AT&T Entertainment Experience Suite
Video Optimizer 1.0

Testing Guide

Publication Date: 12/30/2016

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1 Introduction

The Video Optimizer Testing Guide describes in detail the methods for collecting an application trace using the Video Optimizer Data Collector. It describes how to open a trace in the Video Optimizer Data Analyzer, and it contains a full reference of the tabs, menus, options, charts, graphs, and statistics in Video Optimizer.

This guide is intended for app developers who are interested in testing the performance of their apps.

2 Overview

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

When using Video Optimizer, the traces run against your application by the Video Optimizer Data Collector are benchmarked against recommended best practices in the Video Optimizer Data Analyzer. The Data Analyzer 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.

3 Using Video Optimizer to Collect Data

The Video Optimizer Data Collector captures the data traffic of mobile devices. As data streams across the network during a given period, the Data Collector captures each TCP packet and matches the packet information with recorded video of what the user is seeing on the device. The 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:

1. **iOS** device versions 6 and up.
2. **Android** devices (and emulators) versions 4.4 and up.

   Note: The original Android Collector works on Android versions 2.3.7-5.1, but requires root access. You can learn more about this collector in APPENDIX II Rooted ARO Data Collector APK.
3. **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.
4. **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. For more details, refer to Using the Video Optimizer SDK/Command Line Interface.

3.1 Prerequisites

The following sections describe the prerequisites for collecting traces using the Video Optimizer on iOS and Android devices.

3.1.1 iOS Prerequisites

To collect a Video Optimizer trace on an iOS device, you must have a:

- Mac computer running OSX 10.8 or later, with the following:
  - Administrator rights
  - Ability to use SUDO password from Terminal
  - Xcode installed (appropriate version for the device you are testing)
- iOS device (running iOS 6 or higher)
  - Enabled for development. See the next section: Enabling iOS Device for Development.

3.1.1.1 Enabling an iOS Device for Development

When the iOS device is connected to the Mac computer, open Xcode and select Organizer from the Window menu. From Organizer, select the connected device from the list of devices in the left nav, and click the "Use for Development" button.

Note: Xcode should always be started first, before starting Video Optimizer. This allows you to see that the device is detected and ready to use.

When this button is clicked, you will see a prompt to join the Apple developer program and login with a paid developer account. No paid account is needed to continue in this case, so you can click the Cancel button to continue.

The “Use for Development” button is only available for a device if it has not been enabled before. If the device was enabled previously, Xcode will automatically enable it once it is connected to the computer.

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

3.1.2 Android Prerequisites

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

- PC, Mac or Linux computer
    - Android SDK installed (for adb control of device).
- Android device (or emulator) running 4.4 or higher.

3.2 Collecting a Video Optimizer Trace

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

1. From the Data Collector menu, select Start Collector.

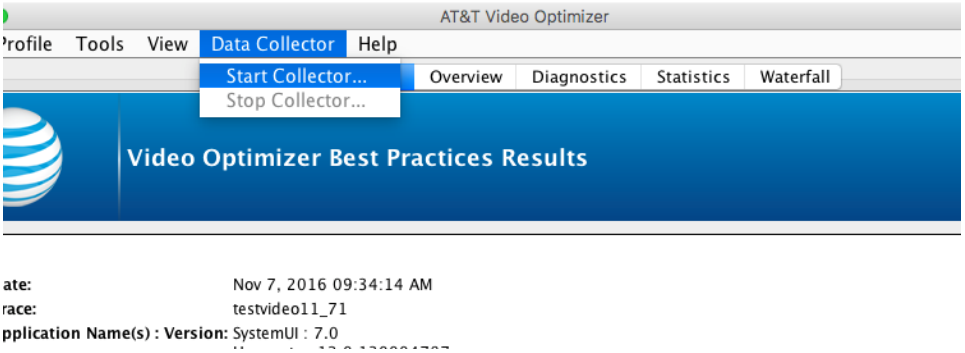


Figure 3-1: Menu to Start Video Optimizer Trace Collection

2. A dialogue box will open with a number of options. To start a trace, walk through the following options and make your selections.

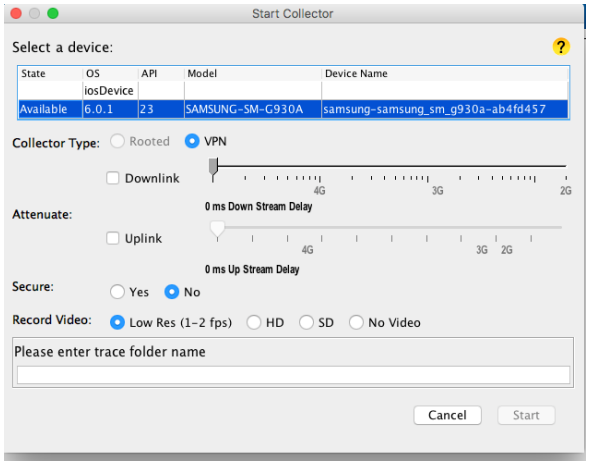


Figure 3-2: Start Collector Dialogue

1. Select a Device: Video Optimizer will discover all iOS and Android devices connected to the computer. In this example (figure 3-2), there are 2 devices connected: an iOS device and an Android device, with the Android device selected.
2. Collector Type: For Android devices that are rooted, the collector type can be chosen. In figure 4-2, the Android device does not have root access, and is set to the VPN method (this is the recommended setting – for more information on the rooted Android collector see APPENDIX II Rooted ARO Data Collector APK). In this example, the Android device is not rooted, so that option is not available.
3. Attenuate: Network Attenuation allows you to slow the network throughput to s slower network speed. By selecting downlink or uplink attenuation, and setting the speed to 3G or 2G on the slider, the Video Optimizer will reduce the throughput of the network connection, allowing tests on networks with lower bandwidth profiles (for more information, see the Attenuation section). The Video Optimizer Attenuation settings, work as follows:
    a. Downlink attenuation will lower the throughput of the packets being downloaded from the server.
    b. Uplink attenuation will lower the throughput of the device uploading files to the server.
    c. Choosing a value between 3G and 2G will allow tests on “slow 3G”. To test the actual throughput that is available, set your attenuation and actually test your throughput using a tool like testmy.net.
    d. **Note**: 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.

    In this example (figure 4-2), Attenuation is not selected, so it is not being used.

4. Secure: (Android devices on KitKat only) The Video Optimizer collector can decrypt HTTPS traffic – providing you with a more thorough analysis of the traffic transmitted during your test.
    a. If you change this value to yes, you will be prompted to install a certificate. You must install the certificate the first time you select Secure collection. On subsequent tests, you do not need to install the certificate.

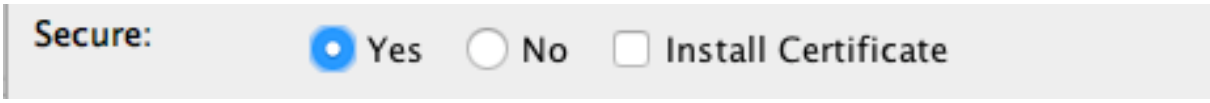


Figure 3-3: Secure Collector Options

5. Record Video: Depending on your device, there will be 2 or more options available for recording the screen while you are collecting Video Optimizer data.
    a. Low Res: 1-2 frames per second. Advantage: Smaller video size
        i. HD/SD (Android only) Video is recorded 27-30 frames per second. **Note**: When the trace is completed, there will be a longer delay before analysis as the video is spliced together.
        ii. 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.
        iii. SD: SD video 3MBPS, 960x540 video – for a smaller size (but lower quality) video.
6. Trace name: Spaces and special characters are not allowed in the trace name. If you pick a name that has already been used, you will be asked if you want to overwrite the previous trace. This is the name of the directory where all of the trace files will be stored.
7. Start/Cancel: Once you have selected the appropriate parameters for your trace, click start to begin collection on your device. If you have decided it is all for naught, and wish to cancel – press cancel to prevent a trace from being run.

3.2.1 Collecting a Trace: iOS Specifics

1. After making your selections, and clicking “Start,” you will be prompted for your sudo password (remember that Admin password requirement? Here it is, raising itself into your consciousness). Enter your password, and click OK.

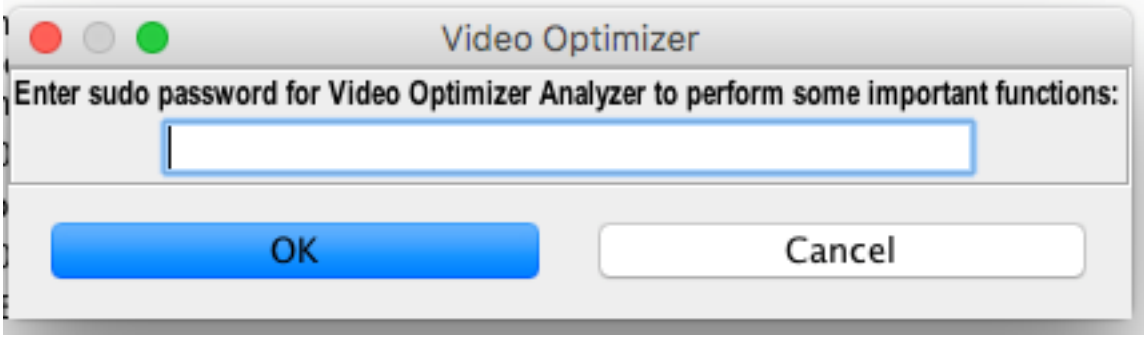


Figure 3-4: Sudo password requirement on iOS trace collection.

3.2.2 Collecting a Trace: Android Specifics

1. Android: If you have selected a secure trace and have opted to install a certificate (required on first test), the device will ask you to install the certificate. Choose the “Wi-Fi” Option, and touch “OK”.

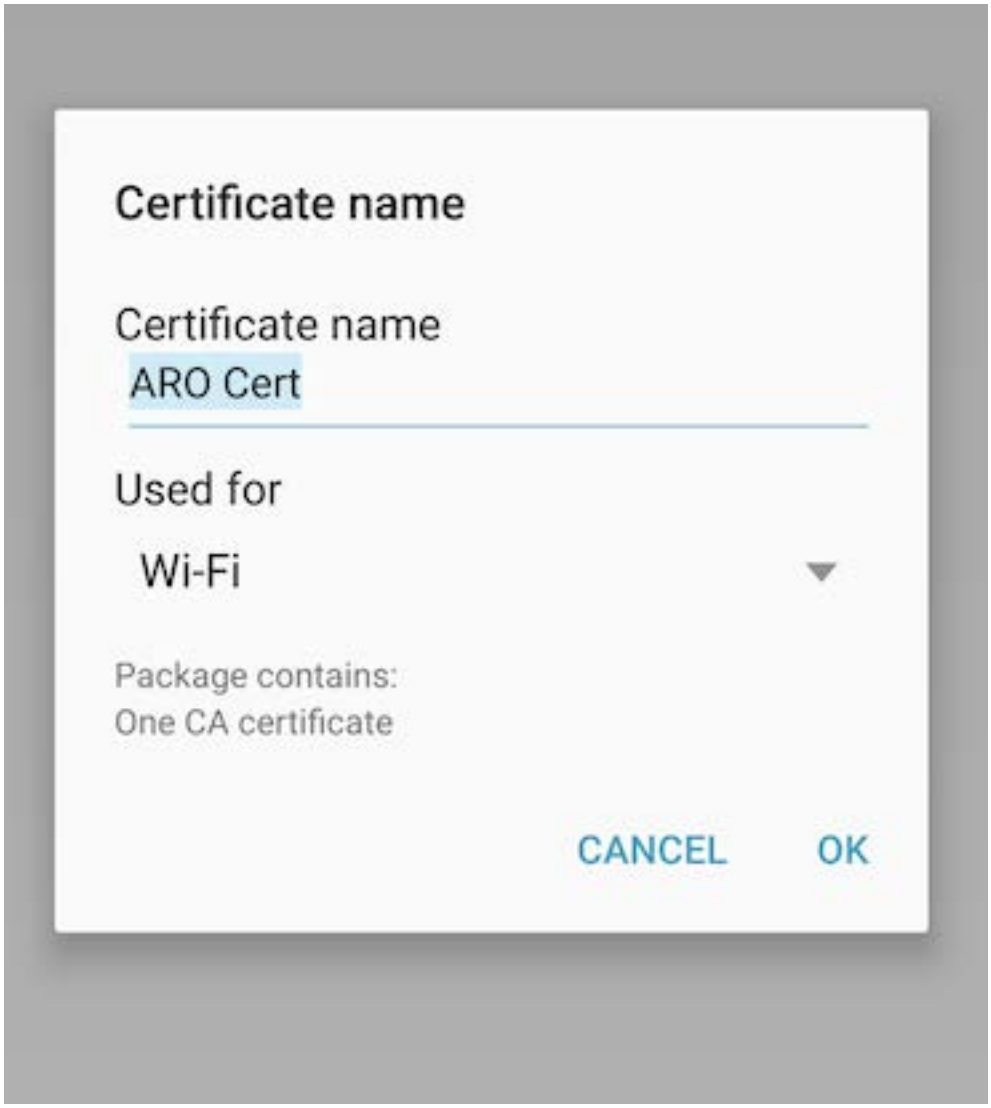


Figure 3-5: Video Optimizer Certificate installation: Android

2. Android: The Android collector establishes a VPN connection on your device. When the trace is started, a Video Optimizer collection app will be installed on the device. It will establish a VPN connection on the device, and will request permission to allow the VPN connection. Press “OK” to allow the VPN to start.
    a. **Note**: The VPN connection is a connection to nowhere. It originates, and terminates on the device. All of the packets flow through the network normally.

3.3 Attenuation

The Network Attenuation features in the Video Optimizer can be utilized to “slow down” a network connection. Without expensive equipment and Faraday cages

to remove external networks, it is very difficult to emulate networks with poor throughput.

The Network Attenuator function allows you to slow down the existing network by simply moving the sliders to the desired position. Note that the attenuation that is added is dependent on the existing network conditions, so it is important to test the speed that the device is actually receiving with a throughput test app (like testmy.net).

3.4 Trace Collection

When collecting traces in the Video Optimizer, there are a few indicators to confirm that your trace is being collected as expected.

- If you are recording video, a new window will appear on your computer:

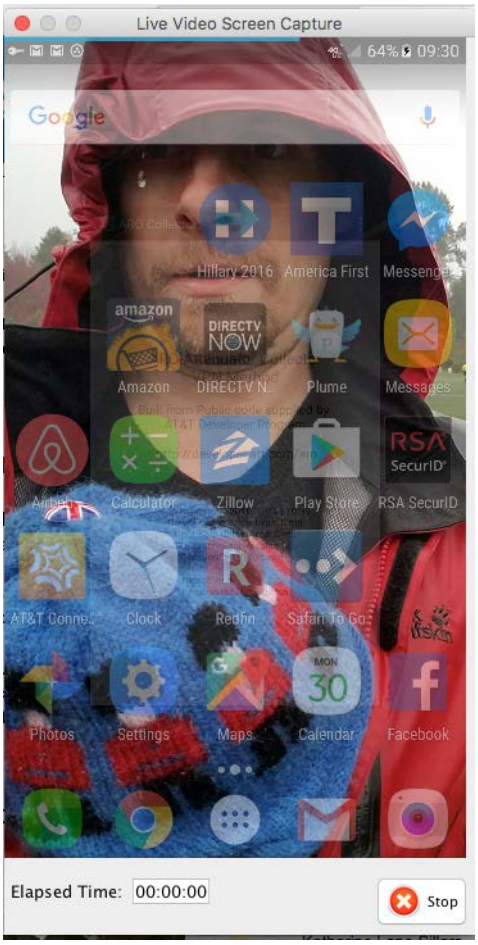


Figure 3-6: Live Video Capture view on Computer

Figure 3-6 shows the screen capture view – an almost real time view of what is on your phone's screen. This view also contains an Elapsed Time counter and, a Stop button, at the bottom right. In the screen capture image (figure 3-6), you can see that there is a key icon in the notifications bar. For Android VPN traces, this key icon signifies that a VPN is active on your device.

3.4.1 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 of 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.

3.4.2 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.

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 3-6).
    b. If you elected to not collect video: Stop the trace using the Stop Collector option on the Data Collector menu (as shown in the following figure 3-7).

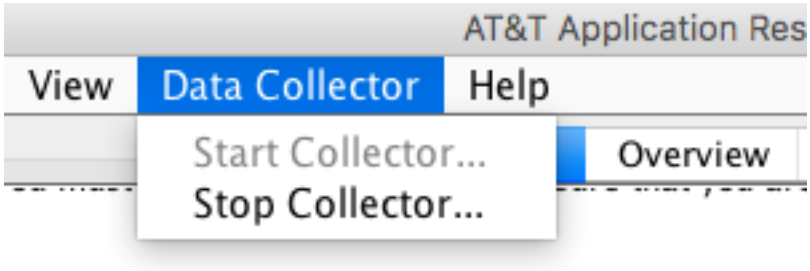


Figure 3-7 Stopping a trace when video is not active.

2. When the trace collection is stopped, the files will be pulled across to your computer. The Video Optimizer will create a folder in your root directory called AROTrace<osName>, and will save the trace there.

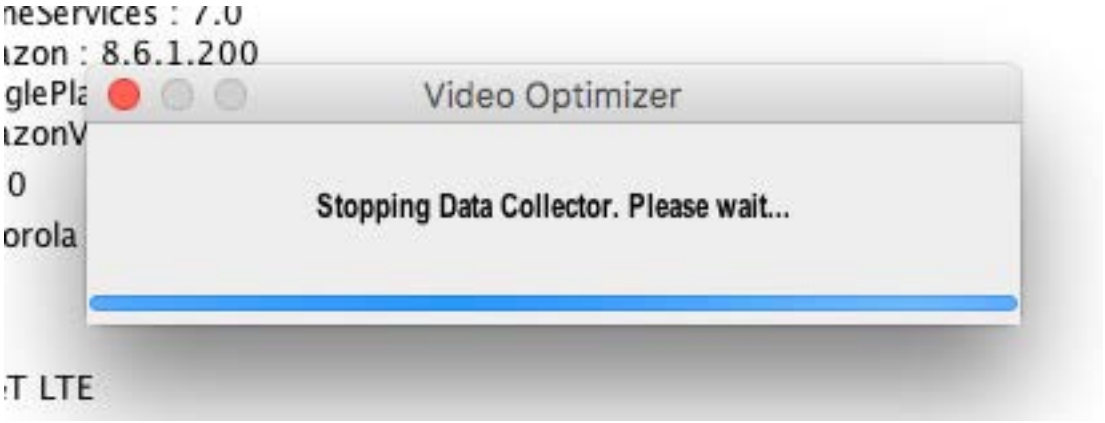


Figure 3-8: Stopping Video Optimizer, and pulling traces to the desktop

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), you will be presented with the following dialog box (figure 4-9), in which you can choose to open the trace in the Video Optimizer analyzer, or click “OK” to continue without opening the trace.

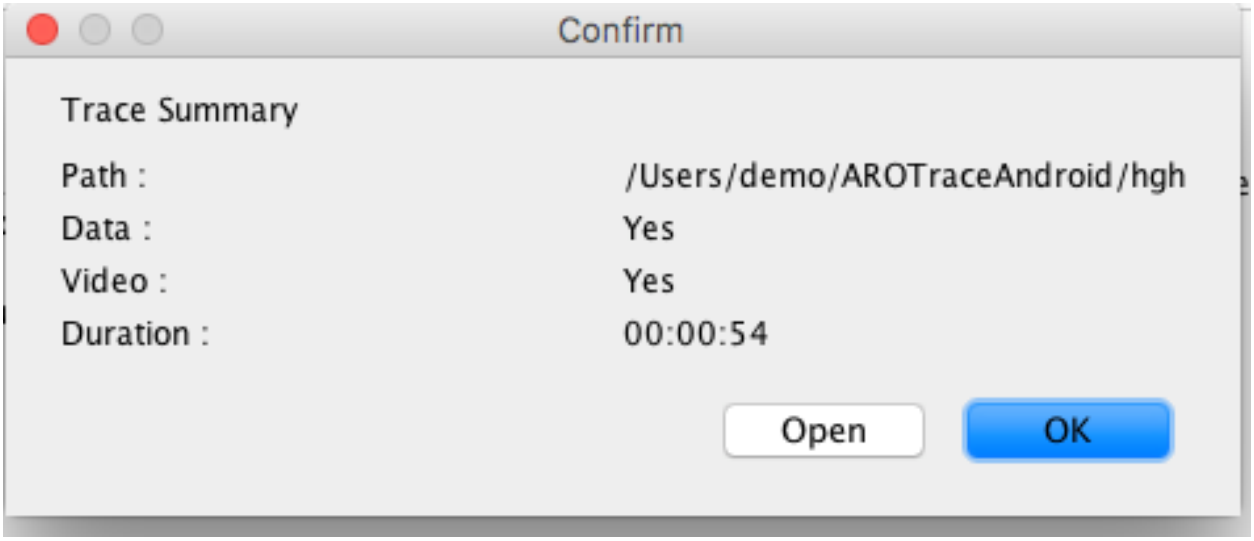


Figure 3-9: Confirmation that the Video Optimizer trace has been copied to the computer. Choose to open the trace for analysis, or click OK to continue without processing the trace.

3.5 Video Optimizer Analysis

For details on how to analyze a Video Optimizer trace, please refer to the following sections in this document: Using the Video Optimizer Data Analyzer, Performing an Analysis of a Video Optimizer Trace, and the Video Optimizer Data Analyzer Reference Guide.

4 Using the Video Optimizer SDK/Command Line Interface

The Video Optimizer SDK/Command Line Interface provides access to the main functionality of the Video Optimizer through simple console commands, allowing you to easily integrate data collection and analysis into your testing and build tools without having to manipulate the Video Optimizer UI.

4.1 Background

The Video Optimizer Command Line Interface is primarily designed for use in the following scenarios:

- As a compliment to other testing tools. Command line access makes Video Optimizer easier to combine with other tools.
- As a part of automated testing: The ability to start and stop data collection, and output analysis without a UI, makes it much easier to integrate Video Optimizer into your automated testing suite.
- As a part of your build cycle/Continuous integration workflow: The Video Optimizer Command Line Interface can be used within Jenkins and other build tools.

The following sections provide steps for collecting and analyzing a trace using the Video Optimizer Command Line Interface.

4.2 Prerequistites

The prerequisites for the Video Optimizer Command Line Interface are the same as for using the Video Optimizer Data Collector manually. See section 3.1 for more details.

4.3 Collecting a Trace using the Command Line Interface

After your device is prepared, the system prerequisites for the Video Optimizer Command Line Interface/SDK have been installed on your computer and you have confirmed that the device and computer are connected via USB, follow these steps to use the Video Optimizer from the command line:

Note: The Video Optimizer Command Line Interface is invoked with the syntax “arocli” so that it remains compatible with the ARO Command Line Interface that it is based on.

1. Start the trace collection using the startcollector command and specify which collector you are using (instructions below are for Mac)

   ```
   Sh arocli.sh  --startcollector [rooted_android|vpn_android|ios]
   ```

   Note: The default value for this parameter is vpn_android.

2. Other parameters to use when you record a trace:

   a. If more than one device is connected, select the device by using:

   ```
   --deviceid <Android ID or iOS serial number>
   ```

b. To select a video recording format, use:

```
--video [hd|sd|slow|no]
```

c. You must specify the name of the trace to be collected using:

```
–-output [filename]
```

The following example shows the command to start the VPN Android collector, output the trace to a folder called test, and record a HD video of the trace.

```
Sh arocli.sh --startcollector vpn_android --output /User/documents/test --video HD
```

3. Manually test the app on your device.
4. When the test is completed, stop the collector by using the stop command from the “>” prompt when the collector is running.

```
> stop
```

4.4 Analysis of Traces with the Command Line Interface

1. If you have a trace collected, you do not need to open the trace to perform an analysis. You can instruct the Video Optimizer to analyze the specified trace using the analyze command. Optionally, you can specify where the analysis should be stored, and whether the format of the analysis report should be (HTML or JSON).

```
--analyze [trace location]
```

2. There are a few required parameters, including the requested output format

```
--format [json|html]
```

   a. The HTML output is a formatted list of best practices with pass and fail criteria.

   b. The JSON output is a full file with all of the results from the trace.

3. Additionally, you need to specify a file to save the data in:

```
--output [filename]
```

The following example shows the command to analyze the trace data in a folder called test and output the analysis report in HTML format to a file named report.html.

```
sh arocli.sh --analyze /User/documents/test --output
/documents/report.html --format html
```

5 Using the Video Optimizer Data Analyzer

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

The Video Optimizer Data Analyzer provides the following:

- Visibility into radio resource and energy utilization.

- Benchmarking of resource efficiencies.
- Automatic diagnosis of application inefficiencies.

To use the Video Optimizer Data Analyzer, you must have the prerequisites described in section 4.1.

5.1 Opening a Trace File

When you open a trace file in the Video Optimizer Data Analyzer, the data is evaluated against a set of recommended best practices. The Data Analyzer 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 procedure to open a trace file.

1. From the File menu in the Video Optimizer Data Analyzer, select the Open Trace menu item to display the Open dialog box.

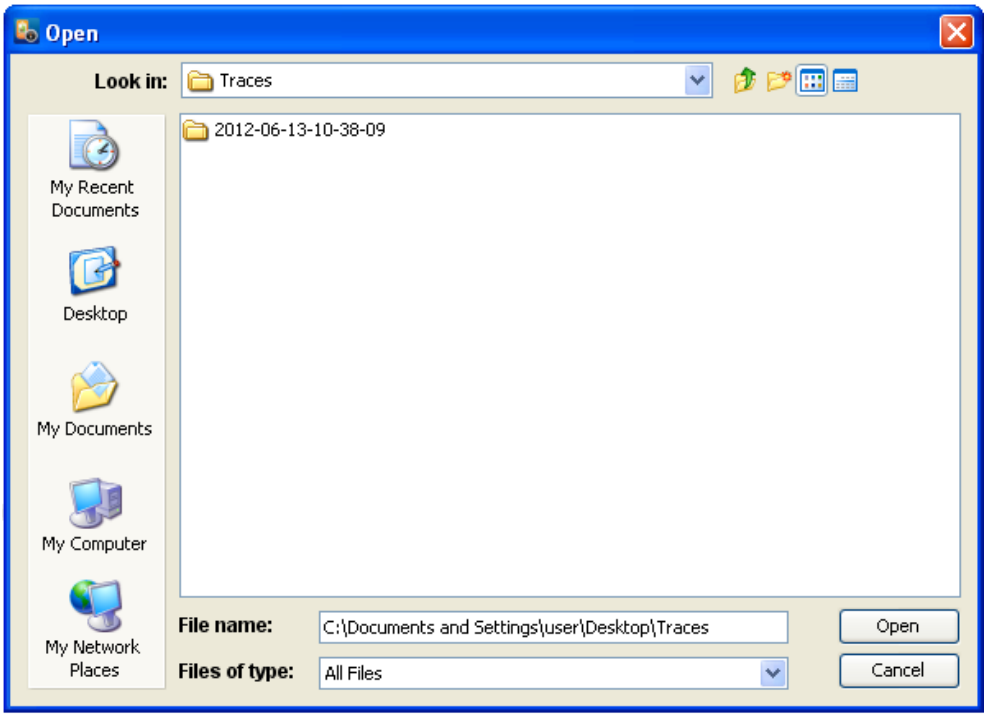


Figure 5-1: Opening a trace for analysis.

2. In the Open dialog box, select a trace folder and then click the Open button. When you click Open the trace files are loaded and the Video Optimizer Data Analyzer begins analyzing the data.

   Note: The time that it takes the Data Analyzer to complete the analysis depends on the size of the trace. As soon as the analysis is complete, all of the content tabs in the Data Analyzer are updated with the analysis results

You can also open pcap trace files, and trace files that have been collected using the Microsoft Network Monitor, by selecting the Open Pcap File command from the File menu. 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: When loading some large traces in the Video Optimizer Data Analyzer, an Out of Memory (OOM) notification error may occur, or a notification message that "Video Optimizer has reached the maximum memory heap size", may appear. When either of these errors occurs, try closing the Video Optimizer Analyzer and reloading the trace. Also consider collecting multiple, smaller, more targeted traces.

For a complete description of the menus, tabs, tools, charts, graphs, and analytical data in the Video Optimizer Data Analyzer, see Section 8 Video Optimizer Data Analyzer Reference.

6 Performing an Analysis of a Video Optimizer Trace

The next section, Video Optimizer Data Analyzer Reference Guide, outlines all of the features and functions of the Video Optimizer Analyzer.

However, you might just want to look at a trace quickly to understand what is happening during your trace. This section will refer to the Video Optimizer Data Analyzer Reference Guide, but in an abbreviated manner to get you started in performing Video Optimizer Analysis.

6.1 How to Analyze a Video Optimizer Trace

The Video Optimizer Analyzer has been built to start at a high level, and then progressively help you "drill down" into the issue – helping 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.

There are a number of ways to uncover issues inside the Video Optimizer, and this section walks you through a few possible scenarios.

6.2 Starting at the Top: Drilling Down

The Video Optimizer will walk you through finding potential issues – starting at a high level, and working deeper and deeper into the trace and data to help you pinpoint the issue. The first thing to look at when investigating a trace is the Best Practices Tab.

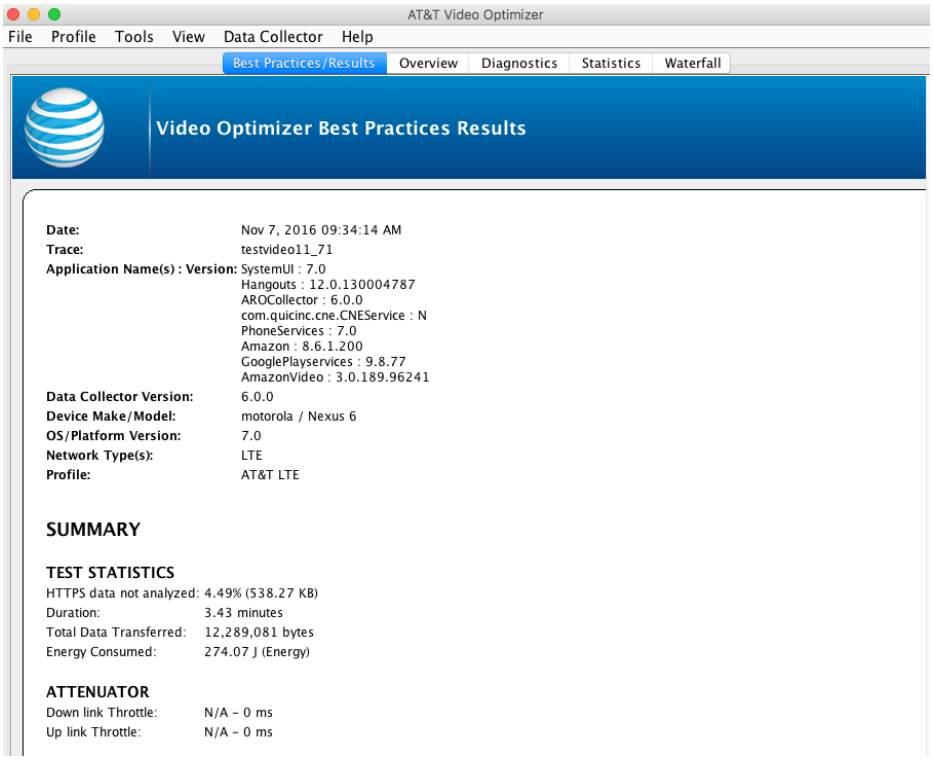


Figure 6-1 Video Optimizer Best Practices tab

The top of the Best practices tab tells you some basic information about the trace – the date, filename, and information on the device used for the test. The Summary will tell you a number of high level stats recorded in the race. Right below this, you'll find a scorecard of the best practices:

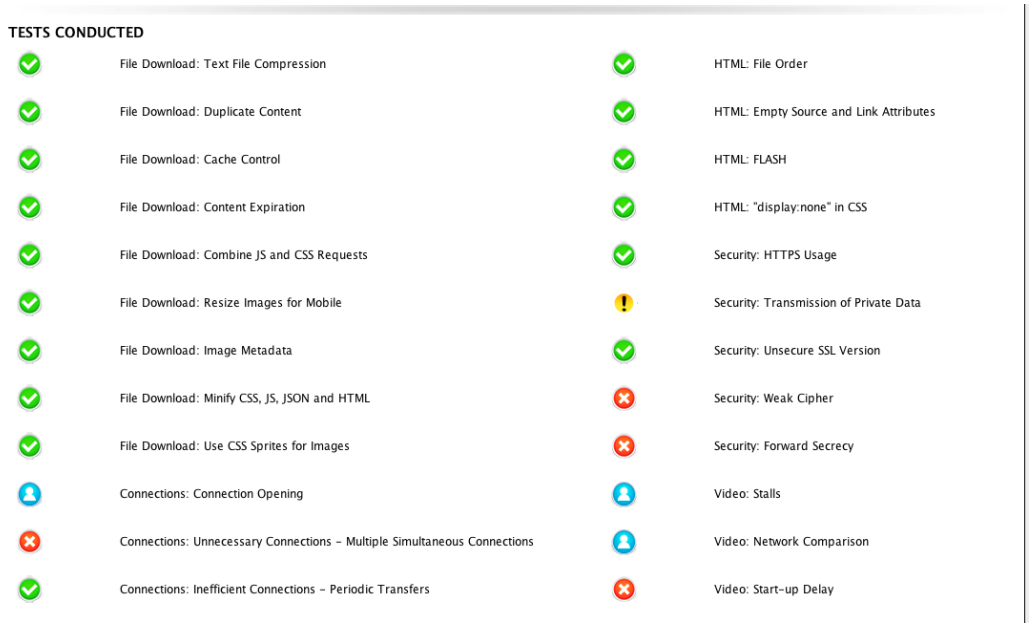


Figure 6-2 Best Practices Summary

6.2.1 Digging into a Best Practice: Example 1

In this section, you can quickly determine which best practices failed. Generally, this is the best place to start to improve your application. To quickly find out more about the failed best practice, click on the text to go to a larger summary. For example, here is a trace that failed the “duplicate content” best practice:

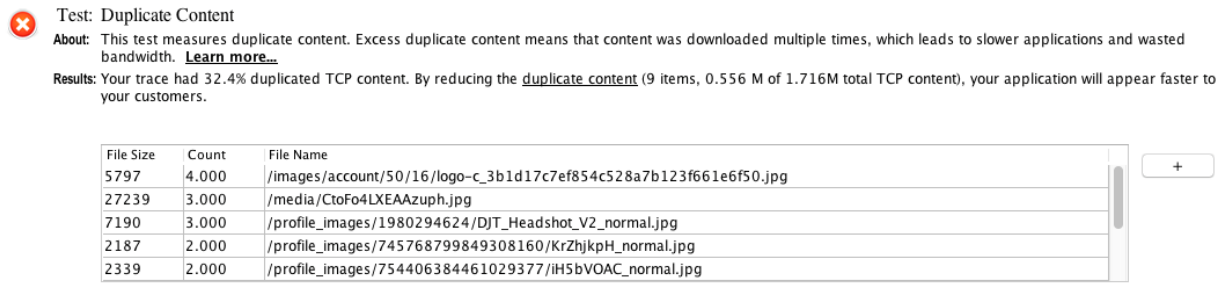


Figure 6-3 Best Practice Detail

In this best practice, we learn that “duplicate content means that content was downloaded multiple times, which leads to slower applications and wasted bandwidth”. The table lists files that were sent multiple times – the count of downloads, and the file name. The table shows that all of the files are images (note the “.jpg” extension), and were downloaded 2-4 times each. Perhaps you can work from here – to identify the files, and make sure that they are being cached correctly, or you may require more details.

Every best practice table can give you more information. Clicking one of the entries will lead you to an area with more detail. In the case of duplicate content – you are taken to the full list of duplicate content in the overview tab: This table lists every download of every file sent multiple times – perhaps you can see the time ranges or other details to figure out the issue.

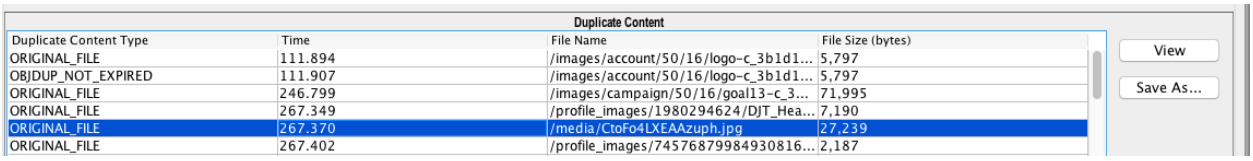


Figure 6-4: Duplicate Content in Overview tab

Oftentimes, file names are obscure and you don’t really know what the file is, or what the content is. By selecting a row in the table and clicking the View button, you can view the contents of the file (so that you can read a text file – or view an image). Clicking one of these rows will take you to the diagnostic tab – where you can see the request/response for the file:

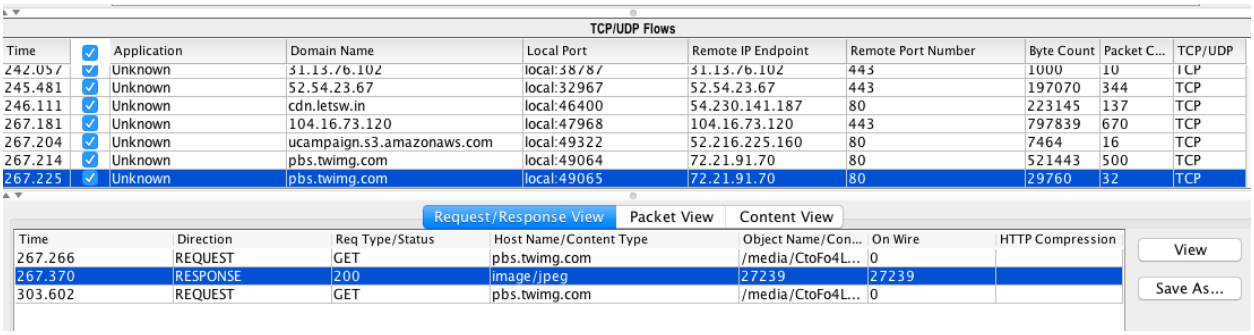


Figure 6-5: Diagnostic tab: detail of duplicate content request/response.

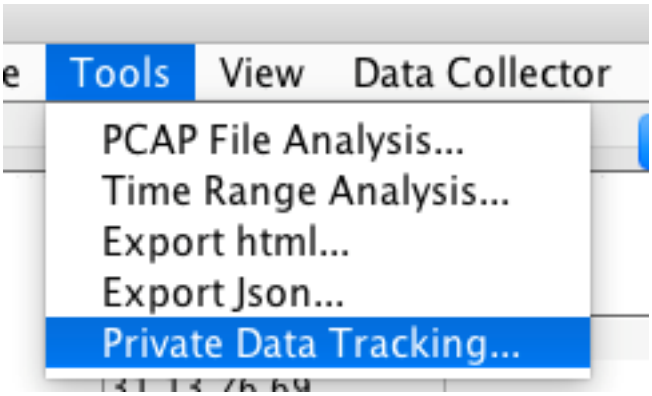
In figure 6-5, The top table shows the IP and domain (pbs.twimg.com) indicating a request from Twitter's image servers. The bottom table has the request/response. So, we know that the file is coming from Twitter – does the file have the correct cache headers? Clicking the Content View tab we can read the headers:

Figure 6-6 Diagnostic Tab: Content View

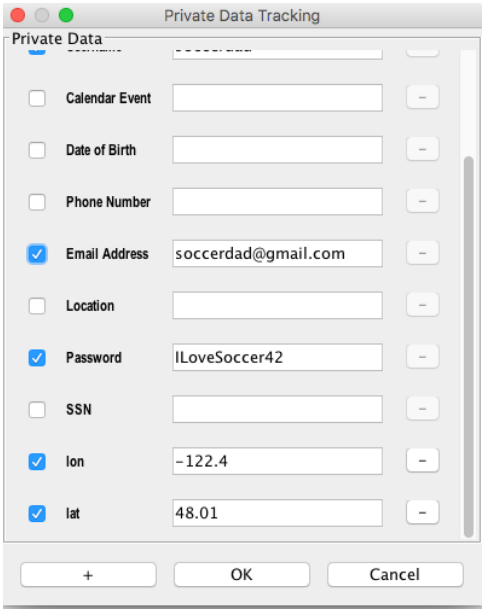
The downlink headers show a Max-Age of 604800s – a cache timeframe of 1 week. Perhaps, in this application, the image cache is not properly set to store files locally on the phone.

6.2.2 Digging into a Best Practice: Example 2

The Transmission of Private Data best practice test allows you to examine all of the decrypted and clear text data files for leakage of private data. To run this test, select the Private Data Tracking option on the Tools menu:



In the Private Data Tracking dialog, enter fields that might appear in your trace:



Clicking “OK” will analyze the trace for these values, and provide you a report in the best practices tab:

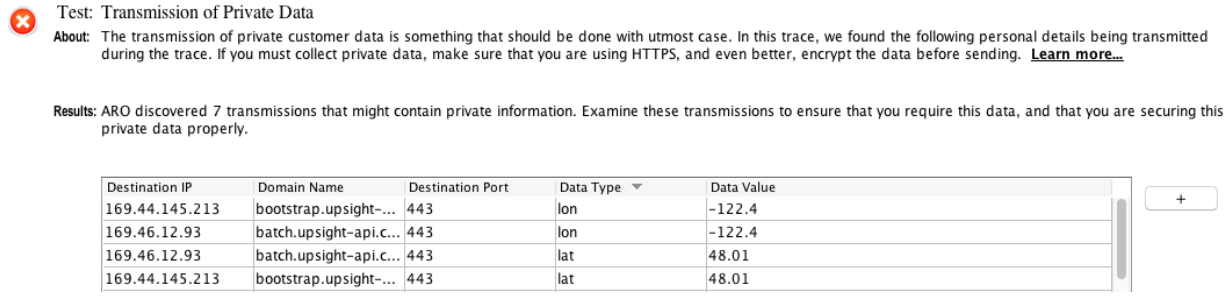


Figure 6-7 Transmission of Private Data Best Practice

As we can see in figure 6-7, the lat and lon that were entered in the Private Data tracking was found in the Video Optimizer trace. We can now dive into these connections by clicking one of the rows in the table.

When the row is clicked, it brings us to the diagnostic tab with the TCP flow highlighted in the top table and the response highlighted in the Request/Response View, as shown in the following figure.

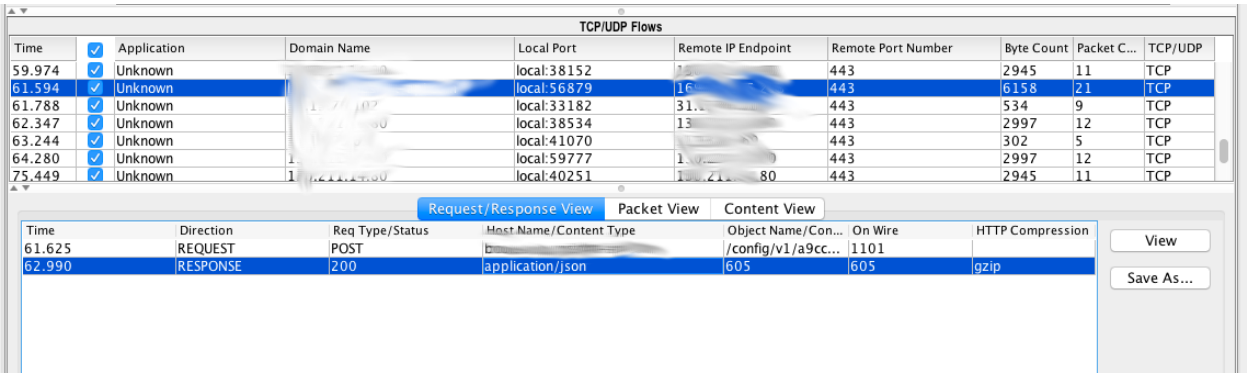
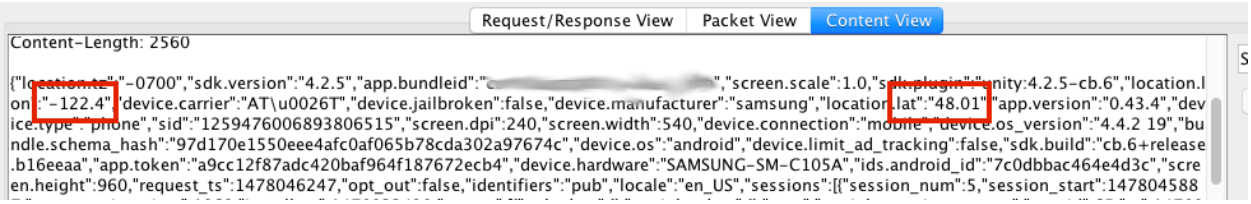


Figure 6-8: Diagnostic Tab with TCP Flow and Response highlighted

Switching the bottom table to the Content View, and reading the POST data finds the private data transmission:



6.3 Drilling Across a Trace

In addition to looking through the best practices, there are other things that you can look for while analyzing a Video Optimizer trace. Starting across the tabs from left to right, you can

6.4 Video Analysis

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

In this section, we will walk through the steps to begin video analysis.

6.4.1 Testing Video Tips

When testing video, your trace should ideally be of a DRM free video, and the application should allow screen recording. We can perform a number of analyses

without these 2 features, but the example analysis in this section is of a trace with a DRM free video, and the recorded screen.

6.4.2 Video Analysis setup

Begin by opening a trace with video content in it, but before beginning analysis, there are a few manual steps required. First, select the Video Usage Preferences option in the Tools menu. You will see the following dialog:

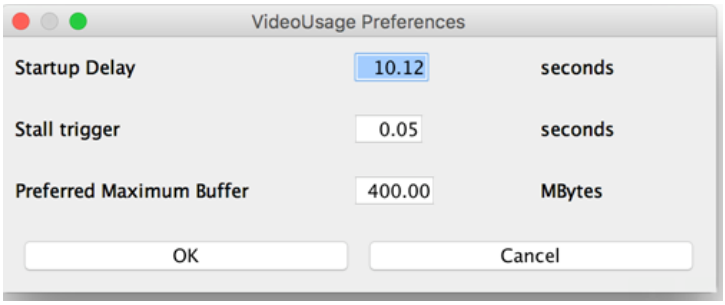


Figure 6-9: Video Usage Preferences

Startup delay: Measured 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.

Stall trigger: Measured 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 screenshot in figure 6-9 tells us that stalls under 0.05s will not be counted in the best practice.

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 6-9 denotes a 400 MB video buffer.

6.4.3 Video Analysis Diagnostic Tab

To further analyze your video, switch to the diagnostic tab. Under the View menu, selection Options. A large dialogue will open, but at the bottom, you will see a “video view” selection. Choose this. This will add 6 lines to the diagnostic chart that are designed specifically to look at video:

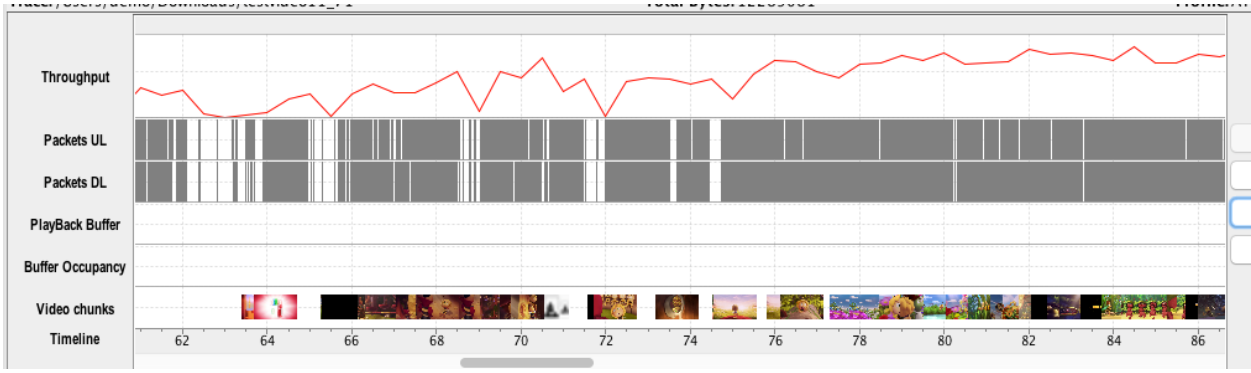


Figure 6-10: Diagnostic Tab Video View

Notice the bottom row of “Video chunks:. If the video you tested was DRM free, the view will be of the first frame in each chunk. If you click the first chunk thumbnail, you will see the following dialogue pop up:

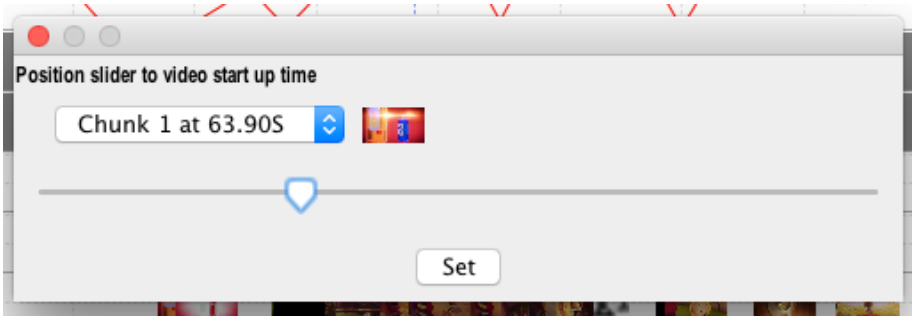


Figure 6-11: Video Startup Time dialogue

Hovering the pointer over the thumbnail will provide a larger image of the frame. We can see that Chunk 1’s download started at 63.90s. If you move the slider, you will see the video viewer move through the captured video. Match the first frame of Chunk 1 with the screen recording, and press “Set.” This allows Video Optimizer to do some initial calculations on the size of the video buffer before the video starts to play.

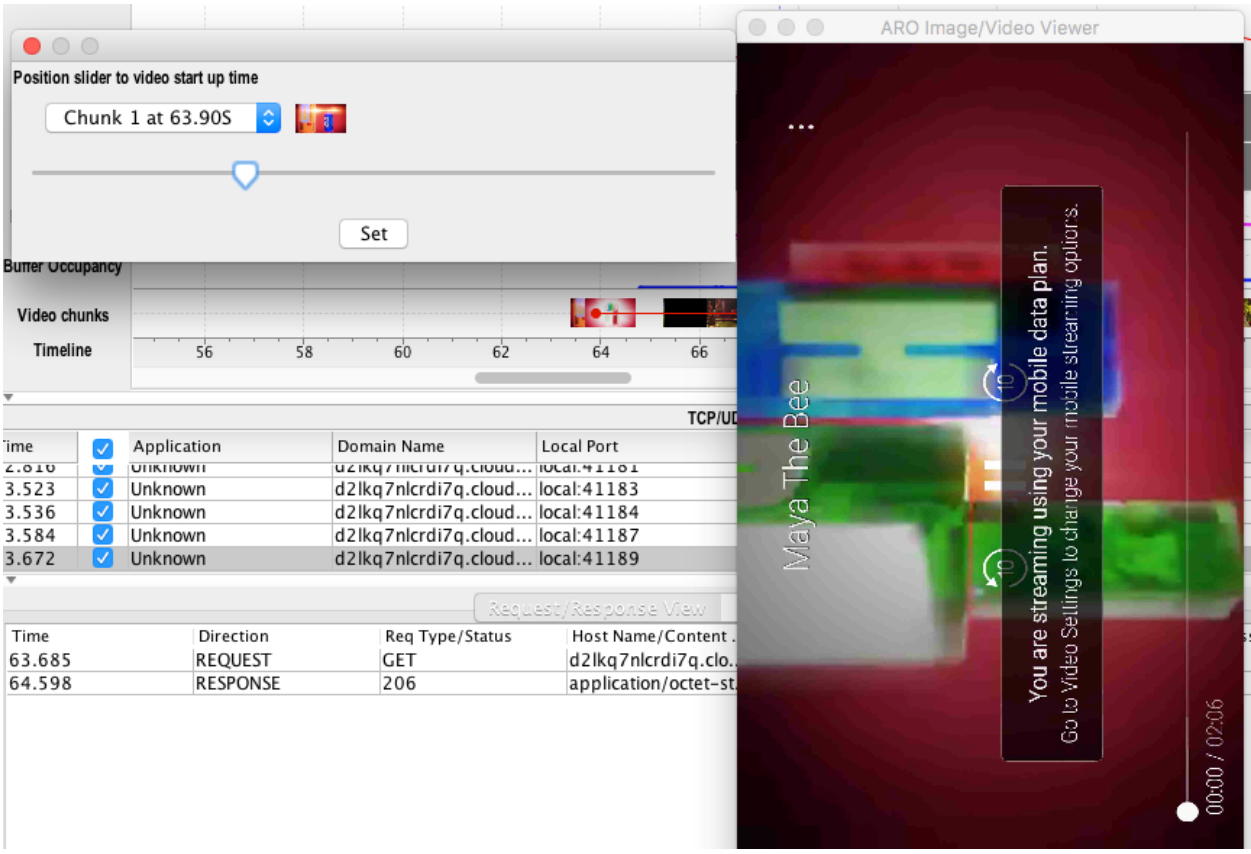


Figure 6-12: Setting the Video Startup Time

The 2nd and 3rd rows from the bottom of the diagnostic tab will now be populated with data. Zooming out, we have a better picture of what we are seeing (figure 7-12):

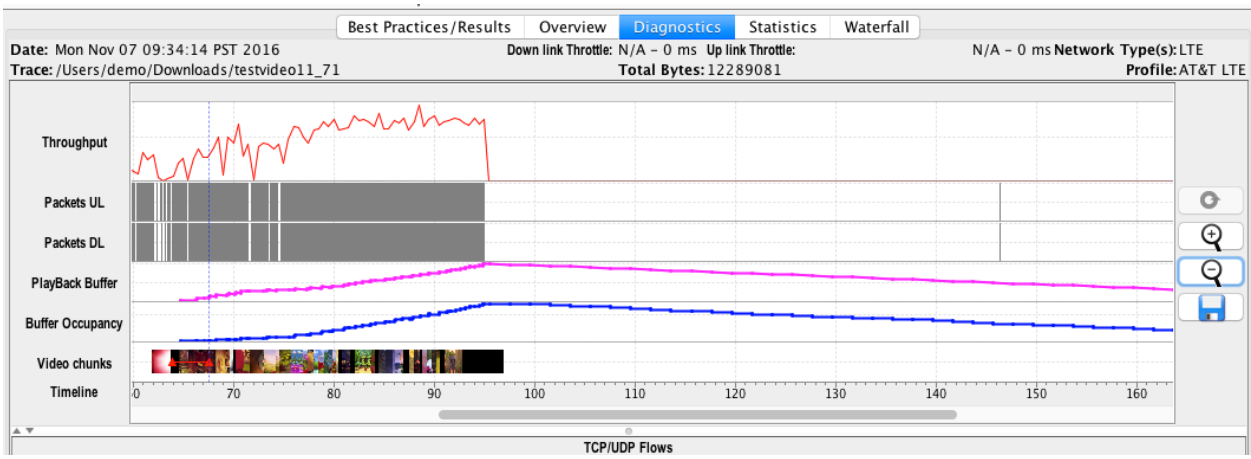


Figure 6-13: Diagnostic Tab Video View with Buffer Details

The diagnostic tab is now showing the Playback Buffer (the seconds of video stored locally) and the Buffer Occupancy (the KB of video stored locally). If you look closely at the Video chunks line, you can also see a red line starting at

chunk 1, and terminating at the time the chunk appears on the screen (in this case around 68s).

This model 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. The Video Optimizer will use the startup occupancy found at the start to estimate when the video will resume playing.

6.4.3.1 Diagnostic Tab Video Information

When you mouse over a video chunk, you will find out when the download, started, stopped, approximately when it played on screen, and the number of KB in the chunk.

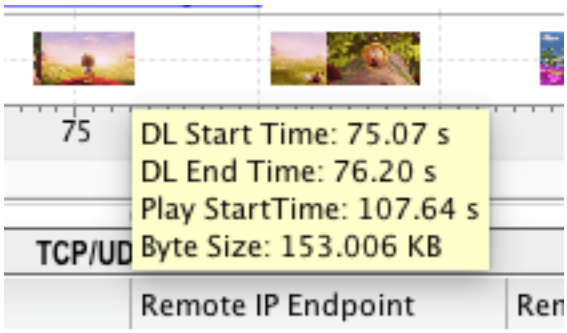


Figure 6-14 Mouseover view of Video Chunks

Hovering over the 2 lines (PlayBack Buffer and Buffer Occupancy) provides information about how much playback is stored in the buffer:

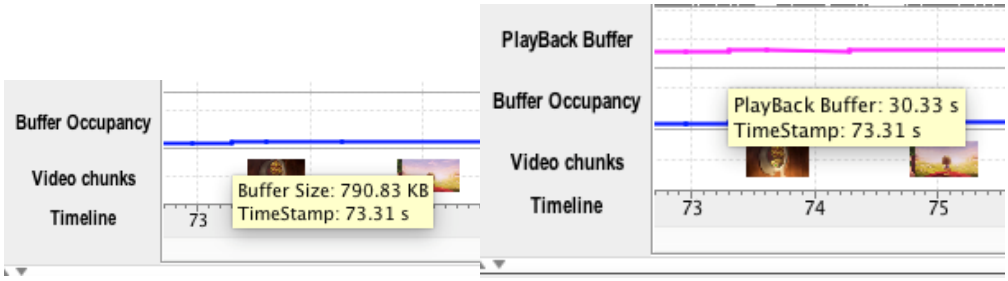


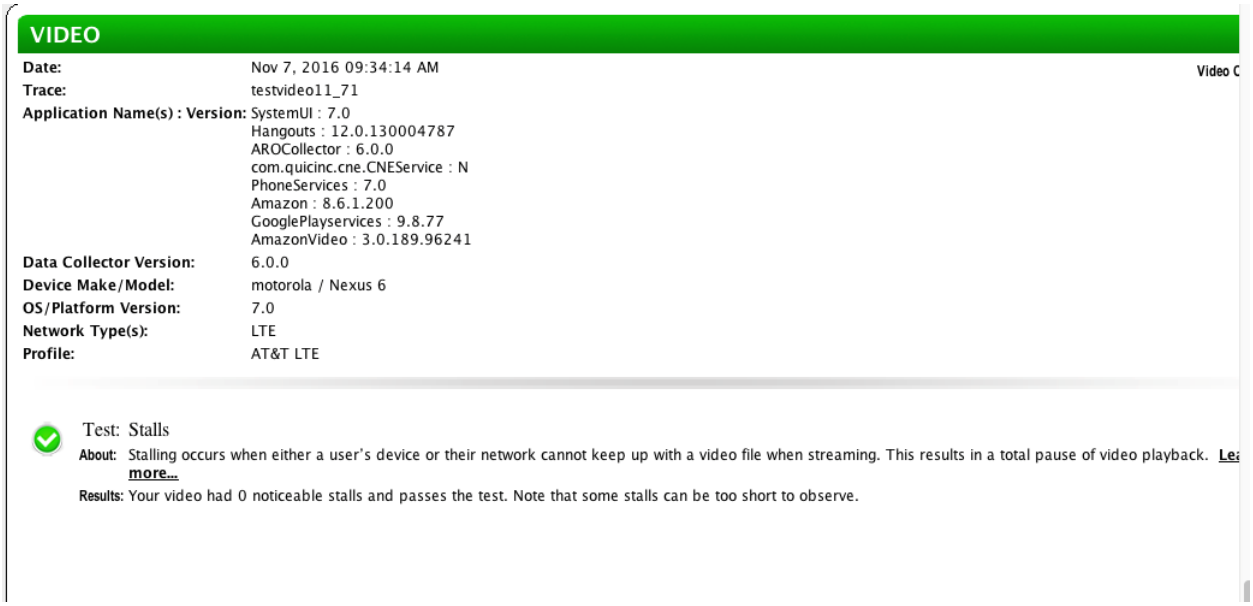
Figure 6-15 Mouseover Views of Buffer Rows

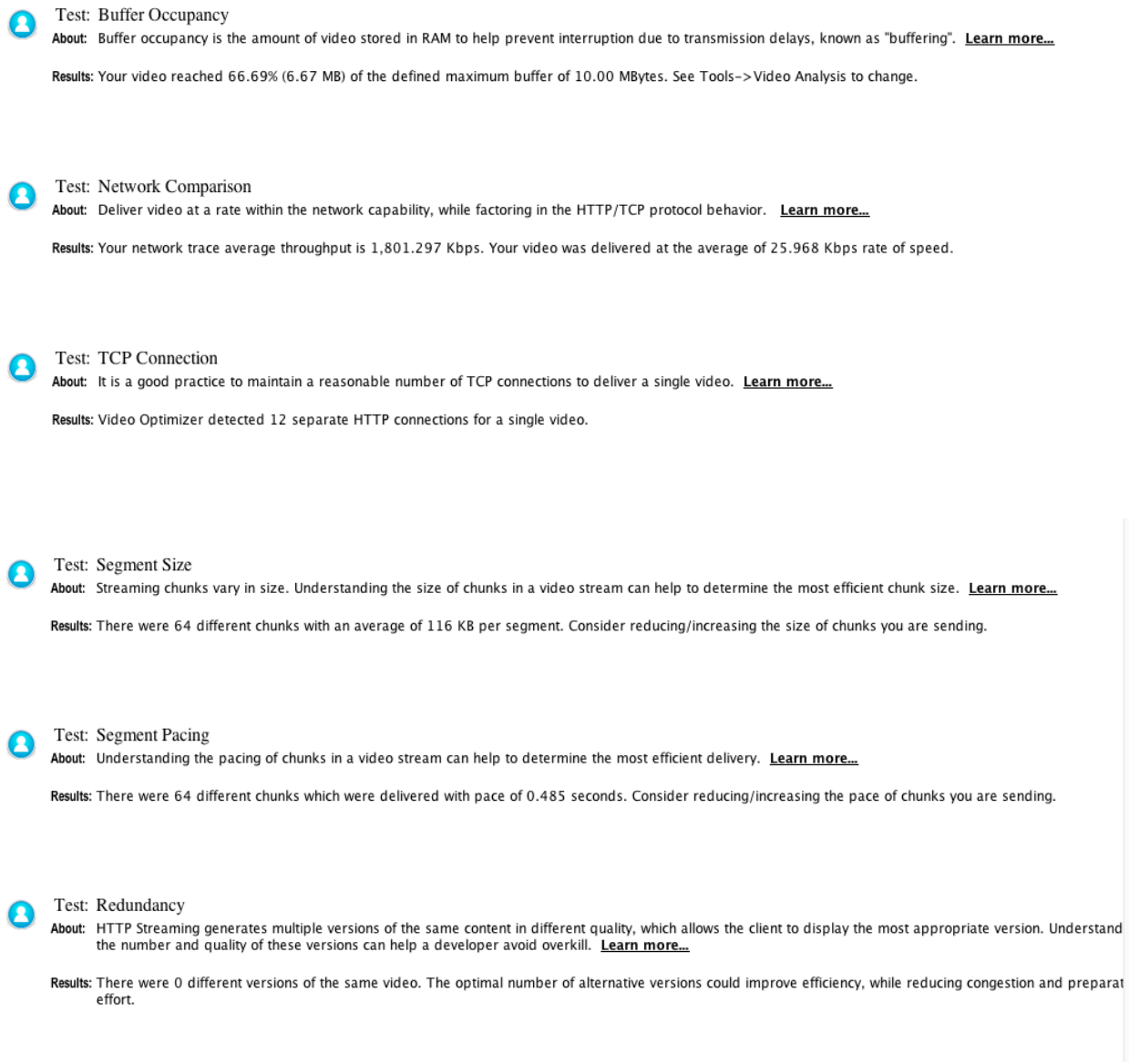
At 73.3s, the video buffer has 790 KB of data, which contains 30.33s of video playback time.

These steps will also allow Video Optimizer to calculate the data presented in the Video Best Practices:

6.4.3.2 Video Best Practices

In Video Optimizer 1.0, 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.





Test: Buffer Occupancy
About: Buffer occupancy is the amount of video stored in RAM to help prevent interruption due to transmission delays, known as "buffering". Learn more...

Results: Your video reached 66.69% (6.67 MB) of the defined maximum buffer of 10.00 MBytes. See Tools->Video Analysis to change.

Test: Network Comparison
About: Deliver video at a rate within the network capability, while factoring in the HTTP/TCP protocol behavior. Learn more...

Results: Your network trace average throughput is 1,801.297 Kbps. Your video was delivered at the average of 25.968 Kbps rate of speed.

Test: TCP Connection
About: It is a good practice to maintain a reasonable number of TCP connections to deliver a single video. Learn more...

Results: Video Optimizer detected 12 separate HTTP connections for a single video.

Test: Segment Size
About: Streaming chunks vary in size. Understanding the size of chunks in a video stream can help to determine the most efficient chunk size. Learn more...

Results: There were 64 different chunks with an average of 116 KB per segment. Consider reducing/increasing the size of chunks you are sending.

Test: Segment Pacing
About: Understanding the pacing of chunks in a video stream can help to determine the most efficient delivery. Learn more...

Results: There were 64 different chunks which were delivered with pace of 0.485 seconds. Consider reducing/increasing the pace of chunks you are sending.

Test: Redundancy
About: HTTP Streaming generates multiple versions of the same content in different quality, which allows the client to display the most appropriate version. Understand the number and quality of these versions can help a developer avoid overkill. Learn more...

Results: There were 0 different versions of the same video. The optimal number of alternative versions could improve efficiency, while reducing congestion and preparat effort.

7 Video Optimizer Data Analyzer Reference Guide

The following sections are a complete reference of the Command Menus and Content Tabs in the Video Optimizer Data Analyzer.

7.1 Command Menus

The Video Optimizer menu bar has the following menus.

Menu	Description

File	Contains options for opening trace files, opening Pcap files, setting the ADB path, 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, exporting analytical data in the JSON format, exporting data from a group of trace files (aka Data Dump) into a single .csv file,
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 from the Video Optimizer Data Analyzer.
Help	Contains options for displaying the Video Optimizer version, the FAQ page, User Documentation, Dependencies, Forum, Support, Downloads, and other Help documentation.

Table 7-1: Video Optimizer menu bar menus.

7.1.1 File Menu

The 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.
Open Pcap File	Opens a Pcap file for packet data analysis and also opens files that have been collected using the Windows Network Monitor (NetMon). When this menu item is selected, a dialog box is displayed that prompts you to select the location of the Pcap file. You must select a Pcap file using this command before you can view a packet data analysis of that file. **Note:** To open a file that was collected using NetMon, you must have NetMon installed on your machine.
Set ADB Location	Opens a dialog that allows you to set a path for the Android Debug Bridge (ADB). **Note:** The format should be "<path to SDK>/Androidsdk/platform-tools/adb"
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.

Table 7-2: File menu selections.

7.1.1.1 Set ADB Location

This feature opens a dialog that allows you to set a path to the Android Debug Bridge (ADB) on your computer.

Note: When entering the ADB path in this dialog, you must include the "adb" at the end of the path. The following figure demonstrates this:

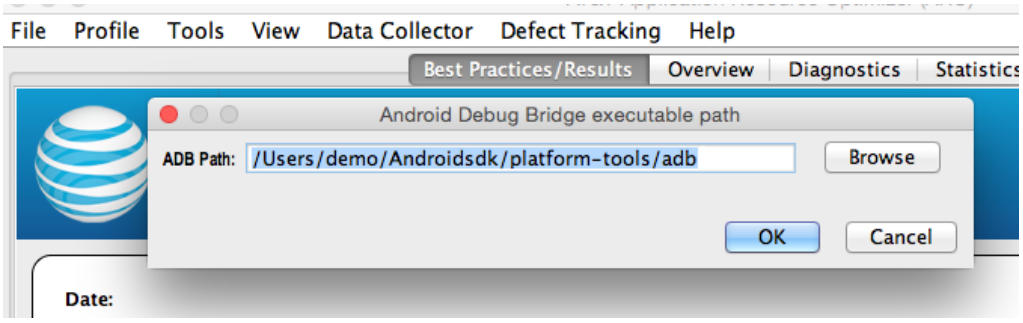


Figure 7-1 Set ADB Location Dialog box.

7.1.2 Profile Menu

The Profile menu contains the following selections. **Note**: Profiles are intended for advanced users of the Video Optimizer are not needed for most trace analysis.

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

Table 7-3: Profile menu selections.

7.1.2.1 Load Selection

When selected, the following dialog box is displayed that prompts you to select a pre-defined Profile. When a Profile is selected, the profile values that are used to calculate the statistical and analytical data are updated accordingly. Each Profile contains a set of attributes pertaining to the network and a set of attributes pertaining to the device. To edit the values of these profile attributes, select the Customize menu option.

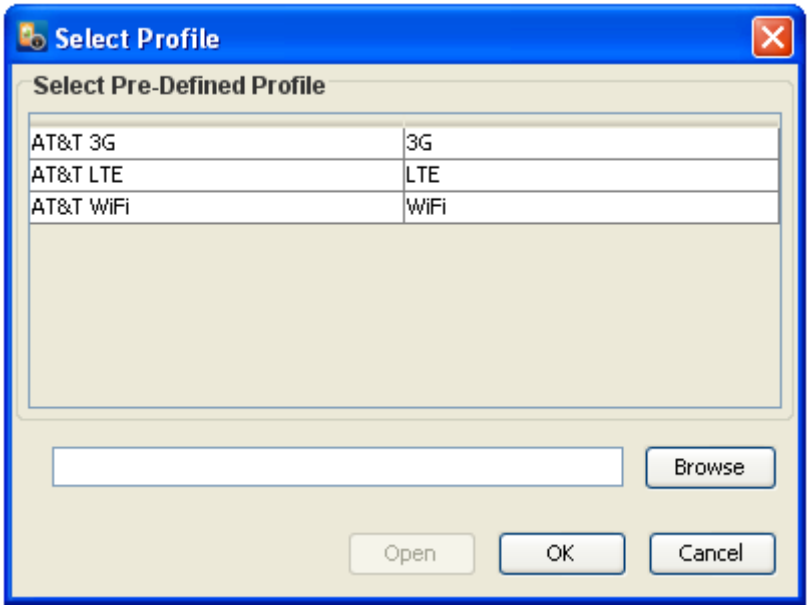


Figure 7-2: Select Profile dialog box.

7.1.2.2 Customize Selection

When selected, displays the profile attributes and values of the specified profile (Figure 7-2) in two tables in the following dialog box. The Network Attributes table contains attributes that vary according to the network type (3G, LTE, or WiFi), and the Device Attributes table contains attributes of the device that impact network activity.

7.1.2.2.1 AT&T 3G Profile Network and Device Attributes

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).

Network Attribute	Description
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.
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.

Network Attribute	Description
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.

Table 7-4: Network attributes for the AT&T 3G profile.

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).
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.

Device Attribute	Description
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.

Table 7-5: Device attributes for the AT&T 3G profile.

7.1.2.2.2 AT&T LTE Profile Network and Device Attributes

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

Network Attribute	Description
Carrier	The network carrier for the device.

Network Attribute	Description
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.
Min cycle for periodical transfers (sec)	The minimum cycle time (in seconds) used for calculating periodical transfers.

Network Attribute	Description	
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.

Table 7-6: Network attributes for the AT&T LTE profile.

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.
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.

Device Attribute	Description
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.

Table 7-7: Device attributes for the AT&T LTE profile.

7.1.2.2.3 AT&T WiFi Profile Network and Device Attributes

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.

Network Attribute	Description
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.

Table 7-8: Network attributes for the AT&T WiFi profile.

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.

Device Attribute	Description
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.

Table 7-9: Device attributes for the AT&T WiFi profile.

7.1.3 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, start or cancel the analysis, and display the analysis results.
Export html	Opens a Save As dialog box that allows you to export the currently loaded trace data to a html file.
Export Json	Opens a Save As dialog box that allows you to export the currently loaded trace data to a .json 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.
Video Analysis	Default settings for analysis of streaming video files downloaded during the trace. Settings can be overridden to customize the data to the specific application.

Table 7-10: Tools menu selections.

7.1.3.1 Time Range Analysis

This feature allows you to set a time range, start or cancel the analysis, and display the analysis results. When the start and end time are entered and the Start button is clicked, the following results are displayed based on the network type of the Profile that has been selected.

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.
Energy	The amount of energy used in joules.
DCH Time	The amount of time, in seconds, that was spent in the DCH state.
Average Throughput	The average data throughput in kilobytes per second.

Table 7-11: Time Range analysis results for a 3G profile.

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.
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.
Average Throughput	The average data throughput in kilobytes per second.

Table 7-12: Time Range analysis results for an LTE profile.

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.
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.
Average Throughput	The average data throughput in kilobytes per second.

Table 7-13: Time Range analysis results for a WiFi profile.

7.1.3.2 Export html

The Export html feature creates an html document with the results from the Best Practices tab.

7.1.3.3 Export Json

The Export Json feature sends the statistical and analytical data from the current trace to a single .json file.

7.1.4 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 / IP Addresses dialog box that allows you to select the application and IP address that are included in the analysis.
Select Time Range	Opens a dialogue to set a start and stop time. The trace will be re-analyzed between these two timestamps.
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

Table 7-14: View menu selections.

7.1.4.1 Show Video Viewer

Opens the Video Optimizer Image/Video Viewer and displays the video of the activities carried out on the device while the trace data was being collected.

The Image/Video Viewer has the following controls at the bottom of the window.

- **Play/Pause:** Plays or pauses the video.
- **Frame Step (Reverse):** Steps one frame at a time in the reverse direction.

- **Frame Step (Forward):** Steps one frame at a time in the forward direction.
- **Media Properties button:** Displays the Media Properties dialog box with three tabs of information about the video: (General, Video, and Plug-in Settings)
    - General Tab: Displays the location of the media file, the content type, and the duration, the current position in the file, the bit rate, and the frame rate.
    - Video Tab: Displays the encoding, size, and frame rate of the video.
    - Plug-in Settings Tab: Displays information about any additional plug-ins that are being used to display the video.

7.1.4.2 Select Applications/IPs

One table allows you to select individual applications and assign colors to them. The other table allows you to select individual IP Addresses, and assign colors to them.

The data from each selected application, and each selected 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.

The following image shows the Select Applications/IPs dialog box (please note that some information has been intentionally obscured).

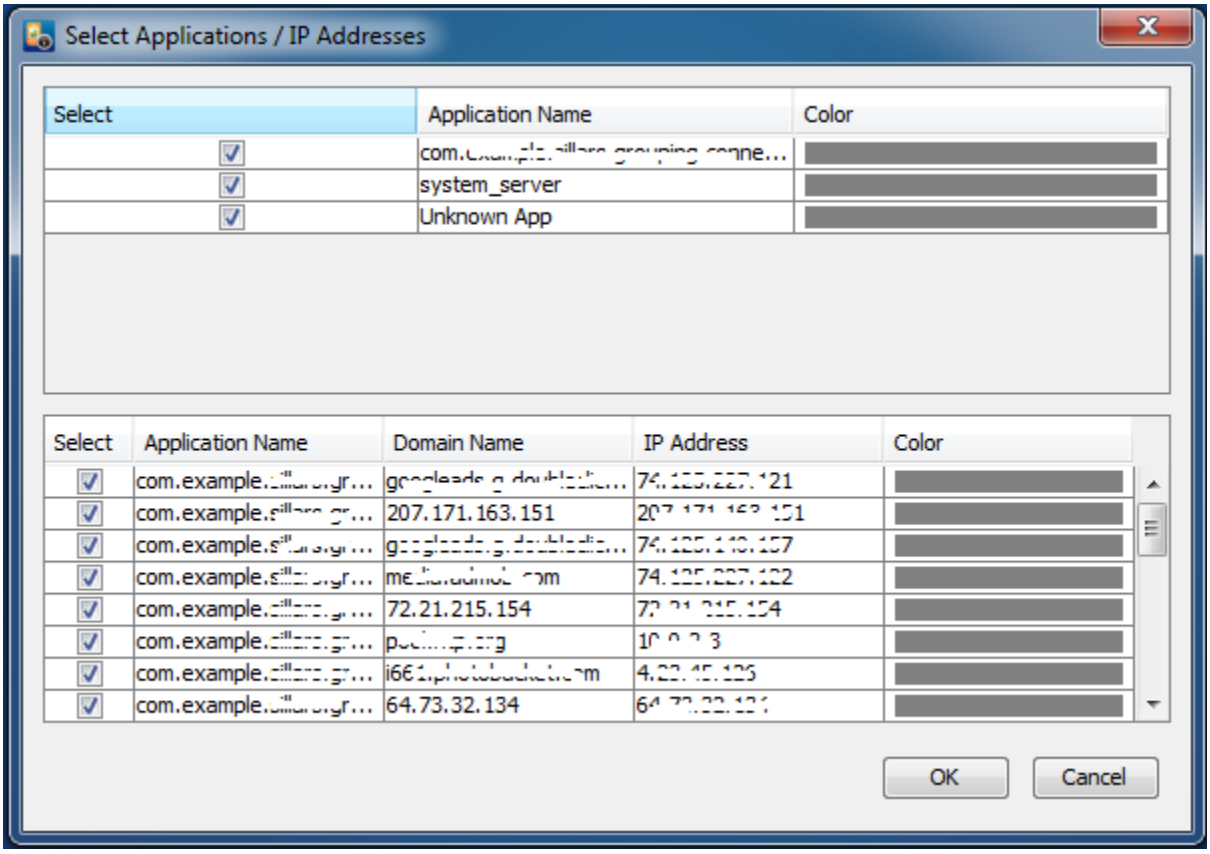


Figure 7-3: Select Applications/IPs dialog box.

When you click in any of the rows in the Color column, the following dialog appears, for selecting a color.

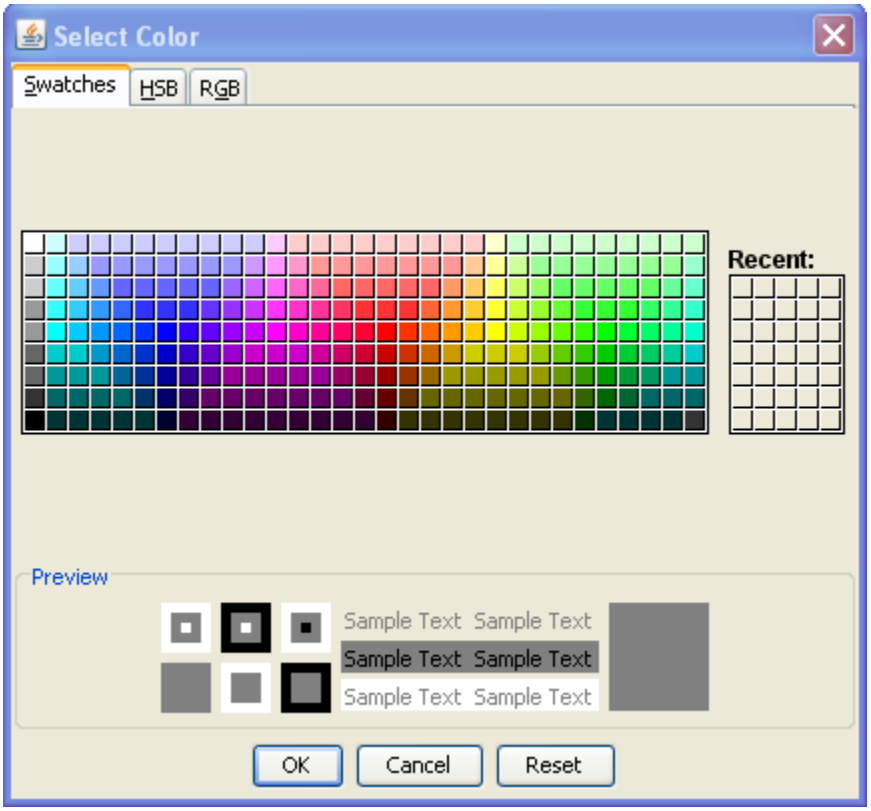


Figure 7-4: Color column.

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

7.1.4.3 Select Time Range

Display a dialog box that allows you to set a new Start time and End time 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.

The following image shows the Select Time Range dialog box.

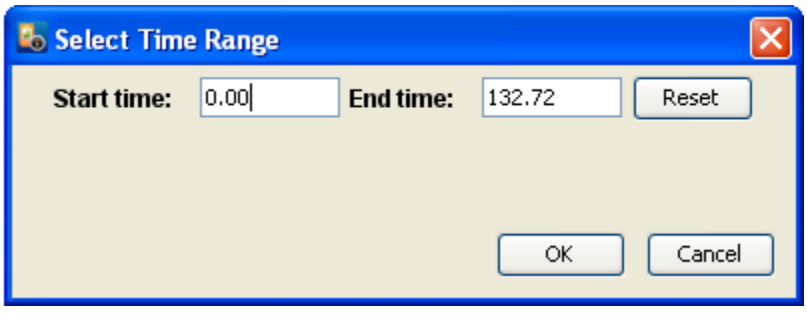


Figure 7-5: Select Time Range dialog box.

7.1.4.4 Select Processes

Opens a dialog box that allows you to select individual processes. The data from each selected process will be included in the analysis on the Diagnostics Chart and those that aren't selected will be excluded.

The following image shows the Select Processes to View dialog box.

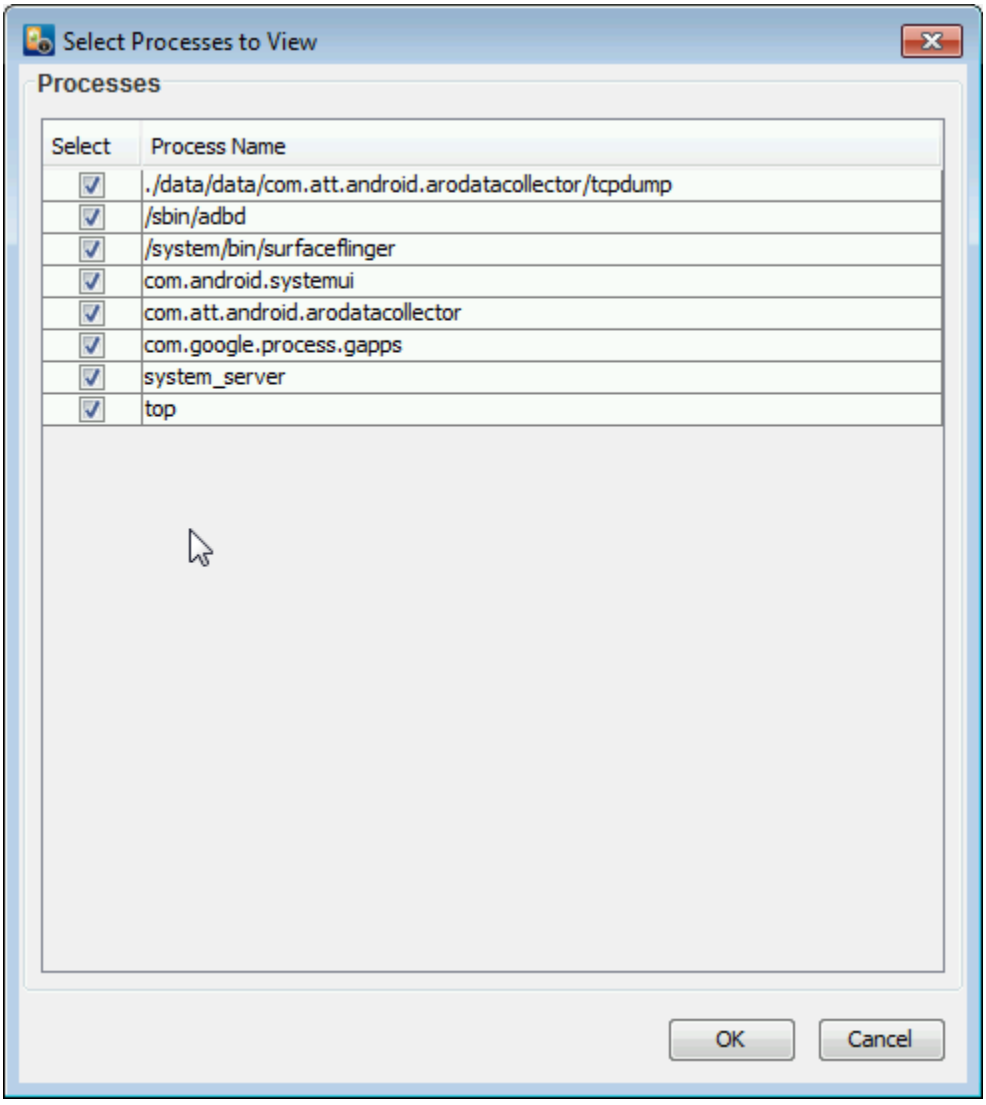


Figure 7-6: Select Processes to View dialog box.

7.1.4.5 Options

Displays a dialog box of View Options that allows you to select the events and states that will be plotted in the Diagnostics View chart. There are two checkboxes at the bottom "Default View" and "Video View" which are two preset views for the diagnostic window. While the Video Optimizer will display all of the options at once, we recommend keeping the list to under 10 views at a given time.

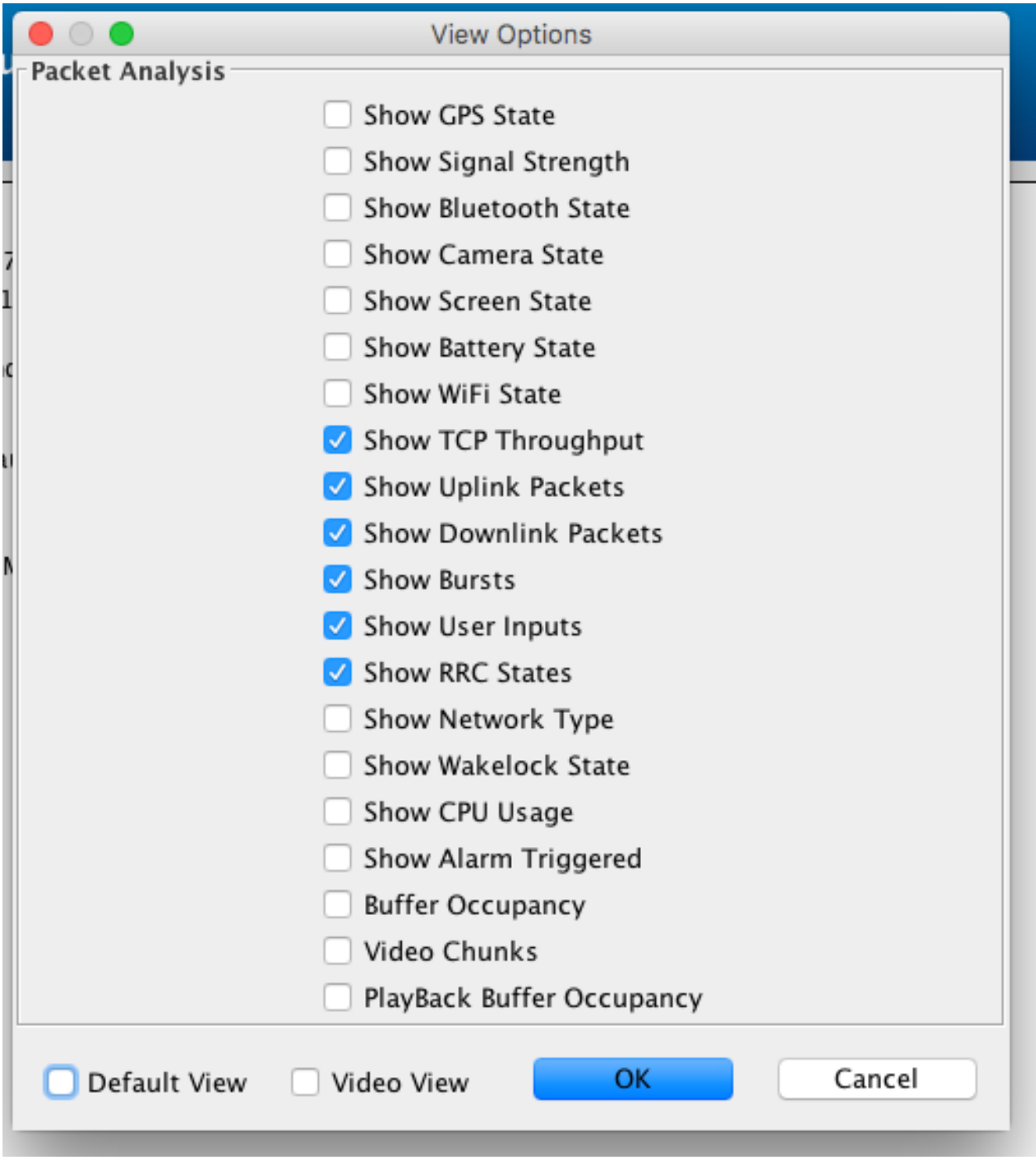


Figure 7-7: View Options dialog box.

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

7.1.5 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.

Table 7-15: Data Collector menu selections.

7.1.6 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 Documentation web page.
Analysis Guide	Opens the default web browser and displays the Video Optimizer Documentation web page.
Dependencies	Displays a dialog box containing the license information for the open source libraries and binaries that are distributed within the Video Optimizer package.
Forum	Opens the default web browser and displays the Video Optimizer User Forum web page.
Support	Provides a link to log in to the AT&T Developer Program and file a ticket with ARO 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 ARO Data Collector.
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.

Table 7-16: Help menu selections.

7.2 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.

Statistics	Displays charts and tables that present key statistical data from the trace.
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.

Table 7-17: Video Optimizer user interface tabs.

7.2.1 Best Practices/Results Tab

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

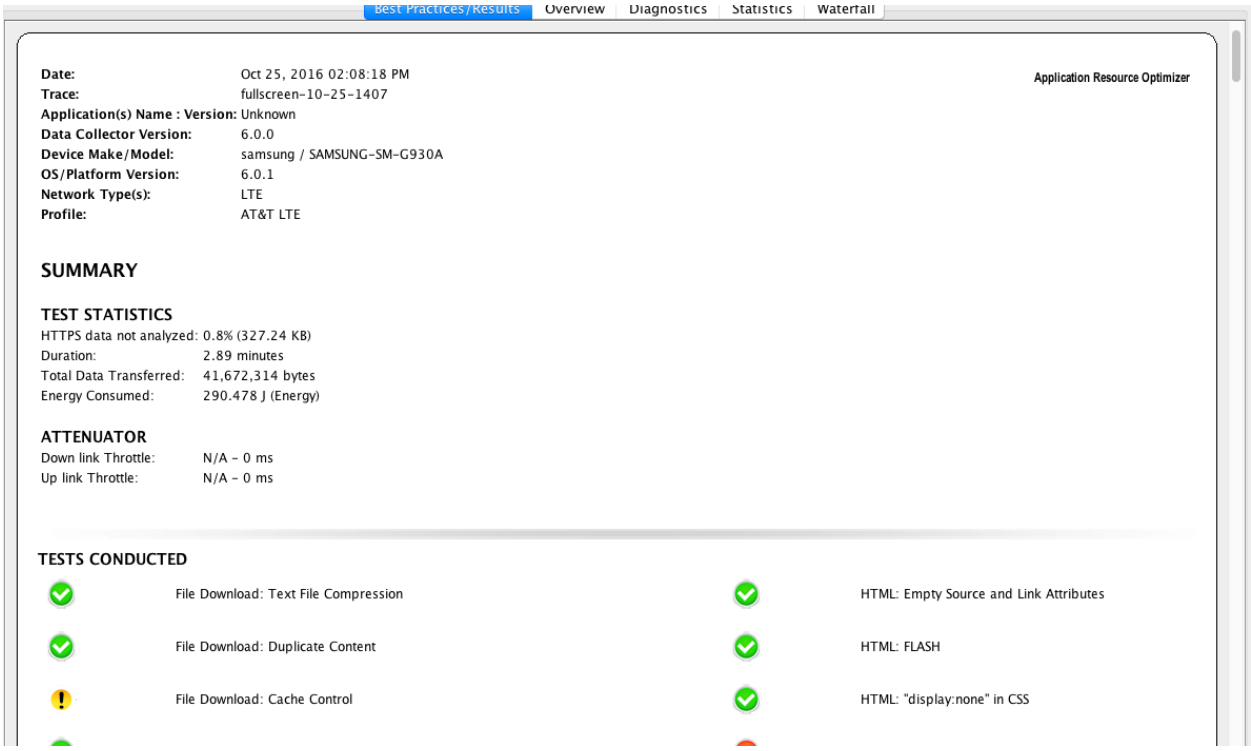


Figure 7-8: Best Practices/Results tab.

When trace files are loaded into the Video Optimizer Data Analyzer, The Best Practices / Results tab contains the following pages of test results.

- A header panel with basic information about the trace.
- A Summary page that contains high-level test statistics and attenuator information.
- A Tests Conducted page that lists all of the tests and has a basic pass/fail/warning result for each in the form of an icon.

- High-level results pages for the all of 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.
Application Name (s): 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.
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.
Profile	The device profile that was used for the trace analysis.

Table 7-18: Best Practices/Results tab common information.

7.2.1.1 Video Optimizer Best Practices Results – Summary Page

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

7.2.1.1.1 Test Statistics

This section shows the following information about the loaded trace files:

Label	Description
HTTPS data not analyzed	The percentage of total content and the size of content, in KB, that was downloaded over HTTPS and was not analyzed.
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.
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.

Table 7-19: Test statistics information.

7.2.1.1.2 Attenuator

If the Network Attenuator functions were used during collection, the parameters will be displayed here. Downlink throttle provides the ms delay in the downlink throttling, and uplink is the delay placed on uplink connections.

7.2.1.1.3 Tests Conducted

This section displays a list of all the best practices tests that were conducted on the loaded trace files with one of the following icons to the left of each test name that indicates the test result status.

Label	Name	Meaning
	Pass	The test has passed the best practice criteria.
	Fail	The test has failed the best practice criteria.
	Warning	The test has failed the best practice criteria, but the test is primarily informational and not critical.

Table 7-20: Test result icons

The Best Practices tests, are conducted on the trace data. The tests are grouped into categories.

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

Test	Category	Description
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.
Minify CSS, JS, JSON and HTML	File Download	Tests if there are any files that could be minified (shrunk through the removal of whitespace).
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.
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.
Inefficient Connections – Periodic Transfers	Connections	Tests if a periodic connection is detected in the loaded trace files.

Test	Category	Description
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.
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.
FLASH	HTML	Tests for any references to the Flash player in the loaded trace files.

Test	Category	Description
“display: none” in CSS	HTML	Tests for any instances of the CSS command “display:none” in the trace files.
Security: HTTPS Usage	Security	Looks for connections that do not feature HTTPS.
Transmission of Private Data	Security	Scans all transmitted data for potential leaks of private data.
Unsecure SSL Version	Security	There are several versions of SSL that are not considered secure. This test identifies connections that use those versions.
Weak Cipher	Security	Scans for security with weak ciphers that can be easily compromised.
Forward Secrecy	Security	Encryption that allows key capture, allowing attackers to gain access to all security keys.
Video Stalls	Video	Identifies when a video stalls (stops playing due to an empty buffer).
Video 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.
TCP Connection	Video	Count of connections used to deliver video during the trace.
Chunk size	Video	Average size of the video chunks downloaded during streaming.

Test	Category	Description
Chunk Pacing	Video	Pacing of the video chunks downloaded during streaming.
Redundancy	Video	Looks to see if the same chunk is downloaded multiple times.
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.

Table 7-21: Best Practices tests.

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

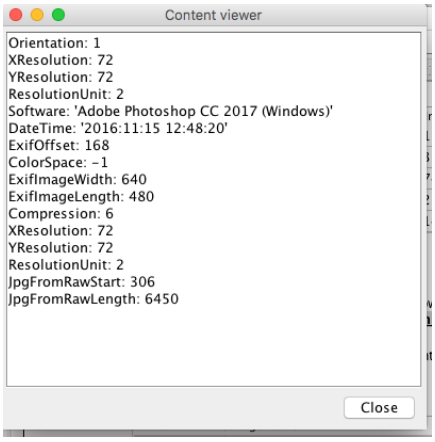
7.2.1.2 Best Practices: Tables

The tables in the Video Optimizer best practices sections have very useful functionality. In addition to helping to pinpoint the issues flagged by the best practice, they also allow you to further investigate the issues.

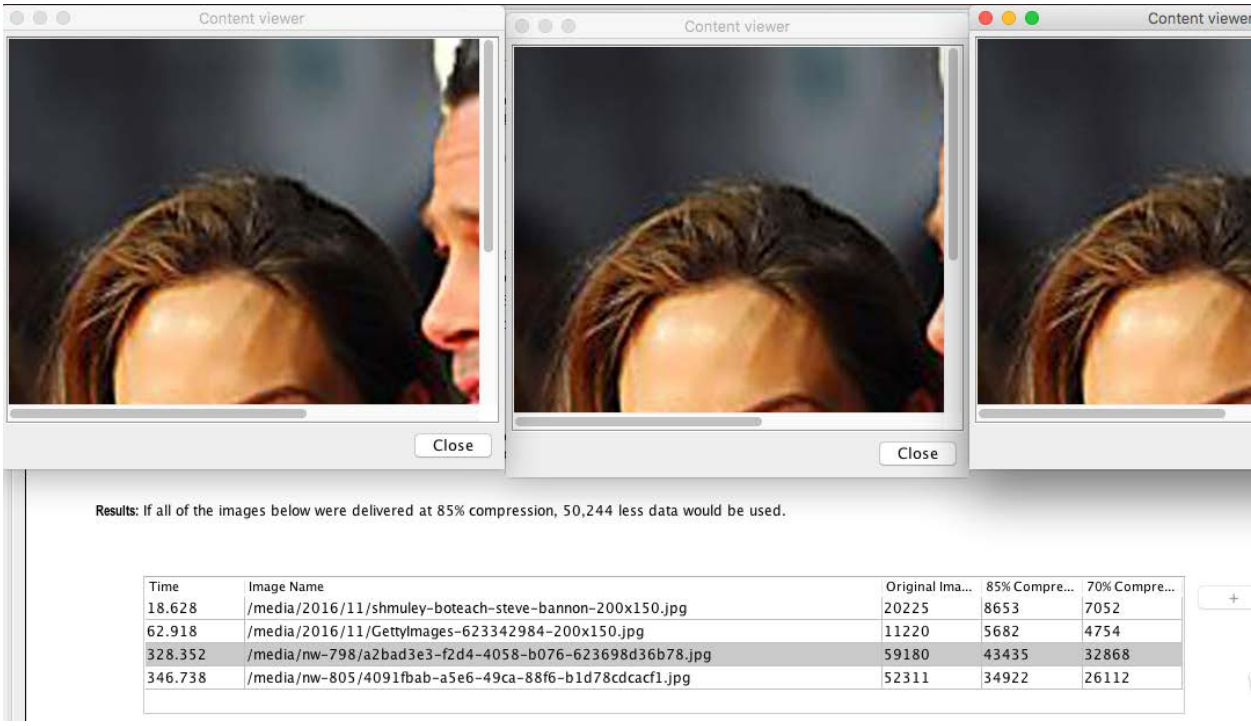
Double clicking a line in a table often will forward you to the Diagnostics tab, highlighting the connection or file that is failing the best practice. Right clicking will export the table as csv. (Alternatively, command-a (select all) command-c (copy) will allow you to paste (command v) the table into your favorite spreadsheet software.

7.2.1.2.1 Best Practices: Image Tables

The Images tables have a couple of additional features. For Image metadata: a single click will open a content view with the metadata:



The Image Compression table also has a single-click property. Clicking on the file name or original file size columns will open a view of the original image. Clicking on the 85% column will open the 85% compressed image, and the 70% column will open the 70% compressed image. In the screenshot below, all 3 images are open (left to right: original, 85%, 70%)



This will allow you to visually compare the 3 images for differences.

7.2.2 Overview Tab

The Overview Tab displays charts and tables that summarize the data in the loaded trace files. The top part of the 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 ms delay.
- **Uplink Throttle:** If Network Attenuator uplink function was used during this trace, this will record the ms delay uplink.
- **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,

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

The tables in the bottom section of the Overview Tab list, and allow the user to drill into, duplicate content, accessed domains, and the TCP sessions in the accessed domains.

The following sections describe each of the charts and tables in the Overview Tab in more detail.

7.2.2.1 File Types Chart

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

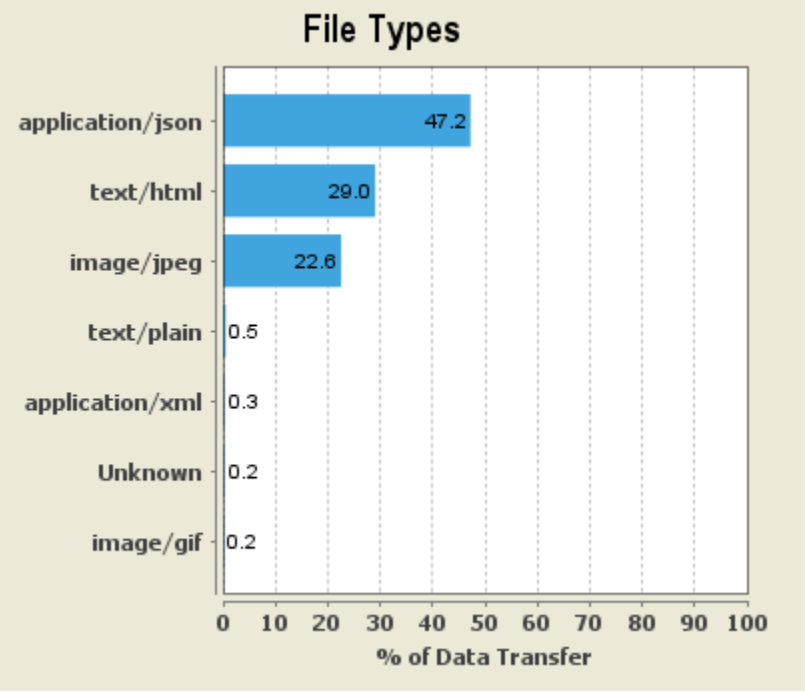


Figure 7-9: File Types chart.

7.2.2.2 Trace Benchmarking Chart

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.

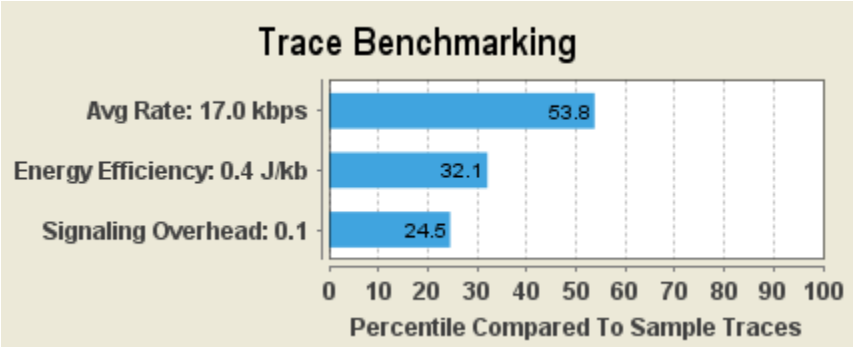


Figure 7-10: Trace Benchmarking chart.

7.2.2.3 Connection Statistics

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, periodic bursts connection, and large burst connection.

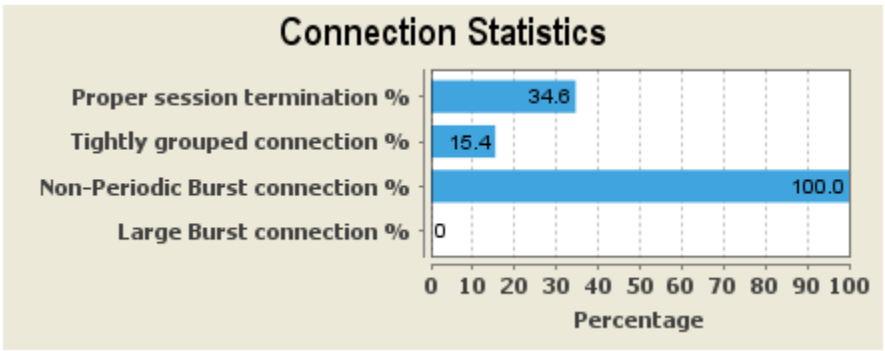


Figure 7-11: Connection Statistics chart.

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.

Field	Description
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 of time, then those bursts are considered *non-periodic 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.

Table 7-22: Connection Statistics chart fields.

7.2.2.4 Duplicate Content Table

The Duplicate Content table lists the files that have been identified as duplicate content. By default, the table is sorted by content type, and includes columns for the file name, the time at which the file was downloaded, and the size of the file. The table can be sorted on any of the columns by clicking the title of the column. The content of the files can be viewed or saved, by selecting the file and clicking the View or Save As buttons on the right side of the table.

Note: The Duplicate Content table supports the following mouse actions:

- Right click: Allows you to export the Duplicate Content table data in the CSV format.
- Double-click: Navigates to the TCP/UDP Flows Table in the Diagnostics tab where you can view the TCP or UDP information for the selected duplicate content. The selected duplicate content will be indicated by highlighted type.

The Duplicate Content table contains 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
Time	The timestamp for this occurrence of the duplicate content.

Column	Description
File Name	The name of the duplicate file.
File Size (bytes)	The size of the duplicate file in bytes.

Table 7-23: Duplicate Content table columns.

7.2.2.5 Accessed Domains Table

The Accessed Domains table contains details about each domain that was accessed during the trace. The details include the name of the accessed domain, the number of TCP sessions that were used to access the domain, the average TCP session length, and the number of files downloaded from the domain. The table can be sorted on any of the columns by clicking the title of the column. When a domain in this table is selected, the Domain TCP Sessions table is populated with information about the TCP sessions that were used when accessing that domain.

Note: The Accessed Domains table supports the following mouse actions:

- Left click: Refreshes the Domain TCP Session table with the appropriate TCP session information for the row that is clicked.
- Right click: Allows you to export the Accessed Domains table data in the CSV format.

The Accessed Domains table contains 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 particular domain name.
Files Downloaded	The number of files downloaded for the domain name session.

Table 7-24: Accessed Domains table.

7.2.2.6 Domain TCP Sessions Table

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 in that table. The details about each session include the time when the session occurred, the remote IP address, the local port, the session length, the number of bytes that

were transmitted during the session, and the session closing details. The table can be sorted on any of the columns by clicking the title of the column.

Note: The Domain TCP Sessions table supports the following mouse actions:

- Right click: Allows you to export the Domain TCP Sessions table data in the CSV format.
- Double-click: Navigates 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.

The Domain TCP Sessions table contains 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.

Table 7-25: The Domain TCP Sessions table

7.2.3 Diagnostics Tab

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

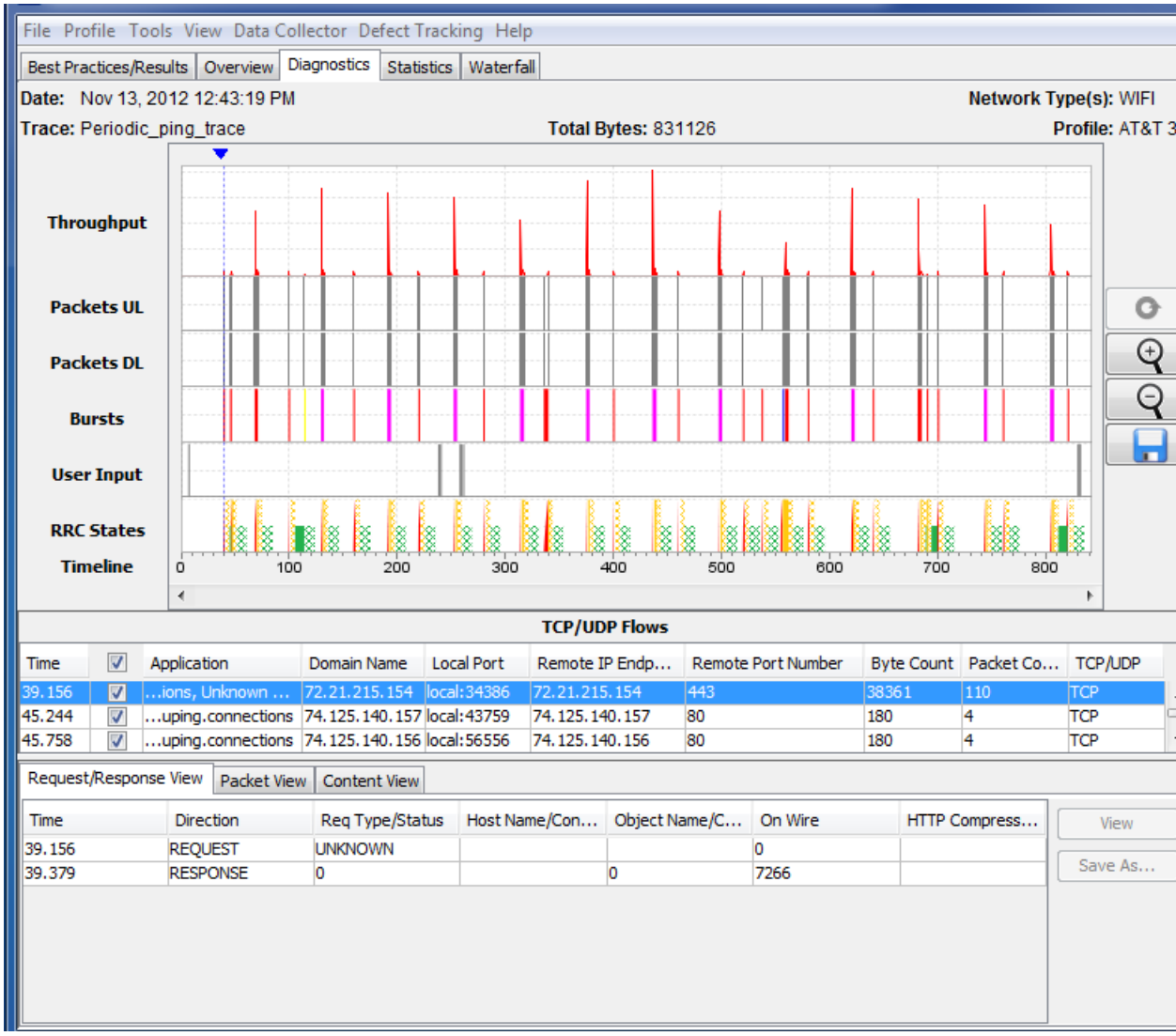


Figure 7-12: Diagnostics chart.

The top part of the Diagnostics section 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 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.

The following sections describe the information displayed in the Diagnostics chart and the TCP/UDP Flows Table.

7.2.3.1 Diagnostics Chart

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

As you view the chart, you can use the buttons on the right side of the chart to Refresh the chart, Zoom In and Zoom Out sections of the chart, and Save a snapshot of the chart.

The chart plots the following information if it is present in the trace. (The default information options are marked in italics and the label that appears on the chart is listed in parenthesis when it is different from the label in the Options dialog box.)

- GPS State
- Signal Strength
- Bluetooth State
- Camera State
- Screen State
- Battery State
- WiFi State
- *TCP Throughput (Throughput)*
- *Uplink Packets (Packets UL)*
- *Downlink Packets (Packets DL)*
- *Bursts*
- *User Input*
- *RRC States*
- Network Type
- Wakelock State
- CPU Usage
- Alarm Triggered
- Buffer Occupancy
- Video Chunks
- Playback Buffer Occupancy

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

3. Select Options in the View menu.
4. Mark the checkboxes for the items to be plotted (Figure 7-13, and then click the OK button.

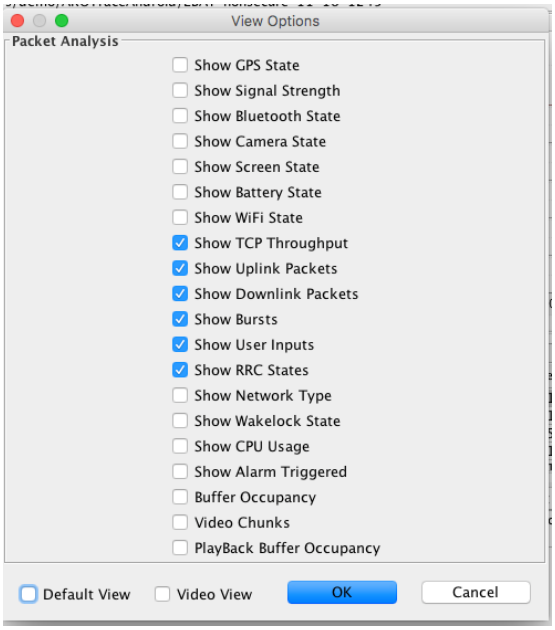


Figure 7-13: View Options dialog box.

The following sections describe in detail the different types of information that are plotted on the Diagnostics Chart.

Note that in addition to creating your own custom view, there is a default view and a video view – especially created to help analyze video traces.

7.2.3.1.1 GPS State Plot

The GPS State plot shows the variation in GPS states over the duration of the trace. When you place the tool tip over the plot, the GPS state at that point in time is displayed, along with the beginning time of the state.

The following table describes the GPS states and how they appear in the plot.

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.

Table 7-26: GPS states.

7.2.3.1.2 Signal Strength Plot

The Signal Strength plot shows the variation in radio signal strength (expressed in Dbm) over the duration of the trace. When you place the tooltip over the junction points in the plot, the signal strength at that point in time is displayed.

7.2.3.1.3 Bluetooth State Plot

The Bluetooth State plot shows the variation in Bluetooth states over the duration of the trace. When you place the tooltip over the plot, the Bluetooth state at that point in time is displayed, along with the beginning time of the state.

The following table describes the Bluetooth states and how they appear in the plot.

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.

Table 7-27: Bluetooth states.

7.2.3.1.4 Camera State Plot

The Camera State plot shows the variation in camera states over the duration of the trace. When you place the tooltip over the plot, the camera state at that point in time is displayed, along with the beginning time of the state.

The following table describes the camera states and how they appear in the plot.

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.

Table 7-28: Camera states.

7.2.3.1.5 Screen State Plot

The Screen State plot shows the variation in screen states over the duration of the trace.

The following table describes the screen states and how they appear in the plot.

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.

Table 7-29: Screen states.

7.2.3.1.6 Battery State Plot

The Battery State plot shows the variation in battery level over the duration of the trace. When you place the tooltip over the plot, the battery level, battery temperature, and battery connection status are displayed.

7.2.3.1.7 WiFi State Plot

The WiFi State plot shows the variation in WiFi states over the duration of the trace.

The following table describes the WiFi states and how they appear in the plot.

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.
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 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.

Table 7-30: WiFi states.

For all states except the WiFi Connected state, the tooltip over the plot displays the WiFi state at that point in time, along with the beginning time of the state. For the WiFi Connected State, the tool tip also shows the Mac Address, Radio

Received Signal Strength Indication (RSSI) and Service set identifier (SSID) along with the state detail.

7.2.3.1.8 Throughput Plot

The Throughput plot shows the variation in network traffic (expressed in kbps) over the duration of the trace. When you place the tooltip over the plot, the throughput kbps at that point in time is displayed. Note that the higher the throughput, the higher the energy consumption.

7.2.3.1.9 Packets Uplink Plot

The Packets UL plot shows the packets that were uploaded (uplinked) in the TCP sessions over the duration of the trace.

When you place the tooltip over the plot, the following information is displayed:

- **Packet Info:** Packet ID, packet timestamp, and Application name.
- **TCP Session Info**: Begin time, end time, remote IP address, remote port, local port.
- **HTTP Info**: File name, content length, and content type.

7.2.3.1.10 Packets Downlink Plot

The Packets DL plot shows the packets that were downloaded (down linked) in the TCP sessions over the duration of the trace.

When you place the tooltip over the plot, the following information is displayed:

- **Packet Info:** Packet ID, packet timestamp, and Application name
- **TCP Session Info**: Begin time, end time, remote IP address, remote port, local port
- **HTTP Info**: File name, content length, and content type.

7.2.3.1.11 Burst Plot

A burst consists of consecutive packets transferred in a batch. The Burst plot shows the various types of bursts that occurred over the duration of the trace.

When you place the tooltip over the plot, the burst type, a message, the packet count, the total bytes, and the throughput (in kbps) are displayed.

The following table describes the burst categories and how they appear in the plot.

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."*

Burst Type	Description
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: *"UserInput: Traffic initiated after a User Input event."*
ScreenRotation	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."*
LargeBurst	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."*
UserDefined	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.

Table 7-31: Burst categories.

7.2.3.1.12 User Input Plot

The User Input plot shows the various user input events that have occurred over the duration of the trace.

When you place the mouse pointer over the plot, a tooltip displays one of the following messages describing the user input event that occurred at that point in time:

- Screen Touch
- Power Button
- Volume Up
- Volume Down
- Ball Key
- Home Key
- Menu Key
- Back Key
- Search Key
- Green Key
- Red Key
- Key Press/Screen Touch
- Screen Orientation Changed to Landscape
- Screen Orientation Changed to Portrait
- Unknown event

7.2.3.1.13 RRC States Plot

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

When you place the mouse pointer over the plot, a tooltip displays the RRC state that occurred at that point in time.

The following table describes the RRC states, and how they appear in the plot.

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.

RRC State	Description
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 PROMOTION	Transition from IDLE to the Continuous Reception state. This indicates the time and power associated with the radio switching from idle to active.
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.
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.

Table 7-32: Radio Resource Control (RRC) states.

7.2.3.1.14 Network Type Plot

The Network Type plot 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, and LTE.

When you place the tooltip over the plot, the number of seconds that the device has been connected to the current network type at that point in the trace, is displayed.

7.2.3.1.15 Wakelock State Plot

The Wakelock State plot indicates whether the device is in the “wake” state (active for user input) or the “lock” state during the trace.

When you place the tooltip over the plot, the number of times the wakelock state has been changed from the plot point to the beginning of the trace is displayed.

7.2.3.1.16 CPU Usage Plot

The CPU Usage plot indicates the percentage of CPU usage for each process that is selected in the Select Processes to View dialog box. Although the CPU Usage percentages for all the processes can be viewed at once, this chart plot 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.

When you place the tooltip over the plot, you will see the total percentage of CPU usage for all processes listed first followed by the name of each selected process and the percentage of CPU that it is using, as in the following image:

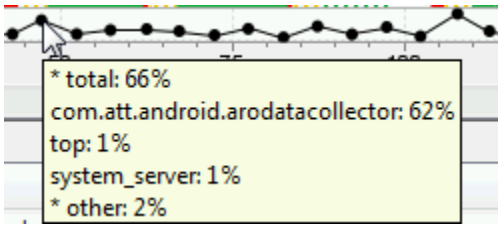


Figure 7-14: CPU Usage chart.

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.

7.2.3.1.17 Alarm Triggered Plot

The Alarm Triggered plot indicates when an application has triggered an alarm.

When you place the tooltip over the plot, the type and timestamp of the alarm, the name of the application that triggered it, and the number of times it repeated, is displayed.

7.2.3.1.18 Playback Buffer Occupancy

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).

7.2.3.1.19 Buffer Occupancy

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).

7.2.3.1.20 Video Chunks

For videos without DRM, Video Optimizer will decode the first frame of each chunk and display it here to indicate when the chunk download commenced. If the chunk has DRM, or Video Optimizer cannot parse the first frame, a placeholder image will be displayed.

Clicking on a chunk thumbnail opens a dialogue to “match” the screenshot with the time it appears in the video (see video analysis section for details). Once the video has been matched with the screen video, moving your mouse over a video frame will display information about the video playback.

7.2.3.2 TCP/UDP Flows Table

The Content Tabs appears below the Diagnostics Chart. When the Diagnostics Chart is clicked, the row of TCP or UDP session data corresponding to that point in the trace is highlighted in the TCP/UDP Flows table.

To narrow the trace data that appears in the Diagnostics Chart by selecting individual rows of TCP or UDP data, select or de-select the check box next to that row. By clicking the check box in the title row, you can select or deselect all of the TCP and UDP data.

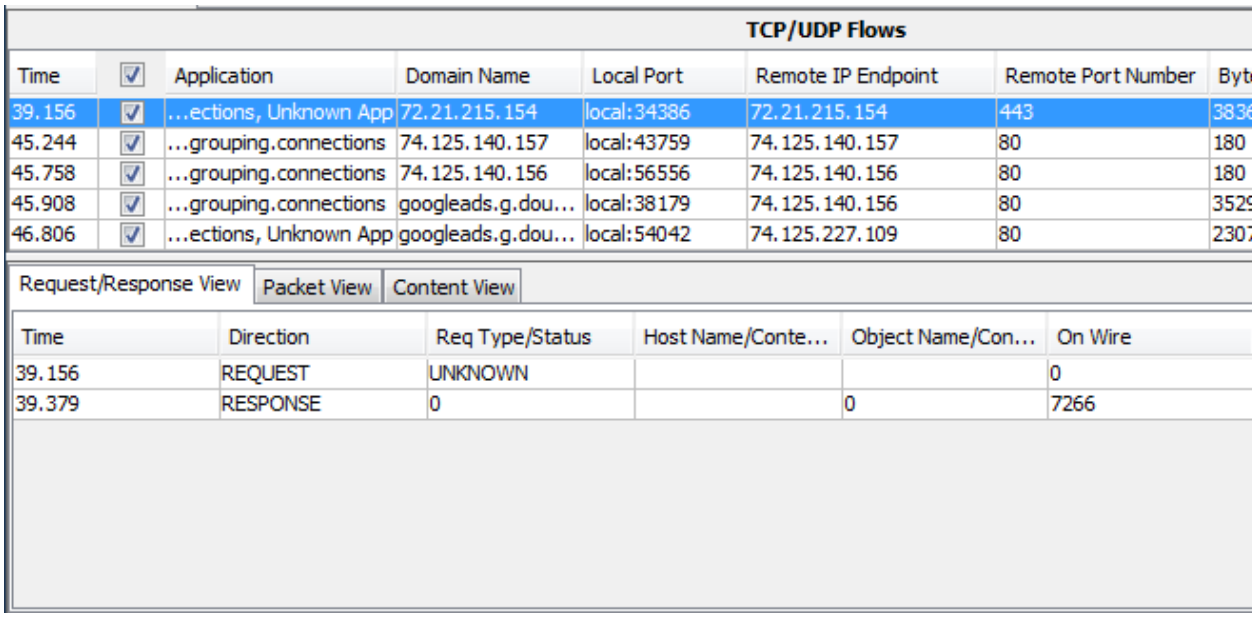


Figure 7-15: TCP/UDP Flows table.

The TCP/UDP Flows table contains the following columns of information:

Column	Description
Time	The amount of time (in seconds) from the beginning of the trace, when this request was made.
Application	The name of the client application that is making the request.
Domain Name	The name of the domain to which the request is being made.
Local port	The local port through which the request is being made
Remote IP Endpoint	The IP address of the domain on which these requests are being listened for.
Remote Port Number	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 flow.
Packet Count	The number of packets in the request.
TCP/UDP	Indicates whether the TCP or UDP protocol was used.

Table 7-33: CP Flows table columns.

When a row in the TCP/UDP Flows table is clicked, detailed information is displayed in the table below it, using one of three different views:

- Request/Response View (The default view)
- Packet View
- Content View

These views are selected by clicking the tabs above the table where the information is displayed.

The following sections describe the information in each of the three views.

7.2.3.2.1 Request/Response View

The Request/Response View tab displays the request/responses associated with the selected row highlighted in the TCP/UDP Flows Table, as in the following example.

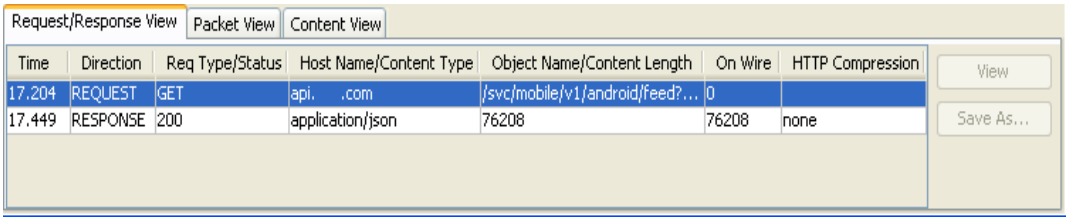


Figure 7-16: Request/Response View tab.

The column headings in the Request/Response View have different meanings (separated by a "/" in the column name) depending on whether the row contains a request or a response.

The following table describes the columns when the row represents a request.

Column	Description
Time	The time of the REQUEST, in seconds, from the beginning of the trace.
Direction	The direction of the TCP flow. The value of this field will be REQUEST when the row represents a request.
Req Type	One of the following HTTP Request Types: GET, PUT, POST, or DELETE.
Host Name	The host name for the HTTP Request.
Object Name	The name of the object requested from the host.
On Wire	The number of bytes on the wire during this REQUEST.
HTTP Compression	This column is only used for RESPONSES with a text MIME type.

Table 7-34: Request/Response View for a request.

The following image and corresponding table describes the columns when the row represents a response.

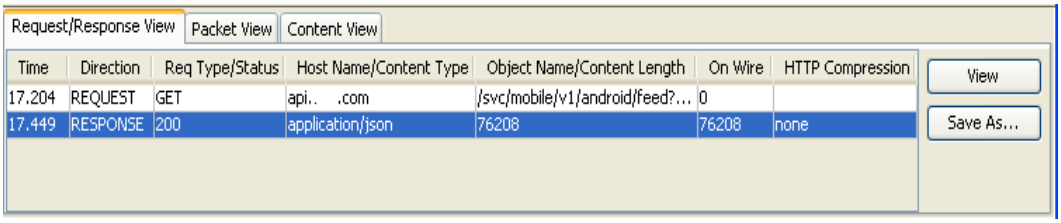


Figure 7-17: Request/Response View for a response.

Column	Description
Time:	The time of the response, in seconds, from the beginning of the trace.
Direction	The direction of the TCP flow: The value of this field will be RESPONSE when the row represents a response.
Status	The HTTP status of the response. For example: 200 means ok, and 404 means that the resource was not found.
Content Type	The content type of the response which consists of a pair of values (type/subtype) representing the internet media type Some examples of content types (and their meanings) are: 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).
Content Length	The length, in bytes, of the response

Column	Description
On Wire	The number of bytes on the wire during this response.
HTTP Compression	If the RESPONSE contains a text file, this column indicates if HTTP compression was used or if there was none.

Table 7-35: Request/Response View for a response.

7.2.3.2.1.1 Viewing and Saving Response Data

When a row containing a response is selected in the Request/Response View, the following buttons are available. (Note that these buttons are not available for Requests).

Button	Description
View	The View button allows the user to view the response object: For an image, the image will be displayed. For text/html, the html will be displayed. For application/JSON, the JSON object will be displayed.
Save As	The Save As button allows the user to save the object as a file in the specified directory.

Table 7-36: Request/Response View buttons.

The following examples show how different types of data objects in a Response can be viewed or saved.

Example 1: Displaying an image.

Clicking on the View button displays the data object in the response. If the data object is an image, it will be displayed in the Content viewer like the following figure:

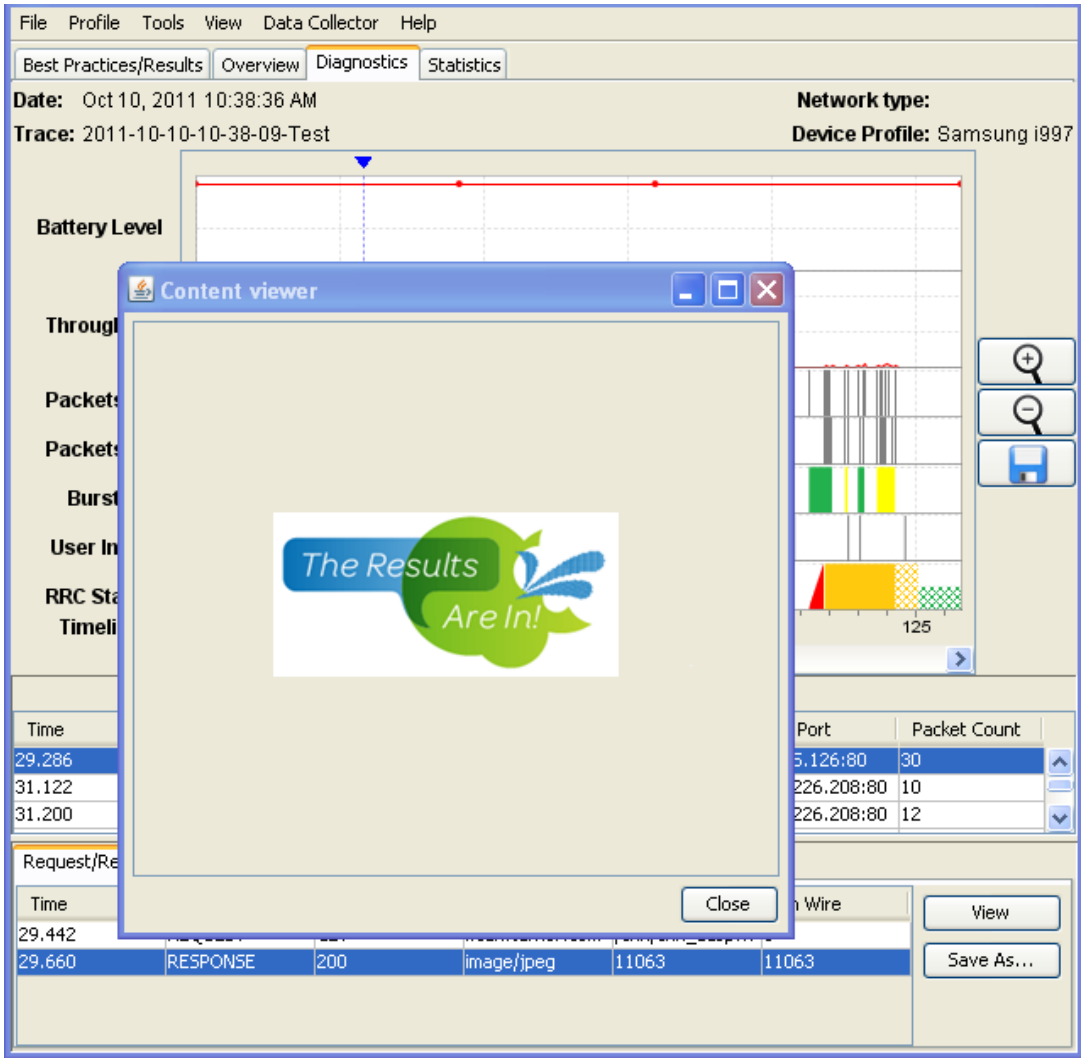


Figure 7-18: Example of displaying an image.

Example 2: Displaying text, HTML, or JSON.

If the data object is a text, HTML, or JSON it will be displayed in the Content viewer like the following figure:

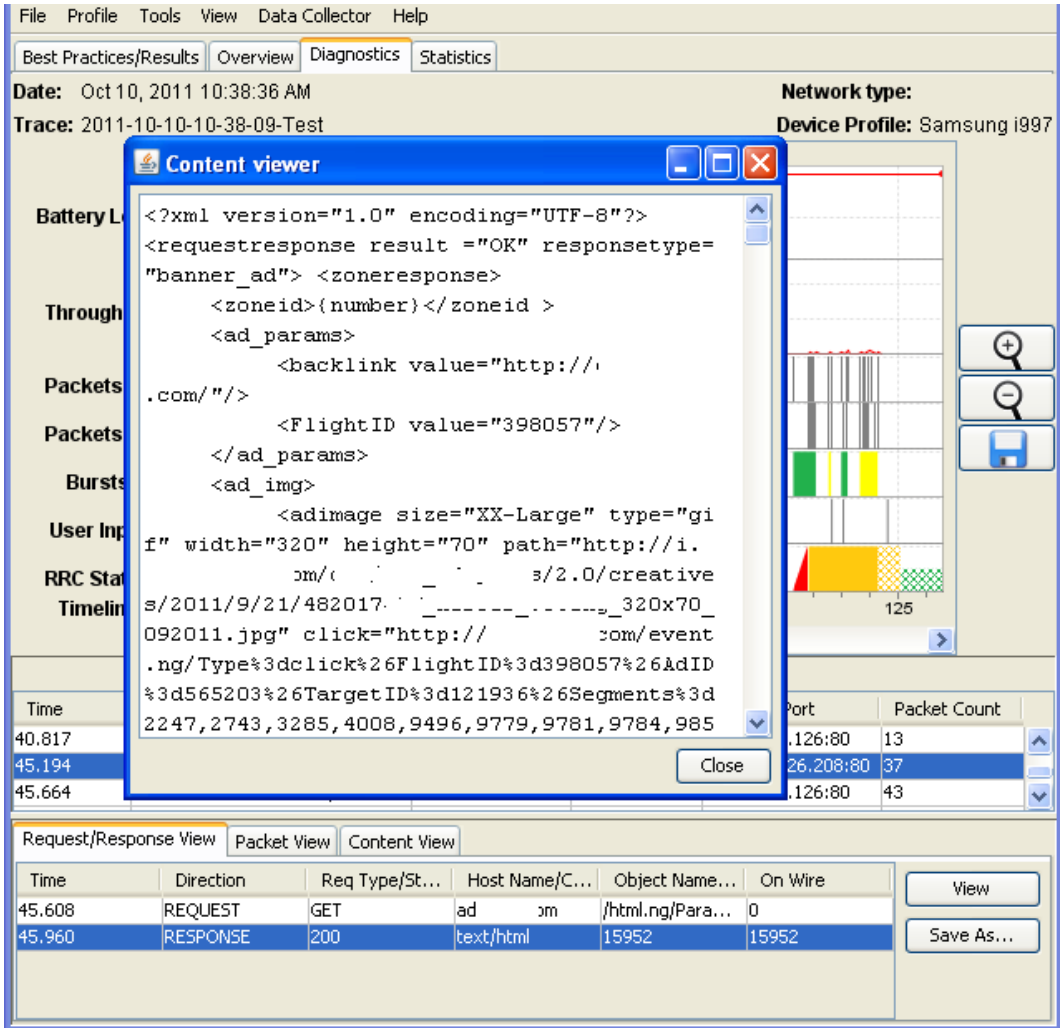


Figure 7-19: Example of displaying text, HTML, or JSON.

Viewing an object that cannot be displayed.

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

Example 4: Saving the object in a file

Clicking on the Content Tabs button displays a dialog box that allows you to save the object to a different location.

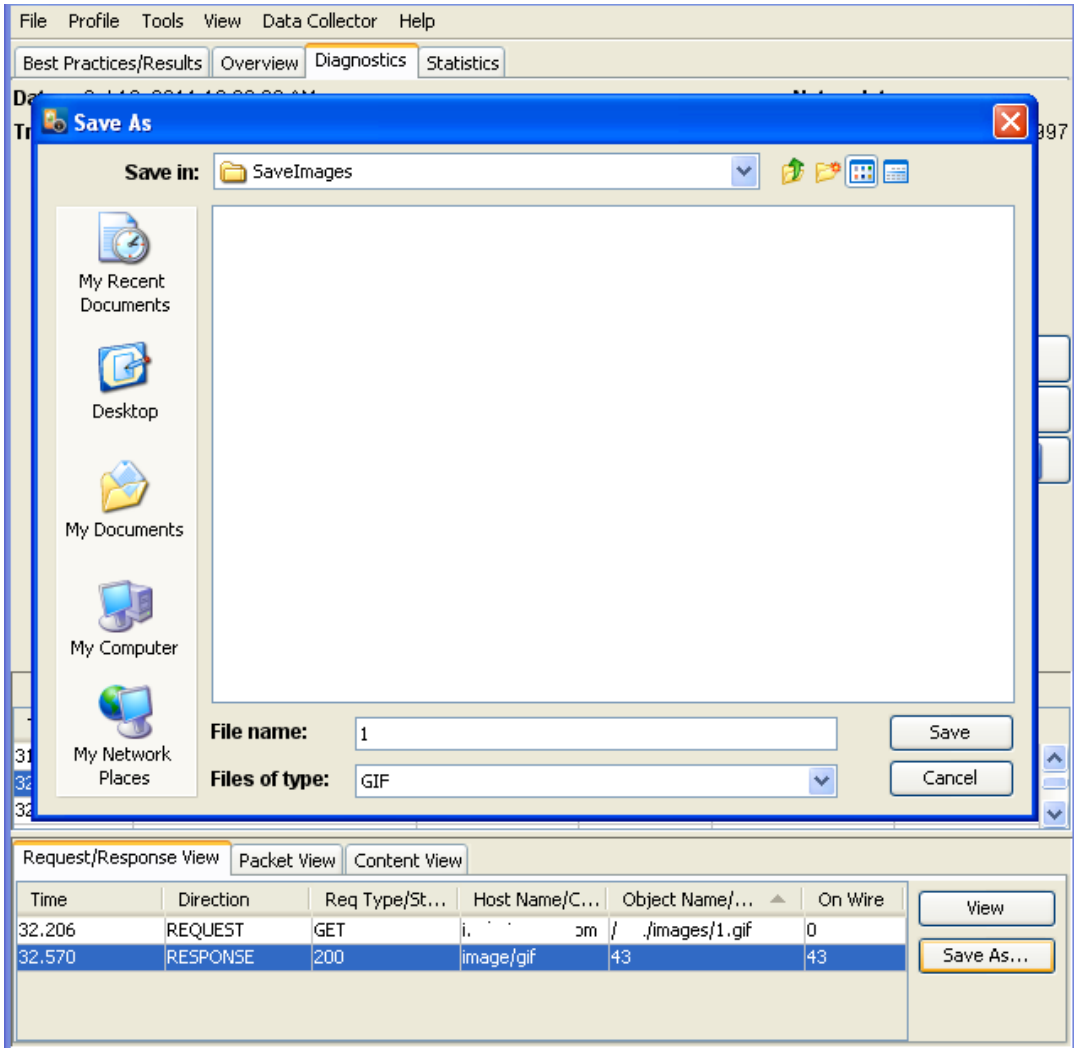


Figure 7-20: Saving an object to a file.

7.2.3.2.2 Packet View

When a row in the TCP/UDP Flows Table is selected, the Video Optimizer Data Analyzer Reference Guide displays a table that shows information about the individual packets associated with the selected TCP or UDP flow as shown in the following figure.

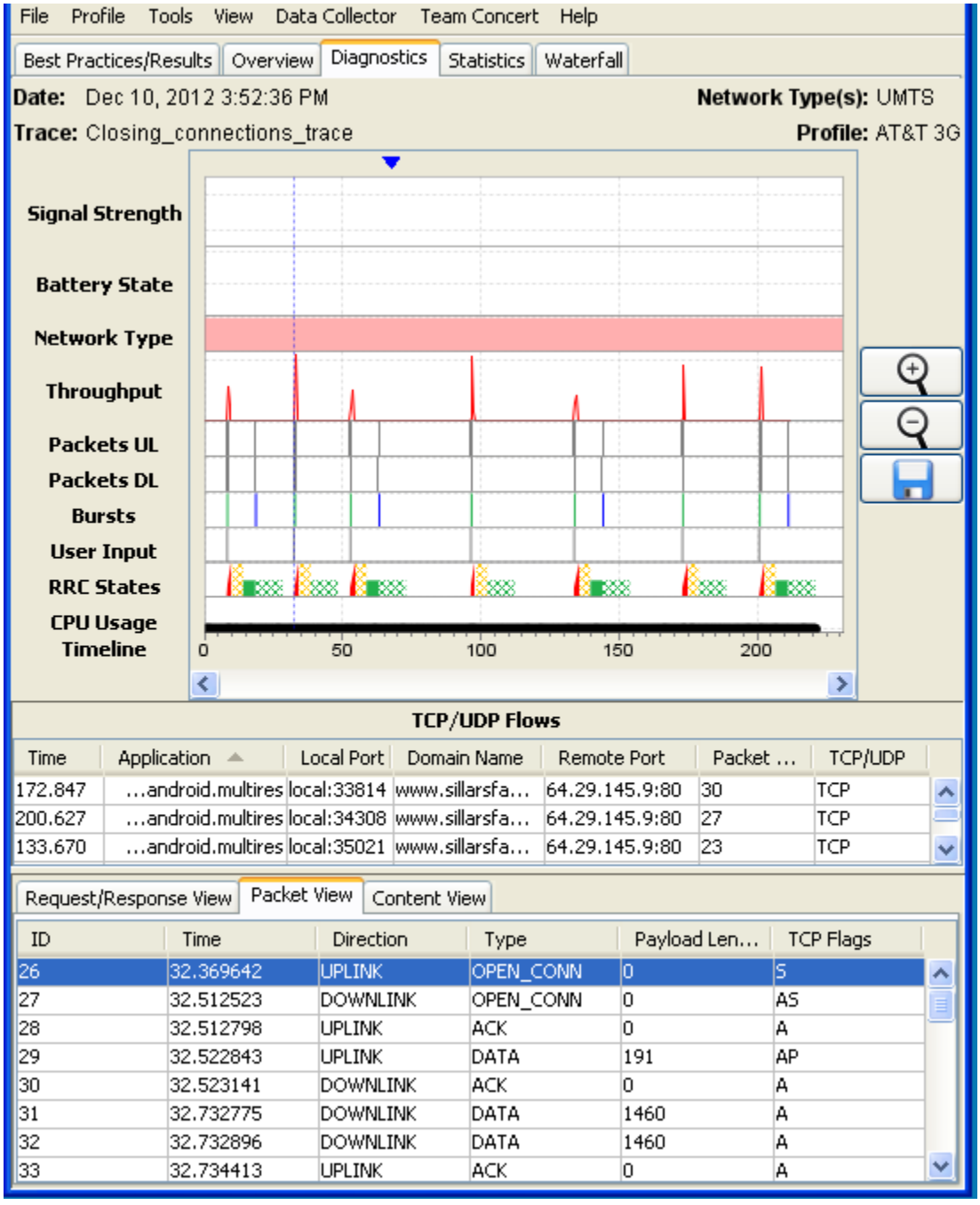


Figure 7-21: Packet view.

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

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

Column	Description
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: A - Ack; P - Push; R - Reset, S - Synchronize, F - Finish/End, E - Echo, U - Urgent, C - Congestion Windows Reduced.

Table 7-37: Packet view columns.

7.2.3.2.3 Content View

When a row in the TCP/UDP Flows Table is selected, the Content View displays the content of the HTTP request/response as in the following figure.

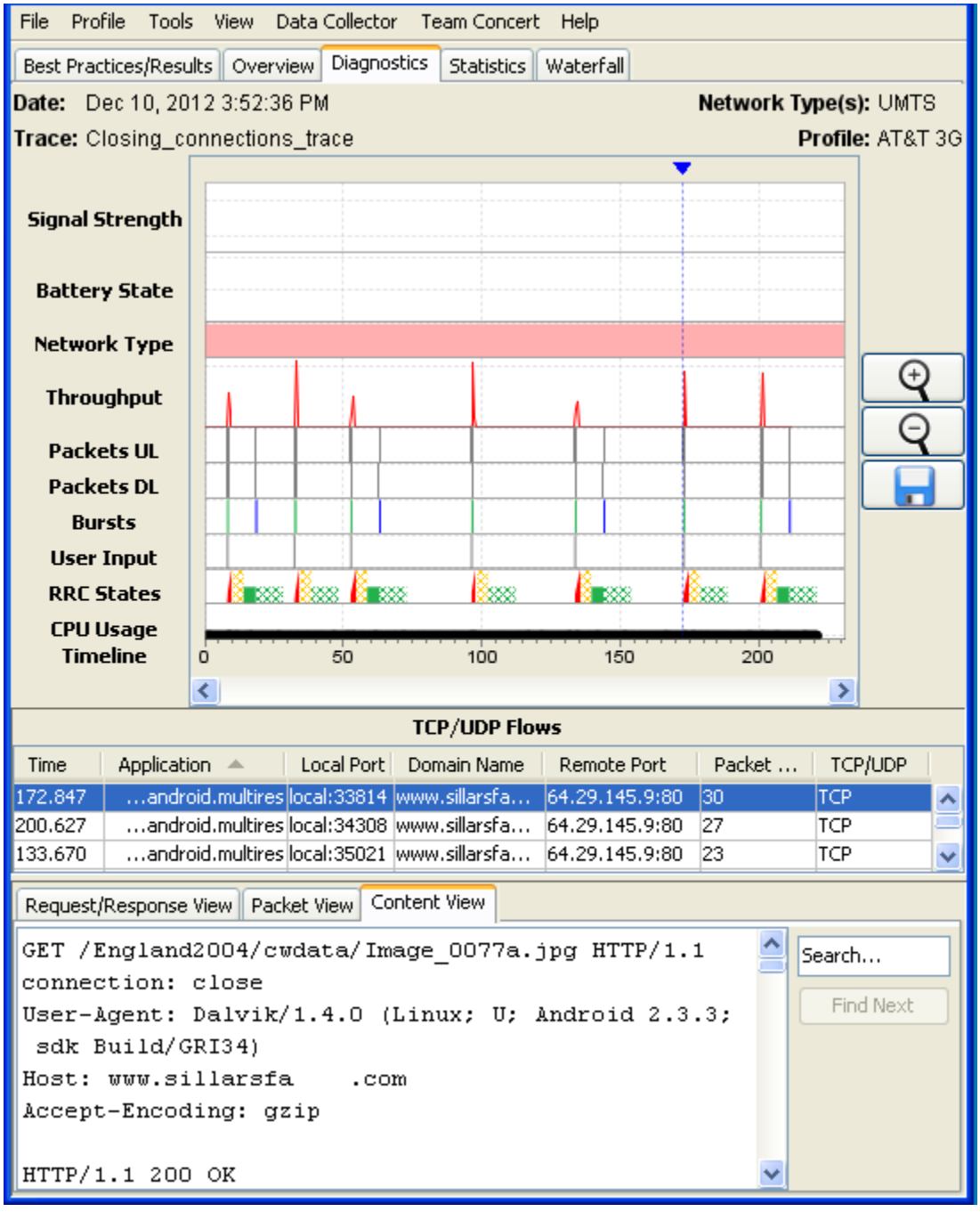


Figure 7-22: Content view.

The Content View 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.

7.2.4 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
- Endpoint Summary
- RRC(Radio Resource Control) State Machine Simulation
- Burst Analysis
- HTTP Cache Statistics
- Energy Efficiency Simulation

7.2.4.1 Export Button

In the top right corner of the Statistics tab, there is an Export button (shown in the following image). When this button is clicked, a Save As dialog box appears that allows you to save all of the data from the Diagnostics tab, and the Statistics tab as a *.csv* file. When the file has been saved, you can either Close the Save As dialog or open the .csv file immediately by clicking the Open button. When you click the Open button, the export file will be opened using the program that you have identified in your OS as the default program for .csv files.

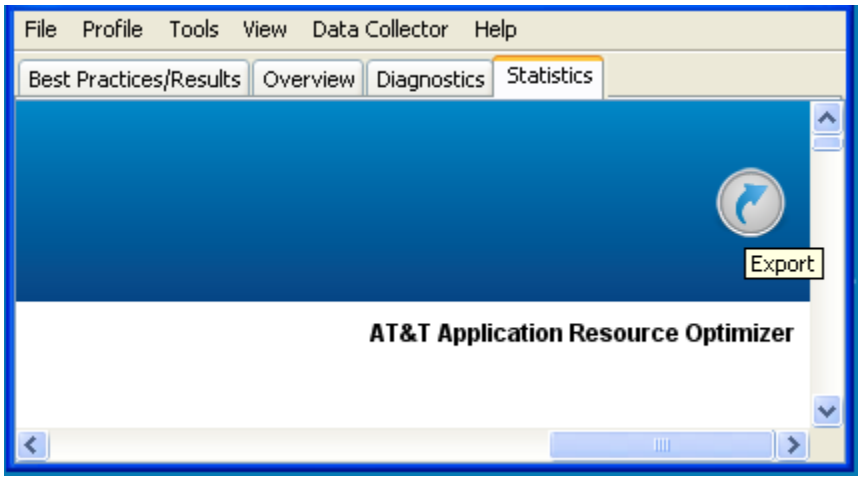


Figure 7-23: Export button on Statistics tab.

7.2.4.2 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.
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.
OS/Platform Version	The operating system version or platform version of the device that the trace was captured on.
Network type	The type of network, like 3G or LTE, which was in use when the data was collected.
Profile	The device profile that was used for the trace analysis.

Table 7-38: Header section for Statistics tab.

7.2.4.3 TCP (Session) Statistics

The TCP (Session) Statistics section of the Statistics Tab information page (shown in the following figure) provides overall statistics about the TCP Packet information captured in the loaded trace files.

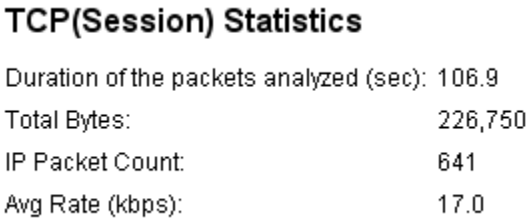


Figure 7-24: TCP(Session) Statistics section

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.
IP Packet Count	The total number of packets in the loaded trace.

Field	Description
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.

Table 7-39: Statistics tab fields.

7.2.4.4 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

7.2.4.4.1 Endpoint Summary Per Application Table

The Endpoint Summary Per Application table (shown in the following figure) summarizes the number of packets and total number of bytes for each application in the trace.

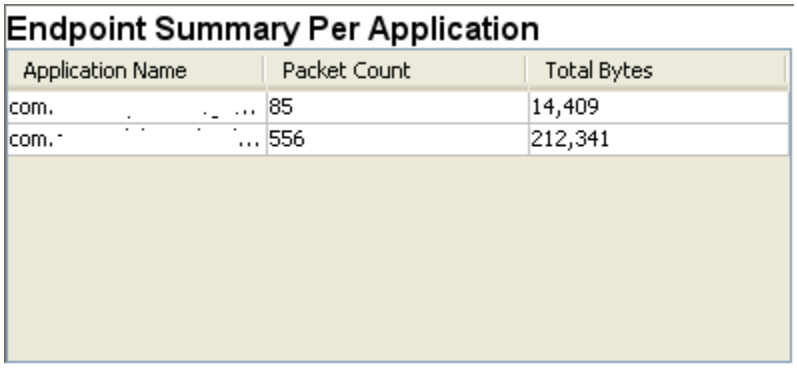


Figure 7-25: Endpoint Summary Per Application table.

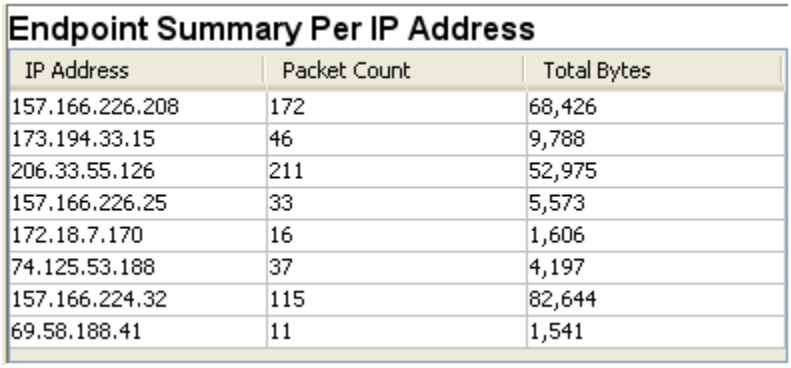
The following describes the statistics contained in the Endpoint Summary Per Application table:

Column	Description
Application Name	The name of the application.
Packet Count	The total number of packets for this application.
Total Bytes	The total number of bytes for this application.

Table 7-40: Endpoint Summary Per Application table columns.

7.2.4.4.2 Endpoint Summary Per IP Address Table

The Endpoint Summary Per IP Address table (shown in the following figure) summarizes the number of packets and total number of bytes for each IP address in the trace.



Endpoint Summary Per IP Address

IP Address	Packet Count	Total Bytes
157.166.226.208	172	68,426
173.194.33.15	46	9,788
206.33.55.126	211	52,975
157.166.226.25	33	5,573
172.18.7.170	16	1,606
74.125.53.188	37	4,197
157.166.224.32	115	82,644
69.58.188.41	11	1,541

Figure 7-26: Endpoint Summary Per IP Address table.

The following 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 Bytes	The total number of bytes for this IP address.

Table 7-41: Endpoint Summary Per IP Address table columns.

7.2.4.5 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:

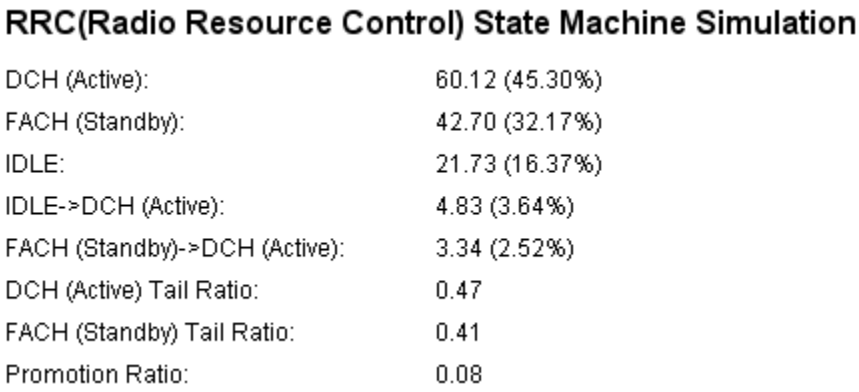


Figure 7-27: RRC(Radio Resource Control) State Machine Simulation section for 3G device profile.

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).

Table 7-42: RRC(Radio Resource Control) State Machine Simulation fields.

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

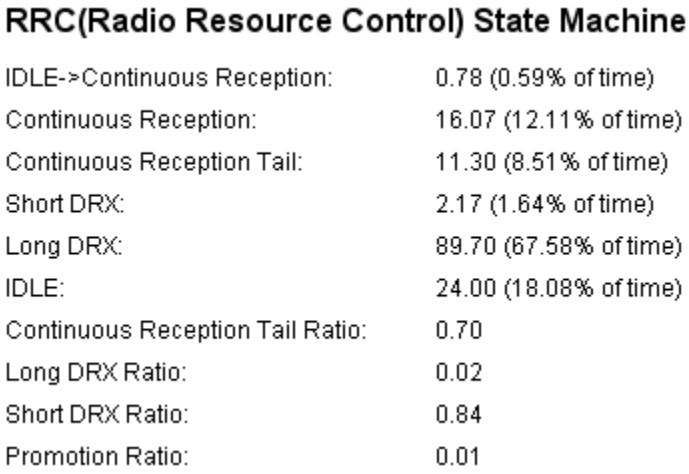


Figure 7-28: RRC(Radio Resource Control) State Machine Simulation section for LTE device profile.

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.

Field	Description
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.

Table 7-43: RRC(Radio Resource Control) State Machine Simulation fields.

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

Figure 7-29: RRC(Radio Resource Control) State Machine Simulation section for WiFi device profile.

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

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

Table 7-44: RRC(Radio Resource Control) State Machine Simulation section for WiFi device profile fields

7.2.4.6 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

7.2.4.6.1 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 CSV 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

Figure 7-30: Burst Analysis table for 3G device profile.

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

Figure 7-31: Burst Analysis table for LTE device profile.

When a WiFi device profile like *AT&T WiFi* 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

Figure 7-32: Burst Analysis table for WiFi device profile.

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

<table>
<tr><th>Field</th><th>Description</th></tr>
<tr><td>Burst</td><td>One of the following Burst types according to the request/response types in the loaded trace.

<table><tr><th>Burst Categories</th></tr><tr><td>TCP Control</td></tr><tr><td>TCP Loss Recover</td></tr><tr><td>User Input</td></tr><tr><td>Screen Rotation</td></tr><tr><td>App</td></tr><tr><td>SvrNetDelay</td></tr><tr><td>NonTarget</td></tr><tr><td>LargeBurst</td></tr><tr><td>Periodical</td></tr><tr><td>Unknown</td></tr><tr><td>Userdef 1</td></tr><tr><td>Userdef 2</td></tr><tr><td>Userdef 3</td></tr></table></td></tr>
<tr><td>Bytes</td><td>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.</td></tr>
<tr><td>% of Bytes</td><td>The percentage of total payload used by the individual burst payload. The total payload is the sum of all burst payloads.</td></tr>
<tr><td>Energy</td><td>The amount of Energy, in Joules, for the corresponding Burst type.</td></tr>
<tr><td>% of Energy</td><td>The percentage of total burst energy used by the individual burst. Total burst energy is the sum of all individual burst Energy amounts.</td></tr>
<tr><td>DCH (Active)</td><td>The amount of DCH Active time for the corresponding Burst type.

Note: This column is only displayed when a 3G device profile is selected.</td></tr>
<tr><td>%DCH (Active)</td><td>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.</td></tr>
</table>

Field	Description
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.
WiFi Active	The amount of WiFi Active time for the corresponding Burst type. **Note:** This column is only displayed when a WiFi device profile is selected.
% of WiFi Active	The percentage of total WiFi Active time used by the individual burst. The total WiFi Active time is the sum of all individual burst WiFi Active times. **Note:** This column is only displayed when a WiFi device profile is selected.
JpKB	The amount of Joules per Kilobytes for the corresponding Burst type calculated from the amount of burst type energy and burst type payload.

Table 7-45: Statistics contained in the Burst Analysis table.

7.2.4.6.2 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

Figure 7-33: Individual Burst Analysis table.

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

Table 7-46: Individual Burst Analysis table statistics.

7.2.4.7 HTTP 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

Figure 7-34: HTTP Cache Statistics section.

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 amount of bytes for this row item expressed as a percentage of the total number of bytes.

Table 7-47: HTTP Cache Statistics section columns:

7.2.4.7.1 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.

Table 7-48: Cacheable vs. Non-Cacheable section rows.

7.2.4.7.2 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 response sent from server	The percentage of total responses and total bytes for content with the HTTP response code 304.
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.

Table 7-49: Acceptable behavior.

Row	Description
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.

Table 7-50: Duplicate file download.

Row	Description
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.

Table 7-51: Duplicate file download streaming.

7.2.4.7.3 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.

Field	Description
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.

Table 7-52: Duplicate File Analysis section.

7.2.4.8 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 particular device.

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

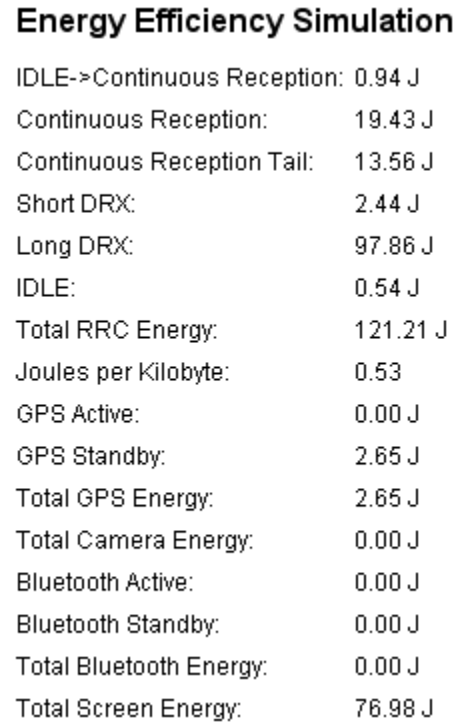
When a 3G device profile like *AT&T 3G* is selected, the Energy Efficiency Simulation section appears like the following:

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

Figure 7-35: Energy Efficiency Simulation section for 3G device profile.

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



Energy Efficiency Simulation

IDLE->Continuous Reception:	0.94 J
Continuous Reception:	19.43 J
Continuous Reception Tail:	13.56 J
Short DRX:	2.44 J
Long DRX:	97.86 J
IDLE:	0.54 J
Total RRC Energy:	121.21 J
Joules per Kilobyte:	0.53
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:	76.98 J

Figure 7-36: Energy Efficiency Simulation section for LTE device profile.

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

Energy Efficiency Simulation

WiFi Active:	11.43 J
WiFi Tail:	5.24 J
WiFi Idle:	2.09 J
Total Wi-Fi Energy:	13.52 J
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:	76.98 J

Figure 7-37: Energy Efficiency Simulation section for WiFi device profile.

The following table describes all of 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.
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 amount of energy consumed during the Long DRX state.
WiFi Active	The amount of amount of energy consumed during the WiFi Active state.
WiFi Tail	The amount of amount of energy consumed during the WiFi Tail state.
WiFi Idle	The amount of 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 amount of Joules per Kilobyte from the loaded trace, calculated from the amount of total energy and total bytes.

Field	Description
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 amount of energy consumed during the Long DRX state.
WiFi Active	The amount of amount of energy consumed during the WiFi Active state.
WiFi Tail	The amount of amount of energy consumed during the WiFi Tail state.
WiFi Idle	The amount of 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 amount 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.

Table 7-53: Energy Efficiency Simulation section fields.

7.2.5 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.)

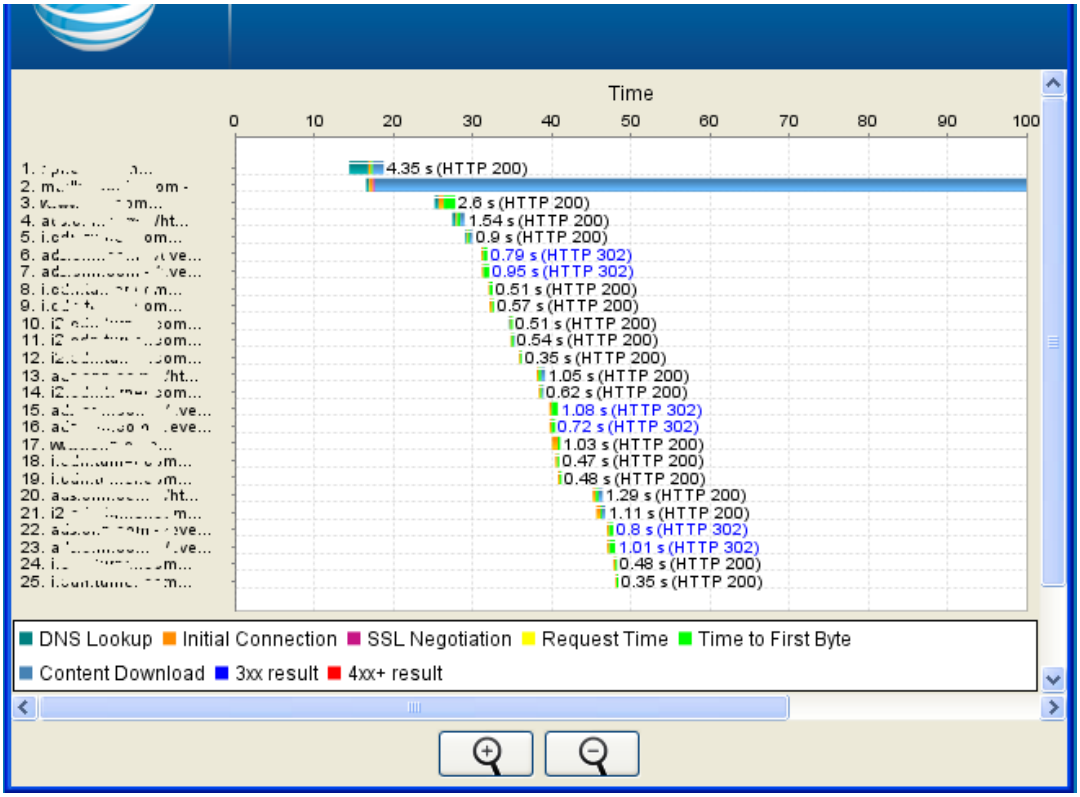


Figure 7-38: Waterfall view chart.

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.

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

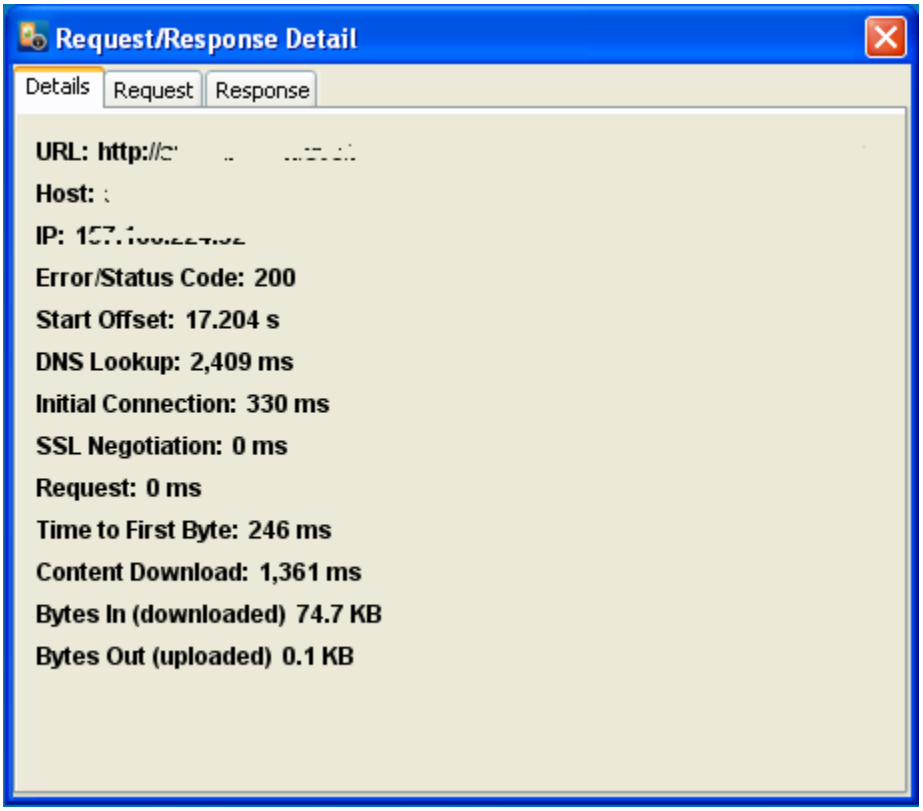


Figure 7-39: Request/Response Detail dialog box.

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 similar to the detail provided in the Request/Response View table on the Diagnostics tab.

8 APPENDIX I

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

8.1 Video Optimizer Data Collector Error Messages

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

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 ARO-Data 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, ARO 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 ARO Data Collector.	This error occurs during data collection, if the data collection process terminates because the SD card is full.
ARO 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
ARO 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.
ARO Data Collector failed to start!	This message appears if an unexpected error occurs when the Start Collector button is clicked.
ARO Data Collector trace collection stopped.	This error occurs during data collection, if the data collection process terminates unexpectedly.
ARO 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.

Table 8-1: Video Optimizer Data Collector error messages.

8.2 Video Optimizer Data Analyzer Error Messages

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

Error Message	Condition
ARO requires WinPcap. Please install WinPcap which can be found at http://www.winpcap.org.	The Video Optimizer Data Analyzer application is dependent on WinPcap, and it looks for the WinPcap installation during every launch. This error occurs if WinPcap is not found.
ARO requires AppleQuartz renderer. Please set apple.awt.graphics.UseQuartz flag to true	This error occurs if the Data Analyzer 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 the Data Analyzer encounters an unexpected exception.
ARO Analyzer has reached the maximum memory heap size. Close the ARO Analyzer and try again or increase ARO Analyzer's heap size. Also consider collecting multiple, smaller, more isolated traces.	This error occurs if the Data Analyzer reaches the maximum amount of memory allocated for it.
ARO Analyzer 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 the Data Analyzer to reach the maximum amount of memory allocated for it.

Error Message	Condition
ARO Analyzer 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 the Data Analyzer.
Invalid trace in directory: *trace folder path* and *exception message*.	This error occurs if the Data Analyzer 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 Data Analyzer: • Time Range Analysis (Tools Menu) • PCAP File Analysis (Tools Menu) • Select Applications/IPs (View Menu)
ARO 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.
ARO 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 non-numeric 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.

Error Message	Condition
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 the Video Optimizer Analyzer 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 the Video Optimizer Analyzer 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.
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 sometime 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.

Error Message	Condition
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 ARO 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 ARO 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 the ARO Data Analyzer.
Error pulling ARO Data Collector traces.	Occurs if there is an error when pulling Trace files from the Video Optimizer Data Collector to the local system.
ARO Analyzer stopped unexpectedly.	Occurs if the Data Analyzer unexpectedly stops.
ADB Rejected the ARO 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 ARO 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.
ARO 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.

Error Message	Condition
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 ARO 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 ARO 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.
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.

Error Message	Condition
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 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.
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 ARO 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 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 Message	Condition
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 ARO Analyzer.
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.
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 Message	Condition
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 ARO Analyzer.	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.
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.

Error Message	Condition
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.
ARO Analyzer 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.
ARO 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.
ARO 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.
ARO 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.
ARO 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.

Table 8-2: Video Optimizer Data Analyzer error messages.

8.3 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.
ARO	The Mobile Application Resource Optimizer (ARO) is the predecessor to Video Optimizer
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, as long as 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 the purpose of 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 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 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. As long as 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 the purpose of making requests on behalf of other clients.

	Requests are either serviced internally, or are passed on with possible translation, to other 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 particular 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.
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 particular 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.
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 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 Last-Modified 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.

9 APPENDIX II

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

9.1 Rooted ARO Data Collector APK

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

9.1.1 Prerequisites for using the Rooted ARO Data Collector APK

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

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

9.1.2 Installing Rooted ARO

1. Start a race as described in Chapter 4, selecting the rooted option.
2. The apk will be installed on your phone.

9.1.2.1 Collecting a Trace Using the ARO Data Collector

Once you have installed the ARO Data Collector on your test device, you can either 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 ARO Data Collector via a USB connection using the commands on the Start Collector menu in the ARO Data Analyzer on your computer.

To operate the ARO Data Collector from the ARO Data Analyzer, do the following:

1. In the ARO Data Analyzer, open the File menu, select the Set ADB Path option, browse to the directory where the Android Debug Bridge (ADB) executable is located, and select it.
2. Ensure a USB connection between the test device and the computer where the ARO Data Analyzer is installed.
3. In the ARO Data Analyzer, open the Data Collector menu and select the Start Collector option. On the test device, select OK when the “Allow USB Debugging” prompt asks you to confirm the RSA key on the test device.
4. Run testing scenarios on your app while ARO is collecting data. For example, launch the app, exercise the main functions of the app, and close the app.
5. In the ARO Data Analyzer, open the Data Collector menu and select the Stop Collector option.

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 ARO Data Collector capturing trace video directly. Also note that this method has the following known issues:

- In some cases, the following notification may appear incorrectly when the trace is completed: "Unexpected error accessing device SD card. ADB Connection Error" When this occurs, the trace is intact and the error message can be disregarded.
- Currently, the ARO Analyzer is unable to pull traces from a Samsung S4 “Active” i537 device when traces are taken via the USB Video method. Following the USB session, when the ‘Open’ button on the Trace Summary page is selected, no data is pulled into the Analyzer and the trace folder is empty.

To operate the ARO Data Collector directly on an Android test device, do the following.

1. Open the program list on your device (like the one in the following image), find the “Video Optimizer” icon, and launch the Video Optimizer Data Collector.

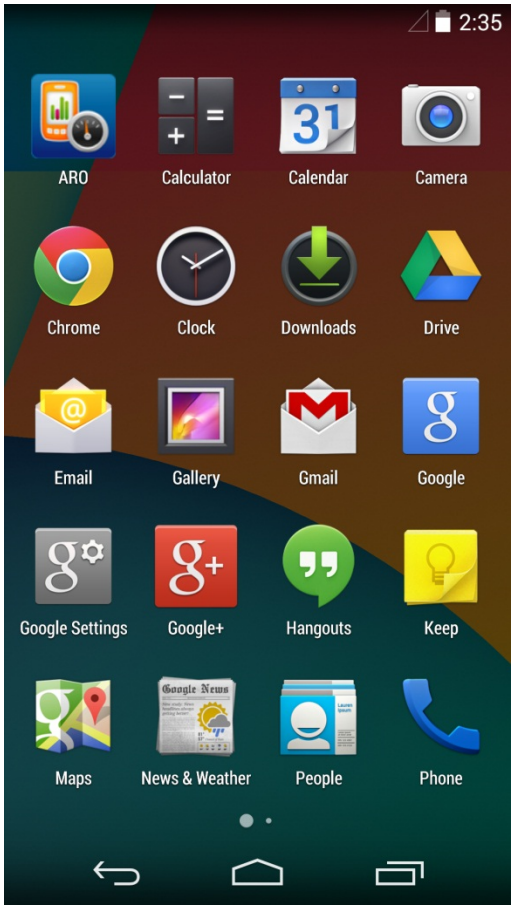


Figure 9-1: Program list for launching the Video Optimizer Data Collector.

2. When Video Optimizer is launched, you will first see a Splash screen and then a Legal Terms Screen (as shown in the following figure). Click the “Accept” button on the Legal Terms screen to proceed to the main screen of Video Optimizer.

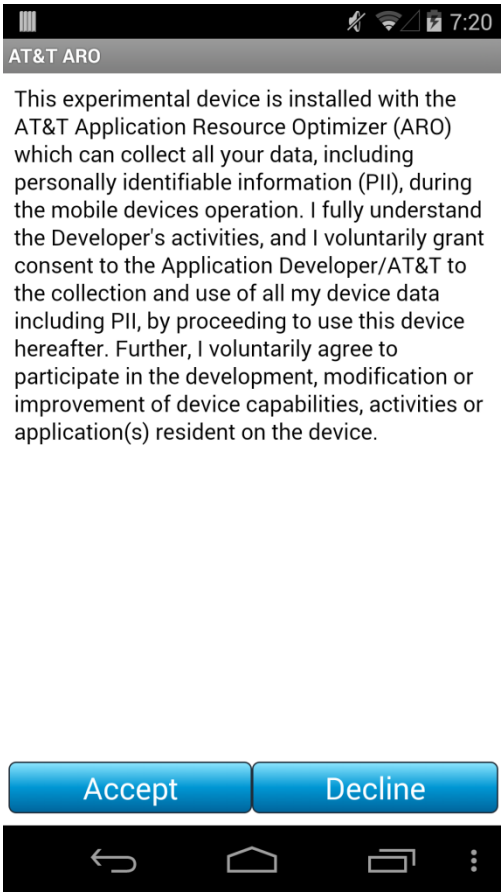


Figure 9-2: Legal Terms screen for Video Optimizer.

3. Use the controls on the Video Optimizer main screen (**Error! Reference source not found.**) to cancel any running applications that you do not want to test, select whether to record video with your trace, and start the Data Collector.

   To stop running tasks, click the Open Task Killer button 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.

   To record video while you are capturing the trace, click the Record Video button.

   To start the ARO Data Collector, click the Start Collector button.

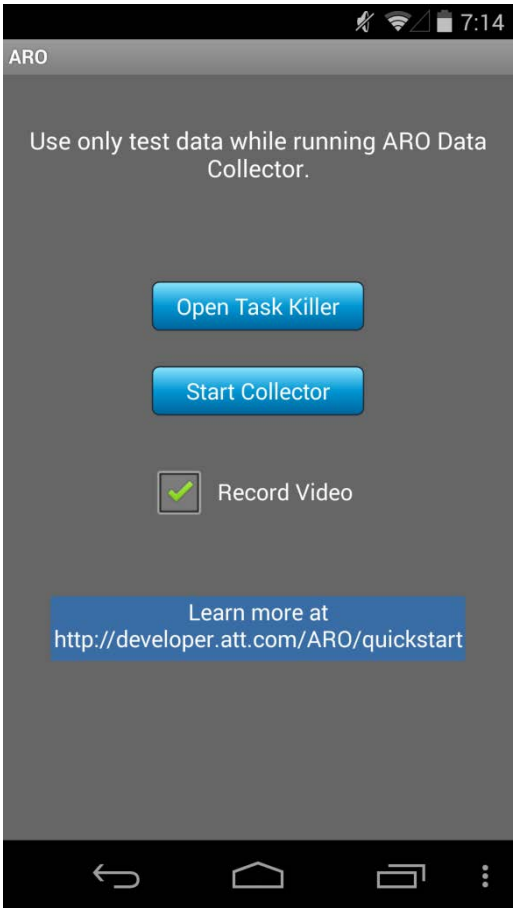


Figure 9-3: Video Optimizer main screen.

4. When you click the Start Collector button on the Video Optimizer main screen, you will see the Create Folder dialog box (**Error! Reference source not found.**). Enter a name for the trace folder or accept the default name.

   The Create Folder dialog displays the default name for the trace folder that is generated from the latest date and time stamp. You can use the default name, or change it to any alphanumeric value up to 50 characters in length.

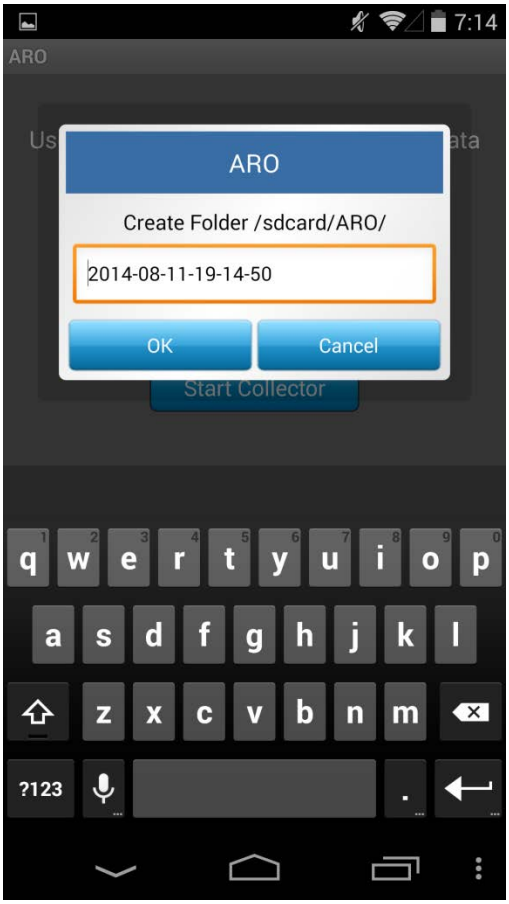


Figure 9-4: Create Folder dialog box.

5. When you press the OK button to accept the trace folder name; trace collection is started, an alert notification is displayed on the Android top status bar, and the ARO Data Collector Home screen (**Error! Reference source not found.**) is displayed. Click the Hide Collector button, and navigate to the application that you are testing.

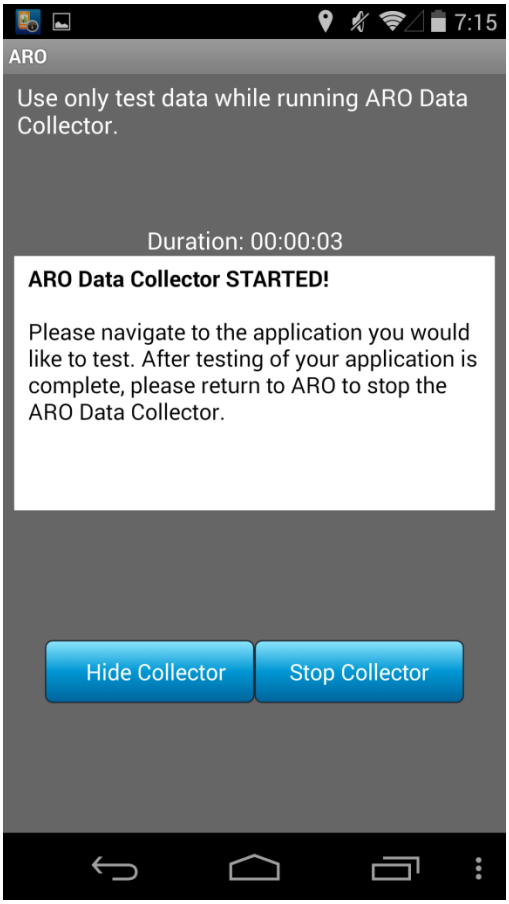


Figure 9-5: The ARO Data Collector Home screen.

6. When you have finished testing your application, open the ARO Data Collector home screen using one of the following methods, and click the Stop Collector button.
   - By tapping on the Video Optimizer icon from the program list of the device.
   - By pressing the On-Going notification on the Android slider message bar (**Error! Reference source not found.**).
   - By accessing Video Optimizer from the recent program list of the device.

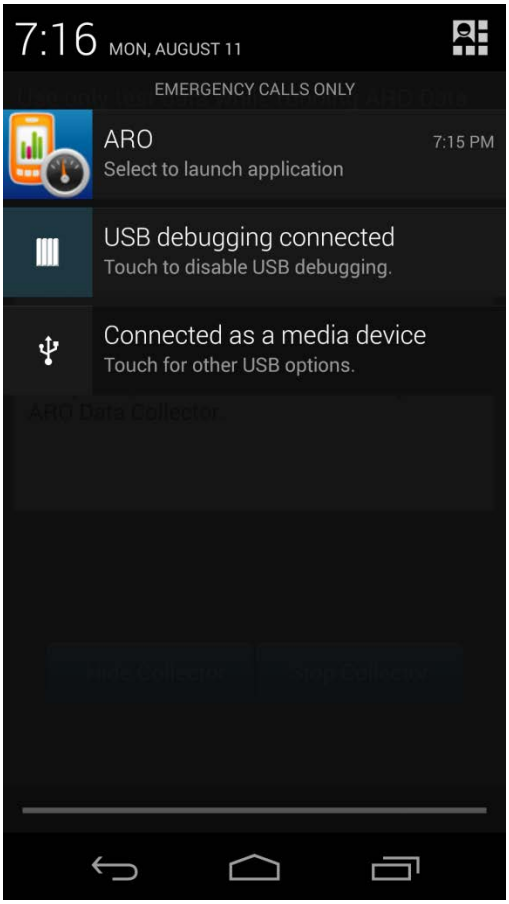


Figure 9-6: The Android slider message bar.

7. When you have clicked the Stop Collector button on the ARO Data Collector Home screen, you will see the Trace Completion screen. Click OK to complete collecting the trace.