SK telecom

New IoT Paradigm for LTE

and Quantum Tech. R&D

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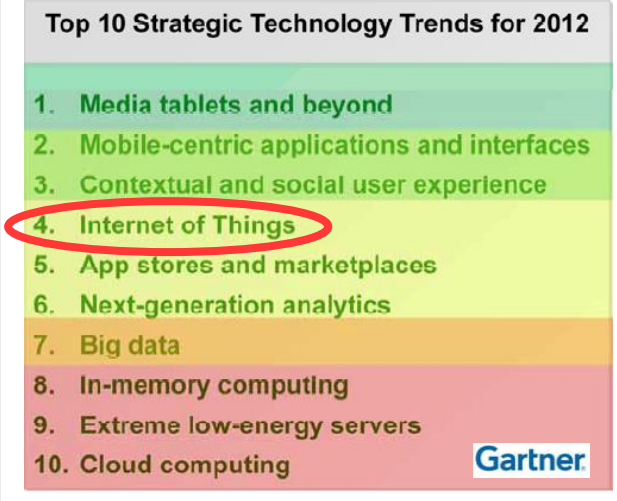
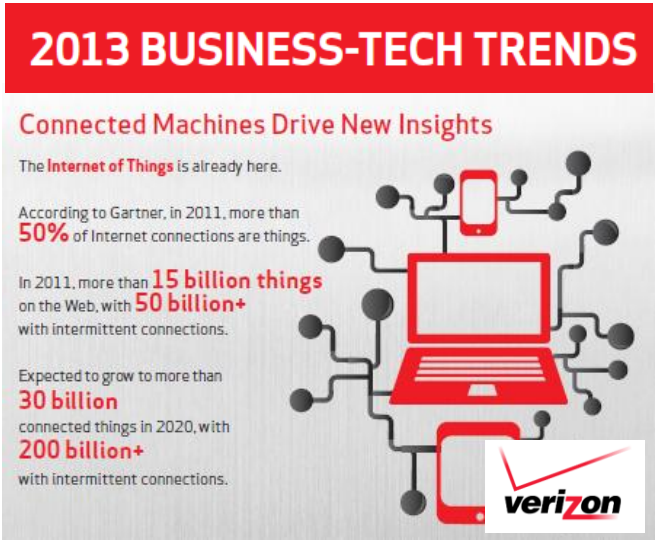
What is Internet of Things (IoT)?

A world
where **Things** are **Connected**
Everywhere, **Everyday**
and **Interact** with
people and other things..

IoT getting more attractive

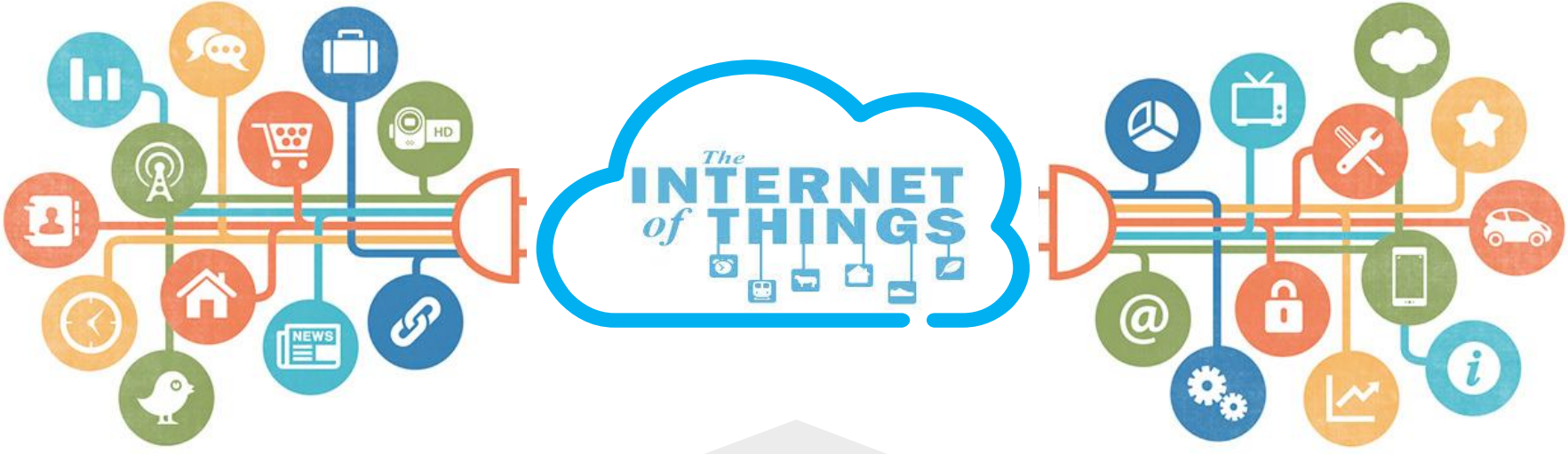
Internet of (Every)Things has been considered as one of the main technology trends for 2012~2014





Why IoT?

Q. Why are MNOs very much interested in M2M/IoT?



verizon at&t SK telecom vodafone 3 O2

Sprint T··Mobile· kt LG U+ orange T··Mobile

Why IoT?

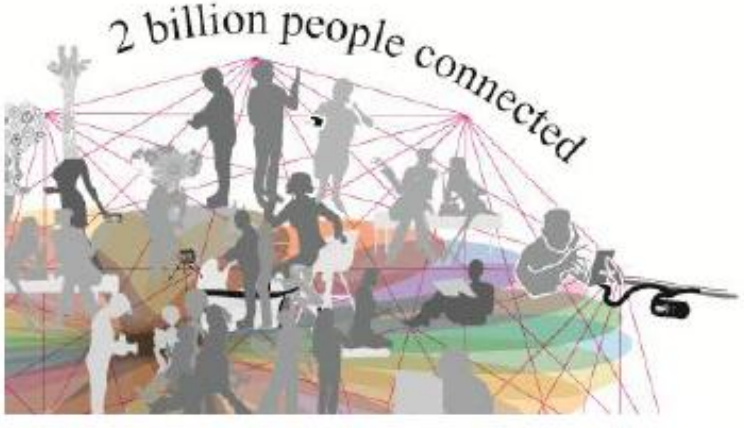
Q. Why are MNOs very much interested in M2M/IoT?

A. IoT is Total Convergence of Communication

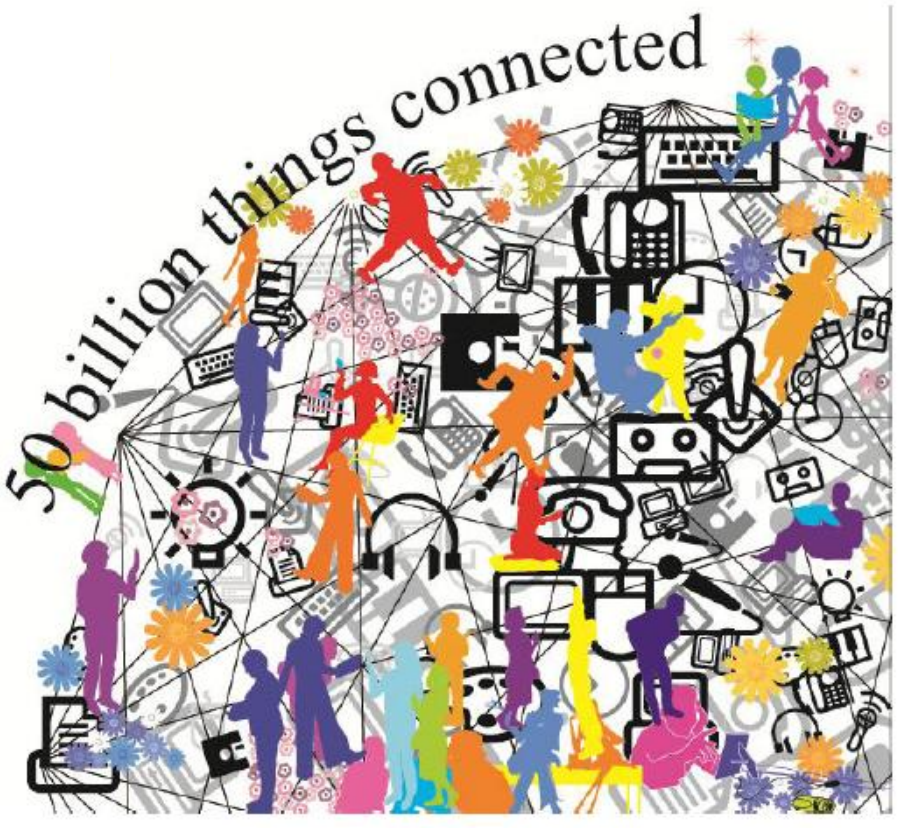
Why IoT?

Q. Why are MNOs very much interested in M2M/IoT?

A. Growing Markets (important for business)



[2012]



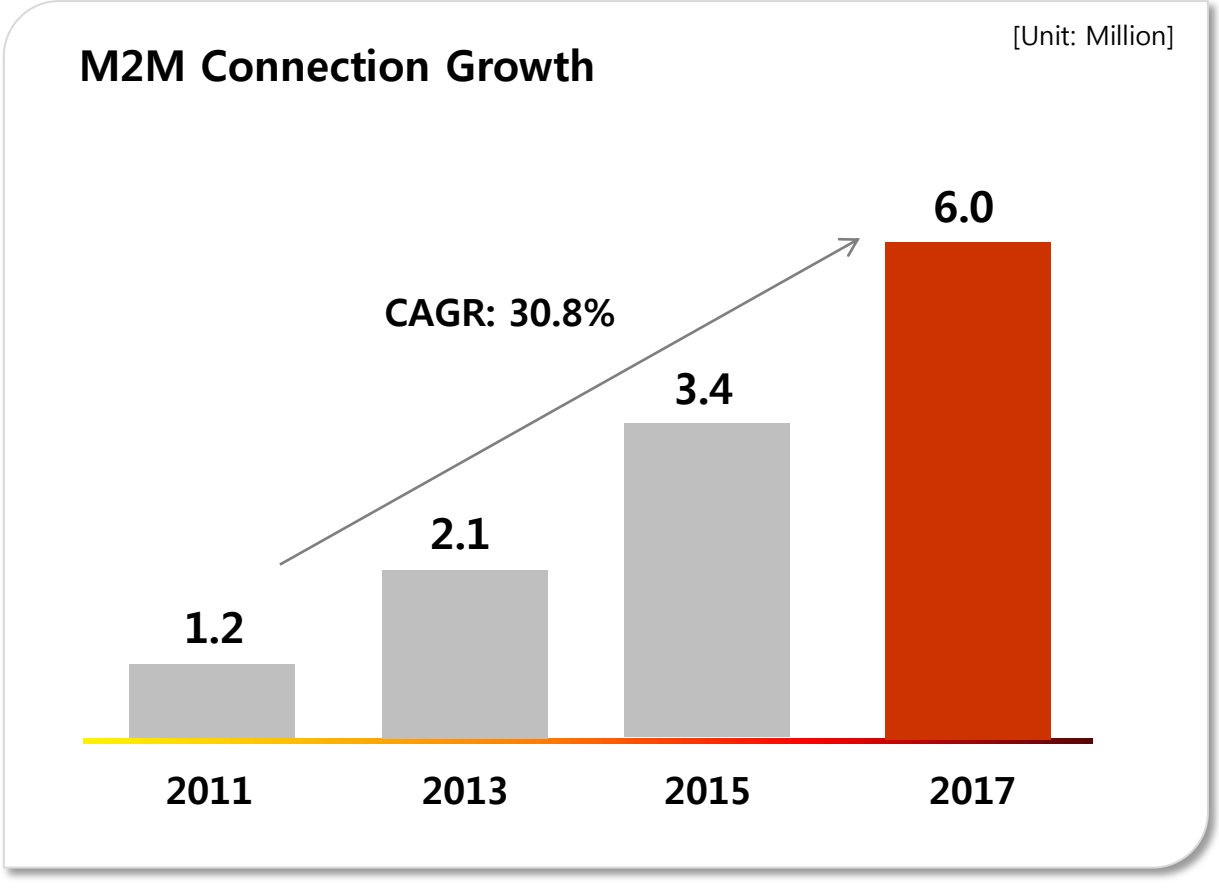
[2020]

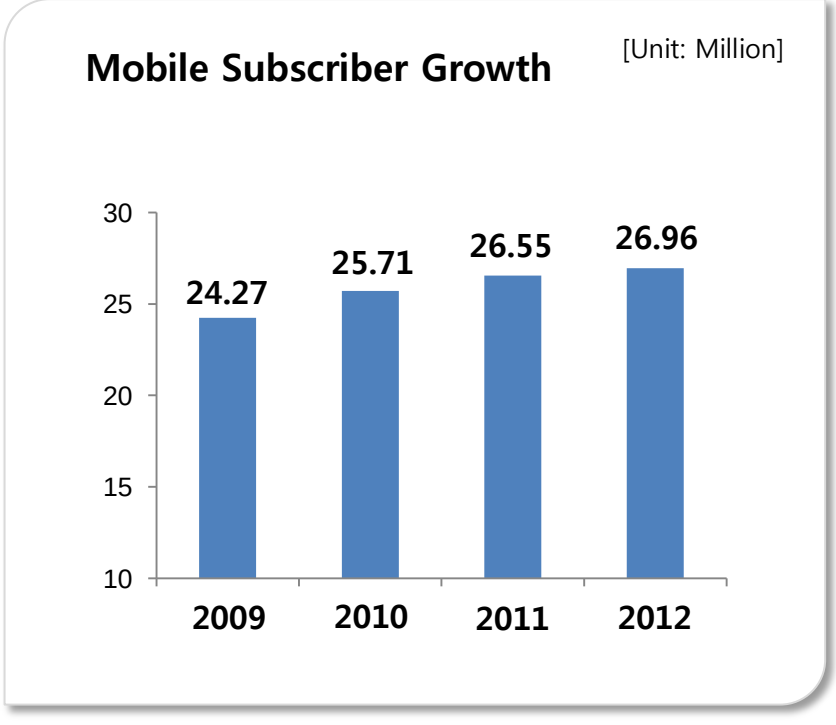
Source: IBM

Why IoT?

Q. Why are MNOs very much interested in M2M/IoT?

A. Growing Markets (more rapidly growing than mobile subscribers)





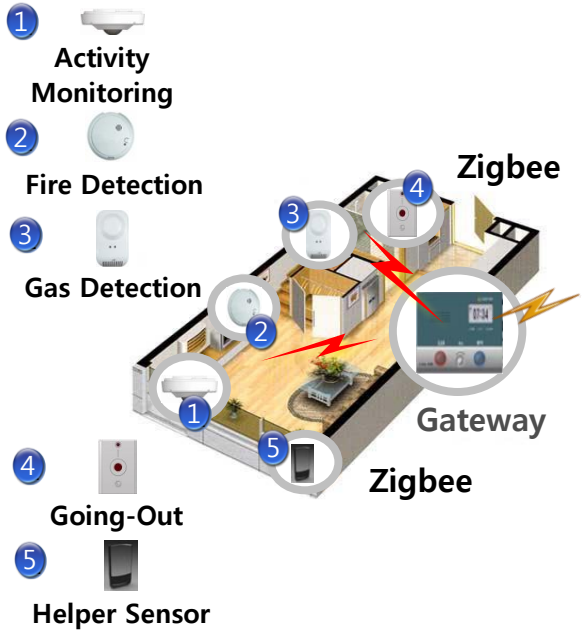
Source: SK Telecom

IoT Services

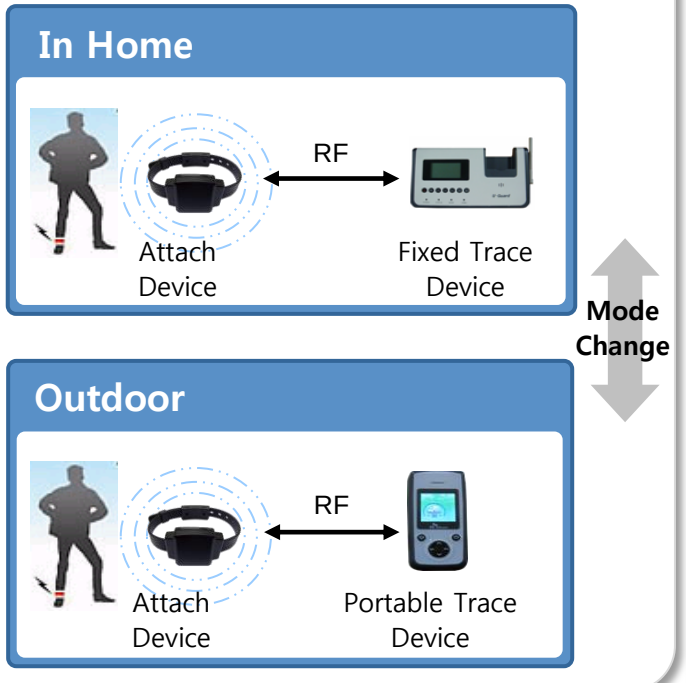
IoT becomes widely used in various applications including utility management, asset management, healthcare, finance and environment facilities

SK Telecom's IoT services

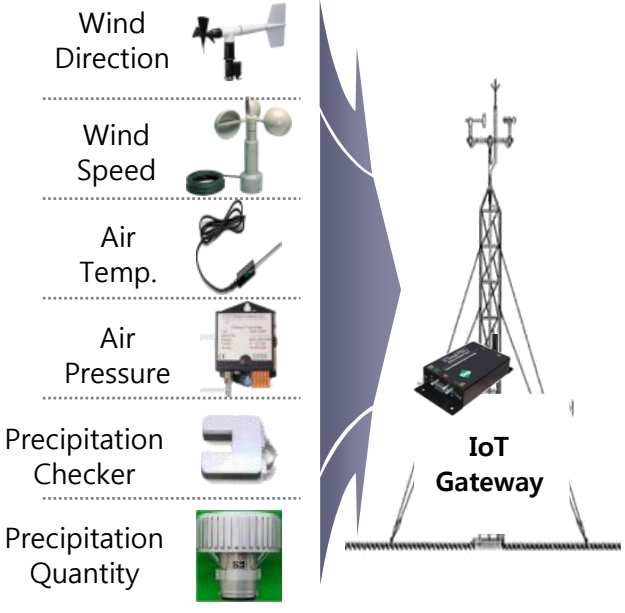
- **Elderly Care System**
  - Over 12,000 lines since Nov. 2009



- **Location Tracing System**
  - Over 500 lines since Sep. 2008



- **Remote Meteorological Observatory**
  - Over 600 lines by Dec. 2010



IoT Services (cont'd)

Vehicle Tracking

Infrastructure Monitoring

Intelligent Building Mgmt

Payment

Logistics

Smart Metering

Volume-rate Garbage Disposal

Agricultural Asset Mgmt

SK Telecom's IoT Architecture

IoT Device

Things






Short Range Comm.

- UWB
- Zigbee
- NFC
- Wi-Fi

IoT Gateway

- CPU
- Modem
- Memory
- SIM

Open IoT Platform

Mobile Network

- 2G
- 3G/WCDMA
- 4G/LTE

IoT Platform

- Diagnosis
- Measurement
- Integration
- Self-Control
- On/Off

Legacy Platform

- SMS
- LBS

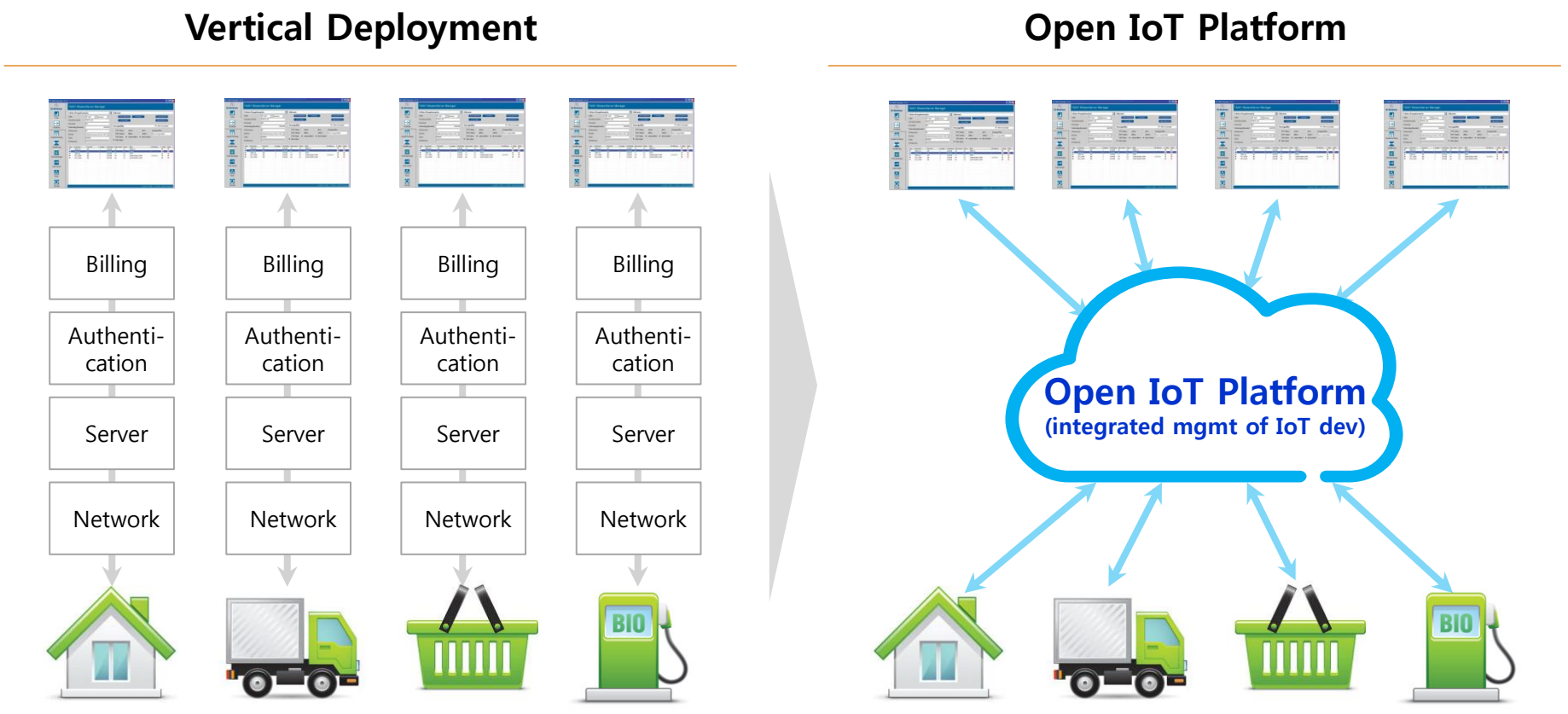
etc

Customer

- B2B Customers
- B2C Customers
- B2G Customers

Role of Open IoT Platform

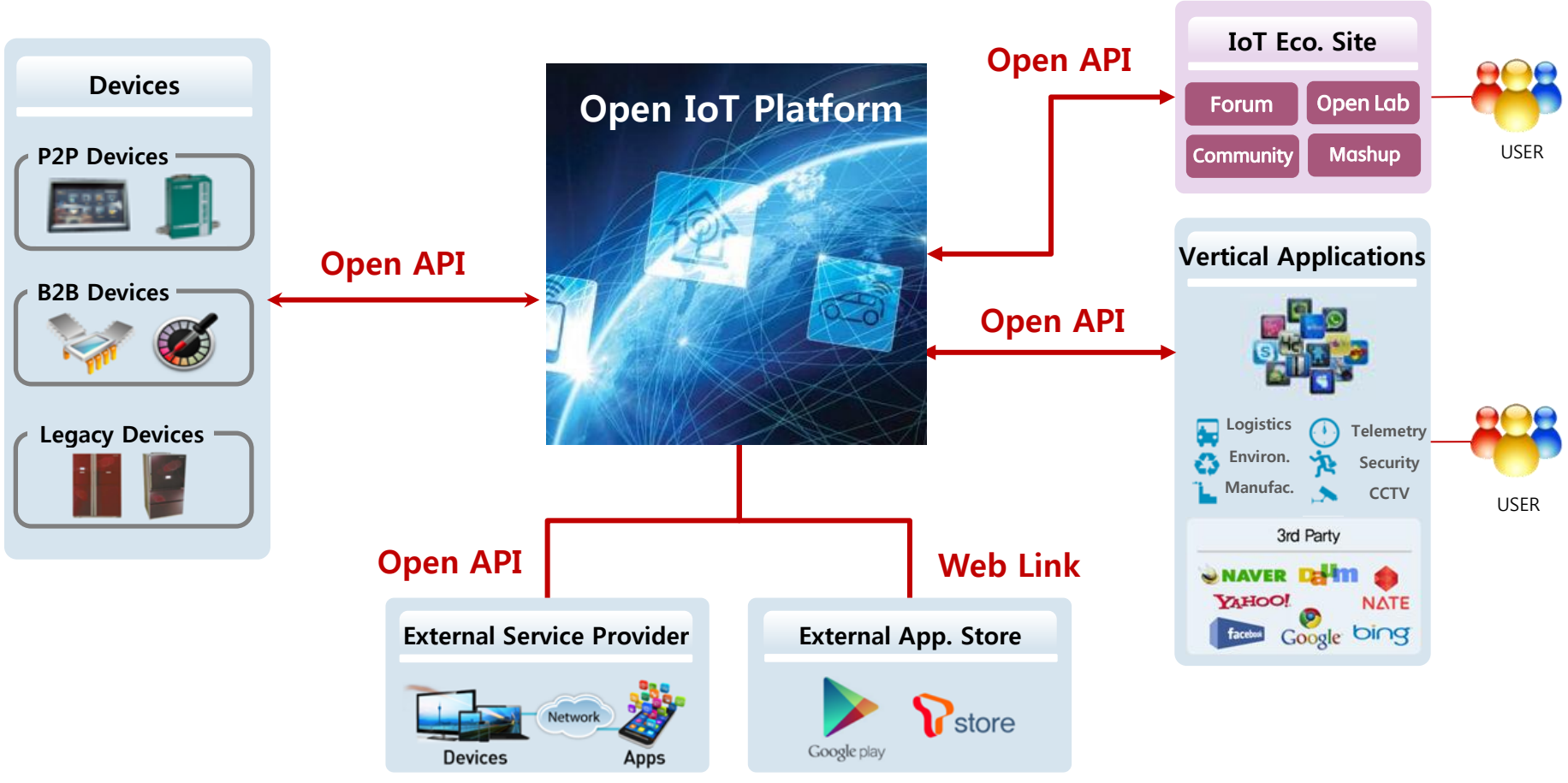
- Vertical Deployment → Horizontal Deployment



- Reducing cost and time of IoT devices/service development
- Leading an ecosystem of IoT devices

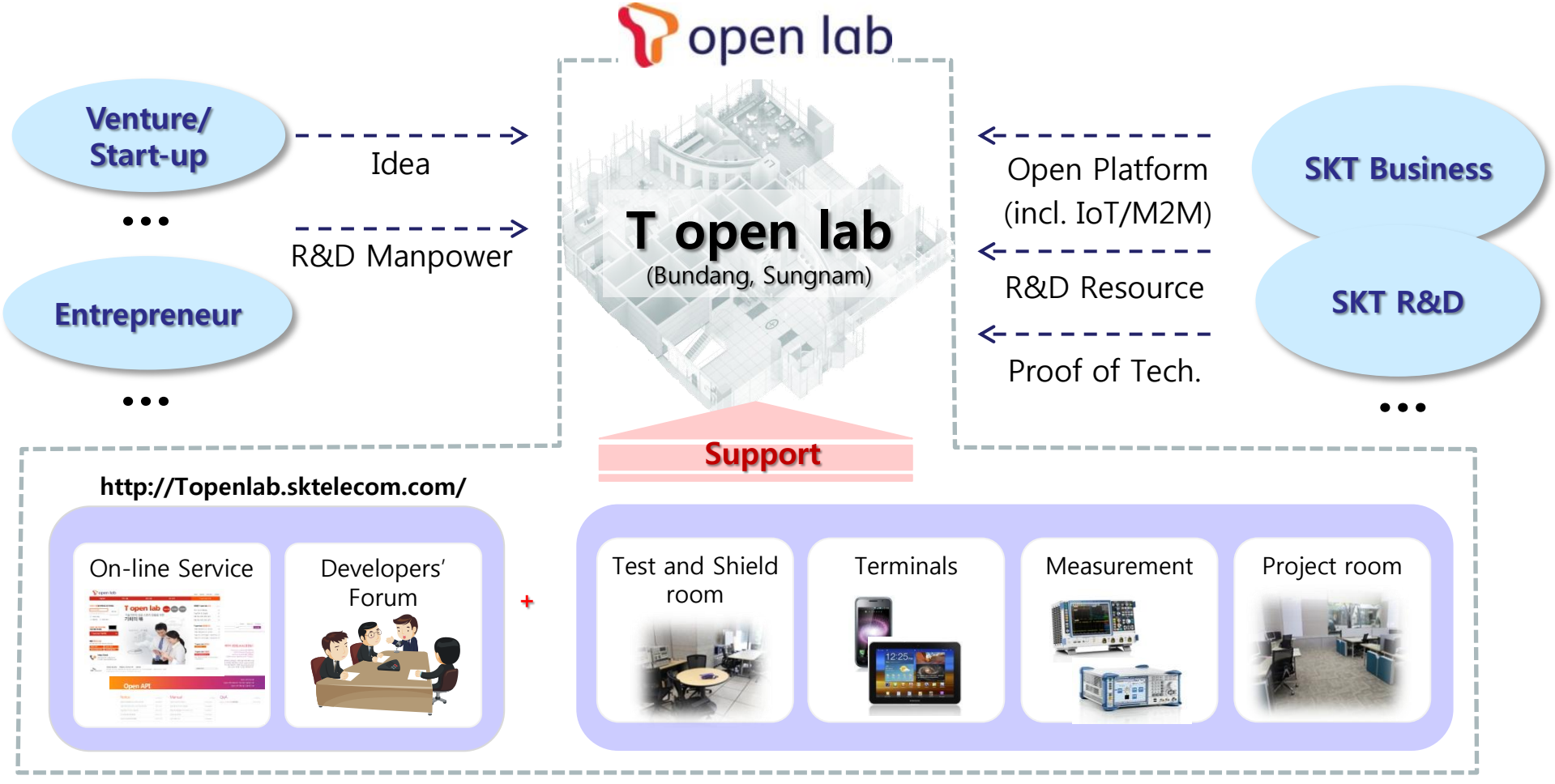
Open API for IoT Platform

SKT IoT Platform provides Open API to app. developers, service providers, device manufactures and other ecosystem supporters



Open Innovation Enabler, T open lab

"T open lab" is an open place where start-ups and SK telecom share ideas and resources. SK Telecom provides H/W and S/W facilities including IoT/M2M platform



History of SK Telecom's IoT/M2M Platforms

Major IoT applications are still using 2G/CDMA, however we are currently developing IoT platforms with 3G/WCDMA and 4G/LTE

M2M Platform v1

- For CDMA
- Closed Interface
- B2G Service

Commercialized

2008

M2M Platform v2

- For WCDMA/LTE/Wi-Fi
- ETSI-based Open API, Web Portal
- B2G & B2B Service

Started development

2010

Commercialized

2012

IoT Platform

On-going

- For WCDMA/LTE/Wi-Fi
- ETSI and OneM2M-based Open API
- B2G & B2B & B2C Service

Started development

2013

Why LTE for IoT?

LTE is ideal for

1) Higher performance IoT applications

	Criteria	3G/HSPA	4G/LTE
Higher Speed	Max down speed Max up speed	14.4M 5.7M	150M 75M
Lower Latency	Latency (Round Trip Time)	Approx. 100ms	Approx. 10ms
Easier Service Integration	Latency (Round Trip Time)	Circuit-based	Packet-based

- **Transmitting high-quality contents**
  - Remote surveillance
  - Black Box
  - Medical Equipment

Surveillance Camera

Black Box

- **Controlling sensitive equipments**
  - Traffic Systems
  - Industrial Alarms & Controls

- **Providing smart things with IP-based services**
  - Smart Cars with VoLTE, UC
  - Smart Home Appliances

Why LTE for IoT?

LTE is also ideal even for

2) Lower performance IoT applications

Longevity

- The lifecycle of 2G is unpredictable
- LTE will support connected things for many years to come

Scalability

- LTE supports IPv6, making it well suited to mass IoT deployment
- Legacy 2G/3G cannot do it

Lower Service Cost

- LTE is much more spectrum-efficient than 2G/3G
- LTE has higher capacity to accommodate more devices


Emergency Response


Agriculture Monitoring


Transportation /Logistics


Medical Informatics


Public /Military Services

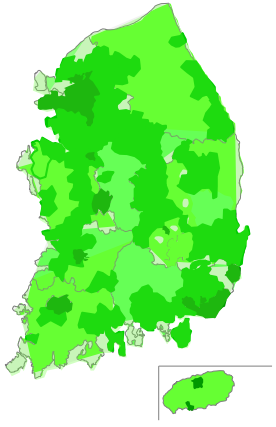

Health Monitoring

Key Challenges for LTE adoption in IoT

Most of worldwide people say that most challenging tasks for LTE adoption in IoT are

1. Limited Coverage → **Not issue for SK Telecom**

- **SK Telecom completed nationwide 99% roll-out**
  - Launched LTE service (Jul. 2011)
  - Major 84 cities (Apr. 2012) and Nationwide (Jun. 2012)



2. Device Cost

3. Increased burden in LTE networks

Enhancing LTE for IoT

Mobile Network Operators, Standard bodies, Vendors are working together to optimize LTE standards and main activities include

1. Developing a new class of low-cost LTE devices

QUALCOMM

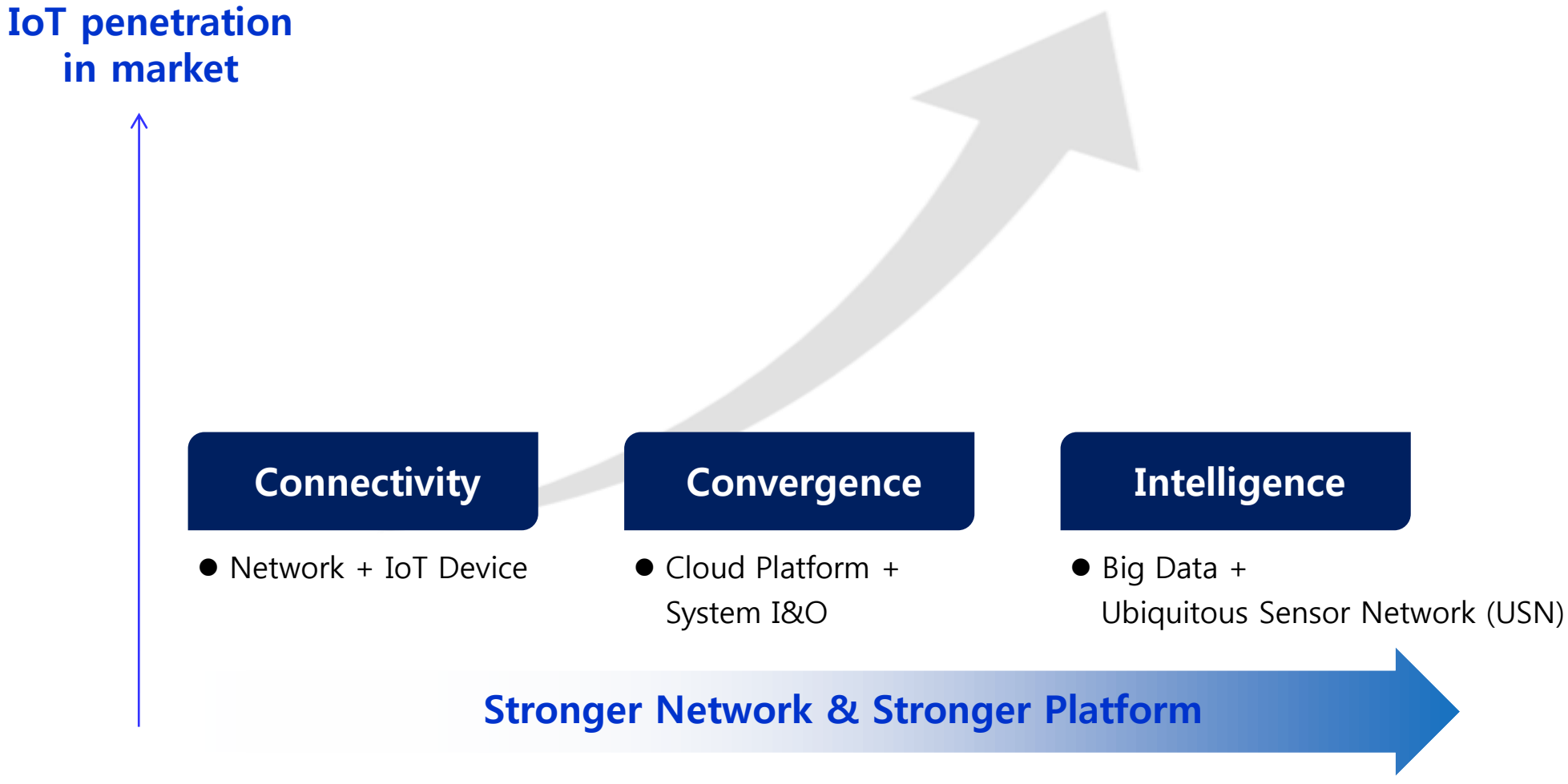
2. Improving power efficiency with longer sleep cycle for latency tolerant applications and configurable mobility management functions

3. Controlling network congestion/overload, and amending mobile network architecture

- Mobile network was designed for voice/data, not for IoT
  (IoT usually has a little data but lots of signaling)
- Increasing and managing mobile network (ex. EPC) resource, potentially with network function virtualization (NFV)

Summary: Our Vision on IoT World

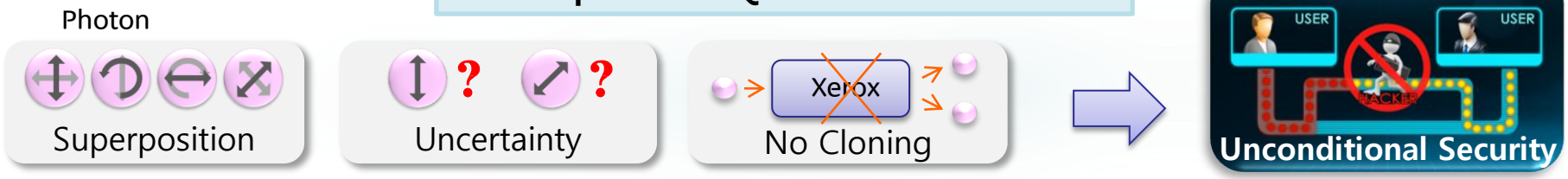
SK Telecom will keep the leading position as an No.1 IoT operator in Korean market with bringing stronger network and platform



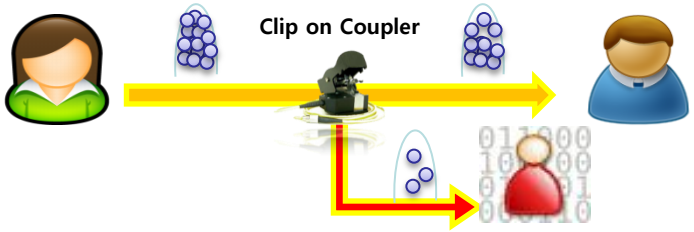
Quantum Cryptography(Unconditional Security)

Essence of Quantum Cryptography is the distribution of secret key using quantum effect. Data is transmitted over normal comm. channel after encrypted by the key.

Properties of Quantum mechanics



Security Threat in Optical Communication

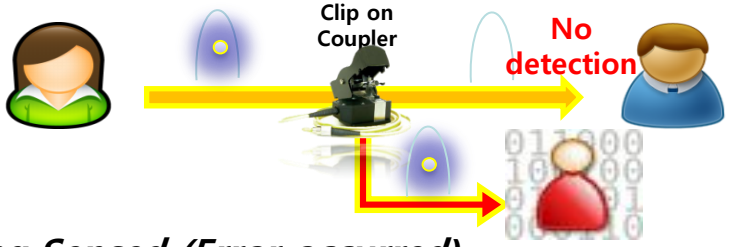


- Any information in Optical Communication can be cloned or sniffed by splitter and amplifier.
- For secure communication, strong cryptography algorithm is required
- But, public-key cryptography(like RSA, Diffie-Hellman) is vulnerable to high-performance computing including quantum computer

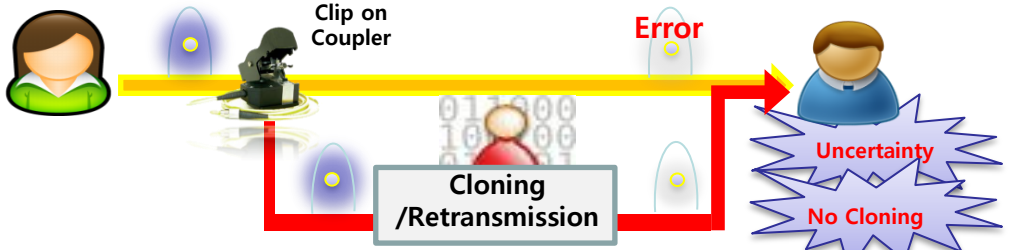
Key Distribution in Quantum Communication

1. No information break

2. Tapping Sensed (No Signal Detection)



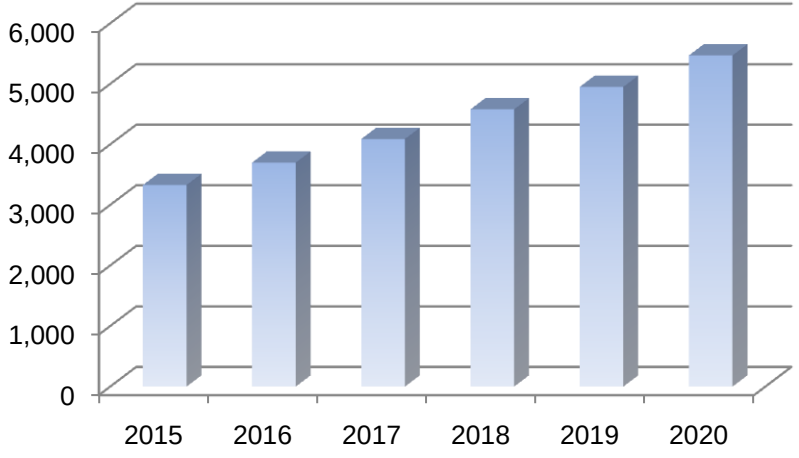
3. Tapping Sensed (Error occurred)



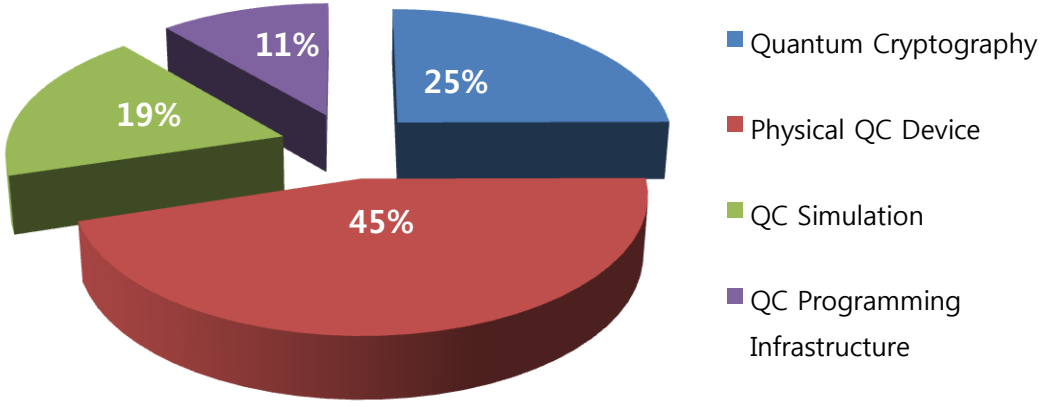
Quantum Technology Market Forecast

Total cumulative market size from 2015 to 2020 is expected to reach $26B and a quarter of total revenue will come from Quantum Cryptography.

Quantum Technology Market Forecast 2015-2020($M)



Quantum Technology Market Share by Segments



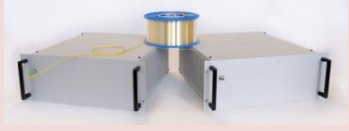
Segments by Technology	2015	2016	2017	2018	2019	2020	2015-2020	CAGR
Quantum Cryptography	950	990	1,040	1,100	1,160	1,270	6,510	6.00%
Physical QC Device	1,700	1,840	1,970	2,030	2,090	2,200	11,830	5.30%
QC Simulation	450	570	700	930	1,040	1,150	4,840	20.60%
QC Programming Infrastr.	230	300	380	520	660	850	2,940	29.90%
Total Market	3,330	3,700	4,090	4,580	4,950	5,470	26,120	10.40%

Source : www.MarketResearchMedia.com

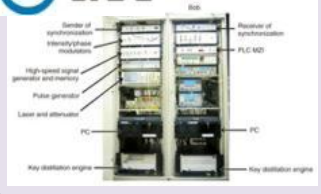
Global activities in Quantum Cryptography

SK telecom

Commercialization



Preparation for commercialization



R&D groups

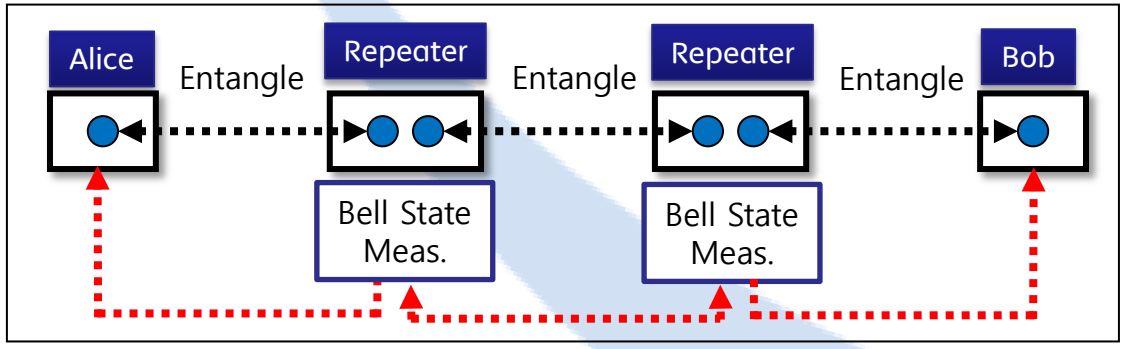
Standardization

QKD-ISG
(2009~, after FP6 SECOQC)

Future of Quantum Technology

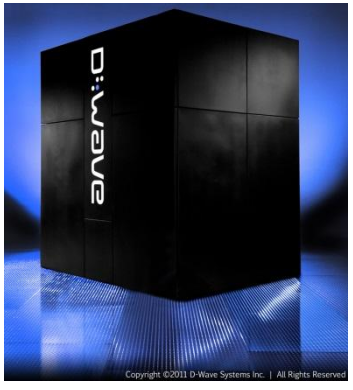
Quantum repeater (5~10 yrs)

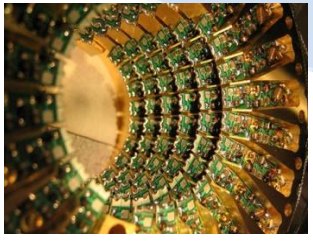
- Implementation of QKD over long distance (> 50km)
- Expansion of network topology from 1-to-1 to N-to-N



Quantum computer (5~15 yrs)

- Exponential speed-up of computation in optimization and search
- Emergence of commercial system already, but still under testing…



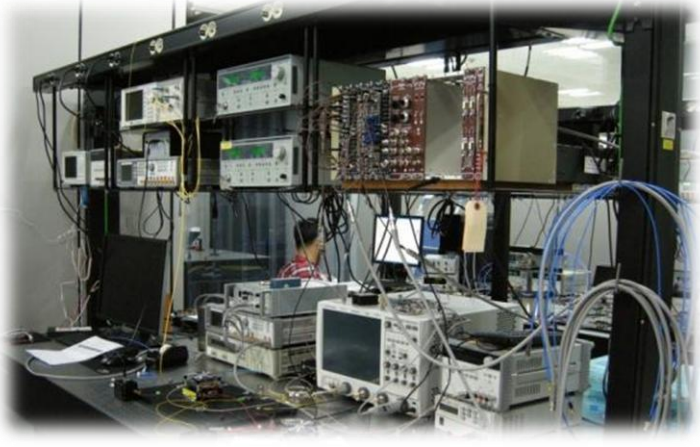


SKT Quantum Technology Laboratory

SKT opened Quantum Tech Lab in 2011 and has promoted the R&D on Quantum Cryptography Area.

Table top QKD system

Clean booth #1 for optics setup

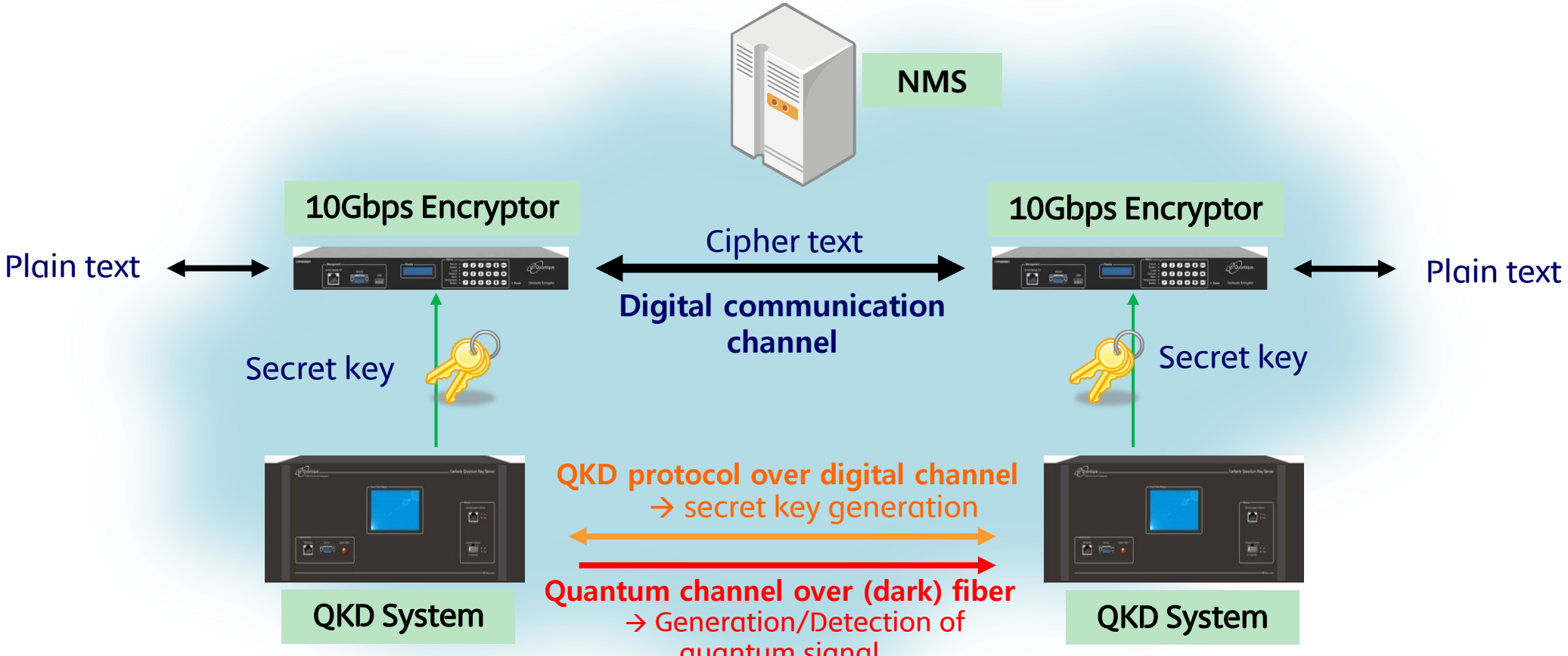


100 MHz Single photon detector

Clean booth #2 for chamber assembly

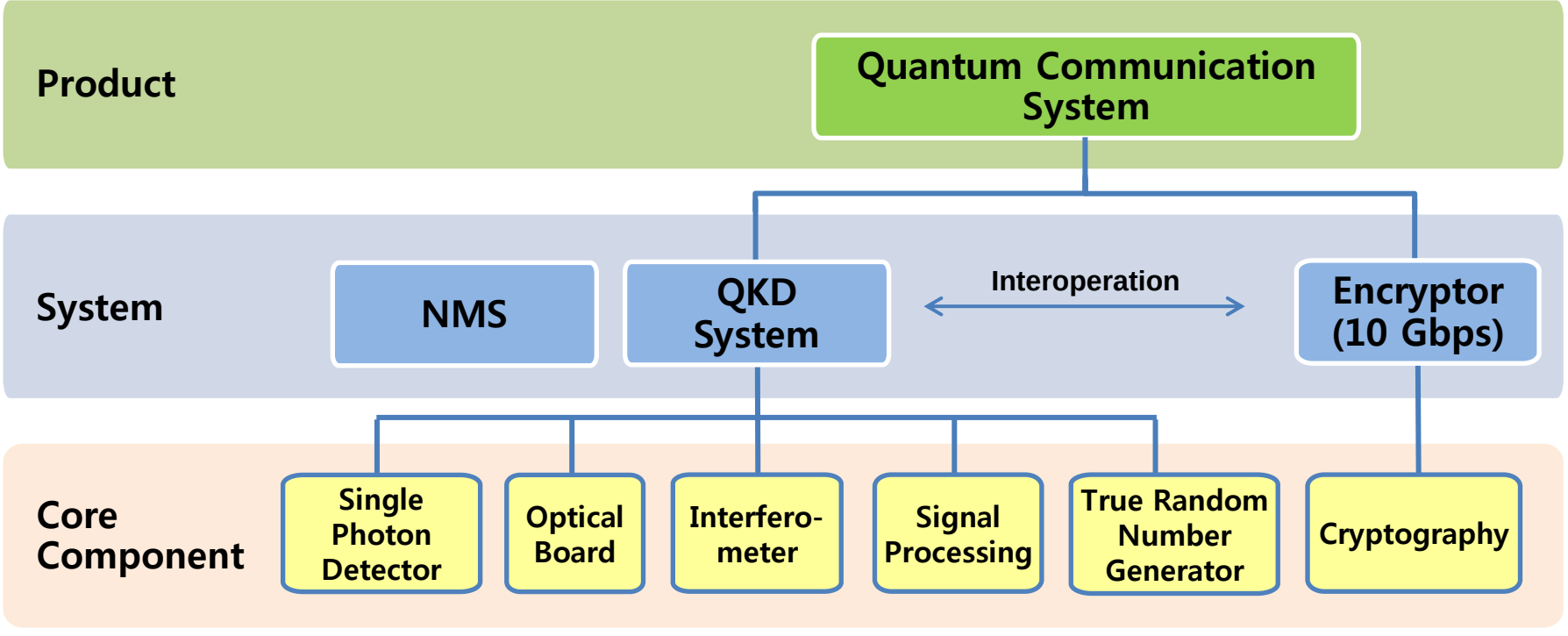
What SKT is doing

SKT Quantum Tech Lab is now developing QKD System, High-speed Encryptor and NMS for Quantum Communication.

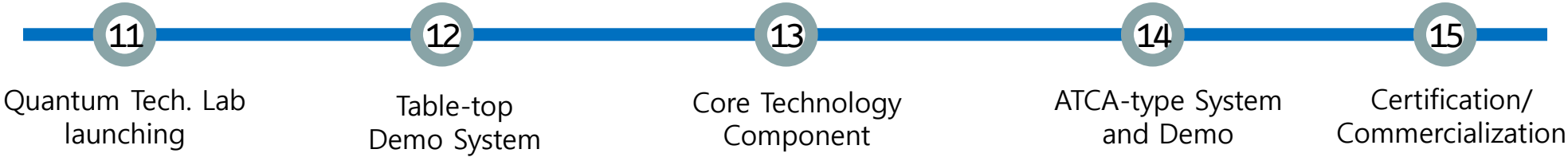


What SKT is doing

R&D Focus Area



Roadmap



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