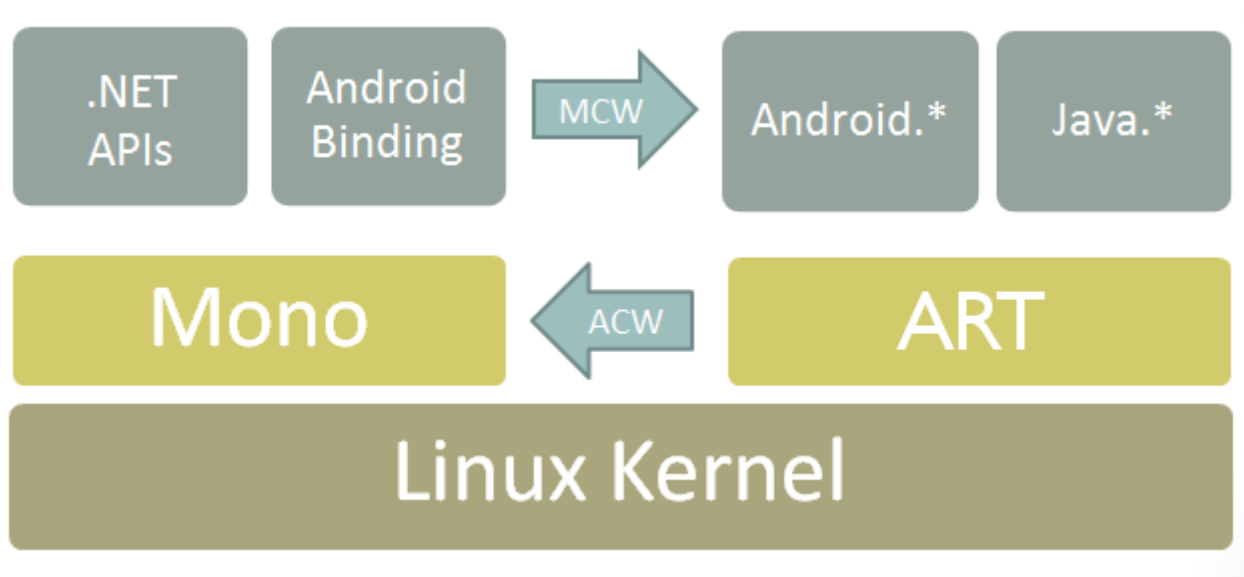


# 做一个高德地图的 iOS / Android MAUI 控件(Android 原生库绑定)

我们已经介绍了如何通过 .NET 绑定 iOS 原生库，本篇开始介绍一下如何通过 .NET 绑定 Android 原生库。

## Android 的库

Android 的库以 .jar 做打包，通过工具你可以将多个 .jar 完成绑定，然后通过 C# 调用原生的 Java 库。对比起 iOS，Android 的库绑定简单很多。



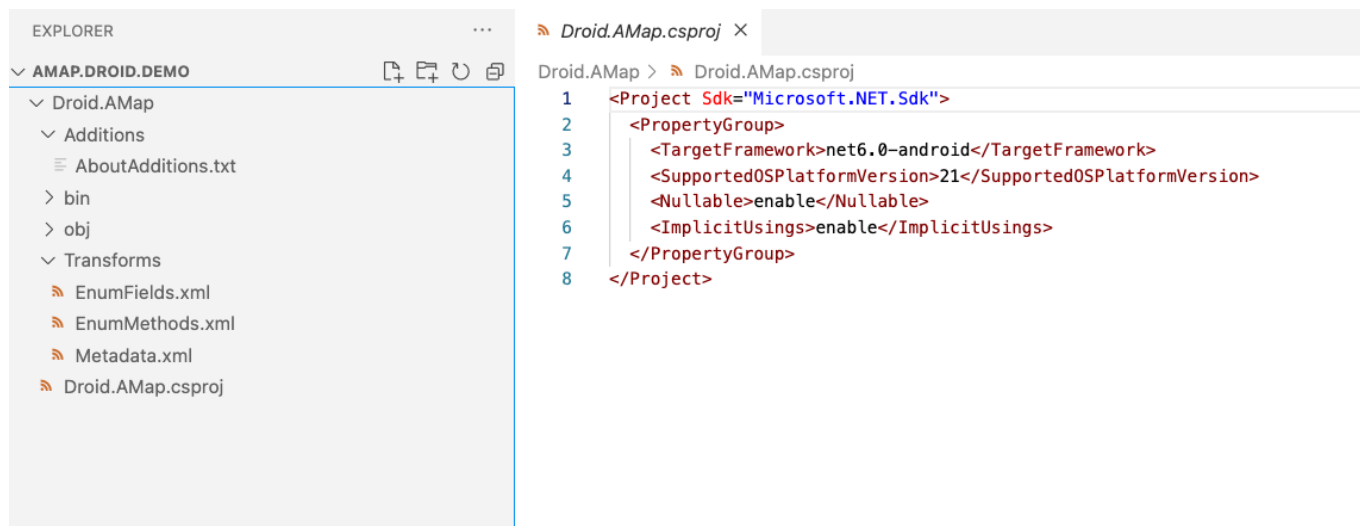
从上图可以看到 Xamarin.Android / .NET for Android 通过使用托管可调用包装器 (MCW) 实现绑定。MCW 是一个 JNI 桥，在托管代码需要调用 Java 代码时会使用它。托管可调用包装器还支持对 Java 类型进行子类化以及覆盖 Java 类型的虚拟方法。同样，每当 Android 运行时 (ART) 代码需要调用托管代码时，它都会通过另一个称为 Android 可调用包装器 (ACW) 的 JNI 桥来实现。

## 创建一个 Android 原生库绑定项目

通过命令行创建一个 Android 原生库绑定项目

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

进入该项目我们看看文件结构



项目里面有 Transforms 文件夹有对应的三个 xml 文件，分别是 EnumFields.xml，EnumMethods.xml，Metadata.xml，各自作用如下：

**Metadata.xml** – 允许对最终 API 进行更改，例如更改生成的绑定的命名空间。

**EnumFields.xml** – 包含 Java int 常量与 C# enums 之间的映射。

**EnumMethods.xml** – 允许将方法参数和返回类型从 Java int 常量更改为 C# enums

其中 Metadata.xml 文件是这些文件中的最常见的导入，因为它允许对绑定进行一般用途的更改，例如：

重命名命名空间、类、方法或字段，使其遵循 .NET 约定。

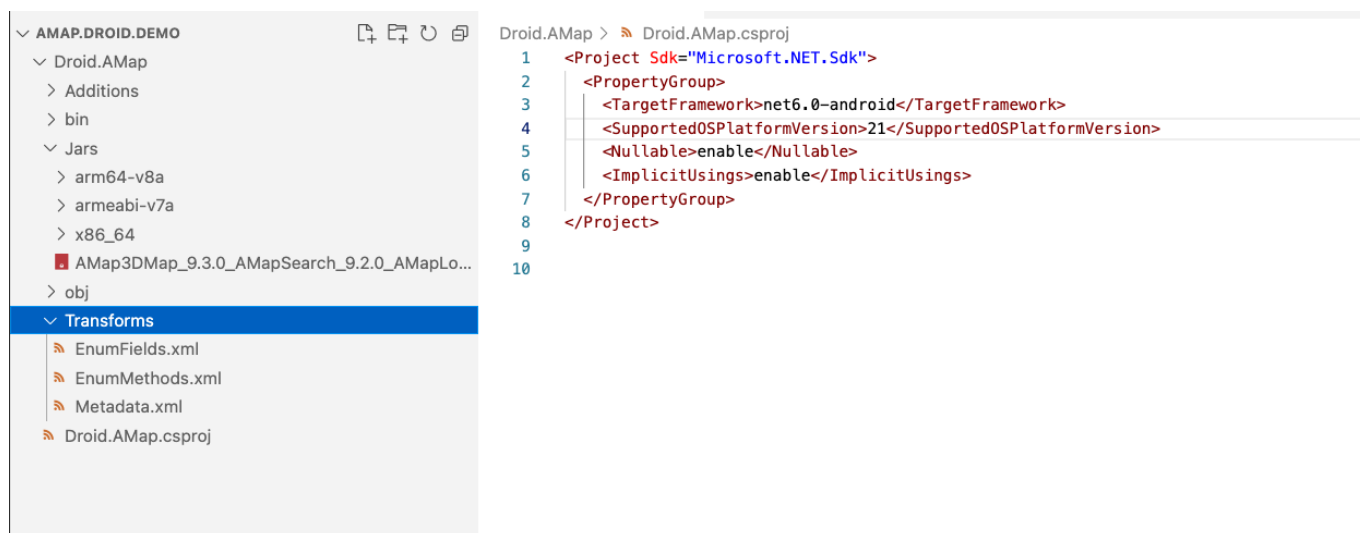
删除不需要的命名空间、类、方法或字段。

将类移到不同的命名空间。

添加其他支持类以使绑定的设计遵循 .NET 框架模式。

### 把 jar 文件添加到绑定项目

在项目中添加 Jars 目录，把高德地图的 jar 包添加到该目录下，并把 arm64-v8a，armeabi-v7a，x86\_64 这三个目录添加进来



添加完成后，修改 .csproj 文件

```
<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>
```

这样就把项目添加好了，没有像 iOS 原生库绑定那么繁琐。然后编译一下，凡尔赛 + 星辰大海了

```
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptions.cs(845,87): error CS0507: 'PolylineOptions.UpdateFlags': cannot change access modifiers when overriding 'protected' inherited member 'BaseOptions.UpdateFlags' [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileOverlayOptionsCreator.cs(10,77): error CS0738: 'TileOverlayOptionsCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'TileOverlayOptionsCreator.CreateFromParcel(Parcel?)' cannot implement 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileOverlayOptionsCreator.cs(10,77): error CS0738: 'TileOverlayOptionsCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'TileOverlayOptionsCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileProjectionCreator.cs(10,73): error CS0738: 'TileProjectionCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'TileProjectionCreator.CreateFromParcel(Parcel?)' cannot implement 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.TileProjectionCreator.cs(10,73): error CS0738: 'TileProjectionCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'TileProjectionCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptionsCreator.cs(10,74): error CS0738: 'PolylineOptionsCreator' does not implement interface member 'IParcelableCreator.CreateFromParcel(Parcel?)'. 'PolylineOptionsCreator.CreateFromParcel(Parcel?)' cannot implement 'IParcelableCreator.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.PolylineOptionsCreator.cs(10,74): error CS0738: 'PolylineOptionsCreator' 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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.VisibleRegionCreator.cs(10,72): error CS0738: 'VisibleRegionCreator' 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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/obj/Debug/net6.0-android/generated/src/Com.Amap.Api.Maps.Model.VisibleRegionCreator.cs(10,72): error CS0738: 'VisibleRegionCreator' does not implement interface member 'IParcelableCreator.NewArray(int)'. 'VisibleRegionCreator.NewArray(int)' cannot implement 'IParcelableCreator.NewArray(int)' because it does not have the matching return type of 'Object[]'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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.CreateFromParcel(Parcel?)' because it does not have the matching return type of 'Object'. [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
136 Warning(s)
65 Error(s)
```

## 排雷工作

看见这么多错，真的要考虑一下是不是放弃，其实这也非常治愈，我们逐个来排雷。

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

错误对应的是这个方法,实际就是返回类型出错了,我们先根据源文件看看 path 路径就可以解决

```
// Metadata.xml XPath method reference:
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PoiCreator']/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 {
    }
}
```

确认好后，需要在 Metadata.xml 做添加

```
<attr
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PoiCreator']/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'***

这个是重复定义导致的，只需要添加如下代码删除就可以了，如

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

**\*'BusLineSearch': member names cannot be the same as their enclosing type**

重命名导致的错误，把名字修改一下即可，如

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

**\*cannot change access modifiers when overriding 'protected'**

重载的时候出现权限问题，这个时候你需要的是把权限修正好，如

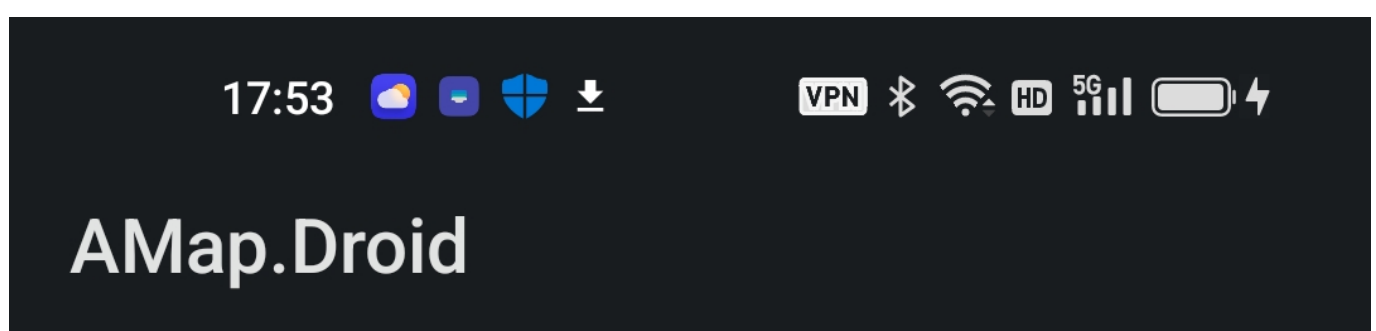
```
<attr
path="/api/package[@name='com.amap.api.maps.model']/class[@name='PolygonOptions']/method[@name='getUpdateFlags' and count(parameter)=0]"
name="visibility">protected</attr>
```

解决上述的所有问题，基本上就可以治愈了，当编译通过一刻你会非常兴奋

```
[/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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 platform' [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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 platform' [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/Desktop/AMap.Droid.Demo/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 platform' [/Users/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
/Users/lokinfe/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/lokinfe/Desktop/AMap.Droid.Demo/Droid.AMap/Droid.AMap.csproj]
513 Warning(s)
0 Error(s)

Time Elapsed 00:00:08.16
(base) -> Droid.AMap
```

## 找个 .NET for Android 项目看看









大家可以去我的 GitHub 下载该示例

<https://github.com/kinfey/AMapMAUIControls/tree/main/samples/Droid.Bindings>

## 小结

Android 的原生绑定比 iOS 的简单得多，所以更容易入手。希望各位小伙伴能多动手，有时候也是一个很好的体验。经过两篇文章的学习，相信大家也掌握了如何用 .NET 绑定 iOS 和 Android 的原生库了。最后一篇文章我们来讨论下如何做一个适配 MAUI 的原生控件

## 相关资料

1. 通过 Microsoft Docs 了解 MAUI <https://aka.ms/Docs.MAUI>
2. 通过 Microsoft Learn 学习 MAUI <https://aka.ms/Learn.MAUI>
3. 使用高德地图 SDK for Android 请访问 <https://developer.amap.com/api/android-sdk/gettingstarted>
4. 了解 Android 原生库绑定的内容，请访问 <https://docs.microsoft.com/en-us/xamarin/android/platform/binding-java-library/>