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Energy consumption levels in 300-Gb/s-class signal processors

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The majority of our semiconductor-related science and engineering has been related to "silicon" semiconductor material, its devices, and their systems, up to now in fact. Many of young university students may not, however, so sensitive to several other kinds of semiconductor materials which are important in our industry more than before, such as photonic nitrides for white lights in displays and houses, electronic nitrides for high-power high-temperature controls in grid-energy-network and in vehicle systems, III-V materials in our broad-band photonic-network systems, and III-V materials for potentially all-optical ultrafast signal-processing capabilities (Fig. 1).

Regarding the all-optical signal-processing capabilities, multiplexers-demultiplexers (mux-demux), regenerators, noise-suppression regenerators, and other fundamental signal processors (wavelength convertors for cross-connects in particular) have been studied experimentally with ultrafast data signals ranging from 40 Gb/s to nearly 1 Tb/s (fully in time domain),[1-4] at around the standard optical-network's carrier frequency, 200 THz (2×10^{14} Hz, whose infrared light wavelength is 1.5μm, within the well-established Er-doped-amp's gain spectra), since mid 1990's through a few years ago.

In addition to global studies to push the limit in processing speed and pioneering varieties of functionarities, our research group in UEC has started paying more attention in reducing their energy consumption levels, from more fundamental, semi-classically quantum, opto-electronic research viewpoints.[5] We have been characterizing a scaling rule,[5] an advantage from nonlinear polarization rotation in previous world-record works (3 to 10 pJ/bit),[1, 4] an advantage from degenerate scheme (after strategy change from conventional non-degenerate one to it), and the strong wavelength-dependence of transient-band-depletion-induced complex-refractive-index changes in our both semi-custom and commercial semiconductor optical amplifiers (SOA's). From application viewpoints on the other hand, we recently estimated optical-micro-processor unit (MPU)'s performance and energy consumption, with respect to the 40-year-long continuous progresses in electronic MPU's, for our start specifying a brand-new groups of network-computational applications which will kick off the practical use of these potentially 300-Gb/s MPU's. In this inter-university symposium, we outline these on-going research activities in UEC.

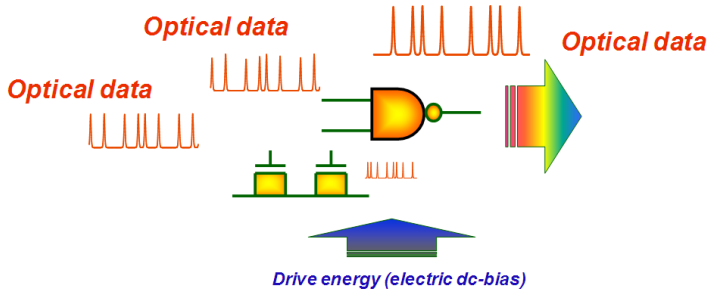

Fig. 1: Elementary unit in optical signal-processor

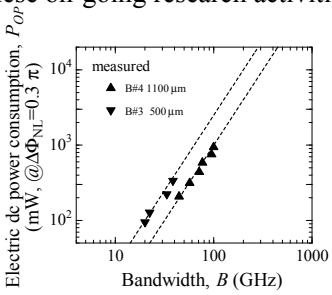

Fig. 2: Scaling rule for energy consumption per bit (Ref. 5).

References

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