Autofac Documentation

Release 4.0

Autofac Contributors

May 13, 2017

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Autofac is an addictive IoC container for Microsoft .NET 4.5, Silverlight 5, Windows Store apps, and Windows Phone 8 apps. It manages the dependencies between classes so that **applications stay easy to change as they grow** in size and complexity. This is achieved by treating regular .NET classes as *components*.

CHAPTER 1

Getting Started

The basic pattern for integrating Autofac into your application is:

- Structure your app with *inversion of control* (IoC) in mind.
- Add Autofac references.
- At application startup...
- Create a *ContainerBuilder*.
- Register components.
- Build the container and store it for later use.
- During application execution...
- Create a lifetime scope from the container.
- Use the lifetime scope to resolve instances of the components.

This getting started guide walks you through these steps for a simple console application. Once you have the basics down, you can check out the rest of the wiki for more advanced usage and *integration information for WCF, ASP.NET, and other application types*.

Structuring the Application

The idea behind inversion of control is that, rather than tie the classes in your application together and let classes "new up" their dependencies, you switch it around so dependencies are instead passed in during class construction. Martin Fowler has an excellent article explaining dependency injection/inversion of control if you want more on that.

For our sample app, we'll define a class that writes the current date out. However, we don't want it tied to the `Console` because we want to be able to test the class later or use it in a place where the console isn't available.

We'll also go as far as allowing the mechanism writing the date to be abstracted, so if we want to, later, swap in a version that writes *tomorrow's* date, it'll be a snap.

We'll do something like this:

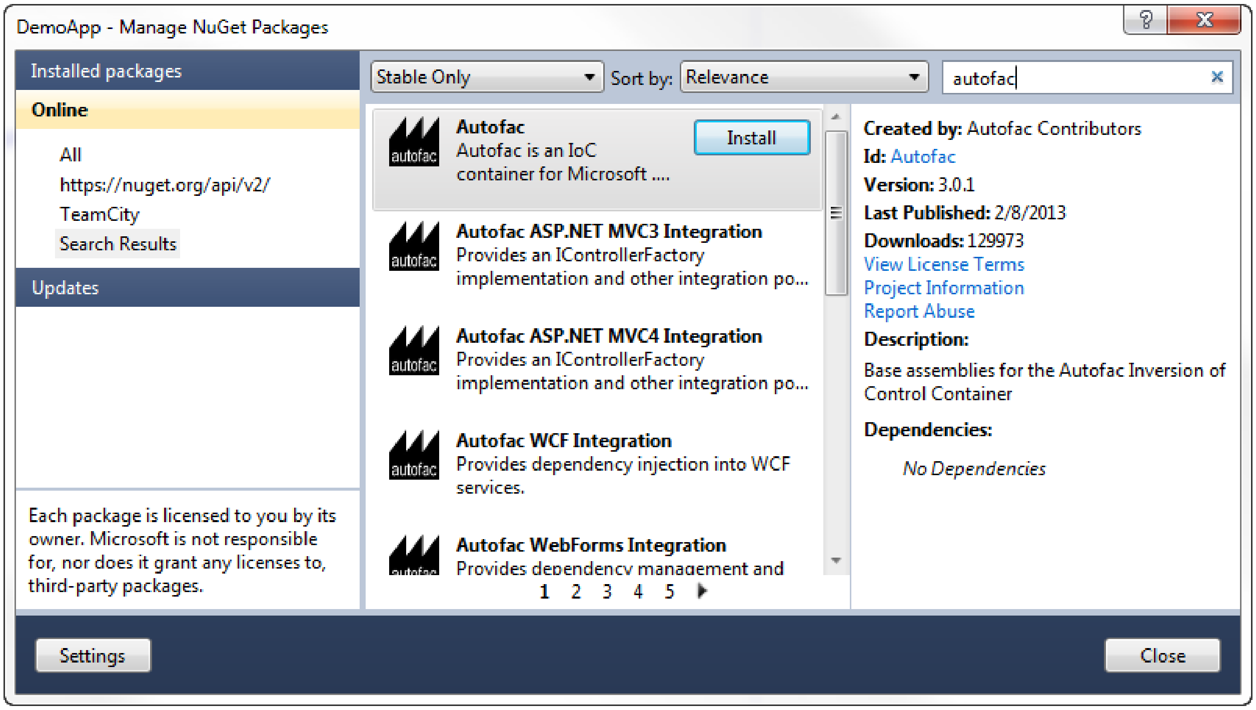
```
using System;

namespace DemoApp
{
  // This interface helps decouple the concept of
  // "writing output" from the Console class. We
  // don't really "care" how the Write operation
  // happens, just that we can write.
  public interface IOutput
  {
    void Write(string content);
  }

  // This implementation of the IOutput interface
  // is actually how we write to the Console. Technically
  // we could also implement IOutput to write to Debug
  // or Trace... or anywhere else.
  public class ConsoleOutput : IOutput
  {
    public void Write(string content)
    {
      Console.WriteLine(content);
    }
  }

  // This interface decouples the notion of writing
  // a date from the actual mechanism that performs
  // the writing. Like with IOutput, the process
  // is abstracted behind an interface.
  public interface IDateWriter
  {
    void WriteDate();
  }

  // This TodayWriter is where it all comes together.
  // Notice it takes a constructor parameter of type
  // IOutput - that lets the writer write to anywhere
  // based on the implementation. Further, it implements
  // WriteDate such that today's date is written out;
  // you could have one that writes in a different format
  // or a different date.
  public class TodayWriter : IDateWriter
  {
    private IOutput _output;
    public TodayWriter(IOutput output)
    {
      this._output = output;
    }

    public void WriteDate()
    {
      this._output.Write(DateTime.Today.ToShortDateString());
    }
  }
}
```

Now that we have a reasonably structured (if contrived) set of dependencies, let's get Autofac in the mix!

Add Autofac References

The first step is to add Autofac references to your project. For this example, we're only using core Autofac. *Other application types may use additional Autofac integration libraries.*.

The easiest way to do this is through NuGet. The "Autofac" package has all the core functionality you'll need.



Application Startup

At application startup, you need to create a *ContainerBuilder* and register your *components* with it. A *component* is an expression, .NET type, or other bit of code that exposes one or more *services* and can take in other *dependencies*.

In simple terms, think about a .NET type that implements an interface, like this:

```
public class SomeType : IService
{
}
```

You could address that type in one of two ways: - As the type itself, `SomeType` - As the interface, an `IService`

In this case, the *component* is `SomeType` and the *services* it exposes are `SomeType` and `IService`.

In Autofac, you'd register that with a `ContainerBuilder` something like this:

```
// Create your builder.
var builder = new ContainerBuilder();

// Usually you're only interested in exposing the type
// via its interface:
builder.RegisterType<SomeType>().As<IService>();

// However, if you want BOTH services (not as common)
```

```
// you can say so:
builder.RegisterType<SomeType>().AsSelf().As<IService>();
```

For our sample app, we need to register all of our components (classes) and expose their services (interfaces) so things can get wired up nicely.

We also need to store the container so it can be used to resolve types later.

```
using System;
using Autofac;

namespace DemoApp
{
  public class Program
  {
    private static IContainer Container { get; set; }

    static void Main(string[] args)
    {
      var builder = new ContainerBuilder();
      builder.RegisterType<ConsoleOutput>().As<IOutput>();
      builder.RegisterType<TodayWriter>().As<IDateWriter>();
      Container = builder.Build();

      // The WriteDate method is where we'll make use
      // of our dependency injection. We'll define that
      // in a bit.
      WriteDate();
    }
  }
}
```

Now we have a *container* with all of the *components* registered and they're exposing the proper *services*. Let's make use of it.

Application Execution

During application execution, you'll need to make use of the components you registered. You do this by *resolving* them from a *lifetime scope*.

The container itself *is* a lifetime scope, and you can technically just resolve things right from the container. **It is not recommended to resolve from the container directly**, however.

When you resolve a component, depending on the *instance scope you define*, a new instance of the object gets created. (Resolving a component is roughly equivalent to calling "new" to instantiate a class. That's really, really oversimplifying it, but from an analogy perspective it's fine.) Some components may need to be disposed (like they implement `IDisposable`) - *Autofac can handle disposing those components for you* when the lifetime scope is disposed.

However, the container lives for the lifetime of your application. If you resolve a lot of stuff directly from the container, you may end up with a lot of things hanging around waiting to be disposed. That's not good (and you may see a "memory leak" doing that).

Instead, create a *child lifetime scope* from the container and resolve from that. When you're done resolving components, dispose of the child scope and everything gets cleaned up for you.

(When you're working with the *Autofac integration libraries*, this child scope creation is largely done for you so you don't have to think about it.)

For our sample app, we'll implement the "WriteDate" method to get the writer from a scope and dispose of the scope when we're done.

```
namespace DemoApp
{
  public class Program
  {
    private static IContainer Container { get; set; }

    static void Main(string[] args)
    {
      // ...the stuff you saw earlier...
    }

    public static void WriteDate()
    {
      // Create the scope, resolve your IDateWriter,
      // use it, then dispose of the scope.
      using (var scope = Container.BeginLifetimeScope())
      {
        var writer = scope.Resolve<IDateWriter>();
        writer.WriteDate();
      }
    }
  }
}
```

Now when you run your program...

- The "WriteDate" method asks Autofac for an `IDateWriter`.
- Autofac sees that `IDateWriter` maps to `TodayWriter` so starts creating a `TodayWriter`.
- Autofac sees that the `TodayWriter` needs an `IOutput` in its constructor.
- Autofac sees that `IOutput` maps to `ConsoleOutput` so creates a new `ConsoleOutput` instance.
- Autofac uses the new `ConsoleOutput` instance to finish constructing the `TodayWriter`.
- Autofac returns the fully-constructed `TodayWriter` for "WriteDate" to consume.

Later, if you want your application to write a different date, you could implement a different `IDateWriter` and then change the registration at app startup. You don't have to change any other classes. Yay, inversion of control!

Note: generally speaking, service location is largely considered an anti-pattern (see article). That is, manually creating scopes everywhere and sprinkling use of the container through your code is not necessarily the best way to go. Using the *Autofac integration libraries* you usually won't have to do what we did in the sample app above. Instead, things get resolved from a central, "top level" location in the application and manual resolution is rare. Of course, how you design your app is up to you.

Going Further

The sample app gives you an idea of how to use Autofac, but there's a lot more you can do.

- Check out the list of *integration libraries* to see how to integrate Autofac with your application.
- Learn about the *ways to register components* that add flexibility.
- Learn about *Autofac configuration options* that allow you to better manage your component registrations.

Need Help?

- You can ask questions on StackOverflow.
- You can participate in the Autofac Google Group.
- There's an introductory Autofac tutorial on CodeProject.
- We have *advanced debugging tips* if you want to dive deep.

Building from Source

The source code along with Visual Studio project files is available on GitHub. Build instructions are in a README in the root of the code, and more information about the project is in the *Contributor Guide*.

CHAPTER 2

What's New / Release Notes

- Core components
- Autofac
- Autofac.Configuration
- Integration libraries
  - ASP.NET
  - Web Forms
  - MVC
  - Web API
  - SignalR
  - RIA/Domain Services
  - OWIN
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- Extended features

- Aggregate Services
- Attribute Metadata
- Dynamic Proxy / Interception
- Multitenant Applications
- Multitenant WCF Services

CHAPTER 3

Registering Components

Registration Concepts

You register *components* with Autofac by creating a `ContainerBuilder` and informing the builder which *components* expose which *services*.

Components can be created via **reflection** (by registering a specific .NET type or open generic); by providing a ready-made **instance** (an instance of an object you created); or via lambda **expression** (an anonymous function that executes to instantiate your object). `ContainerBuilder` has a family of `Register()` methods that allow you to set these up.

Each component exposes one or more **services** that are wired up using the `As()` methods on `ContainerBuilder`.

```
// Create the builder with which components/services are registered.
var builder = new ContainerBuilder();

// Register types that expose interfaces...
builder.RegisterType<ConsoleLogger>().As<ILogger>();

// Register instances of objects you create...
var output = new StringWriter();
builder.RegisterInstance(output).As<TextWriter>();

// Register expressions that execute to create objects...
builder.Register(c => new ConfigReader("mysection")).As<IConfigReader>();

// Build the container to finalize registrations
// and prepare for object resolution.
var container = builder.Build();

// Now you can resolve services using Autofac. For example,
// this line will execute the lambda expression registered
// to the IConfigReader service.
using(var scope = container.BeginLifetimeScope())
{
```

```
  var reader = container.Resolve<IConfigReader>();
}
```

Reflection Components

Register by Type

Components generated by reflection are typically registered by type:

```
var builder = new ContainerBuilder();
builder.RegisterType<ConsoleLogger>();
builder.RegisterType(typeof(ConfigReader));
```

When using reflection-based components, **Autofac automatically uses the constructor for your class with the most parameters that are able to be obtained from the container**.

For example, say you have a class with three constructors like this:

```
public class MyComponent
{
    public MyComponent() { /* ... */ }
    public MyComponent(ILogger logger) { /* ... */ }
    public MyComponent(ILogger logger, IConfigReader reader) { /* ... */ }
}
```

Now say you register components and services in your container like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<MyComponent>();
builder.RegisterType<ConsoleLogger>().As<ILogger>();
var container = builder.Build();

using(var scope = container.BeginLifetimeScope())
{
  var component = container.Resolve<MyComponent>();
}
```

When you resolve your component, Autofac will see that you have an `ILogger` registered, but you don't have an `IConfigReader` registered. In that case, the second constructor will be chosen since that's the one with the most parameters that can be found in the container.

An important note on reflection-based components: Any component type you register via `RegisterType` must be a concrete type. While components can expose abstract classes or interfaces as *services*, you can't register an abstract/interface component. It makes sense if you think about it: behind the scenes, Autofac is creating an instance of the thing you're registering. You can't "new up" an abstract class or an interface. You have to have an implementation, right?

Specifying a Constructor

You can manually choose a particular constructor to use and override the automatic choice by registering your component with the `UsingConstructor` method and a list of types representing the parameter types in the constructor:

```
builder.RegisterType<MyComponent>()
       .UsingConstructor(typeof(ILogger), typeof(IConfigReader));
```

Note that you will still need to have the requisite parameters available at resolution time or there will be an error when you try to resolve the object. You can *pass parameters at registration time* or you can *pass them at resolve time*.

Instance Components

In some cases, you may want to pre-generate an instance of an object and add it to the container for use by registered components. You can do this using the `RegisterInstance` method:

```
var output = new StringWriter();
builder.RegisterInstance(output).As<TextWriter>();
```

Something to consider when you do this is that Autofac *automatically handles disposal of registered components* and you may want to control the lifetime yourself rather than having Autofac call `Dispose` on your object for you. In that case, you need to register the instance with the `ExternallyOwned` method:

```
var output = new StringWriter();
builder.RegisterInstance(output)
       .As<TextWriter>()
       .ExternallyOwned();
```

Registering provided instances is also handy when integrating Autofac into an existing application where a singleton instance already exists and needs to be used by components in the container. Rather than tying those components directly to the singleton, it can be registered with the container as an instance:

```
builder.RegisterInstance(MySingleton.Instance).ExternallyOwned();
```

This ensures that the static singleton can eventually be eliminated and replaced with a container-managed one.

The default service exposed by an instance is the concrete type of the instance. See "Services vs. Components," below.

Lambda Expression Components

Reflection is a pretty good default choice for component creation. Things get messy, though, when component creation logic goes beyond a simple constructor call.

Autofac can accept a delegate or lambda expression to be used as a component creator:

```
builder.Register(c => new A(c.Resolve<B>()));
```

The parameter `c` provided to the expression is the *component context* (an `IComponentContext` object) in which the component is being created. You can use this to resolve other values from the container to assist in creating your component. **It is important to use this rather than a closure to access the container** so that *deterministic disposal* and nested containers can be supported correctly.

Additional dependencies can be satisfied using this context parameter - in the example, `A` requires a constructor parameter of type `B` that may have additional dependencies.

The default service provided by an expression-created component is the inferred return type of the expression.

Below are some examples of requirements met poorly by reflective component creation but nicely addressed by lambda expressions.

Complex Parameters

Constructor parameters can't always be declared with simple constant values. Rather than puzzling over how to construct a value of a certain type using an XML configuration syntax, use code:

```
builder.Register(c => new UserSession(DateTime.Now.AddMinutes(25)));
```

(Of course, session expiry is probably something you'd want to specify in a configuration file - but you get the gist ;))

Property Injection

While Autofac offers *a more first-class approach to property injection*, you can use expressions and property initializers to populate properties as well:

```
builder.Register(c => new A(){ MyB = c.ResolveOptional<B>() });
```

The `ResolveOptional` method will try to resolve the value but won't throw an exception if the service isn't registered. (You will still get an exception if the service is registered but can't properly be resolved.) This is one of the options for *resolving a service*.

Property injection is not recommended in the majority of cases. Alternatives like the Null Object pattern, overloaded constructors or constructor parameter default values make it possible to create cleaner, "immutable" components with optional dependencies using constructor injection.

Selection of an Implementation by Parameter Value

One of the great benefits of isolating component creation is that the concrete type can be varied. This is often done at runtime, not just configuration time:

```
builder.Register<CreditCard>(
  (c, p) =>
    {
      var accountId = p.Named<string>("accountId");
      if (accountId.StartsWith("9"))
      {
        return new GoldCard(accountId);
      }
      else
      {
        return new StandardCard(accountId);
      }
    });
```

In this example, `CreditCard` is implemented by two classes, `GoldCard` and `StandardCard` - which class is instantiated depends on the account ID provided at runtime.

Parameters are provided to the creation function through an optional second parameter named `p` in this example.

Using this registration would look like:

```
var card = container.Resolve<CreditCard>(new NamedParameter("accountId", "12345"));
```

A cleaner, type-safe syntax can be achieved if a delegate to create `CreditCard` instances is declared and *a delegate factory* is used.

Open Generic Components

Autofac supports open generic types. Use the `RegisterGeneric()` builder method:

```
builder.RegisterGeneric(typeof(NHibernateRepository<>))
       .As(typeof(IRepository<>))
       .InstancePerLifetimeScope();
```

When a matching service type is requested from the container, Autofac will map this to an equivalent closed version of the implementation type:

```
// Autofac will return an NHibernateRepository<Task>
var tasks = container.Resolve<IRepository<Task>>();
```

Registration of a specialized service type (e.g. `IRepository<Person>`) will override the open generic version.

Services vs. Components

When you register *components*, you have to tell Autofac which *services* that component exposes. By default, most registrations will just expose themselves as the type registered:

```
// This exposes the service "CallLogger"
builder.RegisterType<CallLogger>();
```

Components can only be *resolved* by the services they expose. In this simple example it means:

```
// This will work because the component
// exposes the type by default:
scope.Resolve<CallLogger>();

// This will NOT work because we didn't
// tell the registration to also expose
// the ILogger interface on CallLogger:
scope.Resolve<ILogger>();
```

You can expose a component with any number of services you like:

```
builder.RegisterType<CallLogger>()
       .As<ILogger>()
       .As<ICallInterceptor>();
```

Once you expose a service, you can resolve the component based on that service. Note, however, that once you expose a component as a specific service, the default service (the component type) is overridden:

```
// These will both work because we exposed
// the appropriate services in the registration:
scope.Resolve<ILogger>();
scope.Resolve<ICallInterceptor>();

// This WON'T WORK anymore because we specified
// service overrides on the component:
scope.Resolve<CallLogger>();
```

If you want to expose a component as a set of services as well as using the default service, use the `AsSelf` method:

```
builder.RegisterType<CallLogger>()
       .AsSelf()
       .As<ILogger>()
       .As<ICallInterceptor>();
```

Now all of these will work:

```
// These will all work because we exposed
// the appropriate services in the registration:
scope.Resolve<ILogger>();
scope.Resolve<ICallInterceptor>();
scope.Resolve<CallLogger>();
```

Default Registrations

If more than one component exposes the same service, **Autofac will use the last registered component as the default provider of that service**:

```
builder.Register<ConsoleLogger>().As<ILogger>();
builder.Register<FileLogger>().As<ILogger>();
```

In this scenario, `FileLogger` will be the default for `ILogger` because it was the last one registered.

To override this behavior, use the `PreserveExistingDefaults()` modifier:

```
builder.Register<ConsoleLogger>().As<ILogger>();
builder.Register<FileLogger>().As<ILogger>().PreserveExistingDefaults();
```

In this scenario, `ConsoleLogger` will be the default for `ILogger` because the later registration for `FileLogger` used `PreserveExistingDefaults()`.

Configuration of Registrations

You can *use XML or programmatic configuration ("modules")* to provide groups of registrations together or change registrations at runtime. You can also use *use Autofac modules* for some dynamic registration generation or conditional registration logic.

Dynamically-Provided Registrations

Autofac modules are the simplest way to introduce dynamic registration logic or simple cross-cutting features. For example, you can use a module to *dynamically attach a log4net logger instance to a service being resolved*.

If you find that you need even more dynamic behavior, such as adding support for a new *implicit relationship type*, you might want to *check out the registration sources section in the advanced concepts area*.

Passing Parameters to Register

When you *register components* you have the ability to provide a set of parameters that can be used during the *resolution of services* based on that component. (If you'd rather provide the parameters at resolution time, *you can do that instead*.)

Available Parameter Types

Autofac offers several different parameter matching strategies:

- `NamedParameter` - match target parameters by name

- `TypedParameter` - match target parameters by type (exact type match required)
- `ResolvedParameter` - flexible parameter matching

`NamedParameter` and `TypedParameter` can supply constant values only.

`ResolvedParameter` can be used as a way to supply values dynamically retrieved from the container, e.g. by resolving a service by name.

Parameters with Reflection Components

When you register a reflection-based component, the constructor of the type may require a parameter that can't be resolved from the container. You can use a parameter on the registration to provide that value.

Say you have a configuration reader that needs a configuration section name passed in:

```
public class ConfigReader : IConfigReader
{
  public ConfigReader(string configSectionName)
  {
    // Store config section name
  }

  // ...read configuration based on the section name.
}
```

You could use a lambda expression component for that:

```
builder.Register(c => new ConfigReader("sectionName")).As<IConfigReader>();
```

Or you could pass a parameter to a reflection component registration:

```
// Using a NAMED parameter:
builder.RegisterType<ConfigReader>()
       .As<IConfigReader>()
       .WithParameter("configSectionName", "sectionName");

// Using a TYPED parameter:
builder.RegisterType<ConfigReader>()
       .As<IConfigReader>()
       .WithParameter(new TypedParameter(typeof(string), "sectionName"));

// Using a RESOLVED parameter:
builder.RegisterType<ConfigReader>()
       .As<IConfigReader>()
       .WithParameter(
         new ResolvedParameter(
           (pi, ctx) => pi.ParameterType == typeof(string) && pi.Name ==
↪"configSectionName",
           (pi, ctx) => "sectionName"));
```

Parameters with Lambda Expression Components

With lambda expression component registrations, rather than passing the parameter value *at registration time* you enable the ability to pass the value *at service resolution time*. (*Read more about resolving with parameters.*)

In the component registration expression, you can make use of the incoming parameters by changing the delegate signature you use for registration. Instead of just taking in an `IComponentContext` parameter, take in an `IComponentContext` and an `IEnumerable<Parameter>`:

```
// Use TWO parameters to the registration delegate:
// c = The current IComponentContext to dynamically resolve dependencies
// p = An IEnumerable<Parameter> with the incoming parameter set
builder.Register((c, p) =>
                 new ConfigReader(p.Named<string>("configSectionName")))
       .As<IConfigReader>();
```

When *resolving with parameters*, your lambda will use the parameters passed in:

```
var reader = scope.Resolve<IConfigReader>(new NamedParameter("configSectionName",
↪"sectionName"));
```

Property and Method Injection

While constructor parameter injection is the preferred method of passing values to a component being constructed, you can also use property or method injection to provide values.

Property injection uses writeable properties rather than constructor parameters to perform injection. **Method injection** sets dependencies by calling a method.

Property Injection

If the component is a *lambda expression component*, use an object initializer:

```
builder.Register(c => new A { B = c.Resolve<B>() });
```

To support *circular dependencies*, use an *activated event handler*:

```
builder.Register(c => new A()).OnActivated(e => e.Instance.B = e.Context.Resolve<B>
↪());
```

If the component is a *reflection component*, use the `PropertiesAutowired()` modifier to inject properties:

```
builder.RegisterType<A>().PropertiesAutowired();
```

If you have one specific property and value to wire up, you can use the `WithProperty()` modifier:

```
builder.RegisterType<A>().WithProperty("PropertyName", propertyValue);
```

Method Injection

The simplest way to call a method to set a value on a component is to use a *lambda expression component* and handle the method call right in the activator:

```
builder.Register(c => {
  var result = new MyObjectType();
  var dep = c.Resolve<TheDependency>();
  result.SetTheDependency(dep);
```

```
  return result;
});
```

If you can't use a registration lambda, you can add an *activating event handler*:

```
builder
  .Register<MyObjectType>()
  .OnActivating(e => {
    var dep = e.Context.Resolve<TheDependency>();
    e.Instance.SetTheDependency(dep);
  });
```

Assembly Scanning

Autofac can use conventions to find and register components in assemblies. You can scan and register individual types or you can scan specifically for *Autofac modules*.

Scanning for Types

Otherwise known as convention-driven registration or scanning, Autofac can register a set of types from an assembly according to user-specified rules:

```
var dataAccess = Assembly.GetExecutingAssembly();

builder.RegisterAssemblyTypes(dataAccess)
       .Where(t => t.Name.EndsWith("Repository"))
       .AsImplementedInterfaces();
```

Each `RegisterAssemblyTypes()` call will apply one set of rules only - multiple invocations of `RegisterAssemblyTypes()` are necessary if there are multiple different sets of components to register.

Filtering Types

`RegisterAssemblyTypes()` accepts a parameter array of one or more assemblies. By default, all public, concrete classes in the assembly will be registered. You can filter the set of types to register using some provided LINQ-style predicates.

To filter the types that are registered, use the `Where()` predicate:

```
builder.RegisterAssemblyTypes(asm)
       .Where(t => t.Name.EndsWith("Repository"));
```

To exclude types from scanning, use the `Except()` predicate:

```
builder.RegisterAssemblyTypes(asm)
       .Except<MyUnwantedType>();
```

The `Except()` predicate also allows you to customize the registration for the specific excluded type:

```
builder.RegisterAssemblyTypes(asm)
       .Except<MyCustomisedType>(ct =>
          ct.As<ISpecial>().SingleInstance());
```

Multiple filters can be used, in which case they will be applied with logical AND.

Specifying Services

The registration syntax for `RegisterAssemblyTypes()` is a superset of *the registration syntax for single types*, so methods like `As()` all work with assemblies as well:

```
builder.RegisterAssemblyTypes(asm)
       .Where(t => t.Name.EndsWith("Repository"))
       .As<IRepository>();
```

Additional overloads to `As()` and `Named()` accept lambda expressions that determine, for a type, which services it will provide:

```
builder.RegisterAssemblyTypes(asm)
       .As(t => t.GetInterfaces()[0]);
```

As with normal component registrations, multiple calls to `As()` are added together.

A number of additional registration methods have been added to make it easier to build up common conventions:

Method	Description	Example
`AsImplementedInterfaces()`	Register the type as providing all of its public interfaces as services (excluding `IDisposable`).	`builder.RegisterAssemblyTypes(asm) .Where(t => t.Name.EndsWith("Repository")) .AsImplementedInterfaces();`
`AsClosedTypesOf(open)`	Register types that are assignable to a closed instance of the open generic type.	`builder.RegisterAssemblyTypes(asm) .AsClosedTypesOf(typeof(IRepository<>));`
`AsSelf()`	The default: register types as themselves - useful when also overriding the default with another service specification.	`builder.RegisterAssemblyTypes(asm) .AsImplementedInterfaces() .AsSelf();`

Scanning for Modules

Module scanning is performed with the `RegisterAssemblyModules()` registration method, which does exactly what its name suggests. It scans through the provided assemblies for *Autofac modules*, creates instances of the modules, and then registers them with the current container builder.

For example, say the two simple module classes below live in the same assembly and each register a single component:

```
public class AModule : Module
{
  protected override void Load(ContainerBuilder builder)
```

```
  {
    builder.Register(c => new AComponent()).As<AComponent>();
  }
}

public class BModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.Register(c => new BComponent()).As<BComponent>();
  }
}
```

The overload of `RegisterAssemblyModules()` that *does not accept a type parameter* will register all classes implementing `IModule` found in the provided list of assemblies. In the example below **both modules** get registered:

```
var assembly = typeof(AComponent).Assembly;
var builder = new ContainerBuilder();

// Registers both modules
builder.RegisterAssemblyModules(assembly);
```

The overload of `RegisterAssemblyModules()` with *the generic type parameter* allows you to specify a base type that the modules must derive from. In the example below **only one module** is registered because the scanning is restricted:

```
var assembly = typeof(AComponent).Assembly;
var builder = new ContainerBuilder();

// Registers AModule but not BModule
builder.RegisterAssemblyModules<AModule>(assembly);
```

The overload of `RegisterAssemblyModules()` with *a Type object parameter* works like the generic type parameter overload but allows you to specify a type that might be determined at runtime. In the example below **only one module** is registered because the scanning is restricted:

```
var assembly = typeof(AComponent).Assembly;
var builder = new ContainerBuilder();

// Registers AModule but not BModule
builder.RegisterAssemblyModules(typeof(AModule), assembly);
```

IIS Hosted Web Applications

When using assembly scanning with IIS applications, you can run into a little trouble depending on how you do the assembly location. (*This is one of our FAQs*)

When hosting applications in IIS all assemblies are loaded into the `AppDomain` when the application first starts, but **when the AppDomain is recycled by IIS the assemblies are then only loaded on demand.**

To avoid this issue use the GetReferencedAssemblies() method on System.Web.Compilation.BuildManager to get a list of the referenced assemblies instead:

```
var assemblies = BuildManager.GetReferencedAssemblies().Cast<Assembly>();
```

That will force the referenced assemblies to be loaded into the `AppDomain` immediately making them available for module scanning.

CHAPTER 4

Resolving Services

After you have your *components registered with appropriate services exposed*, you can resolve services from the built container and child *lifetime scopes*. You do this using the `Resolve()` method:

```
var builder = new ContainerBuilder();
builder.RegisterType<MyComponent>().As<IService>();
var container = builder.Build();

using(var scope = container.BeginLifetimeScope())
{
  var service = scope.Resolve<IService>();
}
```

You will notice the example resolves the service from a lifetime scope rather than the container directly - you should, too.

> **While it is possible to resolve components right from the root container, doing this through your application in some cases may result in a memory leak.** It is recommended you always resolve components from a lifetime scope where possible to make sure service instances are properly disposed and garbage collected. You can read more about this in the *section on controlling scope and lifetime*.

When resolving a service, Autofac will automatically chain down the entire dependency hierarchy of the service and resolve any dependencies required to fully construct the service. If you have *circular dependencies* that are improperly handled or if there are missing required dependencies, you will get a `DependencyResolutionException`.

If you have a service that may or may not be registered, you can attempt conditional resolution of the service using `ResolveOptional()` or `TryResolve()`:

```
// If IService is registered, it will be resolved; if
// it isn't registered, the return value will be null.
var service = scope.ResolveOptional<IService>();

// If IProvider is registered, the provider variable
// will hold the value; otherwise you can take some
// other action.
IProvider provider = null;
```

```
if(scope.TryResolve<IProvider>(out provider))
{
  // Do something with the resolved provider value.
}
```

Both ResolveOptional() and TryResolve() revolve around the conditional nature of a specific service *being registered*. If the service is registered, resolution will be attempted. If resolution fails (e.g., due to lack of a dependency being registered), **you will still get a DependencyResolutionException**. If you need conditional resolution around a service where the condition is based on whether or not the service can successfully resolve, wrap the Resolve() call with a try/catch block.

Additional topics for resolving services:

Passing Parameters to Resolve

When it's time to *resolve services*, you may find that you need to pass parameters to the resolution. (If you know the values at registration time, *you can provide them in the registration instead*.)

The Resolve() methods accept *the same parameter types available at registration time* using a variable-length argument list. Alternatively, *delegate factories* and the Func<T> *implicit relationship type* also allow ways to pass parameters during resolution.

Available Parameter Types

Autofac offers several different parameter matching strategies:

- NamedParameter - match target parameters by name
- TypedParameter - match target parameters by type (exact type match required)
- ResolvedParameter - flexible parameter matching

NamedParameter and TypedParameter can supply constant values only.

ResolvedParameter can be used as a way to supply values dynamically retrieved from the container, e.g. by resolving a service by name.

Parameters with Reflection Components

When you resolve a reflection-based component, the constructor of the type may require a parameter that you need to specify based on a runtime value, something that isn't available at registration time. You can use a parameter in the Resolve() method call to provide that value.

Say you have a configuration reader that needs a configuration section name passed in:

```
public class ConfigReader : IConfigReader
{
  public ConfigReader(string configSectionName)
  {
    // Store config section name
  }

  // ...read configuration based on the section name.
}
```

You could pass a parameter to the `Resolve()` call like this:

```
var reader = scope.Resolve<ConfigReader>(new NamedParameter("configSectionName",
↪"sectionName"));
```

As with registration-time parameters, the `NamedParameter` in the example will map to the corresponding named constructor parameter, assuming the `Person` component was *registered using reflection*.

If you have more than one parameter, just pass them all in via the `Resolve()` method:

```
var service = scope.Resolve<AnotherService>(
                new NamedParameter("id", "service-identifier"),
                new TypedParameter(typeof(Guid), Guid.NewGuid()),
                new ResolvedParameter(
                  (pi, ctx) => pi.ParameterType == typeof(ILog) && pi.Name == "logger
↪",
                  (pi, ctx) => LogManager.GetLogger("service")));
```

Parameters with Lambda Expression Components

With lambda expression component registrations, you need to add the parameter handling inside your lambda expression so when the `Resolve()` call passes them in, you can take advantage of them.

In the component registration expression, you can make use of the incoming parameters by changing the delegate signature you use for registration. Instead of just taking in an `IComponentContext` parameter, take in an `IComponentContext` and an `IEnumerable<Parameter>`:

```
// Use TWO parameters to the registration delegate:
// c = The current IComponentContext to dynamically resolve dependencies
// p = An IEnumerable<Parameter> with the incoming parameter set
builder.Register((c, p) =>
                 new ConfigReader(p.Named<string>("configSectionName")))
       .As<IConfigReader>();
```

Now when you resolve the `IConfigReader`, your lambda will use the parameters passed in:

```
var reader = scope.Resolve<IConfigReader>(new NamedParameter("configSectionName",
↪"sectionName"));
```

Passing Parameters Without Explicitly Calling Resolve

Autofac supports two features that allow you to automatically generate service "factories" that can take strongly-typed parameter lists that will be used during resolution. This is a slightly cleaner way to create component instances that require parameters.

- *Delegate Factories* allow you to define factory delegate methods.
- The `Func<T>` *implicit relationship type* can provide an automatically-generated factory function.

Implicit Relationship Types

Autofac supports automatically resolving particular types implicitly to support special relationships between *components and services*. To take advantage of these relationships, simply register your components as normal, but change the constructor parameter in the consuming component or the type being resolved in the Resolve() call so it takes in the specified relationship type.

For example, when Autofac is injecting a constructor parameter of type IEnumerable<ITask> it will **not** look for a component that supplies IEnumerable<ITask>. Instead, the container will find all implementations of ITask and inject all of them.

(Don't worry - there are examples below showing the usage of the various types and what they mean.)

Note: To override this default behavior *it is still possible to register explicit implementations of these types*.

[Content on this document based on Nick Blumhardt's blog article The Relationship Zoo.]

Supported Relationship Types

The table below summarizes each of the supported relationship types in Autofac and shows the .NET type you can use to consume them. Each relationship type has a more detailed description and use case after that.

Relationship	Type	Meaning
A needs *B*	B	Direct Dependency
A needs *B* at some point in the future	Lazy<B>	Delayed Instantiation
A needs *B* until some point in the future	Owned<B>	*Controlled Lifetime*
A needs to create instances of *B*	Func<B>	Dynamic Instantiation
A provides parameters of types *X* and *Y* to *B*	Func<X,Y,B>	Parameterized Instantiation
A needs all the kinds of *B*	IEnumerable<B>, IList<B>, ICollection<B>	Enumeration
A needs to know *X* about *B*	Meta<B> and Meta<B,X>	*Metadata Interrogation*
A needs to choose *B* based on *X*	IIndex<X,B>	*Keyed Service* Lookup

Relationship Type Details

- *Direct Dependency (B)*
- *Delayed Instantiation (Lazy<B>)*
- *Controlled Lifetime (Owned<B>)*
- *Dynamic Instantiation (Func<B>)*
- *Parameterized Instantiation (Func<X, Y, B>)*
- *Enumeration (IEnumerable<B>, IList<B>, ICollection<B>)*
- *Metadata Interrogation (Meta<B>, Meta<B, X>)*
- *Keyed Service Lookup (IIndex<X, B>)*

Direct Dependency (B)

A *direct dependency* relationship is the most basic relationship supported - component A needs service B. This is handled automatically through standard constructor and property injection:

```
public class A
{
```

```
  public A(B dependency) { ... }
}
```

Register the `A` and `B` components, then resolve:

```
var builder = new ContainerBuilder();
builder.RegisterType<A>();
builder.RegisterType<B>();
var container = builder.Build();

using(var scope = container.BeginLifetimeScope())
{
  // B is automatically injected into A.
  var a = scope.Resolve<A>();
}
```

Delayed Instantiation (Lazy<B>)

A *lazy dependency* is not instantiated until its first use. This appears where the dependency is infrequently used, or expensive to construct. To take advantage of this, use a `Lazy<B>` in the constructor of `A`:

```
public class A
{
  Lazy<B> _b;

  public A(Lazy<B> b) { _b = b }

  public void M()
  {
      // The component implementing B is created the
      // first time M() is called
      _b.Value.DoSomething();
  }
}
```

If you have a lazy dependency for which you also need metadata, you can use `Lazy<B,M>` instead of the longer `Meta<Lazy<B>, M>`.

Controlled Lifetime (Owned<B>)

An *owned dependency* can be released by the owner when it is no longer required. Owned dependencies usually correspond to some unit of work performed by the dependent component.

This type of relationship is interesting particularly when working with components that implement `IDisposable`. *Autofac automatically disposes of disposable components* at the end of a lifetime scope, but that may mean a component is held onto for too long; or you may just want to take control of disposing the object yourself. In this case, you'd use an *owned dependency*.

```
public class A
{
  Owned<B> _b;

  public A(Owned<B> b) { _b = b; }

  public void M()
```

```
  {
      // _b is used for some task
      _b.Value.DoSomething();

      // Here _b is no longer needed, so
      // it is released
      _b.Dispose();
  }
}
```

Internally, Autofac creates a tiny lifetime scope in which the B service is resolved, and when you call Dispose() on it, the lifetime scope is disposed. What that means is that disposing of B will *also dispose of its dependencies* unless those dependencies are shared (e.g., singletons).

This also means that if you have InstancePerLifetimeScope() registrations and you resolve one as Owned<B> then you may not get the same instance as being used elsewhere in the same lifetime scope. This example shows the gotcha:

```
var builder = new ContainerBuilder();
builder.RegisterType<A>().InstancePerLifetimeScope();
builder.RegisterType<B>().InstancePerLifetimeScope();
var container = builder.Build();

using(var scope = container.BeginLifetimeScope())
{
  // Here we resolve a B that is InstancePerLifetimeScope();
  var b1 = scope.Resolve<B>();
  b1.DoSomething();

  // This will be the same as b1 from above.
  var b2 = scope.Resolve<B>();
  b2.DoSomething();

  // The B used in A will NOT be the same as the others.
  var a = scope.Resolve<A>();
  a.M();
}
```

This is by design because you wouldn't want one component to dispose the B out from under everything else. However, it may lead to some confusion if you're not aware.

If you would rather control B disposal yourself all the time, *register B as ExternallyOwned()*.

Dynamic Instantiation (Func<B>)

Using an *auto-generated factory* can let you effectively call Resolve<T>() without tying your component to Autofac. Use this relationship type if you need to create more than one instance of a given service, or if you're not sure if you're going to need a service and want to make the decision at runtime. This relationship is also useful in cases like *WCF integration* where you need to create a new service proxy after faulting the channel.

Lifetime scopes are respected using this relationship type. If you register an object as InstancePerDependency() and call the Func<B> multiple times, you'll get a new instance each time. However, if you register an object as SingleInstance() and call the Func<B> to resolve the object more than once, you will get *the same object instance every time*.

An example of this relationship looks like:

```
public class A
{
  Func<B> _b;

  public A(Func<B> b) { _b = b; }

  public void M()
  {
      var b = _b();
      b.DoSomething();
  }
}
```

Parameterized Instantiation (Func<X, Y, B>)

You can also use an *auto-generated factory* to pass strongly-typed parameters to the resolution function. This is an alternative to *passing parameters during registration* or *passing during manual resoution*:

```
public class A
{
    Func<int, string, B> _b;

    public A(Func<int, string, B> b) { _b = b }

    public void M()
    {
        var b = _b(42, "http://hel.owr.ld");
        b.DoSomething();
    }
}
```

Internally, Autofac treats these as typed parameters. What that means is that **auto-generated function factories cannot have duplicate types in the input parameter list.** For example, say you have a type like this:

```
public class DuplicateTypes
{
  public DuplicateTypes(int a, int b, string c)
  {
    // ...
  }
}
```

You might want to register that type and have an auto-generated function factory for it. *You will be able to resolve the function, but you won't be able to execute it.*

```
var func = scope.Resolve<Func<int, int, string, DuplicateTypes>>();

// Throws a DependencyResolutionException:
var obj = func(1, 2, "three");
```

In a loosely coupled scenario where the parameters are matched on type, you shouldn't really know about the order of the parameters for a specific object's constructor. If you need to do something like this, you should use a custom delegate type instead:

```
public delegate DuplicateTypes FactoryDelegate(int a, int b, string c);
```

Then register that delegate using `RegisterGeneratedFactory()`:

```
builder.RegisterType<DuplicateTypes>();
builder.RegisterGeneratedFactory<FactoryDelegate>(new␣
↪TypedService(typeof(DuplicateTypes)));
```

Now the function will work:

```
var func = scope.Resolve<FactoryDelegate>();
var obj = func(1, 2, "three");
```

Another option you have is to use a *delegate factory, which you can read about in the advanced topics section*.

Should you decide to use the built-in auto-generated factory behavior (`Func<X, Y, B>`) and only resolve a factory with one of each type, it will work but you'll get the same input for all constructor parameters of the same type.

```
var func = container.Resolve<Func<int, string, DuplicateTypes>>();

// This works and is the same as calling
// new DuplicateTypes(1, 1, "three")
var obj = func(1, "three");
```

You can read more about delegate factories and the `RegisterGeneratedFactory()` method *in the advanced topics section*.

Lifetime scopes are respected using this relationship type as well as when using delegate factories. If you register an object as `InstancePerDependency()` and call the `Func<X, Y, B>` multiple times, you'll get a new instance each time. However, if you register an object as `SingleInstance()` and call the `Func<X, Y, B>` to resolve the object more than once, you will get *the same object instance every time regardless of the different parameters you pass in.* Just passing different parameters will not break the respect for the lifetime scope.

Enumeration (IEnumerable<B>, IList<B>, ICollection<B>)

Dependencies of an *enumerable type* provide multiple implementations of the same service (interface). This is helpful in cases like message handlers, where a message comes in and more than one handler is registered to process the message.

Let's say you have a dependency interface defined like this:

```
public interface IMessageHandler
{
  void HandleMessage(Message m);
}
```

Further, you have a consumer of dependencies like that where you need to have more than one registered and the consumer needs all of the registered dependencies:

```
public class MessageProcessor
{
  private IEnumerable<IMessageHandler> _handlers;

  public MessageProcessor(IEnumerable<IMessageHandler> handlers)
  {
    this._handlers = handlers;
  }

  public void ProcessMessage(Message m)
  {
```

```
    foreach(var handler in this._handlers)
    {
      handler.HandleMessage(m);
    }
  }
}
```

You can easily accomplish this using the implicit enumerable relationship type. Just register all of the dependencies and the consumer, and when you resolve the consumer the *set of all matching dependencies* will be resolved as an enumeration.

```
var builder = new ContainerBuilder();
builder.RegisterType<FirstHandler>().As<IMessageHandler>();
builder.RegisterType<SecondHandler>().As<IMessageHandler>();
builder.RegisterType<ThirdHandler>().As<IMessageHandler>();
builder.RegisterType<MessageProcessor>();
var container = builder.Build();

using(var scope = container.BeginLifetimeScope())
{
  // When processor is resolved, it'll have all of the
  // registered handlers passed in to the constructor.
  var processor = scope.Resolve<MessageProcessor>();
  processor.ProcessMessage(m);
}
```

The enumerable support will return an empty set if no matching items are registered in the container. That is, using the above example, if you don't register any `IMessageHandler` implementations, this will break:

```
// This throws an exception - none are registered!
scope.Resolve<IMessageHandler>();
```

However, this works:

```
// This returns an empty list, NOT an exception:
scope.Resolve<IEnumerable<IMessageHandler>>();
```

This can create a bit of a "gotcha" where you might think you'll get a null value if you inject something using this relationship. Instead, you'll get an empty list.

[TODO: Include example of named collection support.]

Metadata Interrogation (Meta<B>, Meta<B, X>)

The *Autofac metadata feature* lets you associate arbitrary data with services that you can use to make decisions when resolving. If you want to make those decisions in the consuming component, use the `Meta<B>` relationship, which will provide you with a string/object dictionary of all the object metadata:

```
public class A
{
  Meta<B> _b;

  public A(Meta<B> b) { _b = b; }

  public void M()
  {
```

```
    if (_b.Metadata["SomeValue"] == "yes")
    {
      _b.Value.DoSomething();
    }
  }
}
```

You can use *strongly-typed metadata* as well, by specifying the metadata type in the `Meta<B, X>` relationship:

```
public class A
{
  Meta<B, BMetadata> _b;

  public A(Meta<B, BMetadata> b) { _b = b; }

  public void M()
  {
    if (_b.Metadata.SomeValue == "yes")
    {
      _b.Value.DoSomething();
    }
  }
}
```

If you have a lazy dependency for which you also need metadata, you can use `Lazy<B,M>` instead of the longer `Meta<Lazy<B>, M>`.

Keyed Service Lookup (IIndex<X, B>)

In the case where you have many of a particular item (like the `IEnumerable<B>` relationship) but you want to pick one based on *service key*, you can use the `IIndex<X, B>` relationship. First, register your services with keys:

```
var builder = new ContainerBuilder();
builder.RegisterType<DerivedB>().Keyed<B>("first");
builder.RegisterType<AnotherDerivedB>().Keyed<B>("second");
builder.RegisterType<A>();
var container = builder.Build();
```

Then consume the `IIndex<X, B>` to get a dictionary of keyed services:

```
public class A
{
  IIndex<string, B> _b;

  public A(IIndex<string, B> b) { _b = b; }

  public void M()
  {
    var b = this._b["first"];
    _b.DoSomething();
  }
}
```

Composing Relationship Types

Relationship types can be composed, so:

```
IEnumerable<Func<Owned<ITask>>>
```

Is interpreted correctly to mean:

- All implementations, of
- Factories, that return
- *Lifetime-controlled*
- `ITask` services

Relationship Types and Container Independence

The custom relationship types in Autofac based on standard .NET types don't force you to bind your application more tightly to Autofac. They give you a programming model for container configuration that is consistent with the way you write other components (vs. having to know a lot of specific container extension points and APIs that also potentially centralize your configuration).

For example, you can still create a custom `ITaskFactory` in your core model, but provide an `AutofacTaskFactory` implementation based on `Func<Owned<ITask>>` if that is desirable.

Note that some relationships are based on types that are in Autofac (e.g., `IIndex<X, B>`). Using those relationship types do tie you to at least having a reference to Autofac, even if you choose to use a different IoC container for the actual resolution of services.

You may also be interested in checking out the list of *advanced topics* to learn about *named and keyed services*, *working with component metadata*, and other service resolution related topics.

CHAPTER 5

Controlling Scope and Lifetime

A great place to start learning about Autofac scope and lifetime is in Nick Blumhardt's Autofac lifetime primer. There's a lot to digest, though, and a lot of intermixed concepts there, so we'll try to complement that article here.

You may recall from the *registration topic* that you add **components** to the container that implement **services**. You then end up *resolving services* and using those service instances to do your work.

The **lifetime** of a service is how long the service instance will live in your application - from the original instantiation to *disposal*. For example, if you "new up" an object that implements IDisposable and then later call `Dispose()` on it, the lifetime of that object is from the time you instantiated it all the way through disposal (or garbage collection if you didn't proactively dispose it).

The **scope** of a service is the area in the application where that service can be shared with other components that consume it. For example, in your application you may have a global static singleton - the "scope" of that global object instance would be the whole application. On the other hand, you might create a local variable in a `for` loop that makes use of the global singleton - the local variable has a much smaller scope than the global.

The concept of a **lifetime scope** in Autofac combines these two notions. Effectively, a lifetime scope equates with a unit of work in your application. A unit of work might begin a lifetime scope at the start, then services required for that unit of work get resolved from a lifetime scope. As you resolve services, Autofac tracks disposable (`IDisposable`) components that are resolved. At the end of the unit of work, you dispose of the associated lifetime scope and Autofac will automatically clean up/dispose of the resolved services.

The two important things lifetime scopes control are sharing and disposal.

- **Lifetime scopes are nestable and they control how components are shared.** For example, a "singleton" service might be resolved from a root lifetime scope while individual units of work may require their own instances of other services. You can determine how a component is shared by *setting its instance scope at registration*.
- **Lifetime scopes track disposable objects and dispose of them when the lifetime scope is disposed.** For example, if you have a component that implements `IDisposable` and you resolve it from a lifetime scope, the scope will hold onto it and dispose of it for you so your service consumers don't have to know about the underlying implementation. *You have the ability to control this behavior or add new disposal behavior if you choose.*

As you work in your application, it's good to remember these concepts so you make the most efficient use of your resources.

> **It is important to always resolve services from a lifetime scope and not the root container.** Due to the disposal tracking nature of lifetime scopes, if you resolve a lot of disposable components from the container (the "root lifetime scope"), you may inadvertently cause yourself a memory leak. The root container will hold references to those disposable components for as long as it lives (usually the lifetime of the application) so it can dispose of them. *You can change disposal behavior if you choose*, but it's a good practice to only resolve from a scope. If Autofac detects usage of a singleton or shared component, it will automatically place it in the appropriate tracking scope.

Let's look at a web application as a more concrete example to illustrate lifetime scope usage. Say you have the following scenario:

- You have a global singleton logging service.
- Two simultaneous requests come in to the web application.
- Each request is a logical "unit of work" and each requires its own order processing service.
- Each order processing service needs to log information to the logging service.

In this scenario, you'd have a root lifetime scope that contains the singleton logging service and you'd have one child lifetime scope per request, each with its own order processing service:

```
+---------------------------------------------------+
|                 Autofac Container                 |
|                Root Lifetime Scope                |
|                                                   |
|                  Logging Service                  |
|            (shared across all requests)           |
|                                                   |
| +----------------------+ +----------------------+ |
| |  First Request Scope | | Second Request Scope | |
| |                      | |                      | |
| |   Order Processor    | |   Order Processor    | |
| +----------------------+ +----------------------+ |
+---------------------------------------------------+
```

When each request ends, the request lifetime scope ends and the respective order processor gets disposed. The logging service, as a singleton, stays alive for sharing by future requests.

You can dive deeper on lifetime scopes in Nick Blumhardt's Autofac lifetime primer.

Additional lifetime scope topics to explore:

Working with Lifetime Scopes

Creating a New Lifetime Scope

You can create a lifetime scope by calling the `BeginLifetimeScope()` method on any existing lifetime scope, starting with the root container. **Lifetime scopes are disposable and they track component disposal, so make sure you always call "Dispose()"" or wrap them in "using" statements.**

```
using(var scope = container.BeginLifetimeScope())
{
  // Resolve services from a scope that is a child
  // of the root container.
```

```
  var service = scope.Resolve<IService>();

  // You can also create nested scopes...
  using(var unitOfWorkScope = scope.BeginLifetimeScope())
  {
    var anotherService = unitOfWorkScope.Resolve<IOther>();
  }
}
```

Tagging a Lifetime Scope

There are some cases where you want to share services across units of work but you don't want those services to be shared globally like singletons. A common example is "per-request" lifetimes in web applications. (*You can read more about per-request scoping in the "Instance Scope" topic.*) In this case, you'd want to tag your lifetime scope and register services as `InstancePerMatchingLifetimeScope()`.

For example, say you have a component that sends emails. A logical transaction in your system may need to send more than one email, so you can share that component across individual pieces of the logical transaction. However, you don't want the email component to be a global singleton. Your setup might look something like this:

```
// Register your transaction-level shared component
// as InstancePerMatchingLifetimeScope and give it
// a "known tag" that you'll use when starting new
// transactions.
var builder = new ContainerBuilder();
builder.RegisterType<EmailSender>()
       .As<IEmailSender>()
       .InstancePerMatchingLifetimeScope("transaction");

// Both the order processor and the receipt manager
// need to send email notifications.
builder.RegisterType<OrderProcessor>()
       .As<IOrderProcessor>();
builder.RegisterType<ReceiptManager>()
       .As<IReceiptManager>();

var container = builder.Build();


// Create transaction scopes with a tag.
using(var transactionScope = container.BeginLifetimeScope("transaction"))
{
  using(var orderScope = transactionScope.BeginLifetimeScope())
  {
    // This would resolve an IEmailSender to use, but the
    // IEmailSender would "live" in the parent transaction
    // scope and be shared across any children of the
    // transaction scope because of that tag.
    var op = orderScope.Resolve<IOrderProcessor>();
    op.ProcessOrder();
  }

  using(var receiptScope = transactionScope.BeginLifetimeScope())
  {
    // This would also resolve an IEmailSender to use, but it
    // would find the existing IEmailSender in the parent
```

```
    // scope and use that. It'd be the same instance used
    // by the order processor.
    var rm = receiptScope.Resolve<IReceiptManager>();
    rm.SendReceipt();
  }
}
```

Again, *you can read more about tagged scopes and per-request scoping in the "Instance Scope" topic.*

Adding Registrations to a Lifetime Scope

Autofac allows you to add registrations "on the fly" as you create lifetime scopes. This can help you when you need to do a sort of "spot weld" limited registration override or if you generally just need some additional stuff in a scope that you don't want to register globally. You do this by passing a lambda to `BeginLifetimeScope()` that takes a `ContainerBuilder` and adds registrations.

```
using(var scope = container.BeginLifetimeScope(
  builder =>
  {
    builder.RegisterType<Override>().As<IService>();
    builder.RegisterModule<MyModule>();
  }))
{
  // The additional registrations will be available
  // only in this lifetime scope.
}
```

Instance Scope

Instance scope determines how an instance is shared between requests for the same service. Note that you should be familiar with *the concept of lifetime scopes* to better understand what's happening here.

When a request is made for a service, Autofac can return a single instance (single instance scope), a new instance (per dependency scope), or a single instance within some kind of context, e.g. a thread or an HTTP request (per lifetime scope).

This applies to instances returned from an explicit *Resolve()* call as well as instances created internally by the container to satisfy the dependencies of another component.

- *Instance Per Dependency*
- *Single Instance*
- *Instance Per Lifetime Scope*
- *Instance Per Matching Lifetime Scope*
- *Instance Per Request*
- *Instance Per Owned*
- *Thread Scope*

Instance Per Dependency

Also called 'transient' or 'factory' in other containers. Using per-dependency scope, **a unique instance will be returned from each request for a service.**

This is the default if no other option is specified.

```
var builder = new ContainerBuilder();

// This...
builder.RegisterType<Worker>();

// ...is the same as this:
builder.RegisterType<Worker>().InstancePerDependency();
```

When you resolve a component that is instance per dependency, you get a new one each time.

```
using(var scope = container.BeginLifetimeScope())
{
  for(var i = 0; i < 100; i++)
  {
    // Every one of the 100 Worker instances
    // resolved in this loop will be brand new.
    var w = scope.Resolve<Worker>();
    w.DoWork();
  }
}
```

Single Instance

This is also known as 'singleton.' Using single instance scope, **one instance is returned from all requests in the root and all nested scopes**.

```
var builder = new ContainerBuilder();
builder.RegisterType<Worker>().SingleInstance();
```

When you resolve a single instance component, you always get the same instance no matter where you request it.

```
// It's generally not good to resolve things from the
// container directly, but for singleton demo purposes
// we do...
var root = container.Resolve<Worker>();

// We can resolve the worker from any level of nested
// lifetime scope, any number of times.
using(var scope1 = container.BeginLifetimeScope())
{
  for(var i = 0; i < 100; i++)
  {
    var w1 = scope1.Resolve<Worker>();
    using(var scope2 = scope1.BeginLifetimeScope())
    {
      var w2 = scope2.Resolve<Worker>();

      // root, w1, and w2 are always literally the
      // same object instance. It doesn't matter
      // which lifetime scope it's resolved from
```

```
        // or how many times.
      }
    }
}
```

Instance Per Lifetime Scope

This scope applies to nested lifetimes. **A component with per-lifetime scope will have at most a single instance per nested lifetime scope.**

This is useful for objects specific to a single unit of work that may need to nest additional logical units of work. Each nested lifetime scope will get a new instance of the registered dependency.

```
var builder = new ContainerBuilder();
builder.RegisterType<Worker>().InstancePerLifetimeScope();
```

When you resolve the instance per lifetime scope component, you get a single instance per nested scope (e.g., per unit of work).

```
using(var scope1 = container.BeginLifetimeScope())
{
  for(var i = 0; i < 100; i++)
  {
    // Every time you resolve this from within this
    // scope you'll get the same instance.
    var w1 = scope1.Resolve<Worker>();
  }
}

using(var scope2 = container.BeginLifetimeScope())
{
  for(var i = 0; i < 100; i++)
  {
    // Every time you resolve this from within this
    // scope you'll get the same instance, but this
    // instance is DIFFERENT than the one that was
    // used in the above scope. New scope = new instance.
    var w2 = scope2.Resolve<Worker>();
  }
}
```

Instance Per Matching Lifetime Scope

This is similar to the 'instance per lifetime scope' concept above, but allows more precise control over instance sharing.

When you create a nested lifetime scope, you have the ability to "tag" or "name" the scope. **A component with per-matching-lifetime scope will have at most a single instance per nested lifetime scope that matches a given name.** This allows you to create a sort of "scoped singleton" where other nested lifetime scopes can share an instance of a component without declaring a global shared instance.

This is useful for objects specific to a single unit of work, e.g. an HTTP request, as a nested lifetime can be created per unit of work. If a nested lifetime is created per HTTP request, then any component with per-lifetime scope will have an instance per HTTP request. (More on per-request lifetime scope below.)

In most applications, only one level of container nesting will be sufficient for representing the scope of units of work. If more levels of nesting are required (e.g. something like global->request->transaction) components can be configured to be shared at a particular level in the hierarchy using tags.

```
var builder = new ContainerBuilder();
builder.RegisterType<Worker>().InstancePerMatchingLifetimeScope("myrequest");
```

The supplied tag value is associated with a lifetime scope when you start it. **You will get an exception if you try to resolve a per-matching-lifetime-scope component when there's no correctly named lifetime scope.**

```
// Create the lifetime scope using the tag.
using(var scope1 = container.BeginLifetimeScope("myrequest"))
{
  for(var i = 0; i < 100; i++)
  {
    var w1 = scope1.Resolve<Worker>();
    using(var scope2 = scope1.BeginLifetimeScope())
    {
      var w2 = scope2.Resolve<Worker>();

      // w1 and w2 are always the same object
      // instance because the component is per-matching-lifetime-scope,
      // so it's effectively a singleton within the
      // named scope.
    }
  }
}

// Create another lifetime scope using the tag.
using(var scope3 = container.BeginLifetimeScope("myrequest"))
{
  for(var i = 0; i < 100; i++)
  {
    // w3 will be DIFFERENT than the worker resolved in the
    // earlier tagged lifetime scope.
    var w3 = scope3.Resolve<Worker>();
    using(var scope4 = scope1.BeginLifetimeScope())
    {
      var w4 = scope4.Resolve<Worker>();

      // w3 and w4 are always the same object because
      // they're in the same tagged scope, but they are
      // NOT the same as the earlier workers (w1, w2).
    }
  }
}

// You can't resolve a per-matching-lifetime-scope component
// if there's no matching scope.
using(var noTagScope = container.BeginLifetimeScope())
{
  // This throws an exception because this scope doesn't
  // have the expected tag and neither does any parent scope!
  var fail = noTagScope.Resolve<Worker>();
}
```

Instance Per Request

Some application types naturally lend themselves to “request” type semantics, for example ASP.NET *web forms* and *MVC* applications. In these application types, it’s helpful to have the ability to have a sort of “singleton per request.”

Instance per request builds on top of instance per matching lifetime scope by providing a well-known lifetime scope tag, a registration convenience method, and integration for common application types. Behind the scenes, though, it’s still just instance per matching lifetime scope.

What this means is that if you try to resolve components that are registered as instance-per-request but there’s no current request... you’re going to get an exception.

There is a detailed FAQ outlining how to work with per-request lifetimes.

```
var builder = new ContainerBuilder();
builder.RegisterType<Worker>().InstancePerRequest();
```

ASP.NET Core uses Instance Per Lifetime Scope rather than Instance Per Request. See the *ASP.NET Core integration doc for more*.

Instance Per Owned

The *Owned<T>* *implicit relationship type* creates new nested lifetime scopes. It is possible to scope dependencies to the owned instance using the instance-per-owned registrations.

```
var builder = new ContainerBuilder();
builder.RegisterType<MessageHandler>();
builder.RegisterType<ServiceForHandler>().InstancePerOwned<MessageHandler>();
```

In this example the `ServiceForHandler` service will be scoped to the lifetime of the owned `MessageHandler` instance.

```
using(var scope = container.BeginLifetimeScope())
{
  // The message handler itself as well as the
  // resolved dependent ServiceForHandler service
  // is in a tiny child lifetime scope under
  // "scope." Note that resolving an Owned<T>
  // means YOU are responsible for disposal.
  var h1 = scope.Resolve<Owned<MessageHandler>>();
  h1.Dispose();
}
```

Thread Scope

Autofac can enforce that objects bound to one thread will not satisfy the dependencies of a component bound to another thread. While there is not a convenience method for this, you can do it using lifetime scopes.

```
var builder = new ContainerBuilder();
builder.RegisterType<MyThreadScopedComponent>()
       .InstancePerLifetimeScope();
var container = builder.Build();
```

Then, each thread gets its own lifetime scope:

```
void ThreadStart()
{
  using (var threadLifetime = container.BeginLifetimeScope())
  {
    var thisThreadsInstance = threadLifetime.Resolve<MyThreadScopedComponent>();
  }
}
```

IMPORTANT: Given the multithreaded scenario, you must be very careful that the parent scope doesn't get disposed out from under the spawned thread. You can get into a bad situation where components can't be resolved if you spawn the thread and then dispose the parent scope.

Each thread executing through `ThreadStart()` will then get its own instance of `MyThreadScopedComponent` - which is essentially a "singleton" in the lifetime scope. Because scoped instances are never provided to outer scopes, it is easier to keep thread components separated.

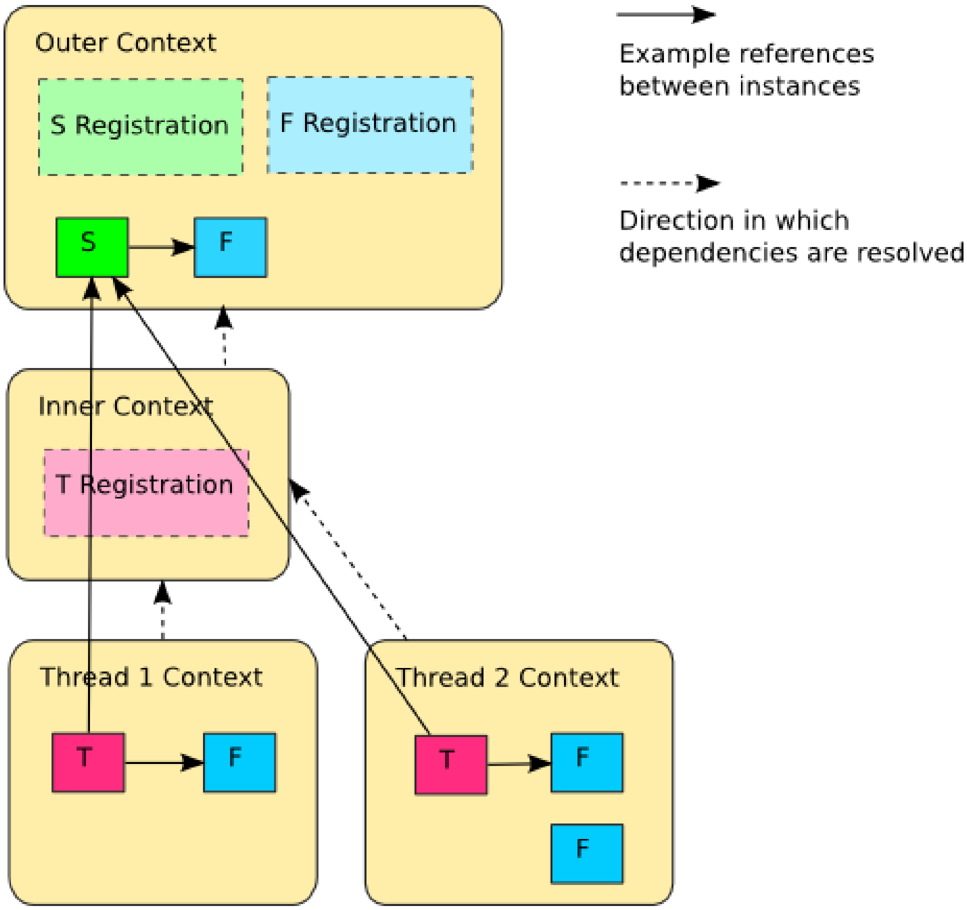
You can inject a parent lifetime scope into the code that spawns the thread by taking an `ILifetimeScope` parameter. Autofac knows to automatically inject the current lifetime scope and you can create a nested scope from that.

```
public class ThreadCreator
{
  private ILifetimeScope _parentScope;

  public ThreadCreator(ILifetimeScope parentScope)
  {
    this._parentScope = parentScope;
  }

  public void ThreadStart()
  {
    using (var threadLifetime = this._parentScope.BeginLifetimeScope())
    {
      var thisThreadsInstance = threadLifetime.Resolve<MyThreadScopedComponent>();
    }
  }
}
```

If you would like to enforce this even more heavily, use instance per matching lifetime scope (see above) to associate the thread-scoped components with the inner lifetime (they'll still have dependencies from the factory/singleton components in the outer container injected.) The result of this approach looks something like:



The 'contexts' in the diagram are the containers created with `BeginLifetimeScope()`.

Disposal

Resources obtained within a unit of work - database connections, transactions, authenticated sessions, file handles etc. - should be disposed of when that work is complete. .NET provides the `IDisposable` interface to aid in this more deterministic notion of disposal.

Some IoC containers need to be told explicitly to dispose of a particular instance, through a method like `ReleaseInstance()`. This makes it very difficult to guarantee that the correct disposal semantics are used.

- Switching implementations from a non-disposable to a disposable component can mean modifying client code.
- Client code that may have ignored disposal when using shared instances will almost certainly fail to clean up when switched to non-shared instances.

Autofac solves these problems using lifetime scopes as a way of disposing of all of the components created during a unit of work.

```
using (var scope = container.BeginLifetimeScope())
{
  scope.Resolve<DisposableComponent>().DoSomething();

  // Components for scope disposed here, at the
  // end of the 'using' statement when the scope
```

```
  // itself is disposed.
}
```

A lifetime scope is created when a unit of work begins, and when that unit of work is complete the nested container can dispose all of the instances within it that are out of scope.

Registering Components

Autofac can automatically dispose of some components, but you have the ability to manually specify a disposal mechanism, too.

Components must be registered as `InstancePerDependency()` (the default) or some variation of `InstancePerLifetimeScope()` (e.g., `InstancePerMatchingLifetimeScope()` or `InstancePerRequest()`).

If you have singleton components (registered as `SingleInstance()`) **they will live for the life of the container**. Since container lifetimes are usually the application lifetime, it means the component won't be disposed until the end of the application.

Automatic Disposal

To take advantage of automatic deterministic disposal, your component must implement `IDisposable`. You can then register your component as needed and at the end of each lifetime scope in which the component is resolved, the `Dispose()` method on the component will be called.

```
var builder = new ContainerBuilder();
builder.RegisterType<SomeDisposableComponent>();
var container = builder.Build();
// Create nested lifetime scopes, resolve
// the component, and dispose of the scopes.
// Your component will be disposed with the scope.
```

Specified Disposal

If your component doesn't implement `IDisposable` but still requires some cleanup at the end of a lifetime scope, you can use *the OnRelease lifetime event*.

```
var builder = new ContainerBuilder();
builder.RegisterType<SomeComponent>()
       .OnRelease(instance => instance.CleanUp());
var container = builder.Build();
// Create nested lifetime scopes, resolve
// the component, and dispose of the scopes.
// Your component's "CleanUp()" method will be
// called when the scope is disposed.
```

Note that `OnRelease()` overrides the default handling of `IDisposable.Dispose()`. If your component both implements `IDisposable` *and* requires some other cleanup method, you will either need to manually call `Dispose()` in `OnRelease()` or you will need to update your class so the cleanup method gets called from inside `Dispose()`.

Disabling Disposal

Components are owned by the container by default and will be disposed by it when appropriate. To disable this, register a component as having external ownership:

```
builder.RegisterType<SomeComponent>().ExternallyOwned();
```

The container will never call `Dispose()` on an object registered with external ownership. It is up to you to dispose of components registered in this fashion.

Another alternative for disabling disposal is to use the *implicit relationship* `Owned<T>` and *owned instances*. In this case, rather than putting a dependency `T` in your consuming code, you put a dependency on `Owned<T>`. Your consuming code will then be responsible for disposal.

```
public class Consumer
{
  private Owned<DisposableComponent> _service;

  public Consumer(Owned<DisposableComponent> service)
  {
    _service = service;
  }

  public void DoWork()
  {
    // _service is used for some task
    _service.Value.DoSomething();

    // Here _service is no longer needed, so
    // it is released
    _service.Dispose();
  }
}
```

You can read more about `Owned<T>` *in the owned instances topic*.

Resolve Components from Lifetime Scopes

Lifetime scopes are created by calling `BeginLifetimeScope()`. The simplest way is in a `using` block. Use the lifetime scopes to resolve your components and then dispose of the scope when the unit of work is complete.

```
using (var lifetime = container.BeginLifetimeScope())
{
  var component = lifetime.Resolve<SomeComponent>();
  // component, and any of its disposable dependencies, will
  // be disposed of when the using block completes
}
```

Note that with *Autofac integration libraries* standard unit-of-work lifetime scopes will be created and disposed for you automatically. For example, in Autofac's *ASP.NET MVC integration*, a lifetime scope will be created for you at the beginning of a web request and all components will generally be resolved from there. At the end of the web request, the scope will automatically be disposed - no additional scope creation is required on your part. If you are using *one of the integration libraries*, you should be aware of what automatically-created scopes are available for you.

You can *read more about creating lifetime scopes here*.

Child Scopes are NOT Automatically Disposed

While lifetime scopes themselves implement `IDisposable`, the lifetime scopes that you create are **not automatically disposed for you.** If you create a lifetime scope, you are responsible for calling `Dispose()` on it to clean it up and trigger the automatic disposal of components. This is done easily with a `using` statement, but if you create a scope without a `using`, don't forget to dispose of it when you're done with it.

It's important to distinguish between scopes **you create** and scopes the **integration libraries create for you**. You don't have to worry about managing integration scopes (like the ASP.NET request scope) - those will be done for you. However, if you manually create your own scope, you will be responsible for cleaning it up.

Advanced Hierarchies

The simplest and most advisable resource management scenario, demonstrated above, is two-tiered: there is a single 'root' container and a lifetime scope is created from this for each unit of work. It is possible to create more complex hierarchies of containers and components, however, using *tagged lifetime scopes*.

Lifetime Events

Autofac exposes events that can be hooked at various stages in instance lifecycle. These are subscribed to during component registration (or alternatively by attaching to the `IComponentRegistration` interface.

- *OnActivating*
- *OnActivated*
- *OnRelease*

OnActivating

The `OnActivating` event is raised before a component is used. Here you can:

- Switch the instance for another or wrap it in a proxy
- *Do property injection or method injection*
- Perform other initialization tasks

In some cases, such as with `RegisterType<T>()`, the concrete type registered is used for type resolution and used by `ActivatingEventArgs`. For example, the following will fail with a class cast exception:

```
builder.RegisterType<TConcrete>() // FAILS: will throw at cast of TInterfaceSubclass
       .As<TInterface>()          // to type TConcrete
       .OnActivating(e => e.ReplaceInstance(new TInterfaceSubclass()));
```

A simple workaround is to do the registration in two steps:

```
builder.RegisterType<TConcrete>().AsSelf();
builder.Register<TInterface>(c => c.Resolve<TConcrete>())
       .OnActivating(e => e.ReplaceInstance(new TInterfaceSubclass()));
```

OnActivated

The `OnActivated` event is raised once a component is fully constructed. Here you can perform application-level tasks that depend on the component being fully constructed - *these should be rare*.

OnRelease

The `OnRelease` event replaces *the standard cleanup behavior for a component*. The standard cleanup behavior of components that implement `IDisposable` and that are not marked as `ExternallyOwned()` is to call the `Dispose()` method. The standard cleanup behavior for components that do not implement `IDisposable` or are marked as externally owned is a no-op - to do nothing. `OnRelease` overrides this behavior with the provided implementation.

Running Code at Startup

Autofac provides the ability for components to be notified or automatically activated when the container is built.

There are two automatic activation mechanisms available: - Startable components - Auto-activated components

In both cases, **at the time the container is built, the component will be activated**.

Startable Components

A **startable component** is one that is activated by the container when the container is initially built and has a specific method called to bootstrap an action on the component.

The key is to implement the `Autofac.IStartable` interface. When the container is built, the component will be activated and the `IStartable.Start()` method will be called.

This only happens once, for a single instance of each component, the first time the container is built. Resolving startable components by hand won't result in their `Start()` method being called. It isn't recommended that startable components implement other services, or be registered as anything other than `SingleInstance()`.

Components that need to have something like a `Start()` method called *each time they are activated* should use *a lifetime event* like `OnActivated` instead.

To create a startable component, implement `Autofac.IStartable`:

```
public class StartupMessageWriter : IStartable
{
   public void Start()
   {
      Console.WriteLine("App is starting up!");
   }
}
```

Then register your component and **be sure to specify** it as `IStartable` or the action won't be called:

```
var builder = new ContainerBuilder();
builder
   .RegisterType<StartupMessageWriter>()
   .As<IStartable>()
   .SingleInstance();
```

When the container is built, the type will be activated and the IStartable.Start() method will be called. In this example, a message will be written to the console.

Auto-Activated Components

An **auto-activated component** is a component that simply needs to be activated one time when the container is built. This is a "warm start" style of behavior where no method on the component is called and no interface needs to be implemented - a single instance of the component will be resolved with no reference to the instance held.

To register an auto-activated component, use the AutoActivate() registration extension.

```
var builder = new ContainerBuilder();
builder
   .RegisterType<TypeRequiringWarmStart>()
   .AutoActivate();
```

CHAPTER 6

Configuration

JSON/XML Configuration

Most IoC containers provide a programmatic interface as well as JSON/XML file-based configuration support, and Autofac is no exception.

Autofac encourages programmatic configuration through the `ContainerBuilder` class. Using the programmatic interface is central to the design of the container. JSON or XML is recommended when concrete classes cannot be chosen or configured at compile-time.

Before diving too deeply into JSON/XML configuration, be sure to read *Modules* - this explains how to handle more complex scenarios than the basic JSON/XML component registration will allow.

- *Configuring With Microsoft Configuration*
  - *Quick Start*
  - *Default Assembly*
  - *Components*
  - *Modules*
  - *Differences from Legacy Configuration*
  - *Additional Tips*
- *Configuring With Application Configuration (Legacy)*
  - *Setup*
  - *Components*
  - *Modules*
  - *Additional Config Files*

- *Configuring the Container*
- *Multiple Files or Sections*

Configuring With Microsoft Configuration

With the release of Microsoft.Extensions.Configuration, and Autofac.Configuration 4.0.0, Autofac takes advantage of the more flexible configuration model not previously available when limited to application configuration files. If you were using the `app.config` or `web.config` based configuration available before, you will need to migrate your configuration to the new format and update the way you set configuration with your application container.

Quick Start

The basic steps to getting configuration set up with your application are:

1. Set up your configuration in JSON or XML files that can be read by `Microsoft.Extensions.Configuration`.
2. Build the configuration using the `Microsoft.Extensions.Configuration.ConfigurationBuilder`.
3. Create a new `Autofac.Configuration.ConfigurationModule` and pass the built `Microsoft.Extensions.Configuration.IConfiguration` into it.
4. Register the `Autofac.Configuration.ConfigurationModule` with your container.

A configuration file with some simple registrations looks like this:

```
{
    "defaultAssembly": "Autofac.Example.Calculator",
    "components": [
        {
            "type": "Autofac.Example.Calculator.Addition.Add, Autofac.Example.
↪Calculator.Addition",
            "services": [
                {
                    "type": "Autofac.Example.Calculator.Api.IOperation"
                }
            ],
            "injectProperties": true
        },
        {
            "type": "Autofac.Example.Calculator.Division.Divide, Autofac.Example.
↪Calculator.Division",
            "services": [
                {
                    "type": "Autofac.Example.Calculator.Api.IOperation"
                }
            ],
            "parameters": {
                "places": 4
            }
        }
    ]
}
```

JSON is cleaner and easier to read, but if you prefer XML, the same configuration looks like this:

```
<?xml version="1.0" encoding="utf-8" ?>
<autofac defaultAssembly="Autofac.Example.Calculator">
    <components name="0">
        <type>Autofac.Example.Calculator.Addition.Add, Autofac.Example.Calculator.
↪Addition</type>
        <services name="0" type="Autofac.Example.Calculator.Api.IOperation" />
        <injectProperties>true</injectProperties>
    </components>
    <components name="1">
        <type>Autofac.Example.Calculator.Division.Divide, Autofac.Example.Calculator.
↪Division</type>
        <services name="0" type="Autofac.Example.Calculator.Api.IOperation" />
        <injectProperties>true</injectProperties>
        <parameters>
            <places>4</places>
        </parameters>
    </components>
</autofac>
```

Note the ordinal "naming" of components and services in XML - this is due to the way Microsoft.Extensions.Configuration handles ordinal collections (arrays).

Build up your configuration and register it with the Autofac `ContainerBuilder` like this:

```
// Add the configuration to the ConfigurationBuilder.
var config = new ConfigurationBuilder();
config.AddJsonFile("autofac.json");

// Register the ConfigurationModule with Autofac.
var module = new ConfigurationModule(config.Build());
var builder = new ContainerBuilder();
builder.RegisterModule(module);
```

Default Assembly

You can specify a "default assembly" option in the configuration to help write types in a shorter fashion. If you don't specify an assembly-qualified type name in a type or interface reference, it will be assumed to be in the default assembly.

```
{
    "defaultAssembly": "Autofac.Example.Calculator"
}
```

Components

Components are the most common thing that you'll register. You can specify several things on each component from lifetime scope to parameters.

Components are added to a top-level `components` element in configuration. Inside that is an array of the components you want to register.

This example shows one component that has *all of the options* on it, just for syntax illustration purposes. You wouldn't actually use every one of these in every component registration.

```
{
    "components": [
        {
            "type": "Autofac.Example.Calculator.Addition.Add, Autofac.Example.
↪Calculator.Addition",
            "services": [
                {
                    "type": "Autofac.Example.Calculator.Api.IOperation"
                },
                {
                    "type": "Autofac.Example.Calculator.Api.IAddOperation",
                    "key": "add"
                },
                // ...
            ],
            "autoActivate": true,
            "injectProperties": true,
            "instanceScope": "per-dependency",
            "metadata": [
                {
                    "key": "answer",
                    "value": 42,
                    "type": "System.Int32, mscorlib"
                },
                // ...
            ],
            "ownership": "external",
            "parameters": {
                "places": 4
            },
            "properties": {
                "DictionaryProp": { "key": "value" },
                "ListProp": [1, 2, 3, 4, 5]
            }
        },
        // ...
    ]
}
```

Element Name	Description	Valid Values
type	The only required thing. The concrete class of the component (assembly-qualified if in an assembly other than the default).	Any .NET type name that can be created through reflection.
services	An array of *services exposed by the component*. Each service must have a type and may optionally specify a key.	Any .NET type name that can be created through reflection.
autoActivate	A Boolean indicating if the component should *auto-activate*.	true, false
injectProperties	A Boolean indicating whether *property (setter) injection* for the component should be enabled.	true, false
instanceScope	*Instance scope* for the component.	singleinstance, perlifetimescope, perdependency, perrequest
metadata	An array of *metadata values* to associate with the component. Each item specifies the name, type, and value.	Any *metadata values*.
ownership	Allows you to control *whether the lifetime scope disposes the component or your code does*.	lifetimescope, external
parameters	A name/value dictionary where the name of each element is the name of a constructor parameter and the value is the value to inject.	Any parameter in the constructor of the component type.
properties	A name/value dictionary where the name of each element is the name of a property and the value is the value to inject.	Any settable property on the component type.

Note that both parameters and properties support dictionary and enumerable values. You can see an example of how to specify those in the JSON structure, above.

Modules

When using *modules* with Autofac, you can register those modules along with components when using configuration.

Modules are added to a top-level modules element in configuration. Inside that is an array of the modules you want to register.

This example shows one module that has *all of the options* on it, just for syntax illustration purposes. You wouldn't actually use every one of these in every module registration.

```
{
    "modules": [
        {
            "type": "Autofac.Example.Calculator.OperationModule, Autofac.Example.
↪Calculator",
            "parameters": {
                "places": 4
            },
            "properties": {
                "DictionaryProp": { "key": "value" },
                "ListProp": [1, 2, 3, 4, 5]
            }
        },
        // ...
    ]
}
```

Element Name	Description	Valid Values
`type`	The only required thing. The concrete class of the module (assembly-qualified if in an assembly other than the default).	Any .NET type name that derives from `Autofac.Module` that can be created through reflection.
`parameters`	A name/value dictionary where the name of each element is the name of a constructor parameter and the value is the value to inject.	Any parameter in the constructor of the module type.
`properties`	A name/value dictionary where the name of each element is the name of a property and the value is the value to inject.	Any settable property on the module type.

Note that both `parameters` and `properties` support dictionary and enumerable values. You can see an example of how to specify those in the JSON structure, above.

You are allowed to register *the same module multiple times using different parameter/property sets* if you so choose.

Differences from Legacy Configuration

When migrating from the legacy `app.config` based format to the new format, there are some key changes to be aware of:

- **Multiple configuration files handled differently.** The legacy configuration had a `files` element that would automatically pull several files together at once for configuration. Use the `Microsoft.Extensions.Configuration.ConfigurationBuilder` to accomplish this now.
- **AutoActivate is supported.** You can specify *components should auto-activate* now, a feature previously unavailable in configuration.
- **XML uses element children rather than attributes.** This helps keep the XML and JSON parsing the same when using `Microsoft.Extensions.Configuration` so you can combine XML and JSON configuration sources correctly.
- **Using XML requires you to name components and services with numbers.** `Microsoft.Extensions.Configuration` requires every configuration item to have a name and a value. The way it supports ordinal collections (arrays) is that it implicitly gives unnamed elements in a collection names with numbers ("0", "1", and so on). You can see an example of this in the quick start, above. If you don't go with JSON, you need to watch for this requirement from `Microsoft.Extensions.Configuration` or you won't get what you expect.
- **Per-request lifetime scope is supported.** Previously you couldn't configure elements to have *per-request lifetime scope*. Now you can.
- **Dashes in names/values are gone.** Names of XML elements used to include dashes like `inject-properties` - to work with the JSON configuration format, these are now camel-case, like `injectProperties`.
- **Services get specified in a child element.** The legacy configuration allowed a service to be declared right at the top of the component. The new system requires all services be in the `services` collection.

Additional Tips

The new `Microsoft.Extensions.Configuration` mechanism adds a lot of flexibility. Things you may want to take advantage of:

- **Environment variable support.** You can use `Microsoft.Extensions.Configuration.EnvironmentVariables` to enable configuration changes based on the environment. A quick way to debug, patch, or fix something without touching code might be to switch an Autofac registration based on environment.
- **Easy configuration merging.** The `ConfigurationBuilder` allows you to create configuration from a lot of sources and merge them into one. If you have a lot of configuration, consider scanning for your configuration files and building the configuration dynamically rather than hardcoding paths.
- **Custom configuration sources.** You can implement `Microsoft.Extensions.Configuration.ConfigurationProvider` yourself backed by more than just files. If you want to centralize configuration, consider a database or REST API backed configuration source.

Configuring With Application Configuration (Legacy)

Prior to the release of Microsoft.Extensions.Configuration and the updated configuration model, Autofac tied into standard .NET application configuration files. (`app.config` / `web.config`). In the 3.x series of the Autofac.Configuration package, this was the way to configure things.

Setup

Using the legacy configuration mechanism, you need to declare a section handler somewhere near the top of your config file:

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration>
    <configSections>
        <section name="autofac" type="Autofac.Configuration.SectionHandler, Autofac.
↪Configuration"/>
    </configSections>
```

Then, provide a section describing your components:

```
<autofac defaultAssembly="Autofac.Example.Calculator.Api">
    <components>
        <component
            type="Autofac.Example.Calculator.Addition.Add, Autofac.Example.Calculator.
↪Addition"
            service="Autofac.Example.Calculator.Api.IOperation" />

        <component
            type="Autofac.Example.Calculator.Division.Divide, Autofac.Example.
↪Calculator.Division"
            service="Autofac.Example.Calculator.Api.IOperation" >
            <parameters>
                <parameter name="places" value="4" />
            </parameters>
        </component>
```

The `defaultAssembly` attribute is optional, allowing namespace-qualified rather than fully-qualified type names to be used. This can save some clutter and typing, especially if you use one configuration file per assembly (see Additional Config Files below.)

Components

Components are the most common thing that you'll register. You can specify several things on each component from lifetime scope to parameters.

Component Attributes

The following can be used as attributes on the `component` element (defaults are the same as for the programmatic API):

Attribute Name	Description	Valid Values
`type`	The only required attribute. The concrete class of the component (assembly-qualified if in an assembly other than the default.)	Any .NET type name that can be created through reflection.
`service`	A service exposed by the component. For more than one service, use the nested `services` element.	As for `type`.
`instance-scope`	Instance scope - see *Instance Scope*.	`per-dependency`, `single-instance` or `per-lifetime-scope`
`instance-ownership`	Container's ownership over the instances - see the `InstanceOwnership` enumeration.	`lifetime-scope` or `external`
`name`	A string name for the component.	Any non-empty string value.
`inject-properties`	Enable property (setter) injection for the component.	`yes`, `no`.

Component Child Elements

Element	Description
`services`	A list of `service` elements, whose element content contains the names of types exposed as services by the component (see the `service` attribute.)
`parameters`	A list of explicit constructor parameters to set on the instances (see example above.)
`properties`	A list of explicit property values to set (syntax as for `parameters`.)
`metadata`	A list of `item` nodes with `name`, `value` and `type` attributes.

There are some features missing from the XML configuration syntax that are available through the programmatic API - for example registration of generics. Using modules is recommended in these cases.

Modules

Configuring the container using components is very fine-grained and can get verbose quickly. Autofac has support for packaging components into *Modules* in order to encapsulate implementation while providing flexible configuration.

Modules are registered by type:

```
<modules>
    <module type="MyModule" />
```

You can add nested `parameters` and `properties` to a module registration in the same manner as for components above.

Additional Config Files

You can include additional config files using:

```
<files>
    <file name="Controllers.config" section="controllers" />
```

Configuring the Container

First, you must **reference Autofac.Configuration.dll in from your project**.

To configure the container use a `ConfigurationSettingsReader` initialised with the name you gave to your XML configuration section:

```
var builder = new ContainerBuilder();
builder.RegisterModule(new ConfigurationSettingsReader("mycomponents"));
// Register other components and call Build() to create the container.
```

The container settings reader will override default components already registered; you can write your application so that it will run with sensible defaults and then override only those component registrations necessary for a particular deployment.

Multiple Files or Sections

You can use multiple settings readers in the same container, to read different sections or even different config files if the filename is supplied to the `ConfigurationSettingsReader` constructor.

Modules

Introduction

IoC uses *components* as the basic building blocks of an application. Providing access to the constructor parameters and properties of components is very commonly used as a means to achieve *deployment-time configuration*.

This is generally a dubious practice for the following reasons:

- **Constructors can change**: Changes to the constructor signature or properties of a component can break deployed `App.config` files - these problems can appear very late in the development process.
- **XML gets hard to maintain**: Configuration files for large numbers of components can become unwieldy to maintain - this is exacerbated by the fact that XML configuration is weakly-typed and hard to read.
- **"Code" starts showing up in XML**: Exposing the properties and constructor parameters of classes is an unpleasant breach of the 'encapsulation' of the application's internals - these details don't belong in configuration files.

This is where modules can help.

A module is a small class that can be used to bundle up a set of related components behind a 'facade' to simplify configuration and deployment. The module exposes a deliberate, restricted set of configuration parameters that can vary independently of the components used to implement the module.

The components within a module still make use dependencies at the component/service level to access components from other modules.

Modules do not, themselves, go through dependency injection. They are used to configure the container, they are not actually registered and resolved like other components. If your module takes a constructor parameter, for example, you need to pass that in yourself. It won't come from the container.

Advantages of Modules

Decreased Configuration Complexity

When configuring an application by IoC it is often necessary to set the parameters spread between multiple components. Modules group related configuration items into one place to reduce the burden of looking up the correct component for a setting.

The implementer of a module determines how the module's configuration parameters map to the properties and constructor parameters of the components inside.

Configuration Parameters are Explicit

Configuring an application directly through its components creates a large surface area that will need to be considered when upgrading the application. When it is possible to set potentially any property of any class through a configuration file that will differ at every site, refactoring is no longer safe.

Creating modules limits the configuration parameters that a user can configure, and makes it explicit to the maintenance programmer which parameters these are.

You can also avoid a trade-off between what makes a good program element and what makes a good configuration parameter.

Abstraction from the Internal Application Architecture

Configuring an application through its components means that the configuration needs to differ depending on things like, for example, the use of an `enum` vs. creation of strategy classes. Using modules hides these details of the application's structure, keeping configuration succinct.

Better Type Safety

A small reduction in type safety will always exist when the classes making up the application can vary based on deployment. Registering large numbers of components through XML configuration, however, exacerbates this problem.

Modules are constructed programmatically, so all of the component registration logic within them can be checked at compile time.

Dynamic Configuration

Configuring components within modules is dynamic: the behaviour of a module can vary based on the runtime environment. This is hard, if not impossible, with purely component-based configuration.

Advanced Extensions

Modules can be used for more than just simple type registrations - you can also attach to component resolution events and extend how parameters are resolved or perform other extensions. The *log4net integration module example* shows one such module.

Example

In Autofac, modules implement the `Autofac.Core.IModule` interface. Generally they will derive from the `Autofac.Module` abstract class.

This module provides the `IVehicle` service:

```
public class CarTransportModule : Module
{
  public bool ObeySpeedLimit { get; set; }

  protected override void Load(ContainerBuilder builder)
  {
    builder.Register(c => new Car(c.Resolve<IDriver>())).As<IVehicle>();

    if (ObeySpeedLimit)
      builder.Register(c => new SaneDriver()).As<IDriver>();
    else
      builder.Register(c => new CrazyDriver()).As<IDriver>();
  }
}
```

Encapsulated Configuration

Our `CarTransportModule` provides the `ObeySpeedLimit` configuration parameter without exposing the fact that this is implemented by choosing between a sane or a crazy driver. Clients using the module can use it by declaring their intentions:

```
builder.RegisterModule(new CarTransportModule() {
    ObeySpeedLimit = true
});
```

or in XML:

```
<module type="CarTransportModule">
  <properties>
    <property name="ObeySpeedLimit" value="true" />
  </properties>
</module>
```

This is valuable because the implementation of the module can vary without a flow on effect. That's the idea of encapsulation, after all.

Flexibility to Override

Although clients of the `CarTransportModule` are probably primarily concerned with the `IVehicle` service, the module registers its `IDriver` dependency with the container as well. This ensures that the configuration is still able to be overridden at deployment time in the same way as if the components that make up the module had been registered independently.

It is a 'best practice' when using Autofac to add any XML configuration *after* programmatic configuration, e.g.:

```
builder.RegisterModule(new CarTransportModule());
builder.RegisterModule(new ConfigurationSettingsReader());
```

In this way, 'emergency' overrides can be made in the XML configuration file:

```
<component
  service="IDriver"
  type="LearnerDriver" />
```

So, modules increase encapsulation but don't preclude you from tinkering with their innards if you have to.

Adapting to the Deployment Environment

Modules can be dynamic - that is, they can configure themselves to their execution environment.

When a module is loaded, it can do nifty things like check the environment:

```
protected override void Load(ContainerBuilder builder)
{
  if (Environment.OSVersion.Platform == PlatformID.Unix)
    RegisterUnixPathFormatter(builder);
  else
    RegisterWindowsPathFormatter(builder);
}
```

Common Use Cases for Modules

- Configure related services that provide a subsystem, e.g. data access with NHibernate
- Package optional application features as 'plug-ins'
- Provide pre-built packages for integration with a system, e.g. an accounting system
- Register a number of similar services that are often used together, e.g. a set of file format converters
- New or customised mechanisms for configuring the container, e.g. XML configuration is implemented using a module; configuration using attributes could be added this way

CHAPTER 7

Application Integration

ASP.NET

Autofac offers integration into several ASP.NET application types. The integration libraries provide features like easy connection of your Autofac container to the application lifecycle as well as support for things like *per-request component lifetime*.

These pages explain ASP.NET classic integration. If you are using ASP.NET Core, *see the ASP.NET Core integration page*.

OWIN

OWIN (Open Web Interface for .NET) is a simpler model for composing web-based applications without tying the application to the web server. To do this, a concept of "middleware" is used to create a pipeline through which requests travel.

Due to the differences in the way OWIN handles the application pipeline (detecting when a request starts/ends, etc.) integrating Autofac into an OWIN application is slightly different than the way it gets integrated into more "standard" ASP.NET apps. You can read about OWIN and how it works on this overview.

The important thing to remember is that order of OWIN middleware registration matters. Middleware gets processed in order of registration, like a chain, so you need to register foundational things (like Autofac middleware) first.

Quick Start

To take advantage of Autofac in your OWIN pipeline:

- Reference the `Autofac.Owin` package from NuGet.
- Build your Autofac container.
- Register the Autofac middleware with OWIN and pass it the container.

```
public class Startup
{
  public void Configuration(IAppBuilder app)
  {
    var builder = new ContainerBuilder();
    // Register dependencies, then...
    var container = builder.Build();

    // Register the Autofac middleware FIRST. This also adds
    // Autofac-injected middleware registered with the container.
    app.UseAutofacMiddleware(container);

    // ...then register your other middleware not registered
    // with Autofac.
  }
}
```

Check out the individual *ASP.NET integration library* pages for specific details on different app types and how they handle OWIN support.

Dependency Injection in Middleware

Normally when you register OWIN middleware with your application, you use the extension methods that come with the middleware. For example *Web API* has the `app.UseWebApi(config);` extension. Middleware registered in this fashion is statically defined and will not have dependencies injected.

For custom middleware, you can allow Autofac to inject dependencies into the middleware by registering it with your application container rather than registering it with a static extension.

```
var builder = new ContainerBuilder();
builder.RegisterType<MyCustomMiddleware>();
//...
var container = builder.Build();

// This will add the Autofac middleware as well as the middleware
// registered in the container.
app.UseAutofacMiddleware(container);
```

When you call `app.UseAutofacMiddleware(container);` the Autofac middleware itself will be added to the pipeline, after which any `Microsoft.Owin.OwinMiddleware` classes registered with the container will also be added to the pipeline.

Middleware registered in this way will be resolved from the request lifetime scope for each request passing through the OWIN pipeline.

MVC

Autofac is always kept up to date to support the latest version of ASP.NET MVC, so documentation is also kept up with the latest. Generally speaking, the integration remains fairly consistent across versions.

MVC integration requires the Autofac.Mvc5 NuGet package.

MVC integration provides dependency injection integration for controllers, model binders, action filters, and views. It also adds *per-request lifetime support*.

This page explains ASP.NET classic MVC integration. If you are using ASP.NET Core, *see the ASP.NET Core integration page*.

- *Quick Start*
- *Register Controllers*
- *Set the Dependency Resolver*
- *Register Model Binders*
- *Register Web Abstractions*
- *Enable Property Injection for View Pages*
- *Enable Property Injection for Action Filters*
- *OWIN Integration*
- *Using "Plugin" Assemblies*
- *Using the Current Autofac DependencyResolver*
- *Unit Testing*
- *Example Implementation*

Quick Start

To get Autofac integrated with MVC you need to reference the MVC integration NuGet package, register your controllers, and set the dependency resolver. You can optionally enable other features as well.

```
protected void Application_Start()
{
  var builder = new ContainerBuilder();

  // Register your MVC controllers.
  builder.RegisterControllers(typeof(MvcApplication).Assembly);

  // OPTIONAL: Register model binders that require DI.
  builder.RegisterModelBinders(Assembly.GetExecutingAssembly());
  builder.RegisterModelBinderProvider();

  // OPTIONAL: Register web abstractions like HttpContextBase.
  builder.RegisterModule<AutofacWebTypesModule>();

  // OPTIONAL: Enable property injection in view pages.
  builder.RegisterSource(new ViewRegistrationSource());

  // OPTIONAL: Enable property injection into action filters.
  builder.RegisterFilterProvider();

  // Set the dependency resolver to be Autofac.
  var container = builder.Build();
  DependencyResolver.SetResolver(new AutofacDependencyResolver(container));
}
```

The sections below go into further detail about what each of these features do and how to use them.

Register Controllers

At application startup, while building your Autofac container, you should register your MVC controllers and their dependencies. This typically happens in an OWIN startup class or in the `Application_Start` method in `Global.asax`.

```
var builder = new ContainerBuilder();

// You can register controllers all at once using assembly scanning...
builder.RegisterControllers(typeof(MvcApplication).Assembly);

// ...or you can register individual controlllers manually.
builder.RegisterType<HomeController>().InstancePerRequest();
```

Note that ASP.NET MVC requests controllers by their concrete types, so registering them `As<IController>()` is incorrect. Also, if you register controllers manually and choose to specify lifetimes, you must register them as `InstancePerDependency()` or `InstancePerRequest()` - **ASP.NET MVC will throw an exception if you try to reuse a controller instance for multiple requests**.

Set the Dependency Resolver

After building your container pass it into a new instance of the `AutofacDependencyResolver` class. Use the static `DependencyResolver.SetResolver` method to let ASP.NET MVC know that it should locate services using the `AutofacDependencyResolver`. This is Autofac's implementation of the `IDependencyResolver` interface.

```
var container = builder.Build();
DependencyResolver.SetResolver(new AutofacDependencyResolver(container));
```

Register Model Binders

An optional step you can take is to enable dependency injection for model binders. Similar to controllers, model binders (classes that implement `IModelBinder`) can be registered in the container at application startup. You can do this with the `RegisterModelBinders()` method. You must also remember to register the `AutofacModelBinderProvider` using the `RegisterModelBinderProvider()` extension method. This is Autofac's implementation of the `IModelBinderProvider` interface.

```
builder.RegisterModelBinders(Assembly.GetExecutingAssembly());
builder.RegisterModelBinderProvider();
```

Because the `RegisterModelBinders()` extension method uses assembly scanning to add the model binders you need to specify what type(s) the model binders (`IModelBinder` implementations) are to be registered for.

This is done by using the `Autofac.Integration.Mvc.ModelBinderTypeAttribute`, like so:

```
[ModelBinderType(typeof(string))]
public class StringBinder : IModelBinder
{
  public override object BindModel(ControllerContext controllerContext,
↪ModelBindingContext bindingContext)
  {
    // Implementation here
  }
}
```

Multiple instances of the `ModelBinderTypeAttribute` can be added to a class if it is to be registered for multiple types.

Register Web Abstractions

The MVC integration includes an Autofac module that will add *HTTP request lifetime scoped* registrations for the web abstraction classes. This will allow you to put the web abstraction as a dependency in your class and get the correct value injected at runtime.

The following abstract classes are included:

- `HttpContextBase`
- `HttpRequestBase`
- `HttpResponseBase`
- `HttpServerUtilityBase`
- `HttpSessionStateBase`
- `HttpApplicationStateBase`
- `HttpBrowserCapabilitiesBase`
- `HttpFileCollectionBase`
- `RequestContext`
- `HttpCachePolicyBase`
- `VirtualPathProvider`
- `UrlHelper`

To use these abstractions add the `AutofacWebTypesModule` to the container using the standard `RegisterModule()` method.

```
builder.RegisterModule<AutofacWebTypesModule>();
```

Enable Property Injection for View Pages

You can make *property injection* available to your MVC views by adding the `ViewRegistrationSource` to your `ContainerBuilder` before building the application container.

```
builder.RegisterSource(new ViewRegistrationSource());
```

Your view page must inherit from one of the base classes that MVC supports for creating views. When using the Razor view engine this will be the `WebViewPage` class.

```
public abstract class CustomViewPage : WebViewPage
{
  public IDependency Dependency { get; set; }
}
```

The `ViewPage`, `ViewMasterPage` and `ViewUserControl` classes are supported when using the web forms view engine.

```
public abstract class CustomViewPage : ViewPage
{
  public IDependency Dependency { get; set; }
}
```

Ensure that your actual view page inherits from your custom base class. This can be achieved using the `@inherits` directive inside your `.cshtml` file for the Razor view engine:

```
@inherits Example.Views.Shared.CustomViewPage
```

When using the web forms view engine you set the `Inherits` attribute on the `@ Page` directive inside your `.aspx` file instead.

```
<%@ Page Language="C#" MasterPageFile="~/Views/Shared/Site.Master" Inherits="Example.
↪Views.Shared.CustomViewPage"%>
```

Due to an issue with ASP.NET MVC internals, dependency injection is not available for Razor layout pages. Razor views will work, but layout pages won't. See issue #349 for more information.

Enable Property Injection for Action Filters

To make use of property injection for your filter attributes call the `RegisterFilterProvider()` method on the `ContainerBuilder` before building your container and providing it to the `AutofacDependencyResolver`.

```
builder.RegisterFilterProvider();
```

This allows you to add properties to your filter attributes and any matching dependencies that are registered in the container will be injected into the properties.

For example, the action filter below will have the `ILogger` instance injected from the container (assuming you register an `ILogger`. Note that **the attribute itself does not need to be registered in the container**.

```
public class CustomActionFilter : ActionFilterAttribute
{
  public ILogger Logger { get; set; }

  public override void OnActionExecuting(ActionExecutingContext filterContext)
  {
    Logger.Log("OnActionExecuting");
  }
}
```

The same simple approach applies to the other filter attribute types such as authorization attributes.

```
public class CustomAuthorizeAttribute : AuthorizeAttribute
{
  public ILogger Logger { get; set; }

  protected override bool AuthorizeCore(HttpContextBase httpContext)
  {
    Logger.Log("AuthorizeCore");
    return true;
  }
}
```

After applying the attributes to your actions as usual your work is done.

```
[CustomActionFilter]
[CustomAuthorizeAttribute]
public ActionResult Index()
{
}
```

OWIN Integration

If you are using MVC *as part of an OWIN application*, you need to:

- Do all the stuff for standard MVC integration - register controllers, set the dependency resolver, etc.
- Set up your app with the *base Autofac OWIN integration*.
- Add a reference to the Autofac.Mvc5.Owin NuGet package.
- In your application startup class, register the Autofac MVC middleware after registering the base Autofac middleware.

```
public class Startup
{
  public void Configuration(IAppBuilder app)
  {
    var builder = new ContainerBuilder();

    // STANDARD MVC SETUP:

    // Register your MVC controllers.
    builder.RegisterControllers(typeof(MvcApplication).Assembly);

    // Run other optional steps, like registering model binders,
    // web abstractions, etc., then set the dependency resolver
    // to be Autofac.
    var container = builder.Build();
    DependencyResolver.SetResolver(new AutofacDependencyResolver(container));

    // OWIN MVC SETUP:

    // Register the Autofac middleware FIRST, then the Autofac MVC middleware.
    app.UseAutofacMiddleware(container);
    app.UseAutofacMvc();
  }
}
```

Using "Plugin" Assemblies

If you have controllers in a "plugin assembly" that isn't referenced by the main application you'll need to register your controller plugin assembly with the ASP.NET BuildManager.

You can do this through configuration or programmatically.

If you choose configuration, you need to add your plugin assembly to the `/configuration/system.web/compilation/assemblies` list. If your plugin assembly isn't in the `bin` folder, you also need to update the `/configuration/runtime/assemblyBinding/probing` path.

```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
  <runtime>
    <assemblyBinding xmlns="urn:schemas-microsoft-com:asm.v1">
      <!--
          If you put your plugin in a folder that isn't bin, add it to the probing␣
↪path
      -->
      <probing privatePath="bin;bin\plugins" />
    </assemblyBinding>
  </runtime>
  <system.web>
    <compilation>
      <assemblies>
        <add assembly="The.Name.Of.Your.Plugin.Assembly.Here" />
      </assemblies>
    </compilation>
  </system.web>
</configuration>
```

If you choose programmatic registration, you need to do it during pre-application-start before the ASP.NET `BuildManager` kicks in.

Create an initializer class to do the assembly scanning/loading and registration with the `BuildManager`:

```
using System.IO;
using System.Reflection;
using System.Web.Compilation;

namespace MyNamespace
{
  public static class Initializer
  {
    public static void Initialize()
    {
      var pluginFolder = new DirectoryInfo(HostingEnvironment.MapPath("~/plugins"));
      var pluginAssemblies = pluginFolder.GetFiles("*.dll", SearchOption.
↪AllDirectories);
      foreach (var pluginAssemblyFile in pluginAssemblyFiles)
      {
        var asm = Assembly.LoadFrom(pluginAssemblyFile.FullName);
        BuildManager.AddReferencedAssembly(asm);
      }
    }
  }
}
```

Then be sure to register your pre-application-start code with an assembly attribute:

```
[assembly: PreApplicationStartMethod(typeof(Initializer), "Initialize")]
```

Using the Current Autofac DependencyResolver

Once you set the MVC `DependencyResolver` to an `AutofacDependencyResolver`, you can use `AutofacDependencyResolver.Current` as a shortcut to getting the current dependency resolver and casting it to an `AutofacDependencyResolver`.

Unfortunately, there are some gotchas around the use of `AutofacDependencyResolver.Current` that can result in things not working quite right. Usually these issues arise by using a product like Glimpse or Castle DynamicProxy that "wrap" or "decorate" the dependency resolver to add functionality. If the current dependency resolver is decorated or otherwise wrapped/proxied, you can't cast it to `AutofacDependencyResolver` and there's no single way to "unwrap it" or get to the actual resolver.

Prior to version 3.3.3 of the Autofac MVC integration, we tracked the current dependency resolver by dynamically adding it to the request lifetime scope. This got us around issues where we couldn't unwrap the `AutofacDependencyResolver` from a proxy... but it meant that `AutofacDependencyResolver.Current` would only work during a request lifetime - you couldn't use it in background tasks or at application startup.

Starting with version 3.3.3, the logic for locating `AutofacDependencyResolver.Current` changed to first attempt to cast the current dependency resolver; then to specifically look for signs it was wrapped using Castle DynamicProxy and unwrap it via reflection. Failing that... we can't find the current `AutofacDependencyResolver` so we throw an `InvalidOperationException` with a message like:

> The dependency resolver is of type 'Some.Other.DependencyResolver' but was expected to be of type 'Autofac.Integration.Mvc.AutofacDependencyResolver'. It also does not appear to be wrapped using DynamicProxy from the Castle Project. This issue could be the result of a change in the DynamicProxy implementation or the use of a different proxy library to wrap the dependency resolver.

The typical place where this is seen is when using the action filter provider via `ContainerBuilder.RegisterFilterProvider()`. The filter provider needs to access the Autofac dependency resolver and uses `AutofacDependencyResolver.Current` to do it.

If you see this, it means you're decorating the resolver in a way that can't be unwrapped and functions that rely on `AutofacDependencyResolver.Current` will fail. The current solution is to not decorate the dependency resolver.

Unit Testing

When unit testing an ASP.NET MVC app that uses Autofac where you have `InstancePerRequest` components registered, you'll get an exception when you try to resolve those components because there's no HTTP request lifetime during a unit test.

The *per-request lifetime scope* topic outlines strategies for testing and troubleshooting per-request-scope components.

Example Implementation

The Autofac source contains a demo web application project called `Remember.Web`. It demonstrates many of the aspects of MVC that Autofac is used to inject.

Web API

Web API 2 integration requires the Autofac.WebApi2 NuGet package.

Web API integration requires the Autofac.WebApi NuGet package.

Web API integration provides dependency injection integration for controllers, model binders, and action filters. It also adds *per-request lifetime support*.

This page explains ASP.NET classic Web API integration. If you are using ASP.NET Core, *see the ASP.NET Core integration page*.

- *Quick Start*
- *Get the HttpConfiguration*
- *Register Controllers*
- *Set the Dependency Resolver*
- *Provide Filters via Dependency Injection*
  - *Register the Filter Provider*
  - *Implement the Filter Interface*
  - *Register the Filter*
  - *Why We Use Non-Standard Filter Interfaces*
  - *Standard Web API Filters are Singletons*
- *Per-Controller-Type Services*
  - *Add the Controller Configuration Attribute*
  - *Supported Services*
  - *Service Registration*
  - *Clearing Existing Services*
  - *Per-Controller-Type Service Limitations*
- *Batching*
- *OWIN Integration*
- *Unit Testing*

Quick Start

To get Autofac integrated with Web API you need to reference the Web API integration NuGet package, register your controllers, and set the dependency resolver. You can optionally enable other features as well.

```
protected void Application_Start()
{
  var builder = new ContainerBuilder();

  // Get your HttpConfiguration.
  var config = GlobalConfiguration.Configuration;

  // Register your Web API controllers.
  builder.RegisterApiControllers(Assembly.GetExecutingAssembly());

  // OPTIONAL: Register the Autofac filter provider.
  builder.RegisterWebApiFilterProvider(config);

  // Set the dependency resolver to be Autofac.
  var container = builder.Build();
  config.DependencyResolver = new AutofacWebApiDependencyResolver(container);
}
```

The sections below go into further detail about what each of these features do and how to use them.

Get the HttpConfiguration

In Web API, setting up the application requires you to update properties and set values on an `HttpConfiguration` object. Depending on how you're hosting your application, where you get this configuration may be different. Through the documentation, we'll refer to "your `HttpConfiguration`" and you'll need to make a choice of how to get it.

For standard IIS hosting, the `HttpConfiguration` is `GlobalConfiguration.Configuration`.

```
var builder = new ContainerBuilder();
var config = GlobalConfiguration.Configuration;
builder.RegisterApiControllers(Assembly.GetExecutingAssembly());
var container = builder.Build();
config.DependencyResolver = new AutofacWebApiDependencyResolver(container);
```

For self hosting, the `HttpConfiguration` is your `HttpSelfHostConfiguration` instance.

```
var builder = new ContainerBuilder();
var config = new HttpSelfHostConfiguration("http://localhost:8080");
builder.RegisterApiControllers(Assembly.GetExecutingAssembly());
var container = builder.Build();
config.DependencyResolver = new AutofacWebApiDependencyResolver(container);
```

For OWIN integration, the `HttpConfiguration` is the one you create in your app startup class and pass to the Web API middleware.

```
var builder = new ContainerBuilder();
var config = new HttpConfiguration();
builder.RegisterApiControllers(Assembly.GetExecutingAssembly());
var container = builder.Build();
config.DependencyResolver = new AutofacWebApiDependencyResolver(container);
```

Register Controllers

At application startup, while building your Autofac container, you should register your Web API controllers and their dependencies. This typically happens in an OWIN startup class or in the `Application_Start` method in `Global.asax`.

```
var builder = new ContainerBuilder();

// You can register controllers all at once using assembly scanning...
builder.RegisterApiControllers(Assembly.GetExecutingAssembly());

// ...or you can register individual controlllers manually.
builder.RegisterType<ValuesController>().InstancePerRequest();
```

Set the Dependency Resolver

After building your container pass it into a new instance of the `AutofacWebApiDependencyResolver` class. Attach the new resolver to your `HttpConfiguration.DependencyResolver` to let Web API know that it should locate services using the `AutofacWebApiDependencyResolver`. This is Autofac's implementation of the `IDependencyResolver` interface.

```
var container = builder.Build();
config.DependencyResolver = new AutofacWebApiDependencyResolver(container);
```

Provide Filters via Dependency Injection

Because attributes are created via the reflection API you don't get to call the constructor yourself. That leaves you with no other option except for property injection when working with attributes. The Autofac integration with Web API provides a mechanism that allows you to create classes that implement the filter interfaces (`IAutofacActionFilter`, `IAutofacAuthorizationFilter` and `IAutofacExceptionFilter`) and wire them up to the desired controller or action method using the registration syntax on the container builder.

Register the Filter Provider

You need to register the Autofac filter provider implementation because it is does the work of wiring up the filter based on the registration. This is done by calling the `RegisterWebApiFilterProvider` method on the container builder and providing an `HttpConfiguration` instance.

```
var builder = new ContainerBuilder();
builder.RegisterWebApiFilterProvider(config);
```

Implement the Filter Interface

Instead of deriving from one of the existing Web API filter attributes your class implements the appropriate filter interface defined in the integration. The filter below is an action filter and implements `IAutofacActionFilter` instead of `System.Web.Http.Filters.IActionFilter`.

```
public class LoggingActionFilter : IAutofacActionFilter
{
  readonly ILogger _logger;

  public LoggingActionFilter(ILogger logger)
  {
    _logger = logger;
  }

  public void OnActionExecuting(HttpActionContext actionContext)
  {
    _logger.Write(actionContext.ActionDescriptor.ActionName);
  }

  public void OnActionExecuted(HttpActionExecutedContext actionExecutedContext)
  {
    _logger.Write(actionExecutedContext.ActionContext.ActionDescriptor.ActionName);
  }
}
```

Register the Filter

For the filter to execute you need to register it with the container and inform it which controller, and optionally action, should be targeted. This is done using the `AsActionFilterFor()`, `AsAuthorizationFilterFor()` and `AsExceptionFilterFor()` extension methods on the `ContainerBuilder`.

These methods require a generic type parameter for the type of the controller, and an optional lambda expression that indicates a specific method on the controller the filter should be applied to. If you don't provide the lambda expression the filter will be applied to all action methods on the controller in the same way that placing an attribute based filter at the controller level would.

In the example below the filter is being applied to the `Get` action method on the `ValuesController`.

```
var builder = new ContainerBuilder();

builder.Register(c => new LoggingActionFilter(c.Resolve<ILogger>()))
    .AsWebApiActionFilterFor<ValuesController>(c => c.Get(default(int)))
    .InstancePerApiRequest();
```

When applying the filter to an action method that requires a parameter use the `default` keyword with the data type of the parameter as a placeholder in your lambda expression. For example, the `Get` action method in the example above required an `int` parameter and used `default(int)` as a strongly-typed placeholder in the lambda expression.

It is also possible to provide a base controller type in the generic type parameter to have the filter applied to all derived controllers. In addition, you can also make your lambda expression for the action method target a method on a base controller type and have it applied to that method on all derived controllers.

Why We Use Non-Standard Filter Interfaces

If you are wondering why special interfaces were introduced this should become more apparent if you take a look at the signature of the `IActionFilter` interface in Web API.

```
public interface IActionFilter : IFilter
{
  Task<HttpResponseMessage> ExecuteActionFilterAsync(HttpActionContext actionContext, ␣
↪CancellationToken cancellationToken, Func<Task<HttpResponseMessage>> continuation);
}
```

Now compare that to the Autofac interface that you need to implement instead.

```
public interface IAutofacActionFilter
{
  void OnActionExecuting(HttpActionContext actionContext);

  void OnActionExecuted(HttpActionExecutedContext actionExecutedContext);
}
```

The problem is that the `OnActionExecuting` and `OnActionExecuted` methods are actually defined on the the `ActionFilterAttribute` and not on the `IActionFilter` interface. Extensive use of the `System.Threading.Tasks` namespace in Web API means that chaining the return task along with the appropriate error handling in the attribute actually requires a significant amount of code (the `ActionFilterAttribute` contains nearly 100 lines of code for that). This is definitely not something that you want to be handling yourself.

Autofac introduces the new interfaces to allow you to concentrate on implementing the code for your filter and not all that plumbing. Internally it creates custom instances of the actual Web API attributes that resolve the filter implementations from the container and execute them at the appropriate time.

Another reason for creating the internal attribute wrappers is to support the `InstancePerRequest` lifetime scope for filters. See below for more on that.

Standard Web API Filters are Singletons

You may notice that if you use the standard Web API filters that you can't use `InstancePerRequest` dependencies.

Unlike the filter provider in *MVC*, the one in Web API does not allow you to specify that the filter instances should not be cached. This means that **all filter attributes in Web API are effectively singleton instances that exist for the entire lifetime of the application.**

If you are trying to get per-request dependencies in a filter, you'll find that will only work if you use the Autofac filter interfaces. Using the standard Web API filters, the dependencies will be injected once - the first time the filter is resolved - and never again.

If you are unable to use the Autofac interfaces and you need per-request or instance-per-dependency services in your filters, you must use service location. Luckily, Web API makes getting the current request scope very easy - it comes right along with the `HttpRequestMessage`.

Here's an example of a filter that uses service location with the Web API `IDependencyScope` to get per-request dependencies:

```
public interface ServiceCallActionFilterAttribute : ActionFilterAttribute
{
  public override void OnActionExecuting(HttpActionContext actionContext)
  {
    // Get the request lifetime scope so you can resolve services.
    var requestScope = actionContext.Request.GetDependencyScope();

    // Resolve the service you want to use.
    var service = requestScope.GetService(typeof(IMyService)) as IMyService;

    // Do the rest of the work in the filter.
    service.DoWork();
  }
}
```

Per-Controller-Type Services

Web API has an interesting feature that allows you to configure the set of Web API services (those such as `IActionValueBinder`) that should be used per-controller-type by adding an attribute that implements the `IControllerConfiguration` interface to your controller.

Through the `Services` property on the `HttpControllerSettings` parameter passed to the `IControllerConfiguration.Initialize` method you can override the global set of services. This attribute-based approach seems to encourage you to directly instantiate service instances and then override the ones registered globally. Autofac allows these per-controller-type services to be configured through the container instead of being buried away in an attribute without dependency injection support.

Add the Controller Configuration Attribute

There is no escaping adding an attribute to the controller that the configuration should be applied to because that is the extension point defined by Web API. The Autofac integration includes an `AutofacControllerConfigurationAttribute` that you can apply to your Web API controllers to indicate that they require per-controller-type configuration.

The point to remember here is that **the actual configuration of what services should be applied will be done when you build your container** and there is no need to implement any of that in an actual attribute. In this case, the attribute can be considered as purely a marker that indicates that the container will define the configuration information and provide the service instances.

```
[AutofacControllerConfiguration]
public class ValuesController : ApiController
```

```
{
  // Implementation...
}
```

Supported Services

The supported services can be divided into single-style or multiple-style services. For example, you can only have one `IHttpActionInvoker` but you can have multiple `ModelBinderProvider` services.

You can use dependency injection for the following single-style services:

- `IHttpActionInvoker`
- `HttpActionSelector`
- `ActionValueBinder`
- `IBodyModelValidator`
- `IContentNegotiator`
- `IHttpControllerActivator`
- `ModelMetadataProvider`

The following multiple style services are supported:

- `ModelBinderProvider`
- `ModelValidatorProvider`
- `ValueProviderFactory`
- `MediaTypeFormatter`

In the list of the multiple-style services above the `MediaTypeFormatter` is actually the odd one out. Technically, it isn't actually a service and is added to the `MediaTypeFormatterCollection` on the `HttpControllerSettings` instance and not the `ControllerServices` container. We figured that there was no reason to exclude `MediaTypeFormatter` instances from dependency injection support and made sure that they could be resolved from the container per-controller type, too.

Service Registration

Here is an example of registering a custom `IHttpActionSelector` implementation as `InstancePerApiControllerType()` for the `ValuesController`. When applied to a controller type all derived controllers will also receive the same configuration; the `AutofacControllerConfigurationAttribute` is inherited by derived controller types and the same behavior applies to the registrations in the container. When you register a single-style service it will always replace the default service configured at the global level.

```
builder.Register(c => new CustomActionSelector())
       .As<IHttpActionSelector>()
       .InstancePerApiControllerType(typeof(ValuesController));
```

Clearing Existing Services

By default, multiple-style services are appended to the existing set of services configured at the global level. When registering multiple-style services with the container you can choose to clear the existing set of services so that only the ones you have registered as `InstancePerApiControllerType()` will be used. This is done by setting the `clearExistingServices` parameter to `true` on the `InstancePerApiControllerType()` method. Existing services of that type will be removed if any of the registrations for the multiple-style service indicate that they want that to happen.

```
builder.Register(c => new CustomModelBinderProvider())
       .As<ModelBinderProvider>()
       .InstancePerApiControllerType(
          typeof(ValuesController),
          clearExistingServices: true);
```

Per-Controller-Type Service Limitations

If you are using per-controller-type services, it is not possible to take dependencies on other services that are registered as `InstancePerRequest()`. The problem is that Web API is caching these services and is not requesting them from the container each time a controller of that type is created. It is most likely not possible for Web API to easily add that support that without introducing the notion of a key (for the controller type) into the DI integration, which would mean that all containers would need to support keyed services.

Batching

If you choose to use the Web API batching functionality, be aware that the initial multipart request to the batch endpoint is where Web API creates the request lifetime scope. The child requests that are part of the batch all take place in-memory and will share that same request lifetime scope - you won't get a different scope for each child request in the batch.

This is due to the way the batch handling is designed within Web API and copies properties from the parent request to the child request. One of the properties that is intentionally copied by the ASP.NET Web API framework from parent to children is the request lifetime scope. There is no workaround for this and is outside the control of Autofac.

OWIN Integration

If you are using Web API *as part of an OWIN application*, you need to:

- Do all the stuff for standard Web API integration - register controllers, set the dependency resolver, etc.
- Set up your app with the *base Autofac OWIN integration*.
- Add a reference to the Autofac.WebApi2.Owin NuGet package.
- In your application startup class, register the Autofac Web API middleware after registering the base Autofac middleware.

```
public class Startup
{
  public void Configuration(IAppBuilder app)
  {
    var builder = new ContainerBuilder();

    // STANDARD WEB API SETUP:
```

```
    // Get your HttpConfiguration. In OWIN, you'll create one
    // rather than using GlobalConfiguration.
    var config = new HttpConfiguration();

    // Register your Web API controllers.
    builder.RegisterApiControllers(Assembly.GetExecutingAssembly());

    // Run other optional steps, like registering filters,
    // per-controller-type services, etc., then set the dependency resolver
    // to be Autofac.
    var container = builder.Build();
    config.DependencyResolver = new AutofacWebApiDependencyResolver(container);

    // OWIN WEB API SETUP:

    // Register the Autofac middleware FIRST, then the Autofac Web API middleware,
    // and finally the standard Web API middleware.
    app.UseAutofacMiddleware(container);
    app.UseAutofacWebApi(config);
    app.UseWebApi(config);
  }
}
```

A common error in OWIN integration is use of the `GlobalConfiguration.Configuration`. **In OWIN you create the configuration from scratch.** You should not reference `GlobalConfiguration.Configuration` anywhere when using the OWIN integration.

Unit Testing

When unit testing an ASP.NET Web API app that uses Autofac where you have `InstancePerRequest` components registered, you'll get an exception when you try to resolve those components because there's no HTTP request lifetime during a unit test.

The *per-request lifetime scope* topic outlines strategies for testing and troubleshooting per-request-scope components.

SignalR

SignalR integration requires the Autofac.SignalR NuGet package.

SignalR integration provides dependency injection integration for SignalR hubs. **Due to SignalR internals, there is no support in SignalR for per-request lifetime dependencies.**

Along with this documentation that's Autofac specific, you may also be interested in the Microsoft documentation on SignalR and dependency injection.

- *Quick Start*
- *Register Hubs*
- *Set the Dependency Resolver*
- *Managing Dependency Lifetimes*
- *OWIN Integration*

Quick Start

To get Autofac integrated with SignalR you need to reference the SignalR integration NuGet package, register your hubs, and set the dependency resolver.

```
protected void Application_Start()
{
  var builder = new ContainerBuilder();

  // Register your SignalR hubs.
  builder.RegisterHubs(Assembly.GetExecutingAssembly());

  // Set the dependency resolver to be Autofac.
  var container = builder.Build();
  GlobalHost.DependencyResolver = new AutofacDependencyResolver(container);
}
```

The sections below go into further detail about what each of these features do and how to use them.

Register Hubs

At application startup, while building your Autofac container, you should register your SignalR hubs and their dependencies. This typically happens in an OWIN startup class or in the `Application_Start` method in `Global.asax`.

```
var builder = new ContainerBuilder();

// You can register hubs all at once using assembly scanning...
builder.RegisterHubs(Assembly.GetExecutingAssembly());

// ...or you can register individual hubs manually.
builder.RegisterType<ChatHub>().ExternallyOwned();
```

If you register individual hubs, make sure they are registered as `ExternallyOwned()`. This ensures SignalR is allowed to control disposal of the hubs rather than Autofac.

Set the Dependency Resolver

After building your container pass it into a new instance of the `AutofacDependencyResolver` class. Attach the new resolver to your `GlobalHost.DependencyResolver` (or `HubConfiguration.Resolver` if you're using OWIN) to let SignalR know that it should locate services using the `AutofacDependencyResolver`. This is Autofac's implementation of the `IDependencyResolver` interface.

```
var container = builder.Build();
GlobalHost.DependencyResolver = new AutofacDependencyResolver(container);
```

Managing Dependency Lifetimes

Given there is no support for per-request dependencies, **all dependencies resolved for SignalR hubs come from the root container**.

- If you have `IDisposable` components, they will live for the lifetime of the application because Autofac will *hold them until the lifetime scope/container is disposed*. You should register these as `ExternallyOwned()`.

- Any components registered as `InstancePerLifetimeScope()` will effectively be singletons. Given there's one root lifetime scope, you'll only get the one instance.

To make managing your hub dependency lifetimes easier you can have the root lifetime scope injected into the constructor of your hub. Next, create a child lifetime scope that you can use for the duration of your hub invocation and resolve the required services. Finally, make sure you dispose the child lifetime when the hub is disposed by SignalR. (This is similar to service location, but it's the only way to get a "per-hub" sort of scope. No, it's not awesome.)

```
public class MyHub : Hub
{
  private readonly ILifetimeScope _hubLifetimeScope;
  private readonly ILogger _logger;

  public MyHub(ILifetimeScope lifetimeScope)
  {
    // Create a lifetime scope for the hub.
    _hubLifetimeScope = lifetimeScope.BeginLifetimeScope();

    // Resolve dependencies from the hub lifetime scope.
    _logger = _hubLifetimeScope.Resolve<ILogger>();
  }

  public void Send(string message)
  {
    // You can use your dependency field here!
    _logger.Write("Received message: " + message);

    Clients.All.addMessage(message);
  }

  protected override void Dispose(bool disposing)
  {
    // Dipose the hub lifetime scope when the hub is disposed.
    if (disposing && _hubLifetimeScope != null)
    {
      _hubLifetimeScope.Dispose();
    }

    base.Dispose(disposing);
  }
}
```

If this is a common pattern in your application, you might consider creating a base/abstract hub from which other hubs can derive to save all the copy/paste creation/disposal of scopes.

Injecting a lifetime scope into your hub does not give you per-request lifetime scopes. It just gives you a way to manage dependency lifetime in a more active way than resolving everything from the root container. Using `InstancePerRequest`, even with this workaround, will still fail. You may want to read *the FAQ on per-request scope* for more info.

OWIN Integration

If you are using SignalR *as part of an OWIN application*, you need to:

- Do all the stuff for standard SignalR integration - register controllers, set the dependency resolver, etc.
- Set up your app with the *base Autofac OWIN integration*.

```
public class Startup
{
  public void Configuration(IAppBuilder app)
  {
    var builder = new ContainerBuilder();

    // STANDARD SIGNALR SETUP:

    // Get your HubConfiguration. In OWIN, you'll create one
    // rather than using GlobalHost.
    var config = new HubConfiguration();

    // Register your SignalR hubs.
    builder.RegisterHubs(Assembly.GetExecutingAssembly());

    // Set the dependency resolver to be Autofac.
    var container = builder.Build();
    config.Resolver = new AutofacDependencyResolver(container);

    // OWIN SIGNALR SETUP:

    // Register the Autofac middleware FIRST, then the standard SignalR middleware.
    app.UseAutofacMiddleware(container);
    app.MapSignalR("/signalr", config);

    // To add custom HubPipeline modules, you have to get the HubPipeline
    // from the dependency resolver, for example:
    var hubPipeline = config.Resolver.Resolve<IHubPipeline>();
    hubPipeline.AddModule(new MyPipelineModule());
  }
}
```

A common error in OWIN integration is use of the `GlobalHost`. **In OWIN you create the configuration from scratch.** You should not reference `GlobalHost` anywhere when using the OWIN integration. Microsoft has documentation about this and other IoC integration concerns here.

Web Forms

ASP.NET web forms integration requires the Autofac.Web NuGet package.

Web forms integration provides dependency injection integration for code-behind classes. It also adds *per-request lifetime support*.

This page explains ASP.NET classic web forms integration. If you are using ASP.NET Core, *see the ASP.NET Core integration page*.

- *Quick Start*
- *Add Modules to Web.config*
- *Implement IContainerProviderAccessor in Global.asax*
- *Tips and Tricks*
  - *Structuring Pages and User Controls for DI*
  - *Manual Property Injection*

- *Explicit Injection via Attributes*
- *Dependency Injection via Base Page Class*
- *Custom Dependency Injection Modules*

Quick Start

To get Autofac integrated with web forms you need to reference the web forms integration NuGet package, add the modules to `web.config`, and implement `IContainerProviderAccessor` on your `Global` application class.

Add the modules to `web.config`:

```
<configuration>
  <system.web>
    <httpModules>
      <!-- This section is used for IIS6 -->
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"/>
      <add
        name="PropertyInjection"
        type="Autofac.Integration.Web.Forms.PropertyInjectionModule, Autofac.
↪Integration.Web"/>
    </httpModules>
  </system.web>
  <system.webServer>
    <!-- This section is used for IIS7 -->
    <modules>
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"
        preCondition="managedHandler"/>
      <add
        name="PropertyInjection"
        type="Autofac.Integration.Web.Forms.PropertyInjectionModule, Autofac.
↪Integration.Web"
        preCondition="managedHandler"/>
    </modules>
  </system.webServer>
</configuration>
```

Implement `IContainerProviderAccessor`:

```
public class Global : HttpApplication, IContainerProviderAccessor
{
  // Provider that holds the application container.
  static IContainerProvider _containerProvider;

  // Instance property that will be used by Autofac HttpModules
  // to resolve and inject dependencies.
  public IContainerProvider ContainerProvider
  {
    get { return _containerProvider; }
  }
```

```
  protected void Application_Start(object sender, EventArgs e)
  {
    // Build up your application container and register your dependencies.
    var builder = new ContainerBuilder();
    builder.RegisterType<SomeDependency>();
    // ... continue registering dependencies...

    // Once you're done registering things, set the container
    // provider up with your registrations.
    _containerProvider = new ContainerProvider(builder.Build());
  }
}
```

The sections below go into further detail about what each of these features do and how to use them.

Add Modules to Web.config

The way that Autofac manages component lifetimes and adds dependency injection into the ASP.NET pipeline is through the use of IHttpModule implementations. You need to configure these modules in `web.config`.

The following snippet config shows the modules configured.

```
<configuration>
  <system.web>
    <httpModules>
      <!-- This section is used for IIS6 -->
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"/>
      <add
        name="PropertyInjection"
        type="Autofac.Integration.Web.Forms.PropertyInjectionModule, Autofac.
↪Integration.Web"/>
    </httpModules>
  </system.web>
  <system.webServer>
    <!-- This section is used for IIS7 -->
    <modules>
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"
        preCondition="managedHandler"/>
      <add
        name="PropertyInjection"
        type="Autofac.Integration.Web.Forms.PropertyInjectionModule, Autofac.
↪Integration.Web"
        preCondition="managedHandler"/>
    </modules>
  </system.webServer>
</configuration>
```

Note that while there are two different sections the modules appear in - one each for IIS6 and IIS7 - **it is recommended that you have both in place**. The ASP.NET Developer Server uses the IIS6 settings even if your target deployment environment is IIS7. If you use IIS Express it will use the IIS7 settings.

The modules you see there do some interesting things:

- **The ContainerDisposalModule** lets Autofac dispose of any components created during request processing as soon as the request completes.
- **The PropertyInjectionModule** injects dependencies into pages before the page lifecycle executes. An alternative `UnsetPropertyInjectionModule` is also provided which will only set properties on web forms/controls that have null values. (Use only one or the other, but not both.)

Implement IContainerProviderAccessor in Global.asax

The dependency injection modules expect that the `HttpApplication` instance supports `IContainerProviderAccessor`. A complete global application class is shown below:

```
public class Global : HttpApplication, IContainerProviderAccessor
{
  // Provider that holds the application container.
  static IContainerProvider _containerProvider;

  // Instance property that will be used by Autofac HttpModules
  // to resolve and inject dependencies.
  public IContainerProvider ContainerProvider
  {
    get { return _containerProvider; }
  }

  protected void Application_Start(object sender, EventArgs e)
  {
    // Build up your application container and register your dependencies.
    var builder = new ContainerBuilder();
    builder.RegisterType<SomeDependency>();
    // ... continue registering dependencies...

    // Once you're done registering things, set the container
    // provider up with your registrations.
    _containerProvider = new ContainerProvider(builder.Build());
  }
}
```

`Autofac.Integration.Web.IContainerProvider` exposes two useful properties: `ApplicationContainer` and `RequestLifetime`.

- `ApplicationContainer` is the root container that was built at application start-up.
- `RequestLifetime` is a component *lifetime scope* based on the application container that will be disposed of at the end of the current web request. It can be used whenever manual dependency resolution/service lookup is required. The components that it contains (apart from any singletons) will be specific to the current request (this is where *per-request lifetime dependencies* are resolved).

Tips and Tricks

Structuring Pages and User Controls for DI

In order to inject dependencies into web forms pages (`System.Web.UI.Page` instances) or user controls (`System.Web.UI.UserControl` instances) **you must expose their dependencies as public properties that allow setting**. This enables the `PropertyInjectionModule` to populate those properties for you.

Be sure to register the dependencies you'll need at application startup.

```
var builder = new ContainerBuilder();
builder.RegisterType<Component>().As<IService>().InstancePerRequest();
// ... continue registering dependencies and then build the
// container provider...
_containerProvider = new ContainerProvider(builder.Build());
```

Then in your page codebehind, create public get/set properties for the dependencies you'll need:

```
// MyPage.aspx.cs
public partial class MyPage : Page
{
  // This property will be set for you by the PropertyInjectionModule.
  public IService MyService { get; set; }

  protected void Page_Load(object sender, EventArgs e)
  {
    // Now you can use the property that was set for you.
    label1.Text = this.MyService.GetMessage();
  }
}
```

This same process of public property injection will work for user controls, too - just register the components at application startup and provide public get/set properties for the dependencies.

It is important to note **in the case of user controls that properties will only be automatically injected if the control is created and added to the page's Controls collection by the PreLoad step of the page request lifecycle**. Controls created dynamically either in code or through templates like the Repeater will not be visible at this point and must have their properties manually injected.

Manual Property Injection

In some cases, like in programmatic creation of user controls or other objects, you may need to manually inject properties on an object. To do this, you need to:

- Get the current application instance.
- Cast it to `Autofac.Integration.Web.IContainerProviderAccessor`.
- Get the container provider from the application instance.
- Get the `RequestLifetime` from the `IContainerProvider` and use the `InjectProperties()` method to inject the properties on the object.

In code, that looks like this:

```
var cpa = (IContainerProviderAccessor)HttpContext.Current.ApplicationInstance;
var cp = cpa.ContainerProvider;
cp.RequestLifetime.InjectProperties(objectToSet);
```

Note you need both the `Autofac` and `Autofac.Integration.Web` namespaces in there to make property injection work because `InjectProperties()` is an extension method in the `Autofac` namespace.

Explicit Injection via Attributes

When adding dependency injection to an existing application, it is sometimes desirable to distinguish between web forms pages that will have their dependencies injected and those that will not. The `InjectPropertiesAttribute` in `Autofac.Integration.Web`, coupled with the `AttributedInjectionModule` help to achieve this.

If you choose to use the AttributedInjectionModule, no dependencies will be automatically injected into public properties unless they're marked with a special attribute.

First, remove the `PropertyInjectionModule` from your `web.config` file and replace it with the `AttributedInjectionModule`:

```
<configuration>
  <system.web>
    <httpModules>
      <!-- This section is used for IIS6 -->
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"/>
      <add
        name="AttributedInjection"
        type="Autofac.Integration.Web.Forms.AttributedInjectionModule, Autofac.
↪Integration.Web"/>
    </httpModules>
  </system.web>
  <system.webServer>
    <!-- This section is used for IIS7 -->
    <modules>
      <add
        name="ContainerDisposal"
        type="Autofac.Integration.Web.ContainerDisposalModule, Autofac.Integration.Web
↪"
        preCondition="managedHandler"/>
      <add
        name="AttributedInjection"
        type="Autofac.Integration.Web.Forms.AttributedInjectionModule, Autofac.
↪Integration.Web"
        preCondition="managedHandler"/>
    </modules>
  </system.webServer>
</configuration>
```

Once this is in place, pages and controls will not have their dependencies injected by default. Instead, they must be marked with the `Autofac.Integration.Web.Forms.InjectPropertiesAttribute` or `Autofac.Integration.Web.Forms.InjectUnsetPropertiesAttribute`. The difference:

- `InjectPropertiesAttribute` will always set public properties on the page/control if there are associated components registered with Autofac.
- `InjectUnsetPropertiesAttribute` will only set the public properties on the page/control if they are null and the associated components are registered.

```
[InjectProperties]
public partial class MyPage : Page
{
  // This property will be set for you by the AttributedInjectionModule.
  public IService MyService { get; set; }
```

```
    // ...use the property later as needed.
}
```

Dependency Injection via Base Page Class

If you would rather not automatically inject properties using a module (e.g., the `AttributedInjectionModule` or `PropertyInjectionModule` as mentioned earlier), you can integrate Autofac in a more manual manner by creating a base page class that does manual property injection during the `PreInit` phase of the page request lifecycle.

This option allows you to derive pages that require dependency injection from a common base page class. Doing this may be desirable if you have only a very few pages that require dependency injection and you don't want the `AttributedInjectionModule` in the pipeline. (You still need the `ContainerDisposalModule`.) If you have more than a small few pages it may be beneficial to consider explicit injection via attributes.

```
protected void Page_PreInit(object sender, EventArgs e)
{
  var cpa = (IContainerProviderAccessor)HttpContext.Current.ApplicationInstance;
  var cp = cpa.ContainerProvider;
  cp.RequestLifetime.InjectProperties(this);
}
```

Custom Dependency Injection Modules

If the provided *Property*, *Unset Property*, and *Attributed* dependency injection models are unsuitable, it is very easy to create a custom injection behavior. Simply subclass `Autofac.Integration.Web.DependencyInjectionModule` and use the result in `Web.config`.

There is one abstract member to implement:

```
protected abstract IInjectionBehaviour GetInjectionBehaviourForHandlerType(Type
↪handlerType);
```

The returned `IInjectionBehaviour` can be one of the predefined `NoInjection`, `PropertyInjection`, or `UnsetPropertyInjection` properties; or a custom implementation of the `IInjectionBehaviour` interface.

RIA / Domain Services

Domain Services integration requires the Autofac.Extras.DomainServices NuGet package.

- *Quick Start*
- *Example Implementation*

Quick Start

To get Autofac integrated with RIA/domain services app you need to reference the Domain Services integration NuGet package, register services, and register the integration module.

```
public class Global : HttpApplication, IContainerProviderAccessor
{
  // The IContainerProviderAccessor and IContainerProvider
  // interfaces are part of the web integration and are used
  // for registering/resolving dependencies on a per-request
  // basis.
  private static IContainerProvider _containerProvider;

  public IContainerProvider ContainerProvider
  {
    get { return _containerProvider; }
  }

  protected void Application_Start(object sender, EventArgs e)
  {
    var builder = new ContainerBuilder();

    // Register your domain services.
    builder
      .RegisterAssemblyTypes(Assembly.GetExecutingAssembly())
      .AssignableTo<DomainService>();

    // Add the RIA Services module so the "Initialize"
    // method gets called on your resolved services.
    builder.RegisterModule<AutofacDomainServiceModule>();

    // Build the container and set the container provider
    // as in standard web integration.
    var container = builder.Build();
    _containerProvider = new ContainerProvider(container);

    // Replace the DomainService.Factory with
    // AutofacDomainServiceFactory so things get resolved.
    var factory = new AutofacDomainServiceFactory(_containerProvider);
    DomainService.Factory = factory;
  }
}
```

When you write your domain services, use constructor injection and other standard patterns just like any other Autofac/IoC usage.

Example Implementation

The Autofac source contains a demo application project called `DomainServicesExample` that is consumed by the `Remember.Web` example project. It demonstrates how to integrate Autofac with a Domain Services project.

ASP.NET Core

ASP.NET Core (previously ASP.NET 5) changes the way dependency injection frameworks have previously integrated into ASP.NET execution. Previously, each functionality - MVC, Web API, etc. - had its own "dependency resolver" mechanism and just slightly different ways to hook in. ASP.NET Core introduces a conforming container mechanism via Microsoft.Extensions.DependencyInjection, including a unified notion of request lifetime scope, service registration, and so forth.

This page explains ASP.NET Core integration. If you are using ASP.NET classic, *see the ASP.NET classic integration page*.

- *Quick Start*
- *Dependency Injection Hooks*
- *Differences From ASP.NET Classic*

Quick Start

To take advantage of Autofac in your ASP.NET Core pipeline:

- Reference the `Autofac.Extensions.DependencyInjection` package from NuGet.
- In the `ConfigureServices` method of your `Startup` class...
  - Register services from the `IServiceCollection`.
  - Build your container.
  - Create an `AutofacServiceProvider` using the container and return it.
- In the `Configure` method of your `Startup` class, you can optionally register with the `IApplicationLifetime.ApplicationStopped` event to dispose of the container at app shutdown.

```
public class Startup
{
  public Startup(IHostingEnvironment env)
  {
    var builder = new ConfigurationBuilder()
        .SetBasePath(env.ContentRootPath)
        .AddJsonFile("appsettings.json", optional: true, reloadOnChange: true)
        .AddJsonFile($"appsettings.{env.EnvironmentName}.json", optional: true)
        .AddEnvironmentVariables();
    this.Configuration = builder.Build();
  }

  public IContainer ApplicationContainer { get; private set; }

  public IConfigurationRoot Configuration { get; private set; }

  // ConfigureServices is where you register dependencies. This gets
  // called by the runtime before the Configure method, below.
  public IServiceProvider ConfigureServices(IServiceCollection services)
  {
    // Add services to the collection.
    services.AddMvc();

    // Create the container builder.
    var builder = new ContainerBuilder();

    // Register dependencies, populate the services from
    // the collection, and build the container. If you want
    // to dispose of the container at the end of the app,
    // be sure to keep a reference to it as a property or field.
    builder.RegisterType<MyType>().As<IMyType>();
```

```
    builder.Populate(services);
    this.ApplicationContainer = builder.Build();

    // Create the IServiceProvider based on the container.
    return new AutofacServiceProvider(this.ApplicationContainer);
  }

  // Configure is where you add middleware. This is called after
  // ConfigureServices. You can use IApplicationBuilder.ApplicationServices
  // here if you need to resolve things from the container.
  public void Configure(
    IApplicationBuilder app,
    ILoggerFactory loggerFactory,
    IApplicationLifetime appLifetime)
  {
      loggerFactory.AddConsole(this.Configuration.GetSection("Logging"));
      loggerFactory.AddDebug();

      app.UseMvc();

      // If you want to dispose of resources that have been resolved in the
      // application container, register for the "ApplicationStopped" event.
      appLifetime.ApplicationStopped.Register(() => this.ApplicationContainer.
↪Dispose());
  }
}
```

Dependency Injection Hooks

Unlike *ASP.NET classic integration*, ASP.NET Core is designed specifically with dependency injection in mind. What that means is if you're trying to figure out, say, how to inject services into MVC views that's now controlled by (and documented by) ASP.NET Core - there's not anything Autofac-specific you need to do other than set up your service provider as outlined above.

Here are some helpful links into the ASP.NET Core documentation with specific insight into DI integration:

- ASP.NET Core dependency injection fundamentals
- Controller injection
- Filter injection
- View injection
- Authorization requirement handlers injection
- Middleware options injection
- Middleware 'Invoke' method injection
- Wiring up EF 6 with ASP.NET Core

Differences From ASP.NET Classic

If you've used Autofac's other *ASP.NET integration* then you may be interested in the key differences as you migrate to using ASP.NET Core.

- **Use InstancePerLifetimeScope instead of InstancePerRequest.** In previous ASP.NET integration you could register a dependency as `InstancePerRequest` which would ensure only one instance of the dependency would be created per HTTP request. This worked because Autofac was in charge of *setting up the per-request lifetime scope*. With the introduction of `Microsoft.Extensions.DependencyInjection`, the creation of per-request and other child lifetime scopes is now part of the conforming container provided by the framework, so all child lifetime scopes are treated equally - there's no special "request level scope" anymore. Instead of registering your dependencies `InstancePerRequest`, use `InstancePerLifetimeScope` and you should get the same behavior. Note if you are creating *your own lifetime scopes* during web requests, you will get a new instance in these child scopes.
- **No more DependencyResolver.** Other ASP.NET integration mechanisms required setting up a custom Autofac-based dependency resolver in various locations. With `Microsoft.Extensions.DependencyInjection` and the `Startup.ConfigureServices` method, you now just return the `IServiceProvider` and "magic happens." Within controllers, classes, etc. if you need to manually do service location, get an `IServiceProvider`.
- **No special middleware.** The *OWIN integration* previously required registration of a special Autofac middleware to manage the request lifetime scope. `Microsoft.Extensions.DependencyInjection` does the heavy lifting now, so there's no additional middleware to register.
- **No manual controller registration.** You used to be required to register all of your controllers with Autofac so DI would work. The ASP.NET Core framework now automatically passes all controllers through service resolution so you don't have to do that.
- **No extensions for invoking middleware via dependency injection.** The *OWIN integration* had extensions like `UseAutofacMiddleware()` to allow DI into middleware. This happens automatically now through a combination of auto-injected constructor parameters and dynamically resolved parameters to the Invoke method of middleware. The ASP.NET Core framework takes care of it all.
- **MVC and Web API are one thing.** There used to be different ways to hook into DI based on whether you were using MVC or Web API. These two things are combined in ASP.NET Core so there's only one dependency resolver to set up, only one configuration to maintain.

Windows Communication Foundation (WCF)

WCF integration for both clients and services requires the Autofac.Wcf NuGet package.

WCF integration provides dependency injection integration for services as well as client proxies. **Due to WCF internals, there is no explicit support in WCF for per-request lifetime dependencies.**

- *Clients*
- *Services*
  - *Quick Start*
  - *Register Service Implementations*
    - *Register By Type*
    - *Register by Interface*
    - *Register by Name*
  - *Svc-Less Services*
  - *Extensionless Services*

- *WAS Hosting and Non-HTTP Activation*
- *Self-Hosting*
- *Handling InstanceContextMode.Single Services*
  - *IIS/WAS Hosted*
  - *Self-Hosted*
- *Simulating a Request Lifetime Scope*
- *Using Decorators With Services*
- *Example Implementation*

Clients

There are a couple of benefits to using Autofac in conjunction with your service client application:

- **Deterministic disposal**: Automatically free resources consumed by proxies created by `ChannelFactory.CreateChannel<T>()`.
- **Easy service proxy injection**: For types that consume services you can easily inject a dependency on the service interface type.

During application startup, for each service register a `ChannelFactory<T>` and a function that uses the factory to open channels:

```
var builder = new ContainerBuilder();

// Register the channel factory for the service. Make it
// SingleInstance since you don't need a new one each time.
builder
  .Register(c => new ChannelFactory<ITrackListing>(
    new BasicHttpBinding(),
    new EndpointAddress("http://localhost/TrackListingService")))
  .SingleInstance();

// Register the service interface using a lambda that creates
// a channel from the factory. Include the UseWcfSafeRelease()
// helper to handle proper disposal.
builder
  .Register(c => c.Resolve<ChannelFactory<ITrackListing>>().CreateChannel())
  .As<ITrackListing>()
  .UseWcfSafeRelease();

// You can also register other dependencies.
builder.RegisterType<AlbumPrinter>();

var container = builder.Build();
```

In this example...

- The call to `CreateChannel()` isn't executed until `ITrackListing` is requested from the container.
- The `UseWcfSafeRelease()` configuration option ensures that exception messages are not lost when disposing client channels.

When consuming the service, add a constructor dependency as normal. This example shows an application that prints a track listing to the console using the remote `ITrackListing` service. It does this via the `AlbumPrinter` class:

```
public class AlbumPrinter
{
  readonly ITrackListing _trackListing;

  public AlbumPrinter(ITrackListing trackListing)
  {
    _trackListing = trackListing;
  }

  public void PrintTracks(string artist, string album)
  {
    foreach (var track in _trackListing.GetTracks(artist, album))
      Console.WriteLine("{0} - {1}", track.Position, track.Title);
  }
}
```

When you resolve the `AlbumPrinter` class from a lifetime scope, the channel to the `ITrackListing` service will be injected for you.

Note that, given *the service proxy is disposable*, it should be resolved from a child lifetime scope, not the root container. Thus, if you have to manually resolve it (for whatever reason), be sure you're creating a child scope from which to do it:

```
using(var lifetime = container.BeginLifetimeScope())
{
  var albumPrinter = lifetime.Resolve<AlbumPrinter>();
  albumPrinter.PrintTracks("The Shins", "Wincing the Night Away");
}
```

Services

Quick Start

To get Autofac integrated with WCF on the service side you need to reference the WCF integration NuGet package, register your services, and set the dependency resolver. You also need to update your `.svc` files to reference the Autofac service host factory.

Here's a sample application startup block:

```
protected void Application_Start()
{
  var builder = new ContainerBuilder();

  // Register your service implementations.
  builder.RegisterType<TestService.Service1>();

  // Set the dependency resolver.
  var container = builder.Build();
  AutofacHostFactory.Container = container;
}
```

And here's a sample `.svc` file.

```
<%@ ServiceHost
    Service="TestService.Service1, TestService"
    Factory="Autofac.Integration.Wcf.AutofacServiceHostFactory, Autofac.Integration.
↪Wcf" %>
```

The sections below go into further detail about what each of these features do and how to use them.

Register Service Implementations

You can register your service types in one of three ways: by type, by interface, or by name.

Register By Type

Your first option is to simply register the service implementation type in the container and specify that implementation type in the .svc file. **This is the most common usage.**

In your application startup, you'd have code like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<TestService.Service1>();
AutofacHostFactory.Container = builder.Build();
```

And your `.svc` file would specify the appropriate service implementation type and host factory, like this:

```
<%@ ServiceHost
    Service="TestService.Service1, TestService"
    Factory="Autofac.Integration.Wcf.AutofacServiceHostFactory, Autofac.Integration.
↪Wcf" %>
```

Note that **you need to use the fully-qualified name of your service in the .svc file**, i.e. `Service="Namespace.ServiceType, AssemblyName"`.

Register by Interface

Your second option is to register the contract type in the container and specify the contract in the `.svc` file. This is handy if you don't want to change the `.svc` file but do want to change the implementation type that will handle requests.

In your application startup, you'd have code like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<TestService.Service1>()
       .As<TestService.IService1>();
AutofacHostFactory.Container = builder.Build();
```

And your .svc file would specify the service contract type and host factory, like this:

```
<%@ ServiceHost
    Service="TestService.IService1, TestService"
    Factory="Autofac.Integration.Wcf.AutofacServiceHostFactory, Autofac.Integration.
↪Wcf" %>
```

Note that **you need to use the fully-qualified name of your contract in the .svc file**, i.e. `Service="Namespace.IContractType, AssemblyName"`.

Register by Name

The third option you have is to register a named service implementation in the container and specify that service name in the `.svc` file. This is handy if you want even further abstraction away from the `.svc` file.

In your application startup, you'd have code like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<TestService.Service1>()
       .Named<object>("my-service");
AutofacHostFactory.Container = builder.Build();
```

Note that the service implementation type is **registered as an object - this is important**. Your service implementation won't be found if it's a named service and it's not registered as an object.

Your `.svc` file specifies the service name you registered and host factory, like this:

```
<%@ ServiceHost
    Service="my-service"
    Factory="Autofac.Integration.Wcf.AutofacServiceHostFactory, Autofac.Integration.
↪Wcf" %>
```

Svc-Less Services

If you want to use services without an `.svc` file, Autofac will work with that.

As shown above, register your service with the container.

```
var builder = new ContainerBuilder();
builder.RegisterType<Service1>();
AutofacHostFactory.Container = builder.Build();
```

To use svc-less services, add a factory entry under the `serviceActivation` element in the `web.config` file. This ensures that the `AutofacServiceHostFactory` is used to activate the service.

```
<serviceHostingEnvironment aspNetCompatibilityEnabled="true"␣
↪multipleSiteBindingsEnabled="true">
  <serviceActivations>
    <add factory="Autofac.Integration.Wcf.AutofacServiceHostFactory"
         relativeAddress="~/Service1.svc"
         service="TestService.Service1" />
  </serviceActivations>
</serviceHostingEnvironment>
```

Extensionless Services

If you want extensionless services, register your service with the container as shown above.

```
var builder = new ContainerBuilder();
builder.RegisterType<Service1>();
AutofacHostFactory.Container = builder.Build();
```

Then define a new `ServiceRoute` using the `AutofacServiceHostFactory` and service implementation type.

```
RouteTable.Routes.Add(new ServiceRoute("Service1", new AutofacServiceHostFactory(),␣
↪typeof(Service1)));
```

Finally, add the `UrlRoutingModule` to the *web.config* file.

```
<system.webServer>
  <modules runAllManagedModulesForAllRequests="true">
    <add name="UrlRoutingModule" type="System.Web.Routing.UrlRoutingModule, System.
↪Web, Version=4.0.0.0, Culture=neutral, PublicKeyToken=b03f5f7f11d50a3a" />
  </modules>
  <handlers>
    <add name="UrlRoutingHandler" preCondition="integratedMode" verb="*" path=
↪"UrlRouting.axd" />
  </handlers>
</system.webServer>
```

After configuring your application in IIS you will be able to access the WCF service at: `http://hostname/appname/Service1`

WAS Hosting and Non-HTTP Activation

When hosting WCF Services in WAS (Windows Activation Service), you are not given an opportunity to build your container in the `Application_Start` event defined in your `Global.asax` because WAS doesn't use the standard ASP.NET pipeline.

The alternative approach is to place a code file in your `App_Code` folder that contains a type with a `public static void AppInitialize()` method.

```
namespace MyNamespace
{
  public static class AppStart
  {
    public static void AppInitialize()
    {
      // Put your container initialization here.
    }
  }
}
```

You can read more about `AppInitialize()` in "How to Initialize Hosted WCF Services".

Self-Hosting

To use the integration when self-hosting your WCF Service, the key is to use the `AddDependencyInjectionBehavior()` extension on your service host. Set up your container with your registrations, but **don't set the global container**. Instead, apply the container to your service host.

```
ContainerBuilder builder = new ContainerBuilder();
builder.RegisterType<Service1>();

using (var container = builder.Build())
{
    Uri address = new Uri("http://localhost:8080/Service1");
    ServiceHost host = new ServiceHost(typeof(Service1), address);
    host.AddServiceEndpoint(typeof(IEchoService), new BasicHttpBinding(), string.
↪Empty);

    // Here's the important part - attaching the DI behavior to the service host
    // and passing in the container.
```

```
    host.AddDependencyInjectionBehavior<IService1>(container);

    host.Description.Behaviors.Add(new ServiceMetadataBehavior {HttpGetEnabled = true,
↪ HttpGetUrl = address});
    host.Open();

    Console.WriteLine("The host has been opened.");
    Console.ReadLine();

    host.Close();
    Environment.Exit(0);
}
```

Handling InstanceContextMode.Single Services

Using `InstanceContextMode.Single` is not a good idea from a scalability point of view, and allowing multiple callers to access the single instance using `ConcurrencyMode.Multiple` means that you also need to be careful about multiple threads accessing any shared state. If possible you should create services with `InstanceContextMode.PerCall`.

IIS/WAS Hosted

The `AutofacServiceHostFactory` identifies WCF services that are marked with `InstanceContextMode.Single` and will ensure that the `ServiceHost` can be provided with a singleton instance from the container. An exception will be thrown if the service in the container was not registered with the `SingleInstance()` lifetime scope. It is also invalid to register a `SingleInstance()` service in the container for a WCF service that is not marked as `InstanceContextMode.Single`.

Self-Hosted

It is possible to manually perform constructor injection for service marked with `InstanceContextMode.Single` when self-hosting. This is achieved by resolving a `SingleInstance()` service from the container and then passing that into the constructor of a manually created `ServiceHost`.

```
// Get the SingleInstance from the container.
var service = container.Resolve<IService1>();
// Pass it into the ServiceHost preventing it from creating an instance with the␣
↪default constructor.
var host = new ServiceHost(service, new Uri("http://localhost:8080/Service1"));
```

Simulating a Request Lifetime Scope

As noted earlier, **due to WCF internals, there is no explicit support in WCF for per-request lifetime dependencies.**

The way Autofac hooks into WCF, it uses an instance provider to resolve your service and dependencies. The instance provider makes use of the service instance context to track the lifetime scope in which your service and its dependencies live.

What that boils down to: A lifetime scope is created based on the instance context mode of your service.

If you leave it default, that's "per session." One instance of your service will be created when a client calls it, and subsequent calls from that client will get the same instance.

However, if you want to simulate a per-request lifetime scope, you can:

- Set your service to be instance-per-call using the WCF ServiceBehaviorAttribute.
- Register your service and dependencies to be instance-per-lifetime-scope.

Doing those two things, you'll get a new lifetime scope for every call (because the WCF instance context will want to create a new service instance per call). Your service and dependencies will then be resolved as just one time within that instance context lifetime scope - effectively a per-request lifetime.

Note this can backfire on you if you have dependencies that are shared between your per-call services and your per-session / single-instance services: In those, you don't get a new instance of the service for each call, which means the shared dependencies (registered "instance per lifetime scope") will also be a singleton for the life of the service. You may need to experiment and test with dependencies registered as "instance per call" or "instance per lifetime scope" to get the desired effect.

Using Decorators With Services

The standard Autofac service hosting works well for almost every case, but if you are using *decorators* on your WCF service implementation (not the dependencies, but the actual service implementation) then you need to use the *multitenant WCF service hosting mechanism* rather than the standard Autofac service host.

You do not need to use a multitenant container, pass a tenant ID, or use any of the other multitenant options, but you do need to use the multitenant service host.

The reason for this is that WCF hosting (internal to .NET) requires the host be initialized with a concrete type (not abstract/interface) and once the type is provided you can't change it. When using decorators, we don't actually know the final type (once you chain together all the decorators, etc.) until you resolve the first instance... but that happens after the host needs the type name. The multitenant hosting mechanism works around this by adding another dynamic proxy - an empty, target-free concrete class that implements the service interface. When the WCF host needs an implementation, one of these dynamic proxies gets fired up and the actual implementation (in this case, your decorated WCF implementation) will be the target.

Again, you only need to do this if you're decorating the service implementation class itself. If you are only decorating/adapting dependencies of the service implementation, you do not need the multitenant host. Standard hosting will work.

Example Implementation

The Autofac source contains a demo web application project called `Remember.Web` that consumes a WCF service from `Remember.Service`. It demonstrates how Autofac WCF integration works. There is also a demo project `MultitenantExample.WcfService` that shows how *multitenant service hosting* works.

Managed Extensibility Framework (MEF)

[TODO: Add documentation about `RegisterMetadataRegistrationSources()`]

The Autofac MEF integration allows you to expose extensibility points in your applications using the Managed Extensibility Framework.

To use MEF in an Autofac application, you must reference the .NET framework `System.ComponentModel.Composition.dll` assembly and get the Autofac.Mef package from NuGet.

Note this is a one-way operation - it allows Autofac to resolve items that were registered in MEF, but it doesn't allow MEF to resolve items that were registered in Autofac.

Consuming MEF Extensions in Autofac

The Autofac/MEF integration allows MEF catalogs to be registered with the ContainerBuilder, then use the RegisterComposablePartCatalog() extension method.

```
var builder = new ContainerBuilder();
var catalog = new DirectoryCatalog(@"C:\MyExtensions");
builder.RegisterComposablePartCatalog(catalog);
```

All MEF catalog types are supported:

- TypeCatalog
- AssemblyCatalog
- DirectoryCatalog

Once MEF catalogs are registered, exports within them can be resolved through the Autofac container or by injection into other components. For example, say you have a class with an export type defined using MEF attributes:

```
[Export(typeof(IService))]
public class Component : IService { }
```

Using MEF catalogs, you can register that type. Autofac will find the exported interface and provide the service.

```
var catalog = new TypeCatalog(typeof(Component));
builder.RegisterComposablePartCatalog(catalog);
var container = builder.Build();

// The resolved IService will be implemented
// by type Component.
var obj = container.Resolve<IService>();
```

Providing Autofac Components to MEF Extensions

Autofac components aren't automatically available for MEF extensions to import. Which is to say, if you use Autofac to resolve a component that was registered using MEF, only other services registered using MEF will be allowed to satisfy its dependencies.

To provide an Autofac component to MEF, the Exported() extension method must be used:

```
builder.RegisterType<Component>()
       .Exported(x => x.As<IService>().WithMetadata("SomeData", 42));
```

Again, this is a one-way operation. It allows Autofac to provide dependencies to MEF components that are registered within Autofac - it doesn't export Autofac registrations to be resolved from a MEF catalog.

Common Service Locator

The Autofac.Extras.CommonServiceLocator package allows you to use Autofac as the backing store for services in places where you require Microsoft Common Service Locator integration.

The Autofac.Extras.CommonServiceLocator package will also work in conjunction with the *Autofac Microsoft Enterprise Library integration package*.

To use the Common Service Locator integration, build your Autofac container as normal, then simply set the current service locator to an `AutofacServiceLocator`.

```
var builder = new ContainerBuilder();

// Perform registrations and build the container.
var container = builder.Build();

// Set the service locator to an AutofacServiceLocator.
var csl = new AutofacServiceLocator(container);
ServiceLocator.SetLocatorProvider(() => csl);
```

Enterprise Library 5

The Autofac.Extras.EnterpriseLibraryConfigurator package provides a way to use Autofac as the backing store for dependency injection in Microsoft Enterprise Library 5 instead of using Unity. It does this in conjunction with *the Autofac Common Service Locator implementation*.

In Enterprise Library 6, Microsoft removed the tightly-coupled dependency resolution mechanisms from the application blocks so there's no more need for this configurator past Enterprise Library 5.

Using the Configurator

The simplest way to use the configurator is to set up your Enterprise Library configuration in your `app.config` or `web.config` and use the `RegisterEnterpriseLibrary()` extension. This extension parses the configuration and performs the necessary registrations. You then need to set the `EnterpriseLibraryContainer.Current` to use an `AutofacServiceLocator` from *the Autofac Common Service Locator implementation*.

```
var builder = new ContainerBuilder();
builder.RegisterEnterpriseLibrary();
var container = builder.Build();
var csl = new AutofacServiceLocator(container);
EnterpriseLibraryContainer.Current = csl;
```

Specifying a Registration Source

The `RegisterEnterpriseLibrary()` extension does allow you to specify your own `IConfigurationSource` so if your configuration is not in `app.config` or `web.config` you can still use Autofac.

```
var config = GetYourConfigurationSource();
var builder = new ContainerBuilder();
builder.RegisterEnterpriseLibrary(config);
var container = builder.Build();
var csl = new AutofacServiceLocator(container);
EnterpriseLibraryContainer.Current = csl;
```

NHibernate

http://chadly.net/2009/05/dependency-injection-with-nhibernate-and-autofac/

Moq

The Moq integration package allows you to automatically create mock dependencies for both concrete and mock abstract instances in unit tests using an Autofac container. You can get the Autofac.Extras.Moq package on NuGet.

Getting Started

Given you have a system under test and a dependency:

```
public class SystemUnderTest
{
  public SystemUnderTest(IDependency dependency)
  {
  }
}

public interface IDependency
{
}
```

When writing your unit test, use the `Autofac.Extras.Moq.AutoMock` class to instantiate the system under test. Doing this will automatically inject a mock dependency into the constructor for you. At the time you create the `AutoMock` factory, you can specify default mock behavior:

- `AutoMock.GetLoose()` - creates automatic mocks using loose mocking behavior.
- `AutoMock.GetStrict()` - creates automatic mocks using strict mocking behavior.
- `AutoMock.GetFromRepository(repo)` - creates mocks based on an existing configured repository.

```
[Test]
public void Test()
{
  using (var mock = AutoMock.GetLoose())
  {
    // The AutoMock class will inject a mock IDependency
    // into the SystemUnderTest constructor
    var sut = mock.Create<SystemUnderTest>();
  }
}
```

Configuring Mocks

You can configure the automatic mocks and/or assert calls on them as you would normally with Moq.

```
[Test]
public void Test()
{
  using (var mock = AutoMock.GetLoose())
  {
    // Arrange - configure the mock
    mock.Mock<IDependency>().Setup(x => x.GetValue()).Returns("expected value");
    var sut = mock.Create<SystemUnderTest>();

    // Act
    var actual = sut.DoWork();
```

```
    // Assert - assert on the mock
    mock.Mock<IDependency>().Verify(x => x.GetValue());
    Assert.AreEqual("expected value", actual);
  }
}

public class SystemUnderTest
{
  private readonly IDependency dependency;

  public SystemUnderTest(IDependency strings)
  {
    this.dependency = strings;
  }

  public string DoWork()
  {
    return this.dependency.GetValue();
  }
}

public interface IDependency
{
  string GetValue();
}
```

Configuring Specific Dependencies

You can configure the `AutoMock` to provide a specific instance for a given service type:

```
[Test]
public void Test()
{
  using (var mock = AutoMock.GetLoose())
  {
    var dependency = new Dependency();
    mock.Provide<IDependency>(dependency);

    // ...and the rest of the test.
  }
}
```

You can also configure the `AutoMock` to provide a specific implementation type for a given service type:

```
[Test]
public void Test()
{
  using (var mock = AutoMock.GetLoose())
  {
    // Configure a component type that doesn't require
    // constructor parameters.
    mock.Provide<IDependency, Dependency>();

    // Configure a component type that has some
    // constructor parameters passed in. Use Autofac
```

```
    // parameters in the list.
    mock.Provide<IOtherDependency, OtherDependency>(
                new NamedParameter("id", "service-identifier"),
                new TypedParameter(typeof(Guid), Guid.NewGuid()));

    // ...and the rest of the test.
  }
}
```

FakeItEasy

The FakeItEasy integration package allows you to automatically create fake dependencies for both concrete and fake abstract instances in unit tests using an Autofac container. You can get the Autofac.Extras.FakeItEasy package on NuGet.

Getting Started

Given you have a system under test and a dependency:

```
public class SystemUnderTest
{
  public SystemUnderTest(IDependency dependency)
  {
  }
}

public interface IDependency
{
}
```

When writing your unit test, use the `Autofac.Extras.FakeItEasy.AutoFake` class to instantiate the system under test. Doing this will automatically inject a fake dependency into the constructor for you.

```
[Test]
public void Test()
{
  using (var fake = new AutoFake())
  {
    // The AutoFake class will inject a fake IDependency
    // into the SystemUnderTest constructor
    var sut = fake.Resolve<SystemUnderTest>();
  }
}
```

Configuring Fakes

You can configure the automatic fakes and/or assert calls on them as you would normally with FakeItEasy.

```
[Test]
public void Test()
{
  using (var fake = new AutoFake())
```

```
    {
      // Arrange - configure the fake
      A.CallTo(() => fake.Resolve<IDependency>().GetValue()).Returns("expected value");
      var sut = fake.Resolve<SystemUnderTest>();

      // Act
      var actual = sut.DoWork();

      // Assert - assert on the fake
      A.CallTo(() => fake.Resolve<IDependency>().GetValue()).MustHaveHappened();
      Assert.AreEqual("expected value", actual);
    }
  }

public class SystemUnderTest
{
  private readonly IDependency dependency;

  public SystemUnderTest(IDependency strings)
  {
    this.dependency = strings;
  }

  public string DoWork()
  {
    return this.dependency.GetValue();
  }
}

public interface IDependency
{
  string GetValue();
}
```

Configuring Specific Dependencies

You can configure the `AutoFake` to provide a specific instance for a given service type:

```
[Test]
public void Test()
{
  using (var fake = new AutoFake())
  {
    var dependency = new Dependency();
    fake.Provide(dependency);

    // ...and the rest of the test.
  }
}
```

You can also configure the `AutoFake` to provide a specific implementation type for a given service type:

```
[Test]
public void Test()
{
  using (var fake = new AutoFake())
```

```
  {
    // Configure a component type that doesn't require
    // constructor parameters.
    fake.Provide<IDependency, Dependency>();

    // Configure a component type that has some
    // constructor parameters passed in. Use Autofac
    // parameters in the list.
    fake.Provide<IOtherDependency, OtherDependency>(
                new NamedParameter("id", "service-identifier"),
                new TypedParameter(typeof(Guid), Guid.NewGuid()));

    // ...and the rest of the test.
  }
}
```

Options for Fakes

You can specify options for fake creation using optional constructor parameters on `AutoFake`:

```
using(var fake = new AutoFake(
    // Create fakes with strict behavior (unconfigured calls throw exceptions)
    strict: true,

    // Calls to fakes of abstract types will call the base methods on the abstract␣
↪types
    callsBaseMethods: true,

    // Calls to fake methods will return null rather than generated fakes
    callsDoNothing: true,

    // Provide an action to perform upon the creation of each fake
    onFakeCreated: f => { ... }))
{
  // Use the fakes/run the test.
}
```

CHAPTER 8

Best Practices and Recommendations

You can always ask for Autofac usage guidance on StackOverflow using the `autofac` tag or in the discussion group, but these quick tips can help get you going.

Always Resolve Dependencies from Nested Lifetimes

Autofac is designed to *track and dispose of resources* for you. To ensure this happens, make sure that long-running applications are partitioned into units of work (requests or transactions) and that services are resolved through unit of work level lifetime scopes. The *per-request lifetime scope support in ASP.NET* is an example of this technique.

Structure Configuration with Modules

Autofac modules give structure to container configuration and allow deployment-time settings to be injected. Rather than using *XML configuration* alone, consider modules for a more flexible approach. Modules can always be combined with XML configuration for a best-of-both-worlds experience.

Use As<T>() in Delegate Registrations

Autofac infers implementation type from the expressions you use to register components:

```
builder.Register(c => new Component()).As<IComponent>();
```

...makes the type `Component` the `LimitType` of the component. These other type casting mechanisms are equivalent but don't provide the correct `LimitType`:

```
// Works, but avoid this
builder.Register(c => (IComponent)new Component());
```

```
// Works, but avoid this
builder.Register<IComponent>(c => new Component());
```

Use Constructor Injection

The concept of using constructor injection for required dependencies and property injection for optional dependencies is quite well known. An alternative, however, is to use the "Null Object" or "Special Case" pattern to provide default, do-nothing implementations for the optional service. This prevents the possibility of special-case code in the implementation of the component (e.g. `if (Logger != null) Logger.Log("message");`).

Use Relationship Types, Not Service Locators

Giving components access to the container, storing it in a public static property, or making functions like `Resolve()` available on a global "IoC" class defeats the purpose of using dependency injection. Such designs have more in common with the Service Locator pattern.

If components have a dependency on the container (or on a lifetime scope), look at how they're using the container to retrieve services, and add those services to the component's (dependency injected) constructor arguments instead.

Use *relationship types* for components that need to instantiate other components or interact with the container in more advanced ways.

Register Components from Least-to-Most Specific

Autofac overrides component registrations by default. This means that an application can register all of its default components, then read an associated configuration file to override any that have been customized for the deployment environment.

Use Profilers for Performance Checking

Before doing any performance optimization or making assumptions about potential memory leaks, **always run a profiler** like SlimTune, dotTrace, or ANTS to see where time is truly being spent. It might not be where you think.

Register Once, Resolve Many

Don't register components during units of work if you can avoid it; it is more expensive to register a component than resolve one. Use nested lifetime scopes and appropriate *instance scopes* to keep per-unit-of-work instances separate.

Register Frequently-Used Components with Lambdas

If you do need to squeeze extra performance out of Autofac, your best bet is to identify the most frequently-created components and register them using an expression rather than by type, e.g.:

```
builder.RegisterType<Component>();
```

Becomes:

```
builder.Register(c => new Component());
```

This can yield an improvement of up to 10x faster `Resolve()` calls, but only makes sense for components that appear in many object graphs. See *the registration documentation* for more on lambda components.

Consider a Container as Immutable

While Autofac provides an `Update()` method to update registrations in an existing container, for the most part it's there for backwards-compatibility with Autofac 2.x. Where at all possible, you should avoid updating a container and instead register everything up front before building the container.

If you modify a container after being built, you run several risks, especially if you've started using the container. This is not an all-inclusive risk list, but examples include:

- *Auto-start components* will have already run and potentially used registrations you've overridden during update. These auto-start components will not re-run.
- Services that have already been resolved may have references to incorrect dependencies based on the additions made.
- Disposable components may have already been resolved and will stick around until their owning lifetime scope is disposed - even if the new registrations would imply the disposable component shouldn't be used.
- Component registrations that subscribe to lifetime events may be subscribed to the wrong events after the update - events don't all get re-initialized during update.

If there's absolutely no way around it, you very well may need to `Update()` a container, but really try to avoid it if possible.

Instead of updating the container, consider registering updates or changes in a child lifetime scope. *There are examples of this in the lifetime scope documentation.*

CHAPTER 9

Advanced Topics

Registration Sources

A *registration source* is a way to dynamically feed registrations into an Autofac component context (e.g., container or lifetime scope).

Registration sources are created by implementing the `IRegistrationSource` interface. Many of the Autofac features are implemented this way - for example, the *implicit relationship types* are added via registration sources. (You didn't think we actually registered every single type of collection manually into the container, did you?) Nick Blumhardt has a great blog article about how this works.

Registration sources are great when you don't have a finite set of registrations you can add to a container. Many times, *assembly scanning* and/or *use of modules* can address dynamic registration concerns... but when all else fails or those means don't accomplish what you're looking to do, a registration source may be the way to go.

"Any Concrete Type Not Already Registered" Source

The `AnyConcreteTypeNotAlreadyRegisteredSource`, or "ACTNARS" as we call it, is an example of a registration source that Autofac ships with that allows you to resolve any concrete type from the Autofac container regardless of whether or not you specifically registered it. People moving from other inversion-of-control containers may be used to this sort of behavior, so ACTNARS is a way to bridge that gap.

You can use the `Autofac.Features.ResolveAnything.AnyConcreteTypeNotAlreadyRegisteredSource` by adding it to your container.

```
var builder = new ContainerBuilder();
builder.RegisterSource(new AnyConcreteTypeNotAlreadyRegisteredSource());
var container = builder.Build();
```

Implementing a Registration Source

The best way to show how to implement a registration source is through a simple example.

Let's say you have a factory that is responsible for generating some sort of event handler class. You need to generate them through the factory rather than through Autofac, so you don't have the handlers themselves registered with Autofac. At the same time, there's not a good way to say "when a person asks for any event handler, generate it through this special factory." This is a great example of where a registration source can come in handy.

For the example, let's define a simple event handler base/abstract class and a couple of implementations.

```
public abstract class BaseHandler
{
  public virtual string Handle(string message)
  {
    return "Handled: " + message;
  }
}

public class HandlerA : BaseHandler
{
  public override string Handle(string message)
  {
    return "[A] " + base.Handle(message);
  }
}

public class HandlerB : BaseHandler
{
  public override string Handle(string message)
  {
    return "[B] " + base.Handle(message);
  }
}
```

Now let's create a factory interface and implementation.

```
public interface IHandlerFactory
{
  T GetHandler<T>() where T : BaseHandler;
}

public class HandlerFactory : IHandlerFactory
{
  public T GetHandler<T>() where T : BaseHandler
  {
    return (T)Activator.CreateInstance(typeof(T));
  }
}
```

Finally, let's create a couple of consuming classes that use the handlers.

```
public class ConsumerA
{
  private HandlerA _handler;
  public ConsumerA(HandlerA handler)
  {
    this._handler = handler;
  }

  public void DoWork()
  {
    Console.WriteLine(this._handler.Handle("ConsumerA"));
```

```
  }
}


public class ConsumerB
{
  private HandlerB _handler;
  public ConsumerB(HandlerB handler)
  {
    this._handler = handler;
  }

  public void DoWork()
  {
    Console.WriteLine(this._handler.Handle("ConsumerB"));
  }
}
```

Now that we have the services and the consumers, let's make a registration source. In the example source, we'll...

1. Determine if the resolve operation is asking for a `BaseHandler` type or not. If it's not, the source won't provide any registration to satisfy the resolve request.
2. Build up the dynamic registration for the specific type of `BaseHandler` derivative being requested, which will include the lambda that invokes the provider/factory to get the instance.
3. Return the dynamic registration to the resolve operation so it can do the work.

Here's the code for the registration source.

```
using Autofac;
using Autofac.Core;
using Autofac.Core.Activators.Delegate;
using Autofac.Core.Lifetime;
using Autofac.Core.Registration;

public class HandlerRegistrationSource : IRegistrationSource
{
  public IEnumerable<IComponentRegistration> RegistrationsFor(
    Service service,
    Func<Service, IEnumerable<IComponentRegistration>> registrationAccessor)
  {
    var swt = service as IServiceWithType;
    if(swt == null || !typeof(BaseHandler).IsAssignableFrom(swt.ServiceType))
    {
      // It's not a request for the base handler type, so skip it.
      return Enumerable.Empty<IComponentRegistration>();
    }

    // This is where the magic happens!
    var registration = new ComponentRegistration(
      Guid.NewGuid(),
      new DelegateActivator(swt.ServiceType, (c, p) =>
        {
          // In this example, the factory itself is assumed to be registered
          // with Autofac, so we can resolve the factory. If you want to hard
          // code the factory here, you can do that, too.
          var provider = c.Resolve<IHandlerFactory>();
```

```
        // Our factory interface is generic, so we have to use a bit of
        // reflection to make the call.
        var method = provider.GetType().GetMethod("GetHandler").
↪MakeGenericMethod(swt.ServiceType);

        // In the end, return the object from the factory.
        return method.Invoke(provider, null);
      }),
    new CurrentScopeLifetime(),
    InstanceSharing.None,
    InstanceOwnership.OwnedByLifetimeScope,
    new [] { service },
    new Dictionary<string, object>());

    return new IComponentRegistration[] { registration };
  }

  public bool IsAdapterForIndividualComponents { get{ return false; } }
}
```

The last step is to register everything with Autofac - the registration source, the factory, and the consuming classes. Notice, though, that we don't have to register the actual handlers themselves because the registration source takes care of that.

```
var builder = new ContainerBuilder();
builder.RegisterType<HandlerFactory>().As<IHandlerFactory>();
builder.RegisterSource(new HandlerRegistrationSource());
builder.RegisterType<ConsumerA>();
builder.RegisterType<ConsumerB>();
var container = builder.Build();
```

Now when you resolve one of your handler consumers, you'll get the correct handler.

```
using(var scope = container.BeginLifetimeScope())
{
  var consumer = scope.Resolve<ConsumerA>();

  // Calling this will yield the following output on the console:
  // [A] Handled: ConsumerA
  consumer.DoWork();
}
```

Adapters and Decorators

Adapters

The adapter pattern takes one service contract and adapts it (like a wrapper) to another.

This introductory article describes a concrete example of the adapter pattern and how you can work with it in Autofac.

Autofac provides built-in adapter registration so you can register a set of services and have them each automatically adapted to a different interface.

```
var builder = new ContainerBuilder();
```

```
// Register the services to be adapted
builder.RegisterType<SaveCommand>()
       .As<ICommand>()
       .WithMetadata("Name", "Save File");
builder.RegisterType<OpenCommand>()
       .As<ICommand>()
       .WithMetadata("Name", "Open File");

// Then register the adapter. In this case, the ICommand
// registrations are using some metadata, so we're
// adapting Meta<ICommand> instead of plain ICommand.
builder.RegisterAdapter<Meta<ICommand>, ToolbarButton>(
   cmd => new ToolbarButton(cmd.Value, (string)cmd.Metadata["Name"]));

var container = builder.Build();

// The resolved set of buttons will have two buttons
// in it - one button adapted for each of the registered
// ICommand instances.
var buttons = container.Resolve<IEnumerable<ToolbarButton>>();
```

Decorators

The decorator pattern is somewhat similar to the adapter pattern, where one service "wraps" another. However, in contrast to adapters, decorators expose the *same service* as what they're decorating. The point of using decorators is to add functionality to an object without changing the object's signature.

This article has some details about how decorators work in Autofac.

Autofac provides built-in decorator registration so you can register services and have them automatically wrapped with decorator classes.

```
var builder = new ContainerBuilder();

// Register the services to be decorated. You have to
// name them rather than register them As<ICommandHandler>()
// so the *decorator* can be the As<ICommandHandler>() registration.
builder.RegisterType<SaveCommandHandler>()
       .Named<ICommandHandler>("handler");
builder.RegisterType<OpenCommandHandler>()
       .Named<ICommandHandler>("handler");

// Then register the decorator. The decorator uses the
// named registrations to get the items to wrap.
builder.RegisterDecorator<ICommandHandler>(
    (c, inner) => new CommandHandlerDecorator(inner),
    fromKey: "handler");

var container = builder.Build();

// The resolved set of commands will have two items
// in it, both of which will be wrapped in a CommandHandlerDecorator.
var handlers = container.Resolve<IEnumerable<ICommandHandler>>();
```

You can also use open generic decorator registrations.

```
var builder = new ContainerBuilder();

// Register the open generic with a name so the
// decorator can use it.
builder.RegisterGeneric(typeof(CommandHandler<>))
       .Named("handler", typeof(ICommandHandler<>));

// Register the generic decorator so it can wrap
// the resolved named generics.
builder.RegisterGenericDecorator(
        typeof(CommandHandlerDecorator<>),
        typeof(ICommandHandler<>),
        fromKey: "handler");

var container = builder.Build();

// You can then resolve closed generics and they'll be
// wrapped with your decorator.
var mailHandlers = container.Resolve<IEnumerable<ICommandHandler<EmailCommand>>>();
```

If you are using decorators on a WCF service implementation class, *there is some additional information on the WCF integration page about some special considerations.*

Circular Dependencies

Circular dependencies are mutual runtime dependencies between components.

Property/Property Dependencies

This is when you have one class (`DependsByProperty1`) that takes a property dependency of a second type (`DependsByProperty2`), and the second type (`DependsByProperty2`) has a property dependency of the first type (`DependsByProperty1`).

If you have this situation, there are some important things to remember:

- **Make the property dependencies settable.** The properties must be writeable.
- **Register the types using** `PropertiesAutowired`. Be sure to set the behavior to allow circular dependencies.
- **Neither type can be registered as** `InstancePerDependency`. If either type is set to factory scope you won't get the results you're looking for (where the two types refer to each other). You can scope them however you like - `SingleInstance`, `InstancePerLifetimeScope`, or any other scope - just not factory.

Example:

```
class DependsByProp1
{
  public DependsByProp2 Dependency { get; set; }
}

class DependsByProp2
{
  public DependsByProp1 Dependency { get; set; }
}
```

```
// ...

var cb = new ContainerBuilder();
cb.RegisterType<DependsByProp1>()
  .InstancePerLifetimeScope()
  .PropertiesAutowired(PropertyWiringOptions.AllowCircularDependencies);
cb.RegisterType<DependsByProp2>()
  .InstancePerLifetimeScope()
  .PropertiesAutowired(PropertyWiringOptions.AllowCircularDependencies);
```

Constructor/Property Dependencies

This is when you have one class (`DependsByCtor`) that takes a constructor dependency of a second type (`DependsByProperty`), and the second type (`DependsByProperty`) has a property dependency of the first type (`DependsByCtor`).

If you have this situation, there are some important things to remember:

- **Make the property dependency settable.** The property on the type with the property dependency must be writeable.
- **Register the type with the property dependency using** `PropertiesAutowired`. Be sure to set the behavior to allow circular dependencies.
- **Neither type can be registered as** `InstancePerDependency`. If either type is set to factory scope you won't get the results you're looking for (where the two types refer to each other). You can scope them however you like - `SingleInstance`, `InstancePerLifetimeScope`, or any other scope - just not factory.

Example:

```
class DependsByCtor
{
  public DependsByCtor(DependsByProp dependency) { }
}

class DependsByProp
{
  public DependsByCtor Dependency { get; set; }
}

// ...

var cb = new ContainerBuilder();
cb.RegisterType<DependsByCtor>()
  .InstancePerLifetimeScope();
cb.RegisterType<DependsByProperty>()
  .InstancePerLifetimeScope()
  .PropertiesAutowired(PropertyWiringOptions.AllowCircularDependencies);
```

Constructor/Constructor Dependencies

Two types with circular constructor dependencies are **not supported**. You will get an exception when you try to resolve types registered in this manner.

You may be able to work around this using the DynamicProxy2 extension and some creative coding.

Component Metadata / Attribute Metadata

If you're familiar with the Managed Extensibility Framework (MEF) you have probably seen examples using component metadata.

Metadata is information about a component, stored with that component, accessible without necessarily creating a component instance.

Adding Metadata to a Component Registration

Values describing metadata are associated with the component at registration time. Each metadata item is a name/value pair:

```
builder.Register(c => new ScreenAppender())
    .As<ILogAppender>()
    .WithMetadata("AppenderName", "screen");
```

The same thing can be represented in XML:

```
<component
   type="MyApp.Components.Logging.ScreenAppender, MyApp"
   service="MyApp.Services.Logging.ILogAppender, MyApp" >
    <metadata>
        <item name="AppenderName" value="screen" type="System.String" />
    </metadata>
</component>
```

Consuming Metadata

Unlike a regular property, a metadata item is independent of the component itself.

This makes it useful when selecting one of many components based on runtime criteria; or, where the metadata isn't intrinsic to the component implementation. Metadata could represent the time that an `ITask` should run, or the button caption for an `ICommand`.

Other components can consume metadata using the `Meta<T>` type.

```
public class Log
{
  readonly IEnumerable<Meta<ILogAppender>> _appenders;

  public Log(IEnumerable<Meta<ILogAppender>> appenders)
  {
    _appenders = appenders;
  }

  public void Write(string destination, string message)
  {
    var appender = _appenders.First(a => a.Metadata["AppenderName"].Equals(
↪destination));
    appender.Value.Write(message);
  }
}
```

To consume metadata without creating the target component, use *Meta<Lazy<T>>* or the .NET 4 *Lazy<T, TMetadata>* types as shown below.

Strongly-Typed Metadata

To avoid the use of string-based keys for describing metadata, a metadata class can be defined with a public read/write property for every metadata item:

```
public class AppenderMetadata
{
  public string AppenderName { get; set; }
}
```

At registration time, the class is used with the overloaded `WithMetadata` method to associate values:

```
builder.Register(c => new ScreenAppender())
    .As<ILogAppender>()
    .WithMetadata<AppenderMetadata>(m =>
        m.For(am => am.AppenderName, "screen"));
```

Notice the use of the strongly-typed `AppenderName` property.

Registration and consumption of metadata are separate, so strongy-typed metadata can be consumed via the weakly-typed techniques and vice-versa.

You can also provide default values using the `DefaultValue` attribute:

```
public class AppenderMetadata
{
  [DefaultValue("screen")]
  public string AppenderName { get; set; }
}
```

If you are able to reference `System.ComponentModel.Composition` you can use the `System.Lazy<T, TMetadata>` type for consuming values from the strongly-typed metadata class:

```
public class Log
{
  readonly IEnumerable<Lazy<ILogAppender, LogAppenderMetadata>> _appenders;

  public Log(IEnumerable<Lazy<ILogAppender, LogAppenderMetadata>> appenders)
  {
    _appenders = appenders;
  }

  public void Write(string destination, string message)
  {
    var appender = _appenders.First(a => a.Metadata.AppenderName == destination);
    appender.Value.Write(message);
  }
}
```

Another neat trick is the ability to pass the metadata dictionary into the constructor of your metadata class:

```
public class AppenderMetadata
{
  public AppenderMetadata(IDictionary<string, object> metadata)
  {
    AppenderName = (string)metadata["AppenderName"];
  }
```

```
  public string AppenderName { get; set; }
}
```

Interface-Based Metadata

If you have access to `System.ComponentModel.Composition` and include a reference to the *Autofac.Mef* package you can use an interface for your metadata instead of a class.

The interface should be defined with a readable property for every metadata item:

```
public interface IAppenderMetadata
{
  string AppenderName { get; }
}
```

You must also call the `RegisterMetadataRegistrationSources` method on the `ContainerBuilder` before registering the metadata against the interface type.

```
builder.RegisterMetadataRegistrationSources();
```

At registration time, the interface is used with the overloaded `WithMetadata` method to associate values:

```
builder.Register(c => new ScreenAppender())
    .As<ILogAppender>()
    .WithMetadata<IAppenderMetadata>(m =>
        m.For(am => am.AppenderName, "screen"));
```

Resolving the value can be done in the same manner as for class based metadata.

Attribute-Based Metadata

The `Autofac.Extras.Attributed` package enables metadata to be specified via attributes as well as allowing components to filter incoming dependencies using attributes.

To get attributed metadata working in your solution, you need to perform the following steps:

1. *Create Your Metadata Attribute*
2. *Apply Your Metadata Attribute*
3. *Use Metadata Filters on Consumers*
4. *Ensure the Container Uses Your Attributes*

Create Your Metadata Attribute

A metadata attribute is a `System.Attribute` implementation that has the System.ComponentModel.Composition.MetadataAttributeAttribute applied.

Any publicly-readable properties on the attribute will become name/value attribute pairs - the name of the metadata will be the property name and the value will be the property value.

In the example below, the `AgeMetadataAttribute` will provide a name/value pair of metadata where the name will be `Age` (the property name) and the value will be whatever is specified in the attribute during construction.

```
[MetadataAttribute]
public class AgeMetadataAttribute : Attribute
{
  public int Age { get; private set; }

  public AgeMetadataAttribute(int age)
  {
    Age = age;
  }
}
```

Apply Your Metadata Attribute

Once you have a metadata attribute, you can apply it to your component types to provide metadata.

```
// Don't apply it to the interface (service type)
public interface IArtwork
{
  void Display();
}

// Apply it to the implementation (component type)
[AgeMetadata(100)]
public class CenturyArtwork : IArtwork
{
  public void Display() { ... }
}
```

Use Metadata Filters on Consumers

Along with providing metadata via attributes, you can also set up automatic filters for consuming components. This will help wire up parameters for your constructors based on provided metadata.

You can filter based on *a service key* or based on registration metadata.

WithKeyAttribute

The `WithKeyAttribute` allows you to select a specific keyed service to consume.

This example shows a class that requires a component with a particular key:

```
public class ArtDisplay : IDisplay
{
  public ArtDisplay([WithKey("Painting")] IArtwork art) { ... }
}
```

That component will require you to register a keyed service with the specified name. You'll also need to register the component with the filter so the container knows to look for it.

```
var builder = new ContainerBuilder();

// Register the keyed service to consume
builder.RegisterType<MyArtwork>().Keyed<IArtwork>("Painting");
```

```
// Specify WithAttributeFilter for the consumer
builder.RegisterType<ArtDisplay>().As<IDisplay>().WithAttributeFilter();

// ...
var container = builder.Build();
```

WithMetadataAttribute

The `WithMetadataAttribute` allows you to filter for components based on specific metadata values.

This example shows a class that requires a component with a particular metadata value:

```
public class ArtDisplay : IDisplay
{
  public ArtDisplay([WithMetadata("Age", 100)] IArtwork art) { ... }
}
```

That component will require you to register a service with the specified metadata name/value pair. You could use the attributed metadata class seen in earlier examples, or manually specify metadata during registration time. You'll also need to register the component with the filter so the container knows to look for it.

```
var builder = new ContainerBuilder();

// Register the service to consume with metadata.
// Since we're using attributed metadata, we also
// need to register the AttributedMetadataModule
// so the metadata attributes get read.
builder.RegisterModule<AttributedMetadataModule>();
builder.RegisterType<CenturyArtwork>().As<IArtwork>();

// Specify WithAttributeFilter for the consumer
builder.RegisterType<ArtDisplay>().As<IDisplay>().WithAttributeFilter();

// ...
var container = builder.Build();
```

Ensure the Container Uses Your Attributes

The metadata attributes you create aren't just used by default. In order to tell the container that you're making use of metadata attributes, you need to register the `AttributedMetadataModule` into your container.

```
var builder = new ContainerBuilder();

// Register the service to consume with metadata.
// Since we're using attributed metadata, we also
// need to register the AttributedMetadataModule
// so the metadata attributes get read.
builder.RegisterModule<AttributedMetadataModule>();
builder.RegisterType<CenturyArtwork>().As<IArtwork>();

// ...
var container = builder.Build();
```

If you're using metadata filters (`WithKeyAttribute` or `WithMetadataAttribute` in your constructors), you need to register those components using the `WithAttributeFilter` extension. Note that if you're *only* using filters but not attributed metadata, you don't actually need the `AttributedMetadataModule`. Metadata filters stand on their own.

```
var builder = new ContainerBuilder();

// Specify WithAttributeFilter for the consumer
builder.RegisterType<ArtDisplay>().As<IDisplay>().WithAttributeFilter();
// ...
var container = builder.Build();
```

Named and Keyed Services

Autofac provides three typical ways to identify services. The most common is to identify by type:

```
builder.Register<OnlineState>().As<IDeviceState>();
```

This example associates the `IDeviceState` typed service with the `OnlineState` component. Instances of the component can be retrieved using the service type with the `Resolve()` method:

```
var r = container.Resolve<IDeviceState>();
```

However, you can also identify services by a string name or by an object key.

Named Services

Services can be further identified using a service name. Using this technique, the `Named()` registration method replaces `As()`.

```
builder.Register<OnlineState>().Named<IDeviceState>("online");
```

To retrieve a named service, the `ResolveNamed()` method is used:

```
var r = container.ResolveNamed<IDeviceState>("online");
```

Named services are simply keyed services that use a string as a key, so the techniques described in the next section apply equally to named services.

Keyed Services

Using strings as component names is convenient in some cases, but in others we may wish to use keys of other types. Keyed services provide this ability.

For example, an enum may describe the different device states in our example:

```
public enum DeviceState { Online, Offline }
```

Each enum value corresponds to an implementation of the service:

```
public class OnlineState : IDeviceState { }
```

The enum values can then be registered as keys for the implementations as shown below.

```
var builder = new ContainerBuilder();
builder.RegisterType<OnlineState>().Keyed<IDeviceState>(DeviceState.Online);
builder.RegisterType<OfflineState>().Keyed<IDeviceState>(DeviceState.Offline);
// Register other components here
```

Resolving Explicitly

The implementation can be resolved explicitly with `ResolveKeyed()`:

```
var r = container.ResolveKeyed<IDeviceState>(DeviceState.Online);
```

This does however result in using the container as a Service Locator, which is discouraged. As an alternative to this pattern, the `IIndex` type is provided.

Resolving with an Index

`Autofac.Features.Indexed.IIndex<K,V>` is a *relationship type that Autofac implements automatically*. Components that need to choose between service implementations based on a key can do so by taking a constructor parameter of type `IIndex<K,V>`.

```
public class Modem : IHardwareDevice
{
  IIndex<DeviceState, IDeviceState> _states;
  IDeviceState _currentState;

  public Modem(IIndex<DeviceState, IDeviceState> states)
  {
     _states = states;
     SwitchOn();
  }

  void SwitchOn()
  {
     _currentState = _states[DeviceState.Online];
  }
}
```

In the `SwitchOn()` method, the index is used to find the implementation of `IDeviceState` that was registered with the `DeviceState.Online` key.

Resolving with Attributes

The *metadata feature of Autofac provides a WithKeyAttribute* that allows you to mark constructor parameters with an attribute specfying which keyed service should be used. The attribute usage looks like this:

```
public class ArtDisplay : IDisplay
{
  public ArtDisplay([WithKey("Painting")] IArtwork art) { ... }
}
```

See the metadata documentation for more info on how to get this set up.

Delegate Factories

[TODO: Include an example of using `RegisterGeneratedFactory`.]

Factory adapters provide the instantiation features of the container to managed components without exposing the container itself to them.

If type `T` is registered with the container, Autofac will *automatically resolve dependencies* on `Func<T>` as factories that create `T` instances through the container.

Lifetime scopes are respected using delegate factories as well as when using `Func<T>` or the parameterized `Func<X,Y,T>` relationshps. If you register an object as `InstancePerDependency()` and call the delegate factory multiple times, you'll get a new instance each time. However, if you register an object as `SingleInstance()` and call the delegate factory to resolve the object more than once, you will get *the same object instance every time regardless of the different parameters you pass in.* Just passing different parameters will not break the respect for the lifetime scope.

Creation through Factories

Shareholdings

```
public class Shareholding
{
  public delegate Shareholding Factory(string symbol, uint holding);

  public Shareholding(string symbol, uint holding)
  {
    Symbol = symbol;
    Holding = holding;
  }

  public string Symbol { get; private set; }

  public uint Holding { get; set; }
}
```

The `Shareholding` class declares a constructor, but also provides a delegate type that can be used to create `Shareholdings` indirectly.

Autofac can make use of this to automatically generate a factory that can be accessed through the container:

```
var builder = new ContainerBuilder();
builder.RegisterType<Shareholding>();
var container = builder.Build();
var shareholdingFactory = container.Resolve<Shareholding.Factory>();
var shareholding = shareholdingFactory.Invoke("ABC", 1234);
```

The factory is a standard delegate that can be called with `Invoke()`, as above, or with the function syntax `shareholdingFactory("ABC", 123)`.

By default, Autofac matches the parameters of the delegate to the parameters of the constructor by name. If you use the generic Func types, Autofac will switch to matching parameters by type.

Portfolio

Other components can use the factory:

```
public class Portfolio
{
  Shareholding.Factory ShareholdingFactory { get; set; }
  IList<Shareholding> _holdings = new List<Shareholding>();

  public Portfolio(Shareholding.Factory shareholdingFactory)
  {
    ShareholdingFactory = shareholdingFactory;
  }

  public void Add(string symbol, uint holding)
  {
    _holdings.Add(ShareholdingFactory(symbol, holding));
  }
}
```

To wire this up, the `Portfolio` class would be registered with the container before building using:

```
builder.RegisterType<Portfolio>();
```

Using the Components

The components can be used by requesting an instance of `Portfolio` from the container:

```
var portfolio = container.Resolve<Portfolio>();
portfolio.Add("DEF", 4324);
```

Autofac supports the use of `Func<T>` delegates in addition to hand-coded delegates. `Func<T>` parameters are matched by type rather than by name.

The Payoff

Imagine a remote stock quoting service:

```
public interface IQuoteService
{
  decimal GetQuote(string symbol);
}
```

We can add a `value` member to the `Shareholding` class that makes use of the service:

```
public class Shareholding
{
  public delegate Shareholding Factory(string symbol, uint holding);

  IQuoteService QuoteService { get; set; }

  public Shareholding(string symbol, uint holding, IQuoteService quoteService)
  {
    QuoteService = quoteService;
    ...
  }

  public decimal Value
  {
```

```
    get
    {
      return QuoteService.GetQuote(Symbol) * Holding;
    }
  }

  // ...
}
```

An implementor of `IQuoteService` can be registered through the container:

```
builder.RegisterType<WebQuoteService>().As<IQuoteService>();
```

The `Shareholding` instances will now be wired up correctly, but note: the signature of `Shareholding.Factory` **doesn't change!** Autofac will transparently add the extra parameter to the `Shareholding` constructor when a factory delegate is called.

This means that `Portfolio` can take advantage of the `Shareholding.Value` property *without knowing that a quote service is involved at all.*

```
public class Portfolio
{
  public decimal Value
  {
    get
    {
      return _holdings.Aggregate(0m, (a, e) => a + e.Value);
    }
  }

  // ...
}
```

Caveat

In a desktop (i.e. stateful) application, when using disposable components, make sure to create nested lifetime scopes for units of work, so that the nested scope can dispose the items created by the factories within it.

Owned Instances

Lifetime and Scope

Autofac controls lifetime using explicitly-delineated scopes. For example, the component providing the `S` service, and all of its dependencies, will be disposed/released when the `using` block ends:

```
IContainer container = // as per usual
using (var scope = container.BeginLifetimeScope())
{
  var s = scope.Resolve<S>();
  s.DoSomething();
}
```

In an IoC container, there's often a subtle difference between releasing and disposing a component: releasing an owned component goes further than disposing the component itself. Any of the dependencies of the component will *also be disposed. Releasing a shared component is usually a no-op, as other components will continue to use its services.*

Relationship Types

Autofac has a system of *relationship types* that can be used to provide the features of the container in a declarative way. Instead of manipulating an `IContainer` or `ILifetimeScope` directly, as in the above example, relationship types allow a component to specify exactly which container services are needed, in a minimal, declarative way.

Owned instances are consumed using the `Owned<T>` relationship type.

Owned of T

An owned dependency can be released by the owner when it is no longer required. Owned dependencies usually correspond to some unit of work performed by the dependent component.

```
public class Consumer
{
  private Owned<DisposableComponent> _service;

  public Consumer(Owned<DisposableComponent> service)
  {
    _service = service;
  }

  public void DoWork()
  {
    // _service is used for some task
    _service.Value.DoSomething();

    // Here _service is no longer needed, so
    // it is released
    _service.Dispose();
  }
}
```

When `Consumer` is created by the container, the `Owned<DisposableComponent>` that it depends upon will be created inside its own lifetime scope. When `Consumer` is finished using the `DisposableComponent`, disposing the `Owned<DisposableComponent>` reference will end the lifetime scope that contains `DisposableComponent`. This means that all of `DisposableComponent`'s non-shared, disposable dependencies will also be released.

Combining Owned with Func

Owned instances are usually used in conjunction with a `Func<T>` relationship, so that units of work can be begun and ended on-the-fly.

```
interface IMessageHandler
{
  void Handle(Message message);
}

class MessagePump
{
  Func<Owned<IMessageHandler>> _handlerFactory;
```

```
  public MessagePump(Func<Owned<IMessageHandler>> handlerFactory)
  {
    _handlerFactory = handlerFactory;
  }

  public void Go()
  {
    while(true)
    {
      var message = NextMessage();

      using (var handler = _handlerFactory())
      {
        handler.Value.Handle(message);
      }
    }
  }
}
```

Owned and Tags

The lifetimes created by `Owned<T>` use the tagging feature present as `ILifetimeScope.Tag`. The tag applied to a lifetime of `Owned<T>` will be `new TypedService(typeof(T))` - that is, the tag of the lifetime reflects its entry point.

Handling Concurrency

Autofac is designed for use in highly-concurrent applications. The guidance below will help you be successful in these situations.

Component Registration

`ContainerBuilder` **is not thread-safe** and is designed to be used only on a single thread at the time the application starts up. This is the most common scenario and works for almost all applications.

Registration into a container ***after*** **is is built, using** `ContainerBuilder.Update()`**, also is not thread-safe.** For applications that register components after the container has been built (which should be very uncommon) additional locking to protect the container from concurrent access during an `Update()` operation is necessary.

Service Resolution

All container operations are safe for use between multiple threads.

To reduce locking overhead, each `Resolve` operation takes place in a 'context' that provides the dependency-resolution features of the container. This is the parameter provided to component registration delegates.

Resolution context objects are single-threaded and should **not** be used except during the course of a dependency resolution operation.

Avoid component registrations that store the context:

```
// THIS IS BROKEN - DON'T DO IT
builder.Register(c => new MyComponent(c));
```

In the above example, the "c" `IComponentContext` parameter is being provided to MyComponent (which takes `IComponent` as a dependency). This code is incorrect because the temporary "c" parameter will be reused.

Instead resolve `IComponentContext` from "c" to access the non-temporary context:

```
builder.Register(c =>
{
  IContext threadSpecificContext = c.Resolve<IComponentContext>(); // access real␣
↪context.
  return new MyComponent(threadSpecificContext);
}
```

Take care also not to initialize components with closures over the "c" parameter, as any reuse of "c" will cause issues.

The container hierarchy mechanism further reduces locking, by maintaining local copies of the component registrations for any factory/container components. Once the initial registration copy has been made, a thread using an 'inner' container can create or access such components without blocking any other thread.

Lifetime Events

When making use of the LifetimeEvents available, don't call back into the container in handlers for the `Preparing`, `Activating` or `Activated` events: use the supplied `IComponentContext` instead.

Thread Scoped Services

You can use Autofac to register services that are specific to a thread. The ThreadScoping page has more information on this.

Internals

Keeping in mind the guidelines above, here's a little more specific information about thread safety and locking in Autofac.

Thread-Safe Types

The following types are safe for concurrent access by multiple threads:

- `Container`
- `ComponentRegistry`
- `Disposer` (default implementation of `IDisposer`)
- `LifetimeScope` (default implementation of `ILifetimeScope`)

These types cover practically all of the runtime/resolution scenarios.

The following types are designed for single-threaded access at configuration time:

- `ContainerBuilder`

So, a correct Autofac application will use a `ContainerBuilder` on a single thread to create the container at startup. Subsequent use of the container can occur on any thread.

Deadlock Avoidance

Autofac is designed in such a way that deadlocks won't occur in normal use. This section is a guide for maintainers or extension writers.

Locks may be acquired in the following order:

- A thread holding a lock for any of the following may not acquire any further locks:
  - `ComponentRegistry`
  - `Disposer`
- A thread holding the lock for a `LifetimeScope` may subsequently acquire the lock for:
  - Its parent `LifetimeScope`
  - Any of the items listed above

Multitenant Applications

`Autofac.Multitenant` enables multitenant dependency injection support. (Prior to v4.0.0, the package was called `Autofac.Extras.Multitenant`.)

- *What Is Multitenancy?*
- *General Principles*
  - *Reference NuGet Packages*
  - *Register Dependencies*
  - *Identify the Tenant*
  - *Resolve Tenant-Specific Dependencies*
- *ASP.NET Integration*
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  - *Tenant-Specific Controllers*
- *WCF Integration*
  - *Reference Packages for WCF Integration*
  - *Passing Tenant ID with a Behavior*
  - *Tenant Identification from OperationContext*
  - *Hosting Multitenant Services*
    - *Managing Service Attributes*
    - *Tenant-Specific Service Implementations*
  - *WCF Application Startup*
    - *WCF Client Application Startup*
    - *WCF Service Application Startup*

What Is Multitenancy?

A **multitenant application** is an application that you can deploy one time yet allow separate customers, or "tenants," to view the application as though it was their own.

Consider, for example, a hosted online store application - you, *the tenant*, lease the application, set some configuration values, and when an end user visits the application under your custom domain name, it looks like your company. Other tenants may also lease the application, yet the application is deployed only one time on a central, hosted server and changes its behavior based on the tenant (or tenant's end-users) accessing it.

Many changes in a multitenant environment are performed via simple configuration. For example, the colors or fonts displayed in the UI are simple configuration options that can be "plugged in" without actually changing the behavior of the application.

In a more complex scenario, **you may need to change business logic on a per-tenant basis.** For example, a specific tenant leasing space on the application may want to change the way a value is calculated using some complex custom logic. **How do you register a default behavior/dependency for an application and allow a specific tenant to override it?**

This is the functionality that `Autofac.Multitenant` attempts to address.

General Principles

In general, a multitenant application has four tasks that need to be performed with respect to dependency resolution:

1. *Reference NuGet Packages*
2. *Register Dependencies*
3. *Identify the Tenant*
4. *Resolve Tenant-Specific Dependencies*

This section outlines how these three steps work. Later sections will expand on these topics to include information on how to integrate these principles with specific application types.

Reference NuGet Packages

Any application that wants to use multitenancy needs to add references to the NuGet packages...

- Autofac
- Autofac.Multitenant

That's the bare minimum. **WCF applications** also need `Autofac.Multitenant.Wcf`.

Register Dependencies

`Autofac.Multitenant` introduces a new container type called `Autofac.Multitenant.MultitenantContainer`. This container is used for managing application-level defaults and tenant-specific overrides.

The overall registration process is:

1. **Create an application-level default container.** This container is where you register the default dependencies for the application. If a tenant doesn't otherwise provide an override for a dependency type, the dependencies registered here will be used.

2. **Instantiate a tenant identification strategy.** A tenant identification strategy is used to determine the ID for the current tenant based on execution context. You can read more on this later in this document.
3. **Create a multitenant container.** The multitenant container is responsible for keeping track of the application defaults and the tenant-specific overrides.
4. **Register tenant-specific overrides.** For each tenant wishing to override a dependency, register the appropriate overrides passing in the tenant ID and a configuration lambda.

General usage looks like this:

```
// First, create your application-level defaults using a standard
// ContainerBuilder, just as you are used to.
var builder = new ContainerBuilder();
builder.RegisterType<Consumer>().As<IDependencyConsumer>().InstancePerDependency();
builder.RegisterType<BaseDependency>().As<IDependency>().SingleInstance();
var appContainer = builder.Build();

// Once you've built the application-level default container, you
// need to create a tenant identification strategy. The details of this
// are discussed later on.
var tenantIdentifier = new MyTenantIdentificationStrategy();

// Now create the multitenant container using the application
// container and the tenant identification strategy.
var mtc = new MultitenantContainer(tenantIdentifier, appContainer);

// Configure the overrides for each tenant by passing in the tenant ID
// and a lambda that takes a ContainerBuilder.
mtc.ConfigureTenant('1', b => b.RegisterType<Tenant1Dependency>().As<IDependency>().
↪InstancePerDependency());
mtc.ConfigureTenant('2', b => b.RegisterType<Tenant2Dependency>().As<IDependency>().
↪SingleInstance());

// Now you can use the multitenant container to resolve instances.
```

If you have a component that needs one instance per tenant, you can use the `InstancePerTenant()` registration extension method at the container level.

```
var builder = new ContainerBuilder();
builder.RegisterType<SomeType>().As<ISomeInterface>().InstancePerTenant();
// InstancePerTenant goes in the main container; other
// tenant-specific dependencies get registered as shown
// above, in tenant-specific lifetimes.
```

Note that **you may only configure a tenant one time.** After that, you may not change that tenant's overrides. Also, if you resolve a dependency for a tenant, their lifetime scope may not be changed. It is good practice to configure your tenant overrides at application startup to avoid any issues. If you need to perform some business logic to "build" the tenant configuration, you can use the `Autofac.Multitenant.ConfigurationActionBuilder`.

```
var builder = new ContainerBuilder();
// ... register things...
var appContainer = builder.Build();
var tenantIdentifier = new MyTenantIdentificationStrategy();
var mtc = new MultitenantContainer(tenantIdentifier, appContainer);

// Create a configuration action builder to aggregate registration
// actions over the course of some business logic.
var actionBuilder = new ConfigurationActionBuilder();
```

```
// Do some logic...
if(SomethingIsTrue())
{
  actionBuilder.Add(b => b.RegisterType<AnOverride>().As<ISomething>());
}
actionBuilder.Add(b => b.RegisterType<SomeClass>());
if(AnotherThingIsTrue())
{
  actionBuilder.Add(b => b.RegisterModule<MyModule>());
}

// Now configure a tenant using the built action.
mtc.ConfigureTenant('1', actionBuilder.Build());
```

Identify the Tenant

In order to resolve a tenant-specific dependency, Autofac needs to know which tenant is making the resolution request. That is, "for the current execution context, which tenant is resolving dependencies?"

Autofac.Multitenant includes an `ITenantIdentificationStrategy` interface that you can implement to provide just such a mechanism. This allows you to retrieve the tenant ID from anywhere appropriate to your application: an environment variable, a role on the current user's principal, an incoming request value, or anywhere else.

The following example shows what a simple `ITenantIdentificationStrategy` that a web application might look like.

```
using System;
using System.Web;
using Autofac.Multitenant;

namespace DemoNamespace
{
  public class RequestParameterStrategy : ITenantIdentificationStrategy
  {
    public bool TryIdentifyTenant(out object tenantId)
    {
      // This is an EXAMPLE ONLY and is NOT RECOMMENDED.
      tenantId = null;
      try
      {
        var context = HttpContext.Current;
        if(context != null && context.Request != null)
        {
          tenantId = context.Request.Params["tenant"];
        }
      }
      catch(HttpException)
      {
        // Happens at app startup in IIS 7.0
      }
      return tenantId != null;
    }
  }
}
```

In this example, a web application is using an incoming request parameter to get the tenant ID. (Note that **this is**

just an example and is not recommended because it would allow any user on the system to very easily just switch tenants.) A slightly more robust version of this exact strategy is provided as `Autofac.Multitenant.Web.RequestParameterTenantIdentificationStrategy` but, again, is still not recommended for production due to the insecurity.

In your custom strategy implementation, you may choose to represent your tenant IDs as GUIDs, integers, or any other custom type. The strategy here is where you would parse the value from the execution context into a strongly typed object and succeed/fail based on whether the value is present and/or whether it can be parsed into the appropriate type.

`Autofac.Multitenant` uses `System.Object` as the tenant ID type throughout the system for maximum flexibility.

Performance is important in tenant identification. Tenant identification happens every time you resolve a component, begin a new lifetime scope, etc. As such, it is very important to make sure your tenant identification strategy is fast. For example, you wouldn't want to do a service call or a database query during tenant identification.

Be sure to handle errors well in tenant identification. Especially in situations like ASP.NET application startup, you may use some contextual mechanism (like `HttpContext.Current.Request`) to determine your tenant ID, but if your tenant ID strategy gets called when that contextual information isn't available, you need to be able to handle that. You'll see in the above example that not only does it check for the current `HttpContext`, but also the `Request`. Check everything and handle exceptions (e.g., parsing exceptions) or you may get some odd or hard-to-troubleshoot behavior.

Resolve Tenant-Specific Dependencies

The way the `MultitenantContainer` works, each tenant on the system gets their own `Autofac.ILifetimeScope` instance which contains the set of application defaults along with the tenant-specific overrides. Doing this...

```
var builder = new ContainerBuilder();
builder.RegisterType<BaseDependency>().As<IDependency>().SingleInstance();
var appContainer = builder.Build();

var tenantIdentifier = new MyTenantIdentificationStrategy();

var mtc = new MultitenantContainer(tenantIdentifier, appContainer);
mtc.ConfigureTenant('1', b => b.RegisterType<Tenant1Dependency>().As<IDependency>().
↪InstancePerDependency());
```

Is very much like using the standard `ILifetimeScope.BeginLifetimeScope(Action<ContainerBuilder>)`, like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<BaseDependency>().As<IDependency>().SingleInstance();
var appContainer = builder.Build();

using(var scope = appContainer.BeginLifetimeScope(
  b => b.RegisterType<Tenant1Dependency>().As<IDependency>().InstancePerDependency())
  {
    // Do work with the created scope...
  }
```

When you use the `MultitenantContainer` to resolve a dependency, behind the scenes it calls your `ITenantIdentificationStrategy` to identify the tenant, it locates the tenant's lifetime scope (with their configured overrides), and resolves the dependency from that scope. It does all this transparently, so you can use the multitenant container the same as you do other containers.

```
var dependency = mtc.Resolve<IDependency>();
// "dependency" will be a tenant-specific value resolved from
// the multitenant container. If the current tenant has overridden
// the IDependency registration, that override will be resolved;
// otherwise it will be the application-level default.
```

The important bit here is that all the work is going on transparently behind the scenes. Any call to `Resolve`, `BeginLifetimeScope`, `Tag`, `Disposer`, or the other methods/properties on the `IContainer` interface will all go through the tenant identification process and the result of the call will be tenant-specific.

If you need to specifically access a tenant's lifetime scope or the application container, the `MultitenantContainer` provides:

- `ApplicationContainer`: Gets the application container.
- `GetCurrentTenantScope`: Identifies the current tenant and returns their specific lifetime scope.
- `GetTenantScope`: Allows you to provide a specific tenant ID for which you want the lifetime scope.

ASP.NET Integration

ASP.NET integration is not really any different than *standard ASP.NET application integration*. Really, the only difference is that you will set up your application's `Autofac.Integration.Web.IContainerProvider` or `System.,Web.Mvc.IDependencyResolver` or whatever with an `Autofac.Multitenant.MultitenantContainer` rather than a regular container built by a `ContainerBuilder`. Since the `MultitenantContainer` handles multitenancy in a transparent fashion, "things just work."

ASP.NET Application Startup

Here is a sample *ASP.NET MVC* `Global.asax` implementation illustrating how simple it is:

```
namespace MultitenantExample.MvcApplication
{
  public class MvcApplication : HttpApplication
  {
    public static void RegisterRoutes(RouteCollection routes)
    {
      // Register your routes - standard MVC stuff.
    }

    protected void Application_Start()
    {
      // Set up the tenant ID strategy and application container.
      // The request parameter tenant ID strategy is used here as an example.
      // You should use your own strategy in production.
      var tenantIdStrategy = new RequestParameterTenantIdentificationStrategy("tenant
↪");
      var builder = new ContainerBuilder();
      builder.RegisterType<BaseDependency>().As<IDependency>();

      // If you have tenant-specific controllers in the same assembly as the
      // application, you should register controllers individually.
      builder.RegisterType<HomeController>();

      // Create the multitenant container and the tenant overrides.
      var mtc = new MultitenantContainer(tenantIdStrategy, builder.Build());
```

```
      mtc.ConfigureTenant("1",
        b =>
        {
          b.RegisterType<Tenant1Dependency>().As<IDependency>().
↪InstancePerDependency();
          b.RegisterType<Tenant1Controller>().As<HomeController>();
        });

      // Here's the magic line: Set up the DependencyResolver using
      // a multitenant container rather than a regular container.
      DependencyResolver.SetResolver(new AutofacDependencyResolver(mtc));

      // ...and everything else is standard MVC.
      AreaRegistration.RegisterAllAreas();
      RegisterRoutes(RouteTable.Routes);
    }
  }
}
```

As you can see, **it's almost the same as regular MVC Autofac integration**. You set up the application container, the tenant ID strategy, the multitenant container, and the tenant overrides as illustrated earlier in *Register Dependencies* and *Identify the Tenant*. Then when you set up your `DependencyResolver`, give it the multitenant container. Everything else just works.

This similarity is true for other web applications as well. When setting up your `IContainerProviderAccessor` for web forms, use the multitenant container instead of the standard container. When setting up your *Web API* `DependencyResolver`, use the multitenant container instead of the standard container.

Note in the example that controllers are getting registered individually rather than using the all-at-once `builder.RegisterControllers(Assembly.GetExecutingAssembly());` style of registration. See below for more on why this is the case.

Tenant-Specific Controllers

You may choose, in an MVC application, to allow a tenant to override a controller. This is possible, but requires a little forethought.

First, **tenant-specific controllers must derive from the controller they are overriding.** For example, if you have a `HomeController` for your application and a tenant wants to create their own implementation of it, they need to derive from it, like...

```
public class Tenant1HomeController : HomeController
{
  // Tenant-specific implementation of the controller.
}
```

Second, **if your tenant-specific controllers are in the same assembly as the rest of the application, you can't register your controllers in one line.** You may have seen in standard *ASP.NET MVC integration* a line like `builder.RegisterControllers(Assembly.GetExecutingAssembly());` to register all the controllers in the assembly at once. Unfortunately, if you have tenant-specific controllers in the same assembly, they'll all be registered at the application level if you do this. Instead, you need to register each application controller at the application level one at a time, and then configure tenant-specific overrides the same way.

The example `Global.asax` above shows this pattern of registering controllers individually.

Of course, if you keep your tenant-specific controllers in other assemblies, you can register all of the application controllers at once using `builder.RegisterControllers(Assembly.GetExecutingAssembly());` and it'll work just fine. Note that if your tenant-specific controller assemblies aren't referenced by the main application (e.g., they're "plugins" that get dynamically registered at startup using assembly probing or some such) *you'll need to register your assemblies with the ASP.NET BuildManager*.

Finally, when registering tenant-specific controllers, register them "as" the base controller type. In the example above, you see the default controller registered in the application container like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<HomeController>();
```

Then when the tenant overrides the controller in their tenant configuration, it looks like this:

```
var mtc = new MultitenantContainer(tenantIdStrategy, builder.Build());
mtc.ConfigureTenant("1", b => b.RegisterType<Tenant1Controller>().As<HomeController>
↪());
```

Due to the relative complexity of this, it may be a better idea to isolate business logic into external dependencies that get passed into your controllers so the tenants can provide override dependencies rather than override controllers.

WCF Integration

WCF integration is just slightly different than the *standard WCF integration* in that you need to use a different service host factory than the standard Autofac host factory and there's a little additional configuration required.

Also, identifying a tenant is a little harder - the client needs to pass the tenant ID to the service somehow and the service needs to know how to interpret that passed tenant ID. A simple solution to this is provided in the form of a behavior that passes the relevant information in message headers.

Reference Packages for WCF Integration

For an application **consuming a multitenant service** (a client application), add references to...

- Autofac
- Autofac.Multitenant

For an application **providing a multitenant service** (a service application), add references to...

- Autofac
- Autofac.Integration.Wcf
- Autofac.Multitenant
- Autofac.Multitenant.Wcf

Passing Tenant ID with a Behavior

As mentioned earlier (*Identify the Tenant*), for multitenancy to work you have to identify which tenant is making a given call so you can resolve the appropriate dependencies. One of the challenges in a service environment is that the tenant is generally established on the client application end and that tenant ID needs to be propagated to the service so it can behave appropriately.

A common solution to this is to propagate the tenant ID in message headers. The client adds a special header to an outgoing message that contains the tenant ID. The service parses that header, reads out the tenant ID, and uses that ID to determine its functionality.

In WCF, the way to attach these "dynamic" headers to messages and read them back is through a behavior. You apply the behavior to both the client and the service ends so the same header information (type, URN, etc.) is used.

`Autofac.Multitenant` provides a simple tenant ID propagation behavior in `Autofac.Multitenant.Wcf.TenantPropagationBehavior`. Applied on the client side, it uses the tenant ID strategy to retrieve the contextual tenant ID and insert it into a message header on an outgoing message. Applied on the server side, it looks for this inbound header and parses the tenant ID out, putting it into an OperationContext extension.

The *WCF Application Startup* section below shows examples of putting this behavior in action both on the client and server sides.

If you use this behavior, a corresponding server-side tenant identification strategy is also provided for you. See *Tenant Identification from OperationContext*, below.

Tenant Identification from OperationContext

Whether or not you choose to use the provided `Autofac.Multitenant.Wcf.TenantPropagationBehavior` to propagate behavior from client to server in a message header (see above *Passing Tenant ID with a Behavior*), a good place to store the tenant ID for the life of an operation is in the `OperationContext`.

`Autofac.Multitenant.Wcf` provides the `Autofac.Multitenant.Wcf.TenantIdentificationContextExtension` as an extension to the WCF `OperationContext` for just this purpose.

Early in the operation lifecycle (generally in a System.ServiceModel.Dispatcher.IDispatchMessageInspector.AfterReceiveRequest() implementation), you can add the `TenantIdentificationContextExtension` to the current `OperationContext` so the tenant can be easily identified. A sample `AfterReceiveRequest()` implementation below shows this in action:

```
public object AfterReceiveRequest(ref Message request, IClientChannel channel,␣
↪InstanceContext instanceContext)
{
  // This assumes the tenant ID is coming from a message header; you can
  // get it from wherever you want.
  var tenantId = request.Headers.GetHeader<TTenantId>(TenantHeaderName,␣
↪TenantHeaderNamespace);

  // Here's where you add the context extension:
  OperationContext.Current.Extensions.Add(new TenantIdentificationContextExtension()
↪{ TenantId = tenantId });
  return null;
}
```

Once the tenant ID is attached to the context, you can use an appropriate `ITenantIdentificationStrategy` to retrieve it as needed.

If you use the TenantIdentificationContextExtension, then the provided Autofac.Multitenant.Wcf.OperationContextTenantIdentificationStrategy will automatically work to get the tenant ID from OperationContext.

Hosting Multitenant Services

In a WCF service application, service implementations may be tenant-specific yet share the same service contract. This allows you to provide your service contracts in a separate assembly to tenant-specific developers and allow them to implement custom logic without sharing any of the internals of your default implementation.

To enable this to happen, a custom strategy has been implemented for multitenant service location - `Autofac.Multitenant.Wcf.MultitenantServiceImplementationDataProvider`.

In your service's `.svc` file, you must specify:

- **The full type name of the service contract interface.** In regular *WCF integration* Autofac allows you to use either typed or named services. For multitenancy, you must use a typed service that is based on the service contract interface.
- **The full type name of the Autofac host factory.** This lets the hosting environment know which factory to use. (This is just like the *standard Autofac WCF integration*.)

An example `.svc` file looks like this:

```
<%@ ServiceHost
    Service="MultitenantExample.WcfService.IMultitenantService, MultitenantExample.
↪WcfService"
    Factory="Autofac.Integration.Wcf.AutofacServiceHostFactory, Autofac.Integration.
↪Wcf" %>
```

When registering service implementations with the Autofac container, you must register the implementations as the contract interface, like this:

```
builder.RegisterType<BaseImplementation>().As<IMultitenantService>();
```

Tenant-specific overrides may then register using the interface type as well:

```
mtc.ConfigureTenant("1", b =>b.RegisterType<Tenant1Implementation>().As
↪<IMultitenantService>());
```

And don't forget at app startup, around where you set the container, you need to tell Autofac you're doing multitenancy:

```
AutofacHostFactory.ServiceImplementationDataProvider =
  new MultitenantServiceImplementationDataProvider();
```

Managing Service Attributes

When configuring WCF services in XML configuration (e.g., web.config), WCF automatically infers the name of the service element it expects from the concrete service implementation type. For example, in a single-tenant implementation, your `MyNamespace.IMyService` service interface might have one implementation called `MyNamespace.MyService` and that's what WCF would expect to look for in `web.config`, like this:

```
<system.serviceModel>
  <services>
    <service name="MyNamespace.MyService" ... />
  </services>
</system.serviceModel>
```

However, when using a multitenant service host, the concrete service type that implements the interface is a dynamically generated proxy type, so the service configuration name becomes an auto-generated type name, like this:

```
<system.serviceModel>
  <services>
    <service name="Castle.Proxies.IMyService_1" ... />
  </services>
</system.serviceModel>
```

To make this easier, `Autofac.Multitenant.Wcf` provides the `Autofac.Multitenant.Wcf.ServiceMetadataTypeAttribute`, which you can use to create a "metadata buddy class" (similar to the `System.ComponentModel.DataAnnotations.MetadataTypeAttribute`) that you can mark with type-level attributes and modify the behavior of the dynamic proxy.

In this case, you need the dynamic proxy to have a `System.ServiceModel.ServiceBehaviorAttribute` so you can define the `ConfigurationName` to expect.

First, mark your service interface with a `ServiceMetadataTypeAttribute`:

```
using System;
using System.ServiceModel;
using Autofac.Multitenant.Wcf;

namespace MyNamespace
{
  [ServiceContract]
  [ServiceMetadataType(typeof(MyServiceBuddyClass))]
  public interface IMyService
  {
    // ...define your service operations...
  }
}
```

Next, create the buddy class you specified in the attribute and add the appropriate metadata.

```
using System;
using System.ServiceModel;

namespace MyNamespace
{
  [ServiceBehavior(ConfigurationName = "MyNamespace.IMyService")]
  public class MyServiceBuddyClass
  {
  }
}
```

Now in your XML configuration file, you can use the configuration name you specified on the buddy class:

```
<system.serviceModel>
  <services>
    <service name="MyNamespace.IMyService" ... />
  </services>
</system.serviceModel>
```

Important notes about metadata: - **Only type-level attributes are copied.** At this time, only attributes at the type level are copied over from the buddy class to the dynamic proxy. If you have a use case for property/method level metadata to be copied, please file an issue. - **Not all metadata will have the effect you expect.** For example, if you use the `ServiceBehaviorAttribute` to define lifetime related information like `InstanceContextMode`, the service will not follow that directive because Autofac is managing the lifetime, not the standard service host. Use common sense when specifying metadata - if it doesn't work, don't forget you're not using the standard service lifetime management functionality. - **Metadata is application-level, not per-tenant.** The metadata buddy class info will take effect at an application level and can't be overridden per tenant.

Tenant-Specific Service Implementations

If you are hosting multitenant services (*Hosting Multitenant Services*), you can provide tenant-specific service implementations. This allows you to provide a base implementation of a service and share the service contract with tenants to allow them to develop custom service implementations.

You must implement your service contract as a separate interface. You can't mark your service implementation with the `ServiceContractAttribute`. Your service implementations must then implement the interface. This is good practice anyway, but the multitenant service host won't allow concrete types to directly define the contract.

Tenant-specific service implementations do not need to derive from the base implementation; they only need to implement the service interface.

You can register tenant-specific service implementations in app startup (see *WCF Application Startup*).

WCF Application Startup

Application startup is generally the same as any other multitenant application (*Register Dependencies*), but there are a couple of minor things to do for clients, and a little bit of hosting setup for services.

WCF Client Application Startup

In a WCF client application, when you register your service clients you'll need to register the behavior that propagates the tenant ID to the service. If you're following the *standard WCF integration guidance*, then registering a service client looks like this:

```
// Create the tenant ID strategy for the client application.
var tenantIdStrategy = new MyTenantIdentificationStrategy();

// Register application-level dependencies.
var builder = new ContainerBuilder();
builder.RegisterType<BaseDependency>().As<IDependency>();

// The service client is not different per tenant because
// the service itself is multitenant - one client for all
// the tenants and ***the service implementation*** switches.
builder.Register(c =>
  new ChannelFactory<IMultitenantService>(
    new BasicHttpBinding(),
    new EndpointAddress("http://server/MultitenantService.svc"))).SingleInstance();

// Register an endpoint behavior on the client channel factory that
// will propagate the tenant ID across the wire in a message header.
// In this example, the built-in TenantPropagationBehavior is used
// to send a string-based tenant ID across the wire.
builder.Register(c =>
  {
    var factory = c.Resolve<ChannelFactory<IMultitenantService>>();
    factory.Opening += (sender, args) => factory.Endpoint.Behaviors.Add(new
↪TenantPropagationBehavior<string>(tenantIdStrategy));
    return factory.CreateChannel();
  });
```

```
// Create the multitenant container.
var mtc = new MultitenantContainer(tenantIdStrategy, builder.Build());

// ... register tenant overrides, etc.
```

WCF Service Application Startup

In a WCF service application, you register your defaults and tenant-specific overrides just as you normally would (*Register Dependencies*) but you have to also:

- Set up the behavior for service hosts to expect an incoming tenant ID header (*Passing Tenant ID with a Behavior*) for tenant identification.
- Set the service host factory container to a `MultitenantContainer`.

In the example below, **we are using the Autofac.Multitenant.Wcf.AutofacHostFactory** rather than the standard Autofac host factory (as outlined earlier).

```
namespace MultitenantExample.WcfService
{
  public class Global : System.Web.HttpApplication
  {
    protected void Application_Start(object sender, EventArgs e)
    {
      // Create the tenant ID strategy.
      var tenantIdStrategy = new OperationContextTenantIdentificationStrategy();

      // Register application-level dependencies and service implementations.
      var builder = new ContainerBuilder();
      builder.RegisterType<BaseImplementation>().As<IMultitenantService>();
      builder.RegisterType<BaseDependency>().As<IDependency>();

      // Create the multitenant container.
      var mtc = new MultitenantContainer(tenantIdStrategy, builder.Build());

      // Notice we configure tenant IDs as strings below because the tenant
      // identification strategy retrieves string values from the message
      // headers.

      // Configure overrides for tenant 1 - dependencies, service implementations,␣
↪etc.
      mtc.ConfigureTenant("1",
        b =>
        {
          b.RegisterType<Tenant1Dependency>().As<IDependency>().
↪InstancePerDependency();
          b.RegisterType<Tenant1Implementation>().As<IMultitenantService>();
        });

      // Add a behavior to service hosts that get created so incoming messages
      // get inspected and the tenant ID can be parsed from message headers.
      AutofacHostFactory.HostConfigurationAction =
        host =>
          host.Opening += (s, args) =>
            host.Description.Behaviors.Add(new TenantPropagationBehavior<string>
↪(tenantIdStrategy));
```

```
        // Set the service implementation strategy to multitenant.
        AutofacHostFactory.ServiceImplementationDataProvider =
          new MultitenantServiceImplementationDataProvider();

        // Finally, set the host factory application container on the multitenant
        // WCF host to a multitenant container.
        AutofacHostFactory.Container = mtc;
      }
    }
}
```

Aggregate Services

Introduction

An aggregate service is useful when you need to treat a set of dependencies as one dependency. When a class depends on several constructor-injected services, or have several property-injected services, moving those services into a separate class yields a simpler API.

An example is super- and subclasses where the superclass have one or more constructor-injected dependencies. The subclasses must usually inherit these dependencies, even though they might only be useful to the superclass. With an aggregate service, the superclass constructor parameters can be collapsed into one parameter, reducing the repetitiveness in subclasses. Another important side effect is that subclasses are now insulated against changes in the superclass dependencies, introducing a new dependency in the superclass means only changing the aggregate service definition.

The pattern and this example are both further elaborated here.

Aggregate services can be implemented by hand, e.g. by building a class with constructor-injected dependencies and exposing those as properties. Writing and maintaining aggregate service classes and accompanying tests can quickly get tedious though. The AggregateService extension to Autofac lets you generate aggregate services directly from interface definitions without having to write any implementation.

Required References

You can add aggregate service support to your project using the Autofac.Extras.AggregateService NuGet package or by manually adding references to these assemblies:

- Autofac.dll
- Autofac.Extras.AggregateService.dll
- Castle.Core.dll (from the Castle project)

Getting Started

Lets say we have a class with a number of constructor-injected dependencies that we store privately for later use:

```
public class SomeController
{
  private readonly IFirstService _firstService;
  private readonly ISecondService _secondService;
  private readonly IThirdService _thirdService;
  private readonly IFourthService _fourthService;
```

```
  public SomeController(
    IFirstService firstService,
    ISecondService secondService,
    IThirdService thirdService,
    IFourthService fourthService)
  {
    _firstService = firstService;
    _secondService = secondService;
    _thirdService = thirdService;
    _fourthService = fourthService;
  }
}
```

To aggregate the dependencies we move those into a separate interface definition and take a dependency on that interface instead.

```
public interface IMyAggregateService
{
  IFirstService FirstService { get; }
  ISecondService SecondService { get; }
  IThirdService ThirdService { get; }
  IFourthService FourthService { get; }
}

public class SomeController
{
  private readonly IMyAggregateService _aggregateService;

  public SomeController(IMyAggregateService aggregateService)
  {
    _aggregateService = aggregateService;
  }
}
```

Finally, we register the aggregate service interface.

```
using Autofac;
using Autofac.Extras.AggregateService;
//...

var builder = new ContainerBuilder();
builder.RegisterAggregateService<IMyAggregateService>();
builder.Register(/*...*/).As<IFirstService>();
builder.Register(/*...*/).As<ISecondService>();
builder.Register(/*...*/).As<IThirdService>();
builder.Register(/*...*/).As<IFourthService>();
builder.RegisterType<SomeController>();
var container = builder.Build();
```

The interface for the aggregate service will automatically have an implementation generated for you and the dependencies will be filled in as expected.

How Aggregate Services are Resolved

Properties

Read-only properties mirror the behavior of regular constructor-injected dependencies. The type of each property will be resolved and cached in the aggregate service when the aggregate service instance is constructed.

Here is a functionally equivalent sample:

```
class MyAggregateServiceImpl: IMyAggregateService
{
  private IMyService _myService;

  public MyAggregateServiceImpl(IComponentContext context)
  {
    _myService = context.Resolve<IMyService>();
  }

  public IMyService MyService
  {
    get { return _myService; }
  }
}
```

Methods

Methods will behave like factory delegates and will translate into a resolve call on each invocation. The method return type will be resolved, passing on any parameters to the resolve call.

A functionally equivalent sample of the method call:

```
class MyAggregateServiceImpl: IMyAggregateService
{
  public ISomeThirdService GetThirdService(string data)
  {
    var dataParam = new TypedParameter(typeof(string), data);
    return _context.Resolve<ISomeThirdService>(dataParam);
  }
}
```

Property Setters and Void Methods

Property setters and methods without return types does not make sense in the aggregate service. Their presence in the aggregate service interface does not prevent proxy generation. Calling such methods though will throw an exception.

How It Works

Under the covers, the AggregateService uses DynamicProxy2 from the Castle Project. Given an interface (the aggregate of services into one), a proxy is generated implementing the interface. The proxy will translate calls to properties and methods into `Resolve` calls to an Autofac context.

Performance Considerations

Due to the fact that method calls in the aggregate service pass through a dynamic proxy there is a small but non-zero amount of overhead on each method call. A performance study on Castle DynamicProxy2 vs other frameworks can be found here.

Type Interceptors

DynamicProxy2, part of the from the Castle Project core, provides a method interception framework.

The `Autofac.Extras.DynamicProxy2` integration package enables method calls on Autofac components to be intercepted by other components. Common use-cases are transaction handling, logging, and declarative security.

Enabling Interception

The basic steps to get DynamicProxy2 integration working are:

- *Create Interceptors*
- *Register Interceptors with Autofac*
- *Enable Interception on Types*
- *Associate Interceptors with Types to be Intercepted*

Create Interceptors

Interceptors implement the `Castle.DynamicProxy.IInterceptor` interface. Here's a simple interceptor example that logs method calls including inputs and outputs:

```
public class CallLogger : IInterceptor
{
  TextWriter _output;

  public CallLogger(TextWriter output)
  {
    _output = output;
  }

  public void Intercept(IInvocation invocation)
  {
    _output.Write("Calling method {0} with parameters {1}... ",
      invocation.Method.Name,
      string.Join(", ", invocation.Arguments.Select(a => (a ?? "").ToString()).
↪ToArray()));

    invocation.Proceed();

    _output.WriteLine("Done: result was {0}.", invocation.ReturnValue);
  }
}
```

Register Interceptors with Autofac

Interceptors must be registered with the container. You can register them either as typed services or as named services. If you register them as named services, they must be named `IInterceptor` registrations.

Which of these you choose depends on how you decide to associate interceptors with the types being intercepted.

```
// Named registration
builder.Register(c => new CallLogger(Console.Out))
       .Named<IInterceptor>("log-calls");

// Typed registration
builder.Register(c => new CallLogger(Console.Out));
```

Enable Interception on Types

When you register a type being intercepted, you have to mark the type at registration time so Autofac knows to wire up that interception. You do this using the `EnableInterfaceInterceptors()` and `EnableClassInterceptors()` registration extensions.

```
var builder = new ContainerBuilder();
builder.RegisterType<SomeType>()
       .As<ISomeInterface>()
       .EnableInterfaceInterceptors();
builder.Register(c => new CallLogger(Console.Out));
var container = builder.Build();
var willBeIntercepted = container.Resolve<ISomeInterface>();
```

Under the covers, `EnableInterfaceInterceptors()` creates an interface proxy that performs the interception, while `EnableClassInterceptors()` dynamically subclasses the target component to perform interception of virtual methods.

Both techniques can be used in conjunction with the assembly scanning support, so you can configure batches of components using the same methods.

Special case: WCF proxy and remoting objects While WCF proxy objects *look* like interfaces, the `EnableInterfaceInterceptors()` mechanism won't work because, behind the scenes, .NET is actually using a `System.Runtime.Remoting.TransparentProxy` object that behaves like the interface. If you want interception on a WCF proxy, you need to use the `InterceptTransparentProxy()` method.

```
var cb = new ContainerBuilder();
cb.RegisterType<TestServiceInterceptor>();
cb.Register(c => CreateChannelFactory()).SingleInstance();
cb
  .Register(c => c.Resolve<ChannelFactory<ITestService>>().CreateChannel())
  .InterceptTransparentProxy(typeof(IClientChannel))
  .InterceptedBy(typeof(TestServiceInterceptor))
  .UseWcfSafeRelease();
```

Associate Interceptors with Types to be Intercepted

To pick which interceptor is associated with your type, you have two choices.

Your first option is to mark the type with an attribute, like this:

```
// This attribute will look for a TYPED
// interceptor registration:
[Intercept(typeof(CallLogger))]
public class First
{
  public virtual int GetValue()
  {
    // Do some calculation and return a value
  }
}

// This attribute will look for a NAMED
// interceptor registration:
[Intercept("log-calls")]
public class Second
{
  public virtual int GetValue()
  {
    // Do some calculation and return a value
  }
}
```

When you use attributes to associate interceptors, you don't need to specify the interceptor at registration time. You can just enable interception and the interceptor type will automatically be discovered.

```
// Using the TYPED attribute:
var builder = new ContainerBuilder();
builder.RegisterType<First>()
       .EnableClassInterceptors();
builder.Register(c => new CallLogger(Console.Out));

// Using the NAMED attribute:
var builder = new ContainerBuilder();
builder.RegisterType<Second>()
       .EnableClassInterceptors();
builder.Register(c => new CallLogger(Console.Out))
       .Named<IInterceptor>("log-calls");
```

The second option is to declare the interceptor at Autofac registration time. You can do this using the `InterceptedBy()` registration extension:

```
var builder = new ContainerBuilder();
builder.RegisterType<SomeType>()
       .EnableClassInterceptors()
       .InterceptedBy(typeof(CallLogger));
builder.Register(c => new CallLogger(Console.Out));
```

Tips

Use Public Interfaces

Interface interception requires the interface be public (or, at least, visible to the dynamically generated proxy assembly). Non-public interface types can't be intercepted.

If you want to proxy `internal` interfaces, you must mark the assembly containing the interface with `[assembly: InternalsVisibleTo("DynamicProxyGenAssembly2")]`.

Use Virtual Methods

Class interception requires the methods being intercepted to be virtual since it uses subclassing as the proxy technique.

Usage with Expressions

Components created using expressions, or those registered as instances, cannot be subclassed by the DynamicProxy2 engine. In these cases, it is necessary to use interface-based proxies.

Interface Registrations

To enable proxying via interfaces, the component must provide its services through interfaces only. For best performance, all such service interfaces should be part of the registration, i.e. included in `As<X>()` clauses.

WCF Proxies

As mentioned earlier, WCF proxies and other remoting types are special cases and can't use standard interface or class interception. You must use `InterceptTransparentProxy()` on those types.

Class Interceptors and UsingConstructor

If you are using class interceptors via `EnableClassInterceptors()` then avoid using the constructor selector `UsingConstructor()` with it. When class interception is enabled, the generated proxy adds some new constructors that also take the set of interceptors you want to use. When you specify `UsingConstructor()` you'll bypass this logic and your interceptors won't be used.

Debugging and Troubleshooting

If you're really having trouble and you haven't been able to get an answer on StackOverflow you may want to try doing a little more in-depth debugging/troubleshooting on your own. Here are some tips on doing that.

Exceptions

The exceptions generated by Autofac really try to point you in the right direction with respect to what could be going wrong. Don't panic! Stop and read what it's actually telling you.

For example, say you see a message that starts like:

```
None of the constructors found with 'Autofac.Core.Activators.Reflection.
↪DefaultConstructorFinder'
on type 'Your.EncryptionService' can be invoked with the available
services and parameters: Cannot resolve parameter 'Your.SecuritySettings␣
↪securitySettings'
of constructor 'Void .ctor(Your.SecuritySettings)'
```

In this case, Autofac is trying to create an instance of your service and it can't resolve a constructor parameter it needs. Chances are you need to look at the things you have registered with Autofac and make sure you have something registered that can fulfill the constructor requirement. You could even verify this by manually trying to resolve the parameter yourself right from the container (in a test/debug environment). You may *think* you have it registered, but for whatever reason Autofac isn't seeing the registration. (Autofac requires you explicitly register all services. Look at the *Any Concrete Type Not Already Registered registration source* if you don't want to register everything.)

It may be that the top-level exception message doesn't make sense, but that there are nested inner exceptions that have more information. Check those out! Creating big object graphs can sometimes yield a deep exception tree to help you pinpoint where exactly in the large graph things went wrong. Don't just stop at the top level.

Also, take a look at your exception stack traces. It may look like Autofac is the source of an exception when really it's getting caught by something going wrong in a constructor in one of your objects.

And, of course, if you're hitting that ever-challenging `No scope with a Tag matching 'AutofacWebRequest'` exception, *we have a whole FAQ on that*.

Symbols and Sources

Autofac publishes symbols and sources for its various packages on SymbolSource and MyGet. (Older packages are on SymbolSource, newer stuff has moved to MyGet.)

You can set up Visual Studio to debug/step *right into Autofac source* using the following symbol servers:

- `https://www.myget.org/F/autofac/symbols/`
- `http://srv.symbolsource.org/pdb/Public/`

There is documentation on MyGet explaining how to configure Visual Studio to make this work.

Support

We have a *whole page outlining how to get support*.

CHAPTER 10

Examples

log4net Integration Module

While there is no specific assembly for log4net support, you can easily inject `log4net.ILog` values using a very small custom module.

This module is also a good example of how to use *Autofac modules* for more than simple configuration - they're also helpful for doing some more advanced extensions.

Here's a sample module that configures Autofac to inject `ILog` parameters based on the type of the component being activated. This sample module willl handle both constructor and property injection.

```
public class LoggingModule : Autofac.Module
{
  private static void InjectLoggerProperties(object instance)
  {
    var instanceType = instance.GetType();

    // Get all the injectable properties to set.
    // If you wanted to ensure the properties were only UNSET properties,
    // here's where you'd do it.
    var properties = instanceType
      .GetProperties(BindingFlags.Public | BindingFlags.Instance)
      .Where(p => p.PropertyType == typeof(ILog) && p.CanWrite && p.
↪GetIndexParameters().Length == 0);

    // Set the properties located.
    foreach (var propToSet in properties)
    {
      propToSet.SetValue(instance, LogManager.GetLogger(instanceType), null);
    }
  }

  private static void OnComponentPreparing(object sender, PreparingEventArgs e)
  {
```

```
    e.Parameters = e.Parameters.Union(
      new[]
      {
        new ResolvedParameter(
            (p, i) => p.ParameterType == typeof(ILog),
            (p, i) => LogManager.GetLogger(p.Member.DeclaringType)
        ),
      });
  }

  protected override void AttachToComponentRegistration(IComponentRegistry
↪componentRegistry, IComponentRegistration registration)
  {
    // Handle constructor parameters.
    registration.Preparing += OnComponentPreparing;

    // Handle properties.
    registration.Activated += (sender, e) => InjectLoggerProperties(e.Instance);
  }
}
```

Performance Note: At the time of this writing, calling `LogManager.GetLogger(type)` has a slight performance hit as the internal log manager locks the collection of loggers to retrieve the appropriate logger. An enhancement to the module would be to add caching around logger instances so you can reuse them without the lock hit in the `LogManager` call.

Thanks for the original idea/contribution by Rich Tebb/Bailey Ling where the idea was posted on the Autofac newsgroup.

CHAPTER 11

Frequently Asked Questions

How do I work with per-request lifetime scope?

In applications that have a request/response semantic (e.g., *ASP.NET MVC* or *Web API*), you can register dependencies to be "instance-per-request," meaning you will get a one instance of the given dependency for each request handled by the application and that instance will be tied to the individual request lifecycle.

In order to understand per-request lifetime, you should have a good general understanding of *how dependency lifetime scopes work in general*. Once you understand how dependency lifetime scopes work, per-request lifetime scope is easy.

- *Note on ASP.NET Core*
- *Registering Dependencies as Per-Request*
- *How Per-Request Lifetime Works*
- *Sharing Dependencies Across Apps Without Requests*
- *Testing with Per-Request Dependencies*
  - *Faking an MVC Request Scope*
  - *Faking a Web API Request Scope*
- *Troubleshooting Per-Request Dependencies*
  - *No Scope with a Tag Matching 'AutofacWebRequest'*
  - *No Per-Request Filter Dependencies in Web API*
- *Implementing Custom Per-Request Semantics*

Note on ASP.NET Core

As noted in the *ASP.NET Core integration docs*, **ASP.NET Core doesn't have a specific per-request scope.** Everything is registered `InstancePerLifetimeScope()` instead of `InstancePerRequest()` for ASP.NET Core.

Registering Dependencies as Per-Request

When you want a dependency registered as per-request, use the `InstancePerRequest()` registration extension:

```
var builder = new ContainerBuilder();
builder.RegisterType<ConsoleLogger>()
       .As<ILogger>()
       .InstancePerRequest();
var container = builder.Build();
```

You'll get a new instance of the component for every inbound request for your application. The handling of the creation of the request-level lifetime scope and the cleanup of that scope are generally dealt with via the *Autofac application integration libraries* for your application type.

How Per-Request Lifetime Works

Per-request lifetime makes use of *tagged lifetime scopes and the "Instance Per Matching Lifetime Scope" mechanism*.

Autofac application integration libraries hook into different application types and, on an inbound request, they create a nested lifetime scope with a "tag" that identifies it as a request lifetime scope:

```
+--------------------------+
|    Autofac Container     |
|                          |
| +----------------------+ |
| | Tagged Request Scope | |
| +----------------------+ |
+--------------------------+
```

When you register a component as `InstancePerRequest()`, you're telling Autofac to look for a lifetime scope that is tagged as the request scope and to resolve the component from there. That way if you have unit-of-work lifetime scopes that take place during a single request, the per-request dependency will be shared during the request:

```
+----------------------------------------------------+
|                 Autofac Container                  |
|                                                    |
| +------------------------------------------------+ |
| |              Tagged Request Scope              | |
| |                                                | |
| | +----------------------+  +----------------------+ | |
| | | Unit of Work Scope |  | Unit of Work Scope | | |
| | +----------------------+  +----------------------+ | |
| +------------------------------------------------+ |
+----------------------------------------------------+
```

The request scope is tagged with a constant value `Autofac.Core.Lifetime.MatchingScopeLifetimeTags.RequestLifetimeScopeTag`, which equates to the string `AutofacWebRequest`. If the request lifetime scope isn't found, you'll get a `DependencyResolutionException` that tells you the request lifetime scope isn't found.

There are tips on troubleshooting this exception below in the *Troubleshooting Per-Request Dependencies* section.

Sharing Dependencies Across Apps Without Requests

A common situation you might see is that you have a single *Autofac module* that performs some dependency registrations and you want to share that module between two applications - one that has a notion of per-request lifetime (like a *Web API* application) and one that doesn't (like a console app or Windows Service).

How do you register dependencies as per-request and allow registration sharing?

There are a couple of potential solutions to this problem.

Option 1: Change your `InstancePerRequest()` registrations to be `InstancePerLifetimeScope()`. *Most* applications don't create their own nested unit-of-work lifetime scopes; instead, the only real child lifetime scope that gets created *is the request lifetime*. If this is the case for your application, then `InstancePerRequest()` and `InstancePerLifetimeScope()` become effectively identical. You will get the same behavior. In the application that doesn't support per-request semantics, you can create child lifetime scopes as needed for component sharing.

```
var builder = new ContainerBuilder();

// If your application does NOT create its own child
// lifetime scopes anywhere, then change this...
//
// builder.RegisterType<ConsoleLogger>()
//        .As<ILogger>()
//        .InstancePerRequest();
//
// ..to this:
builder.RegisterType<ConsoleLogger>()
       .As<ILogger>()
       .InstancePerLifetimeScope();
var container = builder.Build();
```

Option 2: Set up your registration module to take a parameter and indicate which lifetime scope registration type to use.

```
public class LoggerModule : Module
{
  private bool _perRequest;
  public LoggerModule(bool supportPerRequest)
  {
    this._perRequest = supportPerRequest;
  }

  protected override void Load(ContainerBuilder builder)
  {
    var reg = builder.RegisterType<ConsoleLogger>().As<ILogger>();
    if(this._perRequest)
    {
      reg.InstancePerRequest();
    }
    else
    {
      reg.InstancePerLifetimeScope();
    }
  }
}
```

```
// Register the module in each application and pass
// an appropriate parameter indicating if the app supports
// per-request or not, like this:
// builder.RegisterModule(new LoggerModule(true));
```

Option 3: A third, but more complex, option is to implement custom per-request semantics in the application that doesn't naturally have these semantics. For example, a Windows Service doesn't necessarily have per-request semantics, but if it's self-hosting a custom service that takes requests and provides responses, you could add per-request lifetime scopes around each request and enable support of per-request dependencies. You can read more about this in the *Implementing Custom Per-Request Semantics* section.

Testing with Per-Request Dependencies

If you have an application that registers per-request dependencies, you may want to re-use the registration logic to set up dependencies in unit tests. Of course, you'll find that your unit tests don't have request lifetime scopes available, so you'll end up with a `DependencyResolutionException` that indicates the `AutofacWebRequest` scope can't be found. How do you use the registrations in a testing environment?

Option 1: Create some custom registrations for each specific test fixture. Particularly if you're in a unit test environment, you probably shouldn't be wiring up the whole real runtime environment for the test - you should have test doubles for all the external required dependencies instead. Consider mocking out the dependencies and not actually doing the full shared set of registrations in the unit test environment.

Option 2: Look at the choices for sharing registrations in the *Sharing Dependencies Across Apps Without Requests* section. Your unit test could be considered "an application that doesn't support per-request registrations" so using a mechanism that allows sharing between application types might be appropriate.

Option 3: Implement a fake "request" in the test. The intent here would be that before the test runs, a real Autofac lifetime scope with the `AutofacWebRequest` label is created, the test is run, and then the fake "request" scope is disposed - as though a full request was actually run. This is a little more complex and the method differs based on application type.

Faking an MVC Request Scope

The *Autofac ASP.NET MVC integration* uses an `ILifetimeScopeProvider` implementation along with the `AutofacDependencyResolver` to dynamically create a request scope as needed. To fake out the MVC request scope, you need to provide a test `ILifetimeScopeProvider` that doesn't involve the actual HTTP request. A simple version might look like this:

```
public class SimpleLifetimeScopeProvider : ILifetimeScopeProvider
{
  private readonly IContainer _container;
  private ILifetimeScope _scope;

  public SimpleLifetimeScopeProvider(IContainer container)
  {
    this._container = container;
  }

  public ILifetimeScope ApplicationContainer
  {
    get { return this._container; }
  }

  public void EndLifetimeScope()
```

```
  {
    if (this._scope != null)
    {
      this._scope.Dispose();
      this._scope = null;
    }
  }

  public ILifetimeScope GetLifetimeScope(Action<ContainerBuilder> configurationAction)
  {
    if (this._scope == null)
    {
      this._scope = (configurationAction == null)
             ? this.ApplicationContainer.BeginLifetimeScope(MatchingScopeLifetimeTags.
↪RequestLifetimeScopeTag)
             : this.ApplicationContainer.BeginLifetimeScope(MatchingScopeLifetimeTags.
↪RequestLifetimeScopeTag, configurationAction);
    }

    return this._scope;
  }
}
```

When creating your `AutofacDependencyResolver` from your built application container, you'd manually specify your simple lifetime scope provider. Make sure you set up the resolver before your test runs, then after the test runs you need to clean up the fake request scope. In NUnit, it'd look like this:

```
private IDependencyResolver _originalResolver = null;
private ILifetimeScopeProvider _scopeProvider = null;

[TestFixtureSetUp]
public void TestFixtureSetUp()
{
  // Build the container, then...
  this._scopeProvider = new SimpleLifetimeScopeProvider(container);
  var resolver = new AutofacDependencyResolver(container, provider);
  this._originalResolver = DependencyResolver.Current;
  DependencyResolver.SetResolver(resolver);
}

[TearDown]
public void TearDown()
{
  // Clean up the fake 'request' scope.
  this._scopeProvider.EndLifetimeScope();
}

[TestFixtureTearDown]
public void TestFixtureTearDown()
{
  // If you're mucking with statics, always put things
  // back the way you found them!
  DependencyResolver.SetResolver(this._originalResolver);
}
```

Faking a Web API Request Scope

In Web API, the request lifetime scope is actually dragged around the system along with the inbound `HttpRequestMessage` as an `ILifetimeScope` object. To fake out a request scope, you just have to get the `ILifetimeScope` attached to the message you're processing as part of your test.

During test setup, you should build the dependency resolver as you would in the application and associate that with an `HttpConfiguration` object. In each test, you'll create the appropriate `HttpRequestMessage` to process based on the use case being tested, then use built-in Web API extension methods to attach the configuration to the message and get the request scope from the message.

In NUnit it'd look like this:

```
private HttpConfiguration _configuration = null;

[TestFixtureSetUp]
public void TestFixtureSetUp()
{
  // Build the container, then...
  this._configuration = new HttpConfiguration
  {
    DependencyResolver = new AutofacWebApiDependencyResolver(container)
  }
}

[TestFixtureTearDown]
public void TestFixtureTearDown()
{
  // Clean up - automatically handles
  // cleaning up the dependency resolver.
  this._configuration.Dispose();
}

[Test]
public void MyTest()
{
  // Dispose of the HttpRequestMessage to dispose of the
  // request lifetime scope.
  using(var message = CreateTestHttpRequestMessage())
  {
    message.SetConfiguration(this._configuration);

    // Now do your test. Use the extension method
    // message.GetDependencyScope()
    // to get the request lifetime scope from Web API.
  }
}
```

Troubleshooting Per-Request Dependencies

There are a few gotchas when you're working with per-request dependencies. Here's some troubleshooting help.

No Scope with a Tag Matching 'AutofacWebRequest'

A very common exception people see when they start working with per-request lifetime scope is:

```
DependencyResolutionException: No scope with a Tag matching
'AutofacWebRequest' is visible from the scope in which the instance
was requested. This generally indicates that a component registered
as per-HTTP request is being requested by a SingleInstance()
component (or a similar scenario.) Under the web integration always
request dependencies from the DependencyResolver.Current or
ILifetimeScopeProvider.RequestLifetime, never from the container
itself.
```

What this means is that the application tried to resolve a dependency that is registered as `InstancePerRequest()` but there wasn't any request lifetime in place.

Common causes for this include:

- Application registrations are being shared across application types.
- A unit test is running with real application registrations but isn't simulating per-request lifetimes.
- You have a component that *lives longer than one request* but it takes a dependency that *only lives for one request*. For example, a singleton component that takes a service registered as per-request.
- Code is running during application startup (e.g., in an ASP.NET `Global.asax`) that uses dependency resolution when there isn't an active request yet.
- Code is running in a "background thread" (where there's no request semantics) but is trying to call the ASP.NET MVC `DependencyResolver` to do service location.

Tracking down the source of the issue can be troublesome. In many cases, you might look at what is being resolved and see that the component being resolved is *not registered as per-request* and the dependencies that component uses are also *not registered as per-request*. In cases like this, you may need to go all the way down the dependency chain. The exception could be coming from something deep in the dependency chain. Usually a close examination of the call stack can help you. In cases where you are doing *dynamic assembly scanning* to locate *modules* to register, the source of the troublesome registration may not be immediately obvious.

As you analyze the registrations in the problem dependency chain, look at the lifetime scopes for which they're registered. If you have a component registered as `SingleInstance()` but it (maybe indirectly) consumes a component registered as `InstancePerRequest()`, that's a problem. The `SingleInstance()` component will grab its dependencies when it's resolved the first time and never let go. If that happens at app startup or in a background thread where there's no current request, you'll see this exception. You may need to adjust some component lifetime scopes. Again, it's really good to know *how dependency lifetime scopes work in general*.

Anyway, somewhere along the line, *something* is looking for a per-request lifetime scope and it's not being found.

If you are trying to share registrations across application types, check out the *Sharing Dependencies Across Apps Without Requests* section.

If you are trying to unit test with per-request dependencies, the sections *Testing with Per-Request Dependencies* and *Sharing Dependencies Across Apps Without Requests* can give you some tips.

If you have application startup code or a background thread in an ASP.NET MVC app trying to use `DependencyResolver.Current` - the `AutofacDependencyResolver` requires a web context to resolve things. When you try to resolve something from the resolver, it's going to try to spin up a per-request lifetime scope and store it along with the current `HttpContext`. If there isn't a current context, things will fail. Accessing `AutofacDependencyResolver.Current` will not get you around that - the way the current resolver property works, it locates itself from the current web request scope. (It does this to allow working with applications like Glimpse and other instrumentation mechanisms.)

For application startup code or background threads, you may need to look at a different service locator mechanism like *Common Service Locator* to bypass the need for per-request scope. If you do that, you'll also need to check out the *Sharing Dependencies Across Apps Without Requests* section to update your component registrations so they also don't necessarily require a per-request scope.

No Per-Request Filter Dependencies in Web API

If you are using the *Web API integration* and `AutofacWebApiFilterProvider` to do dependency injection into your action filters, you may notice that **dependencies in filters are resolved one time only and not on a per-request basis**.

This is a shortcoming in Web API. The Web API internals create filter instances and then cache them, never to be created again. This removes any "hooks" that might otherwise have existed to do anything on a per-request basis in a filter.

If you need to do something per-request in a filter, you will need to use service location and manually get the request lifetime scope from the context in your filter. For example, an `ActionFilterAttribute` might look like this:

```
public class LoggingFilterAttribute : ActionFilterAttribute
{
  public override void OnActionExecuting(HttpActionContext context)
  {
    var logger = context.Request.GetDependencyScope().GetService(typeof(ILogger)) as
↪ILogger;
    logger.Log("Executing action.");
  }
}
```

Using this service location mechanism, you wouldn't even need the `AutofacWebApiFilterProvider` - you can do this even without using Autofac at all.

Implementing Custom Per-Request Semantics

You may have a custom application that handles requests - like a Windows Service application that takes requests, performs some work, and provides some output. In cases like that, you can implement a custom mechanism that provides the ability to register and resolve dependencies on a per-request basis if you structure your application properly. The steps you would take are identical to the steps seen in other application types that naturally support per-request semantics.

- **Build the container at application start.** Make your registrations, build the container, and store a reference to the global container for later use.
- **When a logical request is received, create a request lifetime scope.** The request lifetime scope should be tagged with the tag `Autofac.Core.Lifetime.MatchingScopeLifetimeTags.RequestLifetimeScopeTag` so you can use standard registration extension methods like `InstancePerRequest()`. This will also enable you to share registration modules across application types if you so desire.
- **Associate request lifetime scope with the request.** This means you need the ability to get the request scope from within the request and not have a single, static, global variable with the "request scope" - that's a threading problem. You either need a construct like `HttpContext.Current` (as in ASP.NET) or `OperationContext.Current` (as in WCF); or you need to store the request lifetime along with the actual incoming request information (like Web API).
- **Dispose of the request lifetime after the request is done.** After the request has been processed and the response is sent, you need to call `IDisposable.Dispose()` on the request lifetime scope to ensure memory is cleaned up and service instances are released.

- **Dispose of the container at application end.** When the application is shutting down, call `IDisposable.Dispose()` on the global application container to ensure any managed resources are properly disposed and connections to databases, etc. are shut down.

How exactly you do this depends on your application, so an "example" can't really be provided. A good way to see the pattern is to look at the source for *the integration libraries* for various app types like MVC and Web API to see how those are done. You can then adopt patterns and adapt accordingly to fit your application's needs.

This is a very advanced process. You can pretty easily introduce memory leaks by not properly disposing of things or create threading problems by not correctly associating request lifetimes with requests. Be careful if you go down this road and do a lot of testing and profiling to make sure things work as you expect.

How do I pick a service implementation by context?

There are times when you may want to register multiple *components* that all expose the same *service* but you want to pick which component is used in different instances.

For this question, let's imagine a simple order processing system. In this system, we have...

- A shipping processor that orchestrates the physical mailing of the order contents.
- A notification processor that sends an alert to a user when their order status changes.

In this simple system, the shipping processor might need to take different "plugins" to allow order delivery by different means - postal service, UPS, FedEx, and so on. The notification processor might also need different "plugins" to allow notifications by different means, like email or SMS text.

Your initial class design might look like this:

```
// This interface lets you send some content
// to a specified destination.
public interface ISender
{
  void Send(Destination dest, Content content);
}

// We can implement the interface for different
// "sending strategies":
public class PostalServiceSender : ISender { ... }
public class EmailNotifier : ISender { ... }

// The shipping processor sends the physical order
// to a customer given a shipping strategy (postal service,
// UPS, FedEx, etc.).
public class ShippingProcessor
{
  public ShippingProcessor(ISender shippingStrategy) { ... }
}

// The customer notifier sends the customer an alert when their
// order status changes using the channel specified by the notification
// strategy (email, SMS, etc.).
public class CustomerNotifier
{
  public CustomerNotifier(ISender notificationStrategy) { ... }
}
```

When you register things in Autofac, you might have registrations that look like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<PostalServiceSender>().As<ISender>();
builder.RegisterType<EmailNotifier>().As<ISender>();
builder.RegisterType<ShippingProcessor>();
builder.RegisterType<CustomerNotifier>();
var container = builder.Build();
```

How do you make sure the shipping processor gets the postal service strategy and the customer notifier gets the email strategy?

- *Option 1: Redesign Your Interfaces*
- *Option 2: Change the Registrations*
- *Option 3: Use Keyed Services*
- *Option 4: Use Metadata*

Option 1: Redesign Your Interfaces

When you run into a situation where you have a bunch of components that implement identical services but *they can't be treated identically*, **this is generally an interface design problem**.

From an object oriented development perspective, you'd want your objects to adhere to the Liskov substitution principle and this sort of breaks that.

Think about it from another angle: the standard "animal" example in object orientation. Say you have some animal objects and you are creating a special class that represents a bird cage that can hold small birds:

```
public abstract class Animal
{
  public abstract string MakeNoise();
  public abstract AnimalSize Size { get; }
}

public enum AnimalSize
{
  Small, Medium, Large
}

public class HouseCat : Animal
{
  public override string MakeNoise() { return "Meow!"; }
  public override AnimalSize { get { return AnimalSize.Small; } }
}

public abstract class Bird : Animal
{
  public override string MakeNoise() { return "Chirp!"; }
}

public class Parakeet : Bird
{
  public override AnimalSize { get { return AnimalSize.Small; } }
}
```

```
public class BaldEagle : Bird
{
  public override string MakeNoise() { return "Screech!"; }
  public override AnimalSize { get { return AnimalSize.Large; } }
}
```

OK, there are our animals. Obviously we can't treat them all equally, so if we made a bird cage class, we *probably wouldn't do it like this*:

```
public class BirdCage
{
  public BirdCage(Animal animal)
  {
    if(!(animal is Bird) || animal.Size != AnimalSize.Small)
    {
      // We only support small birds.
      throw new NotSupportedException();
    }
  }
}
```

Designing your bird cage to take just any animal doesn't make sense. You'd at least want to make it take *only birds*:

```
public class BirdCage
{
  public BirdCage(Bird bird)
  {
    if(bird.Size != AnimalSize.Small)
    {
      // We know it's a bird, but it needs to be a small bird.
      throw new NotSupportedException();
    }
  }
}
```

But if we change the class design just a little bit, we can make it even easier and force only the right kind of birds to even be allowed to be used:

```
// We still keep the base Bird class...
public abstract class Bird : Animal
{
  public override string MakeNoise() { return "Chirp!"; }
}

// But we also add a "PetBird" class - for birds that
// are small and kept as pets.
public abstract class PetBird : Bird
{
  // We "seal" the override to ensure all pet birds are small.
  public sealed override AnimalSize { get { return AnimalSize.Small; } }
}

// A parakeet is a pet bird, so we change the base class.
public class Parakeet : PetBird { }

// Bald eagles aren't generally pets, so we don't change the base class.
public class BaldEagle : Bird
```

```
{
  public override string MakeNoise() { return "Screech!"; }
  public override AnimalSize { get { return AnimalSize.Large; } }
}
```

Now it's easy to design our bird cage to only support small pet birds. We just use the correct base class in the constructor:

```
public class BirdCage
{
  public BirdCage(PetBird bird) { }
}
```

Obviously this is a fairly contrived example with flaws if you dive too far into the analogy, but the principle holds - redesigning the interfaces helps us ensure the bird cage only gets what it expects and nothing else.

Bringing this back to the ordering system, *it might seem like every delivery mechanism is just "sending something"* but the truth is, they send *very different types of things*. Maybe there's a base interface that is for general "sending of things," but you probably need an intermediate level to differentiate between the types of things being sent:

```
// We can keep the ISender interface if we want...
public interface ISender
{
  void Send(Destination dest, Content content);
}

// But we'll introduce intermediate interfaces, even
// if they're just "markers," so we can differentiate between
// the sort of sending the strategies can perform.
public interface IOrderSender : ISender { }
public interface INotificationSender : ISender { }

// We change the strategies so they implement the appropriate
// interfaces based on what they are allowed to send.
public class PostalServiceSender : IOrderSender { ... }
public class EmailNotifier : INotificationSender { ... }

// Finally, we update the classes consuming the sending
// strategies so they only allow the right kind of strategy
// to be used.
public class ShippingProcessor
{
  public ShippingProcessor(IOrderSender shippingStrategy) { ... }
}

public class CustomerNotifier
{
  public CustomerNotifier(INotificationSender notificationStrategy) { ... }
}
```

By doing some interface redesign, you don't have to "choose a dependency by context" - you use the types to differentiate and let auto-wireup magic happen during *resolution*.

If you have the ability to affect change on your solution, this is the recommended option.

Option 2: Change the Registrations

One of the things Autofac lets you do when you *register components* is to register lambda expressions rather than just types. You can manually associate the appropriate type with the consuming component in that way:

```
var builder = new ContainerBuilder();
builder.Register(ctx => new ShippingProcessor(new PostalServiceSender()));
builder.Register(ctx => new CustomerNotifier(new EmailNotifier()));
var container = builder.Build();
```

If you want to keep the senders being resolved from Autofac, you can expose them both as their interface types and as themselves, then resolve them in the lambda:

```
var builder = new ContainerBuilder();

// Add the "AsSelf" clause to expose these components
// both as the ISender interface and as their natural type.
builder.RegisterType<PostalServiceSender>()
       .As<ISender>()
       .AsSelf();
builder.RegisterType<EmailNotifier>()
       .As<ISender>()
       .AsSelf();

// Lambda registrations resolve based on the specific type, not the
// ISender interface.
builder.Register(ctx => new ShippingProcessor(ctx.Resolve<PostalServiceSender>()));
builder.Register(ctx => new CustomerNotifier(ctx.Resolve<EmailNotifier>()));
var container = builder.Build();
```

If using the lambda mechanism feels too "manual" or if the processor objects take lots of parameters, you can *manually attach parameters to the registrations*:

```
var builder = new ContainerBuilder();

// Keep the "AsSelf" clause.
builder.RegisterType<PostalServiceSender>()
       .As<ISender>()
       .AsSelf();
builder.RegisterType<EmailNotifier>()
       .As<ISender>()
       .AsSelf();

// Attach resolved parameters to override Autofac's
// lookup just on the ISender parameters.
builder.RegisterType<ShippingProcessor>()
       .WithParameter(
         new ResolvedParameter(
           (pi, ctx) => pi.ParameterType == typeof(ISender),
           (pi, ctx) => ctx.Resolve<PostalServiceSender>()));
builder.RegisterType<CustomerNotifier>();
       .WithParameter(
         new ResolvedParameter(
           (pi, ctx) => pi.ParameterType == typeof(ISender),
           (pi, ctx) => ctx.Resolve<EmailNotifier>()));
var container = builder.Build();
```

Using the parameter method, you still get the "auto-wireup" benefit when creating both the senders and the processors, but you can specify a very specific override in those cases.

If you can't change your interfaces and you want to keep things simple, this is the recommended option.

Option 3: Use Keyed Services

Perhaps you are able to change your registrations but you are also using *modules* to register lots of different components and can't really tie things together by type. A simple way to get around this is to use *keyed services*.

In this case, Autofac lets you assign a "key" or "name" to a service registration and resolve based on that key from another registration. In the module where you register your senders, you would associate the appropriate key with each sender; in the module where you register you processors, you'd apply parameters to the registrations to get the appropriate keyed service dependency.

In the module that registers your senders, add key names:

```
public class SenderModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<PostalServiceSender>()
           .As<ISender>()
           .Keyed<ISender>("order");
    builder.RegisterType<EmailNotifier>()
           .As<ISender>()
           .Keyed<ISender>("notification");
  }
}
```

In the module that registers the processors, add parameters that use the known keys:

```
public class ProcessorModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<ShippingProcessor>()
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.ResolveKeyed<ISender>("order")));
    builder.RegisterType<CustomerNotifier>();
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.ResolveKeyed<ISender>("notification")));
  }
}
```

Now when the processors are resolved, they'll search for the keyed service registrations and you'll get the right one injected.

You can have more than one service with the same key so this will work if you have a situation where your sender takes in an `IEnumerable<ISender>` as well via *implicitly supported relationships*. Just set the parameter to `ctx.ResolveKeyed<IEnumerable<ISender>>("order")` with the appropriate key in the processor registration; and register each sender with the appropriate key.

If you have the ability to change the registrations and you're not locked into doing assembly scanning for all your registrations, this is the recommended option.

Option 4: Use Metadata

If you need something more flexible than *keyed services* or if you don't have the ability to directly affect registrations, you may want to consider using the *registration metadata* facility to tie the right services together.

You can associate metadata with registrations directly:

```
public class SenderModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<PostalServiceSender>()
           .As<ISender>()
           .WithMetadata("SendAllowed", "order");
    builder.RegisterType<EmailNotifier>()
           .As<ISender>()
           .WithMetadata("SendAllowed", "notification");
  }
}
```

You can then make use of the metadata as parameters on consumer registrations:

```
public class ProcessorModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<ShippingProcessor>()
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.Resolve<IEnumerable<Meta<ISender>>>()
                                .First(a => a.Metadata["SendAllowed"].Equals("order
↪"))));
    builder.RegisterType<CustomerNotifier>();
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.Resolve<IEnumerable<Meta<ISender>>>()
                                .First(a => a.Metadata["SendAllowed"].Equals(
↪"notification"))));
  }
}
```

(Yes, this is *just slightly* more complex than using keyed services, but you may desire the *flexibility the metadata facility offers*.)

If you can't change the registrations of the sender components, but you're allowed to change the object definitions, you can add metadata to components using the "attribute metadata" mechanism. First you'd create your custom metadata attribute:

```
[System.ComponentModel.Composition.MetadataAttribute]
public class SendAllowedAttribute : Attribute
{
    public string SendAllowed { get; set; }

    public SendAllowedAttribute(string sendAllowed)
    {
      this.SendAllowed = sendAllowed;
```

```
    }
}
```

Then you can apply your custom metadata attribute to the sender components:

```
[SendAllowed("order")]
public class PostalServiceSender : IOrderSender { ... }

[SendAllowed("notification")]
public class EmailNotifier : INotificationSender { ... }
```

When you register your senders, make sure to register the `AttributedMetadataModule`:

```
public class SenderModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<PostalServiceSender>().As<ISender>();
    builder.RegisterType<EmailNotifier>().As<ISender>();
    builder.RegisterModule<AttributedMetadataModule>();
  }
}
```

The consuming components can then use the metadata just like normal - the names of the attribute properties become the names in the metadata:

```
public class ProcessorModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<ShippingProcessor>()
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.Resolve<IEnumerable<Meta<ISender>>>()
                               .First(a => a.Metadata["SendAllowed"].Equals("order
↪"))));
    builder.RegisterType<CustomerNotifier>();
           .WithParameter(
             new ResolvedParameter(
               (pi, ctx) => pi.ParameterType == typeof(ISender),
               (pi, ctx) => ctx.Resolve<IEnumerable<Meta<ISender>>>()
                               .First(a => a.Metadata["SendAllowed"].Equals(
↪"notification"))));
  }
}
```

For your consuming components, you can also use attributed metadata if you don't mind adding a custom Autofac attribute to your parameter definition:

```
public class ShippingProcessor
{
  public ShippingProcessor([WithMetadata("SendAllowed", "order")] ISender␣
↪shippingStrategy) { ... }
}

public class CustomerNotifier
{
```

```
  public CustomerNotifier([WithMetadata("SendAllowed", "notification")] ISender␣
↪notificationStrategy) { ... }
}
```

If your consuming components use the attribute, you need to register them `WithAttributeFilter`:

```
public class ProcessorModule : Module
{
  protected override void Load(ContainerBuilder builder)
  {
    builder.RegisterType<ShippingProcessor>().WithAttributeFilter();
    builder.RegisterType<CustomerNotifier>().WithAttributeFilter();
  }
}
```

Again, the metadata mechanism is very flexible. You can mix and match the way you associate metadata with components and service consumers - attributes, parameters, and so on. You can read more about *registration metadata*, *registration parameters*, *resolution parameters*, and *implicitly supported relationships* (like the `Meta<T>` relationship) on their respective pages.

If you are already using metadata or need the flexibility metadata offers, this is the recommended option.

How do I create a session-based lifetime scope in a web application?

Note for doc writing: http://stackoverflow.com/questions/11721919/managing-autofac-lifetime-scopes-per-session-and-request-in-asp-11726210#11726210

Why aren't my assemblies getting scanned after IIS restart?

Sometimes you want to use the *assembly scanning* mechanism to load up plugins in IIS hosted applications.

When hosting applications in IIS all assemblies are loaded into the `AppDomain` when the application first starts, but **when the AppDomain is recycled by IIS the assemblies are then only loaded on demand.**

To avoid this issue use the GetReferencedAssemblies() method on System.Web.Compilation.BuildManager to get a list of the referenced assemblies instead:

```
var assemblies = BuildManager.GetReferencedAssemblies().Cast<Assembly>();
```

That will force the referenced assemblies to be loaded into the `AppDomain` immediately making them available for module scanning.

Alternatively, rather than using `AppDomain.CurrentDomain.GetAssemblies()` for scanning, **manually load the assemblies** from the filesystem. Doing a manual load forces them into the `AppDomain` so you can start scanning.

How do I conditionally register components?

Note for doc writing: This will be about using modules or XML config to do the logic.

How do I share component registrations across application types?

Note for doc writing: This is that question where someone wants to use per-request lifetime scopes in a web app but some other scope in a different kind of app.

How do I keep Autofac references isolated away from my app?

Note for doc writing: This is for those folks who don't want any sort of Autofac reference in their app. We'll be thinking assembly scanning, startup logic, CommonServiceLocator, that sort of thing.

Why are "old versions" of the framework (e.g., System.Core 2.0.5.0) referenced?

Autofac (as of 3.0) is a **Portable Class Library** that targets multiple platforms.

As a Portable Class Library, if you open up Autofac in Reflector, dotPeek, or other like tools, you'll see references to version 2.0.5.0 of various system libraries. Version 2.0.5.0 is, in fact, the Silverlight version of the .NET framework. *This is expected and is not a problem.* At runtime everything pans out. Autofac will correctly bind to the framework version you're using - be it .NET 4.5, Silverlight, or Windows Phone. You can read more about Portable Class Libraries on MSDN.

You may encounter an exception that looks something like this when using Autofac as a Portable Class Library:

```
Test 'MyNamespace.MyFixture.MyTest' failed: System.IO.FileLoadException : Could not␣
↪load file or assembly 'System.Core, Version=2.0.5.0, Culture=neutral,␣
↪PublicKeyToken=7cec85d7bea7798e, Retargetable=Yes' or one of its dependencies. The␣
↪given assembly name or codebase was invalid. (Exception from HRESULT: 0x80131047)
    at Autofac.Builder.RegistrationData..ctor(Service defaultService)
    at Autofac.Builder.RegistrationBuilder`3..ctor(Service defaultService,␣
↪TActivatorData activatorData, TRegistrationStyle style)
    at Autofac.RegistrationExtensions.RegisterInstance[T](ContainerBuilder builder, T␣
↪instance)
    MyProject\MyFixture.cs(49,0): at MyNamespace.MyFixture.MyTest()
```

Make sure your .NET framework is patched. Microsoft released patches to .NET to allow Portable Class Libraries to properly find the appropriate runtime (KB2468871). If you are seeing the above exception (or something like it), it means you're missing the latest .NET framework patches.

This blog entry has a good overview of these and other things you might see when you use Portable Class Libraries.

Why don't all Autofac packages target the latest Autofac core?

Autofac has a lot of *integration packages* and extensions. You'll find that not all of these packages directly reference the very latest of Autofac core.

Unless there's a technical reason to increase the minimum version requirement for one of these packages, we'll keep the version unchanged.

We do this because, generally speaking, we don't want to force anyone to update their version of Autofac core unless they absolutely must. This is a fairly good practice for any library set - if a person doesn't *have* to take an update, you shouldn't *force* them to do so.

What this results in is the need to use assembly binding redirects. This is the official supported way to tell the .NET runtime that you need to redirect requests for one version of a strong-named assembly to a later version of that assembly. This is common enough that both NuGet and Visual Studio will, in many cases, automatically add these to your configuration files.

Here's an example of what assembly binding redirects look like:

```
<?xml version="1.0" encoding="utf-8"?>
<configuration>
    <runtime>
        <assemblyBinding xmlns="urn:schemas-microsoft-com:asm.v1">
            <dependentAssembly>
                <assemblyIdentity name="Autofac"
                                  publicKeyToken="17863af14b0044da"
                                  culture="neutral" />
                <bindingRedirect oldVersion="0.0.0.0-3.5.0.0"
                                 newVersion="3.5.0.0" />
            </dependentAssembly>
            <dependentAssembly>
                <assemblyIdentity name="Autofac.Extras.CommonServiceLocator"
                                  publicKeyToken="17863af14b0044da"
                                  culture="neutral" />
                <bindingRedirect oldVersion="0.0.0.0-3.1.0.0"
                                 newVersion="3.1.0.0" />
            </dependentAssembly>
            <dependentAssembly>
                <assemblyIdentity name="Autofac.Extras.Multitenant"
                                  publicKeyToken="17863af14b0044da"
                                  culture="neutral" />
                <bindingRedirect oldVersion="0.0.0.0-3.1.0.0"
                                 newVersion="3.1.0.0" />
            </dependentAssembly>
            <dependentAssembly>
                <assemblyIdentity name="Autofac.Integration.Mvc"
                                  publicKeyToken="17863af14b0044da"
                                  culture="neutral" />
                <bindingRedirect oldVersion="0.0.0.0-3.3.0.0"
                                 newVersion="3.3.0.0" />
            </dependentAssembly>
    </runtime>
</configuration>
```

Assembly binding redirects are an unfortunate side-effect of assembly strong-naming. You don't need binding redirects if assemblies aren't strong-named; but there are some environments that require assemblies to be strong-named, so Autofac continues to strong-name assemblies.

Even if Autofac always kept every reference up to date, you would still not escape assembly binding redirects. Autofac integration packages, like *the Web API integration*, rely on other strong-named packages that then have their own dependencies. For example, the Microsoft Web API packages rely on Newtonsoft.Json and they don't always keep up with the latest version. They instead specify a minimum compatible version. *If you update your local version of Newtonsoft.Json... you get a binding redirect.*

Rather than try to fight against binding redirects, it may be better to just accept them as a "cost of doing business" in the .NET world. They do add a bit of "clutter" to the application configuration file, but until we can remove strong-naming from the equation, it's an inescapable necessity.

How do I inject configuration, environment, or context parameters?

There are times when you need to resolve a *service* that consumes a *component* somewhere down its dependency chain and that component needs *a parameter passed to it* from configuration, the environment, or some other runtime context location.

For this question, let's imagine a simple email notification system like this:

```
// This interface lets you send an email notification to someone.
public interface INotifier
{
  void Send(string address, string message);
}

// This implementation of the notifier uses a backing email
// repository for doing the heavy lifting.
public class Notifier : INotifier
{
  private IEmailServer _server;
  public Notifier(IEmailServer server)
  {
    this._server = server;
  }

  public void Send(string address, string message)
  {
    this._server.SendMessage(address, "from@domain.com", message);
  }
}

// This email server interface is what the notifier will use
// to send the email.
public interface IEmailServer
{
  void SendMessage(string toAddress, string fromAddress, message);
}

// Notice this implementaton takes a string parameter for the server address -
// something we won't know until runtime so we can't explicitly register the
// parameter value.
public class EmailServer : IEmailServer
{
  private string _serverAddress;
  public EmailServer(string serverAddress)
  {
    this._serverAddress = serverAddress;
  }

  public void SendMessage(string toAddress, string fromAddress, message)
  {
    // ...send the message through the specified server address.
  }
}
```

When you register things in Autofac, you might have registrations that look like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<Notifer>().As<INotifer>();
```

```
builder.RegisterType<EmailServer>().As<IEmailServer>();
var container = builder.Build();
```

The only time you know the email server address is at runtime - maybe through a context or environment parameter, maybe through configuration.

How do you get the configured/environment/context parameter to the email server when you resolve the notifier?

- *Option 1: Register Using a Lambda*
- *Option 2: Use a Provider*

Option 1: Register Using a Lambda

In this option, rather than registering the email server type directly, *register using a lambda expression*. This allows you to resolve things from the container or use the environment to get the value.

```
var builder = new ContainerBuilder();
builder.Register(ctx =>
{
  var address = Environment.GetEnvironmentVariable("SERVER_ADDRESS");
  return new EmailServer(address);
}).As<IEmailServer>();
```

As part of this, you may want to create some sort of abstraction around how you get the server address. For example, it may be something that you got as part of a web request and you've stored it in the `HttpContext`. You could create an address provider like this:

```
public interface IServerAddressProvider
{
  string GetServerAddress();
}

public class ContextServerAddressProvider : IServerAddressProvider
{
  private HttpContextBase _context;
  public ContextServerAddressProvider(HttpContextBase context)
  {
    this._context = context;
  }

  public string GetServerAddress()
  {
    return (string)this._context.Items["EMAIL_SERVER_ADDRESS"];
  }
}
```

Once you have a provider, you could register that with the container and use it in conjunction with the lambda.

```
var builder = new ContainerBuilder();
builder.RegisterType<ContextServerAddressProvider>()
       .As<IServerAddressProvider>()
       .InstancePerRequest();
```

```
builder.Register(ctx =>
{
  var address = ctx.Resolve<IServerAddressProvider>().GetServerAddress();
  return new EmailServer(address);
}).As<IEmailServer>();
```

If you need to pass a string parameter or can't modify the code, this is the recommended option.

Option 2: Use a Provider

Expanding on the provider mechanism described in option 1: Usually the biggest problem is that the parameter you need to pass is a base type like an integer or a string. If you can switch this to use a provider a strongly-typed interface parameter, you can make registration a little easier.

For example, you may be able to get the parameter from a web request context like this.

```
public interface IServerAddressProvider
{
  string GetServerAddress();
}

public class ContextServerAddressProvider : IServerAddressProvider
{
  private HttpContextBase _context;
  public ContextServerAddressProvider(HttpContextBase context)
  {
    this._context = context;
  }

  public string GetServerAddress()
  {
    return (string)this._context.Items["EMAIL_SERVER_ADDRESS"];
  }
}
```

You could then refactor the email server code to take the provider rather than an address string:

```
public class EmailServer : IEmailServer
{
  private IServerAddressProvider _serverAddressProvider;
  public EmailServer(IServerAddressProvider serverAddressProvider)
  {
    this._serverAddressProvider = serverAddressProvider;
  }

  public void SendMessage(string toAddress, string fromAddress, message)
  {
    var address = this._serverAddressProvider.GetServerAddress();
    // ...send the message through the specified server address.
  }
}
```

Now you can just register types:

```
var builder = new ContainerBuilder();
builder.RegisterType<ContextServerAddressProvider>()
       .As<IServerAddressProvider>()
```

```
       .InstancePerRequest();
builder.RegisterType<EmailServer>().As<IEmailServer>();
```

If you can modify the code, this is the recommended option.

How do I pass a parameter to a component in the middle of a resolve chain?

There are times when you need to resolve a *service* that consumes a *component* somewhere down its dependency chain and that component needs *a parameter passed to it*.

For this question, let's imagine a simple email notification system like this:

```
// This interface lets you send an email notification to someone.
public interface INotifier
{
  void Send(string address, string message);
}

// This implementation of the notifier uses a backing email
// repository for doing the heavy lifting.
public class Notifier : INotifier
{
  private IEmailServer _server;
  public Notifier(IEmailServer server)
  {
    this._server = server;
  }

  public void Send(string address, string message)
  {
    this._server.SendMessage(address, "from@domain.com", message);
  }
}

// This email server interface is what the notifier will use
// to send the email.
public interface IEmailServer
{
  void SendMessage(string toAddress, string fromAddress, message);
}

// Notice this implementaton takes a string parameter for the server address -
// something we won't know until runtime so we can't explicitly register the
// parameter value.
public class EmailServer : IEmailServer
{
  private string _serverAddress;
  public EmailServer(string serverAddress)
  {
    this._serverAddress = serverAddress;
  }

  public void SendMessage(string toAddress, string fromAddress, message)
  {
```

```
        // ...send the message through the specified server address.
    }
}
```

When you register things in Autofac, you might have registrations that look like this:

```
var builder = new ContainerBuilder();
builder.RegisterType<Notifer>().As<INotifer>();
builder.RegisterType<EmailServer>().As<IEmailServer>();
var container = builder.Build();
```

The only time you know the email server address is at runtime - maybe through a context or environment parameter, maybe through configuration.

How do you pass a parameter to the email server when you resolve the notifier?

Why This is a Design Problem

Before answering the question, consider that in many respects that **asking this question indicates a sort of design problem**.

Technically speaking, you're resolving an `INotifier` - a component that doesn't need to know about the runtime parameter with the email server address. The implementation of that `INotifier` could change. You could register a stub for testing, or switch up how emails get sent so they no longer need to know about the address.

Passing the server address as a parameter to the `INotifier` breaks the decoupling that interface-based development and inversion of control gives you by assuming that you "know" how the entire dependency chain is being resolved.

The key to solving the problem is to break that "knowledge" so you're not passing a parameter.

Solutions

Instead of trying to pass a parameter, flip the problem around - **figure out how you determine the parameter at runtime and wrap that in a provider or a lamda expression registration.**

This changes the question to a different FAQ where we walk through answers step by step: *How do I inject configuration, environment, or context parameters?*

CHAPTER 12

Glossary

The goal of this page is to help keep documentation, discussions, and APIs consistent.

Term	Meaning
Activator	Part of a *Registration* that, given a *Context* and a set of *Parameters*, can create a *Component Instance* bound to that *Context*
Argument	A formal argument to a constructor on a .NET type
Component	A body of code that declares the *Services* it provides and the *Dependencies* it consumes
Instance	A .NET object obtained by *Activating* a *Component* that provides *Services* within a *Container* (also *Component Instance*)
Container	A construct that manages the *Components* that make up an application
Context	A bounded region in which a specific set of *Services* is available
Dependency	A *Service* required by a *Component*
Lifetime	A duration bounded by the *Activation* of an *Instance* and its disposal
Parameter	Non-*Service* objects used to configure a *Component*
Registration	The act of adding and configuring a *Component* for use in a *Container*, and the information associated with this process
Scope	The specific *Context* in which *Instances* of a *Component* will be shared by other *Components* that depend on their *Services*
Service	A well-defined behavioural contract shared between a providing and a consuming *Component*

Admittedly this seems a bit low-level to fit with the typical idea of a 'universal language', but within the domain of IoC containers and specifically Autofac these can be viewed as concepts rather than implementation details.

Wild deviations from these terms in the API or code should be fixed or raised as issues to fix in a future version.

The terms *Application*, *Type*, *Delegate*, *Object*, *Property* etc. have their usual meaning in the context of .NET software development.

CHAPTER 13

Contributor Guide

Process, Standards, and Build

The Autofac contributor's guide is located in GitHub. If you are interested in contributing or building the project from source, check it out.

Contributors

Contributions have been accepted from:

- Nicholas Blumhardt - original version
- Rinat Abdullin - many enhancements
- Petar Andrijasevic - WCF integration
- Daniel Cazzulino - WCF integration enhancements
- Slava Ivanyuk - Moq integration (now part of Moq Contrib)
- Craig G. Wilson - additional Resolve() overloads
- C J Berg - perf improvements
- Chad Lee - NHibernate Integration
- Peter Lillevold - generated factories improvements
- Tyson Stolarski - Silverlight port
- Vijay Santhanam - Documentation updates
- Jonathan S. Oliver - resolve bug fix
- Carl Hörberg - various
- Alex Ilyin - bug fixes

- Alex Meyer-Gleaves - scanning improvements
- Mark Crowley - WCF integration improvements
- Travis Illig - multitenant support
- Steve Hebert - Autofac.Extras.Attributed project for metadata discovery

This isn't a complete list; if you're missing, file a pull request on this page.

Mention also has to be made of the many wonderful people who have worked in this field and shared their ideas and insights.

CHAPTER 14

Getting Support

Community Support

Autofac has a large community that can help you out if you have questions. If you can't find your answer in the documentation, you can...

- Ask your question on StackOverflow. Be sure to use the `autofac` tag in your question.
- Start a discussion on the forum. This is a good idea if you have multiple questions or a question that might have a more subjective answer (e.g., "recommendations" sorts of things).

Commercial Support

Several companies offer commercial support for Autofac questions/design issues:

- Readify - training and consulting services
- CICLO - commercial support and training
- Continuous IT - training, troubleshooting and implementation help

Note: while the above listed companies offer help, they are not officially affiliated with the Autofac project.

If you would like your company listed here, please send an email to the discussion group.

Filing an Issue

If you're having trouble figuring something out, please do try at least the community support road before filing a question-based issue. We do have a really great set of folks on StackOverflow, and while we definitely want to help you succeed, there is a *far, far, far smaller audience answering issues*.

If you do find a bug or just can't get an answer elsewhere, please file issues **in the repository corresponding to the library you're having trouble with**. For example, if you're having trouble with Web API integration, file the issue with the Web API Autofac integration library rather than in the core Autofac project.

Please include a detailed description of what's going wrong, full exception messages and stack traces, and (ideally) a small reproduction so we can see the problem in action like a failing unit test or a link to a small project. Including as much information as you can will help us address the issue in a more timely fashion.

CHAPTER 15

Indices and tables

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