# Ethernet and TDM Sub-Wavelength Switching in Packet Optical Networking Platforms with a Centralized Switch

Design and Developers Forum, Globecom 2008

**Sunan Han**

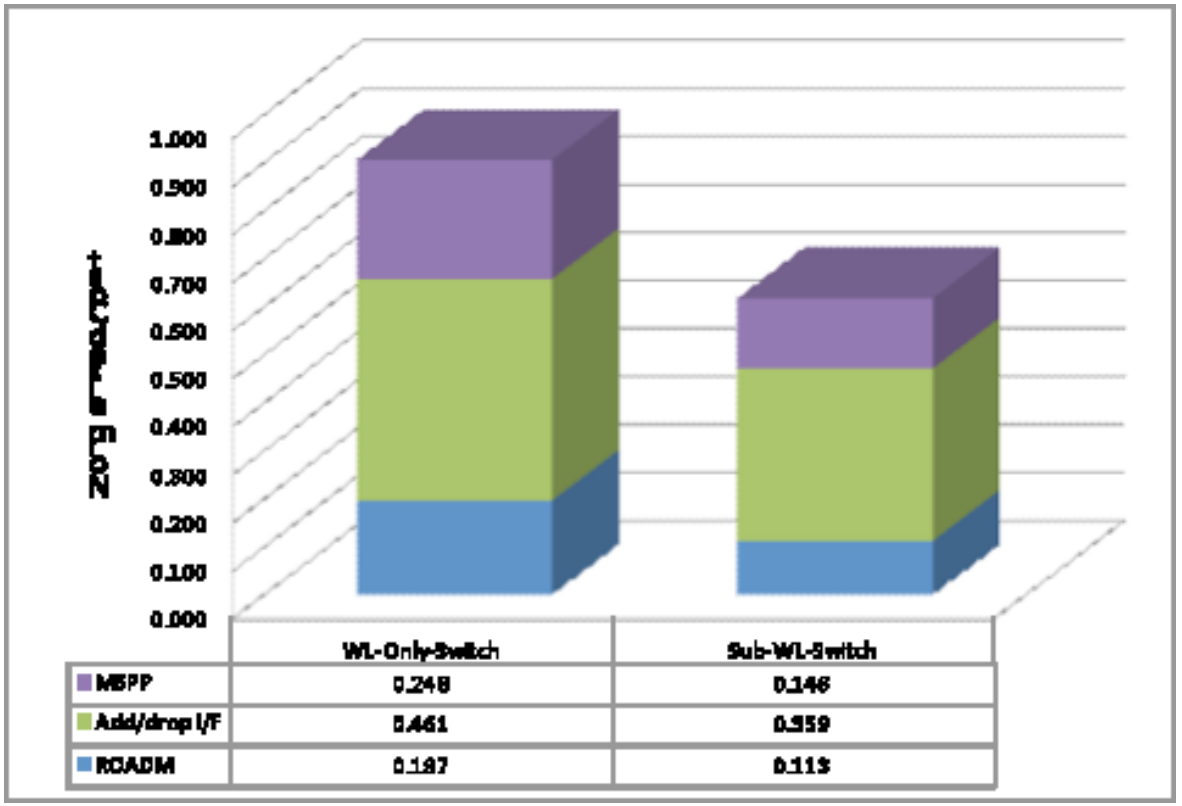
Fujitsu Network Communications

# The Integration of DWDM and Sub-Wavelength Switching

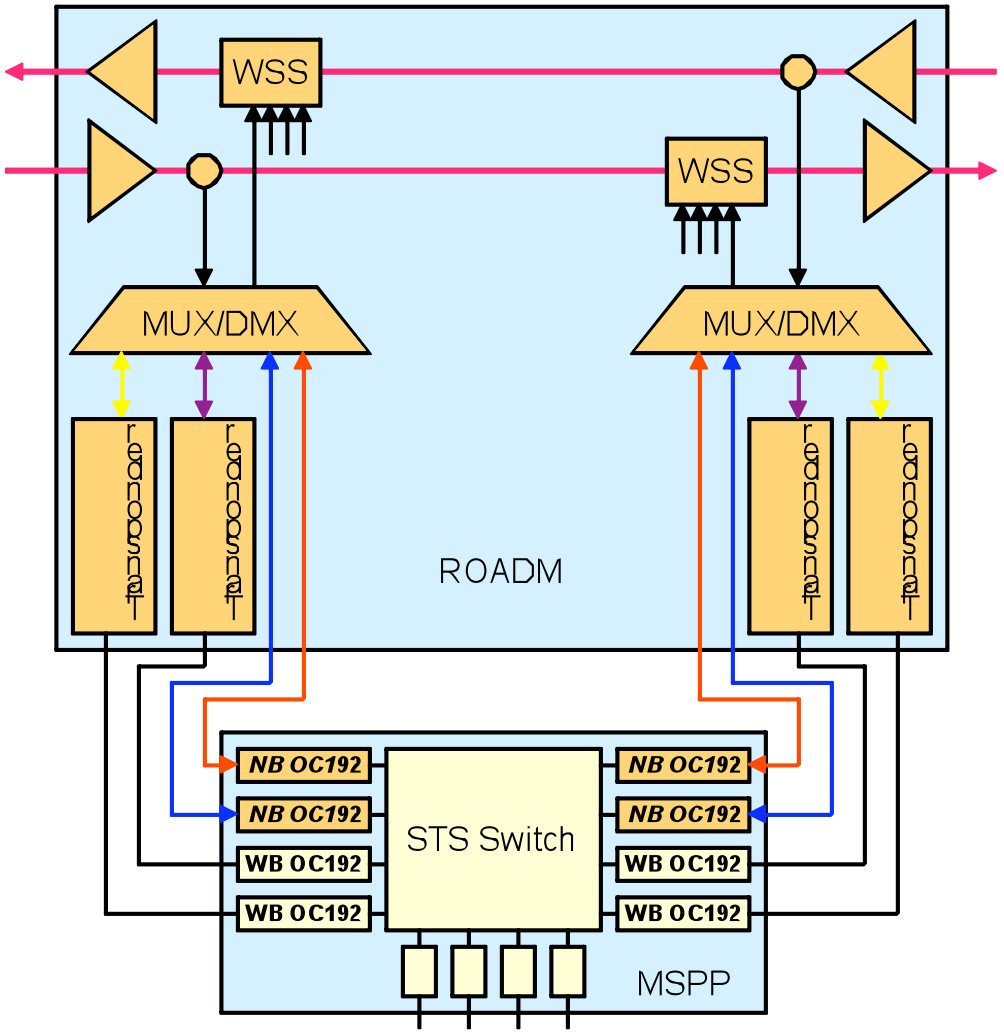
FUJITSU

- Network cost efficiency: wavelength-only network versus wavelength + sub-wavelength network. Wavelength-only network draws analogy to airline operators utilizing airplanes of same size and fights of same frequency between any cities
- Integration stage one: SONET over DWDM – MSPP overlaid with OADM or ROADM
- Integration stage two: ADM-on-a-Wavelength (ADM-on-Card/ Blade) – build-in MSPP on optical transponders
- Integration stage three: Packet Optical Networking Platform (Packet-ONP) – Sub-wavelength centralized switch in a ROADM that switches SONET/SDH, OTN and Ethernet packet traffic and transports aggregated traffic in DWDM

# Economics: WL-Only versus Sub-WL Switching



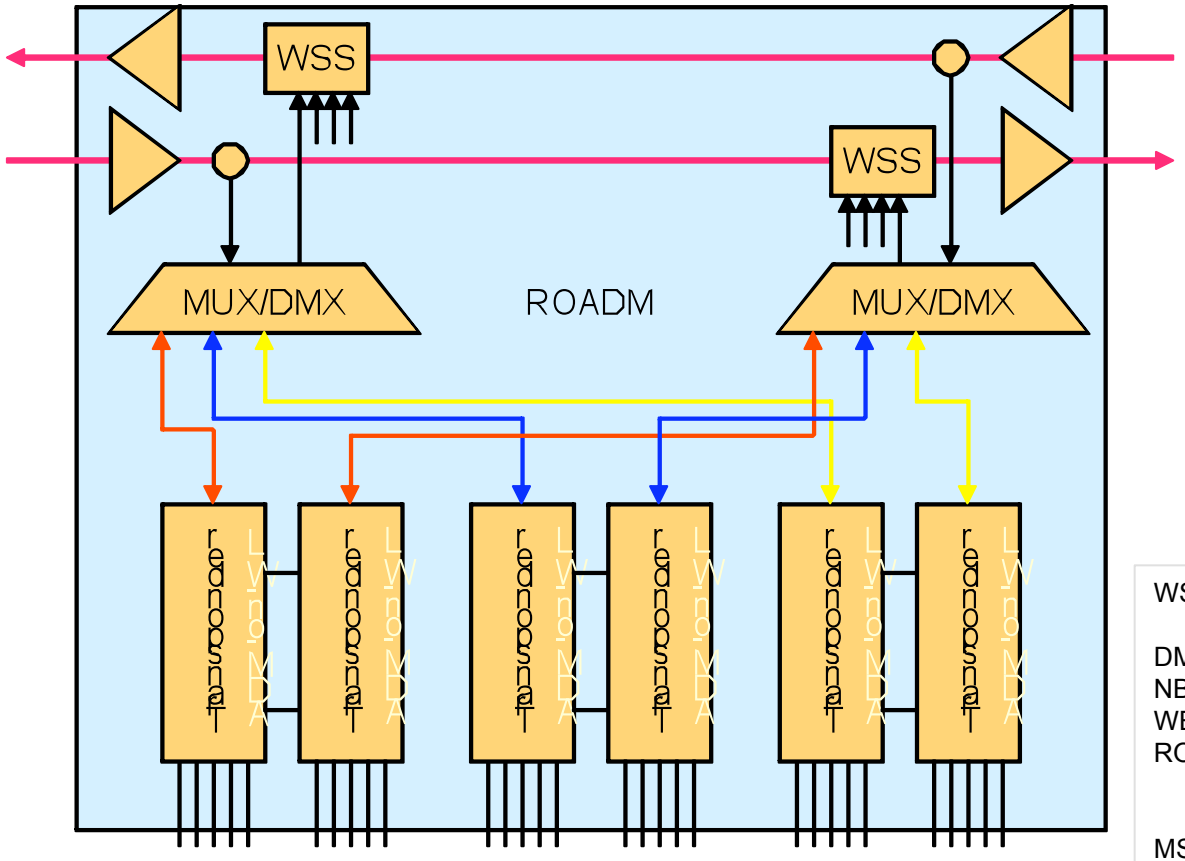
# SONET/SDH over DWDM




DS3/OC-n/Ethernet-over-SONET/Other Data

WSS: Wavelength Selective Switch
DMX: Demux
NB: Narrowband
WB: Wideband
ROADM: Reconfigurable Optical Add/Drop Multiplexer
MSPP: Multi-Service Provisioning Platform

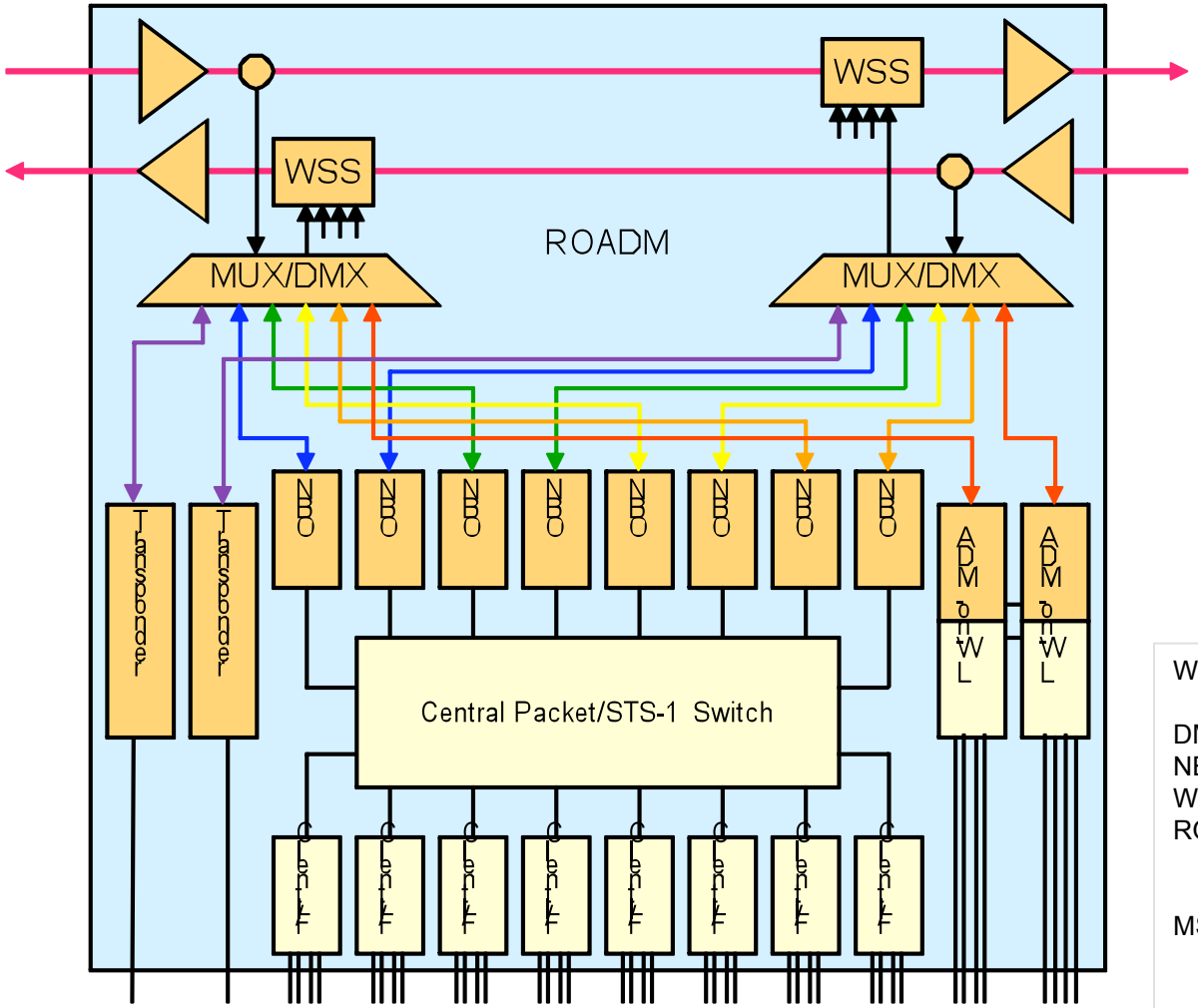
# ADM-on-a-Wavelength (ADM-on-Card/Blade)




OC-n/Ethernet-over-SONET/Other Data

WSS: Wavelength Selective Switch
DMX: Demux
NB: Narrowband
WB: Wideband
ROADM: Reconfigurable Optical Add/Drop Multiplexer
MSPP: Multi-Service Provisioning Platform

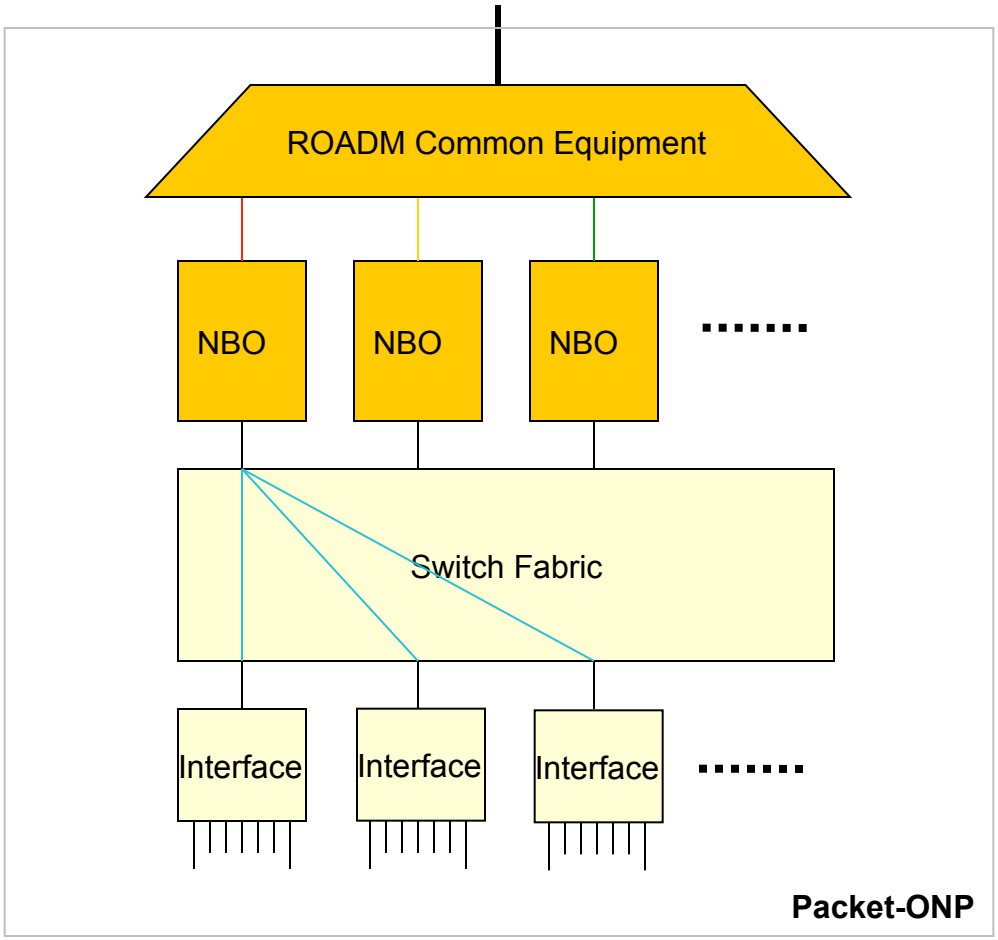
# Packet ONP with a Sub-Wavelength Central Switch



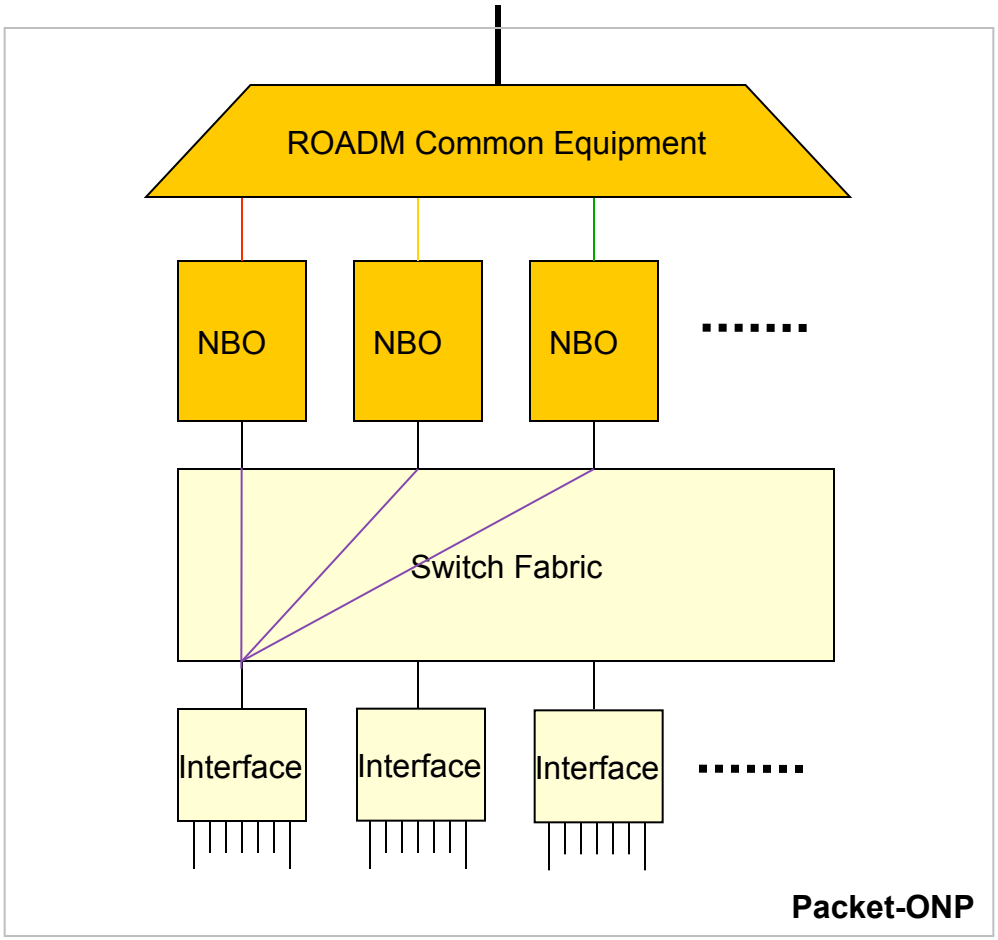

OC-n/ODUk/Ethernet-over-SONET/Ethernet/Other Data

WSS: Wavelength Selective Switch
DMX: Demux
NB: Narrowband
WB: Wideband
ROADM: Reconfigurable Optical Add/Drop Multiplexer
MSPP: Multi-Service Provisioning Platform
NBO: NB Optics Card

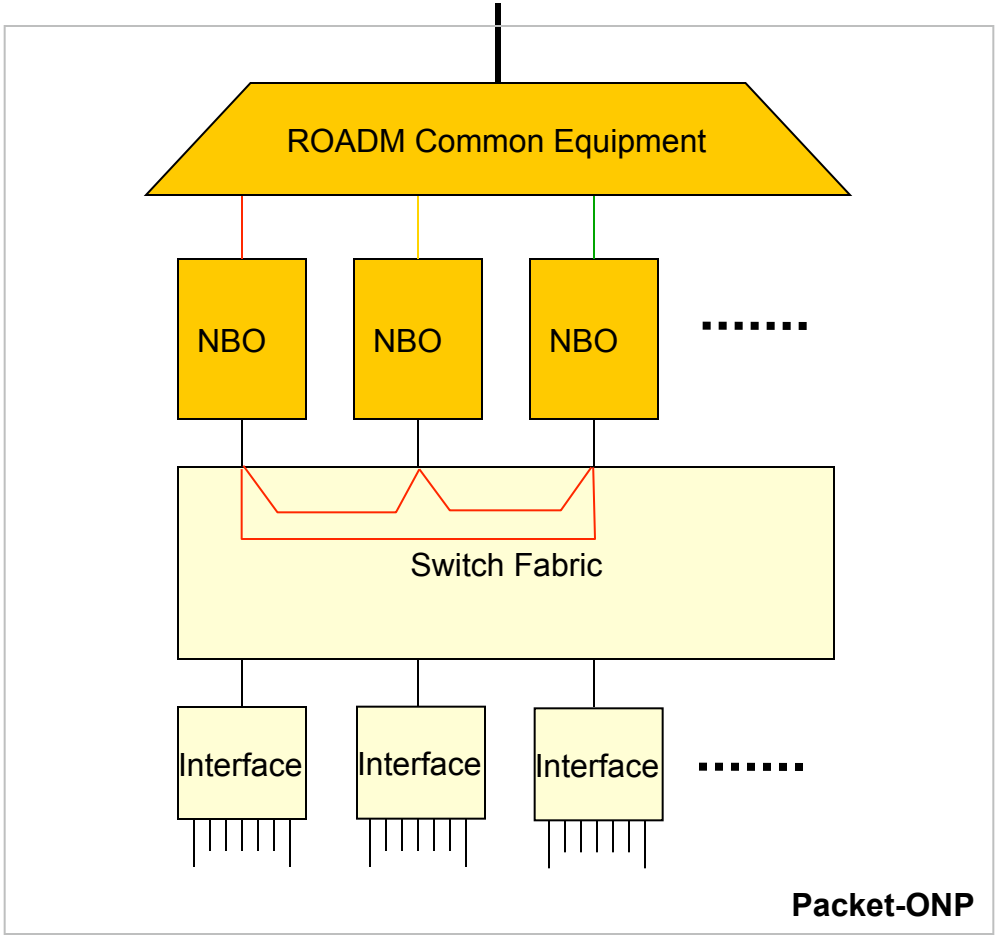
# Trunk Aggregation – Saving Line Cards



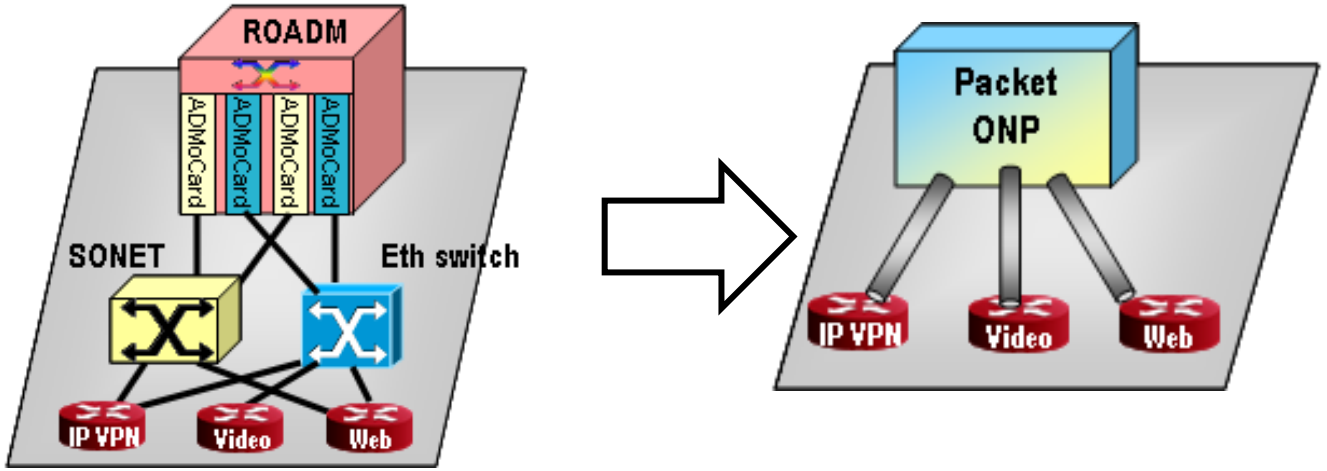
# Client Interface Global Aggregation – Saving Client Interface Cards



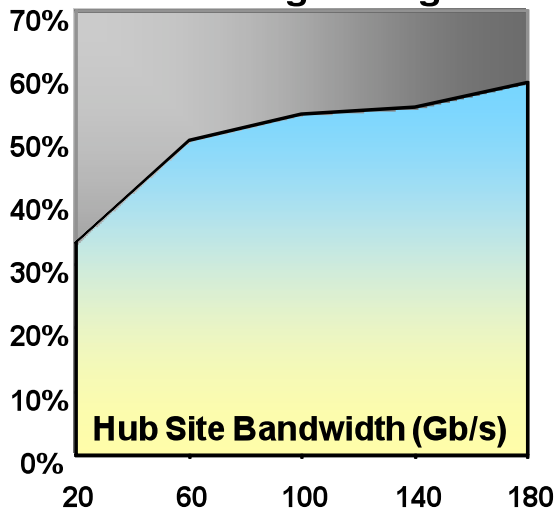
# Cross Wavelength Connectivity



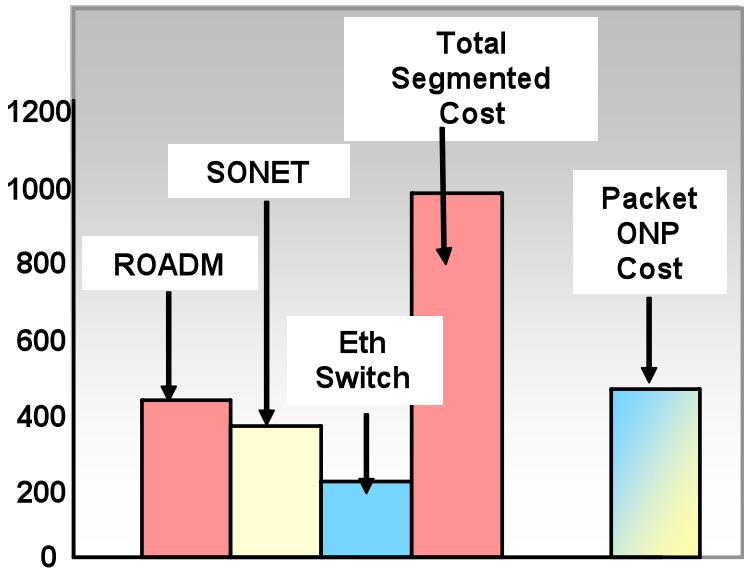
# Elimination Of Ethernet and SONET Aggregation and Grooming Overlays



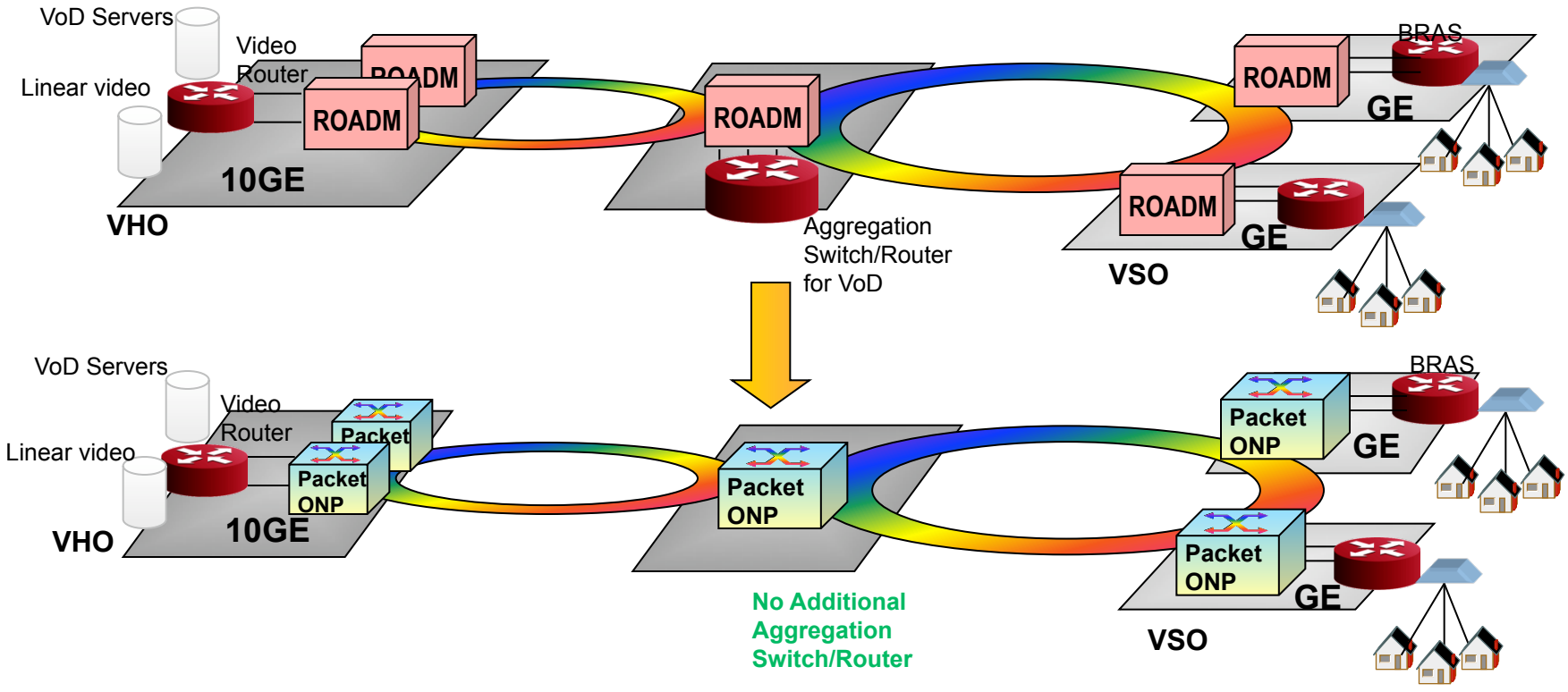

Hub Site Transport and Grooming Savings




Hub Site Transport and Grooming Cost at 100Gb/s

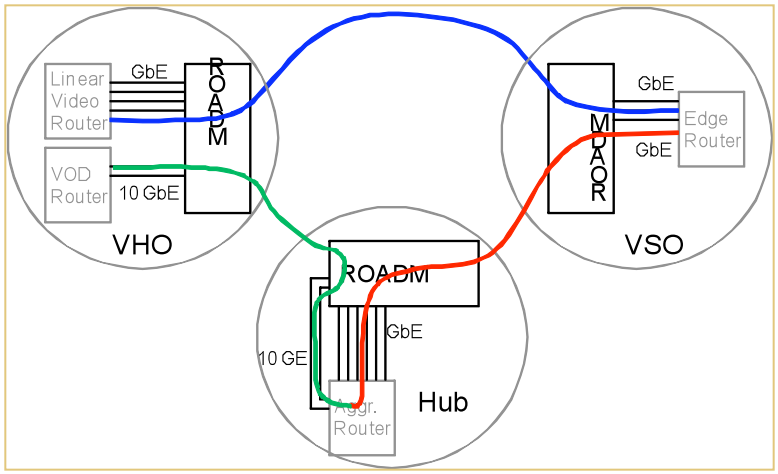


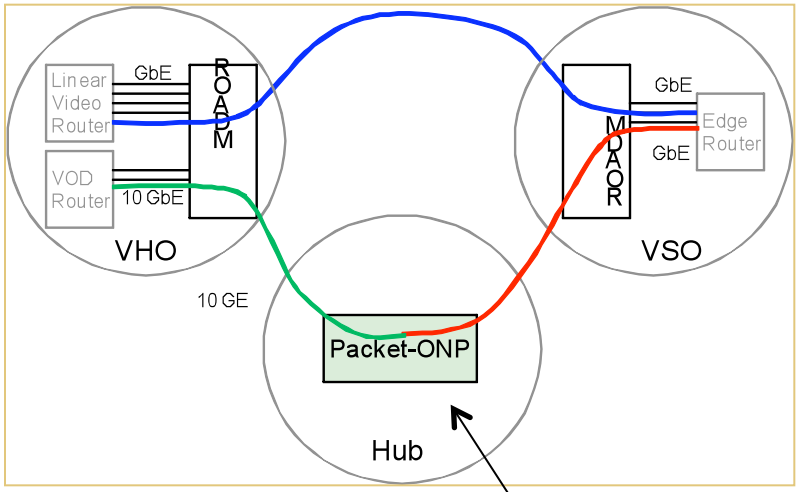
# Example: Video Aggregation



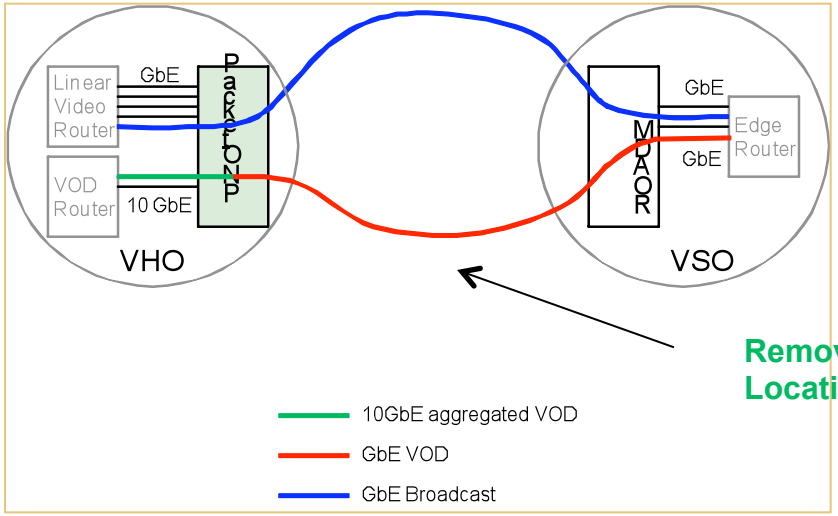

VHO: Video Headend Office
VSO: Video Serving Office
VoD: Video on Demand
BRAS: Broadband Remote Access Server

# Example: Video Aggregation




**Removal of Aggregation Device**

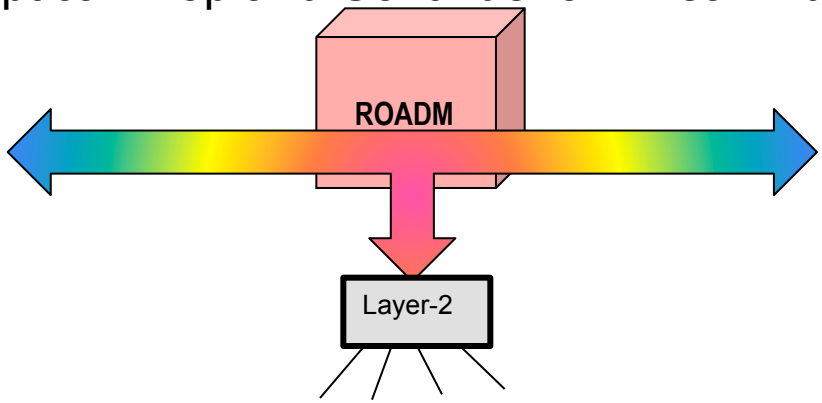



**Removal of Hub Locations**

# Enabling Multicast Applications at Layer-2

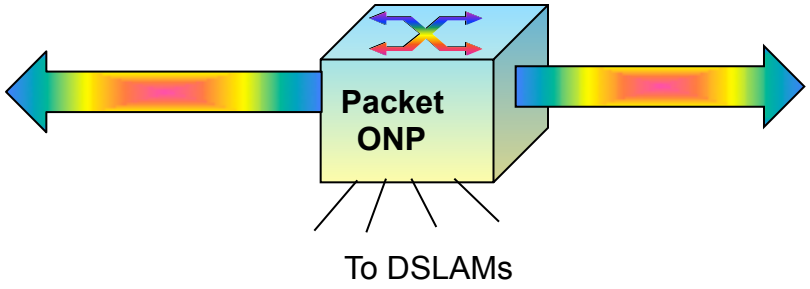
FUJITSU

Optical Drop and Continue for Linear Video



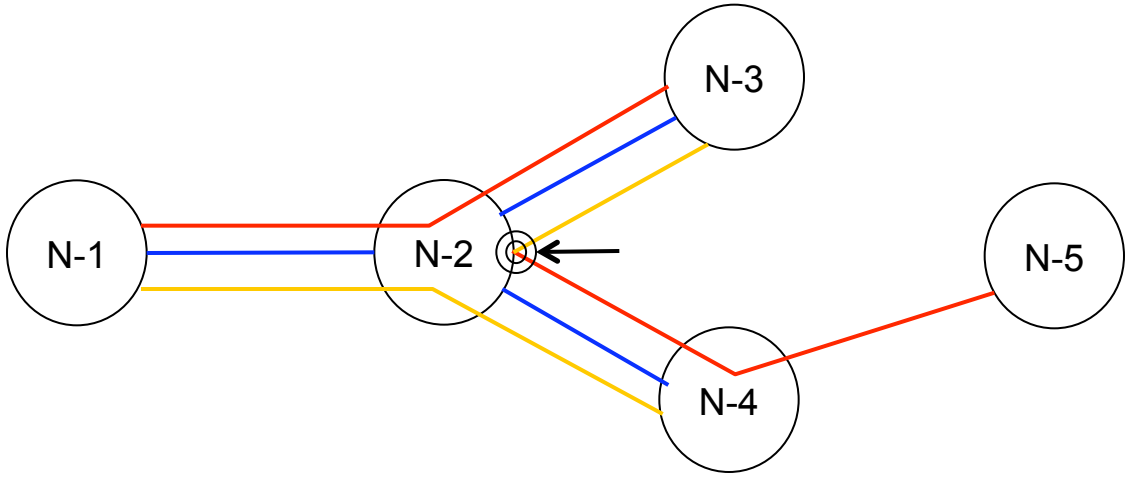

- **Dedicated Wavelength**
- **Layer-2 Overlay**

Layer-2 Multicast for Linear Video




- **Shared Wavelength**
- **No Layer-2 Overlay**

# WL Savings from WL Translation

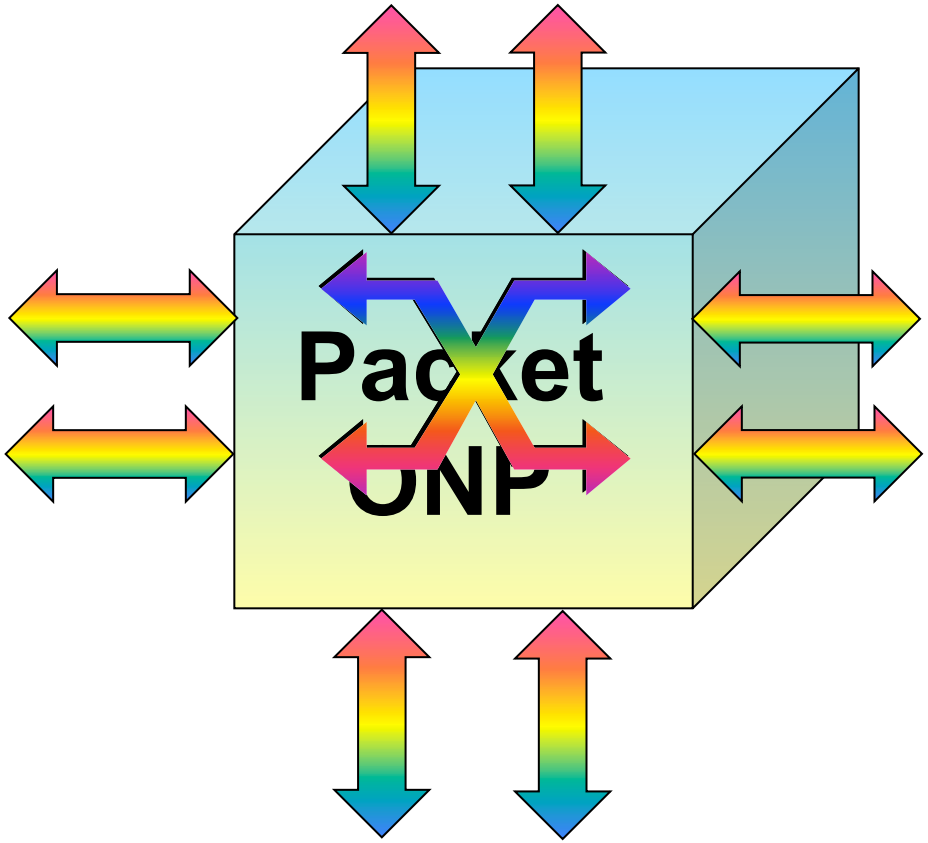



10G Wavelength Demands:

N-1 to N-2 (Wave #1)
N-1 to N-3 (Wave #2)
N-1 to N-4 (Wave #3)
N-2 to N-3 (Wave #2)
N-2 to N-4 (Wave #2)
N-3 to N-5 (Wave #1 & Wave #3)

# Facilitating Optical Mesh Network Designs

FUJITSU

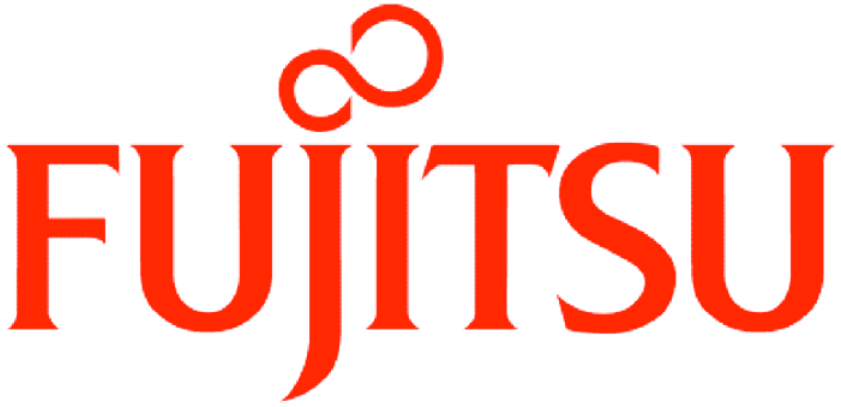



- Wavelength level crossconnect and switching by WSS
- Inter/sub-wavelength switching takes place in the centralized switch, which allows for greater freedom in the provisioning of the trunk ports through which the demands are routed in a mesh network with sub-wavelength granularity and efficiency.
- the sub-wavelength level interconnectivity does not have to terminate to ports and can be remotely provisioned

# Conclusions

FUJITSU

- Packet ONP provides ROADM based DWDM transport and Packet and SONET/SDH level switching
- The integration of Packet, SONET/SDH and DWDM provides significant cost efficiency by granular aggregation and grooming, the elimination of overlay networks and the service diversity
- The Packet ONP architecture embraces carriers' current network infrastructure, which is predominantly TDM, as well as provides an evolution path to an Ethernet dominated all-packet optical transport infrastructure.




THE POSSIBILITIES ARE INFINITE