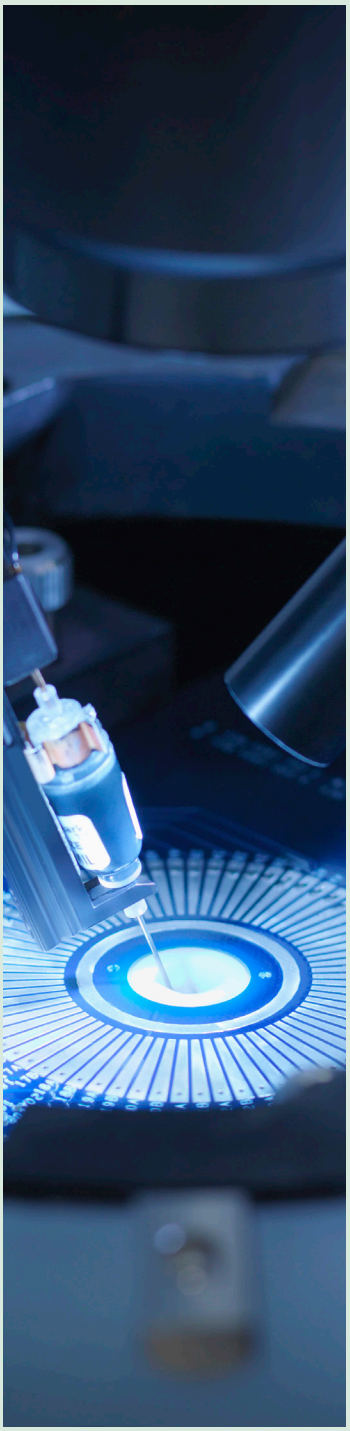
WHITE PAPER



EVOLUTION OF THE SEMICONDUCTOR INDUSTRY IN A 5G WORLD

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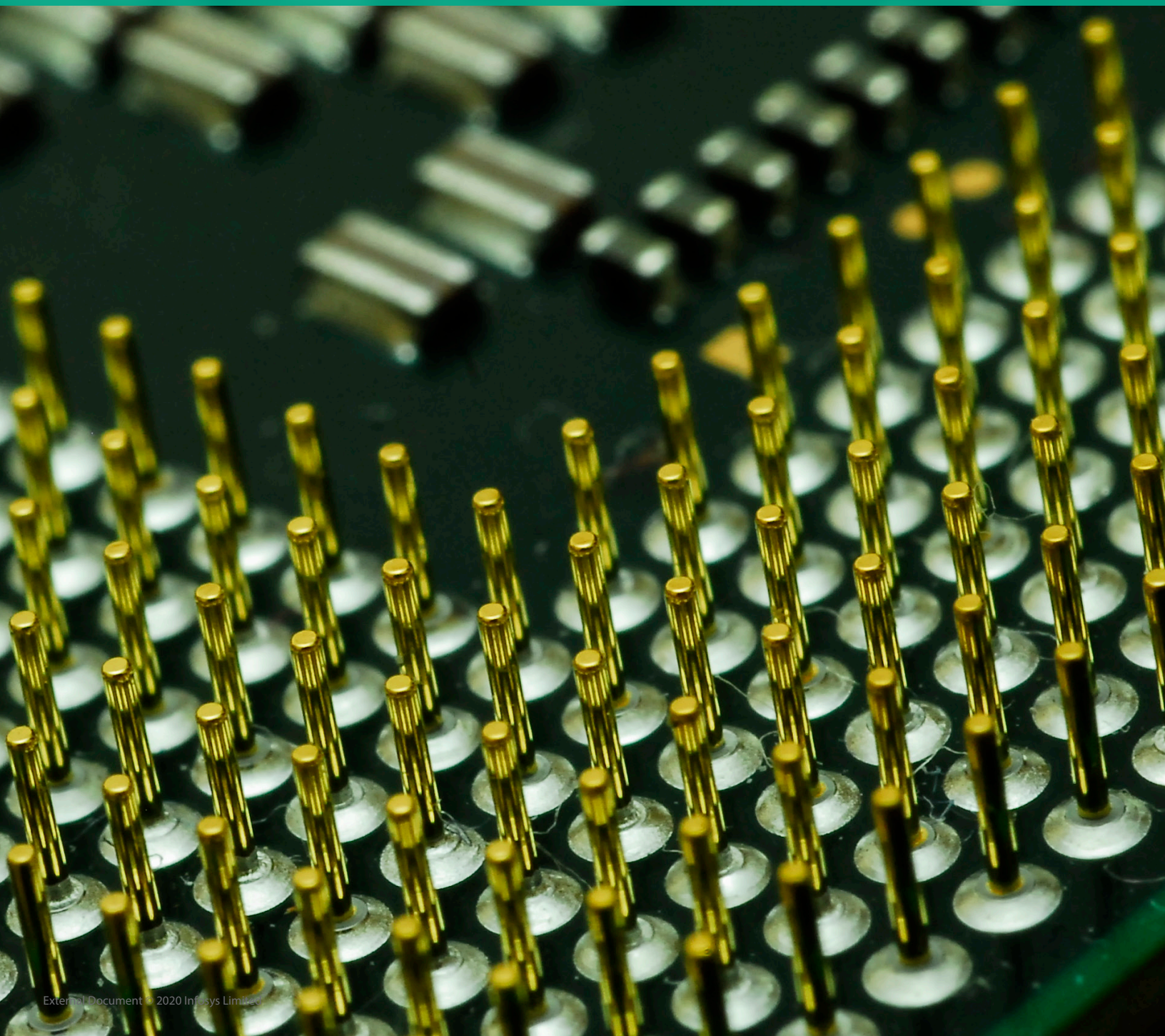
Circa early 2000s - fans of Hollywood may recollect Tom Cruise in 'Minority Report' (2002) or Will Smith in 'I, Robot' (2004) whizzing around in flying cars, hacking through see-through glass panels with infinite computing power or chatting with sentient robots. For the common man, it seemed far-fetched and best left to the sci-fi books of Isaac Asimov and Arthur C. Clarke, or Steven Spielberg's movies.

Fast forward to 2010, when the first 4G networks were rolled out and finally buffer-free YouTube videos became a reality - it seemed like digital paradise. But the human imagination has no limits, and today we are on the cusp of ushering in the next technology revolution with 5G.

5G – with the buzz around it reaching a crescendo, evokes different reactions, depending on the audience. However, what is certain is that this wireless technology of the future is going to offer fascinating options to brighten everyday life, and we are now only just beginning to scratch the surface of 5G's potential.

5G technology promises gigabit data rates, low latency, high reliability and availability. Coupled with technologies such as artificial intelligence (AI), the Internet of Things (IoT), autonomous vehicles, augmented / virtual reality (AR / VR), and the potential of monetizing 5G[1] is endless.



The tiny chip powering the revolution

It is easy to miss the tiny (and sometimes impossible to see) semiconductor device, tucked away unobtrusively in your smart device. Semiconductor chips are central to everything, whether you are driving a car, or surfing the Internet, or using a supercomputer - everything is ultimately based on a semiconductor. Semiconductors have been largely invisible, hidden away under and inside a smart speaker, locked within a phone, buried in data centers and out of view. Every step of the digital, and probably new industrial revolution, over the last 70 years has been powered by semiconductor chips.

New technology is driving demand for innovation in semiconductors

across the semiconductor ecosystem - particularly for processors, sensors, and analog ICs. Over the next decade, it will cause seismic changes in the computing requirements for devices and networks - the complexity and volume of network traffic will grow exponentially due to more users, more transactions per user, and richer content per transaction. Already, industry forecasts for 5G chipsets are projecting a 50% CAGR from 2020 onwards, totaling market demand of US$ 25 billion to 30 billion.

Samsung, Nvidia, Apple, and IBM are investing billions of dollars to be on the bleeding edge of technology, be it new nodes of semiconductor technology build, or new methods of packaging[2] . The new chips that will handle the multitude of opportunities opened up by 5G will lead to renewed focus on the fundamentals of semiconductor chips – performance, scalability, and reliability[3].

Performance

5G will place heavy demands on the chips that power the backbone of the network and the edge device. For example, data center applications will require extremely fast processors and near-100% uptime, while edge-connected devices will require chips with extremely low-power / low-leakage performance, and with embedded memory for storage and RF for wireless connectivity. Couple this with the monetizing possibilities that 5G promises (leveraging network slicing), there will be intense focus on performance of semiconductor chips, resulting in potential changes to chip design and architecture. Chips will be built to perform in extreme harsh conditions (like a roadside edge device) withstanding the vagaries of nature, but at the same time be compact enough to fit into tiny, nearly invisible in size devices, while having low heat emission and energy consumption characteristics.

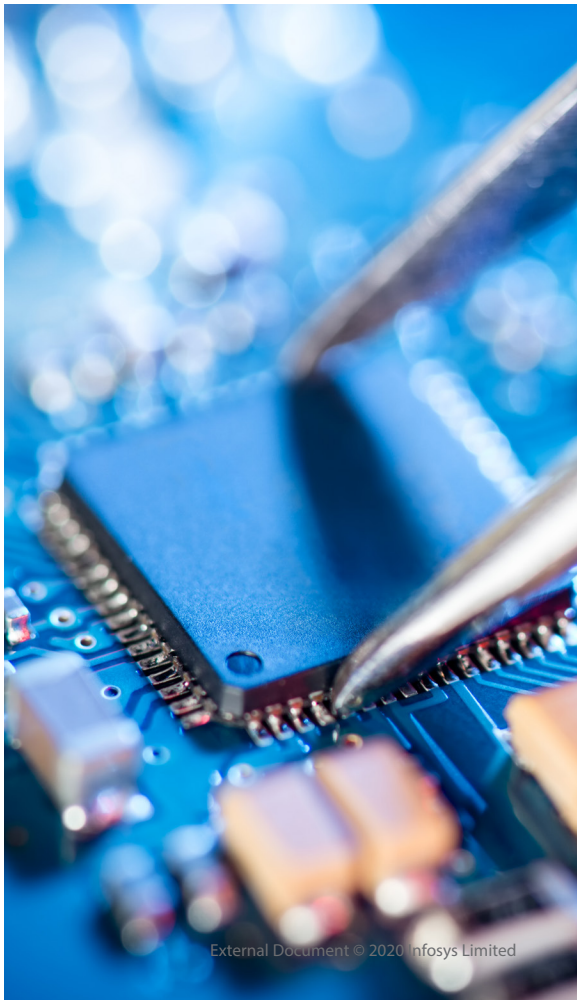
Scalability

As 5G and next generation technology evolves, the chips that power the technology will need to adapt to provide the kind of scalable infrastructure that will make 5G cost-effective. Chip architecture will evolve at a rapid pace, to provide complementary functions, and technology used to manufacture them will need to keep pace. Lithography techniques, chemical compositions, and chip-packaging will evolve to incorporate more per nanometer (denser) transistors. The huge demand for these chips will also mean that the semiconductor companies will have to ramp up production, focusing on environmental sustainability.

Reliability

With the new use cases and applications where machine-to-machine interactions need 100% reliability (imagine a self-driving car encountering even a 2-second glitch while trying to brake), it becomes imperative for semiconductor manufacturers to ensure that the new chips are extremely reliable. Consequently, every step of the manufacturing process, from the design team to the foundry floor to the packaging department, will need to focus on quality and consistency, while balancing out price points. New processes of ensuring better than Six Sigma techniques and error elimination will become the norm.

As the next technology paradigm unfolds, it will be critical for stakeholders in this complex yet efficient ecosystem to be ready to adapt to this wave of demand. ROI will continue to be king, and will drive decision making as sunrise industries adapt and bring digital technologies to their 5G-powered use cases. Stay tuned.



About the Author

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Venkat Srinivasan, Associate Vice President, Infosys focuses growth the Hi-Tech business footprint in US and Europe. He has deep domain expertise in the Semiconductor space – the engine that drives the Hi-Tech industry. He is experienced in Digital Transformation programs and has helped clients solve business challenges related to Time-to-Revenue and Cost-to-Serve. He has helped customers solve complex issues pertaining to Engineering, Customer service, Operational Cost management and is a trusted advisor to multiple CXO's across the industry. Venkat can be reached at Venkat_Srinivasan@infosys.com.

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