**CHAPTER-4**

**VLSI**

# 4. VLSI

**4.1 INTRODUCTION TO VLSI:**

Large-scale combination (VLSI) is the procedure of combining so as to make coordinated circuits a huge number of transistor-based circuits into a solitary chip. VLSI started in the 1970s when complex semiconductor and correspondence advancements were being produced. The chip is a VLSI gadget. The term is no more as normal as it once seemed to be, as chips have expanded in multifaceted nature into the countless transistors.

**4.2 OVERVIEW:**

The principal semiconductor chips held one transistor each. Ensuing advances included more transistors, and, as a result, more individual capacities or frameworks were incorporated after some time. The initially incorporated circuits held just a couple of gadgets, maybe upwards of ten diodes, transistors, resistors and capacitors, making it conceivable to manufacture one or more rationale doors on a solitary gadget. Presently referred to reflectively as "little scale joining" (SSI), upgrades in procedure prompted gadgets with several rationale entryways, known as huge scale incorporation (LSI), i.e. frameworks with no less than a thousand rationale doors. Current technology has moved far past this imprint and today's chips have numerous a large number of entryways and countless individual transistors.

At one time, there was a push to name and adjust different levels of huge scale joining above VLSI. Terms like Ultra-substantial scale Integration (ULSI) were utilized. In any case, the gigantic number of entryways and transistors accessible on regular gadgets has rendered such fine refinements debatable.

Terms recommending more prominent than VLSI levels of combination are no more in boundless use. Indeed, even VLSI is presently to some degree interesting, given the regular suspicion that all chips are VLSI or better.

Starting mid-2008, billion-transistor processors are economically accessible, an illustration of which is Intel's Montecito Itanium chip. This is relied upon to wind up more typical as semiconductor manufacture moves from the present era of 65 nm procedures to the following 45 nm eras (while encountering new difficulties, for example, expanded variety crosswise over procedure corners). Another outstanding case is NVIDIA's 280 arrangement GPU.

This microchip is one of a kind in the way that its 1.4 Billion transistor check, equipped for a teraflop of execution, is totally devoted to rationale (Itanium's transistor tally is to a great extent because of the 24MB L3 store). Current plans, rather than the most punctual gadgets, use broad outline mechanization and computerized rationale combination to lay out the transistors, empowering more elevated amounts of unpredictability in the subsequent rationale usefulness. Certain elite rationale pieces like the SRAM cell, on the other hand, are still composed by hand to guarantee the most noteworthy proficiency (some of the time by bowing or breaking set up outline standards to acquire the last piece of execution by exchanging security).

**4.3 What is VLSI?**

VLSI stands for "Very Large Scale Integration". This is the field which involves packing more and more logic devices into smaller and smaller areas.

**VLSI**

1. Simply we say Integrated circuit is many transistors on one chip.
2. Design/manufacturing of extremely small, complex circuitry using modified semiconductor material
3. Integrated circuit (IC) may contain millions of transistors, each a few mm in size
4. Applications wide ranging: most electronic logic devices

**4.4 History of Scale Integration:**

* Late 40s Transistor Invented At Bell Labs
* Late 50s First IC (JK-FF By Jack Kilby At TI)
* Early 60s Small Scale Integration (SSI)
* 10s Of Transistors On A Chip
* Late 60s Medium Scale Integration (MSI)
* 100s Of Transistors On A Chip
* Early 70s Large Scale Integration (LSI)
* 1000s Of Transistor On A Chip
* Early 80s VLSI 10,000s Of Transistors On A
* Chip (Later 100,000s & Now 1,000,000s)
* Ultra LSI Is Sometimes Used For 1,000,000s
* SSI - Small-Scale Integration (0-102)
* MSI - Medium-Scale Integration (102-103)
* LSI - Large-Scale Integration (103-105)
* VLSI - Very Large-Scale Integration (105-107)
* ULSI - Ultra Large-Scale Integration (>=107)

**4.5 ADVANTAGES OF ICS OVER DISCRETE COMPONENTS:**

While we will concentrate on integrated circuits , the properties of integrated circuits-what we can and cannot efficiently put in an integrated circuit-largely determine the architecture of the entire system. Integrated circuits improve system characteristics in several critical ways. ICs have three key advantages over digital circuits built from discrete components:

**Size:-**

Integrated circuits are much smaller-both transistors and wires are shrunk to micrometer sizes, compared to the millimeter or centimeter scales of discrete components. Small size leads to advantages in speed and power consumption, since smaller components have smaller parasitic resistances, capacitances, and inductances.

**Speed:-**

Signals can be switched between logic 0 and logic 1 much quicker within a chip than they can between chips. Communication within a chip can occur hundreds of times faster than communication between chips on a printed circuit board. The high speed of circuits on-chip is due to their small size-smaller components and wires have smaller parasitic capacitances to slow down the signal.

**Power consumption:-**

Logic operations within a chip also take much less power. Once again, lower power consumption is largely due to the small size of circuits on the chip-smaller parasitic capacitances and resistances require less power to drive them.

**4.6 VLSI AND SYSTEMS:**

These advantages of integrated circuits translate into advantages at the system level:

**Smaller physical size:** Smallness is often an advantage in itself-consider portable televisions or handheld cellular telephones.

**Lower power consumption**:. Replacing a handful of standard parts with a single chip reduces total power consumption. Reducing power consumption has a ripple effect on the rest of the system: a smaller, cheaper power supply can be used; since less power consumption means less heat, a fan may no longer be necessary; a simpler cabinet with less shielding for electromagnetic shielding may be feasible, too.

**Reduced cost:** Reducing the number of components, the power supply requirements, cabinet costs, and so on, will inevitably reduce system cost. The ripple effect of integration is such that the cost of a system built from custom ICs can be less, even though the individual ICs cost more than the standard parts they replace.

Understanding why integrated circuit technology has such profound influence on the design of digital systems requires understanding both the technology of IC manufacturing and the economics of ICs and digital systems.

**4.7 APPLICATIONS**

* Electronic system in cars.
* Digital electronics control VCRs
* Transaction processing system, ATM
* Personal computers and Workstations
* Medical electronic systems.

**4.7.1 APPLICATIONS OF VLSI:**

* Electronic systems now perform a wide variety of tasks in daily life. Electronic systems in some cases have replaced mechanisms that operated mechanically, hydraulically, or by other means; electronics are usually smaller, more flexible, and easier to service. In other cases electronic systems have created totally new applications. Electronic systems perform a variety of tasks, some of them visible, some more hidden:
* Personal entertainment systems such as portable MP3 players and DVD players perform sophisticated algorithms with remarkably little energy.
* Electronic systems in cars operate stereo systems and displays; they also control fuel injection systems, adjust suspensions to varying terrain, and perform the control functions required for anti-lock braking (ABS) systems.
* Digital electronics compress and decompress video, even at high-definition data rates, on-the-fly in consumer electronics.
* Low-cost terminals for Web browsing still require sophisticated electronics, despite their dedicated function.
* Personal computers and workstations provide word-processing, financial analysis, and games. Computers include both central processing units (CPUs) and special-purpose hardware for disk access, faster screen display, etc.
* Medical electronic systems measure bodily functions and perform complex processing algorithms to warn about unusual conditions. The availability of these complex systems, far from overwhelming consumers, only creates demand for even more complex systems.
* The growing sophistication of applications continually pushes the design and manufacturing of integrated circuits and electronic systems to new levels of complexity. And perhaps the most amazing characteristic of this collection of systems is its variety-as systems become more complex, we build not a few general-purpose computers but an ever wider range of special-purpose systems. Our ability to do so is a testament to our growing mastery of both integrated circuit manufacturing and design, but the increasing demands of customers continue to test the limits of design and manufacturing

**4.8 ASIC:**

An Application-Specific Integrated Circuit (ASIC) is an integrated circuit (IC) customized for a particular use, rather than intended for general-purpose use. For example, a chip designed solely to run a cell phone is an ASIC. Intermediate between ASICs and industry standard integrated circuits, like the 7400 or the 4000 series, are application specific standard products (ASSPs).

As feature sizes have shrunk and design tools improved over the years, the maximum complexity (and hence functionality) possible in an ASIC has grown from 5,000 gates to over 100 million. Modern ASICs often include entire 32-bit processors, memory blocks including ROM, RAM, EEPROM, Flash and other large building blocks. Such an ASIC is often termed a SOC (system-on-a-chip). Designers of digital ASICs use a hardware description language (HDL), such as Verilog or VHDL, to describe the functionality of ASICs.

Field-programmable gate arrays (FPGA) are the modern-day technology for building a breadboard or prototype from standard parts; programmable logic blocks and programmable interconnects allow the same FPGA to be used in many different applications. For smaller designs and/or lower production volumes, FPGAs may be more cost effective than an ASIC design even in production.

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A Structured ASIC falls between an FPGA and a Standard Cell-based ASIC Structured ASIC’s are used mainly for mid-volume level design. The design task for structured ASIC’s is to map the circuit into a fixed arrangement of known cells.