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

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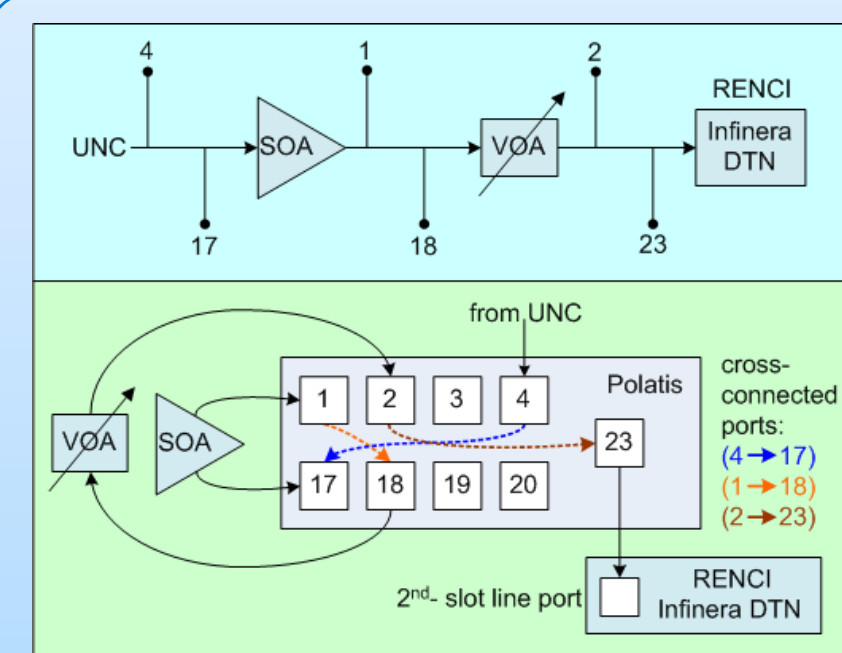
IMF: Integrated Measurement Framework
ERM: Embedded Real-Time Measurements
LEARN: Programmable Measurements over Texas-Based Research Network

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.
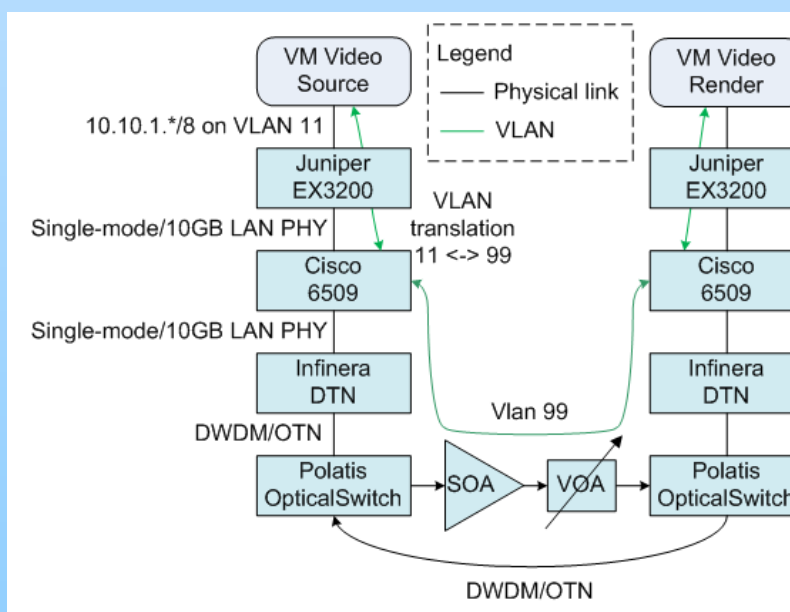
Demo Setup

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.

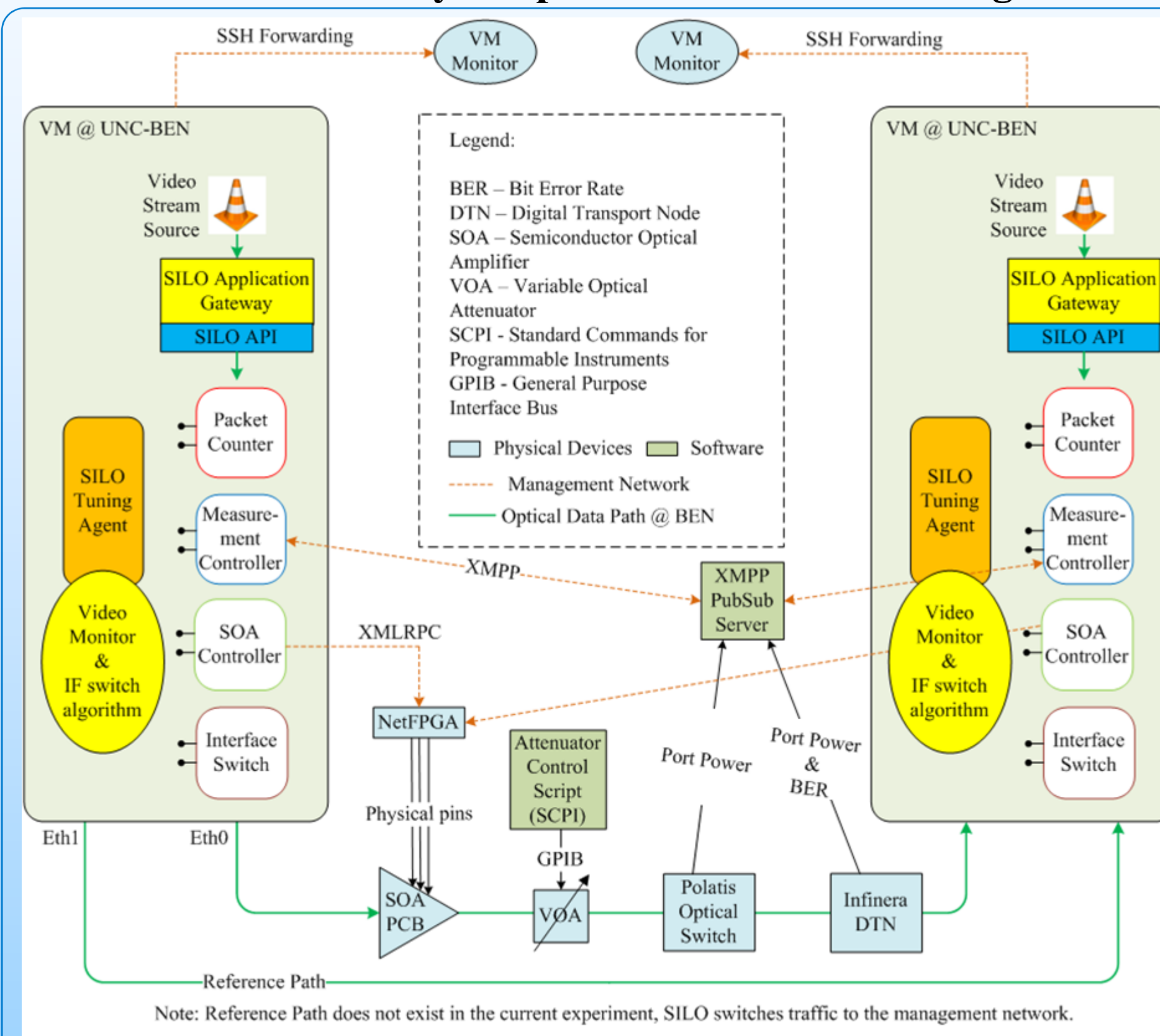### Virtual Machine Configurations

- 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

Note: Reference Path does not exist in the current experiment, SILO switches traffic to the management network.
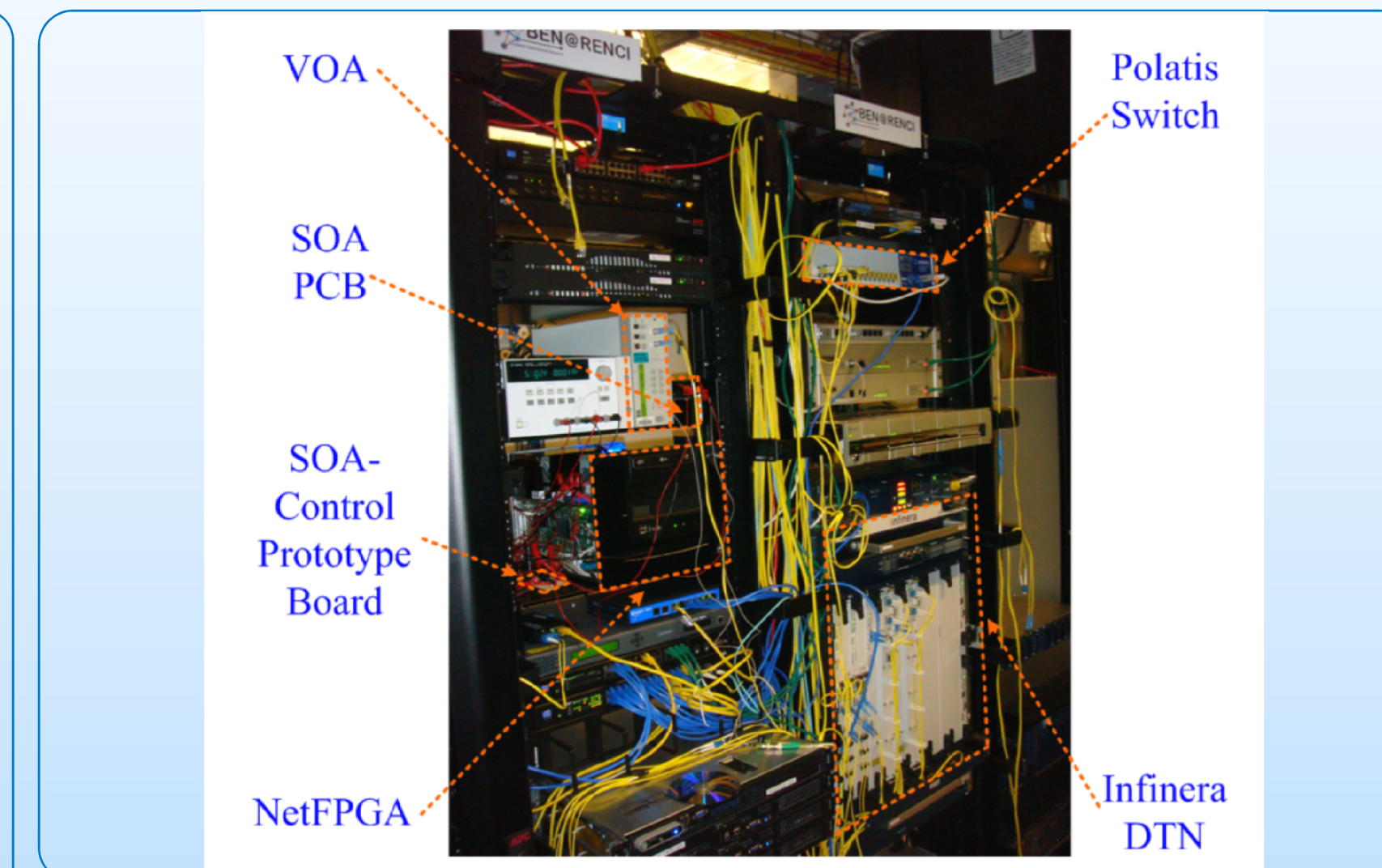
Four SILO services are used on each site (UNC & RENCI):
- *Packet Counter* - counts the number of packets.
- *Measurement Collector* - collects port power/BER from Polatis and Infinera, published by the PubSub server.
- *SOAC* - controls the SOA through XML-RPC.
- *Interface Switch* - switches video 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.
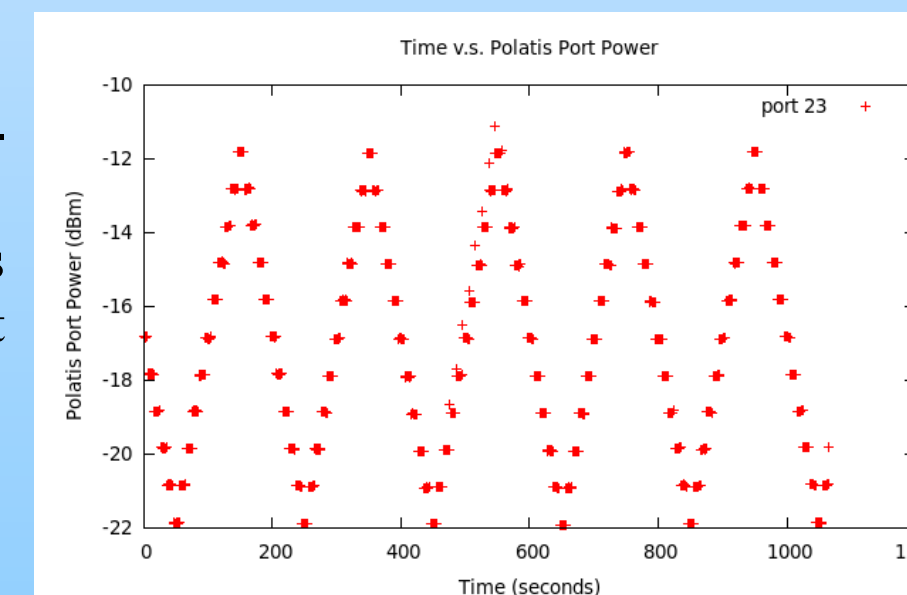
IMF Infrastructure at BEN-RENCI

Experimental Results

Power Level *without* Cross-Layer Compensation
- Range of power fluctuation is 10 dB (-12 to -22 dBm) as set by the 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 (-15 to -19 dBm).
- Power falls within a smaller range of 2 dB (-16 to -18 dBm) most of the time.