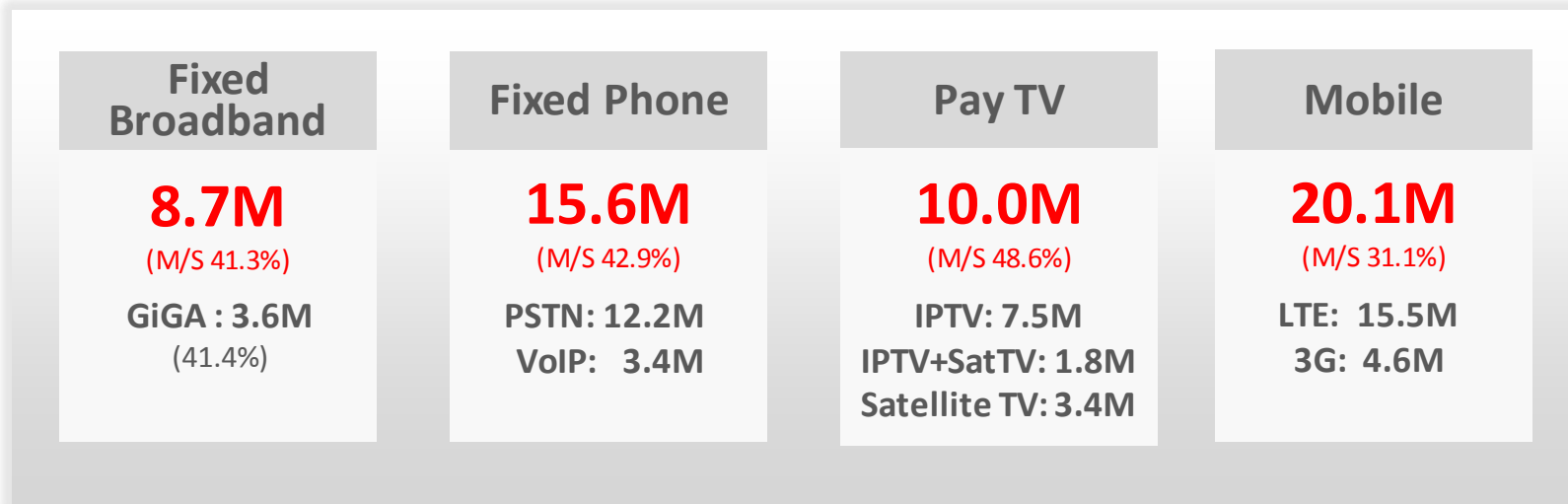# KT Global Business

PEOPLE. TECHNOLOGY.

KT

Company Information

Korea Telecom

- **Established** : **December 10, 1981**
- **Revenue** : **USD 23.4bn** (FY 2017, Consolidated)
- **No. of Employees** : **23,632** (As of Sep 2017, kt only)
- **Stock Exchange Listings** : **Korea, New York**
- **Credit Rating** : **A3** (Moody's)/**A-** (S&P, Fitch)

Number of Subscribers (As of 3Q 2017)

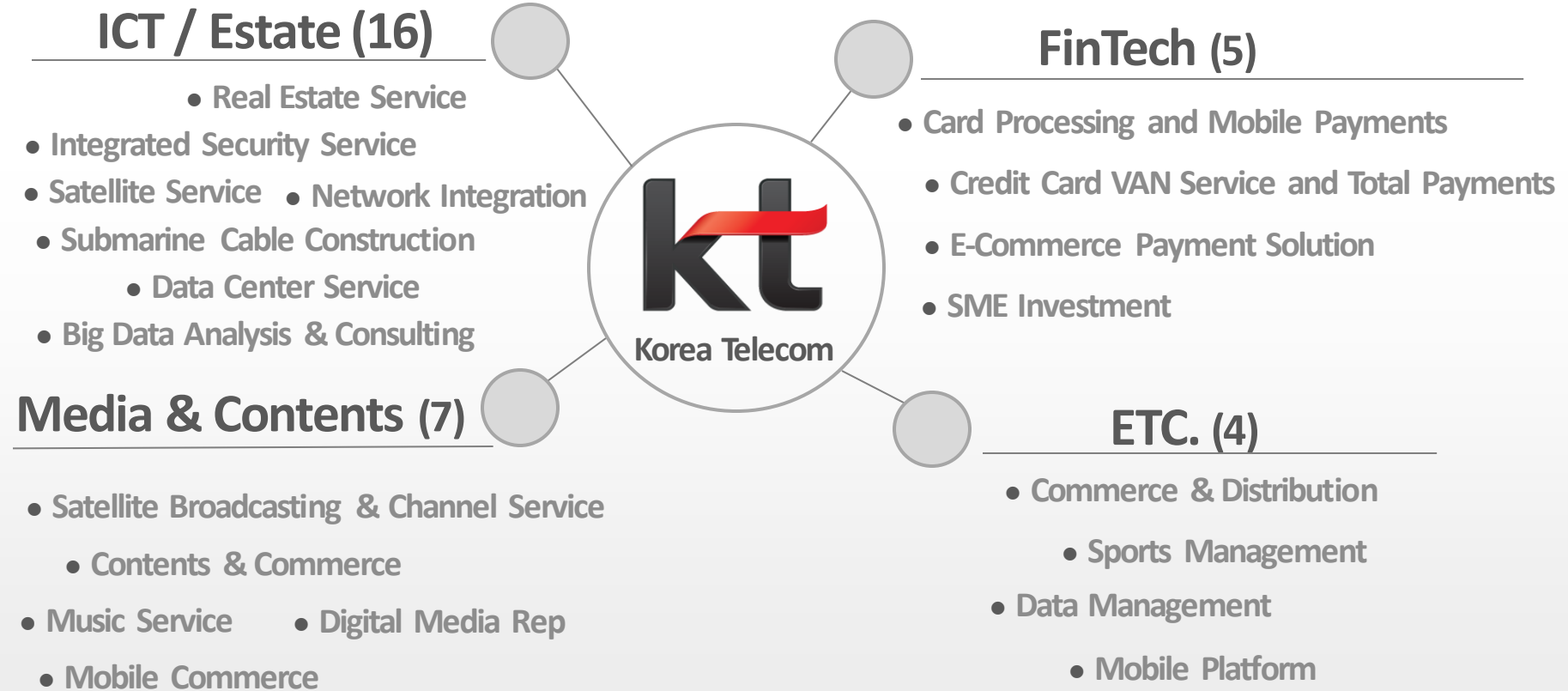| Fixed Broadband	Fixed Phone	Pay TV	Mobile
8.7M	**15.6M**	**10.0M**	**20.1M**
(M/S 41.3%)	(M/S 42.9%)	(M/S 48.6%)	(M/S 31.1%)
GiGA : 3.6M (41.4%)	PSTN: 12.2M VoIP: 3.4M	IPTV: 7.5M IPTV+SatTV: 1.8M Satellite TV: 3.4M	LTE: 15.5M 3G: 4.6M

※ Source: kt, Ministry of Science ICT , Korea Communications Commission

Group & Subsidiaries

32 Subsidiaries in the industry fields of Telecom, IT Convergence and Platform Business

ICT / Estate (16)

- Real Estate Service
- Integrated Security Service
- Satellite Service
- Network Integration
- Submarine Cable Construction
- Data Center Service
- Big Data Analysis & Consulting

kt
Korea Telecom

FinTech (5)

- Card Processing and Mobile Payments
- Credit Card VAN Service and Total Payments
- E-Commerce Payment Solution
- SME Investment

Media & Contents (7)

- Satellite Broadcasting & Channel Service
- Contents & Commerce
- Music Service
- Digital Media Rep
- Mobile Commerce

ETC. (4)

- Commerce & Distribution
- Sports Management
- Data Management
- Mobile Platform

Global Awards & Recognition

- "Telecommunications Super Sector Leader"
  (Dow Jones Sustainability Indexes 2010 ~ 2017)

- "Best VoLTE or LTE Broadcast Product", "Best Network Development"
  (Informa™, LTE & 5G World Awards 2016, 2017)

- "Outstanding Contribution to 5G R&D", "Leadership in IoT", and "Best Network Development"
  (5G Asia Awards 2017)

- "Operator of the Year", "Best Enterprise Service (GiGA Wi-Fi)", and "Innovation Award (GiGA LTE)"
  (Asia Communication Awards 2016)

- "Advancing the Road to 5G (Pyeongchang 5G)", "Fixed Network Evolution (GiGA Wire 2.0)"
  (Global Telecoms Awards 2015-2017)

- "Best Consumer-Centric Wireless Service Innovation"
  (Wireless Broadband Alliance Industry Awards 2016, 2017)

- "Outstanding LTE Contribution", "Outstanding Overall Mobile Technology"
  "GSMA Chairman's Award", "Joyn Innovation Challenge Special Award" and "Best Use of Mobile for Smart Cities"
  (MWC 2013, GSMA 2014, GSMA 2017)

- "Most Significant Development for Commercial LTE Network by an Operator"
  (LTE Awards 2012, 2015)

- "Entertainment Category (Charac-IOT Speaker)", "Computer & IT Category (Phone-Mouse)", "Communication
  Design (olleh kt)", "Smart & Fashion Category (Phone-brella)", "Packaging Design(Burst of Magic)"
  "Visual Identity (olleh Signal)", "Design Concept (Home Networking Devices Packing and Trilogy)",
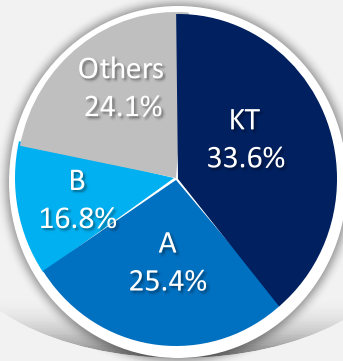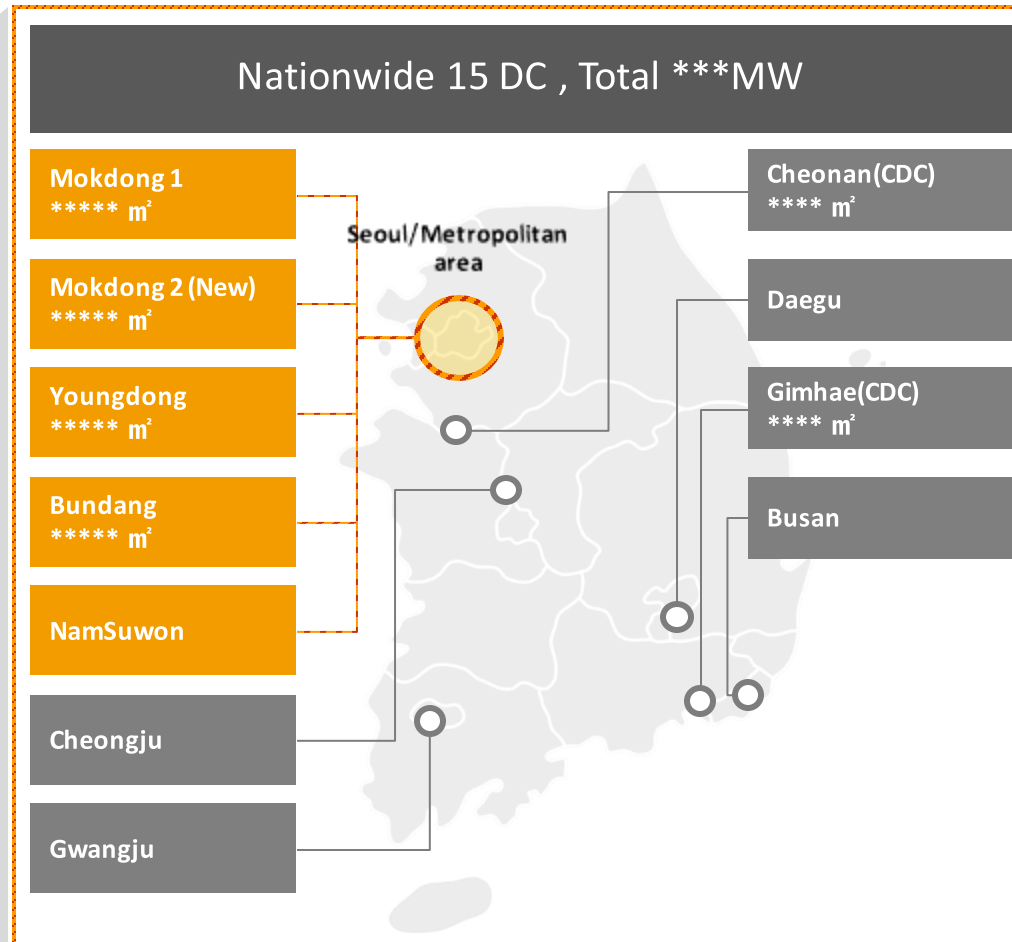 "Corporate Brochure (olleh curve)" (Red Dot Design Award 2010-2016)

KT's Data Center Operation Status

KT is nationwide No.1 IDC operator. KT builds large scale data center(15 data centers, ***MW) in Korea, provides excellent service to our clients .

IDC market share(in Korea)

Others
24.1%

KT
33.6%

B
16.8%

A
25.4%

*Source : IDC Industries association 2013
(including colocation, ICS, MSP, DCDR sales)

Nationwide 15 DC , Total ***MW

Mokdong 1
***** m²

Mokdong 2 (New)
***** m²

Youngdong
***** m²

Bundang
***** m²

NamSuwon

Cheongju

Gwangju

Seoul/Metropolitan area

Cheonan(CDC)
**** m²

Daegu

Gimhae(CDC)
**** m²

Busan

Capabilities - Overall

KT guarantees reliable and efficient DC service operation based on our cutting-edgy technologies and abundant experiences accumulated through about 40 DC operation and construction experiences over 20 years.

	Building (Land, Building)	Facility (Power, Cooling)	Operation/ Management	Network (Backbones/Access/ Overseas Network)
DC Components				
DC Requirements	Land/ DC Construction	High Tier Level/ Low PUE*	Standardization/ Operation Experiences	Connectivity / Scalability
KT Core Capabilities	▪ Vast real-estate portfolio (500 Branch Buildings and lands) ▪ More than 40 domestic and global DC construction experiences	▪ Tier III, IV Level (Concurrently Maintainable) ▪ Korea TOP PUE DC (Green DC Certification) ▪ Dedicated IDC and High Density Cloud DC	▪ 15 years of commercial DC operation experiences (4 years of High Density Cloud DC Operation Experiences) ▪ ITSM, Automation ▪ ISO20000, 27001, ISMS Certification ▪ 10 years veteran 80%	▪ Top domestic wire/wireless network service provider (30 M Customers) ▪ Top Backbone Provider (6.3Tb) ▪ Only Submarine cable provider / Top Global Network (250G)

*PUE = Total Data Center Energy Consumption ÷ IT Equipment Energy consumption (maximum PUE = 1)
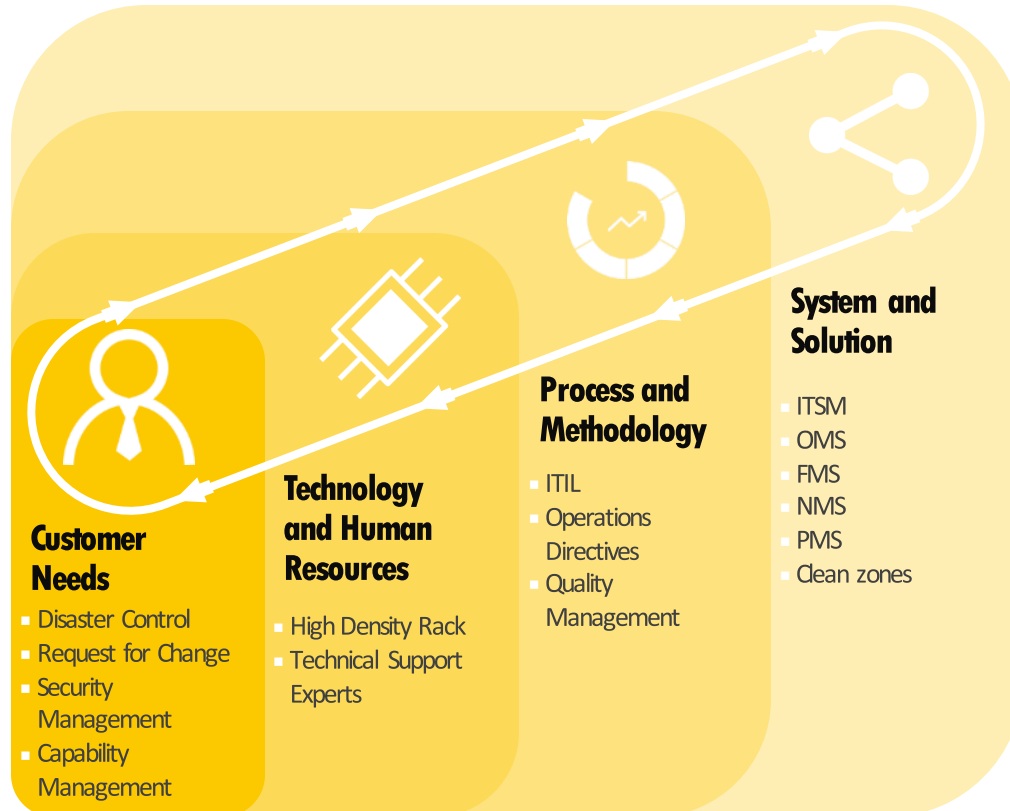
Capabilities - Build/Facility

KT offers the most optimized Data Center service for customers in accordance with the specific requirements. And it also provides competitive edges for customer by leveraging the most optimal infrastructure and service capabilities.

	1999~2007 Co-location DC	2008 ~ Managed Co-location DC	2010 ~ Density/Cloud Data Center	2016~ DaaS (Data Center as a Service)
Major Site				
Commercial DC Projects	Bundang (20MW)/ Yeongdong(10MW) That house Internet Business with max capacities of 1.2G	Mokdong the first Center (40MW) That houses banking industry Stability (Tier 3.5)	Chenan(10MW)/Gimhae (7MW) That house Global companies High Density/ Module	Mokdong the second Center (40MW) Global companies & Utility oriented
Other Sites	Lotte Group/ Shinsegae Group DC	Government Control Tower, Securities Trading Center	Hanwha Group, Incheon city DC	Coscom DC (MOU,10MW)

Capabilities - Operations/Management

Can meet the specified requirements of customer through major governmental entities (Governmental Control Tower), diverse operational experiences in satisfying customer Data Centers(20 years of experiences in DC) and KT's unique handling experiences in infrastructure based on a group of special experts with expertise accrued for the past 20 years and vast knowledge of expert skills of operating High Density Server.

Customer Needs
- Disaster Control
- Request for Change
- Security Management
- Capability Management

Technology and Human Resources
- High Density Rack
- Technical Support Experts

Process and Methodology
- ITIL
- Operations Directives
- Quality Management

System and Solution
- ITSM
- OMS
- FMS
- NMS
- PMS
- Clean zones

Equipped with KT's Unique Infra Operation System
- Operational Management System suitable for Commercial DC
- DC operation experiences & combination of international standards (ISO 20000, ETC)
- Korean Government Certified ISMS
  - Counter measures for prevention of nationwide cyber attacks

Korea's No 1 Top-quality Technology & Human Resources in Data Center
- Average 15 years of work experience in Infra-structure.
- Highest level of PUE in commercial DC PUE
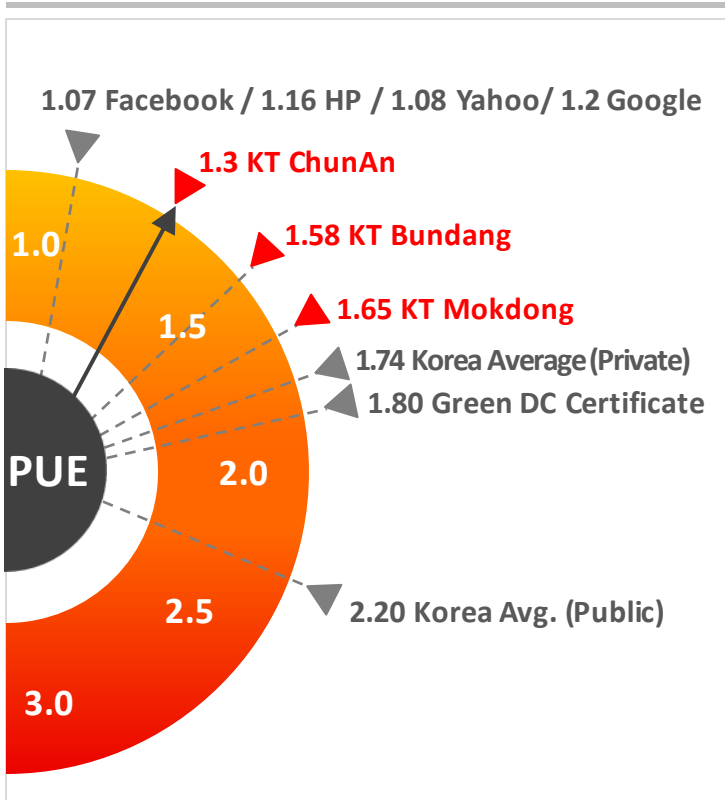
Diverse experiences in Customization
- Maintenance and operation
  Approx. 5,000 customers, Approx. 15,000 Racks
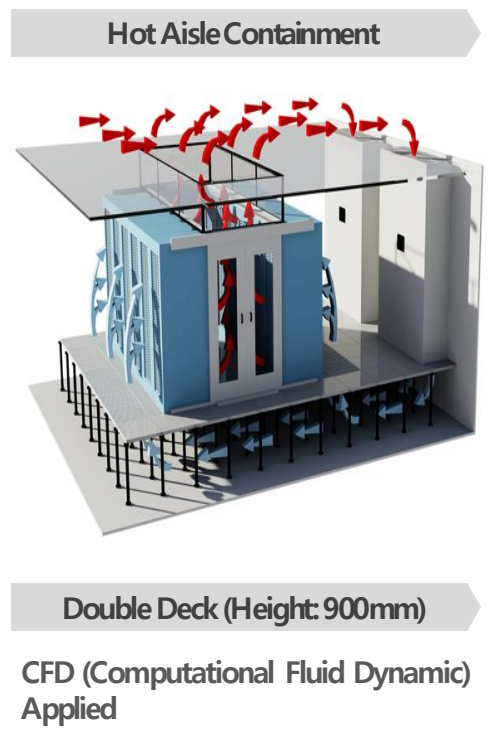
KT Data Center Features 1 - PUE Improvement

36% Cooling energy savings through High Temperature Ambient as PUE improvement

✅ There is trend to increase server room temperature as high and KT will operate as 30℃ in 2014 and 35℃ in 2018.
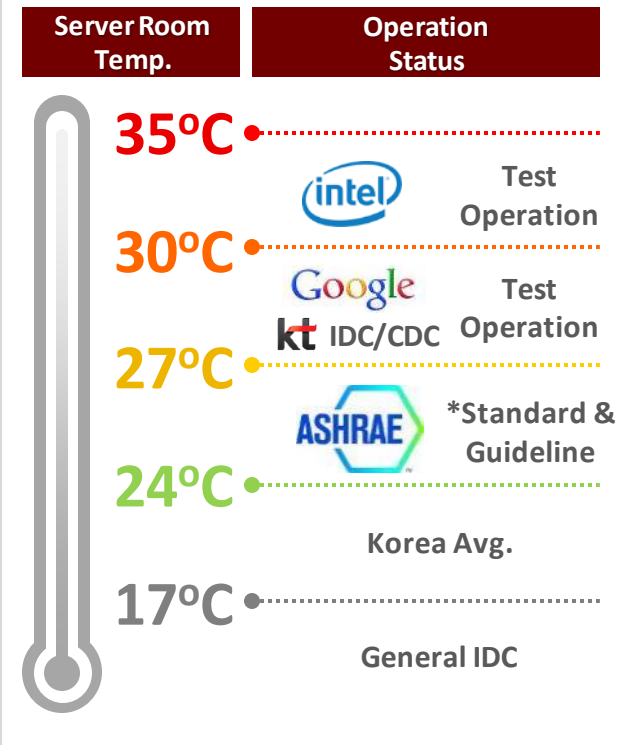
Low PUE Level

1.07 Facebook / 1.16 HP / 1.08 Yahoo/ 1.2 Google

1.3 KT ChunAn

1.58 KT Bundang

1.65 KT Mokdong

1.74 Korea Average (Private)

1.80 Green DC Certificate

1.0 / 1.5 / 2.0 / 2.5 / 3.0

PUE

2.20 Korea Avg. (Public)

Containment: Separation of cold and hot air

Hot Aisle Containment

Double Deck (Height: 900mm)

CFD (Computational Fluid Dynamic) Applied

HTA: Operation temperature as 30℃

Server Room Temp.	Operation Status
35ºC	intel — Test Operation
30ºC	Google / kt IDC/CDC — Test Operation
27ºC	ASHRAE — *Standard & Guideline
24ºC	Korea Avg.
17ºC	General IDC

*ASHRAE: American Society of Heating, Refrigerating and Air-Conditioning Engineers
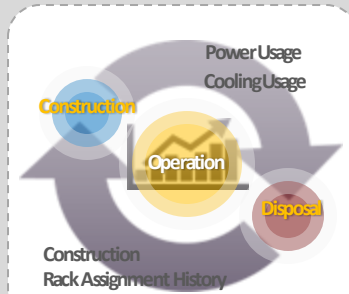
KT Data Center Features 2 - Automation

Up to 20%* energy savings through monitoring and controlling automatically Data Center's major item's energy utilization from DCIM and other system.

✓ Providing real time snapshot of space, power, cooling and Managing lifecycle of data center from construction to disposal

✓ Minimizing power utilization through real time automatic control
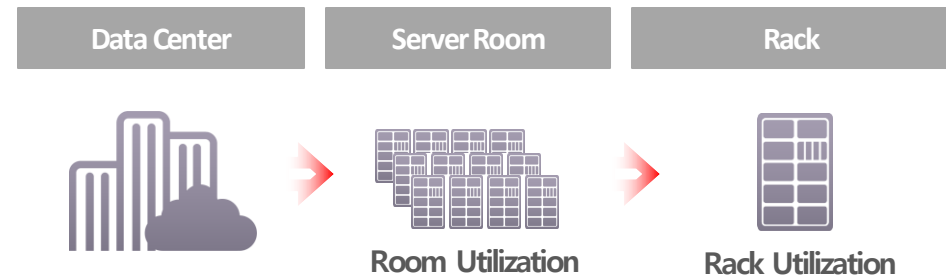
Space Management System

Total Cost Ownership

Real-time Visibility

Cost Effective

Data Center Lifecycle

Power Usage
Cooling Usage

Construction

Operation

Disposal

Construction
Rack Assignment History

Space - Power - Cooling Real-Time Snapshot

| Data Center | Server Room | Rack |

Room Utilization

Rack Utilization

Open Source Software

php   MySQL

openDCIM
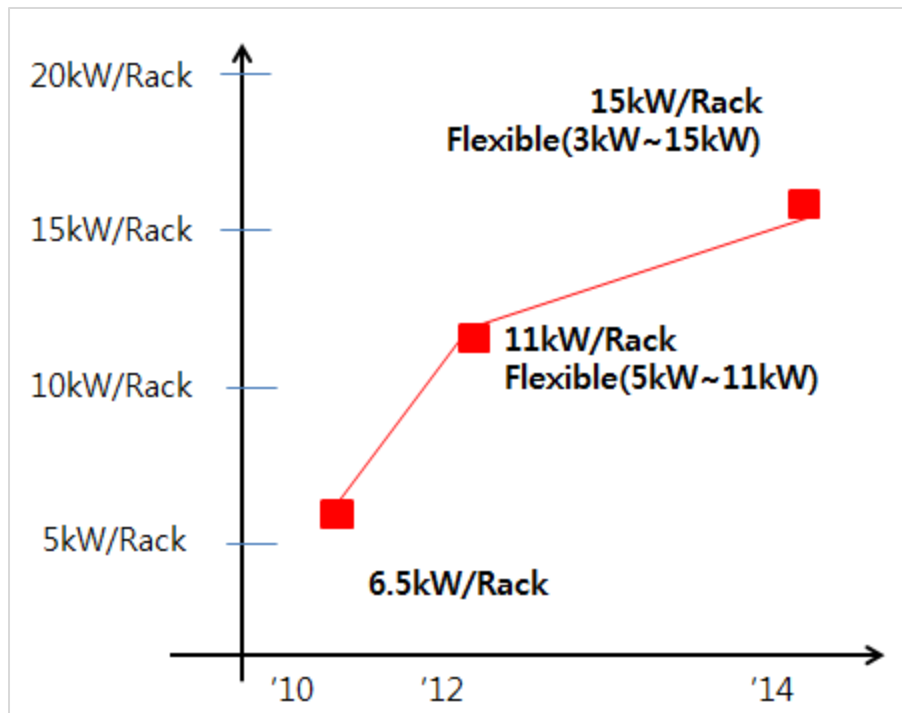
APACHE   CentOS

* Gartner 2010

KT Data Center Features 3 - Standardization

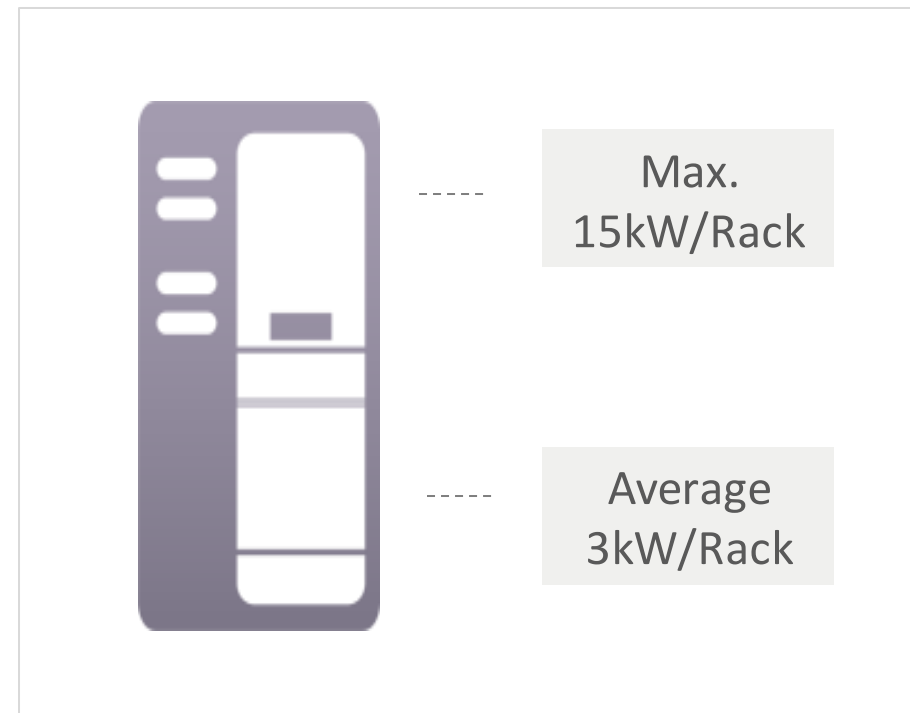## 73% energy savings through rack configuration of high density standardization

✅ Saving IT and Non-IT energy through changing structure as increasing number of servers in rack and accommodating many high performance and power servers

Pursuing of phased High-Density


15kW/Rack
Flexible(3kW~15kW)

11kW/Rack
Flexible(5kW~11kW)

6.5kW/Rack

(Chart axis: 20kW/Rack, 15kW/Rack, 10kW/Rack, 5kW/Rack; '10, '12, '14)

Stable operation of power density 3~15kW/Rack

Max. 15kW/Rack

Average 3kW/Rack

KT Data Center Features 4 - Scale Out Architecture

☑️ **Rapid expansion using Layer 2 Domain expansion as virtual single data center configuration and TCO reduction of data center migration without outage**

Central Management

Inter-DC Layer 2 Domain Expansion

DC

DC

Virtual Single DC
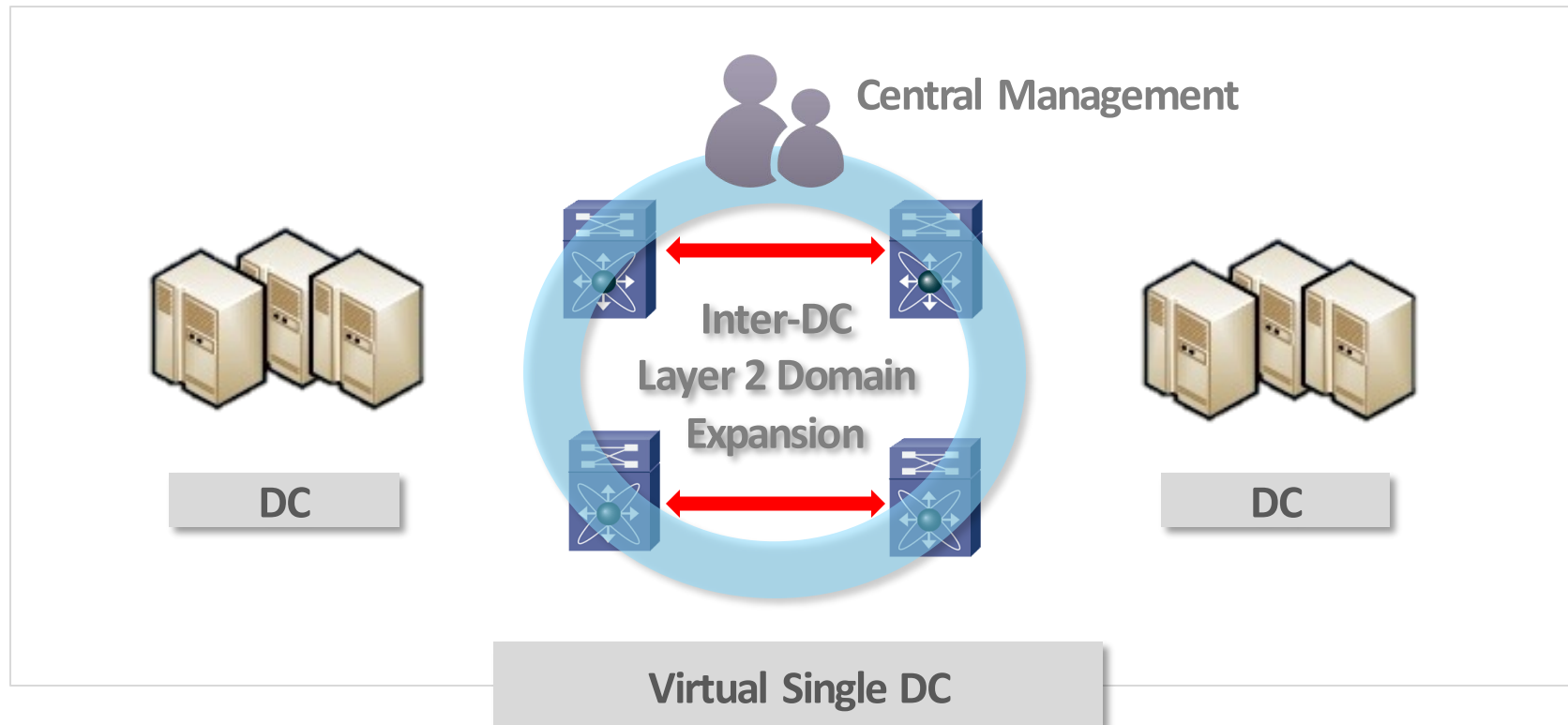
KT's Technology Internalization

KT has been introducing cutting-edgy technologies to improve Data Center **Energy Efficiency** and **Operation Stability**, and successfully customized and internalized the technologies.

2010 (PUE 1.8)	2011	2012 (PUE 1.6)	2013 (PUE 1.6)	2014 (PUE 1.4)	2015 (PUE 1.3)
					Indirect Evaporative Cooling System
				Built-up HVAC	Selective Multi-Tier
				Solar Energy	Renewable Energy (Fuel Cell, Solar, Etc.)
					Recycling Waste Heat (Office, Parking Lot)
			HTA (27°C)	HTA (30°C Partial)	HTA (30°C)
			Intelligent Cooling	Intelligent Cooling	Intelligent Cooling
		Free Cooling (50%)	Free Cooling	Free Cooling (100%)	Free Cooling
		PSM/REM*	PSM/REM (Automation)	PSM/REM (Automation)	PSM/REM (Automation)
	Dynamic-UPS	Dynamic-UPS	Dynamic-UPS	Dynamic-UPS	Dynamic-UPS
Inverter Type (Chiller)	Utilization of existing equipment	Inverter Type (Chiller)	Inverter Type (Chiller, HVAC)	Inverter Type (Chiller, HVAC)	Inverter Type (HVAC)
Modular (Scale up)	Modular (Scale up)	Modular (Scale up)	Modular (Scale up)	Modular (Scale up)	Modular (Scale up)
Hot Aisle Containment (First in Korea)	Hot Aisle Containment	Hot Aisle Containment (False Ceiling 2.5m)	Hot Aisle Containment (Side Door)	Hot Aisle Containment	Hot Aisle Containment
6.5kw/Rack (First in Korea)	6.5kw/Rack	3.3 ~ 6.5kw/Rack (Diversification)	5 ~ 11kw/Rack (Flexible)	3 ~ 15kw/Rack (Flexible)	5 ~ 20kw/Rack (Flexible)

*PSM/REM: Power Status Monitoring/Rack Environment Monitoring

kt's Public Cloud Platform

- Optional combination of commodity HW & open source SW.

Commodity HW

Open source SW

+

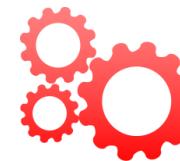|	
Hypervisor	Xen Server™
VM Mgt.	cloudstack
Auto Scaling	
Storage Control	The Combination of OpenSource SW & Commercial SW
Log Monitoring	
VM Monitoring	
System Monitoring	kt Customized & Developed
System Mgt Auto SW	
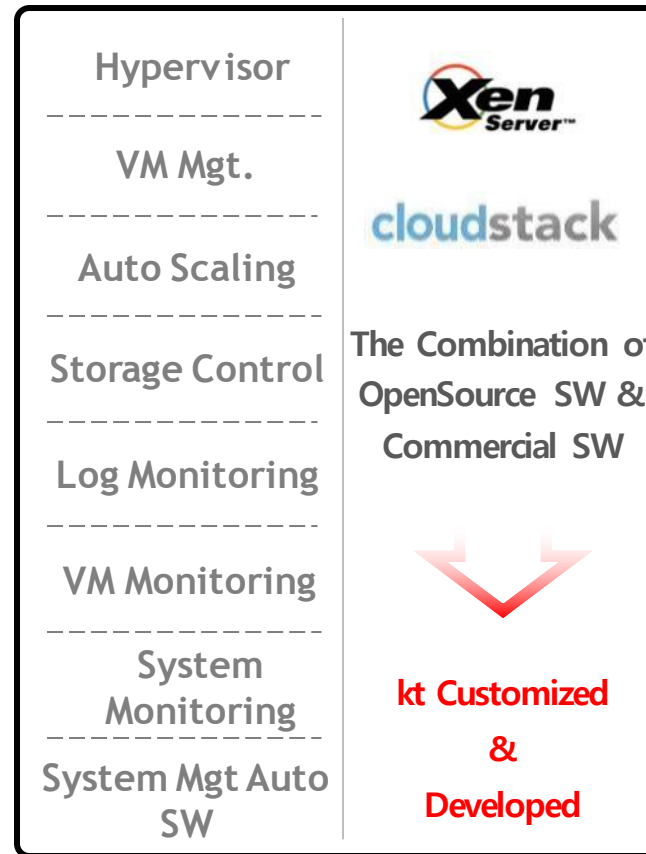
Vendor Independency

Cost Saving

Easy to Customize
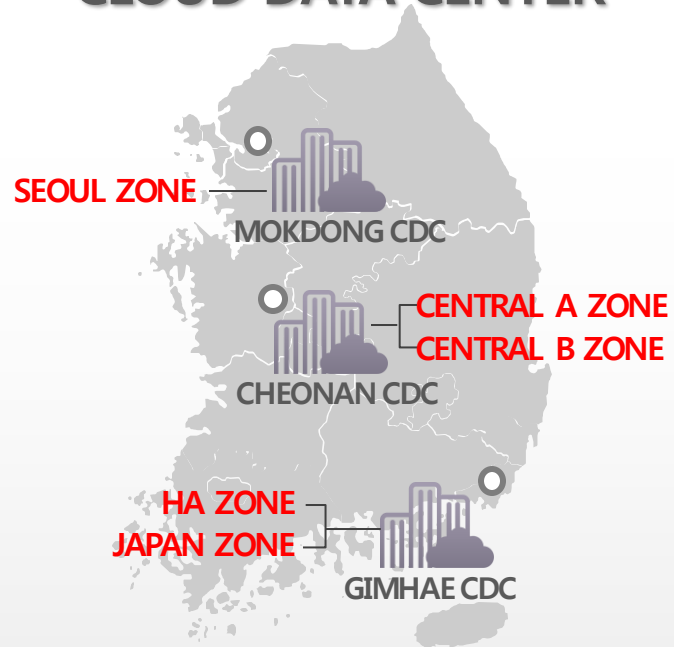
Automatic Rack Configuration

Flexible Scalability
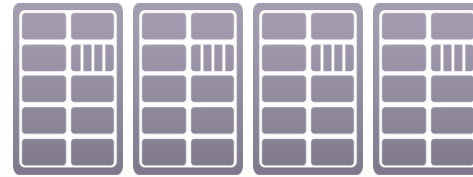
kt 9 Years Experiences in Cloud Business

- KT launched public cloud computing service at 2010 with brand name 'ucloud'

CLOUD DATA CENTER

SEOUL ZONE
MOKDONG CDC

CENTRAL A ZONE
CENTRAL B ZONE
CHEONAN CDC

HA ZONE
JAPAN ZONE
GIMHAE CDC

KT is operating 15 IDC,
3 of it is for Cloud Service
- **Cloud Data Center** (CDC)

STATISTICS

Over 20,000 VM

Over 6,500
Enterprise/Individual
Customers

CUSTOMER STATUS

- ENTERPRISE: 32%
- GAME: 25%
- IT: 19%
- CONTENTS: 17%
- PUBLIC/PRESS: 6%
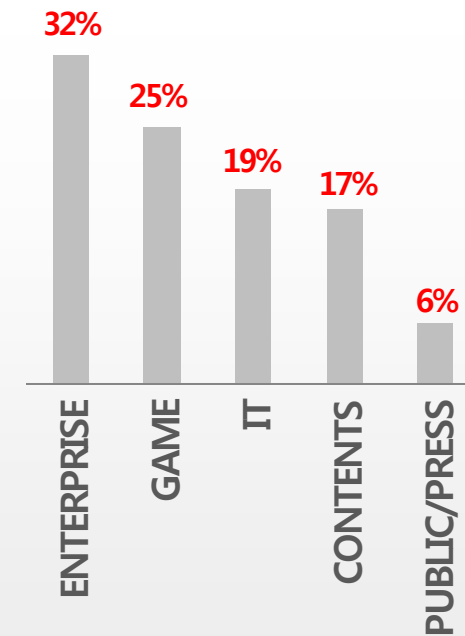
Adapting Cloud business experienced to other area

- Cloud experience enhance other business such as IoT

**Crime Prevention,
Traffic enforcement...**

CCTV

Traffic Signal System, Tolling....

IoT

kt
Cloud Platform

City Operation Center
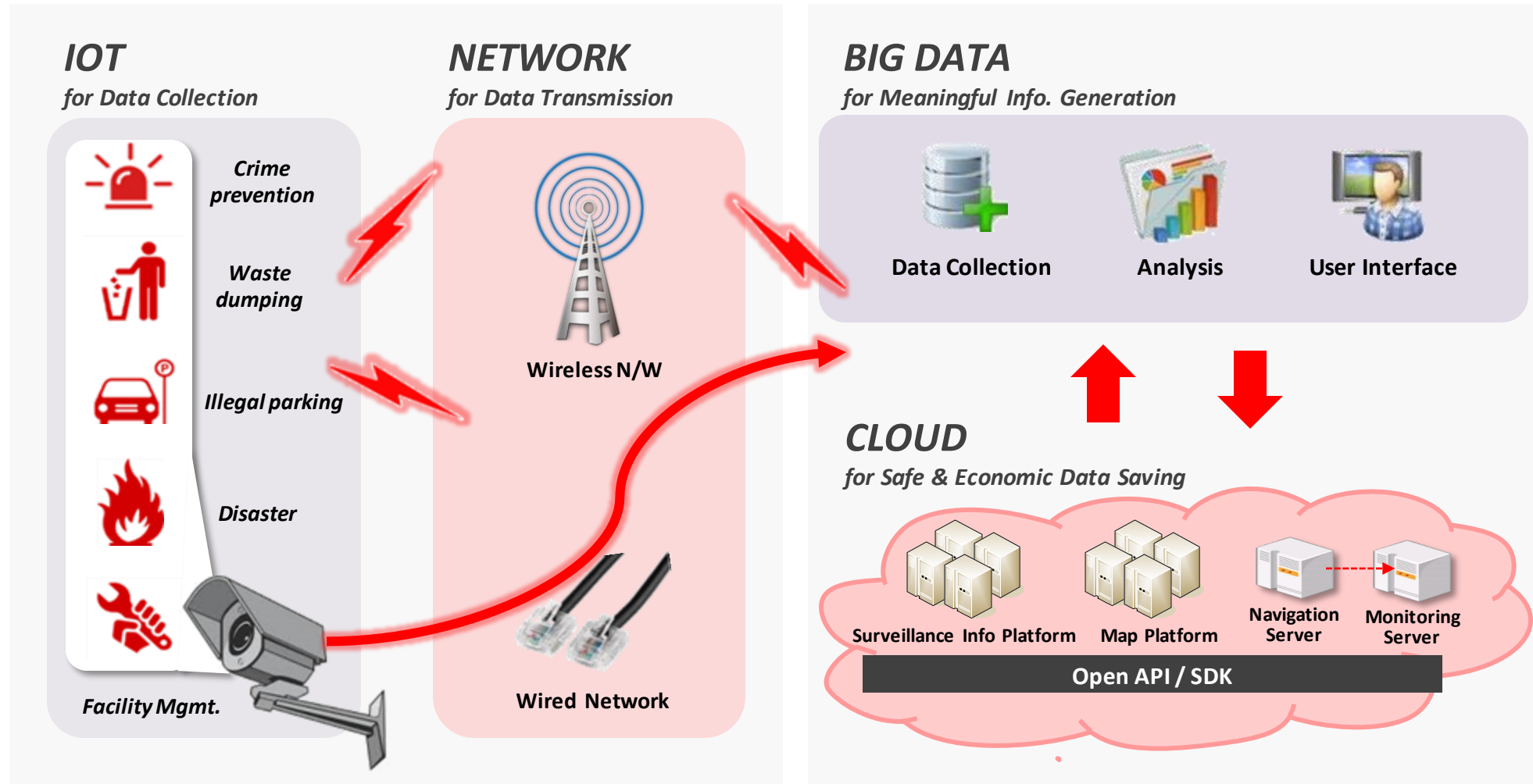
**Smart
City**

ITS

Bus Information System...

Cloud as an Business Infrastructures

- **Cloud Computing is the core of IoT business platform**

On-Site

Integrated Center

IOT
for Data Collection

- Crime prevention
- Waste dumping
- Illegal parking
- Disaster
- Facility Mgmt.

NETWORK
for Data Transmission

Wireless N/W

Wired Network

BIG DATA
for Meaningful Info. Generation

Data Collection   Analysis   User Interface

CLOUD
for Safe & Economic Data Saving

Surveillance Info Platform   Map Platform   Navigation Server   Monitoring Server

Open API / SDK

KT's 5G Roadmap

In Feb. 2016, KT offered a first glimpse of its 5G services including: Sync View, '360° VR', and Hologram Live. KT develops and enhances its 5G services via a 2nd test event and the PyeongChang Winter Olympic Games

2015	2016	2017	2018	2019
Opening 5G Test Bed	5G 1st Test Event	5G 2nd Test Event	Olympic 5G Trial Service	Commercial Service

Activities of 5G-SIG

Moving Towards 5G, Creating the Future

5G is going to provide Ultra High Speed and Low Latency, as well as Massive Connectivity
- 100 times faster, 10 times lower latency, 1,000 times more connectivity compared to LTE

Enhanced MBB (Mobile Broadband)
hyper-reality (hyper-speed)

20 Gbps
(x 100)

Mobile Hologram

360° VR
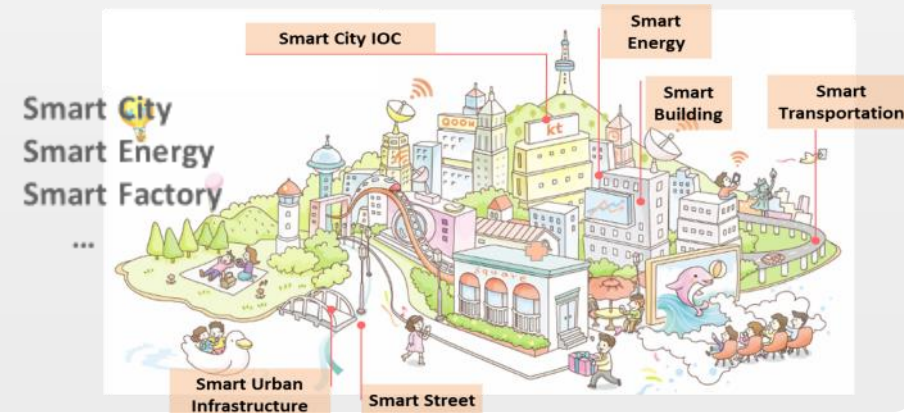
Mission critical
ultra low latency

1 msec
(x 1/10)

Autonomous Driving

Drone Control

Massive IoT
hyper connectivity

1,000,000/km²
(x 1,000)

Smart City
Smart Energy
Smart Factory
...

Smart City IOC

Smart Energy

Smart Building

Smart Transportation

Smart Urban Infrastructure

Smart Street

Major Milestones

Over the past 20 years, the Korean government has ramped up growth of its ICT industry with policies expanding corporate investment and increasing utilization by citizens

GDP of ICT Industry

$35 billion

Policies

'87 ~ '91
Primary planning for national information network

'92 ~ '96
Secondary planning for national information network

'96 ~ '00
Planning for informatization promotion

'99 ~ '02
Cyber Korea 21

'02 ~ '06
e-KOREA VISION 2006

'06 ~ '10
Planning of u-KOREA

'08 ~ '12
Planning for national informatization

Phase 1 ('87~'96) Establishment of the Information Network

Phase 2 ('96~'00) Creation of e-Government Foundation

Phase 3 ('01~'07) Growth and Expansion of e-Government

Phase 4 ('08~) Convergence of e-Government

Phases

$22 billion

Related Services

Cellular service launch
'84

Opening of NATISNET
'93

'94
KT Internet service

National broadband Network

'96
World's first CDMA service

Korea Public session for Internet service
'97

'98
Broadband Internet service

'02
Sync, async IMT2000 service

1st GIDC Construction

'05
Satellite/terrestrial DMB service

World's first WiBro service
'06

'08
Real-time IPTV broadcast service

'12
LTE service

$5 billion

1987 ~1990 | 1991 | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012

No. 1 in UN e-Government Index

Korea is ranked No. 1 out of 192 nations for the second consecutive year in the UN's 2012 Global e-Government Survey

※ **Major assessment factors: ICT infrastructure index, human capital index, online service index**

2001

Rank	Country
1	United States
2	Sweden
3	Australia
4	Denmark
5	United Kingdom
6	Canada
7	Norway
8	Switzerland
⋮	⋮
15	Republic of Korea

2005

Rank	Country
1	United States
2	Denmark
3	Sweden
4	United Kingdom
5	Republic of Korea
6	Australia
7	Singapore
8	Canada
9	Finland
10	Norway

2012

Rank	Country
1	Republic of Korea
2	Netherlands
3	UK and Northern Ireland
4	Denmark
5	United States
6	France
7	Sweden
8	Norway
9	Finland
10	Singapore

Source: The United Nations e-Government Development Database

World's 1st Pan-Governmental Data Center

- Central Korea (Daejeon)
- Ground Space : ****** ㎡
- Floors space : ****** ㎡
- Server Room : ***** ㎡

kt International reference - Data Center Construction
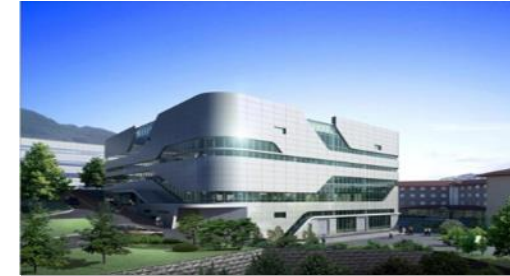

GIDC, Mongolia (2009)
- Construction

GIDC Nepal (2009)
- Construction

NIDC, Tanzania (2018)
- Construction

KT is a Total Data Center Service Provider who offers wide range of Data Center business services

GIDC, Mongolia

DC, Kimhae

GIDC Nepal

DC, Laos

NIDC, Brunei

GIDC Tanzania

DC, KT-SoftBank Kimhae (2011)
- Construction

DC, Laos LSX (2011)
- Construction

NIDC, Brunei (2012)
- Design & Consulting

Nuclear Data Explosion

200 X

Voice

'09.1   '10.1   '11.1   '12.10

(Source: kt)
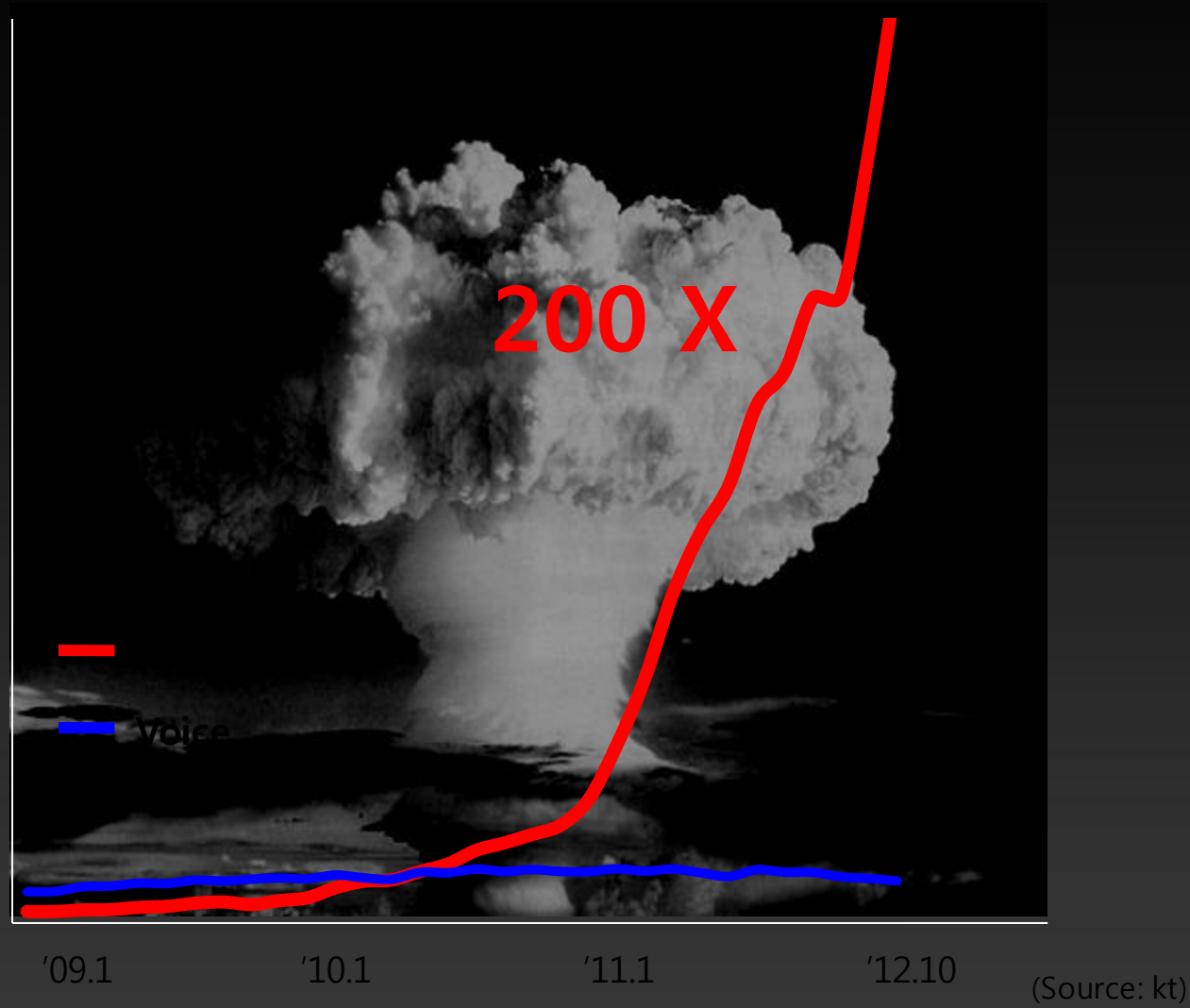
Transform of Mobile Network, CCC

Conventional	CCC*
Coverage	Capacity
Macro cell	Small cell
Standalone	Cloud
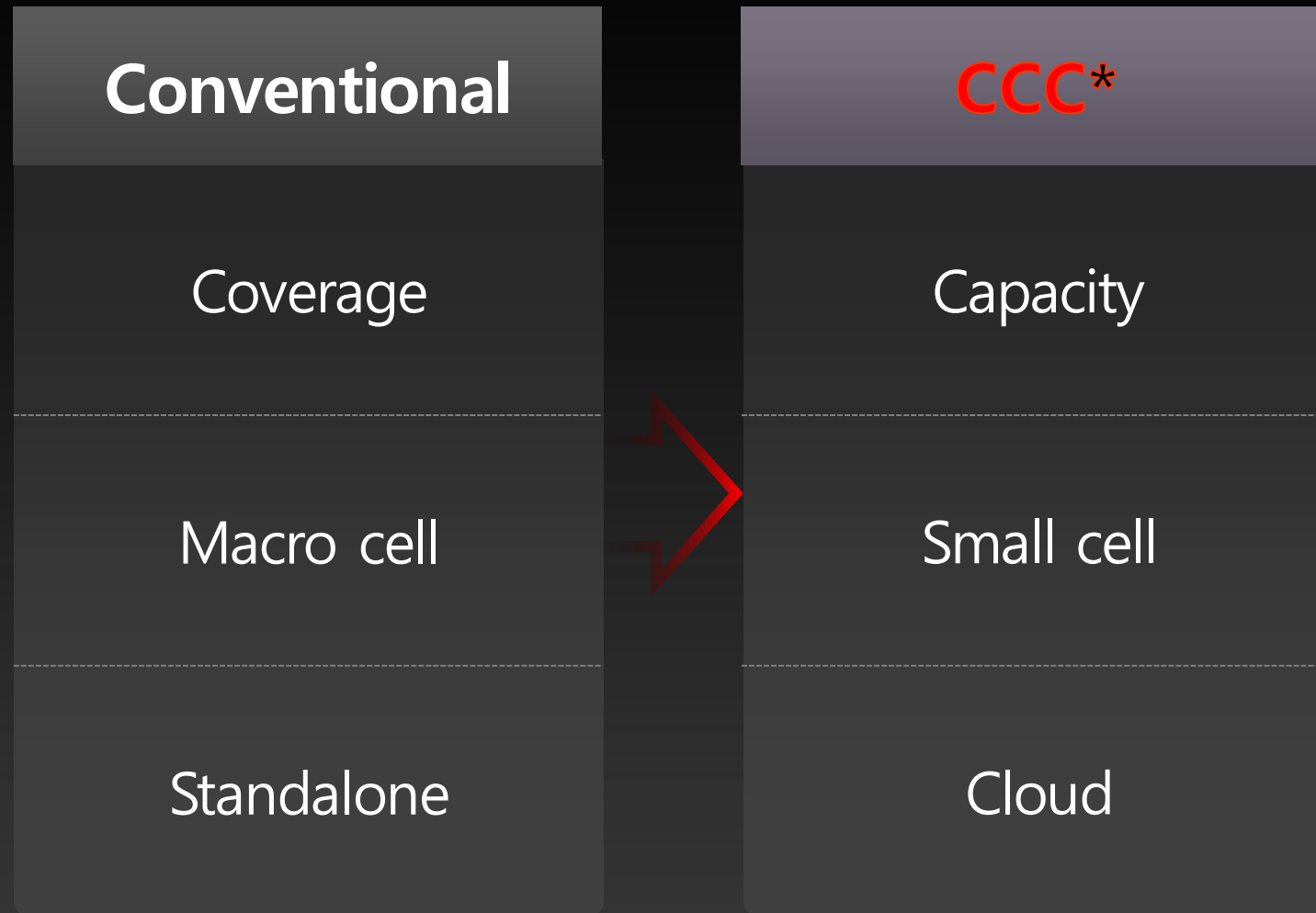
* CCC(Cloud Communication Center)

Evolutionary Phases @ CCC

Phase 1 (Separation)

Traditional Node B

Core

DU
Processor, Channel card

RU
Amp, Filter
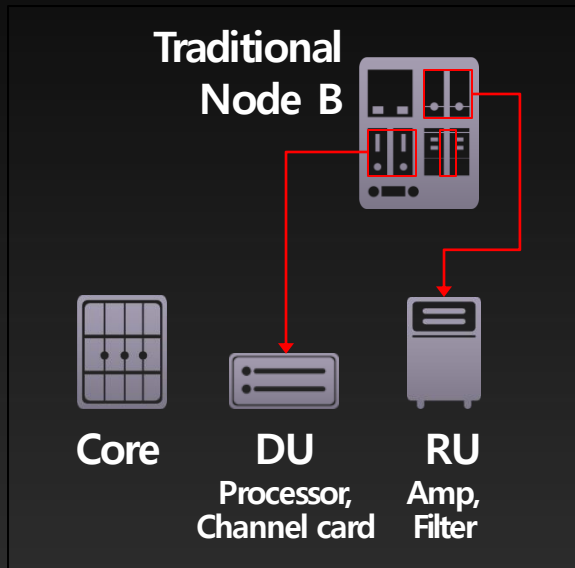
Separation of DU-RU

WiBro (Mobile WiMAX)

Phase 2 (Centralization)

RU

DUs

Core
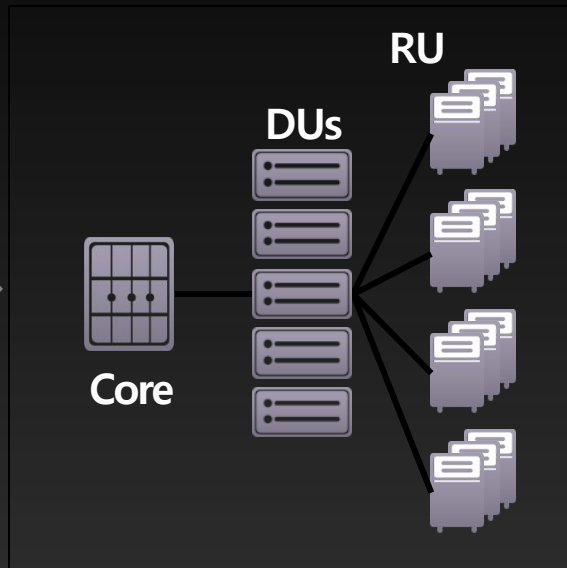
DU Centralization

3G

Phase 3 (Virtualization)

RU

DUs

Cloud

Core
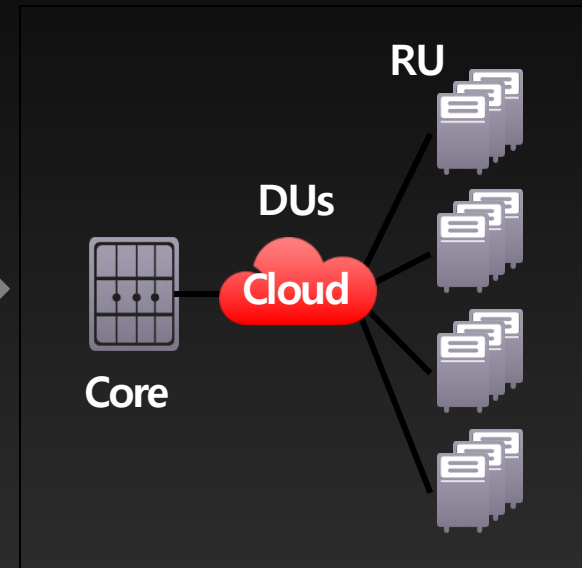
DU Virtualization

LTE WARP

* DU: Digital Unit, RU: Radio Unit

Based on 144 Cell Group

WARP Server

Optic Fiber

● ● ●

(144 cell)

PCI=1

PCI=1

PCI=2

**Joint
Transmission
(JT)**

**Coordinated
Scheduling
(CS)**

**Teleportation
(TP)**
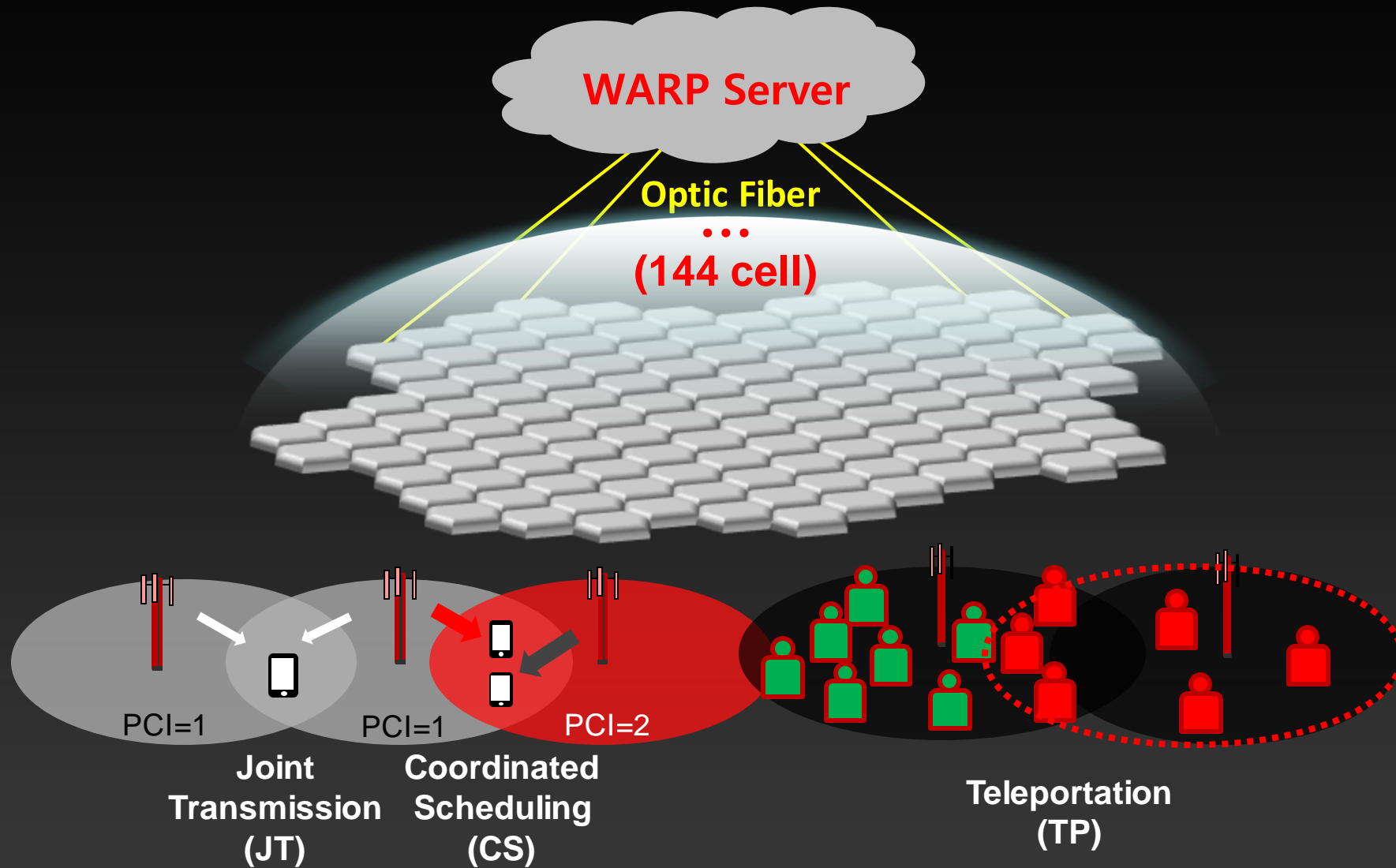
World-Class Speedy Rollout

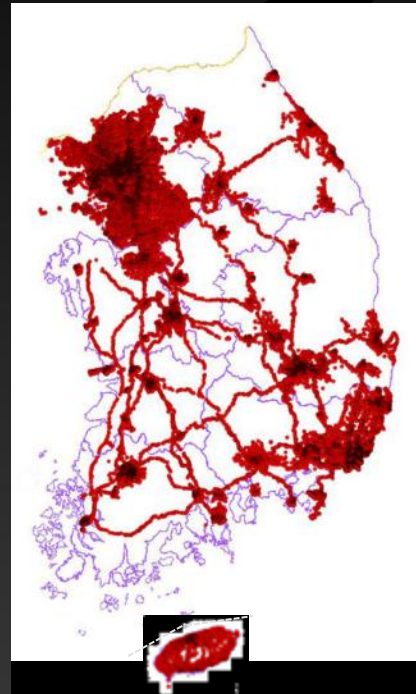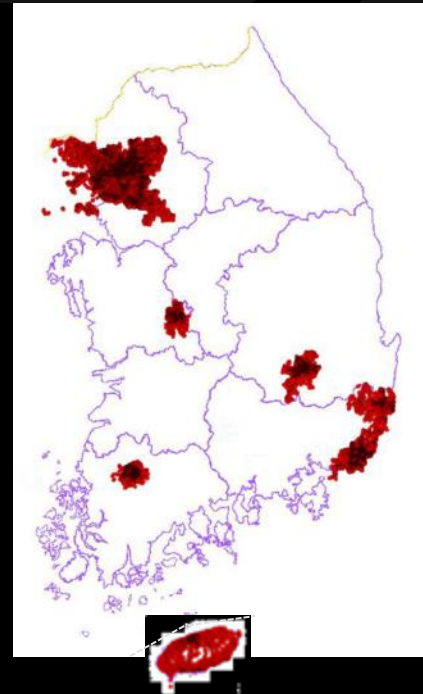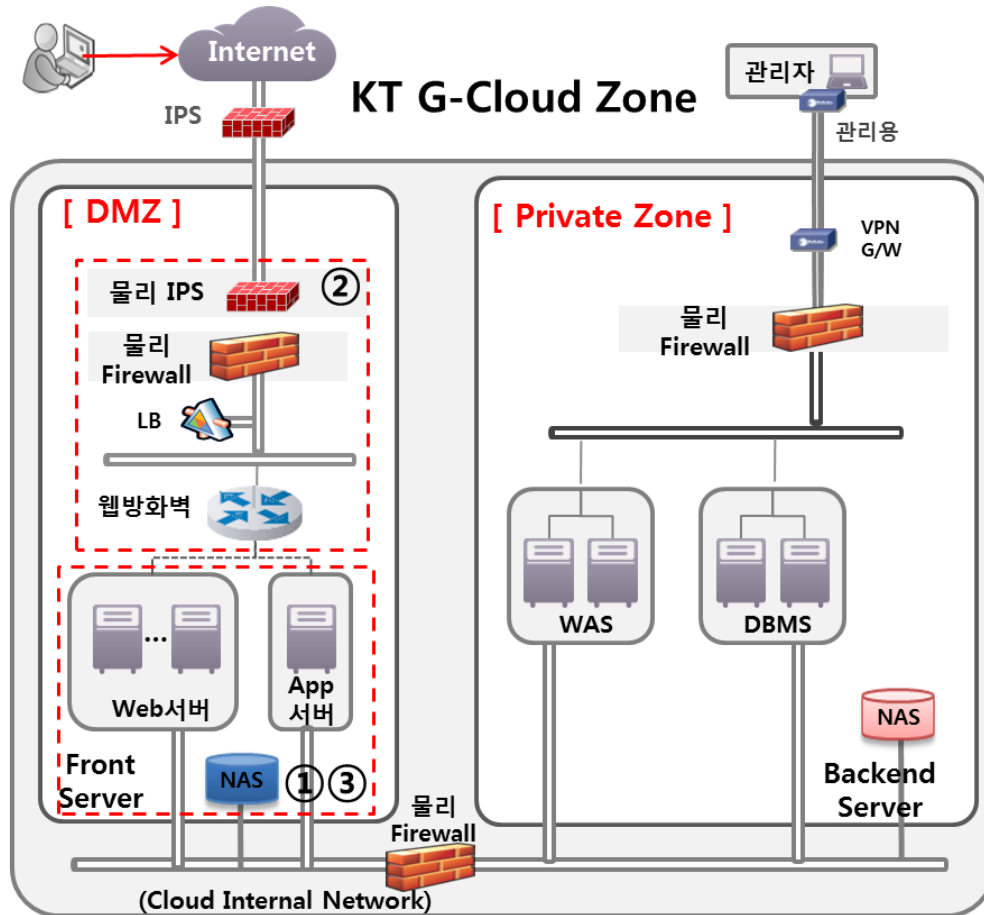| Commercial Launch | 65%(*) 30,000 Cells | 90%(*) 55,000 Cells | 95%(*) 62,000 Cells | more than 99%(*) 83,000 Cells |

Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec

(*) population coverage

G-Cloud

To enable government agencies to use the private cloud, the G-Cloud service provider obtains national security certification and provides G-Cloud services from government agencies

G-Cloud System

KT G-Cloud Zone

[DMZ]
- IPS
- 물리 IPS ②
- 물리 Firewall
- LB
- 웹방화벽
- Web서버
- App 서버
- Front Server
- NAS ① ③
- 물리 Firewall

[Private Zone]
- 관리자
- 관리용
- VPN G/W
- 물리 Firewall
- WAS
- DBMS
- NAS
- Backend Server

(Cloud Internal Network)

Service

Items	Detail
① Virtual Server	Server, Storage
② Security	Web firewall Vaccine(F-Secure) Web-Shell Monitor
③ Back-Up	Ucloud backup
④ Managed	Management & Operation service

Hybrid Cloud

Depending on the user's information system operation status, a service that links its own traditional DC and Cloud DC

3 type of the links btw CDC & DC
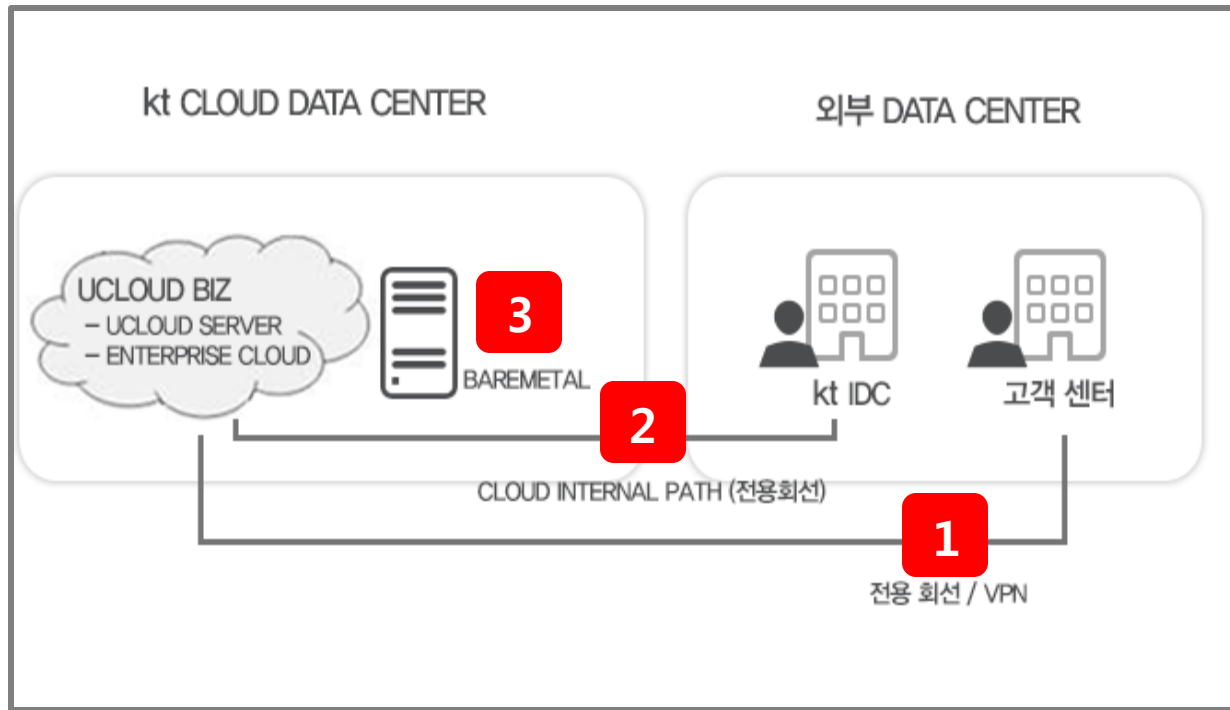
Hybrid Cloud

1 Link btw CDC & DC

2 Link btw KT IDC user & CDC

3 Baremetal link for Oracle DB

Case study for Hybrid Cloud

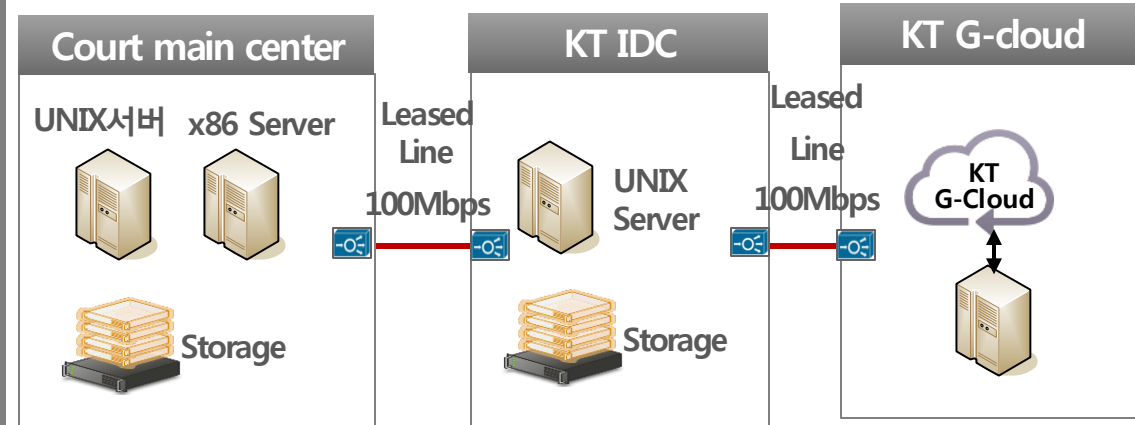## "DR Center for Constitutional Court of Korea"
Cloud + Traditional IDC + DR Configuration using leased line

- **Construct a backup system to prevent information loss by the Constitutional body that massively manages critical judgement materials**

- **Automatic recovery through the cloud center and backup center in the event of a main institutional system failure**

System Diagram

DR Instructure

Court main center | **KT IDC** | **KT G-cloud**

UNIX서버 x86 Server

Leased Line 100Mbps

UNIX Server

Leased Line 100Mbps

KT G-Cloud

Storage

Storage

- Unix servers and dedicated storage are available from existing IDC
- x86 server utilization Cloud Infrastructure

PEOPLE. TECHNOLOGY. **kt**

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