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<td>July 2020</td>
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<td>• 4.3, F.W. Authentication Error</td>
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<td>Initial release.</td>
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Introduction

This document was designed to help debug issues with Intel® QuickAssist Technology (Intel® QAT).

It contains the following sections:

- How To...
- Intel® QAT Driver Installation Issues
- System Configuration Issues
- Application Issues
- Intel® QAT Virtualization Issues
- Intel® QAT Performance Issues
- NGINX® Issues
- OpenSSL*/QAT Engine Issues
- HAProxy* Issues
- Miscellaneous Issues

Terminology

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<th>Term</th>
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<tr>
<td>API</td>
<td>Application Programming Interface</td>
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<tr>
<td>BIOS</td>
<td>Basic Input/Output System</td>
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<td>DC</td>
<td>Data Compression</td>
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<td>GRUB</td>
<td>GRand Unified Bootloader</td>
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<tr>
<td>O.S.</td>
<td>Operating System</td>
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<tr>
<td>PCH</td>
<td>Platform Controller Hub</td>
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<tr>
<td>PCI</td>
<td>Peripheral Component Interconnect</td>
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<td>P.F.</td>
<td>Physical Function</td>
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<td>Intel® QAT</td>
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1.2 Reference Documents and Software

Table 2. Reference Documents and Software

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<th>Title</th>
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<tr>
<td>Intel® QuickAssist Technology Software for Linux® – Release Notes – Hardware Version 1.7</td>
<td>336211, 01.org</td>
</tr>
<tr>
<td>Intel® QuickAssist Technology Software for Linux® – Getting Started Guide – Hardware Version 1.7</td>
<td>336212, 01.org</td>
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<td>Intel® QuickAssist Technology Software for Linux® – Programmer’s Guide – Hardware Version 1.7</td>
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<td>Intel® QuickAssist Technology Software for Linux® – Software Drivers – Hardware Version 1.7</td>
<td>562366, 01.org</td>
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<td>Intel® QuickAssist Technology API Programmer’s Guide</td>
<td>330684, 01.org</td>
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<td>Intel® QuickAssist Technology – Performance Optimization Guide</td>
<td>330687, 01.org</td>
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<td>Using Intel® Virtualization Technology (Intel® V.T.) with Intel® QuickAssist Technology Application Note</td>
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<td>HAProxy® with Intel® QuickAssist Technology Application Note</td>
<td>337430, 01.org</td>
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<td>Intel® QuickAssist Technology Software for Linux – Release Notes – H.W. version 1.7</td>
<td>336211, 01.org</td>
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<tr>
<td>Electronic Design Kit</td>
<td>565762</td>
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1.3 Resources

- [https://01.org/intel-quickassist-technology](https://01.org/intel-quickassist-technology)
- [https://github.com/intel/QAT_Engine](https://github.com/intel/QAT_Engine)
- [http://www.intel.com/quickassist](http://www.intel.com/quickassist)
- [https://github.com/intel/QATzip](https://github.com/intel/QATzip)
- [https://github.com/intel/async_mode_nginx](https://github.com/intel/async_mode_nginx)
- [https://www.haproxy.org/](https://www.haproxy.org/)
- Intel® Select Solutions for NFVI
2.0  How To...

This section describes how to perform various status checks on Intel® QAT.

2.1  How to Determine if Intel® QAT is Installed

1. Determine if Intel® QAT is installed by running the following command:

   ```
   lsmod | grep qa
   ```

   If Intel® QAT is installed, you should see output like the following:

   ```
   ]#  lsmod | grep qa
   qat_c62x               13473  0
   intel_qat             141688  1 qat_c62x
   authenc                17776  1 intel_qat
   dh_generic             13323  1 intel_qat
   rsa_generic            18819  1 intel_qat
   ```

2. If Intel QAT is not installed, follow the instructions in 336212, Intel® QuickAssist Technology Software for Linux* Getting Started Guide Hardware Version 1.7, at 01.org or in the Intel® QuickAssist Technology Videos at https://software.intel.com/enus/networking/quickassist.

3. Then rerun the command above to verify Intel® QAT is installed.

Relevant Collateral

- 336212, Intel® QuickAssist Technology Software for Linux* – Getting Started Guide – Hardware Version 1.7, at 01.org

2.2  How to Determine if Intel® QAT is Running by Looking at Firmware Counters

Monitor the Intel® QAT firmware counters to determine if Intel® QAT is running as in the following example:

```
watch cat /sys/kernel/debug/qat_c6xx_0000\:3d\:00.0/fw_counters
```

These firmware counters are the

```
/sys/kernel/debug/qat_<devicetype>_<bus_device_function>/fw_counters.
```

Intel® QAT firmware counters increase when Intel® QAT is running. If Intel® QAT is not running, the firmware counters remain at their current value.

Relevant Collateral

2.3 How to Determine if Intel® QAT is Active

1. Run one of the following commands:

```
systemctl status qat_service
```

or

```
service qat_service status
```

You should see the resulting output similar to the following:

```
]# systemctl status qat_service
qat_service.service - LSB: modprobe the QAT modules, which loads dependant modules, before calling the user space utility to pass configuration parameters
Loaded: loaded (/etc/init.d/qat_service; generated)
Active: active (exited) since Fri 2019-12-20 18:32:32 UTC; 28min ago
Docs: man:systemd-sysv-generator(8)
Process: 48577 ExecStop=/etc/init.d/qat_service stop (code=exited, status=0/SUCCESS)
Process: 48635 ExecStart=/etc/init.d/qat_service start (code=exited, status=0/SUCCESS)
Dec 20 18:32:30 dbubuntu qat_service[48635]: Restarting all devices.
Dec 20 18:32:30 dbubuntu qat_service[48635]: Processing /etc/c6xx_dev0.conf
Dec 20 18:32:30 dbubuntu qat_service[48635]: Processing /etc/c6xx_dev1.conf
Dec 20 18:32:31 dbubuntu qat_service[48635]: Processing /etc/c6xx_dev2.conf
Dec 20 18:32:32 dbubuntu qat_service[48635]: Checking status of all devices.
Dec 20 18:32:32 dbubuntu qat_service[48635]: There is 3 QAT acceleration device(s) in the system:
Dec 20 18:32:32 dbubuntu qat_service[48635]: qat_dev0 - type: c6xx, inst_id: 0, node_id: 0, bsf: 0000:3d:00.0, #accel: 5 #engines: 10 state: up
Dec 20 18:32:32 dbubuntu qat_service[48635]: qat_dev1 - type: c6xx, inst_id: 1, node_id: 0, bsf: 0000:3f:00.0, #accel: 5 #engines: 10 state: up
Dec 20 18:32:32 dbubuntu qat_service[48635]: qat_dev2 - type: c6xx, inst_id: 2, node_id: 1, bsf: 0000:da:00.0, #accel: 5 #engines: 10 state: up
Dec 20 18:32:32 dbubuntu systemd[1]: Started LSB: modprobe the QAT modules, which loads dependant modules, before calling the user space utility to pass configuration parameters.
]# service qat_service status
Checking status of all devices.
There is 3 QAT acceleration device(s) in the system:
qat_dev0 - type: c6xx, inst_id: 0, node_id: 0, bsf: 0000:3d:00.0, 
#accel: 5 #engines: 10 state: up
qat_dev1 - type: c6xx, inst_id: 1, node_id: 0, bsf: 0000:3f:00.0, 
#accel: 5 #engines: 10 state: up
qat_dev2 - type: c6xx, inst_id: 2, node_id: 1, bsf: 0000:da:00.0, 
#accel: 5 #engines: 10 state: up
```

**Note:** You can also run the systemctl <start, restart or stop> qat_service command, or qat_service <start, restart or stop> to perform the specific request.
2.4 How to Determine if the Intel® QAT Device Has Failed or Hung with Heartbeat Monitoring

You can use Heartbeat monitoring to determine if the Intel® QAT device is in a functional state.

To simulate the Heartbeat management process, run the following commands:

```
cat /sys/kernel/debug/<device>/heartbeat
```

If 0 is returned, it indicates the device is responding. If –1 is returned, it indicates the device is not responding.

```
cat /sys/kernel/debug/<device>/heartbeat_sent
```

This number will increase each time the CAT heartbeat is sent because it tracks the number of times the control process checks to see if the device is responsive.

```
cat /sys/kernel/debug/<device>/heartbeat_fail
```

This number will increase each time the return value of the cat heartbeat is –1 because it keeps track of the number of times the control process finds the device unresponsive.

```
cat /sys/kernel/debug/<device>/heartbeat_sim_fail
```

This command simulates a failure on the Intel® QAT device. The return value will be zero. In addition, you can use the `icp_sal_heartbeat_simulate_failure()` API to simulate a heartbeat failure as well. For examples of other types of applications, refer to the following subdirectory of the Intel® QAT directory where the acceleration software is unpacked:

```
quickassist/lookaside/access_layer/src/sample_code/functional/common
```

Note: To simulate the heartbeat failure, Intel® QAT has to be configured as follows:

```
./configure --enable-icp-hb-fail-sim
```

Relevant Collateral

2.5 How to Reset or Restart the Intel® QAT device When it has Failed or Hung, Using adf_ctl

When the Heartbeat monitoring detects that the Intel® QAT device has failed or hung, the device can be reset or restarted with the adf_ctl utility. In addition, the Intel® QAT device can be configured for auto-reset via the configuration file. For more information, please refer to Document Number 336210, Intel® QuickAssist Technology Software for Linux® – Programmer’s Guide. Sections 3.3 and 5.2.6 contain information on the adf_ctl utility. “Resetting a Failed Device,” under Section 3.17.1, contains information on Intel® QAT device auto-resetting via the configuration file.

The adf_ctl tool is in the subdirectory quickassist/utilities/adf_ctl of the Intel® QAT directory, where the acceleration software is unpacked. In the following steps, /opt/APP/driver/QAT is the directory where the acceleration software is unpacked.

```
/opt/APP/driver/QAT/quickassist/utilities/adf_ctl]
# ./adf_ctl qat_dev0 reset

/opt/APP/driver/QAT/quickassist/utilities/adf_ctl]
# ./adf_ctl qat_dev0 restart
```

The first example above resets the QAT_dev0 device, while the second example restarts the QAT_dev0 device. Note that if AutoResetOnError is set to 1 in the [GENERAL] section of the Intel® QAT Config file (i.e., c6xx_dev0.conf), the reset is done automatically, and there is no need to perform the first example.

**Relevant Collateral**


2.6 How to Gather Necessary Information for Debugging

The icp_dump.sh tool is in the quickassist/utilities/debug_tool subdirectory of the Intel® QAT directory, where the acceleration software is unpacked. In the following steps, the Intel® QAT directory is /opt/APP/driver/QAT and the tar file (created from icp_dump.sh) will be stored in the /root/iss_nfvi/icp_dump directory.

```
Run the command mkdir /root/iss_nfvi/icp_dump (or the directory of your choice) before running these steps.

1. Define ICP_ROOT as the directory you have installed Intel® QAT
   ```
   export ICP_ROOT=/opt/APP/driver/QAT
   ```

2. Run icp_dump.sh with one parameter: the directory where you would like the tar file to be stored.
   ```
   debug_tool ]# ./icp_dump.sh /root/iss_nfvi/icp_dump
   ```

**Note:** Accept and run the debug tool, type yes when prompted.

3. Unzip the file and verify Intel® QAT acceleration devices in the system are up.
   ```
   /iss_nfvi]
   # tar -xzvf ICP_debug_18h_52m_07s_17d_10m_19y.tar.gz
   /iss_nfvi]
   # cd ICP_debug
   /ICP_debug]
   # cat adf_ctl_status.txt
   ```
Checking status of all devices.

There are three Intel® QAT acceleration devices in the system:

- **qat_dev0** - type: c6xx, inst_id: 0, node_id: 0, bsf: 0000:3d:00.0, #accel: 5 #engines: 10 state: up
- **qat_dev1** - type: c6xx, inst_id: 1, node_id: 0, bsf: 0000:3f:00.0, #accel: 5 #engines: 10 state: up
- **qat_dev2** - type: c6xx, inst_id: 2, node_id: 1, bsf: 0000:da:00.0, #accel: 5 #engines: 10 state: up

4. Verify that all Intel® QAT configuration files are the same.

   **Note:** The SHIM section needs to be in place when Intel® QAT SHIMs is used, and this includes the Intel® QAT Engine and QATqzip. The CPA sample code uses the default Intel® QAT configuration files that are installed along with the Intel® QAT driver.

   The following is an example of the configuration that contains the [SHIM] section:

   ```
   ICP_debug]$ cd config_files/
   config_files]$ cat c6xx_dev0.conf
   ...
   # User Process Instance Section
   # User Process Instance Section
   [SHIM]
   NumberCyInstances = 1
   NumberDcInstances = 0
   NumProcesses = 10
   ...
   # Crypto - User space
   Cy0Name = "UserCY0"
   Cy0IsPolled = 1
   Cy0CoreAffinity = 0
   ```

Relevant Collateral

3.0 Intel® QAT Driver Installation Issues

The following sections describe steps for resolving Intel® QAT driver installation issues.

3.1 Intel® QAT Driver Does Not Compile

If you experience compile errors, try one or more of the following steps:

- Update to the latest Intel® QAT Driver version
- Study the errors and warnings
- Update driver to use the kernel functions that correspond with your kernel and structures
- Install dependencies as described in the Intel® QAT Getting Started Guide

**Note:** Compile errors related to the kernel version are usually observed with newer kernels.

Please update to the latest version of the Intel® QAT driver available on 01.org. If you still experience issues, consult with your Intel representative.

**Relevant Collateral**


3.2 Linux* Crypto API Doesn’t Use Intel® QAT

Users may be attempting to use Intel® QAT integrated into the Linux* Crypto API and looking for confirmation that Intel® QAT is being used. Users can look to the Intel® QAT FW counters and verify that they increase as crypto operations are performed. If Intel® QAT counters are not increasing, it may be due to one of the following:

- Depending on the user’s version of Intel® QAT, the Linux Crypto API may not be enabled by default. In Intel® QAT HW Version 1.7 L4.7 and earlier, the Linux Crypto API was enabled by default. With Intel® QAT HW Version 1.7 L4.8 and later, the option must be enabled when installing Intel® QAT, with the following command:
  ```bash
  ./configure --enable-qat-lkcf
  ```

- The required algorithm may not be installed. The user may add the algorithm, or ask their Intel representative to add the algorithm. The following is an example of how to determine the algorithms supported in the current installation:

  ```bash
  $ cat /proc/crypto | grep qat
  driver  : qat-dh
  module   : intel_qat
  driver   : qat-rsa
  module   : intel_qat
  driver   : qat_aes_cbc_hmac_sha512
  module   : intel_qat
  driver   : qat_aes_cbc_hmac_sha256
  ```
3.3 Issues with the Intel® QAT Make or with Starting Intel® QAT

For the issues listed below, the root cause may be a mismatch of the install kernel and/or headers.

- Kernel Header Files Missing:

```
make[1]: Entering directory `/opt/APP/driver/QAT'
make[2]: Entering directory `/opt/APP/driver/QAT/quickassist/qat'
Makefile:66: *** ERROR: Kernel header files not found. Install the appropriate kernel development package necessary for building external kernel modules or run 'make oldconfig && make modules_prepare' on kernel src to fix it. Stop.
make[2]: Leaving directory `/opt/APP/driver/QAT/quickassist/qat'
make[1]: *** [qat-driver-all] Error 2
make[1]: Leaving directory `/opt/APP/driver/QAT'
make: *** [all] Error 2
```

- Errors in Intel® QAT Make:

```
include/asm-generic/pgtable.h:632:19: note:
previous definition of 'pud_trans_huge' was here
static inline int pud_trans_huge(pud_t pud)
 ^
In file included from ./arch/x86/include/asm/pgtable.h:1235:0,
  from include/linux/mm.h:63,
  from ./arch/x86/include/asm/pci.h:4,
  from include/linux/pci.h:1641,
  from /opt/APP/driver/QAT/quickassist/qat/compat/qat_compat.h:87,
    from <command-line>:0:
include/asm-generic/pgtable.h: At top level:
include/asm-generic/pgtable.h:632:19: error:
redefinition of 'pud_trans_huge'
static inline int pud_trans_huge(pud_t pud)
```
Unable to Start/Restart Intel® QAT:

Failed to restart qat_service.service: Unit not found.

Resolution

Follow these steps:

1. Use the following code to determine what kernels are installed on your system, as in the following example:

```
# yum list installed kernel
Loaded plugins: langpacks, product-id, search-disabled-repos,
subscription-manager
Installed Packages
kernel.x86_64          3.10.0-957.el7           @anaconda/7.6
kernel.x86_64          3.10.0-957.12.2.el7      @rhel-7-server-rpms
kernel.x86_64          3.10.0-1062.12.1.el7     @rhel-7-server-rpms
```

2. If there is no kernel list as shown in the previous step, then install it as follows:

```
yum install kernel-devel-$(uname -r)
```

3. If multiple kernels are installed, remove the kernels that you do not need as in the following example:

```
yum remove kernel-devel-3.10.0-1062.12.1.el7.x86_64
```

4. If the only kernel installed is the one you want, then reinstall it by performing Step 3, followed by Step 2.

   Reinstalling the kernel will verify the correct headers are being used (i.e., there may be a chance that Intel® QAT was previously built with a different Linux kernel, with different headers.)

Relevant Collateral

4.0 System Configuration Issues

This section describes resolution steps for system configuration issues.

4.1 Intel® QAT Endpoint is Trained to Less than the PCIe* Max Capability

This issue includes one or more of the following symptoms:

- `lspci` returns a trained value below the maximum PCIe* capability
- Intel® QAT performance is low
- Platform issues: BIOS, jumpers, or analog issues
- Intel® QAT endpoint is trained correctly, but the internal switches report at lower speeds

Resolution

Verify that the `cpa_sample_code` gives the expected performance.
Contact your Intel representative for the expected performance numbers, if necessary.

Relevant Collateral

- 330687, Intel® QuickAssist Technology – Performance Optimization Guide, at 01.org

4.2 “adf_ctl status” Shows Fewer than Expected Devices

If `adf_ctl status` shows fewer than expected devices, try the resolution steps below.

Resolution

Check for one or more of the following conditions:

- Intel® QAT modules were not successfully installed with `insmod`
- Intel® QAT modules were not installed with `insmod` in the correct order

Relevant Collateral

- 336212, Intel® QuickAssist Technology Software for Linux* – Getting Started Guide – Hardware Version 1.7, at 01.org
4.3 **Firmware Authentication Error**

If you see the following symptom, please try the resolution steps below: `dmesg` Intel® QAT: authentication error (`FCU_STATUS = 0x3`), `retry = 0`

**Resolution**

If there is not a PCIe AER error, double-check the firmware version. Mismatching the firmware version and driver version will cause an authentication error.

**Relevant Collateral**

5.0 Application Issues

This section describes resolution steps for application issues.

5.1 Intel® QAT app fails to run

Error messages result when starting the Intel® QAT app, usually during the userStart function.

Resolution

Try one or more of the following:

- Install Intel® QAT.
- Update Intel® QAT configuration files to include the correct section name.

Note: Run the CPA Sample App first to verify that you get good results.

Please refer to Section 4.1 of the Intel® QAT Getting Started Guide.

Relevant Collateral

- 336212, Intel® QuickAssist Technology Software for Linux® – Getting Started Guide – Hardware Version 1.7, at 01.org

For example, Section 3, “Building and Installing Software,” and Section 4, “Sample Applications,” in the Getting Started Guide, will show all the necessary steps.

Also, please refer to the following entries in Section 2.0 of this document:
- How to Determine if Intel® QAT is Installed
- How to Determine if Intel® QAT is Active

5.2 Application is Not Using Intel® QAT

Intel® QAT counters are not increasing. For example,

```
watch cat /sys/kernel/debug/qat_c6xx_0000:3d:00.0/fw_counters
```

Note: Check /sys/kernel/debug for your applicable qat_c6xx* directory.

Resolution

Applications may not be patched or configured to use Intel® QAT. Consult the relevant documentation.

Relevant Collateral

5.3 Intel® QAT Endpoint Hangs

If the Intel® QAT device is not responsive, try the resolution steps below.

Resolution

Try one or more of the following:

- Step through the application to identify the operation that led to the hang, i.e., focus on replication.
- Run adf_ctl reset to recover.
- Verify that all Intel® QAT API operations and addresses are valid.

Relevant Collateral

330687, Intel® QuickAssist Technology – Performance Optimization Guide, at 01.org

5.4 Error Reading the /dev/qat_dev_processes File

When testing the driver (e.g., with functional sample code), you receive the error reading /dev/qat_dev_processes file:

```
# ./ipsec_sample
main(): Starting IPSec Sample Code App ...
ADF_UIO_PROXY err: icp_adf_userProcessToStart: Error reading /dev/qat_dev_processes file
main(): Failed to start user process SSL
```

Resolution Steps

1. Ensure that the configuration files match the application code, i.e., that icp_sal_userStart references "SSL" and that the configuration files in /etc/ also mention "SSL" sections with a declared number of instances.
2. Restart qat_service.

Relevant Collateral


5.5 HKDF or ECEDMONT Operations do not Succeed

There are multiple options for this issue, such as the following:

"The device does not support ECEDMONT"
"The device does not support HKDF"
"ExtAlgChain feature not supported"

Resolution Steps
There are multiple steps you can take, such as follows:

- Ensure that you have the correct ServicesProfile option
- Ensure that you are on the latest release. 4.10 on the host and guest may solve the issue.

Relevant Collateral
336211, Intel QuickAssist Technology Software for Linux Release Notes H.W. version 1.7, at 01.org
336210, Intel QuickAssist Technology Software for Linux Programmers Guide Hardware Version 1.7, at 01.org

5.6 Proxy Application+QAT, no Performance Improvement using Multi-threads

Try the resolution steps below if there is no performance improvement with 1 process and multi-threading(multi workers).

Resolution Steps
Try setting the flag ICP_WITHOUT_THREAD in the USDM (quickassist/utilities/libusdm_drv ) and recompile the USDM alone. Set the additional environment variables mentioned below to recompile USDM alone.

```bash
export ICP_WITHOUT_THREAD=1
export ICP_BUILDSYSTEM_PATH=$ICP_ROOT/quickassist/build_system
export ICP_ENV_DIR=$ICP_ROOT/quickassist/build_system/build_files/env_files
```
6.0 Intel® QAT Virtualization Issues

This section describes resolution steps for Intel® QAT virtualization issues.

6.1 Too Many Intel® QAT VFs are Created

When trying to create fewer virtual functions than the maximum, the maximum number always gets created.

Resolution

None; this is a hardware limitation, currently.

Relevant Collateral

- 330689, Using Intel® Virtualization Technology (Intel® V.T.) with Intel® QuickAssist Technology Application Note, at 01.org

6.2 Intel® QAT VFs are Not Created

If the virtual functions are not created try resolving this issue using the resolution steps below.

Resolution

Check for one or more of the following causes:

- `configure` was not run with the right options and needed to be run with the correct option.
- `intel_iommu=on` is not part of the GRUB boot settings and needs to be included in the grub
- Virtualization is not enabled in the BIOS and needs to be enabled

Example Outputs

1. Run `lscpu` to check if virtualization (vmx) is enabled in the BIOS:

```
# lscpu | grep vmx
Flags:                 fpu vme de pse tsc msr pae mce cx8 apic sep
mtrr pge mca cmov pat pse36 clflush dts acpi mmx fxsr sse sse2 ss ht
tm pbe syscall nx pdpe1gb rdtscp lm constant_tsc art arch_perfmon
pebs bs rep_good nopl xtopology nonstop_tsc aperfmperf eagerfpu pni
pmlсужdq dtstd4 monitor ds_cpl vmx smx est tm2 ssse3 sdbg fma cx16
xtr pdcm pcid dca sse4_1 sse4_2 x2apic movbe popcnt
```

76x1658–1.1

Intel® QuickAssist Technology (Intel® QAT)
Debugging Guide
July 2020
Document Number: 621658–1.1
2. Check `dmesg` to see if Virtualization (DMAR) is enabled for your particular device:

```
# dmesg | grep -i DMAR | grep d8:00.0
[    5.361824] DMAR: Hardware identity mapping for device
0000:d8:00.0
```

**Relevant Collateral**

- [330689, Using Intel® Virtualization Technology (Intel® V.T.) with Intel® QuickAssist Technology Application Note](https://01.org), at 01.org

### 6.3 Virtualization Use Case Issues

You may encounter a Kernel message such as "PTE Read access is not set."

**Resolution**

- Get `cpa_sample_code` working by referring to [Table 2, Using Intel® Virtualization Technology (Intel® VT) with Intel® QuickAssist Technology Application Note](https://software.intel.com/en-us/networking/quickassist).
- Ensure that the BIOS enables virtualization.
- Ensure that `intel_iommu=on` is set in grub, verified using "cat /proc/cmdline".
- Ensure that host configure script was run with `./configure --enable-icp-sriov=host` and that the guest configure script (if applicable) was run with `./configure --enable-icp-sriov=guest`

**Relevant Collateral**

- [330689, Using Intel® Virtualization Technology (Intel® V.T.) with Intel® QuickAssist Technology Application Note](https://01.org), at 01.org
7.0 Intel® QAT Performance Issues

This section describes resolution steps for Intel® QAT performance issues.

7.1 CPU Performance Beats Intel® QAT Performance

If the CPU performance beats Intel® QAT performance resolve this by using the resolution steps below.

Resolution

Try one or more of the following steps:

- Optimize the particular application for memory recycling
- Increase application concurrency and Intel® QAT configuration to use full parallelization
- Increase buffer/packet sizes (small packets may not see the offloading benefit)
- CPU performance may beat Intel® QAT for certain algorithms, for certain packages, with enough cores

Relevant Collateral

- 330687, Intel® QuickAssist Technology – Performance Optimization Guide, at 01.org

7.2 Intel® QAT Performance is Low

When Intel® QAT is not performing as expected try one or more of the following resolution steps to resolve the issue.

Resolution

Try one or more of the following steps:

- Optimize the particular application for memory recycling
- Increase application concurrency and Intel® QAT configuration to use full parallelization
- Increase buffer/packet sizes (small packets may not see the offloading benefit)
- CPU performance may beat Intel® QAT for certain algorithms, for certain packages, with enough cores
- Remove software stack layers to verify that Intel® QAT performance at the lower lever layers is as expected

Relevant Collateral

- 330687, Intel® QuickAssist Technology – Performance Optimization Guide, at 01.org
8.0 **NGINX* Issues**

This section describes steps to resolve NGINX* issues.

8.1 **NGINX* + Intel® QAT Performance is Low**

If performance is low with NGINX and Intel® QAT, follow the resolution steps below.

**Resolution**

Try one or more of the following steps:

- Use the [Intel® Select Solutions for NFVI](#) script to apply the correct settings (i.e., more worker processes, keep-alive settings, high concurrency, etc.)
- Ensure that Intel® QAT is being used with the firmware counters
- Ensure that GRUB does not have `idle=poll`
- Isolating cores in the GRUB has been shown to reduce performance

**Relevant Collateral**

[Intel® Select Solutions for NFVI](#)
Chapter 9: OpenSSL*/QAT_Engine Issues

9.1 Error with Version of OpenSSL*

If you see a result like the following:

```
[root@SR1B011 apps]# ./openssl version
./openssl: error while loading shared libraries: libssl.so.1.1: cannot open shared object file: No such file or directory
```

Then most likely, the library path is not set up.

```
[root@SR1B011 apps]# echo $LD_LIBRARY_PATH
```

Resolution

Export the `$LD_LIBRARY_PATH` and rerun the command as follows:

```
[root@SR1B011 apps]# export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/usr/local/ssl/lib
[root@SR1B011 apps]# ./openssl version
```

OpenSSL 1.1.1 11 Sep 2018

Relevant Collateral

https://github.com/intel/QAT_Engine (including the Troubleshooting section)

9.2 Errors with make/make install of the Intel® QAT OpenSSL* Engine

You experience errors with `make` or `make install` as in the following:

```
qat_ciphers.c:464:26: note: each undeclared identifier is reported only once for each function it appears in
make[1]: *** [qat_rsa.lo] Error 1
qat_ciphers.c: In function 'qat_chained_ciphers_do_cipher':
qat_ciphers.c:1651:59: error: 'ASYNC_STATUS_OK' undeclared (first use in this function)
  if ((job_ret = qat_pause_job(done.opDone.job, ASYNC_STATUS_OK)) == 0)
^
qat_ciphers.c: In function 'qat_sym_perform_op':
qat_ciphers.c:1778:48: error: 'ASYNC_STATUS_EAGAIN' undeclared (first use in this function)
  if ((qat_wake_job(opDone->job, ASYNC_STATUS_EAGAIN) == 0) ||
```

Resolution

The root cause could be you have cloned the QAT_Engine with the OpenSSL repository. It is not normally advised to clone one git repo within another. In this case, clone the QAT_Engine somewhere other than in the OpenSSL repository.
Relevant Collateral

https://github.com/intel/QAT_Engine (including the Troubleshooting section)
10.0 **HAProxy** Issues

This section describes resolution steps for **HAProxy** issues.

10.1 **HAProxy** + Intel® QAT Error when Starting HAProxy

Starting HAProxy results in the following message:

```
"ssl-engine qat: failed to get structural reference"
```

**Resolution**

Review the **HAProxy** with Intel® QuickAssist Technology Application Note to verify that all required steps were covered.

**Relevant Collateral**

337430, **HAProxy** with Intel® QuickAssist Technology Application Note, on 01.org

10.2 **HAProxy** + Intel® QAT Performance is Low

If you experience a low performance of HAProxy and Intel® QAT, refer to the resolution steps below to isolate the issue.

**Resolution**

- Use the Intel® Select Solutions for NFVI script to reapply the correct settings (i.e., more worker processes, keep-alive settings, high concurrency, etc.)
- Ensure that Intel® QAT is being used, with the firmware counters
- Ensure that GRUB does not have `idle=poll`
- Isolating cores in the GRUB has been shown to reduce performance

**Relevant Collateral**

Intel® Select Solutions for NFVI

10.3 **Error with HAProxy** Version

If you experience the following error:

```bash
# ./haproxy -vv
./haproxy: error while loading shared libraries: libssl.so.1.1: cannot open shared object file: No such file or directory
```

It is likely that the `LD_LIBRARY_PATH` variable is not set up.

**Resolution**

Define the `LD_LIBRARY_PATH` and verify that the “Built with” and “Running on” OpenSSL versions are the same.

```
# export LD_LIBRARY_PATH=/usr/local/ssl/lib
# ./haproxy -vv
```
HAProxy version 1.9.4 2019/02/06 – 
https://haproxy.org/

Build Options:

- TARGET = linux2628
- CPU = generic
- CC = gcc
- CFLAGS = -O2 -g -fno-strict-aliasing -Wdeclaration-after-statement -fwrapv -Wno-unused-l
- OPTIONS = USE_OPENSSL=1

Default settings:

- maxconn=2000, bufsize=16384, maxrewrite=1024, maxpollevents=200
- Built with OpenSSL version: OpenSSL 1.1.1 11 Sep 2018
- Running on OpenSSL version: OpenSSL 1.1.1 11 Sep 2018

Relevant Collateral

337430, HAProxy* with Intel® QuickAssist Technology Application Note, at 01.org, especially the following sections:

- Section 3.0, “HAProxy* Setup and Testing for HTTP Connections”
- Section 3.1, “Installing HAProxy*”
- Section 3.2, “Verifying HAProxy* Installation”

10.4 HAProxy* Shared Libraries libssl.so.1.1. and libcrypto.so.1.1 are Not Found

The Haproxy shared libraries libssl.so.1.1. and libcrypto.so.1.1 are not found when running the command "ldd haproxy".

```bash
# ldd haproxy
linux-vdso.so.1 => (0x00007ffe4853e000)
libcrypt.so.1 => /lib64/libcrypt.so.1 (0x00007ff32d26e000)
libdl.so.2 => /lib64/libdl.so.2 (0x00007ff32d06a000)
libpthread.so.0 => /lib64/libpthread.so.0 (0x00007ff32ce4e000)
librt.so.1 => /lib64/librt.so.1 (0x00007ff32cc46000)
libssl.so.1.1 => not found
libcrypto.so.1.1 => not found
libc.so.6 => /lib64/libc.so.6 (0x00007ff32d6a000)
libfreebl3.so => /lib64/libfreebl3.so (0x00007ff32c675000)
/lib64/ld-linux-x86-64.so.2 (0x00007ff32d4a5000)
```
Resolution

Define the `LD_LIBRARY_PATH` variable and verify that the `libssl.so.1.1` and `libcrypto.so.1.1` files point to the correct libraries.

```bash
# export LD_LIBRARY_PATH=/usr/local/ssl/lib
# ldd haproxy
```

```
linux-vdso.so.1 => (0x00007ffd75bbf000)
libcrypt.so.1 => /lib64/libcrypt.so.1 (0x00007feaeb0e4000)
libdl.so.2 => /lib64/libdl.so.2 (0x00007feaeaee0000)
libpthread.so.0 => /lib64/libpthread.so.0 (0x00007feaeacc4000)
librt.so.1 => /lib64/librt.so.1 (0x00007feaeaabc0000)
libssl.so.1.1 => /usr/local/ssl/lib/libssl.so.1.1 (0x00007feaea82a000)
libcrypto.so.1.1 => /usr/local/ssl/lib/libcrypto.so.1.1 (0x00007feaea345000)
libc.so.6 => /lib64/libc.so.6 (0x00007feae9f77000)
libfreebl3.so => /lib64/libfreebl3.so (0x00007feae9d74000)
/lib64/ld-linux-x86-64.so.2 (0x00007feaeb31b000)
```

Relevant Collateral

337430, *HAProxy* with Intel® QuickAssist Technology Application Note, at 01.org, especially the following sections:

- Section 3.0, "HAProxy* Setup and Testing for HTTP Connections"
- Section 3.1, "Installing HAProxy*"
- Section 3.2, "Verifying HAProxy* Installation"

10.5 Fatal Errors with HAProxy* Configuration File

If you experience fatal errors with the HAProxy configuration file, like the following:

```bash
./haproxy -f /etc/haproxy/allhaproxy.cfg
[ALERT] 178/155753 (38095) : ssl-engine qat: failed to get structural reference
[ALERT] 178/155753 (38095) : parsing [/etc/haproxy/allhaproxy.cfg:3] : (null)
[ALERT] 178/155753 (38095) : Error(s) found in configuration file : /etc/haproxy/allhaproxy.cfg
[ALERT] 178/155753 (38095) : Fatal errors found in configuration.
```

It is likely that the `LD_LIBRARY_PATH` variable is not set up.

Resolution

Run the following commands:

```bash
# export LD_LIBRARY_PATH=$LD_LIBRARY_PATH:/usr/local/ssl/lib
./haproxy -f /etc/haproxy/allhaproxy.cfg
```
Relevant Collateral

337430, HAProxy* with Intel® QuickAssist Technology Application Note, at 01.org, especially the following sections:

- Section 3.0, “HAProxy* Setup and Testing for HTTP Connections”
- Section 3.1, “Installing HAProxy*.”
- Section 3.2, “Verifying HAProxy* Installation.”

10.6 HAProxy* Test Does not Appear to Produce the Expected Results using ApacheBench as a Load Generator

If you experience this issue, you may need to use the OpenSSL* `s_time` command as a load generator, with a new HAProxy Intel® QAT configuration file.

Resolution

An example of a recommended HAProxy Intel® QAT configuration file is listed below for use when running the OpenSSL `s_time` command. Please note that the **bold** line would be removed if you were running the test without Intel® QAT (i.e., with software).

```
# cat myhaproxy-qat.cfg

global
  user root
  group root
  nbproc 15
  maxconn 200000
  ulimit-n 700000

daemon

ssl-engine qat algo ALL

ssl-mode-async
ssl-default-bind-ciphers AES128-SHA
ssl-default-bind-options no-tls-tickets no-sslv3 no-tlsv10 no-tlsv11

tune.bufsize 65536

defaults

backlog 327680

balance source

retries 3

frontend myfrontend

  mode http

  bind 127.0.0.1:4400 ssl crt /etc/ssl/myhaproxy/myhaproxy.pem

  option forceclose

  option httpclose

  option http-server-close

  option nolinger

  timeout client 100s

  timeout client-fin 0s

  timeout http-keep-alive 0s

  default_backend mybackend

backend mybackend

  balance roundrobin

  option httpclose

  option http-server-close

  timeout connect 100s
```
### HAProxy* Issues

```
timeout server 100s
timeout server-fin 0s
option nolinger
option forceclose
mode http
timeout http-keep-alive 0s
server myvm 127.0.0.1:80 check
```

### Relevant Collateral

337430, HAProxy* with Intel® QuickAssist Technology Application Note, at 01.org, especially the following sections:

- Section 3.0, "HAProxy* Setup and Testing for HTTP Connections"
- Section 3.1, "Installing HAProxy*.
- Section 3.2, "Verifying HAProxy* Installation."

### 10.7 Issues making ssl Connection against HAProxy Launched with Intel® QAT Configured as Non-root User.

**Note:** You may be able to start HAProxy, and everything is fine. Intel® QAT reports no warnings, but issues occur as soon as a request is made.

One example of debug output:

```
[DEBUG][qat_rsa.c:911:qat_rsa_priv_enc()] - Started.
[DEBUG][qat_rsa.c:403:build_decrypt_op_buf()] - Started
[DEBUG][qat_rsa.c:415:build_decrypt_op_buf()] flen = 256, padding = 3
[WARNING][qat_asym_common.c:112:qat_BN_to_FB()] Failed to allocate fb->pData
[WARNING][qat_rsa.c:460:build_decrypt_op_buf()] Failed to convert privateKeyRep2 elements to flatbuffer
[WARNING][qat_rsa.c:944:qat_rsa_priv_enc()] Failure in build_decrypt_op_buf
[DEBUG][qat_rsa.c:210:rsa_decrypt_op_buf_free()] - Started
[DEBUG][qat_rsa.c:233:rsa_decrypt_op_buf_free()] - Finished
```

Another example:

```
[DEBUG][qat_rsa.c:845:qat_rsa_priv_enc()] - Started.
[DEBUG][qat_rsa.c:369:build_decrypt_op_buf()] - Started
[DEBUG][qat_rsa.c:381:build_decrypt_op_buf()] flen = 256, padding = 3
[MEM_DEBUG][cmn_mem_drv_inf.c:87:qaecryptoMemAlloc()] pthread_mutex_lock
[MEM_DEBUG][cmn_mem_drv_inf.c:99:qaecryptoMemAlloc()] pthread_mutex_unlock
[WARNING][qat_asym_common.c:107:qat_BN_to_FB()] Failed to allocate fb->pData
[WARNING][qat_rsa.c:426:build_decrypt_op_buf()] Failed to convert privateKeyRep2 elements to flatbuffer
```
HAProxy® Issues

[WARNING][qat_rsa.c:872:qat_rsa_priv_enc()] Failure in build_decrypt_op_buf
[DEBUG][qat_rsa.c:209:rsa_decrypt_op_buf_free()] - Started
[DEBUG][qat_rsa.c:232:rsa_decrypt_op_buf_free()] - Finished

Resolution

The Intel® QAT Engine/libqat uses usdm_drv and mmap()'s physical memory regions it gets from
the memory driver. On some distro’s with systemd, non-root users have a memlock limit set by
default to a too low value, and that triggers mmap()' error with -EAGAIN.

To see if this is the case, run:

1. The Linux command strace to see the error.
2. See the memlock limit for your HAProxy process.
   
   If memlock is your problem, set a bigger value, e.g., for your haproxy.service by adding an
   override .conf to it:

   [Service]
   LimitMEMLOCK=<some value, e.g., 16M>

Relevant Collateral

337430, HAProxy® with Intel® QuickAssist Technology Application Note, at 01.org, especially the
following sections:
11.0 DPDK Issues

This section describes resolution steps for DPDK issues.

11.1 DPDK cryptodev failure

If you experience the following issue, please follow the resolution steps below: There is no Intel® QAT PMD available for the DPDK application.

If you experience a DPDK cryptodev failure because there is no Intel® QAT PMD available for the DPDK application, please follow the resolution steps.

**Resolution**

Quick instructions for Intel® QAT cryptodev PMD are as follows:

```
cd to the top-level DPDK directory
make defconfig
sed -i 's,\(CONFIG_RTE_LIBRTE_PMD_QAT_SYM\)=n,\1=y,,' build/.config
or/and
sed -i 's,\(CONFIG_RTE_LIBRTE_PMD_QAT_ASYM\)=n,\1=y,,' build/.config
make
```

**Relevant Collateral**

[https://doc.dpdk.org/guides/cryptodevs/qat.html](https://doc.dpdk.org/guides/cryptodevs/qat.html)
12.0 **Miscellaneous Issues**

This section describes resolution steps for otherwise uncategorized issues.

12.1 **Possible Errors Due to BIOS Setting**

Issues like the following may be due to BIOS settings:

- **Running `make install` on the Intel® QAT Engine returns an error similar to error -14:**
  
  ```
  dh895xcc: probe of 0000:b1:00.0 failed with error -14
  ```

  *Note:* The above result may be seen in `dmesg` and/or `/var/log/syslog`.

- **Error "Failed to send admin msg to accelerator":**
  
  ```
  dh895xcc 0000:b1:00.0: Failed to send init message
  ```

  *Note:* The above result may be seen in `/var/log/messages`.

- **Fewer qat acceleration devices than you expect when starting Intel® QAT:**
  
  For example, you may see all the c6xx type devices, but not the dh895x device.

**Resolution**

Please refer to Section 4.5 of *QuickAssist Technology Software for Linux - Release Notes - H.W. version 1.7* (Document ID 336211). The title of the section is, "When trying to start the Intel QuickAssist Technology driver, I see errors similar to one of the following..."

**Relevant Collateral**