160 Gbps-Based Field Transmission

Tetsuya Miyazaki

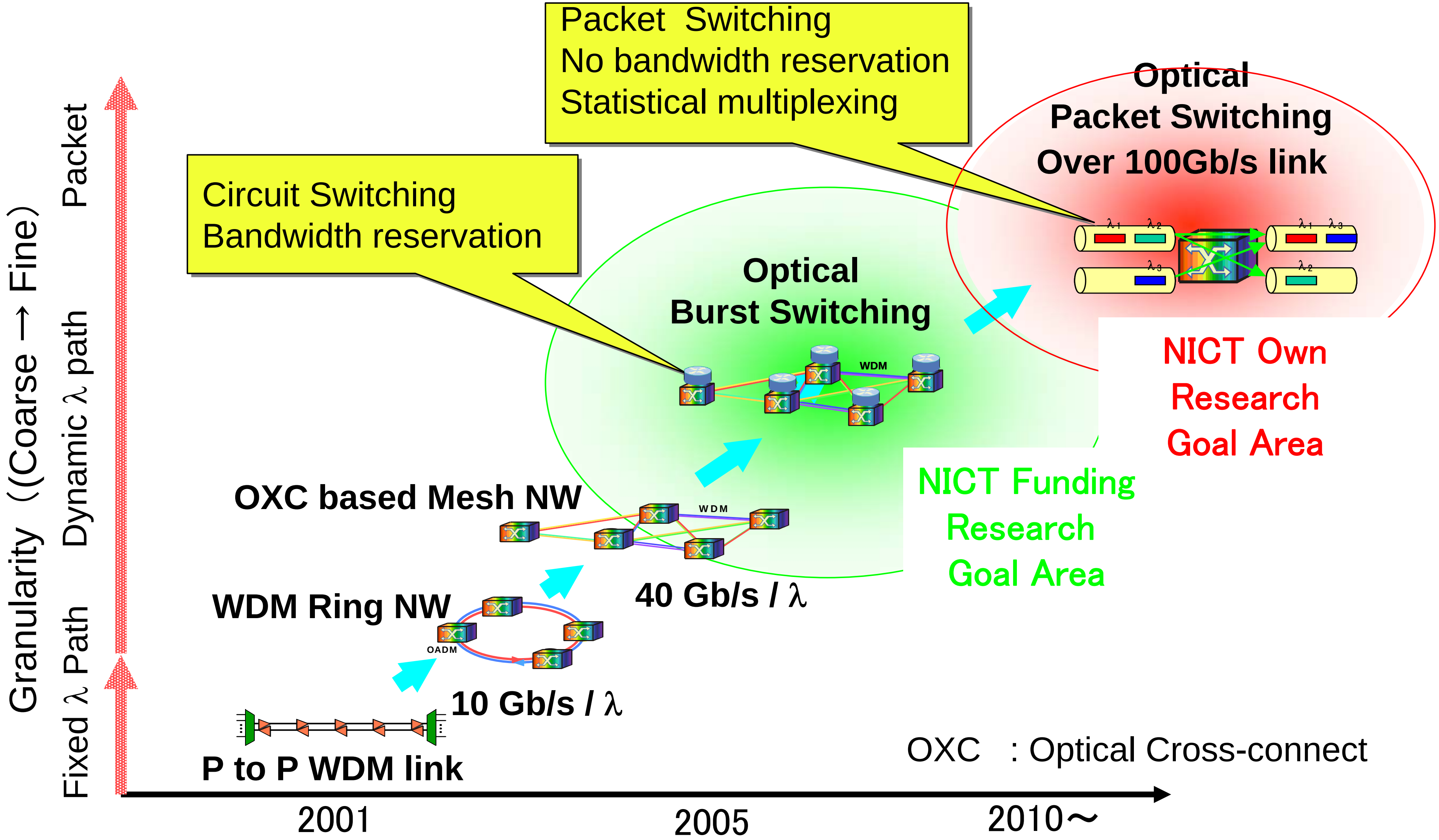
Photonic Network Group, New Generation Network Research Center

National Institute of Information and Communications Technology

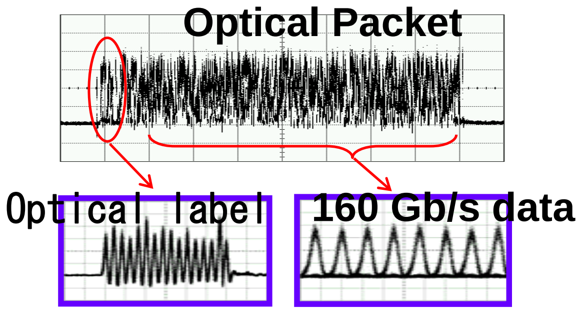
1. 160 Gbps-based Field Trial in 2004~2005.

2. What we would like to do next.

NICT Road Map for 1st Mid. Term Plan (2001-2005)



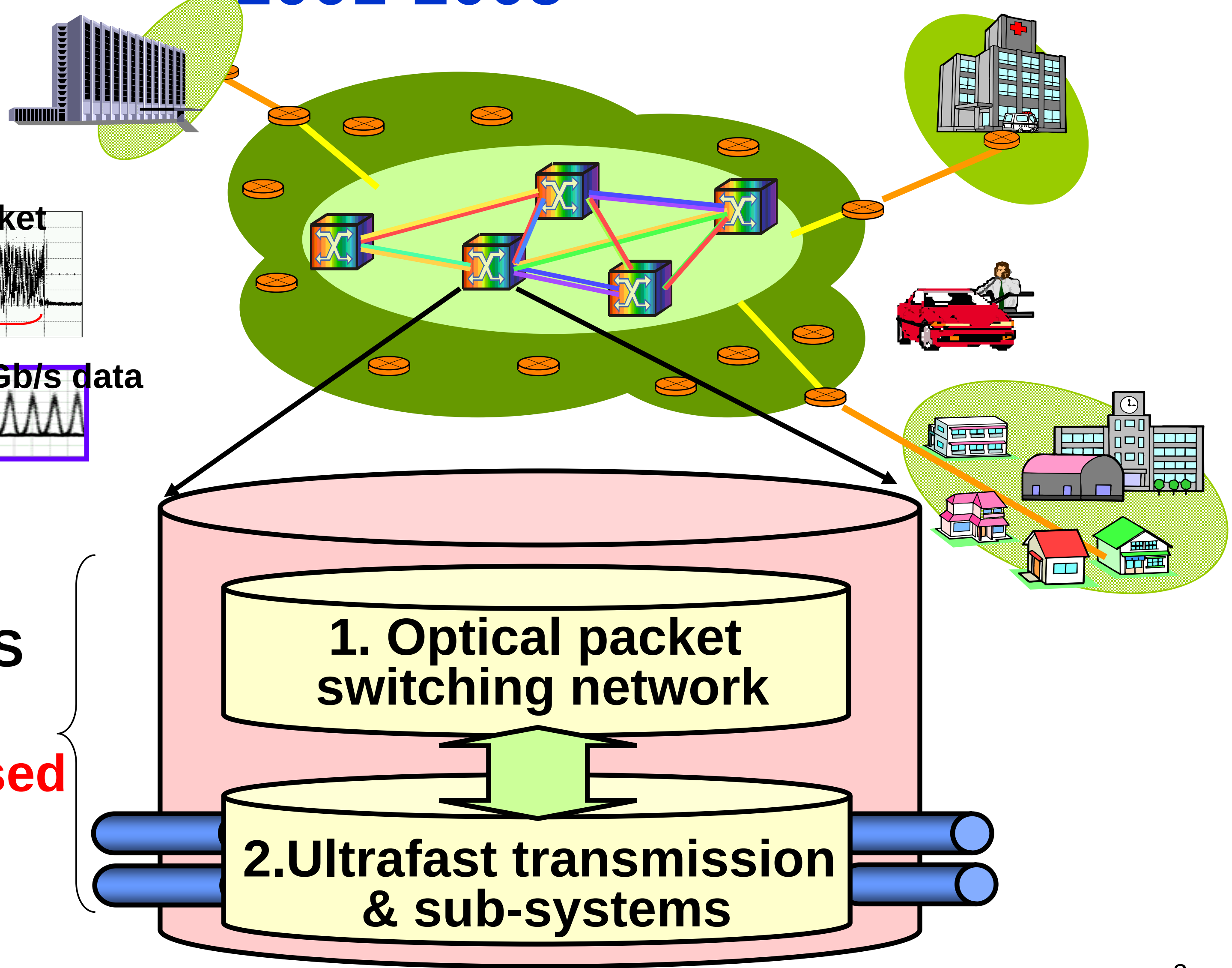
Photonic Network 1st Mid. Term Project 2001-2005



2004~2005

1. 160Gb/s OPS

2. 160Gb/s-based Field Trial

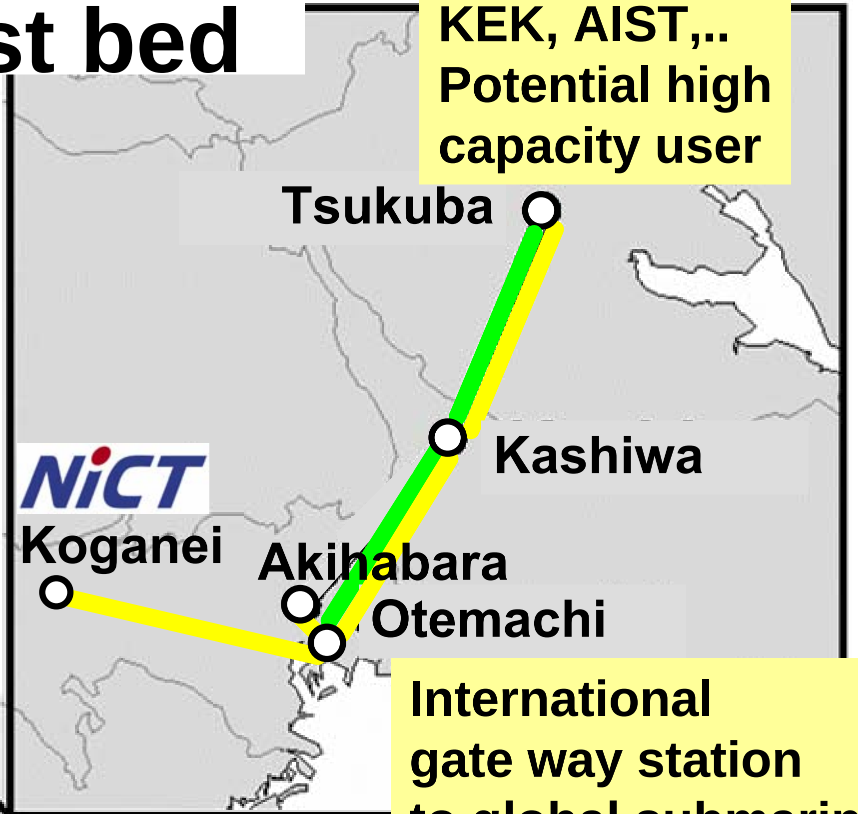


JGN Ⅱ Optical Test bed

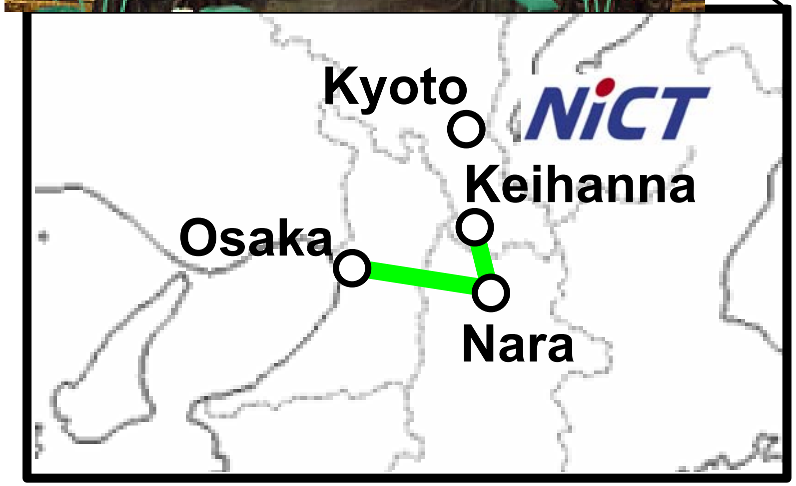
2004~ (green line)

2006~ (yellow line)

Big Statue of Buda in Nara



Optical Te



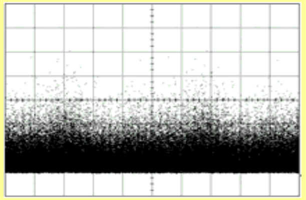
Terabit class transmission capability is expecting in Optical Test beds.

Field Trial on JGN Ⅱ Optical Test Bed 2004～2005 / Photonic NW Group

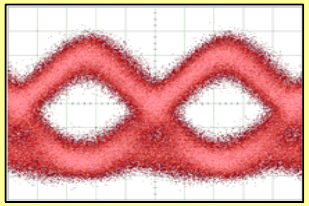
Field Trial in JGN II 300Gb/s OCDM
（10Gb/s、3WDM, 10 users）

OFC‘06 PDP44

DPSK/CDM/WDM Coded waveform

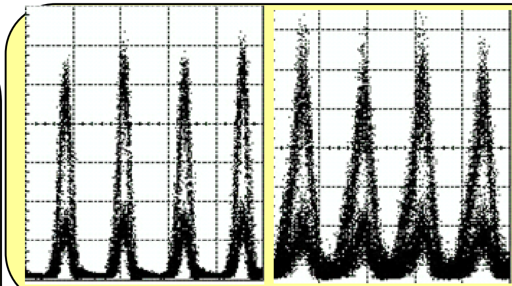


DPSK/CDM/WDM Decoded waveform



Koganei-Otemachi loopback 100km

Collaborative with Rome Univ. Osaka Univ.

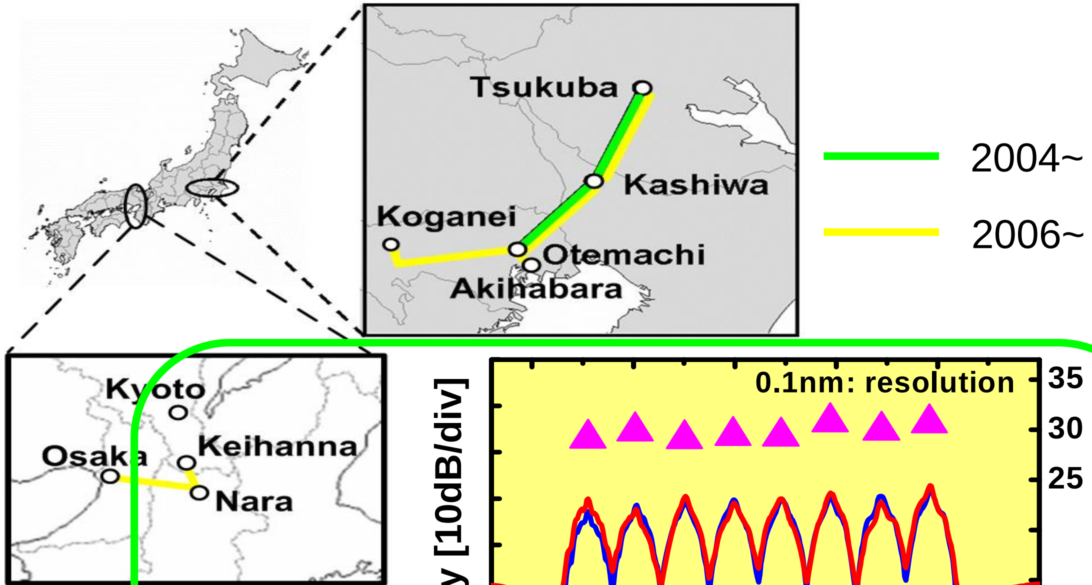


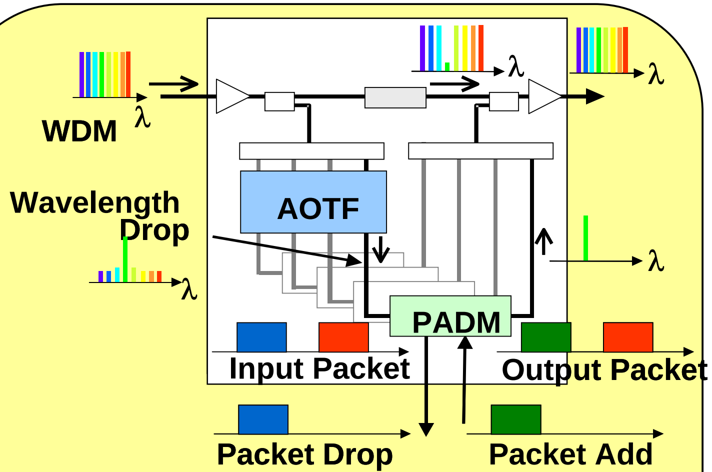
(A)160Gb/sMulti-level（2bit/Symbol）200-km Field Trial in JGNII Link.

Before(left), After(right) Transmission

Loop back between Otemachi-Tsukuba

OFF1, OFC ’05

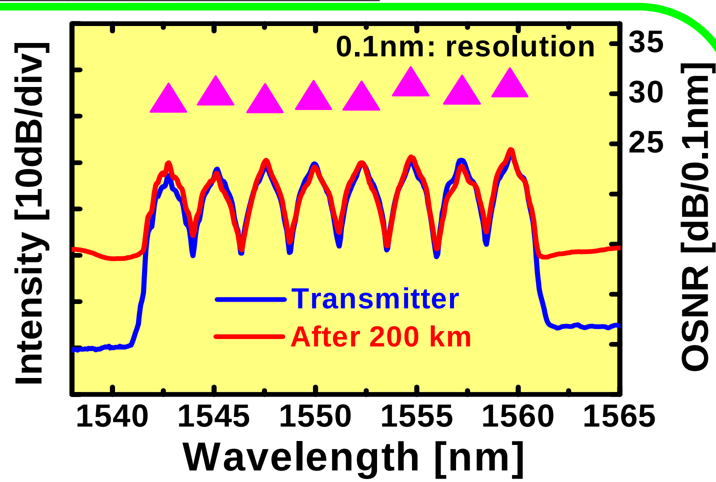




Optical packet / lambda OADM
10 Gb/s 16 Lambdas 90-km, Keihanna-Osaka

Th.2.6.2, ECOC ‘04

Collaborative with Fujitsu, Osaka Univ.

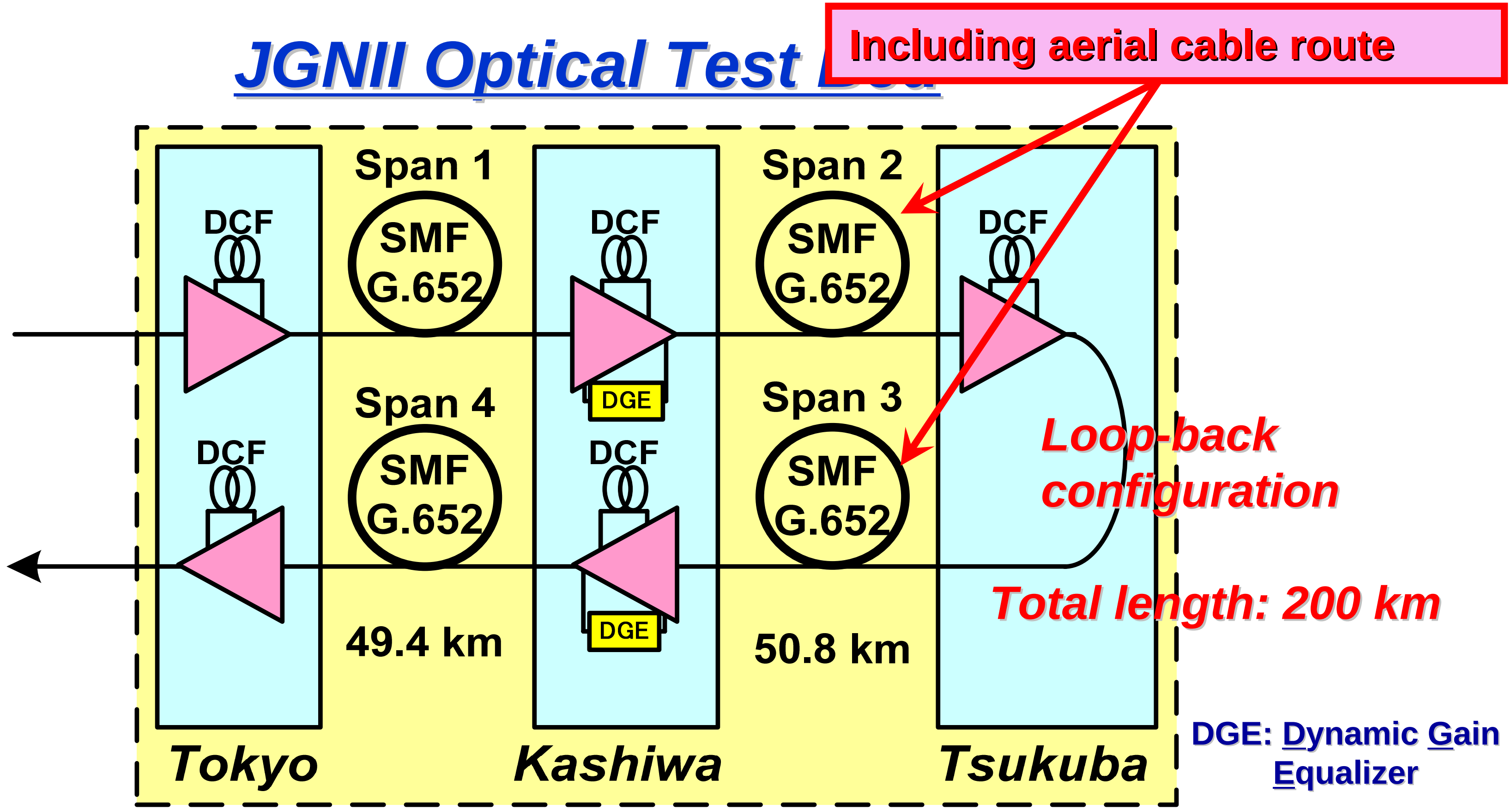


1.28 Tb/s (160Gb/s x 8) 200km Field Trial in JGNII

Collaborative with KDDIR&D **We 2.2.1, ECOC ‘05**

Installed Fiber Link
~ Configuration

JGNII Optical Test Bed

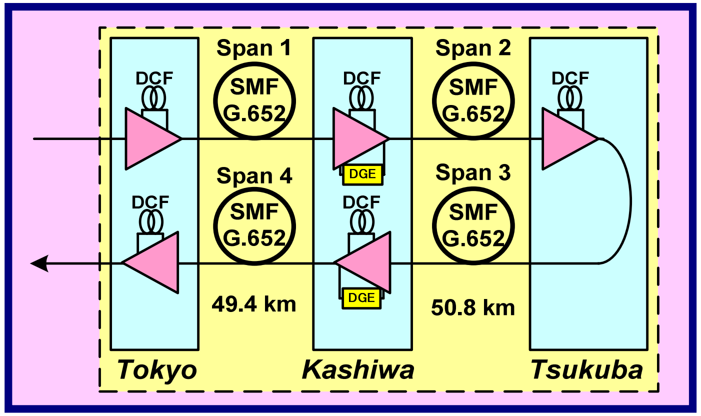


The test bed includes aerial cable routes in Spans 2 and 3.

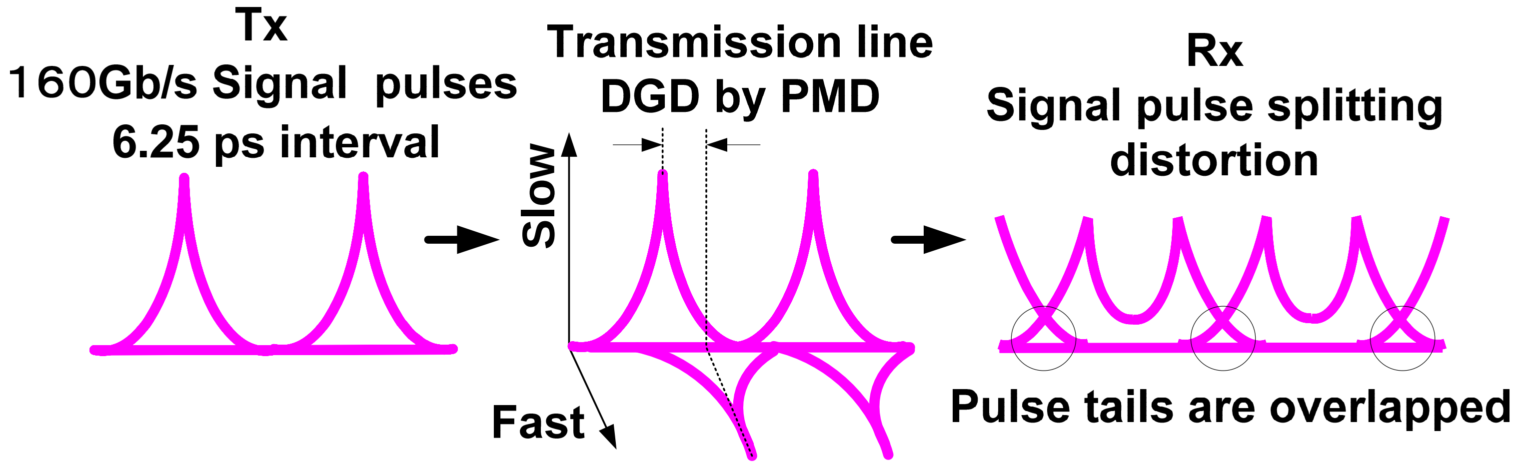
Test bed link has realistic PMD deviation characteristics.

JGN Ⅱ Installed Fiber Link
~ Spans and Link characteristics

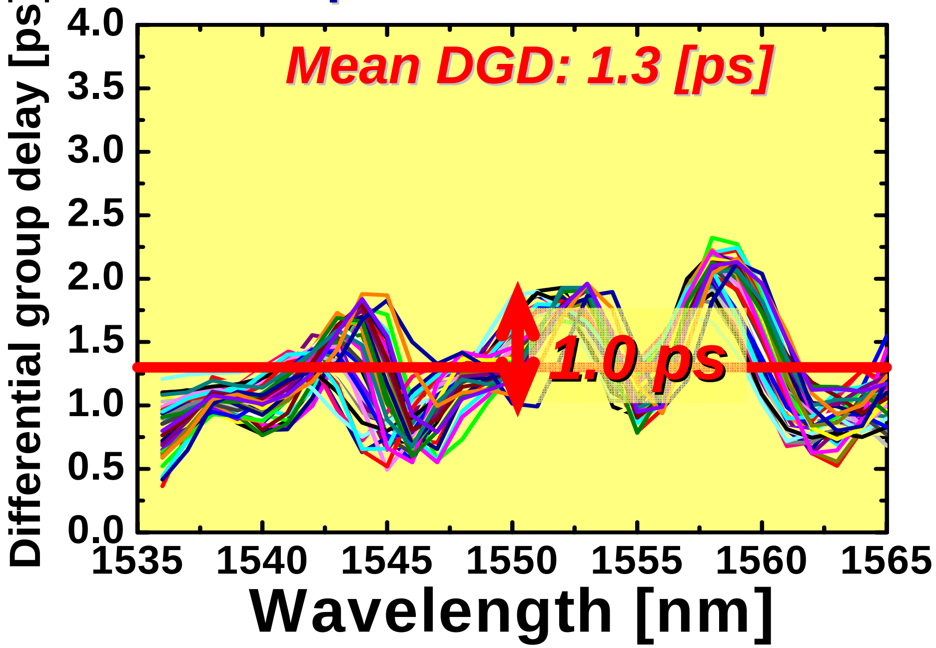
No.	Span Characteristics			200 km Link Characteristics	
	Loss [dB]	Chromatic Dispersion [ps/nm/km]	PMD coefficient [ps/km$^{1/2}$]	Accumulated Chromatic Dispersion [ps/nm]	Accumulated Dispersion Slope [ps/nm^2]
1	13.1	16.3	0.054	0.65 @1558nm	-0.22 @1558nm
2	16.7	16.2	0.088		
3	16.7	16.2	0.130		
4	13.8	16.5	0.088		



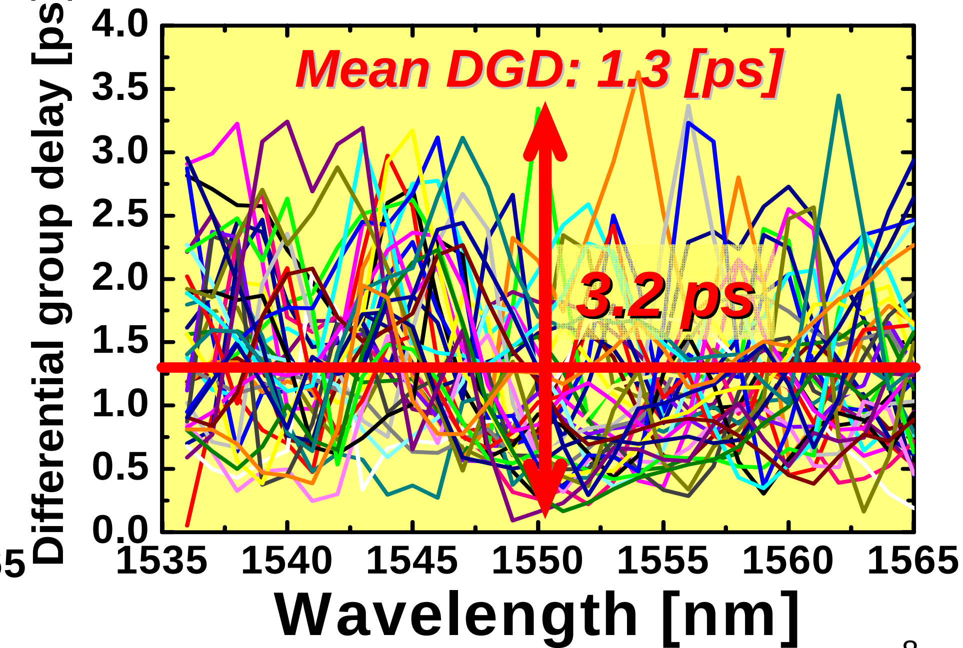
Impairment by PMD



Spooled Fibre Link

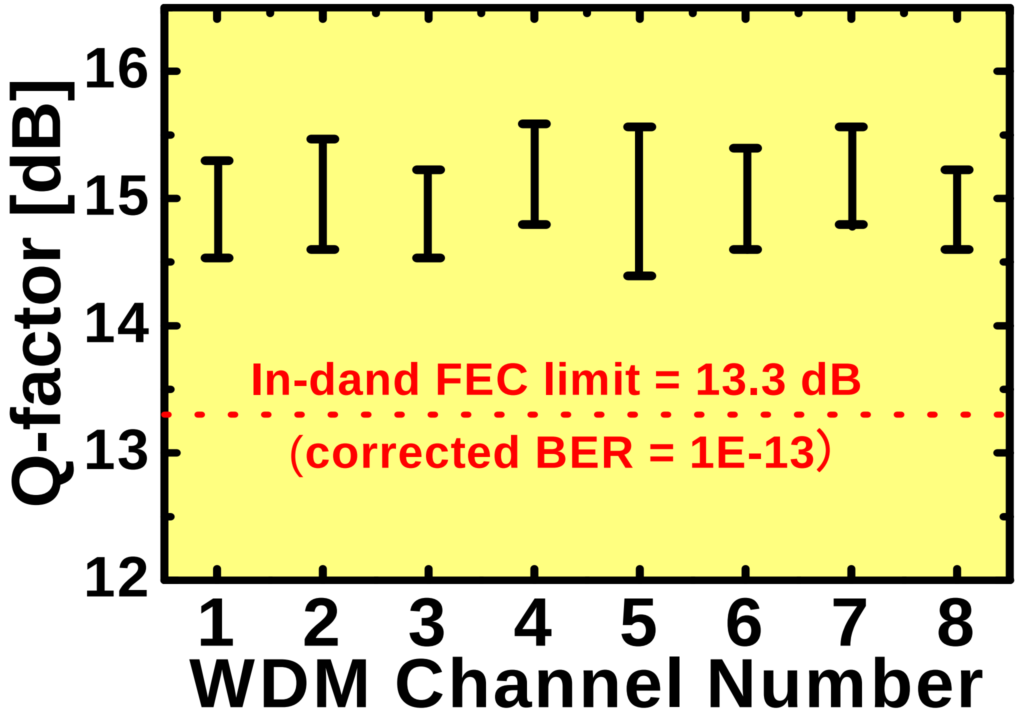


Installed Fibre Link



Field transmission experiment
~ Q-factor variation after 200 km transmission

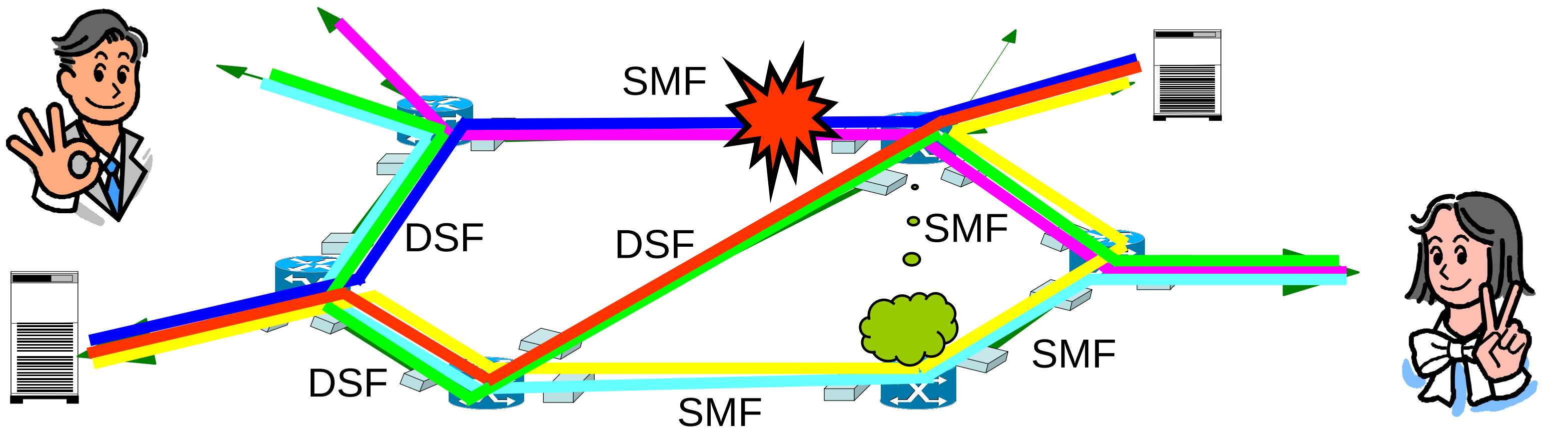
The launched SOP to the installed fiber link was adjusted to obtain the WORST BER.



Worst Q-factor: 14.4 [dB]

It exceeded the expected limit of the standard in-band FEC for decoded BER of less than 10^{-13}.

What should we think for next decade ?



Increasing demands for dynamic wavelength path provisioning or re-routing by traffic demands variation, node-congestion, link failure etc will/may bring about

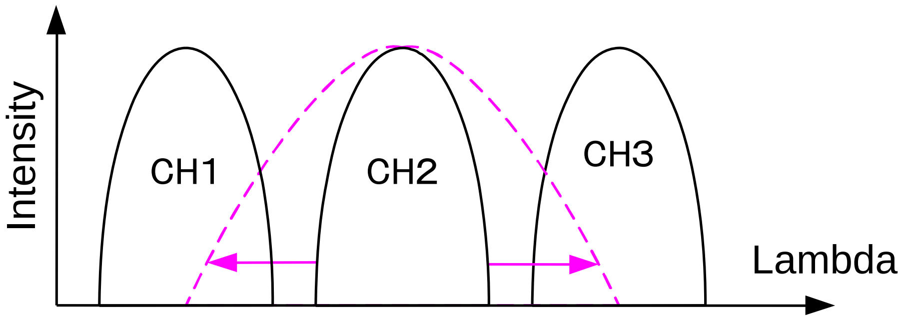
1) Signal quality variation due to link-loss, link-dispersion (PMD) changing
2) Maximum possible transmission capacity changing
3) Available lambda resource changing

In such a dynamic lambda networks, instant connectivity, signal quality, instant bandwidth availability, security (no cross-talk)…will/may be required.

Promising Technical Candidates in Link technology

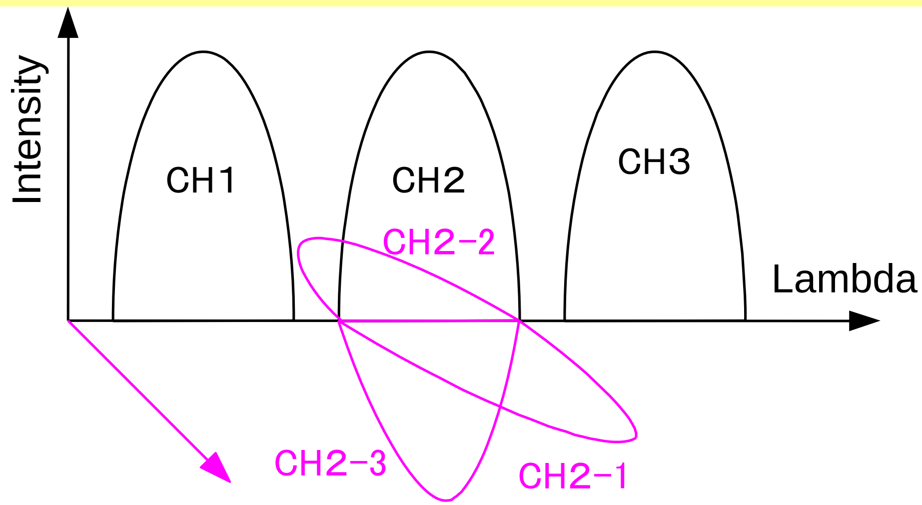
1. Adaptive optical/electrical equalizer
2. FEC
3. Wavelength conversion, All optical 3-R regenerator
4. Bandwidth efficient modulation formats
   - -Duo binary, CS-RZ
   - -Multi-level (DQPSK, 16 QAM …)

Conventional WDM / OTDM scheme
expands bandwidth by increasing capacity



Affecting to adjacent channels
Cross talk, signal quality & security degradation

Multi-level modulation format allows to supply virtual lambda resources with identical bandwidth

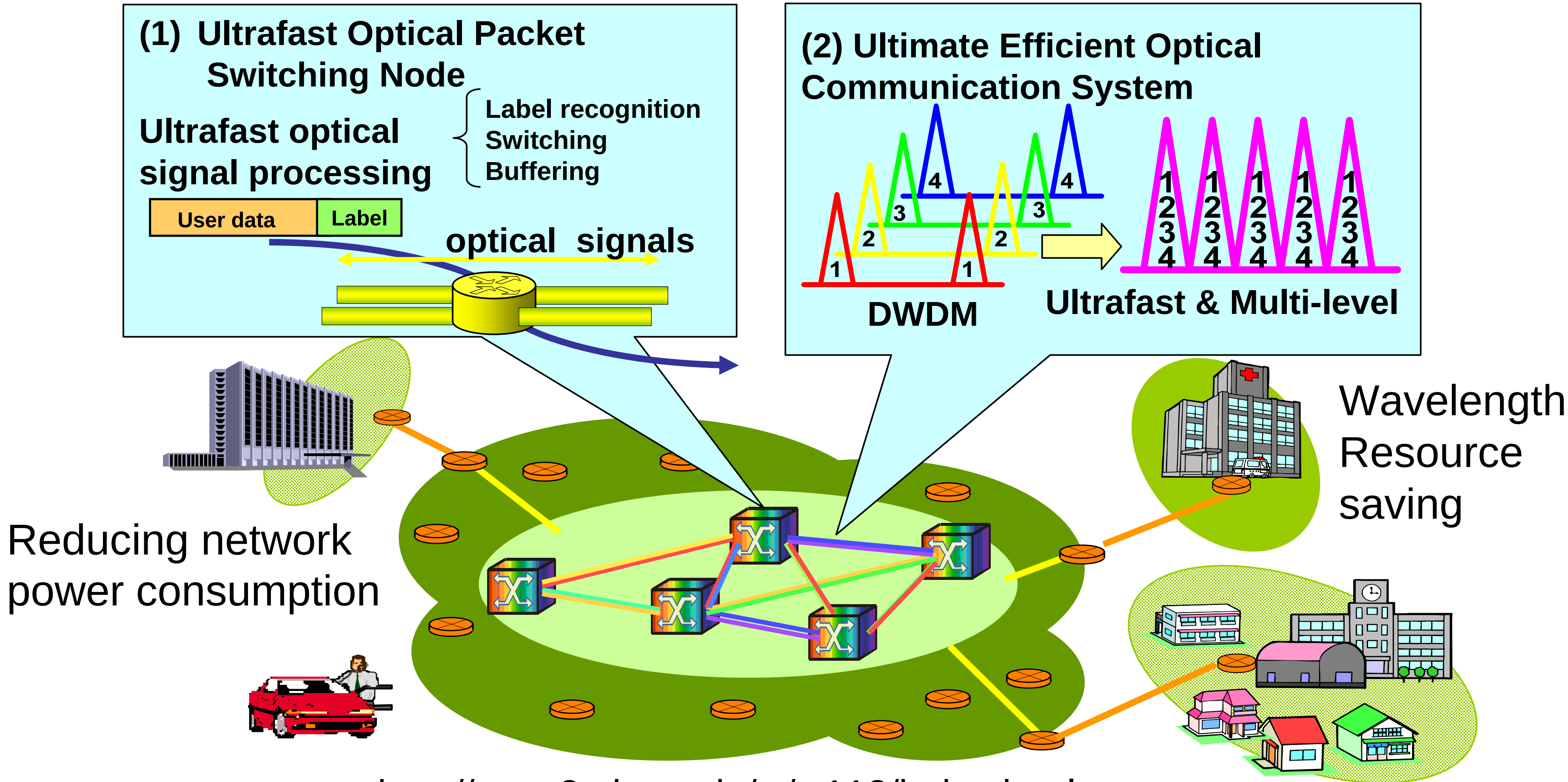


Orthogonal parameters (Phase, Polarization, …)

Mission of NICT Photonic Network Group 2006-2010

For the Evolution of Ultrafast Communications with End-to-End Transparent Photonic Networks

We study and develop core technologies for the photonic networks to accommodate explosive traffic demands in the coming ubiquitous network society.



http://www2.nict.go.jp/w/w112/index.html

Conclusion

1. **We have successfully demonstrated stable 8x160 Gb/s (1.28 Tb/s) WDM 200-km field transmission in JGN Ⅱ test bed.**

2. **We are moving toward to ultimate-efficient transmission to save wavelength resource and electrical power consumption.**

3. **This type of field network test bed is expected to accelerate deployment of new generation photonic network technologies such as ultrafast, ultimate-efficient transmission and optical packet switching systems.**