Intermec Forklift Advanced RFID Extensions (ARX)

User's Guide

Intermec®

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Forklift ARX Overview

The Intermec Forklift Advanced RFID Extensions (ARX) Software provides a forklift solution that differentiates tags on a moving forklift and stationary tags in the surrounding environment. The software also provides a diagnostic data capture interface, based on the existing tag-monitoring service, that can be run on Intermec RFID platforms.

Installation Requirements

Before you can install the Intermec Forklift ARX software, make sure that the CV60 Vehicle Mount Computer has the following software installed on it:

- Windows XP or XPe

- SmartSystems Reference Client (version 3.43 or higher)

- .NET Framework (2.0 or higher)

Before you run the Forklift ARX installer, make sure that your system includes a CV60 connected to an IV7 Vehicle Mount RFID Reader (IV7B or IV7C). For help, see the *IV7 User's Manual* (P/N 943-100-xxx).

To install the Forklift ARX software

1 Download and follow the steps in the wizard to install the SmartSystems Reference Client: `ssref_3.43.06.0598.exe`.

2 Download and follow the steps in the wizard to install the Forklift ARX Installer: `Intermec Forklift ARX 1.00.14.exe`.

Note: Be sure to install the SmartSystems Reference Client before running the Forklift ARX installer. Also, verify that TCP port 8512 is not blocked by the Windows XP Firewall.

Forklift ARX Developer's Notes

The Forklift ARX software package contains a pre-configured ALE environment that makes use of Intermec Spatial ID features such as In Zone Confidence.

Predefined In Zone Confidence Tag Field

Detail	Value
Field Name	intermec.InZoneConfidence
Field Type	Unsigned integer
Field Length	16 bits
Default Format	Decimal
Range of Values	0 to 100

The range of values represent the In Zone confidence factor of a tag. This value is measured in percent certainty that a tag is in the zone of interest (for example, a tag on the fork load).

Predefined LLRP ADD_ROSPEC Command

The default **RoSpec_add.bin** file provided in the Forklift ARX installation package enables tag intermec.InZoneConfidence values to be calculated and returned to the ALE service on the CV60. For specific information about LLRP configuration for ALE, see the *Intermec ALE Engine User's Guide* (P/N 934-026-xxx).

Default ADD_ROSPEC Command XML

```
<ADD_ROSPEC Version="1" MessageID="1">
  <ROSpec>
    <ROSpecID>1</ROSpecID>
    <Priority>0</Priority>
    <CurrentState>Disabled</CurrentState>
    <ROBoundarySpec>
      <ROSpecStartTrigger>
        <ROSpecStartTriggerType>Immediate</ROSpecStartTriggerType>
      </ROSpecStartTrigger>
      <ROSpecStopTrigger>
        <ROSpecStopTriggerType>Null</ROSpecStopTriggerType>
        <DurationTriggerValue>5000</DurationTriggerValue>
      </ROSpecStopTrigger>
```

```xml
        </ROBoundarySpec>
        <AISpec>
          <AntennaIDs>1 </AntennaIDs>
          <AISpecStopTrigger>
            <AISpecStopTriggerType>3</AISpecStopTriggerType>
            <DurationTrigger>0</DurationTrigger>
            <TagObservationTrigger>
              <TriggerType>2</TriggerType>
              <NumberOfTags>0</NumberOfTags>
              <NumberOfAttempts>2</NumberOfAttempts>
              <T>0</T>
              <Timeout>1000</Timeout>
            </TagObservationTrigger>
          </AISpecStopTrigger>
          <InventoryParameterSpec>
            <InventoryParameterSpecID>1</InventoryParameterSpecID>
            <ProtocolID>EPCGlobalClass1Gen2</ProtocolID>
            <AntennaConfiguration>
              <AntennaID>1</AntennaID>
              <C1G2InventoryCommand>
                <TagInventoryStateAware>False</TagInventoryStateAware>
                <Intermec:IntermecEnableABToggle
xmlns:Intermec="urn:www.Intermec.com">
                  <EnableABToggle>True</EnableABToggle>
                </Intermec:IntermecEnableABToggle>
              </C1G2InventoryCommand>
            </AntennaConfiguration>
          </InventoryParameterSpec>
        </AISpec>
        <AISpec>
          <AntennaIDs>2 </AntennaIDs>
          <AISpecStopTrigger>
            <AISpecStopTriggerType>3</AISpecStopTriggerType>
            <DurationTrigger>0</DurationTrigger>
            <TagObservationTrigger>
              <TriggerType>2</TriggerType>
              <NumberOfTags>0</NumberOfTags>
              <NumberOfAttempts>2</NumberOfAttempts>
              <T>0</T>
              <Timeout>1000</Timeout>
            </TagObservationTrigger>
          </AISpecStopTrigger>
          <InventoryParameterSpec>
            <InventoryParameterSpecID>1</InventoryParameterSpecID>
            <ProtocolID>EPCGlobalClass1Gen2</ProtocolID>
            <AntennaConfiguration>
              <AntennaID>2</AntennaID>
```

```
            <C1G2InventoryCommand>
              <TagInventoryStateAware>False</TagInventoryStateAware>
              <Intermec:IntermecEnableABToggle
xmlns:Intermec="urn:www.Intermec.com">
                <EnableABToggle>True</EnableABToggle>
              </Intermec:IntermecEnableABToggle>
            </C1G2InventoryCommand>
          </AntennaConfiguration>
        </InventoryParameterSpec>
    </AISpec>
    <AISpec>
      <AntennaIDs>3 </AntennaIDs>
      <AISpecStopTrigger>
        <AISpecStopTriggerType>3</AISpecStopTriggerType>
        <DurationTrigger>0</DurationTrigger>
        <TagObservationTrigger>
          <TriggerType>2</TriggerType>
          <NumberOfTags>0</NumberOfTags>
          <NumberOfAttempts>2</NumberOfAttempts>
          <T>0</T>
          <Timeout>1000</Timeout>
        </TagObservationTrigger>
      </AISpecStopTrigger>
      <InventoryParameterSpec>
        <InventoryParameterSpecID>1</InventoryParameterSpecID>
        <ProtocolID>EPCGlobalClass1Gen2</ProtocolID>
        <AntennaConfiguration>
          <AntennaID>3</AntennaID>
          <C1G2InventoryCommand>
            <TagInventoryStateAware>False</TagInventoryStateAware>
            <Intermec:IntermecEnableABToggle
xmlns:Intermec="urn:www.Intermec.com">
              <EnableABToggle>True</EnableABToggle>
            </Intermec:IntermecEnableABToggle>
          </C1G2InventoryCommand>
        </AntennaConfiguration>
      </InventoryParameterSpec>
    </AISpec>
    <AISpec>
      <AntennaIDs>4 </AntennaIDs>
      <AISpecStopTrigger>
        <AISpecStopTriggerType>3</AISpecStopTriggerType>
        <DurationTrigger>0</DurationTrigger>
        <TagObservationTrigger>
          <TriggerType>2</TriggerType>
          <NumberOfTags>0</NumberOfTags>
          <NumberOfAttempts>2</NumberOfAttempts>
```

```
            <T>0</T>
            <Timeout>1000</Timeout>
          </TagObservationTrigger>
        </AISpecStopTrigger>
        <InventoryParameterSpec>
          <InventoryParameterSpecID>1</InventoryParameterSpecID>
          <ProtocolID>EPCGlobalClass1Gen2</ProtocolID>
          <AntennaConfiguration>
            <AntennaID>4</AntennaID>
            <C1G2InventoryCommand>
              <TagInventoryStateAware>False</TagInventoryStateAware>
              <Intermec:IntermecEnableABToggle
xmlns:Intermec="urn:www.Intermec.com">
                <EnableABToggle>True</EnableABToggle>
              </Intermec:IntermecEnableABToggle>
            </C1G2InventoryCommand>
          </AntennaConfiguration>
        </InventoryParameterSpec>
      </AISpec>
      <Intermec:IntermecEnableTagInZone
xmlns:Intermec="urn:www.intermec.com">
        <Enable>True</Enable>
      </Intermec:IntermecEnableTagInZone>
      <Intermec:IntermecEnableROSpecLoop
xmlns:Intermec="urn:www.intermec.com">
        <EnableSpecLooping>True</EnableSpecLooping>
      </Intermec:IntermecEnableROSpecLoop>
      <ROReportSpec>
        <ROReportTrigger>Upon_N_Tags_Or_End_Of_AISpec</
ROReportTrigger>
        <N>0</N>
        <TagReportContentSelector>
          <EnableROSpecID>True</EnableROSpecID>
          <EnableSpecIndex>True</EnableSpecIndex>
          <EnableInventoryParameterSpecID>True</
EnableInventoryParameterSpecID>
          <EnableAntennaID>True</EnableAntennaID>
          <EnableChannelIndex>True</EnableChannelIndex>
          <EnablePeakRSSI>True</EnablePeakRSSI>
          <EnableFirstSeenTimestamp>True</EnableFirstSeenTimestamp>
          <EnableLastSeenTimestamp>True</EnableLastSeenTimestamp>
          <EnableTagSeenCount>True</EnableTagSeenCount>
          <EnableAccessSpecID>True</EnableAccessSpecID>
        </TagReportContentSelector>
      </ROReportSpec>
    </ROSpec>
</ADD_ROSPEC>
```
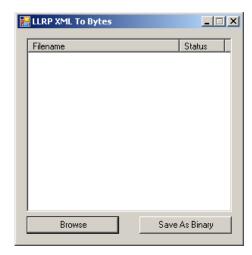
Converting ROSpec XML into Binary Format
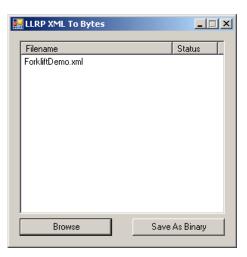
The ALE installation directory contains a .NET executable file that converts the ROSpec XML into binary format.

To convert the ROSpec XML into binary format
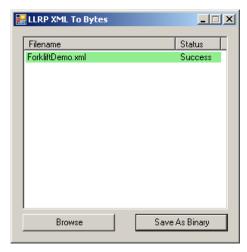
1 Copy the following files from the CV60 ALE installation directory to a PC:

- LLRPXmlToBytes.exe

- LLRP.dll

- LLRP.Intermec.dll

2 Run the LLRPXmlToBytes.exe application.

3 Click **Browse** to select the XML file containing your ADD_ROSPEC command XML.
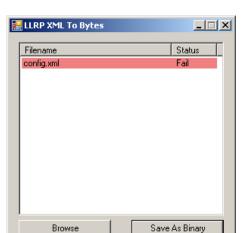
4 Click **Save As Binary** to compile the XML and save it in a file with the same basename as the XML with an extension of **.bin**. If the conversion is successful, the status will show **Success**.

If there is an error, you will receive a popup describing the error:

The status will show **Fail** to note that the conversion failed.

Predefined ECSpecs

The Forklift ARX software package provides two predefined ECSpecs that return the EPC field of each tag along with the intermec.InZoneConfidence value for each tag.

- intermec.ReadForkliftContentsImmediate
- intermec.ReadForkliftContentsTriggered

For specific information about Predefined ECSpecs, see the *Intermec ALE Engine User's Guide* (P/N 934-026-xxx). The following sections describe the predefined ECSpecs and list the XML syntax.

intermec.ReadForkliftContentsImmediate

This ECSpec begins reading tags immediately upon an ALE client Subscribe() and reports the entire tag set every 10 seconds. Tag reading ends upon an ALE client Unsubscribe(). The default report group contains tags with an intermec.InZoneConfidence value greater than 79, while all other tags are placed in the [0-79] group.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<spec creationDate="2008-08-22T10:33:22" schemaVersion="1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:ex="urn:epcglobal:xsd:1" xmlns:eax="urn:epcglobal:ale:xsd:1"
xmlns:eaw="urn:epcglobal:ale:wsdl:1" xsi:type="eax:ECSpec">

<logicalReaders>
<logicalReader>LLRPreader</logicalReader>
</logicalReaders>

<boundarySpec>
        <duration unit="MS">10000</duration>
</boundarySpec>

<reportSpecs>
<reportSpec reportName="InZoneTags" reportIfEmpty="true"
reportOnlyOnChange="false">
<reportSet set="CURRENT" />
<groupSpec>
<pattern>[0-79]</pattern>
<extension>
<fieldspec>
<fieldname>intermec.InZoneConfidence</fieldname></fieldspec>
</extension>
</groupSpec>
<output includeEPC="true" includeTag="true" includeRawHex="true"
includeRawDecimal="false" includeCount="true">
<extension>
<fieldList>
<field>
<fieldspec>
<fieldname>intermec.InZoneConfidence</fieldname>
<datatype>uint</datatype>
<format>decimal</format>
</fieldspec><name>Zone Confidence</name>
<includeFieldSpecInReport>true</includeFieldSpecInReport>
</field></fieldList></extension></output>
</reportSpec>
</reportSpecs>
</spec>
```

intermec.ReadForkliftContentsTriggered

After an ALE client Subscribe() call or Poll() call, this ECSpec begins
reading tags when the named trigger "InZoneStart" fires (which is
defined by default to occur when GPI 1 goes to the TRUE state) and
stops reading tags when the named trigger "InZoneStop" fires (which
is defined by default to occur when GPI 1 transitions to the FALSE
state). A report of the entire set of tags is sent after reading is stopped.
The default report group contains tags with an
intermec.InZoneConfidence value greater than 79, while all other tags
are placed in the [0-79] group.

```xml
<?xml version="1.0" encoding="UTF-8"?>
<spec creationDate="2008-08-22T10:33:22" schemaVersion="1.0"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema"
xmlns:ex="urn:epcglobal:xsd:1" xmlns:eax="urn:epcglobal:ale:xsd:1"
xmlns:eaw="urn:epcglobal:ale:wsdl:1" xsi:type="eax:ECSpec">
<logicalReaders>
<logicalReader>LLRPreader</logicalReader>
</logicalReaders>
<boundarySpec>
        <startTrigger>//intermec.com/trigger:InZoneStart</
startTrigger>
        <stopTrigger>//intermec.com/trigger:InZoneStop</stopTrigger>
</boundarySpec>
<reportSpecs>
<reportSpec reportName="InZoneTags" reportIfEmpty="true"
reportOnlyOnChange="false">
<reportSet set="CURRENT" />
<groupSpec>
<pattern>[0-79]</
pattern><extension><fieldspec><fieldname>intermec.InZoneConfidence</
fieldname></fieldspec></extension>
</groupSpec>
<output includeEPC="true" includeTag="true" includeRawHex="true"
includeRawDecimal="false"
includeCount="true"><extension><fieldList><field><fieldspec><fieldna
me>intermec.InZoneConfidence</fieldname><datatype>uint</
datatype><format>decimal</format></fieldspec><name>Zone Confidence</
name><includeFieldSpecInReport>true</includeFieldSpecInReport></
field></fieldList></extension></output>
</reportSpec>
</reportSpecs>
</spec>
```

Forklift Demo Application

The Forklift ARX Demo software includes a simple ALE client for demonstrating identification of tags in the forklift zone and tags outside of the zone. This optional application can be installed on the CV60 as part of the Forklift ARX installation process, and communicates with the ALE service running on the same device. For more information, see the *Intermec ALE Engine User's Guide* (P/N 934-026-xxx).

Note: The existing forklift RFID system should be configured to read all of the tags on the fork load. Forklift ARX assists with distinguishing ambient tags and tags on the fork load. It does not enhance the overall tag read performance.

Using the Demo Application
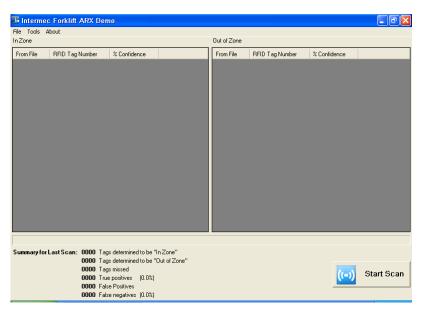
The demo application contains two panels for displaying tag data. The left panel displays the tags that are in the forklift's reading zone or In Zone. The right panel displays other tags that have been identified but are not in the forklift read zone or Out of Zone.

Note: The Intermec Forklift ARX Demo will read tags for 60 days with a self-generated demo license. For extended use, you must purchase a valid Intermec license. For more information, see **"Forklift ARX Licensing" on page 21**, and contact your Intermec Sales Representative.

To begin using the demo application

- Open the demo application by tapping on the Windows **Start** button > **Programs** > **Intermec** > **Forklift ARX**.
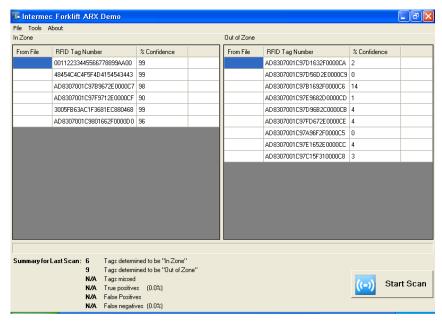
To initiate a read sequence

- Tap **Start Scan** on the lower right of the Forklift application interface. A progress bar below the two panels displays the progress of the read sequence.
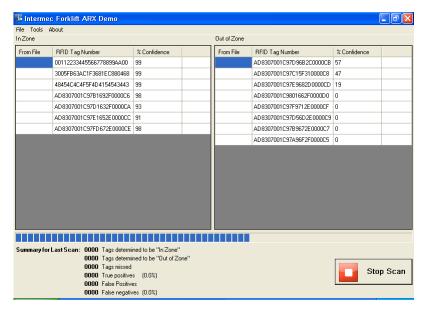
Tags with a confidence level greater than the currently selected Threshold appear in the left In Zone panel, while tags with a confidence level less than the Threshold appear on the right Out of Zone panel.

Completed read sequence with tags read In and Out of Zone

Note: The fewer total tags in a test area reduces the duration of a read sequence and improve the confidence level of the read tags.

The Summary for Last Scan appears below the progress bar after the read sequence is complete. The Summary reports the tags missed and found, and the tags from the imported tag list. For more information about imported tag list files, see **"Modifying and Importing the Tag List XML File" on page 19**.

Summary for Last Scan
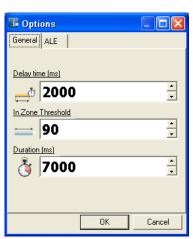
Report	Description
Tags determined to be "IN ZONE"	The number of tags found on the forklift.
Tags determined to be "OUT OF ZONE"	The number of tags found, but not on the forklift.
Tags missed	The number of tags listed in the imported tag list file, but were not found during the read sequence.
True positives	The number of tags from an imported tag list that have been determined to be In Zone.
False Positives	The number of tags not in an imported tag list that have been determined to be In Zone.
False Negatives	The number of tags listed in the imported tag list file, but determined to be Out of Zone or not on the forklift.

Modifying Demo Options

There are three parameters that you can modify to increase the success of properly identifying all the tags within the tag list file.

To modify the demo options

• In the application menu, tap **Tools** then **Options**.

The following parameters appear in the **General** tab:

- Delay time: This parameter is the duration of time (in milliseconds) the application should wait before initializing a user requested read sequence.

Note: To properly identify tags that are In Zone, the forklift must be moving on a horizontal plane away from the off the forklift tags during the entire read sequence. The Delay time parameter allows the operator to tap **Start Scan** while stationary, and have the read sequence begin once the forklift has started moving.

- In Zone Threshold: This parameter is an integer between 0 and 100 that compares each tag's confidence level that is captured during a read sequence. Tags that have a confidence level greater than the In Zone Threshold appear on the left In Zone panel, while all tags with a confidence level less than the In Zone Threshold appear on the right Out of Zone column.

- Duration: This parameter is the duration of time (in milliseconds) the reader continues reading tags after a user requested read sequence. The duration can be set up to 100000 milliseconds (100 seconds).

Note: For best performance, the duration should be kept above 5000 milliseconds (5 seconds) and below 10000 milliseconds (10 seconds). Longer read durations do not necessarily result in more accurate results.

The ALE tab in the Options window displays current hardware configuration.

Modifying and Importing the Tag List XML File

The software contains a sample XML formatted file taglist.xml, which can be found in the Forklift Demo directory and imported into the application. The imported tag list file contains a list of tags that are expected to be found In Zone. You can modify the file to contain the tag IDs in your test environment.

To modify the tag list

1 Open the XML file in a text editor such as Notepad.

2 Replace any tag ID listed between the epcid tags with a specific tag ID you are trying to read.

```
<?xml version="1.0" encoding="utf-8"?>
<tagboard>
  <label>Forklift Example Tag list</label>
  <tags>
    <tag>
      <epcid>48454C4C4F5F4D4154544323</epcid>
    </tag>
    <tag>
      <epcid>48454C4C4F5F4D415454C013</epcid>
    </tag>
    <tag>
      <epcid>48454C4C4F5F4D415454E632</epcid>
    </tag>
    <tag>
      <epcid>D5FE46A7AFC0EE1154544B91</epcid>
     </tag>
  </tags>
</tagboard>
```

3 Save the file and close.

To import a list of In Zone tags formatted as an XML file

• In the application menu, tap **File** then **Import Tag list**. Select the XML file you would like to import.

After the tag list has been imported, the tags appear on the right panel. This panel displays the RFID Tag Number along with a confidence level or "% Confidence" that the software uses to indicate how confident the tags are in or out of zone.

Forklift ARX Licensing

To purchase an Intermec Software license for your Forklift ARX software, contact your Intermec Sales Representative.

Note: If a valid Forklift ARX software license is not available, the CV60 automatically generates a 60-day demo license.

After ordering your license, you will receive an e-mail with a Software Entitlement ID. Visit the Intermec License Center at **https://license.intermec.com** and follow the wizard to generate and download your license. For more information, see the help info provided in the wizard.

After downloading the license file from the Intermec License Center, load the license in your SmartSystems Foundation Console, using SmartSystems Foundation version 3.41 or higher.

If you are exporting a license from the SmartSystems Foundation Console, place the exported license on the CV60 in the following folder: C:\SmartSystems\SSConfigDir. For more information, see the help info provided in the SmartSystems Foundation Console.

When a demo license is acquired, Forklift ARX will continue to use the demo license until it expires, regardless of the presence of a valid license. After a license is exported from the license server, it cannot be managed by the license server again, and it is permanently tied to the device.

After the 60-day demo period, if a valid license is not available, the Forklift ARX software will not report tag singulations when intermec.InZoneConfidence is requested. ALE ECSpecs that do not contain requests for intermec.InZoneConfidence will return tags as expected.

After the 60-day demo period, if a valid license is not available, the Forklift ARX demo software will show all listed tags in the imported tag list file as tags missed.

Troubleshooting

During installation, the firmware update failed.
This occurs if the CV60 loses contact with the IV7 during installation. Verify that all of the connections to the CV60 and the IV7 (including power and data connections) are properly attached.

After un-installing the Forklift ARX Demo software, the firmware update failed.
Again, this occurs if the CV60 loses connection to the IV7. Verify that all the connections to the CV60 and the IV7 (including power and data connections) are properly attached. Re-installing and un-installing the Forklift ARX Demo software insures that the software is properly removed.

What is a false-negative?
This is the term used to identify any tags that the software knows (from the tag list XML file) are supposed to be on the forklift, but whose confidence level is too low to be transferred to the In Zone panel. These tags continue to be listed in the Out of Zone panel until the reader is satisfied that the tag meets or exceeds the user-adjustable Threshold level. Decreasing the Threshold value can assist in reducing the number of reported false-negatives.

What is a false-positive?
This is the opposite of a false-negative. It is the term used to identify any tag the software knows (again, from the tag list XML file) are not supposed to be on the forklift, but whose confidence level met or exceeded the Threshold level. Increasing the Threshold value can assist in reducing the number of reported false-positives.

Our setup requires the forklift to navigate around sharp corners when pulling away and the software determines tags to be In Zone, when they are not supposed to be on the forklift pallet. What can I do to solve this problem?
To determine whether a tag is on the forklift, the tag's physical relation to the reader is stored as a parameter. When navigating around corners or making sharp turns while a read sequence is underway, the position of the unwanted tag may change very little from the point-of-view of the reader. This problem is most prevalent when the unwanted tag is located within the inner radius of the turn.

This problem is a known issue with the Forklift ARX software. As a workaround you can increase the Delay time parameter in the demo Options. This delays the read sequence until after the turn has been made.

What can I do to help improve the performance of the ARX Forklift Demo?

You can modify these three parameters in the demo Options: Duration, In Zone Threshold and Delay time. To learn more about these parameters, see **"Modifying Demo Options" on page 18**.

When more time is required to properly identify all of the tags located on the forklift, you can increase the Duration parameter. However, you should keep the Duration parameter as low as possible, as this helps decrease the chance that the system will read unwanted tags.

When unwanted tags reside within close proximity of the forklift at all times during the read sequence, the user can adjust the In Zone Threshold parameter. Signal strength is one of the parameters used to determine how confident the system is that a tag resides on the forklift. By increasing the In Zone Threshold value, you can help prevent tags that reside near the forklift (but not on the forklift) from becoming listed as In Zone. However, this may prevent the tags that reside on the forklift (but reside the furthest away from the antennas) from being listed as being In Zone. It is optimal that this parameter be adjusted as low as possible.

If the tags do not need to be read immediately, you can increase the Delay time. This will delay the read sequence for a pre-determined time. When many unwanted tags reside in close proximity to the tags being picked up by the forklift, you can wait until the forklift is no longer near the unwanted tags before initiating a read sequence. However, this may increase the amount of time it takes to process the tags. It is optimal to keep the Delay time value as low as possible.

What other parameters does the software use to differentiate between In Zone and Out of Zone tags?

Among other things, the Forklift ARX software relies upon the relative movement between the reader and the tags.

Can I simply place the tags on my forklift and move the forks up and down to determine which tags are In Zone?
The up and down movement of the forks may be too slow to provide the Forklift ARX software enough information to determine which tags are In Zone or Out of Zone. This software is designed to properly identify tags that are moving on a horizontal plane away from the off the forklift tags during the entire read sequence.

Intermec Forklift Advanced RFID Extensions (ARX) User's Guide

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