Language Integrated Query (LINQ)

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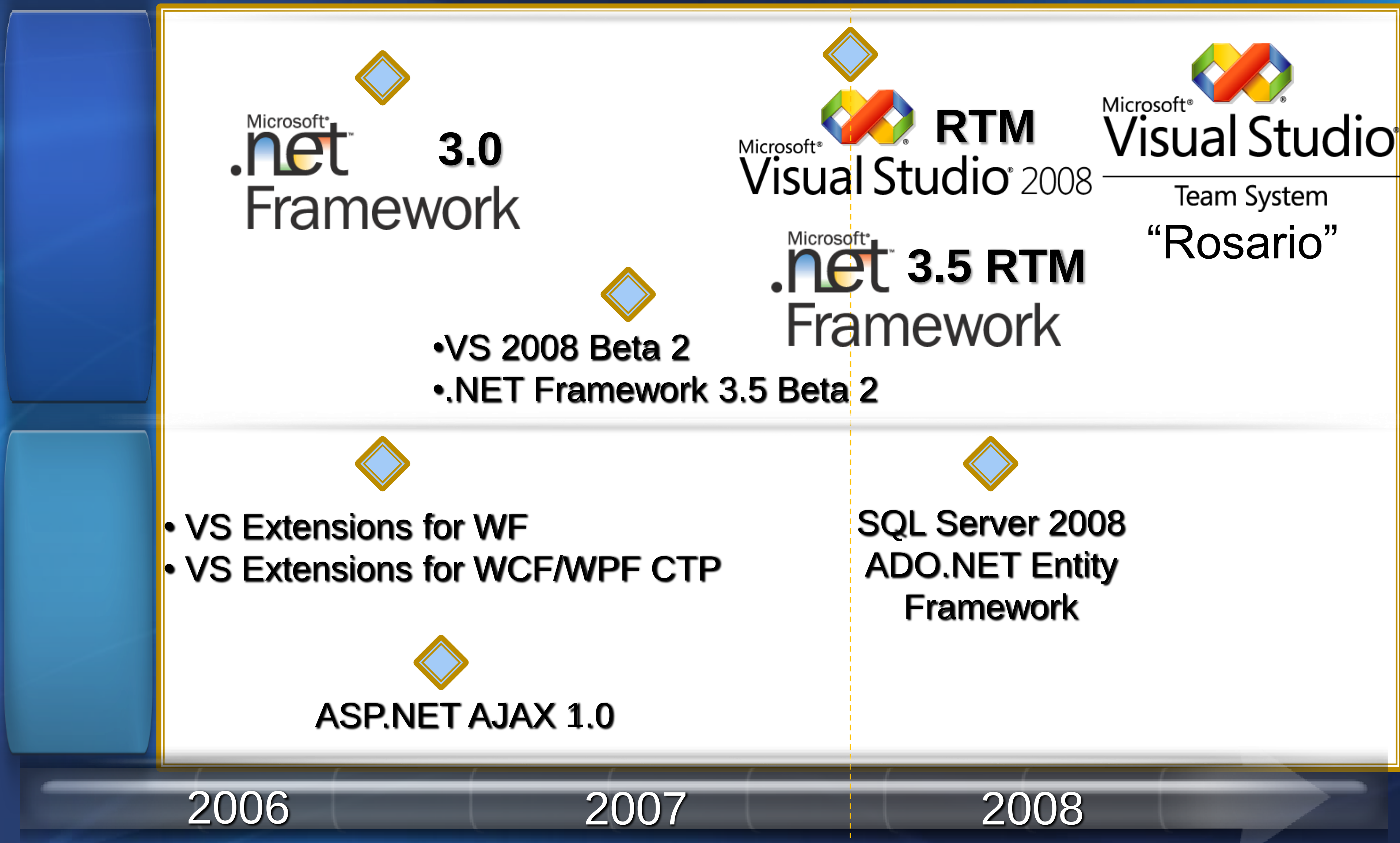
Introduction

- We use many different types of query
  - SQL, XQuery/XPath, DataView row filters, etc.
- Maybe we could enhance productivity by...
  - Deciding on one query expression syntax
  - Enabling compilers to check queries & results
  - Allow extensibility to target all kinds of data

Agenda

- C#3 and VB9 Language Enhancements
  - Building to LINQ to Objects
- LINQ to XML
- LINQ to SQL
- LINQ to DataSets

.NET Framework - VS Roadmap



Microsoft .net Framework 3.0

Microsoft Visual Studio 2008 RTM

Microsoft .net Framework 3.5 RTM

Microsoft Visual Studio Team System "Rosario"

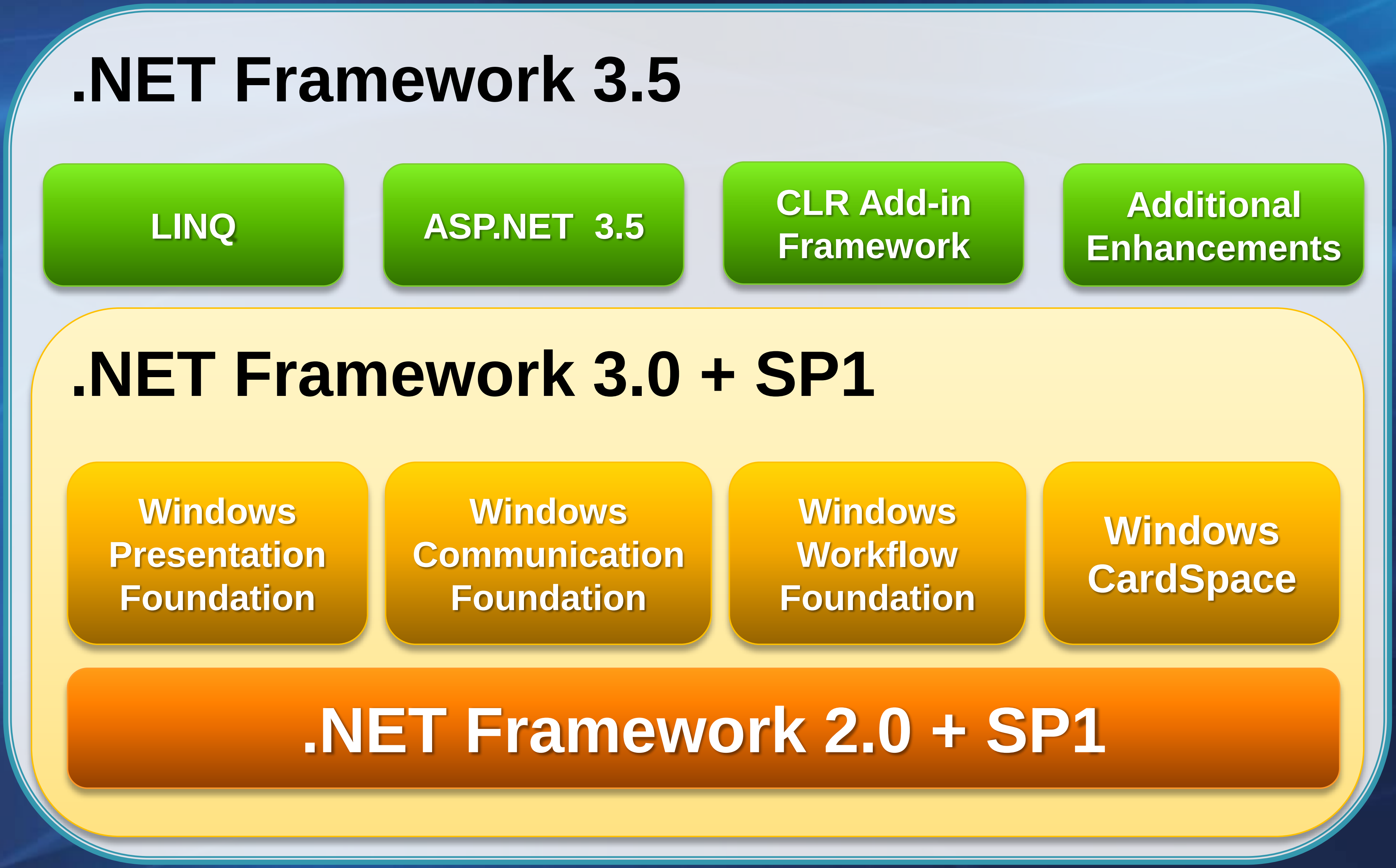
- VS 2008 Beta 2
- .NET Framework 3.5 Beta 2

- VS Extensions for WF
- VS Extensions for WCF/WPF CTP

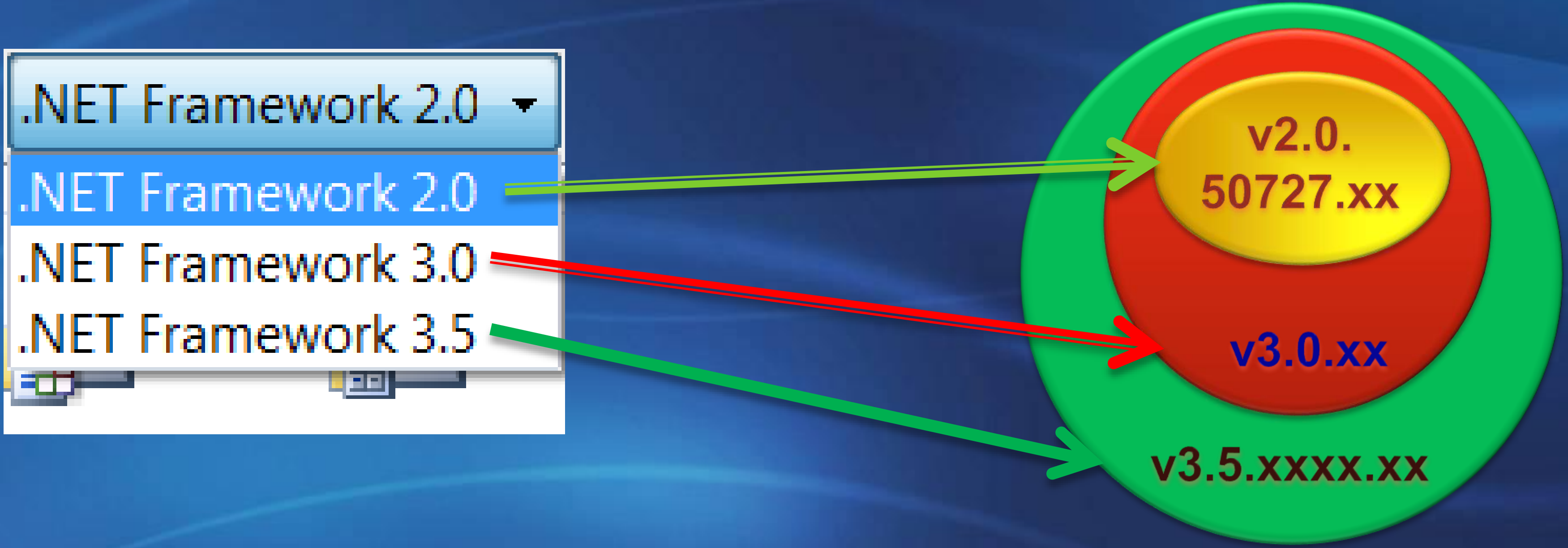
ASP.NET AJAX 1.0

SQL Server 2008
ADO.NET Entity Framework

What is the .NET Framework 3.5?

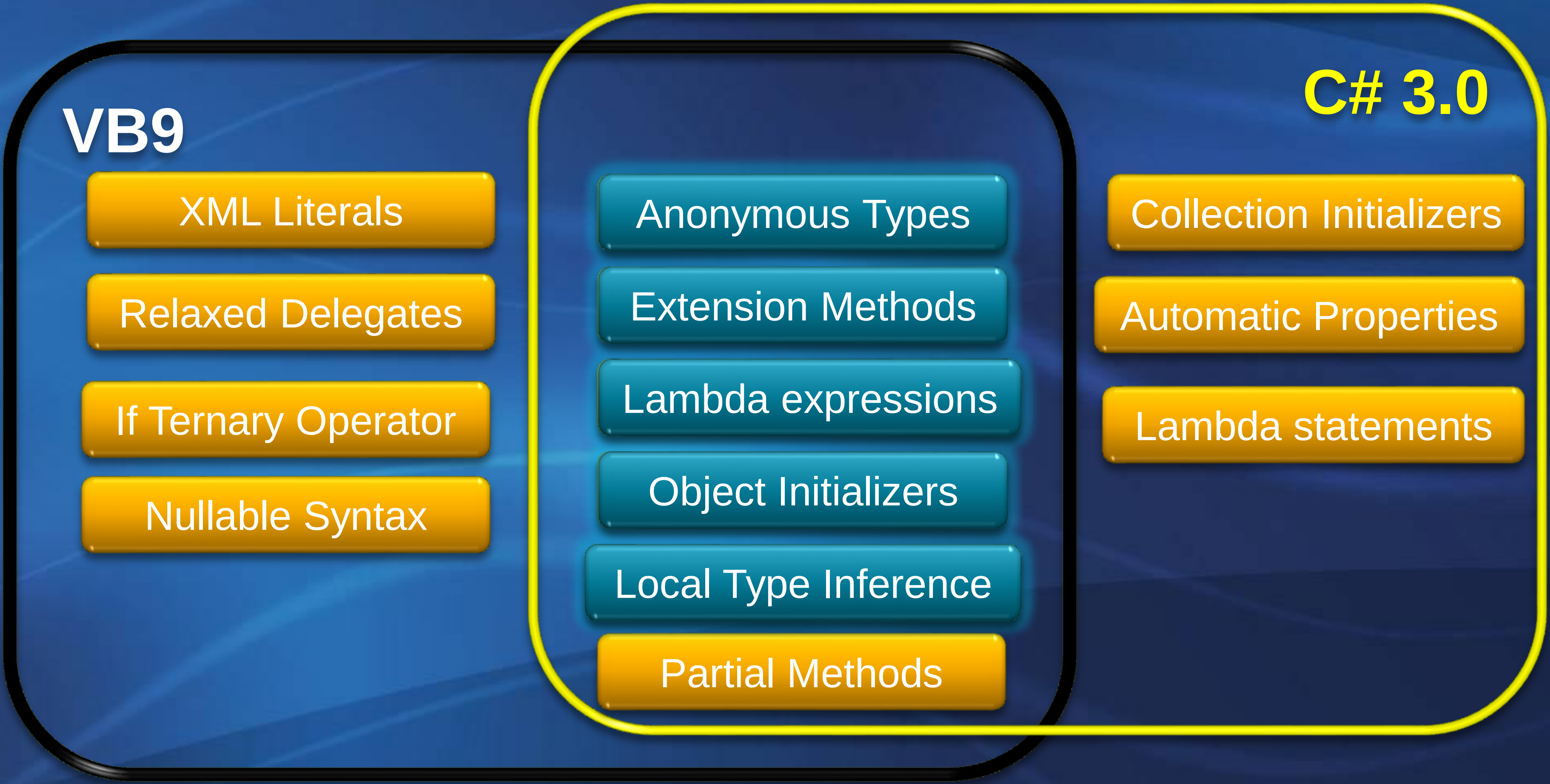


Multi-targeting in Visual Studio 2008



Compiler Features

Most are LINQ enablers



Language Innovations

Query expressions

```
var contacts =
    from c in customers
    where c.City == "Hove"
    select new { c.Name, c.Phone };
```

Local variable type inference

Lambda expressions

```
var contacts =
    customers
    .Where(c => c.City == "Hove")
    .Select(c => new { c.Name, c.Phone });
```

Extension methods

Anonymous types

Object initializers

Extension methods

- Add methods to existing types “virtually”
  - Static method with first “**this**” parameter
  - Scoping using namespaces

```
static class MyExtensions {
   public static string Reverse(this string s) {
      char[] c = s.ToCharArray();
      Array.Reverse(c);
      return new string(c);
   }
}
```

Promoted first parameter

```
string name = “Bart”;
string reversed = name.Reverse();
```

Automatic properties

- Tired of writing properties?
  - Compiler can generate the get/set plumbing

```
class Customer {
   private string _name;

   public string Name
   {
      get { return _name; };
      set { _name = value; };
   }
}
```

Setter required; can be private or internal

```
class Customer {
   public string Name { get; set; }
}
```

Object initializers

- Ever found the constructor of your taste?
  - Insufficient overloads, so pick one
  - Call various property setters

```
class Customer {
   public string Name { get; set; }
   public int Age { get; set; }
}
```

```
Customer c = new Customer();
c.Name = “Bart”;
c.Age = 24;
```

Can be combined with any constructor call

```
var c = new Customer(){ Name = “Bart”, Age = 24};
```

Collection initializers

- Arrays easier to initialize than collections?!

```
int[] ints = new int[] { 1, 2, 3 };
List<int> lst = new List<int>();
lst.Add(1);
lst.Add(2);
lst.Add(3);
```

```
int[] ints = new int[] { 1, 2, 3 };
var lst = new List<int>() { 1, 2, 3 };
```

Works for any ICollection class by calling its Add method

Anonymous types

- Let the compiler cook up a type
  - Can’t be returned from a method
  - Local variable type inference becomes a must
  - Used in LINQ query projections

```
var person = new { Name = “Bart”, Age = 24 };
```

```
var customer = new { Id = id, person.Name };
```

Lambda expressions

- Functional-style anonymous methods

```
delegate R BinOp<A,B,R>(A a, B b);

int Calc(BinOp<int, int, int> f, int a, int b)
{
   return f(a, b)
}
```

```
int result = Calc(
   delegate (int a, int b) { return a + b; },
   1, 2);
```

Parameter types inferred based on the target delegate

```
var result = Calc((a, b) => a + b, 1, 2);
```

Demo

Anonymous types, automatic properties, collection initializers, extension methods

First, A Taste of LINQ

```
using System;
using System.Query;
using System.Collections.Generic;

class app {
  static void Main() {

    string[] names = { "Burke", "Connor",
                       "Frank", "Everett",
                       "Albert", "George",
                       "Harris", "David" };

    var expr = from s in names
               where s.Length == 5
               orderby s
               select s.ToUpper();

    foreach (string item in expr)
      Console.WriteLine(item);
  }
}
```

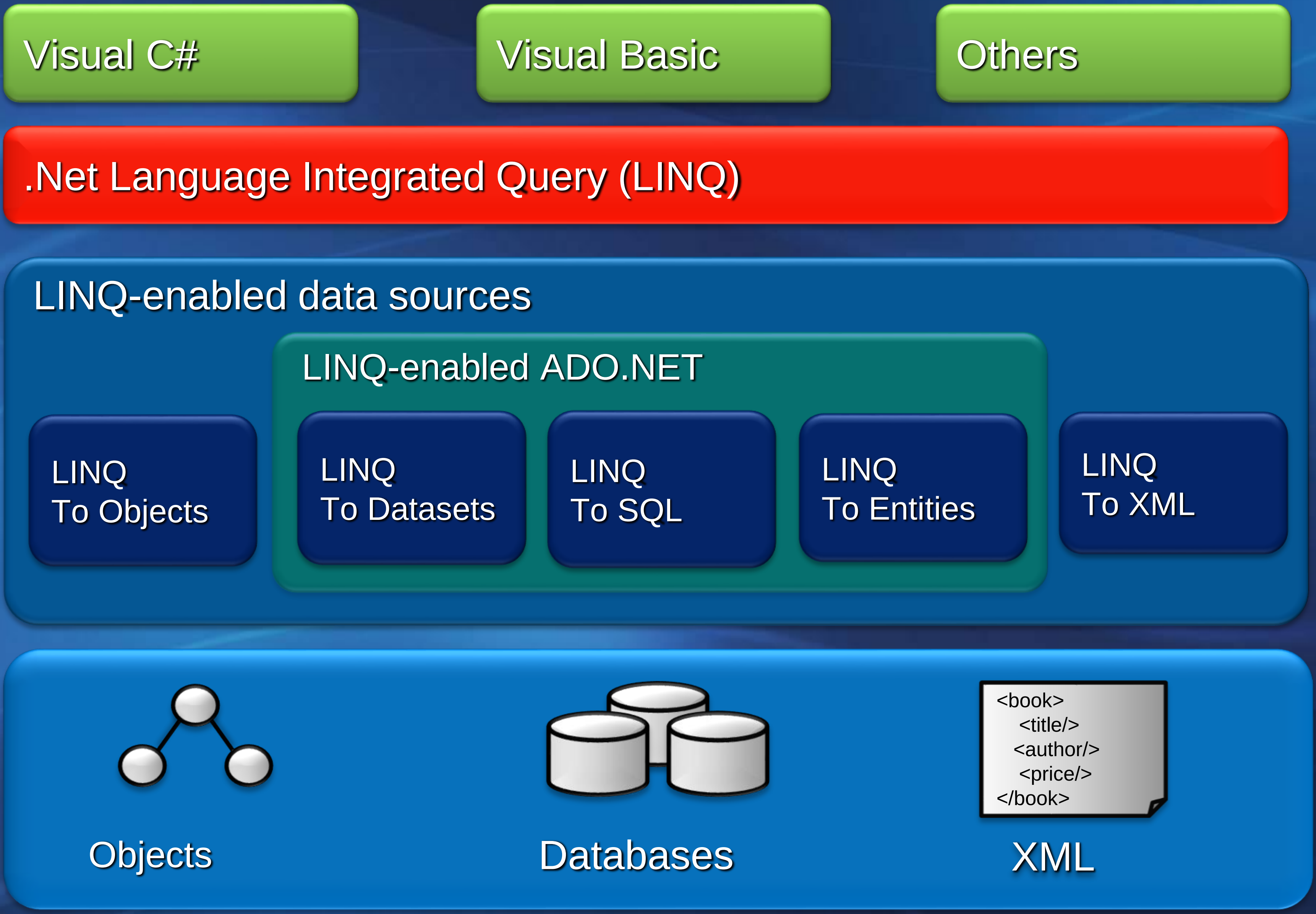
```
BURKE
DAVID
FRANK
```

Query Expressions

- Introduce SQL-Like Syntax to Language
- Compiled to Traditional C# (via Extension Methods)

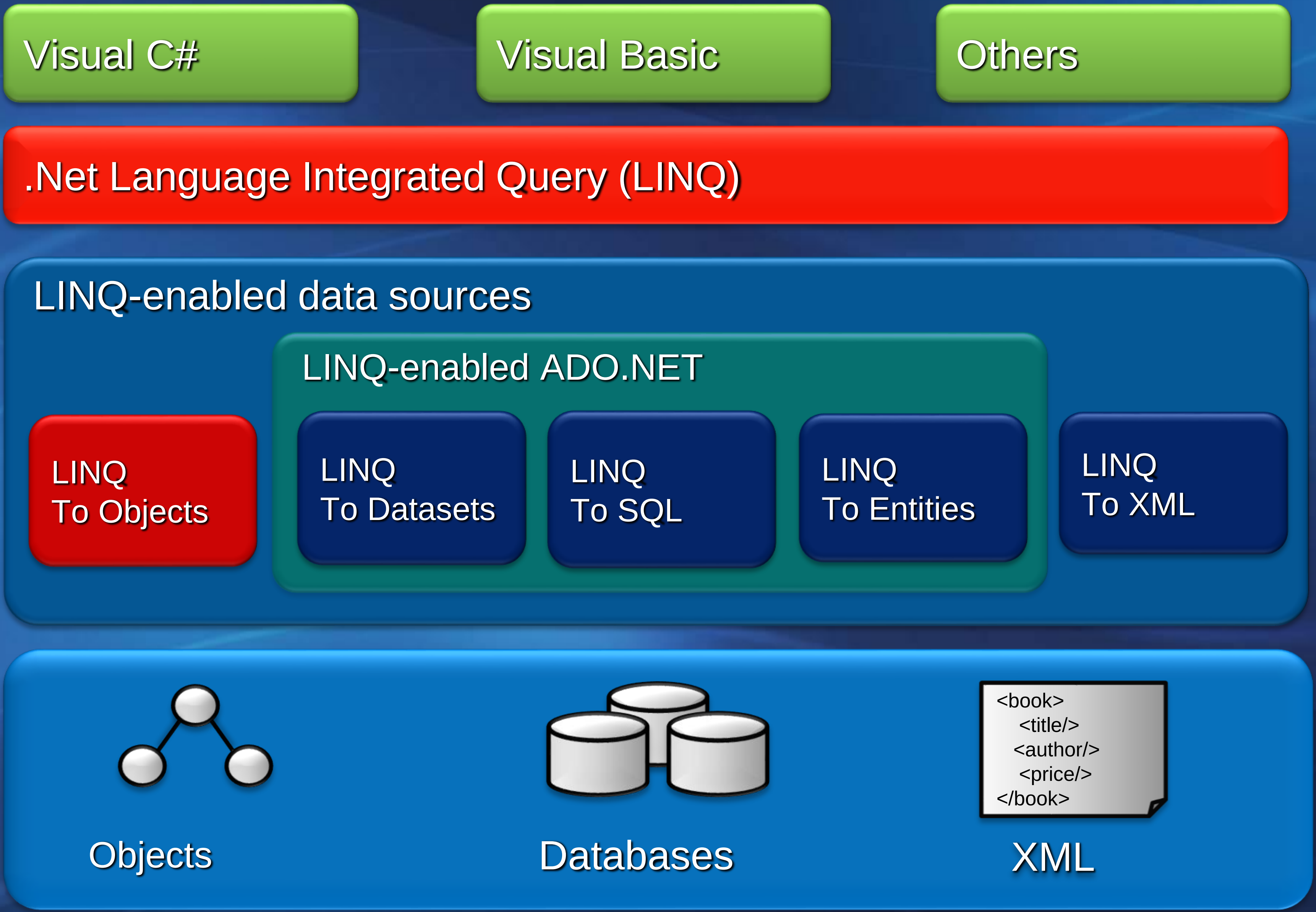
```
from itemName in srcExpr
join itemName in srcExpr on keyExpr equals keyExpr
       (into itemName)?
let itemName = selExpr
where predExpr
orderby (keyExpr (ascending | descending)?)*
select selExpr
group selExpr by keyExpr
into itemName query-body
```

LINQ Architecture



```
<book>
    <title/>
   <author/>
    <price/>
</book>
```

LINQ Architecture



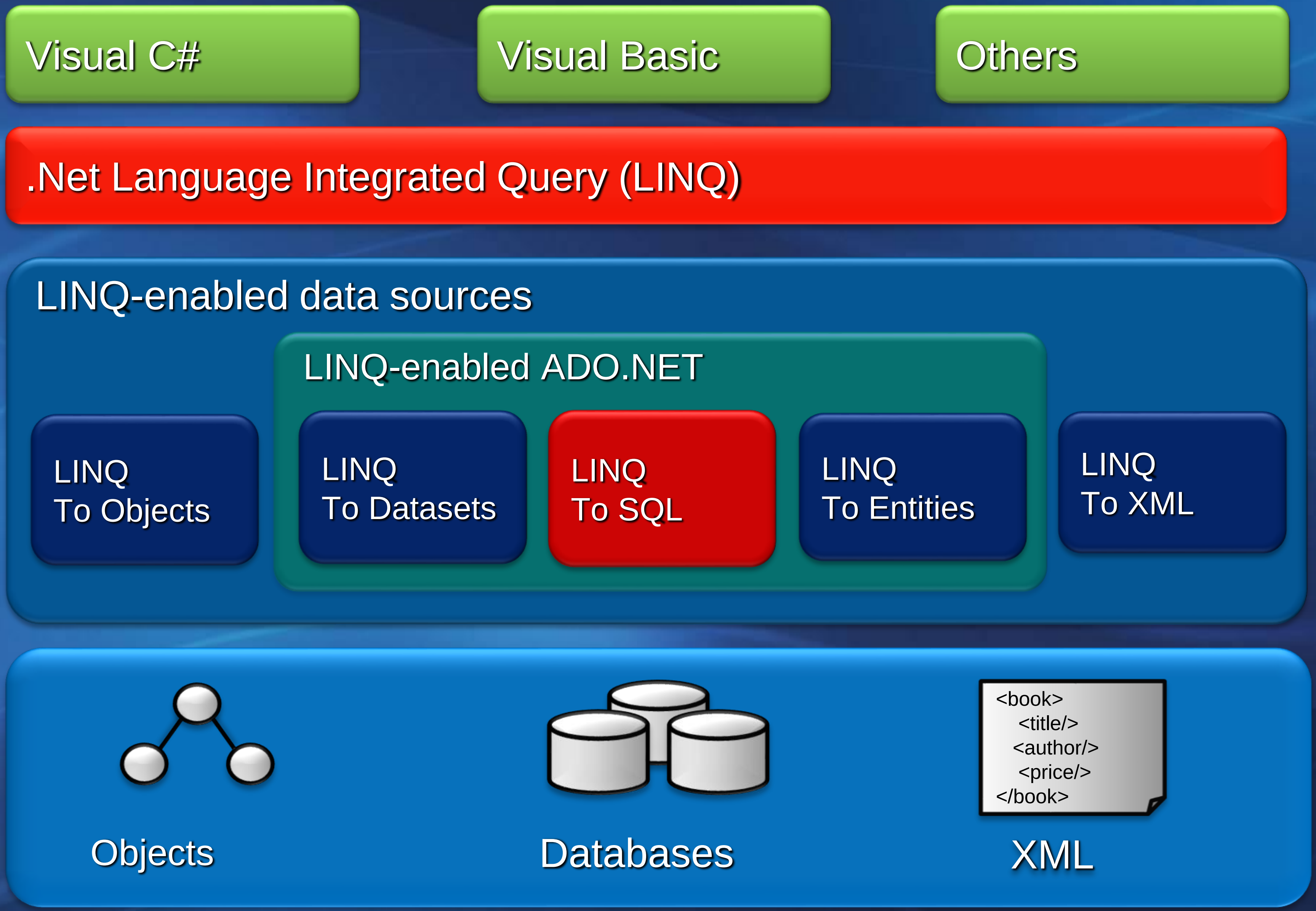
LINQ to Objects

- Native query syntax in C# and VB
  - IntelliSense
  - Autocompletion
- Query Operators can be used against any .NET collection (IEnumerable<T>)
  - Select, Where, GroupBy, Join, etc.
- Deferred Query Evaluation
- Lambda Expressions

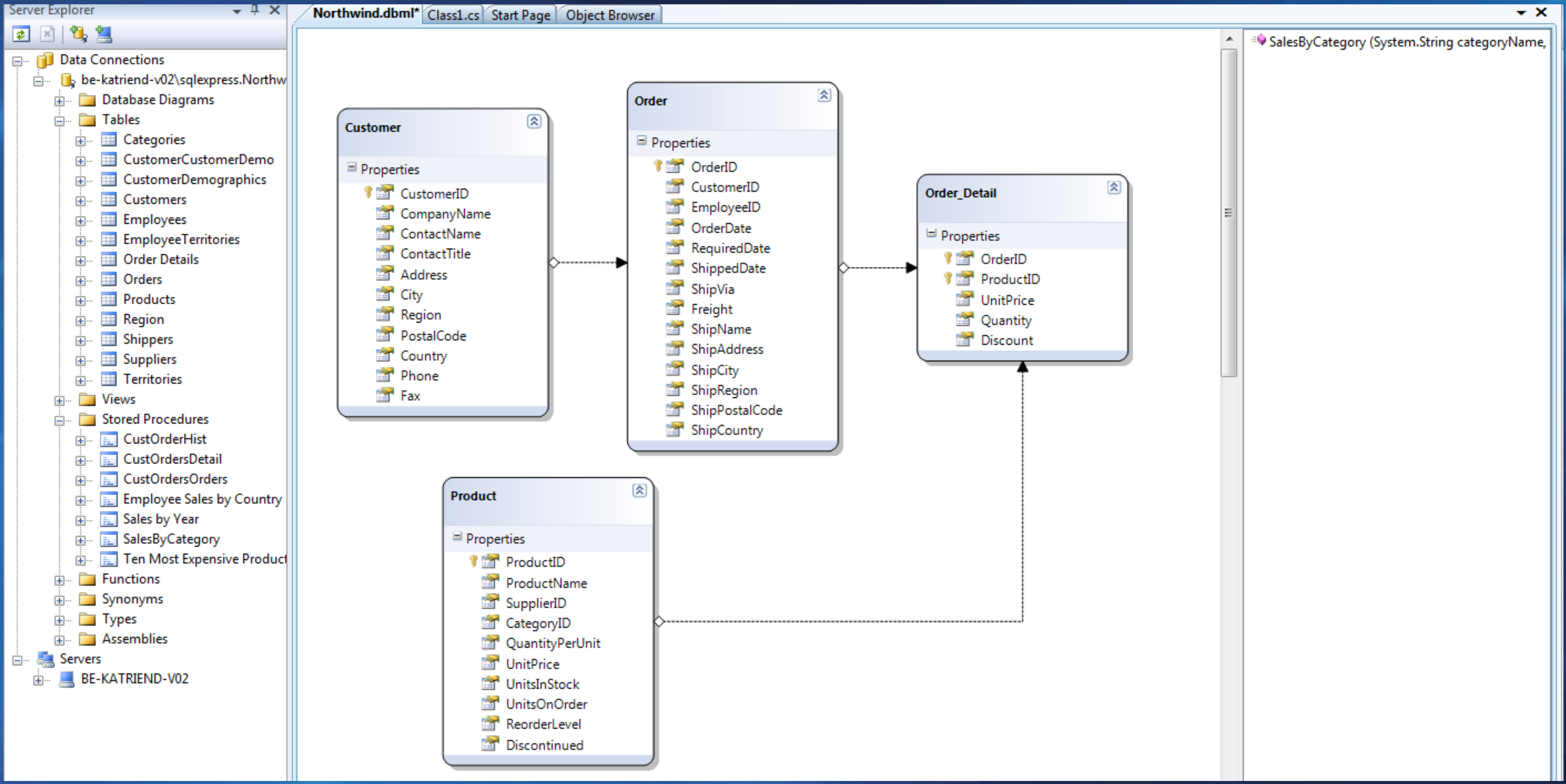
```
using System;
using System.Query;
using System.Collections.Generic;

class app {
  static void Main() {
    string[] names = { "Burke", "Connor",
                 "Frank", "Everett",
                 "Albert", "George",
                 "Harris", "David" };

    IEnumerable<string> expr =
                from s in names
                where s.Length == 5
                orderby s
                select s.ToUpper();

    foreach (string item in expr)
      Console.WriteLine(item);
  }
}
```

```
BURKE
DAVID
FRANK
```

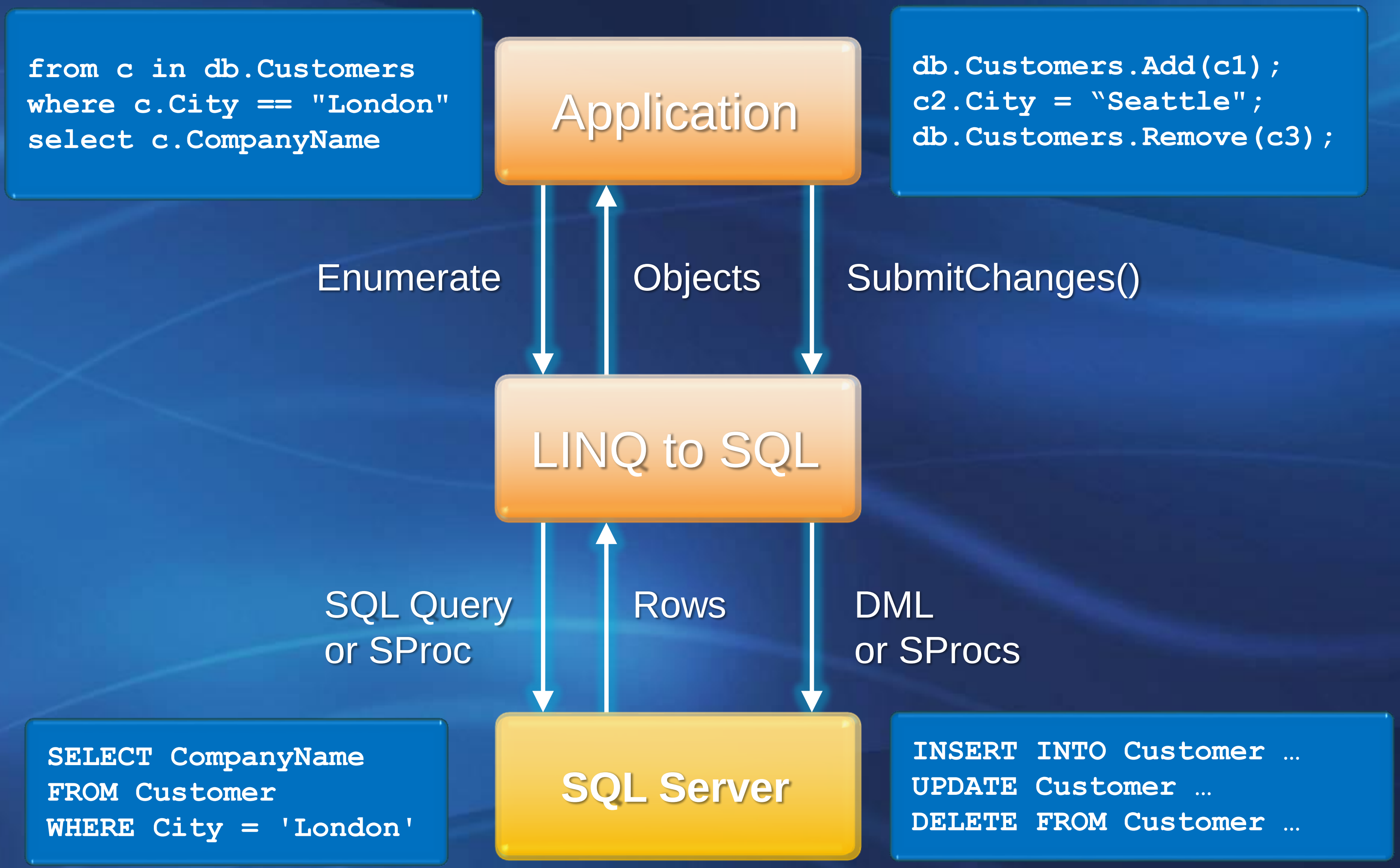
LINQ Architecture



LINQ to SQL Overview



LINQ to SQL Architecture



```
from c in db.Customers
where c.City == "London"
select c.CompanyName
```

```
db.Customers.Add(c1);
c2.City = "Seattle";
db.Customers.Remove(c3);
```

```
SELECT CompanyName
FROM Customer
WHERE City = 'London'
```

```
INSERT INTO Customer …
UPDATE Customer …
DELETE FROM Customer …
```

LINQ to SQL

- DataContext is the central class
- Use code-gen for ORM
- SQL is only submitted when needed
- Parent-child relationships are respected
  - Control of deferred loading
- Can insert/update/delete
  - Transactionally, with concurrency checks

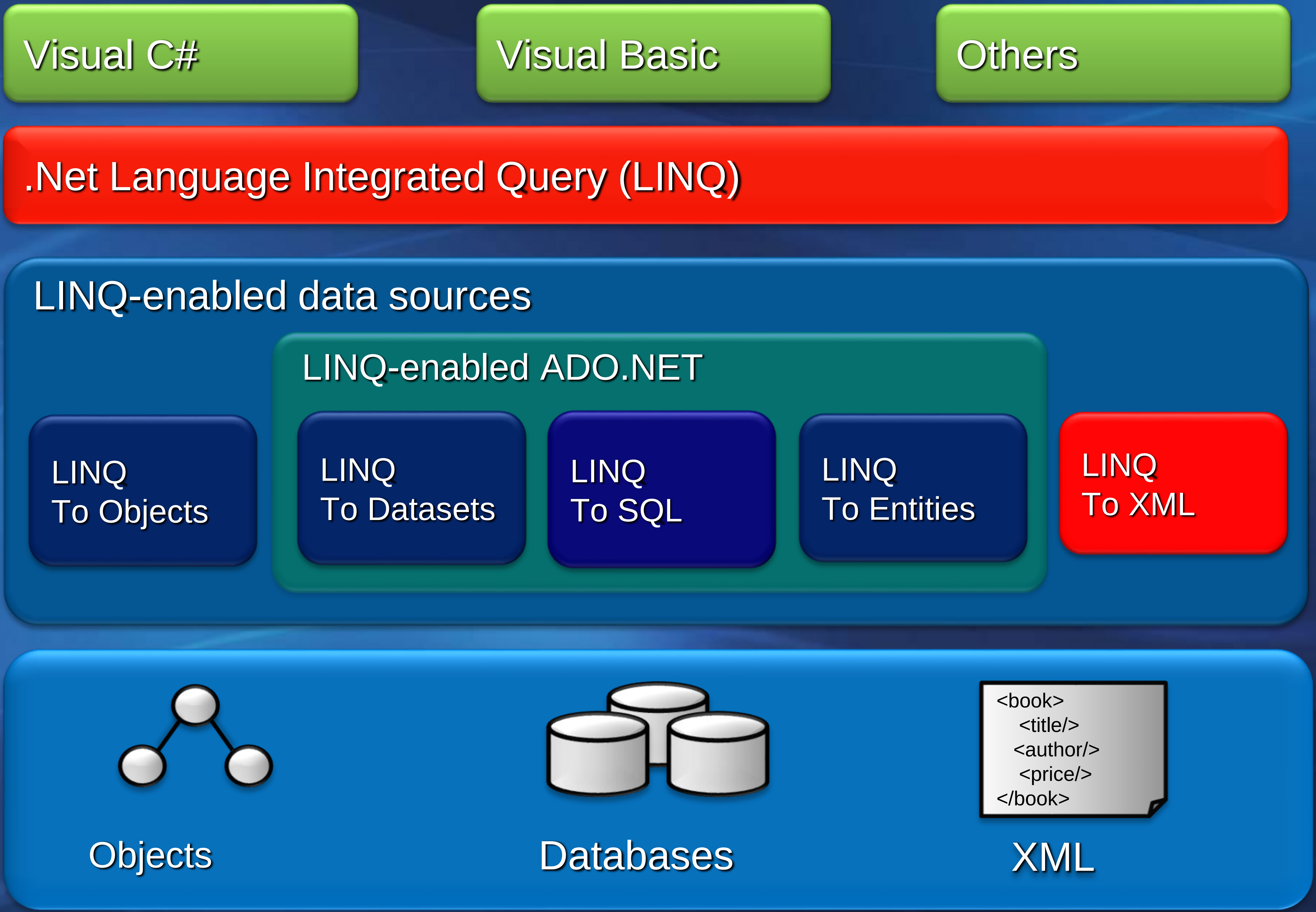
LINQ to DataSet

- Query expressions over in-memory data
- Works with untyped or typed DataSets
- If query returns some kind of DataRow: -
  - Can yield results as a DataView
  - ...and therefore databind to those results

Demo

LINQ to Objects
LINQ to SQL

LINQ Architecture



LINQ to XML

- Creating XML
  - Constructors lend themselves to nesting
  - Can use LINQ (over anything) to build XML
- Querying
  - Use normal *axes* from XML infoset
  - Get full power of query expressions over XML
  - Select, where, group by, etc.
- Xml Namespaces

Demo

LINQ to XML

That’s LINQ

- A combination of new language features, and new fx3.5 classes (with extension methods)
- A common query expression syntax
- Freedom to implement across different kinds of data
- It’s TYPED...
  - The compiler can check your queries
  - The compiler can check your results

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