10 Gigabit Universal Multi-Services Module (LAN, WAN, OC-192c POS)

Ixia's 10 Gigabit Universal Multi-Services Module (MSM) provides a network test solution with unparalleled flexibility and performance. In a single test module, the 10G MSM is configurable for 10 Gigabit Ethernet LAN (IEEE 802.3ae 10GBASE-R), 10 Gigabit Ethernet WAN (10GBASE-W), or OC-192c Packet Over SONET/SDH (POS) operation. Used in conjunction with Ixia's test applications, a broad range of performance, scalability, and conformance testing can be executed on high-speed routers, switches, and other network devices. In addition, the 10G MSM will be extended in the future to support "next generation" SONET features, enabling the efficient delivery of packetbased Ethernet data over a SONET/SDH infrastructure.

Highlights

- Highly flexible architecture allowing 10 GE LAN, 10 GE WAN, or OC-192c POS operation from a single test interface
- Industry's highest port density 10 Gigabit test solution, resulting in significant reduction in rack space, power consumption, and cooling requirements
- Supports traffic generation of millions of unique flows, eliminating the need to aggregate multiple 10G test interfaces to perform high scalability tests
- Tracks and analyzes up to 2 million flows for real-time latency, inter-arrival time, packet loss, data integrity, and sequence checking
- Comprehensive and integrated data plane and control plane traffic generation and analysis for IPv4/v6 routing protocols, L2/L3 MPLS VPNs, multicast, and L4-7 testing
- Sophisticated multi-protocol encapsulation and label stacking, including IPv4/v6, GRE, MPLS, IP over IP, and QinQ (stacked VLANs)
- VCAT, RPR/SRP and Data Communications Channel (DCC) functionality
Key Features

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General Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Ports</td>
<td>1</td>
</tr>
<tr>
<td>Number of Slots</td>
<td>1</td>
</tr>
<tr>
<td>Maximum Ports per Chassis</td>
<td>16</td>
</tr>
<tr>
<td>Pluggable Interface</td>
<td>XFP (For 10GE, supports transceivers compliant to the XFP MSA)</td>
</tr>
<tr>
<td>Capture Buffer</td>
<td>350 Mbytes/port with configurable trigger and filter conditions</td>
</tr>
<tr>
<td>Number of Streams</td>
<td>256 in either Packet Streams (sequential) or Advanced Stream Scheduler (interleaved) modes</td>
</tr>
<tr>
<td>Number of Trackable Flows</td>
<td>Up to 2 million</td>
</tr>
<tr>
<td>Transmit Engine</td>
<td>Built-in FPGA logic for wire-speed packet generation with timestamps, sequence numbers, data integrity signature, and packet group signatures</td>
</tr>
<tr>
<td>Receive Engine</td>
<td>Built-in FPGA logic for wire-speed packet filtering, capturing, real-time latency and inter-arrival time for each packet group, data integrity, and sequence checking</td>
</tr>
<tr>
<td>User Defined Field (UDF) Features</td>
<td>Fixed, increment or decrement by user-defined step, value lists, range lists, cascade, random, and chained</td>
</tr>
<tr>
<td>Table UDF Feature</td>
<td>Comprehensive packet editing function for emulating large number of sophisticated flows. Up to one million entries of up to 256 bytes of lists of values can be specified to be placed at designated offsets within a stream. Each list consists of an offset, a size and a list of values in a table format.</td>
</tr>
</tbody>
</table>
**Applications**


IxExplorer: Layer 2-3 wire-speed traffic generation and analysis

IxScriptMate: Automated test environment for Layer 2-3 data and control plane testing

IxChariot®: Layer 4-7 performance testing

Tcl API: Custom user script development for Layer 2-7 testing

Linux Software Development Kit (SDK): Custom user application development. Full TCP/IP connectivity through management interface (Telnet, FTP, etc.)

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### 10 Gigabit Ethernet LAN and WAN Specifications

<table>
<thead>
<tr>
<th>Feature</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Frame Length</strong></td>
<td>Fixed, random, weighted random, or increment by user-defined step from 24 bytes to 64K bytes</td>
</tr>
<tr>
<td><strong>SONET Statistics (WAN)</strong></td>
<td>Link State, Line Speed, Section LOS, Section LOF, Section BIP (B1), Line AIS, Line RDI, Line REI (FEBE), Line BIP (B2), Path AIS, Path RDI, Path REI (FEBE), Path BIP (B3), Path LOP, Path Signal Label (C2)</td>
</tr>
<tr>
<td><strong>Ethernet Statistics</strong></td>
<td>Link State, Line Speed, Frames Sent, Valid Frames Received, Bytes Sent/Received, Fragments, Undersize, Oversize, CRC Errors, VLAN Tagged Frames, User Defined Stat 1, User Defined Stat 2, Capture Trigger (UDS 3), Capture Filter (UDS 4), User Defined Stat 5, User Defined Stat 6, 8 QoS counters, Data Integrity Frames, Data Integrity Errors, Sequence Checking Frames, Sequence Checking Errors, IP checksum errors, TCP checksum errors, ARP, and Ping requests and replies</td>
</tr>
<tr>
<td><strong>Ethernet Error Generation</strong></td>
<td>CRC (Good/Bad/None), Undersize, Oversize</td>
</tr>
<tr>
<td><strong>Packet Flow Statistics</strong></td>
<td>Real-time statistics to track up to 2 million packet flows</td>
</tr>
<tr>
<td><strong>Filters</strong></td>
<td>48-bit Source/Destination Address, 2x128-bit user-definable pattern and offset, frame length range, CRC error, data integrity error, sequence checking error (small, big, reverse)</td>
</tr>
<tr>
<td><strong>SONET Error Insertion (WAN)</strong></td>
<td>Insert single, continuous, or user-defined rates for Section LOF, B1, B2, B3, and Line</td>
</tr>
<tr>
<td><strong>MAC Source and Destination</strong></td>
<td>Fixed, Increment, Decrement or Random, with User Defined Override (Mask) to force any bit(s) to 1 or 0</td>
</tr>
</tbody>
</table>
### IPv4 Source and Destination
Fixed, Increment, Decrement, or Random, with Subnet Mask

### IPv6 Source and Destination
Fixed, Increment, or Decrement, with Subnet Mask

### Data Field
Fixed, increment (Byte/Word), decrement (Byte/Word), random, repeating, user-specified up to 13K bytes

### Maximum Packet Rate
**LAN**
Up to 14.88 million Packets/Sec @ 64 Bytes with minimum legal gap (12 bytes) between packets and preamble (8 bytes). Ability to exceed the maximum packet rate using less than legal minimum gap.

**WAN**
Up to 13.83 Million Packets/Sec @ 64 Bytes with minimum legal gap (12 bytes) between packets and preamble (8 bytes). Ability to exceed the maximum packet rate using less than legal minimum gap.

### IPv4, IPv6, UDP, TCP
Hardware checksum generation

### VLAN
Statistics and generation of 802.1p/q VLAN frames

### Flow Control
Statistics, response, and generation of 802.3x flow control frames

### Clock Out
161.1328 MHz +/- 20 ppm reference clock, 644.5312 MHz +/- 20 ppm in recovered clock mode

### Latency Measurements
20 ns resolution

### Trigger Out
2 SMA connectors provide triggers

### Visual and Audible Alerts
All statistics

## OC-192c/STM-64 POS Specifications

<table>
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<th>Feature</th>
<th>Details</th>
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<tbody>
<tr>
<td>Layer 2 Encapsulation</td>
<td>Point-to-Point Protocol (PPP) over SONET/SDH as per RFC 2615, Cisco HDLC, Frame Relay, and User-Defined Header</td>
</tr>
<tr>
<td>PPP</td>
<td>Complete LCP, IPCP, OSICP, and MPLSCP Negotiation</td>
</tr>
<tr>
<td>Traffic Types</td>
<td>Full multi-layer (IP, TCP, UDP, IGMP, ICMP, RIP, DHCP) performance traffic generation at full wire-speed</td>
</tr>
<tr>
<td>Clock Out</td>
<td>155.520 MHz +/- 20 ppm reference clock, 622.080 MHz +/- 20 ppm in recovered clock mode</td>
</tr>
<tr>
<td>Latency Measurements</td>
<td>20 ns resolution</td>
</tr>
<tr>
<td>Trigger Out</td>
<td>SMA connector</td>
</tr>
<tr>
<td>Clock In</td>
<td>SMA connector</td>
</tr>
</tbody>
</table>
**Maximum Packet Rate**

29.22 million packets/sec @ 40 bytes with 1 flag between packets

**Frame Length**

Fixed, Random (specify min/max) from 32 Bytes to 64KB

**SONET Statistics**

Link State, Line Speed, Section LOS, Section LOF, Section BIP (B1), Line AIS, Line RDI, Line REI (FEBE), Line BIP (B2), Path AIS, Path RDI, Path REI (FEBE), Path BIP (B3), Path LOP, Path Signal Label (C2), Input Signal Strength

**Packet Statistics**

Frames Sent, Valid Frames Received, Bytes Sent, Bytes Received, FCS Errors, User-Defined Stat 1, User Defined Stat 2, Capture Trigger (UDS 3), Capture Filter (UDS 4), User-Defined Stats 5, User-Defined Stat 4

**Error and Alarm Generation**

Insert single, continuous or user-defined rates for Section LOF, B1, B2, B3, Line and Path AIS, REI (FEBE), and RDI J0 byte, J1 Trace Message Insertion/Capture D1-D12 Data Communication Channel Insertion/Capture

**APS Testing**

K1/K2 Bytes-set/read

**Data Field**

Inc byte, inc word, dec byte, dec word, random, repeating, fixed, user configurable, load from file

**Filters**

2x128-bit user-definable pattern and offset, frame length range, CRC error, data integrity error, sequence checking error (small, big, reverse)

**IPv4, IPv6, UDP, TCP**

Hardware checksum generation

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**Flexible Traffic Generation**

Traffic is generated in real time by intelligent logic implemented in FPGAs on each Ixia port. Data is generated on each port by defining up to 256 streams. Within each stream, millions of packets can be defined with completely customizable characteristics for every packet header field. Customizable payload content can also be defined. Frame size can be fixed, varied according to a pattern, or be randomly assigned across a weighted range.

**Real-Time Latency**

Packets representing different traffic profiles can be associated with Packet Group Identifiers (PGIDs). The receive port measures the minimum, maximum, and average latency or packet inter-arrival time in real time for each packet belonging to different groups. Measurable latencies include:

- Instantaneous latency or inter-arrival time, where each packet is associated with one group ID
- Latency bins, where PGIDs can be associated with a latency range
- Latency over Time, where multiple PGIDs can be placed in "Time Buckets" with fixed durations
- First and Last Timestamps, where each PGID can store the timestamps of first and last received packets
Transmit Scheduler

There are two modes of transmission available - Packet Streams and Advanced Stream Scheduler:

Packet Streams

The packet streams transmit engine allows generation of up to 256 unique streams on each port. Multiple streams can be defined in sequence containing multiple packets with custom characteristics. After transmission of all packets in the first stream, control is passed to the next defined stream in the sequence. After reaching the last stream in the sequence, transmission may either cease or control may be passed on to any other stream in the sequence. In this way, multiple streams are cycled through, each representing different traffic profiles to simulate real-world traffic.

Advanced Stream Scheduler

Up to 256 unique streams can be interleaved per port, each having its own packet characteristics and rate. For example, assume that Port 1 is configured with three streams. If Stream 1 is defined with IP packets at 20% of line utilization, and Stream 2 is defined with TCP packets at 50% of line utilization, and Stream 3 is defined with MPLS packets at 30% of line utilization, then data on Port 1 will be transmitted at an aggregate utilization of 100% with interleaved IP, TCP, and MPLS packets.

Extensive Statistics

- Real-time 64-bit counts and frame rates
- Spreadsheet format for convenient manipulation of statistics counters
- Eight Quality of Service (QoS) counters (supporting 802.1p, DSCP, and IPv4 TOS)
- Up to six user-defined statistics that use a trigger condition
- Extended statistics for ARP, ICMP, BGP, OSPF, IS-IS, RSVP-TE, and LDP
- TX stream statistics for transmit frame count and rate
- External file logging for statistics and alerts
- Audible and visual alerts with user-definable thresholds

Data Capture

Each 10 Gigabit port is equipped with 350 MBytes of capture memory. The capture buffer can be configured to store packets based on user-defined trigger and filter conditions. Decodes for IPv4, IPv6, UDP, ARP, BGP-4, IS-IS, OSPF, TCP, DHCP, IPX, RIP, IGMP, CISCO ISL, VLAN, and MPLS are provided.

Routing/Bridging Protocol Emulation

The 10GE MSM Load Modules support Ixia's routing/bridging Emulation protocol emulation suites via the IxNetwork application, including IPv4/IPv6 routing (BGP-4, OSPF, IS-IS, and RIP), MPLS (RSVP-TE, LDP, L2 MPLS VPNs, L3 MPLS VPNs, and VPLS), and multicast protocols (IGMP, MLD, and PIM-SM). Highly scalable scenarios can be created emulating up to thousands of routers advertising millions of routes per 10GE MSM port. Up to wire-speed Layer 2/3 traffic can be automatically created to target routes and MPLS LSPs.
Data Integrity

As packets traverse through routers and the IP header contents are changed, the CRC value is recalculated by the router. To validate router performance, the data integrity function of the 10G MSM allows packet payload contents to be verified with a unique CRC that is independent of the packet CRC. This ensures that the payload is not disturbed as the router changes header fields.

Sequence and Duplicate Packet Checking

Sequence numbers can be inserted at a user-defined offset in the payload of each transmitted packet. Upon receipt of the packets through the Device Under Test (DUT), out-of-sequence errors, or duplicated packets, are reported in real time at wire-speed rates. The user can define a sequence error threshold to distinguish between small versus big errors, and the receive port can measure the amount of small, big, reversed, and total errors. Alternatively, the user can use the duplicate packet detection mode to observe that multiple packets with the same sequence number are received and analyzed.

In-Line Network Monitoring

The 10G MSM with XFP transceiver can be configured to be used in-line with the network, and can passively monitor at full wire-speed. This is a very useful feature for network troubleshooting, and it eliminates the need for optical splitters.

Tcl API

Ixia's 10G MSM is supported by a full Tcl Application Programming Interface (API). This API allows users to develop custom scripts, and integrate the modules into an automated test environment.

Custom Applications

The Linux Software Development Kit (SDK) enables existing Linux applications to be compiled and run on the 10G MSM. Additionally, users can develop custom applications that can be integrated into the Ixia test environment.
Product Ordering Information

944-0012 MSM10G1-02
1-port, 10 Gigabit Universal Multi-Services Module supporting 10GE LAN, 10GE WAN, and OC-192c POS with XFP-pluggable interface. Full featured with 1 GHz PowerPC and 512 MB RAM. Includes 10GE LAN/WAN operation. Does not include XFP transceiver.

OPTOC192POS
OC-192c POS configuration option for 10G Universal Base Load Module

945-0005 SW-VCAT-SONET
SONET Virtual Concatenation (VCAT) Option for MSM2.5G1-01 and MSM10G1-02 Load Modules, License per port; Includes support for LCAS and GFP-F protocols

945-0002 SW-RPRSRP-SONET
RPR and SRP stream generation and protocol support for OC-48c/ OC-192c POS Load Modules

XFP-1310
XFP 1310nm transceiver

XFP-1550
XFP 1550nm transceiver