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P-3 (Plenary)

Required Device Technologies for Future Photonic Networks

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The employment of practical optical fiber communication systems started in the early 1980s. The transmission capacities of major trunk lines have recently reached 10 Gb/s, thanks to the progress made in time-division multiplexing (TDM) technology. The continuous developments seen in higher-speed opto-electronic device technologies look to achieve 40 Gb/s, probably by 2002.

In the last few years, dense wavelength-division multiplexing (WDM) technology has been combined with TDM to tackle the explosion in demand that has occurred, particularly in North America. Examples include a 2.5 Gb/s x 16 wavelength (totally 40 Gb/s) system and a 10 Gb/s x 40 wavelength (totally 400 Gb/s) system. Reflecting these WDM demands, PIRI (Photonic Integration Research, Inc.) and NEL (NTT Electronics), both of which utilize NTT's device technologies, are now very busy supplying arrayed-waveguide grating (AWG) multiplexers and other related devices to the dense WDM market.

At the laboratory level, total capacities of 3 Tb/s have already been demonstrated in a single optical fiber line with very sophisticated combinations of TDM and WDM. Until recently, however, NTT has been rather reluctant to push WDM technologies into practical use in Japan. The reasons may be due to the facts that 1) NTT has already installed plenty of optical fibers along major trunk lines, 2) Most of these fibers are dispersion-shifted fibers suitable for single channel TDM transmission at 1.55 μm, and 3) the total data traffic in Japan has not exploded in the same way as North America.

NTT's position is now changing as exemplified by the planned introduction of WDM links into NTT's backbone network. This plan is possible only due the technologies developed by NTT Laboratories which suppress four-wave mixing in dispersion-shifted fibers. Another program under way will introduce an optical ADM (add-drop multiplexing) ring for regional area use. These movements not only aim at increasing the bandwidth but also more fully realizing the potential of revolutionary new network architectures with dense WDM. Optical ADM and optical XC (cross-connect) systems with dynamic wavelength path control are, for example, expected to open the door to the construction of more advanced photonic networks that perform switching and routing at the optical level.

This talk will look at the present situation and give some future prospects on required technologies for photonic networks with emphasis on device technologies for TDM, WDM and optical ADM/XC. Outline of NTT's photonic network testbed program, which is now going on by interconnecting NTT R&D Centers, will also be described.