Spectrum Introduction and CJK, EU and US update

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Outline

- Spectrum Introduction
- CJK Update
- EU AND US Update

COVID and the New Normal



"Digital transformation is key to supporting economic activity and wellbeing during the crisis, as well as in sustaining economic recovery." – OECD 2020 Covid-19 Policy Brief⁴

Sources: 1. IMF. "World Economic Outlook" Report. April 2021. 2. "IDC Spending Guide Shows Continued Growth for DT." May 2020. 3. OECD 4. 2020 COVID-19 Policy Brief.

Emerging Technologies Will Drive Economic Growth Back



Artificial Intelligence: \$15 Trillion Gain by 2030



Internet Of Things: \$11 Trillion Gain by 2030

Cybersecurity: \$5.7 Trillion Risk by 2023

Sources: (1) "Unlocking the Potential of the Internet of Things." McKinsey. 2015.; (2) Sizing the Price: PwC's Global Artificial Intelligence Study. 2017.; "Dark Side of Digitalization." World Economic Forum. 2020.; (3) "Everything You Need to Know about 5G" IEEE Spectrum. https://www.outube.com/watch?v=GEx_dOS/vS0.2017.; (4) "The Cost of Cybercrime" Accenture. 2019.

5G: convergence of wireless with computing and the cloud

Next Generation Of Wireless Networks

Higher Speeds, Greater Capacity And Lower Latency

Billions Of Connected Devices And Things

& CLOUD

46

Massive Machine Type Communications

COMPUTE

COMMS

PERSONAL

COMPUTER ERA

2G

Cloud-Network-Edge Continuum

Ultra Reliable Low Latency Communications Enhanced Mobile Broadband

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The 5G Era and broadband connectivity – Intel perspective

 Intel believes that both 3GPP-based and IEEE-based technologies play an important role in 5G. 3GPP standards (e.g., Release 15 and beyond, IMT-2020) and IEEE-based standards (Wi-Fi 6 and beyond, and WiGig) will deliver wireless broadband to consumers and businesses worldwide.

Intel Spectrum Policy Priorities

- 5G and Wi-Fi are both essential and complementary in providing broadband connectivity to the world
- Both technologies see continuously growing traffic and usage, and both require sufficient amounts of suitable spectrum in order to facilitate these developments
- Intel has business interests in both technologies and supports spectrum for licensed and license-exempt use. We consider both technology implications and coexistence possibilities when evaluating a band for licensed or license-exempt use.

Licensed spectrum

- Low-, mid- and high-band spectrum is required to enable all 5G use cases and deployment scenarios
- 600/700/800/900 MHz bands provide excellent propagation conditions, based on existing 3GPP ecosystem
- In addition to the 3300-3800 MHz 5G launch band, further mid-bands are important to provide sufficient capacity with good propagation conditions and existing LTE bands or adjacent bands are most relevant:
 - 2.3-2.4 GHz, 2.5-2.69 GHz, 3.3-4.2 GHz tuning range, 4.4-5.0 GHz tuning range, all based on existing 3GPP ecosystem
- Ultra-high-capacity hotspots with 26 GHz and 40 GHz tuning ranges

License-exempt spectrum

- The 5 GHz license-exempt range (assigned at WRC-03) is congested in many urban areas with very high densities of Wi-Fi access points and other applications.
- 5925-7125 MHz range is key to provide sufficient capacity to enable growth of Wi-Fi and other unlicensed technologies (like 5G-NR U)
 - Existing IEEE ecosystem, extending from adjacent 5 GHz band
 - Coexistence with FS and FSS demonstrated for LPI and VLP
- Multiple Gigabit, low-latency, short range Wireless applications in the 57-71 GHz range



Spectrum Policy Implications of 5G



A diverse set of regulatory models & spectrum is required for 5G to fulfill its promise

WIDE AREA
EXCLUSIVELY
LICENSED

Exclusive to MNOs

 Verticals supported by network slicing

SHARED LICENSED

 e.g. shared between govs/incumbents and MNOs/commercial

LICENSE-Exempt

 "Unlicensed" approaches (e.g. Wi-Fi 6 scheduling)

LOCAL AREA EXCLUSIVELY LICENSED

• For enterprise & industrial on-premise applications

600 MHz 700 MHz	3.3 – 4.9 GHz CBRS in US (different by (~3.5 GHz) region)	5 GHz Unlicensed	6 GHz Unlicensed	26 GHz	28 GHz	40 GHz	60 GHz Unlicensed
LOW BANDS	MID BANDS			HIGH BAN	NDS		
Licensed Band Olicense	ed Band 📃 Hybrid / Shared License Band						

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CJK update

China Update

- IMT/5G Spectrum
 - Already allocated:

Low band: **2*40 MHz (703-743 / 758-798 MHz)**: CBN & CMCC will jointly build 700MHz 5G Network Mid band: **3.3-3.4 GHz (indoor), 3.4-3.6 GHz, 4.8-5.0 GHz** made available for 5G.

2.6 GHz (2500 – 2690 MHz) - 100 + 60 MHz for CMCC 5G deployment

2.1GHz: 2*60 MHz 1920-1980/2110-2170MHz re-farmed LTE to 5G for CTC and CUC 5G deployment

- Planned: 24.75-27.5 GHz or part of bands will be allocated for 5G at appropriate timing.

6 GHz band for IMT

- License Exempt Spectrum:
 - Already in use: 2.4 GHz, 5150 5350 MHz, 5725 5850 MHz for Wi-Fi
 - Other updates: **59 66 GHz** in suspension

Japan Update

IMT/5G Spectrum

Band	Allocated (No auction applied in Japan)	
700 MHz	718-748 MHz / 773-803 MHz	4G/to be 5G
800 MHz	815-845 MHz/860-890 MHz	4G
900 MHz	900-915 MHz/945-960 MHz	4G
1.5 GHz	1427.9-1462.9 MHz/1475.9-1510.9 MHz	4G
1.7 GHz	1710-1785 MHz/1805-1880 MHz	4G/to be 5G
1.9/2 GHz	1884.5~1915.7 MHz/1920-1980 MHz/ 2110-2170 MHz	4G
2.3 GHz	2330-2370 MHz (with DSA)	5G
2.5 GHz	2545-2575 MHz/2595-2645 MHz	4G
3.4 GHz	3400-3600 MHz	4G/to be 5G
3.6 GHz	3600-4100 MHz	5G
4.5 GHz	4500-4600MHz/4600-4900MHz (local 5G)	5G
28 GHz	27.0-28.2 GHz/28.2-29.1 GHz(local 5G)/ 29.1-29.5 GHz	5G
	Understudy	
2.6 GHz	2645-2665 MHz	5G
4.9 GHz	4900-5000 MHz	5G
26 GHz	25.25-26.6 GHz (with DSA)/26.6-27 GHz	5G
40 GHz	37.0-43.5 GHz	5G

License Exempt Spectrum:

Band	Allocated for Wi-Fi	
2.4 GHz	2400-2497 MHz	
5 GHz	5150-5350 MHz (Indoor)/ 5470-5730 MHz (In/outdoor)	
5 GHz	5150-5250 MHz	Low power in-car usage
6 GHz	5925-6425 MHz	LPI, VLP
	Under study for Wi-Fi	
6 GHz	6425-7125 MHz	SP with AFC/LPI/VLP

Korea Update

- IMT/5G Spectrum
 - Already auctioned: 3.42-3.7GHz(280MHz) and 26.5-28.9GHz(2.4GHz) on June 2018 and started global 1st 5G commercial service from Apr 2019. Auction of 3.4-3.42GHz completed in Q3 2022
 - Planned: Considering another 5G Spectrum (3.7-4.0GHz and 26GHz band) auction next year
 - Other updates: 4.72-4.82GHz & 28.9-29.5GHz was assigned for Local 5G on Oct 2021
- License Exempt Spectrum:
 - Already in use: 2.4GHz, 5125-5350MHz, 5470-5850MHz, 5925-7125MHz(LPI; 5925-7125MHz, VLP; 5925-6425MHz, Standard power w/ AFC; TBD), 57-66GHz
 - **Planned:** regulation for Standard power with AFC in 6GHz band is planned.
 - Other updates: Discussing the update of 6GHz band regulation for 320MHz CH BW for WiFi7 and C2C under LPI and consider to discuss others of 6GHz band regulation e.g. VLP spectrum expansion etc.

EU and US update

EU Update

- IMT/5G Spectrum
 - 700 MHz: Regulation in place for 4G/5G (see <u>ECC Decision (15)01</u>). All EU countries to make band available by 2020 (some missed that deadline due to delay in clearing the band)
 - 800 MHz, 900 MHz, 1.8 GHz, 2.1 GHz and 2.6 GHz: Mostly still used for LTE but regulation has been revised to enable 5G (see ECC Decisions (09)03, (06)13, (06)01 and (05)05 respectively)
 - 2.3 GHz: Regulation to be revised until Q1-2023 to enable 5G (see ECC Decision (14)02)
 - 3.4-3.8 GHz: Regulation has been revised to enable 5G (see ECC Decision (11)06)
 - **3.8-4.2 GHz**: Regulation under development for shared use to provide local-area (i.e. low/medium power) network connectivity (to be completed by Q1-2024)
 - 6425-7125 MHz: CEPT position on this band still TBD in preparation of WRC-23
 - 26 GHz: Regulation in place for 5G (see ECC Decision (18)06)
 - 40 GHz: Regulation in place for 5G (see ECC Decision (22)06)

For latest information on the licensing and use of these bands in CEPT and EU see $\frac{\text{ECO Report 03}}{\text{and the EU's 5G Observatory}}$

EU Update (Cont.)

- License Exempt Spectrum
 - 5945-6425 MHz: Regulation in place for WAS/RLAN license-exempt usage under LPI/VLP conditions (see ECC Decision (20)01). Studies ongoing for SP AFC usage up to 4W EIRP (to be completed by Q1-2024)
 - 6425 7125 MHz: Studies ongoing on technical conditions for WAS/RLAN license-exempt usage under LPI/VLP conditions (to be completed by Q1-2024)
 - 57-71 GHz: Regulation in place for license-exempt use by Wideband Data Transmission Systems (e.g., WiGig) under Short Range Device regulation (see ERC Recommendation 70-03)

US Update

- IMT/5G spectrum, auctioned/available, or planned: Low range: 600/700 MHz
 - Mid range: 2-3 GHz range: 2.5 GHz Auctioned / Assigned;
 - **3-5 GHz range**: 3.45-3.55; CBRS 3.55-3.7 GHz, 3-tier access; 3.7-3.98 GHz;
 - Portions of lower 3 GHz under consideration.
 - High range: 24.25-27.5 GHz range: 24.25-24.45 GHz; 24.75-25.25 GHz; 25.25-27.5 auctioned; 26.5-29.5 range: 27.5-28.35 GHz auctioned;
 - **37-40 GHz range**: 38.6-40 GHz: auctioned; 37.6-38.6 GHz auctioned. 37-37.6 GHz under consideration for future shared use with federal.
 - **40-43.5 GHz range**: 42-42.5 GHz under consideration for terrestrial use.
 - 47.2-48.2 GHz range: auctioned.
- License exempt:
 - **5925 7125 MHz range**: unlicensed/shared 5925-7125 MHz Low Power Indoor; Standard power AFC in 5925 6425 + 6525 6875 MHz. VLP, C2C, mAFC under consideration.

57 – 71 GHz: available for unlicensed.

Thank you



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