

Optimized networking / IQ recording using JUMBO frames



Subject: This document describes, how to improve networking throughput and reduce system load by using Jumbo frames

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Symptom

Lost datagrams when recording IQ data with high demodulation bandwidths

Cause

IQ streaming with high resp. maximum demodulation bandwidth almost fully utilizes Gigabit ethernet link capacity and causes very high system load of the device.

Solution

Using 9k (Jumbo) ethernet frames maximizes the netto IQ data rate and reduces the system load. This allows stable IQ data streaming with up to 20MHz demodulation bandwidth when using UDP traces. TCP traces allow up to 15MHz demodulation bandwidth because the TCP protocol consumes even more processing power. The IQ data rate at 20MHz demodulation bandwidth is about 104MB/second. However, also the recording host system must be able to cope with this data rate at any time especially regarding the storage backend.

Configuration of 9k Jumbo frames requires a consistent setup on the complete networking path between the device and the recording host system maybe including switches.

The device configuration is done by setting the MTU size to it's maximum of '9000' with the SCPI command: 'SYST:COMM:LAN:ACT:MTU 9000'

Any value between 1500 (default) and 9000 can be configured depending on the capabilities of the external networking infrastructure. The MTU size doesn't include the size of the IP header which is 14 bytes for IPv4. Usually this must be taken into account i.e. added when configuring the Jumbo ethernet frame size of the other network components.

Note: The device should be re-started after changing the MTU size.

Currently the changed MTU size is applied to the *next* established network connection/trace but this is subject to change in future firmware versions.

It's recommended to use a dedicated network interface adapter of the host system and a direct ethernet connection to avoid any impact of other networking components. In addition a possibly activated firewall on the host system may lead to unpredictable results and should be disabled.

The appropriate ethernet adapter resp. switch setup is vendor dependent. Please refer to the provided documentation of the adapter for details. However, 9k Jumbo frame support is a de facto standard and is widely available for professional networking equipment. Low level ethernet flow control with MAC Pause frames should be enabled as well.

Some vendors support even more sophisticated tuning capabilities. For example some Intel adapters allow to configure the number of 'Rx Descriptors'. Increasing this number can also help to mitigate the impact of host system load peaks to avoid lost datagrams when recording.

Network switches have to be configured accordingly. Usually the vendor provided administration (web browser) interface allows the configuration of each port. It's recommended to setup Jumbo frames only for the ports of the networking path used for recording due to internal buffer constraints of ethernet switches.

Possible issues

If at least one component of the networking path is not configured properly the recording host system won't receive any UDP data although 'ping' and also the SCPI control connection works. In this case the MTU size of the device can be re-configured to the default value of '1500' with the SCPI command.

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Also TCP traces are also unlikely to work due to common Path MTU Discovery (PMTUD) problems in this scenarios. Nevertheless PMTUD works well with direct network connections.