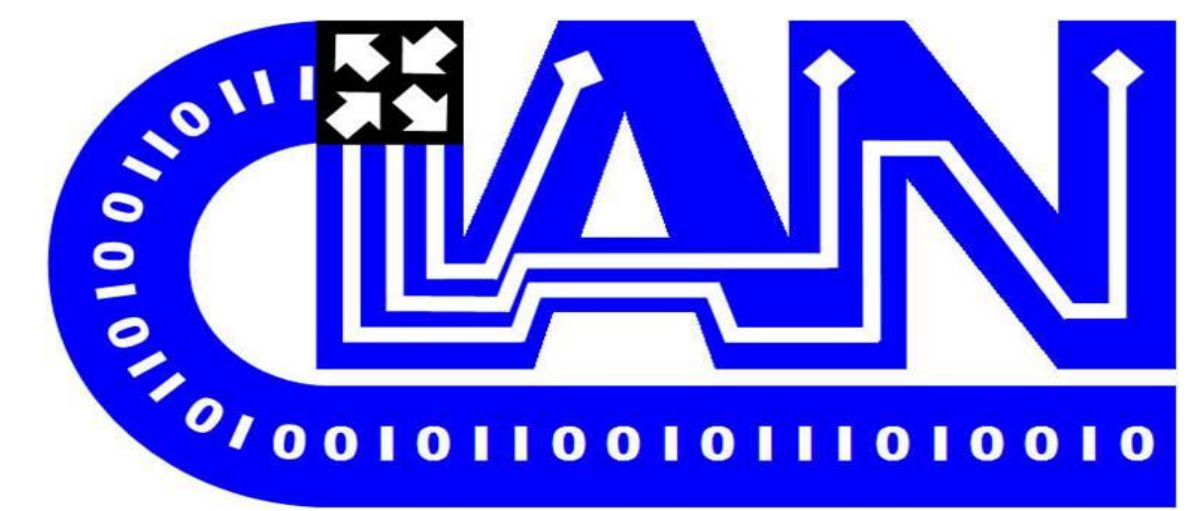




C1-2 CIAN-Box for Intelligent Access Aggregation Networks



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Thrust 1, Working Group 2 – Intelligent Aggregation Networks

Statement of the Problem

Delivering multitude of heterogeneous applications with diverse service-level requirements in a **cost** and **energy-efficient** manner is the main challenge. Creating a transparent intelligent service-aware aggregation network at the code-edge interface delivers the requirements of the end users and improves the network performance via cost and extreme high-energy efficiency.

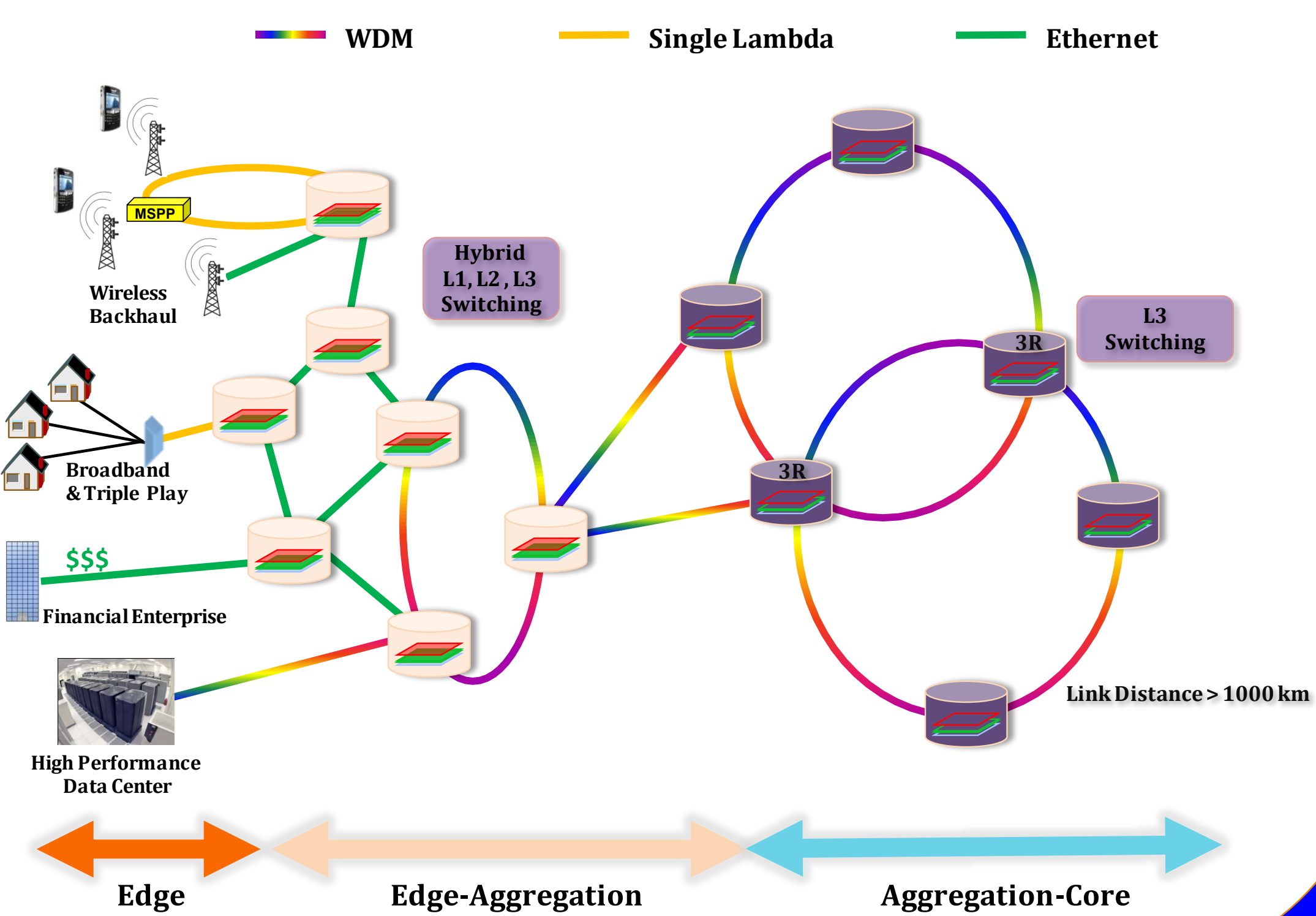
Technical Approach

CIAN-box: Intelligent cross-layer enabled aggregation node consisting of CIAN technologies that overcomes the bottlenecks of current aggregation networks.

Functional gains of CIAN-box:

- ✓ Energy-efficiency
- ✓ Optical-layer introspection
- ✓ Programmable flexibility accounting for application-specific QoS and optical QoT constraints
- ✓ Deliver efficient, low-cost high-bandwidth to multiple users at aggregation/core interface
- ✓ Reliability and protection schemes via a cross-layer communication platform.

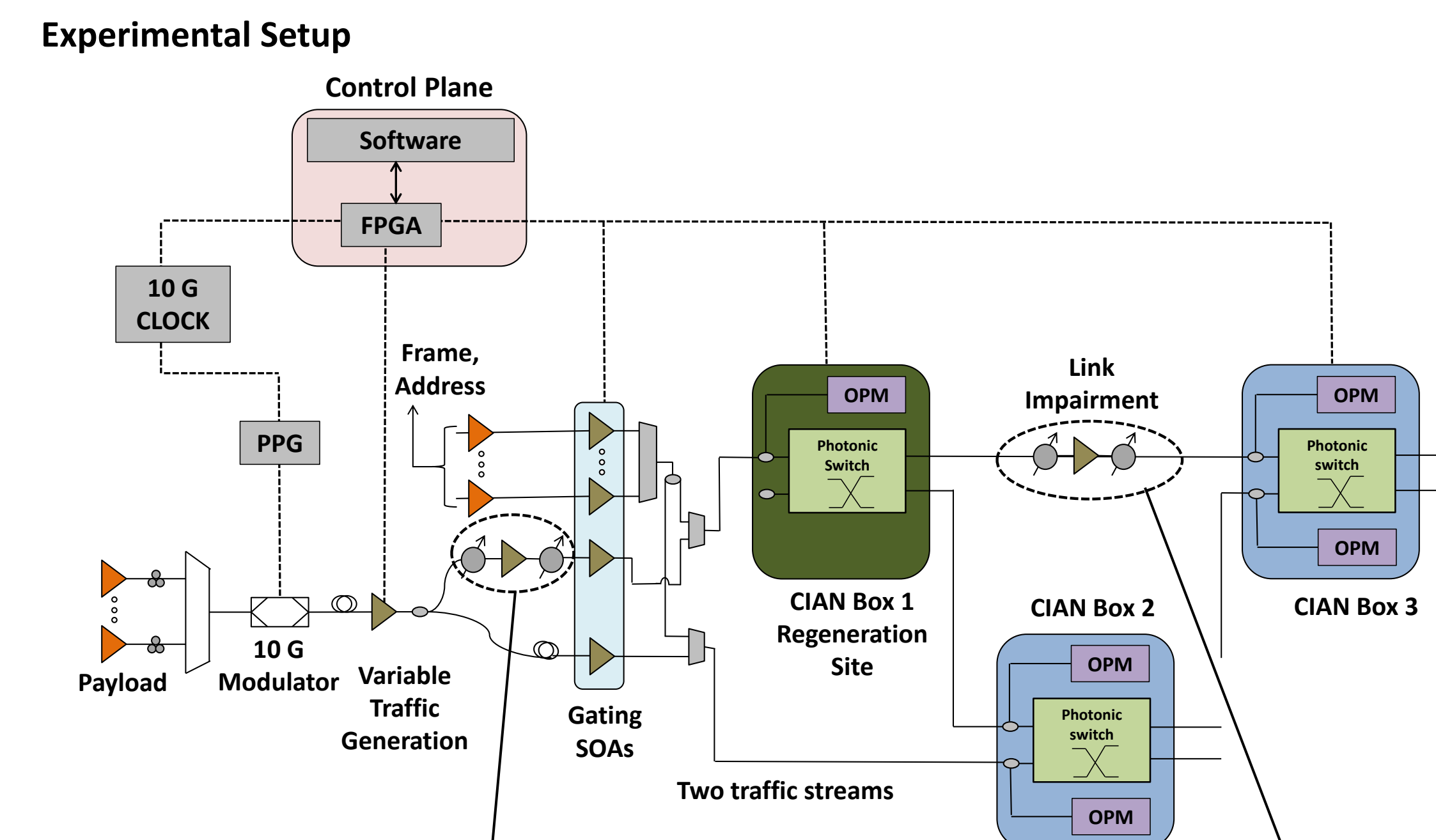
CIAN Box-Enabled Aggregation Network



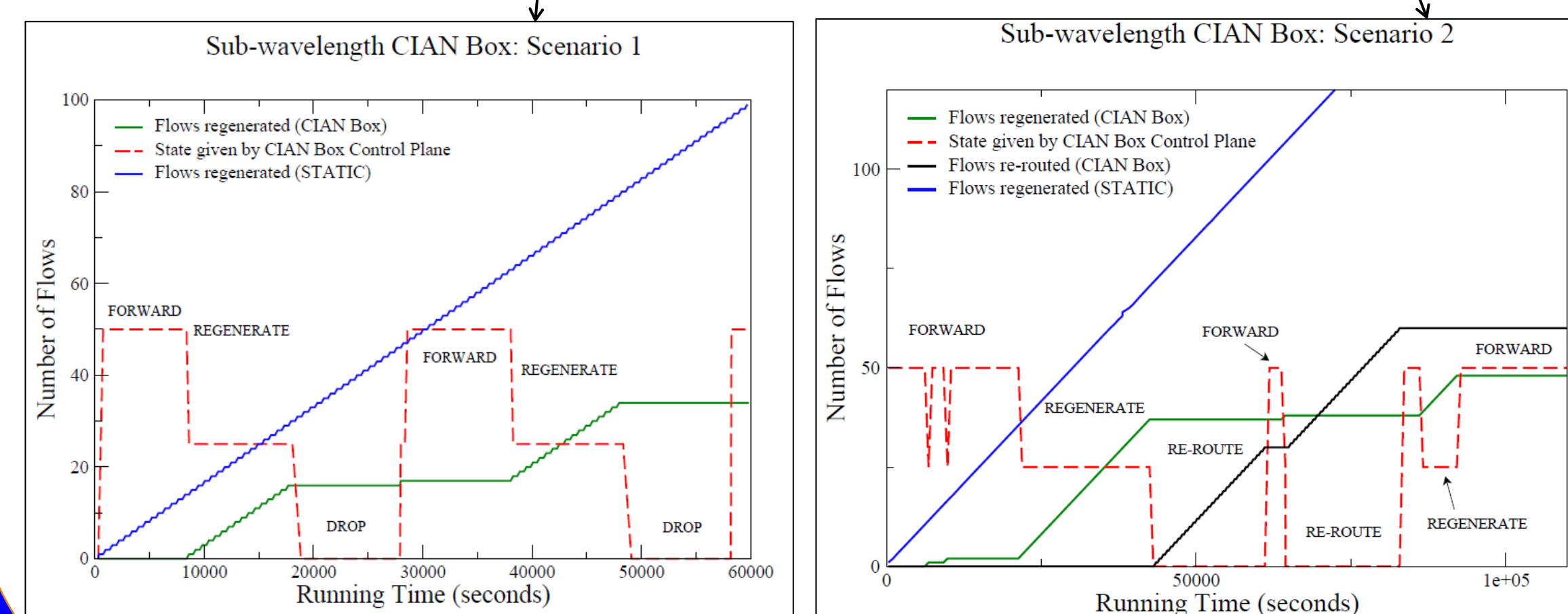
Sub-Wavelength Switched CIAN Box Experimental Set-up

Experimental evaluation:

- ✓ Real-time OSNR monitoring, impairment awareness and FPGA and software control plane
- ✓ Optimized use of OEO regenerators
- ✓ Improved network performance (packet loss probability) by dropping ghost flows
- ✓ Experimental results validate functionality for simulations on large scale networks.



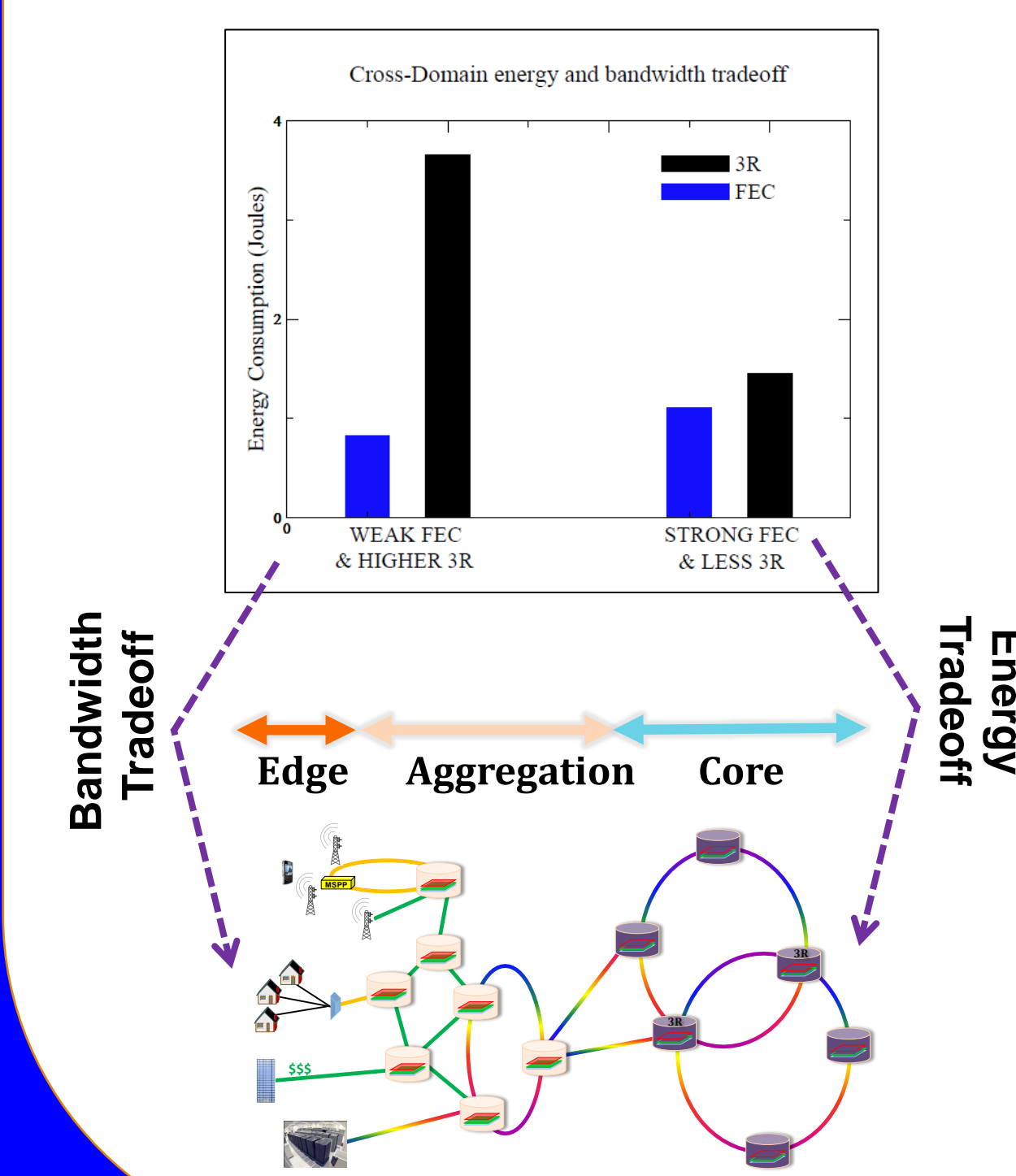
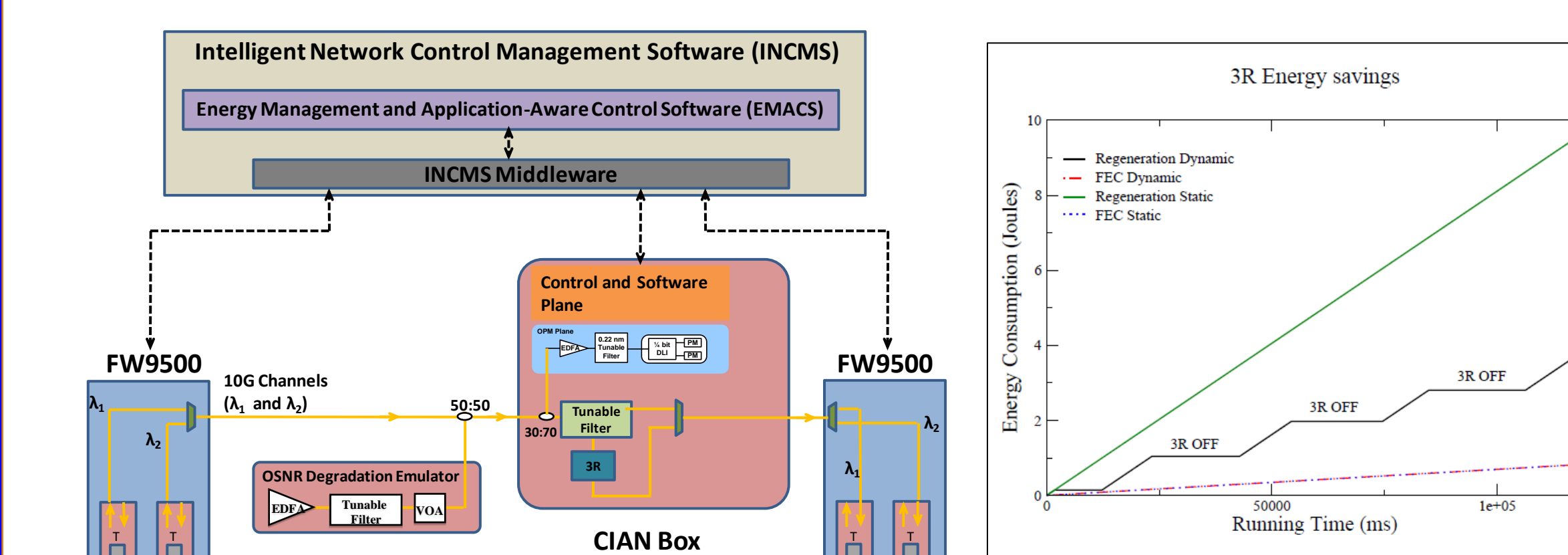
Results



Wavelength Switched CIAN Box and TOAN Insertion

Experimental evaluation:

- ✓ Real-time OSNR monitoring, impairment awareness and centralized software control plane
- ✓ Energy savings via (a) optimized 3R utilization, (b) application-adaptive FEC, and (c) cross-domain bandwidth and energy tradeoff
- ✓ Real-time, application-aware energy estimation across TOAN



Edge network consumes major resources in coding, such as FEC.

FEC Type	Power Consumption (W/Gbps)
Strong	0.8
Medium	0.7 *
Weak	0.6 *

*estimated

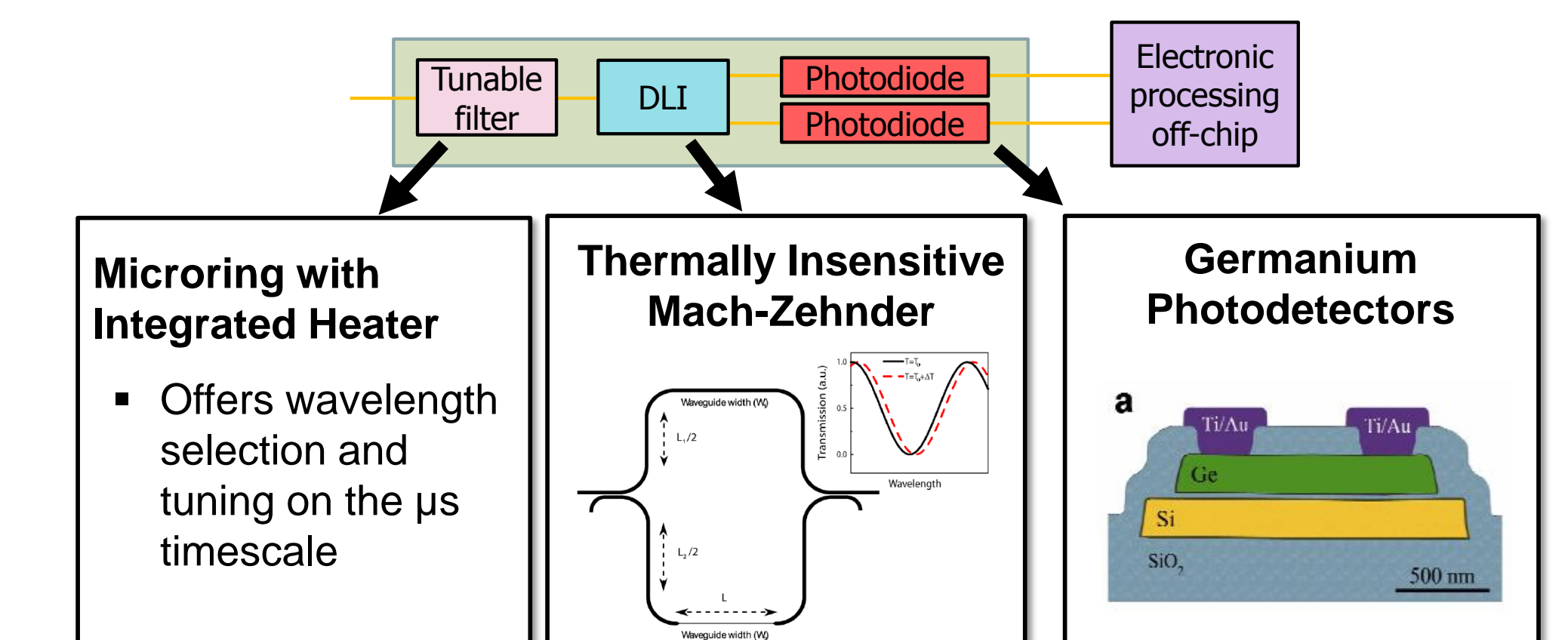
3R energy/bit = 10x FEC energy/bit
of FECs = 100,000x # of 3Rs

CIAN Box enables optimized tradeoff between bandwidth and energy utilization across different domains [edge/core] of the network

Future Plans

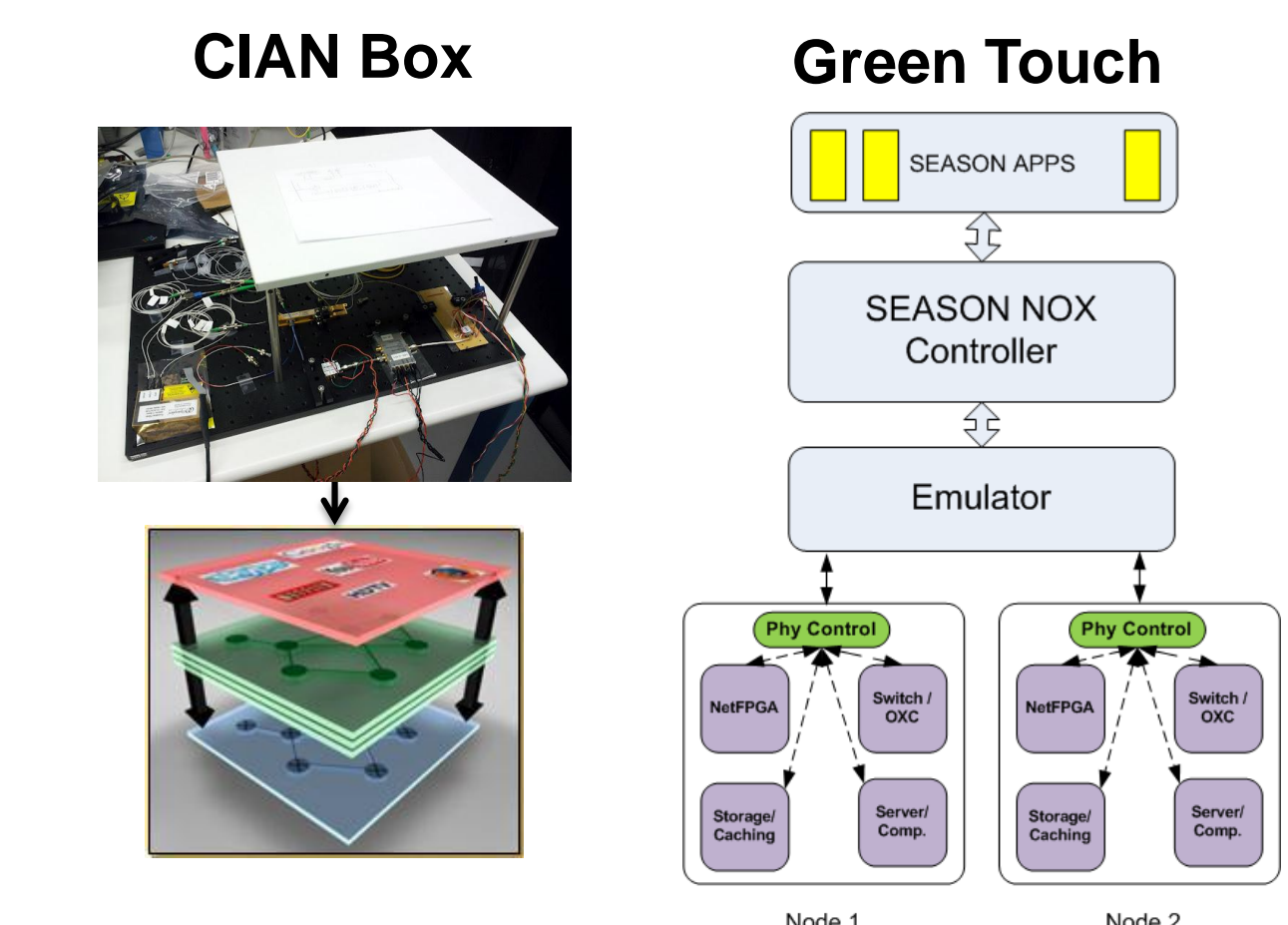
CIAN Box OPM Integration

- ✓ Create OSNR monitoring chip using CIAN devices
- ✓ 160G DLI on-chip for the first experimental demonstration of OSNR monitoring of 40G data using this technique



Green Touch - CIAN Demonstration

- ✓ Deployable CIAN box for the application center demonstration



- Develop extensive simulation tool for CIAN box enabled network

- Demonstrate efficient network traffic engineering using CIAN box