Time and Port Stamping

Time and port stamping capabilities are part of the NETSCOUT nGenius® Packet Flow Switch (PFS) solution. Time stamping and port stamping can be enabled independently or together.

Port stamping and time stamping never alter network through-traffic in the network. Only the traffic output from monitor ports on a packet flow switch will see port and/or time stamped packets.

Port and Time Stamping Background Technology

In many environments, it is important that analytics and other monitoring tools have information that allows them to know the originating location of the packet capture and / or the time that the packet was captured. This can help track packet progress and quality through a network infrastructure, help certain institutions identify the times of transactions, etc. Port and Time Stamping technologies assist users with solving related analysis issues by inserting information, related to port origin and time, into packets destined for monitoring appliances.

NETSCOUT Port Stamping

Port Stamping allows the addition of a single or dual byte to the end of the payload of each packet immediately before the CRC (in the packet's trailer), indicating the input port of the packet flow switch module at which the packet was captured. The CRC is recalculated after the addition of the port stamp, to preserve the integrity of the packet, thereby enabling the port stamped packet to be forwarded on to the destination port(s) as a standard Ethernet packet.

In the example of the nGenius PFS 4200 model with an Advanced chassis module, ports are numbered in hexadecimal format from 0 through 3F. The ports are n/1 through n/16 (for 10G/1G) or n/1 through n/4 (for 40G), where n is the chassis module position, and all ports are numbered 0-64 for the entire chassis.

The example packet in Figure 1 shows the single-byte port stamp in red, indicating the third port (Port 1/3 on a PFS 4200 10G/1G Advanced chassis module) as well as the 4-byte CRC in blue.

The example packet in Figure 2 shows the dual-byte port stamp in red, indicating the fourth port (Port 1/4 on a PFS 6000 10G/1G Advanced line card with a starting VID value of 451) as well as the 4-byte CRC.

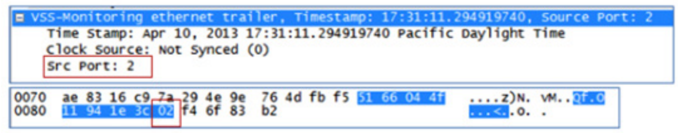

Figure 1: Example of a Single-byte port stamped packet in Wireshark.

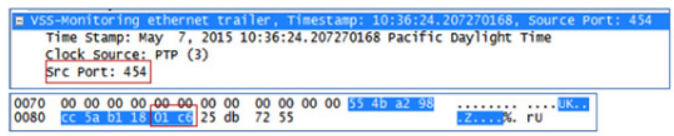

Figure 2: Example of Dual-byte port stamped in Wireshark.

As an alternative to Port Stamping, which is inserted in the trailer at the end of the packet, is Monitor VLAN Tagging. This adds an outer VLAN tag, at the beginning of a packet, where the VLAN ID in the tag represents both the ingress port and the PFS chassis.

nGenius Time Stamping

Time Stamping provides, on an ingress port basis, the addition of an 8-byte time stamp to the end of the data payload of each packet. The 8-byte (64-bit) timestamp has the format shown in Table 1.

Bits 0-31	Bits 32-61	Bits 62-63
Time in seconds since Epoch	Sub-second time in nanosec-onds	Time/Sync Source

Table 1: NETSCOUT Time stamping format.

The first four bytes provide a count in seconds and, in the second four bytes, the least significant 30 bits provide a count in nanoseconds and the most significant 2 bits indicate the clock synchronization source. The first 4-byte group and the least significant 30 bits of the second 4-byte group can be effectively separated by a decimal point and used as an offset value since Epoch time to calculate the actual time. The two most significant bits of the second 4-byte set can then be used to determine whether there was synchronization of the clock, and if so, what the synchronization source was as indicated in Table 2.

The example packet in Figure 3 shows the 8-byte time stamp in red and the 4-byte CRC in blue. The value of the time stamp is 51 66 04 41.11 94 1E 3C (or 1365640257.294919740 seconds) and internal clock source only.

The example packet in Figure 4 shows the 8-byte time stamp the value of 55 4B A2 98 . CC 5A B1 18 (or 1431020184. 207270168 seconds) and PTP clock source.

Time stamp values are the number of seconds since Epoch time, which is 00:00 UTC 1st January 1970, and does not take into account the leap seconds adjustment. All ports are exactly synchronized with each other because they use the same source clock. Although the time stamp is provided in nanoseconds, there are several accuracy characteristics that must be understood.

- A packet must be deserialized, unscrambled, and decoded before being time-stamped. This processing causes a small delay on the input ports. This delay has some non-deterministic components to it due to the way Ethernet interfaces function. In addition, there is always the possibility of a packet arriving just as the timing clock ticks. These two factors can lead to a non-deterministic jitter of +/- one “timing tick interval”, making it possible that two simultaneously arriving packets on two ports could be stamped with a difference of as much as twice the “timing tick interval” between them. However, the likelihood of a packet (arriving after another packet) being stamped with a time more recent (than the other packet) is negligible.

Value	Timing/Synch Source
00	Uncalibrated, Internal Clock only
01	NTP synchronization
10	GPS (1PPS with TSIP) or 1 PPS only synchronization
11	PTP sychronization

Table 2: Clock synchronization indicator (bits 30 and 31).

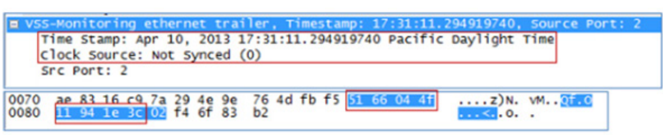

Figure 3: Example of time stamped packet without time sync.

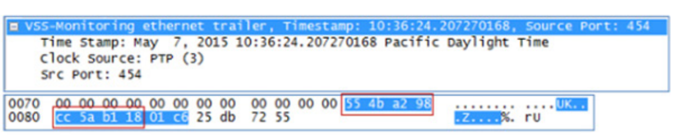

Figure 4: Example of time stamped packet with PTP time sync.

Timing/Synch Source	Timestamp Accuracy	Possible Variation between Ports	Possible Variation between vNodes
Uncalibrated, In-ternal clock only	Indeterminant	≤ 16ns for 1G, ≤ 13ns for 10G, ≤ 9ns for 40G	Indeterminant
NTP Server	≤ 10ms		≤ 10ms
GPS (1PPS with TSIP)	≤ 200ns		≤ 200ns
PTP Master	≤ 1µs		≤ 1µs
1 PPS only	Dependent on 1 PPS timing source		Dependent on 1 PPS timing source

Table 3: Time stamp accuracies.

The nGenius product line offers time stamping resolution and accuracy that is far superior to other existing hardware/ software solutions.

Using Time and Port Stamping Simultaneously

If Time Stamping and Port Stamping are used on the same port and at the same time, the time stamp bytes will precede the port stamp byte, followed by the packet’s 4-byte CRC. The CRC is recalculated after the addition of either or both the port and time stamp bytes, thereby preserving the integrity of the packet. Once the port and/ or time stamp is added to the packet, it is passed on to the monitor destination port(s) as a standard Ethernet packet. See Figure 3 and Figure 4 for examples.

Configuration

Although Time Stamping and Port Stamping are sold as a package, they are independently enabled on a per-port basis via the device’s web interface in the port configuration page, as shown in Figure 5.

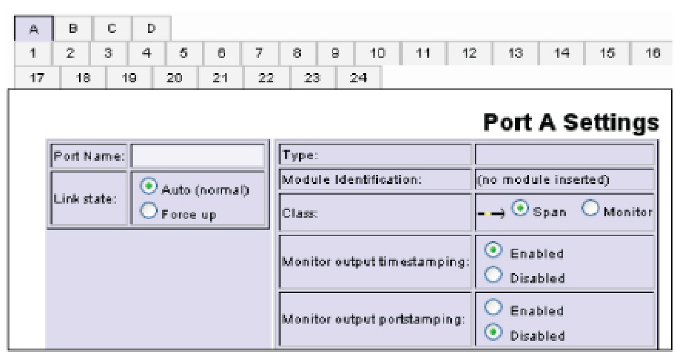

Figure 5: Port and time stamping in Port Settings screen.

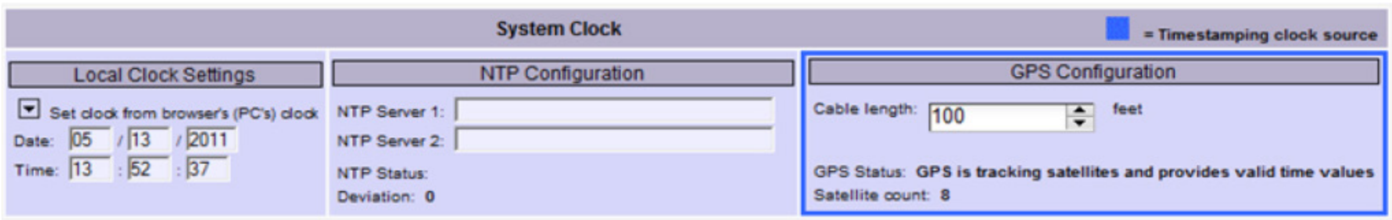

Figure 6: Time synch configuration in Systems Settings screen.

Time Sync Configuration

Time Stamping can be synchronized to one of four sources: Network Time Protocol (NTP), Global Positioning System (GPS), One Pule Per-Second (1PPS), or Precision Time Protocol (PTP) version 2 (IEEE-1588). These are available as options, and really only required for time synchronization between packet flow switches. These time synchronization sources are defined via the device's web interface, in the system configuration page, as shown in Figure 6. The user can define up to two independent NTP servers, physically connect a GPS receiver and define the cable length to the receiver, physically connect and select a separate 1PPS source, and define a PTP master.

PFS advanced line cards and chassis modules, with time stamping, support connection to time synchronization sources as follows:

- NTP is supported over the management ports to any NTP server
- Currently, GPS synchronization is supported from receivers or time distribution servers (TDS) that deliver a one pulse-per-second (1PPS) signal and the Trimble Standard Interface Protocol (TSIP), over a dedicated RJ-45 RS-422 connector
- PTP is supported over a dedicated Ethernet port, or the Management Ethernet ports, to any PTP version 2 (PTPv2) Masters
- One Pule Per-Second (1PPS), or Precision Time Protocol (PTP) version 2 (IEEE-1588)
- 1PPS signal from any timing source over either a dedicated RJ-45 RS-422 or Coax SMA TTL connector, with NTP for time of day over the management ports
- If GPS and/or 1PPS are used as a synchronization source on a given PFS module, then the device can become a PTP Master via the dedicated PTP port, which other packet brokers can in turn obtain synchronization from

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