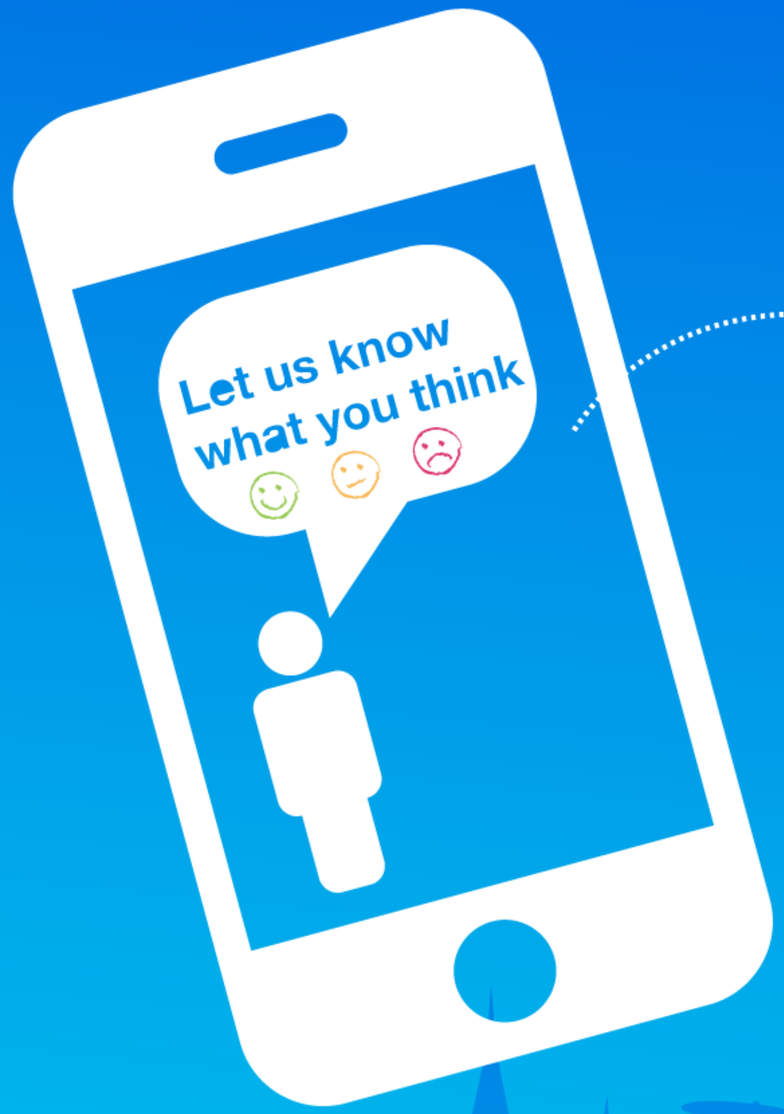
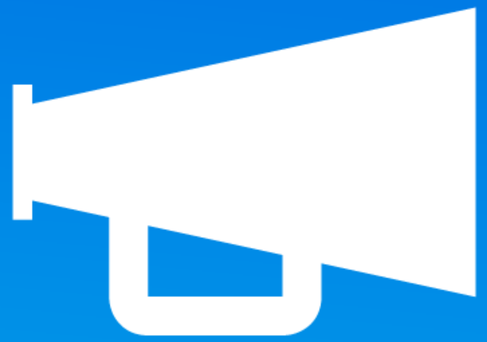
goto; conference

Reactive Systems

Dave Farley
http://www.davefarley.net
@davefarley77

goto; conference





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Reactive Systems

21st Century Architecture for 21st Century Problems

Dave Farley
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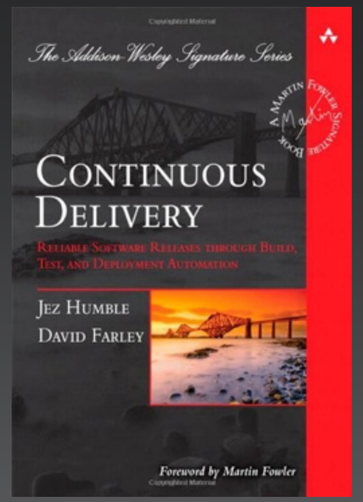

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http://www.continuous-delivery.co.uk

Our World Is Changing

Large Applications circa 2005:

- 10's of Servers
- Seconds of Response Time
- Hours of Offline Maintenance
- Gigabytes of Data

Large Applications Now:

- Handheld Devices to 1000's of multi-core processors
- Millisecond Response Time
- 100% Uptime
- Petabytes of Data

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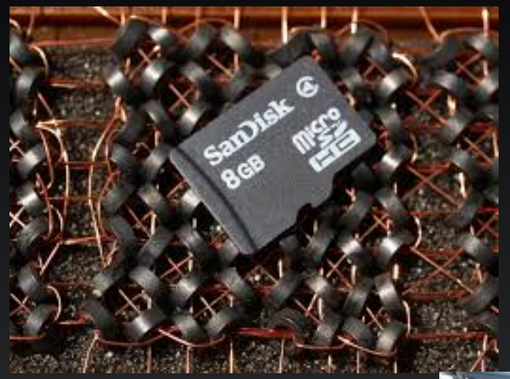
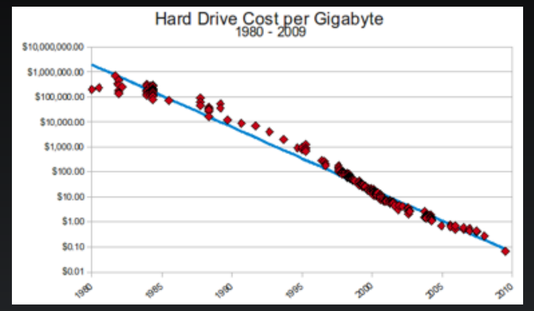
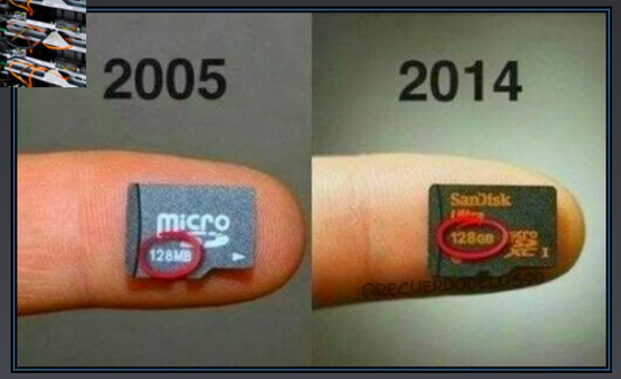
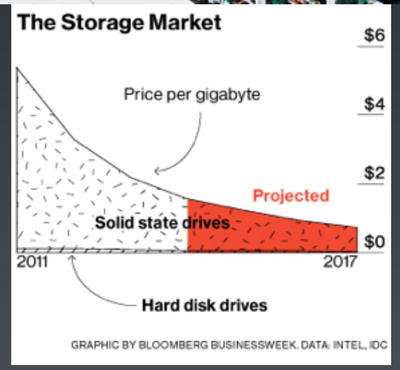
Our World Is Changing









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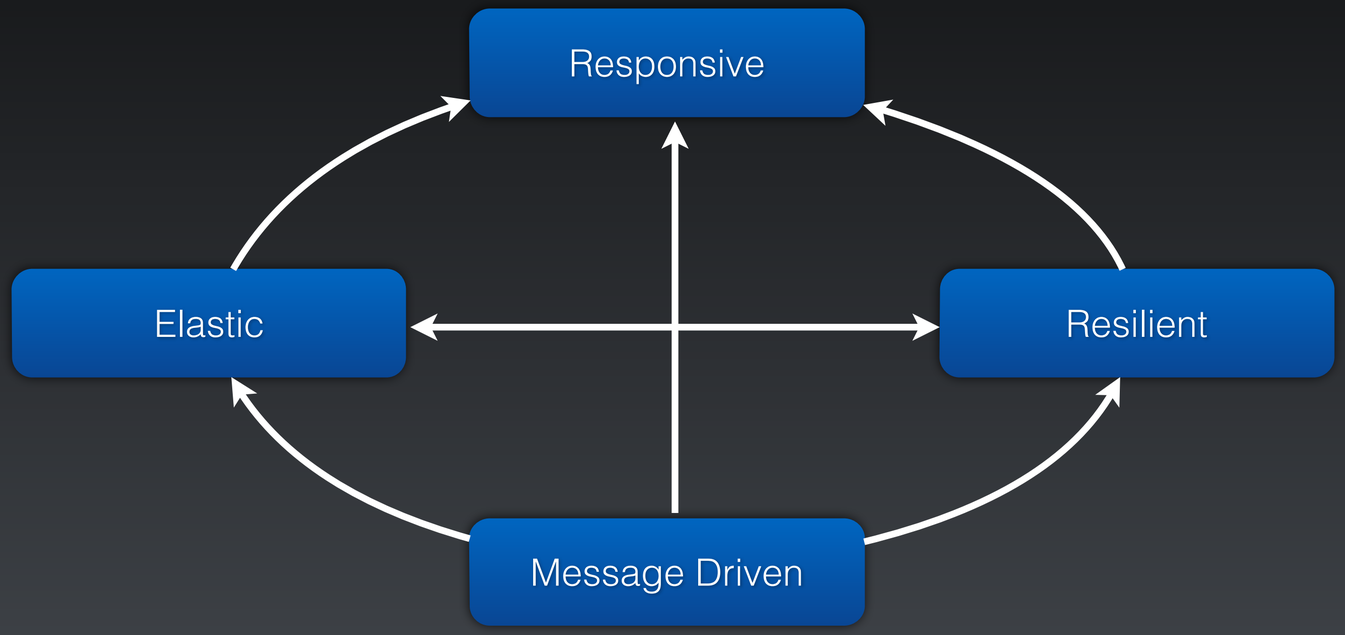
The Reactive Manifesto

"21st Century Problems are not best solved with 20th Century Software Architectures"



The Evolution of modern hardware has changed many of the common assumptions of software development

Source: www.reactivemanifesto.org

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Reactive Systems Are:

Responsive:

- Responds in a Timely Manner
- Cornerstone of Usability
- Also Quick to Detect Problems

Reactive Systems Are:

Resilient:

- Remains Responsive in the Face of Failure
- Resilience Depends on - Replication, Containment, Isolation and Delegation

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Reactive Systems Are:

Elastic:

- Remains Responsive Under Varying Workload
- Responds to Change in the Input Rate By Increasing or Decreasing Resources that Service the Input
- Decentralised Architecture, No Contention Points, No Central Bottlenecks

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Reactive Systems Are:

Message Driven:

- Asynchronous Message Passing is the foundation for all of these properties
- Loose-Coupling, Isolation, Location Transparency
- Ability to Delegate Errors

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Properties of Reactive Systems

- Flexible
- Loosely-Coupled
- Scalable
- Easier to Develop
- More Tolerant of Failure
- Respond to Failure Gracefully
- Responsive to Users

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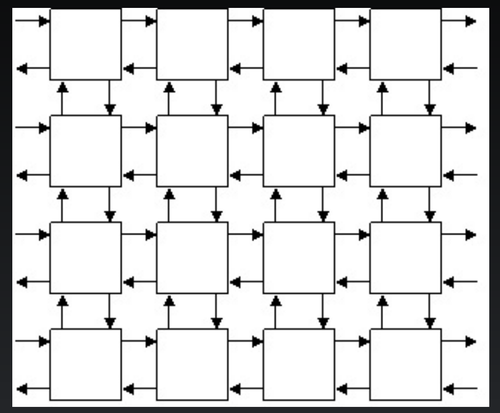
Fractal Architecture



- Large Systems Are Composed of Smaller Ones
- They Depend on the Reactive Properties of Their Constituents
- These Benefits Operate At All Scales
- Such Systems are Composable

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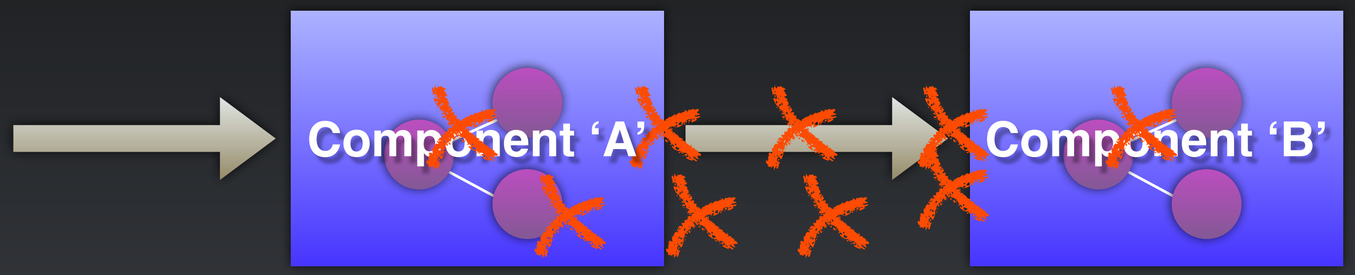
Failure Modes in Synchronous Messaging



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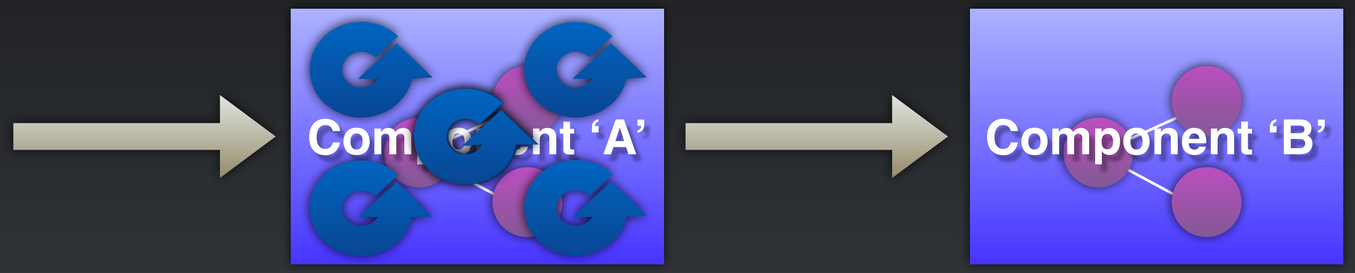
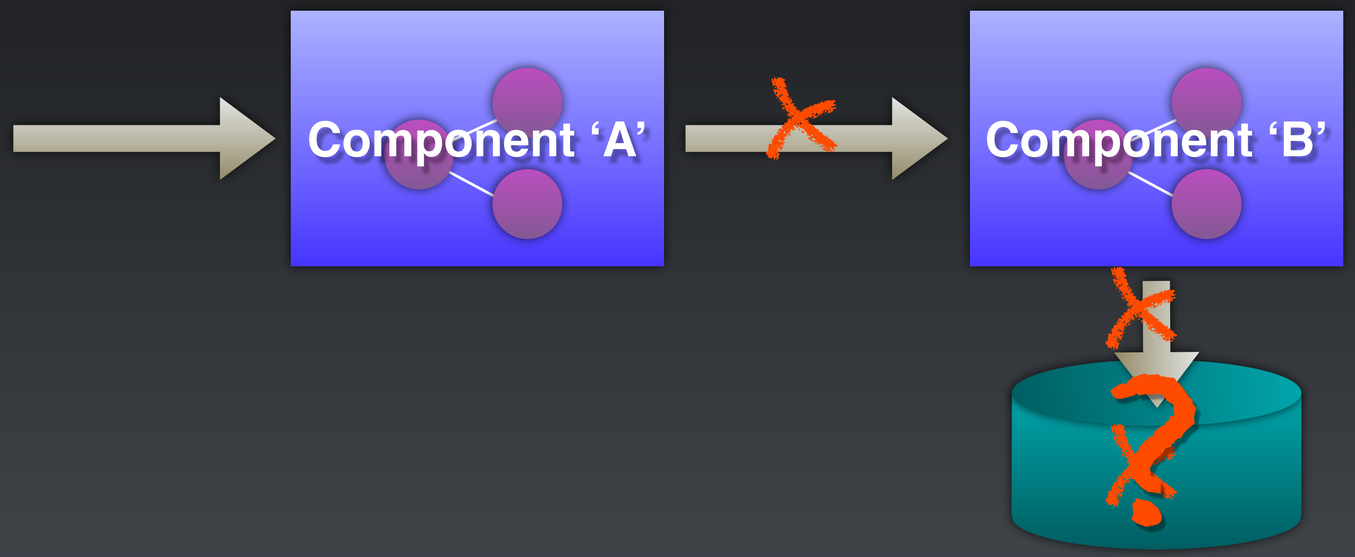
Synch Messaging Breeds Complexity



Synchronous Comms Increases Coupling in Location and Time

Synch Messaging Breeds Complexity



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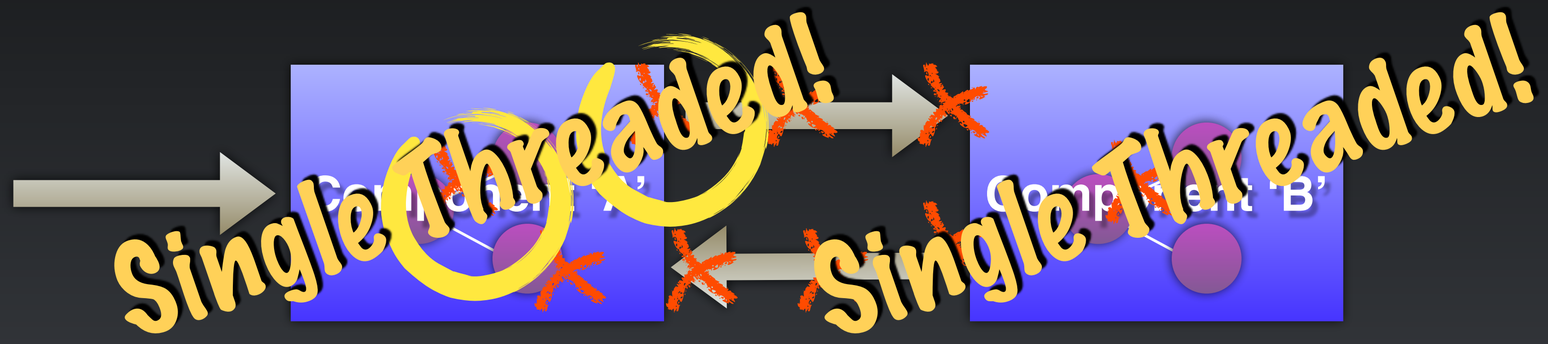
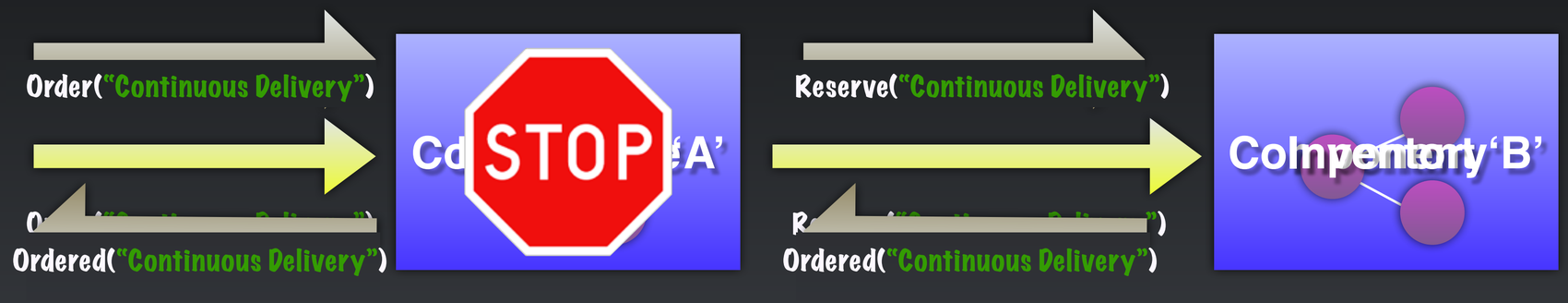
The Benefits of Asynchrony



An Example



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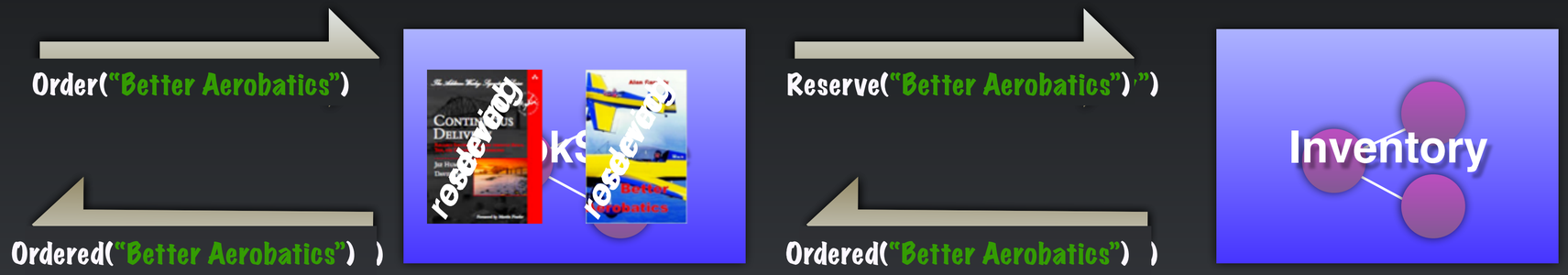
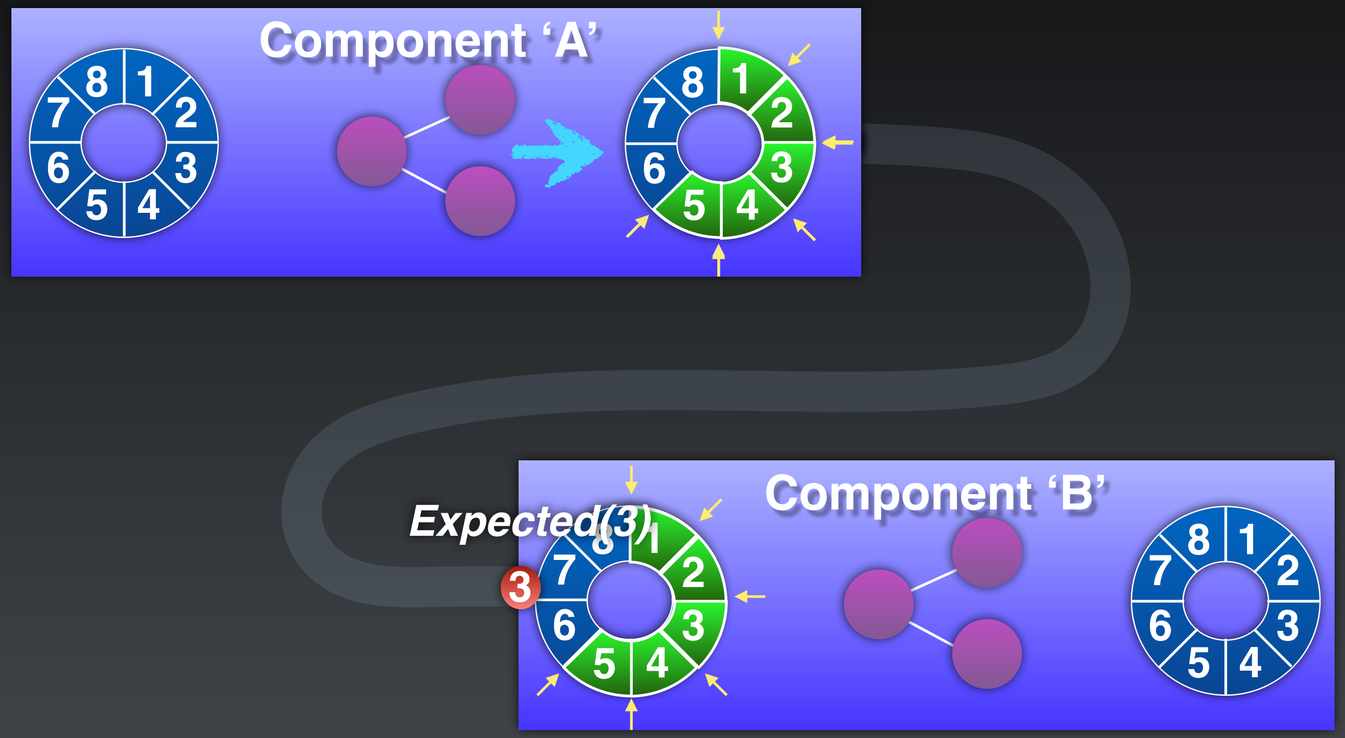
An Example



An Example of Idempotence



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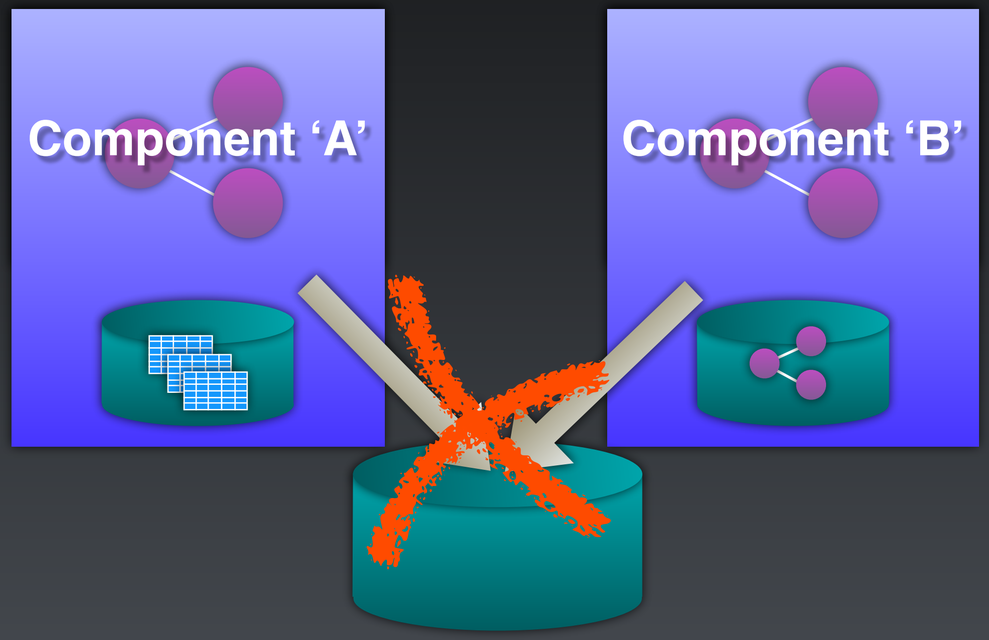
Isolation

- Decoupling in Time and Space
  - Time - Sender and Receiver have independent lifecycle
  - Space - Location Transparency
- Share Nothing!
- Built on Inter-Component Communication over Well Defined Protocols

Isolation



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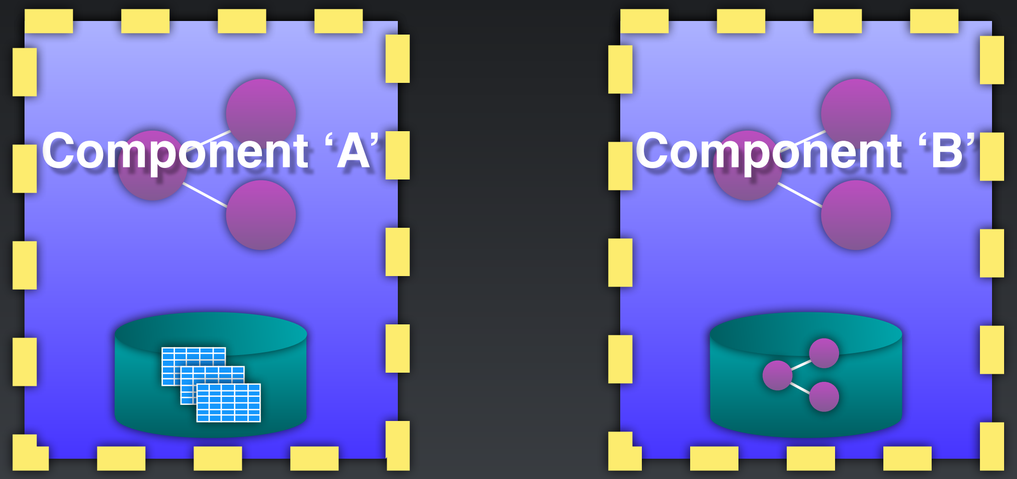
Share Nothing



Back-Pressure

- You Can’t Isolate Stress
- The System as a Whole Needs to Respond Sensibly
- Unacceptable For a Stressed Component to Fail Catastrophically or Loose Messages
- Queues Represent An Unstable State - Load
- Components Under Stress Need to Reflect This By Applying Back-Pressure, Slowing Upstream Inputs

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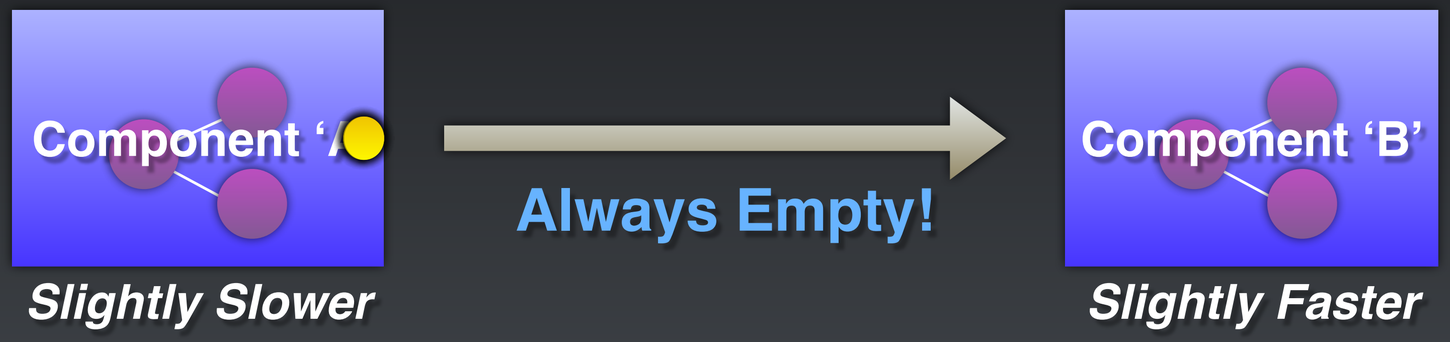
Queues Represent an Unstable State

Queues are always full or always empty.
Anything else is transitional, on its way to full or empty.



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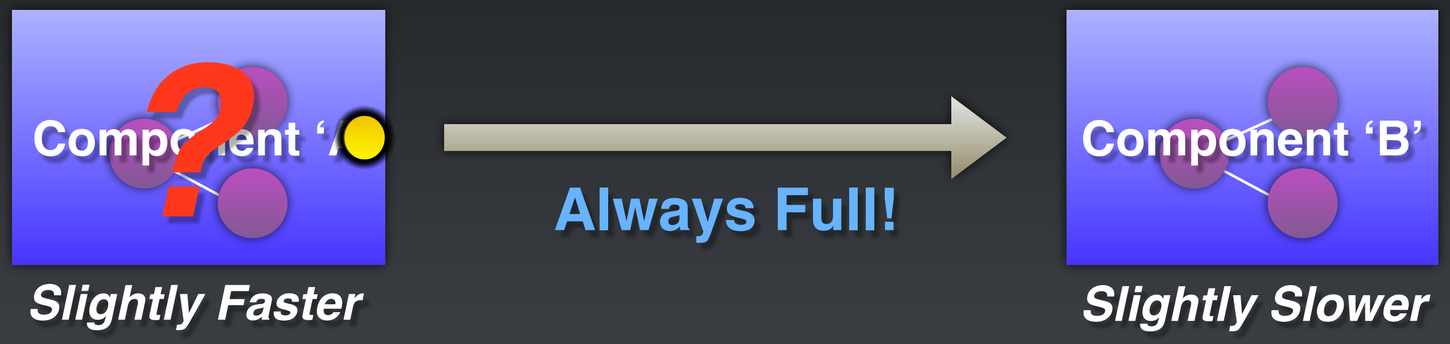

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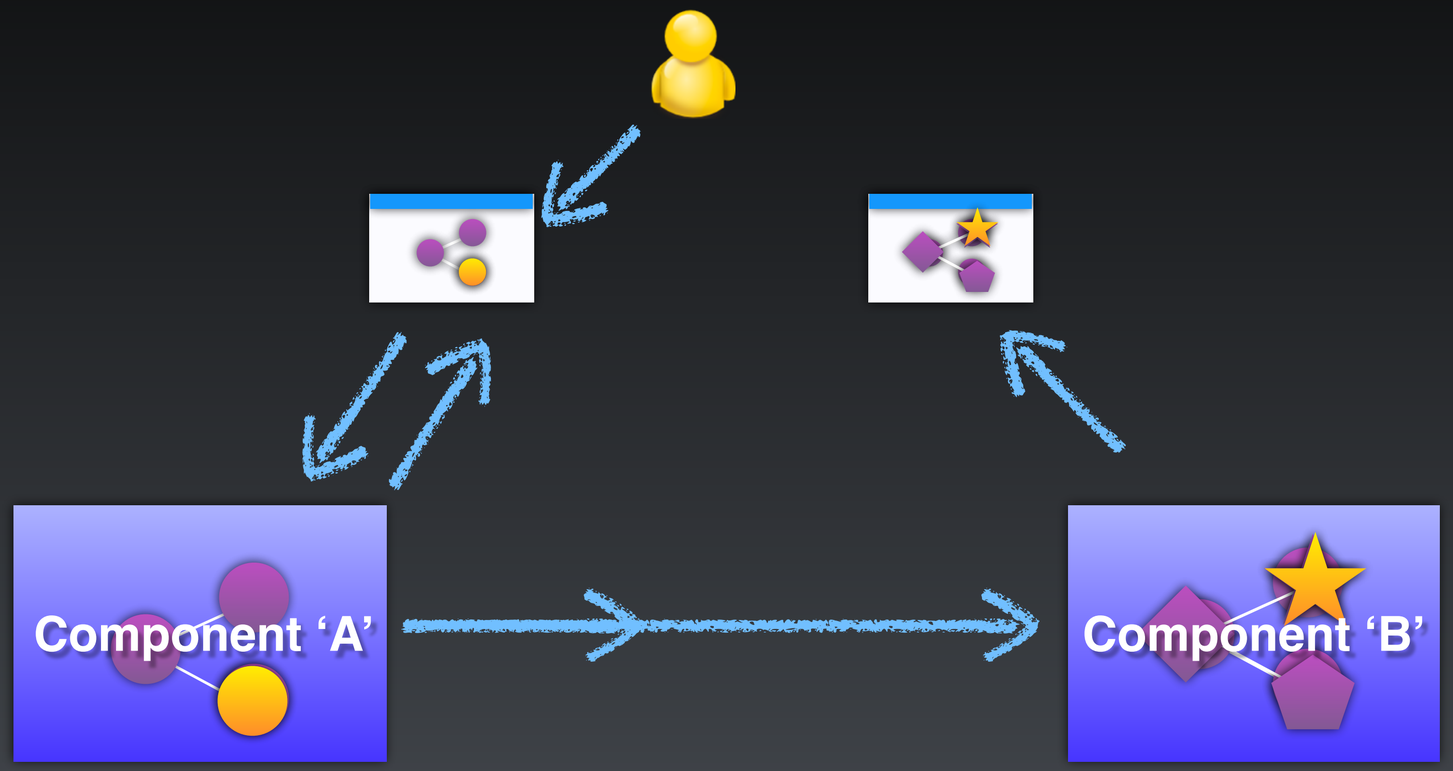
Back-Pressure

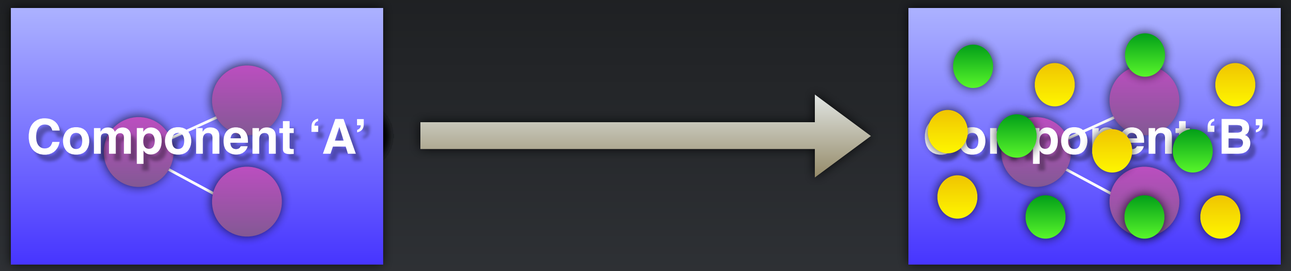
Eventual Consistency



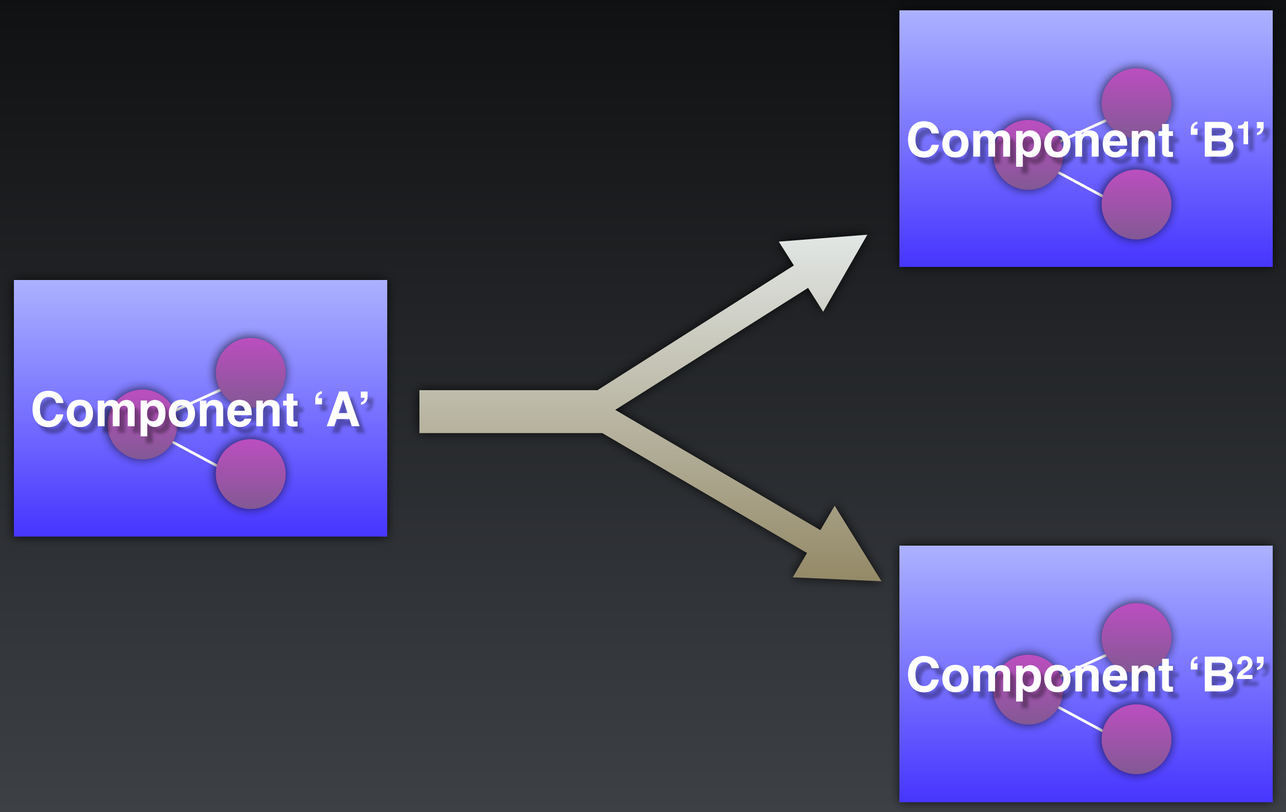
Location Transparency

- Elastic Systems Need To React To Changes In Demand
- We Are All Doing Distributed Computing
- Embracing This Means There Is No Difference Between Horizontal (Cluster) and Vertical (Multicore) Scalability
- Components Should Be Mobile
- One Pattern For Communications
  - Local Communications Is An Optimisation

Linear Scalability Through Sharding



Linear Scalability Through Sharding



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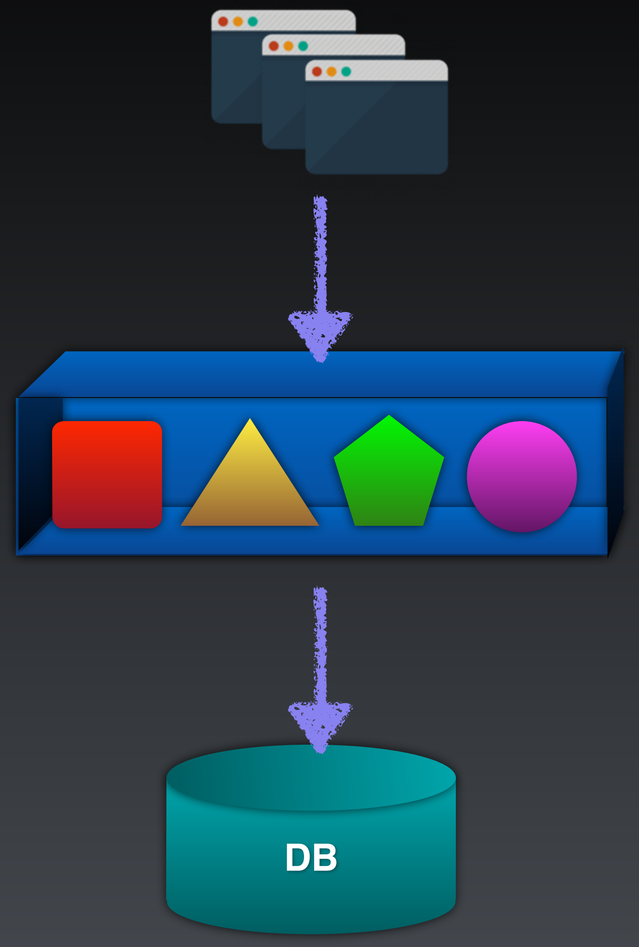
Modern Hardware Should Change Our Assumptions

- For Efficient Software, The Biggest Cost is Shifting Data
- RAM is Not Random Access
- Disk is Not Random Access
- SSD is Not Random Access
- RAM is Slow, Network is Slow, Disk is Slower

Conway's Law

Siloed Teams



Rigid Architecture

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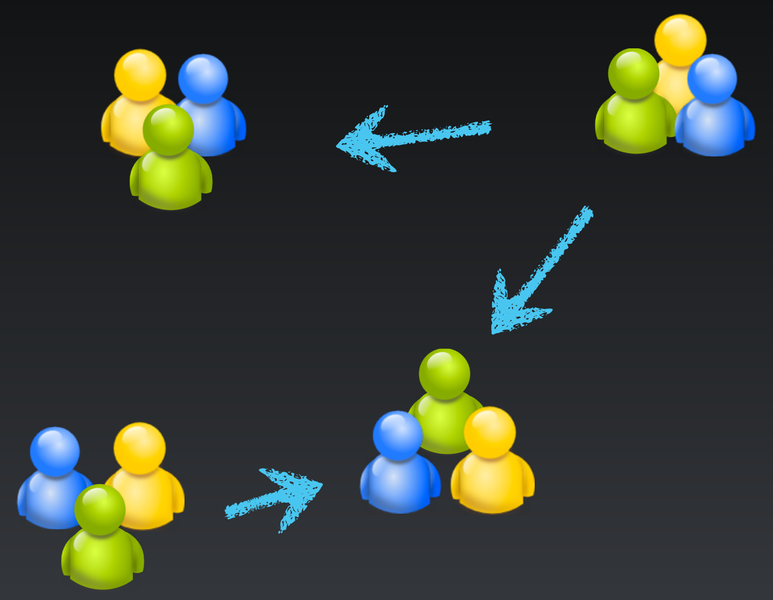
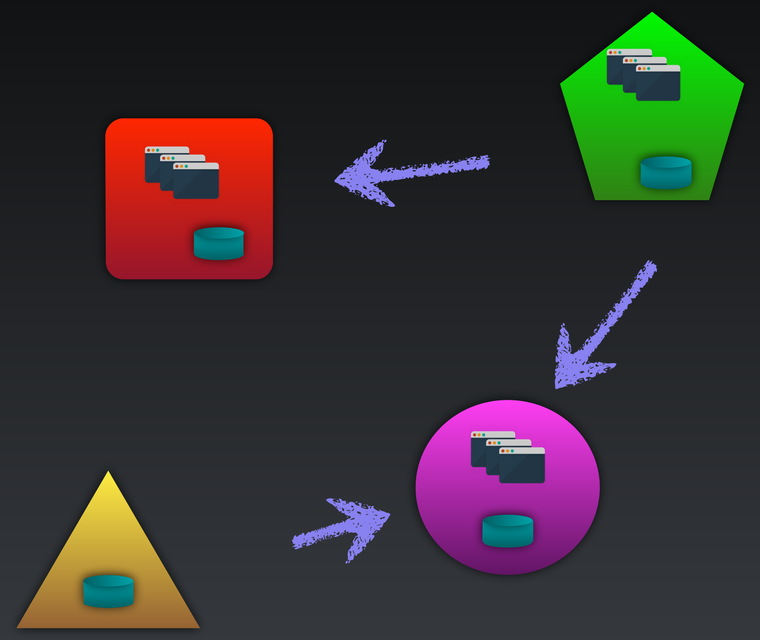
Conway's Law



Cross-Functional Teams Organised by Business Function



Distributed Service Architecture

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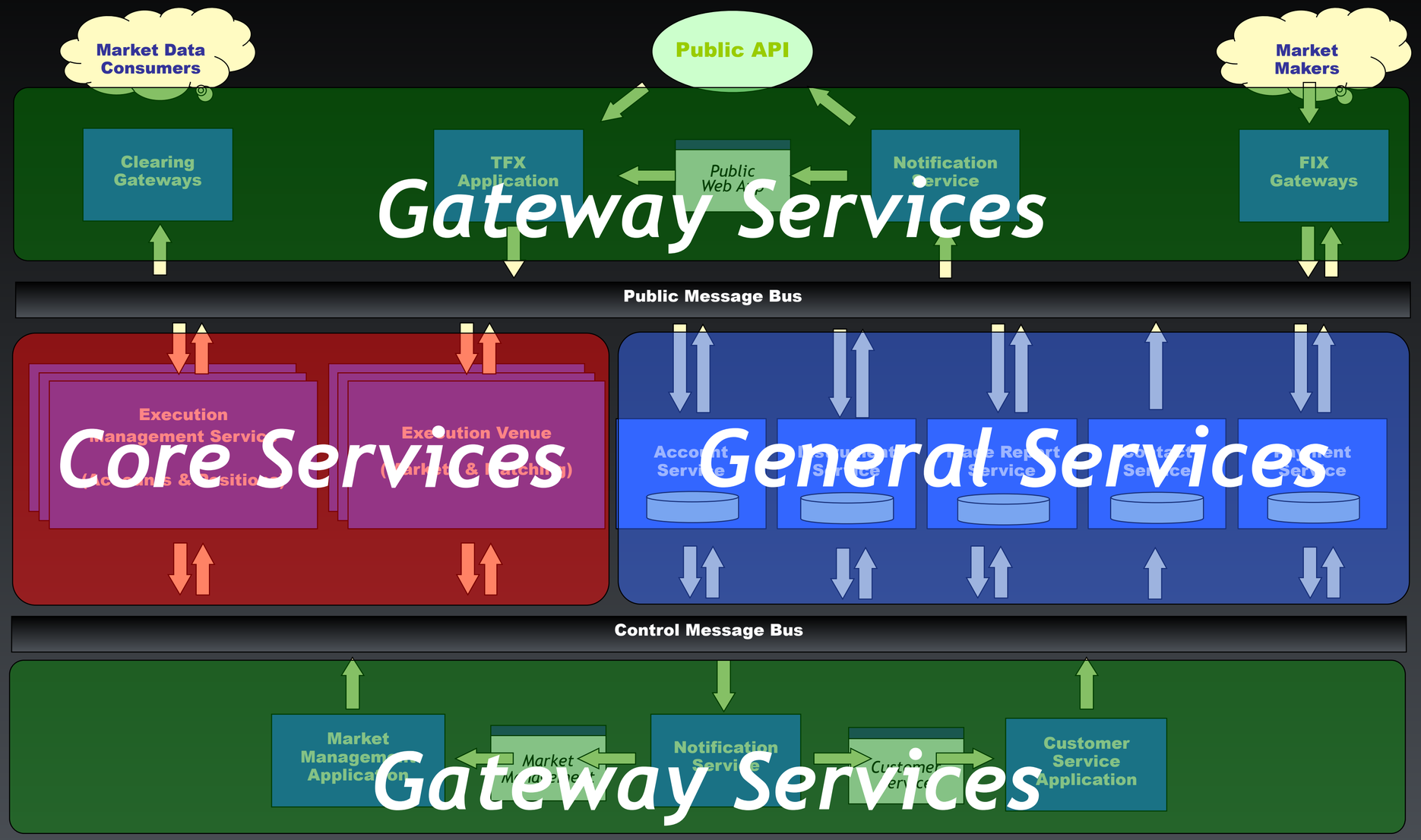
Bounded Contexts

- Each Component Is Autonomous and Isolated
- It Only Communicates Through Well Defined Protocols
- Works Best When Components Are Aligned With Bounded Contexts
- Bounded Contexts Are A Concept From Domain Drive Design (DDD) - Eric Evans
- Bounded Context:
  - The Context Within Which A Model Of the Problem Domain Make Sense
  - There Should Be ‘Translations’ Between Bounded Contexts - No “One Model To Rule Them All”
  - Bounded Contexts Tend To Align With Business Functions
  - Best Way To Decompose Organisations And Systems

Example Reactive, MicroService architecture



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Where to start?

Q&A

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