

GRNet

Advanced Network Services Tool

(and Topology Database)

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Rationale

To create a simple, extensible framework that will:

- Get administrative information about the GRnet network
- Store this information in a DB

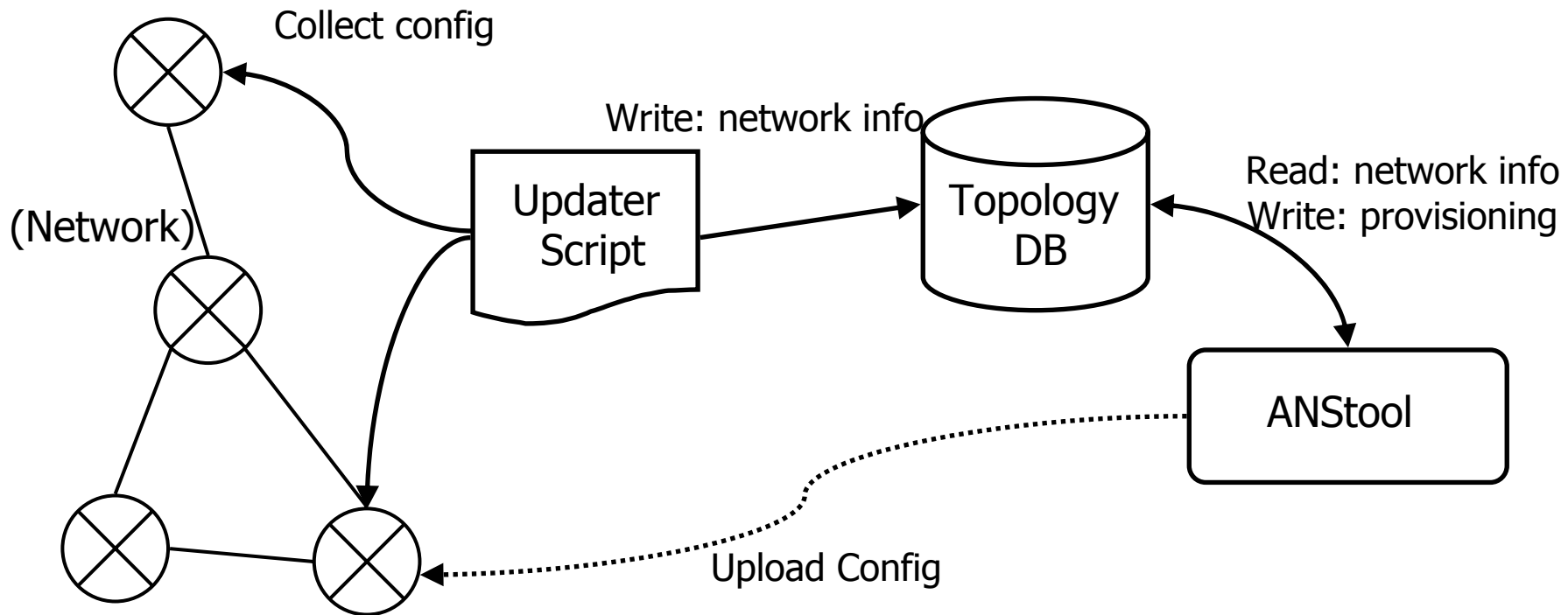
Having that, we can:

- Provide a web interface for network service requests
- Assist network managers in complex network configuration tasks

Design guidelines:

- Simple and modular implementation
 - Open-source tools
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Components

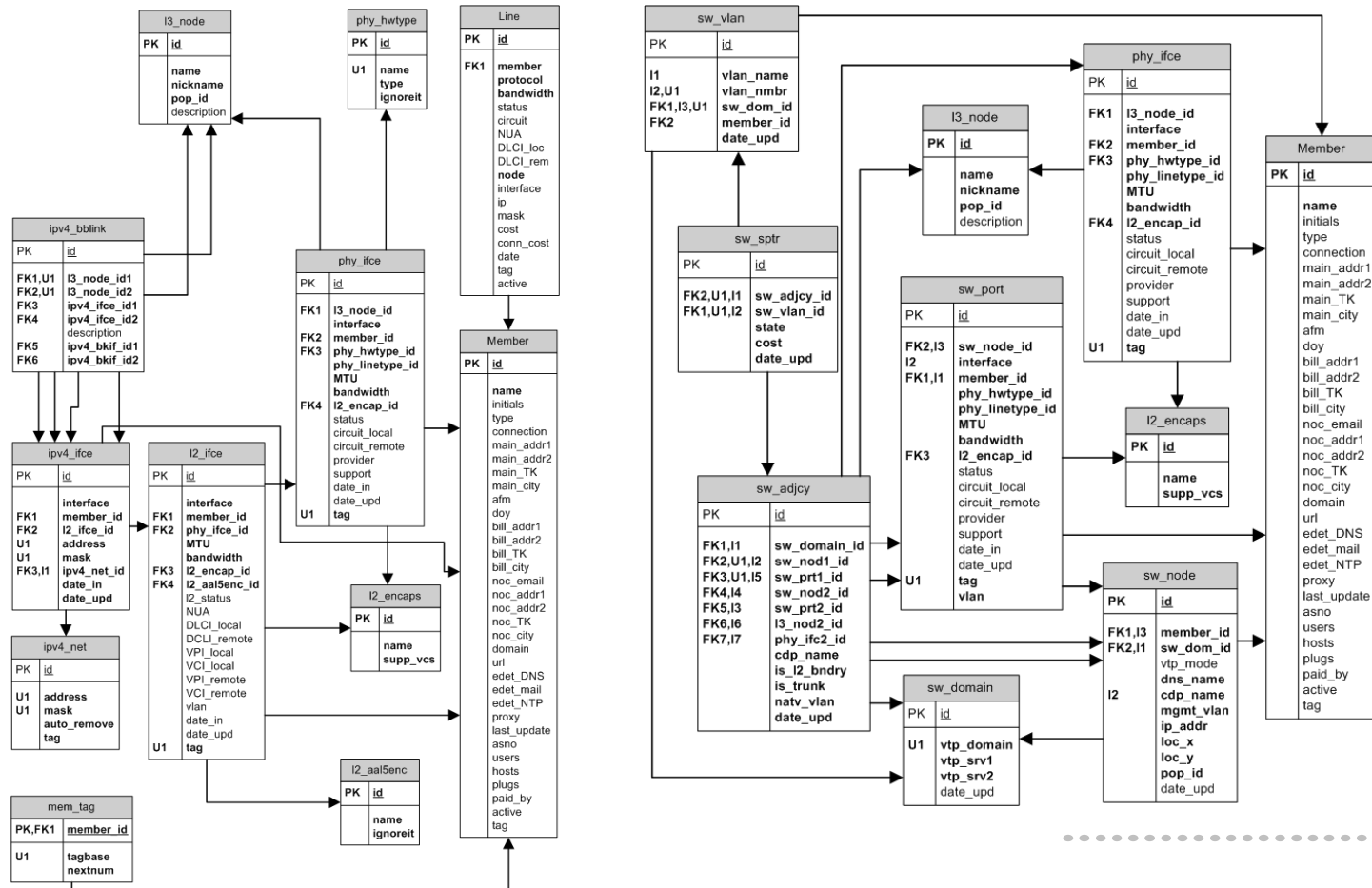


GRNet Topology Database

Models GRnet managed network components:

- Member institutions and networks (ASs, domains, etc)
- Physical points of presence
- Provider Routers
- Interfaces / subinterfaces
- Edge switches, ports and L2 broadcast domains
- Network services (QoS, VPNs, ...)

GRNet Topology Database ERDs



Topology DB Updater

A custom Perl script that keeps the DB up-to-date with RL:

- Network objects are unmanaged by default
- Setting a router as managed: insert a new entry to l3_node
- Setting an interface as managed: add a member tag to description in configuration – i.e. Ethernet1/0.2 : [UOC-23]

Operation:

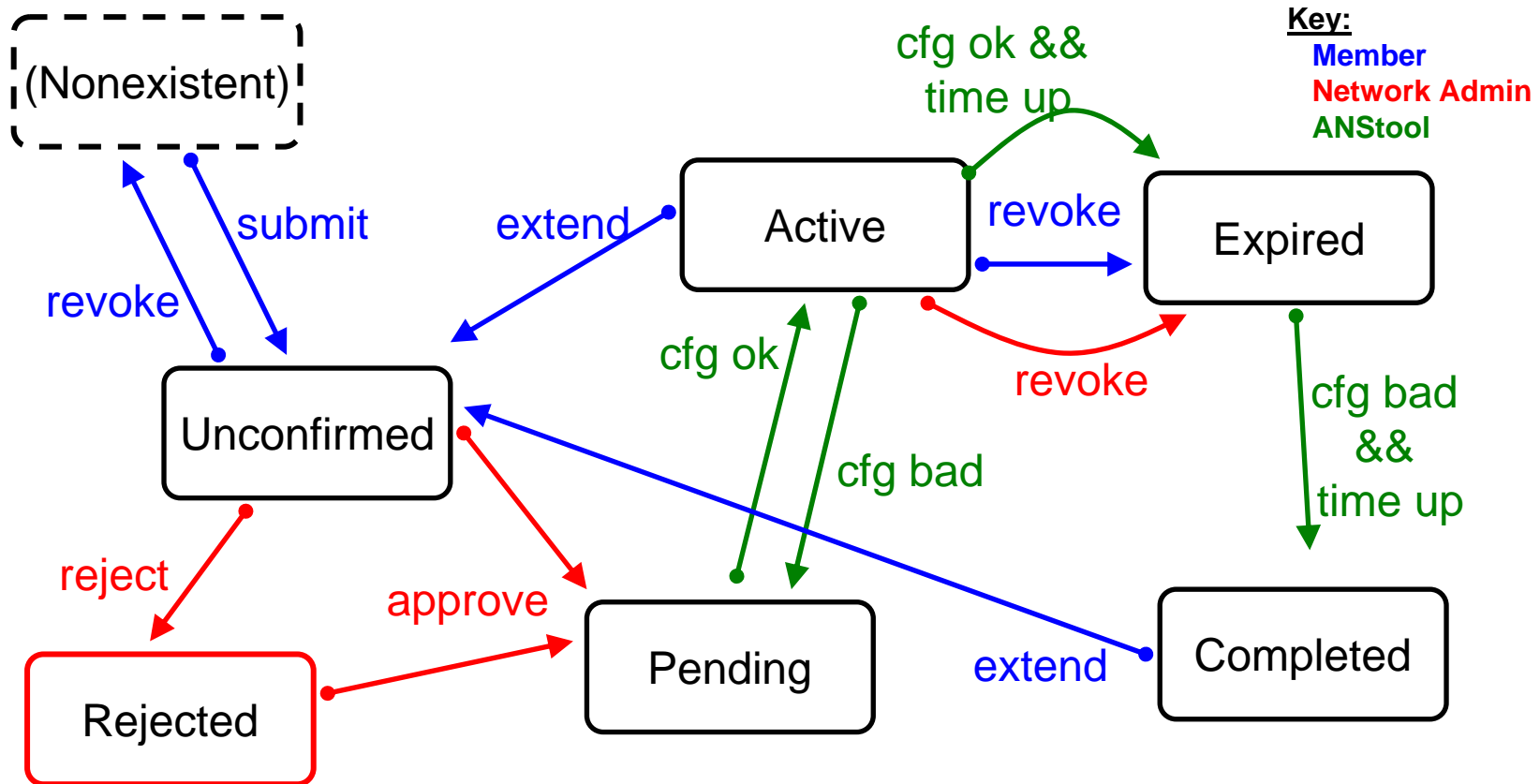
- Updater script looks at router configuration, regexps through it,
- Script adds/updates DB accordingly

ANStool: Overview

- Clients can:
 - submit requests for services
 - view service status

- Network managers can:
 - view requests
 - ask ANStool for recommended router config
 - (soon) tell ANStool to upload config to router

ANStool: Request state diagram



ANStool: Architecture

PHP 4 / MySQL

Common framework:

- AuthN/AuthZ
- User Sessions
- DB access (PEAR::DB)
- Templating engine (Smarty)
- Utility classes and functions

Separate, per-service “pages”

- MPLS VPNs
- QoS
- MBS
- Dimensioning

ANStool: Supported Services

- VPN services:
 - MPLS L2 VPNs
 - MPLS L3 VPNs
- QoS services:
 - IP Premium
 - Managed Bandwidth Services
 - Network Dimensioning
- Composite services:
 - MBS

MPLS L2 / L3 VPNs: Overview

Provide VPN services to GRnet member institutions using network MPLS core.

- Point-to-point L2 VPNs
 - Port mode
 - VLAN transport mode
- Multipoint L3 VPNs
 - Mesh
 - Hub & Spoke

ANSTool: MPLS L2 VPNs

MPLS L2 request comprises of:

- VPN type (Port / VLAN mode)
 - Port mode needs physical ifce, VLAN needs logical subifce
- Desired endpoints (PoPs, Member networks, PE routers / ifces) *
- Administrative details (start / end dates etc.)

* ANStool prefilters managed ifces – only displays ifces that can support VPN owned by Member at PoP (possibly too smart)

Cfg generated (usually) ready for deployment on the PE routers
Relevant parts of the CE router config so that they can be emailed to the client NOC
(see demo for configuration samples)

ANSTool: MPLS L3 VPNs

MPLS L3 request \approx L2 request:

- VPN type is IPv4 L3 (Cisco VRFs)
- Multiple endpoints (2..N)
- Topology (== imported and exported RTs)
 - Full mesh
 - Hub-and-spoke
 - Other

ANStool will reserve RTs / RDs / tunnel endpoint IP addresses from managed pools

Will generate PE router VRFs using above config

CE configuration trivial

(Future challenge: a good algorithm for minimizing # of VRFs)

Quality of Service (QoS) Overview

- GRNET provides:
 - IP Premium (IPP)
 - IP premium (end points aware, marked traffic with DSCP 46)
 - IP premium transparent (to Geant, marked traffic with DSCP 40)
 - IP premium VoIP (source aware, marked traffic with DSCP 47)
 - Best Effort (BE)
 - Less than Best Effort (LBE)
- High priority queue enabled on all output interfaces (MDRR and CBWFQ)
- Strict policing at the edge
 - Avoid unauthorized marked traffic
 - Ensure the profile of traffic from each request (cir policing)

Network's perimeter		MPLS Core	
DSCP value	Name	3MSB value	Name
47	IP Premium - VoIP	5	IP Premium
46	IP Premium		
40	IP Premium Transparent		
0	Best Effort	0	Best Effort
6	Downgraded Premium-Discard Eligible (DP/DE)		
8	Less than Best Effort	1	Less Than Best Effort

Managed Bandwidth Service Overview

- Point-to-point connections (L2 MPLS VPNs) with guaranteed bandwidth
- Currently available to Ethernet connections only
- Implementation:
 - Dedicated VLANs at the edge for the MBS
 - Traffic engineering tunnel between PE routers (across GRNET's backbone)
 - VLANs traffic routed via tunnel
 - At PE routers:
 - Policing in input interface
 - Traffic marking at the MPLS EXP field (value 5)
 - Implementation through AToM and pseudowire classes in GSRs
 - The MBS service follows the dimensioning rules of QoS service
- MBS service combines QoS and L2 MPLS VPNs

Network dimensioning Overview

- An initial amount of bandwidth on each access link available for reservation for IP Premium, QoS and MBS services
- Dimensioning algorithm calculates the maximum reservation in backbone links (even in link failures)
- We try to keep the maximum IP Premium traffic at an acceptable portion of link capacity - keep the delay and jitter low (efficient guarantees for QoS)
- Admission control performed according to reservations at the edges

Access links capacity	Allocation
≥ 1 Gbps	1%
500Mbps - 1Gigps	1,5%
100Mbps - 500Mbps	2%
30Mbps- 100 Mbps	5%
10Mbps-30 Mbps	10%
2Mbps-10Mbps (DSL φορτίς)	15%
≥ 2 Mbps	20%

ANStool: QoS Service

- Using GRNET Topology DB that models:
 - Network interfaces
 - Network dimensioning
 - The QoS and MBS requests
 - The implemented configuration on the routers
 - Preferred paths for traffic engineering (explicit routing)
- Functionality:
 - Clients submit requests through web form
 - Type of service, End points, Duration
 - Traffic profile, Traffic class (through ACLs that users describe in the implemented ACL wizard)

ANStool: QoS Service

- Automatic checking and response
 - Checks the end points (declared interfaces etc)
 - The duration of the request
 - Perform admission control according to request details and network dimensioning
- Automatic management of requests
 - Edit/view requests functionality
 - Automatic notification for expiration, pending for implementation, decommission etc
 - Automatic handling of request status (confirmation pending, active, expired)
- Dynamic production of the relevant configuration
 - Hierarchical in case of VLANs in physical interfaces
 - Takes into account the network topology and changes

ANStool: QoS Service

- Monitoring of the implemented QoS configuration
 - QoS configuration parsing (from routers) and store in DB
 - Comparison of stored configuration with the submitted requests in the tool (consistency checks)
- Automatic and periodic check of the network's dimensioning
 - Checks the topology and insert dimensioning values in DB for new connections on the network
 - Allows manual changes on network's dimensioning (by the administrator)
- Provide statistics per connection for reserved bandwidth for QoS
- Support of traffic engineering characteristics for MBS
 - Declaration of paths for traffic engineering tunnels (explicit-path routing instead of dynamic)

Evaluation

GRnet DB:

- (+) Many features, managed objects and relationships
- (-) Possibly manages a few too many things
- (-) Difficult to add new functionality

ANSTool:

- (+) Simple, straightforward design
 - (+) Easily reconfigurable and extensible
 - (-) Relatively low level of abstraction
 - (-) Cisco-specific
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Demo

Demo available at:

<http://edet.ucnet.uoc.gr/demo/html/>

- Submit a request or two
- View outstanding requests
- See generated config

Next Steps

- Improve tool to support GN2 standards (web services)
- Investigate an XML-based network topology DB
- Create a better provisioning scheme for network services
- QoS: Implement an IPv6 ACL wizard for IPv6 QoS support
- QoS: Implement a second step admission control
 - Routing based admission control (for requests that exceed the allocated bandwidth)
- MPLS VPNs: QinQ support, VLAN rewriting
- MPLS VPNs: Support VPNs spanning different media (Ethernet VLANs \Leftrightarrow ATM VCs)
- Support for L2TP service: LNS / LAC / RADIUS configuration