

To Whom It May Concern,

I am writing to recommend Mr. Shiyu Ji to your graduate program. I have collaborated with him on a conference papers *DAWN: Defending Against Wormhole Attacks in Wireless Network Coding Systems* (in INFOCOM), and also its extended journal version *Wormhole Attack Detection Algorithms in Wireless Network Coding Systems* (in TMC). Based on the experience of collaboration, I feel Shiyu has great potentials in research.

Both of these papers study the threat model called wormhole attacks in the setting of the wireless network coding. Most existing works of wormhole attacks focus on the classical networks, which can be represented in graph model. For example, the connectivity between the nodes can be represented by an edge. However, network coding makes things completely different, because there is a link loss probability between any pair of nodes. As demonstrated in our paper, many classical solutions to defend against wormhole attacks would likely fail when it comes to network coding systems. Therefore, we used the Expected Transmission Count (ETX) as a metric in designing a new detection algorithm for wormhole attacks. Our idea was initially heuristic, but Shiyu did some creative quantitative analysis so that the results became rigorous. For the two algorithms in the papers, he gave the theoretical lower bounds of the successful rates, which made the papers much more convincing. All the proofs were finally written by Shiyu, some of which were quite elegant in my opinion. Therefore, I can safely say Shiyu is a very strong graduate student, with outstanding analytical capabilities.

In addition to the theoretical analysis, Shiyu also did a nice job in conducting experiments. For example, in order to verify the negative impacts of wormhole attacks, Shiyu did extensive simulations, the results of which clearly showed the negative influences caused by wormhole attacks were really significant. From my interactions with him regarding the experiments, I found that he had both the skills of programming and the ability of linking experimental results to our theoretical analysis.

Shiyu was doing very well at OK State University, but his advisor decided to leave for another job. Hence, Shiyu has to either find another advisor, or move to another institution. Since he has proved himself to be an excellent graduate student, I feel that he had better move to a more prestigious institution to do a PhD. I will appreciate it if you can seriously consider his application.

Sincerely,



Sheng Zhong, Professor

Department of Computer Science and Technology
Nanjing University

Email: zhongsheng@nju.edu.cn