Dear Mr. Rager:   
  
Manuscript ID TNET-2016-00326 entitled "Scalability and Satisfiability of Quality-of-Information in Wireless Networks" which you submitted to the IEEE/ACM Transactions on Networking, has been reviewed.  The comments of the reviewer(s) are included at the bottom of this letter. Based on my reading of the reviewers' comments, I recommend that major revisions should be made to the paper for the following reasons:   
  
The reviewers appreciated the proposed contribution, but also recommended a number of changes that can improve the quality of the paper. Their comments can be summarized in three important concerns: (a) the novelty of the paper is questioned by one reviewer, and sufficient argumentation from the authors is needed to address this concern in detail, (b) the related work needs to be updated, extended, and the proposed work needs to be positioned against recent literature improving in this way the presentation, (c) for a new model that aims to replace classical throughput/delay analysis, its wide-applicability to multiple scenarios needs to be demonstrated. The last one is particularly important in my opinion as well. These three concerns are in addition to other comments from the reviewers which aim to further improve the presentation of paper.   
  
Since all these concerns are serious and well-founded, and they aim to improve the value of the paper, I would suggest that the authors address all reviewers' concerns, in a comment-by-comment fashion. I believe that the time provided by "major revisions" is sufficient for this, but if the authors require more time they may contact me, since other schemes are available.   
  
To revise your manuscript, log into https://mc.manuscriptcentral.com/tnet-ieee and enter your Author Center, where you will find your manuscript title listed under "Manuscripts with Decisions."  Under "Actions," click on "Create a Revision."  Your manuscript number has been appended to denote a revision.  Co-authors will find the manuscript in the section Manuscripts I Have Co-authored   
  
You will be unable to make your revisions on the originally submitted version of the manuscript.  Instead, revise your manuscript using a word processing program and save it on your computer.  Please also highlight the changes to your manuscript within the document by using the track changes mode in MS Word or by using bold or colored text. Please bear in mind while writing your revision that ToN prefers that papers exceeding 14 pages in length be separated into a main, self-contained paper and an online-only supplement available alongside the paper on Xplore.  Papers exceeding 14 pages to be published whole require the Associate Editor's approval.   
  
  
Once the revised manuscript is prepared, you can upload it and submit it through your Author Center.   
  
When submitting your revised manuscript, you will be able to respond to the comments made by the reviewer(s) in the space provided.  You can use this space to document any changes you make to the original manuscript.  In order to expedite the processing of the revised manuscript, please be as specific as possible in your response to the reviewer(s).   
  
IMPORTANT:  Your original files are available to you when you upload your revised manuscript.  Please delete any redundant files before completing the submission.   
  
Because we are trying to facilitate timely publication of manuscripts submitted to the IEEE/ACM Transactions on Networking, your revised manuscript should be uploaded as soon as possible.  If it is not possible for you to submit your revision by 05-Feb-2017, we may have to consider your paper as a new submission.  Please note that the time of the deadline on the due date UTC is the time of this decision - the time that this email was sent may be used as a guide - rather than the end of the day.   
  
Once again, thank you for submitting your manuscript to the IEEE/ACM Transactions on Networking and I look forward to receiving your revision.   
  
Sincerely,   
Dr. Georgios Paschos   
Associate Editor, IEEE/ACM Transactions on Networking   
georgios.paschos@huawei.com   
  
Reviewer(s)' Comments to Author:   
Reviewer: 1   
  
Comments to the Author   
In this paper authors present a QoI framework to provide mathematical expressions to estimate limitations on network size and QoI requirements. They primarily focus the context dependent measures of timeliness and completeness, but the framework is generic enough to include other parameters as well.   
  
The paper is very well written and organized. Also, the topic is very timely with increasing interest, since the notions of context awareness and information centricity are gaining popularity. In general, authors manages to describe the framework and its various parameters that affect its performance successfully, to the extent that a reader can adapt it at his/her own network topology and application scenario. Below find some comments for the various sections of the paper.   
  
- The Related work is very brief, although it contains all the major works regarding QoI. For a 13 pages paper and a topic of this importance a reader requires more details for the included related pieces of research. Additionally, a small paragraph with the extra content (i.e., extensions) compared to refs [2][3][4] is also necessary. **[We have expanded the related works section, especially including more clarification on how this work is different from [2][3][4].]**  
  
- The notion of ad hoc networks is rather old. The paper should probably be aligned with current wireless trends such as D2D wireless networks or wireless social networks. Authors should also search for topologies that might have useful topological attributes and are formed in social networks and can be used in their analysis in Section VI and beyond. For example a star topology is formed in D2D networks enabling the WiFi Direct technology.   
  
- The example of Section IV is very useful and detailed, but rather too extended. It spans almost two pages and disconnects the flow between the network model and the QoI model. Probably authors should reduce its size and keep only that part that is also used later in the paper. For instance the experimental results of section IV.B can be moved to the appendix, whereas section IV.A can be cut down to the very necessary attributes of the image retrieval concept.   
  
- Section V, which is the main QoI scalability analysis section of the paper, is absolutely nicely presented and organized with all the necessary details.   
  
- Section VI is also nicely presented. The only negative is the extending details regarding the topologies used. Especially, all the details for the grid topology should be moved to the Appendix section, since they also break the flow of the section. **[Details on deriving Traffic Factor expressions have been moved to appendix B.]**  The used set of topologies are used for their special characteristics, but authors should include in the paper at least one generic known network topology and derive a scalability equation for part of its nodes. For instance an equation for the NSF network would increase the strength of the analysis (e.g., an equation for the bottleneck node based on its usage). Of course, this equation cannot be generic like those for the used topologies, but will prove the generality of the proposed framework. **[NEED: add NSF topology.]**  
  
- Section VII is very useful for the adoption of the framework in real wireless opportunistic networks, e.g., sensor networks, especially the subsection for the probability of timeliness satisfiability. [Minor] Please move Eq. 10 at the same page (page 9). **[NEED: move equation 10 to top of appropriate page after everything else is done.]**  
  
- Section VIII is somehow too verbose and can be shortened in an attempt to save some space. **[We attempted to shorten this section slightly, but we believe the section is very useful in illustrating the utility and flexibility of the overall framework.]**  
  
- Section IX nicely completes the whole framework analysis, since it examines the reverse problem of how large a network can it be assuming a target goal QoI. The only comments here is that it can be positioned earlier in the paper. [Minor 1] Eq 10 is also present in page 11. This should be Eq. 11 since Eq. 10 is on page 8. **[Fixed repeated equation. NEED: make sure equation is at top of correct page]** [Minor 2] Fig. 8 is not readable in a B&W print. **[…Yeah, we kinda figured that, but there’s not a good way to make a 3-d graph with two intersecting planes readable in B&W, so we left it.]**  
  
Reviewer: 2   
  
Comments to the Author   
In this paper, the authors present a QoI-based framework that provide estimates for limitations on network size and achievable QoI requirements. In particular, the authors focus on using completeness and timeliness as QoI attributes, providing an example application and several different ways to measure completeness. The developed framework that can estimate QoI and network size limits and delays for a specific network. Furthermore, they extended this framework to model competing flows and data loads as random variables to capture the stochastic nature of real networks. Finally, this work also present the concept of scalably feasible QoI regions.   
  
I appreciated that the authors presented some “experimental” evaluation of the QoI Model, with set of pictures. In particular, the Example Application: Similarity-based Image Retrieval.   
  
I disagree with the authors on the following statement, page 1, column 1: “Often, extensive simulation or experimentation testbeds must be created to test proposed network setups, which is difficult and time-consuming”. Since nowadays, there are plenty of open (free-of-charge) and large-scale testbeds where the scientists may evaluate their solutions [1], [2], [3]! **[We included references to available simulation packages and network testbeds and distinguished the difficulties in using them that are alleviated by adopting our modeling approach.]**  
  
The justification at page 1, column 2: “Experimental techniques, like Response Surface Methodology [7], for example, may be applied to solve the problem we do, but these require complex test beds instead of a compact mathematical framework.”, sounds too naive! I do not see why is not that important to have real-world applied solution, since eventually, this is the objective of our research community. **[The goals of our work are to provide a framework to quickly determine a proposed network’s abilities and scalability as well as compare similar network setups with substituted protocols, topologies, equipment, etc. While a real-world solution is desirable for any final proposed network design, creating a real solution for each possible design choice to test limits and compare performance is severely impractical. We have expanded text in the introduction and related works to make this distinction more clear.]**  
  
In overall, I found the article superficial, while its contribution remains rather fuzzy. Imho, the authors missed the flow of the paper by concentrating too much in examples and details (such as delay estimation). More specifically, I missed the actual novelty, while its core work is inspired mainly from the literature and extended to certain level:   
- “we use similarity-based image collection 21 as an example of an application that is best evaluated using QoI.” This application has previously been considered in [14] and [15].   
- “We use the same similiary-based image selection algorithm as in [15], but provide new methods of quantifying QoI.”   
- “Here, as in [16], we specify a vector of minimum values for each QoI metric, and information is evaluated based on whether it satisfies all of the QoI requirements or not”.   
- “To get a similarity measurement, we use the same choice as was shown to be effective in [15].”   
- “A technique called Color and Edge Directivity Descriptor (CEDD) [17] provides a 54-byte vector of qualities inherent to a photograph like lightness, contrast, and color.”   
- “The similarity between two images can then be given as a scalar by calculating the Tanimoto Similarity [18] between their CEDD vectors. Dissimilarity is simply defined as 1 minus the similarity.”   
-“For the Spanner algorithm, we employ a greedy algorithm similar to that in [15].” **[The reviewer is correct in pointing out that a number of the techniques utilized in Section IV are not novel. As we point out in the Introduction in the paragraph beginning with “Our main contribution in the paper is…,” the main contributions of the paper are in Section V and beyond, not in Section IV. Since QoI is still an emerging field and not all readers may be familiar with it, and since we believe it is beneficial to solidify its importance by showing the difference in value gained from varying amounts of data, we choose to provide an example of a real application that can utilize QoI. This comment and comments from Reviewer 1 have shown us that Section IV is too long and minimizes the main focus of our work, so we have reduced the size of that section.]**  
  
Furthermore, I do not feel comfortable with the assumption that there is 100% of transmission reliability, in other words considering that by default all data packet transmission will be successful. Since such assumption present certain level of issues in the modeling phase: “In this network, we assume a simple 3-slot TDMA scheme, which allows each node equal time access to the medium and removes any potential interference or hidden terminal issues.” **[We understand and agree that 100% transmission reliability is a non-realistic assumption. After reexamining our approach and calling on previous work, we realize that our framework can incorporate scenarios with losses by modeling channel rates with an *effective* rate that relies on packet loss probabilities and retransmission schemes.]**  
  
Large part of the paper is dedicated on estimating the delay performance, which imho, misleads from the main scope of the study presented here. For example, in Section V. A. QoI Satisfiability Framework, the authors presented detailed, yet non-realistic, delay estimation modeling. In particular, the authors estimate the propagation delay, while not considering the processing and emission delay. **[We realize that we were not precise and clear with our definitions of delays and noting which delays we have included in the model and which we have ignored due to being outweighed. We have rewritten and expanded Section V.A to make this more clear. Specifically we point out that we focus on emission delay and ignore the actual propagation delay since the latter is several magnitudes smaller than the former.]**    
  
[1] G. Z. Papadopoulos, J. Beaudaux, A. Gallais, T. Noel and G. Schreiner, “Adding value to WSN simulation using the IoT-LAB experimental platform" In Proc. IEEE WiMob 2013.   
https://www.iot-lab.info/   
  
[2] M. Doddavenkatappa, M. C. Chan, and A. Ananda. Indriya: A Low-Cost, 3D Wireless Sensor Network Testbed. In Proceedings of the Conference on Testbeds and Research Infrastructures for the Development of Networks & Communities (TridentCom), 2011.   
  
[3] http://www.wisebed.eu/   
  
Reviewer: 3   
  
Comments to the Author   
Resume:   
The authors present a framework for estimating the scalability and “QoI-satisfiability” limits of the network of interest. Quality of Service is a multi-dimensional metric to measure the value of information with attributes like timeliness and completeness. The authors claim that these metrics should be preferred over the traditional performance metrics (throughput and delay) in the sense that through their framework they can provide a quick accurate estimation of the network’s abilities without relying on exhaustive testbeds or incredibly hard to derive theoretical bounds for complex networks.   
  
Completeness is a measure for the necessary information you acquired for your query from the network (sum similarity in pictures), while Timeliness is a metric for delay –acquiring the information you need before the deadline for the query ends. The equations they derive are used by applying the known parameters of the network and acquiring the limit of the remaining variable of interest. For example solving the Scalability equation for T, gives back the minimum “timeliness” value (delay notion) for the network.     
  
The results given in section VIII demonstrate the effect of varying network characteristics, like topology, number of nodes or requested QoI to resulting timeliness or completeness (covering a big percentage of the sets) and also the impact that different variables have on the network performance. The figures give an indication of the scalability of the networks to the specific characteristic. The framework can also be used to acquire an estimate of the maximum nodes a network can support based on QoI requirements (results in section IX).   
  
Review:   
The paper presents, to my best knowledge (which is not great in the area of interest), a novel idea for understanding the scalability and performance of networks through the framework presented using Quality of Information Metrics. The paper is in general well written and is steadily leading the reader to the results. Some modifications in the text are necessary to increase readability, see in the end of the review.   
  
The paper is thorough in defining the new aspects of QoI and the significance on selecting them for making scalability/performance observations. The example application of the paper is well presented, but what is not clear for me from reading the paper is if and how this framework is applicable to other networks or different applications. In my understanding for every new network and application this whole analysis needs to start over, from defining the vector of QoI metrics, to the models used for getting the analytic expressions for the metrics.   
  
I think it would be interesting if there was a bigger variety of options in the modeling choices on the latter sections of the text and also have some references to explain the reasoning behind the choices. For example why are line, grid and clique topologies the interesting topologies for wireless networks? Why TDMA? Is round robin like scheduling good to capture the performance of clique – which appears to be always underperforming to grid?   
  
Sections VII,VIII and IX properly display through plots and text the value of the current work into making network design decisions based on the presented framework for the selected example.   
  
I would recommend reading thoroughly and correcting the text. Some indicative parts that you should consider clarifying or rewrite are:   
1) Section II. Paragraph 3: Dose->Does. Also consider rephrasing. **[Fixed.]**  
2) Section V. A. Paragraph 1: We use a fixed value the data size… of our applications in section VI.  **[Fixed.]**  
3) Section V.A. Paragraph 4: Definition of Channel Factor. **[Fixed.]**  
4) Section V Last Paragraph: To show this usefulness… **[Fixed.]**  
5) Section VI.A. Paragraph 2: Not clear… **[Fixed. Had a typo. n=\rho(x) instead of n=N.]**  
6) Section IV.A. : …into a k clusters.. **[Fixed.]**