# Build MAUI control for AutoNavi map - Android Native Binding

We have already introduced how to bind the iOS native library through .NET, this article begins to introduce how to bind the Android native library through .NET.

Android Libraries

Android libraries are packaged in .jars. With tools, you can bind multiple .jars, and then call native Java libraries through C#. Compared to iOS, Android's library binding is much simpler.
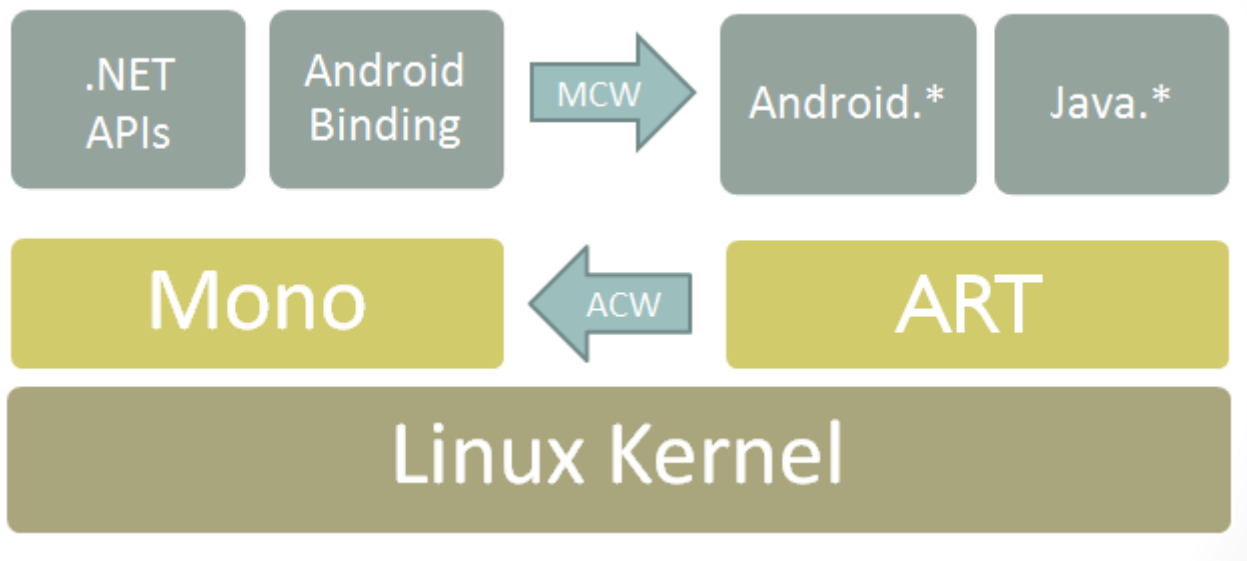

As you can see from the image above, Xamarin.Android / .NET for Android implements the binding by using a Managed Callable Wrapper (MCW). MCW is a JNI bridge that is used when managed code needs to call Java code. Managed callable wrappers also support subclassing Java types and overriding virtual methods of Java types. Likewise, whenever Android Runtime (ART) code needs to call managed code, it does so through another JNI bridge called the Android Callable Wrapper (ACW).

Create an Android native library binding project

Create an Android native library binding project from the command line

```
dotnet new android-bindinglib -o Droid.AMap
```

Enter the project and let's take a look at the file structure
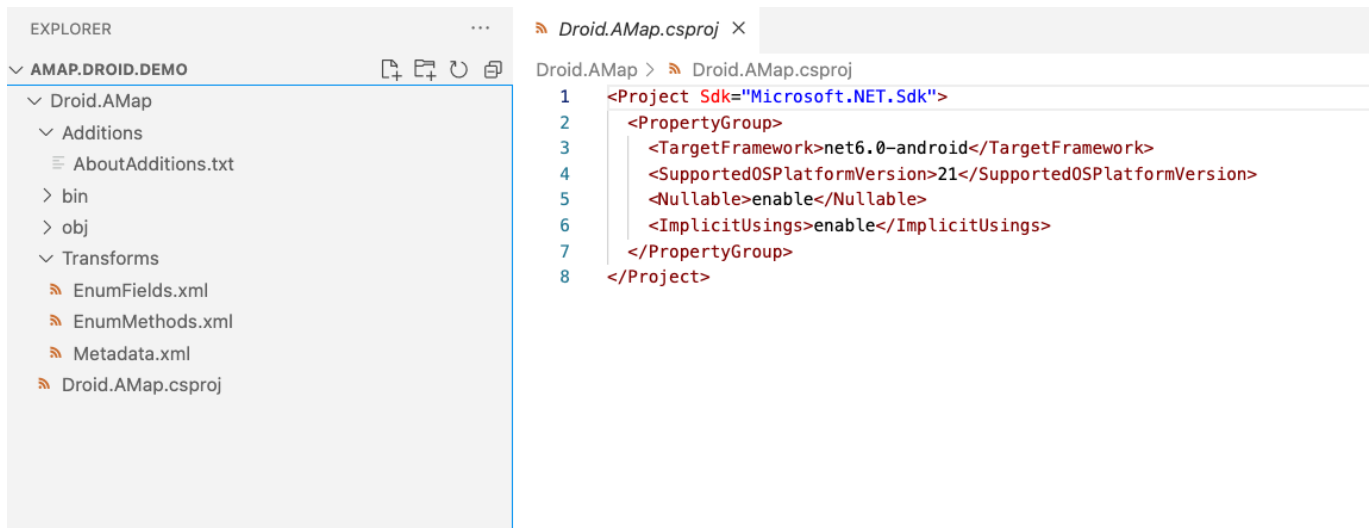
There are three corresponding xml files in the Transforms folder in the project, namely EnumFields.xml , EnumMethods.xml , Metadata.xml , their functions are as follows:

MetaData.xml – Allows changes to the final API, such as changing the namespace of the generated bindings.

EnumFields.xml – Contains mappings between Java int constants and C# enums.

EnumMethods.xml – allows changing method parameters and return types from Java int constants to C# enums

The MetaData.xml file is the most common import of these files, as it allows general-purpose changes to bindings, such as:

Rename namespaces, classes, methods, or fields to follow .NET conventions.

Delete unneeded namespaces, classes, methods or fields.

Move classes to different namespaces.

Add additional support classes to make the design of the binding follow the .NET Framework pattern.

Add the jar file to the binding project

Add the Jars directory to the project, add the jar package of the Gaode map to this directory, and add the three directories arm64-v8a, armeabi-v7a, x86_64 to it
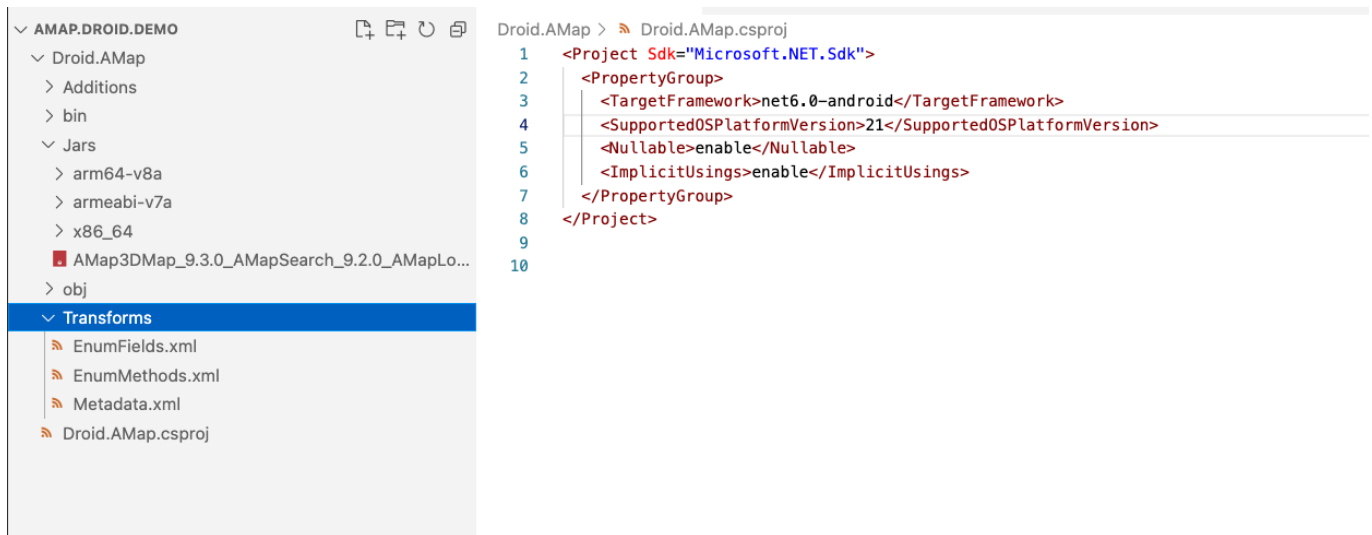
changed .csproj file

```
<Project Sdk="Microsoft.NET.Sdk">
  <PropertyGroup>
    <TargetFramework>net6.0-android</TargetFramework>
    <SupportedOSPlatformVersion>21</SupportedOSPlatformVersion>
    <Nullable>enable</Nullable>
    <ImplicitUsings>enable</ImplicitUsings>
  </PropertyGroup>
  <ItemGroup>
    <EmbeddedNativeLibrary Include="Jars\arm64-
v8a\libAMapSDK_MAP_v9_3_0.so" />
    <EmbeddedNativeLibrary Include="Jars\armeabi-
v7a\libAMapSDK_MAP_v9_3_0.so" />
    <EmbeddedNativeLibrary Include="Jars\x86_64\libAMapSDK_MAP_v9_3_0.so"
/>
  </ItemGroup>
  <ItemGroup>
    <TransformFile Include="Transforms\Metadata.xml" />
    <TransformFile Include="Transforms\EnumFields.xml" />
    <TransformFile Include="Transforms\EnumMethods.xml" />
  </ItemGroup>
  <ItemGroup>
    <EmbeddedJar
Include="Jars\AMap3DMap_9.3.0_AMapSearch_9.2.0_AMapLocation_6.1.0_20220608
.jar" />
  </ItemGroup>
</Project>
```

In this way, the project is added, and it is not as cumbersome as the iOS native library binding. Then compile it, Errors!!!

```
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptions.cs(845,87): error CS0507: 'PolylineOp
tions.UpdateFlags': cannot change access modifiers when overriding 'protected' inherited member 'BaseOptions.UpdateFlags' [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droi
d.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileOverlayOptionsCreator.cs(10,77): error CS0738: 'T
ileOverlayOptionsCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'TileOverlayOptionsCreator.CreateFromParcel(Parcel?)' can
not implement 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Dr
oid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileOverlayOptionsCreator.cs(10,77): error CS0738: 'T
ileOverlayOptionsCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'TileOverlayOptionsCreator.NewArray(int)' cannot implement 'IParcelab
leCreator.NewArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileProjectionCreator.cs(10,73): error CS0738: 'TileP
rojectionCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'TileProjectionCreator.CreateFromParcel(Parcel?)' cannot implemen
t 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Dro
id.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileProjectionCreator.cs(10,73): error CS0738: 'TileP
rojectionCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'TileProjectionCreator.NewArray(int)' cannot implement 'IParcelableCreator.Ne
wArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptionsCreator.cs(10,74): error CS0738: 'Poly
lineOptionsCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'PolylineOptionsCreator.CreateFromParcel(Parcel?)' cannot imple
ment 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/
Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptionsCreator.cs(10,74): error CS0738: 'Poly
lineOptionsCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'PolylineOptionsCreator.NewArray(int)' cannot implement 'IParcelableCreator
.NewArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.VisibleRegionCreator.cs(10,72): error CS0738: 'Visibl
eRegionCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'VisibleRegionCreator.CreateFromParcel(Parcel?)' cannot implement '
IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.
AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.VisibleRegionCreator.cs(10,72): error CS0738: 'Visibl
eRegionCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'VisibleRegionCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewAr
ray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PoiCreator.cs(10,62): error CS0738: 'PoiCreator' does
 not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'PoiCreator.CreateFromParcel(Parcel?)' cannot implement 'IParcelableCreator.CreateFromP
arcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PoiCreator.cs(10,62): error CS0738: 'PoiCreator' does
 not implement interface member 'IParcelableCreator.NewArray(int)'. 'PoiCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewArray(int)' because it does not
have the matching return type of 'Object[]'. [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
    136 Warning(s)
    65 Error(s)
```

Repair

Seeing so many mistakes, I really have to consider whether to give up. In fact, this is also very healing. Let's clear the mines one by one.

*__'PoiCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'.__
__'PoiCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewArray(int)'__

The error corresponds to this method. In fact, the return type is wrong. We can solve it by looking at the path path according to the source file.

```
// Metadata.xml XPath method reference:
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PoiCreato
r']/method[@name='newArray' and count(parameter)=1 and parameter[1]
[@type='int']]"
[Register ("newArray", "(I)[Lcom/amap/api/maps/model/Poi;",
"GetNewArray_IHandler")]
public virtual unsafe global::Com.Amap.Api.Maps.Model.Poi[]? NewArray (int
p0)
{
    const string __id = "newArray.(I)[Lcom/amap/api/maps/model/Poi;";
    try {
            JniArgumentValue* __args = stackalloc JniArgumentValue [1];
            __args [0] = new JniArgumentValue (p0);
            var __rm = _members.InstanceMethods.InvokeVirtualObjectMethod
(__id, this, __args);
            return (global::Com.Amap.Api.Maps.Model.Poi[]?)
JNIEnv.GetArray (__rm.Handle, JniHandleOwnership.TransferLocalRef, typeof
(global::Com.Amap.Api.Maps.Model.Poi));
        } finally {
    }
```

```
    }
```

After confirmation, you need to add it in Metadata.xml

```
<attr
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PoiCreato
r']/method[@name='newArray' and count(parameter)=1 and parameter[1]
[@type='int']]" name="managedReturn">Java.Lang.Object[]</attr>
```

__The type 'AMap' already contains a definition for 'MarkerDragEnd'__

This is caused by repeated definitions, just add the following code to delete, such as

```
  <remove-node
path="/api/package[@name='com.amap.api.maps']/interface[@name='AMap.OnCame
raChangeListener']" />
```

__'BusLineSearch': member names cannot be the same as their enclosing type__

Errors caused by renaming, just change the name, such as

```
<attr
path="/api/package[@name='com.amap.api.services.busline']/class[@name='Bus
LineSearch']" name="managedName">AmapBusLineSearch</attr>
```

__cannot change access modifiers when overriding 'protected'__

There is a permission problem when reloading. At this time, you need to correct the permissions, such as

```
<attr
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PolygonOp
tions']/method[@name='getUpdateFlags' and count(parameter)=0]"
name="visibility">protected</attr>
```

Solve all the above problems, basically you can cure, you will be very excited when the compilation passes

```
[/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(222,48): warning CS0618: 'NearbySearch' is obsolete: 'This class is obsoleted in this android platform'
[/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(235,51): warning CS0618: 'NearbySearchResult' is obsolete: 'This class is obsoleted in this android plat
form' [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(251,48): warning CS0618: 'NearbySearch' is obsolete: 'This class is obsoleted in this android platform'
[/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(307,107): warning CS0618: 'IUploadInfoCallback' is obsolete: 'This class is obsoleted in this android pl
atform' [ Open file in editor (cmd + click) roid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/l [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj] /Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(307,14): warning CS0618: 'IUploadInfoCallback' is obsolete: 'This class is obsoleted in this android pla
tform' [/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Services.Interfaces.INearbySearch.cs(359,48): warning CS0618: 'UploadInfo' is obsolete: 'This class is obsoleted in this android platform' [/
Users/lokinfey/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
    513 Warning(s)
    0 Error(s)

Time Elapsed 00:00:08.16
(base) → Droid.AMap ▊
```

Build .NET for Android

You can go to my GitHub to download the sample
https://github.com/kinfey/AMapMAUIControls/tree/main/samples/Droid.Bindings

Summary

Android's native bindings are much simpler than iOS's, so it's easier to get started. I hope you guys can do more, sometimes it's a good experience. After two articles, I believe that everyone has mastered how to use .NET to bind the native libraries of iOS and Android. In the last article, let's discuss how to make a native control that adapts to MAUI

More

1. Learn about MAUI through Microsoft Docs https://aka.ms/Docs.MAUI
2. Learn MAUI through Microsoft Learn https://aka.ms/Learn.MAUI
3. To use Amap SDK for Android, please visit https://developer.amap.com/api/android-sdk/gettingstarted
4. To learn about Android native library bindings, visit https://docs.microsoft.com/en-us/xamarin/android/platform/binding-java-library/