Mixed Reality Toolkit with ROS2
Azure Edge Robotics

- ROS Nodes for Azure & Windows
  - ONNX (ML) Inferencing
  - Windows Camera + RTSP
  - Language Understanding
  - Azure Kinect
  - Azure IoT Hub

- Azure ‘RoboOps’
  - VMs for ROS
  - Github/Azure DevOps

- VSCode ROS Extension
  - 120,000+ Installs

- ROS on Windows
  - 190,000+ Installs

- Community Engagement
  - ROS 2 Technical Steering Committee
  - ROS Industrial Consortium
  - ROSCon Sponsors

http://aka.ms/ros
What is the Mixed Reality Toolkit?

• User Interface Toolkit
  • Cross Platform
  • Supports AR & VR

• [http://aka.ms/mrtk](http://aka.ms/mrtk)

• Unity & Unreal Game Engines

• Develop with Visual Studio 2019
Hololens + ROS

**ROS1**
- ROS#
  - https://github.com/siemens/ros-sharp
- ROS Bridge
- Web Socket

**ROS2**
- ROS2.net + MRTK
  - https://github.com/ms-iot/ros_msft_mrtk
- ROS2 runtime UWP native
- Direct DDS deserialization
- ROS2.net for Unity
- Investigating ROS MRTK for Unreal
Challenges

• Hololens requires UWP
  • Small subset of Win32 APIs
• Resource Constrained
• Capability Constrained
• ARM64
• Spatial understanding mismatch
• Dev iteration
Resources

- [https://aka.ms/ros/mrtk](https://aka.ms/ros/mrtk)
  - In development
  - Migrating to Foxy

- [https://aka.ms/ros/mrtk_native](https://aka.ms/ros/mrtk_native)
  - In development
  - Migrating to Foxy
  - ROS2 nuget for UWP
  - ROS2 + ROS2.net UPM for Unity
Software Stack

Hololens 1 or 2
Unity Universal Windows App (x86 or ARM64)

Your Unity Application

Mixed Reality Toolkit - ROS
https://github.com/ms-iot/ros_msft_mrtk

ROS2.net
GitHub - ros2-dotnet/ros2_dotnet: .NET bindings for ROS2

ROS2
https://github.com/ms-iot/ros_msft_mrtk_native

Fast DDS Middleware (with eProsima)

Robot
Azure Spatial Anchor ROS Node

ROS2
Spatial Pinning

Spatial Pinning via QR Code or Azure Spatial Anchors

TF2 Spatial translation from Robot through world to HoloLens

Visualization Assets

Interaction Assets

Changing from Apriltag to QR Code

ROS World Zero

Use tag offset from camera + tag offset from ROS world zero to calculate the location of the MRTK world anchor in Unity space.

Use QR Code to estimate the pose of the fiducial tag attached to the robot relative to the HoloLens camera.

Use tf2 to get the transform between the fiducial tag and ROS world zero.

The pose of the QR Code relative to the odom frame in the URDF.

Once the MRTK anchor is placed, QR Code is no longer needed. All updates to robot pose can be pulled from tf2.