5 Points to 5G

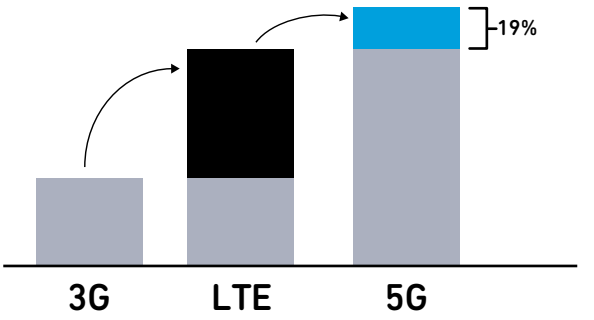
all around you

- Initial transition to 5G will only provide a modest data rate improvement
- Fragmentation in ultra-high bands will produce regional handsets
- First approaches to 5G implementation will differ and drive RF complexity
- 5G requires large increase in RF content
- Additional RF content will drive larger form factors

The Reality of 5G

We are currently witnessing a global rush to 5G. Nations, mobile operators and handset manufacturers are all vying to be first in delivering the next generation of cellular connectivity - or at least get in the game early.

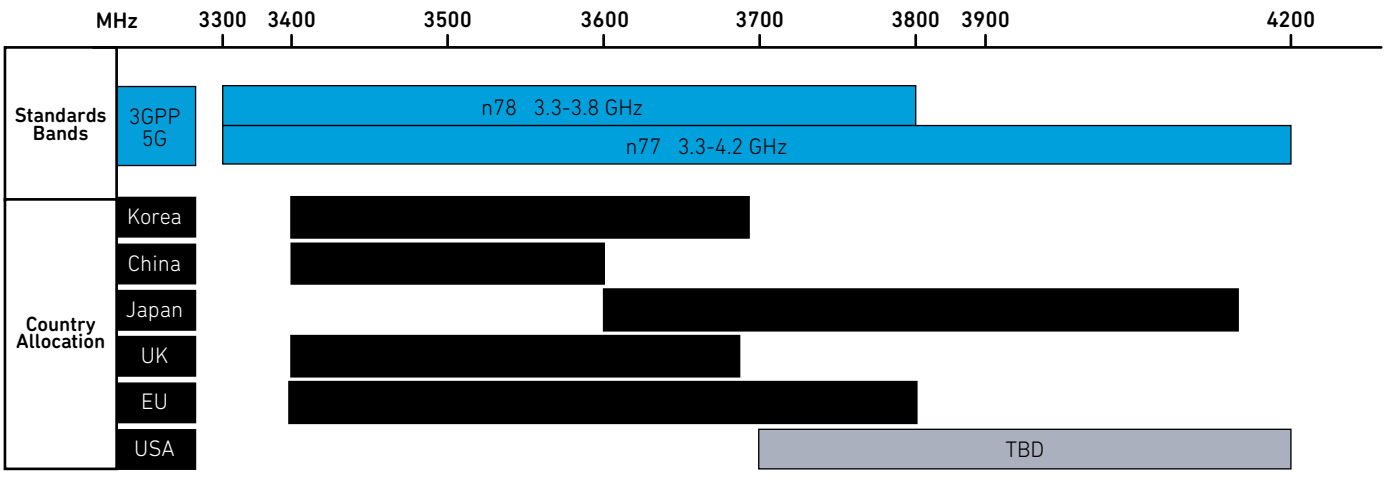
Standards Driven Downlink Data Rates

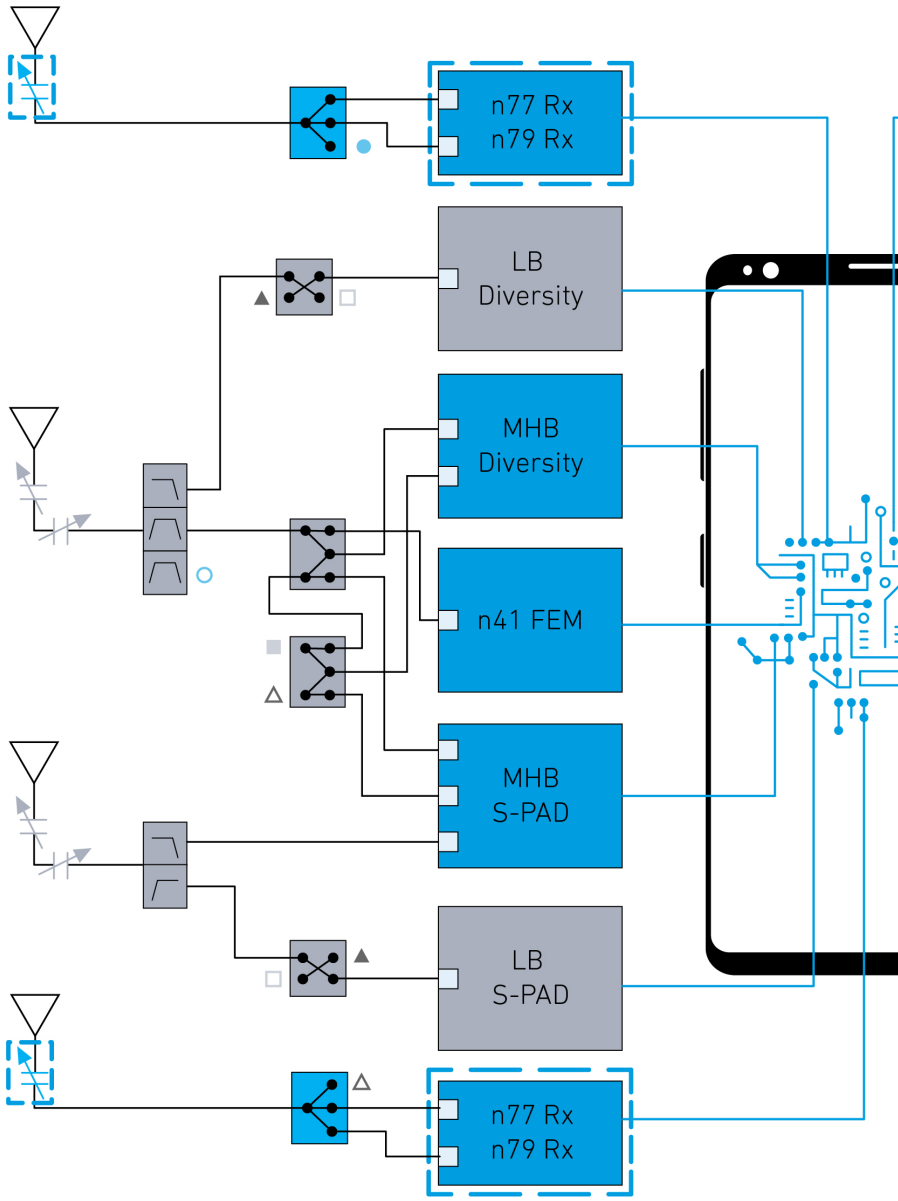


Worldwide, there are robust plans for rapid 5G deployment, especially in regions where wide bandwidth provided by new 5G bands are able to produce significantly higher data rates for consumers. Indeed, it is this access to new radio (NR) bands, along with the re-farming of existing LTE bands, that creates the greatest impact on data rates. Unlike the transition from 3G to LTE, the change in underlying 5G specifications provides only a modest data rate improvement. This may help to explain why, to facilitate fruitful 5G deployment, countries are rapidly allocating new spectrum in both of the new designated ranges: sub-6 GHz frequencies (FR1) and millimeter wave (mmW) frequencies above 24 GHz (FR2). South Korea, Britain, Italy and Spain, among others, have raised billions of dollars in spectrum auctions during 2018, and the U.S., China, Japan and Australia are expected to hold auctions and allocations in 2019. Operators in many countries, including the U.S., plan to start rolling out 5G services in 2019. Several major handset makers have already said they will produce 5G phones that support those services. Overall, these initiatives are driving toward widespread 5G coverage in developed countries by 2021.

But the global drive to 5G doesn't mean that we will see the emergence of global 5G handsets. In contrast to the situation with LTE, it may not be feasible or cost-effective to build global 5G handsets that support roaming across 5G networks worldwide. Instead, 5G will likely drive the handset market in the opposite direction - toward greater regionalization.

New 5G Bands





The RF Challenges of 5G

5G Drives Large Increases in RF Content

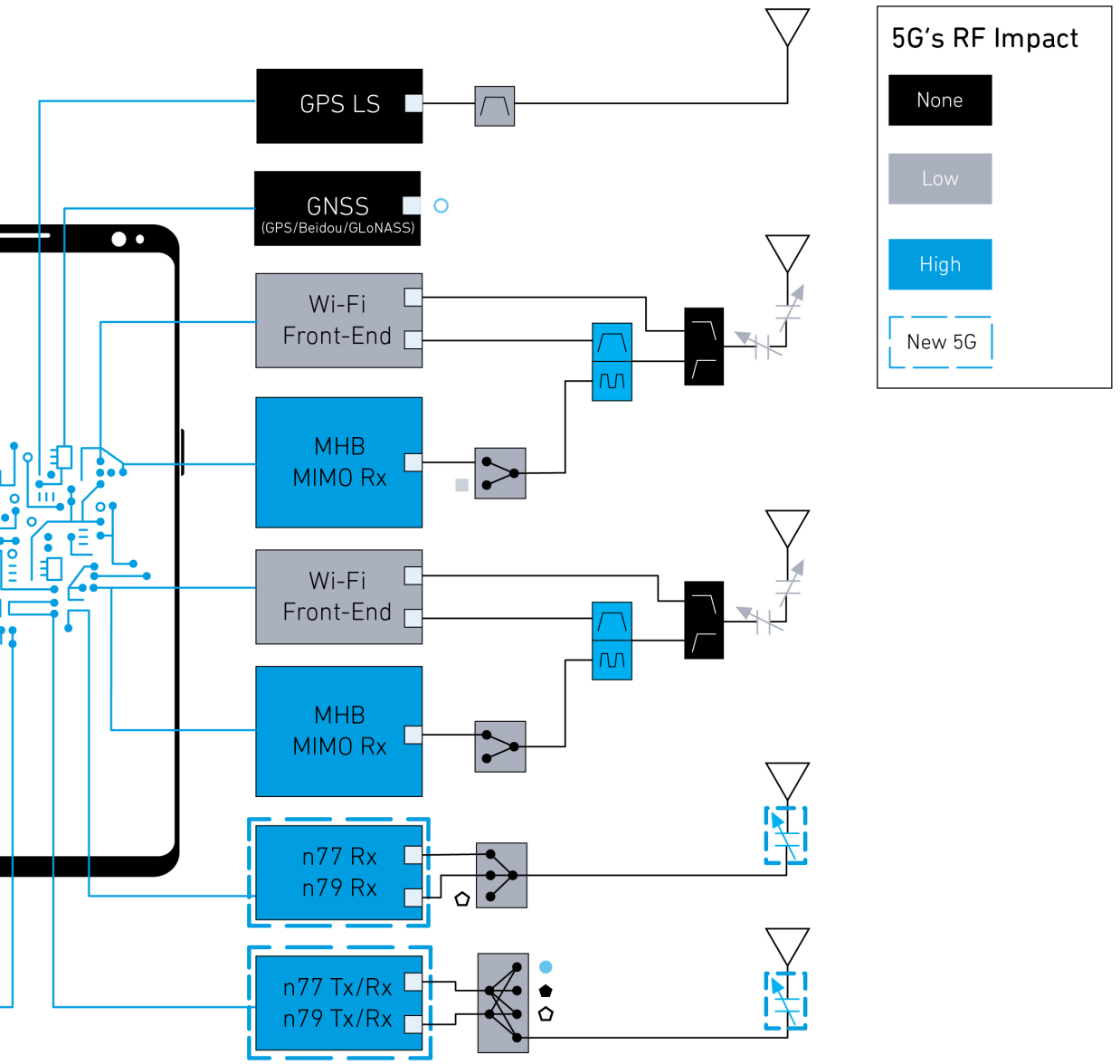
Will consumers be prepared to pay for a global 5G phone?

Global 5G roaming will come with higher costs and other tradeoffs. In order to provide coverage, especially when taking into account ultra-high band fragmentation across regions, there will be an increase in RF content. Even the addition of a single 5G band will result in a modest increase.

5G: Not As Global As It Seems

Fragmentation is occuring in new "global" ultra-high bands: n77, n78 and n79.

The differences in regional allocations will have a large impact on handset manufacturers, who must figure out how to support multiple potentially conflicting desires. Operators generally want handsets that are optimized for the subset of a band used in their region, however, handset manufacturers wanting to sell global devices, or at least regional, want to support the different bandwidths and carrier aggregation (CA) combinations used in their target markets. So, what happens when an operator, or even a group of operators among whom roaming will occur, has decided to deploy a narrower subset of the allocated band?



Initial 5G Implementation Will Be Varied

Non-standalone (NSA) va. Standalone (SA).

Intial approaches to 5G will vary by region, which increases the likelihood for challenging interations. Although NSA helps operators deliver 5G speeds more quickly, it also introduces considerable RF complexity because it requires dual 4G LTE and 5G connectivity. For some 5G bands, the global picture is even more complex due to the need to support SA as well as NSA operation. Of course, if and when all regions move to SA, many of these problems will become much simpler. That's not likely to happen soon, however; 5G will be around for a decade or more before SA becomes the predominant implementation across the globe. In the race to global 5G deployment we have accepted that there will a long period of NSA-driven complexity, especially in RF implementations

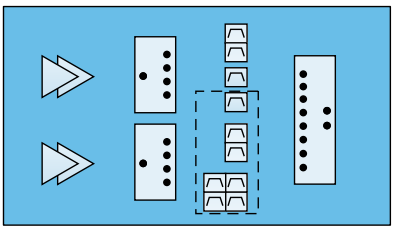
.

New 5G Content: Where Will It Go?

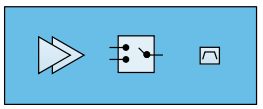
Additonal RF content needs more space, which would be difficult to fit in today's standard-sized form factors. To accommodate, 5G phones may have to be plus-sized.

Qorvo's 5G Portfolio

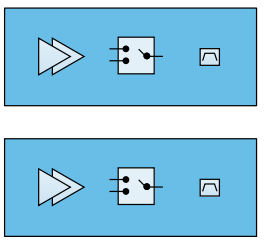
The coming 5G connected world is sure to bring on some of the toughest RF challenges the industry has faced. Qorvo is prepared to take on these complexities and is crafting a product portfolio that brings 5G mobile devices to life.

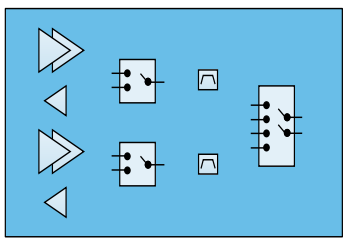


MHB P/N	CA 25/66/30	CA 1+3	CA 39+41	CA 3+41	CA 3+40	CA 3+7	CA 1+3+7	CA 1+3+32	NR
QM78052	✓	✓	✓	✓	✓	✓	✓	✓	n41, n3
QM77138	A	✓	✓	✓	✓	✓	✓	✓	n41, n3
QM77038	A	✓	✓	✓ (120 MHz)	✓	✓	✓	✓	n41, n3
QM77040	A	✓	✓	S	X	S	S	A	n41, n3



n41 FEM P/N	n41	B42	B43	B48	HPUE	LNA	SRS	BiDIR CPLR	APT	ET
QM75041	✓	✓	✓	✓	✓	X	X	✓	✓	✓





n77/n79 P/N	n77	n78	n79	HPUE	LNA	SRS	BiDIR CPLR	APT	ET
QM75077	✓	✓	X	✓	X	A	✓	✓	✓
QM75079	X	X	✓	✓	X	A	✓	✓	✓
QM78202	✓	✓	✓	✓	X	A	✓	✓	✓
QM78203	✓	✓	✓	✓	✓	✓	✓	✓	✓

✓ = Optimized for Best Performance
S = Supported
A = Requires External Components
X = Not Supported