

Demonstration of Cross-Layer Optimized Digital Media Streaming Enabled by the Integrated Measurement Framework (IMF)

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IMF: Integrated Measurement Framework

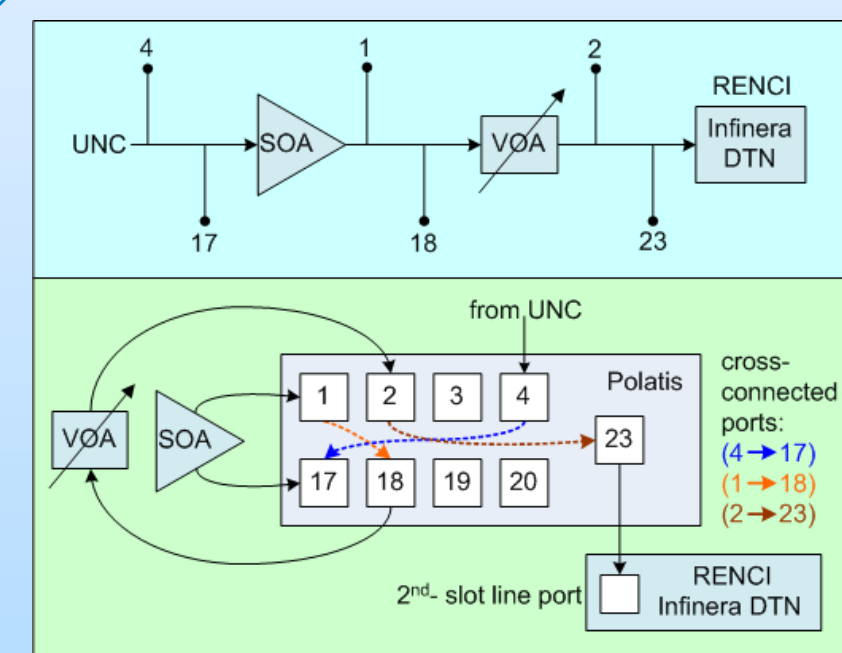
ERM: Embedded Real-Time Measurements

LEARN: Programmable Measurements over Texas-Based Research Network

IMF Overview

- Provides an abstraction of measurement capabilities (physical layer and performance parameters) through a unified PubSub interface.
- Utilizes measurement capabilities to enable cross-layer communication via the Services Integration, control, and Optimization (SILO) network architecture.
- An optical control plane further utilizes measurement capabilities to allow for cross-layer control and management decisions based on optical layer performance.

Demo Setup

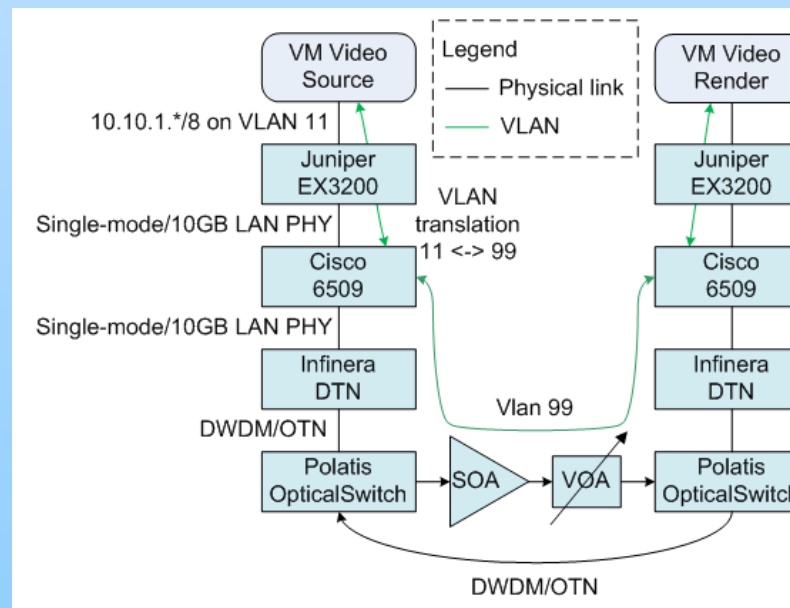


Physical Connections in BEN

- Breakable Experimental Network (BEN) connects together RENCi, UNC, Duke, and NCSU.
- (top) Logical connection among optical devices from UNC to RENCi in BEN.
- (bottom) Physical connection at the RENCi site of BEN.

Virtual Machine Configurations

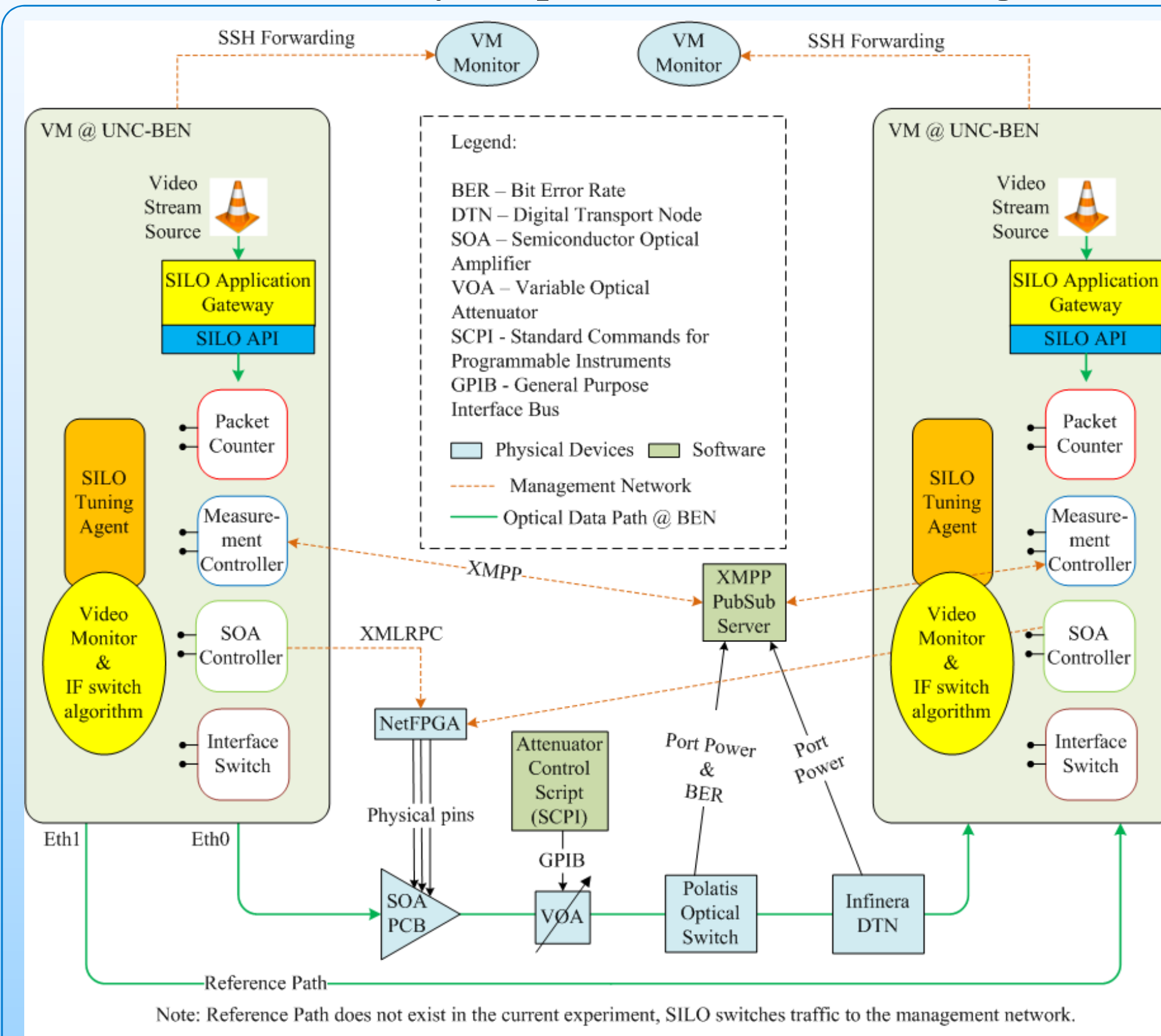
- VM configuration at RENCi and UNC site.
- VMs between RENCi and UNC are manually configured into a VLAN.
- SILO is running on the VMs.



Optical Control Plane

- NetFPGA is used to allow programmable control of optical components.
- NetFPGA SW contains XML-RPC commands to allow remote access of optical comments.
- NetFPGA HW provides I/O interface to optical components.

IMF Demo: Cross-Layer Optimized Video Streaming



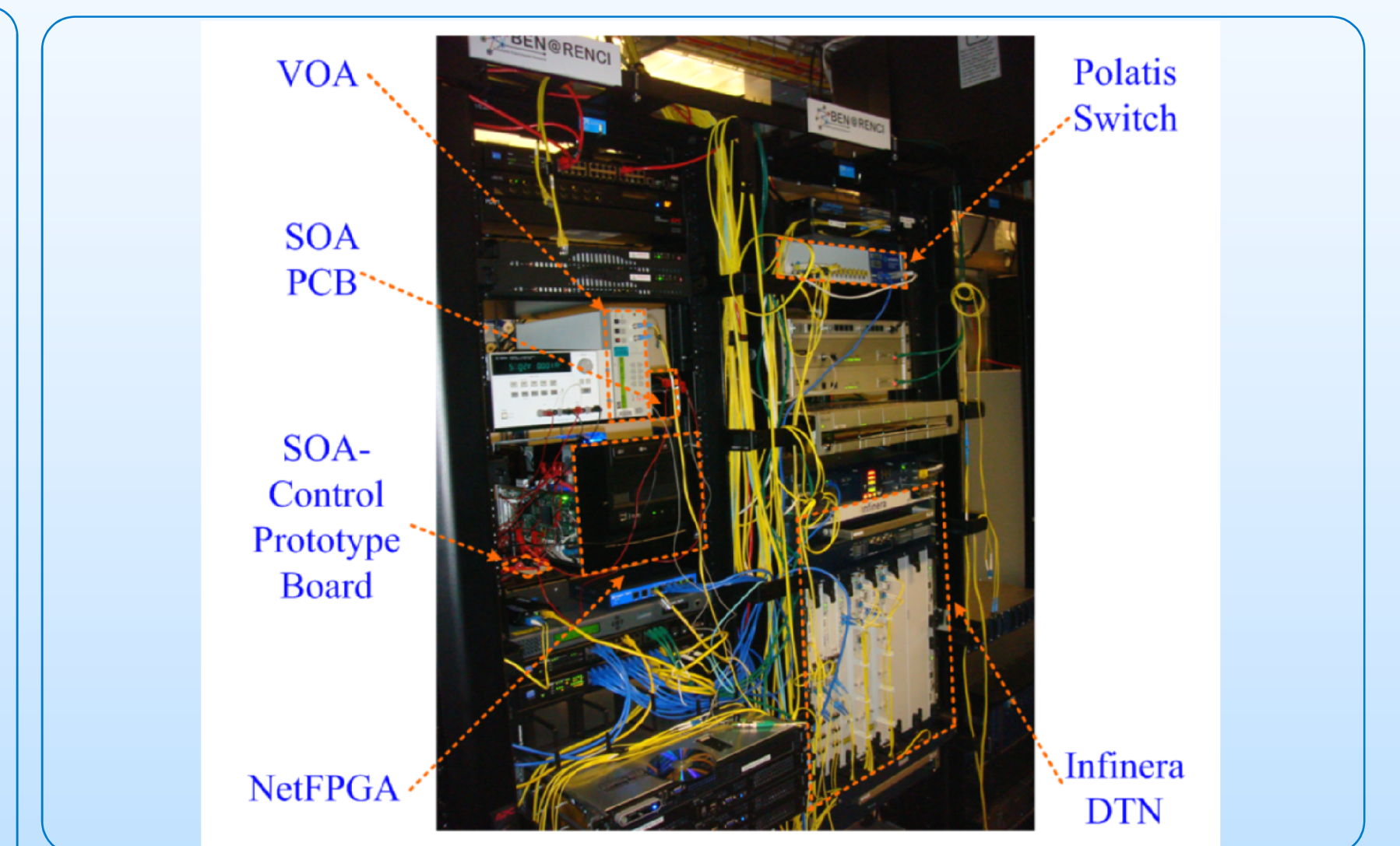
Four SILO services are used on each site (UNC & RENCi):

- *Packet Counter* - counts the number of packets.
- *Measurement Collector* - collects port power/BER from Polatis and Infinera, published by the PubSub server.
- *SOAC* - controls the SOA through XML-RPC.
- *Interface Switch* - switches video stream between Eth0 and Eth1.

Video Monitor and Interface Switch algorithm tunes the SILO services to

- Increase the amplification on the SOA to compensate the power loss due to the VOA.
- Decrease the amplification on the SOA to ensure the port power never exceeds a safe-operating threshold.
- Switch traffic to a reference path when the SOA-protected path cannot be compensated anymore.

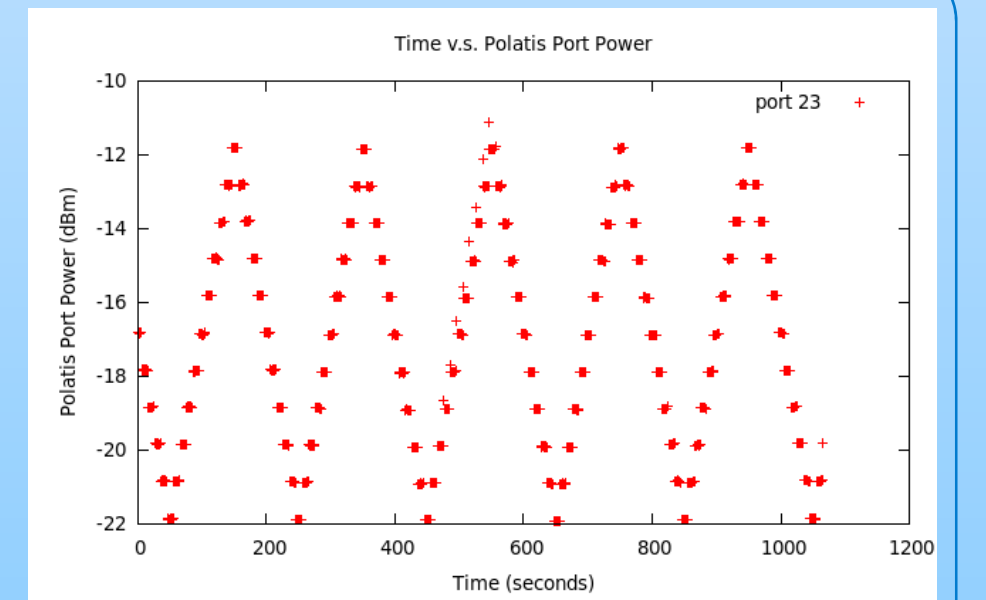
IMF Infrastructure at BEN-RENCi



Experimental Results

Power Level without Cross-Layer Compensation

- Range of power fluctuation is 11 dB (b/w -11 to -22 dBm) as set by VOA.



Power Level with Cross-Layer Compensation

- IMF ensures the power level always falls within a smaller range of fluctuation.
- Full range of power fluctuation is 4 dB (b/w -15 to -19 dBm).
- Power falls within a smaller range of 2 dB (b/w -16 to -18 dBm) most of the time.

