Enterprise Development with NServiceBus

Authored by: Udi Dahan

Topics Covered

- NServiceBus Basics
- Architectural Implications
- Business Processes
- Scalability & Monitoring
- Designing distributed systems

Course Programme

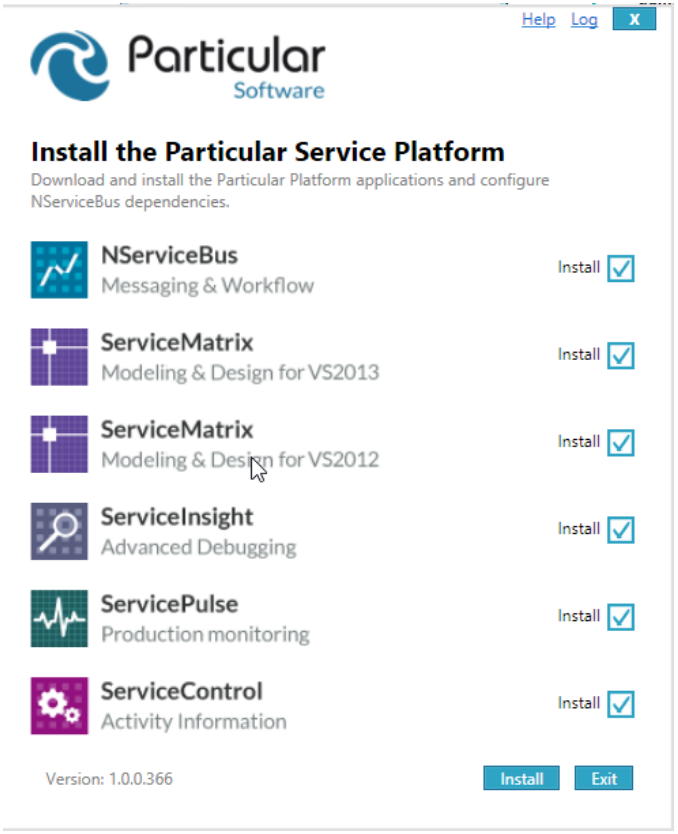
- Day 1
  - One-way messaging
  - Queues
  - Request / Response
  - Exceptions & faults
  - Web Apps
  - WS Integration
- Day 2
  - SOA Intro
  - SOA & Events
  - Publish / Subscribe
  - CQRS

Course Programme

- Day 3
  - Sagas
  - Timeouts
  - Unit testing
- Day 4
  - Scaling & Monitoring
  - Multi Site operations
  - Group exercise

Hello Distributed World

- Downloading NServiceBus
- Using NServiceBus with Visual Studio
- NuGet
- Logging

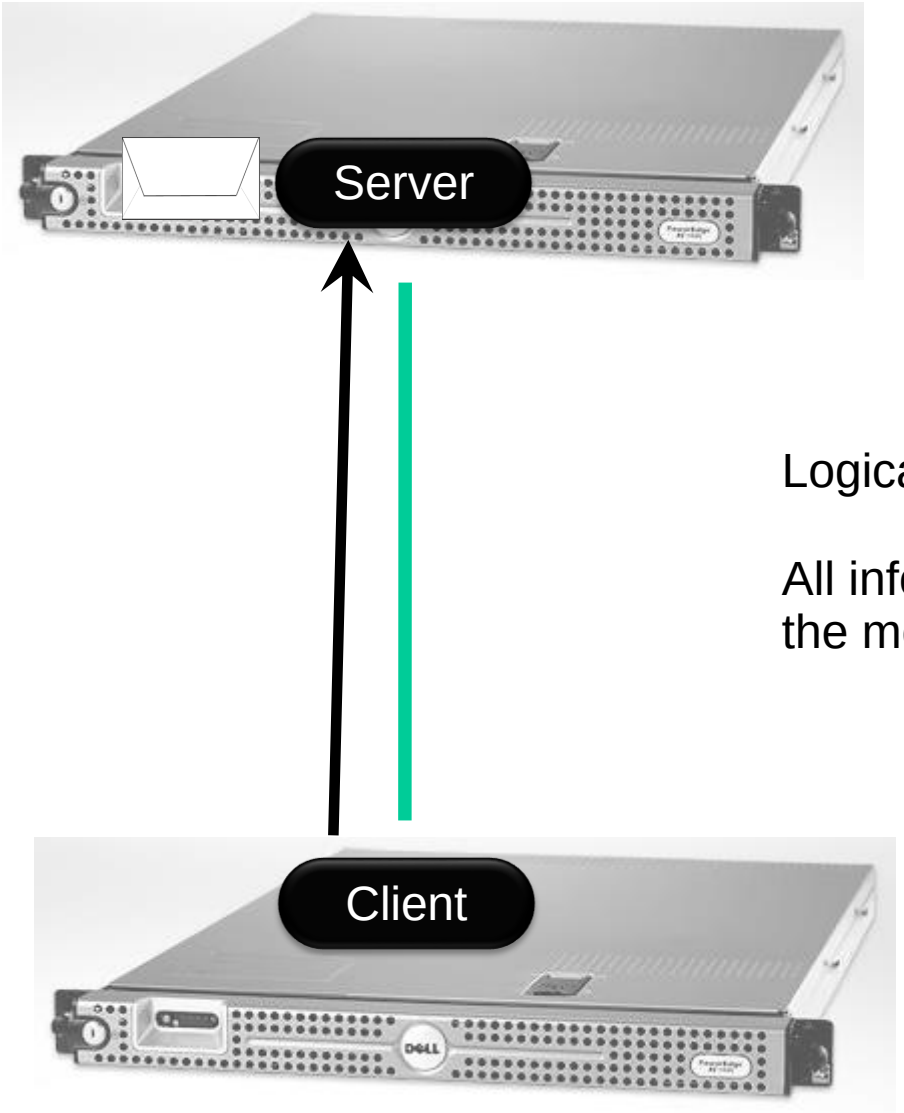


Exercises 1, 2

- Exercise 1:
  - Hello Distributed World
  - Getting ready
  - Hosting NServiceBus
- Exercise 2:
  - Logging

One-Way Messaging

Messaging & Queues



Logically one-way:

All information transferred in the message

How to: Define a message

```
public class MyMessage : IMessage { }
```

Or:

```
public interface IMyMessage : IMessage { }
```

Or:

```
public interface IMyMessage { }

configuration.Conventions()
  .DefiningMessagesAs(t=>MyOwnConvention(t))
```

- Add properties like a regular class/interface

- **Keep messages in their own assembly/project**

How to: Instantiate a message

```
var m = new MyMessage();
```

How to: Send a message

```
Bus.Send(messageObject);
```

- Can instantiate and send together
  - Useful for interfaces:

```
Bus.Send<IMyMessage>(m =>
{
 m.Prop1 = v1; m.Prop2 = v2;
});
```

How to: specify destination

```
Bus.Send(string destination, object msg);
```

- Requires that application manages routing

- Configure destination for message type:
  - In <UnicastBusConfig>, under <MessageEndpointMappings>

```
<add Assembly="assembly" endpoint="destination">
```

Or:

```
<add Assembly="asm" Namespace="ns" endpoint="dest">
<add Assembly="asm" Type="fqn" endpoint="dest">
```

How to: specify destination

- `QueueName@ServerName`
- Or
- Just `QueueName` for the same machine

How to: handle a message

- Write a class that implements `IHandleMessages<T>` where T is message type

```
public class H1 : IHandleMessages<MyMessage>
{
      public void Handle(MyMessage message)
      {
      }
}
```

Exercises 3 - 6

- Exercise 3:
  - Unobtrusive mode, message conventions
- Exercise 4:
  - Customization of serializer
- Exercise 5:
  - Routing
- Exercise 6:
  - Message processing

Fallacies of distributed computing

1. The network is reliable
2. Latency isn't a problem
3. Bandwidth isn't a problem
4. The network is secure
5. The topology won't change
6. The administrator will know what to do
7. Transport cost isn't a problem
8. The network is homogeneous

Can't assume WHEN the message will arrive, IF AT ALL

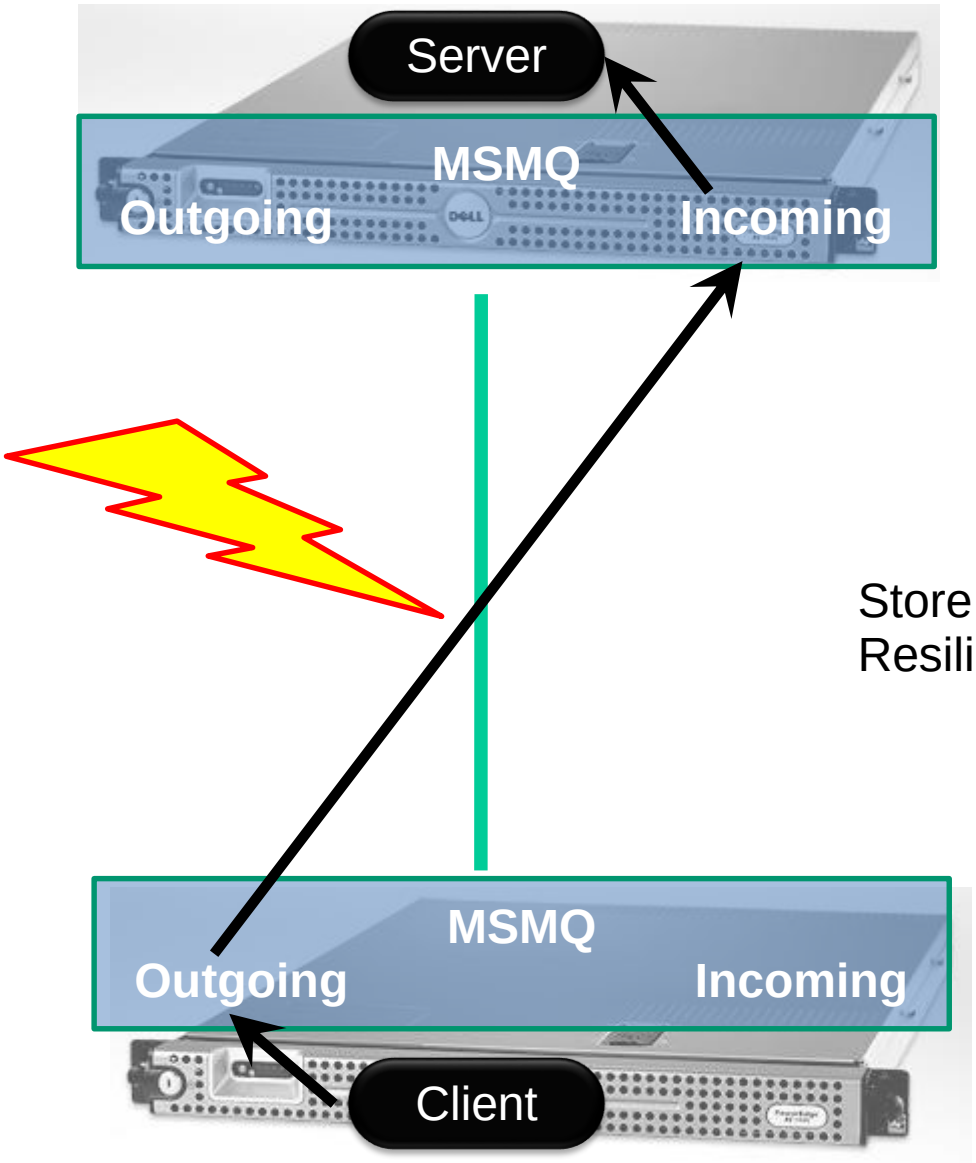
Differences from RPC

- RPC is easy to code
  - After invoking a web service
  - Next line of code assumes we've got a response
- RPC problems
  - Can't reason about the time between one line of code and another
- Messaging makes this all explicit

Fallacy: The network is reliable

- Reasons thing fail
  - Switch goes up in smoke
  - Power out
  - Someone trips over the network cord
  - New/Different security settings (Firewalls, XP SP2)
- This means:
  - Messages/Data can get lost when sent over the wire
- What do you do when that happens?
  - What if you don’t even know when it happens?

Messaging & Queues



Store & Forward writes to disk
Resilient in the face of failures

Dangers of Store & Forward

- If target is offline for an extended period of time messages can fill up the disk
  - Can cause a server to crash
- Especially problematic in B2B integration
  - Example:
    - 1 MB / message, 100 messages/sec = 6GB / minute
- Solution – discard messages after a while

How to: Specify time to discard

- Use the TimeToBeReceivedAttribute:

```
[TimeToBeReceived(“00:01:00”)] // one minute
public class MyMessage : IMessage { }
```

Unobtrusive:

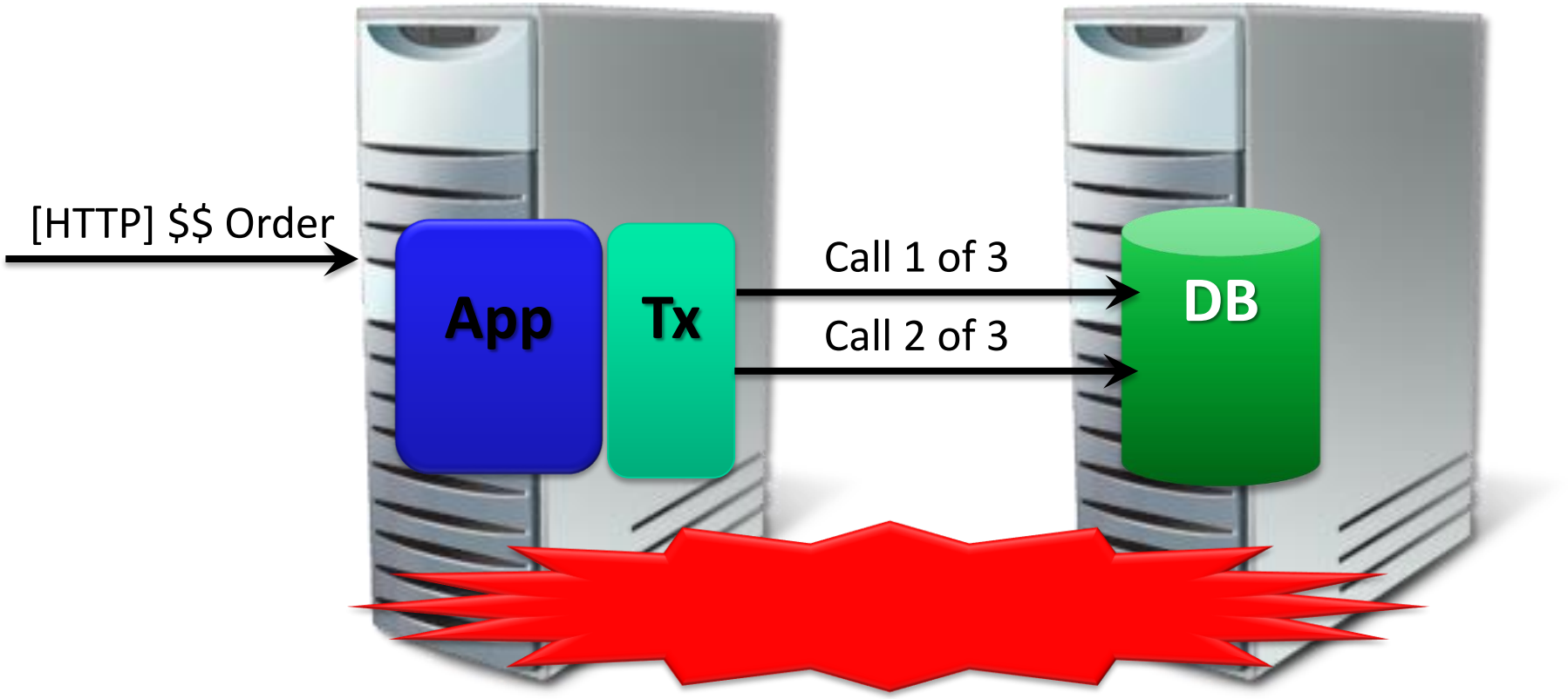
```
configuration.Conventions()
  .DefiningTimeToBeReceivedAs(…)
```

Exercise 7

- Conventions configuration for expiry
- Centralized conventions

Fault Tolerance

Fault Tolerance

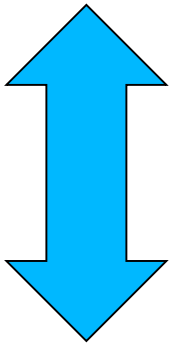


Rollback

Where’s the order!?

Exceptions

- Reasons exceptions happen:
  - Deadlock in the database
  - Database is down
  - Message deserialization fails



- Retrying can resolve transient exceptions

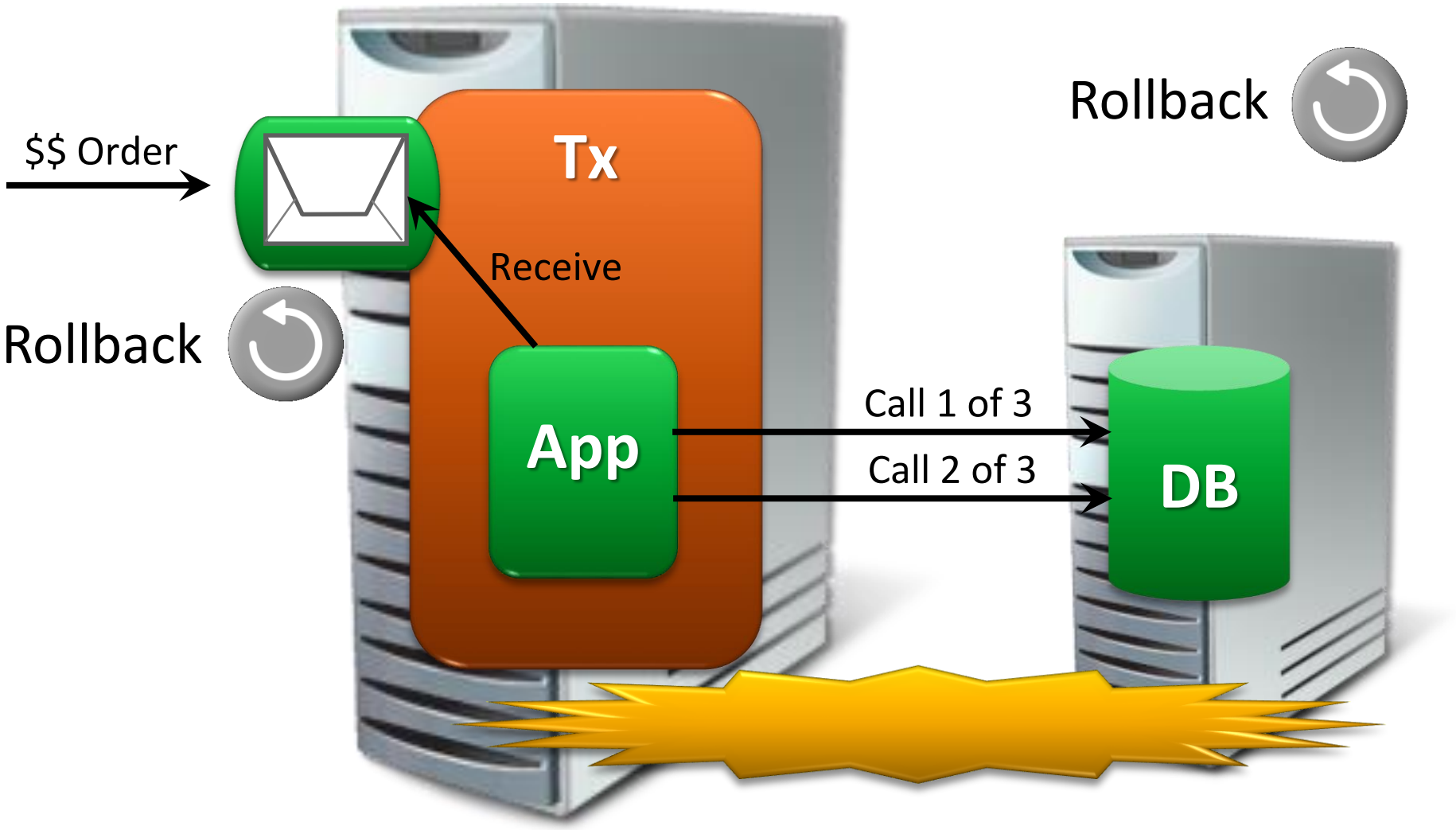
```
<TransportConfig MaxRetries=“5” />
```

- Second Level Retries (SLR)
- Messages that always fail are moved to an error queue

```
<MessageForwardingInCaseOfFaultConfig ErrorQueue="error"/>
```

Deserialization exception: message moved to error queue right away

Messaging and Consistency



The order is back in the queue

Consistency

```
NServiceBus.Configure.With()
  .UseTransport<...>()
     .IsTransactional(true);
```

OR

```
     IConfigureThisEndpoint, AsA_Server
```

Exercise 8

Authorization, Impersonation, Auditing

Headers

```
Bus.OutgoingHeaders[“user”] = “udi”;
```

- Affects all messages sent

```
Bus.SetHeader(msg, “key”, “value”);
```

- Headers attached only to specific message
- For server processing, headers cleared when a new message arrives

Message Processing Pipeline

- Multiple handlers can process the same message
  - Useful for having validation handlers separate from handlers that perform business logic
- Implement `IHandleMessages<IMessage>` or `IHandleMessages<object>` to handle all types of messages
  - Useful for things like authentication and authorization

Set Pipeline Order

```
NServiceBus.Configure.With().UnicastBus()
    .LoadMessageHandlers(
      First<A>.Then<B>().AndThen<C>() );
```

OR

Inherit from ISpecifyMessageHandlerOrdering

```
    order.SpecifyFirst<A>();
```

OR

```
order.Specify(First<A>.Then<B>().AndThen<C>());
```

How to: reference IBus in handler

```
public class H1 : IHandleMessages<MyMessage>
{
    public IBus Bus { get; set; }

    public void Handle(MyMessage message)
    {
        // use Bus to do something
    }
}
```

How to: stop the pipeline

```
public class Auth : IHandleMessages<IMessage>
{
      public IBus Bus { get; set; }
      public void Handle(IMessage message)
      {
          if ( /* some logic */ )
              Bus.DoNotContinueDispatchingCurrentMessageToHandlers();
      }
}
```

How to: get additional meta data

```
public class H1 : IHandleMessages<MyMessage>
{
      public IBus Bus { get; set; }
      public void Handle(MyMessage message)
      {
          Console.WriteLine("Received " +
              Bus.CurrentMessageContext.Id + " from " +
              Bus.CurrentMessageContext.ReplyToAddress);
          // Bus.CurrentMessageContext.Headers (dictionary of strings)
      }
}
```

Message Auditing

- Can forward messages received to another queue

- In config:

```
<UnicastBusConfig
    ForwardReceivedMessagesTo="AuditQueue@AuditServer">
```

Exercise 9

Infrastructure Extension

Dependency Injection

- NServiceBus makes heavy use of IoC
- Uses a container, and exposes its own registration API:

```
Configure.Component<T>(
  DependencyLifecycle lifecycle)
    .ConfigureProperty(o =>
      o.Property, someValue);
```

Dependency Injection

- Also has a resolution API:

```
Configure.Instance.Builder.Build<T>();
```

- Constructor or setter injection is usually better

Unit of work management

- Called once per message
- Called before and after all handlers
  - A way to perform things like session management
- Implement `IManageUnitsOfWork`
- Needs to be registered in the container explicitly
  - `Should be registered as instance per call`

Message Mutators

- Implement `IMessageMutator` to mutate individual messages
  - Useful for things like validation, encryption
- Implement `IMutateTransportMessages` to mutate transport messages
  - Useful for things like compression
- Both on incoming and outgoing messages
- Needs to be registered in the container explicitly

Exercise 10

Encryption

Encryption

- Use the WireEncryptedString type for the message properties you want encrypted

```
public class MyMessage
{
    public string UnencryptedProperty { get; set; }
    public WireEncryptedString Encrypted { get; set; }
}
```

- Get the value using the .Value property
- Unobtrusive:
  - Configure.DefiningEncryptedPropertiesAs(…)

Encryption Service

- Pluggable IEncryptionService
- Default implementation is the RijndaelEncryptionService
  - Based on a shared key
- Enabled by calling `.RijndaelEncryptionService()` after `Configure.With()`

Encryption and Topology

- Same-site / LAN
  - Full message encryption unnecessary
- Cross-site / WAN
  - Full message encryption may be required
  - Configure the Gateway to communicate using HTTPS

Exercise 11

Adjusting runtime behaviour

Profiles

- Change endpoint behavior without recompiling
- Built-in profiles
  - Environment profiles:
    - Lite | Integration | Production
  - Feature profiles:
    - MultiSite | Distributor | Master | etc
- Activated by the command line:

.*NServiceBus.Host.exe* **nservicebus.production nservicebus.multisite**

Defining your own profiles

- Defined by implementing `IProfile`
- Add behavior by implementing:
  - `IHandleProfile<T>`
- Can also add behavior to existing profiles
  - Implement IHandleProfile<ExistingProfile>

Convention over Configuration

Endpoint name

- Is the base for all the conventions
- Must be logically unique
- Conventions
  - Endpoint input queue
  - TimeoutManager input queue
  - Name of Raven database
  - Distributor input, control and storage queues
  - Subscription storage
  - Gateway input queue

Defining the endpoint name

- Ways to define the name
  - Namespace of the endpoint configuration class
  - `[EndpointName("X")]` attribute
  - `/serviceName:"X" | /endpointName:"X"`
- Or define your own convention
  - `Configure.With().DefineEndpointName(()=>{return "X";})`
    - Needs to go right after the With()

Customization

Accessing Configuration Sections

```
public static class MyExtensions
{
    public static Configure Something(this Configure c)
    {
        var section = Configure.GetConfigSection<MySection>();
        c.Component<SaySomething>(
            ComponentCallModelEnum.Singleton)
            .ConfigureProperty(o => o.Prop, section.SomeValue);
    }
}
```

Diverting App.config

- Only holds for config sections accessed via NServiceBus.Configure.GetConfigSection<T>

```
NServiceBus.Configure.With()
    .CustomConfigurationSource(new MySource())
    ... // rest of initialization


public class MySource : IConfigurationSource
{
    public T GetConfiguration<T>() where T : class
    {
       // override everything
    }
}
```

Diverting individual sections

- Use `IProvideConfiguration` to control individual sections

```
class MySource : IProvideConfiguration<SomeSection>
{
     public SomeSection GetConfiguration()
     {
        return new SomeSection
                    {
                       Setting = “”
                    };
     }
}
```

Exercise 12

Custom Hosting

Custom Hosting

- Can host NServiceBus in your own process
  - References required:
    - NServiceBus.dll
    - NServiceBus.Core.dll
  - NuGet: install-package NServiceBus
  - Don’t need to reference NServiceBus.Host.exe

Hosting in a Web Application

- Set up the bus in the Global.asax:
  - Using the “Application_Start” built-in method;
- Set up the bus in a separate assembly:
  - Defining a public static class decorated with the “PreApplicationStartMethod”:
    - The attribute is defined in “System.Web” assembly;
    - Your class will be called at application startup time by the asp.net infrastructure;

Fluent Initialization DSL

```
NServiceBus.Configure.With()
        .DefaultBuilder()
        .UseTransport<Msmq>() //RabbitMq/SqlServer/ActiveMq/WebSphereMq
        .UnicastBus()
        .CreateBus()
        .Start();
```

Send only endpoints

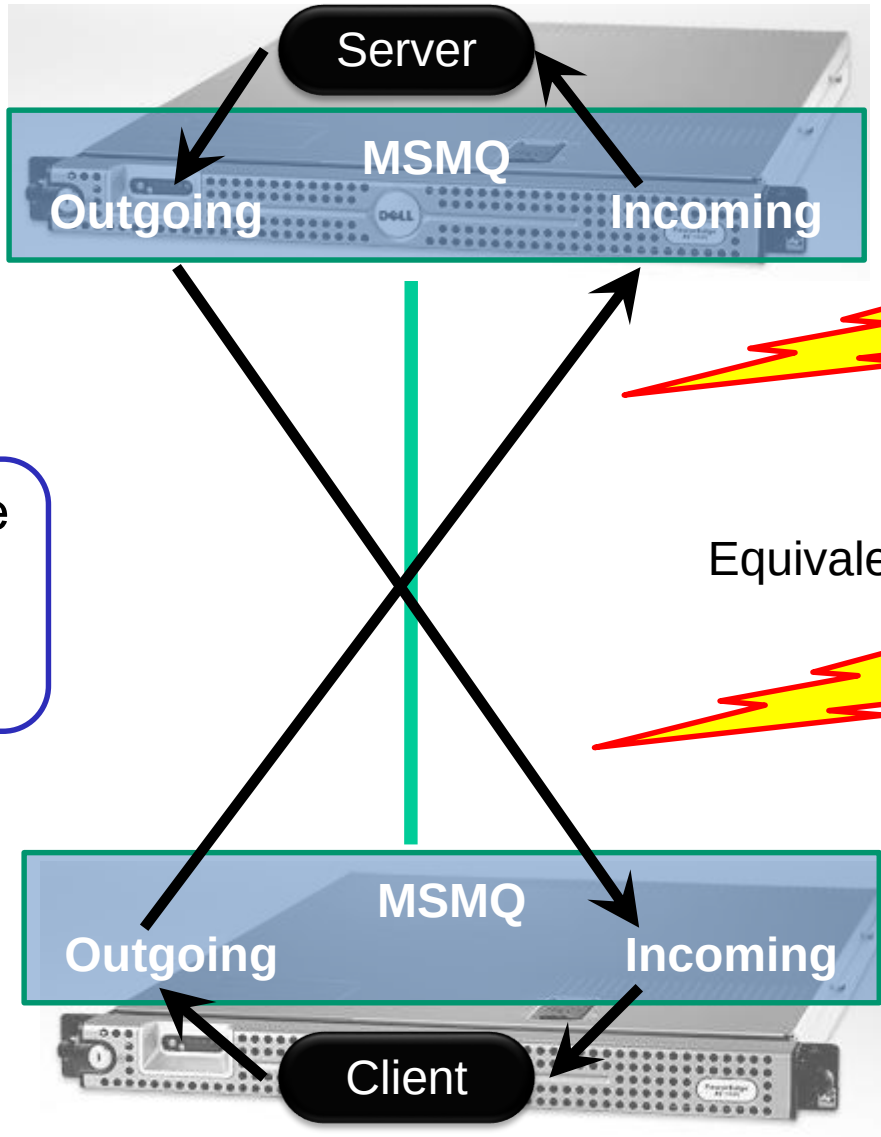
- Useful for endpoints that only sends messages
- Configured by calling .SendOnly()
  - But not .CreateBus().Start()
- Doesn’t need settings for
  - Input queue
  - Error queue
  - Worker threads, Retries

Exercise 13

- .CreateBus() .Start(() => Configure.Instance.ForInstallationOn<Windows>().Install());

Request / Response

Request / Response



Client can't assume when a response will arrive, if at all

Equivalent to 2 one-way messages

Request / Response

- Message is sent from the server to the client's queue
  - If the client is offline, message sits in the server machine's outgoing queue
- Client is not blocked until response arrives
- If two requests were sent, responses may arrive out of order

Warning! This is NOT RPC

- Do NOT try to implement regular request/response patterns on top of messaging
- The client should be designed so that it can continue operating if a response never comes

Fallacy: Latency isn't a problem

- Latency is the time it takes a single call to cross the network
- Reasonably small for a LAN, not so small for a WAN, and significant over the internet
- ~ 1000 times slower than in-memory access
- If a remote object has 10 properties and you access them one by one, you pay 10 round-trips crossing the network 20 times

Fallacy: Latency isn't a problem

- Solutions:
  - Don't cross the network if you don't have to
  - Inter-object chit-chat shouldn't cross the network
  - If you have to cross the network,
    take all the data you might need with you

Messaging makes no assumptions about latency

How to return data

- Bus.Reply(messages);
  - Remember: You don’t know when this will arrive

- `Bus.Return(int errorCode);`
  - Embeds the errorCode in a control message
  - Prefer to define an enumeration:
    - `Bus.Return((int)ErrorCodes.NoSuchUser);`

Handling responses client-side

- Can handle like any regular message:
  - Have a class implement `IHandleMessages<Response>`
- Can register a callback when sending request:
  - `Bus.Send(request).Register(asyncCallback, state)`
  - Callback only fires on first response
    - Then is cleaned up to prevent memory leaks
    - Doesn’t survive restarts – not suitable for server-side
  - Useful for feedback on a command (success/failure)

Client Startup

- Servers shouldn’t throw away messages - ever

- Clients may not care what’s in their queue at startup – preferring not to waste resources

```
NServiceBus.Configure.With()
    .UseTransport<...>()
        .PurgeOnStartup(true);
```

Exercise 14

Unit Testing

Unit Testing Message Handlers

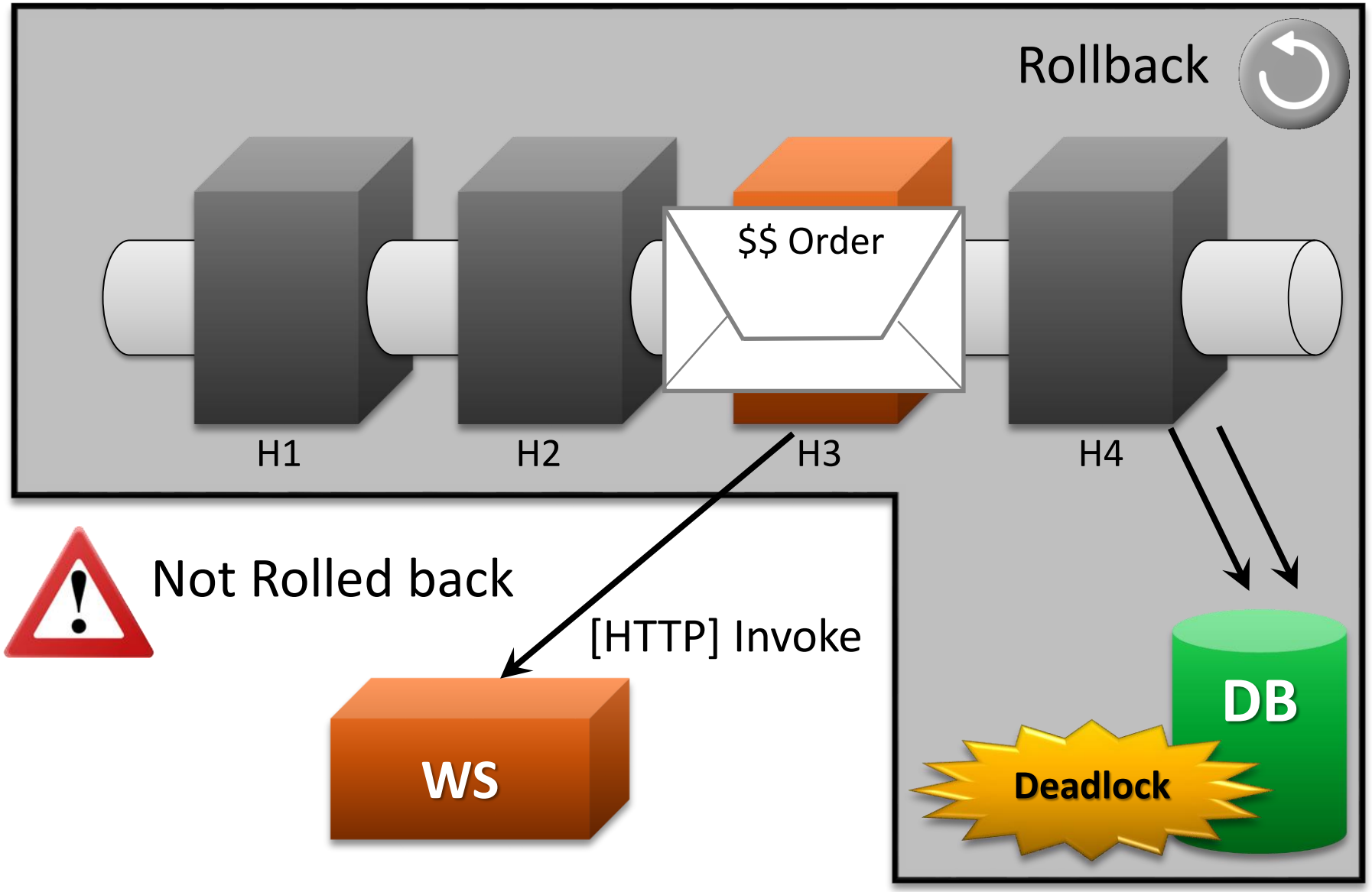
- NServiceBus.Testing.dll

- Provides the ability to set expectations around how message handlers handle messages
  - Expect: Send, Reply, Publish, etc…

Exercise 15

Exceptions, Consistency, Integration

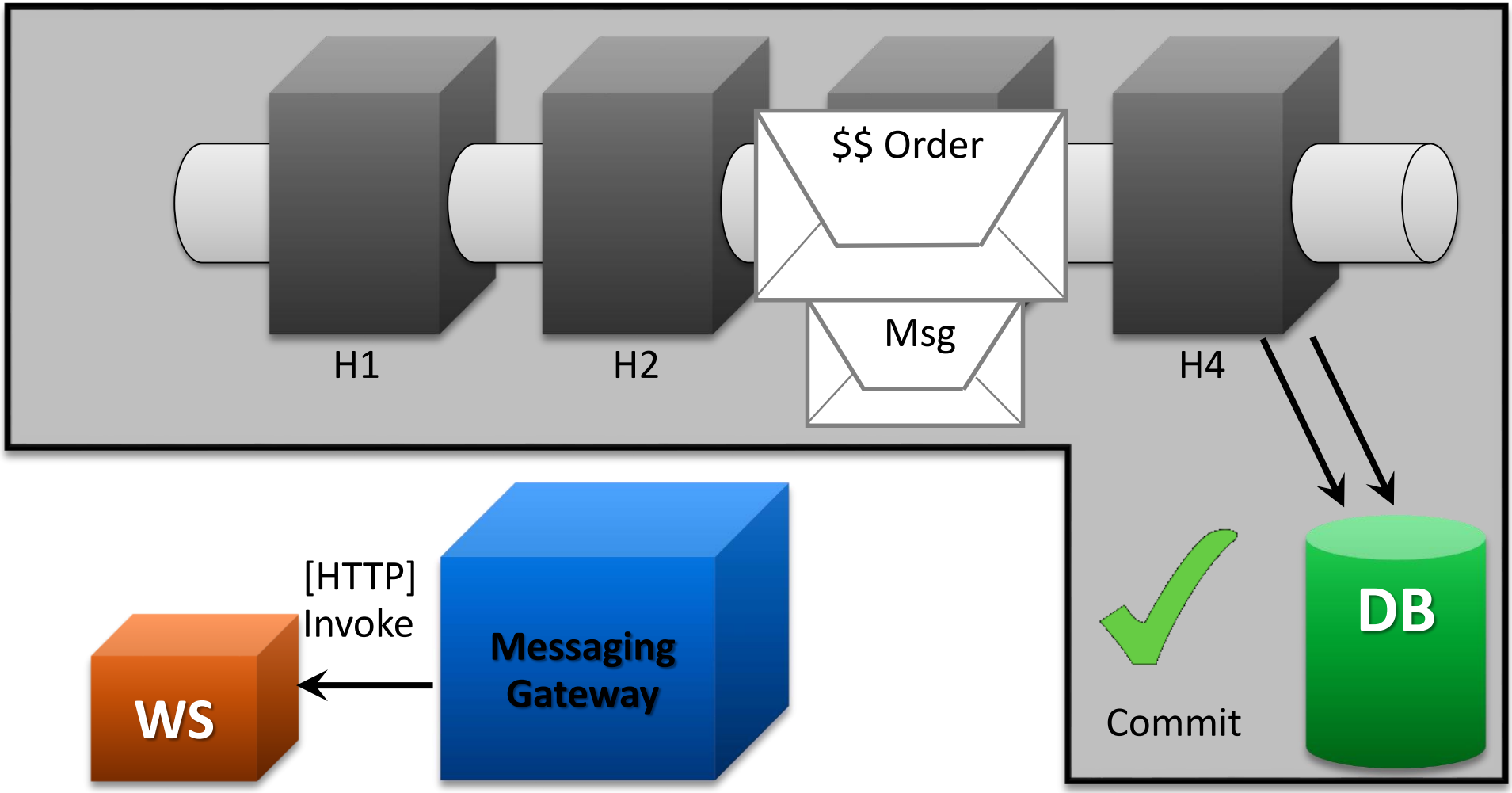
Invoking web services from handlers



Integrating messaging & WS

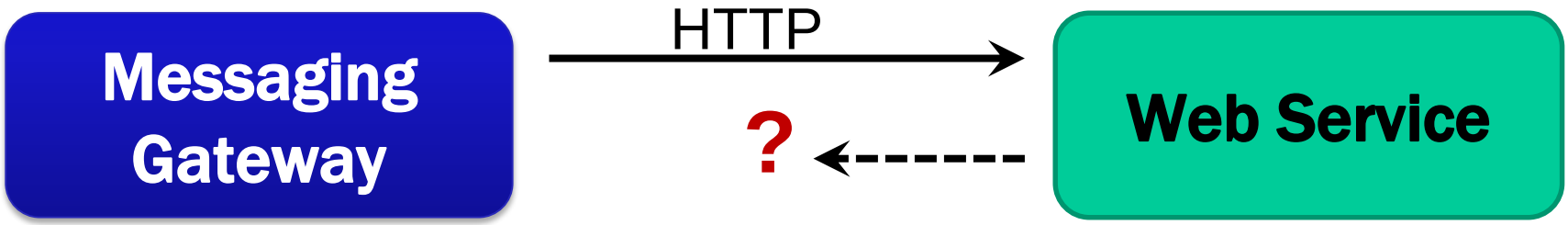
The right way

The message won't be sent if there's a failure



Messaging to WS Integration

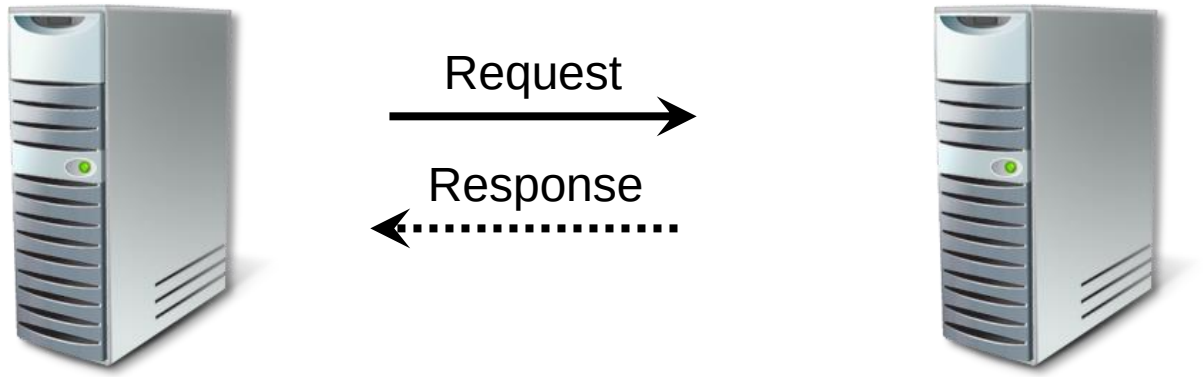
- When calling external web services from a messaging endpoint, if they're down, regular retry logic kicks in.



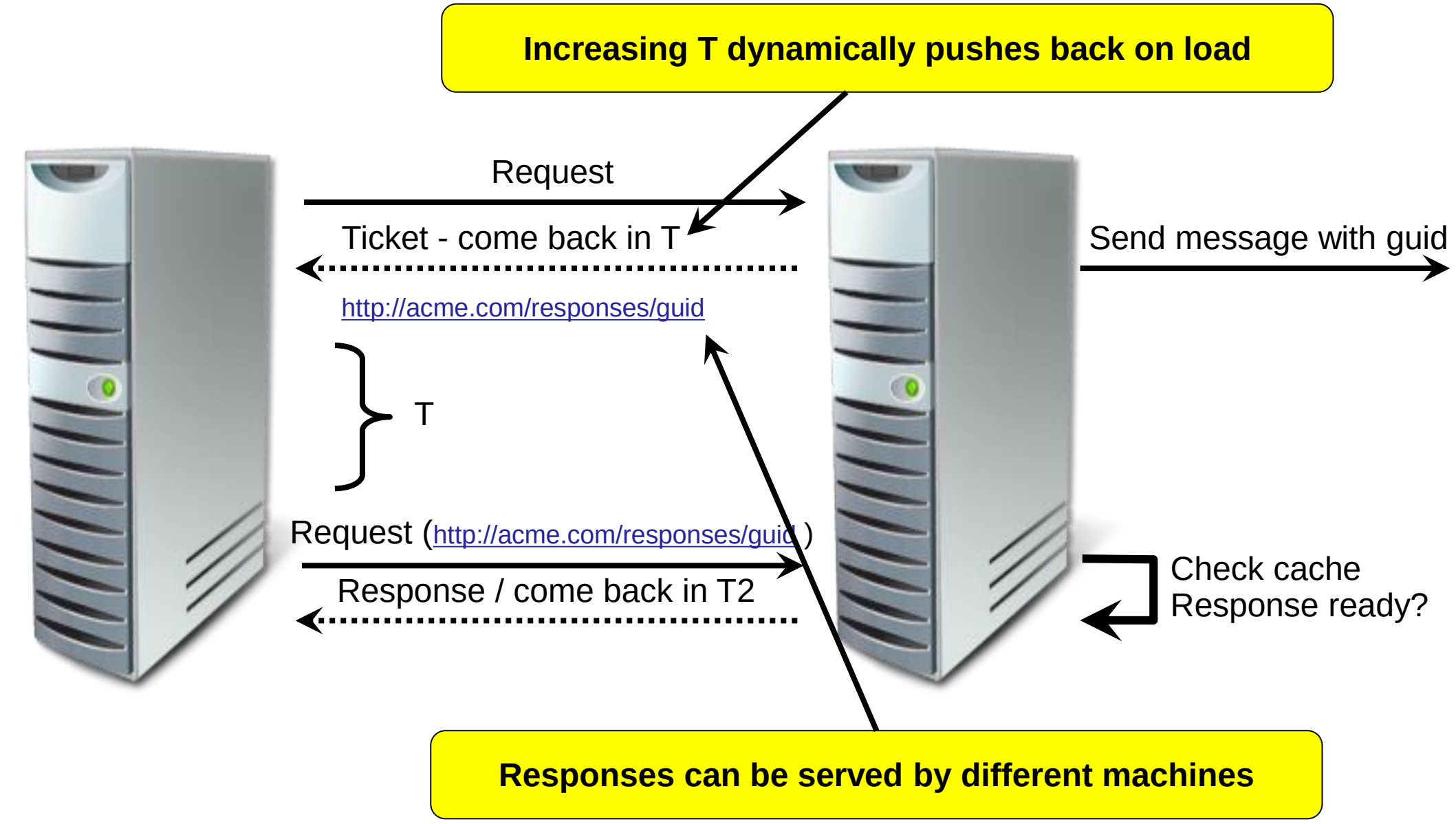
HTTP Timeout Exception & Retry

Web Services & Integration

- Request/response synchronous web service most broadly known
  - Makes sense to expose this kind of endpoint
  - Throttle it – not a scalable solution
  - Direct users to a different integration *protocol*



Web Integration Protocols

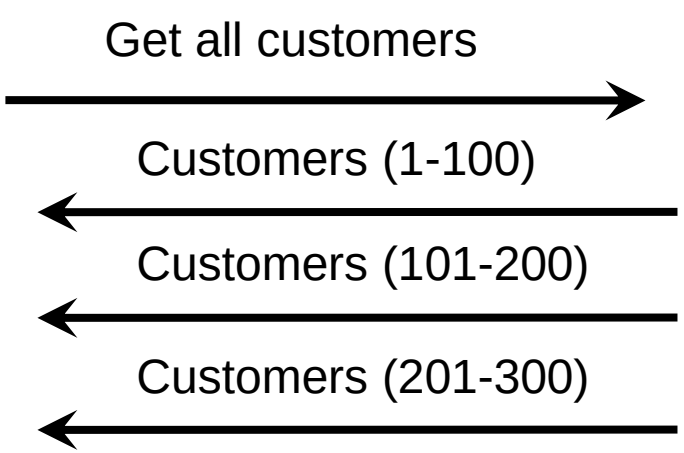


Exceptions & Request / Response

- As opposed to RPC, an exception doesn't return to the endpoint which sent the request
- If there's a problem with the system, users don't need to call the helpdesk – administrators can see that there's a problem from the error queue.
- Consider responding to the user via email

Multiple Responses

- Can call Bus.Reply multiple times
  - Useful for “streaming” back a lot of data



Better user experience

Caps server-side memory use

- Can respond with multiple message types too
  - Each handler in the pipeline can reply differently

Streaming Responses and CQRS

- When the endpoint is transactional, messages are not sent until processing is complete
- Query endpoints do not require transactional fault-tolerance, and MUST not be transactional in order to stream back responses

Exercise 16, 17

Administration & Monitoring

Installing your endpoint

- NServiceBus.Host.exe -install
  - Installs the host as a windows service
  - Add -sideBySide if you want to run in parallel while upgrading
  - Executes the installers
- NServiceBus.Host.exe -uninstall
  - Uninstalls the service
  - It recommended to install/uninstall on each deploy

Installers

- Used by NServiceBus to install runtime dependencies like queues, databases etc
- Implement `INeedToInstallSomething` to create your own installer
  - Used for endpoint related dependencies

Error Queues

- 1 error queue usually enough for the whole system
- Administrators should monitor the error queue
  - First indication that something is wrong
    - Like database going down
- Especially after installing a new version of the system side by side with the old version

Error Queues & Administration

- Deserialization exceptions can be caused by incompatible versions running side-by-side
- After fixing and redeploying, messages from error queue can be retried:
  - /tools/ReturnToSourceQueue.exe
  - Can return single or all messages

Monitoring

- Use performance counters exposed by the queuing system to monitor number of messages waiting in queue

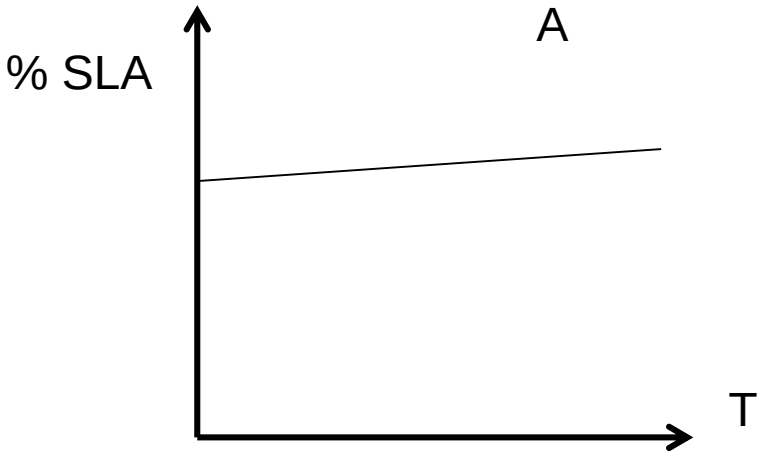
- But various parts of the system process different loads, and have varying computing power

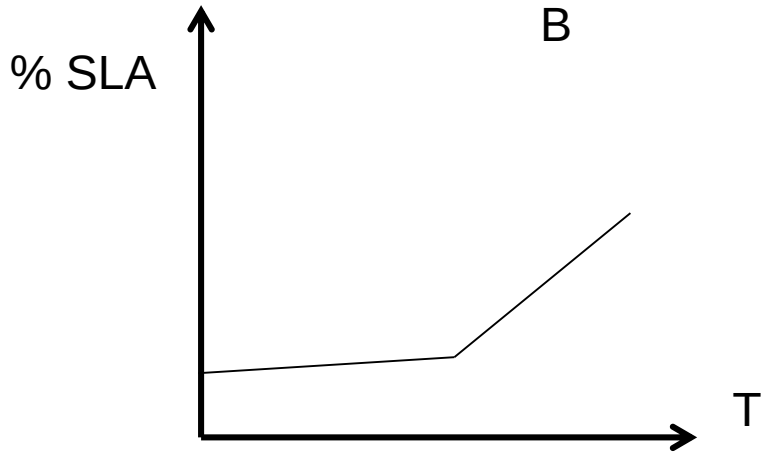
Time is the key

- Age of oldest message equalizes everything

Critical Time Performance Counter

- Can use WMI to pull into existing monitoring apps
- Measure against business-defined SLA





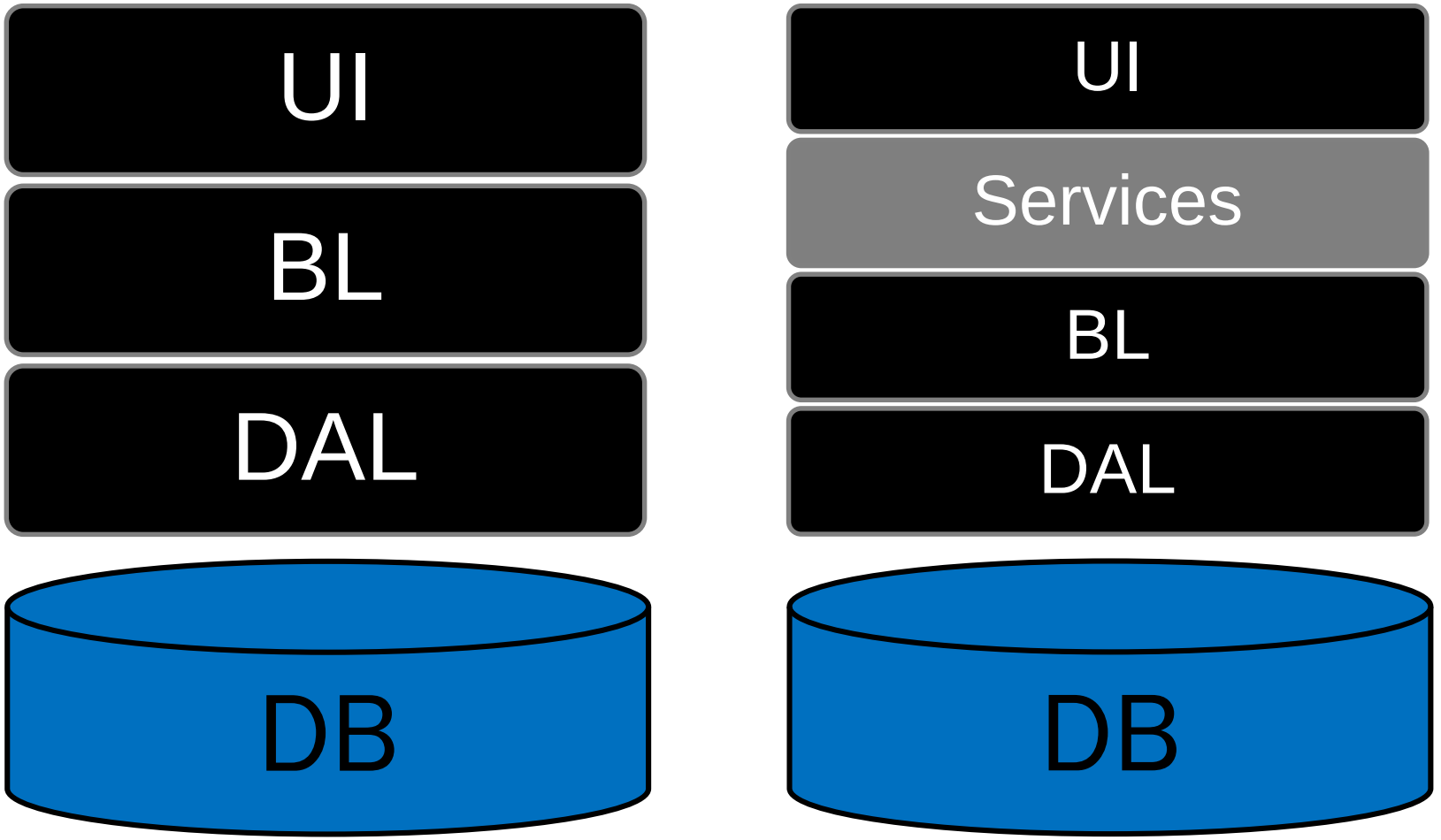
- Calculate “Time to exceed SLA”

SOA Introduction

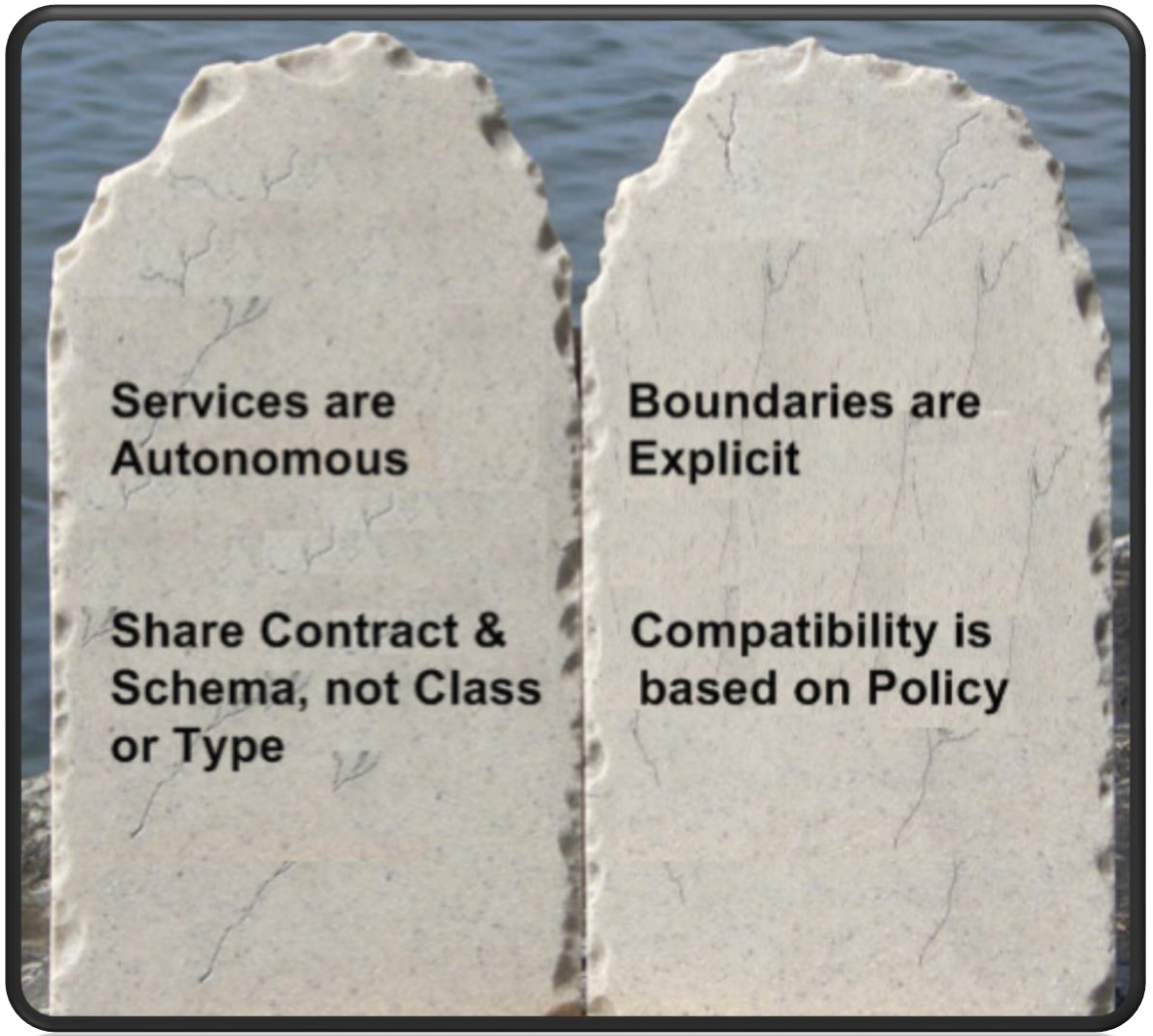
SOA: Definition

A service is the technical authority for a specific business capability

Common SOA Practice



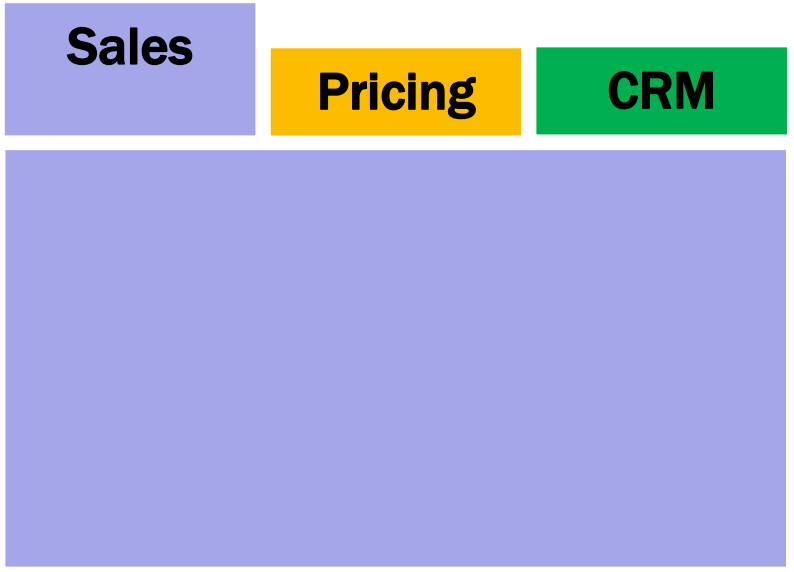
Tenets of Service Orientation



Layers & Coupling

Tight Coupling

Loose Coupling



Referential Integrity

Re-introduces Coupling

Composite Challenges

EBay & Amazon

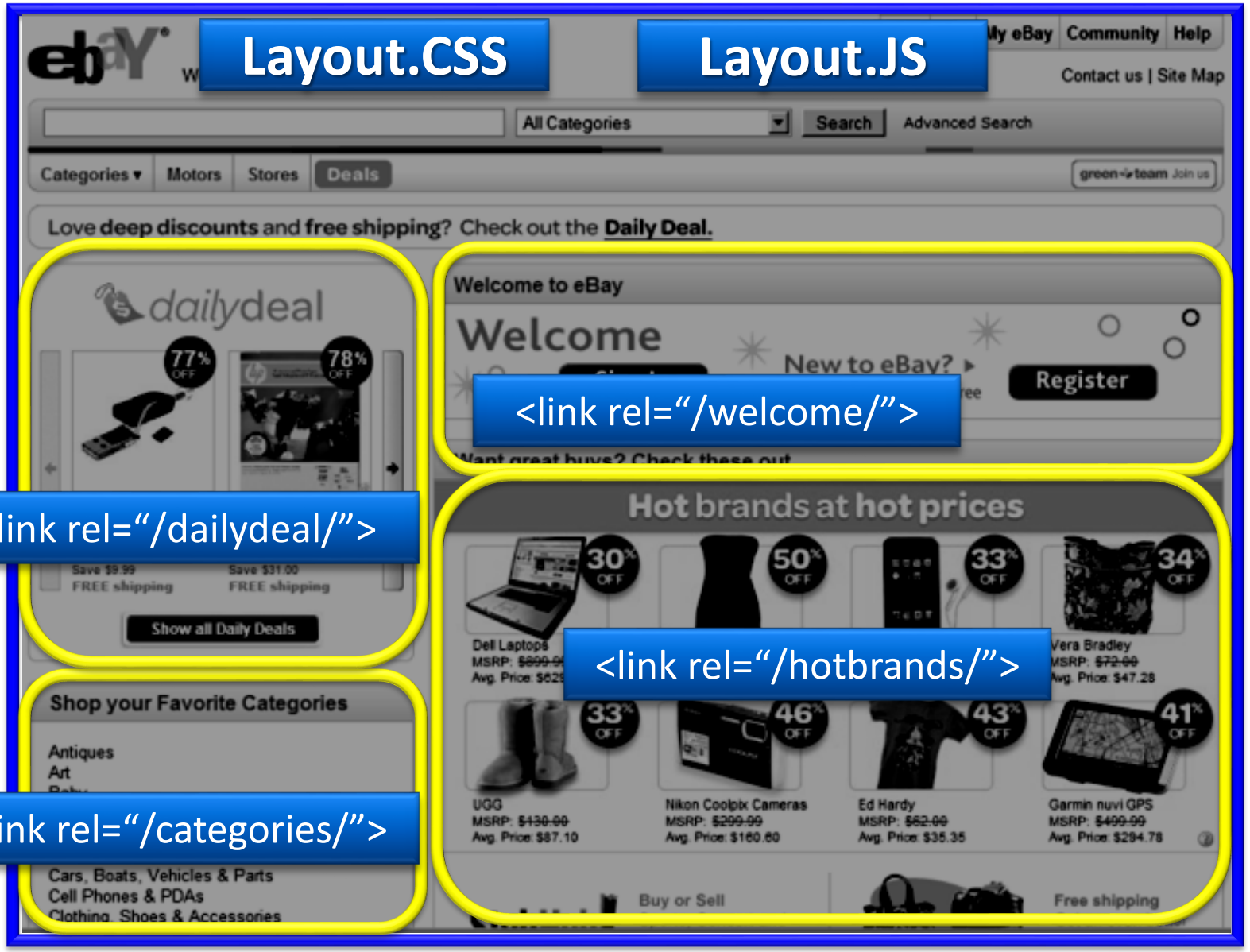
One page showing data from multiple sources

EBay: Browser-side

Amazon: Server-side

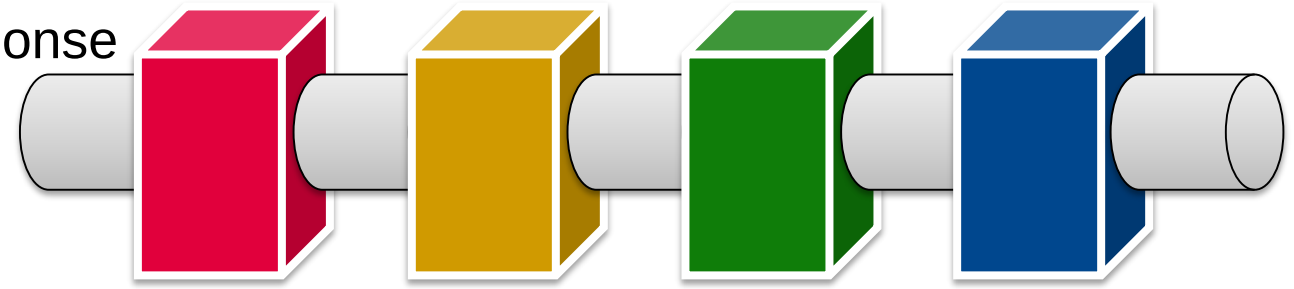
Browser-side Composition

Each URI handled by a different service



Server-Side Composition (SEO friendly)

ASP MVC3 Razor
Builds a single response



Layout

```
<div id="Layout.Top">
```

Product Catalog

```
<div id="Catalog.Name">
```

Price

```
<div id="Pricing.Price">
```

Inventory

```
<div id="Inventory.InStock">
```

Command Query Segregation Principle

Where to use it?

Only within
an SOA service

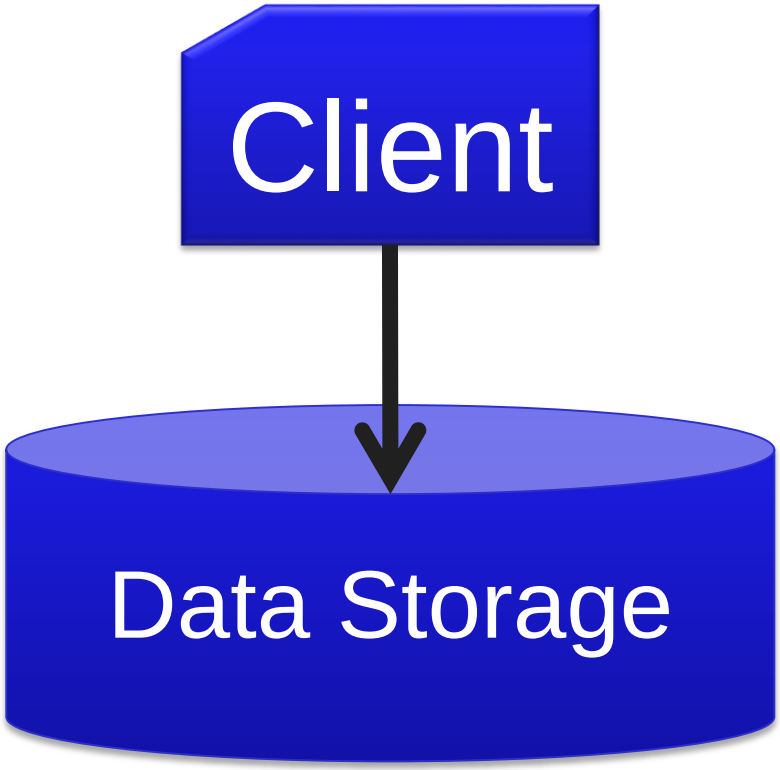
Not the only alternative to N-Tier

Map from DTOs & WS to view model

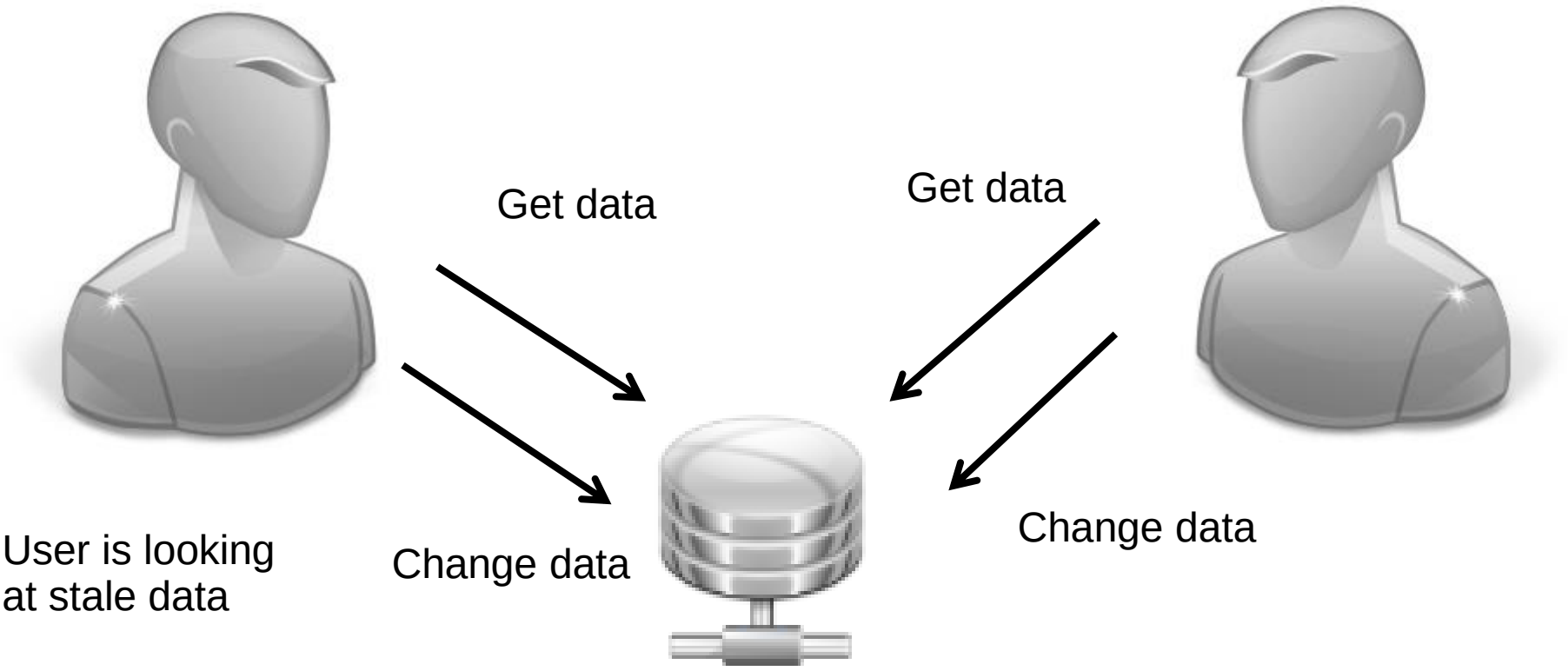
Map from DTOs and WS to domain objects

Use ORM to map from tables to domain objects

In non-collaborative business domains



Collaboration



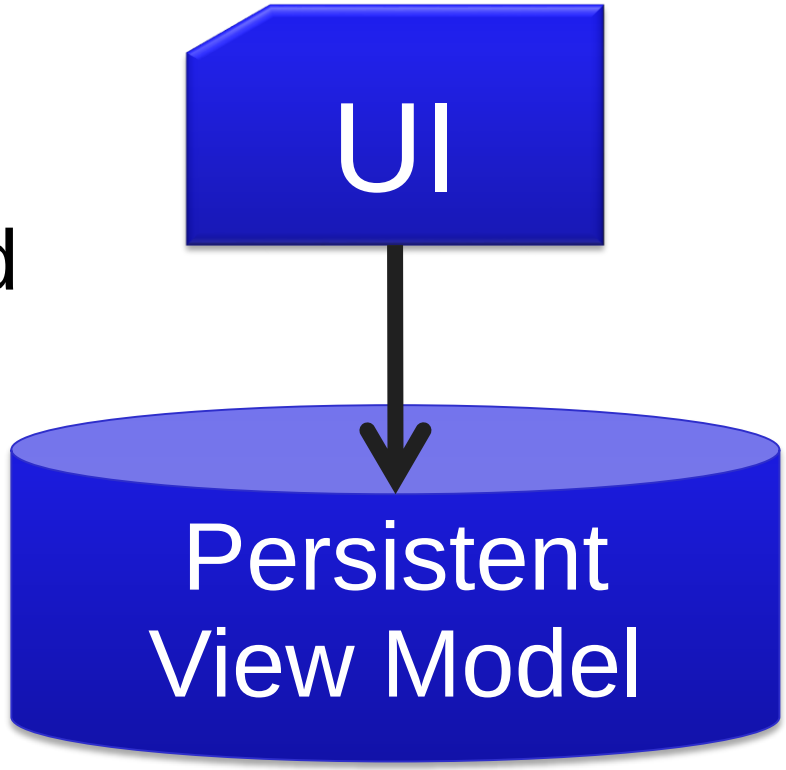
Optimistic concurrency
not good enough

Queries – showing data to the user

- Can be implemented in simple 2-Tier fashion
- Use ADO.NET to get a DataTable, bind to the UI
- No 2-way Data Binding

- Denormalized, pre-calculated
- 1 View == Table

```
SELECT * FROM t1 WHERE ID = @ID
```



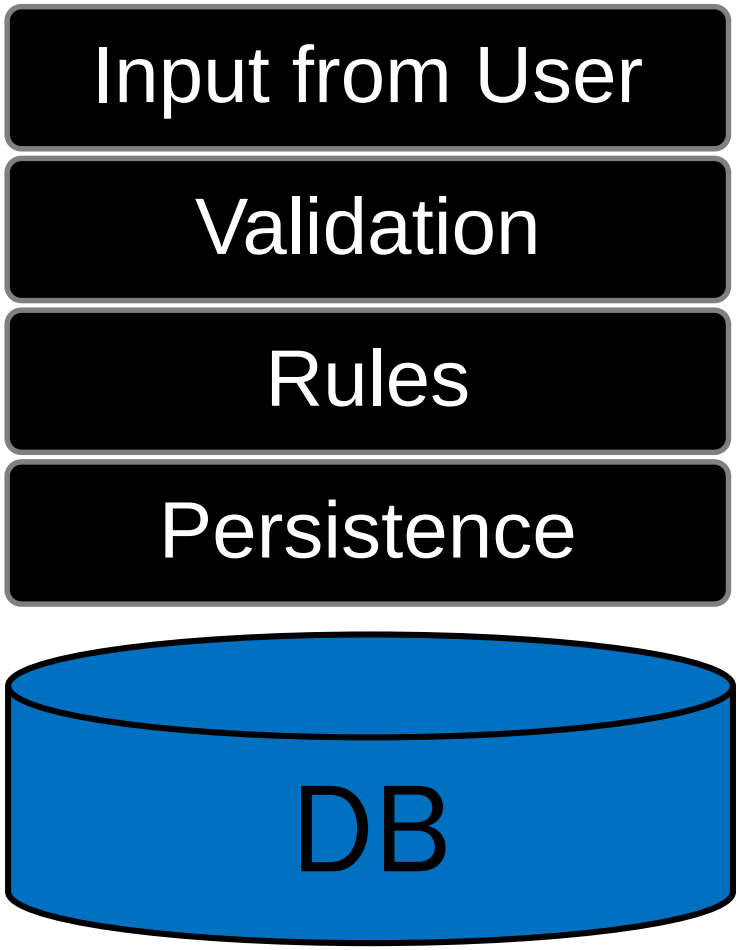
View Model & Preliminary Validation

- Used to decide if commands should be sent
  - Yes – this is business logic. Get over it
  - Client side controllers are supposed to do logic
- Checking for uniqueness
- Other examples:
  - Is product still for sale?

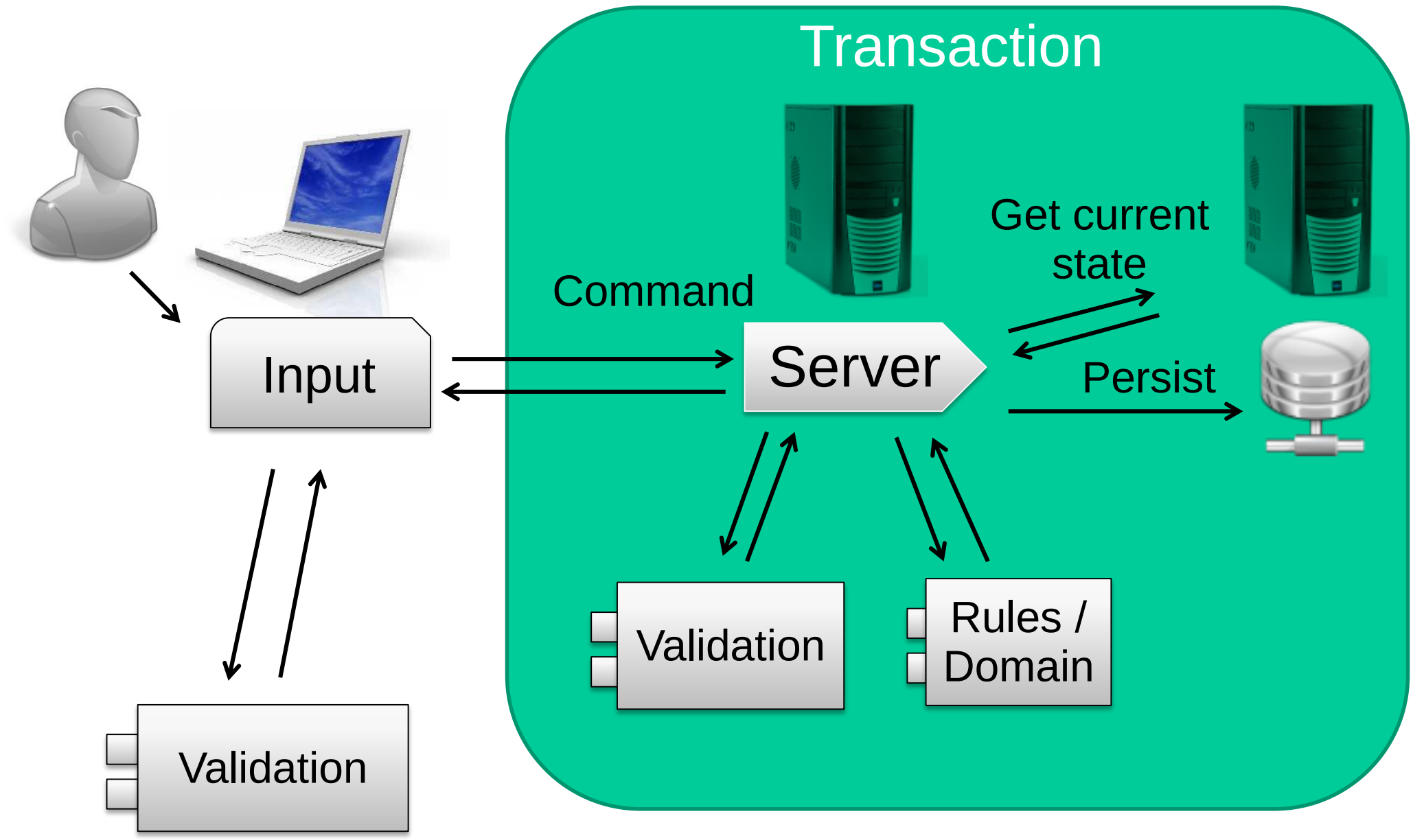
Commands – accepting user input

- Implemented as simple fire & forget mode
- User should assume that the command succeeded
- Therefore validation should occur before sending the command
- Race conditions still need to be dealt with

Command Processing Layers



Command Processing Tiers



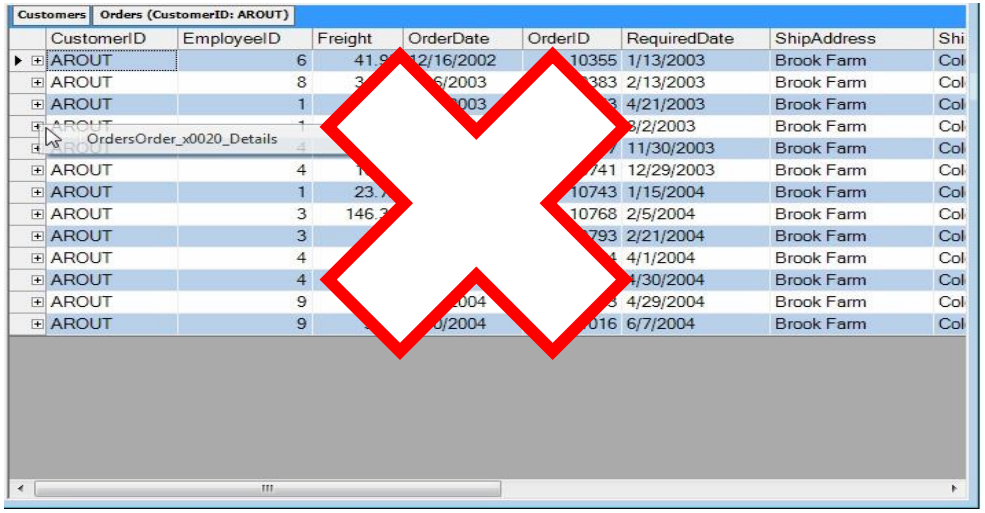
Command Feedback

- Success & failure can be communicated back using email (or something similar)
- Can also invest in AJAX widgets which pop up “toasts” to notify users
- Or just implicitly assume success
  - Stackoverflow: leaving a comment on a question

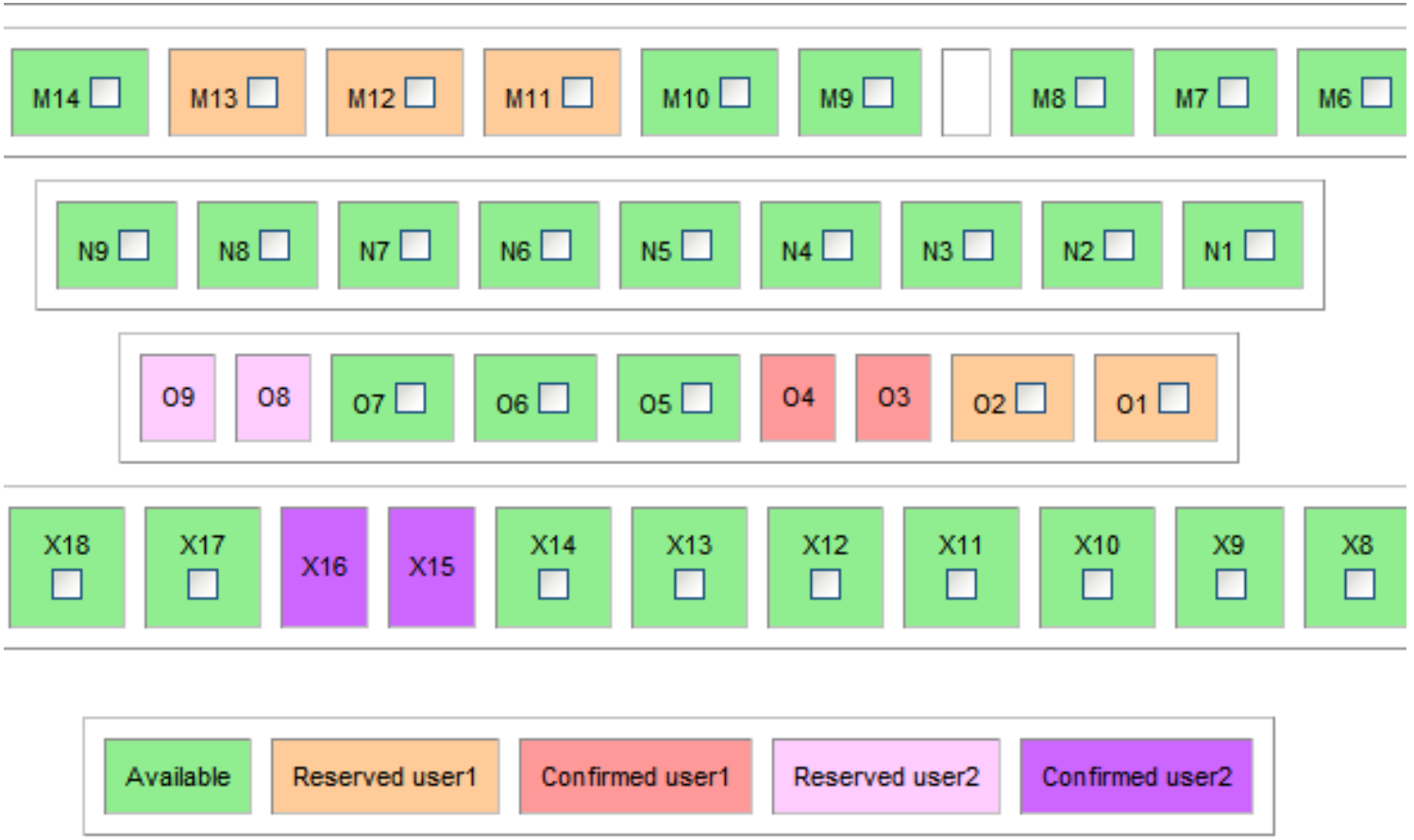
Rethinking the UI

- Design the user-system interaction such that the user doesn't need immediate feedback on their actions

- Stay away from editable grids



Not Capturing User Intent



Capturing user intent

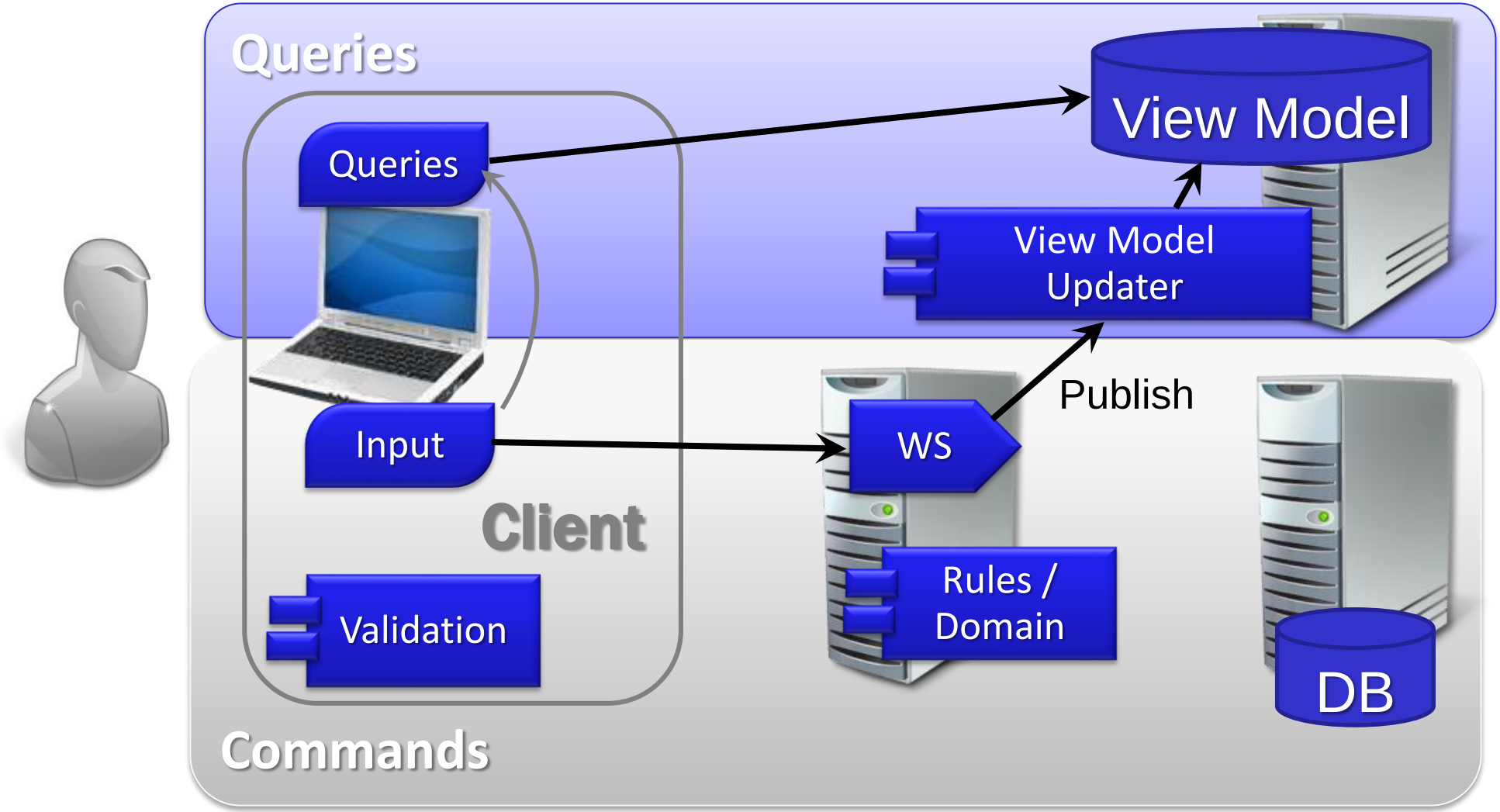
- Group reservation
  - Small group sitting together
  - Large group – several small groups
- Enter number of people
- Enter preferred seat type – indicates cost
- System emails back when reservation is filled

Scalability benefits

- No need to show actual status!

Putting it all together

Data from commands immediately overlaid on queries

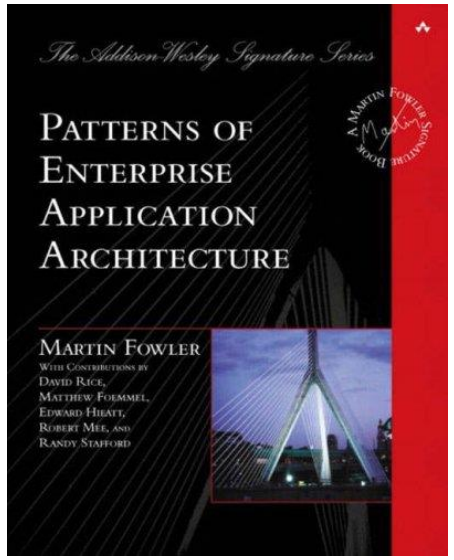


Rules / Domain Components

- What are they for?
  - In addition to doing what the command said to do, doing other things
  - E.g. When a customer withdraws money from their account, if the account is overdrawn, send them an email recommending a loan.
- The focus is NOT on persistence
- The view model provides for most data needs

Domain Models

- “If you have complicated and everchanging business rules…”
- “If you have simple not-null checks and a couple of sums to calculate, a Transaction Script is a better bet”
- p119 Patterns of Enterprise Application Architecture

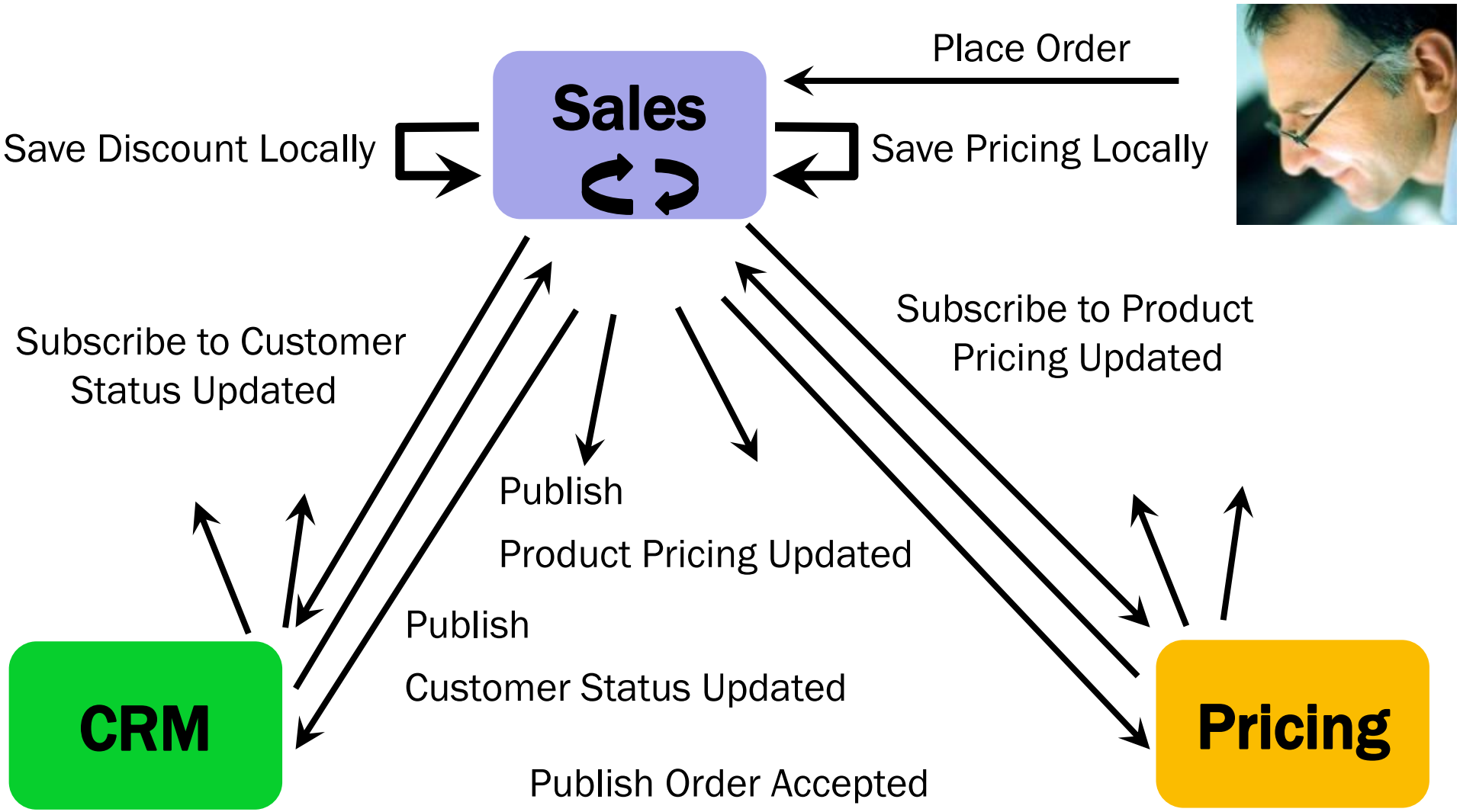


Remember

Use CQRS only within an SOA service

SOA & Events

Loosely Coupled Synchronization



Business Component: Definition

- A service is divided internally into Business Components (BC)

- A Business Component is a sub-division of the business capability, not relevant outside the context of the service

Business Components: Example

- Business Components in Shipping Service
  - Perishable
  - Non-perishable
- Business Components in Sales Service
  - Regular Customers
  - Strategic Partners

Business Component Structure

A business component:

- Has its own database
  - Logically independent
    - No foreign keys to any other BCs
  - Physical separation provides greatest autonomy
- Can subscribe to events from other services
- Logically owns the code, config, DB schema as well as message schema for those it publishes

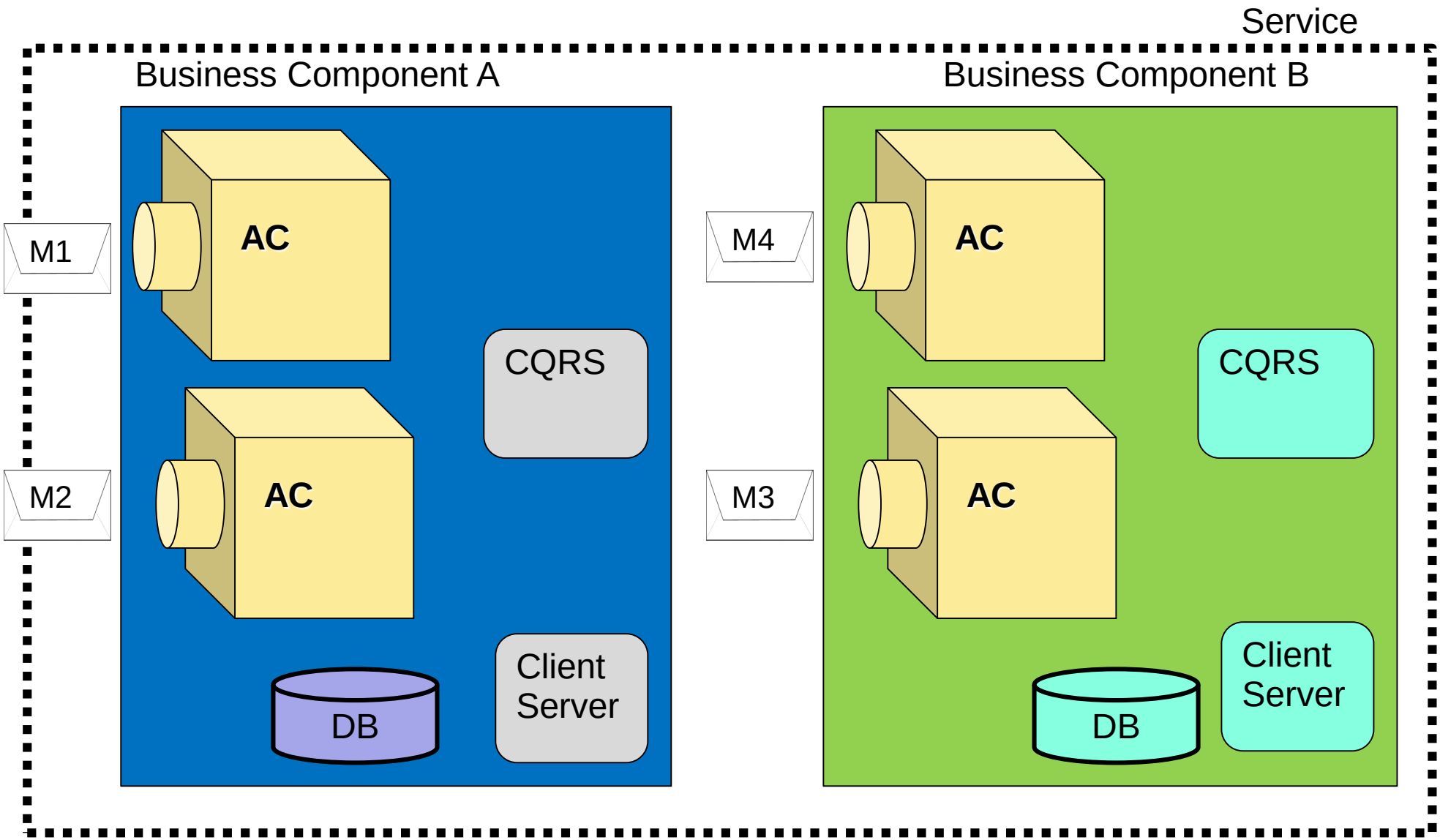
Autonomous Component: Definition

- An Autonomous Component (AC) is a logical unit of deployment, containing all code and config needed to handle a single message type within a given business component.

- When installed on a given machine, that physical instance is called an

  Autonomous Component Instance (ACI)

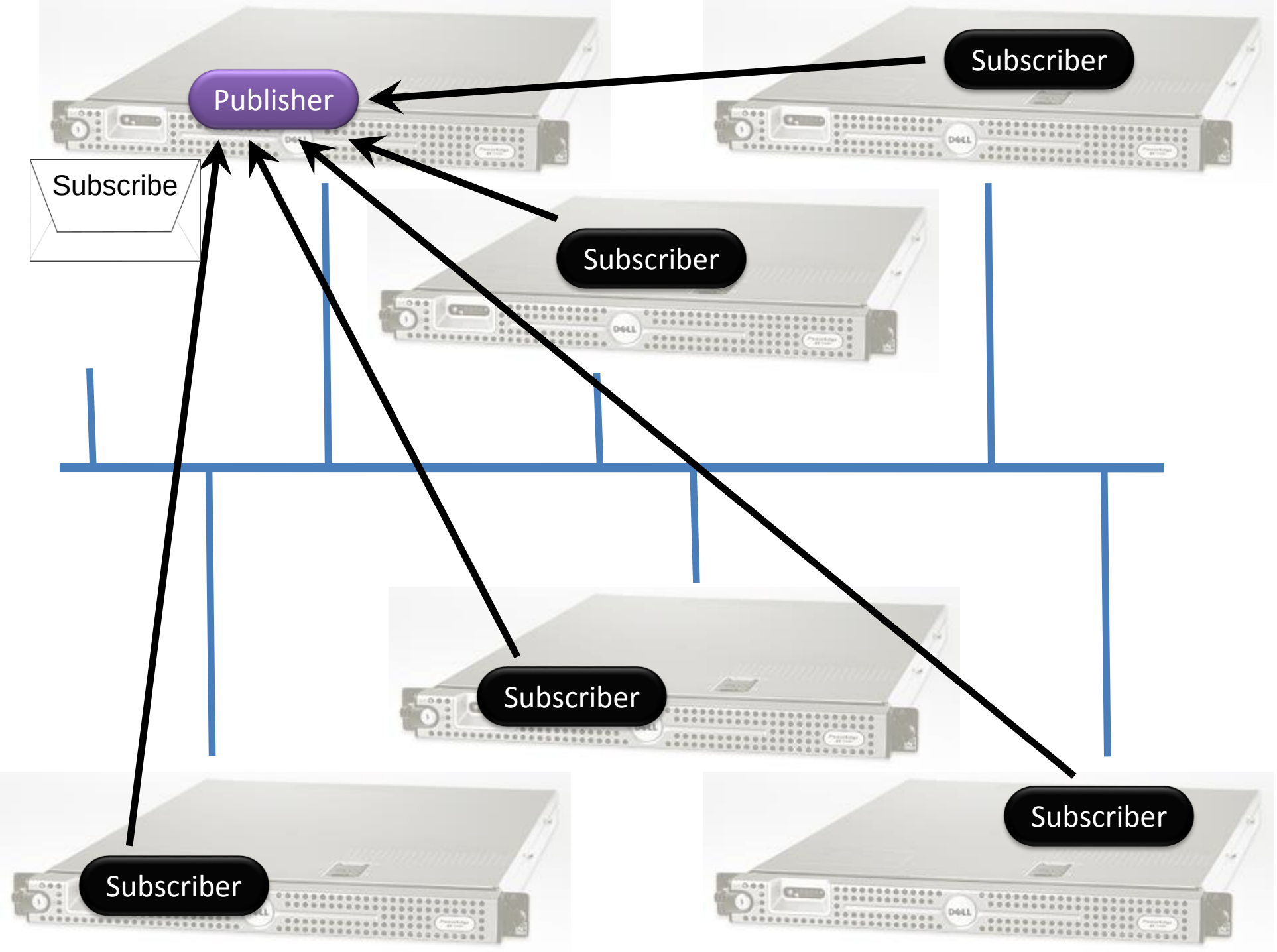
Service Structure

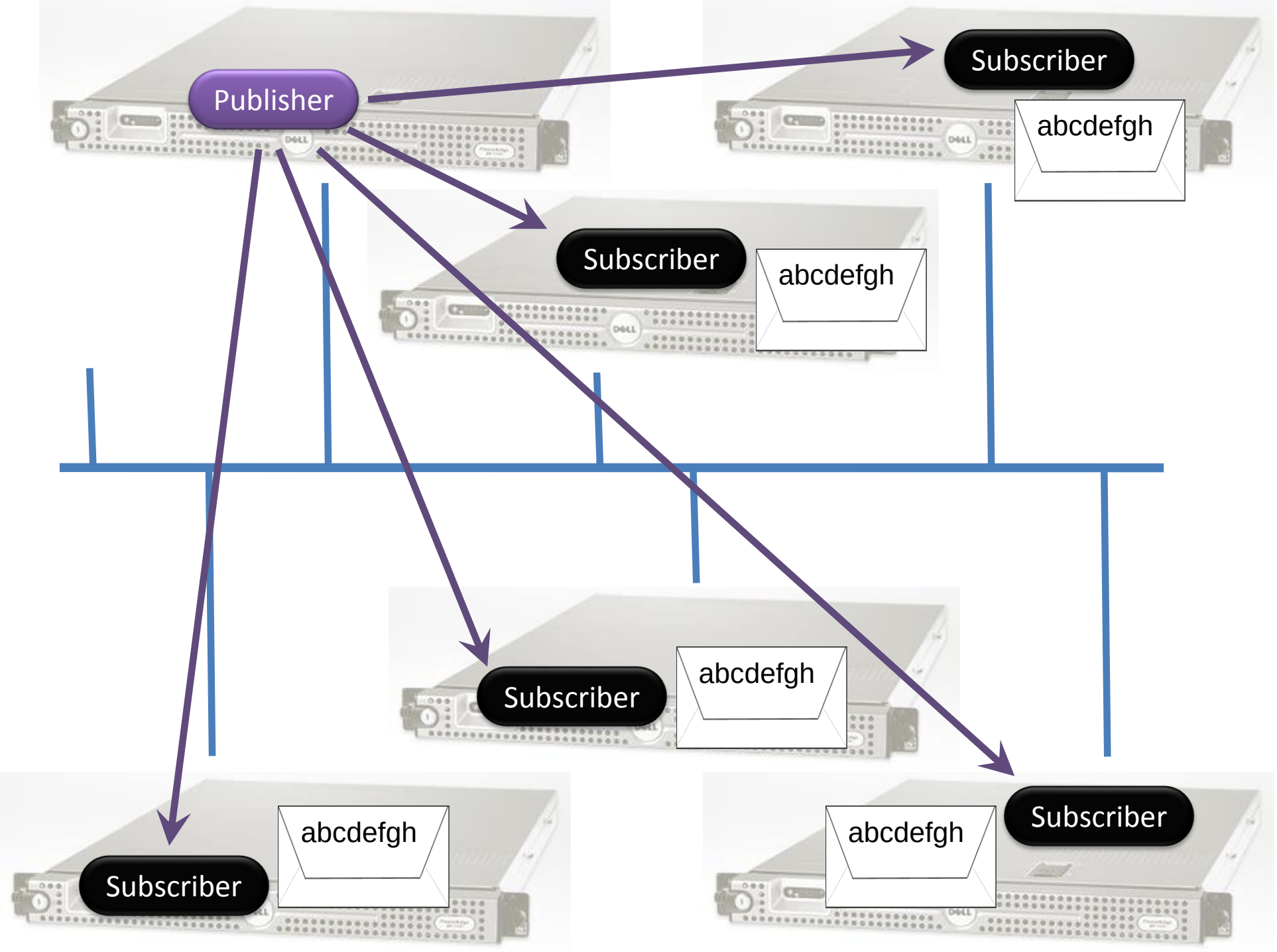


Publish/Subscribe

Advertise / Subscribe / Publish

- Messages represent logical events
  - Technically, there's no difference.
- Publisher advertises these events
- Subscribers express interest in an event
- When a publisher publishes an event, a message arrives in the queues of subscribed parties


Publisher
Subscribe
Subscriber
Subscriber
Subscriber
Subscriber
Subscriber


Publisher
Subscriber
abcdefgh
Subscriber
abcdefgh
Subscriber
abcdefgh
Subscriber
abcdefgh
Subscriber

Advantages

- Extensible
  - Adding subscribers without bringing anything down
- Robust
  - publishers & subscribers can operate independently of each other
- Easy to patch, upgrade, and administer

Advertise

- NServiceBus is not involved in this step

- May be as simple as a wiki
  - Hosts the schema as well as where to go to subscribe
- Configure like regular messaging:
  - In <UnicastBusConfig>, under <MessageEndpointMappings>

```
<add Messages="schema assembly"
     endpoint="subscribe-here@Publisher">
```

Automatic Subscriptions

- Write a handler for the event
  - NServiceBus will contact the configured publisher at startup to subscribe to that message
    - Unless:

```
NServiceBus.Configure.With().UnicastBus.DoNotAutoSubscribe();
```

Manual Subscription Management

- `Bus.Subscribe<T>();`
- `Bus.Unsubscribe<T>();`

- Still requires a handler for the given message

- Consider unsubscribing clients when they shut down

Subscription Storage

- Publisher-side storage of who is interested in what
  - Can be stored in MSMQ (not scale-out friendly)

```
NServiceBus.Configure.With().MsmqSubscriptionStorage();
```

    - Configured:

```
<MsmqSubscriptionStorageConfig Queue="" />
```

  - Can be stored in a database
    - RavenDB is the default

```
NServicebus.Configure.With().RavenSubscriptionStorage();
```

    - NHibernate is still supported but in a separate assembly

```
NServicebus.Configure.With().DbSubscriptionStorage();
```

Publishing Events

- Similar to sending a message:

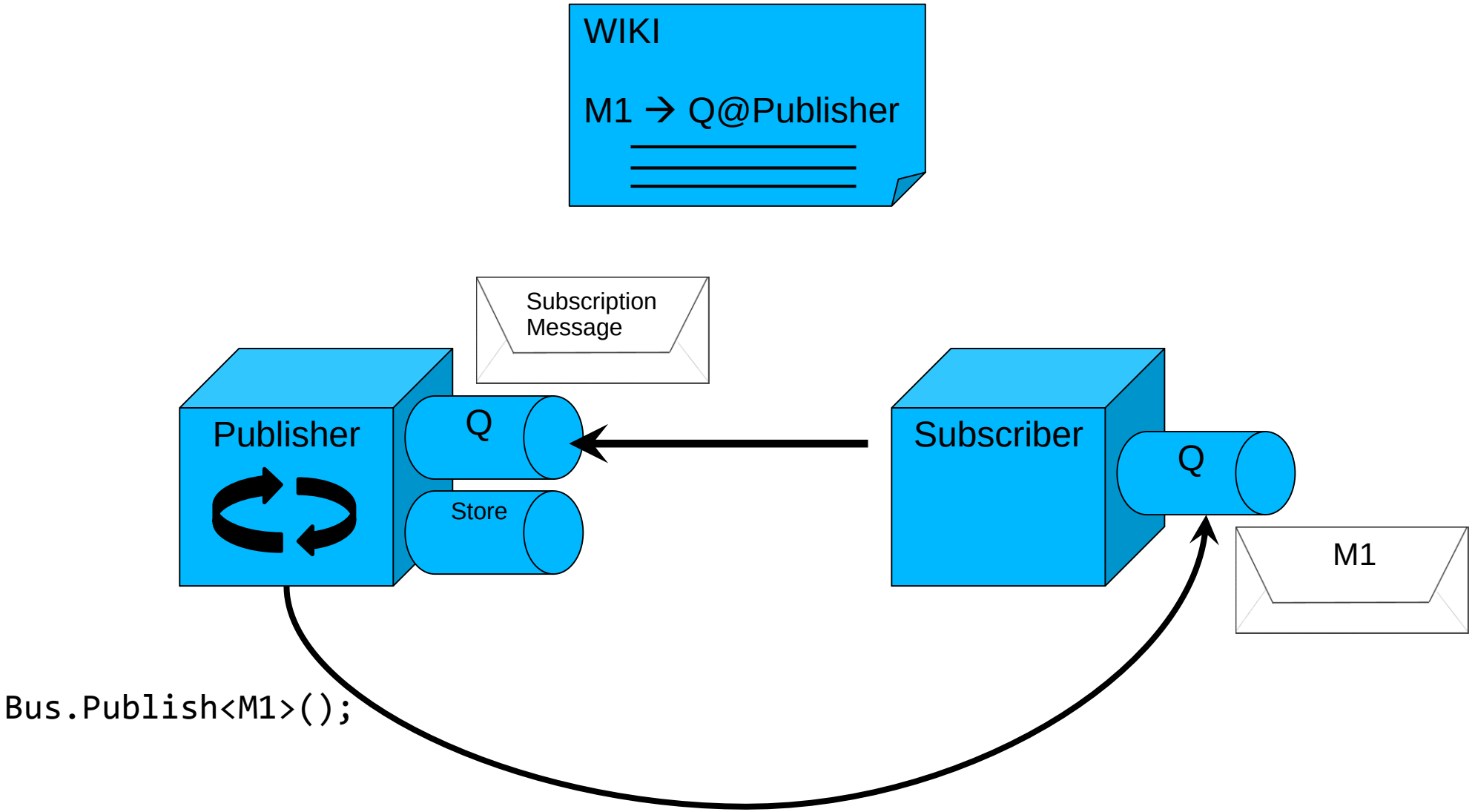
```
Bus.Publish(msg);
```

Or:

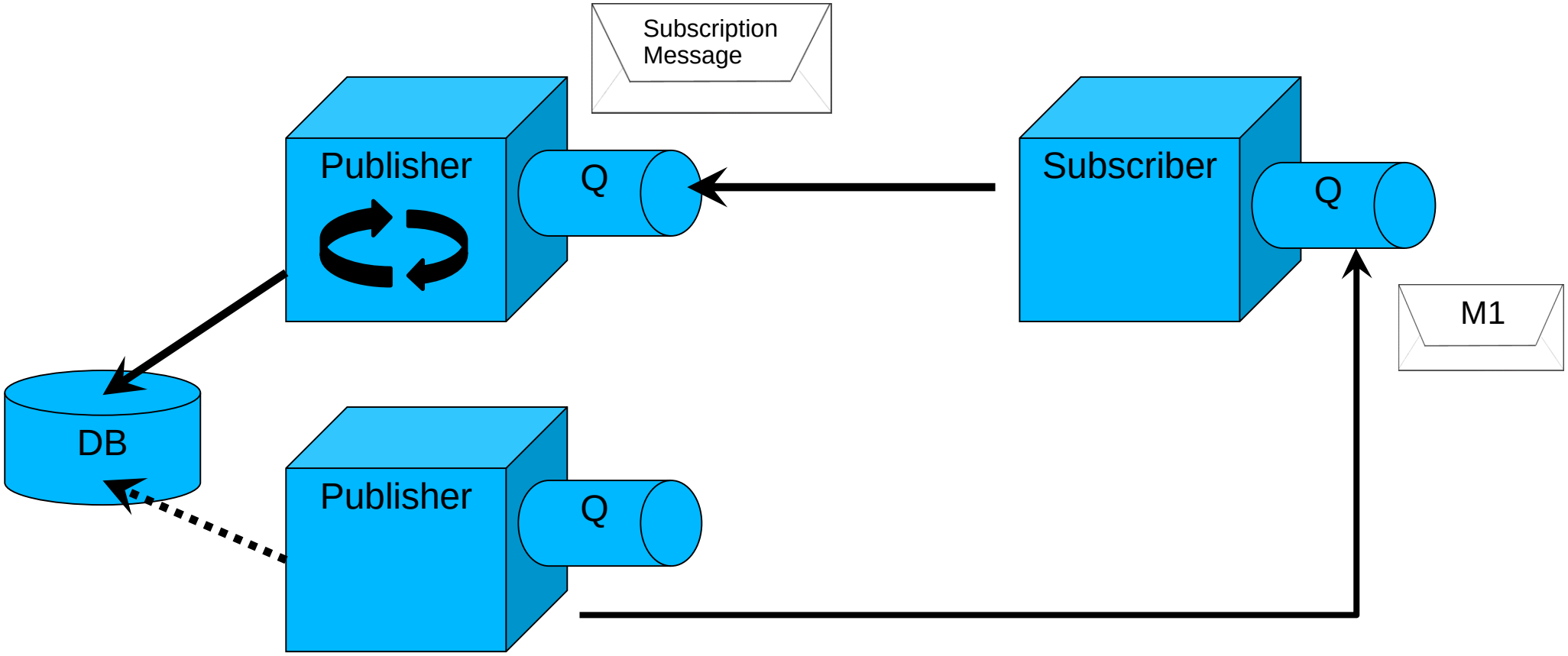
```
Bus.Publish<IMyEvent>( (m) =>
   { m.Prop1 = val1; m.Prop2 = val2; } );
```

- Consider having your events inherit from `IEvent` or define convention `Configure.With().DefiningEventsAs(t =>…)`

Advertise / Subscribe / Publish



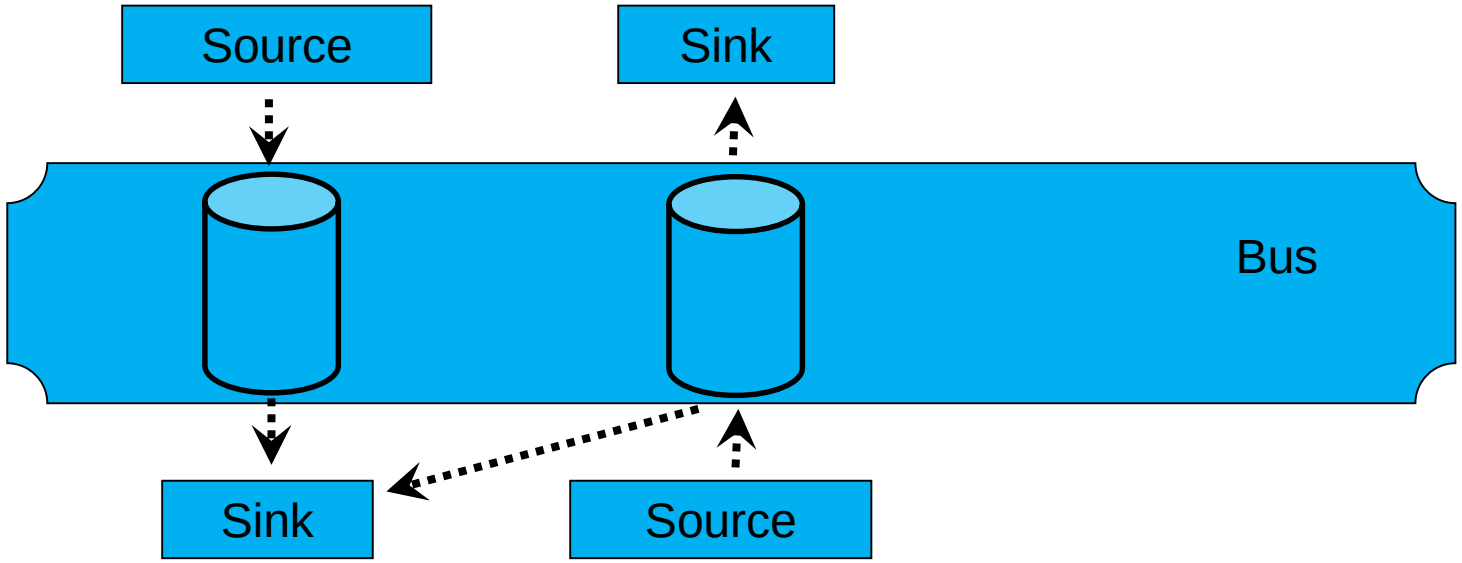
Publisher Scale-Out




```
Bus.Publish<M1>();
```

Bus Architectural Style – not a Broker

- Event sources and sinks communicate via channels in the bus
- Source place events (messages) in channels, sinks are notified about message availability



Bus Characteristics

- Bus is not necessarily physically separate
  - Channels are both physical and logical
- Bus is simpler than most Brokers
  - No routing or service fail over
- No single point of failure

Exercise: Publish / Subscribe

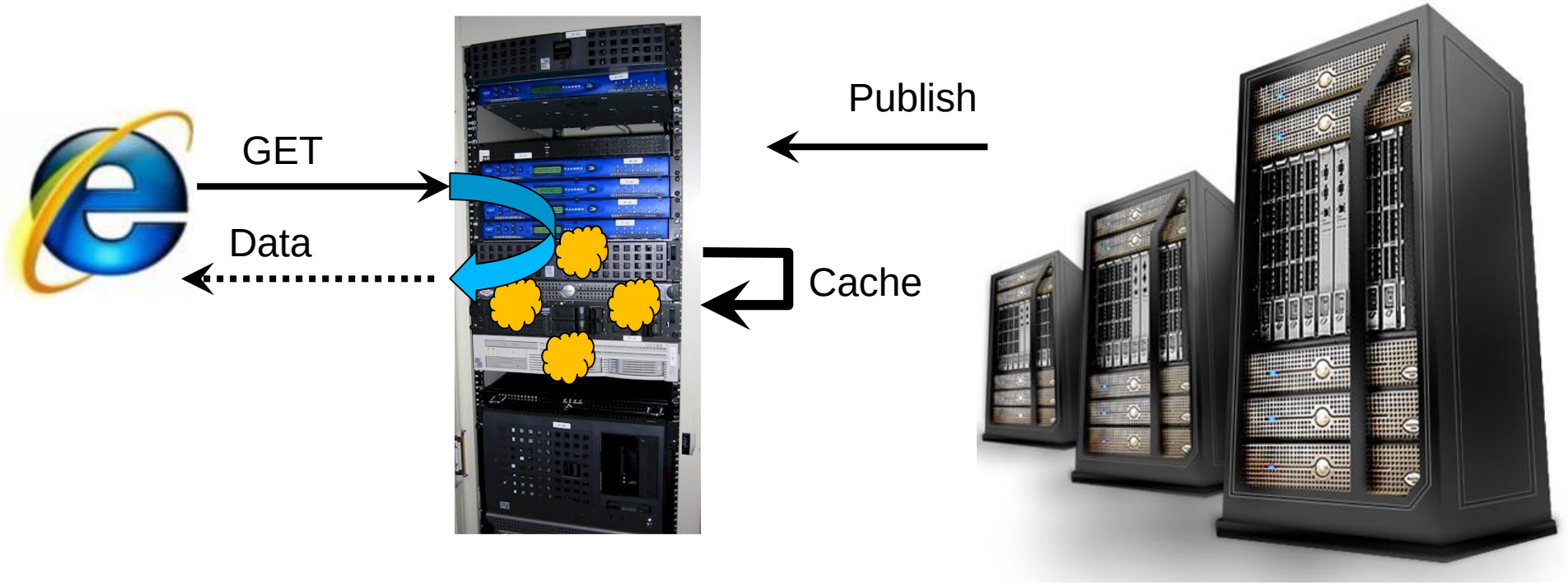
Web, Pub/Sub, Caching

Web Apps

- HTTP request/response with browsers
- Should avoid request/response with backend
  - Easier said than done

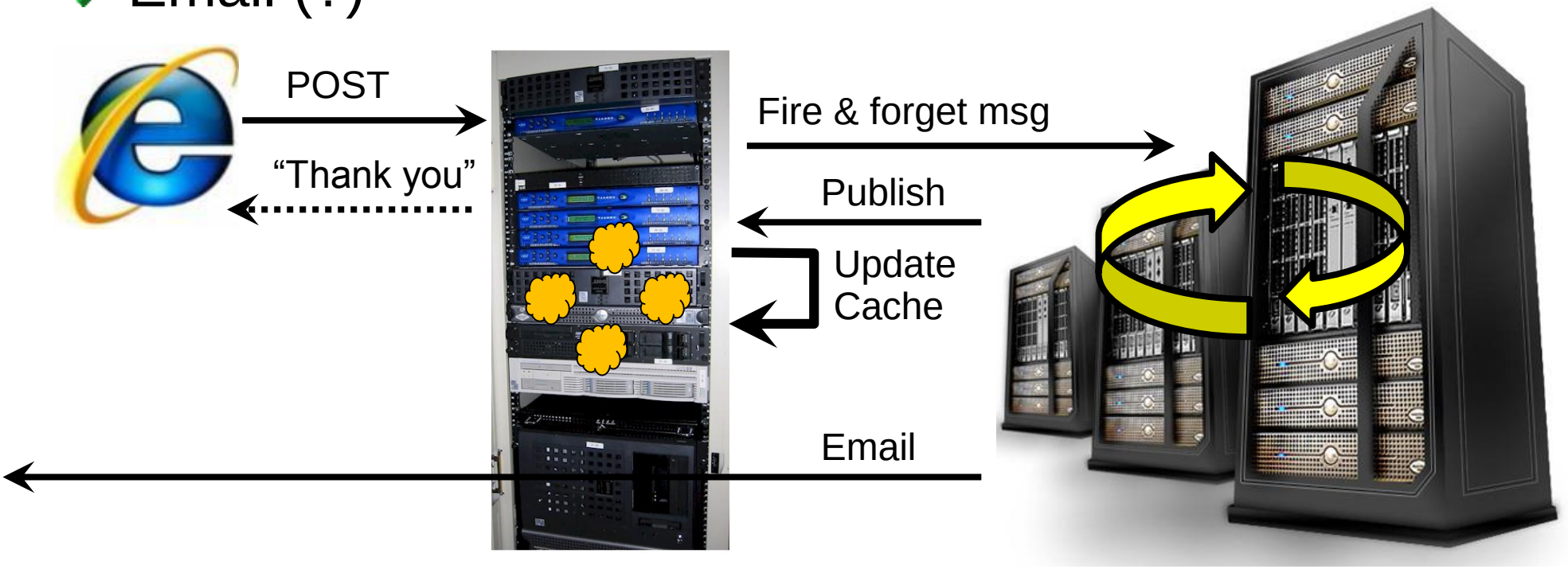
Web Apps, Pub/Sub, and Caching

- Web app front end subscribes to events
  - Caches data from events in the web tier
  - Serves data from the cache to browsers



Changing data

- User submits changes to data
  - Send message and show user “thank you” page
  - Successful processing causes publish/cache update
  - Email (?)

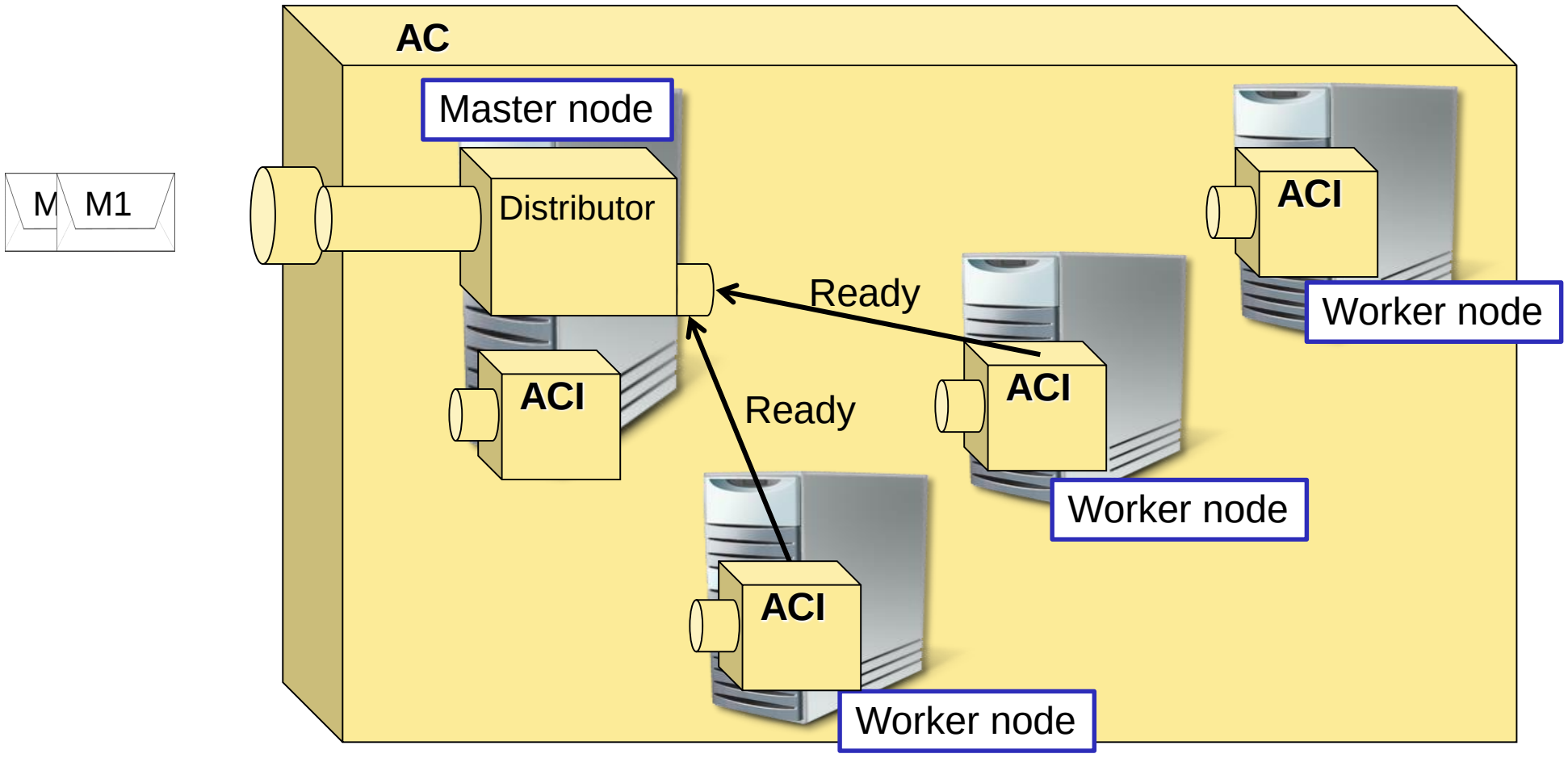


Scaling-out and Multi-Site Messaging

Master nodes and worker nodes

- Master node provides infrastructure capabilities
  - Distributor, RavenDB, TimeoutManager, etc
  - Needs to be highly available
- Worker nodes – process messages delivered from the master node
- Enables scale out with minimal configuration

Scaling a Autonomous Component



Configuring an ACI as the master

- Use the `Master` profile
- Must be running on the master node
- Runs the distributor in-process
- Enlists it self as a worker

- If you want to run the distributor by itself, use the `Distributor` profile

Configuring an ACI as a worker

- Use the `Worker` profile
- Must know the master node

```
<MasterNodeConfig Node=“MyCluster"/>
```

- Sends timeout/gateway requests to the master
- Connects to RavenDB on the master for shared subscriptions and sagas

Distributor – Group Exercise

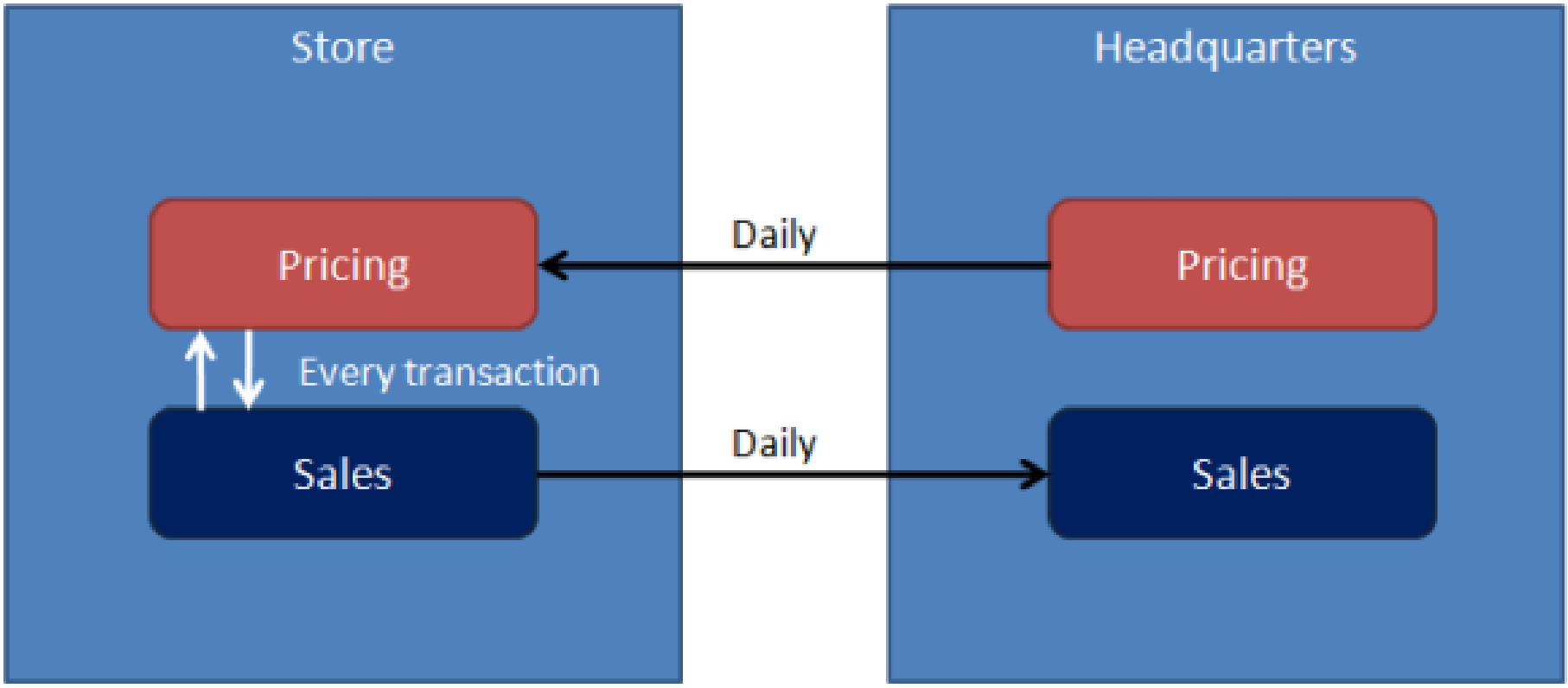
- Use the scale out sample from the download
- Run only the Orders.Handler project
- Have one machine be a masternode
  - *NServiceBus.Production NServiceBus.Master*
- Configure the other machines to be workers
  - *NServiceBus.Production NServiceBus.Worker*
  - *<MasterNodeConfig Node=”smt68"/>*

Cross-site communication

- When your sites are logically different
  - Headquarter vs Stores
- For High Availability (HA) scenarios infrastructure solutions should be used
- Prefer explicit message types for your cross-site communication

```
public class EndOfDaySalesReport : IMessage
{
   public List<Purchase> Purchases{ get;set; }
}
```

Logically significant sites



The Gateway

- Runs in-process with your endpoint
  - Enabled by the `MultiSite` profile
- Use the gateway by calling

```
Bus.SendToSites(endOfDayReport,
                new[]{“Headquarter”})
```

- Builtin channels are Http/Https
  - Create you own by implementing `IChannel`
- Handles de-duplication for you

Sagas

Saga: Definition

- A saga is pattern for implementing long-lived transaction by using a series of shorter transactions
- Sagas hold relevant state needed to process multiple messages in a “saga entity”
- Sagas are initiated by a message

Saga: Declaration

```
public class MySaga : Saga<MySagaData>,
  IAmStartedByMessages<M1>, IHandleMessages<M2>
{
    public void Handle(M1 message) {}
    public void Handle(M2 message) {}
}
```

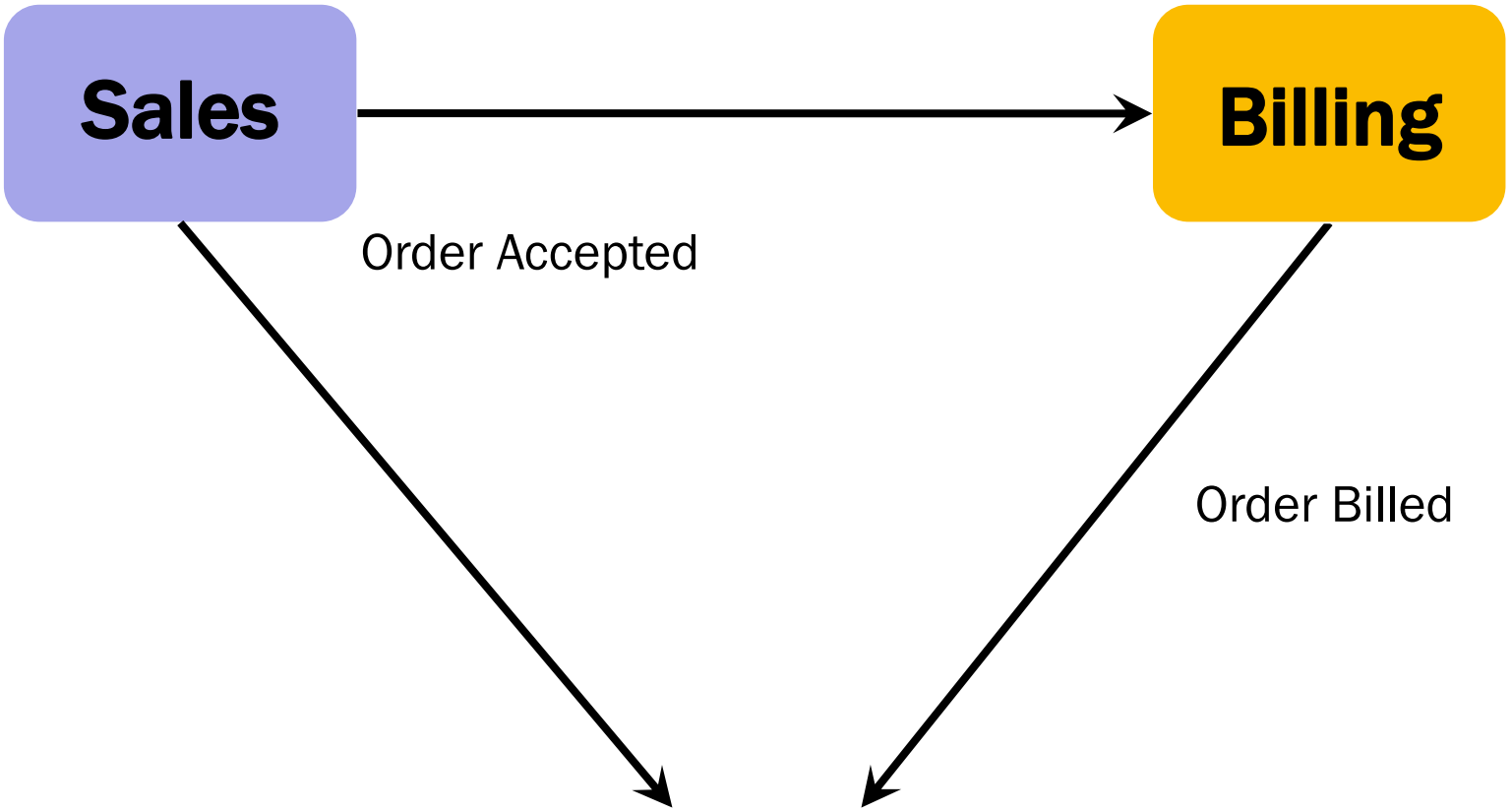
- Methods are like regular message handling logic

SagaEntity: Declaration

```
public class MySagaData : IContainSagaData
{
    public Guid Id { get; set; }
    public string Originator { get; set; }
    public string OriginalMessageId { get; set; }
}
```

- Must have these properties
- Easier to inherit ContainSagaData
  - This was a bad idea prior to V4 due to NHibernate saga storage implementation

Sagas and Services



Events may arrive out of order

Shipping

Process only when both events have arrived

Starting Sagas

- Sagas can be started by multiple messages
  - Implement IAmStartedByMessages<> for each
- First messages should start saga, following messages should be processed by the same one

Finding Sagas

- Saga can declare how to find it using messages:

```
public class MySaga : Saga<MySagaData>,
                      IAmStartedByMessages<M1>,
                      IAmStartedByMessages<M2>
{
     public override void ConfigureHowToFindSaga()
     {
        ConfigureMapping<M1>(m => m.SomeId)
         .ToSaga(s => s.MyId);
        ConfigureMapping<M2>(m => m.SomeId)
         .ToSaga(s => s.MyId);
     }
}
```

Finding Sagas

For greater flexibility:

```
class MySagaFinder : IFindSagas<MySagaData>.Using<M1>
{
  public MySagaData FindBy(M1 message)
  {
     //Go to DB and find it using any/all data from message
  }
}
```

Ending a saga

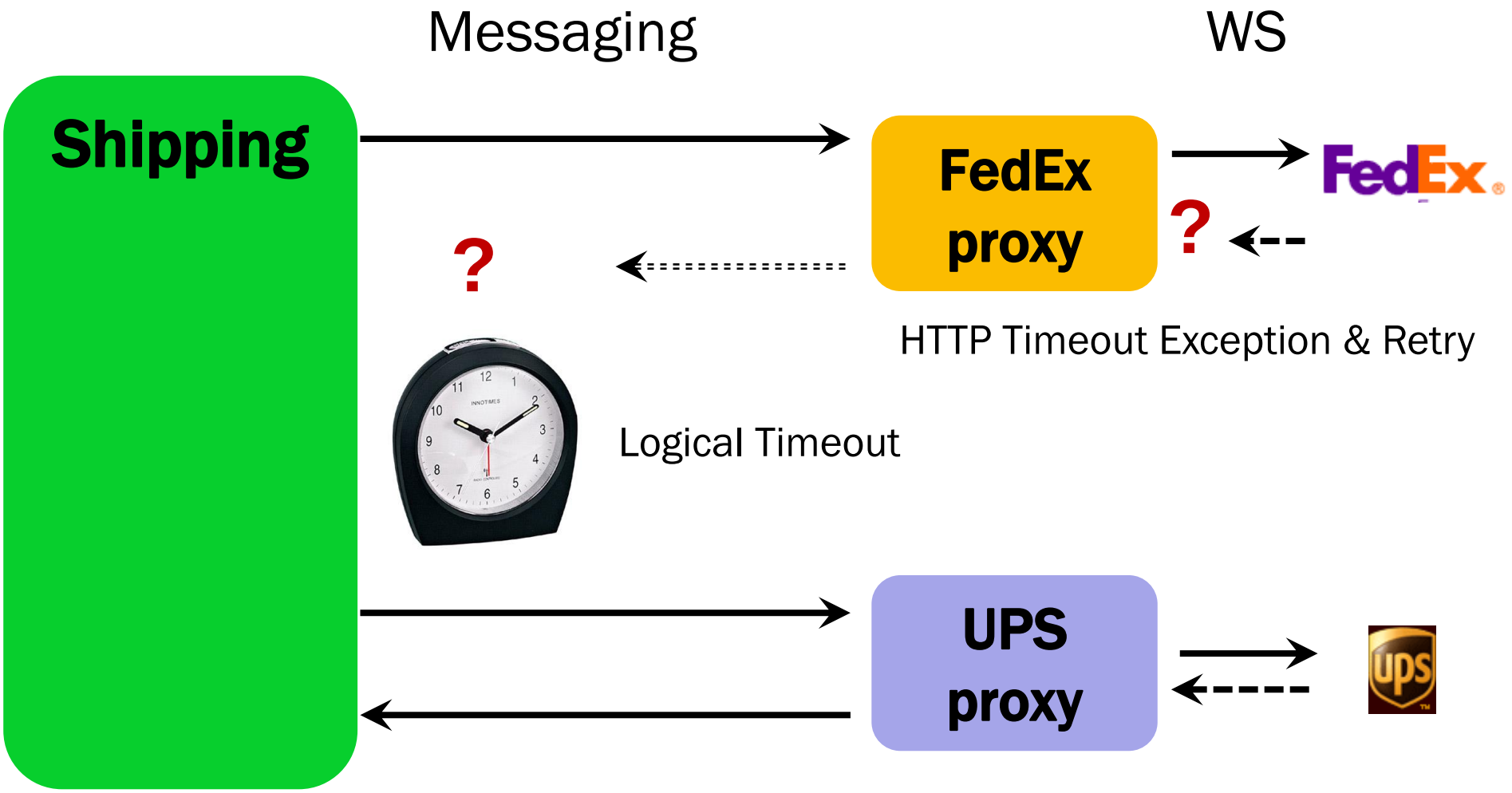
- `MarkAsComplete();`

- Can call this from any method
- Causes the saga to be deleted

- Any data that you want retained should be sent on (or published) via a message

Timeouts

Sagas and Integration



Remember: when handling a response from a partner,
if you want to reply to your client, use `Saga.ReplyToOriginator(msg);`

Sagas and Integration

```
public class ShippingSaga : Saga<ShippingSagaData>,
   IAmStartedByMessages<M1>, IHandleMessages<FedExResponse>,
   IHandleTimeouts<FedexTimedOut>
{
      public void Handle(M1 msg)
      {
         Data.Order = msg.Order;
         Bus.Send<ShipToFedEx>(m => m.Order = msg.Order);
         RequestTimeout<FedexTimedOut>(
                              TimeSpan.FromMinutes(5));
      }
      public void Handle(FedExResponse msg)
      {
         this.MarkAsComplete();
      }

      public void Timeout(FedexTimedOut state)
      {
         Bus.Send<ShipToUps>(m => m.Data = Data.Order);
      }
}
```

Custom timeout state

```
public class FedexTimedOut
{
    public string SomeState{get;set;}
}
```

```
public void Timeout(FedexTimedOut state)
{
    if(state.SomeState)
        …
}
```

Timeout Management

- Runs in process with your endpoint by default
  - Enabled by default
- Easily replaced with your own implementation
- Maintains timeout data in RavenDB

Timeout Configuration

- Convention based configuration
  - Input queue: `{endpointname}.timeouts@{masternode}`
- Override using:

```
<UnicastBusConfig
  TimeoutManagerAddress=“timeouts@myserver"/>
```

Unit testing

Unit Testing Sagas

```
Test.Saga<MySaga>(sagaId)
.WhenReceivesMessageFrom(clientEndpoint)
      .ExpectReplyToOrginator<M1>( /* check data */ )
      .ExpectPublish<M2>( /* check data */ )
      .ExpectSend<M3>( /* check data */ )
      .When( saga => saga.Handle(firstMessage) );
```

```
Check Data:
                m => return (m.Data == Something)
```

Unit Testing Saga Timeouts

```
MyTimeoutState state;

Saga.WhenReceivesMessageFrom(clientEndpoint)
      .ExpectTimeoutToBeSetAt<MyTimeoutState>(…)
      .When( saga => saga.Handle(firstMessage) );

Saga.Expect…
      .When( saga => saga.Timeout(state) );
```

Exercise: Sagas

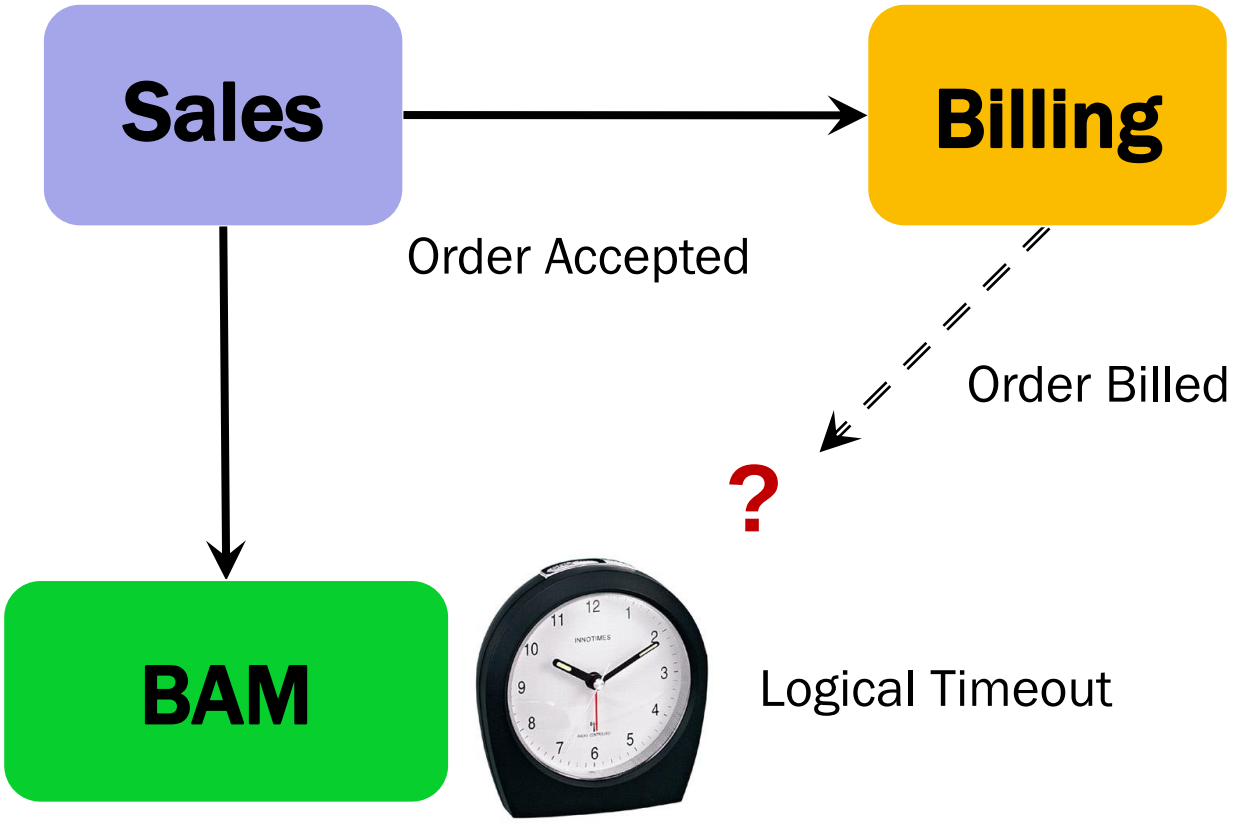
- Implement and unit test the shipping saga described

Business Activity Monitoring

BAM & Monitoring

- Business Activity Monitoring
  - High-level “what’s going on” from a business view
- Monitoring
  - Lower-level “what’s going on” from a technical view
- Important to be able to tie one to the other

When Events Don't Happen In Time



Often makes use of sagas

How big of a timeout?

- The service's SLA specifies time
- BAM bases timeout choices on that SLA

Dashboards

- BAM can show:
  - How many cross-service processes are in progress
  - How many did we do yesterday, last week, etc
  - Statistics around completion time
  - Trends
- In real time
- Useful for administrators to see problematic trends
  - Zoom in on an AC of problem service

SOA, BAM, and Centralization

- There is no central authority which orchestrates autonomous services
- Business Activity Monitoring provides a central point of visibility on what's going on

SOA, CQRS, and Sagas

All together now

Race Conditions – the secret sauce

- Race conditions may indicate a collaborative domain – fertile ground for CQRS
- May even make you think your service boundaries are wrong

Real World Requirements

- Do not allow users to cancel shipped orders
- Don’t ship cancelled orders

- As we shrink the time between actions, a race condition presents itself

Service Boundary Issues

- Cancelling an order is in the Sales service
- Shipping an order is in the Shipping service

- Requirements seem to imply need for consistency/transactions between services

Implementation is simple with 3-Tier

```
public class Order
{
    public  void Cancel()
    {
        if (status != OrderStatusEnum.Shipped)
            //cancel
    }

    public  void Ship()
    {
        if (status != OrderStatusEnum.Cancelled)
            //ship
    }
}
```

Remember

- In CQRS, commands don’t fail
- Race conditions don’t exist in business
- A microsecond either way shouldn’t change business objectives

Find underlying business objectives

Rules:

1. Cannot cancel shipped orders — Why?

   Because shipping costs money — So?

   That money would be lost if the customer cancelled — Why?

   Because we refund the customers money

2. Don’t ship cancelled orders

Refund Policies

Analyze

- When an order is cancelled, does the refund need to be given immediately?

No

- Can we give a partial refund?

Yes

Dig Deeper

- What does a customer have to do

  in order to get a refund?

  Return the products

  Most orders cancelled soon after they were made – buyer's remorse

  Implement a saga for buyer's remorse in the Sales service

Consider Service Boundaries

Order Accepted
Order Cancelled

Sales

Products Returned

Shipping

Customer Charged
Refund Policy

Billing

Implement a saga for the refund policy in Billing

Summary and Q&A

- NServiceBus is *one piece* of the puzzle
- Points you in the right direction
  - Creating friction if you're going the wrong direction
- Keep in mind the importance of the UI
- Q&A …

So long, and thanks for all the fish

www.particular.net

/groups.google.com/forum/#!forum/particularso
stackoverflow.com/questions/tagged/nservicebu