The 5G Evolution Starts With Advanced Infrastructure Solutions

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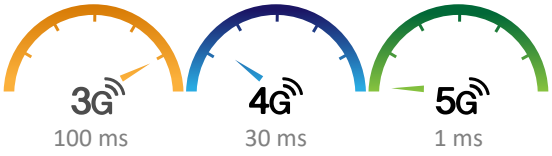
Communications providers are in the process of rolling out fifth-generation (5G) cellular networks that promise to revolutionize a wide range of applications through significantly higher data rates, lower latency and greater connection density than previous networks. Besides providing faster and more reliable coverage for cellular communications, 5G technology will significantly advance the development of devices for smart homes, autonomous vehicles, virtual reality systems, and next-generation medical, among other new applications. With low latency, high bandwidth and high density as the key benefits of 5G, it is imperative that base station infrastructure supports these critical requirements.

Latency is Critical

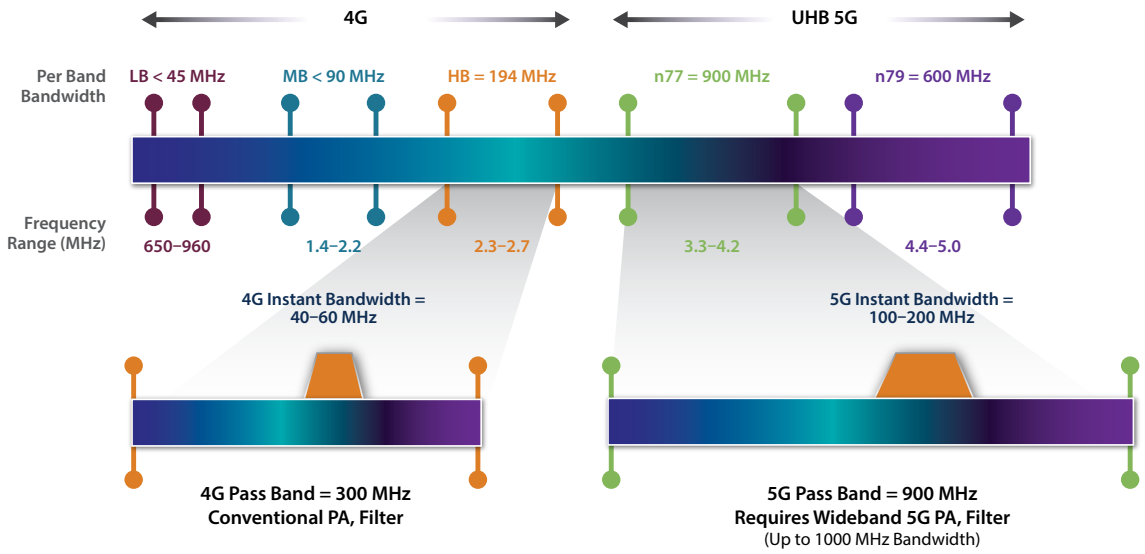
One of the most significant improvements 5G technology provides over previous-generation cellular standards is improved latency. Typically, 3G networks have a response time of 100 milliseconds (ms), 4G approximately 30 ms, and 5G will be as low as 1 ms. Low latency enables real-time decision-making, execution and feedback of data required by new applications. Some examples include autonomous vehicles that can communicate with each other on the road and make instantaneous decisions, or robotic surgical devices operated remotely by surgeons that provide instantaneous motion control and responses to ensure patient safety.



Network response time

Improving Bandwidth and Density

5G New Radio (5G NR) is a completely new air interface being developed for 5G and is additive to the existing 4G Long-Term Evolution (LTE). New bands like 3.5 GHz have been created with bandwidths allowing speeds up to 10 Gbps. 5G networks include up to 64-antenna-element massive MIMO (M-MIMO) base stations, enabling more dedicated antenna beams for higher throughput and a better mobile user experience. To complete the network performance enhancements, small cell base stations are leveraged to improve indoor and dense area coverage common in sporting venues and business complexes. This new radio standard and the deployment of M-MIMO, small cells and macro base stations delivers unprecedented performance gains. However, these gains are not without significant challenges for service providers given the network complexities and large amounts of additional electrical power required.



5G NR Requires Wideband Topologies

Power Efficiency is Key

A network's energy efficiency is measured in terms of the amount of data sent or received per unit of energy consumption. Some of the power consumed by these components will be dissipated as heat, requiring additional power for cooling. The public's desire for less visible base stations is limiting the use of heat-spreading metal structures, which in turn increases the operating temperatures as well as the efficiency requirements of components even further. The energy efficiency of a 5G base station will be about the same as 4G; however, each base station will have much more RF content and will need to handle significantly more users and devices. Therefore, special attention must be paid to developing efficient electronic components that stay within power budget constraints. Also, most small cell base stations are Powered over Ethernet (POE), which sets a hard limit for power consumption. Therefore, upgraded infrastructure with power-efficient components for new bands and higher bandwidths will be crucial for enabling 5G applications.

New Solutions for 5G Infrastructure

As a global leader in developing solutions for empowering the 5G revolution, Skyworks offers a broad portfolio of products that address the special requirements of 5G infrastructure, including small cell amplifiers, circulators, high performance low-noise amplifiers (LNAs) and high-isolation switches.

Skyworks' devices deliver the superior performance required for 5G, and provide greater overall system efficiency. In fact, the company has developed the highest-efficiency MIMO driver amplifiers and the fastest high-power switches.

A sampling of the company's latest infrastructure solutions is listed below as well as in the tables below.

- **SKY67153-396LF** is an LNA with an active bias, high linearity, superior gain and ultra-low noise in the 700 to 3,800 MHz range. It supports multiple 5G bands, including Band 41, 42, 43 and 48.
- **SKY66313-11** is a highly efficient, fully input/output matched power amplifier (PA) with high gain and linearity that operates in the 3.4 to 3.6 MHz range. It supports the 5G band 42 and is specifically designed for small cell efficiency requirements.
- **SKYFR-001705** is a single-junction, surface-mount circulator designed for wireless infrastructure and PA applications, which operates in the 4,400 to 5,000 MHz range. It supports upcoming 5G bands and macro base station power levels.
- **SKY13372-467LF** is a high-isolation absorptive switch that is an ideal component for base station applications in which synthesizer isolation is critical. It operates in the 0.1 to 6.0 GHz range and supports various 5G bands with fast settling times.

Broad Market Low Noise Amplifiers and Transistors

Part Number	Freq. Range (GHz)	Test Freq. (GHz)	Gain (dB)	OIP3 (dBm)	$OP_{1\ dB}$ (dBm)	V_{DD} (V)	Typ. Supply Current (mA)	Typ. NF (dB)	Package (mm)
SKY67153-396LF	0.7–3.8	0.849 2.500 3.600	26.0 19.0 16.5	24.5 36.0 36.0	21.5 20.0 18.0	5	80 72 80	0.25 0.50 0.70	8-pin DFN 2 x 2 x 0.75

High-efficiency Power Amplifiers

Part Number	Frequency (GHz)	Band	Typ. Gain (dB)	Power (dBm)	Power Added Efficiency (%)	iBW (MHz)	V_{DD} (V)	Typ. Quiescent Current (mA)	Package (mm)
SKY66313-11	3.4–3.6	22, 42	37	+23	15	100	5	115	16-pin MCM 5 x 5 x 1.3

Circulator for Wireless Infrastructure

Part Number	Frequency (MHz)	Insertion Loss (dB)	Isolation / Return Loss (dB)	IMD (dBc)	IMD Conditions	Rotation	Case Size (Inch / mm)	Package
SKYFR-001705	4400–5000	0.35	21 / 21	-60	2 x 20W CW Tones, 1 MHz Spacing	CW	0.49 / 12.5	SMT – Robust Lead

High Isolation General Purpose Switch

Part Number	Description (Absorptive/ Reflective)	Frequency (GHz)	Typ. IL (dB)	Typ. Isol. (dB)	Typ. IIP3 (dBm)	Typ. $IP_{1\ dB}$ (dBm)	Package (mm)
SKY13372-467LF	SPDT (A)	0.1–6.0	0.8–1.7	42–65	45	26	61-pin QFN 4 x 4 x 0.9

For more information about our solutions, please visit us at www.skyworksinc.com