RESOURCE AND PATIENT MANAGEMENT SYSTEM

ICE Forecaster

(BI)

Installation Instructions

Version 2.48.1
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Office of Information Technology
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Table of Contents

1.0 Introduction

The HLN Consulting Immunization Calculation Engine (ICE) Forecaster is a Clinical Decision Support (CDS) engine built on the OpenCDS platform (http://www.opencds.org/) and provides immunization forecasting to health information systems.

Detailed technical information on how the ICE Forecaster works, release notes, and documentation can be found at https://www.hln.com/ice/.

The ICE Forecaster runs as an independent service that is used by the Indian Health Service (IHS) Resource and Patient Management System (RPMS) to get an evaluation of the immunizations and the next doses recommended for a patient.

The ICE Forecaster can be deployed locally, even on the same system where RPMS is installed. It can also be deployed centrally and accessed remotely if desired.

2.0 Requirements

The server where the ICE Forecaster will be installed must meet the following requirements:

1. Must be accessible from the RPMS server. RPMS services all internal requests to generate or view immunization forecasts.

2. Must have a supported Operating System: Windows Server 2012 or newer, or AIX 7 or newer.

3. Must have at least 2.5GB of system RAM available for ICE to use at all times.

   Note that this requirement is for available RAM, not total system RAM. If 32GB of RAM is installed in the server and 31GB of RAM could potentially be in use the server does not meet the minimum requirement.

2.1 Java

A supported version of the Java Runtime Environment (JRE) is required. For information on installing Java see Section 4.0.

Supported Versions:

Oracle Java SE 17 64-bit

OpenJDK 17 64-bit

Oracle Java SE 17 requires a paid subscription to Oracle's Java SE service. There is no functional difference for the ICE forecaster between Oracle Java SE and OpenJDK. This document will provide instructions for the installation and use of OpenJDK, but if you have Oracle Java SE 17 installed you may use that instead.

There are many distributions of OpenJDK from multiple vendors. As long as an OpenJDK vendor provides a version compatible with the ICE forecaster, any vendor's implementation of OpenJDK may be used to provide a JRE.

This document will provide examples using Adoptium's "Eclipse Temurin" OpenJDK implementation. This is not an endorsement of this vendor or implementation over any other. Adoptium's OpenJDK is used in examples because they provide OpenJDK builds for both AIX and Windows.

2.2 Tomcat

A supported version of Apache Tomcat is required. For information on installing Tomcat see Section 4.0.

Supported Versions:

Apache Tomcat 10 64-bit

2.3 Immunization Tracking System (BI)

BI v8.5 p1003 or newer must be installed on the RPMS server.

3.0 Special Process: Upgrade from ICE 1 to ICE 2

The Tomcat and Java JRE used with ICE 1 versions (such as 1.43.1) are not compatible with ICE versions starting with '2' (such as 2.45.2). Tomcat 1 runs on Tomcat 9 and Java 8, whereas ICE 2 versions require Tomcat 10 and JRE 17. When upgrading from ICE 1 to ICE 2, a special process must be followed.

If you are installing ICE 2.48.1 on a system which has never hosted the ICE application previously, proceed with the normal installation instructions in Section 4.0. If an ICE 2 version is already installed and you are updating to a newer ICE 2 version, follow the normal update process in Section 5.0 .

3.1 Determine Which Applications Tomcat 9 Hosts

Tomcat can be used to serve many different applications. To check which applications are installed and running in your Tomcat instance you can review the "webapps" folder inside the Tomcat directory. The default location for Tomcat is:

- Windows–C:\Program Files\Apache Software Foundation\Tomcat 9.0\
- AIX–/usr4/tomcat9

The most common applications in the "webapps" directory are listed in Table 3-1 below. Any items located in the "webapps" directory of Tomcat which are not listed below belong to other applications. Please consult the documentation for other applications before attempting to relocate or remove them.

Table 3-1: Common Tomcat webapps items and the applications that own them

Application	Folder/File Name
Tomcat	docs examples host-manager manager ROOT
Simple Message Mover	smm smm.war
ICE Immunization Forecaster	iceweb ice-app opencds-ice

3.1.1 When Tomcat 9 only hosts ICE

If your webapps folder only contains applications from the Tomcat and ICE groups in Table 3-1 above you can uninstall Tomcat 9 entirely once you've completed the ICE 2 installation process in Section 4.0. It is recommended that you stop Tomcat 9 before installing Tomcat 10 to avoid a port conflict, then uninstall Tomcat 9 once you have confirmed that Tomcat 10 works correctly.

3.1.1.1 Tomcat 9 Uninstallation - Windows

Tomcat can be uninstalled through the standard "Programs and Features" or "Installed Apps" tool. When prompted, select "Yes" to remove all files in the application directory.

3.1.1.2 Tomcat 9 Uninstallation - AIX

First, edit the file "/var/spool/cron/crontabs/root" by running the command in Figure 3-1.

```
# crontab -e
```

Figure 3-1: Command to edit the scheduled cron jobs

As part of the standard install process for ICE, a crontab entry is created to restart Tomcat periodically. Remove any directives to restart the Tomcat 9 instance you are removing. The default path for Tomcat 9 is "/usr4/tomcat9", but this path may vary.

```
0 2 * * * /usr4/tomcat9/bin/shutdown.sh > /tmp/tomcat.out 2>&1 &&
/usr4/tomcat9/bin/startup.sh >> /tmp/tomcat.out 2>&1
```

Figure 3-2: Example of a crontab line which restarts Tomcat 9 periodically. Please note that this is a single line which has wrapped to a second line due to space constraints.

Run the Tomcat 9 shutdown script:

```
# /usr4/tomcat9/bin/shutdown.sh
```

Figure 3-3: Command to stop the Tomcat application

Finally, delete the Tomcat folder. Navigate to the folder containing your Tomcat 9 directory and delete the folder and its contents as shown in Figure 3-4 below. Replace the path to the parent directory and Tomcat 9 folder name with the appropriate path to your Tomcat install location and folder for your instance of Tomcat 9.

```
# cd /usr4
# rm -r tomcat9
```

Figure 3-4: Command to delete Tomcat 9 folder

3.1.2 When Tomcat 9 Hosts Other Applications

Between Tomcat versions 9 and 10 the Tomcat software underwent a fundamental change such that software made for one version cannot run on the other. It will be necessary to either move ICE to another server or maintain both Tomcat 9 and Tomcat 10 on the same server simultaneously.

Consult the documentation for all applications in the "webapps" directory before removing them or attempting to migrate them to Tomcat 10. The most common application run in parallel with ICE is Simple Message Mover (SMM), which as of v2.37.0 does not have a version compatible with Tomcat 10.

If Tomcat 9 and 10 will need to run concurrently on the same system, you will need to ensure that ICE is removed from Tomcat 9, and a new Tomcat 10 instance will need to be installed. Tomcat 10 will need to use a different port number than Tomcat 9, and the RPMS BI Site Parameters settings will need to be updated to send forecast requests to the new Tomcat 10 port.

3.1.2.1 Install Tomcat 10 and ICE

Follow the instructions in Section 4.0. When installing Tomcat, make sure that you configure Tomcat 10 to use a different port than Tomcat 9 uses, otherwise Tomcat 10 and Tomcat 9 will not be able to run simultaneously. Directions for configuring the Tomcat port are included in the installation instructions.

3.1.2.2 Test ICE in Tomcat 10

Ensure that the ICE forecaster software is running and accepting forecast requests by following the steps in Section 6.0. Ensure that the port you use when testing this is the new port that Tomcat 10 uses, and not the Tomcat 9 port. Verify that the version number reported by the test tool matches the version number you just installed. Do not proceed until you have confirmed the correct functioning of ICE 2.48.1 in Tomcat 10.

3.1.2.3 Update BI Site Parameters

The BI Site Parameters file controls where immunization forecast requests are sent. If Tomcat 10 is not using the default port (8080) it will be necessary to modify the BI Site Parameters to direct forecast requests to the correct port. For instructions on changing the BI immunization request port, see Section 13.2.

3.1.2.4 Test RPMS and EHR Forecasting

Once the BI Site Parameters have been updated to point to the Tomcat 10 instance, test that forecast requests are correctly generated for the BI package and the EHR Immunizations component. If immunization forecasts cannot be generated, revert the port number in BI Site Parameters to Tomcat 9's port number to restore service while troubleshooting the issue.

3.1.2.5 Stop Tomcat 9

Once you have verified that the new ICE installation is running in Tomcat 10 and servicing forecast requests, stop the Tomcat 9 application by doing the following:

Windows–Stop the "Apache Tomcat 9.0 Tomcat9" service.

AIX–Run the shutdown script "bin/shutdown.sh" under the Tomcat 9 folder.

3.1.2.6 Delete ICE folders from Tomcat 9

The folders and files belonging to ICE should be removed from the following paths related to your Tomcat 9 installation. The paths are the same under Windows and AIX.

- conf/opencds-ice
- webapps/ice-app
- webapps/iceweb
- webapps/opencds-ice

3.1.2.7 Reduce Tomcat 9 Maximum Memory (Optional)

The ICE application requires 2,560 MB of reserved RAM to operate. Removing the ICE application from Tomcat 9 means that Tomcat 9 will no longer need that memory, and Tomcat 10 will require it instead. If both Tomcat installations are configured to allow the use of large amounts of memory, the system could run out of RAM and begin swapping memory pages to disk, reducing performance for the entire system.

To reduce the memory usage of Tomcat 9, first determine the amount of memory that Tomcat 9 applications need. If SMM is the only non-Tomcat application in the Tomcat 9 "webapps" directory the default value of "256" set by Tomcat on install is acceptable. See Table 3-1 in Section 3.1 above for a list of which webapps folders belong to Tomcat. If Tomcat 9 applications do not function correctly after reducing the maximum memory value, it may be necessary to increase this value.

Windows–The maximum memory setting on Windows is controlled by the "bin\Tomcat9w.exe" application under the Tomcat install path. Go to the "Java" tab and change the "Maximum memory pool" option at the bottom of the tab to the desired value.

AIX–The maximum memory setting on AIX is controlled by an environment variable in the "bin/setenv.sh" file under Tomcat's directory. To change this value, edit Tomcat 9's "bin/setenv.sh", find the line starting with "CATALINA_OPTS=" and change the "-Xmx" argument to match the desired value. For example, if only SMM is in use on the instance of Tomcat 9, your "CATALINA_OPTS" line should look like the example in Figure 3-5 below. If additional applications are hosted by Tomcat 9, increase the "-Xmx" value from "256" to whatever value is appropriate.

```
CATALINA_OPTS="-Xms128M -Xmx256M"
```

Figure 3-5: Example setenv.sh "CATALINA_OPTS" line for Tomcat 9

3.1.2.8 Restart Tomcat 9

Start Tomcat 9 again to allow other applications to resume availability.

Windows–Start the "Apache Tomcat 9.0 Tomcat9" service.

AIX–Run the startup script "bin/startup.sh" under your Tomcat 9 path.

4.0 Installing the ICE Forecaster

The ICE Forecaster requires a 64-bit installation of Java JRE 17, and Tomcat version 10. If you already have a functioning Tomcat 10 installation, but it is not the latest version available, it is recommended that before installing or updating ICE you update Tomcat to the latest version by following the instructions in Section 8.0.

4.1 Locate Java Version and Architecture

Before beginning the installation process, it is necessary to know which version of Java JRE is installed.

4.1.1 Windows

OpenJDK instances may have vendor-specific install locations, or may come packaged as an archive, in which case the user is responsible for managing the install location and identifying the versions installed. Typically, the version number will be included as part of the JRE folder name. If the version number is not included in the folder name you can inspect the exact JRE version by reading the file named "release" in the JRE folder. This will contain a line starting with "JAVA_VERSION", which will declare the full JRE version number.

```
IMPLEMENTOR="Eclipse Adoptium"
IMPLEMENTOR_VERSION="Temurin-17.0.16+8"
JAVA_RUNTIME_VERSION="17.0.16+8"
JAVA_VERSION="17.0.16"
JAVA_VERSION_DATE="2025-07-24"
```

Figure 4-1: Example of an OpenJDK "release" file showing the JAVA_VERSION property.

The recommended path for self-managed OpenJDK installs is "C:\JVM\".

OpenJDK install paths will vary depending on your vendor. If using the Adoptium OpenJDK installer, instances will be installed in the following path:

"C:\Program Files\Eclipse Adoptium\"

4.1.2 AIX

OpenJDK builds for AIX are typically distributed as tar.gz archives, and there is no system-managed default location where JRE instances reside. This document and the AIX ICE installer script assume that all JRE instances for use by ICE will be installed to the path "/usr/lib/jvm". If no JRE versions compatible with ICE are found in this location the updater script will prompt the user to manually enter the path to a compatible JRE instance.

To check which JRE versions you have installed, run the command below.

```
# ls -1 /usr/lib/jvm
  jdk-17.0.16+8-jre
```

Figure 4-2: Verifying the JRE version on AIX

The command output example in Figure 4-2 above shows an installation of "jdk-17.0.16+8-jre". JRE 17 is a supported version, so this system has a version of Java which meets the compatibility criteria for the ICE software. If no compatible JRE is found with the command above, it will be necessary to install one. See Section 4.3.2.

4.2 Windows Installation

4.2.1 Step 1: Install Java

4.2.1.1 When Java 17 is not currently installed

To install OpenJDK 17 on Windows:

Any OpenJDK 17 implementation may be used and will follow a similar process as the instructions below for Adoptium OpenJDK. When installing OpenJDK, note the installation path. You will need the path when configuring Tomcat.

Installer:

1. Navigate to https://adoptium.net/temurin/releases/?os=windows&arch=x64&version=17&package=jre .
2. Click the button to download the .msi version.
3. Run the downloaded file to install OpenJDK 17.

4.2.1.2 When a compatible 64-bit version of Oracle Java SE 17 or OpenJDK JRE 17 is already installed

Please check for a newer JRE 17 release and install it at this time to ensure you have all available security updates. Once the newest JRE 17 version is installed you may proceed to Section 4.2.2.

4.2.1.3 When a 32-bit version of Java is currently installed

Because ICE requires more system memory than a 32-bit version of Java can supply, it is necessary to ensure that a 64-bit installation of Java is available. Instructions on the process of updating from 32-bit to 64-bit JRE can be found in Section 7.0.

4.2.2 Step 2: Install Tomcat

Before installing Tomcat, please ensure that you already have a 64-bit JRE installed. If you do not have a 64-bit JRE installed, and a 32-bit JRE is installed on the system, the Tomcat installer will install 32-bit Tomcat, which is not capable of running the ICE forecaster.

Navigate to https://tomcat.apache.org/download-10.cgi.

Download the “32-bit/64-bit Windows Service Installer”.

Install the application, following all standard installation prompts. It is recommended that the default installation path be used.

The installer will prompt you to select a JRE for Tomcat 10 to use. Select the latest JRE 17 installation as determined by Section 4.2.1 above.

If you are installing Tomcat 10 on the same system that already hosts Tomcat 9, or which has another application that binds to the default port 8080, it will be necessary to select a different listener port for Tomcat 10 during installation. The input for entering a custom listener port is labeled “HTTP/1.1 Connector Port”.

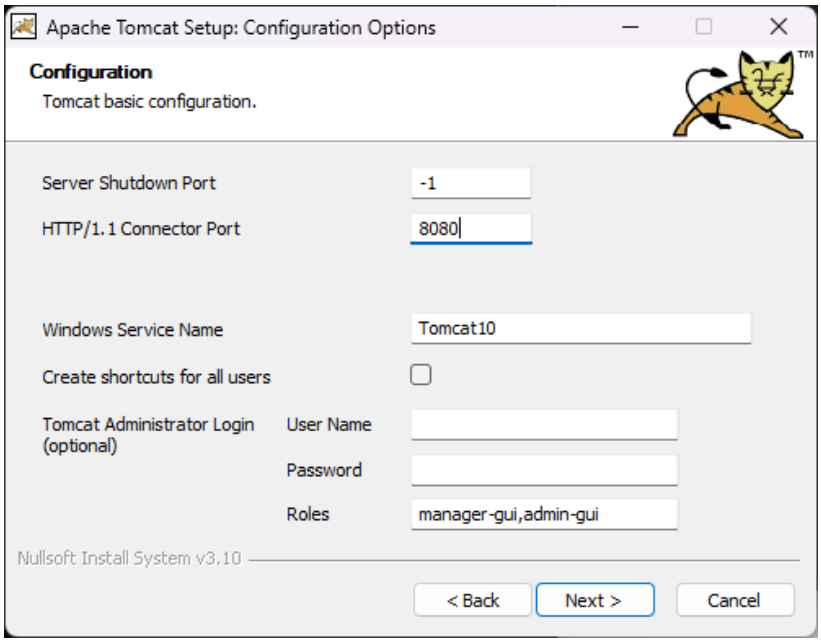

Figure 4-3: Tomcat 10 installer showing the Configuration page with port number option

Any unreserved port may be used. If you change this from the default (8080), the configuration for the RPMS BI (Immunizations) package will need to be updated with the new port number in order for RPMS and EHR to generate immunization forecasts. For instructions on configuring BI to send requests to a non-default port, see Section 3.1.2.3. In order to minimize immunization forecaster service disruptions, do not change the BI ICE port until after ICE is installed and Tomcat is running.

4.2.3 Step 3: Update Tomcat's Configuration

When Tomcat is installed, the service defaults to manual startup. You can use Windows Services to change the service to Automatic startup and stop it before installing ICE, or you can use the Tomcat configuration tool to configure the service.

1. Navigate to the Tomcat 'bin' directory (the default install location places this at C:\Program Files\Apache Software Foundation\Tomcat 10.1\bin).
2. Launch the Tomcat10w.exe executable. Click 'Yes' if the User Account Control box displays.
3. Ensure the "General" tab is selected.
4. Change "Startup Type" to "Automatic".
5. Click "Stop" (if the Stop button is enabled).
6. Click "Apply" to save changes. This window may remain open while installing ICE. It can be used to start the Tomcat webserver after installing ICE.

4.2.4 Step 4: Install ICE Forecaster

The ICE immunization forecaster application is tested and packaged for deployment at IHS facilities by the IHS Office of Information Technology (OIT). This distribution automatically configures the ICE Forecaster. Versions of ICE distributed by HLN should not be directly used to install or update the ICE Forecaster as they will not function without additional configuration.

The installer must be run on the server itself, as the installer requires environment information from the system that will be serving the ICE Forecaster. It is not sufficient to run the installer on a workstation and install it to a remote location on the server.

Due to the very long file paths and names used by the ICE forecaster it is necessary to place these files as close to the root of a drive as possible. The recommended location is C:\ICE.

To install ICE, use the following steps:

1. Create the directory “C:\ICE”
2. Download the newest version of the ICE Forecaster installer from the IHS File Transfer Protocol (FTP) site (https://www.ihs.gov/rpms/applications/ftp/).
3. Right-click on the downloaded zip file and extract the contents to “C:\ICE”
4. Navigate to C:\ICE and run the file “ICE Installation Manager.exe”. The application will automatically detect any Tomcat versions installed and the version of Java they are currently configured to use. Ensure that the selected Tomcat version and path are your intended install target.

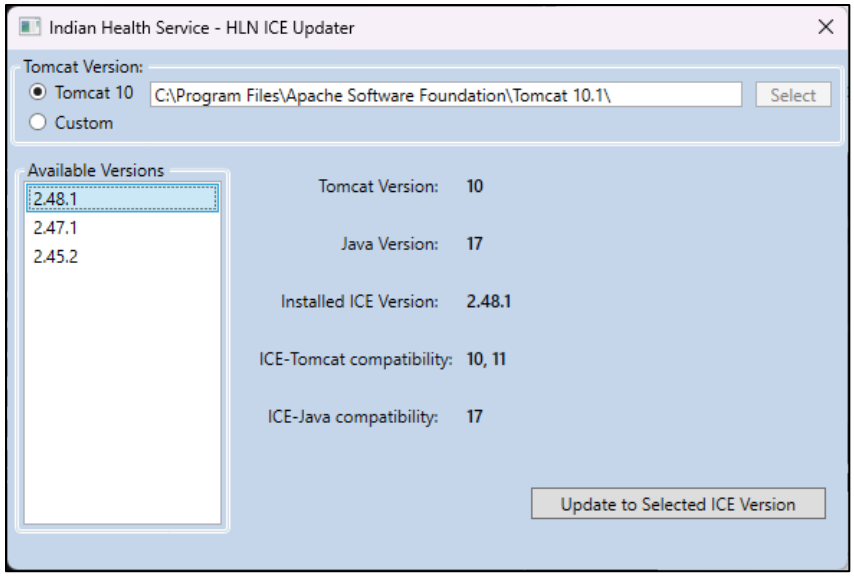

Figure 4-4: ICE Installation Manager software showing a version of Tomcat and Java which are compatible with the selected updater version

5. Click the Install button and follow any prompts. If Tomcat is currently configured to use an incompatible version of Java, you will receive a warning.

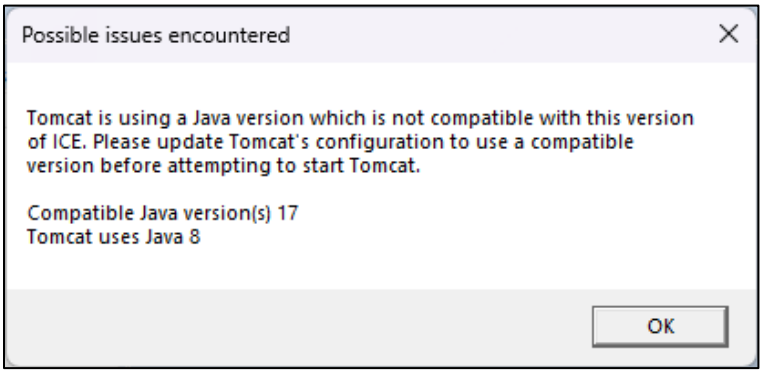

Figure 4-5: A warning message showing that Java 17 is required but the Tomcat instance is currently configured to use Java 8

Instructions on changing the JRE version that Tomcat is configured to use are provided in Section 12.0.

6. Close the installer application when the installation is completed and start the Tomcat 10 service.

4.2.5 Step 5: Installation Verification

Table 4-1: Installation Verification Checklist

Completed?	Steps
☐	Java is installed
☐	Tomcat is installed
☐	Tomcat Configuration has been updated
☐	ICE Forecaster is installed

4.3 AIX Installation

Formatting Note: This section contains terminal snippets which include a shell prompt character at the beginning of each input line (#). For example:

```
# uname
  AIX
```

Figure 4-6: Terminal snippet example

The shell prompt character is intended to make clear which lines are console input and which are the output of console commands. When entering commands, or pasting commands into the terminal, this shell prompt character should be excluded.

Path Note: During the installation and configuration process there are several default paths which will be referenced. If your system places a resource at a different location than these defaults, replace all references to the default path in these instructions with the path where the resource is located on your system.

Default Paths:

- JRE Path**:** "/usr/lib/jvm/"
- Tomcat 10 Path**:** "/usr4/tomcat10"
- ICE Path**:** "/usr4/ice"

4.3.1 Step 1: Install Dependencies

OpenJDK 17 for AIX requires the IBM XL C++ Runtime v16.1.0.7 or higher. Do not proceed with ICE installation until you have confirmed that the XL C/C++ Runtime is installed.

To determine if the XL C++ Runtime is already installed, perform the following checks. Please be aware that the commands are case-sensitive, and you must capitalize the 'C'. If both files are noted as existing and have a version starting with "16.1", then the dependency has been met. For comprehensive instructions on locating the installed version, please see IBM's documentation at: https://www.ibm.com/support/pages/xl-c-runtime-environment-and-c-utilities.

```
# lslpp -L xlC.rte
  Fileset        Level State  Type   Description (uninstaller)
  ----------------------------------------------------------------
  xlC.rte    16.1.0.10   C      F    IBM XL C++ Runtime for AIX


# lslpp -L xlC.aix61.rte
  Fileset        Level   State Type  Description (uninstaller)
  ----------------------------------------------------------------
  xlC.aix61.rte 16.1.0.10  C    F    IBM XL C++ Runtime for AIX 6.1
                                      and later
```

Figure 4-7: File xlC.rte and xlC.aix61.rte are installed at a compatible version

```
#lslpp -L xlC.aix61.rte
  Fileset        Level State  Type   Description (uninstaller)
  ----------------------------------------------------------------
lslpp: 0504-132  Fileset xlC.aix61.rte not installed.
```

Figure 4-8: File xlC.aix61.rte is not present. The XL C++ Runtime needs to be installed

The XL C++ Runtime software and its installation instructions can be found at https://www.ibm.com/support/pages/ibm-xl-cc-runtime-aix-161.

4.3.2 Step 2: Install Java

To check which version of Java JRE you have installed (if any), run the command shown in Figure 4-9.

```
# ls -1 /usr/lib/jvm
  jdk-17.0.16+8-jre
  jdk-21.0.5+11-jre
```

Figure 4-9: Identifying available JRE versions

If Java JRE 17 is not installed, you can download the latest version from IBM at this link:
developer.ibm.com/languages/java/semeru-runtimes/downloads/
Or from Adoptium at this link:
adoptium.net/temurin/releases/?os=aix&arch=ppc64&version=17&package=jre

Other vendors of OpenJDK are also available and may be used. Once the JRE is downloaded on the system, navigate to the directory containing the .tar.gz file and install it with the commands shown in Figure 4-10 (the file name and version number will vary):

```
# mkdir /usr/lib/jvm
# mv OpenJDK17U-jre_ppc64_aix_hotspot_17.0.16_8.tar.gz /usr/lib/jvm
# cd /usr/lib/jvm
# gzip -d OpenJDK17U-jre_ppc64_aix_hotspot_17.0.16_8.tar.gz
# tar -xopf OpenJDK17U-jre_ppc64_aix_hotspot_17.0.16_8.tar
```

Figure 4-10: Java JRE installation commands

Please check for a newer JRE 17 release and install it at this time to ensure you have all available security updates. The ICE installer will set Tomcat to use the newest compatible version available in "/usr/lib/jvm" when it is run.

4.3.3 Step 3: Install Tomcat

4.3.3.1 Install Tomcat

Download the binary distribution of Apache Tomcat as a tar.gz from the following site: https://tomcat.apache.org/download-10.cgi

Once downloaded, run the commands shown in Figure 4-11 to install Tomcat. Substitute the file name and Tomcat path as appropriate:

```
# gzip -d apache-tomcat-10.1.48.tar.gz
# tar -xopf apache-tomcat-10.1.48.tar
# mv apache-tomcat-10.1.48 /usr4/tomcat10
```

Figure 4-11: Tomcat extraction commands

4.3.3.2 Configure Port Numbers

If this is the only instance of Tomcat on the system, and the only webserver application on the system which uses the default port (8080) you may skip this step.

It is important that port configuration be completed before installing ICE as ICE detects this port number and embeds it in a configuration file. If the port number is changed after ICE is installed, you must re-run the ICE installer to allow it to configure ICE with the correct port number or you will be unable to communicate with the immunization forecaster.

If another application uses port 8080 (such as Tomcat 9) it is necessary to configure Tomcat 10 to use a different port number. Any available port number may be used.

Replacing ports programmatically:

Port 8081 is used in the example below (Figure 4-12). Please replace this number with whichever listener port you wish to set. From Tomcat's "conf" directory, run the following commands:

```
# cp server.xml server.xml.old
# cat server.xml.old | sed -e 's/8080/8081/g' -e 's/8005/-1/g' > server.xml
```

Figure 4-12: AIX commands to configure Tomcat to use port 8081

Replacing ports manually with a text editor:
Ports are defined in the configuration file "conf/server.xml" in the Tomcat directory. When replacing ports manually, the file may be edited in any text editor.
Listener Port:
Locate the "Connector" element and change the "port" attribute value to match the port you wish to use. In the example below the port number has been changed to "8081".

```
<Connector port="8081" protocol="HTTP/1.1"
               connectionTimeout="20000"
               redirectPort="8443"
               maxParameterCount="1000"
               />
```

Figure 4-13: Connector element from server.xml configured to use port 8081

Shutdown Port:
It may also be necessary to disable the "shutdown" port by setting it to "-1". Some distributions of Tomcat have the shutdown port disabled by default, in which case no change is necessary. The shutdown port is defined in the top element of the server.xml file:

```
<Server port="8005" shutdown="SHUTDOWN">
```

Figure 4-14: server.xml file's Server element with shutdown port 8005

If this value is set to "8005" in your server.xml file, replace "8005" with "-1".

4.3.3.3 Schedule Cron Job

To prevent the Tomcat server and ICE application from encountering memory issues, it is necessary to restart Tomcat regularly. The following instructions will install a command in the crontab file that the AIX cron utility uses to run scheduled maintenance activities. The command in Figure 4-15 on the following page will stop and then restart Tomcat every day at 2:00 a.m.

Note that the command is shown on multiple lines in this document due to space restrictions; this is a single command and should be fully entered (or copied and pasted into the terminal, excluding the terminal prompt #) before pressing the Enter key.

```
# echo "0 2 * * * /usr4/tomcat10/bin/shutdown.sh > /tmp/tomcat.out 2>&1 &&
/usr4/tomcat10/bin/startup.sh >> /tmp/tomcat.out 2>&1" >>
/var/spool/cron/crontabs/root
```

Figure 4-15: Scheduled maintenance command

Once completed, run the following command in Figure 4-16 to verify the command was added successfully.

```
# crontab -l | grep tomcat

0 2 * * * /usr4/tomcat10/bin/shutdown.sh > /tmp/tomcat.out 2>&1 &&
/usr4/tomcat10/bin/startup.sh >> /tmp/tomcat.out 2>&1
```

Figure 4-16: Added successfully verification

4.3.4 Step 4: Install the ICE Forecaster

The ICE immunization forecaster application is tested and packaged for deployment at IHS facilities by the IHS Office of Information Technology (OIT). This distribution automatically configures the ICE Forecaster. Versions of ICE distributed by HLN should not be directly used to install or update the ICE Forecaster as they will not function without additional configuration.

The first time the ICE installation script is run it will attempt to automatically detect the Tomcat install location. If no compatible Tomcat installations are found, or the user declines all of the detected paths, the user will be prompted to enter the path manually.

The installer will scan the default JRE path (/usr/lib/jvm) for compatible JRE versions and select the highest compatible version available. If the scan finds no JRE versions, it checks if Tomcat is currently configured to use a compatible JRE. If no compatible JRE has been found, the user will be prompted to enter the path manually.

If you know your Tomcat and/or Java JRE paths are not in the default locations, make sure that you have the paths written down before starting the installer script.

To install the ICE Forecaster, log in as a user with write access to the ICE installer and Tomcat directories (typically root), go to the location containing the ICE updater file, and run the commands shown in Figure 4-17 on the following page.

```
# mkdir -p /usr4/ice
# mv ICE_2.48.1.tar.gz /usr4/ice
# cd /usr4/ice
# gzip -d ICE_2.48.1.tar.gz
# tar -xopf ICE_2.48.1.tar
# chmod +x deploy_ice.sh
# ./deploy_ice.sh
```

Figure 4-17: ICE Forecaster install commands

Below (Figure 4-18) is an example of output from the installer.

```
# ./deploy_ice.sh
[Status] ICE Installation Manager (AIX)
[Status] Using most recent ICE version '2.48.1'
[Status] Tomcat versions compatible with ICE update: 10, 11
[Status] Java JRE versions compatible with ICE update: 17
[Status] Installing to Tomcat 10 at '/usr4/tomcat10'
[Status] Using JRE 17 at '/usr/lib/jvm/jdk-17.0.16+8-jre'
[Status] Clearing existing ICE directory
[Status] Installing ICE Cache application
[Status] Copying ICE files
[Status] Installing ICE test application (iceweb)
[Status] Updating ICE configuration files
[Status] Configuring Tomcat
[Status] Completed successfully. Please restart Tomcat
```

Figure 4-18: Example output of the AIX ICE installer

Once the installation is completed, restart Tomcat by running the commands in Figure 4-19.

```
# /usr4/tomcat10/bin/shutdown.sh
# /usr4/tomcat10/bin/startup.sh
```

Figure 4-19: Tomcat restart

4.3.5 Step 5: Update BI Site Parameters

If the Tomcat port was not changed during installation, this step may be skipped.

If a non-default port number is used, the configuration for the RPMS BI (Immunizations) package will need to be updated with the new port number in order for RPMS and EHR to generate immunization forecasts. For instructions on updating the BI package's port configuration, see Section 13.2.

4.3.6 Step 6: Installation Verification

Table 4-2: Installation Verification checklist

Completed?	Steps
☐	IBM XL C++ Runtime is installed

Completed?	Steps
☐	Java is installed
☐	Tomcat is installed
☐	Tomcat port is configured
☐	ICE Forecaster is installed
☐	BI Site Parameters is configured

5.0 Updating the ICE Forecaster

If ICE is currently installed and the version number begins with a "1.", please complete Section 3.0 instead of this section. Instructions on checking the installed version of ICE are in Section 6.0.

5.1 Windows

5.1.1 Confirm Java JRE Version

Ensure that the latest version of Java JRE 17 is installed as there may be important security updates. If the JRE version Tomcat is currently configured to use is not the latest version from your JRE vendor, please follow the instructions in Section 9.0.

The JRE version Tomcat uses can be found by opening the Tomcat configuration tool ("C:\Program Files\Apache Software Foundation\Tomcat\bin\Tomcat10w.exe"), going to the "Java" tab, and looking at the "Java Virtual Machine" path. The JRE version number should be part of the JRE path.

5.1.2 Confirm Tomcat 10 Version

Search for "Tomcat" in Apps and Features or Installed Apps and confirm that the installed version matches the latest version listed on the Tomcat 10 website: https://tomcat.apache.org/download-10.cgi

If your version of Tomcat is out of date, please follow the instructions in Section 8.0.

5.1.3 Update ICE

1. Download the newest version of the ICE Forecaster installer.
2. Extract the downloaded ICE installer zip ("ICE 2.48.1.zip") to C:\ICE.
3. Navigate to "C:\ICE" and run "ICE Installation Manager.exe".
4. The newest ICE version available will be pre-selected. Ensure that the Tomcat version the updater has pre-selected matches the Tomcat instance you wish to update. Click "Update" and follow the prompts. Close the application when the update is completed.
5. Restart the Tomcat 10 service.

5.2 AIX Update

5.2.1 Confirm Java JRE Version

Ensure that the latest Java JRE version is installed. To identify the installed JRE versions, run the command below.

```
# ls -1 /usr/lib/jvm
  jdk-17.0.16+8-jre
```

Figure 5-1: Command to list installed JRE versions

Compare the versions listed against the latest version from your JRE vendor. If there is a newer version of Java JRE available, please follow the instructions in Section 9.0.

5.2.2 Confirm Tomcat 10 Version:

Compare the version of Tomcat in the "RELEASE-NOTES" text file in your Tomcat directory against the latest release number at the Apache Tomcat site:

https://tomcat.apache.org/download-10.cgi

If your version of Tomcat is out of date, please follow the instructions in Section 8.0.

```
# grep "Apache Tomcat Version" /usr4/tomcat10/RELEASE-NOTES
    Apache Tomcat Version 10.1.48
```

Figure 5-2: Command to read "RELEASE-NOTES" file to retrieve Tomcat version number.

5.2.3 Update ICE:

Download the latest version of ICE to your system. Log in as the user Tomcat runs under (typically root), navigate to where you placed the latest version of ICE, and run the following commands in Figure 5-3.

```
# mv ICE_2.48.1.tar.gz /usr4/ice
# cd /usr4/ice
# gzip -d ICE_2.48.1.tar.gz
# tar -xopf ICE_2.48.1.tar
# chmod +x deploy_ice.sh
# /usr4/tomcat10/bin/shutdown.sh
# ./deploy_ice.sh
# /usr4/tomcat10/bin/startup.sh
```

Figure 5-3: AIX updater extraction and execution

6.0 Validating the ICE Forecaster

Once the ICE Forecaster has been installed and Tomcat is running, it is recommended that the availability of the ICE Forecaster be verified by the following procedure:

1. Open any web browser.
2. To access the ICE test website, navigate to the following URL, replacing {server} with the name or IP of the server with ICE installed, and {port} with the port number that Tomcat is configured to use (default is 8080):

   {server}:{port}/iceweb

3. The ICE test website contains a list of patients, and for each patient there is a button to generate an immunization forecast (indicated in Figure 6-1). Click the far-right button on the default patient (named “Bare, Yogii”) to generate a sample forecast.

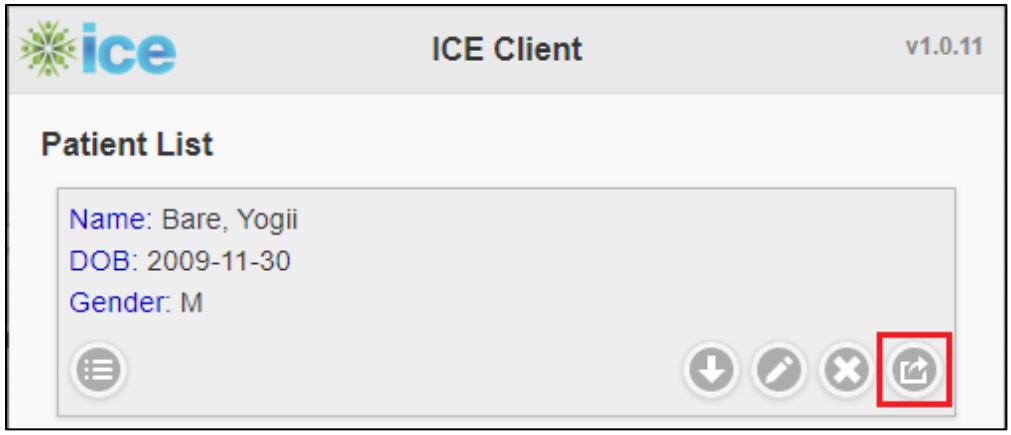

Figure 6-1: ICE test website

4. A page containing a grid of immunizations and forecast information for each immunization should display. If an error message displays instead of the immunization forecast page, then there is an issue with the ICE installation or configuration. If no error is displayed, then the ICE Forecaster has been installed and configured correctly.
5. The top of the forecast results page declares the version of the ICE forecaster. Ensure that this number matches the version which was just installed.

Figure 6-2: ICE version number in forecast result

7.0 Migrating from 32-bit Java to 64-bit Java

7.1 AIX

It is unlikely that an AIX system will be using a 32-bit JRE. If a 32-bit version is found, the process for switching to a 64-bit version of Java JRE on AIX is to simply install an AIX PPC64-targeted version of OpenJDK to the path "/usr/lib/jvm", then run the ICE updater. The ICE updater will automatically configure Tomcat to use the 64-bit JRE.

7.2 Windows

7.2.1 Evaluate existing Tomcat applications

Please note that this only applies to migrating to a 64-bit version of the same major Tomcat version. If you are migrating ICE from a 32-bit version of Tomcat 9 to a 64-bit version of Tomcat 10, please follow the process in Section 3.0.

Migrating to 64-bit Java and Tomcat will require that existing Tomcat applications (if any) be backed up and restored after 64-bit Tomcat is installed.

Tomcat is a web server application which can serve many different applications, including applications not authored or supported by IHS. Any applications installed in your 32-bit Tomcat webapps directory (C:\Program Files (x86)\Apache Software Foundation\Tomcat 10.1\webapps) will be affected by migrating to 64-bit Java and Tomcat.

The ICE application should be removed and reinstalled in the new Tomcat instance. Any other applications present in your Tomcat webapps directory should have their migration process evaluated by a system administrator before beginning the process of migrating to 64-bit Tomcat.

Do not proceed until all applications in the Tomcat webapps directory have a known migration process. Once you begin the migration process, any unmigrated applications will be rendered inoperable.

7.2.2 Back up Tomcat webapps directory

If Tomcat is already installed, it will be necessary to back up the currently installed Tomcat applications before proceeding. The following directory should be copied and stored in a safe location to be restored in Section 7.2.3 below:

- C:\Program Files (x86)\Apache Software Foundation\Tomcat 10.1\webapps

7.2.3 Install Java and Migrate Tomcat to 64-bit

Follow the Java installation process detailed in Section 4.2.1.1. Make sure that you use an Orace Java SE or OpenJDK installer and not an archive as Tomcat evaluates the presence of registry entries to determine if a 64-bit JRE is installed, and if it cannot find one it will fall back to the 32-bit version of Tomcat. The installer will add the requisite registry entries, but JREs distributed as archives will not.

Uninstall Tomcat (if it is currently installed).

Follow the Tomcat installation process detailed in Section 4.2.2. Now that a 64-bit version of Java is installed, the Tomcat installer will detect 64-bit Java and install the 64-bit version of Tomcat.

If Tomcat was installed previously, copy all files and folders in the webapps directory backed up in Section 7.2.1 above and paste them into the new 64-bit Tomcat webapps directory (C:\Program Files\Apache Software Foundation\Tomcat 10.1\webapps).

Stop the Tomcat service in the Services management panel.

Proceed with the ICE install or update process.

8.0 Upgrading to a new version of Tomcat

The process for upgrading to a new version of Tomcat is outlined sequentially below. Follow each step in the order it appears. These instructions are intended for minor version changes within the same major version, not major version changes (i.e., upgrading from “10.1.11” to “10.1.44”, not for upgrading from Tomcat 9 to 10).

8.1 Stop the Old Version of Tomcat

Before the new version of Tomcat can be installed, the old version must be stopped.

Windows–Stop the old Tomcat version’s service in the Services management panel and set the service startup type to “Manual” to prevent it from starting automatically.

AIX–Go to the old Tomcat version’s folder, enter the “bin” directory, and run the file “shutdown.sh”.

8.2 Create Port Configuration Backup

The port number that Tomcat uses is saved in the configuration file “conf/server.xml”. To ensure that the RPMS BI package and EHR can continue to communicate with ICE after Tomcat is upgraded, it is necessary to save the port configuration and restore it after Tomcat is upgraded.

Create a backup copy of the following file in a temporary location:

Windows–C:\Program Files\Apache Software Foundation\Tomcat 10.1\conf\server.xml

AIX–/usr4/tomcat10/conf/server.xml

8.3 Uninstall the Old Version of Tomcat

8.3.1 Windows

A new version of the Tomcat application cannot be installed on Windows until the previous version is removed. Please uninstall the application through the Windows "Apps and Features" or "Installed Apps" utility before proceeding.

When prompted if you wish to "Remove all files in your Apache Tomcat 10.1 Tomcat 10 directory?" select "No".

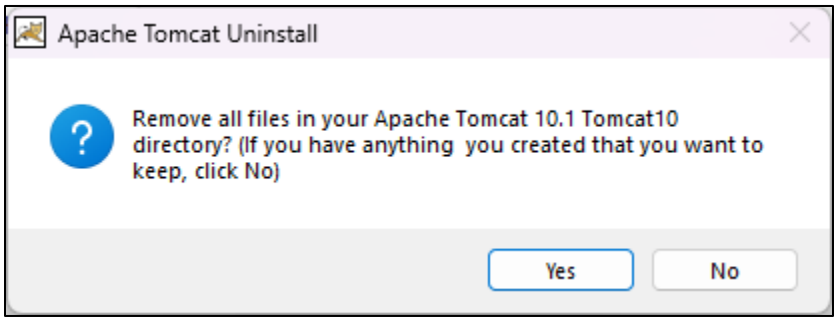

Figure 8-1: Prompt asking if all files should be removed

8.3.2 AIX

It is not necessary to uninstall the previous version of Tomcat on AIX. Following the Tomcat installation process will replace the old version of Tomcat with the new version.

8.4 Install the New Version of Tomcat

Follow the instructions for installing and configuring Tomcat.

Windows: Sections 4.2.2 and 4.2.3.

AIX: Section 4.3.3.1.

8.5 Restore Port Configuration File

Replace the "conf/server.xml" file in the new Tomcat installation's folder with the version you backed up in Section 8.2 above.

8.6 Run the ICE Installer

To install ICE under the new version of Tomcat, follow the instructions in Section 5.0.

8.7 Update the Cron Job (AIX Only)

In Section 4.3.3.3, an entry is created in the Crontab file to automatically restart Tomcat every night. When migrating to a newer version of Tomcat this must be updated to point to the new Tomcat version only if the installed folder has changed. If the same folder was used and the final file paths are the same, this step may be skipped.

While logged in as root, enter the following command:

```
# crontab -e
```

Figure 8-2: crontab command

This will open the Crontab file for root in the default text editor. Update any references to the old Tomcat path to point to the new Tomcat version's location instead.

8.8 Start the New Version of Tomcat

8.8.1 Windows

Start the new Tomcat version's service in the Services management panel and set the service startup type to "Automatic". If the service is already running, restart the service.

8.8.2 AIX

Run the file "/usr4/tomcat10/bin/startup.sh".

9.0 Upgrading to a New Version of Java JRE

9.1 Windows

1. Download the latest version of JRE 17 from your JRE/OpenJDK vendor. Download the installer version if available.

2. Run the installer if using a Windows installer. Note the path that the JRE was installed to. If installing from an archive file, extract the archive to "C:\JVM\".

3. Open the Tomcat configuration tool. If Tomcat is installed to the default path this tool will be at "C:\Program Files\Apache Software Foundation\Tomcat 10.1\bin\Tomcat10w.exe".

   Go to the "Java" tab and change the "Java Virtual Machine" path to point to the new JRE version you just installed. Point Tomcat to the "jvm.dll" file under the following path of your JRE:
   "bin\server\jvm.dll"

   If you installed the full JDK instead of just the JRE, the file will be in this path: "jre\bin\server\jvm.dll"

4. Click the "Apply" button to save the change.

5. If you wish to start Tomcat now, go to the "General" tab, stop the service if it's running, and start it again.

9.2 AIX

1. Download the latest version of JRE 17 from your JRE/OpenJDK vendor. If there are multiple packaging options, download the .tar.gz archive.

2. Extract the archive to the path: "/usr/lib/jvm"

   If you are updating Java before installing or updating ICE, proceed with the install/update instructions instead of continuing these instructions. The installer/updater will detect and use the new JRE.

3. Stop Tomcat by running the script "bin/shutdown.sh" in your Tomcat directory.

4. Re-run the latest ICE updater.

5. Start Tomcat by running the script "bin/startup.sh" in your Tomcat directory.

An example of the process is present in Figure 9-1 below. This assumes that the JRE .tar.gz file has been placed in "/usr/lib/jvm" and that the default ICE and Tomcat folders are being used. The JRE archive file name and paths may vary.

```
# cd /usr/lib/jvm
# gzip -d OpenJDK17U-jre_ppc64_aix_hotspot_17.0.16_8.tar.gz
# tar -xopf OpenJDK17U-jre_ppc64_aix_hotspot_17.0.16_8.tar
# /usr4/tomcat10/bin/shutdown.sh
# /usr4/ice/deploy_ice.sh
# /usr4/tomcat10/bin/startup.sh
```

Figure 9-1: Example of JRE update process on AIX

10.0 Advanced AIX Installer Usage

The AIX ICE installer recognizes optional command line arguments which may be helpful for installing or troubleshooting in certain circumstances.

10.1 -c–Color Mode

In color mode the message category ([Status], [DEBUG], or [ERROR]) will dictate the coloration of the text in the terminal output. If your terminal supports color output and uses a dark background color, this option can be included to make it easier to read the output.

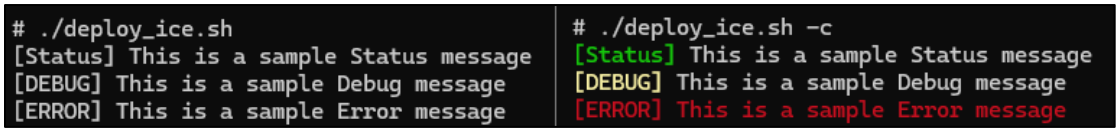

Figure 10-1: Two terminals displaying the difference in coloration with the -c argument

10.2 -d–Debug Mode

In debug mode additional messages are printed to the output which are helpful when troubleshooting an error or evaluating the paths being used by the updater.

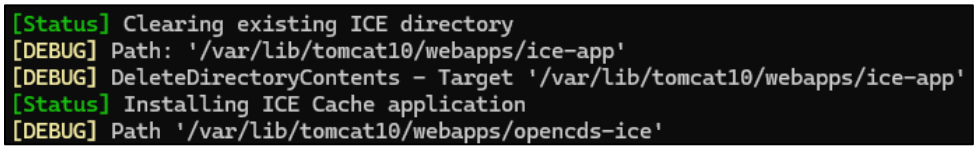

Figure 10-2: Sample output showing debug messages generated by the install script

10.3 -q–No Prompts

If this argument is present, the ICE installer will not wait for input from the user. Input is requested to confirm if the user wishes to use a detected Tomcat installation, and for manual input of a path to Tomcat or a JRE.

In the case of asking if a detected Tomcat path should be used: the script will assume ‘Yes’ and continue accordingly.

In the case of asking a user to input a location for Tomcat or a JRE: the script cannot continue without these paths, so will exit with exit code 7 without installing ICE.

10.4 -C–Keep Existing Cache Config

The ICE Cache application installed with ICE has a configuration file containing several parameters that dictate its behavior. The default updater behavior is to rebuild this configuration file using the default values each time ICE is updated. This argument can be used to preserve the full configuration file between updates to the ICE forecaster. For more information on the ICE Cache application and its configuration, see Section 11.0.

10.5 -J [path]–JRE Path Override

Sample usage: ./deploy_ice.sh -J "/usr/lib/jvm/jdk-17-testing"

This argument allows the user to specify the path to a JRE that Tomcat will be set to use. This overrides the updater's auto-detection of JRE versions and the JRE that Tomcat is currently configured to use. If this argument is present, it must be followed by a fully qualified path to the base directory of a JRE installation. The JRE version at the provided path is not validated, and if the path does not contain a compatible JRE version ICE will be unable to run.

It is recommended that this only be used when troubleshooting issues with the auto-detected Java version.

10.6 -T [path]–Tomcat Path Override

Sample usage: ./deploy_ice.sh -T "/usr4/tomcat11-testing"

This argument allows the user to specify the path to a Tomcat installation to use. If the argument is present, it must be followed by a fully qualified path to the base directory of a Tomcat installation. The Tomcat version number is not validated against the ICE update's compatibility list when this argument is provided.

The path specified by this argument does not replace the default install path that the ICE updater uses, so this argument only applies during the update where it is provided. To reset the default Tomcat path which is used when no -T argument is provided, delete the "tomcat.path" file in the ICE updater directory, or replace the contents of that file with the fully-qualified path to the Tomcat installation you wish to use.

10.7 -U [user:group]–Owner of Installed Files

Sample usage: ./deploy_ice.sh -U tomcat:tomcat

This argument allows the user to specify the user and group which will own the installed files. This supports configurations where Tomcat is run under a service account with limited privileges instead of being run by the root user. This is more secure than running Tomcat as root but requires additional setup.

The ICE installer does not require that it be executed as root, and it attempts to write files as the logged-in user. If the user running the script owns the Tomcat directory and its contents, they can update ICE without running the script as root.

If the user that owns the Tomcat directory is a service account that has no shell privileges, the installer script cannot be directly run as the service account. This argument supports running the updater script as root to install the files, then changing ownership of the installed files to the service account.

This argument accepts input in the standard “user:group” format. The provided user and group are validated, and if either is not valid the ICE updater will exit without installing ICE.

10.8 Additional Consideration–Service Manager

The ICE installer configures the Tomcat environment by setting environment variables in the Tomcat file “bin/setenv.sh”. The variables in this file are automatically added to the environment when running Tomcat through the “bin/startup.sh” script. The default configuration for AIX assumes that this will be the case, and a crontab job will be scheduled to run “bin/startup.sh” automatically.

If you have manually configured Tomcat to launch from a service manager instead (such as an AIX subsystem defined with mksys, or a Linux service managed by systemd), the service manager might be configured to launch Tomcat directly instead of using the “bin/startup.sh” script. In these instances, the environment variables which hold the path to the correct JRE and the memory options needed for ICE to run may not be set correctly.

If you are using a service manager to run ICE it is recommended that you either modify the service to run “bin/startup.sh” or modify the service to load the variables from Tomcat’s “bin/setenv.sh” file. Please consult your service manager’s documentation for information on how to modify the service target or configure environment variables prior to launching Tomcat.

11.0 ICE Cache Layer

When the ICE immunization forecaster is installed, a “cache layer” application is also installed which receives the forecast requests and checks if the same forecast request has been made recently; if it has, the ICE forecaster is bypassed and the response for the previous request is returned immediately.

When a cached response is available the time required to return the forecast is reduced from several hundred milliseconds to 2 milliseconds or less. This can result in a significant performance increase on systems where automated processes may request the same forecast many times in a short period, which can overwhelm system resources, tie up HealthShare licenses, and delay forecast requests.

11.1 Installation

The ICE cache layer application is installed by default as of ICE 2.45.2. It is highly recommended that the cache layer be used whenever possible. If you wish to disable the cache layer you can do so by creating the file “cache.off” in the ICE installer directory then performing the ICE update process.

11.2 Configuration

When the cache layer is installed, its configuration file is located under the Tomcat directory in the path “webapps/opencds-ice/META-INF/context.xml”. It contains the following options:

- endpoint–This defines the URL to the ICE application. The ice-application is installed next to the cache application under the name “ice-app”. The ICE installer automatically populates this setting with “http://127.0.0.1:[port]/ice-app/evaluate”, where [port] is the port number that Tomcat is configured to use.
- cacheSize–This determines how many forecasts are kept in the cache. The default value is 100, which should be sufficient for even very large sites. Every 100 forecasts in the cache increases the memory that Tomcat will require by approximately 10MB. If you increase this value, it will be necessary to increase the memory available to Tomcat accordingly.
- logLevel–This determines which events will write log entries to Tomcat log files when a forecast request is received. The default value is “Error”. Valid values are “Error”, “Info”, and “Debug”. It is recommended to use the default value unless troubleshooting an issue with the cache layer. Changing the log level can dramatically increase the amount of space that Tomcat logs occupy on the hard drive.

11.3 Keeping Custom Configuration When Updating ICE

The configuration file is rebuilt, and the default configuration values are set every time that ICE is updated. In the majority of instances, it will not be necessary to modify the configuration of the cache layer, and resetting to defaults will be desirable. If you make changes to the configuration that you wish to retain between updates, it is possible to do so. This may be necessary if, for example, the cache layer and ICE application are hosted on different servers.

Option 1: Windows and AIX

Copy the ICE cache layer configuration file to the ICE updater directory (typically "C:\ICE" on Windows, "/usr4/ice" on AIX) and rename the file in the ICE updater directory from "context.xml" to "IceCacheConfigOverride.xml". On AIX this filename is case-sensitive. This file will be copied to the cache application every time you update ICE. If you wish to return to the default configuration, simply rename, move, or delete this file.

Option 2: AIX only

When running the ICE installation script, the "-C" argument can be supplied to preserve the ICE cache configuration instead of rebuilding it. If you wish to return to the defaults, simply omit this argument when updating ICE. For more information on the "-C" argument see Section 10.0.

12.0 Managing Tomcat JRE Version

12.1 Windows

The JRE that Tomcat is configured to use can be managed through the graphical Tomcat configuration tool “bin\Tomcat10w.exe”. If the default install location was used, the full path to this file will be:

“C:\Program Files\Apache Software Foundation\Tomcat 10.1\bin\Tomcat10w.exe”

Run the application, select the “Java” tab, and set the path to the “Java Virtual Machine” setting. This needs to be pointed to the file “jvm.dll” in the JRE folder, which is typically in the path:

“[JRE base path]\bin\server\jvm.dll”

Depending on your JRE vendor and whether the full Java Development Kit is installed, the “bin” folder may be under another directory in the JRE base path named “jre”.

Once the new JRE path has been set, the Tomcat service must be restarted for the new JRE to be used.

12.2 AIX

The JRE that Tomcat uses is determined by the Tomcat 10 file “bin/setenv.sh”, specifically the line starting with “JAVA_HOME=”. The ICE updater manages the JRE location in this file and each time the updater runs it updates setenv.sh to point to the newest ICE-compatible JRE in the default JRE path (“/usr/lib/jvm”). If setenv.sh does not yet exist, installing the ICE forecaster will generate it and pre-configure it.

If you wish to update the JRE that Tomcat uses, the simplest method is to extract the new JRE version to the default JRE path and re-run the ICE updater. Tomcat must be restarted to use the new JRE.

If you wish to update the JRE location to point to a JRE other than the newest version in the JRE path, the ICE updater’s “-J” argument can be used to force it to use a specific JRE. See Section 10.0 for details.

13.0 Tomcat Port Management

13.1 Changing the Tomcat Listener Port

The port number that Tomcat uses can be changed by modifying the file "conf/server.xml" under the Tomcat directory. The default port is 8080, but any unreserved and unused port may be used. The process is the same for Windows and AIX.

1. Stop Tomcat.
2. Navigate to the Tomcat directory, then open the file "conf/server.xml" in a text editor.
3. Locate the element named "Connector". Make sure that the element you edit is not inside of comment tags, which start with "<!--" and end with "-->". An example of the default element in Tomcat 10 is given in Figure 13-1 below.
4. Edit the "port" attribute to the desired port number.
5. Save and close the server.xml file.
6. Start Tomcat and test to ensure that Tomcat is listening on the new port. See Section 6.0 for an example of how to test this.
7. Follow the instructions in Section 13.2 to configure BI to use the new port number.

```
64      <!-- A "Connector" represents an endpoint by which requests are received
65           and responses are returned. Documentation at :
66           HTTP Connector: /docs/config/http.html
67           AJP  Connector: /docs/config/ajp.html
68           Define a non-SSL/TLS HTTP/1.1 Connector on port 8080
69      -->
70      <Connector port="8080" protocol="HTTP/1.1"
71                 connectionTimeout="20000"
72                 redirectPort="8443"
73                 maxParameterCount="1000"
74                 />
```

Figure 13-1: Example of the Connector element with port set to 8080

13.2 Update BI Forecast Request Port

By default, Tomcat listens on port 8080, so the BI (Immunizations) RPMS package will send requests to port 8080. If Tomcat is configured to use a non-default port, such as in cases where two versions of Tomcat must run simultaneously, it will be necessary to change the port that BI sends forecast requests to.

1. Connect to RPMS "Roll and Scroll" and enter Programmer Mode.
2. Enter the command "D ^DI" and press Enter.

3. Type “Enter” and press Enter.
4. You will be prompted for the file you wish to edit. Type “BI Site Parameter” and press Enter.
5. You will be prompted to decide which field you wish to edit. Type “ICE PORT” and press Enter twice.
6. You will be prompted to enter the name of the site you wish to edit. Type your site name, or the first few letters, then press Enter. It will try to auto-complete the name if a partial name is entered. Entering a question mark will display possible values.
7. The prompt will show the current value of the ICE PORT parameter. Type the new port number for Tomcat 10 and press Enter.
8. Exit RPMS “Roll and Scroll”.
9. Ensure Tomcat 10 is running and test generating immunization forecasts in RPMS or EHR.

Below is an example of editing the BI Site Parameters to point to a non-default port.

```
D ^DI


VA FileMan 22.0


Select OPTION: ENTER OR EDIT FILE ENTRIES



INPUT TO WHAT FILE: BI SITE PARAMETER// BI SITE PARAMETER
                                        (1 entry)
EDIT WHICH FIELD: ALL// ICE PORT
THEN EDIT FIELD:

Select BI SITE PARAMETER SITE/FACILITY NAME: 2017 DEMO CLINIC TEHRD
HEADQU
ARTERS WEST       ALBUQUERQUE       01    NM    8068
         ...OK? Yes//   (Yes)

ICE PORT: 8080// 8083
```

Figure 13-2: Changing the BI Site Parameters to use port 8083 instead of 8080

14.0 Troubleshooting

14.1 How to Check if Tomcat Is Running

You can determine if Tomcat is running by directing a web browser to the endpoint Tomcat listens on. Navigate to the following URL in your browser, replacing {server} with the name or IP of the server with ICE installed, and {port} with the port number that Tomcat is configured to use (default is 8080):

http://{server}:{port}

If the Tomcat default page displays, it confirms that Tomcat is running. If you receive an error page instead it suggests that Tomcat is not running, however it is also possible that Tomcat has encountered an issue which does not prevent it from starting, but which does prevent it from responding to requests (e.g., the port is in-use by a different process).

14.1.1 Windows

Open the Services management panel and locate the service whose name starts with "Apache Tomcat" (exact name will vary depending on version of Tomcat installed). If Tomcat is running the **Status** column will display **Running**.

14.1.2 AIX

Run the following command:

```
ps -ef | grep -i catalina
```

Figure 14-1: grep tomcat command

If Tomcat is not running the output will contain only a single line for the grep command:

```
# ps -ef | grep -i catalina
root 39846216  8454722   0 08:10:14 pts/70  0:00 grep tomcat
```

Figure 14-2: Single-line grep command – Tomcat is not running

If Tomcat is running the output will also contain one or more long lines describing the Tomcat process and its start arguments:

```
# ps -ef | grep -i catalina
root 28246284 36307204   0 07:50:27 pts/89  0:00 grep tomcat
root 445      300       87 14:30    ?       00:00:30 /usr/lib/jvm/java-17-
openjdk-amd64/bin/java -
Djava.util.logging.config.file=/var/lib/tomcat10/conf/logging.properties -
Djava.util.logging.manager=org.apache.juli.ClassLoaderLogManager -
Djdk.tls.ephemeralDHKeySize=2048 -
Djava.protocol.handler.pkgs=org.apache.catalina.webresources -
Dorg.apache.catalina.security.SecurityListener.UMASK=0027 --add-
opens=java.base/java.lang=ALL-UNNAMED --add-opens=java.base/java.io=ALL-
UNNAMED --add-opens=java.base/java.util=ALL-UNNAMED --add-
opens=java.base/java.util.concurrent=ALL-UNNAMED --add-
opens=java.rmi/sun.rmi.transport=ALL-UNNAMED -Xms256M -Xmx2560M -classpath
/usr/share/tomcat10/bin/bootstrap.jar:/usr/share/tomcat10/bin/tomcat-
juli.jar -Dcatalina.base=/var/lib/tomcat10 -
Dcatalina.home=/usr/share/tomcat10 -Djava.io.tmpdir=/var/lib/tomcat10/temp
org.apache.catalina.startup.Bootstrap start
```

Figure 14-3: Example command showing a running instance of Tomcat.

14.2 Tomcat Fails to Start

14.2.1 Check the Java Installation Path

If the Java installation path has been modified, Tomcat will be unable to start. This should not occur on AIX unless the Java installation is intentionally modified, and if it does happen re-running the AIX ICE updater should detect and fix the issue. This section will focus on troubleshooting in Windows.

When the Oracle Java SE updater installs an update on Windows new versions are placed in a folder whose name contains the new version number, and the previous version of Java is uninstalled. Applications which are configured to use a previous version of Java will fail to launch until they are updated to look for Java in the new path.

14.2.1.1 Windows

Open the Tomcat configuration utility. For Tomcat 10 the default location is:

"C:\Program Files\Apache Software Foundation\Tomcat**bin**\Tomcat10w.exe"

1. Select the **Java** tab and uncheck the "Use Default" checkbox (if checked), then change the **Java Virtual Machine** field to the path of the newest compatible Java/OpenJDK version on the system. Click "Apply" and restart Tomcat, then test again.

For Oracle Java JRE:

Consult the vendor's documentation and resources for information on where JRE folders are located.

For OpenJDK:

The install location will vary depending on the OpenJDK vendor and whether you used a vendor-supplied installer or simply extracted an archive to a self-managed path. The recommended path for self-managed OpenJDK instances is "C:\JVM\".

Adoptium OpenJDK installations are stored in "**C:\Program Files\Eclipse Adoptium\"**. The full path will be:
"C:\Program Files\Eclipse Adoptium\jdk-17.[version]\bin\server\jvm.dll"

Where [version] is the latest version number you have installed. If you have the full Java development Kit (JDK) installed instead of just the JRE, the "bin" folder in the path above may be under a "jre" folder.

14.2.2 Check if Tomcat Is Already Running

If Tomcat is currently running, a second process from the same Tomcat installation will not be able to be started. To determine if another instance of Tomcat is running follow instructions in Section 14.1.

14.2.3 Check Available Memory

Tomcat requires a minimum of 2.5 gigabytes of available RAM. If there is not enough available RAM Tomcat may fail to start and may lock up or encounter errors when trying to shut down. When the ICE installer is run, it pre-configures Tomcat to reserve a sufficient amount of memory for ICE to function, but if other applications are hosted in the Tomcat instance it may be necessary to increase the memory allocated to Tomcat.

On Windows:

Open the Tomcat configuration tool at "C:\Program Files\Apache Software Foundation\Tomcat 10.1\bin\Tomcat10w.exe". Go to the "Java" tab and check the "Maximum memory pool" option. For ICE this must be at least 2560 MB.

On AIX:

The maximum memory value is set in the "bin/setenv.sh" file under Tomcat's directory. Edit this file, locate the line starting with "CATALINA_OPTS=" and set the value for the parameter "-Xmx" to the desired size.

14.2.4 Check Port Availability

By default, Tomcat will bind to port 8080. If any other applications (e.g., other instances of Tomcat, IIS, Apache) are running which have bound to the port Tomcat uses, Tomcat will start, but it will be unable to listen on the port, and the ICE Forecaster will be unable to generate immunization forecasts. If you are running Tomcat 9 and Tomcat 10 together on the same system, they must be configured to use different ports.

Ensure that the instance of Tomcat which hosts ICE is stopped before proceeding.

14.2.4.1 Windows

At a command shell or PowerShell, run the command:

```
netstat -aon | findstr {port}
```

Figure 14-4: Port availability command

Where {port} is the port number Tomcat is configured to use.

If the output is empty, the port is free for Tomcat to use. If the port is already in use, the last column of the output will contain the PID of the process which is using the port.

```
C:\>netstat -aon | findstr 8080
TCP    0.0.0.0:8080           0.0.0.0:0              LISTENING       93984
TCP    [::]:8080              [::]:0                 LISTENING       93984
```

Figure 14-5: Identifying the PID of the process

14.2.4.2 AIX

While logged in as root, run the command:

```
lsof -i :{port}
```

Figure 14-6: Port availability command

Where {port} is the port number Tomcat is configured to use.

If the output is empty, the port is free for Tomcat to use. If the port is already in use, the second column of the output will contain the PID of the process which is using the port.

```
# lsof -i :8080
COMMAND PID   USER   FD   TYPE DEVICE SIZE/OFF NODE NAME
java    981 tomcat   56u  IPv4  25141      0t0  TCP *:http-alt (LISTEN)
```

Figure 14-7: Identifying the PID of the process

14.3 Tomcat Is Running but Immunization Forecasts Cannot Be Generated

To verify that the ICE Forecaster is running, please follow the steps outlined in Section 6.0.

If ICE is not running, please stop Tomcat, reinstall ICE, and start Tomcat again. If the issue persists, please open a support ticket for further assistance.

15.0 Default Paths and Names

This section contains the file names and default paths for ICE, Tomcat, and Java. These may be referenced to quickly locate a path or file.

15.1 Windows

Table 15-1: ICE

Item	Default Path
Distribution File	ICE 2.48.1.zip
Installer Folder	C:\ICE
Installer Executable	ICE Installation Manager.exe

Table 15-2: Tomcat

Item	Default Path
Install Folder	C:\Program Files\Apache Software Foundation\Tomcat 10.1.48.1
Config Executable	Tomcat10w.exe

Table 15-3: Java

Item	Default Path
Install Folder	C:\JVM\

15.2 AIX

Table 15-4: ICE

Item	Default Path
Distribution File	ICE_2.48.1.tar.gz
Intermediate Tar File	ICE_2.48.1.tar
Installer Folder	/usr4/ice
Installer Script	deploy_ice.sh

Table 15-5: Tomcat

Item	Default Path
Install Folder	/usr4/tomcat10
Config Script	setenv.sh
Compatible Version	10

Table 15-6: Java

Item	Default Path
Install Folder	/usr/lib/jvm
Compatible JVM	17

Glossary

Immunization Forecaster

A software that, when provided with patient disease and immunization history, provides a schedule of upcoming or due immunizations.

Resource and Patient Management System

A decentralized integrated solution for management of both clinical and administrative information in these healthcare facilities. Flexible hardware configurations, over 50 software applications, and network communication components combine to create a comprehensive clinical, financial, and administrative solution; a solution that can stand alone or function in concert with other components as needed. Professionals in American Indian, Alaska Native, and private sector health facilities use RPMS every day to efficiently manage programs, maximize revenue generation, and most important, to provide high-quality care for patients.

Tomcat Webserver

A web hosting software provided by the Apache Software Foundation; used to host websites and web applications.

Acronym List

Acronym	Term Meaning
CDS	Clinical Decision Support
FTP	File Transfer Protocol
ICE	Immunization Calculation Engine
IHS	Indian Health Service
JDK	Java Development Kit
JRE	Java Runtime Environment
OIT	Office of Information Technology
RPMS	Resource and Patient Management System
SMM	Simple Message Mover
TCH	Texas Children's Hospital

Contact Information

If you have any questions or comments regarding this distribution, please contact the IHS IT Service Desk.

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