

# In-slice Sensing with PerfSONAR and Network Performance Simulation

## ERM

## IMF



### Embedded Real-Time Measurements

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### Integrated Measurement Framework

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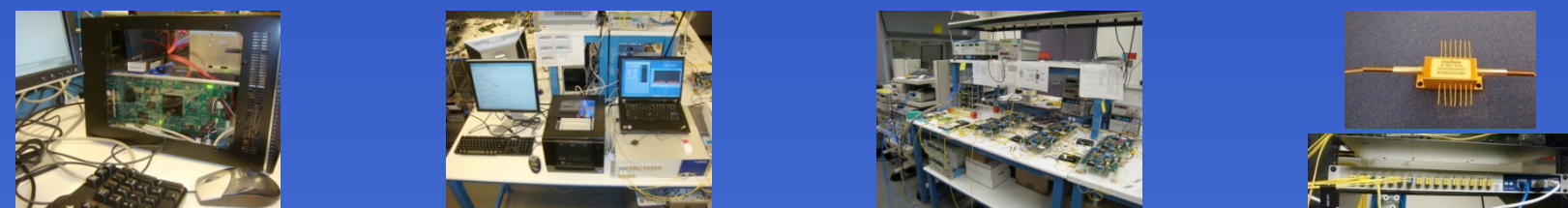
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### ERM Overview

Address the GENI challenge of architectural experimentations across diverse heterogeneous technologies by

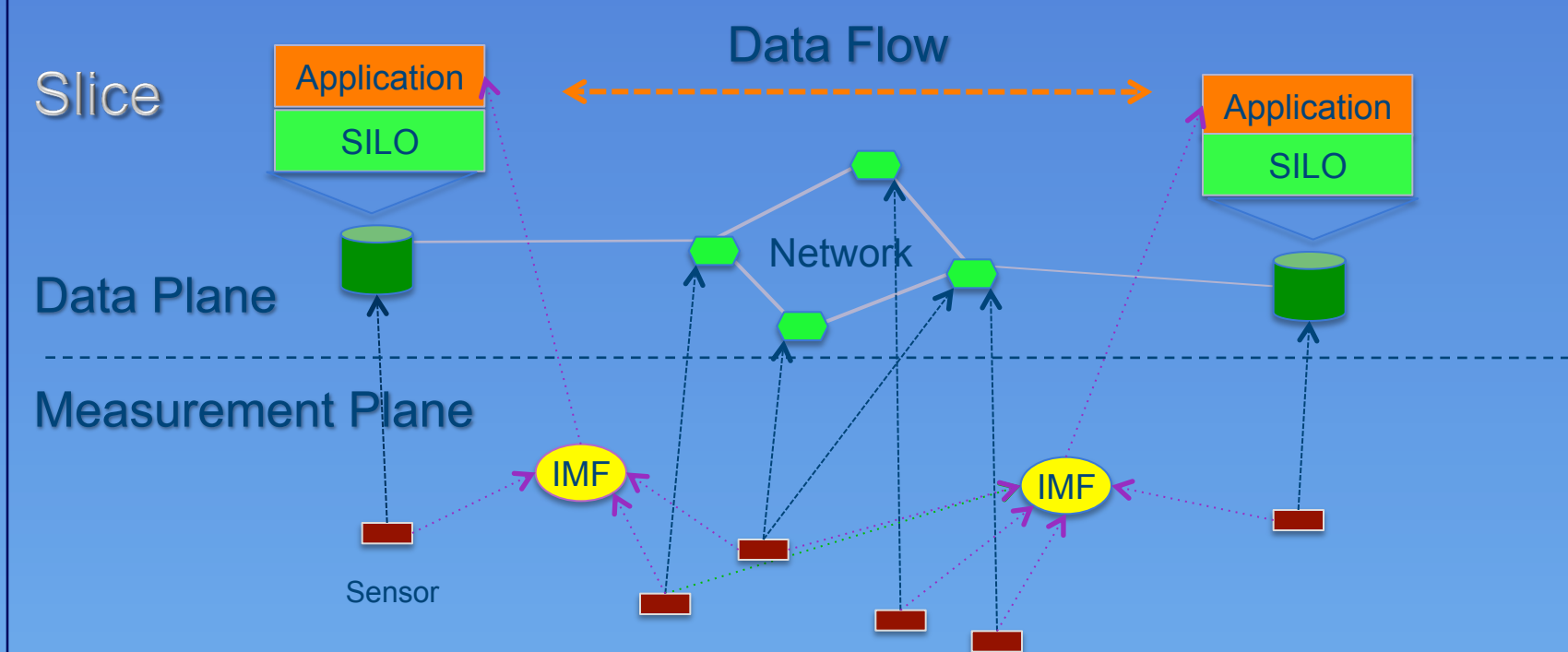
- Supporting embedded real-time measurements from GENI substrates.
- Utilizing measurement capabilities to enable cross-layer communication and control.



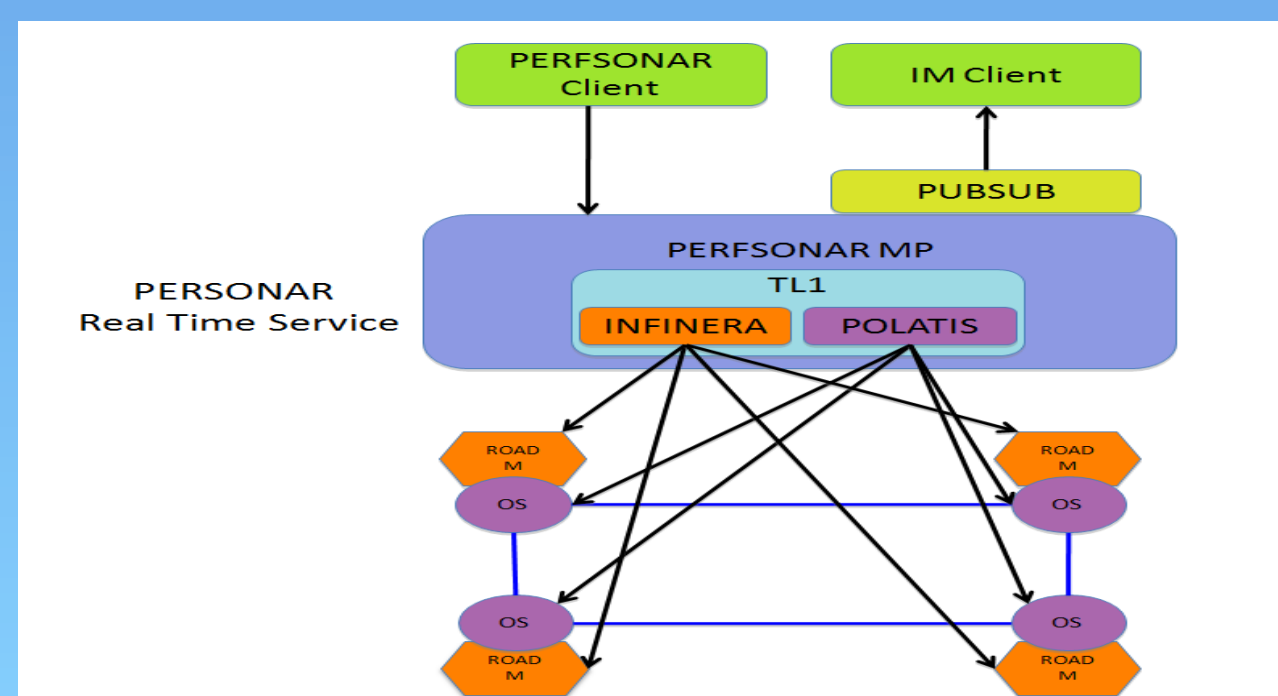
### IMF Overview

Enable in-slice consumption of measurements generated by optical substrate  
 Enable experimentation with intelligent in-stack protocols reacting to measurements

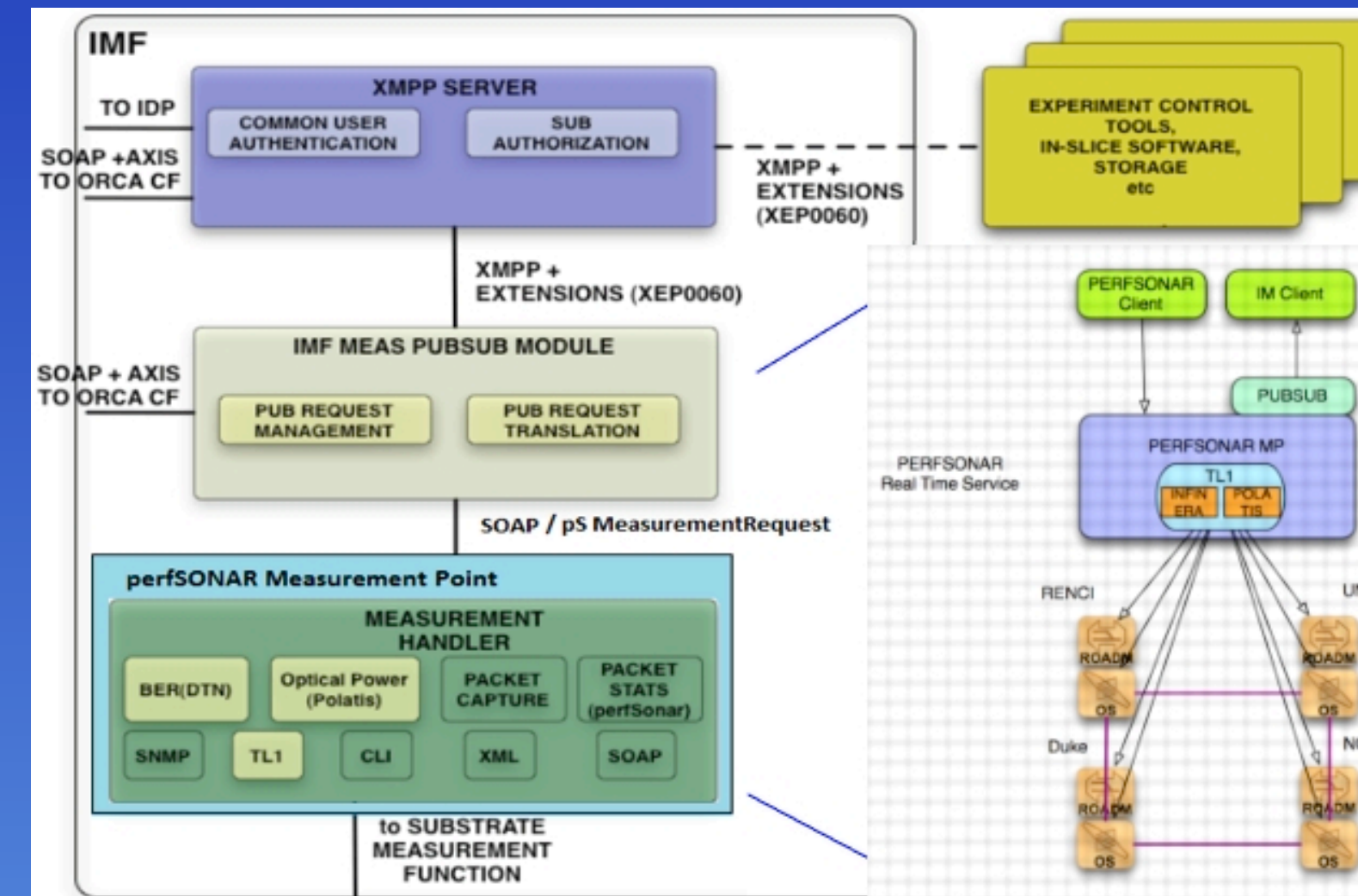
Currently spiral: Interface with perfSONAR, enable ERM box with pS  
 Future: provide experimenter interface to measurement resources through CF



### Integration with PerfSONAR

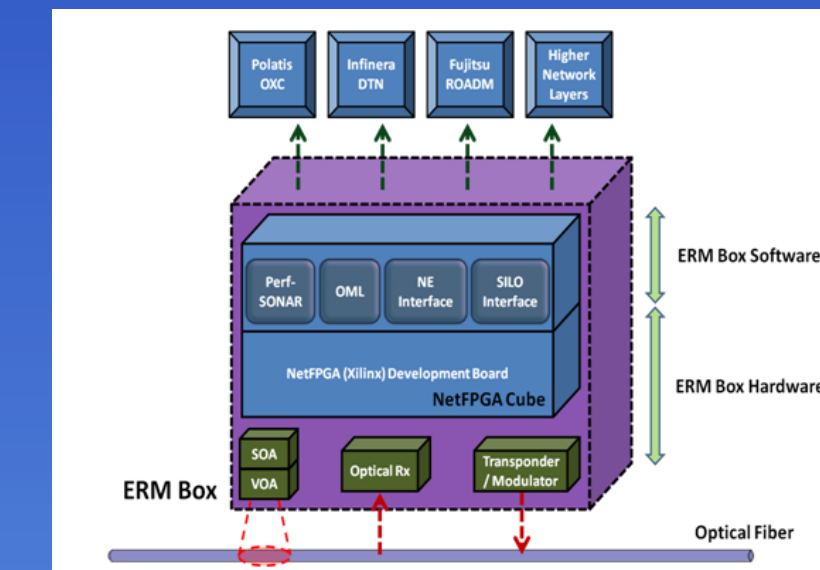


### Detailed IMF Software Architecture with perfSONAR



### ERM Box: Hardware and Software solution

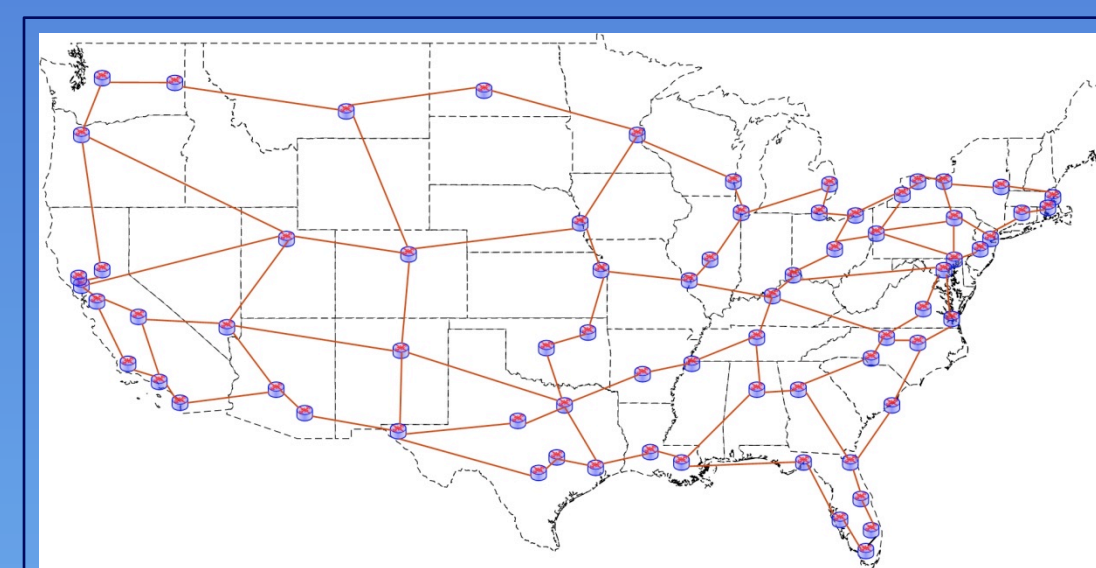
- Hardware and Software Solution to :
  - Support real-time measurements from GENI substrates
  - Utilized measurement capabilities to enable cross-layer communication and control
  - ERM box that is robust and universally deployable
  - Enhanced performance of existing optical networks in GENI



ERM Box

1. Design and develop a robust, universally deployable version of the UMF (called the 'ERM Box'): The design of this box will integrate the needs and requirements of current GENI infrastructures. We plan to integrate with perfSONAR.
3. Develop a simulation environment with network models incorporating the ERM Box and cross-layer measurement capabilities to enable experimental modeling in large-scale networks.
5. Deploy multiple ERM boxes (between 2 to 4) within suitable GENI infrastructures. Potential GENI infrastructures include:

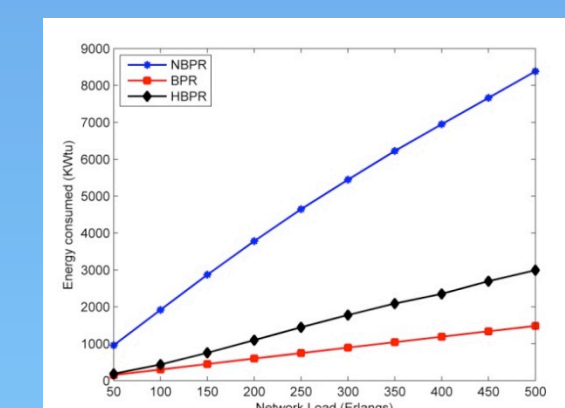
### Network Performance with ERM capabilities



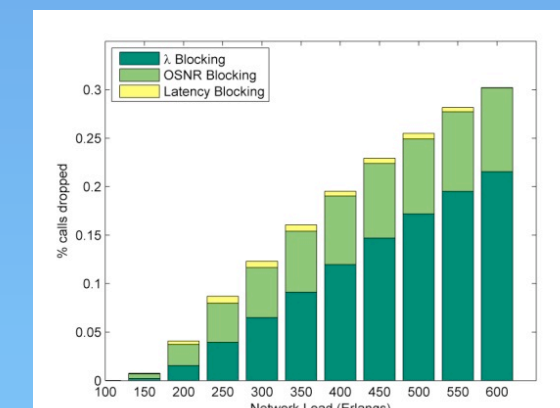
US CORONET Network Topology

Fiber-optic backbone network developed for use in the research of large-scale DWDM networks.

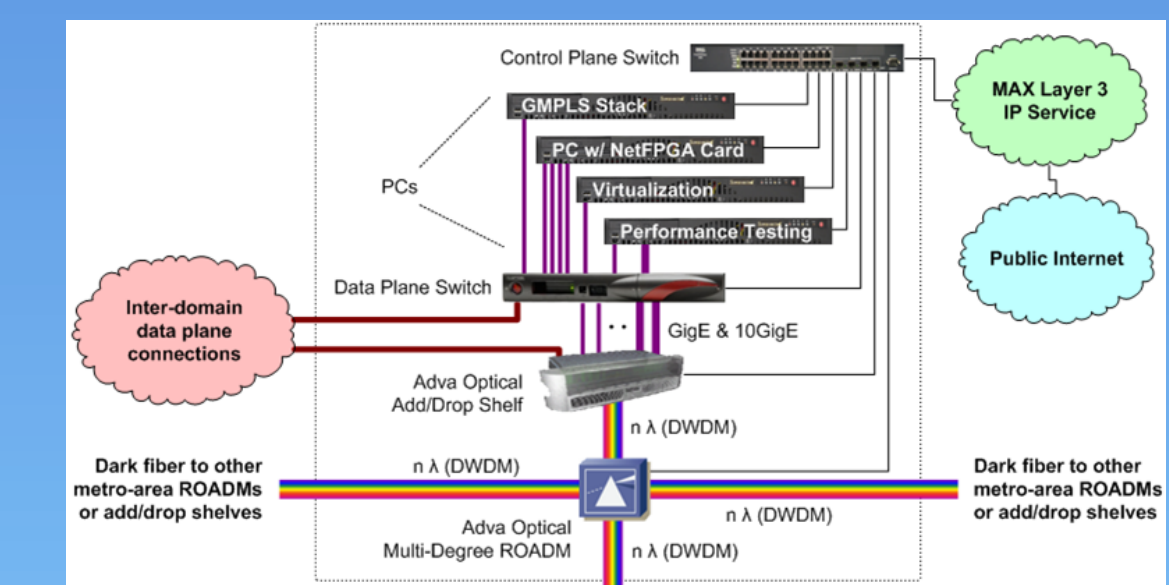
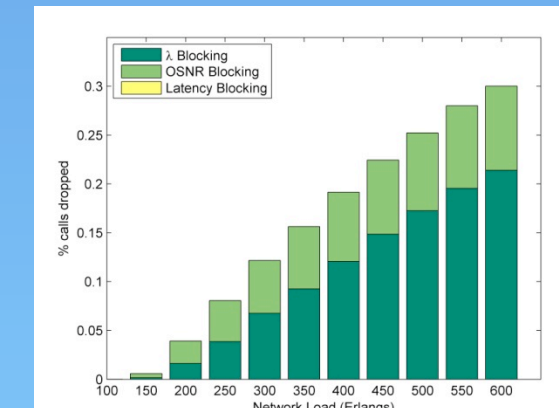
Network enabled with ERM, communicating across layers by IMF or similar, can route a lightpath with energy efficiency with minimal impact on quality-of-service (QoS) constraints imposed during the connection provisioning. Routing methods for lightpath include (1) Bypass (2) Non-bypass, and (3) Hybrid bypass.



(a) Energy consumptions in CORONET for different routing methods

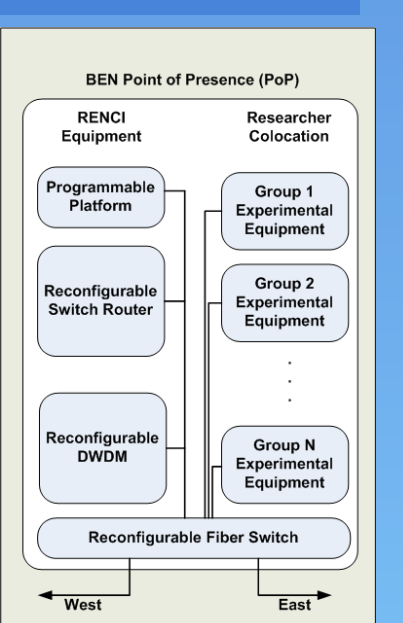


(b) Calls blocked due to constraints such as wavelength continuity, OSNR and latency. In (b) latency threshold is 70 ms and in (c) 100ms



DRAGON Network

BEN Network



4. Conduct an experiment using this ERM-enabled network involving non-GENI researchers. We have initiated collaborations with AT&T Research and Alcatel-Lucent.