mmWave Access Scenarios

Nov. 2, 2016
Berlin
**5G Spectrum**

**Sub 6G**
- Highly fragmented Carriers with up to 5 radios per sector

**mmWave**
- Green field
- Huge spectrum potential
- Lack of commercial ecosystem

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**WRC15**
- Requirement >500MHz for IMT-2020

**WRC19**
- 45GHz available for future Cellular Access and Self-Backhaul

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**Cellular Bands**

**5G Primary bands**

**5G Complementary Bands for Capacity, 45GHz available**

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**FCC**

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**Future Consideration**
Full Spectrum RAN Architecture

mmWave Technology for Hot-Spot Solution
5G mmWave Typical Scenarios

Dense Urban

information society & campus & airport & Street lamp & mobile bus
200,000 users/km² outdoor and indoor (NLOS/nLOS), larger cell

Public Event

200,000 users/km² – outdoor (LOS and nLOS)

Stadium

800k – 2M users/km² – indoor and outdoor (LOS/NLOS)

Shoping Center

100,000 users/km² – indoor (LOS, NLOS)

Typical Scenario Support 10-200m in Range、User Gbps User Experience 、Dense Multi-User Access。
# Ultra-Hot Spot Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Users per km²</th>
<th>Node Radius NLOS</th>
<th>Node Radius LOS</th>
<th>Percent Active Users</th>
<th>Active Users per Node</th>
<th>HF Users per Node</th>
<th>Average HF User Rate (Mbps)/Sector</th>
<th>BackHaul Capacity after Access</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street</td>
<td>200k</td>
<td>40m</td>
<td>100m</td>
<td>40%</td>
<td>TBD</td>
<td>TBD</td>
<td>80G</td>
<td>Flexible</td>
</tr>
<tr>
<td>Stadium</td>
<td>800k-2M</td>
<td>40m</td>
<td>100m</td>
<td>20-25%</td>
<td>2510</td>
<td>792</td>
<td>224</td>
<td>-</td>
</tr>
<tr>
<td>Festival</td>
<td>200k</td>
<td>40m</td>
<td>100m</td>
<td>20-25%</td>
<td>250</td>
<td>90</td>
<td>312</td>
<td>252G</td>
</tr>
<tr>
<td>Shopping Center</td>
<td>100k</td>
<td>40m</td>
<td>100m</td>
<td>33%</td>
<td>166</td>
<td>59</td>
<td>315</td>
<td>261G</td>
</tr>
</tbody>
</table>

Lambeau Field: Green Bay Capacity: 79,500

Time Square New York, New Year's Eve

Mall of America: Minneapolis
The New Landscape of MBB in 5G
The Emerging of Mega Hot Zone for top 200 Cities

Opening New Frontier for Higher Frequency Spectrum with mmWave Technology

<table>
<thead>
<tr>
<th>Frequency</th>
<th># Pico sites /macro cell</th>
<th>Pico Thr. [Gbps/km²]</th>
<th>Pico Thr. / Macro Thr.</th>
</tr>
</thead>
<tbody>
<tr>
<td>28GHz (BW=1GHz)</td>
<td>1</td>
<td>176.349</td>
<td>590</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>353.771</td>
<td>1183</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>536.411</td>
<td>1794</td>
</tr>
<tr>
<td>73GHz (BW=2.5GHz)</td>
<td>1</td>
<td>1457.321</td>
<td>4875</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>2906.467</td>
<td>9722</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>4305.935</td>
<td>14403</td>
</tr>
</tbody>
</table>

1,000 times higher capacity zone with 10Gbps user rate

73GHz spectrum is suitable for unified access and backhaul solution and multi-operator market scenarios
Key Technologies Areas

- Higher Path Loss
- Higher Diffraction Loss
- Higher Doppler Effect
- Candidate Bands
- Low Cost Device

mmWave Key Technologies

- Unified Air-Interface
- Unified Access/Backhaul
- ASIC/SoC Design
- Channel Model
Industry first channel model for 6GHz-100GHz Completed
THANK YOU

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