Port Stamping and Time Stamping

Time Stamping and Port Stamping are part of the Packet Optimization™ feature set, available as an option, on Advanced and Expert editions of the Distributed Series, Finder Series, and Protector Series products. Time Stamping and Port Stamping can be enabled independently or together.

If time stamping and port stamping are used on the same port, 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.

Port Stamping and Time Stamping never alter network through-traffic on the tap. Inline tap ports always contain an exact replica of the original packet. Only the monitor ports on the Tap device will see port and/or time stamped packets.

Port Stamping

Port Stamping allows, on an input network port basis, the addition of a single byte to the end of the payload of each packet, immediately before the CRC, indicating the input port of the Tap device that the packet was captured at. The CRC is recalculated, after the addition of the byte, to preserve the integrity of the packet. Once the port stamp is added to the packet, it is passed on to the destination port(s) as a standard Ethernet packet.

In the example of a v4x24 Advanced edition, ports are numbered in hexadecimal format from 0 through 13. 10G XFP ports A through D are numbered 0-3, and 1G built-in & SFP ports are numbered 4-13. The SFP ports do not have port stamp assignments as they are not capable of port stamping.

The example packet in Figure 1 shows the 1-byte port stamp in red, indicating port 4 (built-in Port 1 on the v4x24 Advanced Tap), and the 4-byte CRC in blue. In a future release, this port stamp will be expanded to two bytes.

An alternative to Port Stamping at the end of the packet is VLAN Tagging, which adds a port stamp in a VLAN tag at the beginning of a packet, and is available as a standard feature on all VSS Dual-Interface Management Module (vDIMM) products.

Time Stamping

Time Stamping provides, on an input network port basis, the addition of an 8-byte time stamp to the end of the data payload of each packet. The first four bytes count in seconds and, in the second four bytes, the least significant 30 bits 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 2 most significant bits of the second 4 bytes can then be used to determine whether there was synchronization of the clock, and if so, what the synchronization source was, as per Table 1.

The example packet in Figure 2 shows the 8-byte time stamp in red, and the four byte CRC in blue. The value of the time stamp is 00 00 0B 7F . 00 2D C9 40 (or 2943.003000640 seconds) and internal clock source only.

<table>
<thead>
<tr>
<th>Value</th>
<th>Timing/Sync Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>00</td>
<td>Uncalibrated, Internal Clock only</td>
</tr>
<tr>
<td>01</td>
<td>NTP synchronization</td>
</tr>
<tr>
<td>10</td>
<td>GPS (1PPS with TSIP) or 1PPS with NTP synchronization</td>
</tr>
<tr>
<td>11</td>
<td>PTP synchronization</td>
</tr>
</tbody>
</table>

Table 1. Clock Synchronization Indicator (bits 30 & 31)
Time stamp values are the number of seconds since Epoch time, which is 00:00 UTC 1st January 1970. All ports are exactly synchronized with each other because they use the same clock source. Although the time stamp is provided in nanoseconds, there are several accuracy limitations that must be understood.

- A packet must be de-serialized, unscrambled, and decoded before being time-stamped. This processing causes a fixed delay on the input ports. This delay has some non-deterministic components to it due to the way Ethernet interfaces function. Also, there is always the possibility of a packet arriving just as the 20ns clock ticks. These two factors can lead to a non-deterministic jitter of +/- 20ns, thus, it is possible that two identically arriving packets on two ports could be stamped with a difference of as much as 40ns between them.
- The hardware de-serialization and decoding procedures for 10G fiber, 1G fiber, and 1G copper interfaces are not the same, and each type offers a differing static time delay in the input path before time stamping. Therefore, any comparison of time stamps between port types is not going to be nanosecond exact.
- The system clock has an inherent accuracy of +/-1PPM, thus timestamps from two different units may have a long-term drift between them, although, this drift will be controlled by clock synchronization (<=10ms for NTP, <=200 ns for GPS, and <=1μs for PTP).

Despite the limitations listed above, the VSS product offers time stamping resolution and accuracy that is far superior to most other existing hardware/software solutions.

Configuration

Enabling/Disabling both Time Stamping and Port Stamping are independently enabled on a per-port basis via the device’s web interface, in the port configuration page, as shown in Figure 3.

Time Sync Configuration

Time Stamping can be synchronized to one of three sources: Network Time Protocol (NTP), Global Positioning System (GPS), or Precision Time Protocol (PTP). These are available as options. These time synchronization sources are defined via the device’s web interface, the system configuration page, as shown in Figure 4. 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 a 1PPS source and select 1PPS with NTP, and physically connect and define a PTP server.

VSS time stamping products 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 connector to any PTP version 2 server.