White Paper

FPGA

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How to Deliver Rock-Solid Supply in a Complex and Ever-Changing World

A Combination of Careful Planning, Focused Investment, Accurate Tracking, and Commitment to Product Longevity Delivers the Resilient Supply Chain FPGA Customers Require

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Supply Chain Upheaval—Learning from the Crisis!

From 2021 through 2023, the industry experienced a major disruption of global supply chains. While every industry and all types of products were affected, the semiconductor supply chain was under extreme stress due to its impact on virtually every other segment.

The combination of a global pandemic with its geo-political impacts and a rapid growth in demand for semiconductor products was an unprecedented shock. The systems and capacity that had worked well in the past suddenly became inadequate in the face of COVID-19 restrictions and its associated workforce impacts. The industry experienced shortages, long lead times, and inevitable allocations that threatened not only profits but the very existence of many companies that depend on a steady semiconductor supply. These global shortages have largely eased since mid-2023, but the experience was an eye-opener. We learned that the world is too complex, interconnected, and dynamic to rely on traditional supply chain practices.

As semiconductors become increasingly pervasive in nearly every aspect of our lives, the demand for them will naturally continue to grow. While semiconductor manufacturing companies are spending billions to keep pace with expanded capacity needs, building new wafer fabs and other advanced manufacturing facilities takes years to implement. In addition, the risk of macro-environmental disruptions – be it a natural disaster, a geo-political event, or another public health crisis – persists.

By taking action now to manage the capacity we have more effectively and to build more resilient and predictable supply chains, we can help reduce the risk and lessen the impacts of potential future supply chain disturbances.

This paper focuses on supply chain practices that Altera® recommends for FPGA users based on learnings from the supply constraints experienced during 2021-2022. It also shares improvements that Altera is making to further strengthen its resilience as an FPGA supplier.

Resilient Supply Chain Considerations for FPGA Users

FPGAs enable highly customized and compact electronic solutions that deliver significant time-to-market advantages. One of the primary value propositions of FPGAs is their extreme flexibility, with the ability to program custom logic circuits and later reprogram them whenever necessary. This reduces development times since engineers can repeatedly program, test, correct, and reprogram—iterating to the target design solution more quickly. It also provides design flexibility and upgradeability once a solution is deployed by enabling in-field reprogramming.

To maximize flexibility and minimize cost, FPGAs are offered in many sizes and variations with different combinations of logic elements, memory, transceivers, input-output options, and processing components. This wide selection of device configurations enables FPGAs to service a broad range of workloads across nearly every market segment.

However, offering such a proliferation of device configurations also requires that FPGA users understand and manage their FPGA supply needs and implement a well-tuned procurement strategy. We share our recommendations in the following sections.

Consider Supply Chain When Making Vendor and Component Decisions

When making vendor and product decisions, set yourself up for long-term supply success at the beginning of your project. While technical performance and critical product features must be met, considering the reliability and resilience of the device supplier is a proactive step that can help mitigate supply risks during your project's development, launch, and production stages.

There are multiple aspects you may consider when evaluating the supply resilience of a semiconductor vendor or product. For devices manufactured on the most advanced process nodes, including many FPGAs and other digital devices, multi-sourcing wafer production may not be possible.

However, other elements of manufacturing, such as substrates, packaging, and assembly and test, lend themselves to redundancy that can greatly mitigate supply disruption risks. Even if wafers cannot be multi-sourced, it is worth asking whether the wafer manufacturer can move mask sets (or create a second set of masks) to an alternate fabrication location.

In addition to manufacturing redundancy, companies may have other strategies for mitigating supply chain risk. Robust buffer inventory holdings and manufacturing geographic diversity also contribute to the provider's supply chain robustness.

Consider Your Vendor's Product Longevity Commitment

One supply consideration that seems obvious when your attention is called to it is the product life cycle longevity of the devices that your design is based on. It's a factor that may be overlooked in the race to get a new product to market, but as a product reaches maturity and ramps in volume, component end-of-life can cause the ultimate supply disruption. This may result in a loss of sales to competing products, force costly redesigns, or both. This is especially important where FPGAs are concerned because they tend to be critical parts of an overall system design with widespread ripple effects. Understanding the supplier's commitment to the longevity of device life cycles is important and should be aligned with the planned life and evolution of the dependent solution.

Understand and Incorporate Product Lead-Time Guidance into Your Procurement Strategy

Semiconductor suppliers provide lead-time guidance for their products, which says how far in advance of a desired delivery date to place an order for a component. While commoditized components may be available "off the shelf," others, including FPGAs, are kept as work-in-process inventories of sorted known good die and substrates. These are then assembled into a complete product and tested when an order is placed. For FPGA suppliers with massive lists of orderable devices, this provides supply chain efficiency and flexibility to ensure that customers can receive the exact configuration or stock-keeping unit (SKU) much more quickly than the time needed to build a product from the beginning of the entire manufacturing process.

To set your company up for success, we recommend that you implement these basic measures:

- **Ensure your orders align with the supplier's and distributor's lead-time guidance.** Placing an order requesting shipment sooner than the lead-time guidance may create a completely avoidable supply disruption. We suggest extra communication and early ordering for high-volume orders to ensure on-time delivery to meet your needs.
- **Continuously monitor your demand and re-align your orders with current lead-time guidance.** Given the dynamic character of macroeconomic conditions, adjusting in real-time to demand changes is a key strategy to ensure supply continuity.
- **Make sure your distributor fully understands your future needs and the size and timing of planned future orders.** Distributors typically have demand for SKUs across multiple customers and have their own order prioritization and delivery schedule methods. Providing advanced visibility of orders can reduce the risks of supply gaps or delays in distribution channels.
- **Evaluate the lead-time guidance versus your supply risk tolerance and adjust your procurement strategies accordingly.** Consider employing self-buffering strategies by increasing internal inventory when demand is more volatile. Having a small parts buffer can reduce production stoppages. This strategy can have a big payoff when deliveries are time-critical — as with new product introduction (NPI) ramps or when faced with contractually specified delivery dates.

Understand and Take Proactive Ownership of Your Complete, Global Supply Chain Ecosystem

Proactively owning your supply chain requires collaborating closely with FPGA suppliers, distributors, and other partners such as original design manufacturers (ODMs) and contract manufacturers (CMs). This can be a complex matrix of relationships if your organization works with multiple ODMs or CMs, or places orders from multiple production locations across the globe.

In many instances, manufacturing partners place orders for necessary components with an electronics distributor, who then places orders with the device vendors. With multiple steps involved there is potential for misalignment of quantity, timing, or even project identity and manufacturing location — leading to painful supply impacts.

So, it is crucial to understand the complete, aggregated demand – including forecasted demand – across all projects and production sites and to regularly check and align this demand with order backlogs placed by partner ODMs, CMs, and distributors.

Sharing this information with your FPGA supplier — even when the actual orders are placed and fulfilled via distributors — further strengthens your supply chain resilience. With detailed knowledge, suppliers can proactively align supply with current demand and mitigate risks due to shortages or lines-down scenarios. Manufacturing a semiconductor device like an FPGA from silicon wafer to finished goods takes approximately two quarters. This includes the major

production steps: advanced node wafer fabrication, die sort and prep, assembly, and final test. Sharing business and forecast insights enables suppliers to plan future supply more accurately and well before you need parts for production. With more information, suppliers can reduce risk and improve supply continuity because they can make the required material ordering and capacity planning decisions early enough to ensure they hit shipment targets. Early visibility to future supply needs helps all participants – you, your CMs and ODMs, your distributors, and your FPGA supplier – improve their supply agility to accommodate rapid or unexpected changes. Such agility can also enable you to take advantage of market opportunities. For example, a responsive supply chain can help you respond to unexpected upside demand, which can be a strategic advantage over your competitors.

Oversights, miscommunications, unexpected market or project changes, and other factors are just business realities. Having and communicating a comprehensive, real-time view of your orders, your supply inventory status versus your total needs, and your forecasted demand will maximize your entire supply chain's ability to maintain continuity even under dynamic circumstances.

Altera's FPGA Supply Chain Approach

Supply resilience is a strategic focus area for Altera. We have taken explicit actions to strengthen our supply chain for greater supply predictability, agility, and longevity and, ultimately, to deliver a robust supply chain that our customers can trust.

Our supply chain strategy incorporates multiple elements, including:

- Focused Investment — Altera is investing to increase manufacturing capacity across the end-to-end supply chain, covering wafer fabrication, substrate manufacturing, assembly, and testing capacity. We are increasing supply redundancy by expanding our multi-source capabilities, such as qualifying new substrate suppliers as alternative sources and bringing up new manufacturing, assembly, and test lines at existing suppliers. We are also investing in our inventory strategy to offer predictable, competitive lead-time guidance and to increase agility to handle demand growth and volatility. This includes offering 12-to-16-week lead-time guidance as standard for most device families used in new designs, and extremely fast — 6-week or better — lead-time guidance for select devices used in prototyping.
- Building a Resilient Portfolio — We work to deliver a broad, resilient portfolio that considers supply chain robustness along with performance, features, and other critical product characteristics. We work closely with our wafer, substrate, and assembly and test partners to jointly maximize supply continuity and leadership capabilities for our shared customers.
- Commitment to Product Longevity — We're focused on providing supply longevity to match the long FPGA application life cycles with device availability extending to at least 2035 for most product families. In addition MAX II, MAX V, MAX 10, Cyclone III, Cyclone IV, Cyclone V, and Cyclone 10 LP products are being extended all the way to 2040! Cyclone 10, MAX V, and MAX 10 devices offering newer features are good options for new applications or designs, and as alternatives to products from other vendors that have reached end-of-life. Extended product longevity mitigates the risk of obsolescence and minimizes the cost of redesigning so customers can have peace of mind when designing our products.

1. Applicable for all products recommended for new designs.

Figure 1. Altera's strategy for delivering a resilient portfolio of FPGAs includes focused investment to enable accurate lead-time guidance, agile prototyping, supply longevity, and diverse manufacturing.

Conclusion

The semiconductor supply chain has always been important, but never more important than today, as shown by recent global shortages. While painful, the 2021-2023 supply chain crisis provides an opportunity to learn and adapt so that semiconductor suppliers and end-product manufacturers alike can eliminate or reduce the impact of future supply chain disruptions.

Resources

- What are Semiconductors? Manufacturing 101 article
- Global Manufacturing web page
- FPGAs and SoC FPGAs web page

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