Designing Issues Associated with Very Large Scale Integrated Circuits

[1]Arvind Singh Rawat, [2]Amit Kumar

[1]Uttarkhand Technical University, Dehradun, UK, India

[2]SSGI Shahpur, Yamunanagar, Haryana, India

Abstract

The Very Large Scale Integration or VLSI is the process of placing thousands or hundreds of thousands of electronic components on a single chip. Nearly all modern chips employ VLSI architectures or ULSI i.e. Ultra Large Scale Integration. Very-large-scale integration (VLSI) is the process of creating integrated circuits by combining thousands of transistor-based circuits into on a single chip. VLSI began when complex semiconductor and communication technologies were being developed. The first semiconductor chips held one transistor each. Subsequent advances added more and more transistors, and as a consequence more individual functions or systems were integrated over time. The microprocessor is a VLSI device. In this paper we mainly focus on the designing issues associated with the VLSI.

Keyword

Small Scale Integrated Circuits, Very Large Scale Integrated Circuits, Ultra Large Scale Integrated Circuits, Application Specific Integrated Circuits, Field Programmable Gate Arrays, System On Chips.

I. Introduction

The development of microelectronics spans a time which is even lesser than the average life expectancy of a human, and yet it has seen as many as four generations. Early 60's saw the low density fabrication processes classified under Small Scale Integration (SSI) in which transistor count was limited to about 10. This rapidly gave way to Medium Scale Integration in the late 60's when around 100 transistors could be placed on a single chip.

It was the time when the cost of research began to decline and private firms started entering the competition in contrast to the earlier years where the main burden was borne by the military. Transistor-Transistor logic (TTL) offering higher integration densities outlasted other IC families like ECL and became the basis of the first integrated circuit revolution. Early seventies marked the growth of transistor count to about 1000 per chip called the Large Scale Integration.
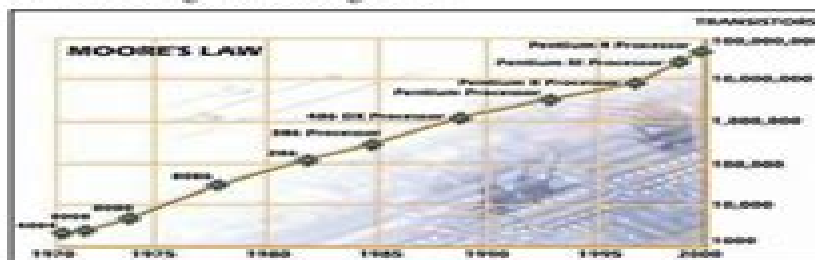

Fig. 1: Moore's Law & IC's

By mid eighties, the transistor count on a single chip had already exceeded 1000 and hence came the age of Very Large Scale

Integration or VLSI. Though many improvements have been made and the transistor count is still rising, further names of generations like ULSI are generally avoided. It was during this time when TTL lost the battle to MOS family owing to the same problems that had pushed vacuum tubes into negligence, power dissipation and the limit it imposed on the number of gates that could be placed on a single die.

II. Factors Involved in VLSI

In VLSI circuits it takes less power because each of the devices consumes only a tiny amount of power. In a switching circuit most of the power is consumed switching the charge on the capacitors that connect the switches to each other. In a large IC the components are so small and close together that that capacitance is much smaller and thus less power. It also supports less testing. If you built the same circuit out of discrete ICs and other components, each IC has to be tested before you use it for the many different ways it could be used in different applications. For 10000 ICs this is a lot of testing. In a VLSI the components are dedicated to a single use. Most are located in the middle of the VLSI and there is no access to them for testing. We can only test the function; the entire circuit was designed for.

Normally, VLSI circuits are highly reliable. The reliability of an IC is a function depends on of how many connections it has to the outside world. So if the function is constructed with many smaller ICs connected together, then there are many connections, and the reliability is lower. Those VLSI that have fewer connections should be higher reliability. Small transistor count precision circuits such as Amplifiers, Data converters, filters, Phase Locked Loops, Sensors etc.
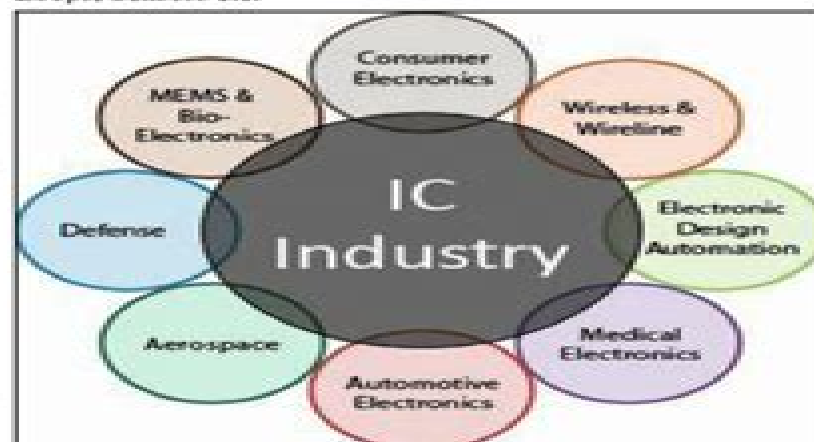

Fig. 2: Integrated Circuit Industry Impact

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aided design in control systems CADCS The latest information and exchange of ideas presented at the Symposium illustrates the development of computer aided design science and technology within control systems The Proceedings contain six plenary papers and six special invited papers and the remainder are divided into five themes CADCS packages CADCS software and hardware systems design methods CADCS expert systems CADCS applications with finally a discussion on CADCS in education and research **Integrated Circuit and System Design: Power and Timing Modeling, Optimization and Simulation** José Monteiro,Rene van Leuken,2010-02-06 This book constitutes the thoroughly refereed post conference proceedings of 19th International Workshop on Power and Timing Modeling Optimization and Simulation PATMOS 2009 featuring Integrated Circuit and System Design held in Delft The Netherlands during September 9 11 2009 The 26 revised full papers and 10 revised poster papers presented were carefully reviewed and selected from numerous submissions The papers are organized in topical sections on variability statistical timing circuit level techniques power management low power circuits technology system level techniques power timing optimization techniques self timed circuits low power circuit analysis optimization and low power design studies *VLSI-SoC: Technology Advancement on SoC Design* Victor Grimblatt,Chip Hong Chang,Ricardo Reis,Anupam Chattopadhyay,Andrea Calimera,2022-09-28 This book contains extended and revised versions of the best papers presented at the 29th IFIP WG 10 5 IEEE International Conference on Very Large Scale Integration VLSI SoC 2021 held in Singapore in October 2021 The 12 full papers included in this volume were carefully reviewed and selected from the 44 papers out of 75 submissions presented at the conference The papers discuss the latest academic and industrial results and developments as well as future trends in the field of System on Chip SoC design considering the challenges of nano scale state of the art and emerging manufacturing technologies In particular they address cutting edge research fields like low power design of RF analog and mixed signal circuits EDA tools for the synthesis and verification of heterogenous SoCs accelerators for cryptography and deep learning and on chip Interconnection system reliability and testing and integration of 3D ICs The conference was held virtually **Large Scale Network-Centric Distributed Systems** Hamid Sarbazi-Azad,Albert Y. Zomaya,2013-10-10 A highly accessible reference offering a broad range of topics and insights on large scale network centric distributed systems Evolving from the fields of high performance computing and networking large scale network centric distributed systems continues to grow as one of the most important topics in computing and communication and many interdisciplinary areas Dealing with both wired and wireless networks this book focuses on the design and performance issues of such systems Large Scale Network Centric Distributed Systems provides in depth coverage ranging from ground level hardware issues such as buffer organization router delay and flow control to the high level issues immediately concerning application or system users including parallel programming middleware and OS support for such computing systems Arranged in five parts it explains and analyzes complex topics to an unprecedented degree Part 1 Multicore and Many Core Mc Systems on Chip Part 2 Pervasive Ubiquitous Computing and

Peer to Peer Systems Part 3 Wireless Mobile Networks Part 4 Grid and Cloud Computing Part 5 Other Topics Related to Network Centric Computing and Its Applications Large Scale Network Centric Distributed Systems is an incredibly useful resource for practitioners postgraduate students postdocs and researchers **Transforming Reconfigurable Systems: A Festschrift Celebrating The 60th Birthday Of Professor Peter Cheung** Wayne Luk,George A Constantinides,2015-02-26 Over the last three decades Professor Peter Cheung has made significant contributions to a variety of areas such as analogue and digital computer aided design tools high level synthesis and hardware software codesign low power and high performance circuit architectures for signal and image processing and mixed signal integrated circuit design However the area that has attracted his greatest attention is reconfigurable systems and their design and his work has contributed to the transformation of this important and exciting discipline This festschrift contains a unique collection of technical papers based on presentations at a workshop at Imperial College London in May 2013 celebrating Professor Cheung s 60th birthday Renowned researchers who have been inspired and motivated by his outstanding research in the area of reconfigurable systems are brought together from across the globe to offer their latest research in reconfigurable systems Professor Cheung has devoted much of his professional career to Imperial College London and has served with distinction as the Head of Department of Electrical and Electronic Engineering for several years His outstanding capability and his loyalty to Imperial College and the Department of Electrical and Electronic Engineering are legendary Professor Cheung has made tremendous strides in ensuring excellence in both research and teaching and in establishing sound governance and strong financial endowment but above all he has made his department a wonderful place in which to work and study *Computer Aided Systems Theory -- EUROCAST 2011* Roberto Moreno-Díaz,Franz Pichler,Alexis Quesada-Arencibia,2012-01-26 The two volume proceedings LNCS 6927 and LNCS 6928 constitute the papers presented at the 13th International Conference on Computer Aided Systems Theory EUROCAST 2011 held in February 2011 in Las Palmas de Gran Canaria Spain The total of 160 papers presented were carefully reviewed and selected for inclusion in the books The contributions are organized in topical sections on concepts and formal tools software applications computation and simulation in modelling biological systems intelligent information processing heurist problem solving computer aided systems optimization model based system design simulation and verification computer vision and image processing modelling and control of mechatronic systems biomimetic software systems computer based methods for clinical and academic medicine modeling and design of complex digital systems mobile and autonomous transportation systems traffic behaviour modelling and optimization mobile computing platforms and technologies and engineering systems applications **Emerging Technology and Architecture for Big-data Analytics** Anupam Chattopadhyay,Chip Hong Chang,Hao Yu,2017-04-19 This book describes the current state of the art in big data analytics from a technology and hardware architecture perspective The presentation is designed to be accessible to a broad audience with general knowledge of hardware design and some interest in big data analytics Coverage

includes emerging technology and devices for data analytics circuit design for data analytics and architecture and algorithms to support data analytics Readers will benefit from the realistic context used by the authors which demonstrates what works what doesn t work and what are the fundamental problems solutions upcoming challenges and opportunities Provides a single source reference to hardware architectures for big data analytics Covers various levels of big data analytics hardware design abstraction and flow from device to circuits and systems Demonstrates how non volatile memory NVM based hardware platforms can be a viable solution to existing challenges in hardware architecture for big data analytics **VLSI 2010 Annual Symposium** Nikolaos Voros,Amar Mukherjee,Nicolas Sklavos,Konstantinos Masselos,Michael Huebner,2011-09-08 VLSI 2010 Annual Symposium will present extended versions of the best papers presented in ISVLSI 2010 conference The areas covered by the papers will include among others Emerging Trends in VLSI Nanoelectronics Molecular Biological and Quantum Computing MEMS VLSI Circuits and Systems Field programmable and Reconfigurable Systems System Level Design System on a Chip Design Application Specific Low Power VLSI System Design System Issues in Complexity Low Power Heat Dissipation Power Awareness in VLSI Design Test and Verification Mixed Signal Design and Analysis Electrical Packaging Co Design Physical Design Intellectual property creating and sharing Computer Aided Systems Theory - CAST '94 Tuncer I. Ören,George J. Klir,1996-07 This volume presents a collection of revised refereed papers selected from the presentations at the Fourth International Workshop on Computer Aided Systems Theory CAST 94 held in Ottawa Ontario Canada in May 1994 The 31 full papers included in the book were chosen from originally 82 submissions and reflect the state of the art in the area of computer aided systems theory The volume is divided into sections on foundations methods and tools and environments Split Manufacturing of Integrated Circuits for Hardware Security and Trust Ranga Vemuri,Suyuan Chen,2021-05-25 Globalization of the integrated circuit IC supply chains led to many potential vulnerabilities Several attack scenarios can exploit these vulnerabilities to reverse engineer IC designs or to insert malicious trojan circuits Split manufacturing refers to the process of splitting an IC design into multiple parts and fabricating these parts at two or more foundries such that the design is secure even when some or all of those foundries are potentially untrusted Realizing its security benefits researchers have proposed split fabrication methods for 2D 2 5D and the emerging 3D ICs Both attack methods against split designs and defense techniques to thwart those attacks while minimizing overheads have steadily progressed over the past decade This book presents a comprehensive review of the state of the art and emerging directions in design splitting for secure split fabrication design recognition and recovery attacks against split designs and design techniques to defend against those attacks Readers will learn methodologies for secure and trusted IC design and fabrication using split design methods to protect against supply chain vulnerabilities **Multi-Core Embedded Systems** Georgios Kornaros,2018-10-08 Details a real world product that applies a cutting edge multi core architecture Increasingly demanding modern applications such as those used in telecommunications networking and real time processing

of audio video and multimedia streams require multiple processors to achieve computational performance at the rate of a few giga operations per second This necessity for speed and manageable power consumption makes it likely that the next generation of embedded processing systems will include hundreds of cores while being increasingly programmable blending processors and configurable hardware in a power efficient manner Multi Core Embedded Systems presents a variety of perspectives that elucidate the technical challenges associated with such increased integration of homogeneous processors and heterogeneous multiple cores It offers an analysis that industry engineers and professionals will need to understand the physical details of both software and hardware in embedded architectures as well as their limitations and potential for future growth Discusses the available programming models spread across different abstraction levels The book begins with an overview of the evolution of multiprocessor architectures for embedded applications and discusses techniques for autonomous power management of system level parameters It addresses the use of existing open source and free tools originating from several application domains such as traffic modeling graph theory parallel computing and network simulation In addition the authors cover other important topics associated with multi core embedded systems such as Architectures and interconnects Embedded design methodologies Mapping of applications   **The Electrical Engineering Handbook,Second Edition** Richard C. Dorf,1997-09-26 In 1993 the first edition of The Electrical Engineering Handbook set a new standard for breadth and depth of coverage in an engineering reference work Now this classic has been substantially revised and updated to include the latest information on all the important topics in electrical engineering today Every electrical engineer should have an opportunity to expand his expertise with this definitive guide In a single volume this handbook provides a complete reference to answer the questions encountered by practicing engineers in industry government or academia This well organized book is divided into 12 major sections that encompass the entire field of electrical engineering including circuits signal processing electronics electromagnetics electrical effects and devices and energy and the emerging trends in the fields of communications digital devices computer engineering systems and biomedical engineering A compendium of physical chemical material and mathematical data completes this comprehensive resource Every major topic is thoroughly covered and every important concept is defined described and illustrated Conceptually challenging but carefully explained articles are equally valuable to the practicing engineer researchers and students A distinguished advisory board and contributors including many of the leading authors professors and researchers in the field today assist noted author and professor Richard Dorf in offering complete coverage of this rapidly expanding field No other single volume available today offers this combination of broad coverage and depth of exploration of the topics The Electrical Engineering Handbook will be an invaluable resource for electrical engineers for years to come   **Electronics, Power Electronics, Optoelectronics, Microwaves, Electromagnetics, and Radar** Richard C. Dorf,2018-10-03 In two editions spanning more than a decade The Electrical Engineering Handbook stands as the definitive reference to the

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