Windows Communication Foundation (WCF)

Outline

- Introduction
- WCF Contracts
  - Service
  - Data
  - Message
- Bindings
- Security
- Reliability
- Declarative
- Summary

Introduction

- WCF is a unified programming model for building service oriented application.
- It is used to build
  - Secure
  - Reliable
  - Transacted
- applications that integrated across platforms and interoperate with existing applications.

Features of WCF

- Service orientation
- Loosely coupled
- Interoperability
- Multiple message patterns
  - Request-reply, one-way, duplex
- Publishing service metadata
  - WSDL, XSD, WS-Policy
- Data Contract
  - Classes

Features of WCF

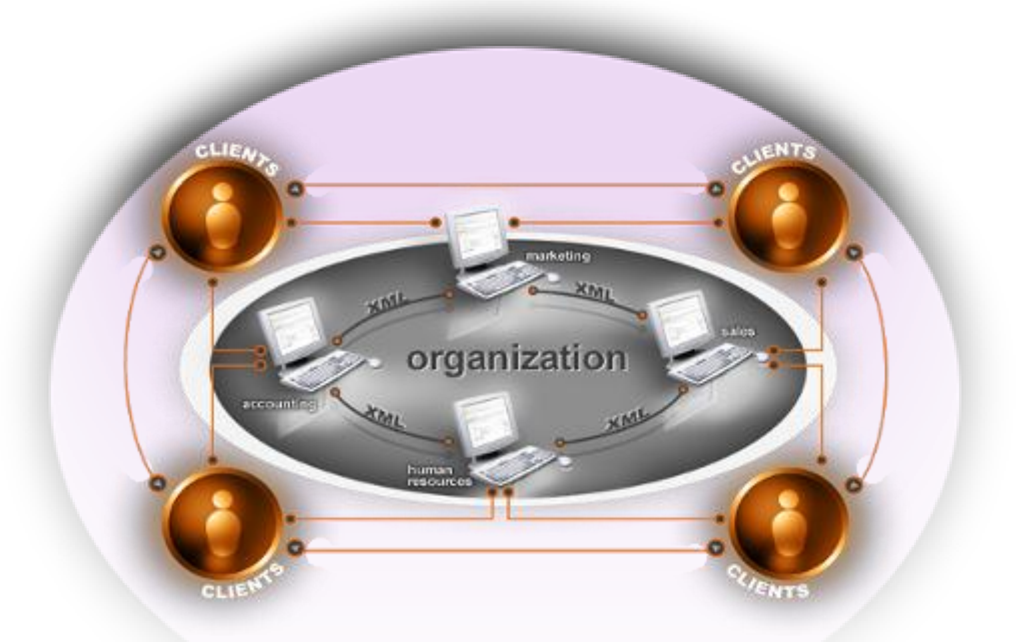
- Security
  - SSL, WS-SecureConversation
- Multiple Transports and Encodings
  - HTTP, TCP, named Pipe, MSMQ
  - Text, binary encoding (MTOM-Message Transmission Optimization Mechanism**)**
- Reliable and Queued Messages
  - WS-Reliable messaging and MSMQ
- Durable Messages
  - Message never lost during disruption in communication (saved to a database). Used in Windows Workflow foundation

Features of WCF

- Transactions
  - WS-AtomicTransaction, API, MS Distributed Transaction Coordinator
- AJAX and REST support
  - XML, ATOM, JSON
- Extensibility
- Multiple service hosting options
  - IIS, app-hosting

The Challenge

Radically Simplifying Distributed Application Development



Development of connected systems remains costly and frustrating

- **Different programming models for different tasks**
- **Need for security and reliable messaging**
- **Interoperability with applications on other platforms**
- **Productive service-oriented programming model needed**

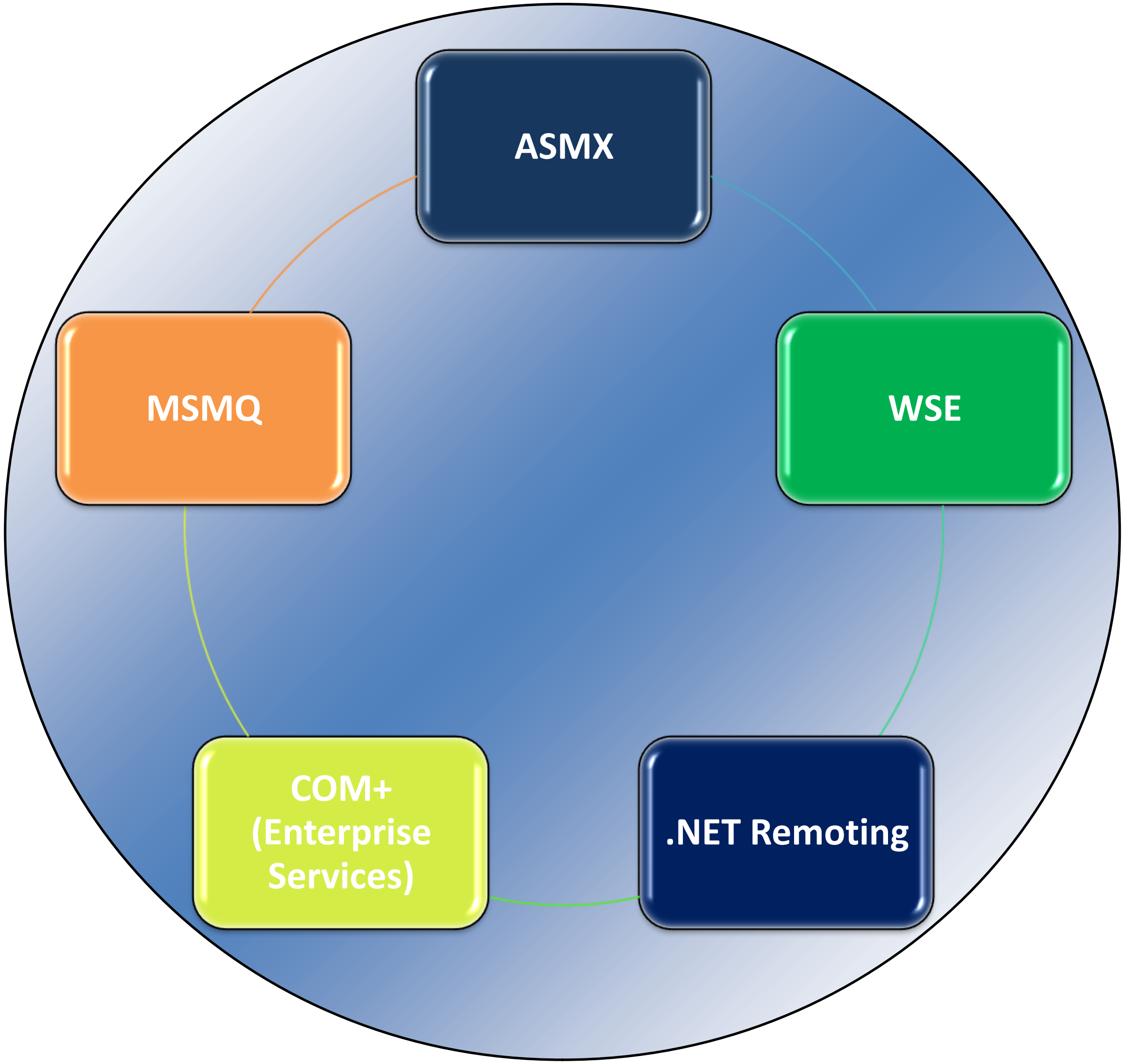
Windows Communication Foundation

Unified framework for

rapidly building

service-oriented applications

What Does WCF Replace?



ASMX

WSE

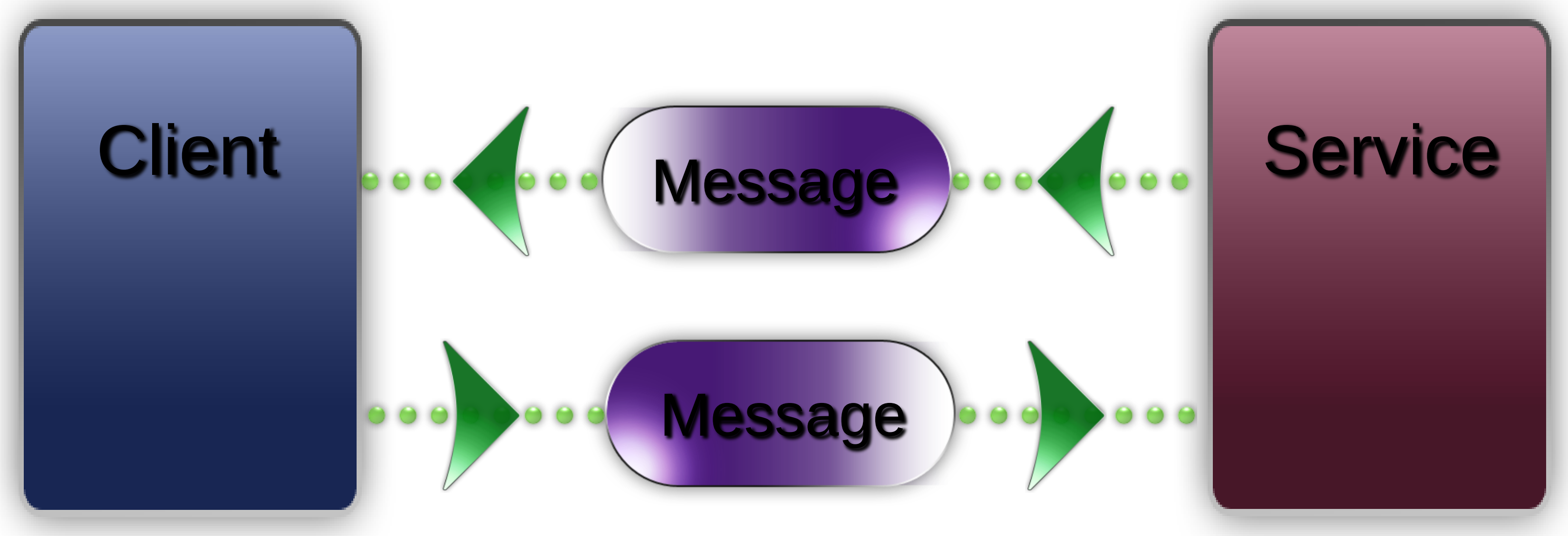
.NET Remoting

COM+ (Enterprise Services)

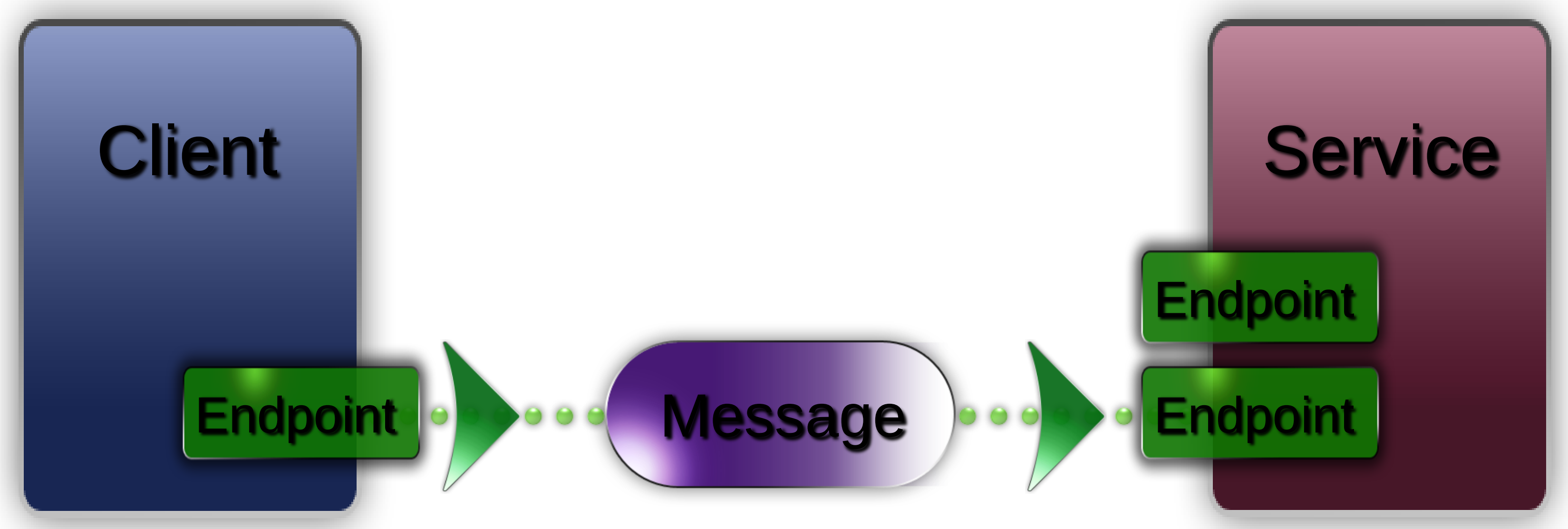
MSMQ

UNDERSTANDING WCF PRINCIPLES

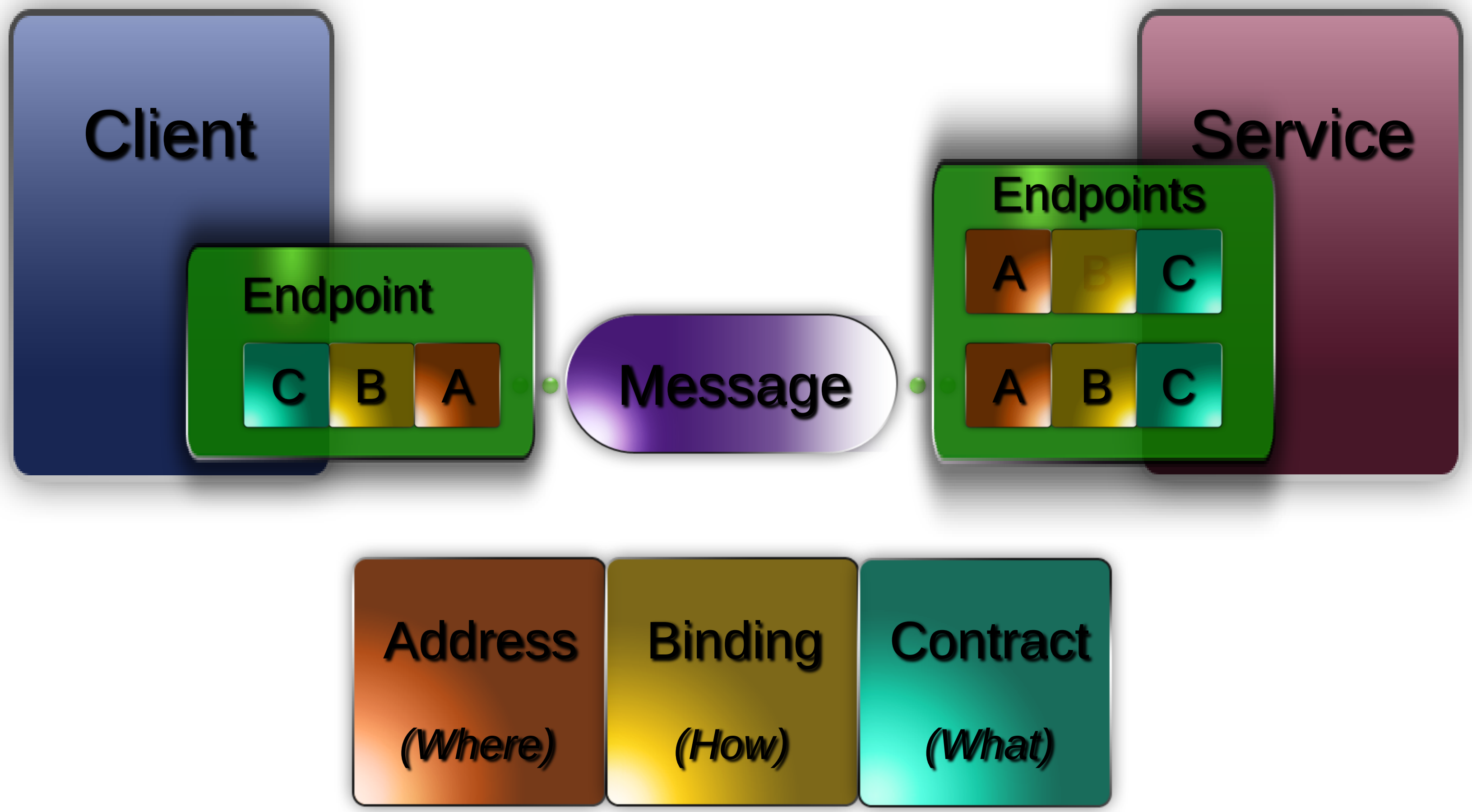
Services and Clients



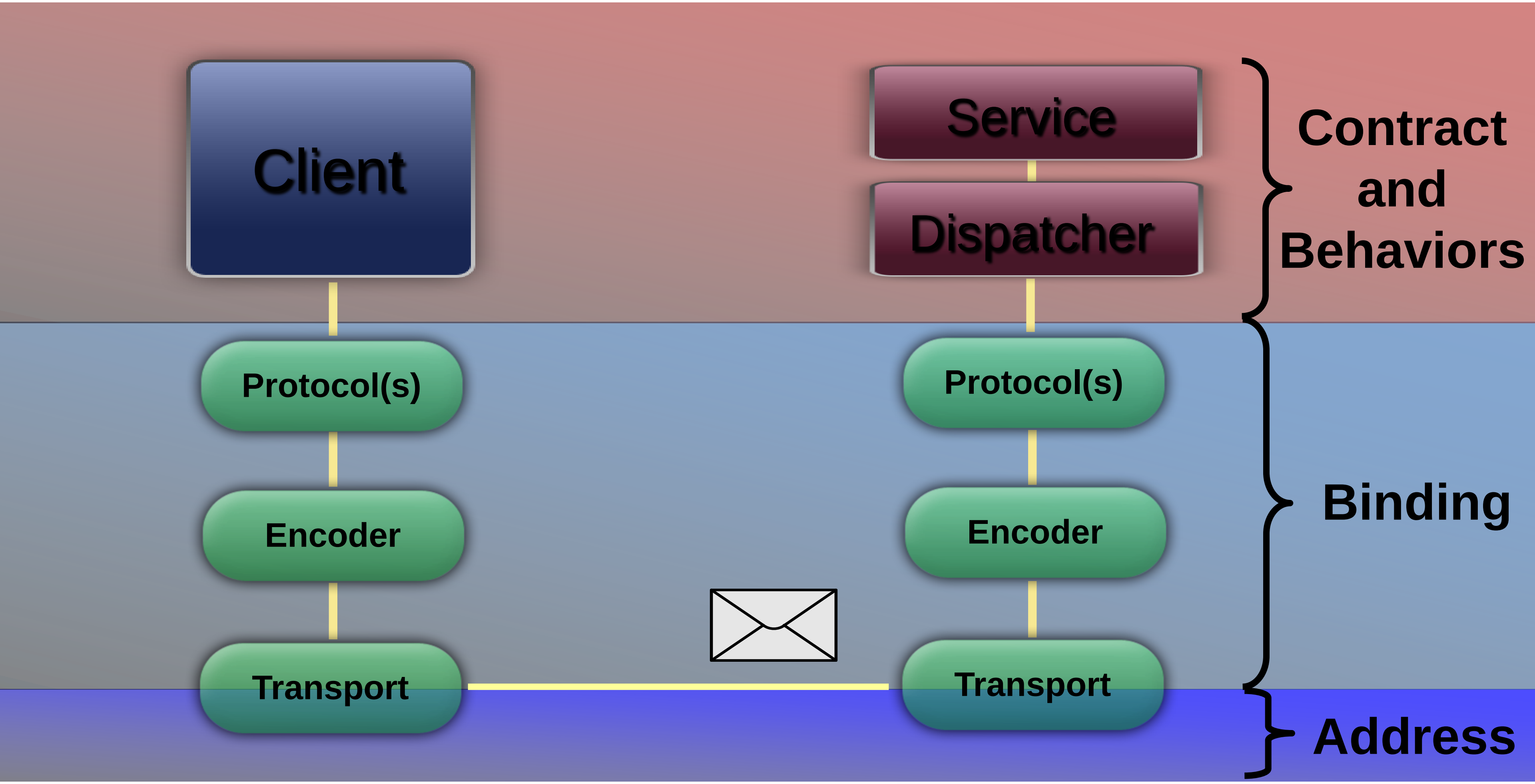
Endpoints



Address, Binding, Contract



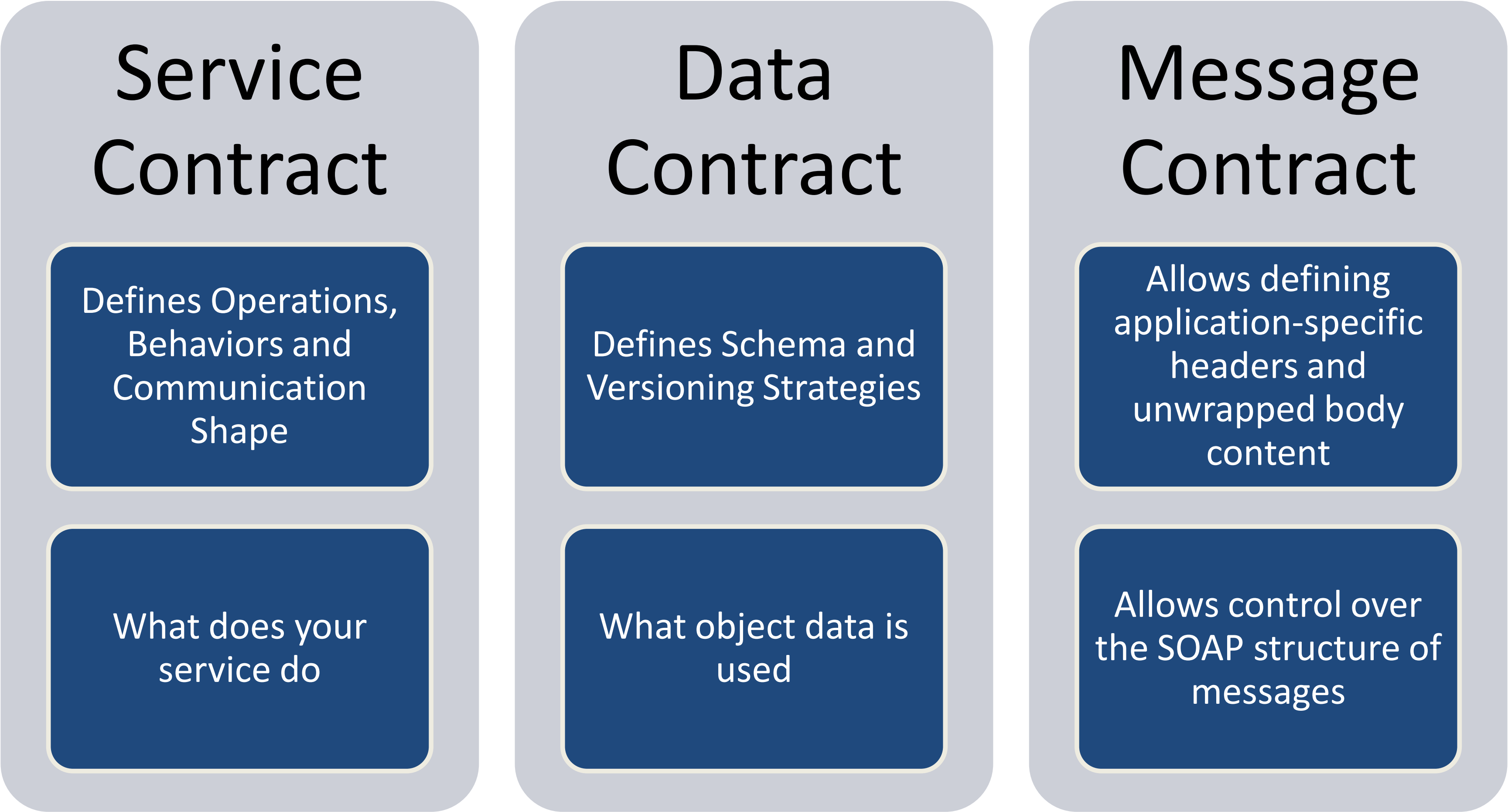
WCF Architecture: Messaging Runtime



The what

CONTRACTS

Three Types of Contracts



Service Contract

Defines Operations, Behaviors and Communication Shape

What does your service do

Data Contract

Defines Schema and Versioning Strategies

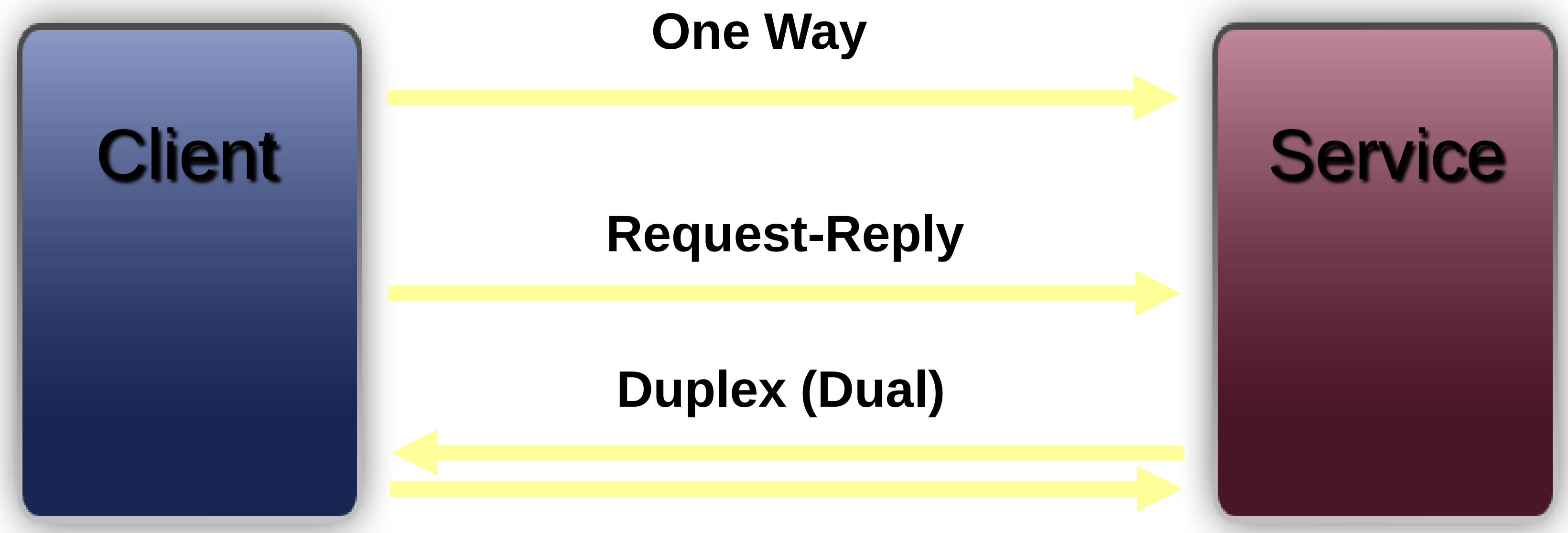
What object data is used

Message Contract

Allows defining application-specific headers and unwrapped body content

Allows control over the SOAP structure of messages

Ways to Talk



- One Way:
  - Datagram-style delivery
- Request-Reply
  - Immediate Reply on same logical thread
- Duplex
  - Reply “later” and on backchannel (callback-style)

What does your service do?

SERVICE CONTRACTS

Service Contract

```
using System.ServiceModel;

[ServiceContract]
public interface ICalculate
{
       [OperationContract]
       double Add( double a, double b);
       [OperationContract]
       double Subtract( double a, double b);
}
```

Service Contract: OneWay

```
[ServiceContract]
public interface IOneWayCalculator
{
    [OperationContract(IsOneWay=true)]
    void StoreProblem (ComplexProblem p);
}
```

Service Contract: Duplex Asymmetric

```
[ServiceContract(Session=true,
          CallbackContract=typeof(ICalculatorResults)]
public interface ICalculatorProblems
{
    [OperationContract(IsOneWay=true)]
    void SolveProblem (ComplexProblem p);
}

public interface ICalculatorResults
{
    [OperationContract(IsOneWay=true)]
    void Results(ComplexProblem p);
}
```

What object data needs to flow back and forth?

DATA CONTRACTS

Data Contract

```
[DataContract]
public class ComplexNumber
{
    [DataMember]
    public double Real = 0.0D;
    [DataMember]
    public double Imaginary = 0.0D;

    public ComplexNumber(double r, double i)
    {
        this.Real = r;
        this.Imaginary = i;
    }
}
```

Defines the mapping between the type and a SOAP envelope

MESSAGE CONTRACTS

Message Contract

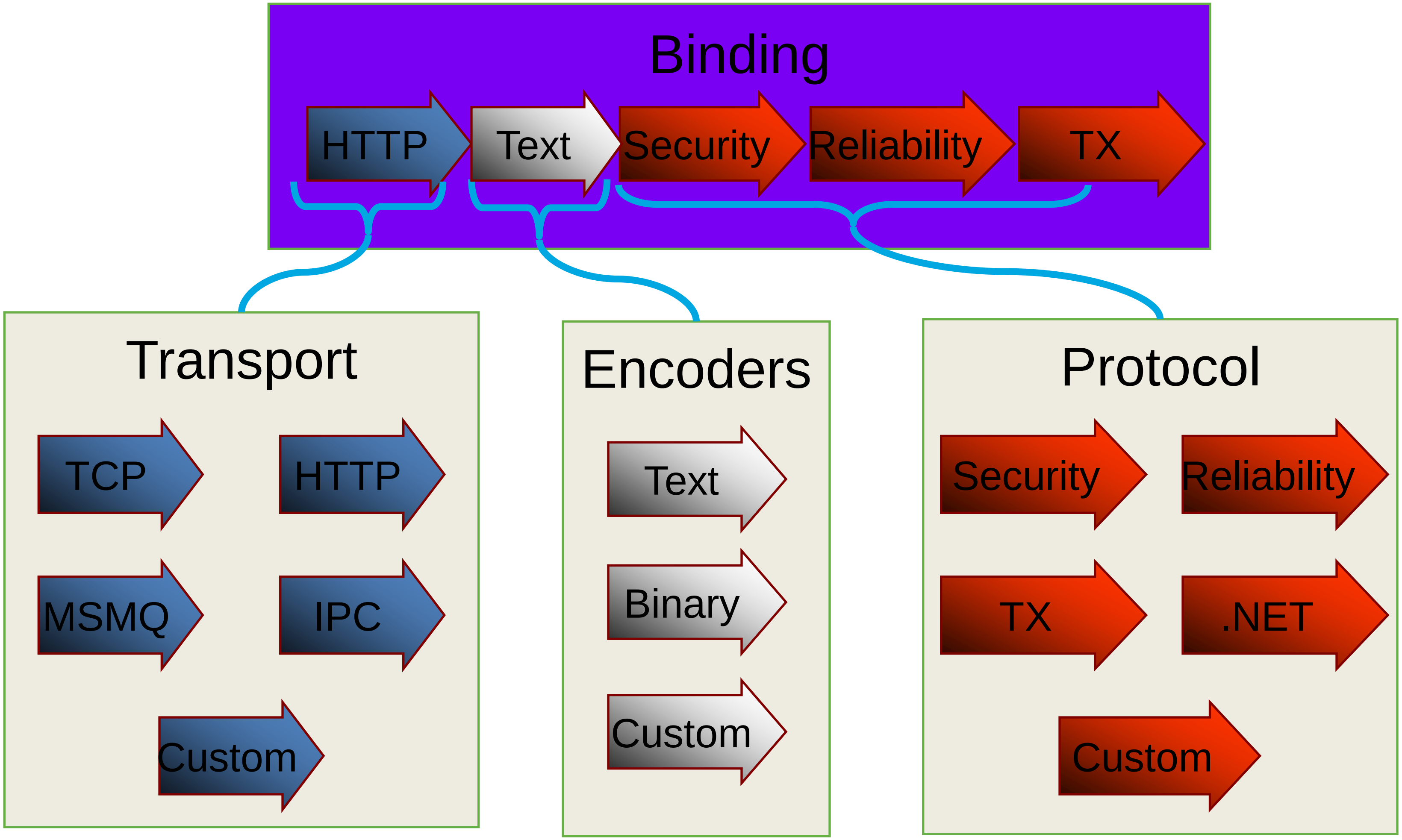
```
[MessageContract]
public class ComplexProblem
{
    [MessageHeader]
    public string operation;
    [MessageBody]
    public ComplexNumber n1;
    [MessageBody]
    public ComplexNumber n2;
    [MessageBody]
    public ComplexNumber solution;

    // Constructors…
}
```

How?

BINDINGS

Bindings & Binding Elements

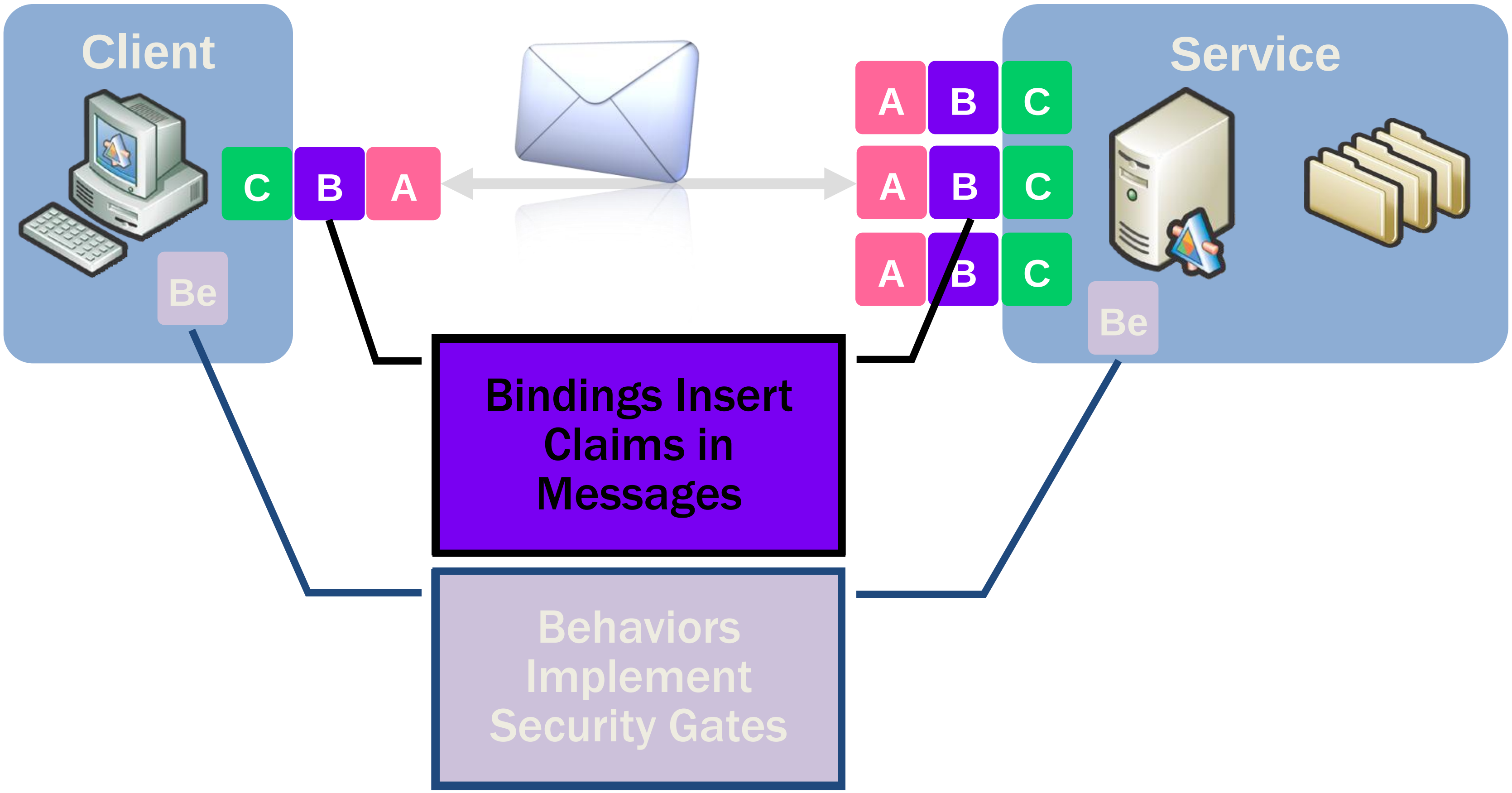


Standard Bindings

Binding	Interop	Security	Session	TX	Duplex
BasicHttpBinding	**BP 1.1**	**N, T**	**N**	**N**	**n/a**
WSHttpBinding	**WS**	**M, T, X**	**N, T, RS**	**N, Yes**	**n/a**
WSDualHttpBinding	**WS**	**M**	**RS**	**N, Yes**	**Yes**
WSFederationBinding	**Federation**	**M**	**N, RS**	**N, Yes**	**No**
NetTcpBinding	**.NET**	**T, M**	**T ,RS**	**N, Yes**	**Yes**
NetNamedPipeBinding	**.NET**	**T**	**T, N**	**N, Yes**	**Yes**
NetPeerTcpBinding	**Peer**	**T**	**N**	**N**	**Yes**
NetMsmqBinding	**.NET**	**T, M, X**	**N**	**N, Yes**	**No**
MsmqIntegrationBinding	**MSMQ**	**T**	**N**	**N, Yes**	**n/a**

N = None | T = Transport | M = Message | B = Both | RS = Reliable Sessions

Bindings & Behaviors: Security



Bindings Insert Claims in Messages

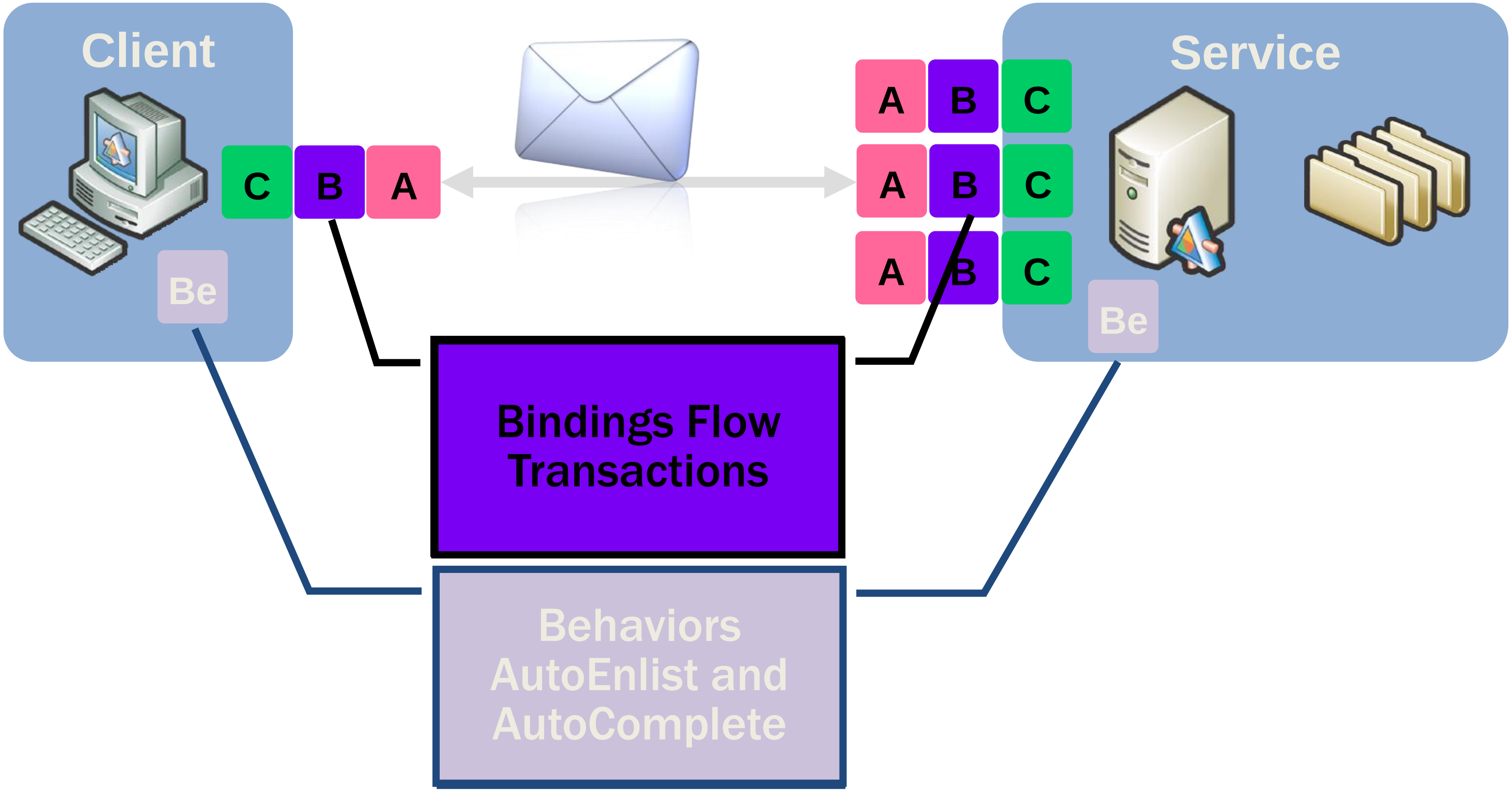
Behaviors Implement Security Gates

Feature Overview

Security

- Claims based end-to-end security
  - Secure end-to-end message exchanges
  - Secure access to resources
  - Record resource access requests
- X509, Username/Password, Kerberos, SAML, custom credentials
- Message security
  - Confidentiality and integrity
  - Transport or message level
- Access to resources
  - Authentication and authorization

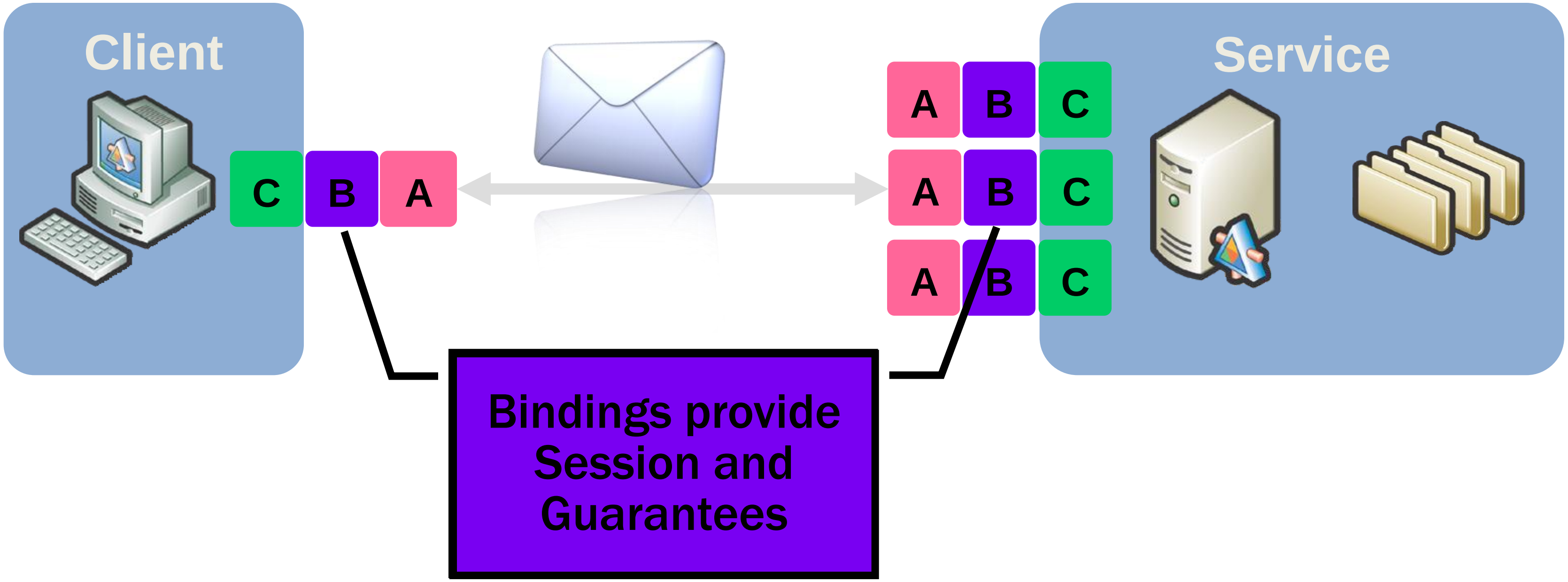
Bindings & Behaviors: Transactions



Bindings Flow Transactions

Behaviors AutoEnlist and AutoComplete

Bindings & Behaviors: Reliable Sessions



Bindings provide Session and Guarantees

Feature Overview

Reliability and Transactions

- End-to-end Reliable messaging
  - In-order guarantees
  - Exactly once guarantees
- Transport-Independent Sessions
  - Integration with ASP.NET Sessions in IIS-Hosted compatibility mode
- Transactions
  - Guaranteed atomic success or failure across services

Code vs. Config

Defining Endpoints

```
<?xml version="1.0" encoding="utf-8" ?>
<configuration xmlns="http://schemas.microsoft.com/.NetConfiguration/v2.0">
  <system.serviceModel>
    <services>
      <service serviceType="CalculatorService">
        <endpoint address="Calculator"
                  bindingSectionName="basicProfileBinding"
                  contractType="ICalculator" />
      </service>
    </services>
  </system.serviceModel>
</configuration>
```

Configuring Bindings

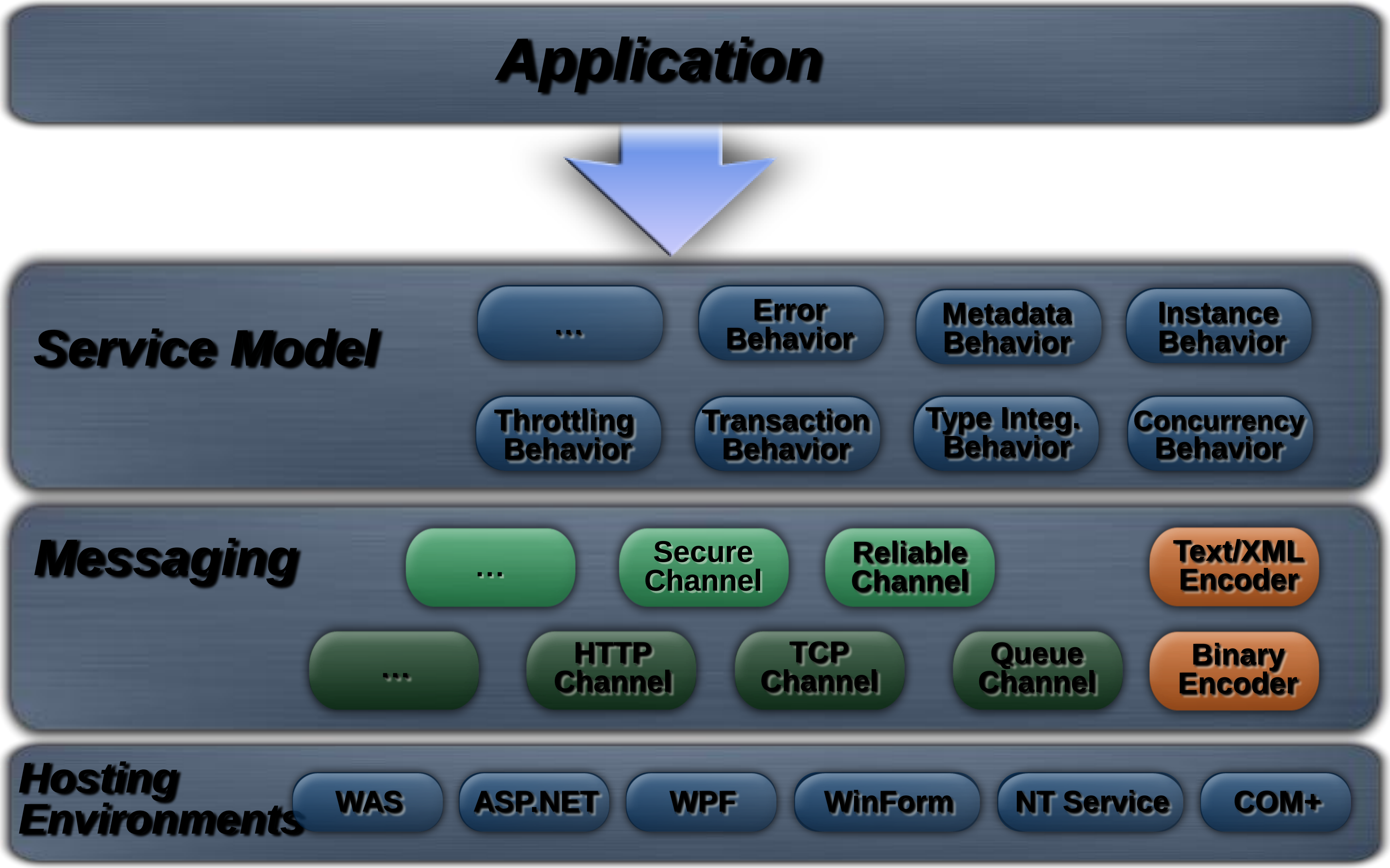
```
<endpoint address="Calculator"
          bindingSectionName="basicProfileBinding"
          bindingConfiguration="Binding1"
          contractType="ICalculator" />
```

```
<bindings>
  <basicProfileBinding>
    <binding configurationName="Binding1"
             hostnameComparisonMode="StrongWildcard"
             transferTimeout="00:10:00"
             maxMessageSize="65536"
             messageEncoding="Text"
             textEncoding="utf-8"
    </binding>
  </basicProfileBinding>
</bindings>
```

Custom Bindings

```
<bindings>
    <customBinding>
        <binding configurationName="Binding1">
            <reliableSession bufferedMessagesQuota="32"
                inactivityTimeout="00:10:00"
                maxRetryCount="8"
                ordered="true" />
            <httpsTransport manualAddressing="false"
                maxMessageSize="65536"
                hostnameComparisonMode="StrongWildcard"/>
            <textMessageEncoding maxReadPoolSize="64"
                maxWritePoolSize="16"
                messageVersion="Default"
                encoding="utf-8" />
        </binding>
    </customBinding>
</bindings>
```

WCF Summary


Application
Service Model
...
Error Behavior
Metadata Behavior
Instance Behavior
Throttling Behavior
Transaction Behavior
Type Integ. Behavior
Concurrency Behavior
Messaging
...
Secure Channel
Reliable Channel
Text/XML Encoder
...
HTTP Channel
TCP Channel
Queue Channel
Binary Encoder
Hosting Environments
WAS
ASP.NET
WPF
WinForm
NT Service
COM+

WCF Summary

- WCF is the future of distributed computing
- It combines the best of all existing Microsoft distributed computing stacks
- It uses WS-* standards for interoperability and .NET value-add for performance and integration with existing solutions
- WCF is available for Windows Vista, Windows XP SP2, Windows Server 2003, Windows Server 2008