

***IM 2005 Distinguished Expert Panel***  
**Managing New Networked Worlds -  
Dealing with their Complexity and  
Keeping Them Manageable**

**Alexander Clemm**

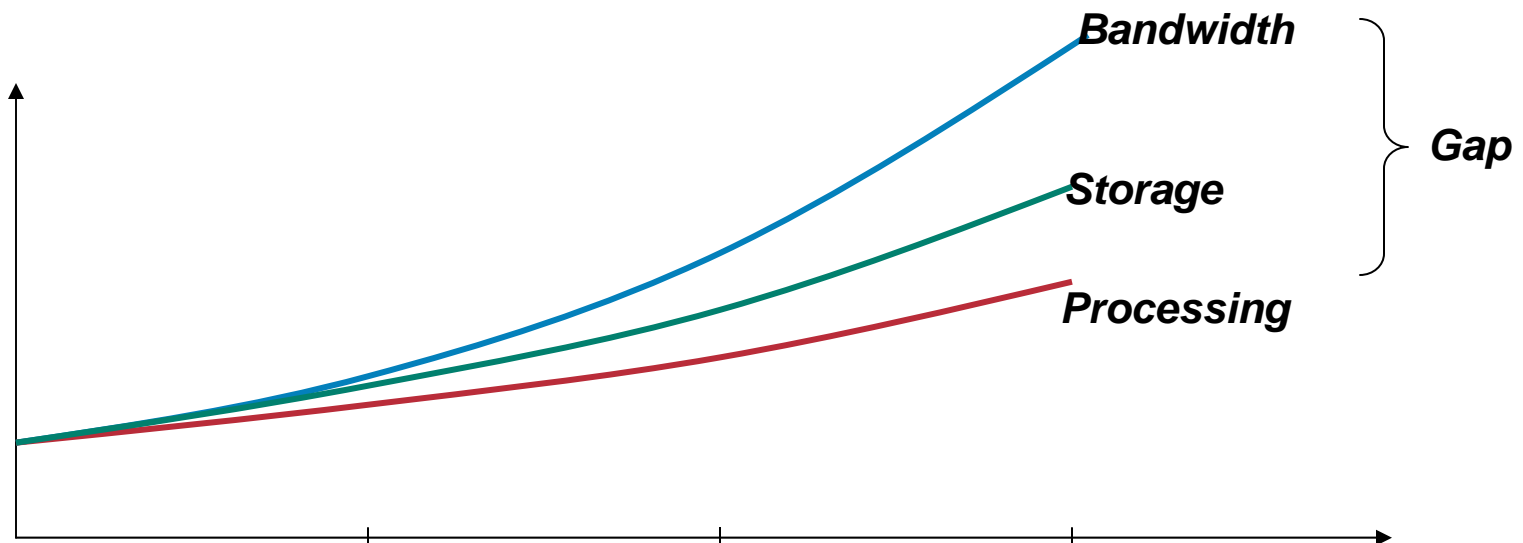
**alex@cisco.com**

***May 18, 2005***

# Dealing with Complexity in Management

Cisco.com

- **Not a new theme**
  - “Increasing number of devices”
  - “Increasing heterogeneity”
  - Standard motivation for IM papers since 1989
- **Price/performance of processors vs storage vs bandwidth**



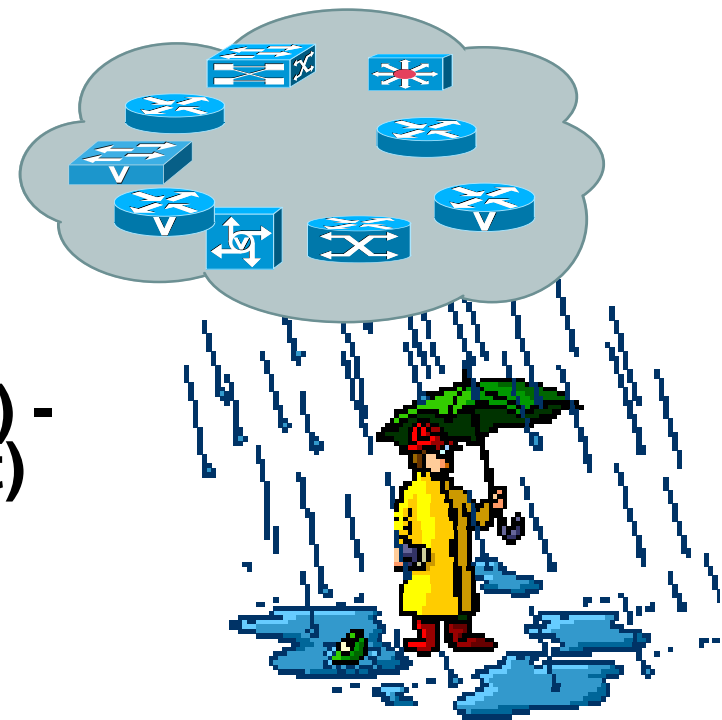
# New networked worlds

- All that, plus:
  - Multi-service, multi-technology networks
  - Ubiquity, SANs, PANs, HANs in addition to LANs, WANs
  - Security threats: viruses, spam, phishing, ...
  - New services/ applications: data centers, P2P, VoD, ...
  - More complex business relationships: MSPs, ASPs, ...

## HELP!

# Time-tried techniques

- Layering – abstraction and hiding
- Partitioning – “Divide and Conquer”
- Bad weather (network complexity) - dress appropriately (management)



# Themes for keeping complexity manageable

Cisco.com

- 1) We need more complexity, not less**
- 2) Manage less, not more**
- 3) Think divergence, not convergence**

# “More complexity, not less”

- **Complexity is in the eye of the beholder**
  - compare DOS/Windows
- **Balance complexity**
  - ex. system complexity needs to keep up with (and offset) growth in management complexity
  - out of balance → prohibits progress



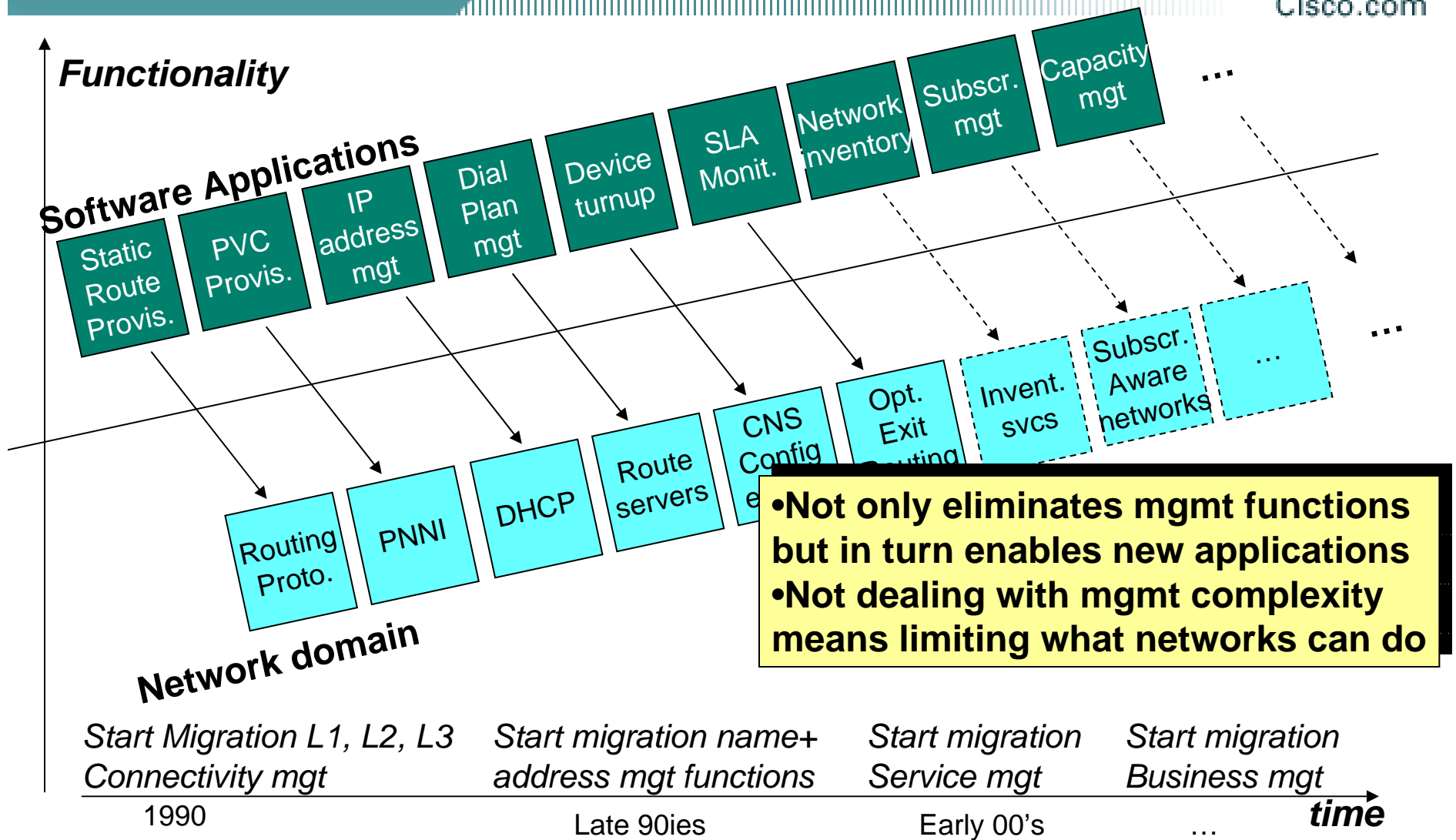
# More complexity is less complexity: Network intelligence

Cisco.com

- Added network intelligence
  - Added network complexity
  - Reduced management complexity
- “Self-management”
  - Close control loops for routine management tasks
  - Management is also about intent
- Virtualization – very powerful concept
- Signaling and control: Additional layer between management and network function
  - Special purpose, not general purpose

# Migration of management intelligence into the network

Cisco.com



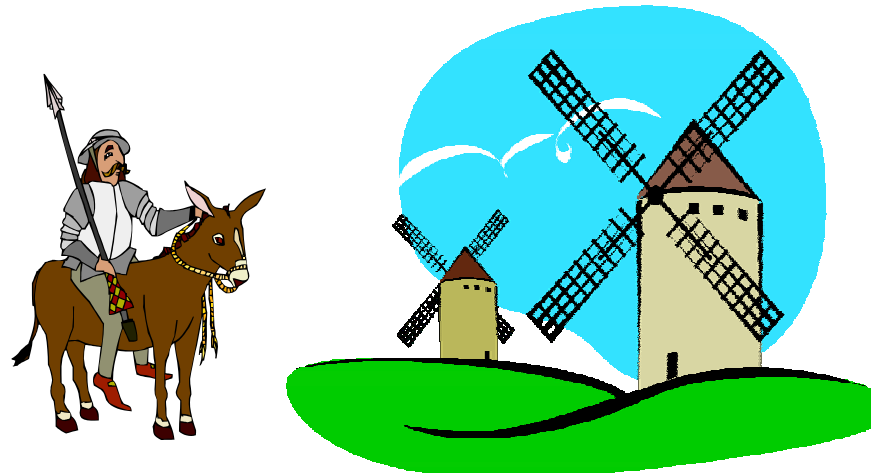
# Manage less, not more

- **Accomplish the same with less**
  - **Management by delegation**
  - **Management by objectives**
    - **Policy-based management**
  - **Management by exception**
    - **Event driven management**
    - **Collect data but only analyze when needed**
- **Accomplish less**
  - **Rethink: how much do you REALLY have to manage**
  - **Turns out to be acceptable in other areas...**

# Manage less, not more

Cisco.com

- **One extreme: Everybody becomes an administrator**
  - IT users/ notebooks; digital photography/ video, cell phones/ address books
  - Painful but acceptable if enough value is perceived
- **Learn to harness chaos if you cannot control it**
  - Metaphors: Directory (orig. Yahoo!) vs. Search (Google)
  - Command economy vs. free market economy
- **Approaches applying epidemic concepts hold promise**



# Think divergence

- **Preamble: Packet vs circuit switching**
  - **Packets: basis for convergence**
  - **Problem: interaction between services, users → “Best Effort”; where are the guarantees?**
  - **Approaches: MPLS, RSVP, ...:**
    - **Distinguish between different traffic types, streams**
    - **Recreate “circuits” on top of packet infrastructure**

# Think divergence

Cisco.com

- **Management of New World Networks**
  - Converged networks, applications, services
  - Problem: feature interactions
    - Resource contention
    - Performance impact
    - Guarantees?
    - De-facto “Best Effort Management”
- **Approaches:**
  - Clear separation of management concerns –  
Don’t manage things as a “blob”
  - Virtualization (partitioning, virtual machines)
  - Business fragmentation
- (To avoid misunderstandings: of course, converged networks + integrated management are still a GOOD thing)

# In response to John's questions...

Cisco.com

- ***How can we build a self-governing system if it is too complex to comprehend?***  
**A: Contain complexity e.g. through layering, abstractions, separating concerns.**
- ***Can a system REALLY manage itself?***  
***Can it ever be self-governing, -healing, etc.?***  
**A: Yes, but when it does so for a specific purpose we do not think of it as management but as signaling and control.**  
**(No, as far as intent is concerned.)**
- ***How to prevent a system from learning bad habits?***  
**A: Teach it properly. Defining proper control is hard.**  
**Circuit breakers for closed control loops are important.**
- ***What is the role of policy management?***  
**A: Very important, to allow for management by objectives**
- ***What is the role of standards? NM standards?***  
**A: defer to the panel**
- ***How do we build network components to collaborate intelligently?***  
**A: for example, through proper signaling and control protocols, not generically but for one function at a time**

# CISCO SYSTEMS



## EMPOWERING THE INTERNET GENERATION<sup>SM</sup>