

Real-world mobile experience and the role of spectrum

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Open and transparent

Independent

- Editorially independent reports follow a standard cadence
- Reports are never sponsored

Revealing Network Experience

- Experiential metrics measuring typical end to end experience
- Best practice automated tests across broad user base

Scientific Analysis

• Sophisticated, pioneering methodology applied consistently

We are an independent business which transparently publishes the rules that govern our operations

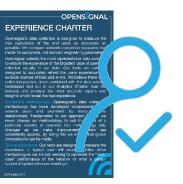
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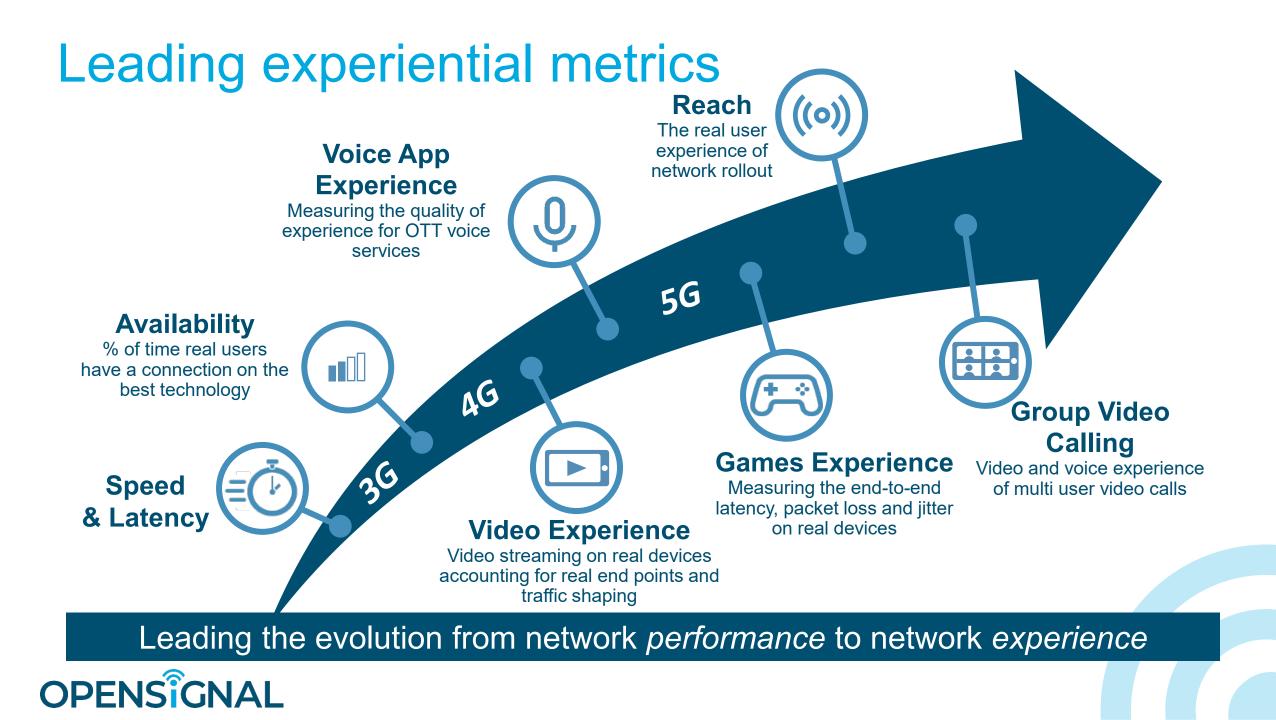
EXPERIENCE CHARTER

INDEPENDENCE

CHARTER







First real-world analysis of C-band 5G experience

5G Download Speed (Mbps) 5G Upload Speed (Mbps) 250 25 225.5 211.8 20.7 200 20 5G Download Speed on Verizon improved after its C-band launch 18 5 18.2 160.0 5G Download Speed (Mbps) 5G Upload Speed (Mbps) 200 150 15 T-Mobile 160 16 100 10 12 120 C-band launch 80 Verizon 50 AT&T 40 0 0 Verizon AT&T T-Mobile Verizon AT&T T-Mobile 2.5 GHz C-band C-band C-band 2.5 GHz C-band Note: AT&T's initial C-band launch was limited to parts of eight metro areas across the U.S. **OPENSIGNAL** Data collection period: January 19 - March 19, 2022 | © Opensignal Limited Data collection period: 7 day periods ending on the date shown. Shaded areas represent confidence intervals

T-Mobile

Verizon

AT&T

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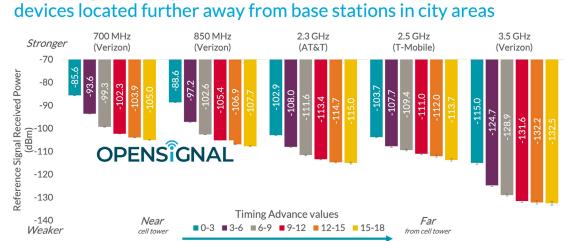
• C-band launch

Analyzing mid-band 5G speeds in the US

Source: Quantifying the impact of C-band on 5G mobile experience in the US https://www.opensignal.com/2022/03/29/quantifying-the-impact-of-c-band-on-5g-mobile-experience-in-the-us



Shared license spectrum analysis on CBRS



The 4G signal strength on the CBRS band deteriorates for mobile

Timing Advance is the the length of time a signal takes to reach the base station from a mobile device. Smaller values of Timing Advance mean the devices were closer to the cell site. Lower negative values of Reference Signal Received Power indicate worse signal strength. Data collection period: Aug 1, 2021- Oct 29, 2021 | © Opensignal Limited

4G download speeds with the CBRS band support dramatically decline when users are far away from base stations Timing Advance values Near Far ■ 0-3 ■ 3-6 ■ 6-9 **■** 9-12 **■** 12-15 **■** 15-18 150 from cell tower (sdqW) 120 OPENSIGNAL Average 4G download speeds 90 60 30 700 MHz 850 MHz 2.3 GHz 2.5 GHz 3.5 GHz (Verizon) (Verizon) (AT&T) (T-Mobile) (Verizon) Timing Advance is the the length of time a signal takes to reach the base station from a mobile device. Smaller values of Timing Advance mean the devices were closer to the cell site. Data collection period: Aug 1, 2021- Oct 29, 2021 | © Opensignal Limited

Source: CBRS usage highlights the strengths and weaknesses of C-band spectrum in the US https://www.opensignal.com/2021/12/07/cbrs-usage-highlights-the-strengths-and-weaknesses-of-c-band-spectrum-in-the-us



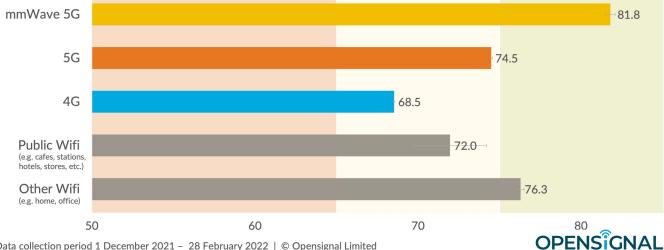


5G comparison with WiFi, using unlicensed spectrum

For real-time multiplayer gaming using smartphones, 5G is a better experience than public Wifi

Poor Fair Good

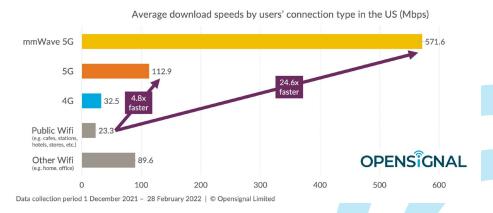
Games Experience by users' connection type in the US (0-100 score)



Data collection period 1 December 2021 - 28 February 2022 | © Opensignal Limited

Source: 5G beats Public Wifi for gaming as well as speed https://www.opensignal.com/2022/05/11/5g-beats-public-wifi-for-gaming-as-well-as-speed

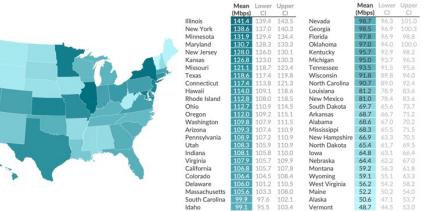
Users' average 5G download speeds are 4.8 times faster than Public Wifi, and mmWave is over 24 times faster





Tackling the US digital divide

The state of 5G in the US: 5G Download Speed

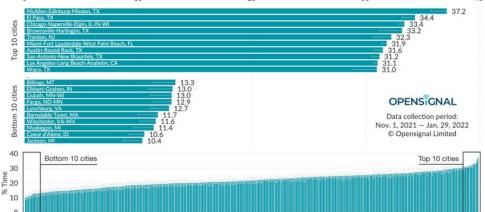


% Time

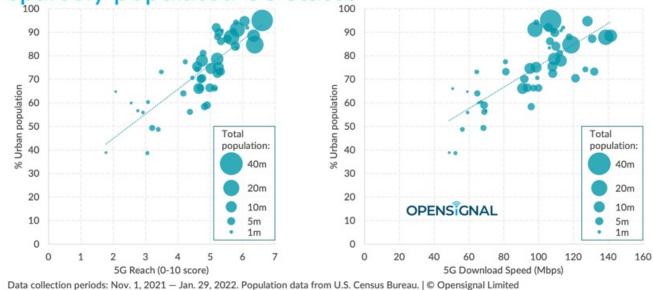
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⊃ata collection periods: Nov. 1, 2021 – Jan. 29, 2022 | © Opensignal Limited





Smartphone users have a reduced 5G experience in sparsely populated US states



Source: How the 5G experience has improved across 50 US states and 300 cities https://www.opensignal.com/2022/03/10/how-the-5g-experience-has-improved-across-50-us-states-and-300-cities

