VanSLUG

Introduction to MEF (mef.codeplex.com)

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Date: January 26, 2010

vanslug.net
forum.vanslug.net

About Jeremiah Redekop

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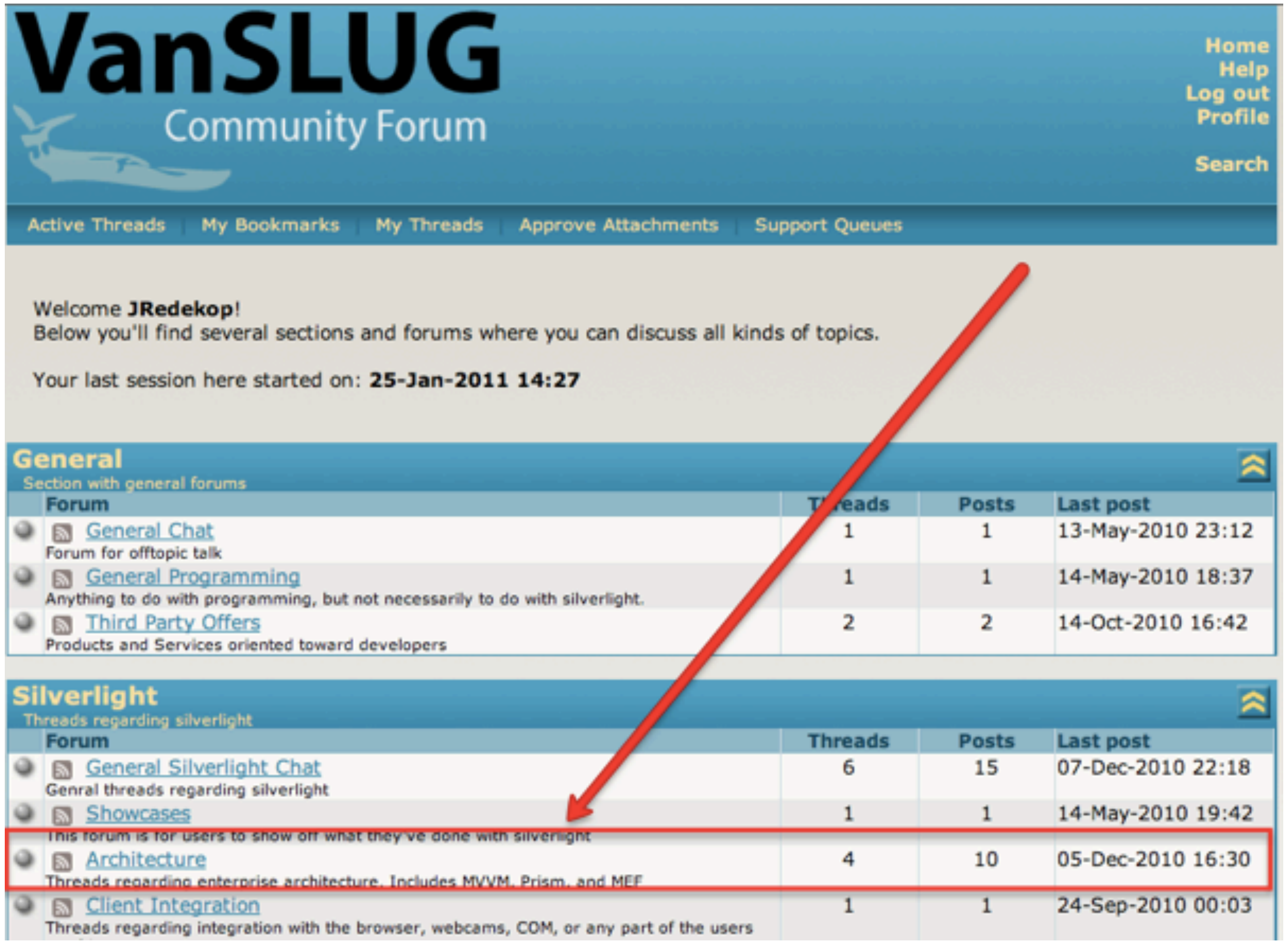
  - (case sensitive)
- twitter: @JRedekop

Questions?

- Now: Don't hesitate to ask during the talk
- Later: forums.vanslug.net
  - /Architecture



VanSLUG Community Forum

Welcome **JRedekop**!
Below you'll find several sections and forums where you can discuss all kinds of topics.

Your last session here started on: **25-Jan-2011 14:27**

General
Section with general forums

Forum	Threads	Posts	Last post
General Chat Forum for offtopic talk	1	1	13-May-2010 23:12
General Programming Anything to do with programming, but not necessarily to do with silverlight.	1	1	14-May-2010 18:37
Third Party Offers Products and Services oriented toward developers	2	2	14-Oct-2010 16:42

Silverlight
Threads regarding silverlight

Forum	Threads	Posts	Last post
General Silverlight Chat Genral threads regarding silverlight	6	15	07-Dec-2010 22:18
Showcases This forum is for users to show off what they've done with silverlight	1	1	14-May-2010 19:42
Architecture Threads regarding enterprise architecture. Includes MVVM, Prism, and MEF	4	10	05-Dec-2010 16:30
Client Integration Threads regarding integration with the browser, webcams, COM, or any part of the users	1	1	24-Sep-2010 00:03

Outline

- Introduction
- What problems does MEF address?
- How does MEF work?
- What are some good scenarios for MEF?
  - .Net
  - Silverlight
- Demos
- Additional Resources
- Q&A

If you only learn two things:

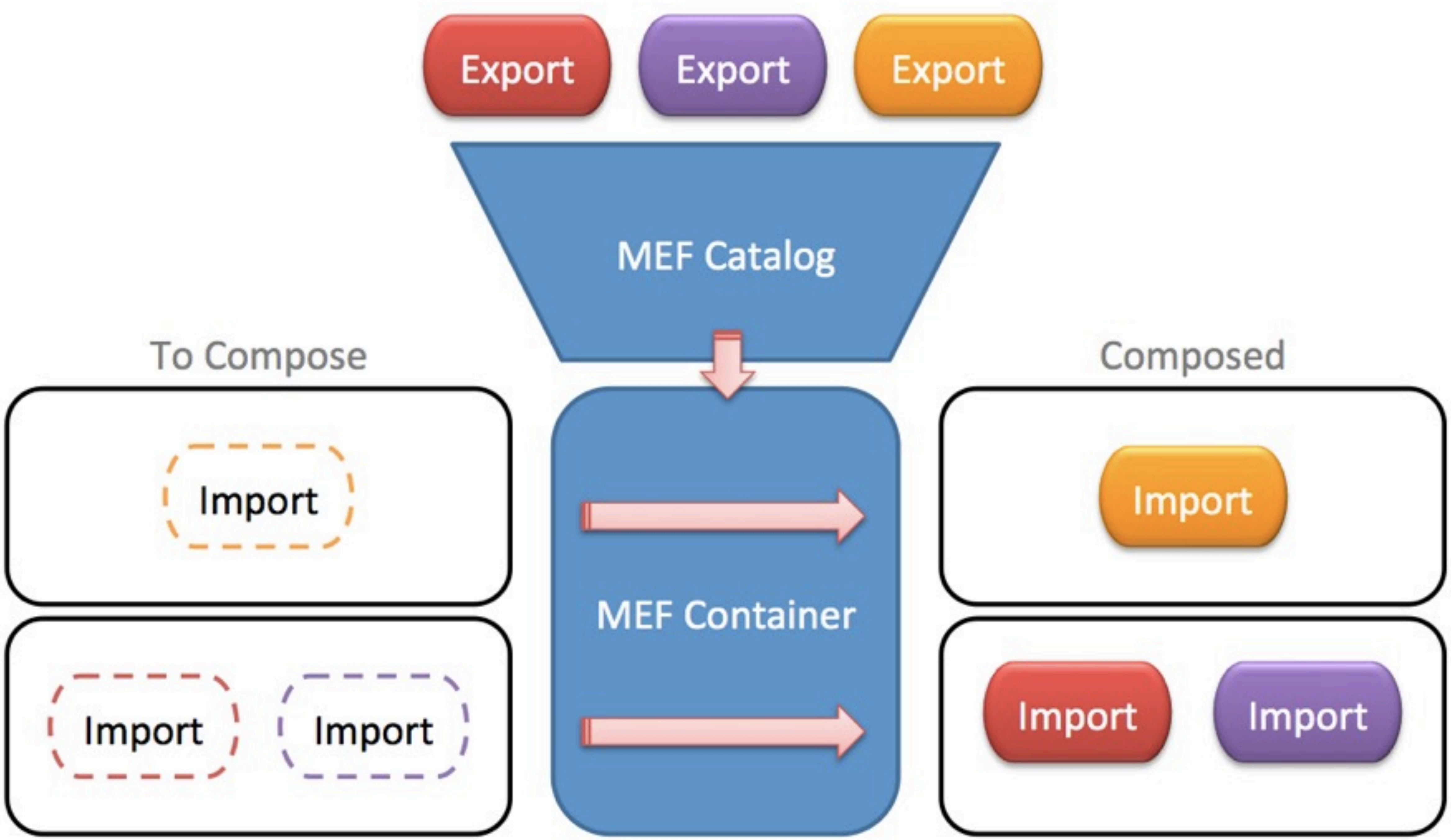
If you only learn two things:

- EXPORT - “use this”

If you only learn two things:

- EXPORT - “use this”
- IMPORT - “get this”

Diagram


Export
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MEF Catalog
To Compose
Composed
Import
Import
Import
MEF Container
Import
Import
Import

Quick Code Preview

- What will happen when composition occurs?

```
public class ToCompose
{
    [Import]
    public int IntegerToImport { get; set; }
}


public class ClassWithInteger
{
    [Export]
    public int IntegerToExport
    {
        get { return 5; }
    }
}
```

MEF Introduction

- used by Microsoft internally
- built into the framework
- suitable for heavy duty applications, flexible for small ones

- How to get MEF:
  - Included in the .net framework 4.0
  - Included in SL 4
  - download build for 3.5 from mef.codeplex.com

Problem:

Managing apps that are monolithic in nature

Monolithic Applications

- components are “tightly coupled” and there is no clear separation between them
- difficult for developers to **maintain**
- difficult to add **new features** to the system or replace existing features
- difficult to **resolve bugs** without breaking other portions of the system
- difficult to **test** and **deploy**
- difficult for designer and developers to **work together**
- difficult == costly == $$

Solution:

Extensible Applications

Extensible Applications

- Extensible: the **E** in M**E**F
- aka Composite, Plugins, Modular, etc

- Modules can be **individually** developed, tested, and deployed by **different individuals or teams**
- **Separation** of teams and responsibilities
- Recompile modules **individually**
- **Independent** modules
- Use central **contract** library instead of direct references
- Reduces cost of development and maintenance for long term

How does MEF work?

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Magic!

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“The good kind of Magic...”
Glenn Block, MS Project Manager

3 Main Parts of MEF

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  - source of discoverable MEF parts

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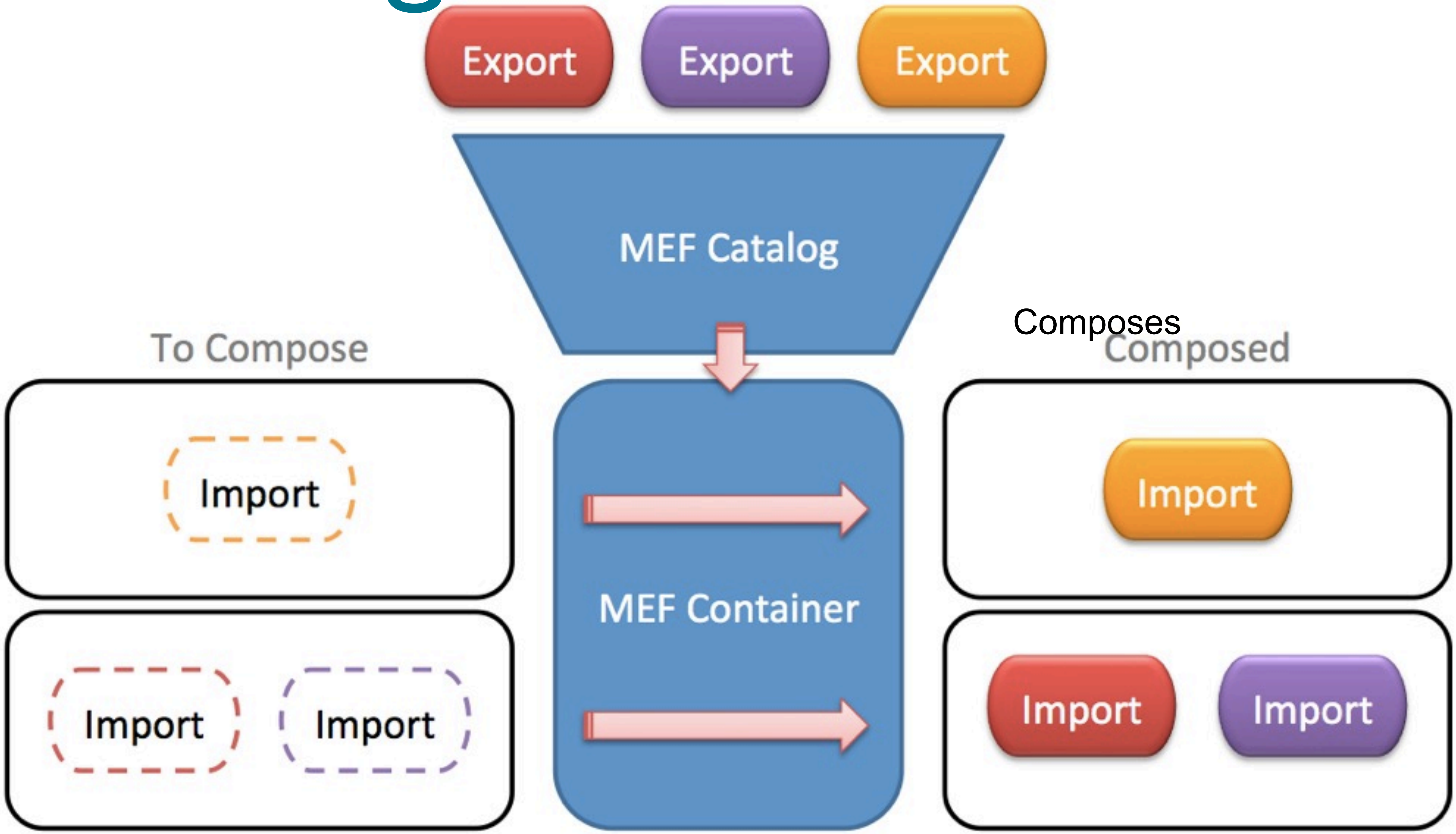
- Catalog
  - source of discoverable MEF parts
- Container
  - performs composition for an object
- Parts (imports and exports)
  - Exports and Imports that are to be discovered
    - Exports are discovered by the catalog
    - Imports are passed in to the container

Catalog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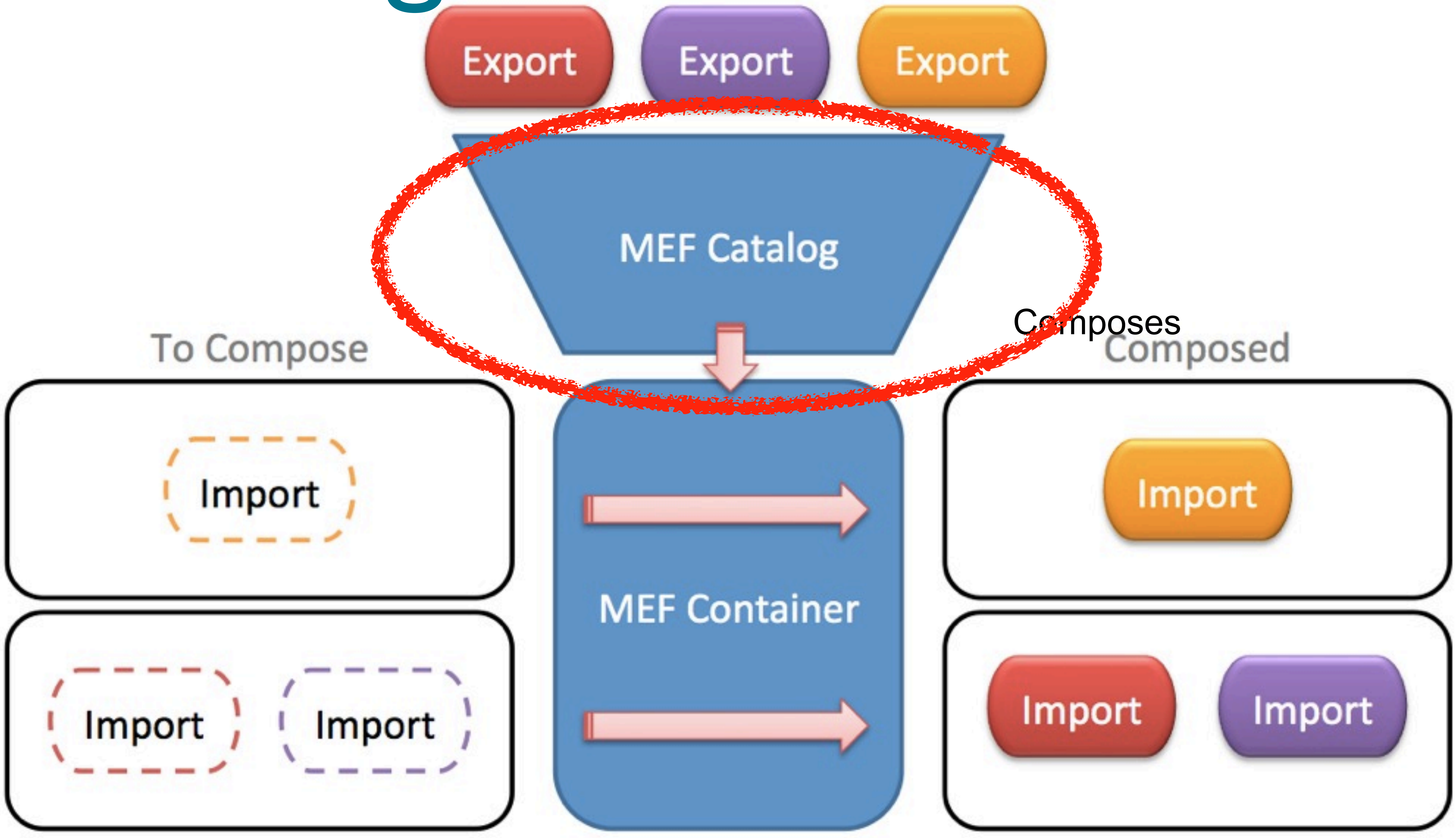
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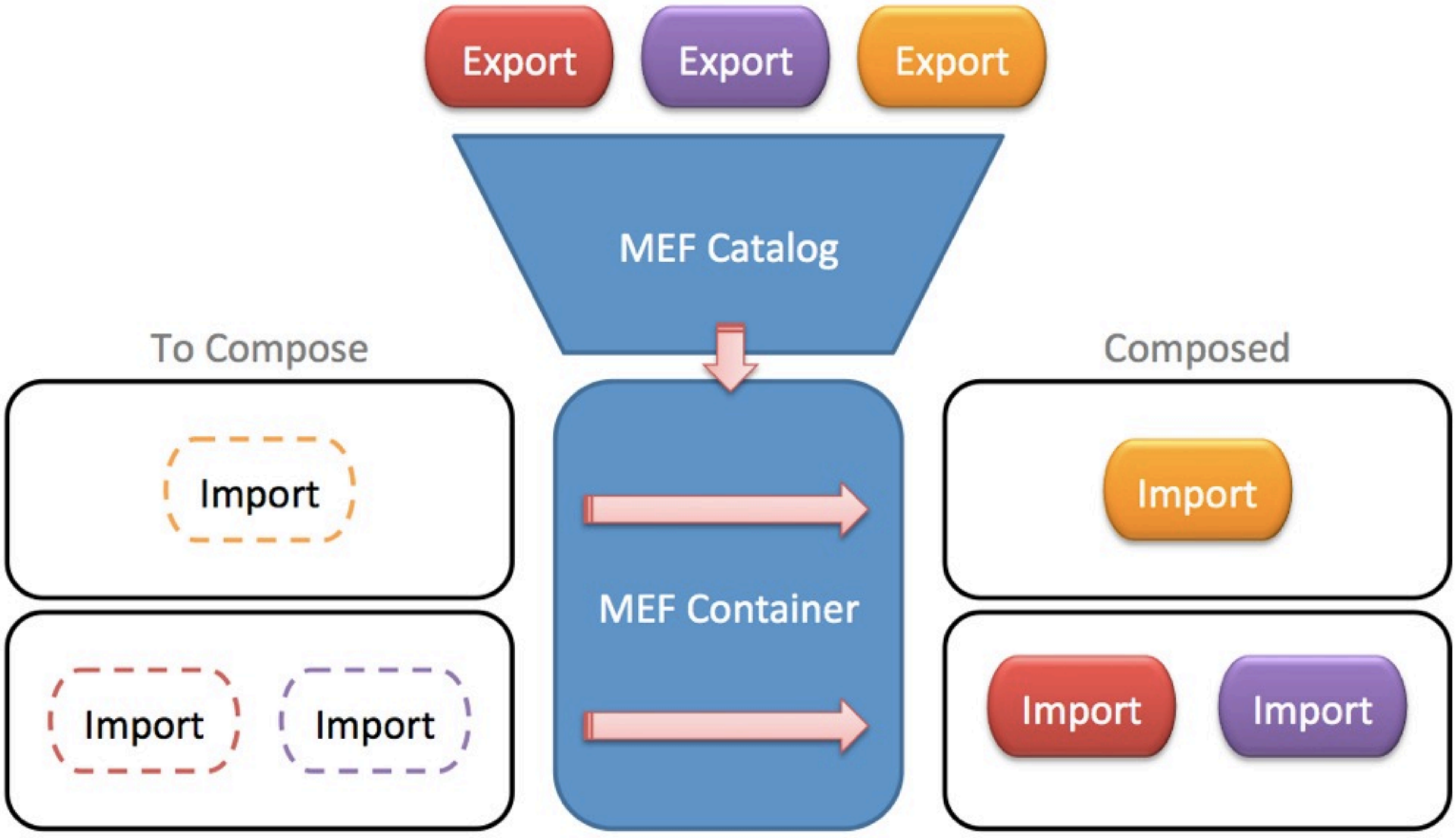
- Aggregate Catalog
  - collection of catalogs
  - Useful as a container can only have a single catalog
- Directory Catalog (*not supported in Silverlight*)
  - discovers exports in dlls in a given directory

Container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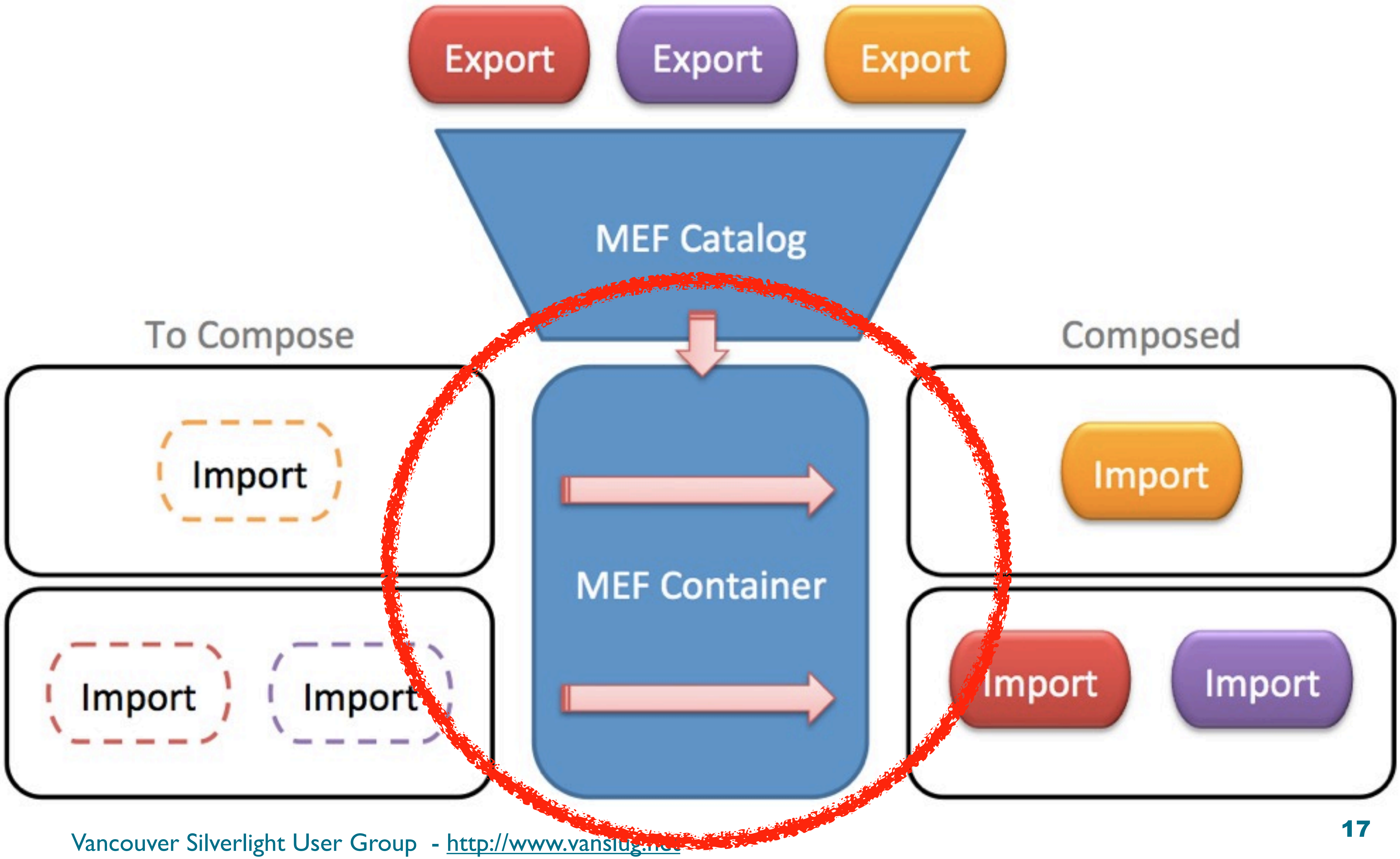
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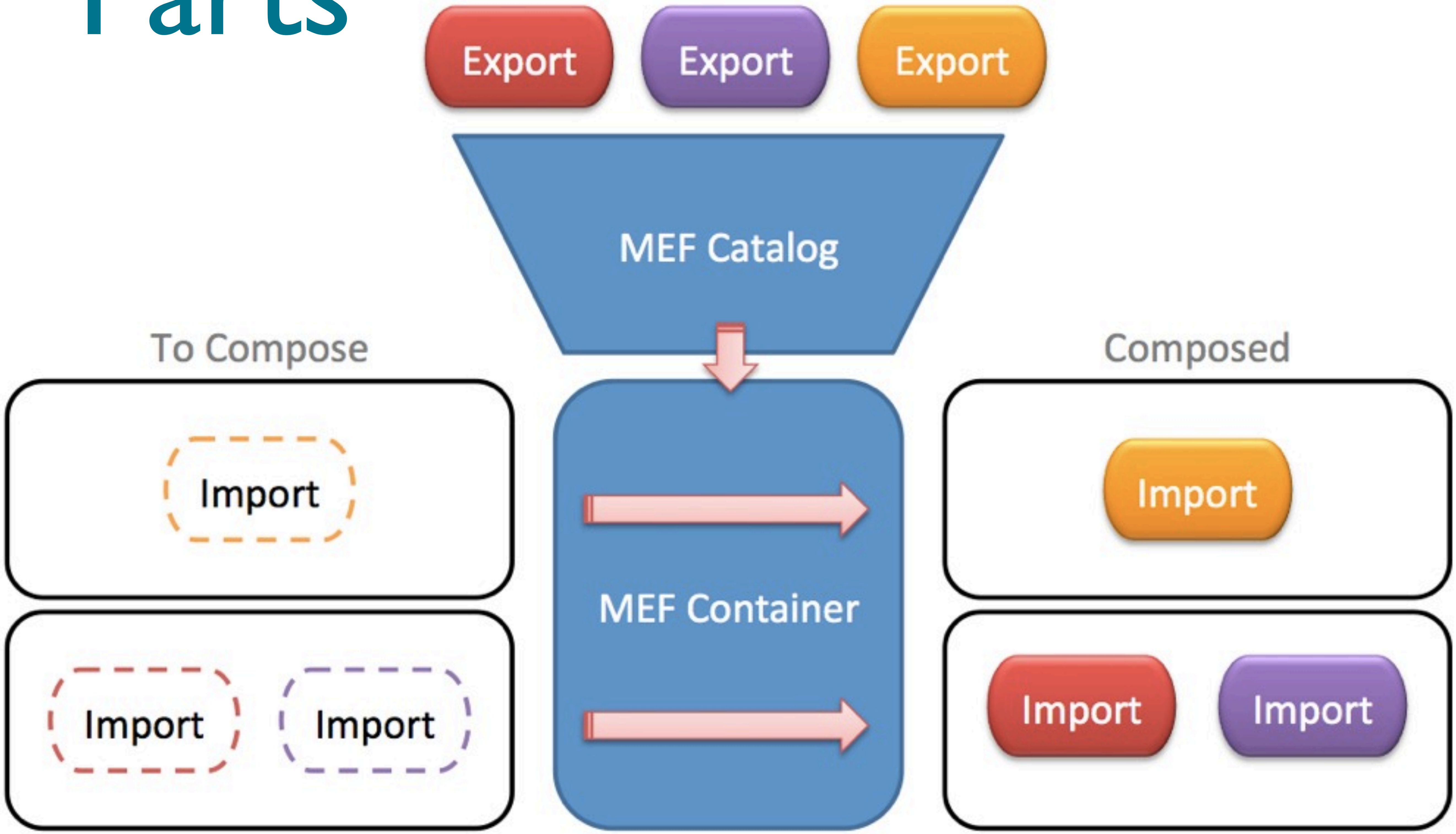
Composition Container

- Performs composition for an object using a **single** catalog
- Can hold references to objects

```
    private void ComposeObject(object toCompose)
    {
      // Create Catalog:
      AssemblyCatalog catalog = new AssemblyCatalog
(Assembly.GetExecutingAssembly());
     // Create Container:
      var container = new CompositionContainer(catalog);
     // Perform Composition:
      container.ComposeParts(toCompose);
    }
```

- ComposeParts is ***Recursive***
  - exported parts with imports will be satisfied

Parts



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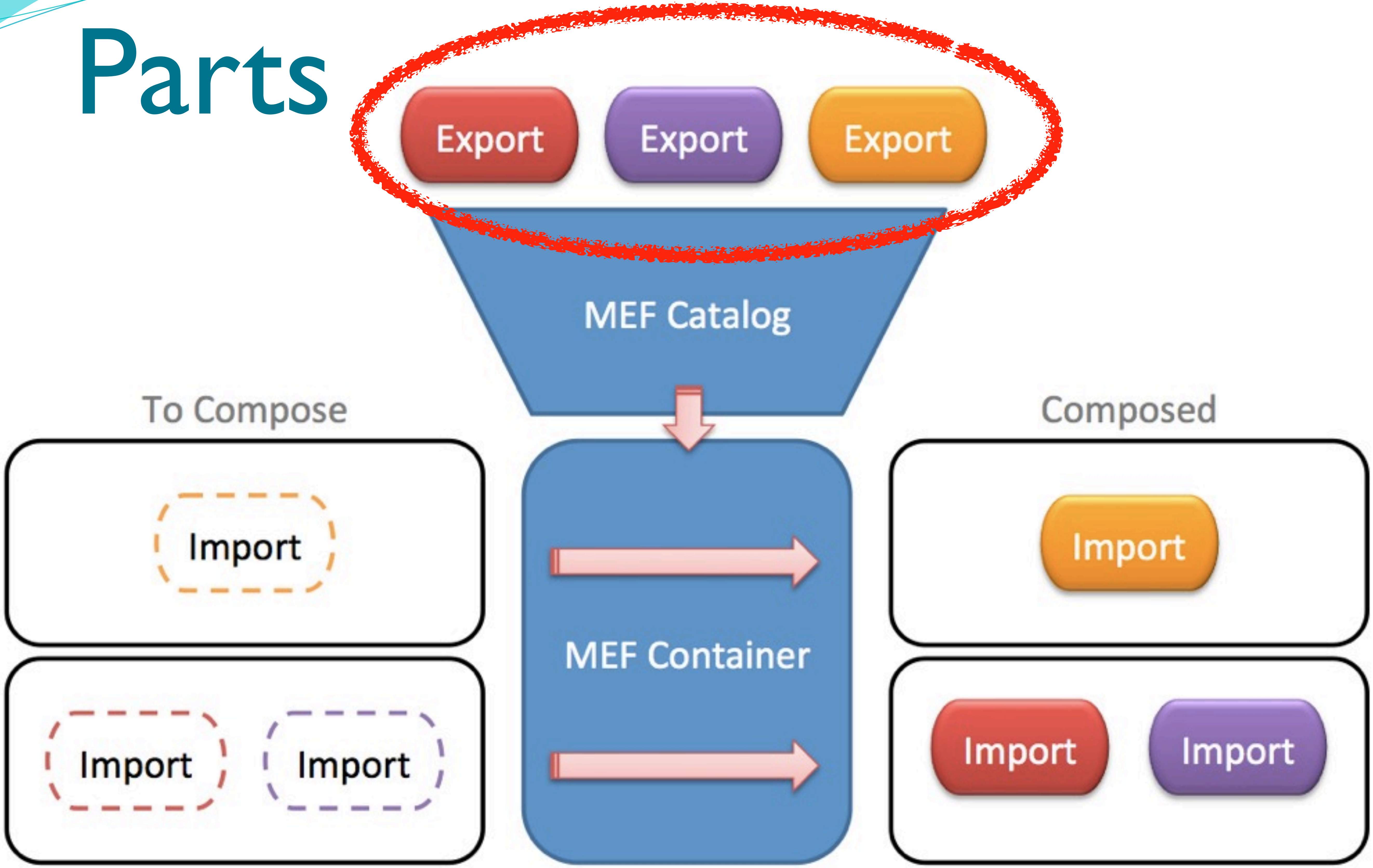
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Parts

- While catalogs & containers are types in themselves, a part is declared through attributes:
  - System.ComponentModel.Composition.**Export**Attribute
  - System.ComponentModel.Composition.**Import**Attribute
- Anything can be a part, if decorated with attribute
- Parts can have Metadata, which describe the part

- For Later:
  - Metadata is available without having to *instantiate* the object that the part represents (Lazy<T,M>, ExportFactory<T,M>)

Export / Import of Parts

- Contracts can specified, default contract is value type
  - String Contract (eg. Timeout): recommended for simple values
  - Type Contracts (eg. IConfiguration): recommended for objects
    - requires implementation of contract
    - converted to string contract internally

```
[Export(typeof(IConfiguration)]
public class Configuration : IConfiguration]
  {
    [Export("Timeout")]
    public int Timeout
    {
      get { return int.Parse(ConfigurationManager.AppSettings["Timeout"]); }
    }
  }

  public class UsesTimeout
  {
    [Import("Timeout")]
    public int Timeout { get; set; }
  }
```

Import Collections

- AllowRecomposition: Senders updated as more parts discovered

```
public class Notifier
{
   [ImportMany(AllowRecomposition=true)]
   public IEnumerable<IMessageSender> Senders {get; set;}

   public void Notify(string message)
   {
     foreach(IMessageSender sender in Senders)
     {
       sender.Send(message);
     }
   }
 }
```

Lazy Imports

- Import is only created when accessed
- IMessageSender will be instantiated upon request, then cached for future requests.
- Only one instance will be created per container

```
public class HttpServerHealthMonitor
{
    [Import]
    public Lazy<IMessageSender> Sender { get; set; }
}
```

Export w/ Metadata

- Metadata is browsable **before** part is instantiated
- Allows for parts to be expose values to your application without a part instance
- Metadata is declared via attributes, must be a constant value

```
public interface IMessageSender
{
    void Send(string message);
}

[Export(typeof(IMessageSender))]
[ExportMetadata("Transport", "smtp")]
[ExportMetadata("IsSecure", true)]
public class EmailSender : IMessageSender
{
}
```

Import w/ Metadata

- Interface is used, **needs to match** metadata types and names for parts to be imported
- Use Lazy<T,Metadata>[] to sort through all matching exports

```
public interface IMessageSenderCapabilities
{
    string Transport { get; }
    bool IsSecure { get; }
}

public class HttpServerHealthMon
{
    [ImportMany]
    public Lazy<IMessageSender, IMessageSenderCapabilities>[] Senders
{ get; set; }
```

```
[Export(typeof(IMessageSender))]
[ExportMetadata("Transport", "smtp")]
[ExportMetadata("IsSecure", true)]
public class EmailSender : IMessageSender {}
```

Objects & Instances

- Export Instances are stored by container, re-used unless explicitly specified
- PartCreatePolicyAttribute applied on export part:
  - NonShared: one instance of the part may exist per container
  - Shared: each request for exports of the part will be served by a new instance

```
[PartCreationPolicy(CreationPolicy.NonShared)]
[Export(typeof(IMessageSender))]
public class SmtpSender : IMessageSender
{
}
```

ExportFactory<T> Import

- ExportFactory will give you a **new instance for every request**, as opposed to Lazy (single instance per composition.)
- Instance will never be shared
- has a sibling - ExportFactory<T,M> which uses Metadata

```
public class OrderController {

  [Import]
  public ExportFactory<OrderViewModel> OrderVMFactory {get;set;}

  public OrderViewModel CreateOrder() {
    return OrderVMFactory.CreateExport().Value;
  }
}
```

Good MEF Scenarios

- Plugin based Applications
  - **Visual Studio** uses MEF
  - Seesmic Desktop Twitter Client uses MEF

- Application that reference GPL Assemblies
  - develop open source plugins, not applications

- Silverlight
  - Split your application into **multiple XAPs**, not one XAP
    - faster start time
    - Only load the modules you need, when you need them
  - Navigation uri resolution
  - Loading Views dynamically
  - ViewModel locators

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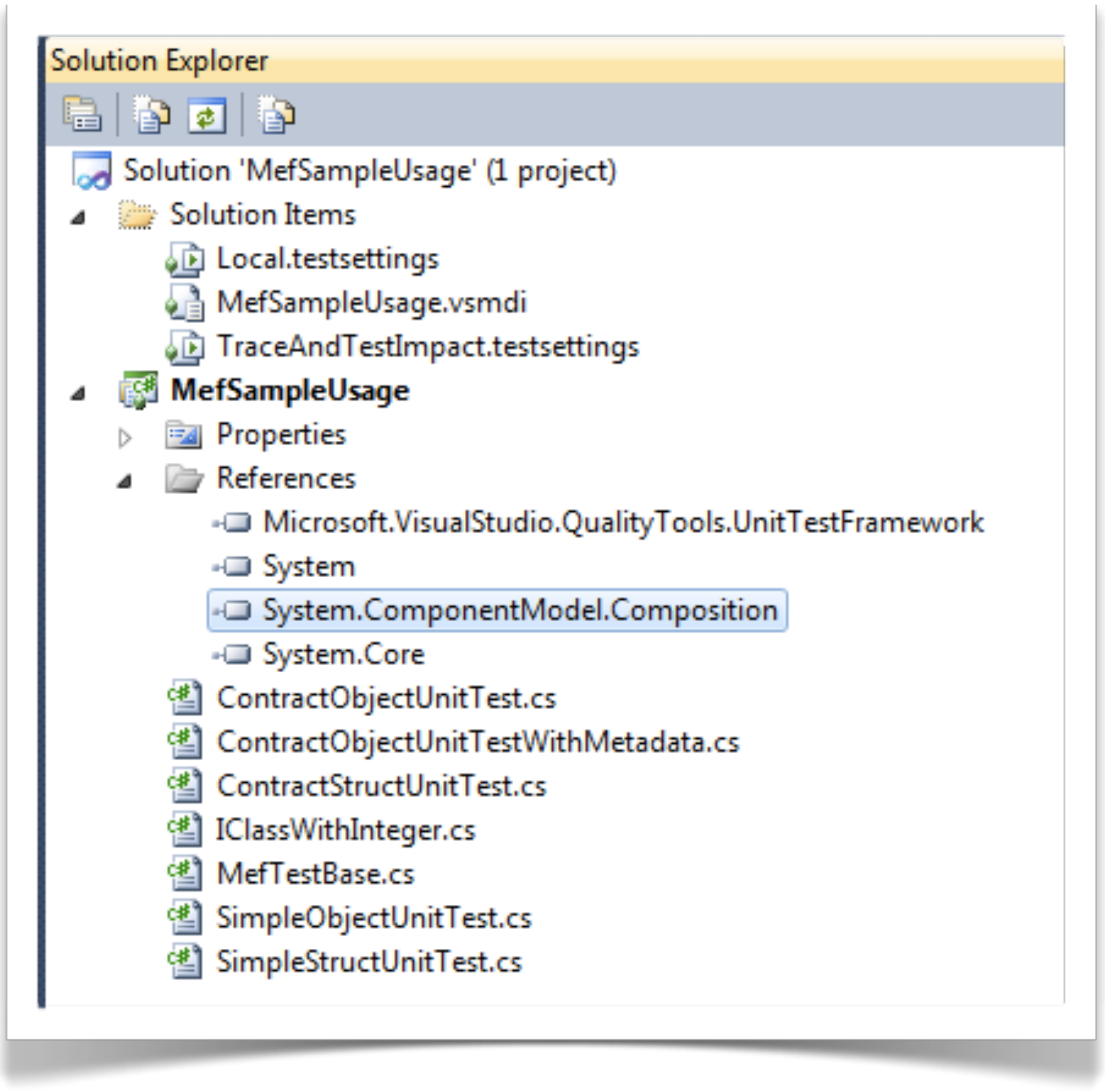
Demos

Simple MEF & Silverlight-Specific XAP downloads

Simple Demo: Unit Tests

- Using Struct:
  - Simple
  - Contract
- Using Objects:
  - Simple
  - Contract
  - Lazy with Metadata



Solution Explorer

```
Solution 'MefSampleUsage' (1 project)
  Solution Items
    Local.testsettings
    MefSampleUsage.vsmdi
    TraceAndTestImpact.testsettings
  MefSampleUsage
    Properties
    References
      Microsoft.VisualStudio.QualityTools.UnitTestFramework
      System
      System.ComponentModel.Composition
      System.Core
    ContractObjectUnitTest.cs
    ContractObjectUnitTestWithMetadata.cs
    ContractStructUnitTest.cs
    IClassWithInteger.cs
    MefTestBase.cs
    SimpleObjectUnitTest.cs
    SimpleStructUnitTest.cs
```

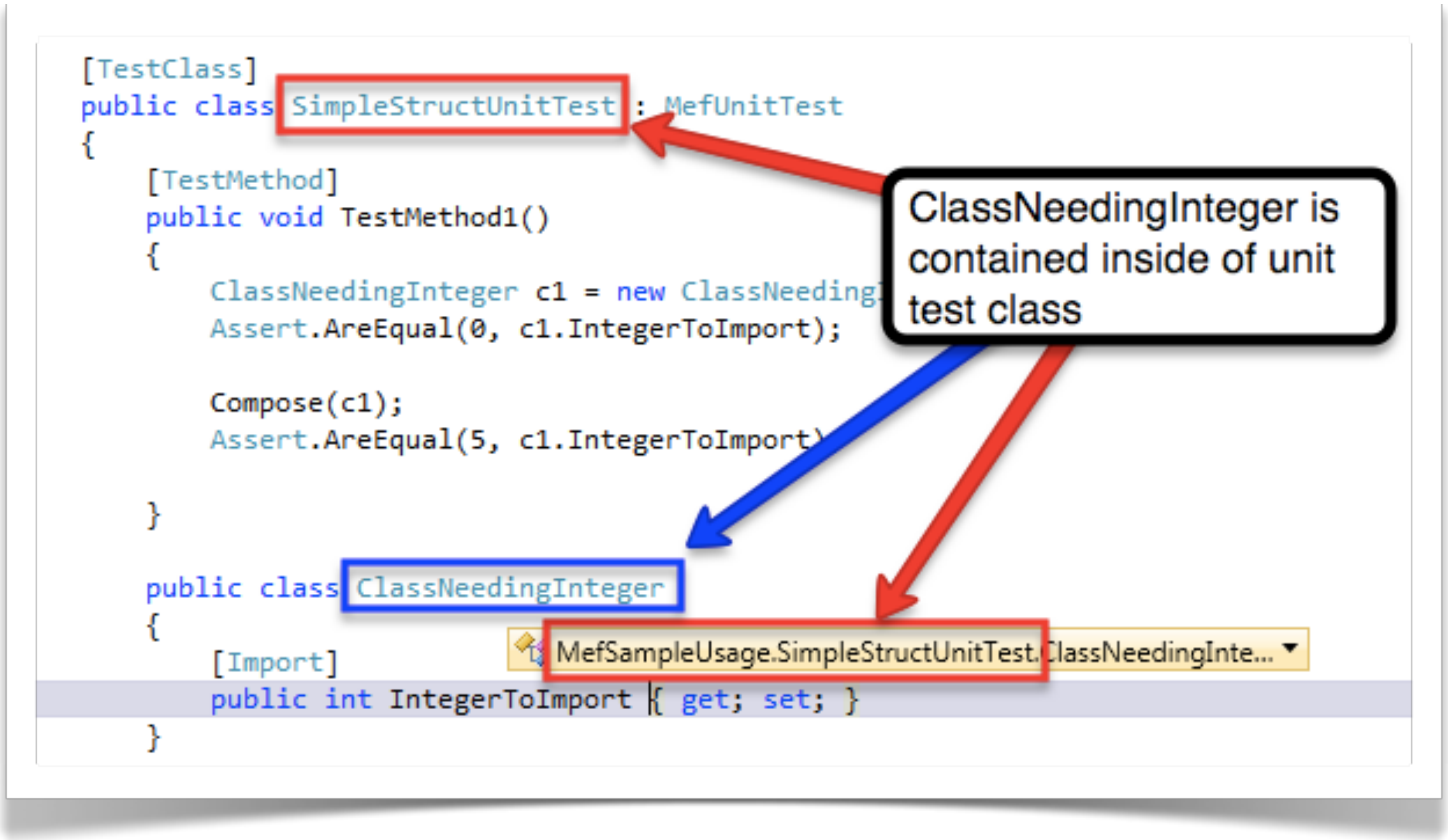
Notes: Base Class for Unit Tests

- My custom base class to encapsulate MEF for Unit Tests

```
public class MefUnitTest
{
    public MefUnitTest()
    {
        // create catalog to use current assembly
        var cat = new AssemblyCatalog(Assembly.GetExecutingAssembly());
        // create container instance
        container = new CompositionContainer(cat);
    }

    // container instance
    protected CompositionContainer container;

    protected void Compose(object toCompose)
    {
        container.ComposeParts(toCompose);
    }
}
```

Notes: Nested Classes Used

- Types used for MEF are isolated inside of unit test class
- No conflicts between types used in different unit tests



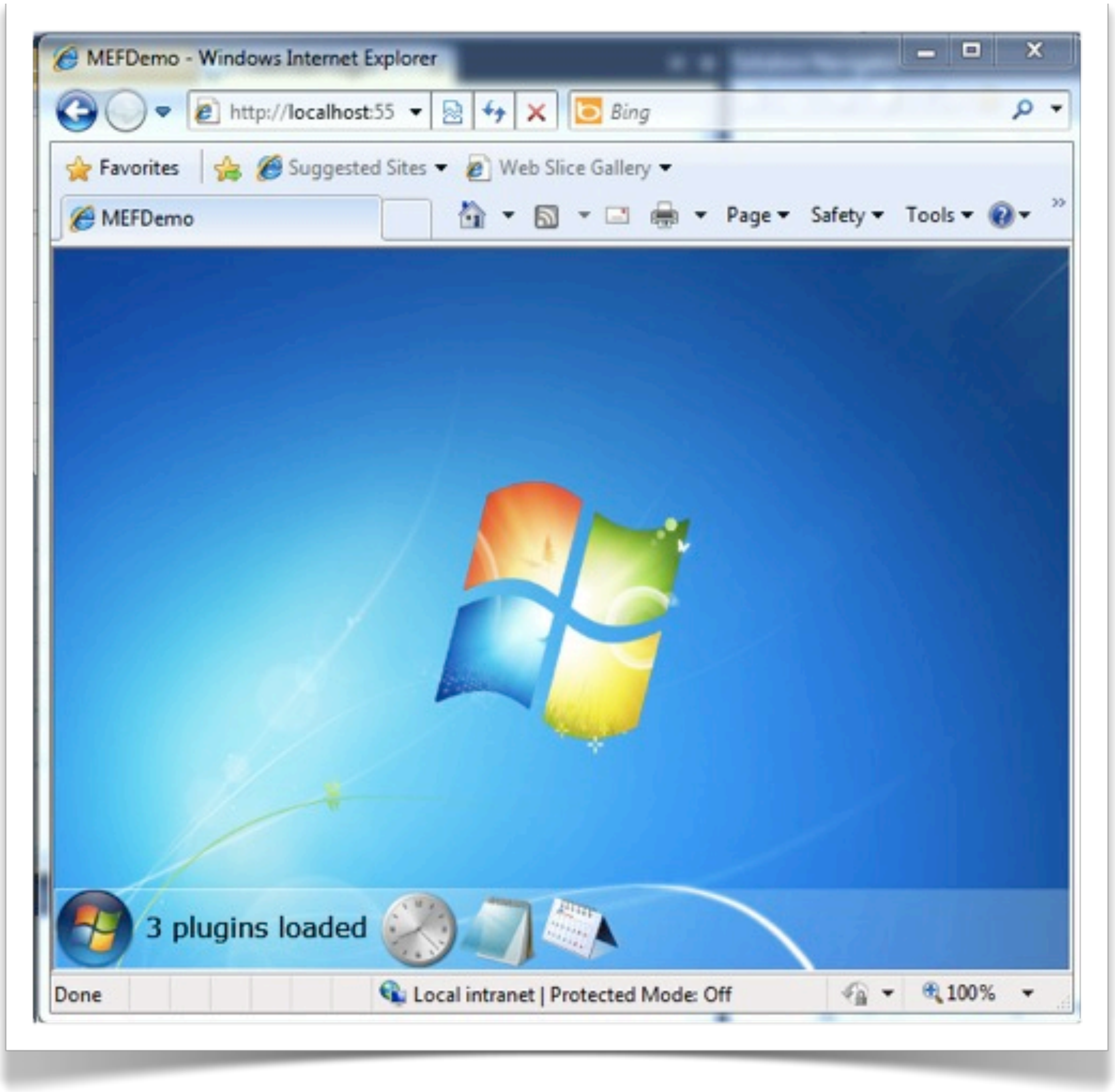
```
[TestClass]
public class SimpleStructUnitTest : MefUnitTest
{
    [TestMethod]
    public void TestMethod1()
    {
        ClassNeedingInteger c1 = new ClassNeeding
        Assert.AreEqual(0, c1.IntegerToImport);

        Compose(c1);
        Assert.AreEqual(5, c1.IntegerToImport

    }

    public class ClassNeedingInteger
    {
        [Import]
        public int IntegerToImport { get; set; }
    }
```

MefSampleUsage.SimpleStructUnitTest.ClassNeedingInte...
ClassNeedingInteger is contained inside of unit test class

Let’s take a look

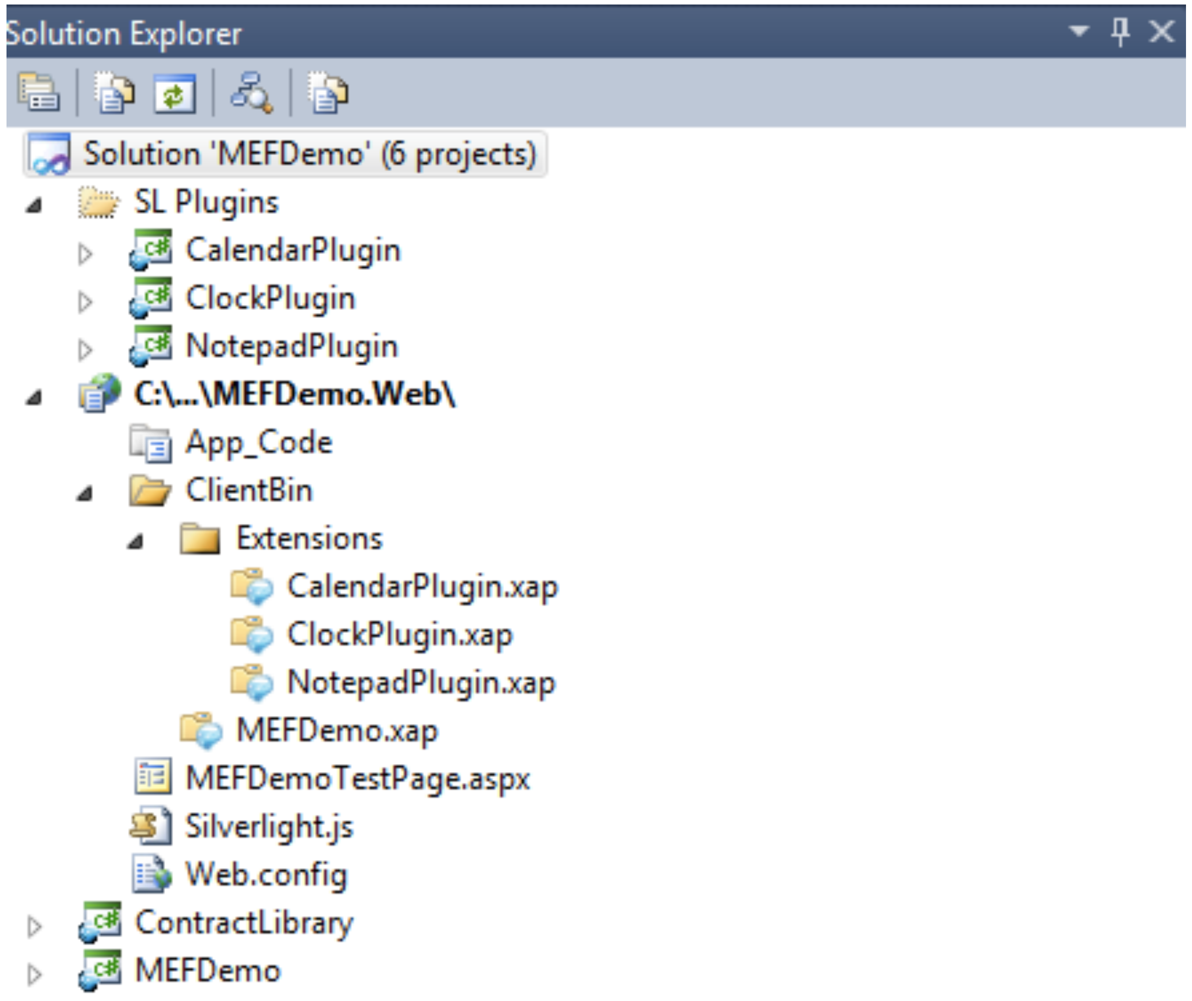
Advanced SL Demo

- Taken from Glenn's Mix10 Session:
- Demonstrating:
  - XAP Partitioning
  - Delayed Composition of XAPs
    - ie - downloading xaps



Multiple XAPS

- Each XAP is a silverlight application
- Plugin applications reference Contract Library
- Plugin applications do not reference MefDemo (host) app
- MefDemo does not reference plugin apps
- Website exposes XAP files


Solution Explorer

Solution 'MEFDemo' (6 projects)
SL Plugins
CalendarPlugin
ClockPlugin
NotepadPlugin
C:\...\MEFDemo.Web\
App_Code
ClientBin
Extensions
CalendarPlugin.xap
ClockPlugin.xap
NotepadPlugin.xap
MEFDemo.xap
MEFDemoTestPage.aspx
Silverlight.js
Web.config
ContractLibrary
MEFDemo

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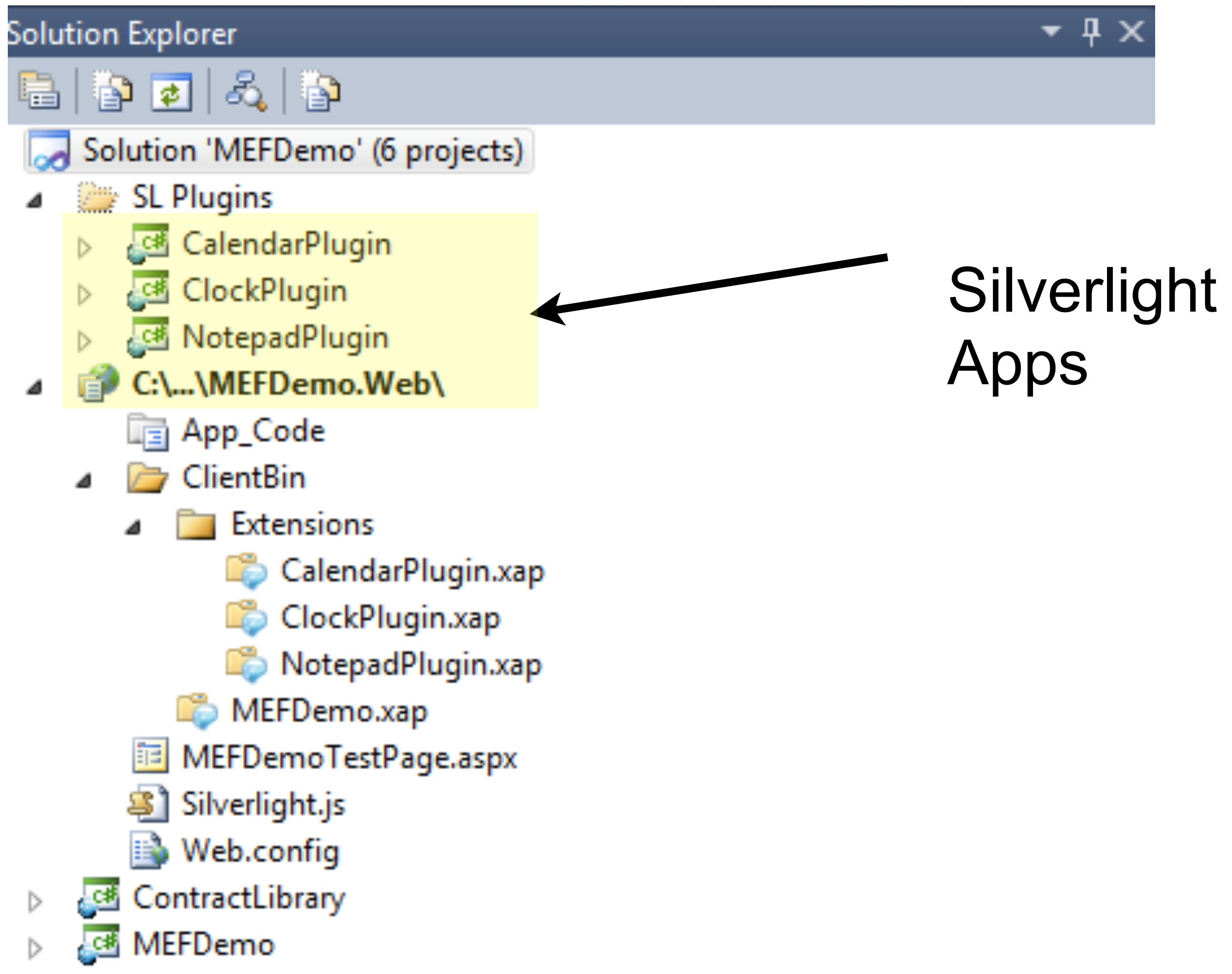
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    MEFDemoTestPage.aspx
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    Web.config
  ContractLibrary
  MEFDemo
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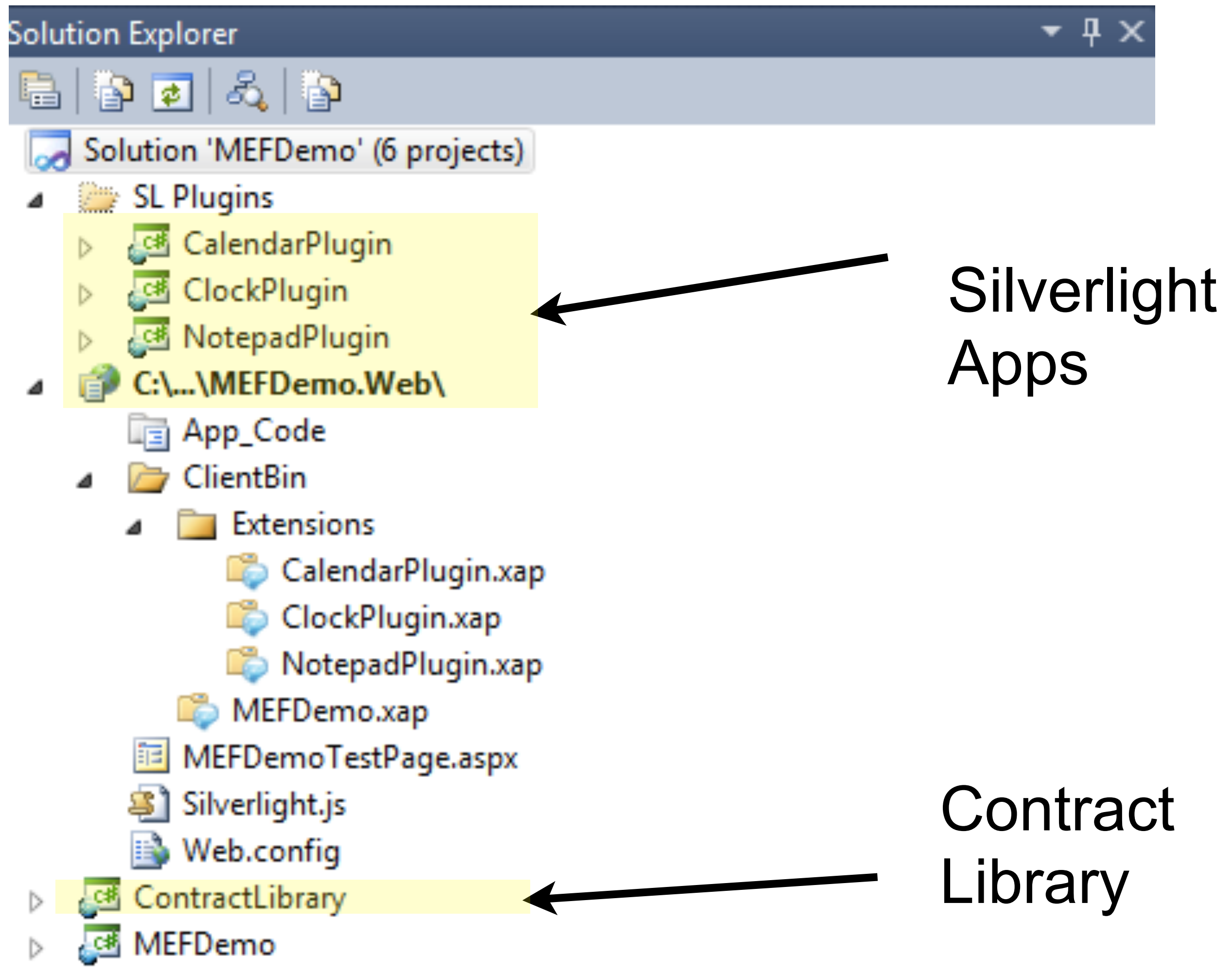

Loading XAPS on the fly

- Clicking Start button will request the download of 3 xaps

```
        public void LoadPluginsAsync()
        {
            CatalogService.AddXap("Extensions/ClockPlugin.xap");
            CatalogService.AddXap("Extensions/NotepadPlugin.xap");
            CatalogService.AddXap("Extensions/CalendarPlugin.xap");
        }
```

- Glenn's example uses a "CatalogService" class to wrap Xap download requests

Catalog Service

- Sample code to create deployment catalog, and add to aggregate catalog

```
        public void AddXap(string uri, Action<AsyncCompletedEventArgs> completedAction = 
null )
        {
            DeploymentCatalog catalog;
            if (!_catalogs.TryGetValue(uri, out catalog))
            {
                catalog = new DeploymentCatalog(uri);

                if (completedAction != null)
                    catalog.DownloadCompleted += (s, e) => completedAction(e);
                else
                    catalog.DownloadCompleted += new 
EventHandler<System.ComponentModel.AsyncCompletedEventArgs>(catalog_DownloadCompleted);

                catalog.DownloadAsync();
                _catalogs[uri] = catalog;
                _aggregateCatalog.Catalogs.Add(catalog);
            }
        }
```

Let’s take a look

Additional Resources

- Documentation on Home page @ Codeplex:
  - mef.codeplex.com
- Silverlight TV
- Glenn Block's Blog
- multiple blogs (~~Google~~ Bing is your friend)

- Links are available on VanSlug forum page

Q&A

- Keep the discussion going:
  - forum.vanslug.net