AT&T Entertainment Experience Suite Video Optimizer 5.2

User Guide

Publication Date: April 24th, 2024

Legal Disclaimer

This document and the information contained herein (collectively, the "**Information**") is provided to you (both the individual receiving this document and any legal entity on behalf of which such individual is acting) ("**You**" and "**Your**") by AT&T, on behalf of itself and its affiliates ("**AT&T**") for informational purposes only. AT&T is providing the Information to You because AT&T believes the Information may be useful to You. The Information is provided to You solely on the basis that You will be responsible for making Your own assessments of the Information and are advised to verify all representations, statements and information before using or relying upon any of the Information. Although AT&T has exercised reasonable care in providing the Information to You, AT&T does not warrant the accuracy of the Information and is not responsible for any damages arising from Your use of or reliance upon the Information. You further understand and agree that AT&T in no way represents, and You in no way rely on a belief, that AT&T is providing the Information in accordance with any standard or service (routine, customary or otherwise) related to the consulting, services, hardware or software industries.

AT&T DOES NOT WARRANT THAT THE INFORMATION IS ERROR-FREE. AT&T IS PROVIDING THE INFORMATION TO YOU "AS IS" AND "WITH ALL FAULTS." AT&T DOES NOT WARRANT, BY VIRTUE OF THIS DOCUMENT, OR BY ANY COURSE OF PERFORMANCE, COURSE OF DEALING, USAGE OF TRADE OR ANY COLLATERAL DOCUMENT HEREUNDER OR OTHERWISE, AND HEREBY EXPRESSLY DISCLAIMS, ANY REPRESENTATION OR WARRANTY OF ANY KIND WITH RESPECT TO THE INFORMATION, INCLUDING, WITHOUT LIMITATION, ANY REPRESENTATION OR WARRANTY OF DESIGN, PERFORMANCE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE OR NON-INFRINGEMENT, OR ANY REPRESENTATION OR WARRANTY THAT THE INFORMATION IS APPLICABLE TO OR INTEROPERABLE WITH ANY SYSTEM, DATA, HARDWARE OR SOFTWARE OF ANY KIND. AT&T DISCLAIMS AND IN NO EVENT SHALL BE LIABLE FOR ANY LOSSES OR DAMAGES OF ANY KIND, WHETHER DIRECT, INDIRECT, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, SPECIAL OR EXEMPLARY, INCLUDING, WITHOUT LIMITATION, DAMAGES FOR LOSS OF BUSINESS PROFITS, BUSINESS INTERRUPTION, LOSS OF BUSINESS INFORMATION, LOSS OF GOODWILL, COVER, TORTIOUS CONDUCT OR OTHER PECUNIARY LOSS, ARISING OUT OF OR IN ANY WAY RELATED TO THE PROVISION, NON-PROVISION, USE OR NON-USE OF THE INFORMATION, EVEN IF AT&T HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSSES OR DAMAGES.

Table of Contents

1. Introduction

The Video Optimizer User Guide describes in detail the methods for collecting an application trace with Video Optimizer. This guide describes how to open a trace and it includes a reference section with the tabs, menus, options, charts, graphs, and statistics. This guide is intended for app developers who are interested in testing the performance of their apps.

2. Overview

Video Optimizer is a diagnostic tool for analyzing mobile web application performance. Video Optimizer automatically profiles your application and provides recommendations that let you optimize performance, make battery usage more efficient, and reduce network impact.

The traces that Video Optimizer runs against your application are benchmarked against recommended best practices. Video Optimizer looks at how your application (and your server) is handling caching, and how you are managing the network connections for your application. By optimizing against these best practices, your application will run faster, use the network less (saving valuable battery life for your users), and improve the experience of customers using your application.

2.1. Installation Requirements

To install Video Optimizer 5.2, be sure that your computer has at least 4GB of RAM. Please use the hyperlinks below to get installation requirements and instructions for specific operating systems -

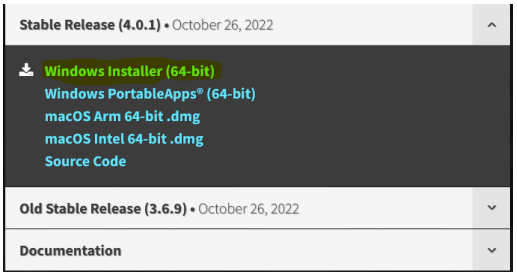
- **Windows**
- **Mac**
- **Linux**

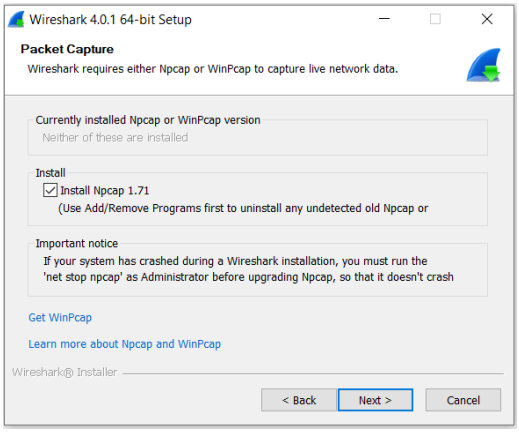
2.1.1. Windows

- **Java –** Java 8 or above
- **Wireshark –** 4.0.11 and above, preferably current

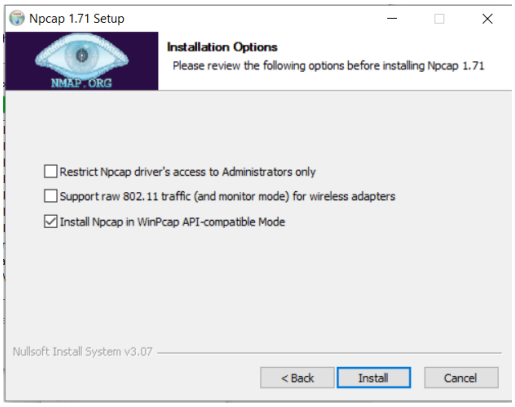
  Wireshark is required for maintaining cross-platform compatibility of traces.

  You can download it from https://www.wireshark.org/





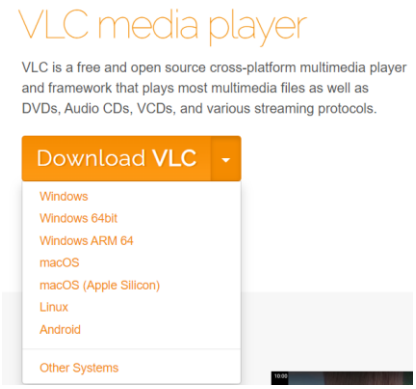
- Choose Install Npcap



- Choose Install Npcap in WinPcap API-compatible Mode
- Wireshark normally installs in Program Files. If user chooses to install in a different location:
    - Add Wireshark to the System environmental variables path.
    - Or configure in Video Optimizer Preferences. See section 5.1.2

- **VLC Media Player –**

  Video Optimizer uses VLC media player to play most types of videos (namely mp4/SD|HD and mov/low-res videos). You need to have VLC installed on your computer (you can download it from https://www.videolan.org/vlc/). Version 3.x.x or higher is required.



- **FFmpeg & FFProbe Setup –**

  FFmpeg, and FFprobe are used by Video Optimizer in a few different ways, including Video Analysis. You can download it from https://ffmpeg.org/. FFmpeg normally installs in Program Files.

  If user chooses to install in a different location:

  - Add FFmpeg bin folder to the System environmental variables path.
  - Or configure in Video Optimizer Preferences. See section 5.1.2

  Additional dependencies must be met to collect network or traffic data from Android devices.

2.1.2. Mac OS

- **Java** – Java 8 or above
- **Xcode** –
  - Make sure you have the most current version
  - In a terminal, run xcode-select --install
- **Homebrew** – install Xcode before installing Homebrew.
  - Visit https://brew.sh to install
- **FFmpeg** – In the terminal, install with the command –
  - 'brew install ffmpeg'
  - It will also install ffprobe.

  PATH - Mac OS uses Z shell and as such you want to configure your path variables in .zprofile.

Note – For instructions on how to create a bash profile on Mac follow the instructions specified at the link -

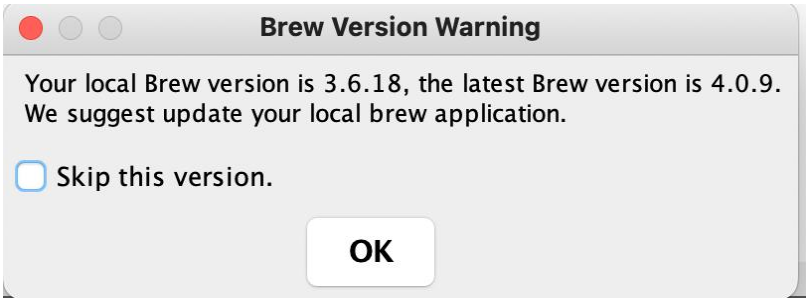
https://www.insightsjava.com/2022/01/how-to-create-bash-profile-on-mac.html

A sample bash profile is available to download from our GitHub repository using the link below –

https://raw.githubusercontent.com/attdevsupport/VideoOptimizer/master/sample.zprofile.txt

(To save the file locally, once the file opens in the browser, right click and click 'Save as')

Note – A warning message is displayed if a lower version of Brew is detected and a suggestion to update by specifying the latest version is made.



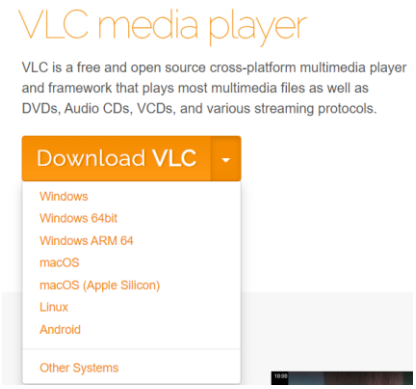
2.1.2.1. Intel (Macs 2019 and before)

- **Wireshark -** 4.0.11 and above, preferably current

Install the Intel version of Wireshark into /Applications.

- **VLC Media Player**

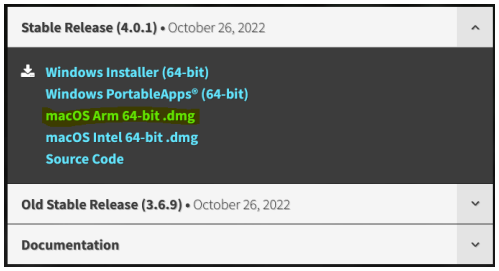
Video Optimizer uses VLC media player to play most types of videos (namely mp4/SD|HD and mov/low-res videos). You need to have VLC installed on your computer (you can download it from https://www.videolan.org/vlc/). Version 3.x.x or higher is required.



Install the macOS version.

2.1.2.2. Apple silicon

- **Wireshark -** 4.0.11 and above, preferably current

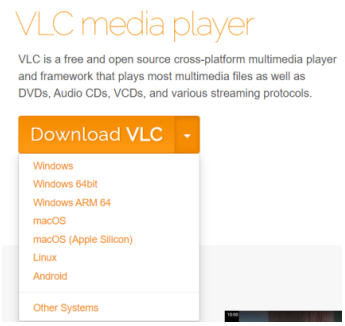


Install the appropriate version (depending on which architecture of Java you have installed) -

If you are using Intel builds of Java, you must install the macOS Intel 64-bit version.

If you are using Arm 64-bit version of Java, then you must install the macOS Arm 64-bit version.

- **VLC Media Player**



Install the appropriate version (depending on which architecture of Java you have installed) -

If you are using Intel builds of Java, you must install the macOS version.

If you are using Arm 64-bit version of Java, then you must install the macOS (Apple silicon) version.

Additional dependencies must be met to collect network or traffic data from Android, or iOS devices.

2.1.3. Linux

- **Java –** Java 8 or above
- **Wireshark -** 4.0.11 and above, preferably current

In terminal, use the following commands one by one -

```
sudo add-apt-repository ppa:wireshark-dev/stable
sudo apt update
sudo apt upgrade -y
sudo apt install wireshark
sudo apt install tshark
```

- **VLC Media Player**

  It needs to be installed using 'sudo apt-get install vlc'. If VLC is installed in a different way, Video Optimizer will not recognize it.

- **FFmpeg**

  FFmpeg is available in the default repositories. Open Terminal and run the following command to install it.

  - sudo apt-get install ffmpeg

Additional dependencies must be met to collect network or traffic data from Android devices.

Note – Video Optimizer installer will alert you of the missing dependencies during the install process.

3. Video Optimizer to Collect Data

Video Optimizer captures the data traffic of mobile devices. As data streams across the network during a given period, Video Optimizer captures each TCP packet and matches the

packet information with recorded video of what the user is seeing on the device. Video Optimizer also looks at other parameters from the mobile device such as signal strength, network type, CPU & GPS usage, etc.

You can use Video Optimizer to test the following:

- iPhone or iPad running iOS 14 or newer is supported.
- Android devices (and emulators) versions 6.0 and up.
- Note: The original Android Collector works on Android versions 2.3.7 - 5.1 but requires root access. See APPENDIX II for more information about how to use the legacy Rooted Data Collector API.
- Pcap Packet traces: Pcap packet trace files contain basic (network only) data that can be captured using several different tools. Once captured, pcap files can be opened directly in the Video Optimizer. Pcapng and pcap formats are supported.
- Automated Collection using Video Optimizer SDK. To facilitate the integration of Video Optimizer with developer tools, automated testing environments and Enterprise build environments, we've exposed APIs for collecting and analyzing traces.

3.1. Prerequisites

This section describes the prerequisites for collecting a Video Optimizer trace on iOS and Android devices.

3.1.1. iOS Prerequisites

Collecting a Video Optimizer trace on an iOS device requires the following:

Mac computer running OSX 10.8 or higher, with the following:

1. Administrator rights
2. Ability to use SUDO password from Terminal
3. Apple's XCode

   Note - Xcode must stay up to date with the highest iOS version of the devices that will be used to collect traces.

   Required for maintaining cross-platform compatibility of traces.
4. For Apple silicon (M1/M2) machines, please ensure kernel extensions are authorized using instructions from one of the links below –

   Kernel extensions in macOS - Apple Support

   How to Enable and Activate Kernel Extensions on Apple Silicon Macs (makeuseof.com)
5. Homebrew

Recommended to simplify the install of the following software packages used by Video Optimizer.

Note – On Apple silicon, brew will install software at /opt/homebrew/bin

6. MacFuse

   Required for retrieving HD video from iOS device

7. Libimobiledevice and ifuse for macOS

   Required for obtaining HD iOS traces. Note - With Apple silicon(M1/M2) Macs, the default path has changed.

   There are differences in the installation approach for Intel and Apple silicon (M1/M2) architecture machines. Please find a script below that will help you with the installation.

   https://raw.githubusercontent.com/attdevsupport/VideoOptimizer/master/vo_dependency_installer.sh

   (To save the file locally, once the file opens in the browser, right click and click 'Save as')

3.1.2. Android Prerequisites

To collect a Video Optimizer trace on an Android device, you must have the following:

1. PC, Mac or Linux computer along with Android SDK installed (for ADB control of device).
2. Android device running 6.0 or higher.
3. Android SDK (Level 24 or above)

   Install SDK Platform Tools for using Video Optimizer.

   Windows path

   Add the locations of these components to your windows path:

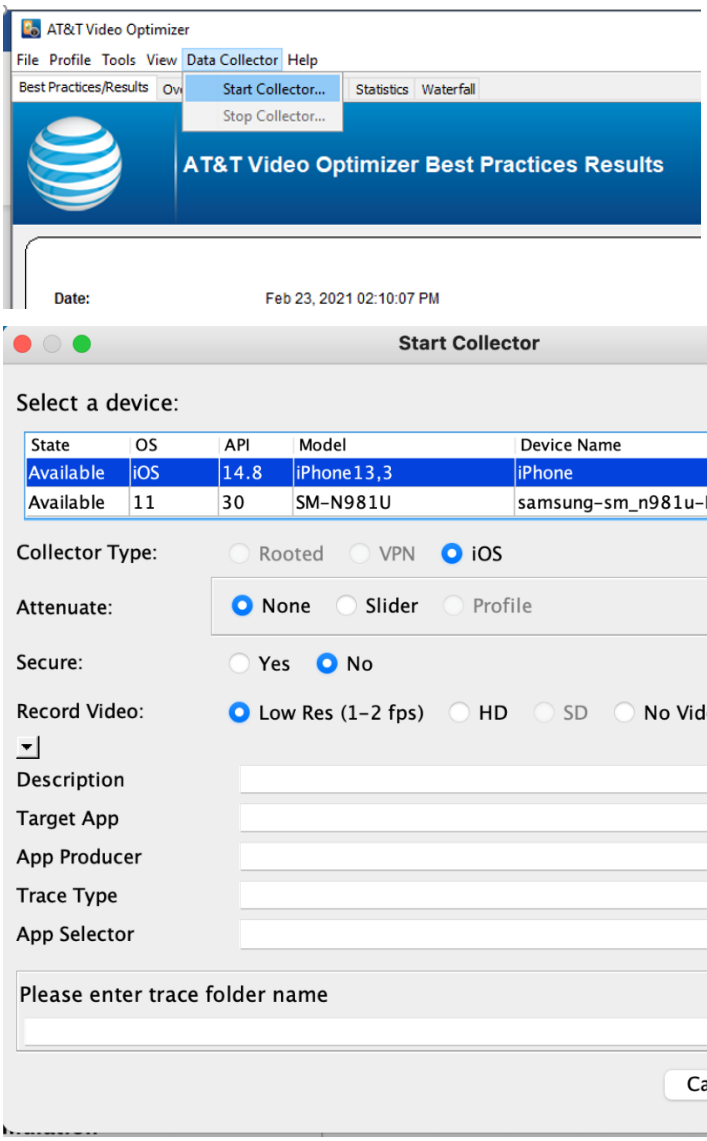
   - Start Button>Computer>System Properties>Advanced system settings>Environment Variables
   - Scroll down System variables to "Path" and select Edit
   - Add the paths to adb.exe, ffmpeg.exe, ffprobe.exe, wireshark.exe to the end of the existing Path.

4. ADB path set in Preferences dialog.

3.2. Collecting a Video Optimizer Trace

Collecting a trace works similarly for all devices. Simply connect the device to your computer and open the Video Optimizer application.

Step 1. Select Start Collector from the Data Collector menu.



Step 2. Select a Device in the Start Collector dialog. Video Optimizer will discover all iOS and Android devices connected to the computer. **Figure** above shows that two devices are connected: an iOS device and an Android device, with State, OS, API, Model, Device Name is detected.

Step 3. Select the Collector Type. The recommended setting is VPN, especially for an Android device that does not have root access. Other collector types are available for Android devices that are rooted.

Step 4. ***Optional:*** Select an Attenuate option. This lets you reduce the throughput of the network connection, allowing tests on networks with lower bandwidth profiles (for more information, see the Network Attenuation section). In the **Figure** above Attenuation is not selected, so it is not being used.

Step 5. ***Optional:*** Secure collection is available on Android versions **6.0 – 14**. Select Yes for Secure if you want Video Optimizer to decrypt HTTPS traffic – providing you with a more thorough analysis of the traffic transmitted during your test. You will be prompted to install a certificate if this is your first time using secure collection. On subsequent tests, you do not need to install the certificate.

Step 6. Select a Record Video option. Depending on your device, there will be two or more options available for recording the screen while you are collecting Video Optimizer data.

- Low Res:1-2 frames per second. Advantage: Smaller video size
- HD: 8 MBPS, 1920x1080.
  Note: This will generate very large video files. Generally, you should only use this format for short traces. If HD video record fails, it may indicate that there were not enough system resources, so try with SD or Low-res settings.
- SD:SD video 3MBPS, 960x540 video – for a smaller size (but lower quality) video.

Step 7. Click on the arrow button to add further trace collection details –

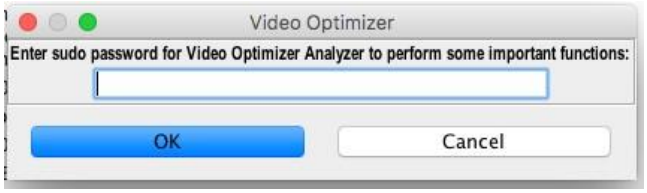
- Description – add a description of the trace activities
- Target App – the app that is being tested
- App Producer – the details about the app producer
- Trace Type – ex: video streaming, live video, downloading, browsing, etc
- App Selector – helps select the app that you want to target the collection from.

Note: additional trace details can also be added at the end of the trace, or after opening a trace for analysis.

Step 8. Type a trace name in the “Please enter trace folder name” box. This is where all the trace files will be stored. Spaces and special characters are not allowed and if you pick an existing name you will be asked if you want to overwrite the previous trace.

Step 9. Click Start to begin collection on your device after you have selected the appropriate parameters or click Cancel to prevent a trace from being run.

Step 10. ***iOS Only:*** Video Optimizer will prompt you to enter the OS password, this is required to start the traffic capture utility.

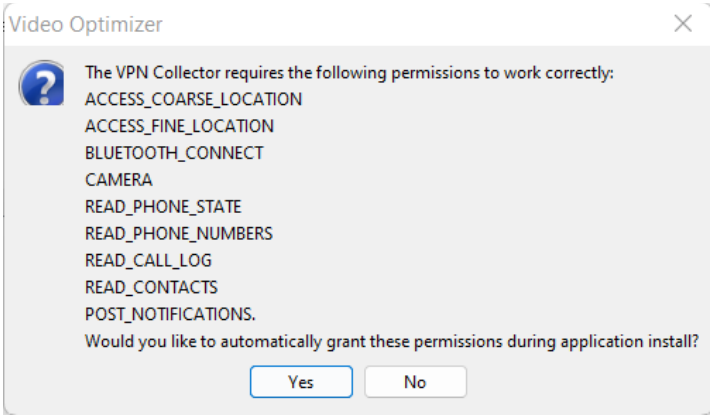


If you get any unexpected error messages when starting an iOS trace, it is likely that one of your dependencies is not installed correctly. Please download the following script and run it to correct your dependencies –

https://raw.githubusercontent.com/attdevsupport/VideoOptimizer/master/vo_dependency_installer.sh

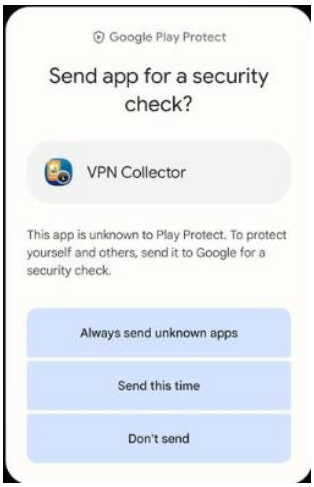
(To save the file locally, once the file opens in the browser, right click and click 'Save as')

Step 11. ***Android Only:*** First time when vpn collector is installed on the device, following pop up is displayed to the user to grant permissions. Choosing "Yes" will grant the permissions automatically. Clicking on "No" will display all the permissions on the device and user must manually allow all the permissions.



Step12. ***Android Only:*** When collecting a trace from an Android device, you may see a security popup message about exposing sensitive info during casting/recording. This is just a reminder that any sensitive information revealed during the trace will be included in the recording. Your trace recording will only be stored on your computer and will not be sent or stored anywhere else. You will need to click **Start now** in order to proceed with gathering a trace.

If the app is installed for the first time, android may pop up an alert like in the screen shot below. This is a feature from Google to scan applications for security issues. User can choose to send.



Note – The following VPN Collector icon is installed on the device when the collection is started –

3.2.1. Collecting a HD Trace: iOS Specifics (iOS 12 and above only)

iOS 12 added the functionality to be able to record the device screen. We now have a companion app, capable of pulling the recorded video off the device as long as the user requests it. The following section details some additional steps that must be done to collect a HD video on an iOS device.

- **Enabling an iOS Device for Development**

  If you haven't enabled Developer settings on your iOS device, this section details how to do that. This needs to be done only once.

  1. Connect the iOS device to the Mac computer.
  2. Open XCode and from the Window menu >select devices and simulators.
  3. Select the connected device from the list of devices in the left nav.
  4. Click Use for Development.
  5. Click Cancel when you see a prompt to join the "Apple developer program and login with a paid developer account." (You do not need a paid account to continue.)

     Note: Always start XCode before you start Video Optimizer so that you can see that the device is detected and ready to use.

6. When the device is enabled for development, you will see a "Developer" option on the Settings menu of the device.

- **Collect iOS HD Video**

1. Attach the iOS device, that you want to collect from, to the Mac.
2. Launch Analyzer>Data Collector>Start Collector
3. Choose HD>Enter trace name>click start
4. On the Analyzer validate for the instructions pop-up message for user to start screen recording

5. Continue to test the application for HD on the iPhone.
6. Click stop on live screen capture or on the Analyzer>Data collector>stop collector.
7. Stop Screen recorder on the device

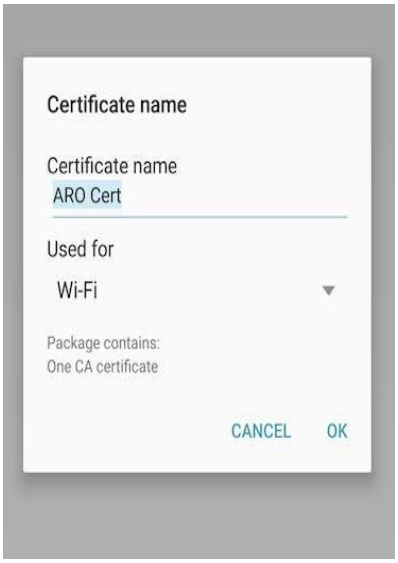
8. Trace summary is displayed. Enter the optional metadata information.
9. Click open.
10. Validate that the video played in the video viewer is played in HD.

3.2.2. Collecting a Secure Trace (Android steps, up to Android 14)

The Video Optimizer android collector can do an MITM based capture of secure traffic. This requires a user certificate installed on the phone on which the trace is being captured. Following are the steps to be followed to capture a secure trace.

Step 1. Install a certificate (required on first test)—if you have selected a secure trace and have opted to install a certificate. Choose the VPN

and apps (not Wi-Fi) option for Certificate name on your device and select OK.

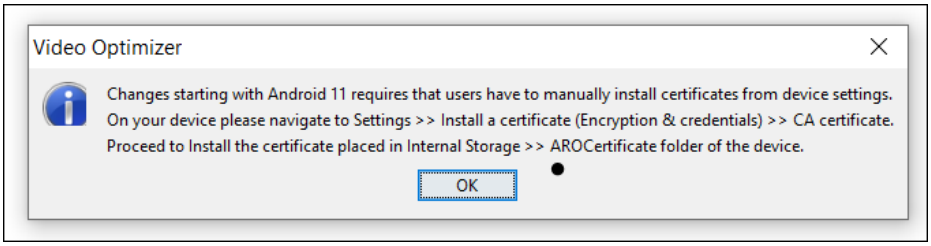


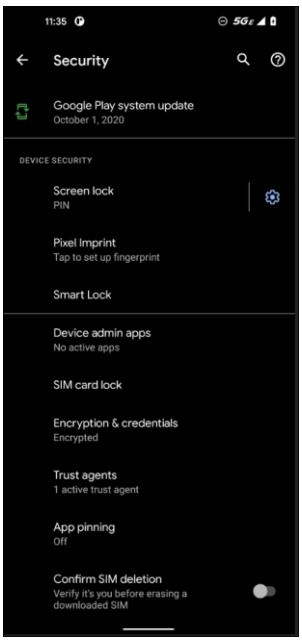
Step 2. Select OK to allow the VPN connection to start on the device—when the trace is started, Video Optimizer installs a collection app on the device. The app establishes a VPN connection and requests permission to allow the connection.

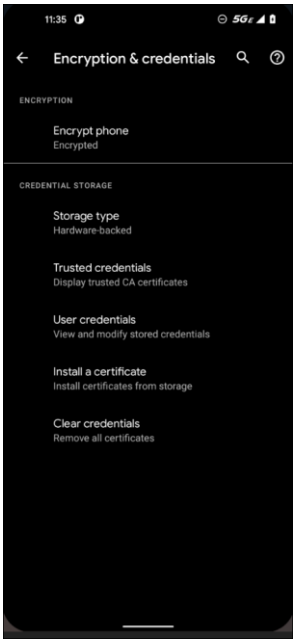
Note: The VPN connection is a connection to nowhere. It originates and terminates on the device. All packets flow through the network normally.

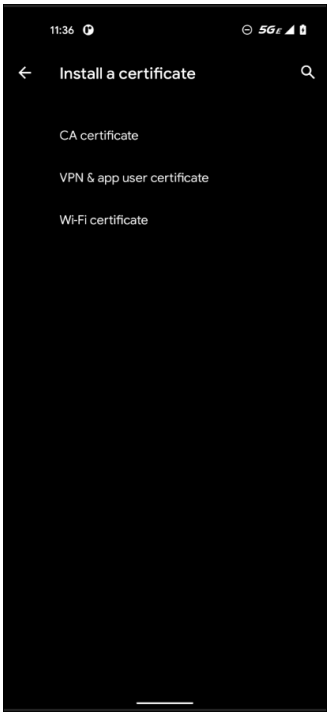
- **Secure collection: certificate install instructions for Android**

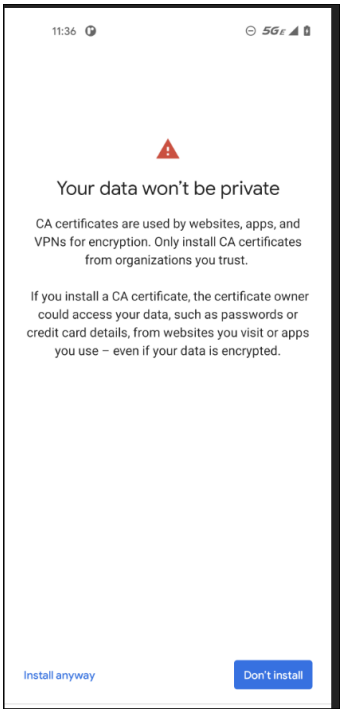
  Starting with Android 11, user must install the certificate manually on the device by following the instructions given in the pop-up below and follow the screenshots:

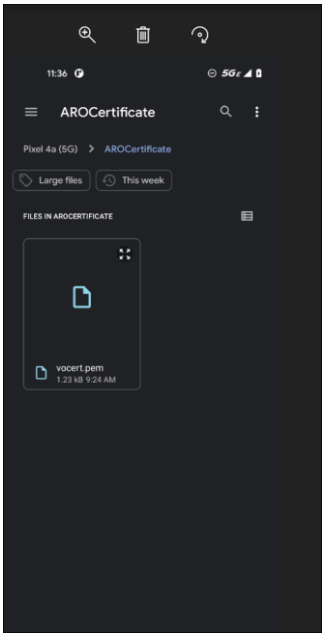


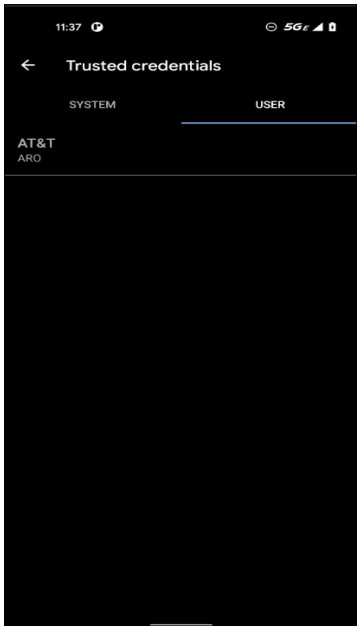


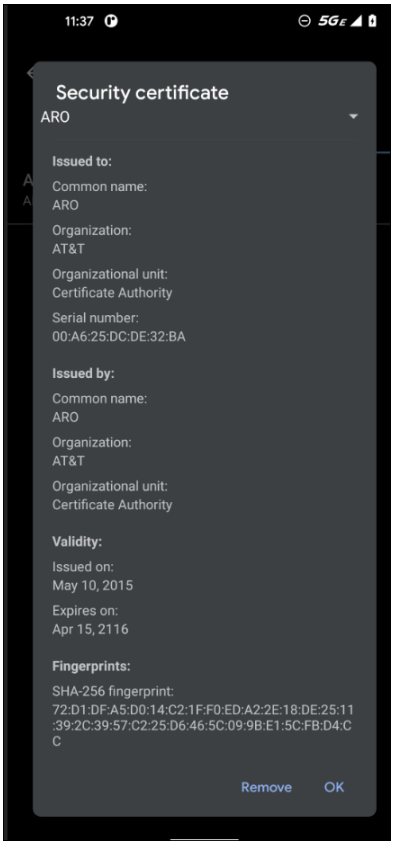










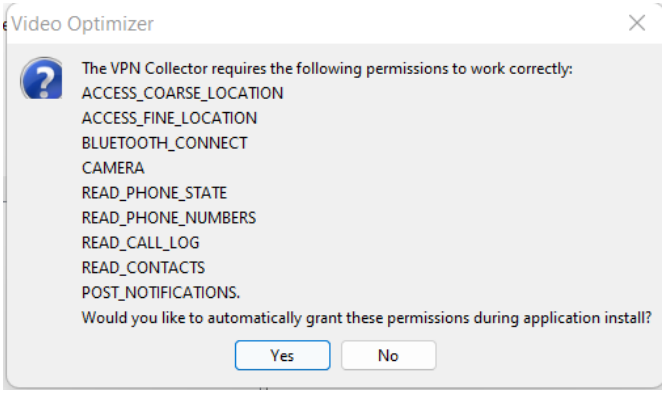


Note - For Samsung devices, the user is prompted to save the vocert.pem file in the Downloads folder. Once the file is saved,

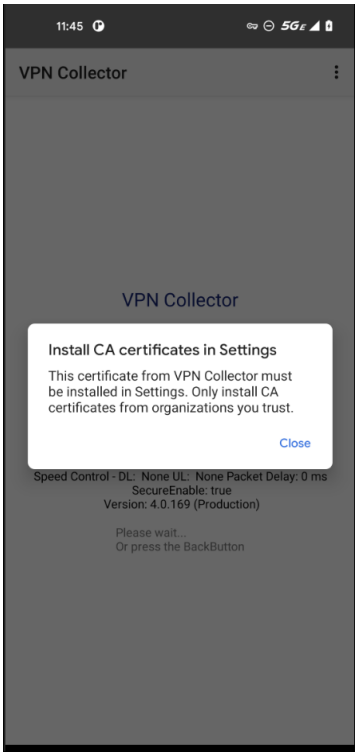
navigate to Settings->Biometrics and security->Other security settings->Install from device storage->CA certificate->Install anyway->Download->vocert.pem. The user is then displayed a message that the CA certificate is installed.

After following the above steps click ok on the Analyzer information pop-up window and the following screens will appear on Analyzer and then on device.

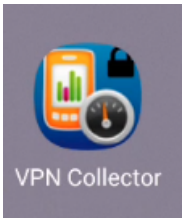
On Analyzer: First Time collection



On Device:



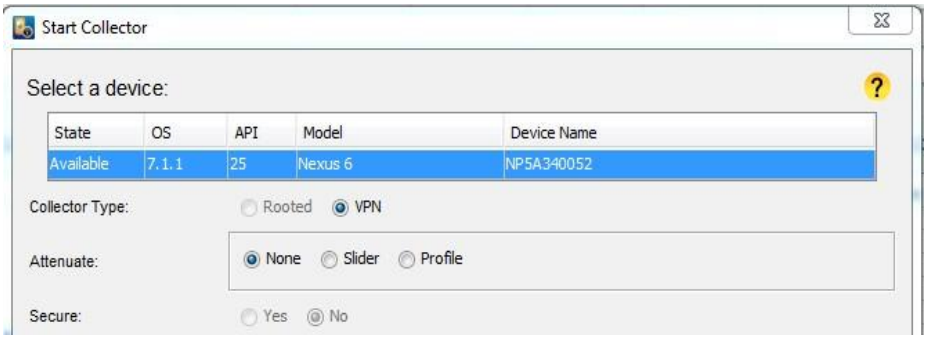
The following VPN Collector icon will be installed on the device when a secure collection is started –



3.2.3. Collecting an Attenuated Trace

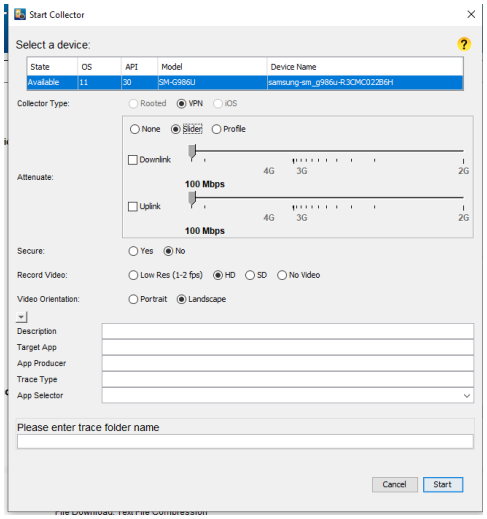
Video Optimizer can attenuate a trace collection, restricting the upload/download speed of traffic flowing through the VPN/MITM.

- **Android Attenuation**
  When you collect a trace, you can add a network throughput cap for uplink or downlink, set in KBPS. This will limit all data traffic on the phone to a maximum data throughput. This is a useful way to test your mobile application in a network constrained environment; perhaps at a busy sporting event, or in a country that does not yet have a LTE network.
  When you are collecting a trace, the default attenuation setting is "None," meaning that no attenuation is performed by default.



3.2.3..1. Static Attenuation

Step 1. Select Slider from the attenuate options.



Step 2. Select Downlink to lower the throughput of the packets being downloaded from the server or select Uplink to lower the throughput of the device uploading files to the server.

Step 3. Set the speed to 4G, 3G or 2G on the slider. A value between 3G and 2G will allow tests on “slow 3G.” Video Optimizer sets the attenuation value that you selected as the maximum throughput available for the entire test. Note: If you set a maximum throughput value that is higher than the actual speed of your network, you will not see an improvement. Video Optimizer attenuation will only SLOW the network throughput – it cannot enhance the speed of your network. If your phone is on a slow network, and attenuation is set to 4G, it will still be a slow connection.

3.2.3..2. Dynamic Attenuation

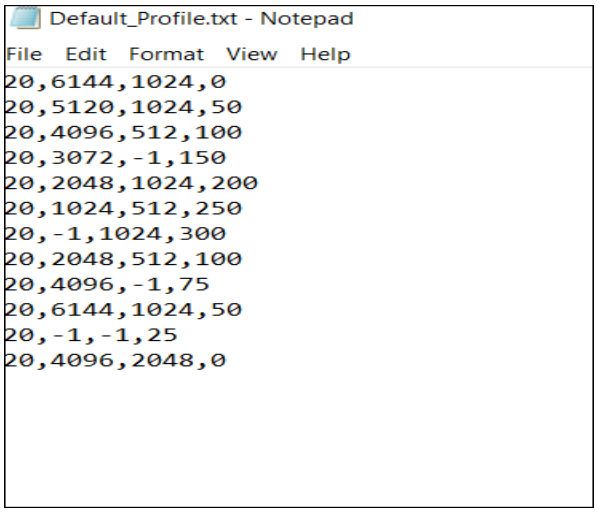
The Attenuate feature in Video Optimizer is a useful way to test how apps and video behave in a constrained environment. But when you are testing mobile video, it is also interesting to consider how changes in network throughput affect a stream that is in progress.

When network changes occur while a video is playing, the player may change the bitrate of the video to ensure that the video buffer remains full – because when the buffer is dry, the video will stall. It may request multiple versions of the same segment – yet only play the highest quality

segment received. Understanding how your video stream behaves in changing network environments is the best way to understand and prevent stalls from occurring.
The dynamic profile option allows you to change the network speeds while the trace is running. Now you can test your app or video in changing network conditions (that you can control and re-use systematically and in a repeatable manner). Video Optimizer Library folder->Default_Profile file has been updated with an additional Packet Latency parameter (in milliseconds) in the end of each line for Dynamic Attenuation which is accounted in VO while taking a collection.

Step 1. Select Profile from the attenuate options.

Step 2. ***To modify the default profile***, you can create your own script file—just modify the default_profile.txt document in a text editor and save with a new name.
Step 3. The format of the text file is comma delimited, with 4 entries per line: time in seconds, downlink in KBPS, uplink in KBPS & Latency. 102400 KBPS indicates “no throttle” in that time frame.
Step 4. For example, in the figure below, the first 20 seconds of the trace, throttling begins at 6144 kbps downlink, 1024 kbps for uplink and 0 ms for latency. After that, next 20 seconds, throttling adjusts to 5120kbps for downlink, 1024 for uplink, and 50 ms for latency.



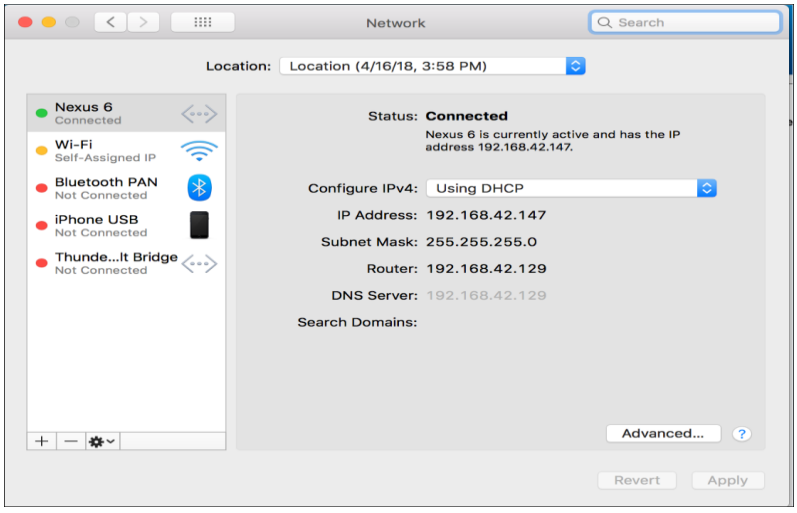
- **iOS Attenuation**

Starting with Catalina and above, user must use a LAN or an iOS device for setting up the hotspot connection.
Note: Previous mac OSs allowed any source of hotspot connection.

Following are the steps to setup the environment on MAC.

Step 1. Choose Apple menu > System Preference, then click Network.

Step 2. Select Ethernet (wired) or the USB tethering for network connection.



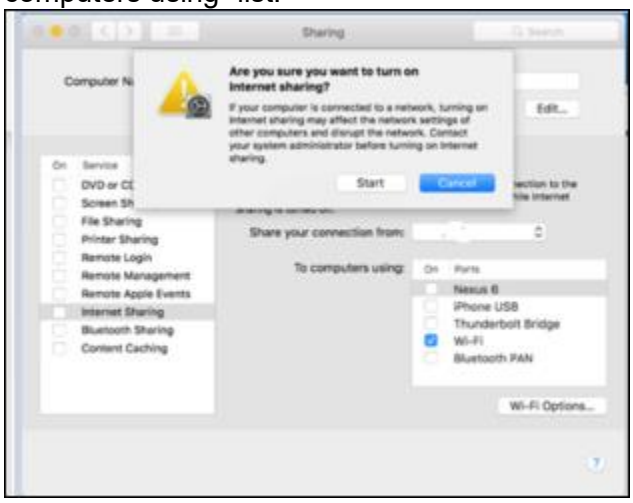
Step 3. Turn the Mac Hotspot on.

Step 4. Choose Apple menu > System preferences, then click Sharing  , open Sharing preferences if it isn't already open.

Step 5. Select the internet Sharing checkbox.

Step 6. Click the “Share your connection from” pop-up, then choose the Internet connection you want to share.

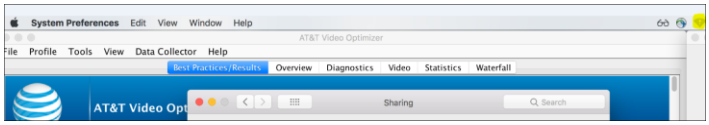
Step 7. Select the type to share your internet connection in the “To computers using” list.



Step 8. Select Wi-Fi.

Step 9. If your Internet connection and your local network use Wi-Fi, sharing your internet connection disrupts the network.

Step 10. Observe on the Mac, the internet sharing icon is seen in the Menu bar.



Following are the steps to setup the environment on wi-fi on iOS device:

Step 1. Go to settings>Wi-Fi. Turn on Wi-Fi and Airplane mode.

Step 2. For wi-fi: select the Mac computer shared hot spot from the listed networks, then enter the password, if required.

Step 3. Adjust the settings for a Wi-Fi network: Select the more Info button next to a network. Set up a HTTP proxy.

Step 4. Set Proxy: Enter the IP address of the Mac computer Hotspot and port number is “8080”

Step 5. Depending on the device make sure the wi-fi and air-plane mode are enabled and displayed.

3.2.4. iOS Secure Collector

Introduction:

Video Optimizer iOS collector can be used as a man-in-the-middle HTTPS proxy, enabling you to view the communication between web browser and SSL web server.

Video Optimizer does this by becoming a man-in-the-middle. Instead of your browser seeing the server's certificate, Video Optimizer generates a certificate for the server and signs it with its own root certificate (the Video Optimizer CA Certificate). Video Optimizer receives the server's certificate, while your browser receives Video Optimizer's certificate. Therefore, you will see a security warning, indicating that the root authority is not trusted. If you add the Video Optimizer CA Certificate to your trusted certificates you will no longer see any warnings – see below for how to do this.

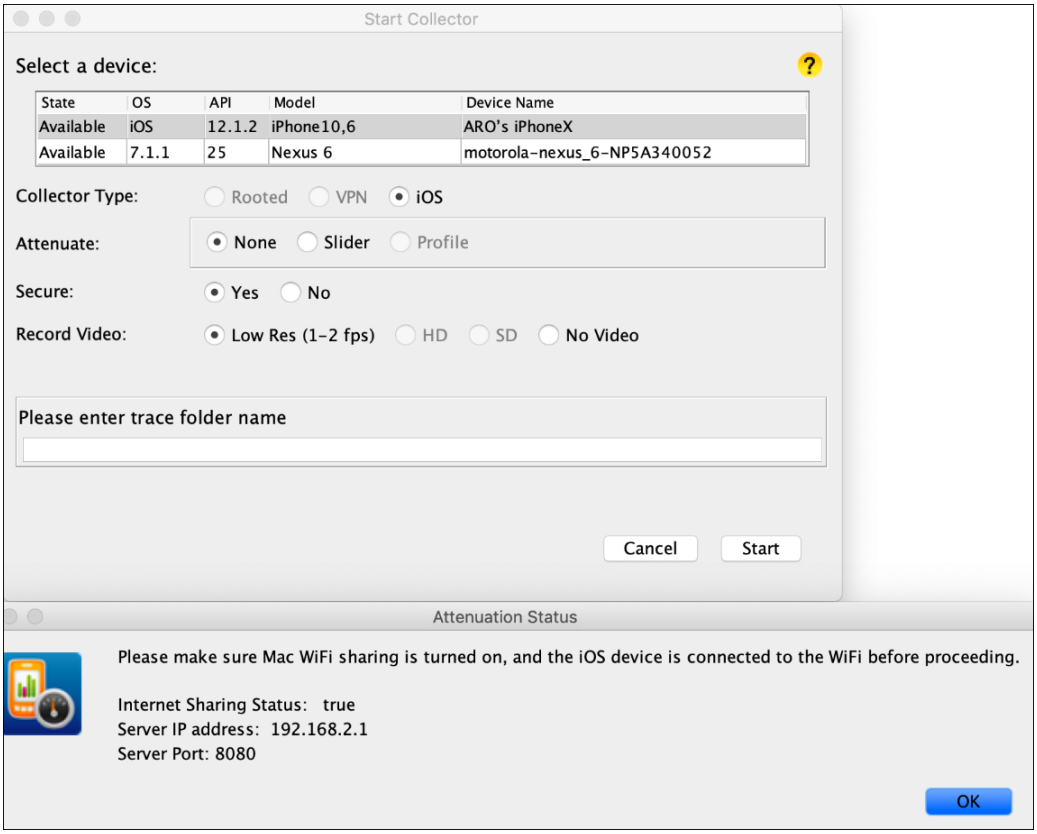
Video Optimizer still communicates via SSL to the web server. The communication is SSL (encrypted) from web browser to Video Optimizer and SSL (encrypted) from Video Optimizer to the web server.

Connection Set-up for Secure Trace:

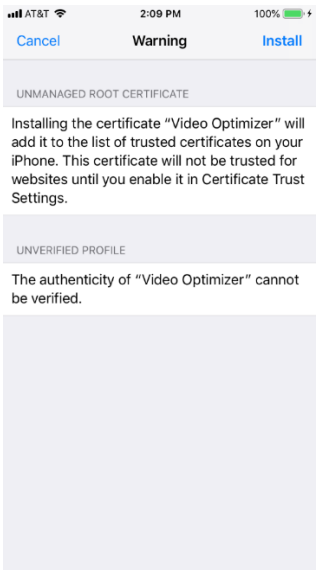
Pre-Requisite- MITM Proxy setup

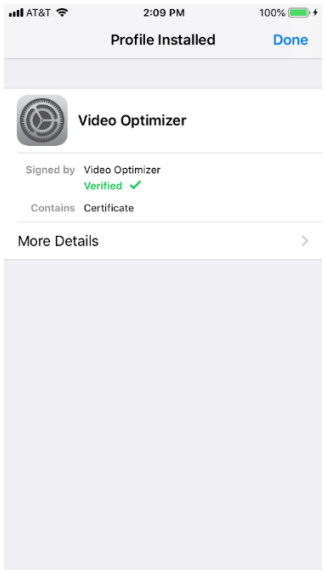
→Navigate to Menu>Start collector to launch the start collector window.

→On the start collector window Secure(yes) should display MITM status with Internet Sharing Status, Server address IP and server port and then enter a valid trace name and then click start. Refer to the screenshot below.

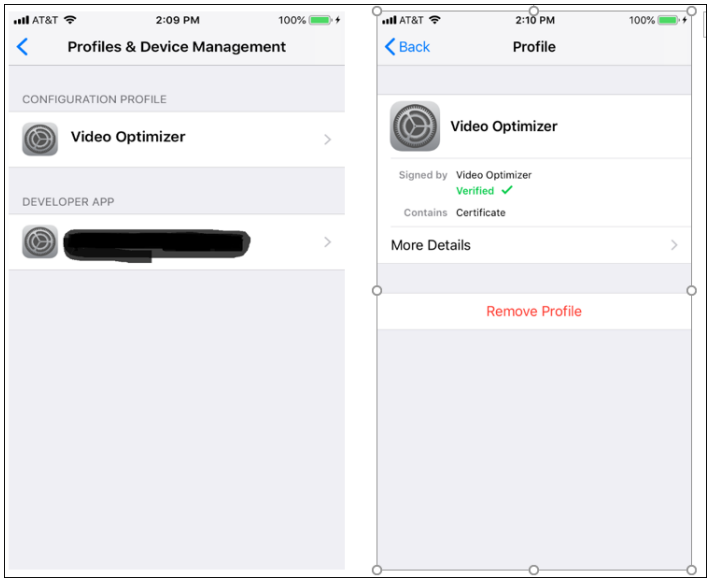


→Navigate to Safari and type in IP address 192.168.2.1:9091 to install the SSL certificate on the phone.

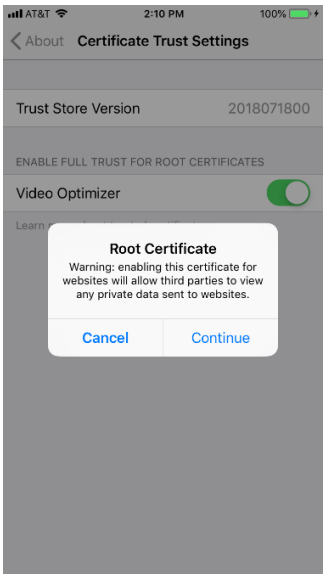




→Navigate to settings>general>Profiles and Device Management to verify that Video Optimizer is present in the configuration profile and click on it to see that the certificate is verified.

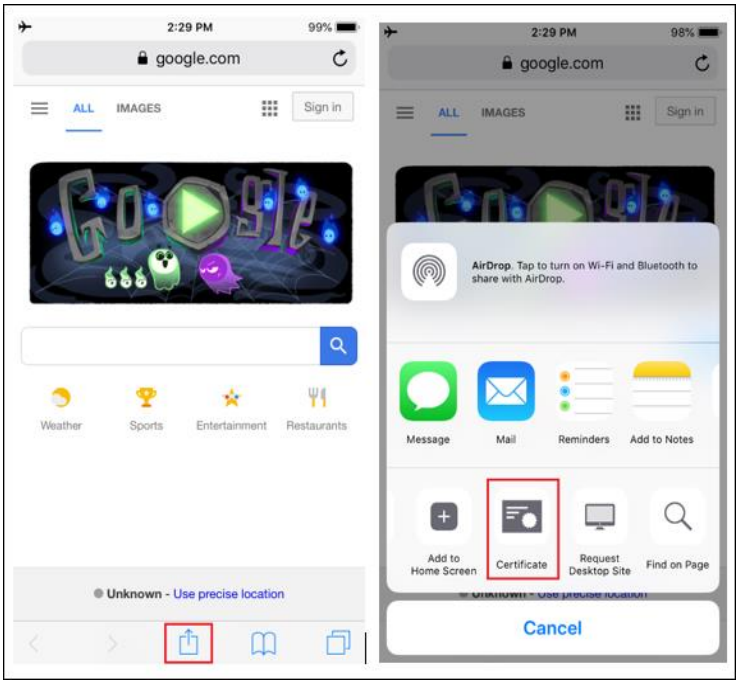


→ If you are on iOS 10.3 or higher, open the Settings>General > About > Certificate Trust Settings, and find the Video Optimizer Proxy certificate, switch it "ON" to enable full trust for it.

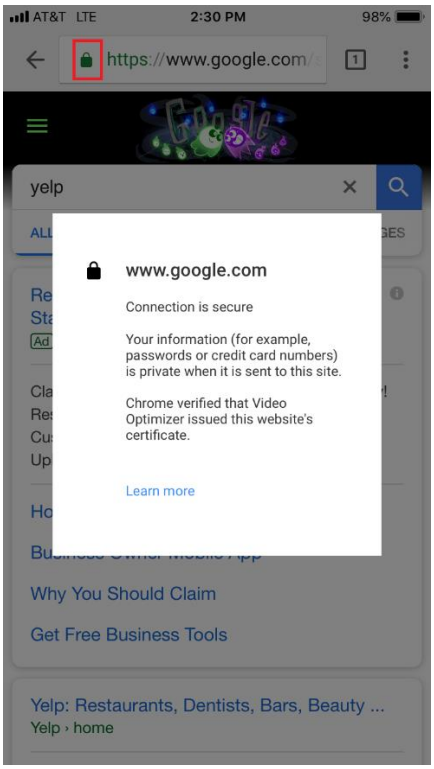


→Open Safari or Google to validate the certificate.

→On Safari following screenshots display the method to validate secured



→On Google click on the lock symbol to validate that the connection is secure.



3.3. Testing your Application

Now that the Video Optimizer is running on your mobile device, you can run tests on your mobile application or website.

When testing your application, use your app like a typical user. Test logging in, or other common use cases. Follow general test cases that you may run on each build to ensure that the application functions properly.

Note: All the data transmitted during your test is being recorded, and the screen may also be recorded if you have chosen to record video. Please only use test data while using the Video Optimizer, or your private credentials will become available to anyone who has access to the trace.

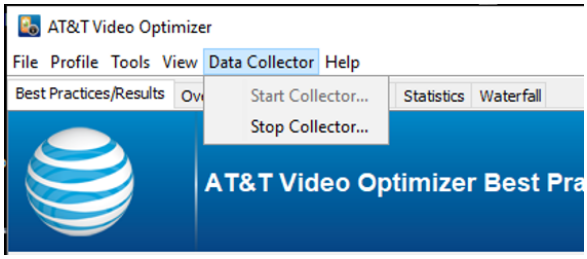
3.4. Ending the Trace

When you have completed the Video Optimizer recording, use the following steps to stop the trace, confirm that the trace files have been pulled to your computer, and begin your Video Optimizer analysis.

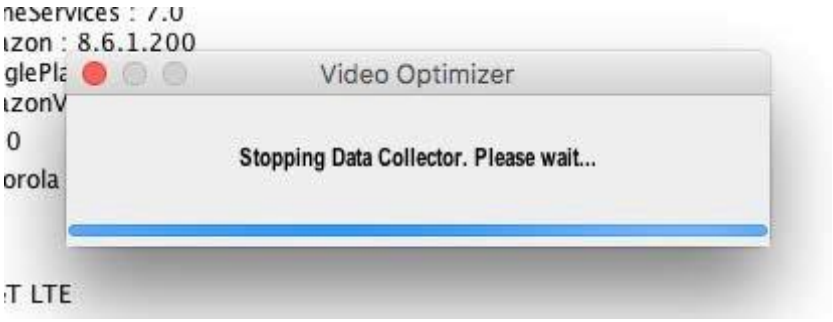
Step 1. Stop the trace in one of the following ways.

a. If you are collecting video: Click the stop button on the video viewer (as shown in **Figure**).

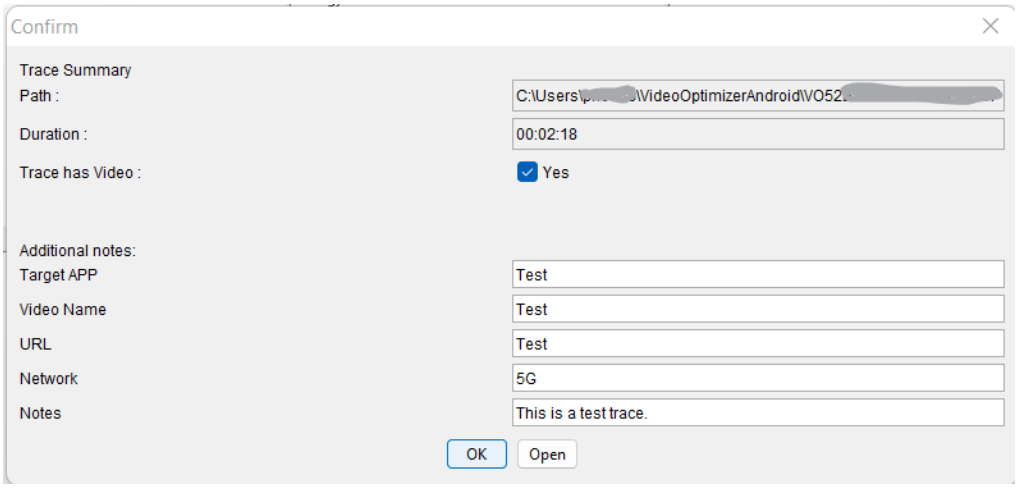
b. If you elected to *not* collect video: Stop the trace using the Stop Collector option on the Data Collector menu (as shown in **Figure**).



Step 2. When the trace collection is stopped, the files will be pulled across to your computer. The trace will be saved by default in the VideoOptimizerAndroid / VideoOptimizeriOS trace folder depending on the device used.



Step 3. Once the files have been pulled across (this may take a while if you recorded HD or SD video due to the large file size), the Confirm window is displayed (**Figure**). The fields under the Additional notes section are editable and you can enter further details about the trace. You can use the Notes section to add details about the trace being collected. Next, you can open the trace in the Video Optimizer analyzer or click "OK" to continue without opening the trace.



Step 4. The trace folder contains a file called environment_details.json which records the environment when the trace was taken. This file is created when the trace is launched. It displays the following details –

- Trace path – location where the trace is saved
- Date & Time - Date and Time information with local time zone of the trace
- VO version – Video Optimizer version
- Collector details –
  - VPN version
  - Xcode version
    - dumpcap version
    - libimobiledevice version
- Platform
  - Mac
  - Windows
  - Linux
- OS version
- Java version
- voTimeZoneID – computer's timezone ID
- voTimestamp – computer's UTC date
- Device the trace was collected on-
  - OS version
  - Platform
  - Rooted
  - Timing offset

- deviceTimeZoneID - TimeZone of the device
- deviceTimestamp - Date/Time of the device
- timeDiff
- localIpAddressList - includes both the IPV4 and IPV6 addresses from the networkInterfaceList plus the VPN collector. (Populated on Android only)
- networkInterfaceList – includes the Network IPs for the connected device. (Populated on Android only)
- voIpAddressList - includes the IPV4 and IPV6 addresses for the computer running Video Optimizer at the time of collecting a trace.

4. Analyzing a Trace

Video Optimizer will perform an analysis of your network trace, including the radio resource and energy usage of the applications run during the trace. Video Optimizer works from application traces gathered through its Data Collector to do the analysis.

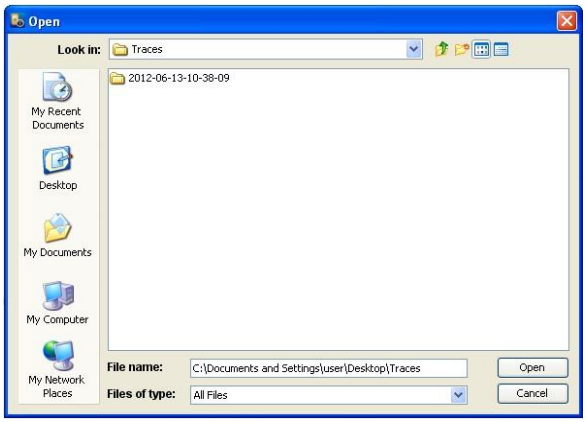
Video Optimizer provides the following:

- Visibility into radio resource and energy utilization.
- Benchmarking of resource efficiencies.
- Automatic diagnosis of application inefficiencies.

4.1. Opening a Trace

When you open a trace in Video Optimizer, the data is evaluated against a set of recommended best practices. Video Optimizer looks at how your application (and your server) is handling caching, how you are managing the network connections for your application, how your app is using HTML, whether your app is treating data securely, and how it is handling video streaming. Use the following options to open a trace file.

a. Select Open Trace from the File menu to display the Open dialog box.



Select a trace folder and click Open. The trace files are loaded, and Video Optimizer begins analyzing the data.

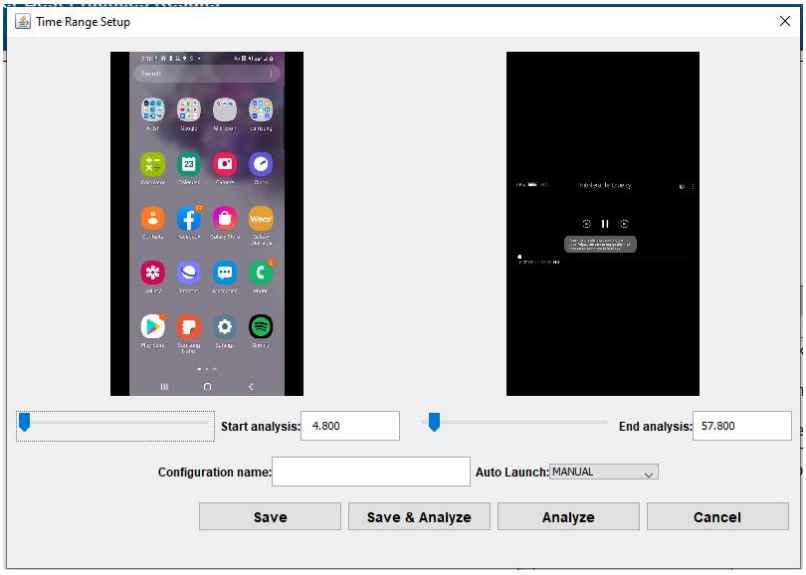
Note: The time required for Video Optimizer to complete the analysis depends on the size of the trace. As soon as the analysis is complete, all the content tabs in the Video Optimizer are updated with the analysis results.

Video Optimizer can recognize a folder which has one packet trace (.cap or .pcap file) and one video file (.mp4 or .mov) and convert it to a Video Optimizer trace folder. For example, if a pcap file was captured on an Android device using the PCAPdroid app and a mov/mp4 file was created during this capture using Screen Recording, and these files were placed in a folder, Video Optimizer would be able to open this folder as a trace folder and perform video analysis for this capture. Similarly, it would also work with pcapng files captured if using the Wireshark app and a mov/mp4 file present in a folder.

Additionally, a folder with just a packet trace and no video in it can also be converted into a trace folder in the same manner.

b. Select “Open Trace with Time Range…” from the File menu.

A partial section of a trace can be opened and analyzed, excluding data before a start point and eliminating data after an end point. This can be helpful if there is unwanted data in an otherwise good trace. For example, if a speed test was run at the beginning of a trace, but you don’t want the speed test data included in your app analysis.



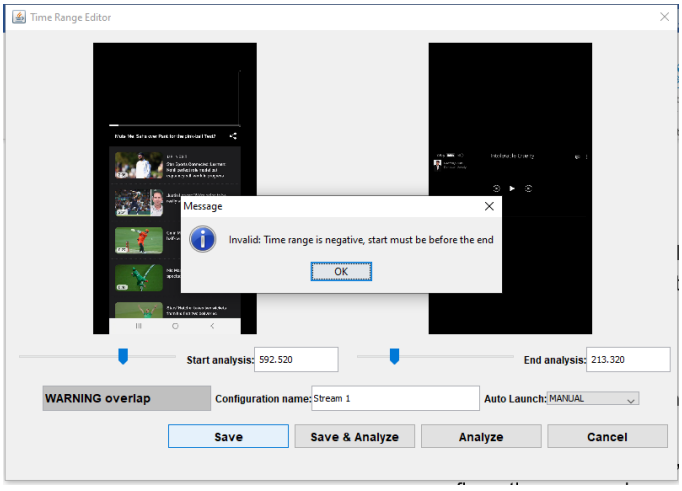
The dialog displays

- Frames from user’s device video (video.mp4 or video.mov).
- Time Range
    - Start Analysis:
        - Slider - user can slide it or select it, then use left or right arrow keys for fine control.
        - Text field - user can enter a value directly, image gets updated after leaving the text field.
    - End Analysis:
        - Slider - user can slide it or select it, then use left or right arrow keys for fine control.
        - Text field - user can enter a value directly, image gets updated after leaving the text field.

- Configuration Name - Text field where the user can enter a name for the time range. Naming is optional if user just wants to click on the Analyze button to analyze the trace for the specified trace range.
- Auto Launch -
    - Default – time range that is used to automatically launch the trace.
    - Manual – time range the user must manually select to launch the trace with the specified time range.
- A button bar at bottom of dialog
    - Save
        - if no configuration name is specified, a popup message - "Invalid: cannot be saved without a name" is displayed to the user.
        - saves any changes.
    - Save & Analyze - Saves then continues with opening trace with selected time range.
    - Analyze - Analyzes trace with the displayed time range, does not require a name, since it will not save a new configuration or any changes if editing.
    - Cancel - does not save changes or does not open a trace.

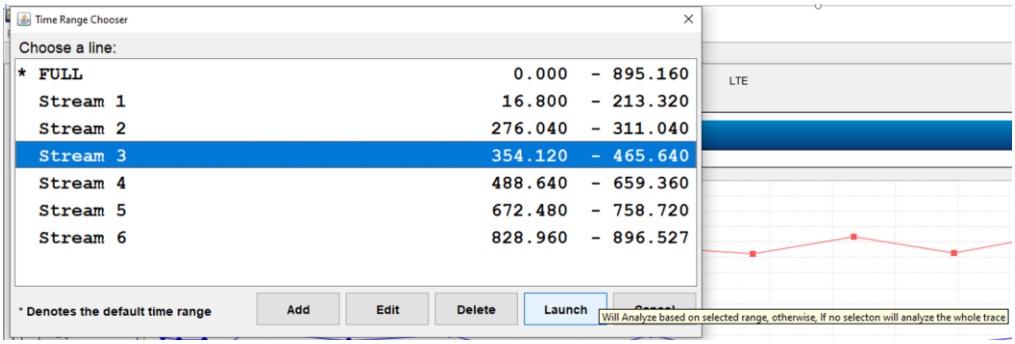
User will be able to scan/play through the video to set start and end time-range.

If the start time is beyond the end time, the user is displayed an error message.

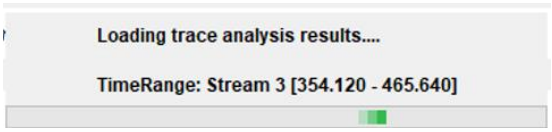


Opening a trace with Open Trace with Time Range... that does not contain a video.mov or video.mp4 will result in an Error Dialog displaying "Exception in TimeRangeDialog: No Device Video file".

If time-range(s) already exist, they will be listed in the Time Range Chooser dialog.

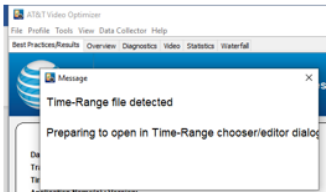


Time Range can be added, edited, selected, or deleted. An entry, “FULL”, is created at the top of the list as a Default and will display the complete trace range, after user creates the first configuration. When setting a different entry to be Default, any entry that was Default earlier will become Manual. At any time, there can only be one entry marked as Default. If the Auto Launch option for a time range is selected as Default, it will be marked with an asterisk to denote the default time range. Any time range that is Default will be the range used to open the trace in the future. Selecting a time range and clicking on the Launch button opens a part of a trace specified by a time range. Progress dialog will display a second line, detailing the time range being used while opening a trace.

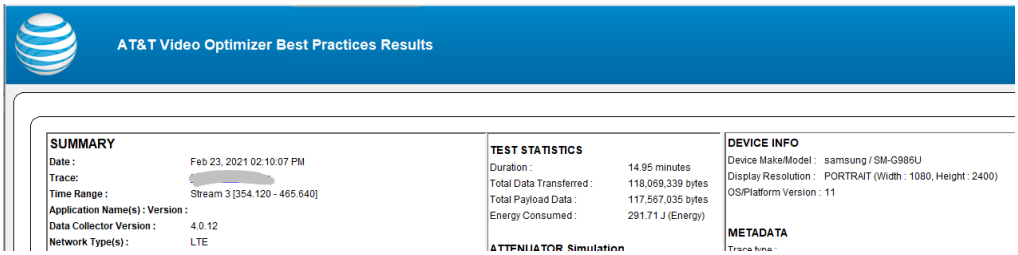


Note: If a trace has a Default entry and the user wants to bring up the chooser, they need to use the menu, File->Open Trace with Time Range.

For traces that have time range set, and none of the time ranges are marked as Default, the File->Open Trace, and the File->Open Recent menu options display the following dialog to let the user know that this trace has time ranges detected -



and displays the chooser dialog to let the user choose the time range to launch.



A new label "Time Range:" is displayed in the Best Practices/Results tab summary section which lists the time range used for the trace/pcap/cap file that was opened.

When time ranges are created, they are saved in a json file called time-range.json in the trace folder. It will contain one or more time ranges. It will list the details of the time range saved such as the Title, the time range type – Default or Manual, the Start Time, End Time, and the Range.

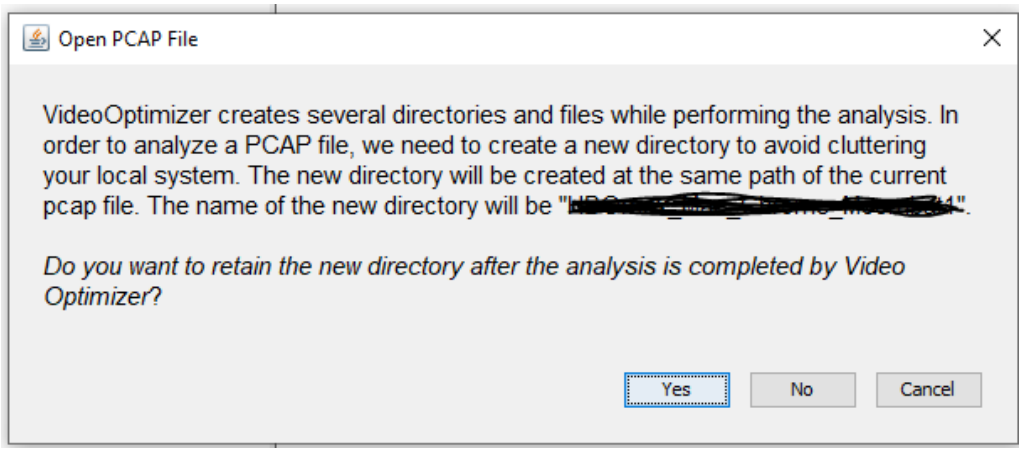
If a time range is marked as default, Open Trace or Open Recent will open the trace with the specified time range automatically or by default. If none of the

time ranges are marked as default, the time range chooser dialog is displayed so that the user can select which time range to open the trace with.

By deleting all entries or time ranges, the entire json file will be deleted.

c. Select “Open Pcap File…” from the File menu (instead of Open Trace) to open pcap/pcapng trace files. These files allow you to view statistical and analytical data for the trace based on the packet information in the file, but you will not be able to view any video information in the Viewer and you will not see any information for peripheral applications (i.e. GPS or Bluetooth). **Note**: If the trace is too big to load due to the current memory setting then Video Optimizer will quit and restart and present a dialog with options for the user.

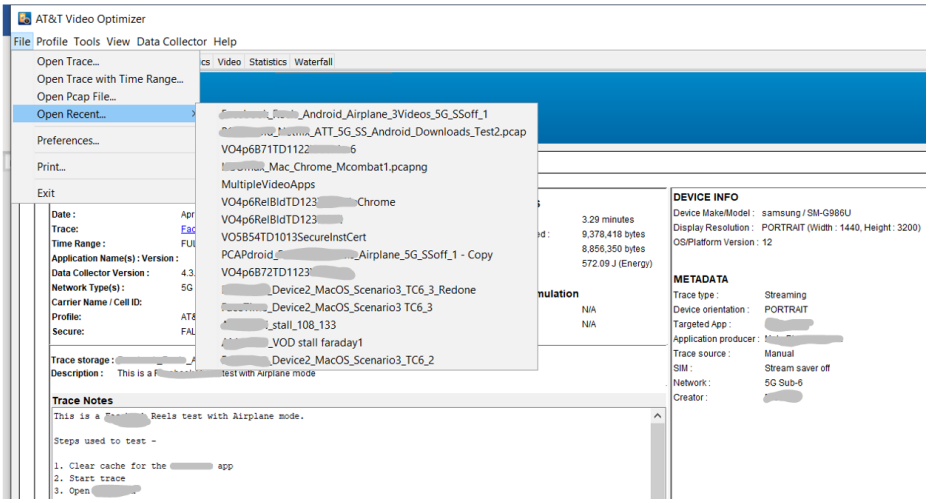
Video Optimizer needs to create several folders while performing analysis. When using the “Open Pcap file…” feature to analyze a standalone pcap or pcapng file, which may not be in a Video Optimizer Trace folder, a dialog will be displayed with options of performing the analysis in either a temporary or a permanent folder. The new folder’s name will be the name of pcap/pcapng file without the extension. The new folder will be created at the same path of the pcap/pcang file. The temporary folder will be deleted immediately after the analysis. Tools->Edit Metadata option will be disabled, and the user will not be able to save any metadata or any notes in the Trace Notes section. If the user attempts to double click the notes area, it will display “Sorry, You cannot edit or save notes on filename.cap, try reopening the PCAP and approve conversion.” If permanent folder analysis is selected, the original pcap/pcapng file is moved to the newly created folder. The user is able to save metadata and trace notes when the permanent folder option is selected.



“Open Pcap File…” function remembers the location of the last PCAP file opened. For any exports or images to be saved for the currently opened pcap

file, the location displayed in the Save window is the same location where the opened pcap file resides.

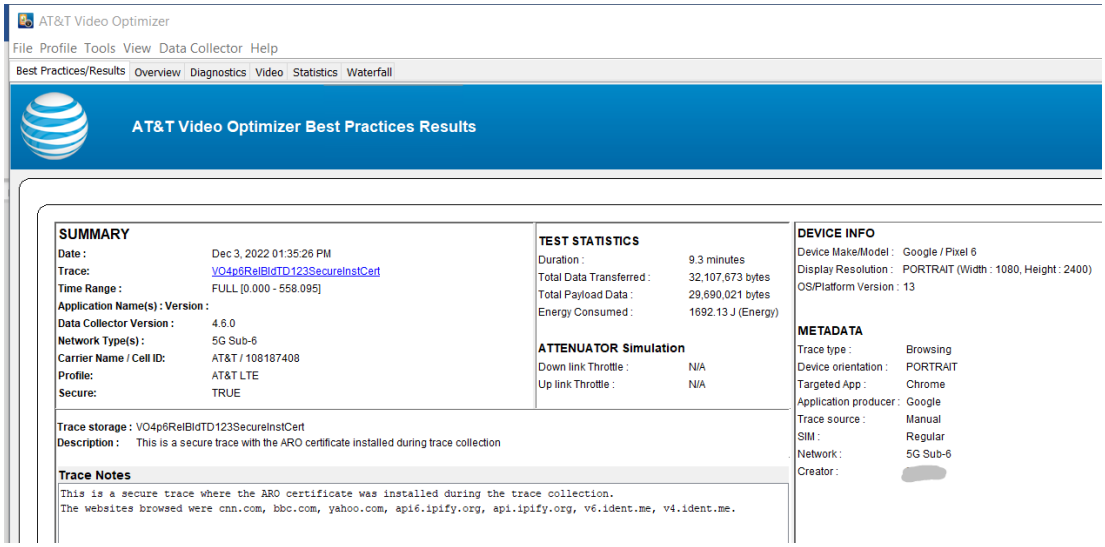
d. *Open Recent:* User has the option to open the recent 15 traces/files from Analyzer which allows user to find the last few traces/files. File->Open Recent menu displays the recently opened pcap, and pcapng files as well. If the user had decided to create a folder when opening a pcap file, the Open Recent menu will list the folder name in the menu. If a folder wasn't created, the menu will list the pcap file including its extension to differentiate files from folders.



Open Recent file: When user re-names any file which was opened and displayed in the open recent file, the file name will be removed from list. The file name will not appear in the open recent until the user re-loads the trace. Also, user can re-name the trace with any special characters and load it in the Analyzer. For error traces like, no activity in traffic file, or, there is no traffic file in the trace, will not be shown in the open recent files. User can hover over the open recent menu names and a tooltip will be displayed which will list the full path for the trace/file.

4.2. Best Practices Results

Video Optimizer trace analysis starts at a high level, with the Best Practices Results, and then it helps you to pinpoint the issue as much as is required to solve the problem. The high-level views work well for executive readouts, while moderate digging might be useful for a deeper dive, and for a deep technical understanding – you can dig even deeper.



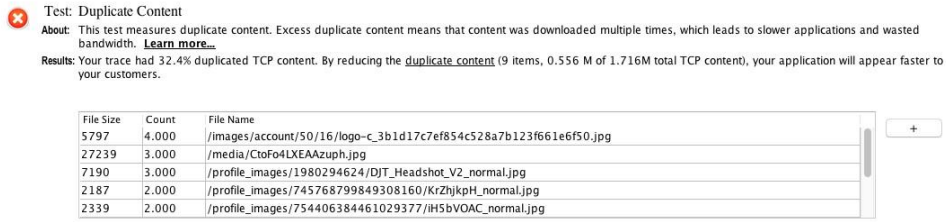
The top of the Best Practices/Results tab tells you some basic information about the trace such as the date, trace name, and information about the device that was used for the test. The trace name is clickable and when clicked opens the trace folder. It also displays the details of the trace collected as entered by the user. Double clicking on the Trace Notes section is a shortcut into the Metadata editor section to be able to make changes to the trace information and trace notes. The Summary section reveals a few high-level statistics recorded in the trace. Right below this is the Tests Conducted section, which contains a summary of the best practices so that you can quickly determine which best practices failed. The below screenshot refers to a trace that is uploaded in the analyzer.

A ‘N/A’ icon is displayed to indicate that a Best Practice is not applicable when a trace does not have relevant data available for analysis. Refer the image below -

Generally, the Tests Conducted section of the Best Practices tab is the best place to start to improve your application.

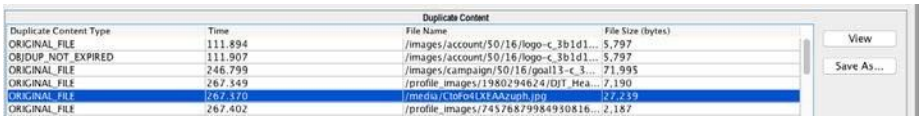
Step 1. Click on the text for the Best Practices test to go to a larger summary. A green checkmark means that the test was successful, and a red x means that the

test failed. For example, here is a trace that failed the Duplicate Content best practice.

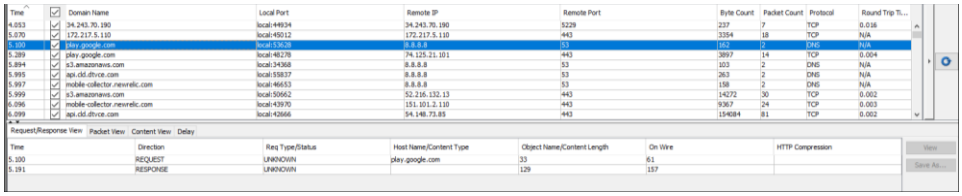


Step 2. Review the About section to learn more about this best practice. Review the Results section for details about how to fix the problem. This example has a table listing files that were sent multiple times including the count of downloads and the file name.

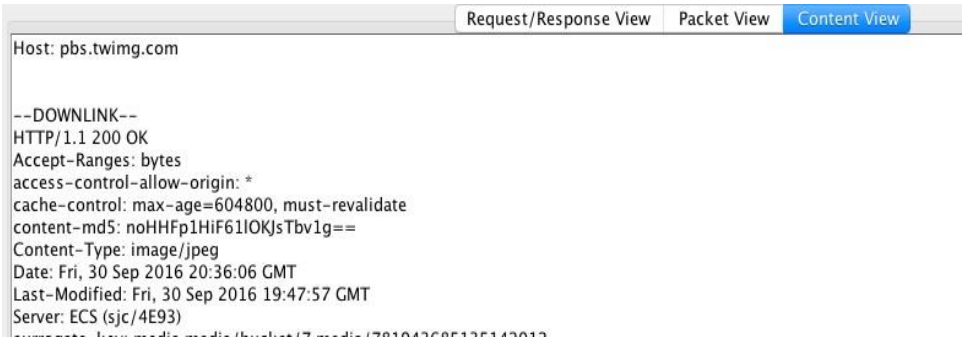
Step 3. Click one of the table entries for more information—every best practice table will let you do this. In this example, you are taken to the full list of duplicate content in the Overview tab, from which you may be able to determine the time ranges or other details to figure out the issue.



Step 4. Select a row in the table and click View to view the contents of the file. This helps when a file name is obscure, and you don't really know what the file is or the type of content. The Diagnostics tab is displayed, and you can see the request/response for the file.



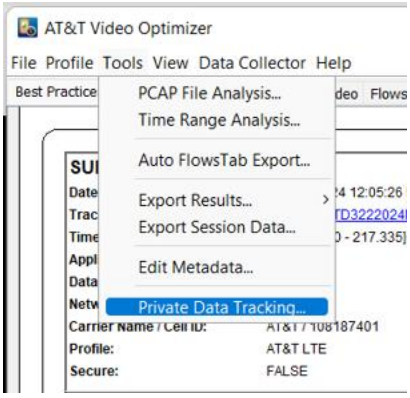
Step 5. Click Content View to see the headers. In **Figure**, the top table shows the IP and domain (pbs.twimg.com) indicating a request from Twitter's image servers. The bottom table shows the request/response. In this example, the file is coming from Twitter. Check the cache-control parameter in the DOWNLINK header to see if the file has the correct cache headers. In **Figure**, cache-control shows a max-age of 604800s—a cache timeframe of one week—so in this application, the image cache may not be properly set to store files locally on the phone.



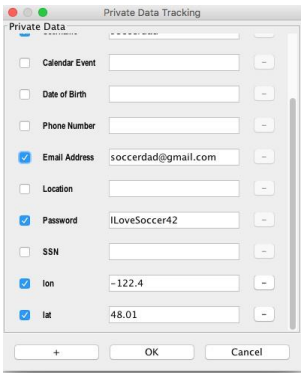
4.3. Private Data Tracking

The Transmission of Private Data best practice test allows you to examine all the decrypted and clear text data files for leakage of private data.

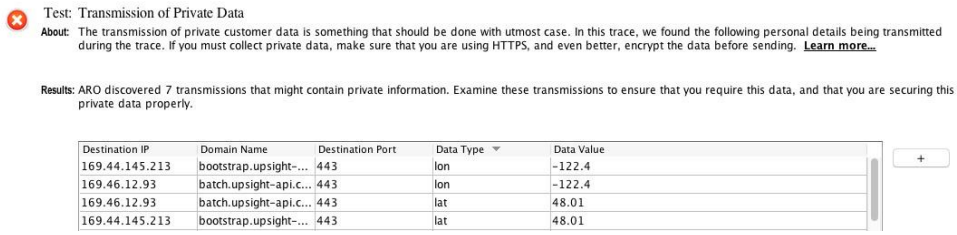
Step 1. Select Private Data Tracking from the Tools menu.



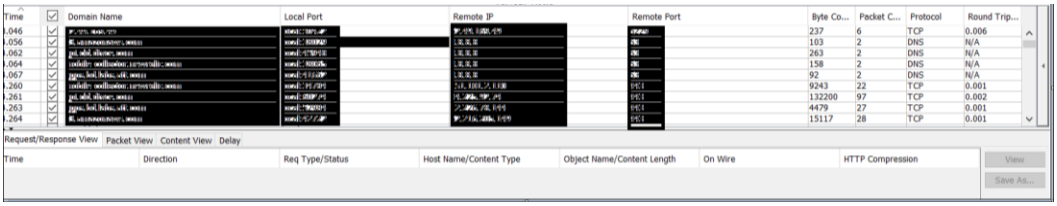
Step 2. In the Private Data Tracking dialog, complete the fields that apply to your trace.



Step 3. Click OK to analyze the trace for these values. A report will be provided for you in the best practices tab. The Data Types and Data Values in **Figure** were found in the Video Optimizer trace because they were entered in the Private Data Tracking dialog.



Step 4. Click one of the rows in the table to see the Diagnostics tab. The top table shows the TCP stream and the bottom table shows the Request/Response View.



4.4. Video Analysis

Video Optimizer contains several functions to analyze the delivery of streaming video in your mobile application. These specialized tools have some unique features that require additional configuration.

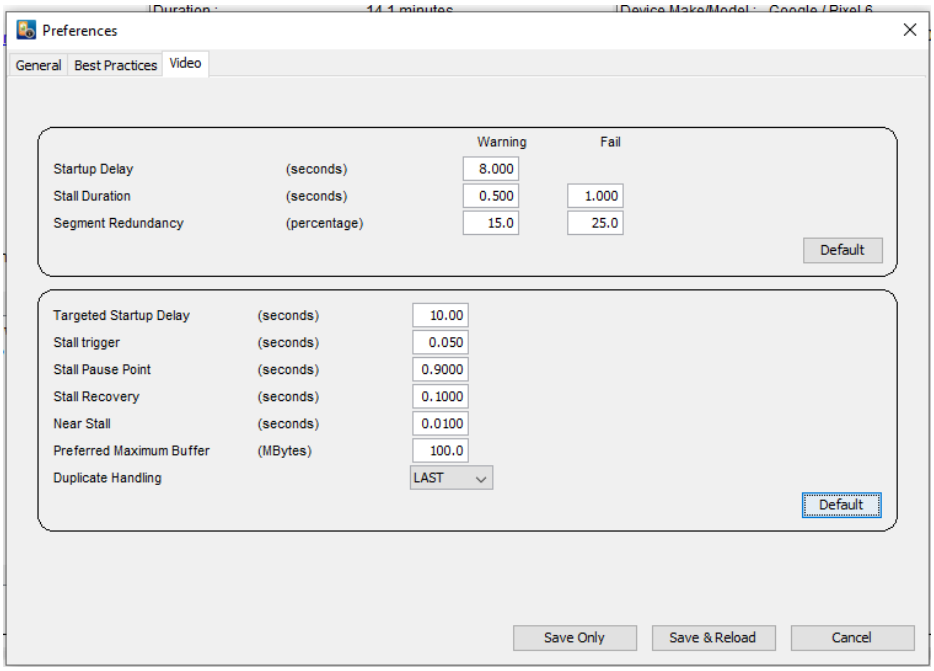
When testing video, your trace should ideally be of a DRM free video, and the application should allow screen recording. Video Optimizer can perform several analyses without these two features, but the examples in this section are of a trace with a DRM free video, and the recorded screen.

Oracle Java 8 is required if video analysis will include DASH manifests with encoded segment list format otherwise any Java 8 and above will work.

4.4.1. Video Analysis Setup

Begin by opening a trace with video content in it, but before beginning analysis, there are a few manual steps required.

Step 1. Select File>Preferences>Video.



Step 2. Enter the **Targeted Startup Delay** in seconds. This is the KPI (Key Performance Indicator) requirement for how quickly a video should begin playing. The default is set at 10 seconds. A video that takes longer to begin playing than the value set for Startup Delay will fail the Video Startup best practice.

Step 3. Enter the **Stall trigger** in seconds. The default value is 0.05s (50ms). Stalls that are under the threshold value set for Stall trigger will not be counted in the best practice. For example, the value in **Figure** means that stalls under 0.05s will not be counted in the best practice.

Step 4. Enter the **Preferred Maximum Buffer**. Video Optimizer measures the amount of video stored in the buffer. Here you can set the max buffer size (in MB). For example, the value in **Figure** denotes a 100 MB video buffer.

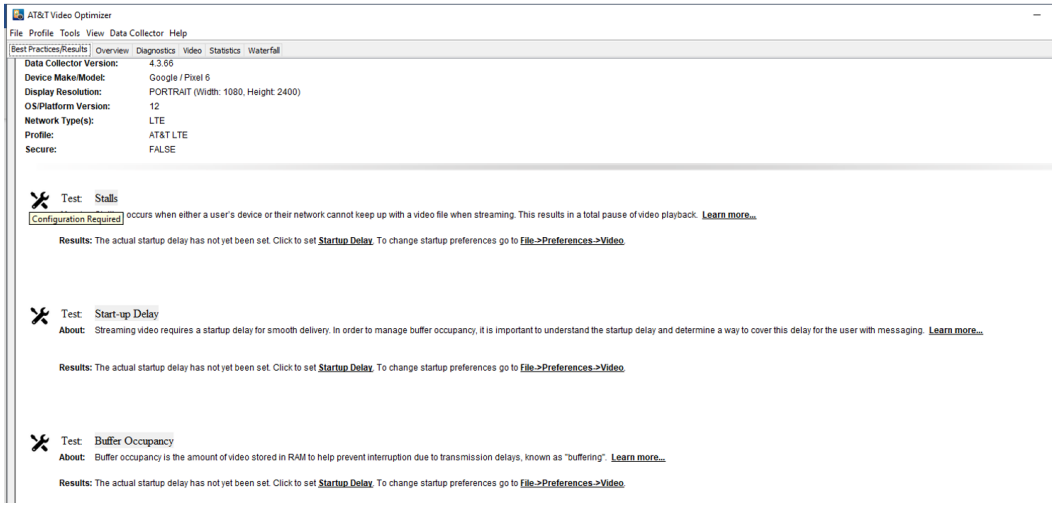
Step 5. **Stall Pause Point** - if a segment is late to arrive, the currently playing segment must pause before it finishes playing, a value greater than 0 is suggested.

Step 6. **Stall Recovery –** estimated time it takes for a player to start or resume playing once segments are arriving. A value greater than 0 is suggested.

Step 7. Click OK.

4.4.2. Configuration Required

From the best practices tab, user can set the start-up delay by clicking on the icon of any of these three best practices - Video: Stalls, Start-up Delay, Buffer Occupancy. Refer to the screenshot below –

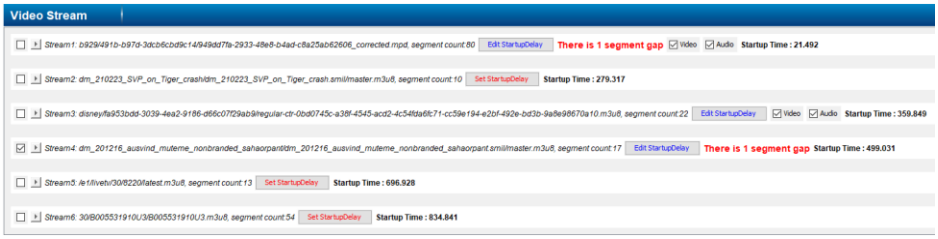


4.4.3. Analyzing a Video

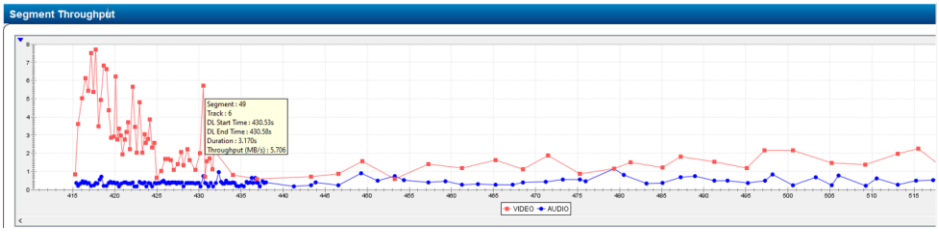
Video Optimizer will extract streaming video from the trace, when successful, you will see the video stream table as in step 1 below. However, sometimes there are video requests, but no streams showing, in such a case, the user is displayed a message that 'Video segments could not be assigned to a Video Stream.'

Video Optimizer can handle Dash, HLS, MPEG, as well as Transport Stream. For other video streaming you may need to use inferencing.

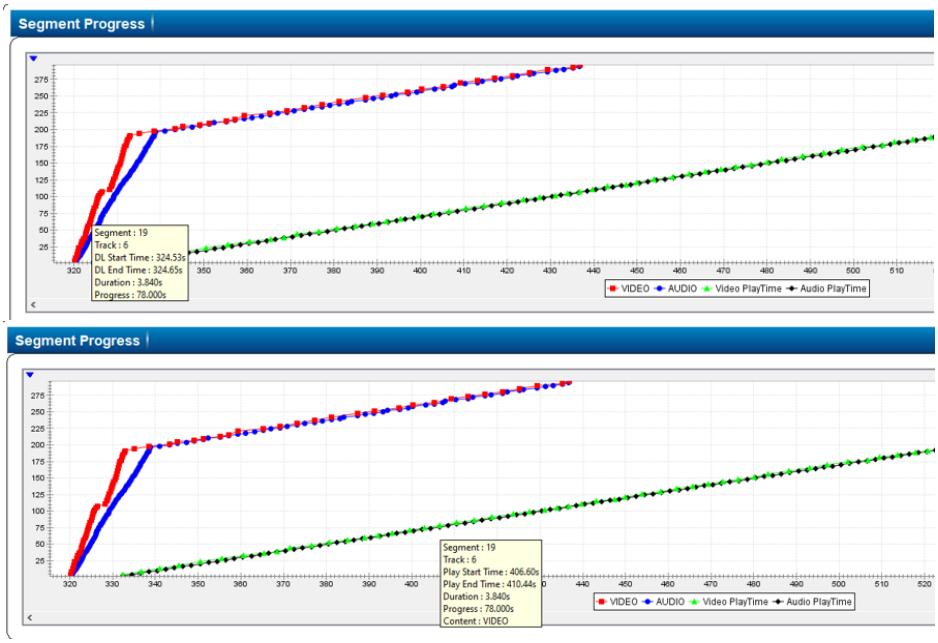
Step 1. Navigate to Video tab->Video Stream and choose a stream. You can choose by using the checkbox or clicking the Set/Edit StartupDelay button. The first stream is chosen by default.



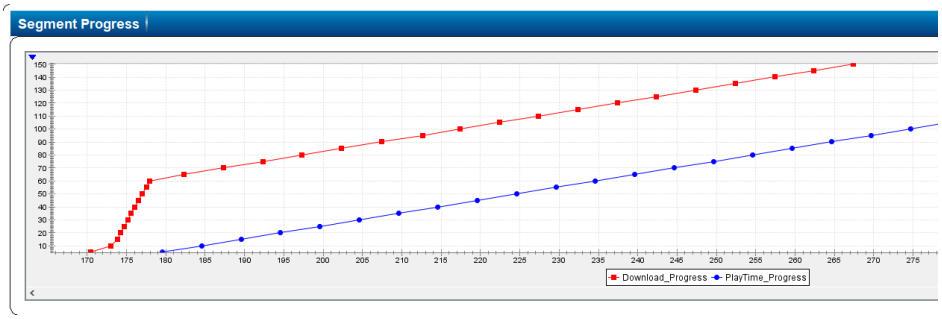
Step 2. On selecting the stream, the Segment Throughput graph, the Segment Progress graph, and the Segment Buffer graph are displayed.



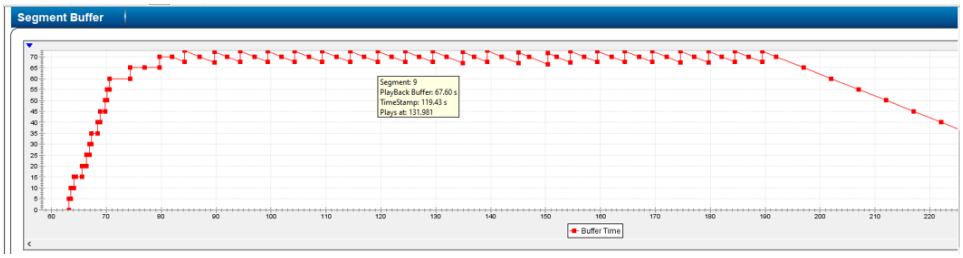
The Segment Throughput graph displays the throughput for the video and audio segments in the case of demuxed video and for the segments in the case of muxed video. Hovering over each of the points displays a tooltip with the following information – Segment #, Track #, Download Start Time, Download End Time, Duration, and the Throughput.



The Segment Progress graph displays the progress of the Video and Audio segments. Hovering over each of the points displays the following information - Segment #, Track #, Download Start Time, Download End Time, Duration, and the Progress. The graph also displays the Video and the Audio PlayTime. Hovering over each of the points displays a tooltip with the following information – Segment #, Track #, Play Start Time, Play End Time, Duration, Progress, and the Content (Video/Audio). The Legend in the graph helps the user differentiate between the various graphs. For a muxed video, there would be just two graphs – the Download_Progress graph and the PlayTime_Progress graph. Graph refreshes when each stream is selected.

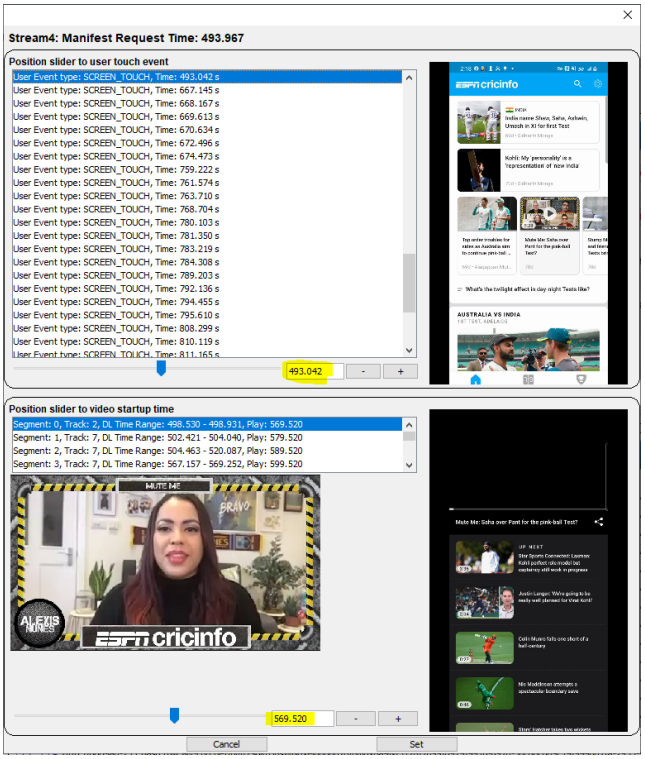


The Segment Buffer graph displays information about the playback buffer. Hovering over the points in the graph displays the following information – Segment #, PlayBack Buffer in seconds, the TimeStamp, and the Plays at value. The graph refreshes when each selected stream has its startup delay set.



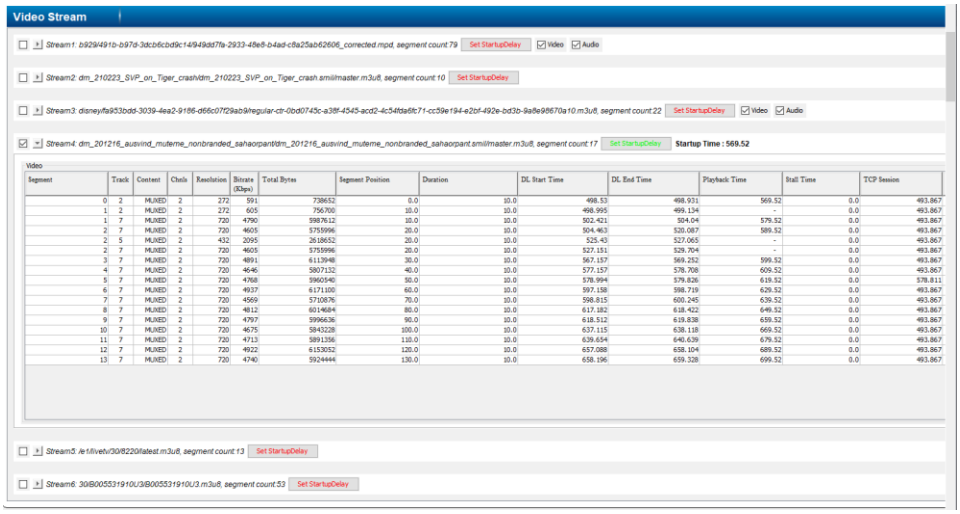
Double clicking on the header of the Segment Throughput, Segment Progress, and Segment Buffer graphs can expand/collapse the graph. On hover over the headers, a tooltip is displayed to let the user know about the same.

Step 3. Click on Set StartupDelay button in red which indicates that the startup delay is not set or Edit Startup Delay in blue which indicates it was previously set. If the video you tested was DRM free, the view will be of the first frame in each chunk.
User input window is displayed.



In the above image, user events and video start up time are displayed. Selecting an event or segment will highlight the entire line and only one event or segment can be selected at any time. If there are no user events in the trace, then the user event area will be collapsed. If there are no segment thumbnails, then the segment thumbnail area will collapse.

In the User Touch Event section, navigate through the touch events viewing the simultaneously changing frame images on the right-hand side of the dialog to choose the time stamp of the precise video playback requested time. The time chosen should be before the Manifest Request Time displayed at the top of the window and less than the time range found in the first segment. Enabling the Settings->Developer Option->Show Taps option on an Android device helps with the identification of the precise video playback requested time. Next, position the slider in the Video Startup Time window to a point where the video startup time is greater than the arrival time of the first segment. The arrival time is the second number in the highlighted Time Range. In the example above its 498.931. Click Set.



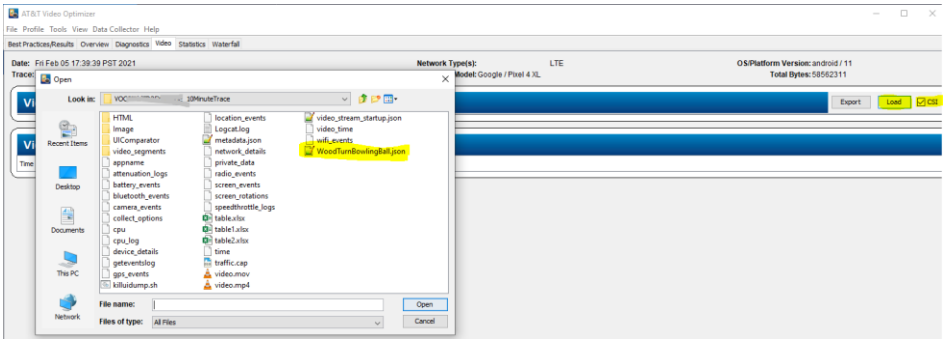
Initially video streams will have an estimated start time. These will show a red StartupDelay button. You can set the actual startup delay by clicking this button, the button will become green while using the dialog and becomes blue once the set button has been clicked.

Step 4. Once the Startup Delay has been set for a stream/streams, the values for the Play requested time and the startup time are saved in a file called video_stream_startup.json which is saved in the trace folder. Subsequently when the trace is opened at any time and the startup delay must be set, these previously set values are displayed when the Startup Delay window opens for the stream. A validationStartup field displays the following -

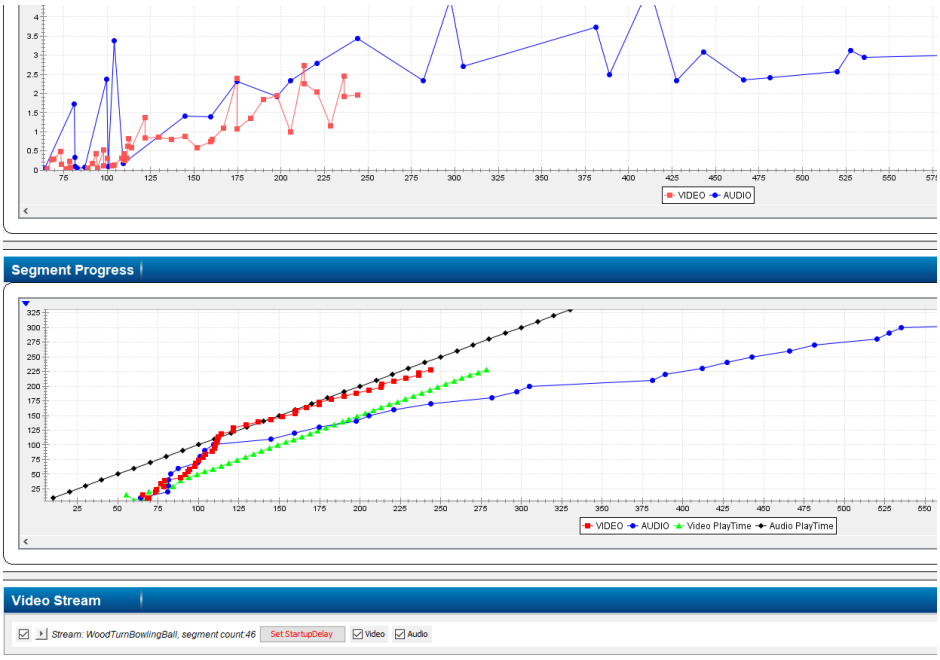
- USER - User has set the startup delay
- ESTIMATED - VO estimated the startup, user has not set startup delay

- If the default video analysis does not provide any results and a manifest is available, then the CSI(Chunk Sequence Inferencer) feature can be used for analysis. Adaptive Bitrate Streaming behavior and QoE measurement and analysis is becoming challenging due to the increase in usage of end to end encryption protocols like HTTPS and QUIC. CSI helps here in inferring the ABR behavior based on packet size and timing information that is available in the encrypted traffic. The CSI feature in Video Optimizer is based off of research by Shichang Xu, Subhabrata Sen, and Z. Morley Mao presented in the white paper “CSI: Inferring Mobile ABR Video Adaptation Behavior under HTTPS and QUIC”, 2020. https://doi.org/10.1145/3342195.3387558

  To use the CSI feature, after loading a trace, navigate to Video tab->Video Stream, check the CSI checkbox and click on the Load button to load the manifest.



This loads a video stream and allows video analysis based on inference-



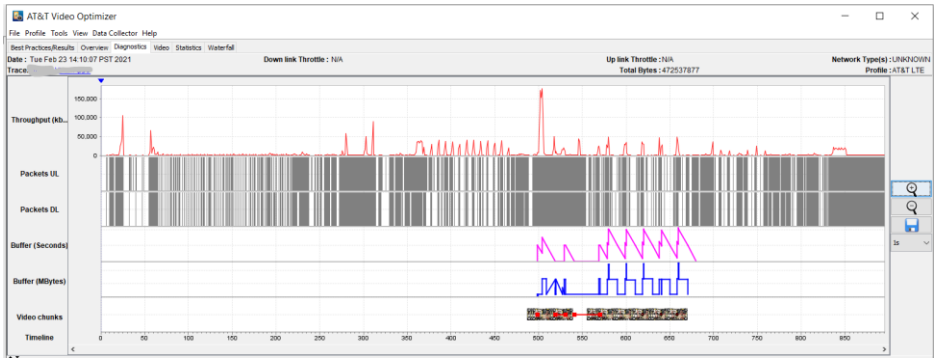
A video_stream_startup.json file, which records the play requested time, and startup time set, is stored even for CSI analysis when the startup delay for the stream has been set. For subsequent analysis of the same trace, when startup delay has to be set, it displays the stored values when the startup delay dialog opens up.

When performing CSI analysis, if the manifest loaded is in a path different from the trace folder, then a copy of the manifest file is stored within a CSI subfolder for the trace folder. If the CSI manifest exists in the root trace folder, then it is moved to the CSI subfolder. If the CSI subfolder already has the manifest, then it is not copied again. If the CSI subfolder already has an alternate manifest in it, the user is prompted and asked if the existing files should be deleted. After the CSI analysis is completed, the status of the CSI analysis along with the new path for the manifest is stored inside of the CSI subfolder in a file named CSIState.json. Subsequent analysis of the same trace will automatically lookup the stored CSI status and auto-analyze CSI.

- **Viewing Buffer Details**

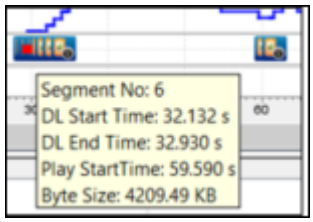
The Diagnostics tab shows the Playback Buffer (the seconds of video stored locally) and the Buffer Occupancy (the KB of video stored locally). Examine the Video chunks line closely—in **Figure** there is a red line starting at chunk 1 and ending when the chunk appears on the screen—in this case, around 569s. This allows Video Optimizer to calculate if the video buffer runs out of video time or KB. When this occurs, there is no more video to play, and a stall occurs to the viewer.

Video Optimizer will use the startup occupancy found at the start to estimate when the video will resume playing. Please note some processing now happens in the background for video stream analysis. As a result, you may notice the image of a thumbnail updating over time.

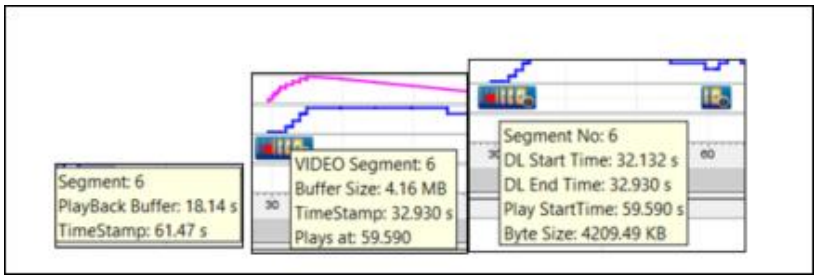


- ***Getting Video Information***

1. Move the pointer over a video chunk to determine when the download started, stopped, played on the screen, and the number of KB in the chunk.

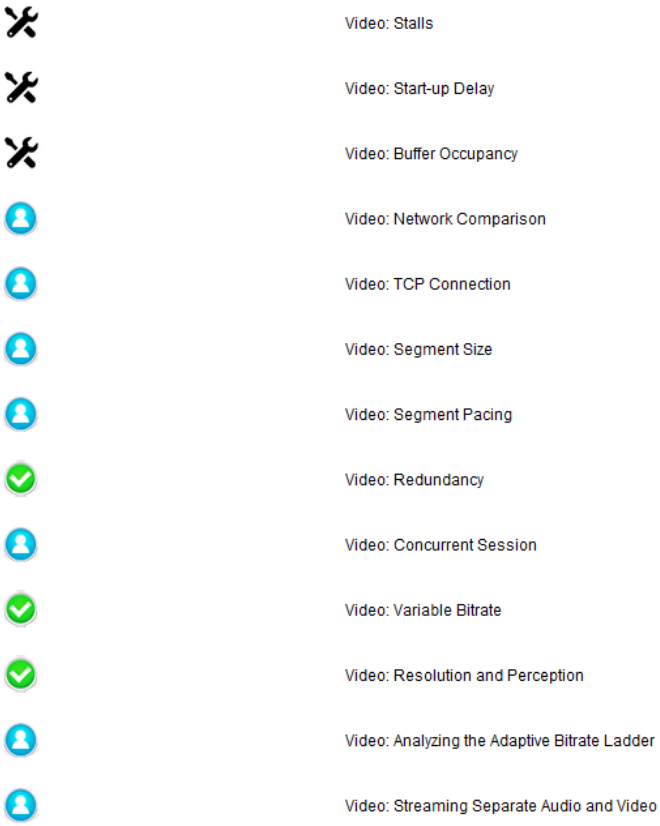


2. Point to the Play Back Buffer and Buffer Occupancy lines for more information about how much playback is stored in the buffer and how much is used. In the Image below for segment 6, at 32.930, the video buffer has 4.16MB of data, which contains 59.590s of video playback time. These steps will also allow Video Optimizer to calculate the data presented in the Video Best Practices.



4.4.4. Video Best Practices

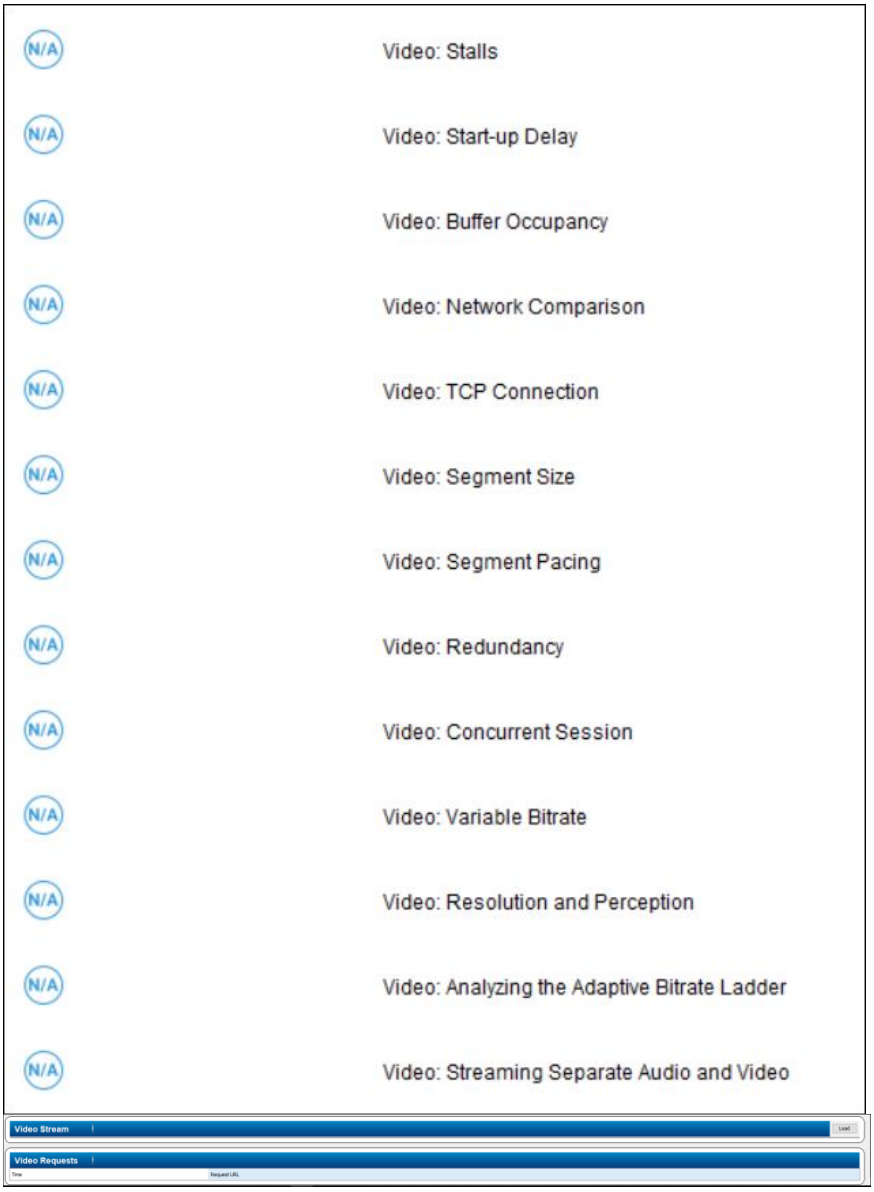
The following are examples of the best practices in Video Optimizer. These best practices are still very experimental and are simply providing information. As Video Optimizer matures, these will become fully fledged tests with pass and fail criteria.



- ***Video Conditions***

  1)There is no video in the trace

  - [NA] across all VBP
  - Response: No streaming video data found.
  - no Stream
  - no segments
  - no urls



2)Video not handled in the trace
- [Config_Required] across all VBP (no analysis)
- Response:Video Optimizer was unable to analyze video stream file(s) Hint: look for ways to locate Stream/segment information with the Video Parser Wizard. Click here to select Request URL Stream on the Video tab
    - no Streams
    - no segments
    - urls exist

3)There is only one invalid Stream created.
- [Config_Required] across all VBP (no analysis)
- Response: Invalid Streams. Video Optimizer did not have enough information for analyzing streaming video. Hint: look for ways to locate segment information with the Video Parser Wizard. Click

here to select Request URL Stream on the Video tab.
- Stream - invalid
- segments
- urls exist

4)There is only one valid video Stream created
- apply tests to all VBP for selected Stream only
- Stream-Valid
- segments
- urls Exist

5)There is only one valid Stream but de-selected video Streams
- [Config_Required] across all VBP (no analysis)
- Response: No Stream is selected. Please select a Stream on the Video tab.
- Stream
- segments
- urls exist

6) There are Multiple valid Streams
One selected
- [Config_Required] across all VBP (no analysis)
- Response: Please select only one Stream on the Video tab. Click here to select a Stream on the Video tab.
- none selected
- [Config_Required] across all VBP (no analysis)
- No Stream is selected. Please select a Stream on the Video tab.

7) There are Invalid with valid Stream
- one Selected Stream
    - apply tests to all VBP for selected Stream only
    - ignore invalid Streams

8)There are invalid with valid Stream
- none Selected Stream
- [Config_Required] across all VBP (no analysis)
- Response: No valid Stream has been selected. Please select a Stream on the Video tab. Note: There are invalid Streams detected. Video Optimizer did not have enough information for analyzing streaming video. Hint: look for ways to locate segment information with the Video Parser Wizard. Click here to select Request URL Stream on the Video tab.

5. Video Optimizer Reference

The following sections are a complete reference of the Menus and Content Tabs that are available in Video Optimizer.

5.1. Menu

Video Optimizer has the following menus.

Menu	Description
File	Contains options for opening trace, opening Trace with Time Range, opening Pcap File, Open Recent, Go To Recent Folder, Preferences, Printing results, and Exiting the application.
Profile	Contains options for loading and customizing device/trace profiles.
Tools	Contains options for running a Pcap file analysis, running a Time Range Analysis, Auto FlowsTab Export - exporting the Flows Tab for multiple traces at a time, Export Results->HTML, Json, Excel, Export Session Data, Edit Metadata, Private Data Tracking.
View	Contains options for displaying the video viewer, filtering the set of data that appears in the analysis and diagnostics based on application, IP address, and time range, and configuring which data should appear in the Diagnostics Chart.
Data Collector	Contains options for accessing the Video Optimizer Data Collector.
Help	Contains options for displaying the Video Optimizer version, the FAQ page, User Documentation, Dependencies, Support, Downloads, and other Help documentation.

5.1.1. File Menu

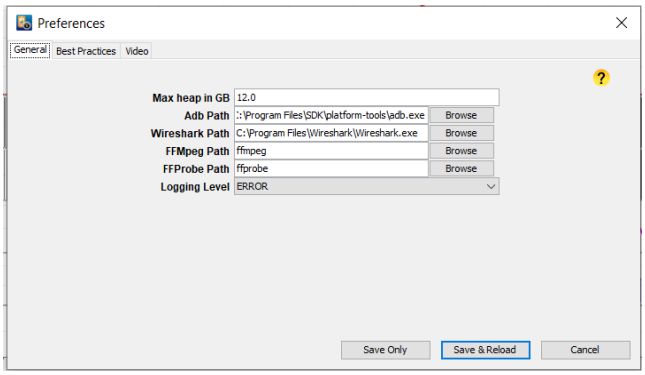
File menu contains the following selections.

Selection	Description
Open Trace	Opens a file for trace analysis. When this menu item is selected, a dialog box is displayed that prompts you to select the location of the trace folder containing the trace files. You must select a trace file using this command before you can view the trace analysis of that file.

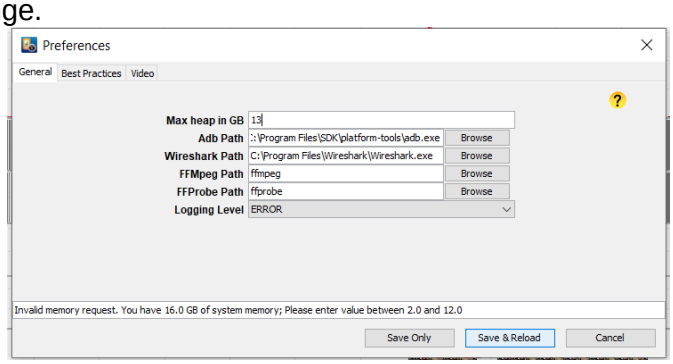
Selection	Description
Open Trace with Time Range	Opens a part of a trace, with a time range. When this menu item is selected, a dialog box will open the frames from the device video. User will be able to scan/play through the video to set the start and end time-range. If time-range(s) already exist they will be listed in the chooser dialog. User can create, edit, select, or delete time-ranges. The time-range will be used to open the trace.
Open Pcap File	Opens a Pcap/pcapng file for packet data analysis. When this menu item is selected, a dialog box is displayed that prompts you to select the location of the Pcap/pcapng file. You must select a Pcap/pcapng file using this command before you can view a packet data analysis of that file.
Open Recent	User has the option to open the recent 15 traces/files from Analyzer which allows user to find the last few traces/files.
Go To Recent Folder…	This option lists the 15 recent traces opened. Click on the trace name to open the trace folder without opening the trace for analysis.
Preferences	Opens a Preferences dialog where you can choose the Best Practices that you want to analyze and set a path for the Android Debug Bridge (ADB), Max heap in GB and Logging level. User can also set the preferences using the Video tab.
Print	Prints the results that are displayed when the Best Practices or Statistics tab is selected. This menu option is only enabled when the Best Practices or Statistics tab is selected.
Exit	Exits the Video Optimizer application.

5.1.2. Preferences

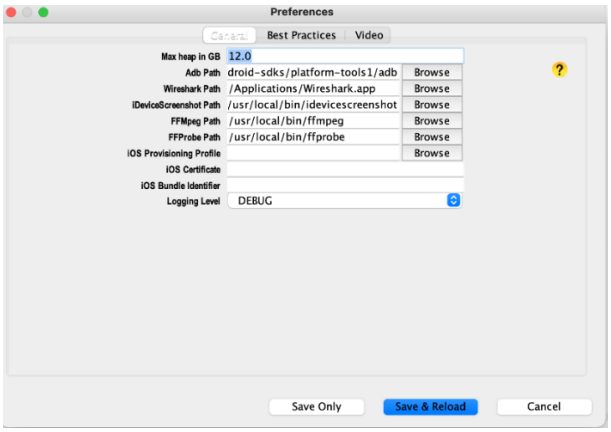
This feature opens a dialog with three tabs available, General, Best Practices, and Video. Select Preferences from the File menu. Select the General tab.



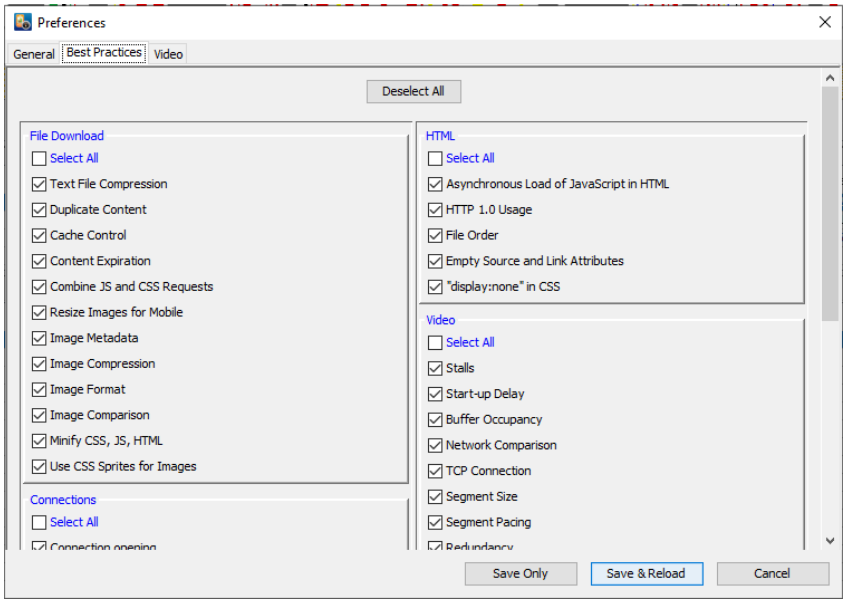
- Enter the **Max heap in GB**. Here you can set the maximum memory heap size for Video Optimizer (in GB). For example, the value in **Figure above** denotes 12 GB as the heap size. If the total system memory is 8GB or greater then you can choose from 2 GB to within 4GB of Full memory. If the total system memory is less than 8GB then the memory allocation allowed is up to 85% of total installed memory. Only one decimal point value is allowed and no letters/special characters are allowed. An error message is displayed if the value entered is invalid or out of range.



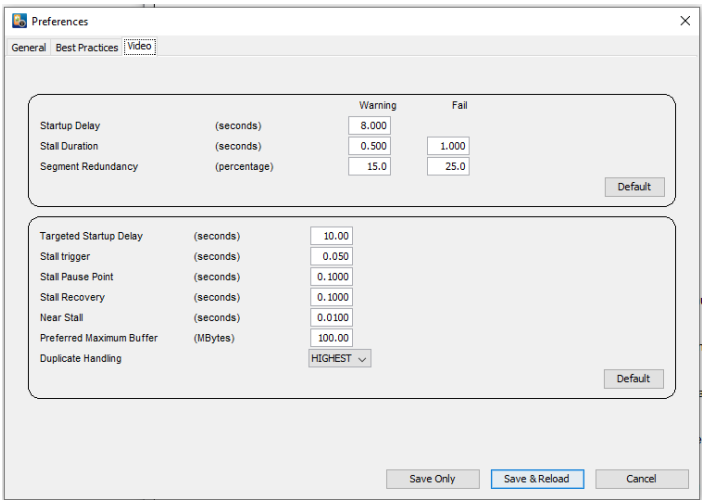
- Enter the **Adb Path**. This is the location of the Android Debug Bridge (ADB) on your computer.
  Note: When entering the ADB path in this dialog, you must include the “adb.exe” at the end of the path.



- Wireshark path: required.
- iDeviceScreenshot Path: required on iOS for screen capture.
- ffmpeg path: required for video analysis
- ffprobe path: required for video analysis
- Logging Level: There are 5 types of levels that user can choose – Trace, Debug, Info, Warn, and Error.
- Select the Best Practices tab.
- Choose the best practices that you want to analyze while opening the trace.



- Select/Deselect All
  User has the ability to select or de-select all the best practices preferences.
- Select Video
- Here you can modify the parameters for pass/fail criteria for some of the video best practices. In the screenshot below, a startup delay over 8s is a warning.



- The Save Only button only saves the current preferences and doesn't reload the trace. It will not affect the current state of analysis of an open trace, changes will only be seen after opening another trace or using Save & Reload. The Save & Reload button saves the changes in the Preferences dialog, a refresh is done on the trace and the selected values are persisted across Video Optimizer launches. This means that only the selected best practices are run while opening the trace. Also, we limit the video segments to be displayed in the diagnostics and Video tabs when any of the Video best practices or any of the Image best practices such as Compression, Metadata or Format are selected for analysis.

5.1.3. Profile Menu

The Profile menu contains the following selections-

Note: Profiles are intended for advanced users of Video Optimizer trace analysis.

Selection	Description
Load	Loads the selected Profile.
Customize	Displays the attribute values of the selected Profile and allows you to edit them.

i. AT&T 3G Profile Network and Device Attributes
ii. The following network attributes are defined for the AT&T 3G profile.

Network Attribute	Description
Carrier	The network carrier for the device.
DCH (Active)->FACH (Standby) timer (sec)	The amount of time (in seconds) used when the RRC state changes from (direct channel) DCH to (forward access channel) FACH.
FACH (Standby)->IDLE timer (sec)	The amount of time (in seconds) used when the RRC state changes from FACH (Forward access channel) to IDLE.
Min IDLE->DCH (Active) promotion delay (sec)	The minimum amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active).
Avg IDLE->DCH (Active) promotion delay (sec)	The average amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active).
Max IDLE->DCH (Active) promotion delay (sec)	The maximum amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active).
Min FACH (Standby)->DCH (Active) promotion delay (sec)	The minimum amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active) and FACH (Forward access channel) to DCH (Active).
Avg FACH (Standby)->DCH (Active) promotion delay (sec)	The average amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active) and FACH (Forward access channel) to DCH (Active).
Max FACH (Standby)->DCH (Active) promotion delay (sec)	The maximum amount of time used (in seconds) when the RRC state is promoted from IDLE to DCH (Active) and FACH (Forward access channel) to DCH (Active).
RLC threshold for uplink (bytes)	The RLC threshold value (in bytes) for uplink.
RLC threshold for downlink (bytes)	The RLC threshold value (in bytes) for downlink.
Threshold for resetting DCH (Active) timer (bytes)	The threshold for resetting the DCH (Active) timer (in bytes).
Timing window for resetting DCH (Active) timer (sec)	The timing window for resetting the DCH (Active) timer (in seconds).
RLC consumption rate (^2) for uplink	The RLC consumption rate (^2) for uplink.

Network Attribute	Description
RLC consumption rate (^1) for uplink	The RLC consumption rate (^1) for uplink.
RLC consumption rate (^0) for uplink	The RLC consumption rate (^0) for uplink.
RLC consumption rate (^2) for downlink	The RLC consumption rate (^2) for downlink.
RLC consumption rate (^1) for downlink	The RLC consumption rate (^1) for downlink.
RLC consumption rate (^0) for downlink	The RLC consumption rate (^0) for downlink.
Time delta for throughput calculations (sec)	The time delta (in seconds) used for calculating throughput.
Threshold for defining a burst (sec)	The time threshold (in seconds) used for defining a burst.
Threshold for defining a long burst (sec)	The time threshold (in seconds) used for defining a long burst.
Threshold for user input window (sec)	The time threshold (in seconds) used for calculating user input.
Periodical Transfer Analysis - Min size of periodical clusters (sec)	The minimum size (in seconds) of a cluster of periodical transfers.
Periodical Transfer Analysis - Max tolerable variation for periodical transfers (sec)	The maximum tolerable variation (in seconds) used for calculating periodical transfers.
Periodical Transfer Analysis - Min number of periodical transfers	The minimum number of periodical transfers.
Threshold for duration of a large burst (sec)	The duration threshold (in seconds) used for defining a large burst.
Threshold for size of a large burst (bytes)	The size threshold (in bytes) used for defining a large burst.
Threshold for close spaced bursts (sec)	The threshold (in seconds) used for defining a close spaced burst.

The following device attributes are defined for the AT&T 3G profile.

Device Attribute	Description
Device Name	The make and model of the device.
DCH (Active) Power (w)	The amount of power (in watts) that should be used when the RRC state is DCH (Active).

Device Attribute	Description
FACH (Standby) Power (w)	The amount of power (in watts) that should be used when the RRC state is FACH (Standby).
IDLE Power (w)	The amount of power (in watts) that should be used when the RRC state is IDLE.
Average power for IDLE->DCH (Active) promotion (w)	The average amount of energy used when the RRC state is promoted from IDLE to DCH (Active).
Average power for FACH (Standby)>DCH (Active) promotion (w)	The average amount of power (in watts) that should be used when the RRC state is promoted from FACH (Standby) to DCH (Active).
Average power for active GPS (w)	The average amount of power (in watts) for active GPS.
Average power for standby GPS (w)	The average amount of power (in watts) for standby GPS.
Average power when camera is on (w)	The average amount of power (in watts) when the camera is on.
Average power for active Bluetooth (w)	The average amount of power (in watts) for active Bluetooth.
Average power for standby Bluetooth (w)	The average amount of power (in watts) for standby Bluetooth.
Average power when screen is on (w)	The average amount of power (in watts) when the screen is on.

iii. AT&T LTE Profile Network and Device Attributes

iv. The following network attributes are defined for the AT&T LTE profile.

Network Attribute	Description
Carrier	The network carrier for the device.
Promotion time from Idle to CR (sec)	The amount of time (in seconds) spent in promotion from the IDLE state to the CR state.
Time of inactivity from CR before DRX (sec)	The amount of inactive time (in seconds) spent in the CR state before changing to the DRX state.
Time in short DRX (sec)	The amount of time (in seconds) spent in the Short DRX state.
Ping length during DRX (sec)	The length of a ping (in seconds) during the DRX state.
Time in Long DRX (sec)	The amount of time (in seconds) spent in the Long DRX state.
Ping length in IDLE (sec)	The length of a ping (in seconds) during the IDLE state.
Period between pings DRX Short (sec)	The length of the period between pings (in seconds) in the Short DRX state.
Period between pings DRX Long (sec)	The length of the period between pings (in seconds) in the Long DRX state.
Period between pings IDLE (sec)	The length of the period between pings (in seconds) in the IDLE state.
Time delta for throughput calculations (sec)	The time delta (in seconds) used for calculating throughput.
Threshold for defining a burst (sec)	The time threshold (in seconds) used for defining a burst.
Threshold for defining a long burst (sec)	The time threshold (in seconds) used for defining a long burst.
Threshold for user input window (sec)	The time threshold (in seconds) used for calculating user input.

Network Attribute	Description
Min cycle for periodical transfers (sec)	The minimum cycle time (in seconds) used for calculating periodical transfers.
Max tolerable variation for periodical transfers (sec)	The maximum tolerable variation (in seconds) used for calculating periodical transfers.
Min observed samples for periodical transfers	The minimum number of observed samples used for calculating periodical transfers.
Threshold for duration of a large burst (sec)	The duration threshold (in seconds) used for defining a large burst.
Threshold for size of a large burst (bytes)	The size threshold (in bytes) used for defining a large burst.

The following device attributes are defined for the AT&T LTE profile.

Device Attribute	Description
Device Name	The make and model of the device.
Average power during promotion (w)	The average power (in watts) used during promotion.
Average power of ping during short DRX (w)	The average power (in watts) used by a ping in the Short DRX state.
Average power of ping during long DRX (w)	The average power (in watts) used by a ping in the Long DRX state.
Average power during tail (baseline) (w)	The average power baseline (in watts) used in a tail state.
Average power of ping in idle (w)	The average power (in watts) used by a ping in the IDLE state.

Device Attribute	Description
Multiplier for throughput upload energy calc. (mW/Mbps)	The multiplier used for throughput energy calculations, expressed in mW/Mbps.
Multiplier for throughput download energy calc. (mW/Mbps)	The multiplier used for download energy calculations, expressed in mW/Mbps.
Baseline for CR energy (before throughput modifiers added) (w)	The baseline value (in watts) for energy used in the CR state, before throughput modifiers are added.
Average power for active GPS (w)	The average amount of power (in watts) for active GPS.
Average power for standby GPS (w)	The average amount of power (in watts) for standby GPS.
Average power when camera is on (w)	The average amount of power (in watts) when the camera is on.
Average power for active Bluetooth (w)	The average amount of power (in watts) for active Bluetooth.
Average power for standby Bluetooth (w)	The average amount of power (in watts) for standby Bluetooth.
Average power when screen is on (w)	The average amount of power (in watts) when the screen is on.

v. AT&T WiFi Profile Network and Device Attributes
vi. The following network attributes are defined for the AT&T WiFi profile.

Network Attribute	Description
Carrier	The network carrier for the device.
WiFi tail time (sec)	The amount of time (in seconds) spent in promotion from the IDLE state to the CR state.
Time delta for throughput calculations (sec)	The time delta (in seconds) used for calculating throughput.
Threshold for defining a burst (sec)	The time threshold (in seconds) used for defining a burst.
Threshold for defining a long burst (sec)	The time threshold (in seconds) used for defining a long burst.
Threshold for user input window (sec)	The time threshold (in seconds) used for calculating user input.
Min cycle for periodical transfers (sec)	The minimum cycle time (in seconds) used for calculating periodical transfers.
Max tolerable variation for periodical transfers (sec)	The maximum tolerable variation (in seconds) used for calculating periodical transfers.
Min observed samples for periodical transfers	The minimum number of observed samples used for calculating periodical transfers.
Threshold for duration of a large burst (sec)	The duration threshold (in seconds) used for defining a large burst.
Threshold for size of a large burst (bytes)	The size threshold (in bytes) used for defining a large burst.

The following device attributes are defined for the AT&T WiFi profile.

Device Attribute	Description
Device Name	The make and model of the device.

Average power WiFi connected (w)	The amount of inactive time (in seconds) spent in the CR state before changing to the DRX state.
Average power WiFi inactive (w)	The amount of time (in seconds) spent in the Short DRX state.
Average power for active GPS (w)	The average amount of power (in watts) for active GPS.
Average power for standby GPS (w)	The average amount of power (in watts) for standby GPS.
Average power when camera is on (w)	The average amount of power (in watts) when the camera is on.
Average power for active Bluetooth (w)	The average amount of power (in watts) for active Bluetooth.
Average power for standby Bluetooth (w)	The average amount of power (in watts) for standby Bluetooth.
Average power when screen is on (w)	The average amount of power (in watts) when the screen is on.

5.1.4. Tools Menu

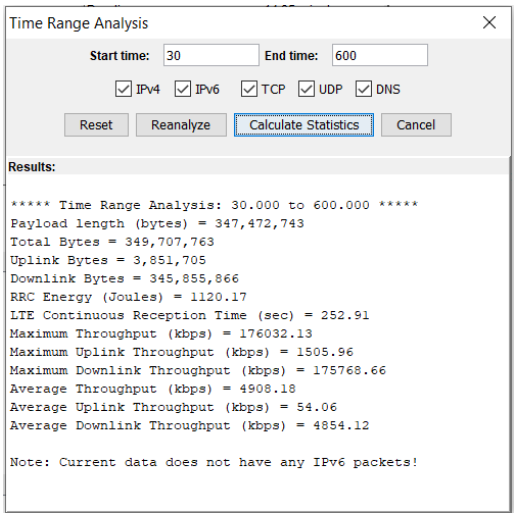
The Tools menu contains the following selections.

Selection	Description
PCAP File Analysis	Opens Wireshark to access the Pcap file and displays the trace results in the Video Optimizer Data Analyzer.
Time Range Analysis	Displays the Time Range Analysis dialog box that allows you to set a time range, reset the time range, start or cancel the analysis, calculate the statistics for the time range, analyze based on the applied filters for IPv4, IPv6, TCP, UDP, and DNS for a specific time range, and display the analysis results.

Selection	Description
Auto FlowsTab Export	Provides the option to export the Flows tab information for multiple traces automatically.
Export Results	Html->Opens a Save As dialog box that allows you to export the currently loaded trace data to a html file with the results from the Best Practices tab. Json-> Opens a Save As dialog box that allows you to export the statistical and analytical data from the current trace to a single json file. Excel-> Exports the required trace information from the best practices tab along with all the best practices test results. All three export files include details of the time range that is currently active such as Average Total Throughput, Uplink Bytes, Average Upload Throughput, Downlink Bytes, Average Download Throughput. The exported files having a default naming convention of <Trace_Folder_Name>_best_practices_results)
Export Session data	This feature exports all the request response and packet view results information of all the sessions in the TCP/UDP Flows table
Edit Metadata	Opens the metadata window where the user can enter/edit information about the trace such as - Trace storage, Description, Trace Type, Target App, Application Producer, Application Version, Sim, Network, Creator, and Trace notes. This option is disabled if the user opens a PCAP file and chooses not to retain the directory that is created during opening of the file.
Private Data Tracking	Opens a menu that allows you to set parameters for the Video Optimizer to search for in the trace. This allows you to find instances where private data is transmitted in an unsecure way.

- ***Time Range Analysis***

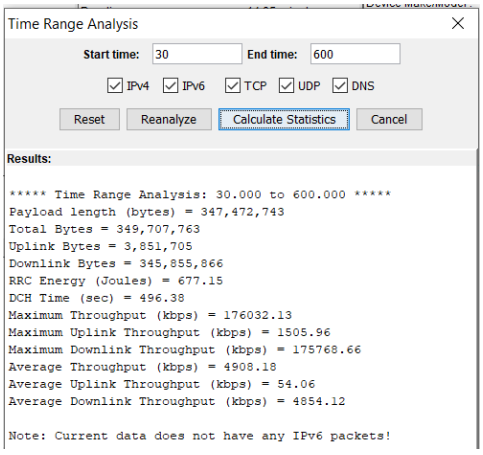
  This feature allows you to set a time range, start or cancel the analysis, analyze based on the applied filters for IPv4, IPv6, TCP, UDP, and DNS for a specific time range, and display the analysis results. Start and end times can be entered in seconds, minutes:seconds, or hours:minutes:seconds format. If the time range entry is invalid, an error message is displayed for the input time range format. The data populated in the Results text area is selectable so that it can be copied to another application for comparison & further analysis.



User has the ability to filter based on the IPV4, and IPV6 packets and further for TCP, UDP, and DNS for each of those options. All 5 boxes are checked by default when a trace is loaded. The user can choose a specific time range and analysis will be done based on applied filters and time range.

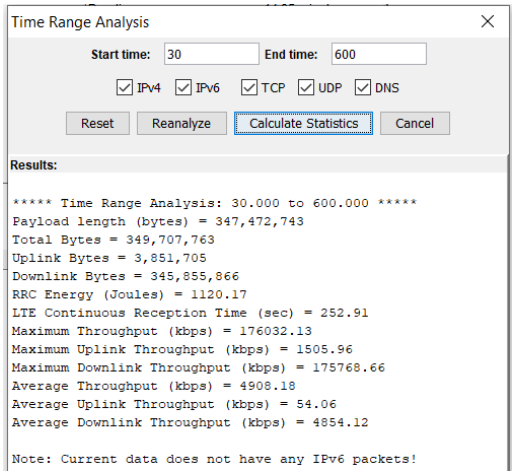
The Calculate Statistics button performs the analysis on the provided time range and filters. The statistics results are displayed in the text area based on the network profile that has been selected in Profile->Load.
The Reanalyze button reanalyzes the trace with the selected time range and filter.
The Reset button resets the timestamp to the entire trace duration.

For a 3G Profile, you will see the following results in the Time Range Analysis dialog box.



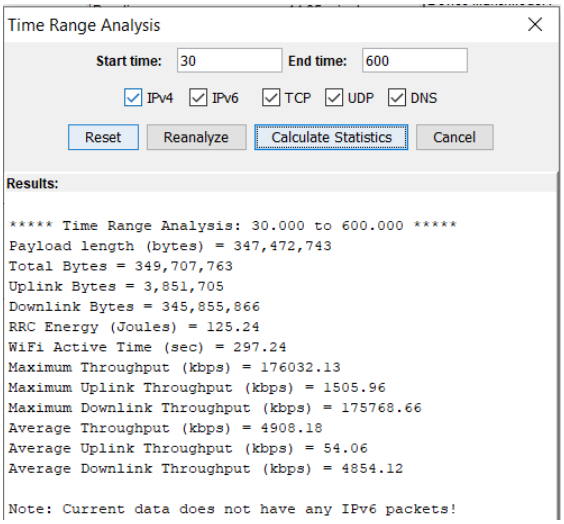
Result	Description
Payload length	The length of the payload in bytes.
Total Bytes	The total number of bytes in the trace.
Uplink Bytes	The total number of bytes of uplink data in the trace.
Downlink Bytes	The total number of bytes of downlink data in the trace.
RRC Energy	The amount of energy used in joules.
DCH Time	The amount of time, in seconds, that was spent in the DCH state.
Maximum Throughput	The maximum data throughput in kilobytes per second.
Maximum Uplink Throughput	The maximum uplink data throughput in kilobytes per second.
Maximum Downlink Throughput	The maximum downlink data throughput in kilobytes per second.
Average Throughput	The average data throughput in kilobytes per second.
Average Uplink Throughput	The average uplink data throughput in kilobytes per second.
Average Downlink Throughput	The average downlink data throughput in kilobytes per second.

For an LTE Profile, you will see the following results in the Time Range Analysis dialog box.



Result	Description
Payload length	The length of the payload in bytes.
Total Bytes	The total number of bytes in the trace.
Uplink Bytes	The total number of bytes of uplink data in the trace.
Downlink Bytes	The total number of bytes of downlink data in the trace.
RRC Energy	The amount of energy used in joules.
LTE Time	The amount of time, in seconds, that was spent in the Continuous Reception (CR) state.
Maximum Throughput	The maximum data throughput in kilobytes per second.
Maximum Uplink Throughput	The maximum uplink data throughput in kilobytes per second.
Maximum Downlink Throughput	The maximum downlink data throughput in kilobytes per second.
Average Throughput	The average data throughput in kilobytes per second.
Average Uplink Throughput	The average uplink data throughput in kilobytes per second.
Average Downlink Throughput	The average downlink data throughput in kilobytes per second.

For a WiFi Profile, you will see the following results in the Time Range Analysis dialog box.

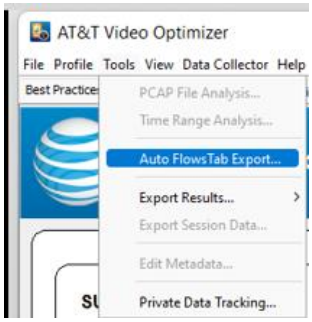


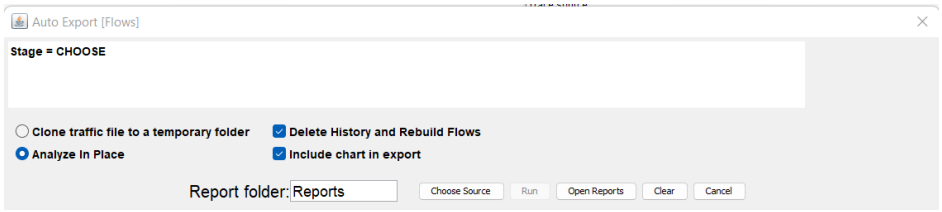
Result	Description
Payload length	The length of the payload in bytes.
Total Bytes	The total number of bytes in the trace.
Uplink Bytes	The total number of bytes of uplink data in the trace.
Downlink Bytes	The total number of bytes of downlink data in the trace.
RRC Energy	The amount of energy used in joules.
WiFi Active Time	The amount of time, in seconds, that was spent in the WiFi Active state.
Maximum Throughput	The maximum data throughput in kilobytes per second.
Maximum Uplink Throughput	The maximum uplink data throughput in kilobytes per second.
Maximum Downlink Throughput	The maximum downlink data throughput in kilobytes per second.
Average Throughput	The average data throughput in kilobytes per second.
Average Uplink Throughput	The average uplink data throughput in kilobytes per second.
Average Downlink Throughput	The average downlink data throughput in kilobytes per second.

- ***Auto FlowsTab Export***

This option under the Tools menu launches an automatic process of analyzing all traces/pcap files within a folder, links included, and exports the Flows Tab details as an xlsx spreadsheet, for each of the traces/pcap files. The exported reports output will be saved in a user designated folder. This feature helps the user who wants to export the flows tab reports for multiple traces by avoiding having to open each trace manually in Video Optimizer to be able to export the flows tab report.

The Video Viewer will be hidden until the export is completed or the export is cancelled.





The window on the top part of the dialog box specifies the stage of the auto export. For example, stage=CHOOSE specifies that Video Optimizer is waiting for the user to choose the files to be auto exported.

There are 2 radio buttons -

- **Clone traffic file to a temporary folder** – this option can be chosen when the trace files do not reside in the local machine but exist in an external source like OneDrive. A trace folder will be created in the 'work' folder (\.VideoOptimizer\AutoExport\AutoExportFolder\Work) of the same name. The traffic file will be the only file copied into the new trace folder and once Video Optimizer opens the new folder, all other files will be created as needed for analysis. This work folder is temporary and will be deleted the next time the Auto FlowsTab Export is launched.

- **Analyze in Place** - opens trace folders in place.

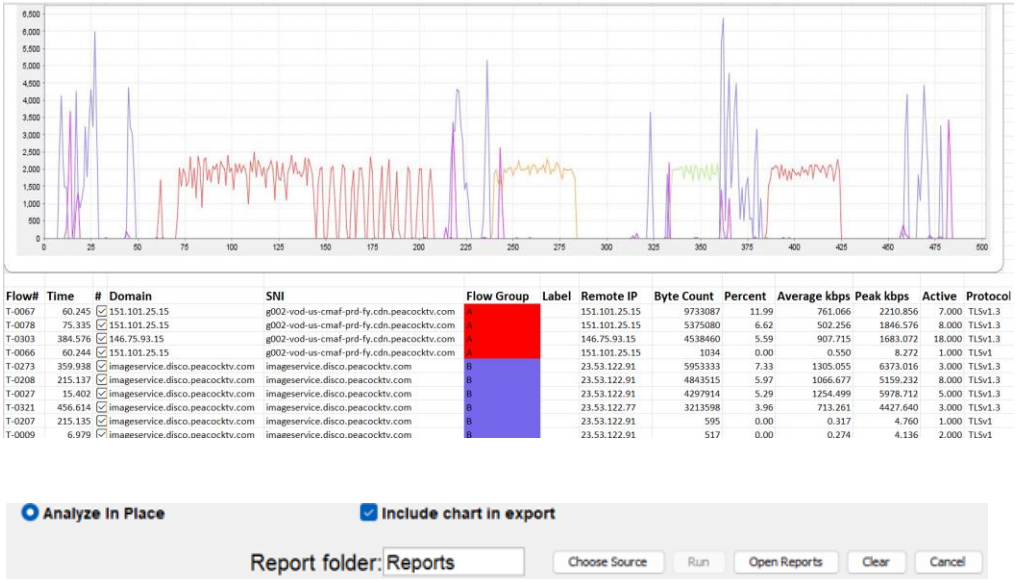
The chosen option persists across multiple launches of the dialog until the user changes the option.

There are 2 check boxes -

- **Delete History and Rebuild Flows** – any existing FlowTableHistory.json file will be deleted, and the FlowGroup assignments

will be rebuilt. If unchecked, the pre-existing FlowsTableHistory will be used.

- **Include chart in export** – when checked, the Flows tab graph will be exported along with the report.



Flow#	Time	#	Domain	SNI	Flow Group	Label	Remote IP	Byte Count	Percent	Average kbps	Peak kbps	Active	Protocol
T-0067	60.245	☑	151.101.25.15	g002-vod-us-cmaf-prd-fy.cdn.peacocktv.com	A		151.101.25.15	9733087	11.99	761.066	2210.856	7.000	TLSv1.3
T-0078	75.335	☑	151.101.25.15	g002-vod-us-cmaf-prd-fy.cdn.peacocktv.com	A		151.101.25.15	5375080	6.62	502.256	1846.576	8.000	TLSv1.3
T-0303	384.576	☑	146.75.93.15	g002-vod-us-cmaf-prd-fy.cdn.peacocktv.com	A		146.75.93.15	4538460	5.59	907.715	1683.072	18.000	TLSv1.3
T-0066	60.244	☑	151.101.25.15	g002-vod-us-cmaf-prd-fy.cdn.peacocktv.com	A		151.101.25.15	1034	0.00	0.550	8.272	1.000	TLSv1
T-0273	359.938	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.91	5953333	7.33	1305.055	6373.016	3.000	TLSv1.3
T-0208	215.137	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.91	4843515	5.97	1066.677	5159.232	8.000	TLSv1.3
T-0027	15.402	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.91	4297914	5.29	1254.499	5978.712	5.000	TLSv1.3
T-0321	456.614	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.77	3213598	3.96	713.261	4427.640	3.000	TLSv1.3
T-0207	215.135	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.91	595	0.00	0.317	4.760	1.000	TLSv1
T-0009	6.979	☑	imageservice.disco.peacocktv.com	imageservice.disco.peacocktv.com	B		23.53.122.91	517	0.00	0.274	4.136	2.000	TLSv1

There is a text box present called 'Report Folder'. User can enter the name of the folder to receive the exported reports. This folder will be created in the VideoOptimizerReports folder, in the user's home directory.

A button called 'Choose Source' is present. Clicking on the button opens a dialog where the user can choose -

- a single trace folder

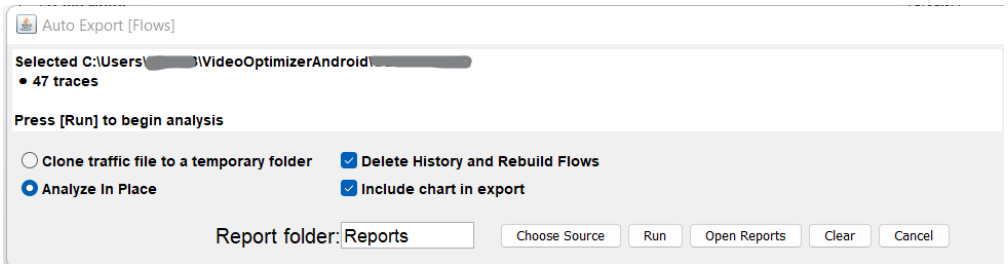
or

- a folder containing multiple traces

Note – All traffic files will be found within the selection and analyzed no matter how deep into the directory structure.

Click on the 'Open' button in the 'Choose folder' dialog box. The Auto Export [Flows] window displays the path of the 'Source' folder chosen for Auto export and lists the total number of traffic files for which the report/reports will be exported.

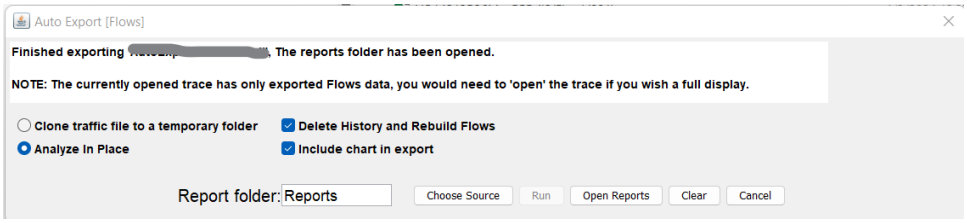
The window will also display the message, 'Press [Run] to begin analysis'.



The Run button will become active after a source has been selected. Clicking on the Run button starts the auto export. The window displays the progress of the exporting flows tab reports as they cycle through the traces chosen for export.

At any point during the auto export if Video Optimizer runs into issue like memory, Video Optimizer will close and relaunch and then continue with the auto export processing.

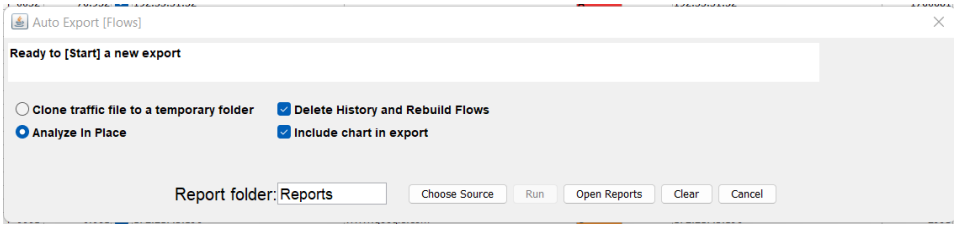
After the export is completed, a message is displayed, 'Finished exporting, The reports folder has been opened. NOTE: The currently opened trace has only exported Flows data, you would need to 'open' the trace if you wish a full display.' The Auto FlowsTab Export has been optimized for speed and as such does not analyze best practices and some of the other tabs will not be fully populated.



The Report folder specified in the text box is opened after the export is completed and all the traces in the folder have a corresponding Flows tab exported.

The 'Open Reports' button opens the folder mentioned in the Report folder text box. New export folders will only be created and can be opened as soon as the Run button has been clicked.

The 'Clear' button clears all items that are currently in the queue. Normally there is one final report that will be exported before processing stops.



The 'Cancel' button closes the Auto Export [Flows] dialog box.

5.1.5. View Menu

The View menu contains the following selections.

Selection	Description
Show Video Viewer	Opens a window that displays the video of the activities carried out on the device while the trace data was being collected.
Select Applications/IPs	Opens the Select Applications/IPs dialog box that allows you to select the application and IP address that are included in the analysis.
Select Time Range	Displays the Time Range Analysis dialog box that allows you to set a time range, reset the time range, start or cancel the analysis, calculate the statistics for the time range, analyze based on the applied filters for IPv4, IPv6, TCP, UDP, and DNS for a specific time range, and display the analysis results.
Options	Opens the View Options dialog box that allows you to select the events and states that will be plotted in the Diagnostics View chart

- ***Displaying a Video***

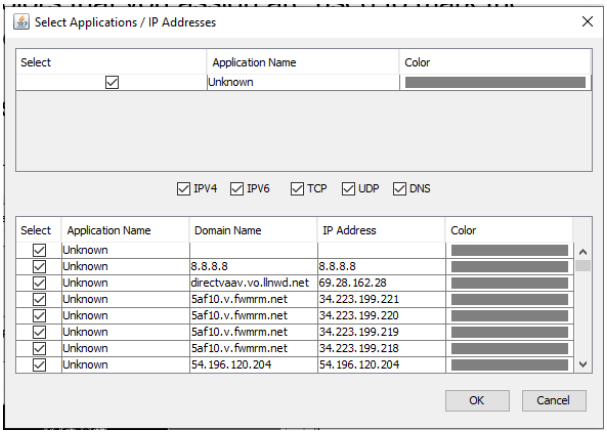
  i. The Video Viewer in Video Optimizer displays the video of the activities carried out on the device while the trace data was being collected.
  ii. Select Show Video Viewer from the View menu.
  iii. Play/Pause: Plays or pauses the video.

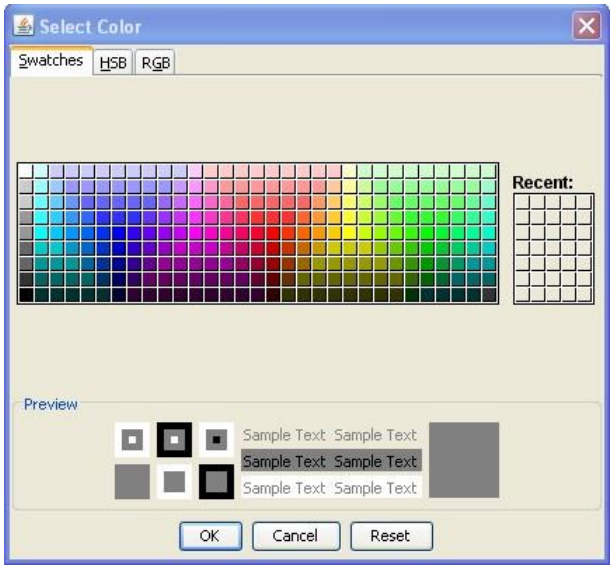
- ***Selecting Applications and IP Addresses***

  i. Choose Select Applications/IPs from the View Menu.
  ii. You can select individual applications from a table and assign colors to them. Another table lets you do the same thing to individual IP Addresses. The data from each selected application and IP Address is included in the analysis. The colors that you assign are used to mark the

packet information for that specific application or IP Address on the Diagnostics Chart.

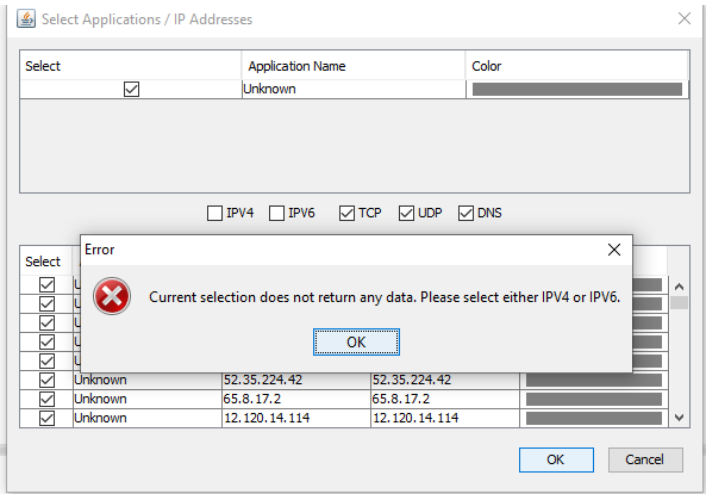
iii. Click any of the rows in the Color column to select a color.





Once a color is selected, the trace will be recalculated, and all packets in the Diagnostics tab will be recolored based on your selections.

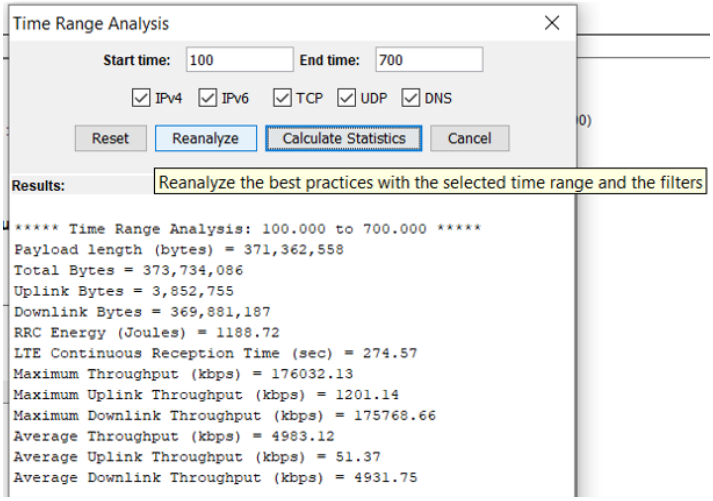
iv. User has the ability to filter based on the IPV4, and IPV6 packets and further for TCP, UDP, and DNS for each of those options. All 5 boxes are checked by default when a trace is loaded. An error message is displayed if a selection does not return any data –

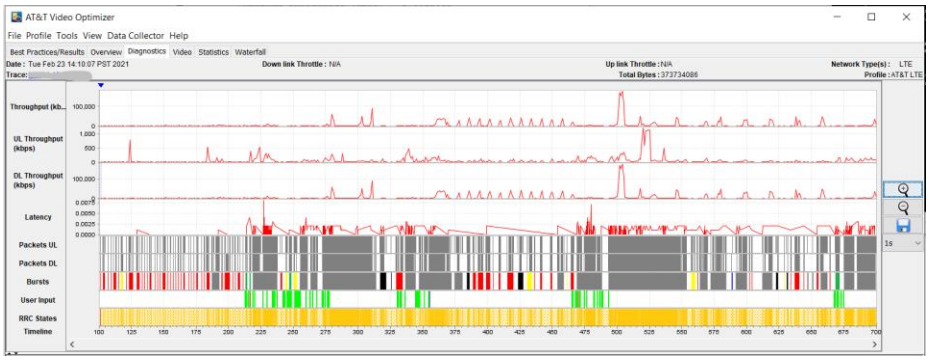


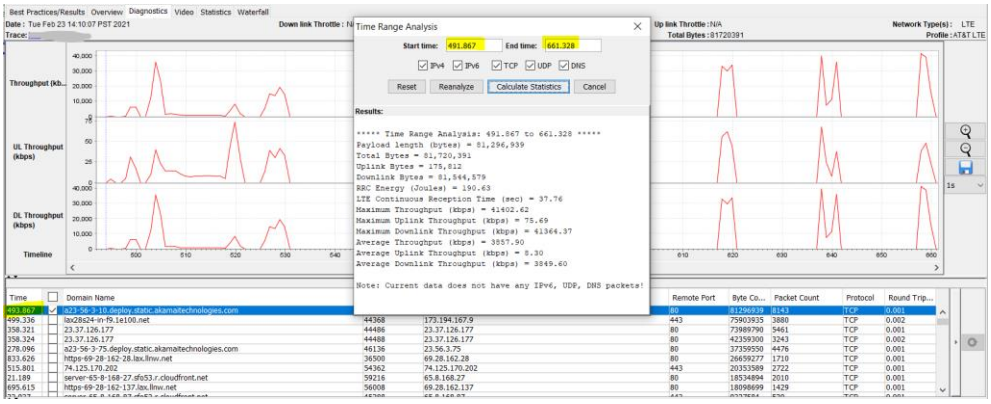
- ***Selecting a Time Range***

  You can set a new time range for the trace analysis. This allows you to analyze a subset of the loaded trace. When you set the new start and end times, all of the analysis data in the Best Practices/Results, Overview, Diagnostics, and Statistics Tabs will display information for only your selected time range.

  1. Choose Select Time Range from the View menu.
  2. Enter a Start time and End time for the trace analysis.
  3. User has the ability to filter based on the IPV4, and IPV6 packets and further for TCP, UDP, and DNS for each of those options. All 5 boxes are checked by default when a trace is loaded.
  4. Click on Reanalyze to reanalyze the best practices with the selected time range.
  5. The Reset button resets the timestamp to the entire trace length.
  6. Calculate Statistics calculates throughput and data statistics for the selected time range and displays it in the Results section.





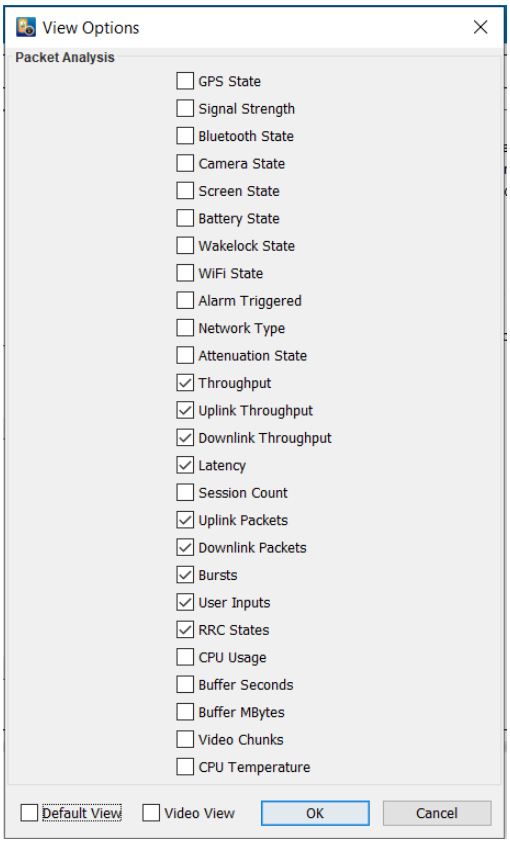


Filter selections made in the TCP/UDP streams table (after the refresh button has been clicked) will carry over to the Time Range Analysis dialog. The Start time and End Time fields reflect the time for the session/s. Time range analysis calculation is based on this selection. Complete trace analysis or individual stream analysis can be done as required.

- ***Options***

  From File>View>Options list, you can determine what will be plotted in the Diagnostics View chart. Default View and Video View are two checkboxes at the bottom with preset views for the diagnostic window. Video Optimizer allows 11 views at a time.

  1. Select Options from the View menu.
  2. Select the events and states that you want to be plotted in the Diagnostics View chart.
  3. Click OK.



See the Diagnostics Tab section for more details on this menu.

5.1.6. Data Collector Menu

The Data Collector menu contains the following selections.

Selection	Description
Start Collector	Starts the Video Optimizer Data Collector.
Stop Collector	Stops the Video Optimizer Data Collector.

5.1.7. Help Menu

The Help menu contains the following selections.

Selection	Description
FAQ	Opens the default web browser and displays the Video Optimizer FAQs web page.
User Guide	Opens the default web browser and displays the Video Optimizer User Guide
Dependencies	Displays a dialog box containing the license information for the open source libraries and binaries that are distributed within the Video Optimizer package.
Support	Provides a link to log in to the AT&T Developer Program and file a ticket with Video Optimizer Support.
Downloads	Opens the default web browser and displays the Video Optimizer Downloads web page that contains links for downloading and installing the different types of Video Optimizer.
Learn More	Opens the default web browser and displays the Learn More about Video Optimizer web page.
About	Displays a dialog box containing information about the Video Optimizer application including its version.

5.2. Content Tabs

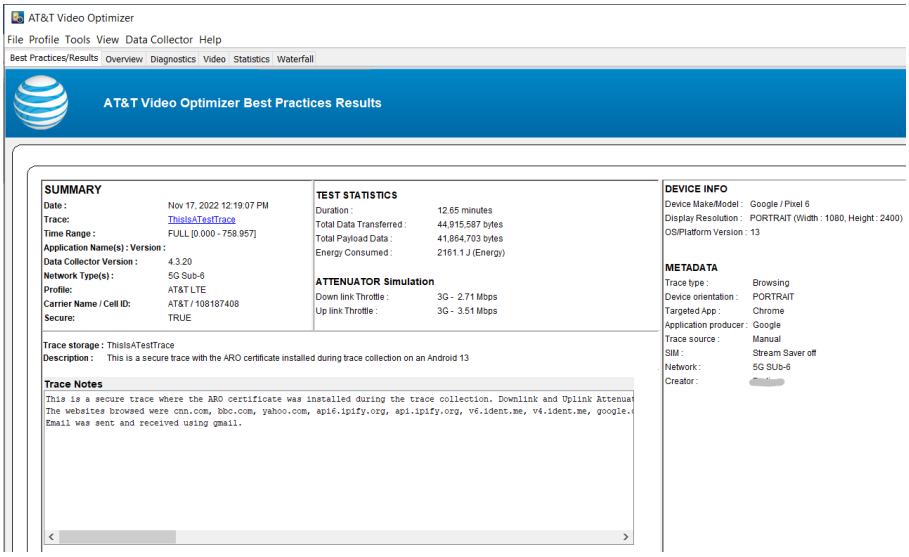
The Video Optimizer user interface is divided into the following tabbed sections.

Tab	Description
Best Practices / Results	Displays the results of the Best Practices tests that are conducted on the trace data.
Overview	Displays charts and tables that present an overview of key statistical data from the trace.
Diagnostics	Displays charts and tables that present key diagnostic data from the trace.
Video	Displays throughput chart, Movie Streams, and Video Requests.
Flows	Displays a graph and tables for the analysis done on network flows.
Statistics	Displays charts and tables that present key statistical data from the trace.

Tab	Description
Waterfall	Displays a waterfall view chart of the TCP connections from the trace spread over time. The details, requests, and responses of each connection can be viewed when the chart is clicked.

5.2.1. Best Practices/Results Tab

The Best Practices/Results tab displays the results for all the Best Practices tests that are conducted on the data captured in the trace files.



When trace files are loaded into Video Optimizer, the Best Practices/Results tab displays the following test results.

- A SUMMARY section with basic information about the trace.
- A TEST STATISTICS section with high-level test statistics and ATTENUATOR Simulation section with attenuator information.
- A DEVICE INFO section which provides details about the device the trace was collected on – Device Make/Model, Display Resolution, and OS/Platform version.
- Details of the trace collected as entered by the user – Trace storage, Description, Trace type, Device Orientation, Targeted App, Application Producer, Trace source, Sim, Network, Creator, and Trace notes.
- A TESTS CONDUCTED section that lists all the tests and has a basic pass/fail/warning result indicated by a specific icon.

- High-level results pages for all the tests grouped into the test categories: File Download, Connections, HTML, Security, Video, and Others.

Each of these pages has a common header panel that shows the following information about the loaded trace files:

Label	Description
Date	The date when the trace files were generated.
Trace	The name of the folder containing the trace files.
Time Range	The time range description name followed by the time range that is used to open the trace.
Application Name (s): Version	The names and versions of the applications that were running when the trace data was collected. Note: on iOS, application name and version are not displayed. On Android 8 and above the application names are not displayed.
Data Collector Version	The version of the Video Optimizer Data Collector that was used to collect the trace data.
Device Make/Model	The make and model of the device from which the data was collected.
Display Resolution	The Orientation mode, and the Width and height of the display from which the data was collected.
OS/Platform Version	The operating system version or platform version of the device that the trace was captured on.
Network Type(s)	The types of any networks (such as 3G or LTE) that were in use when the data was collected.
Carrier Name/Cell ID	Carrier name, and the Cell tower ID the device was connected to when the trace was captured.
Profile	The device profile that was used for the trace analysis.
Secure	Option for true and false is displayed.

- ***iPhone Make/Model***

The iPhone make & model displayed by Video Optimizer is confusing to many users. However, it is based on the manufacturer settings. Please refer to the chart below to clarify iOS make & model.

VO displays	iOS device	VO displays	iOS device
iPhone1,1	iPhone	iPhone10,6	iPhone X GSM
iPhone1,2	iPhone 3G	iPhone11,2	iPhone XS
iPhone2,1	iPhone 3GS	iPhone11,4	iPhone XS Max
iPhone3,1	iPhone 4	iPhone11,6	iPhone XS Max China
iPhone3,2	iPhone 4 GSM Rev A	iPhone11,8	iPhone XR
iPhone3,3	iPhone 4 CDMA	iPhone12,1	iPhone 11
iPhone4,1	iPhone 4S	iPhone12,3	iPhone 11 Pro
iPhone5,1	iPhone 5 (GSM)	iPhone12,5	iPhone 11 Pro Max
iPhone5,2	iPhone 5 (GSM+CDMA)	iPhone12,8	iPhone SE 2nd Gen
iPhone5,3	iPhone 5C (GSM)	iPhone13,1	iPhone 12 mini
iPhone5,4	iPhone 5C (Global)	iPhone13,2	iPhone 12
iPhone6,1	iPhone 5S (GSM)	iPhone13,3	iPhone 12 Pro
iPhone6,2	iPhone 5S (Global)	iPhone13,4	iPhone 12 Pro Max
iPhone7,1	iPhone 6 Plus	iPhone14,4	iPhone 13 mini
iPhone7,2	iPhone 6	iPhone14,5	iPhone 13
iPhone8,1	iPhone 6s	iPhone14,2	iPhone 13 Pro
iPhone8,2	iPhone 6s Plus	iPhone14,3	iPhone 13 Pro Max
iPhone8,3	iPhone SE (GSM+CDMA)	iPhone14,6	iPhone SE 3rd Gen
iPhone8,4	iPhone SE (GSM)	iPhone14,7	iPhone 14
iPhone9,1	iPhone 7	iPhone14,8	iPhone 14 Plus
iPhone9,2	iPhone 7 Plus	iPhone15,2	iPhone 14 Pro
iPhone9,3	iPhone 7	iPhone15,3	iPhone 14 Pro Max
iPhone9,4	iPhone 7 Plus	iPhone15,4	iPhone 15

iPhone10,1	iPhone 8	iPhone15,5	iPhone 15 Plus
iPhone10,2	iPhone 8 Plus	iPhone16,1	iPhone 15 Pro
iPhone10,3	iPhone X Global	iPhone16,2	iPhone 15 Pro Max
iPhone10,4	iPhone 8		
iPhone10,5	iPhone 8 Plus		

- ***Summary***

The Summary section shows the summary of results for all the best practices tests conducted on the loaded trace files. It contains the following sections.

TEST STATISTICS shows the following information about the loaded trace files.

Label	Description
Duration	The total time, in minutes, for which the trace data was collected.
Total Data Transferred	The total size, in bytes, of all data packets that are transferred for the entire duration of the trace data collection. This total includes the size of the packet and the packet header.
Total Payload Data	This gives the total payload of the entire traffic.
Energy Consumed	The total energy, in Joules, that is consumed during the entire duration of the trace data collection. This total includes the energy of RRC, GPS, WiFi, Bluetooth, Camera and Screen.

ATTENUATOR shows the parameters that were used for network attenuation during collection. For example, Downlink throttle provides the ms delay in the downlink throttling, and uplink is the delay placed on uplink connections. See Network Attenuation.

TESTS CONDUCTED displays a list of all the best practices tests that were conducted on the loaded trace files with an icon to the left of each test name that indicates the test result status (Pass, Fail, Warning, Configuration required and no data(N/A) icon.

The tests are grouped into the following categories.

Note: When any of the best practice tests in a category fails, the header for that category turns red. The category header remains green if all the tests in that category have passed.

Test	Category	Description
Text File Compression	File Download	Tests if any text files sent by the app that were larger than 850 bytes are uncompressed.
Duplicate Content	File Download	Tests if more than three files are downloaded in a duplicate manner in the loaded trace files.
Cache Control	File Download	Tests if the amount of “not expired duplicate data” is greater than the amount of “not changed data” in the loaded trace files.
Content Expiration	File Download	Tests if there is more than 10% of non-cacheable data available in the loaded trace files.
Combine Java Script and CSS Requests	File Download	Tests if there are multiple requests for CSS or JS files occurring within 2 seconds of one another.
Resize Images for Mobile	File Download	Tests if there are any images that are 150% larger than the area specified for them.
Image Metadata	File Download	Tests for EXIF text metadata in your images. An image fails if the file is more than 1% metadata.
Image Compression	File Download	Tests JPEG images for compression. If a file is saved at 85% quality and is >15% smaller (in KB), the best practice fails.

Test	Category	Description
Image Format	File Download	Alternative image formats can help increase the speed of your mobile application, as newer compression algorithms compress the files to a much smaller size, with virtually no loss in quality.
Image Comparison	File Download	Images downloaded from the network should be approximately the same size as the images that appear on the screen. Video Optimizer measures each image on the screen and compares the dimensions to the images downloaded over the network.
Minify CSS, JS, and HTML	File Download	Tests if there are any files that could be minified (shrunk through the removal of whitespace).
Use CSS Sprites for Images	File Download	Tests for any groups of small images that are downloaded at once, which could be combined into one image using sprites.
Connection Opening	Connections	This test helps ensure connections are opened properly. Some connection startups consist of an input burst, followed by a series of bursts spread out over time which can dramatically slow down the application's response time and waste energy on the device. This is a self test.
Unnecessary Connections – Multiple Simultaneous Connections	Connections	Tests if there are several bursts in a row that are not user initiated in the loaded trace files.

Test	Category	Description
Multiple Simultaneous Connections to One Endpoint	Connections	With HTTP2, you can utilize multiplexing – to download multiple files in one connection. Using fewer connections allows content to be downloaded faster and uses fewer resources on the device. The threshold is increased to 7 or more simultaneous connections to same server.
Multiple Simultaneous Connections to Many Endpoints	Connections	Opening many connections all at once can cause bottlenecks in slower network conditions. Android limits the number of TCP connections to 15.
Inefficient Connections – Periodic Transfers	Connections	Tests if a periodic connection is detected in the loaded trace files.
Inefficient Connections – Screen Rotation	Connections	Tests if the application triggers network activity when the screen orientation changes.
Inefficient Connections – Connection Closing Problems	Connections	Tests if 5% of the energy is used for TCP control in the loaded trace files.
400,500 HTTP Status Response Codes	Connections	Tests if there are any HTTP response codes in the 400 range (indicating a client request error) or in the 500 range (indicating a server request error) in the loaded trace files.

Test	Category	Description
301,302 HTTP Status Response Codes	Connections	Tests if there are any occurrences of the HTTP status response code 301 (indicating that the URI of a requested resource has been changed permanently), and any occurrences of the HTTP status response code 302 (indicating that the URI of a requested resource has been changed temporarily) in the loaded trace files...
3rd Party Scripts	Connections	Tests for files where at least 2 external scripts are being called.
Asynchronous Load of JavaScript in HTML	HTML	Tests for any HTML files with a synchronous load of JavaScript in the HEAD.
Http 1.0 Usage	HTML	Tests if HTTP 1.0 is seen in the header of the loaded trace files.
File Order	HTML	Tests for any HTML files where JS is loaded immediately before CSS.
Empty Source and Link Attributes	HTML	Tests for the empty attributes: iframe src, href src, img src, script src, and link href, in the trace files.
“display: none” in CSS	HTML	Tests for any instances of the CSS command “display:none” in the trace files.
HTTPS Usage	Security	Looks for connections that do not feature HTTPS. The best practice displays information about Total HTTPS data, Total HTTPS unanalyzed and % of Total HTTPS Data.
Transmission of Private Data	Security	Scans all transmitted data for potential leaks of private data.

Test	Category	Description
Unsecure SSL Version	Security	There are several versions of SSL that are not considered secure. This test identifies connections that use those versions.
Forward Secrecy	Security	Encryption that allows key capture, allowing attackers to gain access to all security keys.
Stalls	Video	Identifies when a video stalls (stops playing due to an empty buffer).
Start Up Delay	Video	Quantifies the time it takes for video to start from the first download of video data.
Buffer Occupancy	Video	Quantifies the amount of video stored in the buffer over time.
Network Comparison	Video	Compares the video bandwidth download with the available network bandwidth, to determine if the optimal bitrate is being displayed. Results section include Declared Manifest(kbps) and Calculated Network Bitrate(Kbps) for each segment.
TCP Connection	Video	Count of connections used to deliver video during the trace.
Segment size	Video	Average size of the video chunks downloaded during streaming.
Segment Pacing	Video	Pacing of the video chunks downloaded during streaming.
Redundancy	Video	Looks to see if the same chunk is downloaded multiple times.
Concurrent Session	Video	Using too many concurrent sessions may cause problems with smooth delivery of content

Test	Category	Description
Variable Bitrate	Video	Analysis for Non- DRM stream.
Resolution and Perception	Video	Video Optimizer conducts a test that flags video files with resolutions greater than 720p that are being sent to a smartphone.
Analyzing the Adaptive bitrate ladder	Video	By analyzing your ABR Ladder and designing it to stream files more efficiently over HTTP networks, with careful consideration of device. Results Section includes Track #, Resolution, Playback %, Segment Count, Total Duration(Sec), Segment Position(Sec), Declared Bitrate(kbps), Average Bitrate(Kbps)
Streaming Separate Audio and Video	Video	Streaming Separate Audio and Video segments, known as demuxing, has a number of benefits. There are also challenges that can lead to video stalling
Accessing Peripheral Applications	Others	Tests if any peripheral applications are seen to be ON for more than 5% of the total duration recorded in the loaded trace files. The peripheral applications checked during this test are: GPS, WiFi, Bluetooth, and camera.

For more detail on each of these best practices, visit https://developer.att.com/video-optimizer/docs/best-practices.

- ***Tables***

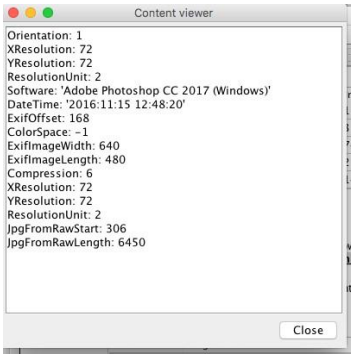
  The tables in the Video Optimizer best practices sections help you pinpoint the issues flagged by the best practice and they let you further investigate the issues. Double-click a line in the Best Practices table to view the Diagnostics tab, which

highlights the connection or file that is failing the best practice.

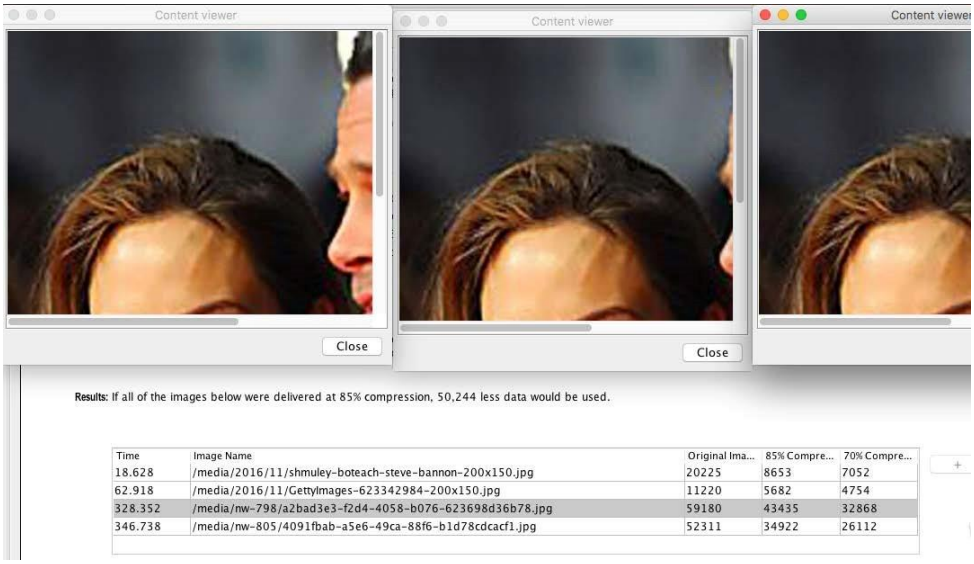
Right click a line in the Best Practices table to export the table. (Alternatively, command-a (select all) command-c (copy) will allow you to paste (command v) the table into your favorite spreadsheet software). Export table feature has a relevant default table name as file name - (Default filename => <Trace_Folder_Name>_<table_name>). For example, for best practices results export: Default filename => <Trace_Folder_Name>_<best_practice_name>. The <best_practice_name> usually follows the naming convention of best practice category and corresponding test name.

Images tables have additional features such as metadata views.

1. Click an image table to open a content view with the metadata:



2. Click the file name or original file size columns in the Image Compression table to open a view of the original image.
3. Click the 85% column to open the 85% compressed image and click the 70% column to open the 70% compressed image. In **Figure**, all three images are open in the Content Viewer (the original image, the 85% compressed image, and the 70% compressed image).



5.2.2. Overview Tab

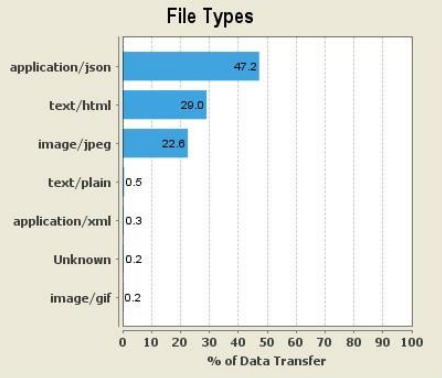
The Overview Tab displays charts and tables that summarize the data in the loaded trace files. The top part of the Overview tab contains the following information:

- Date: The date when the trace files were generated.
- Trace: The name of the folder containing the trace files.
- Downlink Throttle: If the Network attenuator downlink function was used during this trace, it will register the speed in mbps/kbps.
- Uplink Throttle: If Network Attenuator uplink function was used during this trace, this will record the speed in mbps/kbps.
- Network Type: The type of network, like 3G or LTE, which was in use when the data was collected.
- Profile: The profile that was used for the trace analysis.
- Total Bytes: The total number of bytes in the trace

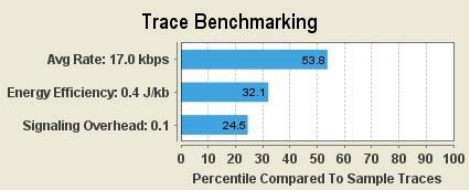
- ***Charts***

  The top of the Overview tab has three charts with high level information about the type of content, the energy usage compared with benchmark traces, and the number and type of connections used.

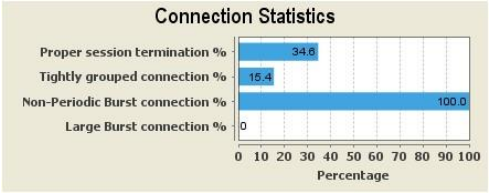
  The File Types chart plots the percentage of the various file types found in the trace data.



The Trace Benchmarking chart plots the average data rate, energy efficiency, and signaling overhead of the loaded trace, as a percentage, compared with a set of sample benchmark traces.



The Connection Statistics chart plots the percentage of the various types of session terminations based on the data captured in the trace. Four types of session terminations are plotted: Proper session termination, tightly grouped connection, nonperiodic bursts connection, and large burst connection.



The Connection Statistics chart contains the following fields:

Field	Description
Proper session termination	If the amount of time between the last data packet and the data packet that signaled the TCP session termination is less than or equal to 1 sec, then the session termination is represented as proper session termination. In the session termination plot, the sessions are displayed as a percentage of the total number of TCP sessions.
Tightly grouped connection	If 3 bursts occur in less than 15 seconds or 4 bursts occur in less than 60 seconds, then those sets of bursts are referred to a tightly grouped connection. In the session termination plot, these bursts are displayed as a percentage of the total number of bursts.
Non-Periodic Burst connection	If the Internet Addresses, host names, or object names are not the same for the packets in a set burst over a period, then those bursts are considered nonperiodic bursts. In the session termination plot, these bursts are displayed as a percentage of the total number of bursts.
Large Burst connection	If the burst duration is more than 5 seconds, then that burst is considered a large burst. In the session termination plot, these bursts are displayed as a percentage of the total number of bursts.

- ***Tables***

  The bottom section of the Overview tab has tables for the accessed domains. You can get more information about these items by clicking on table rows.

  The Duplicate Content table lists files that have been identified as duplicate content. By default, the table is sorted by content type, and it includes the following columns.

Column	Description
Duplicate Content Type	One of the following types of duplicate content: ORIGINAL_FILE OBJDUP_NOT_EXPIRED OBJDUP_NOT_CHANGED_SERVER OBJDUP_NOT_CHANGED_CLIENT OBJDUP_PARTIAL_NOT_CHANGED_SERVER OBJDUP_PARTIAL_NOT_CHANGED_CLIENT OBJDUP_PARTIAL_NOT_EXPIRED OBJDUP_DIFF_ETAG

Time	The timestamp for this occurrence of the duplicate content.
File Name	The name of the duplicate file.
File Size (bytes)	The size of the duplicate file in bytes.

1. Click the title of any column to sort the table.
2. Select a file and click View or Save As to view or save the content of the file.
3. Right-click the table to export the data. The default naming convention for the exported file is <Trace_Folder_Name>_overview_<table_name>

The Accessed Domains table contains details about each domain that was accessed during the trace. The table includes the following columns.

Column	Description
Domain Name	The list of domain names that are captured in the loaded trace files. These domain names are application independent and may have occurred in the browser app or any other application.
TCP Sessions	The count of TCP sessions for the corresponding domain name.
Average Session Length (sec)	The average session length in seconds. This average is calculated by dividing the total TCP session time (the difference between the session end time and the session start time) by the size of the session for this domain name.
Files Downloaded	The number of files downloaded for the domain name session.

1. Click the title of any column to sort the table.
2. Left-click a domain in this table to populate the adjoining table (Domain TCP Sessions) with information about the TCP sessions that were used when accessing that domain.
3. Right-click the table to export the data in preferred format. The default naming convention for the exported file is <Trace_Folder_Name>_overview_accessed_domains.

The Domain TCP Sessions table contains the collection of TCP Session information for the currently selected domain name in the Accessed Domains table and refreshes each

time a new domain name is selected. The table includes the following columns.

Column	Description
Time	The time stamp of the Domain TCP Session.
Remote IP Address	The Remote IP Address of the Domain TCP Session.
Local Port	The Local port value of the Domain TCP Session.
Session Length (sec)	The session length, in seconds, of the Domain TCP Session. The session length is the difference between the starting time stamp and the ending time stamp for the session.
Bytes Transmitted	The number of bytes transmitted during the Domain TCP session.
Session Close Delay (sec)	The session termination delay, in seconds, of the Domain TCP Session.
Closed By	Indicates whether the Client or the Server closed the Domain TCP Session. The Closed By value can be Client, Server, or Status Unknown, and is determined by the session packet direction.

1. Click the title of any column to sort the table.
2. Double-click a domain in this table to navigate to the TCP/UDP Flows Table in the Diagnostics tab where you can view the TCP flow information for the selected Domain TCP session. The selected TCP information will be indicated by highlighted type.
3. Right-click the table to export the data in preferred format. The default naming convention for the exported file is <Trace_Folder_Name>_overview_ domain_tcp_sessions.

5.2.3. Diagnostic Tab

The Diagnostics tab plots data from the loaded trace files and displays it in a Diagnostics chart. Detailed information is displayed in the TCP/UDP Streams Table, which has additional tabs for three different views into the TCP or UDP data.

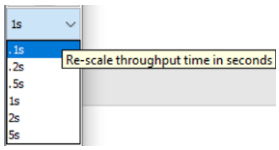
The Diagnostics tab displays the following information at the top before the chart:

- Date: The date when the trace files were generated.
- Trace: The name of the folder containing the trace files.
- Downlink Throttle: If the Network attenuator downlink function was used during this trace, it will register the ms delay.
- Uplink Throttle: If Network Attenuator uplink function was used during this trace, this will record the ms delay uplink.
- Total Bytes: The total number of bytes in the trace.
- Network type: The type of network, like 3G or LTE, which was in use when the data was collected.
- Profile: The profile that was used for the trace analysis.

- ***Diagnostics Tab Chart***

  The Diagnostics tab chart displays the graph data with an X-axis for the trace timeline and a Y-axis for labels of the information that is being plotted.

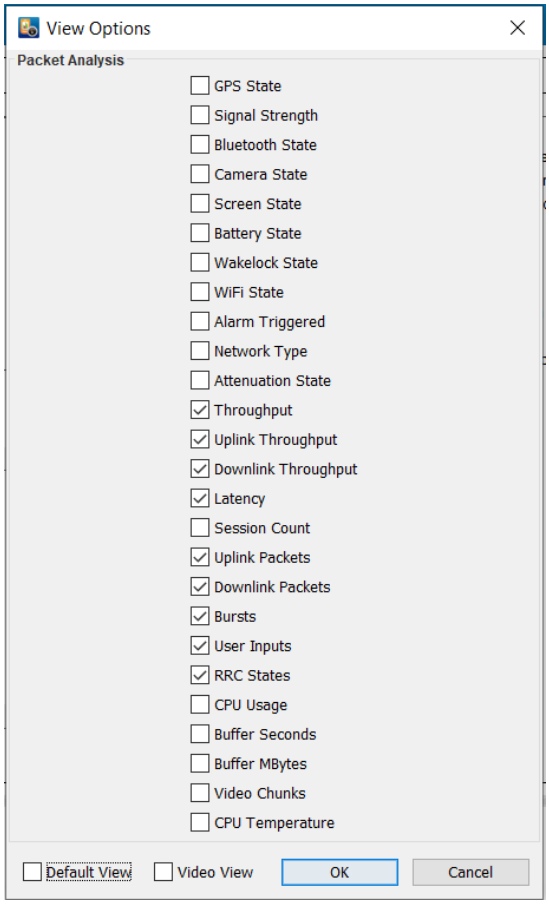
  - Click  or  for a zoom view.
  - Click  to save a snapshot of the chart. The File name field is populated with tracename_img by default in the Save dialog box. The location chosen by default is the trace folder.
  - Choosing a resolution from the drop down helps change the time resolution of the graphs displayed. On hover over the icon, a dialog informs the user that the graphs can change based on the setting. The default resolution is set to 1s



Changing the resolution does not reload the trace and all relevant graphs use the same resolution settings. The chosen resolution persists across trace loads and Video Optimizer restarts.

Use the following procedure to configure the items that are plotted on the Diagnostics tab chart.

1. Select Options from the View menu.
2. Select the items to be plotted in the View Options dialog
3. Click OK.
4. Move the pointer over the graphed items in the Diagnostics tab chart for more information on each one.



Note: In addition to creating your own custom view, there is a Default View and a Video View – especially created to help analyze video traces.

- ***Diagnostics Tab Chart Items***

  The following sections describe in detail the different types of information that can be plotted on the Diagnostics tab chart.

  - GPS State— shows the variation in GPS states over the duration of the trace.

GPS State	Description
GPS Active	The GPS receiver is turned on and is fixing the location. Energy consumption during this state is high. This state is colored green in the plot.
GPS Standby	The GPS receiver is turned on but is in standby mode. Energy consumption during this state is low. This state is colored yellow in the plot.
GPS Off	The GPS receiver is turned off.

  - Signal Strength—shows the variation in radio signal strength (expressed in Dbm) over the duration of the trace.
  - Bluetooth State—shows the variation in Bluetooth states over the duration of the trace.

Bluetooth State	Description
Bluetooth Connected	The Bluetooth is turned on and the device is paired with another device for data transfer. Energy consumption during this state is high. This state is colored green in the plot.
Bluetooth Standby	The Bluetooth is turned on, but the device is not paired with another device. Energy consumption during this state is low. This state is colored yellow in the plot.
Bluetooth Off	The Bluetooth is turned off.

  - Camera State—shows the variation in camera states over the duration of the trace

Camera State	Description
Camera On	The Camera is turned on. Energy consumption during this state is high. This state is colored green in the plot.
Camera Off	The Camera is turned off.

- Screen State—shows the variation in screen states over the duration of the trace.

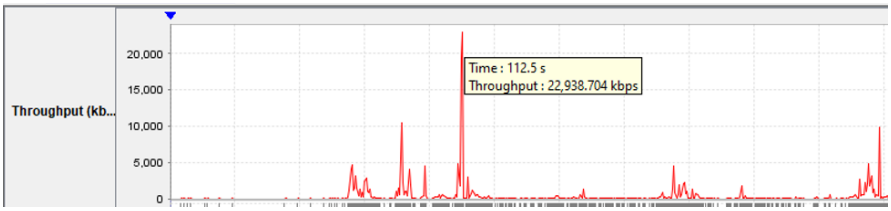
Screen State	Description
Screen On	The Screen is active. Energy consumption during this state is high. This state is colored green in the plot. When you place the tooltip over this state in the plot, the screen time out value (in seconds) and the brightness (in %) are displayed.
Screen Off	The device is in sleep mode.

- Battery State—shows the variation in battery level over the duration of the trace. Includes battery level, battery temperature, and battery connection status.
- WiFi State—shows the variation in WiFi states over the duration of the trace.

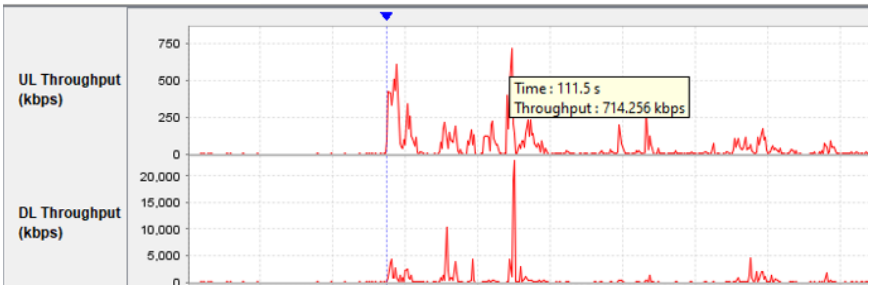
WiFi State	Description
WiFi Connecting	The device is trying to connect to a WiFi network. Energy consumption during this state is high. This state is colored green in the plot.
WiFi Connected	The device is connected to a WiFi network. Energy consumption during this state is high. This state is colored green in the plot. In addition to state detail, also shows the Mac Address, Radio Received Signal Strength Indication (RSSI) and Service set identifier (SSID).
WiFi Disconnecting	The device is disconnecting from a WiFi network. Energy consumption during this state is high. This state is colored green in the plot.
WiFi Standby	The device is disconnected from WiFi network. Energy consumption during this state is low. This state is colored yellow in the plot.

WiFi State	Description
WiFi Suspended	A WiFi network was disconnected unexpectedly. Energy consumption during this state is low. This state is colored yellow in the plot.
WiFi Off	WiFi is disabled in the device.
WiFi Unknown State	The WiFi is in an unknown state.

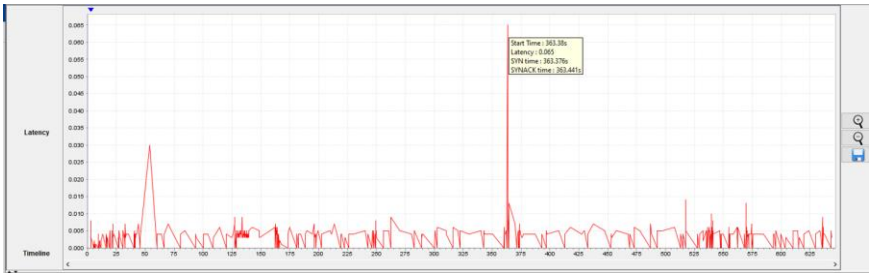
- Throughput — shows the variation in network traffic (expressed in kbps) over the duration of the trace. The higher the throughput, the higher the energy consumption. The Y axis displays values to help with analysis.



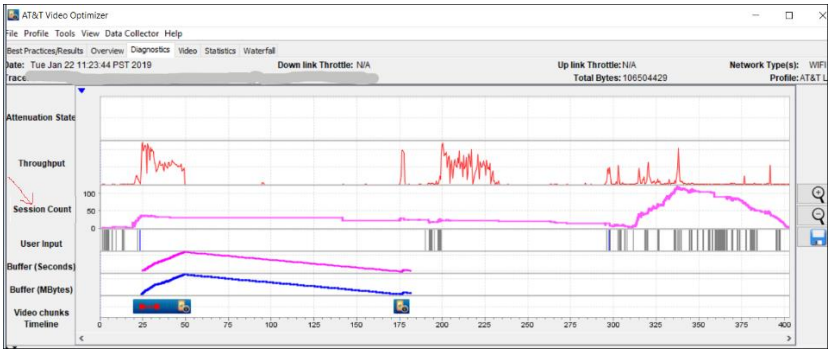
- Uplink Throughput (UL Throughput) — shows the variation in uplink network traffic (expressed in kbps) over the duration of the trace. The higher the throughput, the higher the energy consumption. The Y axis displays values to help with analysis.



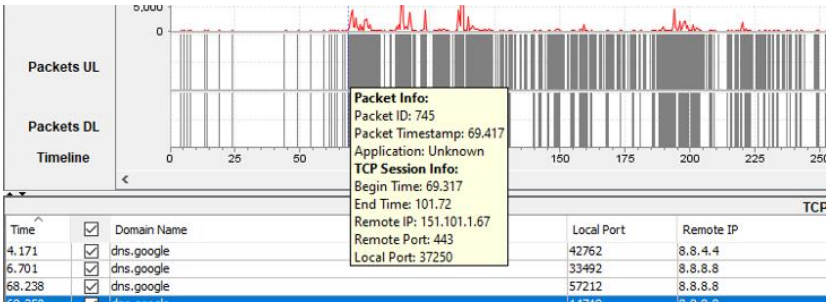
- Downlink Throughput (DL Throughput) — shows the variation in downlink network traffic (expressed in kbps) over the duration of the trace. The higher the throughput, the higher the energy consumption. The Y axis displays values to help with analysis.
- Latency – each TCP session's latency measurements captured over the course of the trace is mapped and displayed graphically in a horizontal band in the diagnostics tab. Hovering over the points in the graph displays the Start time, Latency, SYN time, and the SYNACK time.



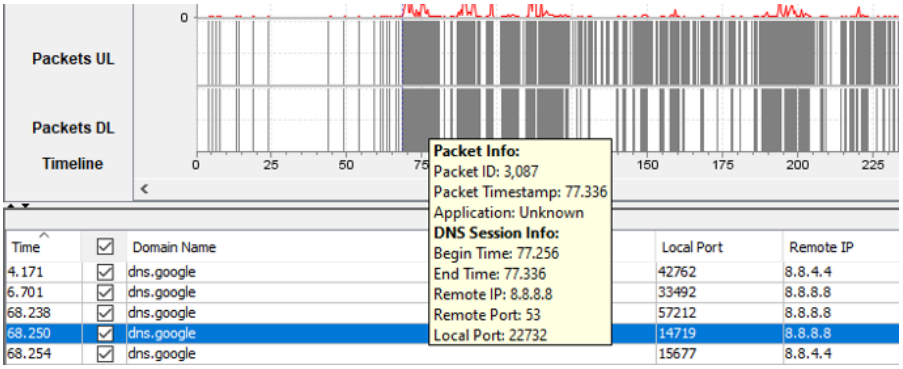
- Session Count- A graphic element added to the Diagnostics Tab titled 'Session count'. Values will be from a count of simultaneous sessions open at a given time. User will be able to see how many sessions are open at each transition, using the tool tip. A sharp rise in session count should allow user to see in the TCP/UDP Flows section, exactly which sessions were being connected to cause the sudden rise.



- Uplink Packets (Packets UL)—shows the packets that were uploaded (uplinked) in the sessions over the duration of the trace. Includes Packet Info, TCP, UDP, UDP/QUIC, DNS Session Info.



- Downlink Packets (Packets DL)—shows the packets that were downloaded (down linked) in the sessions over the duration of the trace. Includes Packet Info, TCP, UDP, UDP/QUIC, DNS Session Info.



- Bursts—shows the various types of bursts that occurred over the duration of the trace. A burst consists of consecutive packets transferred in a batch. Includes the burst type, a message, the packet count, the total bytes, and the throughput (in kbps).

Burst Type	Description
TcpControl	This category of burst is colored blue in the chart plot, and displays the tooltip message: ”TcpControl: Traffic that is delayed from a previous burst.”
TcpLossRecoverOrDup	This category of burst is colored black in the chart plot, and displays the tooltip message: “TcpLossRecover: Traffic that has been resent due to long delay.”
UserInput	This category of burst is colored green in the chart plot and displays the tooltip message: “User Input: Traffic initiated after a User Input event.“
Screen Rotation	This category denotes a burst caused by the rotation of the device. It displays the following tooltip message: “Screen Rotation: This traffic was initiated by a rotation of the device”.
App	This category of burst is colored red in the chart plot and displays the tooltip message: “App: Traffic initiated by the client.”
SvrNetDelay	This category of burst is colored yellow in the plot, and displays the tooltip message: “SvrNetDelay: Traffic initiated by the server.”

Burst Type	Description
Large Burst	If a burst duration is more than 5 seconds, then that burst is considered to be a long (or large) burst. This category of burst is colored gray in the chart plot, and displays the tooltip message: "LargeBurst: Traffic in a large burst (configurable in settings)." Note: The tooltip refers to the fact that the length and size thresholds for what is considered to be a long/large burst can be configured using the Customize dialog in the Profile menu.
Periodical	If the Internet Addresses, or the host names, or object names are the same for the packets in a set burst over a period of time, then those bursts are considered periodic bursts. This category of burst is colored purple/pink in the chart plot, and displays the tooltip message: "Periodical: Traffic that has a distinct periodic pattern."
User Defined	These are user defined bursts. This category of burst is colored magenta in the chart plot.
Unknown	This category denotes an unknown type of burst.

- User Input—shows the various user input events that have occurred over the duration of the trace including the following:

  SCREEN_LANDSCAPE->BLUE

  SCREEN_PORTRAIT->RED

  SCREEN_TOUCH - > GREEN

  KEY_VOLUP ->DARK_GRAY

  KEY_VOLDOWN -> MAGENTA

  KEY_POWER ->YELLOW

- RRC States—shows the variation in the Radio Resource Control (RRC) states over the duration of the trace. The states are determined by calculating the battery usage when network packets are received.

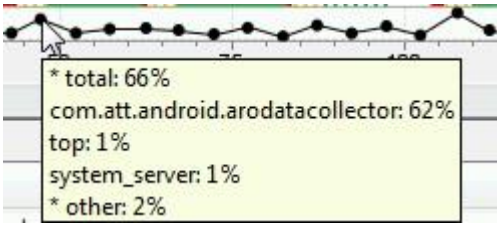
Note: DCH stands for dedicated channel, FACH stands for forward access channel, and CR stands for Continuous Reception.

RRC State	Description
IDLE	Indicates the radio is off.
DCH (Active)	This state is colored yellow in the chart plot. It indicates that the radio is in a high data, high radio energy, and high bandwidth mode which allows maximum throughput.
DCH TAIL	This state is colored with a yellow cross hatch pattern in the chart plot. It indicates that the radio is in a high throughput, high bandwidth state, but no packets are being sent.
FACH (Standby)	This state is colored green in the chart plot. It indicates that the radio is in low power state. Signaling packets may be sent, but content requires transition to DCH.
FACH TAIL	This state is colored with a green cross hatch pattern in the chart plot. It indicates that the radio is in a low power state with no traffic.
PROMOTION IDLE->DCH (Active)	Transition from IDLE to DCH (Active) state. This state is represented by a red triangle in the chart plot. It indicates the radio switching from off to a high-power state.
PROMOTION FACH (Standby)->DCH (Active)	Transition from FACH (Standby) to DCH (Active) state. This state is represented by a red polygon in the chart plot. It indicates switching from low power state to the high-power state.
LTE IDLE	Indicates that the radio is in an idle state, with occasional pings to the network for data.
LTE CONTINUOUS	Continuous Reception is the time of active packet transfer. High throughput high energy data transfer. Energy here is indicated as constant, but it does vary based on throughput.
LTE CR TAIL	Continuous Reception Tail is the inactivity timer after packets are sent, prior to DRX.
LTE DRX SHORT	The Short DRX state indicates that the radio is in a high bandwidth, high energy state, looking for packets.

RRC State	Description
LTE DRX LONG	The Long DRX state is the LTE Tail. It indicates that the radio is in a high bandwidth, high energy state, looking for packets.
WIFI ACTIVE	The WiFi transmitter is at full power - sending and receiving information.
WIFI TAIL	The WiFi Tail state is an inactivity timer after packets are sent.
WIFI IDLE	The Radio is in an idle state, with a small trickle of power usage

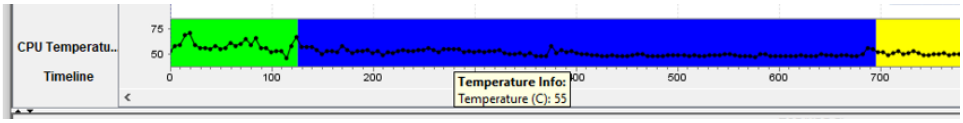
- Network Type—indicates how long the device has been connected to a particular network type, or if the network type has changed during the trace. The network types that are identified include GPRS, UMTS, HSDPA, HSPA, HSPAP, HSUPA, Wi-fi, and LTE. For 5G, the following will the displayed
    - OVERRIDE_NETWORK_TYPE_LTE_ADVANCED_PRO ->Advanced pro LTE (5Ge)
    - OVERRIDE_NETWORK_TYPE_NR_NSA -> NR (5G) -> 5G Sub-6 networks
    - OVERRIDE_NETWORK_TYPE_NR_NSA_MMWAVE -> (5G+/5G UW) -> 5G mmWave networks

- Wakelock State—indicates whether the device is in the wake state (active for user input) or the lock state during the trace. Includes the number of times the wakelock state has been changed from the plot point to the beginning of the trace.
- CPU Usage—shows the total percentage of CPU usage for each process followed by the name of each selected process and the percentage of CPU that it is using (**Figure**). Although the CPU Usage percentages for all the processes can be viewed at once, this chart is most useful when only one process is selected or when a small number of processes are selected, because the changes between the data points is more clearly visible.

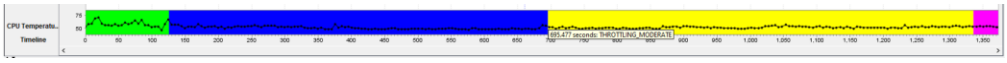


Note: It is possible that the percentages for individual processes may not always add up to the total percentage. This is because the process called top is a command that pulls the information from different locations that may not be completely in sync.

- Alarm Triggered—indicates when an application has triggered an alarm. Includes the type and timestamp of the alarm, the name of the application that triggered it, and the number of times it repeated.
- Buffer Occupancy—provides an estimate on how much video (in KB) has been downloaded into the buffer. This line is populated after the video chunk startup is calculated (see Video analysis section for details).
- Video Chunks—displays the first frame of each chunk (for videos without DRM) to indicate when the chunk download started. If the chunk has DRM, or Video Optimizer cannot parse the first frame, a placeholder image will be displayed.
    1. Click a chunk thumbnail to open a dialog to “match” the screenshot with the time it appears in the video (see video analysis section for details).
    2. Once the video has been matched with the screen video, point to a video frame to display information about the video playback.
- Playback Buffer Occupancy—provides an estimate on how much video (in seconds) is stored in the buffer. This line is populated after the video chunk startup is calculated (see Video analysis section for details).
- CPU Temperature – displays the temperature of the device for Android captures. The CPU temperature is captured every 5 seconds and plotted.



The chart also displays the thermal events that have occurred over the duration of the trace, indicating where the device may have overheated and throttled. The functionality is available only for devices running Android 10 or above. Thermal mitigation has become increasingly important and is needed when a device starts to overheat.

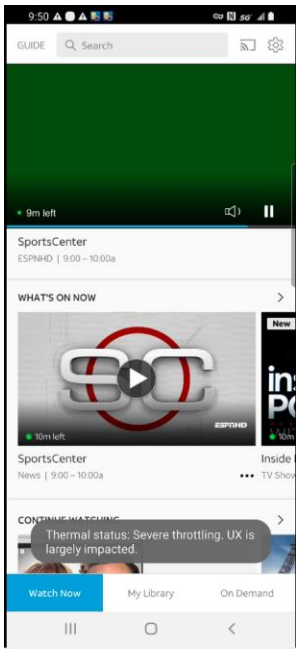


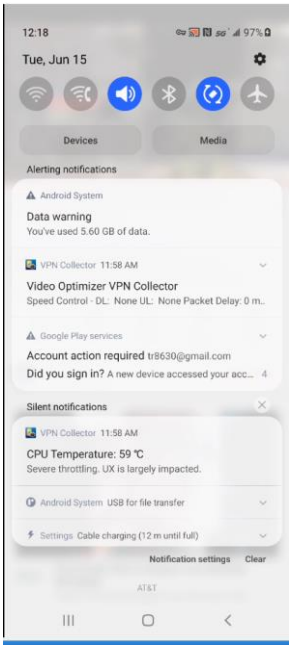
- NO throttling -> Green color
- LIGHT throttling -> Blue color-> UX isn't impacted.
- MODERATE throttling ->Yellow color -> UX isn't greatly impacted.

- SEVERE throttling ->Magenta color -> UX is largely impacted.
- CRITICAL ->Red color ->Platform has done everything to reduce power.
- EMERGENCY -> Purple color -> Key components in the platform are shutting down due to thermal conditions.
- SHUTDOWN -> Black color -> Shutdown immediately.

Please refer to the link below for additional information - https://source.android.com/devices/architecture/hidl/thermal-mitigation

The thermal status is displayed on the device during trace collection –

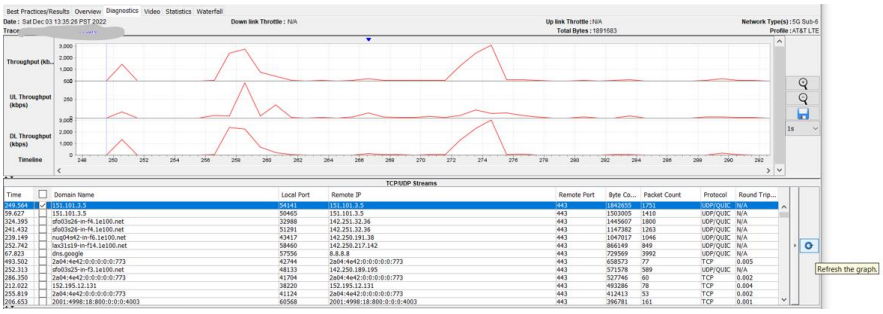




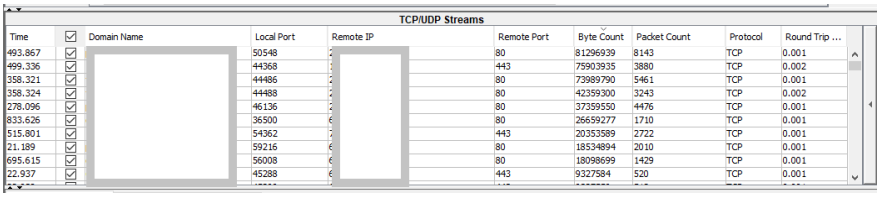
- ***Diagnostics Tab Tables***

  The TCP/UDP Streams table in the Diagnostics tab has rows of TCP or UDP session data that correspond to trace points in the Diagnostics chart.

1. Select or deselect the rows of TCP or UDP data and click on the Refresh button next to the TCP/UDP Streams table to narrow the trace data that appears in the Diagnostics chart.



2. Click the check box in the title row to select or deselect *all* of the TCP and UDP data.



The TCP/UDP Streams table contains the following columns of information. These columns are sortable.

Column	Description
Time	The amount of time (in seconds) from the beginning of the trace when this request was made.
Domain Name	The name of the domain to which the request is being made. When loading traces, Domain information is populated by prioritizing DNS queries already present in the traffic file rather than current network data (Reverse DNS of Session Remote IP). This is so that the data reflects information at the time of collection rather than DNS changes that may have happened since then.
Local port	The local port through which the request is being made
Remote Ip	List all the remote IP server addresses. Support for IPV4 and IPV6. Supports parsing IPV6 headers and all different formats of IPV6 representations.
Remote Port	The number of the remote port (on the domain) through which the request is being received.
Byte Count	The number of bytes in the TCP/UDP Stream.
Packet Count	The number of packets in the request.

Column	Description
Protocol	Indicates whether the TCP or UDP or QUIC or DNS or STUN protocol was used. The highest-level protocol will be the entry in the protocol column. For example, TLSv1.3 is a higher level than TCP, so if a TCP stream has TLSv1.3, the TLSv1.3 will be displayed. If a stream started before the trace capture started, then not enough information is available to determine the protocol and it will be displayed in lowercase.
RTT(Round Trip Time)	RTT time is calculated by SYNC and ASYNC time displayed in the Packet view. The calculated value is displayed in the TCP/UDP streams.

Note – Additional functionality – double clicking on the session will bring up a dialog box. The SNI is populated for TCP, and UDP/QUIC sessions where the data is available. This data is select-able for copying, but not editable.

A second table below the TCP/UDP Streams table has tabs that let you change the data view in four different ways: Request/Response (default view), Packet, Content View and Delay.

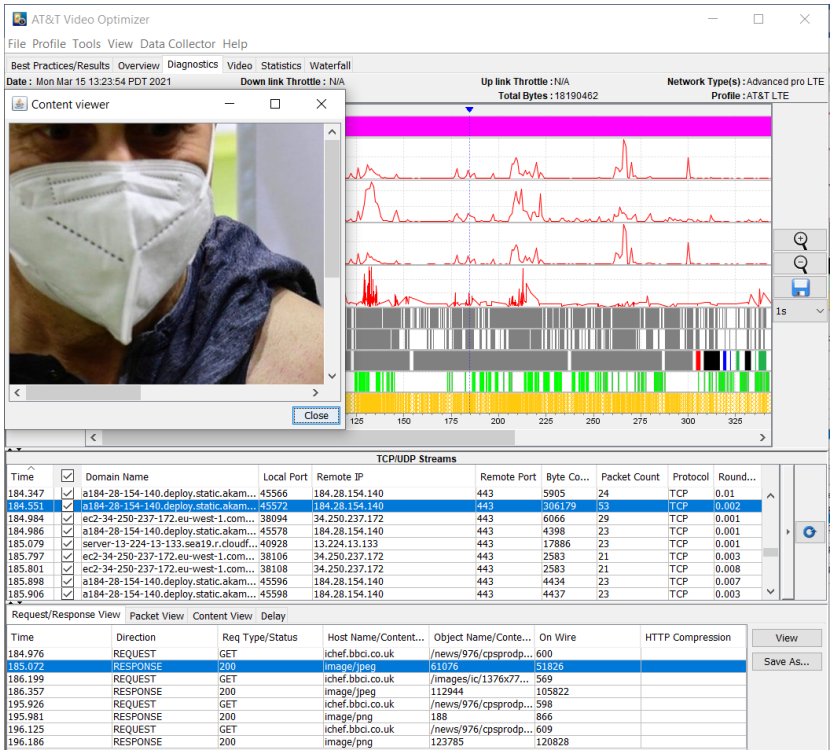
The Request/Response View tab displays the request/responses associated with the selected row highlighted in the TCP/UDP Streams Table.

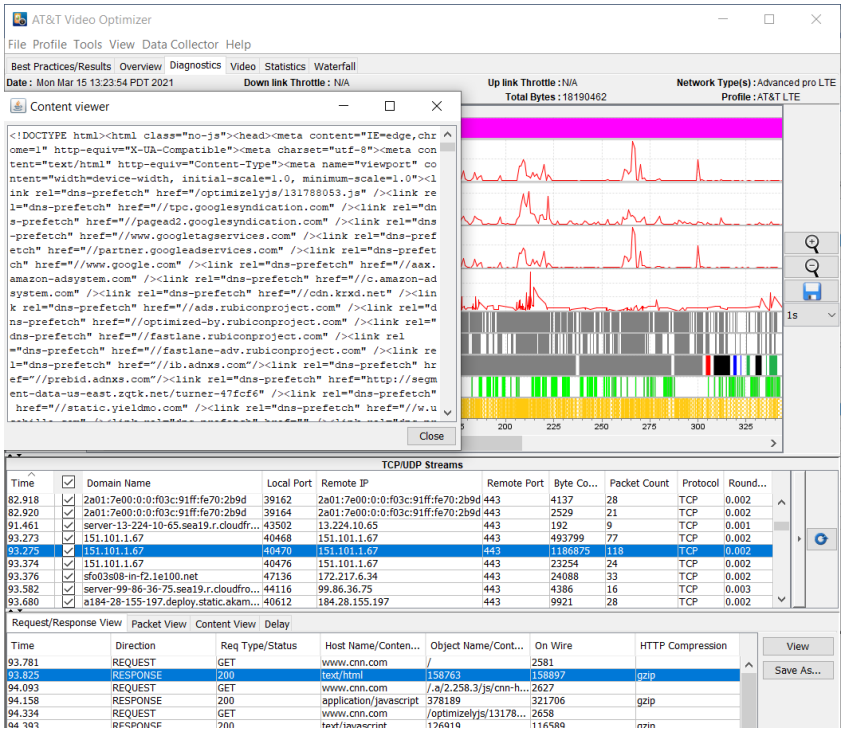
Column headings in the Request/Response View have different meanings (separate by a “/” in the column name) depending on whether the row contains a request or a response.

Column	Description
Time	The time of the request or response, in seconds, from the beginning of the trace.
Direction	The direction of the TCP stream (REQUEST or RESPONSE)
Req Type/Status	HTTP request type (GET, PUT, POST, or DELETE) or the HTTP status of the response (such as 200 for OK or 404 for resource not found).
Host Name/Content Type	The host name for the HTTP request or the content type of the response. Content type consists of a pair of values (type/subtype) representing the Internet media type, for example, text/plain (simple text messages), text/html (HTML document), text/CSS (cascading style sheet), image/gif (GIF Image), image/jpeg (JPEG Image), application/JSON (JSON data object).
Object Name/Content Length	The name of the object requested from the host or the length, in bytes, of the response.
On Wire	The number of bytes on the wire during this request or response.
HTTP Compression	This column is only used for responses with a text MIME type. If the response contains a text file, this column indicates if HTTP compression was used or if there was none. BR and gzip Compression are triggered under HTTP Compression.

1. Select one of the rows from the Request/Response View tab that has a response.

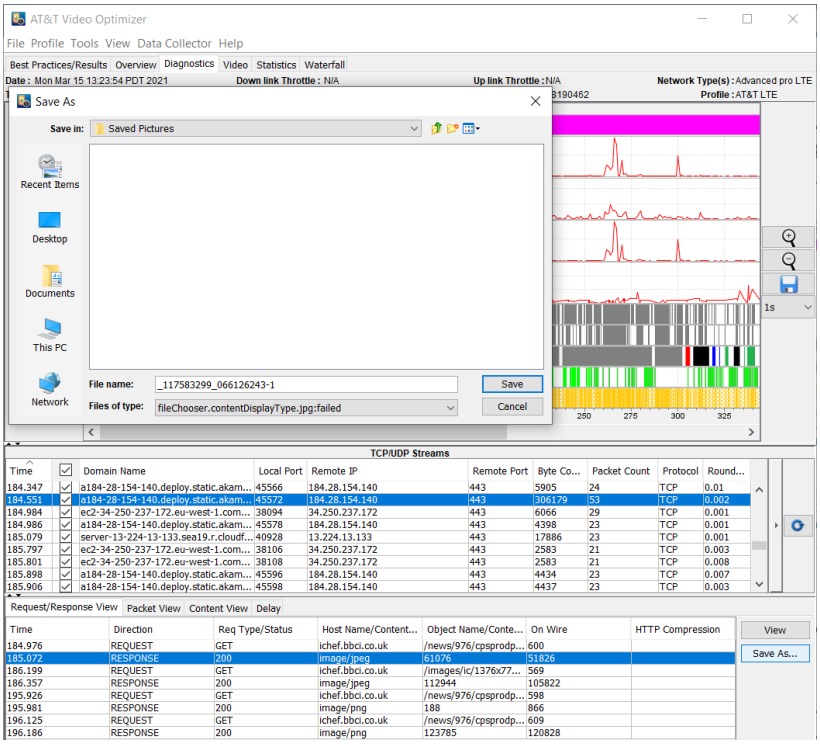
2. Click View to display the data object in the response. For an image, the image will be displayed in the Content viewer (**Figure**). If the data object is text, HTML, or JSON it will be displayed in the Content viewer (**Figure**).





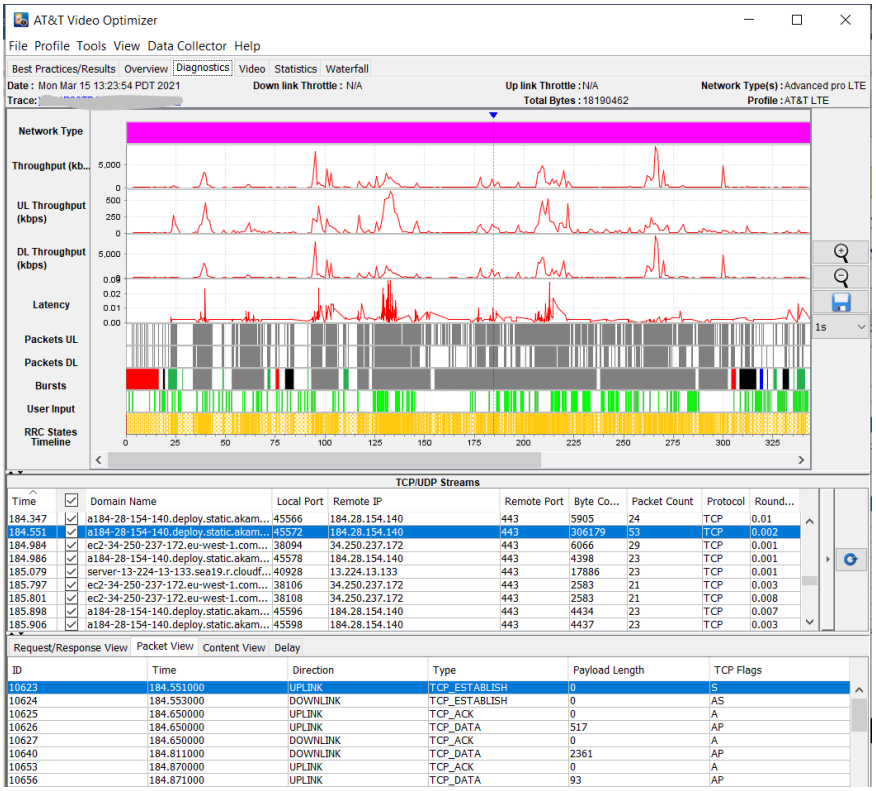
3. Click Save As to save the object as a file in the specified directory.

(Note that the View and Save As buttons are not available for Requests).



If the object cannot be displayed, an error message will indicate that the content was unable to be viewed because it may be corrupted.

The Packet View tab shows information about the individual packets associated with the selected TCP or UDP stream (**Figure**).

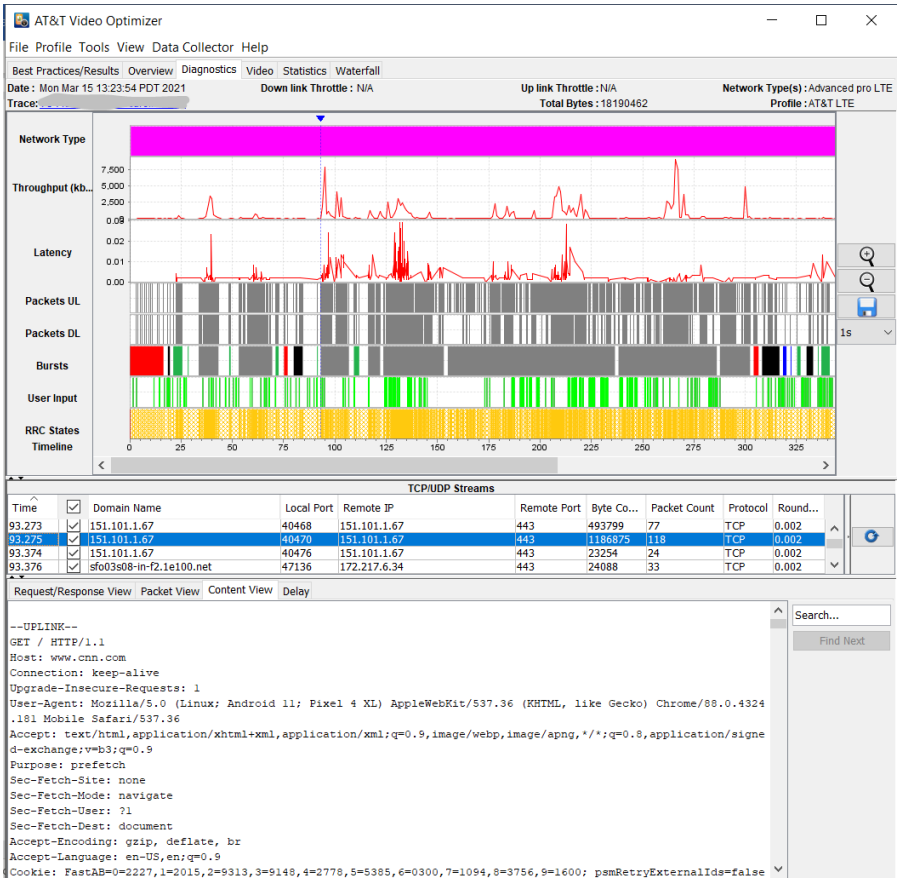


The following table describes the columns of data in the Packet View tab.

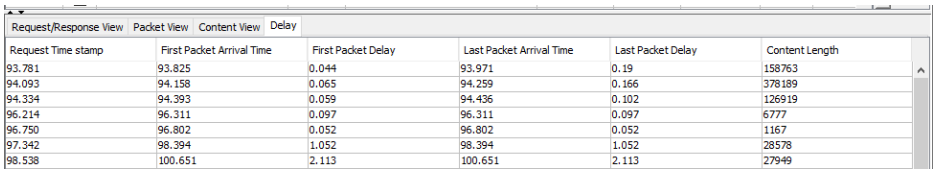
Column	Description
ID	An integer value that uniquely identifies each packet within the trace.
Time	The time, in seconds, from the beginning of the trace
Direction	The packet direction. One of the following values: UPLINK (The packet is sent up to the server), DOWNLINK (The packet is sent down from the server/host), UNKNOWN (The packet direction cannot be determined).
Type	Indicates the type of packet. One of the following values: OPEN_CONN (A packet that opens a connection), ACK (An acknowledgement packet), DATA (A data packet).
Payload Length	The length of the payload (the data being sent in the packet) in bytes.

TCP Flags	Each letter in this field represents a different TCP flag associated with the packet. More than one flag can be associated with a packet. The possible flags are: AS - Ack; P - Push; R - Reset, S - Synchronize, F - Finish/End, E - Echo, U - Urgent, C - Congestion Windows Reduced.

The Content View tab displays the content of the HTTP request/response (**Figure**). All Request and Responses will show in the same order as in Request/Response View. It has a Search field to the right of the content window, in which you can enter a search string. All instances of the string will be highlighted in the content window and the Find Next button can be used to navigate through the instances. The Content view is not editable.



Delay: Displays the delay associated with a response corresponding to each request in a trace. Below screenshot displays the fields added:



Request Time stamp	First Packet Arrival Time	First Packet Delay	Last Packet Arrival Time	Last Packet Delay	Content Length
93.781	93.825	0.044	93.971	0.19	158763
94.093	94.158	0.065	94.259	0.166	378189
94.334	94.393	0.059	94.436	0.102	126919
96.214	96.311	0.097	96.311	0.097	6777
96.750	96.802	0.052	96.802	0.052	1167
97.342	98.394	1.052	98.394	1.052	28578
98.538	100.651	2.113	100.651	2.113	27949

Column	Description
Request Time stamp	This field represents the timestamp of the first TCP_DATA packet in a given request
First Packet Arrival Time	This field represents the timestamp of the first TCP_DATA packet in a corresponding response.
First Packet delay	Difference between the First Packet Arrival Time and the Request Time stamp
Last Packet Arrival Time	This field represents the timestamp of the last TCP_DATA packet in a corresponding response
Last Packet delay	Difference between the Last Packet Arrival Time and the Request Time stamp
Content Length	Displays the size of the response in bytes

Export TCP/UDP: Right click on the tcp/udp table to export the table. All the columns including the SYN and SYN ACK Times for the Round Trip Time are exported to an excel file and saved by default in Trace Folder location. The default naming convention for the exported file is <Trace_Folder_Name>_diagnostics_tcp_udp_streams.

5.2.4. Video Tab

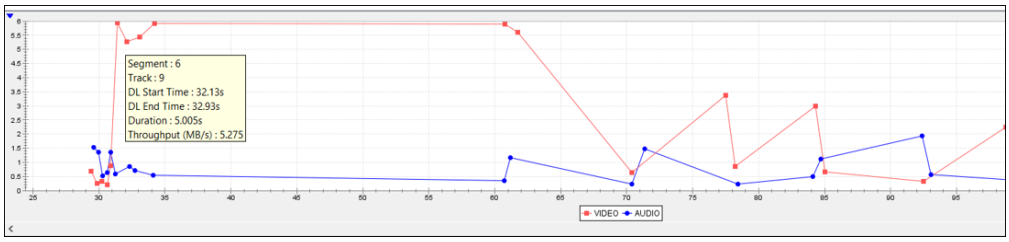
The Video tab breaks down the video usage during the data collection. This feature helps you understand how your application downloads video. If you have a trace with video collected, you will see this tab populated with Segment Throughput graph, Segment Progress graph, Segment Buffer graph, Video Stream, and Video Requests.

- ***Segment Throughput graph:***

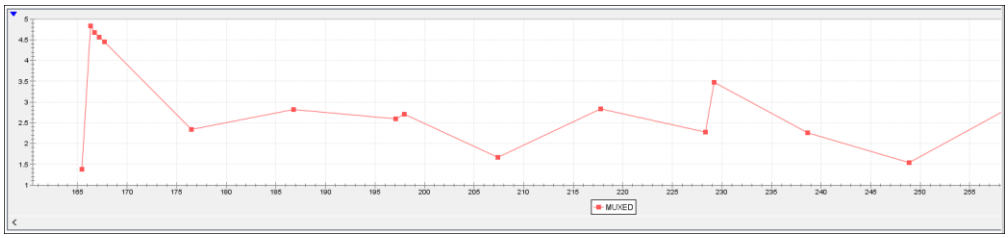
This graph is enabled when at least one stream is selected in the case where there are multiple streams present. However, if the trace has only one stream then the graph is displayed as soon as

the user loads the trace. Based on the type of stream that has both audio/video or Muxed, the graph will be displayed with the headers below.

Audio/Video Stream Segment Throughput graph:

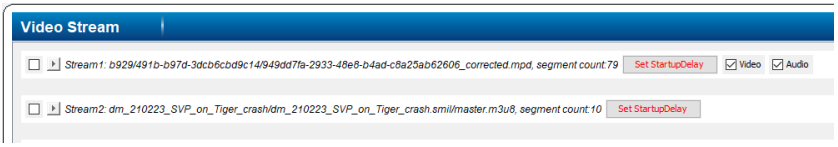


Muxed Stream Segment Throughput graph:



- ***Stream Examples***

  If Video Optimizer can read the movie stream, it will break down the observed videos into tables.



Click the arrow  for one of the Streams to expand the Audio/ Video segments table with each segment that is observed from that Stream.

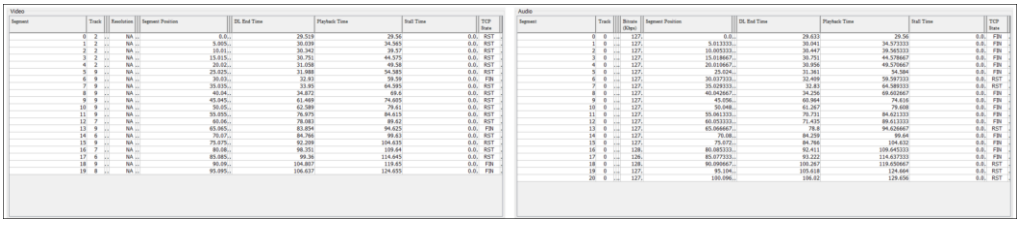
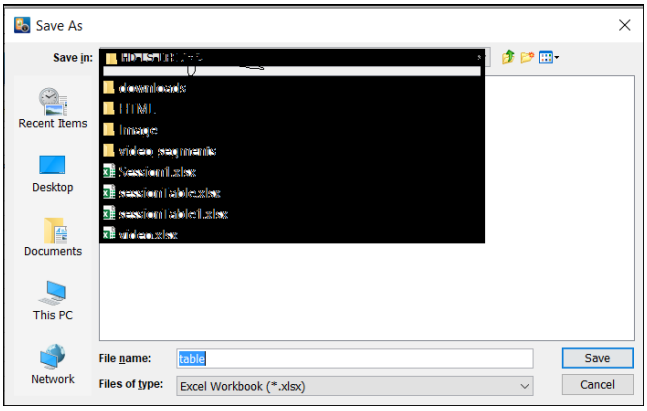


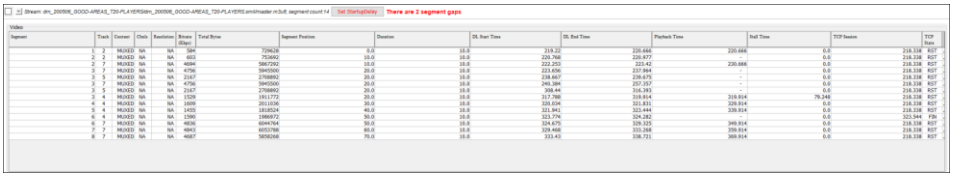
Figure above shows that Audio/Video segment number from 0-19 in Video and 0-20 in Audio. In the table, Segment number 0 was downloaded with Audio Track 0 and Video Track 2. When user double clicks on any of the segment row then user will be taken to diagnostic tab.

When audio and video are sent separate from each other (demuxed) there will be separate tables for video & audio. You can view partial details of video & audio side by side or uncheck one or the other to see full details.

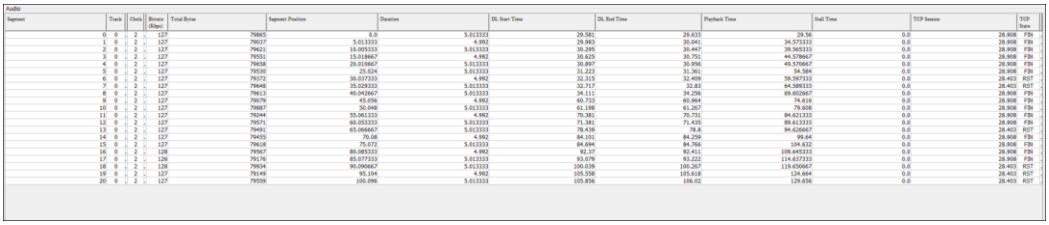
Export: Clicking on Export, exports the details of all the streams. The exported data is saved in .xlsx file. The default naming convention for the file is <Trace_Folder_Name>_video_streams. In the file, the first column of the first line will be "Name" and the second column of the first line will be the actual "Stream Name". The sheet names will correspond to Stream numbers like Stream 1, Stream 2, and so on. For CSV export, "Stream<Number>" is added on the line above the Stream Name. In the case of Video, and Audio tables present for a stream, the excel sheet displays the Video table information above the Audio table information. In the case of Muxed video, the information is displayed under the video table.



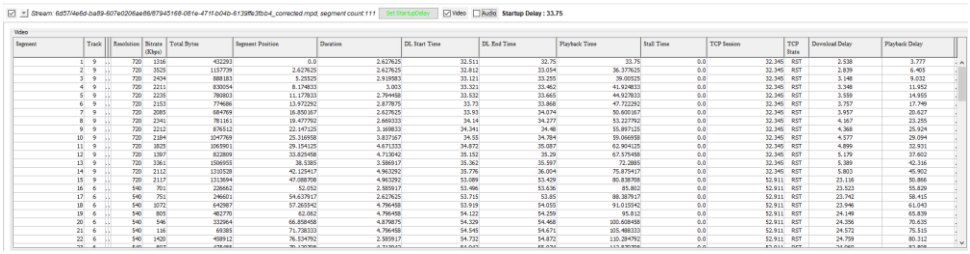
You may see a message indicating Video Optimizer observed a gap in the segments, based on one or more missing records in the list of sequential segments. This message is primarily informational. There are many reasons a gap may have occurred, and it might not signal a problem. Refer to the screen shot below.



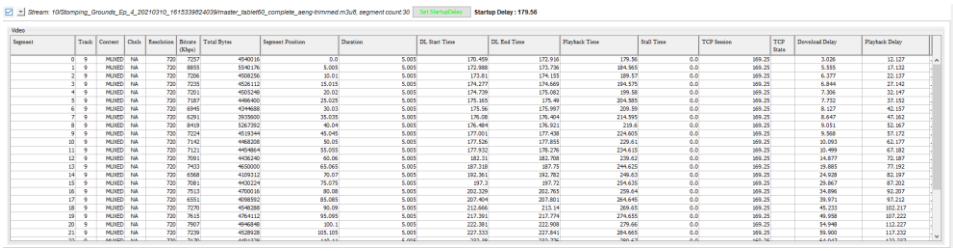
Audio Segments:



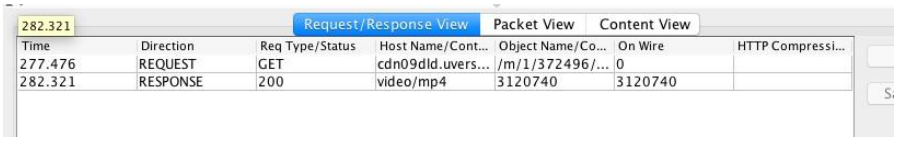
Video Segments:



MUXED(Audio/Video):



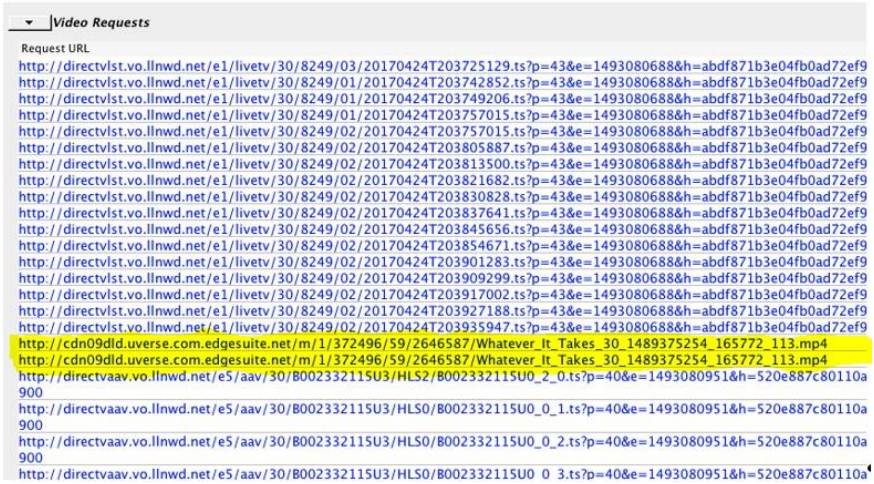
The Diagnostics tab reveals that the segments from **Figure** are not actually movie segments, but an entire Mp4 video advertisement.



This ad was downloaded twice during the trace (possibly due to slow network connectivity). A full 3 MB file that is downloaded twice can add significant delay to the end user (and it does appear as a failure in the duplicate file best practice). Video Optimizer uses the Stream and a URL parsing method to retrieve the values that are displayed in the Video tab.

- ***Video Request Examples***

  The last chart in the Video tab, Video Requests, is a list of all the URLs that are used in video requests:



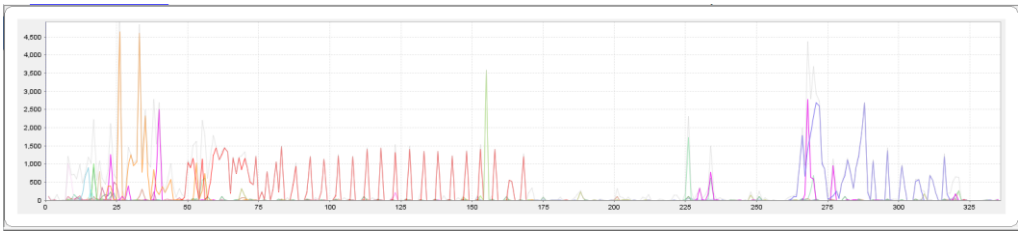
5.2.5. Flows Tab

The Flows tab displays individual flows and the analysis of the network flows. The information in the Flows tab is divided into the following sections –

- Flows Graph
- Flows Table
- Flows Summary

- ***Flows Graph***

  The Flows Graph displays the throughput for each individual flow group in a different color. The graph for each of the flow groups can be hidden or displayed by right clicking in the Flow Group column in the Flows Table and selecting Toggle Group. This can also be done for individual flows within a group by checking or unchecking the checkbox for that flow in the Flows Table.

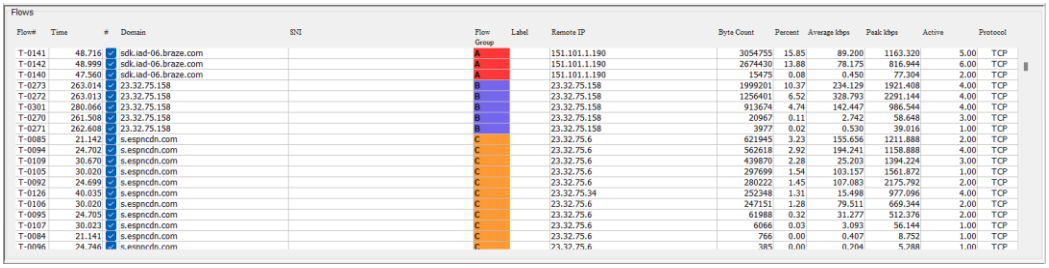


The X-axis displays time in seconds, and Y-axis displays the total throughput (download+upload) in kbps. The graph will display multiple (overlapping) lines for each set of data plots. Each will have a unique color. The sum of ALL traffic, including traffic not included in any flow group, can be displayed by right-click selecting “Toggle Background”. Sometimes the other flow groups will completely overlap this gray colored graph. When no flow is selected, the graph is will be blank.

Clicking on a position in the chart will sync the video player to the timestamp of the click, like it does on the Diagnostics tab. While video is playing the hairline will move synchronously.

- ***Flows Table***

  Flows table will show individual flows, also known as sessions or streams.



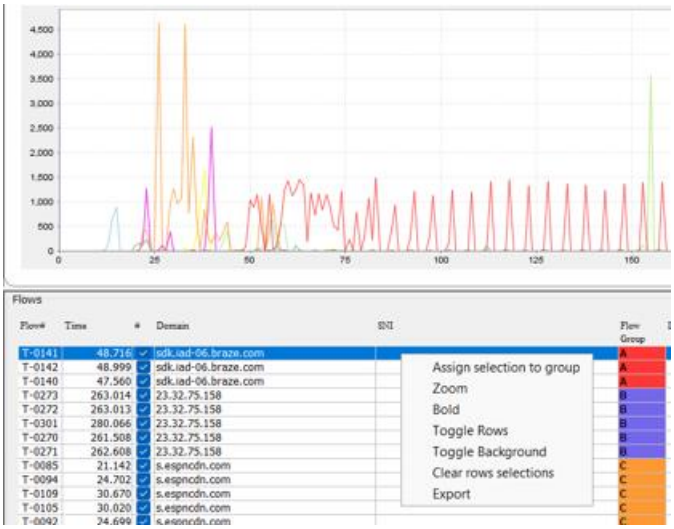
  The flows table will have the following columns –

  - Flow # - Prefix ‘T-‘ is for a TCP stream and ‘U-‘ is for a UDP stream and the number following the prefix is the stream number.
  - Time – Flow start time
  - Checkbox – adds or removes a flow from the graph and summary sections
  - Domain
  - SNI – Server Name Indicator
  - Flow Group – Selected flows will have a color and a group name indicating what flow group the flow belongs to. Flows are auto detected and grouped.
    - Starting with the largest flow, the remaining flows will be searched for a match with SNI, Domain name, or remote IP address, in that order.
    - Sorted flows are then scanned through for the first or the next unassigned flow. Scanning flows that are not assigned to a flow group continues until flows have no payload, or all of the default flow groups have been assigned.
    - All matching flow groups with less than 1 percent of total trace traffic will be dropped unless 're-assign without limits' option is chosen. In that case, the flow groups below 1% will be retained.
    - Group fields can be changed to match group number of other flows.
  - Label – blank until user defined
  - Remote IP
  - Byte Count
  - Percent – percentage of total trace traffic
  - Average kbps
  - Peak kbps - highest bitrate in a time period
  - Active – time from start of bitrate exceeding the minimum active bitrate until the bitrate falls below a defined bitrate
  - Protocol – TLS, UDP, QUIC, etc

The column widths are adjustable, and the column positions in the table can be changed. Rows are initially auto sorted by Flow Group and each checkbox is checked for display. User can uncheck the box to temporarily hide the flow from the chart and summary. Changing the checkbox in the flows table will not change the selections in the Diagnostic tab.

There are two different popup menus within the Flows table. One is for the Flow Group column and other is for all other columns.

Starting with all other columns, select any row and right click on any cell other than a Flow Group cell.

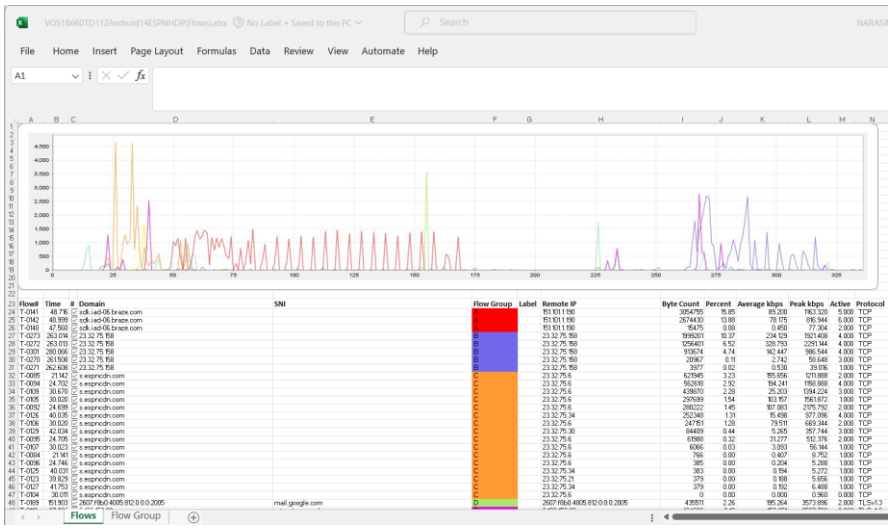


A popup menu is displayed with the following options –

- Assign selection to group
  - Row selection(s) highlighted in blue will be assigned to the chosen group.
  - FlowGroup dropdown chooser will appear in a dialog along with an option to edit color.
  - All row selection(s) will be assigned to a new flow group regardless of their current group assignment.
- Zoom
  - All selected rows will be zoomed into within the graph. No flows will be bolded.
  - Zoom will display the start-time through end-time of the selection and the vertical height will be controlled by the peak kbps of selected rows.
  - If no rows are selected, Zoom will zoom out to the full trace length, and height will be based on the peak total throughput. Any previous bolding will be un-bolded.
- Bold

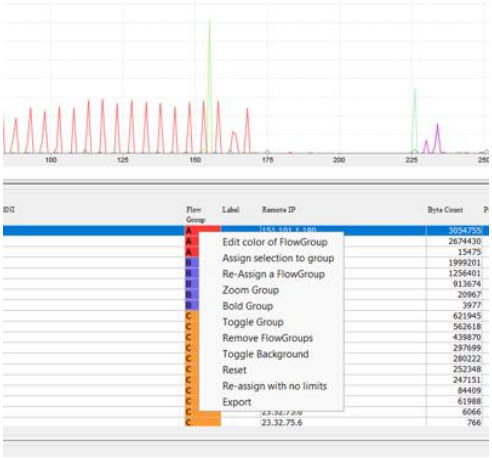
- All selected rows will toggle the line in the graph between bold and un-bold.

- Toggle Rows
  - All selected rows that are in a flow group will toggle their checkbox on/off.
  - Each row is independently toggled off or on based on its current checkbox status.
- Toggle Background
  - Toggles the background throughput in the graph. The gray plot line in the chart will be displayed/hidden.
- Clear rows selections
  - All selected rows will lose flow group assignments if they had an assignment.
- Export
  - Exports the graph, Flows table, and Flow Summary table to a multi-tab xlsx file.



The exported xlsx sheet will display the chart at the top. Below the chart it displays the Flows table in the ‘Flows’ sheet and the Flows summary table in the ‘Flow Group’ sheet. The spreadsheet is not dynamically updating, unlike inside VO. For example: a checkbox will be displayed for the selected flows, but changing the checkboxes will not make any change to the rest of the spreadsheet. Sometimes the column widths may be too wide and the graph might not be completely visible. In those instances reducing the column widths can bring the graph back into complete view.

Flow Group Pop-up: Select any row and right click on a Flow Group cell.



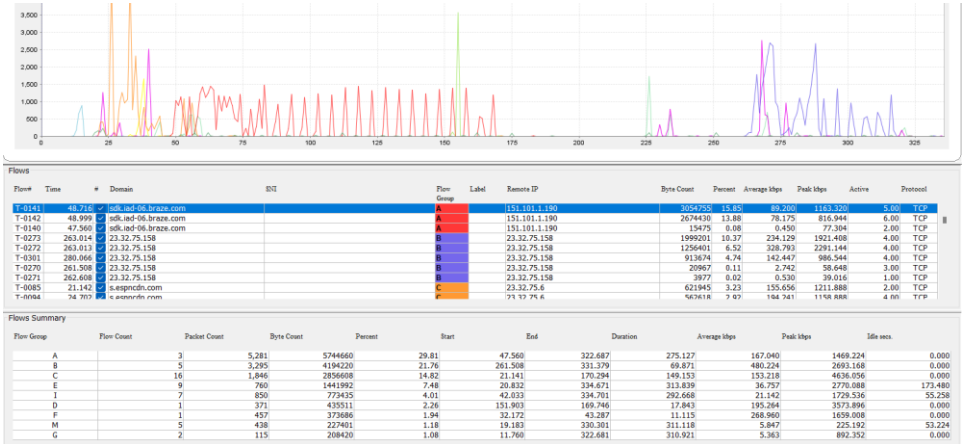
A popup menu is displayed with the following options –

- Edit color of FlowGroup
  - Provides a selection of color choices.
  - Select a color and click 'OK' to set the new color for all flows within the named flow group, within the trace only. Default colors will not be changed.
- Assign selection to group
  - A FlowGroup dropdown chooser will appear with a color editor.
  - The rows selected will be added to the group selected in the dropdown.
- Re-Assign a FlowGroup
  - Based on the Flow Group cell that received the right-click, and effecting all flows within that flow group
  - A FlowGroup dropdown chooser will appear with a color editor.
  - The entire Flow Group selected will be added to the group selected in the dropdown.
- Zoom Group
  - Based on the Flow Group cell that received the right-click, ignoring rows selected.
  - This will Zoom the chart from start-time to end-time and vertical height of peak kbps of flow group.
  - Will also make the flow group be bold.
  - To un-Zoom the group, you need to Zoom it a second time.
- Bold Group
  - Based on the Flow Group cell that received the right-click, all the flows in that group will toggle to be bold or not.
- Toggle Group
  - Based on the Flow Group cell that received the right-click, the reverse of that row will be applied to all Flows within the Flow Group.

    - If de-selected the Flow Group will still remain as a Flow Group, but temporarily disappear from the summary table.
- Remove FlowGroups
    - Based on the Flow Group cell that received the right-click, all Flows will lose their Flow Group assignment.
    - The Flow Group itself will vanish.
- Toggle Background
    - Toggles the background (sum of ALL traffic) throughput in the graph to be hidden or visible.
- Reset
    - Deletes the existing FlowTableHistory.json
    - Any color changes will revert to the defaults from the user's Library file.
    - Re-creates default FlowGroup assignments.
- Re-assign with no limits
    - Deletes the existing FlowTableHistory.json
    - Re-creates default FlowGroup assignments
    - Will assign Flow Groups until ALL of the Flows have been scanned, or until VO runs out of Flow Groups to assign.
    - The 1 percent rule will be ignored.
    - Flows with zero data will be ignored.
- Export
    - Exports the graph, Flows table and Flow Summary table as described above.

A file called FlowTableHistory.json is created and saved in the trace folder when a trace is opened. This file will include a complete log of changes since the file was created, and the current state of the Flows tab. Choosing the option "Reset" or "Re-assign with no limits" from the dropdown will delete and create a new FlowTableHistory.json.

- ***Flows Summary***



The Flows Summary table consists of the following columns –

- Flow Group
- Flow Count - the number of flows in the group
- Packet Count
- Byte Count – is the sum of all flows in the group
- Percent – percent of total bytes in the trace
- Start – start time of the earliest flow within the Flow Group
- End – last time stamp of all the flows within the Flow Group
- Duration – difference between the Start and End time
- Average kbps – Byte Count times 8 divided by Duration
- Peak kbps – the highest combined throughput throughout the Duration of the Flow Group
- Idle secs – idle time between flows of the Flow Group

Flows Summary table is sorted by the Byte Count of each Flow Group.

Sometimes the Flows Groups may appear to be out of order alphabetically. This might happen when a flow grouping starts with a relatively small byte count but with many flows culminates into a larger flow group. It can also happen when some flows in a Flow Group are deselected manually.

If the checkbox status changes in the Flows table on any of the flows within a flow group, the values in the Flows Summary table will change. A deselected flow is temporarily removed from the Summary calculations.

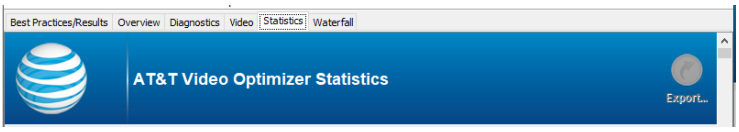
5.2.6. Statistics Tab

The Statistics tab displays key statistical information based on the analysis of the loaded trace. The information on the Statistics Tab is divided into the following sections:

- Header
- TCP(Session) Statistics
- Attenuator Simulation
- Endpoint Summary
- RRC(Radio Resource Control) State Machine Simulation
- Burst Analysis
- HTTP Cache Statistics
- Energy Efficiency Simulation

- ***Export Button***

  The top right corner of the Statistics tab has an Export button.



1. Click Export.
2. The default naming convention for the file is <Trace_Folder_Name>_best_practices_results. Click Save in the Save As dialog box to save all the data from the Best Practices/Results tab as a .html file.
3. Click OK when the file has been saved or click Open to open the file immediately. When you click Open, the export file will be opened using the program that you have identified in your OS as the default program for .html files.

- ***Header Section***

  The Header section of the Statistics tab displays information about the trace that the statistics are derived from. The information in the Header section is the same as in the header of the Best Practices/Results tab.

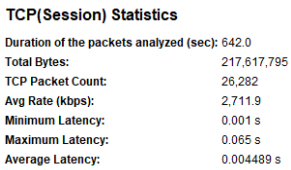
  The following table describes the information displayed in the Header section:

Label	Description
Date	The date when the trace files were generated.
Trace	The name of the folder containing the trace files.
Time Range	The time range description name followed by the time range that is used to open the trace.
Application(s) Name: Version	The names and versions of the applications that were running when the trace data was collected.
Data Collector Version	The version of the Video Optimizer Data Collector that was used to collect the trace data.
Device make/model	The make and model of the device from which the data was collected.
Display Resolution	The Orientation mode, and the Width and height of the display from which the data was collected.
OS/Platform Version	The operating system version or platform version of the device that the

Label	Description
	trace was captured on.
Network type	The type of network, like 3G or LTE, which was in use when the data was collected.
Carrier Name/Cell ID	Carrier name, and the Cell tower ID the device was connected to when the trace was captured.
Profile	The device profile that was used for the trace analysis.
Secure	True for a secure trace and False for non-secure traces.

- ***TCP (Session) Statistics***

  The TCP (Session) Statistics section of the Statistics Tab information page provides overall statistics about the TCP Packet information captured in the loaded trace files. The minimum, maximum, and average values for the captured latency measurements are displayed. The values are calculated only for sessions where session based latency is available.

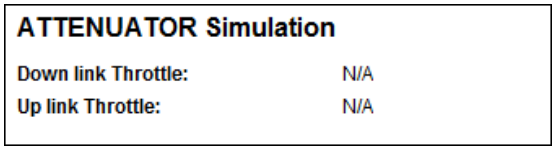


The following table describes the statistics contained in the TCP (Session) Statistics section:

Field	Description
Duration of the packets analyzed (sec)	The time difference, in seconds, between the last packet time stamp and the first packet time stamp in the loaded trace.
Total Bytes	The sum of the packet length values from the loaded trace. The packet length value includes both the header length and the data length.
TCP Packet Count	The total number of tcp packets in the loaded trace.
Avg Rate (kbps)	The average transfer rate of data in kilobytes per second. This value is derived from the total number of transferred bytes and the trace duration.

Field	Description
Minimum Latency	Displays the minimum latency detected across all TCP sessions in a trace.
Maximum Latency	Displays the maximum latency detected across all TCP sessions in a trace.
Average Latency	Displays the average latency for all TCP sessions in a trace.

- ***ATTENUATOR Simulation***



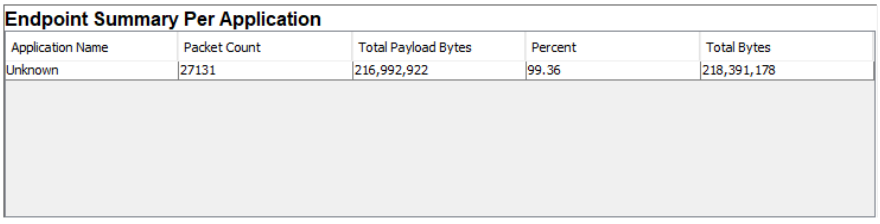
- ***Endpoint Summary Section***

The Endpoint Summary section of the Statistics Tab information page contains two tables that summarize the packet information for each application, and for each IP Address. These two tables are:

- Endpoint Summary Per Application
- Endpoint Summary Per IP Address

- ***Endpoint Summary Per Application Table***

The Endpoint Summary Per Application table summarizes the number of packets, the total payload bytes, the percent of total payload bytes in regards with the total bytes, and total number of bytes for each application in the trace.

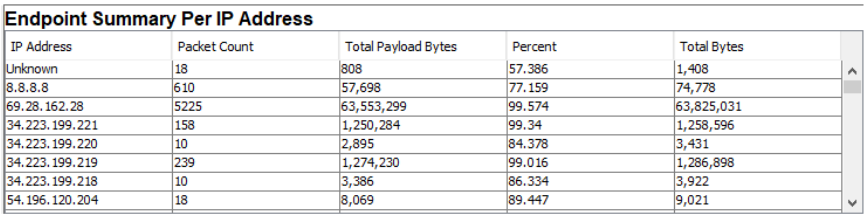


The following table describes the statistics contained in the Endpoint Summary Per Application table:

Column	Description
Application Name	The name of the application.
Packet Count	The total number of packets for this application.
Total Payload Bytes	The total number of payload bytes for this application.
Percent	The percent of total payload bytes in regards with the total bytes for this application.
Total Bytes	The total number of bytes for this application.

- ***Endpoint Summary Per IP Address Table***

  The Endpoint Summary Per IP Address table summarizes the number of packets, the total payload bytes, the percent of total payload bytes in regards with the total bytes, and total number of bytes for each IP address in the trace.



Endpoint Summary Per IP Address

IP Address	Packet Count	Total Payload Bytes	Percent	Total Bytes
Unknown	18	808	57.386	1,408
8.8.8.8	610	57,698	77.159	74,778
69.28.162.28	5225	63,553,299	99.574	63,825,031
34.223.199.221	158	1,250,284	99.34	1,258,596
34.223.199.220	10	2,895	84.378	3,431
34.223.199.219	239	1,274,230	99.016	1,286,898
34.223.199.218	10	3,386	86.334	3,922
54.196.120.204	18	8,069	89.447	9,021

The following table describes the statistics contained in the Endpoint Summary Per IP Address table:

Column	Description
IP Address	The IP Address.
Packet Count	The total number of packets for this IP address.
Total Payload Bytes	The total number of payload bytes for this IP address.
Percent	The percent of total payload bytes in regards with the total bytes for this IP address.
Total Bytes	The total number of bytes for this IP address.

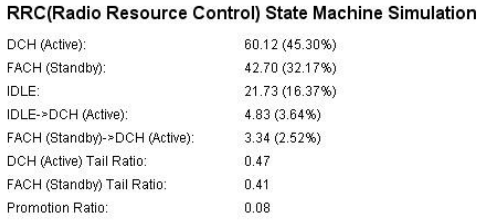
- ***RRC (Radio Resource Control) State Machine Simulation***

  The RRC (Radio Resource Control) State Machine Simulation section of the Statistics Tab information page

displays an analysis of how much time was spent in the various RRC states.

Note: The names of the RRC states and the information displayed in this section depend on the type of device profile that is selected (3G, LTE, or WiFi).

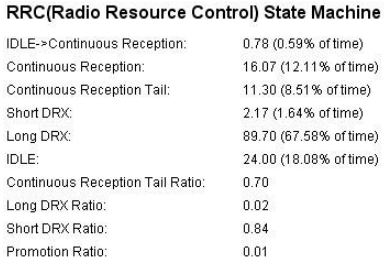
When a 3G device profile like *AT&T 3G* is selected, then the section appears like the following:



The following table describes the statistics contained in the RRC (Radio Resource Control) State Machine Simulation section when a 3G device profile like *AT&T 3G* is selected:

Field	Description
DCH (Active)	The amount of DCH (Active) state time, in seconds, and its percentage of total packet duration.
FACH (Standby)	The amount of FACH (Standby) state time, in seconds, and its percentage of total packet duration.
IDLE	The amount of IDLE state time, in seconds, and its percentage of total packet duration.
IDLE→DCH (Active)	The amount of time spent in promotion from the IDLE state to the DCH (Active) state, in seconds, and its percentage of total packet duration.
FACH (Standby) → DCH (Active)	The amount of time spent in promotion from the FACH (Standby) state to the DCH (Active) state, in seconds, and its percentage of total packet duration.
DCH (Active) Tail Ratio	The ratio between the amount of DCH (Active) Tail state time and the amount of DCH (Active) state time.
FACH (Standby) Tail Ratio	The ratio between the amount of FACH (Standby) Tail state time and the amount of FACH (Standby) state time.
Promotion Ratio	The ratio between the sums of the total promoted RRC states time and the total packet duration. The promoted RRC states are IDLE→DCH (Active) and FACH (Standby) →DCH (Active).

When an LTE device profile like *AT&T LTE* is selected, then the section appears like the following:



RRC(Radio Resource Control) State Machine Simulation

IDLE->Continuous Reception:	0.78 (0.59% of time)
Continuous Reception:	16.07 (12.11% of time)
Continuous Reception Tail:	11.30 (8.51% of time)
Short DRX:	2.17 (1.64% of time)
Long DRX:	89.70 (67.58% of time)
IDLE:	24.00 (18.08% of time)
Continuous Reception Tail Ratio:	0.70
Long DRX Ratio:	0.02
Short DRX Ratio:	0.84
Promotion Ratio:	0.01

The following table describes the statistics contained in the RRC (Radio Resource Control) State Machine Simulation section when an LTE device profile is selected:

Field	Description
IDLE->Continuous Reception	The amount of time spent in promotion from the IDLE state to Continuous Reception, in seconds, and its percentage of total packet duration.
Continuous Reception	The amount of Continuous Reception state time, in seconds, and its percentage of total packet duration.
Continuous Reception Tail	The amount of Continuous Reception Tail state time, in seconds, and its percentage of total packet duration.
Short DRX	The amount of Short DRX state time, in seconds, and its percentage of total packet duration.
Long DRX	The amount of Long DRX state time, in seconds, and its percentage of total packet duration.
IDLE	The amount of IDLE state time, in seconds, and its percentage of total packet duration.
Continuous Reception Tail Ratio	The ratio between the amount of Continuous Reception Tail state time and the amount of Continuous Reception state time.
Long DRX Ratio	The ratio between the amount of Long DRX state time and the amount of Continuous Reception and Short DRX state time.

Short DRX Ratio	The ratio between the amount of Short DRX state time and the amount of Continuous Reception and Long DRX state time.
Promotion Ratio	The ratio between the promoted state time (IDLE→Continuous Reception), and the sum of the IDLE, IDLE→Continuous Reception, Continuous Reception, and Continuous Reception Tail state times.

When a Wi-Fi device profile like *AT&T Wi-Fi* is selected, then the section appears like the following:

The following table describes the statistics contained in the RRC (Radio Resource Control) State Machine Simulation section when a Wi-Fi device profile is selected:

Field	Description
Wi-Fi Active	The amount of Wi-Fi Active state time, in seconds, and its percentage of total packet duration.
Wi-Fi Tail	The amount of Wi-Fi Tail state time, in seconds, and its percentage of total packet duration.
Wi-Fi Idle	The amount of Wi-Fi Idle state time, in seconds, and its percentage of total packet duration.

- ***Burst Analysis Section***

  The Burst Analysis section of the Statistics Tab information page, contains two tables that provide burst information. One that groups the bursts by burst type, and another that lists individual bursts. These two tables are:

  - Burst Analysis
  - Individual Burst Analysis

- ***Burst Analysis Table***

  The Burst Analysis table provides information about the collected bursts from the loaded trace, summarized by burst type. You can export the contents of this table in the preferred format by right-clicking on it.

Note: The columns of information displayed in this table depend on the type of device profile that is selected.

When a 3G device profile like *AT&T 3G* is selected, the Burst Analysis table appears like the following:

Burst Analysis

Burst	Bytes	% of Bytes	Energy	% of Energy	DCH (Active)	% DCH (Active)	JpKB
TcpControl	0	0.0	9.97	10.3	3.850	6.4	0.000
UserInput	5,968	3.1	27.38	28.3	15.693	26.1	0.574
App	182,733	94.5	45.01	46.5	31.196	51.9	0.031
SvrNetDelay	4,625	2.4	14.41	14.9	9.377	15.6	0.389

When an LTE device profile like *AT&T LTE* is selected, the Burst Analysis table appears like the following:

Burst Analysis

Burst	Bytes	% of Bytes	Energy	% of Energy	Continuous Reception	% of Continuous Reception	JpKB
TcpControl	0	0.0	21.29	17.6	0.810	5.0	0.000
UserInput	4,602	2.4	32.21	26.6	1.278	8.0	0.875
App	184,099	95.2	50.62	41.8	12.679	78.9	0.034
SvrNetDelay	4,625	2.4	17.08	14.1	1.301	8.1	0.462

When a Wi-Fi device profile like *AT&T Wi-Fi* is selected, the Burst Analysis table appears like the following:

Burst Analysis

Burst	Bytes	% of Bytes	Energy	% of Energy	WiFi Active	% of WiFi Active	JpKB
TcpControl	0	0.0	1.12	8.3	1.560	5.5	0.000
UserInput	4,602	2.4	1.75	13.0	2.963	10.4	0.048
App	184,099	95.2	9.24	68.3	21.042	74.2	0.006
SvrNetDelay	4,625	2.4	1.41	10.4	2.794	9.9	0.038

The following table describes all the statistics contained in the Burst Analysis table for all types of device profiles

Field	Description
Burst	One of the following Burst types according to the request/response types in the loaded trace. Burst Categories TCP Control TCP Loss Recover User Input Screen Rotation App SvrNetDelay NonTarget LargeBurst Periodical Unknown Userdef 1 Userdef 2 Userdef 3
Bytes	The payload length, in bytes, for the corresponding Burst type. The payload length considers only the data length of packets which occurred during the burst.
% of Bytes	The percentage of total payload used by the individual burst payload. The total payload is the sum of all burst payloads.
Energy	The amount of Energy, in Joules, for the corresponding Burst type.
% of Energy	The percentage of total burst energy used by the individual burst. Total burst energy is the sum of all individual burst Energy amounts.
DCH (Active)	The amount of DCH Active time for the corresponding Burst type. Note: This column is only displayed when a 3G device profile is selected.

Field	Description
%DCH (Active)	The percentage of total DCH Time used by the individual burst. The total DCH Time is the sum of all individual burst DCH Times. Note: This column is only displayed when a 3G device profile is selected.
Continuous Reception	The amount of Continuous Reception time for the corresponding Burst type. Note: This column is only displayed when an LTE device profile is selected.
% of Continuous Reception	The percentage of total Continuous Reception time used by the individual burst. The total Continuous Reception time is the sum of all individual burst Continuous Reception times. Note: This column is only displayed when an LTE device profile is selected.
Wi-Fi Active	The amount of Wi-Fi Active time for the corresponding Burst type. Note: This column is only displayed when a Wi-Fi device profile is selected.
% of Wi-Fi Active	The percentage of total Wi-Fi Active time used by the individual burst. The total Wi-Fi Active time is the sum of all individual burst Wi-Fi Active times. Note: This column is only displayed when a Wi-Fi device profile is selected.
Jpkb	The number of Joules per Kilobytes for the corresponding Burst type calculated from the amount of burst type energy and burst type payload.

- ***Individual Burst Analysis Table***

  The Individual Burst Analysis table provides information about each individual burst in the loaded trace. You can export the contents of this table in the CSV format by right-clicking on it.

Individual Burst Analysis

Start Time	Time Elapsed	Bytes	Packet Count	Burst
14.465	5.240	78,568	146	App
23.757	12.496	42,367	171	App
38.155	3.138	24,380	91	App
43.477	7.985	37,418	124	App
55.323	1.091	0	32	TcpControl
60.104	0.656	1,229	10	UserInput
72.772	2.193	1,041	9	UserInput
85.046	0.037	0	2	TcpControl

The following table describes the statistics contained in the Individual Burst Analysis section:

Field	Description
Start Time	The start time of the burst, in seconds, from the beginning of the trace.
Time Elapsed	The time elapsed during the burst, in seconds.
Bytes	The payload length, in bytes, for the burst. The payload length considers only the data length of packets which occurred during the burst.
Packet Count	The number of packets in the burst.
Burst	One of the following Burst types according to the request/response types in the loaded trace.

Burst Categories.
TCP Control
TCP Loss Recover
User Input
Screen Rotation
App
SvrNetDelay
NonTarget
LargeBurst
Periodical
Unknown
Userdef 1
Userdef 2
Userdef 3

Cache Statistics

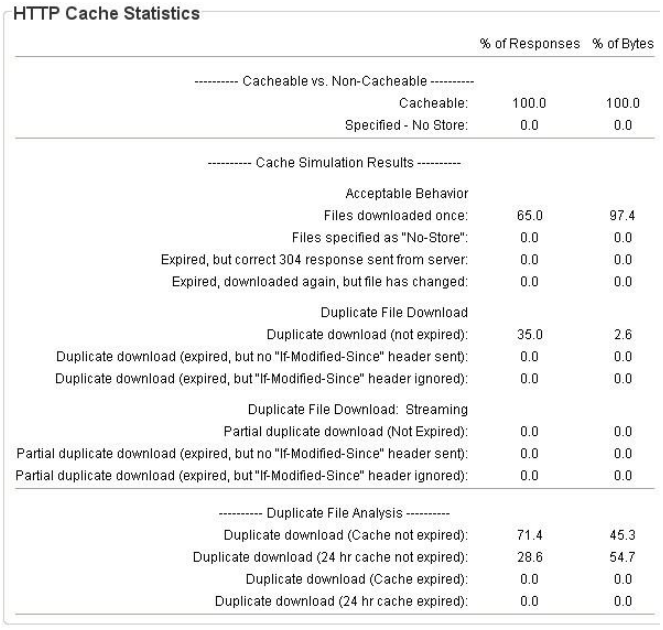
The HTTP Cache Statistics section of the Statistics Tab information page displays statistical information about the cache based on the data in the loaded trace. Caching is the process of storing data on the client side to avoid the repeated download of data from the server. This increases the amount of bandwidth available for common requests and responses.

This section contains the following sub-categories:

- Cacheable vs. Non-Cacheable

- Cache Simulation Results
- Duplicate File Analysis

The following figure shows the columns and sub-categories of the HTTP Cache Statistics section.



HTTP Cache Statistics

	% of Responses	% of Bytes
---------- Cacheable vs. Non-Cacheable ----------		
Cacheable:	100.0	100.0
Specified - No Store:	0.0	0.0
---------- Cache Simulation Results ----------		
Acceptable Behavior		
Files downloaded once:	65.0	97.4
Files specified as "No-Store":	0.0	0.0
Expired, but correct 304 response sent from server:	0.0	0.0
Expired, downloaded again, but file has changed:	0.0	0.0
Duplicate File Download		
Duplicate download (not expired):	35.0	2.6
Duplicate download (expired, but no "If-Modified-Since" header sent):	0.0	0.0
Duplicate download (expired, but "If-Modified-Since" header ignored):	0.0	0.0
Duplicate File Download: Streaming		
Partial duplicate download (Not Expired):	0.0	0.0
Partial duplicate download (expired, but no "If-Modified-Since" header sent):	0.0	0.0
Partial duplicate download (expired, but "If-Modified-Since" header ignored):	0.0	0.0
---------- Duplicate File Analysis ----------		
Duplicate download (Cache not expired):	71.4	45.3
Duplicate download (24 hr cache not expired):	28.6	54.7
Duplicate download (Cache expired):	0.0	0.0
Duplicate download (24 hr cache expired):	0.0	0.0

The HTTP Cache Statistics section contains the following columns:

Column	Description
% of Response	Displays the amount of responses for this row item expressed as a percentage of the total number of responses.
% of Bytes	Displays the number of bytes for this row item expressed as a percentage of the total number of bytes.

- ***Cacheable vs. Non-Cacheable***

  The Cacheable vs. Non-Cacheable section of the HTTP Cache Statistics section contains the following rows of information:

Row	Description
Cacheable	This field analyzes the cacheable contents from the loaded trace. The percentage of Cacheable Responses is calculated from the amount of Cacheable content and the amount of total cache content. The percentage of Cacheable Bytes is calculated from the number of Cacheable bytes and total number of cache bytes.
Specified - No Store	This field analyzes the files from the loaded trace that are specified as “No Store”. The percentage of No Store Responses is calculated from the amount of No Store content and the amount of Total Cache content. The percentage of No Store Bytes is calculated from the number of No Store bytes and the total number of cache bytes.

- ***Cache Simulation Results***

  The Cache Simulation Results sub-category of the HTTP Cache Statistics section contains the Acceptable behavior, Duplicate File Download, and Duplicate File Download: Streaming sub-sections.

  The following tables describe the rows of information in those sub-sections.

Row	Description
Files downloaded once	The percentage of total responses and total bytes for files that were downloaded only once. This content is populated from the caching missed contents.
Files specified as "No-Store"	This content is calculated from the “No-Store” HTTP responses. The percentages are calculated from the cache diagnosis total and the number of total bytes.
Expired, but correct 304 responses sent from server	The percentage of total responses and total bytes for content with the HTTP response code 304.

Row	Description
Expired, downloaded again, but file has changed	The percentage of total responses and total bytes for content where the HTTP response has changed from the expired response.
Duplicate download (not expired)	The percentage of total responses and total bytes for content which is a duplicate download but has not expired.
Duplicate download (expired, but no "If-Modified Since" header sent)	The percentage of total responses and total bytes for content which is a duplicate download that has expired, and for which an “If-Modified-Since” header was not sent.
Duplicate download (expired, but "If-Modified Since" header ignored)	The percentage of total responses and total bytes for content which is a duplicate download that has expired and contains an “If-Modified-Since” header that was ignored.
Partial duplicate download (Not Expired)	The percentage of total responses and total bytes for content which is a partial duplicate download that has not expired.
Partial duplicate download (expired, but no "If-Modified Since" header sent)	The percentage of total responses and total bytes for content which is a partial duplicate download that has expired and for which an “If-Modified-Since” header was not sent.
Partial duplicate download (expired, but "If-Modified Since" header ignored)	The percentage of total responses and total bytes for content which is a partial duplicate download that has expired and for which an “If-Modified-Since” header was ignored.

- ***Duplicate File Analysis***

  The Duplicate File Analysis section of the Statistics Tab information page displays information about duplicate files that were downloaded during the trace.

  The Duplicate File Analysis section contains the following information:

Field	Description
Duplicate download (Cache not expired)	The percentage of total responses and total bytes for content which is a duplicate download, and for which the cache has not expired. These values are calculated with the total cache expiration count and cache expiration ratios.
Duplicate download (24 hr. cache not expired)	The percentage of total responses and total bytes for content which is a duplicate download, and for which the 24-hour cache has not expired.
Duplicate download (Cache expired)	The percentage of total responses and total bytes for content which is a duplicate download, and for which the cache has expired.
Duplicate download (24 hr. cache expired)	The percentage of total responses and total bytes for content which is a duplicate download, and for which the 24-hour cache has expired.

- ***Energy Efficiency Simulation***

  The Energy Efficiency Simulation section of the Statistics Tab information page displays the overall energy efficiency from the loaded trace. The section lists the amount of energy used for each of the different types of energy consumption that can affect the performance of the application, or the energy level of the device.

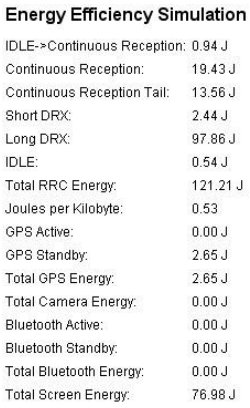
  Note: The information displayed in this section depends on the type of device profile that is selected.

  When a 3G device profile like *AT&T 3G* is selected, the Energy Efficiency Simulation section appears like the following:

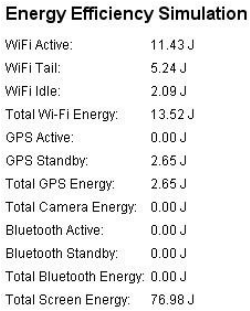
Energy Efficiency Simulation

DCH (Active):	78.15 J
FACH (Standby):	12.81 J
IDLE:	0.00 J
IDLE->DCH (Active):	3.14 J
FACH (Standby)->DCH (Active):	2.68 J
DCH (Active) Tail:	36.40 J
FACH (Standby) Tail:	5.22 J
Total RRC Energy:	96.78 J
Joules per Kilobyte:	0.43
GPS Active:	0.00 J
GPS Standby:	2.65 J
Total GPS Energy:	2.65 J
Total Camera Energy:	0.00 J
Bluetooth Active:	0.00 J
Bluetooth Standby:	0.00 J
Total Bluetooth Energy:	0.00 J
Total Screen Energy:	84.54 J

When an LTE device profile like *AT&T LTE* is selected, the Energy Efficiency Simulation section appears like the following:



When a WiFi device profile like *AT&T WiFi* is selected, the Energy Efficiency Simulation section appears like the following:



The following table describes all the statistics contained in the Energy Efficiency Simulation section for either type of device profile:

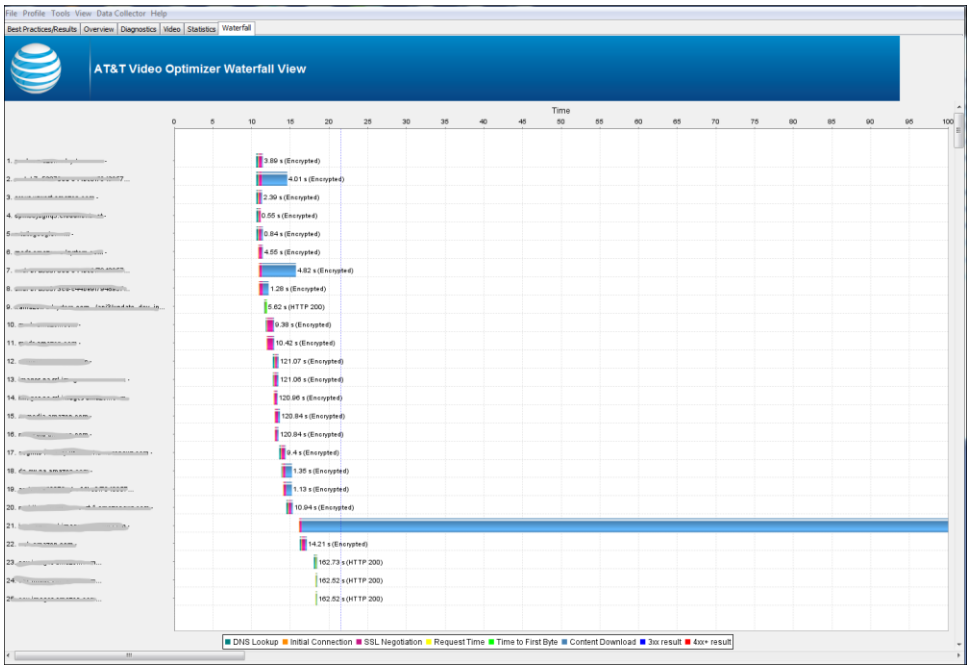
Field	Description
CELL_DCH (Active)	The total DCH time energy expended in the loaded traces. This is calculated from the RRC DCH time value and the power DCH value.
CELL_FACH (Standby)	The total FACH energy expended in the loaded trace. This is calculated from the RRC FACH time value and the power FACH value.
IDLE	The total idle time energy from the loaded trace. The idle energy should always be 0.
IDLE->DCH (Active)	The amount of RRC IDLE to DCH (Active) state time energy consumption.
FACH (Standby) ->DCH (Active)	The amount of RRC FACH (Standby) to DCH (Active) time energy consumption.

Field	Description
DCH (Active) Tail	The amount of energy consumed during the RRC DCH (Active) Tail state period.
FACH (Standby) Tail	The amount of energy consumed during the RRC FACH Tail state period.
IDLE -> Continuous Reception	The amount of energy consumed during all transitions from the IDLE state to Continuous Reception.
Continuous Reception	The amount of energy consumed during the Continuous Reception state.
Continuous Reception Tail	The amount of energy consumed during the Tail time of the Continuous Reception state.
Short DRX	The amount of energy consumed during the Short DRX state.
Long DRX	The amount of energy consumed during the Long DRX state.
WiFi Active	The amount of energy consumed during the WiFi Active state.
WiFi Tail	The amount of consumed during the WiFi Tail state.
WiFi Idle	The amount of energy consumed during the WiFi Idle state.
Total RRC Energy	The sum of the CELL_DEH (Active), CELL_FACH (Standby), FACH (Standby) □DCH (Active), IDLE□DCH (Active), and IDLE energy consumption amounts.
Joules per Kilobyte	The number of Joules per Kilobyte from the loaded trace, calculated from the amount of total energy and total bytes.
GPS Active	The total energy consumed during the GPS Active state. In GPS Active state, the energy consumption will be equal to the time multiplied by the energy draw for Active GPS.
Long DRX	The amount of energy consumed during the Long DRX state.
WiFi Active	The amount of energy consumed during the WiFi Active state.
WiFi Tail	The amount of energy consumed during the WiFi Tail state.
WiFi Idle	The amount of energy consumed during the WiFi Idle state.

Field	Description
Total RRC Energy	The sum of the CELL_DEH (Active), CELL_FACH (Standby), FACH (Standby) □DCH (Active), IDLE□DCH (Active), and IDLE energy consumption amounts.
Joules per Kilobyte	The number of Joules per Kilobyte from the loaded trace, calculated from the amount of total energy and total bytes.
GPS Active	The total energy consumed during the GPS Active state. In GPS Active state, the energy consumption will be equal to the time multiplied by the energy draw for Active GPS.

5.2.7. Waterfall Tab

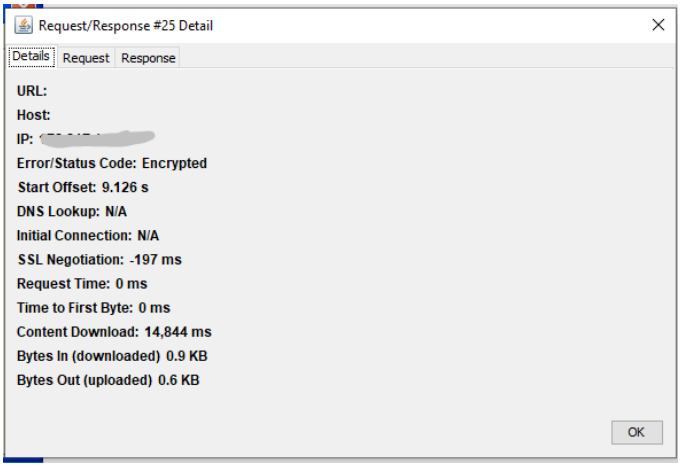
The Waterfall tab displays a waterfall view chart of the TCP connections from the trace spread over time. The chart can be expanded or contracted to get a detailed view into the connections in the trace data. The following image shows the Waterfall Tab. (Note: The URLs of the TCP connections have been deliberately hidden.)



1. As the key at the bottom of the tab indicates, the color-coded plots on the chart indicate the following information for each connection listed on the left side of the chart:

Label	Description
DNS Lookup	The time until the DNS lookup was completed.
Initial Connection	The time until the initial connection was made.
SSL Negotiation	The time spent in SSL negotiation.
Request Time	The time spent requesting data from the server.
Time to First Byte	The time until the first byte was downloaded.
Content Download	The time spent downloading the content.
3xx result	An HTTP response code in the 300 range.
4xx+ result	An HTTP response code in the 400 or 500 range. These codes indicate an error.

2. When any of the color-coded plots on the chart are clicked, a Request/Response Detail dialog box (like the following) is shown:

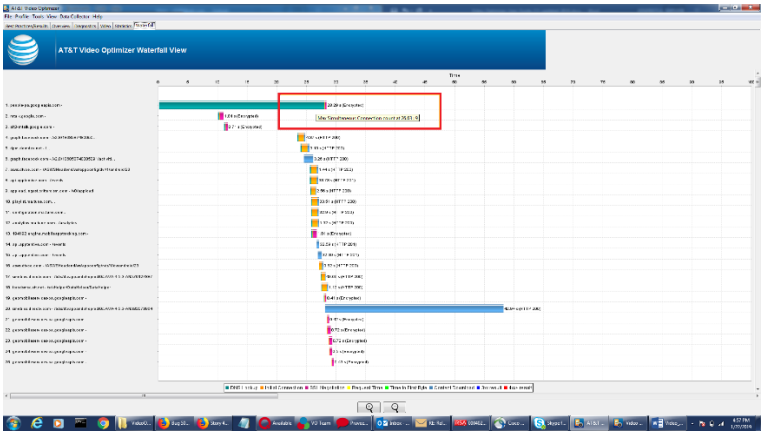


3. The tabs on the dialog box show details about the connection, information about the request, and the actual content of the response. The request/response data is like the detail provided in the Request/Response View table on the Diagnostics tab.

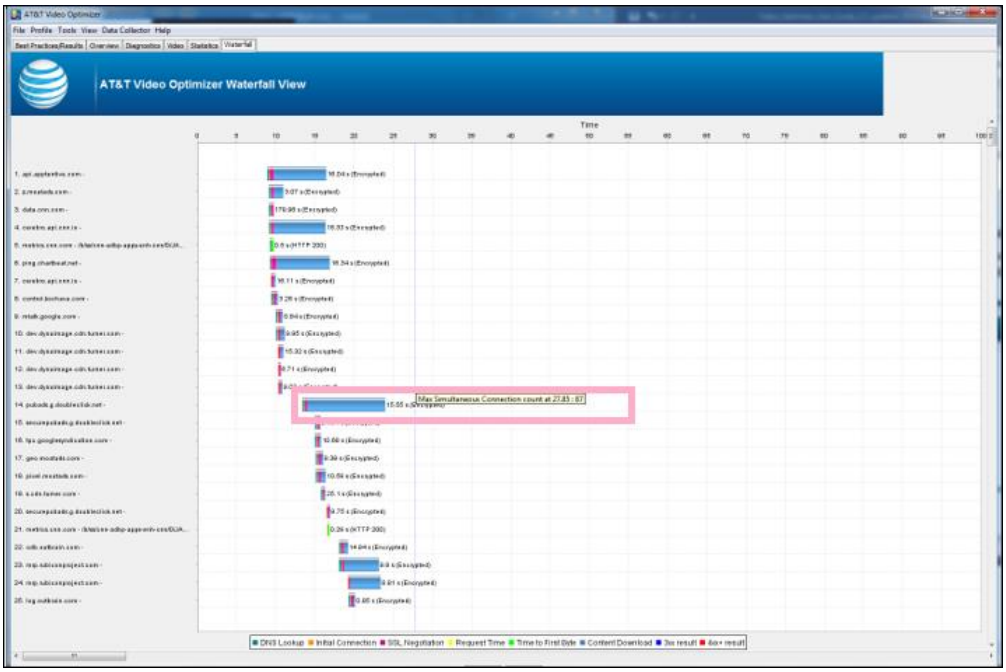
- ***Multiple Simultaneous connections to many end points***

  Double clicking on the results section of the Multiple Simultaneous Connections to Many Endpoints best practice navigates to the waterfall tab.

  The Waterfall tab displays appropriate domain names and IP addresses and shows the total connections at any point in time in the graph where a user hovers. The Maximum Simultaneous Connections count for the trace is highlighted using a blue vertical line indicator at the moment when the most connections were open



  Double clicking on the results section of multiple simultaneous connections navigates to the waterfall tab shows the maximum connections at that point.



6. Appendix I

The sections in Appendix I list the error messages for the Data Collector and for Video Optimizer.

6.1. Data Collector Error Messages

The following table lists and describes the error messages that can appear when using the Data Collector option in Video Optimizer.

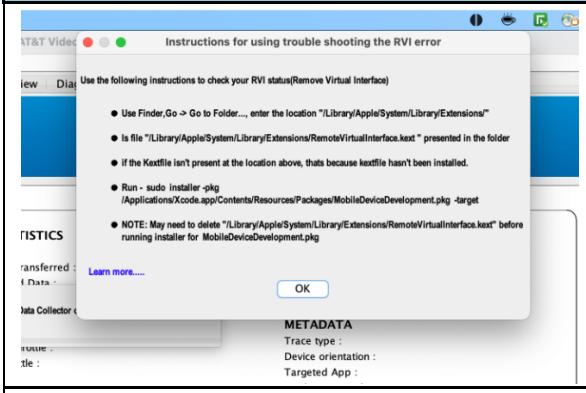
Error Message	Condition
Please enter trace folder name.	This error occurs if data collection is started without providing a trace folder name.
Trace folder name cannot have special characters or spaces.	This error occurs if data collection is started, and the trace folder name contains either non-alphanumeric characters, or spaces.
Trace folder already exists! Do you want to overwrite existing trace?	This error occurs if data collection is started, and the trace folder name already exists. When this error occurs, click Ok to proceed and overwrite the folder contents, or press Cancel to provide another name.
SD card is either not available or it is mounted. Please check the SD card before running Video OptimizerData Collector.	The Data Collector writes data files to a folder on the device's onboard SD card—but the SD card must not be mounted during data collection. This error occurs if no SD card is detected, or if the SD card is mounted when starting the Data Collector.
SD Card mounted, Video Optimizer Data Collector trace session terminated.	When the Data Collector finishes collecting data, it writes the data files to the device's onboard SD card—but the SD card must not be mounted during data collection. This error occurs if data collection is started, and the SD card is mounted.
SD Card memory full, stopping Video Optimizer Data Collector.	This error occurs during data collection, if the data collection process terminates because the SD card is full.
Video Optimizer Data Collector trace session can't be started with Flight Mode on and no active WIFI connection.	This error occurs if data collection is started when the device is in Flight Mode and there is no active WiFi connection.

Error Message	Condition
Video Optimizer Data Collector trace session stopped due to Flight Mode being turned on while there was no active WIFI connection.	This error occurs if Flight Mode is turned on while there is no active WiFi connection and data collection is taking place.
Video Optimizer Data Collector failed to start!	This message appears if an unexpected error occurs when the Start Collector button is clicked.
Video Optimizer Data Collector trace collection stopped.	This error occurs during data collection, if the data collection process terminates unexpectedly.
Video Optimizer Data Collector trace session can't be started with no active network connection.	This error occurs if a trace session is started with no active network connection.

6.2. Video Optimizer Error Messages

The following table lists and describes the error messages that can appear when using the Video Optimizer.

Error Message	Condition
iOS: Remote Virtual Interface (rvi) error.	There was a disconnect between the mac interface and RVI. Please disconnect and reconnect the device or restart the device for continuation.
iOS: Video Optimizer is unable to locate Wireshark/Dumpcap, Please update the Wireshark location in the preferences setting.	This error messages occurs when the location is not configured properly. The default location is under Applications.
iOS: Error.rvi.reset connection	There was a disconnect between the mac interface and RVI. Please disconnect and reconnect the device or restart the device for continuation.

Error Message	Condition
	This troubleshooting message provides instructions to check the RVI status in case of an error.
Missing Prerequisite Library: Unable to detect prerequisite dependency ideviceinstaller. Please verify.	This message occurs when one of the pre-requisites is not installed.
Missing Prerequisite Library: Unable to detect prerequisite dependency libimobiledeivice. Please verify.	This message occurs when one of the pre-requisites is not installed.
Missing Prerequisite Library: Unable to detect prerequisite dependency ifuse. Please verify.	This message occurs when one of the pre-requisites is not installed.
“Video Optimizer requires Npcap installed in WinPcap API-compatible Mode. It can be found at: https://nmap.org/npcap/	The Video Optimizer application is dependent on WinPcap, and it looks for the WinPcap installation during every launch. This error occurs if WinPcap is not found, or if Npcap is not installed in WinPcap API-compatible Mode
The Startup Delay cannot be set on this video stream. You can log a support ticket by visiting Help -> Support…	This message is displayed when FFprobe is not installed on the machine or the path is not set correctly.
Video Optimizer requires AppleQuartz renderer. Please set apple.awt.graphics .UseQuartz flag to true	This error occurs if the Video Optimizer is being used on a Mac OS, and the apple.awt.graphics.UseQuartz flag is not set to true.
Unexpected Exception: exception message	This error occurs if Video Optimizer encounters an unexpected exception.

Error Message	Condition
The previous operation had caused the system to reach it's memory limit. To recover, Video Optimizer had to restart the application	This occurs if Video Optimizer reaches the maximum amount of memory allocated for it. The message also displays 2 buttons – Edit Memory Settings, and OK. Clicking on the Edit Memory Settings button navigates the user to File->Preferences so that the user can edit the memory allocation. Clicking on OK navigates the user to the Best Practices/Results tab.
Video Optimizer is unable to open a file of this size. Please Save As... to a local disk and open from there.	This error occurs if the opening of a trace file will force Video Optimizer to reach the maximum amount of memory allocated for it.
Video Optimizer is unable to open a file extension type file. Please Save As... to a local disk and open from there.	This error occurs if the type of the file that is being opened is not recognized by Video Optimizer.
Invalid trace in directory: trace folder path and exception message.	This error occurs if Video Optimizer encounters data in a trace file that is invalid when performing analysis.
An error occurred when trying to save the chart.	Occurs if there is an error while saving the Diagnosis Chart to an image file.
No trace loaded. Please load trace files before selecting this option.	This error occurs if one of the following menu options is selected before a trace file has been opened in the Video Optimizer: • Time Range Analysis (Tools Menu) • PCAP File Analysis (Tools Menu) • Select Applications/IPs (View Menu)

Error Message	Condition
Video Optimizer could not find trace folders in selected path. Please select a valid trace folder path.	This error occurs when a folder that does not contain valid trace files is selected when using the Open Trace or Data Dump menu options.
The USB device got disconnected. Please check the connection.	Occurs when a device that is connected via USB to a device running the Data Collector, is disconnected unexpectedly.
Video Optimizer Collector is already running on the device. Please stop it and try again.	Occurs when an instance of the Data Collector is running on a device while another instance is started.
Time values must be numeric.	Occurs in the Time Range Analysis Dialog if a nonnumeric value is entered for the Start or End time.
Start time must be less than End Time.	Occurs in the Time Range Analysis Dialog if a Start Time value is entered that is greater than the End Time value.
Start Time and End Time must be between 0.00 and trace length.	Occurs in the Time Range Analysis Dialog if time value is entered that is less than 0 or greater than the total time of the trace.
The system is unable to open .csv files by default. Please set a default program for .csv files.	Occurs if the Export option is selected to save one of the charts or tables in the Overview, Diagnosis and Statistics tabs to the .csv format, and there is no default program set in the system for .csv files.
Unable to connect to printer: printer name.	Occurs when Video Optimizer is unable to connect to a printer when the Print option is selected in the File menu.
Error in parsing alarm analysis info.	Occurs when Video Optimizer is unable to parse information about an alarm on the device.
More than one device or emulator is connected to PC.	Occurs if the computer is connected to multiple devices of device emulators, when the Start Collector option on the Data Collector menu is selected.

Error Message	Condition
Could not find device or emulator connection. Please verify the connection and ADB daemon is started.	Occurs if the user is not connected to a device or device emulator, or if the ADB daemon is not started, when the Start Collector option on the Data Collector menu is selected.
An unexpected error has occurred, please restart the device.	Occurs when there is an unexpected error in the device emulator.
Connection to device or emulator is lost. Please wait for some time before starting data collector.	Occurs if there is an error with the ADB connection.
Trace directory already exists. Do you want to overwrite trace files in the directory?	Occurs if an existing Trace directory name is entered in the dialog box when the Start Collector menu option is selected on the Data Collector menu.
Unable to create the Emulator trace directory.	Occurs when the trace directory cannot be created.
Trace name which you want to replace is currently loaded. Do you want to clear the trace?	Occurs if the name of the currently loaded Trace is entered in the dialog box when the Start Collector menu option is selected on the Data Collector menu.
Error starting Video Optimizer Data Collector.	Occurs if there is an error when the Start Collector menu option is selected on the Data Collector menu.
Error tcpdump not compiled for this device.	Occurs if the device is not supported by the Data Collector.
Error stopping Video Optimizer Data Collector.	Occurs if there is an error when stopping the Video Optimizer Data Collector (using the Stop Collector menu option on the Data Collector menu) after it has been started from Video Optimizer.
Error pulling Video Optimizer Data Collector traces.	Occurs if there is an error when pulling Trace files from the Video Optimizer Data Collector to the local system.

Error Message	Condition
Video Optimizer Analyzer stopped unexpectedly.	Occurs if the Data Analyzer unexpectedly stops.
ADB Rejected the Video Optimizer Data Collector device Connection.	Occurs if the Android Debug Bridge (ADB) cannot connect to the device.
Emulator SD card is full. Please free some space to start Video Optimizer Data Collector.	Occurs if the Emulator does not have enough space on its SD card to save the trace files collected by the Video Optimizer Data Collector.
Please set your device USB Mode to "Charge Only" - otherwise the SD Card is not available but is required by application.	Occurs if the Emulator does not have an SD card available. An SD card is required by the Video Optimizer Data Collector when using the Emulator.
Video Optimizer requires a virtual SD card to be configured when using the Android Emulator.	Occurs if no virtual SD card was configured before using the Android Emulator.
Emulator SD card does not have enough space; it must have 5 MB or more.	Occurs if the Emulator does not have at least 5MB of space available on its SD card to save the trace files collected by the Video Optimizer Data Collector.
Device SD card does not have enough space; it must have 5 MB or more.	Occurs if a device does not have at least 5MB of space available on its SD card to save the trace files collected by the Video Optimizer Data Collector.
Emulator SD Card memory full, stopping Video Optimizer Data Collector.	Occurs if the Emulator does not have enough any memory remaining on its SD card. When this error occurs the Video Optimizer Data Collector is stopped.
Device SD Card memory full, stopping Video Optimizer Data Collector.	Occurs if the Device does not have enough any memory remaining on its SD card. When this error occurs the Video Optimizer Data Collector is stopped.

Error Message	Condition
Unexpected error accessing emulator SD Card: exception message	Occurs if there is an unexpected error while the Video Optimizer Data Collector is accessing the Emulator.
Unexpected error accessing device SD Card: exception message	Occurs if there is an unexpected error while the Video Optimizer Data Collector is accessing the SD Card of a device.
Device SD card is not available but is required by application.	Occurs when the Video Optimizer Data Collector attempts to access the SD Card of a device when it is not available.
Trace folder name should not contain special characters or spaces.	When the Start Collector menu option is selected on the Data Collector menu, the user is prompted to enter a Trace folder name. This error occurs if the Trace folder name contains an invalid special character or a space. The folder name can only contain alphanumeric characters or a (-) special character.
Trace folder name should not be more than 50 characters.	Occurs if the Trace folder name that is entered in the dialog box when the Start Collector menu option is selected on the Data Collector menu, is longer than 50 characters.
Emulator error with tcpdump/key.db push.	Occurs if there is an error while transferring the collected trace files from the device or device emulator to the local system. This transfer is initiated by the Video Optimizer Data Analyzer when the Stop Collector menu option is selected on the Data Collector Menu, and the Pull Traces menu option is selected on the Data Collector.
Emulator I/O exception caused data collector failure.	Occurs if there is an Input / Output exception when the Data Collector tries to connect to the

Error Message	Condition
	device or device emulator. The Data Collector is started from the Data Analyzer by selecting the Start Collector option on the Data Collector menu
No application found to open PCAP trace. Please install an application like WireShark for PCAP analysis.	Occurs if the PCAP File Analysis option is selected on the Tools menu, but an external tool (like WireShark) for analyzing PCAP files is not installed.
Wireshark is a required utility and could not be found, please install Wireshark and set its path in File:Preferences for Wireshark	Occurs if Wireshark PATH is incorrect in preferences and system Path has wrong Wireshark path or is missing.
No traffic.cap file found in trace.	Occurs if the PCAP File Analysis option is selected on the Tools menu, but a traffic.cap file is not found in the loaded trace folder.
Not able to start.	Occurs if the APK is unable to start.
Video file is not valid.	Occurs if the Video Optimizer Image/Video Viewer attempts to load an invalid video file, or if a trace is loaded that contains an invalid video file.
Unable to read file.	Occurs if the Video Optimizer Image/Video Viewer attempts to load a video file that it is unable to read, or if a trace is loaded that contains a video file that Video Optimizer is unable to read.
Video display conversion of video.mp4 to video.mov file failed.	Occurs if the Video Optimizer Data Analyzer fails while converting the video file from .MP4 to .MOV.
ERROR: Trace directory is empty	Occurs if the Video Optimizer Image/Video Viewer attempts to load a video file, but the Trace

Error Message	Condition
	directory is empty.
ERROR: Input file does not exist; nothing to convert.	Occurs if the .MP4 video file does not exist when the Video Optimizer Image/Video Viewer is attempting to convert it to .MOV.
ERROR: No permission to write to output file for conversion.	Occurs if the Video Optimizer Image/Video Viewer does not have permission to write the output file, when it is converting the .MP4 video to the .MOV format.
ERROR: Input file is a directory; cannot be converted.	Occurs if the Video Optimizer Image/Video Viewer cannot convert the input file (an .MP4 video) to the .MOV format.
ERROR: Output file is a directory; cannot be converted.	Occurs if the Video Optimizer Image/Video Viewer encounters a directory name instead of a file name when it is converting the .MP4 video to.MOV format.
ERROR: Output file still exists after deletion; cannot be converted.	Occurs if the Video Optimizer Image/Video Viewer encounters an error when preparing the output file for conversion from .MP4 to.MOV.
ERROR: Unable to read file.	Occurs if a file that was placed in the trace directory cannot be read by the Video Optimizer.
ERROR: Video display conversion of video.mp4 to video.mov file failed.	Occurs if the Video Optimizer Image/Video Viewer encounters an error when converting the output file from .MP4 to.MOV.
ERROR: Exception setting up video player.	Occurs if there is an exception when the Video Optimizer Image/Video Viewer is initializing.
Video is already Synched. Do you want to Re-Sync again?	Occurs if the Sync Video button is clicked when the video is already in sync.

Error Message	Condition
The previous sync point has been cleared. In order to Re-sync the video, select the desired time point in the Video player and then press the Sync Video button now.	Occurs if the Sync Video button is clicked when no sync points have been set.
ERROR: Multiple external video files exist in the trace folder. Please add only one external video and remove the rest.	Occurs when there is more than one video file in the trace folder when the trace is loaded.
Category String Error	Occurs when an invalid string is entered for the name of a User Defined Burst.
Unexpected error exporting table	Occurs when there is an error exporting the Burst Analysis Table.
Error loading the list of profiles.	Occurs when there is an error loading a device profile.
Error setting the selected profile to the Video Optimizer.	Occurs when there is an error setting a device profile in selected in the Select Device Profile dialog box that is opened by the Load option in the Profile menu.
Error loading last device profile. Default device profile is being used.	Occurs if there is an error loading the device profile. In this case, the default profile will be used instead.
Error reading device profile attributes: attribute name.	Occurs when a Device Profile is loaded that contains an unrecognized attribute name.
Unable to save file due to the errors below: file error(s).	Occurs when there are file errors while attempting to save a customized Device Profile.
Unable to open file due to errors below: file error(s).	Occurs when there are file errors while attempting to open a Device Profile.
Unable to load file due to errors below: file error(s).	Occurs when there are file errors while attempting to load a Device Profile.
Error writing to file: file error(s).	Occurs when there is an error writing to the file selected in the file chooser dialog.

Error Message	Condition
Unable to load content. Download may have been interrupted.	Occurs when there is an error opening content in the Video Optimizer Image/Video Viewer.
Microsoft Network Monitor related error.	Occurs when there is an error related to the Microsoft Network Monitor.
Could not load Microsoft Network Monitor trace file.	Occurs when there is an error loading a trace file that was collected by the Microsoft Network Monitor.
Video Optimizer was unable to open the file. It may be necessary to install Microsoft Network Monitor.	Occurs when a trace file that was collected by the Microsoft Network Monitor is opened, but Microsoft Network Monitor is not installed.
Timeout in starting the collector trace.	Occurs when the trace file is so large that it time out before it can be loaded by the Analyzer.
Video Optimizer Collector is not installed on the device.	Occurs when the Start Collector menu option is selected but the Data Collector apk is not installed on the device.
Video Optimizer collector is not started. Its current activity has been brought to the front. Please exit the activity and try again.	Occurs when activity by the Collector is displayed in front of the main start screen before the Collector is started.
Video Optimizer collector is not stopped. Please hide the activity on the device and press OK.	Occurs when the Collector is not stopped, and activity on the device is displayed in front of the main screen.
Video Optimizer could not find a trace in the selected folder. Please select a valid trace folder.	Occurs when a trace folder is selected (using the Open Trace menu option) that does not contain valid trace files.
To perform video analysis you must have VLC player 64 bit version. Please check the user guide for installation. Contact us for further troubleshooting.	When a user with the wrong VLC version (ie: 32 bit) opens a trace, and the installed VLC is an incompatible architecture with the Video Optimizer installation (64 bit).

6.3. Glossary

This following table contains a list of Mobile Web-associated terms, with their associated definitions. For a more comprehensive list, see the World Wide Web Consortium (W3C).

Term	Definition
Age	A property of a Response Entity. The length of the elapsed time since the Entity was either Served by the Origin Server, or successfully validated.
Average Rate	The amount of data in KB over the time the trace was run. Apps that stream content should score high here, apps with few connections should score lower.
Burst	Consecutive packets of data transferred in a batch over a TCP connection. Bursts can be initiated by the user, the app, or the network.
Cache	A local process implemented in the client that creates copies of Response Messages and serves them to the client on the Server's behalf, if it remains identical to the Origin Server's copy. When used properly, the use of Response Caches significantly reduces application response time and bandwidth consumption.
Cacheable	A response is cacheable if the requirements of the Request Method, Request Header Fields, and the Response Status indicate that it is cacheable.
Client	A program that establishes connections for sending requests.
Connection	A virtual circuit, established at the Transport Layer, that is used to connect two programs so that they can communicate using TCP.
Content Negotiation	The mechanism for selecting the appropriate representation for servicing a request. The representation of entities in any response can be negotiated (including Error Responses).
Core Network	The Internet backbone. The network that the Radio Access Network is connected to.
Energy Consumption	As your application becomes more efficient, the J/KB should decrease. This means you are consuming less battery energy per kilobyte.
Entity	The requested content. Delivered as the payload of Response/Request messages. Request and Response messages do not always carry a

Term	Definition
	payload. An Entity consists of entity-header that contains meta-information and an entity-body that contains web content, although some responses will include only the entity-headers.
Explicit Expiration Time	The expiration time associated with an Entity—when specified by the Origin Server. Beyond that point in time, the Cache can continue serving the local copy of the Entity, but only if it passes a Validation test.
File Types	A breakdown of all files seen during the trace (in bytes). Files sent through HTTPs are listed as Encrypted.
First-Hand	A property of a Response. A response that is received directly from the Origin Server. Cached Responses are copies of First-Hand Responses.
Fresh	A property of a Response Entity. Indicates that a Cached Response is still implicitly valid. A Fresh Response is a response that has not exceeded its Freshness Lifetime.
Freshness Lifetime	A property of a Response Entity. The period in which a cacheable response remains implicitly valid. How long it takes for a cacheable response to reach its expiration time.
Gateway	A Server that acts as an intermediary for another server. Unlike proxies, gateways behave like Origin Servers, receiving resource requests. The requesting client cannot be aware that it is communicating with a gateway.
GPRS	General Packet Radio Services. Single GSM error-corrected circuit-switched data channel.
Heuristic Expiration Time	The expiration time associated with an entity—determined programmatically by Cache management logic. A Cache management strategy used whenever the Origin Server doesn't specify an Explicit Expiration Time.
HSDPA	High-speed Downlink Packet Access. In the same way that EDGE uses techniques to

Term	Definition
	increase speeds over GPRS, HSDPA employs these same techniques, as well as others, to increase the speed of UMTS data channels. Also known as UMTS/HSDPA. UMTS/HSDPA is a wide-area wireless data service
HTTP	Application level, stateless, communication protocol. Client/server communication consists solely of independent pairs of Requests and Responses.
Inbound/Outbound	Terms indicating the path of Request and Response messages. Inbound messages travel toward the Origin Server. Outbound messages travel toward the User Agent.
Joules	The SI unit of energy. The work required to produce one watt of power for one second (think of Kilowatt Hours).
Long Burst Connection	A long burst is one that sends a large amount of data in a short period of time. If most of the data is consumed, this is a good way to send data (see tightly grouped above).
Message	The basic unit of HTTP communication.
MIME	Multipurpose Internet Mail Extensions.
Non-Periodic Connections	Connections that recur periodically can cause rapid battery drainage. Consider if your periodic pings are required, if the timing could be lengthened, or if other alternatives exist (Pushing alerts is more efficient than regular polling).
Origin Server	The server on which a given Resource either resides or is created.
Pcap	Packet Capture An API for capturing network traffic. Unix-like systems implement Pcap in the libpcap library; Windows uses a port of libpcap known as WinPcap.
Proper Session Termination	The percentage of connections that close immediately with no delay. Connections that close in a delayed fashion, keep the RRC state Machine on longer - needlessly draining the battery.
Proxy	A program that acts as both a server and a client for making requests on behalf of other clients. Requests are either serviced internally, or are passed on with possible translation, to other

Term	Definition
	servers. A proxy MUST implement both the client and server HTTP requirements. A transparent proxy is a proxy that does not modify the request or response beyond what is required for authentication and identification. A non-transparent proxy is a proxy that modifies the request or response to provide some added service to the user agent, such as group annotation services, media type transformation, protocol reduction, or anonymity filtering. Except where either transparent or non-transparent behavior is explicitly stated, the HTTP proxy requirements apply to both types of proxies.
Radio Access Network (RAN)	The UMTS wireless network, connecting mobile devices to the Core Network.
Representation	A Response Entity that is subject to Content Negotiation. Multiple representations can be associated with a Response Status.
Request	A request message from a client to a server includes, within the first line of that message, the method to be applied to the resource, the identifier of the resource, and the protocol version in use.
Resource	Any network Data Object or Service that can be identified by a URI. Resources can be made available in multiple representations (e.g. multiple languages, data formats, size, and resolutions) or vary in other ways.
Response	After receiving and interpreting a Request Message, a web server fulfills the request by sending back an HTTP Response Message, which contains the requested content as the payload.
Semantically Transparent	A property that describes the way a Cache behaves. In terms of content quality, content served from a Cache that is Semantically Transparent matches that served from the Origin Server. Except for the addition of hop-by-hop headers, the client receives Responses that are identical to First-Hand Responses.

Term	Definition
Server	A program that accepts connections to service requests and sends back responses. Any given program can be capable of being both a client and a server; our use of these terms refers only to the role being performed by the program for a connection, rather than to the program's capabilities in general. Likewise, any server can act as an origin server, proxy, gateway, or tunnel, switching behavior based on the nature of each request.
Session	HTTP Session. The conversation that takes place, between a client and a server. Initiated by the client but concluded by either the client or the server. Consists of a series of network Request-Response transactions. Lasts for the duration of the conversation, usually minutes.
Session Termination	This graph is scoring the types and actions of the TCP connections found in this trace.
Signaling overhead	The higher the percentile, better the performance of your application. Signaling overhead indicates the time spent in RRC state transitions. The lower the signaling overhead number, lower the count of state transitions, and the higher your percentile rank.
Simulation	Based on device profile.
Stale	A property of a response entity that indicates that a cached response is no longer implicitly valid. A stale response is a response that has exceeded its freshness lifetime.
Stateful	In a session, at least one of the communicating parties needs to save information about the session history to be able to communicate.
Stateless	The communication consists of independent requests and responses.
Tightly Grouped Connections	Connections that are grouped together efficiently use the radio while it is turned on. Connections that are spread out keep the radio on for a longer period, adding to the battery drain.

Term	Definition
Trace	A record of the Information generated by a device and by the network communicating with the device. Trace information can include packets transferred between the device and network, radio energy usage information, user input information, device information, and information from peripheral applications.
Trace Benchmark	This graph benchmarks your trace to the results of traces run on top mobile applications. This gives you an idea of where your application stands in comparison to other applications. The rankings here do not signify anything specific other than a ranking.
Tunnel	An intermediary program that acts as a blind relay in the Client/Server connection. Once active, a Tunnel is not considered a party to the HTTP communication. Tunnels are initiated by an HTTP Request. A tunnel ceases to exist when the connections terminates.
UMTS	Universal Mobile Telecommunications System. The 3G version of the GPRS technology. Based on GSM. UMTS radio link.
UMTS Data Channel	The link established between the mobile device and the cell tower.
Upstream/Downstream	Terms that describe the direction in which messages flow. Messages travel from Upstream, to Downstream.
User Agent	The client that initiates a Request. Clients are usually End-user programs, such as Web Browsers, but they can also be Service programs such as Spiders (web-traversing robots).
User Agent	A client application. Usually implements HTTP 1.1, to communicate with a web server.
Validator	Timestamp information that accompanies Response Entities. Stored a Response Entity header field. Used to validate Stale cache entries. When an Origin Server sends a Full Response, it includes a Validator in the Entity-header, which along with the Entity-body, becomes a local cache entry. A Client (user agent or proxy cache) makes a

Term	Definition
	Conditional Request for a cached copy a Resource when it must guarantee the Resource's validity. The Server evaluates the condition based on the result of comparing the value of its local copy of the requested resource's validator (the current version of the Resource), against that of the value of one in the Request. If they match, it responds with a special status code (usually, 304 (Not Modified)) and no entity-body. Otherwise, it returns a Full Response. Thus, we avoid transmitting the full response if the validator matches, and we avoid an extra round trip if it does not match. A protocol element (e.g., an entity tag or a LastModified time) that is used to determine whether a Cache Entry is usable (i.e., an equivalent copy of an entity.
Variant	At a given instant, Resources can have multiple Representation(s). Each Representation is referred to as Variant. Use of the term Variant does not necessarily imply that the resource is subject to Content Negotiation.

7. Appendix II

The sections in Appendix II describe how to use the legacy Rooted Data Collector APK.

7.1. Rooted Data Collector APK

Rooted collection is a legacy product and is no longer updated. It is still included in the Video Optimizer package, but if you encounter issues, they are unlikely to be resolved in a future release.

7.1.1. Prerequisites for using the Rooted Data Collector APK

To collect an application trace using the Data Collector APK, you need the following:

- A Video Optimizer Data Collector APK (included in the install on your computer)
- An Android test device running Android version between 4.x and 6.0 (rooted Data Collector does not work on Marshmallow and above)

7.1.2. Installing Rooted Data Collector APK

1. Start a trace as described in Using Video Optimizer to Collect Data, selecting the rooted option.
2. The apk will be installed on your phone.

- ***Collecting a Trace Using the Data Collector***

Once you have installed the Video Optimizer on your test device, you can operate it directly on the device to collect a trace; or for devices that do not allow you to capture trace video, you can operate the Data Collector via a USB connection using the commands on the Start Collector menu in Video Optimizer.

To operate the Data Collector from Video Optimizer, do the following:

Step 1. Select Preferences from the File menu.
Step 2. Select the General tab.
Step 3. For the Adb Path field, browse to the directory where the Android Debug Bridge (ADB) executable is located, and select it.
Step 4. For mac(iOS) select the Wireshark path if not installed under the default location displayed.
Step 5. Click Save and Close.
Step 6. Ensure that you have a USB connection between the test device and the computer where Video Optimizer is installed.
Step 7. Select Start Collector from the Data Collector menu.
Step 8. On the test device, select OK when the “Allow USB Debugging” prompt asks you to confirm the RSA key on the test device.
Step 9. Run testing scenarios on your app while Video Optimizer is collecting data. For example, launch the app, exercise the main functions of the app, and close the app.
Step 10. Select Stop Collector from the Data Collector menu

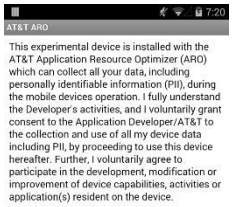
The trace data, including video, will be transferred to the computer via USB as part of the trace collection process.

Note: This method allows you to capture a video of the trace via USB for Android devices that do not support the Video Optimizer Data Collector capturing trace video directly.

To operate the Video Optimizer Data Collector directly on an Android test device, do the following:

Step 1. Open the program list on your device (**Figure**), find the “Video Optimizer” icon, and launch it.

Step 2. Click Accept on the Legal Terms screen (**Figure**) to proceed to the main screen of Video Optimizer.



Step 3. Use the controls on the Video Optimizer main screen to cancel any running applications that you do not want to test.

Step 4. Select whether to record video with your trace and start the Data Collector.

Step 5. Click Open Task Killer to stop running tasks and select the tasks that you want to stop before you start collecting data. This ensures that you are collecting trace data only from the application that you want to test.

Step 6. Click Record Video to record video while you are capturing the trace.

Step 7. Click Start Collector to start the Data Collector.