Fast download of waveform data with the R&S®RTO oscilloscope

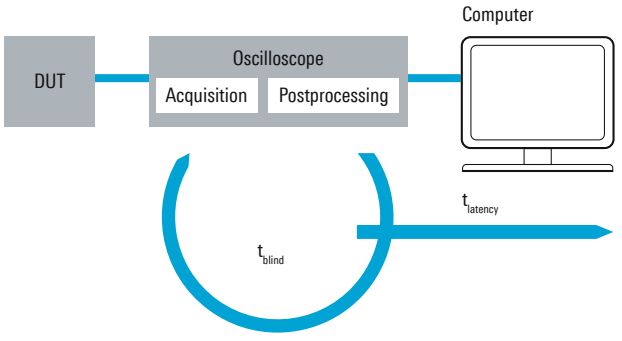
Overview of the choices for downloading waveform data for remote processing

Your task

Postprocessing of acquired waveform data on a remote computer is a must for many applications. Areas of interest are high energy physics, nuclear science, molecular bioscience, high-voltage measurements or radar applications.

Even an oscilloscope with rich analysis software might not be able to perform user-specific analysis. In some cases, download and offline processing of waveform data are necessary, e.g. for highly specialized waveform analysis, for monitoring or documentation tasks, or for a DUT that is measured with more than one oscilloscope.

Timing of waveform download



The R&S®RTO oscilloscope offers multiple ways to download the waveform data. In order to select the most suitable way, the user has to determine the four key parameters that characterize the download:

- Average throughput in steady state: This is important for statistical analysis to get as much data as possible
- Acceptable maximum latency: The latency $t_{latency}$ is the interval from the point in time when the waveform is recorded to the point when the waveform data is received on the remote computer. A low maximum latency is the most essential for monitoring applications that react to recent acquisitions
- The trigger blind time t_{blind} is key to capturing sporadic signals emitted by the DUT. During the trigger blind time the oscilloscope is not able to acquire signals because it is postprocessing previous waveform data
- The internal storage capacity might also impact the maximum latency. The oscilloscope's memory is limited, in contrast to remote storage media with virtually unlimited capacity

T&M solution

The R&S®RTO oscilloscope offers three modes for storing acquisitions:

- History mode: stores the waveform data in the acquisition memory, the amount of stored data depending on the memory option
- Data logging: stores the data on the local hard disk
- SCPI download: stores the waveform data of each acquisition on a remote computer

These three modes are part of the standard instrument functionality.

The history mode stores all acquisitions in the acquisition memory. Once all acquisitions are completed or the acquisition memory is full, the waveform data can be stored on the disk and then downloaded via network file access. Both actions, i.e. storage and subsequent download, increase latency and decrease the average throughput of the history mode.

Data logging captures a waveform and then stores it immediately on the local disk. The oscilloscope repeats this action up to the maximum or configured number of acquisitions and stores these waveforms in a single file. Then the remote computer retrieves the waveform data from the oscilloscope via network file access and starts again.

A different approach is data download via SCPI. A remote computer controls the recording and downloading of each individual waveform via SCPI commands. This approach provides good latency and virtually unlimited storage capacity.

```
%%                  visaObj is the visa object created with the visa() call
while 1;                                %            steady state download
    fprintf(visaObj,'RUNSingle;*OPC?');
    [~] = fscanf(visaObj);              % wait to complete the acquisition
    fprintf(visaObj,'Channel1:DATA:VALues?');
    wfm = fread(visaObj, bufferLength , 'int8');
    %          wfm contains the now the data according to IEEE488.2 - 8.7.9
end
```

Example for the SCPI download of channel 1 in MATLAB®.

Application

In order to obtain comparable results for all three modes, the measurement setup involves four active channels with a short record length of 1000 samples, which is typical of applications requiring fast download. The samples are stored in the native 8-bit format, and the download is run in steady state.

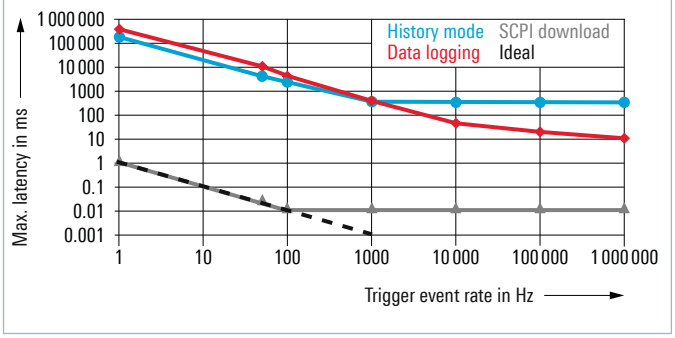
To achieve the best possible download performance, other functionalities such as automated measurements or math functions should not be enabled on the oscilloscope.

The table shows the key download parameters and compares the described approaches.

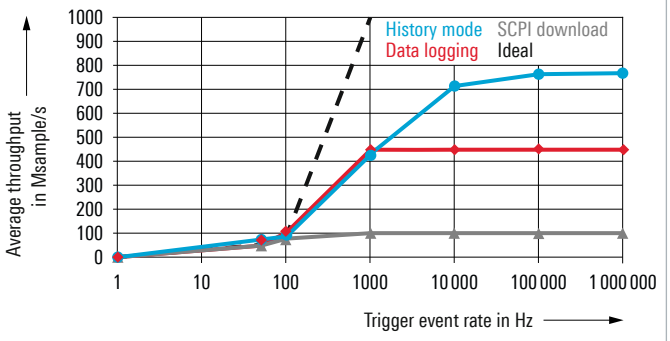
Performance parameter	History mode	Data logging	SCPI download
Storage capacity in Msample	200 [1]	390	∞
Max. latency in ms	262 000	400 000	10
Average throughput in Msample/s	depends on trigger rate (see figure on right)		
Trigger blind time in ms	0.0003	0.4	6

[1] With the R&S®RTO-B102 option.

Maximum latency in steady state



Average throughput in steady state



The figure on top shows the dependency of the maximum latency on the trigger rate for each method. The lower the latency, the faster the download. The ideal setup is indicated as a dashed line. The figure below shows the dependency of the average throughput on the trigger rate for each method. A higher number indicates better performance.

SCPI download is a good choice for low latency measurement applications. When the average throughput or the trigger blind time is the key parameter, the history mode is the first choice.

The R&S®RTO oscilloscope is the perfect solution for measurement applications that require further remote processing. Excellent analog capabilities such as noise, linearity and trigger sensitivity combined with low latency or high throughput remote processing techniques make it easy to meet the user's measurement requirements.

Rohde&Schwarz GmbH&Co. KG
Europe, Africa, Middle East | +49 89 4129 12345
North America | 1 888 TEST RSA (1 888 837 87 72)
Latin America | +1 410 910 79 88
Asia Pacific | +65 65 13 04 88
China | +86 800 810 82 28 | +86 400 650 58 96
www.rohde-schwarz.com
customersupport@rohde-schwarz.com

PD 3607.2132.92 | Version 01.01 | February 2018 (sk)
Fast download of waveform data with the R&S®RTO oscilloscope
Data without tolerance limits is not binding | Subject to change

3607213292

3607.2132.92 01.01 PDP 1 en