

5G mmWave today

Insights on monetization and global adoption



Philippe Poggianti
VP, Business Development
Qualcomm France S.A.R.L.



Vikas Dhingra
Sr Dir, Business Development
Qualcomm Technologies International, Ltd.



Alberto Cicalini
Sr Director, Product Management
Qualcomm Europe, Inc.



5G mmwave

Agenda - 5G mmWave today

1. State of the global mmWave ecosystem
2. mmWave monetization strategies
3. Upcoming technology enhancements



5G mmWave

A mature ecosystem

- 1 Abundant spectrum available
- 2 Adoption in all key markets
- 3 Proven technology
- 4 A mature device ecosystem
- 5 Use cases for today and the future
- 6 Substantive growth and returns

mmWave ROI for mobile use



With
2000
mmWave hot zones*



24%
Subscribers daily
reach*



4.8 years
Payback period*

* Hypothetical UK operator with 30% market share
Source: Qualcomm and Bell Labs Consulting study, April 2022



5G mmWave commercialization and spectrum

Commercialization - 28 operators*
 Spectrum available - 31 countries*

* Current or expected by end of 2022

Expanding
breadth,
availability
of 5G mmWave
devices

150+

5G mmWave devices
launched or announced
by 50+ vendors

5G smartphones



PCs



Hotspots



Modules



CPEs



Source: GSA, Feb. 2022

5G mmWave growth scales with availability in lower tiers

22 < \$800
mmWave smartphones

30+
mmWave smartphones available above \$800

Number of 5G mmWave smartphones available by price category



22 sub-\$800 smartphones available with 5G mmWave

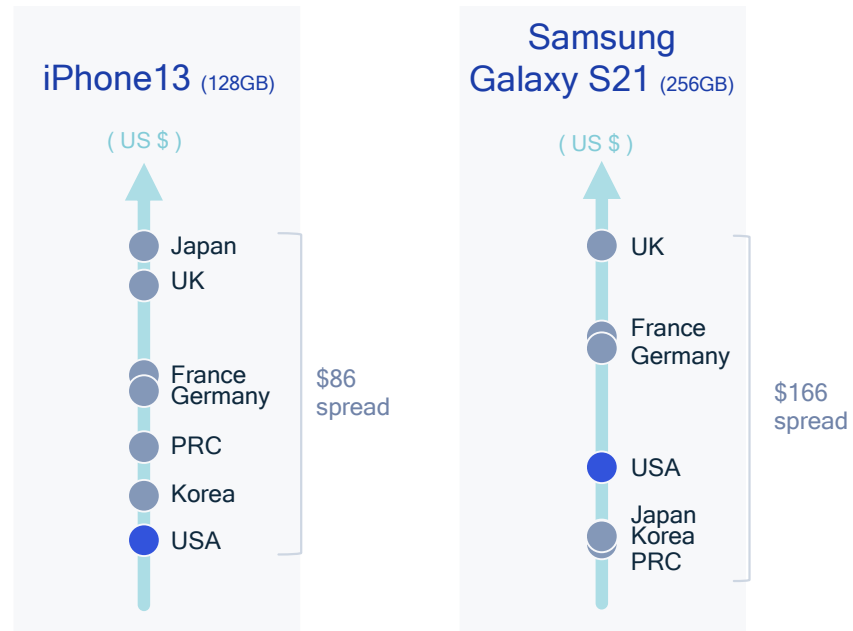
(Q1, 2022)

TCL 10 UW
TCL Alcatel 30 V
OnePlus 8 UW
Nokia 8 V UW
Kyocera DuraSport 5G
Samsung Galaxy A53
Samsung Galaxy A71
Samsung Galaxy S20 FE
Samsung Galaxy S21 FE
Samsung Galaxy S20+
Samsung Galaxy S21

iPhone 12
iPhone 12 Mini
iPhone 13 Mini
Orbic Magic
Orbic Myra
Moto One
Google Pixel 4a
Google Pixel 5
Google Pixel 6
Sharp AQUOS zero6
Others (1 device)

Average selling price (ASP) for 5G mmWave smartphone models is not higher relative to non-mmWave equivalents

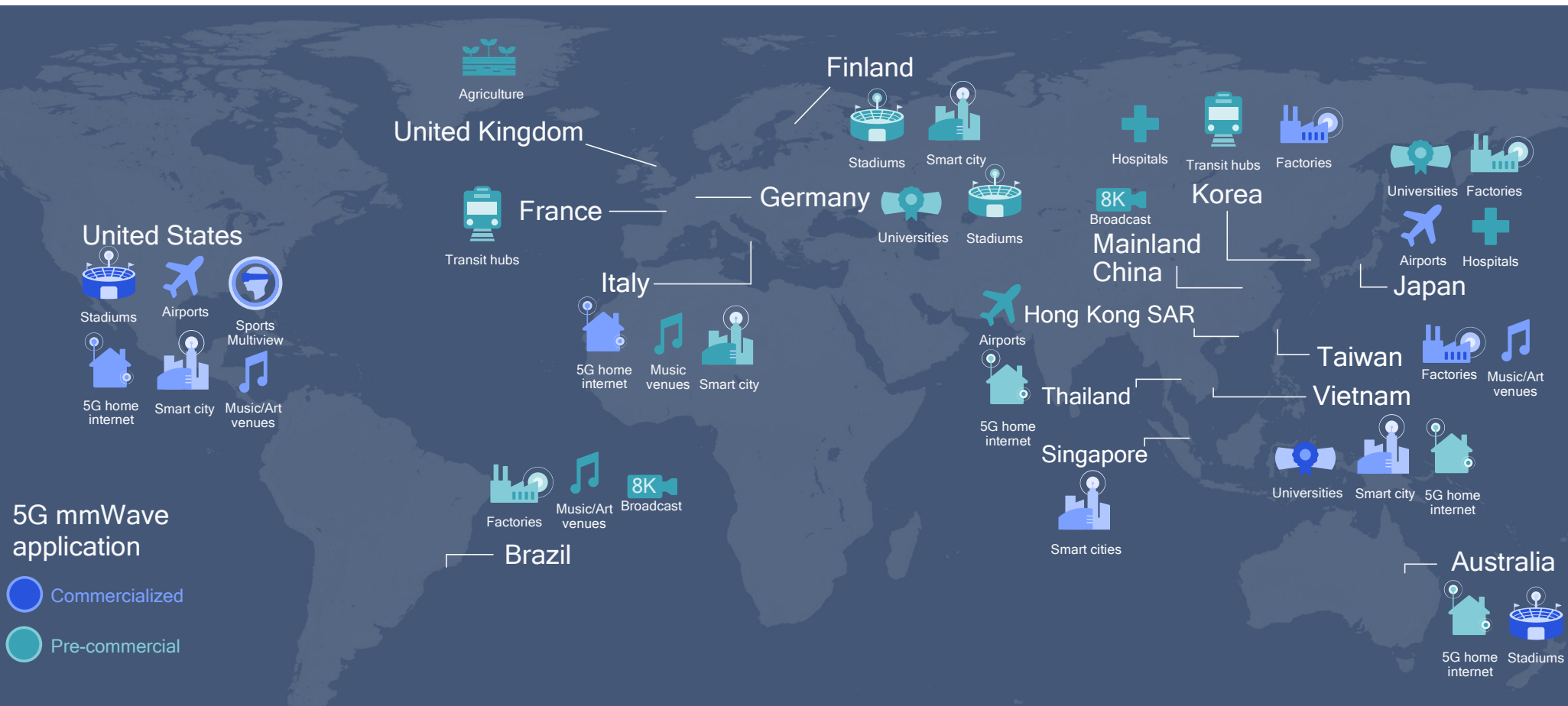
Smartphone ASP in different countries



Source: Data from IDC mobile phone tracker, Q1 2022, analyzed by Qualcomm Technologies, Inc.

Average selling price (ASP) is the average end-user (street) price paid for a typically configured mobile phone. Additional subsidies offered by mobile operators are not factored into this price [IDC's mobile phone tracker taxonomy]

No correlation observed between smartphone prices and 5G mmWave
Other factors may contribute to in-country smartphone price



5G mmWave applications

Countries and regions with mmWave use cases across mobile, fixed-wireless access, enterprise and private networks

Meet users where they are & maximize returns and cost-efficiency

The high throughput and network capacity of mmWave can lead to near-term cost-efficiency in key environments:

Homes & SOHO
fixed access



Train Stations
& Transit Hubs



Offices



Outdoor
Hot Zones



Indoor Malls
and Venues



What are consumers
willing to pay
for an enhanced 5G service
enabled by mmWave ?

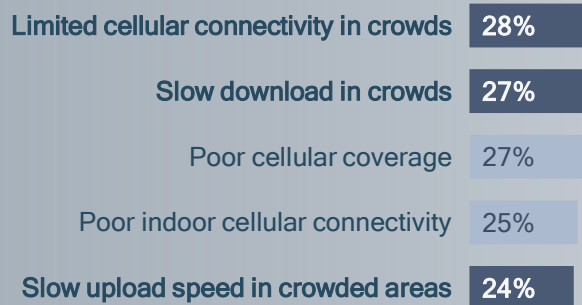


Results from global consumer survey conducted by Qualcomm Technologies, Inc.

Majority are willing to pay \$7 a month for 5G enhanced service

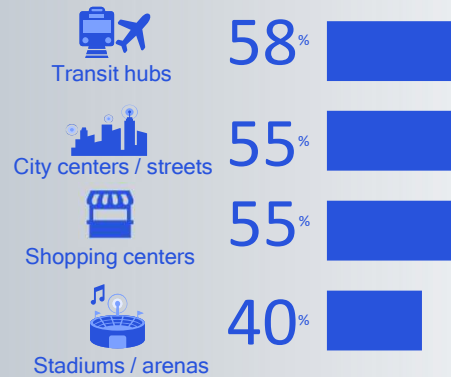
Pain Points

with smartphone experience are in crowded places



Most Desired Use Locations

Two thirds experience issues in crowded areas at least weekly



Source: Global consumer survey conducted by Qualcomm Technologies, Inc. (2022)

74%



would pay extra for enhanced 5G service enabled by mmWave

66%

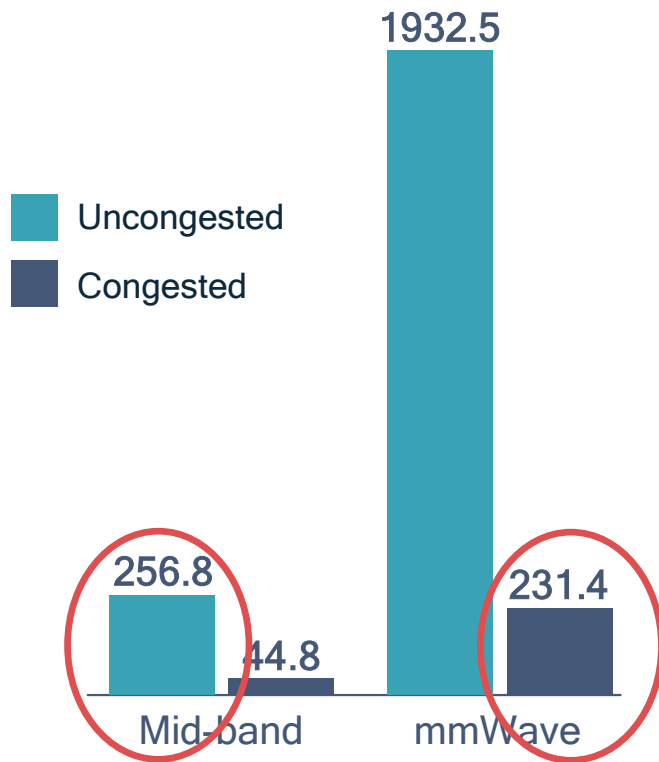
would pay an extra

\$7

a month via monthly subscription or month-pass

5G mmWave + mid-band = Best possible QoE wherever you are

Median download throughput (Mbps)

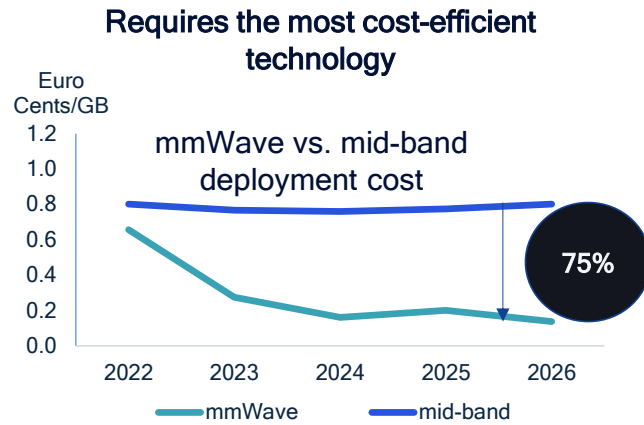


- RootMetrics study shows 5G mmWave can deliver more **uniform user experiences** even in congested network
- 5G mmWave delivers on the promise of providing **extreme capacity** and blazing-fast speeds **under heavy network loads**

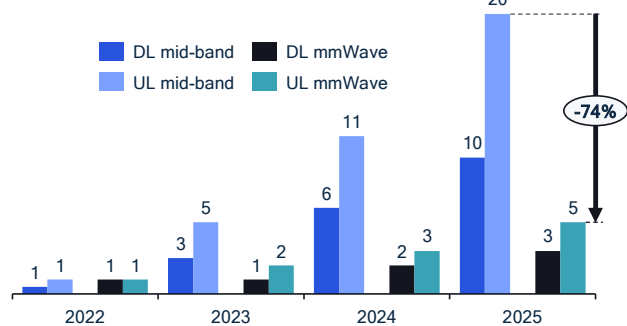


ROI study - 5G mmWave is cost-effective in congested hot-zones

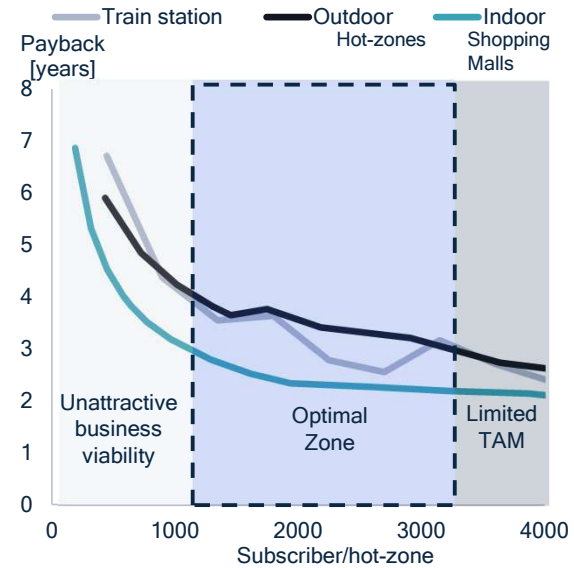
mmWave to select and scale 5G mmWave considering zones of advantage



mmWave vs. mid-band number of small cells per hot-zone



Deployed at 'right' places with optimal subscriber density to offer best QoE



The operator can strategically select and scale 5G mmWave deployments considering zones of advantage of mmWave

Source: Qualcomm Technologies and Bell Labs Consulting study, April 2022

5 approaches to be explored by operators to monetize mmWave

1

Location and event-based packages



Stadium package

Per event pricing:

- Exclusive content
- Multi-angle
- AR stats
- Immersive experience

2

3

Daily and Monthly instant boost



Daily and monthly pass

On location:

- Instant boost
- Zero-rating services

4

Enticing subscribers to higher bundles



mmWave service and benefits free for premium users

- Ultra speed tier (2+ Gbps) for premium users, among other exclusive benefits

Move next lower tier to premium plans

5

B2B Services



HD mobile video cameras

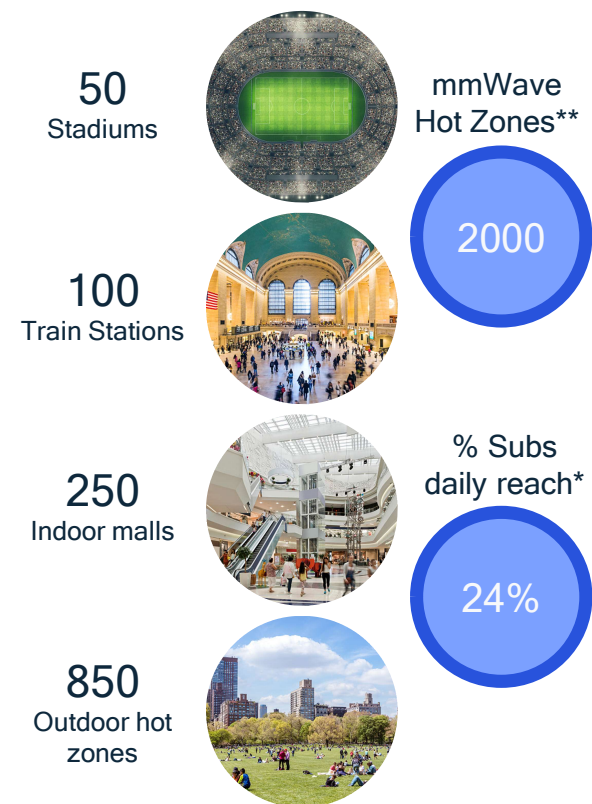
AGVs/Service bots

Ticketing booths

Workforce AR/VR

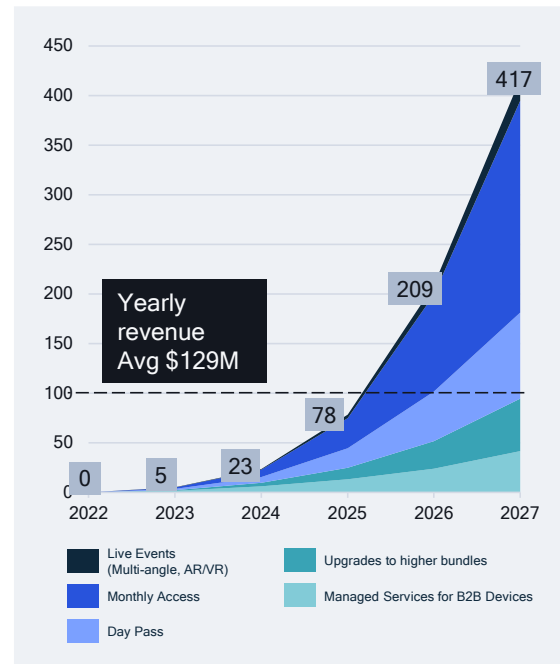
5G mmWave positions the operator as a quality leader

Differentiated services attracts early adopters while addressing capacity demand cost-effectively

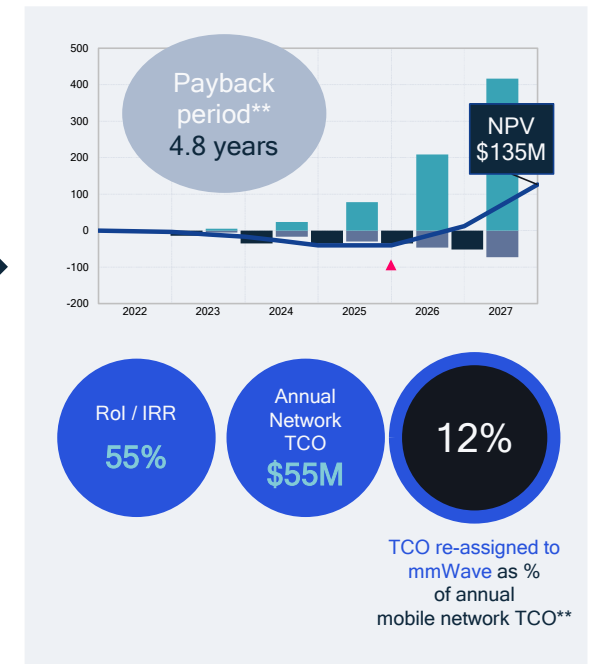


* Subscribers able to experience mmWave daily

Annual revenue from difference streams



Business case for 5G mmWave rollout



** Hypothetical UK operator with 30% market share

Operators to offer **differentiated services** to monetize 5G mmWave

Starting with stadiums and scaling elsewhere; higher penetration of subs. will require mmWave



Ongoing 5G mmWave technology enhancements

Uplink carrier aggregation

4 carrier component aggregation (4CC) helps increase critical uplink throughput and capacity

mmWave-sub6 dual connectivity

Aggregates 5G mid-band and mmWave spectrum on both downlink and uplink for increased data speeds, improved coverage, and better mobility into and out of mmWave coverage areas

Standalone mmWave

Allows the deployment of fixed-wireless access solutions and private networks using only mmWave spectrum

Snapdragon is a product of Qualcomm Technologies, Inc. and/or its subsidiaries

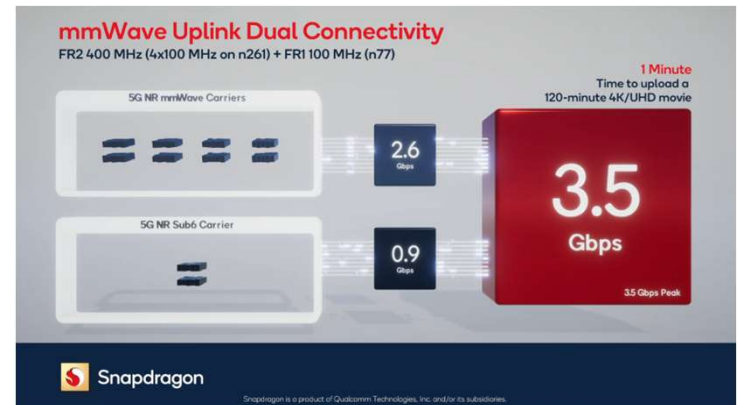
Nokia and Elisa achieve over 2 Gbps 5G uplink speeds on mmWave with Qualcomm solutions

Press Release

Nokia and Elisa achieve over 2 Gbps 5G uplink speeds on mmWave with Qualcomm solutions

- Companies reach uplink speed of over 2 Gbps on mmWave spectrum
- Carrier Aggregation helped make best use of spectrum assets in different frequency bands
- Live demonstration took place at the Nokia Arena in Tampere, Finland

21 June 2022



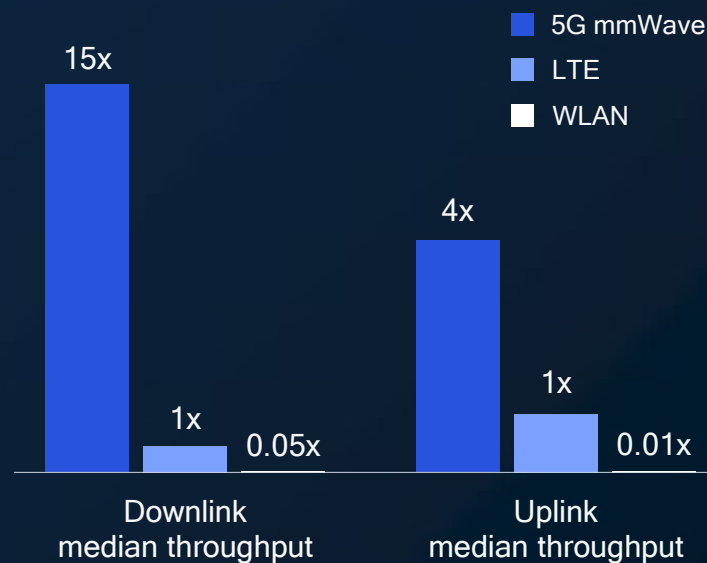
Fastweb and Qualcomm Announce Collaboration to Commercialize 5G Standalone mmWave Services in Italy

Standalone FR2 Capabilities Powered by Qualcomm Technologies Can Enable Fastweb to Bring the Full Benefits of 5G mmWave Fixed Wireless Access to Italian Households and Businesses

FEB 27, 2022 | BARCELONA | Qualcomm products mentioned within this press release are offered by Qualcomm Technologies, Inc. and/or its subsidiaries.

Bringing massive capacity and new experiences to venues

- Densest Super Bowl venue deployment ever in 2022
- 100% 5G mmWave coverage on all levels
- 5G mmWave carried 29% more data than sub-6 GHz¹
- Excellent network performance
 - > 3 Gbps Downlink peak throughput
 - > 170 Mbps Uplink peak throughput
 - 10 ms average ping latency



1. Data from the bowl seating area

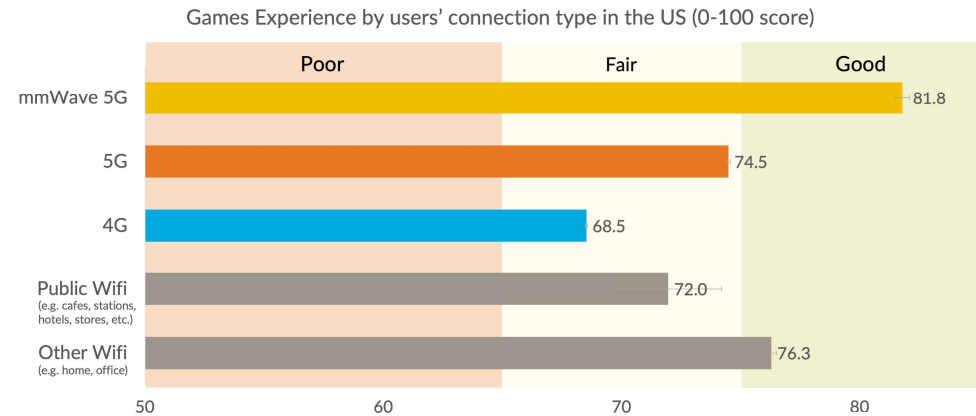
Sub-6 GHz aggregated bandwidth: 50 MHz + 50 MHz (DL + UL, FDD)
5G mmWave bandwidth: Up to 800 MHz (TDD)



Deliver an exceptional in-venue user experience with 5G mmWave

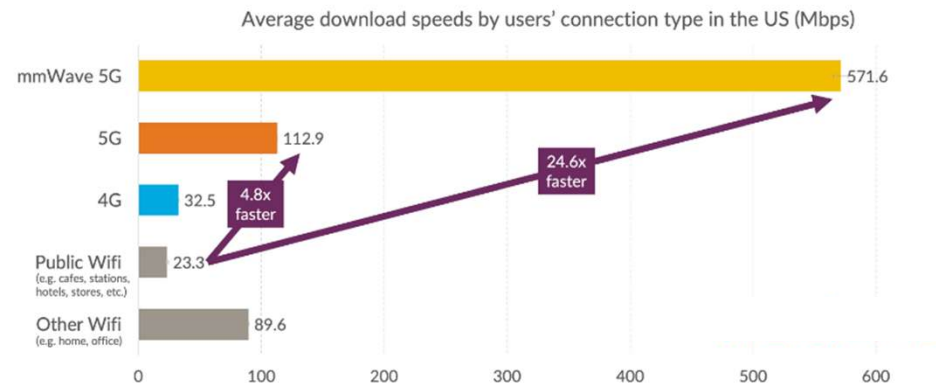
Mobile gaming benefits from 5G mmWave speed and capacity

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



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

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



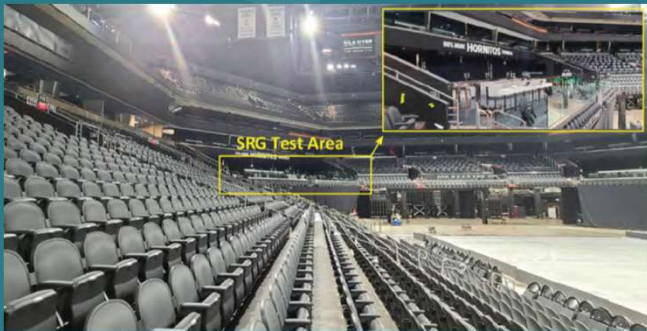
Data collection period 1 December 2021 - 28 February 2022 | © Opensignal Limited

Source: OpenSignal - <https://www.opensignal.com/2022/05/11/5g-beats-public-wifi-for-gaming-as-well-as-speed>



Footprint Center Phoenix

Network loading and user experience tests



3.7x DL speeds in loaded network compared to LTE

Glitch-free video streaming when LTE unable to support video call



Market Square Helsinki

Coverage, capacity comparisons with 5G mid-band

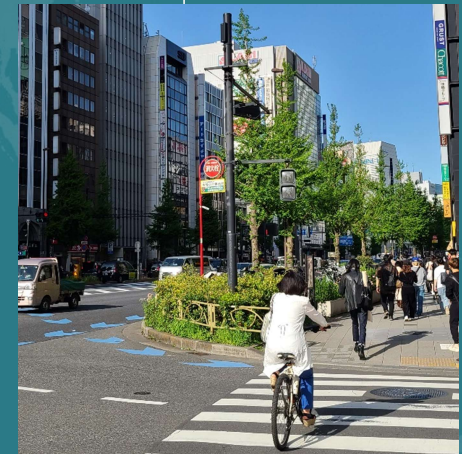


4.4x capacity density increase over 5G mid-band with 400 MHz of mmWave spectrum



Tokyo

Uplink and downlink tests



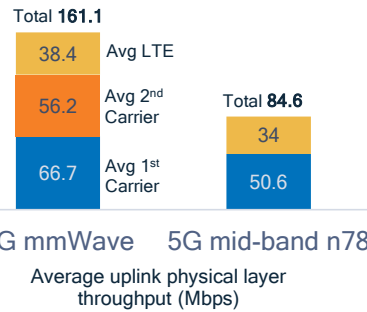
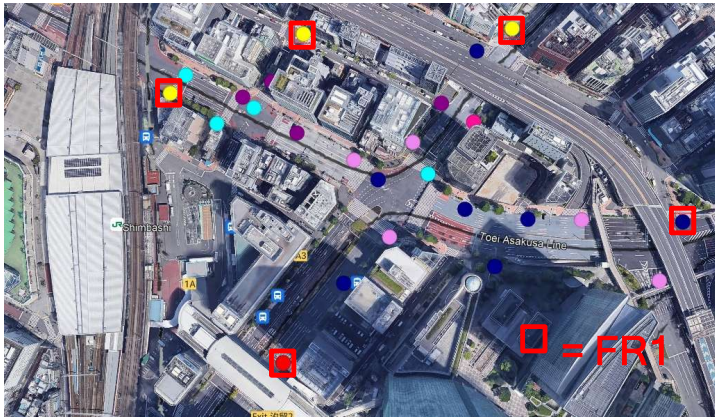
3x average uplink speeds compared to 5G mid-band

5G mmWave commercial field tests

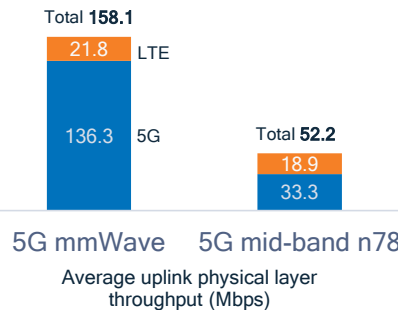
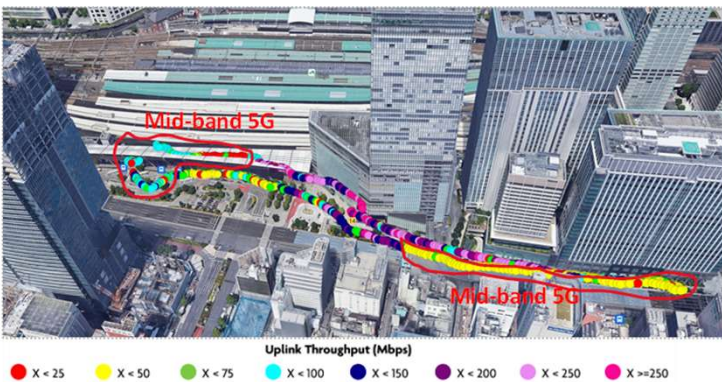
Source : Signals Research Group

5G mmWave uplink testing in Tokyo

Stationary testing outside Shimbashi Station



Walk testing outside Tokyo Station



"Impressive from a capacity and coverage perspective"

- Signals Research Group

Stationary testing

Over 2X faster uplink with 5G mmWave vs 5G mid-band

Downlink : 2 Gbps (400 MHz)
 Uplink : 300 Mbps uplink (200MHz)
 @160 meters from gNobeB

Walk testing

2.8X faster uplink when the smartphone connected to 5G mmWave (compared to 5G mid-band)

Smartphone attached to 15 unique LTE PCI values whilst used 3 different 5G mmWave PCI values and 3 different Band n78 PCI values



Thank you

Follow us on: **f** **t** **in** **@**

For more information, visit us at:

www.qualcomm.com & www.qualcomm.com/blog

Nothing in these materials is an offer to sell any of the components or devices referenced herein.

©2018-2022 Qualcomm Technologies, Inc. and/or its affiliated companies. All Rights Reserved.

Qualcomm and Snapdragon are trademarks or registered trademarks of Qualcomm Incorporated. Other products and brand names may be trademarks or registered trademarks of their respective owners.

References in this presentation to “Qualcomm” may mean Qualcomm Incorporated, Qualcomm Technologies, Inc., and/or other subsidiaries or business units within the Qualcomm corporate structure, as applicable. Qualcomm Incorporated includes our licensing business, QTL, and the vast majority of our patent portfolio. Qualcomm Technologies, Inc., a subsidiary of Qualcomm Incorporated, operates, along with its subsidiaries, substantially all of our engineering, research and development functions, and substantially all of our products and services businesses, including our QCT semiconductor business.