
LIGHTWAVELOGIC®
Faster by Design
NASDAQ
LWLG
Investor Presentation
April 2024

Safe Harbor

LIGHTWAVELOGIC®

The information in this presentation may contain forward-looking statements within the meaning of the Private Securities Litigation Reform Act of 1995. You can identify these statements by use of the words "may," "will," "should," "plans," "explores," "expects," "anticipates," "continue," "estimate," "project," "intend," and similar expressions. Forward-looking statements involve risks and uncertainties that could cause actual results to differ materially from those projected or anticipated. These risks and uncertainties include, but are not limited to, general economic and business conditions, effects of continued geopolitical unrest and regional conflicts, competition, changes in technology and methods of marketing, delays in completing various engineering and manufacturing programs, changes in customer order patterns, changes in product mix, continued success in technological advances and delivering technological innovations, shortages in components, production delays due to performance quality issues with outsourced components, and various other factors beyond the Company's control.

Corporate Overview

Lightwave Logic develops a platform leveraging its proprietary engineered electro-optic (EO) polymers to transmit data at higher speeds with less power

- **Large Addressable Market:** Optical transceivers market expected to grow to at least $100B by 2030 chiefly driven by data centers, fiber comm & AI requirements
- **Proprietary EO Polymer Technology:** Supports >3x faster data transmission speeds with ~10x lower power, relieving key bottlenecks in internet infrastructure
- **Robust Patent Portfolio:** Composed of 70+ patents and patents pending
- **Commercialization Underway:** Secured initial licensing agreement in May '23
- **Robust Balance Sheet:** $31M+ cash position provides significant optionality
- **Building a Foundation:** Expanded facility and team with in-house control of material supply, device fabrication & package design enables Lightwave to control its own destiny and maintain key trade secrets in-house
- **Experienced Leadership**: Management and Board are composed of technology and finance experts with 200+ years of combined experience

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NASDAQ
LWLG

Share Price[1]	$4.36
Market Cap[1]	$519.7M
Cash & Cash Equivalents[2]	$31.4M
Debt[2]	$0
Shares Outstanding[3]	119.2M
Headquarters	Englewood, CO

1) As of April 5, 2024
2) At Dec. 31, 2023
3) As of Feb. 29, 2024

Existing Internet Infrastructure

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Innovation is needed to keep up with data traffic

'Traffic jams' within internet infrastructure are increasing, because the data "pipes" inside data centers, between data centers, and from data centers to consumers have **not kept pace with the immense growth of data traffic**

Existing Infrastructure

How many times have we seen this?

Radical innovation is needed to enable tomorrow's data services within the current framework of existing internet infrastructure

Data Speed Choke Points

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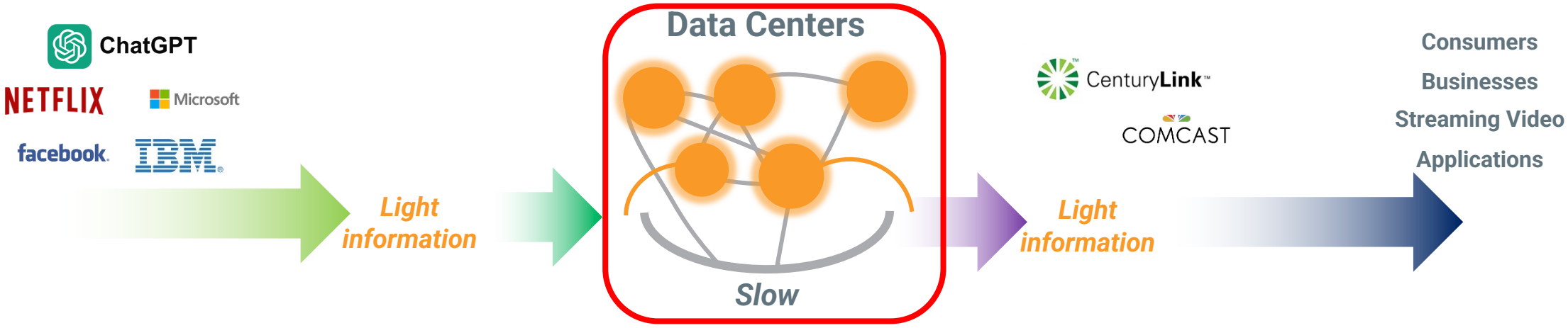
Data centers are the bottleneck in legacy internet infrastructure

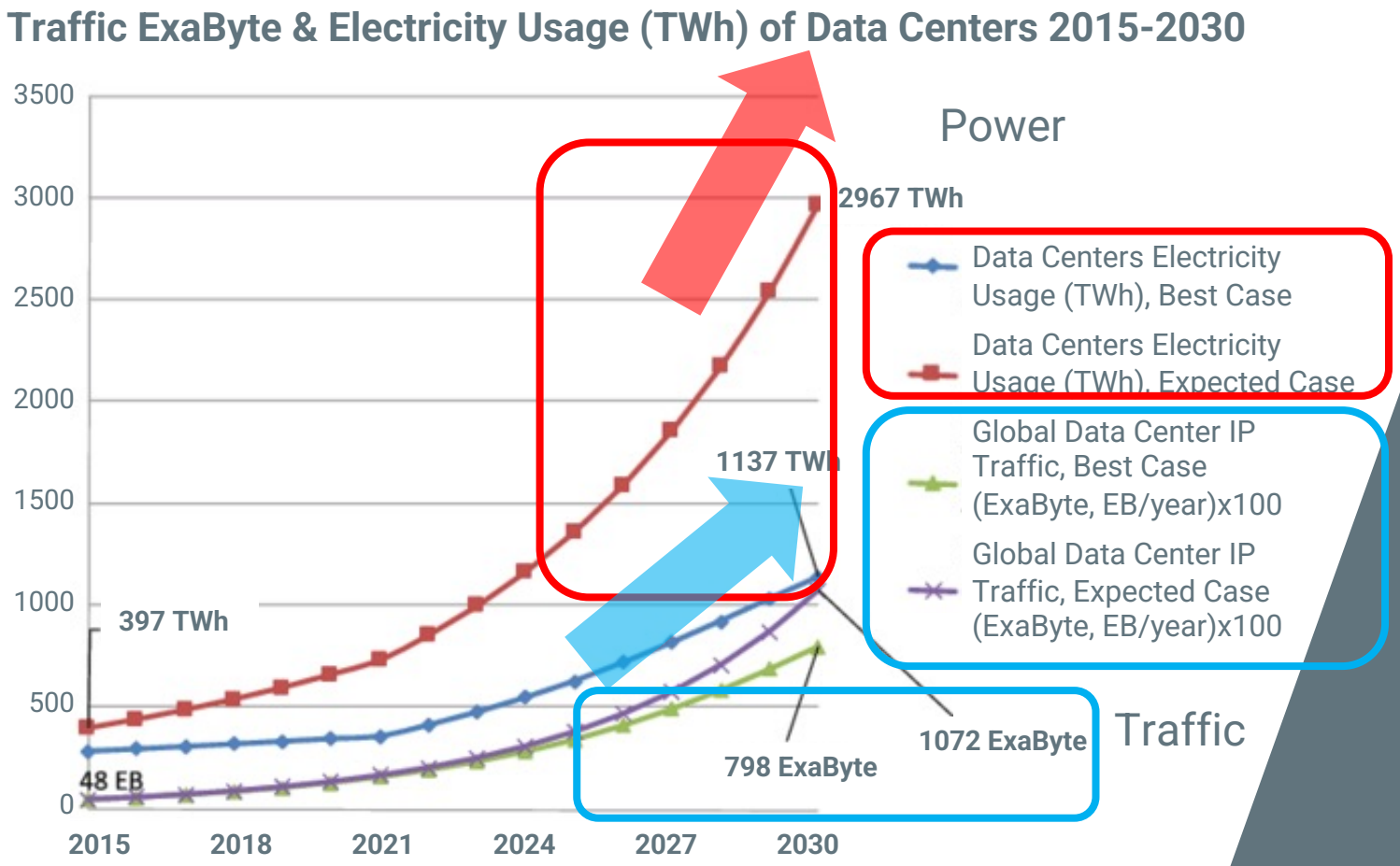


Legacy digital technology in data centers is the choke point – our technology addresses increasing optical data speeds with lower power consumption in tiny form factors

The goal is a higher performing optical network (or internet), where speed and low power consumption are key drivers. Lightwave's technology can vastly improve the incumbent technology used today…

Datacenter industry 'Achilles Heel'…

Existing solutions require excessive amounts of power to scale



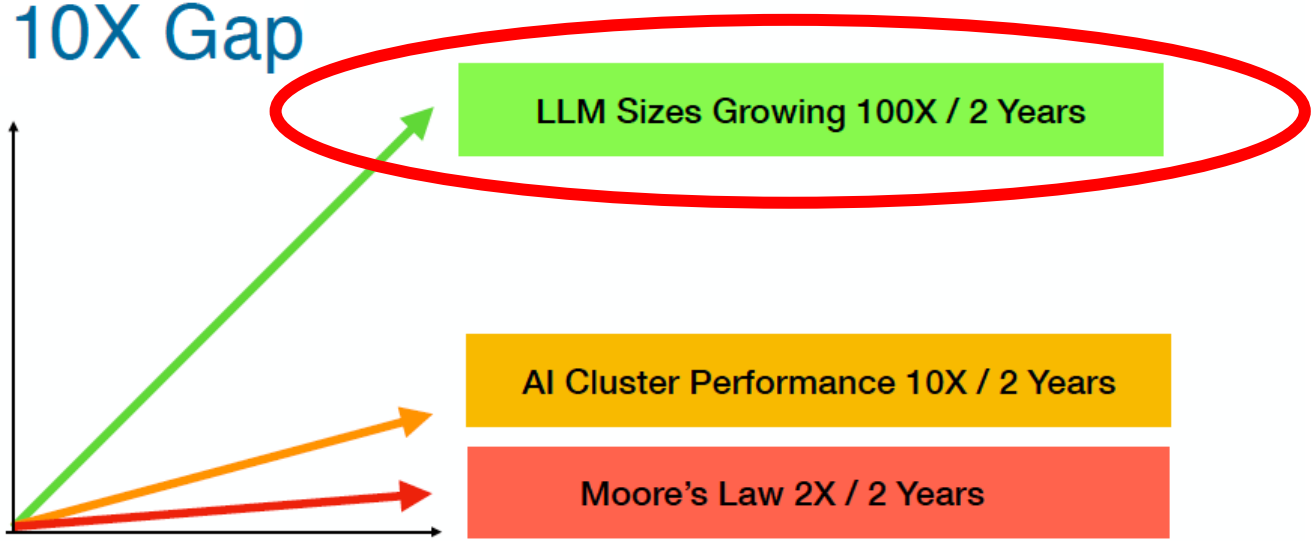
Data center power use is growing exponentially with increased traffic levels → *the Achilles Heel* and a major challenge for data centers, hyperscalers, and service providers

Source: Publication: Walnum, HJ et al

G-AI is driving the market…

ARISTA

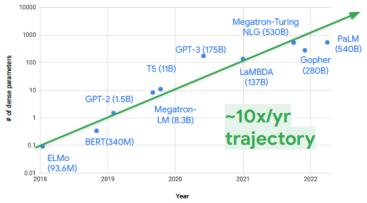
A 10X Gap



To accelerate AI we need "More than Moore"

ARISTA

Generative AI Changes Everything



ChatGPT 4.0 Model Size > 1T Parameters

Large Language Model sizes have been increasing 10X per year

Source: Lightwave Logic (LWLG), Arista (2023)

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G-AI is driving new frontiers in both computational electronics and *interconnect* photonics

Industry Demand Drivers

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Macro-tailwinds driving adoption of next-generation components

Switch Density

Need For Space

Real Estate Efficiency

Space is limited in data centers and competing solutions generally require a larger footprint than EO polymers

AI, Cloud & Streaming

Need For Speed

Artificial Intelligence
Cloud Services
Streaming/Gaming

Computing power required to train and utilize AI systems has been doubling every 2-4 months

Energy Usage

Need For Green

Energy Demand

Traffic and computing power is driving power consumption in data centers to extreme levels

Supporting the big macro trends today…and in the future

Sources: Lightwave Logic (LWLG), Statista, OpenAI, The Economist


What we do...

Perkinamine® Electro-Optic polymers

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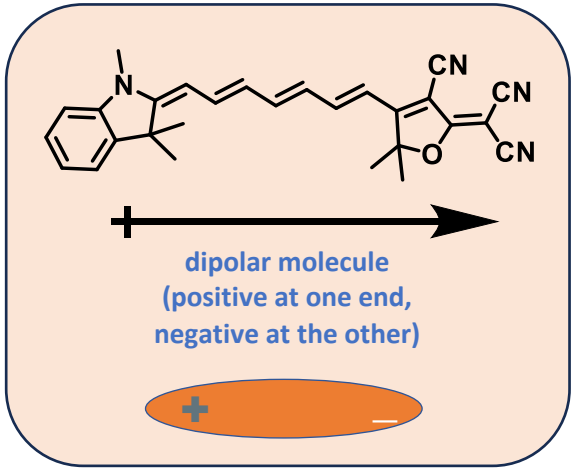
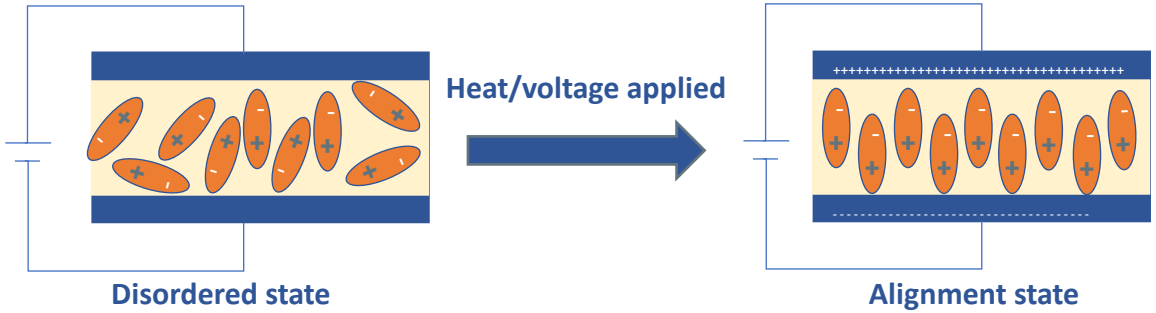
Our polymers are world-class and proven by third parties

Electro-optic polymers can be used to fabricate optical modulators





We create organic chromophores…

- Designed, simulated and modeled in Denver, Colorado
- Manufacturing chemistry facility that can scale volume
- Deep experience with material characterization, testing, lifetime, and reliability

Solving the Problem

Polymers provide unique advantages over legacy technologies

- Lightwave Logic creates its own materials with a **strong IP/patent portfolio**
- Materials modulate light-speed data transmission **very fast**
  - Much faster than Liquid Crystals in displays → ideal for a faster, lower power internet
- Materials are **polymers**
  - Like OLEDs – Organic LEDs used for TVs where their polymers generate light: ours switch light
- Modulators are **very small**
  - So small that they fit easily into pluggable transceivers, the critical devices used to transmit and receive data in data centers
- Polymer modulators have **transformational** performance head-room **for the next decade**
- Can **integrate** other devices with polymer modulators
  - Adding to existing silicon photonics infrastructure as well as multi-channel solutions for higher aggregate speeds

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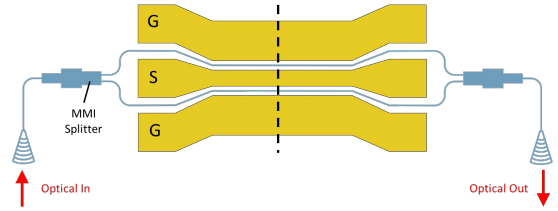
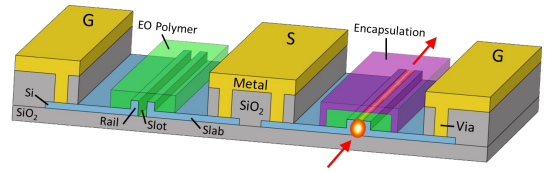
Lightwave Logic Voted ECOC 2023 Industry Innovation Award Winner

ecoc 2023 GLASGOW

Perkinamine® Electro-Optic Polymer





Electro-Optic Polymer slot modulators

Polymer modulator opportunities

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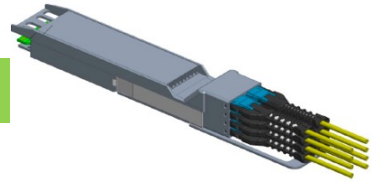
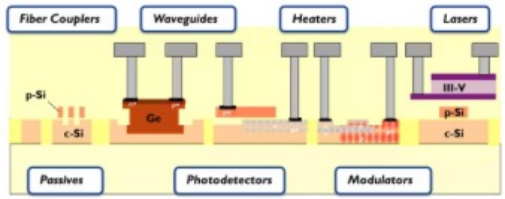
Electro-optic polymer modulators for transceivers suppliers

Upgrading to a 'V8'…



Electro-optic polymer modulators for Silicon Photonic platforms

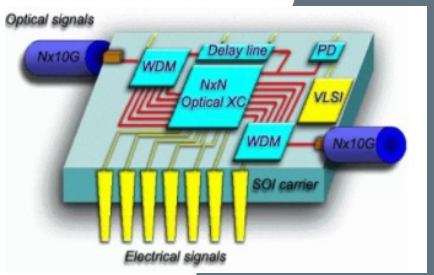
'Turbo-boosting' SiPh…



Source: ePIX Fab

Electro-optic polymer modulators for "Other" platforms including optical/quantum computing, HPC, and RF applications

Faster, lower power, smaller…



EO polymers *enable* higher performance data communications

Electro-optic polymer engines for fiber optic communications

Source: Ethernet Alliance, OSFP MSA, https://www.researchgate.net/figure/Schematic-of-an-on-chip-optical-network-with-various-components-illustrated-including_fig2_239929876, ePIXfab, corning


Exciting and growing markets

Initial Target Markets

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Polymers address a large, rapidly growing market

Fiber Communications

Photonics Applications	Photonics Components Market 2030*	Optical Transceivers* TAM (2022)	Optical Transceivers* TAM (2030)	Partner Type	Opportunity for Integrated Photonics (PICs) (Polymer, SiPh, InP)
Fiber comms	~$60-80B	$7B	~$40-60B	Foundry, OEM/CM (TxRx)	Existing/very strong growth
HPC/compute/AI	~$10-20B	$1B	~$10-15B	Foundry, OEM/CM (TxRx)	Existing/very strong growth
DCI/datacenter	~$20-30B	$9B	~$20-30B	Foundry, OEM/CM (TxRx)	Existing/strong growth
5G systems/back haul/RF	~$5-10B	~$1-2B	~$4-8B	Foundry, OEM/CM (TxRx)	Existing/strong growth
Display/project	~$10-20B	<$1B	~$5-15B	Foundry, OEM/CM (panel)	High-volume/strong forecast
Automotive (LIDAR)	~$30-50B	~$1-2B	~$20-30B	Foundry, OEM/CM (LIDAR)	High-volume & very strong forecast
Optical sensing/3D	~$4-10B	~$1-2B	~$2-5B	Foundry, OEM/CM (sensor)	High-volume & solid forecast
Bio-photonic sensing	~$2-5B	<$1B	~$2-3B	Foundry, OEM/CM	Strong forecast
Medical	~$5-10B	<$1B	~$5-8B	Foundry, OEM/CM	Strong forecast
Instrumentation	~$2-3B	<$1B	~$1-2B	Foundry, OEM/CM	Strong forecast

Sources: *Lightwave Logic (LWLG) estimates using market research data


Silicon foundry compatible…

Polymers are ideal for silicon foundries…

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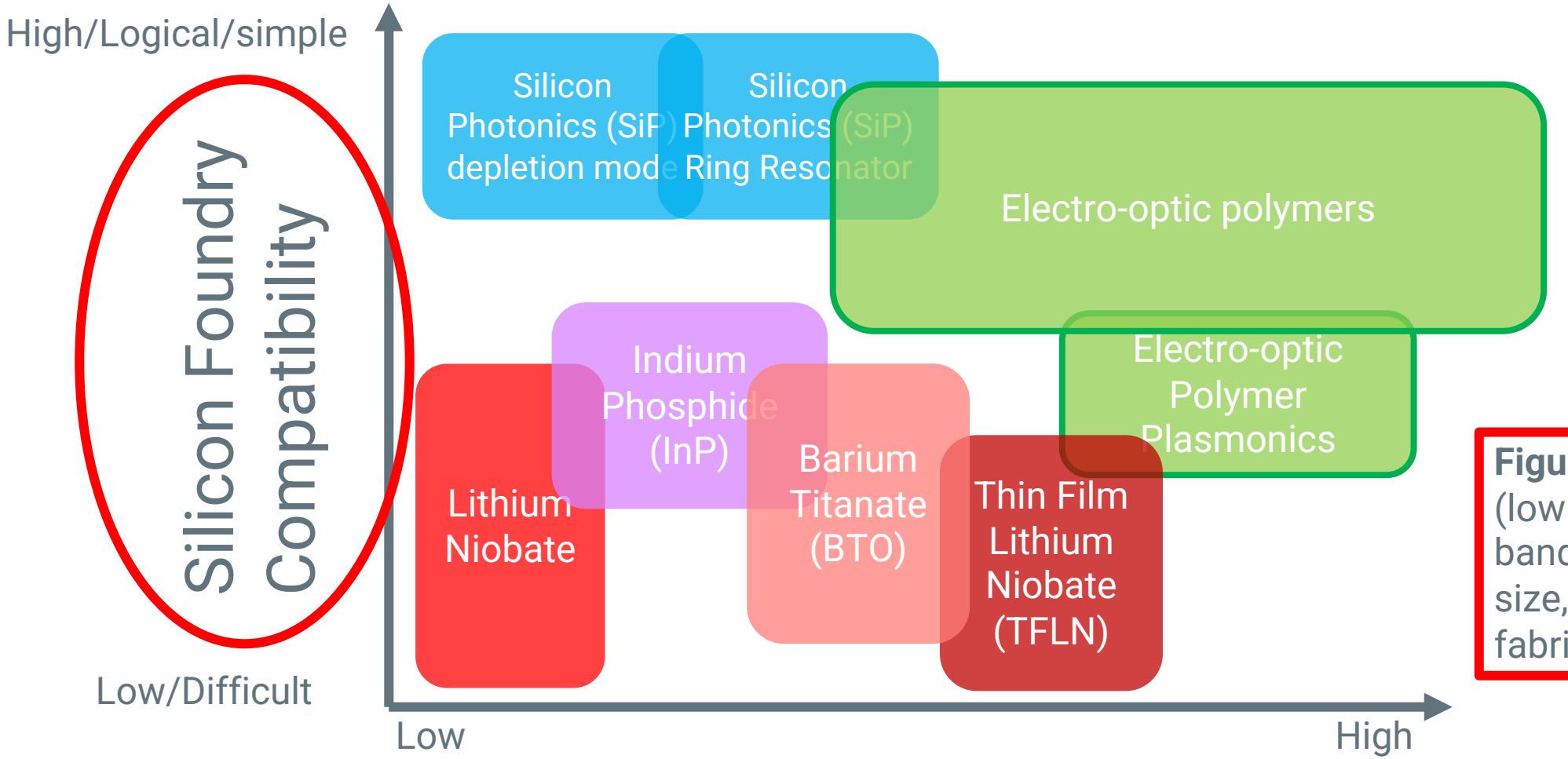
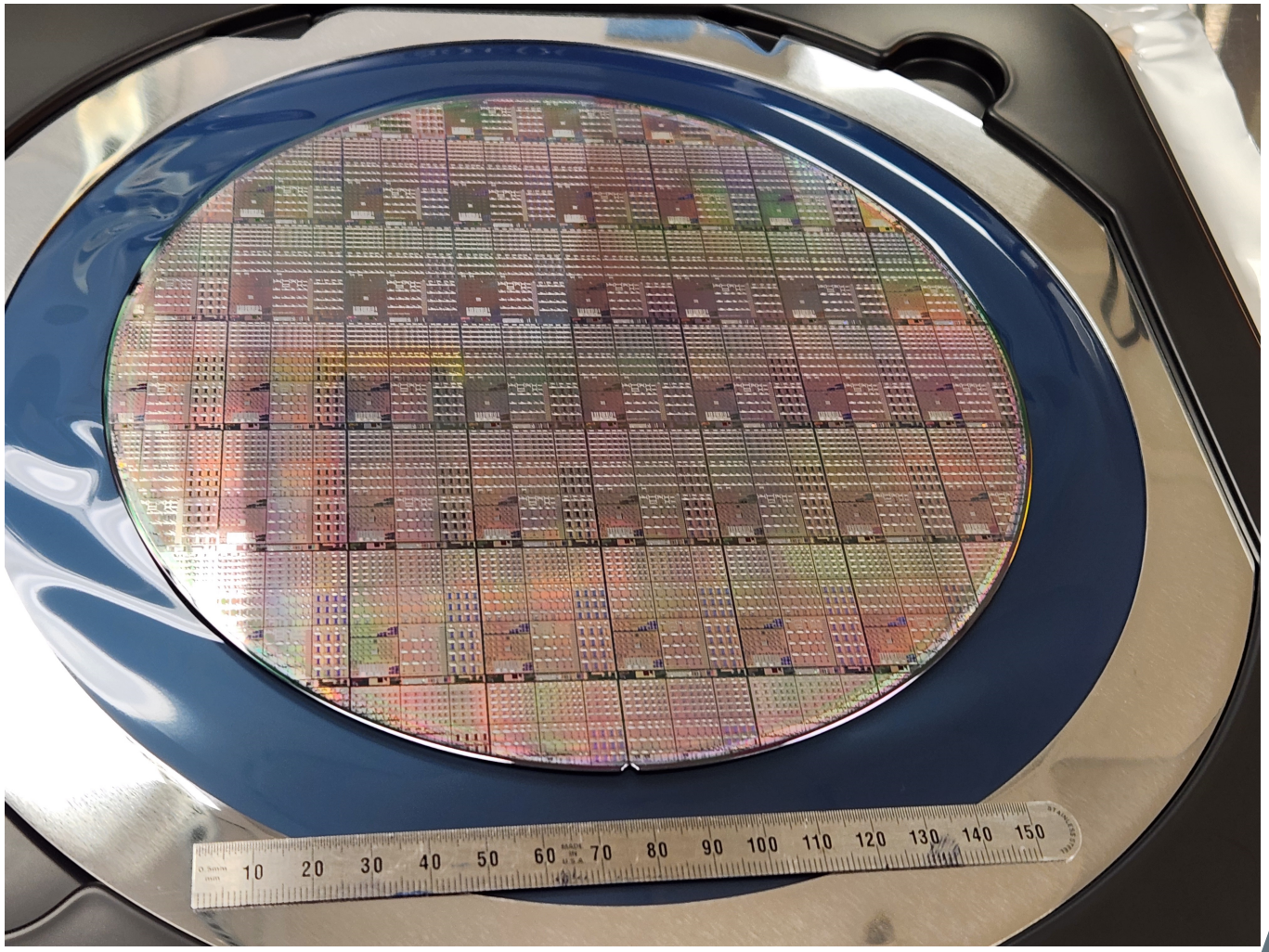


Figure of Merit (low V, high bandwidth, small size, ease of PDK, fabrication)

Polymer positioning for heterogeneous integration is aligns with silicon foundries very well

Scalability with 200 mm Wafers



Commercial Foundry

200 mm Wafer

Volume scale silicon slot designs on 200mm wafers

Heterogeneous Polymer Slot Modulator

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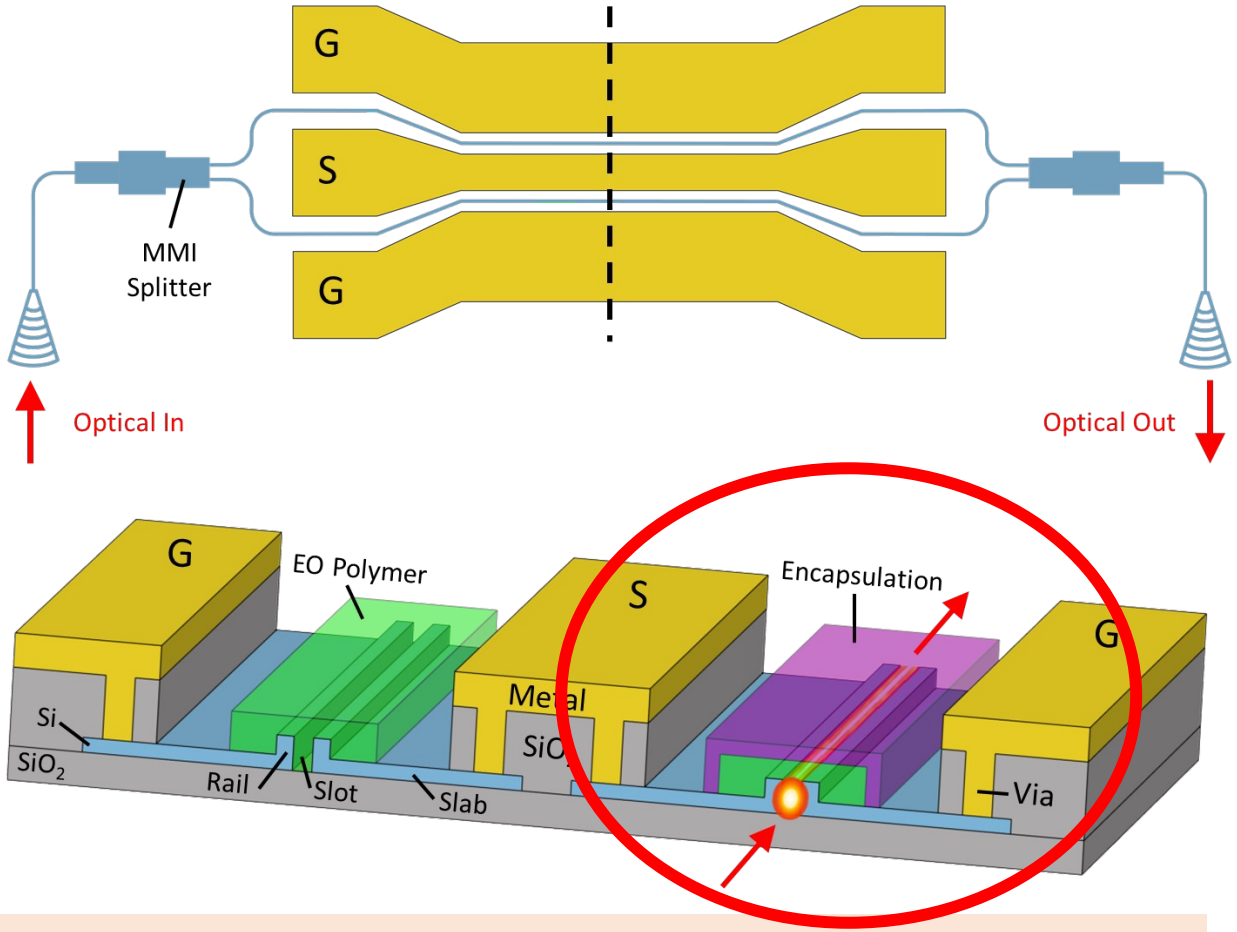
Our polymers are ***easily fabricated*** in silicon fabs → ideal for heterogenous integration

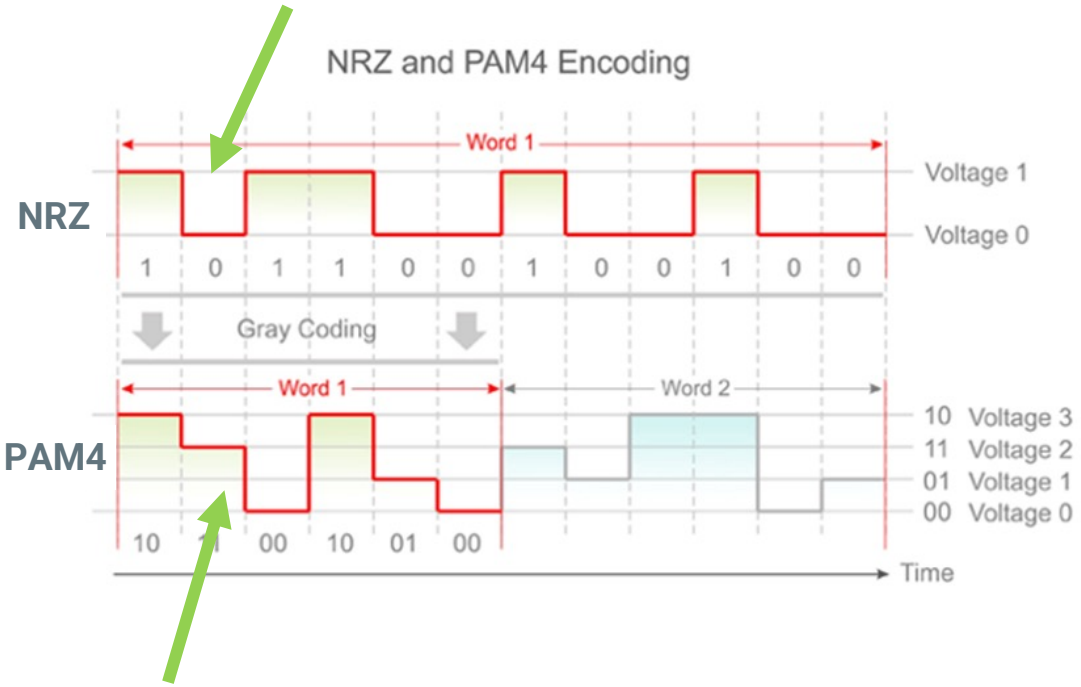


EO polymer heterogeneous integration onto silicon wafers

- **Heterogeneous integration** of polymer on Silicon Photonics Platform
- Low drive voltage and small form factor for **low power consumption** and high density
- Very high bandwidth (**70-100GHz**)
- Fabricated onto **200mm** silicon wafers

Commercial Modulation and Eyes

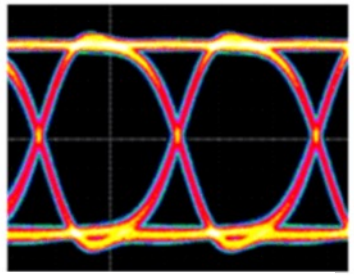
NRZ = Non-return to Zero
(i.e. castellated waveform)



PAM4 = Pulse Amplitude Modulation at 4 levels (step waveform)

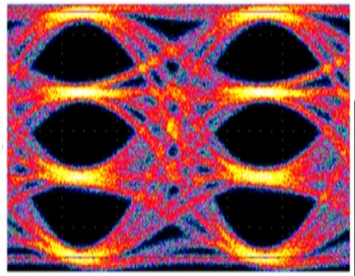
Open eyes mean no errors

2 levels → 1 bit



NRZ
1 bit per symbol

4 levels → 2 bits



PAM4
2 bits per symbol

- Open Eyes mean high quality transmission and no errors
- For Same Bandwidth PAM4 as Double the Capacity
- Eyes show superposed traces for many sequential bits
- Show the levels and the transitions for any different data pattern, i.e. any different sequence of 1's and 0's

PAM4 has X2 the capacity for the same bandwidth

World-class performance…

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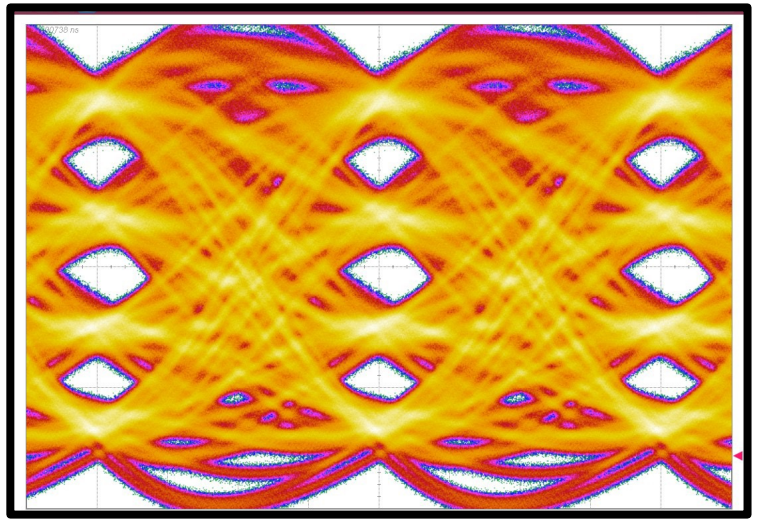
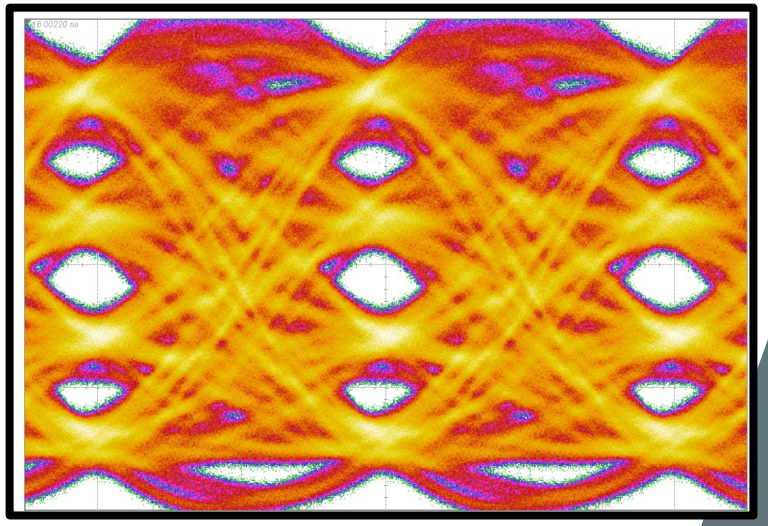
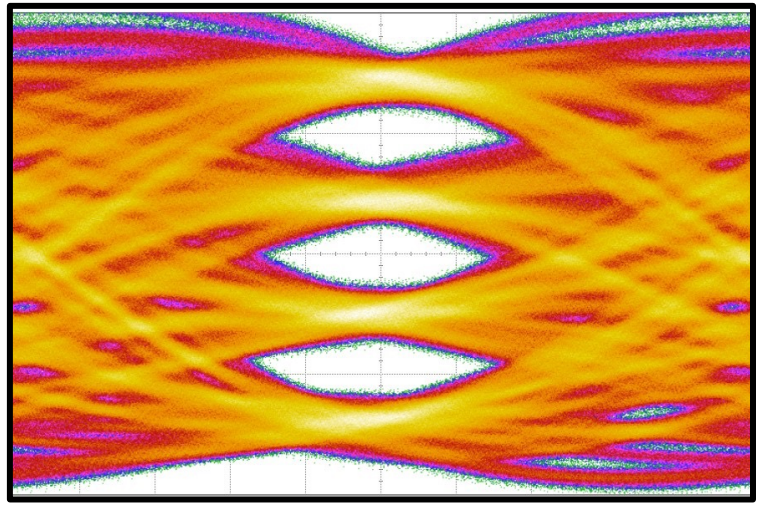
90 Gbaud, 180 Gbit/s, V_{drive} < 2 V



100 Gbaud, 200 Gbit/s, V_{drive} < 2 V



53 Gbaud, 106 Gbit/s, V_{drive} < 2 V



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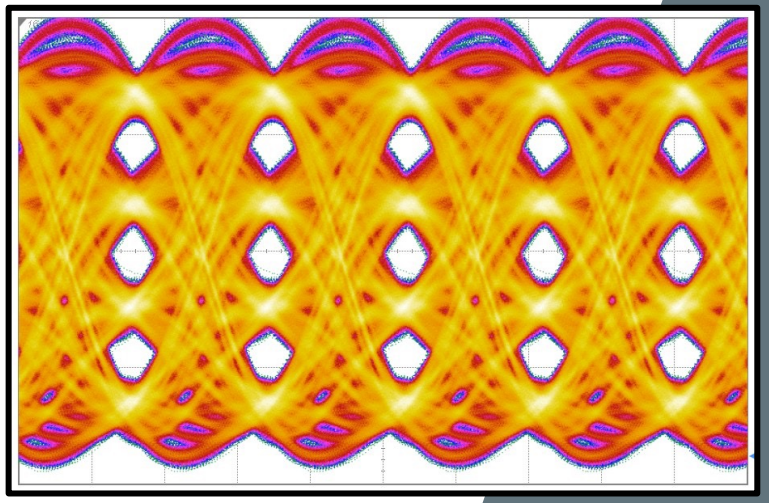

Drive Voltage ~1V

Up to 100GBaud PAM4 (200Gbps)

Open eyes…

Open eyes…

Ideal for low voltage 800Gbps 4 channel pluggable transceivers


3rd party verification...

3rd party use of Perkinamine® LWLG polymers

LIGHTWAVELOGIC®

- 400G lanes = next generation node for datacenters
- *World class performance EO polymers* used for *400G lanes*
- Potential for 4 channel x 400Gbps pluggable transceiver at 1.6Tbps (1600Gbps) & 8 Channel at 3.2Tbps

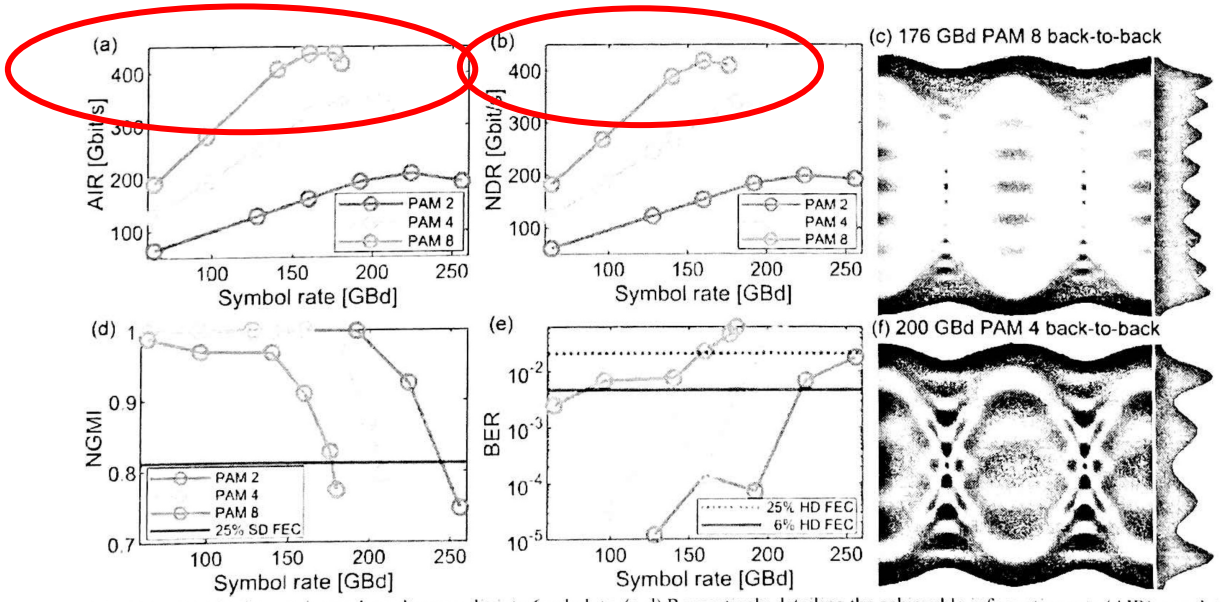

Fig. 2 Back-to-back experimental results are split into 6 subplots (a-d) Respectively detailing the achievable information rate (AIR), net-data rate (NDR), normalized general mutual information (NGMI) as well as bit-error rate (BER) for the back-to-back measurements (e-f) Showing the achieved eye-diagrams for the 176 GBd PAM 8 signal reaching the highest AIR and the 200 GBd PAM 4 signal.

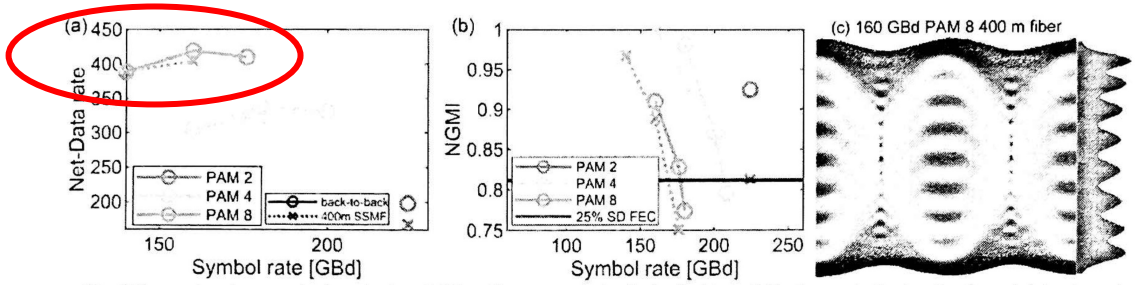

Fig. 3 Comparison between back-to-back and 400 m fiber transmission is detailed in (a & b). Respectively showing the net-data rate and normalized general information (NGMI) for the back-to-back (solid lines) as well as the 400 m fiber transmission (dashed lines). (c) Showing the achieved eye-diagrams for the 160 GBd PAM 8 signal reaching the highest data rate after fiber transmission of 404.5 Gbit/s.

Sources: ETH Zurich, Kulmer et al, OFC 2024 (W4H.5), LWLG Perkinamine™ chromophore series 3 material

Business plan: licensing our material and selling polymer modulators

Implementing a New Technology Platform

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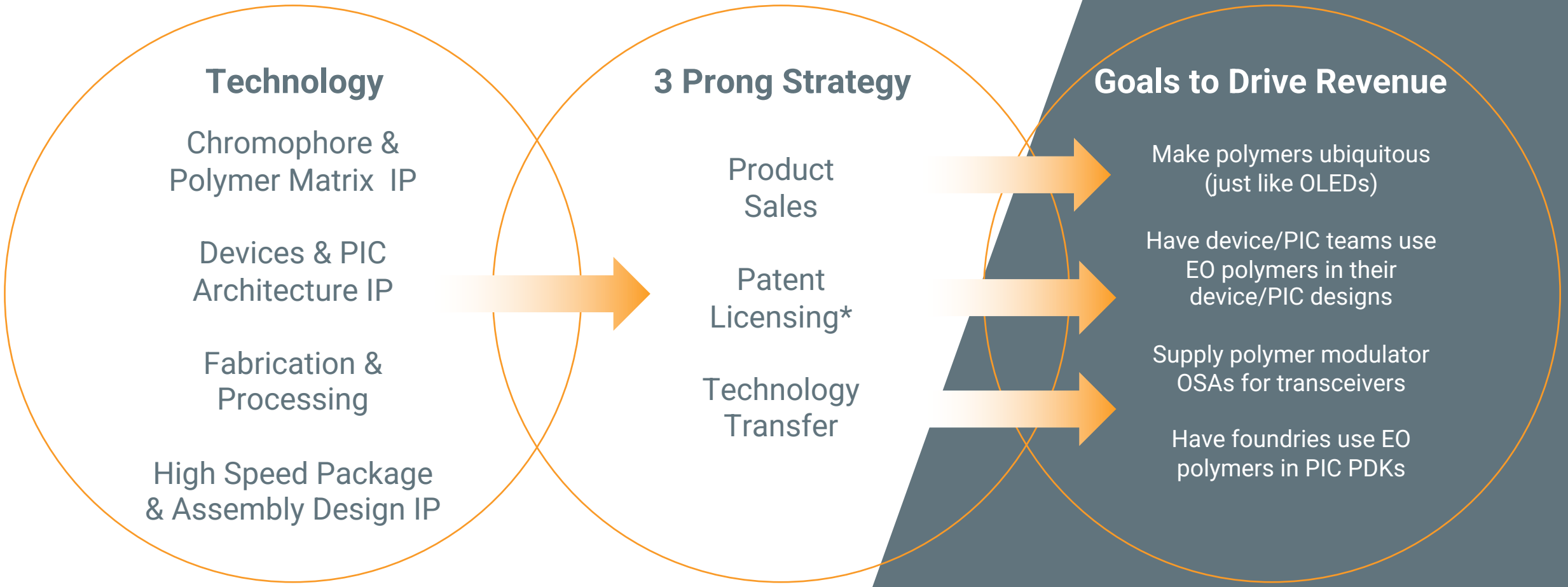
Licensing model provides inherent scalability



***1st commercial material supply license agreement 2Q23 → market acceptance**

Source: Lightwave Logic (LWLG)

Patents Drive Licensing Opportunities

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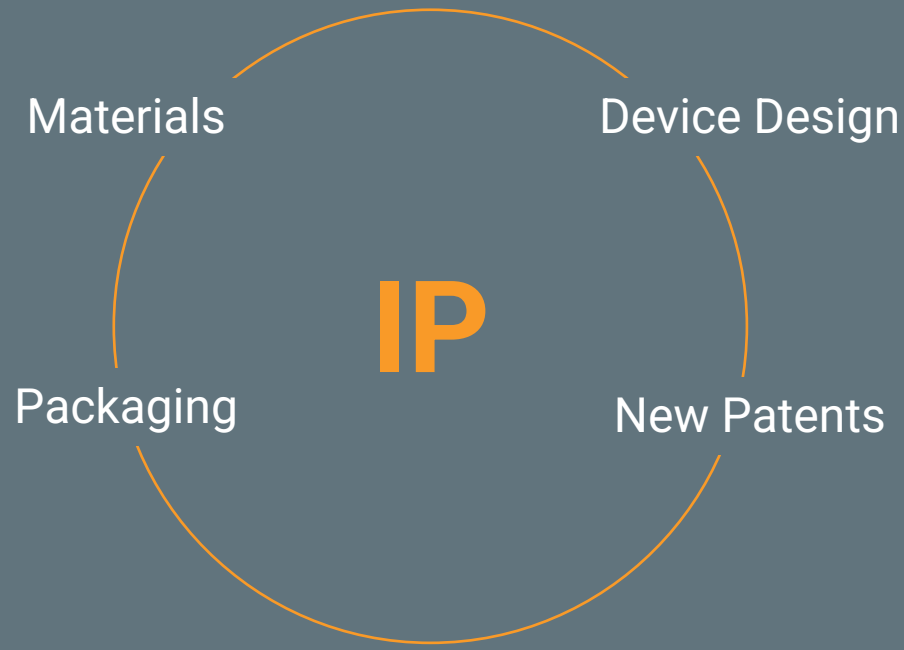
Robust intellectual property (IP) portfolio enables licensing & tech transfer for long term revenue generation



- Develop and license polymer-based technologies that are engines for the internet, optical networking, data centers
- Patent portfolio creates a strong moat and know-how to carve out a leadership position with high speed, low power EO polymers
- Proprietary EO polymers are continually strengthened to fortify the patent moat, currently with over 70 patents issued and pending

Initial Licensing Agreement

Secured initial market acceptance for polymer technology

First Perkinamine® customer licensing agreement secured in May 2023

Agreement Structure:

- LWLG to supply EO material
- License initiation fee
- Royalties (% per unit)
- Minimum royalty
- Minimum sales volume (units)

Represents commercial market acceptance of our polymers, with follow-on licensees in progress

Chromophore Commercial Plan

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Next-gen polymers continue to improve, providing performance headroom for years to come

Chromophore Material Roadmap

	2023	2024	2025
Perkinamine® 2	License	License	License
Perkinamine® 3	License	License	License
Perkinamine® 5	License	License	License
Perkinamine® 6	Development	License	License

Source: LWLG, Perkinamine® Series Electro-optic polymers; Pk® = Perkinamine®; Perkinamine® is a registered trademark of Lightwave Logic Inc.

Near Term Commercial Activities & Goals

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Initial commercial activity developing well and is expected to grow in 2025

Value Proposition

Key "Pull" drivers

- Hyperscalers, AI & Quantum computing focused solution providers
- Overall industry understands our value proposition
- Fabs and foundries focused on alternate growth, transceiver vendors, packaging houses

- Key "Push" drivers:
  - Turbo-boosting Silicon Photonics Platform
  - Putting in a 'V8' into transceivers

Prospects

>20 prospects identified based on value proposition discussions

Leads

>10 "leads" engaged including trial runs of technology

Selection

Selection of "push" & "pull" categories based on "leads" efforts

Customers

Plan is to scale in volume

2024→ 2025
Engagement with Tier 1,2, and 3 companies for both materials supply licensing as well as polymer modulator prototypes

Source: LWLG internal data

Scaling Growth…

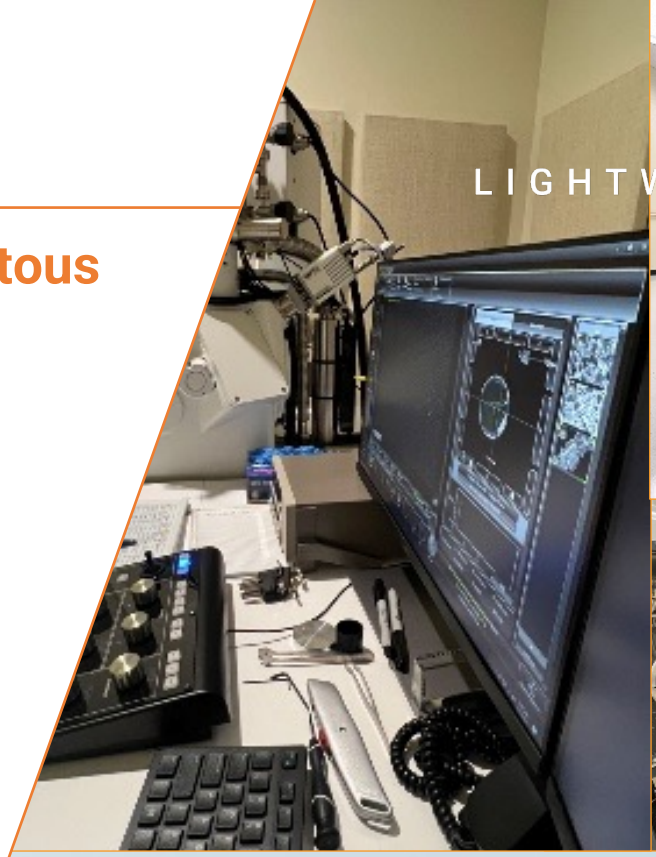
We now have the team and facilities to make polymers ubiquitous

Expanded Lightwave Logic facility is complete and operational:

- Acquired almost 10,000 sq ft adjoining current facility, representing a 70% increase in available space
- New space is being used for:
  - Production device test and evaluation center
  - Production reliability center
  - Laser characterization center
  - SEM analysis center
  - Expansion of chemical synthesis production line
  - Office and meeting space for additional staff

New space supports notable recent hires, including:

- Organic and computational chemists
- Material science and device engineers
- Packaging and reliability engineers



Experienced Management & Board

LIGHTWAVELOGIC®

Dr. Michael S. Lebby
Chairman & CEO

35+ years experience in photonics & semiconductors

Ronald A. Bucchi
Independent Director

35+ years experience in accounting & finance

Dr. Fred Leonberger
Independent Director

35+ years leadership in optical modulators & systems

Siraj Nour El-Ahmadi
Independent Director

30+ years leadership experience in telecom network equipment

Mr. Jim Marcelli
President & COO

35+ years experience in finance & operations

Craig Ciesla
Independent Director

25+ years experience in technology and engineering

Laila Partridge
Independent Director

30+ years experience in technology, corporate innovation and finance

Key Takeaways

We believe our polymers are positioned to become ubiquitous

- **Large Addressable Market:** Optical transceivers market expected to grow to at least $100B by 2030 chiefly driven by data centers, fiber comm & AI requirements
- **Proprietary EO Polymer Technology:** Supports >3x faster data transmission speeds with ~10x lower power, relieving key bottlenecks in internet infrastructure
- **Robust Patent Portfolio:** Composed of 70+ patents and patents pending
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- **Experienced Leadership**: Management and Board are composed of technology and finance experts with 200+ years of combined experience

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Faster by Design

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