Dynamic Photonics

Dynamic-Bias Enhanced Avalanche Photodiodes

Avalanche photodiodes in Telecom and Datacom

Avalanche photodiodes (APDs) provide a cost-effective solution to receivers for Telecom and Datacom. An APD relaxes the power requirement for incoming optical pulses, which translates to longer optical links and/or higher bit rates. APDs are used, whenever their speeds permit, to improve the receiver sensitivity. Due to the APD's traditional speed limitations, also referred to as the buildup-time limitation, which constrains the gain-bandwidth product, producing viable 25-Gbps APDs has been a challenge for the optical communication wavelengths of 1.3 or 1.55 micron.

The Market

The worldwide APD market is estimated at $200M per year and it is estimated to grow beyond $350M by 2019. The market for the DPI technology fits any high-speed (25 Gbps per channel) long-reach optical communication system where power is a limitation. These may include today's 100Gb Ethernet, next-generation 400Gb Ethernet, PON (passive optical networks), GPON (Gigabit PON), Datacom, Datacenters, etc. DPI's technology is an excellent fit to APD-on-silicon-photonics chips, and it can also be incorporated in Si-Ge APD receivers to enhance the sensitivity for short range systems.

Business Summary

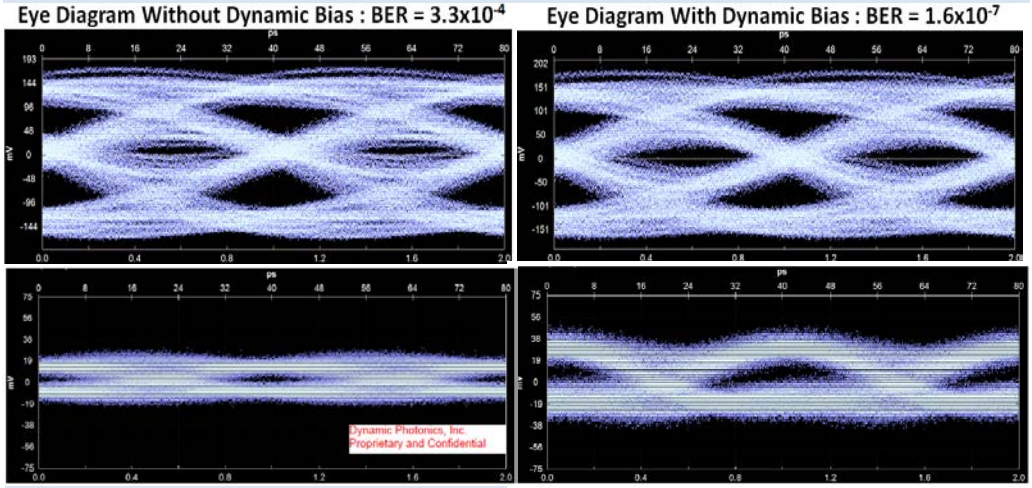
Dynamic Photonics, Inc. (DPI) invented a revolutionary dynamic-biasing method for APDs that substantially raises the envelope for the speed-sensitivity tradeoff in APD receivers well beyond the traditionally known limits.

- Method can enhance gain-bandwidth-product by a factor of 5 and the receiver sensitivity by up to 6 dB.
- It can enable existing InGaAs avalanche photodiodes that are designed for 10Gbps to be adapted to operate at 25 Gbps.
- Method is device agnostic and applicable to any high-speed APD by exploiting certain unexplored physics of the avalanche process, which is DPI's expertise.

Technology Overview

The primary innovation is the replacement of the traditional static bias voltage across the APD with a bit-synchronous, time-varying voltage. Our other innovations relate to implementation, in particular to ensuring that the dynamic bias voltage does not affect the photo-current, and hence the data recovery circuit. Our technology enables any APD receiver limited by avalanche buildup time to operate at previously impossible rates. DPI has recently demonstrated that dynamic biasing enables the 25 Gbps NRZ operation of an off-the-shelf InGaAs-InP 10 Gbps APD operating at a speed of 25 Gbps (λ=1.55μm), as well has a 5.2dB improvement in the sensitivity for a commercial InGaAs 25-Gbps APD. Other potential applications beyond NRZ include PAM4.

10-Gbps InGaAs APD operating at 25 Gbps with DPI's dynamic-biasing technology



25-Gbps InGaAs APD operating with (R) and without (L) DPI's technology

Intellectual Property

DPI has an intellectual property portfolio of four patents and patent applications. The core technology, invented by the DPI co-founders, has been patented (in 2016) and exclusively licensed from the University of New Mexico. Other patent applications cover various methods of implementation and extensions to various signaling modalities.

Partnership Opportunities

The technology has been tested and proven; we are looking for a strategic partner to take us to market.

Management

Earl Fuller, CEO, has over three decades of experience in the semiconductor industry including the solar companies Emcore (now SolAero) and Suncore Photovoltaics.

Technical Team

Dr. Payman Zarkesh-Ha, VP Engineering (Ph.D. in Electrical and Computer Engineering from the Georgia Institute of Technology) is an expert in high speed RF circuit design and VLSI systems. He has designed multiple analog and digital low power and high performance circuits using various foundries, including TSMC, IBM, Global Foundries, and Tower Jazz. He is a senior member of IEEE and a member of ACM.

Dr. Majeed Hayat, CTO (Ph.D. in Electrical and Computer Engineering from the University of Wisconsin-Madison) is an expert in avalanche photodiodes and has made numerous seminal contributions to modeling impact ionization, noise, breakdown probability and time response in avalanche photodiodes, as well as their application to optical communication. Dr. Hayat is a Fellow of IEEE (Citation: "For contributions to the modeling of impact ionization and noise in avalanche-photodiode devices"), a Fellow of OSA and SPIE.

Scientific Advisory Board

Dr. Joe C. Campbell (University of Virginia) and Dr. Keren Bergman (Columbia University).

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