5G PyeongChang & Way Forward

Dr. HôngBeom JEON | May 11, 2018
5G PyeongChang Olympics
( Feb. 09 ~ Feb. 25, 2018)
5G: The Beginning

**MWC 2015**

We must not jump too fast into the next generation of networks. Let's enjoy 4G. We should also remember what happened with 3G with the delay and the disappointment it created.

- From another keynote speech at MWC 2015

5G should not distract from more immediate technological developments.

- 'Understanding 5G: Perspective on future technological advancements in mobile', GSMA Intelligence

We’re going to make it (PyeongChang 2018) the first 5G Olympics ever."
5G Trial Specifications

PyeongChang SIG Specifications: World’s First 5G Common Specifications

<table>
<thead>
<tr>
<th>Specification</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Throughput</td>
<td>Max. 20Gbps</td>
</tr>
<tr>
<td>Latency</td>
<td>Less than 1ms</td>
</tr>
<tr>
<td>Frequency</td>
<td>28GHz band / 800MHz BW</td>
</tr>
<tr>
<td>Waveform</td>
<td>OFDM based</td>
</tr>
<tr>
<td>MIMO Support</td>
<td>Hybrid Beamforming</td>
</tr>
</tbody>
</table>
Trial Spectrum

Best Spectrum for 5G eMBB features

- Peak 20Gbps
- Ultra Wide Band
World’s First 5G Trial Networks

Driving Route (PyeongChang)

Olympic Stadium

Driving Route (Gangneung)

Airport (ICN)

Seoul

Pangyo

BoKwang

JeongSeon

PyeongChang

Gangneung

Express Railroad

Seoul Live Site

Highway

Venue
5G Trial Services

Immersive Media & Connected Car

- Omni View
- Sync View
- Interactive Time Slice
- 360° VR
- 5G Autonomous Car
Sync View
Live video upload from the fast-moving Bobsleigh

On Air Video
Interactive Time Slice
Delivering Massive Camera Views over 5G

On Air Video

Short-track, Figure Skating, Ice Hockey, Half Pipe
Omni View
5G as a Wireless Backhaul for Live Cameras

Cross-country Skiing
360° VR
Live VR Transmission over 5G

Ice Hockey, Figure Skating, Free-style Skiing
5G Autonomous Bus

Real-time Collaboration among Autonomous Cars and Traffic Lights

* GPS-RTK: GPS-Real Time Kinematic
* LiDAR: Light Detection And Ranging
Lessons Learned
5G Coverage: Outdoor

Coverage Map - LTE co-site

Coverage Map - Additional 5G sites

“4.6 times more cell sites for outdoor coverage”

<table>
<thead>
<tr>
<th>LTE</th>
<th>5G</th>
</tr>
</thead>
<tbody>
<tr>
<td>46</td>
<td>212</td>
</tr>
</tbody>
</table>
5G Coverage: Outdoor-to-Indoor

Need to enhance Indoor Coverage with 5G Repeater or Small Cell

<table>
<thead>
<tr>
<th>Penetration Loss (dB)</th>
<th>1.8GHz (LTE)</th>
<th>28GHz (5G)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Multi-pane Glass</td>
<td>10</td>
<td>18</td>
</tr>
<tr>
<td>Infrared Reflective Glass</td>
<td>24</td>
<td>38</td>
</tr>
</tbody>
</table>

- Penetration Loss (dB) for Standard Multi-pane Glass:
  - 1.8GHz (LTE): 10 dB
  - 28GHz (5G): 18 dB

- Penetration Loss (dB) for Infrared Reflective Glass:
  - 1.8GHz (LTE): 24 dB
  - 28GHz (5G): 38 dB

- Gap: 14dB for 1.8GHz (LTE) to 28GHz (5G)
- Gap: 8dB for Standard Multi-pane Glass
- Gap: 6dB for Infrared Reflective Glass
5G Architecture: Edge Cloud

Low Latency Application Located in Edge Cloud

**Center** (Seoul)

**Edge Cloud** (HoengGye)

**Cell Site** (PyeongChang)

- **Edge Application** (ex. Live Broadcast)
- **Round-Trip Delay**: 7~8msec

**Core System (GW-C)**

**Core System (GW-U)**

**Base Station (BBU)**

**Long Distance**

**Distributed Core**
5G Roadmap

Feb. 2018  PyeongChang 2018  Trial

Jun. 15, 2018  Spectrum Auction in Korea

Mar. 2019  Commercialization
# 5G Spectrum Plan in Korea

Spectrum auction on both 3.5GHz and 28GHz (2,680MHz bandwidth in total) for three operators

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Total Bandwidth</th>
<th>Upper Cap per operator</th>
<th>Starting bid</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5GHz</td>
<td>280MHz</td>
<td>100MHz</td>
<td>USD 2.65 billion USD 94.6mil per block</td>
</tr>
<tr>
<td></td>
<td>3.42~3.7GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>28 10MHz Blocks</td>
<td></td>
<td></td>
</tr>
<tr>
<td>28GHz</td>
<td>2400MHz</td>
<td>1000MHz</td>
<td>USD 0.62 billion USD 25.8mil per block</td>
</tr>
<tr>
<td></td>
<td>26.5~28.9GHz</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>24 100MHz Blocks</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Clock Auction**

- **Step 1: Allocation Stage**
  - Determining # of spectrum blocks

- **Step 2: Assignment Stage**
  - Mapping acquired spectrum blocks to physical frequencies
Spectrum for Commercial Deployment

28GHz mainly for Hotspot/Urban and 3.5GHz for nationwide coverage
5G Use Cases

FWA
5G Island
5G Village

VR/AR
KT VRight

Factory
5G Factory
Pilot Project

Connected Car
Autonomous Vehicle Cluster (PanGyo)
5G as a Platform

Evolution to Unified Platform beyond Network Infra

- FWA
- VR/AR
- Factory
- Connected Car

E2E Orchestrator

- Automation
- A.I. Deep Learning
- Virtualization

Central Cloud, Edge Cloud

kt 5G

GiGA internet
5G Open LAB

KT 5G Open LAB (w/ more than 100 SMEs, ‘18.2Q)

5G Demo Zone
for General Visitors
Demonstrations on 5G New Experiences

5G Service Zone
for Developers
New 5G services/Business based on KT 5G platform

5G Infra Zone
for Developers
Antenna/RFU, Small cell, Repeater, Devices
5G: Opportunities for All

Vitalizing new industry by innovating network infra and ecosystem

New Lifestyle
Proactive Intelligence
All-new Experience

Mobile Users

New Horizon
Extreme Efficiency and Smartness
Convergence

Industry

Operators
Domain Leaders
Platform Players