5G Device Segments Drive Strategies

By Boris Petrov, 04.30.19 -- EETimes
https://www.eetimes.com/author.asp?section_id=36&doc_id=1334625

The 5G smartphone market should be analyzed by its three distinctly different segments, says a veteran semiconductor analyst.

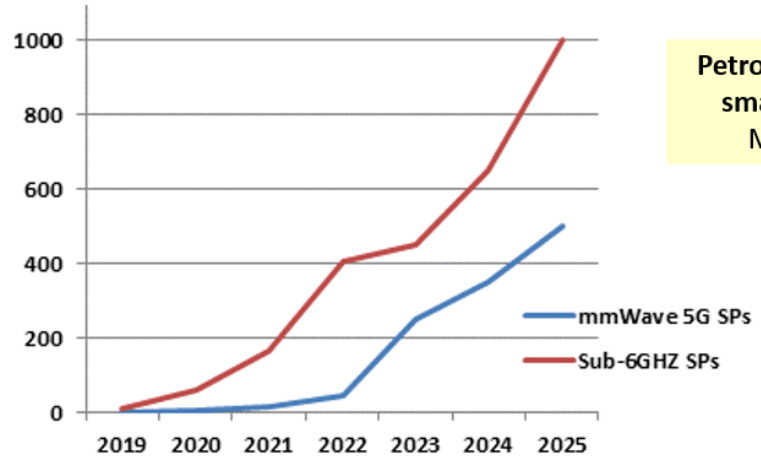
About a dozen market research forecasts predict the number of 5G smartphones will range between half and one billion units by 2023, rising faster than the adoption rate of 4G LTE smartphones. However, 5G devices are best seen segmented into three main segments.

In the next three-to-five years, the main segment will be for sub-6 GHz handsets, representing an evolution of the 4G telecom standard. Early high volumes will be in the new 3.5-4.5 GHz frequency range.

Sub-6GHz 5G technology is critical since it adds a large frequency spectrum with wide bandwidth to the current heavily saturated 4G and 3G cellular bands, mainly concentrated below the 2.1-GHz frequency. Interestingly, the current 4G technology will continue to evolve and complement sub-6GHz 5G for a variety of reasons I won't discuss here.

A second, more disruptive and revolutionary segment is in millimeter wave (mmwave) 5G, at present mostly at 28 and 39 GHz. The 5G mmwave capability in smartphones will be added on top of sub-6-GHz 5G. By the year 2025, only a third of 5G smartphones will likely have mmwave capability, giving components for the sub-6 segment a 3:1 edge.

Figure Two: 5G Smartphones (M)



Petrov Group model of 5G smartphones (M units)
March 2019 Model

Apple is expected to gradually introduce a mmWave 5G iPhone starting in 2021

Total SPs (M)	2019	2020	2021	2022	2023	2024	2025	21-25 CAGR	22-25 CAGR
mmWave 5G SPs	1	5	15	45	250	350	500	140%	123%
Sub-6GHZ SPs	12	59	166	407	450	650	1000	57%	35%
Total 5G SPs	13	64	181	452	700	1000	1500	70%	49%
4G (LTE) + LTE-ADV	1390	1441	1419	1274	1116	940	500	-23%	-27%
3G	226	243	236	174	124	30			
2G	121	52	14						
Total SPs	1750	1800	1850	1900	1940	1970	2000	2%	2%

Handsets supporting mmwave bands will only make up a third of 5G smartphones by 2025. *Click to enlarge. (Source: Petrov Group)*

A separate 5G IoT segment addresses data transfer from a very large number of end devices at below gigahertz frequencies. The standards and protocols for 5G IoT are not defined yet, in part because initial optimistic expectations of cellular IoT in 4G have not been met despite big efforts, especially in China.

It's important to note that in the next few years many smartphones will claim to have 5G capabilities that a network operator can enable with a simple software upgrade of its network. However, the sub-6-GHz and mmwave segments are distinct and significant for several reasons, including regional differences, potential for supply chain disruption and for positioning of smartphone and infrastructure vendors.

In the near term mmwave 5G is important primarily in the U.S. market, as well as in the much smaller Japan and South Korea markets. It is aggressively promoted by network operators who pushed for municipal installation permits for base stations in a less time consuming and less expensive manner.

Actual use cases for mmwave 5G are somewhat unconvincing and uncertain due to cost and performance challenges. The much larger sub-6GHz market is expected to blossom in Asia, mostly in China. Thus, it could be dominated by Huawei's wireless infrastructure equipment.

The two segments are significantly different in their likely effect on supply chains in RF front end (RFFE) modules. The sub-6GHz segment likely will extend the current dominance of RFFE module vendors Broadcom, Skyworks, Qorvo, Murata and the more recent fabless entrant, Qualcomm.

The mmwave segment brings challenges in cost, low power, new materials, packaging, and testing. In particular, mmwave transmitters need to be very close to antenna arrays, preferably in the same system-in-package. Thus, they are likely to disrupt the established supply chain, giving an advantage to modem suppliers such as Qualcomm, Samsung, HiSilicon, MediaTek, and Unisoc.

Huawei/HiSilicon is effectively prevented from competing in the U.S. 5G market today. That's giving Samsung a big incentive to compete in 5G segments against Apple and its supplier Qualcomm.

A high priority for Samsung is to build up its volumes in foundry wafers as well as IC packages (note its investments in panel-level fan-out capability) in order to compete against TSMC. Samsung already has reclassified support of its smartphone group as part of its foundry business.

Samsung also stated a goal to become the third largest global supplier of wireless infrastructure equipment. In the next few years, it will be very active in achieving its corporate strategy goals.

Overall, market segmentation for 5G smartphones will continue to evolve. And 5G has major implications beyond smartphones for a large number of other markets and industries.

--Boris Petrov is managing partner of the Petrov Group. He spent the last ten years leading market intelligence and strategic marketing at the SCL/JCET group and previously held positions at Intel, Zilog, Siemens, McKinsey, Boston Consulting, and Booz-Allen.

2 comments
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This is a hot topic – thank you for analyzing it. Could you please clarify your statement that mmWave will likely disrupt the important well established RF front end supply chain, giving an advantage to modem suppliers?

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Thank you for your comment. The primary reason that mmWave 5G will likely disrupt the well-established RF front end supply chain, giving an advantage to modem suppliers, is that in mmWave 5G the cellular transceiver has to be very close to its antenna arrays – preferably in the same SiP (system-in-package) solution.

Cellular transceivers are technically very closely interrelated to baseband processor technology in modems. Because of that a vendor of a cellular baseband processor and its transceiver is always the same company. Note that all modems (except for Apple) are by now integrated into a smartphone's application processor SoC solution -- for cost reasons – their cellular transceivers are always a separate IC component.

The emergence of the mmWave 5G segment, a technology that requires that the cellular transceiver is very close to the antenna, offers an opportunity to disrupt the traditional RF-FE supply chain -- giving an advantage to modem suppliers (Qualcomm, Samsung, HiSilicon, MediaTek, Unisoc) to dislodge traditional RF-FE suppliers in mmWave 5G RF-FE module SiP (system-in-package) solutions. Note that only Qualcomm has both modem and RF-FE module capabilities.

There have been hypotheses that such mmWave 5G RF-FE modules will be offered as highly integrated SoC solutions using MOS and SiGe technologies. All our discussions with technology experts indicate that this will be highly unlikely in the medium term (next three to five years) -- if ever. It is best to keep designs simple with a technology like mmWave 5G, which is extremely complicated to build and test. SiP provides a more flexible and less expensive time-to-market approach -- at both the smartphone and base station levels. At both -- the key will be energy efficiency.

A major implication is that an additional IC component has emerged in smartphones that offer mmWave 5G capability (always on top of the mainstream Sub-6GHz 5G capability) – an mmWave 5G RF-FE module with antenna. These mmWave RF-FE SiP modules will not only remain separate modules – they will be always in multiples (from two to four) in different locations in smartphones. Unlike mobile application processors (now in 7nm node), mmWave RF-FE SiPs will not migrate into advanced nodes any time soon.

As already stated, such mmWave 5G RF-FE SiP modules:

-- Will always include a cellular transceiver (now offered in 65nm and older nodes) with antenna arrays.

-- Traditional leading RF-FE module suppliers (all are IDMs except for the more recent entrant Qualcomm) face insurmountable barriers in adopting 5G modem technologies.

5G chipset integration is undergoing rapid evolution. At this point there are still many issues and unknowns; there are a lot of variables that could have a big effect on how mmWave 5G technology will evolve and be implemented. At this point mmWave 5G is more of a concept and use direction than any single technology and – attractive in many other applications beyond smartphones.

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