EPSRC
Engineering and Physical Sciences Research Council

Li-Fi Centre

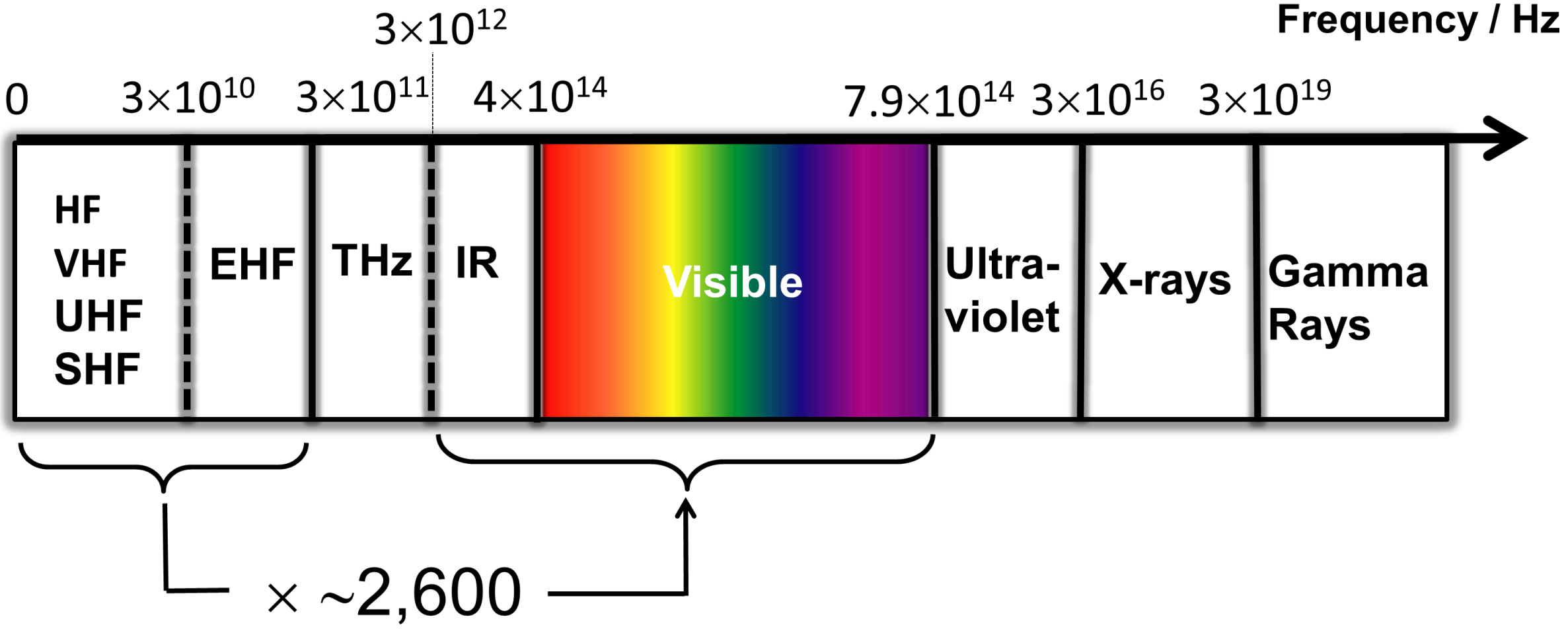
University of Strathclyde Engineering

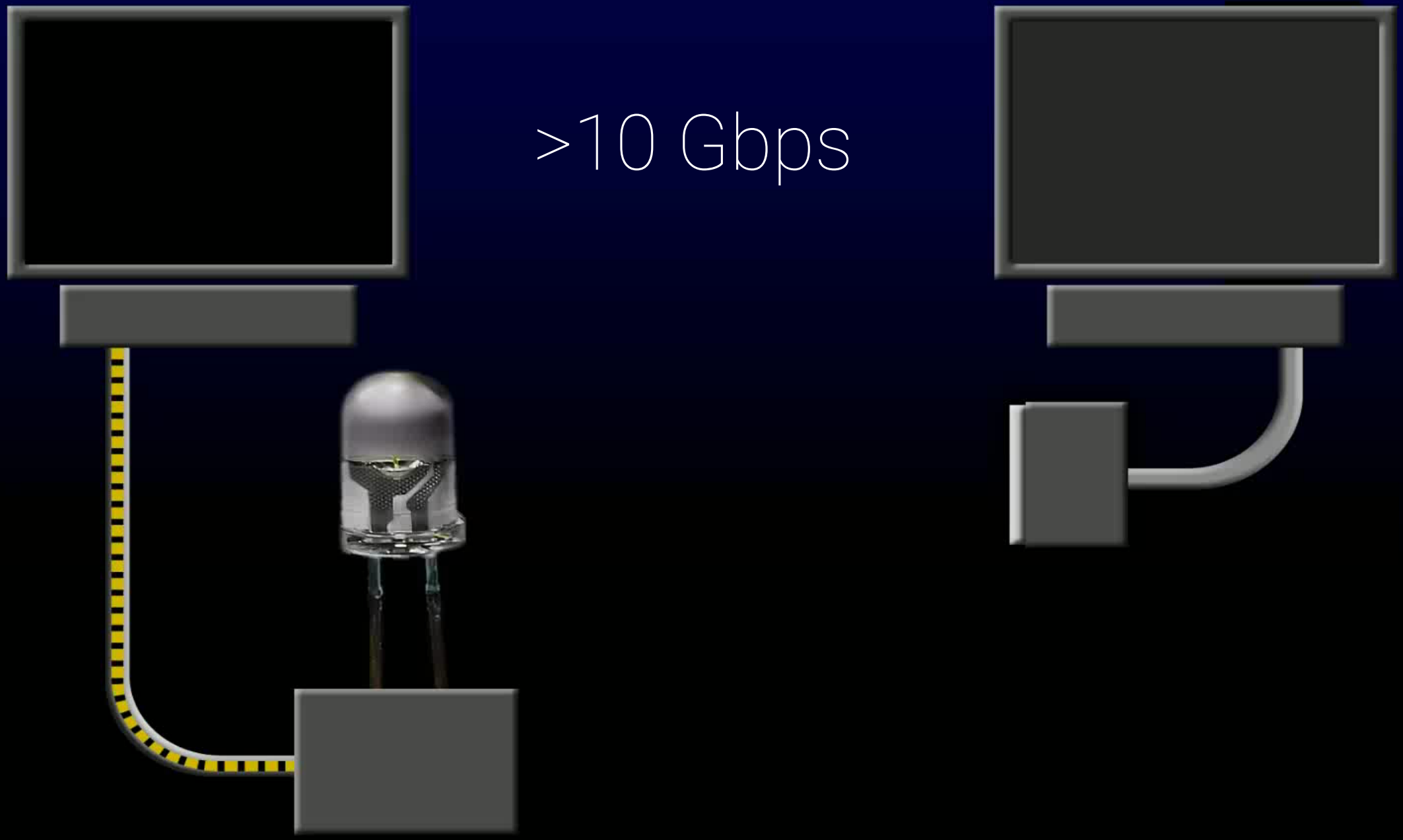
The Role of LiFi in 6G

Professor Harald Haas

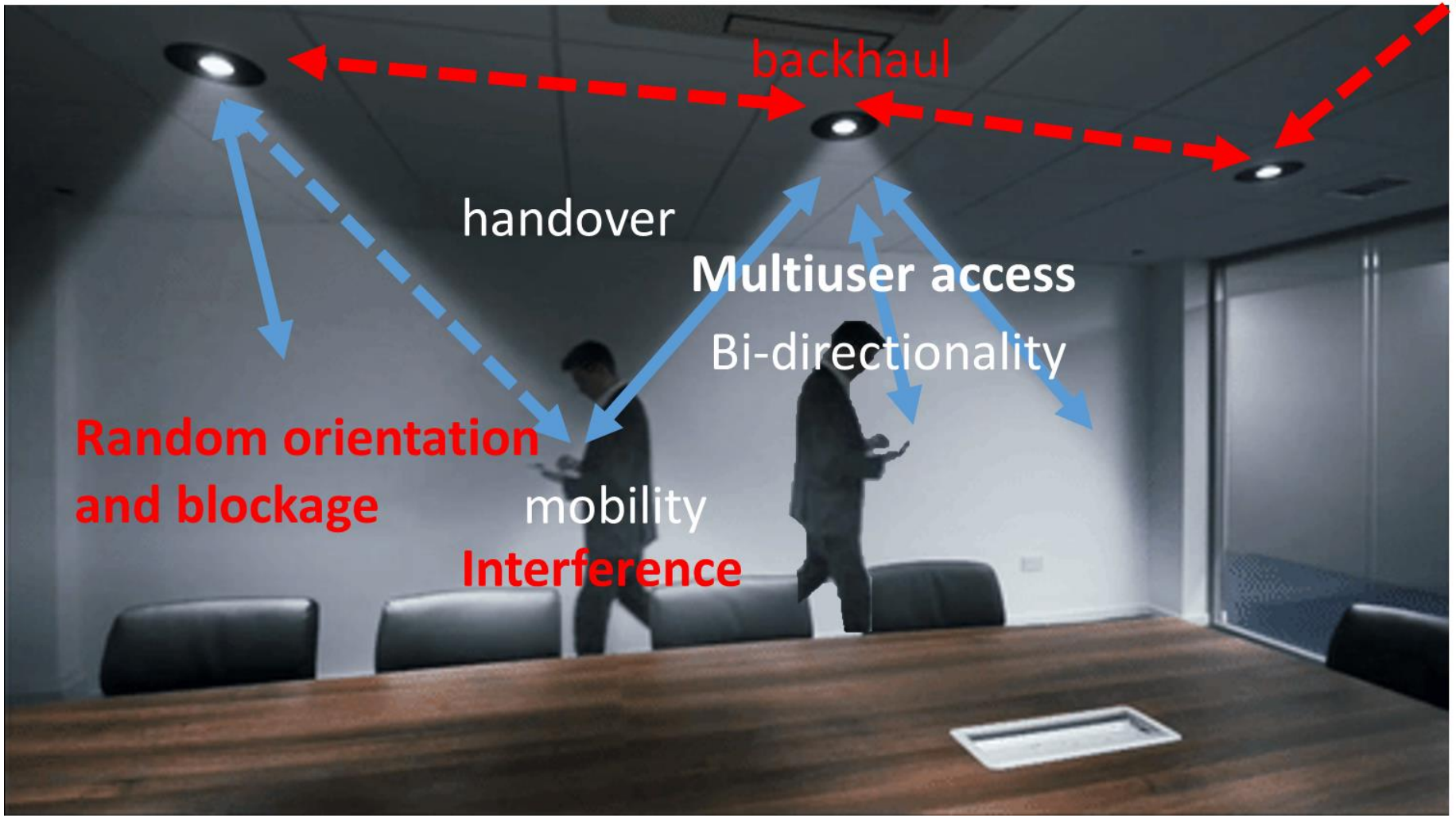
Source: ESA

New unregulated spectrum

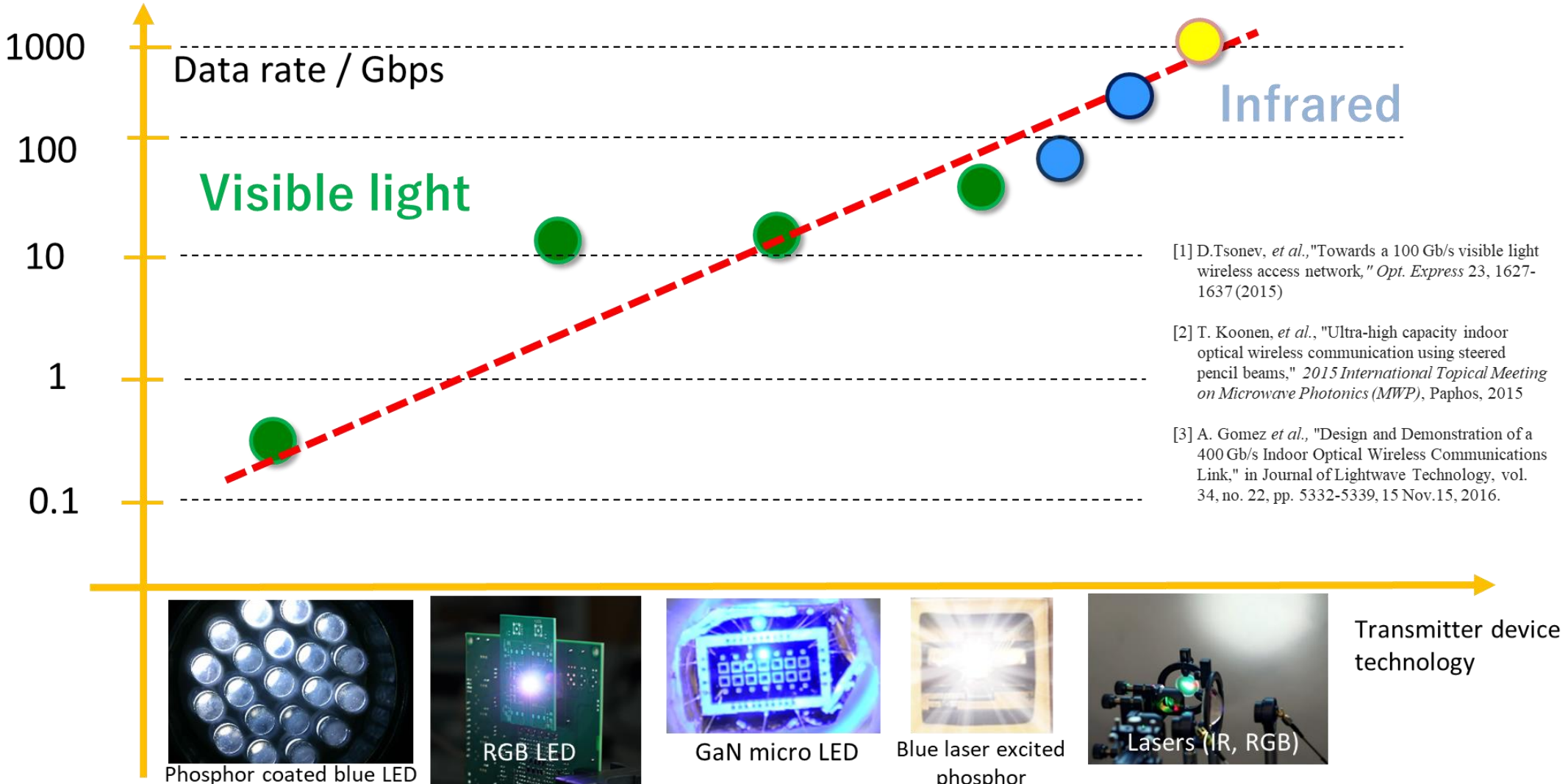



>10 Gbps

LiFi Networking



Devices are already available



[1] D.Tsonev, *et al.*,"Towards a 100 Gb/s visible light wireless access network," *Opt. Express* 23, 1627-1637 (2015)

[2] T. Koonen, *et al.*, "Ultra-high capacity indoor optical wireless communication using steered pencil beams," *2015 International Topical Meeting on Microwave Photonics (MWP)*, Paphos, 2015

[3] A. Gomez *et al.*, "Design and Demonstration of a 400 Gb/s Indoor Optical Wireless Communications Link," in Journal of Lightwave Technology, vol. 34, no. 22, pp. 5332-5339, 15 Nov.15, 2016.

Terabit Bidirectional Multi-user Optical Wireless System (TOWS) for 6G LiFi

Li-Fi Centre

TOWS TERABIT OPTICAL WIRELESS SYSTEM

University of Strathclyde Engineering

Our vision is to develop and experimentally demonstrate multiuser Terabit/s optical wireless systems that offer capacities at least two orders of magnitude higher than the current planned 5G optical and radio wireless systems, with a roadmap to wireless systems that can offer up to four orders of magnitude higher capacity.

First UK 6G project; paradigm shift from radio to optical, indoor

UKRI Engineering and Physical Sciences Research Council

April 2019 – March 2024, £6.6M project

University of Leeds

University of Strathclyde

The University of Edinburgh

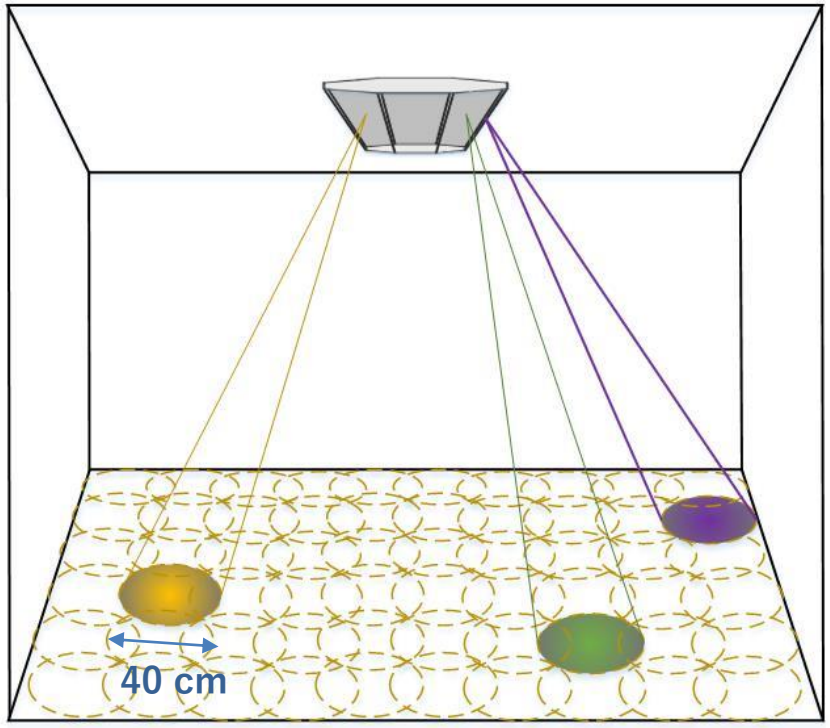
University of Bath

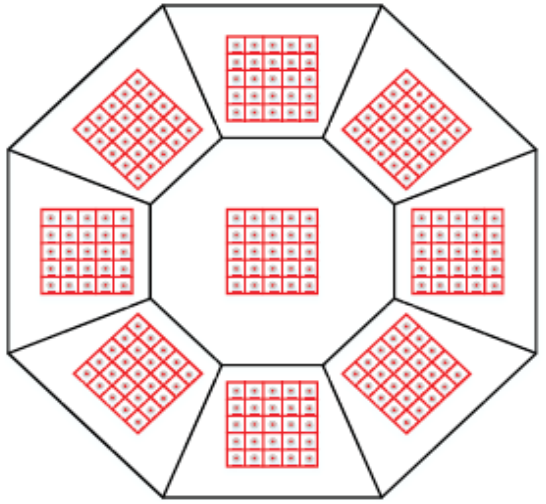
University of Cambridge

Access point architecture

Objectives:

- The access points (APs) need to cover the entire indoor area.
- The APs are required to provide greater than 1 Tb/s aggregate data rate (at least 10 Gb/s per user).
- Each AP needs to be structured such that the inter-beam interference is minimized.



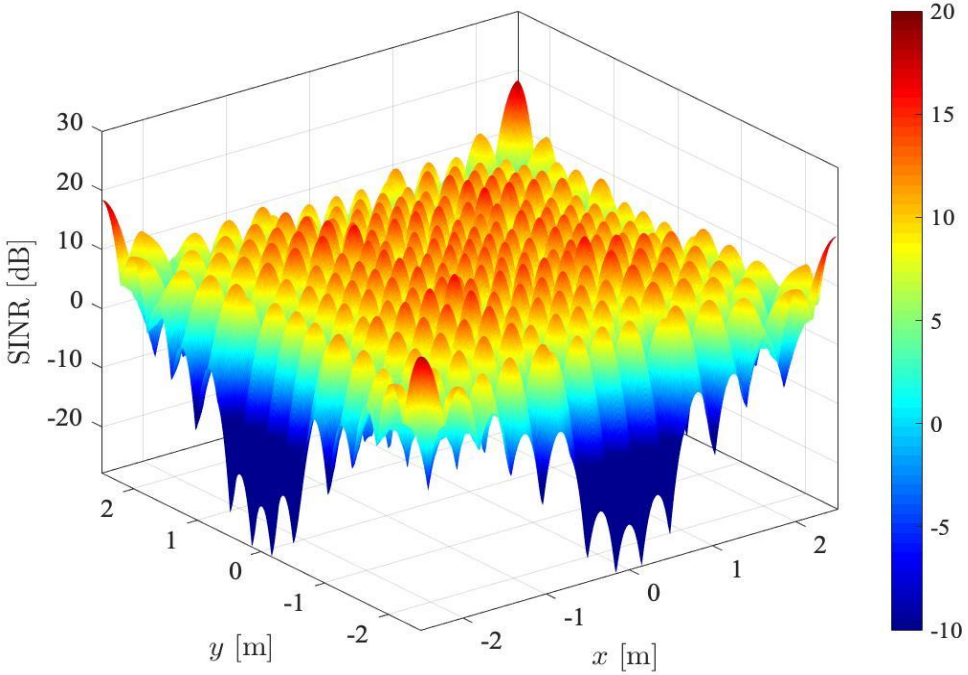


An array of arrays of VCSELs (in total: 225, bandwidth 5 GHz) (top view).

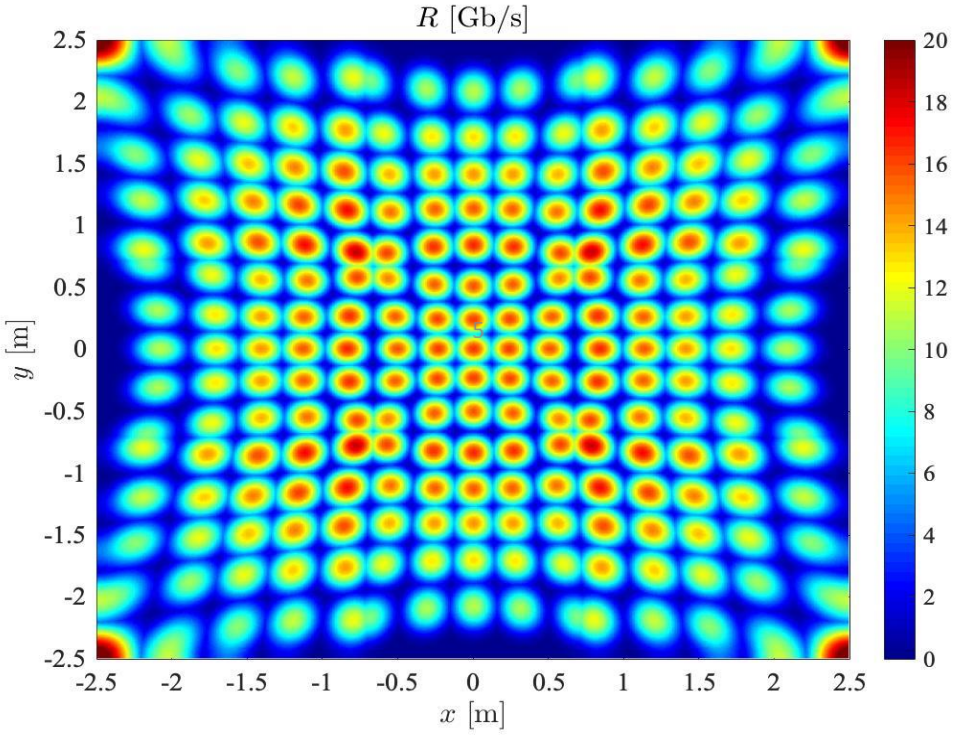
[1] E. Sarbazi, H. Kazemi, M. Dehghani Soltani, M. Safari and H. Haas, "A Tb/s Indoor Optical Wireless Access System Using VCSEL Arrays," *2020 IEEE 31st Annual International Symposium on Personal, Indoor and Mobile Radio Communications*, London, United Kingdom, 2020, pp. 1-6, doi: 10.1109/PIMRC48278.2020.9217158.

Data rates

Spatial distribution of SINR at $z = 3\text{m}$



Spatial distribution of R at $z = 3$ m



10 mW	8 mW	10 mW
8 mW	7 mW	8 mW
10 mW	8 mW	10 mW

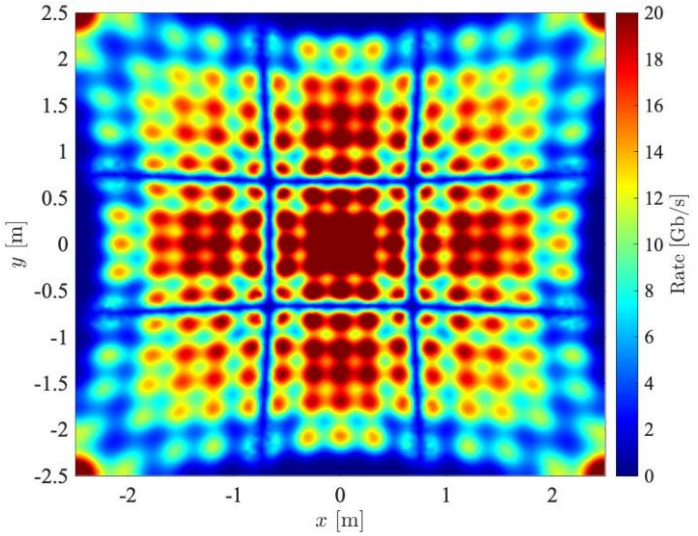
$P_{\text{Total}} = 1.975$ W

$R_{\text{Aggregate}} > 2.25$ Tb/s

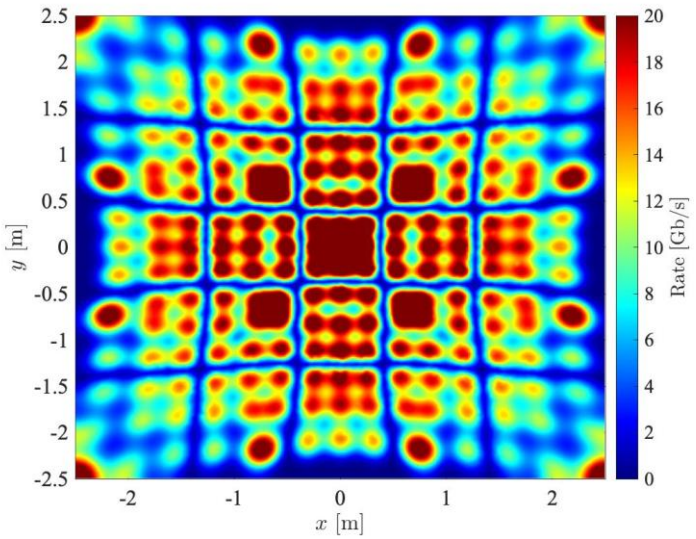
[1] E. Sarbazi, H. Kazemi, M. Dehghani Soltani, M. Safari and H. Haas, "A Tb/s Indoor Optical Wireless Access System Using VCSEL Arrays," *PIMRC*, London, United Kingdom, 2020, pp. 1-6

Beam clustering

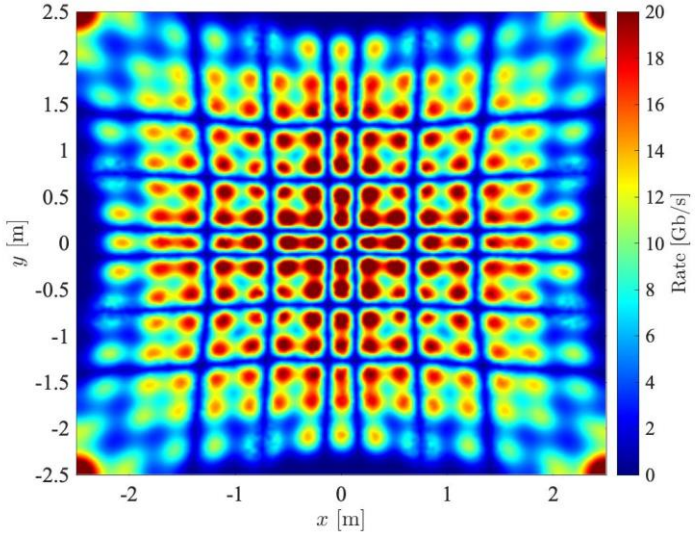
Scenario 1



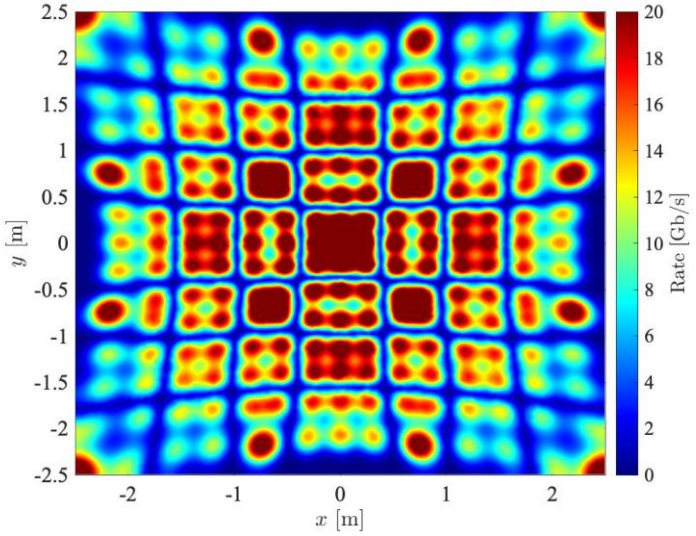
Scenario 2



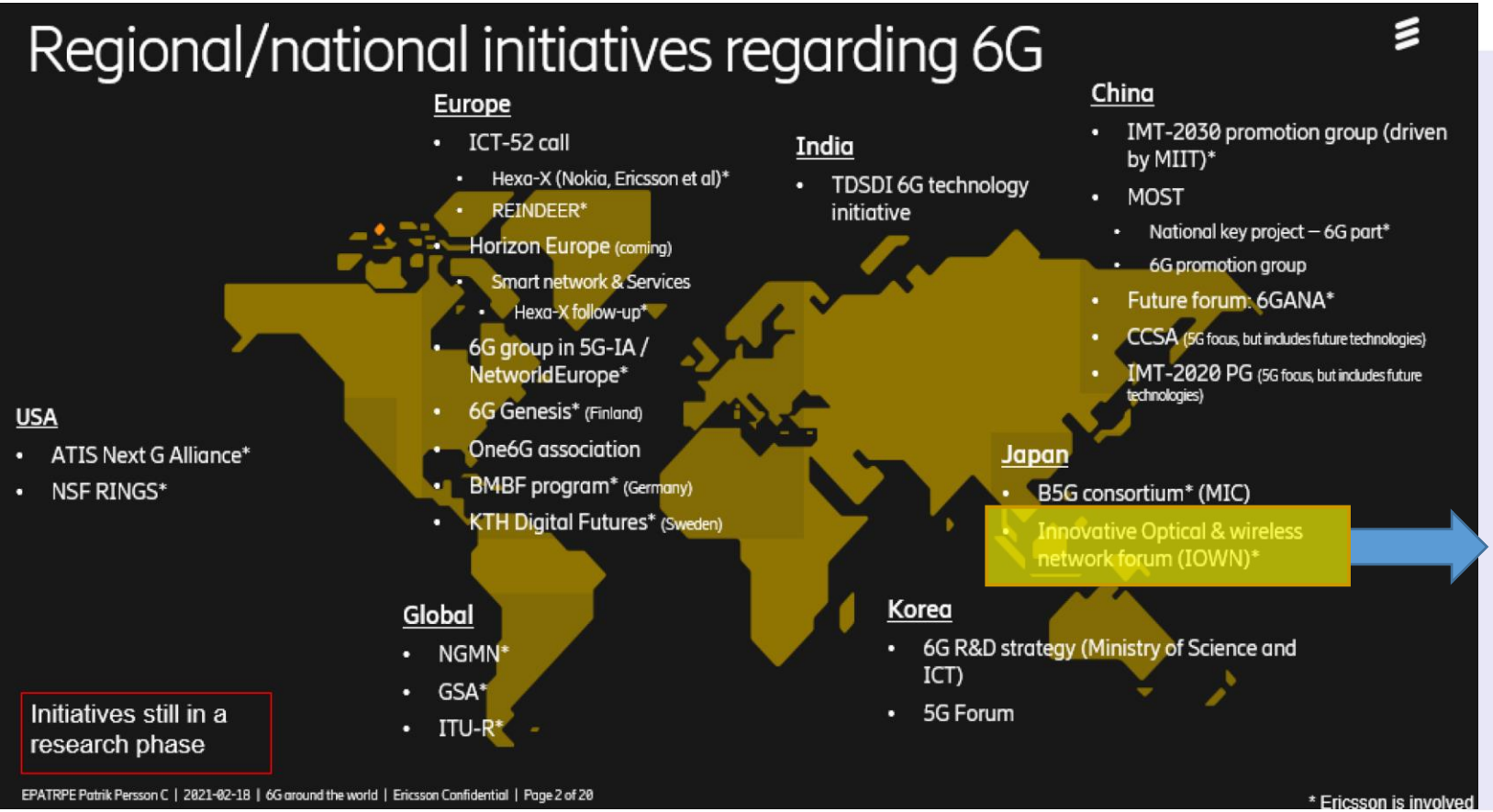
Scenario 3



Scenario 4

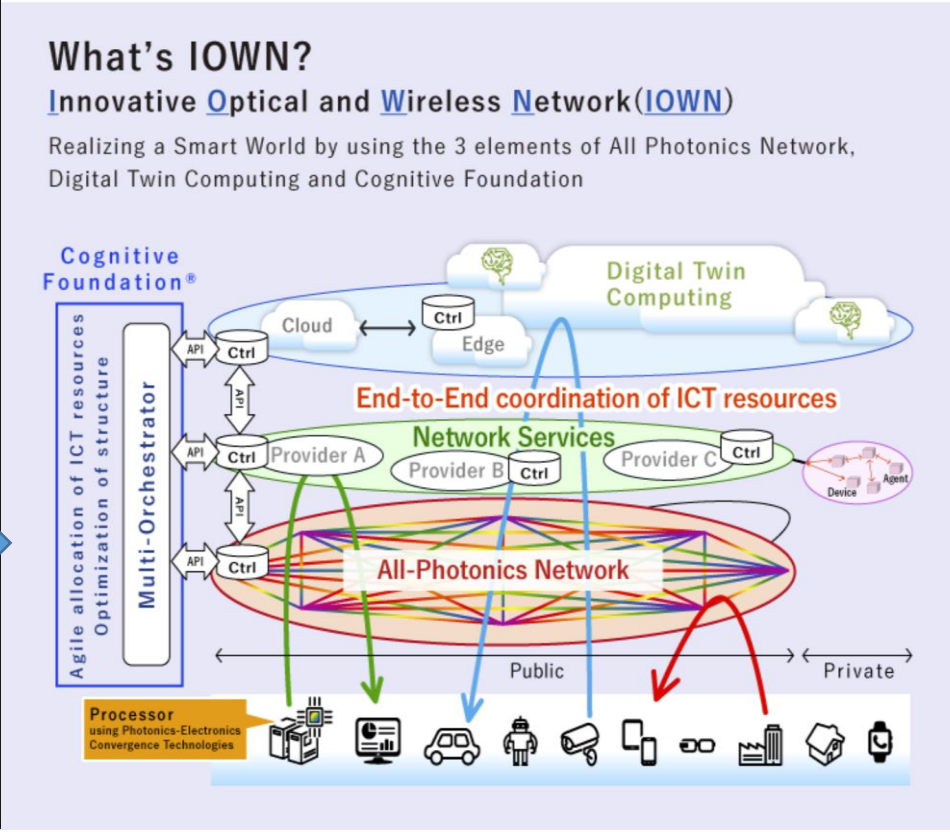


6G global initiatives



Source: Dr. Mallik Tatipamula, Ericsson

NTT R&D

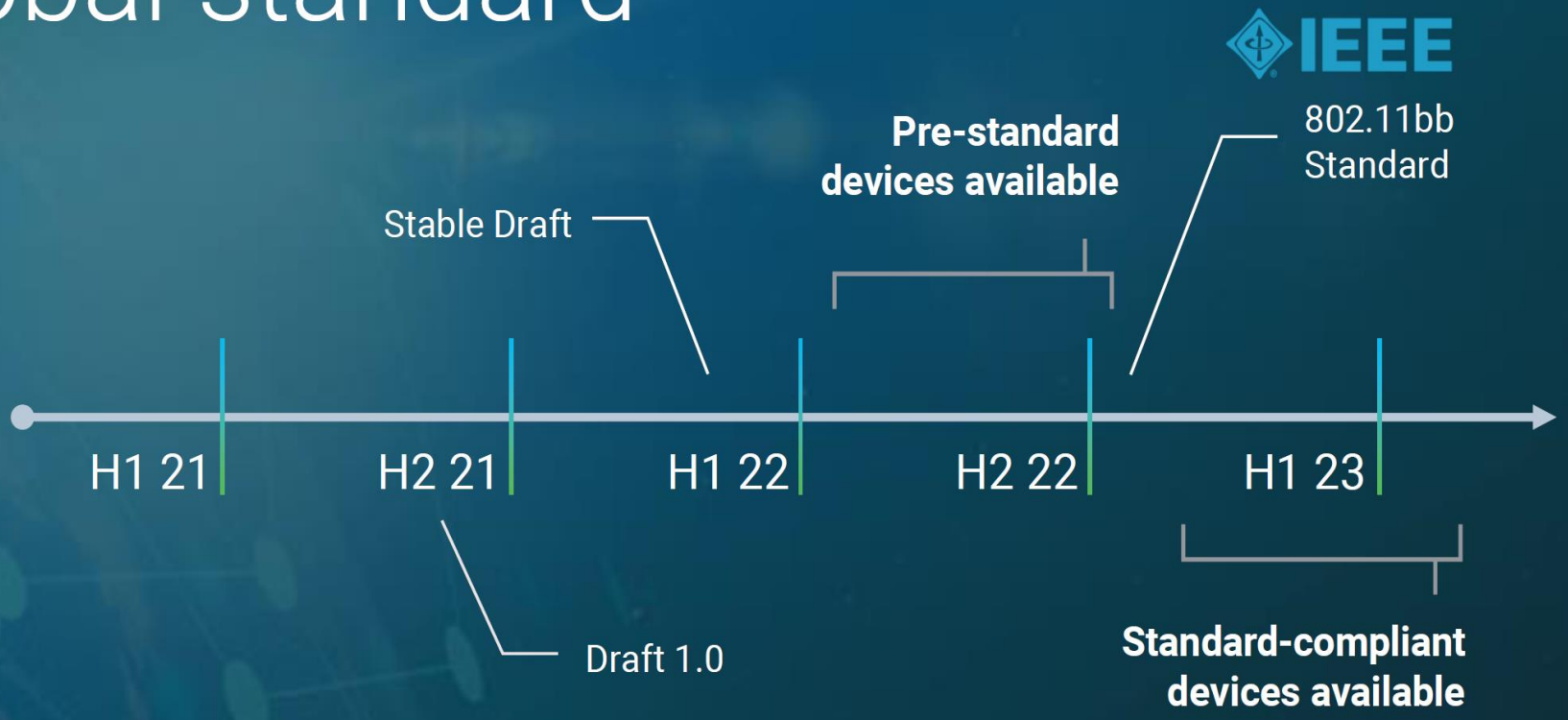


https://www.rd.ntt/e/iown/

The new global standard

pureLiFi chairs the IEEE 802.11bb Task Group **standardising LiFi**

- LiFi will **interoperate with WiFi**
- LiFi can **take advantage of billions of WiFi baseband integrations** with little or no modification



pureLiFi co-founded the **Light Communications Alliance** to foster technology promotion & industry coordination.

Light technology firm strikes deal with US Army

28 April

PURELIFI

The Kitefin li-fi system harnesses the light spectrum to transmit data securely.

Scottish high-tech firm pureLiFi has announced a multi-million dollar deal t supply the US military with an optical wireless communication system.

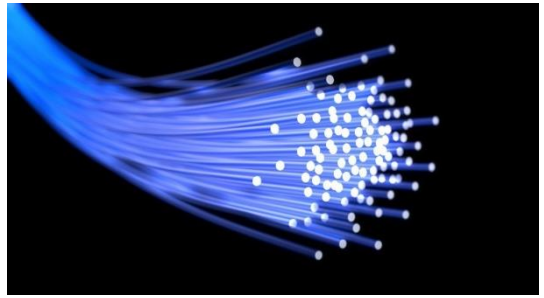
The Kitefin li-fi system harnesses the light spectrum rather than radio frequencies to transmit data securely.

The deal with the United States Army Europe and Africa is the world's first large-scale deployment of li-fi technology, according to the company.

PureLifi said $4.2m (£3m) had been invested in the deployment.

Summary

- There are optical devices that can be used now to build Tbps wireless networks.
- Use of optical spectrum to build future wireless networks with significantly improved user experience and security
- LiFi will play major role in 6G and will support vision of all-optical networking
- 6G Paradigm shift: Convergence of optical fibre and wireless



(credit: ProMotion/ fotolia)