Binding Objective-C Libraries

When working on iOS, you might encounter cases where you want to consume a third-party Objective-C library. In those situations, you can use Xamarin.iOS's Binding Projects to create a C# binding to the native Objective-C libraries. The project uses the same tools that we use to bring the iOS APIs to C#.

This document describes how to bind Objective-C APIs, if you are binding just C APIs, you should use the standard .NET mechanism for this, [the P/Invoke framework](#) . Details on how to statically link a C library are available on the [Linking Native Libraries](#) page.

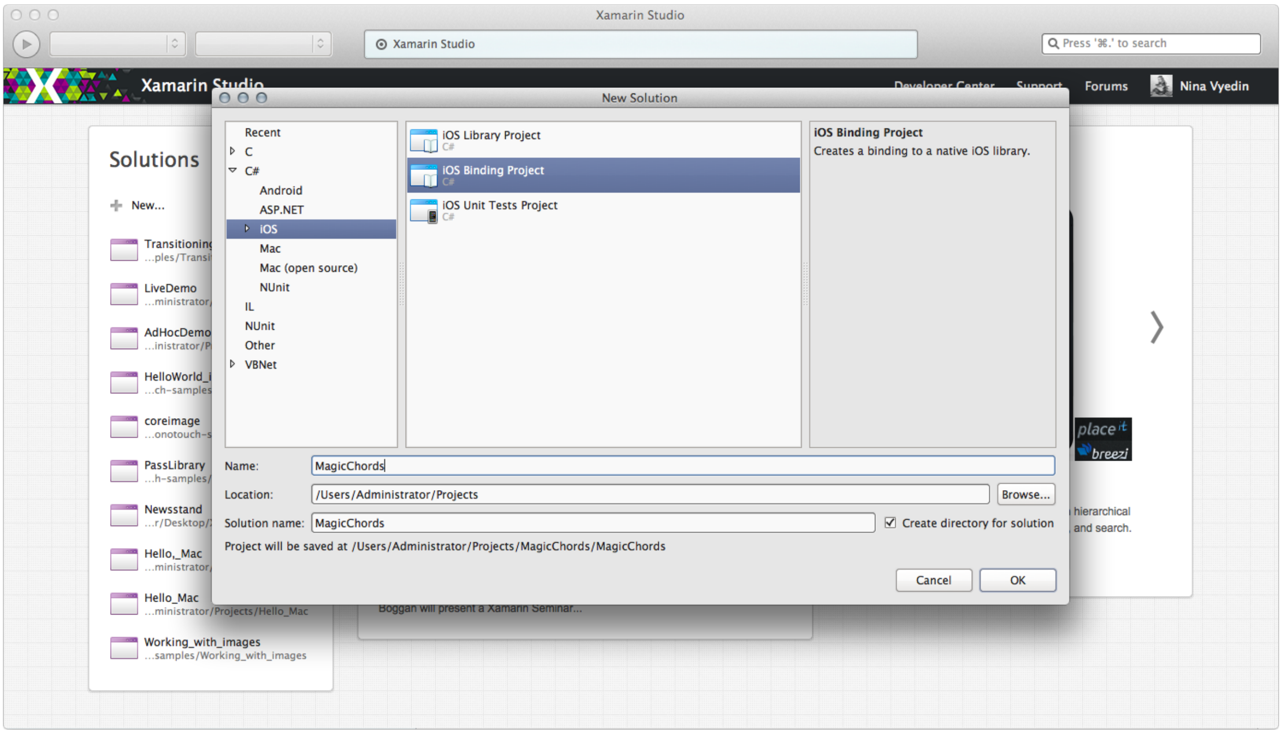
See our companion [Binding Types Reference Guide](#) . Additionally, if you want to learn more about what happens under the hood, check our [Binding Details](#) page.

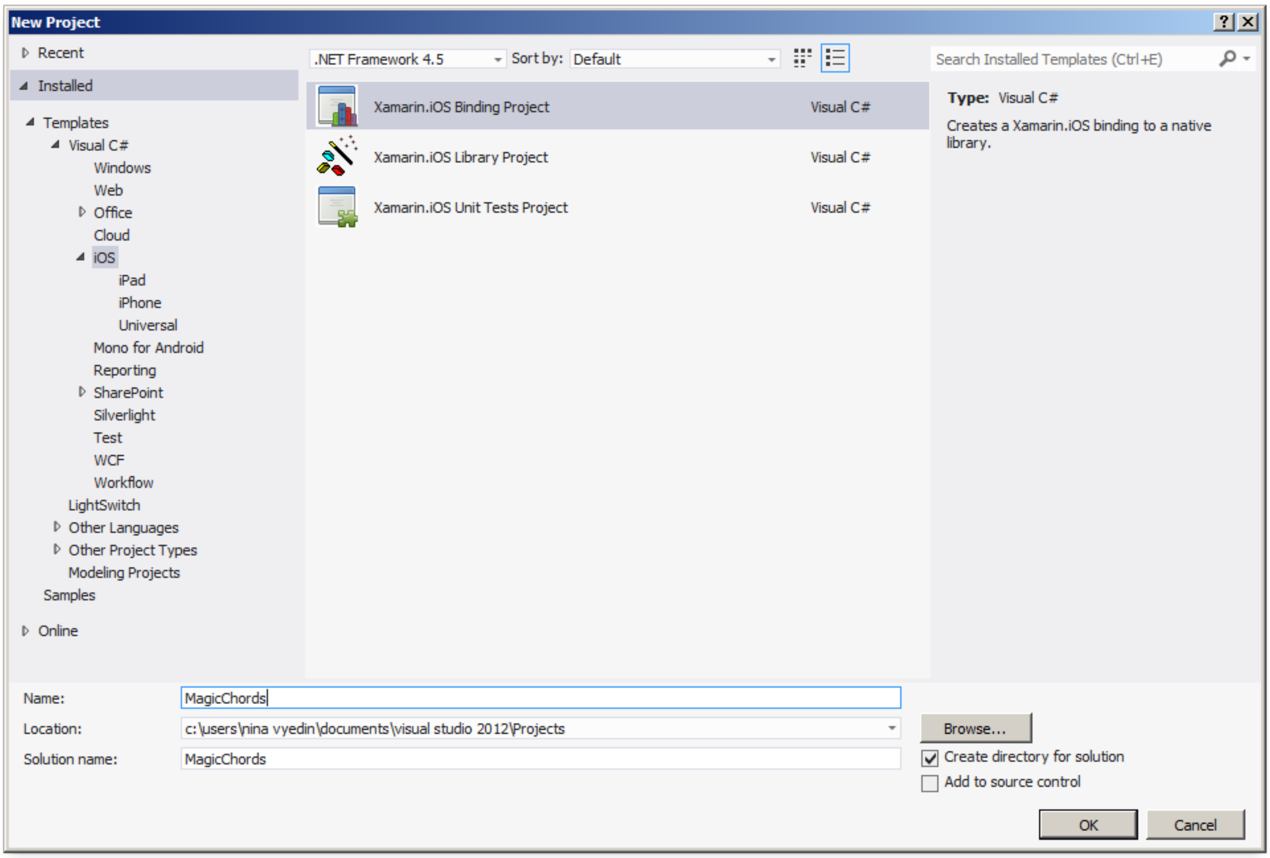
Sample Code

You can use the [BindingSample](#) project to experiment with bindings.

Getting Started

The easiest way to create a binding is to create a Xamarin.iOS Binding Project. You can do this from Xamarin Studio or Visual Studio by selecting the project type:





The generated project contains a small template that you can edit, it contains two files: ApiDefinition.cs and StructsAndEnums.cs.

The ApiDefinition.cs is where you will define the API contract, this is the file that describes how the underlying Objective-C API is projected into C#. The syntax and contents of this file are the main topic of discussion of this document and the contents of it are limited to C# interfaces and C# delegate declarations. The StructsAndEnums.cs file is the file where you will enter any definitions that are required by the interfaces and delegates. This includes enumeration values and structures that your code might use.

Binding an API

To do a comprehensive binding, you will want to understand the Objective-C API definition and familiarize yourself with the .NET Framework Design Guidelines.

To bind your library you will typically start with an API definition file. An API definition file is merely a C# source file that contains C# interfaces that have been annotated with a handful of attributes that help drive the binding. This file is what defines what the contract between C# and Objective-C is.

For example, this is a trivial api file for a library:

```
using MonoTouch.Foundation;

namespace Cocos2D {
  [BaseType (typeof (NSObject))]
  interface Camera {
    [Static, Export ("getZEye")]
```

```
    float ZEye { get; }

    [Export ("restore")]
    void Restore ();

    [Export ("locate")]
    void Locate ();

    [Export ("setEyeX:eyeY:eyeZ:")]
    void SetEyeXYZ (float x, float y, float z);

    [Export ("setMode:")]
    void SetMode (CameraMode mode);
  }
}
```

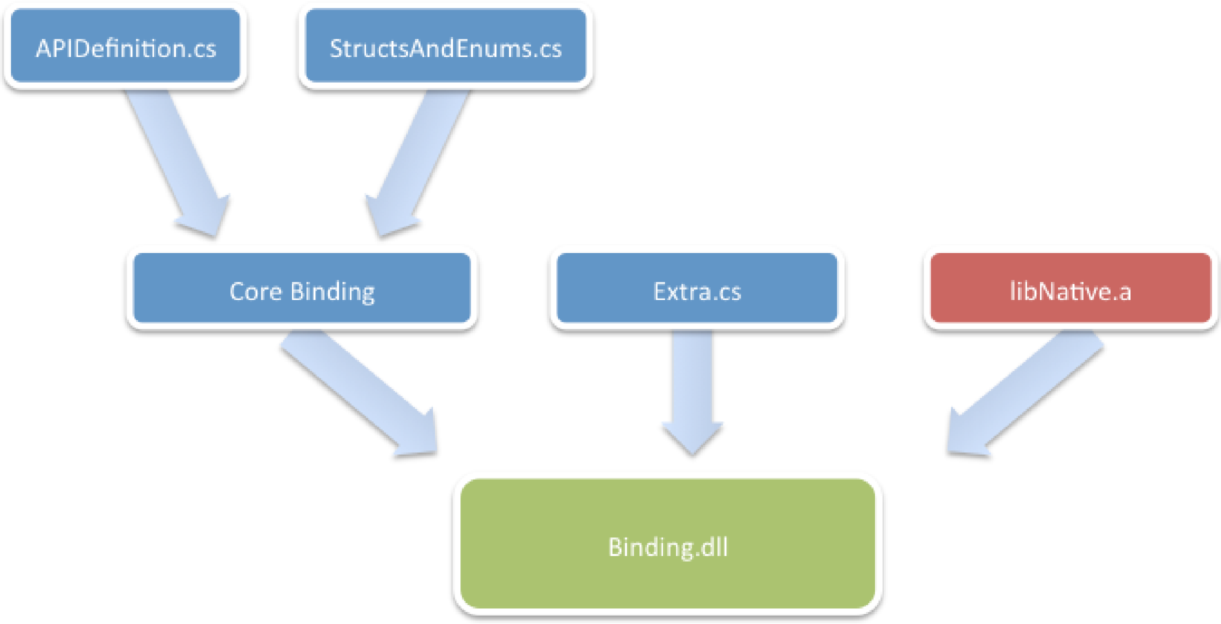
The above sample defines a class called Cocos2D.Camera that derives from the NSObject base type (this type comes from MonoTouch.Foundation.NSObject) and which defines a static property (ZEye), two methods that take no arguments and a method that takes three arguments.

An in-depth discussion of the format of the API file and the attributes that you can use is covered in the API definition file section below.

To produce a complete binding, you will typically deal with four components:

- The API definition file (ApiDefinition.cs in the template).
- Optional: any enums, types, structs required by the API definition file (StructsAndEnums.cs in the template).
- Optional: extra sources that might expand the generated binding, or provide a more C# friendly API (any C# files that you add to the project).
- The native library that you are binding.

This chart shows the relationship between the files:



The API Definition file: will only contain namespaces and interface definitions (with any members that an interface can contain) and should not contain classes, enumerations, delegates or structs. The API definition file is merely the contract that will be used to generate the API.

Any extra code that you need like enumerations or supporting classes should be hosted on a separate file, in the example above the "CameraMode" is an enumeration value that does not exist in the CS file and should be hosted in a separate file, for example "StructsAndEnums.cs":

```
public enum CameraMode {
    FlyOver, Back, Follow
}
```

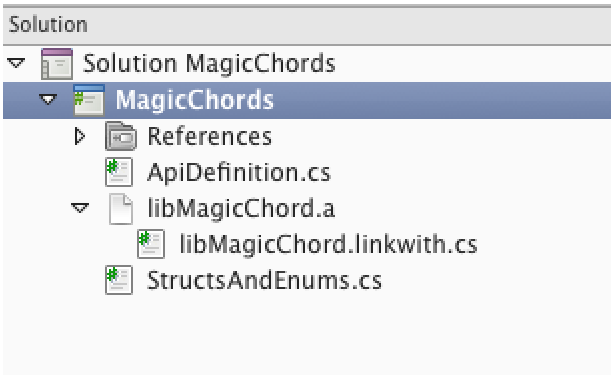
The APIDefinition.cs file is combined with the StructsAndEnum class and are used to generate the core binding of the library. You can use the resulting library as-is, but typically, you will want to tune the resulting library to add some C# features for the benefit of your users. Some examples include implementing a ToString() method, provide C# indexers, add implicit conversions to and from some native types or provide strongly-typed versions of some methods. These improvements are stored in extra C# files. Merely add the C# files to your project and they will be included in this build process.

This shows how you would implement the code in your Extra.cs file. Notice that you will be using partial classes as these augment the partial classes that are generated from the combination of the ApiDefinition.cs and the StructsAndEnums.cs core binding:

```
public partial class Camera {
    // Provide a ToString method
    public override string ToString ()
    {
         return String.Format ("ZEye: {0}", ZEye);
    }
}
```

Building the library will produce your native binding.

To complete this binding, you should add the native library to the project. You can do this by either by adding the native library into your project. Native libraries by convention start with the word "lib" and end with the extension ".a". When you do this, Xamarin Studio or Visual Studio will add two files: the .a file and an automatically populated C# file that contains information about what the native library contains:



The contents of the libMagicChord.linkwith.cs file has information about how this library can be used and instructs your IDE to package this binary into the resulting DLL file:

```
using System;
using MonoTouch.ObjCRuntime;

[assembly: LinkWith ("libMagicChord.a", LinkTarget.Simulator | LinkTarget.ArmV6 | LinkTarget.ArmV7, ForceLoad = true)]
```

Full details about how to use the LinkWith attribute are documented in our [Binding Types Reference Guide] .

Now when you build the project you will end up with a MagicChords.dll file that contains both the binding and the native library. You can distribute this project or the resulting DLL to other developers for their own use.

Sometimes you might find that you need a few enumeration values, delegate definitions or other types. Do not place those in the API definitions file, as this is merely a contract

The API definition file

The API definition file consists of a number of interfaces. The interfaces in the API definition will be turned into a class declaration and they must be decorated with the [BaseType] attribute to specify the base class for the class.

You might be wondering why we did not use classes instead of interfaces for the contract definition. We picked interfaces because it allowed us to write the contract for a method without having to supply a method body in the API definition file, or having to supply a body that had to throw an exception or return a meaningful value.

But since we are using the interface as a skeleton to generate a class we had to resort to decorating various parts of the contract with attributes to drive the binding.

Binding Methods

The simplest binding you can do is to bind a method. Just declare a method in the interface with the C# naming conventions and decorate the method with the [Export] attribute. The [Export] attribute is what links your C# name with the Objective-C name in the Xamarin.iOS runtime. The parameter of the Export attribute is the name of the Objective-C selector, some examples:

```
// A method, that takes no arguments
[Export ("refresh")]
void Refresh ();

// A method that takes two arguments and return the result
[Export ("add:and:")]
int Add (int a, int b);

// A method that takes a string
[Export ("draw:atColumn:andRow:")]
void Draw (string text, int column, int row);
```

The above samples show how you can bind instance methods. To bind static methods, you must use the [Static] attribute, like this:

```
// A static method, that takes no arguments
[Static, Export ("refresh")]
void Beep ();
```

This is required because the contract is part of an interface, and interfaces have no notion of static vs instance declarations, so it is necessary once again to resort to attributes. If you want to hide a particular method from the binding, you can decorate the method with the [Internal] attribute.

The btouch command will introduce checks for reference parameters to not be null. If you want to allow null values for a particular parameter, use the [NullAllowed] attribute on the parameter, like this:

```
[Export ("setText:")]
string SetText ([NullAllowed] string text);
```

When exporting a reference type, with the [Export] keyword you can also specify the allocation semantics. This is necessary to ensure that no data is leaked: TODO DOCUMENT.

Binding Properties

Just like methods, Objective-C properties are bound using the [Export] attribute and map directly to C# properties. Just like methods, properties can be decorated with the [Static] and the [Internal] attributes.

When you use the [Export] attribute on a property under the covers btouch actually binds two methods: the getter and the setter. The name that you provide to export is the basename and the the setter is computed by prepending the word "set", turning the first letter of the basename into upper case and making the selector take an argument. This means that [Export ("label")] applied on a property actually binds the "label" and "setLabel:" Objective-C methods.

Sometimes the Objective-C properties do not follow the pattern described above and the name is manually overwritten. In those cases you can control the way that the binding is generated by using the [Bind] attribute on the getter or setter, for example:

```
[Export ("menuVisible")]
bool MenuVisible { [Bind ("isMenuVisible")] get; set; }
```

This then binds "isMenuVisible" and "setMenuVisible:".

In addition to support for static properties using [Static], you can decorate thread-static properties with [IsThreadStatic] , for example:

```
[Export ("currentRunLoop")][Static][IsThreadStatic]
NSRunLoop Current { get; }
```

Just like methods allow some parameters to be flagged with [NullAllowed] , you can apply [NullAllowed] to a property to indicate that null is a valid value for the property, for example:

```
[Export ("text"), NullAllowed]
string Text { get; set; }
```

The [NullAllowed] parameter can also be specified directly on the setter:

```
[Export ("text")]
string Text { get; [NullAllowed] set; }
```

Binding Constructors

The **btouch** tool will automatically generate fours constructors in your class, for a given class Foo, it generates:

- Foo (): the default constructor (maps to Objective-C's "init" constructor)
- Foo (NSCoder): the constructor used during deserialization of NIB files (maps to Objective-C's "initWithCoder:" constructor).
- Foo (IntPtr handle): the constructor for handle-based creation, this is invoked by the runtime when the runtime needs to expose a managed object from an unmanaged object.
- Foo (NSEmptyFlag): this is used by derived classes to prevent double initialization.

For constructors that you define, they need to be declared using the following signature inside the Interface definition: they must return an IntPtr value and the name of the method should be Constructor. For example to bind the initWithFrame: constructor, this is what you would use:

```
[Export ("initWithFrame:")]
IntPtr Constructor (RectangleF frame);
```

Binding Protocols

As described in the API design document, in the section discussing Models and Protocols , Xamarin.iOS maps the Objective-C protocols into classes that have been flagged with the [Model] attribute. This is typically used when implementing Objective-C delegate classes.

The big difference between a regular bound class and a delegate class is that the delegate class might have one or more optional methods.

For example consider the UIKit class UIAccelerometerDelegate, this is how it is bound in Xamarin.iOS:

```
[BaseType (typeof (NSObject))]
[Model]
interface UIAccelerometerDelegate {
        [Export ("accelerometer:didAccelerate:")]
        void DidAccelerate (UIAccelerometer accelerometer, UIAcceleration acceleration);
}
```

Since this is an optional method on the definition for UIAccelerometerDelegate there is nothing else to do. But if there was a required method on the protocol, you should add the [Abstract] attribute to the method. This will force the user of the implementation to actually provide a body for the method.

In general, protocols are used in classes that respond to messages. This is typically done in Objective-C by assigning to the "delegate" property an instance of an object that responds to the methods in the protocol.

The convention in Xamarin.iOS is to support both the Objective-C loosely coupled style where any instance of an NSObject can be assigned to the delegate, and to also expose a strongly typed version of it. For this reason, we typically provide both a "Delegate" property that is strongly typed and a"WeakDelegate" that is loosely typed. We usually bind the loosely typed version with Export, and we use the [Wrap] attribute to provide the strongly typed version.

This shows how we bound the UIAccelerometer class:

```
[BaseType (typeof (NSObject))]
interface UIAccelerometer {
        [Static] [Export ("sharedAccelerometer")]
        UIAccelerometer SharedAccelerometer { get; }

        [Export ("updateInterval")]
        double UpdateInterval { get; set; }
```

```
        [Wrap ("WeakDelegate")]
        UIAccelerometerDelegate Delegate { get; set; }

        [Export ("delegate", ArgumentSemantic.Assign)][NullAllowed]
        NSObject WeakDelegate { get; set; }
}
```

Binding Class Extensions

In Objective-C it is possible to extend classes with new methods, similar in spirit to C#'s extension methods. When one of these methods is present, you can use the [Target] attribute to flag the first parameter of a method as being the receiver of the Objective-C message.

For example, in Xamarin.iOS we bound the extension methods that are defined on NSString when UIKit is imported as methods in the UIView, like this:

```
[BaseType (typeof (UIResponder))]
interface UIView {
        [Bind ("drawAtPoint:withFont:")]
        SizeF DrawString ([Target] string str, PointF point, UIFont font);
}
```

Binding Objective-C Argument Lists

Objective-C supports variadic arguments, you can use the following technique described by Zach Gris on this post .

An Objective-C message looks like this:

- (void) appendWorkers:(XWorker *) firstWorker, ... NS_REQUIRES_NIL_TERMINATION ;

To invoke this method from C# you will want to create a signature like this:

```
[Export ("appendWorkers"), Internal]
void AppendWorkers (Worker firstWorker, IntPtr workersPtr)
```

This declares the method as internal, hiding the above API from users, but exposing it to the library. Then you can write a method like this:

```
public void AppendWorkers(params Worker[] workers)
{
    if (workers == null)
         throw new ArgumentNullException ("workers");

    var pNativeArr = Marshal.AllocHGlobal(workers.Length * IntPtr.Size);
    for (int i = 1; i < workers.Length; ++i)
        Marshal.WriteIntPtr (pNativeArr, (i - 1) * IntPtr.Size, workers[i].Handle);

    // Null termination
    Marshal.WriteIntPtr (pNativeArr, (workers.Length - 1) * IntPtr.Size, IntPtr.Zero);

    // the signature for this method has gone from (IntPtr, IntPtr) to (Worker, IntPtr)
    WorkerManager.AppendWorkers(workers[0], pNativeArr);
    Marshal.FreeHGlobal(pNativeArr);
}
```

Binding Fields

Sometimes you will want to access public fields that were declared in a library.

Usually these fields contain strings or integers values that must be referenced. They are commonly used as string that represent a specific notification and as keys in dictionaries.

To bind a field, add a property to your interface definition file, and decorate the property with the [Field] attribute. This attribute takes one parameter: the C name of the symbol to lookup. For example:

```
[Field ("NSSomeEventNotification")]
NSString NSSomeEventNotification { get; }
```

If you want to wrap various fields in a static class that does not derive from NSObject, you can use the [Static] attribute on the class, like this:

```
[Static]
interface LonelyClass {
    [Field ("NSSomeEventNotification")]
    NSString NSSomeEventNotification { get; }
}
```

The above will generate a LonelyClass which does not derive from NSObject and will contain a binding to the NSSomeEventNotification NSString exposed as an NSString.

The [Field] attribute can be applied to the following data types:

- NSString references (read-only properties only)
- NSArray references (read-only properties only)
- 32-bit ints (System.Int32)
- 64-bit ints (System.Int64)
- 32-bit floats (System.Single)
- 64-bit floats (System.Double)
- System.Drawing.SizeF

In addition to the native field name, you can specify the library name where the field is located, by passing the library name:

```
[Static]
interface LonelyClass {
    [Field ("SomeSharedLibrarySymbol", "SomeSharedLibrary")]
    NSString SomeSharedLibrarySymbol { get; }
}
```

If you are linking statically, there is no library to bind to, so you need to use the __Internal name:

```
[Static]
interface LonelyClass {
    [Field ("MyFieldFromALibrary", "__Internal")]
    NSString MyFieldFromALibrary { get; }
}
```

Binding Notifications

Notifications are messages that are posted to the NSNotificationCenter.DefaultCenter and are used as a mechanism to broadcast messages from one part of the application to another. Developers subscribe to notifications typically using the NSNotificationCenter 's AddObserver method. When an application posts a message to the notification center, it typically contains a payload stored in the NSNotification.UserInfo dictionary. This dictionary is weakly typed, and getting information out of it is error prone, as users typically need to read in the documentation which keys are available on the dictionary and the types of the values that can be stored in the dictionary. The presence of keys sometimes is used as a boolean as well.

The Xamarin.iOS binding generator provides support for developers to bind notifications. To do this, you set the [Notification] attribute on a property that has been also been tagged with a [Field] property (it can be public or private).

This attribute can be used without arguments for notifications that carry no payload, or you can specify a System.Type that references another interface in the API definition, typically with the name ending with "EventArgs". The generator will turn the interface into a class that subclasses EventArgs and will include all of the properties listed there. The [Export] attribute should be used in the EventArgs class to list the name of the key used to look up the Objective-C dictionary to fetch the value.

For example:

```
interface MyClass {
    [Notification]
    [Field ("MyClassDidStartNotification")]
    NSString DidStartNotification { get; }
}
```

The above code will generate a nested class MyClass.Notifications with the following methods:

```
public class MyClass {
   [..]
   public Notifications {
      public static NSObject ObserveDidStart (EventHandler<NSNotificationEventArgs> handler)
   }
}
```

Users of your code can then easily subscribe to notifications posted to the NSDefaultCenter by using code like this:

```
var token = MyClass.Notifications.ObserverDidStart ((notification) => {
    Console.WriteLine ("Observed the 'DidStart' event!");
});
```

The returned value from ObserveDidStart can be used to easily stop receiving notifications, like this:

```
token.Dispose ();
```

Or you can call NSNotification.DefaultCenter.RemoveObserver and pass the token. If your notification contains parameters, you should specify a helper EventArgs interface, like this:

```
interface MyClass {
    [Notification (typeof (MyScreenChangedEventArgs)]
    [Field ("MyClassScreenChangedNotification")]
    NSString ScreenChangedNotification { get; }
}

// The helper EventArgs declaration
interface MyScreenChangedEventArgs {
    [Export ("ScreenXKey")]
    int ScreenX { get; set; }
```

```
    [Export ("ScreenYKey")]
    int ScreenY { get; set; }

    [Export ("DidGoOffKey")]
    [ProbePresence]
    bool DidGoOff { get; }
}
```

The above will generate a MyScreenChangedEventArgs class with the ScreenX and ScreenY properties that will fetch the data from the NSNotification.UserInfo dictionary using the keys "ScreenXKey" and "ScreenYKey" respectively and apply the proper conversions. The [ProbePresence] attribute is used for the generator to probe if the key is set in the UserInfo, instead of trying to extract the value. This is used for cases where the presence of the key is the value (typically for boolean values).

This allows you to write code like this:

```
var token = MyClass.NotificationsObserveScreenChanged ((notification) => {
    Console.WriteLine ("The new screen dimensions are {0},{1}", notification.ScreenX, notification.ScreenY);
});
```

Binding Categories

Categories are an Objective-C mechanism used to extend the set of methods and properties available in a class. In practice, they are used to either extend the functionality of a base class (for example NSObject) when a specific framework is linked in (for example UIKit), making their methods available, but only if the new framework is linked in. In some other cases, they are used to organize features in a class by functionality. They are similar in spirit to C# extension methods.

This is what a category would look like in Objective-C:

```
@interface UIView (MyUIViewExtension)
-(void) makeBackgroundRed;
@end
```

The above example if found on a library would extend instances of UIView with the method makeBackgroundRed.

To bind those, you can use the [Category] attribute on an interface definition. When using the Category attribute, the meaning of the [BaseType] attribute changes from being used to specify the base class to extend, to be the type to extend.

The following shows how the UIView extensions are bound and turned into C# extension methods:

```
[BaseType (typeof (UIView))]
[Category]
interface MyUIViewExtension {
        [Export ("makeBackgroundRed")]
        void MakeBackgroundRed ();
}
```

The above will create a MyUIViewExtension a class that contains the MakeBackgroundRed extension method. This means that you can now call "MakeBackgroundRed" on any UIView subclass, giving you the same functionality you would get on Objective-C.

In some other cases, categories are used not to extend a system class, but to organize functionality, purely for decorational purposes. Like this:

```
@interface SocialNetworking (Twitter)
- (void) postToTwitter:(Message *) message;
@end

@interface SocialNetworking (Facebook)
- (void) postToFacebook:(Message *) message andPicture: (UIImage*)
picture;
@end
```

Although you can use the Category attribute also for this decorational style of declarations, you might as well just add them all to the class definition. Both of these would achieve the same:

```
[BaseType (typeof (NSObject))]
interface SocialNetworking {
}

[Category]
[BaseType (typeof (SocialNetworking))]
interface Twitter {
        [Export ("postToTwitter:")]
        void PostToTwitter (Message message);
}

[Category]
[BaseType (typeof (SocialNetworking))]
interface Facebook {
        [Export ("postToFacebook:andPicture:")]
        void PostToFacebook (Message message, UIImage picture);
}
```

It is just shorter in these cases to merge the categories:

```
[BaseType (typeof (NSObject))]
interface SocialNetworking {
        [Export ("postToTwitter:")]
        void PostToTwitter (Message message);

        [Export ("postToFacebook:andPicture:")]
        void PostToFacebook (Message message, UIImage picture);
}
```

Binding Blocks

Blocks are a new construct introduced by Apple to bring the functional equivalent of C# anonymous methods to Objective-C. For example, the NSSet class now exposes this method:

```
- (void) enumerateObjectsUsingBlock:(void (^)(id obj, BOOL *stop) block
```

The above description declares a method called "*enumerateObjectsUsingBlock:*" that takes one argument named *block*. This block is similar to a C# anonymous method in that it has support for capturing the current environment (the "this" pointer, access to local variables and parameters). The above method in NSSet invokes the block with two parameters an NSObject (the "id obj" part) and a pointer to a boolean (the "BOOL *stop") part.

To bind this kind of API with btouch, you need to first declare the block type signature as a C# delegate and then reference it from an API entry point, like this:

```
// This declares the callback signature for the block:
delegate void NSSetEnumerator (NSObject obj, ref bool stop)

// Later, inside your definition, do this:
[Export ("enumerateObjectUsingBlock:")]
void Enumerate (NSSetEnumerator enum)
```

And now your code can call your function from C#:

```
var myset = new NSMutableSet ();
myset.Add (new NSString ("Foo"));

s.Enumerate (delegate (NSObject obj, ref bool stop){
    Console.WriteLine ("The first object is: {0} and stop is: {1}", obj, stop);
});
```

You can also use lambdas if you prefer:

```
var myset = new NSMutableSet 9) { Add (new NSString ("Foo")) };

s.Enumerate ((obj, stop) => {
    Console.WriteLine ("The first object is: {0} and stop is: {1}", obj, stop);
});
```

Type mappings

This section covers how Objective-C types are mapped to C# types.

Simple Types

The following table shows how you should map types from the Objective-C and CocoaTouch world to the Xamarin.iOS world:

Type mappings

Objective-C type name	Xamarin.iOS type
BOOL, GLboolean	bool
NSInteger	int
NSUInteger	uint
CFTimeInterval / NSTimeInterval	double
NSString (more on binding NSString)	string
char *	[PlainString] string
CGRect	System.Drawing.RectangleF
CGPoint	System.Drawing.PointF
CGSize	System.Drawing.SizeF
CGFloat, GLfloat	float
CoreFoundation types (CF*)	MonoTouch.CoreFoundation.CF*
GLint	int
GLfloat	float
Foundation types (NS*)	MonoTouch.Foundation.NS*
id	MonoTouch.Foundation.NSObject

NSGlyph	int
NSSize	System.Drawing.SizeF
NSTextAlignment	int
SEL	MonoTouch.ObjCRuntime.Selector
dispatch_queue_t	MonoTouch.CoreFoundation.DispatchQueue
NSGlyph	uint

Arrays

The Xamarin.iOS runtime automatically takes care of converting C# arrays to NSArrays and doing the conversion back, so for example the imaginary Objective-C method that returns an NSArray of UIViews:

```
// Get the peer views - untyped
- (NSArray *)getPeerViews ();

// Set the views for this container
- (void) setViews:(NSArray *) views
```

Is bound like this:

```
[Export ("getPeerViews")]
UIView [] GetPeerViews ();

[Export ("setViews:")]
void SetViews (UIView [] views);
```

The idea is to use a strongly typed C# array as this will allow the IDE to provide proper code completion with the actual type without forcing the user to guess, or look up the documentation to find out the actual type of the objects contained in the array.

In cases where you can not track down the actual most derived type contained in the array, you can use NSObject [] as the return value.

Selectors

Selectors appear on the Objective-C API as the special type "SEL". When binding a selector, you would map the type to MonoTouch.ObjCRuntime.Selector. Typically selectors are exposed in an API with both an object, the target object, and a selector to invoke in the target object. Providing both of these basically corresponds to the C# delegate: something that encapsulates both the method to invoke as well as the object to invoke the method in.

This is what the binding looks like:

```
interface Button {
   [Export ("setTarget:selector:")]
   void SetTarget (NSObject target, Selector sel);
}
```

And this is how the method would typically be used in an application:

```
class DialogPrint : UIViewController {
    void HookPrintButton (Button b)
    {
        b.SetTarget (this, new Selector ("print"));
    }

    [Export ("print")]
    void ThePrintMethod ()
    {
       // This does the printing
    }
}
```

To make the binding nicer to C# developers, you typically will provide a method that takes an NSAction parameter, which allows C# delegates and lambdas to be used instead of the Target+Selector. To do this you would typically hide the "SetTarget" method by flagging it with an "Internal" attribute and then you would expose a new helper method, like this:

```
// API.cs
interface Button {
   [Export ("setTarget:selector:"), Internal]
   void SetTarget (NSObject target, Selector sel);
}

// Extensions.cs
public partial class Button {
     public void SetTarget (NSAction callback)
     {
         SetTarget (new NSActionDispatcher (callback), NSActionDispatcher.Selector);
     }
}
```

So now your user code can be written like this:

```
class DialogPrint : UIViewController {
    void HookPrintButton (Button b)
    {
        // First Style
        b.SetTarget (ThePrintMethod);

        // Lambda style
        b.SetTarget (() => {  /* print here */ });
    }

    void ThePrintMethod ()
    {
       // This does the printing
    }
}
```

Strings

When you are binding a method that takes an NSString, you can replace that with a C# string type, both on return types and parameters.

The only case when you might want to use an NSString directly is when the string is used as a token. For more information about strings and NSString, read the API Design on NSString document.

In some rare cases, an API might expose a C-like string (char *) instead of an Objective-C string (NSString *). In those cases, you can annotate the parameter with the [PlainString] attribute.

out/ref parameters

Some APIs return values in their parameters, or pass parameters by reference.

Typically the signature looks like this::

```
- (void) someting:(int) foo withError:(NSError **) retError
- (void) someString:(NSObject **)byref
```

The first example shows a common Objective-C idiom to return error codes, a pointer to an NSError pointer is passed, and upon return the value is set. The second method shows how an Objective-C method might take an object and modify its contents. This would be a pass by reference, rather than a pure output value.

Your binding would look like this:

```
[Export ("something:withError:")]
void Something (int foo, out NSError error);
[Export ("someString:")]
void SomeString (ref NSObject byref);
```

Memory management attributes

When you use the [Export] attribute and you are passing data that will be retained by the called method, you can specify the argument semantics by passing it as a second parameter, for example:

[Export ("method", ArgumentSemantic.Retain)]

The above would flag the value as having the "Retain" semantics. The semantics available are:

- Assign:
- Copy:
- Retain:

Style Guidelines

Using [Internal]

You can use the [Internal] attribute to hide a method from the public API. You might want to do this in cases where the exposed API is too low-level and you want to provide a high-level implementation in a separate file based on this method.

You can also use this when you run into limitations in the binding generator, for example some advanced scenarios might expose types that are not bound and you want to bind in your own way, and you want to wrap those types yourself in your own way.

Event Handlers and Callbacks

Objective-C classes typically broadcast notifications or request information by sending a message on a delegate class (Objective-C delegate).

This model, while fully supported and surfaced by Xamarin.iOS can sometimes be cumbersome. Xamarin.iOS exposes the C# event pattern and a method-callback system on the class that can be used in these situations. This allows code like this to run:

```
button.Clicked += delegate {
    Console.WriteLine ("I was clicked");
};
```

The binding generator is capable of reducing the amount of typing required to map the Objective-C pattern into the C# pattern.

Starting with Xamarin.iOS 1.4 it will be possible to also instruct the generator to produce bindings for a specific Objective-C delegates and expose the delegate as C# events and properties on the host type.

There are two classes involved in this process, the host class which will is the one that currently emits events and sends those into the Delegate or WeakDelegate and the actual delegate class.

Considering the following setup:

```
[BaseType (typeof (NSObject))]
interface MyClass {
        [Export ("delegate", ArgumentSemantic.Assign)][NullAllowed]
        NSObject WeakDelegate { get; set; }

        [Wrap ("WeakDelegate")][NullAllowed]
        MyClassDelegate Delegate { get; set; }
}

[BaseType (typeof (NSObject))]
interface MyClassDelegate {
    [Export ("loaded:bytes:")]
    void Loaded (MyClass sender, int bytes);
}
```

To wrap the class you must:

- In your host class, add to your [BaseType] declaration the type that is acting as its delegate and the C# name that you exposed. In our example above those are "typeof (MyClassDelegate)" and "WeakDelegate" respectively.
- In your delegate class, on each method that has more than two parameters, you need to specify the type that you want to use for the automatically generated EventArgs class.

The binding generator is not limited to wrapping only a single event destination, it is possible that some Objective-C classes to emit messages to more than one delegate, so you will have to provide arrays to support this setup. Most setups will not need it, but the generator is ready to support those cases.

The resulting code will be:

```
[BaseType (typeof (NSObject),
    Delegates=new string [] {"WeakDelegate"},
```

```
    Events=new Type [] { typeof (MyClassDelegate) })]
interface MyClass {
        [Export ("delegate", ArgumentSemantic.Assign)][NullAllowed]
        NSObject WeakDelegate { get; set; }

        [Wrap ("WeakDelegate")][NullAllowed]
        MyClassDelegate Delegate { get; set; }
}

[BaseType (typeof (NSObject))]
interface MyClassDelegate {
        [Export ("loaded:bytes:"), EventArgs ("MyClassLoaded")]
        void Loaded (MyClass sender, int bytes);
}
```

The EventArgs is used to specify the name of the EventArgs class to be generated. You should use one per signature (in this example, the EventArgs will contain a "With" property of type int).

With the definitions above, the generator will produce the following event in the generated MyClass:

```
public MyClassLoadedEventArgs : EventArgs {
        public MyClassLoadedEventArgs (int bytes);
        public int Bytes { get; set; }
}

public event EventHandler<MyClassLoadedEventArgs> Loaded {
        add; remove;
}
```

So you can now use the code like this:

```
MyClass c = new MyClass ();
c.Loaded += delegate (sender, args){
        Console.WriteLine ("Loaded event with {0} bytes", args.Bytes);
};
```

Callbacks are just like event invocations, the difference is that instead of having multiple potential subscribers (for example, multiple methods can hook into a "Clicked" event or a "Download Finished" event) callbacks can only have a single subscriber.

The process is identical, the only difference is that instead of exposing the name of the EventArgs class that will be generated, the EventArgs actually is used to name the resulting C# delegate name.

If the method in the delegate class returns a value, the binding generator will map this into a delegate method in the parent class instead of an event. In these cases you need to provide the default value that should be returned by the method if the user does not hook up to the delegate. You do this using the [DefaultValue] or [DefaultValueFromArgument] attributes.

DefaultValue will hardcode a return value, while [DefaultValueFromArgument] is used to specify which input argument will be returned.

Enumerations and Base Types

You can also reference enumerations or base types that are not directly supported by the btouch interface definition system. To do this, put your enumerations and core types into a separate file and include this as part of one of the extra files that you provide to btouch.

Linking the Dependencies

If you are binding APIs that are not part of your application, you need to make sure that your executable is linked against these libraries.

You need to inform Xamarin.iOS how to link your libraries, this can be done either by altering your build configuration to invoke the mtouch command with some extra build arguments that specify how to link with the new libraries using the "-gcc_flags" option, followed by a quoted string that contains all the extra libraries that are required for your program, like this:

```
-gcc_flags "-L${ProjectDir} -lMylibrary -force_load -lSystemLibrary -framework CFNetwork -ObjC"
```

The above example will link libMyLibrary.a, libSystemLibrary.dylib and the CFNetwork framework library into your final executable.

Or you can take advantage of the assembly-level LinkWithAttribute, that you can embed in your contract files (such as AssemblyInfo.cs). When you use the LinkWithAttribute, you will need to have your native library available at the time you make your binding, as this will embed the native library with your application. For example:

```
// Specify only the library name as a constructor argument and specify everything else with properties:
[assembly: LinkWith ("libMyLibrary.a", LinkTarget = LinkTarget.ArmV6 | LinkTarget.ArmV7 | LinkTarget.Simulator,
ForceLoad = true, IsCxx = true)]

// Or you can specify library name *and* link target as constructor arguments:
[assembly: LinkWith ("libMyLibrary.a", LinkTarget.ArmV6 | LinkTarget.ArmV7 | LinkTarget.Simulator, ForceLoad =
true, IsCxx = true)]
```

You might be wondering, why do you need "force_load" command, and the reason is that the -ObjC flag although it compiles the code in, it does not preserve the metadata required to support categories (the linker/compiler dead code elimination strips it) which you need at runtime for Xamarin.iOS.

Assisted References

Some transient objects like action sheets and alert boxes are cumbersome to keep track of for developers and the binding generator can help a little bit here.

For example if you had a class that showed a message and then generated a "Done" event, the traditional way of handling this would be:

```
class Demo {
    MessageBox box;

    void ShowError (string msg)
    {
        box = new MessageBox (msg);
        box.Done += { box = null; ... };
    }
}
```

In the above scenario the developer needs to keep the reference to the object himself and either leak or actively clear the reference for box on his own. While binding code, the generator supports keeping track of the reference for you and clear it when a special method is invoked, the above code would then become:

```
class Demo {
    void ShowError (string msg)
    {
        var box = new MessageBox (msg);
        box.Done += { ... };
    }
}
```

Notice how it is no longer necessary to keep the variable in an instance, that it works with a local variable and that it is not necessary to clear the reference when the object dies.

To take advantage of this, your class should have a Events property set in the [BaseType] declaration and also the KeepUntilRef variable set to the name of the method that is invoked when the object has completed its work, like this:

```
[BaseType (typeof (NSObject), KeepUntilRef="Dismiss"), Delegates=new string [] { "WeakDelegate" }, Events=new
Type [] { typeof (SomeDelegate) }) ]
class Demo {
    [Export ("show")]
    void Show (string message);
}
```

Inheriting Protocols

As of Xamarin.iOS v3.2, we support inheriting from protocols that have been marked with the [Model] property. This is useful in certain API patterns, such as in MapKit where the MKOverlay protocol, inherits from the MKAnnotation protocol, and is adopted by a number of classes which inherit from NSObject.

Historically we required copying the protocol to every implementation, but in these cases now we can have the MKShape class inherit from the MKOverlay protocol and it will generate all the required methods automatically.

Source URL: http://docs.xamarin.com/guides/ios/advanced_topics/binding_objective-c_libraries