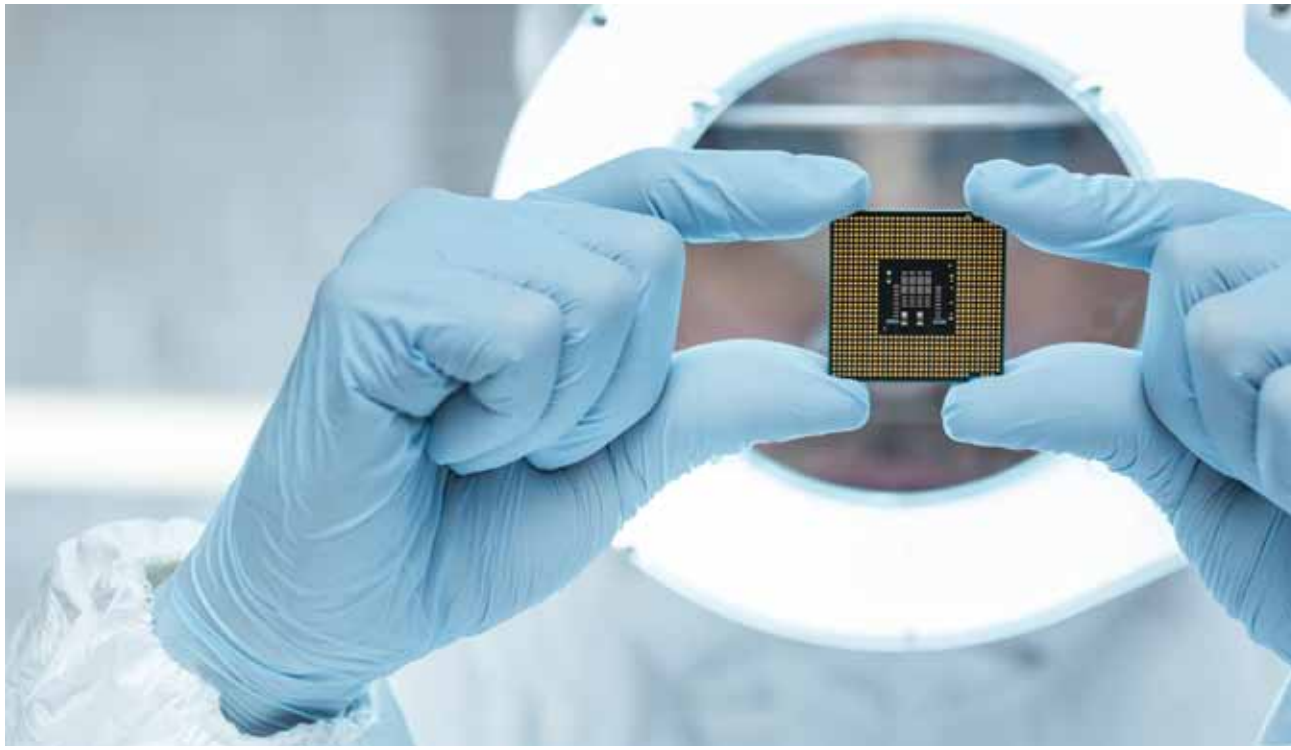
UNLEASHING VLSI: Job Roles, Convergence With Embedded Systems, And Startups



KUNAL GHOSH, an IIT-Bombay Alumni, is the founder of VLSI System Design (VSD) in Bengaluru. With a background in technical leadership at Qualcomm's Test-chip business unit and as a Lead Sales Application engineer for Tempus STA tool at Cadence, he brings extensive expertise to his role

From job roles to startup opportunities, let's delve into the world of VLSI—where convergence meets innovation. Explore career prospects and discover the limitless possibilities of VLSI in shaping the future of technology

From the early days of electronics engineering to the present, very large scale integration (VLSI) has remained a fundamental and ubiquitous component, shaping engineers' knowledge and skills in integrated circuit design. Have you ever considered VLSI as a promising career path worth exploring? Engineers face a common challenge in selecting the perfect domain to establish a career path. This decision raises various considerations, such as determining the most appropriate direction, acquiring the necessary skills, potential relocation for educational purposes, and evaluating the required investment. In the era of online education, individuals often overlook the potential of VLSI

learning when exploring available educational opportunities.

VLSI has emerged as a dynamic field offering exciting job prospects for individuals passionate about semiconductor design and integrated circuit technology. In a recent conversation, Kunal Ghosh, VLSI System Design (VSD) founder, shared invaluable insights into the diverse range of job roles within this domain. Unravelling the VLSI job market, Kunal's discussion focused on the multitude of employment opportunities that await individuals interested in VLSI. Kunal discloses, "Most students tend to pursue job opportunities after completing their VLSI education. Some may go for pursuing a master's or PhD degree, while a small percentage may choose to attend different institutes to learn about proprietary tools and practices. However, the majority tends to enter the industry directly after learning VLSI design online courses."

Exploring diverse job profiles in electronic design

The field of electronic design encompasses a wide range of job profiles, each requiring unique skill sets and expertise. From writing register transfer level (RTL) coding to tape-out and tape-in processes, professionals with various specialisations contribute to creating complex integrated circuits. Let's take a closer look at some of these roles:

1. RTL coding (register transfer level coding). One crucial job opening in electronic design involves writing RTL coding. RTL coding serves as the foundation for designing digital circuits, specifying the desired behaviour and functionality of the circuit.

2. Synthesis and gate-level design. After the RTL coding is complete, the synthesis domain is next. Here, the RTL code is converted into gates, creating a gate-level representation of the circuit. This process optimises the circuit's performance, power consumption, and area utilisation.

3. Field programmable gate array (FPGA) design. Field-programmable gate arrays (FPGAs) play a vital role in electronic design. Professionals specialising in FPGA development work on designing and implementing circuits using FPGA technology. They utilise the reconfigurable nature of FPGAs to prototype and test digital circuits rapidly.

4. Analogue design. Analogue design engineers focus on the analogue portion of integrated circuits. They work with IPs and develop circuit designs for functions such as data converters, amplifiers, and filters. Their expertise lies in achieving high-performance analogue circuitry.

5. System-on-chip (SoC) design. SoCs are complex integrated circuits that combine multiple functionalities on a single chip. SoC design engineers are responsible for designing and integrating various IPs and subsystems to create a cohesive and efficient chip. They work on tasks such as bus architecture, interconnect design, and integration of IP blocks.

6. Layout design. Layout engineers collaborate with circuit design engineers to create integrated circuits' physical layouts. They ensure the circuit components are arranged optimally, considering power distribution, signal integrity, and manufacturing constraints.

7. Physical design and SoC implementation. Physical design engineers convert the soft IP into a hard IP. They work on tasks like floor planning, placement, and routing to ensure efficient utilisation of chip area and optimised performance. SoC implementation engineers oversee the entire physical design process and manage the integration of various IP blocks.

8. Physical verification. Physical verification engineers play a critical role in ensuring that the foundry can accurately fabricate the designed circuit. To identify and rectify potential manufacturing issues, they

Transitioning from open source to proprietary VLSI tools

The field of VLSI has seen the growing popularity of open source tools for learning and development. However, questions arise regarding the readiness of students who primarily work with open source tools to transition seamlessly to proprietary tools.

- Online tools for VLSI design and development are web-based, accessible from anywhere with an internet connection, and often offer free or subscription-based pricing models.
- Online tools may have a more limited feature set, limited support, and may need better integration with other design tools.
- Intellectual Property (IP) protection can be a concern when using online tools.
- Proprietary tools developed by established companies provide advanced features, extensive libraries, comprehensive functionality, and dedicated technical support.
- Proprietary tools offer better integration with other tools, robust IP protection mechanisms, regular updates, and customisation options.

However, proprietary tools often come with higher costs and require installation on specific systems. The transition from open source to proprietary tools varies among individuals. Learning through open source tools can provide a quick understanding of concepts. The learning curve for proprietary tools is complex and requires extensive brainstorming. Kunal says, "Many students with open source tool experience pick up any proprietary EDA tool, making them more productive, out-of-the-box thinkers, and get hired directly by product and services companies globally. Today, companies are looking for smart students who can figure out things on their own, and open source brings out this skill."

perform thorough checks, such as design rule checks (DRC) and layout versus schematic (LVS) verification.

9. Tape-out and tape-in. Tape-out and tape-in processes involve preparing the final design for fabrication and receiving the fabricated chips. Engineers specialising in these processes manage the transfer of design files to the foundry, collaborate with foundry partners, and ensure successful chip production. "We give certificates only if they have done tape-out. Writing on a resume that you have done a tape-out, I think companies look for these kinds of people who have done silicon tape-outs," Kunal says.

Understanding the responsibilities and expertise required in each job role is crucial for individuals seeking a career in electronic design and for organisations aiming to develop innovative and efficient electronic products. "Every student goes through all these training sessions to get a VSD certificate. This is basically to bring out what their interest is. So, they have to go through all of it, and then they will identify what they're interested in. For that field, they can either go for higher studies or some other institute that takes care of that particular field with the commercial tools," he says.

VLSI, embedded systems, firmware: expanding opportunities

The field of VLSI is undergoing a transformation as it expands to encompass embedded systems and firmware, raising questions about the job opportunities and roles that arise from integrating these elements. Let's delve into the relationship between VLSI, embedded systems, and firmware, exploring how these domains converge and the implications for job prospects.

Expanding beyond VLSI. Traditionally, VLSI engineers focused on chip design and fabrication, and completing chip manufacturing signified the conclusion of their primary responsibilities. However, a critical question emerged: What comes next? Embedded systems emerged as a potential answer to this query. The interface between the board and the chip is at the core of this transition. This interplay offers significant advantages, enabling a comprehensive understanding of the chip's internals, such as the RTL code. Moreover, the ability to write software to initiate and operate the chip marks the domain of firmware design engineers.

Unlocking the potential of embedded systems. Embedded systems play a pivotal role in realising the full potential of chips. The hardware board serves as a bridge between the chip and its practical applications. With this board, engineers gain visibility into the chip's internal components, allowing for a deeper exploration of its functionalities. The board's capacity to reveal the RTL code of the chip facilitates thorough analysis and customisation. Leveraging this insight, engineers can develop software to boot up the chip, harnessing its capabilities. The integration of embedded systems augments the role of VLSI engineers, expanding their expertise beyond chip design and delving into firmware development.

Diverse job prospects. The fusion of VLSI-embedded systems and firmware widens the horizon for job prospects in the field. While VLSI expertise forms the foundation, additional proficiency in embedded systems and firmware paves the way for diverse opportunities. Companies seek professionals with a comprehensive skill set capable of seamlessly navigating these domains. The integration of hardware and software aspects and the ability to customise chip functionalities make individuals well-equipped for various positions in chip design, system integration, firmware development, and application-specific roles.

The convergence of VLSI, embedded systems, and firmware brings an exciting era of diverse job prospects. Moving beyond chip design, engineers explore the potential of embedded systems, where the interplay between the board and chip unlocks new avenues for innova-

The open source foundry kit and development of SoC

The emergence of open source foundry kits has brought about a transformative shift in the chip design world, creating new opportunities for learning and innovation.

- These kits consist of essential files and libraries, opening up new opportunities for learning and innovation in chip design.
- The integration of the SkyWater open source foundry kit has facilitated chip design education, despite the proprietary nature of chip design libraries.
- Collaborative partnerships between SkyWater, Google, Efabless, The OpenROAD Project, and the University of California, San Diego, have formed the foundation of the open source foundry ecosystem.
- RISC-V processors play a crucial role within this ecosystem, offering flexibility and adaptability to chip designs.
- The open source foundry ecosystem promotes accessibility by requiring minimal infrastructure and providing pre-installed image files for easy access to necessary tools.
- This accessibility encourages the democratisation of chip design and fosters broader community participation in the innovation process.

The open source foundry ecosystem is revolutionising the chip design field, empowering individuals to explore and innovate while promoting inclusivity. "After successfully constructing the SoC, the designer possesses their own custom chip," Kunal says.

tion. This expansion calls for professionals skilled in VLSI, embedded systems, and firmware who fully understand the chip-to-application journey. Kunal adds, "Our chip is based on RISC-V architecture. The conventional boards do not provide access to the chip internals. However, in the case of vsdsquadron, an educational embedded board, you have the unique advantage of peering inside both the chip and the board, allowing a comprehensive understanding of the internal components and functionalities."

VLSI unleashes startup potential

In the era of technological innovation, startups often find fertile ground in emerging fields. VLSI has opened up new pathways for entrepreneurial ventures. It offers a myriad of opportunities for startups to thrive and disrupt traditional industries. By leveraging the power of integrated circuits, entrepreneurs can develop highly efficient and compact electronic systems that cater to specific market needs. These systems have the potential to revolutionise industries ranging from healthcare to telecommunications, enabling startups to gain a competitive edge in crowded markets.

Kunal says, "One of our students, driven by a passion for cutting-edge technology, has chosen to dive headfirst into the realm of neuromorphic computing. Hailing from a prestigious nursery in the United States, she has set her sights on exploring the potential of this emerging field. Tasked with building and optimising neuromorphic applications, her work promises to push the boundaries of what is possible in this exciting domain."

"Another talented student, a member of the electronics club, has set his sights on developing an accelerator designed specifically for vsdsquadron board. With an unwavering determination to create a game-changing device, he channels his expertise and creativity into bringing this innovative idea to life. His endeavours demonstrate the limitless possibilities that can be realised through focused exploration and collaboration," he adds.

As this startup continues to thrive, it serves as an inspiration to aspiring entrepreneurs and young minds around the world. It showcases the limitless possibilities that arise when VLSI education and passion converge, opening doors to a future where innovation knows no bounds. VLSI has become a launchpad for startups, propelling entrepreneurial ventures into the forefront of technological innovation. Its scalability, accessibility, collaborative ecosystem, and dynamic nature make it an ideal platform for startups to flourish. With VLSI as their foundation, startups are well-positioned to shape the future and leave an indelible mark on the world.

VLSI offers a promising and dynamic career path in integrated circuit design. With its fundamental presence in electronics engineering and its ubiquitous nature, VLSI has shaped the knowledge and skills of engineers over the years. The diverse job profiles within electronic design, the convergence with embedded systems and firmware, and the opportunities it provides for startups make VLSI a field worth exploring. Professionals skilled in VLSI, embedded systems, and firmware have the potential to innovate, customise, and disrupt industries, propelling technological advancements and leaving a lasting impact on the world. EFY

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