

# **INTERCONNECT TECHNOLOGY AND DESIGN FOR GIGASCALE INTEGRATION**

*Edited by:  
Jeffrey A. Davis  
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# Interconnect Technology And Design For Gigascale Integration

**Muhannad S. Bakir, James D. Meindl**



## **Interconnect Technology And Design For Gigascale Integration:**

**Interconnect Technology and Design for Gigascale Integration** Jeffrey A. Davis, James D. Meindl, 2012-12-06

Interconnect Technology and Design for Gigascale Integration is the cumulative effort from academic researchers at Georgia Tech MIT and Stanford as well as from industry researchers at IBM T J Watson Research Center LSI Logic and SUN microsystems The material found in this book is unique in that it spans IC interconnect topics ranging from IBM's revolutionary copper process to an in depth exploration into interconnect aware computer architectures This broad swath of topics presented by leaders in the research field is intended to provide a comprehensive perspective on interconnect technology and design issues so that the reader will understand the implications of the semiconductor industry's next substantial milestone gigascale integration

### **Integrated Interconnect Technologies for 3D Nanoelectronic Systems**

Muhannad S. Bakir, James D. Meindl, 2009 This cutting edge book on off chip technologies puts the hottest breakthroughs in high density compliant electrical interconnects nanophotonics and microfluidics at your fingertips integrating the full range of mathematics physics and technology issues together in a single comprehensive source You get full details on state of the art I/O interconnects and packaging including mechanically compliant I/O approaches fabrication and assembly followed by the latest advances and applications in power delivery design analysis and modeling The book explores interconnect structures materials and packages for achieving high bandwidth off chip electrical communication including optical interconnects and chip to chip signaling approaches and brings you up to speed on CMOS integrated optical devices 3D integration wafer stacking technology and through wafer interconnects

### **Transactions on High-Performance**

**Embedded Architectures and Compilers IV** Per Stenström, 2011-11-22 Transactions on HiPEAC aims at the timely dissemination of research contributions in computer architecture and compilation methods for high performance embedded computer systems Recognizing the convergence of embedded and general purpose computer systems this journal publishes original research on systems targeted at specific computing tasks as well as systems with broad application bases The scope of the journal therefore covers all aspects of computer architecture code generation and compiler optimization methods of interest to researchers and practitioners designing future embedded systems This 4th issue contains 21 papers carefully reviewed and selected out of numerous submissions and is divided in four sections The first section contains five regular papers The second section consists of the top four papers from the 4th International Conference on High Performance Embedded Architectures and Compilers HiPEAC 2009 held in Paphos Cyprus in January 2009 The third section contains a set of six papers providing a snap shot from the Workshop on Software and Hardware Challenges of Manycore Platforms SHCMP 2008 held in Beijing China in June 2008 The fourth section consists of six papers from the 8th IEEE International Symposium on Systems Architectures Modeling and Simulation SAMOS VIII 2008 held in Samos Greece in July 2008

**Integrated Circuit and System Design. Power and Timing Modeling, Optimization, and Simulation** Rene van Leuken, Gilles

Sicard,2011-01-16 This book constitutes the refereed proceedings of the 20th International Conference on Integrated Circuit and System Design PATMOS 2010 held in Grenoble France in September 2010 The 24 revised full papers presented and the 9 extended abstracts were carefully reviewed and are organized in topical sections on design flows circuit techniques low power circuits self timed circuits process variation high level modeling of poweraware heterogeneous designs in SystemC AMS and minalogic

**Microsystems for Bioelectronics** Victor V. Zhirnov,Ralph K. Cavin III,2015-02-27 The advances in microsystems offer new opportunities and capabilities to develop systems for biomedical applications such as diagnostics and therapy There is a need for a comprehensive treatment of microsystems and in particular for an understanding of performance limits associated with the shrinking scale of microsystems The new edition of Microsystems for Bioelectronics addresses those needs and represents a major revision expansion and advancement of the previous edition This book considers physical principles and trends in extremely scaled autonomous microsystems such as integrated intelligent sensor systems with a focus on energy minimization It explores the implications of energy minimization on device and system architecture It further details behavior of electronic components and its implications on system level scaling and performance limits In particular fundamental scaling limits for energy sourcing sensing memory computation and communication subsystems are developed and new applications such as optical magnetic and mechanical sensors are presented The new edition of this well proven book with its unique focus and interdisciplinary approach shows the complexities of the next generation of nanoelectronic microsystems in a simple and illuminating view and is aimed for a broad audience within the engineering and biomedical community

Advanced Nanoscale ULSI Interconnects: Fundamentals and Applications Yosi Shacham-Diamand,Tetsuya Osaka,Madhav Datta,Takayuki Ohba,2009-09-19 In Advanced ULSI interconnects fundamentals and applications we bring a comprehensive description of copper based interconnect technology for ultra lar scale integration ULSI technology for integrated circuit IC application In grated circuit technology is the base for all modern electronics systems You can nd electronics systems today everywhere from toys and home appliances to a planes and space shuttles Electronics systems form the hardware that together with software are the bases of the modern information society The rapid growth and vast exploitation of modern electronics system create a strong demand for new and improved electronic circuits as demonstrated by the amazing progress in the eld of ULSI technology This progress is well described by the famous Moore s law which states in its most general form that all the metrics that describe integrated circuit performance e g speed number of devices chip area improve expon tially as a function of time For example the number of components per chip d bles every 18 months and the critical dimension on a chip has shrunk by 50% every 2 years on average in the last 30 years This rapid growth in integrated circuits te nology results in highly complex integrated circuits with an increasing number of interconnects on chips and between the chip and its package The complexity of the interconnect network on chips involves an increasing number of metal lines per interconnect level more interconnect

levels and at the same time a reduction in the interconnect line critical dimensions      Introduction to VLSI Design Flow Saurabh,2023      **Advanced Field-Solver Techniques for RC Extraction of Integrated Circuits** Wenjian Yu,Xiren Wang,2014-04-21 Resistance and capacitance RC extraction is an essential step in modeling the interconnection wires and substrate coupling effect in nanometer technology integrated circuits IC The field solver techniques for RC extraction guarantee the accuracy of modeling and are becoming increasingly important in meeting the demand for accurate modeling and simulation of VLSI designs Advanced Field Solver Techniques for RC Extraction of Integrated Circuits presents a systematic introduction to and treatment of the key field solver methods for RC extraction of VLSI interconnects and substrate coupling in mixed signal ICs Various field solver techniques are explained in detail with real world examples to illustrate the advantages and disadvantages of each algorithm This book will benefit graduate students and researchers in the field of electrical and computer engineering as well as engineers working in the IC design and design automation industries Dr Wenjian Yu is an Associate Professor at the Department of Computer Science and Technology at Tsinghua University in China Dr Xiren Wang is a R D Engineer at Cadence Design Systems in the USA      Design and Crosstalk Analysis in Carbon Nanotube Interconnects P. Uma Sathyakam,Partha Sharathi Mallick,2020-10-31 This book provides a single source reference on carbon nanotubes for interconnect applications It presents the recent advances in modelling and challenges of carbon nanotube CNT based VLSI interconnects Starting with a background of carbon nanotubes and interconnects this book details various aspects of CNT interconnect models the design metrics of CNT interconnects crosstalk analysis of recently proposed CNT interconnect structures and geometries Various topics covered include the use of semiconducting CNTs around metallic CNTs CNT interconnects with air gaps use of emerging ultra low k materials and their integration with CNT interconnects and geometry based crosstalk reduction techniques This book will be useful for researchers and design engineers working on carbon nanotubes for interconnects for both 2D and 3D integrated circuits

**International Conference on Intelligent Computing and Smart Communication 2019** Geetam Singh Tomar,Narendra S. Chaudhari,Jorge Luis V. Barbosa,Mahesh Kumar Aghwariya,2020-01-07 This book gathers high quality research papers presented at the First International Conference ICSC 2019 organised by THDC Institute of Hydropower Engineering and Technology Tehri India from 20 to 21 April 2019 The book is divided into two major sections Intelligent Computing and Smart Communication Some of the areas covered are Parallel and Distributed Systems Web Services Databases and Data Mining Applications Feature Selection and Feature Extraction High Performance Data Mining Algorithms Knowledge Discovery Communication Protocols and Architectures High speed Communication High Voltage Insulation Technologies Fault Detection and Protection Power System Analysis Embedded Systems Architectures Electronics in Renewable Energy CAD for VLSI Green Electronics Signal and Image Processing Pattern Recognition and Analysis Multi Resolution Analysis and Wavelets 3D and Stereo Imaging and Neural Networks      Nano-Net Alexandre Schmid,Sanjay

Goel,Wei Wang,Valeriu Beiu,Sandro Carrara,2009-10-13 This book constitutes the proceedings of the 4th International Conference on Nano Networks Nano Net 2009 held in Lucerne Switherland in October 2009 The 36 invited and regular papers address the whole spectrum of Nano Networks and spans topics like modeling simulation standards architectural aspects novel information and graph theory aspects device physics and interconnects nanorobotics as well as nano biological systems The volume also contains the workshop on Nano Bio Sensing Paradigms as well as the workshop on Brain Inspired Interconnects and Circuits

**Design of 3D Integrated Circuits and Systems** Rohit Sharma,2018-09-03 Three dimensional 3D integration of microsystems and subsystems has become essential to the future of semiconductor technology development 3D integration requires a greater understanding of several interconnected systems stacked over each other While this vertical growth profoundly increases the system functionality it also exponentially increases the design complexity Design of 3D Integrated Circuits and Systems tackles all aspects of 3D integration including 3D circuit and system design new processes and simulation techniques alternative communication schemes for 3D circuits and systems application of novel materials for 3D systems and the thermal challenges to restrict power dissipation and improve performance of 3D systems Containing contributions from experts in industry as well as academia this authoritative text Illustrates different 3D integration approaches such as die to die die to wafer and wafer to wafer Discusses the use of interposer technology and the role of Through Silicon Vias TSVs Presents the latest improvements in three major fields of thermal management for multiprocessor systems on chip MPSoCs Explores ThruChip Interface TCI NAND flash memory stacking and emerging applications Describes large scale integration testing and state of the art low power testing solutions Complete with experimental results of chip level 3D integration schemes tested at IBM and case studies on advanced complementary metal oxide semiconductor CMOS integration for 3D integrated circuits ICs Design of 3D Integrated Circuits and Systems is a practical reference that not only covers a wealth of design issues encountered in 3D integration but also demonstrates their impact on the efficiency of 3D systems

Nanoelectronic Circuit Design Niraj K. Jha, Deming Chen,2010-12-21 This book is about large scale electronic circuits design driven by nanotechnology where nanotechnology is broadly defined as building circuits using nanoscale devices that are either implemented with nanomaterials e g nanotubes or nanowires or following an unconventional method e g FinFET or III V compound based devices These nanoscale devices have significant potential to revolutionize the fabrication and integration of electronic systems and scale beyond the perceived scaling limitations of traditional CMOS While innovations in nanotechnology originate at the individual device level realizing the true impact of electronic systems demands that these device level capabilities be translated into system level benefits This is the first book to focus on nanoscale circuits and their design issues bridging the existing gap between nanodevice research and nanosystem design

**Nanoelectronics** Robert Puer, Livio Baldi, Marcel Van de Voorde, Sebastiaan E. van Nooten,2017-04-11 Offering first hand insights by top scientists and industry experts at the forefront of R D into

nanoelectronics this book neatly links the underlying technological principles with present and future applications A brief introduction is followed by an overview of present and emerging logic devices memories and power technologies Specific chapters are dedicated to the enabling factors such as new materials characterization techniques smart manufacturing and advanced circuit design The second part of the book provides detailed coverage of the current state and showcases real future applications in a wide range of fields safety transport medicine environment manufacturing and social life including an analysis of emerging trends in the internet of things and cyber physical systems A survey of main economic factors and trends concludes the book Highlighting the importance of nanoelectronics in the core fields of communication and information technology this is essential reading for materials scientists electronics and electrical engineers as well as those working in the semiconductor and sensor industries

Design and Test Technology for Dependable Systems-on-Chip Ubar, Raimund, Raik, Jaan, Vierhaus, Heinrich Theodor, 2010-12-31 This book covers aspects of system design and efficient modelling and also introduces various fault models and fault mechanisms associated with digital circuits integrated into System on Chip SoC Multi Processor System on Chip MPSoC or Network on Chip NoC

*Silicon Photonics* Lorenzo Pavesi, 2004-03-04 This book gives a fascinating picture of the state of the art in silicon photonics and a perspective on what can be expected in the near future It is composed of a selected number of reviews authored by world leaders in the field and is written from both academic and industrial viewpoints An in depth discussion of the route towards fully integrated silicon photonics is presented This book will be useful not only to physicists chemists materials scientists and engineers but also to graduate students who are interested in the fields of microphotonics and optoelectronics

*High Speed, Low Driving Voltage Vertical Cavity Germanium-silicon Modulators for Optical Interconnect* Yiwen Rong, 2010 Information processing requires interconnects to carry information from one place to another Optical interconnects between electronics systems have attracted significant attention and development for a number of years because optical links have demonstrated potential advantages for high speed low power and interference immunity With increasing system speed and greater bandwidth requirements the distance over which optical communication is useful has continually decreased to chip to chip and on chip levels Monolithic integration of photonics and electronics will significantly reduce the cost of optical components and further combine the functionalities of chips on the same or different boards or systems Modulators are one of the fundamental building blocks for optical interconnects Previous work demonstrated modulators based upon the quantum confined Stark effect QCSE in SiGe p i n devices with strained Ge SiGe multi quantum well MQW structures in the i region While the previous work demonstrated the effect it did not examine the high speed aspects of the device which is the focus of this dissertation High speed modulation and low driving voltage are the keys for the device s practical use At lower optical intensity operation the ultimate limitation in speed will be the RC time constant of the device itself At high optical intensity the large number of photo generated carriers in the MQW region will limit the performance of the device through photo

carrier related voltage drop and exciton saturation In previous work the devices consist of MQWs configured as p i n diodes The electric field induced absorption change by QCSE modulates the optical transmission of the device The focus of this thesis is the optimization of MQW material deposition minimization of the parasitic capacitance of the probe pads for high speed low voltage and high contrast ratio operation The design fabrication and high speed characterization of devices of different sizes with different bias voltages are presented The device fabrication is based on processes for standard silicon electronics and is suitable for mass production This research will enable efficient transceivers to be monolithically integrated with silicon chips for high speed optical interconnects We demonstrated a modulator with an eye diagram of 3 125GHz a small driving voltage of 2 5V and an f3dB bandwidth greater than 30GHz Carrier dynamics under ultra fast laser excitation and high speed photocurrent response are also investigated

**Three-Dimensional Integrated Circuit Design** Vasilis F. Pavlidis, Ioannis Savidis, Eby G. Friedman, 2017-07-04 Three Dimensional Integrated Circuit Design Second Edition expands the original with more than twice as much new content adding the latest developments in circuit models temperature considerations power management memory issues and heterogeneous integration 3 D IC experts Pavlidis Savidis and Friedman cover the full product development cycle throughout the book emphasizing not only physical design but also algorithms and system level considerations to increase speed while conserving energy A handy comprehensive reference or a practical design guide this book provides effective solutions to specific challenging problems concerning the design of three dimensional integrated circuits Expanded with new chapters and updates throughout based on the latest research in 3 D integration Manufacturing techniques for 3 D ICs with TSVs Electrical modeling and closed form expressions of through silicon vias Substrate noise coupling in heterogeneous 3 D ICs Design of 3 D ICs with inductive links Synchronization in 3 D ICs Variation effects on 3 D ICs Correlation of WID variations for intra tier buffers and wires Offers practical guidance on designing 3 D heterogeneous systems Provides power delivery of 3 D ICs Demonstrates the use of 3 D ICs within heterogeneous systems that include a variety of materials devices processors GPU CPU integration and more Provides experimental case studies in power delivery synchronization and thermal characterization

**Nanoelectronics and Information Technology** Rainer Waser, 2012-05-29 Fachlich auf h chstem Niveau visuell berzeugend und durchg ngig farbig illustriert Das ist die neue Auflage der praxisbew hrten Einf hrung in spezialisierte elektronische Materialien und Bauelemente aus der Informationstechnologie ber ein Drittel des Inhalts ist neu alle anderen Beitr ge wurden gr ndlich bearbeitet und aktualisiert

**Nanometer CMOS** Juin J. Liou, Frank Schwierz, Hei Wong, 2010-02-28 This book presents the material necessary for understanding the physics operation design and performance of modern MOSFETs with nanometer dimensions It offers a brief introduction to the field and a thorough overview of MOSFET physics detailing the relevant basics The authors apply presented models to calculate and demonstrate transistor characteristics and they include required input data e g dimensions doping enabling readers to repeat the calculations and compare their results The book introduces



conventional and novel advanced MOSFET concepts such as multiple gate structures or alternative channel materials Other topics covered include high k dielectrics and mobility enhancement techniques MOSFETs for RF radio frequency applications MOSFET fabrication technology

Discover tales of courage and bravery in Crafted by is empowering ebook, **Interconnect Technology And Design For Gigascale Integration** . In a downloadable PDF format ( \*), this collection inspires and motivates. Download now to witness the indomitable spirit of those who dared to be brave.

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