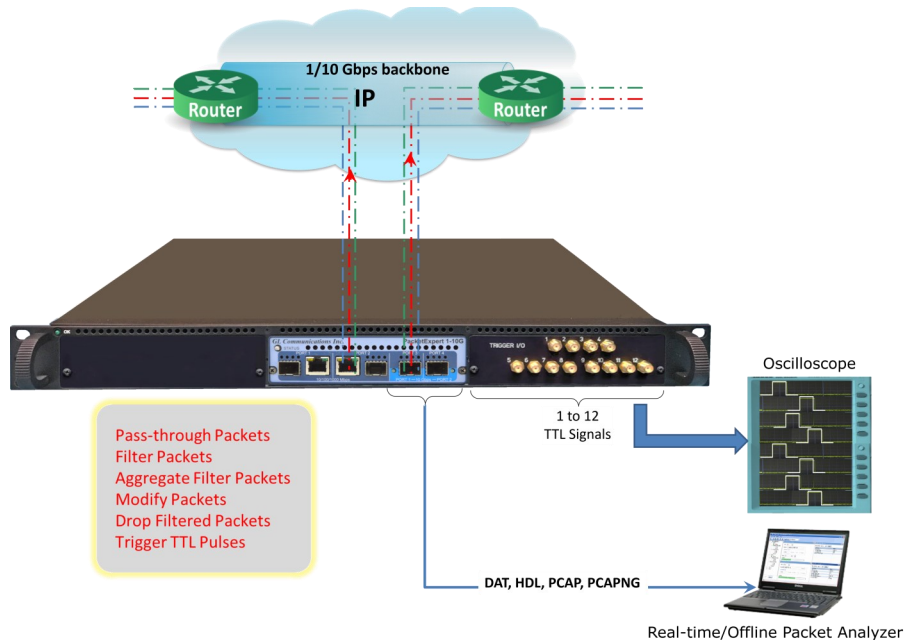# PacketBroker – Active Ethernet Tap

(Tap, Filter, Aggregate, Modify, Drop, TTL Trigger Generation)

Overview

All the features of high-end network taps, including non-intrusive tap, filter, trigger, drop, modifier, aggregation, and trigger generation features are packaged into PacketBroker application making PacketExpert™ 10GX platform suitable for testing any point in the network. The PacketBroker (PXN107) is an optional application with PacketExpert™ 10GX platform.

PacketBroker is an Active Ethernet Tap, where the incoming frames Ethernet FCS is checked and the frames with bad FCS are dropped. The frames with valid FCS are taken up for processing after the FCS is stripped off. After processing, while sending the packet out of the opposite port, the FCS is recalculated and attached to the outgoing Ethernet frame.

PacketBroker strengthens PacketExpert™ 10GX platform to be used as a network monitoring and detection tool to capture real world traffic, multiple filters to drill-down to traffic of interest, generate TTL triggers based on packet filters, and transmit filtered/aggregated packets for deep-packet data analysis.

PacketExpert™ 10GX (PXN100) has two 10/1 Gbps Optical/Electrical ports, and two 10/100/1000 Mbps Electrical/Optical ports. The two 10 Gbps ports can now be down-shifted to support 1 Gbps/2.5 Gbps Optical/Electrical ports with appropriate SFP. It requires additional **PXN101** license installation to run the tests on 2.5 G/10G ports.

PacketExpert™ 10GX is available in portable as well as mTOP™ rack mount platforms. The PacketBroker application captures on 2 Span Ports (can be either 1G or 10G) and outputs the filtered, aggregated and modified packets on 2 Drop Ports (can only be 1G). The Hardware also includes optional 4 to 12 Programmable I/O (Input/Output) ports, which is capable of generating or accepting TTL signals.

The PacketBroker application utilizes all these ports to support advanced features such as -

- **Network Tap** - capable of handling bidirectional 100% wirespeed traffic up to 10 Gbps
- **Wirespeed Filtering** - powerful and easy to use
- **Packet Modification** to convey useful information like Timestamp, Filter number etc. inband to precisely time and identify source
- **TTL Trigger I/O** - generates or accept TTL signals based on packet filters
- **Output aggregation** - both direction traffic multiplexed on the same output port

The traffic-of-interest captured on a live network can be analyzed using packet analyzers such as PacketScan™-All IP analyzer or Wireshark®.

For more information, refer to PacketBroker - Active Ethernet Tap webpage.

Main Features

Network Interfaces

- Multi-device support for PacketBroker application controlled using single GUI

Capture

- Capture packets non-intrusively on 10G, 2.5G and 1G ports (Electrical/Optical) at nano-second precision
- Supports capturing Full Duplex traffic (traffic from both directions) at wire speed (up to 10 Gbps)
- 2 Span Ports; 2 Drop Ports
- Span Ports can be either 1G or 10G, whereas Drop ports can only be 1G
- Turn On/Off advanced features like Filters, Aggregation, Packet Modification, and Output traffic at run time
- Log all captured events at single clock with precise timestamping

Filters

- Operates in Normal/Basic and Group filter configuration
- Supports a total of 32 filters per PacketExpert™ 10GX unit, with up to 16 simultaneous user-configurable filters per port, combined using a simple OR/AND expression
- Combined "Packet Mode" and "Raw Mode" modes of filtering
- Packet Mode Filtering -
  - Filter on various header fields like Source/Destination MAC Address, VLAN Id, MPLS Label, Source/Destination Ipv4 Address, Source/Destination UDP Ports
- Raw Mode Filtering -
  - High filter definition flexibility – drill down to the bit level and define mask at bit level, so that each bit can either be filtered or ignored
  - User defined filter offset to filter from any byte within the packet, including payload
  - Up to 120 bytes wide filter that covers almost entire packet header up to UDP
  - NOT" operation can be applied optionally on each configured filter complementing the filter action
- Grouping and Super Group Filters -
  - Advanced filter configuration option using filter grouping and Super grouping configurations
  - "AND"/ "OR" logical operators allows to create various combinations of filter groups
  - Variety of filter combinations possible for maximum filter flexibility – combine all filters into a single group (Basic Mode), combine subset of the filters into groups, and then combine the groups with AND/OR (Group mode) or even combine multiple groups into a Super Group and combine Super Groups with AND/OR (Super Group mode)
- Filter Setup and Trigger:
  - Continuous mode for automatic and continuous packet filtering
  - Trigger mode (stops after the first packet detected and waits till the filter is enabled again)
  - Enable/disable individual filter at run time for maximum flexibility
  - Triggered/Filtered Packet Statistics for both continuous and mono trigger mode
  - TTL trigger generation for every filter match
- Pulse width configuration in msec for TTL configuration

Packet Modification

- Modify filtered packets to include useful information like timestamp with nanosecond precision, filter number, port number etc., before sending out through the output ports

Aggregation

- Aggregate packets filtered from both directions and send out on a single output port

Main Features *(Contd.)*

Programmable I/O

- Four to twelve Programmable I/O (Input/Output) ports are available on the unit, which is capable of generating or accepting TTL signals
- A filter match generates TTL triggers and the filtered packets are forwarded out on DROP ports
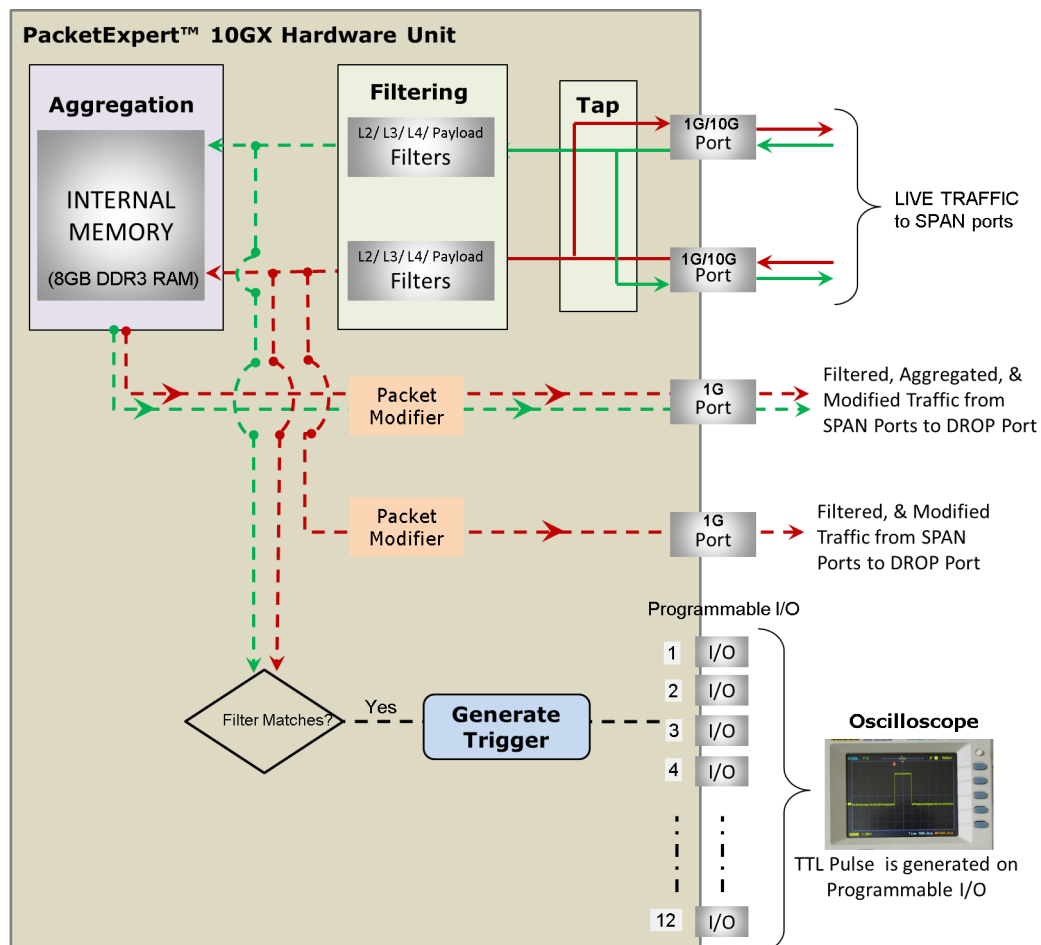- With the new 12 TTL I/O enhancement (coming soon), the Filter to TTL Mapping will be user-configurable

Statistics

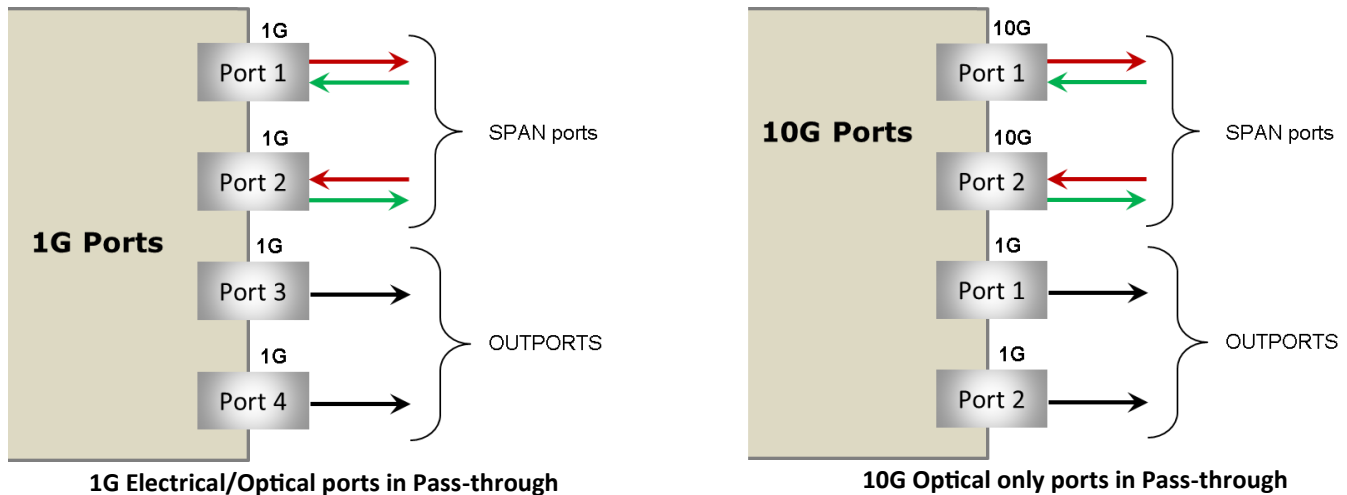- Provides port level statistics like Total Frames/Bytes Received, Rx Frame Rate, Rx Data Rate, etc.

CLI (Command Line Interfaces)

- With additional CLI Server license (CXN100) installed at the server side PacketExpert can connect to all CLI clients
- Supported API clients are Python and C#
- Command interface includes layer-wise MAC, VLAN, MPLS, IP and UDP commands

Working Principle

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Working Principle *(Contd.)*

1G Electrical/Optical ports in Pass-through

10G Optical only ports in Pass-through

PacketBroker supports tap, filter, aggregation, and packet modification functions.

- **Tap:** Traffic is forwarded between the Pass-through ports (Port 1 and Port 2) without any modification or delay, except processing the Ethernet FCS. The incoming frames' Ethernet FCS is checked and the frames with bad FCS are dropped. The frames with valid FCS are sent to the opposite port after stripping off the FCS. While sending the packet out of the opposite port, the FCS is recalculated and attached to the outgoing Ethernet frame. PassThrough (SPAN) and Output (DROP) Ports on PacketExpert™ 10GX hardware unit are as listed in the table.

	SPAN Ports	DROP Ports
10G	Port 1 (10G) Port 2 (10G)	Port 1 (1G) Port 2 (1G)
1G	Port 1 (1G) Port 2 (1G)	Port 3 (1G) Port 4 (1G)

- **Filter:** It supports wirespeed filtering of Layer 2/ Layer 3/ Layer 4 Ethernet packets, with each port featuring up to 16 simultaneous filters each of 120 bytes length. Basic mode and Group mode filter configurations are also supported. Individual filters are setup while the PacketBroker is running in Normal / Basic mode. Individual filters can be combined into Groups and Super Groups using "OR" or "AND" operations. PacketBroker can be configured to run in either mono trigger (manual mode) or continuous filter mode (automated).

- **TTL Generation:** Programmable I/O are capable of generating or accepting TTL signals, depending on whether they are configured as Output or Input. Currently, there are four Programmable I/O on the device, which accepts each filter match and generates a TTL trigger. With the 12 TTL I/O enhancement (available on rack mount hardware), the Filter to TTL Mapping will be user-configurable. The TTL signals can be monitored using Oscilloscope and for measuring precise timing between any two events.

- **Aggregation:** The 10G: Port1 (pass-through port) traffic filtered is normally sent out on 1G: Port1 (output port). Similarly, 10G: Port2 traffic filtered is sent out on 1G: Port2. Alternatively, the filtered traffic from both 10G: Port 1 and Port 2 can be aggregated and sent out on a single 1G port as a single stream. Since the aggregated stream rate can exceed wirespeed rate of a single port, the aggregated traffic is buffered in the onboard 8 GB DDR3 RAM memory, before being sent out.

- **Packet Modification:** Filtered packets can be modified to insert useful information within the packet itself. PacketBroker uses an inband method of conveying this information to the packet analyser by carrying this information in the packet's MAC header itself.

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Filters Configurations

Filters Configuration includes 2 modes Basic/Normal mode and Group Mode:

Basic Mode:

PacketBroker application includes a powerful "Wirespeed filter" feature that allows user to filter-in, and continuously capture only the traffic of interest.

- Captured traffic on pass-through ports are filtered as per the filter criteria
- In real-time up to 16 simultaneous filters per port each of length 120 bytes can be set
- Edit the raw filter bytes and Mask and Individual Filter Fields
- Filter can be set to each bit in the packet (Raw mode)
- Create filters by editing the individual fields of the incoming packet's Layer stack in Packet mode
- In Raw mode, each bit can be set to 'filtered' or 'don't care' condition via filter mask
- In Packet mode, the layer stack parameter can be set to fixed value, or randomize by providing the min and max range, or can even set to ANY to filter all traffic
- Jumbo frame support up to 16000 frame length
- For each filter, offset can be set to any byte within the packet (from 0 to 15999) which gives flexibility to filter any fields within any protocol headers, and even the payload
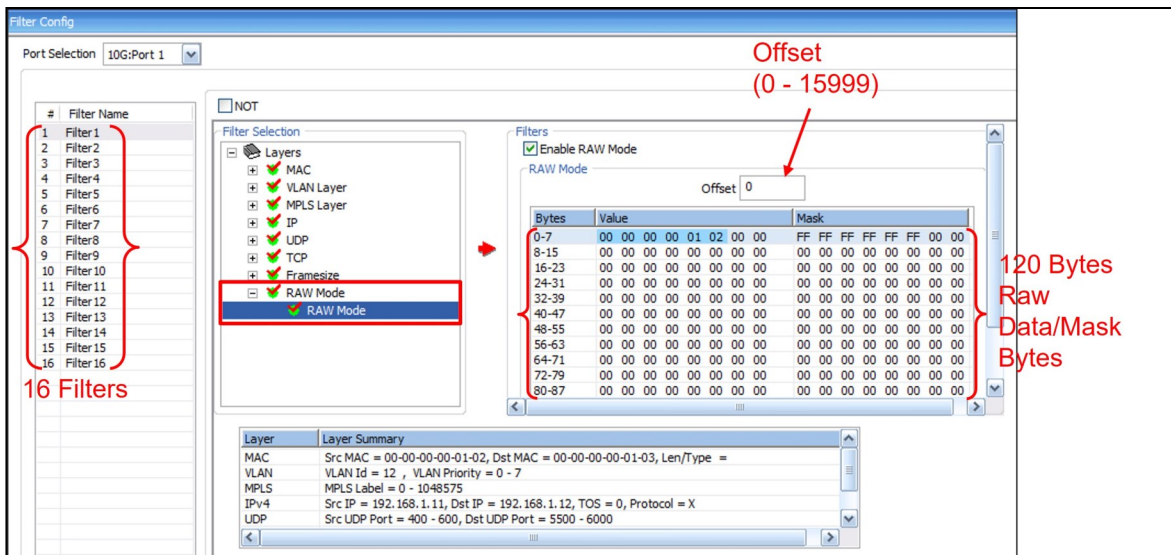
Figure: Filter Configuration in Raw Mode
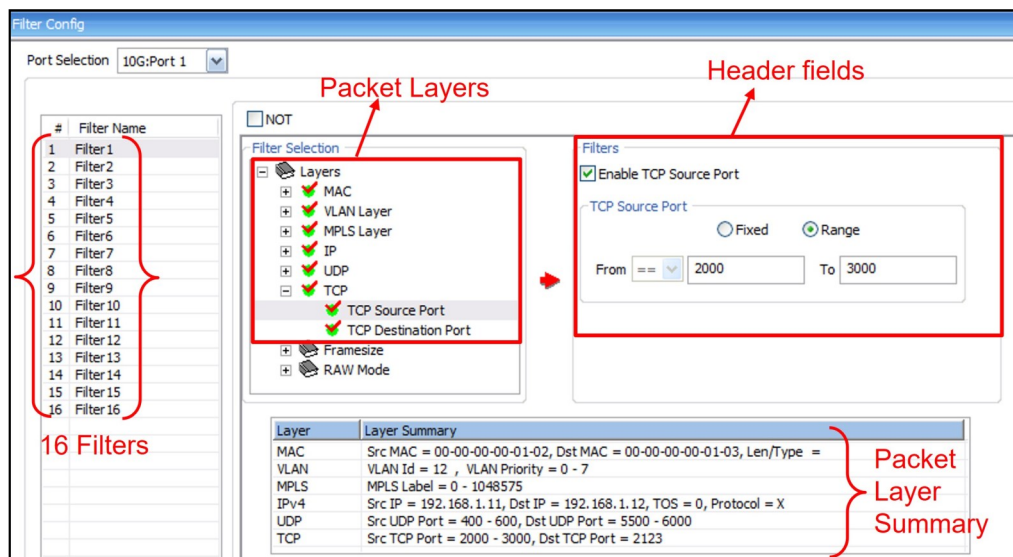
Figure: Filter Configuration in Packet Mode

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Filters Configurations *(Contd.)*

Group Mode:

PacketBroker includes an option to group the configured filters. Individual filters are setup while the PacketBroker is running in Normal / Basic mode.

Individual filters can be combined into groups using "OR" or "AND" operations. Groups of filters can be further combined into "Super Groups" again using "OR" or "AND".
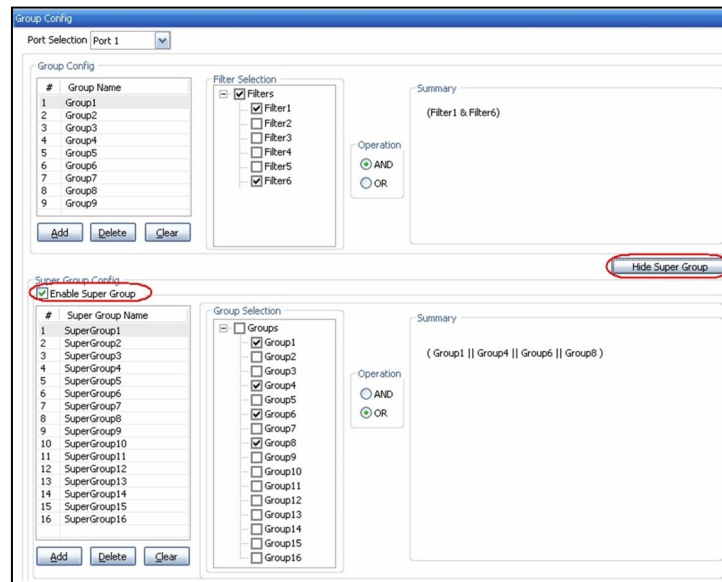
Figure: Super Grouping Configuration

Filter Trigger Setup

Basic Mode:

Each filter can be configured to run in either mono trigger or continuous filter mode.

Continuous mode is the normal filter operation mode where packets are set to filter continuously. Correspondingly, Triggered/Filtered Packets statistics are logged. In **Mono Trigger filter mode**, once the packet that matches the filter is filtered, filtering is stopped and, any further packets are not accepted, even if they match the filter. The first single matching packet is said to have "triggered" the filter.

Up to 16 filters can be defined, and combined with "AND" /"OR" condition. Further, "NOT (!==)" condition can be applied to accept or reject the packets.
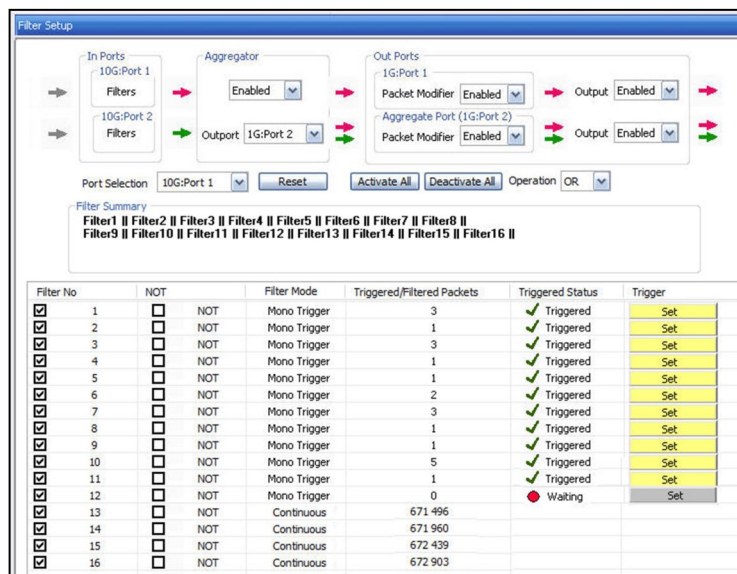
Figure: Basic mode Filter Setup

Filter Trigger Setup.(Contd.)

Aggregator

Aggregation option can be enabled /disabled and the output port for the aggregated traffic can be selected accordingly. The selected aggregation port is indicated by the double arrows, and also indicated by the Aggregate Port (1G: Port2), as shown in the figure below.
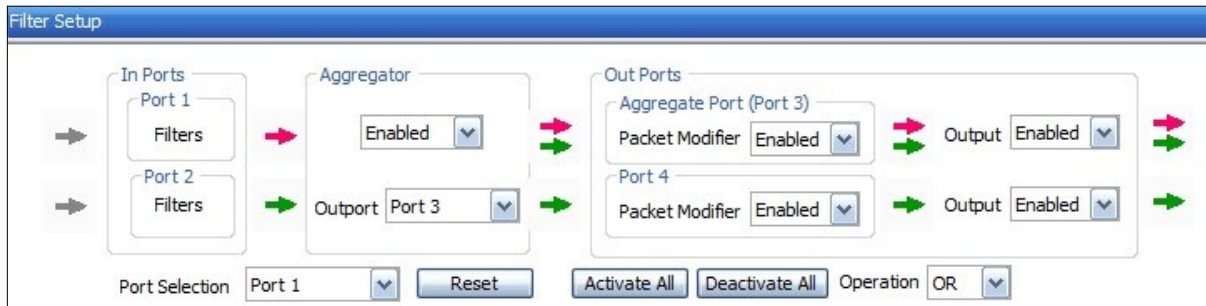
Figure: Aggregation Enabled and Output on 1G: Port 2

Group Mode

Filter Setup option allows to control (enabled/disabled) the filter groups at any time, even when the PacketBroker application is started, and filtering is going on.

In Group Mode, the **Filter Setup** screen displays list of configured Super groups. The checkbox provided for each Super group allows easy filter activation (checked) or deactivation (unchecked).

Figure: Group mode Filter Setup

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TTL Signal Generation

PacketBroker application supports generating output TTL signal pulses for every filter/group match. PacketExpert™ 10GX Hardware includes 12 Programmable TTL I/O (Input/Output) ports. User-configurable Filter/group to TTL Mapping is supported. The 12 TTL (TTL1 to TTL12) options can be uniquely assigned to filter groups to output the signal generated on the respective port. TTL signal (representing the Filter match) can be taken out and processed using an external device like Oscilloscope.
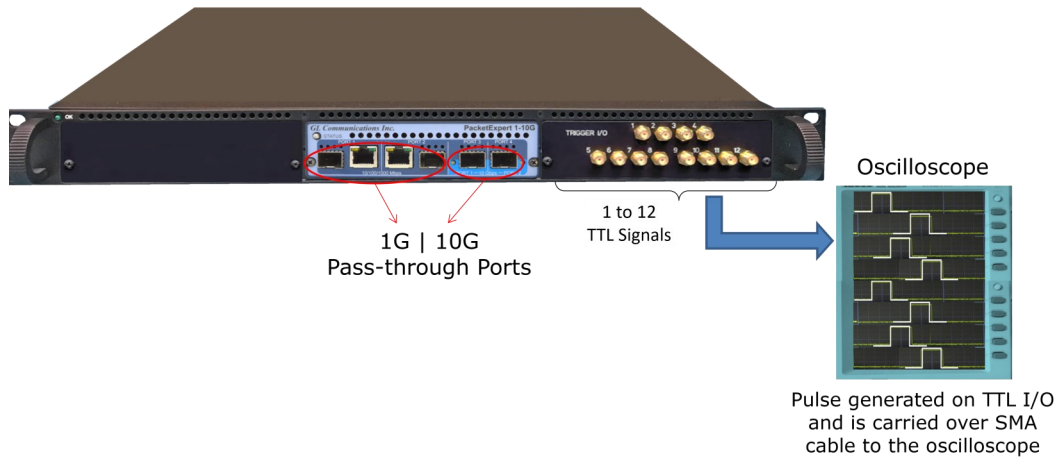

Figure: PacketExpert™ 10GX Rackmount with Programmable I/O

Packet Modification

Packet Modification option can be enabled/disabled on either of the output ports (10G/1G: Port1 or Port2). The aggregated or filtered traffic will be modified and is sent on the output ports accordingly.

Finally, user can completely stop any traffic being sent out on the output ports by disabling the Output ports (10G/1G: Port1 or Port2) as shown in the below screenshot.
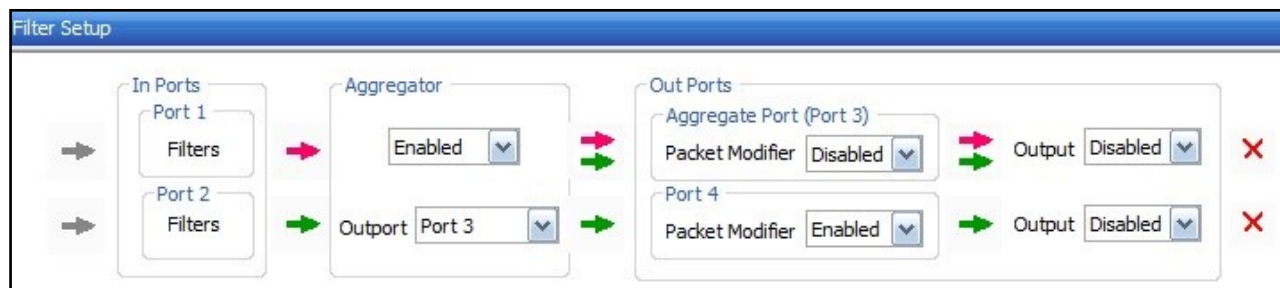
Figure: Packet Modification Enabled/Disabled

Packet Modifier Field Configuration

The PacketExpert™ hardware modifies the received Original Ethernet packets at 10G/1G: Ports 1 /2 and replaces the Source and Destination MAC Addresses (of 12 bytes) fields with Timestamp (8 bytes), Filter No (2 bytes), Board Serial No. (1 byte), and Port No (4 bits) fields as shown in the figure. The new CRC is calculated for the modified fields and the new CRC (4 bytes) is appended. The Hardware modified packets are then sent on 10G/1G: Ports 1 /2 (Output Ports).
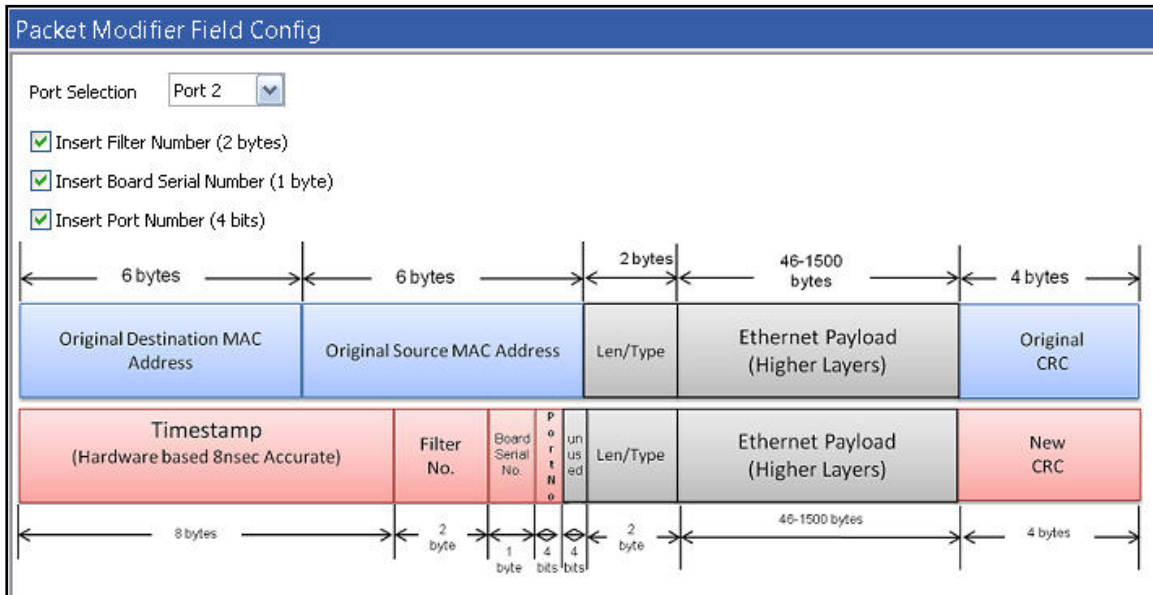

Figure: Packet Modifier Field Configuration

Statistics

Detailed Tx Rx frame statistics per port are provided. In addition to statistics like Frame Count, Frame Rate, Link Utilization, other statistics like Frame Type (Unicast/Broadcast/Multicast, VLAN), frame lengths (64, 65-127, 1024-1518, Oversized, Undersized), and FCS Error Frames are also provided.

The following figure displays Tx and Rx port statistics for 10G: Port1 (connected in pass-through) and also Tx statistics for 1G: Port1 output port.

Figure: Port Statistics

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Hardware Specifications

Portable 10GX Hardware Unit

1U mTOP™ PacketExpert™ 10GX Rack Unit

Stacked 1U mTOP™ PacketExpert™ 10GX Rack Unit

PacketExpert™ 10GX mTOP™ Probe

Physical Specification: Length: 8.45 in. (214.63 mm) Width: 5.55 in. (140.97 mm) Height: 1.60 in (40.64 mm) Weight: 1.713 lbs. (0.75 kg)	• **Dimension:** 1U/2U mTOP™ - 19" W x 16" L • 1U mTOP™ Rackmount Enclosure can support up to 3 PXN100s • 2U mTOP™ Rackmount Enclosure can support up to 6 PXN100s • Optional 4 to 12 Port SMA Jack Trigger Board (TTL Input/Output) • **Weight:** (not including the rails) 1U with 3x PXN100 : 11 lbs 2U with 6x PXN100 : 22 lbs	**Physical Specification:** Length: 10.4 in. (264.16 mm) Width: 8.4 in. (213.36 mm) Height: 3.0 in. (76.2 mm)
Bus Interface: USB 3.0 **External Power Supply**: • +12 Volts (Medical Grade), 3 Amps (For portable units having serial number ≥ 188400) • +9 Volts, 2 Amps (For portable units having serial number < 188400) • Optional 4-Port SMA Jack Trigger Board (TTL Input/Output)	**SBC Specifications:** • Intel Core i3 or optional i7 Equivalent • Windows® 11 64-bit Pro Operating System • USB 3.0 and USB 2.0 Ports, ATX Power Supply • USB Type C Ports, Ethernet 2.5GigE port • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports	**SBC Specifications:** • Intel Core i3 or optional i7 Equivalent • Windows® 11 64-bit Pro Operating System • USB 3.0 and USB 2.0 Ports, 12V/3A Power Supply • USB Type C Ports, Ethernet 2.5GigE port • 256 GB Hard drive, 8G Memory (Min) • Two HDMI ports

Temperature: Operating Temperature
0° C to +50° C (only up to operating altitude of 5000 feet, and for Optical SFPs only i.e. Non Electrical SFPs)
+5° to +40° C (for operating altitude up to 10,000 feet, and for both Electrical and Optical SFPs)
Non-Operating Temperature: -30° to +60° C

Humidity: Operating Humidity: 0% to 80% RH
Non-Operating Humidity: 0% to 95% RH

Altitude: Operating Altitude: up to 10,000 feet
Non-Operating Altitude: up to 50,000 feet

Interfaces:
4 x 1G Base-X Optical OR 10/100/1000 Base-T Electrical
2 x 100Mbps Base-FX Optical
2 x 2.5 Gbps Electrical/Optical Interface
2 x 10G Base-SR, -LR -ER Electrical/Optical Interface
Single Mode or Multi Mode Fiber SFP support with LC connector
Protocols:
IEEE 802.3ae LAN PHY compliance
RFC 2544 compliance

Pelican Carry Case

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Buyer's Guide

Item No	Product Description
PXN107	PacketBroker 10GX
PXN100	PacketExpert™ 10GX
PXN101	10G and 2.5G option for PXN100
CXN100	CLI Server for PXN100

Item No	Related Hardware
PXE100	PacketExpert™ 1G
PXN112G	PacketExpert™ 10GX (12-Port) - Rackmount
PXN124G	PacketExpert™ 10GX (24-Port) - Rackmount
MT001	mTOP™ 1U Rackmount Enclosure w/ SBC
MT002	mTOP™ 1U Rackmount Enclosure w/o SBC

Item No	Related Software
PXN105	Wirespeed Record / Playback
PXN108	Multi-Stream UDP/TCP Traffic Generator and Analyzer
IPN507	IPNetSim™/IPLinkSim™ option for PXN100

Note: PCs which include GL hardware/software require Intel or AMD processors for compliance.

For more information, refer to PacketBroker - Active Ethernet Tap webpage.