

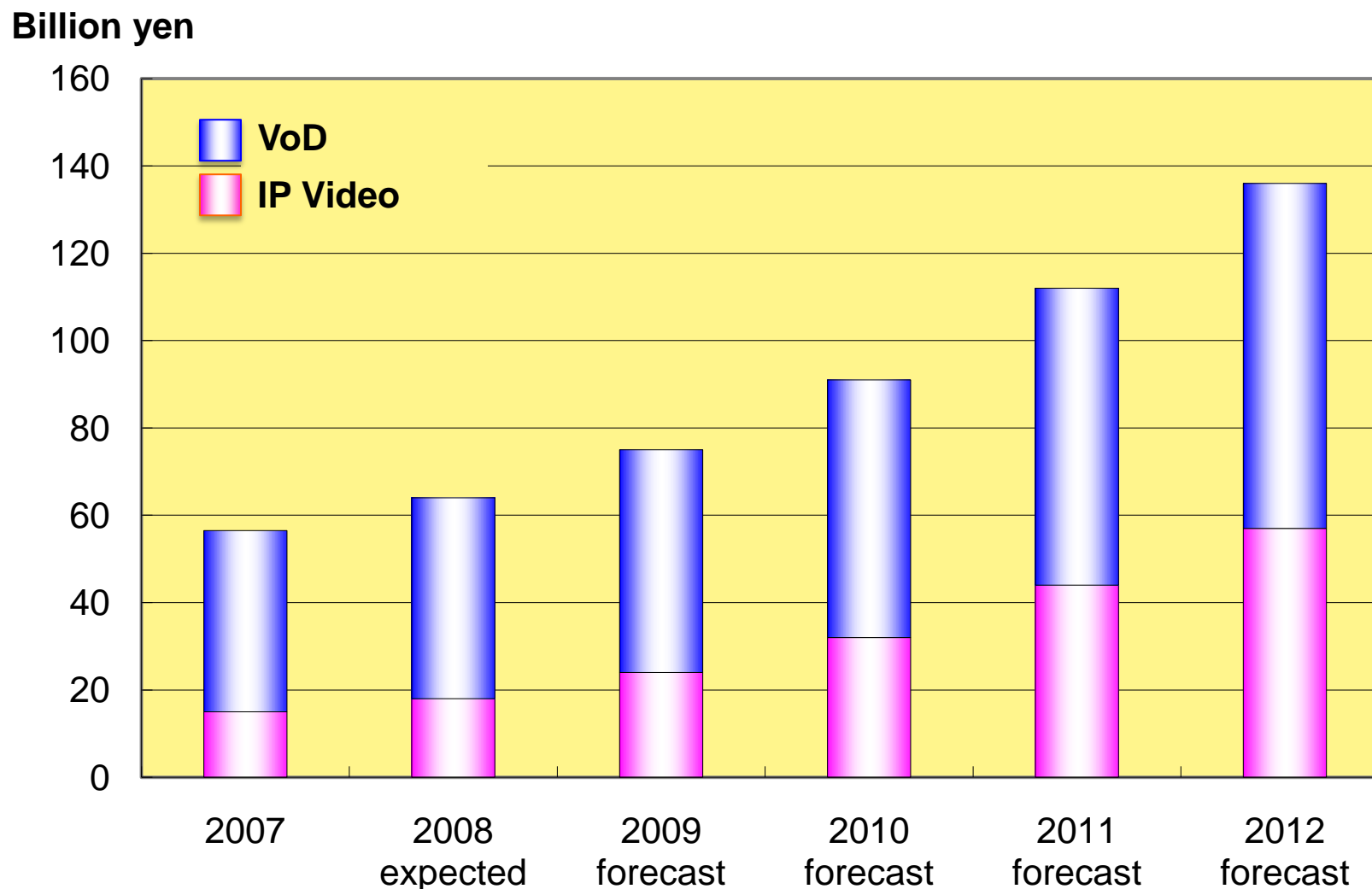
Future High-Bandwidth Demand Services and Network Trends

July 13, 2009
OECC 2009, Workshop

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Nagoya University

Market Size of Pay-view Video Content Distribution Services

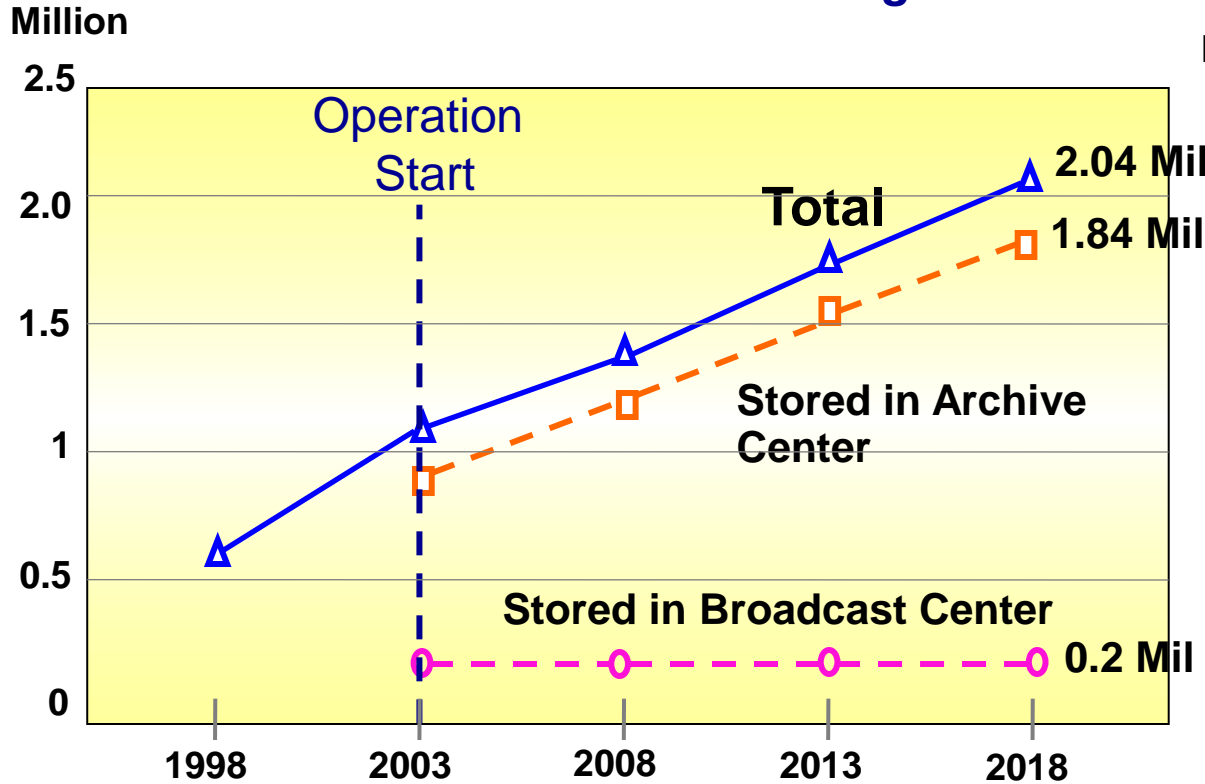
In Japan



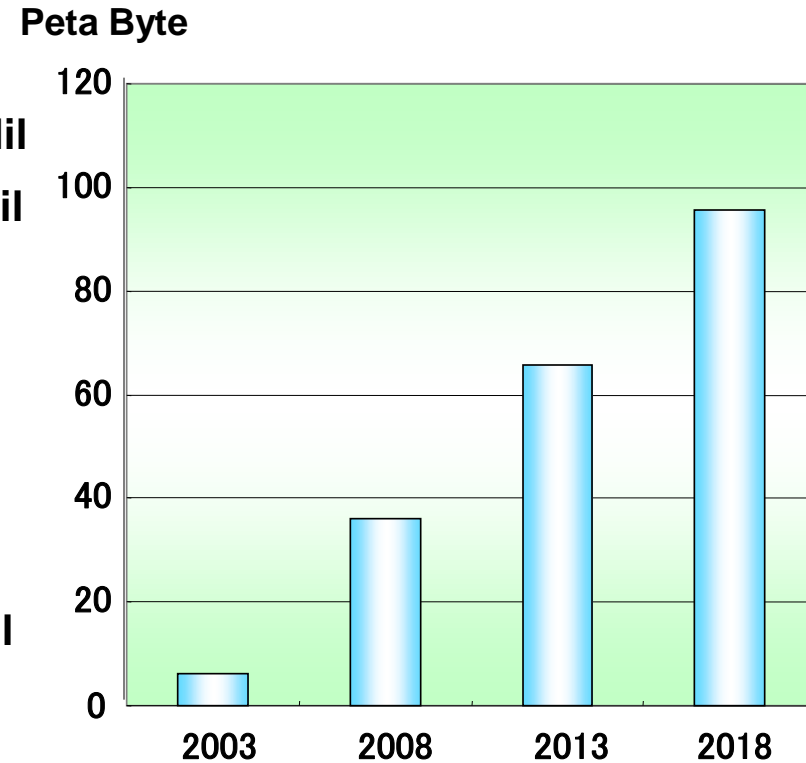
K. Kawazoe, NTT R&D Forum 2009 Workshops, February 20, 2009.

Increase in Number of Archived TV Programs and Digital Data in NHK

Number of Archived TV Programs



Archived Digital Data



Total Downloaded Traffic Volume per Day by Broadband Users in Japan=9.5 PB/day*1 (May 2008)

Courtesy of Dr. Yoshihiro Fujita, Presented at the 11th Optical Technology Symposium, March 4, 2008, AIST, Tokyo.

*1: http://www.soumu.go.jp/menu_news/s-news/2008/080829_9.html

HIGH RESOLUTION SCIENTIFIC DISPLAY SYSTEM

High-Resolution Multi-Tile Displays at the University of California, San Diego

300 Million Pixels

(180 Gb/s=300 M x 2 x 10 bit x 30 frame: HD spec.)



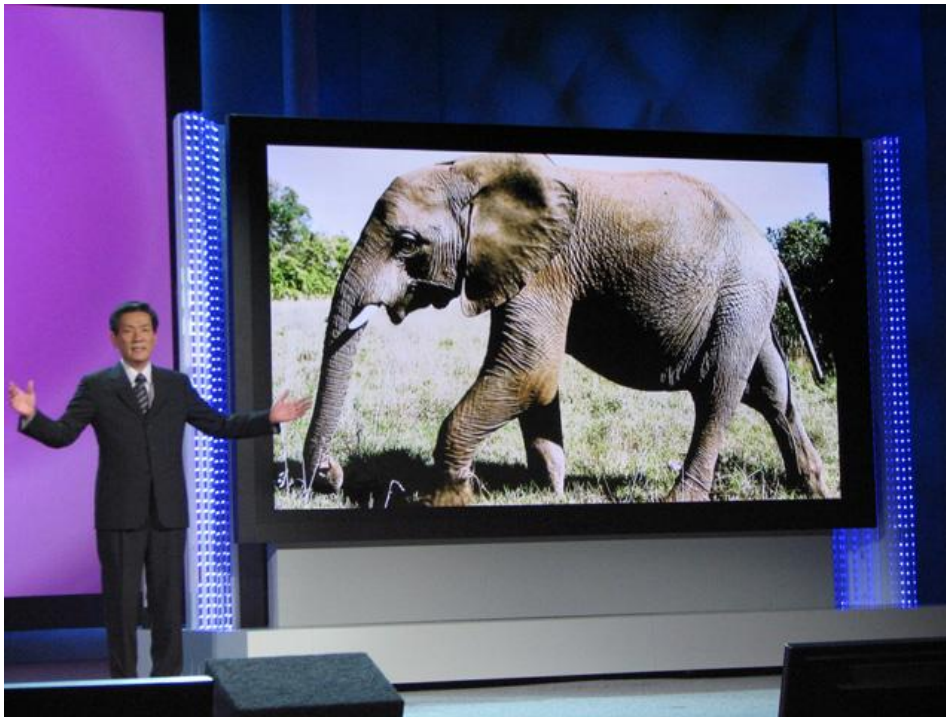
| | |
|----------------------|---|
| HIPerSpace: | 286,720,000 (Calit2 UC San Diego) |
| hyperwall-2: | 256,000,000 (NASA Ames) |
| HIPerWall: | 204,800,000 (Calit2 UC Irvine) |
| VARRIER: | 124,800,000 (Calit2 UC San Diego) |
| LambdaVision: | 105,600,000 (UIC Electronic Viz Lab) |
| OzIPortal: | 81,920,000 (University of Melbourne) |

(all numbers in pixels)

http://www.jacobsschool.ucsd.edu/news/news_releases/release.sfe?id=753

Screen Size is Getting Bigger

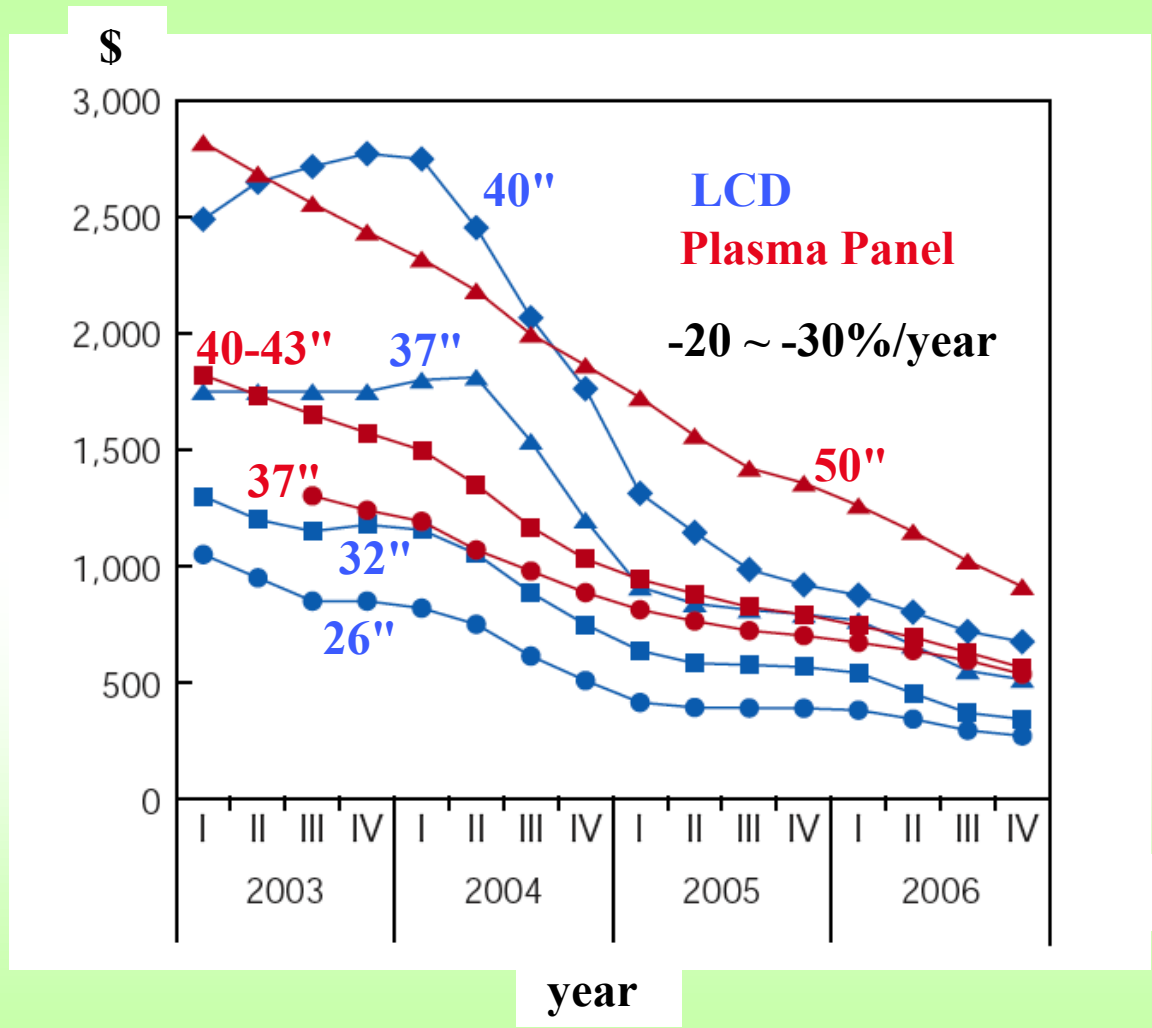
**Large Screen TV,
100" is already available,
150" has already been presented**



2006, 102 inch, Samsung and LG
2007, 103-inch plasma TV, Panasonic
(commercially available)
2007, 108-inch LCD TV, Sharp
(commercially available)
2007, 110-inch Projection TV, Victor
(commercially available)
2008, 150-inch plasma TV, Panasonic
(presented at 2008 CES, expected to be
available in 2008)

150" PDP presented at 2008 International CES
Expected to be commercially available in 2009

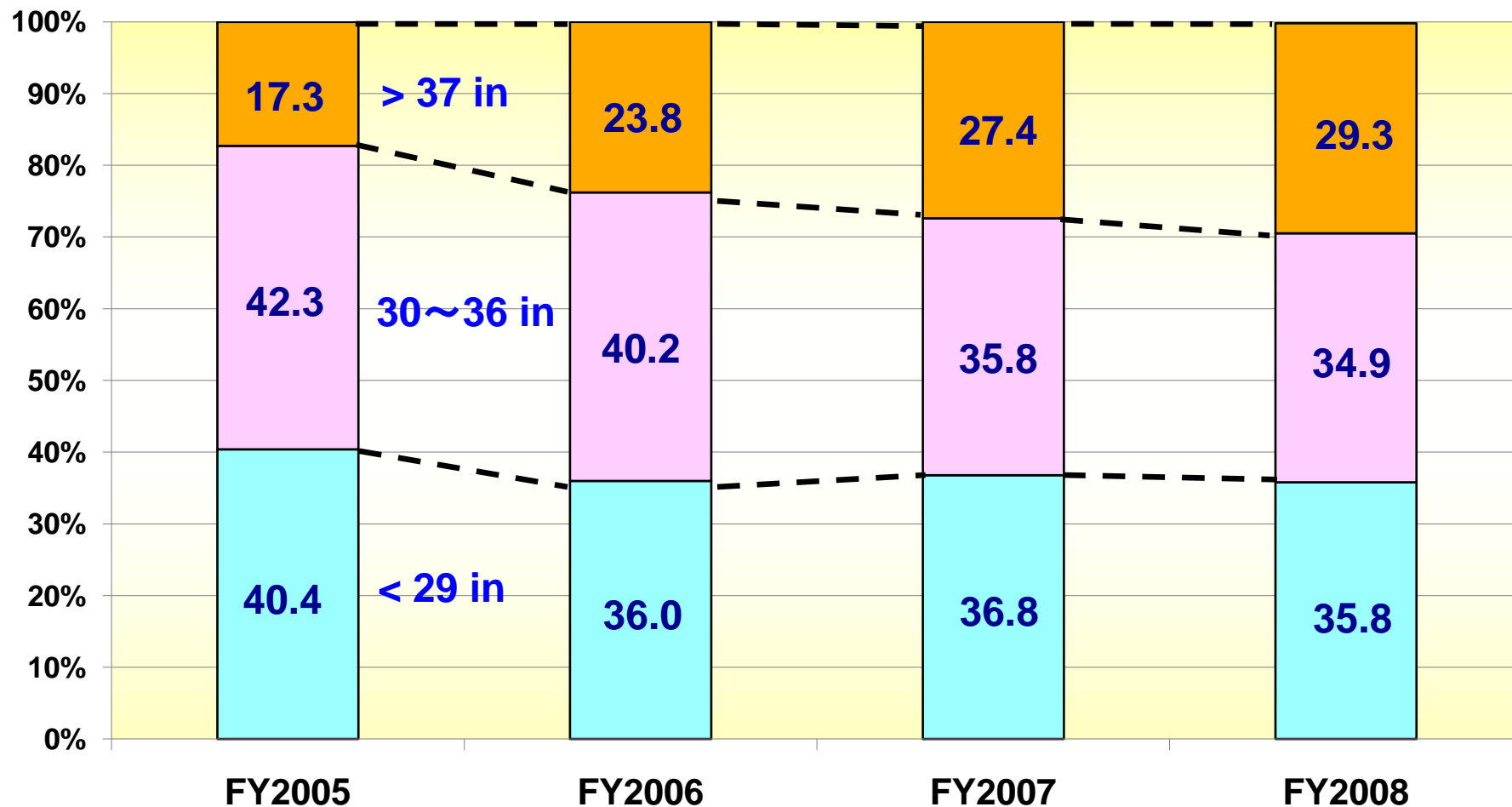
Price Trend of LCD and Plasma Panel for High Definition TV (in Japan)



White Paper, Ministry of Internal Affairs and Communications, 2007

Trend of TV Screen Size in Japan

Liquid Crystal TV Shipping



Source : Japan Electronics and Information Technology Industries Association

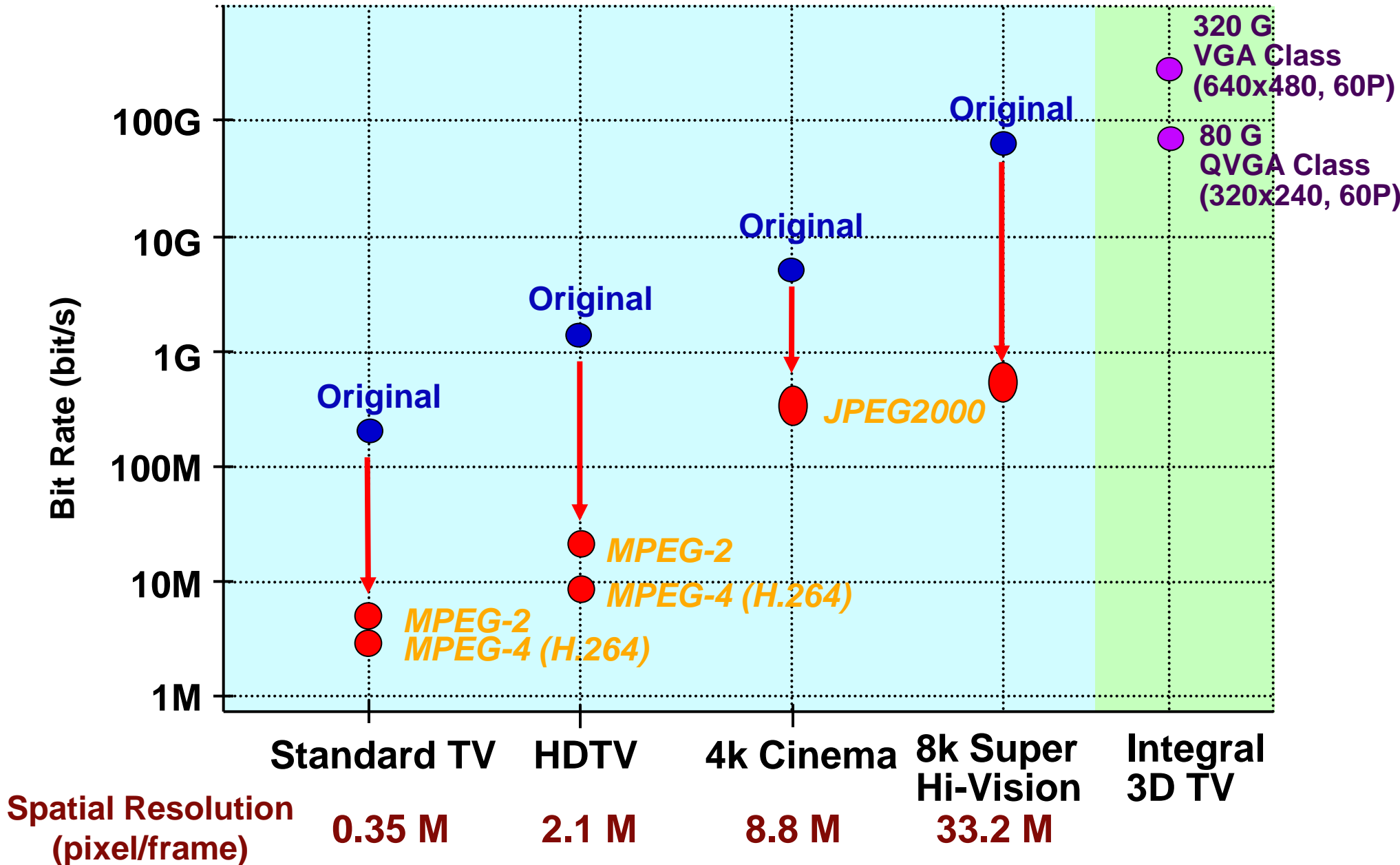
Life Wall -the entire wall of your living room becomes the display-

Presented at 2008 International CES

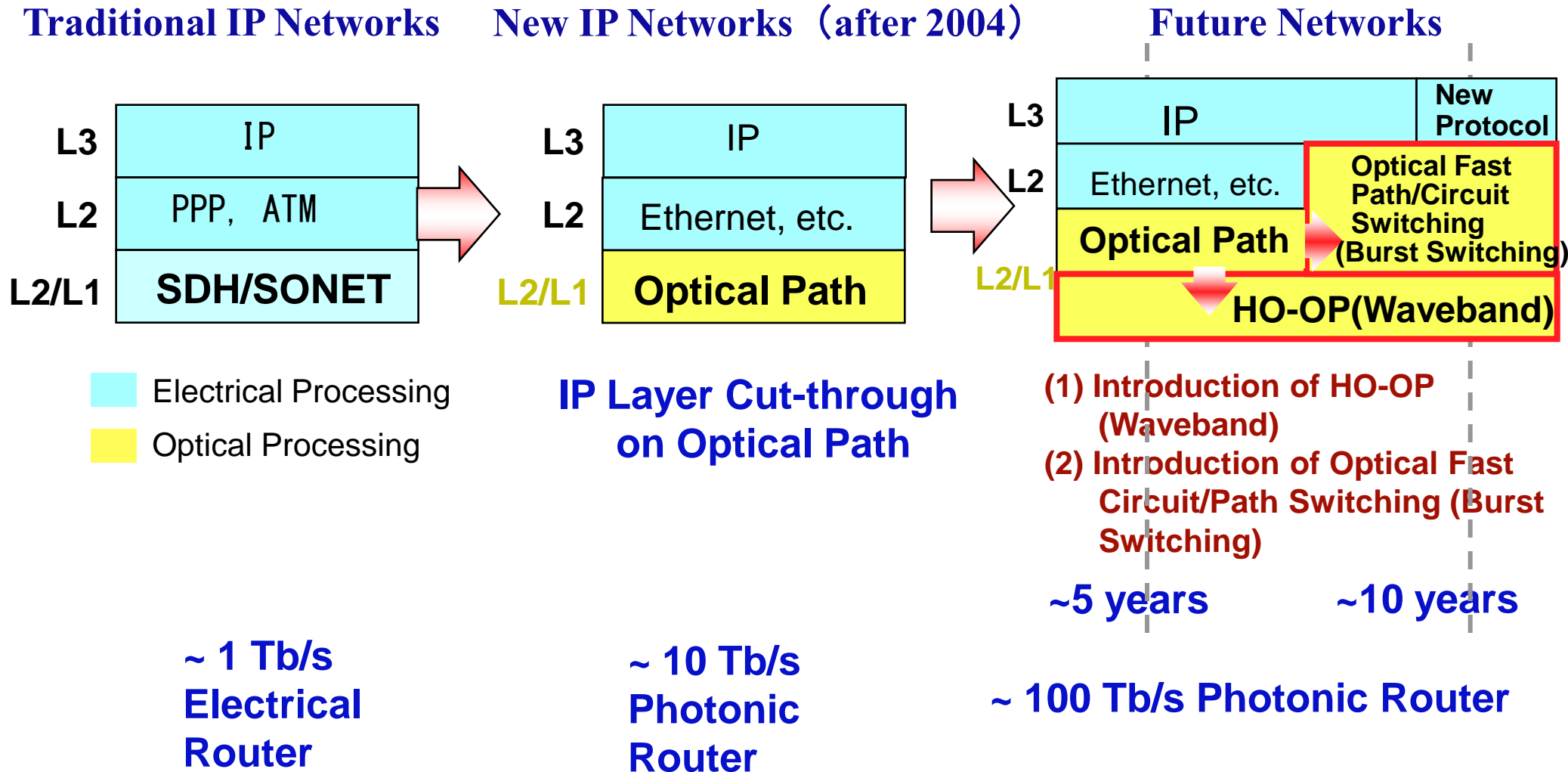


http://ex-blog.panasonic.co.jp/exhibition/2008/09/ceatec08_250.html

Video Bit Rate; Source and Compressed



Direction towards Network Throughput Expansion and Total Power Reduction



Hierarchical Optical Path Networks

■ WaveBand:

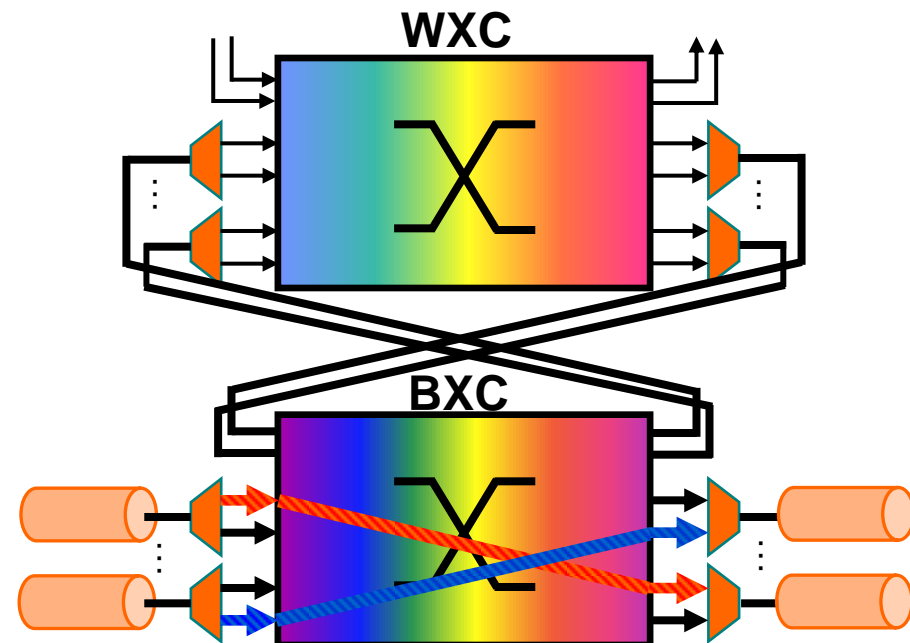
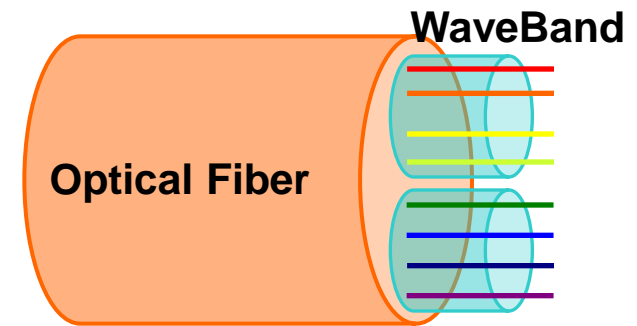
Grouped optical path to be treated as a higher order path

Merits

- Large Capacity Optical Path is Realized by Multiplexing Multiple Optical Paths
- Routing is done as a WaveBand; cut through of wavelength level routing processing

- Reduction of necessary number of switch ports
- Reduction of switch size

Node cost reduction



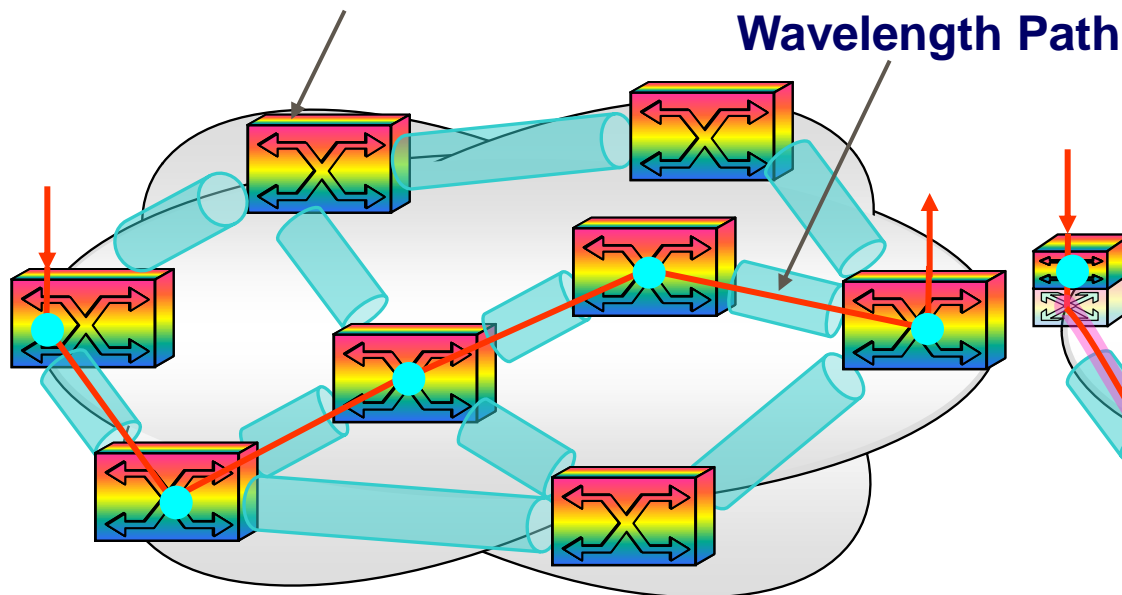
Single Layer and Hierarchical Optical Path Networks

Single Layer Optical Path Network

To implement fast optical path/circuit (or burst) switching, link-by-link switching is necessary.

➔ Network Scalability can be limited.
Path/Circuit set-up delay increases.

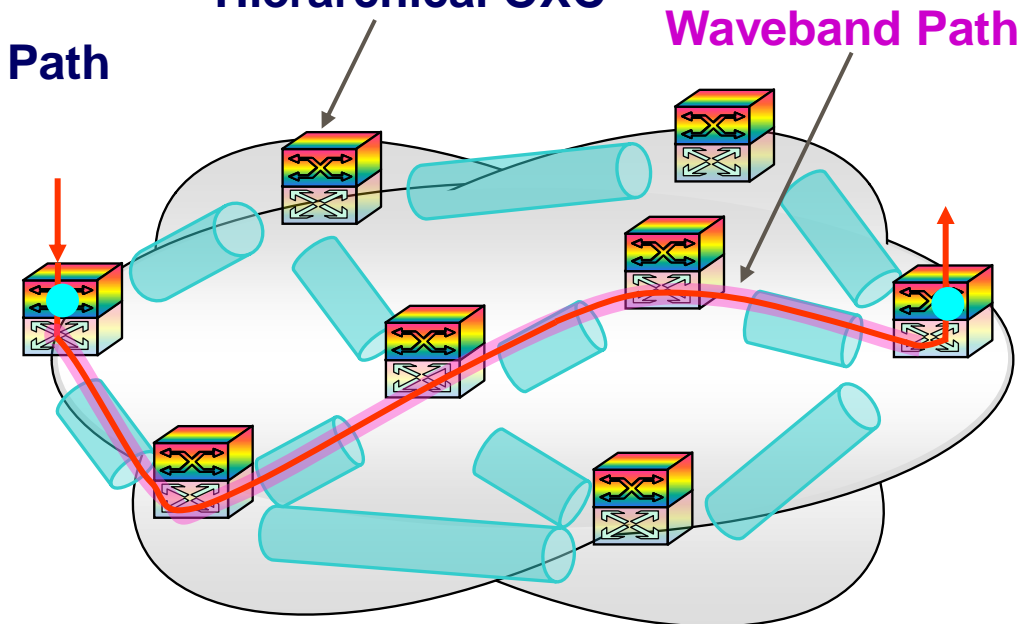
Single Layer OXC



Hierarchical Optical Path Network

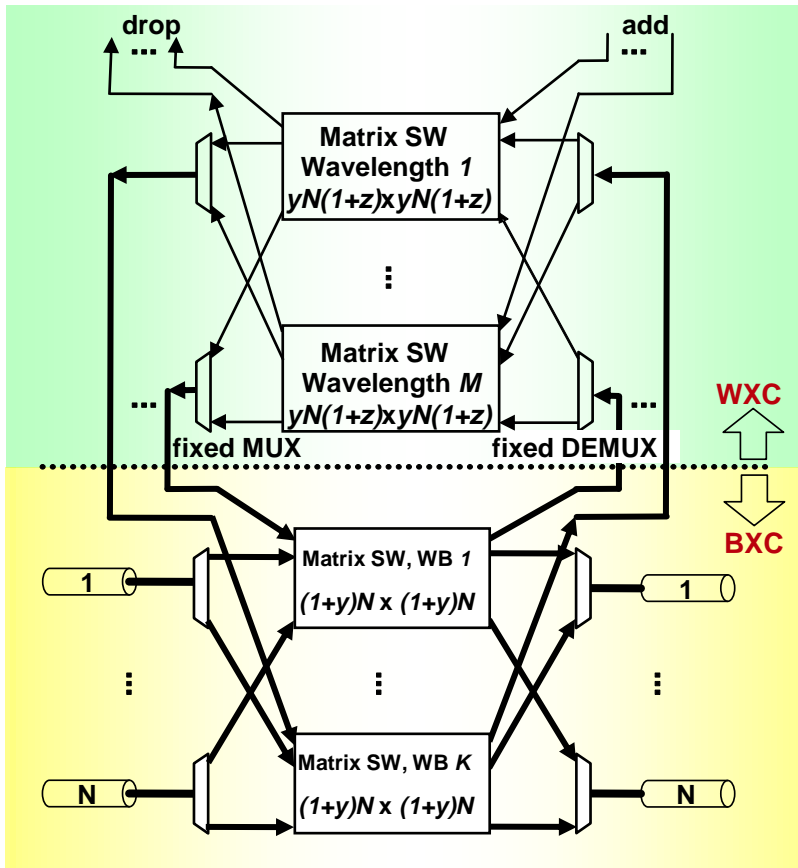
Direct higher-order optical paths (wavebands) mitigate the problem. (Virtual direct fiber connection can be created with a waveband path.)

Hierarchical OXC

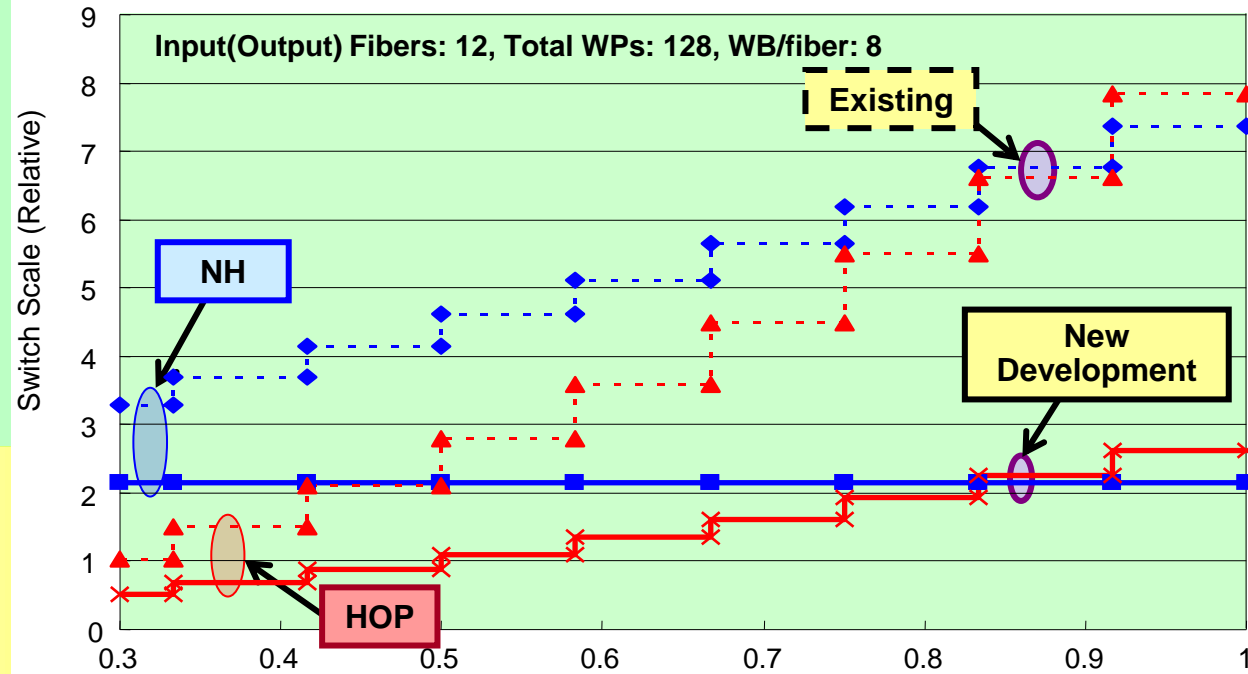


Switch Scale Reduction Attained with Hierarchical Optical Path Architecture -Matrix Type Switch-

Space Switch Based Hierarchical Optical Path Cross-connect Switch Architecture

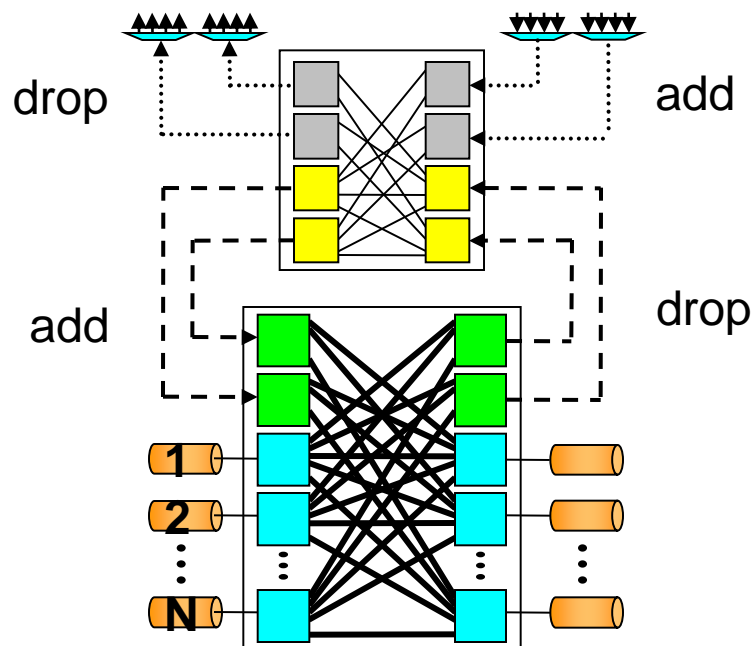


Comparison of Switch Scale

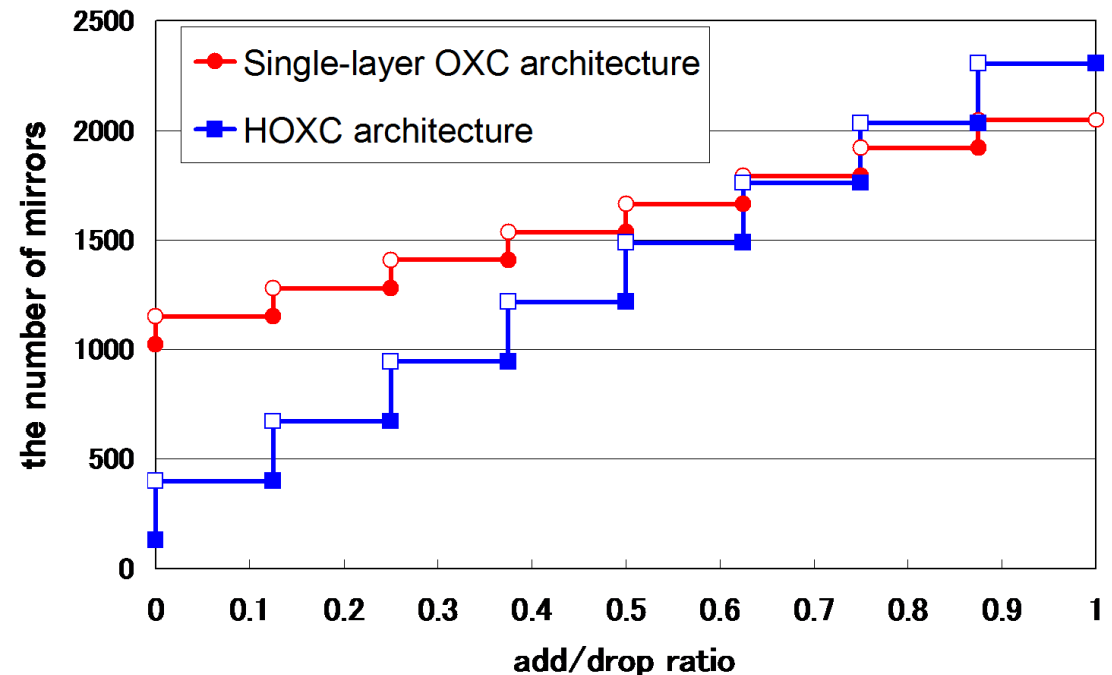


Switch Scale Reduction Attained with Hierarchical Optical Path Architecture -WSS/WBSS Type Switch-

WBSS based Hierarchical OXC

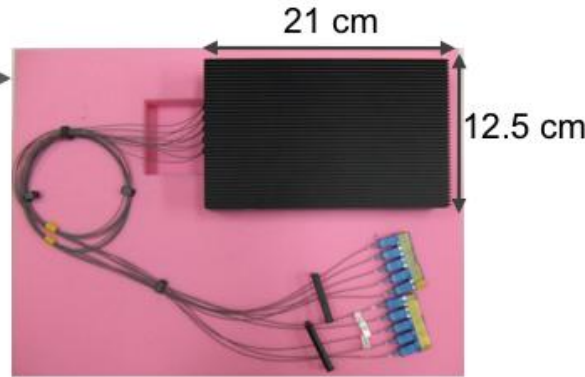
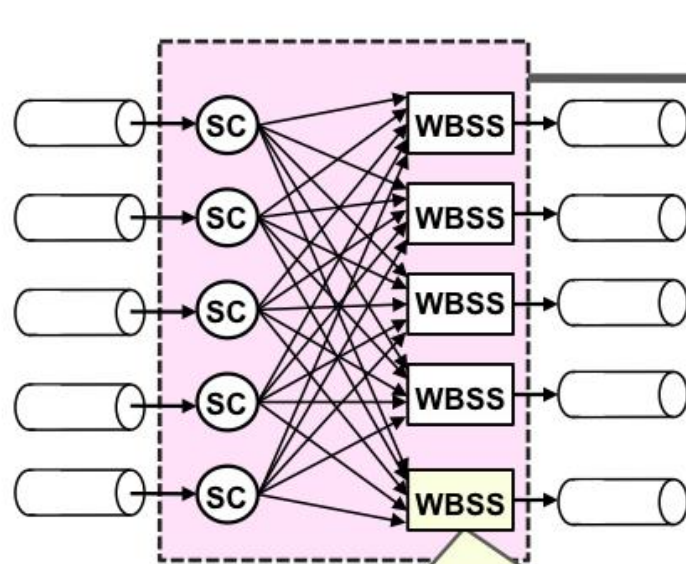


Total number of mirrors can be reduced by 48% to 21% over an area where the add/drop ratio is between 0.25 and 0.5.



Ref. [48]

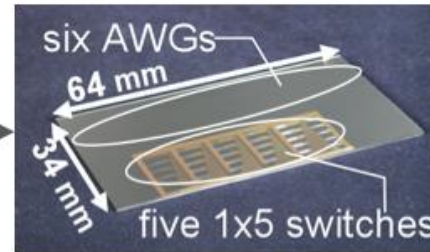
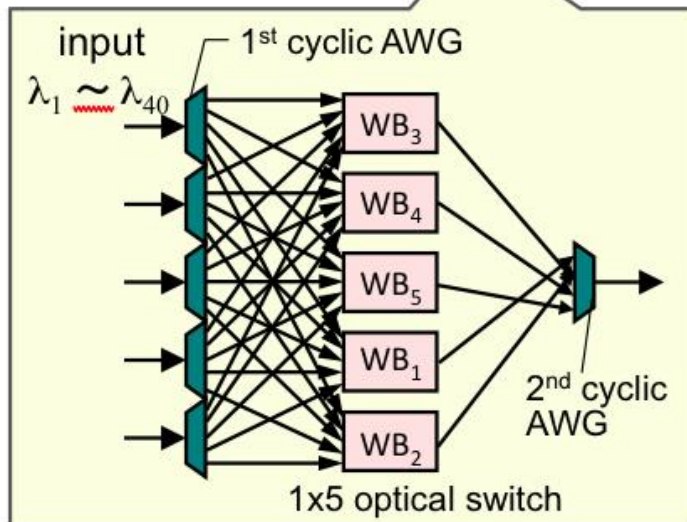
Ultra-Compact Waveband Cross-Connect Switch Module



WBXC Module

Total Throughput:
2 Tb/s; 10 Gb/s/ λ
8 Tb/s; 40 Gb/s/ λ

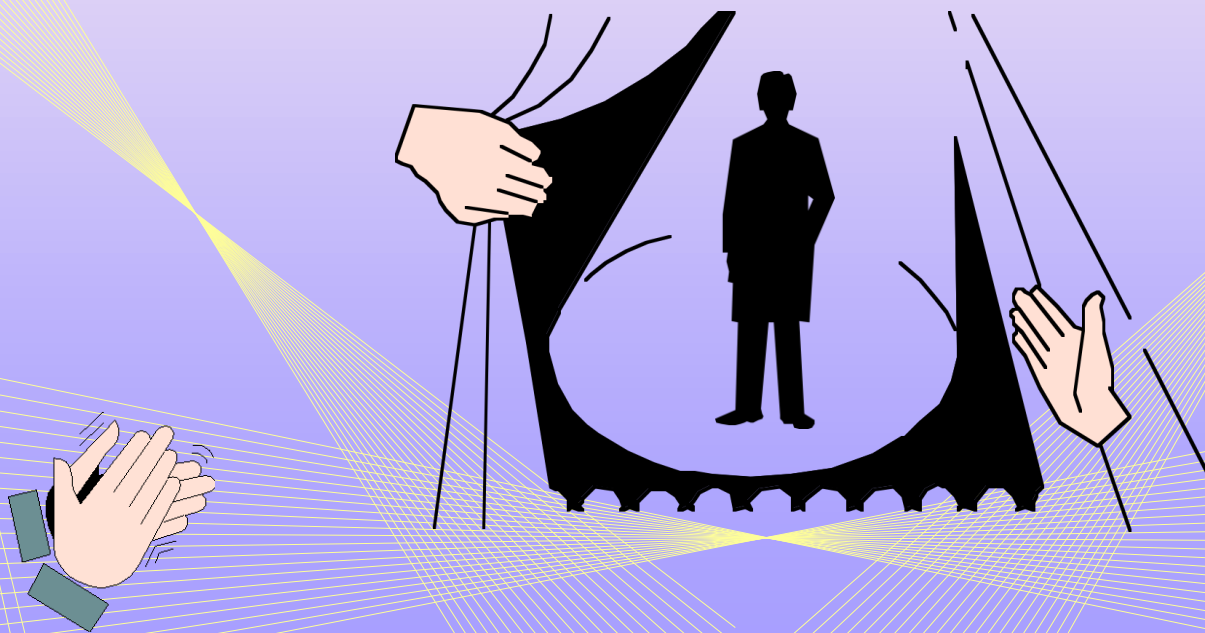
40 λ s x 5 = 200 λ s
 8 λ s/Waveband
 5 Waveband/Fiber
 5 input/output Fibers



WBSS Chip

WB₁ : $\lambda_1 \lambda_6 \lambda_{11} \lambda_{16} \lambda_{21} \lambda_{26} \lambda_{31} \lambda_{36}$
 WB₂ : $\lambda_2 \lambda_7 \lambda_{12} \lambda_{17} \lambda_{22} \lambda_{27} \lambda_{32} \lambda_{37}$
 WB₃ : $\lambda_3 \lambda_8 \lambda_{13} \lambda_{18} \lambda_{23} \lambda_{28} \lambda_{33} \lambda_{38}$
 WB₄ : $\lambda_4 \lambda_9 \lambda_{14} \lambda_{19} \lambda_{24} \lambda_{29} \lambda_{34} \lambda_{39}$
 WB₅ : $\lambda_5 \lambda_{10} \lambda_{15} \lambda_{20} \lambda_{25} \lambda_{30} \lambda_{35} \lambda_{40}$

Thank you.



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