Esri Developer Summit

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QML and JavaScript for Native App Development

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Agenda

- Native apps. Why?
- Overview of Qt and QML
- How to use JavaScript skills to build native apps

Web vs Native vs Hybrid

Why build native apps?

Why build native apps?

- Work online & offline
- Access hardware and sensors
  - GPS, camera, Bluetooth, NFC, etc
- Great performance
- Publish apps to stores

The challenge

- Lots of platforms
- Lots of devices
- Unique development patterns
  - Languages
  - Frameworks
  - IDEs
  - Workflows

Swift

Objective C

MacBook

iOS

iPhone

Windows Desktop

XCode

Mac OS X

iPad

Java

Cocoa

Windows

Android

Galaxy S 5

.NET

Nexus 10

Visual Studio

Surface

Android Studio

C#

Eclipse

Linux

Windows Universal

Embedded

Gradle

You can build *native* apps

with your **JavaScript** skills… and Qt!

What is Qt and QML?

And how is it related to JavaScript?

Qt and QML

- Cross platform framework
- Build native apps
- Same source code compiled for each platform
- Powered by C++ on the backend (very fast)
- Exposed through QML (based on JavaScript)
- ArcGIS Runtime SDK for Qt
  - Mapping API provided by Esri
  - Brings the power of ArcGIS to your devices

The Qt Company

QML

Highly readable JSON/CSS-like syntax

Declarative UI elements

Imperative JavaScript Code to handle events

```
Rectangle {
    anchors.fill: parent

    Map {
        id: map
        anchors.fill: parent

        ArcGISTiledMapServiceLayer {
            url: "http://server.arcgisonline.com/ArcGIS/rest/services/World_Street_Map/MapServer"
        }
    }

    Button {
        anchors {
            left: parent.left
            top: parent.top
        }
        text: "Zoom to U.S."
        enabled: map.status === Enums.MapStatusReady
        onClicked: {
            var extent = {"xmin":-16780134,"ymin":-195554,
                          "xmax":-4566023,"ymax":8472000,
                          "spatialReference":{"wkid":3857}};
            map.zoomTo(extent);
        }
    }
}
```

ArcGIS Runtime

Dynamic property binding

JavaScript & QML

- If you understand JSON and JavaScript, this will come naturally
- Call JavaScript functions from QML
- Bind properties to JavaScript expressions
- Implements 5th edition of ECMA-262
- Access to the language standard types and functions
  - Object, Array, Math, and Date.
- JS is integrated in Qt Creator IDE
  - Intellisense in IDE
  - qmllint syntax tool
- Major Differences from the browser?
  - No DOM or window object
  - No Dojo, jQuery, or other frameworks

JavaScript Expressions

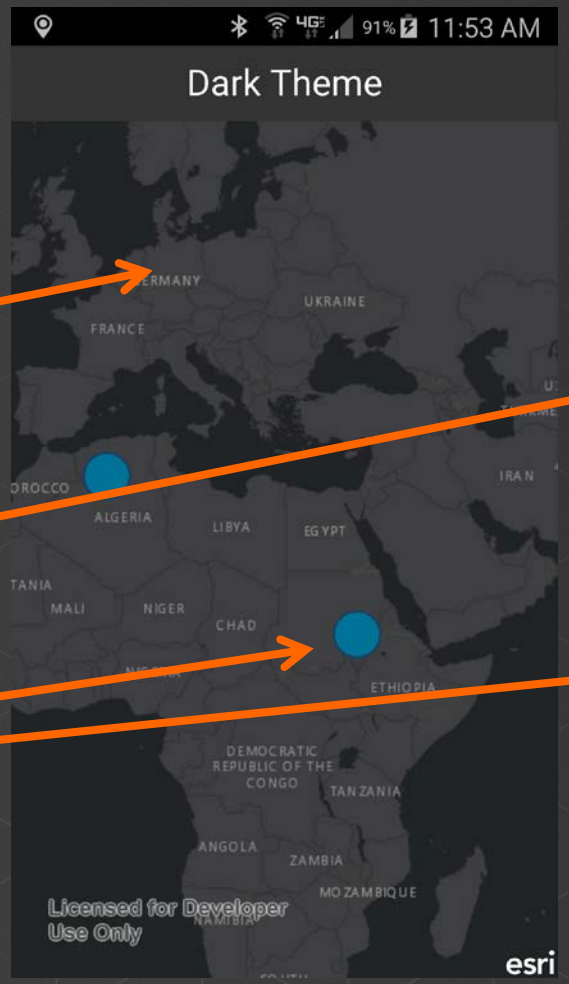
JavaScript expressions

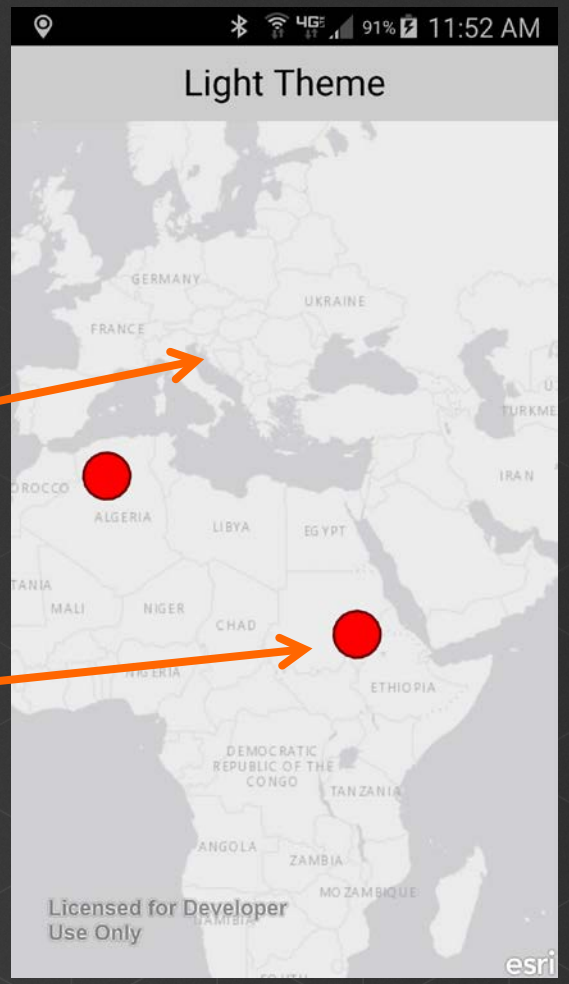
- Bind properties to JS expressions
- Update UI automatically
- Any JS expression (no matter how complex) may be used in a property binding definition
- ex: Change UI depending on ambient light

```
ArcGISTiledMapServiceLayer {
    url: darkGrayBasemapUrl
    visible: !isAmbientLightBright
}

ArcGISTiledMapServiceLayer {
    url: lightGrayBasemapUrl
    visible: isAmbientLightBright
}

GraphicsLayer {
    id: graphicsLayer
    renderer: isAmbientLightBright ? lightRenderer : darkRenderer
}
```





Updating the UI Automatically with Ambient Light Sensor

JavaScript Functions

JavaScript functions

- QML is declarative, but… You can (and will need to) call JavaScript functions from QML
  - Declare a visual component in QML (e.g. Button)
  - Write imperative JavaScript code to respond to an event
- “var” basic type used in functions (same as JavaScript var)
  - Can store numbers, strings, objects, arrays and functions
- Syntax based off ECMAScript 5th edition
  - Object, Array, Math, and Date
  - Syntax for if statements, switch statements, ternary operators, for loops, while loops, and more are no different than using JavaScript in the browser

JavaScript functions

function declaration

for loop

Conditionals and comparisons

console.log

function invocation

```
function logInfo(callback) {
    var theArray = [];
    var theDate = new Date();

    for (var i = 0; i < 10; i++) {
        if (i !== 5)
            theArray.push("Item " + i);
    }

    console.log("There are", theArray.length, "items in the array");
    console.log("The time is", theDate.toUTCString());
    console.log("The square root of 9 is:", Math.sqrt(9));

    callback();
}

Component.onCompleted: {
    logInfo(function() { console.log("callback fired") });
}
```

JavaScript Array

JavaScript Date

JavaScript Math

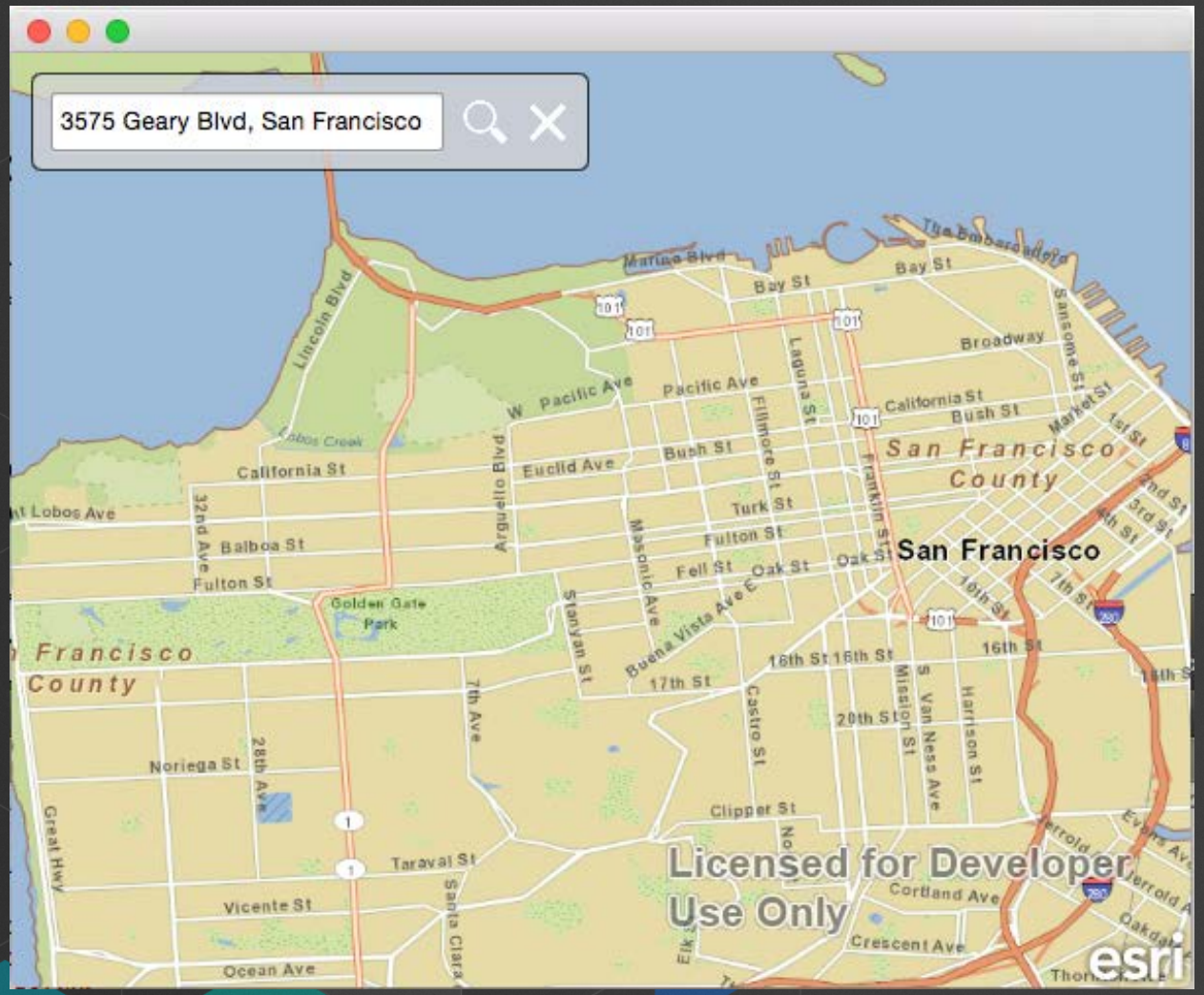
Callback function

Asynchronous Programming with QML

Async programming with QML

- Signal and Handler Event System
- The event is a *signal* (ex: mouseClicked)
- The signal is responded to through a *signal handler*
  - Signal handler is the name of the signal with the “on” prefix (ex: onMouseClicked)
  - Write JavaScript to perform some procedure when a signal is emitted

```
Map {
    // handle the mouseClicked signal on map with onMouseClicked handler
    onMouseClicked: {
        console.log("you clicked at", mouse.mapX, mouse.mapY);
    }
```



Using async JS functions for offline geocoding

Leveraging external JavaScript resources

Importing standalone JavaScript

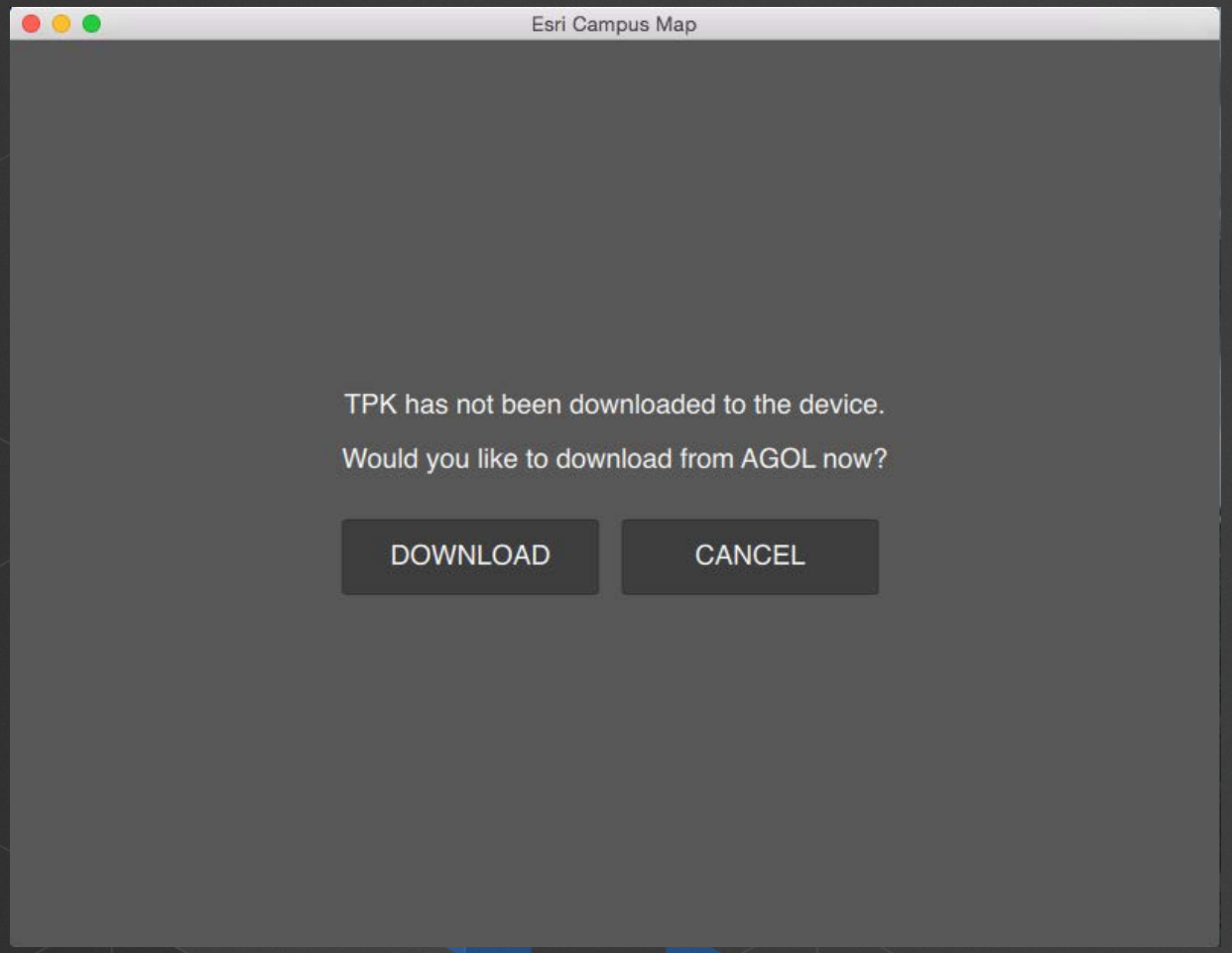
- Separate non-trivial logic into external JavaScript files
- Make your code reusable
- How?
- Place your functions inside a .js file
- Import to QML files with import statement:

```
import "../Resources/DataDownload.js" as JS_Download
```

- Execute your external functions from QML

```
JS_Download.downloadData(dataNeeded);
```

- Include external JavaScript files from other JavaScript files with Qt.include()



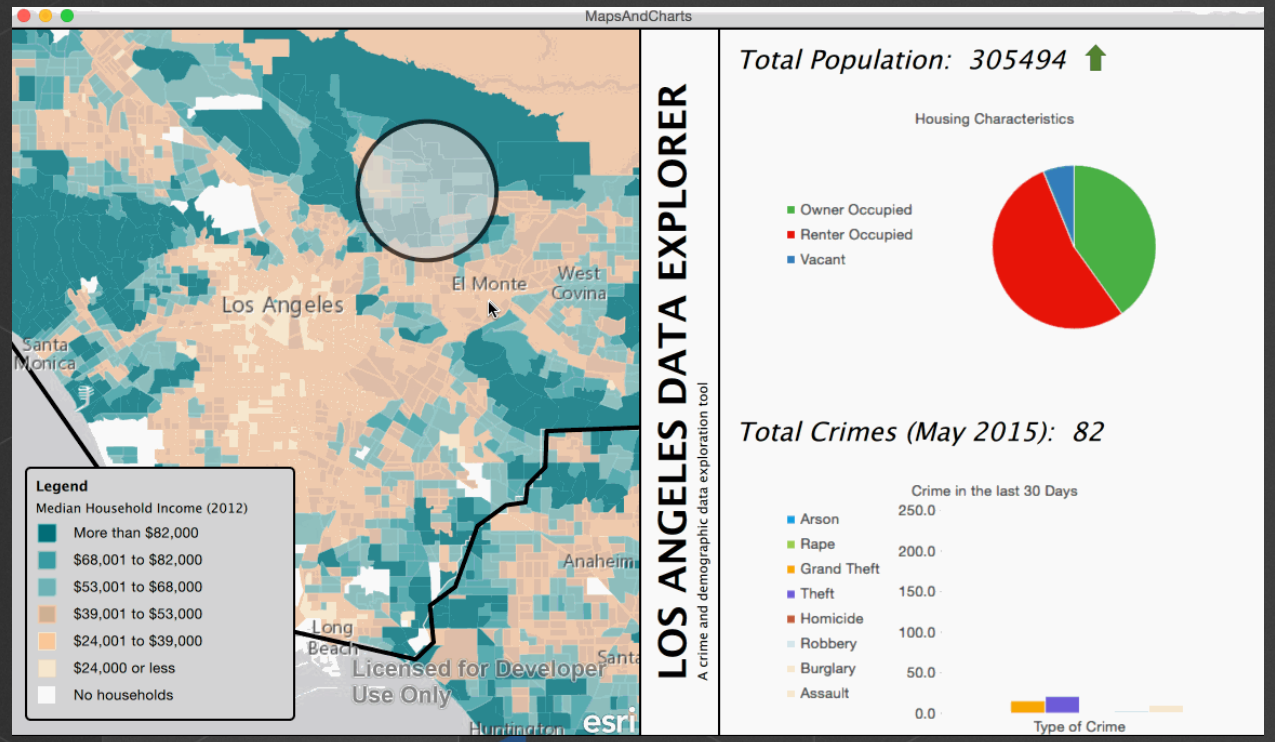
Downloading items from ArcGIS Online for offline use

QML Canvas

QML Canvas

- 2D and a 3D canvas item
  - Enables drawing via JavaScript
- Allows drawing of:
  - straight and curved lines
  - simple and complex shapes
  - graphs
  - referenced graphic images
- Convert HTML5 Canvas to QML
  - ex: charts.js
  - See [Canvas QML Type](#) doc

```
ctx.beginPath();
ctx.moveTo(75,40);
ctx.bezierCurveTo(75,37,70,25,50,25);
ctx.bezierCurveTo(20,25,20,62.5,20,62.5);
ctx.bezierCurveTo(20,80,40,102,75,120);
ctx.bezierCurveTo(110,102,130,80,130,62.5);
ctx.bezierCurveTo(130,62.5,130,25,100,25);
ctx.bezierCurveTo(85,25,75,37,75,40);
ctx.closePath();
```



charts.js in QML using QML Canvas

How is Esri using QML?

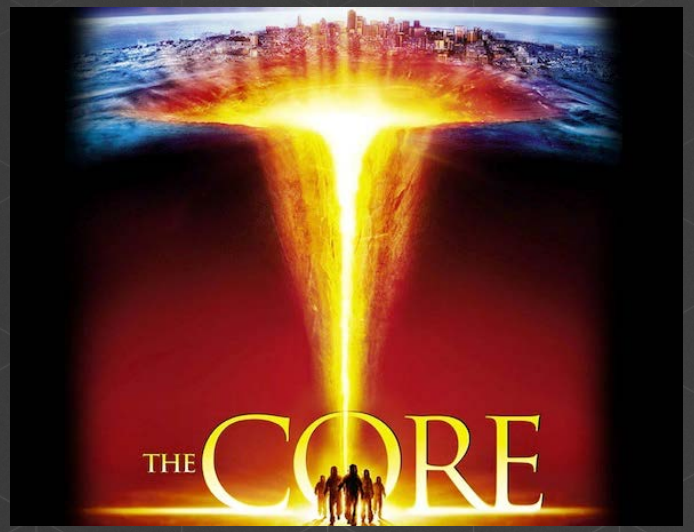
Esri & QML

ArcGIS Runtime SDK for Qt

AppStudio for ArcGIS

Survey 123

Runtime Core (for testing)



How to get started?

- Visit the Developer’s page – http://developers.arcgis.com/qt
- Download the sample viewer
- Install Qt and ArcGIS Runtime, and start building apps!
- Talk to us on GeoNet, Slack, Twitter, etc
- Come visit us at the showcase!

Recap

- Native apps. Why?
- Overview of Qt and QML
- How to use JS skills to build native apps
  - Property binding with JavaScript expressions
  - JavaScript functions
  - External JavaScript resources
  - Canvas

Related sessions

- Developing Cross-Platform Native Apps with AppStudio for ArcGIS (Advanced)
  - Wednesday 4:00 – 5:00 pm in Primrose A
- Cross-platform Native App Development with Qt/QML
  - Thursday 2:30 – 3:30 pm in Demo Theater 3
- Extending the Survey123 for ArcGIS Mobile App
  - Thursday 5:30 – 6:30 pm in San Jacinto Renaissance Hotel

Questions?

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