

Contents

Acknowledgments	iii
Abstract	xvii
Resumen	xix
Resum	xxiii
1 Introduction	1
1.1 Motivation	1
1.2 Objectives	6
1.3 Dissertation Outline	8
2 Background and State of the Art	9
2.1 Interconnection Networks	10
2.1.1 Interconnection Network Basics	11
2.1.2 Interconnection Network Design Parameters	14
2.1.3 Topology	15
2.1.4 Switching Techniques	25
2.1.5 Virtual Channels	28
2.1.6 Routing Technique	31
2.1.7 Fault-Tolerance	42
2.1.8 Network Metrics	46
2.2 State of the Art	49
2.2.1 Fault-Tolerance in MINs	49
2.2.2 Routing in Commodity Fat-Trees	53

3 FT²EI : Fault-Tolerant Fat-Tree with Exclusion Intervals	57
3.1 Introduction	59
3.2 Static Fault-tolerant Routing with Exclusion Intervals	64
3.2.1 Computing the Exclusion Intervals	67
3.2.2 Extension to more than one fault	75
3.3 Dynamic Fault-tolerance Routing with Exclusion intervals	79
3.3.1 Informal Description	80
3.3.2 Formal Description	81
3.3.3 Multiple Faults Considerations	84
3.3.4 Avoiding Losing Packets during Reconfiguration	89
3.4 Evaluation	93
3.4.1 Simulation Environment	94
3.4.2 Fault-Tolerance Results	95
3.4.3 Dynamic Issues	101
3.4.4 Impact on Network Performance	107
3.4.5 FT ² EI Memory Requirements	111
3.5 Conclusions	113
4 DESTRO: Effective Deterministic Routing in Fat-Trees	115
4.1 Introduction	117
4.2 Description of the Deterministic Routing algorithm	122
4.2.1 Implementation of DESTRO by using Flexible Interval Routing	130
4.3 Evaluation	136
4.3.1 Adaptive Routing Issues	136
4.3.2 Traffic Patterns	140
4.3.3 Simulation Environment	142
4.3.4 Performance Results	143
4.3.5 DESTRO Memory Requirements	162
4.4 Conclusions	163
5 RUFT: Simplifying the Fat-tree Topology	167
5.1 Introduction	168
5.2 Description of the RUFT Topology	169
5.3 Advantages and Disadvantages	175

5.4 Evaluation	177
5.4.1 Cost Comparison	178
5.4.2 Simulation Environment	181
5.4.3 Performance Results	183
5.4.4 Cost and Performance Comparison	194
5.5 Conclusions	201
6 Conclusions	203
6.1 Conclusions	203
6.2 Future Work	205
6.3 Contributions	206
Bibliography	209