

# 5G and Private Network Technology

## Technical Summary



## Company Overview

**Name** EUCAST

**Established** May, 2011

**Business**

1. 4G/5G System Equipment Vendor
2. IOT and Digital Twin Solution
3. Military Communications

**Address** 4F, 262 Hwangsaeul-ro, Bundang-gu, Seongnam-si, Gyeonggi-do, Korea

**Website** [www.eu-cast.com](http://www.eu-cast.com)

## About CEO

**Name** Jaehyeong Kim

**Education**

- Seoul National University, EE, B.S. & M.S.
- University of California, LA, USA, EE, Ph.D.

**Career**

- CEO, EUCAST Global
- CEO, EUCAST
- Board Member, Korea Communications Agency (KCA)
- Counseling Member, Institute for Information & Communications Technology promotion (IITP)
- CTO, SeAH Networks/SeAH ICT
- Director of System Eng., POSCO ICT
- MTS, Lucent Technologies, Bell Labs, USA

**Patents**

US Patent 17  
KR Patent 22

- Signal Processing for Communication systems
- Radio Resource Management and MAC layer scheduling,
- Power Amplifier Linearization
- Channel Coding & Modulation
- Architectures for Upcoming Wireless Communication systems

# Company History and References

2004	2005-2009	2009-2010	2011
<p><b>POSCO ICT</b> Launched WiMAX Business Unit</p>	<p>Successful feasibility test with Korean Telecom (KT)</p>	<p><b>SeAH Network acquired WiMAX R&amp;D group from POSCO ICT</b></p>	<p><b>Established EUCAST</b></p>
<p>A key contributor to IEEE 802.16e standardization</p>	<p>Commercial Deployment</p> <ul style="list-style-type: none"> <li>• Q-MAX (Singapore)</li> <li>• KT (Korea)</li> <li>• Lucky Town TV (Japan)</li> <li>• Super iMAX (Uzbekistan)</li> <li>• DUCAT (Kazakhstan)</li> </ul>	<p>Technical Trials</p> <ul style="list-style-type: none"> <li>• CISCO, Clearwire, Intel</li> </ul> <p>Commercial Deployment</p> <ul style="list-style-type: none"> <li>• Super iMAX: 3<sup>rd</sup> order</li> <li>• Sprint Campus Solution (USA)</li> </ul>	<p><b>R&amp;D Contract</b></p> <ul style="list-style-type: none"> <li>• Next Generation Wireless access system for Korean military application (3.5 year contract) □ Korean Army is using the system since 2016</li> </ul>
2012-2013	2014-2016	2017-2020	2021-2022
<p><b>Commercial Account</b></p> <ul style="list-style-type: none"> <li>• WiMAX (Shikama Cho, Japan)</li> <li>• WiMAX (KOZA, Zambia)</li> <li>• IoT solution for Korean National Assembly</li> </ul>	<p><b>Commercial Account</b></p> <ul style="list-style-type: none"> <li>• WiMAX (Mimata Cho, Japan)</li> <li>• Satellite system for Korean military application</li> <li>• LTE BTS supply 26,000 units (UQC/KDDI, Japan)</li> <li>• IoT solution for E-Health</li> </ul>	<p><b>Commercial Account</b></p> <ul style="list-style-type: none"> <li>• LTE for Maritime Police (KT)</li> <li>• LTE for public safety (Korean Gov., KT)</li> <li>• LTE-Marine (Korean Gov., KT)</li> <li>• LTE system (Gujo city, Japan)</li> <li>• LTE for Korean Military</li> </ul>	<p><b>Commercial Account</b></p> <ul style="list-style-type: none"> <li>• 5G mmWave gNodeB trial (KT)</li> <li>• 5G based smart light trial at Brazil (Qualcomm, Juganu)</li> <li>• 5G small cell demo site (Qualcomm)</li> <li>• CBRS trial site (Colorado Department of Transportation, USA)</li> <li>• 5G system for drone communication (Korean local government)</li> </ul>
<p><b>R&amp;D Contract</b></p> <ul style="list-style-type: none"> <li>• LTE All-in-one Gateway for IoT solution (Korean Gov. Fund)</li> </ul>	<p><b>R&amp;D Contract</b></p> <ul style="list-style-type: none"> <li>• LTE eMBMS system (Korean Gov. Fund)</li> <li>• 5G Wireless Access Core Tech. (Korean Gov. Fund)</li> </ul>	<p><b>R&amp;D Contract</b></p> <ul style="list-style-type: none"> <li>• IoT based Location measurement system (Korean Gov. Fund)</li> <li>• 5G NR small Cell (ETRI, Qualcomm, Korean Gov.)</li> <li>• 5G for Virtual Reality (Korea-Europe joint project)</li> </ul>	<p><b>R&amp;D Contract</b></p> <ul style="list-style-type: none"> <li>• 5G for smart factory (Korean Gov.)</li> <li>• 5G Network in a Box for military application (Korean Gov.)</li> </ul>

**Established EUCAST Global in USA**

# Business Area and Roadmap

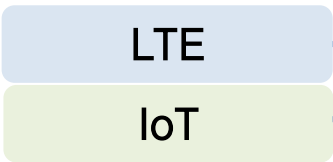
Business

- 4G LTE and 5G
  - Core Network and Base station (indoor/outdoor)
  - Public Network ( Public Safety, Military, Railway, etc.)
- Digital Twin Solution
  - Smart City/Factory/Energy/Farm, etc.

Industry 4.0  
Digital Transformation



WiMAX

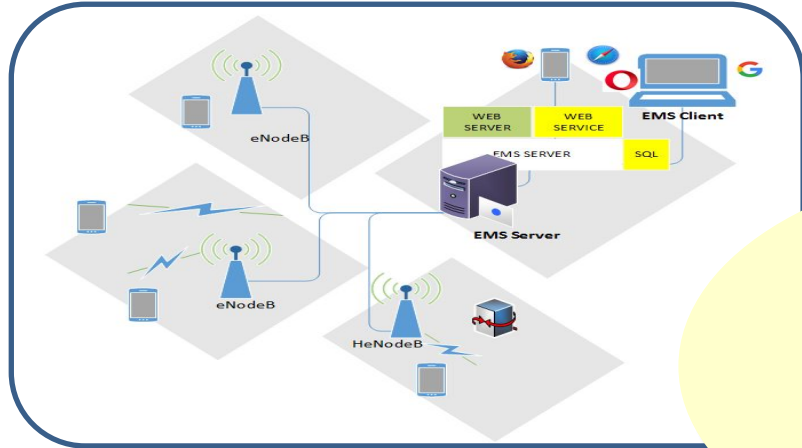


Technology

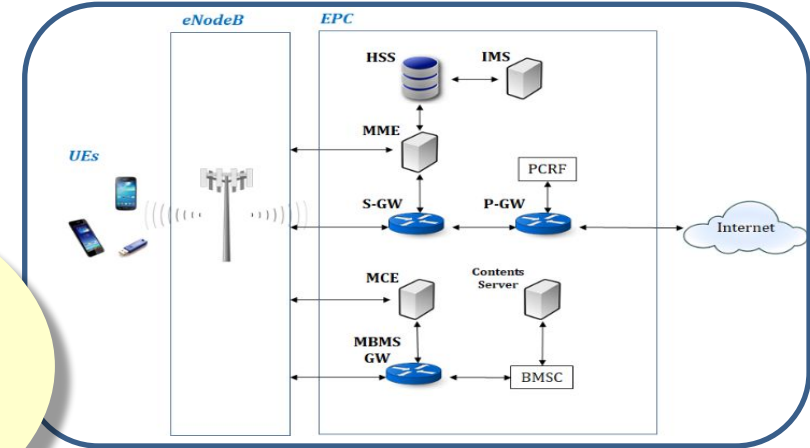
- Digital Twin
- Data collection/analysis & Control
  - 3D visualization

# 4G LTE / 5G Total Solution – EUCAST Products

## EMS (element management system)



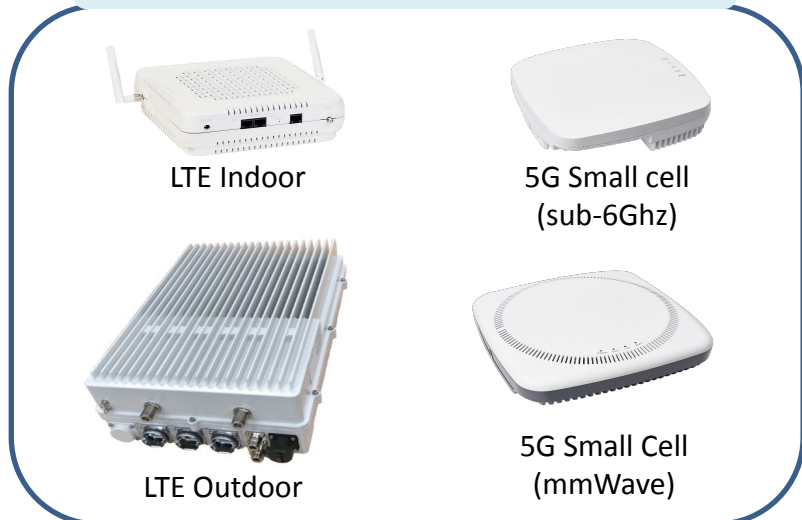
## Core Network : EPC / 5G Core



Field proven at  
Korean/Japanese Market

- Commercial
- Public Safety
- Military

## 4G/5G Base Station



### Korea

- Public Safety Network
- LTE Marine
- Maritime Police
- Military

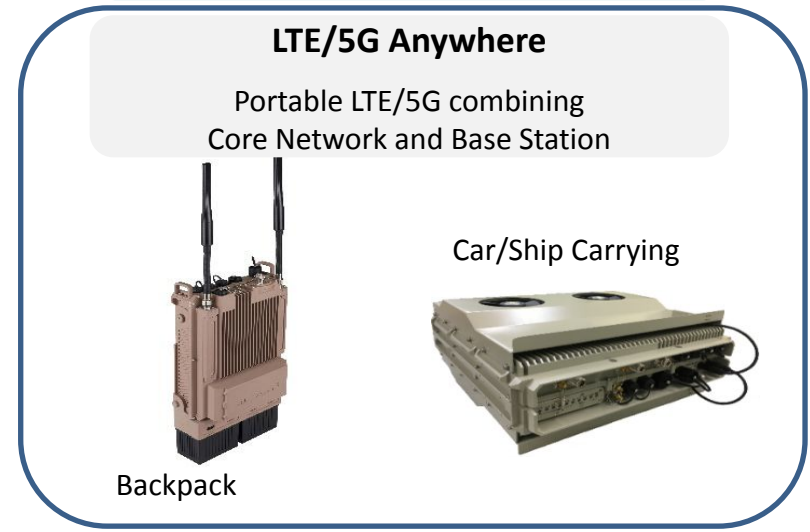
### Japan

- Enterprise Small Cell
- Public Safety Network




## Network in a Box

### LTE/5G Anywhere

Portable LTE/5G combining  
Core Network and Base Station



# Commercial Accounts – Korean Market

Products (supply year)	Purpose	Description	End Customer and Supply chain
<b>Portable LTE System (or Network in a Box) Manpack type (2019)</b> 	Public Safety Network	<ul style="list-style-type: none"> <li>▪ Make LTE total network (core network and base station) portable by implementing them within compact enclosure.</li> <li>▪ It can quickly restore telecommunication network whenever and wherever communication network is not available.</li> <li>▪ Portable LTE system is a new type of product, and this is the first case to be used for nationwide usage.</li> <li>▪ This product has global leading capacity, features and quality.</li> </ul>	Korean Government (Ministry of Interior and Safety) and KT
<b>Umbrella Cell (2019)</b>	Public Safety Network	<ul style="list-style-type: none"> <li>▪ Equipment that covers an area with a radius of 20-30 Km in the event of a disaster by installing LTE base stations and core networks in high mountains</li> </ul>	Korean Government (Ministry of Interior and Safety) and KT
<b>LTE-M (Marine) (2019)</b> 	For ships near seashore	<ul style="list-style-type: none"> <li>▪ Base station installed on the coast to enable LTE service in the coastal sea.</li> <li>▪ Base station for outdoor usage</li> </ul>	Korean Government (Ministry of Oceans and Fisheries) and KT
<b>Portable LTE System Car/Ship carrying type (2019)</b> 	For Maritime Police ships	<ul style="list-style-type: none"> <li>▪ Portable LTE system to be installed at car or ship (It has higher transmission power and has more coverage than manpack type)</li> <li>▪ Installed at maritime police ships (Trial completed in 2019, To be supplied for the main project in 2020)</li> </ul>	Korean Maritime Police and KT

# Commercial Accounts – Japanese Market

## ❖ UQ Communications: Indoor Small Cell for Enterprise customers

- Product type: 2.6 GHz LTE TDD Indoor small cell
- Supply Quantity: 26,000 units [From 2015 to 2016]
- Telecom. Operator: UQ Communications (a subsidiary of KDDI, Japan)
- Sold by Hitachi Brand
- [Field proven quality] Nationwide commercial service started since March 2016 □ more than 5 years of service without noticeable issues.



## ❖ Japanese Local Government (Gujo city, Kihu-hyun)

- LTE total solution (2.6 GHz LTE TDD)
  - Base Station: Indoor base station, Outdoor base station.
  - Core Network and Management: EPC (evolved packet core), EMS
  - Portable LTE system: Manpack type portable LTE system
  - User Device: CPE and Mobile Router
- Status
  - Contract on December 2019
  - Completed Product delivery on May 2020



# Product – Outdoor eNodeB

- DU (digital unit) / RU (radio unit) integrated
- Standard : 3GPP Release 13
- Seamless mobility
- Full QoS
- Sync. : GPS (IEEE1588v2 option)
- IP-65



ITEM	Specification	Remark
Frequency Range	LTE Standard Frequency Band	TDD or FDD
Maximum Tx Power	+43dBm/ANT, 2T2R @BW 10MHz	
Bandwidth	5MHz/10MHz/20MHz	
Modulation	QPSK/16QAM/64QAM	
Antenna Config.	2x2 MIMO	
Backhaul	1000Base-T, Copper or Optic support	
Power	-48VDC	Using AC/DC adaptor
Power Consumption	250W	@ 40 Watt total Max. transmission power
Size (mm)	447(W) x 282(D) x 144(H)	Without Bracket
Weight	15 Kg	Without Bracket
GPS Interface	L1 band	
Installation	Wall or Pole Mount	



# Product – Indoor eNodeB

- DU (digital unit) / RU (radio unit) integrated
- Standard : 3GPP Release 13
- Seamless mobility
- Full QoS
- Sync. : GPS (IEEE1588v2 option)



ITEM	Specification	Remark
Frequency Range	LTE Standard Frequency Band	FDD or TDD
Maximum Tx Power	+20dBm/ANT, 2T2R @BW 20MHz	
Bandwidth	5MHz/10MHz/20MHz	
Modulation	QPSK/16QAM/64QAM	
Antenna Config.	2x2 MIMO	6dBi internal patch antenna installed
Backhaul	1000Base-T × 1	
Power	AC adaptor : AC 100~240V, 50/60Hz DC 12V	Using AC/DC adaptor
Power Consumption	35W	
Size (mm)	200(W) x 200(D) x 70(H)	Excluding protrusion
Weight	1.5 Kg	
GPS Interface	L1 band	
Installation	Wall Mount	

# Product – CBRS Outdoor High Gain eNodeB (Class B)

- DU (digital unit) / RU (radio unit) integrated
- Standard : 3GPP Release 13
- Seamless mobility
- Full QoS
- Sync. : GPS (IEEE1588v2 option)
- IP-65



Item	Description	Remark
Duplexing Mode	TDD	3550MHz ~ 3700MHz
Frequency Band	LTE band 48	
Carrier Configuration	Single Carrier	for Omni or Sector
Antenna Configuration	2T2R	
Channel Bandwidth	10MHz/20MHz	
Max Output Power	1.5W + 1.5W	47 dBm EIRP per 10 MHz
Synchronization	GPS or IEEE1588 v2	
Network Interface	100/1000 Base-T / 1000 Base-X	RJ-45 or Optic (SFP)
Installation	Wall Mount or Pole Mount	
Input Power	-48 VDC	
Size (WxHxD) [mm]	209 x 335 x 109	without Bracket
Weight	7.5 kg	without Bracket
Power Consumption	65 Watt [typ. avg.] 80 Watt [typ. Peak]	
Operating Temperature	-40°C ~ 55°C	
Humidity	5% ~ 95%	

### Peak data rate

- DL 75Mbps, UL 15Mbps (Frame Config 1)
- DL 100Mbps, UL 7.5Mbps (Frame Config 2)

### User Capacity

- 100 concurrent users

# Product – CBRS Indoor Low Gain eNodeB (Class A)

- DU (digital unit) / RU (radio unit) integrated
- Standard : 3GPP Release 13
- Seamless mobility
- Full QoS
- Sync. : GPS (IEEE1588v2 option)

Item	Description	Remark
Duplexing Mode	TDD	3550MHz ~ 3700MHz
Frequency Band	LTE band 48	
Carrier Configuration	Single Carrier	for Omni or Sector
Antenna Configuration	2T2R	
Channel Bandwidth	10MHz/20MHz	
Max, Output Power	22dBm + 22dBm	Changeable on requests
Synchronization	GPS or IEEE1588 v2	
Network Interface	100/1000 Base-T	RJ-45
Installation	Wall Mount	
Input Power	+12VDC	with AC/DC Adaptor
Size (WxDxH) [mm]	188 x 272 x 55	
Weight	2.1 kg	
Power Consumption	40 Watt	
Operating Temperature	0°C ~ 40°C	
Humidity	5% ~ 95%	



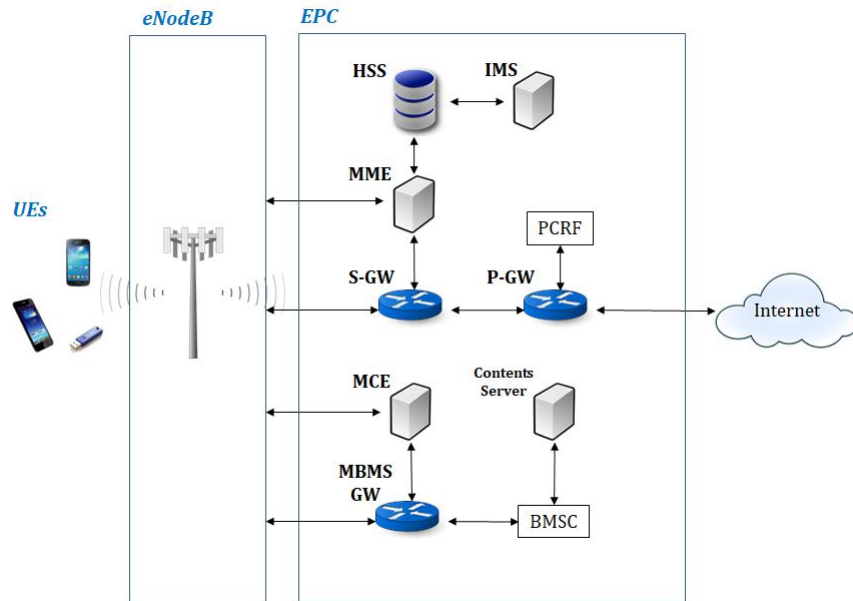
### Peak data rate

- DL 75Mbps, UL 15Mbps (Frame Config 1)
- DL 100Mbps, UL 7.5Mbps (Frame Config 2)

### User Capacity

- 100 concurrent users

# Product – Evolved Packet Core (EPC)



## Capacity and Interface

function	Remark
<b>Performance</b>	<ul style="list-style-type: none"> <li>Module type (1G NIC) : 300 UEs, 350Mbps</li> <li>PC type (2 x 10G NIC) : 2K UEs, 10Gbps</li> <li>Server type (2 x 40G NIC) : 10K UEs, 24Gbps</li> <li>+400K UE data management</li> </ul>
<b>Function</b>	<ul style="list-style-type: none"> <li>UE/E-RAB management process</li> <li>UE authentication (AES, Snow3G, ZUC)</li> <li>Handover (S1, X2)</li> <li>Bearer management based on QCI 65, 66, 69, 70</li> </ul>
<b>Interface</b>	<ul style="list-style-type: none"> <li>SCTP (S1, Diameter), UDP (GTP)</li> <li>IPv4/v6 (Transport layer, assign UE IP)</li> <li>Support diameter (HSS)</li> </ul>

## Default and Option

Default	Option
<ul style="list-style-type: none"> <li>Mobility Management Entity (MME)</li> <li>Serving Gateway (SGW)</li> <li>Packet Data Network Gateway (PGW)</li> <li>Home Subscriber Server (HSS)</li> <li>Policy &amp; Charging Rules Function (PCRF)</li> </ul>	<ul style="list-style-type: none"> <li>Multimedia Broadcast Multicast Service Gateway (MBMS GW)</li> <li>Broadcast Multicast Service Center (BMSC)</li> <li>IP Multimedia Subsystem (IMS)</li> <li>Multicast Coordination Entity (MCE)</li> </ul>

# Product – Network in a Box (Backpack)

## Combined eNodeB + EPC for Public Safety & Military applications

- eNodeB : Digital Unit (DU) / Radio Unit (RU) integrated
- EPC : MME, S-GW, P-GW, HSS, PCRF
- App Servers (option) : VoIP, PTT
- Isolated E-UTRAN Operation for Public Safety (IOPS)
- Standard : 3GPP Release 13
- Freq. Band : FDD / TDD LTE Standard Band
- Ch. BW : 5 / 10 / 20 MHz
- MIMO : 2x2
- Seamless mobility
- Full QoS
- SON
- IP-65



ITEM	Specification	Remark
BTS Configuration	Single Carrier	
Network Interface	100/1000 Base-T (RJ-45), 1000Base-X (SFP)	
Max Output Power	4W + 4W	
Installation	Backpack	
Input Power	Battery type + AC 110/220V	
Size(WxHxD) [mm]	295 x 553 x 173	With battery/bag/frame
Weight	10.5 kg	Without battery
Power Consumption	130 Watt (typical)	
Operating Temperature	-30 ~ +50°C	

# Product – Network in a Box (Car/Ship Carrying)

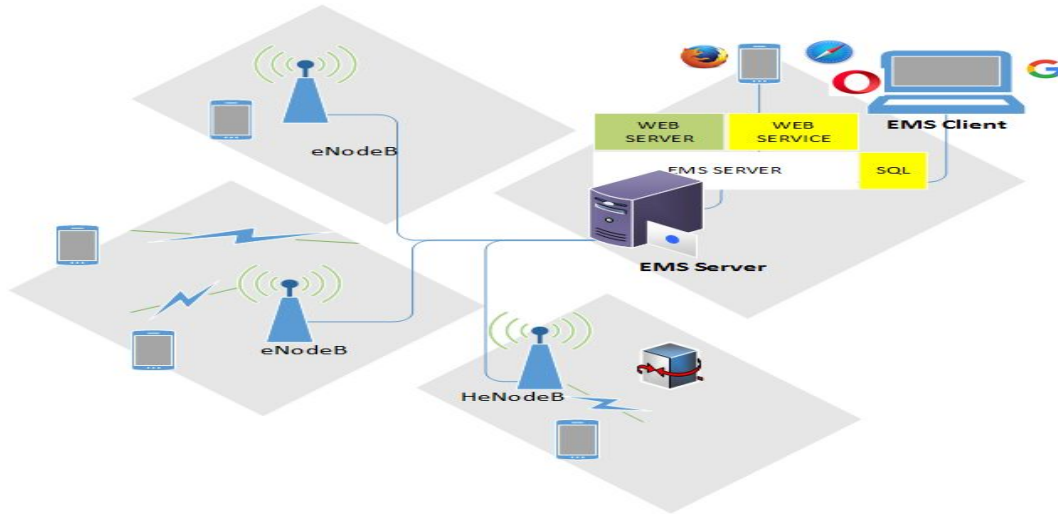
## Combined eNodeB + EPC for Public Safety & Military applications

- eNodeB : Digital Unit (DU) / Radio Unit (RU) integrated
- EPC : MME, S-GW, P-GW, HSS, PCRF
- App Servers (option) : VoIP, PTT
- Isolated E-UTRAN Operation for Public Safety (IOPS)
- Standard : 3GPP Release 13
- Freq. Band : FDD / TDD LTE Standard Band
- Ch. BW : 5 / 10 / 20 MHz
- MIMO : 2x2
- Seamless mobility
- Full QoS
- SON
- IP-65



ITEM	Specification	Remark
BTS Configuration	Single Carrier	
Network Interface	100/1000 Base-T (RJ-45), 1000Base-X (SFP)	
Max Output Power	20W + 20W	
Installation	Rack Mount	
Input Power	-48 VDC	
Size(WxHxD) [mm]	295 x 553 x 173	Including FAN units
Weight	25 kg	Including FAN units
Power Consumption	360 Watt (typical)	Including FAN units
Operating Temperature	-30 ~ +50°C	

# Product – Element Management System (EMS)



- HTTP/TR-069 support
- TR-181/TR-196 standard data model
- EMS is based on web, so EMS client is not relevant with OS and doesn't require to install other SW.
- EMS HW module redundancy can be provided.

Function	Remark
<b>Configuration Management</b>	. eNodeB configuration through RPC methods . Get/Set LTE stack related parameters
<b>Auto configuration and provisioning (ANR)</b>	. Check/set parameters (add eNB, eNB operation, SW manage, neighbor manage, restart)
<b>Status management</b>	. Set GUI based on information from equipment
<b>Fault management</b>	. Alarm list/history/information
<b>Performance management</b>	. Get performance data from equipment . Check/analyze statistic information
<b>eNB diagnostics</b>	. diagnostics
<b>SW management</b>	SW & firmware image management
<b>System Event Records</b>	. Event records
<b>Log/history management</b>	. Log/history management

# Product Line-up Comparison

**Compact & Low Cost**  
**East to Install/Maintenance**

**Big Vendors**

- Ericsson
- Nokia
- Samsung
- Huawei



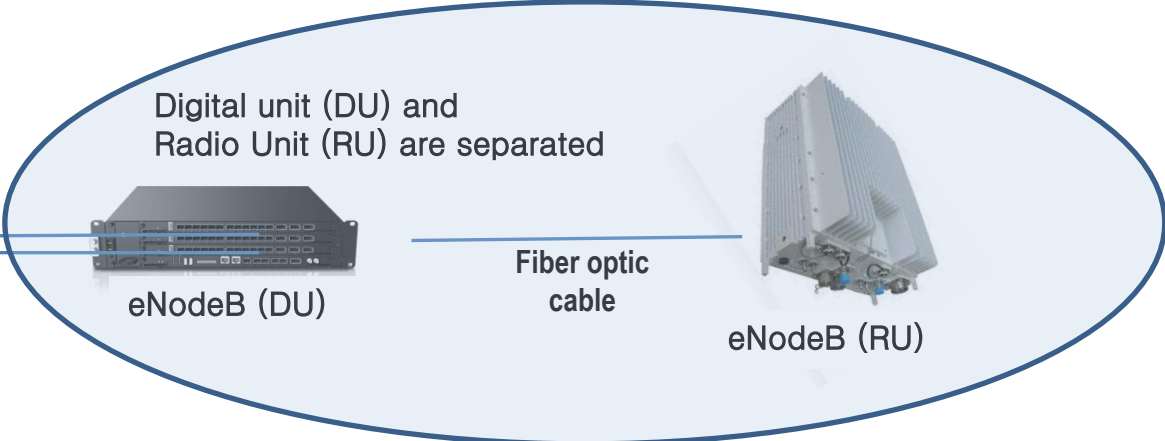
EPC



Network



EMS



**EUCAST**



EPC (evolved packet core)



Network



EMS (element management system)

equivalent

eNodeB



Network in a Box (NIB)  
(Car/Ship carrying)



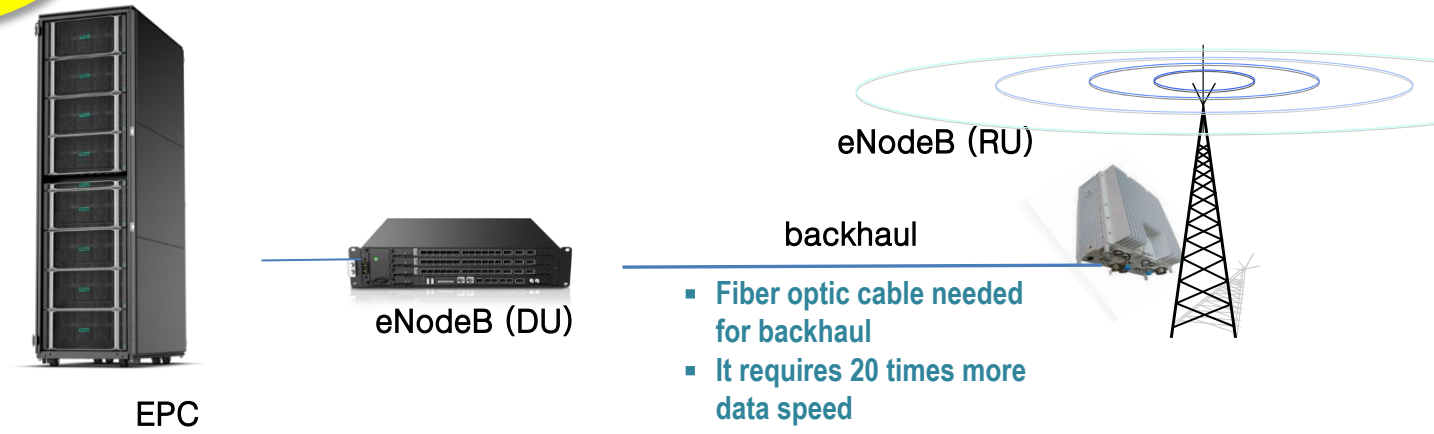
NIB (manpack)

- **Compact:** Digital unit and Radio unit are combined (no need fiber optic cable in-between)
- **Low Cost**
- **Light weight, Low power consumption**
- **Easy to install**
- **Easy Maintenance**



# Base Station Configuration – DU and RU

**DU-RU Separated eNodeB**

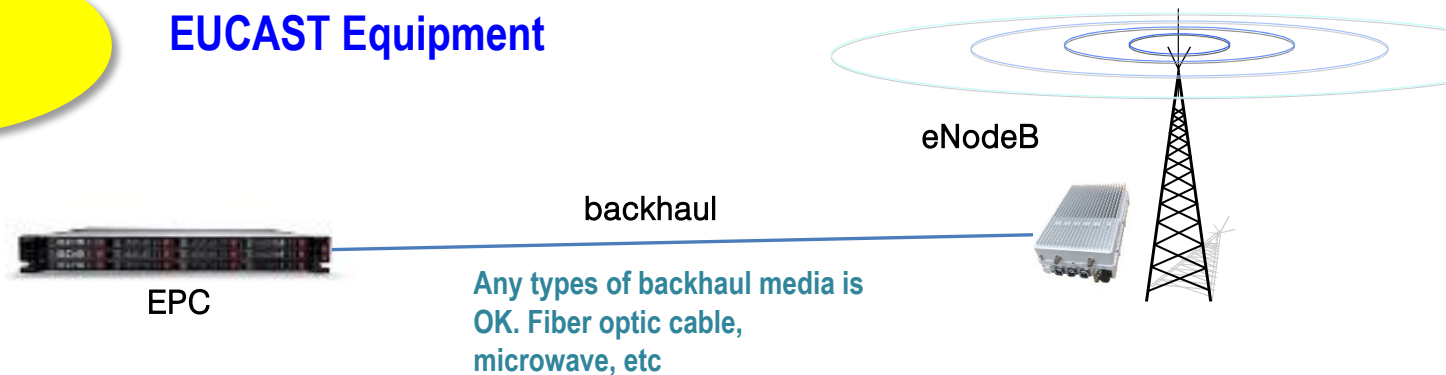


- Fiber optic cable needed for backhaul
- It requires 20 times more data speed

- Digital unit (DU) and radio unit (RU) of base station are separated
- DU manages several RU's
- DU can handle large capacity □ good for high population density area which has good fiber optic cable infrastructure
- Backhaul requires very high speed (20x data speed)

**DU-RU Combined eNodeB**

**EUCAST Equipment**



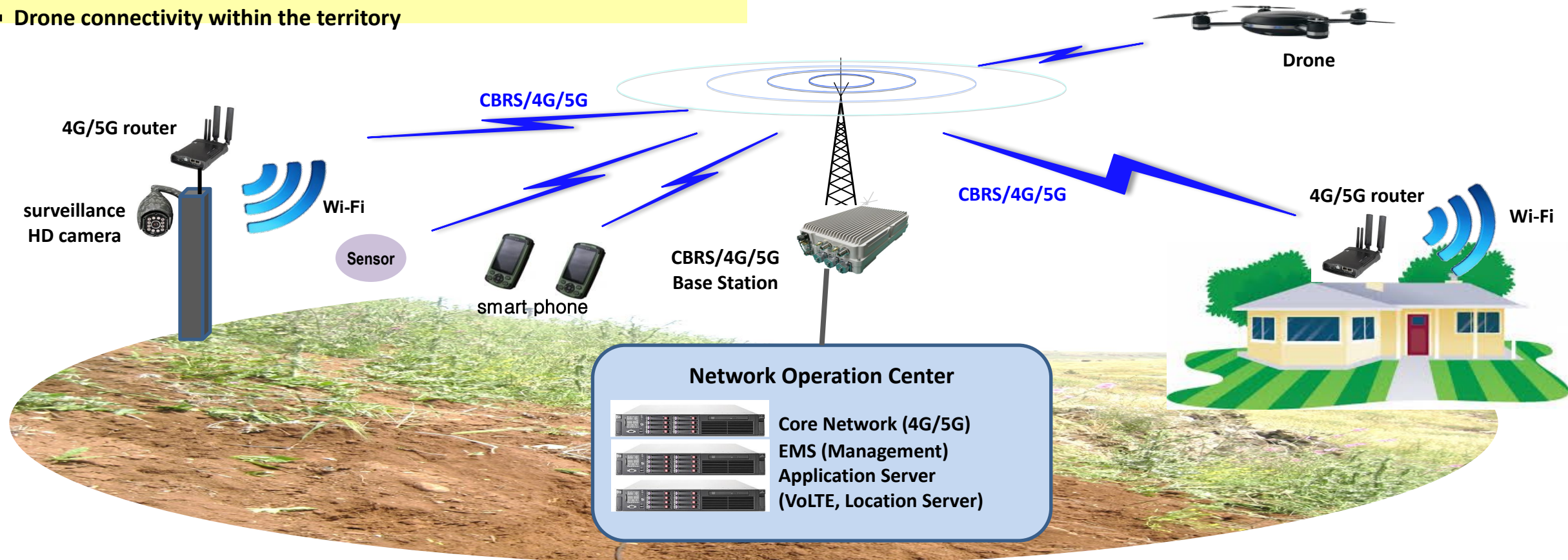
Any types of backhaul media is OK. Fiber optic cable, microwave, etc

- Digital unit (DU) and radio unit (RU) of base station are combined within one body
- Any types of backhaul is OK
- Easy to install
- Low maintenance cost

# Internet Coverage – Rural Area / Mining / Farming / Private Network

## Connectivity Everywhere covering the whole terrain

- 4G/5G total solution for private network
- Full data coverage in the territory
- Voice & Video call available everywhere
- All the sensors are connected
- Drone connectivity within the territory



# Internet Coverage – Rural Area / Mining / Farming / Private Network

## Trial Site: Colorado Department of Transportation (CDOT)



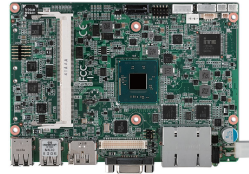
# Internet Coverage – Rural Area / Mining / Farming / Private Network



## Portable LTE System



**[Car/Ship Carrying]**



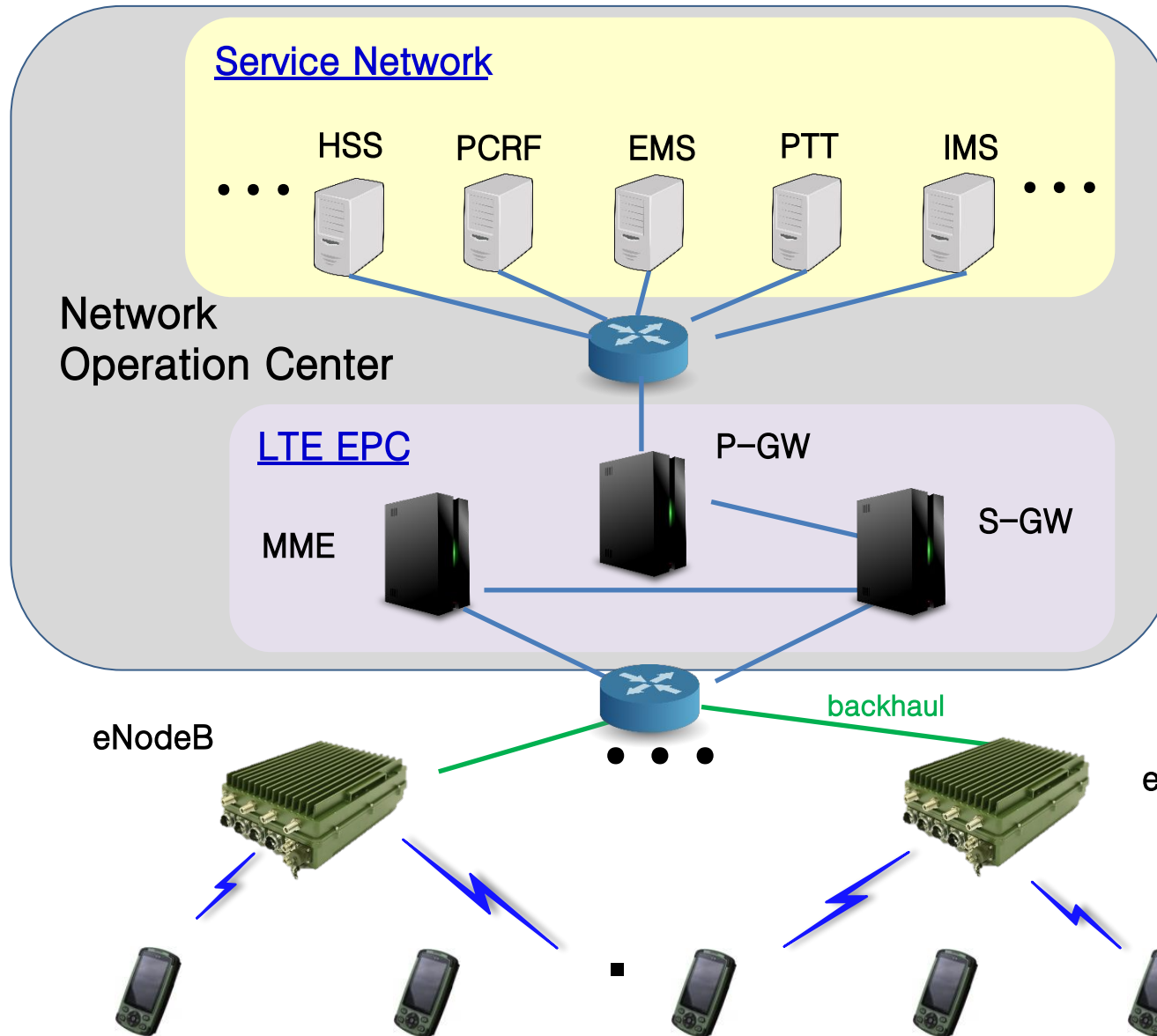
- On-board
- Local EPC
  - IMS (VoIP)
  - PTT Server



**[Backpack]**

- ◆ LTE Anywhere: Portable system Combining EPC/IMS and eNodeB).
- ◆ Self-Organizing/Self-Healing :
  - Self network configuration □ Quick and easy network deployment
  - Self sustainable network in case of backhaul disconnection.
- ◆ Full LTE EPC/IMS
  - 3GPP Rel. 13 compliant system
  - Full EPC (HSS, MME, S-GW, P-GW)

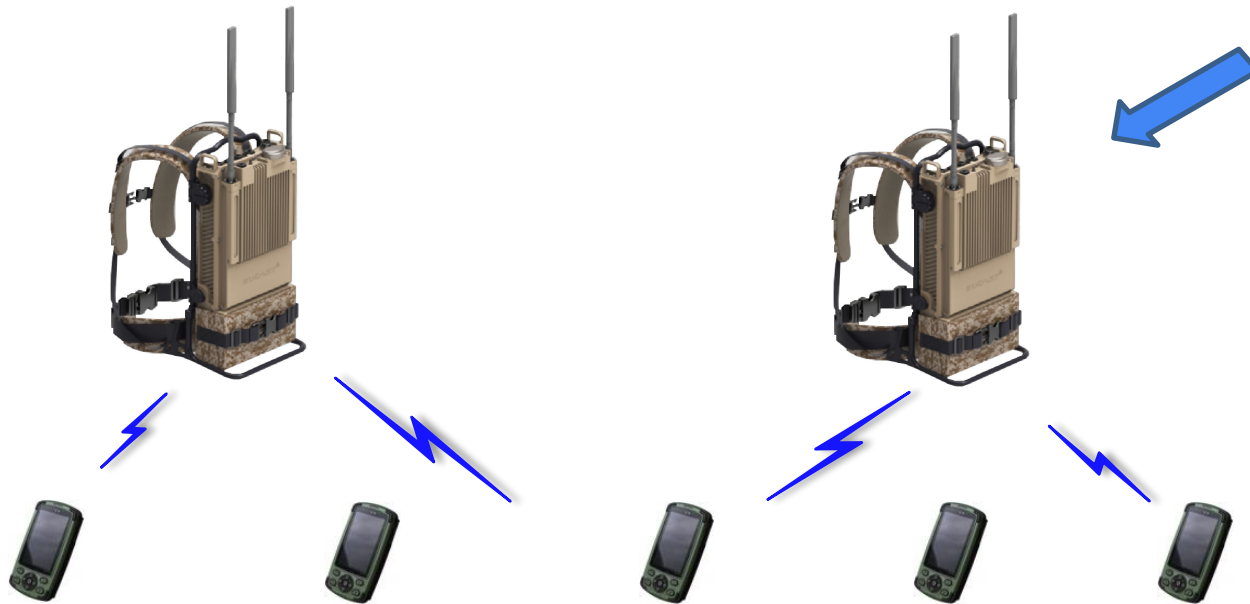
# Network Concept – Conventional LTE Network



- eNodeB : LTE Base Station
- EPC (Evolved Packet Core)
  - MME (Mobility Management Entity)
  - S-GW (Serving Gateway)
  - P-GW (PDN Gateway)
- HSS (Home Subscriber Server)
- PCRF (Policy & Charging Rules Function)
- IMS (IP Multimedia Subsystem)
- PTT (Push To Talk)

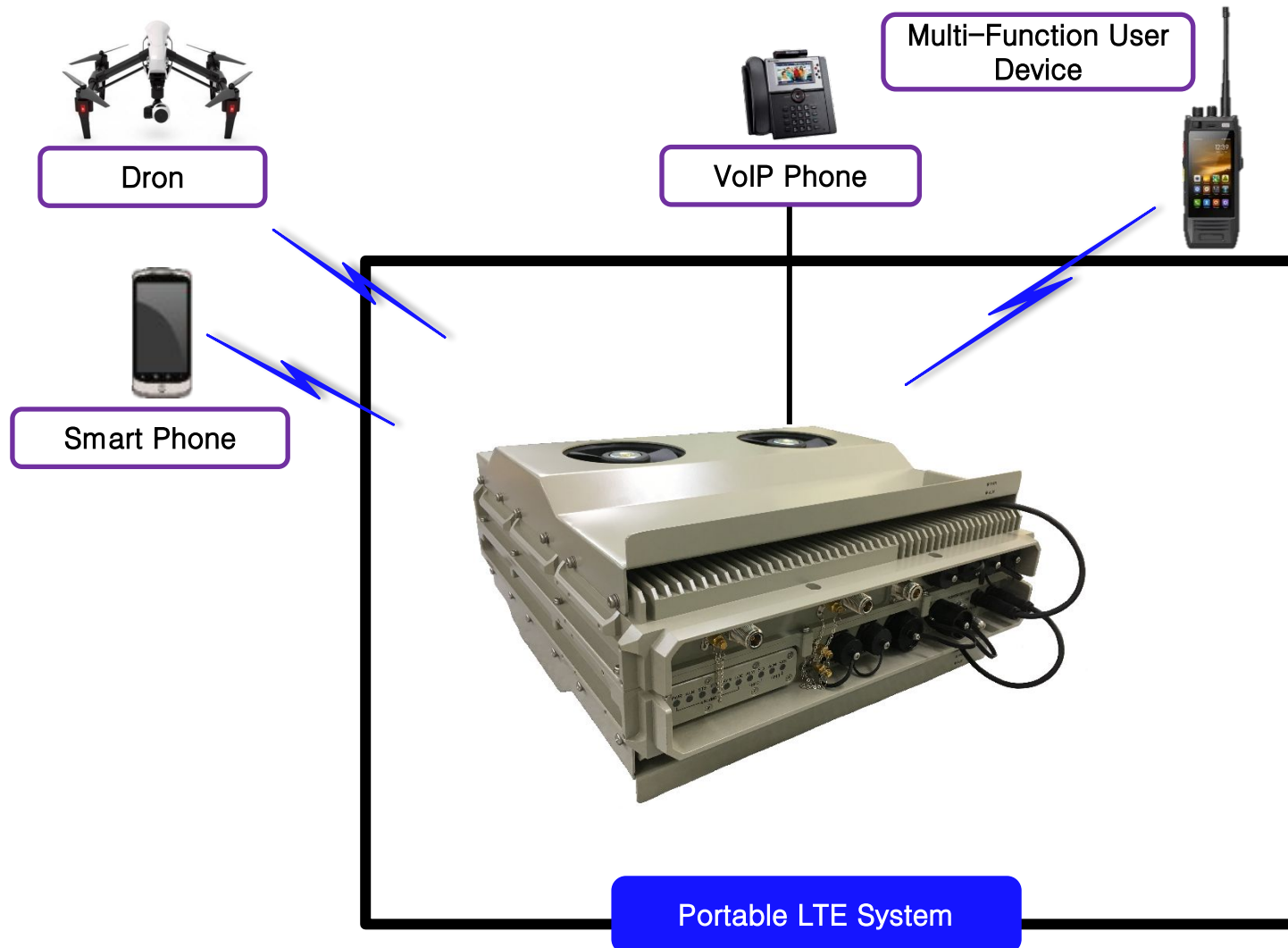
# Network Concept – Portable LTE System

- eNodeB : LTE Base Station
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- IMS (IP Multimedia Subsystem)
- PTT (Push To Talk)



# Network in a Box – Car/Ship Carrying

## Network in a Box (Portable LTE System) for Public Safety and Military Applications



### Portable Type

- Carried by Car or Ship
- Man Carry

### Backhaul

- Optical Cable
- Microwave (P2P Bridge)
- Satellite

### 3GPP - Isolated E-UTRAN Operation for Public Safety (IOPS)

- Local EPC (MME, SGW, PGW, HSS + more)
- eNodeB
- Separate PLMN with “reserved for operator mode”



# Network in a Box – Backpack



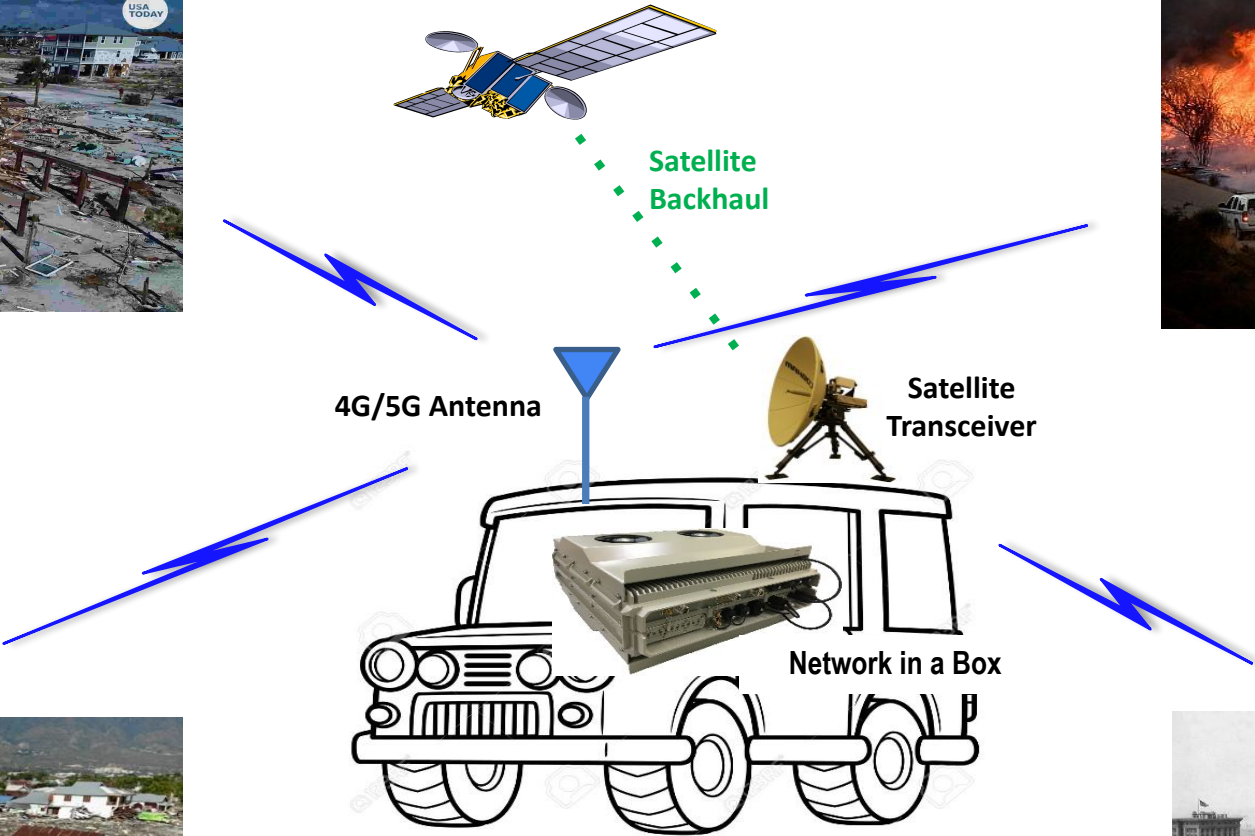
## Feature Overview

- Frequency: LTE full band (FDD/TDD)
- Data speed
  - FDD: 150Mbps/50Mbps @ 20MHz BW
  - TDD: 75Mbps/15Mbps @ 20MHz BW
- Coverage: > 1 Km (depends on terrain)
- Weight: <10Kg (without battery)
- Battery : Rechargeable Li-Ion rugged battery packs
- Dual removable antennas providing MIMO air interface
- Rugged enclosure designed IP65
- Backhaul port: Ethernet & Fiber optic

## EPL2000 Components

- LTE eNodeB
- Core Network and Application SW Functions
  - EPC (evolved packet core)
  - HSS (Home Subscriber Server)
  - PCRF (policy & charging rules function)
  - IMS (IP multimedia subsystem)
  - PTT (push to talk) server

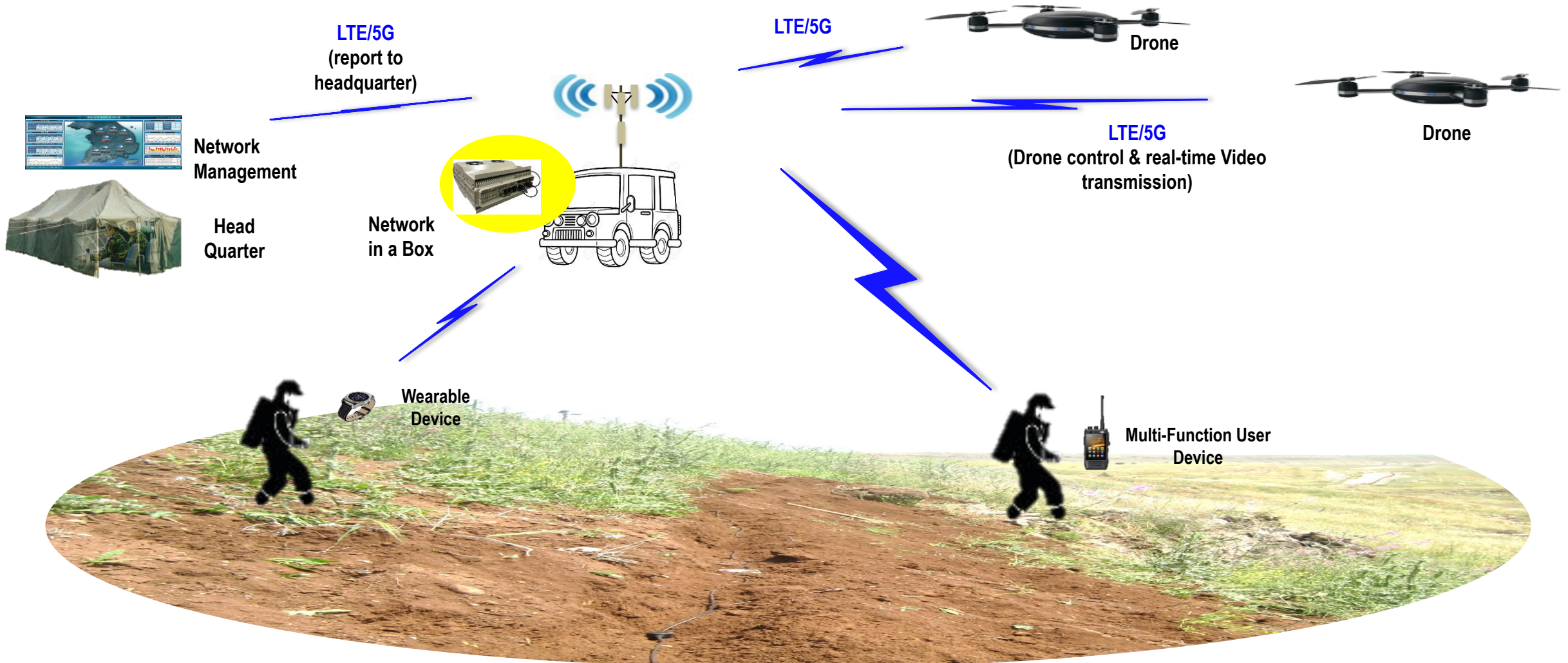
# Network in a Box System – Disaster Recovery



- Quickly establish communication link**
- 4G/5G total solution are carried to disaster area
  - Establish 4G/5G link in minutes

# Network in a Box System – Drone usage 1

- Drone needs LTE network to send video
- Portable LTE follows drone to establish LTE network where there is no existing LTE network



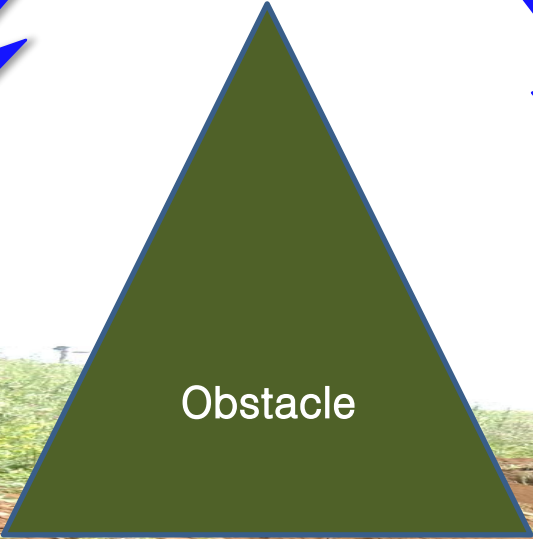
# Network in a Box System – Drone usage 2

- Network in a Box is installed in Drone at high altitude
- LTE installed in drone covers wider area
- LTE installed in drone overcomes communication obstacles



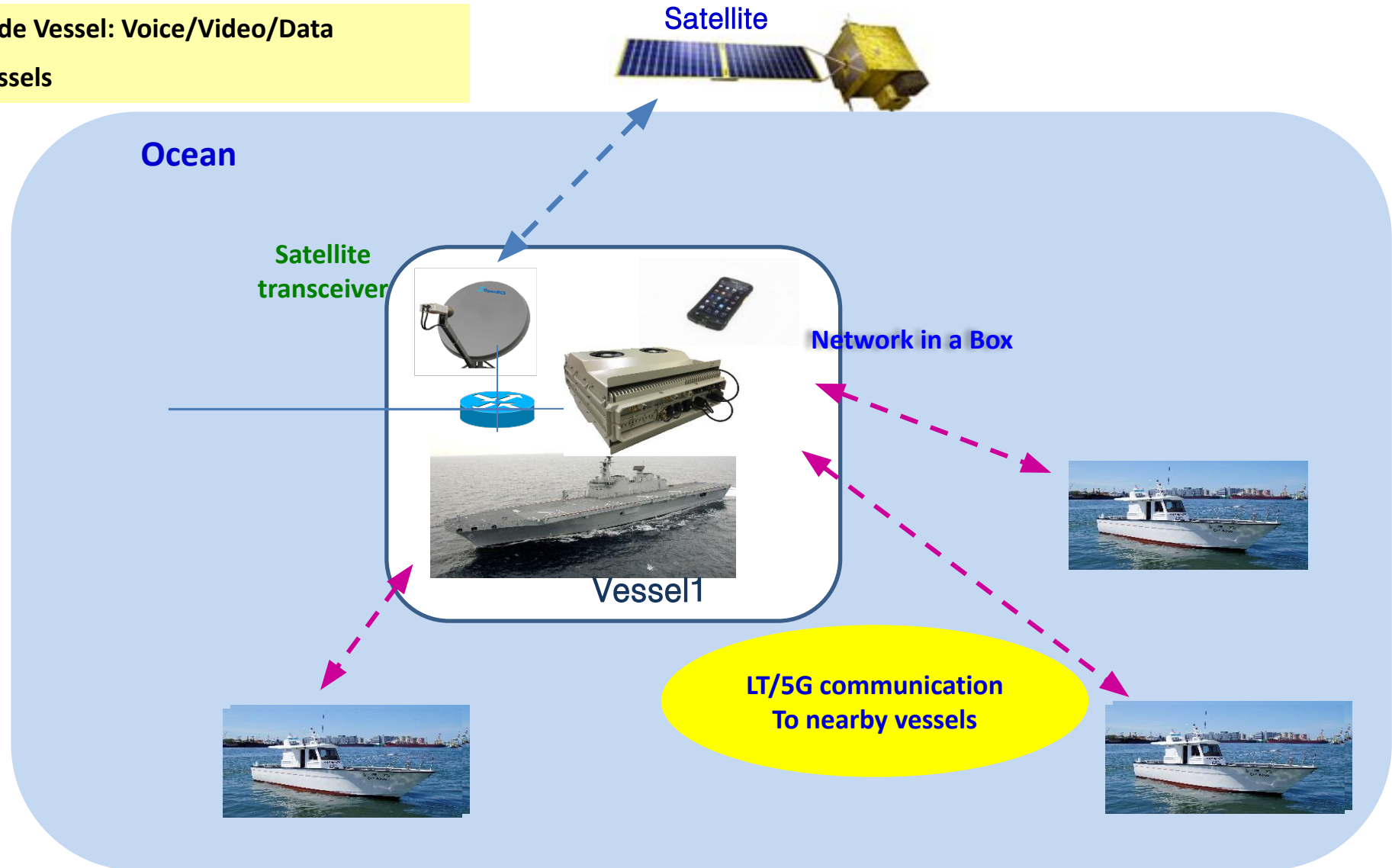
LTE/5G  
(Drone control & real-time Video transmission)

LTE/5G



# Network in a Box System – Inside and outside ship communication

LTE/5G communication outside Vessel: Voice/Video/Data  
communication to nearby vessels

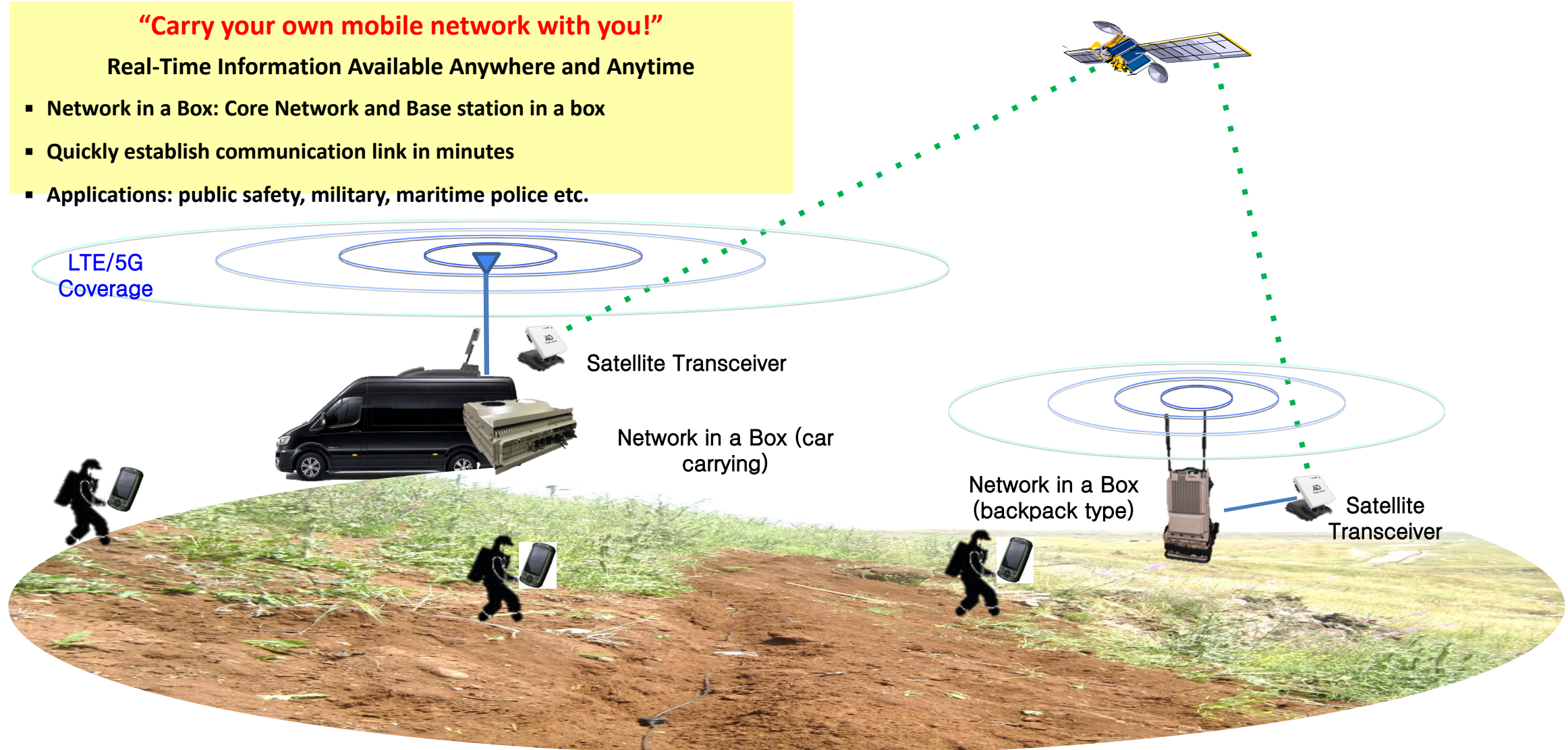


# UN Peace Keeping Camp – LTE Communication far from Camp

**“Carry your own mobile network with you!”**

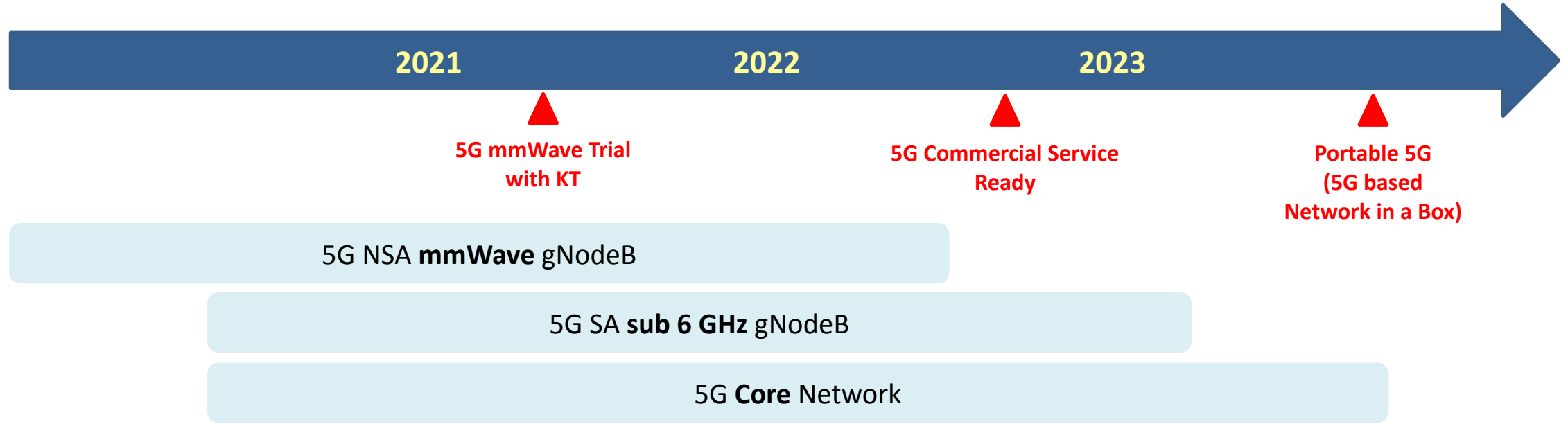
**Real-Time Information Available Anywhere and Anytime**

- Network in a Box: Core Network and Base station in a box
- Quickly establish communication link in minutes
- Applications: public safety, military, maritime police etc.



# 5G System Solution

# EUCAST 5G Roadmap



### Korean Government Funded 5G NR Project

This section contains the logos of the project partners, arranged in two rows:

- Top row: **과학기술정보통신부** (Ministry of Science and ICT), **ETRI** (Electronics and Telecommunications Research Institute), and **IITP** (Institute of Information & Communications Technology Planning & Evaluation).
- Bottom row: **Qualcomm**, **EUCAST**, and **SK telecom**.



# 5G Product – Sub 6 GHz 5G small cell

- CU / DU / RU integrated
- Standard : 3GPP Release 15
- 5G NR SA
- Max 128 connected, 64 active users
- Sync. : GPS or IEEE1588v2



ITEM	Specification	Remark
Frequency (Band)	Sub 6GHz	n78, n79, and etc.
Maximum Tx Power	24 dBm per antenna port	
Bandwidth	100MHz	
Modulation	QPSK/16QAM/64QAM/256QAM	
Antenna	2T/2R	DL: 2 layer, UL: 1 layer
Backhaul	2.5Gbps NBase-T Ethernet	802.3 10GBase-X
Power	AC adaptor : AC 100~240V, 50/60Hz DC 12V	Using AC/DC adaptor,
Power Consumption	<25W	
Size (mm)	200(W) x 200(D) x 62(H)	
Weight	1.5 Kg	
Temperature	-5 ~ +40°C	
Installation	Wall Mount, Ceiling	

# 5G Product – mmWave 5G small cell

- CU (Central Unit) / DU (Digital Unit) / RU (Radio Unit) integrated
- Standard : 3GPP Release 15
- 5G NR NSA
- EN-DC (E-UTRAN NR Dual Connectivity)
- Sync. : GPS or IEEE1588v2



ITEM	Specification	Remark
Frequency (Band)	28GHz (n257) : 26.5~29.5GHz	
Maximum Tx Power	EIRP 50dBm (64QAM)	
Bandwidth	800MHz (2*400MHz or 8*100MHz)	
Modulation	QPSK/16QAM/64QAM	
Antenna	128T/128R	DL: 2 layer, UL: 1 layer
Backhaul	10Gbps SFP+	802.3 10GBase-X
Power	AC adaptor : AC 100~240V, 50/60Hz DC 12V	Using AC/DC adaptor
Power Consumption	<75W	
Size (mm)	275(W) x 275(D) x 50(H)	
Weight	3.5 Kg	
Temperature	-5 ~ +40°C	
Installation	Wall Mount	

# 5G Product – gNodeB Features and Specifications (3GPP Rel. 15 Products)

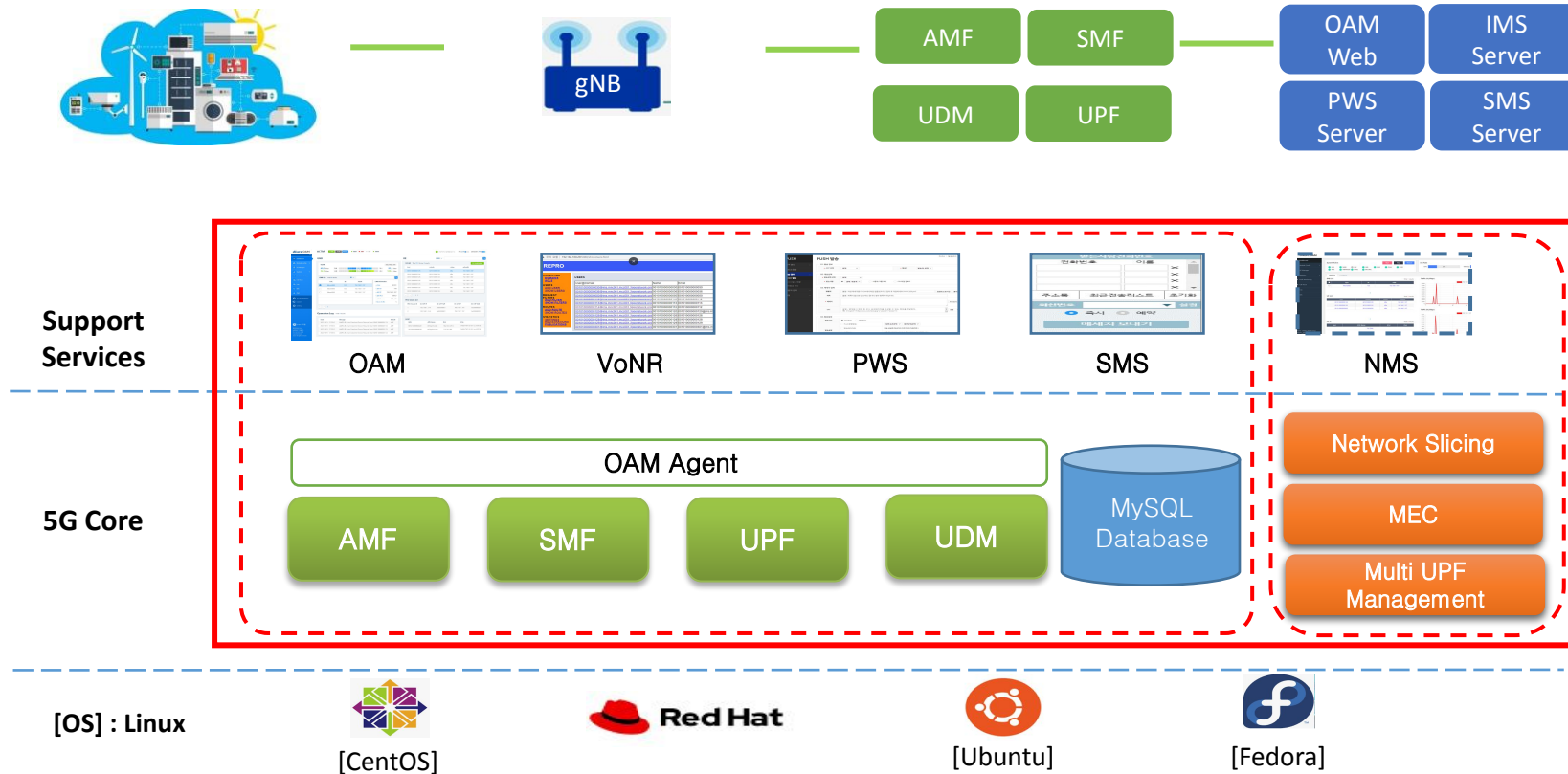
5G Capability	mmWave	Sub-6 GHz
<b>Standard Support</b>	3GPP 5G-NR Rel-15	3GPP 5G-NR Rel-15
<b>Duplexing mode</b>	TDD	TDD
<b>Peak throughput</b>	DL: 3.2 Gbps, UL: 1.6 Gbps	DL: 1.1 Gbps, UL: 0.84 Gbps
<b>Max. Modulation</b>	64 QAM	DL: 256 QAM, UL: 64 QAM
<b>Component carrier BW</b>	100 MHz	10, 20, 30, 40, 60, 80, 90, 100 MHz
<b>Max. Bandwidth (OBW)</b>	DL: 400 MHz (2L), UL: 400 MHz (1L)	DL: 100 MHz (2L), UL: 100 MHz (2L)
<b>Instantaneous BW (IBW)</b>	800 MHz	100 MHz
<b>Sub-carrier spacing</b>	120 kHz	30 kHz
<b>MIMO layers</b>	DL: 2, UL: 1	DL:2, UL:2
<b>DL/UL MU-MIMO</b>	DL: 2L to 1UE or 1L to 2UEs, UL: 1L to 2UE	DL/UL: 2L to 1UE or 1L to 2UEs
<b>Antennas (Tx/Rx)</b>	Up to 128Tx 128Rx	2Tx 2Rx
<b>TTI duration</b>	0.125ms	0.5ms
<b># Users/TTI</b>	DL/UL: 2 users/TTI	DL/UL: 8 users/TTI
<b>Spectrum support</b>	26.5-29.5 GHz, 37.0-40.0 GHz (n257, n258[partial], n260, n261)	n41, n48, n77, n78, n79

# 5G Product – gNodeB Features and Specifications (3GPP Rel. 16 Products)

5G Capability	mmWave	Sub-6 GHz
Standard Support	3GPP 5G-NR Rel-16	3GPP 5G-NR Rel-16
Duplexing mode	TDD	TDD, FDD
Peak throughput	DL: 8.11+ Gbps, UL: 8.11 Gbps	DL/UL: Upto 4.46 Gbps
Max. Modulation	64 QAM	256 QAM
Component carrier BW	100, 200 MHz	10, 20, 100 MHz
Max. Bandwidth (OBW)	DL/UL 1GHz (2L)	DL/UL: 200 MHz (4L)
Instantaneous BW (IBW)	Up to 1400 MHz	400 MHz
Sub-carrier spacing	120, 240 khz	15, 30 kHz
SU-MIMO layers	2	4
MU-MIMO layers	2	4
Antennas (Tx/Rx)	256Tx 256Rx (outdoor) 64Tx 64Rx (indoor)	Up to 4Tx 4Rx
TTI duration	0.125 ms	0.5 ms
# Users/TTI	DL/UL: 4 users/TTI	DL/UL: 8 users/TTI (TDD) 16 users/TTI (FDD)
Spectrum support	n257, n258, n259, n260, n261	n41, n48, n77, n78, n79, FDD bands
Release time	2Q 2024	4Q 2023

# 5G Product – 5G Core (1/2)

- Standard : 3GPP Release 16
- Core Network that supports SA mode
- Support Protocol : N1, N2, N3, N4, N6, N8, N11, N12, N13
- Node : AMF, SMF, UPF, AUSF, UDM
- Support 300 to 100K UEs



# 5G Product – 5G Core (2/2)

## Main Features

- N1 Interface with UEs (5GMM/5GSM)
- N2 Interface Functionality for gNB and Control Plane Message Processing (NGAP)
- N3 Interface Functionality for Processing User Plane Messages with gNB
- N2 Interface-Based PDU Session Setup & Release Features
- Network Registration/Deregistration Capabilities of UEs
- Session Management capabilities on UE
- UE IP Address Assignment and Management Features
- UE Identification, Access Authorization & Authentication Capabilities
- Packet Routing and Forwarding Capabilities
- External Interface Capabilities with Data Network
- QoS Handling Capabilities for User Planes
- IDLE–ACTIVE State Transition Control Function of the UEs
- Downlink Packet Buffering & Paging Triggering Capabilities
- Handover Function
- UE Context Management Features

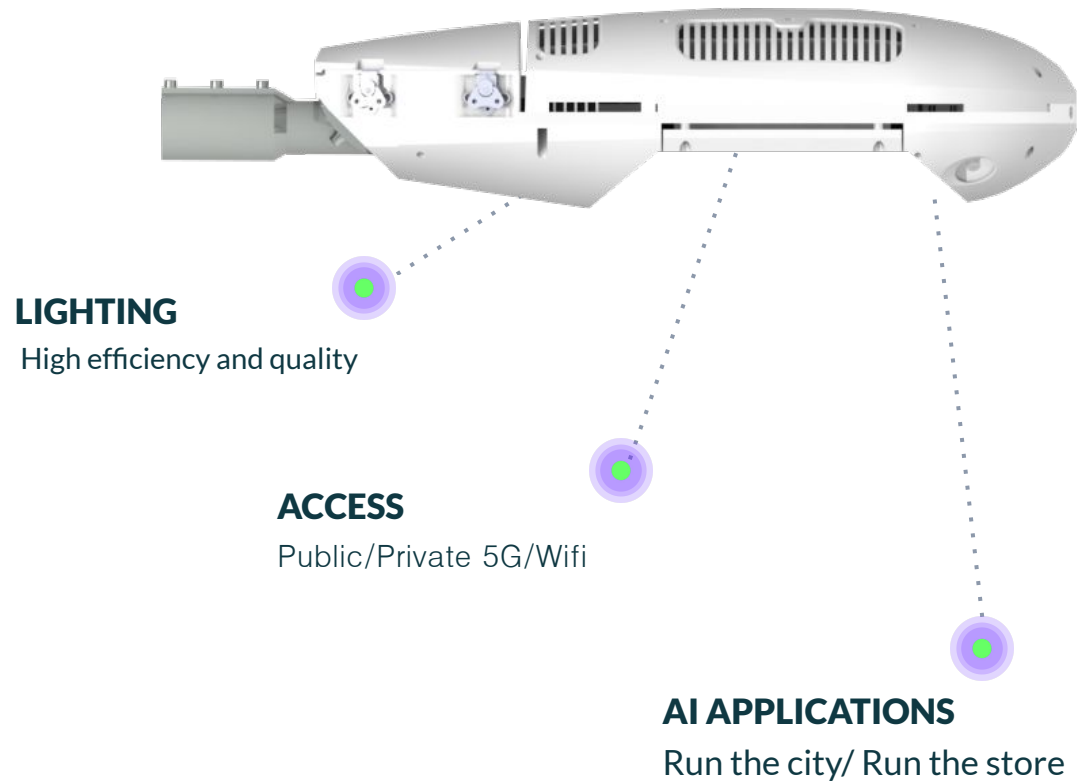
## Capacity and interface

Functions	Remark
Performance	<ul style="list-style-type: none"> <li>▪ Module type (1G NIC) : 300 UEs, 350Mbps</li> <li>▪ PC type (2 x 10G NIC) : 2K UEs, 10Gbps</li> <li>▪ Server type (2 x 40G NIC) : 100K UEs, 24Gbps</li> <li>▪ +400K UE data management</li> </ul>
Function	<ul style="list-style-type: none"> <li>▪ UE/PDU Session management process</li> <li>▪ UE authentication (AES, Snow3G, ZUC)</li> <li>▪ Handover (NG/Xn)</li> <li>▪ QoS Flow Management</li> </ul>
Interface	<ul style="list-style-type: none"> <li>▪ SCTP (S1, Diameter), UDP (GTP)</li> <li>▪ IPv4/v6 (Transport layer, assign UE IP)</li> </ul>

## Default / Option

Default	Option
<ul style="list-style-type: none"> <li>▪ Access and Mobility Management Function (AMF)</li> <li>▪ Session Management Function (SMF)</li> <li>▪ User Plane Function (UPF)</li> <li>▪ Unified Data Management (UDM)</li> <li>▪ Authentication Server Function (AUSF)</li> </ul>	<ul style="list-style-type: none"> <li>▪ Policy Control Function (PCF)</li> <li>▪ IP Multimedia Subsystem (IMS)</li> <li>▪ Mobile Edge Computing (MEC)</li> </ul>

# 5G on Smart Light Head



## ❖ 5G small cell inside Smart Light

- 5G Small cell installed inside Smart Light head □ Provide full 5G connectivity at Smart City
- 5G capacity increase
- Low power consumption (Green Energy)
- Trial installation at 7 cities in Brazil on January 2023 (Qualcomm, Juganu, EUCAST)



# Thank You



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