



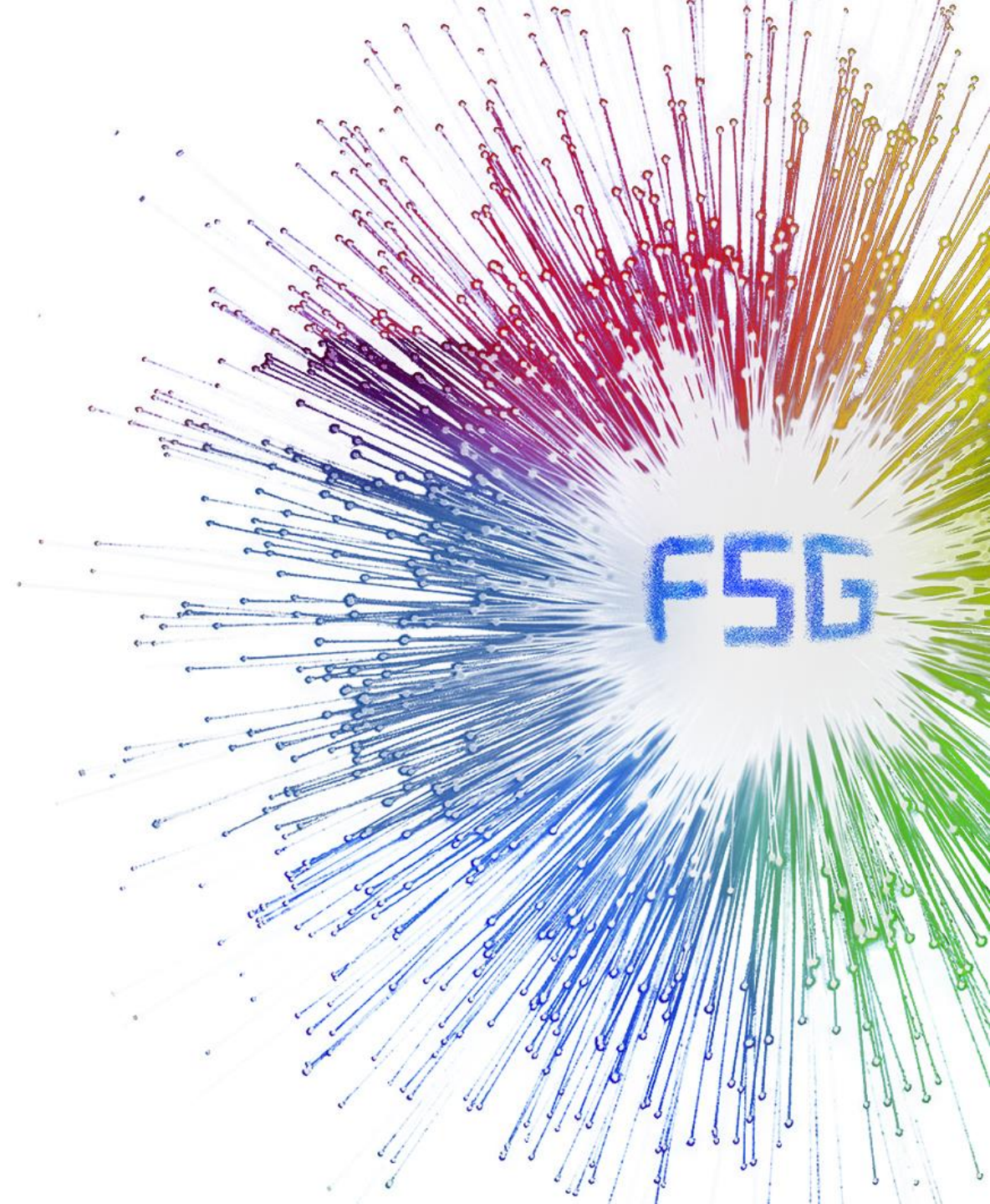
Evolution to F5G-Advanced and F6G Networks & Services

China Communications Standards Association
(CCSA) Workshop on Optical Communications

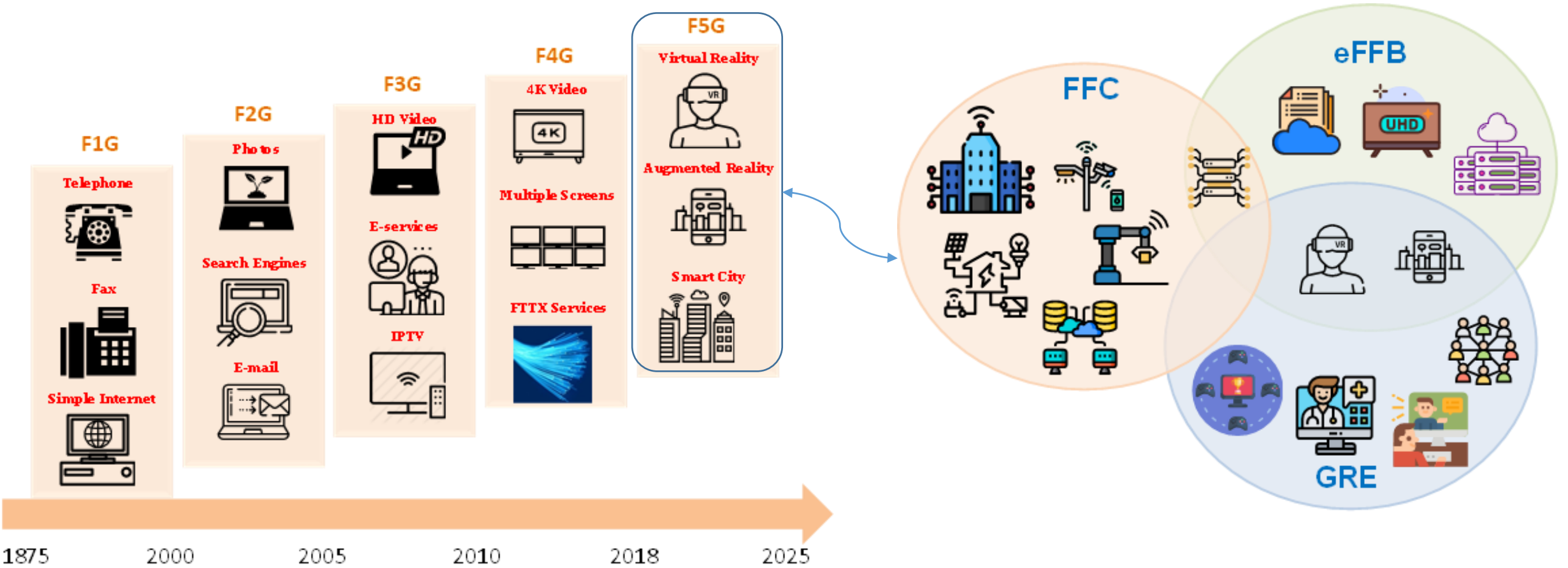
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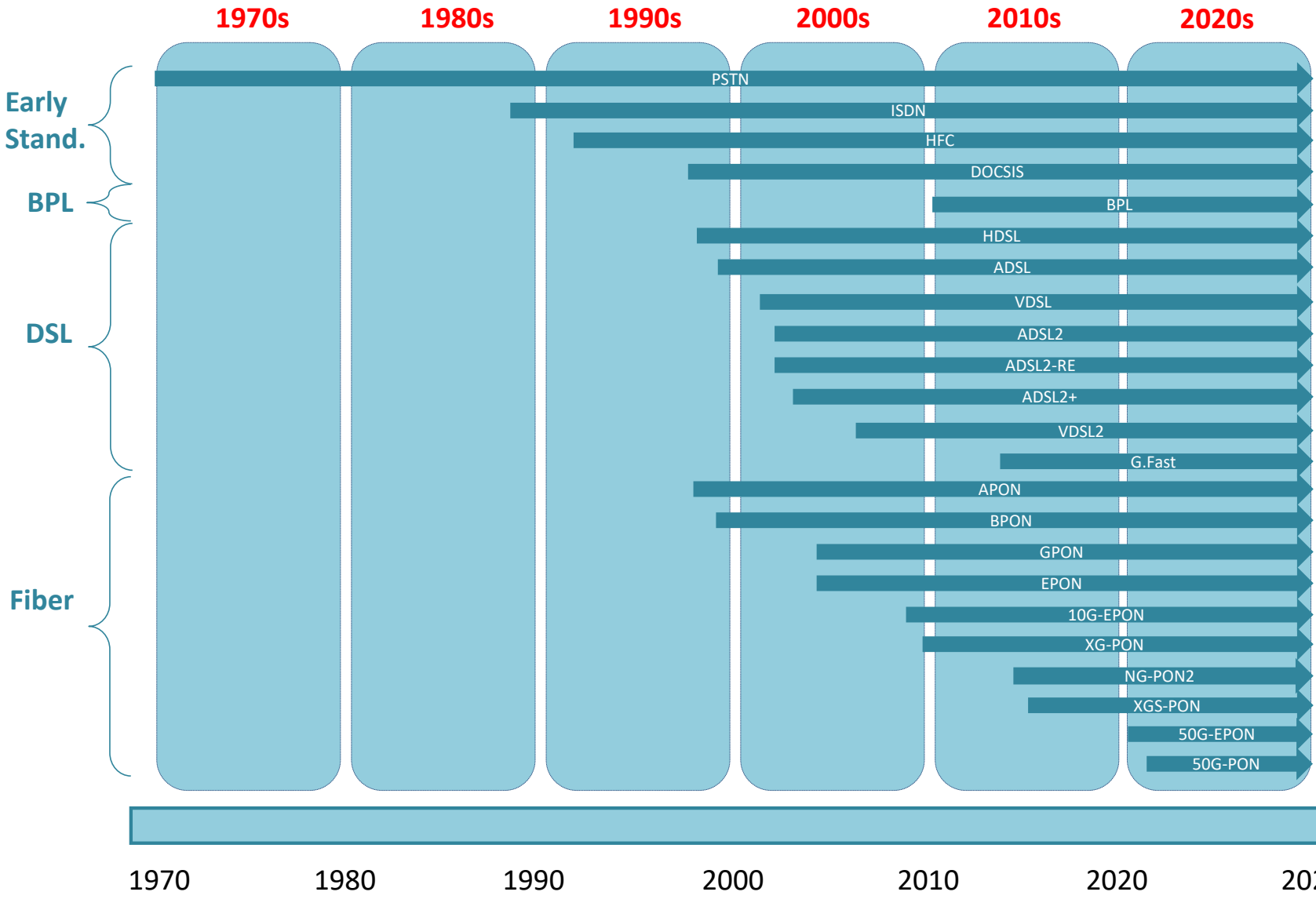
Evolution of Fixed Access Networks: Applications



- The Generations of the Fixed Networks, as has been the case for the Mobile Networks, follow the needs of the end users and the requirements of the services that are offered to them

“Fifty years of fixed optical networks evolution: A survey of architectural & technological developments in a layered approach”
Dimitris Uzunidis, Michael Logothetis, Alexandros Stavdas, David Hillerkuss and Ioannis Tomkos, Telecoms Journal, 2022
Review Article (60 pages; 100 References)

Evolution of Fixed Access Networks: Technologies



- The fixed network contains many different technologies
 - It is unrealistic to expect all these things to synchronize their development
 - For example, PON generations happen 2005, 2015, and 2025

Point to Multi-Point Passive Optical Network (PON) based

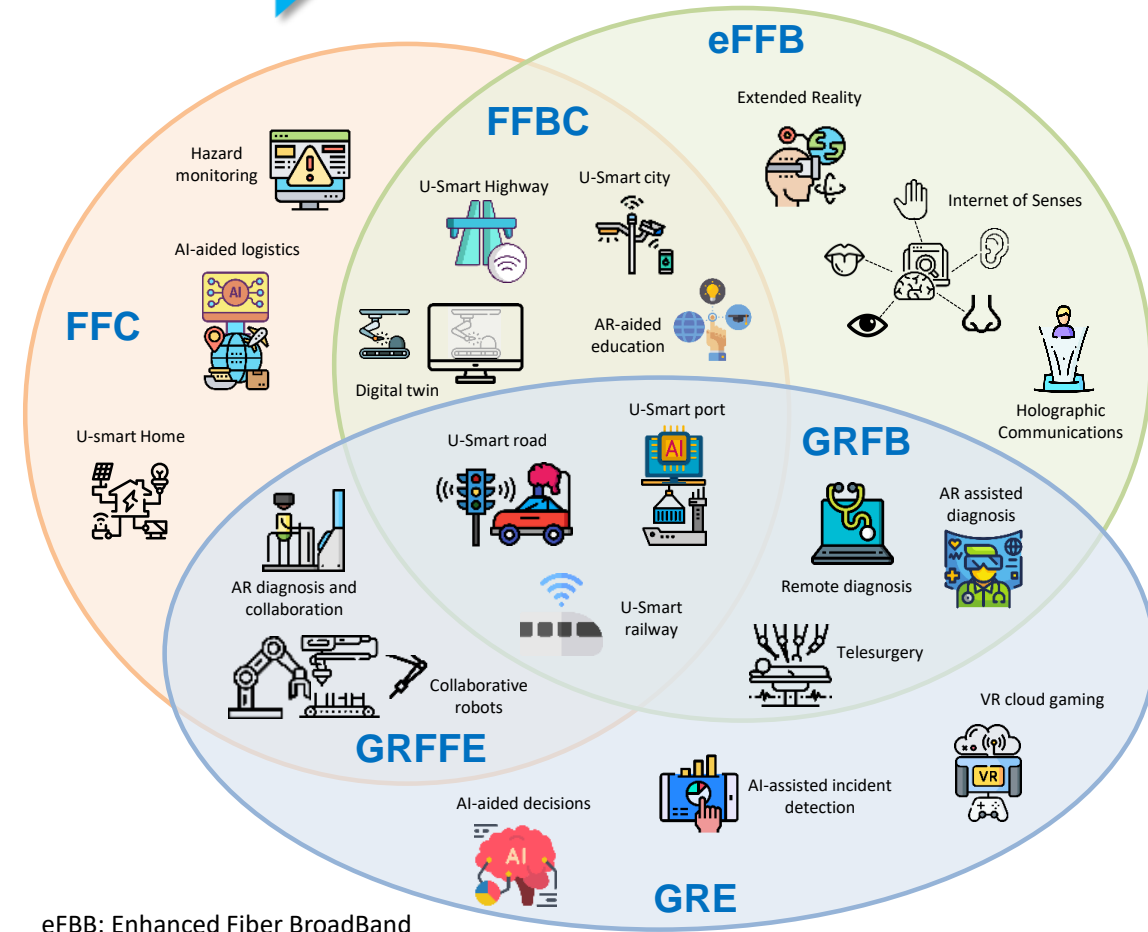
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Drivers for F5G Advanced



- Digitization or cloudification of applications
 - UHD immersive experience services
 - Enterprise digitization and cloudification
 - Industry going fibre
 - Metaverse as a driver for new infrastructure
- Network infrastructure improvements
 - Digitization of network operations
 - Optical fibre infrastructure becoming ubiquitous
 - Smart infrastructures for a sustainable society
 - The green challenge
 - Business environment change every 9+ years

<https://www.etsi.org/newsroom/press-releases/2122-2022-09-etsi-publishes-a-white-paper-on-fixed-5th-generation-advanced>



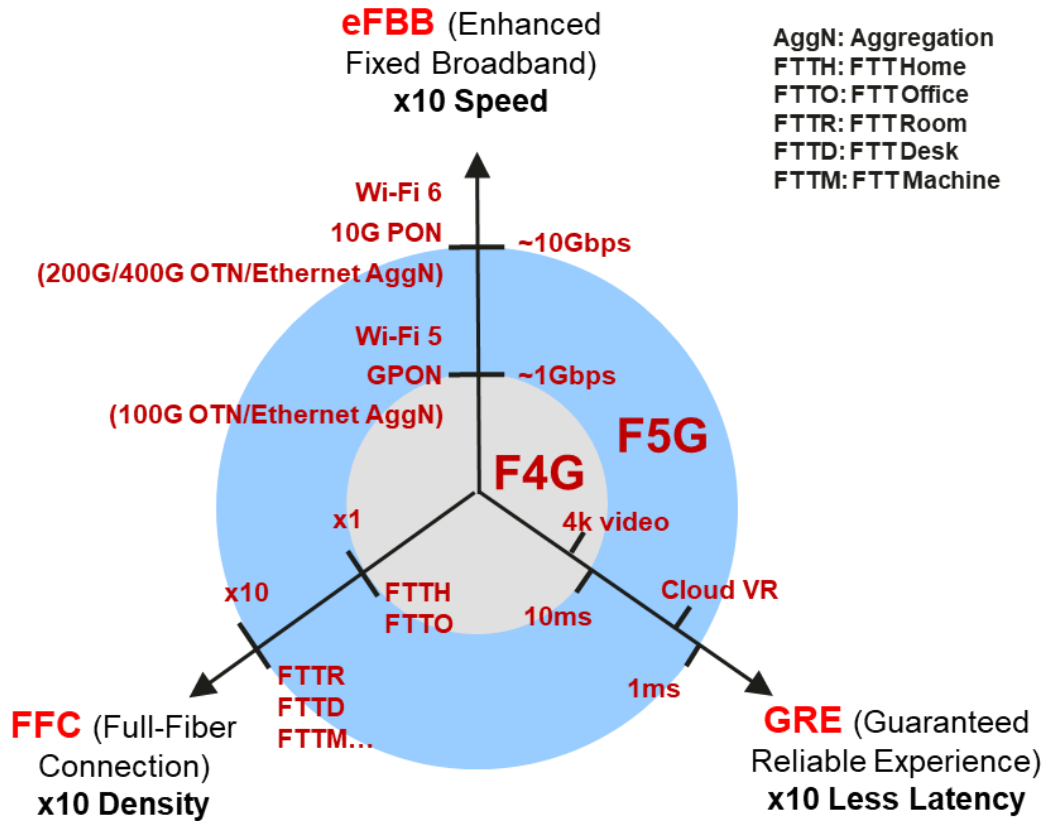
eFFB: Enhanced Fiber BroadBand
 FFC: Full Fibre Connection
 GRE: Guaranteed Reliable Experience
 FFBC: Full Fibre BroadBand Connection
 GRFB: Guaranteed Reliable Fiber Broadband
 GRFFE: Guaranteed Reliable Full Fibre Experience

Performance dimensions: From “F5G” to “F5G Advanced”

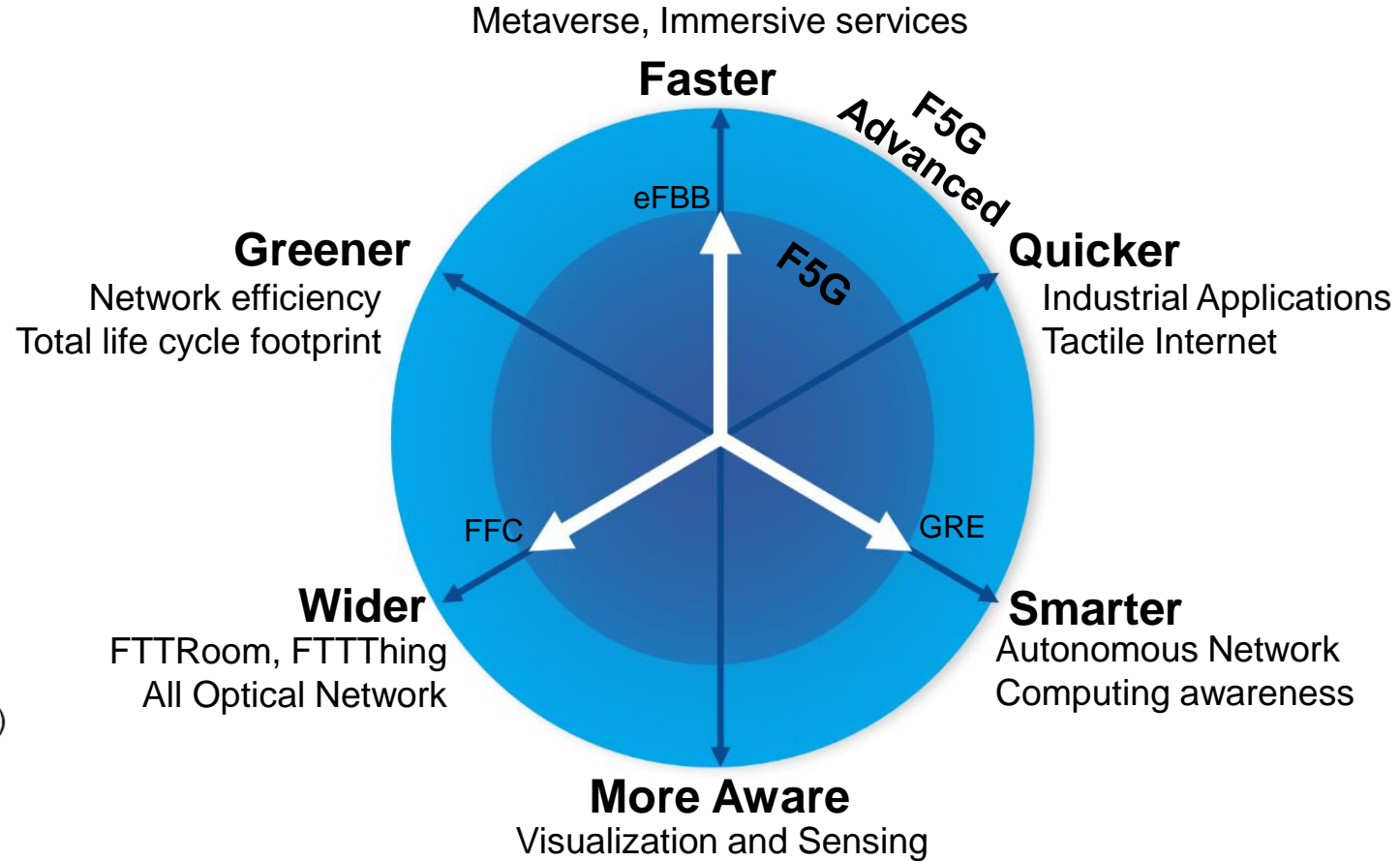
The three dimensions of “F5G”



“F5G Advanced”: Extend and Expand



AggN: Aggregation
FTTH: FTTHome
FTTO: FTTOffice
FTTR: FTTRoom
FTTD: FTTDesk
FTTM: FTTMachine



The F5G Advanced work can be thought of as a “F5.5G”, an interim step forward in capabilities, that allows all the technologies to happen in their natural time



F5G-Advanced

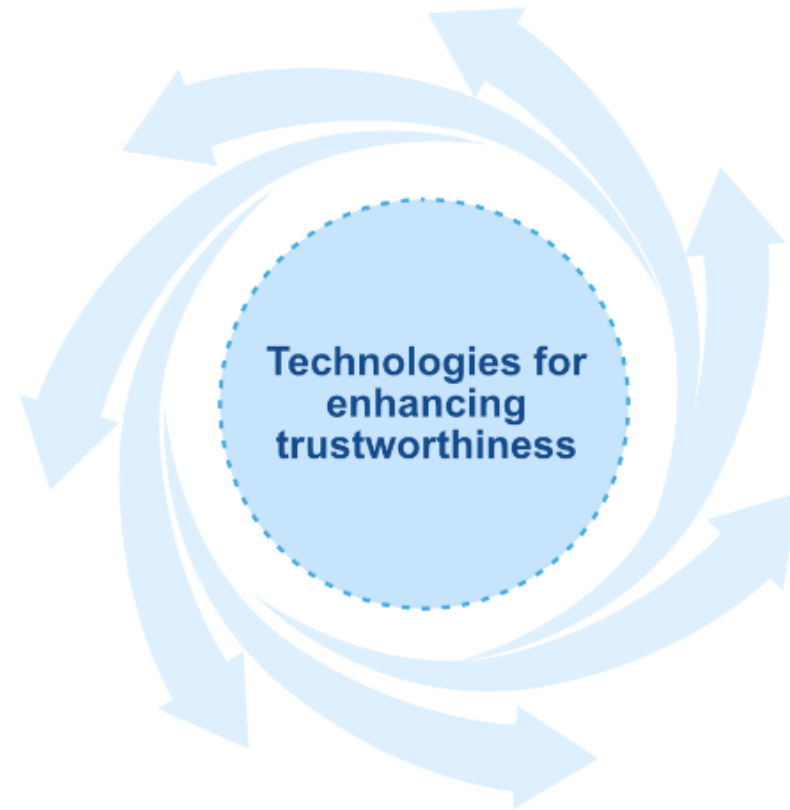
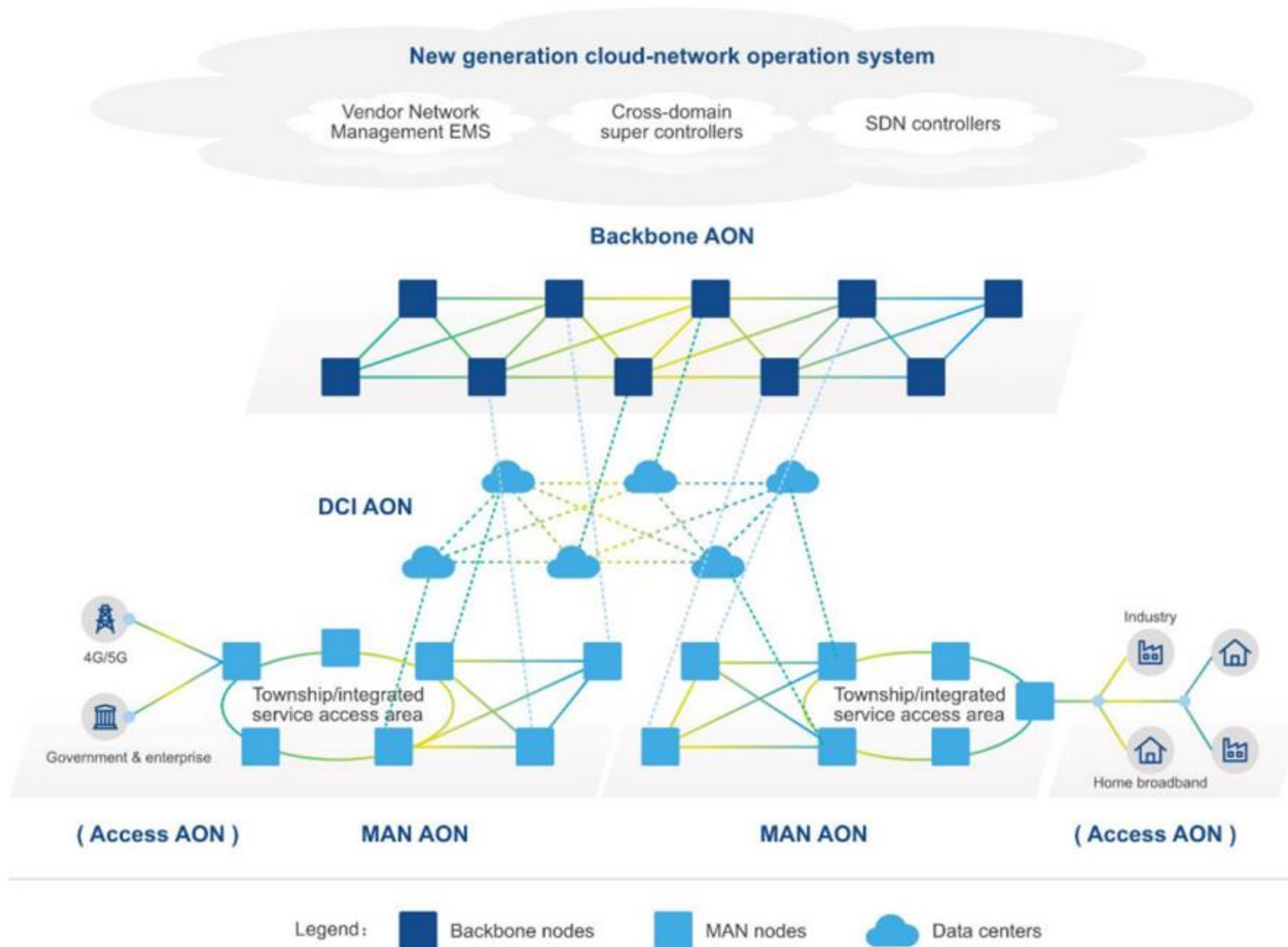
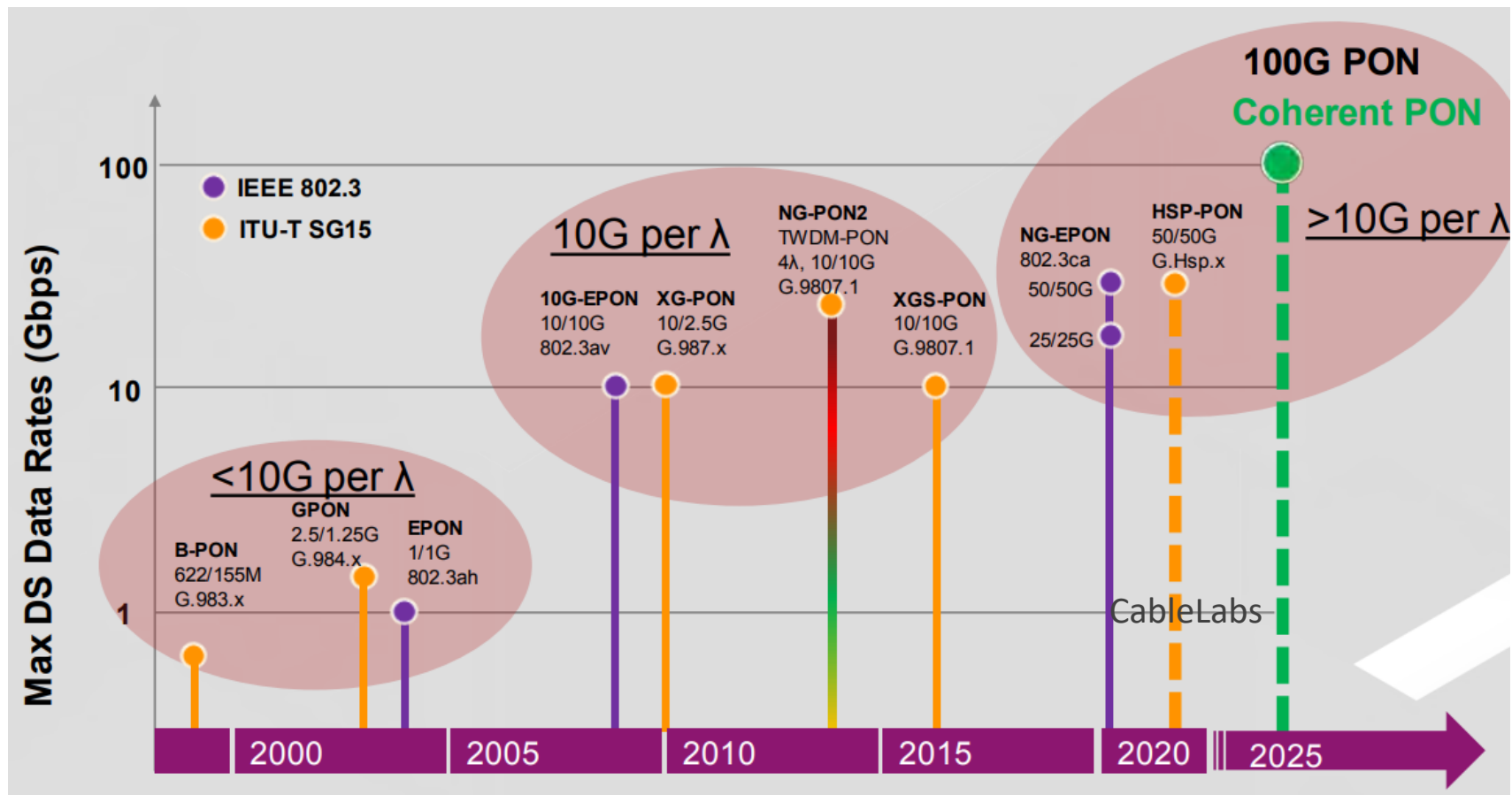


Illustration of F5G-Advanced all-optical network, including access, metro, DCI, and backbone networks



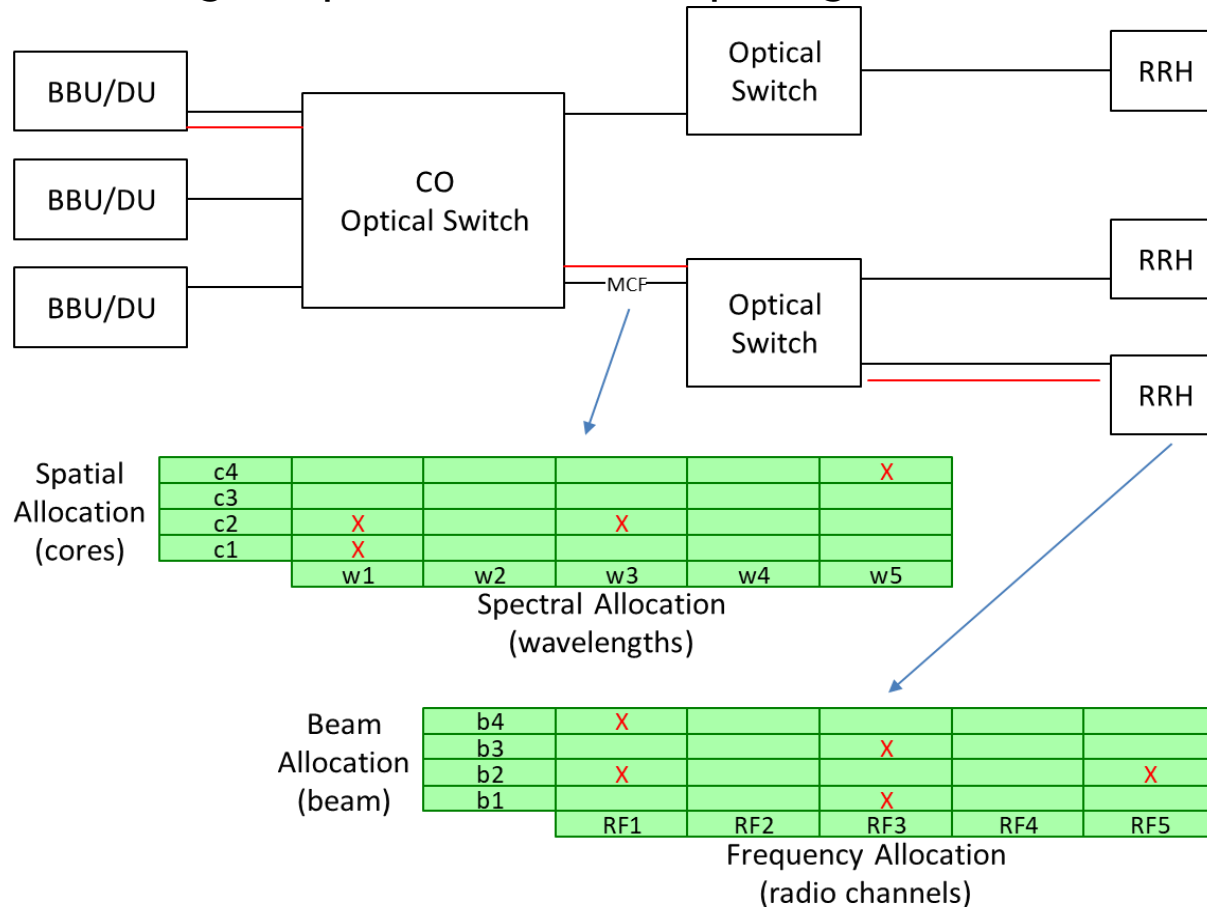
Industry view on the Evolution to 100G TDM-PON: move to Coherent



- ▶ After 50G PON, the next step for PON evolution is 100G, but 200G might be possible as well (i.e. skipping an intermediate step).
 - ▶ A n^* 50G TWDM PON is in early stages of development at ITU-T and may be completed in 2023, with lab trials and deployments in the 2023/2025 timeframe.
 - ▶ CableLabs recently announced the development of a symmetric 100G Coherent PON (“C-PON”) that offers 100Gbps per λ , at a reach of 80 km and up to a 1:512 split ratio.

Converged optical/radio communications & computing infrastructures in 6G networks

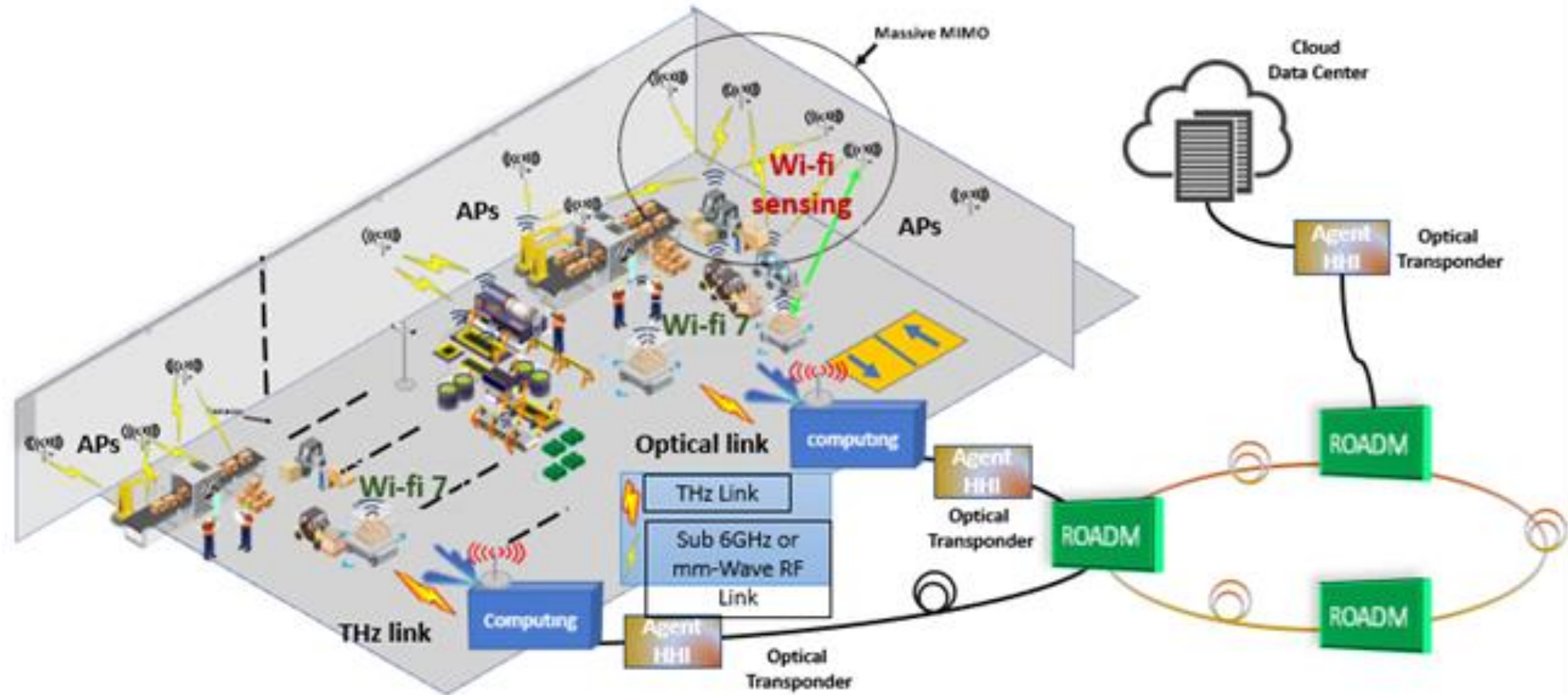
Abstracted 6G Network Architecture Model for a converged Optical/Radio/Computing infrastructure



- Spatial-Spectral Fronthaul resources
 - ... in radio domain
 - RF band
 - Beam
 - Radio Channel
 - ... in Optical domain
 - Cores/Fibres
 - Wavelengths
- Computing resources required at edge

Joint Allocation of Radio, Optical, and MEC Resources for 6G Fronthaul
 T Lagkas, D Klondis, PG Sarigiannidis, I Tomkos
 IEEE Transactions on Network and Service Management, 2021

Envisioned F6G technologies and applications: Example of AI-supported Fiber-based Networks augmented by Terahertz/Optical Wireless Access & Sensing



- Advanced ultra-fast optical switching and high-capacity optical transmission links will serve fixed and mobile users in various short-reach scenarios within I4.0 use-case scenarios requiring ultra-high bandwidth and ultra-low latency.
- The capabilities of the fixed fiber-optic networks will be augmented by “next-gen Wi-Fi” wireless technologies relying on terahertz and optical frequencies to support communications, sensing and computation.

Way forward

- Now that the first white paper on F5G Advanced is complete, work can begin on realizing all of its components
 - Use cases
 - Architectures
 - Technology studies
 - Gap identification
 - Liaison with all relevant SDOs
- All interested parties are welcome to join in this work!



Thank you.

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