



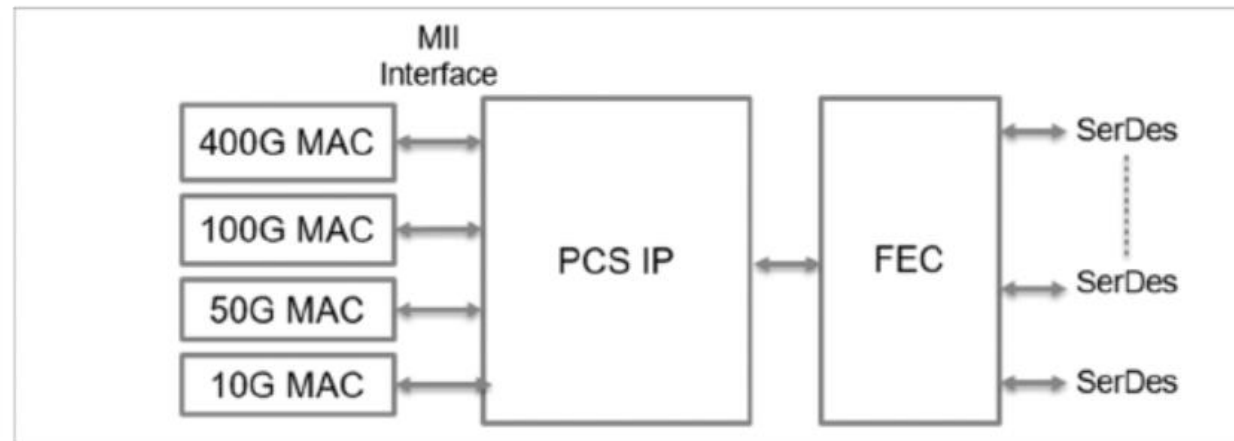
SiFive Ethernet-PCS IP Verification by Emulation | **Case Study**



SiFive's Physical Coding Sublayer (PCS) IP

SiFive's PCS IP Core provides an Media Independent Interface between Ethernet MAC and SerDes Lanes via the FEC IP

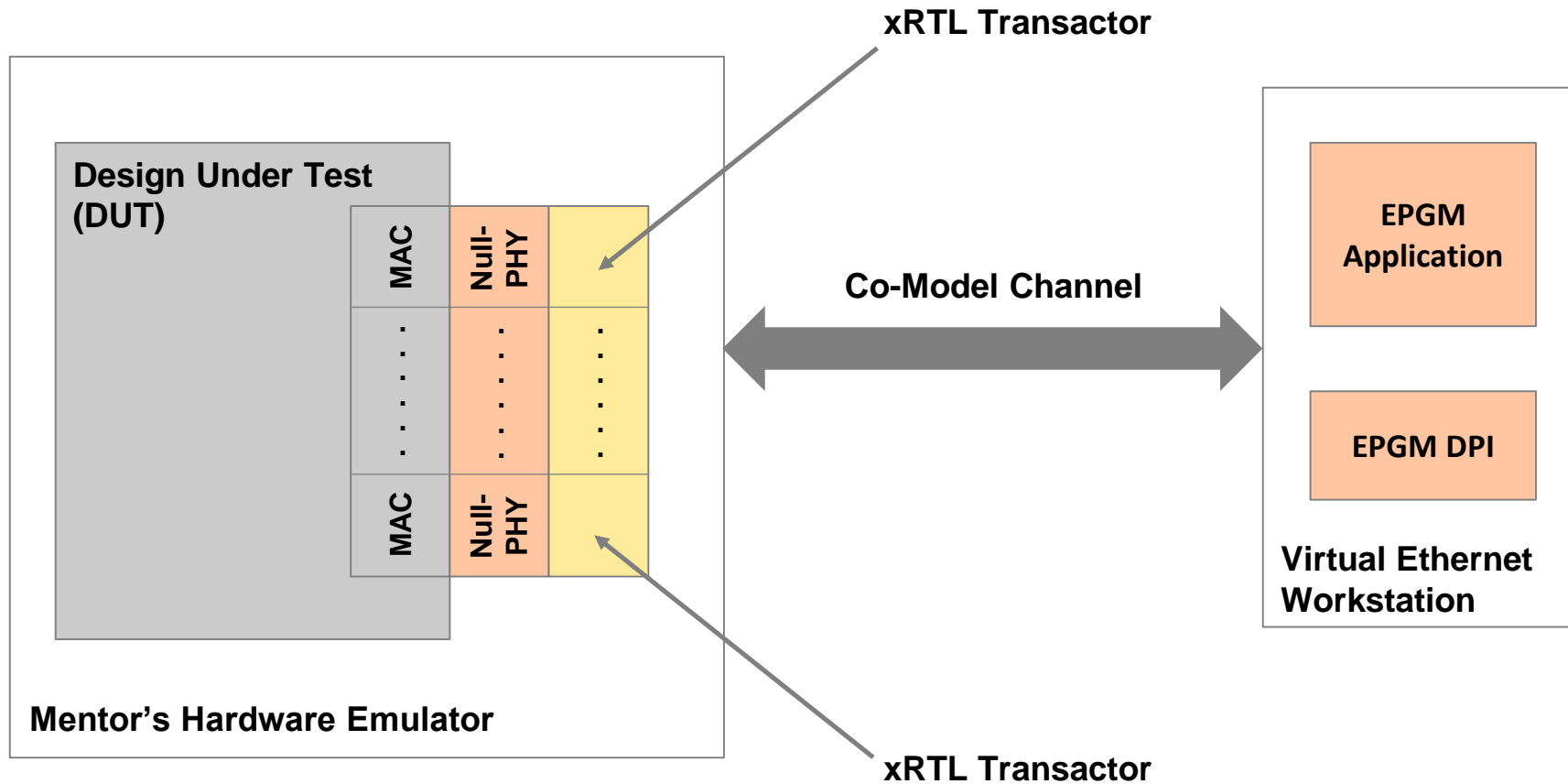
- Fully compliant with IEEE 802.3 Standard
- Supports MAC Rates like 10G, 25G, 50G, 100G, 200G, and 400G
- Flexible and Robust Architecture
- Compatible with different MII interface for connecting to the MAC
- Supports Ethernet and Flex Ethernet 1.0 Interfaces





Verification of Ethernet-PCS IP with Mentor's Veloce Emulator

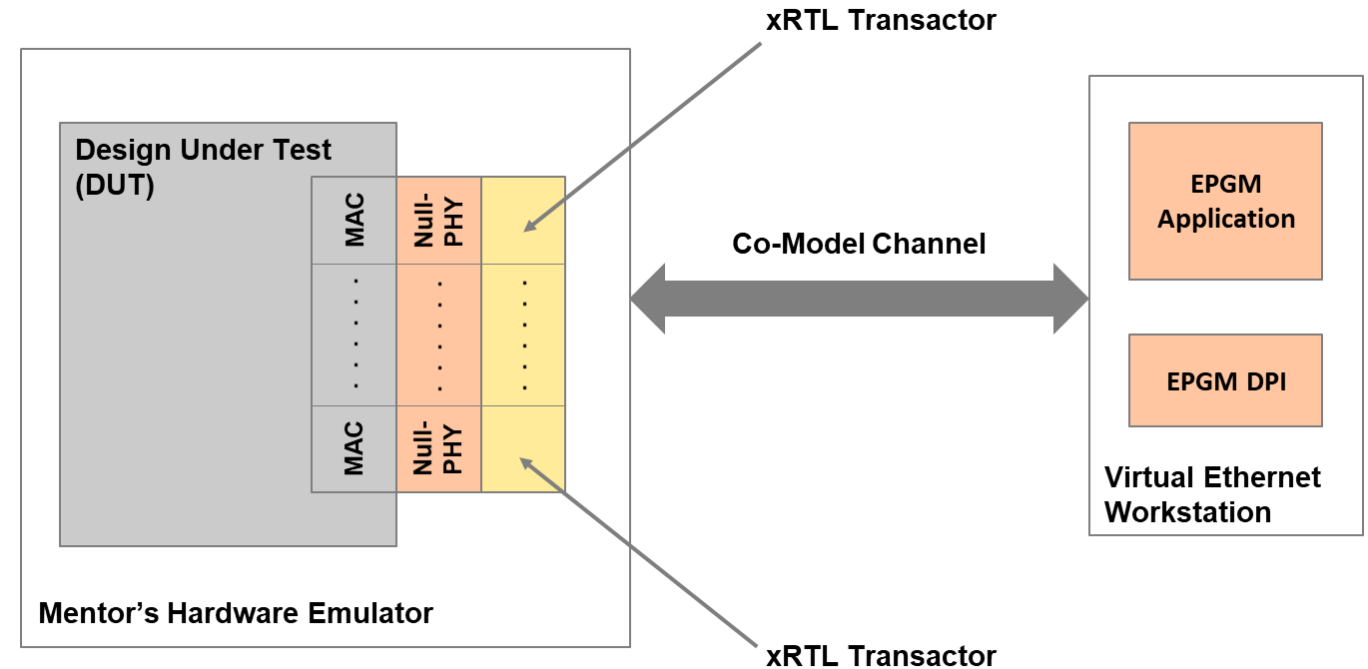
- Single Co-model Architecture





Ethernet Packet Generator Monitor (EPGM) Application

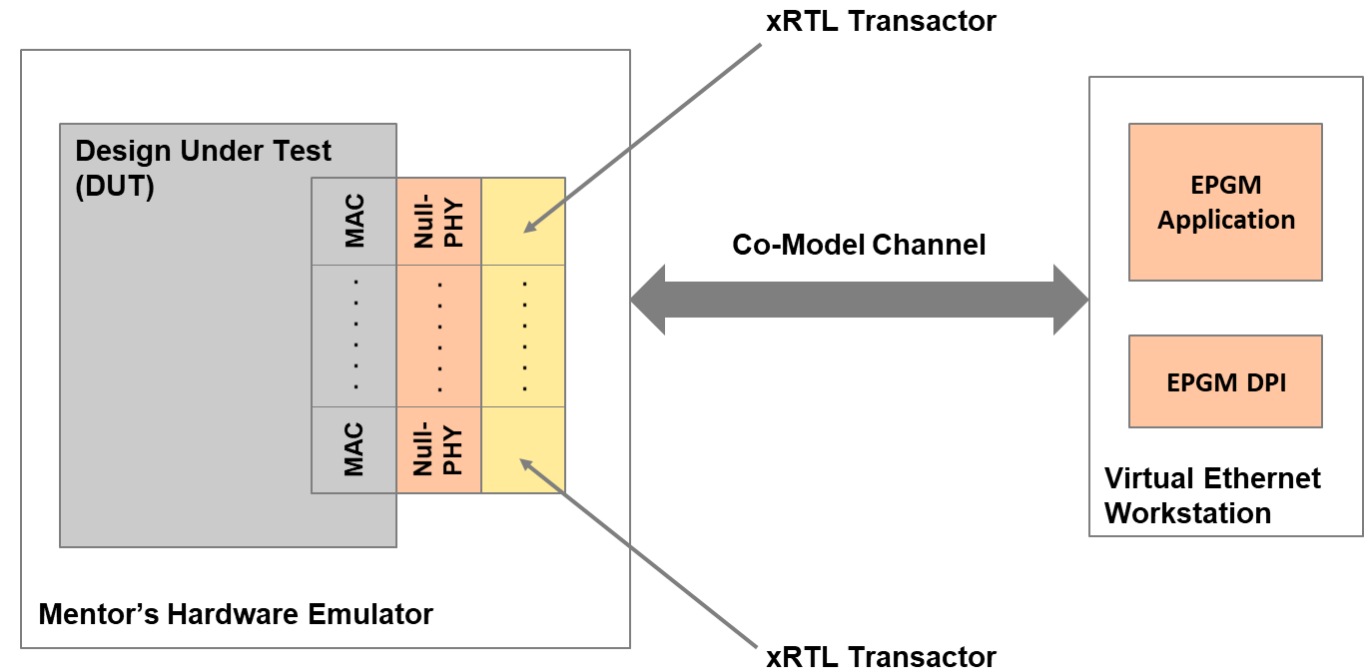
- EPGM is a software application that runs on the Veloce Virtual Ethernet Device workstation.
- It generates custom Ethernet frames, and sends them to the DUT in the emulator through the EPGM DPI.
- EPGM also receives and monitors the Ethernet frames sent from the DUT in the emulator for additional analysis, such as validating data received and providing statistics.
- The 32 supported ports can be monitored and analyzed at the same time.





Virtual Ethernet Workstation

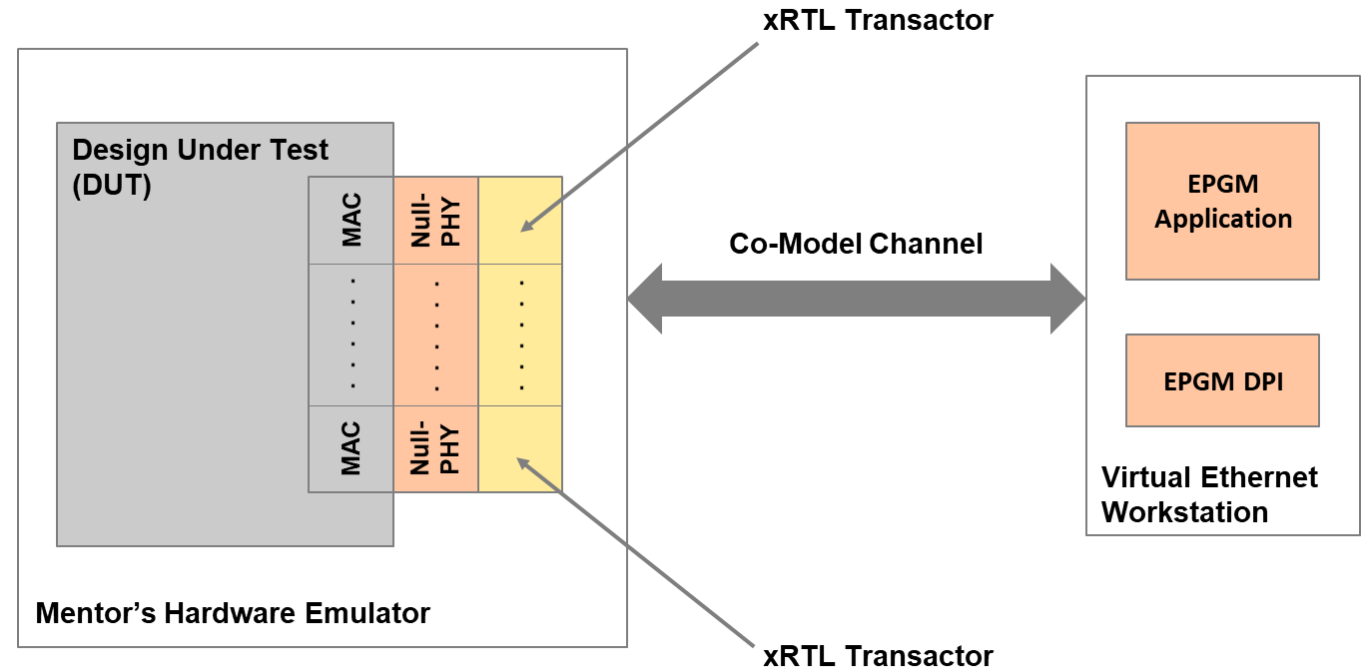
- Virtual Ethernet Workstation is a high performance workstation that hosts the EPGM DPI.
- In emulation mode it is the co-model host, and has Veloce software installed to run the EPGM DPI.
- It is connected to the Veloce emulator via the co-model channel, otherwise it should have Questa installed to run EPGM DPI in simulation mode.





EPGM Direct Programming Interface (DPI)

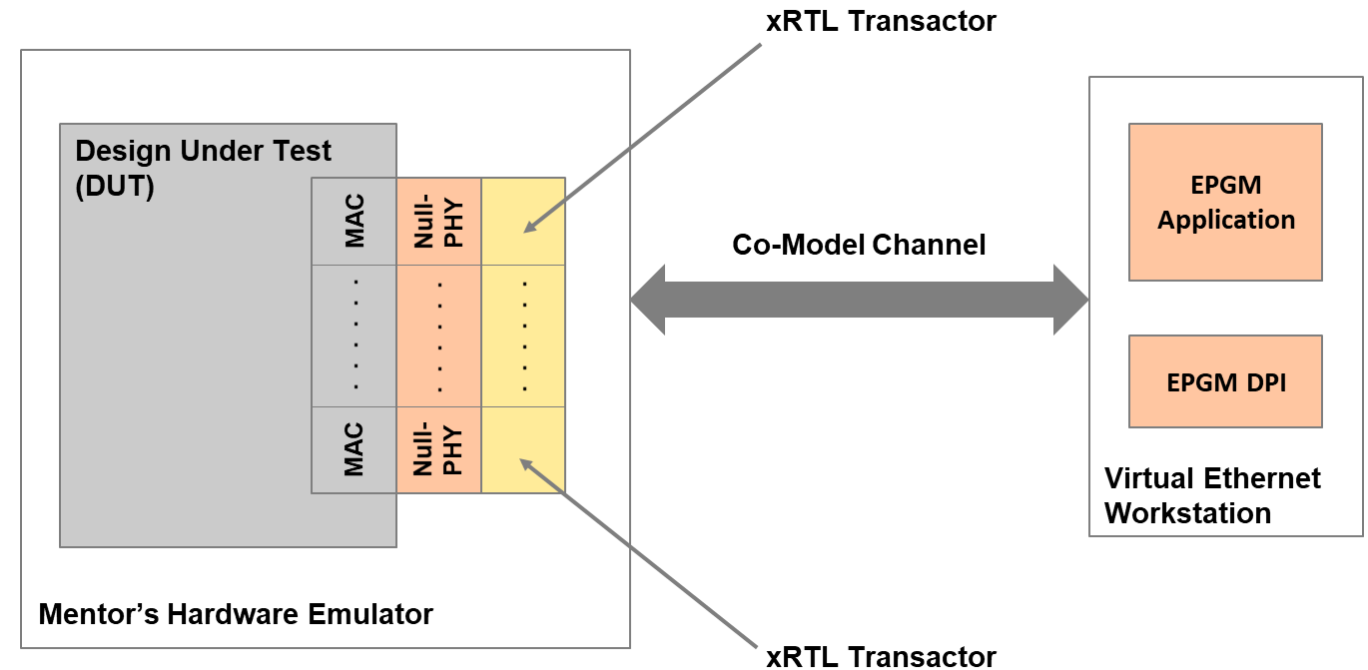
- EPGM DPI is a software program that runs concurrently with the DUT to forward data received from EPGM to the DUT and vice versa.
- It is delivered as a shared object library and linked during the compilation of the RTL code, and runs in emulation under Veloce, or in simulation under Questa®.





Virtual Ethernet xRTL Transactor

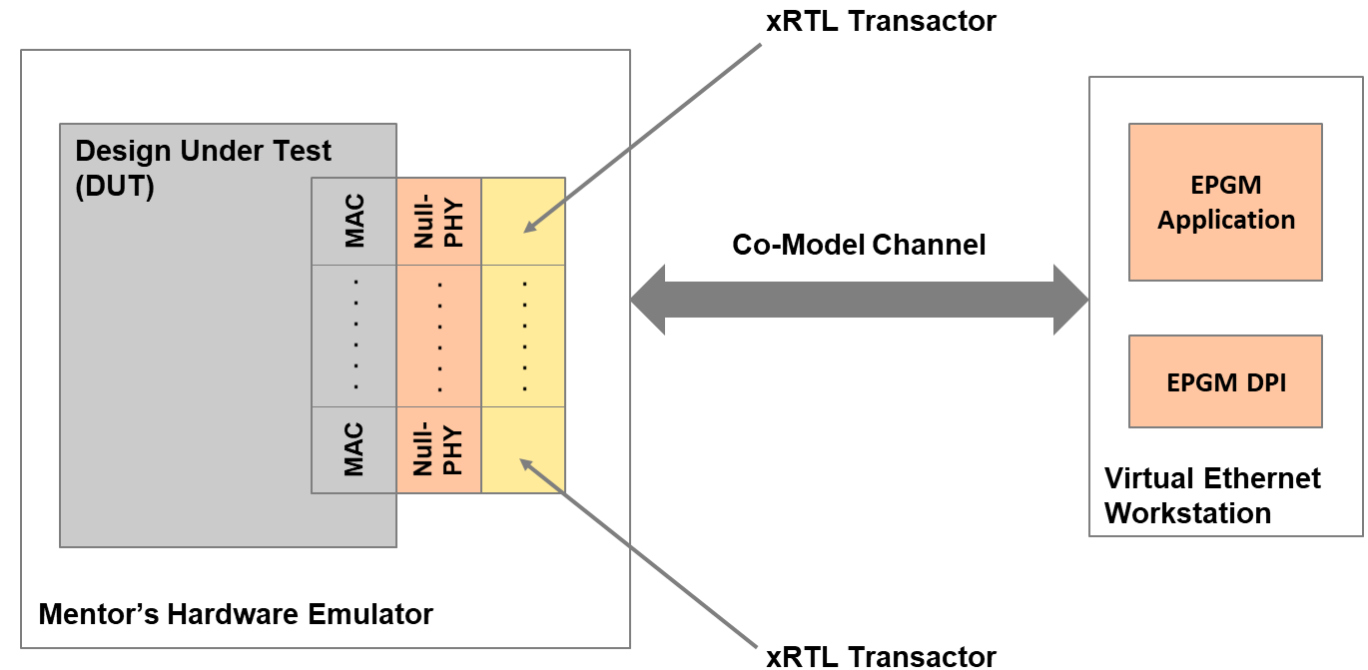
- Virtual Ethernet xRTL Transactor is a synthesizable SystemVerilog® xRTL module delivered with the Veloce Virtual Ethernet Device.
- It is the hardware interface from a Null-PHY, or Null-PM, interface to the EPGM DPI.
- One Virtual Ethernet xRTL Transactor may be connected to one of the Null-PHY interfaces or one of the Null-PM interfaces within the compiled RTL.





Null-PHY

- Null-PHY is a synthesizable Verilog RTL module delivered within the Veloce Virtual Ethernet Device that provides an MII interface to the DUT.
- This module must be compiled into the hardware emulator and interfaced to your MAC within the DUT.





Verification Environment of Ethernet-PCS IP with Mentor's Veloce Emulator

SiFive has successfully verified Ethernet-PCS IP with **Veloce Emulator** with 3-different environment setup:

- Null-Phy Environment
- Mutable Port Group(MPG) Environment
- Flex-E Environment



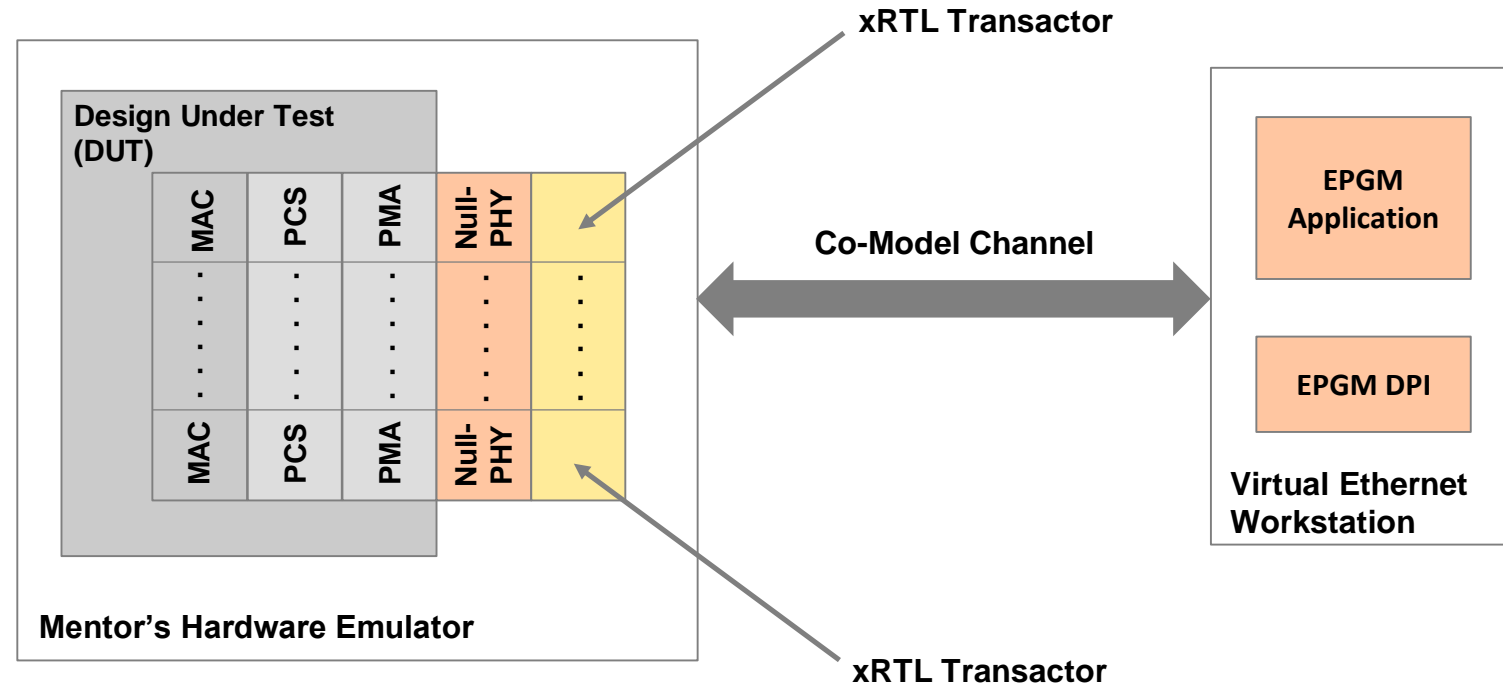
Null-Phy Environment

Loopbacks covered:

- MCMR External Loopback (with and without FEC)
- RX to TX Client to Client loopback

DUT Configurations:

- 400G (2 Lanes 80 bit; Max BW: 800G)
- 200G (4 Lanes 80 bit; Max BW: 800G)
- 100G (8 Lanes 80 bit; Max BW: 800G)
- 50G (16 Lanes 80 bit; Max BW: 800G)
- Mix Bandwidth(400G,200G,100G and two 50G)





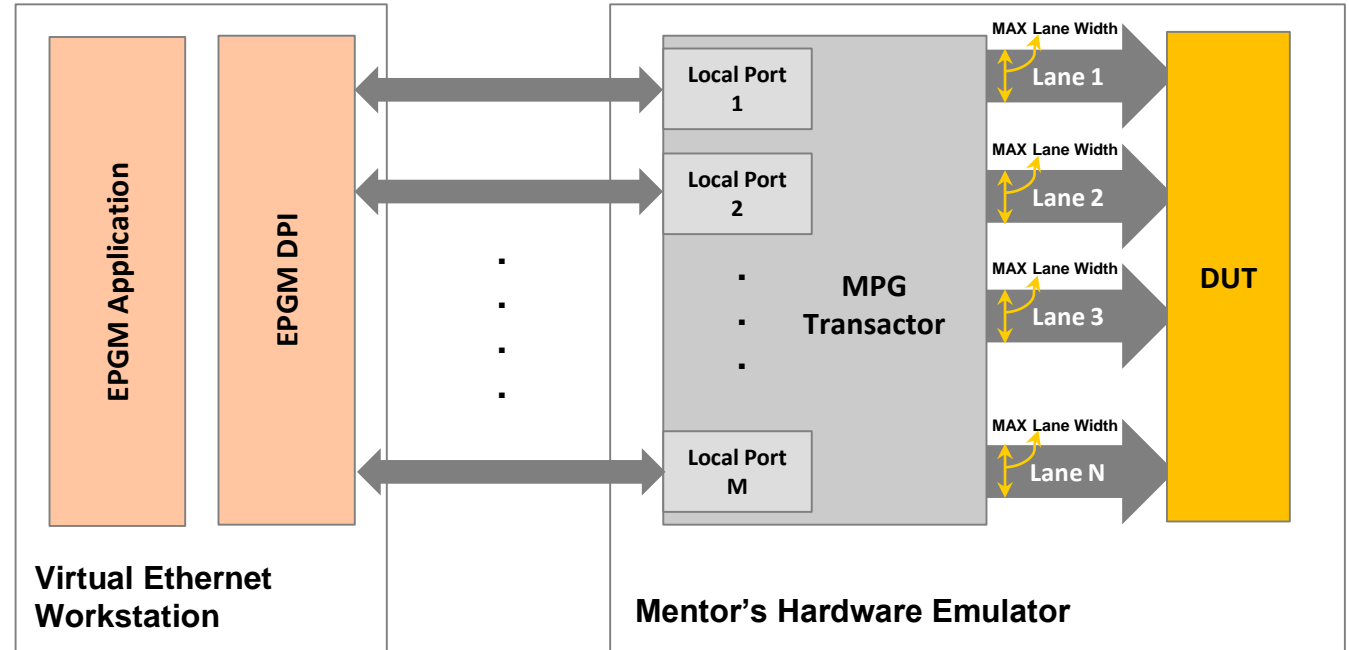
Mutable Port Group(MPG) Environment

Loopbacks covered:

- MCMR External Loopback
- RX to TX Client to Client loopback

DUT Configurations:

- Dynamic Switching between 800G, 400G, 200G, 100G and 50G
- Runtime Reset scenarios (soft and hard)





400G Configuration

```
mpgConfig 1 --clear  
mpgLocalPort l1 --lanes 8 --laneSize 80 --speed 400  
mpgConfig 1 --setPort l1 --localPortID 1 --startLaneIndex 1  
mpgLocalPort l2 --lanes 8 --laneSize 80 --speed 400  
mpgConfig 1 --setPort l2 --localPortID 2 --startLaneIndex 9  
applyMPGConfig 1
```

200G Configuration

```
mpgConfig 1 --clear  
mpgLocalPort l1 --lanes 4 --laneSize 80 --speed 200  
mpgConfig 1 --setPort l1 --localPortID 1 --startLaneIndex 1  
mpgLocalPort l2 --lanes 4 --laneSize 80 --speed 200  
mpgConfig 1 --setPort l2 --localPortID 2 --startLaneIndex 5  
applyMPGConfig 1
```



Flex-E Environment

Loopbacks covered:

- MCMR External Loopback
- RX to TX Client to Client loopback

DUT Configurations:

- 100G (8 Lanes 80 bit; Max BW: 100G)

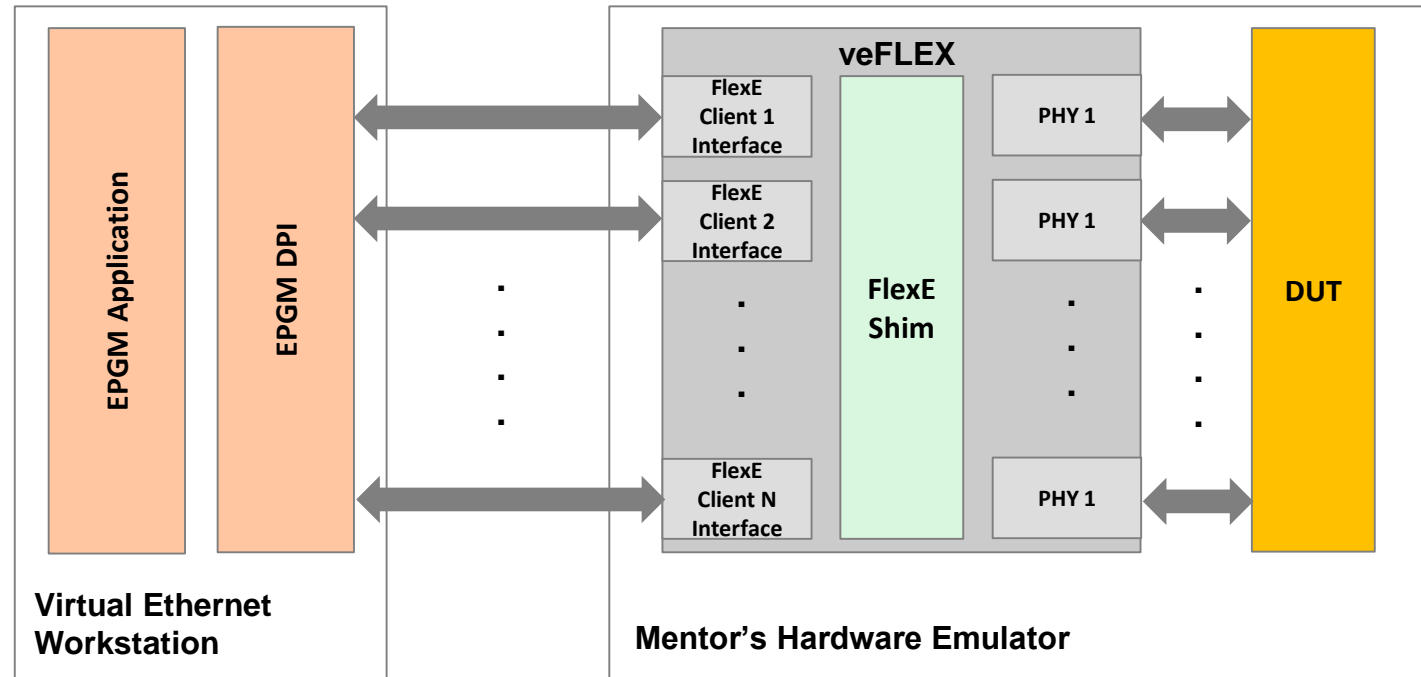
```

veFlexGroup shim1 --veFlexID 1 --phyNumbers 1 --groupNumberField 1
veFlexGroup shim2 --veFlexID 2 --phyNumbers 1 --groupNumberField 2
veFlexGroup shim3 --veFlexID 3 --phyNumbers 1 --groupNumberField 3
veFlexGroup shim4 --veFlexID 4 --phyNumbers 1 --groupNumberField 4

veFlexClient client1 --clientInterfaceID 1 --calendarField 1 --rate 25
veFlexClient client2 --clientInterfaceID 2 --calendarField 2 --rate 25
veFlexClient client3 --clientInterfaceID 3 --calendarField 3 --rate 25
veFlexClient client4 --clientInterfaceID 4 --calendarField 4 --rate 25
veFlexClient client5 --clientInterfaceID 5 --calendarField 5 --rate 25
veFlexClient client6 --clientInterfaceID 6 --calendarField 6 --rate 25
veFlexClient client7 --clientInterfaceID 7 --calendarField 7 --rate 25
veFlexClient client8 --clientInterfaceID 8 --calendarField 8 --rate 25

applyVeFlexConfig 1
applyVeFlexConfig 2
applyVeFlexConfig 3
applyVeFlexConfig 4

```



EPGM programming for FLEX-E



Summary

- Quick turn-around for IP Validation
- No Packets Errors and No Packet Drops found even after 24 hours of Emulation.
- Validated multiple configurations in less duration of time
- Support for FlexE 1.0 protocol
- Easy adaption of tools installation and emulation flow



Thank You
