



RESOURCE AND PATIENT MANAGEMENT SYSTEM

TCH Forecaster Installation Instructions

(BI)

Addendum to Installation Guide and Release Notes

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Revision Changes History

Change No.	Date	Subject	Section
001	June 23, 2014	Removal of Section 2.5, step 4: "Configure EHR to Connect."	2.5
002	June 23, 2014	Updated Section 2.6 to 2.5 and removed the "The EHR is configured to connect" checklist item from the Installation Verification table.	2.6
003	August 13, 2014	Added Section 2.4 - Step 3 (instructions on ensuring that the server has Internet access and if it doesn't, instructions on how to manually download and install the TCH Forecaster) Added a troubleshooting section that gives details on where to find the logs that the TCH Forecaster creates. Added instructions on how to run the TCH Forecaster manually outside of the Tomcat.	Section 2.4
004	September 14, 2015	Added a new Section 4.1 and Section 4.2 covering memory usage issues and testing performance of the forecaster.	Section 4.1 moved to 4.3. Section 4.1 and 4.2 added.

1.0 Introduction

The Texas Children's Hospital (TCH) Forecaster is a Clinical Decision Support (CDS) engine for immunizations. It provides evaluations and forecasts for immunization records using both the adult and childhood standard schedules as defined by the Centers for Disease Control and Prevention's (CDC) Advisory Committee on Immunization Practices (ACIP).

Detailed technical information on how the TCH Forecaster works, release notes, and documentation can be found at <http://tchforecasttester.org/>.

1.1 System Architecture

The TCH Forecaster is written in Java and runs as an independent service and is accessed by the Electronic Health Record (EHR) system by a plain TCP/IP connection. The EHR submits a text-based, formatted string of data that includes the patient's date of birth (DOB) and vaccination history, and the TCH Forecaster returns a text-based, formatted string of data that includes an evaluation of the immunizations and the next doses recommended. The TCH Forecaster does not receive enough information to identify the patient and does not store any information received.

The TCH Forecaster can be deployed locally, even on the same system as which the EHR is installed on. It can also be deployed centrally and accessed remotely if desired.

As the TCH Forecaster is written in Java, it will operate on any system that supports the most recent versions of Java.

1.2 Temporary Installation

This document details the temporary installation instructions that Indian Health Service (IHS) will utilize in 2014. TCH is building a new TCH Forecaster installation that will automatically update the TCH Forecaster with updates from TCH. Until this is available, this document will provide the details on how to install the TCH Forecaster.

2.0 Installation

The TCH Forecaster requires Java 1.6 or higher and Tomcat webserver (or equivalent Java web service). The TCH Forecaster has no minimum memory or disk space requirements beyond those required of Java and Tomcat. The TCH Forecaster itself is very small, 170kb in size, and requires the minimum amount of resources to operate.

2.1 Note for Simple Message Mover (SMM) Users

If you have already installed and are using SMM skip to Step 3 Download TCH Forecaster. The TCH Forecaster can run under the same Tomcat installation that SMM uses.

2.2 Step 1: Install Java

To install the latest version of Java on Windows:

1. Navigate to <https://www.java.com/en/>.
2. Click **Free Java Download**.
3. Click **Agree and Start Free Download**.
4. Run the download file and allow the installation to proceed.

Please note that the installation steps may differ for your operating system.

For more details on installing Java, follow the instructions on the **Help** link.

2.2.1 Installation Instructions.

For more details on downloads for other operating systems click **See All Java Downloads**.

2.3 Step 2: Install Tomcat

To install Tomcat:

1. Navigate to <http://tomcat.apache.org/download-70.cgi>.
2. Select the **Binary Distribution** for your OS. For Windows please select **32-bit/64-bit Windows Service Installer**.
3. Install the application, following all standard installation prompts.
4. Start Tomcat using your operating specific methods.
 - a. For Unix-based systems, this requires running script to start Tomcat.

- b. For Windows-based systems, this requires starting Tomcat service in the service panel. Details of this are below.

2.3.1 Windows Instructions

Tomcat runs as a service in Windows. This means that it can run in the background all the time allowing the TCH Forecaster to service requests at any time. Information on how to access the service configuration panel is needed to operate the TCH Forecaster:

1. Open the Service panel by opening the Control Panel and searching in the search box for Services and selecting **View local services** or by pressing the Windows Key and R, typing **SERVICES.MSC**, and pressing Enter.
2. Tomcat will display on the list under Apache Tomcat 7.0 Tomcat7.
3. Double-click to display the service properties.
4. Set **Startup type** to **Automatic**. This is critical to ensure that Tomcat is always running even after a system reboot.
5. Notice the **Start** and **Stop** buttons. You will use these to start and stop Tomcat when needed. Every time Tomcat is started, the TCH Forecaster will download the latest TCH Forecaster from TCH. This panel can be used to essentially update your Forecaster.

2.3.2 AIX Instructions

Tomcat in AIX needs two components to function. Their respective instructions are below.

Java: To find out if Java is installed, run the following:

```
lslpp -l| grep -i java
```

Next, to find out what version:

```
ava -version
Also add to path o cd /etc
o vi environment
o update path to include java o
PATH=/usr/bin:/etc:/usr/sbin:/usr/ucb:/usr/bin/X11:/usr/java71_64/jre/bin
:/sbin:/usr/java14/jre/bin:/usr/java14/bin:/usr/cachesys:/usr/cachesys/bin:
/usr/cachesys/mgr:/usr/ensemble/bin:/usr/ensemble/mgr:/usr/
```

- Install Java: If you need to install the latest Java, download from IBM at <http://www.ibm.com/developerworks/java/jdk/aix/service.html>.
- GCC-Compiler download your version of AIX latest RPM at <http://www.perzl.org/aix/index.php?n=Main.Gcc#v4.8.2>.

- To install an open source application type the following:

```
o rpm -Uhv /usr5/ gcc-4.8.2-1.aix7.1.ppc.rpm
```

- Install Tomcat: Unzip and extract the Apache binary distribution downloaded from <http://tomcat.apache.org/download-70.cgi> and follow the instructions:

```
o gunzip /usr5/ apache-tomcat-7.0.53.tar.gz
o tar -xopf /usr5/ apache-tomcat-7.0.53.tar
o cd apache-tomcat-7.0.52
o ll
-rw-r--r-- 1 root system 56812 Feb 12 22:31 LICENSE
-rw-r--r-- 1 root system 1192 Feb 12 22:31 NOTICE
-rw-r--r-- 1 root system 8965 Feb 12 22:31 RELEASE-NOTES
-rw-r--r-- 1 root system 16204 Feb 12 22:31 RUNNING.txt
drwxr-xr-x 3 root system 4096 Mar 24 12:18 bin/
drwxr-xr-x 3 root system 256 Mar 20 13:47 conf/
drwxr-xr-x 2 root system 4096 Mar 20 09:54 lib/
drwxr-xr-x 2 root system 4096 Apr 09 13:10 logs/
drwxr-xr-x 2 root system 256 Mar 20 09:54 temp/
drwxr-xr-x 9 root system 4096 Mar 24 12:18 Webapps/
drwxr-xr-x 3 root system 256 Mar 20 13:47 work/
```

To start Tomcat:

```
o in tomcat directory i.e. apache-tomcat-7.0.53
o cd /bin
o type startup.sh
```

2.3.3 Install in Startup Script

Place the Tomcat start script in the startup script to ensure that if the system is restarted, Tomcat will be started.

2.3.4 Install Crontab Command

The following instructions will install a command in the crontab file that the AIX cron utility uses to run scheduled maintenance activities. The command will stop and then restart Tomcat every day at 2:00 a.m. This will ensure that Tomcat continues to run every day and initiates the process for downloading and installing new versions of the TCH Forecaster whenever it is released. By executing this command AIX will always have the latest version of the TCH Forecaster.

1. Log in to your system as “root”.
2. Cut and paste the following command onto the command line at the “#” prompt:

```
echo "0 2 * * * /usr5/tomcat/apache-tomcat-7.0.52/bin/shutdown.sh
>/tmp/tomcat.out 2>&1 && /usr5/tomcat/apache-tomcat-7.0.52/bin/startup.sh
>/tmp/tomcat.out 2>&1" >> /var/spool/cron/crontabs/root
```

3. When pasted, press Enter.

4. After pressing Enter, run `crontab -l` to verify the command has been added.

2.4 Step 3: Ensure Internet Access

The TCH Forecaster automatically downloads and installs updates to the TCH Forecaster from <http://tchforecasttester.org/tch-forecaster.jar>. To access this URL the TCH Forecaster must be able to connect from the local machine to this address on port 80.

2.4.1 Instructions for Manually Loading Forecaster (Optional)

If access through port 80 is not permitted, or Internet access is never available, then the TCH Forecaster jar must be installed and updated manually.

Note: Only complete these steps if you know that Internet access is not available and you are prepared to manually update the software each time a new version of the TCH Forecaster is released.

The following are optional steps for manually loading forecaster:

1. Download the TCH Forecaster jar from <http://tchforecasttester.org/tch-forecaster.jar>.
2. Determine the Start folder for the Tomcat instance.
 - a. On Windows machines where Tomcat is installed as a service, it is typically found here: `C:\Program Files\Apache Software Foundation\Tomcat 7.0`.
 - b. If the program is started from the `\bin` folder, then this is the Start folder.
3. Save the `tch-forecaster.jar` in the Start folder. If upgrading, overwrite the file saved there previously.
4. Continue on with the installation steps. When the TCH Forecaster is installed it will attempt to download the TCH Forecaster jar, and when it fails it will continue to look for it locally.
5. This process will need to be repeated every time an update is available in order to bring the TCH Forecaster up to date. (The TCH forecaster is updated about two or three times a year.)

2.5 Step 4: Download TCH Forecaster

Now that Tomcat is installed and running, the TCH Forecaster can be downloaded. The initial installation is 7.5 kb and it will in turn install a 170 kb package.

1. Download the TCH Forecaster from here: <http://tchforecasttester.org/tch-forecaster.html> .
 - a. Right click on the Download the TCH Forecaster link and select **Save target as...** or **Save link as...**
 - b. This should open the **File Save as** dialog on Internet Explorer or Firefox and allow the application file to be saved to your local computer.
2. The TCH Forecaster application is called “fweb.war” and must be installed into Tomcat in order to operate on your local system.
3. Save or copy the downloaded file to the Tomcat/webapps directory.
 - a. On Windows systems this is typically found here: C:\Program Files\Apache Software Foundation\Tomcat 7.0\webapps.
4. If the previous steps have been followed correctly, Tomcat will automatically create a folder named “fweb” inside the webapps folder. This happens because fweb.war is actually a zip file that Tomcat recognizes. When the fweb.war file is saved in the webapps folder, Tomcat recognizes it and expands it into a folder.
5. Once Tomcat has expanded the webapps folder, it will download a 140kb sized file named tchforecaster.jar and save it in Tomcat’s /bin folder or in Tomcat’s root folder. This file is the TCH Forecaster logic and is updated each time Tomcat is started.

After completing this step, the TCH forecaster should be ready to receive requests from the EHR.

2.6 Step 5: Installation Verification

Check if...	Installation step is complete and verified
<input type="checkbox"/>	Java is installed
<input type="checkbox"/>	Tomcat is installed and running
<input type="checkbox"/>	Tomcat is setup to automatically start (in Windows) or Tomcat start command has been added to the system startup scripts (AIX)
<input type="checkbox"/>	A TCH Forecast report can be generated in the EHR for a sample patient record
<input type="checkbox"/>	The version in the TCH Forecast report matches the latest version documented here: http://tchforecasttester.org/

3.0 Updating the TCH Forecaster

To update the TCH Forecaster with the latest version available from TCH:

- For Windows: Stop and then start the Tomcat service. The latest version will be downloaded automatically.
- For AIX: The crontab will be updating the forecaster on a daily basis, so manual updates should not be necessary. But if they are considered necessary, this can be done by stopping and then starting the Tomcat process

4.1 Memory Usage

The TCH Forecaster is a Java application and relies on Java for memory management. The TCH Forecaster requires no external resources but does use a large amount of memory to do the calculations. This memory usage is only transitory and is immediately made available again for reuse, but Java memory management generally prefers to request additional memory from the operating system before examining whether it can re-allocate memory internally first. By doing this Java maximizes performance instead of conserving memory usage. This means under a heavy forecasting load Java may request and hold a large amount of memory, even after the forecasting work has been completed. For systems dedicated to supporting only forecasting this is not an issue, but otherwise it may be wise to instruct Tomcat to cap the memory usage to a maximum. This can be done in various ways.

The following are helpful links on how to set up memory configuration in Tomcat:

- How to Change JVM Heap Settings: <http://crunchify.com/how-to-change-jvm-heap-setting-xms-xmx-of-tomcat/>
- Performance Tuning the JVM for Running Apache Tomcat: <http://www.tomcatexpert.com/blog/2011/11/22/performance-tuning-jvm-running-tomcat>

Example AIX Script

The following example was given for an AIX system. Please note this script will only work if changed to match the local system:

```
echo 'export CATALINA_OPTS="-Xms512M -Xmx1024M"' > /usr5/apache-tomcat-7.0.34/bin/setenv.sh
```

4.2 Testing TCH Forecaster Performance

The TCH Forecast Tester installation includes a performance testing tool. This tool is run separately from the TCH Forecaster and can verify how quickly the TCH Forecaster is responding to requests across TCP/IP.

The testing tool has the following capabilities:

- Can send a query a set number of times in sequence
- Can run multiple threads, each sending the same query again multiple times

The instructions for running it require creating a special command and running it on the Windows or AIX command line. An example script is shown:

```
java -classpath tch-forecaster.jar  
org.tch.forecast.core.server.CaretForecasterTester 20 5
```

This command creates 5 threads that run in parallel; each thread sends 20 messages in sequence. The results will look something like the following:

```
Starting IHS Caret Forecast Tester
+ thread count: 5
+ host name    : localhost
+ port number  : 6708
Will send one request after another, press Ctrl-C to break
Connecting to TCH Forecaster version 3.11.05
- Thread 5 OK 177 ms for 20 requests
- Thread 5 OK 181 ms for 20 requests
- Thread 5 OK 193 ms for 20 requests
- Thread 5 OK 195 ms for 20 requests
- Thread 5 OK 196 ms for 20 requests
```

This output indicates that each thread took 177 milliseconds (ms) to send 20 requests. This means the average response time for a single request was 177ms / 20 messages, or 8.85ms per message. From this testing it can be determined that at least 5 users should be able to make requests at the exact same time to the forecaster and receive responses back well within 10ms.

The tool has further options that can be used to run the tool remotely from the TCH Forecaster itself. Here are the options that may be added to the end of the command:

- repeat-count (shown in the example above)
- thread-count (shown in the example above)
- host-name (defaults to localhost)
- port-number (defaults to 6708)

Complete description of the command:

```
java -classpath tch-forecaster.jar
org.tch.forecast.core.server.CaretForecasterTester repeat-count [thread-
count [host-name [port-number]]]
```

4.3 Manually Operating the TCH Forecaster

Tomcat is the ideal platform to operate the TCH Forecaster, as it provides a stable environment that ensures that the TCH Forecaster is up and operating and allows the TCH Forecaster to keep itself updated.

However, the TCH Forecaster can be run independently if so desired. This is particularly useful when troubleshooting. Below are the instructions:

1. Download the TCH Forecaster jar as described above in Step 3 of Section 2.4 for manually installing the TCH Forecaster.
2. Make sure that the TCH Forecaster is not running anywhere else on the same machine. (If Tomcat is running, shut it down, particularly if the TCH Forecaster is installed and running in it.)

3. Run the following command in your command line or shell: `java -classpath tch-forecaster.jar org.tch.forecast.core.server.ForecastServer 6708`.
 - a. Java must be in the path or the name must be changed to reference where Java is.
 - b. The `-classpath` option must point to the `tch-forecaster.jar` that was downloaded. Either the command is run in the same folder as the `tch-forecaster.jar` or the command should be updated to point specifically to where the `tch-forecaster.jar` is.
 - c. The last option is the port number and should be `6708` unless the TCH Forecaster has been configured to a non-standard port.

Below is an example of what the instructions should look like:

```
C:\ >java -classpath tch-forecaster.jar
org.tch.forecast.core.server.ForecastServer 6708 TCH Forecaster: Starting
TCH Forecaster: + loading forecaster core TCH Forecaster: + loading cvx
codes
TCH Forecaster: Testing
TCH Forecaster: TCH Forecaster: + Test 1: TCH Forecaster: pass TCH
Forecaster: TCH Forecaster: + Test 2: TCH Forecaster: pass TCH Forecaster:
TCH Forecaster: + Test 3: TCH Forecaster: pass TCH Forecaster: TCH
Forecaster: + Test 4: TCH Forecaster: pass TCH Forecaster: TCH Forecaster:
+ Test 5: TCH Forecaster: pass TCH Forecaster: TCH Forecaster: + Test 6:
TCH Forecaster: pass TCH Forecaster: Connected on port 6708
```

This will continue to run and respond to requests on port 6708 until the process is terminated, which can be done by pressing Ctrl-C.

This command can be included in shell script and the TCH Forecaster can be run in production this way, but doing so has the following drawbacks:

- The application will not automatically restart if the system is restarted. Shell script would need to ensure it was restarted.
- The application will not automatically update itself as it would in Tomcat.

Acronym List

Acronym	Term Meaning
ACIP	Advisory Committee on Immunization Practices
CDC	Centers for Disease Control and Preventions
CDS	Clinical Decision Support
EHR	Electronic Health Record
IHS	Indian Health Service
OS	Operating System
RPMS	Resource and Patient Management System
TCH	Texas Children's Hospital

Contact Information

If you have any questions or comments regarding this distribution, please contact the OIT Help Desk (IHS).

Phone: (888) 830-7280 (toll free)

Web: <http://www.ihs.gov/helpdesk/>

Email: support@ihs.gov