Paul Doolan, Chair of WP2/15, ITU-T SG15

Paul has been involved in standards development for over 25 years in organizations including IETF, BBF, OIF and ITU. He made his first contribution to standardization in the ITU in 1998. In SG15 he has served as editor for several Recommendations, as Associate Rapporteur of Q12/15 and as Vice Chair of WP2/15.

Paul is currently serving as a senior consulting expert for Optical Standards at the Hong Kong Research Center of Huawei.

ITU Workshop on “Future Optical Networks for IMT2030, AI, broadband and more”

Arcs de Seine, Quai du Point du Jour,
Boulogne-Billancourt, France

12 June 2025, 15:30 - 18:00 CEST

Paul Doolan
Chairman ITU-T SG15 WP2
HK research centre of Huawei

Workshop series

	Montreal	Hong Kong	Paris
Tracks/topics	• Review of SG15 work in support of IMT-2020/5G • ITU-R work on IMT-2030/6G • Operator presentations	• Physical Layer (B800G WDM, ROADM/OXC and DFOS etc.) • OTN Layer (B1T OTN and intelligent networking etc.) • Synchronization and Generation Definition (Resiliency, computing and IOT2030)	• ION-2030 • AI • Synchronization (AI) • Future optical networks (access)
Panel composition	8 presenters (6 operators)	12 presenters (3 external, 2 academics, 9 SG15, 1 operator)	6 presenters (2 academics, 2 operators)
Geographic coverage	North America, Asia, Europe	North America, Asia, Europe	North America, Asia, Europe (SA?)

Montreal workshop

- Three tracks:
  - Review of SG15 work in support of IMT-2020/5G
  - ITU-R work on IMT-2030/6G
  - Operator presentations
    - Telus
    - AT&T
    - NTT
    - China Mobile
    - BT
    - China Unicom
- 8 presenters (6 operators)

Common themes from Network operator presentations

- It was recognized that the access/transport network, including physical optical network infrastructure, will be a critical resource in the IMT-2030/6G network and stability of operator physical infrastructure is very important.
- Every effort should be made to coordinate the evolution of the access/transport network with the anticipated requirements of the IMT-2030/6G network.
- Power consumption and efficient use of network resources will be a critical factor in the deployment of IMT-2030/6G
- The IMT-2030/6G network will be required to support ubiquitous high bitrate low latency services.
  - The amount of equipment required to support this demand means that power efficiency will be an important consideration.
- Both the peak bitrate and connectivity required to support IMT-2030/6G services will vary over a typical day.
  - To make efficient use of the access/transport infrastructure the connections (network slices) provided by the access/transport network should be modified to track the demand patterns.
  - To minimize power consumption unused interfaces should be powered down when demand is low.
- The complexity and size of the network and the anticipated near constant “churn” to track demand patterns will require a high degree of automation.
  - This will require close coordination of the actions of the access/transport management systems with the shifting demand patterns observed by the IMT-2030/6G management systems.
  - It was suggested that AI/ML could play an important role in this coordination.
- SG15 should play a leading role in defining the access/transport network for IMT-2030/6G.
  - The experience gained by SG15 in supporting IMT-2020/5G (e.g. collaboration with other SDOs; understanding terminology used by other SDOs), should be applied to work on IMT-2030/6G.
  - SG15 has the opportunity to create a Focus Group to further study the impact of IMT2030/6G on transport networks.

Hong Kong workshop

- Three tracks:
  - Physical Layer (B800G WDM, ROADM/OXC and DFOS etc.)
  - OTN Layer (B1T OTN and intelligent networking etc.)
  - Synchronization and Generation Definition (Resiliency, computing and IOT2030)
- 12 presenters (3 external, 2 academics, 9 SG15, 1 operator)

Presenter's summaries

- It was recognized that the access/transport network, including physical optical network infrastructure, will be a critical resource in the IMT-2030/6G network and stability of operator physical infrastructure is very important.
- Optical infrastructures are vital for our society and economy
- SG and 6G are leading to new developments = opportunities & risks
- Standardization is the key for operators and industry to mitigate these risks
- ITU-T (and Q6😊) are at the forefront of this evolution, developing standards for key enabling technologies
- Fiber optic sensing is not new, but doing it on a telecom network is,
- Exciting applications are demonstrated by operators and continue to evolve
- Standardization helps create a healthy ecosystem to bring down costs
- ITU-T started the first DFOS standard (G.dfos) for telecom applications. Study of DFOS for access also started. Many open points to be addressed
- Integration of sensing functionality will increase the value of deployed optical network. In addition, it may help to ensure reliable operation of high-capacity optical networks.
- Preliminary experiments have shown the possibilities. Further study is still necessary to choose the best approach.
- Many potential applications have been demonstrated with many future opportunities.
- Dr Liu reminded us of the four overarching design principles common to all the IMT-2030 usage scenarios.
- Mr Bett's 'high level vision'
- Q13 – G.Suppl.DCSync (wip that started in Montreal)
- Potential utility of ETSI and the Networld SRIA materials

Paris objective

This ITU Workshop aims to discuss with the industry and our global society the progress made in ITU-T SG15 to support emerging applications — such as IMT-2030, AI, data center interconnections, and broadband access—through enabling optical network architectures and technologies. This includes discussion of the framework and overall objectives for the future optical networks, currently underdevelopment in ITU-T SG15 and provisionally called International Optical Networks towards 2030 and Beyond (ION-2030).

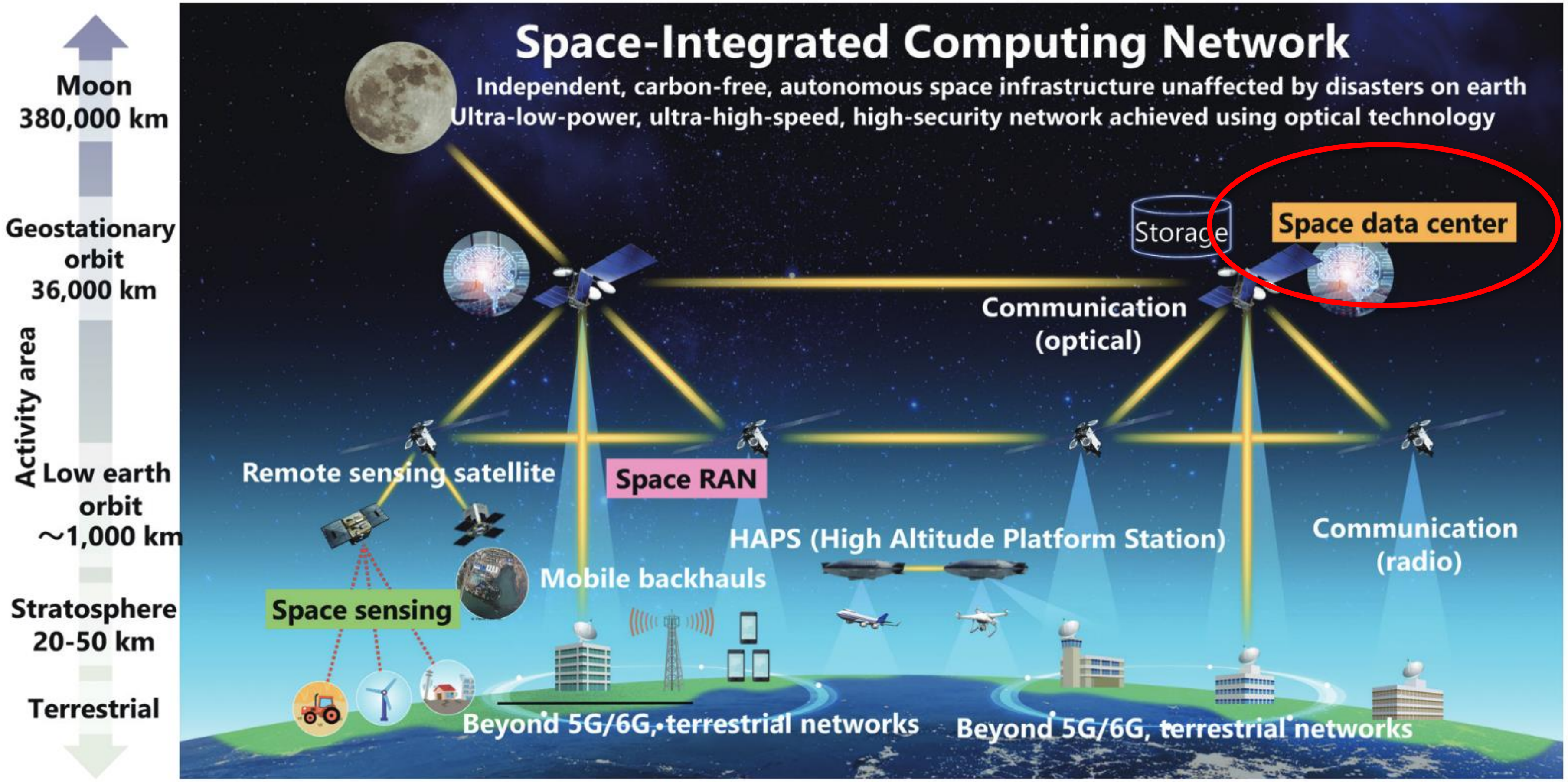
Which one is more responsible?

	Centralized	Distributed
Security	Long path between user and GPU with multiple IP hops Encrypted Internet communication	Short path between user and GPU with physical channel isolation via Fiber or wavelength, optical encryption, quantum cryptography
Energy	Huge energy requirements in central locations Increased power consumption in transport networks due to new capacity and cooling demands in multiple IP hops	Energy consumption distribution in multiple locations Optimization techniques based on GPU sharing between telecom real time services and AI training
Survivability	Susceptible to catastrophic failures affecting large regions	Distributed computing systems are resilient to catastrophic failures
Telecom Resources	Huge impact in e2e packet and optical networks access, metro, backbone and international networks.	Minor impact on packet networks Significant traffic increase in optical networks Traffic matrix coul be defined by Telecom operator

Juan Pedro Fernandez-Palacios Gimenez

Telefónica

See also: WD06-11 Considerations of optical transmission technology in the distributed intelligent computing datacenter networks



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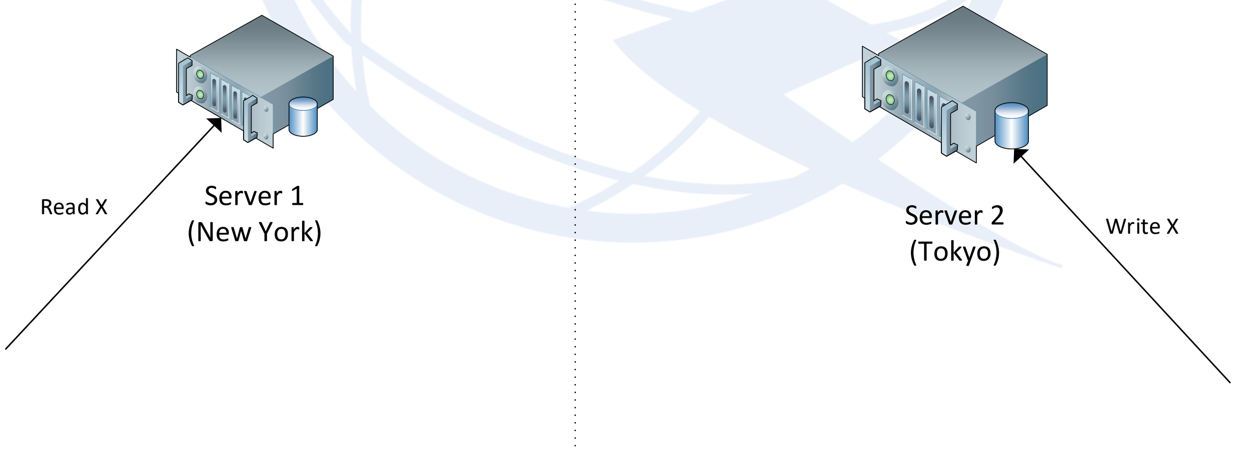
Distributed Databases

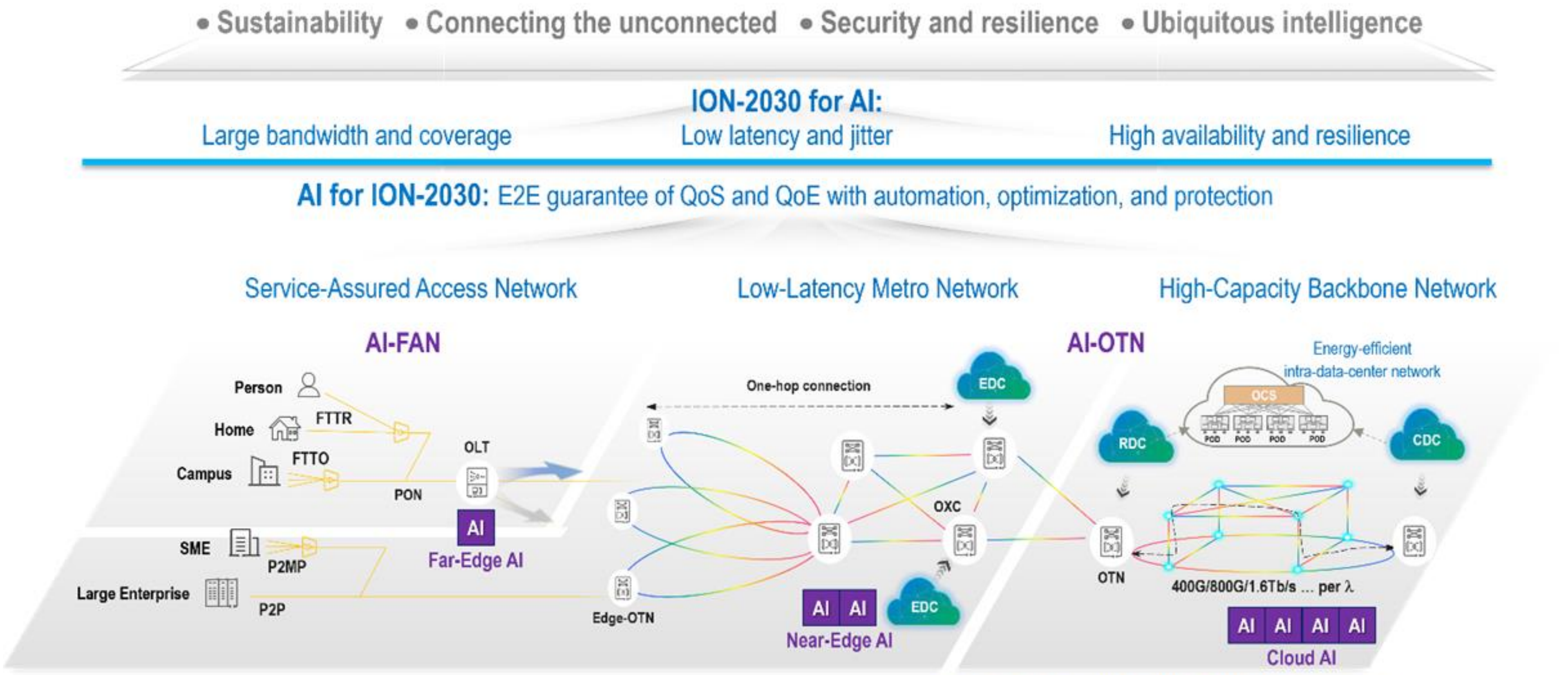
Use Cases and Requirements for Time Sync in Data Centers

- **Scalable Databases**
  - Scalable Databases with lock-free distributed read transactions based on an API that exposes time uncertainty. Utilize time synchronization to achieve external consistency of distributed transactions.
- **Accuracy requirements**
  - Upon a read transaction, a server must wait a period equal to the time uncertainty. To avoid this being the bottleneck, the time uncertainty should be lower than the network delay and processing time. Absolute time accuracy is a must.



Bar Shapira - NVIDIA

From Distributed Database to Distributed AI



Source: wd1214-56, Multi-company

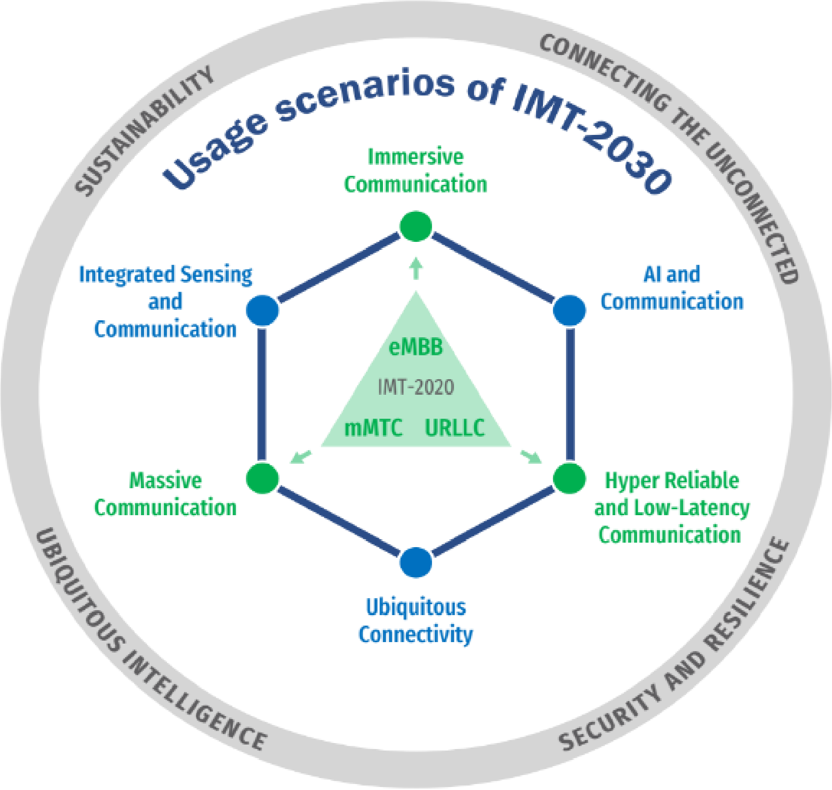
Key performance indicators

	Target KPI		Current	Short-term Evo	Mid-term Evo	Long-term Evo
			2024	~2027	~2030	~2033
Metro/Core Networks	Aggregated Spectrum[1]		10 THz	20 THz	40 THz	100 THz
	Port speed[2]		800 Gbps	1.6 Tbps	3.2 Tbps	6.4 Tbps
	Bandwidth[3]		<150 GHz	<300 GHz	<600 GHz	<1.2 THz
	Line capacity[4]		50 Tbps	200 Tbps	600 Tbps	2 Pbps
	Node capacity[5]		300 Tbps	1.2 Pbps	3.6 Pbps	12 Pbps
	FSO Feeder capacity[6]	HAP	N/A	50 Gbps	100 Gbps	200 Gbps
		LEO sat.	N/A	100 Gbps	400 Gbps	800 Gbps
		GEO sat.	N/A	10 Gps	20 Gbps	100 Gbps

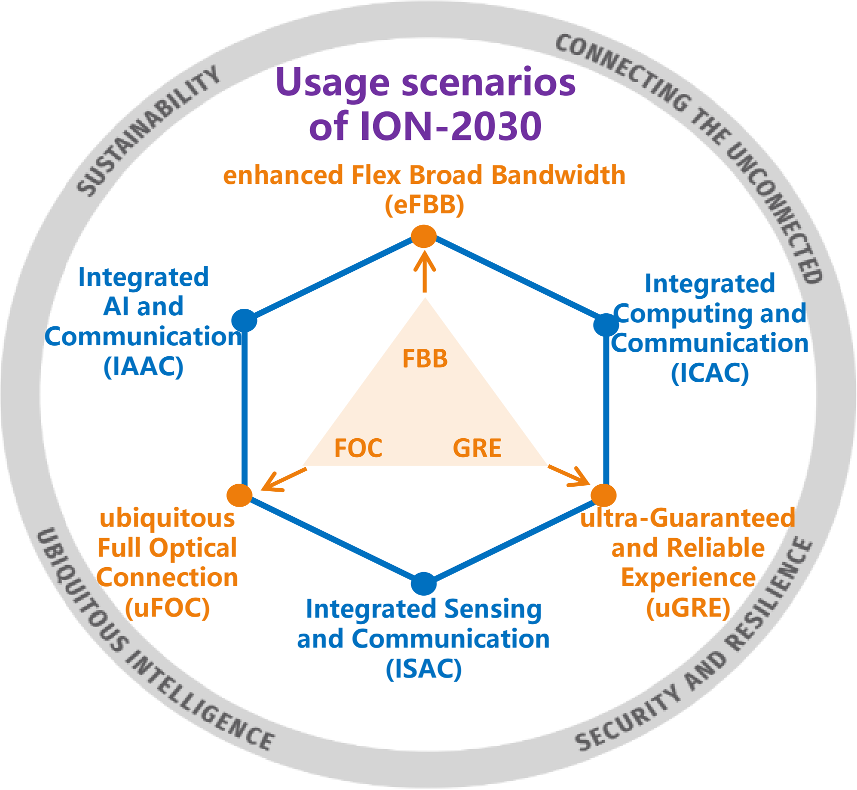
- [1] 25% CAGR, in line with conservative traffic predictions. Assumes spectrum for a single core SMF. In likely future spatial-multiplexed systems (multicore, or fiber bundles), this value can be split across the available cores.
- [2] From predictions of Ethernet roadmap 2023 and extrapolation further
- [3] Indicative values, using 400G DP-16QAM) as baseline. Should be tuned to choice of the modulation format and split across multiple spectral slots in case spatial division multiplexing is used.
- [4] 50% CAGR, in line with internet content provider traffic predictions. Assumes exploitation of frequency and space domain.
- [5] Based on degree 4 node with 50% local add/drop
- [6] Cross-atmospheric optical link for ground-to-satellites and ground to high altitude platforms, assuming 25% CAGR. New technology. Actual growth rate shall be corrected over time by technological readiness more than by traffic needs.

Progress made (non exhaustive)

- GSTR.ION-2030 - Technical Report on International Optical Networks towards 2030 and Beyond
- G. Suppl.DCSync - ITU-T G Suppl.DCSync Synchronization for Data Centres
- G.dfos - Distributed fibre optic sensing system for terrestrial optical transmission system
- G.fso - Terrestrial free space optics for mobile backhaul with short reach interfaces
- GSTR.ENO - Technical report on enhanced network operations for transport networks
- G.suppl.VHSP - PON transmission technologies above 50 Gb/s per wavelength
- Study points – e.g power saving in Q12 LL
- New ITU Sector members join the activity



Usage scenarios of IMT-2030
SUSTAINABILITY
CONNECTING THE UNCONNECTED
UBIQUITOUS INTELLIGENCE
SECURITY AND RESILIENCE
Immersive Communication
Integrated Sensing and Communication
AI and Communication
eMBB
IMT-2020
mMTC
URLLC
Massive Communication
Hyper Reliable and Low-Latency Communication
Ubiquitous Connectivity



Usage scenarios of ION-2030
SUSTAINABILITY
CONNECTING THE UNCONNECTED
UBIQUITOUS INTELLIGENCE
SECURITY AND RESILIENCE
enhanced Flex Broad Bandwidth (eFBB)
Integrated AI and Communication (IAAC)
Integrated Computing and Communication (ICAC)
FBB
FOC
GRE
ubiquitous Full Optical Connection (uFOC)
ultra-Guaranteed and Reliable Experience (uGRE)
Integrated Sensing and Communication (ISAC)

Thank you!