Quantum Safe Communication – Cybersecurity for 5G era

Dong-Hi SIM (a.k.a Donghee Shim)
Head of Global Standards, SK Telecom

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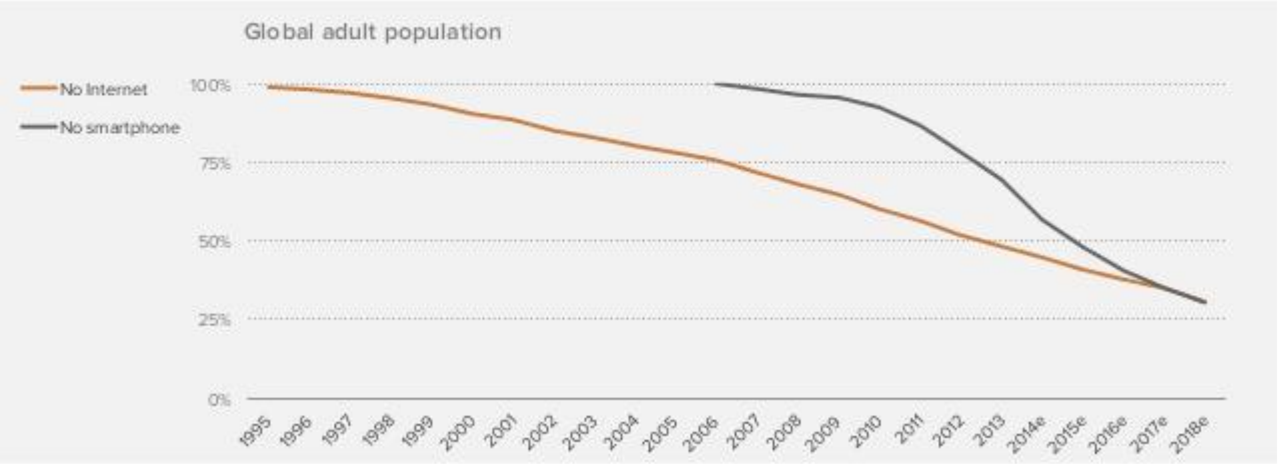
What does Mobile Deployment mean?

The end of the unconnected

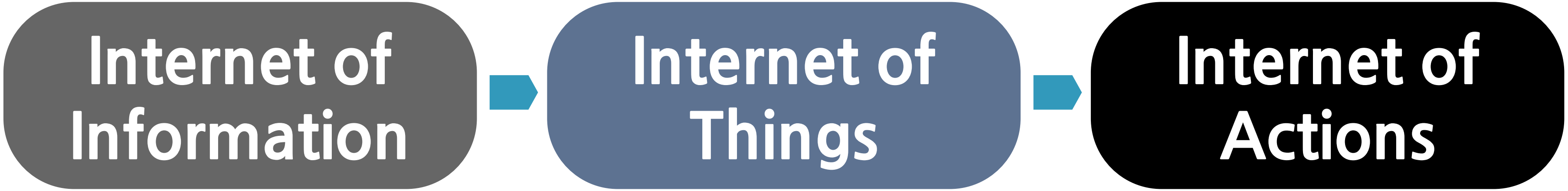
Smartphones drive much greater internet penetration



ANDREESSEN HOROWITZ

Source: a16z, World Bank, Apple, Google, Nokia

Now things are getting connected and even more intelligent to provide service at offline



Internet of Information

Internet of Things

Internet of Actions

So What?

Cybersecurity is expanded to Physical Space as Internet is becoming Internet of Actions

Life or Death Situation can happen in Internet of Actions

TARGET

POS hacking via HVAC

- Massive customer data breach(‘14.01)
- 40M debit and credit card info
- Hackers gained access to Target POS system using login credentials belonging to an HVAC company

Autopilot Hacking

- Tencent Keen Security Lab(‘19.03)
- Remotely gain root privilege of Autopilot SW & Control the steering system
- Can disturb the autowipes functions
- Can mislead the Tesla car into the reverse lane with minor changes on the road

TESLA

Now is the early stage of 4th Industrial Revolution, to create 'Unprecedented Value' in the offline with online tech

Mid 18C
Factory

1st Industrial Rev

19C~Early 20C
Electricity

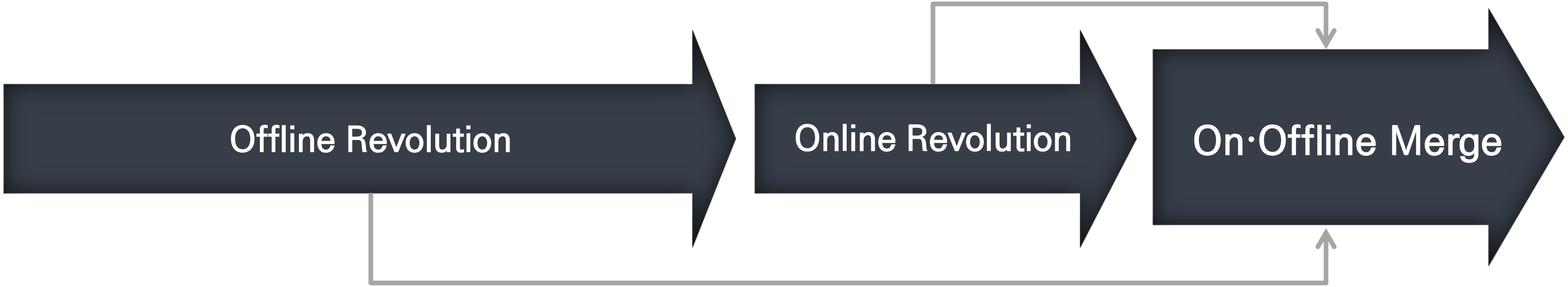
2nd Industrial Rev

Mid 20C
PC, Internet

3rd Industrial Rev

Early 21C
On·Off Merge, Energy, Bio

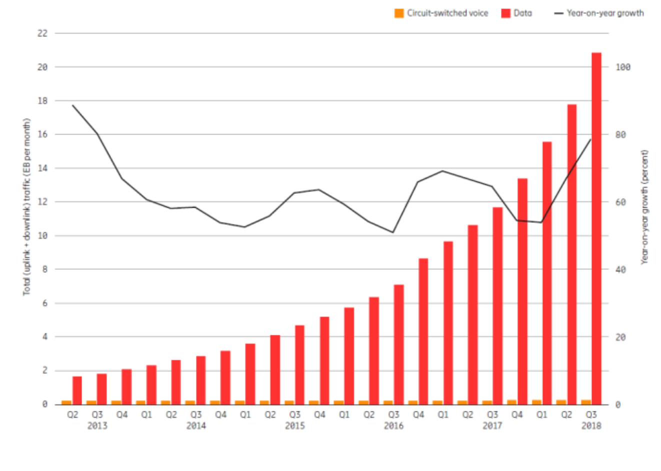
4th Industrial Rev



Influence of ICT Technology extended to Offline

SK Telecom Mobile Network History

leading mobile network evolution to 5G



Source: Ericsson traffic measurements (Q3 2018)

[1] Traffic does not include DVB-H, Wi-Fi or Mobile WiMAX. VoIP is included in data traffic

2G
CDMA1x & EVDO
1996~2002
World's First

3G
WCDMA/HSDPA
2006

4G/LTE
75Mbps
2011.7
Korea's First

Multi-Carrier
2012.7
World's First

LTE-A
150Mbps
2CC CA
(20MHz)
2013.6
World's First

LTE-A
225Mbps
2CC CA
(30MHz)
2014.6
World's First

LTE-A
300Mbps
3CC CA
(40MHz)
2014.12
World's First

LTE-A
500Mbps
256QAM
3CC CA
(40MHz)
2016.6
World's First

LTE-A Pro
700~900Mbps
900Mbps
2CC 4x4
256QAM
3CC CA
(50MHz)
or
700Mbps
256QAM
5CC CA
(70MHz)
2017.6
World's First

LTE-A Pro
1Gbps
3CC 4x4
256QAM
3CC CA
(50MHz)
2018.1H

5G
~10Gbps
800MHz Bandwidth
28GHz
100MHz Bandwidth
3.5GHz
2019~

5G Opens up New Possibility

With the vision of "Transforming Offline Things into Online/Mobile",
SK Telecom is trying to differentiate 5G in terms of Speed, Latency, Stability and Security

SKT's perspective

By transforming offline objects into mobile ones

5G realizes
Cyber Physical System
in 4th industrial revolution era

Value Proposition

SKT 5GX

- eXCEED
- eXPAND
- eXCELLENT
- eXCITING
- eXPLORE
- eXTRAORDINARY

Brand new 5G Experience

① Speed ② Latency ③ Stability ④ Security

Personal Experiences stored & replayed

Sensors & Wearables will store vivid experiences even can be replayed

- What do you like
- are Enthusiastic about

- Who are you talking to
- What kind of talk

- Bedtime habit
- What kind of dream

Private life

Should be Concerned

Human-Machine Partnership

Machine knows too well Humans? →

← Humans too dependent on Machines?

From de-stress

- Automation
- Helping decision making
- Offloading labors
- Distributed Machines seamlessly fulfill our wants & needs

Interfering & Controlling

- Beyond helping becomes interfering
- Big brothers manipulating our lives?

OS One in Movie 'her'

Security Everywhere

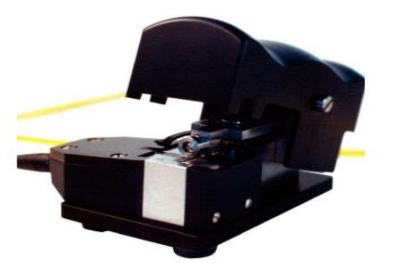
End to End Security of Everything

Megatrends - Security Threats

- **Computing Power Increases**
  - Making public key cryptography ever more vulnerable
- **Hacking is on the rise**
  - in a society increasingly relying on ICT
- It is now common knowledge that governments are also engaged in **massive eavesdropping projects**

Optical Fiber Hacking

- A simple equipment can penetrate into optical fiber network to intercept and de-information



  - Kingfisher International(Australia) optical cable tapping equipment delivered to SKT Quantum Lab
  - **Anyone can order without restrictions. Only $500!**

Problems of the security of currently used Public Key Cryptography

- **Human Ingenuity**
  - Public key cryptography is based on mathematical problems which could be BROKEN by future technology
- **Moore's Law**
  - The increase in computing power makes it increasingly easier to break public key cryptography
- **Quantum Physics**
  - Public key cryptography is vulnerable to quantum computing which can solve certain mathematical problems exponentially faster than classical computers

Vulnerable to Quantum attack

- **Any Cryptosystem based on mathematical complexities**
  - Integer Factoring & Discrete Logarithms(RSA, DSA, DH etc)
  - Almost all public key cryptography use these types of ciphers
- **Any Security Protocol from the above public key ciphers**
- **Any products or security systems from these protocols**

→Some symmetric key ciphers like AES are believed to be Quantum-safe, whereas many public key ciphers are known not to be

Quantum Key Distribution(QKD)

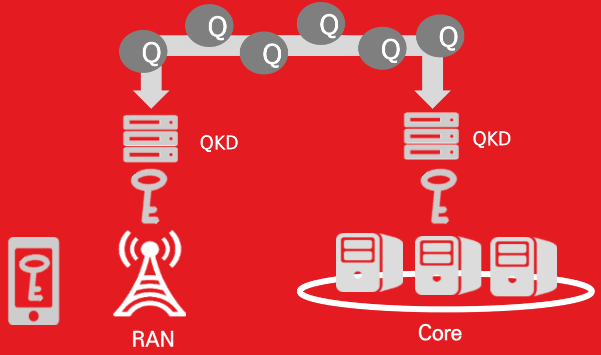
- **How to securely distribute symmetric keys between distant parties without relying on insecure legacy public key algorithms?**
  - A security solution is as secure as its weakest link and in network encryption, the current weakest link is the key distribution based on public key cryptography

- **QKD answers this question**
  - QKD is a technology uses Quantum Physics to secure the distribution of symmetric encryption keys
  - i.e. Quantum cryptography solves the problem of key distribution by allowing the exchange of a cryptographic key between two remote parties with **ABSOLUTE security**, guaranteed by the fundamental **LAWS of PHYSICS**
  - This key can then be used securely with conventional cryptographic algorithms

Security based on Physics

SK Telecom has been developing quantum cryptography and invested in Swiss quantum company, IDQ

Quantum Key Distribution (QKD)



2011~	Launched R&D program on Quantum Crypto
2016.6.21	Applied World's first Quantum Crypto to LTE backhaul network between Sejong and Daejeon Cities
2018.2.25	Invest in IDQ(ID Quantique (World leading company in Quantum-safe crypto solutions)
2018.12.1	Applied World's First Quantum Crypto to 5G Network(B2B Site)

IDQ

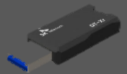
○ When a third party tries to intercept information in the middle, the sender and receiver will know it
→ hacking is fundamentally impossible

Quantum Random Number Generation

Support any type of 5G device

Chip Type

PCIe Type



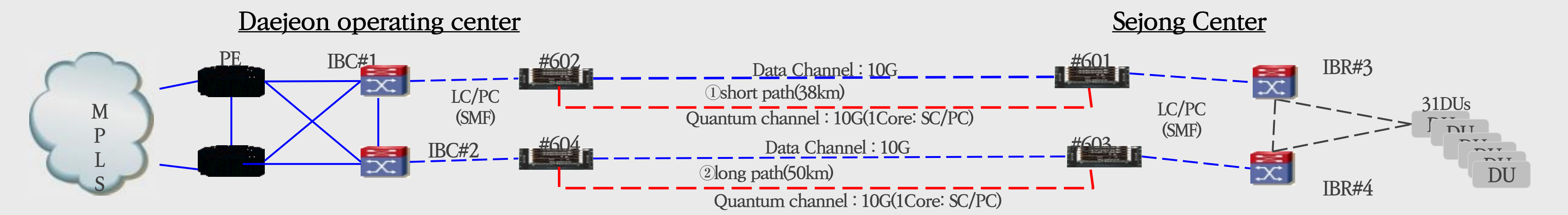
USB Type

Server Type

○ Quantum random number generation chip is smaller than a nail and can be mounted on various IoT devices as well as autonomous vehicles, smartphones and drones

QKD Deployment in LTE

SKT deployed its Quantum Key Distribution system for LTE network with 350,000+ subscribers in Sejong City in South Korea



QKD system in Daejeon

Sejong coverage

QKD system in Sejong

Security emerges the most important issue in 5G era

SK Telecom is determined to provide the most secure 5G network & focus on expanding the ecosystem of quantum cryptography technologies

SK telecom 5GX

SK telecom