

Contents

Part I Foundation

1	Introduction to Software Thermal Management	3
1.1	Introduction.	3
1.2	Purpose.	4
1.3	Audience.	5
1.4	Scope	5
1.5	Goals	6
1.6	Benefits	7
1.7	Features	8
1.8	Organization	8
1.9	Text Features.	9
1.10	How to Read This Book	9
1.11	Science Versus Art.	9
	References	11
2	Landscape: History, Present Barriers, and The Road Forward	13
2.1	History	13
2.2	Barriers.	17
2.2.1	Moore’s Limitations.	19
2.2.2	Thermal Wall	19
2.2.3	Dynamic Power.	22
2.2.4	Multicore Promise	24
2.2.5	Amdahl’s Wet Blanket	26
2.2.6	Temperature Limits	27
2.2.7	Embedded Complications	30
2.3	Solutions.	32
2.3.1	Reduce Power Consumption	33
2.3.2	Transfer Heat Efficiently	34
2.3.3	Define The Environment	35
2.4	Crossroads.	36
2.4.1	Thermodynamics	37

- 2.4.2 Electrical Engineering 39
- 2.4.3 Software Engineering 42
- References 43
- 3 Roots: A Bedrock of Giants 47**
 - 3.1 Computation 47
 - 3.2 Thermodynamics 48
 - 3.3 Electronics 53
 - 3.4 Dynamic Scaling 57
 - 3.4.1 Relationship of Heat to Power 57
 - 3.4.2 Traversing the Curve 59
 - 3.4.3 Moving the Curve 65
 - 3.4.4 Finding Alternative Curves 66
 - 3.5 Case Study: Amazon Kindle Fire 67
 - 3.5.1 Under Load 68
 - 3.5.2 Idle Mode 70
 - 3.5.3 Voltage Tuning 72
 - 3.5.4 Wake Time 73
 - References 75

Part II Catalog

- 4 Techniques: Putting the Silicon to Work 79**
 - 4.1 Silicon Fabrication Trends 79
 - 4.2 Dynamic Voltage and Frequency Scaling 81
 - 4.2.1 Voltage Slew 82
 - 4.2.2 Sequencing 83
 - 4.3 Adaptive Voltage Scaling 85
 - 4.3.1 Open-Loop 86
 - 4.3.2 Closed-Loop 87
 - 4.4 Clock and Power Gating 88
 - 4.4.1 Clock Gating 88
 - 4.4.2 Power Gating 89
 - 4.5 Static Leakage Management 91
 - References 92
- 5 Frameworks: Choreographing the Parts 95**
 - 5.1 Software Coordination 95
 - 5.1.1 Advanced Power Management 96
 - 5.1.2 Advanced Configuration and Power Interface 98
 - 5.2 Thermal Management Framework 99
 - 5.2.1 Resource Manager 100
 - 5.2.2 Policy Manager 101

Contents	xiii
5.2.3 Mode Manager	102
5.2.4 Storage Manager	106
5.3 Case Study: Linux	107
5.3.1 System Power Management	108
5.3.2 Device Power Management.	111
References	114
6 Frontiers: The Future of Software Thermal Management	115
6.1 Predictive Stochastic Processes	115
6.2 Thermal Management Tools for Software Engineers	116
6.3 Benchmarks.	117
6.4 Thermal Management Frameworks.	118
References	118
Appendix A: Checklists	121
Index	123



<http://www.springer.com/978-1-4939-0297-2>

The Art of Software Thermal Management for
Embedded Systems

Benson, M.

2014, XVI, 124 p. 51 illus., 2 illus. in color., Hardcover

ISBN: 978-1-4939-0297-2