

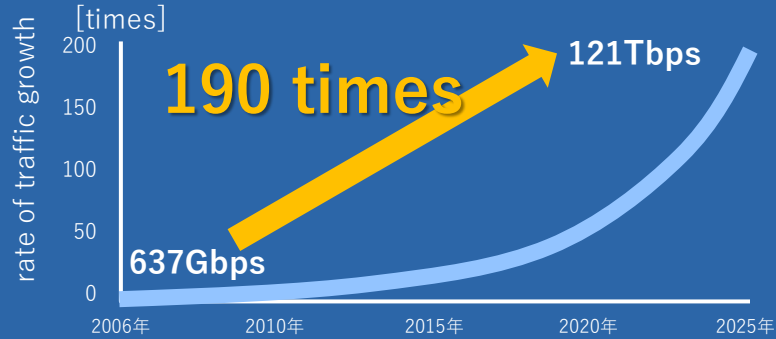


IOWN Concept for the Sustainable World (Innovative Optical and Wireless Network)

19th of October 2021

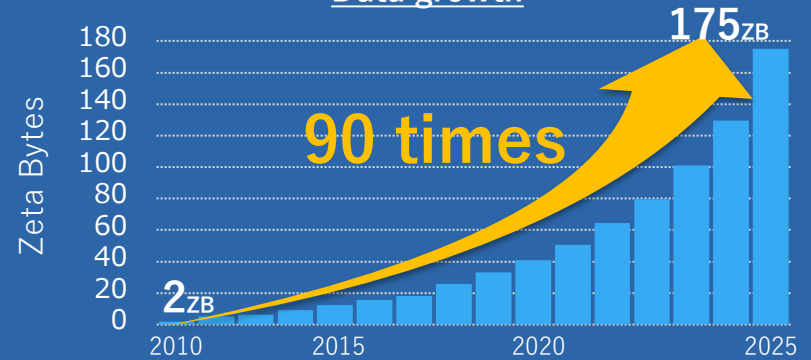
Dr. Yosuke Aragane, NTT

Estimating the amount of information distributed through the Internet



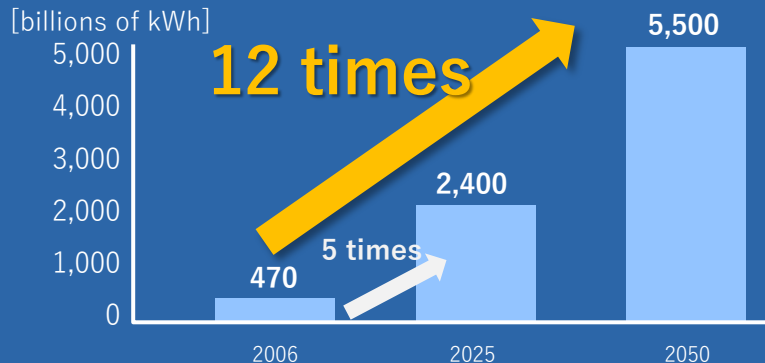
Source: "Green IT Initiative" (2007.12) by the Ministry of Economy, Trade and Industry

Data growth



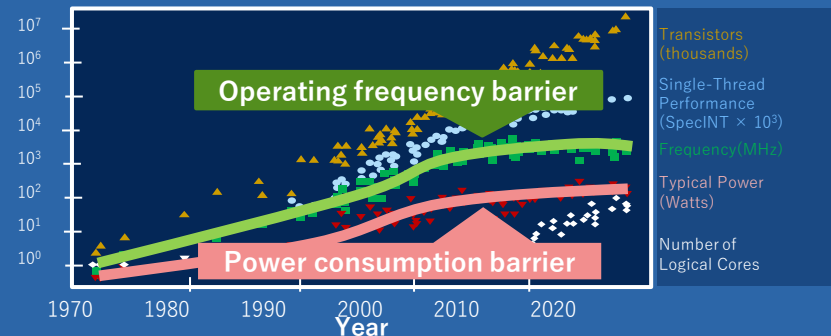
Source: IDC "November 2018 The Digitization of the World From Edge to Core"
The Digitization of the World from Edge to Core, November 2018

Estimation of IT equipment power consumption



Source: "Green IT Initiative" (2007.12) by the Ministry of Economy, Trade and Industry

Stagnation in technological evolution



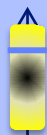
Original data up to year 2010 collected and plotted by M.Horowitz, F.Labonte, O.Shacham, K.Olukotun, L.Hammond, and C.Batten. New plot and data collected for 2010-2017 by K.Rupp

Source: <https://www.karlrupp.net/2018/02/42-years-of-microprocessor-trend-data/>

Key Requirements and Leap toward 2030 NTT

Cognitive and Communication Capacity

How finely, precisely, and multisensory the system can capture objects in the physical world and process the captured data



Beyond Human (Natural)
20-150,000 Hz sound,
120 FPS motion, etc.



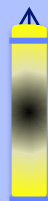
Human-Level (High-Quality Digital)
20-20,000 Hz sound,
30 FPS motion,
encoded at fine-for-human quality

Low Quality Digital
10 FPS motion, etc.



Response Speed

How responsively the system can react to an event. Can be represented with turn around time (TAT).



Beyond Human (Natural)
Act in 10 msec



Human-Level
Act in 0.1 second



Act in a second

Act after several minutes

Scalability in Computing

How efficiently the system can accommodate varying and uncertain workload.



Dynamic Scaling with Linear Efficiency

Dynamic Scaling (with Diminishing Effect)

Semi-Static Computing Scaling

Energy Efficiency

How energy-efficiently the system can run.



Event-Driven, LED-Light-Level Consumption
e.g. 300 mWsec per event

Unit-Driven, Light-Bulb-Level Consumption
e.g. 10-15 W per camera

Dominated by Very Large Fixed Consumption

Energy consumption for camera-based cognitive systems

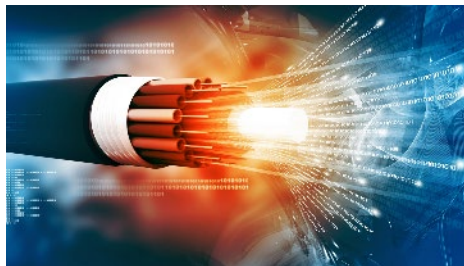


Key Technology for IOWN:

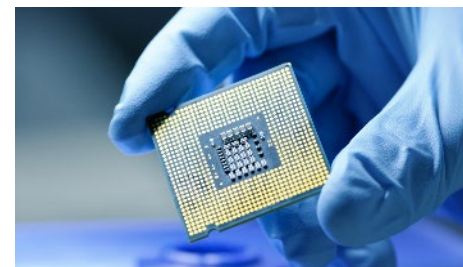


Photonics Electronics Convergence Technology

“Transmitting”
by Photonics Technology



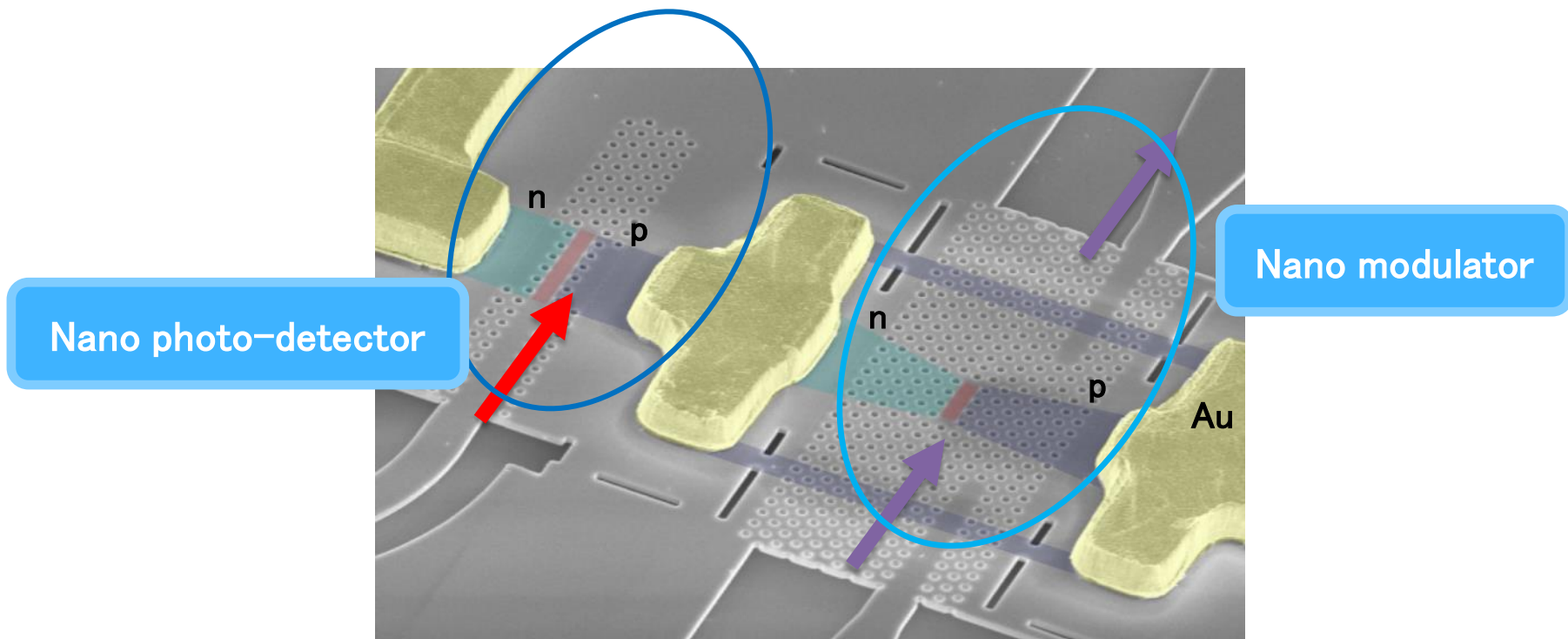
“Processing”
by Electronics Technology



**Combination of photonics & electronics
for next gen networking and computing**

**“Photonics Electronics
Convergence”**

Optical transistor with high speed and ultra-low power consumption



Optical device technology improvements



Apr. 2019

Nov. 2019

Mar. 2020

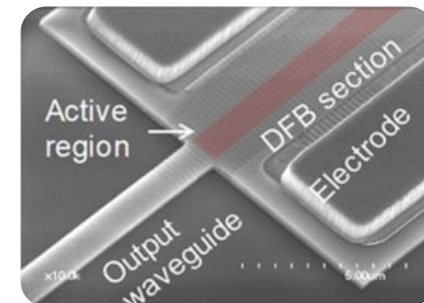
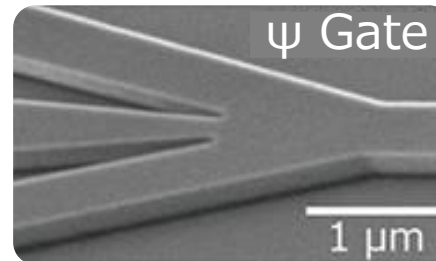
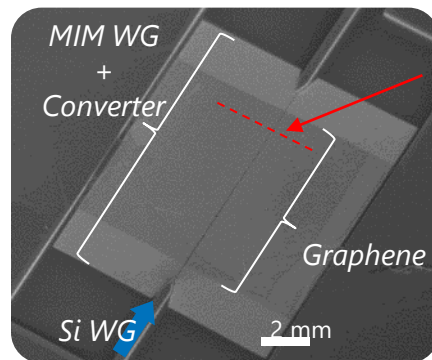
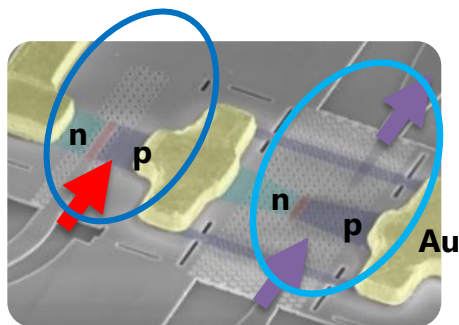
Oct. 2020

Photonics transistor

All-optical switch

Optical logic gate

Directly modulated laser



Published in:

Nature Photonics

Nature Photonics

Communications Physics

Nature Photonics

IOWN:

“Converged infrastructure for next gen communication and computing”

by using cutting-edge technologies like photonics and computing technologies

Aim for:

Lower power consumption

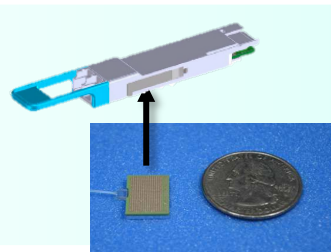
Large capacity and high capacity

Low latency

Photonics technologies into:

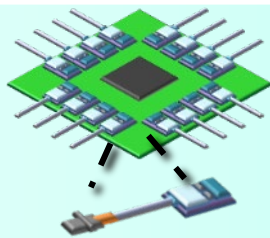
Photonics-electronics convergence devices

“Transmitting”
by Photonics Technology



COSA

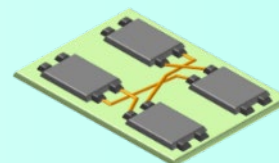
Connection around the chip



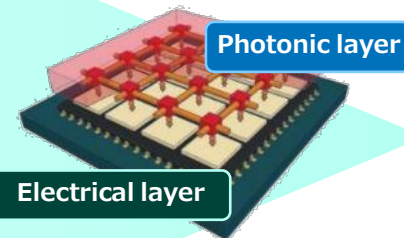
Co-packaged optics

Photonics-electronics convergence processing

Combination of
photonics and electronics

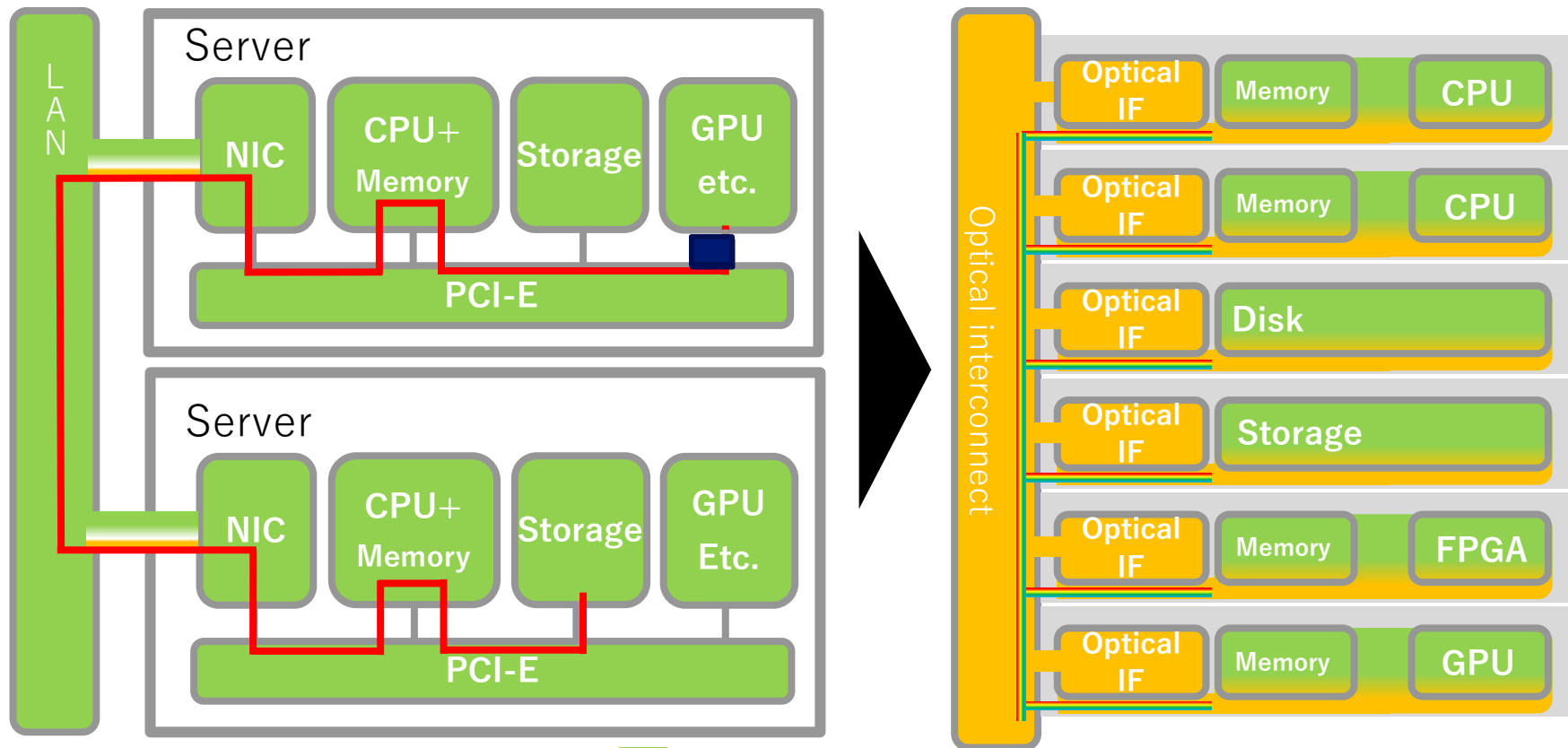


Inter-chip
connection



Photonics-electronics
convergence processor

Photonic disaggregated computing



NTT Green Innovation toward 2040



NTT is challenging to achieve conflicting objectives of "zero environmental impact" and "economic growth" by "Reduction of Environmental Impact through Business Activities" and "Creation of Breakthrough Innovation."

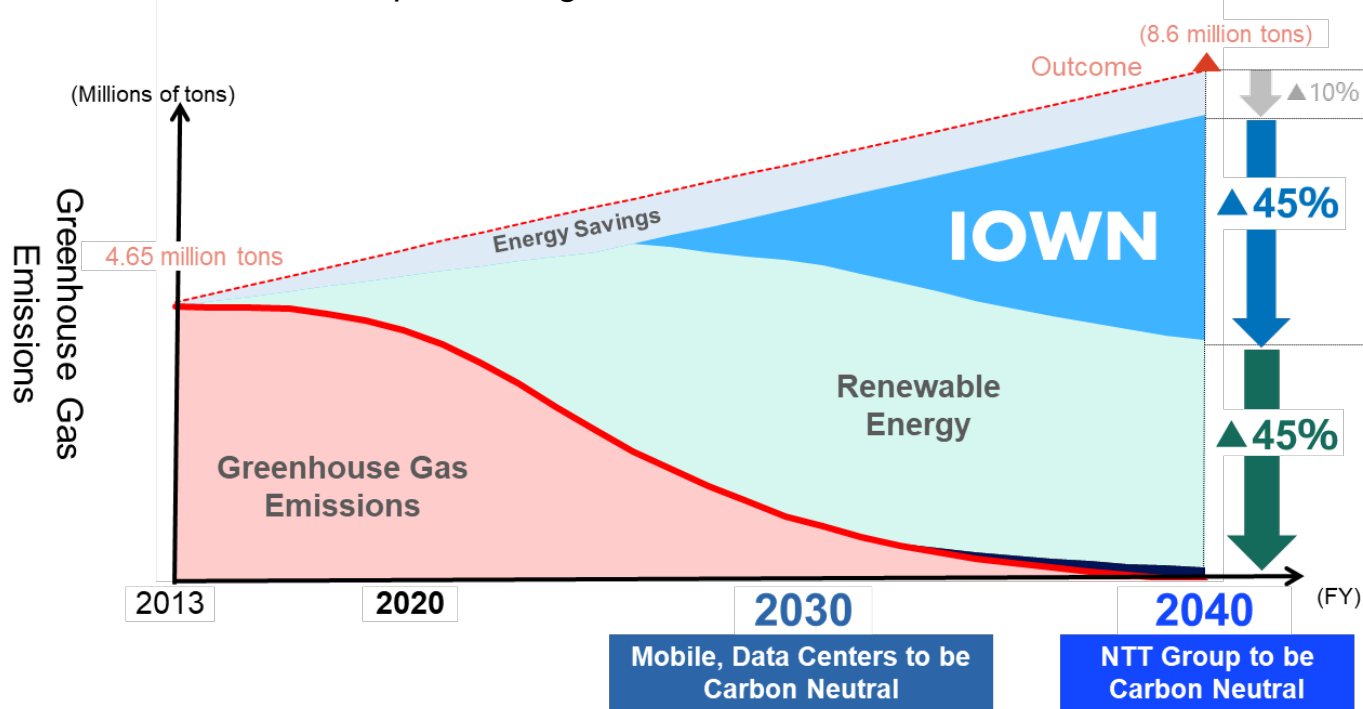


Illustration of NTT Group greenhouse gas emission reductions (domestic and overseas)

IOWN Global Forum

Global Collaboration is crucial for developing cutting-edge IOWN technologies and global eco-system



- ✓ **In January 2020, NTT, Intel and Sony established Innovative Optical and Wireless Network (IOWN) Global Forum for the future communication**
- ✓ **Global non-profit organization for developing the next generation communication and computing infrastructure with new technologies, frameworks, specifications and reference architectures**

Forum Activities

IOWN Global Forum will work on technology components and use cases for enabling a smarter world



Use cases and applications

(IOWN Global Forum vision, motivating use cases, potential business impact estimations, technology requirements)



Smart Energy



Smart Cities



Smart Mobility



Smart Finance



Smart Entertainment

More Use Cases and Applications

Technical solutions

(reference architectures, protocols, interfaces, specifications)



Networking
Optical & Wireless



Distributed
Computing



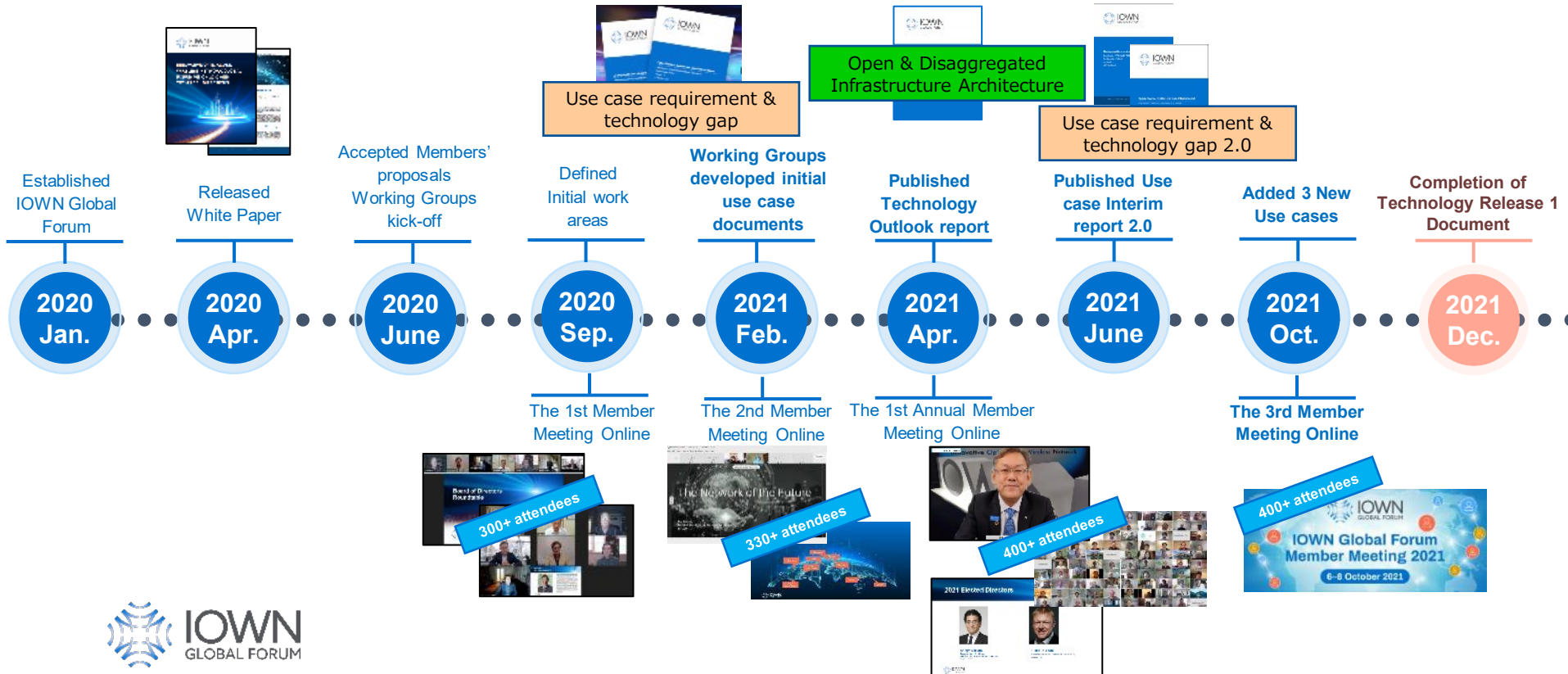
Photonics &
Optoelectronics



Devices,
Interfaces
& Terminals

More Technologies

Achievements & Plan



Available Public Resources

IOWN Global Forum System and Technology Outlook Reference Document



Introduction to a Smarter World Fact Sheet



Vision 2030: A Smarter, Better World for All Fact Sheet



Innovative Optical and Wireless Network Global Forum Vision 2030 and Technical Directions White Paper



Cyber-Physical System Use Case Interim Report



AI-Integrated Communications Use Case Interim Report



IOWN Global Forum Short & Long Videos



IOWN Global Forum members

Sponsor Members

Chunghwa Telecom	Intel	ORANGE
Ciena	KIOXIA	PwC Japan
Cisco Systems	Microsoft	Red Hat
Dell Technologies	Mitsubishi Electric	Samsung Electronics
Delta Electronics	NEC	Sony Group
Ericsson	NICT	Toyota Motor
Fujitsu	Nokia	Wistron
Furukawa Electric	NTT	
Hewlett-Packard Japan	Oracle Japan	

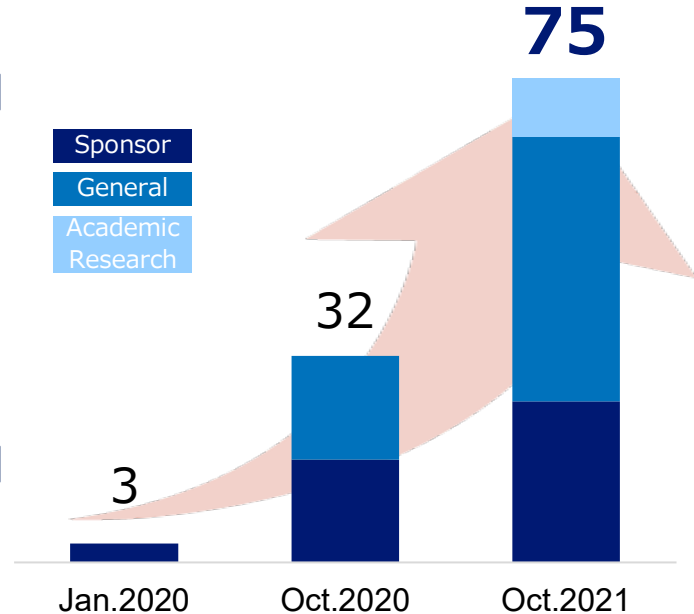
General Members

ADVANTEST	I-PEX	OKI Electric Industry
AGC	IBIDEN	Peers
AIOCORE	Infinera	Santec Corporation
AJINOMOTO	IP Fusion	SENKO Advanced Components
ANRITSU	ITOCHU Techno-Solutions	Shin-Etsu Chemical
Avago Technologies	JGC Japan	SKY Perfect JSAT
Deloitte Tohmatsumu	Juniper Networks	Sumitomo Corporation Kyushu
Dentsu	KYOTO SEMICONDUCTOR	Sumitomo Electric Industries
DIC	Keysight Technologies	TELEFÓNICA
EXEO Group	MIRAIT	Toshiba
Fujikura	MIRISE Technologies	Toyo Ink SC Holdings
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 National Research Institute for Earth Science and Disaster Resilience (NIED)
 National Institute of Informatics (NII)
 Photonics Electronics Technology Research Association (PETRA)
 Photonics Industry & Technology Development Association (PIDA)
 Tohoku University

As of Oct. 4, 2021



Thank you for your attention

IOWN

Get Smarter with No Carbon!