Research Challenges for Multicast in Carrier Networks

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Elastic Networks thematic network

New Elastic Networking Paradigms for a world radically-based on Cloud and Fog Computing

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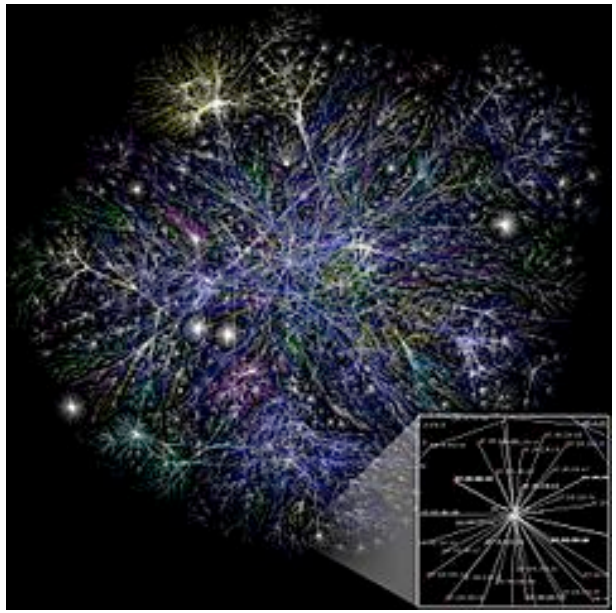
Objetives

- Objetive: Strongly Cloud-Fog-Oriented Networking
- Elastic Network Concept:
  - Research towards the architecting a more agile, flexible, programmable network with ultra-low deployment & OAM costs and energy efficient.
  - Putting ultra-low latency and ultra-high capacity where needed
- Open to collaboration with interested third parties
  - Phd students exchange, joint papers, joint thesis



Topics

- Addressed Topics
  - EON
  - 5G
  - Fronthaul/backhaul transport: SDM, Ethernet, …
  - Power over Fiber
  - Control plane SDN/NFV
  - Fog2Cloud computing
  - Opportunistic network/computing
  - Advanced forwarding techniques
  - Optical Multicast
  - ..

	Network	
UC3M	Larrabeiti	David
CTTC	Martinez	Ricardo
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2nd workshop

- OPEN Free open workshop : ElasticNETS 2017
  - **2nd International Workshop on Elastic Networks Design and Optimisation** (ELASTICNETS 2017)
  - June 13-14, 2017
    Vilanova, Spain
  - https://elasticnetworks.org/2nd-workshop
  - Dates: send paper or register before June 1st
    - No proceedings, informal discussion of on-going work
    - pre-located to

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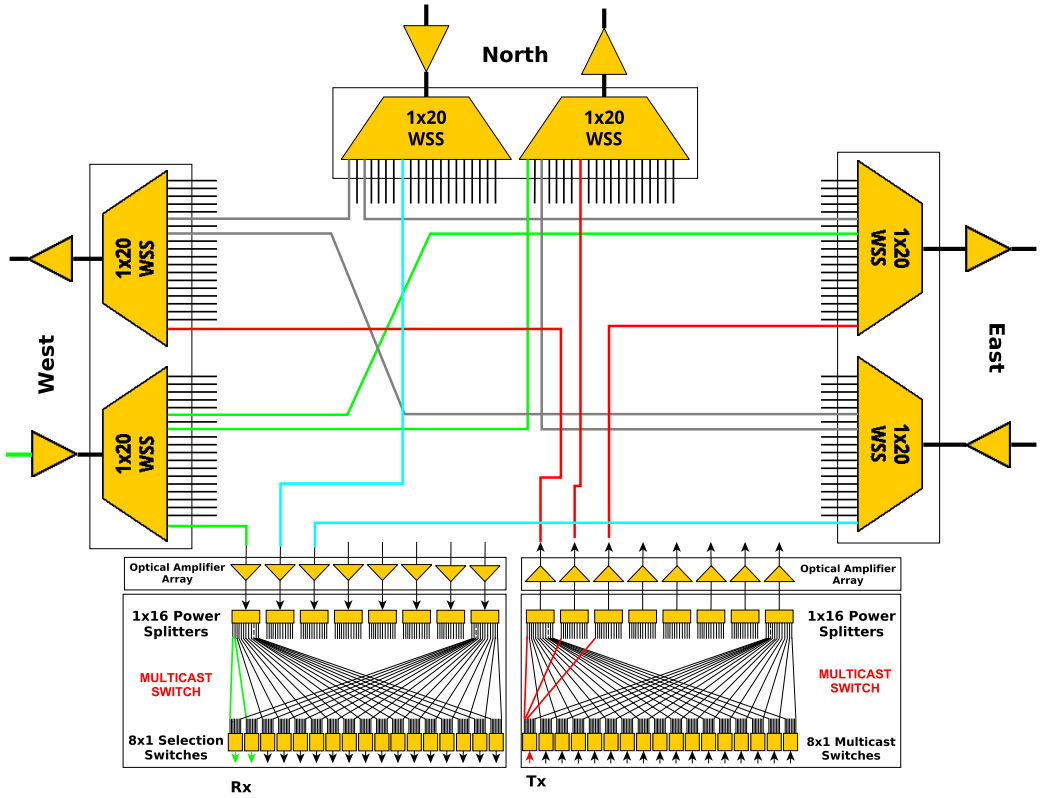
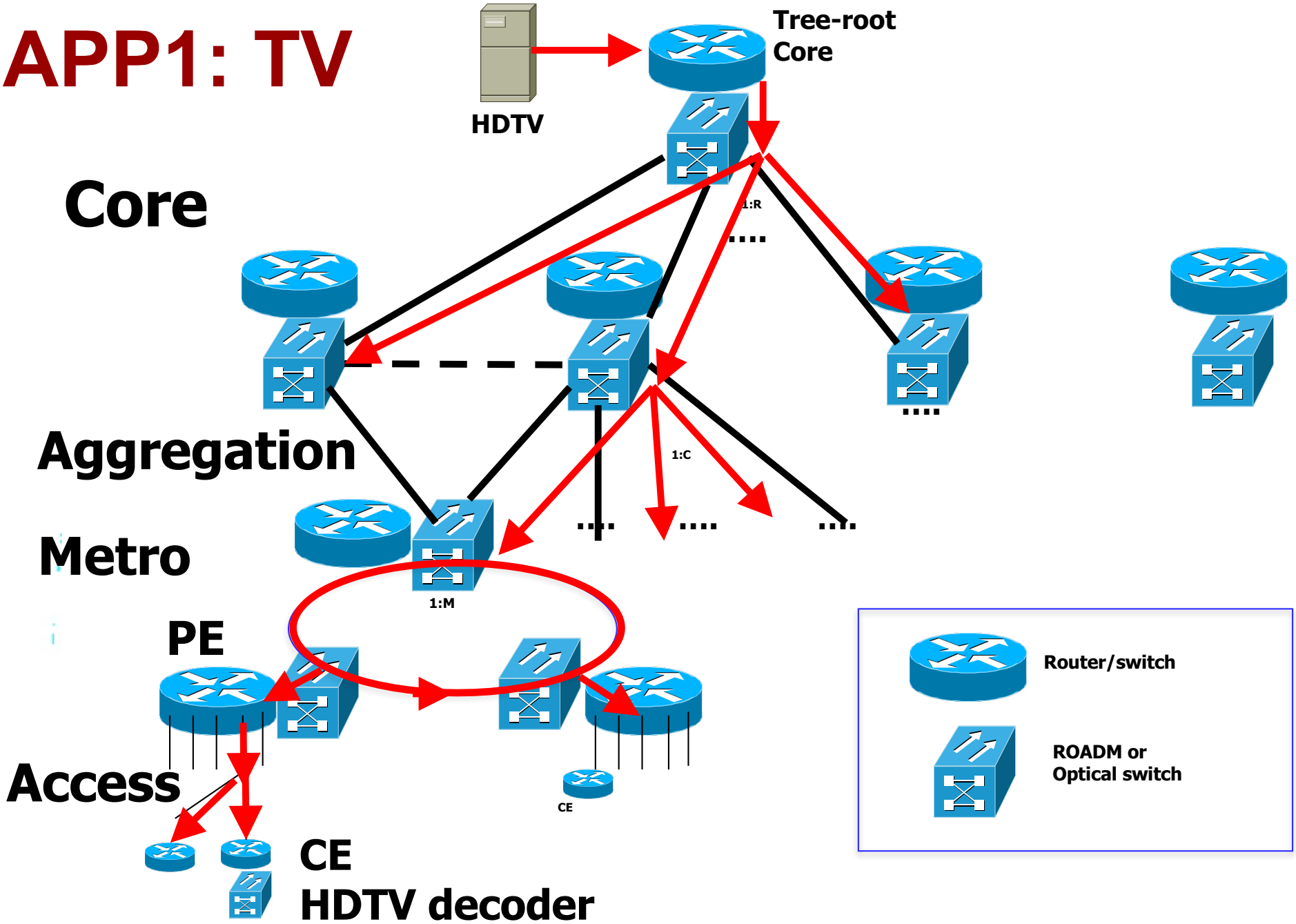
WHY OPTICAL MULTICAST ?

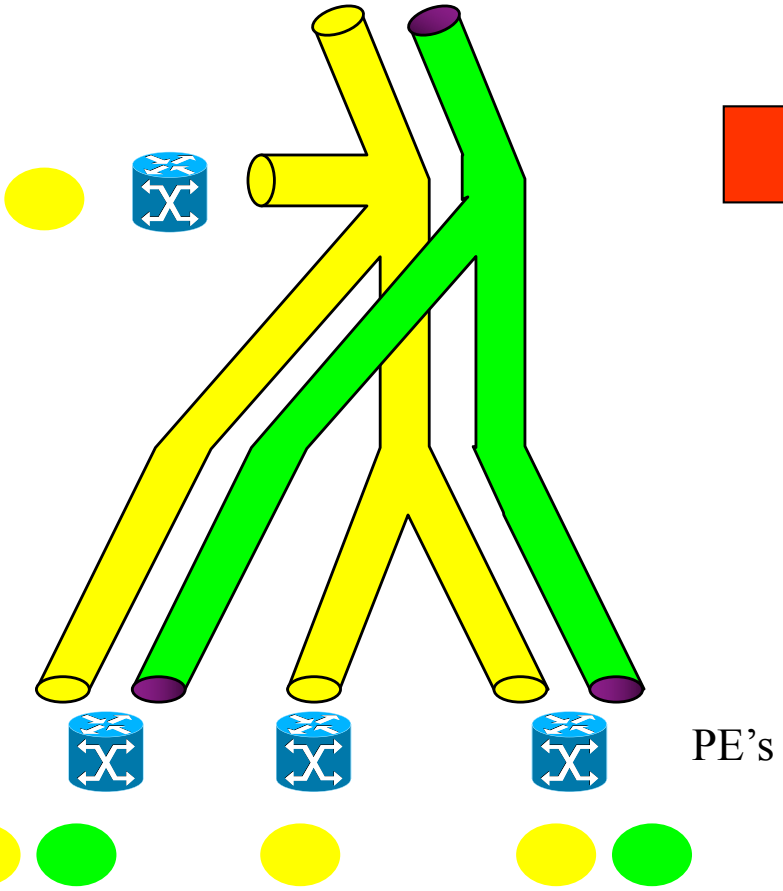


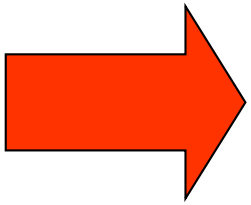
APP1: TV


HDTV
Tree-root
Core
Core
1:R
Aggregation
1:C
Metro
1:M
PE
Access
CE
CE
HDTV decoder
Router/switch
ROADM or
Optical switch

App2: IP mcast: eventually a zombie
App3: VPLS

- Problem: VPN LSP trees do not match
  - Penalty: tail-end overhead



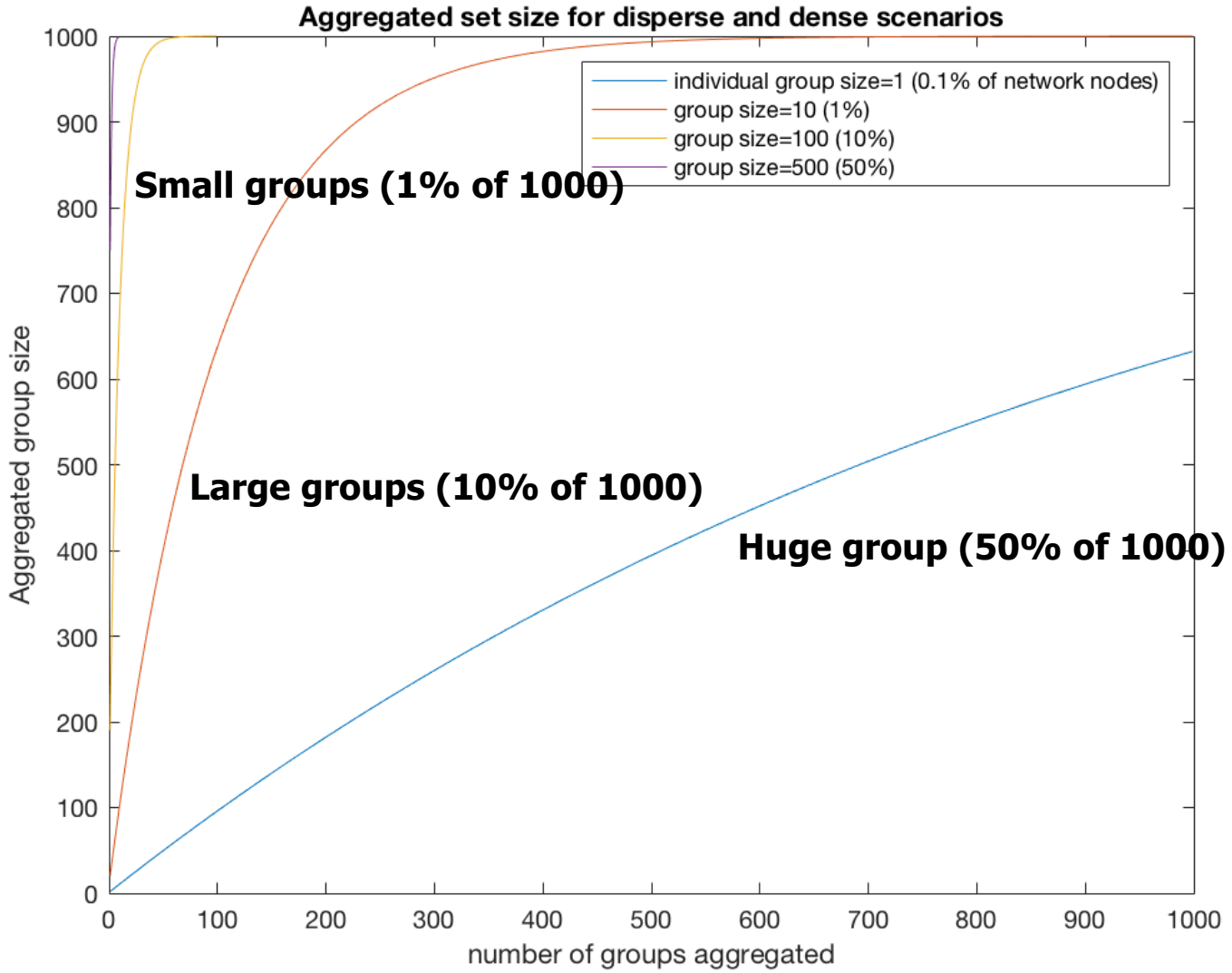


•Per-VPN Forwarding entries in the core
  • Only affordable for a well selected set of high speed multicast sessions

•VPN FEC awareness in the core !!!

•If Optical: a light tree per VPLS
• NOT VIABLE:
• Consequence: 100 papers on aggregation strategies

How aggregation converts your multicast light-tree into a broadcast tree



25 years of Optical Multicast Research

- 90% : Resource allocation: ILP+heur
  - Light-tree RWA
  - Multicast Traffic Grooming over Light-trees
    - NO SENSE IN PRACTICE FOR SPARSE SCENARIOS !!!
- 10%: Switch Architectures
  - Broadcast-and-select
  - Reconfigurable Splitters
  - Tap-and-Continue
  - Sharing of MC unit
  - Tap-Configurable-2-Split-and-Continue (T2SC)

Is the Research on Multicast Terminated?

Challenge: adapt to App3 ?

- OCS via:
  - Use a broadcast channel
  - Engineer protocols to use it
  - EON adaptation to demand

- Alternatives to OCS? KEYS:
  - Sub-lambda switching
  - Source routing (SPRING/BIER)
  - Long-haul burst-mode transmission

Approaches to multicast

- Circuit-Switched Light-tree (CSLT)
  - High overhead => Aggregation of groups
- Traffic grooming in CSLT
  - Electronic grooming
  - High overhead if small groups, and/or few light-trees
- OBS light-tree
  - High loss: mcast => higher probability of collision
- Optical Packet Switching
  - Mature enough ?
- Optical light-trail
  - Electronic switching & copying among trails
  - No overhead, but suboptimal
- Optical light-tree trail

T2Sg Switch Functionality

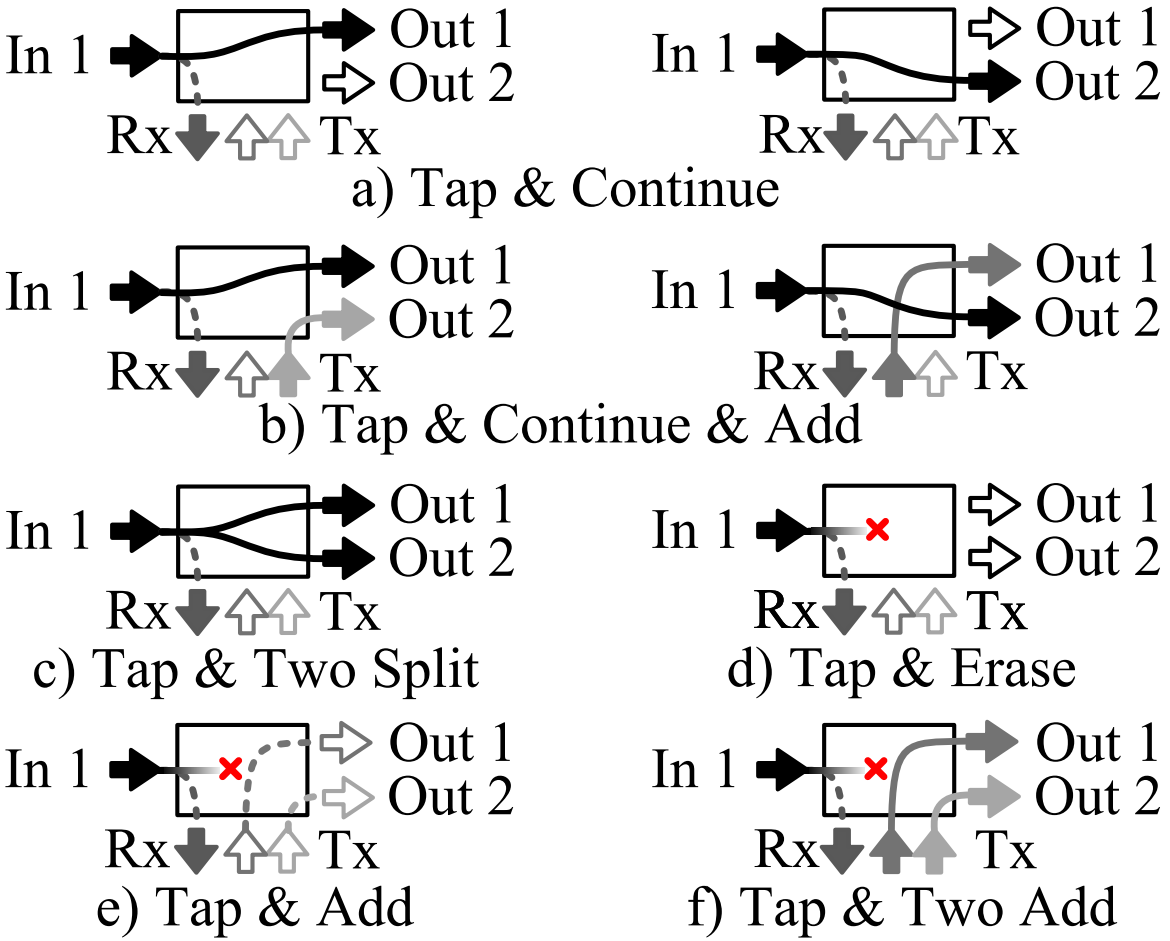


Fig. 2. T2Sg Switch functionalities

Implementation

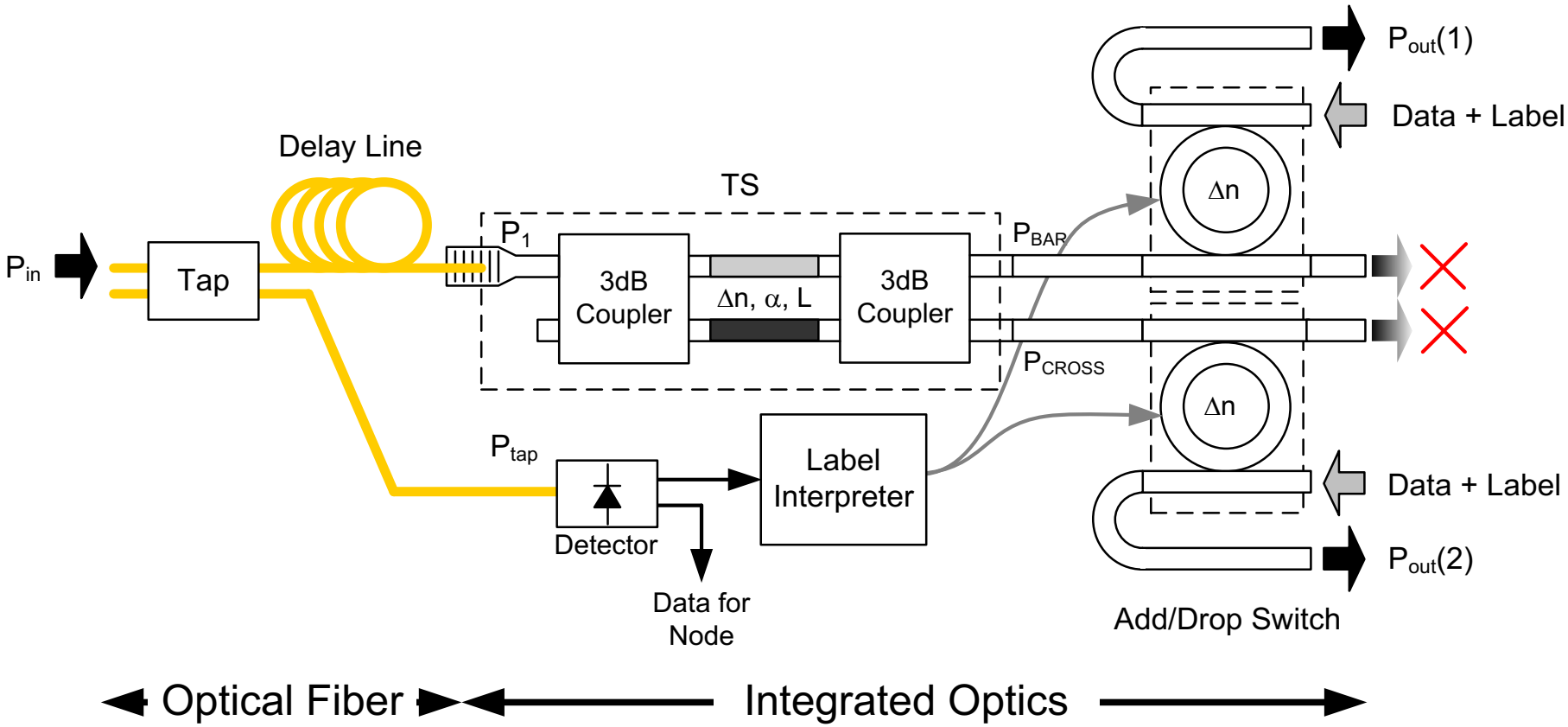


Fig. 3. Structure of the proposed Tap 2-Split Traffic Grooming Switch (T2Sg).

Full WDM switch

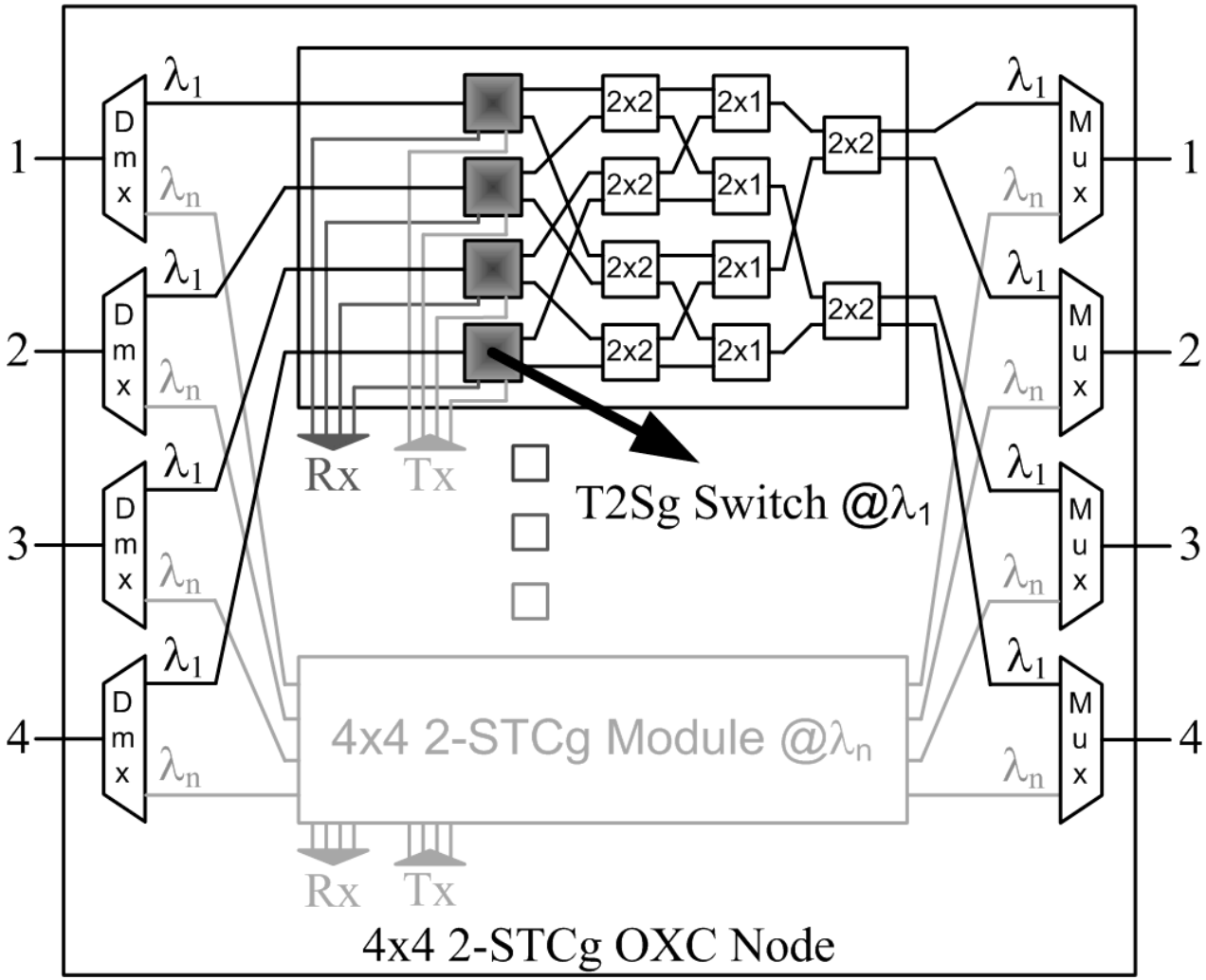
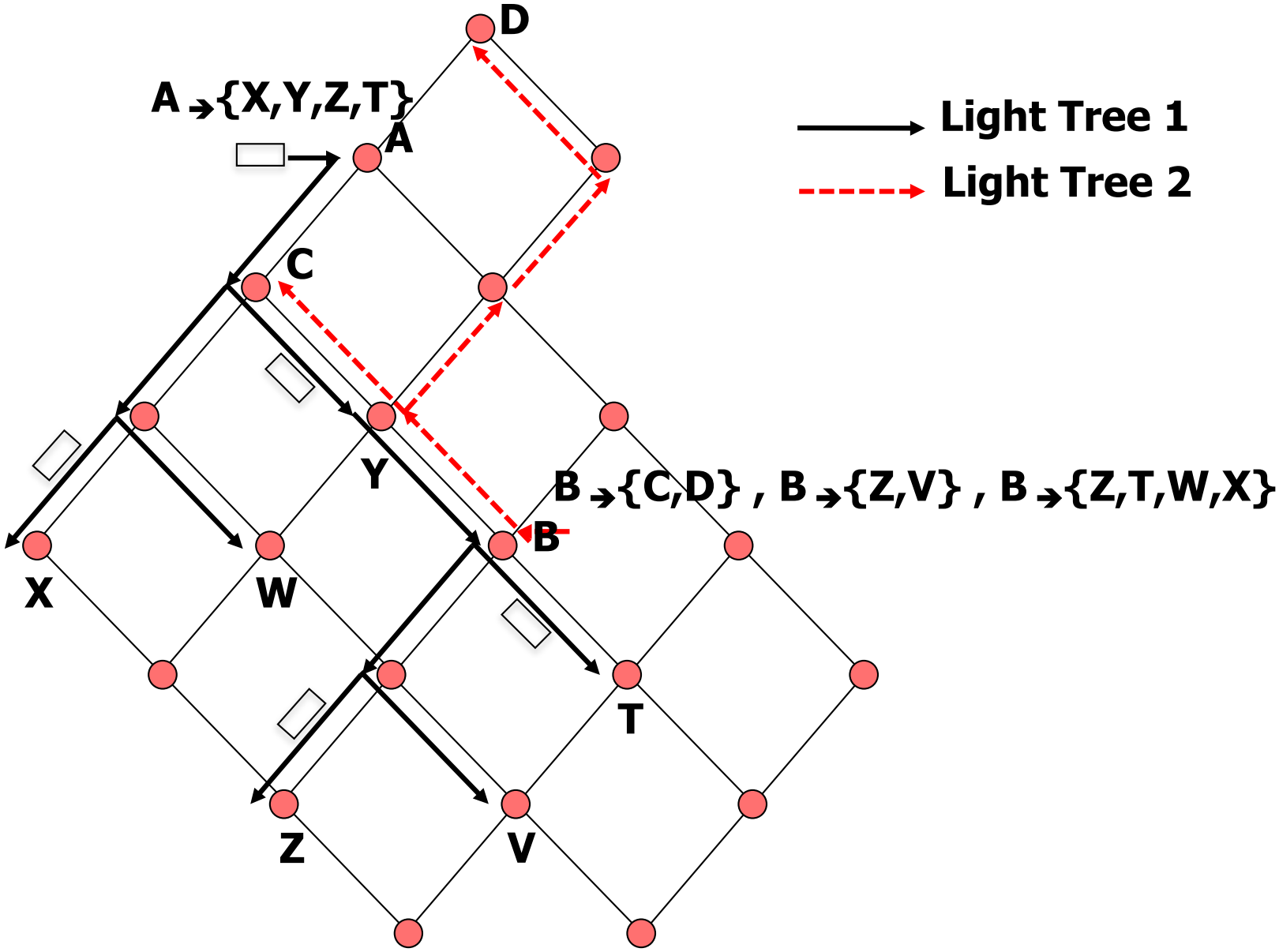


Fig. 1. 4x4 2-STCg OXC node structure.

T2Sg: sample multicast requests & light-tree



Relative bandwidth saving

Saving w.r.t. OCS light-tree

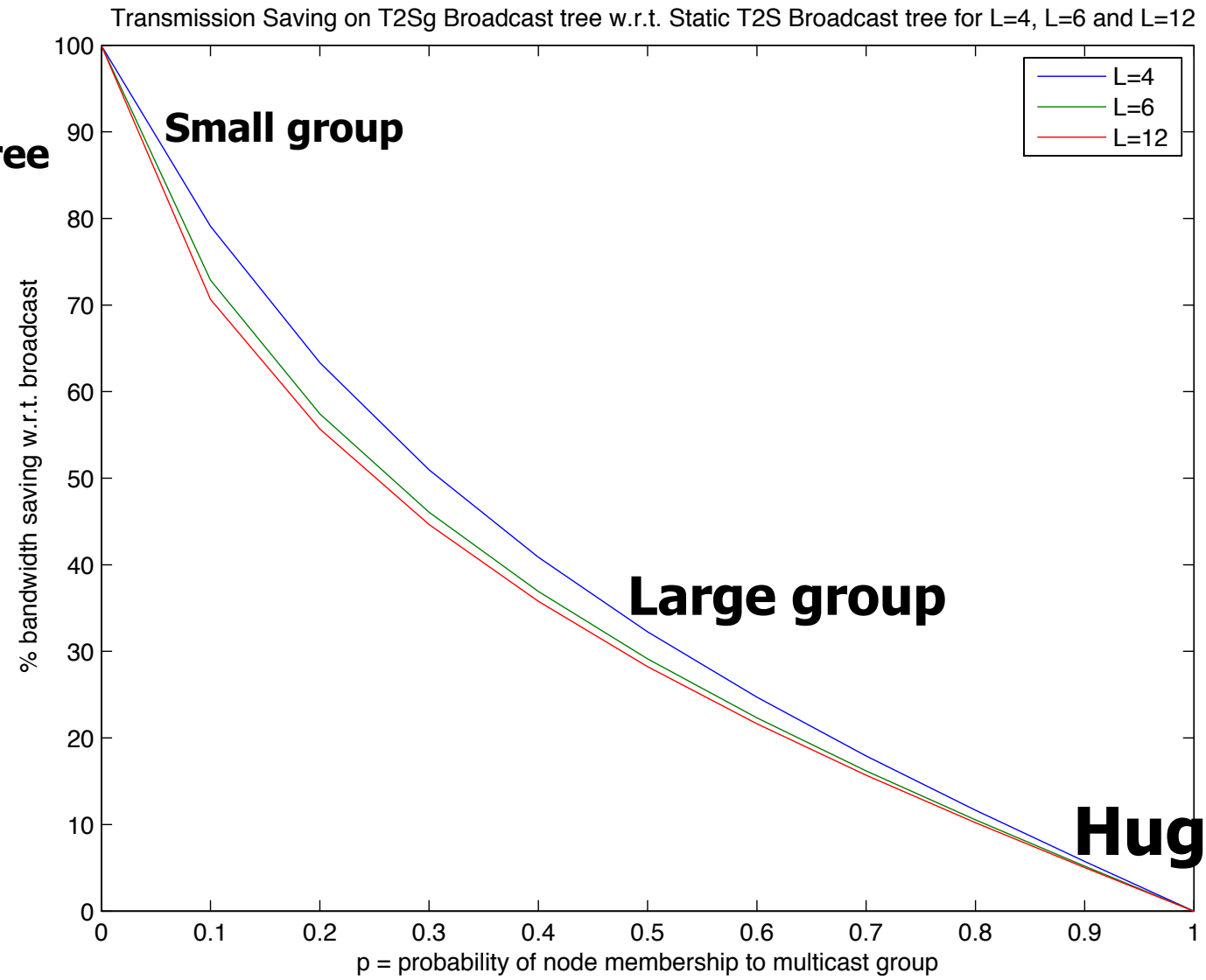


Fig. 12. Relative bandwidth saving featured by T2Sg with respect to T2S in a shared broadcast tree

Path attenuation

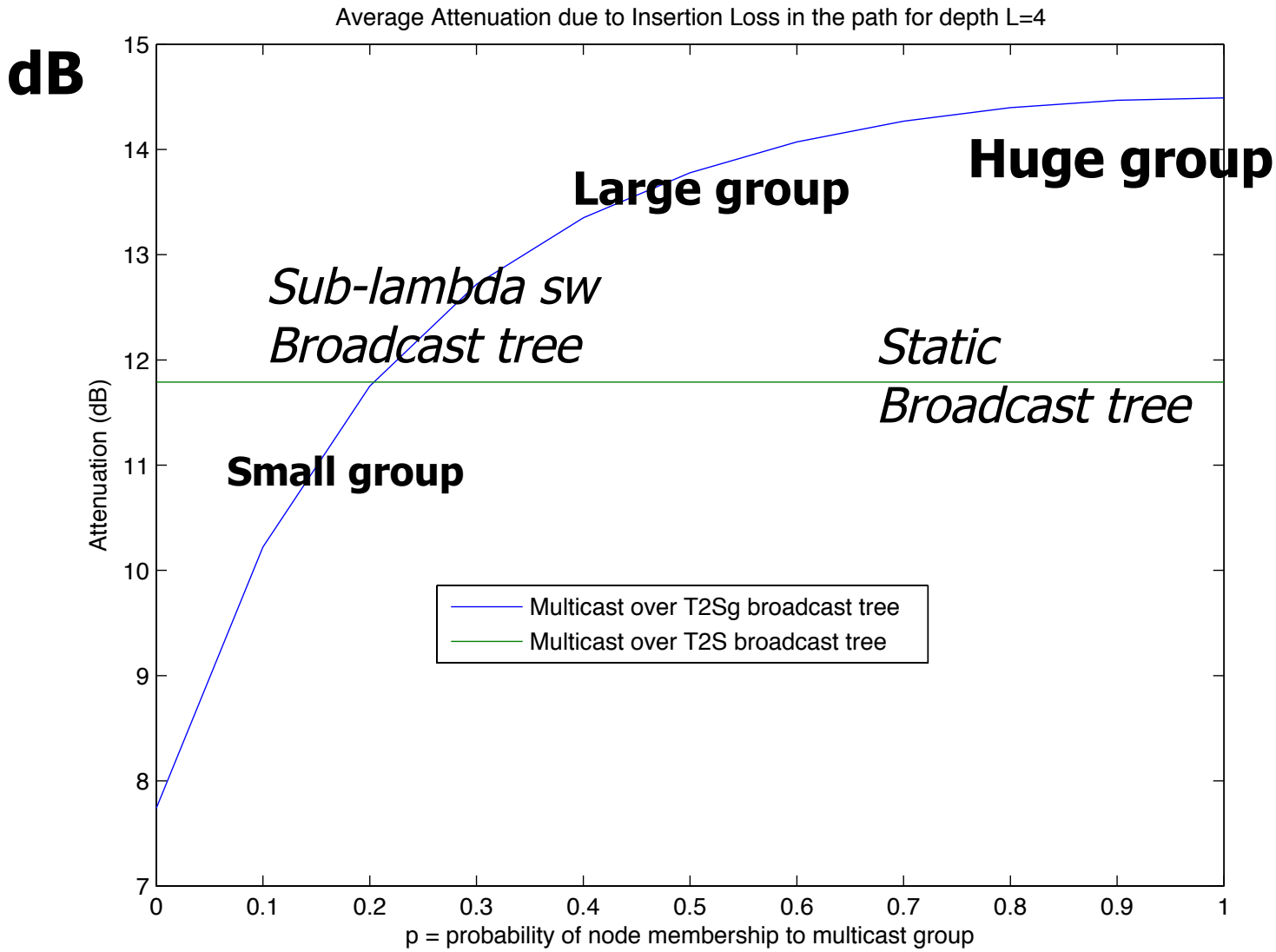


Fig. 13. Average attenuation due to insertion loss in a path root-leaf for a 4-node-deep binary light-tree

Conclusions/Challenges

- A lot of existing OCS multicast papers but..
- NO effective solutions for sparse multicast
- Little effort devoted to map electronic advances to optical layer
  - BIER/BF header optical processing
  - Multicast Segment Routing ?
    - .. into optical
  - Undone: Leverage Broadcast Channel by L3/L2 protocols
  - Multicast OPS
  - Light-tree trail multicasting ?

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