

Qosium Scope

Qosium Scope is a real-time analyzer for managing Qosium measurements. You can use Scope to activate and control Qosium Probes over a network connection. The essential features of Scope are measurement parameterization, running measurements, results collection, and results visualization. Qosium Scope is an excellent tool for manual QoS and QoE measurements.

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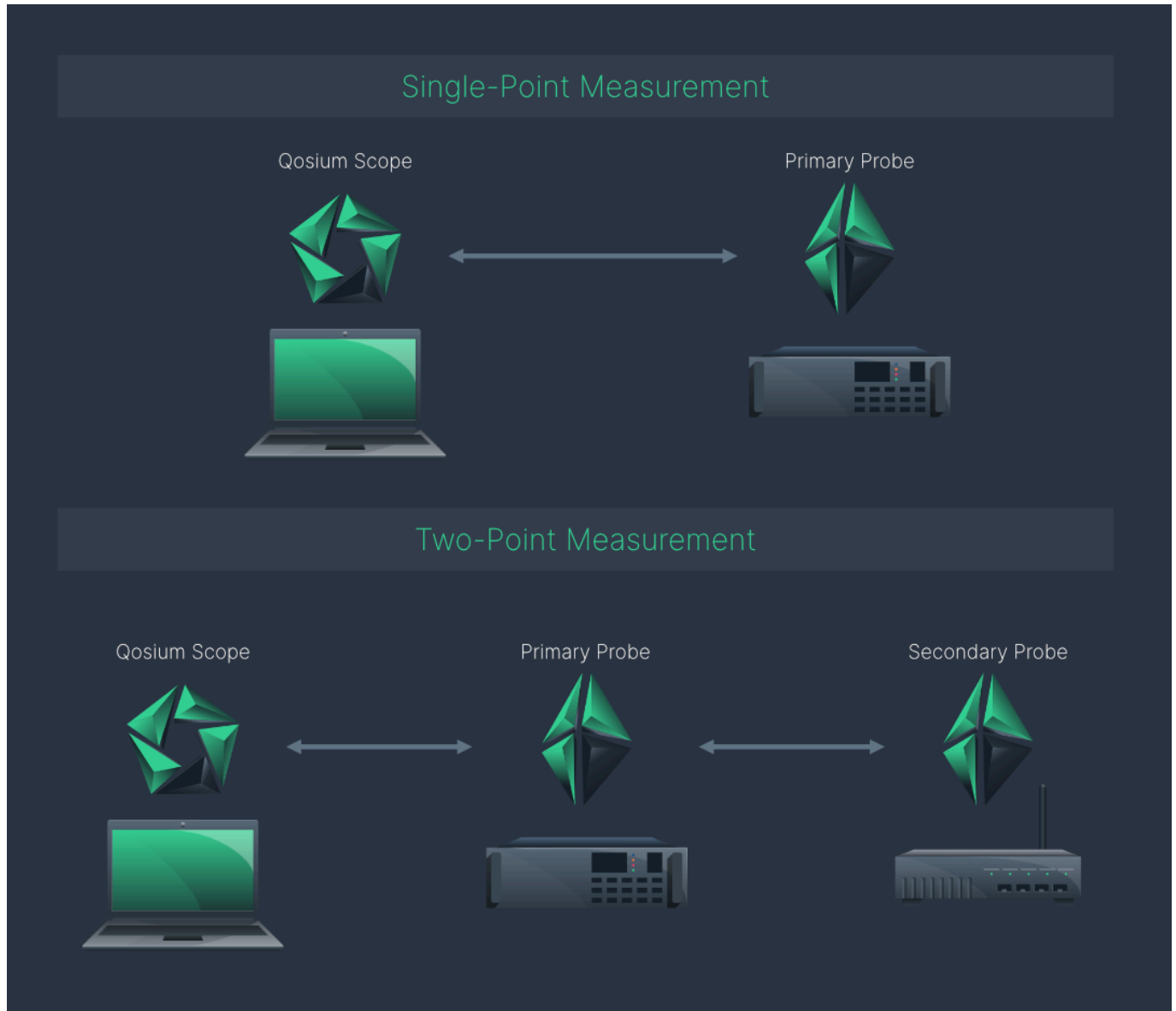


1. Overview

Qosium Scope is the primary tool for carrying out manual measurements in the Qosium product family. It is a *controlling entity*, which means that it connects to [Qosium Probes](#) and uses them to do the measurement work. Scope then collects the measurement results and offers various ways to visualize, store, and process these results.

Qosium Scope is like any other desktop application. It doesn't require any external hardware and can be run on a regular PC or laptop. With Scope, all features of Qosium measurements are at your fingertips.

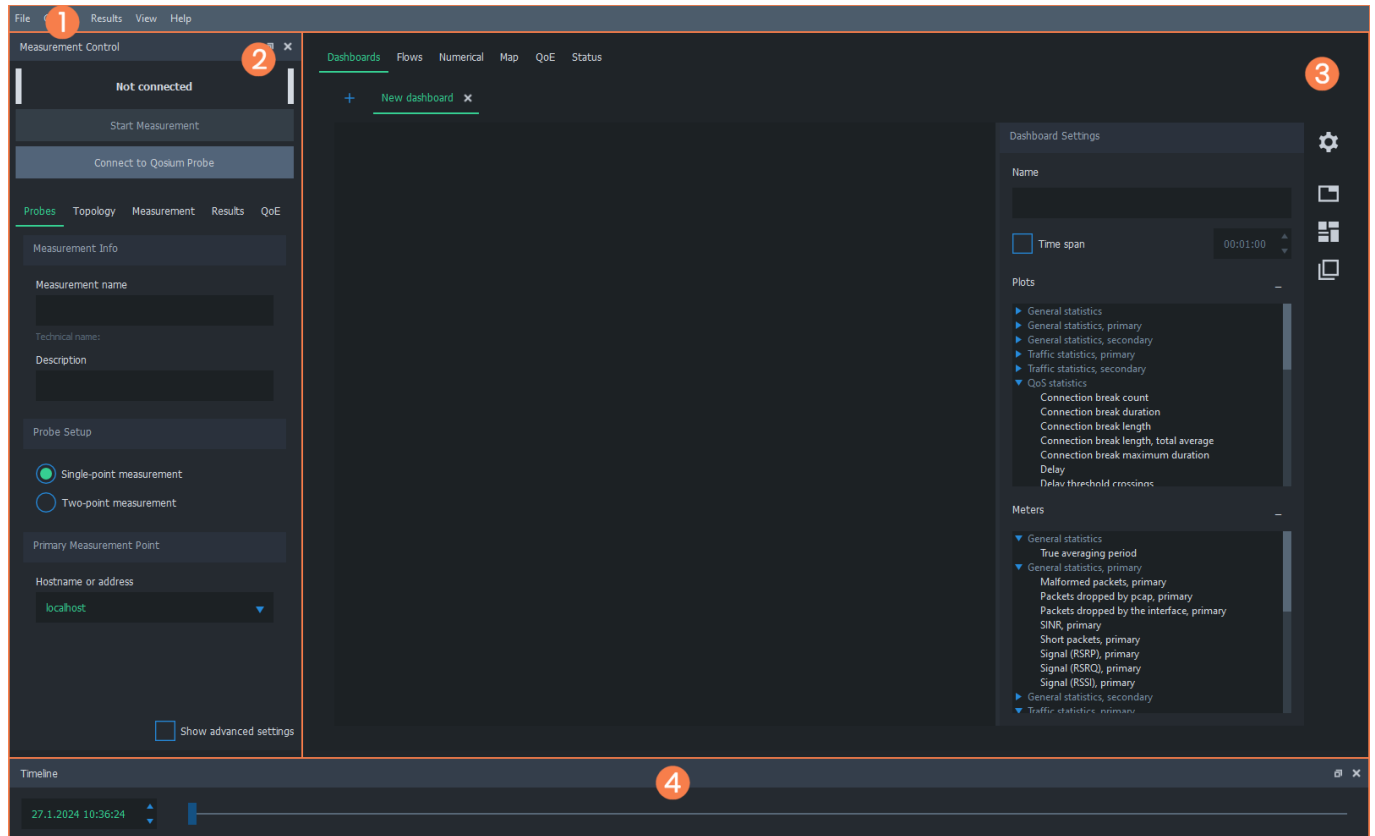
Scope has two distinct measurement modes: **Single-point measurement** and **two-point measurement**. In *single-point measurement*, Scope uses one Probe to measure a single network node or point. In *two-point measurement*, Scope instead uses two Probes to measure a network path.



2. User Interface at a Glance

After [installing and launching](#) Scope, the main window opens up. The window consists of the following elements:

1. [Menu Bar](#) - Access basic measurement functions, settings, etc.
2. [Measurement Control](#) - Configure and start/stop measurements
3. [Workspace Area](#) - View and analyze measurement results
4. [Timeline](#) - Pinpoint and compare findings across different views



3. How to Get Started with Scope

See the sub-sections for more information on installation, launching, and on each UI element. To learn how to use Scope to carry out measurements, see [Get Started with Qosium](#).

4. Install and Launch Qosium Scope

Qosium Scope is a graphical Qosium measurement control and analyzer software. You can run Qosium Scope practically on any device with a modern desktop environment.

Qosium Scope is available to most Windows, Linux, and macOS operating systems equipped with a graphical desktop environment. For heatmap results visualization, a graphics card with OpenGL 3.2+ support is required.

See platform-specific instructions for more information on each operating system. If you wish to install Scope on another system not included in this documentation, ask about OS support from us through a [support ticket](#) or by email tuki@kaitotek.fi.

4.1. Installation & Launch on Windows

Qosium has an installer package available for Windows, which also contains Scope. Installation is very similar to other Windows software, and the whole process takes only a few minutes. After installation, Scope can be launched as any other Windows application.

4.1.1. OS Requirements

Various Windows versions, starting from Windows 8, are currently supported.

4.1.2. Installation

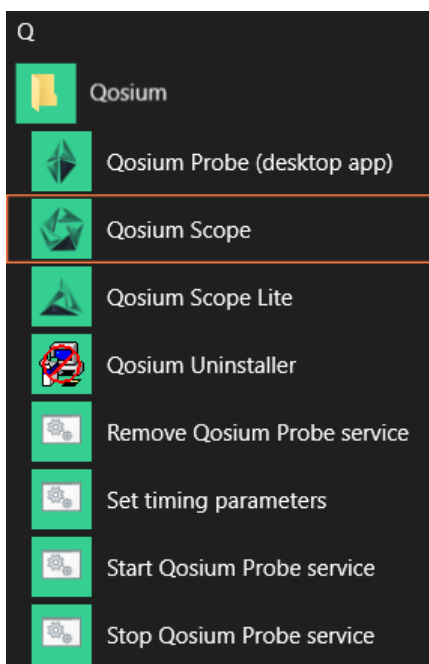
Follow these steps to install Qosium Scope:

1. [Sign in](#) to your account
2. Download the Qosium installer from [your downloads page](#)
3. Launch the installer, which guides you through the installation process

After completing these steps, Qosium Scope has been successfully installed in your system.

4.1.3. Launching Scope

After installation, the most convenient method for launching Scope is to use Qosium shortcuts, which can be accessed via the Windows start menu.



Another way is to use the executable directly. If installed on the default location, Scope can be launched by executing `C:\Program Files\Qosium\Scope\QosiumScope.exe`.

4.2. Installation on Debian-Based Systems

Qosium Scope can be installed by using the Debian package management system. This works in Ubuntu and other Debian-based Linux systems in Terminal or package manager applications, like Software Center and Synaptic.

4.2.1. Installation

First, [sign in](#) to your account and access [your downloads page](#). Then download Qosium products for the target machine.

The name of the product file should have format `QosiumScope_<version_details>.deb`, for example `QosiumScope_Ubuntu_18.04_64_20200513.deb`.

To install a new copy, or to upgrade an existing one, open terminal and run


```
sudo dpkg -i QosiumScope_<version_details>.deb
```

After installation, you can check which version of Qosium Scope is installed by running:

```
dpkg -l qosiumscope
```

4.2.2. Launching Scope

After installation, Scope can be launched by executing the following command in the terminal:

```
/opt/QosiumScope/bin/QosiumScope
```



Qosium Scope does not require root/sudo privileges.

4.2.3. Uninstallation

To remove Qosium Scope from the device, run:

```
sudo dpkg -r qosiumscope
```

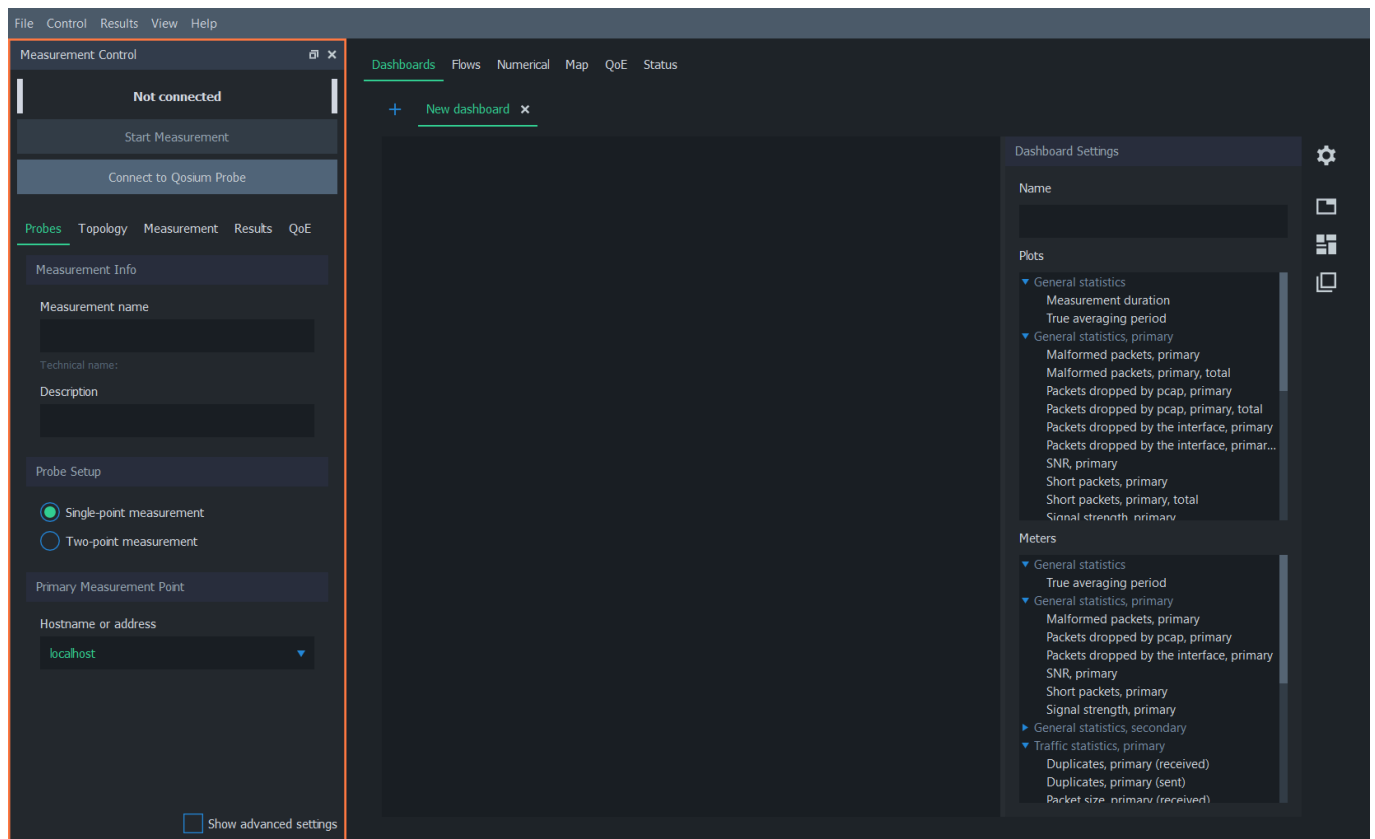
5. Measurement Control

The measurement control panel is used to parameterize and control measurements.

5.1. Overview

The measurement control panel is located on the left side of Scope window. It has three main elements:

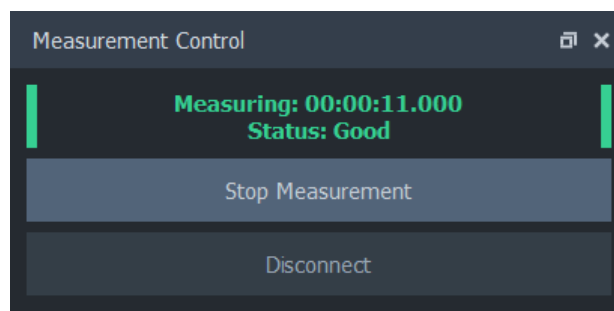
- Status indicator
- Buttons for controlling the measurements
- Tabs for parameterizing measurements



On the bottom of the panel is the **Show advanced settings**. This toggles the visibility of some rarely needed settings.

5.2. Status Indicator

Scope has a simple status indicator located in the upper left corner of the measurement control panel. It shows the Probe connectivity status, whether currently conducting a single or two-point measurement, and whether a measurement is running. For example, when the measurement is running without issues, the status bar appears as follows:



5.2.1. Status Warnings

Qosium has some built-in health inspection checks for the current measurement. If any anomalies are detected, they are reported in the status indicator.

First, if system clocks of measurement points are not in sync together, a warning message appears to the Status. This message is given only for larger synchronization errors (> 100 ms).

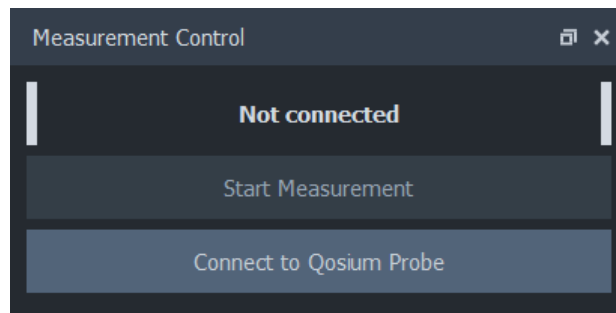
Another warning is given if Qosium observes some issues in one of the measurement points, e.g., dropped

packets. These are typically caused by too high CPU load or insufficient system resources.
Also, temporary connection breaks between entities are shown here.

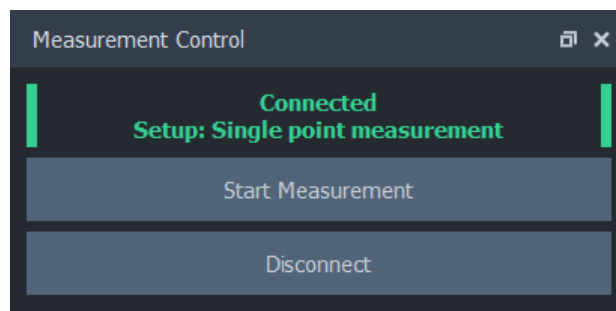
5.3. Control Buttons

Control buttons below the status indicator can be used to control the measurement. The actions of the two buttons vary depend on the current state of Scope as follows:

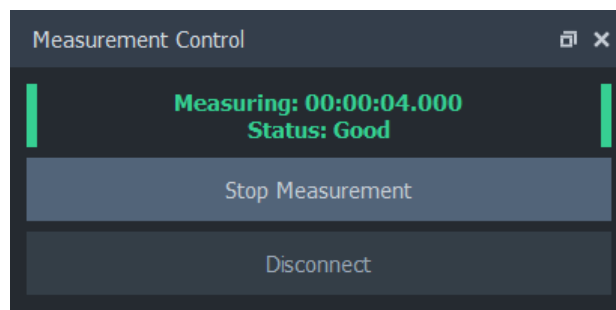
When no connection to Probe(s) is active, only connect button is available:



When a connection has been established, it's possible to either start a new measurement or disconnect:

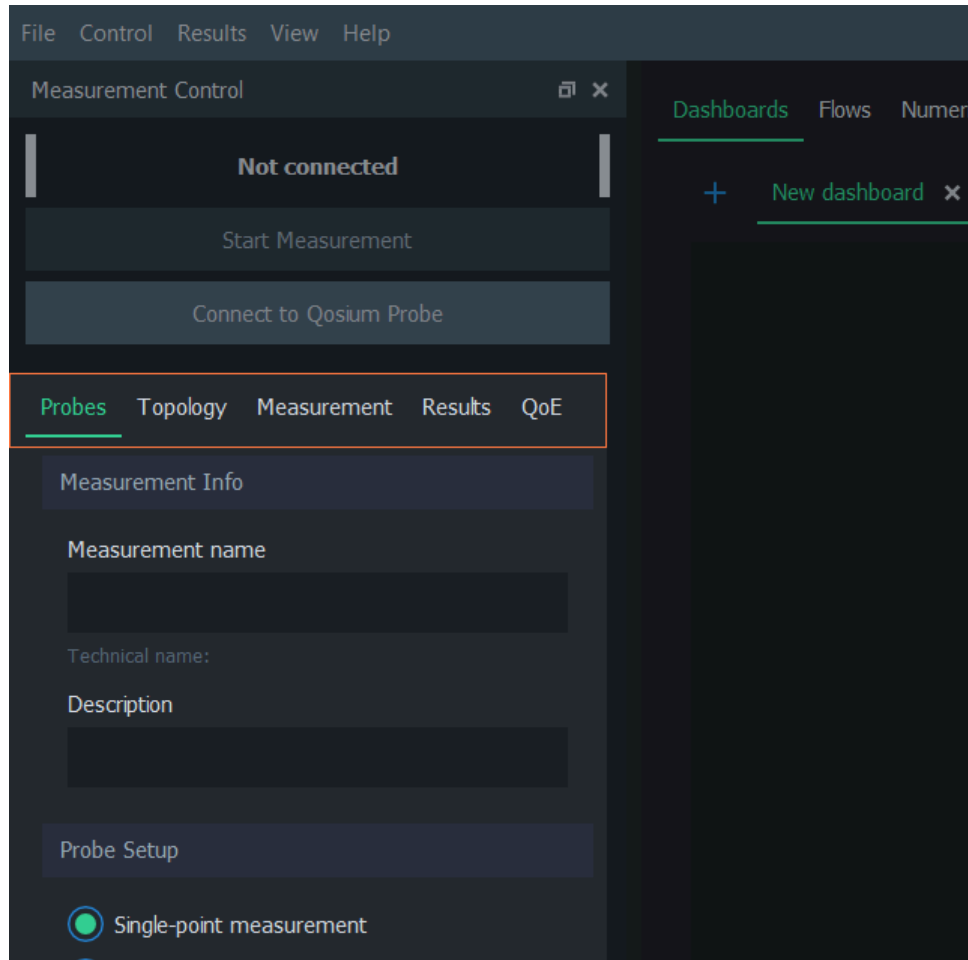


During measurement, the only action available is stopping the measurement:



5.4. Parameterization Tabs

Measurements are configured by adjusting parameters. These parameters are located in the five tabs of the measurement control panel. See more details on each tab.



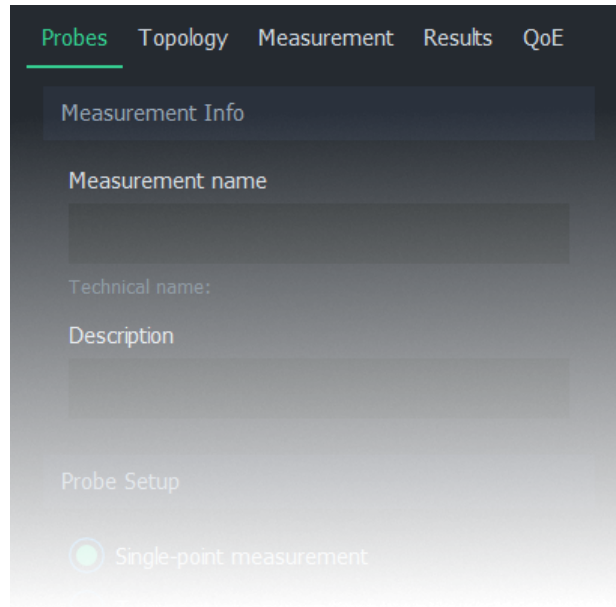
5.5. Probes Tab

The Probes tab in Scope measurement control panel contains Probe connection settings and other general settings for the measurement. It's usually the place where a new measurement parameterization is started.

5.5.1. Overview

This tab consists of the following settings groups. Detailed information on each group can be found in the following sections. All groups in this tab, excluding *Measurement Info*, are disabled when a connection to Probe(s) is active. To re-enable the tab for editing, stop the current measurement and disconnect from Probes.

- **Measurement Info**
- **Probe Setup**
- **Primary Measurement Point**
- **Secondary Measurement Point** - Visible when two-point measurement is selected
- **Client Settings** - Visible when advanced settings are enabled



5.5.2. Measurement Info

The measurement info group contains the basic information of the measurement. While optional, it's a good practice to fill out this information for each measurement.



5.5.2.1. Measurement Name

The name or title of the measurement. Naming the measurement is optional.



Technical name is a machine-friendly version of measurement name, which is used by Scope to, for example, suggest a filename for settings

5.5.2.2. Measurement Description

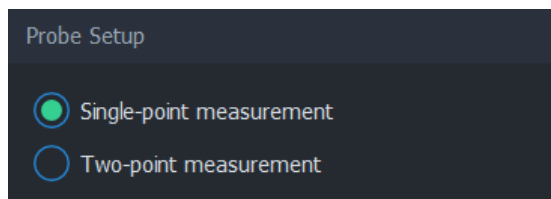
Measurement description is an optional text you can use as you wish, e.g., to describe the measurement scenario or some details in the measurement. The text set here will be part of measurement results, appearing in the results files and results systems like Qosium Storage. It is up to you how to use this.


5.5.3. Probe Setup


In the Probe setup group, the selection between *single-point measurement* and *two-point measurement* can be made.

- **Single-point measurement** mode uses one Probe to measure a single network node or point

- **Two-point measurement** mode utilizes two Probes to measure a network path

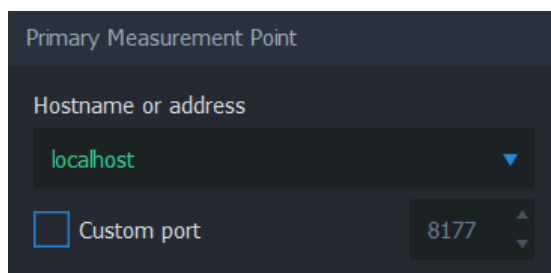


 Some measurement result types are not available in single-point measurement

 Some options in Scope are visible only when a two-point measurement is selected

5.5.4. Primary Measurement Point

The primary measurement point group contains connection settings for the Probe installed in the primary measurement point. Qosium Probe must be running and reachable via this address and port. For more information on installing and launching Probes, see [Qosium Probe documentation](#).



5.5.4.1. Hostname or Address


The address can be either a hostname or an IPv4 address. If the primary Probe is installed on the same PC where Scope is running, use local address `127.0.0.1` or `localhost`.

5.5.4.2. Custom Port

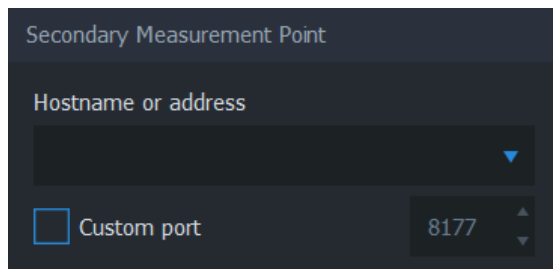
 Visible when advanced settings are enabled

If the primary Probe has been [configured](#) to listen to other than the default Qosium port `8177`, set the correct port number here before connecting.

5.5.5. Secondary Measurement Point

 Visible only when a two-point measurement is selected

The secondary measurement point group contains connection settings for the Probe installed in the secondary measurement point. Qosium Probe must be running and reachable via this address and port. For more information on installing and launching Probes, see [Qosium Probe documentation](#).



5.5.5.1. Hostname or Address

The address can be either a hostname or an IPv4 address. If the secondary Probe is installed on the same PC where Scope is running, use local address `127.0.0.1` or `localhost`.

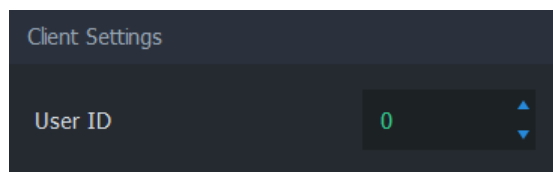
5.5.5.2. Custom Port

 Visible when advanced settings are enabled

If the secondary Probe has been [configured](#) to listen to other than the default Qosium port `8177`, set the correct port number here before connecting.

5.5.6. Client Settings

 Visible when advanced settings are enabled



5.5.6.1. User ID

User ID is used to identify this controlling entity and differentiate it from other controlling entities. Setting user ID is typically not needed, except when multiple controlling entities collect measurement results to the same result pool. In that scenario, a user ID can be used to identify the user/device which carried out the measurement since it's saved into the measurement result files.

5.6. Topology Tab

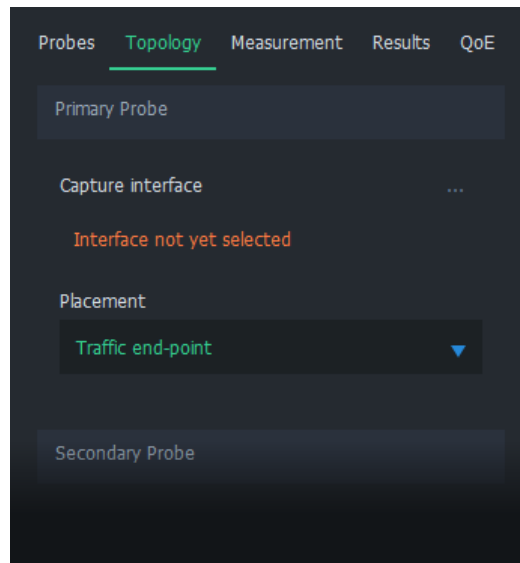
Topology defines how Qosium Probes are located concerning the target network traffic. In Scope, this means defining network capture interfaces and Probe placement. Depending on the settings, it may also be necessary to define the direction of traffic manually.

5.6.1. Overview

This tab consists of the following settings groups. Detailed information on each group can be found in the following sections.

- **Primary Probe**
- **Secondary Probe** - Visible when a two-point measurement is selected
- **Primary Probe Senders** - Visible when manual senders definition is required

- **Secondary Probe Senders** - Visible when a two-point measurement is selected, and manual senders definition is required
- **NAT Settings** - Visible when a two-point measurement is selected

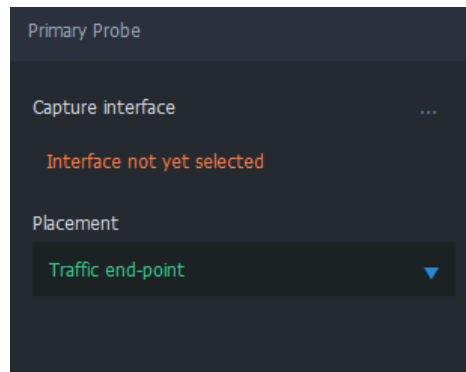


Before proceeding, it is recommended to complete the [Probes tab](#), connect to Probes(s), and then edit this tab. A connection must be made in any case for Scope to receive the list of available capture interfaces.


For more information on topology, see [Understanding Measurement Topology](#).

5.6.2. Primary Probe

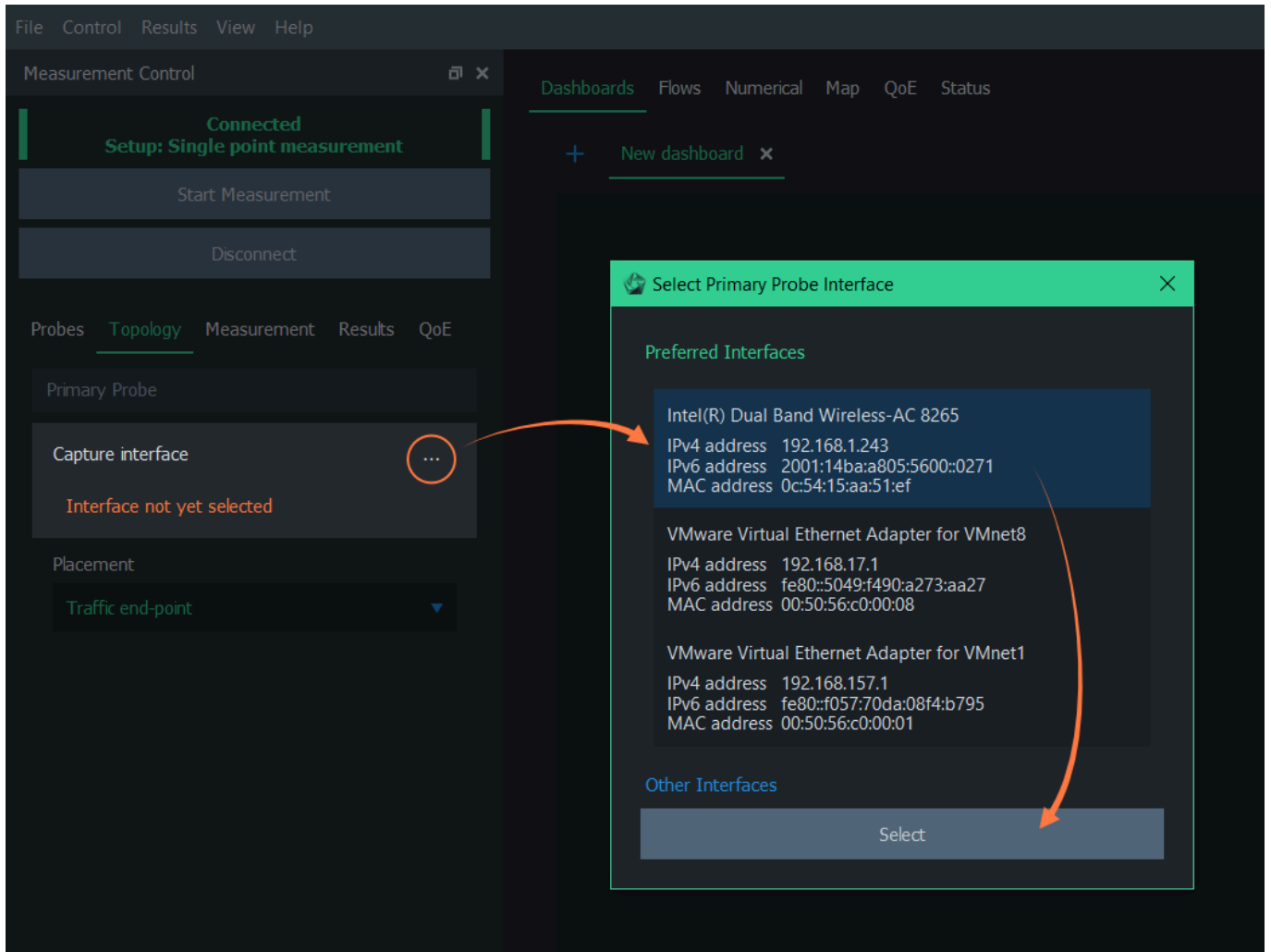
In this group, capture interface and placement can be selected for the primary Probe.



5.6.2.1. Capture Interface

 Interface can be selected only while connected to Probes

This field displays the selected interface, which the primary Probe uses for capturing network traffic. An interface can be selected by clicking the “...” icon on the right side. That opens up an interface selection dialog, which lists interfaces available for this Probe.



The interface selection dialog is split into two views:

- **Preferred Interfaces** - Interfaces that have valid addresses
- **Other Interfaces** - Other available interfaces (some of these might not work for capturing)

Locate the desired interface. Double-click on the interface, or click once and then press *Select*. It appears on the topology tab as the selected interface.

5.6.2.2. Placement

Placement indicates the location of the Probe in relation to the measured network traffic. The options are:

- **Traffic end-point** - The Probe is in either one of the measured traffic endpoints. In other words, the device Probe is installed to is sending and/or receiving the measured network traffic.
- **On traffic path: router, switch** - The Probe is not located at either one of the endpoints but instead resides somewhere along the path where the measured traffic traverses through a network device that participates actively in the communications. Examples of such devices are a router and a switch. Note: This option uses MAC addresses in flow direction analysis. Thus, if your measured interface does not have a MAC address (e.g., a cellular modem), select the next option instead.
- **On traffic path: bridged, mirrored** - This placement is similar to the previous, but now Probe is located in a passive network device that does not participate in communications actively. For example, Probe can be located in a network bridge, traffic sniffer, or external device where the measured traffic is mirrored. Also, if you wish to define the direction of traffic, i.e., *Senders* (see below), manually select this option.

 Only end-point placements allow the Packet filter to be calculated automatically.


For more information on placement, see [Understanding Measurement Topology](#).

5.6.3. Secondary Probe

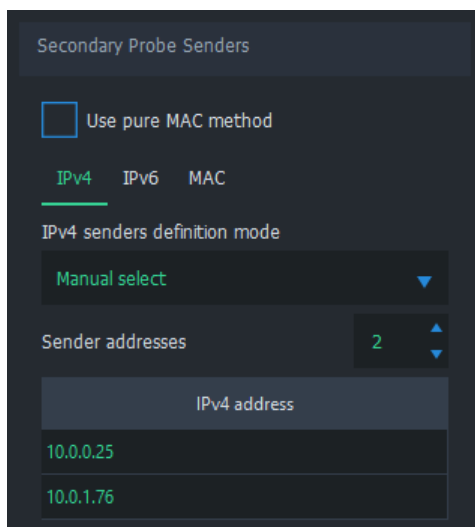
 Visible only when a two-point measurement is selected

This group contains topology settings for the secondary Probe. These settings are identical to the [Primary Probe](#) group, but they consider the secondary Probe instead.

5.6.4. Primary Probe Senders

 Visible only when manual senders definition is required

If Qosium is unable to determine the direction of traffic automatically, the Primary Probe Senders group appears. There, you manually define the direction of traffic by telling Probe the sender addresses behind each Probe.



For more information on this topic, see [Understanding Measurement Topology](#).

5.6.4.1. Pure MAC

Use pure MAC method is the first option in the view. If this method is desired, select it. Nothing more is required for senders definition for this measurement point.

When this mode is active, traffic direction is checked from the MAC-addresses. If the interfaces and the traffic is such that there are MAC-addresses, e.g., Ethernet *NIC*, then this setting works very well. However, some interfaces, like Linux *any* interface, does not show the MAC header for the captured traffic, causing this mode to fail.

5.6.4.2. Manual Senders Definition

There are multiple methods for defining which addresses are considered senders. Any address that does

not meet the given criteria is deemed to be a *receiver*.

Senders can be defined independently for IPv4, IPv6, and pure Ethernet traffic. The following options are available for each of them:

- **Local addresses** - Look up known addresses in interfaces and declare these as senders
 - Note: Selecting this option, basically, in most cases, means that your measurement point would be in the traffic endpoint. That, however, hardly is the case since your Probe placement option states otherwise.
- **According to secondary Probe** - Take the definition of the secondary Probe and reverse it
 - This option allows you to define the senders in one end.
 - Note: Be careful with *NATs*: you may need to define the senders accurately to both ends.
- **Mask** - Define a network address and a mask
 - E.g., for IPv4, address: 192.168.1.0 and a mask: 255.255.255.0
 - E.g., for IPv6, address: fe80:1ab3:8f01:12df::0 and a mask: ffff:ffff:ffff:ffff::0
 - Note: Not available for Ethernet/MAC addresses
- **Manual select** - Define a list of sender addresses
 - Select the number of addresses and then fill the list



When using the Pure MAC method or when sender addresses are defined inversely in one of the ends (According to primary/secondary Probe), the Packet filter cannot be calculated automatically.

5.6.5. Secondary Probe Senders



Visible only when a two-point measurement is selected and manual senders definition is required

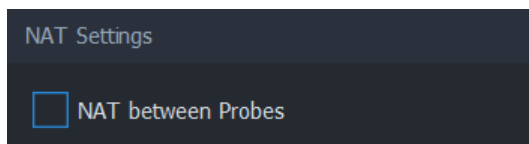
This group contains sender settings for the secondary Probe. These settings are identical to the [Primary Probe Senders](#) group, but they consider secondary Probe senders instead.

5.6.6. NAT Settings



Visible only when a two-point measurement is selected

Qosium needs to be aware if a *NAT* occurs between Probes. If this is the case, check the option **NAT between Probes**. For more information, see [How to Measure over NAT](#).



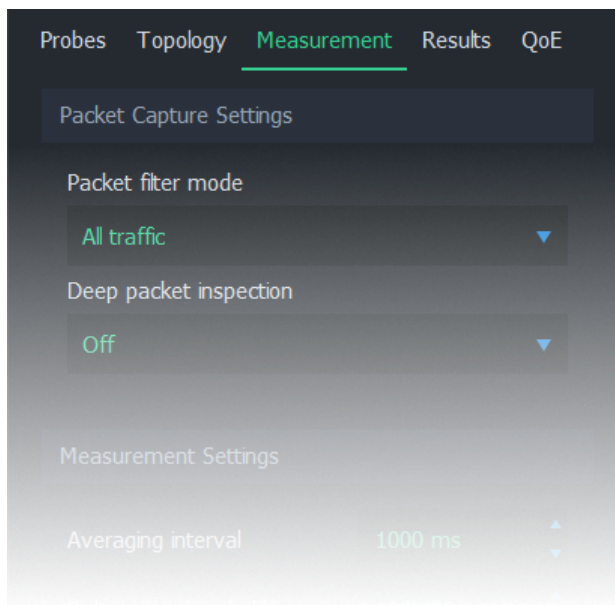
5.7. Measurement Tab

Qosium offers a wide selection of parameters for configuring how measurements are performed. In Qosium Scope, these parameters are configured in the measurement tab.

5.7.1. Overview

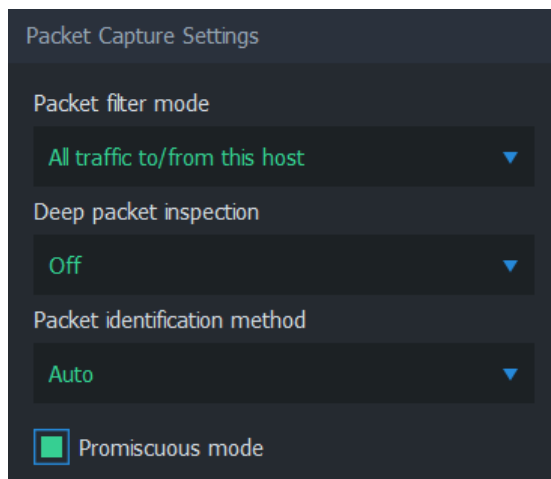
This tab consists of the following settings groups. Detailed information on each group can be found in the following sections.

- **Packet Capture Settings**
- **Measurement Settings**
- **Control Connection Settings** - Visible when advanced settings are enabled



5.7.2. Packet Capture Settings

This group contains settings on how packets are captured and identified.



5.7.2.1. Packet Filter Mode

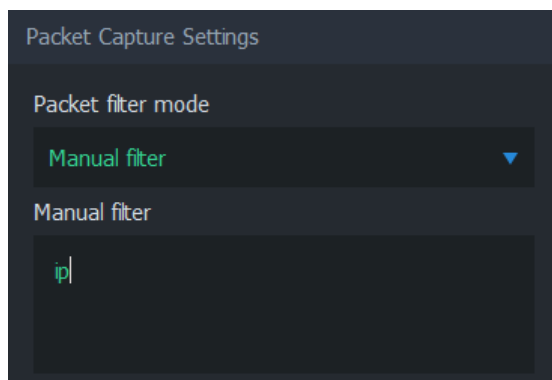
Packet filter mode determines how packets are filtered. In other words, packets that meet the given filter criteria contribute to the measurement results. The available options depend on current settings. For more information, see [Packet Filters in Qosium](#).

The first option in the list is an *automatic* mode. The name and function of this setting depend on whether a

single-point or two-point measurement is selected:

- In a single-point measurement, this option is named **All IP traffic to/from this host**. Only (IPv4 or IPv6) traffic originating from or targeted to the measurement point is captured.
- In a two-point measurement, this option is named **All IP traffic between hosts**. Only (IPv4 or IPv6) traffic that is generated by the measurement points and is targeted to the other measurement point is captured.

The second option in this list is **Manual filter**. When selected, a text field appears below, where an arbitrary packet filter can be typed manually.



Regardless of the choices made, the final filter applied to the measurement can be seen on [Status Tab](#) once the measurement is started.

5.7.2.2. Secondary Probe Filter Mode



Visible when two-point measurement, NAT between Probes, and manual filter are selected

Secondary Probe Filter Mode determines how the given manual packet filter is treated in the secondary Probe. Setting this option is relevant only if NAT occurs on the measurement path. For more information, see [How to Measure over NAT](#).

- **Equal filter** (default) - The same filter as to the primary Probe is set to the secondary.
- **Strict autofilter** - The filter is composed automatically based on what kind of flow the primary Probe with its filter observes. The IPv4 addresses, protocol, and ports (when they exist) are included in the filter. Thus, this filter is *strict* in the sense that only a single flow will fit it.
- **Loose autofilter** - Similar to **Strict autofilter**, but only the IPv4 addresses of the flow are included in the filter. The filter is loose in the sense that multiple flows will fit that.

5.7.2.3. Deep Packet Inspection



Available only in single-point measurements

Two measurement points are always required to perform a QoS measurement. However, some protocols themselves carry information from the other end, allowing QoS calculations to be made by a single Qosium Probe. Thus, this is still a two-point measurement, but now there is no Probe in the other end. Instead, the application/service acts as the secondary measurement point, providing valid information and enabling QoS calculation.

Qosium currently supports two protocols for this kind of deep packet inspection: RTP and MPEG-2 (TS). These methods enable packet loss statistic calculation by a single Qosium Probe. Please note that this QoS

calculation can be done for received traffic only as there is no feedback channel for the sent traffic.

- **RTP** - Use RTP protocol header information.
- **MPEG-2 (TS)** - Use MPEG-2 Transport stream header information.



The measured traffic stream must be of the selected type. Otherwise, the DPI-based QoS calculations cannot be made.

5.7.2.4. Packet Identification Method




Visible when advanced settings are enabled.

The packet identification method defines how Qosium identifies packets between measurement points. Thus, the meaning of this is important under a two-point measurement and not that much in a single-point measurement. This is one of the parameters that you generally do not need to touch since the default automatic setting will handle most of the measurement cases. However, if you do need to set this manually, here are the options and their explanations.

- **Auto** (default) - Qosium selects the method from the options below based on the measurement scenario. The selection is made safely, i.e., a method typically known to function in most of the cases in a similar scenario is selected. This might not always be the optimal method.
- **IPv4 ID Field** - Qosium uses the *Identification field* in the IPv4 header for packet identification. Naturally, the first requirement for this to work is that the measured traffic shall be of IPv4 type. A second requirement is that the measured stream is using the IPv4 Identification field as specified. This is not always the case, but luckily the non-standard usage is rare. A restriction lies in the fact that the *Identification field* has only 16 bits, limiting the available unique numbering per time instance to 65536. Thus, if you are using a 1 s averaging interval, your measurement should be working fine, as long as the target measurement stream's packet rate is clearly less than this (e.g., < 30000 pkts/s). Beyond that, QoS calculation is not guaranteed to be entirely accurate. Then, if you are using a longer averaging interval, e.g., 10 s, the safe packet rate drops to one-tenth of the previous, accordingly.
- **RTP Sequence Number** - Qosium uses the *Sequence number field* in the RTP header for packet identification. This lightweight option is ideal for measuring RTP streams. But, be aware that while Qosium checks that there is room in the packet for the RTP header, it does not check its actual existence. Thus, setting this option with non-RTP traffic can result in unpredictable behavior.
- **Payload-Based ID** - Qosium calculates the identification based on the packet payload. This method is not dependent on the protocol headers, so it works for IP packets and pure L2 (e.g., Ethernet) packets. If a packet has no payload, **IP4 ID Field**, when present, is used.
- **Extended Payload-Based ID** - Qosium calculates the identification based on the packet payload, including some parts of the transport layer header. This can be your choice if the measured traffic stream is composed of, e.g., very short packets or packets with duplicated data in their payloads. However, if your NIC is using offloading methods, this method might not always work correctly.
- **Pure Payload-Based ID** - This is a very similar method with **Payload-Based ID**, but packets without payload are just ignored from QoS calculation. In many ways, this is the most robust identification method. However, the drawback, as with all the payload-based methods, is that if the payloads between packets have little or no variation, QoS calculation might not always be accurate.
- **NAT bypasser + Payload based ID** - Operates as **Payload-Based ID** but with NAT bypasser functionality enabled. NAT bypasser lets you perform a passive measurement in a scenario where there is a NAT between the measurement points.
- **NAT Bypasser + Pure Payload Based ID** - Operates as **Pure Payload-Based ID** but with NAT bypasser

functionality enabled.

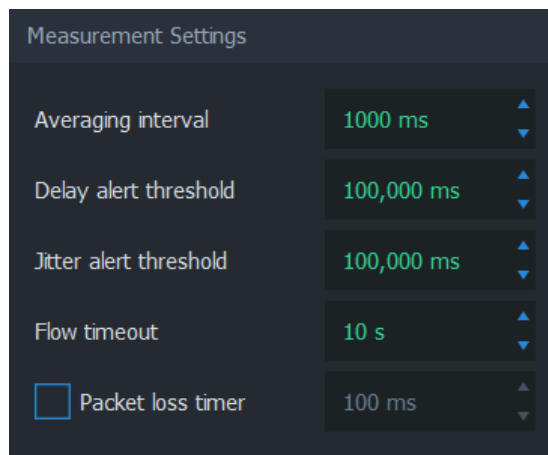
5.7.2.5. Promiscuous Mode

 Visible when advanced settings are enabled.

Promiscuous Mode allows Qosium to capture packets that are not designated to the network card performing the capture. This is a fairly common case with Qosium, and it's recommended to leave this option enabled unless there's a specific reason to disable it. Some network cards might not support promiscuous mode, which is an example of such a specific reason.


5.7.3. Measurement Settings

Measurement settings contribute to the way how measurement results are gathered and interpreted.



5.7.3.1. Averaging Interval

As the name implies, this parameter defines the time interval each average sample represents. Coincidentally, averaging interval also determines how often Scope receives average results.

 Please note that this sets the target averaging interval.

If Qosium Probe is not running in a platform with a real-time operating system, the target is hardly ever fully met. For example, in Windows, it is quite common to see that the real averaging interval varies between 999 – 1001 ms when 1000 ms averaging interval is set. Instead of the target value, Qosium always uses [the true averaging period](#) in its calculations. Qosium also follows and corrects the behavior of the averaging interval's variations over time. Thus, the long-term averaged averaging interval should be relatively close to the set target value.


5.7.3.2. Delay Alert Threshold

Packets with a delay above this threshold are counted in [QoS Statistics: Th. ex. delay pkts](#). This statistic provides a way to understand the number of highly delayed single packets without actual packet-level statistics.

5.7.3.3. Jitter Alert Threshold

Packets with a jitter above this threshold are counted in [QoS Statistics: Th. ex. jitter pkts](#). This statistic provides a way to understand the number of single packets with high jitter without going to the actual packet-level statistics.

5.7.3.4. Flow Timeout

 Visible when advanced settings are enabled.

Flow timeout determines the duration in which a flow remains in the flow map after the most recent packet belonging to the flow has been registered.


Ideally, this value should be set as small as possible. However, if packets are arriving sporadically, flows may disappear from the flow map too early. This results in flows disappearing and re-appearing, as Scope deems these flows terminated prematurely. To counter this phenomenon, increase the flow timeout. As a result, the correct value is always somewhat dependent on the traffic flows' properties to be measured.

5.7.3.5. Packet Loss Timer

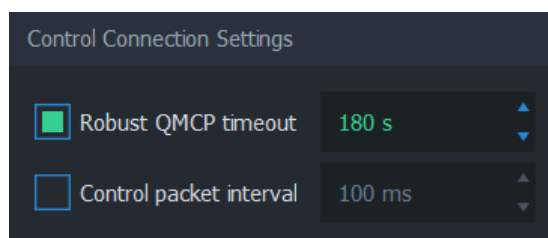
 Visible when advanced settings are enabled.

Packet Loss Timer determines the duration used to determine packet losses. Setting this parameter is always a compromise between reactivity and the capability to detect long delays. If not enabled, Qosium automatically sets a generally well-functioning value for this parameter. The final value can be seen on the [Status Tab](#) during the measurement.

5.7.4. Control Connection Settings

 Visible when advanced settings are enabled.

These settings are related to the QMCP connections between Qosium Products (e.g., from Scope to primary Probe to external Listener and Secondary Probe). Adjusting these settings is not typically needed.



5.7.4.1. Robust QMCP Timeout

This parameter is for toggling *Robust QMCP Mode* on/off and for adjusting the duration of how long reconnection is tried before giving up. This is especially useful when measuring over a weak, unreliable network path.

Set this value according to your needs. Very large values are ideal while carrying out long-term monitoring, while small values are recommended for carrying out short measurement campaigns.

5.7.4.2. Control Packet Interval

This parameter affects the control packet interval between the Qosium Probes in a two-point measurement. It is recommended to leave this option unchecked to allow Qosium to calculate an optimal value automatically instead. The final value can be seen on the [Status Tab](#).

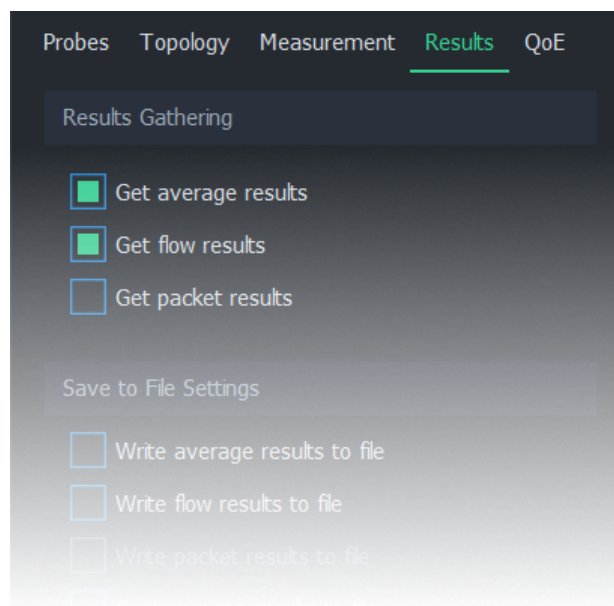
5.8. Results Tab

In Scope, each result type has to be explicitly selected for gathering. The selected result types can then be selected to be saved to file for later analysis. These and other results-related parameters are configured in the results tab.

5.8.1. Overview

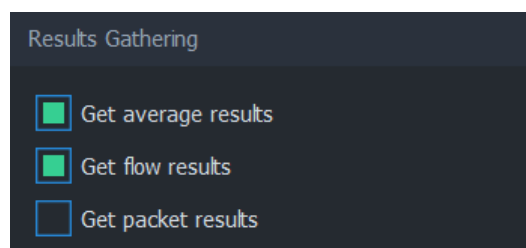
This tab consists of the following settings groups. Detailed information on each group can be found in the following sections.

- **Results Gathering**
- **Save to File Settings**
- **Limit Results**
- **Results Direct Distribution** - Visible when advanced settings are enabled



5.8.2. Results Gathering

Scope gathers different types of results only when explicitly instructed to do so. In this group, you may select the result types for the next measurement.



For more information on each result type, see [Measurement Results in Qosium](#).

5.8.2.1. Get Average Results

When this option is selected, average results will be gathered during measurement. Average results are the most common type of results in Qosium measurements. In Scope, there are several options available for handling average results:

- View the results in [dashboards](#)
- View the results in [numerical form](#)
- Save the results to file [during measurement](#)
- Save the results to file [after measurement](#)

5.8.2.2. Get Flow Results

When this option is selected, flow results will be gathered during measurement. In Scope, there are two options available for handling flow results:

- Observe [flowmap](#), which displays currently active flows
- Save the complete list of flows to file [during measurement](#)

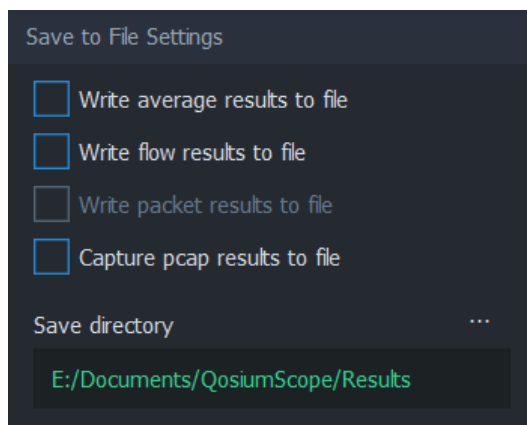
5.8.2.3. Get Packet Results

When this option is selected, packet results will be gathered during measurement. In Scope, there are two options available for handling packet results:

- View the results in [numerical form](#)
- Save the packet results to file [during measurement](#)

5.8.3. Save to File Settings

Each result type can be selected to be saved to files in real time during measurement.



5.8.3.1. Write Average Results to File

 Enabled when Get average results is selected

When this option is selected, average results will be written to file in real time during the measurement. The directory where this file will be saved is determined by [Save directory](#).

The file will be named `averages_[technical_name].txt`, where `[technical_name]` is auto-generated from the [Measurement Name](#).

5.8.3.2. Write Flow Results to File



Enabled when Get flow results is selected

When this option is selected, flow results will be written to file in real time during the measurement. The directory where this file will be saved is determined by [Save directory](#).

The file will be named `flows_[technical_name].txt`, where `[technical_name]` is auto-generated from the [Measurement Name](#).

5.8.3.3. Write Packet Results to File



Enabled when Get packet results is selected

When this option is selected, packet results will be written to file in real time during the measurement. The directory where this file will be saved is determined by [Save directory](#).

In a single-point measurement, this option produces a single file with filename format `pk_info_[technical_name].txt`.

In a two-point measurement, this option produces two files with filename formats `pk_qos_DL_[technical_name].txt` and `pk_qos_UL_[technical_name].txt`.

The `[technical_name]` is auto-generated from the [Measurement Name](#).

5.8.3.4. Capture Pcap Results to File

When this option is selected, full packet traces will be written to file in real time during the measurement. The directory where this file will be saved is determined by [Save directory](#).

For more information, see [How to Take Packet Capture?](#).

5.8.3.5. Save Directory

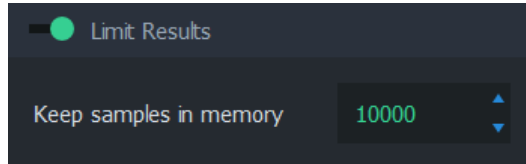
The save directory determines the folder where results files will be written during measurement. Click on ... to select another directory.

It's recommended to have a separate directory for each measurement scenario to avoid mixing up the results.

Save directory has no effect if none of the result types have been selected for real-time saving.

5.8.4. Limit Results

The number in **Keep samples in memory** states how many results per result type Scope holds in memory. Set this value high enough for the measurement purpose. The limit can also be disabled, but this is not recommended, as this will eventually consume the available memory of the computer where Scope is running.



Limiting results in memory does not have an impact on results saved to files. The selected results will be saved regardless of whether this setting is enabled or what limit is given.

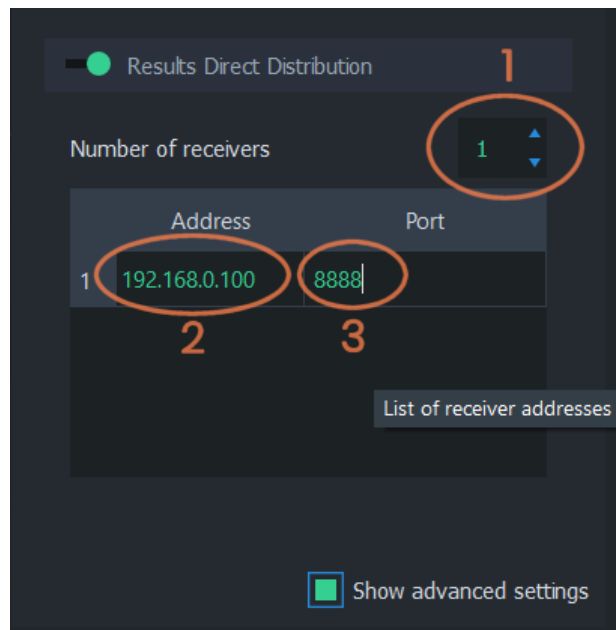
5.8.5. Results Direct Distribution

 Visible when advanced settings are enabled

Qosium supports direct results sending to external systems. Such a system can be, for example, [Qosium Storage](#) or any QMCP listener. See the possibilities for [integration](#) if you are interested in receiving results directly in your system.

In Qosium Scope, the external receivers are defined in this group. Activating results distribution is straightforward:

1. Set the number of result destinations,
2. Set the IPv4 address(es) of the destination(s), and
3. Set the port(s) of the destination(s).



Once you start the measurement, the results distribution destinations will be connected. The distribution takes place in the same phase as Qosium Scope's result reception.

 Result receivers have to be running before starting the measurement.

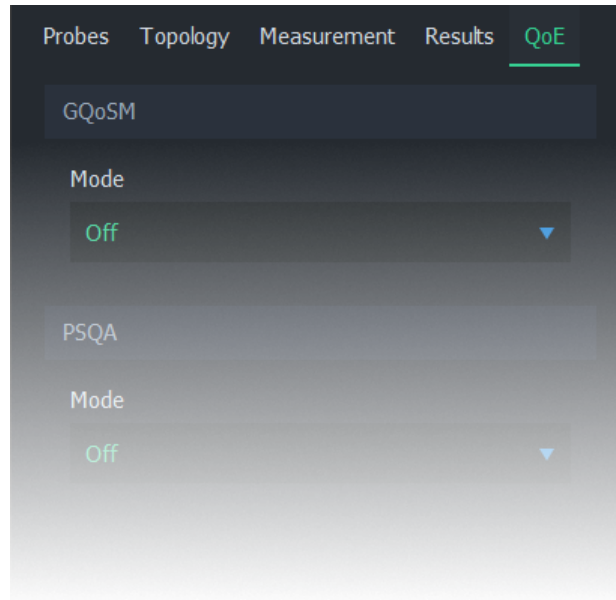
5.9. QoE Tab

Configuring Quality of Experience models has its own dedicated tab in Qosium Scope. GQoSM and PSQA models can be selected and parameterized in this tab.

5.9.1. Overview

This tab consists of the following settings groups:

- **GQoSM**
- **PSQA**
- **Sample Averaging** - Visible when advanced settings are enabled



5.9.2. GQoSM

Setting this option from *Off* to **Manual** enables GQoSM samples in *average results*.

The model can use up to 4 QoS parameters in QoE calculation: **Delay**, **jitter**, **packet loss**, and **connection break length**. Each of these parameters can be enabled/disabled individually. Each parameter has 2 adjustments: **Bad performance limit** and **form factor**. For more information on how to configure this model, see [Quality of Experience](#).

The screenshot displays the GQoS configuration interface. At the top, the title 'GQoSM' is visible. Below it, the 'Mode' is set to 'Manual'. There are four main sections, each with a toggle switch and a title: 'Delay' (green), 'Jitter' (green), 'Packet Loss' (green), and 'Connection Break Length' (blue). Each section contains two input fields: 'Bad perf. limit' and 'Form factor'. The values for these fields are: Delay (1000,00 ms and 0,30), Jitter (50,00 ms and 0,30), Packet Loss (3,000 % and 0,30), and Connection Break Length (5 pkts and 0,00). The interface uses a dark theme with green and blue accents.

5.9.3. PSQA

Pseudo-Subjective Quality Assessment (PSQA) uses a trained feed-forward neural network for determining quality. For more information on how to configure this model, see [Quality of Experience](#).

The available options depend on the current

- **Off** - The model is not calculated
- **VoIP Listening** - A model for voice over IP for one-way listening
- **VoIP Conversational** - A model for voice over IP for a two-way conversation
- **Streaming Video (H.264) AV** - A model for streaming video
- **Streaming Video (H.264) AV MLP** - A model for streaming video

5.9.3.1. VoIP Listening

This listening model is applicable when the targeted traffic consists of a one-direction VoIP flow. The model has a few parameters:

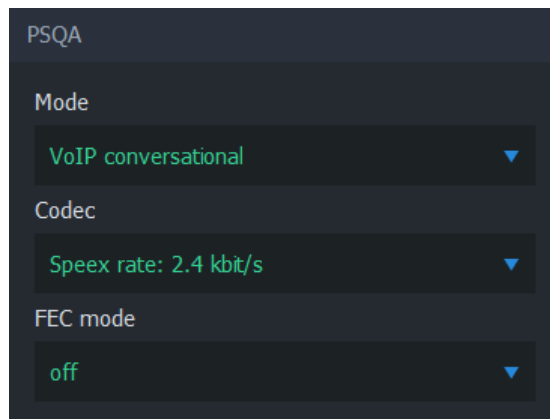
- **Codec** - The codec of the VoIP stream
- **FEC mode** - The Forward Error Correction mode
- **Packetization interval** - The duration of audio each packet contains



5.9.3.2. VoIP Conversational

This conversational model is applicable when the targeted traffic consists of a two-direction VoIP conversation flow. The model has a few parameters:

- **Codec** - The codec of the VoIP stream
- **FEC mode** - The Forward Error Correction mode



5.9.3.3. Streaming Video (H.264) AV

This streaming video model is applicable when the targeted traffic consists of a video stream. The model has a few parameters:

- **Resolution** - The resolution of the video frame
- **Motion level** - The amount of motion in the video content



5.9.3.4. Streaming Video (H.264) AV MLP

This streaming video model is applicable when the targeted traffic consists of a video stream. The model has a few parameters:

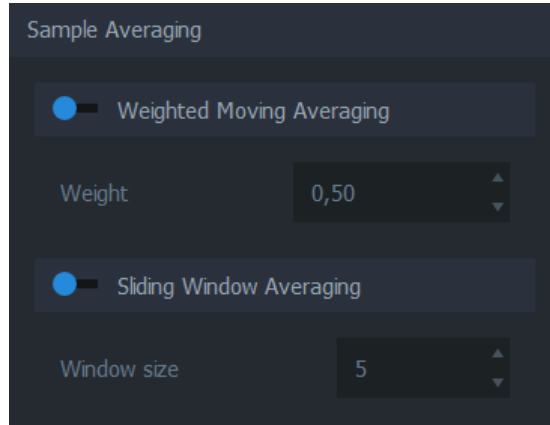
- **Resolution** - The resolution of the video frame
- **Motion level** - The amount of motion in the video content
- **Error concealment** - Whether the codec is attempting to conceal errors or not
- **Calculated movement quantity**



5.9.4. Sample Averaging

 Visible when advanced settings are enabled

Sample averaging settings can be adjusted to pre-average QoE samples. This reduces sporadic fluctuations in the results when using small [averaging interval](#), or when the quality model yields low scores for brief deterioration of network conditions not visible in the end-application.



5.9.4.1. Weighted Moving Averaging

When enabled, the average is calculated by using the weighted moving average algorithm. See [Wikipedia article on weighted moving average](#).

5.9.4.2. Sliding Window Averaging

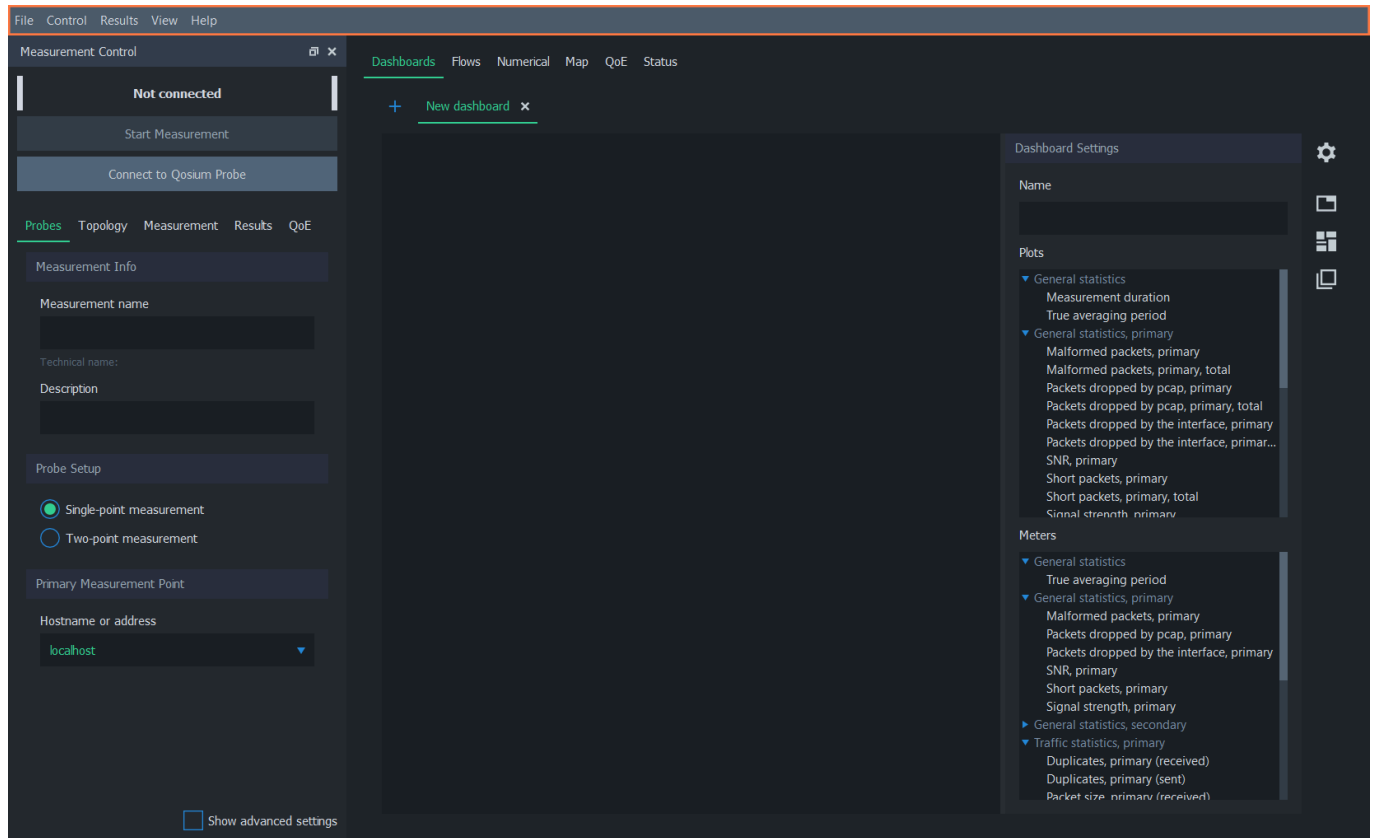
When enabled, the average is calculated from a fixed number of most recent samples. The number can be adjusted manually.

6. Menu Bar

Scope's top menu bar offers application-wide actions and options, such as measurement control, Probe discovery, themes, and measurement settings management.

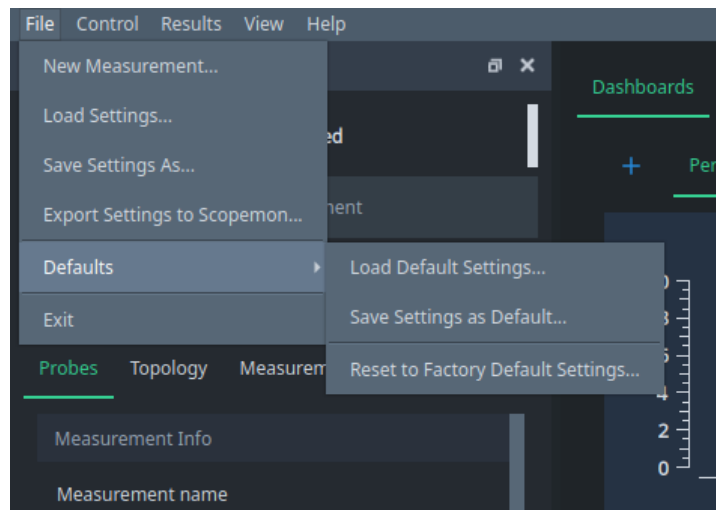
6.1. Overview

The menu bar is located at the top of the Scope main window. This menu contains useful options for saving and loading measurement settings, controlling measurements, and managing results. Each menu item is described in the following sections.



6.2. File

The *File* menu contains options for saving and loading settings.



- **New Measurement...** - Clear all current measurement results and load the default settings
- **Load Settings...** - Load a measurement settings file
- **Save Settings As...** - Save the current measurement settings to a file
- **Export Settings to Scopemon...** - Generate a Scopemon configuration file based on the current settings
- **Defaults** - Scope loads default settings automatically after launch. These settings can be modified to avoid setting the same initial settings repeatedly
 - **Load Default Settings...** - Load default settings as current settings

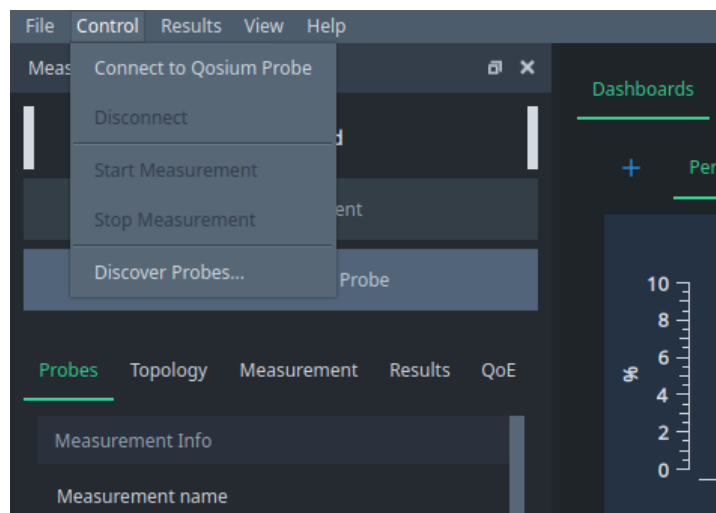
- **Save Settings as Default...** - Save the current settings as new default settings
- **Reset to Factory Default Settings** - Load factory defaults as current settings
- **Exit** - Quit Scope

Restore Factory Defaults Permanently

To permanently restore “factory defaults”, select *Reset to Factory Default Settings* and then select *Save Settings as Default...*

6.3. Control

These options are used to control the current measurement. The first four options are identical to the [control buttons](#) in the measurement control panel. Also, the Probe discovery feature can be accessed via this menu.

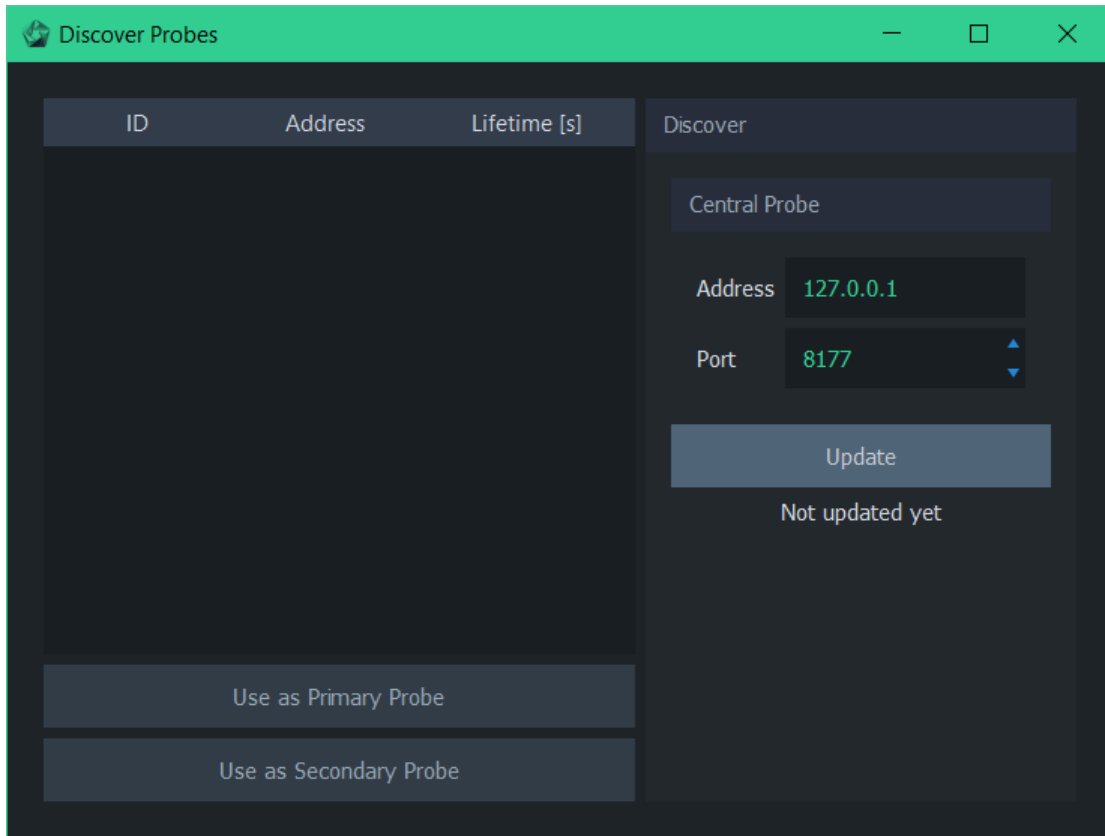


- **Connect to Qosium Probe** - Connect to Probe(s)
- **Disconnect** - Disconnect from Probe(s)
- **Start Measurement** - Start a new measurement
- **Stop Measurement** - Stop ongoing measurement
- **Discover Probes** - Discover Probes registered to a central Probe

6.3.1. Discover Probes

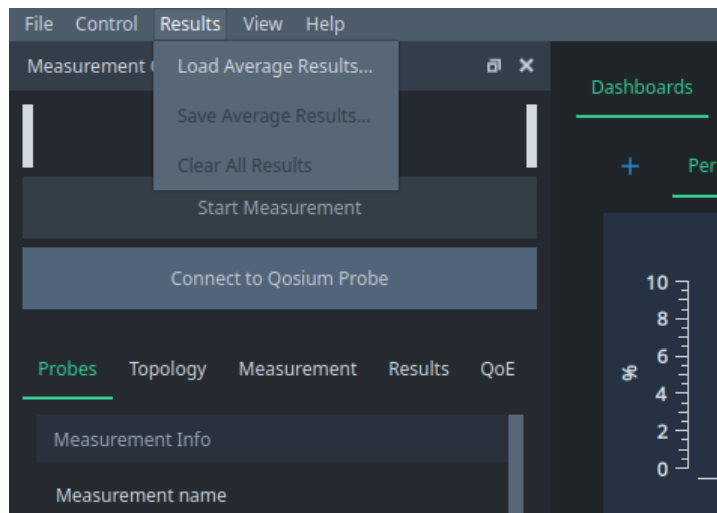
This option opens a dialog where Probes can be discovered automatically. Type the address and port of the central Probe and click *Update* to get a list of available Probes.

Using Probe discovery requires setting up a central Probe. To learn more about this functionality, see [How to Discover Probes](#).



6.4. Results

The results menu can be used to load and save average results or to clear all measurement results.



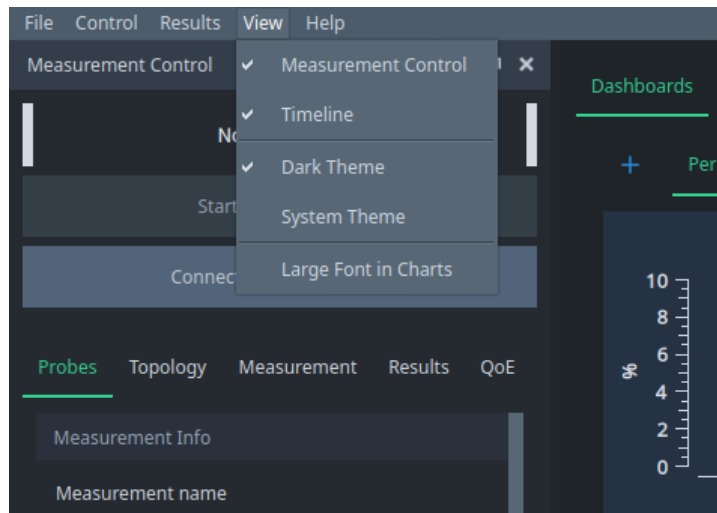
- **Load Average Results...** - Load average results from a file
- **Save Average Results...** - Save current average results to a file
- **Clear All Results...** - Remove all current measurement results from Scope.

Clearing the measurement results does not affect measurement settings or result files.

Average results can also be selected for automatic saving during measurement, as with all other measurement result types. For more information on real-time saving, see [Results Tab](#).

6.5. View

The view menu contains options for changing the visual appearance of Scope.

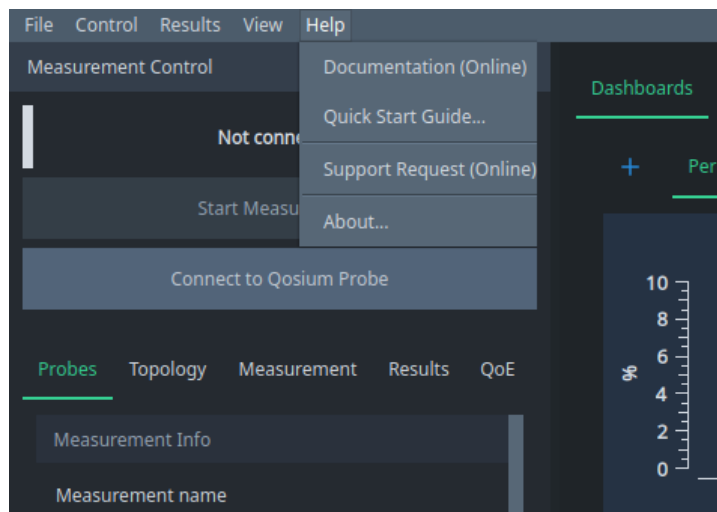


- **Measurement Control** - Toggle the visibility of the [Measurement Control panel](#)
- **Timeline** - Toggle the visibility of the [Timeline](#)
- **Dark Theme** - Apply the default theme of Qosium Scope
- **System Theme** - Apply the legacy system theme of Qosium Scope
- **Large Font in Charts** - Use large font size in dashboard charts to allow better visibility, for example, in demo events

Hiding the *Measurement Control* panel is useful, for example, when a maximal amount of space is required for results visualization. Note that the *Measurement Control* panel can also be undocked from the main window by dragging.

6.6. Help

The help menu contains the quick start guide and software information.



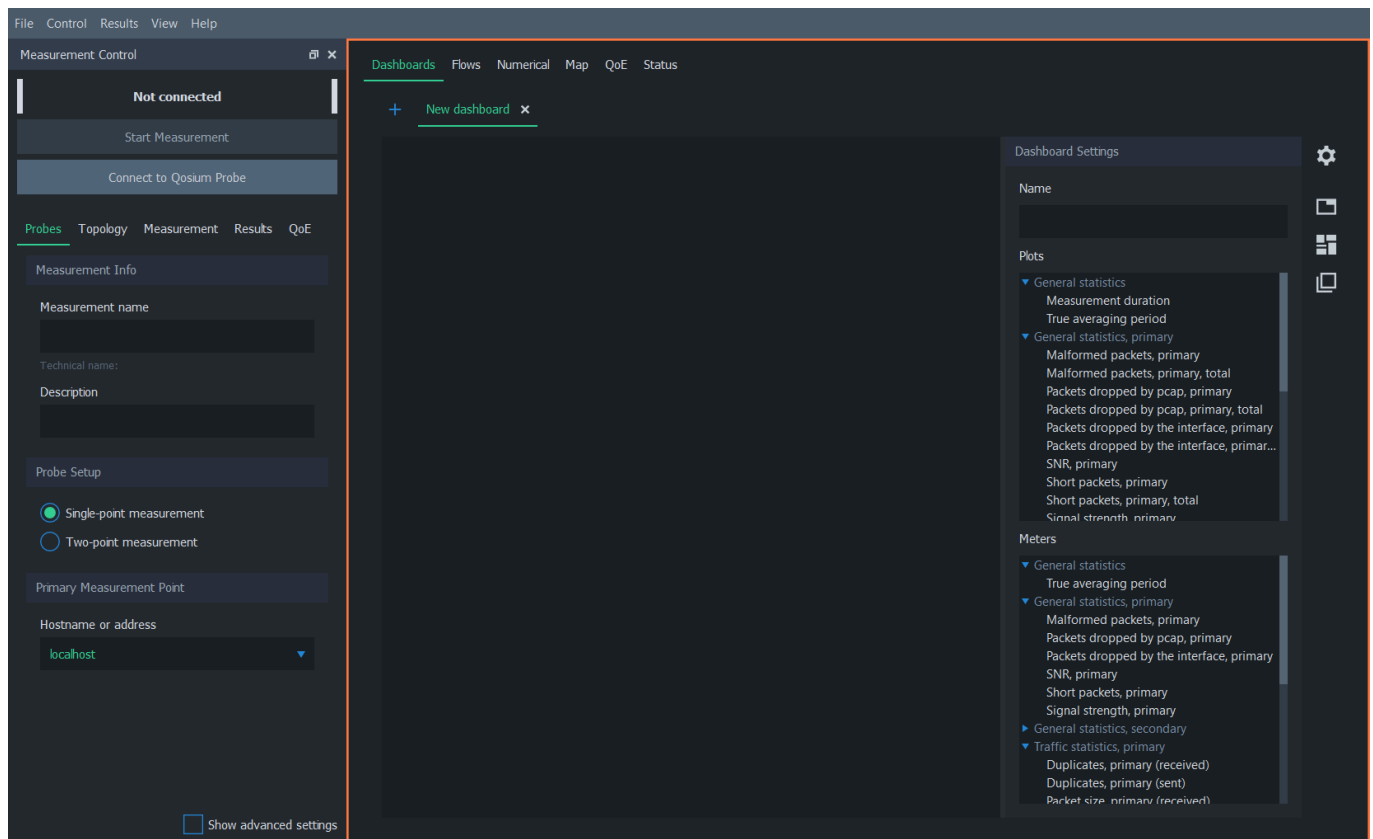
- **Documentation (Online)** - Link to this documentation
- **Quick Start Guide...** - Show the quick start guide for tutorials and exercises

- **Support Request (Online)** - Link to our support ticket form
- **About...** - Show technical information about Qosium Scope, such as software version

7. Workspace Area

The workspace area in Scope hosts the result visualization views. In this area, measurement results can be configured, viewed, and analyzed.

The workspace area is on the right side of the window:



The workspace area is divided into six main tabs, which offer various methods to view and analyze measurement results. See the subsections below for more information on each tab.

7.1. Dashboards Tab

Visualizing average results in charts is the most common way to analyze measurement results in Qosium Scope. This can be done in the dashboards tab.

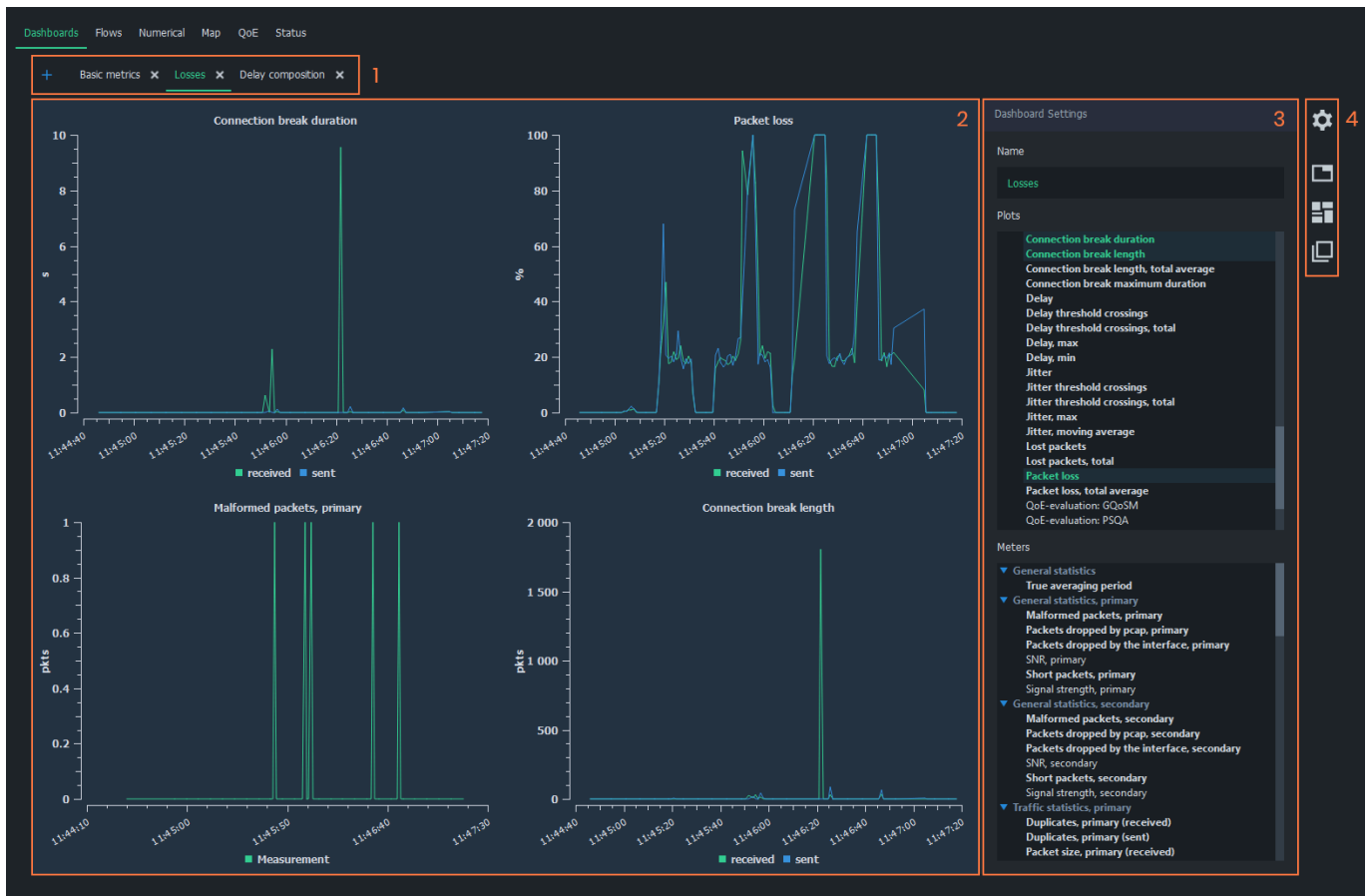
7.1.1. Overview

The dashboards tab contains, as the name implies, dashboards. Dashboards visualize *average results* with plots and charts. Each dashboard has its own tab, and you can freely create, remove, and switch between tabs, even during an ongoing measurement.

Dashboards tab has four main elements. These elements are further explained in the following sections.

1. **Dashboard Tabs** - List of created dashboards
2. **Charts Area** - Active plots and meters in the current dashboard

- 3. **Settings** - Settings for the current dashboard
- 4. **Toolbar** - Quick actions for the current dashboard

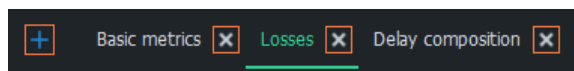



7.1.2. Dashboard Tabs

The dashboard tabs panel is used to organize and browse dashboards. In a typical, simple measurement, a single dashboard is sufficient. However, when viewing many various statistics, organizing the charts in multiple dashboards helps keep the interface neat and tidy.

Dashboards can be freely added and removed to allow better organization of measurement results. For example, you can add plots in one dashboard and meters in another. Also, arranging different statistics in their own dashboards is a good option.

- To add a new empty dashboard, click the *blue plus-sign* on the left side of the tab panel
- To remove an existing dashboard, click the *white x* next to the dashboard name in the tab panel



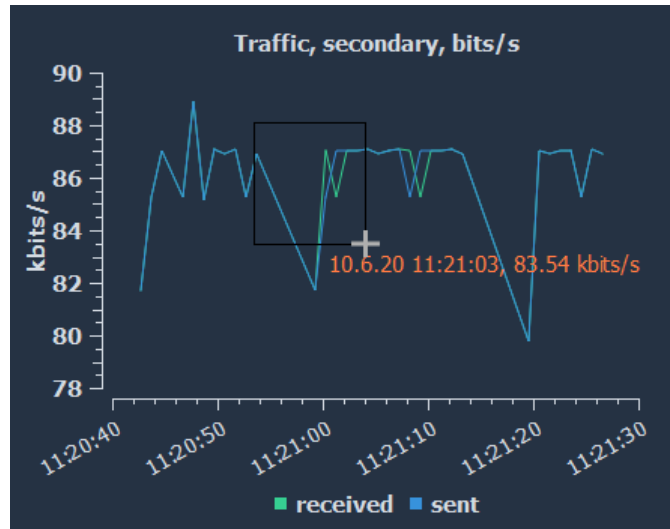
 Removing dashboards does not remove any measurement results

7.1.3. Chart Area

This region of the dashboard shows the opened charts. Each chart represents a single statistic in average results. Some plots have the combined *sent* and *received* directions of the same metric.

Plots have a few mouse controls available for viewing the results. Hover cursor over plots lines to inspect

values. To zoom, draw a rectangle over the area of interest with the left mouse button. Use the right mouse button to zoom back out.

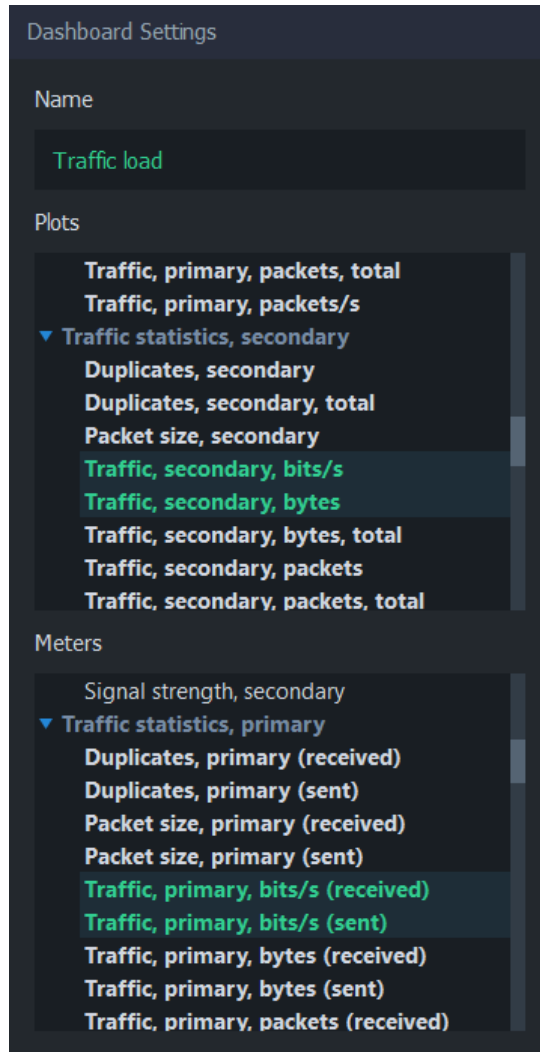


7.1.4. Settings

Each dashboard has its own settings panel, where you can select the charts from two categories: plots and meters. You can also give the dashboard a name, shown in the dashboard tabs panel, for easy recognition.

Use the *blue triangles* to expand/collapse each statistics group in *Plots* and *Meters* lists. Left-click on any statistics to display them immediately in the charts area. To select multiple statistics, press and drag with the left mouse button over the preferred statistics. Statistics, which have results, are marked with *bold* text. Clicking an active statistic removes the corresponding chart from the chart area.

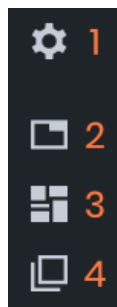
For more information on each statistic in average results, see [Average Results](#).



7.1.5. Toolbar

The buttons on the right side of each dashboard can be used to control the settings group's visibility and the arrangement of charts.

1. **Dashboard Settings** - Show/hide [Dashboard settings](#)
2. **Arrange in Tabs** - Arrange charts in tabs, where only one chart can be visible at a time
3. **Arrange in Tiles** - Arrange charts in tiles, where charts are stacked in a grid-like format (*default*)
4. **Arrange Freely** - Move and resize charts manually



7.2. Flows Tab

The Flows tab of Scope contains the flow map, which lists currently active flows and their statistics in a table.

The flow monitor in Scope is very useful, showing the individual traffic flows composing the total captured traffic in the monitored interface with the given packet filter. It also has a security aspect, allowing you to easily detect if there are flows that should not be. In addition, you can use it to verify that the packet filter is functioning as expected, especially in complex measurement scenarios.

	Source	Destination	Protocol	State	Load [b/s] (downlink)	Load [b/s] (uplink)	Age [s]	Inactivity
1	192.168.0.112 : 58492	89.166.9.145 : 443	TCP	Persistent	1180	3502	118.4	2
2	192.168.0.100 : 55301	239.255.255.250 : 1900	UDP	New	0	3259	1.1	0
3	192.168.0.100 : 55300	239.255.255.250 : 1900	UDP	New	0	3017	1.1	0
4	192.168.0.106 : 54915	192.168.0.255 : 54915	UDP	Persistent	0	2439	119.4	0
5	192.168.0.112 : 54915	192.168.0.255 : 54915	UDP	Persistent	0	2439	119.5	0
6	192.168.0.112 : 58694	37.16.105.72 : 22	TCP	New	7968	2326	2.5	0
7	00:d8:61:7a:ba:94 : 62654	ff:ff:ff:ff:ff:ff : 5355	ARP	Persistent	0	335	7.8	0
8	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 63771	2001:14b8:1000::0002 : 53	UDP	New	315	195	4.1	4
9	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 61255	2001:14b8:1000::0002 : 53	UDP	New	311	193	4.1	4
10	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 49169	2001:14b8:1000::0002 : 53	UDP	Persistent	0	0	24.1	24
11	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 60534	2001:14b8:1000::0002 : 53	UDP	Persistent	0	0	12.9	12
12	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 60933	2001:14b8:1000::0002 : 53	UDP	Old	0	0	32.9	32
13	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 61121	2001:14b8:1000::0002 : 53	UDP	Persistent	0	0	11.1	11
14	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 62755	2001:14b8:1000::0002 : 53	UDP	Old	0	0	32.8	32
15	2001:14ba:16fd:8300:24d4:ba2f:5f70:7dab : 63309	2001:14b8:1000::0002 : 53	UDP	Persistent	0	0	18.3	18
16	fe80::bad9:4dff:fe61:8564	ff02::0001	ICMPV6	Persistent	0	0	110.8	15
17	192.168.0.112 : 57671	37.16.105.72 : 8888	TCP	Persistent	0	0	118	7
18	192.168.0.112 : 123	62.241.198.252 : 123	UDP	Persistent	0	0	108.7	12
19	192.168.0.112 : 56210	139.99.46.91 : 443	TCP	Persistent	0	0	119.6	5
20	192.168.0.112 : 58490	139.99.46.91 : 443	TCP	Persistent	0	0	11.1	10
21	192.168.0.112 : 58447	172.67.72.165 : 443	TCP	Old	0	0	32.9	32

The view has a set of fixed columns. For more information on the columns and flow results in general, see [Flow Results](#).

Column Header	Description
Source	The source address and port (if port number is available)
Destination	The source address and port, (if port number is available)
Protocol	The protocol above the address layer
State	New => Persistent => Old

Column Header	Description
Load [b/s] (downlink)	The current throughput in the downlink (received direction)
Load [b/s] (uplink)	The current throughput in the uplink (sent direction)
Age [s]	The age of the flow in seconds
Inactivity	The time passed in seconds since the last packet detected in this flow

Each flow has a **state**, which can have one of three values:

- **New** - The flow is new and reported for the first time
- **Persistent** - The flow has traffic or has been inactive less than the set limit
- **Old** - The flow has been inactive longer than the set limit and will be removed the next time flow results arrive

The *inactivity* counts duration from the last observed packet in the flow. If the flow is active, this number remains at or near zero. When inactivity begins to increase, the flow has stopped, i.e., no more packets are observed related to that. Once it reaches the set limit, i.e., [Flow timeout](#), the flow is deemed ended and will be removed from the visualization.



No flows

If flows do not appear in the flow monitor during measurement:

- Check that flow results are selected in the [Results Tab](#)
- Check that [the capture interface](#) is pointing to the correct interface
- If using [manual packet filter](#), make sure that the packet filter is not too strict
 - Test by switching to automatic filtering and see if flows begin to appear in the flow map

7.3. Numerical Tab

The numerical tab in Scope has two sub-tabs: Average results and Packet results. As the names imply, these two tabs show the corresponding result types in numerical table format.

7.3.1. Average Results Tab

This tab displays the average results in a table format. The table has a set of columns that can be selected for view. For more information on the columns and average results in general, see [Average Results in Qosium](#).

Dashboards Flows Numerical Map QoE Status

Average Results Packet Results

	Jitter (received)	Jitter (sent)	Traffic, primary, bytes (received)	Traffic, secondary, bytes (received)
10.6.2020 15:08:01.812	956 us	509 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:02.813	370 us	1.362 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:03.813	923 us	466 us	888 bytes	1.11 kbytes
10.6.2020 15:08:04.812	379 us	738 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:05.811	1.889 ms	1.439 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:06.813	511 us	791 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:07.812	1.033 ms	693 us	1.11 kbytes	888 bytes
10.6.2020 15:08:08.812	615 us	819 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:09.812	668 us	1.115 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:10.811	3.99 ms	1.096 ms	888 bytes	1.11 kbytes
10.6.2020 15:08:11.813	684 us	1.366 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:12.813	152 us	1.148 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:13.811	7.061 ms	1.752 ms	1.11 kbytes	888 bytes
10.6.2020 15:08:14.813	1.338 ms	3.219 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:15.813	1.519 ms	896 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:16.812	1.456 ms	1.153 ms	888 bytes	1.11 kbytes
10.6.2020 15:08:17.813	2.555 ms	902 us	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:18.812	1.042 ms	1.111 ms	1.11 kbytes	1.11 kbytes
10.6.2020 15:08:19.811	830 us	777 us	1.11 kbytes	888 bytes
10.6.2020 15:08:20.811	1.098 ms	636 us	888 bytes	1.11 kbytes

Table Settings

Table columns

- Jitter threshold crossings, total (received)
- Jitter threshold crossings, total (sent)
- Jitter, max (received)
- Jitter, max (sent)
- Jitter, moving average (received)
- Jitter, moving average (sent)
- Lost packets (received)
- Lost packets (sent)
- Lost packets, total (received)
- Lost packets, total (sent)
- Packet loss (received)
- Packet loss (sent)
- Packet loss, total average (received)
- Packet loss, total average (sent)
- QoE-evaluation: GQoSIM (received)
- QoE-evaluation: GQoSIM (sent)
- QoE-evaluation: PSQA (received)
- QoE-evaluation: PSQA (sent)
- QoS samples (received)
- QoS samples (sent)
- Sent info is not found (received)
- Sent info is not found (sent)
- Sent info is not found, total (received)
- Sent info is not found, total (sent)

Freeze table

Auto Column Width (include headers)

Auto Column Width (exclude headers)

Table columns lists all available average results. Use the *blue triangles* to expand/collapse each statistics group. Left-click on any statistics to display it immediately in the table as a column. Left-clicking an active statistic again will remove the column. To select multiple statistics, press and drag with the left mouse button. Statistics, which have results, are shown with bold text.

Freeze table stops automatic update of the table. This is especially helpful if there's a need to study the results in more detail during the measurement.

Auto Column Width (Include Headers) resizes columns according to the widest row. If you want to resize columns without taking the header row's width into account, use **Auto Column Width (Exclude Headers)**.

i Tip

Double-click a result row to see the corresponding packet results in [Packet Results Tab](#).

7.3.2. Packet Results Tab

This tab displays the packet results in a table format. The table has a set of fixed columns. For more information on the columns and packet results in general, see [Packet Results in Qosium](#).

Dashboards Flows Numerical Map QoE Status

Average Results Packet Results

Showing results 291 / 292 Always show most recent results

Timestamp	Direction	Source Address	Destination Address	Protocol	Packet Size [B]	Delay [us]	Jitter, average [us]	Jitter, absolute [us]	Packet ID	Fragment Number
18:36:39.126	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 954	53	50	2 880 328 801	0
18:36:39.219	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 987	52	33	1 910 538 051	0
18:36:39.329	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 906	54	81	1 996 812 314	0
18:36:39.384	Received	192.168.0.104 : 8177	192.168.0.103 : 49801	TCP	317	3 945	39	94	1 604 892 196	0
18:36:39.422	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	7 023	57	117	1 919 550 222	0
18:36:39.515	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	7 097	59	74	1 422 555 879	0
18:36:39.530	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	7 058	57	39	1 543 584 274	0
18:36:39.592	Sent	fe80::c1ba:0470:1617:a73c	fe80::9553:ee0e:63d4:af83	ICMPv6	86	6 976	59	82	1 856 191 011	0
18:36:39.599	Received	fe80::9553:ee0e:63d4:af83	fe80::c1ba:0470:1617:a73c	ICMPv6	78	3 876	40	69	1 673 280 681	0
18:36:39.623	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 961	56	15	3 967 444 118	0
18:36:39.717	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 997	55	36	3 709 558 840	0
18:36:39.826	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 968	53	29	3 562 893 671	0
18:36:39.884	Received	192.168.0.104 : 8177	192.168.0.103 : 49801	TCP	122	3 886	39	10	3 634 862 732	0
18:36:39.918	Sent	fe80::c1ba:0470:1617:a73c : 56761	fe80::9553:ee0e:63d4:af83 : 5201	UDP	1 162	6 996	48	10	2 111 925 241	0
18:36:39.940	Received	192.168.0.104 : 8177	192.168.0.103 : 49801	TCP	334	3 843	39	43	3 812 242 168	0
18:36:39.990	Received	192.168.0.104	192.168.0.103	ICMP	98	3 878	39	35	4 037 182 691	0
18:36:39.994	Sent	192.168.0.103	192.168.0.104	ICMP	98	6 986	51	18	2 902 645 265	0
18:36:40.001	Received	192.168.0.104 : 22	192.168.0.103 : 49828	TCP	154	3 844	38	34	1 942 516 962	0

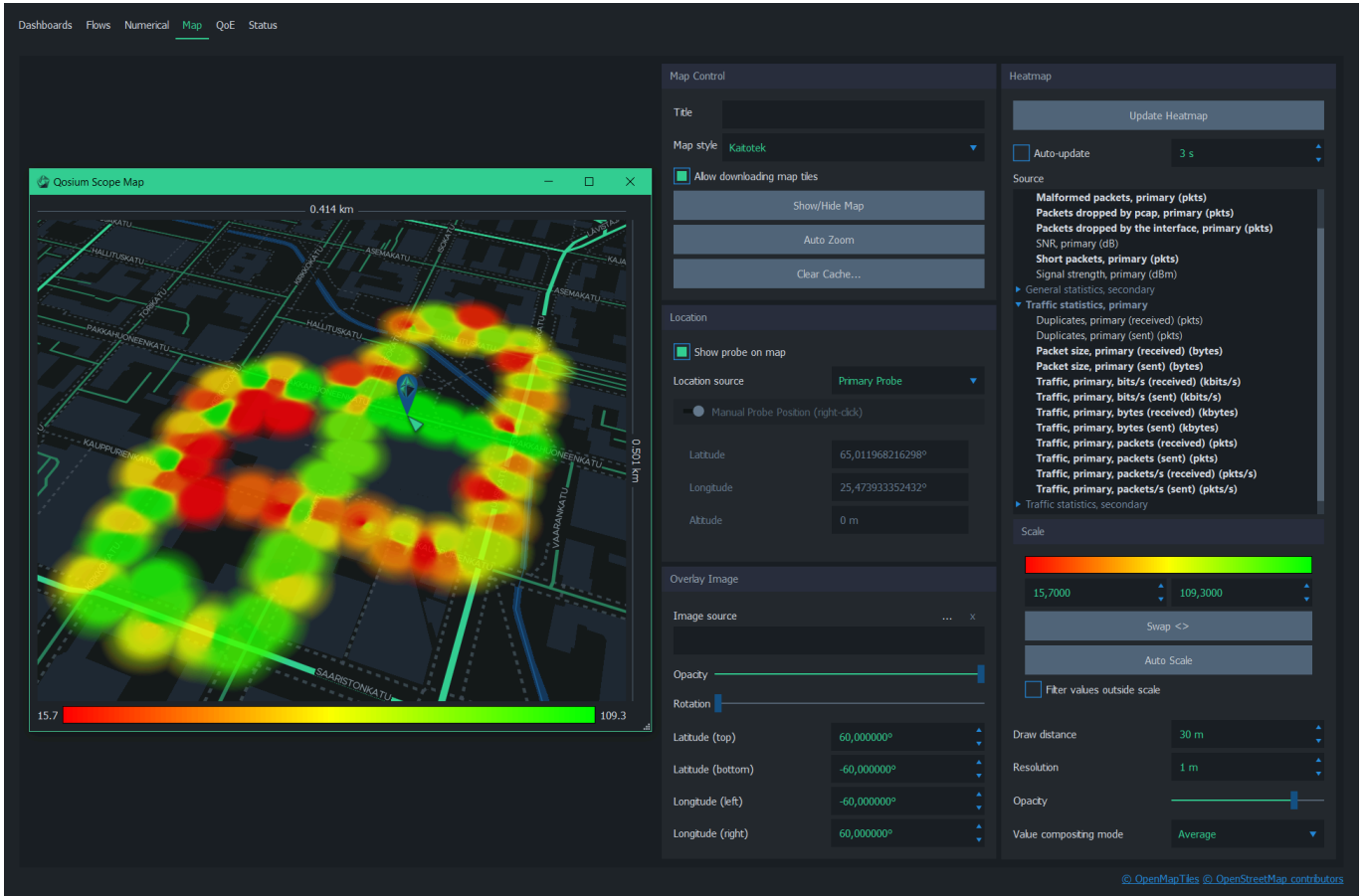
When **Always show most recent results** is checked, Scope will automatically switch to the newest complete result. Unchecking it allows you to select any result index.

7.4. Map Tab

The map tab in the Scope workspace area is used to draw heatmaps on a geographical map. This type of visualization is beneficial when measuring Quality of Service or Quality of Experience in a real location.

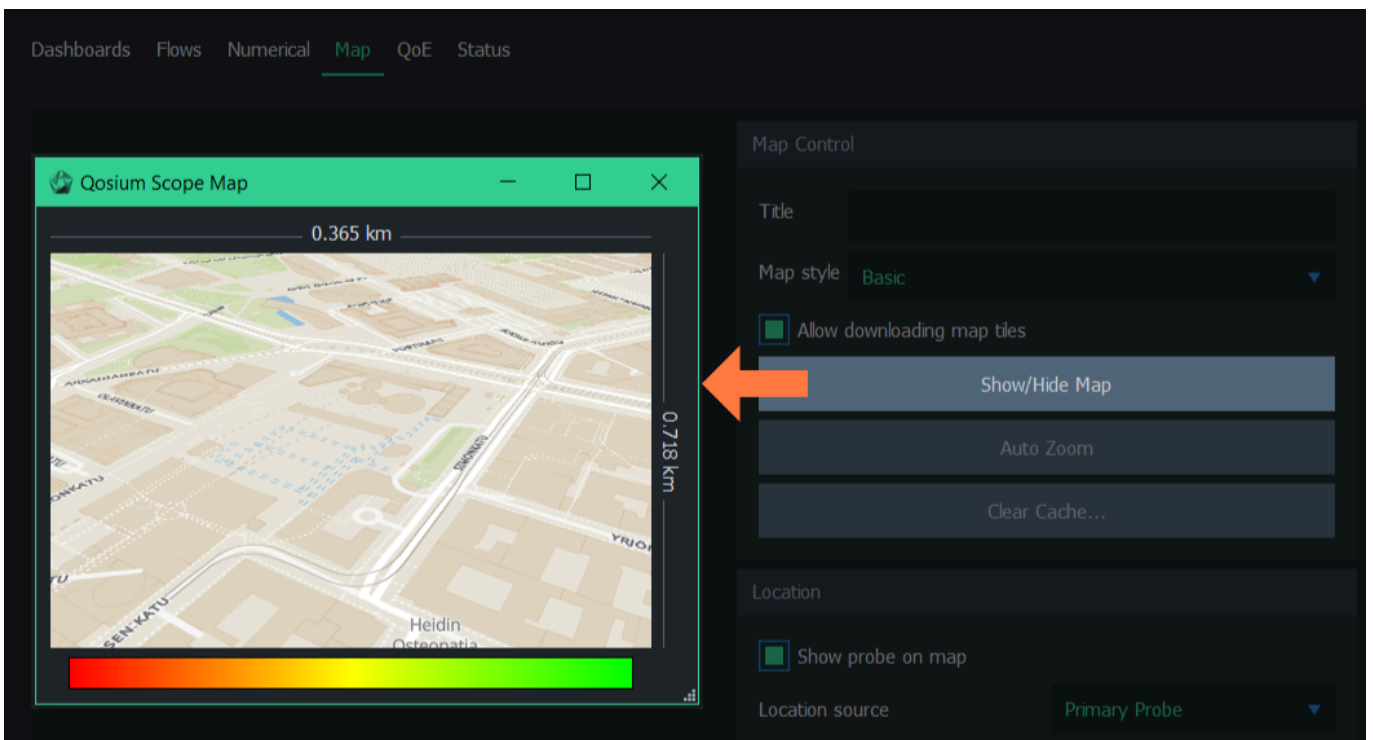
7.4.1. Overview

The map tab consists of two main elements: *Map Window* and *Settings*. See the following subsections for more information on these elements. For a practical example of using this tab, see [resources/documentation/how-to-guides/qos-heatmaps-with-scope](#).



7.4.2. Map Window

To open the map window, press **Show/Hide Map** in the *Map Control* settings group.



The window can be moved, scaled, maximized, and minimized normally as any other window. The map can be navigated with a few mouse/keyboard controls:

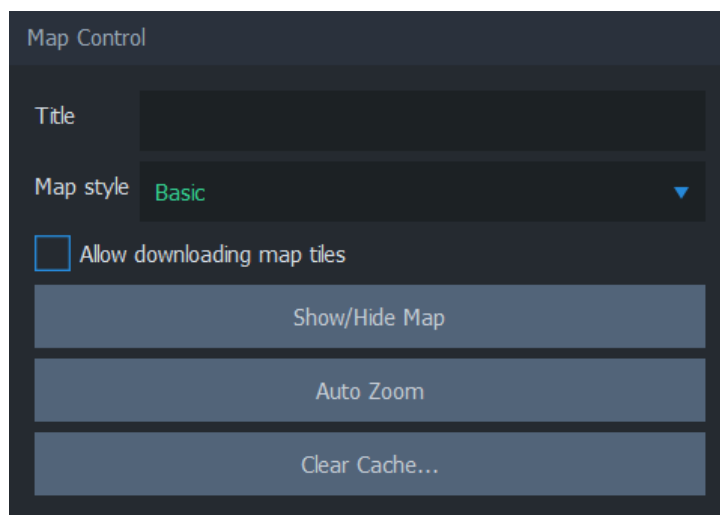
- **Zoom in/out** - Mouse wheel up/down
- **Pan map** - Press and hold the left mouse button and drag
- **Pitch/rotate map** - Press and hold either left or right *Ctrl* button on the keyboard, then simultaneously press and hold the left mouse button and drag

7.4.3. Settings

The map is configured via settings displayed on the right side of the tab. See the following subsections for more information on each settings group.

7.4.3.1. Map Control

The map control group has controls for showing/hiding the map window, selecting map theme, and controlling map data download and caching.



When **Allow downloading map tiles** is checked, Scope can download map data from the map cloud service. It is recommended to keep this option checked when preparing a measurement but unchecked during measurement if there's a risk that the traffic between Scope and map cloud service will disrupt measurement results.

Show/Hide Map toggles the visibility of the map window.

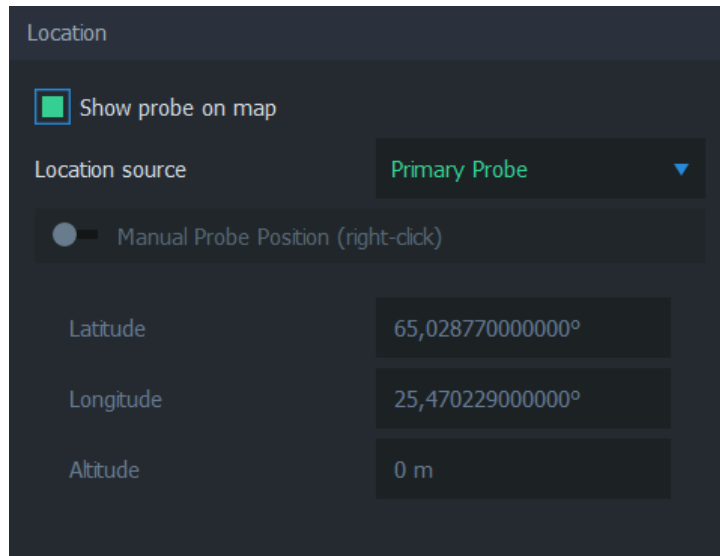
Use **Auto Zoom** to reset pitch and rotation. Auto-zoom also sets location and zoom according to the following priority:

- Focus on the heatmap, if available
- Focus on overlay image, if available
- If neither heatmap nor overlay image is visible, focus on the map cursor

Clear Cache... removes the map cache file from the computer. Use it to release disk space (typically ~10-60MB). Removing the cache file can be helpful when resolving issues related to map data download & rendering. Removing the map cache does not affect heatmap or measurement results.

7.4.3.2. Location

The location group considers the geographical location of the Probes.



Show Probe on map toggles the visibility of the selected source Probe icon on the map. The icon appears on the map as follows:



If the Probe icon is not visible on the map even when this option is checked, it may be due to the Probe having no location info yet, or the map hasn't been updated.

Manual Probe Position allows placing the location of the source Probe manually. This is useful functionality when you are performing, e.g., indoor measurements, where it is not possible to enable GNSS or other automatic positioning systems to Probe. During measurement, enable this option, then right-click anywhere on the map. The map cursor appears in this location. Manual positioning is available only when the measurement is running.



7.4.3.3. Overlay Image

The overlay image can be used to add an image on top of the map. Typically, this feature is used to add a floor plan for an interior measurement or another layout image of a known location whenever the map itself is visually inadequate.

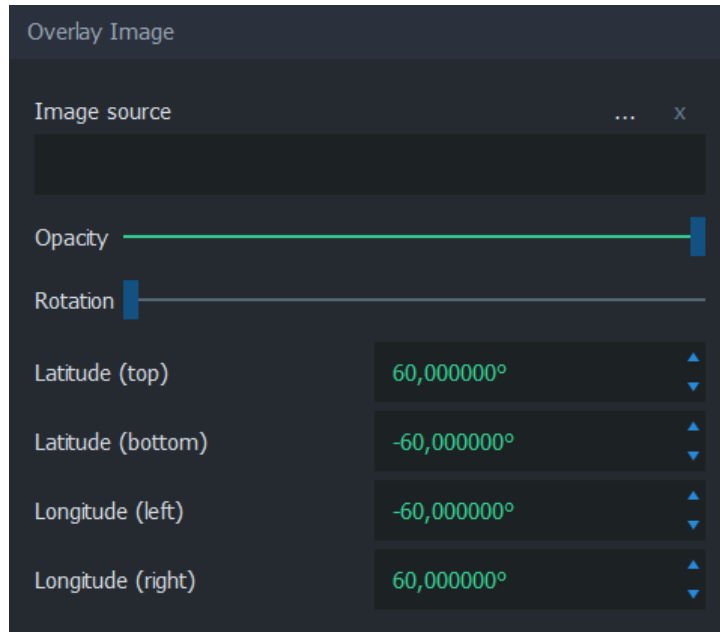


Image source indicates the filename of the current overlay image. Use ... to select the image file or x to remove the current overlay image.

Opacity controls the transparency of the image. By default, the overlay image is fully opaque. Adjust the opacity to allow map visuals to pass through the overlay image partially.

Rotation allows adjusting the overlay image orientation if the source image is not aligning with the map projection.

Latitude (top), **Latitude (bottom)**, **Longitude (left)**, and **Longitude (right)** are used to align the overlay image on top of the map.

7.4.3.4. Heatmap

The heatmap group contains controls for drawing and displaying the QoS heatmap on the geographical map.

Heatmap


Update Heatmap

Auto-update 10 s

Source

- ▼ General statistics
 - True averaging period (s)
- ▼ General statistics, primary
 - Malformed packets, primary (pkts)
 - Packets dropped by pcap, primary (pkts)
 - Packets dropped by the interface, primary (pkts)
 - SNR, primary (dB)
 - Short packets, primary (pkts)
 - Signal strength, primary (dBm)
- ▶ General statistics, secondary
- ▼ Traffic statistics, primary
 - Duplicates, primary (received) (pkts)
 - Duplicates, primary (sent) (pkts)
 - Packet size, primary (received) (bytes)
 - Packet size, primary (sent) (bytes)
 - Traffic, primary, bits/s (received) (kbits/s)
 - Traffic, primary, bits/s (sent) (kbits/s)
 - Traffic, primary, bytes (received) (kbytes)
 - Traffic, primary, bytes (sent) (kbytes)
 - Traffic, primary, packets (received) (pkts)
 - Traffic, primary, packets (sent) (pkts)
 - Traffic, primary, packets/s (received) (pkts/s)
 - Traffic, primary, packets/s (sent) (pkts/s)

Scale



0,000 0,000

Swap <>

Auto Scale

Filter values outside scale

Draw distance 50 m

Resolution 5 m

Opacity

Value compositing mode Average

Update Heatmap, as the name implies, updates the heatmap immediately. The time the update takes

depends on the amount of data and the visualization settings.

Auto-update can be used to update the heatmap in every n th second. Use the spin box to adjust the interval.

Source determines the QoS statistic that the heatmap visualizes. Use the *blue triangles* to expand/collapse each statistics group.

The **Scale** group controls how the sample values are scaled linearly into the displayed gradient. Give the scale limits manually, or use **Auto Scale** to automatically use the current minimum and maximum samples as scale limits. Use **Swap <>** to swap the given scale limits, effectively inverting the heatmap colors. When **Filter values outside scale** are checked, values outside scale limits are not included in the heatmap.

Draw distance indicates the radius of influence of each data point. There's no right or wrong value for draw distance; instead, choose a value that serves the best visual appearance. For an outdoor measurement, values starting from 10 m are usually sensible. For small indoor spaces, values between 1 and 10 meters make more sense.

Resolution determines the draw precision of the heatmap image. Low-resolution values yield more accurate images than higher values. Keep in mind that the heatmap's actual precision depends on the amount and distribution of the measurement samples.

Opacity controls the transparency of the heatmap. By default, the heatmap is fully opaque. Adjust the opacity to allow map visuals to pass through the heatmap partially.

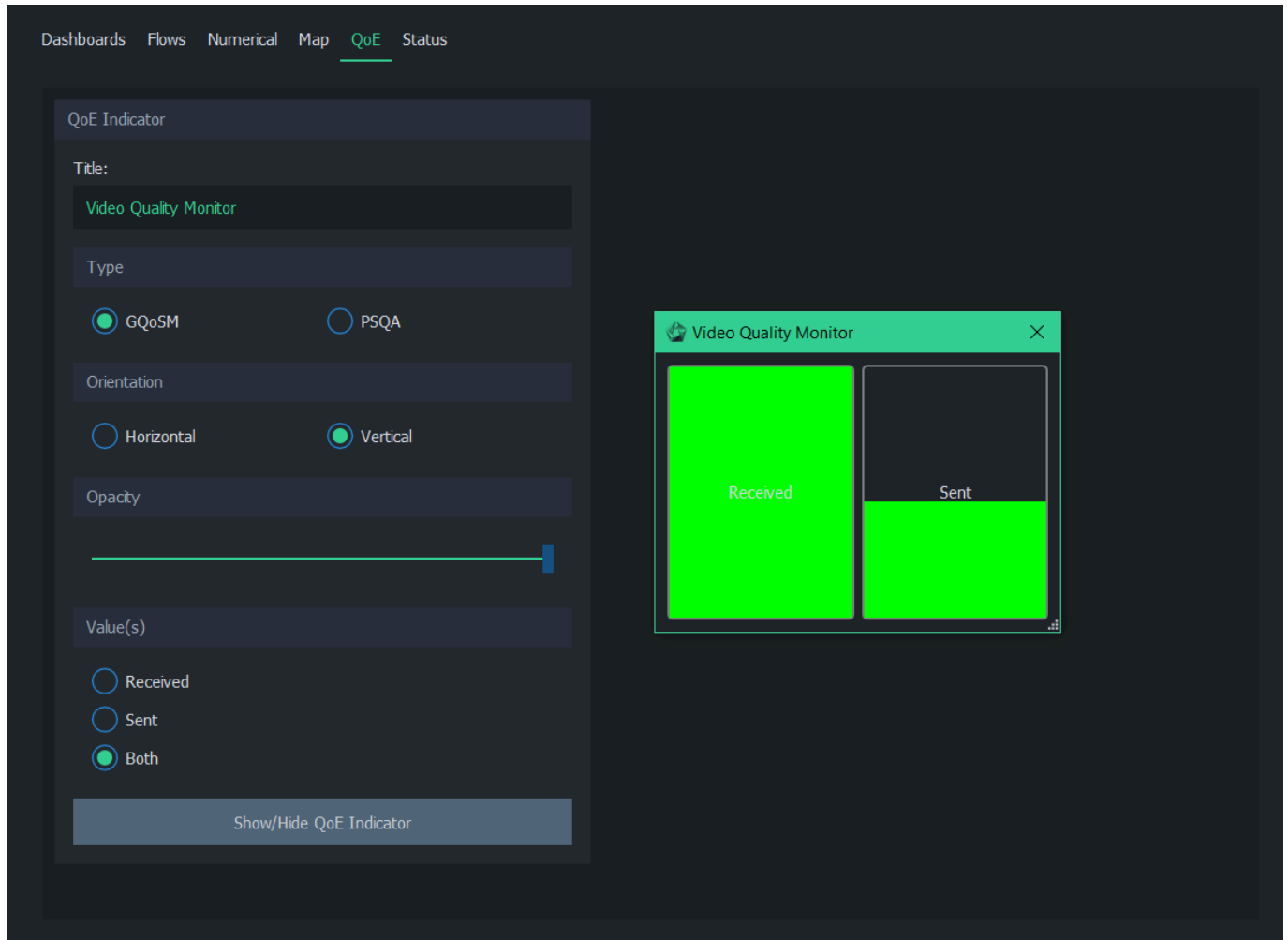
Value compositing mode determines the method of resolving the value of overlapping samples. Overlapping samples occur when two or more measurement samples are taken from the same location. The options are:

- **Average** - Calculate the average of the samples
- **Worst value** - Take the worst value and visualize it
- **Best value** - Take the best value and visualize it

7.5. QoE Tab

The QoE tab can be used to configure and show a Quality of Experience indicator window. This window visualizes QoE statistics from average results and can be placed, for example, next to an external application window for quality reference.

The *QoE* tab contains one group for configuring and displaying a QoE indicator window. This window can be placed anywhere on the screen visualizing QoE results.



The QoE indicator has the following options:

- **Title** - Type the title of the QoE Indicator Window
- **Type** - Use either *GQoSM* or *PSQA* as the source model
- **Orientation** - Display quality bars either with horizontal or vertical orientation
- **Opacity** - Change the opacity of the indicator window
- **Value(s)** - Show either the *received*, *sent*, or both directions
- **Show/Hide QoE Indicator** - Toggle visibility of the QoE indicator window

No Quality Results

If the quality bars remain colorless during measurement:

- Verify from [numerical average results](#) that quality results are received properly
- If quality results are not received (all values are -):
 - See [No QoS Results](#) in [Troubleshooting](#). If QoS results are missing, then the QoE indicator won't work either
- If quality results are received (values are - or 1):
 - If using GQoS, try relaxing the model settings in [QoE Tab](#) by disabling QoS parameters used for calculating the results
- If quality results are received properly (values range from 5 to 1):
 - Check that the correct source model is selected in **Type** (GQoS or PSQA)

Scopemon

Scope is intended for targeted manual measurements. For continuous QoE monitoring needs, see [Qosium Scopemon](#). Scopemon has, in fact, a QoE visualization similar to Scope's, but it has some advanced features, such as automated alerts.

7.6. Status Tab

The status tab displays information about the current measurement and the operation of Scope.

7.6.1. Overview

The status tab contains three groups:

- **Computed Parameters**
- **Results in Memory**
- **Log**

The screenshot shows the 'Status' page in Qosium. At the top, there are navigation tabs: Dashboards, Flows, Numerical, Map, QoE, and Status (which is selected). Below the tabs, there are two main sections: 'Computed Parameters' and 'Results in Memory'. The 'Computed Parameters' section shows 'Packet filter' as 'ip and host 192.168.0.112', 'Control packet interval' as '500 ms', and 'Averaging interval' as '1000 ms'. The 'Results in Memory' section shows 'Averages' as '671 (6 %)', 'Packets' as '0', and 'Period' as '11.11.2024 17:29:05 - 12.11.2024 20:01:01'. Below these sections is a 'Log' section displaying a series of messages from the controller, including PSQA packetization interval, PSQA resolution, PSQA calculated movement quantity, Primary Probe hostname, Primary Probe custom port, Primary Probe senders mode (IPv4), Primary Probe senders mode (IPv6), Primary Probe senders mode (Ethernet), Use secondary Probe, Fetching packet filter, Packet filter fetched, Stopping measurement, and Measurement stopped. To the right of the log is a 'Logging settings' panel with a checkbox for 'Print detailed messages' (which is checked) and a 'Clear' button.

7.6.2. Computed Parameters

The computed parameters group displays the values, which are automatically calculated by Qosium when a measurement is started. Depending on the measurement settings, these may be the given manual values, but they may also differ if Qosium can determine values better suited for the measurement scenario.

This screenshot shows a close-up of the 'Computed Parameters' section. The 'Packet filter' is now 'ip and (host 169.254.61.171 or host 169.254.155.140 or host 192.168.1.4 or host 192.168.1.243 or host 192.168.17.1 or host 192.168.157.1)'. The 'Control packet interval' remains '500 ms' and the 'Averaging interval' remains '1000 ms'.

 Tip

Use the button next to the computed packet filter to copy it to the clipboard. You can then paste it as a template for [a manual packet filter](#).

7.6.3. Results in Memory

This group shows how many results there are currently in Qosium Scope's memory.

- **Averages**

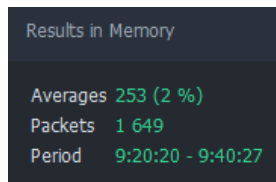
- The number of average results in memory
- The percentage in parenthesis tells the fraction of the reserved average results sample memory.
- The sample memory size can be set under [the Results tab](#).
- When the sample memory is about to get full, some of the earliest samples will be erased.

- **Packets**

- Indicates the number of packet-based results in memory
- When average samples are erased from memory, the corresponding packet results are also removed.

- **Period**

- Describes the period of time from the earlier result to the latest in memory.



```
Results in Memory
Averages 253 (2 %)
Packets 1 649
Period 9:20:20 - 9:40:27
```

7.6.4. Log

The log window contains information on the operation and events of Scope. Error and warning messages are also printed in the log for later review.

This group contains a few settings:

- **Print detailed messages** - When checked, low level measurement functional messages are also included in the log
- **Clear** - Clear the log window

Log

```
[19:48:50] [detailed] [ controller]: fe90:0000:0000:0000:0000:0000:9000
[19:48:50] [detailed] [ controller]: fe99:0000:0000:0000:0000:0000:9999
[19:48:50] [detailed] [ controller]: Primary Probe senders mode (Ethernet): 0
[19:48:50] [detailed] [ controller]: 00:d8:61:7a:ba:94
[19:48:50] [detailed] [ controller]: 02:00:4c:4f:4f:50
[19:48:50] [detailed] [ controller]: 0a:00:27:00:00:15
[19:48:50] [detailed] [ controller]: 5c:f3:70:8b:93:b8
[19:48:50] [detailed] [ controller]: 84:af:ec:38:07:3d
[19:48:50] [detailed] [ controller]: Use secondary Probe: 0
[19:48:50] [detailed] [ controller]: Fetching packet filter
[19:48:50] [detailed] [ controller]: Packet filter fetched: icmp
[19:48:52] [ info] [ controller]: Stopping measurement
[19:48:53] [ info] [ controller]: Measurement stopped
[19:48:53] [detailed] [ ui]: Measurement duration: 2000 ms
[19:48:56] [detailed] [ controller]: Sending measurement parameters to primary Probe
[19:48:56] [detailed] [ controller]: Parameters sent successfully
[19:48:56] [detailed] [ controller]: Setting interface for primary Probe: Realtek PCIe
GbE Family Controller
[19:48:56] [detailed] [ controller]: Primary Probe interface set successfully
[19:48:56] [detailed] [ controller]: Setting capture filter mode: 220
[19:48:56] [detailed] [ controller]: Setting capture filter:
[19:48:56] [detailed] [ controller]: Requesting average results
[19:48:56] [detailed] [ controller]: Requesting average results from primary Probe only
[19:48:56] [detailed] [ controller]: Requesting flow results
[19:48:56] [detailed] [ controller]: Polling results every 100 milliseconds
[19:48:56] [ info] [ controller]: Measurement started
[19:48:56] [detailed] [ controller]: Fetching Probe parameters
[19:48:56] [detailed] [ controller]: Parameters fetched successfully
[19:48:56] [detailed] [ controller]: Printing out Probe parameters:
```

Logging settings

Print detailed messages

Clear

Accessing the log file

Scope also saves the log to a file. The location of the log file depends on the operating system.

In Windows, the filename is `c:\users\[username]\AppData\Local\kaitotek\QosiumScope\debug.log`.

In Linux, the filename is `~/config/QosiumScope/debug.log` or `/etc/xdg/QosiumScope/debug.log`.

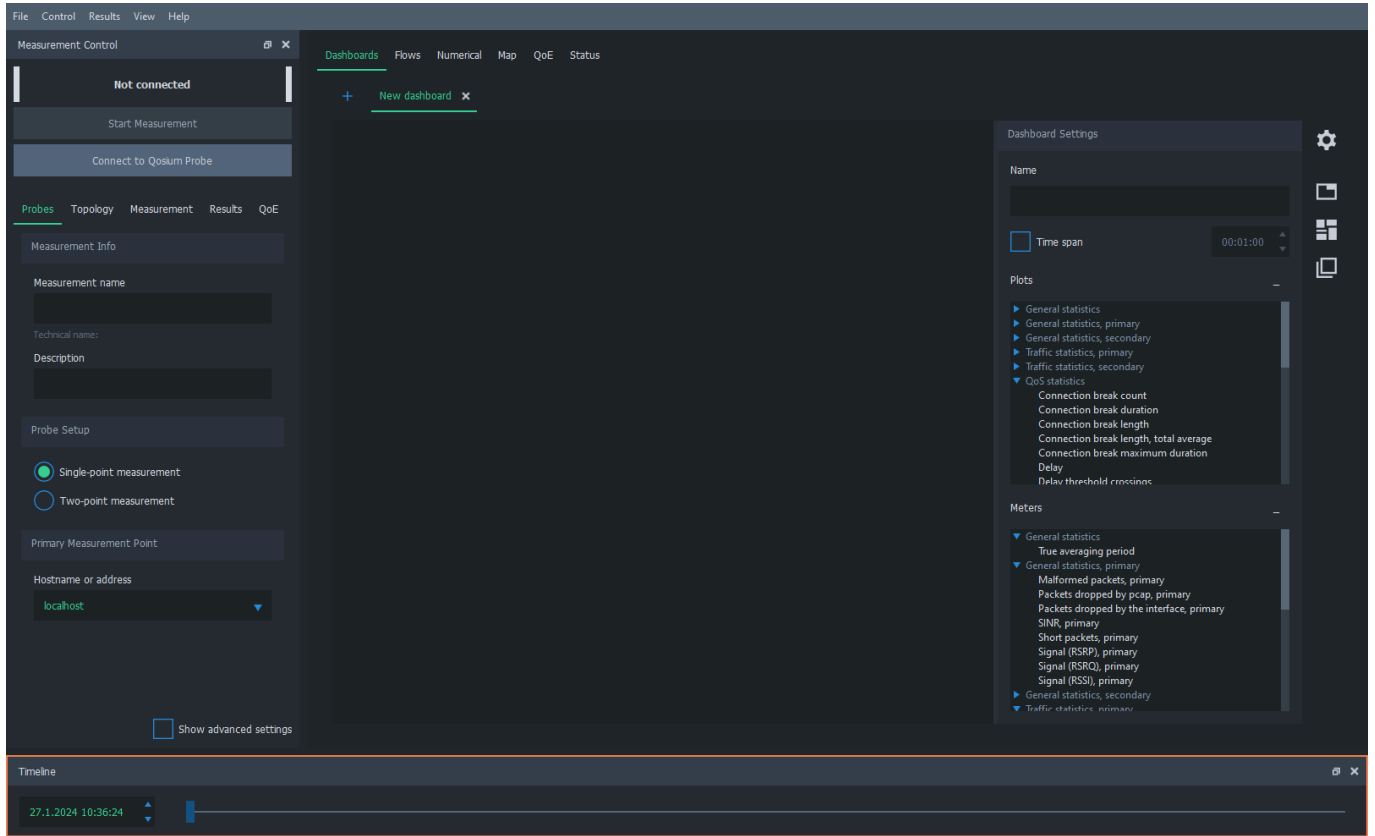
8. Timeline

Timeline is a useful feature in Qosium Scope to align interesting observations in the results between different statistics and views.

8.1. Overview

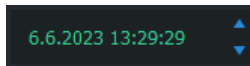
Timeline is, by default, located at the bottom of the Scope main window. As with all the other floating elements, it can be relocated and its visibility controlled in the Menu bar. Timeline has two elements:

- Time display
- Time selection bar

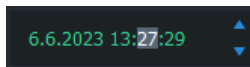


8.2. Time Display

The time display shows the time where the timeline marker is currently set.



The display works in two directions. You can also set the time manually. Use your mouse to place the cursor in the display and write the time you seek. In addition, you can use the blue arrows to step the time up and down. Place the cursor on the time unit you want to manipulate, and use the arrows. For example, to step minutes up and down, select the minutes in the display and then use the arrows:



8.3. Time Selection Bar

The time selection bar also works in two directions. As seen below, the bar shows that the timeline marker is now located around the middle of the measurement. To set the marker to the desired place, grab the timeline indicator (the blue rectangle) with your mouse and drag it where desired. Once you have selected the timeline indicator, you can also use the arrow keys right and left to move the timeline in single result steps.



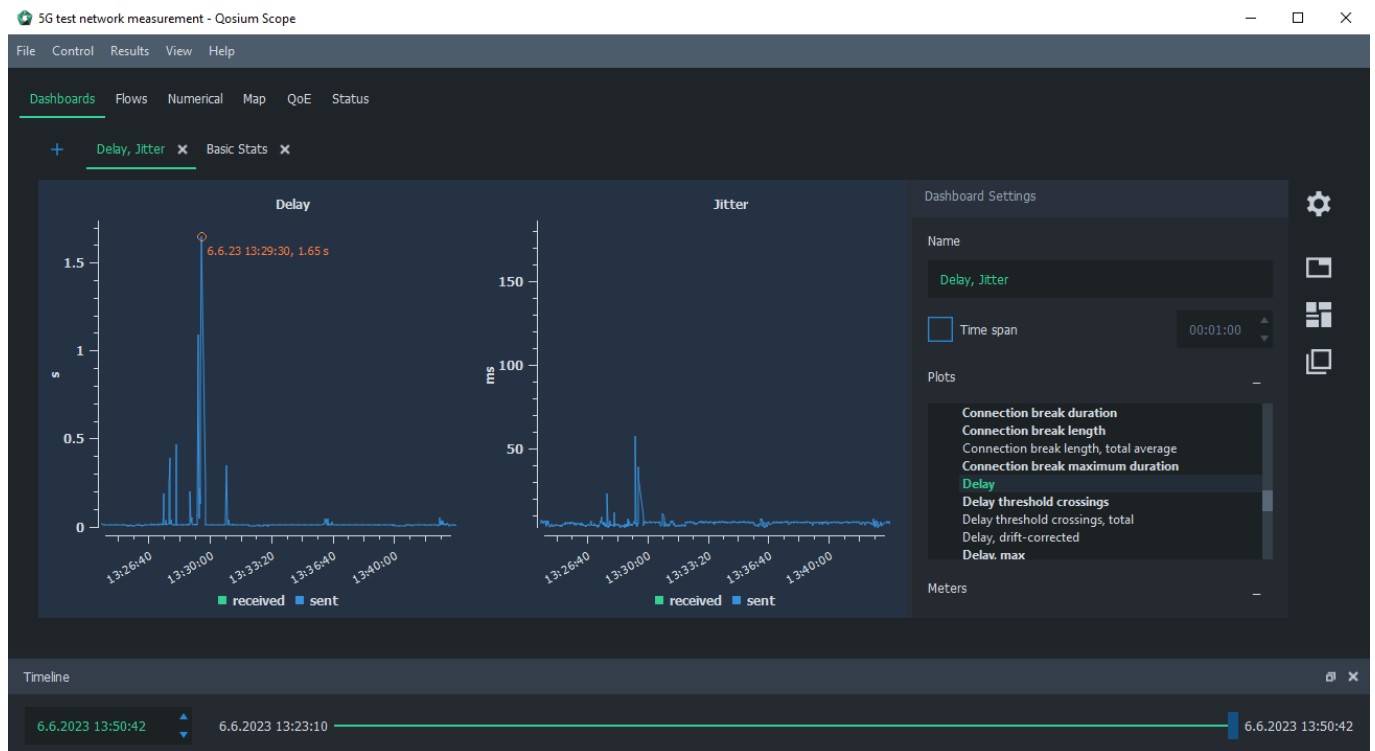
The left-hand end of the bar shows the start time of the measurement. The right-hand end of the bar shows the end time of the measurement. If the measurement is still running, it always shows the latest time

results have been received.

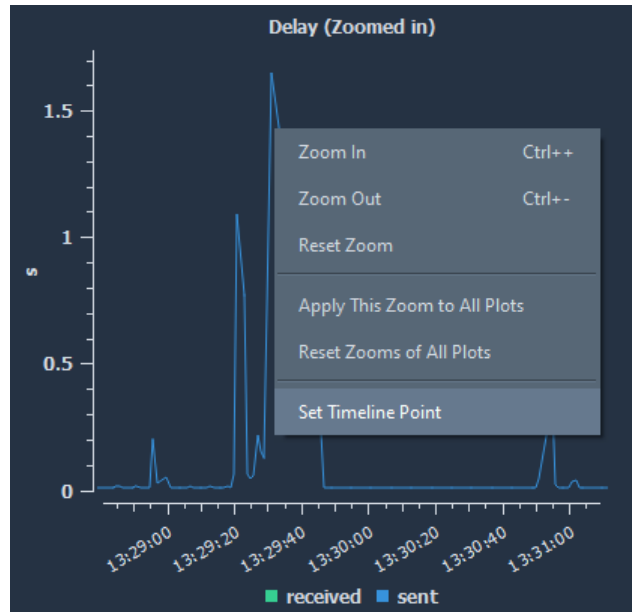
8.4. Tracing an Interesting Event

The main purpose of the timeline is to trace interesting events in the results and align the findings across different views.

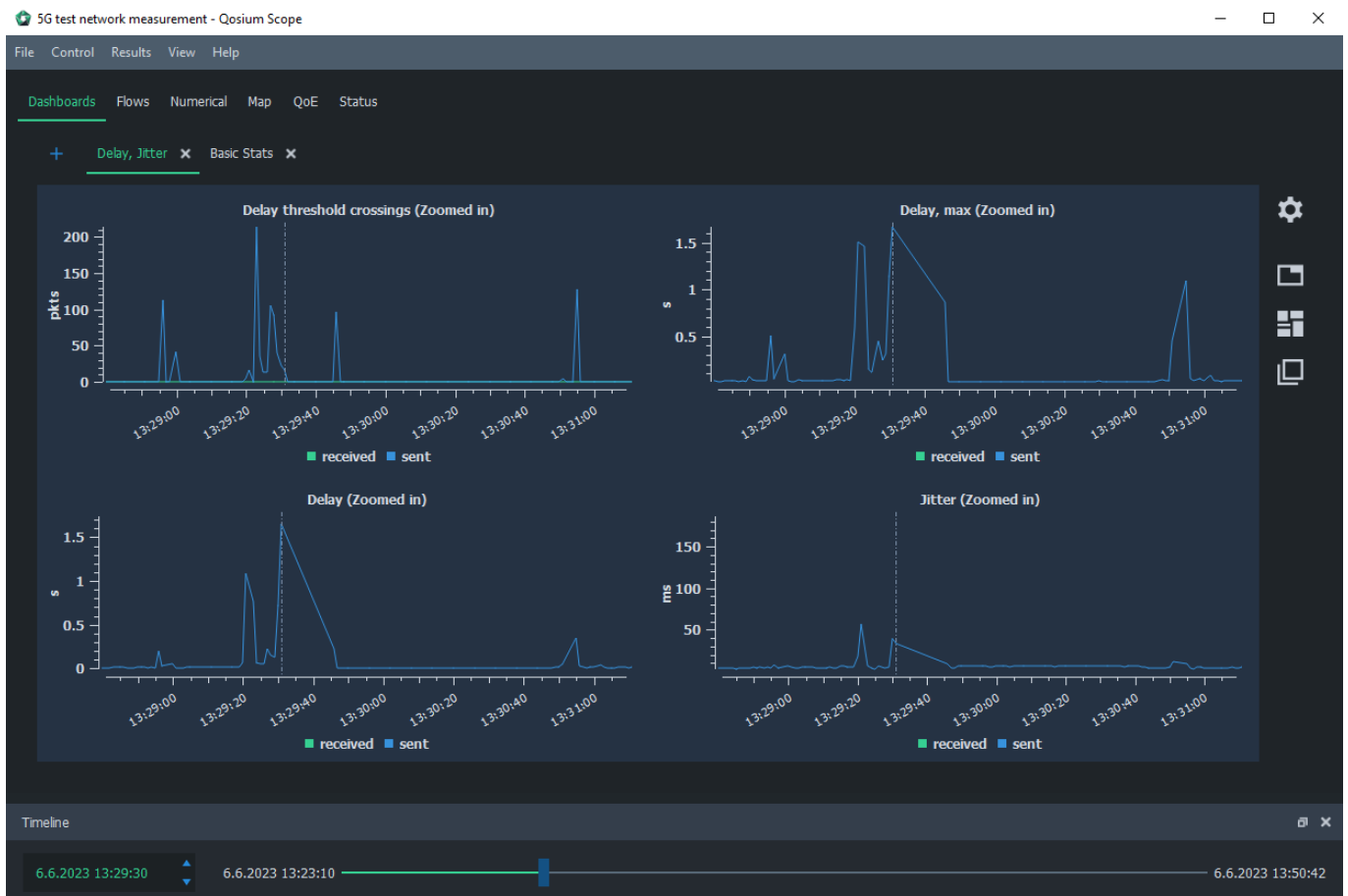
Let's take an example. We have a set of field measurement results of a 5G test network for a video stream from a camera on board a measurement vehicle. There were some QoS problems observed, so let's take a closer look at them. As seen below, there are very high occasional delay spikes and increased jitter observed.



We first zoom in on the delay figure using the mouse scroll wheel. The most interesting spike is the one over 1.5 s, so let's set the timeline marker there by clicking the right mouse button and selecting: *Set Timeline Point*.



Then, we also take other graphs visible and set the same zoom level for all of them by clicking again the right mouse button on top of the zoomed graph and selecting: *Apply This Zoom to All Plots*. As seen now, the zoom level is the same in all the graphs, and the timeline marker pinpoints the interesting spot in all of them, enabling easy comparison.



Timeline applies across different views. Thus, let's go next to the heatmap and visualize, e.g., the delay there. As seen in the figure below, an icon pinpoints Qosium Probe's location at the timeline marker. You can try to move the timeline marker and see that Probe on the map moves accordingly. This is a handy way

to see where the interesting event occurred.



Finally, in this example, we check the numerical view. As seen below, the numerical view has also settled (the underlined timestamp) according to the timeline marker. The view reveals that when the delay jumps to over 1 s, a connection break also starts as we no longer get delay values, and the packet loss ratio jumps to 100 %. By checking the Cell ID, we see it remaining the same, i.e., the cause of the connection break is not a handover. In addition, the signal values show that they are not poor enough to explain the bad QoS. Thus, simple coverage issues are ruled out, and the reason for the bad QoS must be searched elsewhere.

The screenshot displays the Qosium Scope interface. At the top, there is a menu bar with 'File', 'Control', 'Results', 'View', and 'Help'. Below it, a navigation bar includes 'Dashboards', 'Flows', 'Numerical' (selected), 'Map', 'QoE', and 'Status'. Under 'Numerical', there are sub-tabs for 'Average Results' and 'Packet Results'. The main area contains a table with the following columns: 'Cell ID, primary', 'Delay (sent)', 'Packet loss ratio (sent)', 'SINR, primary', 'Signal (RSRP), primary', and 'Signal (RSRQ), primary'. The table lists 16 rows of data for the date 6.6.2023, with times ranging from 13:29:22.927 to 13:29:36.927. The 'Delay (sent)' column shows values like 767.415 ms, 63.429 ms, and 1.647 s. The 'Packet loss ratio (sent)' column shows values like 0 %, 33.6 %, 86.4 %, and 100 %. The 'Signal (RSRP), primary' column shows values like -94 dBm, -95 dBm, and -91 dBm. The 'Signal (RSRQ), primary' column shows values like -11 dB. To the right of the table is a 'Table Settings' panel with various options like 'Connection break length, total averag...', 'Delay (sent)', 'Delay threshold crossings (received)', etc. At the bottom, there is a 'Timeline' section with a horizontal axis showing the time range from 6.6.2023 13:29:30 to 6.6.2023 13:50:42.

	Cell ID, primary	Delay (sent)	Packet loss ratio (sent)	SINR, primary	Signal (RSRP), primary	Signal (RSRQ), primary
6.6.2023 13:29:22.927	29 822 381	767.415 ms	0 %	20 dB	-94 dBm	-11 dB
6.6.2023 13:29:23.927	29 822 381	63.429 ms	0 %	20 dB	-95 dBm	-11 dB
6.6.2023 13:29:24.929	29 822 381	47.138 ms	0 %	21 dB	-94 dBm	-11 dB
6.6.2023 13:29:25.927	29 822 381	56.527 ms	0 %	20 dB	-95 dBm	-11 dB
6.6.2023 13:29:26.927	29 822 381	219.528 ms	0 %	20 dB	-94 dBm	-11 dB
6.6.2023 13:29:27.927	29 822 381	151.708 ms	0 %	21 dB	-94 dBm	-11 dB
6.6.2023 13:29:28.927	29 822 381	127.246 ms	0 %	20 dB	-93 dBm	-11 dB
6.6.2023 13:29:29.927	29 822 381	721.011 ms	33.6 %	22 dB	-93 dBm	-11 dB
6.6.2023 13:29:30.927	29 822 381	1.647 s	86.4 %	21 dB	-93 dBm	-11 dB
6.6.2023 13:29:31.927	29 822 381	-	100 %	22 dB	-91 dBm	-11 dB
6.6.2023 13:29:32.928	29 822 381	-	100 %	21 dB	-91 dBm	-11 dB
6.6.2023 13:29:33.928	29 822 381	-	100 %	21 dB	-93 dBm	-11 dB
6.6.2023 13:29:34.927	29 822 381	-	100 %	21 dB	-93 dBm	-11 dB
6.6.2023 13:29:35.927	29 822 381	-	100 %	21 dB	-94 dBm	-11 dB
6.6.2023 13:29:36.927	29 822 381	-	100 %	20 dB	-94 dBm	-11 dB

This was an example of how to use the Timeline feature of Qosium Scope. It is very useful when you need to trace interesting events. Timeline allows aligning the different views of Qosium Scope to see where the interesting event was and what values the other statistics showed at that time.

9. Glossary

Network Interface Card

A piece of hardware which offers a device a networking interface.

Network Address Translation

A technique for remapping an IP address space

[Wikipedia article on Network Address Translation](#)

Promiscuous Mode

A mode in network interfaces, which allows packet sniffers to process packets even if they are not designated to said network interface.

This mode is essential in Qosium, since it's fairly common to measure network traffic by placing Probes somewhere in-path or off-path via port mirroring instead of end-points.

Some network interfaces do not support promiscuous mode, so try turning it off if starting measurement results in an error, or no packets are captured.

For more information, see the [Wikipedia article on Promiscuous mode](#).

Packet Loss Timer

Qosium determines packet losses by waiting each packet a predefined amount of time. Packet loss timer defines this duration.

If this value is set too small, packets exceeding this duration in the traversal of the measurement path will be incorrectly considered lost. A large value yields more precise results, but causes a lag to the reporting of lost packets, since Qosium needs to wait for this duration for packets before reporting them as lost.

Loss timer should be always at least $2 \times$ control packet interval. The latter parameter is typically set automatically according to the averaging interval, but it can be also changed manually. In order to have short packet loss timer value, set the control packet interval as well.

Robust QMCP Mode

A feature which allows Qosium products to re-connect each other and carry on the measurement, even if connectivity is momentarily lost.

If robust QMCP mode is not enabled, the measurement is stopped if the connection between Qosium products is lost. It is recommended to keep this feature always on unless there's a good reason to disable it.

Uplink / Sent Direction

Refers to a network path direction where traffic is flowing away from the observer towards a remote point.

Downlink / Received Direction

Refers to a network path direction where traffic is flowing from a remote point towards the observer.

Quality of Experience

Indicates the overall performance of a network application, and how user's experience is affected by the network conditions.

For more information, see our article on [Quality of Experience](#).

Generic QoS Measure Algorithm

A parameter based QoS mapping algorithm allowing to map a single quality indicator from several parameters. When tuned with real user tests, GQoSM allows also QoE estimations.

GQoS, however, is meant for evaluating the influence of the network to the quality – not for estimating the absolute quality (e.g., including the defects of codecs, etc.). For more information, see our article on [Quality of Experience](#).

Pseudo-Subjective Quality Assessment

A neural network based model for estimating QoE.

For more information, see our article on [Quality of Experience](#).