LIST OF FIGURES

1.0.1.1 General Architecture of LMDDBSs…….……..…3
1.0.2.1 Characteristics of Wireless Communication and Mobile Units……..……...…6
2.2.1.1 Example of Master/Slave Replication with Three Slaves……..…..……17
2.2.2.1 Example of Multi-master Replication with Four Replicas…….……..…18
2.3.1 Phases involved in a replica operation request……...……..…21
2.5.1 Spectrum between Strong and Eventual Consistency……..…….....26
2.6.1.1 Basic Ward Architecture……..…..…..36
3.2.1 Publisher-Subscriber Relationship between Two Hosts ……...…….49
3.2.2 Five Phases for the Replication Process in LMDDBMs…….…50
3.3.1 Replication Architecture for Large-Scale Mobile Environments……..……..53
3.4.1 Location and Interactions of IIRA in its Environment…….……..…..55
3.4.1.1 General Structure of VLDS…….….56
3.4.3.1 State Diagram for IIRA and its Instance……...…61
3.5.1.1 Structure of Objects-Information-VLDS……..……...…….65
3.5.1.2 Structure of Replicated-Objects-Information-VLDS…….…..65
4.1.1 Water Wheel Structure ……...……68
4.1.2 Updates Propagation Wheel……..……..70
4.1.6.1 (a) Outer-to-Inner Propagation (b) Inner-to-Outer Propagation……...74
4.2.1 (a) Mapping of the master area into a wheel (b) Mapping of the zone area into a wheel……76
4.2.2 Mapping of Hidden Wheels in Figure 4.2.1 into the Propagation Wheel……...77
4.3.2.1 P2P-Concentrate in the Zone Area…….……..79
4.4.1.1 Hops that are involved in propagating an update from the source to the destination……...…….81
4.4.1.2.1 Actual Difference between the Different Pairs of Means…….……....88
4.4.2.1 Comparison of the Three Techniques Based on the Total Number of Messages for the Worst Case……..….91
4.4.2.2 Comparison of the Three Techniques Based on the Total Number of Messages for the Average Case……..……..91
4.4.3.1 Average Load Balance When D=4…….……..94
4.4.3.2 ALB for CS Where D=2, 3, 4,…, 8……..95

4.4.3.3 ALB for Hosts other than CS for Different Values of D (D=2, 3, …, 8)…….96
4.4.4.1. Comparison of the Two Protocols Based on the Updates Propagation Delay for the Worst Case……....98
4.4.4.2 Comparison of the NTPP and the Four Cases of WPP Based on the Updates Propagation Delay for the worst case……..….99
5.1.1 IIRA-Based Propagation System……..…..…..102
5.1.3.1.1 Description of MH-RU-Propagation-VLDS…….....107
5.1.3.1.2 Structure of the Body Part in CS-RU-Propagation-VLDS…….……109
5.1.3.2.1 Description of CS-Collection-VLDS…….……..…...111
5.1.3.2.2 Structure of the Body Part in ZS-Collection-VLDS……...…112
5.1.4.1.1 Description of ReRU-Propagation-VLDS……..115
5.2.1.1 SynchSPN…….….122
5.2.2.1 Reachability Graph…….131
5.2.2.2 Derived Markov Chain……..…….131
5.2.2.3 Transition Rate Matrix…….……..132
6.1.1 A Scenario of the Local Ordering of the Updates in a Set of Four Replicas ……138
6.2.2.5.1 Directed Tree for the Ordering System…….……..152
6.2.2.5.2 Contains of UD in (a) CS (b) ZS (c) MS…….152
6.2.2.7.1 A state Machine for the Description of the Ordering Process……155