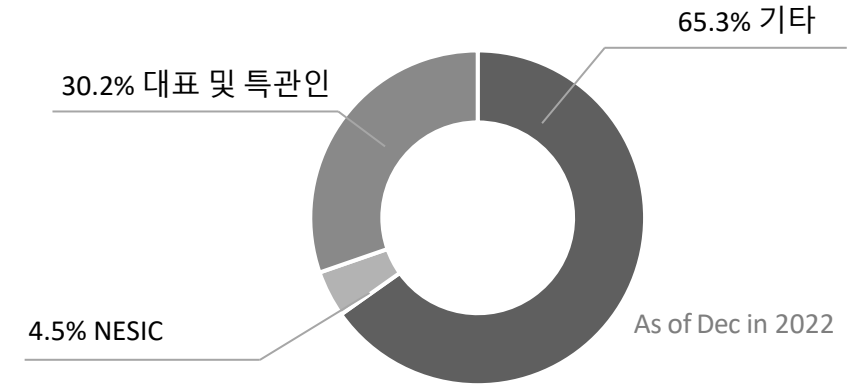# HFR
Company
Profile

Create the Resonant Networking

Networking should include not only providing connectivity tools, but also providing
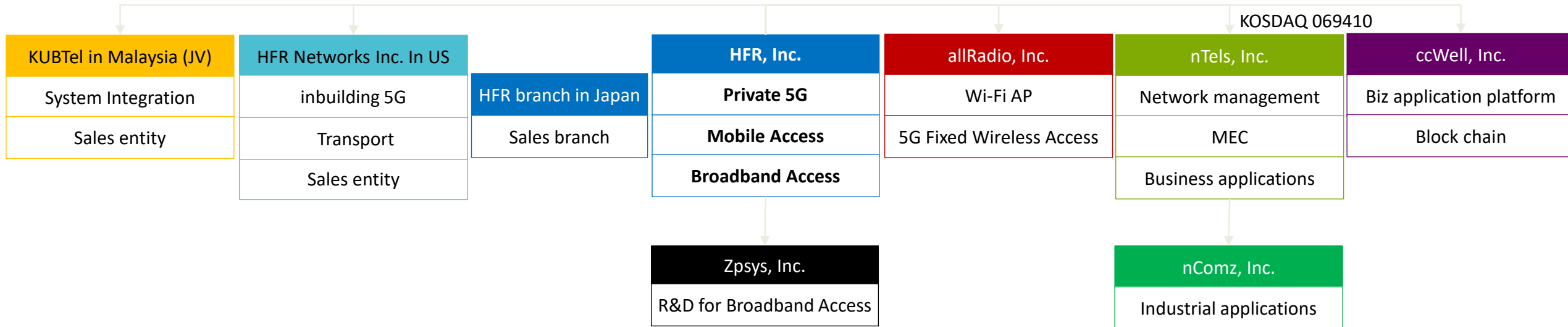the necessary services. Networking, like nature, will be always staying next to us.

June 2023

Company Overview

설립일 2000.01.05	업종 **정보통신장비 제조 및 제조 서비스**	IPO 2018년 (KOSDAQ 230240)
인원 202명	사업영역 Mobile · Broadband Access, Private 5G & Services	홈페이지 http://www.hfrnet.com

65.3% 기타

30.2% 대표 및 특관인

4.5% NESIC

As of Dec in 2022

We will exert our best to maximize customer satisfaction

HFR and its Affiliates

"Many skills", "Different views" but teaming up like "One company" based on empowering culture to enrich growth

KOSDAQ 069410

KUBTel in Malaysia (JV)	HFR Networks Inc. In US		HFR, Inc.	allRadio, Inc.	nTels, Inc.	ccWell, Inc.
System Integration	inbuilding 5G	HFR branch in Japan	**Private 5G**	Wi-Fi AP	Network management	Biz application platform
Sales entity	Transport	Sales branch	**Mobile Access**	5G Fixed Wireless Access	MEC	Block chain
	Sales entity		**Broadband Access**		Business applications	

Zpsys, Inc.
R&D for Broadband Access

nComz, Inc.
Industrial applications

VISION & BUSINESS STRATEGY

Networking은 연결 도구와 필요한 서비스를 제공하는 것을 의미하며, HFR은 인간 욕구 충족을 위해 공감 네트워킹을 창조하고자 합니다.

인간 욕구 충족을 위한 공감 네트워킹 창조
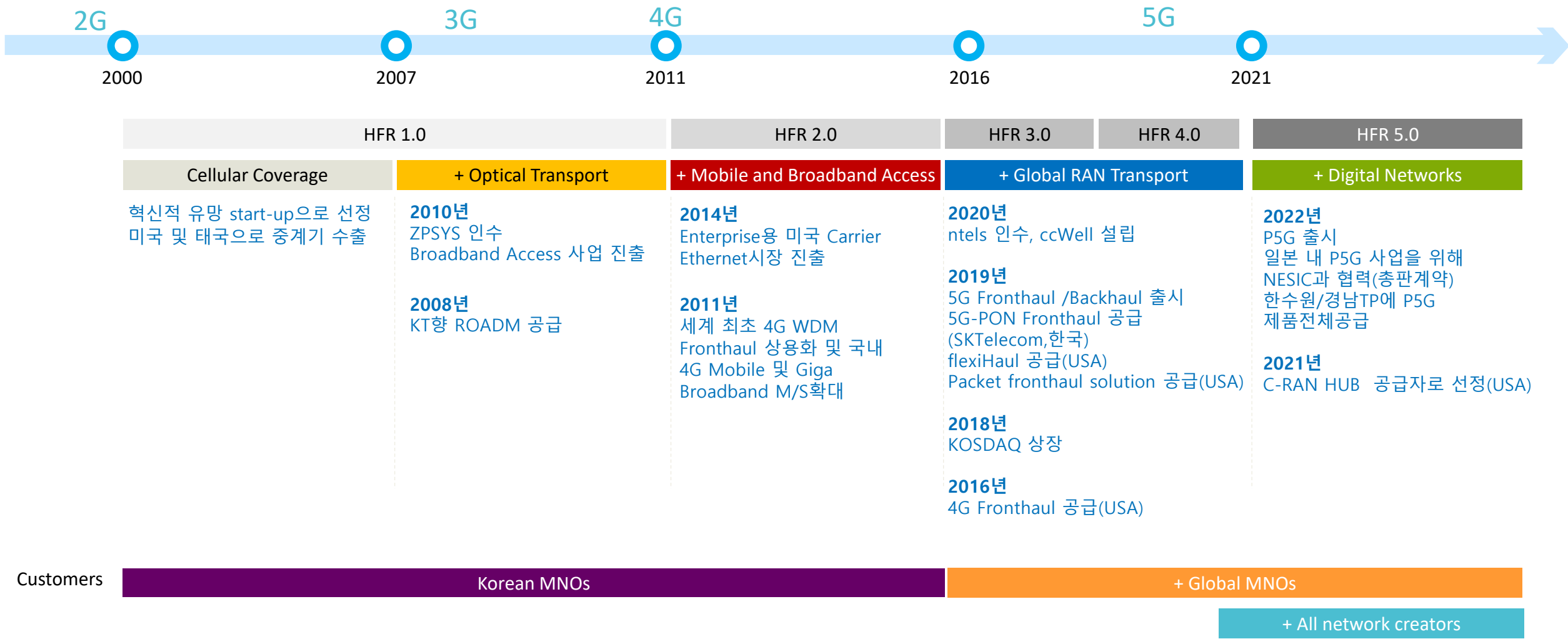
'Create the Resonant Networking'

사업전략

성장전략

조직전략

사업 자산 활용

파트너와 탐험

젊고 활기찬 조직

BUSINESS STRATEGY

HISTORY

2G	3G	4G		5G	
2000	2007	2011	2016	2021	

HFR 1.0		HFR 2.0	HFR 3.0	HFR 4.0	HFR 5.0
Cellular Coverage	+ Optical Transport	+ Mobile and Broadband Access	+ Global RAN Transport		+ Digital Networks

Cellular Coverage
혁신적 유망 start-up으로 선정
미국 및 태국으로 중계기 수출

+ Optical Transport
2010년
ZPSYS 인수
Broadband Access 사업 진출

2008년
KT향 ROADM 공급

+ Mobile and Broadband Access
2014년
Enterprise용 미국 Carrier
Ethernet시장 진출

2011년
세계 최초 4G WDM
Fronthaul 상용화 및 국내
4G Mobile 및 Giga
Broadband M/S확대

+ Global RAN Transport
2020년
ntels 인수, ccWell 설립

2019년
5G Fronthaul /Backhaul 출시
5G-PON Fronthaul 공급
(SKTelecom,한국)
flexiHaul 공급(USA)
Packet fronthaul solution 공급(USA)

2018년
KOSDAQ 상장

2016년
4G Fronthaul 공급(USA)

+ Digital Networks
2022년
P5G 출시
일본 내 P5G 사업을 위해
NESIC과 협력(총판계약)
한수원/경남TP에 P5G
제품전체공급

2021년
C-RAN HUB 공급자로 선정(USA)

Customers

Korean MNOs	+ Global MNOs

+ All network creators

ECOSYSTEM

HFR and its ecosystem are vital links in an innovation value chain, creating a family of companies empowered to achieve vital advancements through their combined technical synergies.

	Mobile Access	Broadband Access	Private 5G & Services
Customers	verizon✓ AT&T NTT docomo SK telecom kt	SK broadband kt LG U+ TM	SK telecom kt 한국수력원자력㈜ 재단 경남테크노파크
Partner Companies	FUJITSU NOKIA JTOWER		NEC NECネッツエスアイ
Subsidiaries and affiliates	ACTUS ACTUS NETWORKS.INC.	ZP SYS ZPSYS CO.,LTD. allRadio	ntels ccWell
Overseas Branch	HFR NETWORKS	HFR JAPAN for Mobile Internet	KUBTEL

HFR's Ecosystem

Business Domain

Mobile Access
- 4G/5G xHaul (WDM & Packet RAN Transport)
- Indoor & Outdoor Cellular Radio Units

Broadband Access
- 10G Gigabit Internet (FTTx)
- Wi-Fi Access Point & Controller

Private 5G & Services
- 5G SA Network (5G vCore, vCU/DU,RU)
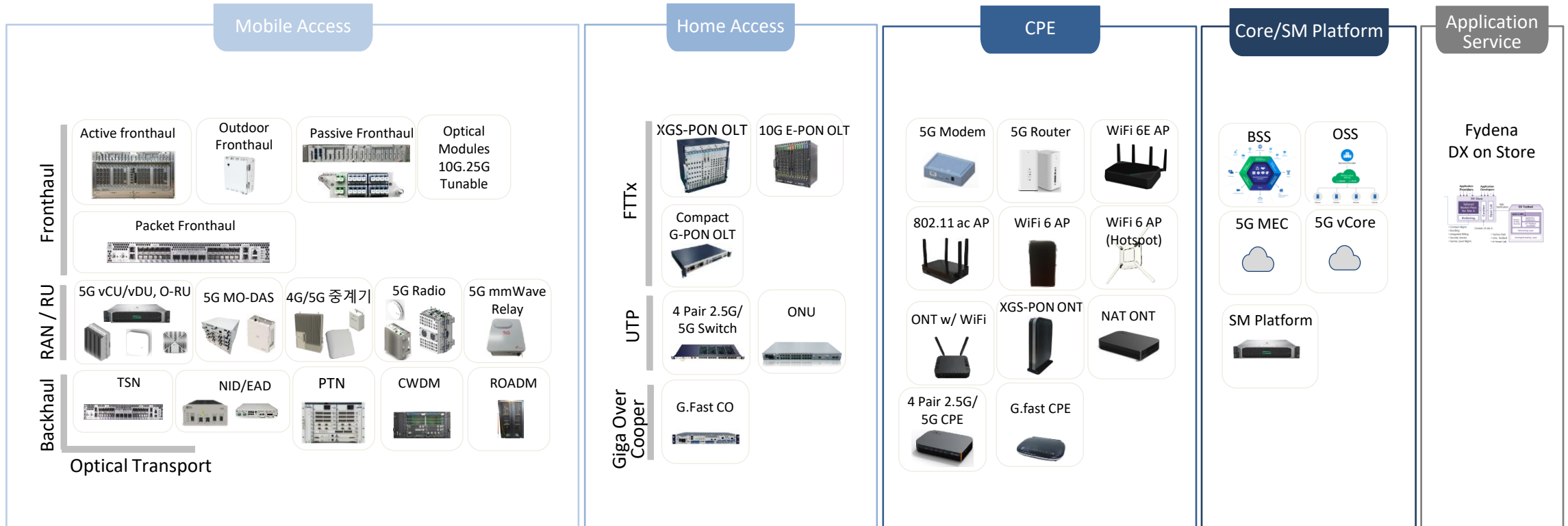- 5G SM Platform

Telecom Operator's Edge Cloud

UPF, GW-U
5G CU, 5G DU
4G BBU

COT   OLT

5G WDM/Packet xHaul   **10 Gigabit FTTx**   NG-PON2/XGS-PON/ 10G-EPON

RT   Cell Site   Splitter   Private 5G   SM Platform

eCPRI F1   CPRI   ONU   PoE Switch   **5G SA Network**

CPRI/eCPRI   UTP/ G.fast   CPE   Wi-Fi AP   5G O-RU   5G SA vCore (CP, UP)

5G RU 5G DRU 4G RRH   ONT Wi-Fi AP   Wi-Fi AP   5G vRAN (O-DU, O-CU)

5G In-Building DAS   **5G RF Repeater**   **5G FWA**   UTP   5G-FWA

In-Building   Out-Door   Single Home   MDU   Hot Spot   Enterprise, Factory, Office, Airport, Hospital, Hotel, etc.

HFR   Connecting human and device to content, data and applications   HFR

제품 및 서비스 Portfolio

통신사업자와 공공 또는 기업 고객을 대상으로 유무선 및 모바일 네트워킹 장비 및 소프트웨어 솔루션을 개발, 제조, 공급 하고 있습니다. 또한, End-to-End Private 5G System 통합솔루션을 제공하고 있습니다.

Mobile Access

Fronthaul
- Active fronthaul
- Outdoor Fronthaul
- Passive Fronthaul
- Optical Modules 10G.25G Tunable
- Packet Fronthaul

RAN / RU
- 5G vCU/vDU, O-RU
- 5G MO-DAS
- 4G/5G 중계기
- 5G Radio
- 5G mmWave Relay

Backhaul
- TSN
- NID/EAD
- PTN
- CWDM
- ROADM

Optical Transport

Home Access

FTTx
- XGS-PON OLT
- 10G E-PON OLT
- Compact G-PON OLT

UTP
- 4 Pair 2.5G/5G Switch
- ONU

Giga Over Cooper
- G.Fast CO

CPE

- 5G Modem
- 5G Router
- WiFi 6E AP
- 802.11 ac AP
- WiFi 6 AP
- WiFi 6 AP (Hotspot)
- ONT w/ WiFi
- XGS-PON ONT
- NAT ONT
- 4 Pair 2.5G/5G CPE
- G.fast CPE

Core/SM Platform

- BSS
- OSS
- 5G MEC
- 5G vCore
- SM Platform

Application Service

Fydena DX on Store

성과 및 사업방향

5G Mobile Access 및 10G Broadband Access 시장에서의 리더십을 바탕으로,
HFR의 향후 성장은 IoT 플랫폼에서 통합 관리 서비스를 제공하여 "Private 5G " 시장에서의 리더십을 확보하는 데 초점을 맞추고 있습니다

Private 5G & Services

Future Digital Infrastructure Builder

Managed Service Provider
(On-Site Private 5G Network & Services)

Provide Private 5G Total Solution

5G SA vCore	5G vCU/DU, RU	SM Platform

Broadband Access

10G Gigabit Internet Commercialization in Korea

Dominant Player in Korea's Wired Access G-PON Market

The World s 1st 2-Pair Giga Ethernet Switch Commercialization

G-PON	2-Pair Ethernet	10G-EPON	XGS-PON

Mobile Access

Packet Fronthaul (RoE, TSN) Development
The 1st Korean Company to Enter the US Fronthaul Market
The World s 1st C-RAN Fronthaul Commercialization

In-Building Cellular	4G WDM Fronthaul	4G/5G WDM xHaul	4G/5G Packet xHaul

Recent Highlights

HFR boasts repeated success in introducing disruptive technologies.

Private 5G	Mobile Access	Broadband Access
일본 P5G 사업을 위한, NEC 자회사 NESIC과의 협력 및 투자	북미 C-band Fronthaul 단독 공급	가정용, 기업용 및 Hotspot용 WiFi 6/6E
국방 P5G 사업 수주	Packet Fronthaul 장비 공급	5G Fixed Wireless Access
한국수력원자력(한수원)에 P5G 제품전체공급	O-RAN을 기반으로 한 최초의 fronthaul Mux (SKT향)	2023년 WiFi 7 상용화 계획
경남 TP에 5G 시스템, WiFi 6 구축	LTE&5G 동시 서비스(기존 4G 스펙트럼의 RRH 이용)	초저지연 TSN(Time Sensitive Network) Switch상용화

Market Snapshots

[Worldwide 5G infrastructure]

(USD billion)

by MNOs ■ by Enterprises

	'21	'22	'23	'24	'25	'26	'27
by Enterprises	57.63	58.96	62.54	64.86	67.18	69.59	71.96
by MNOs	131.9	132	140.9	146.6	152.6	159	165.3

[Private 5G]

(USD million)

■ RAN ■ Core ■ Transport

	'21	'22	'23	'24
Transport	81.2	164.8	281.2	398.2
Core	367	550.1	938	1,137.80
RAN	1,350.00	2,707.50	3,450.00	4,185.00
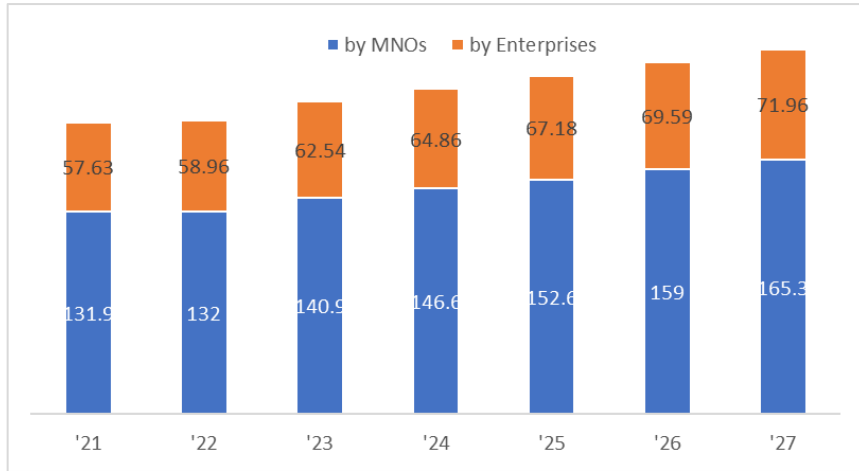
* Source: IDC, Private 5G: Empowering Digitalization for Enterprise and Industrial Organizations, 2021
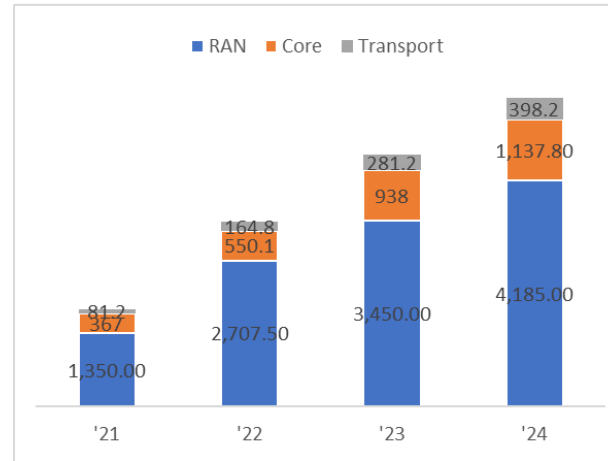
[P5G Services by Revenue Category]

2025

- 17% Data Service
- 40% Network Management
- 5% Provisioning & Commissioning
- 28% Network Security
- 6% Network Service Orchestration
- 4% Other Network Services

■ Data Service
■ Network Management
■ Provisioning & Commissioning
■ Network Security
■ Network Service Orchestration
■ Other Network Services
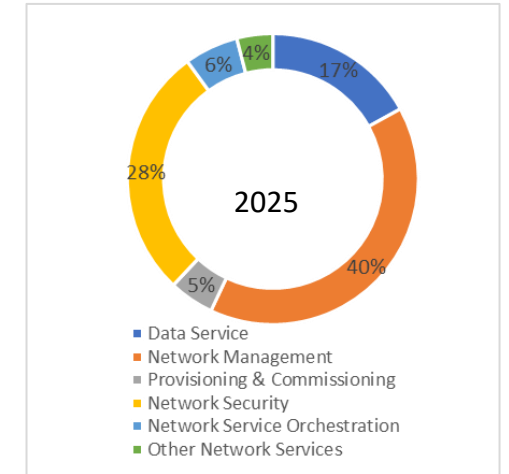
* Source: Harbor Research, 2021

[PON OLT optical component forecast]

(000 Units)

- 50G GPON
- 25G GPON
- NG-PON2
- XGS-PON
- 2.5G GPON
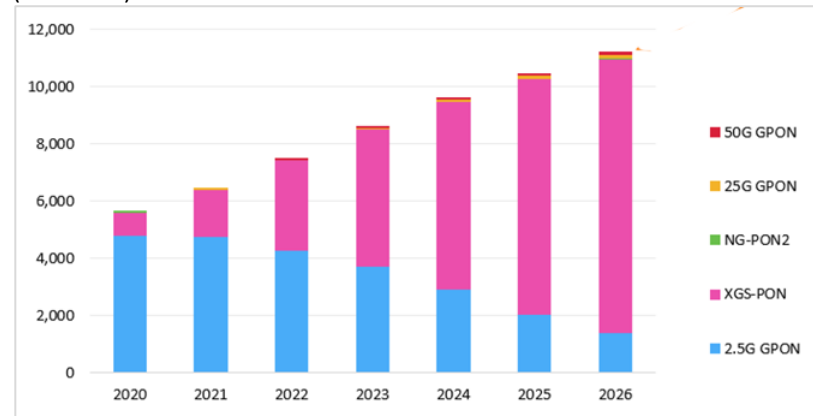
* Source: Omdia, 2021

[Global Consumer WiFi CPE forecast]

CPE shipments (millions) / CPE revbenue ($bn)

- Retail gateway shipments
- Router shipments
- Whole-home system AP shipments
- Extender shipments
- Retail gateway revenue
- Router revenue
- Whole-home system AP revenue
- Extender revenue

© 2022 Omdia

* Source: Omdia, 2022

HFR,Inc.
for Mobile Internet

Financial Performance

매출/영업이익

■ 매출액 ■ 영업이익   (단위 : 억원)

	2019	2020	2021	2022	2023(~1Q)
매출액	1567	921	2064	3663	368
영업이익	22	-259	218	902	-9
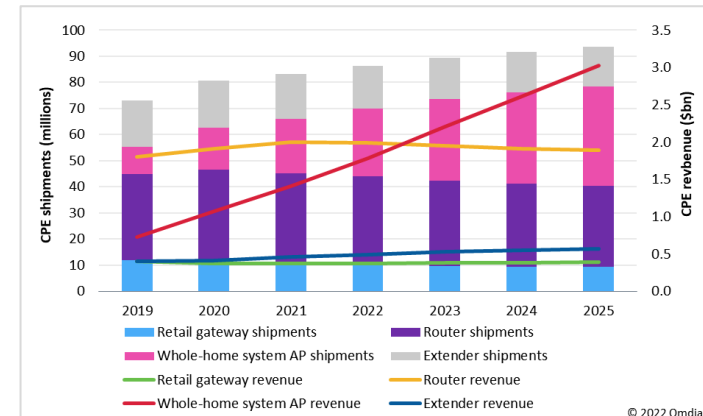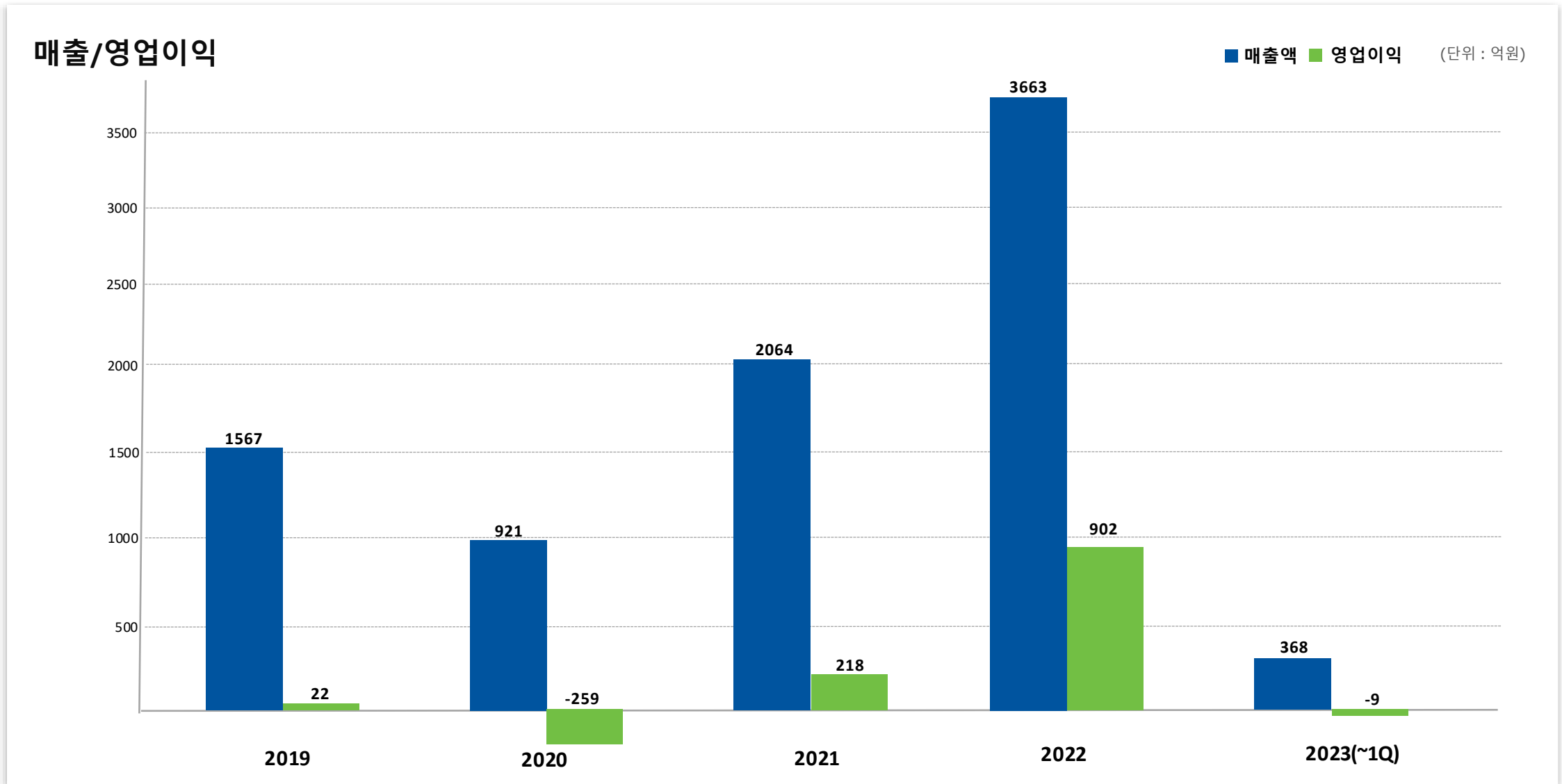
Financial Performance

Mobile Access / Broadband Access

	2020	2021	2022	2023(~1Q)
Broadband	69%	28%	27%	57%
Mobile	31%	72%	73%	43%

■ Mobile ■ Broadband

국내 / 해외

(단위 : 억원,%)

	2020	2021	2022	2023(~1Q)
해외	109 / 12%	1165 / 56%	2643 / 72%	206 / 56%
국내	812 / 88%	899 / 44%	1020 / 28%	162 / 44%

■ 국내 ■ 해외

자산총계

(단위 : 억원,%)

	2020	2021	2022	2023(~1Q)
유동자산	746 / 52%	1500 / 69%	2341 / 79%	2275 / 74%
비유동자산	684 / 48%	668 / 31%	768 / 21%	786 / 26%

■ 비유동자산 ■ 유동자산
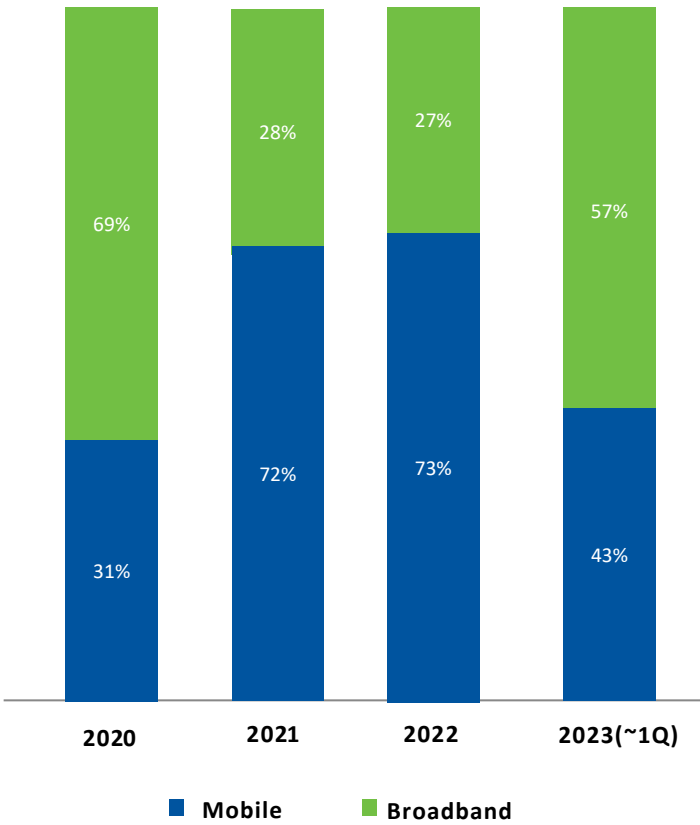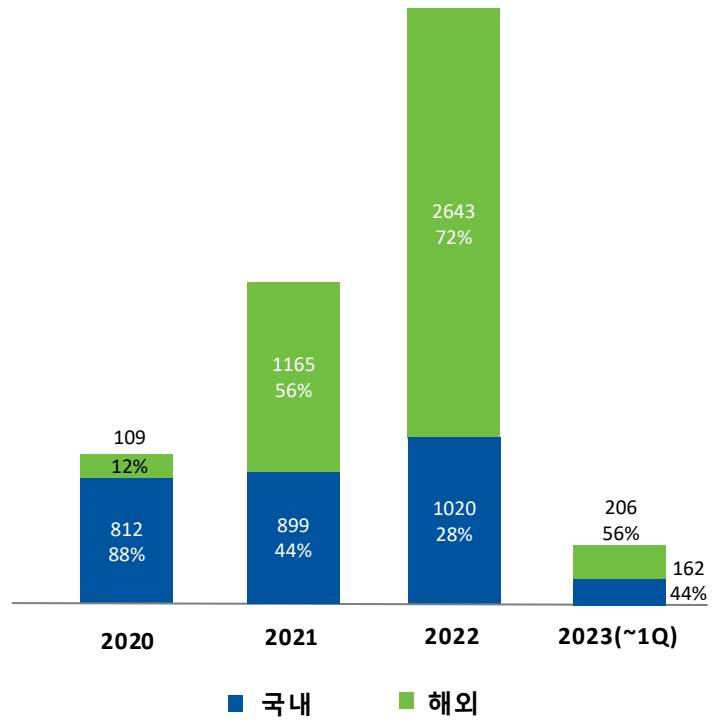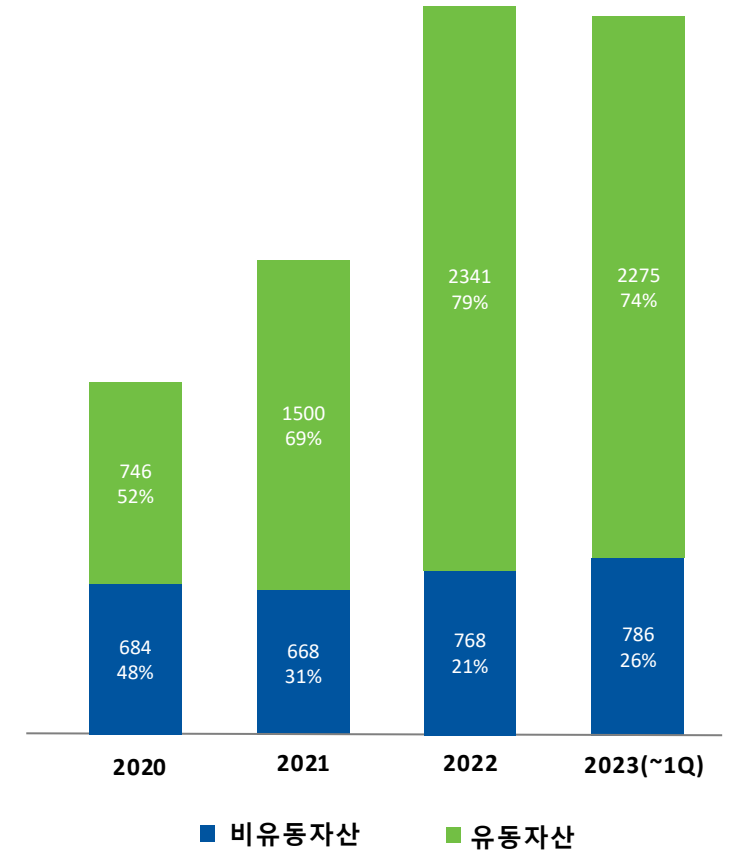
HFR's Quality and Process Management System

Resonant System Management	Quality Certifications	Assessment by Customers

Resonant System Management

- Adopted HFR System Management in 2007
- Run Innovation/Improvement proposal program every month
- Regularly updated every year
- In conjunction with the **internal control system** in 2021

Quality Certifications

- TL 9000 / ISO 9001
- ISO 140001
- NEBS Level 3
- Bronze from EcoVadis for sustainable growth

Assessment by Customers

- Supplier process audited and proved by global vendors and telecom customers

Strongly tied with Global Standard Bodies

HFR은 혁신적인 DNA를 가진 기술 중심 기업으로, CBRS, O-RAN, IEEE, SCTE ISBE 등 글로벌 표준 분야의 전문가들과 함께하고 있습니다.

Global Standard Bodies

CBRS Alliance	O-RAN Alliance	IEEE 1914.3	SCTE ISBE	TIP
Support the common interests of members, implementers and operators for the development, commercialization, and adoption of LTE solutions for the US 3.5 GHz Citizens Broadband Radio Service	Leading the industry towards open, interoperable interfaces and RAN virtualization	IEEE Standard for Radio over Ethernet Encapsulations and Mappings	SCTE ISBE is the applied science leader for cable telecommunications	An engineering-focused, collaborative methodology for building and deploying global telecom network infrastructure
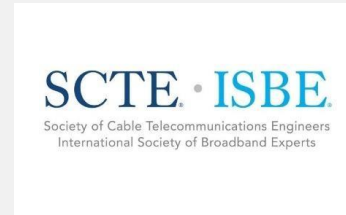
Business Place

한국 내 본사를 포함하여 미국, 일본, 말레이시아에 해외 법인/지사를 두고 **글로벌 비지니스를 위한 역량을 키워가고 있습니다.**

Chiyoda-ku, Tokyo, Japan

HFR Japan

HFR, Inc.

Seongnam-si, Gyeonggi-do, Republic of Korea

HFR Networks, Inc.

Richardson, Texas, USA

KUBtel

Shah Alam, Selangor, Malaysia

HFR Product Portfolio

HFR,Inc.
for Mobile Internet
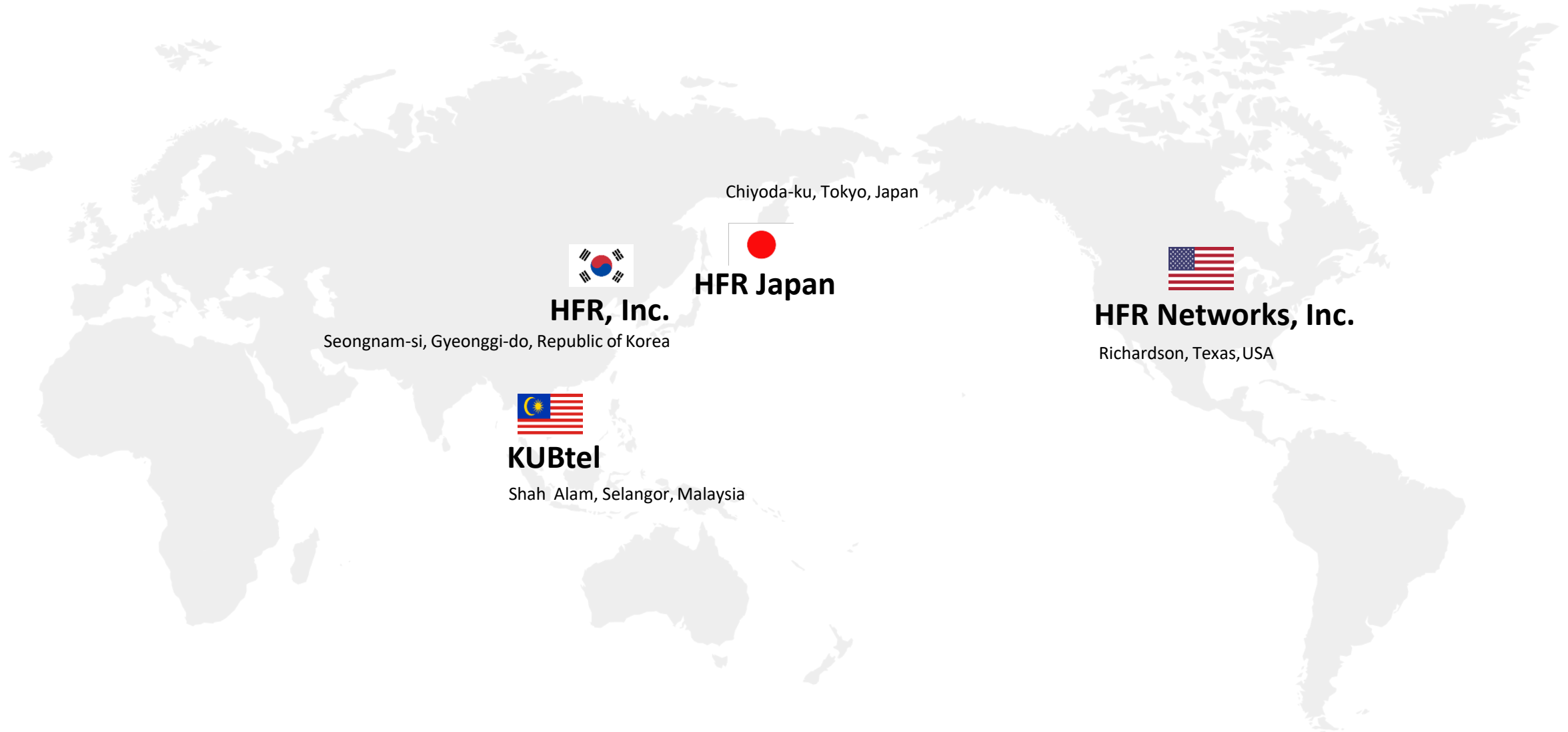
flexiHaul Solution

Converged Transport of All Mobile Traffic to save Operator s CAPEX/OPEX for 4G & 5G Services

- Provides fronthaul/midhaul for 4G (CPRI) and 5G (F1, eCPRI) traffic
- Available as a WDM or packet-based solution
- RAN vendor-neutral

4G BBU **5G DU** **5G CU**

CPRI   eCPRI/RoE   Ether.(F1)

flexiHaul
(Unified 4G&5G xHaul)

4G RRH **5G RU** **5G DRU**
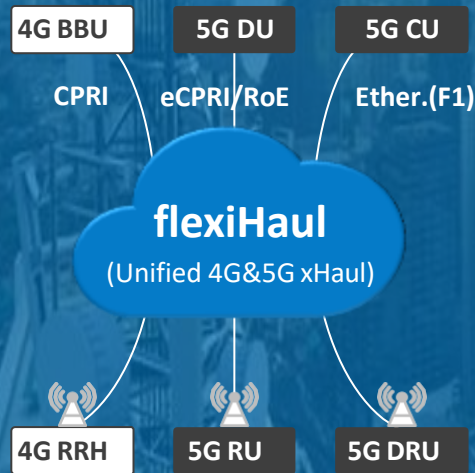
WDM Fronthaul Solution

- Optimize services over limited fiber assets for better economics and improved time to market
- Cost-effective, highly flexible family of scalable transport units that delivers a broad range of xHaul (fronthaul, midhaul and backhaul) services.
- Configurable as point-to-point, linear chain, point-to-multipoint, or ring network topologies and also Active to Active, Active to Passive configuration.
- WDM xHaul platform has an integrated transponder, controller and WDM filter. It offers a variety of performance, quality measurement and monitoring.

Packet Fronthaul Solution

- TSN switch optimized for xHaul supports CPRI, eCPRI and Ethernet
- The network migrating into Packet Radio Access Network for the future Function Split and software centric Radio Access Network.
- HFR's packet-based fronthaul platform supports 4G / 5G centralized and cloud-based RAN architectures by leveraging next-generation Packet RAN access technology.
- Time-Sensitive Networking (TSN) aggregation and transport switch supports interfaces for CPRI, eCPRI and Ethernet services.

Central Office

4G BBU   5G DU   5G CU

CPRI eCPRI F1   CPRI eCPRI F1

RoE

WDM COT   **Packet SW**

WDM Solution
CPRI + eCPRI + Ethernet over WDM

Active
Passive   **WDM**   **Ethernet**
Semi-Passive

TSN
RoE
O-RAN

Packet Solution
CPRI(RoE) + eCPRI + Ethernet over TSN Ethernet

HSN8000NA
5G-PON

WDM RT   **Packet SW**
RoE

Cell Site

CPRI eCPRI F1   CPRI eCPRI F1

M6424

4G RRH   5G RU   5G RU/DU

Legacy 4G Fronthaul   5G Fronthaul   5G Midhaul

With HFR's solution, 5G overlay is not needed on existing 4G transport networks, helping to reduce total costs and speed time to market of lucrative new 5G services

Mobile Transport

Converged Transport of All Mobile Traffic to save
Operator s CAPEX/OPEX for 4G & 5G Services

- LTE&5G simultaneous service through the existing 4G RRH using LTE spectrum
- Copying and forwarding the data to the radio unit to increase the number of radio units being managed by a single DU.

FlexiGate

- **LTE&5G simultaneous service** through the existing 4G RRH using LTE spectrum

  - Reducing Capex/Opex since a service provider does not need new 5G NR
  - In the initial phase of deploying new service, they can deploy 5G NR of 100M/200M in hotspots
  - Supporting multi vendors' DUs and RRHs
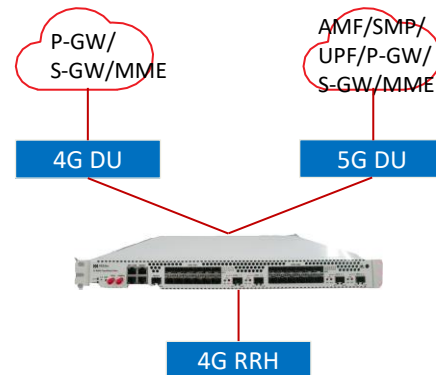
Fronthaul Mux based on O-RAN interface

- Copying and forwarding the data to the radio unit to increase the number of radio units being managed by a single DU.

  - If no FHM is being used, each RU is accommodated as one cell, but when using a FHM, a maximum of 12 RUs can be accommodated as one cell in a DU. At the launch of 5G services, this meant that more RUs could be accommodated in a single CU when forming a service area in a location having low required radio capacity.
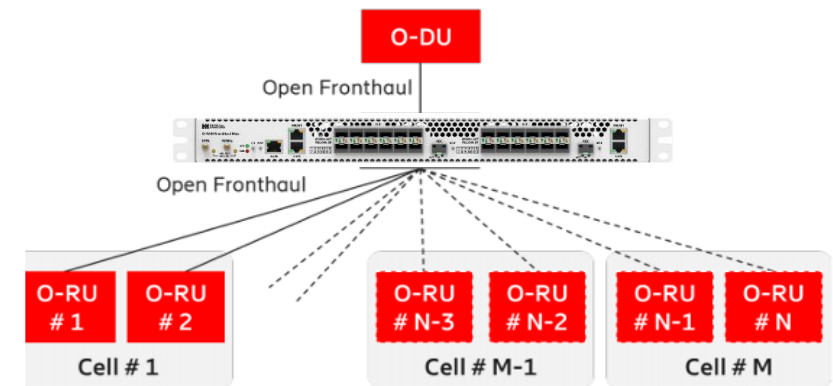
Multiple Cell Scenario
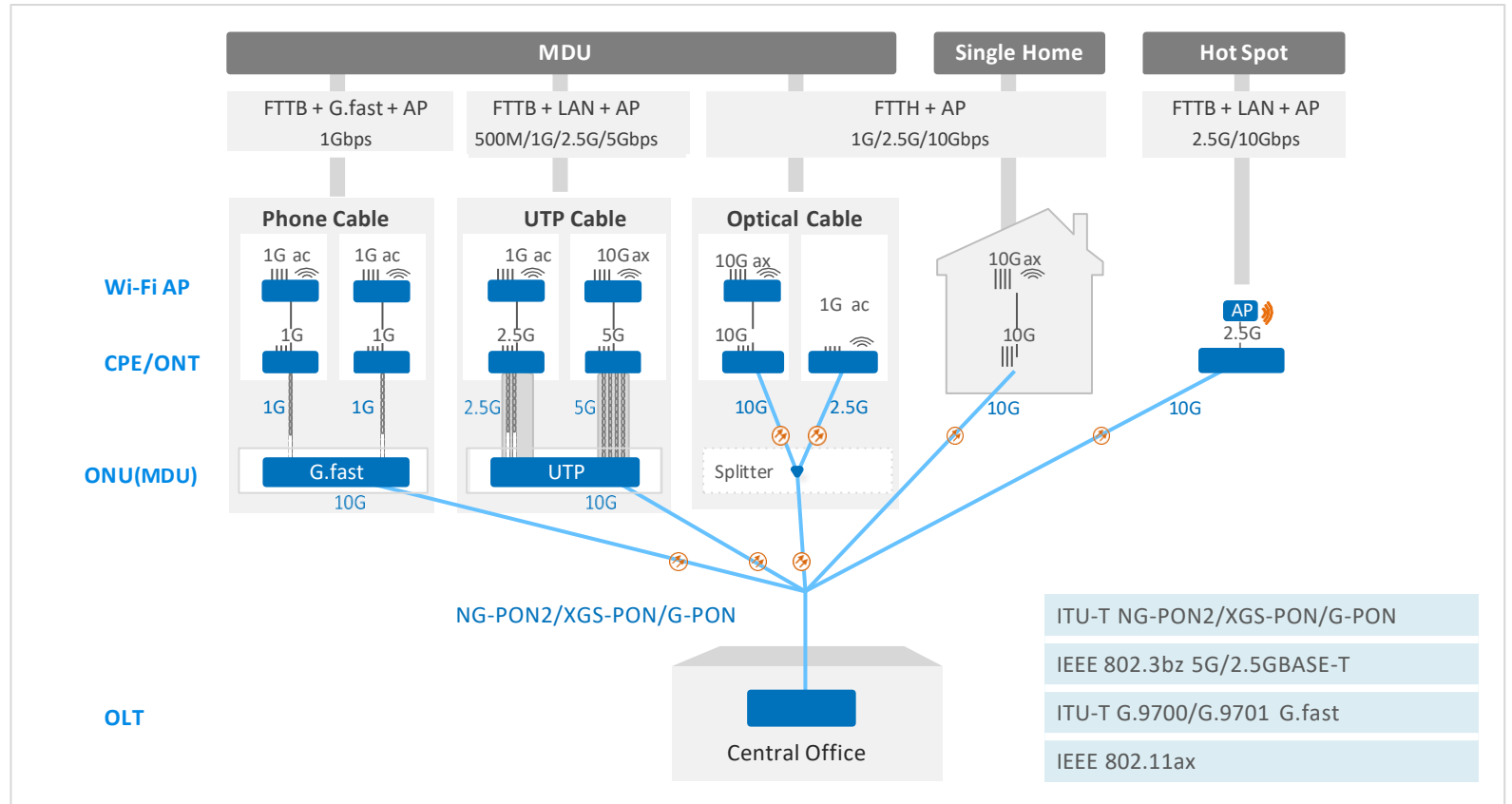
Broadband Access Solution

1G/2.5G/5G/10G to the Home

HFR is currently providing all three broadband solutions- FTTH, FTTB + LAN and FTTB + G.fast, allowing telecom operators to deliver ultra-high speed internet (1/2.5/5/ 10Gbps) to users for any residential environment.

## HFR's Broadband Access Solution

Any Residential Environment

MDU			+ Single Home + Hot Spot
+	+	+	+ +
Fiber	UTP	2-Pair	Fiber
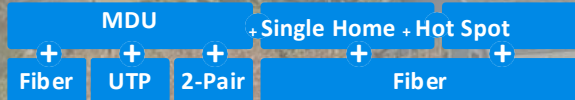
True Turnkey Solution

Wi-Fi AP: 4.8Gbps
+
CPE/ONT: 1G/2.5G/5G/10Gbps
+
ONU(MDU): UTP 4-Pair/2-Pair
+
OLT: NG-PON2/XGS-PON/10G-EPON/G-PON

---

10 Gigabit Internet Solution: XGS-PON and 10G-EPON

- XGS-PON lead fiber access technology for delivering residential, business, and mobile backhaul services.
- HFR to provide 10 Gigabit Internet service (2.5G/5G/10G to the home)for any residential environment
- Wired terminals up to 10G service and wireless terminals for 4.8G services
- End-to-end 10 Gigabit Internet solutions from OLT to ONU, ONT, CPE, and Wi-Fi access points.
- Multi-Gigabit Ethernet and G.fast provide the optimal solutionfor MDU/ MTU services.

Wi-Fi 6/6E Access Point

HFR,Inc.
for Mobile Internet

MDU			Single Home	Hot Spot
FTTB + G.fast + AP 1Gbps	FTTB + LAN + AP 500M/1G/2.5G/5Gbps	FTTH + AP 1G/2.5G/10Gbps		FTTB + LAN + AP 2.5G/10Gbps

Phone Cable — UTP Cable — Optical Cable

Wi-Fi AP: 1G ac, 1G ac, 1G ac, 10G ax, 10G ax, 1G ac, 10G ax, AP 2.5G

CPE/ONT: 1G, 1G, 2.5G, 5G, 10G, 10G

ONU(MDU): G.fast 10G, UTP 10G, Splitter

NG-PON2/XGS-PON/G-PON

OLT — Central Office

ITU-T NG-PON2/XGS-PON/G-PON
IEEE 802.3bz 5G/2.5GBASE-T
ITU-T G.9700/G.9701 G.fast
IEEE 802.11ax

my5G Solution

Our End-to-End Private 5G Solution, my5G includes 5G SA vCore, O-RAN based 5G vRAN and Business Platform.

HFR is transforming into a Private 5G solution provider delivering BSS/OSS, vCore, vRAN and vertical applications for digital transformation in enterprise and industry.
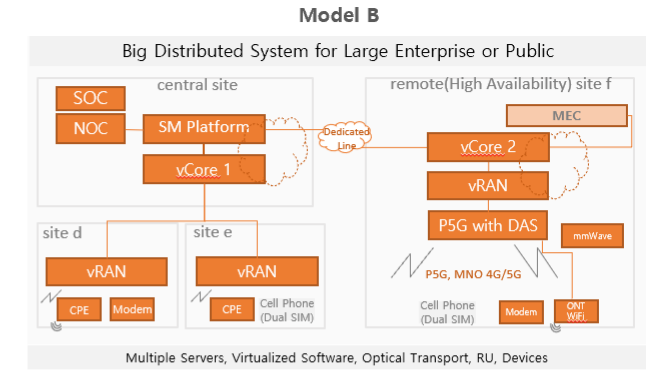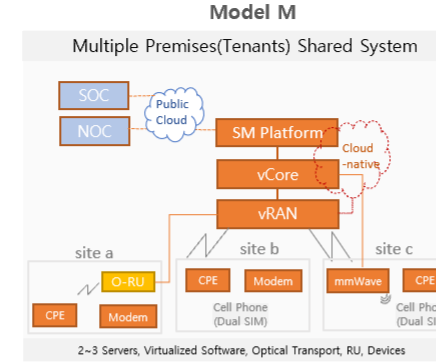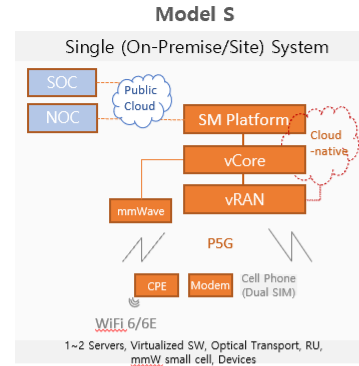
my5G Solution
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HFR Biz & Service Mgt Platform
+
HFR NaaS Platform (Fydena)
+
HFR Cloud Native 5G SA vCore
+
HFR Open vRAN (O-CU, O-DU)
+
HFR Radio Unit (O-RU)

Model S — Single (On-Premise/Site) System
1~2 Servers, Virtualized SW, Optical Transport, RU, mmW small cell, Devices

Model M — Multiple Premises(Tenants) Shared System
2~3 Servers, Virtualized Software, Optical Transport, RU, Devices

Model B — Big Distributed System for Large Enterprise or Public
Multiple Servers, Virtualized Software, Optical Transport, RU, Devices
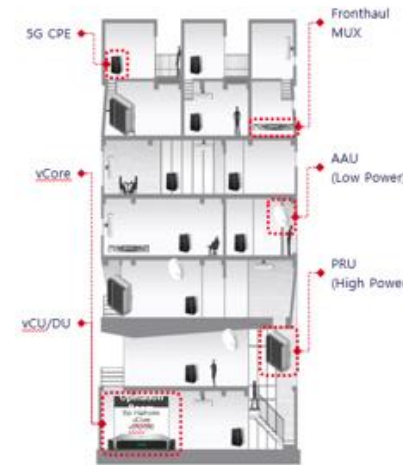
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