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.  
  
- 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. 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.  
  
- 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).  
  
- Section VIII is somehow too verbose and can be shortened in an attempt to save some space.  
  
- 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. [Minor 2] Fig. 8 is not readable in a B&W print.  
  
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]!  
  
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.  
  
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].”  
  
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.”  
  
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.  
  
[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?

**-Rebut with NSF network and applicability there**  
**- References that show that these networks are often representative of certain networks in the real world, e.g. Social networks, data centers, mesh networks.**

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.  
2)      Section V. A. Paragraph 1: We use a fixed value the data size… of our applications in section VI.  
3)      Section V.A. Paragraph 4: Definition of Channel Factor.  
4)      Section V Last Paragraph: To show this usefulness…  
5)      Section VI.A. Paragraph 2: Not clear…  
6)      Section IV.A. : …into a k clusters..