To: The Final Defense Committee

Subject: Response to Dr. Fahad Dogar’s comments

Dear Sirs

Dr. Fahad Rafique Dogar, who is a foreign reviewer for my PhD thesis asked me to give him a presentation about my thesis on Skype. I gave that presentation in the presence of my advisor. Dr. Fahad gave several useful comments about my thesis, during that presentation. The following outlines the suggestions and my response to the same:

1. It is not clear whether RED-BL is the problem, the formulation, a framework an algorithm: This confusion arises from the fact that the word RED-BL is used interchangeably for the problem as well as the optimization formulation and its optimal solution. RED-BL is also called a framework at some points in the thesis. I thought more about it and decided that RED-BL is not a framework because to me a framework would provide a complete mechanism for deployment. We don’t really discuss how the energy saving scheme may be deployed in practice.

I have re-phrased the discussion in the thesis such that the underlying problem is referred to as energy saving using WR and RP, whereas RED-BL is the optimization formulation. When referring to graphs in the results, the discussion clearly mentions that we are looking at the optimal solution to RED-BL.

1. Contextualization of our work amongst the prior literature may be improved : I have added references to prior work and included some discussion of prior work in chapter 1.
2. Contributions 2 (RED-BL formulation that does electricity cost minimization) and 4 (RED-BL considers cost of workload relocation as well) of the thesis appear to be the same: These are quite related and may be considered overlapping. I have removed this redundancy.
3. Is WR needed in addition to RP: Yes, as it is shown in the motivating example for the cellular networks as well as the results in chapter 5, using WR and RP combined can achieve greater savings than RP alone.
4. It may be useful to show the geo-temporal diversity in our electricity price dataset as a figure in the thesis: Prior work has already shown that geo-temporal diversity exists in electricity prices. Nonetheless, Figure 1.3 has been added to the thesis. This figure shows the electricity price as a function of time for two different locations in our dataset. Geo-temporal diversity is clearly visible.
5. Since we are able to solve the electricity cost minimization problem for both networks within reasonable time, the case for a heuristic is weak: Since the electricity cost minimization problem using WR and RP in both cases is NP-hard, as shown in the thesis, there exists a need for a heuristic. Techniques such as Branch and bound are used to solve such problems. The running time for such techniques depends on the data values and not just on the size of data. So, a different dataset, even that of a smaller size might not be solved optimally within reasonable time. Since this is textbook knowledge, there is no need to show this.
6. In the case of data centers, the underlying energy cost minimization problem can be shown as NP-Complete simply by mentioning that it is the unit-commit problem itself: The same has been done in the updated thesis (section 4.4.1).

I am grateful to Dr. Fahad Dogar for his candid and extremely useful feedback.

Muhammad Saqib Ilyas