Белорусский государственный университет информатики и радиоэлектроники
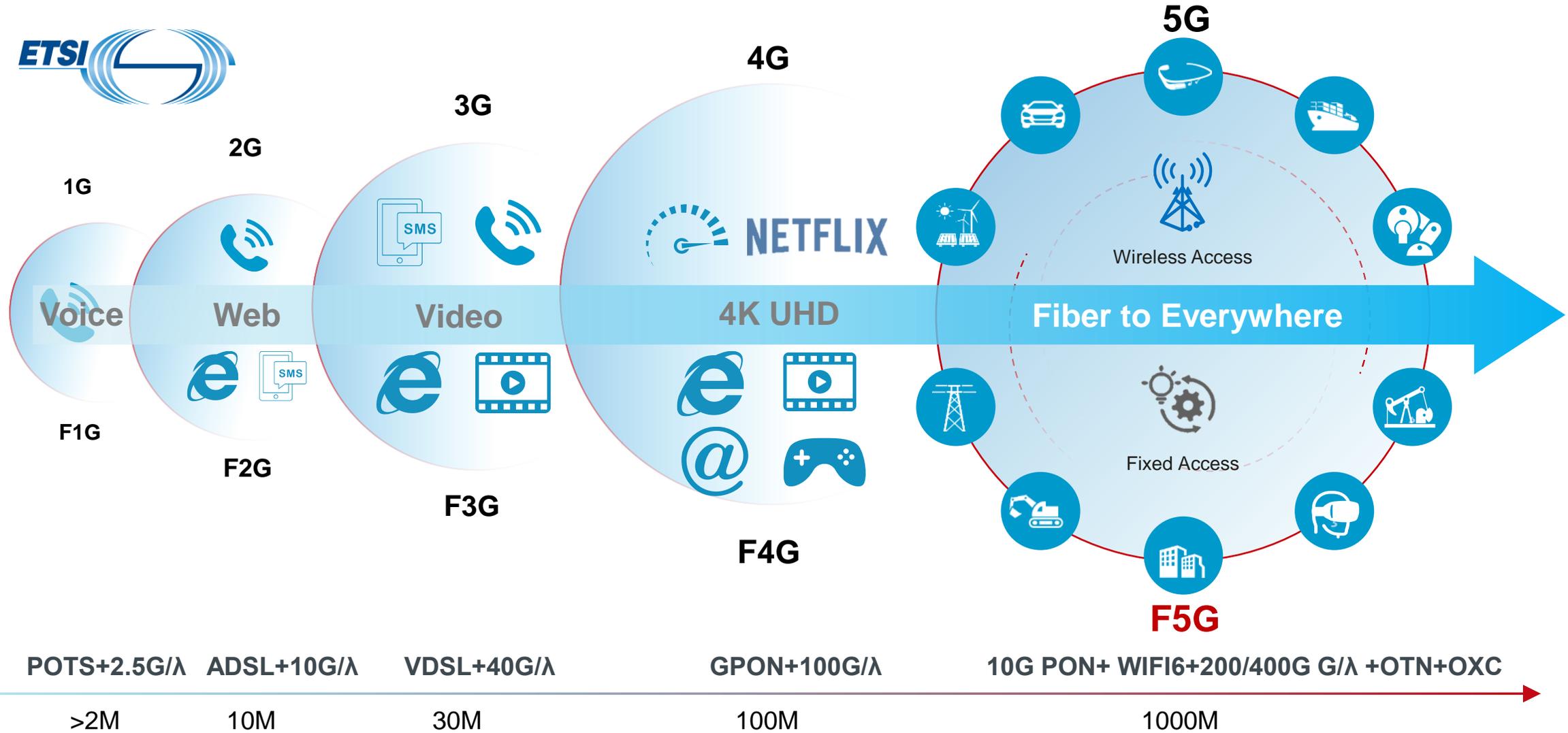
beCloud
Белорусские облачные технологии

ITU
Международный Союз Электросвязи

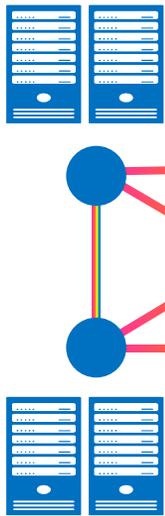# «Концепция и технологии Fixed 5G (F5G)»

Константин Савин, Эксперт МСЭ по сетевой инфраструктуре, Бизнес-партнер IXP Consulting

FBB Evolves to F5G New Era

1G

F1G

2G

F2G

3G

F3G

4G

F4G

5G

F5G

Voice

Web

Video

4K UHD

Fiber to Everywhere

Wireless Access

Fixed Access

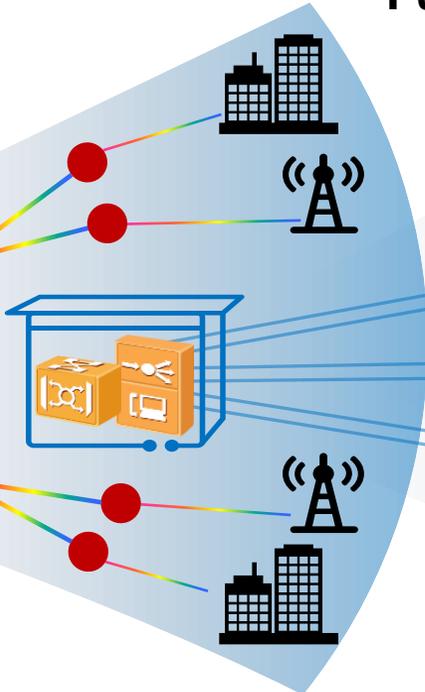| POTS+2.5G/λ	ADSL+10G/λ	VDSL+40G/λ	GPON+100G/λ	10G PON+ WIFI6+200/400G G/λ +OTN+OXC
>2M	10M	30M	100M	1000M

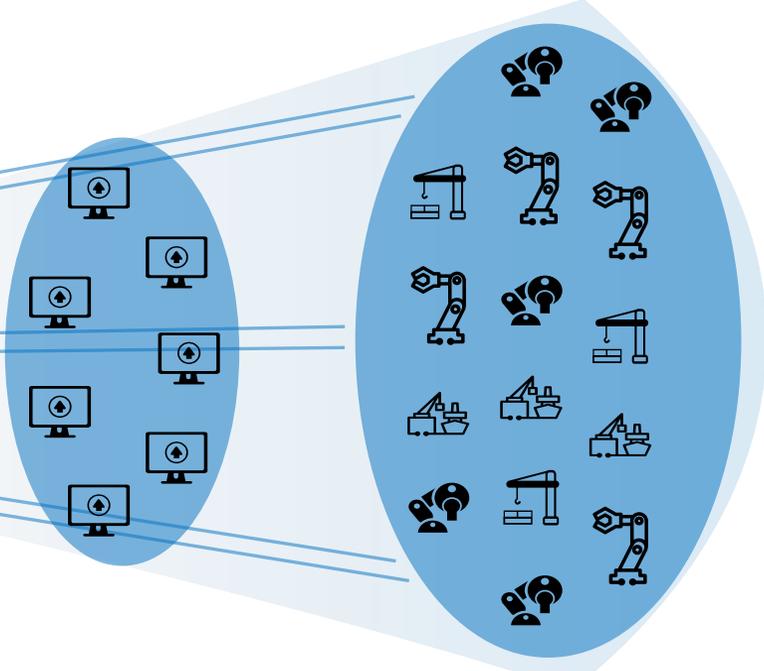# F5G Brings Full-Fiber Connectivity

Full-fibre DC

Full-fibre Home

Full-fibre Campus

OTN to CO → to Site

Fibre to Home → to FTTRoom

Fibre to Enterprise → to FTTDesk

Fibre to Factory → to FTTMachine

| Fiber to the office (FTTO) | Fiber to the room (FTTR) | Fiber to the desktop (FTTD) | Fiber to the machine (FTTM) |

F5G Enables Brand New Applications, Meeting User Demands and Promoting Fiber Deployment

Cloud VR
Rate Gbps
Latency: < 8 ms

Smart home
Rate > 370 Mbps
Latency: < 20 ms

Gaming
Rate > 300 Mbps
Latency: < 50 ms

Socialization
Panoramic real-time live streaming
Upstream rate > 200 Mbps

Cloud desktop
Upstream rate > 50 Mbps
Latency: < 10 ms

Safe city
AI-based real-time monitoring
Upstream rate > 200 Mbps

Enterprise to cloud
Symmetric rate > 100 Mbps
Reliability > 99.99%

Online education
Rate > 750 Mbps
Latency: < 20 ms

Telemedicine
Rate > 200 Mbps
Latency: < 10 ms

Smart manufacturing
Synchronized real-time operations
Latency: < 100 µs

Working Scope and Key Deliverable of ETSI ISG F5G

2020 — 2021 — 2022 — 2023 — 2024 — 2025 — 2026 — 2027 — 2028 — 2029 — 2030

| F5G Release 1 | F5G Release 2 | F5G / F5G advanced **Release 3** | F5G advanced **Release 4** | F5G advanced **Release 5** | F6G Requirement / F5G advanced **Release 6** | F6G Basic **Release 7** |

Generation Definition

Network Architecture

Use cases & POCs

Testing Specification

White papers

❑ **Release 1&2 published/ Release3 finished**

❑ **2000+ Contribution documents**

❑ **30+ Use cases & 6 PoCs**

❑ **2 Testing Projects**

❑ **4 White papers**
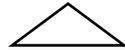
High-quality White Paper Contributed to Optical Industry

2020

2021

2022

2023

① **F5G:** Fiber to Everywhere

② **FDI:** Gigabit Society
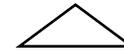
③ **F5G-A:** 10Gbps Everywhere
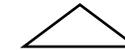
④ **Green All-optical Network**

ETSI White Paper No. #41

The Fifth Generation Fixed Network (F5G): Bringing Fibre to Everywhere and Everything

1st edition – September 2020

ISBN No. 979-10-92620-36-5

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ETSI White Paper No. 47

Fibre Development Index: Driving Towards an F5G Gigabit Society

1st edition – July 2021

ISBN No. 979-10-92620-41-1

Rapporteur: Michael Philpott

Contributors: Jorge Bonifacio, Luca Pesando, Marcus Brunner, Qidong Zou, Hakim Mkinsi

ETSI White Paper No. #50

Fixed 5th Generation Advanced and Beyond

1st edition – September 2022

ISBN No. 979108262071

Author:
Dr. F.J. Effenberger, Futurewei (rapporteur) with contributions from Beijing University of Post and Telecommunication (BUPT), Bouygues Telecom, CAICT, China Telecom, China Unicom, CICT, CTTC, Global Telecom, Fraunhofer HHI, Huawei, MTN, OI, Orange, POST Luxembourg, TIM, TNO, Turk Telecom, University of Patras

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ETSI White Paper No. 60

All-optical network facilitates the Carbon Shift.

1st edition – November-2023

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2024: Intelligent FTTR (on going)

Testing Group : Building the Connection Between Standard and Deployment

ITU-T SG15

Tech specification

1. Transport: fgOTN
2. Access: 50GPON/FTTR
3. O&M: ASON, eOMCI

ETSI ISG F5G

Testing Group

1. Function testing
2. Performance testing
3. Two ongoing project

FTTR /50GPON / 800G/1.6T / C+L

Global Service operator

Deployment

1. Proof of concept
2. Pilot deployment
3. Massive deployment

ALL players can join in and contribute to

Service Operator	Vendors	Testing Lab
Provide use case and requirement for developing testing cases	Provide the equipment for testing and improve the performance if necessary	Conduct the testing and provide testing report for customers

Current supporters(20+): CAICT, Keysight, VIAVI, Spirent, Changeself, CICT, ZTE, China Telecom, China Mobile, Huawei, CTTC…

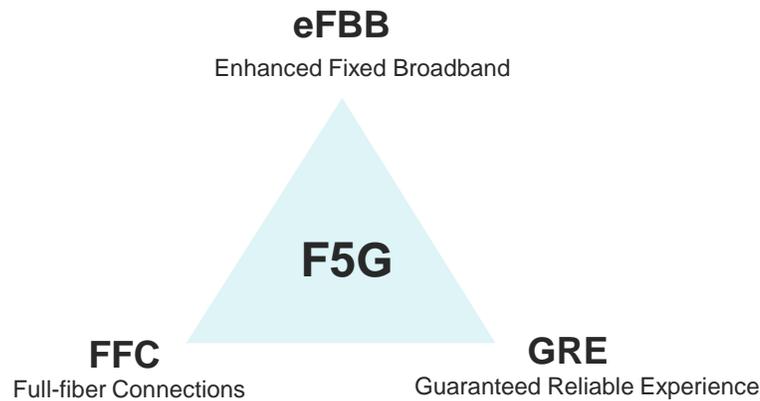# 100+ ETSI ISG F5G Members from all over the world

30+ Operators

30+ Vendors & Supplier

20+ SDOs & Academics

10+ Verticals

ETSI ISG F5G publishes F5G-A Release-3 use cases and requirements

2020~2023
R0 & R1 & R2

2024~2027
R3 & R4 & R5

eFBB
Enhanced Fixed Broadband

F5G

FFC
Full-fiber Connections

GRE
Guaranteed Reliable Experience

eFBB

GAO
Green Agile
Optical Network

RRL
Real-time
Resilient Link

F5G
Advanced

FFC

GRE

OSV
Optical Sensing & Visualization
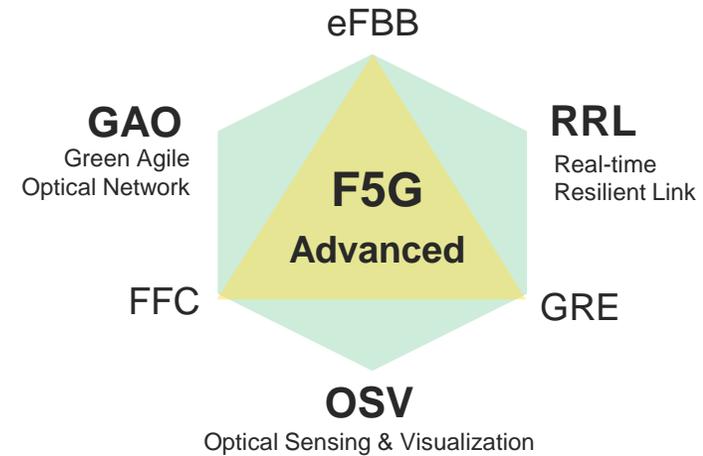
1 Gbit/s → 10 Gbit/s
10x bandwidth
Virtual gaming

XR 1G~10Gbps

Deterministic Latency <1ms
One hope to DC

Ultra-Resilience 99.9999%
Intelligent detection & prediction

OPU Intelligent unit
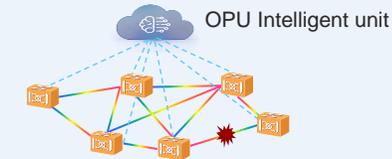
Detection in milliseconds

Communication → Sensing
Meter-level accuracy
Oil & gas pipeline inspection

1 meter positioning precision,
99% sensing accuracy

Fixed 5G and Fixed 5G Advanced

Three key dimensions:
- ❑ enhanced Fixed Broadband (eFBB)
- ❑ Full-Fibre Connection (FFC)
- ❑ Guaranteed Reliable Experience (GRE)

Thee advanced dimensions:
- ❑ Green Agile Optical network (GAO)
- ❑ Real-Time Resilient Link (RRL)
- ❑ Optical Sensing and Virtualization (OSV)

https://www.etsi.org/deliver/etsi_gr/F5G/001_099/021/01.01.01_60/gr_F5G021v010101p.pdf

Architecture as per ETSI GS F5G 024 V1.1.1 (2024-10)

Target F5G use cases

#1 Premium private line service automation
#2 Stable & reliable Wi-Fi® connection over FTTR
#4 Intelligent power grid
#6 Naked-eye 3D display
#10 Cloud Desktop
#12 On-premises Millimetre Wave (mmWave) WLAN
#13 Wavelength-shared WDM aggregation network (AGGN)
#14 Robotics as a Service
#17 QoD App-Flow service provisioning

eFBB

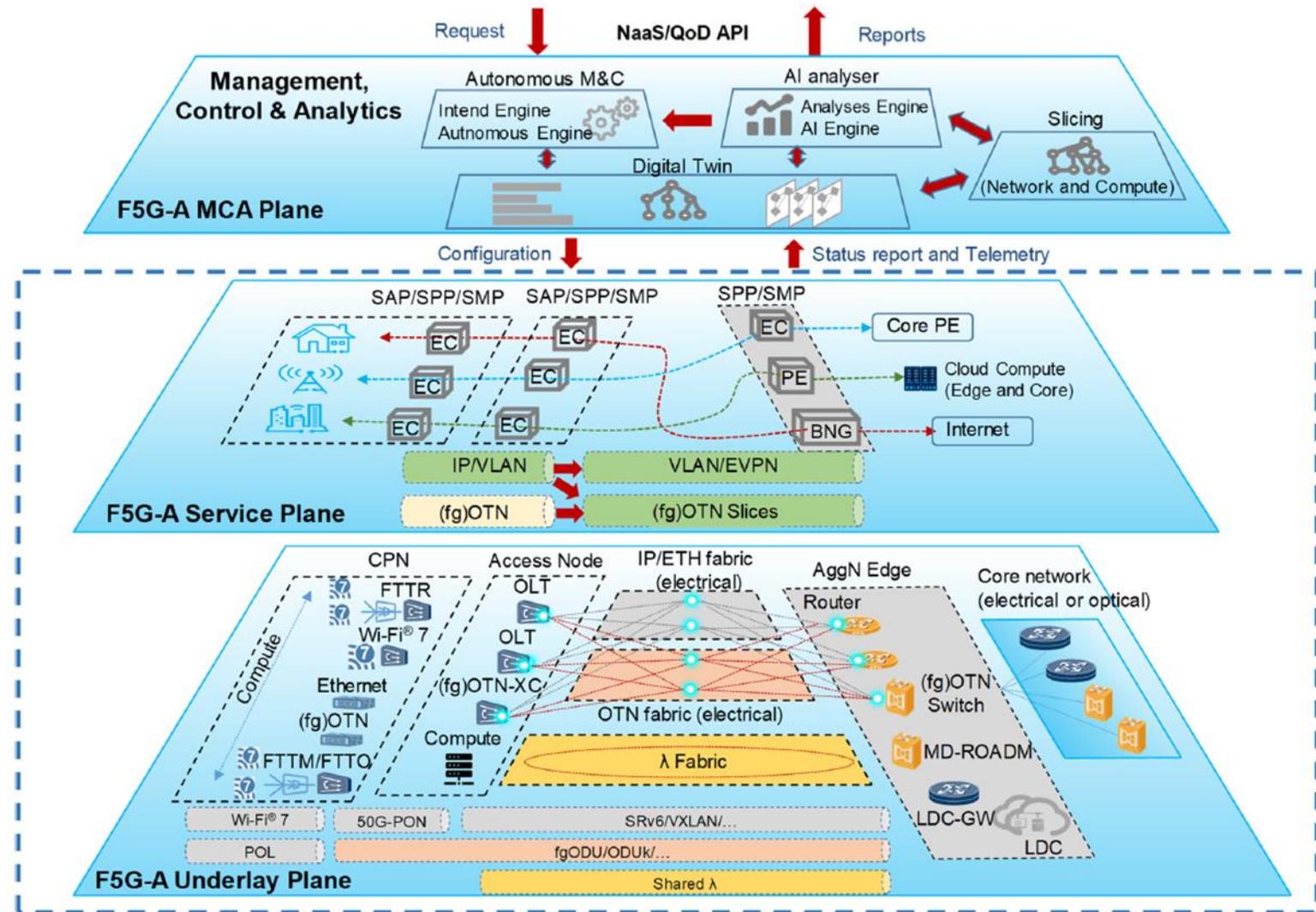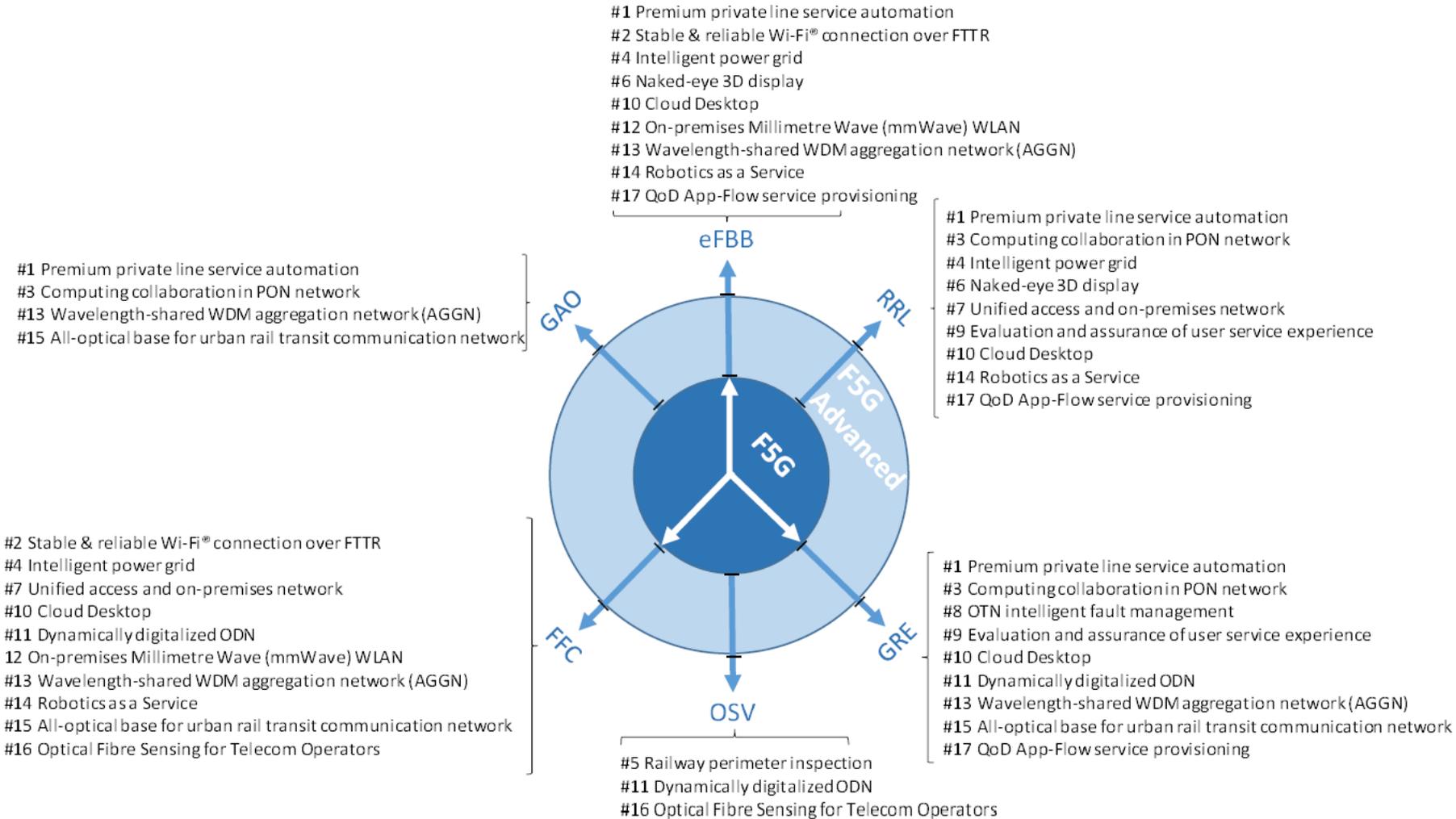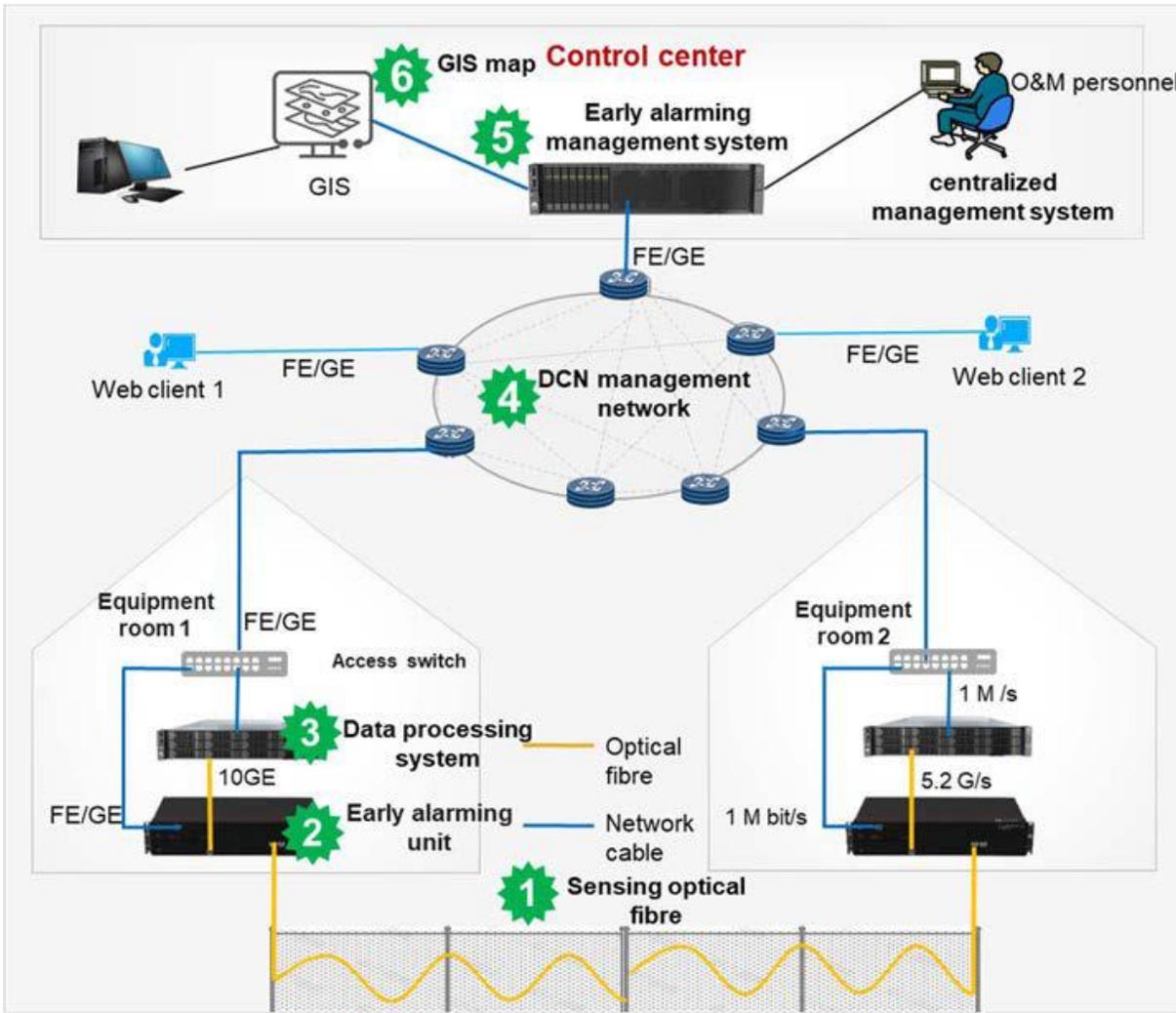#1 Premium private line service automation
#3 Computing collaboration in PON network
#13 Wavelength-shared WDM aggregation network (AGGN)
#15 All-optical base for urban rail transit communication network

GAO

RRL

#1 Premium private line service automation
#3 Computing collaboration in PON network
#4 Intelligent power grid
#6 Naked-eye 3D display
#7 Unified access and on-premises network
#9 Evaluation and assurance of user service experience
#10 Cloud Desktop
#14 Robotics as a Service
#17 QoD App-Flow service provisioning

F5G Advanced

F5G

#2 Stable & reliable Wi-Fi® connection over FTTR
#4 Intelligent power grid
#7 Unified access and on-premises network
#10 Cloud Desktop
#11 Dynamically digitalized ODN
12 On-premises Millimetre Wave (mmWave) WLAN
#13 Wavelength-shared WDM aggregation network (AGGN)
#14 Robotics as a Service
#15 All-optical base for urban rail transit communication network
#16 Optical Fibre Sensing for Telecom Operators

FFC

GRE

#1 Premium private line service automation
#3 Computing collaboration in PON network
#8 OTN intelligent fault management
#9 Evaluation and assurance of user service experience
#10 Cloud Desktop
#11 Dynamically digitalized ODN
#13 Wavelength-shared WDM aggregation network (AGGN)
#15 All-optical base for urban rail transit communication network
#17 QoD App-Flow service provisioning

OSV

#5 Railway perimeter inspection
#11 Dynamically digitalized ODN
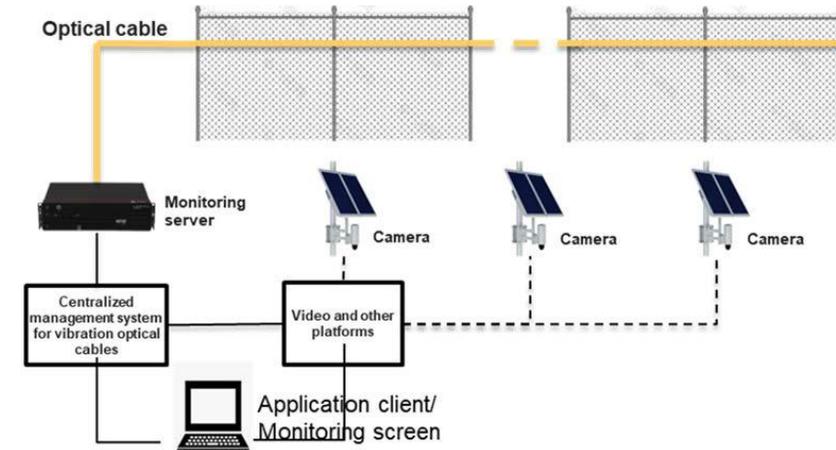#16 Optical Fibre Sensing for Telecom Operators
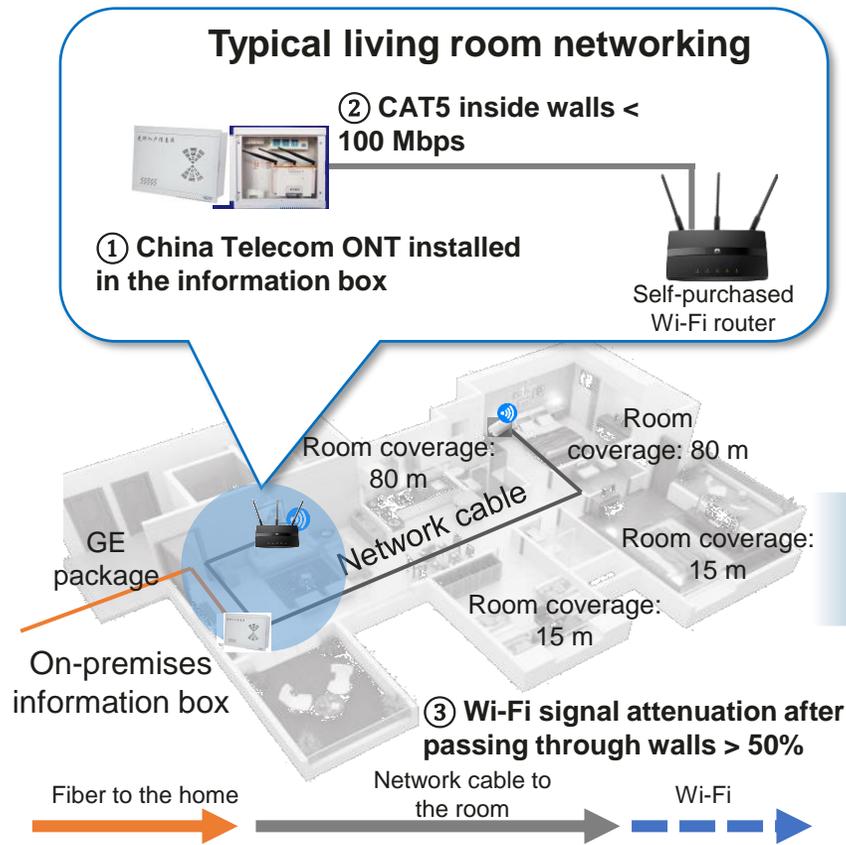
New services based on fiber sensing

The perimeter intrusion detection optical fibre sensor is deployed on the railway perimeter fence, and the data
processing unit and early alarming unit are deployed in the monitoring centre of the stations along the railway. Cameras are mobilized remotely to confirm the intrusion, and then intrusion data is reported
to the train control system.
- Unidirectional coverage range: Optical cable coverage range ≤ 50 km
- Event identification time for a single port: ≤ 5 s.
- False positive rate: ≤ 0,002 per km per hour.
- Detection rate: ≥ 99,9 %.

A Successful UC from ETSI ISG F5G to Commercial: FTTR (fiber to the room)

UC proposed by ETSI ISG F5G

2020

Product Released in China

2022

Massive commercial

2024~

China MKT-2024

90 + commercial deployment (provincial)

12+ million FTTR users

Oversea MKT-2024

200K+ FTTR users

Portugal, France, Iceland Ireland,
Finland, Spain..

FTTR Enables Premium True Gigabit Experience

Typical living room networking

② CAT5 inside walls < 100 Mbps

① China Telecom ONT installed in the information box

Self-purchased Wi-Fi router

Fiber to the Room: full gigabit coverage

Room coverage: 80 m

Room coverage: 80 m

GE package

Network cable

Room coverage: 15 m

Room coverage: 15 m

On-premises information box

③ Wi-Fi signal attenuation after passing through walls > 50%

Fiber to the home → Network cable to the room → Wi-Fi

The maximum transmission bandwidth of home network cables (mostly CAT5) is only 100 Mbps, and due to improper installation + outdated networks, the common bandwidth is only 80 Mbps.

Gigabit room coverage

Gigabit room coverage

GE package

Optical fiber

Gigabit room coverage

Gigabit room coverage

ONT out of the information box

Gigabit room coverage

Fiber to the home → Fiber to the room → Wi-Fi

Fiber to the room: working with home decoration companies to simplify and standardize indoor cabling solutions.

Terminal to the room: innovative mini ONUs and level-2 edge ONTs for homes.

Gigabit to the home full-fiber networking pilot

True gigabit in every room Smooth VR gaming experience

Exclusive dual-band Wi-Fi in every room

Благодарю за внимание

17-18 марта 2026 года, г. Минск, Республика Беларусь