Service Independent Access Points (SIAP) to Optical Wide Area Networks

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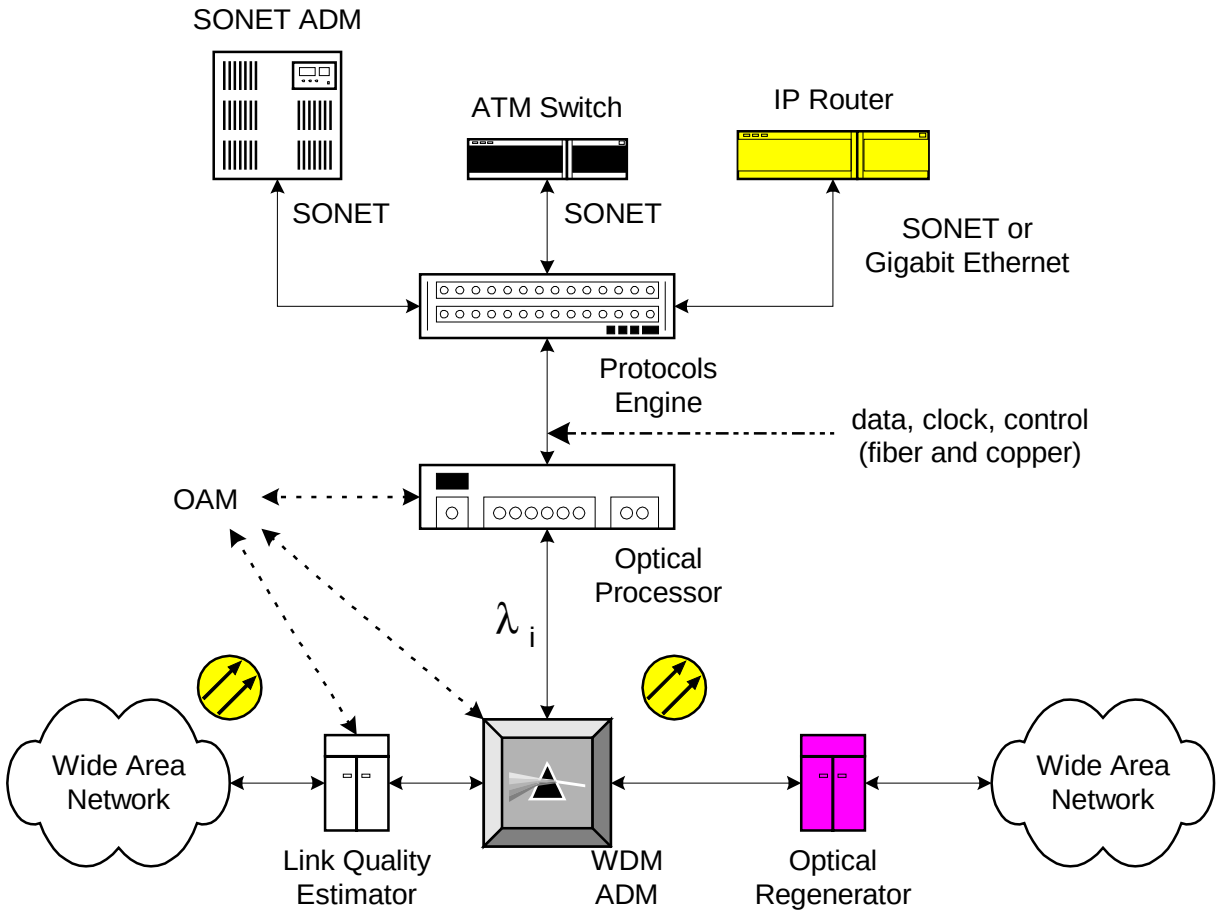
Motivation

- Directions
  - SONET, ATM, IPv4 and IPv6 - what's next?
- Objective
  - develop extremely high speed (100+ Gbps to 1 Tbps) networks
  - support multiple protocol options
    - SONET frames, ATM cells, frame relay, IP datagrams
  - support wide area networks
- Why?
  - develop technologies for future extremely high speed networks
  - provide flexible high speed transport for large traffic volumes of different types and with varying requirements

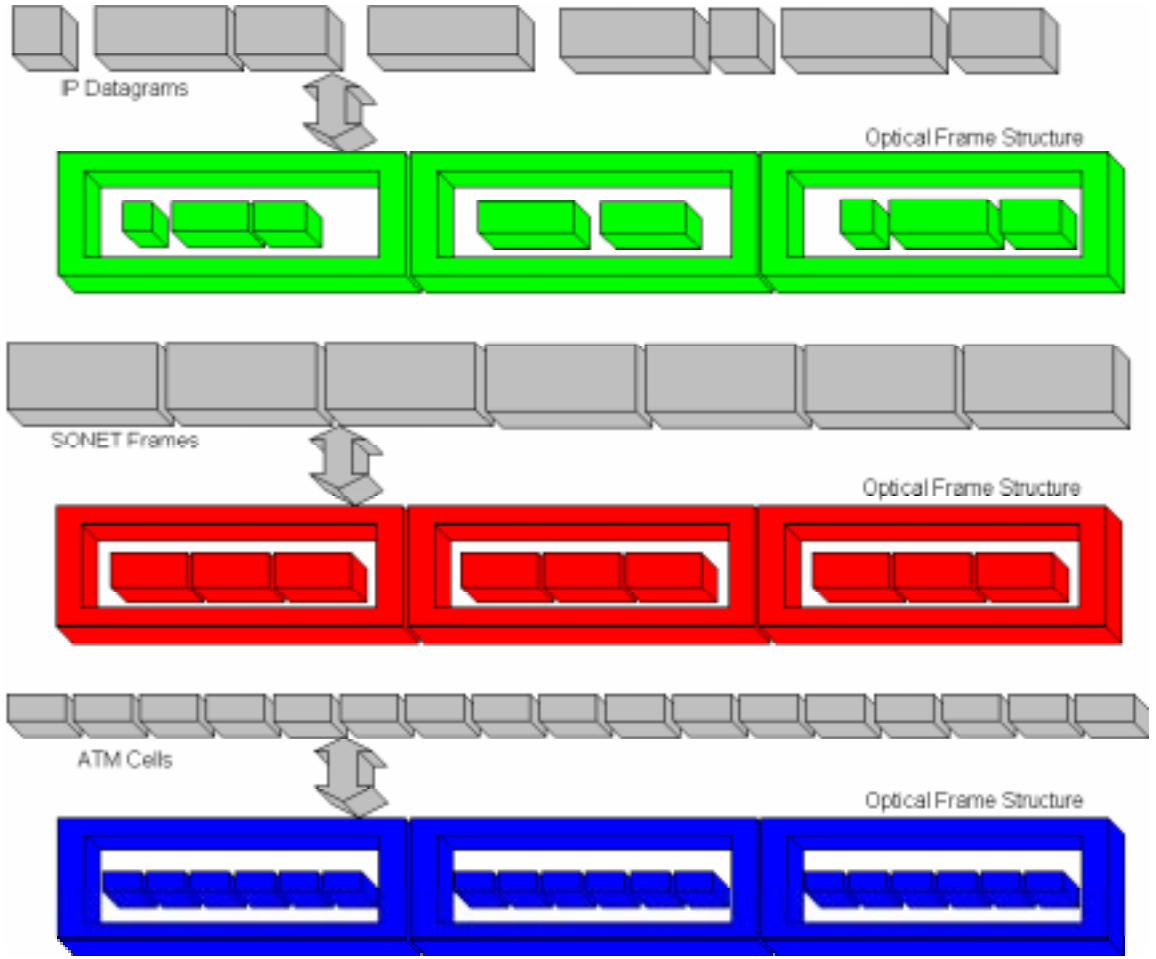
Some Assumptions

- Small address spaces
  - optical correlation expensive
- Wavelengths available are increasing
  - 100 λ systems available soon?
- Large switching times
  - for TDM systems, matching decision times relatively long
  - for WDM systems, tuning times relatively long
- Buffering in datapath is difficult and expensive...
- Significant portions of datapath must be optical
  - electronics too slow for datapath
  - portions of control path may be electronic

Overview of Architecture

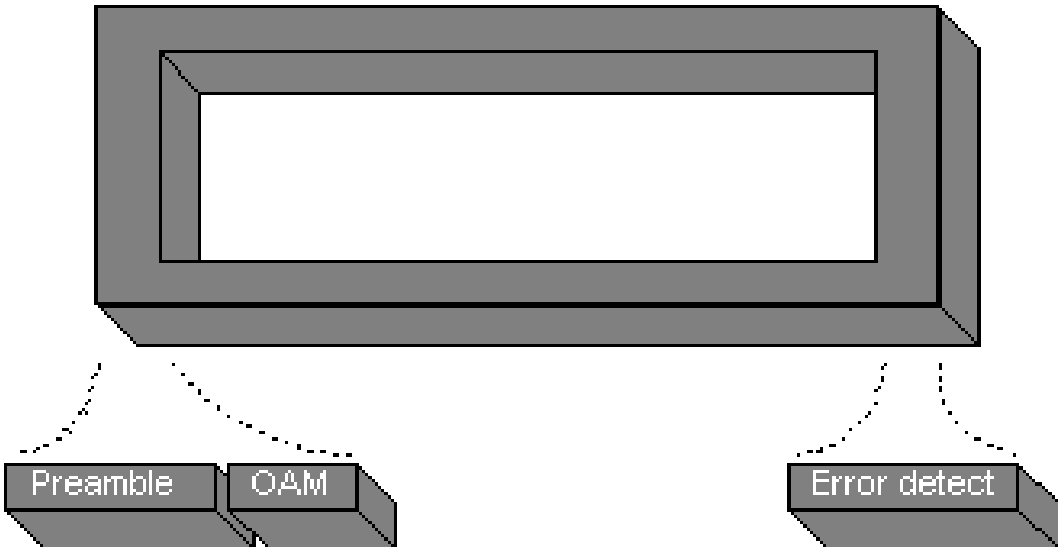


SIAP Protocols



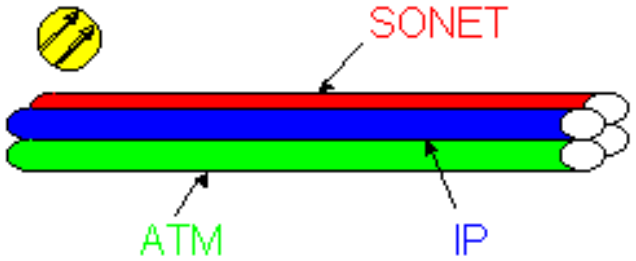
SIAP Protocols

- Simple framing format
  - alignment
  - some error detection
  - limited OAM functions



Protocol Engine

- Used to convert between existing networking services and the O-WAN transmission protocol
- Direct support for multiple higher layer protocols at the bit transport layer
  - buffering and retiming for interface to higher layer
  - simplifies implementation and supports high speeds
  - avoids unnecessary processing and queuing delays
- Each wavelength carries a single protocol



Optical Processor

- Provides the mechanism by which a flow is encapsulated and its associated framing fields are processed
- Utilizes high capacity (up to 10 Gbps) optical processing where necessary
  - optical scrambling and descrambling for payload independence

Optical Processor

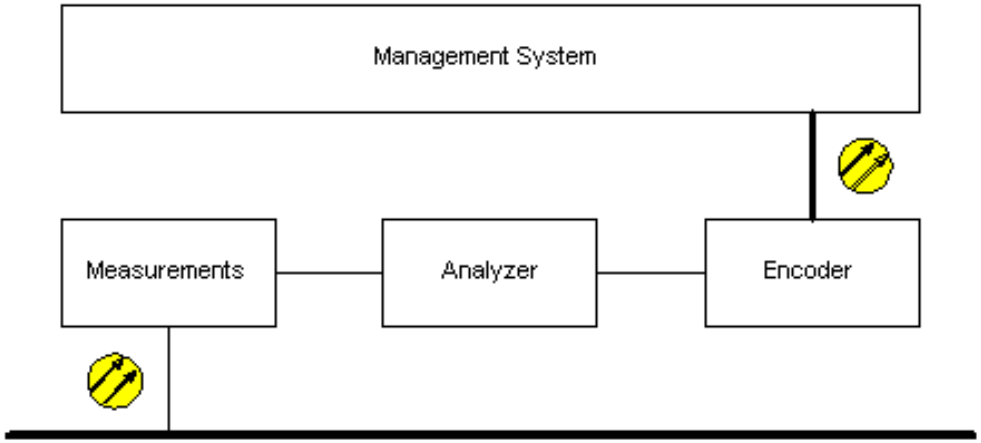
- Datapath, control, and management functions
  - framing
  - address/protocol identification
  - scrambling and descrambling
  - error control

Link Quality Estimator

- Used to estimate signal quality on each of many wavelengths (8-16 wavelengths) for OA&M functions
- Minimize complexity and cost of management overhead for support of multi-wavelength systems
- SONET-like functionality at interface

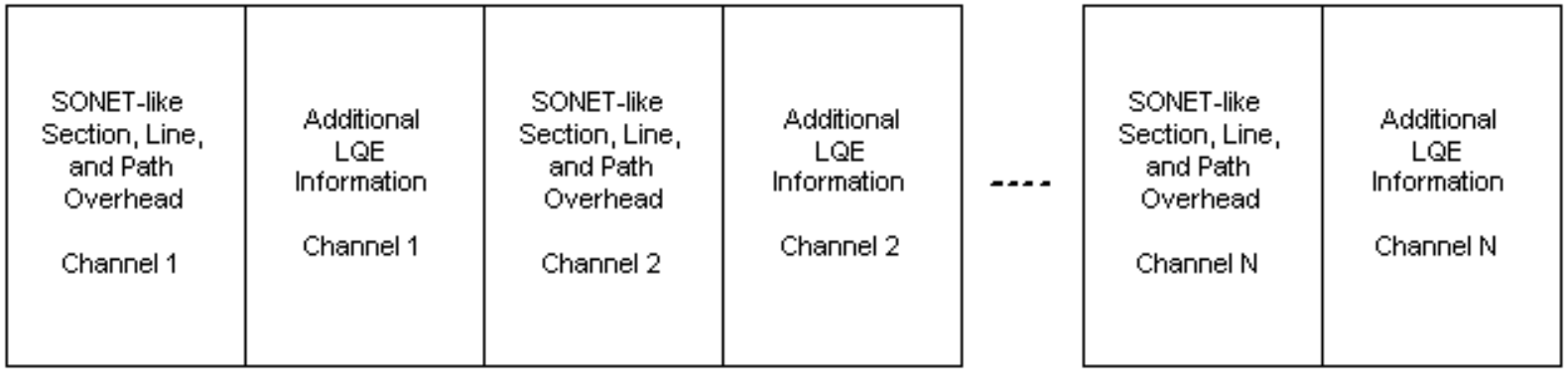
Link Quality Estimator Elements

- Measurements
  - analysis of optical spectrum
- Analyzer
  - extract management information such as error rate estimates in real time, generate alarms
- Encoder
  - SONET-like information, other data of interest



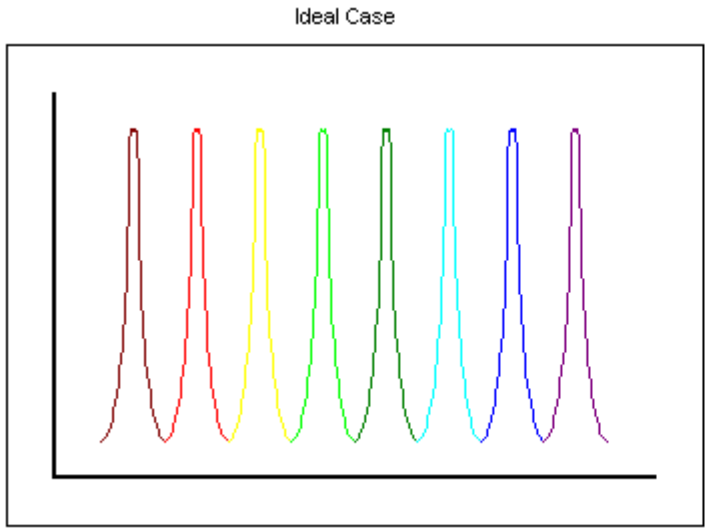
Link Quality Estimator Protocols

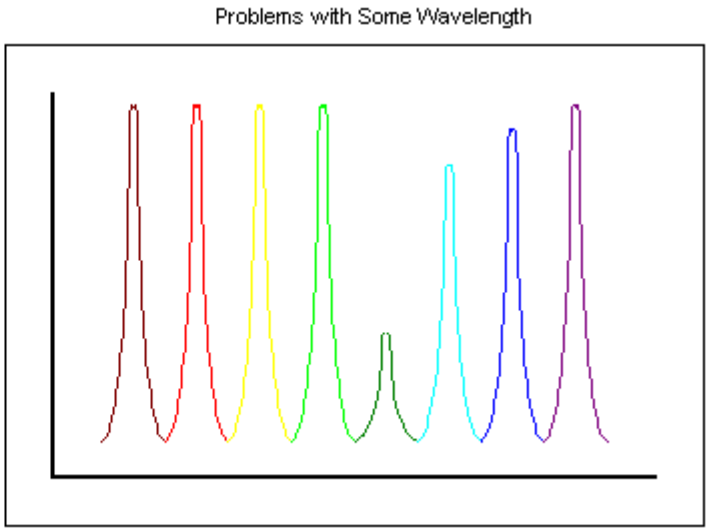
- SONET-like information
  - estimated Section, Line, and Path BIPs
  - alarm information
  - orderwire, datacom channels?



Link Quality Estimator Protocols

- Other data from measurements
  - for example, estimated SNR per channel, wavelength peaks, or noise floor might be used directly





Other Components

- WDM Add/Drop Multiplexers - Selects a single wavelength from a received WDM signal or injects new wavelength into a transmitted signal
  - Cienna 16 λ system, Lucent 8 λ system
- Protocol-specific engines - Equipment that transmits and receives SONET, ATM, IP or other networking service protocols
  - Alcatel and NEC SONET ADMs
  - FORE/Nortel ATM switches
  - Cisco 12008, 7513, 7507 routers
- The rest of the network…
  - wavelength switching capability

Questions - Network Control

- How best to reconfigure WDM systems?
- Datagram based approach
  - buffering required?
- Circuit-based approach
  - reserve resources along path
  - switched wavelengths
  - use control architecture *somewhat similar* to ATM?
- Switchlets
  - late binding is best...

Questions - Survivability

- Where do survivability functions best reside?
- WDM
  - new technology, offers many options
- SONET
  - mature, known performance, but expensive in a WDM world?
- ATM
  - virtual circuit rerouting is non-trivial…
  - signaling rates need to be high to meet constraints
- IP
  - convergence times acceptable?
  - data or voice...

Summary

- Extremely high speed networking technologies
- Multiple protocol options
- Supporting wide area networks
  - OA&M functions
  - network control
  - survivability