The Impact of Electronic Component Shortages on the Global Space Industry

In 2021, the global satellite-manufacturing industry was valued at $25 Bn, predicted to increase significantly over the next decade from 380 to 1,700 new satellites annually. Satellites and spacecraft need lots of electronic components and semiconductors in particular, have enabled many new applications for space technology.

Covid-enforced production stops of raw materials, the soaring demand for commercial work-from-home devices such as laptops, tablets and routers, and the continued growth of the space market, has resulted in supply-chain issues such as component shortages, extended lead-times, increased prices and in several cases, postponed launches.

In 2021, the global semiconductor market was valued at $450 Bn, predicted to increase to almost $1 Tn by 2028. The world-wide space-microchip sector was valued at $2.1 Bn, predicted to increase to $3.3 Bn by 2028 (CAGR of 6.9%). 20% of all parts were used by launchers! Sales of space-grade integrated circuits represent less than 1% of the total semiconductor market. In the middle of an international pandemic, is it right for our industry to request more wafers when there are other, more immediate priorities?

As an OEM, my company, Spacechips, has experienced extended lead-times and increased component prices. Several prospects have required proof that we can get parts before signing a contract to guarantee on-time delivery of their space electronics. I recently spoke to many diverse stakeholders around the world to understand the impact of the supply-chain issues being experienced by the global space industry and want to share feedback from space-grade semiconductor manufacturers with foundries, fabless chip providers, suppliers of passive parts, component distributors, as well as satellite and sub-system OEMs.

Several space-grade semiconductor manufacturers with their own foundries have reported delays sourcing ‘raw materials’ such as ceramic packages and lead frames. Typically these are made in Asia and COVID-enforced lockdowns have impacted their availability, resulting in longer lead-times for some space-qualified integrated circuits. To make matters worse, some manufacturers are required to produce to AS9100 quality, which includes an audit for on-time delivery. The cost of materials has increased which is then passed-on to the final customer. Will we ever see prices reduce I wonder and could there be a future glut of parts once the supply-chain normalises? Some space-grade foundries in the US and Europe fabricate for specific applications using specialist processes containing features advantageous for radiation hardness, *e.g.* SOI, low charge-collection accumulation and SiGe.

Several manufacturers have been able to buffer the shortage by keeping material and wafer stocks. To help you source parts quickly, some suppliers with their own foundries now allow you to buy parts directly from their on-line store. Websites provide an indication of inventory, date code, lot information and provided you are not procuring for a new, non-forecasted 500 satellite constellation, your parts will arrive in a few days.

Several fabless providers of space-grade integrated circuits are fighting and competing for wafers and foundry time. Is this really a surprise? The problem we have as an industry is that while we pay significantly more for fully-qualified parts, our industry represents less than 1% of the global semiconductor market while at the same time competing with the surge for

work-from-home and home-learning devices. Subsequently, fabrication costs have risen to meet this enforced need which has resulted in higher component prices and extended lead-times for spacecraft manufacturers. Only last week, TSMC reported a record quarterly profit with a major increase in investment planned for this year. One well-known provider of space-grade semiconductors told me, "*We are getting primes coming to us with multi-million dollar contracts jumping up and down screaming, do you know who we are and the importance of our programme? The problem is that we simply can't secure enough wafers*". During a global pandemic, should priority be given to producing urgently-needed, life-saving medical electronics? This question poses many moral and human considerations!

Distributors of space-grade parts used to keep stock, but this trend is becoming less popular and they too are experiencing longer lead-times and higher prices. One key comment from distributors is that New Space companies baselining automotive or industrial-grade COTS parts will see delays. One approach that is helping some investor-rich space companies is their ability to procure and then hold components for when they are ready to build, to ensure on-time future delivery to their customers.

I spoke to OEMs and those that act quickly and are prepared to take risk have secured parts. Some bought large stocks in early 2020 and now have a healthy inventory that is allowing them to deliver to schedule. However, access to COTS, industrial and automotive-grade parts has been a challenge that existed before the pandemic with some spacecraft manufacturers competing with larger-volume buyers from other industries. Several British OEMs mentioned that BREXIT has complicated export control requirements within the EU and the rest of Europe, adding further delays.

What can we do as an industry to reduce the impact of supply-chain shortages, longer lead times and increased prices?

Understandably, many satellite/spacecraft manufacturers only order parts after winning a firm contract, however, given the current challenges, this may be a risky approach to guarantee on-time delivery. As an industry, we need to improve our ability to forecast future sales and plan procurement accordingly. To increase our influence in accessing materials and wafers, as well as our buying power, in my opinion, distributors could play a more leading role by combining the purchasing needs of multiple OEMs, while respecting individual sensitivities, and negotiate directly with manufacturers/foundries. There's an entrepreneurial opportunity here! I also believe agencies, governments and catapults could make a positive contribution to this discussion by providing loans or up-front contract payments to facilitate early procurement to mitigate longer lead-times.

Producers of high-volume smart phones, tablets and laptops are able to forecast future sales more accurately and then plan procurement accordingly, *e.g.* they have data for how many customers will want to upgrade their phones next year. This certainty gives them an advantage allowing them to place large orders while the space industry adopts a more risk-averse approach. Saying that, even Apple has been affected, delaying the launch of the iPhone 12 with production impacted throughout 2021. Chip shortages also affected SpaceX's new user terminals.

There have been political and national reverberations with some countries investing in new, local foundries to reduce their reliance on foreign fabs. However, it takes time and billions to build new foundries and several providers of space-grade semiconductors have started this investment.

While I don't think the current challenges will get worst, I do expect them to last throughout 2022. Foundries have worked hard to squeeze as much capacity as they can and ramp-up production, but this takes time. The CEO of Microchip recently provided his views on the supply chain and future outlook.

Have your space projects been impacted by longer lead times, increased component costs, schedule slips or postponed launches? If so, how have you managed the situation? What do you think the space industry could do better to reduce the impact of the current shortages and how should we plan for the future? Please leave your comments below and the best answer will win a Courses for Rocket Scientists World Tour tee-shirt. Congratulations to Dave from Canada, the first to answer the riddle from my previous post.

I'd like to thank all the component manufacturers, distributors and OEMs whom I spoke to while writing this post. Your inputs have been invaluable!

Dr. Rajan Bedi is the CEO and founder of Spacechips, which designs and builds a range of advanced, L to K-band, ultra high-throughput on-board processors, transponders and Edge-based OBCs for telecommunication, Earth-Observation, navigation, internet, 5G and M2M/IoT satellites. The company also offers Space-Electronics Design-Consultancy, Avionics Testing, Technical-Marketing, Business-Intelligence and Training Services. (www.spacechips.co.uk). Rajan can also be contacted on Twitter to discuss your space-electronics' needs: https://twitter.com/DrRajanBedi

Spacechips' Design-Consultancy Services develop bespoke satellite and spacecraft sub-systems, as well as advising customers how to use, select and procure the right components, how to design, test, assemble and manufacture space electronics.