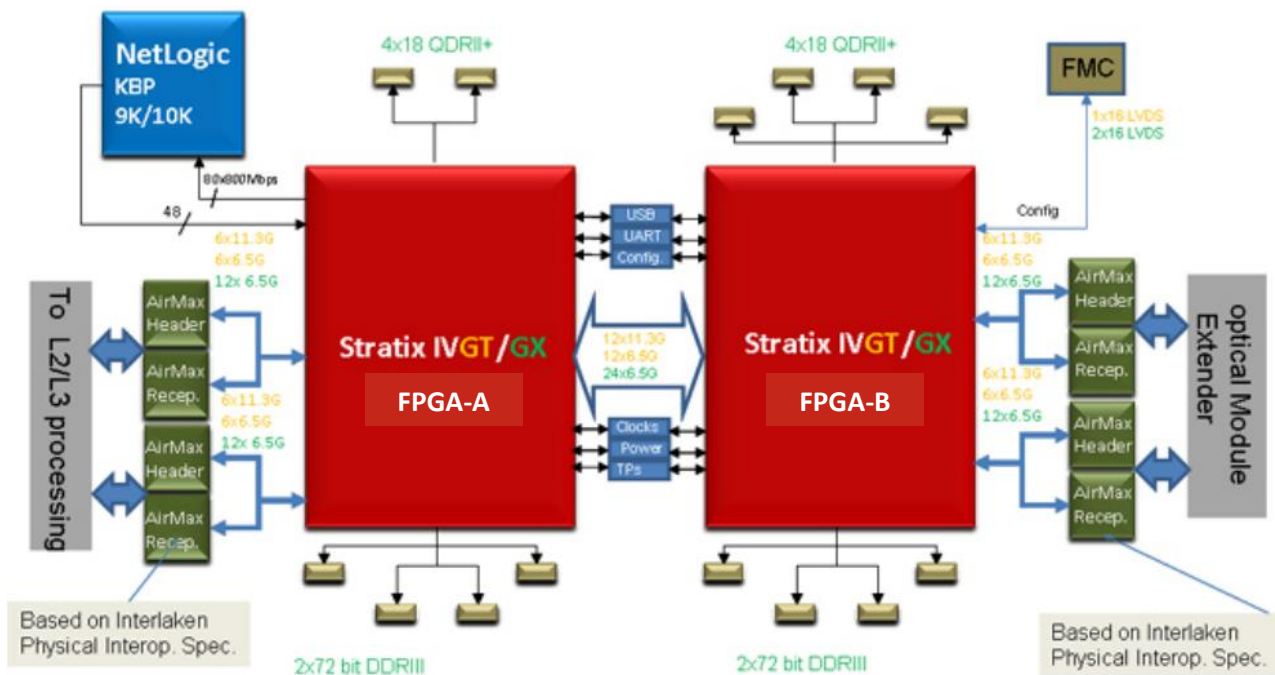


## HTG-S4GT-100G Module

Mantaro HTG-S4GT-100G module is designed as an evaluation and development platform for 100Gbps networking and communication protocols including 100Gbps Ethernet, OTN and 100Gbps Interlaken. Integration of highest density Altera Stratix IV FPGA with DDR3 and QDRII+ memories, two 120Gbps Interlaken interfaces (12x10Gbps lanes with FCI AirMax connectors) on two edges of the module, 2 FMC interfaces and available extender modules makes HTG-S4GT-100G a versatile development platform.

Key features of the HTG-S4GT-100G module:

- Altera Dual or Single FPGA supporting EP4S100G5 or EP4SGX530 offerings for ultra high bandwidth applications.
- Two 144-bit dual-bank (72x2) DDR3 memory using thirty six DDR III memory components (MT41J64M16LA-15E); One per FPGA
- Three 36-bit QDRII+ memories using 6 Cypress QDR II+ SRAM memory components (CY7C2563KV18); one on FPGA-A and two on FPGA-B
- Populated with one NetLogic NL9000 (or NL10000) knowledge-based processor (KBP)
- Interlaken interfaces for network processing or packet processing
  - Transmit and Receive lanes with robust CEI electrical performance (24 with GX and 12 with GT)
  - Up to 100G of Interlaken bandwidth
  - FCI AirMax Connector for interoperability with existing linecards
  - Interface to external CFP and SFP+ expansion modules using AirMax connectors
- USB 2.0 Host and Device /UART
- High-speed connectors for IO expansion

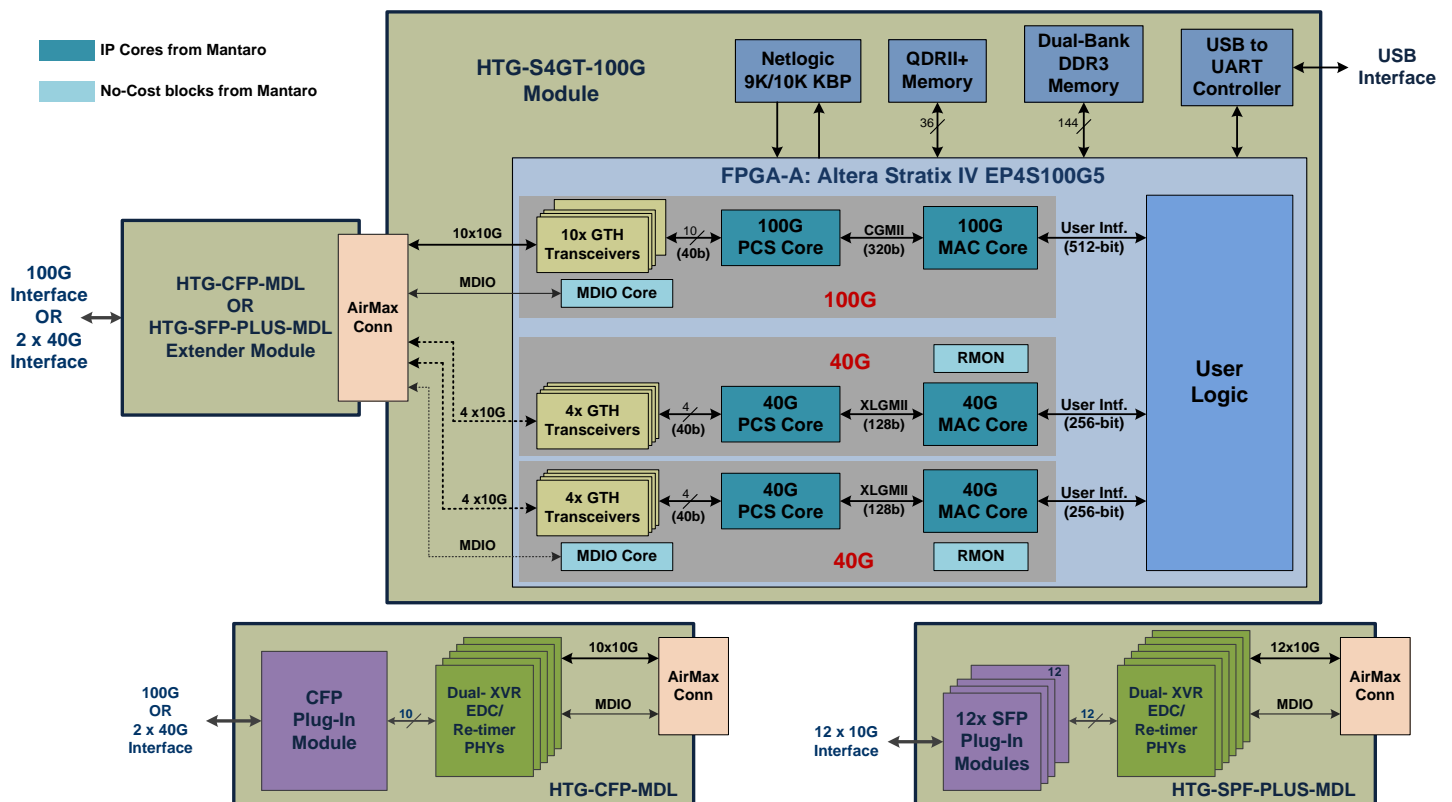


## Ethernet IP Solutions for the HTG-S4GT-100G Module

HTG-S4GT-100G module can be used as an evaluation and development platform for 100Gbps, 40Gbps and 10Gbps Ethernet solutions by connecting the module to various AirMax extender modules (available from Mantaro). Ethernet IP solutions provided by Mantaro for the module are:

- **100Gbps** 802.3ba Compliant Ethernet; Based upon Mantaro supplied 100G MAC and 100G PCS IP cores; 10x 10Gbps links on the AirMax connector to the CFP/SFP+ extender module
- **40Gbps** 802.3ba Compliant Ethernet; Based upon Mantaro supplied 40G MAC and 40G PCS IP cores; 10x 10Gbps links on the AirMax connector to the CFP/SFP+ extender module
- **10Gbps/1Gbps** 802.3-2008 compliant, runtime configurable 10Gbps/1Gbps dual-mode Ethernet; Based upon Mantaro supplied 10G/1G MAC core and Xilinx no-charge 10GBASE-R plus 1000Base-X PCS cores; 1x 10Gbps link on the AirMax connector to the SFP+ extender module
- **10Gbps only** 802.3-2008 compliant Ethernet; Based upon Mantaro supplied 10G MAC core and Xilinx no-charge 10GBASE-R core; 1x 10Gbps link on the AirMax connector to SFP+ module

All Ethernet solutions are supplied with no-charge statistics (RMON) block. If required, MDIO, I2C and DRP controller cores to control and configure the external PHYs/XVRs and GTH blocks are also provided by Mantaro on a no-charge basis. Following diagram shows the elements and the IP blocks used for the 100G and Dual 40G Ethernet solutions for the HTG-S4GT-100G module mated with either the HTG-CFP-MDL or HTG-SPF-PLUS-MDL AirMax extender modules. Although, only one FPGA (*FPGA-A*) is shown, IP solutions can be targeted to either/both FPGAs on the HTG-S4GT-100G module.





## Stratix IV-GT-100G Ethernet Solutions

### 40G/100G MAC Core Summary

- Highly optimized 320-bit data path design at 312.5MHz for 100Gbps mode
- 512-bit user interface @ 312.5MHz (non-segmented) or 512-bit user interface @ 225MHz (segmented) for 100Gbps mode
- 320-bit data path and 512-bit user interface (non-segmented) @ 125MHz for 40Gbps mode

<b>Device</b>	<b>RMON</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV GT (-I2 Speed)	Yes	17,126	18	18,327	60
	No	15,822	18	16,524	60

### 40G/100G PCS Core Summary

- Highly optimized 320-bit data path design at 312.5MHz for 100Gbps mode or 125MHz for 40Gbps mode
- 10x 10.3125Gbps links for 10x 10G interface to the CFP module or 10x 10G interface to Fiber links for 100Gbps mode
- 4x 10.3125Gbps links for 4x 10G interface to the QSFP or CFP module

<b>Device</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV GT (-I2 Speed)	43,500	384	36,100	222

### 100G PCS Core Summary

- Highly optimized 320-bit data path design at 312.5MHz
- 10x 10.3125Gbps links for 10x 10G interface to the CFP module or 10x 10G interface to Fiber links

<b>Device</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV GT (-I2 Speed)	30,600	2664	38,050	152



## Stratix IV-GT-100G Ethernet Solutions

### 40G MAC Core Summary

- Highly optimized 128-bit data path design at 312.5MHz
- Flexible 128-bit @ 312.5MHz or 256-bit @ 225MHz user interfaces

<b>Device</b>	<b>User Interface Width</b>	<b>RMON and MDIO</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV GT (-I2 Speed)	128-Bit	Yes	5,084	349	6,964	21
		No	3,926	349	5,347	21
	256-Bit	Yes	5,234	349	8,145	34
		No	4,141	349	6,528	34

### 40G PCS Core Summary

- Highly optimized 128-bit data path design at 312.5MHz
- 4x 10.3125Gbps links for 4x10G fiber interface (through QSFP+ plug-in transceivers)

<b>Device</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV GT (-I2 Speed)	7,388	24	9,115	49

### 10G/1G MAC Core Summary

- 64-bit data path design at 156.25MHz for 10G mode
- 64-bit user (application layer) interface
- Run-time configurable selection of 10Gbps and 1Gbps mode of operation
- Provides the flexibility to switch between 1G and 10G operation based upon the type of SFP (optical/electrical) transceiver plugged into the SFP cage without separate image downloads
- Provides RJ-45 GiGE Ethernet interface for the HTG-S4GT-100G through 1000-BaseX copper SFP plugged into the HTG-SPF-PLUS-MDL extender module

<b>Device</b>	<b>RMON And MDIO</b>	<b>COMB. ALUTs</b>	<b>Memory ALUTs</b>	<b>Registers</b>	<b>Memory M9K</b>
Stratix-IV	Yes	5,483	0	5,735	7 – M9K
230GX	No	4,368	0	4,684	7 – M9K



## Stratix IV-GT-100G Ethernet Solutions

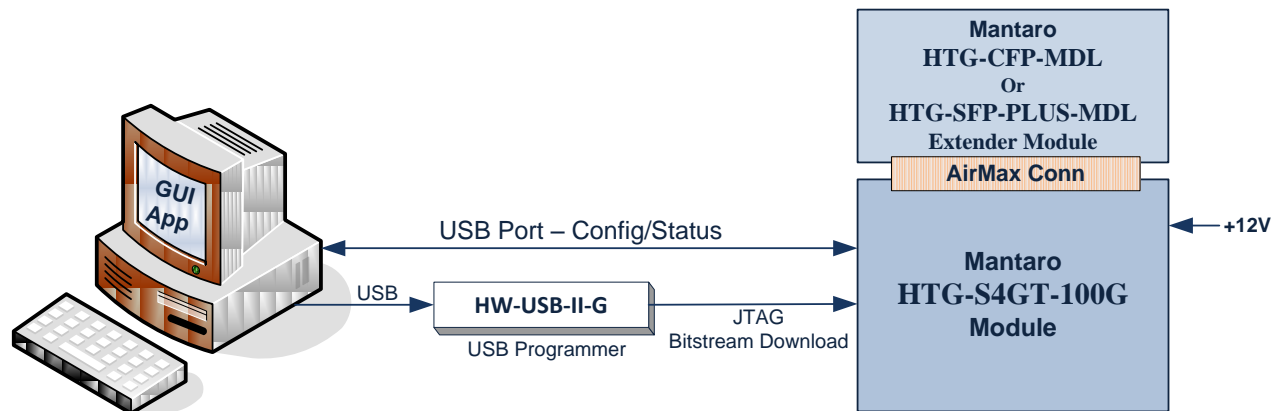
### *10G MAC Core Summary*

- 64-bit data path design at 156.25MHz
- 64-bit user (application layer) interface

<b><i>Device</i></b>	<b><i>RMON And MDIO</i></b>	<b><i>COMB. ALUTs</i></b>	<b><i>Memory ALUTs</i></b>	<b><i>Registers</i></b>	<b><i>Memory M9K</i></b>
Stratix-IV	Yes	5,205	0	5,278	7 – M9K
230GX	No	4,097	0	4,220	7 – M9K

### Demonstration/Evaluation Setup for Mantaro Ethernet Solutions

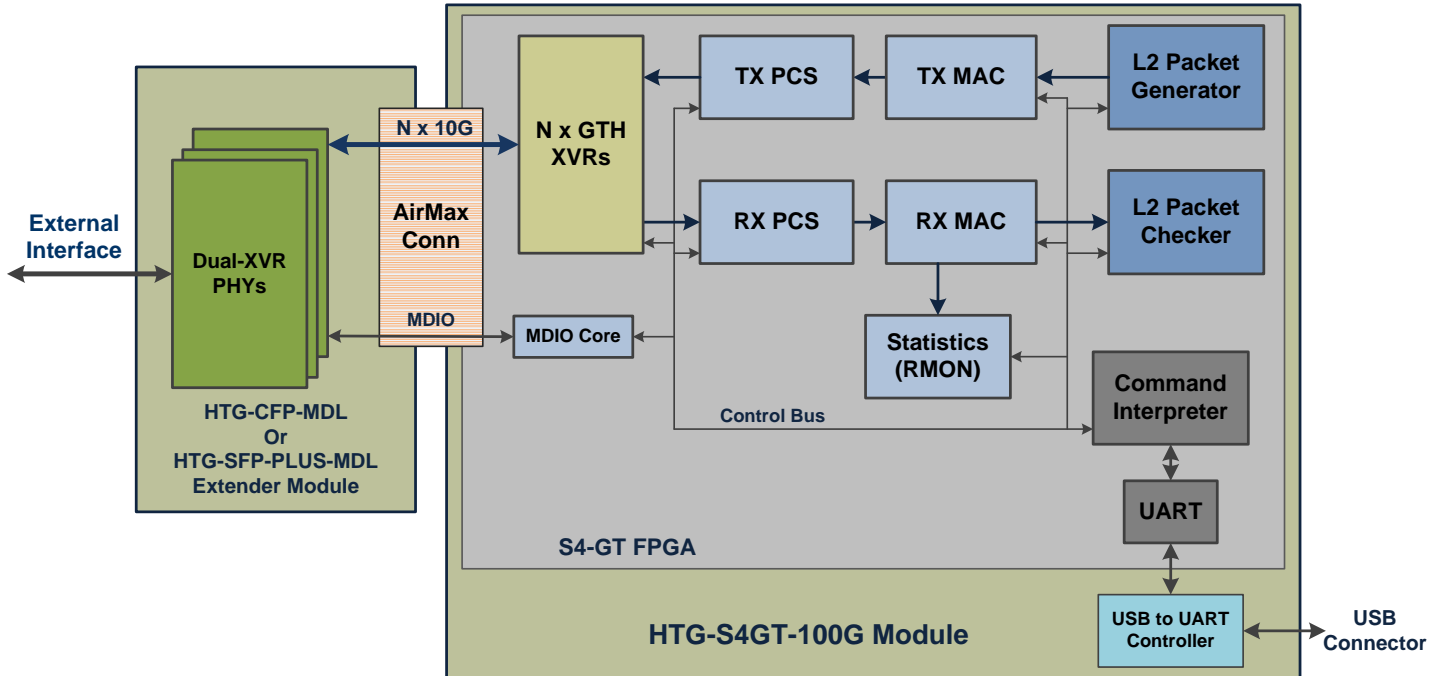
As shown in the figure below, Ethernet demonstration and core evaluation setup uses a Windows PC running a custom GUI application to configure and control the HTG-S4GT-100G FPGA and HTG-CFP-MDL/HTG-SFP-PLUS-MDL extender modules. The module is powered in stand-alone mode of operation and a Xilinx USB programmer is used to load the FPGAs images. Another USB interface to the module (through the USB-UART converter) is used to configure and control the FPGA and extender modules. It is also used to gather statistics from the FPGA on the HTG-S4GT-100G module.



Four Ethernet demonstration and evaluation setups are provided by Mantaro for the HTG-S4GT-100G module. All the evaluation setups implement the control and configuration of the extender modules. The four setups for the HTG-S4GT-100G module are:

1. **100Gbps** Ethernet evaluation setup using the HTG-S4GT-100G mated with HTG-CFP-MDL or HTG-SFP-PLUS-MDL extender modules. For the 100G demo using the HTG-CFP-MDL extender module, a 100Gbps CFP module is plugged into the CFP cage. When using HTG-SFP-PLUS-MDL extender module, 10 10Gbps SPF modules are plugged into the SFP+ cages.
2. **Dual 40Gbps** Ethernet evaluation setup using the HTG-S4GT-100G mated with HTG-CFP-MDL or HTG-SFP-PLUS-MDL extender modules. For the dual 40G demo using the HTG-CFP-MDL extender module, a dual 40G CFP module is plugged into the CFP cage. When using HTG-SFP-PLUS-MDL extender module, 8 10Gbps SPF modules are plugged into the SFP+ cages.
3. **10G/1G** Ethernet evaluation setup using the HTG-S4GT-100G mated with HTG-SFP-PLUS-MDL extender module with one SPF module plugged into the first SFP+ cage. Demo application for this setup implements the I2C interface to the SFP module (through the dual-PHY chip on the extender module) to identify the type of the module inserted in the cage (10G or 1G). A DRP controller is also implemented to dynamically configure the GTH transceiver and PLLs for 10G or 1G mode of operation.
4. **10G** Ethernet evaluation setup using the HTG-S4GT-100G mated with HTG-SFP-PLUS-MDL extender module with one SPF module plugged into the first SFP+ cage.

Each of the evaluation setup uses a line speed (up to 100Gbps) L2 Ethernet packet generator and checker along with the Ethernet (MAC/PCS) and interface cores required for each setup. The following is a generic block diagram for all evaluation and demonstration setups.



Following snap-shots shows the interface of the GUI application running on the PC.

