

Qualcomm
snapdragon



Qualcomm® Snapdragon™ Tech Summit 2018

#SnapdragonSummit

Qualcomm

December 4, 2018

Maui, Hawaii

@cristianoamon

Building the 5G future

Cristiano Amon
President, Qualcomm Incorporated



A new technology phase has begun

Virtually everything becoming connected and intelligent





5G will be bigger than 3G and 4G

The foundation for what's next

5G



Hotel

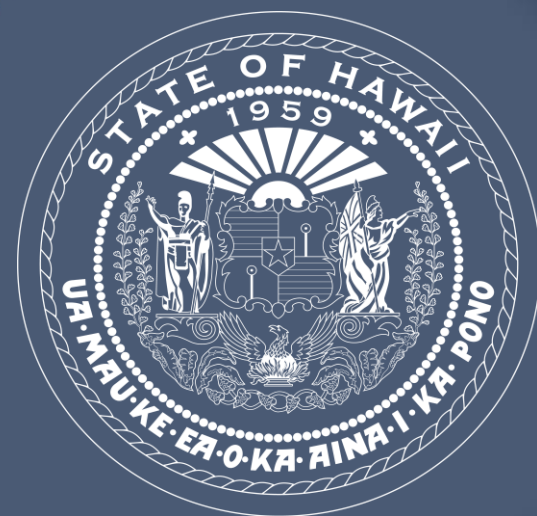
Ratings 4.5

Rooms

Occupancy (%)

Map

Tour



David Ige

Governor of Hawaii

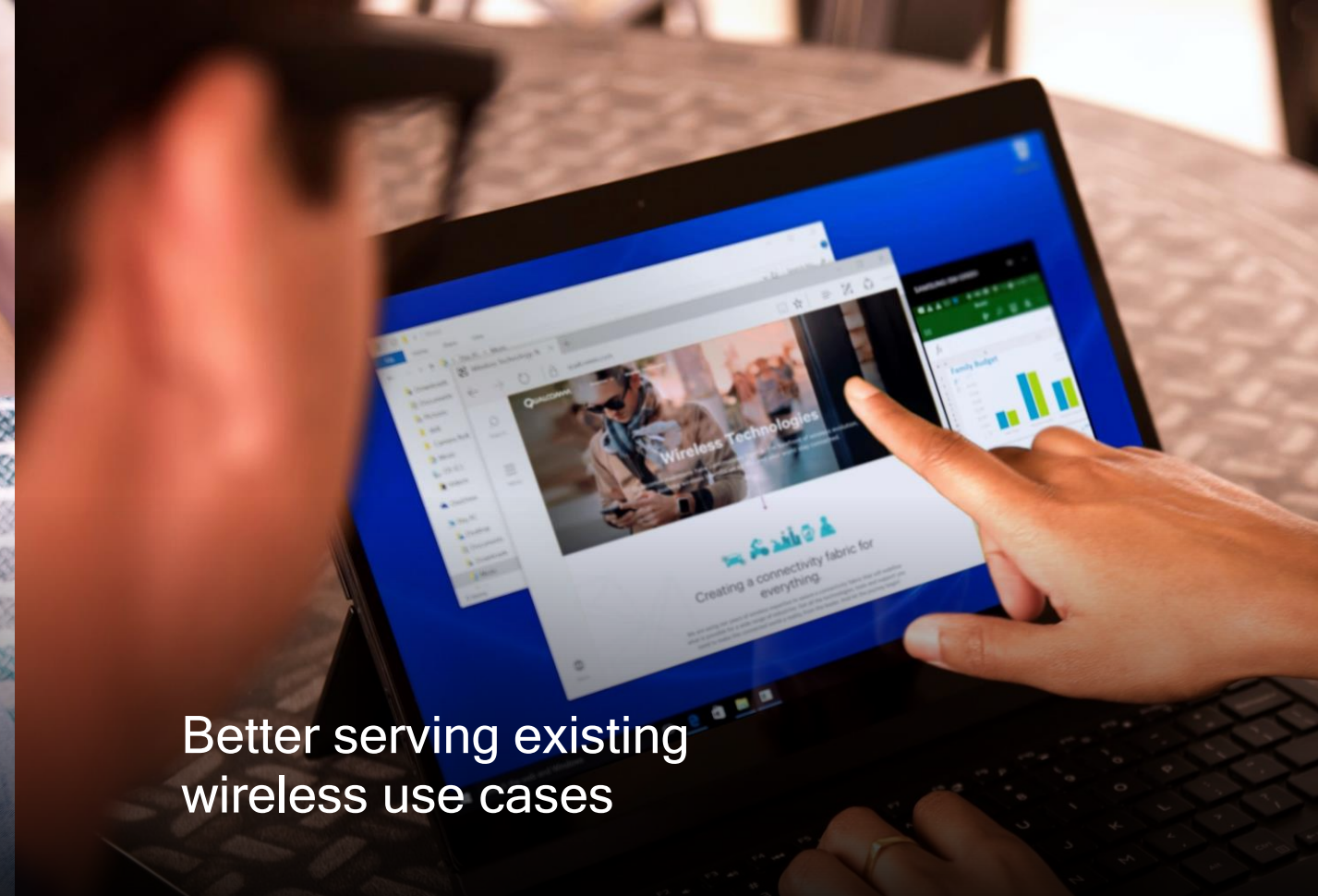
[Facebook.com/GovernorDavidIge](https://www.facebook.com/GovernorDavidIge)

[Twitter.com/GovHawaii](https://twitter.com/GovHawaii)

[Instagram.com/GovHawaii](https://www.instagram.com/GovHawaii)



Vastly improving cellular
user experiences



Better serving existing
wireless use cases



Creating new wireless
service opportunities

Ushering in a new era of wireless communications

5G will power new capabilities, services and experiences



Smart cities



Energy



Manufacturing



Industrial



Computing



Automotive



Retail



Media and entertainment



5G

is here

5G is here

Qualcomm® 5G NR reference design

Qualcomm 5G NR reference design is offered by Qualcomm Technologies, Inc. and/or its subsidiaries.



5G will be a reality across regions starting in 2019



North America
Sub-6 and mmWave

Europe
Sub-6 and mmWave
(mmW in 2H19)

China
Sub-6

Japan
Sub-6 and mmWave

South Korea
Sub-6 and mmWave
(mmW in 2H19)

Australia/SEA
Sub-6

See Appendix

AT&T

“We plan to bring mobile 5G to 12 cities this year, reaching at least 19 cities in early 2019.”

Sprint

“In the first half of 2019 we plan to launch mobile 5G in nine markets...”

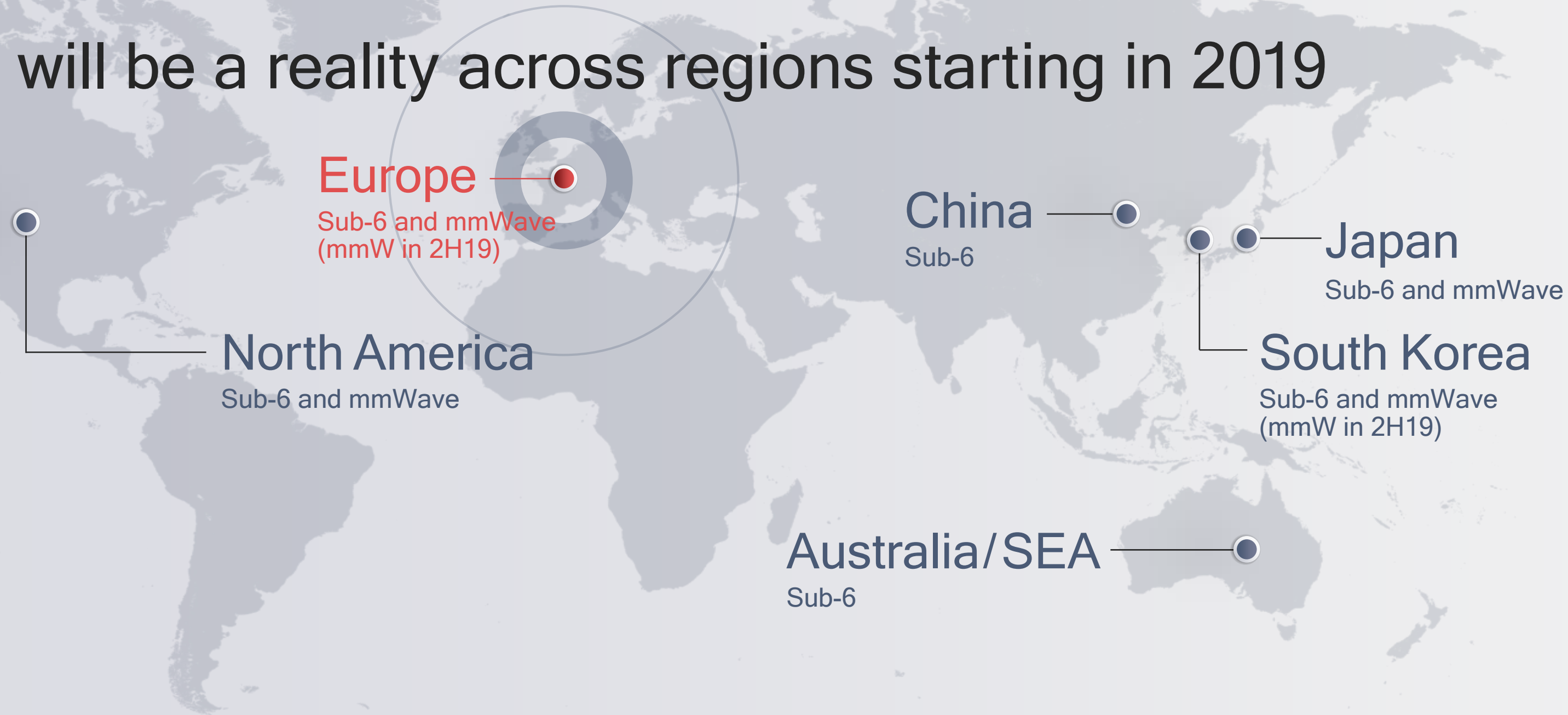
T-Mobile

“T-Mobile is building out 5G in six of the Top 10 markets... and 100’s of cities across the U.S. in 2018.”

Verizon

“Verizon 5G mobility service will go live in early 2019 and expand rapidly.”

5G will be a reality across regions starting in 2019



See Appendix

Deutsche Telekom

“We’re continuing on our strong preparation course for the rollout of 5G in 2020.”

EE

“We’re launching 5G in 16 UK cities in 2019... And that’s just the start.”

Swisscom

“We plan to bring 5G to 60 towns by the end of 2019.”

Vodafone

“In 2019 we will be ready for launch across [60 5G sites] by the middle of the year... By 2020 we will scale well past 1,000 sites...”

5G will be a reality across regions starting in 2019



See Appendix

China Mobile

“With the goal of 5G pre-commercialization by 2019 and official commercialization by 2020, we are fully promoting 5G commercialization...”

China Telecom

“We will build 5G demonstration projects and conduct scale trials of 5G applications in 17 cities... launching commercial 5G services in 2020.”

China Unicom

“We are... conducting 5G application demonstrations and pre-commercialization in 2019, and plan to officially launch 5G by 2020”

5G will be a reality across regions starting in 2019



See Appendix

Korea Telecom

“[December 1] 5G frequency transmission means 5G is on stage. KT will build up nationwide 5G network coverage and provide high-quality 5G service...”

LG U+

“5G service begins here [December 1] and it will be the Company’s growth engine the next 10 years.”

SK Telecom

“At midnight [on December 1], the 5G network switch was turned on and marked the beginning of the new ICT era.”

5G will be a reality across regions starting in 2019



See Appendix

KDDI

“KDDI will continue our collaboration with various business partners and prepare for commercial 5G service launch in 2020.”

NTT DoCoMo

“In September [2019], we will start [5G] precommercial service, and in the spring of 2020, the commercial launch will be scheduled.”

Optus (Singtel)

“...Optus is confident in its ability to deliver commercial 5G services in January 2019”

Telstra

“...[we] have been investing in our network to lay the groundwork for 5G. We expect to be offering 5G services in 2019.”

Inventing technologies that fuel innovation

Transforming how the world connects, computes and communicates



Ultra reliable, low-latency wireless connection



Dynamic factory reconfigurability

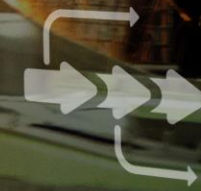


Weld strength

98.2%



5G NR
Private network



Real-time supply chain and progress updates

Completion



Serial: AZ71238109379ZD12H

Model: AH213

Shipping to: Detroit, MI

Key milestones to commercialize 5G NR

1990+
Foundational research
on mmWave, MIMO,
advanced RF, more

Qualcomm

Nov 2015
5G mmWave
design demo

2016

Feb 2016
Qualcomm
snapdragon
X16 LTE modem

Jun 2016
Qualcomm
snapdragon
X50 5G modem

Oct 2016
5G NR sub-6
prototype system



Feb 2017
Small group
proposes 5G NR
timeline acceleration

First 5G NR
connection

2017

Sep 2017
5G NR mmWave
prototype



Oct 2017
5G NR
smartphone
reference design

5G data
connection

Nov 2017
5G NR IoT with
ZTE, China Mobile

Dec 2017
5G NR standard
completed

5G NR mmWave
connection with
Ericsson

Key milestones to commercialize 5G NR

2018

Feb 2018

5G NR IoT with
multiple infra vendors

Network simulations
show significant UX,
capacity gains



Jun 2018

5G NR standalone (SA)
mode specification

5G NR interoperability
testing with Datang



Jul 2018

5G NR RF
module for
mobile devices



Sep 2018

5G NR mmWave
OTA call with mobile
form factor device

Oct 2018

5G NR sub-6 OTA
call with mobile
form factor device



Aug 2018

Moto Z3 smartphone -
world's first announced 5G
NR upgradable device and
5G moto mod

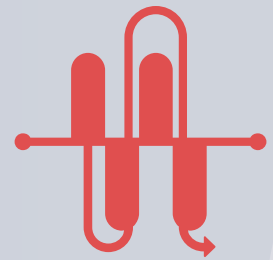
5G

Meeting the 5G network challenge

5G

A high-angle, low-look-up shot of a telecommunications technician working on a 5G antenna array. The technician is wearing a bright red hooded jacket, a white safety helmet, and black gloves. They are positioned on a metal structure, likely a tower or rooftop, and are focused on adjusting or connecting components of the antenna. The antenna itself is a large, white, rectangular unit with multiple ventilation grilles. In the background, a dense forest of green trees is visible under bright, natural light. A semi-transparent white circle with the text '5G' is overlaid on the image, centered near the technician. The overall scene conveys the technical and physical challenges of deploying 5G networks.

Diverse
spectrum



Sub-6GHz
to mmWave

Licensed, shared
and unlicensed

FDD, TDD

Scalable,
flexible platform

Massive MIMO

mmWave
beamforming and
beam steering

Advanced wireless
technologies



5G network diversity

Driving tremendous complexity



Robust
compatibility

Band
combinations

Gigabit LTE

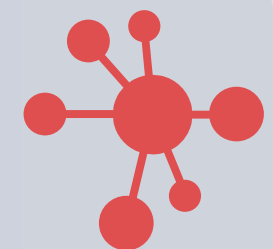
Multi-connectivity

Broad ecosystem

Private networks

Wide area
to small cells

NSA, SA



Diverse
deployments

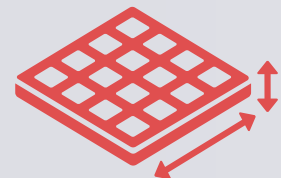




Meeting the 5G smartphone challenge



Link
budget



Stringent size
constraints



Mobility

5G



Power
consumption



Thermal
performance



RF

5G smartphone

Design complexity increasing exponentially

Uniquely positioned to
make 5G smartphones
a commercial reality



2015

They said,

“mmWave
won’t work.”



We showed them:

mmWave with beam
steering

Feb 2017

They said,

“mmWave needs
line-of-sight.”



We showed them:

Non-line-of-sight
van mobility

Oct 2017

They said,

“Mobility mmWave
is not possible.”



We showed them:

mmWave smartphone reference
design and antenna modules

Sep 2018

They said,

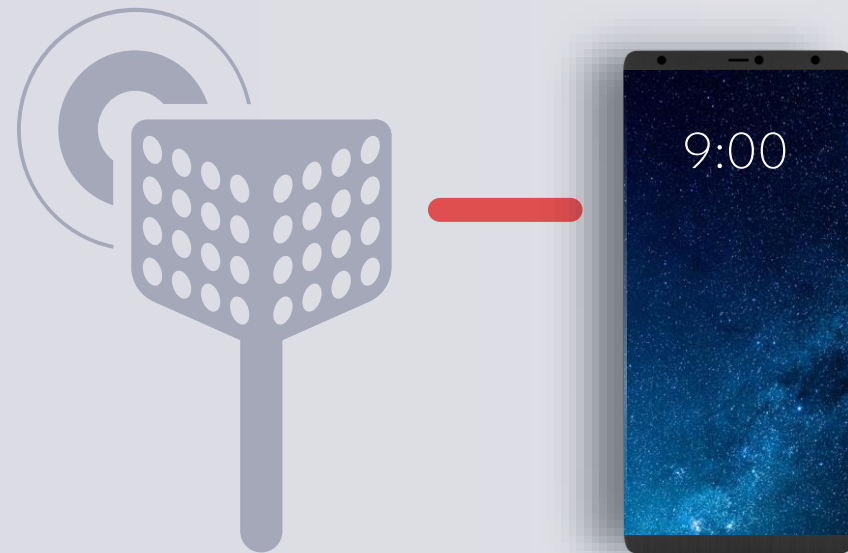
“The device
looks too big”



We showed them:

Mobile form-factor
test platform

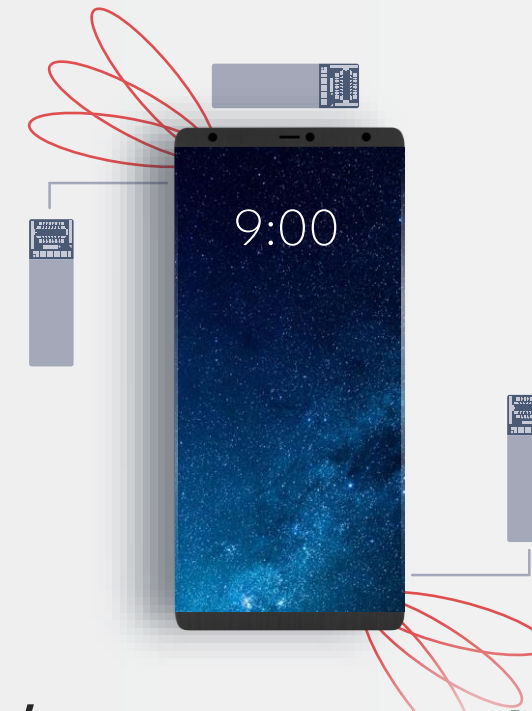
Making the impossible, inevitable



Path loss
With analog beamforming



Blockage
With adaptive beam steering, switching

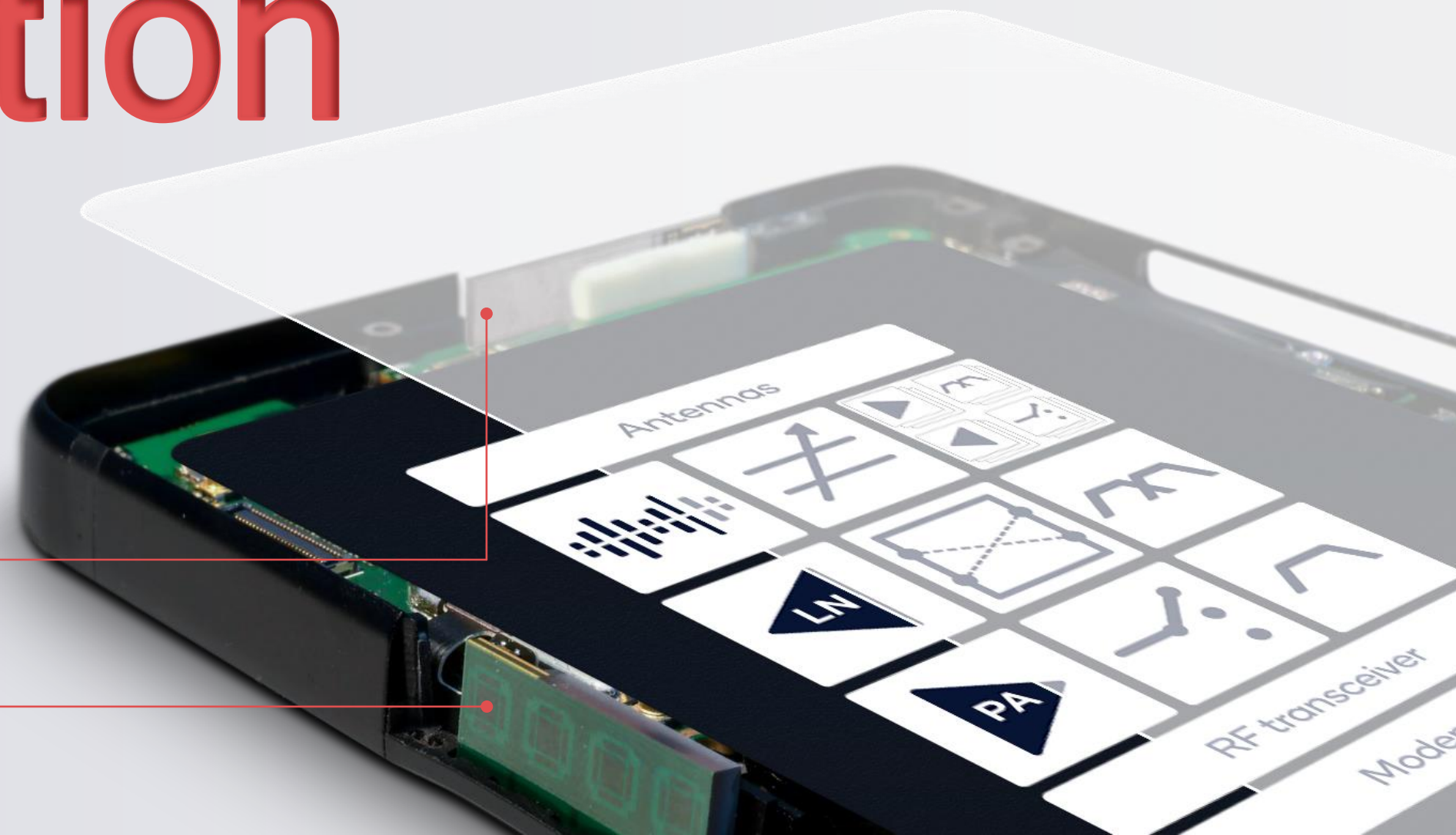
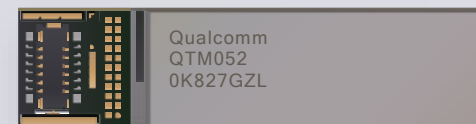


Size/power constraints
With different antenna configurations

Overcoming numerous challenges to mobilize mmWave

5G leadership requires RF innovation

End-to-end system capability, integration
needed to address 5G complexity



The only company
**With tunable
front end
for 4G/5G**

5G is here



Qualcomm
snapdragon
X50 5G modem

•
Snapdragon™ X50
5G modem family



•
Qualcomm®
QTM052 mmWave
antenna modules



•
Qualcomm®
5G NR Qualcomm®
reference design

Ongoing collaborations

With mobile operators on 5G commercial readiness



Continued collaborations

With OEMs on 5G devices

ASUS®

FUJITSU

Google

hmd.
The Home of Nokia Phones

htc

insee**go**

LG

motorola

NETGEAR

NetComm
WIRELESS

1+

oppo

SAMSUNG

SHARP

SIERRA
WIRELESS®

SONY

Telit

vivo

WINGTEC

WNC
Wistron NeWeb Corp.



ZTE中兴



Nicki Palmer

Chief Network Engineering Officer and
Head of Wireless Networks

Powering next-generation mobile experiences

Connectivity and intelligence everywhere

Immediate, rich social interactions

Wow! It's like I'm right there.



Enriching lives

By turning the ordinary into the extraordinary



Watching



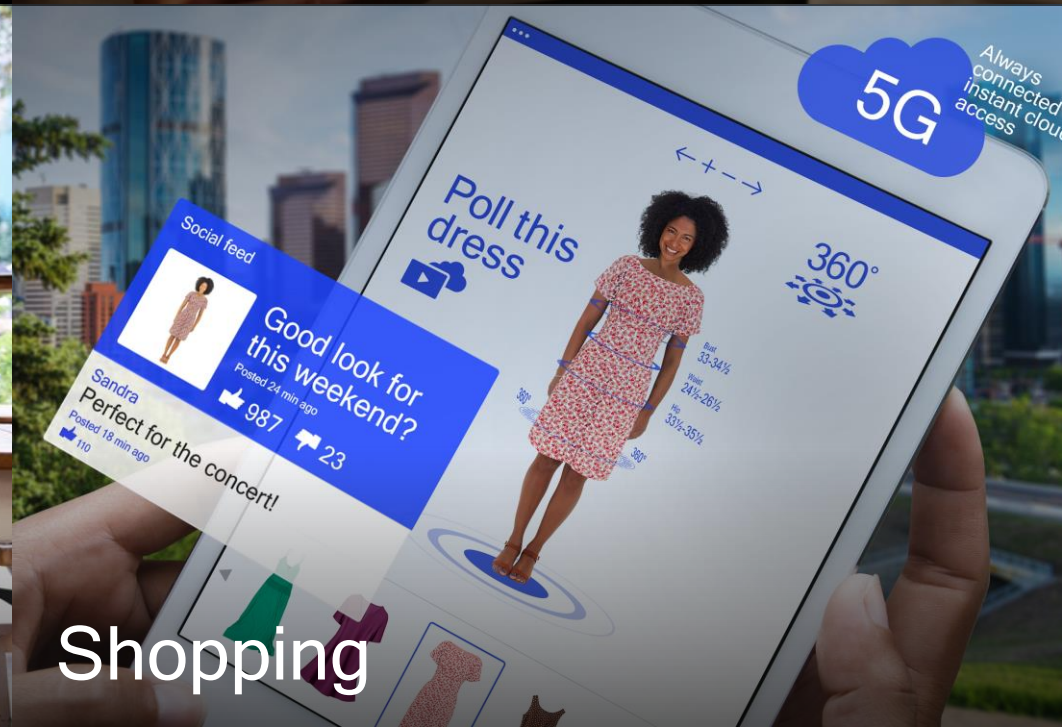
Socializing



Creating



Gaming



Shopping



Communicating

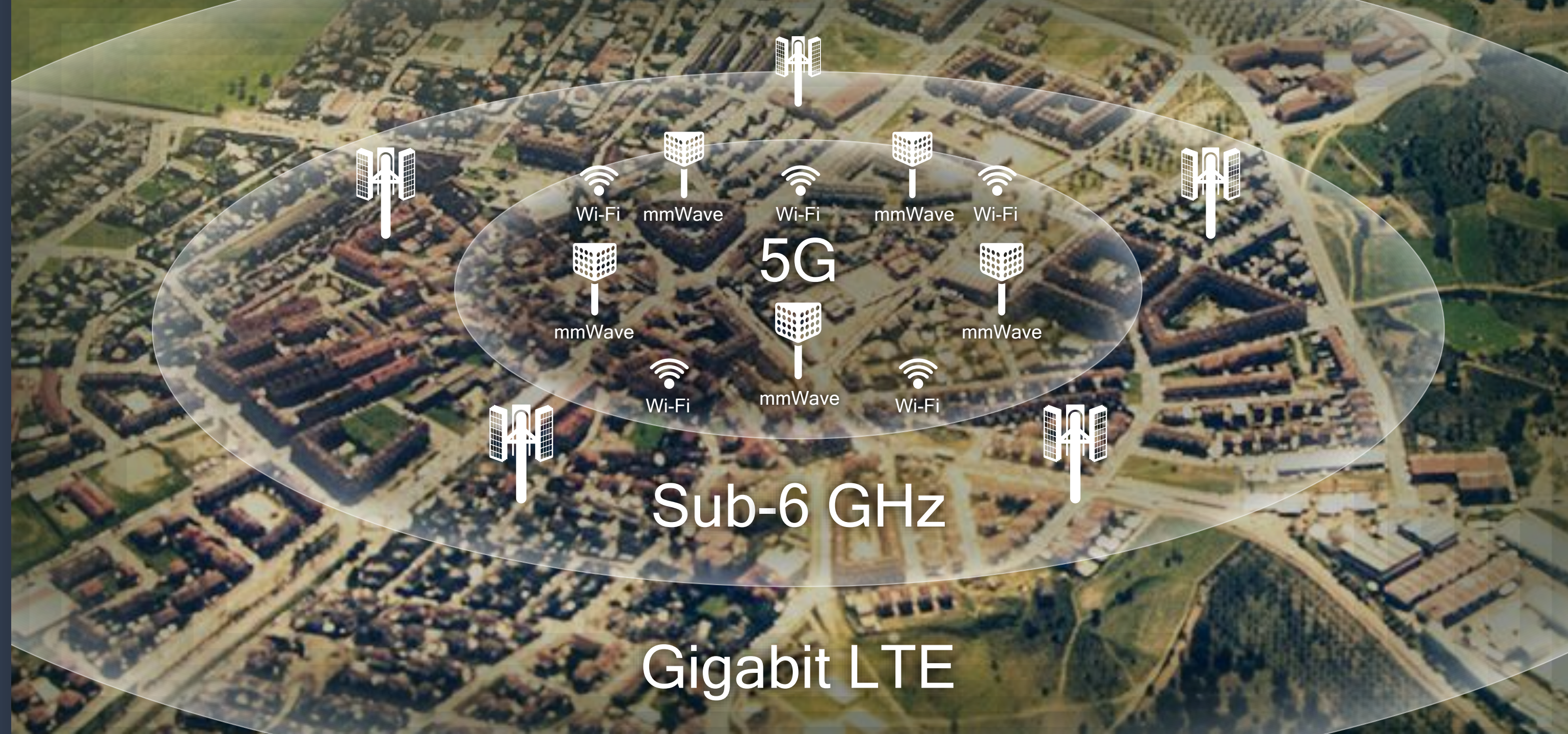


Kevin Petersen

SVP, Wireless Product Marketing

5G network architecture

Includes multiple technologies





Fotis Karonis

BT/ EE Group Executive Advisor for 5G

The smartphone
remains the
essential device



Qualcomm
snapdragon



Alex Katouzian

SVP and GM, Mobile,
Qualcomm Technologies, Inc.

A graphic consisting of three concentric circles. The innermost circle is dark blue and contains the word "SAMSUNG" in white. The middle circle is a lighter shade of blue, and the outermost circle is a very light blue. The circles are slightly offset from each other, creating a layered effect.

SAMSUNG

Justin Denison

SVP of Mobile Product Strategy and Marketing,
Samsung Electronics America



5G



5G

What we have now is
only the tip of the iceberg

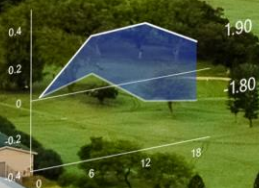


Qualcomm

Leading the world to 5G



Golf greens





Thank you

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Appendix

North America

AT&T

https://about.att.com/newsroom/2018/5g_evolution_market_update.html

Sprint

<http://investors.sprint.com/news-and-events/press-releases/press-release-details/2018/Sprints-Next-Gen-Network-Build-Gains-Momentum/default.aspx>

T-Mobile

<https://www.t-mobile.com/news/best-financials-ever-q3-2018>

Verizon

<https://www.verizon.com/about/news/verizon-and-samsung-release-5g-smartphone-us-first-half-2019>

Europe

Deutsche Telecom

<https://www.telekom.com/en/media/media-information/archive/5g-rollout-in-germany-523636>

EE

<https://twitter.com/EE/status/1062393714507743238>

Swisscom

<https://www.swisscom.ch/en/about/medien/news/60-towns-with-5G-by-end-of-2019.html>

Vodafone

<http://the-mobile-network.com/2018/09/vodafone-hails-5g-readiness-with-virtual-transformation/>

China

China Mobile

http://news.youth.cn/gn/201811/t20181109_11780783.htm

China Telecom

<http://www.c114.com.cn/news/117/a1065054.html>

China Unicom

<http://www.c114.com.cn/local/3884/a1062870.html>

Korea

Korea Telecom

<http://news.mk.co.kr/newsRead.php?year=2018&no=751452>

LG U+

<http://news.mk.co.kr/newsRead.php?year=2018&no=751446>

SK Telecom

<https://twitter.com/SKtelecom/status/1068688071355289602>

Australia/Sea/Japan

KDDI

<https://www.swisscom.ch/en/about/medien/news/60-towns-with-5G-by-end-of-2019.html>

NTT DoCoMo

<https://seekingalpha.com/article/4216778-ntt-docomos-dcmey-ceo-kazuhiro-yoshizawa-q2-2018-results-earnings-call-transcript?part=single>

Optus (Singtel)

<https://www.zdnet.com/article/optus-hits-back-at-telstra-5g-claims/>

Telstra

<https://www.afr.com/technology/web/telstra-to-offer-5g-in-2019-as-it-aims-to-cool-optus-marketing-push-20180204-h0ta7p>