MWC™ Barcelona

5G mmWave Summit

Unlocking the Full Potential of 5G

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Alex Sinclair

CTO,

GSMA


GSMA
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GSMA.com/5GmmWave

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Philippe Poggianti

VP Business Development,

Qualcomm Communications

March 2022

Qualcomm

Reshaping mobile experiences

The Year of 5G mmWave Key Decisions

Philippe Poggianti
VP Business Development
Qualcomm Communications S.A.R.L

New frontier of mobile broadband – mobilizing 5G mmWave for vast bandwidth

Multi-Gbps data rates
With large bandwidths (100s of MHz)

Much more capacity
With dense spatial reuse

Lower latency
Bringing new opportunities

5G mmWave growing presence

Countries and regions with commercial mmWave deployments or spectrum allocation

Expanding breadth, availability of 5G mmWave devices

150+

5G mmWave devices launched or announced by 50+ vendors

Source: GSA, Feb. 2022

5G smartphones

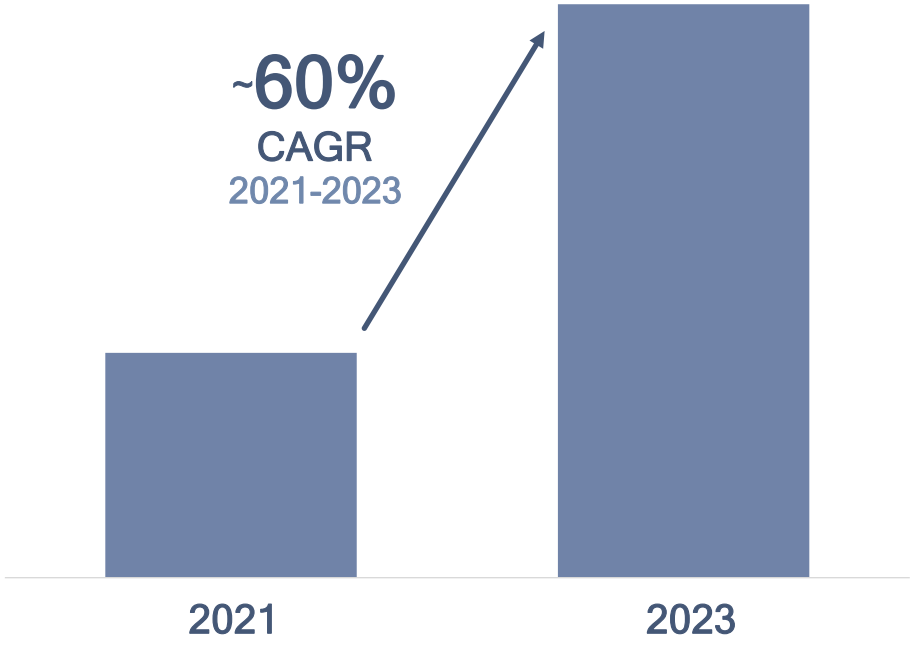
PCs

Hotspots

Modules

CPEs

Growing 5G mmWave smartphone shipments



~20% mmWave penetration of total 5G smartphone shipments expected in 2023

Source: Average of analyst estimates (ABI, Jan. '22; Counterpoint Research, Nov. '21; Mobile Experts, Dec. '21; Strategy Analytics, Oct. '21)

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:

5G mmWave High-Power CPEs enable Fiber-like FWA applications

+10 km
~1 Gbps
United States
US Cellular

+6 km
1 Gbps
Italy
FastWeb

+7 km
~1 Gbps
Australia
NBN

RF Sensing Suite for high performance mmWave, self-installed CPEs

Standalone 5G mmWave support

mmWave-sub6 Dual Connectivity (NR-DC) rollout

Ericsson, Telstra and Qualcomm set Uplink Speed Record of Close to 1Gbps Using 5G Dual Connectivity and Carrier Aggregation

DEC 16, 2021 | SAN DIEGO

22 Dec 2021 | NEWS RELEASE

Singtel and Ericsson achieve Southeast Asia first with fastest download speeds of 5.4Gbps on 5G standalone New Radio-Dual Connectivity

TIM'S 5G exceeds 5 Gigabits per second, setting a new european record

The record was achieved on the live network in Rome, combining 5G 3.7 GHz and millimetre wave frequencies in a complete 5G Stand Alone system

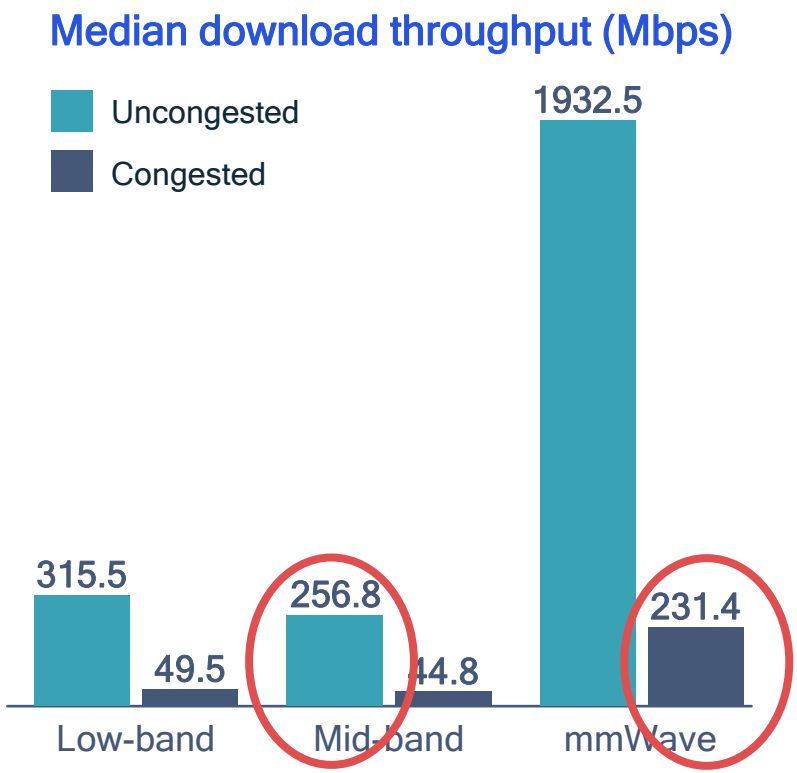
12/16/2021 - 11:30 AM

Qualcomm and ZTE Achieve Landmark 5G mmWave Results

— Comply with 200MHz Carrier Bandwidth Support as Required by IMT-2020 (5G) Promotion Group —
— High Speeds Achieved Using 200 MHz Carrier Bandwidth in NR-DC Demonstrate Progress Towards 5G mmWave Commercialization in China —

AUG 26, 2021 | SAN DIEGO

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



RootMetrics study shows mmWave can deliver more uniform user experiences even in congested network

mmWave provides speeds 4-5x faster than those of low-band and mid-band in congested conditions

mmWave delivers on the promise of providing extreme capacity and blazing-fast speeds under heavy network loads

Source: https://www.rootmetrics.com/en-US/content/mmwave-cutting-through-congestion

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5G mmWave can support diverse use cases in factories of the future

Enhanced mobile broadband

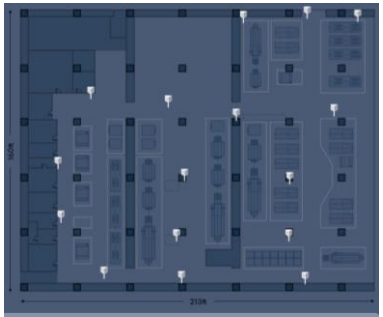
- Smartphone and laptops
- Boundless XR

Mission-critical services

- Industrial automation (e.g., robots)

Massive IoT

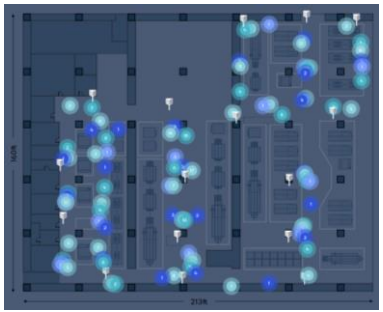
- Camera sensors



Smart Factory | Network Information

mmWave Sites	Test Area
16	34,080ft²

Proof-of-concept end-to-end system simulations



Simulated Devices

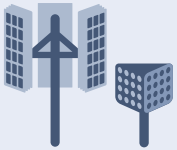
Smartphones and Laptops
- Average DL Throughput: 805.5 Mbps

Extended Reality
- Average DL Throughput: 212.2 Mbps (> 100 Mbps required)
- Successful Packets: ≥ 99 %
- Average Latency: 0.8 ms (< 10 ms required)

Industrial Automation
- Traffic Profile: 48.0 bytes / ms
- Successful Packets: ≥ 99.9999 %
- Average Latency: 0.5 ms (< 1 ms required)

Camera Sensors
- Average UL Throughput: 281.5 Mbps

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



5G mmWave + Fixed Wireless Access = Wireless Fiber

5G mmWave

DEPLOYING 5G MMWAVE TO

Complete the 5G puzzle

5G mmWave + Open RAN = Easily scalable, flexible, high-performance 5G

5G mmWave + mid-band + Stand Alone = Critical infrastructure for Industry 4.0

Qualcomm

Thank you

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

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Stephen Rose

Senior Partner, Global Head of Telco Practice,

Bell Labs

The business imperatives of 5G mmWave

Techno-economic evaluation of business attractiveness, revenue potential, and cost-effectiveness of 5G mmWave deployment across Europe

Bell Labs Consulting

Can telecom operators serve 5G subscribers with better profitability and technically superior solution by investing in 5G mmWave?

mmWave challenges

Limited coverage

Challenging propagation

Lack of assigned spectrum, devices & networks

mmWave opportunities

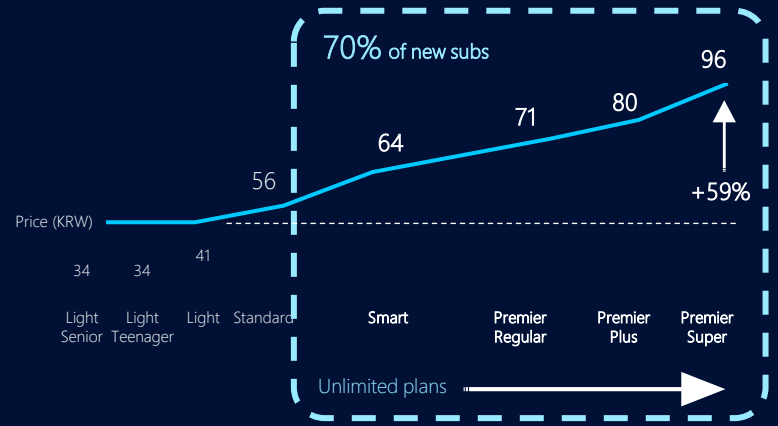
Significantly more capacity

Ideal for hot-zones and indoor locations

Business attractiveness…

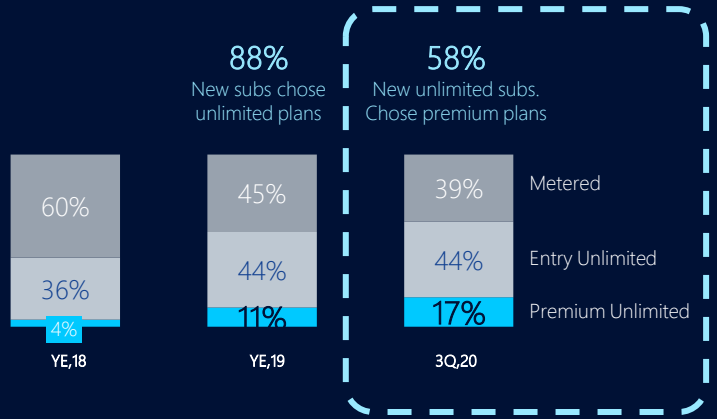
Telecom operators across the globe target to monetize 5G by enticing end-user to increase data usage and move to higher-price data bundles

5G Pricing plans & take rate



Source: LGU+

4G/5G Pricing plans & take rate



Source: Verizon

Replicating mmWave deployment by strategically selecting hot-zones across high-density locations enables significant revenue uplift opportunities

1M Homes & SOHOs

2150 PB/Year

7,200 Offices

1100 PB/Year

150 Train Stations

85 PB/Year

2.3K Outdoor hotspots

600 PB/Year

400 Indoor malls

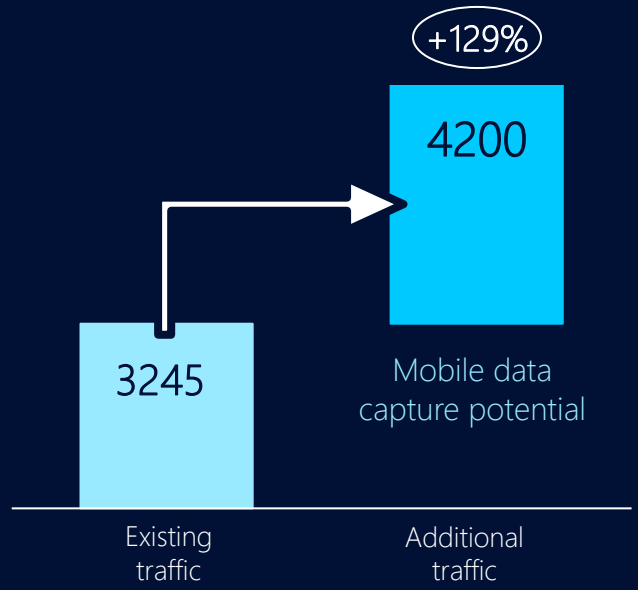
70 PB/Year

85 Stadiums

170 PB/Year

GLA – Gross Leasing Area

2021-26 UK* Operator Annual Mobile Traffic



* Estimated for one operator with 30% market share

Replicating mmWave deployment by strategically selecting hot-zones across high-density locations enables significant revenue uplift opportunities

1M Homes & SOHOs

Underserved

7,200 Offices

>70 Employees

150 Train Stations

>10k Daily Passengers

2.3K Outdoor hotspots

>5,000 sq. m GLA +

400 Indoor malls

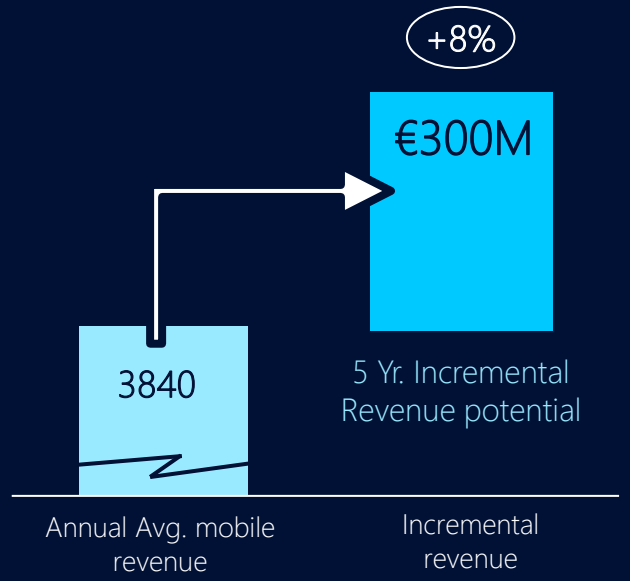
>5,000 sq. m GLA

85 Stadiums

>20K Seating Capacity

GLA – Gross Leasing Area

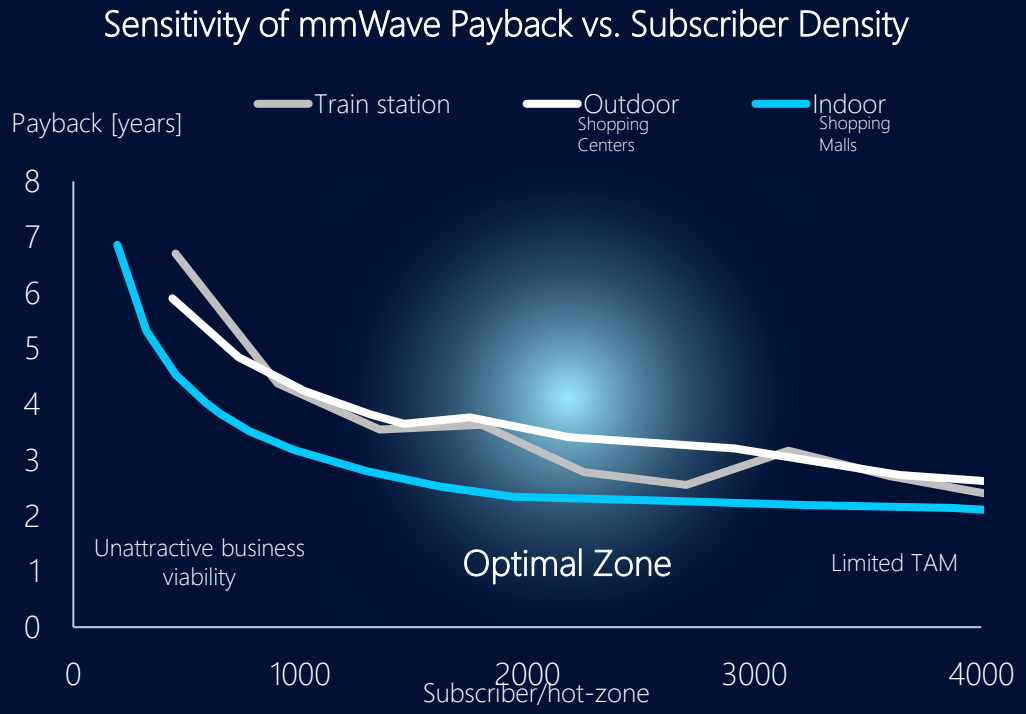
2021-26 UK* Operator Annual Mobile Revenue



* Estimated for one operator with 30% market share

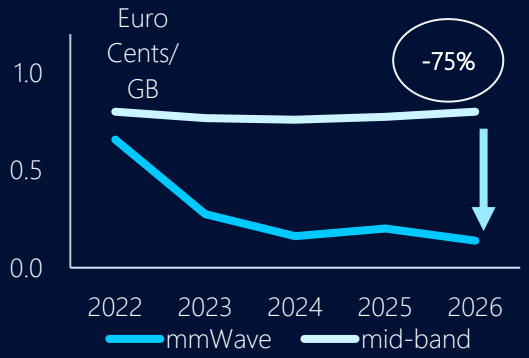
mmWave business viability excels with higher subscriber densities
Sweet spot of 5G mmWave at 1000-3000 subscribers/hot-zone

- Range of 1,000-3,000 subscribers per hot zone is the sweet spot for 5G mmW deployment
- Focusing on hot zones having higher subscriber densities than 3,000 subscribers/hot zone reduces the addressable market
- Lower than 1,000 subscribers/hot zone leads to a relatively unattractive business case



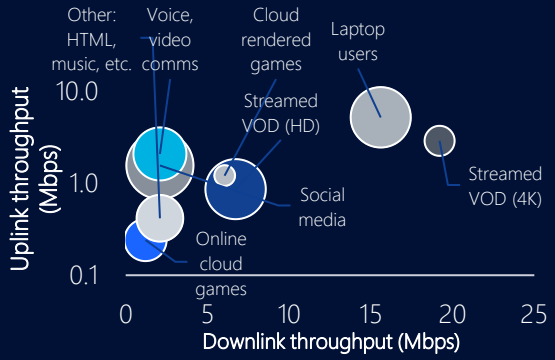
Gare du Nord case; findings & key-takeaways

Cost/GB comparison for Hot Zones at Gare du Nord



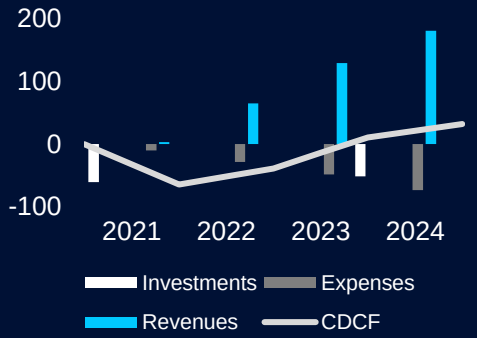
Up to 75% less Cost/GB vs. Sub-6 GHz at hot-zones in a busy train station

End-user applications in a train station hot-zone



Multiple strategies to position & upsell the technology to B2C and B2B subscribers

Business Case for hot-zones at Gare du Nord



payback period less than 4 years and RoI of 20-30% in high density locations

Deploy 5G mmWave at hot zones across swarm of locations to monetize 5G cost-effectively, with attractive RoI and capture new revenue streams

1. Accelerate deployment of **5G mmWave at hot zones across swarm of locations** to complement 5G Sub-6 GHz and accelerate demand for MBB

2. Strategically implement **5G mmWave to capture new markets and extend/introduce service offering** beyond fixed line broadband or connecting smartphones

3. **Surgically select and scale 5G mmWave deployments** considering zones of advantage of mmWave over alternative technologies

Bell Labs Consulting

NOKIA Bell Labs

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Peter Moberg

Head of Massive MIMO Radios, Ericsson

Leveraging the potential of 5G mmWave

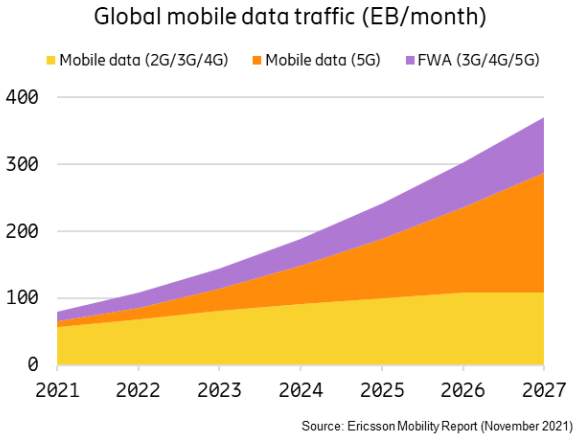
5G mmWave Summit

Peter Moberg
Head of Massive MIMO Radios
Ericsson

Leveraging the potential of 5G mmWave

5x

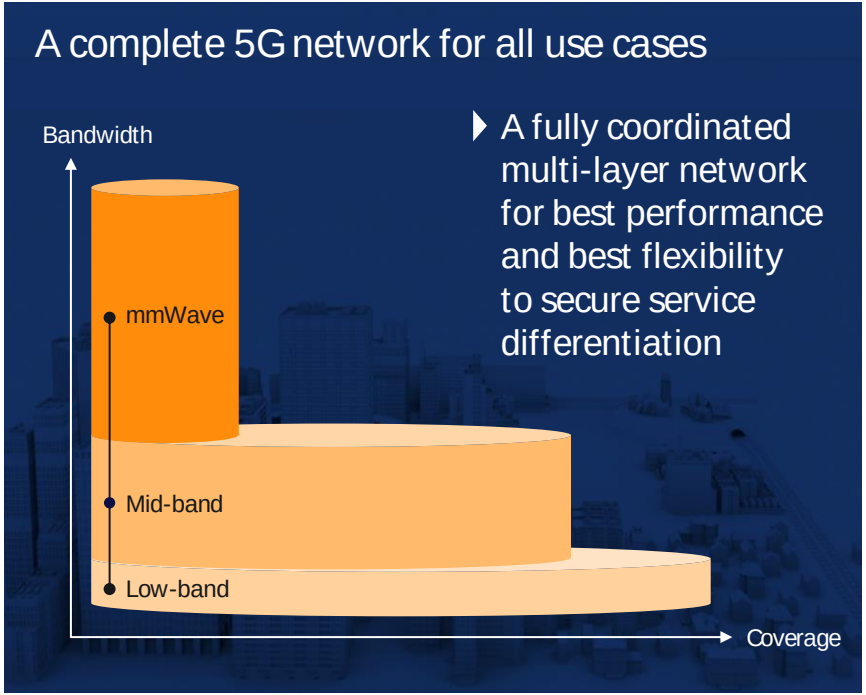
Total mobile data traffic to grow globally to 2027



10x more spectrum with mmWave

Provide a leap in capacity

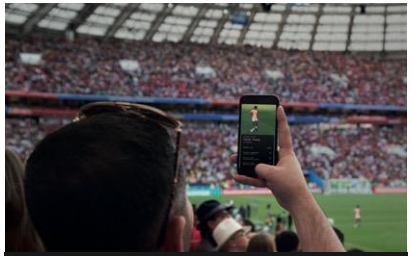
Enable revenues from new use cases



Add value now with mmWave

mmWave for any deployment

High-capacity radio enhancing the multi-layer network



Targeted speed and capacity for superior sports experiences

Small and non-intrusive Streetmacro for top speeds

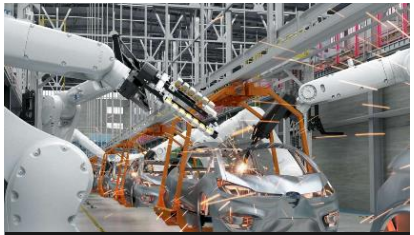
Reliable indoor network for growth and innovation

Seize growth with more use-cases

Differentiate by best performance

Best experience in a crowd

Capture new revenues with Fixed Wireless Access



Superior performance for industry and enterprise

Add mmWave for 5G FWA wireless fiber

Dispel a myth!

mmWave is not limited to short ranges

Gigabit speeds beyond 7 km

with extended range and line-of-sight

Line-of-sight is a challenge for mmWave

Limits realistic range to few kilometers

Unlock the full mmWave potential – use with midband

Superior FWA speed, coverage and capacity

- Wireless fiber services
- Higher data consumption
- Connect more homes

Add mmWave for Gbps uplink

Sharing experience at a crowded event

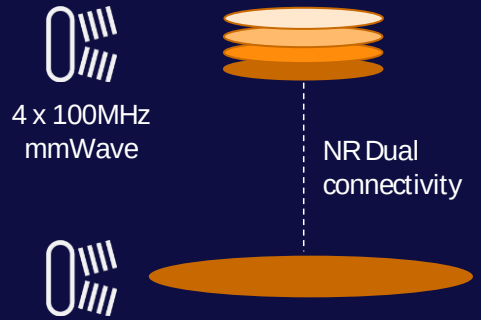
Media production and live streaming

Everywhere AR/ VR

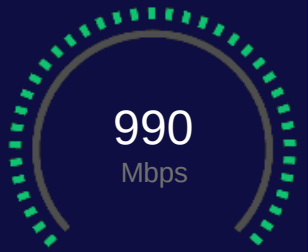
Smart factories industry 4.0

Now in commercial networks

Combined 5G mid-band and mmWave spectrum

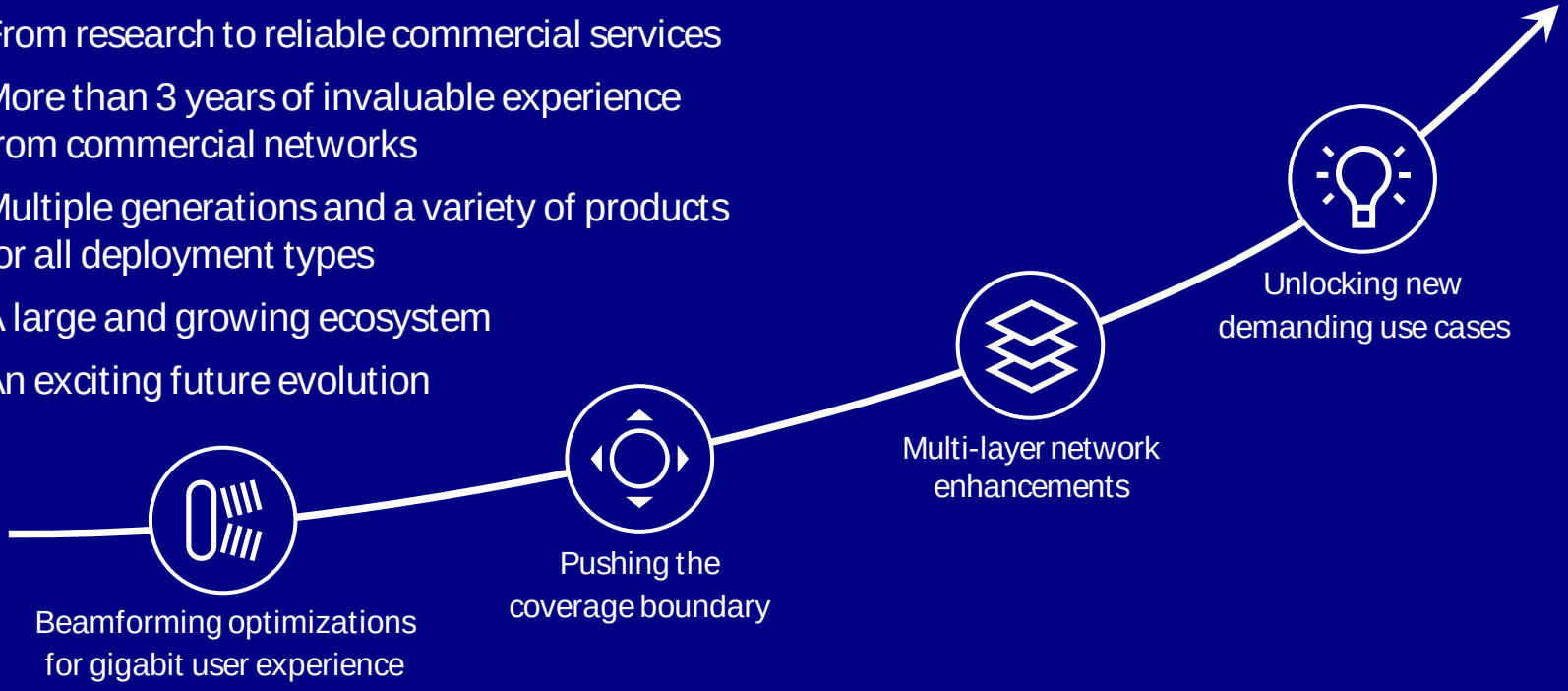


Uplink speed



A fantastic journey for 5G mmWave

- From research to reliable commercial services
- More than 3 years of invaluable experience from commercial networks
- Multiple generations and a variety of products for all deployment types
- A large and growing ecosystem
- An exciting future evolution



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Federico Agnoletto

Senior Economist,

GSMA Intelligence

GSMA Intelligence

gsmaintelligence.com @GSMAi

MWC Barcelona 2022 - mmWave 5G summit

mmWave 5G: high-band economics

DATE
02/03/2020

AUTHOR
Federico Agnoletto

Senior Economist

GSMA Intelligence

Definitive data and analysis for the mobile industry

3 Global Offices

Delhi Barcelona London

Serves over **800** organisations

40,000 users worldwide

Extensive Datasets

Over 30 million data points, updated daily.

Topical and Timely Research

Over 100 reports and exclusive analyses published annually.

Pinpoint Accuracy

Five-year forecasts consistently accurate within +/- 2.5 % of reported data, updated quarterly.

Industry Trusted

Serving businesses across the mobile ecosystem and many other vertical industries.

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The pros and cons of mmWave

The CONS

- Short range
- Indoor penetration difficulties
- New deployment strategies required

The PROS

- Mobile data traffic growing rapidly
- High-speeds and low-latency a must for 5G
- More spectral bandwidth and contiguous spectrum than any other band
- **Cost-effective?**

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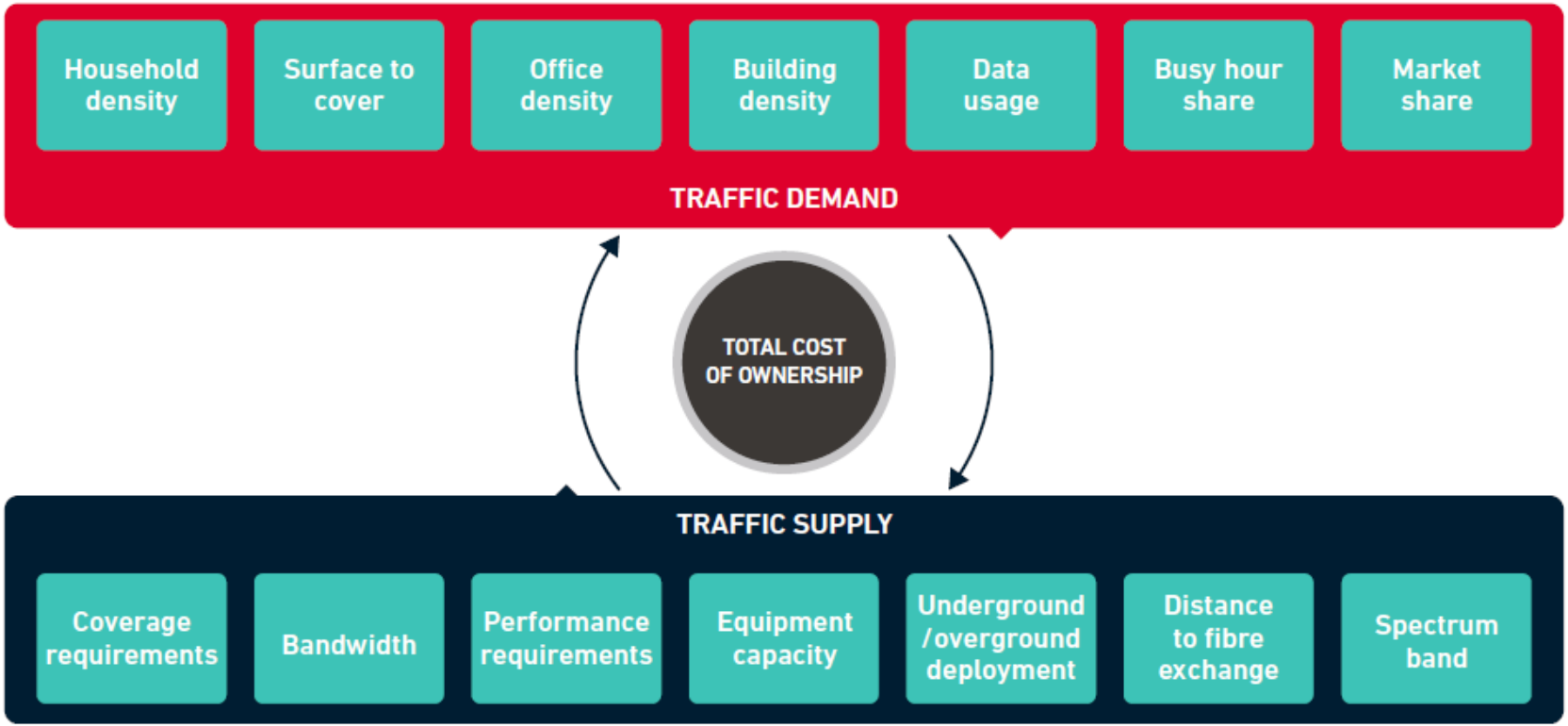
mmWave: cost effective?

Cost-effective?

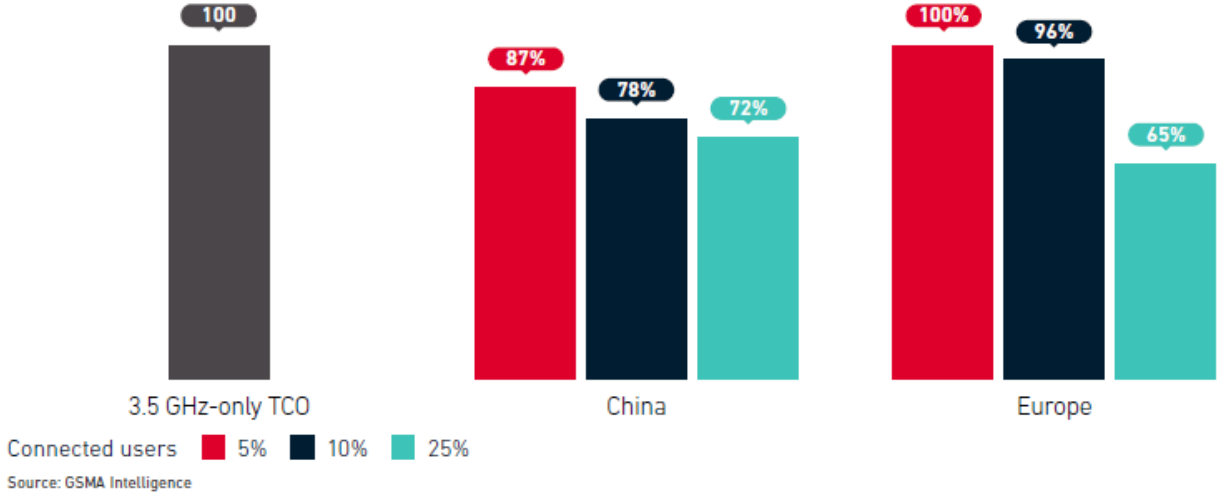


Scenario: Dense Urban

Cost-effective?

- Two deployment strategies: 3.5GHz-only vs 3.5GHz + mmWave
- Period now to 2025
- Scenario constructed using population density and satellite data on major cities in Greater China and Europe

- In **dense urban Greater China,** mmWave cost effective assuming the percentage of connected users is above 5% at the peak demand hour
- In **dense urban Europe**, mmWave 5G cost effective if the percentage of connected is 10% or above

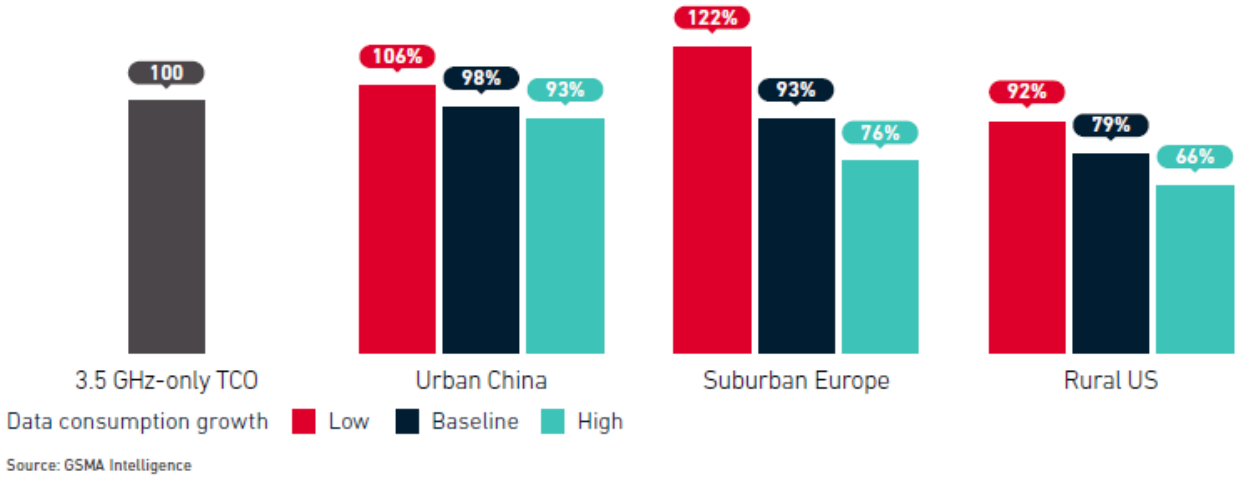


Scenario: 5G FWA

Cost-effective?

- Two deployment strategies : 3.5GHz FWA vs mmWave FWA
- Period now to 2025
- Scenarios constructed using population density data and satellite data on urban areas in Greater China, sub-urban areas in Europe and rural towns in the US

- mmWave-only FWA in **urban China, sub-urban Europe** and **rural towns in the US** can be cost effective if a good share of the residential broadband market is captured
- Results particularly sensitive to assumptions on traffic demand growth and the UL/DL traffic ratio

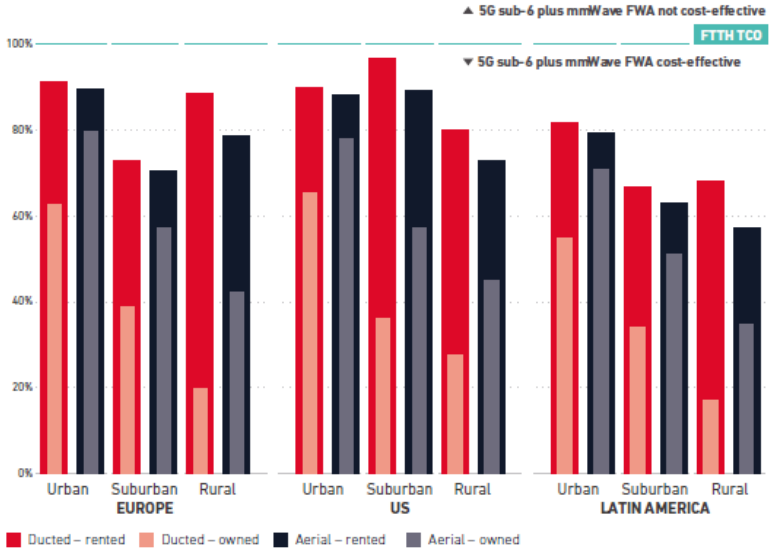


Scenario: 5G FWA

Cost-effective?

- Comparing TCOs: 5G FWA vs. FTTH for a mobile operator within 10 years
- Looking at both 5G mmWave FWA and 5G mid-band plus mmWave FWA
- Urban, sub-urban and rural in Europe, US and Latin America

- mmWave-only FWA generally cost-effective if fibre cannot be deployed in ducts or poles that can be rented or shared
- Mid-band + mmWave FWA cost effective in a number of instances even when fibre can be deployed in ducts or poles that can be rented or shared.

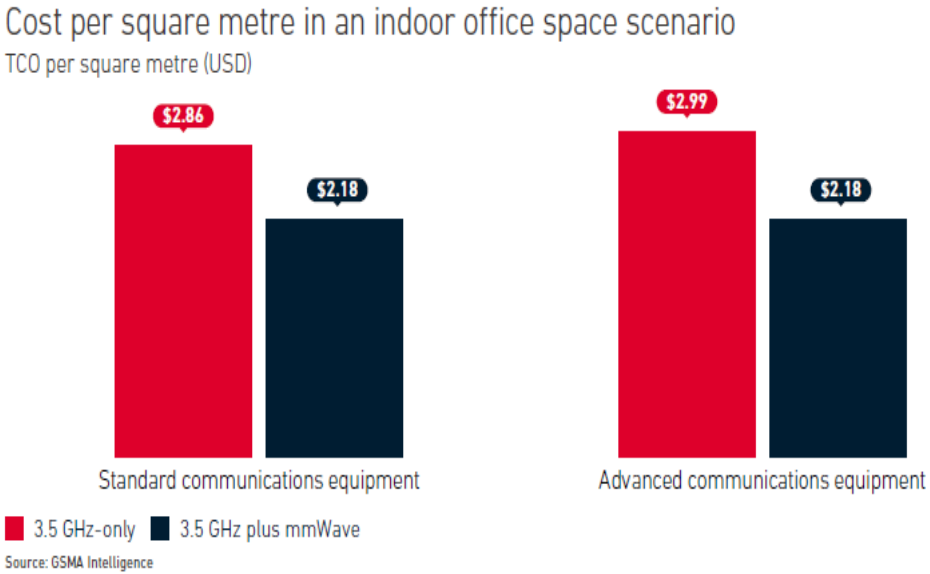


Scenario: Indoor

Cost-effective?

- Two deployment strategies compared: 3.5 GHz-only vs 3.5 GHz and mmWave
- Scenario constructed using a hypothetical office building where indoor coverage is limited; only a small share of traffic on 5G (just 10% of downlink traffic and 5% of uplink traffic) can be offloaded to outdoor sites

- A mmWave **indoor office** 5G network could be cost effective and generate cost savings up to 54%.
- The precise value in the range depends on the share of devices concurrently active and on whether and to what extent there is the need to provide connectivity to next-generation video communications equipment.



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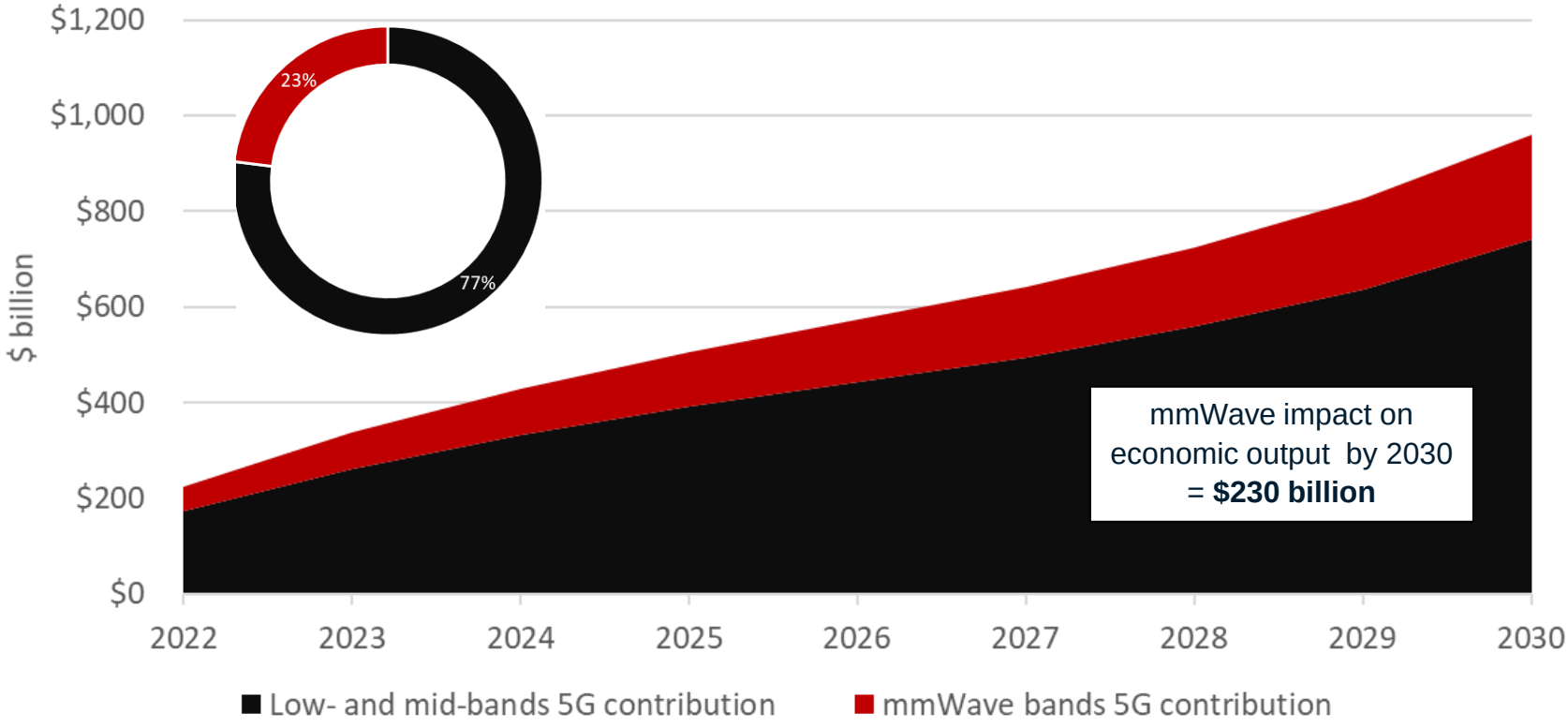
mmWave out to 2030: importance will continue to grow



Key takeaways

1. **In Dense Urban areas,** a mmWave capacity layer can cost-effectively complement mid-band 5G for smartphones.

2. **5G mmWave FWA** can be a cost-effective alternative to FTTH in rural towns, urban and suburban areas in Europe, US and LatAm whenever fibre cables cannot be deployed in existing ducts or poles. **5G mid-band + mmWave FWA** can also be cost-effective whenever they can.

3. **Indoor Enterprise**: small mmWave indoor cells are a cost-effective complement to mid-band for high levels of concurrent demand

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Recommendations

1. **Operators** – do not underestimate the role of mmWave in the short run

2. **Governments** – make clear plans for the assignment of mmWave bands

3. **Vendors** – scale is key: a wider choice of consumer devices and equipment will reduce costs and facilitate adoption

GSMA Intelligence

Read more…

NEW!

THANKS!

Federico Agnoletto

fagnoletto@gsma.com

Senior Economist, GSMA Intelligence

MWC Barcelona

Brian Mecum

VP Device Technology,
Verizon

Federico Agnoletto

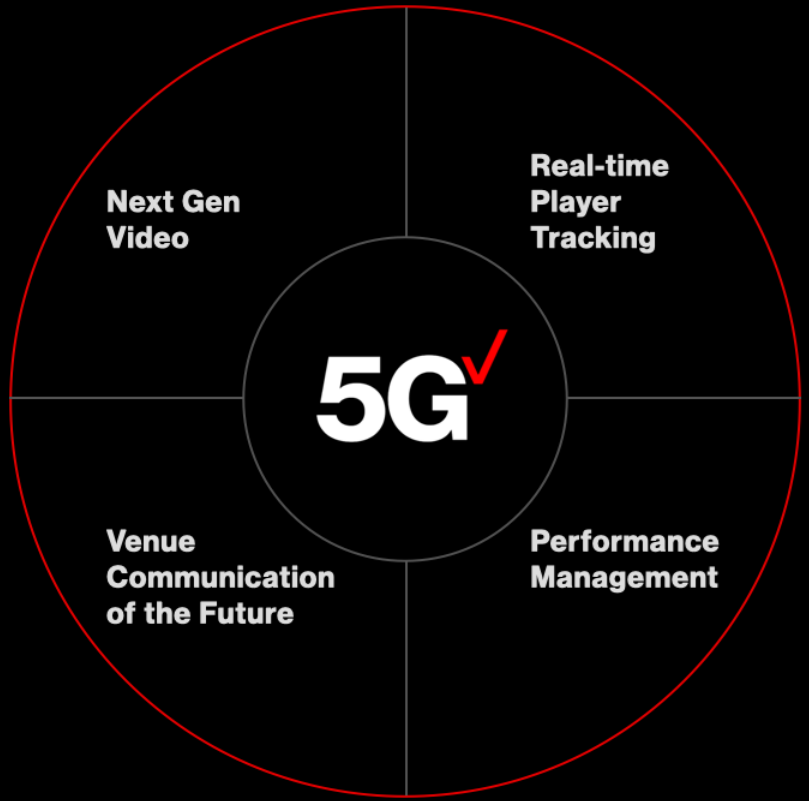
Senior Economist,
GSMA Intelligence


5G


5G
built for
sports

Sports Innovation Strategy

STRATEGIC PILLARS



RESULTS

- Multi-View
- 5G Portal Experience
- 5G Camera Broadcast
- Player Tracking
- Weight Room & Skill Development
- NFL Field Communications Development

5G

Stadium of the Future Innovation


9:10
Verizon 5G Multi-View
89
Q4
03:22
113
LIVE
1280x720
1280x720
1280x720
120
EARNED COINS
4
ACTIVE PREDICTIONS
Will the combined point total exceed 205?
51
sec
Yes
No
3pt Shot
PHX • 4TH 04:29
3pt Shot
PHX • 3RD 00:20


1:25
Verizon 5G Multi-View
14
3RD
QTR
14
LIVE
Touchdown
LAC • 3RD 11:58
Pass
PIT • 2ND 13:00

MWC Barcelona

Sul Jaejin

Director,

MSIT (Ministry of Science and ICT of South Korea)

Promoting 5G service at 28㎓ band by MSIT

Introducing POC of 5G at 28㎓ band in subway

Ministry of Science and ICT

CONTENTS

디지털뉴딜 한국판뉴딜

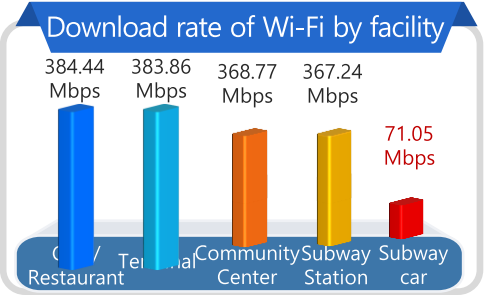
Ministry of Science and ICT 과학기술정보통신부

I Background

Current Status of using subway Wi-Fi

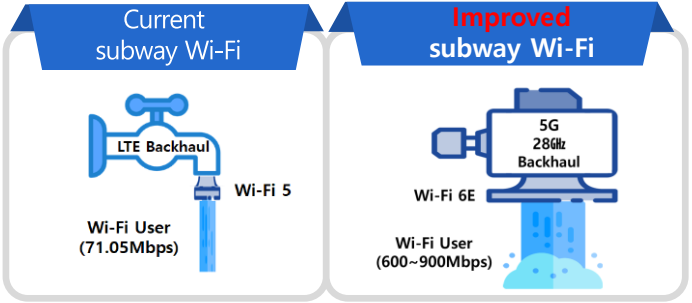
As mobile data traffic has surged, enhancement of data offloading performance of Wi-Fi is demanded. However, Wi-Fi environment in subway car is insufficient.

- Average download speed of commercial subway car Wi-Fi has recorded lowest (71.05Mbps).



Results of communication service coverage inspection and evaluation of quality in 2020(MSIT)

- One of main cause of low quality is to use slow LTE as Wi-Fi backhaul.
- Reviewing usage of 5G 28㎓ as backhaul to improve quality of subway Wi-Fi.



Ⅱ

Overview of POC for Wi-Fi in subway car

POC Timeline

Create TF

- MSIT, 3 mobile network operators, 7 organizations

Install Equipment

- Consultation with Seoul Metro
- Start installing

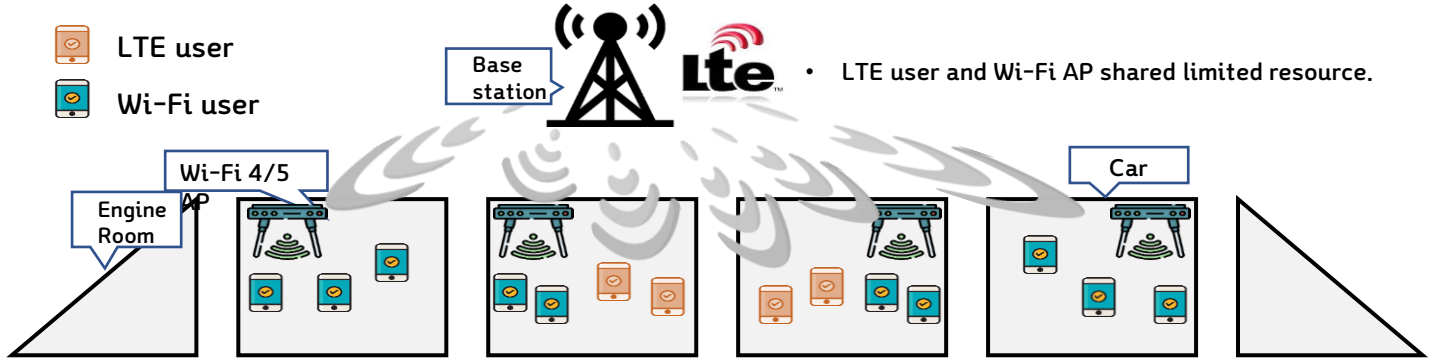
Launch POC

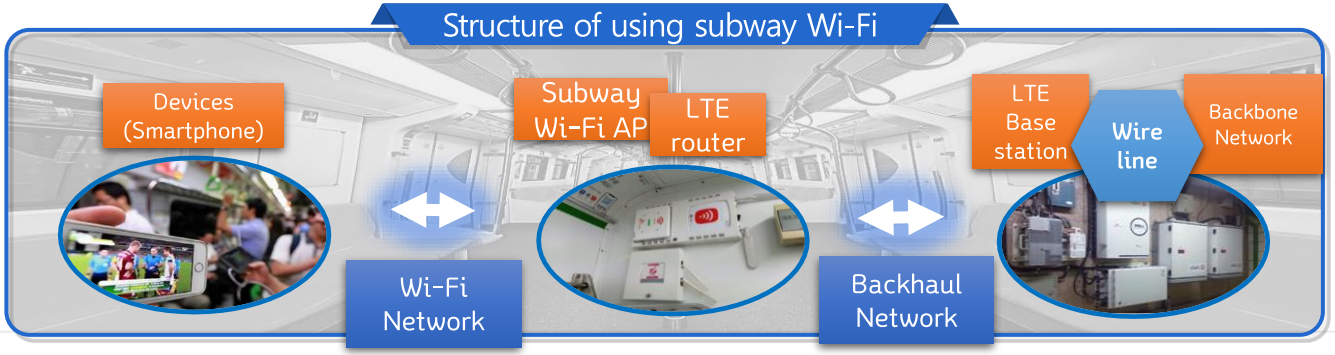
- Start POC
- Open Wi-Fi service to public

< Mar. 2021 > < Jun. 2021 > < Sep. 2021 >

(As-Is) Insufficient Wi-Fi capacity in subway car

Using LTE as backhaul and deploying Wi-Fi 4/5 operating at 2.4㎓/5㎓

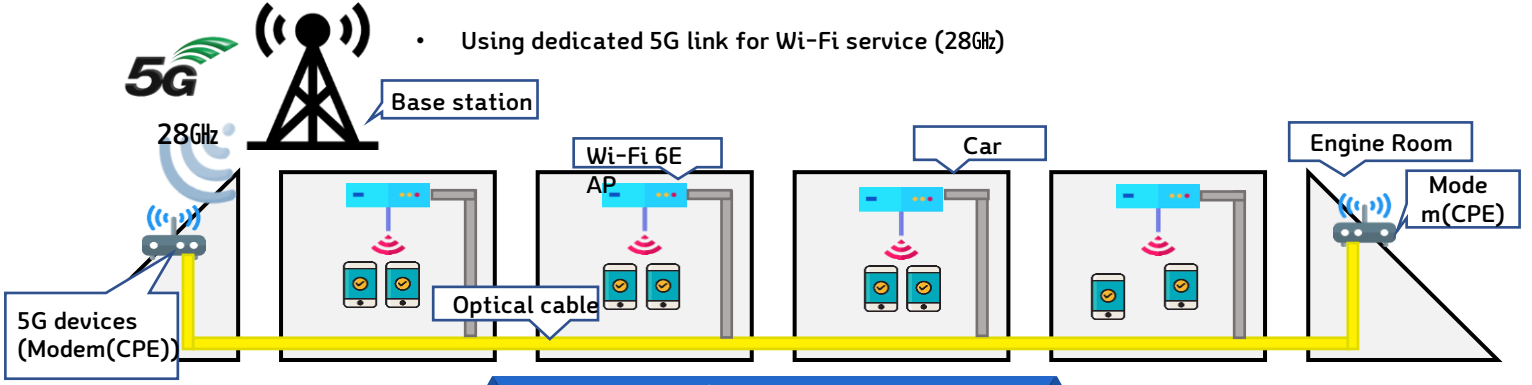


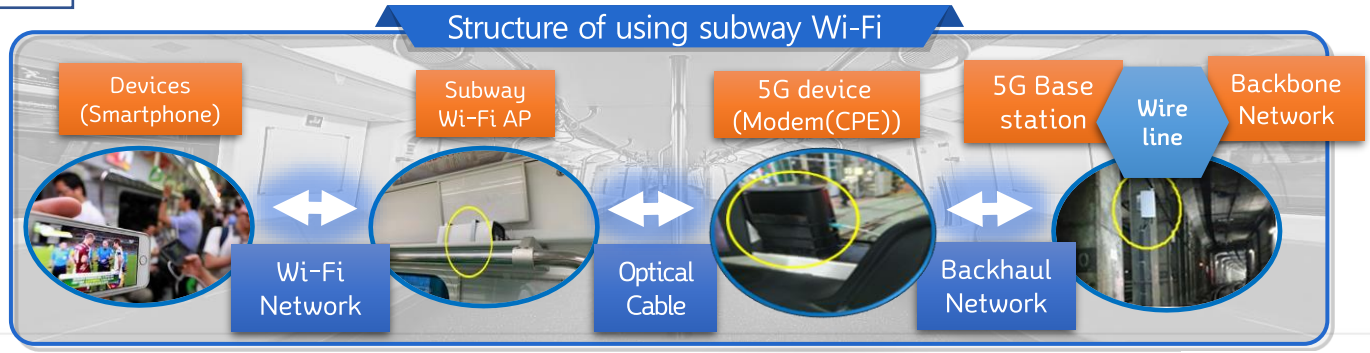


(To-Be) Dramatically increased Wi-Fi capacity

Constructing 5G at 28GHz band as backhaul, installing Wi-Fi 6E at 2.4GHz/5GHz/6GHz

- Using dedicated 5G link for Wi-Fi service (28GHz)





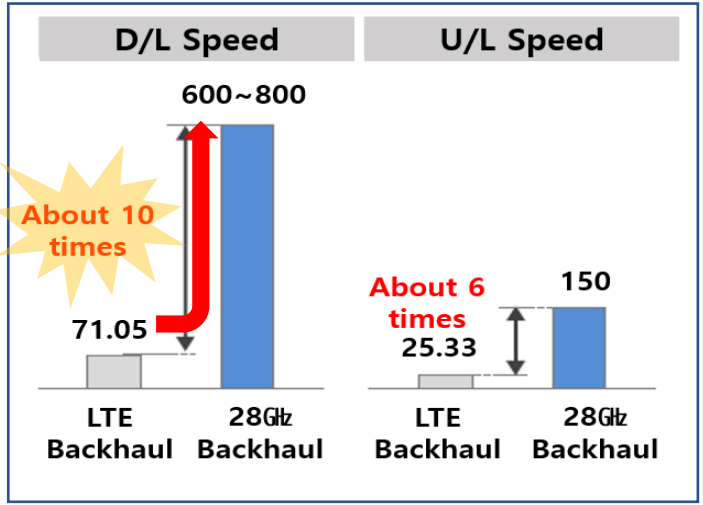
Ⅲ

POC results and Future plan

Ministry of Science and ICT

Speed trial of demonstration network

In case of using 5G(28㎓) as a backhaul, Wi-Fi download speed was dramatically increased(approximately 10 times than before) in subway car..!!

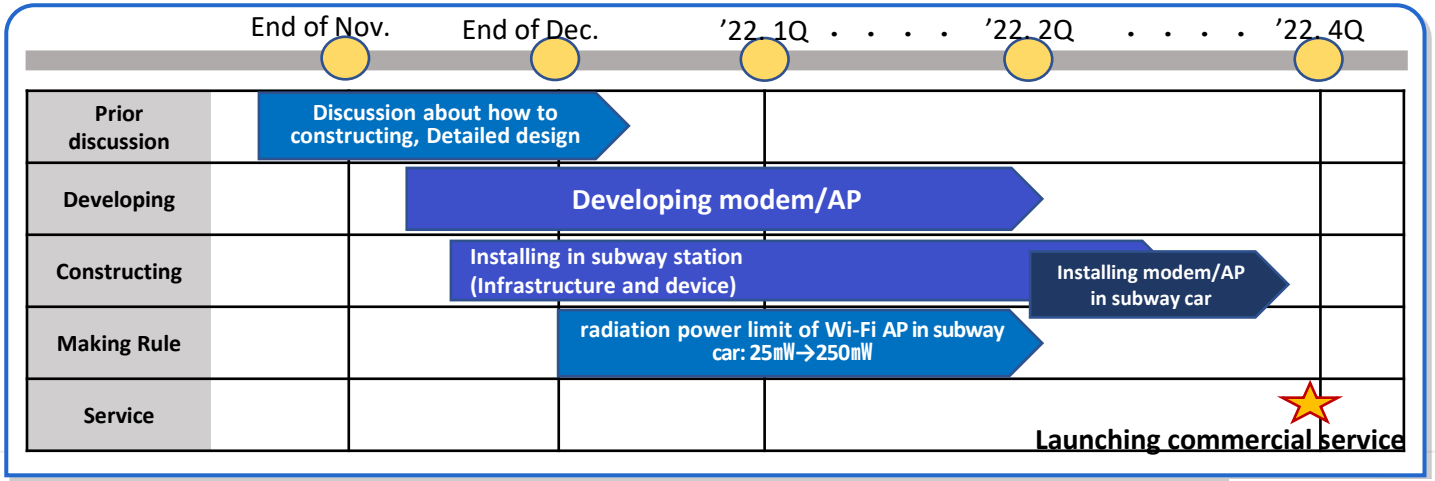


LTE as backhaul & Wi-Fi 5	Average Speed : about 70 Mbps
5G(28㎓) as backhaul & Wi-Fi 6E	Average Speed : 600~800 Mbps (Peak Speed : 1,800 Mbps)

Future plan

Promoting installation through Seoul metro 2, 5~8 lines

- Developing CPE, AP for moving vehicle(~2Q 2022)
- Amending and implementing technical regulation(~2Q 2022)
- Completing installation and launching service(~4Q 2022)



Promoting 28㎓ 5G service by MSIT

Thank You

MWC Barcelona

Iskra Nikolova

Executive Networks & Infrastructure Engineering,

Telstra

mmWave: Now & Next

Iskra Nikolova
Network and Infrastructure Executive Telstra

Our History with mmWave

2016	• Launched 1st 5G test bed in Australia
2017	• Start mmWave trials at our 5G innovation centre
2018	• mmWave rollout begins
2020	• First mmWave device launches in Australia
2021	• Spectrum Auction • mmWave live trials begin • First mmWave handset in Australia

Ongoing Strategy

- The value of mmWave
- Metro / High Traffic Areas
- Small Cells and Repeaters
- Our 2025 Ambitions

Case Study: MCG

- 100,000 seater stadium
- mmWave included as part of new connectivity upgrades
- Download speeds between 2-3 Gbps

What's next for mmWave?

- Growing market opportunity
- Increasing hardware capability
- mmWave as a broad coverage option

Moving forward

- Working together
- mmWave accelerator initiative
- Cost effectiveness
- Increasing software capabilities

Final Thoughts

- The true value of 5G will be unlocked with mmWave
- We need to work together to build the industry eco system

MWC Barcelona

Yang Shen

Senior Solution Architect,

ZTE

ZTE

THANK YOU

MWC Barcelona

Michael Thelander

President and Founder,

Signals Research Group

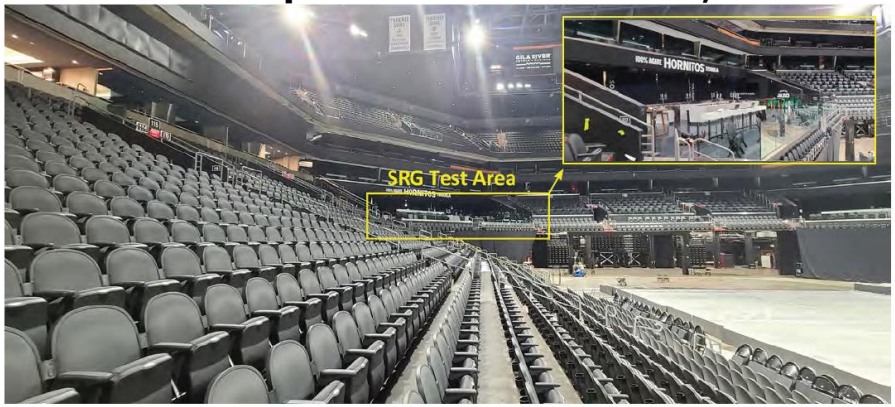
5G mmWave Benchmark Study

March 2022

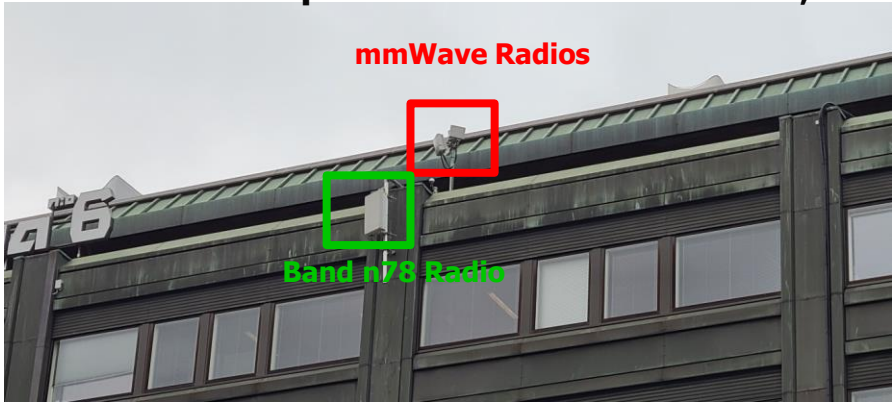
SiGNALS Research Group

IN JUST 10 SHORT MINUTES YOU WILL LEARN….

Footprint Center in Phoenix, AZ



Market Square in Downtown Helsinki, FI



- How mmWave performs in real-world venues (an outdoor market square in Europe and a basketball arena in North America)
- Why operators with mid-band 5G spectrum should consider mmWave
- Why consumers need access to Gigabit-per-second throughput

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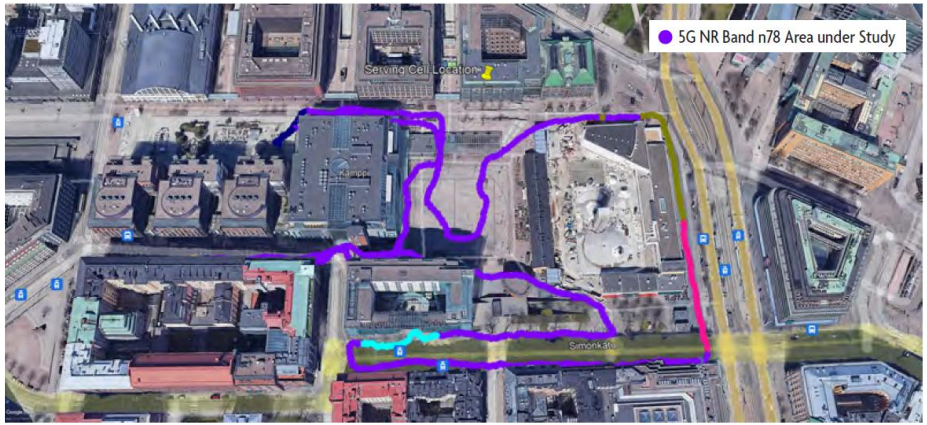
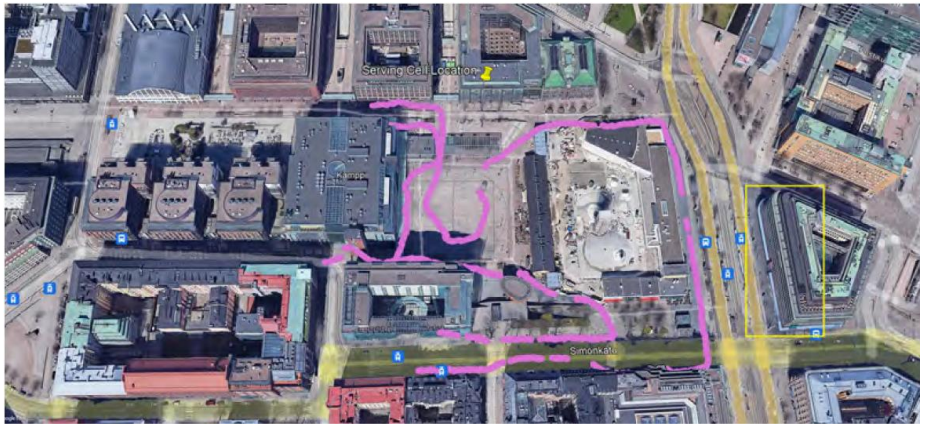
Mid-band and mmWave Cell Coverage Areas

Band n78 (3.8 GHz)



Band n258 (26 GHz)



- Colored circles show area walked during each test – unique colors map to unique 5G radios (PCI values)
- Mid-band 5G and LTE (not shown) had similar coverage areas
- mmWave coverage included areas not covered by the same 5G mid-band radio (covered by adjacent radios)

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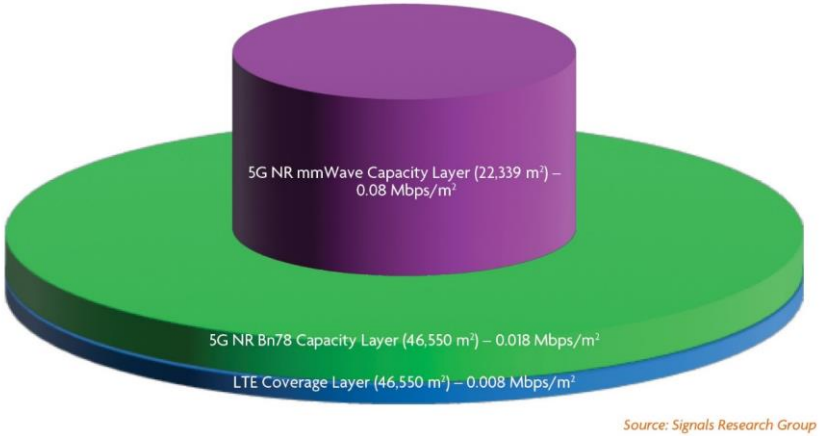
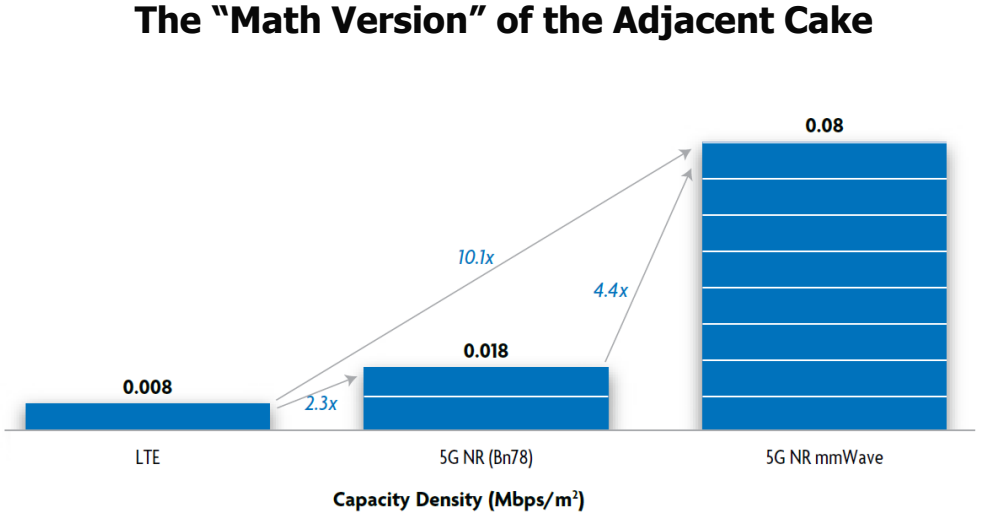
Capacity increases by 10.1x vs LTE (4.4x over Bn78)



Source: Signals Research Group



- Mid-band 5G increased LTE capacity by 2.3x (comparable coverage)
- 5G mmWave increased LTE capacity by 10.1x, and it increased mid-band 5G capacity by 4.4x (~50% outdoor coverage of mid-band 5G)

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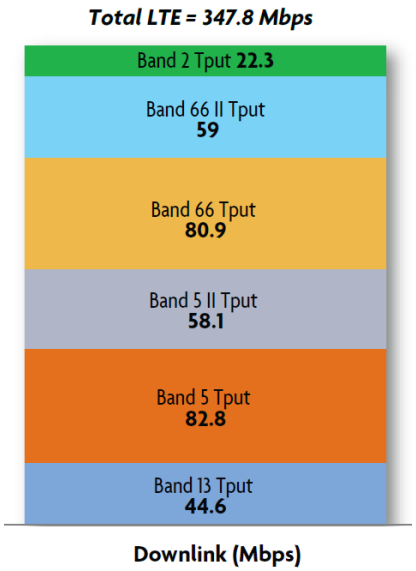
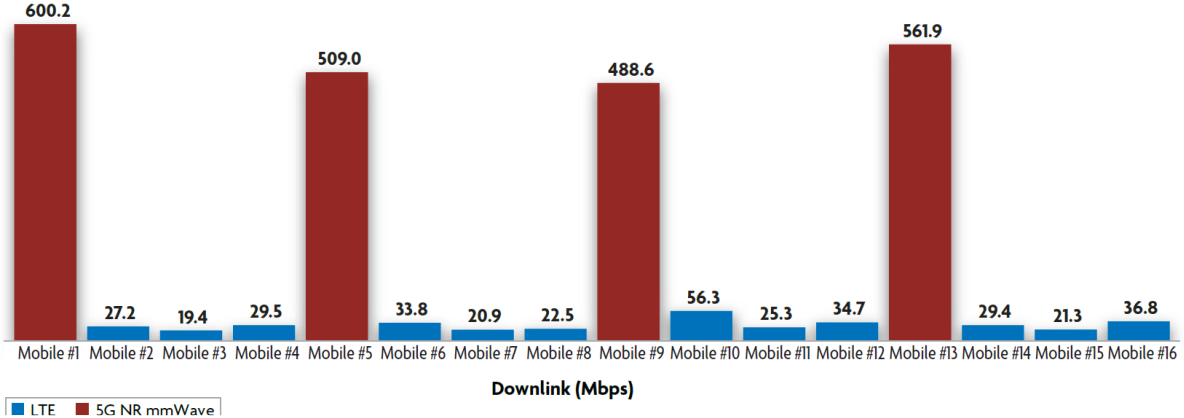
5G mmWave in a Loaded LTE Network - downlink

Total Downlink Throughput (by LTE band)



Device Throughput Comparison (with and without mmWave)



- 16 smartphones downloading in parallel – 4 smartphones on mmWave
- LTE spectral efficiency is quite good but lack of ample spectrum impacts user speeds – all LTE phones used carrier aggregation (3 carriers)

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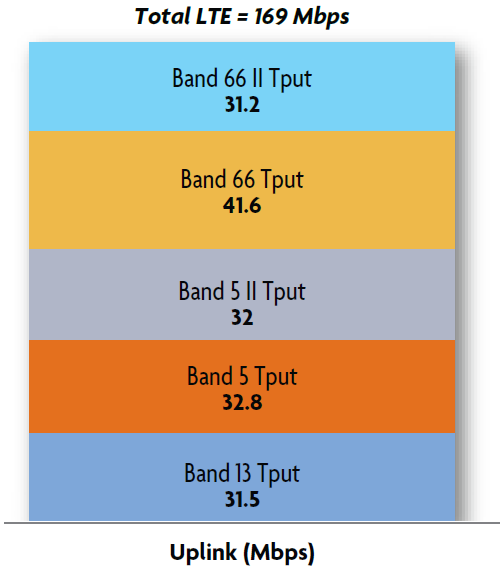
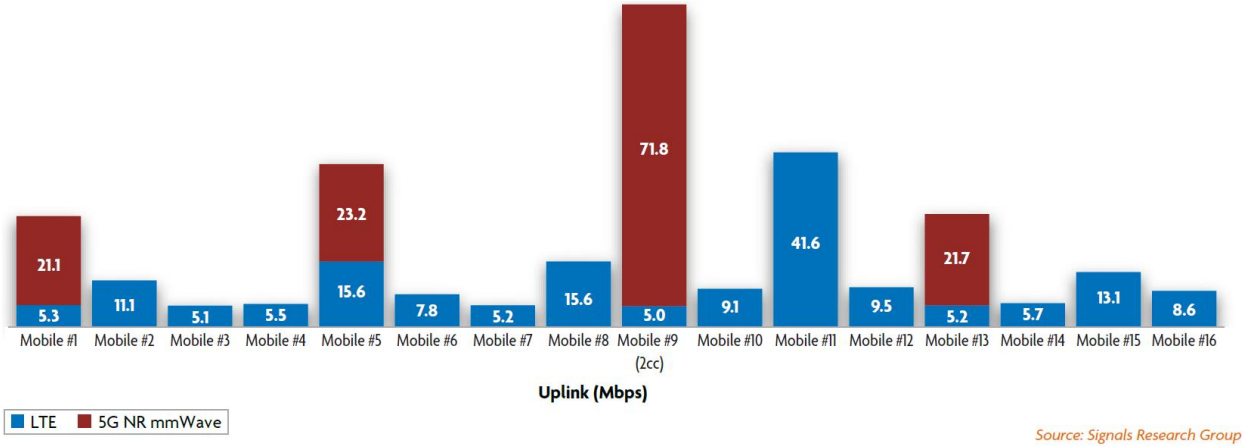
5G mmWave in a Loaded LTE Network - uplink

Total Downlink Throughput (by LTE band)



Device Throughput Comparison (with and without mmWave)



Source: Signals Research Group

- 16 smartphones uploading in parallel – 4 smartphones on mmWave
- Phones with mmWave had 3.7x higher throughput, on average, than LTE only phones

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Why it Matters!

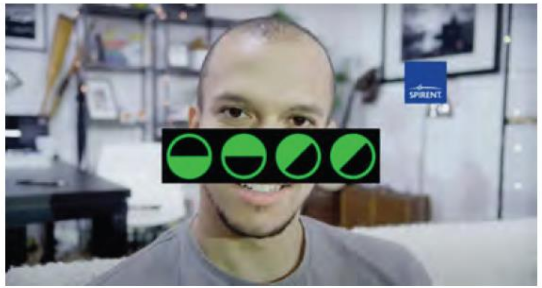
Video Streaming in a Congested LTE Network

Source Video
(VMOS = 4.94)

LTE Video with Network Congestion
(VMOS = 4.28)

5G NR Video with LTE Network Congestion
(VMOS = 4.84)

YouTube Live in a Congested LTE Network



Good

Bad

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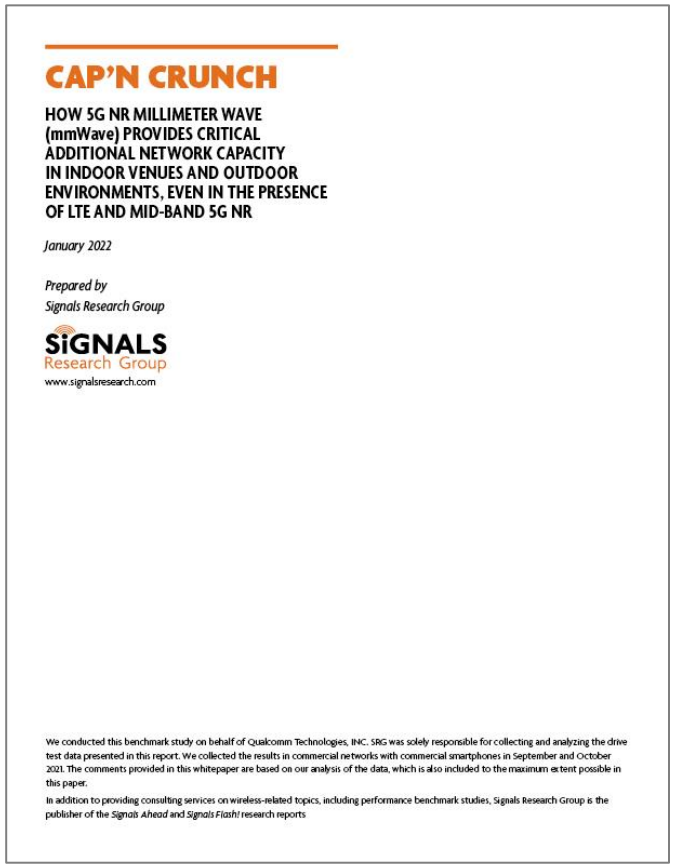
READ ALL ABOUT IT!



CAP'N CRUNCH

HOW 5G NR MILLIMETER WAVE (mmWave) PROVIDES CRITICAL ADDITIONAL NETWORK CAPACITY IN INDOOR VENUES AND OUTDOOR ENVIRONMENTS, EVEN IN THE PRESENCE OF LTE AND MID-BAND 5G NR

January 2022

Prepared by
Signals Research Group

SIGNALS Research Group
www.signalsresearch.com

We conducted this benchmark study on behalf of Qualcomm Technologies, INC. SRG was solely responsible for collecting and analyzing the drive test data presented in this report. We collected the results in commercial networks with commercial smartphones in September and October 2021. The comments provided in this whitepaper are based on our analysis of the data, which is also included to the maximum extent possible in this paper.

In addition to providing consulting services on wireless-related topics, including performance benchmark studies, Signals Research Group is the publisher of the *Signals Ahead* and *Signals Flash!* research reports

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Research Group

MWC Barcelona

Marco Arioli

CTO,

FastWeb

MWC Barcelona

Henry Calvert

Head of Networks,

GSMA