Work Zone Data Collection Mobile Application

Technical Set up and Documentation

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1 Mobile application requirements

1.1 Android Studio software

The Work Zone Data Collection Tool (WZDC-Tool) mobile application is written with Android Studio version 4.0.1 and runtime version 1.8.0_242-release-1644-b01. The WZDC tool is written in Kotlin(version 1.3.73-release-Studio4.0-5) and uses the Gradle build system.

1.1.1 Android APK Supported Versions

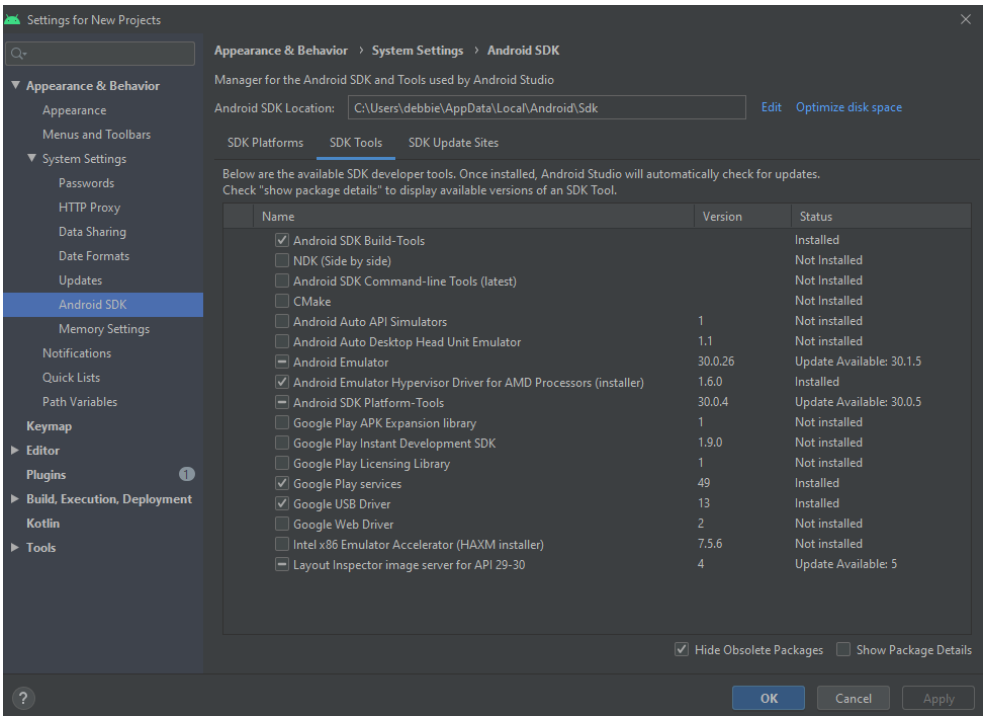
The WZDC tool Android application supports multiple Android APK platforms and SDK Tools.

Tested and deployed APK platforms:

- API version: 29 (Android 10.0+(R))
- API Version: 30 (Android 10.0(Q))

1.1.2 SDK Tools

- Android SDK Build-Tools
- Android Emulator (for local development – optional)
- Android Emulator Hypervisor Driver for AMD Processors(optional)
- Android SDK Platforms-Tools
- Google Play services
- Google USB Driver



1.2 Device Requirements/Permissions

1.2.1 Location

The WZDC Tool required the mobile device to have location services enabled before allowing the user to create a work zone data collection file. When the application opens the user will be prompted to turn on location services if it is off. The application will also request the user to allow or deny the use of the location before allowing the user to drive and collect data for the work zone data collection.

1.2.1 Internet Access

The mobile phone must have access to the internet to receive information for:

- Downloading configuration files
- Uploading collected work zone map data (csv file)

*Future release will allow a user to map the work zone offline and upload later

1.3 Azure Connection

The WZDC Tool uses an MS Azure backend to host the configuration files, WZDx and RSM files. To gain access to this environment a specific account name and account key are required. To gain access to this information, please email tony@neaeraconsulting.com for this.

1.3.1 Azure Service Location

Configuration files, WZDx and RSM messages are stored in a MS Azure Storage Account. To request access to this information, please email tony@neaeraconsulting.com.

1.3.2 Azure Container

- archived and in progress configuration files
- work zone uploads

1.3.2 Azure Functions

We have 2 Azure functions that run

- generate-messages - <when does this run>
- ingest-unzip - <when does this run>

<describe the functions here and maybe put snippets of code>

1.4 Manual vs Automatic GPS

The WZDC tool can capture path data in two ways, using the internal GPS from the mobile phone or capturing data from an external GPS. Depending on the frequency of the capturing of the data, it will determine if an RSM message can be generated.

1.4.1 GPS detection

Internal GPS

- Status is disconnected if the internal location service is not enabled
- Status is invalid if internal location service is enabled and location is disabled
- Status is valid if internal location service is enabled and location is enabled

*Note: Status is re-evaluated every 5 seconds

USB GPS

- Status is disconnected if no USB devices are connected
- Status is invalid if a USB device is detected
- Status is valid if a valid GPS fix is received from the GPS

*Note: Valid GPS Fix requires DateTime, latitude, longitude, altitude, HDOP, speed and heading. This can take a long time to establish for devices that are obscured (inside buildings) or stationary

1.6 Supported Devices

The WZDC Tool was tested and developed for several Android mobile devices.

- Device Requirements
  - Minimum Android Version: Marshmallow (Android v6.0), API 23
  - Maximum Android Version: Android 11, API 30
- Tested Devices
  - Oneplus 6T, OxygenOS v10.3.6
  - Samsung S8, Android v9.0
  - LG Aristo, Android v7.1.2
  - Samsung Galaxy Note 10, Android v10.0
  - Tony's Phone
  - Samsung Galaxy S10E, Android v10.0

External (USB) GPS

- Device Requirements
  - Serial Output: NMEA v2.3
  - Data Rate: 1-10 Hz
  - Accuracy
    - < 2m for RSM + WZDx message generation
    - > 2m for only WZDx message generation
- Tested Devices
  - VK-162 G-Mouse USB GPS
  - U-Blox EVK-M8N-0 (Part# 672-1056-ND)

Internal GPS

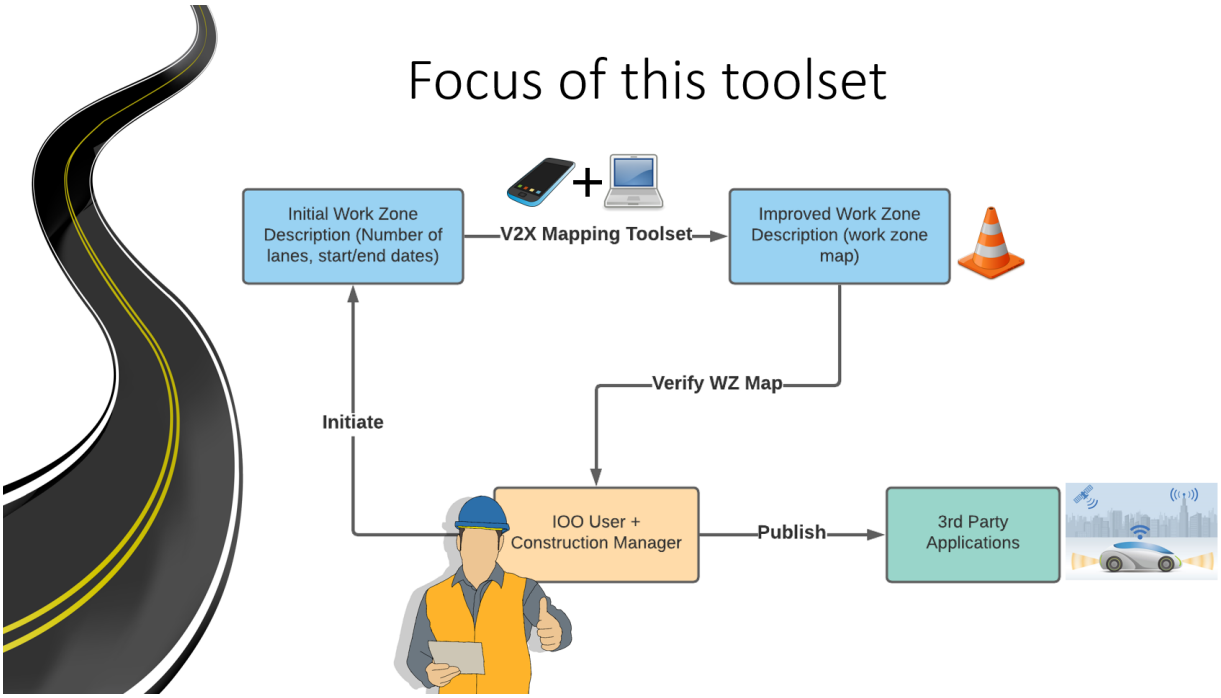
RSM

- RSM messages are only generated if every collected datapoint has a horizontal accuracy (HDOP) < 2 meters

- If any data point has an accuracy > 2 meters, RSM messages will not be downloaded

2 Application Details

The WZDC Tool mobile applications initially was created to allow the user to capture work zone data collection with few hardware requirements.



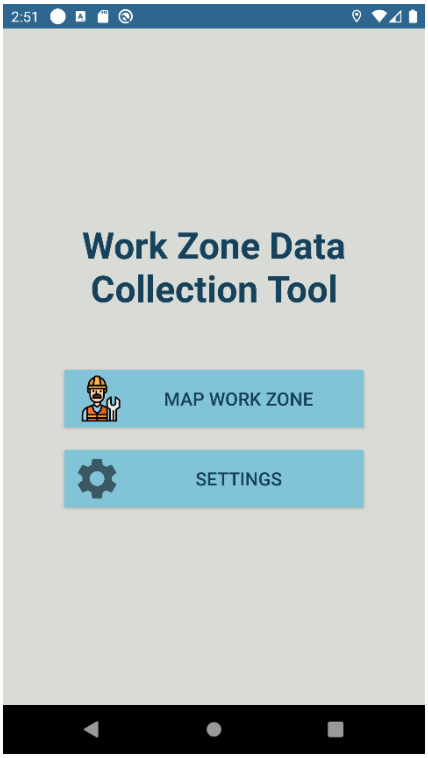
2.1 Install Application

Google Play Store

Install

2.2 Main Page

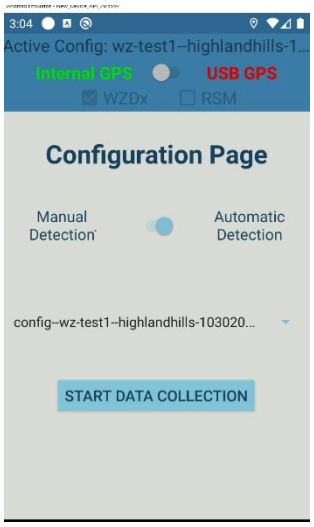
The firs page that loads is the main page. When this page loads, the Map Work Zone option will be unavailable until the Azure Account name and Account Key are entered under the Settings option. Once that information has been entered and verified then the Map Work Zone option will be enabled.



2.3 Settings

The settings page contains the Azure required information to allow a user access to the Map Work Zone data collection part of the application. To receive this information, please contact tony@neaeraconsulting.com to get these values. Once the information has been entered and the users clicks SAVE, the information will be verified and notify the user if the information is incorrect. The Map Work Zone option will be made enabled once the connection has been established. This information is saved on the mobile device in the user preferences. If the application is uninstalled this information will need to be re-entered.

2.4 Map Work Zone



2.4.1 Import configuration File

Configuration files are located in the dropdown list on this page. These are the published configuration files that were created on the Work

2.4.2 GPS Selection

Internal GPS

- Status is disconnected if the internal location service is not enabled
- Status is invalid if internal location service is enabled and location is disabled
- Status is valid if internal location service is enabled and location is enabled

*Note: Status is re-evaluated every 5 seconds

USB GPS

- Status is disconnected if no USB devices are connected
- Status is invalid if a USB device is detected
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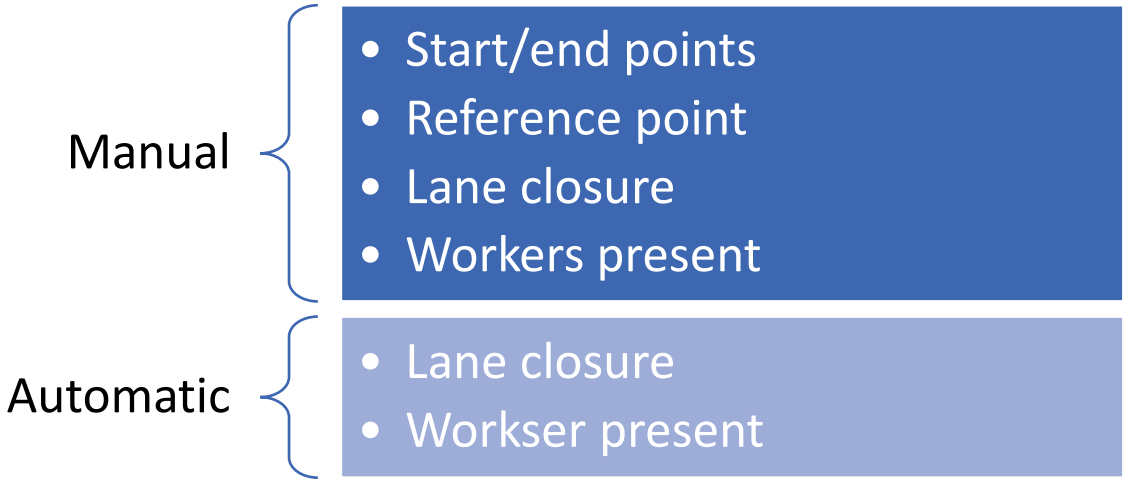
*Note: Valid GPS Fix requires DateTime, latitude, longitude, altitude, HDOP, speed and heading. This can take a long time to establish for devices that are obscured (inside buildings) or stationary

2.4.3 Work Zone Type

Map zone data collection has 2 modes available as defined in graphic below. In Manual mode, all options are manually set by the user. In automatic mode, the start and end points are automatically set, and lane closures and workers present are manually set by the user.



2.5.1 Manual

For manual work zone data collection this will require you to manually select all the work zone features. The following figure represents the options that are available to mark will in data collection mode.

2.5.1 Automatic

For automatic work zone data collection this will require the user to manually set the lane closure and workers present only. The data collection will automatically start and end when the vehicle enters or exits the geofence location.

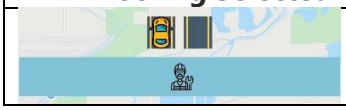
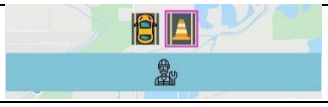
2.5 Map Work Zone

Data collection functions slightly differently in manual and automatic detection modes. The application behavior is described below

1. In automatic detection mode (default), data collection will automatically commence when a set starting location is reached (from configuration file). Data collection will commence as normal, until the set ending location is reached, at which point data collection will end and the data file will be uploaded.
2. In manual detection mode, the user manually starts and ends data collection. When the user is approaching a work zone, the user presses the play button. When the work zone begins, the user presses the marker button. Then, data collection commences as normal. Once the user exits the work zone, they will press the stop button.

The user is (usually) required to drive in a specific lane, except in cases where the user does not intend to generate RSM messages. This lane is set in the configuration file and shown in the data collection screen by a car icon.

Once data collection has begun, the user can mark lane closures and the presence of workers. Lane closures are marked at the beginning of the taper. For a closing lane, mark the lane closed when the lane starts to taper to closed. For an opening lane, mark the lane open when the lane starts to taper to open. To mark a lane closure in the application, simply click the corresponding lane button. A cone will appear, signifying that the lane is closed. To open that lane, simply press the lane again. The lane with a yellow/orange car displays the lane that the user is driving in and cannot be closed. Images are shown below To mark workers present, press the worker button at the bottom. The background will change color and the worker will be colored in, signifying that workers are present. To mark workers no longer present, simply press the worker button again. Images are shown below

Nothing Selected	Lane Closed	Workers Present
		

2.5 Upload Path Data

The final step is to upload the generated path data file. The application will execute this step automatically at the end of data collection, and a notification (shown above) will be shown. If the path data file fails to upload, you can upload it manually
to https://neaeraconsulting.com/V2X_Upload (Generated data files can be found at Android/data/com.wzdctool.android/files/Download)