Can Management Systems Leverage Self Organization?

Goal Driven Adaptive Management of Converged Networks and Services

SelfMan 2005
Panel 2

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Joint work with:
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- Self-organization
  – Engineer heuristics for goal-directed control of desired emergent behavior
- Distributed management
  – Decentralize control loops, local knowledge only
  – Deterministic rules and policies
- Centralized management
  – One omniscient management system

- Is there a middle ground? Where?
- What have we tried? What have we learned?
  – In any complex system, grief is conserved – Mike O'Dell

Challenges

- Complex systems require multiple types of controllers
  - Avoid destructive interference between controllers
  - How do we make sure multiple controllers work towards the greater good?
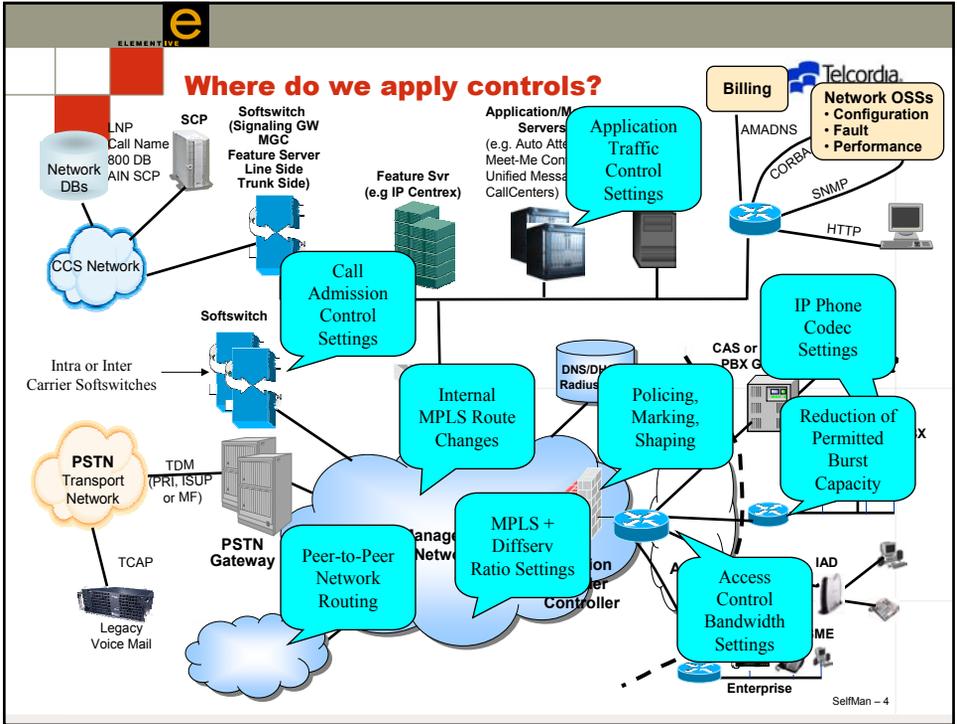
- Local controllers optimize without global objectives
  - E.g., Bandwidth load balancing in the face of DDoS attack
  - Tend to be local resource aware, not service aware
  - But can be self-organizing

- Difficult to increase awareness in local controllers
  - Usually impossible to modify proprietary systems
  - Too complex, will never keep up with growth of constraints
  - Wrong Approach? Still need a coarse-grain behavior modifier?
  - But is some amount of local interaction needed?

- Too many rules
  - Better knowledge representation
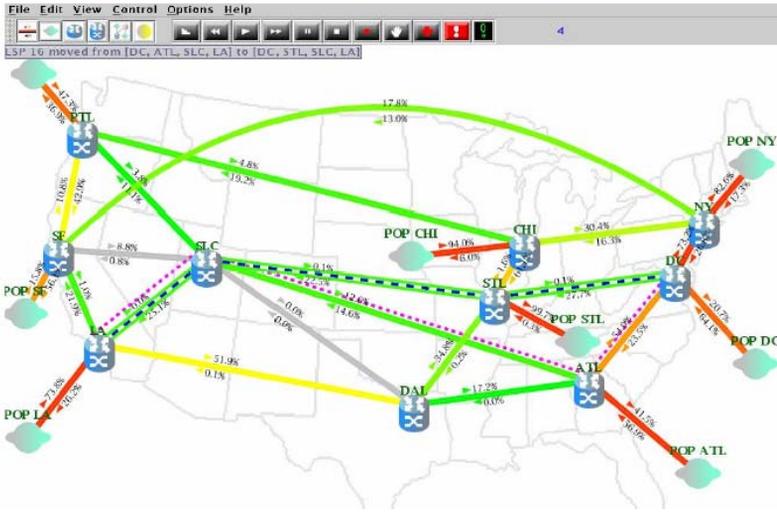 - Adaptive weight setting, learning
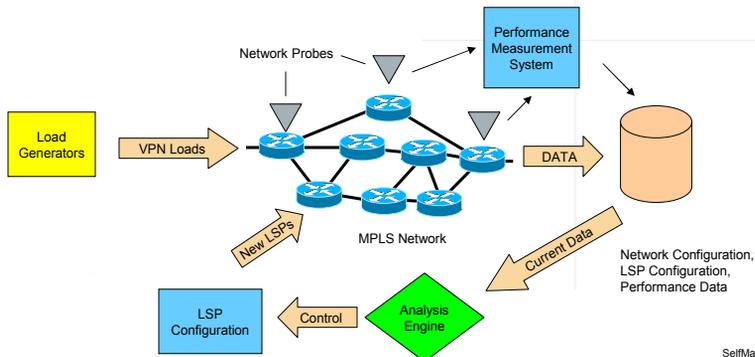
Where do we apply controls?

Slide 1

Local Resource Controller example - Automatic Bandwidth Management

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Slide 2

MPLS Bandwidth Management

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- Closed Loop – Monitor – Analyze - Reconfigure
  - Single Goal
  - Simple Objective function
    - Minimize maximum load
    - Minimize hop count over minimum possible hops
- Use of Trending and Prediction
- Could be self organizing, adapting to load usage patterns
- But - Not Service Aware – all bandwidth users are equal

Network Probes

Performance Measurement System

Load Generators

VPN Loads

MPLS Network

New LSPs

DATA

Current Data

Network Configuration, LSP Configuration, Performance Data

LSP Configuration

Control

Analysis Engine

- What happens when multiple applications have conflicting demands on the same supporting set of resources?
  - Converged networks with voice, video, data
  - Differing demands on delay, jitter, bandwidth
- No single, static solution will suffice
  - Allow local controllers to operate in well-defined comfort zones
  - **Be careful about allowing local controllers to conspire**
    - **E.g., VoIP manager dealing with MPLS bandwidth manager**
  - Invoke (passively or actively) higher level management when zones are violated
  - Don't micro-manage
- Additional considerations to manage:
  - Changing priority of services and sessions within services
  - Profitability of services
    - Admit billable voice call rather than in-plan call
    - Limit data capacity to allow high speed, high QoS video transmission
    - Discard existing traffic to allow new applications to fit

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Experimental Telcordia Test Bed for Multi-Layer Converged Services Management

- Independent Controllers manage private view of their world
- Free Running Controllers
  - Until exception occurs
- Rule driven interactions

Global Policy Manager (Arpeggio)

VoIP Service Manager

IP/MPLS

Bandwidth Manager (PECAN)

Optical Manager

ROADM — ROADM

Optical Ring

ROADM — ROADM

BoD Service Manager

UCSD BoD Service Client