

# CS514: Intermediate Course in Computer Systems

Lecture 40: April 29, 2003  
Autonomic Computing



## Trends of the moment...



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- We've seen a series of *architectural responses* to big current trends
  - *Web Services*: a web for direct computer-computer interactions
  - *NAT's and Overlay Networks*: Custom Internet tailed for your own needs
  - *Transactions, Replication*: Got copies?
  - *Grid Computing*: Computing power treated as a utility

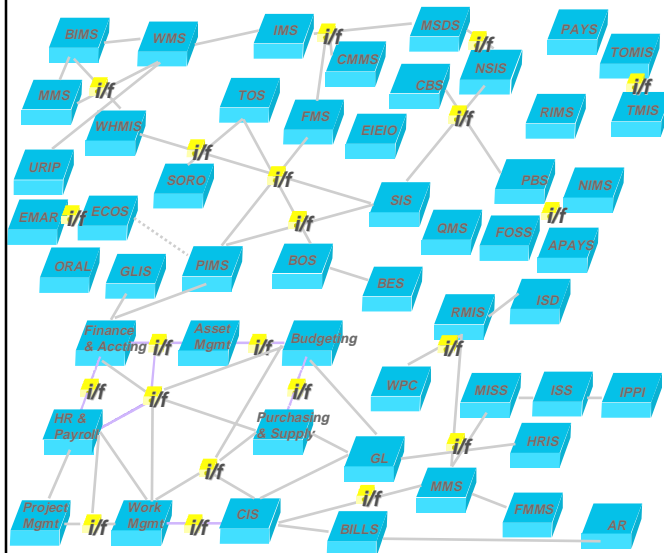


## Trends of the moment...

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- Such trends have much in common with fashion
  - There is a perceived need
    - For example: "We're running out of Internet addresses! Oh my!"
  - People start to hack around the issue
    - Network address translation
  - Eventually this grows into a more coherent architecture
    - Overlay networks, STUN, etc.
  - The architecture is perceived a magic bullet

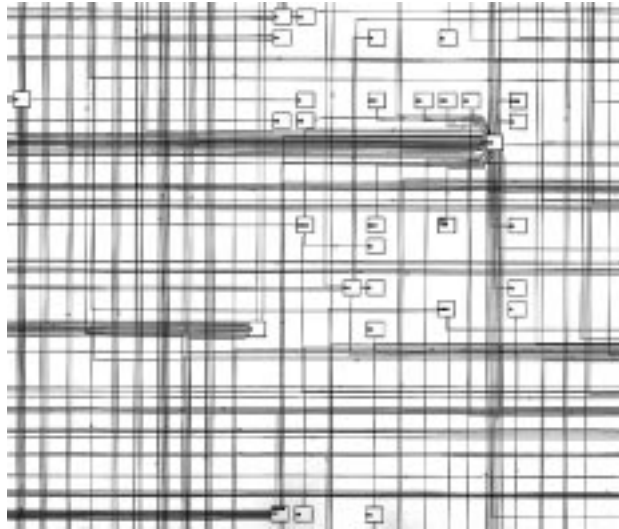
## Best of Breed



- ◆ No common look, feel
- ◆ Conflicting, redundant data models
- ◆ Overlapping functionality
- ◆ Disaster recovery
- ◆ Multiple contracts
- ◆ No single support source
- ◆ Release synchronization
- ◆ Cost of interfacing

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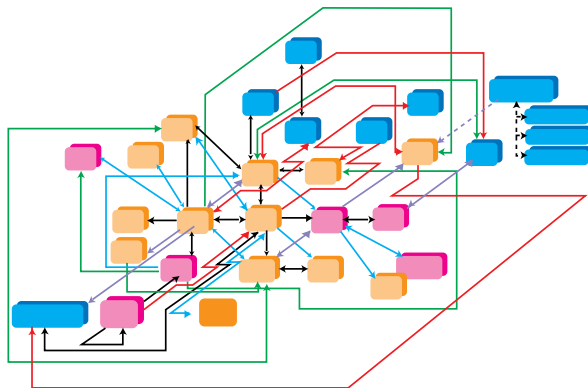
## Legacy Operational ISs



## Scale of GTE's (Verizon's) IT Environment

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- ◆ \$1.2 billion/year IT expense
- ◆ > 5000 ISs
- ◆ > 1.5 *petabytes* operational data





## Magic bullets

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- A very common pattern in computing, especially in the business world
  - You are spending a fortune on something
  - Technology is the problem
    - Most of that money is spent because a technology is somehow inadequate
  - Then along comes a (snake oil) salesman with “a radical advance”!
    - And you leap because the consequence of being left behind is too horrible to contemplate



## Magic bullets

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- When a vampire is stalking the castle, loading your gun with magic silver bullets can have irresistible appeal
- (especially to management!)





## What's the threat?

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- Enormous complexity of modern distributed computing systems is overwhelming organizational resources
- People needed to
  - Install/configure software, hardware
  - Diagnose problems
  - Repair things that aren't working right



## In CS514 we talk too much about application development

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- In fact, developing new applications is just the foam on an ocean of stuff
- Microsoft .NET
  - Estimates of 10 to 20 millions lines of code
  - Enables you to add your 2500 line application at the edge...
- J2EE, CORBA no different



## Real world “issue?”

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- System administration can be overwhelmingly hard
- Talk by Michael Brodie focuses on this... [visit briefly](#)
- How does this relate to Autonomic Computing at IBM?



## IBM's goals

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- Autonomic Computing represents an exciting new research direction in computing.
- IBM believes that the spiraling cost of managing the increasing complexity of computing systems is one of the biggest single issues threatening to undermine the future growth and societal benefits of information technology, and proposes a solution inspired by the human body: *autonomic computing*.
- The goal is to create computing networks and systems that -- like the biological analog -- hide complexity from the user and deliver much greater value than today's systems can.
- These new systems need to be self-managing, self-configuring, self-healing, self-protecting, and continuously self-optimizing.



## Technical and Social Issues

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- Represent nominal system
- Capture current state
- Diagnose problems
- Plan response
- Carry out repair strategy
- Evaluate outcome...
- Does anyone have any idea what the system looks like?
- Are the components “instrumentable”?
- Faults cascade: How can we construct fault-trees?
- How long will it take for the repair to occur?



## Is Autonomic Computing Hopeless?

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- Strictly speaking: yes. The problem can't be solved
- But we can certainly improve systems
  - Need new services to capture state
  - Routine attention to robustness
  - Avoid tighter-than-needed coupling of components



## Lesson from Y2K?

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- People reasoned that
  - Systems are complex and interdependent
  - If many fail at same time, results will cascade worldwide
  - And society as we know it will end!
- But Y2K came “not with a bang, but a whimper”



## Strange robustness

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- Social engineering forces heavily used systems to become robust
- People tend to focus on and improve components that often cause disruptive failures
- Causes systems to be much more robustness than we can explain





## From Shakespeare in Love.

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- *Lambert holding Henslowe's feet to the fire*
- HENSLOWE Mr. Fennyman, let me explain about the theatre business. (they stop). The natural condition is one of insurmountable obstacles on the road to imminent disaster. Believe me, to be closed by the plague is a bagatelle in the ups and downs of owning a theatre.
- FENNYMAN So what do we do?
- HENSLOWE Nothing. Strangely enough, it all turns out well.
- FENNYMAN How?
- HENSLOWE I don't know. It's a mystery.
- LAMBERT (dumbly) Should I kill him, Mr. Fennyman?
- *A din is heard in the background. A messenger, ringing a bell, is running though the street.*
- MESSENGER The theatres are reopened. By order of the Master of the Revels, the theatres are reopened