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Thermal Management Market Visions & Strategies

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EXECUTIVE BRIEFING: THERMAL MANAGEMENT MARKET VISIONS & STRATEGIES

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A ONE-DAY SYMPOSIUM AND EXHIBITS

SEMI-THERM® EXECUTIVE BRIEFING:
Thermal Management Market Visions & Strategies

MORNING AGENDA

7:00 a.m.	**Registration Opens**
8:15 a.m. – 8:30 a.m.	**Welcome and Introduction**
8:30 a.m. – 9:00 a.m.	**TRENDS AND COMPETITIVE ACTIVITY IN THERMAL MANAGEMENT R&D** Kevin M. Closson, Senior Analyst, Nerac, Inc.
9:00 a.m. – 9:30 a.m.	**ARE YOU LEVERAGING DOD FUNDING?** Kenneth E. Goodson, Ph.D., Professor and Vice Chair of Mechanical Engineering, Stanford University
9:30 a.m. – 10:00 a.m.	**EMERGING TRENDS FOR THERMALLY CONDUCTIVE MATERIALS IN ELECTRONICS PACKAGING** Radesh Jewram, Sr. R&D Engineer, The Berquist Company
10:00 a.m. – 10:30 a.m.	**Morning Break and Exhibits**
10:30 a.m. – 11:00 a.m.	**THERMAL MANAGEMENT IN THE "3D-SIP" WORLD OF THE FUTURE** Wilmer (Bill) R. Bottoms, Ph.D., President, 3MTS
11:00 a.m. – 11:30 a.m.	**LED LIGHTING - A HOT TOPIC WITH A BRIGHT FUTURE** Pat Bournes, Senior Development Engineer for Packaging, Philips Lumileds
11:30 a.m. – 12:00 p.m.	**DATACENTER AND SERVER THERMAL TRENDS AND CHALLENGES** David Copeland, DrEng, Thermal Engineering, Packaging Technology, Oracle Corporation
12:00 p.m. - 1:15 p.m.	**Lunch and Exhibits**

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AFTERNOON AGENDA

1:15 p.m. – 2:00 p.m.	***KEYNOTE ADDRESS:*** **WHAT BURNS ME UP?** Roger Stout, PE, Research Scientist, Packaging Technology, Corporate R&D, ON Semiconductor
2:00 p.m. – 2:30 p.m.	**INCREASED PERFORMANCE FROM A LEGACY SYSTEM** Patrick Loney, Fellow Mechanical Engineer, Northrop Grumman Electronics Systems
2:30 p.m. – 3:00 p.m.	**THERMAL CHALLENGES OF COMPLEX FPGA/3D ICS FOR SPACE APPLICATIONS** Reza Ghaffarian, Ph.D., Principal Engineer, Jet Propulsion Laboratory, California Institute of Technology
3:00 p.m. – 3:30 p.m.	**Afternoon Break and Exhibits**
3:30 p.m. – 4:00 p.m.	**COMMUNICATIONS: EVOLUTION OR REVOLUTION?** Dave Redford, Principal Network Design Engineer, Thermal Management SME, Global Engineering Support, AT&T NPE / The "Kool" Guy
4:00 p.m. – 4:30 p.m.	**MOBILE PHONE THERMAL DESIGN ANALYSIS** Sam Z. Zhao, Associate Technical Director, Broadcom Corporation
4:30 p.m. – 5:00 p.m.	**THERMAL MANAGEMENT CHALLENGES IN MOBILE INTEGRATED SYSTEMS** Ilyas Mohammed, Sr. Director and Principal Technologist, Invensas
5:00 p.m. – 6:00 p.m.	**Reception and Exhibits**

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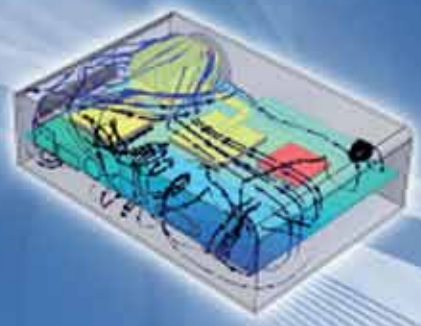

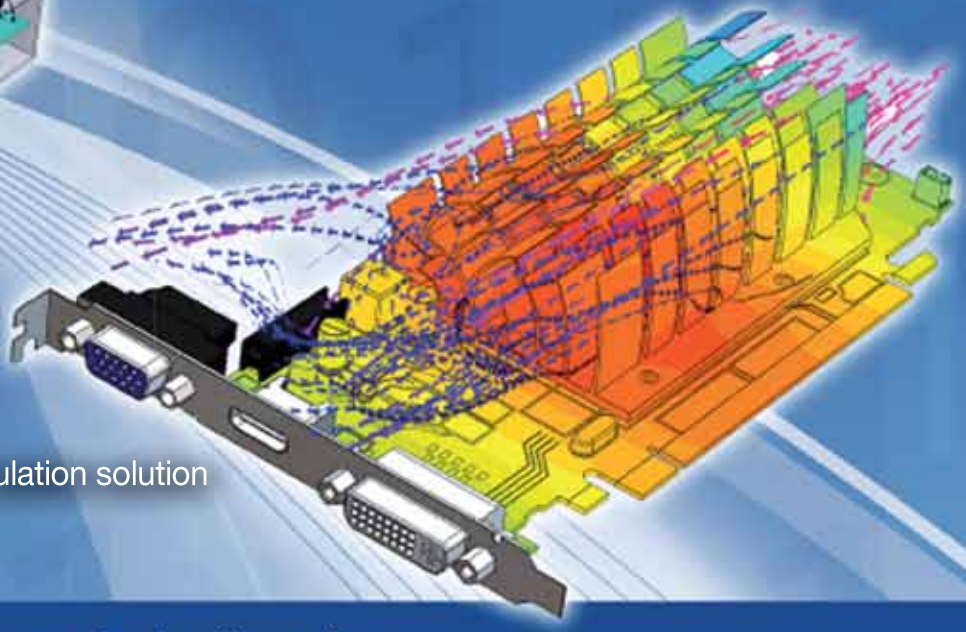

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Electronics Cooling Magazine has been providing a technical data column since 1997 with the intent of providing you, the readers, with pertinent material properties for use in thermal analyses. They have largely covered the most common materials and their associated thermal properties used in electronics packaging.

Electronic Protection Magazine

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Electronics Protection is a solutions and technology magazine edited for OEM design engineers and product development professionals of electrical, electronic, commercial, consumer and industrial products; and for managers and integrators of highly sensitive equipment who utilize electronics protection technologies and testing. The magazine features technical articles and covers the latest technology advancements, innovative projects, new products, service capabilities, business news and market developments covering all aspects of the electronics protection and electronics packaging marketplace.

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PARTICIPANT BIOGRAPHIES

SYMPOSIUM CHAIR

MARTIN GOETZ is Design Manager of Hardware Engineering at Northrop Grumman Electronics Systems. He is a senior member of IEEE and leads a group at Northrop Grumman which designs multi-chip modules used in a variety of defense electronic systems. He has over 25 years' experience in leading edge microelectronics, ranging from chip scale and wafer level packaging to 2.5 and 3D integration, from high speed digital processing to RF/Microwave/mm wave communications, radar and sensors. His career has taken him through both large organizations such as IBM, HP, Alcoa and the U.S. Air Force, as well as start-up microelectronics companies. He has published widely on electronic device architectures, processes, integration and application topics and presented numerous invited talks worldwide. Additionally, he has served as the chair of the IEEE CPMT Silicon Valley Chapter as well as a variety of technical conferences and symposiums.

SYMPOSIUM COMMITTEE

GEORGE A. MEYER IV is CEO of Celsia is an industry veteran with over three decades experience in electronics thermal management. He has been with Celsia since December 2005, first as VP Sales and Marketing for the Americas and Europe regions and then as COO and CTO. Prior to Celsia, he held various positions with Thermacore International (a leading supplier of thermal management solutions) including chairman and general manager of Thermacore Taiwan and Korea, as well as vice president, worldwide sales and marketing. He graduated from Penn State University with a degree in Communications and holds an International Business Certificate from Franklin and Marshall College. Mr. Meyer holds over 70 patents and patents pending in the field of electronics thermal management.

BHAVESH MUNI is currently Global Marketing Manager for Dow Electronic Materials' Advanced Packaging Technologies business and is responsible for the strategic marketing of the semiconductor packaging materials segment. Prior to joining Dow, Mr. Muni worked with leading electronic material suppliers, such as Henkel Electronic Materials, Lord Corp., Emersion & Cuming and Olin Hunt Conductive Materials, and has held various positions covering global business development. He is an active member of MEPTEC advisory board and strong believer in partnership between supplier and customers across the assembly value chain. He holds an M.S. degree in Polymer Science from University of Detroit, MI and a B.E. in Chemical Engineering from Regional Engineering College in Srinagar, India. He is based in the Los Angeles, CA area.

TOM TARTER is a working professional in the area of thermal management and electrical characterization of packaging structures. He is the president and found of Package Science Services LLC. His prior experience includes over 16 years at Advanced Micro Devices, Advanced Interconnect Technology and Neophotonics Corporation. Tom has authored or co-authored over 30 published papers and numerous short courses and lectures on thermal and electrical phenomenon in microelectronic packaging and most recently in optoelectronic packaging. He is the general manager of the semiconductor heat transfer conference Semi-Therm. He has worked with the IEEE/CPMT for several years and has an excellent track record of engineering community service. Tom is a senior member of the IEEE.

(continued)

KEYNOTE SPEAKER

ROGER STOUT, PE, is "some kind" of Scientist and charter employee of ON Semiconductor. He received his BSE in Mechanical Engineering at Arizona State University in 1977, and went on as a Hughes Fellow to earn his MSME at the California Institute of Technology in 1979. He then joined Motorola in the equipment engineering side of the semiconductor business, which after about four years evolved into factory automation and control engineering. In about 1990, he took on the responsibility for thermal characterization of ASIC products.

In his 35 year career, Roger has authored and coauthored 61 technical papers, the vast majority related to thermal characterization of semiconductor devices. Many have been presented at industry conferences, several published in peer-reviewed journals, and a number appear as "Application Notes" on the ON Semiconductor web site. In turn, Roger has been a peer reviewer for a number of technical conferences and journals, most recently as a referee for the journal IEEE Transactions on Components and Packaging Technologies. Over the past decade, Roger has contributed articles to trade magazines, and created and presented thermal seminars and tutorials for a number of industry conferences, including ITherm (2004, 2010), Semi-Therm (2005), APEC (2006, 2008, & 2011), the Automotive Electronics Reliability Workshop (2007), InterPACK (2007), and the Power Electronics Technology Exhibition & Conference (2007). Two of his 1 hour seminars (on the subjects of Linear Superposition and Thermal Runaway) were published in late 2006 by IEEE on their Expert Now educational web site, and variations on these two tutorials are also available through ON's external web site. He has also presented versions of these seminars at a number of ON customer/marketing "tech days" around the country and in Europe.

Roger holds six patents, and has been a registered Professional Engineer (Mechanical) in the state of Arizona since 1983. He lives in a very energy-efficient custom-designed and built monolithic thin-shell concrete dome house, partially powered by photovoltaic panels. On long trips he drives hybrid (gasoline-electric) Prius's, and on his daily commute he drives a Tesla Roadster 2.5. When he's not collecting data somewhere, he sings tenor in (and is the webmaster for) the Sonoran Desert Chorale.

PRESENTERS

WILMER (BILL) R. BOTTOMS, PH.D. received a B.S. degree in Physics from Huntington College in Montgomery, Alabama in 1965, and a Ph.D. in Solid State from Tulane University in New Orleans in 1969 and is currently Chairman of Third Millennium Test Solutions. He has worked as a faculty member in the department of electrical engineering at Princeton University, manager of Research and Development at Varian Associates, founding President of the Semiconductor Equipment Group of Varian Associates and general Partner of Patricof & Co. Ventures. Dr. Bottoms has participated in the start-up and growth of many companies through his venture capital activity and through his own work as an entrepreneur. These include companies both directly and indirectly related to semiconductor.

PAT BOURNES is a Senior Development Engineer for packaging at Philips Lumileds, a leader in LED lighting industry. He has over 20 years of experience in the laser and optics industry. He holds patents covering packaging of power laser devices and novel packaging technologies. Pat was formerly with the US government where he served as a scout for technologies appropriate for use by government agencies. He earned a B.S. in Mechanical Engineering and an MS in Electrical Engineering from the Georgia Institute of Technology.

KEVIN M. CLOSSON is a senior analyst at Nerac, where he advises clients on business, technical, and intellectual property issues. In his role as consulting analyst, he advises technology and manufacturing companies on issues related to innovation, competitive intelligence and market analysis. He has industry experience in electronics manufacturing, photonics, and telecommunications. Kevin has a BS in Mechanical Engineering from Penn State University, an MS in Mechanical Engineering from the University of Maryland, and an MBA from the University of Baltimore. He is a member of IEEE, ASME, and IMAPS.

DAVID COPELAND, DrEng, is in Thermal Engineering and Packaging Technology at Oracle Corporation where he develops packaging and cooling technology for UltraSPARC processors and the systems which use them. Areas of development include thermal interfaces, heat spreading materials, vapor chamber heatsinks, single-phase and phase-change liquid cooling and data center cooling. He received the BS from Massachusetts Institute of Technology, MS from Stanford University and DrEng from Tokyo Institute of Technology, all in Mechanical Engineering. Before coming to Sun in 2005, David worked in packaging and cooling at IBM, Hitachi and Fujitsu and in heatsink development and design at Intricast, Sumitomo and Showa Aluminum. He belongs to ASME, IEEE and IMAPS and is a frequent participant at conferences on electronics cooling.

REZA GHAFFARIAN, PH.D. has more than 30 years of industrial and academic experience. For the last 20 years at NASA/JPL, he led R&D reliability and quality assurance activities in advanced electronic packaging and has been a consultant resource for most JPL flight projects including Mars Curiosity Rover. He received many awards including the NASA Exception Service Medal for outstanding leadership and industrial partnership. He has authored more than 150 technical papers, co-editor of a CSP book, two guidelines, and 7 book chapters (two recent book chapters in "Encyclopedia of Thermal Stresses" edited by R.B. Hetnarski). He serves as technical Advisor/Committee to IPC, Microelectronics Journal, SMTA, IMAPS and IEEE IEMT/CPMT. He received his Ph.D. in 1982 from University of California at Los Angeles (UCLA).

KENNETH E. GOODSON, PH.D. is Professor and Vice Chair of Mechanical Engineering at Stanford. His NanoHeat Lab has graduated 40 PhDs including a dozen professors from MIT to UC Berkeley and UIUC and numerous engineering staff at high-tech companies. Goodson studied at MIT (BS89, PhD93) and has co-authored 30 US patents, 160 archival journal articles, and 200 conference papers. Goodson is a Fellow with ASME and IEEE. Recognition includes the ASME Kraus Medal, plenary lectures at INTERPACK, ITHERM, PHONONS, SEMI-THERM, and THERMINIC, and best/outstanding paper awards at SEMI-THERM, ITHERM, and IEDM. He is a former Associate editor with the ASME Journal of Heat Transfer and former Editor-in-Chief of Microscale & Nanoscale Thermophysical Engineering. Goodson co-founded Cooligy, which builds microfluidic cooling systems for computers (including the Apple G5) and was acquired by Emerson in 2006.

RADESH JEWRAM is a Senior R&D Engineer at the Bergquist Company. He has been an R&D Engineer with The Bergquist Company for the last 15 years. He is responsible for the development thermal interface materials; as well as assisting the manufacturing facilities with process and application development. Radesh has seven patents for Thermal Interface Materials to his credit. He graduated from the City University of New York in 1996 in Chemical Engineering.

PATRICK LONEY is a Fellow Mechanical Engineer at Northrop Grumman Electronics Systems (NGES) where he specializes in electronics cooling. He has worked for Northrop Grumman for 24 years. For his entire career he has been involved in thermal engineering. This includes ground applications to deep space platforms with experience in the commercial, defense, and NASA realms. He received a Bachelor of Sciences degree in Nuclear Engineering for the University of Illinois (Urbana) and a Master of Sciences degree in Mechanical Engineering from Cleveland State University.

(continued)

ILYAS MOHAMMED is a Sr. Director and Principal Technologist at Invensas. He works on identifying future technological challenges and creating solutions through innovation and research. His expertise is in the areas of design and simulation, advanced packaging, research management, and intellectual property. He received his Ph.D. from the University of Texas at Austin and B. Tech. from the Indian Institute of Technology, Madras, India, both in Aerospace Engineering. He has numerous publications and 25 US patents.

DAVE REDFORD is the Thermal Management Subject Matter Expert (SME) for AT&T Network Services. With over 30 years of service in the industry, he has held various positions in Operations, Marketing and Engineering. For the past 12 years he has directly supported the design, development and build-out of network equipment offices supporting the rollout of services such as Internet, U-Verse, Mobility Wireless and migrations to IP convergence. He is an active contributor and editor of national thermal management standards including Telcordia, ASHRAE, ATIS (ANSI). In the thermal management community he is known as the "Kool Guy".

SAM Z. ZHAO is Associate Technical Director at Broadcom and specializes in the areas of 3D IC packaging/interconnect technologies and IC chip thermal solutions. His experiences include burn-in oven design, establishing and managing Broadcom thermal group as well as managing a package design team. Sam currently holds 46 US issued patents and has 38 journal and conference publications. Sam received his Bachelor's and Master's degrees from Tsinghua University, Beijing, China, and his Ph.D. degree from the University of Illinois, Chicago.

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TRENDS AND COMPETITIVE ACTIVITY IN THERMAL MANAGEMENT R&D

Kevin M. Closson
Senior Analyst
Nerac, Inc.

Innovation is the lifeblood of successful companies. For companies in the thermal management space, that innovation comes most often from their research & development programs. However, during the Great Recession beginning in 2008, R&D projects at most companies took major budget cuts. That trend appears to have reversed in the last couple of years. According to an analysis by Nerac, thermal management R&D programs have staged a major turn-around since 2010.

In this presentation, we will review the state of R&D activity in thermal management. We will identify key trends and emerging technologies. An analysis of patent activity in thermal management materials and technologies will be presented. Finally, we'll focus on specific products and R&D activities at competitors in the thermal management space.

ARE YOU LEVERAGING DoD FUNDING?

Kenneth E. Goodson, Ph.D.
Professor & Vice Chair of Mechanical Engineering
Stanford University

The past decade brought an impressive surge in thermal management funding from the US government. Department of defense (DoD) agencies, in particular, have fostered an unprecedented environment for commercially-relevant research by linking companies and academic labs. While much focus is on defense electronics such as radar, the impacts will be profound throughout the semiconductor industry, particularly for those companies that are keeping track.

This presentation provides a perspective on the new research environment and highlights Stanford DoD programs and corporate linkages on a broad range of topics ranging from radar to smart phones. The presentation will also describe the rapidly evolving thermal management toolset – from ultrafast lasers to diffraction-beating infrared imaging – that is fundamentally changing the research and product development landscape.

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EMERGING TRENDS FOR THERMALLY CONDUCTIVE MATERIALS IN ELECTRONICS PACKAGING

Radesh Jewram
Sr. R&D Engineer
The Berquist Company

Bergquist Company is engaged in developing thermal management materials for electronics from package through board/package level in all major markets including consumer electronics, automotive lighting and telecom. There are several unifying trends that are driving materials and technology development: (1) Low out gassing, (2) Non silicone materials, and (3) platform changes without new tooling. The development of materials has the added complexity in that different markets have different cost sensitivity to both materials and capital investments. We will address why these trends are emerging and Bergquist strategy to address these.

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THERMAL MANAGEMENT IN THE "3D-SIP" WORLD OF THE FUTURE

Wilmer (Bill) R. Bottoms
President
3MTS

System-in-Package (SiP) architectures are already appearing in consumer products and growth in SiP products will accelerate to meet the demand for ever more capable consumer products. The pace of adoption is gated by availability of solutions to problems limiting cost, bandwidth and power density while maintaining reliability. Thermal management is one key factor in solving each of these problems. Heterogeneous integration of many different component types, each with their own thermal and mechanical requirements, into the same package poses many thermal management challenges. The problem becomes even more challenging as we incorporate 3D components into SiP products.

The first step is to minimize heat generation within the package. This can only be accomplished using co-design of the devices to be incorporated into the package and the package itself. The second step is to maximize the ability to remove heat from the package. The design of both the components and packages will require new architectures and new materials. Potential solution to meet the thermal management requirements of the "3D-SiP" products of the future will be discussed.

LED LIGHTING – A HOT TOPIC WITH A BRIGHT FUTURE

Pat Bournes
Senior Development Engineer for Packaging
Philips Lumileds

The LED market is growing rapidly. The CEO of Philips Corporation announced that sales of LED related products grew by 70% last year. LEDs have taken over some markets and are rapidly encroaching on the remaining segments. As solid-state lighting becomes ever more competitive, industry will need to embrace a system level approach to LED lighting.

In this presentation we will begin by discussing the differences between the various lighting technologies- LEDs, Incandescent, fluorescents. Heat and how it is removed represents the main cost driver in most LED bulbs and lighting systems. Heat also directly affects efficiency and lifetimes of the LEDs. Next, technology roadmaps will be presented that show where the LED industry is expected to go in the next few years in terms of efficiency and costs. Lastly, an illustrative LED design will be shown that highlights how LEDs and novel thermal technologies can be combined to transform the lighting industry.

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DATACENTER AND SERVER THERMAL TRENDS AND CHALLENGES

David Copeland, DrEng
Thermal Engineering, Packaging Technology
Oracle Corporation

Environmental concerns and increased energy prices have driven massive improvements in the efficiency of data-center cooling as well as improvements in the efficiency of server cooling. Within the datacenter, distribution of air to and from the servers, once haphazard, is now achieved by precise ducting. Increasing the use of outside air for cooling to a greater fraction of the year has become widespread, even mandated by government in some regions. This has led to higher, though more closely controlled, temperatures of inlet air to the servers as power per rack continues to increase, even as the volume of airflow per unit power has decreased.

Within the servers, power dissipation of the processor die continues to increase rapidly. While cost performance processors, which constitute the majority of the market, are not anticipated to operate at lower junction temperatures, high performance processors are projected to require significantly lower junction temperatures. Such increases in power and/or decreases in junction temperature are driving improvements in thermal packaging and cooling, as heatsinks with embedded heatpipes or vapor chambers become standard and liquid cooling migrates closer to the mainstream. Future improvements in thermal management will be necessary to sustain the ongoing improvements in system performance and energy efficiency.

KEYNOTE

WHAT BURNS ME UP?

Roger Stout, PE
Research Scientist, Packaging Technology, Corporate R&D
ON Semiconductor

Thermal errors, misconceptions, and oversights occur at all scales, from semiconductor packaging, thermocouple theory, and infrared imaging, to cold fusion calorimetry and hot dense-plasma-focus fusion reactor design, to energy efficient architecture, plumbing, and electric vehicle charging equipment, to perpetual motion machines and global warming. In this somewhat whimsical presentation, the author will draw on examples he's encountered over the thirty-plus years of his career as a mechanical engineer and specialist in heat transfer and energy systems. If there's a moral to be found here, it's that the entire world, and the electronics industry in particular, needs better thermal education.

Presented in Association with

SEMI-THERM 29

MEPTEC THE NEXT GENERATION | Electronics COOLING

EXECUTIVE BRIEFING: THERMAL MANAGEMENT MARKET VISIONS & STRATEGIES

INCREASED PERFORMANCE FROM A LEGACY SYSTEM

Patrick Loney
Fellow Mechanical Engineer
Northrop Grumman Electronics Systems

The current and future driver for defense electronics cooling is not a new application of physics, an embryonic technology, or advancement in materials. The dominant driver in the defense electronics cooling industry is, and will be, cost. And costs are reduced by utilizing a legacy system and requiring more performance from that system. Thermally, this means taking an existing chassis, board, module, or chip, and removing more heat. There are no opportunities to employ augmented cooling subsystems since that would violate the legacy footprint. How does the thermal engineer solve this problem?

THERMAL CHALLENGES OF COMPLEX FPGA/3D ICS FOR SPACE APPLICATIONS

Reza Ghaffarian, Ph.D.
Principal Engineer
Jet Propulsion Laboratory, California Institute of Technology

Advanced electronic packaging technologies in high reliability versions are now being considered for use in a number of National Aeronautics and Space Administration (NASA) electronic systems. Thermal management become extremely challenging especially for complex IC packaging developed to meet demands of high-processing power FPGA with significant heat generation and power dissipation and 3D IC technologies with poor heat dissipation paths. Field programmable gate array (FPGA), which enable programmer to modify software on-the-spot during flight, come in area array configuration with more than thousands of solder balls/columns under the package. These columns are not only need to be correctly joined onto PCB; they also act as the one of the key heat dissipation elements in an space environment since an efficient heat sinking yet to be developed.

The power dissipation induces significant temperature rise on solder joints; it reduces the already weak thermo-mechanical reliability of the attachment/system. Stack IC technologies, more than Moore, which are developed to overcome recent limitation of IC density shrinkage, are also lack heat dissipation robustness mechanisms. Significant progress in thermal management not only needed for these package; they also become even more critical as miniaturization in IC packaging continues. The key current thermal challenges for advanced complex FPGA and 3D IC systems are presented followed by discussion on important strategies and new emerging technologies being developed to address and manage thermal challenge.

COMMUNICATIONS: EVOLUTION OR REVOLUTION?

Dave Redford
Principal Network Design Engineer, Thermal Management SME, Global Engineering Support
AT&T NPE / The "Kool" Guy

Today's world of communications is changing not by evolution but by revolution. If a communications service cannot provide complete mobility and full integration with IP enabled data networks like the Internet, then it will be brushed aside.

The challenge for AT&T and other global network providers and by connection each of us is: What enables our customers? What does the phone, car, TV network, security connection, pill minder, refrigerator, and even coffee brewer need for communications; and what is the next network device to dazzle the public's interest?

One common element behind the connected network is data transport. How do we get the information from one point to another across wireless airwaves and land based fiber networks? Our challenge, and it is a challenge, is to design and produce equipment that will enable us to meet and exceed our customer's expectations. Better, faster, more reliable networks is just the beginning. We need to make them more versatile, upgradable, deployable, and replaceable. Some of us here today may recall with chagrin the excitement of upgrading your 300 baud modem with a blinding fast 1200 baud one. In contrast your 4G LTE wireless hand held communications device, you call it a phone, reaches speeds nearing 14MPS. Speed IS of the essence. At AT&T we are aggressively building the network of the future – are you?

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EXECUTIVE BRIEFING: THERMAL MANAGEMENT MARKET VISIONS & STRATEGIES

MOBILE PHONE THERMAL DESIGN ANALYSIS

Sam Z. Zhao
Associate Technical Director
Broadcom Corporation

Public teardown information on iPhone 5, Galaxy S3, and other smart phones are analyzed for thermal design. Thermal design constrains from mismatch of IC thermal ratings, demand for innovative heat dissipation paths design, and opportunities for thermal management devices and materials are also discussed.

THERMAL MANAGEMENT CHALLENGES IN MOBILE INTEGRATED SYSTEMS

Ilyas Mohammed
Sr. Director and Principal Technologist
Invensas

Thermal management has relied on two main techniques, air cooling and heat transfer components, to maintain desired thermal profiles of components and systems. The air cooling requirement proved to be strong enough to stop the GHz race and hastened multi-core processing. However, the heat transfer components hierarchy, from heat spreaders and heat sinks to heat pipes and fans, is yielding to the mobile computing onslaught where densification is demanding a more optimized and integrated thermal management system. Even though the low power components have helped mitigate the thermal problem, opportunities and challenges lie ahead in the areas of 3D packaging, materials, design and analysis, and system level thermal management.

In this presentation, the future thermal challenges as seen from packaging and sub-systems will be presented. The competing requirements of electrical interconnects, thermal interfaces and mechanical robustness will be discussed. Examples of current and future applications will be shown. Some of the challenges include fabrication and assembly of thermally efficient 3D packages and modules, defects and failures through interconnect interfaces, thermally induced failures such as electromigration and warpage of thin packages, accurate characterization of advanced thermal materials, etc.

About SEMI-THERM

The mission of the IEEE Semiconductor Thermal Management and Measurement Symposium or SEMI-THERM is to provide an annual forum for the exchange of latest technical developments in thermal management of electronic devices, components and systems. SEMI-THERM's mission is accomplished by providing a multifaceted program of events of interest to developers, practitioners and researchers from academia and industry. The symposium is dedicated to providing an informal atmosphere, which highlights the latest advances in the field. The technical program, including papers, tutorials and short courses, is to be void of commercialism and presented in a spirit of lively exchange and collegiality. While the symposium continues to evolve to maintain its currency, the goals of technical excellence and premier position among the technical gatherings in electronics cooling remain constant. Visit www.semi-therm.org for more information.

About MEPTEC

MEPTEC is a trade association of semiconductor suppliers, manufacturers, and vendors concerned exclusively with packaging, assembly, and testing, and is committed to enhancing the competitiveness of the back-end portion of the semiconductor industry. Since its inception over 30 years ago, MEPTEC has provided a forum for semiconductor packaging and test professionals to learn and exchange ideas that relate to packaging, assembly, test and handling. Through our monthly luncheons, and one-day symposiums, and an Advisory Board consisting of individuals from all segments of the semiconductor industry, MEPTEC continuously strives to improve and elevate the roles of assembly and test professionals in the industry. For more information about MEPTEC events and membership visit www.meptec.org.

About Electronics Cooling Magazine

Electronics Cooling Magazine has been providing a technical data column since 1997 with the intent of providing you, the readers, with pertinent material properties for use in thermal analyses. They have largely covered the most common materials and their associated thermal properties used in electronics packaging.. For more information about Electronics Cooling Magazine visit www.electronics-cooling.com.