Bi-Level Active Networks

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Background: IP

- IP architecture built on Layered Model
- Some current efforts bend/break the model
  - Congestion avoidance: RED
  - Division of resources: CBQ, WFQ
  - QoS: diff-serv, int-serv
Background: Active Networks

- Add functionality/services “on the fly”
- Initially, Active Router (AR)
  - ‘Reprogram’ code in data packets
- Active Server (AS)
  - Dynamically loaded software modules
  - Used as proxies for additional services offered by the network
  - Transcoding
  - Dynamic VPNs
Active Net Issues

• Security
  – Need to prevent adverse functions
  – Approaches include strict semantics (SecuNet), polices (Android/FAIN), and ‘sandboxes’ (execution environments)

• Performance
  – ‘Slow path’ for option-filled data packets in routers
  – Lack of inter-layer information leads to…
    • Redundant functions between layers (e.g., Application layer routing/discovery)
    • Sub-optimal performance of end-to-end flows
Objectives

• Retain the layered model
  – Break it for ‘active’ flows

• Focus solution on integrated operation between AR and AS
Bi-Level Architecture

• Network consisting of AR and AS
  – Similar to ALAN architecture
  – *AS and AR communicate/compliment each other*

• Language between AR and AS
  – Articulate type, form, target
  – Expansion of Secunet language(?) and/or XML-programable router project(??)

• Policies
Architecture Example

Network Perspective

Active Network (Overlay) Perspective

- Active Server
- Normal Router
- Active Router
- Active Flow
Bi-Level Usage Example

1. Active Flow through AS-A and AS-B
2. AS-A determines that flow is subject ‘active’ service
3. AS-A triggers AR to send constrained flood
   - Determine new paths with different metrics
   - Constrain advertisement to shaded region using ‘active’ routing protocol

Note: Example represents gradual active service
Another Example????

[Diagram of a network with labels: Host-A, Host-B, AR-1, VPN Cloud, Active Server (AS), Active Router (AR), Standard Router]