# SierraNet™ M648
## Ethernet and Fibre Channel Protocol Test System



**The Teledyne LeCroy SierraNet™ M648 is a highly advanced, fully integrated Ethernet and Fibre Channel protocol analysis and impairment system. The SierraNet M648 platform provides best in class traffic capture and manipulation for testing application or link characteristics. SierraNet M648 is the latest in the line of industry leading test and measurement tools from Teledyne LeCroy, designed for today's high-speed storage and communications fabrics. SierraNet M648 supports examination of Ethernet and Fibre Channel links utilizing both Pulse Amplitude Modulation 4 (PAM4) and legacy Non-Return to Zero (NRZ) technologies.**

## Key Features

- Analyze PAM4 Native Ethernet and Fibre Channel fabrics
  - 50/100/200GbE PAM4
  - 64GFC PAM4

- Fall-Back support for NRZ based links/speeds
  - 10/25/40/50/100GbE NRZ
  - 16/32GFC NRZ

- Layer 1 analysis support for link layer negotiation analysis

- Complete bi-directional capture of line rate traffic

- API for automation of test routines
  - Python scripts for popular Linux OS environments
  - Post capture, comprehensive analysis capabilities with Verification Script Engine™

- Deep memory buffers and pre-capture filtering for extended analysis needs

- 2U form-factor with optional rack mount kits

- Integrated 50GbE and 64GFC SFP-56 ports, backward compatible for SFP+ legacy applications
  - 4-Analog Pass Through
  - 4-Digital Re-Time
  - 2-QSFPCombination analog and digital

- Optical or copper cable connections supported

To achieve 50Gb Ethernet and 64G Fibre Channel data rates, the industry has adopted the use of PAM4 physical layer signaling technologies. PAM4 signaling offers advantages in doubling the effective data-rate, however, it has added more complexity to basic link connectivity. SierraNet M648 leverages Teledyne LeCroy's renowned physical layer test capabilities, applying non-intrusive, high-speed – "bump in the wire" – probing methodologies resulting in the industry's only Layer 1 protocol capture and analysis functionality.

### Complete Coverage

The SierraNet M648 combines the exceptional Teledyne LeCroy expertise for physical layer testing with triggering, analysis and debug functions for a wide range of current and evolving SAN and LAN specific protocols (i.e. NVMe-oF™, NVMe/TCP, RoCE v1/v2, iSCSI, and TCP/IP). The SierraNet M648 supplies Ethernet and Fibre Channel test and validation engineers 100% complete visibility into all layers of the communication protocols.

The SierraNet M648 will support the PAM4 signaling requirements in Ethernet and Fibre Channel communications, as well as supporting the large-scale installation of legacy NRZ based 10/25GbE and 16/32GFC networks and SANs. The result is the M648 - the most versatile and capable fabric and network test and analysis platform available!

### InFusion™

Teledyne LeCroy pioneered the art of "real time traffic" corruption and manipulation with the InFusion™ jamming and impairment tool software capabilities. Infusion is an integrated component of the NetProtocol Suite™ and used in conjunction with the SierraNet M648 provides users with intuitive and powerful tools for altering traffic and data patterns in the effort to determine the behavior of the test components. Extremely useful for problem recreation and remediation testing, the patented InFusion software may be used singularly or in automated test batch scenarios.

For example, engineers may use InFusion for the disruption of stable links to observe recovery or fail over characteristics; test the capabilities of operating system drivers, or for introduction of corner case error conditions.

## Fabric Exerciser™

Fabric Exerciser is a full featured Fibre Channel generation utility, a SierraNet M648 exclusive feature. Fabric test engineers may create Speed Negotiation packets at 16/32GFC and 64GFC PAM4 for emulating physical layer instantiation conditions, either within specification parameters, or to generate out of spec error conditions. Fabric Exerciser supports creation of a myriad of Training Frame Status and Control Field combinations and may be programmed for creating Differential Manchester encoding errors and generate custom link speed negotiation packets for Extended Marker bit values in both NRZ and PAM4 links.

The Fabric Exerciser comes ready for integration into the users test bed and is configured with our Python based File Generation Language. Generation routines may be crafted using text-to-traffic commands which will construct the primitives or frames that are sent to the DUT(s). Easily and quickly create libraries of generation scripts and exerciser routines and archive them for reuse, either in a stand-alone operation or as part of a larger automated test and validation routine.

| SierraNet M648FC Exerciser |
| --- |
| Complete 16GFC & 32GFC NRZ and PAM4 64GFC traffic generation and manipulation |
| • Generates Speed Negotiation & Transmitter Training packets |
| - Generate custom link speed negotiation packets, including 64G Extended Markers |
| - Generate Transmitter Training signals, both compliant and off spec to test DUT receiver(s) |
| - Generate all possible Training Control and Status field combinations |
| • Manchester Encoding Errors |
| - Create encoding errors to stress test DUTs |
| - Generate all possible Training Control and Status field combinations |
| - Testing |
| • Framed Data Generation |
| • PRBS |
| • Corner Case conditions |
| • Enable/Disable FEC capabilities |
| • Creating FEC errors |
| • Integrate Fabric Exerciser with Rest API interface |
| • Generate traffic for all layers of the Fibre Channel fabric |
| • Flow Control – Configure Buffer-to-Buffer credits |
| • Automated Login for Link Services configuration |
| • N+1 Exchange (OX-ID) capable |
| • NPIV Support for each physical port |

**Connection Setting** ✕

| | |
| --- | --- |
| Speed : | LINK_SPEED_AUTO ▼ |
| Generation Mode : | GEN_MODE_FC_INITIATOR ▼ |
| FC16G_FEC_Mode : | BASER_FEC ▼ |
| FC16_TTS_DISABLE : | OFF ▼ |
| TTS_TX_TF : | ON ▼ |
| TTS_TX_XCVR_ADAPT_EQ : | OFF ▼ |
| SPF_TYPE : | SFP_TYPE_OPTICAL ▼ |

Ok     Cancel

| Frame Example |
| --- |
| Frame Some_Frame |
| { |
| Field32 : 32 = 0xAABBFFEE |
| FrameType : 8 = 12 |
| HashedDest : 24 = HEX_DATA |
| Reserved1 : 8 = 0xDA |
| Field16 : 16 = 0xAAAA |
| Reserved2 : 8 = 0xAD |
| Data : * = PATTERN_1 |
| CRC : 32 |
| Primitive : * |
| Primitive : SOF, 48 |
| Primitive : SOF, 96 |
| Primitive : "CLOSE (NORMAL)", 36, 5 |
| Prolog = SOF |
| Epilog = EOF |
| } |

| Alignment Marker Error Generation |
| --- |
| • Generate compliant or errored Alignment Markers |
| - BIP Error |
| - Marker Position errors |
| - Marker Value errors |
| • Program Marker Position Skew |
| - Modify the 3-bit positional skew value to delay marker on specific lane(s) |
| • Program Marker Error Count |
| - Sets the 8-bit value for consecutive Markers with errored values |
| • Program Marker SH Value Error |
| - Sets the 2-bit Sync Header value of the Marker BIP error |
| • Framed Data Generation |
| • PRBS |
| • Corner Case conditions |
| • Enable/Disable FEC capabilities |
| • Creating FEC errors |
| • Integrate Fabric Exerciser with Rest API interface |
| • Generate traffic for all layers of the Fibre Channel fabric |

### Connectivity

Networks or Fabrics under examination are connected to the M648 through either Small Form Factor Pluggable-56 (SFP-56) connectors, or Quad-Small Form Factor Pluggable Double Density-56 (QSFPDD-56) connectors.

For completely unaltered 50GbE and 64GFC traffic capture and analysis – a typical requirement when examining physical layer signaling – four (4) dedicated SFP56 analog pass through connections are provided.  The SierraNet M648 has an additional 4-SFP56 digitally retimed ports dedicated for use with the InFusion impairment and jamming functions, in addition to supporting analysis.  Ethernet 100GbE and 200GbE testing is accomplished via the multifunction QSFP-DD ports, supporting both analog pass through and digital retiming operational modes.
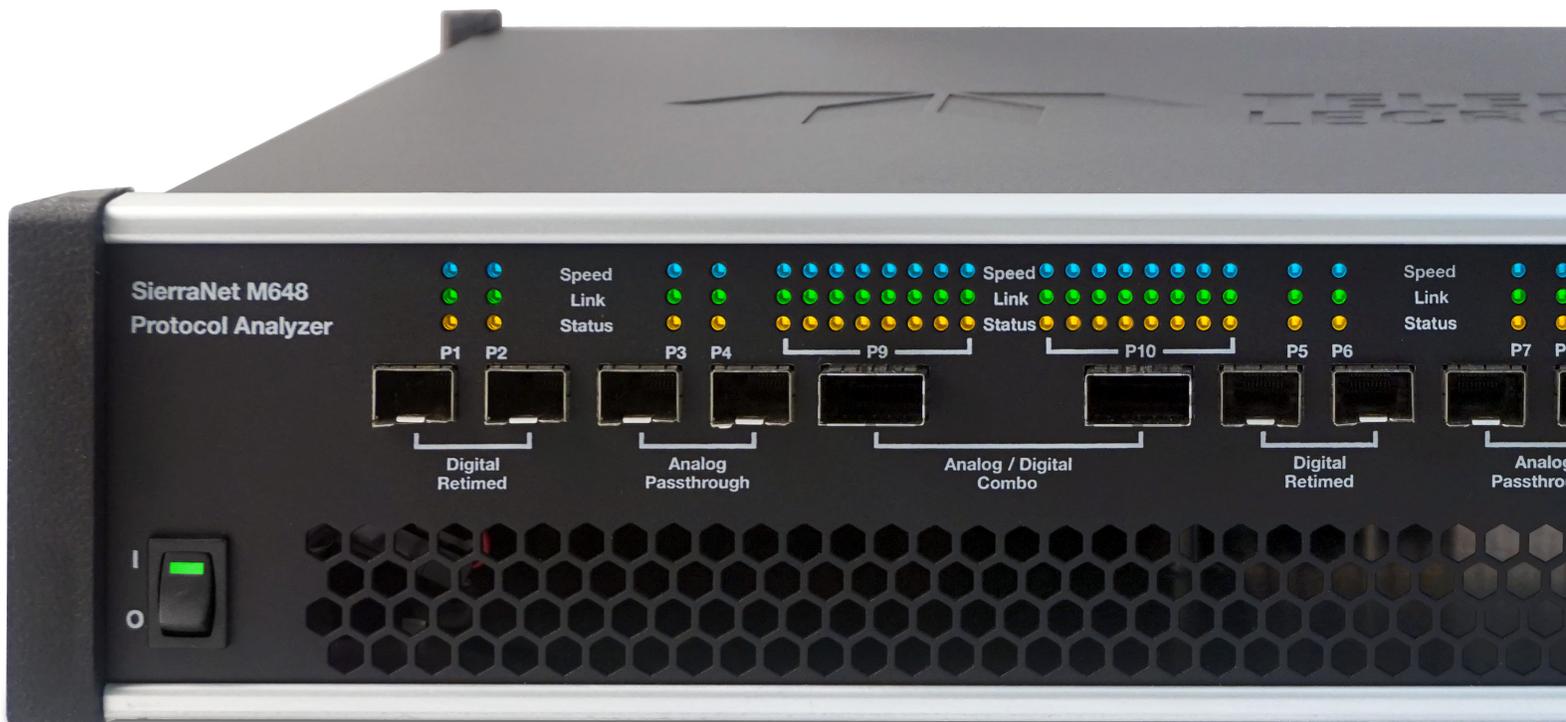
Users may daisy-chain multiple SierraNet platforms to examine higher port counts and analyze captured traffic across all systems in a single, easy to understand Net Protocol Suite™ trace view.  SierraNet platforms may be connected via the CrossSync™ application to other Teledyne LeCroy protocol tools to observe traffic across multiple connections to understand how traffic, stimulus, or errors propagate across bridges or adapters.

### Net Protocol Suite™

The Net Protocol Suite™ is a completely integrated software utility for use with the SierraNet products.  It provides users with the ability to capture traffic, review, examine and annotate the resulting traces, create conditional triggering, filtering, or jamming profiles, and with its API functions supports powerful Python based automation capabilities.

Net Protocol Suite provides the most advanced triggering and filtering state machines available.  Up to 24 states, with four transitions per state, and multiple trigger, filter, and timer conditions per capture project are standard features.  Advanced triggering enables state-specific filtering to eliminate the capture of unwanted traffic, providing users intuitive and easy navigation to the information and events of importance.

Post capture analysis is augmented with the Verification Script Engine (VSE), providing users with advanced data processing tools for extensive investigation of the fabric or network, and the components under observation.

## Specifications

| | |
|---|---|
| Host Machine Minimum Requirements | Microsoft® Windows® 10, Windows 7, Windows Server 2016 (x64), Windows Server 2019 (x64); 2 GB of RAM; Storage with at least 200 MB of free space for the installation of the software and additional space for recorded data; display with resolution of at least 1024x768 with at least 16-bit color depth; USB 3.0 port and/or 100/1000 Mbps Ethernet network interface.  For optimal performance, please refer to our recommended configuration in the product documentation. |
| Data Rates Supported | 16, 32, 64G Fibre Channel; and 10, 25, 40, 50, 100, and 200* Gbps Ethernet (* via the QSFP-DD connections) |
| Recording Memory Size | 64/128 GB in a single M648 platform |
| Host System Interface | USB 3.0 and 1Gb Ethernet |
| Front Panel Indicators | Three LEDs (Link, Speed, Status/ Errors) for each TX & RX pair, Status LCD Panel, Power LED |
| Front Panel Controls | Power ON/OFF, Menu Navigation and Selection Wheel |
| Front Panel Connections | Four (4) Analog Pass Through SFP-56 cages; four (4) Digitally Retimed SFP-56 cages; two (2) Analog Pass Through/Digitally Retimed QSFPDD-56 cages; two (2) SMA Trigger IN/OUT connectors; one (1) USB 3.0 compliant connector; one (1) 1GBASET connector |
| Rear Panel Connectors | AC Power, Expansion Port |
| Cascade and Expansion Capability | Up to 8 SierraNet Systems; 10/25/50GbE and/or 16/32/64GFC: Up to 32 Links; 40/100/200GbE: Up to 8 Links (Configuration and rates under test will affect these) |
| Dimensions (H x W x D) | Chassis: 88x432x356mm (3.5"x17"x14.1") With Bumpers: 104x455x367mm (3.75"x17.9"x14.5") |
| Weight | 6.82Kg (15lbs) |
| Power Requirements | 100-240VAC, 50-60Hz, 500W |
| Environmental Requirements | Operating:  0 to 55C (32 to 131F); Non-operating:  -20 to 80C (-4 to 176F); Humidity:  10 to 90% RH (non-condensing) |

## Ordering Information

### Base Hardware Platform

SierraNet M648 Platform (Base HW platform with 64GB Memory)

**Product Code**

HSF-M648-064-X

### M648 Analysis License Option Examples

| | Product Code |
|---|---|
| SierraNet 50G PAM4 Ethernet Analysis - Supports fall back rates to 10/25GbE NRZ, License for 4 ports | NET-T050-P04-A |
| SierraNet 100G PAM4 Ethernet Analysis - Supports fall back rates to 50GbE NRZ, License for 4 ports | NET-T100-P04-A |
| SierraNet 200G PAM4 Ethernet Analysis - Supports fall back rates to 40/100GbE NRZ, License for 4 ports | NET-T200-P08-A |
| SierraNet 64G Fibre Channel Analysis - Supports fall back rates to 16/32GFC, License for 2 ports | FC-T064-P02-A |

### M648 InFusion™ License Option Examples

| | Product Code |
|---|---|
| SierraNet 50Gb PAM4 Ethernet InFusion - Supports fall back rates to 10/25GbE NRZ, License for 2 ports | NET-J050-P02-A |
| SierraNet 100Gb PAM4 Ethernet InFusion - Supports fall back rates to 50GbE NRZ, License for 4 ports | NET-J100-P04-A |
| SierraNet 64G Fibre Channel InFusion - Supports fall back rates to 16/32GFC, License for 2 ports | FC-J064-P02-A |

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