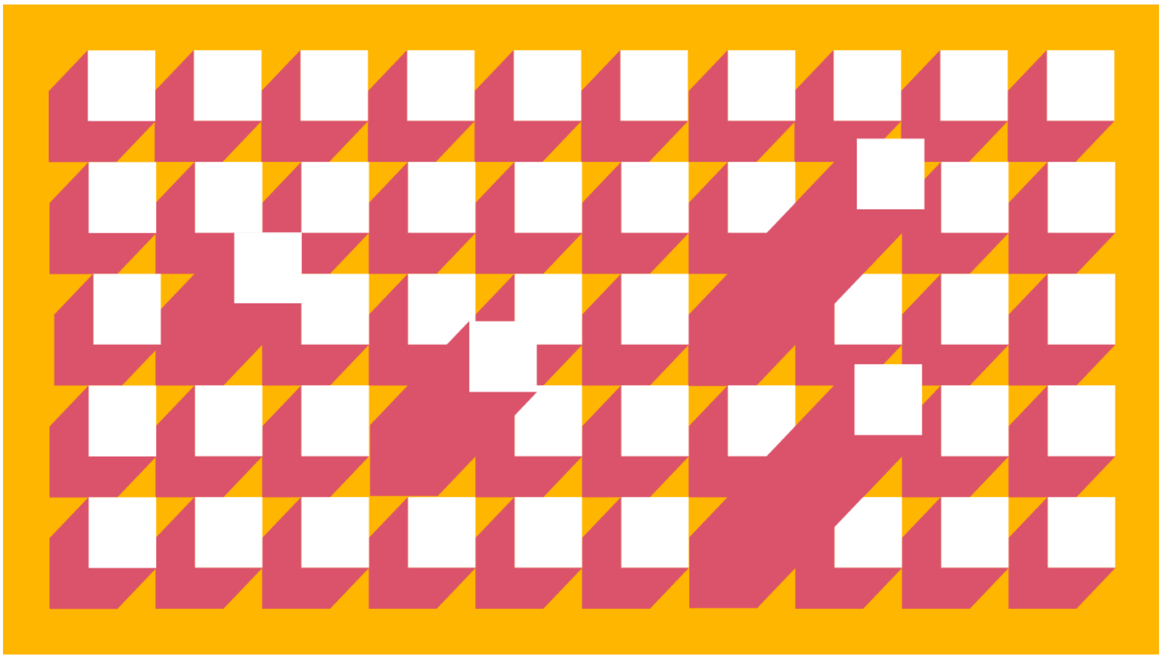
European EEE-component landscape analysis

Executive Summary

1 Context of the initiative and objectives of the study



1.1 European sovereignty concerns in the field of EEE components

Electrical, Electronic and Electro-mechanical (EEE) components play an essential role in the functional performance, quality, life cycle and costs of space systems. EEE components are fundamental building blocks of any spacecraft and major drivers in determining their performances.

Guaranteeing access to EEE components able to provide the necessary performances to comply with the requirements of future satellite missions is of paramount importance to maintain a successful and autonomous satellite manufacturing capabilities.

The global supply context and the lack of a dedicated initiative for space components after the end of the European Component Initiative (ECI) have contributed to an increasing European dependence for high-performance and high value added EEE components, with an estimated 70 to 75% of component value for ESA science missions going to non-European suppliers, primarily US-based.[1]

The widespread shortage of semiconductors that began in late 2020 has exposed risks and vulnerabilities of the global supply chain and has affected the European space supply chain with increased lead times.

With all the other semiconductor nations announcing in the past months ambitious plans to strengthen their supply chain and intensification of competition, the situation could further

[1] Source: ESA White Paper, EEE Component Sovereignty

compromise Europe's independence and weaken the competitiveness of the European space industry.

1.2 Study rationale and main objectives

The scope of the study was to carry out an analysis of the EEE component market demand and supply landscape, to support the development of a strategy for a sustainable EEE component sovereignty for space components in Europe.

In more details, the study aimed at:

- **Objective #1**: analysing the key drivers behind the adoption of critical components and their main applications for current and future space missions
- **Objective #2**: providing a market analysis and forecasts for critical space components, based on trends in number of satellite launches
- **Objective #3**: providing an analysis of the current supply landscape for critical components and identify main gaps in the European supply chain
- **Objective #4**: providing an overview of the key strategies and funding mechanisms put in place for the semiconductor industry in Europe, US, China, Taiwan and other countries, and the specific initiatives for the space sector.

The study focused on the following critical components and technologies:

- Ultra Deep Sub-micron (UDSM)
- Field Programmable Gate Array (FPGAs)
- Radio frequency GaN
- Power GaN / SiC
- Packaging and Hybrids
- Photonic
- Solar Cells
- Irradiation test facilities

This executive summary provides an overview of the main results and conclusions of the study.

2 Conclusion and recommendations

Trends concerning high number of launches driven by small satellites are expected to continue globally, with an impact on components demand drivers

2021 represented a record year in global space activities with 1860 satellites launched. Driven by large constellations and New Space trends, a shift is occurring, with a majority of new launches driven by the small satellite classes.

The trend is expected to continue in the next decade but is largely dependent on the sustained financial viability and continued deployment of large constellations, e.g., Starlink, OneWeb, Amazon Kuiper, Telesat and China SatNet. Under these assumptions, an average number of ~1900 satellites are expected to be launched yearly in the decade 2022 – 2032, largely driven by North American operators and the small satellite mass classes (< 500 kg).

Considering demand originating in Europe, the trend toward smaller satellites is present but less pronounced. Satellites manufactured in Europe are expected to represent ~10% of global demand, with an almost equal split among small and larger satellite classes (> 500 kg).

In general, the shift to requirements driven by higher-volumes, quicker time to market and increase of performances is driving a shift in risk taking mindset and increased used of COTS components for constellations and small satellites.

At the same time, EEE components for space applications will need to respond to future trends deriving from evolving mission and satellites requirements: for example, trends on higher on-board processing capabilities, higher payload frequencies and increased data rates for Satcom payloads, or the increased adoption of electric propulsion and the implementation of onboard artificial intelligence. These trends can be particularly impactful for FPGAs, which might require usage of high performance UDSM technology (e.g., 7 nm), currently not available in Europe, and drive demand of RF GaN, Solar Cells and Power GaN/SiC components. In addition, trends in miniaturization, integration of components and mass reduction are driving interest for solutions such as System in Package (SIP), while Satcom and EO constellations are promising for the adoption of inter-satellite communication systems, including laser communication.

The forecasted number of satellites and the identified demand drivers result in an average projected yearly demand in Europe in the order of ~60000 components (considering FPGAs, RF GaN, Power GaN/SiC, Photonics detectors and laser terminals, and Packaging & Hybrids), corresponding to ~12% of projected global demand. Solar cells are estimated at ~520000/year. After solar cells, the largest segment is represented by Packaging & Hybrids, followed by RF GaN, Power GaN/SiC and FPGAs.

In addition, with an expected sustained high number of satellites to be launched and a trend in increase in use of COTS, combined with a lack of EEE testing slots in Europe, availability of testing facilities could become a bottleneck, in particular for SEE.The total number of components to be tested yearly due to satellites manufactured in Europe is estimated in the order of ~40000, corresponding to ~20% of the total global demand.

Even considering the increase in the past decade in the number of satellites launched, the volumes for space remain low compared to other industries.

Moreover, despite some exceptions, spin-offs possibility of components developed for space are generally limited, since components designed to be rad-hard are not competitive on the market.

The value of space-grade components is challenging to preserve for semiconductor players, while COTS have a clear role to play

While the increase of COTS use is more widely witnessed in the New Space mindset, it is also present in more traditional missions. At the same time, there will remain a need for highly reliable components, and the space industry must make sure that these components can be developed, with the support of the semiconductor industry. It is important to note also that the development of high reliability, space-dedicated components contribute to sustaining the required skills and supply chain for the development of rad-hard COTS. Both types of components therefore benefit from the co-existence with the other.

In this context, though, the development costs for new high-reliability (rad-hard) components are increasing for semiconductor companies as the requirements become more demanding and more specific. Given the very low volumes of demand, this creates challenges in terms of financial viability for them with disincentivizing effects: developing specific chips for space is less and less affordable, and therefore it becomes challenging to maintain space-capabilities, R&D investments and a space-qualified supply chain. At the same time, a lack of long-term visibility over future space components specifications for space is adding to the challenge of developing dedicated components.

A focused action is required to maintain the attractiveness of space components development

While high-reliability components dedicated to space will remain indispensable for some of the missions and key functionalities, it is therefore important to:

- maintain the European space (rad-hard) components capabilities, focusing on critical technologies
- enable and facilitate a sustainable cohabitation of rad-hard and COTS components, while securing the value-added creation segment of the value chain within Europe.

To answer these two strategic needs, the study concludes that a dedicated initiative is required. To support this, a prioritisation of the technologies analysed is proposed, together with a set of 16 recommendations addressing technology aspects and strategy orientations regarding the public support.

Based on the demand drivers analysed and the identified supply landscape, the following 6 critical technologies are prioritised:

- FPGAs
- UDSM
- Power GaN
- RF GaN
- Packaging & Hybrids

- Irradiation Test Facilities.

The recommendations are structured along four main axes:

- Investment in components and technologies
- Cooperation between Space and EEE players
- Cohabitation of COTS and high-reliability components
- Funding and procurement approach.

Investment in components and technology

Recommendations are focused on the prioritised critical technologies and include support to the development of a high-capacity European FPGA, strategies to ensure supply of UDSM, developing of new irradiation test capabilities, investment in packaging and SIP components, power GaN and RF GaN for high frequency bands.

Cooperation between Space and EEE players

Potential actions address the aggregation of demand in order to increase volumes, focused on the use of flexible components compatible with the requirements of different space missions. Moreover, the provision of a higher visibility for manufacturers on future requirements for space components in envisaged, to be promoted through coordinated discussions between requirements originators and component manufacturers.

Cohabitation of COTS and high-reliability components:

Recommendations focus on the prioritisation of public support for space-grade components on high volumes and, for COTS, a focus on upscreening know-how and expertise.

Funding and procurement approach:

Recommendations include the increase of the provision of public funding dedicated to the development of long-term components and an increase in efficiency of funding schemes, through the provision of contracts with an end-to-end scope, up to technology IoD, and an improvement of the administrative efficiency and timeliness for grants. Moreover, the available financial support should be more concentrated in order to reach some critical amounts in the areas of interest, while ensuring an efficient targeting of European strengths.

Coordination with different European activities ongoing or planned, e.g., by the EC or EDA, should also be envisaged, in order to maximise synergies and avoid duplication of effort.

Contact

Luigi Scatteia
Partner, PwC Space Practice Leader
Mobile: +33 (0) 6 42 00 71 67
scatteia.luigi@pwc.com