**1. Title of the workshop: Network Science for Quantum Communication Networks (NetSciQCom)**

**2. Names and affiliations of the organization team**

Proposers

(i) Dr. Nageswara Rao, Corporate Fellow, Oak Ridge National Laboratory, Oak Ridge, TN 37830

(ii) Dr. Arun Sen, Professor, School of Computing and Augmented Intelligence, Arizona State University, Tempe, AZ 85281

Steering Committee Members

1. Dr. Nageswara Rao, Corporate Fellow, Oak Ridge National Laboratory, Oak Ridge, TN 37830

2. Prof. Saikat Guha, Director, Center of Quantum Networks, University of Arizona, Tucson, AZ 85721

3. Prof. Arun Sen, School of Computing and Augmented Intelligence, Arizona State University, Tempe, AZ 85281

4. Prof. Guoliang Xue, School of Computing and Augmented Intelligence, Arizona State University, Tempe, AZ 85281

**3. Scope and topics of the workshop**

Along with advances in the Quantum Computing domain, Quantum Communication has also made significant strides in the last twenty years, starting with DARPA Quantum Network effort in the first decade of the twenty-first century. The pace of advances in Quantum Communication/Networking has accelerated significantly in the second decade with efforts all across the world on advancing this important technology. Major efforts are currently underway, not only in the United States, but also in countries such as China, India, U.K., The Netherlands and Singapore. Network Science has been used to model the structure and dynamics of a wide variety of large-scale complex networks, including Internet connectivity, the WWW, peer-to-peer networks, and online social networks. The concepts from Network Science can play an equally important role in Quantum Communication as it has played in the classical communication. Recognizing the important role of Network Science in Quantum Communication, the U. S. Department of Defense has recently awarded a Multidisciplinary University Research Initiative (MURI) award to a consortium of U.S. universities for conducting research on Quantum Network Science. The topic of this workshop will be of particular relevance to the INFOCOM community, as Quantum Communication technology is going to play a major role in the computer communication in the future. Consequently, it’s extremely important to understand the physics of quantum communication, the higher layer protocols of classical communication as well as tools and techniques from Network Science to derive comprehensive benefit from the Quantum Communication technology. A deeper understanding of such interplay between multiple disciplines can only be achieved through closer interaction between physicists, mathematicians, network scientists and communication network designers. The goal of this workshop is to provide a forum for this diverse group of researchers to come together and exchange ideas leading to insights into the design of robust and complex quantum communication networks of the future.

**4. Rationale**

Quantum Communication technology is going to play a major role in computer communication in the foreseeable future. Network Science is likely to play as important a role in Quantum Communication, as it has played in classical communication. The workshop will provide a forum for this diverse group of researchers to come together and exchange ideas leading to insights into the design of robust and complex quantum communication networks of the future.

*a.* *Why the workshop is related to INFOCOM 2022*

As the focus of Infocom is computer communication and quantum communication is going to play a major part in computer communication in the future, the workshop topic will be of interest to a significant part of participants of the Infocom 2022 conference.

*b. Why the topic is timely and important*

The topic of Quantum Computation and Communication have emerged as two most important topics of research in recent times. The governments of several major countries across the world have allocated significant amount of funding for development of these technologies. Accordingly, the topic of the workshop is both timely and important.

*c.* *Why the workshop may attract a significant number of submissions of good quality*

As Quantum Communication is going to be a major part of computer communication in the future, it’s expected that there will be significant interest among the computer communication network researchers to explore the emerging discipline of Quantum Communication Networks. Accordingly, we expect a significant number of high-quality submissions.

*d*. *Why the workshop may attract a large number of attendees, in addition to the authors*

As Quantum Communication is going to be a major part of computer communication in the future, and the Infocom participants are focused to all aspects of computer communication, it’s expected that there will be significant interest among the Infocom participants in the topic of this workshop. As a point of reference, it may be noted that as the predecessor of this workshop, the Workshop on Network Science for Communication Networks (NetSciCom) took place very successfully, in conjunction with Infocom from 2009-2017.

*e.* *Why the workshop differs from others, i.e., related workshops and conferences of similar topic*

#### To the best of our knowledge, the proposed workshop will be first workshop solely devoted to application of Network Science concepts in the Quantum Communication domain. In the last two years, there were two workshops with broader themes, related to the topic of the proposed workshop. These two workshops are:

#### **1. First International Workshop on Quantum Network Science,** 2019, University of Arizona

2. Second **International Workshop on Quantum Network Science,** 2020, NetSci Satellite Workshop

It may be noted that the organizers of these two workshops are also involved in organizing this workshop.

**5. Tentative committee lists (organizers, steering committee if any, etc.)**

*Technical Program Committee (Co-Chairs)*

1. Dr. Nageswara Rao, Oak Ridge National Laboratory, Oak Ridge, TN 37830

2. Prof. Arun Sen, Arizona State University, Tempe, AZ 85281

*Technical Program Committee (Members)*

1. Prof. Biplab Sikdar, National University of Singapore (accepted)

2. Dr. Kanu Sinha, Princeton University (accepted)

3. Prof. Gil Zussman, Columbia University (accepted)

4. Prof. Stefan Schmidt, Technical University of Berlin (accepted)

5. Dr. Victoria Goliber, D-Wave Systems (accepted)

6. Prof. Stephanie Wehner, Delft University, The Netherlands (pending)

7. Prof. Urbasi Sinha, Raman Research Institute, Bangalore, India (accepted)

8. Dr. Joe Lukens, Oak Ridge National Laboratory (accepted)

9. Dr. Raj Kettimuthu. Argonne National Laboratory (accepted)

10. Dr. Prithwish Basu, Raytheon BBN Technologies (accepted)

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**6. A draft call for papers**

We solicit papers addressing the fundamental concepts and applications of network science, particularly as it intersects with the design of Quantum Communication Networks. We welcome theoretical approaches and data-driven approaches, as well as position papers.  Topics of interest include, but are not limited to:

* Modelling, design and analysis of complex and interdependent (classical and quantum) communication networks
* Information diffusion and knowledge transfer in networks, propagation studies, routing, traffic modelling
* Algorithms for static, time-varying, and dynamic communication networks
* Network robustness, phase transitions, security, privacy, trust in quantum communication networks
* Economic aspects of Quantum Communication Networks, incentives, marketing
* Quantum information theory - Entanglement-assisted multi-user quantum channels, Quantum error correction
* Quantum repeaters, multipath and multiflow routing of entanglement, manipulating graph states, quantum network coding,

Papers should contain original material, i.e., that has not been previously published or currently submitted elsewhere. Manuscripts must be limited to 6 pages in IEEE 8.5x11 conference format, and formatted in strict accordance with the IEEE Communications Society author guidelines. All submissions will be handled electronically. The accepted and presented papers will be published in the IEEE INFOCOM 2022 workshop proceedings and appear in IEEE Xplore.

**7. Workshop tentative internal and external schedule**

*a*. *Submission deadline; January 4, 2022*

*b. Review deadline: February 11, 2022*

*c. Acceptance deadline: February 18, 2022*

*d. Camera ready; February 28, 2022*

*e. Program ready: March 7, 2022*

**8. Workshop format planned (keynote, papers, demos, panels, etc.)**

#### Tentative Program

13:30 – 13:45 Opening Remarks  
13:45 – 15:00 Keynote Session

15:00 – 15:30 Coffee Break

15:30-16:25: Session 1

1. Paper 1

2. Paper 2

3. Paper 3

16:30-17:25: Session 2

4. Paper 4

5. Paper 5

6. Paper 6

17:25-17:30 Wrap-up

**9. If the workshop has past editions, the history of the workshop (where held, number of papers submitted and accepted, peer reviewed or invited, number of attendees)**

The proposed workshop (NetSciQCom) doesn’t have a history. However, another workshop, Network Science for Communication Networks (NetSciCom), that very successfully took place in conjunction with IEEE Infocom from 2009-2017, may be viewed as the predecessor to the proposed NetSciQCom workshop. The structure of the NetSciQCom workshop will be similar to the one of the NetSciCom workshop, except that the focus of the new workshop will be on the emerging discipline of Quantum communication.

**SUBMISSION INSTRUCTIONS**

Papers should contain original material, i.e., that has not been previously published or currently submitted elsewhere. Manuscripts must be limited to 6 pages in IEEE 8.5x11 conference format, and formatted in strict accordance with the IEEE Communications Society author guidelines. All submissions will be handled electronically. The accepted and presented papers will be published in the IEEE INFOCOM 2022 workshop proceedings and appear in IEEE Xplore.