



Qualcomm

#SnapdragonSummit

# Cristiano Amon

President, Qualcomm Incorporated  
@cristianoamon





December 4, 2018

One year ago  
we were talking  
about the 5G  
future...



# 2019

5G has tremendous momentum  
across regions

**40+** Operators  
launched

**40+** OEMs  
announced

**325+** Operators in 109  
countries investing  
in 5G

**5G** Sub-6   **5G** Sub-6 + mmWave

**USA**  
Verizon, AT&T, Sprint, T-Mobile

**United Kingdom**  
EE, Vodafone UK, Three, O2

**Ireland**  
Vodafone IE, EIR

**Switzerland**  
Sunrise, Swisscom

**Spain**  
Vodafone ES

**Monaco**  
Monaco Telecom

**Italy**  
Vodafone IT, TIM

**Finland**  
Elisa, Telia

**Germany**  
Deutsche Telekom, Vodafone Germany

**Romania**  
Vodafone, RCS/RDS, Orange

**Bahrain**  
Batelco, Viva

**China**  
China Mobile, China  
Unicom, China Telecom

**Qatar**  
Ooredoo, Vodafone

**United Arab Emirates**  
Du, Etisalat

**Kuwait**  
Viva, Ooredoo, Zain

**Saudi Arabia**  
STC, Zain

**South Korea**  
LGU+, KT, SKT

**Philippines**  
Globe

**Australia**  
Telstra, Optus

**South Africa**  
Rain



# 2020

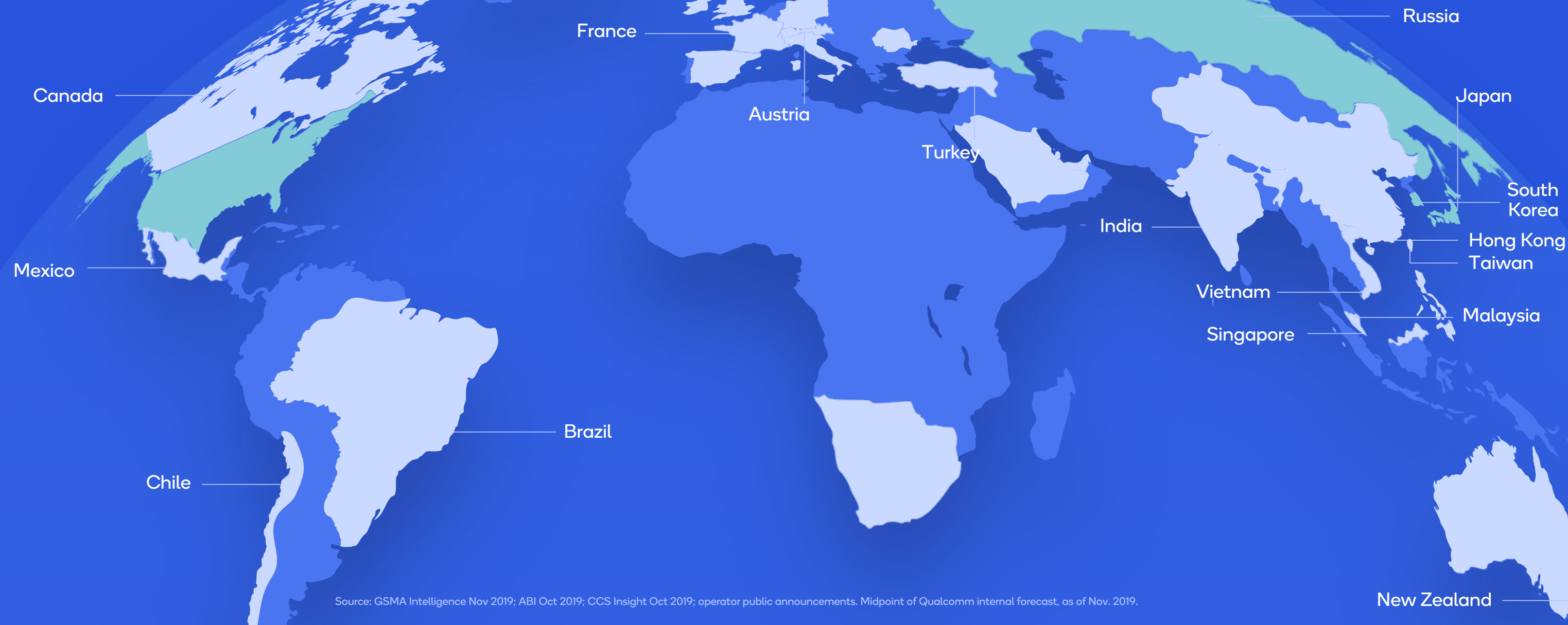
Commercialization rapidly  
expanding around the globe

5G

Sub-6

5G

Sub-6 + mmWave



Source: GSMA Intelligence Nov 2019; ABI Oct 2019; CCS Insight Oct 2019; operator public announcements. Midpoint of Qualcomm internal forecast, as of Nov. 2019.



# 2021+

Commercialization rapidly  
expanding around the globe

## 2.8B

5G connections  
forecast by 2025

5G

Sub-6

5G

Sub-6 + mmWave



Source: GSMA Intelligence Nov 2019; ABI Oct 2019; CCS Insight Oct 2019; Ericsson Nov 2019; operator public announcements

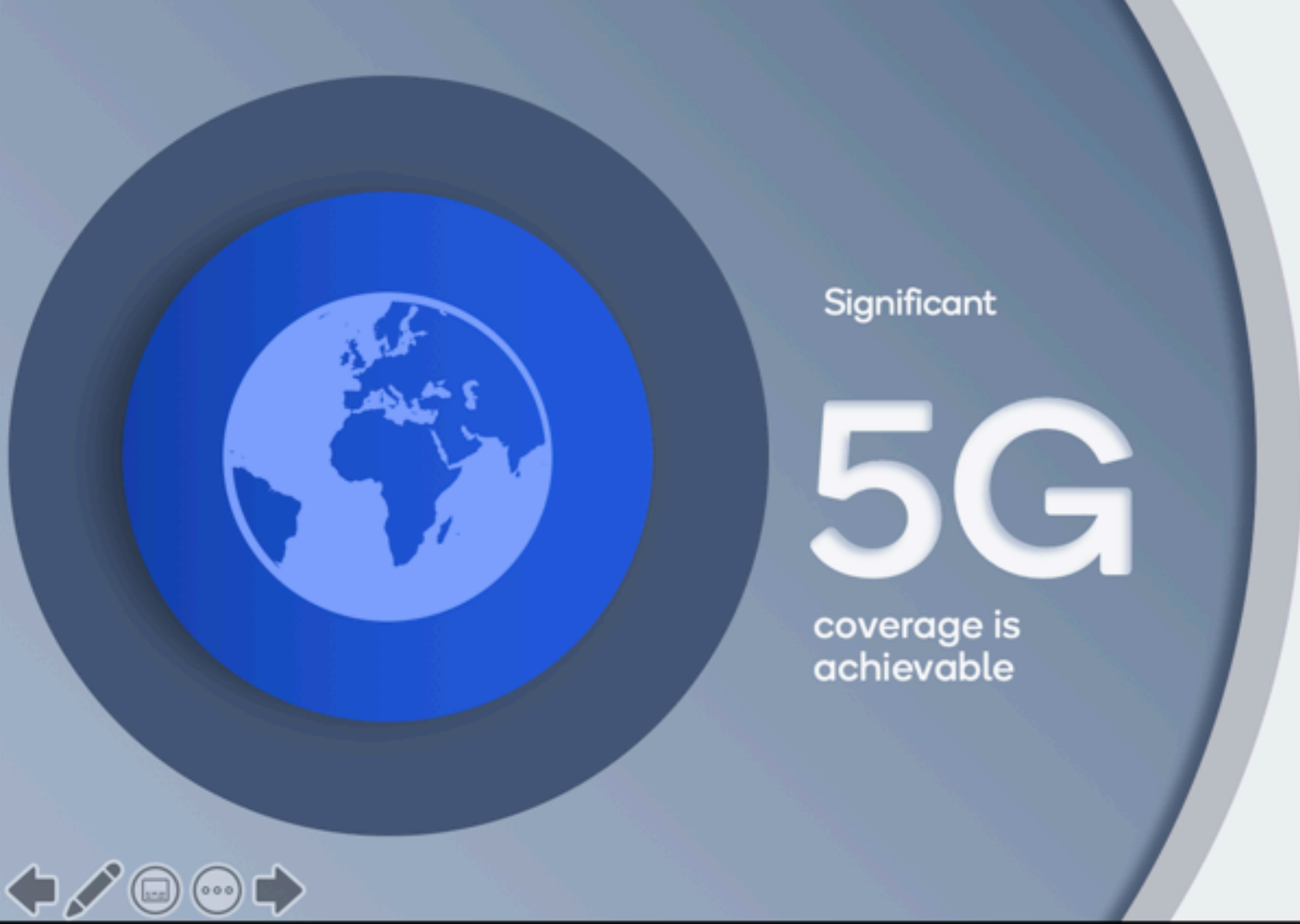


# Sub-6 + mmWave is real 5G

Combining coverage and capacity benefits







## San Francisco

5G multimode mmWave

# 65%

outdoor coverage using  
existing LTE sites

## Frankfurt

5G multimode Sub-6 GHz

# 78%

outdoor coverage using  
existing LTE sites

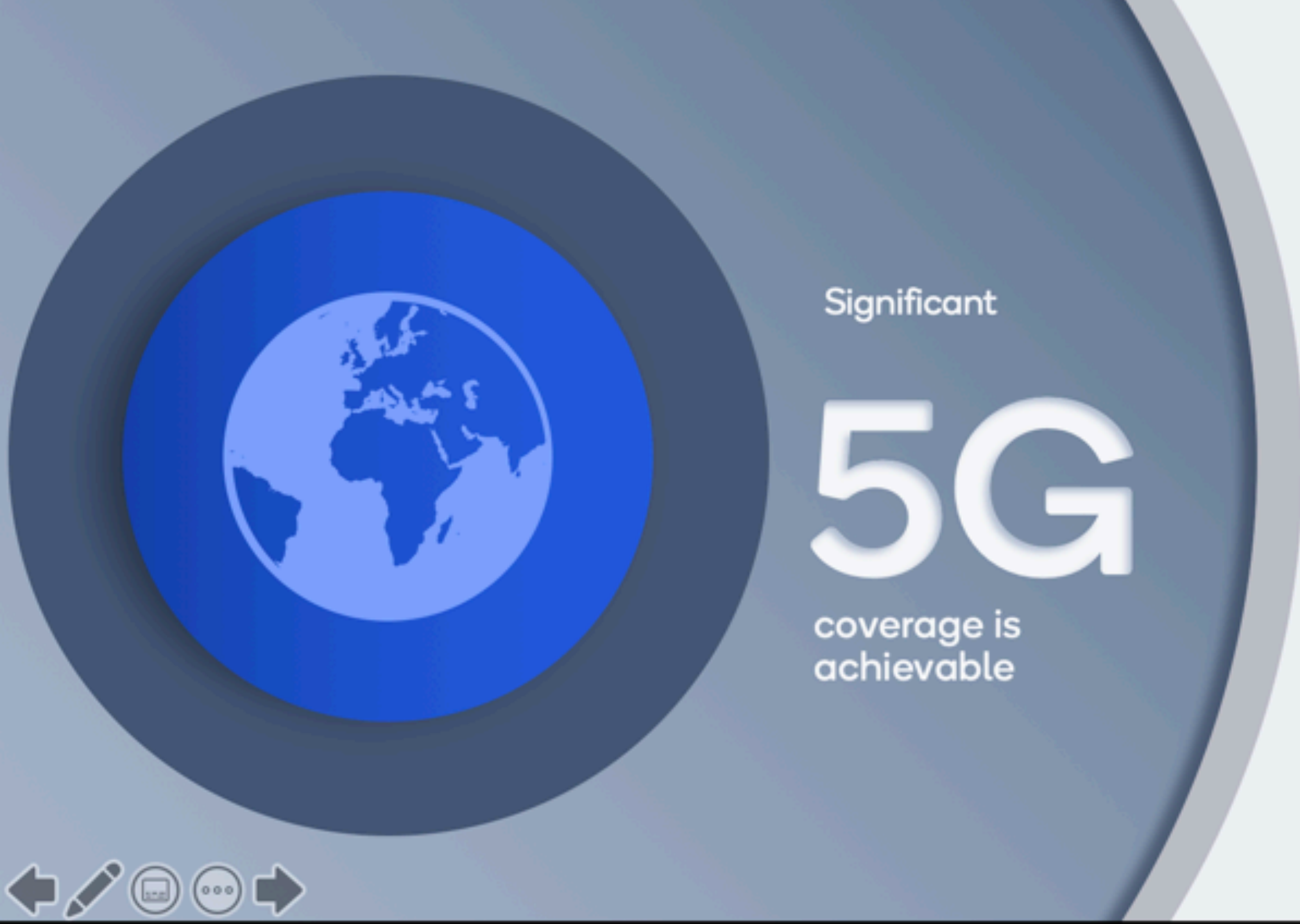
Source: Company simulation data and internal analysis

Frankfurt: 3.5 GHz 5G NR + LTE multimode; DSS carrier using n1 (2.1 GHz)

San Francisco: 28 GHz 5G NR + LTE multimode







## San Francisco

5G multimode mmWave

# 65%

outdoor coverage using  
existing LTE sites

## Frankfurt

5G multimode Sub-6 GHz

Approximately

# 96%

with Dynamic Spectrum  
Sharing carrier

Source: Company simulation data and internal analysis

Frankfurt: 3.5 GHz 5G NR + LTE multimode; DSS carrier using n1 (2.1 GHz)

San Francisco: 28 GHz 5G NR + LTE multimode







5G

## Proven 5G mmWave performance, coverage, and power efficiency

Signals Research Group's field  
results show 5G mmWave  
performing as designed

More than

**10x**

peak performance gains compared to LTE only

Non-line-of-sight:

**200+ Mbps**

1+ Gbps line-of-sight; with mobility

Over

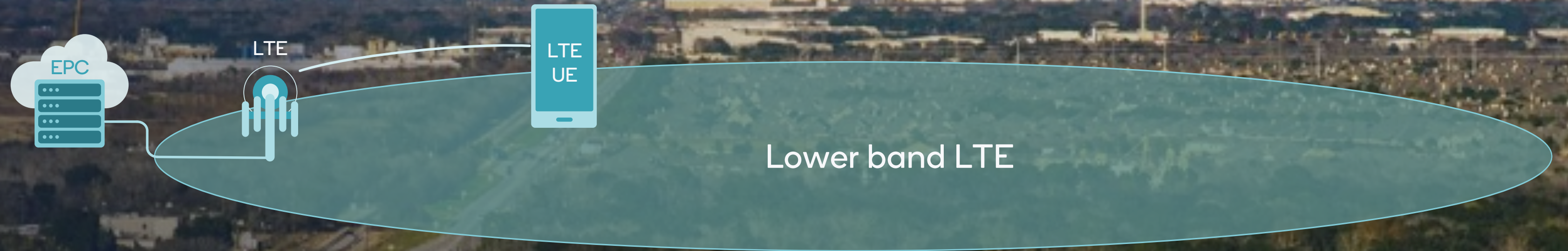
**14 hours**

usage meeting power and thermal requirements



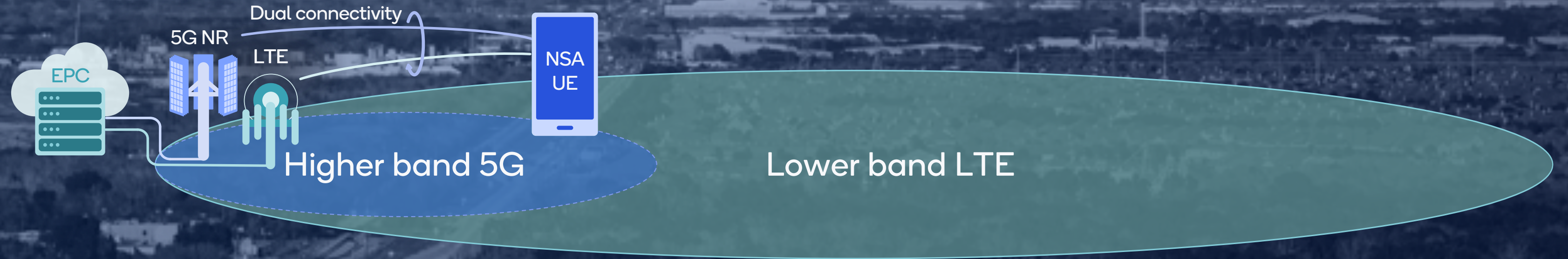
# Executing on a phased approach for 5G rollout

5G is NSA, SA, FDD, TDD, CA, DSS, Sub-6, mmWave





# Supporting 2019 5G rollouts with non-standalone mode

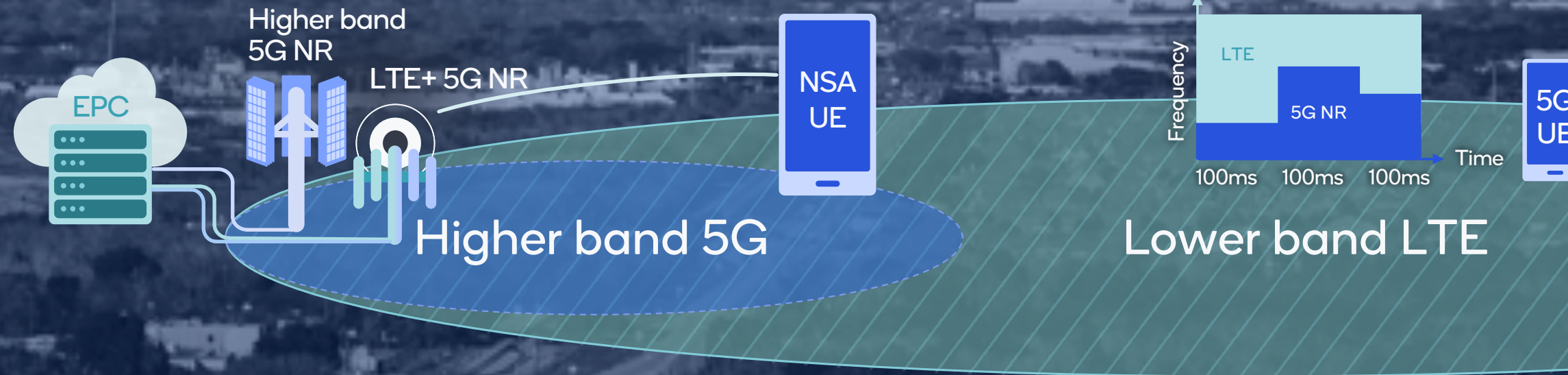




# Expanding coverage with lower bands

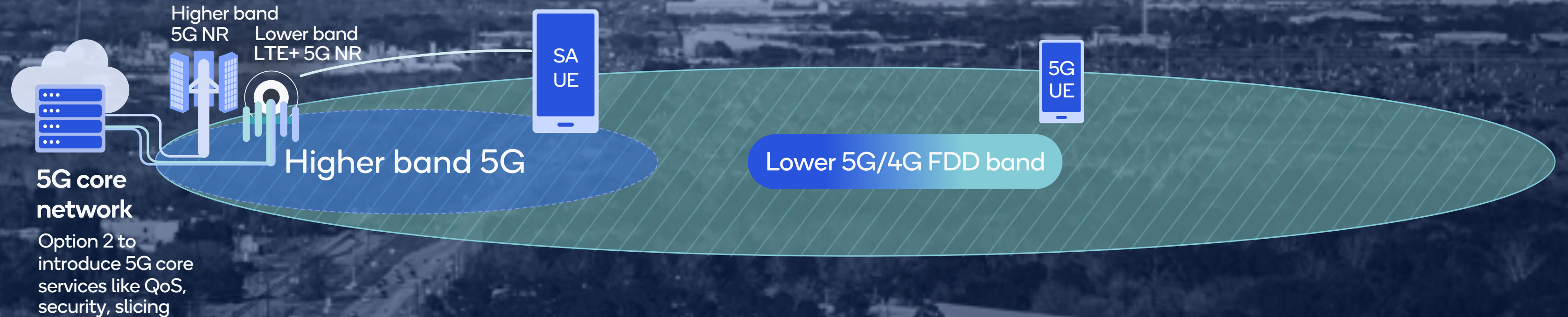
## Expand 5G coverage

- Dynamic Spectrum Sharing (DSS)
- 5G FDD in low bands



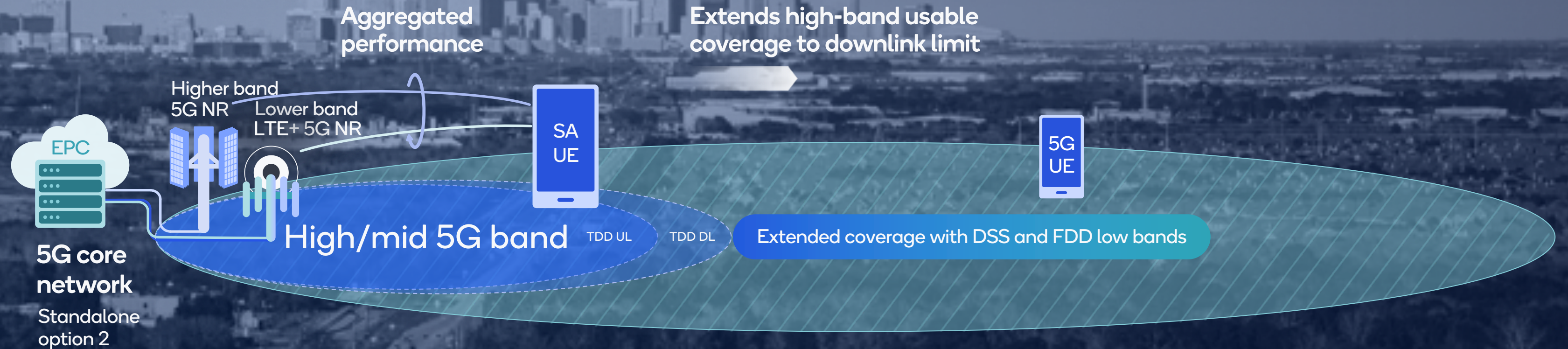


# Direct migration to standalone core network with DSS





# Increasing 5G performance with carrier aggregation





# DSS live demo

ERICSSON 

verizon<sup>✓</sup>

Qualcomm

# Global deployments will require full set of 5G features







**5G network**



**Artificial intelligence**



**Edge cloud**

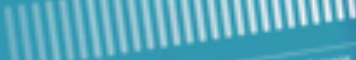


# The age of intelligent cloud connectivity

## 5G + AI + Edge cloud

### 5G Connection

100% Connection Strength



Smart Watch Accessing 5G

5G Smartphone streaming video

### Vehicle Summary

87% Battery Life

23 Miles to Next Charge

### Cloud Connection

Connection Strength

8.5

Transfer Speed

2.3 Gbps



19.5% Improvement in data transfer speed

10 Vacancies

Hotel private network

Autonomous Vehicle

Autonomous Vehicle

Autonomous Vehicle

Autonomous Vehicle

Autonomous Vehicle

Driver Parking Assistance Sensors



# Driving distributed intelligence

Public network



5G



Private networks

On-device



Edge cloud



Cloud



Bringing the cloud closer  
to devices at the edge

Public network



5G

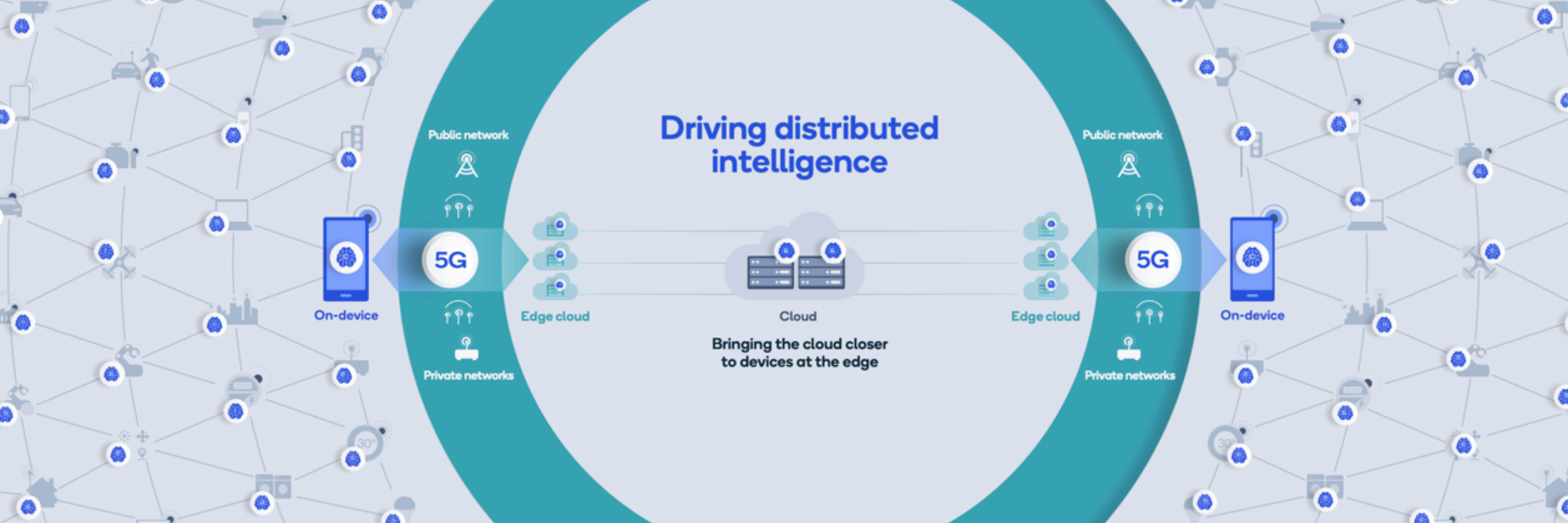
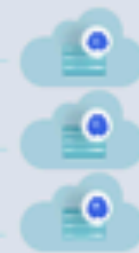


Private networks

On-device



Edge cloud



Local network analytics

Low-latency interactive content

Boundless XR

On-demand computing

Industrial automation and control

Enterprise data



# Edge cloud + On-device AI

Voice activation

Text recognition

Face detection

Voice recognition

Computational photography

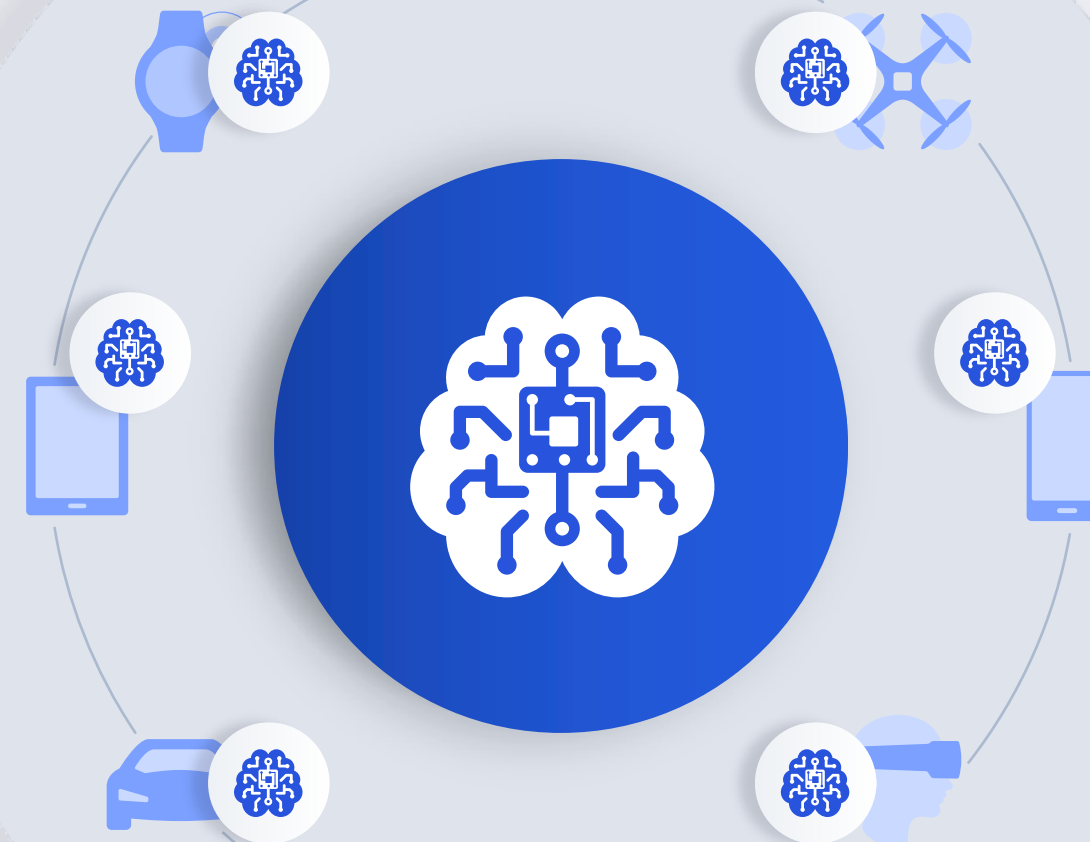
Object classification

Fingerprint

On-device security

Gesture/  
hand tracking

Contextual awareness





# The edge is gaining momentum



“The 5G world will integrate big data, data analytics, A.I., and the [IoT], creating demand for a mobile cloud computing environment that is all interconnected.”

**Zhang Xia**

Principal Enterprise Strategic Evangelist,  
AWS



“ [With 5G], cloud-based applications can now be decoupled from the console. This allows these game providers to go mobile and nomadic and not be tethered to a console anymore.”

**Ron Malenfant**

Lead Global Systems Architect 5G,  
Cisco



“ In a 5G world, new services and applications will not be driven by massively scaled, centralized data centers, but by intelligently distributed systems built at the network edge.”

**Kevin Shatzkamer**

VP and GM, Service Provider Solutions,  
Dell EMC



“ ...the power of IBM Cloud, 5G, AI and edge computing [will] enable our clients to leverage these advanced technologies to have greater impact on the way people work, shop and protect their health and families.”

**Martin Schroeter**

Senior Vice President of Global Markets,  
IBM



“ ... when we infuse data, artificial intelligence, and mixed reality into the cloud and power it with 5G, what you get is an intelligent cloud, and an intelligent edge, which presents tremendous potential for the industry to come together to nurture a local ecosystem to help transform enterprises.”

**Kevin Wo**

Managing Director, Microsoft Singapore



“ To us, 5G represents both a technical inflection point, as well to some extent a fortuitous coming together of things that leads to a new opportunity landscape for telecom operators globally. You now have the ability to connect the dots between private, public, telco, and edge [clouds].”

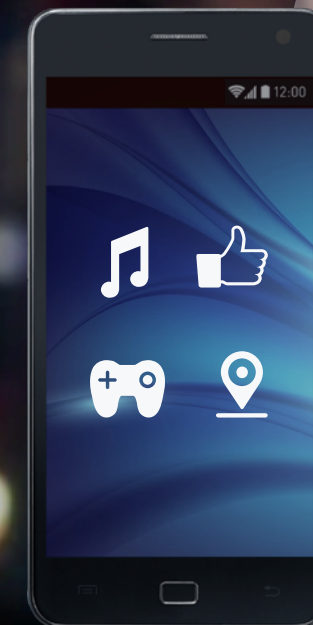
**Shekar Ayyar**

EVP and GM of Telco and Edge Cloud,  
VMware

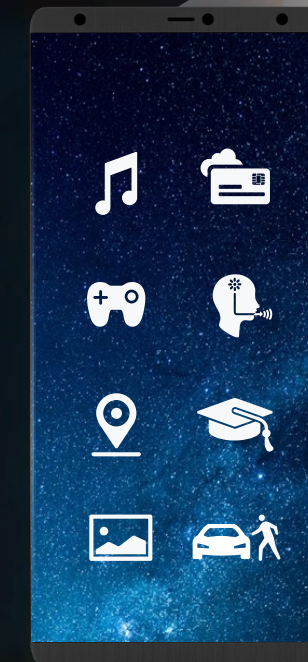


# 5G elevates the role of cloud services

Powerful app  
platforms



4G Smartphone

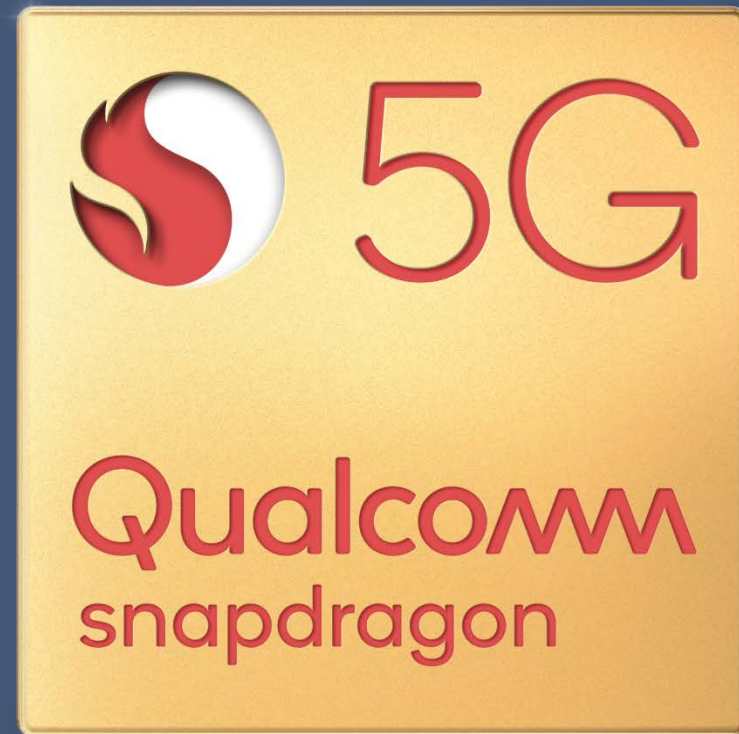


5G Smartphone



Always connected  
Virtually unlimited storage  
On-demand computing





# Qualcomm<sup>®</sup> Snapdragon<sup>™</sup> is **the** platform for 5G

Powering trials, commercial deployments in 2019 and beyond

The device ecosystem is  
delivering 5G

Qualcomm  
snapdragon



230+

5G devices launched or in  
development

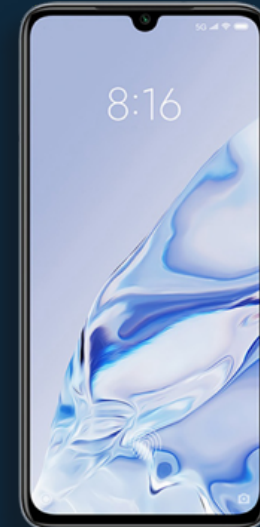
Smart car



Inseego  
MiFi 5G NR



Xiaomi  
Mi 9



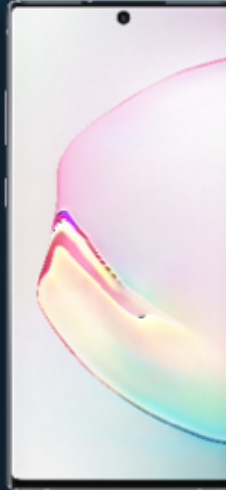
Samsung  
Galaxy S10 5G



WNC  
5G Outdoor  
CPE



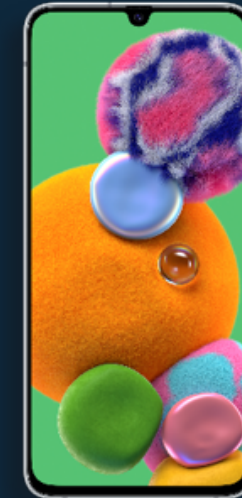
Samsung  
Galaxy Note10+  
5G



Vivo  
iQOO 5G Edition



Samsung  
A90 5G



Motorola  
moto z4/z3 +  
5G moto mod



ZTE  
Axon 10 Pro 5G



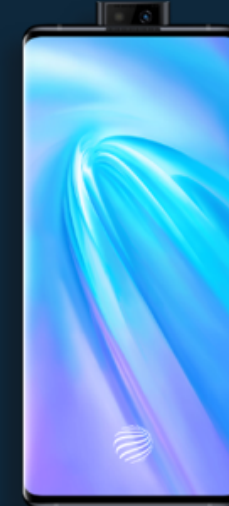
Nokia  
FastMile 5G CPE



OPPO  
Reno 5G



FRITZ!box  
6850 5G CPE



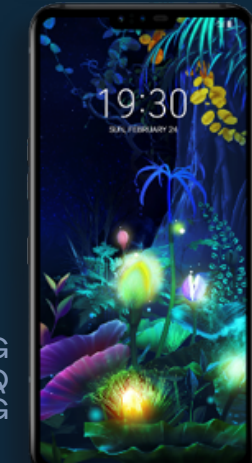
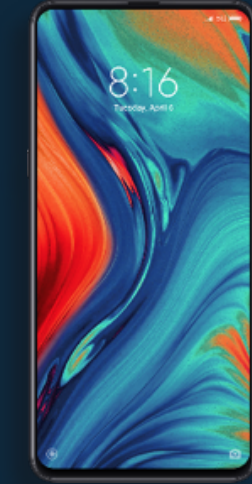
Vivo  
NEX 3 5G

Nubia  
Mini 5G

LG  
V50 ThinQ  
5G



Xiaomi  
Mi MIX 5G



Rexroth  
AGV

Lenovo  
Z6 Pro 5G



HTC  
5G Hub



OnePlus  
7 Pro 5G



Samsung  
Galaxy Fold



5G Always  
Connected PC



A graphic consisting of three concentric circles. The innermost circle is a vibrant blue and contains the text '5G' in white. The middle circle is a lighter shade of blue, and the outermost circle is a very dark blue, matching the background.

5G

>1.4 billion

Cumulative 5G smartphone shipments by 2022





Qualcomm  
snapdragon

# Powering amazing experiences



Artificial  
intelligence



Stunning photos  
and videos



Intelligent  
architectures



Immersive  
entertainment



Augmented  
reality



Virtual  
presence



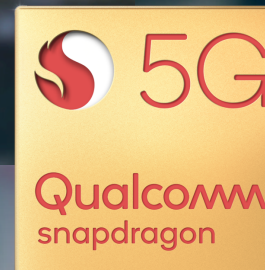
Streaming  
video



Cloud  
gaming



Our daily



experiences





Brought



together



VR player  
Johnny  
Tallin, Estonia



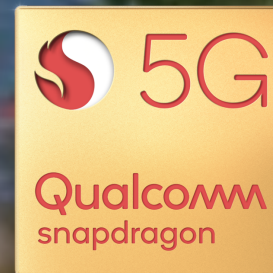
AR player  
Lindsay  
Toronto, Canada



AR player  
Liz  
Perth, Australia



And made

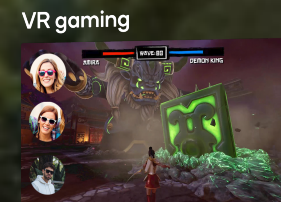


extraordinary



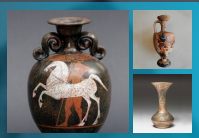
New character  
found!  
Leveling up

- ☐ Life belt
  - ☐ Blow darts
  - ☒ Invisible arrows
  - ☐ Electric lasso
  - ☐ Sight stones
  - ☒ Ivory bow
  - ☒ Dragon gloves
  - ☒ Lava boots
- Stride 42  
Strength 28  
Magic 39  
Accuracy 64





Wine Amphoras



Boundless XR



Roman soldier

Roman Colosseum  
Construction started: 70 AD  
The Colosseum or Coliseum, also known as the Flavian Amphitheatre, is an oval amphitheatre in the centre of the city of Rome, Italy.

**Pérez**  
Granollers, Spain  
Right wing  
PKs 2019 7 (95%)

View 1



View 2



View 3



View 4

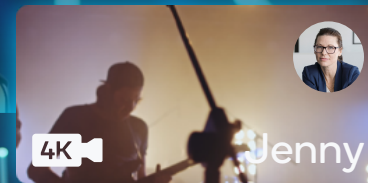


High-density  
venue connectivity



360°

4K multi-view  
streaming and sharing



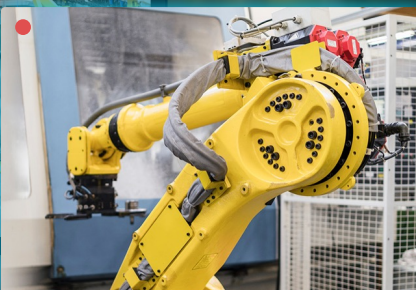
XR guided execution



Dynamic factory  
reconfiguration



4K  
4K video  
surveillance



Precision  
positioning

Industrial

Virtual conferencing



5G  
enterprise



Leader board

#1 Soma Abe: New York, USA

#2 Liu Wei: Nantes, France

#3 Zhi Ruo: Olinda, Brazil

#4 Harvey Brown: Surrey, London

Desktop-quality  
multi-player gaming





# 5G mmWave brings new levels of indoor wireless performance

Average data rates of

# 1.6 Gbps

and near-ubiquitous coverage in  
stadium setting with 13 mmWave radios

**Williams**  
Running Back  
Yds 2019 (307)

View 1

View 2

View 3

View 4

360°



# Accelerating the future of live entertainment







Qualcomm

#SnapdragonSummit


# Penny Baldwin

Senior Vice President and Chief Marketing Officer  
Qualcomm Technologies, Inc.







A portrait of DJ Steve Aoki. He has long dark hair and a beard, wearing a blue and red jacket. He is in a DJ booth with pink and blue lights in the background.

DJ, producer, entrepreneur

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STEVE AOKI

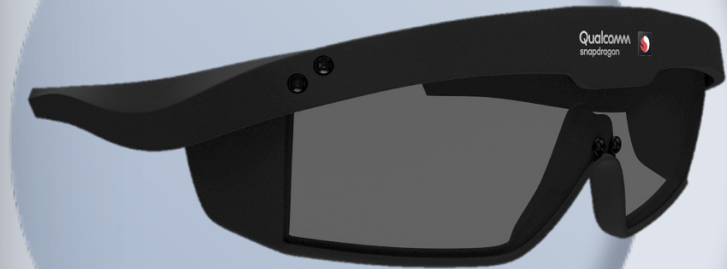
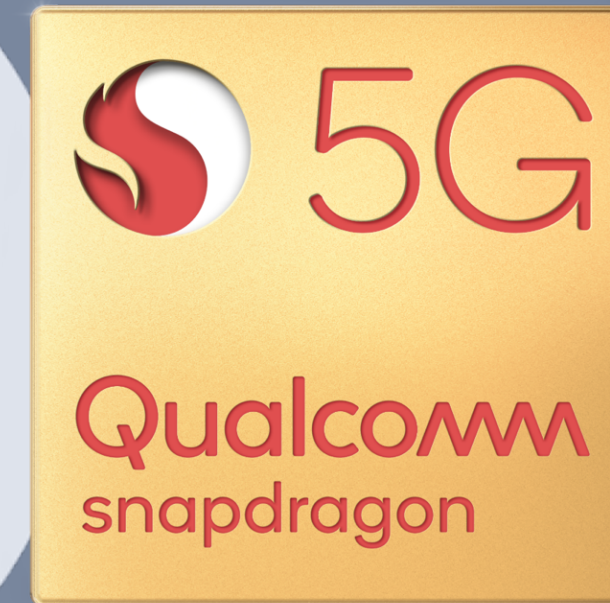
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# Extending beyond the smartphone







# Thank you

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