Chapterthon 2018 Questionnaire

Submitted by Disaster.Radio, a Project of Sudo Mesh

1. Chapter /SIG Name

Use the Chapter /SIG official name as indicated here:
https://www.internetsociety.org/find-chapter#chapterlist

Community Networks SIG

2. Project Region

If you're part of a SIG, please select "SIG". We remind you that SIG's projects shall have a global scope.

X SIG

3. Project Title

The title should be short and attractive while conveying the project meaning. Use your imagination and keep it simple.

Open IoT Mesh Routing: Decentralizing Long-range Packet Radio Networks

4. Project Team

List Chapter/SIG members involved in the project, their expertise and role in the project. The project team should be composed of a minimum of 3 Chapter/SIG members. Please indicate their email and membership ID.

Grant Gallo - grant@peoplesopen.net - #199817
Grant is a firmware developer and hardware prototyper for the Disaster Radio Project. He has a degree in Electrical Engineering from Cleveland State University and has more than five years experience in technical support. He has also extensive experience with wireless network technologies and has contributed to community network projects. He will be the lead developer for this project.

Jenny Ryan - jenny@peoplesopen.net - #779171
Jenny works on administrative, social and documentarian support for humanitarian endeavors around access, equity and justice. She's a former academic with Masters degrees in Anthropology and Communication. Core projects in line with deep-hearted values include building community spaces such as Sudo Room and Omni Commons, and developing decentralized alternative infrastructure such as People's Open Network and disaster.radio.

She will be the Project Manager for this project, ensuring adequate completion of milestones, documentation and field testing.

Marc Juul - isoc@juul.io - #588001
Marc is a software developer on the Disaster.Radio project. He has 5 years of experience working on community wireless networks in the SF Bay Area and 10 years experience starting and running community technology spaces in Copenhagen, Denmark and Oakland, CA. Marc hold's engineering degrees in IT and Biotechnology from the Technical University of Denmark. He will be acting in an advisory role, reviewing documentation and code and providing feedback.

5. Project Location
Indicate the name of the community or institution where the project will be implemented and why you have chosen it.

Sudo Mesh holds events, meetings, and stores equipment in Sudo Room, a hackerspace in Oakland, California that resides in and has shared ownership over the Omni Commons, a building owned by and composed of a collective of collectives working on shared projects and shared stewardship of commons-based resources. Omni is home to dozens of community groups and local organizations who collaborate on projects and campaigns relevant to our livelihoods, shared struggles, and future utopias.

6. Project Summary
Describe in no more than 20 lines of text, what the project is about, the problem it will solve and how you will do it.

Disaster.Radio is a project dedicated to enabling communication in real-time disaster scenarios using solar-powered long-range low-bandwidth radios that continue to function after the power grid goes down. Disaster.Radio is entirely open source and open hardware.

Recently, long-range packet radios such as GoTenna have become more popular and technologies such as LoRa have made multi-mile long-range low-power links feasible at low cost. There is increasing interest in decentralized networks using such packet radios - yet no open mesh routing protocols exist that are suitable to the unique constraints of such networks.

Currently, Disaster.Radio nodes have only very basic relaying where all nodes repeat all packets. The goal of this project is to develop a simple mesh routing algorithm optimized for very low-bandwidth omnidirectional packet radios (a few kilobits per second), with small

maximum packet sizes, that relay packets only when needed for delivery of packets to target nodes.

You can learn more about the Disaster.Radio project on https://disaster.radio/

7. Project Goals and Objectives

To help you create measurable, tangible and realistic objectives. You may refer to the chart example in the "How to Plan a Project" presentation.

We will design a mesh routing algorithm suitable for Disaster.Radio and similar hardware as previously described:

1. The first milestone will be a write-up of the proposed algorithm and reasoning for design parameters.
2. The second milestone will be an implementation of the algorithm on the physical Disaster.Radio hardware. This will be a very simple mesh-routing algorithm since it will be designed to operate on single-radio nodes with omni-directional antennas, meaning that every routing decision is the reduced to a binary choice: Should the node repeat the packet or not.
3. After the above milestones have been accomplished, the next step will be field-testing on Disaster.Radio hardware deployed around Oakland and Berkeley (roughly 5 nodes spanning 10 miles). Results will be documented and published on the Disaster.Radio website.

8. Project Timeline

List the key tasks or activities needed to implement the project successfully. Use the space below for main steps and project timeline. Remember to consider the marathon deadlines.

Project Start: 1 September 2018

- Deadline at 1.5 weeks (10 Sep 2018): Design and write up a description of the proposed minimal mesh routing algorithm;
- Deadline at 5 weeks (7 Oct 2018): Implement the mesh routing algorithm on Disaster.Radio hardware;
- Deadline at 6 weeks (14 Oct 2018): Deploy at least 5 test nodes spanning ~10 miles and document results;
- Deadline at project end (19 Oct 2018): Second round of field testing as needed;
- Deadline at end of October: Creation of final report and 3-minute video for ISOC presentation.

9. Project Impact

Describe how the project will benefit the community and contribute for the development of IoT security and privacy awareness.

As long-range protocols like LoRa become increasingly popular there will be increased demand for decentralized protocols that don't involve central points of failure such as with star-topology networks like LoRaWAN-based The Things Network. There is currently a lack of open mesh routing protocols for very simple long-range low-bandwidth packet radios. The GoTenna products implement a protocol similar to what we propose and have been gaining adoption but these are unfortunately using a proprietary secret protocol.

We believe the Internet should be implemented using open standards that allow anyone to create interoperable hardware and software. Open standards have been a big part of the success of the Internet, so why should the Internet of Things be any different?

Designing communications protocols and mesh routing algorithms is a difficult and involved problem, but these very low-bandwidth radios that implement only OSI Layer 1 and have APIs consisting of "pick a channel and a transmission speed and hand me some bytes" are simple enough that a single person can realistically design and implement a proof of concept in ~1 month. We're hoping that this work can be demonstrated in the field and inspire both continued development and other similar efforts.

10. Project Risks

List any potential risks that may interfere on the project roll-out and how you plan to overcome it.

Designing a mesh routing algorithm, even a very simple one, will almost certainly require multiple iterations of testing and modification. We're unlikely to have time for more than one cycle during the ~1 month period but plan to continue work on a volunteer basis after the end of the project period.

Since many IoT are low-power devices operating on battery or solar, there is the risk that a mesh algorithm will be too power-hungry since all radios will need to be constantly receiving (when they are not sending) in order to receive packets that need to be relayed. This could be a significant power draw compared to the deep-sleep mode that client device can often utilize in more traditional star topology IoT networks where only servers/gateways need to be receiving at all times. We've looked up the power draw of reception and transmission of a few popular packet radios and while the power draw will be greater than what could be achieved in a non-meshing topology, we still believe there are many scenarios where the benefits outweigh the increased power requirements, e.g. ease of deployment, cost reduction

(gateway nodes are usually more expensive), and ability for the network to dynamically adapt to topology changes.

11. Project Sponsors

Describe any sponsorship, donors, funding, institutional or in-kind support that you have collected outside ISOC resources.

The Disaster.Radio project has over the past few months received the following donations, though none are earmarked specifically for the development of this mesh routing protocol:

- Private Donor - $2500 - August 2018 – For 50 disaster.radio boards to be produced and distributed at the 2018 Decentralized Web Summit
- Institute for the Future - $2500 - July 2018 - Unrestricted donation to Disaster.Radio
- People's Life Fund - $750 / $2500 - June 2018 – No War Tax grant to Sudo Mesh apportioned to Disaster.Radio, People's Open Network and Laptops For All

12. Measuring the Project Success and Impact

The project success is directly in line with its objectives. Make sure your goals are measurable and tell us how you plan to measure your success.

We will test the mesh routing algorithm on the Disaster.Radio hardware in a lab setup, and if time permits in nodes deployed across multiple miles in Oakland, CA. We will look at total network bandwidth usage and reliability of packet delivery as compared to a naive flooding protocol (every node re-transmits each packet). If performance is better than the naive approach then that is one measure of success.

Another measure of success is whether we manage to attract collaborators in the form of either open source developers or other projects willing to port test the protocol on different hardware and software platforms. Current and prospective collaborators include:

- People's Open Network - Local WiFi mesh network with ~50 nodes across the Bay Area;
- Secure Scuttlebot - Send and receive SSB messages via Disaster.Radio nodes;
- Grey Cat Collective - Designing Disaster.Radio-compatible handheld client devices;
- Libre Router - Potentially implementing a LoRa radio in next iteration of their open hardware WiFi mesh router;
- Metoomentor - Utilizing Disaster.Radio for backup access to local mesh networks used for serving educational content to girls in the Madurai Area of India;
- Human Rights Foundation - Beginning conversations about future deployment of Disaster.Radio hardware in disaster scenarios around the world.

13. Chapter Visibility

Describe how the project will contribute to the Chapter's local presence and mission.

We are in active conversation with communities and institutions across the globe who are eager to deploy disaster.radio networks for a wide variety of use cases, including fire evacuation safety, lost hikers and pets, community garden monitoring, and emergency communications and mapping. Current collaboration possibilities are under discussion with project organizations in Toronto, CA; Argentina; Seattle, Washington; Nigeria; Brazil; India and elsewhere.

Most recently we handed out more than 50 Disaster.Radio development kits at the Internet Archive's Decentralized Web Conference and held a free follow-up un-conference at our headquarters the following weekend, where ISOC stickers were handed out alongside Disaster.Radio equipment.

14. Budget

In this section, you are invited to describe your overall budget, including expenses and sponsors (if any). Complete the sections below taking into account your project narrative and the goals you trying to achieve. The project budget should be clear, well organised and easy to understand.

The amount available for this programme is of $2,000.00 USD. At the end of project you will be required to provide a financial report with the actual costs. Be as accurate as possible.

Section 1

List potential project sponsors, which may include in-kind donations or funding.

Here are some future funding opportunities. We're one of the seven finalists in the Mozilla WINS Challenge and have already produced the first 50 Disaster.Radio hardware development kits.

Item Description	**Amount (USD)**	**In-Kind Value (USD)**
Mozilla Foundation WINS Challenge Award	$50,000 - $400,000	
Educational Kit Sales	$100,000	
Storage and Meeting Space - Sudo Room		$2,500
TOTAL	***$150-$500,000***	***$2,500***

Section 2

List only expenses to be covered by this ISOC funding; e.g professional services, equipment, travels etc. List only expenses to be covered by this ISOC funding; e.g professional services, equipment, travels etc.

Item Description	***No. of Items (if applicable)***	***Amount (USD)***
Professional Services: Engineer	1	$1500
Professional Services: Administrative	1	$500
Total		***$2000***

15. Narrative

In this section include any complementary information that helps the selection committee understand your proposal.

We have long sustained this project on volunteer energy and charitable donations. However, to further the evolution of alternative networks, we seek to create an equitable system for individual self-sustainability and community resilience. To this end, we're seeking grants and collaborations for funding individuals working to sustain the project.

Given the additional time and labor needed to set up our nonprofit to administer and support contract employees, we've also allocated a small portion of the grant fund to provide a stipend for our Treasurer, Jenny, who will also be involved in the management and documentation of this project.