Capability of optical code-based MPLS (OC-MPLS)

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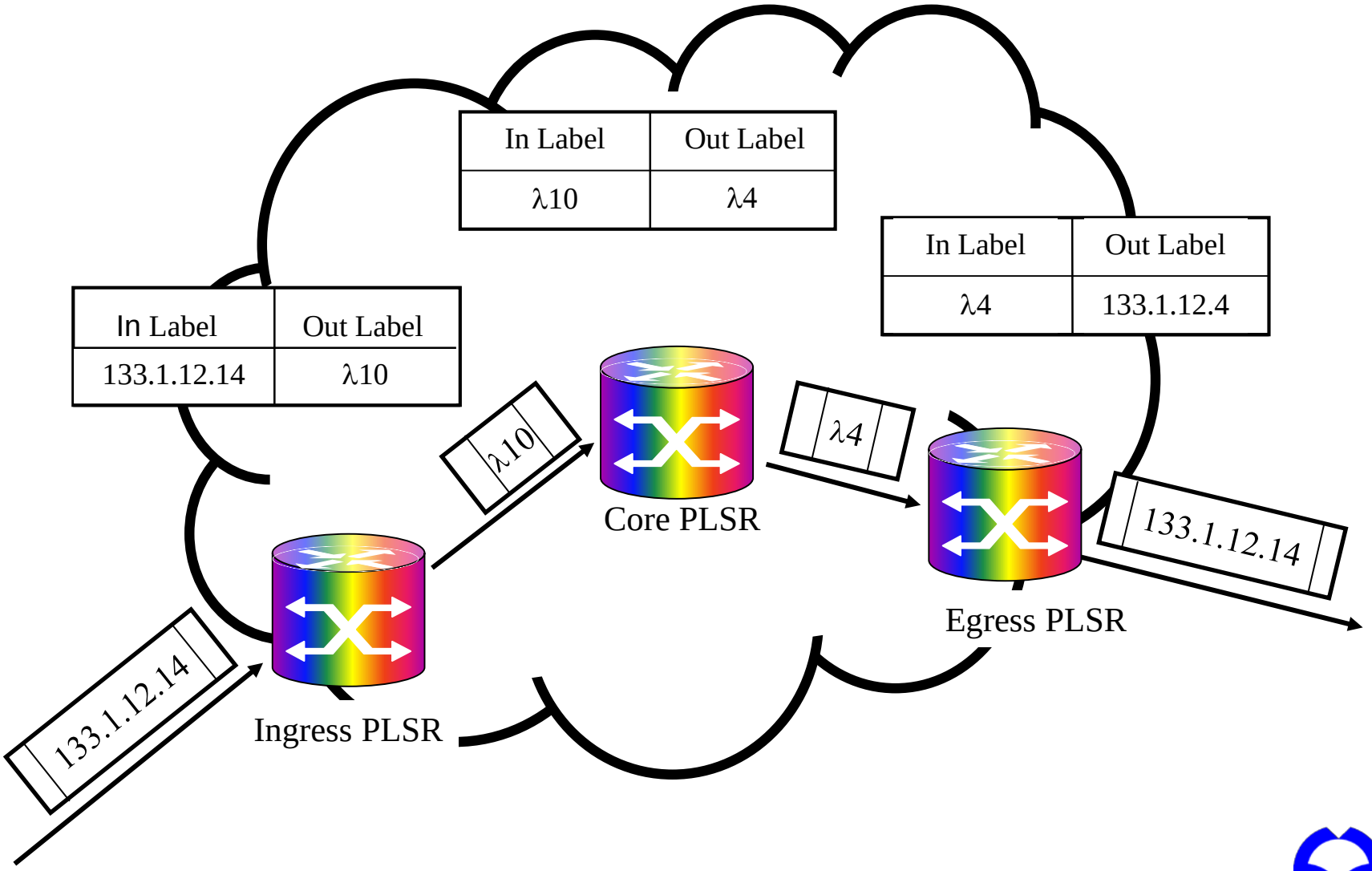
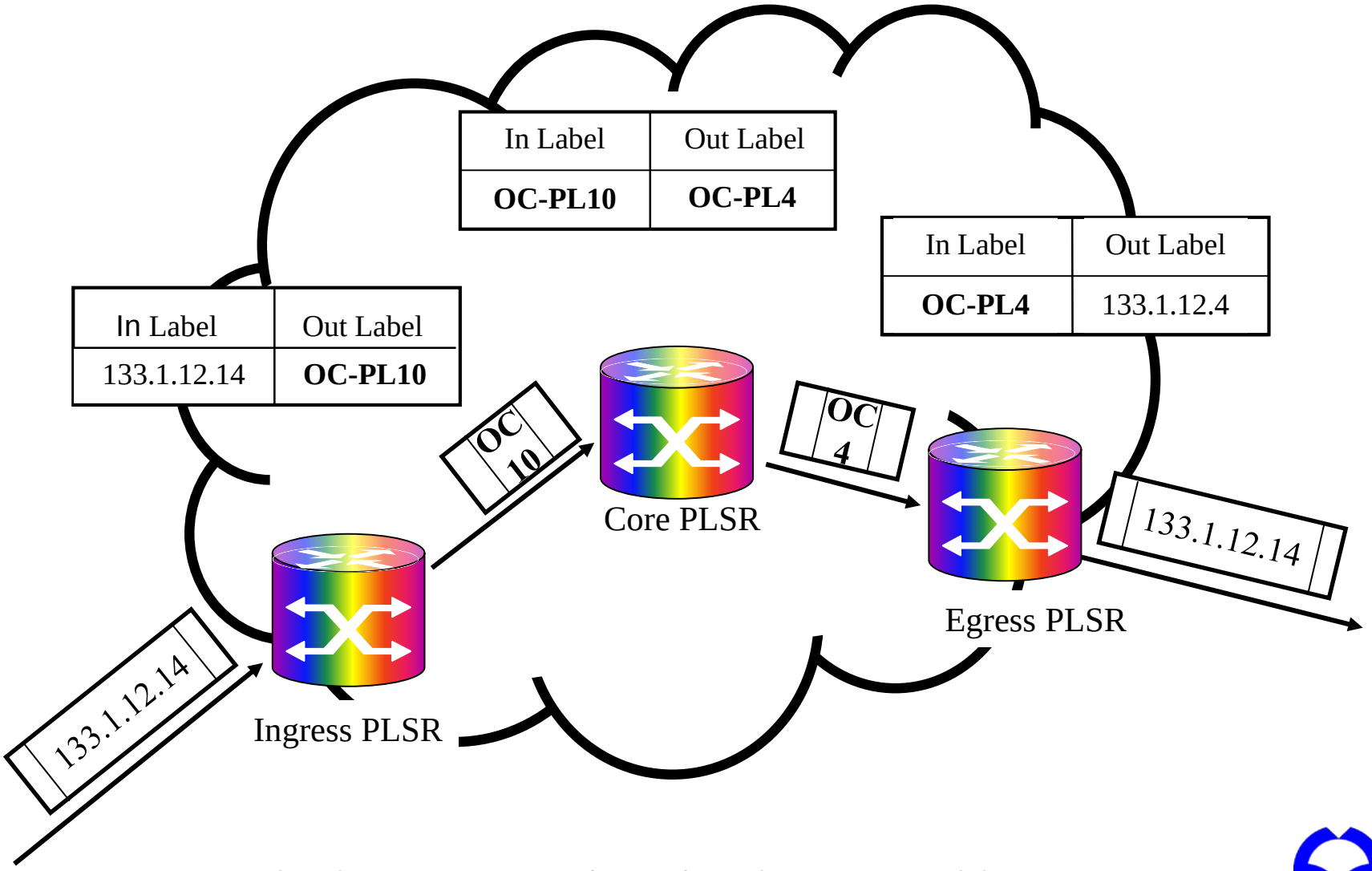
Outline

- ✓ Motivations for optical-code based (OC)-MPLS
- ✓ OC-photonic labels
  and their ultra-fast processing capability
- ✓ Versatile applications to;
  - ➢ LSP switching
  - ➢ Flow/packet classification for diffserv

MPL(ambda)S or MPλS

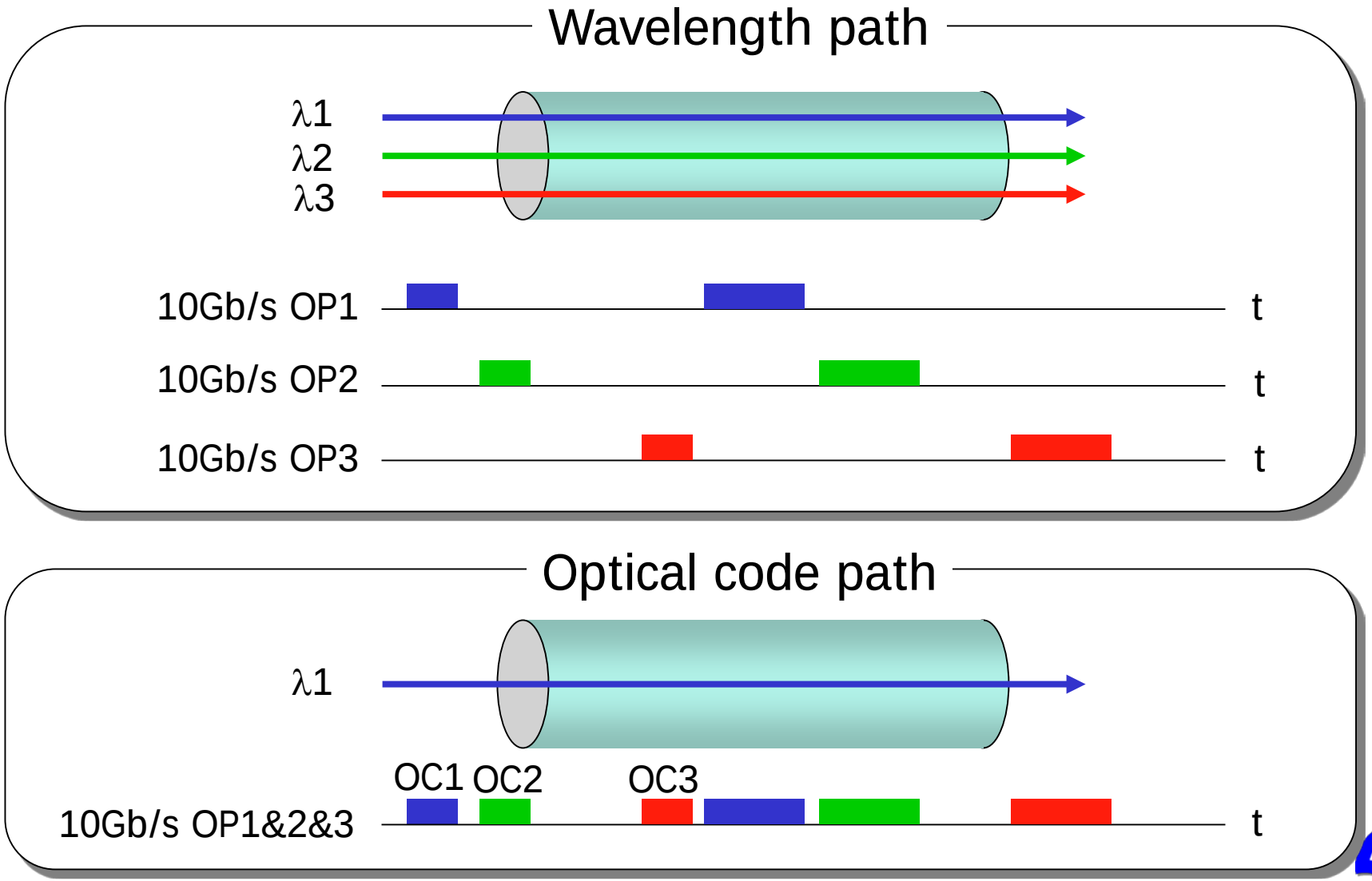


Optical-code based MPLS



M. Murata and K. Kitayama, *IEEE Network Magazine*., vol.15, pp.56-63, July/Aug. 2001.

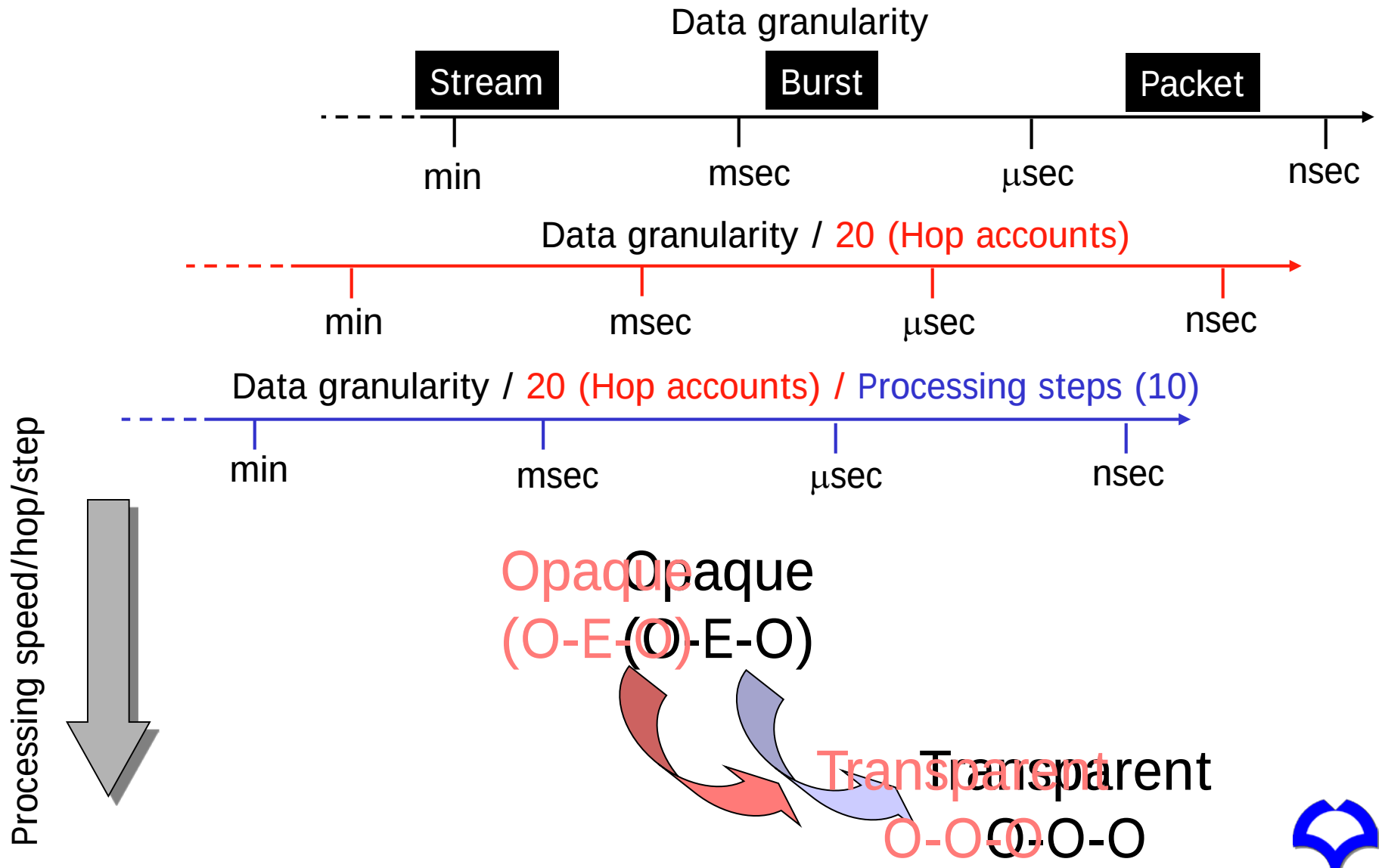
Granularity issue : Bandwidth efficie(curre)ncy



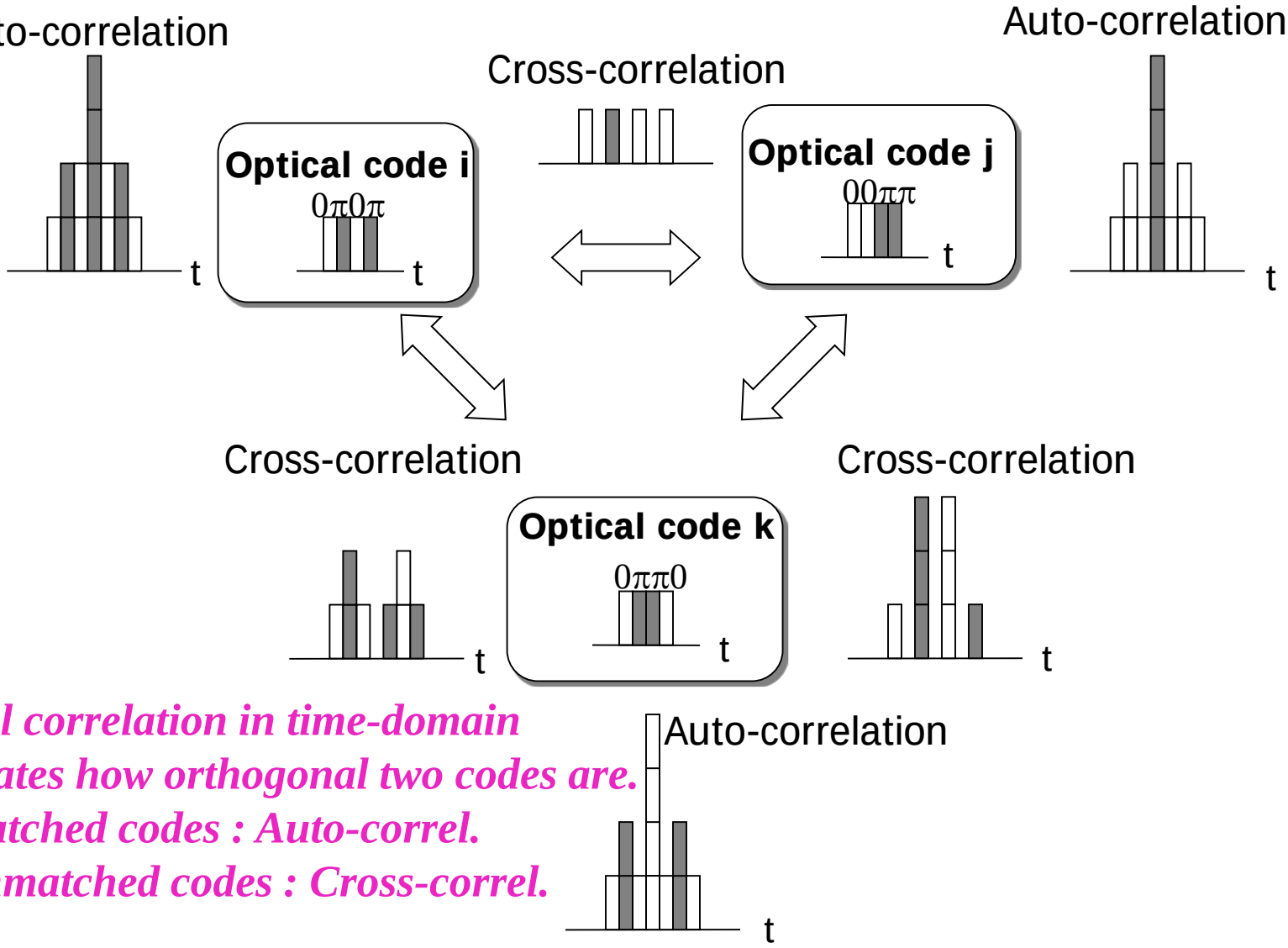
Wavelength resource for MPλS : Photonic label space

	Number of addresses	Table lookup	Disadvantages
Wavelength	～1,000 (～ 2^{10})	Simple Optical filter	May not large enough Flow merge impossible
Subcarrier (m-wave)	～100	Milimeter-wave filter	May not large enough < 40Gb/s
Optical codes	Abundant	Ultra-fast Passive device	As many as label count Impairments in propagation

How fast label processings do we need?



Optical correlation:
A technique to recognize OC-photonic labels -1-



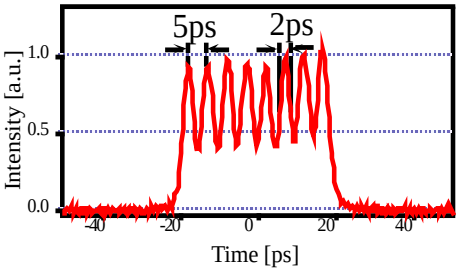
Optical correlation in time-domain indicates how orthogonal two codes are.

Matched codes : Auto-correl.

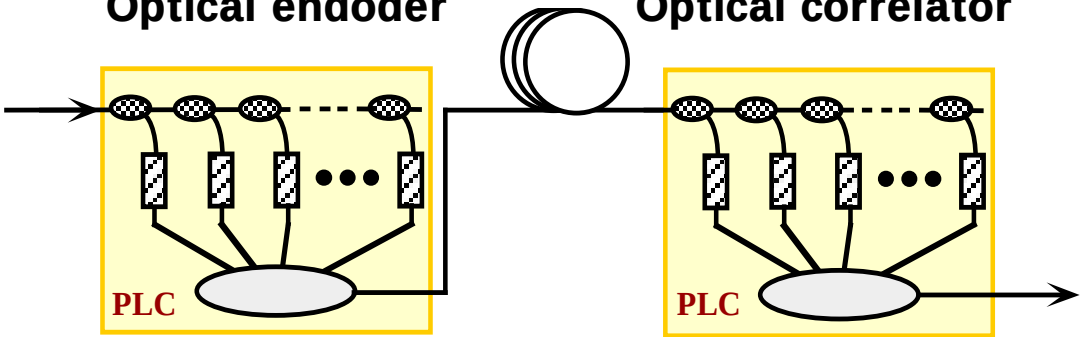
Unmatched codes : Cross-correl.

Optical correlation: A technique to recognize OC-photonic labels -2-

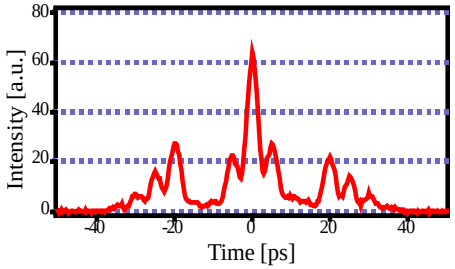
8-chip bipolar OC-photonic label@10Gb/s



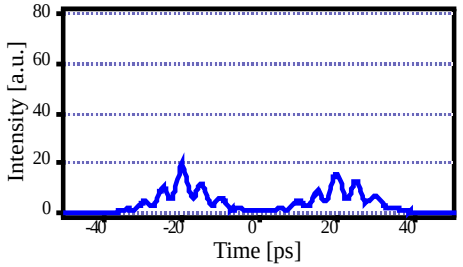
Optical endoder **Optical correlator**



Auto-correlation: Label match



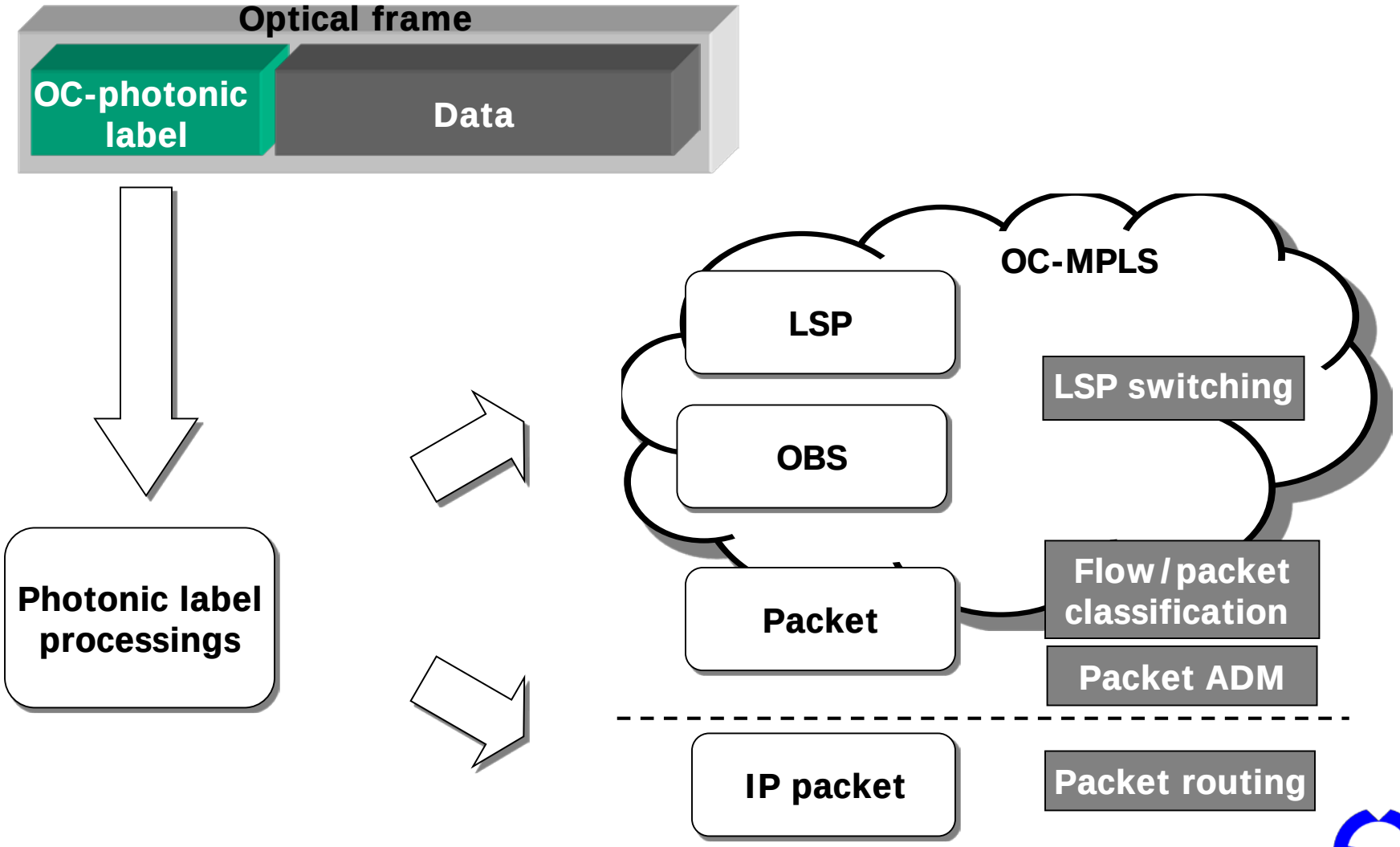
Cross-correlation: Label unmatch



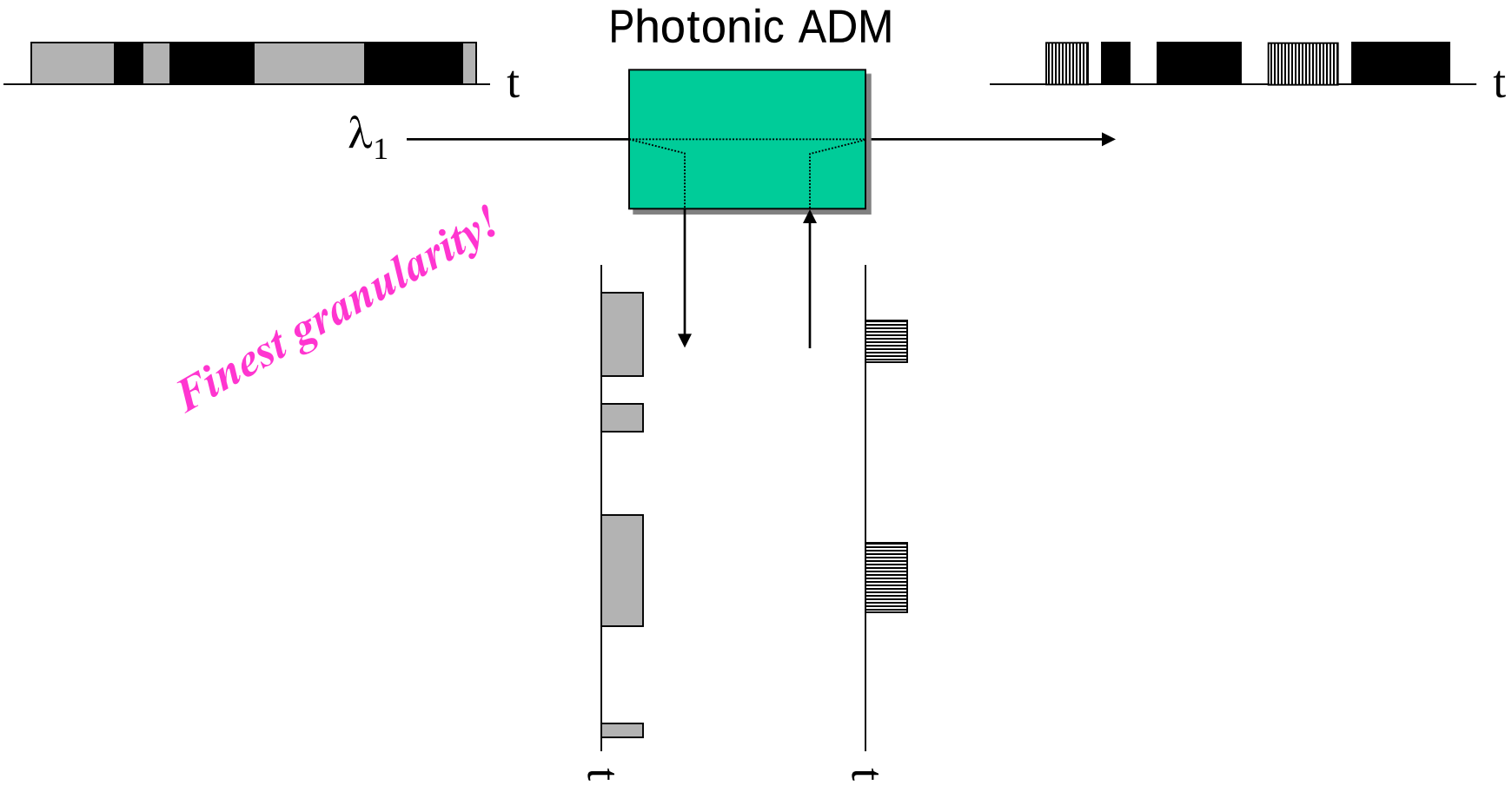
Proccessing speed is only limited by the light velocity!!!
No optical logic devices but passive waveguide devices!!!

K. Kitayama, N. Wada, and H. Sotobayashi,
IEEE J. Lightwave Technol., vol.18, pp.183-1844, 2000.

Versatile applications of OC-photonic labels

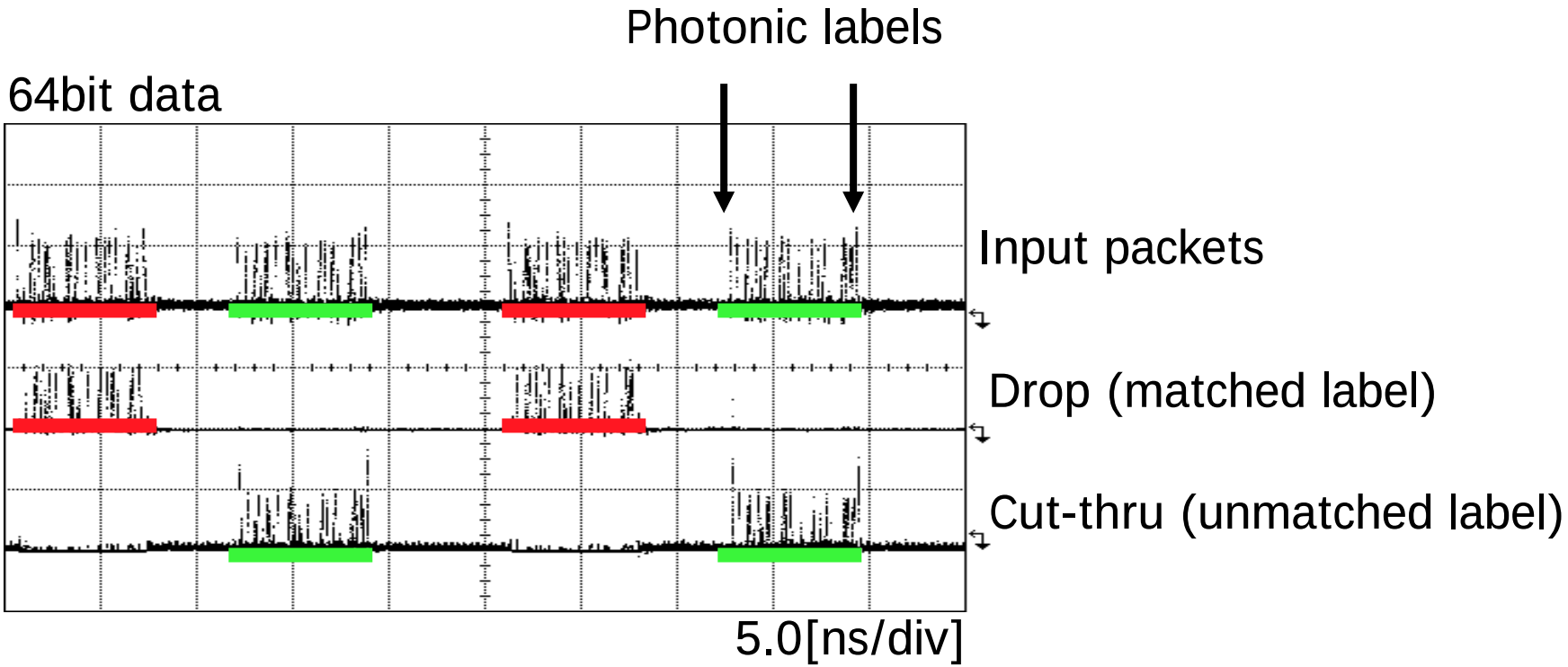


Packet-selective photonic add/drop multiplexer



K. Kitayama et al, *ONDM2001* (Viena, Feb.2001)

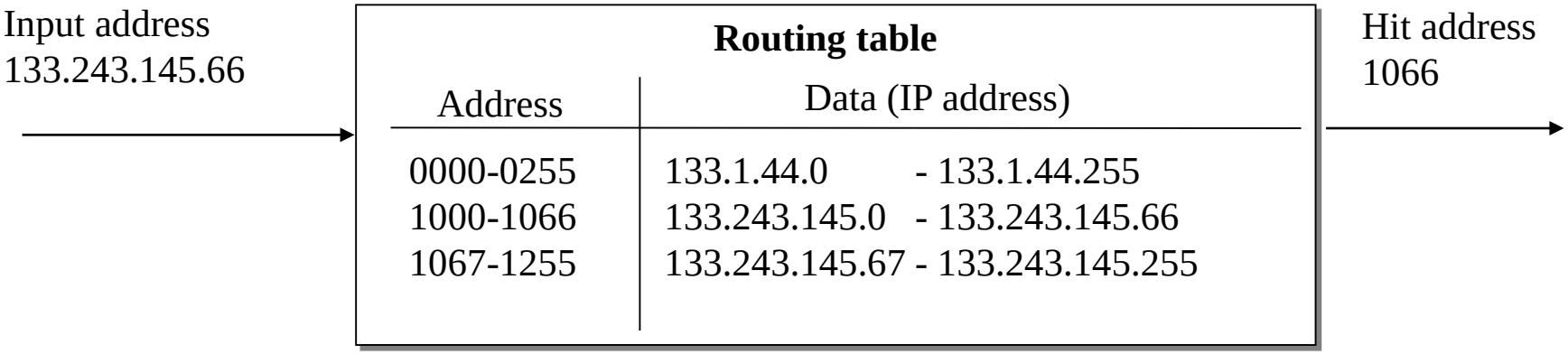
Experimental results of variable-length packet-selective PADM @ 10Gbit/s



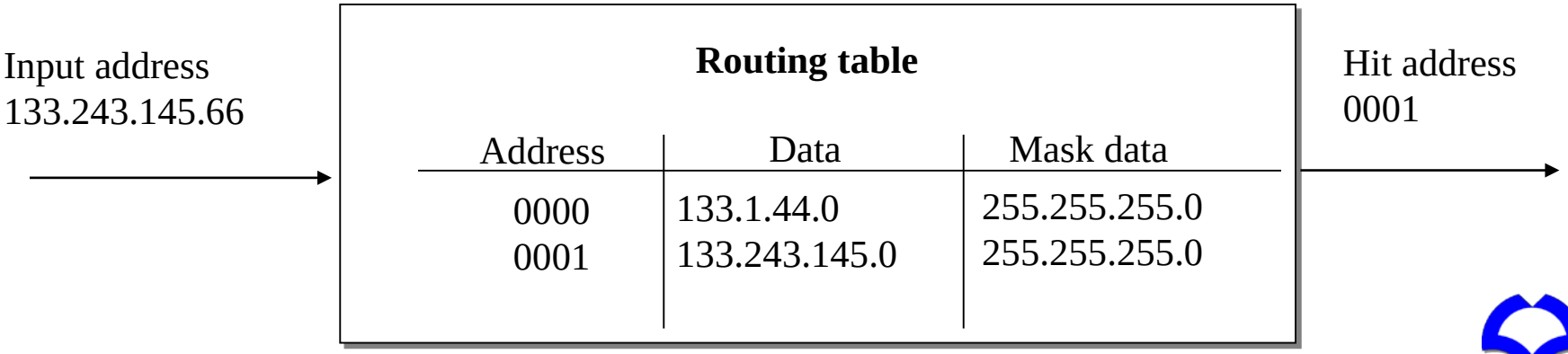
K. Kitayama et al., *ECOC2001*., Th.L.1.6 (Amsterdam 2001).

Exact match & longest-prefix match algorithms

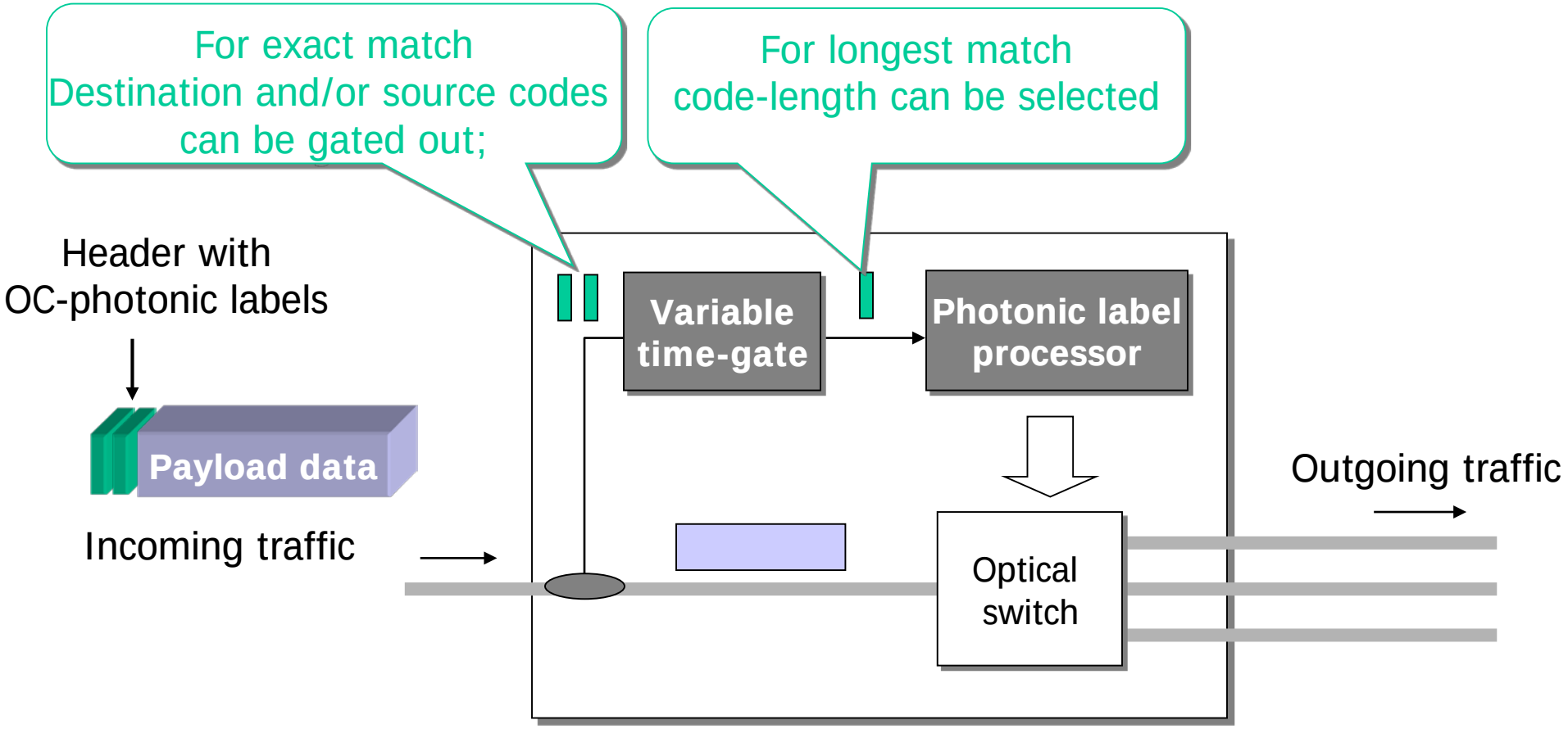
Exact match algorithm for MPLS



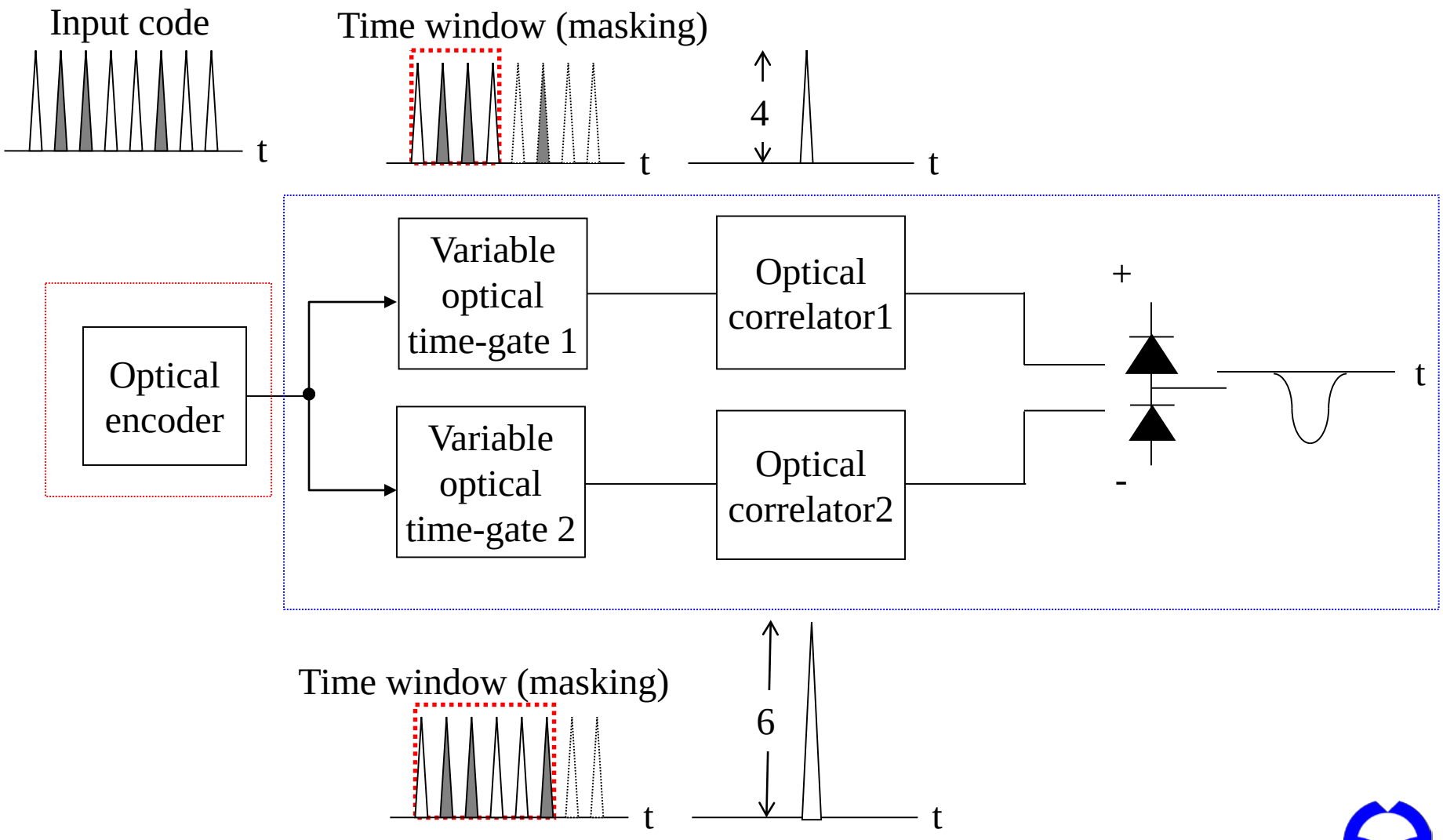
Longest-prefix match algorithm for IP routing



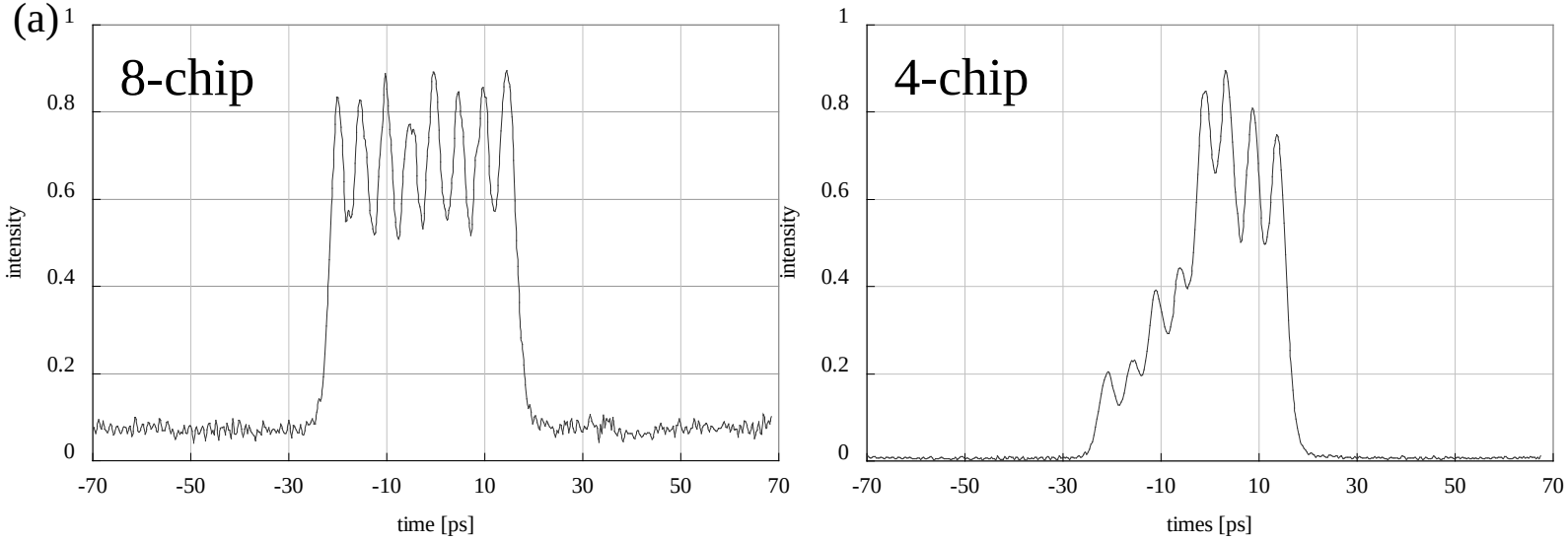
Photonic label processing with variable optical time-gate

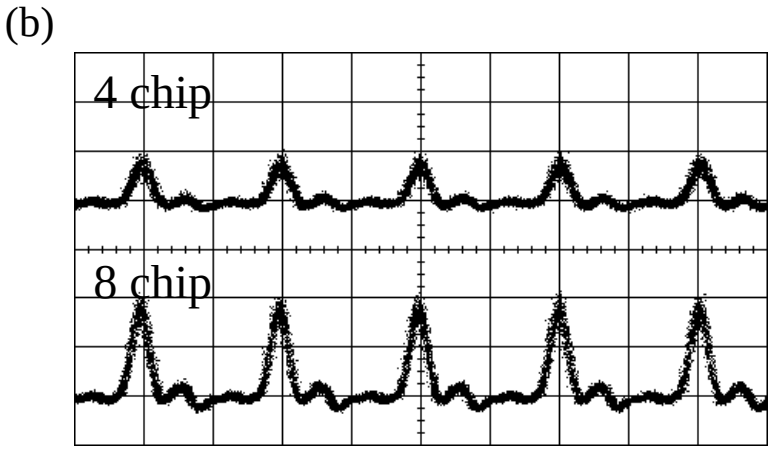


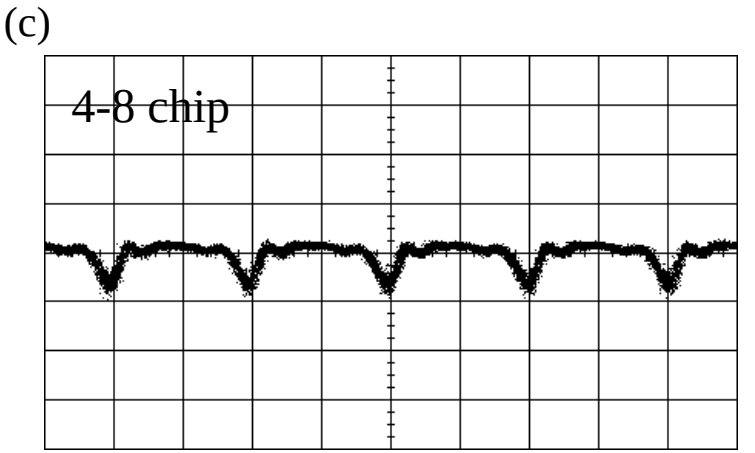
Experimental setup for longest-prefix match



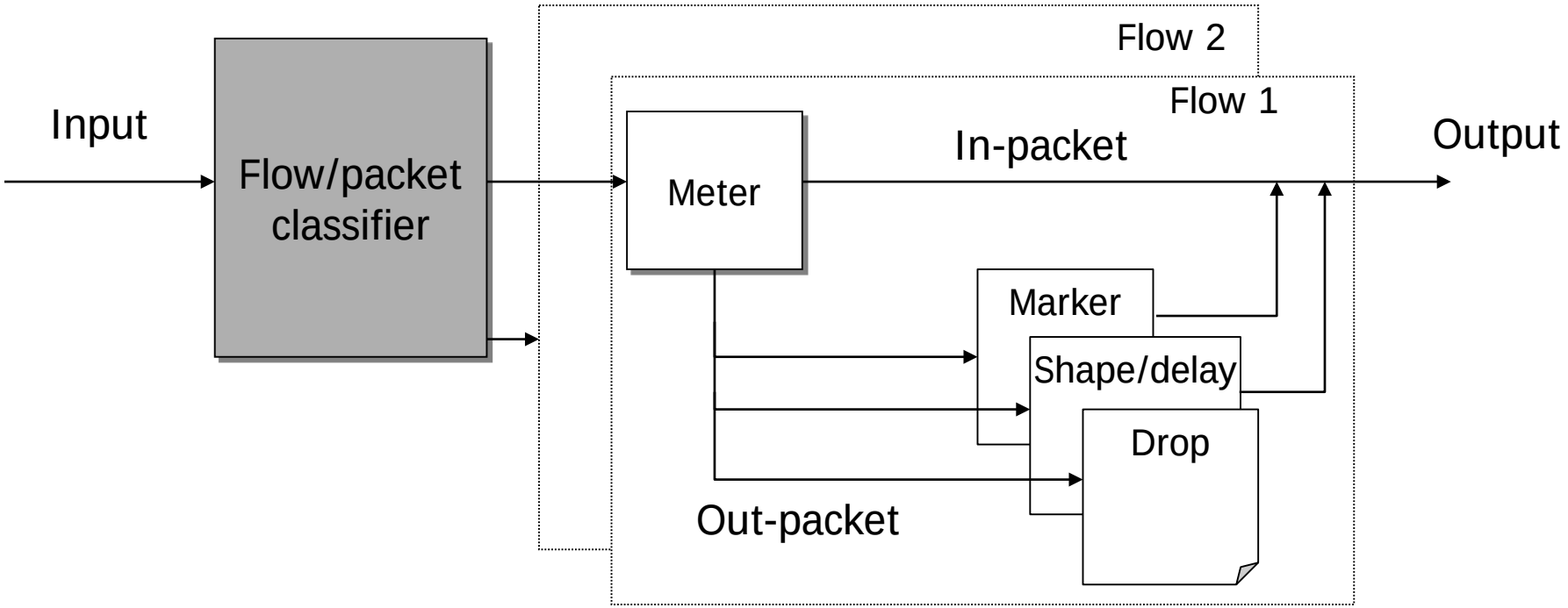
Experimental results of longest-prefix match





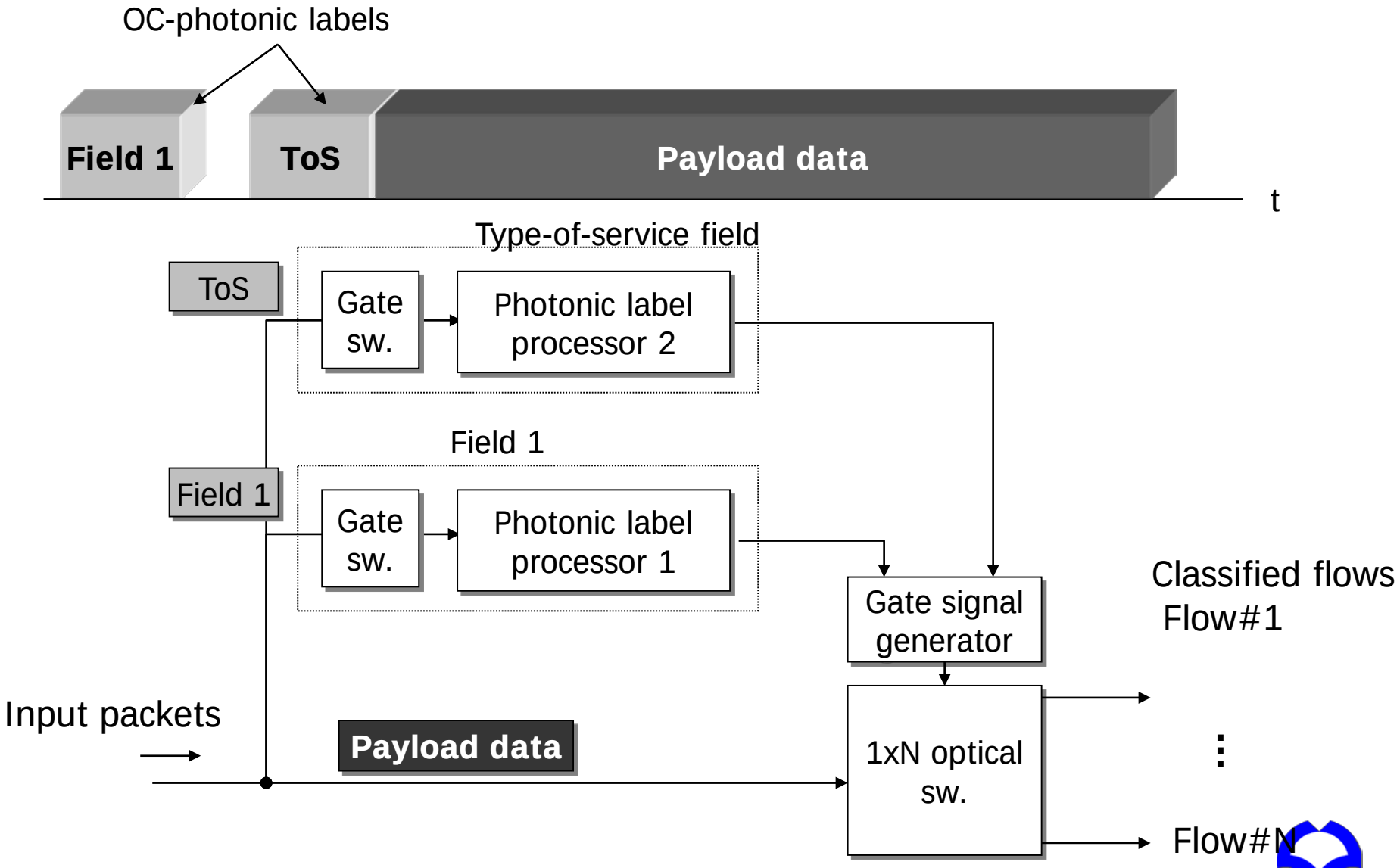


Flow / packet classifier -1

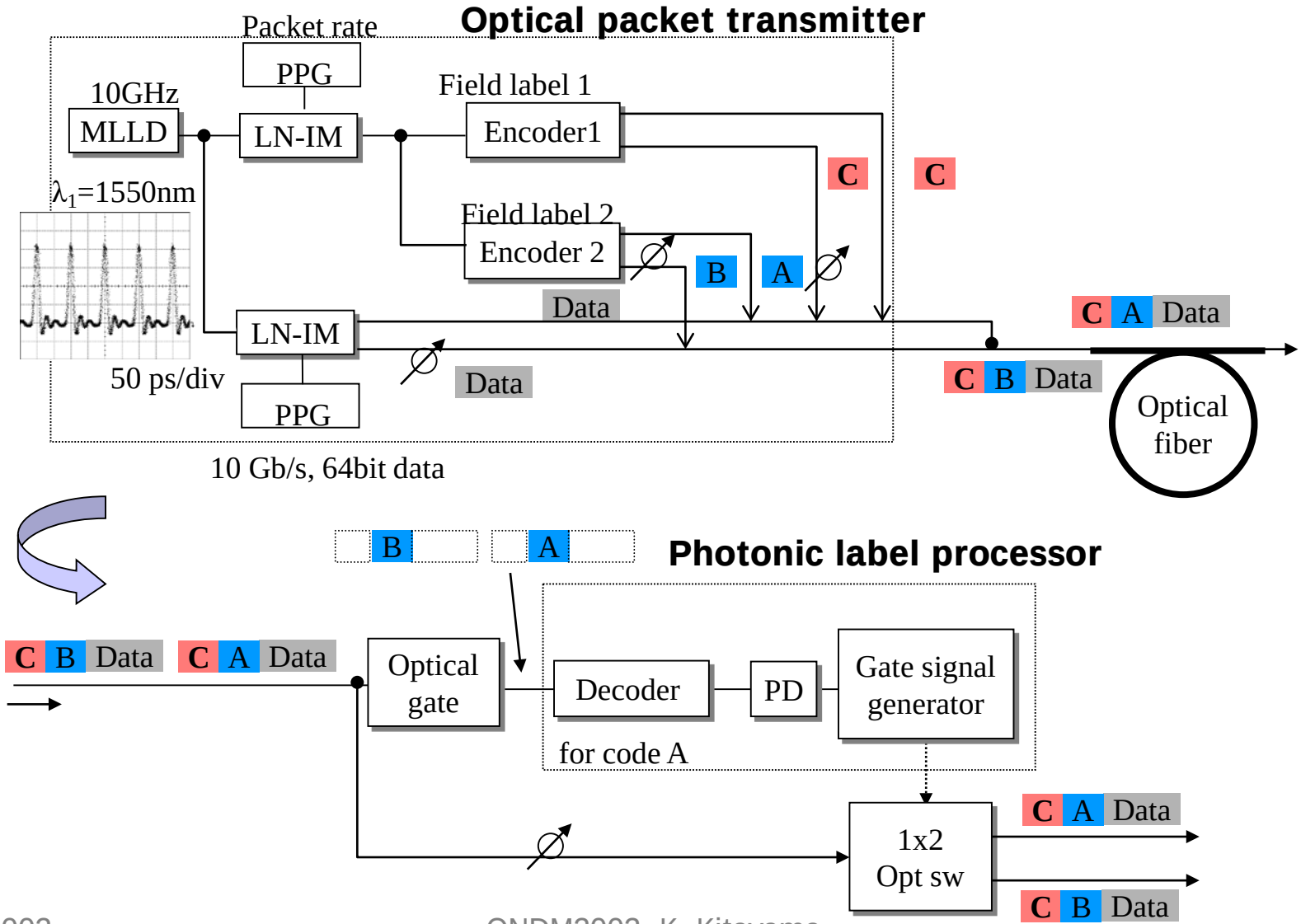


- ***Diffserve has a good scalability!!!***
- ***Per-hop behavior (PHB) facilitates hop-by-hop QoS control***

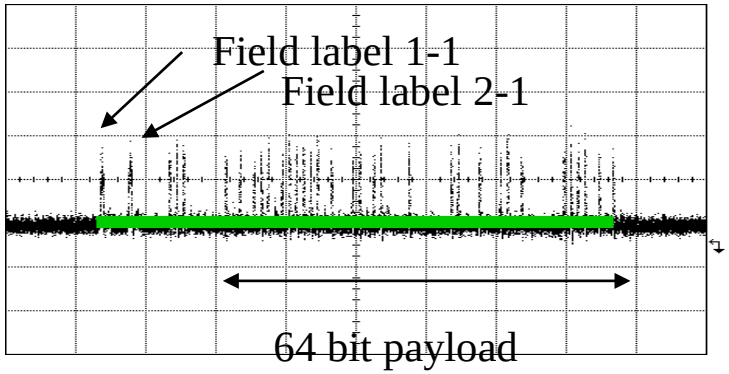
Flow / packet classifier -2: Diffserve



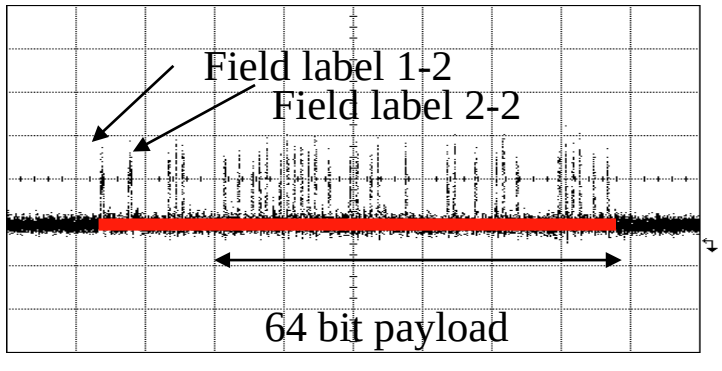
Experimental setup for packet classification



Experimental results of packet classification



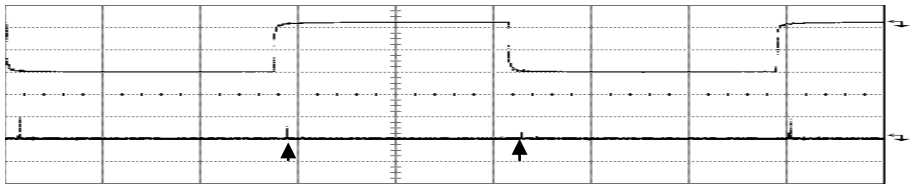
1 ns/div



1 ns/div

Gate signal

Auto-correlation output from decoder

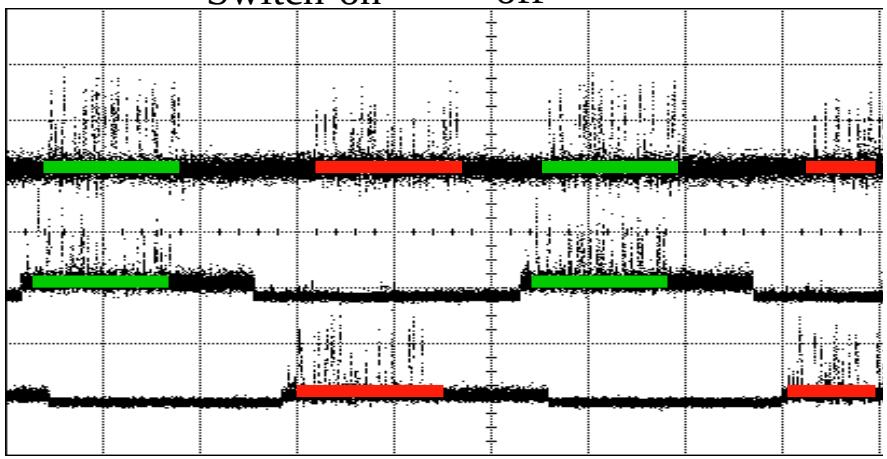


Switch-on off

Input packets

Matched

Unmatched



5 ns/div

Summary

- ✓ OC-MPLS improves bandwidth efficie(curre)ncy and provides larger label space
- ✓ OC-photonic label enables ultra-fast label processing
- ✓ Experimental demonstrations of versatile applications;
  - ➢ Exact and longest-prefix match algorithms @ 10Gb/s
  - ➢ Flow/packet classification @ 10Gb/s

➢Fast OBS path setup

➢Photonic packet switching