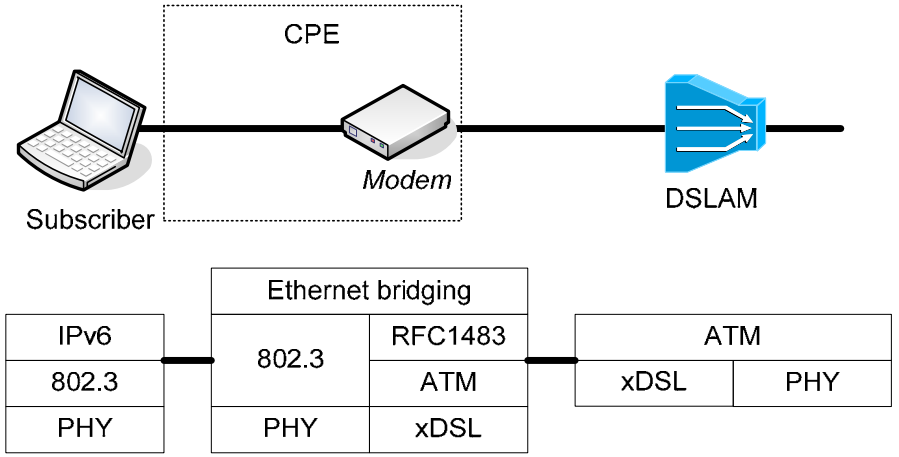


Implementation details

- xDSL modem
  - Encapsulates Subscribers' traffic to ATM cells, signal (de)modulation
- DSL Access Multiplexer (DSLAM)
  - Signal (de)modulation, aggregates traffic over ATM links
- Broad Band Remote Access Concentrator (BBRAS)
  - Terminates the Subscribers' ATM connections, tunnels or routes traffic to the *NSP* edge router.
- Radius Server
  - Contains subscriber configuration templates
- NSP edge router
  - Terminates PPP sessions or L2TP tunnels, gateway to Internet

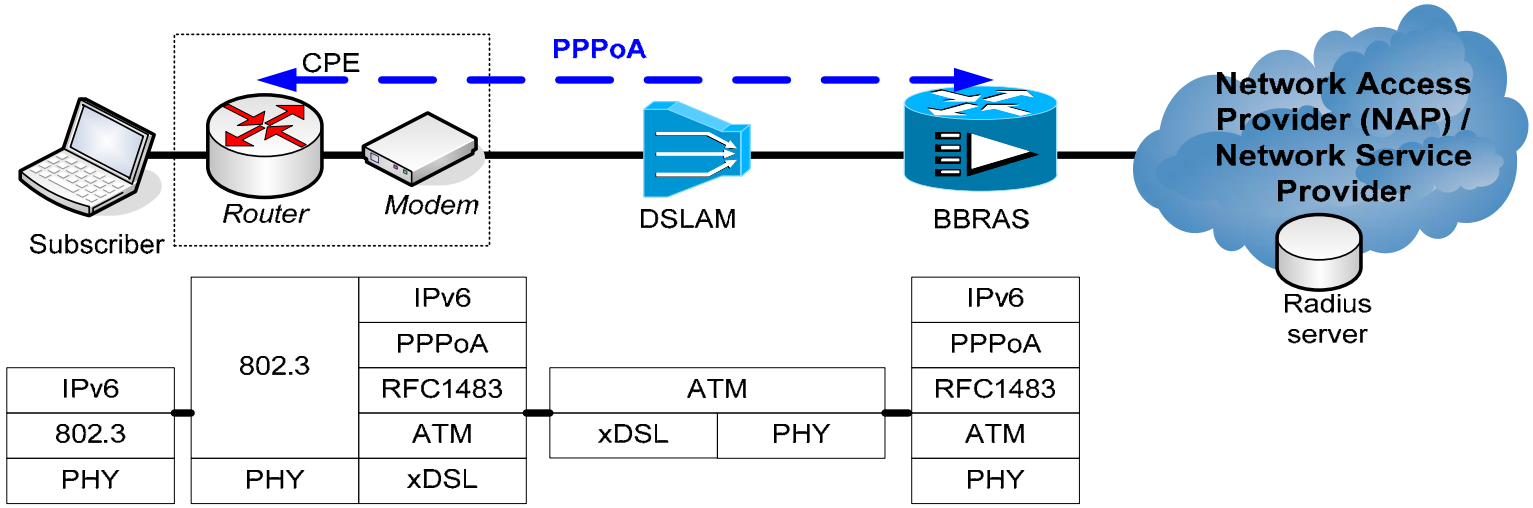
Ethernet bridging over ATM

- The CPE forwards IP packets using multi-protocol encapsulation over ATM adaptation layer 5 (AAL5).
- Minimum functionality is required for CPE, aka xDSL modem (L3 unaware device).
- A single ATM PVC is used for IPv4/6 interconnection
- Subscriber's PCs are configured with static IPv6 address, or via DHCPv6 or via auto-configuration
- This method does not support authentication and authorization functionality!



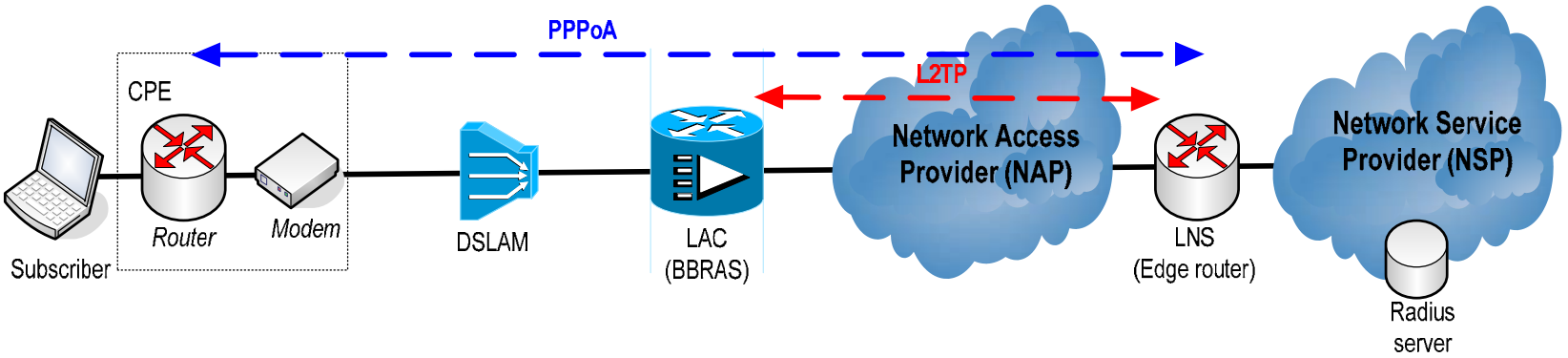
PPP over AAL5 (PPPoA) - PTA

- The CPE supports IPv6/4 packet forwarding and interconnects multiple systems in the *Subscriber's* local network.
- A single PPPoA session is established over a ATM PVC allowing the CPE router to establish two PPP sessions; an IPv6 (IPCPv6) and an IPv4 (IPCPv6).
- IPv6 addresses are assigned automatically over the PPP session using attributes stored in a centralised radius server or local database.
- The CPE can be authenticated using one of the multiple protocols, such as PAP, CHAP, MS-CHAP, EAP, etc.



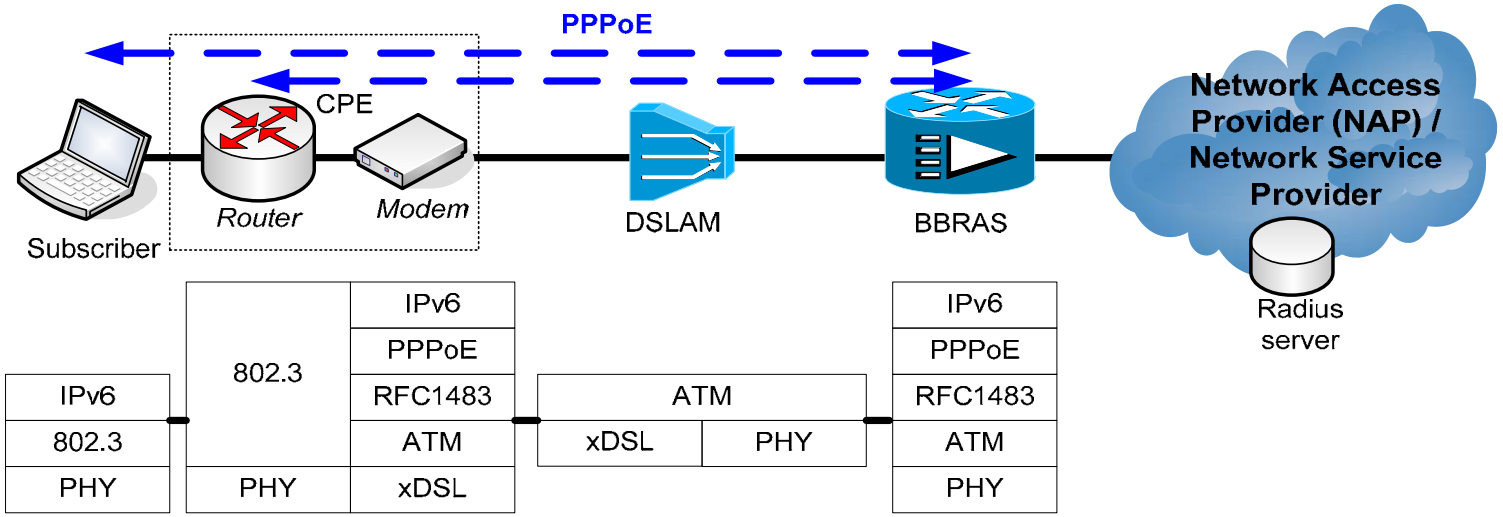
PPP over AAL5 (PPPoA) - LAA

- In case the *NAP* and the *NSP* are different, the PPP sessions do not terminate at the *BBRAS* but at the edge router.
  - BBRAS = *L2TP Access Concentrator (LAC)*
  - Edge router = *L2TP Network Server (LNS)*
- Two PPP sessions are established from the CPE router, which terminate at the *LNS*. *LAC* is IPv6-unaware.
- Address assignment and authentications methods are performed in the same way as previously but now the radius server is managed by the *NSP*.



PPP over Ethernet (PPPoE)

- Separate PPP sessions are established between the Subscriber's systems (or CPE) and the BBRAS for IPv6 and IPv4 traffic.
  - Same IPv4/6 address allocation schema as in PPPoA
  - Sessions may terminate in the LNS in the NSP network (not shown).
  - If PPP sessions terminate at the *Subscriber's* system, then the CPE may be L3 unaware, aka cheap(!). It requires, however, specific software to be installed in the *Subscribers'* systems. The advantage of this approach is that allows access control and service selection to be done on per-subscriber rather than on per-site basis.



The *DIODOS* project

- In Greek, the word "*diodos*" means "passage".
- Established under the authority of the *Ministry of Development*, the *Ministry of National Education & Religious Affairs* and the *Ministry of Transport and Communications*
  - Realised by the *General Secretariat for Research and Technology* with the support of *Greek Research & Technology Network*.
- http://www.diodos.net.gr/ (in Greek)

The *DIODOS* objectives

- Enhance the training process in Universities
  - Enable tele-teaching, collaboration, videoconferencing, etc
  - Easy access to available content, such as digital libraries, multimedia content, virtual labs, etc.
- Increase the penetration of broadband technology in Greece
  - Broadband penetration in Greece in one of the lowest in Europe (of 25 countries)

The *DIODOS* objectives

- Give motives to ISPs to improve their infrastructure
  - Increase their business revenue
- Avoid market distortion
  - Does not provide any advantage to ISP/NAP participating to the project
- Create future potential *Users* of advanced services
  - Students are expected to continue their broadband subscription after the end of their studies.

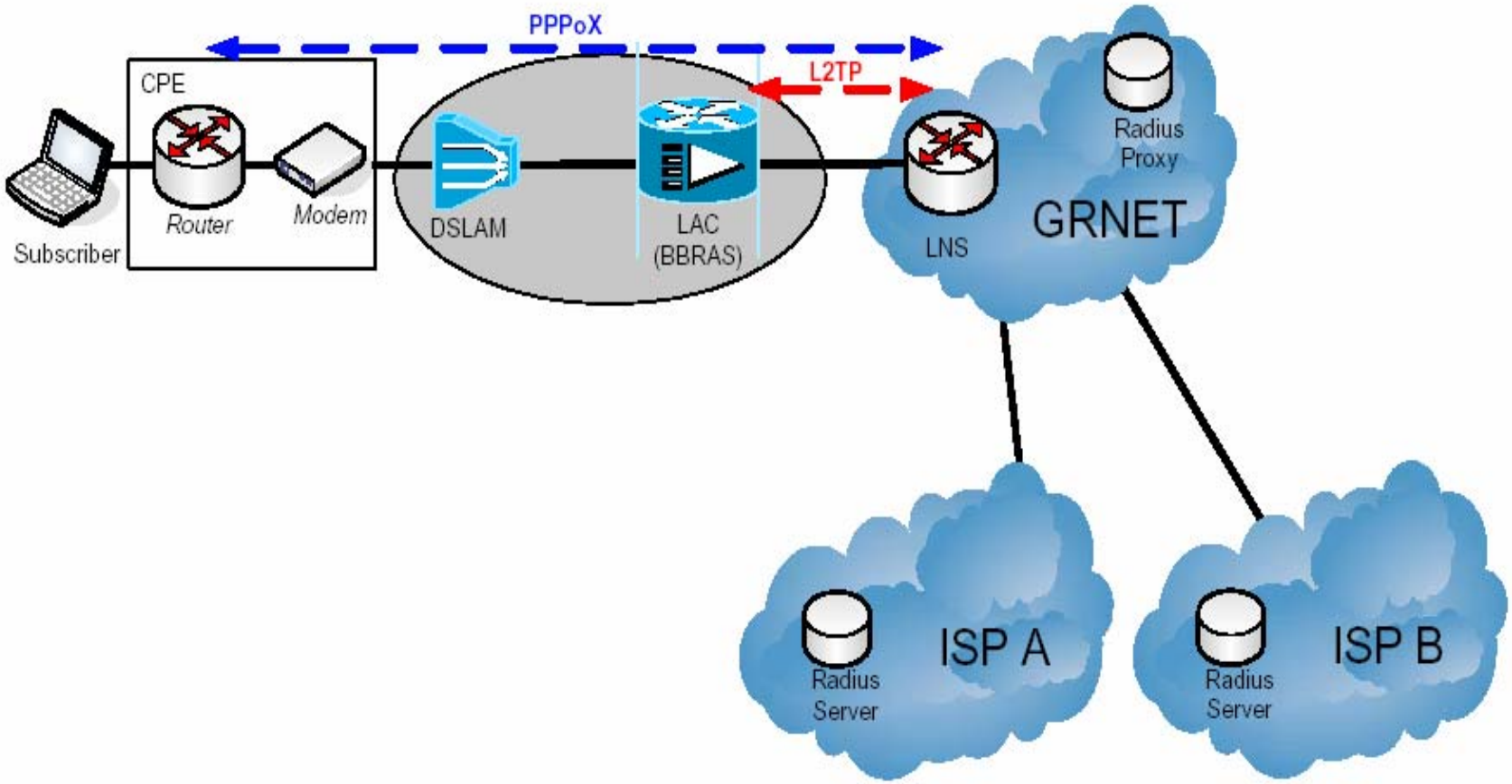
Entities in DIODOS architecture

- Network Access Provider (NAP)
- Network Service Provider – "*Role A*"
  - *Realised by GRNET (NREN)*
  - Provides the IP interconnection services
  - Operates a proxy radius server
- Network Service Provider – "*Role B*"
  - Realised by commercial ISPs
  - Accounting & Management operations
  - Maintaining separate radius servers with the profiles of their Subscribers

Services - Benefits

- All under- and postgraduate students are eligible to take advantage of project benefits during their studies
- Interconnection speed at 384-512/128 kbps
  - No transferred volume (or other) restrictions
- Reduced subscription fees compared to similar commercial services
  - More than 50% less expensive than commercial offers - Subscription to commercial services have also reduced
- Added-value services also offered by ISP
  - VoIP, Web hosting, security and anti-virus protection, etc.

Network architecture



Why enabling IPv6 in DIODOS?

- “Always-on” xDSL connections require a routable IP address per subscriber
  - Thousands of new IPv4 addresses have to be allocated for *DIODOS* connections.
- Strengthens the impact of other IPv6-enabled networks in Greece
  - GRNET IPv6 core network, Greek School Network (GSN) core & access network, multiple university networks
- Exposing students to new technologies is one of the major objectives of any educational system
  - New advanced services and applications may take advantage of the unique IPv6 features – Simulate innovation

Current Status & Future Plans

- DIODOS pilot-phase has successfully completed
  - Full operational solution – Development of diverse set of management tools
  - Subscribers / Offers / ISPs / Universities /
- Proposal for delivering IPv6 interconnection services has been submitted (under evaluation)
- A commercial ISP has already expressed interest to offer IPv6 services to all of its Subscribers