

# Extensive Power

## Debug Guide

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# Revision history

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Revision	Date	Description
A	June 2015	Initial release
B	August 2015	Updated
C	November 2018	Updated to conform to QTI standards; no technical content was changed in this document revision.

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# 1 Introduction

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## 1.1 Purpose

This document provides details on how to optimize specific power test cases and debug issues related to the resource power manager (RPM), application processor subsystem (APSS), multimedia, and modem.

## 1.2 Conventions

Function declarations, function names, type declarations, attributes, and code samples appear in a different font, for example, `#include`.

Code variables appear in angle brackets, for example, `<number>`.

Commands to be entered appear in a different font, for example, `copy a:*. * b:.`

Button and key names appear in bold font, for example, click **Save** or press **Enter**.

## 1.3 Technical assistance

For assistance or clarification on information in this document, submit a case to Qualcomm Technologies, Inc. (QTI) at <https://createpoint.qti.qualcomm.com/> with the following information:

- Chipset – AMSS build ID and operating system
- Initial problem type – Software
- For multimedia use cases, select the following problem areas:
  - Problem Area 1 – Multimedia
  - Problem Area 2 – Power
  - Problem Area 3 – Use-case specific
    - Audio, video, graphics, browsing, sensors, etc.
- For core and modem use cases, select the following problem areas:
  - Problem Area 1 – BSP/HLOS
  - Problem Area 2 – Power/thermal (BSP/HLOS)
  - Problem Area 3 – Use-case specific
    - Power-modem, power-idle power, etc.

- Problem description
  - Describe the use case if different from the QTI standard use case
  - List steps to reproduce the issue
  - Describe the debugging done so far
  - Include the following debugging logs:
    - Waveforms, rail-level breakdown, node power architecture (NPA) dumps, kmsg, Top, PowerTop, clock dump, SurfaceFlinger, ftrace, systrace, logcat, etc.

If you do not have access to the CDMATech Support website, register for access or send email to [support.cdmatech@qti.qualcomm.com](mailto:support.cdmatech@qti.qualcomm.com).

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## 2 Debug setup

QTI recommends the following tools to ensure a complete and effective power debugging process.

### 2.1 Required software tools and setup

Specific debugging tools are required for use cases involving RPM, modem, and apps processor.

#### 2.1.1 Debugging tools for RPM and modem use cases

- Trace32 (T32) software – This is essential for using JTAG for power debugging, especially to obtain on-target logs, load RAM dumps, and capture off-target logs using a T32 simulator.
- Licensed QPST and QXDM Professional™ tools – These tools are necessary to obtain logs and messages pertaining to modem power use case debugging.

#### 2.1.2 Debugging tools for apps processor use cases

Tool	Precondition	Install	Where to find
PowerTop	NA	adb root adb remount adb push <PowerTop location>\powertop / data/ adb shell chmod 777 /data/powertop	Through a Salesforce case
PerfTop	NA	adb root adb remount adb push <perf location>\perf /data/ adb shell chmod 777 /data/perf	Through a Salesforce case
Pytime chart	Pythonxy tool; verify that ETS and pythonxy are selected for installation	<a href="http://python-xy.github.io/">http://python-xy.github.io/</a> After installation, open a command prompt in C:\ and run easy_install pytimechart.	<a href="http://python-xy.github.io/">http://python-xy.github.io/</a>
Systrace	SDK tool	<a href="http://developer.android.com/tools/sdk/tools-notes.html">http://developer.android.com/tools/sdk/tools-notes.html</a>	Android SDK toolkit
msmbusvoting	adb root adb remount	No installation required	Through a Salesforce case



## 2.2 Required hardware tools

- JTAG – This is required to obtain on-target logs, such as clock, PMIC, and GPIO dumps, when doing power optimization or debugging a power issue.
- Power monitor – This is required with a minimum of 5 kHz sampling rate to accurately measure use case power consumption and for waveform analysis.

## 2.3 Power breakdown board

- Detailed breakdown measurements are essential for power debugging and help to quickly narrow down higher power consumption issues.
- Build a board that has the capability of measuring rail level current and voltage by using the system power monitor (SPM); see *System Power Monitor Version 4 Application Note* (80-N6594-16).

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## 3 Dashboard use case debugging flow

Before starting with power debugging, it is necessary to have all the software and hardware tools required for debugging and power optimization purposes.

References to steps in the following tables refer only to the steps within that table, unless otherwise specified.

### RELATED INFORMATION

[“Required software tools and setup” on page 8](#)

[“Required hardware tools” on page 9](#)

### 3.1 Rockbottom

Step no.	Step	Reference
1	<ul style="list-style-type: none"><li>■ To make a proper comparison with the QTI reference data, the hardware configuration also must be comparable.</li><li>■ Current consumption for any sensors or external components must be quantified for that purpose.</li><li>■ Quantify the current consumed by the following; this must be accounted for as the known delta:<ul style="list-style-type: none"><li>□ Sensors and other third-party components</li><li>□ Different DDR size compared to the QTI reference used in the device</li></ul></li><li>■ For this information, file a case.</li></ul>	<a href="#">Technical assistance</a>
2	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1
	<ul style="list-style-type: none"><li>■ Compare it with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 1.</li><li>■ If the customer device measurement data minus the known delta is greater than the QTI reference data, go to Step 3.</li></ul>	Release Notes
3	<p>Capture the battery level current waveform and check what is causing the higher power consumption.</p> <ul style="list-style-type: none"><li>■ For a higher base current, go to Step 4.</li><li>■ For occurrences of unexpected wakeups, go to Step 7.</li></ul>	<a href="#">Analyze rockbottom waveform</a>
4	<p>For debugging a higher base current, verify that the device enters VDD Minimization mode.</p> <ul style="list-style-type: none"><li>■ If the device is not in VDD Minimization mode, go to Step 5.</li><li>■ If the device is in VDD Minimization mode, go to Step 6.</li></ul>	<a href="#">Verify crystal oscillator (XO) shutdown and VDD minimization</a>

Step no.	Step	Reference
5	Check the subsystem status to determine which one is blocking the device from entering in VDD Minimization mode and debug further for that subsystem.	<ul style="list-style-type: none"> <li>Check subsystem (APSS/MPSS/LPASS) power collapse from RPM</li> <li>Determine subsystem votes for major resources using RPM logs</li> </ul>
6	<ul style="list-style-type: none"> <li>File a case to obtain the following: <ul style="list-style-type: none"> <li>A procedure to check VDD_CORE, VDD_MEM retention voltages of the device under test</li> <li>For comparison, PMIC dumps and GPIO reference logs (debug logs obtained from a reference device where the current consumption meets the goals for the particular chipset)</li> </ul> </li> <li>Capture PMIC dumps on the device under test and compare them with the QTI reference PMIC logs to determine if any unused switched-mode power supplies (SMPS) or low dropout regulators (LDOs) are left on. Turn off any SMPS and LDOs.</li> <li>Capture GPIO dumps and compare with the QTI reference GPIO logs to determine if the GPIO configuration is as expected. For GPIOs used differently compared to the QTI reference design, sleep configuration must follow the custom design.</li> <li>Capture rail level voltage and current data and compare with the QTI reference breakdown data to determine the rails consuming higher current and debug further.</li> </ul>	<ul style="list-style-type: none"> <li>Check leakage in sleep current</li> <li>Specific chipset application note for power breakdown reference</li> </ul>
7	For debugging unexpected wakeups, check which subsystem is causing those wakeups by monitoring subsystem rails and checking subsystem specific logs, for example, modem NPA logs, RPM NPA logs, or APSS kernel logs.	Check unexpected wakeups
8	If power consumption is still higher than expected after following Steps 1 through 7, file a case with QTI for further debugging help.	Technical assistance

## 3.2 Standby

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta: <ul style="list-style-type: none"> <li>Sensors</li> <li>Different DDR size – Request estimated value through a case</li> <li>Other third-party components</li> </ul> </li> <li>For this information, file a case.</li> </ul>	Technical assistance
2	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1
	Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 3.	Release Notes

Step no.	Step	Reference
3	<p>Capture the battery level current waveform and determine what is causing the higher power consumption.</p> <ul style="list-style-type: none"> <li>For a higher base current, go to Step 6 of <a href="#">Rockbottom</a>.</li> <li>For occurrences of unexpected wakeups, go to Step 7 in <a href="#">Rockbottom</a>.</li> <li>If discontinuous reception (DRX) wakeup power consumption is higher, go to Step 4.</li> </ul>	
4	<p>For debugging higher current consumption in the DRX wakeup period, compare with the reference waveforms and determine the cause from the following:</p> <ul style="list-style-type: none"> <li>For a longer awake period, go to Step 5.</li> <li>For a higher awake amplitude, go to Step 6.</li> </ul>	
5	<p>If the DRX wakeup timeline is longer, reconfirm the call box settings, for example, the device does intra- or inter-RAT searching if the neighbor cells are enabled, which in turn causes the wakeup timeline to increase.</p>	<a href="#">Analyze higher paging awake penalty</a>
6	<ul style="list-style-type: none"> <li>If the wakeup timeline is close to the reference timeline and the awake period amplitude is higher, i.e., higher peak current, determine the following: <ul style="list-style-type: none"> <li>If the proper calibration is done for that particular RAT and band configuration</li> <li>If APT/ET enablement and calibration is done correctly</li> </ul> </li> <li>If using a third-party PA, the current consumption must be quantified for the same.</li> </ul>	<a href="#">Analyze higher paging awake penalty</a>
7	<p>If power consumption is still higher than expected after following Steps 1 through 6, file a case with QTI for further debugging help.</p>	<a href="#">Technical assistance</a>

### 3.3 Static display

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>If display panel power can be quantified, go to Step 2.</li> <li>If display panel power cannot be quantified, go to Step 3.</li> </ul>	
2	<ul style="list-style-type: none"> <li>Compare the following device components to the QTI reference setup: <ul style="list-style-type: none"> <li>Panel resolution</li> <li>Smart/dumb panel</li> <li>Any other additional OEM-specific components</li> </ul> </li> <li>File a case with QTI for power impact of any of the above components that vary from the standard QTI reference setup.</li> </ul>	
3-1	<p>Obtain the power measurement on the device following the QTI standard power measurement test procedure. If the known delta from Step 2 cannot be quantified, go to Step 4.</p>	80-N6837-1
3-2	<p>Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta quantified in Step 2.</p>	Release Notes
4	<ul style="list-style-type: none"> <li>If using a smart panel, check if the device enters VDD Minimization mode. If the device does not enter VDD Minimization, go to Step 5.</li> <li>If the device enters VDD Minimization, go to Step 15. No clocks are active if the device enters CX power collapse.</li> <li>If using a dumb panel, go to Step 6.</li> </ul>	<a href="#">Verify crystal oscillator (XO) shutdown and VDD minimization</a>

Step no.	Step	Reference
5	Resolve the root cause for the device not entering CX power collapse and go to Step 15.	
6	Observe the power waveform pattern and identify if the baseline current is high, there are frequent wakeups, or both are observed. <ul style="list-style-type: none"> <li>■ If the baseline current is high, go to Step 7.</li> <li>■ If frequent wakeups are observed, go to Step 14.</li> </ul>	
7	<ul style="list-style-type: none"> <li>■ If a device has breakdown capability, capture a full power rail breakdown and compare it with the QTI reference data to identify if any rail is consuming higher current.</li> <li>■ Capture SurfaceFlinger and compare it with SurfaceFlinger reference logs to check for total number of layers, composition type, and number of layers being updated.</li> </ul>	<a href="#">Debug SurfaceFlinger</a>
8	Identify the subsystems on that particular rail found in the specific chipset power overview document. Collect and debug clock information for those subsystems following the instructions in Steps 9 through 13.	
9	Capture and compare clock dumps with the static image clock plan to determine if any clocks are high or any additional clocks are enabled.	<ul style="list-style-type: none"> <li>■ <a href="#">Collect clock dumps</a></li> <li>■ Specific chipset dashboard goals and use case clock plan document</li> </ul>
10	If the CPU clock is high, capture ftrace, PowerTop, and Top to understand CPU residency and CPU load information.	<a href="#">Analyze high CPU usage process</a>
11	<ul style="list-style-type: none"> <li>■ Determine which process has high CPU usage and look for any unexpected processes/interrupts compared to the reference logs.</li> <li>■ Resolve the abnormal process/thread by contacting the respective area engineer.</li> </ul>	<a href="#">Analyze high CPU usage process</a>
12	<ul style="list-style-type: none"> <li>■ If the bus integrated memory controller (BIMC) clock is high, compare the bandwidth voting under /d/msm-bus-dbg/client-data/ with the reference logs.</li> <li>■ If reference logs are needed, file a case.</li> <li>■ After a particular client that voted for more bandwidth is identified, contact the respective subsystem engineer to resolve this.</li> </ul>	<a href="#">Analyze BIMC clock</a>
13	If another clock is high, file a case with all the debug information, for example, clock dump, ftrace, waveform, PowerTop, Top, and power rail breakdown.	<a href="#">Technical assistance</a>
14	<ul style="list-style-type: none"> <li>■ For frequent wakeups, check PowerTop for any unexpected interrupts compared to the reference logs.</li> <li>■ Use pytime chart to analyze ftrace to determine the source of the interrupt.</li> <li>■ Resolve interrupts by contacting the respective engineer for the domain.</li> </ul>	<a href="#">Analyze interrupt</a>
15	Ensure that the rockbottom use case is optimized or subtract the delta between the QTI rockbottom use case and customer device.	<a href="#">Rockbottom</a>
16	Collect and compare the GPIO and PMIC LDO configurations with the QTI reference.	<a href="#">Check leakage in sleep current</a>
17	<ul style="list-style-type: none"> <li>■ GPIO and LDO configurations are dependent on the hardware design.</li> <li>■ Captured GPIO and LDO data must be reviewed by QTI and OEM hardware teams to turn off unnecessary components.</li> <li>■ If there are still issues, go to Step 13.</li> </ul>	

## 3.4 MP3 playback

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>■ To make a proper comparison with the QTI reference power data, the hardware configuration also must be comparable.</li> <li>■ Check for any custom components on the device. <ul style="list-style-type: none"> <li>□ Tunnel mode vs. Nontunnel mode</li> <li>□ Sensors and other third-party components</li> <li>□ Different DDR size compared to the QTI reference</li> <li>□ Any additional postprocessing hardware</li> </ul> </li> <li>■ Disable all of the above or account for the current delta from each of these components as the known delta.</li> <li>■ For this information, file a case.</li> </ul>	<a href="#">Technical assistance</a>
2	Check Tunnel mode.	<a href="#">Tunnel mode and player type check</a>
3	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1
	<ul style="list-style-type: none"> <li>■ If using Tunnel mode audio playback, compare the measured number with the QTI reference data to determine if power consumption is higher, considering the known delta as quantified in Step 1.</li> <li>■ If using Nontunnel mode, request the reference power number by filing case with QTI.</li> </ul>	Release Notes
4	<p>Observe the power waveform pattern and identify if the baseline current is high, there are frequent wakeups, or both are observed.</p> <ul style="list-style-type: none"> <li>■ If the baseline current is high, go to Step 5.</li> <li>■ If frequent wakeups are observed, go to Step 11.</li> </ul>	
5	<ul style="list-style-type: none"> <li>■ If a device has breakdown capability, capture a full power rail breakdown and compare it with the QTI reference to identify if any rail is consuming higher current.</li> <li>■ If a breakdown cannot be captured, go to Step 7.</li> </ul>	Specific chipset dashboard goals and use case clock plan document
6	Identify which power rail is higher than the QTI power data and determine the subsystems using it; look only for these components in Steps 7 through 16.	Specific chipset power overview document
7	Capture full clock dump to compare with the QTI reference clock plan for MP3.	Specific chipset dashboard goals and use case clock plan document
8	If the CPU clock is high, capture ftrace, PowerTop, and Top to understand CPU residency and CPU load information.	<a href="#">Analyze high CPU usage process</a>
9	<ul style="list-style-type: none"> <li>■ Determine which process has high CPU usage and look for any unexpected processes/interrupts compared to the reference logs.</li> <li>■ Resolve the abnormal process/thread by contacting the respective area engineer.</li> </ul>	<a href="#">Analyze high CPU usage process</a>
10	<ul style="list-style-type: none"> <li>■ If the BIMC clock is high, compare the bandwidth voting under <code>/d/msm-bus-dbg/client-data/</code> with the QTI reference data.</li> <li>■ File a case for the QTI reference data.</li> <li>■ After a particular client that voted for more bandwidth is identified, contact the respective subsystem engineer to resolve this.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Analyze BIMC clock</a></li> <li>■ <a href="#">Technical assistance</a></li> </ul>

Step no.	Step	Reference
11	<ul style="list-style-type: none"> <li>For frequent wakeups, check the period of the wakeup.</li> <li>Capture PowerTop and ftrace and look for periodic wakeups.</li> </ul>	<a href="#">Analyze interrupt</a>
12	<ul style="list-style-type: none"> <li>Check PowerTop for any unexpected interrupts compared to the reference log.</li> <li>Use pytime chart to analyze ftrace to determine the source of the interrupt.</li> <li>Resolve the interrupts by contacting the respective engineer for the domain.</li> </ul>	<a href="#">Analyze interrupt</a>
13	If dsp irq is observed frequently with a period less than 2 sec, check and resolve app wake lock issue.	<a href="#">Music application wake lock check and debugging</a>
14	Ensure that the rockbottom use case is optimized, or subtract the delta between the QTI rockbottom use case and the customer device.	<a href="#">Rockbottom</a>
15	Collect and compare the GPIO and PMIC LDO configurations with QTI reference.	<a href="#">Check leakage in sleep current</a>
16	<ul style="list-style-type: none"> <li>GPIO and LDO configuration are dependent on the hardware design.</li> <li>Captured GPIO and LDO data must be reviewed by QTI and OEM hardware teams to turn off unnecessary components.</li> <li>If the issue still exists, file a case with QTI for further debugging help; include all the debug information, for example, a clock dump, ftrace, waveform, PowerTop, Top, and power rail breakdown.</li> <li>For this information, file a case.</li> </ul>	<a href="#">Technical assistance</a>

### 3.5 Video playback

Step no.	Step	Reference
1	Ensure that baseline rockbottom, static image, and MP3 use cases are optimized.	<ul style="list-style-type: none"> <li><a href="#">Rockbottom</a></li> <li><a href="#">MP3 playback</a></li> </ul>
2	If display panel power can be quantified, ask QTI for comparable panel power before proceeding to Step 3.	
3	<ul style="list-style-type: none"> <li>To make a proper comparison with the QTI reference data, the hardware configuration also must be comparable.</li> <li>Check for any custom components on the device; account for the current delta from each component as the known delta: <ul style="list-style-type: none"> <li>Audio playback in Tunnel mode vs. Nontunnel mode</li> <li>Awesome player or Nuplayer</li> <li>Sensors and other third-party components</li> <li>Different DDR size compared to the QTI reference</li> <li>Any additional postprocessing hardware</li> </ul> </li> <li>For this information, file a case.</li> </ul>	<a href="#">Technical assistance</a>
4	Check Tunnel mode and player type.	<a href="#">Tunnel mode and player type check</a>
5	If using Nontunnel mode or Nuplayer, which are not part of the QTI standard, ask QTI for the power impact for this variation.	
6	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1



Step no.	Step	Reference
	<ul style="list-style-type: none"> <li>■ If using Tunnel mode audio playback, compare it with the measured number with the QTI reference data to determine if power consumption is higher, taking into consideration the known delta as quantified in Step 3.</li> <li>■ If using Nontunnel mode, request the reference power number through a case.</li> </ul>	Release Notes
7	<p>Observe the power waveform pattern and identify if the baseline current is high, there are frequent wakeups, or both are observed.</p> <ul style="list-style-type: none"> <li>■ If the baseline current is high, go to Step 8.</li> <li>■ If frequent wakeups are observed, go to Step 16.</li> </ul>	
8	<ul style="list-style-type: none"> <li>■ If a device has breakdown capability, capture a full power rail breakdown and compare it with the QTI reference to identify if any rail is consuming higher current.</li> <li>■ If the breakdown cannot be captured, go to Step 6.</li> </ul>	Specific chipset dashboard goals and use case clock plan document
9	Identify which power rail is higher than the QTI power data and determine the subsystems using it; look only for these components in Steps 10 through 14.	Specific chipset power overview document
10	Capture SurfaceFlinger and compare it with the SurfaceFlinger reference logs to check for total number of layers, composition type, and number of layers being updated.	<a href="#">Debug SurfaceFlinger</a>
11	Capture a full clock dump to compare it with the QTI reference clock plan for video playback.	Specific chipset dashboard goals and use case clock plan document
12	If the CPU clock is high, capture ftrace, PowerTop and Top to understand CPU residency and CPU load information.	<a href="#">Analyze high CPU usage process</a>
13	<ul style="list-style-type: none"> <li>■ Determine which process has high CPU usage and look for any unexpected processes/interrupts compared to the reference logs.</li> <li>■ Resolve the abnormal process/thread by contacting the respective area engineer.</li> </ul>	<a href="#">Analyze high CPU usage process</a>
14	<ul style="list-style-type: none"> <li>■ If the BIMC clock is high, compare the bandwidth voting under <code>/d/msm-bus-dbg/client-data/</code> with the reference log.</li> <li>■ If reference logs are needed, file a case.</li> <li>■ After a particular client which voted for more bandwidth is identified, contact the respective subsystem engineer to resolve this.</li> </ul>	<a href="#">Analyze BIMC clock</a>
15	If the issue still exists, file a case with QTI for further debugging help; include all the debug information, for example, clock dump, ftrace, waveform, PowerTop, Top, and power rail breakdown.	<a href="#">Technical assistance</a>
16	<ul style="list-style-type: none"> <li>■ For frequent wakeups, check the period of the wakeup.</li> <li>■ Capture PowerTop, ftrace and look for periodic wakeups.</li> </ul>	<a href="#">Analyze interrupt</a>
17	<ul style="list-style-type: none"> <li>■ Check PowerTop for any unexpected interrupts compared to a reference log.</li> <li>■ Use pytime chart to analyze ftrace to determine the source of the interrupt.</li> <li>■ Resolve the interrupts by contacting the respective engineer for the domain.</li> </ul>	<a href="#">Analyze interrupt</a>



Step no.	Step	Reference
18	Collect and compare the GPIO, PMIC LDO configurations with the QTI reference.	<a href="#">Check leakage in sleep current</a>
19	<ul style="list-style-type: none"> <li>GPIO and LDO configuration are dependent on the hardware design.</li> <li>Captured GPIO and LDO data must be reviewed by QTI and OEM hardware teams to turn off unnecessary components.</li> <li>If issues still exist, go to Step 15.</li> </ul>	

## 3.6 Talk/Voice call

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta: <ul style="list-style-type: none"> <li>Sensors</li> <li>Different DDR size</li> <li>Other third-party components</li> </ul> </li> <li>For this information, file a case.</li> </ul>	<a href="#">Technical assistance</a>
2	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1
	Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 3.	Release Notes
3	Capture rail level power breakdown data and determine which subsystem or module is consuming higher current than expected.	Specific chipset application note for power breakdown reference
4	Check the following points for higher current consumption by a particular module or rail: <ul style="list-style-type: none"> <li>APSS not in power collapse – Go to <a href="#">Check subsystem (APSS/MPSS/LPASS) power collapse from RPM</a>.</li> <li>Shared clocks/resources running at a higher level – Go to Step 5.</li> <li>Modem software Hexagon™ processor taking higher current – Go to Step 6.</li> <li>Modem RF or PA consuming higher current – Go to Step 7.</li> </ul>	
5	Check clock dumps and RPM NPA dumps to determine if any clocks or shared resources are running at a higher level and which subsystems are voting for the same.	<a href="#">Inspect clocks and shared resources</a>
6	Check modem NPA resource logs to determine the modem-specific resources running at a higher level and which clients are voting for those resources.	<a href="#">Check modem resource votings</a>
7	<ul style="list-style-type: none"> <li>Check if proper calibration is done for that particular RAT and band configuration.</li> <li>Check if APT/ET enablement and calibration is done correctly.</li> <li>If using a third-party PA, the current consumption must be quantified for the same.</li> </ul>	<a href="#">Check PA/RF power consumption</a>
8	<ul style="list-style-type: none"> <li>If power consumption is still higher than expected after following Steps 1 through 7, file a case with QTI for further debugging help.</li> </ul>	<a href="#">Technical assistance</a>

### 3.7 Data call

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta:               <ul style="list-style-type: none"> <li>Sensors</li> <li>Different DDR size</li> <li>Other third-party components</li> </ul> </li> <li>For this information, file a case.</li> </ul>	<a href="#">Technical assistance</a>
2	Obtain the power measurement on the device following the QTI standard power measurement test procedure.	80-N6837-1
	Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 3.	Release Notes
3	Capture rail level power breakdown data and determine which subsystem or module is consuming higher current than expected.	Specific chipset application note for power breakdown reference
4	Check the following points for higher current consumption by a particular module or rail: <ul style="list-style-type: none"> <li>Shared clocks/resources running at a higher level – Go to Step 5.</li> <li>APSS consuming higher current – Go to Step 6.</li> <li>Modem software Hexagon processor taking higher current – Go to Step 7.</li> <li>Modem RF or PA consuming higher current – Go to Step 8.</li> </ul>	
5	Check clock dumps and RPM NPA dumps to determine if any clocks or shared resources are running at a higher level and which subsystems are voting for the same.	<a href="#">Inspect clocks and shared resources</a>
6	Check modem NPA resource logs to determine the modem-specific resources running at a higher level and which clients are voting for those resources.	<a href="#">Check modem resource votings</a>
7	Check APSS-specific logs, such as PowerTop, Top, and ftrace logs, to determine what is causing the higher current consumption from the APSS.	<a href="#">Check APSS</a>
8	<ul style="list-style-type: none"> <li>Check if proper calibration is done for that particular RAT and band configuration.</li> <li>Check if APT/ET enablement and calibration is done correctly.</li> <li>If using a third-party PA, the current consumption must be quantified for the same.</li> </ul>	<a href="#">Check PA/RF power consumption</a>
9	If power consumption is still higher than expected after following Steps 1 through 8, file a case with QTI for further debugging help.	<a href="#">Technical assistance</a>

## 3.8 Game

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta:               <ul style="list-style-type: none"> <li>LCD resolution</li> <li>Smart/dumb panel</li> </ul> </li> <li>If panel power is quantified, go to Step 3.</li> <li>If panel power is not quantified, the data cannot be compared with the QTI reference data. Compare all of the debug information with MTP data. Go to Step 5.</li> </ul>	
2	<ul style="list-style-type: none"> <li>Ensure that the junction temperature is 35°C.</li> <li>Obtain the power measurement on the device following the QTI standard power measurement test procedure.</li> </ul>	<ul style="list-style-type: none"> <li>Check the temperature before measuring the power</li> <li>80-N6837-1</li> </ul>
	Compare it with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 1.	Release Notes
3	Capture the full breakdown and compare it with the 3D gaming breakdown. If power rail breakdown cannot be captured, go to Step 6.	Specific chipset dashboard goals and use case clock plan document
4	Identify which power rail is higher than the QTI power data and determine what subsystems are using it.	
5	Capture all of clocks and regulators to compare them with QTI data.	<ul style="list-style-type: none"> <li>Collect clock dumps</li> <li>Capture clock and regulator dumps</li> </ul>
6	<ul style="list-style-type: none"> <li>Compare the captured clock data with the 3D gaming clock plan to determine which clock is high.</li> <li>Typically, the game power issues are from the CPU/GPU/BIMC clock, interrupts. Follow Steps 6-1-2, 6-2, and 6-3.</li> </ul>	Specific chipset dashboard goals and use case clock plan document
6-1	CPU clock is high.	Analyze high CPU usage process
6-1-1	Governor, scheduler, and CPU freq parameters: <ul style="list-style-type: none"> <li>Compare the governor, scheduler, and CPU freq parameters with QTI default settings.</li> <li>If there are different parameters:               <ul style="list-style-type: none"> <li>Remeasure after changing the parameters to the QTI default.</li> <li>If there is no improvement, go to the next step in this Step 6-1-1.</li> </ul> </li> <li>If there are no different parameters, capture CPU-related information by ftrace, PowerTop, and Top.</li> </ul>	Check governor, scheduler, and CPU freq parameters
6-1-2	High CPU usage process.	Analyze high CPU usage process

Step no.	Step	Reference
6-1-3	Unexpected interrupt or interrupt count.	<a href="#">Analyze interrupt</a>
6-2	BIMC clock is high. <ul style="list-style-type: none"> <li>Compare the bandwidth voting under <code>/d/msm-bus-dbg/client-data/</code> with the MTP.</li> <li>File a case with QTI if the MTP data needs to be compared.</li> <li>If the client that voted more bandwidth compared to MTP can be determined, contact the subsystem engineer or file a case.</li> </ul>	<a href="#">Analyze BIMC clock</a>
6-3	GPU clock is high.	<a href="#">Debug high GPU clock frequency</a>
6-4	If other clocks are high, file a case with the debugging information clock dump, ftrace, waveform, PowerTop, Top, systrace data, and power rail breakdown data.	<a href="#">Technical assistance</a>
7	<ul style="list-style-type: none"> <li>GPIO and LDO configuration are dependent on the hardware design.</li> <li>Captured GPIO and LDO must be reviewed by data by QTI and OEM hardware teams to turn off unnecessary components.</li> </ul>	<a href="#">Check leakage in sleep current</a>
8	If power consumption is still higher than the QTI reference data, go to Step 6-4.	

### 3.9 Browser

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta:               <ul style="list-style-type: none"> <li>LCD resolution</li> <li>Smart/dumb panel</li> </ul> </li> <li>If panel power is quantified, go to Step 3.</li> <li>If panel power is not quantified, the data cannot be compared with the QTI reference data. Only compare all of debug information with MTP data. Go to Step 5.</li> </ul>	
2	<ul style="list-style-type: none"> <li>Verify that the junction temperature is 35°C.</li> <li>Obtain the power measurement on the device following the QTI standard power measurement test procedure.</li> </ul>	<ul style="list-style-type: none"> <li>80-N6837-1</li> <li><a href="#">Check the temperature before measuring the power</a></li> </ul>
	Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 1.	Release Notes
3	Capture the full breakdown and compare it with the browser breakdown. If power rail breakdown cannot be captured, go to Step 5.	Specific chipset dashboard goals and use case clock plan document.
4	Identify which power rail is higher than the QTI power data and determine what subsystems are using it.	Specific chipset power overview document

Step no.	Step	Reference
5	<ul style="list-style-type: none"> <li>Quantify the current consumed by Wi-Fi.</li> <li>Verify Wi-Fi power.</li> <li>Check with module engineer or solution provider to determine if Wi-Fi current is expected.</li> </ul>	<a href="#">Verify Wi-Fi power</a>
6	Compare the waveform with reference data.	<a href="#">Analyze waveforms</a>
7	Capture all clocks and regulators to compare with QTI data.	<ul style="list-style-type: none"> <li><a href="#">Collect clock dumps</a></li> <li><a href="#">Capture clock and regulator dumps</a></li> </ul>
8	<ul style="list-style-type: none"> <li>Compare the captured clock data with the browser clock plan to determine which clock is high.</li> <li>Typically, the browser current issues are high from CPU/GPU/BIMC clock, interrupts, and Wi-Fi power. Follow Steps 8-1 through 10 in the respective problem area.</li> </ul>	Specific chipset dashboard goals and use case clock plan document
8-1	CPU clock is high.	
8-1-1	Governor, scheduler, and CPU freq parameters: <ul style="list-style-type: none"> <li>Compare the governor, scheduler, and CPU freq parameters with QTI default settings.</li> <li>If there are different parameters:               <ul style="list-style-type: none"> <li>Remeasure after changing the parameters as QTI default.</li> <li>If there is no improvement, go to Step 8-1-2.</li> </ul> </li> <li>If there are no different parameters, capture CPU-related information by ftrace, PowerTop, and Top.</li> </ul>	<a href="#">Check governor, scheduler, and CPU freq parameters</a>
8-1-2	High CPU usage process	<a href="#">Analyze high CPU usage process</a>
8-1-3	Unexpected interrupt or interrupt count.	<a href="#">Analyze interrupt</a>
8-2	BIMC clock is high. <ul style="list-style-type: none"> <li>Compare the bandwidth voting under <code>/d/msm-bus-dbg/client-data/</code> with the MTP.</li> <li>File a case if the MTP data must be compared.</li> <li>If the client that voted for more bandwidth compared to the MTP can be determined, discuss it with the module engineer or file a case.</li> </ul>	<a href="#">Analyze BIMC clock</a>
8-3	GPU clock is high.	<a href="#">Debug high GPU clock frequency</a>
8-4	Other clock is high. File a case with the debugging information clock dump, ftrace, waveform, PowerTop, Top, systrace data, and power rail breakdown data.	<a href="#">Technical assistance</a>
9	<ul style="list-style-type: none"> <li>GPIO and LDO configuration are dependent on the hardware design.</li> <li>Captured GPIO and LDO data must be reviewed by QTI and OEM hardware teams to turn off unnecessary components.</li> </ul>	<a href="#">Check leakage in sleep current</a>
10	If power consumption is still higher than the QTI reference data, go to Step 8-4.	

### 3.10 Web streaming

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>Quantify the current consumed by the following used in the device; this must be accounted for as the known delta:               <ul style="list-style-type: none"> <li>LCD resolution</li> <li>Smart/dumb panel</li> </ul> </li> <li>If panel power is quantified, go to Step 3.</li> <li>If panel power is not quantified, the data cannot be compared with the QTI reference data. Only compare all debug information with MTP data. Go to Step 5.</li> </ul>	
2	<ul style="list-style-type: none"> <li>Verify that the junction temperature is 35°C.</li> <li>Check the temperature before running the use case.</li> <li>Obtain the power measurement on the device following the QTI standard power measurement test procedure.</li> </ul>	<ul style="list-style-type: none"> <li>80-N6837-1</li> <li><a href="#">Check the temperature before measuring the power</a></li> </ul>
	Compare with the QTI reference power data and determine if the power consumption is higher, taking into consideration the known delta as quantified in Step 1.	Release Notes
3	Capture the full breakdown and compare it with the video streaming breakdown. If power rail breakdown cannot be captured, go to Step 5.	Specific chipset dashboard goals and use case clock plan document
4	Identify which power rail is higher than the QTI power data and determine what subsystems are using it.	Specific chipset power overview document
5	<ul style="list-style-type: none"> <li>Quantify the current consumed by Wi-Fi.</li> <li>Check with the module engineer or solution provider if Wi-Fi current is expected.</li> </ul>	<a href="#">Verify Wi-Fi power</a>
6	Check Tunnel mode and player type.	<a href="#">Tunnel mode and player type check</a>
7	Capture all of the clocks and regulators to compare with QTI data.	<ul style="list-style-type: none"> <li><a href="#">Collect clock dumps</a></li> <li><a href="#">Capture clock and regulator dumps</a></li> </ul>
8	<ul style="list-style-type: none"> <li>Compare the captured clock data with the video streaming clock plan to determine which clock is high.</li> <li>Typically, the video streaming current issues are high from CPU/GPU/BIMC clock, interrupts, FPS, and Wi-Fi power. Follow Steps 8-1 to 8-3 in the respective problem area.</li> </ul>	Specific chipset dashboard goals and use case clock plan document
8-1	CPU clock is high.	

Step no.	Step	Reference
8-1-1	Governor, scheduler, and CPU freq parameters: <ul style="list-style-type: none"> <li>■ Compare the governor, scheduler, and CPU freq parameters with QTI default settings.</li> <li>■ If there are different parameters:               <ul style="list-style-type: none"> <li>□ Remeasure after changing the parameters as QTI default.</li> <li>□ If there is no improvement, go to Step 8-1-2.</li> </ul> </li> <li>■ If there are no different parameters, capture CPU-related information by ftrace, PowerTop, and Top.</li> </ul>	<a href="#">Check governor, scheduler, and CPU freq parameters</a>
8-1-2	High CPU usage process.	<a href="#">Analyze high CPU usage process</a>
8-1-3	Unexpected interrupt or interrupt count.	<a href="#">Analyze interrupt</a>
8-2	BIMC clock is high. <ul style="list-style-type: none"> <li>■ Compare the bandwidth voting under <code>/d/msm-bus-dbg/client-data/</code> with the MTP.</li> <li>■ File a case if the MTP data needs to be compared.</li> <li>■ If the client that voted for more bandwidth compared to the MTP can be determined, discuss it with the module engineer or file a case.</li> </ul>	<a href="#">Analyze BIMC clock</a>
8-3	Other clock is high. File a case with the debugging information clock dump, ftrace, waveform, PowerTop, Top, systrace data, and power rail breakdown data.	<a href="#">Technical assistance</a>
8-4	<ul style="list-style-type: none"> <li>■ Must check FPS.</li> <li>■ File a case for debug in detail if there is a different FPS.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Technical assistance</a></li> <li>■ <a href="#">Debug high GPU clock frequency</a></li> </ul>
9	If power consumption is still higher than the QTI reference data, go to Step 8-3.	

### 3.11 Camera preview

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>■ Prepare the required setup and tools as mentioned in the power debug setup section.</li> <li>■ Verify that the junction temperature is 35°C.</li> <li>■ Obtain the power measurement on the device following the QTI standard power measurement test procedure.</li> </ul>	<ul style="list-style-type: none"> <li>■ 80-N6837-1</li> <li>■ <a href="#">Check the temperature before measuring the power</a></li> </ul>
2	<ul style="list-style-type: none"> <li>■ If the OEM does not have a breakdown of power numbers from the customizations, go to Step 4 for general debugging.</li> <li>■ If the OEM has a breakdown of power numbers due to various components, quantify the current consumed by the following; this must be accounted for as the known delta:               <ul style="list-style-type: none"> <li>□ OIS</li> <li>□ Dual camera</li> <li>□ Hardware-based face detection</li> </ul> </li> </ul>	



Step no.	Step	Reference
	<ul style="list-style-type: none"> <li>Any other special hardware, such as a separate image signal processor (ISP) for image quality (IQ) processing</li> <li>Extra software library included in the camera pipeline, such as noise reduction, video stabilization, and scene detect, other than QTI IQ libraries</li> <li>Current delta is usually calculated by enabling and disabling the feature and measuring the difference in current.</li> </ul>	
3	<ul style="list-style-type: none"> <li>When taking power numbers for comparison, use the mainline Qualcomm® Snapdragon™ camera application for all power measurements.</li> <li>Find the Snapdragon camera application in the Code Aurora Forum (CAF) repository at <a href="https://www.codeaurora.org/cgit/quic/la/platform/packages/apps/SnapdragonCamera/tree/">https://www.codeaurora.org/cgit/quic/la/platform/packages/apps/SnapdragonCamera/tree/</a>.</li> </ul>	
	<ul style="list-style-type: none"> <li>Obtain the reference power numbers for the use case from the release notes.</li> <li>If the customer device measurement data minus the known delta from Step 2 is greater than the QTI reference data, go to Step 4.</li> </ul>	Release Notes
	<ul style="list-style-type: none"> <li>If the reference power numbers are not available, file a case with QTI requesting the power numbers for a similar configuration on the QTI MTP.</li> <li>If customer numbers are higher than QTI numbers, go to Step 4.</li> </ul>	Technical assistance
4	<p>Camera sensor configuration analysis:</p> <ul style="list-style-type: none"> <li>Collect details about sensor, such as configured sensor resolution or sensor FPS configuration.</li> <li>Check if the sensor is configured to the minimal resolution and FPS as possible to meet OEM requirements; for example, if preview is 1080p and snapshot size is 8 MP for 30 FPS, confirm that the sensor is configured to output resolution and FPS closer to these settings.</li> <li>After the sensor configuration is correct, go to Step 5.</li> </ul>	Measure sensor resolution during use case
5	<p>Camera subsystem analysis:</p> <ul style="list-style-type: none"> <li>Collect the clock dump and check clocks of the camera subsystem (VFE0, VFE1, CPP, and BIMC).</li> <li>If the VFE clock is running at TURBO, determine if you can enable dual ISP hardware to process the sensor output.</li> <li>If the VFE and camera postprocessor (CPP) clocks are aligned with the clock plan, the camera hardware is running at the correct frequency; go to Step 6.</li> </ul>	<p>Obtain camera subsystem clock dumps</p> <ul style="list-style-type: none"> <li>See the specific chipset dashboard goals and use case clock plan document.</li> <li>Dual ISP configuration</li> </ul>
6	<p>CPU usage analysis:</p> <ul style="list-style-type: none"> <li>Identify the Top process using the CPU.</li> <li>Collect CPU usage logs (ftrace, systrace, PowerTop).</li> <li>Check with the module engineer or solution provider if Wi-Fi current is expected.</li> <li>Obtain details about imaging libraries, such as third-party 3A, any noise reduction algorithms used in OEM camera pipeline for the use case.</li> </ul>	<ul style="list-style-type: none"> <li>Analyze high CPU usage process</li> <li>Capture PowerTop and Top data</li> <li>Capture clock and regulator dumps</li> </ul>
6-1	<ul style="list-style-type: none"> <li>If the Top CPU usage is from QTI 3A (thread names – AEC, AWB, AF, AFD, ASD) or other QTI modules, file a case with all debugging information</li> </ul>	



Step no.	Step	Reference
	(clockdump, ftrace dump, and Top logs). Go to <a href="#">Collect GPIO dumps</a> for other subsystem analysis. <ul style="list-style-type: none"> <li>■ If Top usage is from the third-party algorithms, discuss with the third party vendor for CPU optimization.</li> </ul>	
6-2	BMIC usage: <ul style="list-style-type: none"> <li>■ Follow the steps to log BMIC usage during the use case. Compare the BMIC usage with the QTI MTP.</li> <li>■ File a case if the MTP data needs to be compared.</li> <li>■ If high BMIC clock and bandwidth vote is observed during the camera use case, follow the suggestions for collecting PMIC dumps to reduce bus bandwidth. Otherwise, go to Step 7 to debug GPU usage.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Analyze BMIC clock</a></li> <li>■ <a href="#">Collect PMIC dumps</a></li> </ul>
6-3	<ul style="list-style-type: none"> <li>■ If display resolution is higher than 1080p, verify that the preview size requested by the camera can be maintained at 1080p and allow display hardware to upscale to physical display resolution.</li> <li>■ Reducing preview size reduces the bus bandwidth requested by the CPP and mobile display processor (MDP).</li> <li>■ If display resolution is not high, go to Step 7 to debug GPU usage.</li> </ul>	<a href="#">Reduce camera preview size</a>
7	GPU usage analysis: <ul style="list-style-type: none"> <li>■ Monitor GPU usage during the use case using a script. If GPU usage is high, go to Step 7.1. Otherwise, go to Step 8.</li> </ul>	<a href="#">Use script to monitor GPU usage</a>
7-1	Check if the camera application is using GPU to render preview frames. <ul style="list-style-type: none"> <li>■ If GPU is used, follow the SurfaceView suggestions to reduce GPU usage.</li> <li>■ If TextureView is no longer used and GPU usage is still high, go to Step 7-2.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Check camera using GPU for preview buffer render</a></li> <li>■ <a href="#">Use SurfaceView instead of TextureView</a></li> </ul>
7-2	Check if the camera use case triggers GPU composition from SurfaceFlinger. <ul style="list-style-type: none"> <li>■ If GPU composition is triggered, identify the reason for GPU composition.</li> <li>■ If GPU composition occurs because of more layers, contact the application developer to reduce the number of layers.</li> <li>■ If the number of layers are not high to trigger Mixed mode composition, file a case with QTI for further analysis of the problem.</li> <li>■ Go to Step 8.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Determine if camera uses GPU for composition instead of MDP/overlay</a></li> <li>■ <a href="#">Identify reason for GPU composition</a></li> </ul>
8	Other power optimizations: <ul style="list-style-type: none"> <li>■ If the above optimization suggestions do not yield improvements, follow the suggestions for disabling TNR, tintless, and CAC.</li> <li>■ See the impact/side effect suggestions for information about possible IQ and/or performance impact with the optimization.</li> </ul>	<ul style="list-style-type: none"> <li>■ <a href="#">Disable TNR</a></li> <li>■ <a href="#">Disable tintless</a></li> <li>■ <a href="#">Disable chromatic aberration correction (CAC)</a></li> </ul>

## 3.12 Video recording

Step no.	Step	Reference
1	<ul style="list-style-type: none"> <li>As video recording uses a similar pipeline as camera, optimize the camera preview current.</li> <li>If power usage is still higher, go to Step 2 for optimizations specific to video recording.</li> </ul>	<a href="#">Camera preview</a>
2	<p>Camera sensor configuration analysis:</p> <ul style="list-style-type: none"> <li>Find the sensor operating mode and resolution, i.e., mode at which the sensor hardware is initialized and configured, and ISP configuration during the use case.</li> <li>Check if the sensor output is configured to be close to the OEM preview and live shot resolution. For example, if the live shot requirement is 8 MP, preview is 1080p, and sensor is 16 MP, the sensor should be configured to output only 8 MP. The sensor should not be configured to Full Resolution mode of 16 MP.</li> <li>If smaller sensor output size is not feasible, or if power improvement is not enough, enable dual ISP configuration, if possible.</li> <li>Go to Step 3.</li> </ul>	<ul style="list-style-type: none"> <li><a href="#">Measure sensor resolution during use case</a></li> <li><a href="#">Measure ISP configuration during camera use case</a></li> <li><a href="#">Dual ISP configuration</a></li> </ul>
3	<p>Video encoder configuration:</p> <ul style="list-style-type: none"> <li>Collect the clock dump and check clocks of the camera subsystem (VFE0, VFE1, CPP, and BIMC) and video encoder (venus0_vcodec0_clk)</li> <li>If this is an UHD recording and the video encoder clocks are high, consider enabling the Lower Power mode of the video encoder.</li> <li>Go to Step 4.</li> </ul>	<a href="#">Encoder Power Save mode</a>
4	<p>CPU usage analysis:</p> <ul style="list-style-type: none"> <li>Check if there is any additional IQ processing library used in camera pipeline during recording.</li> <li>Quantify delta due to additional IQ processing library. Check if extra image processing can be reduced only for video recording or 4K cases to save power.</li> </ul>	
5	<p>GPU usage analysis:</p> <ul style="list-style-type: none"> <li>Collect GPU usage logs and apply all optimization suggestions mentioned in the GPU usage analysis section of camera preview.</li> <li>If GPU usage is optimized fully, go to Step 6.</li> </ul>	<a href="#">Camera preview</a>
6	<p>Other power optimizations:</p> <ul style="list-style-type: none"> <li>If the above optimization suggestions do not yield improvements, follow the suggestions for disabling TNR. TNR is an IQ feature triggered during recording.</li> <li>See the impact/side effect suggestions for information about possible IQ and/or performance impact with the optimization.</li> </ul>	<a href="#">Disable TNR</a>

## 4 Dashboard use case debugging details

### 4.1 Rockbottom

The following sections describe methods to analyze and optimize rockbottom use cases.

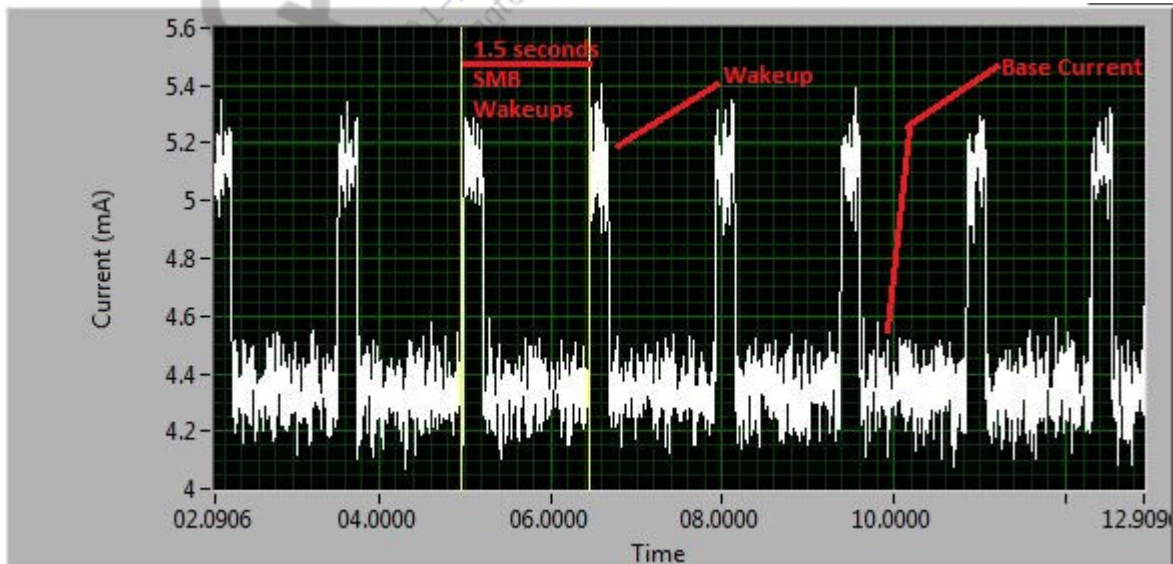
#### 4.1.1 Analyze rockbottom waveform

Waveform analysis is critical for power debugging and gives information on the nature of the issue and correct direction of debug.

Rockbottom waveform can be divided into the following parts:

- Base current
- Wakeups, for example, fuel gauge wakeups and PMIC watchdog wakeups

The following is a snapshot of the rockbottom use case waveform taken on an MSM or SDM chipset:



Compare rockbottom waveform captured on the device under test with the QTI reference waveform to determine whether the base current is higher and/or there are occurrences of unexpected wakeups.

### 4.1.2 Verify crystal oscillator (XO) shutdown and VDD minimization

To verify if the system is entering XO shutdown and VDD minimization, use one of the following methods:

- T32 breakpoints on the RPM
  - For XO shutdown – `xo_shutdown_enter()` and then `mpm_sw_done()`
  - For VDD minimization – `vdd_min_enter()` and then `mpm_sw_done()`

- adb shell commands for XO shutdown and VDD minimization count

- Type the following commands to obtain the RPM statistics:

```
mount -t debugfs none /sys/kernel/debug
cat /sys/kernel/debug/rpm_stats
```

The following is the output of the above commands; the count represents the number of occurrences of XO shutdown and VDD minimization:

RPM Mode:xosd

**count:0**

```
time in last mode(msec):0
time since last mode(sec):791
actual last sleep(msec):0
client votes: 0x00020001
RPM Mode:Vdd Min
```

**count:28**

```
time in last mode(msec):8000
time since last mode(sec):475
actual last sleep(msec):233000
client votes: 0x00000000
```

- Alternatively, check the following variables from RPM RAM dumps to determine count of XO shutdown and VDD minimization:
    - `sleep_stats[0]` – XO shutdown count (number of times the system went to XO shutdown)
    - `sleep_stats[1]` – VDD minimization count

If the system enters the VDD minimization state, only the VDD minimization count is incremented. VDD minimization is the lowest power state, and it includes XO shutdown. XO shutdown count is only incremented when the system fails to enter VDD minimization and enters XO shutdown.

### 4.1.3 Check subsystem (APSS/MPSS/LPASS) power collapse from RPM

1. Check the RPM external logs.

- For APSS power collapse, look for the following messages in the RPM external log:

```
34.521729 - rpm_shutdown_req (master: "APSS") (core: 0)
34.521759 - rpm_shutdown_ack (master: "APSS") (core: 0)
34.522064 - rpm_master_set_transition (master: "APSS") (leaving:
"Active Set") (entering: "Sleep Set")
```

- For modem peripheral subsystem (MPSS) power collapse, look for the following messages in the RPM external log:

```
34.513367 - rpm_shutdown_req (master: "MSS") (core: 0)
34.513397 - rpm_shutdown_ack (master: "MSS") (core: 0)
34.514038 - rpm_master_set_transition (master: "MSS") (leaving: "Active Set") (entering: "Sleep Set")
```

- For low power audio subsystem (LPASS) power collapse, look for following messages in the RPM external log:

```
34.513367 - rpm_shutdown_req (master: "LPASS")
34.513397 - rpm_shutdown_ack (master: "LPASS")
34.514038 - rpm_master_set_transition (master: "LPASS") (leaving: "Active Set") (entering: "Sleep Set")
```

As APSS/MSS/LPASS are expected to power collapse as soon as there are no tasks to block Low Power modes, the above messages might be overwritten and are not visible in the RPM logs. For improved verification, check the data structures available in RPM.

## 2. Check the RPM data structure.

- Power collapse status of subsystems can be confirmed by checking the RPM data structure on RPM. After the display is off and given enough time to go to sleep, break the T32 execution in RPM randomly to monitor the following variables:

- Check rpm.ees[0].subsystem\_status, 0→APSS information
- Check rpm.ees[1].subsystem\_status, 1→Modem information
- Check rpm.ees[2].subsystem\_status, 2→LPASS information

Alternately, obtain a crash dump using a system reset and analyze the RPM dumps using the T32 simulator.

- If status is SPM\_SLEEPING, the subsystem can be considered in the lowest power state.
- If status is SPM\_AWAKE, the subsystem is awake and not in lowest power state.

- Continue debugging by taking subsystem specific logs to determine why the subsystem is not voting for sleep.

## 3. Ensure all masters are power collapsed. Obtain the master (EE) status from the ee-status.txt file generated by the hansei parser tool from the RPM dump.

ee-status.txt contains information about which subsystems (and their cores) are active or sleeping.

```
*** APPS ***
    status:          SPM_AWAKE
    num_active_cores: 2
    pending_bringups: 0x00000000
*** MSS ***
    status:          SPM_SLEEPING
    num_active_cores: 0
    pending_bringups: 0x00000000
*** WCSS ***
    status:          SPM_SLEEPING
```

```
num_active_cores: 0
pending_bringups: 0x00000000
```

#### 4.1.4 Determine subsystem votes for major resources using RPM logs

The following are the major resources that can be relinquished or voted for low power to attain XO shutdown and VDD minimization:

- VDD CX – Digital power rail
- VDD MX – Memory power rail
- CXO – System clock (XO)

1. Check CXO votes by different subsystems using the RPM NPA log.

When there are no CXO client votes, the XO can be shutdown to save power. The system can choose to enter VDD minimization by keeping the digital (CX) and memory (MX) rails at the retention voltage to save more power.

2. Check the RPM NPA log for the following messages to determine which subsystem requires CXO and is preventing XO shutdown and VDD minimization. Check the active state of the /xo/cxo node from the RPM NPA logs; for example, from the following NPA log snippet, MPSS and APSS are shown as the clients requesting the CXO resource:

```
npa_resource (name: "/xo/cxo") (handle: 0x196DE8) (units: Enable)
(resource max: 1) (active max: 1) (active state: 1) (active headroom: 0)
(request state: 1)
npa_client (name: MPSS) (handle: 0x19C780) (resource: 0x196DE8) type:
NPA_CLIENT_LIMIT_MAX) (request: 1)
npa_client (name: MPSS) (handle: 0x19C740) (resource: 0x196DE8) (type:
NPA_CLIENT_REQUIRED) (request: 1)
npa_client (name: WCSS) (handle: 0x19C620) (resource: 0x196DE8) (type:
NPA_CLIENT_LIMIT_MAX) (request: 1)
npa_client (name: LPASS) (handle: 0x19C260) (resource: 0x196DE8) (type:
NPA_CLIENT_LIMIT_MAX) (request: 1)
npa_client (name: LPASS) (handle: 0x19C220) (resource: 0x196DE8) (type:
NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: APSS) (handle: 0x196FF0) (resource: 0x196DE8) (type:
NPA_CLIENT_REQUIRED) (request: 1)
npa_change_event (name: sleep) (handle: 0x198C10) (resource: 0x196DE8)
end npa_resource (handle: 0x196DE8)
```

This indicates that the device sleep is blocked by the MPSS and APSS. Continue debugging on the subsystem level.

## 4.1.5 Check power collapse of individual subsystems

Individual subsystems prevent system power collapse for one of the following reasons:

- Active applications or processes on the subsystem requiring a system to be running
- Applications or processes not releasing resources gracefully for a successful suspend; the following are examples for resources held by a system:
  - Clocks
  - Voltage rails
- Frequent interrupts preventing system power collapse

### 4.1.5.1 Determine why the APSS is not voting for power collapse

Wake locks are one of the major reasons that the APSS does not vote for power collapse. To check which wake lock is holding power collapse:

1. Connect the USB to the system.
2. In the adb shell, type the following command to obtain the wake lock logs:  

```
sleep 60 && cat /d/wakeup_sources > /data/wakelocks.txt &
```

**Note:** The unit of time in wakeup\_sources log is milliseconds.
3. Remove the USB and use the power key to suspend the system immediately.
4. After 60 sec, type the following command to reconnect the USB and pull wakelocks.txt:  

```
adb pull /data/wakelocks.txt <destination_folder>
```
5. Open wakelocks.txt and check the active\_since field. If any of the wake locks were active for more than 60 sec, this suggests that wake lock is holding power collapse.

### 4.1.5.2 Check clocks preventing XO shutdown/VDD minimization

1. Type the following command to enable the clock debug suspend:

```
echo 1 > /d/clk/debug_suspend
```

After enabling this flag, the clocks that are enabled are shown when the system is going into Suspend mode in the dmesg logs.

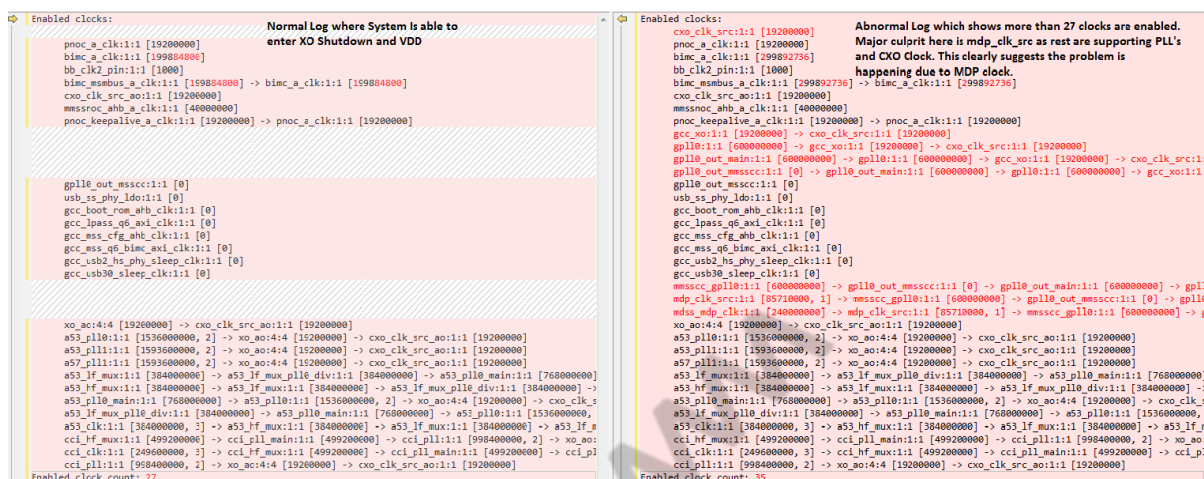
2. Suspend and resume the system by pressing the power button three to four times, and type the following command to take a dmesg log:

```
adb shell dmesg
```

Some clocks are always expected to be shown as enabled in this log. If any clocks other than usual major system clocks are shown as enabled, this can be a reason for preventing power collapse. The following are examples of clocks that should not be seen in this log:

- Any peripheral clocks
- Display-related clocks (MDSS)
- Any multimedia subsystem-related clocks, etc.

The following figure shows a comparison of enabled clocks:



Observe that in the clock log on the left side of the figure, there are 27 clocks shown as enabled, but the system goes to sleep without any issues. These clocks/PLLs are turned off later by RPM and are part of major shared resources like BIMC, system buses, and subsystem PLLs.

In the snippet on the right, there are 35 clocks enabled but a few have distinctive features.

- CXO clock source is requested by the APSS.
- MDP (display subsystem) clocks are enabled, suggesting that the driver is holding CXO from being power collapsed.

#### 4.1.5.3 Check interrupts activity that can prevent XO shutdown/VDD minimization

Higher frequency of interrupts can prevent the system from entering XO shutdown/VDD minimization.

1. Type the following command in an adb shell to check the interrupts that are firing more frequently:

```
sleep 20 && cat /proc/interrupts > /data/interrupt1.txt && sleep 30 &&  
cat /proc/interrupts > /data/interrupt2.txt &
```

2. Remove the USB immediately and suspend the system by pressing the power button.
3. Reconnect the USB and pull interrupt1.txt and interrupt2.txt.
4. Compare the count of interrupts in both files.
5. If any of the interrupts has a substantially high difference between counts in interrupt1.txt and interrupt2.txt, contact the respective subsystem engineer.

#### 4.1.5.4 Determine why the modem subsystem is not voting for power collapse

Checking the active state of resources can provide information about the state of the resource.

1. Check the MPSS NPA log for information about various NPA requests made by the MPSS.
2. In the NPA log, search for the term `npa_dump` to check which subsystem is holding sleep. This is the starting point for resource states for the system at the point of log collection



### 3. Check the following main resources:

- CXO
- VDD\_CX
- VDD\_MX
- CPU\_VDD (modem subsystem rail)

If any of the clients for these resources are holding the resource, review them. In this snippet, the resource `/core/cpu/vdd` is requested by the GPS client. This means GPS is holding CPU\_VDD (modem subsystem rail) from going into power collapse.

```
npa_resource (name: "/core/cpu/vdd") (handle: 0xD38ECA84) (units: active/
off) (resource max: 1) (active max: 0) (active state: 1) (active
headroom: 1) (request state: 0)
npa_client (name: gps_pe) (handle: 0xD3B6E450) (resource: 0xD38ECA84)
(type: NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: gps_rx) (handle: 0xD3B6E660) (resource: 0xD38ECA84)
(type: NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: GPS_MC_CPU_VDD_CLIENT) (handle: 0xD3B12850) (resource:
0xD38ECA84) (type: NPA_CLIENT_REQUIRED) (request: 1)
npa_client (name: RFCA_NPA_CLIENT) (handle: 0xD3B12A60) (resource:
0xD38ECA84) (type: NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: a2_latency_client) (handle: 0xD394F778) (resource:
0xD38ECA84) (type: NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: mcpm_wakeup_priority_cpu_vdd_client) (handle:
0xD394D068) (resource: 0xD38ECA84) (type: NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: mcpm_cpu_vdd_client) (handle: 0xD394D0C0) (resource:
0xD38ECA84) (type: NPA_CLIENT_REQUIRED) (request: 0)
end npa_resource (handle: 0xD38ECA84)
```

### 4. To find the root cause of why GPS is not going to power collapse, continue analyzing from the GPS side.

Analyze NPA logs carefully as the resource states only give the instantaneous request state. NPA logs also contain the history of requests and can be checked when a particular request was made by a subsystem.

#### 4.1.5.5 Determine why the LPASS is not voting for power collapse

Checking the `active_state` of resources can provide information about the state of the resource.

1. Check the LPASS NPA log for information about various NPA requests made by the MPSS.
2. In the NPA log, search for the term `npa_dump` to check which subsystem is holding sleep. This is the starting point for resource states for the system at the point of log collection.
3. Check the following main resources:
  - CXO
  - VDD\_CX

- VDD\_MX
- CPU\_VDD (modem subsystem rail)

If any of the clients for these resources are holding the resource, review them.

#### 4.1.6 Check unexpected wakeups

Wakeup is one reason that can cause the rockbottom to be higher. The following reasons can also cause wakeups:

- Subsystem wakeups due to sensor processing requests
- Scheduled wakeups (timer expiry)
- Subsystem wakeups due to interrupts from another subsystem, for example, smd interrupts from MPSS to APSS

One method to identify the wakeup source includes monitoring the subsystem and digital rails. Most chipsets have a dedicated power rail for each subsystem. All subsystems are expected to be in sleep during VDD minimization, and the subsystem waking up can be easily identified.

Monitoring rails for external components and sensors can also be helpful in cases where the wakeups are external to the chipset.

Check subsystem-specific logs to determine if that particular subsystem is waking up from power collapse to do some scheduled activity or due to some interrupts.

##### 4.1.6.1 Check modem wakeups

The MPSS is not expected to wake up during this use case because the rockbottom use case is performed while the device is in Airplane mode. Capture modem uLogs to see if the modem is waking up from power collapse. MPSS uLogs contain several sleep-related logs that can be useful in determining if the modem subsystem is waking up and, if so, for what reason.

The following is a snippet of the sleep info log, part of the MPSS uLogs. See the timestamp when the modem exited the previous mode and entered the new mode.

```
0x00000000FE597E4E:   Exiting modes
0x00000000FE59DBA3:   Master wakeup stats (reason: Timer) (int pending: 33)
(Actual: 0xfe597803) (Expected: 0xfe5ae383) (Err: -93056)
0x00000000FE5A584F:   Sleep CPU frequency set (576000 Khz)
0x00000000FE5A58B2:   Solver entry (cpu frequency: 576000) (hard duration:
0x11879) (soft duration: 0x249fffffd1f) (latency budGet: 0xffffffff)
0x00000000FE5A58F3:   Solver table (mLUT: 1) (Duration: 17930)
0x00000000FE5A592D:   Mode chosen: ("CLM.disable + l2.ret + tcm.ret +
cpu_vdd.pc_l2_tcm_ret")
0x00000000FE5A5955:   Solver exit
0x00000000FE5A5AD6:   Entering modes (hard deadline: 0xfe5b7101) (backoff
deadline: 0xfe5b6985) (backoff: 0x77c) (sleep duration: 0x10ed8)
0x00000000FE5A5D40:   Program QTMR (match tick: 0xfe5b6985)
0x00000000FE5B6FB5:   Exiting modes
0x00000000FE5B763D:   Master wakeup stats (reason: Timer) (int pending: 242)
(Actual: 0xfe5b6985) (Expected: 0xfe5b6985) (Err: 0)
```

The reason for wakeup, which in this example is *Timer*, means it was a scheduled wakeup. After the required processing is done by the modem, the sleep solver selects the appropriate mode for modem to enter depending on the latency available until the next scheduled wakeup, if any. Also see the mode chosen by the solver and the hard deadline for the next wakeup.

According to the wakeup reason, check if any timers are set or modification relating to the timer has been made in the code.

If the wakeup reason is “rude,” which is the nonscheduled wakeup, QXDM Professional logs can help determine what activity is occurring in the MPSS.

#### 4.1.6.2 Check APSS wakeups

Kernel logs with the appropriate logging enabled can indicate if the APSS is waking up from its sleep state and, if so, for what reason.

1. Enable the following debug mask to log the interrupt information in the kernel logs:

```
echo 1 > /sys/module/msm_show_resume_irq/parameters/debug_mask
```

2. Check prints in the kernel log to identify which interrupt is causing the APSS to wake up. The following snippet shows that the APSS is awakened by `qnpn_kdpwr_status`, which is the power key press interrupt:

```
<6>[0414 06:51:27.872744]@0 @0 __qnpnint_handle_irq: 288 triggered [0x0,
0x08,0x0] qnpn_kdpwr_status
<6>[0414 06:51:27.872751]@0 @0 gic_show_resume_irq: 200 triggered qcom,smd-
rpm
<6>[0414 06:51:27.872758]@0 @0 gic_show_resume_irq: 203 triggered
601d0.qcom,mpm
<6>[0414 06:51:27.872765]@0 @0 gic_show_resume_irq: 222 triggered
200f000.qcom,spmi
```

#### 4.1.7 Check leakage in sleep current

If the base current is higher than expected, even after the device successfully enters VDD minimization, there are one or more leakage sources on the device contributing to the total current consumption.

Leakage can occur from multiple sources, such as the following:

- Leakage from SMPS and LDOs not used during sleep but are kept enabled; a PMIC dump is helpful in checking possible leakage from SMPS and LDOs
- Leakage from GPIO pads if one or more GPIOs are not configured correctly in their lowest leakage settings; a GPIO dump can be helpful in determining the sleep configuration of the MSM™ GPIOs
- Leakage from peripherals and external components not disabled or put in Low Power mode configuration

##### 4.1.7.1 Analyze PMIC dumps

PMIC dumps provide information about the status of all LDOs, and SMPS and PMIC register settings for different modules powered by the PMIC.

The following is a snippet of a parsed PMIC dump taken on a device just before entering sleep. There is information about SMPS and LDO status, the voltage level, and operating mode. Use this information to determine if any SMPS or LDOs not required during Sleep mode are still enabled but can be turned off to save leakage. Leakage can also be reduced for those SMPS and LDOs that are required during sleep by putting them in LPM mode instead of NPM mode.

Generator: Trace32

Power Rail Analysis:

Rail	Level	Enabled	VREG_OK	VREG_ON	PD	Frequency	Mode
S1_CTRL	0.92500	On	Yes	-	On	3.200 MHz	AUTO
S2_CTRL	1.01500	On	Yes	-	On	3.200 MHz	AUTO
S3_CTRL	1.20000	On	Yes	-	On	2.133 MHz	AUTO
S4_CTRL	1.80000	On	Yes	-	On	1.600 MHz	AUTO
S5_CTRL	2.15000	On	Yes	-	On	1.600 MHz	AUTO
S6_CTRL	0.92500	On	Yes	-	Off	3.200 MHz	AUTO
S7_CTRL	1.02500	Off	No	-	On	2.133 MHz	AUTO
S8_CTRL	1.05000	Off	No	-	On	3.200 MHz	AUTO
S9_CTRL	0.83000	Off	No	-	Off	3.200 MHz	AUTO
S10_CTRL	0.83000	Off	No	-	Off	3.200 MHz	AUTO
S11_CTRL	0.83000	Off	No	-	Off	3.200 MHz	AUTO
S12_CTRL	1.01500	On	Yes	-	Off	3.200 MHz	AUTO
LDO1	1.00000	Off	No	No	On	-	LPM
LDO2	1.25000	Off	No	No	On	-	NPM
LDO3	1.20000	Off	No	No	On	-	LPM
LDO4	1.20000	Off	No	No	On	-	LPM
LDO5	1.74000	Off	Yes	No	-	-	LPM
LDO6	1.80000	On	Yes	Yes	Off	-	LPM

#### 4.1.7.2 Analyze GPIO dumps

GPIO dumps provide information about the configuration of all MSM GPIOs at the time of dump collection. The following is a snippet of a GPIO dump taken on a device just before entering sleep:

```
GPIO[0x0]: [FS]0x1, [DIR]IN, [PULL]NO_PULL, [DRV]12mA, [VAL]HIGH
GPIO[1.]: [FS]0x1, [DIR]IN, [PULL]NO_PULL, [DRV]12mA, [VAL]LOW
GPIO[2.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]HIGH
GPIO[3.]: [FS]0x1, [DIR]OUT, [PULL]NO_PULL, [DRV]12mA, [VAL]LOW
GPIO[4.]: [FS]0x2, [DIR]OUT, [PULL]NO_PULL, [DRV]8mA, [VAL]LOW
GPIO[5.]: [FS]0x2, [DIR]OUT, [PULL]NO_PULL, [DRV]8mA, [VAL]LOW
GPIO[6.]: [FS]0x3, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[7.]: [FS]0x3, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[8.]: [FS]0x4, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]HIGH
GPIO[9.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[10.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[11.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[12.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[13.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[14.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[15.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[16.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[17.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[18.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[19.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[20.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[21.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[22.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[23.]: [FS]0x4, [DIR]OUT, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[24.]: [FS]0x5, [DIR]OUT, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[25.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[26.]: [FS]0x0, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]LOW
GPIO[27.]: [FS]0x3, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]HIGH
GPIO[28.]: [FS]0x3, [DIR]IN, [PULL]NO_PULL, [DRV]2mA, [VAL]HIGH
GPIO[29.]: [FS]0x0, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]LOW
GPIO[30.]: [FS]0x0, [DIR]OUT, [PULL]NO_PULL, [DRV]2mA, [VAL]HIGH
GPIO[31.]: [FS]0x1, [DIR]IN, [PULL]PULL_DOWN, [DRV]2mA, [VAL]HIGH
```

The red box is read as GPIO 11 is configured as Input - Pull Down with 2 mA drive and the value is Low. The correct GPIO sleep configuration depends on how the GPIO is used in the device design and if it is required during sleep. For the GPIOs that are used the same as the QTI reference design, a direct comparison can be made with GPIO dumps taken on a QTI reference device to determine any misconfiguration that needs to be changed to fix it.

For the GPIOs that are used differently as compared to the QTI reference design, the correct sleep configuration needs to be determined according to the usage of those GPIOs.

#### 4.1.7.3 Analyze rail level current consumption breakdown

Breakdown of current consumption for individual power rails can help narrow which component of the system is consuming higher current consumption.

1. Collect current consumption of all PMIC rails on PMIC input, for example, SMPS current, any LDOs that are not sourced by SMPS, etc.
2. Collect current consumption of components directly powered by VPH (components not powered by PMIC).
3. After determining which SMPS or component is consuming higher current consumption, collect further breakdowns of components connected to that particular SMPS to identify which component is consuming higher current.

Current consumption breakdowns are published in power application notes for that particular chipset for each of the dashboard use cases.

## 4.2 Standby

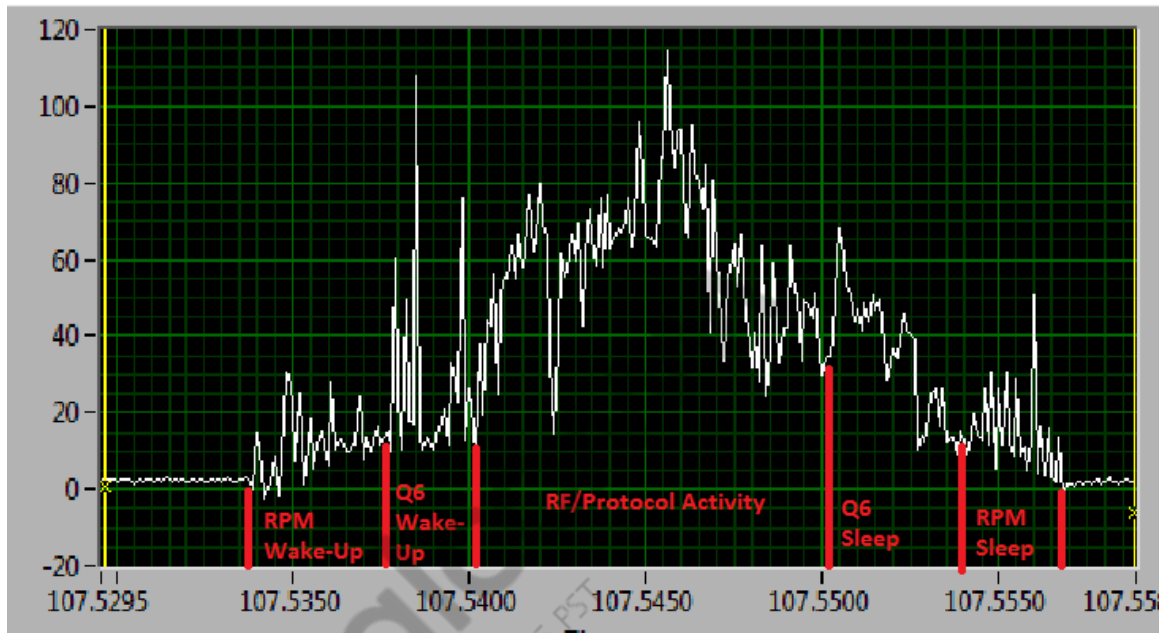
Total average standby current is highly dependent on the average rockbottom current consumption. If not already done, the first step for standby optimization is to optimize the rockbottom current consumption. Follow the steps in [Rockbottom](#) to optimize rockbottom current consumption.

### 4.2.1 Analyze higher paging awake penalty

Waveforms from current consumption capturing tools can be helpful in analyzing the awake penalty incurred by paging wakeups.

1. Compare waveforms of the paging awake cycle to determine which part of wakeup consumes more time or more current consumption:
  - System wakeup time
  - RF wakeup
  - RF/protocol processing
  - RF sleep
  - System sleep

The following figure shows correlating sections of the paging awake waveform to the stages of activities of different modules of the system involved during a DRX paging period:



2. Check the following common areas if the paging timeline is higher than expected:
  - Callbox settings error, such as enablement of neighbor cells
  - Code modification in RPM or enablement of some of the modem logging
3. Collect F3 logs, which are helpful in debugging the awake period during paging, by setting the appropriate configuration for log messages. For example, if debugging WCDMA awake penalty, use the following method to collect logs:
  - a. Open QXDM Professional and press **F3** to open the Message View window.
  - b. Right-click in the Message View window and select **Config** from the menu. The Message View Configuration window opens.
  - c. Under the Message Packets tab, select **Known Message (By Subsystem)** and expand its view.
  - d. Select **Legacy**, **Mpower**, **UMTS**, and **Radio Frequency**.
  - e. Under the Log Packets tab, select **WCDMA** log packets.
  - f. Run the WCDMA standby use case and collect F3 logs.

These are detailed logs for protocol/power/RF and have accurate timestamps that help determine the part of the system that is taking higher time and narrow down the issue.

4. Check the following common areas if the paging awake amplitude/peak is higher:
  - Proper RF calibration for that RAT and band and APT/ET enablement, if applicable.
  - In case of high peak currents during paging awake cycle, a rail level breakdown is helpful to narrow down the rail causing the peak current consumption. The problem could be focused in that area.

## 4.3 Talk

Talk use case current consumption can be higher due to the following reasons:

- Processor clocks or system clocks are running at a higher frequency.
- APSS is not in power collapse.
- PA/RF front end is consuming higher current consumption.
- Software and hardware design deltas, for example, using OEM proprietary voice algorithms, power amplifier ICs in the audio output path, special featured microphone hardware, etc.

### RELATED INFORMATION

[“Check APSS” on page 42](#)

### 4.3.1 Inspect clocks and shared resources

Clocks running at higher frequency than expected can cause the system to consume more power. Take a clock dump and compare it with the QTI reference device clock dump to ensure that clocks are at expected state.

1. Break the system at any point through RPM and run the clock dump script.
2. Verify that no extra clocks are running other than the expected clocks.
3. Verify that all clocks are running at similar frequencies as the QTI reference device. A complete comparison is more accurate and helpful, but the following are important clocks to compare:
  - BIMC (DDR) controller clocks
  - Modem clock
  - LPASS clock
  - Buses (system NOC, peripheral NOC, config NOC)
4. Check the RPM NPA logs if the shared resources or clocks are running at a higher level than expected.

The following snippet shows the voting of different subsystems for the shared resources. In this example, votings by clients “MPSS, LPASS, APSS and ICB Driver” for the shared resource pcnoc clock is observed. Check the NPA\_CLIENT\_REQUIRED request for the actual votings for that particular resource.

```
npa_resource (name: "/clk/pnoc") (handle: 0x198418) (units: KHz) (resource
max: 100000) (active max: 100000) (active state: 50000) (active headroom:
-50000) (request state: 50000)
npa_client (name: MPSS) (handle: 0x19ed58) (resource: 0x198418) (type:
NPA_CLIENT_LIMIT_MAX) (request: 4294967295)
npa_client (name: MPSS) (handle: 0x19ed18) (resource: 0x198418) (type:
NPA_CLIENT_REQUIRED) (request: 0)
npa_client (name: LPASS) (handle: 0x19e2d0) (resource: 0x198418) (type:
NPA_CLIENT_LIMIT_MAX) (request: 4294967295)
npa_client (name: LPASS) (handle: 0x19e290) (resource: 0x198418) (type:
NPA_CLIENT_REQUIRED) (request: 1)
```



```

npa_client (name: APSS) (handle: 0x11ea78) (resource: 0x198418) (type:
NPA_CLIENT_REQUIRED) (request: 50000)
npa_client (name: ICB Driver) (handle: 0x1988e8) (resource: 0x198418)
(type: NPA_CLIENT_REQUIRED) (request: 25000)
end npa_resource (handle: 0x198418)

```

Further debugging can be done for a particular subsystem whose votings are found higher than expected. For example, check MPSS NPA resource logs for MPSS-specific clients and resource votings, if MPSS is found to be voting higher level of one or more shared resources.

### 4.3.2 Check PA/RF power consumption

If current consumption is still high even after confirming correct votings for clocks, rail voltages, and shared resources, check current consumption from the RF hardware and PA by measuring the respective rails.

If RF and PA is consuming higher current compared to the QTI reference data, proper RF calibration is required to be checked. Improper calibration can lead to the PA operating at higher gain stage even at 0 dBm Tx power. APT/ET enablement and proper calibration for the same is also required.

The PA current consumption varies with the usage of third-party PAs, and the delta for the same must be accounted for.

### 4.3.3 Check modem resource votings

Modem NPA resource logs, similar to the RPM NPA resource logs, provide information about modem-specific client voting for modem resources and shared resources.

Modem Hexagon clock, modem rail (VDD MSS), VDD\_Core and VDD\_Mem, BIMC clock, and modem clock and power manager (MCPM) are some of the many resources whose voting can be seen from the modem NPA logs.

The following figure shows a snippet of modem NPA resource logs collected during a navigation use case, voting for system level resource (such as rail\_MX) and modem internal resources (such as clock/CPU and CPU/busy resources). In this example, the GPS client is voting for all the abovementioned resources.

Check the voting to see if it is as expected. For example, verify `gps_rx` voting for the 288 MHz CPU clock by reviewing the QTI reference logs for the same use case.

```

: npa_resource (name: "/clk/cpu") (handle: 0xA6061AA8) (units: KHz) (resource max: 844800) (active max: 844800) (active state: 288000) (active headroom: -556800) (request state:
: npa_client (name: gps_pe) (handle: 0xA634A600) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: gps_rx) (handle: 0xA634A7F8) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 288000) (sequence: 0x00041E00)
: npa_client (name: GPS_MC_CPU_CLIENT) (handle: 0xA63026B8) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: GPS_CC_CPU_CLIENT) (handle: 0xA6302790) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: RFILM_W_TX) (handle: 0xA61DE1F0) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: IPA_Q6_CPU_CLK_CLIENT) (handle: 0xA6157010) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: a2_q6sw_cpu_clk_client) (handle: 0xA6157130) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_fw_cpu_boost) (handle: 0xA61448F8) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_clk_q6) (handle: 0xA6149940) (resource: 0xA6061AA8) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 115200) (sequence: 0x00041F00)
: npa_client (name: time2_clk_client) (handle: 0xA60EA798) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00041D00)
: npa_client (name: npa_scheduler_clk_cpu_client) (handle: 0xA6056658) (resource: 0xA6061AA8) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: /node/core/cpu) (handle: 0xA60868E0) (resource: 0xA6061AA8) (type: NPA_CLIENT_REQUIRED) (request: 115200) (sequence: 0x00049400)
: npa_client (name: /clk/cpu/impulse) (handle: 0xA6055A00) (resource: 0xA6061AA8) (type: NPA_CLIENT_IMPULSE) (request: 0) (sequence: 0x00041C00)
: npa_reserved_event (name: ) (handle: 0xA60302E0) (resource: 0xA6061AA8)
: end npa_resource (handle: 0xA6061AA8)

: npa_resource (name: "/pmic/client/rail_mx") (handle: 0xA604C990) (units: ModeID) (resource max: 6) (active max: 6) (active state: 4) (active headroom: -2) (request state: 4)
: npa_client (name: mcpm_voltage_mx_proxy) (handle: 0xA6143950) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_gsm_cipher1) (handle: 0xA6142B98) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_gsm_cipher) (handle: 0xA6142B00) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_a2) (handle: 0xA6142C28) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_rf) (handle: 0xA6142C70) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x000A8E00)
: npa_client (name: mcpm_voltage_mx_gps) (handle: 0xA6142CB8) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 4) (sequence: 0x00025900)
: npa_client (name: mcpm_voltage_mx_tdsdma) (handle: 0xA6142D00) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_lte) (handle: 0xA6142D48) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_wcdma) (handle: 0xA6142D90) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_do) (handle: 0xA6142DD8) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_gsm1) (handle: 0xA6142E20) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_gsm) (handle: 0xA61422A8) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_voltage_mx_1x) (handle: 0xA61422F0) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 0) (sequence: 0x00000000)
: npa_client (name: vdda/mss) (handle: 0xA6055C40) (resource: 0xA604C990) (type: NPA_CLIENT_SUPPRESSIBLE) (request: 2) (sequence: 0x0002F600)
: npa_client (name: vdda/mss) (handle: 0xA6050488) (resource: 0xA604C990) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00002000)
: end npa_resource (handle: 0xA604C990)

: npa_resource (name: "/core/cpu/busy") (handle: 0xA6087BC8) (units: BINARY) (resource max: 1) (active max: 1) (active state: 1) (active headroom: 0) (request state: 1)
: npa_client (name: mcpm_busy_gsm_cipher1) (handle: 0xA6144530) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_gsm_cipher) (handle: 0xA6144578) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_a2) (handle: 0xA61445C0) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_rf) (handle: 0xA6144608) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00041F00)
: npa_client (name: mcpm_busy_gps) (handle: 0xA6144650) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 1) (sequence: 0x0001F500)
: npa_client (name: mcpm_busy_tdsdma) (handle: 0xA6144698) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_lte) (handle: 0xA61446E0) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_wcdma) (handle: 0xA6144728) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_do) (handle: 0xA6144770) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_gsm1) (handle: 0xA61447F8) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_gsm) (handle: 0xA6144840) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_client (name: mcpm_busy_1x) (handle: 0xA6144288) (resource: 0xA6087BC8) (type: NPA_CLIENT_REQUIRED) (request: 0) (sequence: 0x00000000)
: npa_reserved_event (name: ) (handle: 0xA6086D6C) (resource: 0xA6087BC8)
: end npa_resource (handle: 0xA6087BC8)

```

## 4.4 Data

The data use case is complex. It involves the modem obtaining the packet data and transferring those packets to the APSS for processing, and then being used by one or more user applications.

The rail-level breakdown is helpful in debugging the data use case because it can be quickly identified if the MPSS or APSS is consuming current higher than expected. Subsystem-level debugging can then be done accordingly.

For RF/PA rails consuming higher current, see [Check PA/RF power consumption](#).

If rail-level breakdowns are not readily available, resource voting by a different subsystem can be checked from the RPM NPA logs; see [Inspect clocks and shared resources](#).

If modem rail current consumption is higher or it is found that MPSS is the subsystem that is voting for higher system resources, check the modem NPA resource logs to narrow down the modem client causing that vote; see [Check modem resource votings](#).

### 4.4.1 Check APSS

The APSS can be one of the major reasons for higher current consumption during data use cases because added features can impact power consumption. Use the following methods or logs to determine if the APSS is consuming higher current consumption:

- Analyze PowerTop logs and compare them against the QTI reference device as follows:
  - Observe the time in each C-State (low power states) in PowerTop logs.
  - Check time in each frequency and interrupt activity in PowerTop logs. If any unexpected interrupts are seen in the PowerTop logs, check the driver requesting the interrupts.

- These tests provide a rough estimate of why the APSS consumes higher current.
- These logs can be compared with the QTI reference device logs for a comparative analysis of which system components are supposed to be up.
- Analyze Top logs and compare them against the QTI reference device as follows:
  - Stop or kill any unexpected processes in the Top logs that are consuming CPU time.
  - Check for any extra running processes using Top data.
- Analyze ftrace logs as follows:
  - Analyze any process or API running in kernel resulting in extra CPU time.
  - Analyze the amount of time each core is in a particular frequency.
  - Check which process monopolizes the CPU if kworker thread activity is high.
  - Compare ftrace logs with the QTI reference device to determine which processes are more active on the APSS and if they can be stopped.

## 4.5 Debug VDD minimization for static image with smart panel

1. Use the following debug mask to collect a kmsg:

```
adb root
adb remount
adb shell
mount -t debugfs none /sys/kernel/debug
echo 1 > /sys/kernel/debug/clk/debug_suspend
echo 32 > /sys/module/msm_pm/parameters/debug_mask
echo 8 > /sys/module/mpm_of/parameters/debug_mask
```

2. In the kmsg, look for any clock holding CXO. For example, in the following snippet, UART is holding CXO and blocking collapse XO shutdown and VDD minimization:

```
<6>[ 1163.416398] gpll0_out_main:1:1 [600000000] -> gpll0:1:1 [600000000] -> gcc_xo:1:1 [19200000] -> cxo_clk_src:2:2 [19200000]
<6>[ 1163.416441] blsp1_uart2_apps_clk_src:1:1 [7372800, 1] -> gpll0_out_main:1:1 [600000000] -> gpll0:1:1 [600000000]
-> gcc_xo:1:1 [19200000] -> cxo_clk_src:2:2 [19200000]
<6>[ 1163.416497] gpll0_out_msscc:1:1 [0]
<6>[ 1163.416515] usb_ss_phy_ldo:1:1 [0]
<6>[ 1163.416532] gcc_blsp1_ahb_clk:1:1 [0]
<6>[ 1163.416551] gcc_blsp1_uart2_apps_clk:1:1 [7372800] -> blsp1_uart2_apps_clk_src:1:1 [7372800, 1] -> gpll0_out_main:1:1 [600000000] -> gpll0:1:1 [600000000] -> gcc_xo:1:1 [19200000] -> cxo_clk_src:2:2 [19200000]
<6>[ 1163.416610] gcc_boot_rom_ahb_clk:1:1 [0]
<6>[ 1163.416628] gcc_mss_q6_bimc_axi_clk:1:1 [0]
<6>[ 1163.416648] gcc_usb2_hs_phy_sleep_clk:1:1 [0]
```

There might be other clocks requesting `cxo_clk_src_ao`. These are the “Active Only” requests by these clients and should be ignored. Only look for `cxo_clk_src`.

3. Look for any hwirqs that occur, as shown in the following example:

```
<6>[ 376.522299] msm_mpm_interrupts_detectable(): gic preventing system sleep modes during idle
<6>[ 376.522312] hwirq: 65
<6>[ 376.522316] hwirq: 115
<6>[ 376.589984] msm_mpm_interrupts_detectable(): gic preventing system sleep modes during idle
<6>[ 376.589997] hwirq: 115
```

- To check to what the irq corresponds, look for the specific irq in the interrupt list for the device by typing the following commands:

```
adb shell
cat /proc/interrupts
```

- Check with corresponding teams to understand why this irq is triggered. For example, in the following figure, check with the display and graphics teams. If the particular irq is not expected and can safely be ignored, add it to the bypass list in the chipset power management .dtsi file.

65:	0	81	15	141	0	0	0	0	GIC kgsl-3d0
74:	0	0	0	0	0	0	0	0	GIC msm_iommu_nonsecure_irq
75:	0	0	0	0	0	0	0	0	GIC msm_iommu_secure_irq, msm_iommu_secure_irq,
	msm_iommu_secure_irq, msm_iommu_secure_irq								
76:	822	0	0	1082	0	0	0	0	GIC msm_vidc
78:	0	0	0	0	0	0	0	0	GIC msm_iommu_secure_irq, msm_iommu_secure_irq
79:	0	0	0	0	0	0	0	0	GIC msm_iommu_nonsecure_irq
81:	2	0	0	1	0	0	0	0	GIC
82:	70	0	0	1582	0	0	0	0	GIC cgl
83:	3	0	0	0	0	0	0	0	GIC csid
84:	0	0	0	0	0	0	0	0	GIC csid
85:	0	0	2	0	0	0	0	0	GIC csid
86:	0	0	0	0	0	0	0	0	GIC csid
89:	4	0	0	0	0	0	0	0	GIC
90:	4	0	0	0	0	0	0	0	GIC
97:	0	0	0	0	0	0	0	0	GIC msm_iommu_nonsecure_irq, msm_iommu_nonsecure_irq,
	msm_iommu_nonsecure_irq								
102:	0	0	0	0	0	0	0	0	GIC msm_iommu_nonsecure_irq, msm_iommu_nonsecure_irq,
	msm_iommu_nonsecure_irq, msm_iommu_nonsecure_irq								
109:	0	0	0	0	0	0	0	0	GIC ocmem_dm_irq
110:	0	0	0	0	0	0	0	0	GIC csiphy
111:	0	0	0	0	0	0	0	0	GIC csiphy
112:	0	0	0	0	0	0	0	0	GIC csiphy
115:	0	333	1632	0	0	0	0	0	GIC MDSS

6. Add the irq with a 0xff to mask the irq to the .dtsi file, and ignore it. For MSM8994, the .dtsi file is found in `/kernel/arch/arm64/boot/dts/qcom/msm8994-v2-pm.dtsi`.

For example, for masking irq 66, add `<0xff 66>` to the mpm interrupt map at the end of the list in the .dtsi file, as shown in the following:

```
qcom,mpm@fc4281d0 {
    compatible = "qcom,mpm-v2";
    reg = <0xfc4281d0 0x1000>, /* MSM_RPM_MPM_BASE 4K */
        <0xf900f008 0x4>; /* MSM_APCS_GCC_BASE 4K */
    reg-names = "vmpm", "ipc";
    interrupts = <0 171 1>;
    clocks = <&clock_rpm clk_cxo_lpm_clk>;
    clock-names = "xo";

    qcom,ipc-bit-offset = <1>;

    qcom,gic-parent = <&intc>;
    qcom,gic-map = <2 216>, /* tsens_upper_lower_int */
        <47 165>, /* usb30_hs_phy_irq */
        <52 212>, /* lfps_rxterm_irq for pwr_event_irq */
        <55 172>, /* usb1_hs_async_wakeup_irq */
        <62 222>, /* ee0_krait_hlos_spmi_periph_irq */
        <0xff 20>, /* arch_timer */
        <0xff 23>, /* ARM64 Single-Bit Error PMU IRQ */
        <0xff 33>, /* APCC_qgicL2PerfMonIrptReq */
        <0xff 34>, /* APCC_qgicL2ErrorIrptReq */
        <0xff 35>, /* WDT_barkInt */
        <0xff 40>, /* qtimer_phy_irq */
        <0xff 48>, /* cpr */
        <0xff 51>, /* cpr */
        <0xff 54>, /* CCI error IRQ */
        <0xff 56>, /* modem_watchdog */
        <0xff 57>, /* mss_to_apps_irq(0) */
        <0xff 58>, /* mss_to_apps_irq(1) */
        <0xff 59>, /* mss_to_apps_irq(2) */
        <0xff 60>, /* mss_to_apps_irq(3) */
        ..
```

## 4.6 Debug SurfaceFlinger

SurfaceFlinger is the service used to compose the display frame based on multiple sources for rendering on the screen.

SurfaceFlinger creates a layer and a buffer for each source, and these layers are rendered on the screen.

Common layers observed are as follows:

- Status bar
- Navigation bar
- Application

To collect SurfaceFlinger logs, type the following commands:

```
adb shell
dumpsys SurfaceFlinger
```

The following shows a static image SurfaceFlinger:

```
numLayers=5, flags=00000000
type  handle  hint  flag  tr  blnd  format  source crop (l,t,r,b)  frame  name
HWC 15895928 0002 0000 00 0100 020_888 0.0, 0.0, 1000.0, 1920.0 0, 0, 1000, 1920 con.android.systemui.ImageWallpaper
HWC 15897768 0002 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 1920.0 0, 0, 1000, 1920 con.google.android.googlequicksearchbox/com.google.android.laun
HWC 15873216 0002 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 75.0 0, 0, 1000, 75 StatusBar
HWC 1576e8c8 0002 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 144.0 0, 1776, 1000, 1920 NavigationBar
FB TARGET 15801658 0000 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 1920.0 0, 0, 1000, 1920 HWC_FRAMEBUFFER_TARGET
Qualcomm HWC state:
MDPVersion=500
DisplayPanel=9
HWC Map For Dpy: "PRIMARY"
CURR_FRAME: layerCount: 4 ndpCount: 4 fbCount: 0
needsFBDraw: NO pipesUsed: 4 MaxPipesPerMixer: 4
listIdx  cached?  ndpIndex  compType  Z
0  NO  0  MDP  0
1  NO  1  MDP  1
2  NO  2  MDP  2
3  NO  3  MDP  3
```

The following shows a full-screen video playback SurfaceFlinger:

```
numLayers=3, flags=00000000
type  handle  hint  flag  tr  blnd  format  source crop (l,t,r,b)  frame  name
HWC 15895928 0002 0000 04 0100 7 2f30c04 0.0, 0.0, 192.0, 144.0 0, 240, 1000, 1600 SurfaceView
HWC 15897712 0002 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 1920.0 0, 0, 1000, 1920 con.motorola.MotoGallery/com.android.gallery3d.app.MovieActivity
FB TARGET 15801658 0000 0000 00 0105 0200_8888 0.0, 0.0, 1000.0, 1920.0 0, 0, 1000, 1920 HWC_FRAMEBUFFER_TARGET
Qualcomm HWC state:
MDPVersion=500
DisplayPanel=9
HWC Map For Dpy: "PRIMARY"
CURR_FRAME: layerCount: 2 ndpCount: 2 fbCount: 0
needsFBDraw: NO pipesUsed: 2 MaxPipesPerMixer: 4
listIdx  cached?  ndpIndex  compType  Z
0  NO  0  MDP  0
1  NO  1  MDP  1
```

In the above examples, the following are shown:

- Application
- Rendering type
- Composition types:
  - MDP composition
  - GPU composition causes higher power
- Total number of layers – Higher number of layers being updated implies higher current
- Rendering format – RGB, YUV, etc.
- Screen rotation
- Layers cached and noncached (a cached layer is not updated)

## 4.7 Tunnel mode and player type check

The following describes methods to analyze Tunnel mode and player type.

### 4.7.1 Check Tunnel mode

1. Capture user-space (logcat) logs by typing the following adb command:

```
adb logcat > c:\temp\logcat.txt
```

2. Play MP3 and capture logs for approximately 30 sec of MP3 playback duration.
3. In the logcat logs, look for the following message that ensures Tunnel mode playback is ongoing:

```
music_offload_avg_bit_rate=128000;music_offload_sample_rate=44100
```

If the deep-buffer-playback message is found in the log, this indicates that nontunnel, i.e., normal, playback is ongoing.

### 4.7.2 Check player type

While running the use case, check the type of player (Nuplayer or Awesome Player) by typing the following commands:

```
adb shell
```

```
Dumpsys media.player
```



## Examples

```

shell@victara:/ $ dumphsys media.player
dumphsys media.player
Client
  pid(21338), connId(35), status(0), looping(false)
  AwesomePlayer
  flags(0x00006011)
  Track 1
    MIME(audio/mp4a-latm), decoder(OMX.google.aac.decoder)
  Track 2
    MIME(video/avc), decoder(OMX.qcom.video.decoder.avc)
  videoDimensions(192 x 144)
  Total Video Frames Decoded(43)
  Total Video Frames Rendered(41)
  Total Playback Duration(2783 ns)
  numVideoFramesDropped(1)
  Average Frames Per Second(14.7381)
  First Frame Latency (75 ns)
  Number of times AV Sync Lost(1)
  Max Video Ahead Time Delta(136)
  Max Video Behind Time Delta(43)
  Max Time Sync Loss(40055)
  EOS(0)
  PLAYING(1)
  AudioOutput
    stream type(3), left - right volume(1.000000, 1.000000)
    nsec per frame(0.022676), latency (261)
    aux effect id(0), send level (0.000000)
  AudioTrack::dump
    stream type(3), left - right volume(1.000000, 1.000000)
    format(1), channel count(2), frame count(7680)
    sample rate(44100), status(0)
    state(0), latency (261)

```

```

shell@victara:/ $ dumphsys media.player
dumphsys media.player
Client
  pid(21338), connId(36), status(0), looping(false)
  NuPlayer
  numFramesTotal(127), numFramesDropped(0), percentageDropped(0.00)
  AudioOutput
    stream type(3), left - right volume(1.000000, 1.000000)
    nsec per frame(0.022676), latency (435)
    aux effect id(0), send level (0.000000)
  AudioTrack::dump
    stream type(3), left - right volume(1.000000, 1.000000)
    format(1), channel count(2), frame count(15360)
    sample rate(44100), status(0)
    state(0), latency (435)

```

## 4.8 Music application wake lock check and debugging

The following describes how to check and debug music application wake lock.

### RELATED INFORMATION

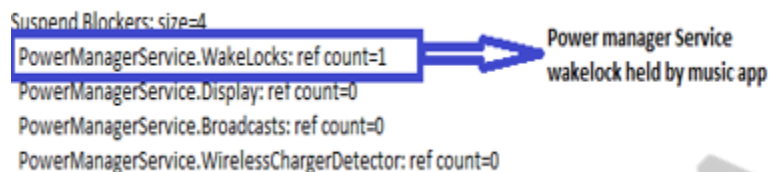
[“Collect wake locks” on page 78](#)

[“Determine why the APSS is not voting for power collapse” on page 31](#)



### 4.8.1 Analyze wake lock

1. Ensure that the power manager service is holding a wake lock using the following check, which shows expected dumpsys power output:



The screenshot shows the output of the `dumpsys power` command. A blue box highlights the line `PowerManagerService.WakeLocks: ref count=1`. An arrow points from this line to the text `Power manager Service wakelock held by music app`. Other lines in the output include `Suspend Blockers: size=4`, `PowerManagerService.Display: ref count=0`, `PowerManagerService.Broadcasts: ref count=0`, and `PowerManagerService.WirelessChargerDetector: ref count=0`.

2. If the above wake lock is not observed, hold a test wake lock to determine if power consumption reduces. Type the following commands:

```
adb shell
echo test > sys/power/wake_lock
```

To remove a test wake lock, type the following commands:

```
adb shell
echo test > sys/power/wake_unlock
```

3. If this check resolves the issue, modify the music app to hold a wake lock during MP3 playback with display turned off.

## 4.9 Analyze high CPU usage process

1. Capture the Top or ftrace data as described in [Capture PowerTop and Top data](#).
2. Determine which process is consuming the most CPU and look for any processes that should not be running.
  - a. If there is an unexpected process or thread, discuss it with the module engineer in charge of process or thread.
  - b. If there is no unexpected process or thread, do the following:
    - i. Determine the high CPU usage process or thread. The following shows that the CPU usage of process ID (PID) 472 is different between the customer device and the MTP device.

#### Top data A

PID	TID	PR	CPU%	S	VSS	RSS	PCY	UID	Thread	Proc
11893	11893	5	3%	R	13316K	2792K	fg	root	top	top
472	11867	2	3%	S	335924K	30376K	fg	media	VideoDecMsgThre	/system/bin/mediaserver
417	417	0	1%	S	256940K	28608K	fg	system	surfaceflinger	/system/bin/surfaceflinger
472	11869	2	0%	S	335924K	30376K	fg	media	gle.aac.decoder	/system/bin/mediaserver

## Top data B

PID	TID	PR	CPU%	S	VSS	RSS	PCY	UID	Thread	Proc
11587	11587	5	3%	R	13316K	2768K	fg	root	top	top
472	11501	2	1%	S	459768K	26320K	fg	media	VideoDecMsgThre	/system/bin/mediaserver
417	417	1	1%	S	343732K	28588K	fg	system	surfaceflinger	/system/bin/surfaceflinger
472	11503	1	0%	R	459768K	26320K	fg	media	gle.aac.decoder	/system/bin/mediaserver

ii. Debug in detail with the PerfTop tool (see [Debugging tools for apps processor use cases](#)).

3. Connect the USB.

4. Type the following commands to capture PerfTop data:

```
adb root
adb remount
adb shell /data/perf top -p 472
```

The following shows the PerfTop data A and B:

## PerfTop data A

```
+ [2J
PerfTop: 502 irqs/sec kernel:65.1% exact: 0.0% [1000Hz cycles], <target_pid: 472>

samples  pcnt function  DSO
-----
161.00 +[31m13.0%+ [m applyLimiter linker
65.00 +[31m 5.3%+ [m android::AwesomePlayer /system/lib/libstagefright.so
61.00 +[32m 4.9%+ [m dit_fft<long*, int, FI linker
55.00 +[32m 4.4%+ [m imdct_block<mdct_t*, 1 linker
53.00 +[32m 4.3%+ [m __memcpy_base /system/lib/libc.so
46.00 +[32m 3.7%+ [m ifree /system/lib/libc.so
42.00 +[32m 3.4%+ [m __rindex /system/lib/libc.so
41.00 +[32m 3.3%+ [m android_atomic_add /system/lib/libcutils.so
40.00 +[32m 3.2%+ [m CBlock_InverseQuantize linker
39.00 +[32m 3.2%+ [m pthread_mutex_lock /system/lib/libc.so
36.00 +[32m 2.9%+ [m dct_IV<long*, int, int linker
30.00 +[32m 2.4%+ [m je_malloc /system/lib/libc.so
27.00 +[32m 2.3%+ [m CBlock_headspectraldat linker
28.00 +[32m 2.3%+ [m __udivsi3 /system/lib/libc.so
23.00 +[32m 1.9%+ [m CBlock_FrequencyToTime linker
19.00 +[32m 1.5%+ [m android::TimedEventQue /system/lib/libstagefright.so
```

## PerfTop data B

```
+ [2J
PerfTop: 860 irqs/sec kernel:54.5% exact: 0.0% [1000Hz cycles], <target_pid: 472>

samples  pcnt function  DSO
-----
323.00 +[31m 8.4%+ [m memcpy_base /system/lib/libc.so
283.00 +[31m 7.4%+ [m android_atomic_add /system/lib/libcutils.so
274.00 +[31m 7.1%+ [m ifree /system/lib/libc.so
267.00 +[31m 7.0%+ [m void android::HudHooks linker
206.00 +[31m 5.4%+ [m je_malloc /system/lib/libc.so
158.00 +[32m 4.1%+ [m applyLimiter linker
113.00 +[32m 2.9%+ [m pthread_mutex_lock /system/lib/libc.so
107.00 +[32m 2.8%+ [m memcpy_to_i16_from_flo /system/lib/libaudioutils.so
90.00 +[32m 2.3%+ [m memcpy_to_float_from_g /system/lib/libaudioutils.so
87.00 +[32m 2.3%+ [m android::RefBase::inc$ /system/lib/libutils.so
77.00 +[32m 2.0%+ [m __udivsi3 /system/lib/libc.so
69.00 +[32m 1.8%+ [m pthread_mutex_unlock /system/lib/libc.so
61.00 +[32m 1.6%+ [m dit_fft<long*, int, FI linker
57.00 +[32m 1.5%+ [m memcpy /system/lib/libc.so
56.00 +[32m 1.5%+ [m android::RefBase::dec$ /system/lib/libutils.so
54.00 +[32m 1.4%+ [m imdct_block<mdct_t*, 1 linker
```

As the PerfTop data shows, the memory handling (memcpy, malloc, free) function in PID 472 is more frequently called in PerfTop data A.

After analyzing this data, discuss it with the module engineer in charge of the media server or submit a case.

## 4.10 Analyze interrupt

1. Capture the PowerTop data.
2. If the data is similar to the following examples, capture an ftrace log to debug in detail for qcom,smd-rpm.

### Data A

```
Top causes for wakeups:
 37.9% (514.6)      <interrupt> : arch_timer
 11.6% (157.0)      <interrupt> : qcom,smd-rpm
 10.7% (145.0)      <interrupt> : MDSS
  5.7% ( 78.0)      <interrupt> : kgs1-3d0
  4.7% ( 63.6)      <interrupt> : arch_mem_timer
  0.8% ( 10.4)      <interrupt> : mmc0
  0.1% (  1.0)      <interrupt> : i2c-msm-v2-irq
  0.0% (  0.2)      <interrupt> : mmc0
```

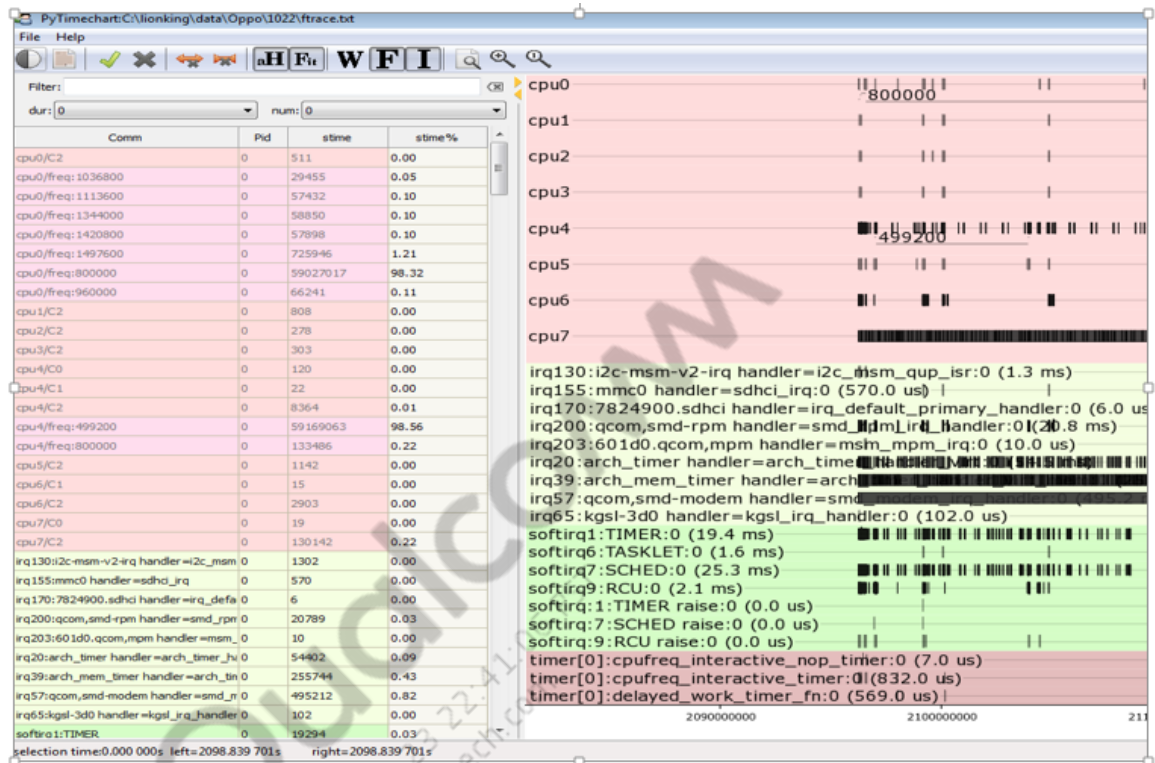
### Data B

```
Top causes for wakeups:
 36.5% (504.2)      <interrupt> : arch_timer
 10.3% (142.0)      <interrupt> : MDSS
  5.0% ( 72.0)      <interrupt> : kgs1-3d0
  4.8% ( 65.8)      <interrupt> : arch mem timer
  4.0% ( 52.0)      <interrupt> : qcom,smd-rpm
  0.9% ( 11.2)      <interrupt> : mmc0
  0.1% (  1.0)      <interrupt> : i2c-msm-v2-irq
  0.0% (  0.2)      <interrupt> : mmc0
```

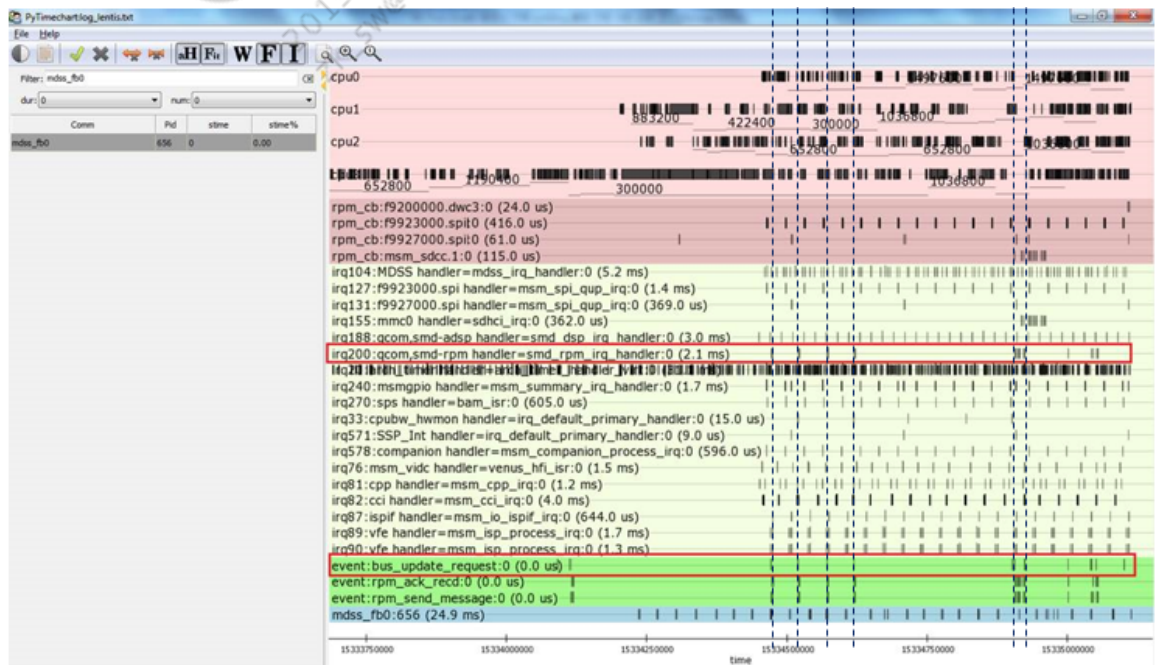
3. Launch and use the pytime chart to debug interrupt.

- Open the ftrace log using the menu in the pytime chart.

The following screen appears:



- Determine which module caused the qcom,smd-rpm interrupt by alignment as shown.



- If you observe similar behavior as in ftrace above (bus\_update\_request), check the client for bus\_update\_request in the ftrace log file as follows:

```
[001] ...1 1489.961370: bus_update_request: time:1489.952861564 name:mdss_mdp src:22 dest:512 ab:1830570776 ib:1830570776
[001] ...1 1489.961373: bus_update_request: time:1489.952861564 name:mdss_mdp src:23 dest:512 ab:1830570776 ib:1830570776
```

As a result of the analysis, MDSS\_MDP caused qcom,smd-rpm interrupts. Discuss this with the display engineer to resolve this issue or submit a case.

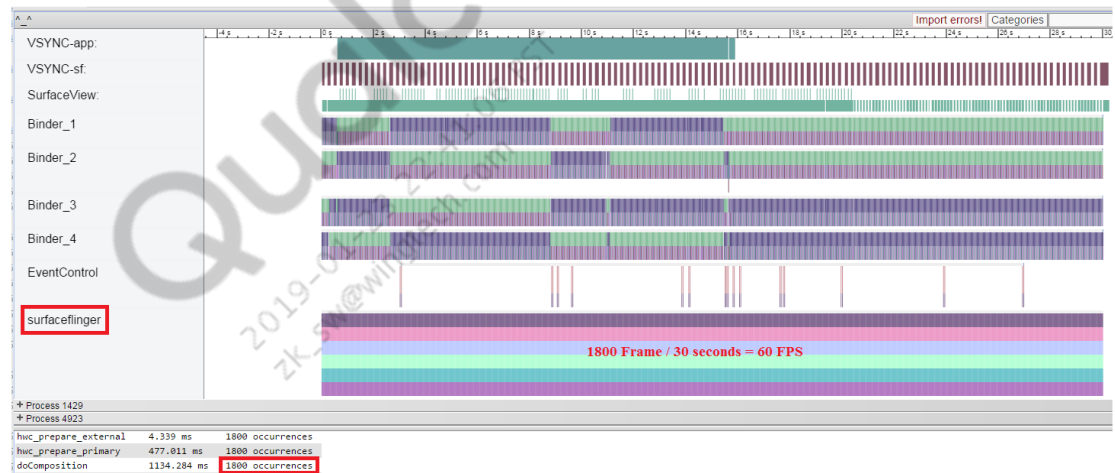
#### RELATED INFORMATION

[“Debugging tools for apps processor use cases” on page 8](#)

## 4.11 Debug high GPU clock frequency

For this procedure, a Chrome browser is required.

- Verify the FPS first by systrace.
  - Capture the systrace log and open it with a Chrome browser.
  - Calculate the FPS with an amount of doComposition and duration.



- Verify the GPU busy rate by typing the following command and comparing it to MTP:

```
Cat /sys/class/kgsl/kgsl-3d0/gpubusy
355818 1013309
```

- GPU busy rate = (active time per frame/total time per frame) \* 100
  - Total time means active time per frame + nap time per frame
  - The value of gpubusy is reset if the GPU goes to slumber.
  - For example, (355818/1013309) \* 100 = 35.1% per frame
  - If there is a different GPU busy rate compared to the MTP, the GPU is used by another context.
- File a case with the proper debug information. See *Graphics Power and Performance Overview* (80-NP885-1) for more debug-related information.

### 4.11.1 Use script to monitor GPU usage

1. Copy and paste the following script into a file named `gpu_busy.pl`:

```
>>>
#!/usr/bin/perl -w
while(1)
{
    &busy;
    print "\n";
    sleep 1 ;
}
sub busy
{
    $gpu3d = `adb shell cat /sys/class/kgsl/kgsl-3d0/gpubusy`;
    $pct = 0.0;
    if( $gpu3d =~ m/\s*(\d+)\s+(\d+)/ )
    {
        if( $1 > 0 && $2 > 0 )
        {
            $pct = $1 / $2 * 100;
        }
        printf("3D GPU Busy: %5.2f\n", $pct);
    }
}
>>>
```

2. From a Linux or Windows machine with Perl, type the following command:

```
$. /perl gpu_busy.pl
```

## 4.12 Analyze waveforms

For a basic understanding of waveform analysis, read the following steps in conjunction with the images and systrace logs that follow.

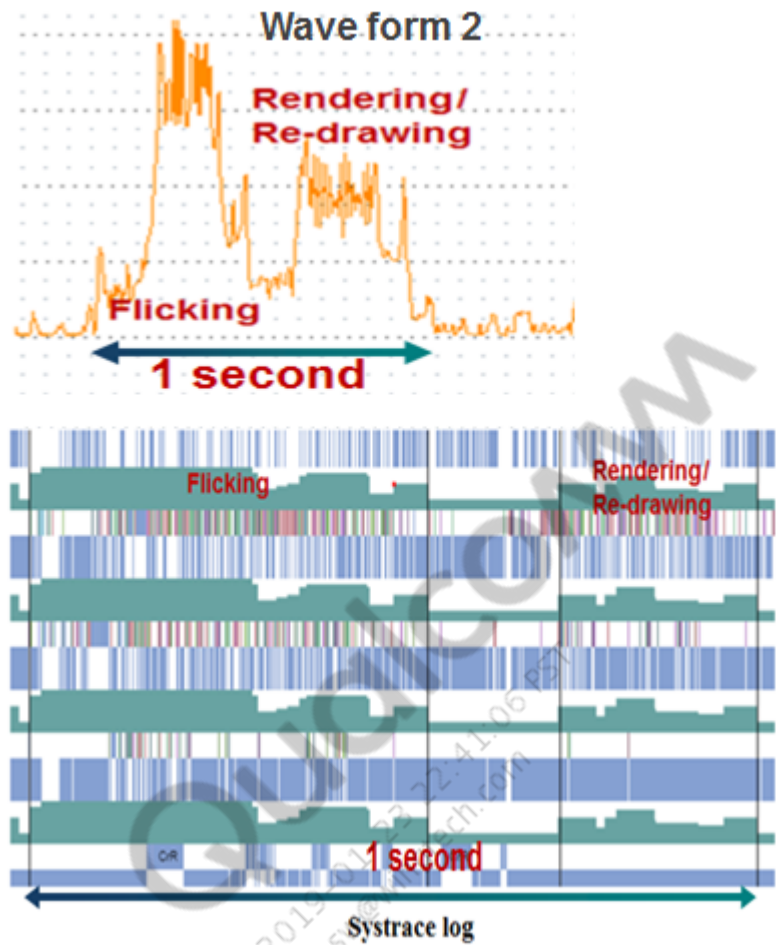
1. Observe that waveform 1 and waveform 2 have different behavior, i.e., there are two waves per one flicking wave from waveform 2 compared to waveform 1.
2. To determine the problem, use the systrace tool to debug in detail. A Chrome browser is required.
3. Capture a systrace log and open it with a Chrome browser.
4. Align each waveform and each systrace log by timeframe.
5. Observe that the systrace log for waveform 1 and 2 have different behaviors.
6. Ensure that the second area of the systrace log for waveform 2 is systrace log 2.
7. In the systrace log, see the render thread and composition thread.

As a result of the analysis, the second wave in waveform 2 is caused by render thread and composition thread.

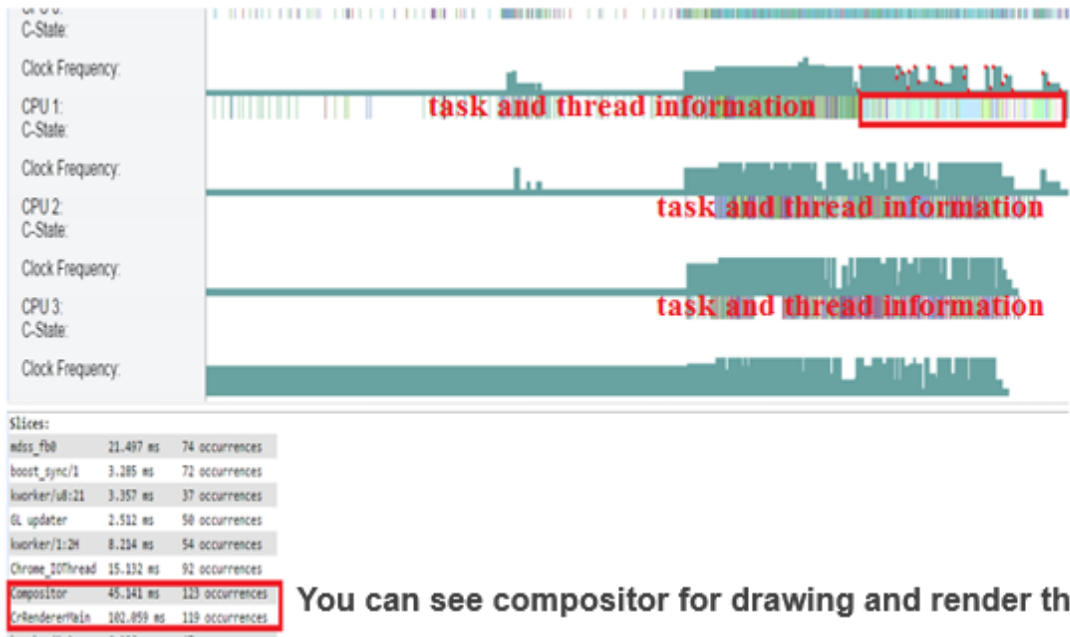


8. In this case, consult with the graphic engineer and display engineer as to whether this is the correct behavior.





systrace log 2



You can see compositor for drawing and render thread



### 4.13 Analyze BIMC clock

1. Use the msmbusvoting tool to analyze the BIMC clock.
2. Check the clock and bandwidth voting by each client in real time.

```
Msmbusvoting.exe --clock bimc_clk -msm_bus-list <a client name seen in the
following example>
```

3. Determine which client voted BIMC clock in real time, as shown in the following example:

[illegible]

#### 4.14 Check governor, scheduler, and CPU freq parameters

1. For governor parameters, check all nodes under the following paths:
  - Cortex-A53 (little cluster) `—/sys/devices/system/cpu/cpu0/cpufreq/interactive/`
  - Cortex-A57 (big cluster) `—/sys/devices/system/cpu/cpu4/cpufreq/interactive/`

```
root@msm8992:/sys/devices/system/cpu/cpu0/cpufreq/interactive # ls
ls
above_hispeed_delay
align_windows
boost
boostpulse
boostpulse_duration
go_hispeed_load
hispeed_freq
io_is_busy
max_freq_hysteresis
min_sample_time
target_loads
timer_rate
timer_slack
use_migration_notif
use_sched_load
```

2. For scheduler parameters, check all nodes under the `/proc/sys/kernel/` path.

```
root@msm8992:/proc/sys/kernel # ls sched_*
ls sched_*
sched_account_wait_time
sched_boost
sched_cfs_bandwidth_slice_us
sched_child_runs_first
sched_cpu_high_irqload
sched_downmigrate
sched_enable_power_aware
sched_freq_account_wait_time
sched_freq_dec_notify
sched_freq_inc_notify
sched_heavy_task
sched_init_task_load
sched_latency_ns
sched_migration_cost_ns
sched_migration_fixup
sched_min_granularity_ns
sched_min_runtime
sched_nr_migrate
sched_power_band_limit
sched_ravg_hist_size
sched_rr_timeslice_ms
sched_rt_period_us
sched_rt_runtime_us
sched_shares_window_ns
sched_small_task
sched_spill_load
sched_spill_nr_run
sched_time_avg_ms
sched_tunable_scaling
sched_upmigrate
sched_upmigrate_min_nice
sched_wakeup_granularity_ns
sched_wakeup_load_threshold
sched_window_stats_policy
```

3. For CPU freq policy parameters, check all nodes under the following paths:

- Cortex-A53 (little cluster) – /sys/devices/system/cpu/cpu0/cpufreq
- Cortex-A57 (big cluster) – /sys/devices/system/cpu/cpu4/cpufreq

```
root@msm8992:/sys/devices/system/cpu/cpu0/cpufreq # ls
ls
affected_cpus
cpuinfo_cur_freq
cpuinfo_max_freq
cpuinfo_min_freq
cpuinfo_transition_latency
interactive
related_cpus
scaling_available_frequencies
scaling_available_governors
scaling_cur_freq
scaling_driver
scaling_governor
scaling_max_freq
scaling_min_freq
scaling_setspeed
stats
```

- See cpufreq.h for more information – cpufreq.h (/kernel/include/linux)

```
struct cpufreq_policy {
    /* CPUs sharing clock, require sw coordination */
    cpumask_var_t cpus; /* Online CPUs only */
    cpumask_var_t related_cpus; /* Online + Offline CPUs */

    unsigned int shared_type; /* ACPI: ANY or ALL affected CPUs
                               should set cpufreq */
    unsigned int cpu; /* cpu nr of CPU managing this policy */
    unsigned int last_cpu; /* cpu nr of previous CPU that managed
                           * this policy */
    struct cpufreq_cpuinfo cpuinfo; /* see above */

    unsigned int min; /* in kHz */
    unsigned int max; /* in kHz */
    unsigned int cur; /* in kHz, only needed if cpufreq
                       * governors are used */
    unsigned int policy; /* see above */
    struct cpufreq_governor *governor; /* see below */
    void *governor_data;
    bool governor_enabled; /* governor start/stop flag */

    struct work_struct update; /* if update_policy() needs to be
                               * called, but you're in IRQ context */

    struct cpufreq_real_policy user_policy;

    struct list_head policy_list;
    struct kobject kobj;
    struct completion kobj_unregister;
}
```

#### 4.14.1 Example of CPU freq policy parameters

- Customer reported 15 mA regression in browser use case compared to the previous build.
- Current version is v1.3 and previous version was v1.2.
- Scaling\_min\_freq on Cortex-A53 in v1.3 was 864 MHz, and scaling\_min\_freq on Cortex A53 in v1.2 was 384 MHz, which is QTI default value.
- 864 MHz is requesting Turbo and 384 MHz is requesting LowSVS by the clock plan
- 
- □ v1.2 and RCM

```
root@msm8992:/sys/devices/system/cpu/cpu0/cpufreq # cat scaling_min_freq
cat scaling_min_freq
384000
```

- v1.3

```
root@msm8992:/sys/devices/system/cpu/cpu0/cpufreq # cat scaling_min_freq
cat scaling_min_freq
864000
```

- 
- Clock plan for Cortex-A53 (little cluster)

Performance level	Frequency (MHz)	Source	VDD APC0 requirement
0	300.00	GPLL0	LowSVS
1	384.00	A53PLL	LowSVS
2	460.80	A53PLL	SVS
3	600.00	GPLL0	SVS
4	672.00	A53PLL	Nominal
5	787.20	A53PLL	Nominal
6	864.00	A53PLL	Turbo
7	960.00	A53PLL	Turbo
8	1248.00	A53PLL	SuperTurbo
9 *	1440.00	A53PLL	SuperTurbo

- Clock plan for Cortex-A57 (big cluster)

Performance level	Frequency (MHz)	Source	VDD APC1 requirement
0	300.00	GPLL	SVS
1	384.00	A57PLL	SVS
2	480.00	A57PLL	SVS
3	633.60	A57PLL	SVS
4	768.00	A57PLL	Nominal
5	864.00	A57PLL	Nominal
6	960.00	A57PLL	Nominal
7	1248.00	A57PLL	Turbo
8	1344.00	A57PLL	Turbo
9	1440.00	A57PLL	Turbo
10	1536.00	A57PLL	Turbo
11	1632.00	A57PLL	Turbo
12	1689.60	A57PLL	Turbo
13	1824.00	A57PLL	SuperTurbo

- □
- 

## 4.15 Check the temperature before measuring the power

1. Ensure that the comparative measurements are done at the same temperature.  
High temperature causes high current consumption.

2. Check the temperature by typing the following commands:

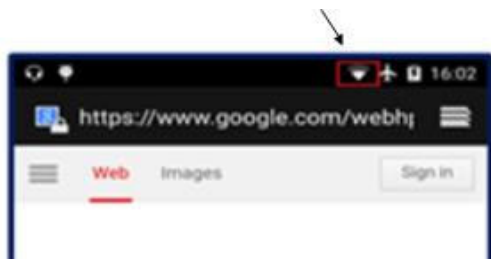
```
Cat /sys/devices/virtual/thermal/thermal_zone8/temp (temperature for Core 0)
```

```
Cat /sys/devices/virtual/thermal/thermal_zone20/temp (temperature for XO)
```

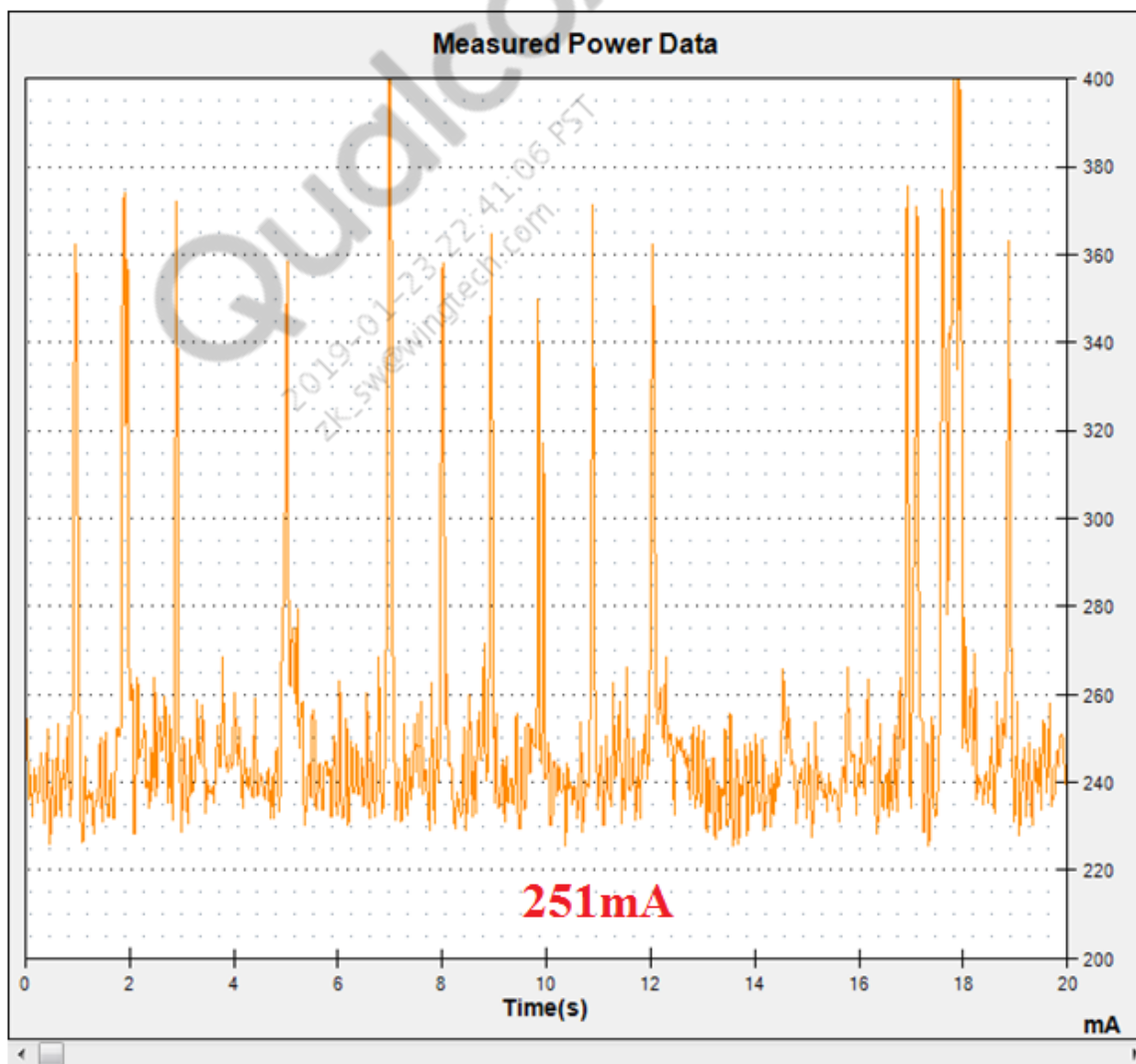
Most dashboard use case data are captured with 25°C excluding the graphics use case (75°C).

## 4.16 Verify Wi-Fi power

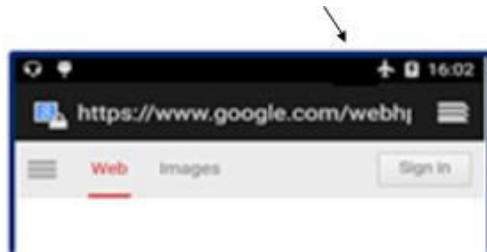
1. Use a dedicated apps processor to verify Wi-Fi power.
2. Open a browser with any page; see the following icon that shows Wi-Fi power is turned on:



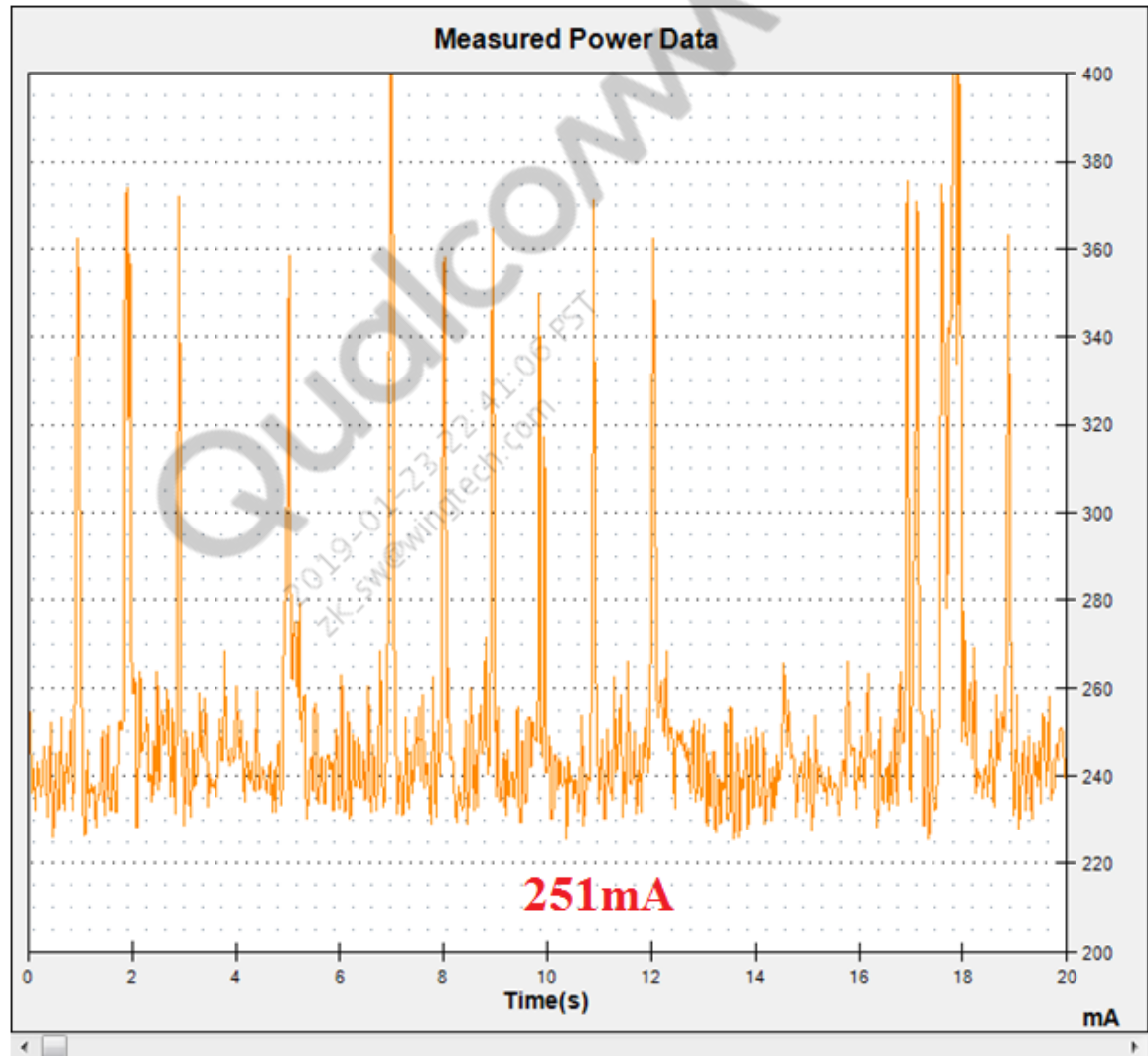
3. Measure power during 20 sec after the page loading is done. The following figure shows waveform with Wi-Fi on:



4. Turn off Wi-Fi; see the following without the icon that shows Wi-Fi power is turned off:



5. Measure power again during 20 sec. The following figure shows waveform with Wi-Fi off:



6. Compare the power number between Wi-Fi on and off.  
If there is a power difference that means the Wi-Fi power portion is in total power.
7. If high power is consumed by Wi-Fi, discuss it with the Wi-Fi engineer or solution provider.

## 4.17 Camera preview debugging

The following sections describe camera preview debugging.

### 4.17.1 Obtain camera subsystem clock dumps

1. Follow the steps in [Collect clock dumps](#).
2. Check for the following clocks:

Clock name	Description
camss_vfe_vfe0_clk	VFE0 clock
camss_vfe_vfe1_clk	VFE1 clock (if applicable)
camss_vfe_cpp_clk	CPP clock
fd_core_clk	HW FD clock (if applicable)
bimc_a_clk	BIMC clock

### 4.17.2 Measure camera preview FPS

1. Type the following commands:
 

```
adb shell setprop persist.camera.hal.debug 1
adb shell setprop persist.camera.sf.showfps 1
```
2. Restart the camera.
3. In preview, type the following command:

```
adb logcat | grep sensor_pick_resolution
```

The following is the resolution and mode selected for the use case:

```
mm-camera-sensor: sensor_pick_resolution:636 res_idx: 0
```

```
mm-camera-sensor: sensor_pick_resolution:636 res_idx: 0
```

The above log indicates that the sensor driver has opened the sensor using Readout mode 0 (res idx 0). This is typically the Full Resolution mode of the sensor.

### 4.17.3 Measure sensor resolution during use case



1. Type the following command:
 

```
adb shell setprop persist.camera.sensor.debug 1
```
2. Restart the camera.



3. In preview, type the following command:

```
adb logcat | grep sensor_get_output_info
```

The preview FPS logs are similar to the following:

```
I/mm-camera-sensor( 454): sensor_get_output_info:3422requested dim 0 0
stream mask 0
I/mm-camera-sensor( 454): sensor_get_output_info:3448pick res 2 dim
2104X1560 op clk 319200000
```

The resolution output by the camera sensor is 2104 x 1560. The resolution of the sensor clock is 319200000.

#### 4.17.4 Measure ISP configuration during camera use case



Type the following command:

```
adb logcat | grep port_sensor_caps_reserve
```

The following shows the ISP configuration logged:

```
I/mm-camera-sensor( 470): port_sensor_caps_reserve:151ide 10001 stream type
3 w*h 1920*1080
```

Stream 3 is the snapshot stream. The above log indicates that ISP is configured to output a (snapshot) liveshot resolution of 1920\*1080.

```
I/mm-camera-sensor( 470): port_sensor_caps_reserve:151ide 10002 stream type
4 w*h 3840*2160
```

Stream 4 is the video stream. The above log indicates that ISP is configured to output a video stream of size : 1920\*1080.

```
I/mm-camera-sensor( 470): port_sensor_caps_reserve:151ide 10004 stream type
1 w*h 1920*1080
```

Stream 1 is the video stream. The above log indicates that ISP is configured to output a preview stream of size : 1920\*1080.

```
E mm-camera-isp2: isp_util_decide_stream_mapping:5145 INFO: type 3 resolution
4160x3120 hw_stream 2 need_native_buff 0 controllable_output 0 shared_output 0
```

StreamType 3 is the camera snapshot stream. The resolution of this stream is 4160 x 3120.

```
E mm-camera-isp2: isp_util_decide_stream_mapping:5145 INFO: type 1 resolution
2048x1536 hw_stream 1 need_native_buff 0 controllable_output 0 shared_output 0
```

StreamType 1 is the camera preview stream. The resolution of this stream is 2048 x 1536.

```
E mm-camera-isp2: isp_util_decide_stream_mapping:5145 INFO: type 11
resolution 640x480 hw_stream 0 need_native_buff 0 controllable_output 0
shared_output 0
```

StreamType 11 is the FaceDetect stream. This resolution of this stream is 640 x 480.

### 4.17.5 Modify camera preview resolution

1. To reduce the camera preview size, type the following commands:

```
adb root
adb shell setprop persist.camera.preview.size <value>
```

2. Use the different size options available in the QTI Snapdragon Camera application:

- Value: 0 – Default size per snapshot aspect ratio
- Value: 1 – 640 x 480
- Value: 2 – 720 x 480
- Value: 3 – 1280 x 720
- Value: 4 – 1920 x 1080

#### Example

```
adb shell setprop persist.camera.preview.size 1 // this will set the
preview to 640x480
```

3. To reset to the default resolution, type the following commands:

```
adb shell setprop persist.camera.preview.size 0
```

### 4.17.6 Check camera using GPU for preview buffer render

1. Run the following command on the device:

```
$adb shell dumpsys SurfaceFlinger
```

2. Check the color format and for SurfaceView layer in the layers.

- SurfaceView example

1	type	handle	hint	flag	tr	bind	format	source crop(l,t,r,b)	frame	dirtyRect	name
2											
3	HWC	7fab242c0	0002	0000	07	0100	00000011	0,0, 0,0, 352,0, 231,0	0, 126, 1600, 2560	[ 0, 0, 352, 231]	SurfaceView
4	HWC	7fab230e0	0002	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 2434,0	0, 126, 1600, 2560	0, 0, 1600, 2434	org.codeaurora.snapcam/com.android.camera.Camera
5	Launcher	7fab24560	0002	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	NavigationBar
6	HWC	7fab24560	0002	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	HWC_FRAMEBUFFER_TARGET
7	FB TARGET	7fa7ec9a0	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	
8											

SurfaceView directly rendering YUV buffers using MDP (GPU bypass is enabled). Low power consumption.

The Dumpsys above indicates SurfaceFlinger got a YUV buffer to be rendered and it was sent via SurfaceView. The GPU is not involved in this case of color conversion.

- TextureView example

1	type	handle	hint	flag	tr	bind	format	source crop(l,t,r,b)	frame	dirtyRect	name
2											
3	HWC	7fab5172c0	0002	0000	00	0100	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	org.codeaurora.snapcam/com.android.camera.Camera
4	TextureView	7fa77134a0	0002	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	NavigationBar
5	FB TARGET	7fa89cac40	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1600,0, 126,0	0, 0, 1600,0, 126,0	0, 0, 1600, 126	HWC_FRAMEBUFFER_TARGET
6											

TextureView is used to render Preview frames. GPU is used for color conversion. High power used due to GPU.

The Dumpsys above indicates SurfaceFlinger got an RGB buffer to be rendered, and it was sent via TextureView. The GPU is involved and it does color conversion. There is higher GPU usage with this case.

#### RELATED INFORMATION

[“Use SurfaceView instead of TextureView” on page 68](#)

## 4.17.7 Determine if camera uses GPU for composition instead of MDP/overlay

Run the following command on the device:

```
$Adb shell dumpsys Surfaceflinger
```

- SurfaceFlinger dumpsys during GPU composition – GPU is used for composition.

type	handle	hint	flag	tr	bind	format	source crop(l,t,r,b)	frame	dirtyRect	name
1	HWC	7f81491500	0002	0000	04	0100	ImpDef	0,0, 0,0, 1280,0, 768,0	2, 0, 1437, 2392	SurfaceView
4	GL ES	7f81492520	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2392,0	0, 0, 1440, 2392	org.codeaurora.snapcam/com.android.camera.CameraLa
5	GL ES	7f84c5df80	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2392,0	0, 0, 1440, 2392	org.codeaurora.snapcam/com.android.camera.CameraLa
6	GL ES	7f84c5e160	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 168,0	0, 2392, 1440, 2560	NavigationBar
7	GL ES	7f84c5e0b0	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 268,0, 228,0	10, 98, 278, 326	40, 0, 268, 228
8	GL ES	7f81492700	0000	0000	00	0105	RGBA_8888	1440,0, 2392,0	0, 0, 1440, 2392	0, 0, 1440, 2392
9	GL ES	7f81492dc0	0000	0000	00	0105	RGBA_8888	1440,0, 2392,0	0, 0, 1440, 2392	0, 0, 1440, 2392
10	FB TARGET	7f814a2200	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2560,0	0, 0, 1440, 2560	0, 0, 0, 0

- SurfaceFlinger dumpsys during MDP/overlay composition – GPU is not used for composition.

type	handle	hint	flag	tr	bind	format	source crop(l,t,r,b)	frame	dirtyRect	name
1	HWC	7f81491500	0002	0000	04	0100	ImpDef	0,0, 0,0, 1280,0, 768,0	2, 0, 1437, 2392	SurfaceView
4	GL ES	7f81492520	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2392,0	0, 0, 1440, 2392	org.codeaurora.snapcam/com.android.camera.CameraLa
5	GL ES	7f84c5df80	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2392,0	0, 0, 1440, 2392	org.codeaurora.snapcam/com.android.camera.CameraLa
6	GL ES	7f84c5e160	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 168,0	0, 2392, 1440, 2560	NavigationBar
7	GL ES	7f84c5e0b0	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 268,0, 228,0	10, 98, 278, 326	40, 0, 268, 228
8	GL ES	7f81492700	0000	0000	00	0105	RGBA_8888	1440,0, 2392,0	0, 0, 1440, 2392	0, 0, 1440, 2392
9	GL ES	7f81492dc0	0000	0000	00	0105	RGBA_8888	1440,0, 2392,0	0, 0, 1440, 2392	0, 0, 1440, 2392
10	FB TARGET	7f814a2200	0000	0000	00	0105	RGBA_8888	0,0, 0,0, 1440,0, 2560,0	0, 0, 1440, 2560	0, 0, 0, 0

### 4.17.7.1 Identify reason for GPU composition

GPU composition is enabled when the number of layers to be composed is greater than the number of pipes/overlays available for MDP-based composition. This usually happens when there are several layers created by applications and sent for composition to hardware composition.

1. Enable the following logs in the display module:

```
adb shell service call display.qservice 15 i32 1 i32 1
adb shell "echo 'file mdss_mdp_ctl.c +p' > /d/dynamic_debug/control"
adb shell "echo 'file mdss_mdp_overlay.c +p' > /d/dynamic_debug/control"
adb shell "echo 'file mdss_mdp_pipe.c +p' > /d/dynamic_debug/control"
```

2. Run the camera use case and capture the logcat logs.
3. Check for following log pattern in the logcat:

```
05-01 15:15:47.726 411 D qdhwcomposer: resourceCheck: Exceeds MAX_PIPES_PER_MIXER
05-01 15:15:47.726 411 D qdhwcomposer: postHeuristicsHandling: resource check failed
05-01 15:15:47.726 411 D qdhwcomposer: post-heuristic-handling-failed
05-01 15:15:47.726 411 D qdhwcomposer: fullMDPCompWithPTOR: Frame not supported!
// Until here, fullMDP comp. failed since there are too many layers
7 // Try to compose with the cache based mixed mode. LoadBased is not an option with YUV layer
05-01 15:15:47.726 411 D qdhwcomposer: updateLayerCache: MDP count: 1 FB count: 6 drop count: 0
05-01 15:15:47.726 411 D qdhwcomposer: updateYUV: fb count: 5
05-01 15:15:47.726 411 D qdhwcomposer: updateSecureRGB: fb count: 5
05-01 15:15:47.726 411 D qdhwcomposer: markLayersForCaching: cached count: 3
// 3 layers were cached
05-01 15:15:47.726 411 D qdhwcomposer: resourceCheck: Exceeds MAX_PIPES_PER_MIXER
// Total 7 layer = 1 Video + 3 RGB + 1 Cached(including 3 layers) - 5 layers should be composed
// # of max pipes per mixer in 8992 is 4
05-01 15:15:47.726 411 D qdhwcomposer: postHeuristicsHandling: resource check failed
05-01 15:15:47.726 411 D qdhwcomposer: post heuristic handling failed
19 05-01 15:15:47.726 411 D qdhwcomposer: : No secure video/ui layers
20 05-01 15:15:47.726 411 D qdhwcomposer: updateYUV: fb count: 6
21 05-01 15:15:47.726 411 D qdhwcomposer: configure: configuring: layer: 0x7fb5fb828 z_order: 0 dest_pipe: 3dest_pipeR: 10
22 05-01 15:15:47.726 411 D qdhwcomposer: GEOMETRY change: 0
23 05-01 15:15:47.726 411 D qdhwcomposer: HWC Map for Dpy: "PRIMARY"
24 05-01 15:15:47.726 411 D qdhwcomposer: CURR_FRAME: LayerCount: 7 mdpCount: 1 fbCount: 6
25 05-01 15:15:47.726 411 D qdhwcomposer: needsFBRedraw: YES pipesUsed: 1 MaxPipesPerMixer: 4
26 05-01 15:15:47.726 411 D qdhwcomposer: Programmed ROI's: Left: [0, 0, 1440, 2560] Right: [0, 0, 0, 0]
```

## 4.18 Camera power optimization techniques

The following sections describe camera power optimization techniques.

### 4.18.1 Dual ISP configuration

Some of the recent Snapdragon chipsets support two image processing cores that could process the Bayer input to YUV. When sensor resolution is high, the camera software automatically splits the sensor output separately and passes it to both ISPs.

When using higher resolution sensors, QTI recommends that OEMs enable the Dual ISP feature so that the data processed by the ISPs is split evenly across two ISP hardware blocks instead of a single ISP.

- Enable Dual ISP – adb shell setprop persist.camera.isp.dualisp 1
- Disable Dual ISP – adb shell setprop persist.camera.isp.dualisp 0

Enabling Dual ISP for lower resolutions is not beneficial and sometimes can consume more power. QTI recommends following the guidelines shown in the table. Follow the guideline sensor resolutions above as to which Dual ISP must be enabled (assumption – 30 FPS ZSL preview).

MSM	Single ISP (MP)	Dual ISP (MP)
MSM8996	≤ 8	> 8
MSM8994	≤ 13	> 13
MSM8992	≤ 13	> 13
APQ8084	≤ 13	> 13
MSM8952	≤ 8	> 8
MSM8956	≤ 8	> 8

### 4.18.2 Use SurfaceView instead of TextureView

Camera applications can either use the TextureView or SurfaceView to render the camera preview buffers. With TextureView, the camera preview area is part of the Android view hierarchy. However, this causes the preview frames to go through the GPU for YUV to ARGB conversion. The UI layer and preview frames blending along with the GPU consume more power compared to using SurfaceView.

With SurfaceView, the preview content is directly composited as an overlay by the display hardware and there is no GPU involvement.

For more details, go to <https://source.android.com/devices/graphics/architecture.html#surface-or-texture>.

The Snapdragon camera application uses SurfaceView by default. See the following commit that updates the Snapdragon camera application to use SurfaceView instead of TextureView:

[https://www.codeaurora.org/cgit/quic/la/platform/packages/apps/SnapdragonCamera/commit/?h=caf/LA.BF64.1.1\\_rb1.18&id=6ee7e415bf6f73d423df8da68f72fa6fdabde714](https://www.codeaurora.org/cgit/quic/la/platform/packages/apps/SnapdragonCamera/commit/?h=caf/LA.BF64.1.1_rb1.18&id=6ee7e415bf6f73d423df8da68f72fa6fdabde714)

To convert camera applications to use SurfaceView instead of TextureView for Camera preview:

1. Replace TextureView with SurfaceView.
2. Replace SurfaceTexture with SurfaceHolder.
3. Modify TextureView.SurfaceTextureListener to SurfaceHolder.Callback.
4. Modify TextureView.setSurfaceTextureListener(TextureView.SurfaceTextureListener) to surfaceHolder = surfaceView.GetHolder(); surfaceHolder.addCallback(SurfaceHolder.Callback).

5. Replace the `setPreviewTexture(SurfaceTexture)` of the camera object with `setPreviewDisplay(SurfaceHolder)`.
6. For proper scaling to take effect, set the `SurfaceView` within a type of layout, which should not be a part of the root `<merge>` tag.
7. If the preview dimension does not exactly match the screen, in the `SurfaceView` path, manually rescale the preview with the correct aspect ratio when the surface changes as follows:

```
mSurfaceView.GetLayoutParams().width = (int) correctWidth;
mSurfaceView.GetLayoutParams().height = (int) correctHeight;
mSurfaceView.requestLayout();
```

No side effect with IQ or performance is expected. If the application uses complex transformations and animation effects on camera preview data, it cannot be done with `SurfaceView`.

### 4.18.3 Reduce camera preview size

If the Sensor mode is set to a higher resolution than the display size or if the MDP hardware supports upscaling, consider requesting a smaller preview size from the camera.

Reducing the preview size to an optimal size reduces the traffic from the ISP to the DDR bus and from the DDR bus to the MDP. This reduces the power consumption for camera preview use cases.

No side effect with IQ or performance is expected.

### 4.18.4 CPP mirroring during camcorder use case

The preview and video size can be configured differently along with the color formats. If there is a difference in the preview or video size or in the color format, CPP takes two-pass processing paths that result in more power consumption.

OEMs can avoid two-pass processing in CPP by configuring the preview and video to be of same format and resolution.

If the following log is output in adb, the software can trigger the CPP output duplication feature for the use case:

```
cpp_module_set_output_duplication_flag:643 linked streams formats match:
output duplication enabled
```

Preview and video streams have the same IQ settings applied. Apart from that, there are no adverse effects with this change.

### 4.18.5 Disable TNR

The TNR feature is available on select chipsets. The complexity of this algorithm depends on the resolution of the image frame. Disabling it reduces DDR bandwidth and overall power consumption during high resolution use cases, such as 4K recording and preview frames.

1. To disable TNR, type the following commands:

```
adb shell setprop persist.camera.tnr.preview off
adb shell setprop persist.camera.tnr.video off
```

2. Rerun IQ and performance testing after this change. This change can impact IQ.

### 4.18.6 Set the sensor mode resolution to video resolution

1. Set the sensor mode resolution to the same as video recording resolution instead of full resolution to reduce the power consumption in the camcorder recording use case. For example, set a 13 MP sensor mode to 1080p for 1080p video camcorder recording.
2. Similarly, set the sensor mode to display size or lower size to reduce the power consumption in a non-ZSL preview use case.

QTI recommends that the Sensor mode is set to a lower resolution in camcorder and camera preview use cases, if the device feature set permits it, or if tuning is available for the respective resolution size. Users can make changes in their respective sensor driver.

No impact is anticipated. Preview frames are output at a lower resolution.

### 4.18.7 Disable tintless

1. To disable tintless to reduce power consumption, type the following command:  

```
adb shell setprop persist.camera.tintless disable
```
2. Rerun IQ and performance testing after this change. This change can impact IQ.

### 4.18.8 Disable chromatic aberration correction (CAC)

The CAC block is a special hardware block with the camera ISP. It is present on some of the high-end chipsets to provide finer noise cleaning capability. Disable this feature for preview or for preview and snapshot to get power savings.

CAC is disabled in the Chromatix™ color optimization tool file. Submit a case for steps to disable the CAC feature.

Check for any IQ impact when the CAC operation is disabled from the camera preview.

## 4.19 Video recording power optimization techniques

The following describes a technique to optimize video recording power.

### 4.19.1 Encoder Power Save mode

The Encoder Power Save mode is an optional mode power optimization feature supported for the single session of a 4K H.264 camcorder.

To enable the encoder power save mode, type the following command:

```
adb shell setprop vidc.debug.perf.mode 2
```

The feature is exposed through the OMX\_QcomIndexConfigVideoVencPerfMode OMX extension.

See *Video Power Encoder Save Mode and Encoder DCVS* (80-NV307-1) for more details about this feature.

This option is applicable only for UHD (4K) encoding. It also requires the VFE to be running at Nominal clocks instead for Turbo.

There can be a slight impact with the quality of encoding in this mode.

## 5 Log collection

---

### 5.1 RPM logs

RPM publishes a small log into a limited area of spare message RAM. The physical format of the log is the uLog format used for various other logs. It is a circular buffer, currently sized at about 4 kB. It is a raw log with a set of IDs and a variable number of parameters per message.

#### 5.1.1 Save RPM RAM dumps

It is not necessary to disable RPM halt to keep the JTAG daisy-chain connection. To save the RPM RAM dumps:

1. Open RPM T32 and attach using the `sys.m.a` command.
2. Create the issue scenario where the RPM dumps are needed.
3. Break T32 at the desired point and run the following script to save the RPM logs:

```
do <RPM Build location>\rpm_proc\core\bsp\rpm\scripts\rpm_dump.cmm
<Location to save dumps>
```

#### 5.1.2 Load RPM dumps onto T32 and extract logs

To load the RPM dumps onto T32 simulator for further analysis:

1. Open the T32 simulator and do `sys.up`.
2. Run the following script:

```
do <RPM Build location>\rpm_proc\core\bsp\rpm\scripts\rpm_load_dump.cmm
<Location of logs>
```

3. Load `RPM.elf` to start debugging.

```
d.load.elf <RPM_Build>\rpm_proc\core\bsp\rpm\build\RPM_XXXXXXXX.elf
/nocode /noclear
```

##### 5.1.2.1 RPM external logs (RPM uLog) using T32

1. While attached to the RPM and in the break state or if the RPM RAM dumps are loaded on the T32 simulator, run the following command in T32:

```
do <RPM_build>\rpm_proc\core\power\ulog\scripts\rpm_ulogdump.cmm
<Location to save logs>
```

This places the RPM external logs into the desired log directory. The RPM external log requires the use of a Python parsing tool to interpret its contents.

2. Use the following Python script on extracted logs using a command prompt:

```
Python \\<RPM_build_location>\rpm_proc\core\power\rpm\debug\scripts\
rpm_log_bfam.py -f "RPM External Log.ulong"
```

### 5.1.2.2 RPM NPA logs using T32

While attached to the RPM and in the break state or if the RPM RAM dumps are loaded on the T32 simulator, run the following command in T32:

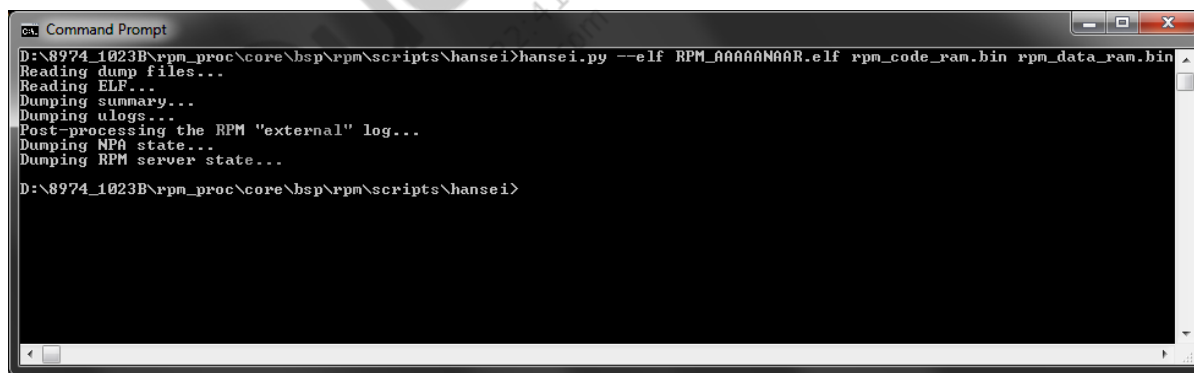
```
do <RPM_build>\rpm_proc\core\power\npa\scripts\rpm_npadump.cmm
<Location to save logs>
```

### 5.1.2.3 RPM logs using hansei script

Hansei – An RPM RAM dump parser tool found in the `rpm_proc\core\bsp\rpm\scripts\hansei` folder (needs Python Ver 2.7.2)

Usage - `hansei.py [-h] --elf rpm.elf [--output path] dumpfile [dumpfile ...]`

Example - `hansei.py -elf rpm.elf -o . rpm_code_ram.bin rpm_data_
ram.bin rpm_msg_ram.bin`



- Summary of the output file:
  - rpm-summary.txt – Contains general information about the health of the RPM, including the core dump state and various fault information
  - rpm-log.txt – Postprocessed RPM external log
  - rpm-rawts.txt – Postprocessed RPM external log with the raw timestamp
  - npa-dump.txt – Standard NPA dump format
  - ee-status.txt – Contains information about the subsystems (and their cores) that are active or sleeping
  - reqs\_by\_master/\* – Folder containing a file for each execution environment, detailing all current requests that EE has in place with the RPM
  - reqs\_by\_resource/\* – Folder structure containing a folder for each of the resource types registered with the RPM server and, under that folder, a file containing all of the requests to each resource of that type



## 5.2 Collect GPIO dumps

All GPIOs in the hardware use the following script, which can be run from the RPM T32 window, to read the current configuration:

```
do <Modem_Build>\modem_proc\core\systemdrivers\tlmm\scripts\
tlmm_gpio_hw.cmm
```

1. Select **Option 14: Read All GPIO Configurations**.
2. Run the following script to read the default sleep configuration stored in software. This is read from TLMM.xml:

```
do <Modem_Build>\modem_proc\core\systemdrivers\tlmm\scripts\
tlmm_sleep_configs.cmm
```

## 5.3 Collect PMIC dumps

1. Open an RPM T32 window.
2. Type `sys.m.a` to attach T32 to the device under test.
3. Load the .elf file from `<RPM_Build>/rpm_proc/core/bsp/rpm/build/*.elf` and set the breakpoint if needed.
4. Recreate the use case scenario.
5. Break T32 using one of the following methods:
  - Click **Pause** in the T32 user interface.
  - Press **F8**.
  - User-defined breakpoint.

6. After the breakpoint is hit, type the following:

```
CD.DO <RPM_Build>/rpm_proc\core\systemdrivers\pmic\scripts\PMICDump.cmm
```

By default, the raw PMIC dump file is saved in `c:\temp\pmicdump.xml`.

7. Type the following command to parse the `pmicdump.xml` file:

```
python PMICDumpParser.py --flat=<RPM_BUILD>\rpm_proc\core\systemdrivers
\pmic\scripts\pm8994\v1_1\CORE_ADDRESS_FILE_CUSTOMER.FLAT --
file=pmicdump.xml > pmic_parsed.txt
```

## 5.4 Collect clock dumps

Use the JTAG method if the device has JTAG capability. If the device does not have JTAG, use the ADB method for clock dumps.

### 5.4.1 Collect clock dumps using JTAG

1. Open an RPM T32 window.
2. Type `sys.m.a` to attach T32 to the device under test.
3. Load the `.elf` file from `<RPM_Build>/rpm_proc/core/bsp/rpm/build/*.elf` and set breakpoint if needed.
4. Recreate the use case scenario.
5. Break T32 using one of the following methods:
  - Click **Pause** in the T32 user interface.
  - Press **F8**.
  - User-defined breakpoint.
  - Type the following command:

```
do <Build_Location>\rpm_proc\core\systemdrivers\clock\scripts\msm8994\testclock.cmm
```
6. To obtain a dump of all clocks, type **all** in the pop-up window.

The clock dump is printed in the message area of T32.

### 5.4.2 Collect clock dumps using the adb shell

1. Connect the USB.
2. Run the following command:

[illegible]

- Unplug the USB when the PID appears.
- Run the test scenario **<execute test scenario for at least 2 min>**.

5. Connect the USB and kill the clock checking PID by typing the following commands:

```
adb shell ps | grep [PID]
adb shell "kill [PID]"
adb pull /data/dumpclk.txt
```

## 5.5 Collect modem logs

Collect modem uLogs and modem NPA logs.

### 5.5.1 Collect modem uLogs

Run the following script from Modem\_Build in the modem T32 window:

```
do <Modem_Build>\modem_proc\core\power\ulog\scripts\UlogDump.cmm <location
to save logs>
```

This places the modem uLogs in the specified directory.

### 5.5.2 Collect modem NPA logs

Run the following script from Modem\_Build in the modem T32 window:

```
do <Modem_Build>\modem_proc\core\power\npa\scripts\NPADump.cmm
<Location to save logs>
```

This places the modem NPA logs in the specified directory.

## 5.6 Collect modem F3 messages/QXDM Professional logs

1. Connect the device to a PC via USB where the QXDM Professional is installed.
2. Load the logs mask (dmc file) through **File > Load** configuration.
3. Press **F3** or select **Messages View** from the View tab.
4. Press **Alt+L** to start logging; press **Alt+L** again to stop logging.
5. Obtain the saved logs from the location defined in **Options > Log View Config > Misc > Log File Path**.

## 5.7 Capture ftrace logs

1. Connect the USB.
2. Type the following commands:

```
adb root
adb remount
adb shell
cd /sys/kernel/debug/tracing
echo 0 > tracing_on;
echo 100000 > buffer_size_kb;
```



- Run the use case.
- Connect the USB and kill the process after completing the use case by typing the following commands:

```
adb shell "kill [PID]"
adb pull /data/ dumptop.txt C:\<location>
```

## 5.9 Capture clock and regulator dumps

1. Connect the USB.
2. Type the following commands:

```
adb root
adb remount
adb shell
```

3. Start capturing data by typing the following command:

```
sleep 3 && while true;
do echo \=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=\=
\=\=;
cat /proc/uptime;
cd /sys/kernel/debug/clk;
for i in *;
do if [ -d $i ];
then if [ "$(cat $i/enable)" == "1" ];
then if [ -e $i/measure ];
then echo $i \=> enable:`cat $i/enable` measure:`cat $i/measure`;
else echo $i \=> enable:`cat $i/enable` rate:`cat $i/rate`;
fi; fi; fi; done;
echo \-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-\-;
cd /sys/class/regulator; for i in *;
do if [ -d $i ];
then if [ -e $i/state ];
then if [ "$(cat $i/state)" == "enabled" ];
then if [ -e $i/microvolts ];
then echo $i \=> name:`cat $i/name` state:`cat $i/state` microvolt:`cat
$i/microvolts`;
else echo $i \=> name:`cat $i/name` state:`cat $i/state` microvolt: N/A;
fi; fi; fi; fi; done;
sleep 2;
done > /data/dumpclk.txt &
```

4. Disconnect the USB when the PID appears.
5. Run the use case.
6. Connect the USB and kill the process after completing the use case by typing the following commands:

```
adb shell "kill [PID]"
adb pull /data/ dumpclk.txt C:\<location>
```

## 5.10 Collect wake locks

Type one of the following commands:

```
adb shell
```

```
cat /sys/kernel/debug/wakeup_sources
```

or

```
adb shelldumpsys power
```

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2019-01-23 22:41:06 PST  
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# A References

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## A.1 Related documents

Title	Number
<b>Qualcomm Technologies, Inc.</b>	
<i>System Power Monitor Version 4.1 Application Note</i>	80-N6594-16
<i>Power Consumption Measurement Procedure for MSM (Android-Based)/MDM Devices</i>	80-N6837-1
<i>Graphics Power and Performance Overview</i>	80-NP885-1
<i>Video Power Encoder Save Mode and Encoder DCVS</i>	80-NV307-1

## A.2 Acronyms and terms

Acronym or term	Definition
AOSS	Always on subsystem
APSS	Applications processor subsystem
BIMC	Bus integrated memory controller
CAC	Chromatic aberration correction
CAF	Code aurora forum
CPP	Camera postprocessor
CPU	Central processing unit
DRX	Discontinuous reception
FPS	Frames per second
GPIO	General purpose input/output
GPU	Graphics processing unit
IQ	Image quality
ISP	Image signal processor
MCPM	Modem clock and power manager
MDP	Mobile display processor
LDO	Low dropout (voltage regulator)
LPASS	Low power audio subsystem
MPSS	Modem peripheral subsystem

Acronym or term	Definition
NPA	Node power architecture
PID	Process ID
PMIC	Power management integrated circuit
QPST	Qualcomm Product Support Tool
RAM	Random access memory
RF	Radio frequency
RPM	Resource power manager
SMPS	Switched-mode power supply
SPM	System power monitor
TNR	Temporal noise reduction
XO	Crystal oscillator
YUV	Luminance, bandwidth, chrominance; also known as YCbCr and YPbPr