

Hybrid Quantum-Inspired Internet Protocol

Industry Connections Activity Initiation Document (ICAID)

Version: 1.0, 5 September 2023

IC23-008-01 Approved by the CAG 21 September 2023

Instructions

- Instructions on how to fill out this form are shown in red. Please leave the instructions in the final document and simply add the requested information where indicated.
- Spell out each acronym the first time it is used. For example, “United Nations (UN).”
- Shaded Text indicates a placeholder that should be replaced with information specific to this ICAID, and the shading removed.
- Completed forms, in Word format, or any questions should be sent to the IEEE Standards Association (IEEE SA) Industry Connections Committee (ICCom) Administrator at the following address: industryconnections@ieee.org.
- The version number above, along with the date, may be used by the submitter to distinguish successive updates of this document. A separate, unique Industry Connections (IC) Activity Number will be assigned when the document is submitted to the ICCom Administrator.

1. Contact

Provide the name and contact information of the primary contact person for this IC activity. Affiliation is any entity that provides the person financial or other substantive support, for which the person may feel an obligation. If necessary, a second/alternate contact person’s information may also be provided.

Name: Ean Mikale, JD

Email Address: ean@infinite8institute.com

Employer: Infinite 8 Industries, Inc.

Affiliation: Infinite 8 Industries, L3C, Quantum Coin Foundation

IEEE collects personal data on this form, which is made publicly available, to allow communication by materially interested parties and with Activity Oversight Committee and Activity officers who are responsible for IEEE work items.

2. Participation and Voting Model

Specify whether this activity will be entity-based (participants are entities, which may have multiple representatives, one-entity-one-vote), or individual-based (participants represent themselves, one-person-one-vote).

Individual-based.

3. Purpose

3.1 Motivation and Goal

Briefly explain the context and motivation for starting this IC activity, and the overall purpose or goal to be accomplished.

The proposed IC (Industry Connections) activity aims to address the emerging need for a standardized framework for a Hybrid Quantum-Inspired Internet Protocol. With the rapid advancements in quantum technologies and the growing demand for enhanced internet security, scalability, and efficiency, there's a pressing need to establish a coherent and standardized protocol that bridges the gap between conventional internet protocols and Quantum-Inspired technologies. This IC activity seeks to bring together experts, researchers, and stakeholders from various domains to collaboratively define the specifications, principles, and guidelines for a Hybrid Quantum-Inspired Internet Protocol. By doing so, the goal is to foster interoperability, drive innovation, and establish a foundation for secure and efficient communication networks that harness the power of both classical and quantum computing paradigms.

3.2 Related Work

Provide a brief comparison of this activity to existing, related efforts or standards of which you are aware (industry associations, consortia, standardization activities, etc.).

The proposed activity is complementary to the IEEE Quantum Computing Initiative and the Quantum Internet Alliance, as it focuses on the development of standards for hybrid quantum-classical communication protocols. These two initiatives are more broadly focused on quantum computing technologies and quantum networking, respectively.

In addition to these two initiatives, there are a number of other ongoing efforts related to quantum computing and internet protocols. These include the European Telecommunications Standards Institute (ETSI) Quantum Internet Technical Committee, the International Organization for Standardization (ISO)/International Electrotechnical Commission (IEC) Joint Technical Committee 1 (JTC1) Quantum Computing and Communication Systems, and the National Institute of Standards and Technology (NIST) Quantum Information Science and Technology Program. These efforts are all working to develop standards and protocols for quantum computing and internet technologies. The proposed activity can draw inspiration from these efforts and contribute to the development of a comprehensive set of standards for hybrid quantum-classical communication.

Overall, the proposed activity is a unique and important contribution to the development of standards for hybrid quantum-classical communication. It is complementary to existing efforts and can draw inspiration from them to create a comprehensive set of standards that will be essential for the future of quantum networking.

3.3 Previously Published Material

Provide a list of any known previously published material intended for inclusion in the proposed deliverables of this activity.

- A Survey of Quantum Internet Protocols by A. M. Akl et al. (2020)
- Quantum Communication Protocols: A Comprehensive Review by S. Pirandola et al. (2017)
- The Quantum Internet: A Vision for the Future of Networking by J. G. Rarity et al. (2015)
- Quantum Networking: The Next Frontier in Networking Research by H. Weinfurter (2018)
- Quantum Communication and Networking by N. Gisin et al. (2007)

3.4 Potential Markets Served

Indicate the main beneficiaries of this work, and what the potential impact might be.

The main beneficiaries of this work are researchers and engineers in the field of quantum computing and networking, companies that are developing quantum networking products and services, government agencies and organizations that are interested in using quantum networking for secure communication and other applications, and the general public.

The potential impact of this work is significant. By developing a comprehensive set of standards for hybrid quantum-classical communication, the proposed activity will help to accelerate the development of quantum networking technologies and to make them more accessible to a wider range of users. This could lead to a number of benefits, including:

- **More secure communication:** Quantum cryptography can be used to create unbreakable encryption keys, which could be used to protect sensitive data from unauthorized access. This could be beneficial for financial institutions, healthcare organizations, and other businesses that need to protect sensitive data.
- **Faster and more reliable communication:** Quantum networking could be used to transmit data at speeds that are far faster than those possible with today's classical networks. This could be beneficial for businesses that need to transmit large amounts of data quickly, such as financial institutions and telecommunications companies.
- **New applications for quantum computing:** Quantum networking could be used to connect quantum computers together, which would enable them to perform even more powerful computations. This could lead to new developments in artificial intelligence, machine learning, and drug discovery.
- **Improved understanding of the universe:** Quantum networking could be used to study the quantum properties of the universe, which could lead to new insights into fundamental physics. This could benefit a wide range of scientific fields, including cosmology, astrophysics, and materials science.

The markets that may benefit from this technological innovation include:

- The financial sector: Quantum cryptography could be used to protect sensitive financial data, such as credit card numbers and bank account information.
- The healthcare sector: Quantum networking could be used to transmit medical images and data securely, which could improve the quality of care.
- The telecommunications sector: Quantum networking could be used to transmit data at much faster speeds than today's classical networks, which could revolutionize the way we communicate.
- The defense sector: Quantum cryptography could be used to protect classified information from unauthorized access.
- The research sector: Quantum networking could be used to connect quantum computers together, which could enable them to perform even more powerful computations.

The potential monetary benefits of this technological innovation are significant. The global quantum computing market is expected to reach \$22 billion by 2025, and the quantum networking market is expected to reach \$1.3 billion by 2027. The proposed activity could help to accelerate the growth of these markets and to create new opportunities for businesses and investors.

3.5 How will the activity benefit the IEEE, society, or humanity?

Describe how this activity will benefit the IEEE, society, or humanity.

- **Benefit to IEEE:** The IEEE is a professional organization that promotes the advancement of technology for the benefit of humanity. The proposed activity could help the IEEE to achieve its mission by:
 - Facilitating the development of standards for quantum networking, which would help to ensure that quantum networking technologies are interoperable and secure.
 - Providing a forum for researchers and engineers to share ideas and collaborate on research projects.
 - Educating the public about the potential benefits of hybrid Quantum-Inspired networking.
- **Benefit to society:** Hybrid Quantum-Inspired networking has the potential to revolutionize the way we communicate and interact with the world around us. The proposed activity could help to make these benefits a reality by:
 - Developing standards that make it easier for businesses and governments to adopt Hybrid quantum networking technologies.
 - Promoting research into new applications for Quantum-Inspired and quantum networking.
 - Educating the public about the potential benefits of quantum networking.
- **Benefit to humanity:** Hybrid Quantum-Inspired networking has the potential to improve the lives of people all over the world. For example, it could be used to:
 - Secure financial transactions and protect sensitive data.
 - Improve healthcare by providing remote diagnosis and treatment.
 - Speed up scientific research and development.

- Connect people in remote areas and improve access to education and information.

Overall, the proposed activity has the potential to make a significant contribution to the advancement of Hybrid Quantum-Inspired networking and to the benefit of IEEE, society, and humanity.

4. Estimated Timeframe

Indicate approximately how long you expect this activity to operate to achieve its proposed results (e.g., time to completion of all deliverables).

Expected Completion Date: 09/2025

IC activities are chartered for two years at a time. Activities are eligible for extension upon request and review by ICCom and the responsible committee of the IEEE SA Board of Governors. Should an extension be required, please notify the ICCom Administrator prior to the two-year mark.

5. Proposed Deliverables

Outline the anticipated deliverables and output from this IC activity, such as documents (e.g., white papers, reports), proposals for standards, conferences and workshops, databases, computer code, etc., and indicate the expected timeframe for each.

Here is the timeline with the additional deliverables added:

Year 1

- **Q1:** Kickoff meeting to establish the IC activity group and scope of the activity.
- **Q2:** Literature review and identification of gaps in the current state of the art.
- **Q3:** Development of a roadmap for the development of standards for hybrid quantum-classical communication.
- **Q4:** Publication of a white paper on the roadmap.
- **Q4:** Development of a database of resources related to quantum networking, such as papers, patents, and software.

Year 2

- **Q1:** Proposals for standards for specific aspects of hybrid quantum-classical communication.
- **Q2:** Workshops and conferences to solicit feedback on the proposed standards.
- **Q3:** Additional proposals for standards for consideration.
- **Q4:** A report on the status of the development of standards for hybrid quantum-classical communication.
- **Q4:** Computer code library for quantum networking applications.
- **Q4:** Training program for engineers and scientists who are interested in quantum networking.

This timeline is just our suggestion, and the actual timeline may vary depending on the progress of the work. However, it provides a general overview of what could be achieved in two years.

5.1 Open Source Software Development

Indicate whether this IC Activity will develop or incorporate open source software in the deliverables. All contributions of open source software for use in Industry Connections activities shall be accompanied by an approved IEEE Contributor License Agreement (CLA) appropriate for the open source license under which the Work Product will be made available. CLAs, once accepted, are irrevocable. Industry Connections Activities shall comply with the IEEE SA open source policies and procedures and use the IEEE SA open source platform for development of open source software. Information on IEEE SA Open can be found at <https://saopen.ieee.org/>.

Will the activity develop or incorporate open source software (either normatively or informatively) in the deliverables? Yes.

Yes. The proposed IC Activity will develop or incorporate open source software in the deliverables. The IEEE SA Open Source Policies and Procedures state that "all contributions of open-source software for use in Industry Connections activities shall be accompanied by an approved IEEE Contributor License Agreement (CLA) appropriate for the open source license under which the Work Product will be made available." CLAs, once accepted, are irrevocable.

The IEEE SA Open Source Platform is a web-based platform that provides a centralized repository for open source software developed by IEEE Industry Connections activities. The platform also provides tools for managing the development and deployment of open-source software, as well as for tracking the progress of open-source projects.

If the proposed IC Activity decides to develop or incorporate open-source software, it will comply with the IEEE SA Open Source Policies and Procedures and use the IEEE SA Open Source Platform. This will ensure that the open-source software is developed and managed in a responsible and transparent manner.

Here are some of the benefits of using open-source software in the proposed IC Activity:

- Open source software is often more reliable and secure than proprietary software.
- Open source software is more cost-effective, as it can be freely reused and modified by others.
- Open source software can help to build a community of developers and users who can collaborate on its development and improvement.
- Open source software can help to promote innovation, as it allows anyone to contribute to its development.

Overall, the use of open source software in the proposed IC Activity could have a number of benefits, including improved reliability, security, cost-effectiveness, and innovation.

6. Funding Requirements

Outline any contracted services or other expenses that are currently anticipated, beyond the basic support services provided to all IC activities. Indicate how those funds are expected to be obtained (e.g., through participant fees, sponsorships, government, or other grants, etc.). Activities needing substantial funding may require additional reviews and approvals beyond ICom.

7. Management and Procedures

7.1 Activity Oversight Committee

Indicate whether an IEEE Standards Committee or Standards Development Working Group has agreed to oversee this activity and its procedures.

Has an IEEE Standards Committee or Standards Development Working Group agreed to oversee this activity? No

If yes, indicate the IEEE committee's name and its chair's contact information.

IEEE Committee Name: N/A

Chair's Name: N/A

Chair's Email Address: N/A

Additional IEEE committee information, if any. Please indicate if you are including a letter of support from the IEEE Committee that will oversee this activity.

IEEE collects personal data on this form, which is made publicly available, to allow communication by materially interested parties and with Activity Oversight Committee and Activity officers who are responsible for IEEE work items.

This information is not available.

7.2 Activity Management

If no Activity Oversight Committee has been identified in 7.1 above, indicate how this activity will manage itself on a day-to-day basis (e.g., executive committee, officers, etc.).

Briefly outline the activity management structure.

The Executive Committee of this program will manage the activities.

7.3 Procedures

Indicate what documented procedures will be used to guide the operations of this activity; either (a) modified baseline *Industry Connections Activity Policies and Procedures* ([entity](#), [individual](#)), (b) *Abridged Industry Connections Activity Policies and Procedures* ([entity](#), [individual](#)), (c) Standards Committee policies and procedures accepted by the IEEE SA Standards Board, or (d) Working Group policies and procedures accepted by

the Working Group's Standards Committee. If option (a) is chosen, then ICom review and approval of the P&P is required. If option (c) or (d) is chosen, then ICom approval of the use of the P&P is required.

b) Abridged Industry Connections Activity Policies and Procedures

8. Participants

8.1 Stakeholder Communities

Indicate the stakeholder communities (the types of companies or other entities, or the different groups of individuals) that are expected to be interested in this IC activity and will be invited to participate.

Specify types of entities or groups of individuals.

Here are the stakeholder communities that are expected to be interested in this IC activity and will be invited to participate:

- **Companies that are developing quantum networking technologies:** These companies are interested in the development of standards for hybrid quantum-classical communication because it will help them to ensure that their products and services are interoperable with each other and with existing classical networking infrastructure.
- **Government agencies and organizations that are interested in using quantum networking for secure communication and other applications:** These organizations are interested in the development of standards for hybrid quantum-classical communication because it will help them to make informed decisions about the deployment of quantum networking technologies.
- **Researchers and engineers in the field of quantum computing and networking:** These researchers and engineers are interested in the development of standards for hybrid quantum-classical communication because it will help them to advance the state of the art in quantum networking technologies.
- **Standards organizations:** These organizations are interested in the development of standards for hybrid quantum-classical communication because it will help them to ensure that quantum networking technologies are compatible with other technologies.
- **The general public:** The general public is interested in the development of quantum networking technologies because they have the potential to revolutionize the way we communicate and interact with the world around us.

The working group will reach out to these stakeholder communities through a variety of channels, including:

- **Publications:** The working group will publish articles and white papers about its activities in technical journals and magazines.
- **Conferences:** The working group will participate in conferences and workshops to present its work and to solicit feedback from stakeholders.

- **Social media:** The working group will use social media platforms, such as LinkedIn and Twitter, to connect with stakeholders and to share information about its activities.
- **Direct outreach:** The working group will also reach out directly to stakeholders, such as by sending emails or making phone calls.

By reaching out to these stakeholder communities, the working group can ensure that it is developing standards that are relevant to the needs of the community and that are supported by a broad range of stakeholders.

8.2 Expected Number of Participants

Indicate the approximate number of entities (if entity-based) or individuals (if individual-based) expected to be actively involved in this activity.

Between 50 and 100 individual participants in this activity. This number could be higher or lower, depending on the specific circumstances.

8.3 Initial Participants

Provide a few of the entities or individuals that will be participating from the outset. It is recommended there be at least three initial participants for an entity-based activity, or five initial participants (each with a different affiliation) for an individual-based activity.

Use the following table for an individual-based activity:

| Individual Name | Employer | Affiliation |
|-----------------|--|-------------|
| Ean Mikale | Infinite 8 Industries, Inc. | N/A |
| Sharon Waters | Innovative Grant Concepts | N/A |
| JaQuala Yarbro | Compete Institute | N/A |
| Darshika Perera | University of Colorado, Colorado Springs | University |
| LaResha Swiney | Aerial Stratagems | N/A |

8.4 Activity Supporter/Partner

Indicate whether an IEEE committee (including IEEE Societies and Technical Councils), other than the Oversight Committee, has agreed to participate or support this activity. Support may include, but is not limited to, financial support, marketing support and other ways to help the Activity complete its deliverables.

Has an IEEE Committee, other than the Oversight Committee, agreed to support this activity? No

If yes, indicate the IEEE committee’s name and its chair’s contact information.

IEEE Committee Name: N/A

Chair’s Name: N/A

Chair’s Email Address: N/A

Please indicate if you are including a letter of support from the IEEE Committee.