Lightwave Communications Systems Research:

Optical Link Quality Monitoring

The University of Kansas
Information and Telecommunications Technology Center

Link Quality Monitor
Motivation

Observed trends

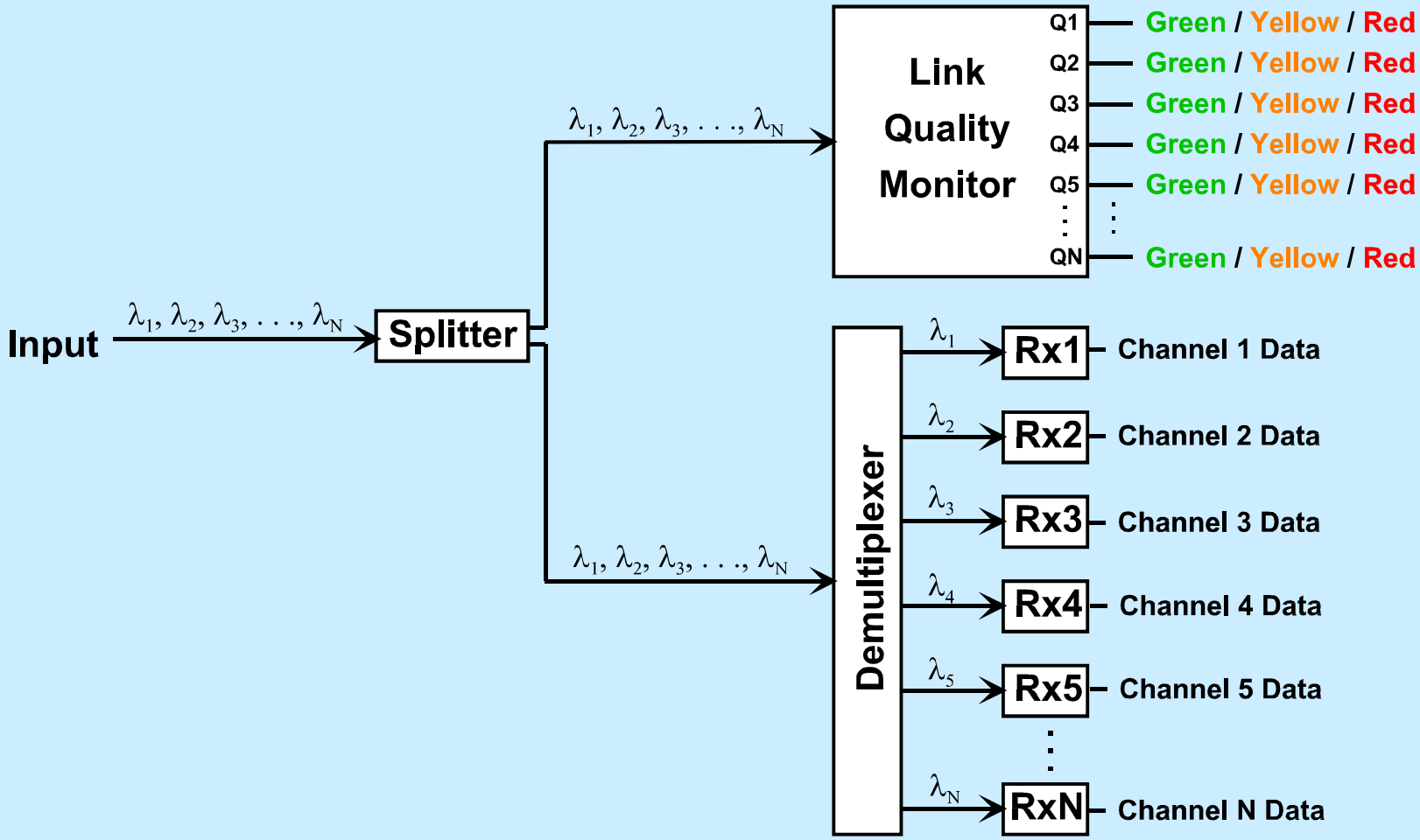
- Narrower DWDM channel spacing
- Increasing number of DWDM channels
- Higher data rates per channel

Consequences

- Increased challenge for OA&M*
  wavelength management
- Redundant quality monitoring functions

** OA&M = Operation, Administration and Maintenance*

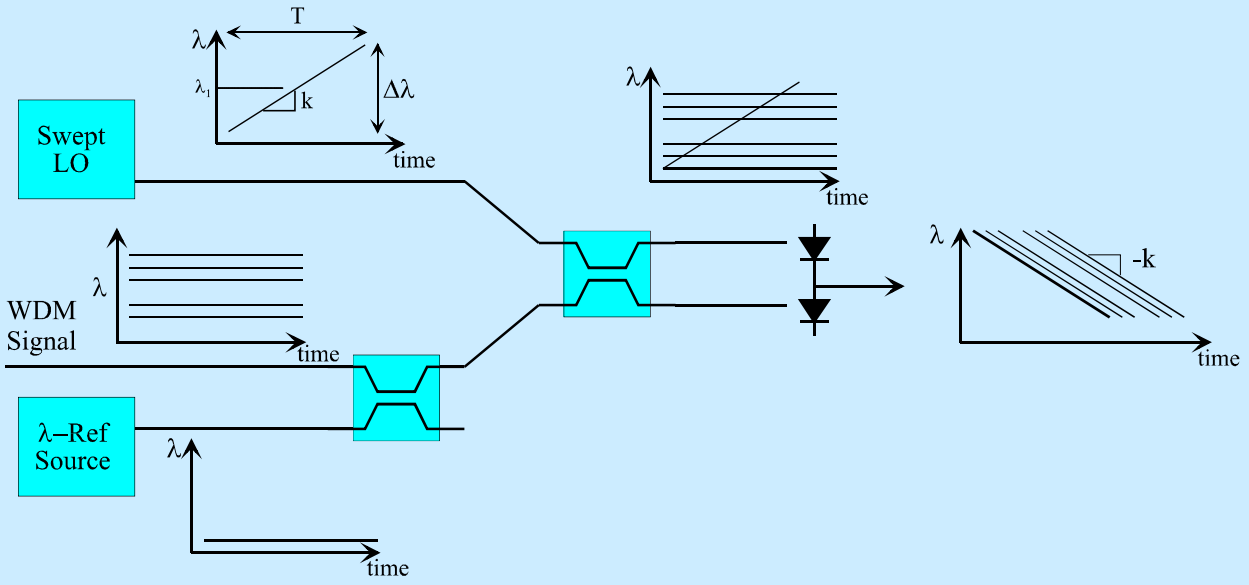
Link Quality Monitor
High Level Block Diagram



Link Quality Monitor

Basic Concepts

Fine resolution, optical spectrum analysis via a coherent optical receiver using a local oscillator swept in frequency (wavelength) over the entire EDFA band.



Link Quality Monitor
Capabilities

Continuous measurement of these parameters:

- number of channels
- channel carrier wavelength (λ_n)
- channel signal power
- background noise power
- channel modulation spectral characteristics
  - sideband structure
  - dithered carrier

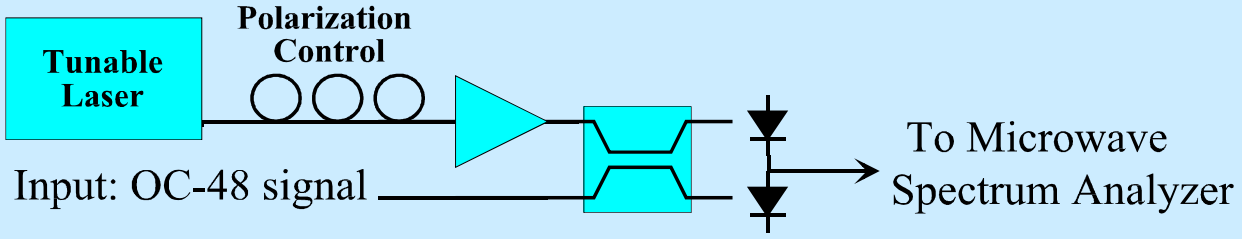
Derived link quality parameters:

- channel signal-to-noise ratio
- channel data-rate
- channel modulation format *AM, FM, PM, PolM, NRZ, RZ, Solitons*
- wavelength stability
- detection of probe signals (FWM)

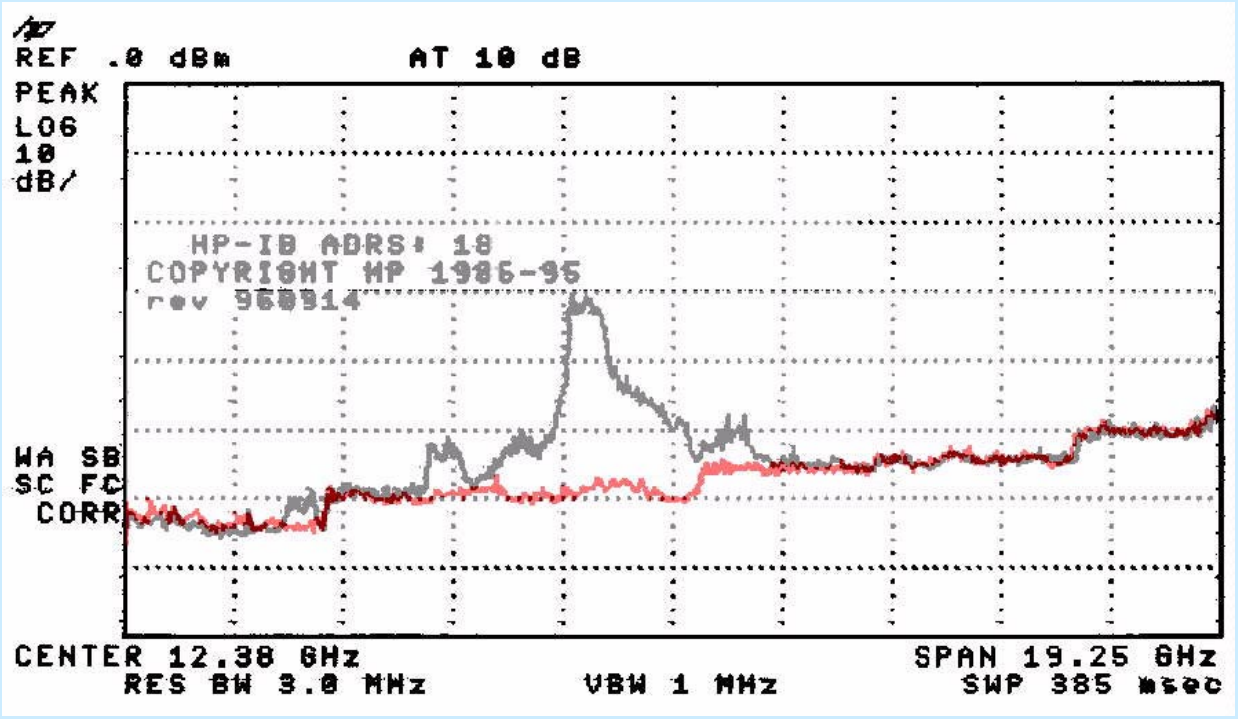
Link Quality Monitor

Simple Proof-of-Concept

Experiment Setup



Measured Results



Link Quality Monitor
Challenges

Swept local oscillator generation
$\Delta\lambda > 35$ nm *or* $\Delta f > 4$ THz

Fine optical spectral resolution
resolution < 800 MHz *or* 0.01 nm

Absolute wavelength calibration
uncertainty < 0.01 nm

Real-time continuous signal processing
estimating common quality metrics (like BER) from observable parameters

Economical implementation

Link Quality Monitor
Conclusions & Status

A concept for continuous, simultaneous monitoring of the optical link quality has been developed.

Measureable parameters include:
channel wavelength, signal-to-noise ratio, modulation rate

Applications include -
optical layer OA&M observability
link security monitoring

Status: demonstration of basic concept anticipated this summer