WCF Coding Standard

Guidelines and Best Practices
Version 2.0

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Preface

A comprehensive coding standard is essential for a successful product delivery. The standard helps in enforcing best practices and avoiding pitfalls, and makes knowledge dissemination across the team easier. Traditionally, coding standards are thick, laborious documents, spanning hundreds of pages and detailing the rationale behind every directive. While these are still better than no standard at all, such efforts are usually indigestible by the average developer. In contrast, the WCF coding standard presented here is very thin on the "why" and very detailed on the "what". I believe that while fully understanding every insight that goes into a particular programming decision may require reading books and even years of experience, applying the standard should not. When absorbing a new developer into your team, you should be able to simply point him or her at the standard and say: "Read this first." Being able to comply with a good standard should come before fully understanding and appreciating it—that should come over time, with experience. The coding standard presented next captures dos and don'ts, pitfalls, guidelines, and recommendations. It uses the best practices and helper classes discussed in both the WCF Master Class and my book Programming WCF Services.

Juval Lowy

1 General Design Guidelines

1. All services must adhere to these principles:

    a) Services are secure.

    b) Service operations leave the system in a consistent state.

    c) Services are thread-safe and can be accessed by concurrent clients.

    d) Services are reliable.

    e) Services are robust.

2. Services can optionally adhere to these principles:

    a) Services are interoperable.

    b) Services are scale-invariant.

    c) Services are available.

    d) Services are responsive.

    e) Services are disciplined and do not block their clients for long.

2 Essentials

1. Place service code in a class library and not in any hosting EXE.

2. Do not provide parameterized constructors to a service class unless it is a singleton that is hosted explicitly.

3. Enable reliability in the relevant bindings.

4. Provide a meaningful namespace for contracts. For outward-facing services use your company's URL or equivalent URN with a year and month to support versioning. For example:

```
[ServiceContract(Namespace = "http://www.idesign.net/2008/10")]
interface IMyContract
{...}
```

   For intranet services you use any meaningful unique name such as MyApplication, for example:

```
[ServiceContract(Namespace = "MyApplication")]
interface IMyContract
{...}
```

5. With intranet applications on Windows XP and Windows Server 2003, prefer self-hosting to IIS hosting.

6. On Windows Vista and Windows Server 2008 or later, prefer WAS hosting to self-hosting.

7. Enable metadata exchange.

8. Always name all endpoints in the client config file.

9. Do not use SvcUtil or Visual Studio 2008 to generate a config file.

10. When using a tool such as Visual Studio 2008 to generate the proxy, do clean up the proxy.

11. Do not duplicate proxy code. If two or more clients use the same contract, factor the proxy to a separate class library.

12. Always close or dispose of the proxy.

3 Service Contracts

1. Always apply the ServiceContractAttribute on an interface, not a class.

```csharp
//Avoid
[ServiceContract]
class MyService
{
    [OperationContract]
    public void MyMethod()
    {...}
}
//Correct
[ServiceContract]
interface IMyContract
{
    [OperationContract]
    void MyMethod();
}
class MyService : IMyContract
{
    public void MyMethod()
    {...}
}
```

2. Prefix the service contract name with I

```csharp
[ServiceContract]
interface IMyContract
{...}
```

3. Avoid property-like operations:

```csharp
//Avoid
[ServiceContract]
interface IMyContract
{
    [OperationContract]
    string GetName();

    [OperationContract]
    void SetName(string name);
}
```

4. Avoid contracts with one member.

5. Strive to have three to five members per service contract.

6. Do not have more than twenty members per service contract. Twelve is probably the practical limit.

4 Data Contracts

1. Avoid inferred data contracts (POCO). Always be explicit and apply the `DataContract` attribute.

2. Use the `DataMemberAttribute` on properties or read-only public members only.

3. Avoid explicit XML serialization on your own types.

4. When using the `Order` property, assign the same value to all members coming from the same level in the class hierarchy.

5. Support `IExtensibleDataObject` on your data contracts. Use explicit interface implementation.

6. Avoid setting `IgnoreExtensionDataObject` on the `ServiceBehavior` and `CallbackBehavior` attributes to `true`. Keep the default of `false`.

7. Do not mark delegates and events as data members.

8. Do not pass .NET specific types such as `Type` as operation parameters.

9. Do not accept or return ADO.NET `DataSet` and `DataTable` (or their type-safe subclasses) from operations. Return a neutral representation such as an array.

10. Suppress the generation of a generic type parameter hash code and provide a legible type name instead.

11. Share data contract across projects in a solution when possible.

5 Instance Management

1. Prefer the per-call instance mode when scalability is a concern.

2. Do prefer durable services configuration to explicit per-call configuration.

3. If selecting `SessionMode.NotAllowed` on the contract, always configure the service instancing to `InstanceContextMode.PerCall`.

4. Do not mix sessionful contracts and session-less contracts on the same service.

5. Avoid a singleton unless you have a natural singleton.

6. Use ordered delivery with a sessionful service.

7. Avoid instance deactivation with a sessionful service.

8. Avoid demarcating operations.

9. With durable services, always designate a completing operation.

6 Operations and Calls

1. Do not treat one-way calls as asynchronous calls.

2. Do not treat one-way calls as concurrent calls.

3. Expect exceptions out of a one-way operation.

4. Enable reliability even on one-way calls. Use of ordered delivery is optional for one-way calls.

5. Avoid one-way operations on a sessionful contract. If used, make it the terminating operation:

```
[ServiceContract(SessionMode = SessionMode.Required)]
interface IMyContract
{
   [OperationContract]
   void MyMethod1();

   [OperationContract(IsOneWay = true,IsTerminating = true)]
   void MyMethod2();
}
```

6. Name the callback contract on the service side after the service contract suffixed by Callback:

```
interface IMyContractCallback
{...}
[ServiceContract(CallbackContract = typeof(IMyContractCallback))]
interface IMyContract
{...}
```

7. Strive to mark callback operations as one-way.

8. Use callback contracts for callbacks only.

9. Avoid mixing regular callbacks and events on the same callback contract.

10. Event operations should be well designed:

   a) void return type

   b) No out parameters

   c) Marked as one-way operations

11. Avoid using raw callback contracts for event management, and prefer using IDesign's Publish-Subscribe framework.

12. Always provide explicit methods for callback set-up and teardown:

```
[ServiceContract(CallbackContract = typeof(IMyContractCallback))]
interface IMyContract
{
   [OperationContract]
   void DoSomething();

   [OperationContract]
   void Connect();

   [OperationContract]
   void Disconnect();
}
interface IMyContractCallback
{...}
```

13. Use IDesign's type safe DuplexClientBase<T,C> instead of DuplexClientBase<T>.

14. Use IDesign's type safe DuplexChannelFactory<T,C> instead of DuplexChannelFactory<T>.

15. In debugging or in intranet deployment of callbacks over `WSDualHttpBinding` use IDesign's `CallbackBaseAddressBehaviorAttribute` with `CallbackPort` set to `0`:

```
[CallbackBaseAddressBehavior(CallbackPort = 0)]
class MyClient : IMyContractCallback
{...}
```

7 Faults

1. Never use a proxy instance after an exception even if you catch that exception.

2. Avoid fault contracts and allow WCF to mask the error.

3. Do not reuse the callback channel after an exception even if you catch that exception as the channel may be faulted.

4. Use the `FaultContractAttribute` with exception classes as opposed to mere serializable types:

```
//Avoid
[OperationContract]
[FaultContract(typeof(double))]
double Divide(double number1,double number2);

//Correct:
[OperationContract]
[FaultContract(typeof(DivideByZeroException))]
double Divide(double number1,double number2);
```

5. Avoid lengthy processing such as logging in `IErrorHandler.ProvideFault()`.

6. With both service classes and callback classes set `IncludeExceptionDetailInFaults` to `true` in debug sessions, either in the config file or programmatically:

```
public class DebugHelper
{
   public const bool IncludeExceptionDetailInFaults =
#if DEBUG
      true;
#else
      false;
#endif
}
[ServiceBehavior(IncludeExceptionDetailInFaults =
                 DebugHelper.IncludeExceptionDetailInFaults)]
class MyService : IMyContract
{...}
```

7. In release builds do not return unknown exceptions as faults except in diagnostic scenarios.

8. Consider using IDesign's `ErrorHandlerBehaviorAttribute` on the service for both promoting exceptions to fault contracts and automatic error logging:

```
[ErrorHandlerBehavior]
class MyService : IMyContract
{...}
```

9. Consider using IDesign's CallbackErrorHandlerBehaviorAttribute on the callback client for both promoting exceptions to fault contracts and automatic error logging:

```
[CallbackErrorHandlerBehavior(typeof(MyClient))]
public partial class MyClient : IMyContractCallback
{
    public void OnCallabck()
    {...}
}
```

8 Transactions

1. Never manage transactions directly.

2. Apply `TransactionFlowAttribute` on the contract not the service class.

3. Do not perform transactional work in the service constructor.

4. Using IDesign terminology, configure services for either Client or Client/Service transactions. Avoid None or Service transactions.

5. Using IDesign terminology, configure callbacks for either Service or Service/Callbacks transactions. Avoid None or Callback transactions.

6. When using the Client/Service or the Service/Callback modes, constrain the binding to flow transaction using IDesign's `BindingRequirement` attribute.

7. On the client always catch all exceptions thrown by a service configured for None or Service transactions.

8. Enable reliability and ordered delivery even when using transactions.

9. In a service operation, never catch an exception and manually abort the transaction:

```
//Avoid:
[OperationBehavior(TransactionScopeRequired = true)]
public void MyMethod()
{
    try
    {
        ...
    }
    catch
    {
        Transaction.Current.Rollback();
    }
}
```

10. If you catch an exception in a transactional operation, always re-throw it or another exception.

11. Keep transactions short.

12. Always use the default isolation level of `IsolationLevel.Serializable`.

13. Do not call one-way operations from within a transaction.

14. Do not call non-transactional services from within a transaction.

15. Do not access non-transactional resources (such as the file system) from within a transaction.

16. With a sessionful service, avoid equating the session boundary with the transaction boundary by relying on auto complete on session close.

17. Strive to use the IDesign's TransactionalBehavior attribute to manage transactions on sessionful services:

```
[Serializable]
[TransactionalBehavior]
class MyService : IMyContract
{
   public void MyMethod()
   {...}
}
```

18. When using a sessionful or transactional singleton, use IDesign's volatile resource managers to manage state and avoid explicitly state-aware programming or relying on WCF's instance deactivation on completion.

19. With transactional durable services, always propagate the transaction to the store by setting SaveStateInOperationTransaction to true.

9 Concurrency Management

1. Always provide thread-safe access to:

    a) Service in-memory state with sessionful or singleton services.

    b) Client in-memory state during callbacks.

    c) Shared resources such as files.

    d) Static variables.

2. Prefer ConcurrencyMode.Single (the default). It enables transactional access, and it is thread-safe without any effort.

3. Keep operations on single-mode sessionful and singleton services short in order to avoid blocking other clients for long.

4. With ConcurrencyMode.Multiple you must use transaction auto-completion.

5. Consider using ConcurrencyMode.Multiple on per-call services to allow concurrent calls.

6. Transactional singleton services with ConcurrencyMode.Multiple must have ReleaseServiceInstanceOnTransactionComplete set to false:

```
[ServiceBehavior(InstanceContextMode = InstanceContextMode.Single,
                 ConcurrencyMode = ConcurrencyMode.Multiple,
                 ReleaseServiceInstanceOnTransactionComplete = false)]
class MySingleton : IMyContract
{...}
```

7. Never self-host on a UI thread, and have the UI application call the service.

8. Never allow callbacks to the UI application that called the service unless the callback posts the call using SynchronizationContext.Post().

9. When supplying the proxy with both synchronous and asynchronous methods apply the FaultContractAttribute only to synchronous methods.

10. Keep asynchronous operations short. Do not equate asynchronous calls with lengthy operations.

11. Do not mix transactions with asynchronous calls.

10 Queued Services

1. On the client, always verify that the queue (and a dead-letter queue, when applicable) is available before calling the queued service. Use IDesign's `QueuedServiceHelper.VerifyQueues()` for this purpose.

2. Always verify that the queue is available when hosting a queued service (done automatically by IDesign's `ServiceHost<T>`).

3. Except in isolated scenarios, avoid designing the same service to work both queued and non-queued.

4. The service should participate in the playback transaction.

5. When participating in the playback transaction avoid lengthy processing in the queued service.

6. Avoid sessionful queued services.

7. When using a singleton queued service use a volatile resource manager to manage the singleton state.

8. When using a per-call queued service, do explicitly configure the contract and the service for per-call and sessionless:

```
[ServiceContract(SessionMode = SessionMode.NotAllowed)]
interface IMyContract
{...}
[ServiceBehavior(InstanceContextMode = InstanceContextMode.PerCall)]
class MyService : IMyContract
{...}
```

9. Always explicitly set contracts on a queued singleton to disallow sessions:

```
[ServiceContract(SessionMode = SessionMode.NotAllowed)]
interface IMyContract
{...}
[ServiceBehavior(InstanceContextMode = InstanceContextMode.Single)]
class MyService : IMyContract
{...}
```

10. The client should call a queued service inside a transaction.

11. On the client side do not store a queued service proxy in a member variable.

12. Avoid relatively short values of `TimeToLive` as they negate the justification for a queued service.

13. Never use non-transactional queues.

14. When using a response queue, have the service participate in the playback transaction and queue the response in that transaction.

15. Have the response service participate in the response playback transaction.

16. Avoid lengthy processing in a queued response operation.

17. With MSMQ 3.0, prefer a response service to a poison queue service dealing with failures of the service itself.

18. With MSMQ 4.0, use `ReceiveErrorHandling.Reject` for poison messages unless you have advanced processing with `ReceiveErrorHandling.Move`. Avoid `ReceiveErrorHandling.Fault` and `ReceiveErrorHandling.Drop`.

19. With MSMQ 4.0, do consider the use of a response service to handle service playback failures.

20. Unless dealing with a sessionful contract and service, never assume the order of queued calls.

11 Security

1. Always protect the message and provide for message confidentiality and integrity.

2. In the intranet, you can use Transport security as long as the protection level is set to `EncryptAndSign`.

3. In the intranet, avoid impersonation. Set the impersonation level to `TokenImpersonationLevel.Identification`.

4. When using impersonation, have the client use `TokenImpersonationLevel.Impersonation`.

5. Use IDesign's declarative security framework and avoid manual configuration.

6. Never apply the `PrincipalPermissionAttribute` directly on the service class:

```
//Will always fail
[PrincipalPermission(SecurityAction.Demand,Role = @"...")]
public class MyService : IMyContract
{...}
```

7. Avoid sensitive work that requires authorization at the service constructor.

8. Avoid demanding a particular user, with or without demanding a role:

```
//Avoid
[PrincipalPermission(SecurityAction.Demand,Name = "John")]
public void MyMethod()
{...}
```

9. Do not rely on role-based security in the client's callback operations.

10. With Internet clients, always use message security.

11. Allow clients to negotiate the service certification (the default).

12. Use the ASP.NET providers for custom credentials.

13. When developing a custom credentials store, develop it as a custom ASP.NET provider.

14. Validate certificates using peer-trust.

15. Strive to run the client under partial trust. Grant the client permission only to:

    a) Execute

    b) Display the user interface (if required)

    c) Connect to the service

    d) Obtain local credentials

16. When you own the service host environment, run the service and the host under full trust. Grant Microsoft and ECMA full trust, but remove all other code groups and grant them no permissions.

17. When hosting in partial trust, grant the host and the service permission only to

    a) Execute.

    b) Accept client calls

    c) Obtain local credentials

    d) Authenticate and authorize the client

    e) Access local resources if required

Resources

1 Programming WCF Services 2nd Edition

By Juval Lowy, O'Reilly 2008## 2 The WCF Master Class

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