Software Release V2.4.4

Quantum Orchestration® Platform (QOP)

Contents

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Affected Products

Products affected by this release include:

	Product	Affected	Comment
1	OPX	No	
2	OPX+	Yes	It is recommended to use QOP v2.4.4 with QUA SDK (qm-qua) version 1.2.1 or above
3	OPX1000	No	
4	Octave	Yes	It is recommended to use QOP v2.4.4 with QUA SDK (qm-qua) version 1.2.1 or above
5	OPT	Yes	OPX+ add-on, clock distribution
6	OPD	Yes	OPX+ add-on, additional digital inputs

Installation and Upgrade Process

Note – You can update to this version directly from any QOP version newer than 2.1.3. If you have an earlier version, please update to QOP 2.1.3 first.

Please follow these steps to upgrade using the package release files:

1. Open a web browser in a computer that can access the OPX+ system and type in its IP address to access the admin panel.
2. In the admin panel, go to the "Versions" tab, then click on the blue "Change" button.
3. Upload the QOP2.4.4.tar.gz.age file by dragging and dropping it or by selecting it from the prompt.
4. Refresh the version list using the refresh button on the right.
5. QOP 2.4.4 should appear in the list of available versions; hover your mouse over it and click install.
6. The installation may take up to 10 minutes. During this time, access to other clusters in the same network may be limited.
7. Once the version is installed, click "Finish". The page might need to be refreshed by using CTRL+F5.
8. After the update, the boot will start, and you can check its status in the "Topology" tab

Note – Updating to this version will set your cluster's clock setting to "Internal".

Note – In some rare cases, the system cannot play anything after an update. In these cases, please shut down the system from the admin panel and power cycle.

Note - In rare cases, the update might report it succeeded when it has failed. In this case, the version at the top of the admin panel would show as **"initial."** Reinstalling the version will fix this, and the version will be successfully installed.

Contact the Quantum Machines Customer Success team if you encounter any difficulties or have any questions.

New Features

1. QMAPP Octave support

When clustering octaves with OPXes, they now fully become part of the cluster:

- Restarting the cluster will also restart the Octaves
- A new revamped clock flow unifies and simplifies the clocking of clusters using Octaves, controlled directly from the QMapp:
    - Setting the cluster clock configuration will automatically set the Octave clock.
    - Octave's clock is automatically set to 1 GHz if it's connected to an OPT in a cluster.
    - When an OPX+ and an Octave are used without an OPT, **the cluster clock will be the Octave clock**, and the OPX will automatically be set to accept its own clock from the Octave clock output (1GHz).
    - The octave will raise an error if a command to update the clock is sent from Python (*qm.octave.set_clock()*).
- Octaves will automatically be named ("oct1", "oct2", etc) according to their order in the cluster.
    - When opening a *QuantumMachinesManager*, the octaves are automatically added and there is no need to manually write their IPs and port with an *OctaveConfig* object.
    - This will not work when opening a *QuantumMachinesManager* directly with port 9510
- Upgrading the QOP version will also upgrade the Octave.

2. Graceful shutdown through QMAPP

There is now a "Shutdown" button per cluster that gracefully shuts down all systems' running services in the cluster. Using the "Shutdown" function before powering off the system is essential to avoid potential HW/SW failures.

3. Gapless sequences with switch-case

The switch-case QUA statement has been enhanced to improve performance when used inside a for loop. It now supports playing gapless sequences, meaning that play commands from different iterations will be executed back-to-back without any gaps. This is possible as long as there are no calculations or dynamic parameters within the play commands. For instance, this improvement allows for Randomized Benchmarking with pulse durations as short as 16 nanoseconds without any gaps.

Note—Putting the switch case inside a strict-timing block will produce a false-positive error about a gap at the beginning of the sequence. It is recommended that you use the [compilation flag](#) `not-strict-timing` and ignore the raised warning.

4. The devices' temperatures are now available through the API

Getting the list of devices using *qmm.get_devices()* will now also return their temperatures.

5. Keeping DC offsets when closing a QM

It is now possible to have the DC offsets persistent even when a quantum machine is closed. When opening a quantum machine via *open_qm()*, there is now an additional keyword parameter *keep_dc_offsets_when_closing*. Quantum Machine instances opened with this keyword *keep_dc_offsets_when_closing=True* will keep the DC offset level set by the configuration or the program on all channels even when *qm.close()* is used. The DC levels then will persist until either a new quantum machine is opened, or the system is rebooted.

Fixed Issues

As with all previous software releases, significant efforts were invested in ensuring this software is stable and reliable. Here is the list of issues fixed in QOP 2.4.4 release:

Fixed in 2.4.4

Note that for all purposes, version 2.4.4 is identical to 2.4.3.

- Fixed rare cases in which the update to 2.4.3 would fail.

Fixed in 2.4.3

- The system now supports newer versions of the MikroTik router (tested up to RouterOS 7.18)
- Improved various stability issues and the upgrade process.
  - An OPX+ & Octave system now works in a more reliable way.

Fixed in 2.4.x

1. **OPX+**
   a. Fixed a bug that caused for a few specific cases different inter-OPX align latency between the simulator and the real hardware.
   b. Fixed a bug that caused the SDK to throw a fake error when adding controller connections to a "SimulationConfig".
   c. Fixed a bug that caused OPX+ clock to reset in rare cases due to bad batteries.
   d. It is now possible to compose crosstalk matrix elements between -2 to 1.99 to support the inverse crosstalk matrix.
   e. A single OPX+ (with or without Octave) will now use an OPT connected to it.
   f. Fixed a bug that caused a potential fault in fixed type variables when using `save()`.
   g. Fixed a bug that delayed the sliced demod operation when used after a `reset_phase()` command.
   h. A conditional pulse will now appear correctly in the waveform report.
   i. Fixed cases where gaps could occur due to variables being assigned to wrong elements. This removes the need to use `assign_variables_to_element()` from *qualang_tools*.

j. Updated the temperature monitor thresholds to prevent system shutdown under normal working conditions.
k. The accuracy of the high-resolution time-tagging features has been improved in some cases. Note that the input is now limited to +-0.25V
l. Fixed an issue with the router being misconfigured after an update, causing connectivity issues when connecting via the router.

2. **Octave**
   a. It is now possible to use the whole range of output gains from -20 dB at all frequencies.
   b. Fixed a bug where sometimes automatic mixer calibration with external LO source would not work.
   c. Fixed a bug that prevented the octave FPGA to auto-shutdown on overheat.
   d. Fixed a bug that caused Octave's output phase noise to be worse than what is stated in the specification sheet.
   e. Fixed cases in which log files would pile up inside the Octave, rendering it unusable.

3. **OPD**
   a. Fixed rare cases in which an OPD was not detected.

4. **QMAPP**
   a. Fixed bugs that caused instabilities in cluster view and operations in a multi-cluster environment.
   b. The cluster will now report its status correctly in the admin panel Topology page when booting.

Timing changes

The feedback latency has increased by 2 cycles (8ns) in this version.

Known Issues and Limitations

Following is the list of this release's known issues and limitations, and how to mitigate them:

1. In some rare cases, after updating, the system will indicate it booted successfully but will timeout when opening a qm or playing a program. In these cases, please shut down the system from the admin panel and power cycle the system.
2. The octave clock status is not reported on the Topology page in the admin panel.
3. In cases where the Octave's clock is invalid, Octave's reported temperature is wrongly reported as cryogenic. This can be mitigated by connecting it to a valid clock and then performing a power cycle on the system.
4. When renaming a cluster, the topology page still shows the previous cluster name and is only updated after the cluster reboot.
5. If an external clock is disconnected/removed while the system is running, the system might reboot.
6. Using `set_dc_offset()` in QUA right after a pulse play will cause the DC offset command to be executed one cycle too early while the previous pulse was playing.
7. In rare cases, the update might report it succeeded when it has failed. In this case, the version at the top of the admin panel would show as "initial." Reinstalling the version will fix this, and the version will be successfully installed.
8. In rare cases, some OPD channels may not work. Please report to QM if encountered.