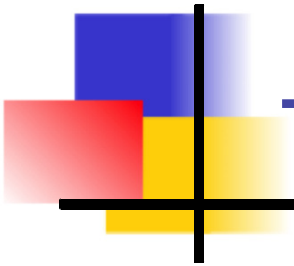

The Cost Of New Technology

Simon Roberts
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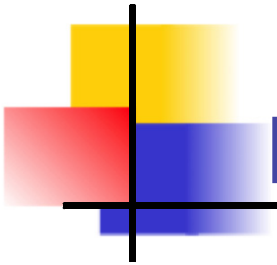
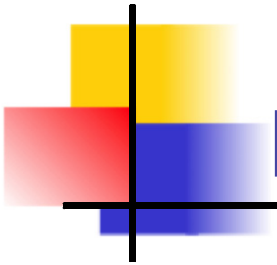
Colorado Software Summit



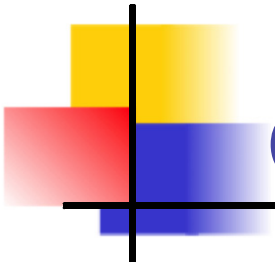
Libraries *et cetera*

- Libraries, frameworks, toolkits, whatever you call them
  - Intended to simplify programmer's lives
  - Are designed to be simple to use
  - Generally follow good OO principles
  - Increasingly, perform complex operations
- Hide the complexities of their behavior
- Discourage programmers from thinking about what the library does and how



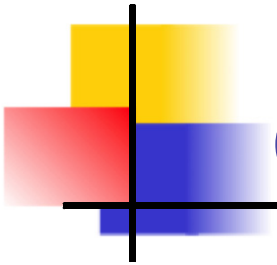
Example Frameworks

- These exemplify principles of more general relevance
- EJB
  - Manageability
  - Security
  - Transaction framework
  - Memory management (object pools)
  - ORM
  - Legacy integration



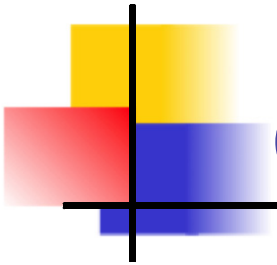
Quality Of Service Issues

- Performance
  - Latency
  - Throughput
- Scalability
- Reliability
  - “Transactional” Correctness
- Availability



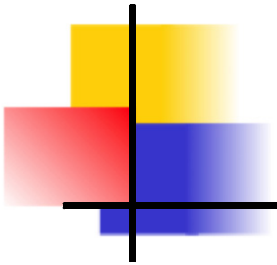
Quality Of Service Drivers

- Amdahl's law
  - Transactions
  - Synchronized blocks
  - Other constraints
- Persistence
  - Search efficiency/flexibility
  - Data integrity
  - Speed



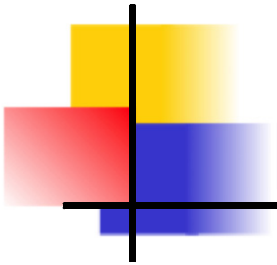
Quality Of Service Drivers

- Network/Disk/DB I/O
  - Latency
  - Bandwidth
  - Concurrency
- Memory usage
  - Physical memory constraints
  - Garbage collector impact



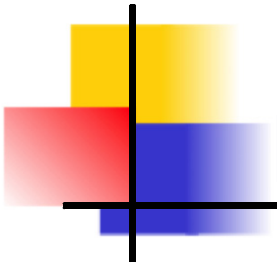
EJB 2.x Transactions

- EJB 2.x entity beans “simplify” transactional correctness
  - Default behavior — everything is in a transaction, so developer “need not worry”
  - Creates illusion of 100% OO system — persistence “just happens”



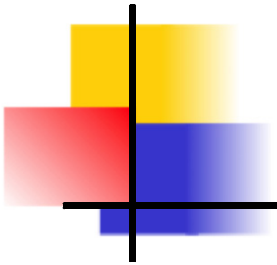
EJB 2.x Transactions

- Drawbacks:
  - Unnecessary transactions — when entity is “live” DB must be locked
    - Even if you're only reading the data
  - Transaction model is mapped directly to method model
    - Fine control is lost
    - Transactions last longer than needed
    - Transaction scope might be inadequate if “session facade” is not used
  - (Might map methods to transaction model)



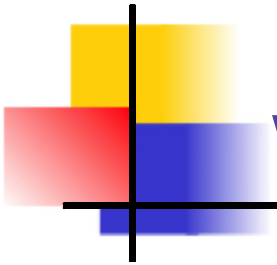
EJB 2.x Transactions

- More drawbacks:
  - Transactions are always propagated over a network
    - Network latency further increases duration of transaction
  - Access code is automatically generated, runs client side
    - Can't (generally) use stored procedures in CMP



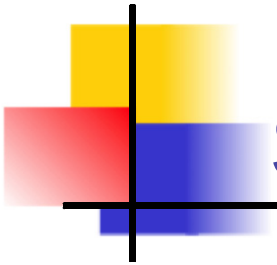
Improving On EJB 2.x

- Newer frameworks return transaction control to the programmer
  - Along with the responsibility
- Most still make it hard to avoid client side transactions
  - And the network trips associated with this



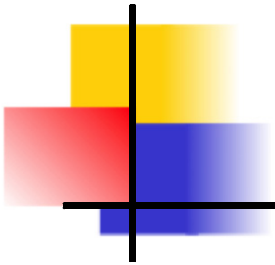
Web Services & SOA

- Started out essentially without transaction support
  - Now being added in
  - But XML is a splendidly slow mechanism
- How smart is a transactional service?



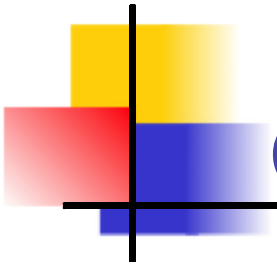
Synchronized Blocks

- Early collection classes attempted to provide thread-safety
  - Liberally synchronized
- This protects the data structure, but not the higher level meaning
  - So you have to add more synchronization
- Newer collections don't synchronize
  - Concurrency is hard and usually, you just have to face up to this



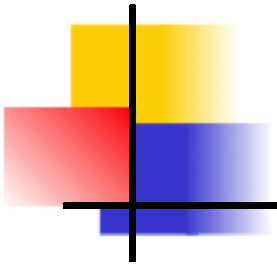
ORM Systems

- Option 1: Use objects to create a schema?
  - Objects are designed without regard to use, schema usually requires denormalization for performance
  - All ORM tends to force client-side queries



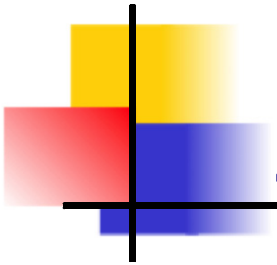
ORM Systems

- Option 2: Connect objects to existing schema?
  - A denormalized schema is typically poorly supported
  - Much of the benefit of ORM may be lost if you have to patch up duplicate fields and indexes manually
- ORM has been described as the “Vietnam of modern computing” (Ted Neward)



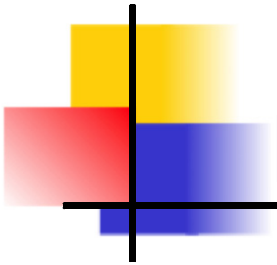
Network Issues

- First law of networking:
  - Minimize round trips
- Second law of networking:
  - Avoid sending redundant data
- But what's the most important law?



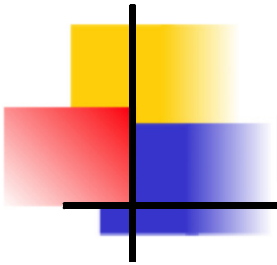
Zeroth Law Of Networking

- 20 minute drive, or a trip to Pluto?
- Zeroth Law: DON'T
  (...OK, Don't *without a reason*)
- Reasons:
  - You need to access a remote resource
  - You need capacity and/or availability (clustering)
  - Your vendor's marketing department says it's cool



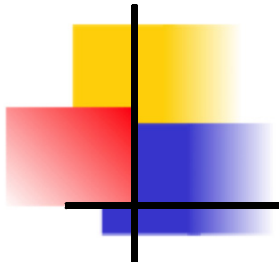
EJB And The Zeroth Law

- EJB 1, everything was remote
  - (To support clustering, for sure)
- Hard knocks introduces:
  - Session Facade
    - Make coarse-grained business methods that support the use of the data, not the OO design
  - “Composite Entity”
    - Avoiding the network becomes so important we avoid using entities when using entities!



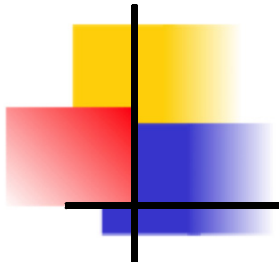
EJB And The Zeroth Law

- Then, in EJB 2, we get local interfaces
  - And quite soon most containers allow local communications between web container and ejb container
- Now in EJB 3, there's hardly even the expectation of remote access to entities
  - We'd probably serialize them and copy them in preference



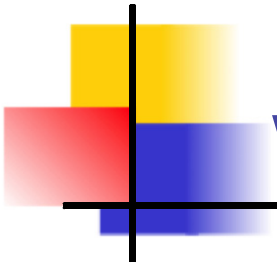
RMI And The First Law

- Prior to RMI, most distributed computing systems required you to design the "structure" that would carry data over the network
  - RMI changed this, allowing almost any object to be used
- RMI and EJB users quickly invent:
  - Session facade — coarse-grained methods
  - Transfer object — get all the data in one place



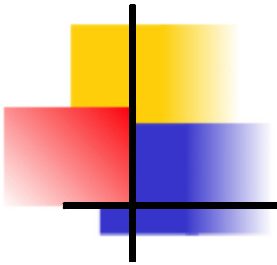
RMI And The First Law

- In EJB 3, we often suggest serializing entities directly rather than using custom designed transfer objects
  - Is that always a good idea?
- How about using `transient`, or customized serialization?
  - OO tells us we don't need to understand the innards of an object
  - How well would invisible-inconsistent-object-semantics sit with this notion?



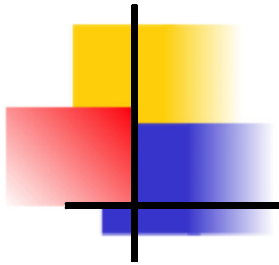
Web Services & SOA

- XML is greedy
  - Parsing & generation of XML is computationally very demanding
  - Adding this to network latency is bad
  - Network bandwidth overhead grows hugely too
- They told us “it's plain text which is good”
  - But now, everyone has to compress it anyway



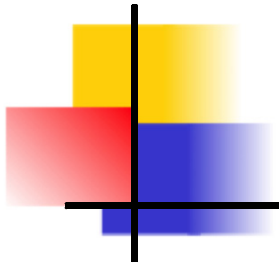
Transactions Over Networks

- Transactions limit scalability
  - The longer the transaction duration, the worse the potential impact
- Networks are slow
- Networks are unreliable
- Consider the consequences of transactions spanning networks
  - Potentially much longer duration
  - Partial failure forces timeout (and rollback)



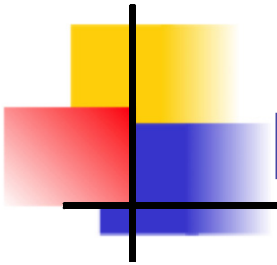
Memory Effects

- Reference following garbage collection (*e.g.* Java) is incompatible with large virtual memory
  - GC breaks the optimization on which virtual memory is based
  - Do not let the VM allocation exceed (90% of) the physical memory available



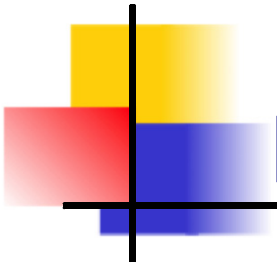
Memory Effects

- EJB introduces application-level virtual memory (HTTPSession and Stateful Session Beans)
- Naively implemented, these would increase GC load
  - Page out operation would waste an object, page in would have to allocate a new one
- Implementation along with pooling would seem to correct this



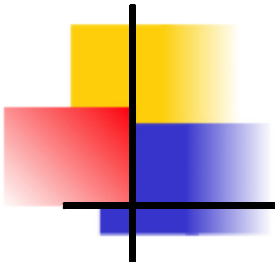
Early Java GC

- In early Java releases (1.0, 1.1) GC was slow and costly
  - Many people, including the EJB team, adopted pooling approach to mitigate this
  - Reuse the object, rather than collect one and allocate another
  - In 1.0 and 1.1 this was unequivocally a good thing
- Since 1.2, GC has become ever faster



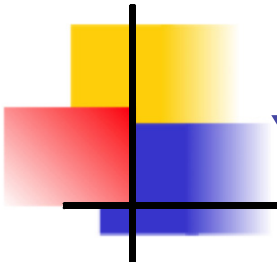
Modern Java GC

- GC today is faster than you can code a simple pool
  - *i.e.* Code for get and put operations is more time consuming than typical GC
  - Still worth pooling if you have costly, but reusable object initialization
  - Still worth pooling non-memory artifacts, notably DB connections
  - Sometimes, objects should be pooled for memory use



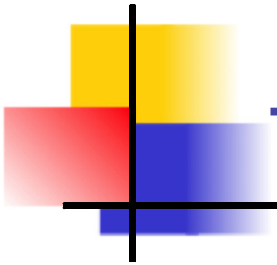
Modern GC Weakness

- Unfortunately, the new GC algorithms are an optimization, based on an assumption
  - Short-lived objects, and long lived objects
  - But objects of medium lifespan are not collected efficiently
  - *e.g.* conversational state



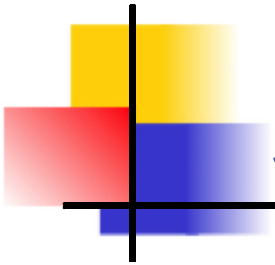
Your Pool Has A Leak

- Unfortunately, most pools don't really work anyway
  - What's in an object?
  - So, what's pooled?
  - And what's not?
- How can you create an effective pool?
  - `final` variables
  - mutable component objects
  - And no luck with `String`!



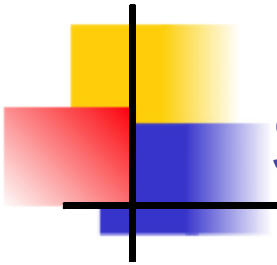
The Power Of Decoupling

- Messaging provides spatial and temporal decoupling
  - Along with stateless services provides for capacity and redundancy
- XML provides syntactic decoupling
  - Can “easily” change the message format
- But XML does not provide semantic decoupling
  - So don't expect to be able to connect “just anything” just because they're “services”



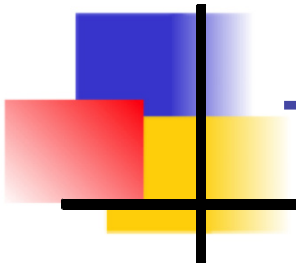
Summary

- Transactions are expensive, and can place a hard-limit on scalability
  - Trying to generalize them might be unacceptably inefficient
  - Spreading them over a network is bad too
- Good DB behavior depends on understanding how the data are used
  - Which usually means that the programmer has some important work to do



Summary

- Networks are slow and unreliable
  - If your network is fast, your CPU is *way* faster
  - Three laws, starting with the zeroth
- Java's memory handling is good, but has some vicious failure modes
  - Make sure you're fixing the right problem, not the one you think might be there
  - Beware of other folk's attempts at general solutions too



The Cost Of New Technology

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