TVSTUDY

INSTALLATION AND UPGRADE GUIDE

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version 2.2.2

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UPGRADING FROM TVSTUDY 2.2.1

The following text will guide you through the process of upgrading TVStudy 2.2.1 to the latest version, 2.2.2. (Please note that version 1.3.2 (Patched) remains the final version of the TVStudy software for purposes of the incentive auction, and is still available for download at: http://data.fcc.gov/download/incentive-auctions/OET-69/.) It is strongly recommended that you upgrade only from version 2.2.1, since upgrading from older versions of the software could require you to drop and recreate the database. Otherwise, you should Uninstall and then Install the database again using the Manage Database window, instructions for which can be found at the beginning of the TVStudy manual.

Downloading the TVStudy Files

From the FCC TVStudy website, you will need to obtain one of the two files listed below.

> **2017May16_tvstudy_mac_files.tgz** – Contains all of the necessary code and executables to run TVStudy 2.2.2 on the Mac platform.
> **2017May16_tvstudy_linux64_files.tgz** – Contains all of the necessary code and executables to run TVStudy 2.2.2 on the Linux platform.

These files have been posted to https://www.fcc.gov/oet/tvstudy and can be downloaded by the end user. The .tgz file should then be unzipped to the directory that TVStudy is contained in, overwriting some older files. The .tgz file has the file structure found on the next page. The complete TVStudy directory structure can be found on page 10. Please note that the xml/ directory should only contain the one file shown on the next page.

The Terrain Database Test and Verification Utility has been updated with TVStudy 2.1. If you did not do so when upgrading to TVStudy 2.1, you should download the new version and place its files in the dbase/ directory.

Please see the notes on page 6 before attempting to launch TVStudy 2.2.2.

It is highly recommended that Mac users running Mac OS X 10.9 ("Mavericks") or newer disable "App Nap", if they have not already done so, since that operating system feature may cause poor performance with TVStudy. To do so, open a terminal and enter this command:

```
defaults write gov.fcc.TVStudy NSAppSleepDisabled -bool YES
```

It is also possible to disable AppNap on your system entirely, but the instructions for doing so are beyond the scope of this document.

You should now be done except for configuring Ghostscript (see page 9 for Mac or pages 11-12 for Linux), unless you need to recompile TVStudy. (See page 14 for more information on recompiling TVStudy.)

TVStudy Files Download Data Structure

```
dev/
      build/                  (empty)
      Makefile
      Manifest.txt
      Manifest_dbutil.txt
      src/                    (this is the source code for compilation)
help/
      manual.pdf
lib/
      api_login.props
      cdbs_table_defs.dat
      check_install
      config.props
      convert_ned13
      dbutil.jar
      dbutil.props
      fix_application
      land_mobile.csv
      land_mobile_exclude.csv
      land_mobile_waiver.csv
      monitor_station.csv
      mysql-jdbc.jar
      pair_study_post
      pgsql-jdbc.jar
      ptelev
      ptelev.conf
      tvstudy
      tvstudy-api.jar
      tvstudy-core.jar
      tvstudy-gui.jar
      xercesImpl.jar
xml/
      TVIXCheck.xml
tvstudy.jar
```

Notes About TVStudy Upgrades

TVStudy 2.x on the Mac no longer launches using the TVStudy.app launcher and must be launched with the tvstudy.jar file or from the command line using the same method as in Linux.

Attempting to import the November 2015 CDBS Extracts (or older) provided for incentive auction-related analysis into TVStudy 2.x will result in an error that the app_tracking.dat and am_ant_sys.dat files are missing. To correct this, simply download copies of those files from the current CDBS download files on the FCC website and place them in the directory with the extracts. The datasets should then import successfully.

TVStudy 2.x now requires the Java 8 JDK. Users of the Mac can download it here:

http://www.oracle.com/technetwork/java/javase/downloads/jdk8-downloads-2133151.html

Linux users can use their normal method involving the package manager to install the `openjdk-8-jdk` package. If this is not available, Ubuntu users may need to run these commands first:

```
sudo apt-add-repository ppa:openjdk-r/ppa -y
sudo apt-get update
```

Please be sure the Java 8 JDK is installed before attempting to launch TVStudy 2.x. If you encounter problems when launching, try uninstalling older versions of Java. To uninstall Java 6 on the Mac, run these commands:

```
sudo rm -rf /System/Library/Java/JavaVirtualMachines/1.6.0.jdk
sudo rm -rf /Library/Java/JavaVirtualMachines/1.6.0*.jdk
```

To uninstall older Java versions on Linux, use the normal method involving the package manager. For example, an Ubuntu user may need to run this command:

```
sudo apt-get remove openjdk-7-jre icedtea-7-jre-jamvm openjdk-7-jre-headless
```

For Ubuntu users, please note that the FCC has now upgraded its Ubuntu installations from Ubuntu 14.04 to Ubuntu 16.04. This may cause unforeseen issues or inconsistencies for users of 14.04 versus the information contained in this installation guide. Additionally, you may now need to install the libmysqlclient20 package in order for TVStudy to run successfully. This may be the case if you receive the error message: "The study engine executable file is not properly installed. Editing may occur however no study runs will be performed."

Please note that even if you are upgrading an existing installation of TVStudy, the database upgrade process may take up to 20-30 minutes because TVStudy 2.1 requires reimportation of all Census and population data. Previous upgrades, which did not require this step, went quicker. Please do not terminate your database upgrade early if it is taking a long time. If you are upgrading from a version older than TVStudy 2.2, be sure to download and install 2017Apr_tvstudy_data_updates.tgz.

INSTALLING TVSTUDY FOR THE FIRST TIME

In most cases, installing TVStudy is straightforward; both the Mac and 64-bit Linux versions come with pre-compiled executables. Compilation instructions are included in this document in case the user is attempting to install on a 32-bit Linux or would like to recompile after making modifications. (Modifications are not recommended if the intent is to produce results matching those produced by the FCC.) On the Mac platform, Mac OS 10.6 ("Snow Leopard") or newer is required; the FCC is presently running Mac OS 10.11 ("El Capitan").

Please note that the Terrain Database Test and Verification Utility may be useful if you experience problems with terrain or other underlying data files in TVStudy 2.1. You should download the utility and place its files in the dbase/ directory.

Disclaimer: The TVStudy software was developed using MySQL Community Server version 5.5.29 and has been tested with version 5.7.15; it may or may not work with other versions. The MySQL server typically runs on the same computer as TVStudy itself, and these instructions assume that this is the case. Please note that you must have administrator privileges on your computer to complete this process; you will be prompted to enter your password several times.

Installing TVStudy on a Mac

Installing and Configuring Prerequisites

Download a copy of MySQL Community Server from: http://www.mysql.com/downloads/mysql/

Open the "mysql-5.7.15-osx10.11-x86_64.dmg" disk image file. Install the package "mysql-5.7.15-osx10.11-x86_64.pkg". Use the default install location. Be careful to note the password that MySQL sets for you; you will need it to set up MySQL for TVStudy. When it is finished installing, open System Preferences, select the "MySQL" icon, and click the button "Start MySQL Server". The box "Automatically Start MySQL Server on Startup" may be checked so the server is always running. This should not affect normal computer operations. If you do not check the box, you will have to open System Preferences and make sure the server is running before each use of TVStudy.

Launch the Terminal application. At the prompt, open the MySQL monitor by entering:

```
/usr/local/mysql/bin/mysql -u root -p
```

Enter the password you noted earlier. At the MySQL command prompt, enter the following commands, exactly as shown except for replacing the quoted text string `'pass_here'` with your desired root password.

```
ALTER USER 'root'@'localhost' IDENTIFIED BY 'pass_here';
```

Close the MySQL monitor by entering the `exit` command. You may now close the terminal window.

You may need to install Java 8 if it is not already installed. See the instructions on page 6.

Installing and Configuring TVStudy

From the FCC TVStudy website, you will need to obtain the three files listed below.

2013Jan_tvstudy_data_files.tgz – Contains all of the necessary data files.
2017Apr_tvstudy_data_updates.tgz – Contains updates to the necessary data files.
2017May16_tvstudy_mac_files.tgz – Contains all of the necessary code and executables.

Due to the large file size, **2013Jan_tvstudy_data_files.tgz** was split into seven segments of about 2 GB each. Those seven segments have been posted to https://www.fcc.gov/oet/tvstudy and can be downloaded, verified, and concatenated by the end user as described below. The resulting .tgz file is then unzipped to recover four data directories and their contents. The unzipped files are approximately 25GB in size. The seven segments can be concatenated using a concatenation utility such as Split & Concat to recreate the .tgz file.

To minimize the possibility of uncorrectable transmission errors, parity archive (PAR2) files with Reed-Solomon error correction (5% redundancy) were created. While not strictly required to recover the original .tgz file, it is recommended that the user also download the PAR2 files and use appropriate software to verify (and correct if necessary) the .tar file is complete. A number of no-cost applications are available for utilizing the PAR2 functionality to verify and correct the .tgz segment files, including MacPAR Deluxe.

You should extract the files into a directory called TVStudy/ in the /Applications/ directory. Once these files are extracted, you should have a directory structure which looks like the one shown at the end of this section. You may need to move any .dat files in the root to the data/ directory.

Three optional data files, **CDED**, **2013Mar_nlcd**, and **2017Feb_nlcd**, are also available at the URL above. These contain high-resolution terrain data for Canada (Canadian Digital Elevation Data) and the 2006 and 2011 U.S. National Land Cover Data. The CDED dataset is about 34 GB in size and the NLCD datasets are each about 2 GB. There is some overlap of the USGS National Elevation Dataset (DEM, included with the 2013Jan_tvstudy_data_files) in Canada, so the CDED dataset should not be needed except for certain studies in Canada outside the U.S.-Canada border areas. Note, however, that the FCC uses the CDED dataset for all 1-second terrain calculations involving Canada and the NED and CDED elevation data are not identical, so to match FCC analysis results, the CDED data may be required. The 2006 NLCD is used as a reference for clutter adjustments in studies using the method of OET Bulletin No. 73 and is not used in the method of OET Bulletin No. 69 or OET Bulletin No. 74.

It is highly recommended that Mac users disable "App Nap" since that operating system feature will cause poor performance with TVStudy. To do this, open a terminal and enter this command:

```
defaults write gov.fcc.TVStudy NSAppSleepDisabled -bool YES
```

It is also possible to disable AppNap on your system entirely, but the instructions for doing so are beyond the scope of this document.

You may now proceed to the Launching TVStudy section of this document on page 18.

Installing and Configuring Ghostscript

If you do not wish to create image output maps in TVStudy, you may skip this section.

In order to create image output maps in TVStudy, the Ghostscript software needs to be installed. The best way to install it is to download and run the installer for the software which can be found here: http://pages.uoregon.edu/koch/

In order to use the image output functionality in TVStudy, a symbolic link needs to be created to the ghostscript executable and placed within the lib/ directory. To do this, run the `which gs` command, which will give the location of the executable. For this example, the result of the command will be /usr/lib/gs. Then, navigate to the lib/ directory and run this command, modified to match your result:

```
ln –s /usr/lib/gs
```

TVStudy Directory Structure

```
/Applications/TVStudy/
   cache/                          (directory is initially empty)
   cdbs/
      22Feb2012/                   (this is CDBS data from February 22, 2012)
   data/
      country_poly.dat
      pop_ca_2006.dat              (this is 2006 Census data for Canada)
      pop_ca_2011.dat              (this is 2011 Census data for Canada)
      pop_ca_2016.dat              (this is 2016 Census data for Canada)
      pop_mx_2010.dat              (this is 2010 Census data for Mexico)
      pop_us_2000.dat              (this is 2000 Census data for the US)
      pop_us_2010.dat              (this is 2010 Census data for the US)
   dbase/
      cded/        (empty)         (placeholder for Canadian terrain data)
      cem/         (223 files)     (these are Mexican terrain data)
      gtopo/       (25,537 files)  (these are 30-second terrain data)
      nadcon/      (28 files)      (these are data for converting between datums)
      ned/         (1,964 files)   (these are 1-second terrain data)
      ned13/       (empty)         (placeholder for 1/3-second terrain data)
      nlcd/        (empty)         (this is a placeholder for 2006 clutter data)
      nlcd2011/    (empty)         (this is a placeholder for 2011 clutter data)
      srtm/        (719 files)     (these are SRTM terrain data)
      usgs/        (1,362 files)   (these are U.S. 3-second terrain data)
   dev/
      build/                       (empty)
      Makefile
      Manifest.txt
      Manifest_dbutil.txt
      src/                         (this is the source code for compilation)
   help/
      manual.pdf                   (instruction manual for TVStudy)
   lib/
      api_login.props                    monitor_station.csv
      cdbs_table_defs.dat                mysql-jdbc.jar
      check_install                      pair_study_post
      config.props                       pgsql-jdbc.jar
      convert_ned13                      ptelev
      dbutil.jar                         ptelev.conf
      dbutil.props                       tvstudy
      fix_applcation                     tvstudy-api.jar
      land_mobile.csv                    tvstudy-core.jar
      land_mobile_exclude.csv            tvstudy-gui.jar
      land_mobile_waiver.csv             xercesImpl.jar

   out/                            (directory is initially empty)
   xml/
      TVIXCheck.xml
   tvstudy.jar
```

Installing TVStudy on Linux

These instructions assume the use of a Debian-based Linux distribution, such as the popular Ubuntu operating system. If you are using a different distribution, you will need to adjust these instructions accordingly. Additionally, the TVStudy executable provided was compiled for a 64-bit Linux system.

Installing and Configuring Prerequisites

To begin, you will need to install some prerequisites (MySQL server, Java, and PyPAR2). In a terminal window, enter the command:

```
sudo apt-get install mysql-server openjdk-8-jre pypar2 ghostscript
libmysqlclient20
```

The system should install the prerequisite software, and should then ask you to set a root password for MySQL. Please make sure to note the root password for MySQL, as you will need it to configure and run TVStudy. If you are not prompted to create a root password, you will need to open a terminal and open the MySQL monitor by entering:

```
mysql -u root
```

(Please note that if, at this point, you are entirely unable to log into MySQL, you may have to enter MySQL in safe mode to change the password. Instructions for doing this are beyond the scope of this installation guide but can be found online.)

At the MySQL command prompt, enter the following commands, exactly as shown except for replacing the quoted text string `'pass_here'` with your desired root password.

```
ALTER USER 'root'@'localhost' IDENTIFIED BY 'pass_here';
```

Close the MySQL monitor by entering the `exit` command.

Installing and Configuring TVStudy

From the FCC TVStudy website, you will need to obtain the three files listed below.

2013Jan_tvstudy_data_files.tgz – Contains all of the necessary data.
2017Apr_tvstudy_data_updates.tgz – Contains updates to the necessary data files.
2017May16_tvstudy_linux64_files.tgz – Contains all of the necessary code and executables.

Due to the large file size, **2013Jan_tvstudy_data_files.tgz** was split into seven segments of about 2 GB each. Those seven segments have been posted to https://www.fcc.gov/oet/tvstudy and can be downloaded and concatenated by the end user. The resulting .tgz file is then unzipped to recover the four data directories and their contents. The unzipped files are approximately 25GB in size. Once the seven segments are recovered, they can be concatenated using the `cat` command to recreate the .tgz file.

A sample command to concatenate the seven pieces is:

```
cat 2013Jan_tvstudy_data_files.tgz.001 2013Jan_tvstudy_data_files.tgz.002
2013Jan_tvstudy_data_files.tgz.003 2013Jan_tvstudy_data_files.tgz.004
2013Jan_tvstudy_data_files.tgz.005 2013Jan_tvstudy_data_files.tgz.006
2013Jan_tvstudy_data_files.tgz.007 > 2013Jan_tvstudy_data_files.tgz
```

To minimize the possibility of uncorrectable transmission errors, parity archive (PAR2) files with Reed-Solomon error correction (5% redundancy) were created. While not strictly required to recover the original .tgz file, it is recommended that the user also download the PAR2 files and use appropriate software to verify (and correct if necessary) the .tar file is complete. A number of no-cost applications are available for utilizing the PAR2 functionality to verify and correct the .tgz segment files, including the PyPAR2 utility installed previously.

Once these files are extracted, you should have a directory structure which looks like the one shown at the end of this section. You may need to move any .dat files in the root to the data/ directory.

Three optional data files, **CDED**, **2013Mar_nlcd**, and **2017Feb_nlcd**, are also available at the URL above. These contain high-resolution terrain data for Canada (Canadian Digital Elevation Data) and the 2006 and 2011 U.S. National Land Cover Data. The CDED dataset is about 34 GB in size and the NLCD datasets are each about 2 GB. There is some overlap of the USGS National Elevation Dataset (DEM, included with the 2013Jan_tvstudy_data_files) in Canada, so the CDED dataset should not be needed except for certain studies in Canada outside the U.S.-Canada border areas. Note, however, that the FCC uses the CDED dataset for all 1-second terrain calculations involving Canada and the NED and CDED elevation data are not identical, so to match FCC analysis results, the CDED data may be required. The 2006 NLCD is used as a reference for clutter adjustments in studies using the method of OET Bulletin No. 73 and is not used in the method of OET Bulletin No. 69 or OET Bulletin No. 74.

In order to create image output maps in TVStudy, a symbolic link needs to be created to the ghostscript executable and placed within the lib/ directory. To do this, run the `which gs` command, which will give the location of the executable. For this example, the result of the command will be /usr/lib/gs. Then, navigate to the lib/ directory and run this command:

```
ln –s /usr/lib/gs
```

Be sure to alter the command to match your result.

If you are using a Linux installation that is not 64-bit, or otherwise determine that you need to compile TVStudy from source, please continue to page 14. Otherwise, you may advance to the Launching TVStudy section of this document on page 18.

TVStudy Directory Structure

```
cache/                              (directory is initially empty)
cdbs/
      22Feb2012/                    (this is CDBS data from February 22, 2012)
data/
      country_poly.dat
      pop_ca_2006.dat               (this is 2006 Census data for Canada)
      pop_ca_2011.dat               (this is 2011 Census data for Canada)
      pop_ca_2016.dat               (this is 2016 Census data for Canada)
      pop_mx_2010.dat               (this is 2010 Census data for Mexico)
      pop_us_2000.dat               (this is 2000 Census data for the US)
      pop_us_2010.dat               (this is 2010 Census data for the US)
dbase/
      cded/       (empty)           (placeholder for Canadian terrain data)
      cem/        (223 files)       (these are Mexican terrain data)
      gtopo/      (25,537 files)    (these are 30-second terrain data)
      nadcon/     (28 files)        (these are data for converting between datums)
      ned/        (1,964 files)     (these are 1-second terrain data)
      ned13/      (empty)           (placeholder for 1/3-second terrain data)
      nlcd/       (empty)           (this is a placeholder for 2006 clutter data)
      nlcd2011/   (empty)           (this is a placeholder for 2011 clutter data)
      srtm/       (719 files)       (these are SRTM terrain data)
      usgs/       (1,362 files)     (these are U.S. 3-second terrain data)
dev/
      build/                        (empty)
      Makefile
      Manifest.txt
      Manifest_dbutil.txt
      src/                          (this is the source code for compilation)
help/
      manual.pdf                    (instruction manual for TVStudy)
lib/
      api_login.props                     monitor_station.csv
      cdbs_table_defs.dat                 mysql-jdbc.jar
      check_install                       pair_study_post
      config.props                        pgsql-jdbc.jar
      convert_ned13                       ptelev
      dbutil.jar                          ptelev.conf
      dbutil.props                        tvstudy
      fix_applcation                      tvstudy-api.jar
      land_mobile.csv                     tvstudy-core.jar
      land_mobile_exclude.csv             tvstudy-gui.jar
      land_mobile_waiver.csv              xercesImpl.jar

out/                                (directory is initially empty)
xml/
      TVIXCheck.xml
tvstudy.jar
```

USING THE PROPAGATION MODEL API

TVStudy 2.1 and newer supports multiple propagation models. By default, TVStudy comes with three models:

1) Longley-Rice
2) FCC curves
3) Free space

While the latter two are not strictly "propagation models" in the traditional sense, the point is that they can be used as if they are propagation models on a cell-by-cell basis.

Additionally, and more importantly, TVStudy now provides an API in C such that developers outside the FCC can implement their own propagations models in TVStudy if desired. To learn more about this API, open the dev/src/model directory and read the instructions contained in the comments weaved throughout the model.c and model.h files. The inclusion of FCC curves and free space as models were designed to provide additional examples of how propagation model code could be written with the new API beyond the single Longley-Rice model that was included previously.

To compile the modified code, follow the compilation instructions on the following page.

In order to use your alternate propagation models in TVStudy, you must recompile your code and then restart TVStudy. At start-up, the TVStudy Java UI queries the C utility to determine which propagation models are available and will then display them accordingly. If the Java UI is not restarted, it will have no way of knowing that new models are available.

COMPILING TVSTUDY FROM SOURCE

These instructions assume the use of a Debian-based Linux distribution, such as the popular Ubuntu operating system. If you are using a different distribution or the Mac, you will need to adjust these instructions accordingly.

In your terminal, enter the following command:

```
sudo apt-get install openjdk-8-jdk gfortran libmysqlclient-dev
```

This will install the additional prerequisites necessary to compile TVStudy.

You are now ready to build TVStudy. Enter:

```
cd dev
make
```

Waiting a few seconds should result in newly-compiled tvstudyexecutable and JAR files. If it does not, you may need additional prerequisites or you may need to make additional modifications to dev/src/tvstudy.h or dev/Makefile in order to compile TVStudy successfully. Those instructions are beyond the scope of this document. Then enter:

```
make install
cd ..
```

These commands should place you back in the folder in which you placed the TVStudy files and allow you to continue to the "Launching TVStudy" section of this document on page 18.

Note: If you are using CentOS or another Red Hat-based operating system, you may need to adjust your Makefile. In CentOS, libmysqlclient.so is located in /usr/lib64/mysql, as opposed to /usr/lib/x86_64-linux-gnu as it is on Debian-based operating systems.

COMMENTS REGARDING TVSTUDY ON WINDOWS

An executable version of TVStudy is not provided for the Windows platform, but there is no reason to believe that it should not be possible to compile and run TVStudy on Windows with some modification to the code. As such, this section is designed to obtain the appropriate files necessary, short of actual compilation of the code. As an alternative to compiling the TVStudy source code for direct execution under Windows, the user may wish to consider installing a virtual OS environment (such as Ubuntu under Oracle's VirtualBox) and running one of the supplied executables in a virtual machine.

From the FCC TVStudy website, you will need to obtain the data files and one of the two platform-specific files listed below.

2013Jan_tvstudy_data_files.tgz – Contains all of the necessary data files required to run TVStudy successfully. All users need to download this file.
2017Apr_tvstudy_data_updates.tgz – Contains updates to the necessary data files.
2017May16_tvstudy_mac_files.tgz – Contains all of the necessary code and executables to run TVStudy on Mac OS or to compile TVStudy for Mac OS.
2017May16_tvstudy_linux64_files.tgz – Contains all of the necessary code and executables to run TVStudy on 64-bit Linux or to compile TVStudy for Linux.

Due to the large file size, **2013Jan_tvstudy_data_files.tgz** was split into seven segments of about 2 GB each. Those seven segments have been posted to https://www.fcc.gov/oet/tvstudy and can be downloaded and concatenated by the end user. The resulting .tgz file is then unzipped to recover the four directories and their contents. The unzipped files are approximately 25GB in size. The seven segments can be concatenated using 7-Zip. Once 7-Zip is installed, right-click on the first segment (.001) and choose "Extract files..." from the menu.

To minimize the possibility of uncorrectable transmission errors, the seven segments have been used to create parity archive (PAR2) files with Reed-Solomon error correction (5% redundancy). While not strictly required to recover the original .tgz file, it is recommended that the user also download the PAR2 files and use appropriate software to verify (and correct if necessary) the eight segments comprising the .tar file. A number of no-cost applications are available for utilizing the PAR2 functionality to verify and correct the .tgz segment files, such as Multipar.

Please note that you will need to install Java 8 and MySQL in order to use TVStudy. You are strongly advised to read either the Mac or Linux installation section in full in order to ensure you have the installation fully configured.

USING THE TVSTUDY DATABASE UTILITY

TVStudy has the ability to manage its internal database, as well as the datasets within it, from the command line. This gives users the ability to set TVStudy to automatically download the daily dump of LMS or CDBS by adding a job to crontab (on Linux) or by otherwise using the normal method of automating tasks (on Mac).

To access this utility directly, navigate to your TVStudy directory, and then run:

```
java -jar lib/dbutil.jar
```

This utility allows database installation, update, un-installation, and station data download and import, to be performed from a command-line environment. Running without any further commands will print usage details.

Database host and user can be provided by command option, and password entered interactively. Alternately, login information can be placed in a new properties file, lib/dbutil.props, using property keys "host", "user", "name", and "password". The "name" is optional, and is for supplying an alternate root database name for multiple installations on the same server. If "name" is not specified it defaults to "tvstudy", which is the default name used in a typical TVStudy installation. The password is stored in cleartext, so if you are concerned about password security, the file should have limited permissions, i.e. only owner read and write.

For automating the download and import process, here is an example of how to automate the download and import of LMS data every day at 5AM on Linux. Run "`crontab -e`" and then add this line to the bottom of the file, adjusted for the location of your TVStudy directory:

```
0 5 * * * cd /home/username/tvstudy && java -jar lib/dbutil.jar
download lmstv
```

Save and quit. Every day, when 5AM strikes, the LMS download and import process should occur automatically.

Important: Do not attempt to build studies or search for stations while a download is occurring, as this could lead to incomplete results.

USING THE TVSTUDY COMMAND LINE TOOL

TVStudy comes with a command line tool which exposes several of the useful internal functions of the software such that they can be run separately or scripted for other purposes. This tool is called ptelev (from its original function, to look up ground elevation at a point) and is found in the lib/ directory. To run correctly, it must be called from the root of the TVStudy installation.

The tool is configured using the lib/ptelev.conf file. This file contains various settings for the command line tool. Be sure these are set the way you want them to get the answers you expect.

The command operates in the following manner:

```
lib/ptelev <switch> <mode number> <inputs>
```

To see all of the details, run `lib/ptelev help` and you will get a full set of switches, numbers, and required inputs. The number sets which function the software performs, and these are as follows.

Mode 1 – Ground elevation at a point.
Mode 2 – Convert NAD83 coordinates to NAD27.
Mode 3 – Convert NAD27 coordinates to NAD83.
Mode 4 – Calculate HAAT from RCAMSL.
Mode 5 – Calculate HAAT from RCAGL.
Mode 6 – Determine the distance provided by the FCC Curves for given parameters.
Mode 7 – Determine the ERP required to reach a distance with FCC Curves.
Mode 8 – Calculate RCAGL from RCAMSL.
Mode 9 – Calculate RCAMSL from RCAGL.
Mode 10 – Calculate RCAGL from HAAT.
Mode 11 – Calculate RCAMSL from HAAT.
Mode 12 – Distance and bearing from point to point.
Mode 13 – Coordinates from point to a distance and bearing.
Mode 14 – UHF dipole factor adjustment.
Mode 15 – Land clutter at a point.
Mode 16 – Terrain profile from point to point.
Mode 17 – Terrain profile from a point to a distance and bearing.
Mode 18 – Field strength from point to point.
Mode 19 – Field strength from a point to a distance and bearing.

Additionally, TVStudy provides a stand-alone nadcon utility, which can be built by running `make nadcon` in the dev/ directory. This utility will run with nothing more than dbase/nadcon available, making it possible to perform NADCON conversions one by one or with a script while using very little disk space.

LAUNCHING TVSTUDY

On the Mac, launch tvstudy.jar from Finder. In Linux (or on the Mac), use a terminal window to launch:

```
java -jar tvstudy.jar
```

Please note that the TVStudy.app file provided with TVStudy 1.3.2 (Patched) and earlier no longer works properly with TVStudy 2.x. Launching tvstudy.jar from Finder (on Mac), or launching tvstudy.jar from the command line (on Linux or Mac), is now the proper method for launching TVStudy.

On the Mac, prior to launching TVStudy 2.x, you will need to install Java 8. This can be downloaded from the Oracle Java website, and instructions for its installation are found on page 6.

Upon first login, TVStudy will open the "Manage Database" window and prompt you to update your database to the latest version if you are upgrading, or install the root database for a new installation. Click "Update" or "Install," as appropriate, and it will do so automatically, taking up to about 20 minutes, though it could be more depending on the speed of your computer.

For instructions on using TVStudy, please refer to the TVStudy manual.

CHANGE LOG

Differences Between 1.3.2 (Patched) and Older Versions

The change logs for older versions of TVStudy have been removed from this document. However, the Installation and Upgrade Guide for 1.3.2 (Patched) is still available at the link below, and contains the changelog for all previous versions of TVStudy.

http://data.fcc.gov/download/incentive-auctions/OET-69/2015Oct_TVStudyInstallationGuide.pdf

Differences Between 2.0 and 1.3.2 (Patched)

The Mac version of TVStudy 2.0 can no longer use the TVStudy.app file contained with past TVStudy releases. On a Mac, TVStudy 2.0 may be started by directly opening the tvstudy.jar file from Finder, or from the command line using the same method described in the manual for Linux.

Updated the stations.csv file output during a pair study to specify NAD83 coordinates rather than NAD27 coordinates. All TVStudy outputs now have NAD83 coordinates in them.

Corrected the treatment of Digital Replacement Translators (DRTs) which were previously being treated as mutually exclusive with the parent station even when they operate on different channels. However, please note that if two DRTs are on the same channel and within 30 km of each other, they will still be treated as mutually exclusive.

Improved caching functionality when using smaller cell sizes. TVStudy now writes to cache after calculating 1,000,000 fields instead of waiting for all field calculations to be complete. This prevents TVStudy from waiting, for example, more than an hour before writing to cache when using 0.1 km cell size.

Added the ability to queue studies. This means that if you start multiple pair studies, or more non-pair studies than the amount for which memory has been allocated, TVStudy will treat them as a queue and run the studies in the order they are started.

TVStudy now outputs the parameters in a separate tvstudy_settings.txt output file, instead of at the bottom of the tvstudy.txt file. This tvstudy_settings.txt file also contains the rules used in the study.

TVStudy can now output detailed and summary tvstudy.txt files. The summary tvstudy.txt file is primarily useful with the new Interference Check study mode.

Added the ability to output KML map files as an alternative to the ESRI ShapeFile map files.

A new cell file output format is available called "Detail CSV". This creates a set of CSV files with equivalent information as the existing detail cell file format.

Map file output now includes undesired station records in the "sources" file.

Station data, e.g. CDBS, LMS, and study templates, are no longer managed from the "New Study" window. Separate "Station Data Manager" and "Template Manager" windows are now used to import, export, and generally manage station data sets and study templates. Station data may also be viewed in a separate station data search window without first creating a study and scenario.

Added the ability to import station data from LMS download files.

CDBS data imports now require additional download files, as noted in Appendix B of the TVStudy 2.0 Manual.

TVStudy can now adapt to changes in CDBS and LMS download file structures without requiring a full update to the software, as long as the changes do not directly affect the table columns used by TVStudy. For LMS data this process is fully automatic because the column names are embedded in the download files themselves. For CDBS data a new table definition file installed with TVStudy, "lib/cdbs_table_defs.dat", provides the column names. Most changes to CDBS can be handled by updating that file alone. However, with CDBS there is no "backwards compatibility"– if the table definitions file is updated, TVStudy will no longer be able import CDBS data in the earlier format(s). A potential workaround could be to keep multiple versions of the table definitions file and manually exchange the installed file as needed. Please note that TVStudy must be shut down and restarted any time this lib/cdbs_table_defs.dat file is changed.

Added the ability to create and permanently save new station records in a "User Records" data set. New records may be created from scratch, or by duplicating and modifying records from an imported station data set. Each user record is assigned a permanent ID number that may be used to locate the record again in the future. The user records data set may also be searched by call sign, etc. as with other station data sets. Currently, user records cannot be deleted.

The station data search window has greatly enhanced capabilities. This window appears when adding a single station record to a scenario in a study. The window may also appear in other contexts, such as when viewing station data outside any study. This window allows searching station data by various criteria, as before. It now also allows any record appearing in the search results to immediately be viewed in a record editor while the search window is still active. It is also possible to create and edit new records, and if appropriate, save those as user records. Individual station records may also be imported and exported using XML files.

Added the ability to conduct interference check studies, as *tv_process*, the FCC's application processing tool, does. This includes the functionality which checks distance to AM stations, distance to the border, distance to land mobile and monitoring stations, and other functions familiar to those who use *tv_process* or similar tools. Please note that while the baseline analysis mode is fully functional in this version of TVStudy, it will likely be modified in a future TVStudy release upon additional guidance from the Media Bureau.

Created a new study type for evaluating interference between FM stations using procedures analogous to those described in OET Bulletin 69. FM station data sets can be imported from CDBS download files, or FM records can be created manually within the application.

Created a new study type for evaluating interference from wireless base stations to TV station coverage, using the procedures described in OET Bulletin 74. Wireless base station data sets can be

imported from CSV files, or wireless records can be created manually within the application. In the new study type, wireless records can be added to study scenarios along with a desired TV station record and optional undesired TV stations for "masking" interference. Wireless records do not have frequency and bandwidth values when first imported, those values are assigned to all wireless records in a particular study scenario using parameters.

When a study is run, default values are now automatically applied to study parameters that don't already exist in a particular study. It is no longer necessary to manually open and save all studies after a software update has added new parameters to the default template.

Added a separate parameter for the number of radials used in calculating HAAT. The old HAAT radial switch is now used exclusively to set the number of HAAT radials used in computing the contour.

Added parameters to support a range of “Rule Extra Distances.” The extra distance is added to interference rule culling distances to ensure that initial searches done using station-to-station distances will not miss stations that are close enough to pass the station-to-cell distance check done in the actual study. The changes allow this distance to vary by desired station ERP, so smaller distances are used for stations that will have smaller service contours, reducing the number of unnecessary stations included in a search.

A new filtering capability has been added to tables that list station data records and interference rules in various user interface contexts. A set of menus appearing below the table can be used to "drill down" into the table contents by selecting filter terms by column.

Any study can now contain records from many different imported station data sets. When a study is first created an associated data set may still be selected, however that is now just a default for the user interface and is no longer required; the data set menu has a "(None)" option. Regardless of the selected default, any available data set may be chosen during searches that add records to a study scenario.

Frequency in MHz is now displayed alongside channel for TV and FM stations.

TVStudy now has a web API, and a servlet for use with Apache Tomcat is available on the TVStudy website. However, since this is an advanced function intended primarily for software developers and is not one used by OET, no support is being provided for this functionality.

Differences Between 2.0.1 and 2.0

Fixed bugs in the table filtering code affecting station record tables in the scenario editor and record search dialog. Attempting to select and take action on a record while the table content was filtered would lead to various failure conditions due to the selection not always being mapped through the filter.

Fixed bug in parameter UI, when viewing parameters in a study or template with parameters locked, the pop-up table for editing wireless culling distances would still allow values to be changed, although the changes would not be saved.

Scenario parameters are now included in scenario XML export/import.

Wireless station bandwidth now appears in study reports.

Parameters have unit labels (kW, dB, etc.) in the UI and the parameter summary report. The parameter summary is re-formatted to be more readable.

Differences Between 2.0.2 and 2.0.1

The study engine code that does the checks of land mobile protections, monitor stations, etc. for an interference-check study has been rewritten. This includes fixing the land-mobile check and adding a new check for the 74.709(e) offshore radio service protection. The report output is expanded; more details will appear in the Report tab in the UI as well as the output file. This includes the operating parameters for all sites in a DTS operation; antenna ID, name, and orientation as relevant; and showing the actual heights and ERPs even when those are derived. The list of stations potentially affected includes a distance column. For the land mobile and monitor station checks, the coordinates and other parameters have been moved to CSV data files located in the lib/ directory for easier updating in the future.

Changed record status determination logic for both CDBS and LMS to mark records with facility status FVOID as archived regardless of other flags. Also improved detection of STA status so more STA records are correctly identified.

Changed the interference-check study build logic to exclude STA records and analog Class A records, which should not have been included. This significantly reduces the number of "leaf count too high" errors.

Added check for horizontal pattern data that is all zeroes and treats that data as omni-directional.

Fixed a bug in study engine queries to eliminate an ambiguous reference error.

Differences Between 2.1 and 2.0.2

TVStudy 2.1 is the result of many months of work. This work was undertaken to fully implement the TV IX Check mode, convert the software to function entirely in the NAD83 datum, and provide new features and improved performance. During this process, much of the code in TVStudy was examined, edited, reorganized, and/or corrected along the way. As such, this changelog lists all major changes/updates but does not name every individual issue which has been addressed since the 2.0.2 release.

Interference (IX) Check

The TV Interference (IX) Check mode, initially released as a beta version in 2.0 through 2.0.2 for trial testing, has been extensively modified and now more closely matches the processes used by the older *tv_process* software. The TV IX Check study setup dialog has been removed as all of the settings can now be managed in other locations in the software. Every TV IX Check study outputs a file named "tvixstudy.dat" which mimics the output of *tv_process*. Studies in this mode conducted with TVStudy 2.0.2 or older should be discarded and recreated in TVStudy 2.1.

In the TV IX Check mode, it is now possible to name a study when run from the Java UI.

When running a TV IX Check study from the GUI and replicating the study record, you can now put multiple channel numbers in the "Rep. Channel" box using commas and dashes (e.g., "15,16,18-22"). TVStudy will automatically queue up one study run for each channel. To keep the studies from causing duplicate name errors, TVStudy adds " (on NN)" to the end of the study name, where NN is the replication channel. When creating a series of TV IX Check studies for multiple replicated channels, the study record's own channel may be included in the channel list even for a digital study record. That will cause the wizard to automatically set up a non-replicated study for the record, in addition to one or more replicated studies. This will be done only when more than one channel appears in the replication channel field; entering the same channel as a single channel input for a digital record results in an error. Entering the same channel in any manner for an analog study record is not an error; that will create a study for on-channel replication to digital service. To get a non-replicated study for an analog record the replicate option must not be checked.

TV IX Check mode supports the 1% contour increase and 5% population decrease tests that will be used during the first 90 days after the Incentive Auction Closing and Channel Reassignment Public Notice is issued. Additionally, to facilitate post-auction filings, TVStudy has the ability via a study parameter to exclude records filed before a specific date unless there is an associated baseline record on that channel. This will allow applications to be analyzed with respect to post-auction records.

There is no longer a setting to select the station data used for the AM station search in TV IX Check mode. If no suitable data set is found, the study run will note in the report output that the AM check could not be performed, then proceed with the rest of the study. (See below for more information on the AM check.)

The default study template for TV IX Check mode can be set by naming a suitable template "Interference Check". Similarly, the default output file settings can be set by naming those settings "Interference Check". It is also possible to set a default set of station data in the same manor, but it

is more likely that you will want to use the "Most recent TV" data option, which is the default if a station dataset named "Interference Check" does not exist.

Added a filing cut-off date field to the wizard dialog and web servlet form for setting up TV IX Check studies. Entering a date in this field will cause records with a sequence date on or after the cut-off date to be excluded from the study. If the study record is an LPTV/translator, the exclusion applies only to other LPTV/translator records. If the study record is full-service or Class A, the exclusion applies to all records. Note that this feature is not a "roll-back" to a previous point in time. In other words, it does not deal with records that are archived when the study is run but were not archived as of the cut-off date.

TV6<->FM

Implemented TV6<->FM interference study mode. The options for FM into DTV 6 interference are to use 73.525 directly with extrapolation to DTV service levels, or use a fixed D/U table derived from the 2007 NPR report.[1]

Geographies/Recv Pats

TVStudy can now perform analyses on individual fixed location points. These points are defined using the new "Geography Editor" that can be used for various alternate study analyses, not just points mode. Additionally, points can be analyzed using alternate user-provided receive antenna patterns. A receive pattern can have different azimuth patterns for a set of frequencies, edited in a manner similar to a matrix elevation pattern. Both geographies and receive antenna patterns can be imported and exported.

Alternate Service Areas

Added the ability to project contours by various new methods, including contours based on Longley-Rice projections, or FCC contours with a fixed distance or percentage added. In the study parameters, a default contour mode can now be set which applies to all desired stations in the study that have the default contour service area mode.

New parameters to select different methods of determining study point location(s) in each cell have been added. These are population-weighted centroid of Census points in cell (existing method), geographic center of the cell, largest Census point in cell, and all Census points in cell (each point gets actual population and a fraction of cell area based on total population in the cell). There is a second new parameter to choose whether or not to use the actual Census point location that is nearest to the previously-determined location.

Changed the undesired record search in the study engine to use the actual service area boundary instead of the "rule extra distance" approximation. However, the check of the actual boundary vs. the extra distance with a warning if the extra distance is too small still occurs, since the GUI

[1] NPR Labs. (2007). *Interference Rejection Thresholds of Consumer Digital Television Receivers on Channel 6 with FM Broadcast Signals*. Retrieved from http://www.nprlabs.org/sites/nprlabs/files/documents/reports/20071217C%20Report.pdf and it was filed on the record in docket RM-11579.

application still uses the extra distance algorithm for scenario-building searches. If the warning appears from the study engine, some undesireds may not have been included in the scenario.

Datasets

All coordinates in all station datasets are now stored in the NAD83 datum. For LMS datasets, this means TVStudy has moved from using the NAD27 fields to the NAD83 fields. For CDBS datasets, this means that TVStudy converts all of the coordinates when the dataset is imported or, for datasets already in TVStudy during the database update, at update time. A consequence of this change is that new XML exports now use different attribute names for coordinates, LATITUDE83 and LONGITUDE83, which are unambiguously NAD83. The previous attribute names LATITUDE and LONGITUDE are generally assumed to be NAD27 coordinates during import, except for wireless records which have always been NAD83. For the sake of clarity, XML import now recognizes attributes LATITUDE27/LONGITUDE27 to explicitly provide coordinates in NAD27.

"Most recent" options now appear in menus for selecting station data for a record search or study build. These options automatically select an appropriate imported data set with the most recent data. The test is based on the content of the import, not when it was imported. Most-recent items are provided for LMS TV, CDBS TV, and CDBS FM, plus a "Most recent TV" option that will select either LMS or CDBS. Wireless data sets do not contain date information so this feature is not available for those.

Imported data sets are no longer considered "in use," allowing a data set to be deleted at any time. Existing studies built from a now-deleted data set can still be used and further modified using data from any currently-available data set. However, in such a study it may not be possible to revert a record that has been made editable because the original data set is no longer available.

During LMS record translation, the city and state are now retrieved from fields in the application_facility and lkp_dtv_allotment tables, rather than the facility table. However, call signs are still retrieved from the facility table for consistency with CDBS. CDBS translation continues to use the facility table for all three pieces of information.

Call sign searches will now match regardless of leading D characters appearing in the database fields, e.g. a search for WXYZ will also match DWXYZ. However, a search for DWXYZ will not match WXYZ.

A new record status has been added for experimental facility records. The status EXP is assigned when the facility status field contains "EXPER". The EXP status is assigned regardless of the underlying APP/CP/LIC/STA status; that underlying status is no longer available.

Fixed an issue where the optional name for an imported data set was not being checked for uniqueness during import. This is now checked; however, the import does not fail if the name is not unique, the name is just not saved. The name can be changed later as needed.

TVStudy now displays CDBS-style antenna ID number for LMS records instead of a UUID string.

AM station data tables in LMS are now supported. The table files will be read during an LMS data set import if possible, however the files are not required. If the AM files are missing, the import will

continue but AM data will not be available in that data set. The AM station search done during an TV IX Check study using an LMS data set will now attempt to query the LMS AM tables. If those tables are not present, e.g. the files were not present at import, or if any error occurs during the queries, the AM check will not be performed but the study will otherwise continue. Note this feature is only partially tested because the AM files do not yet appear in LMS downloads. Sample files were used to simulate the presence of the data for testing. However, if the actual files that eventually appear in the LMS downloads do not have the same structure as the samples, future LMS imports with AM data could fail entirely. If the files are present, they must be in the expected format; apparent errors within the files are not ignored.

New "generic" data set import capability has been added. The concept here is that a generic data set is created empty, then once it exists you can import things into that set from any format supported (currently just XML). Then you can add more by importing more things in the same or different formats. In other words, the data set is not just a single fixed import, you can build a whole database by importing pieces from different sources. This is a work in progress and is expected to be updated in a future release.

Wizards/Windows

Expanded the UI for creating types of studies that pre-select a target record (i.e. TV IX Check and TV6<->FM) to allow the selected record to be replicated to a different channel before starting the study.

Changed the logic for assigning study names to studies created with the "wizard" dialogs, e.g. TV IX Check. The name entered in the dialog no longer has to be unique. When the study is actually created, if the name already exists, a numerical suffix e.g. "(123)" will be appended to make the new name unique.

The separate run windows have been replaced with a single “Run Manager” window which contains all of the runs that are active or completed and not yet removed.

Study-build dialogs now have two action buttons, “Build” and “Build & Run.” The Build button will cause the study build to occur (in the run manager as usual) but without a subsequent run of the study. Build & Run builds and then runs the study as in previous versions.

Addressed editing issues in the scenario and record editors in TV IX Check, wireless -> TV, and TV6<->FM studies. To prevent the scenario from inadvertently being made invalid, the channel and geographic location of the study record now cannot be changed even if the record is otherwise editable. This includes not allowing the record to be replicated, or if it is already a replication, not allowing it to be reverted to the original channel. Also, for a DTS record, individual DTS sites cannot be added or removed.

Output

TVStudy now sets the output file selection in an output settings window. It is possible to save preferred configurations of output files and map files and choose them at run-time or while configuring the study. The output file options and the map file options are on separate tabs.

The scenario name is now written in the KML output file <NAME> element instead of just the file name.

TV IX Check study runs now have the option to only output detail files as requested for scenarios that fail the interference check.

Restored antenna ID value to parameters CSV file, and when replicating by equal-area method, the antenna ID from the original record is preserved.

Created composite coverage output as a new option in the output file settings for examining combined coverage across multiple desired station records. When selected, there will be a composite coverage total in both the summary and detail report files, and if map files are requested, a composite coverage points file is created called "cmpcvpts". The point coordinates in the composite map files are always the cell center point, not the actual study point in the cell. If selected, the composite map output will be generated using the cell center point regardless of the mode used to define study points in cells. If the "all Census points" mode is used, all points in a given cell will be considered individually when accumulating the final result for that cell. That means if just one of those study points has coverage, the composite output will indicate the entire cell has coverage, which limits its usefulness and is not recommended. Note that the points output files ("points" in the map files and the "points.csv" file) benefit from the new code added to support composite mode. Regardless of whether composite mode is active, the new code for determining the coverage status across the entire cell grid for a scenario is used to support the points output. As a result, those outputs will no longer contain duplicate points.

New map output settings have been added. Provides options for additional columns in the coverpts file, as well as general options like excluding points with no service or no population. Each option for output in coverpts may activate multiple actual columns, such as separate latitude and longitude columns if the study point coordinates are selected.

TVStudy can now output maps as images, but the option only appears if TVStudy detects an available version of the GhostScript software installed. The user needs to install GhostScript, then manually create a symbolic link in TVStudy's lib/ directory to the actual "gs" command wherever it is located. Note that image maps will only be generated from a scenario that has exactly one desired station.

Changes have been made to attribute options and behaviors for map output files. Additional attributes are now included in both the points map file and points CSV file, including ground elevation, receiver height (in points study mode), and land-cover and clutter types (when clutter adjustments are being applied). When the output coordinates are at the cell center in the points file, the study point coordinates will automatically be included in the file as attributes.

Changed the report and CSV labels to "Service Area" instead of "Noise-Limited", since that can now be something other than a noise-limited contour. If the record is being studied in unrestricted mode, those columns are blank or say "(unrestricted)" with no numbers.

Individual Census point information can now be included in the detail cell file. If enabled, following each "P" record describing a study point is a list of new "C" records each describing one Census point used in defining that study point. The "C" records include the Census block ID (a unique identifier

in each country's Census data that can be used to match other Census data attributes), the population, and the household count for each Census point. Note the Census point information is currently not saved in the study engine cache files. As a result, if a detail cell file is requested, even when study points and field-strength calculation results are reloaded from cache, the study engine must still repeat the Census data search queries to reconstruct the point lists. This significantly reduces the performance benefit of caching; however, those repeat queries will occur only when a detail cell file is requested and the option is enabled.

Site number for desired DTS transmitters are now included in cell file outputs, following the desired source key. The column is always present, but is empty if the record is not a DTS desired. Additionally, the site number for each DRT is now included in the sources section of the cell file outputs.

Fixed the rules summary printout to show FM study rules correctly.

Study Editor, Parameters, and Templates

Fixed problems throughout the study setup logic where channel range was not being checked, incorrectly allowing some records on out-of-range channels to be added to a study.

Added a "Rename..." item to the Template menu in the Template Manager. This allows templates to be renamed even after they are locked.

Added NLCD 2011 data as an option for clutter adjustments.

Major improvements have been made to the antenna pattern editor, allowing matrix patterns to be fully edited including converting a non-matrix pattern to a matrix (or vice-versa), adding and removing pattern slices, and changing the azimuths of existing pattern slices.

Fixed bugs in the scenario editor. When the filtering menus at the bottom of the window were used, the filter applied to the visible content of the table; however, the filter was not applied when a menu item or button was used. The requested action would thus be performed on a different record than appeared to be selected.

Fixed bug in elevation pattern handling that caused the pattern mirroring and built-in electrical tilt detection features to work incorrectly when the elevation pattern maximum was not at 0 degrees.

Added an option to derive a horizontal-plane pattern for contour projection if a record has a real elevation pattern and mechanical tilt, or has a matrix pattern. Also added a new option in the output file settings to write horizontal plane patterns to CSV files.

Added an option in the "Add Many" scenario-building dialog to search the baseline record table. When baseline is selected, search options for service and country are available but selecting anything other than US full-service DTV will yield an empty result in current datasets. The service and country criteria are enabled because future LMS imports may contain baseline records in other countries or with other service codes.

TVStudy now supports facility ID values less than or equal to 0. Facility ID values in most situations can now have any value. Two exceptions are in a pair study baseline scenario and in the CDBS/LMS TV baseline record tables, facility IDs must still be greater than 0.

Changed the logic for retrieving call sign, city, and state from CDBS/LMS, including FM. First try the facility table, if the field is blank there, fall back to the application or application_facility table.

In the study editor "Study" tab, there is a new menu to pick the propagation model used when running that study. Currently the options are "Longley-Rice", "FCC curves", and "Free space". New models can be added, as described in the TVStudy source files (look in the "src/model/" directory at the files "model.h" and "model.c"; comments in those files will guide you from there). When a new model is added in those code files, it will automatically appear in the UI. The Java application queries the study engine for a list of available models when it starts up, so it is necessary to restart the Java UI to load new models.

When a new DTS record is created from a non-DTS record, the non-DTS record is used to set the DTS reference facility as well as the DTS "parent" properties. Previously when that was done, the reference facility was changed to digital. Now it is left alone, which means you can create a DTS record with an analog reference.

An editable DTS record can now have a sectors boundary area.

The parameter for mirroring on generic patterns has been expanded from a simple yes-no option to a menu with choices "Never", "Always", and "Propagation only."

Changes have been made to the XML import code to improve performance and to fix a number of bugs. When records need to be retrieved from a data set by record ID search, rather than doing lookups one record at a time while parsing the XML, record IDs are accumulated then all retrieved in a single batch query at the end. Imports in which a large number of records need to be retrieved, especially from LMS data, are now dramatically faster.

Added better reporting messages following an XML import during which no errors occurred but nothing was successfully imported. The message will indicate if the XML file did not contain a recognized structure, or if all records were ignored due to being an incompatible type (such as FM when importing into a TV study).

In the scenario editor, it is now possible to include the same record more than once as long as each appearance is replicated to a different channel.

Fixed an issue causing the Site # tabs in the source editor for a DTS station to be out of numerical order.

The single-record search UI layout has been re-arranged (the "Add One" and the study-build "wizard" windows). Mostly this is a cosmetic change and all the UI elements still function as before, but there is a new option to search by country, and country is now shown in the record table.

The study and template editor UI layouts have been changed. Parameters are in their own tab, and parameter sections are picked from a drop-down menu rather than tabs. In the study editor, the "Study" tab still exists to show those settings that can't be handled as parameters.

The "Add Many" search dialog in the scenario editor now has the ability to save search criteria for later re-use.

When importing station data from XML, up to two station data sets can now be selected for resolving record elements that reference a data set record by ID. This allows, for example, selecting one LMS and one CDBS data set so either type of ID can be resolved, when the content of the XML being imported is mixed or unknown. Otherwise import behavior is unchanged; if a by-reference element cannot be resolved it is not imported but the rest of the import continues.

All file open and save dialogs are now configured to require an appropriate file name extension; the "All Files" choice is no longer available in most cases. For example, when importing XML data, only files with names ending in ".xml" can be chosen. Likewise, on XML export, the file created will always end in ".xml" regardless of whether or not that is actually entered in the file name field.

Default parameter values for the rule-extra-distance ERP table have been modified slightly. The ERP for the low-to-mid ERP break is changed from 0.25 kW to 0.2 kW. Note this change applies only to the default template. Existing studies and templates will not be affected by the change; it will only take effect for templates created after the update.

Added a new option parameter to disable the rule-extra-distance ERP table and instead use the maximum desired signal calculation distance as the rule-extra-distance for all searches. This is meant to be used with alternate service area methods, or altered service contour levels, that result in service areas substantially larger than standard FCC contours. Particularly, this option is needed to avoid rule-extra-distance failures when using the unrestricted service area mode. Note this option should never be set in a template used to create a TV IX Check study. Doing so would result in frequent study build failures because the additional stations appearing in undesired searches cause the scenario-generation tree to become unmanageably large.

Changed the behavior of TV contour distance limit parameters. These now apply to all contours including Longley-Rice, and they apply when the contour is projected rather than as an overlay during point analysis, so the contour actually appears truncated in map outputs.

The new maximum desired signal distance parameter is checked in all cases including contours and geographies. Points that fall inside a service area but beyond the maximum distance will still appear in outputs but with a -999 field strength indicating no calculation actually occurred.

Command line utility

TVStudy 2.1 includes a command line utility called “ptelev” that makes some of the TVStudy internal functionality available from the command line. It reads a configuration file at "lib/ptelev.conf" and otherwise is run with the “lib/ptelev” command. See page 18 for more information on this utility.

TVStudy 2.1 also provides a simpler command line utility called “nadcon” that allows for coordinate conversions only using a minimum number of files. No support is provided for this utility.

Underlying Data

Status feedback is now provided during long database updates, such as the one for TVStudy 2.1.

Added a households field to all population tables. Household values and tallies appear in all CSV and cell output files immediately following population. Population data has been re-processed to add household counts and will be reimported when TVStudy is updated.

After a new database installation or after some major upgrades (including TVStudy 2.1), TVStudy will search for XML files located in the xml/ directory and attempt to import those as templates or geographies.

Optimized the terrain cache memory management algorithm for improved behavior. In the previous version, memory use could become excessive under some conditions, leading to memory compression and virtual memory swapping. Out-of-memory errors in environments with no swap space should now be much less likely.

Improved the caching algorithm used for land-cover database lookups. The previous algorithm was seriously deficient once the cache reached the "full" state, causing very long run-times for large-area studies with clutter adjustment applied. The new algorithm is much better, although there is still a 20-30% performance penalty when applying clutter adjustments in a large-area study (previously that was 300-500%).

TVStudy 2.1 comes with a utility to convert 1/3-second terrain for use in TVStudy. This feature is currently unsupported.

Other

Added DTS self-interference analysis, activated with new parameter, and added supporting parameters. Self-interference will appear in detail report and CSV files as a separate "undesired" line. In the DTS self-interference analysis, all signals outside time arrival limits are RSS to a composite undesired signal rather than being checked individually for D/U failure. DTS self-interference analysis is output to the detail cell file using new record formats S and DS.

Improvements have been made to the handling of insufficient-memory situations. If the study engine does abort for that reason, the error message is now visible in the run window. However, that should never occur now because the UI asks the engine for a report on memory at startup and if there isn't enough, the UI won't even let study runs be started at all. You can continue editing in the UI as much as you like, but you can't run anything.

Fixed a bug where a study point result code could incorrectly be the 11, 12, or 13 value indicating a propagation model error when the result was not in doubt due to the error. Under some conditions, the error flag could be set due to an undesired-signal calculation on a point that did not have service due to desired signal below threshold, with no error on the desired-signal calculation. In that situation the undesired-signal error is irrelevant and should not affect the result status.

Fixed a bug where changes to the rule-extra-distance parameters did not always take immediate effect. Sometimes the actual distances used in database searches would not update until the study was closed and re-opened.

Fixed a bug that could cause incorrect use of invalid cached calculation results after certain types of concurrent edits (changes by two different applications sharing the same database installation).

Differences Between 2.2 and 2.1

If a DTS record in CDBS or LMS has no reference facility, a warning is shown and a "dummy" reference record is created using the reference coordinates, minimum height, and 1 kW ERP, so the contour should never extend beyond the radius distance limit.

Added an option for interference-check studies to include baseline records as protected facilities when studying an LPTV.

Added Canadian 2016 Census data. Note the default parameter setting did not change, that is still 2011.

Added service level to the sources map file attribute data.

Added new columns in parameters.csv showing the original record's antenna ID and rotation for replication records (the new columns are always blank on non-replication records). The existing antenna ID column is now always blank, and the rotation always 0, on replication records. There was no need for any new fields in the database or cache files; the entire original record is available so those values can be taken directly from that record when writing the parameters file. The previous behavior was to copy the antenna ID to the replication record itself. Note that the new original-value columns will always be filled in regardless of the replication mode; previously the antenna ID was copied only in equal-area mode.

Added a new output file option for interference-check studies. When the baseline contour extension check is done, the contour being checked may be written to a CSV file for post-processing. Each row in the file reports the status of one point along the contour (or contours in the case of DTS) that was checked versus an enlarged baseline contour. Columns are the azimuth, distance, latitude, longitude, HAAT, ERP, and a flag indicating if the point fails the test (is not inside the enlarged baseline contour). Note that as of TVStudy 2.2, the file is only created if the baseline contour check is actually performed. If that check is turned off by parameter, or if there is no baseline record to check, the contour file will not be created.

Fixed bugs involving output options meant for grid mode, e.g. use cell center, exclude no-service cells, etc., which would cause crashes and failures when selected in points mode.

Fixed a bug in the output configuration dialog. After deleting a saved configuration, the dialog could not be closed with the OK button and only the Cancel button would work.

Fixed an issue in the Run Manager window where internal status messages (starting with '$$') would sometimes appear in the run log. These messages should not have been displayed.

TVStudy no longer shows service area settings in the record editor when it is opened from a search dialog. The settings now only appear when the record editor is opened from a scenario editor.

Land-mobile checks are now performed for a channel 21 proposal; however, any issues are not reported as failures, just as advisory messages in the output report.

When deriving an azimuth pattern for contour projection in cases of mechanical beam tilt, the pattern can be computed using vertical angles to the radio horizon on each azimuth. Various labels and messages appropriately changed so this is no longer referred to as an "h-plane pattern" since it may not necessarily be that; it is now referred to as a "derived azimuth pattern".

Coordinate input fields with separate degrees, minutes, and seconds input will now recognize values entered in the degrees or minutes fields with a fractional part, and expand the value into minutes and/or seconds as needed.

Fixed bugs in parameters.csv output causing values for household totals to be transposed between columns.

In an FM study involving 53rd- or 54th-adjacent channel rules, the map file outputs for worst D/U and margins are no longer affected by those rules unless both desired and undesired signals are above the threshold (91 dBu). In other words, the signal threshold is treated as a logical condition determining if the rule applies at the study point. Just like other logical conditions such as culling distance, if the conditions are not met the rule does not apply and has no effect on any output.

Please note that while this version produces interference studies for low power television (LPTV) stations assuming all post-auction transitions have been completed, it does not accurately account for full power and Class A television stations' pre-auction and post-auction channel assignments during the transition period. OET expects to release another updated version of TVStudy in the coming weeks which will enable LPTV stations to conduct interference analyses that correctly consider pre-auction channel assignments as well as post-auction assignments. LPTV stations should wait for this future release before using TVStudy to conduct interference analyses regarding potential new channel assignments.

Differences Between 2.2.1 and 2.2

Viewing a replicated DTS baseline record in the search dialog now shows a note "will replicate to D##" below the channel field.

In the record editor, when viewing a replicated DTS record, the note indicating original channel now appears on individual transmitter tabs as well as the parent tab.

The "Add Many..." function in the scenario editor now correctly applies replications for DTS baseline records.

Wireless study mode lower frequency limit changed to 50 MHz.

Added support for emission mask field on Class A records in the LMS baseline table. Note that LMS dump files from before April 20 will no longer import into TVStudy.

Fixed random false positives on 1% baseline contour test in TV IX Check studies.

Fixed search dialog option to restrict by service type in baseline table searches.

Fixed failures of azimuth pattern lookup for DTS baseline records.

Fixed possible incorrect column typing in table used to index the cache of past interference-check studies run through the servlet API. If the problem occurred in a particular installation, it would cause past run links to show the correct date but the time would always be 12:00:00.

Differences Between 2.2.2 and 2.2.1

Changed the interference-check wizard build logic to support pre-transition and transitional studies. The previous option to categorically exclude records dated before the baseline effective date on a different channel than the station's baseline has been removed. A new option "Protect records not on baseline channel" allows control over whether or not such pre-baseline channel records can be included as protected stations. For study of full service and Class A records, the default is no; for LPTV the default is yes. Including pre-baseline records as undesireds is now automatic. If the protected record is a pre-baseline record, then other pre-baseline records are included but baseline records are excluded. Otherwise, the opposite occurs. The previous option "Protect baseline from LPTV" is still available, by checking both "Protect records not on baseline channel" and "Protect baseline from LPTV" options when studying an LPTV record, to do a transitional study in which the LPTV must protect all current and future facilities.

Added a new option and parameter to the interference-check wizard that controls interference-check behavior for protection of LPTV stations when studying a Class A record. The parameter is a date which sets the end of the 90-day filing window; the option is a UI check-box "Protect LPTV from Class A". If a Class A study record is before the date, by default LPTV stations are not protected, but the option can be selected in the UI to protect them. If the Class A record is after the window end date, the LPTV protection option is always selected and cannot be deselected. Note the date parameter has no default value, if it is not set then the LPTV protection option is available to be selected but is not selected by default, but that it is being set to shortly after the end of the 90-day filing period in the Interference Check template.

Changed the data type of the latitude and longitude seconds fields in the LMS baseline table to floating-point so fractional seconds will be supported on new LMS imports. Added support for the electrical_deg field in the app_dtv_channel_assignment table. Added support for the foreign_station_beam_tilt field in the app_antenna table.

Made changes to AM station search in interference-check study. Separate searches are now conducted for ND and DA stations, and search distances are now in template parameters.

The terrain profile resolution in interference-check study output is now reported in kilometer spacing rather than points per kilometer.

Added a new parameter to set HAAT radial count separately for LPTV.

Overhauled the automatic XML import logic. Files in the xml/ directory are now checked and indexed every time the application is launched. Any new or modified files in the directory are immediately imported. TVStudy will initially re-import everything in xml/, but after that it will only import changed files. If a file name has never been seen before, it will be imported regardless. If a file name is in the index and either the modification time or file length has changed, it is re-imported.

User records can now be deleted. In any record search dialog e.g. View Station Data there is now a delete button below the search results list. When a saved user record is selected, that button activates and will delete the record.

Improved station data import code. When importing, a directory containing the extracted text files can be selected as before, or the downloaded ZIP file can be selected directly. The import code now has some ability to detect an LMS download in a previous format and set the internal import version accordingly so older LMS downloads can usually still be imported.

Added a feature to automatically download LMS, CDBS, or CDBS FM station data and import directly from ZIP file. The ZIP file is stored in a temporary location and deleted once the import is complete. Station data imported by this method is flagged as a download, and will automatically be deleted the next time new data is downloaded. To prevent a past download from being automatically deleted, give it a specific name in the station data manager; this will clear the download flag.

Added a cancel button to the station data download or import message dialog.

Included a new command-line utility for database management. This allows database management and station data download and import to be performed from a command-line environment.

Corrected an issue in azimuth pattern lookup. The pattern lookup code in the study engine did not deal with pattern rotation values outside the range 0 to 360, causing incorrect results if such rotations were entered. The UI allowed rotations from -360 to 360. The lookup code, UI code, XML and CSV parsing code, etc., now all do a modulo-360 operation to ensure both rotation and lookup azimuth values are always in legal range.

Corrected an issue in the interference-check baseline search logic, that caused it to include Canadian and Mexican baseline records when the include foreign stations box was not checked.

Fixed a problem in the record editor when creating a new DTS record. Starting from a completely blank editor state selecting DTS service would result in a reference facility sub-record with undefined service that could not be edited. Now the reference facility will default to digital TV rather than undefined. However, the reference facility service still cannot be edited, so if you want an analog reference facility, first select analog TV service in the initial blank editor, then select DTS.

Fixed header misalignment and numerical precision issues in parameters.csv output.

Fixed a bug where an uncaught exception would occur when clicking the run button on an empty study (no scenarios). Now a warning message is displayed indicating that the study cannot run because it has no desired stations.

Fixed custom rendering in tables that color-code text so the text stays readable in a selected row regardless of highlight color.

KML map output of coverage points now sorts the points into folders according to the analysis result code, allowing related points to be manipulated more easily in mapping software.

Added a "Defaults" button in the image color map editor to restore default colors.

Added a properties file "lib/config.props", allowing various configuration settings to be changed without a software update. To make changes just quit, edit or replace the file, and relaunch. See the config.props file for further details, it includes comment lines describing the properties.

TROUBLESHOOTING

Problems Running TVStudy

Below are some common errors and suggestions for troubleshooting.

- **Exception in thread "main" java.lang.UnsupportedClassVersionError: gov/fcc/tvstudy/AppManager : Unsupported major.minor version 51.0**

  This message or one like it, seen on the command line in Linux, usually means that you have two versions of Java installed, and TVStudy is attempting to launch using the older one. To resolve this issue, remove the older version of Java from your system, using the normal method of removing such software.

- **The database needs to be updated, but studies are currently in use.**

  Assuming your database is not currently in use by TVStudy by either yourself or another user, it is possible the database was left in an unclean state with locked databases. To unlock all of your databases and allow the update to proceed, in the Manage Database window, click "Unlock All," and then "Update." The update should complete successfully.

  If the problem is not resolved, you may try to drop the database, as described below.

- **The database is being updated by another application, or is damaged.**

  This can happen when a database update fails. If this happens, the simplest method of repair is to drop the database and rebuild from scratch. To do this, in the Manage Database window, click "Uninstall," and then "Install." Click "Open" and TVStudy should open successfully.

  If, after doing the above steps, the database fails to install correctly, you most likely do not have the file structure correct. Ensure that your data/ contains all of the appropriate files and that your file structure matches the ones found on pages 10 or 13, then repeat the steps in the above paragraph.

  The database can also fail to install correctly when TVStudy is running from a location other than the directory which contains the other TVStudy directories such as data/. If so, simply close TVStudy and launch it again from the correct location.

For further help, see the TVStudy FAQ page: https://www.fcc.gov/oet/tvstudy-faq

Contact Information

If you encounter any problems and wish to speak with someone at the FCC about TVStudy, please e-mail Mark J. Colombo at the following address: mark.colombo@fcc.gov

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