

How Big Is It?

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Agenda

- **ToF Sensor**
 - What it is and how it works
 - Android APIs
 - Use Cases

- **Mobile Parcel Dimensioning**
 - Key Features
 - Architecture
 - Versioning / Installation
 - API

Zebra DevCon 2023



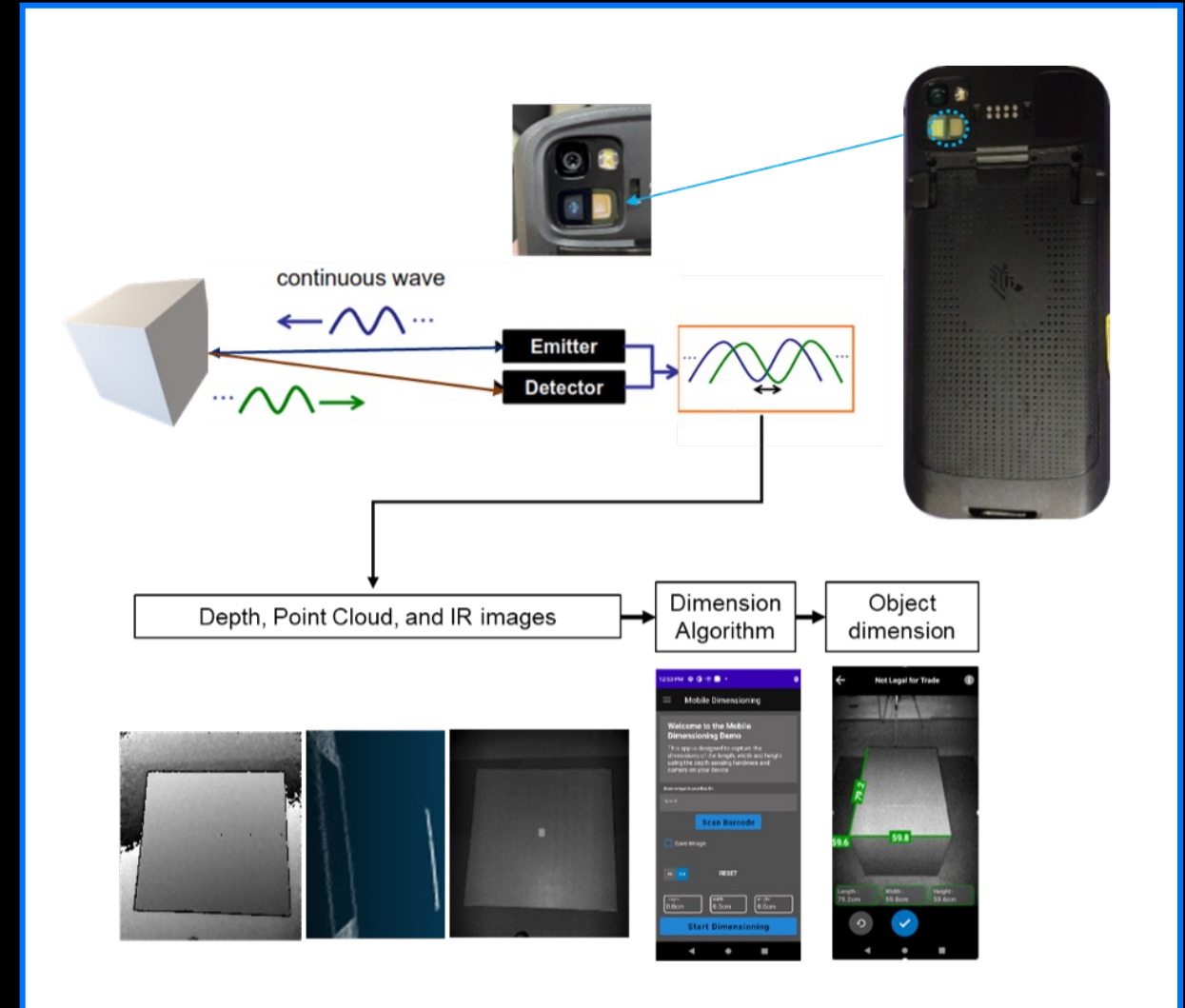
ToF Sensor

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ToF Sensor

What is it?

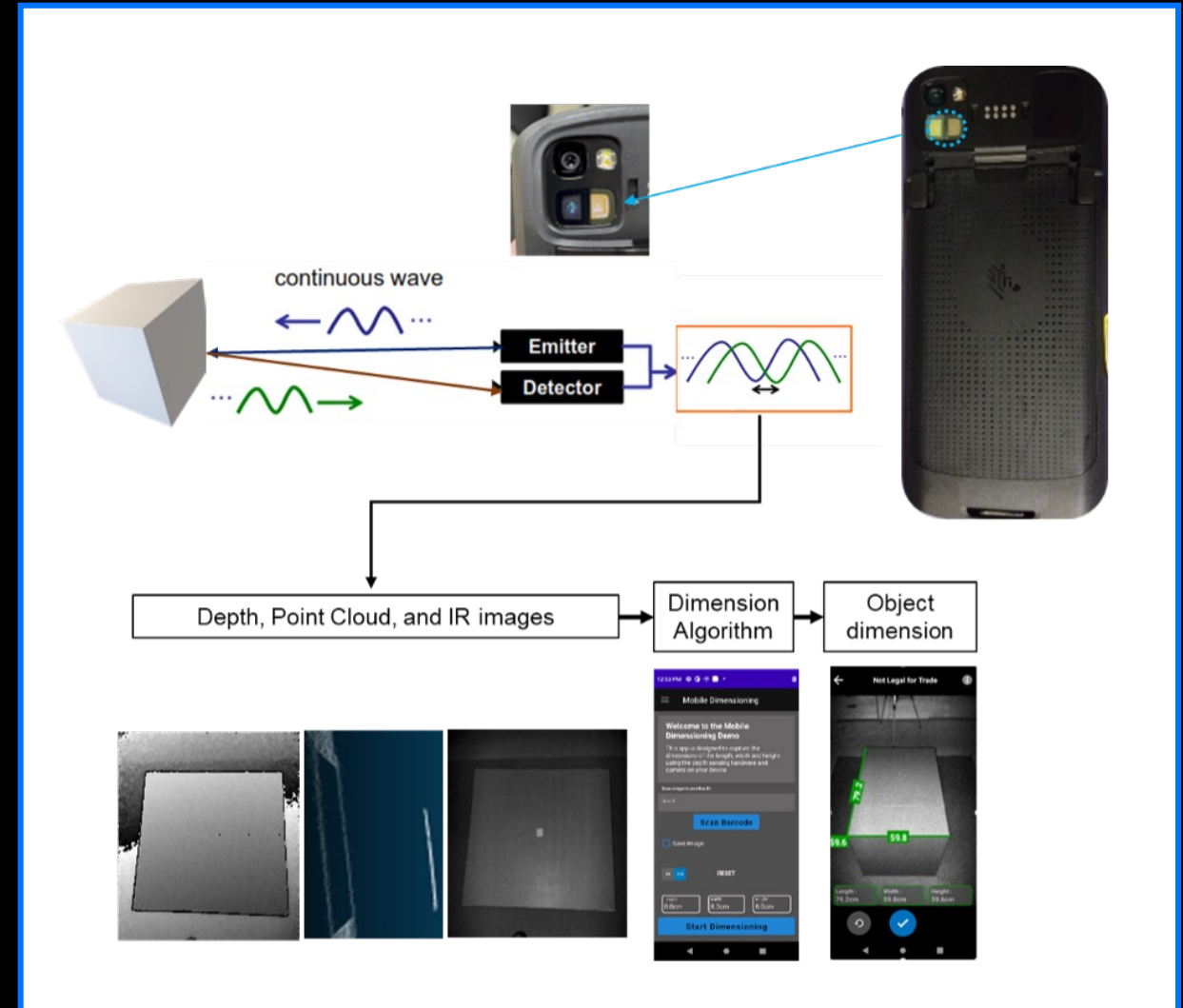
- Sensor with a 3D imaging system
- Composed of:
 - Emitter
 - Detector
 - Support Circuitry
- Can be integrated into a mobile device/smartphone without affecting the overall shape and size of the device
- Zebra ToF solution does not require recalibration



ToF Sensor

How does it work?

- When activated, the ToF sensor will illuminate the scene with a modulated light source.
- Once the signal is emitted, it will travel through space until it encounters an object or a surface.
- The sensor will then detect the time delay or phase shift of the reflected light relative to the emitted signal to travel from the sensor to the object and back again.
- Given that the sensor knows the original speed of the signal, it can accurately calculate the distance of the object based on the time delay or phase shift



Using Android Camera2 API

Getting Started

- Must use the Camera2 API because the CameraX API does not support ToF
- Support for both Java & Kotlin
- To get started, first thing to do is adding the appropriate permissions in the Android Manifest of the project

```
<uses-permission android:name="android.permission.CAMERA" />  
<uses-feature android:name="android.hardware.camera" />
```


Using Android Camera2 API

Check if the device supports ToF sensor

```
CameraManager manager = (CameraManager) this.getSystemService(Context.CAMERA_SERVICE);

try {
    for (String cameraId : manager.getCameraIdList()) {
        CameraCharacteristics characteristics = manager.getCameraCharacteristics(cameraId);
        int[] capabilities = characteristics.get(CameraCharacteristics.REQUEST_AVAILABLE_CAPABILITIES);

        for (int capability : capabilities) {
            if (capability == CameraCharacteristics.REQUEST_AVAILABLE_CAPABILITIES_DEPTH_OUTPUT) {
                Log.d("Camera", "Found ToF sensor with ID " + cameraId);
                // cameraId now holds the camera ID of the depth camera
            }
        }
    }
    Log.e("Camera", "Unable to find ToF sensor");
} catch (CameraAccessException e) {
    e.printStackTrace();
}
```

Using Android Camera2 API

Determine maximum resolution of the ToF sensor

```
try {
    CameraCharacteristics characteristics = manager.getCameraCharacteristics(cameraId);
    StreamConfigurationMap configs = characteristics.get(CameraCharacteristics.SCALER_STREAM_CONFIGURATION_MAP);

    for (int i : configs.getOutputFormats()) {
        if (i == ImageFormat.DEPTH16) {
            Size selectedSize = new Size(0, 0);
            Size[] sizes = configs.getOutputSizes(i);

            for (Size s : sizes) {
                if (s.getWidth() > selectedSize.getWidth() && s.getHeight() > selectedSize.getHeight()) {
                    selectedSize = s;
                }
            }
        }
    }
} catch (Exception e) {
    e.printStackTrace();
}
```


Using ToF with NDK Android Native Camera API

Overview

- The ToF Sensor also supports Android NDK Development
 - The Android NDK is a toolset that lets you implement parts of your app in native code, using languages such as C and C++
- To communicate with the ToF sensor, you will need to use the native camera API:
<https://developer.android.com/ndk/reference/group/camera>
- Better option for developers experienced with C or C++
- Provides improved performance since depth-processing algorithms are usually written in C or C++ (including ours)



ToF Sensor

Use Cases

- AR & VR – ToF sensors can be used to map the user's surroundings and create realistic and immersive virtual experiences so that the device can understand the environment and recognize objects
- Facial Recognition and Biometric Security – ToF sensors can enable the recognition of faces by capturing facial features in 3D, making it more secure compared to the old 2D based methods. This is similar to how Face ID works on Apple devices
- Distance Measurement and Object Detection – ToF sensors can be used to gather distance measurements (which also involves detecting the presence and position of objects). This is similar to how the dimensioning algorithm works on our Zebra devices
-and more



Mobile Parcel Dimensioning

Mobile Parcel Dimensioning

Overview

- Fast and accurate Weights & Measure certified Mobile Dimensioning of parcels
- Solution offered on Premium TC73/TC78 Mobile Computer with Time of Flight (ToF) Sensor
- Solution offered as Certified and Non-Certified SKU
- Solution to be certified at following OIML, NTEP, MC, NMI regulatory agencies

SKU	Error Specifications (d-value) and Size Ranges Dimensions in Centimeters		
US, CA	(1) 12 - 24	(2) 24 - 60	(5) 60 - 100
EU, NN, AU/NZ	(1) 10 - 20	(2) 20 - 80	
Non-certified (no regulatory rounding)	(0.1) 10 - 120		
Note: Metric to imperial mapping: (1 cm) → (0.5”), (2 cm) → (1”), (5 cm) → (2”) for rounding			



Mobile Parcel Dimensioning

Key Features



- Supports dimensioning of Cuboidal Parcels
- Supports top down and isometric (top and front face of parcel) dimensioning approaches
- Supports both certified and non-certified solutions
- Initial software is pre-installed from factory
- Demo application also pre-installed for demonstration & testing purpose
- Software persists across factory and enterprise reset
- Software is updatable independent of OS image via stagenow/EMM
- Supports all regulatory requirements for certified solutions, such as: event log, information screen, rounding rules, software sealing, etc...
- SDK / APIs available to integrate dimensioning into line of business applications
- Supports diagnostic capability (image dumping, log capture, etc.)

Mobile Parcel Dimensioning

Software Architecture

- **MDCClient**

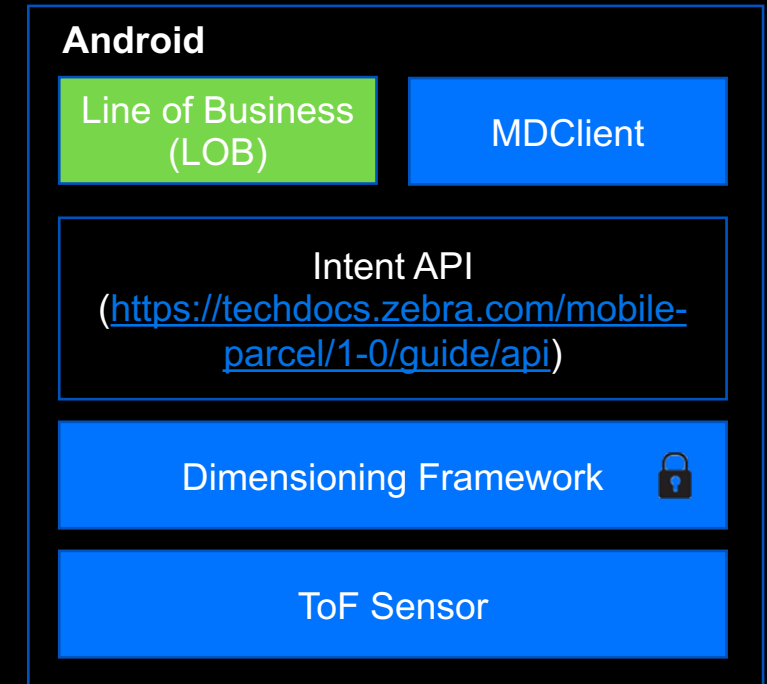
- Mobile Dimensioning Client demo application pre-installed on the mobile computer
- Application uses Mobile Parcel Dimensioning API (Intent)
- Application is delivered as part of software bundle along with Dimensioning Framework

- **Dimensioning Framework**

- Dimensioning Framework is the core software component of the dimensioning solution and comes pre-installed on the mobile computer
- Dimensioning Framework is a foreground service, which has a notification icon which shows “Dimensioning is running”
- Framework handles all incoming intents from the API and delivers dimension data to applications once successfully dimensioned
- Framework is signed by a special Zebra key and protected to meet regulatory software sealing requirements

- **ToF Sensor**

- Dimensioning Framework uses input from ToF sensor to perform measurement



Mobile Parcel Dimensioning

Software Versioning Scheme

- **Sample Version Format**

- MP_NONCERTIFIED_1_0_0_0_20220730.zip – Software Version 1 for Non-Certified Solution
- CMP_US_1_0_0_0_20220730.zip – Software Version 1 for NTEP (metrological)
- CMP_US_1_1_0_0_20220830.zip – Software Version 1.1 for NTEP (non-metrological)
- CMP_EU_1_0_0_0_20220830.zip – Software Version 1 for OIML (metrological)
- CMP_US_1_1_1_0_20220930.zip – Non-Metrological Custom Changes for a specific custom request (internal modules will have patch version bumped if they are modified)

- **Software Versioning Format**

- CMP / MP: Certified Mobile Parcel for certified solution & Mobile Parcel for non-certified solution
- Regulatory Region: Tracks the software for specific regulatory region
- Major Version (aa): Major version (aa) tracks any Metrological changes
- Minor Version (bb): Minor version (bb) tracks any non-Metrological changes
- Patch(cc): Tracks any non-Metrological point fixes to specific customers

Mobile Parcel Dimensioning

Software Installation Procedure

- Software can be installed one of two ways:
 - 1. Using StageNow**
 - Installation using OS update Feature
 - Installation using Xpert Mode
 - 2. Using an Enterprise Mobility Management (EMM) Client**
 - Airwatch
 - SOTI

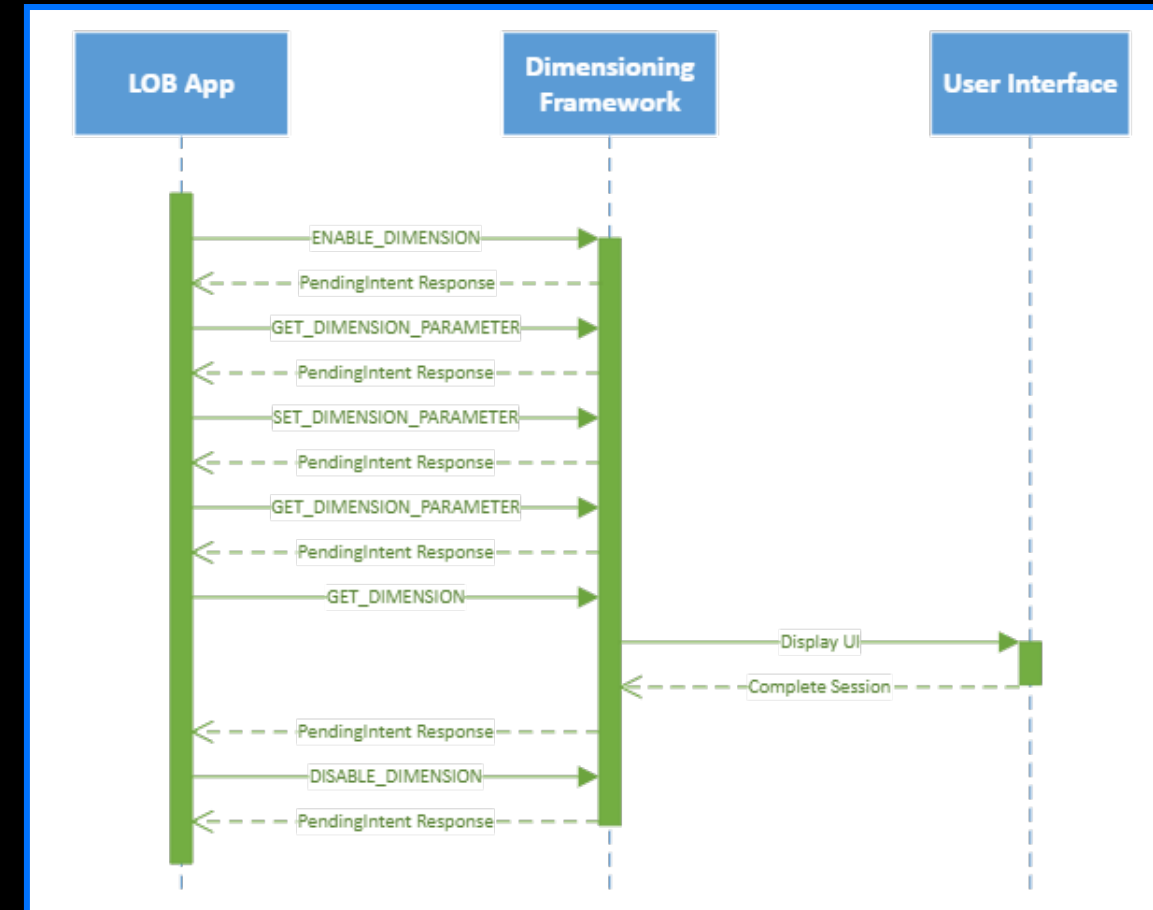
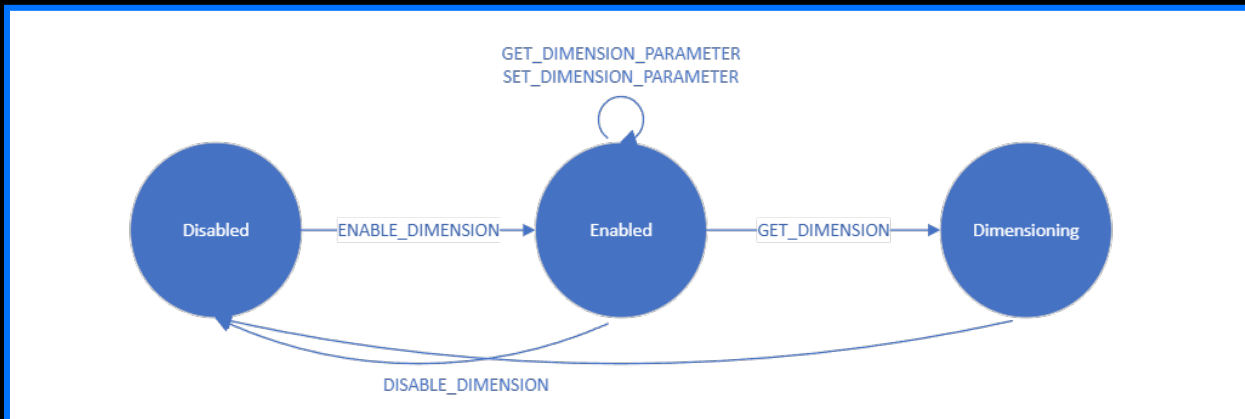
Note: Dimensioning Software (MDClient and Dimensioning Framework) **will persist across Factory and Enterprise reset**

https://www.zebra.com/content/dam/zebra_new_ia/en-us/manuals/software/mobile-parcel/mobile-parcel-ig-en.pdf

Dimensioning API

Overview – Sequence Diagram

- Enable Dimension
- Disable Dimension
- Get Dimension Parameter
- Set Dimension Parameter
- Get Dimension



See <https://techdocs.zebra.com/mobile-parcel/1-0/guide/api/>

Dimensioning API

Security

- Zebra requires developers use an access control method through MX Access Manager (<https://techdocs.zebra.com/mx/accessmgr/>)
- Only trusted applications can communicate with the Mobile Parcel API
- All application packages must be placed on the allow list
- Line of Business (LOB) application must generate API token using MX Access Manager
- API requires LOB application to pass API token and package name in each API for authentication

Dimensioning API

Security – Allow listing procedure

- Extract LOB App Certificate
 - This is a pre-requisite to create the StageNow profile that places the app in the allow list
 - Steps to extract the LOB app certificate:
 - Download SigTools.jar from Zebra’s App Signature Tools (<https://techdocs.zebra.com/emdk-for-android/latest/samples/sigtools/>)
 - Follow the instructions provided from the link to extract the certificate from the LOB app APK file using command (where [filename.apk] is the full path and file name of the LOB app APK file and [filename.crt] is the designated certificate file name):

```
java -jar SigTools.jar GetCert -INFORM APK -OUTFORM DER -IN [filename.apk] -OUTFILE [filename.crt]
```

Dimensioning API

Security – Allow listing procedure

- Create StageNow Profile to place the LOB app in the allow list
- Download and install StageNow on a host computer
- Open StageNow. In the StageNow home screen, click Create New Profile from the left menu
- Ensure MX version 11.1 or higher is selected at the top drop-down selector. The MX version on the device should match this or higher. See MX documentation for instructions how to check the version
- Select Xpert Mode from the list and click Create

The screenshot shows the StageNow web interface. The left sidebar has a menu with 'Create new Profile' highlighted in red. The main content area displays 'Complete Profiles' with a table of existing profiles.

Name	Description	Last Updated	MX Version	Connection Type	RD	Actions
TC58A11newbuild	XpertConfig	12/22/2021 3:54 PM	11.1	None	○	→ ↵ 🗑️
TC77A11	XpertConfig	12/22/2021 2:53 PM	11.1	None	○	→ ↵ 🗑️
A11test122-12	XpertConfig	12/22/2021 11:44 AM	11.1	None	○	→ ↵ 🗑️
A10working	XpertConfig	12/22/2021 11:26 AM	10.2	None	○	→ ↵ 🗑️
A1120-12	XpertConfig	12/22/2021 11:21 AM	11.1	None	○	→ ↵ 🗑️
A11	XpertConfig	12/17/2021 2:39 PM	11.1	None	○	→ ↵ 🗑️

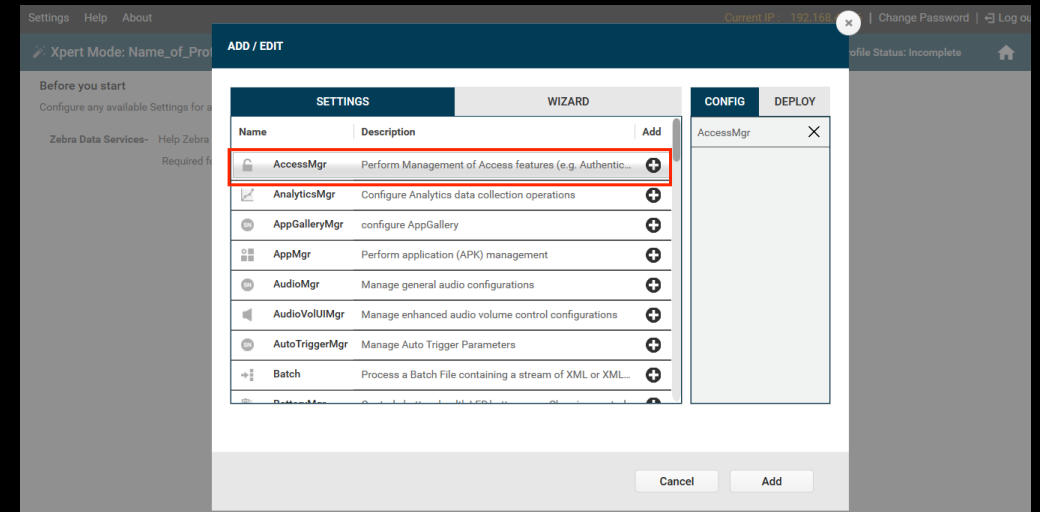
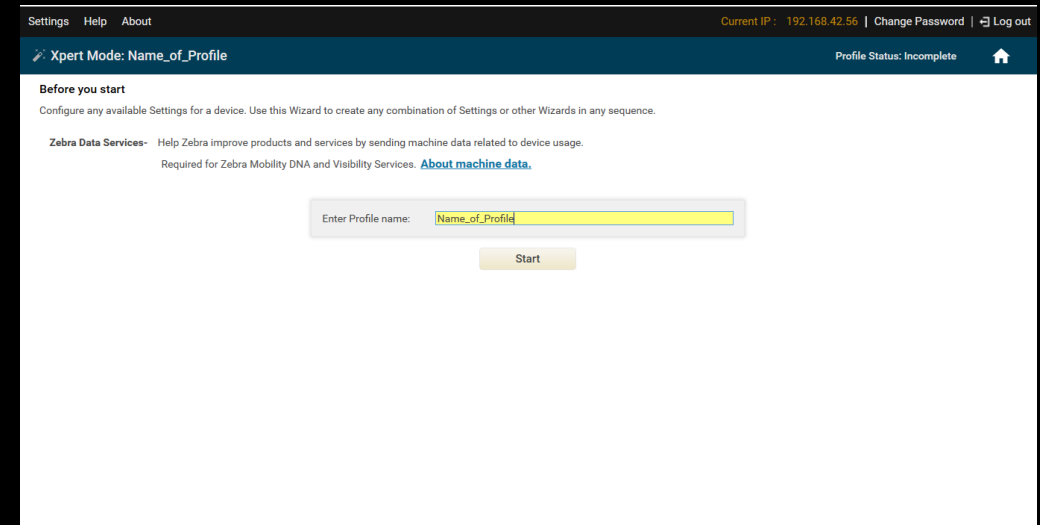
The screenshot shows the StageNow web interface with a 'Select a Wizard' dialog box open. The dialog box has a dropdown menu for 'MX version' set to 'MX 11.1'. The 'Xpert Mode' option is highlighted with a red box.

Name	Description
Configure a Device	Configure most common Settings for a device. Use this Wizard to Manage...
Configure Zero Touch Network	Configure a Network to use for Zero Touch. Use this Wizard to Configure a...
Connect Network	Connect to a Network. Use this Wizard to connect to a Wi-Fi, GPRS, or Ether...
Enroll in an MDM	Enroll a device for management by an MDM. Use this Wizard to Download,...
Manage Application(s)	Manage applications on a device. Use this Wizard to Download, Install, Uni...
Manage Device Security	Configure Security options and policies for a device. Use this Wizard to Wh...
Perform OS Update	Perform an OS Update on a device. Use this Wizard to apply an Update or a...
Wipe a Device	Destroy device data using Enterprise or Factory Reset
Xpert Mode	Configure any available Settings for a device. Use this Wizard to create any...

Dimensioning API

Security – Allow listing procedure

- Enter the profile name. Click Start
- Scroll to AccessMgr and click the plus (+) sign to add AccessMgr to the Config tab on the right side
- Click Add



Dimensioning API

Security – Allow listing procedure

- Enter the appropriate information as prompted:
 - Service Access Action: Allow Caller to Call Service
 - Service Identifier: delegation-zebra-com.zebra.mobiledimensioning-Enable
 - Caller Package Name: [Enter package name of the LOB app.]
 - Caller Signature: [Browse to the app certificate generated from Extract LOB App Certificate.]
- Click Continue
- Click Complete Profiles. Profile creation is complete
- 10. Perform one of the following steps based on the staging method. Ensure devices are connected to the network during the staging process:
 - StageNow: Generate the barcode. Open StageNow on the device and scan the barcode to place the app in the allow list
 - EMM: Click on Export the XML for MDM. Send the XML using either OEMConfig or MX to place the app in the allow list

XpertConfig: Name_of_Profile Profile Id: 7 Profile Status: Incomplete

StageNow Config Review Publish

1 AccessMgr ADD / EDIT

Do not Change Single User without Whitelist Single User with Whitelist

Service Access Action: Allow Caller to Call Service

Service Identifier: delegation-zebra-com.zebra.mobiledimensioning-Enable

Caller Package Name: com.zebra.mobiledimensioning

Caller Signature: C:\Users\A0011355\Downloads\Token\TCS8newbuild

CSP Access Action: Do Nothing

Continue >

Settings Help About Current IP: 192.168.42.56 | Change Password | Log out

XpertConfig: Name_of_Profile Profile Id: 7 Profile Status: Incomplete

StageNow Config Review Publish

Staging Profile

StageNow Config 1 + Expand

Profile Description: XpertConfig

Encrypt Barcode, NFC Data: Security Warning: Your Barcode, NFC data will be Encrypted

< Back Complete Profiles >

Dimensioning API

Security – Token Generation

- The application must use Access Manager to dynamically generate an API token
- The API token is one of the parameters that must be sent with each API request for authentication
- Mobile Dimensioning sample code demonstrates how to talk to the Device Manager through the ZDM Content Provider
 - See <https://techdocs.zebra.com/flux/query/>

Add Queries tag

This is required to allow the application to communicate with Dimensioning and Device Manager for generating the token.

```
<queries>
  <package android:name="com.zebra.dimensioning" />
  <package android:name="com.zebra.devicemanager" />
</queries>
```

Specify Permission

This is also needed to communicate with the Device Manager.

```
<uses-permission android:name="com.zebra.devicemanager.provider.READ_PERMISSION" />
```

Dimensioning API

Security – Token Generation

```
public static final String SERVICE_IDENTIFIER = "delegation-zebra-com.zebra.mobiledimensioning-Enable";

private String token = "";
private Instant tokenExpiration;

private void generateToken() {

    final Uri ZDM_AUTHORITY_URI = Uri.parse("content://com.zebra.devicemanager.zdmcontentprovider");
    final Uri ACQUIRE_TOKEN_URI = Uri.withAppendedPath(ZDM_AUTHORITY_URI, "AcquireToken");

    try {
        Cursor cursor = getContentResolver().query(ACQUIRE_TOKEN_URI, (String[]) null,
            "delegation_scope=?", new String[]{SERVICE_IDENTIFIER}, (String) null);

        if (cursor != null && cursor.getCount() > 0) {
            cursor.moveToFirst();
            int columnIndex = cursor.getColumnIndex("query_result");

            if (columnIndex >= 0) {
                token = cursor.getString(columnIndex);
            }
            cursor.close();
        }
    } catch (Exception e) {
        e.printStackTrace();
    }

    if (token != null && !token.isEmpty()) {
        tokenExpiration = Instant.now().plus(24, ChronoUnit.HOURS);
        // Communicate with Service
    }
}
```

Note - The API token expires after 24 hours and must be regenerated.

Dimensioning API

Overview – Common Intent Extras

- Request

- Intent.putExtra(String name, String value)

Key	Type	Description/Value
API_TOKEN	String	API authentication token
PACKAGE_NAME	String	LOB application package name
CALLBACK_RESPONSE	PendingIntent	PendingIntent object that receives the response

- Response

- Intent.getStringExtra(String name)

Key	Type	Description/Value
RESULT_CODE	Integer	Success / Failure / Error / Cancelled
RESULT_MESSAGE	String	Human-readable description (localized)

Dimensioning API

Overview – Results

- **Response RESULT_MESSAGE values**

RESULT_CODE	RESULT_MESSAGE (English)
0: Success	<ul style="list-style-type: none"> • Success • Dimension Complete
1: Failure	<ul style="list-style-type: none"> • Dimensioning In Use by Another App • Dimensioning Already In Use • Dimensioning Not Supported • Failed to Open Camera • Failed to Enable • Framework Not Installed • Failed Integrity Check • Integrity Check Fault • Insufficient Permissions • Failed to Disable • Failed to Get Dimension • Failed to Get Parameters • Failed to Set Parameter
2: Error	<ul style="list-style-type: none"> • Access Denied • Invalid Module Parameter • Already Dimensioning • Invalid State • Invalid Value • Invalid Parameter
3: Cancelled	<ul style="list-style-type: none"> • User Cancelled • User Inactivity

Dimensioning API

Enable Dimension

- **Enable Dimension**

- **ENABLE_DIMENSION** starts the Dimensioning service, enables and configures the time-of-flight (ToF) camera for the app to be ready for dimensioning. This must be called before any other API to ensure the Mobile Parcel API is enabled, allowing communication with the app
- NOTE: **ENABLE_DIMENSION** prevents other apps from accessing the ToF camera until **DISABLE_DIMENSION** is called. To save battery and reduce resource conflicts, Zebra recommends calling **DISABLE_DIMENSION** when dimensioning is not in use or when the app is running in the background

- **Request**

- Use the following action to call **ENABLE_DIMENSION**:

```
com.zebra.dimensioning.ENABLE_DIMENSION
```

Key	Type	Description/Value
MODULE	String	parcel

- **Response**

- Standard RESULT extras

Dimensioning API

Disable Dimension



- **Disable Dimension**

- **DISABLE_DIMENSION** releases the ToF camera and any other Dimensioning service resources allocated during **ENABLE_DIMENSION**. To save battery, call **DISABLE_DIMENSION** when dimensioning is not in use or when the app is running in the background

- **Request**

- Use the following action to call **DISABLE_DIMENSION**:

```
com.zebra.dimensioning.DISABLE_DIMENSION
```

- **Response**

- Standard **RESULT** extras

Dimensioning API

Get Dimension Parameter - Request

- **Get Dimension Parameter**

- **GET_DIMENSION_PARAMETER** returns the values for all Mobile Parcel API parameters. Only call this API after **ENABLE_DIMENSION** is successfully called

- **Request**

- Use the following action to call **GET_DIMENSION_PARAMETER**:

```
com.zebra.dimensioning.GET_DIMENSION_PARAMETER
```

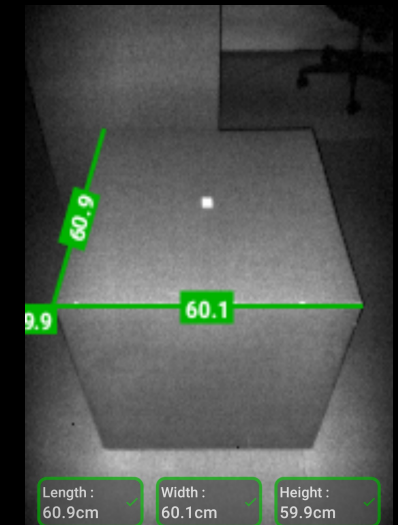

Dimensioning API

Get Dimension Parameter – Response

- **Response**

– Standard RESULT extras plus:

Key	Type	Description/Value
READY_LENGTH / READY_WIDTH / READY_HEIGHT	BigDecimal	Length / width / height value to display in app when ready to dimension
DIMENSION_UNIT	String	<ul style="list-style-type: none">• Inch• CM
FRAMEWORK_VERSION	String	Framework version
SERVICE_VERSION	String	Service version
PACKAGE_VERSION	String	Parcel dimensioning software package version
REGULATORY_APPROVAL	String	For Certified Solution: "OIML1234" For Non-Certified Solution: ""
SUPPORTED_UNITS	StringArray	<ul style="list-style-type: none">• ("Inch", "CM")• ("CM")
REPORT_IMAGE	Boolean	Enable reporting proof of dimension image with dimension response <ul style="list-style-type: none">• True• False



Dimensioning API

Set Dimension Parameter

- **Set Dimension Parameter**

- **SET_DIMENSION_PARAMETER** configures the parameters supported by the Mobile Parcel API. Set any number of parameters through a single call by adding them as intent extras
- **ENABLE_DIMENSION** must be called before calling **SET_DIMENSION_PARAMETER**
- Supported values for **DIMENSIONING_UNIT** are reported by the **SUPPORTED_UNITS** value in **GET_DIMENSION_PARAMETER**
- NOTE: Changing **DIMENSIONING_UNIT** will change the ready value

- **Request**

- Use the following action to call **SET_DIMENSION_PARAMETER**:

```
com.zebra.dimensioning.SET_DIMENSION_PARAMETER
```

Key	Type	Required
DIMENSIONING_UNIT	String	No
REPORT_IMAGE	Boolean	No

- **Response**

- Standard RESULT extras

Dimensioning API

Get Dimension - Request

- **Get Dimension**

- **GET_DIMENSION** returns the values of the parcel measurements when an end-user dimensions a parcel. When this API is called, the Mobile Parcel API renders its user interface (UI) on top of the application, allowing the user to aim the camera at the parcel and begin dimensioning. Upon successful dimensioning and confirmation from the user, the results are sent back to the application through an intent response. If dimensioning fails, the result message contains details about the cause of failure
- NOTE: When calling **GET_DIMENSION**, the Mobile Parcel UI controls are overlaid on top of the application. This prevents the user from accessing the application until the dimensioning is complete or the user exits the dimensioning session by tapping the back button

- **Request**

- Use the following action to call GET_DIMENSION:

```
com.zebra.dimensioning.GET_DIMENSION
```

Key	Type	Description/Value
PARCEL_ID	String	ID of parcel

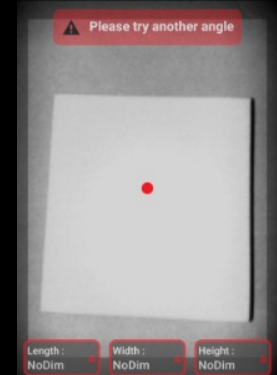
Dimensioning API

Get Dimension – Response

- **Response**

- Standard RESULT extras plus:

Key	Type	Description/Value
LENGTH / WIDTH / HEIGHT	BigDecimal	Length / Width / Height of parcel
LENGTH_STATUS / WIDTH_STATUS / HEIGHT_STATUS	String	<ul style="list-style-type: none"> • NoDim - No dimension result is provided • BelowRange - Dimension result is below the certified range • InRange. - Dimension result is within the certified range • AboveRange. - Dimension result is above the certified range
DIMENSIONING_UNIT	String	<ul style="list-style-type: none"> • Inch • CM
TIMESTAMP	Instant	Time when dimension took place
IMAGE	Bitmap	Bitmap Image (only reported if REPORT_IMAGE parameter is enabled)
PARCEL_ID	String	Parcel ID set by the app
Key	Type	Description/Value



Dimensioning API

References

- [TechDocs Documentation](#)
- [Sample Application](#)

Thank You

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