# Toward the Future with IOWN

## Low-Power Optical Computing for the AI Era

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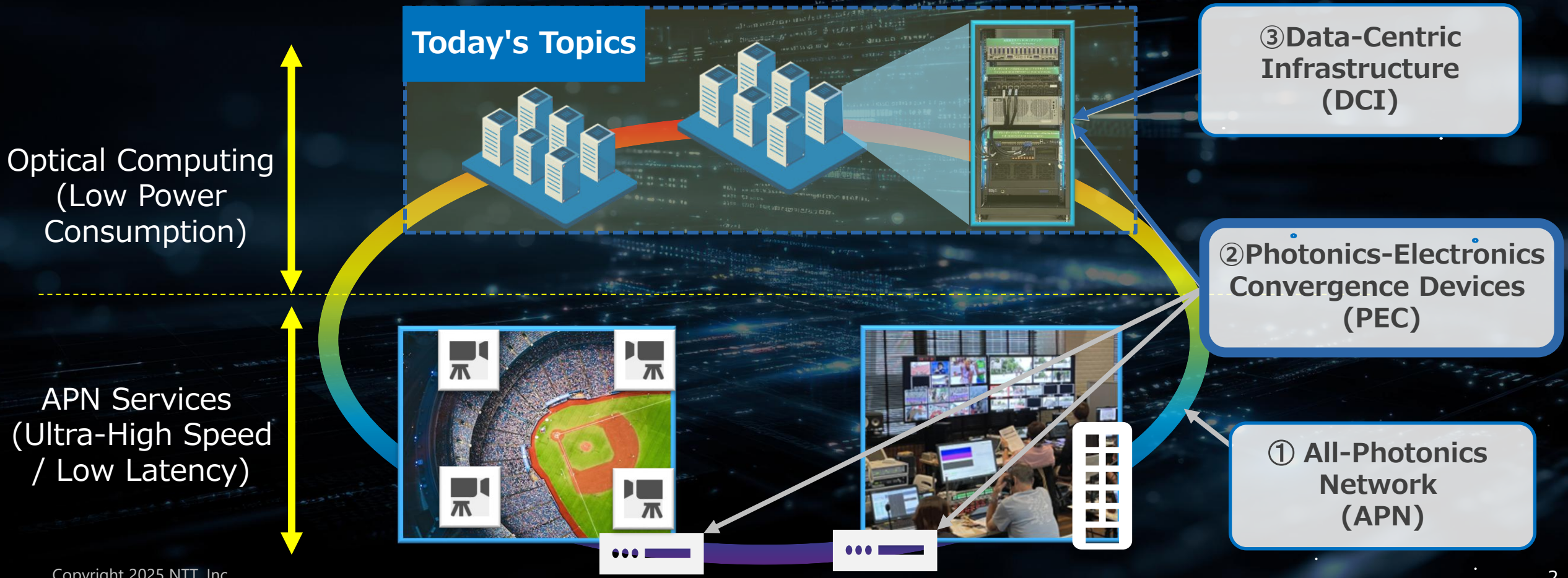
Representative Member of the Board
Senior Executive Vice President and CTO
Riaki Hoshino

# Optical Computing in IOWN

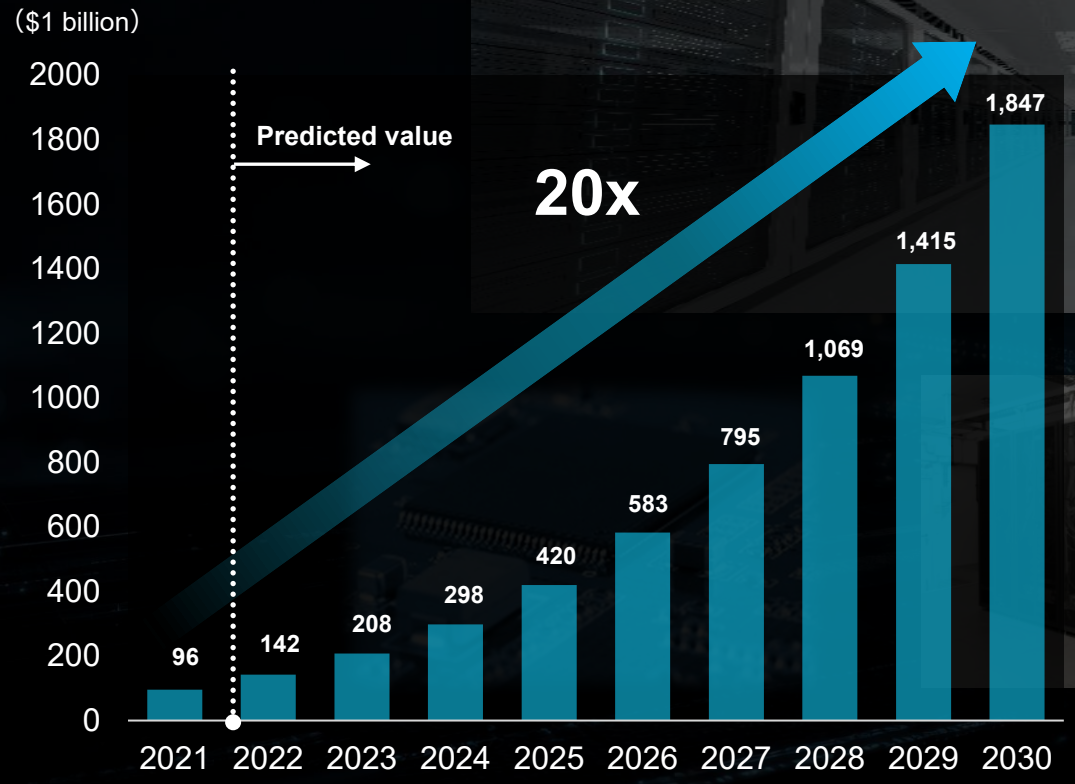
- IOWN consists of the All-Photonics Network (APN), Photonics-Electronics Convergence devices (PEC) , and Data-Centric Infrastructure (DCI).
- Until now, implementation has focused mainly on APN services, leveraging ultra-high speed and low latency.
- The scope of implementation will expand to optical computing, which realizes low power consumption.



# Increased power consumption due to expansion of the AI market

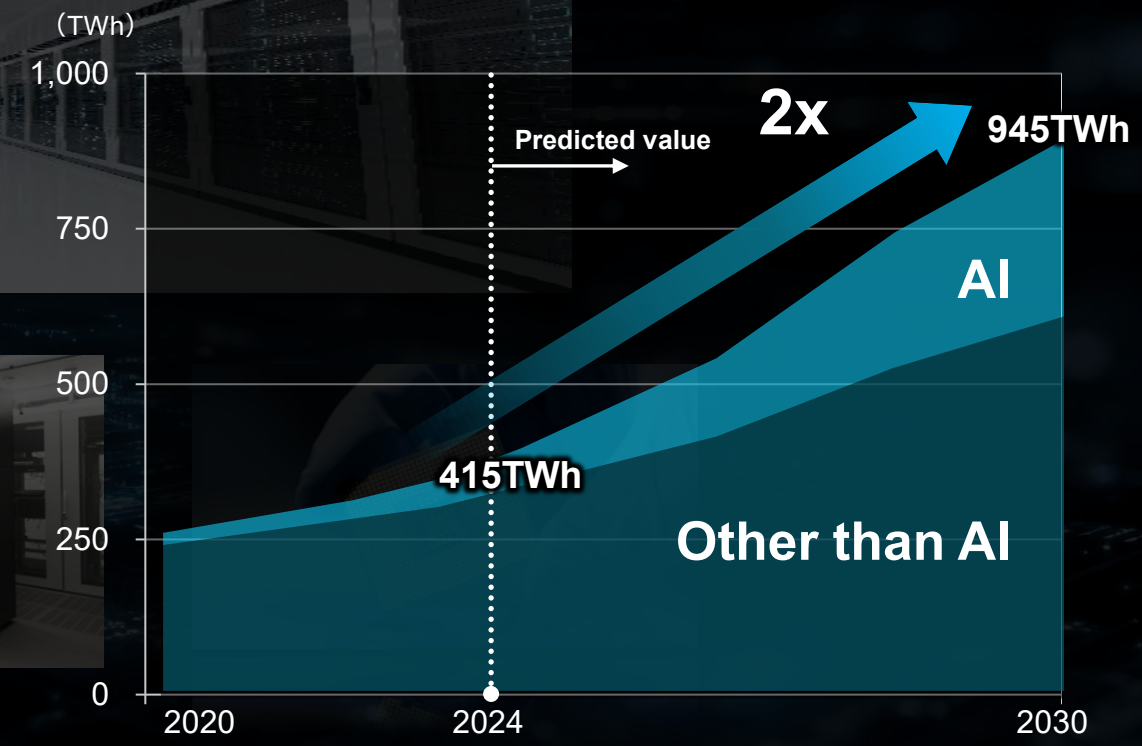
- The AI market is predicted to grow 20 times compared to 2021, reaching $1.8 trillion (approximately 280 trillion yen) by 2030.
- Data center power consumption is predicted to double by 2030 compared to 2024.

## Global AI market size (sales)




Source: Ministry of Internal Affairs and Communications Information and Communications White Paper 2024 Edition, Section 9

## Power consumption in data centers around the world

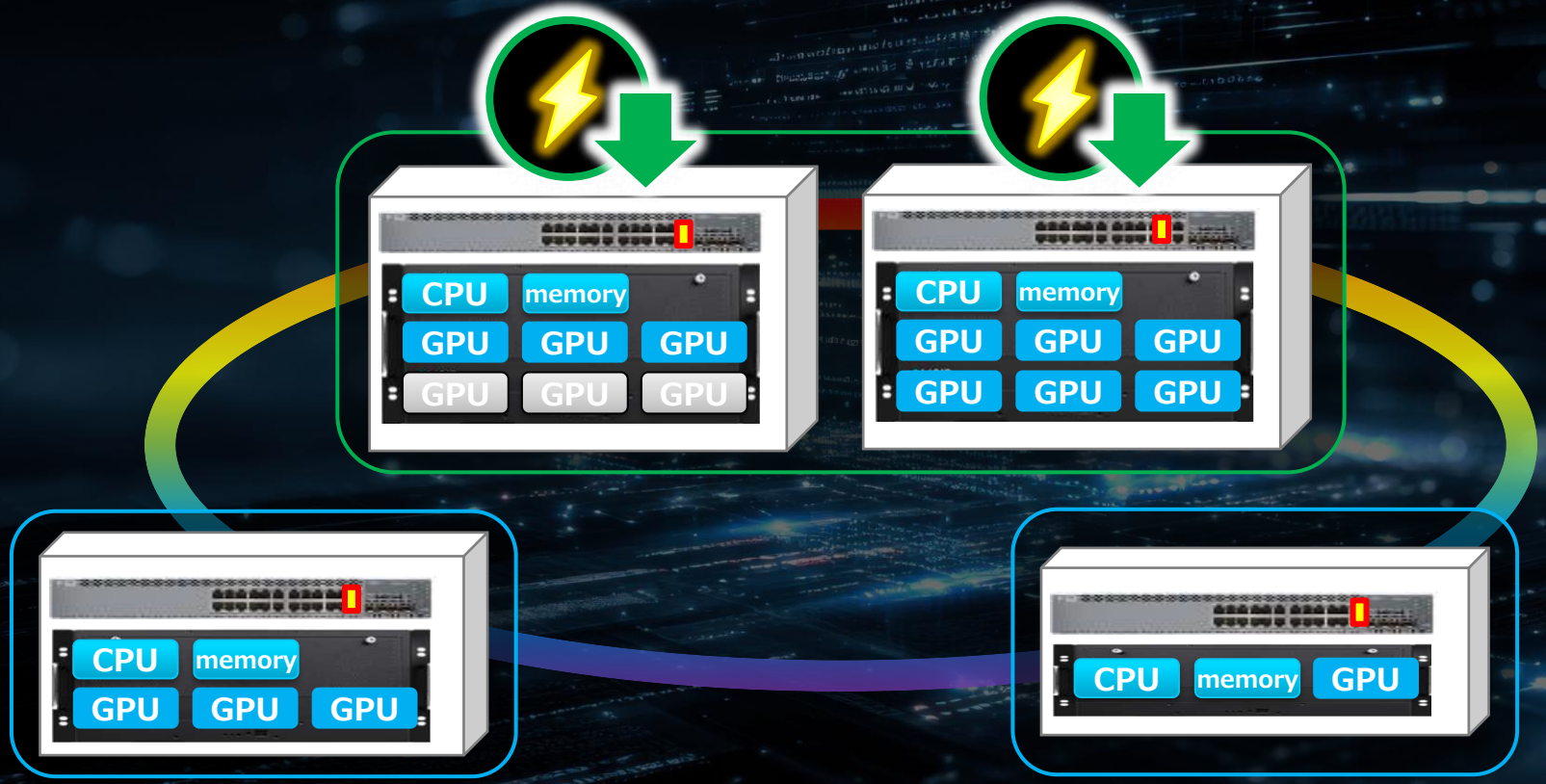



Source: IEA “Energy and AI” (published April 2025) Figure 2.11

# Infrastructure Direction

- Addressing the significant increase in power consumption associated with the expanding use of AI.

## Reducing total infrastructure power consumption through photonic computing

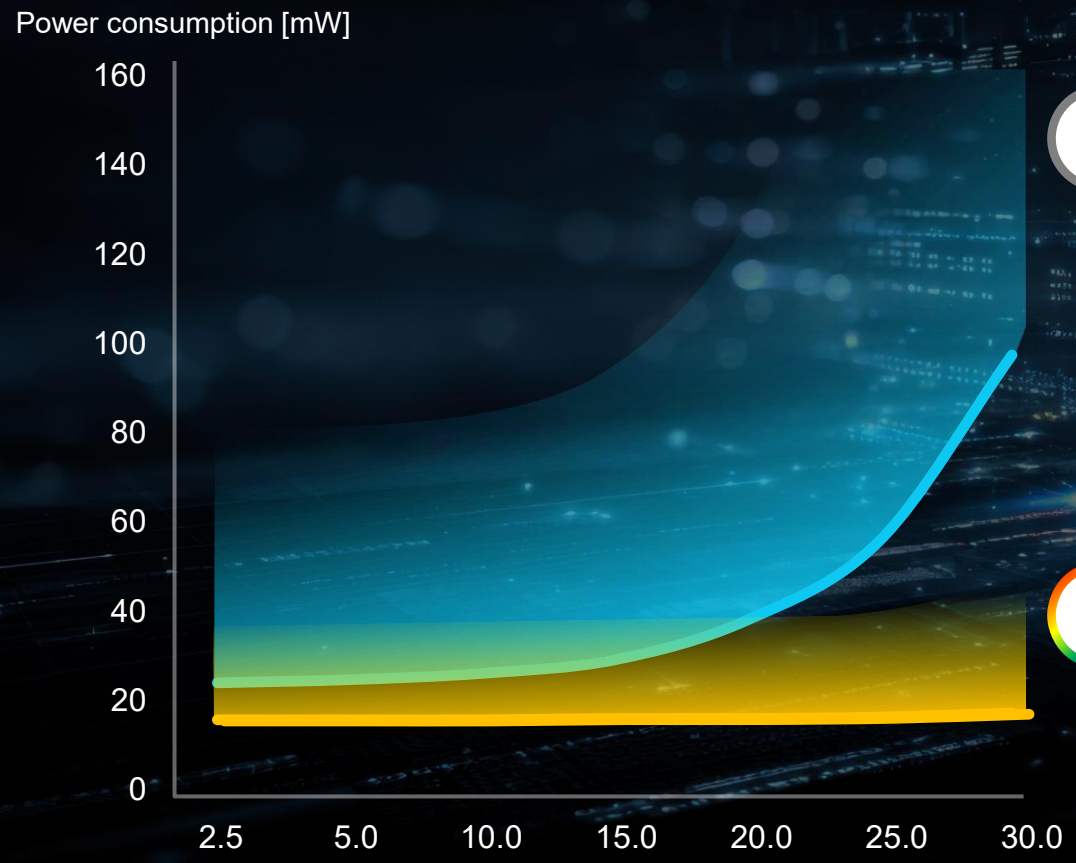



## Efficient infrastructure operation through resource sharing

# The advantages of optical fiber in large-capacity communications

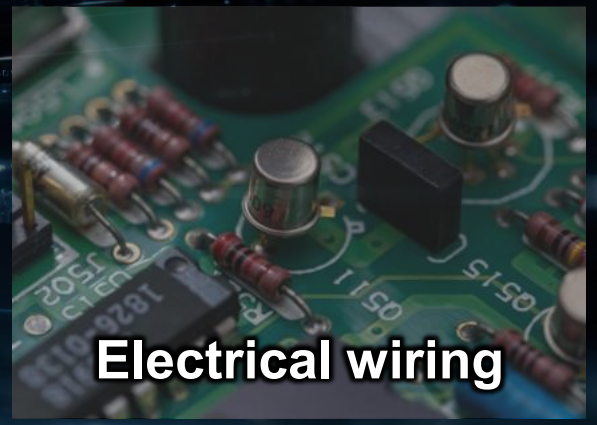
- In large-volume electrical communications, power consumption increases dramatically as the transmission distance increases.
- On the other hand, optical communication has the advantage of hardly increasing power consumption.

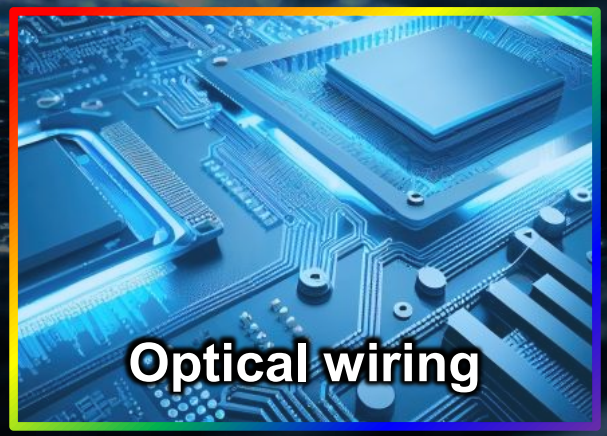
**Relationship between transmission distance and power consumption**




Electro

Opto



# IOWN Roadmap and Application Areas

- In 2023, we developed IOWN 1.0, photonics-electronics convergence devices (PEC-1) for networks, and applied it to relay devices and DC connections.
- In 2025, we developed IOWN 2.0, photonics-electronics convergence devices (PEC-2) for board connections.

※PEC: Photonics-Electronics Convergence

| 2023 | 2025 | 2028~ | 2032~ |
|---|---|---|---|
| IOWN 1.0<br>PEC-1 (Already commercialized as APN* 1.0) | IOWN 2.0<br>PEC-2 | IOWN 3.0<br>PEC-3 | IOWN 4.0<br>PEC-4 |
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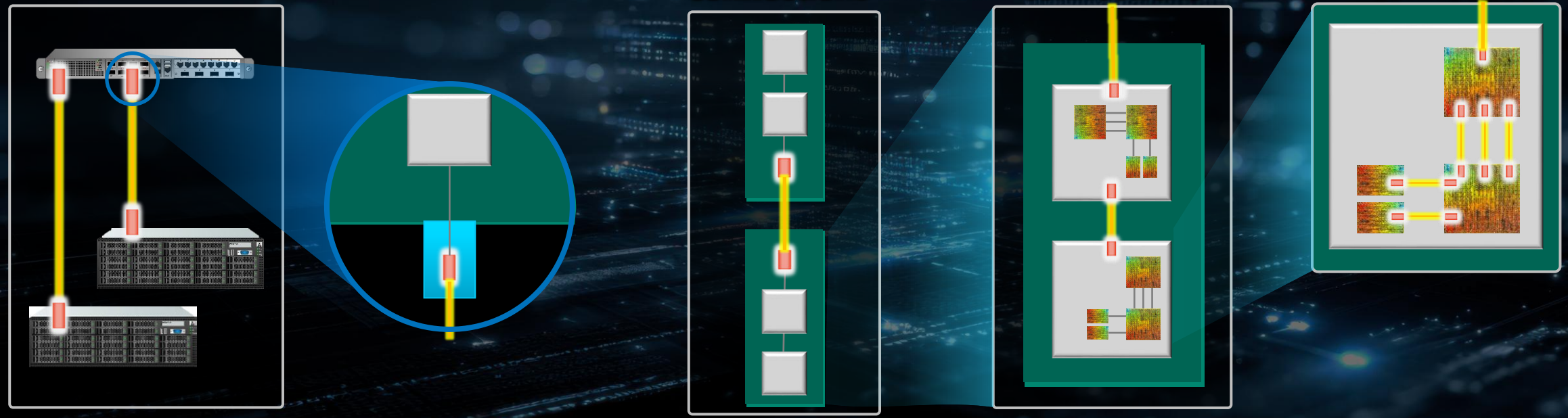


Network

Computing

# Demonstration of IOWN use cases at the Expo

- At the Osaka/Kansai Expo, use cases such as real-time spatial transmission and remote production were demonstrated using IOWN technology.
- Real-time analysis using photonic computing with IOWN2.0 was also conducted.

## IOWN x Perfume

Real-time spatial transmission for Perfume and Expo Commemorative Park was realized

3D spac & haptics

NTT Pavilion

## IOWN photonic disaggregated computing

Real-time analysis of visitors' facial expressions is reflected in the movement of the pavilion curtains

Yumeshima NTT Pavilion

Visitors' expressions

IOWN

Video analysis results

Kyobashi NTT West Japan Headquarters

IOWN photonic disaggregated computing with integrated photonic -electronics devices

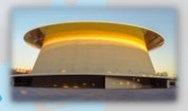
## CHO-KABUKI

Utilizing the Japan-Taiwan APN to enable a Kabuki performance with some performers in Tawan and some at the Osaka Expo

Taiwan

Osaka

Osaka Yumeshima Shine Hut



Osaka over 3,000 tency of 40 ms

## Remote

Connecting cloud editing program produc

Satellite Studio

Media Center



KAIROS

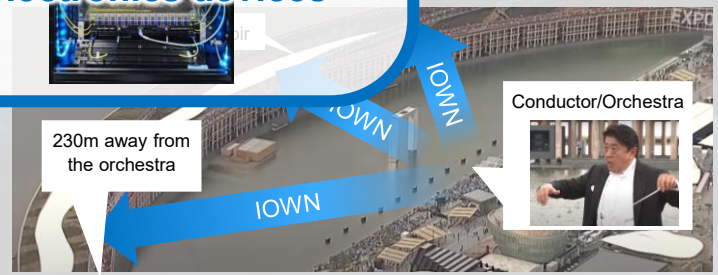
ABC

ytv

8 ガンテレ

## mphony EXPO2025

ideo was delivered eople via IOWN



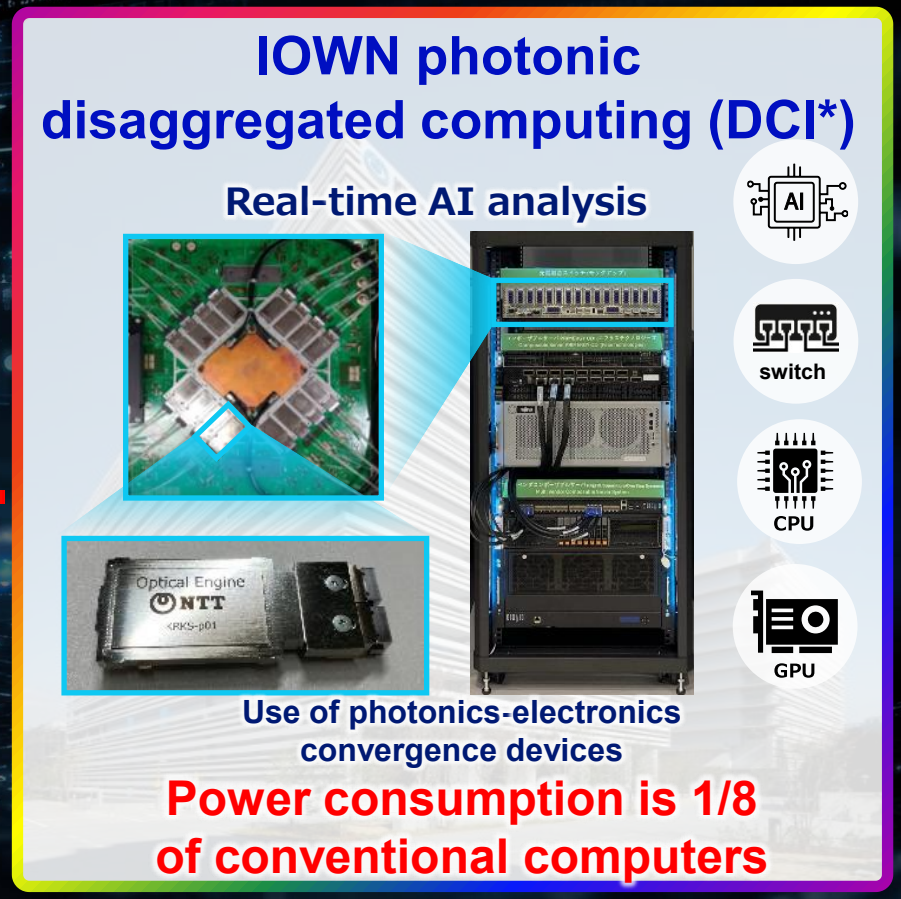
# Optical computing at the Expo pavilion

- The IOWN 2.0 photonics-electronics convergence device was used in the AI camera analysis at the NTT Pavilion at the Osaka-Kansai Expo, achieving a computer with 1/8 the power consumption.


Real-time video data transfer

IOWN

Utilization of analysis results at the pavilion




※DCI: Data-Centric Infrastructure

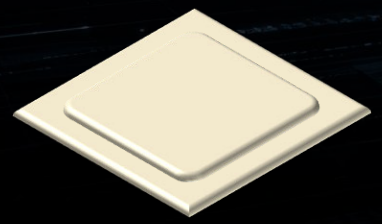
# The role of ecosystem players in realizing optical computing

- IOWN photonic disaggregated computing is realized by combining NTT's photonics-electronics convergence technology with the latest technologies from chip/switch manufacturers, etc.

**Optical engine (optical device PEC-2)**

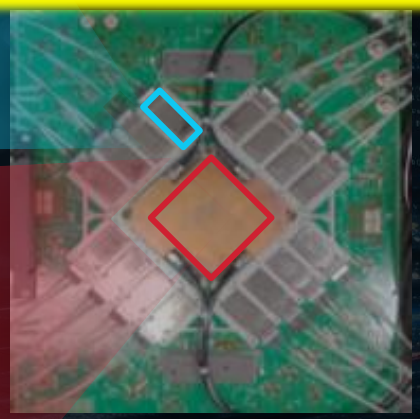
NTT Innovative Devices


**Switch ASIC**

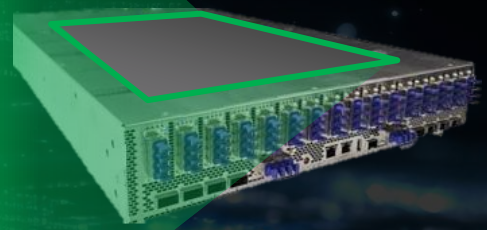


**Switchboard**

NTT Innovative Devices



**Photonics-electronics convergence switch**



Rack equipped with photonics-electronics convergence switch and servers

# History of NTT's innovation in optical communications technology

- For over 40 years, NTT has been involved in the research, development, and practical application of optical communications, and has been working to realize optical communications in smaller units to meet the needs of the times.

**1977** Practical application of optical fiber communications

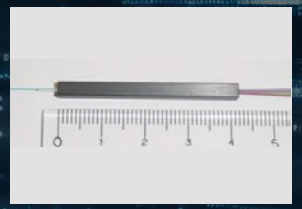
**1983** Commercialization of the Internet

**1990** The spread of broadband and smartphones

**2000** The spread of cloud computing and IoT

**2015** Rapid expansion of the AI market

**2023**





## VAD Method

Mass production of optical fiber

**Reducing the cost of optical communication networks**

## Flame deposition method

High-precision optical fiber manufacturing

**Improved service quality through high-quality lines**

## AWG

Wavelength separation of optical signals

**Provision of high-capacity communication services**

## FTTH Splitter

Multi-branching of optical signals

**Spread of fiber optic lines to homes**

## COSA

Interference control of optical signals

**Achieving high-speed, high-precision communication**

## CoPKG

Monolithic integration of DSP※, analog circuitry, and silicon photonics

**Bringing compact, high-performance products to market**

※DSP: Digital Signal Processor

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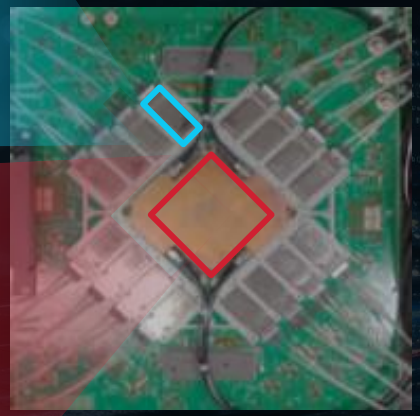
BROADCOM

**Switchboard**

NTT Innovative Devices



**Photonics-electronics convergence switch**

Accton

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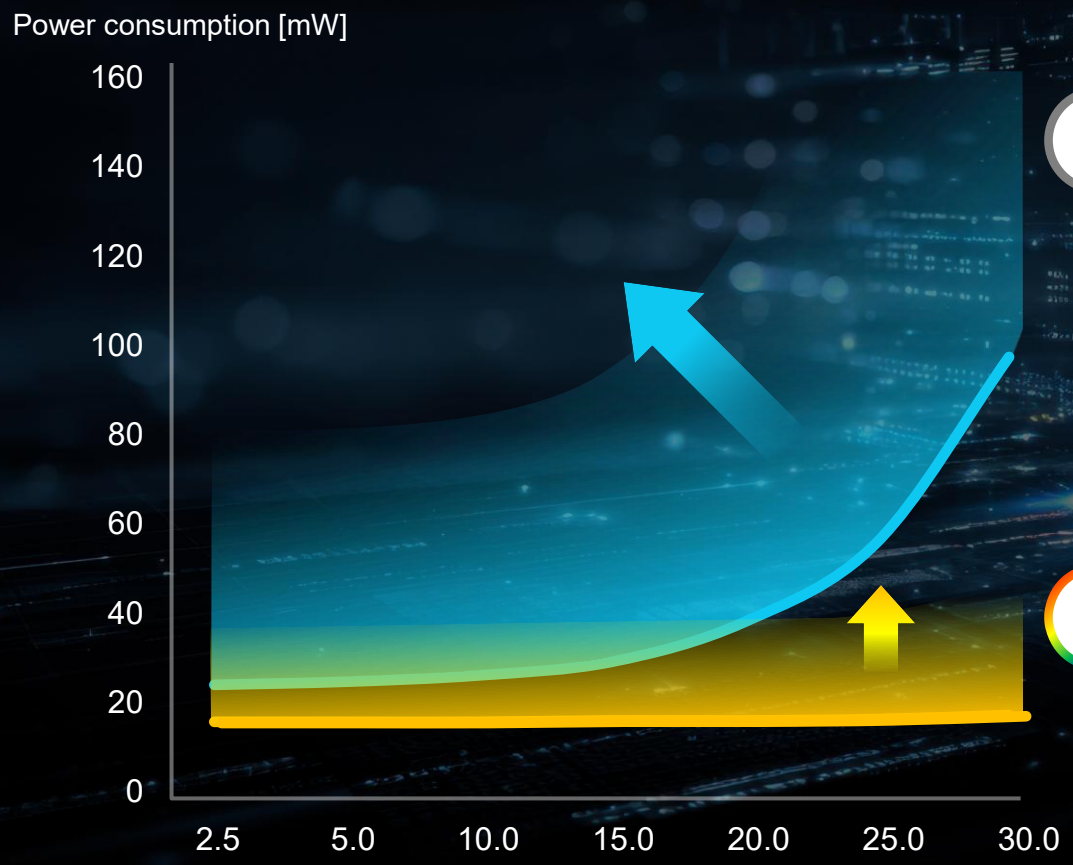


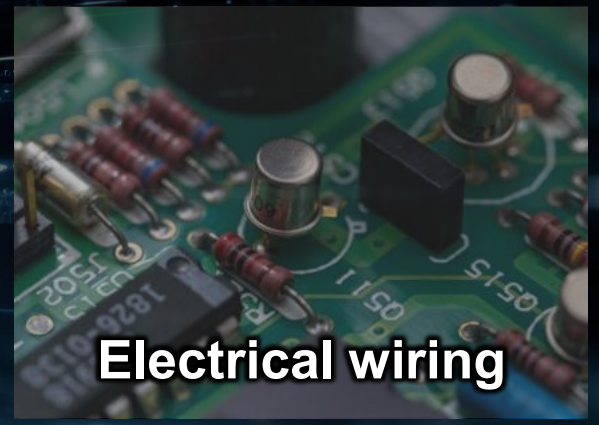


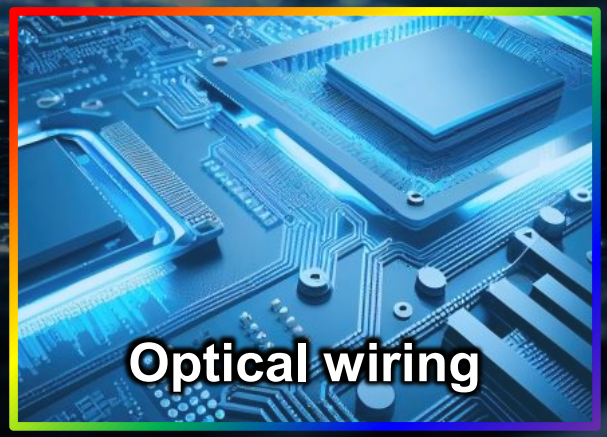

# IOWN 3.0: Further evolution of optical computing

- IOWN 3.0 will achieve dramatic power reductions by using the advanced photonics-electronics convergence device PEC-3 to achieve optical wiring between semiconductor packages such as CPUs and GPUs.

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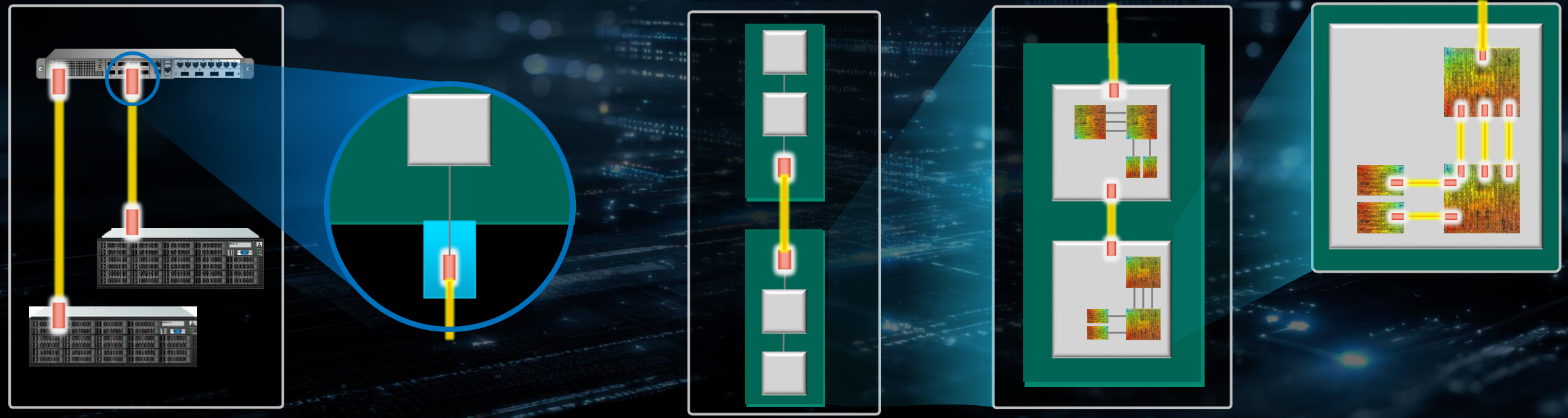
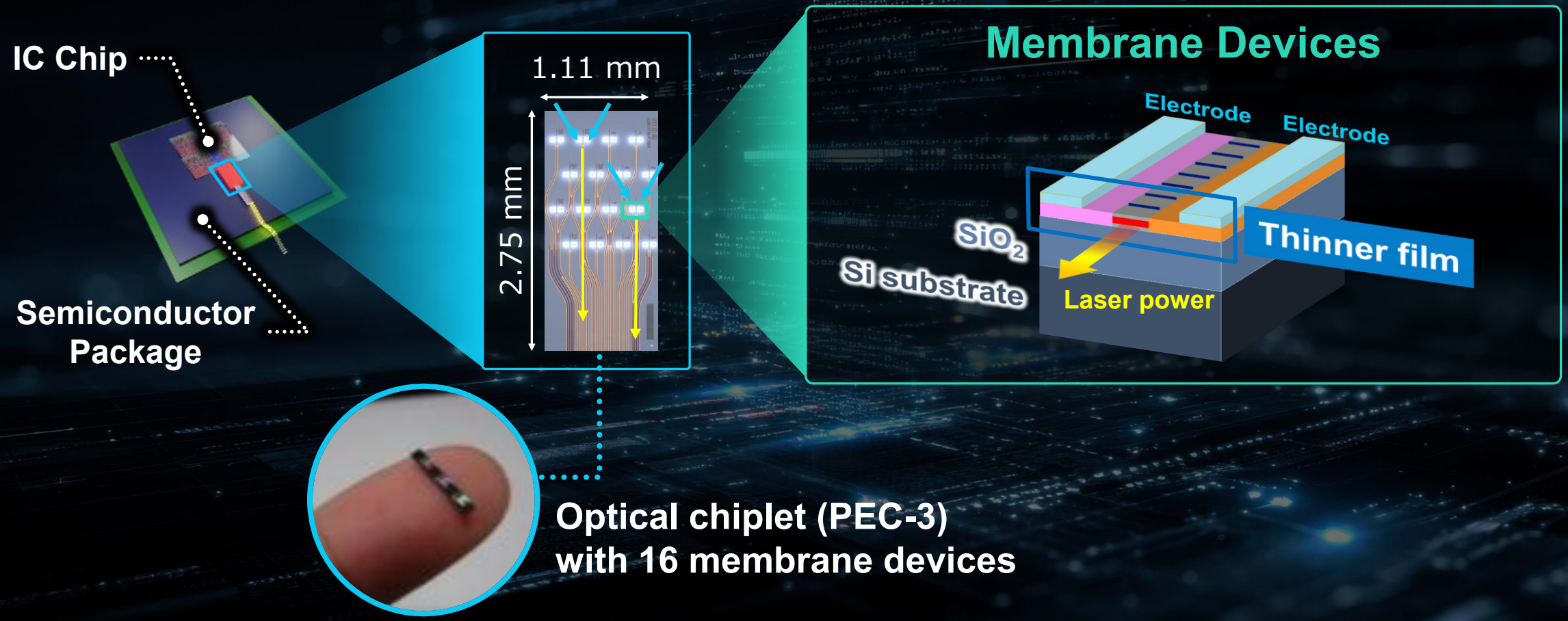


Network

Computing

# Membrane devices that achieve IOWN 3.0

- IOWN3.0 utilizes NTT's proprietary thin-film technology (membrane technology).
- The structure of conventional optical devices has been radically changed, resulting in a device that is small enough to be directly attached to a chip.



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NTT

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