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REVIEWER'S REPORT

Manuscript No.: IJAR-59600

Title: ENERGY OPTIMIZATION OF NETWORKS THROUGH A HYBRID SDN-CRDT ARCHITECTURE: AN EXPLORATORY STUDY BASED ON SYNTHETIC DATA

Recommendation:

Accept as it is .....

Accept after minor revision.....

Accept after major revision yes

Do not accept (*Reasons below*) .....

Rating	Excel.	Good	Fair	Poor
Originality			Y	
Techn. Quality			Y	
Clarity			Y	
Significance			y	

Reviewer's ID: JPR-Dr.Shaweta Sachdeva

Detailed Reviewer's Report

1. The manuscript addresses a relevant research topic by exploring the integration of Software-Defined Networking (SDN) and Conflict-Free Replicated Data Types (CRDTs) for energy-efficient network management. However, the novelty and specific scientific contribution of the proposed hybrid architecture should be articulated more clearly.

2. The study relies entirely on synthetic data generated using hypothetical equations. The authors are strongly encouraged to validate the proposed framework through network simulation using Mininet or NS-3 before making claims regarding its effectiveness.

3. The methodology section should provide a more detailed explanation of the mathematical equations, parameter selection, and assumptions used to generate the synthetic dataset, ensuring complete reproducibility.

4. The authors should clearly define the proposed SDN–CRDT architecture, including the number of controllers, communication mechanisms, replication process, and data synchronization workflow.

5. The rationale behind selecting the coefficients used in the energy consumption equations, particularly the factors 0.91 and 0.82, should be explained and justified. Sensitivity analysis would help demonstrate how these assumptions influence the reported results.

6. The experimental design should include a comparison with established replication mechanisms and alternative SDN-based energy optimization approaches to better establish the contribution of CRDT integration.

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7. The reported energy reductions of 3.3%, 5.8%, and 10.3% should be interpreted cautiously because these values are derived from predefined generation equations rather than actual measurements. The manuscript should avoid presenting them as evidence of experimentally demonstrated energy savings.

8. The authors should clarify the energy measurement methodology and units. In particular, the use of Wh/h should be reconsidered, and the distinction between energy consumption in Wh and power consumption in W should be maintained consistently throughout the manuscript.

9. The study should provide a more comprehensive analysis of the trade-offs among energy consumption, latency, throughput, CPU utilization, packet loss, and control overhead. The increased CPU utilization of the hybrid architecture requires particular attention.

10. The statistical analysis should be strengthened by explaining the random variation model, the distribution used for generating observations, and the method for calculating standard deviations. The authors should also clarify the limitations of statistical comparisons based on synthetic data.

11. The results section would benefit from additional tables and visualizations covering all network sizes and traffic loads, rather than emphasizing only selected scenarios. All figures should have clear labels, consistent units, readable legends, and appropriate captions.

12. The scalability analysis should consider additional factors, including the number of controllers, CRDT replica count, update frequency, replicated state size, and network topology, to provide a more comprehensive assessment of the proposed architecture.

13. The authors should explain how the proposed framework handles controller failures, network partitions, delayed updates, duplicate messages, and stale replicated data. The implications of eventual consistency for routing correctness and network reliability should also be discussed.

14. The manuscript should include a detailed algorithm or pseudocode describing the interaction between the SDN controller, CRDT replication mechanism, and energy optimization policy. This would improve the technical clarity and reproducibility of the proposed framework.

15. The discussion should distinguish more explicitly between the benefits of SDN, the benefits of CRDT-based state replication, and the effects of the assumed energy optimization policy. An ablation study would help isolate the contribution of each component.

16. The literature review should be expanded to include recent studies on energy-aware SDN, distributed controller coordination, CRDT-based network management, and energy measurement methodologies. The research gap should be established through a more critical comparison with existing approaches.

17. The authors should verify that all technical abbreviations are defined at their first occurrence and used consistently. In particular, the terminology associated with CRDTs should be corrected and standardized throughout the manuscript.

18. The reference list requires careful proofreading to ensure consistent APA formatting, accurate author names, correct punctuation, and complete bibliographic details. The correspondence between in-text citations and listed references should also be verified.

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19. Several editorial inconsistencies should be corrected, including the use of "Knots" instead of "Nodes" in Table 1, inconsistent numerical formatting, and awkward line breaks in figure captions. The manuscript would benefit from thorough language editing.

20. The conclusion should more clearly separate the methodological contribution from the expected practical benefits. Future work should prioritize simulation-based or real-world validation, publication of the dataset generation scripts, and reproducible measurement of network-wide energy consumption.