Wind: A Network in Motion, Powered by People

Guardian Project + OkThanks
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How can we leverage wireless technology to keep people connected to each other and to vital information sources in the aftermath of a disaster where Internet access is unavailable or compromised?
https://wirelesschallenge.mozilla.org/_assets/NSF-OffTheGrid.pdf

What is the name of your solution?

Wind: Off-Grid Services for Everyday People

https://guardianproject.info/wind

PROBLEM STATEMENT:

When a natural disaster strikes, connectivity and electricity often become difficult. Being connected to others may save your life, by helping you know where to go to find safety and services. An earthquake leaves people disconnected from one another, trying to locate loved ones. After a hurricane, rural communities struggle to coordinate in order to provide aid and relief. Journalists work to document the situation, looking for ways to share and distribute what they have learned. Even after the initial emergency subsides, recovery requires coordination that is dependent upon having access to remote systems and critical knowledge.

However, it doesn't take a disaster to experience these kind of challenges. Communities around the world, everyday, face them through lack of infrastructure or economic means. Often, these are man-made situations - war, authoritarian rule or economic disparity. The problem to consider, then, is not just the complete off-grid scenario of a total disaster, but also the factors that lead to it. In many Latin American countries, individuals move between being connected to the internet and being offline, if they live or work in a rural area or low connectivity region. Often on cheap phones, the amount of data one can afford, or access to electricity, affects how connected they are.

Many see the problem as a lack of societal or economic incentive to provide the kind of robust, resilient infrastructure needed to address these gaps and blackouts. They look to the sky for the answers, hoping to see a balloon or drone miles up, beaming down “free” signals. Others have designed “internet in a suitcase” setups, using static wifi mesh networks with long-range uplinks to traditional internet service providers. While these can be helpful, the focus on connecting to the “real Internet” misses the opportunity to build more opportunistic nearby networks, serving local needs.

Unfortunately, most apps and browsers on smartphones, are dependent upon connecting to cloud-based servers to function. Some provide an offline mode to access cached content or send a message that will queue until you get back online. These apps see lack of an internet connection as a failure state. Recently, with “Android Go”, Google provided a means to download content for offline viewing and sharing over Bluetooth. Apple’s AirShare service works well, but only within their proprietary ecosystem. Something needs to fundamentally change in the design of apps, to consider both affluent users, and those in the aftermath of disaster.

Ultimately, with the success of the singular Internet, we have seen a lack of investment in the many other possible nets. It is these other nets, that are better suited for situations where high-band connections to the global internet are not available or affordable. It is these other nets that can fully utilize all of the potential in the advanced radios, sensors and processing power available in even the cheapest of smartphones and routers, available around the world. Our solutions focuses on these other nets, through the metaphor of Wind.

SOLUTION STATEMENT:

Describe your solution and how it will connect the unconnected. 500 words

Guardian Project has been developing an approach for off-grid networks that we call Wind. A windy network is one that is designed around opportunistic communication and sharing of local knowledge. It is built on impermanence, movement, and spontaneity. Wind is a direct counterpoint to the metaphor of the Web, a system built upon the concept of fixed physical nodes, centralized authorities and permanent links. We believe that any approach to designing and implementing an off-grid network, must not simply try to somehow port the a web-centric view to this unstable environment. Instead, we must completely rethink the approach to network topography, the client-server model, and how we develop interactive apps.

Any proposed solution must be rooted in the mindsets and needs of people and communities who find themselves in them. A pure technology solution is not enough. One way that we have developed our understanding through hosting and participating in a number of workshops and “simulation events” over the last three years. These events allowed developers to meet people and communities with experience in facing disasters and limited connectivity. Together, a deeper understanding was gained, and future solutions benefited greatly.

Below you will find some core tenets of the Wind approach:

1) Wind is a characteristic of a network that is shaped by the movements and density of people in time and space.
2) The strength of a windy network is dependent on the number of nodes connected over time and space, the density of nodes, and how their velocity and bearing are changing.
3) A windy network has no expectation of static infrastructure and requires no permissions by centralized authorities.
4) A windy app doesn't consider lack of connectivity a failure state
5) A windy app saves and caches all, in order to be able to pass along to others.

For the Off-Grid Challenge prototype, we will implement four components: WindChime, WindFarm, WindSock and WindReport. First, we will implement the WindChime communication protocol, building on existing peer-to-peer protocols we have developed, contributed to, or studied. WindChime will be exposed to users as a messaging app, and to developers as a communication backbone for any off-grid app or service. Second, we will create WindFarm, based on our work on decentralized app stores, full of free apps, content and media useful in an off-grid disaster scenario. WindFarm will be deployed on WindSock, based on the LibraryBox project, enhanced to support WindChime for peer-to-peer communication. Finally, the WindReport app will be developed, based on our work with WITNESS, as an eyewitness testimony and evidence capture tool. It will communicate through WindChime with other users and to any nearby WindSock.

USERS:

Who will the users of your solution be? How does the design of your solution address those users' needs? How will it benefit those users? Did you conduct any user research that shaped the design of your solution? 1250 words

Over the last four years, we have been investigating solutions and best practices for handling Internet "blackout" events, whether they be natural or man-made. We have held workshops, undertaken design exercises, participated in simulation events, developed new concept protocols and patterns, written code, and shipped working apps and services focused on this problem. More recently, we have undertaken an intensive investigation of limited connectivity regions of Latin America. All of this was done with the goal of more deeply understanding the needs of the people and communities that have been, or will be, affected by future off-grid states.

To help in our design and engineering process, we have created ten personas that represent prototypical users in Mexico, Colombia and Cuba. In these countries, individuals move between being connected to the internet, through mobile data or wifi, and being completely offline. Often using entry-level, two generations old smartphones, cost is an important factor when it comes to connectivity. Unlimited data plans are uncommon and expensive. People are regularly offline if they live or work in a rural area or low-connectivity region. These insights were informed by surveys, research and personal narratives from interviews, blogs and social media. You can view the full set of our existing personas at http://okthanks.com/blog/peronas-latin-america. Below are three we think are most relevant to this challenge:

- Camila, Social Worker, Colombia: *"I love my job. As a social worker, I am dedicated to helping people in need. I often travel to rural, communities affected by violence for work. Generally there is no Wifi and occasionally not even cell service. I often download documents and videos onto my phone while I'm at the office using Wifi, so when I arrive in remote areas I can easily share the files over bluetooth."*

- Guadalupe, Journalist, Mexico: *"I travel a lot to do research, find stories, raise awareness about my findings, helping the families of the victims in my stories, and to raise money to continue fighting the crimes against women in Mexico. My smartphone is the best tool. I can basically run a whole investigation with it; recording conversations, taking pictures, doing research online, sending the information to other colleagues and staying in contact with her clients and sources. But if my phone were to fall into the wrong hands, my life, and all the contacts on it would be in danger."*

- Don Benito, Bakery Owner, Cuba: *"Instead of a landline, I own a cellphone for customer orders and personal use. I'm constantly at the bakery and I miss my family during the day, so they frequently send me multimedia messages. Which I love showing to my customers. My wife's brother in Miami pays for her cellphone. Every month we get a 5 hour Nauta card to access wifi spots around town. My wife's phone is what we use to access the internet, send emails and connect on Facebook. I usually download videos and photos from the family in the US and send them to my phone via bluetooth.*"

Within this proposal for the off-grid challenge, we are expanding our set of personas to include more, to ensure we address specific kinds of users within a disaster scenario. Here are the proposed personas:

1) Joseph, a Survivor, is constantly trying to find the best food, shelter and services for his family, while keeping up-to-date with where and when services are being offered by relief organizations. Keeping connected to friends and family outside of the disaster area is important, but not as important as navigating the immediate situation.

2) Rakesh, a Community Organizer, has taken on the local leadership role for the town, which was mostly reduced to rubble and ashes during the disaster. The town meeting hall is still standing, along with a local school, where services are being provided to anyone who can make it there. However, there is limited electricity, and no working mobile service. Rakesh receives daily deliveries of supplies from trucks and relief workers who are coming and going from other nearby towns.

3) Maria, a Relief Worker, has arrived in the affected region, and is trying to figure out how she can be most useful. She made initial contact at the regional government relief center, who provided her some information about where she might go, and how she might help. Not knowing the local area well, she is constantly trying to find updated maps, guides, directories, and other helpful knowledge. She is building up a good collection of resources and custom maps on her phone, that she hopes to share with others.

4) Rene, a Medical Responder, is providing first aid and basic medical procedures to people in need at various relief centers throughout the affected region. He has experience as a paramedic, and is pushed to his skill limits everyday. Having reference medical materials is important, as is communicating with other medical responders in the region, to ask for assistance, advice and supplies.

5) Pema, a Journalist, in the days after the disaster, has been sent on assignment to interview those affected, and keep up with the latest developers in the recovery process. She is new to new to the area, and finding it difficult to know where to go to find specific people. Since texting or emailing doesn't work, she relies mostly on posting messages to paper bulletin boards and catching rides with relief trucks and caravans. She captures audio, photos and videos on her phone, and edits stories on there, or with her laptop, which is often out of battery.

Some of the technology that we have developed previously, and that will contribute to this solution, is already deployed in the real-world. The Wind Farm is based on the F-Droid open-source app store platform. One of our community members traveled to Cuba over the summer, and met with open-source enthusiasts and developers there. Most interesting, was his visit to the "DroidT Shop" in Sancti Spíritus, Cuba. They run their own F-Droid app repository within their local WiFi network in the shop. Currently, they offer more than 2000 apps, mostly games, but also other useful apps, for free to everybody within the range of their WiFi router. Having a worse store location than their competitors, it really helps them to drive people to their shop and to build up their reputation within the local community.

So far, they are the only store in their city offering this free and convenient service to their customers. The apps are downloaded by the store employees once, put into the repository and then are available to an unlimited number of customers without ever needing to connect to the internet again. Another nice service they offer are app updates that are securely delivered by F-Droid. When somebody who has already downloaded apps from their repository, comes into the range of their WiFi again, F-Droid will check for updates and offer to install the ones that are available. This is a huge advantage in a country where people normally never care about updates at the expense of security.

COMMUNITY/LOCATION:

Describe the communities, geographic location(s) and/or types of environments in which this solution could be most useful. 1250 words

Our work on limited connectivity communities has focused on Colombia, Mexico and Cuba. While they share some similarity in terms of geography and culture, they offer quite a different set of challenges to respond to. We picked these three countries knowing that the would offer an opportunity to model three diverse environments and communities. Beyond Latin America, we also have significant experience living and working in the Himalayan region, from Nepal, to Northern India, and Tibet. These regions are often without power in the normal course of life, and face a variety of issues when it comes to connectivity, from the practical, to the economic and political. Lastly, many of us lived in New York during 9/11, the 2003 Northeast Blackout and Hurricane Sandy. All of these experiences push us to provide a solution that is as potentially beneficial in a future disaster to our communities, families and friends, as it is to strangers on the other side of the world.

In Colombia, years of war and economic disparity along racial lines, has created significant differences in mobile services between the affluent urban areas and the poorer rural areas. In particularly, the lack of roads and the significant amount of travel done by boat, makes the development of reliable, contiguous mobile infrastructure very difficult. However, even these rural and remote areas, opportunities exist to provide local communication services, through community centers, schools and churches. People gather at these spaces, even after a disaster, for protection and prayer. The flow of people from urban to rural is constant, creating invisible, yet essential, human networks between the regions, that can be utilized to carry digital content and communications. The WindChime and WindStore components of our proposal both can benefit and build upon these links.

In Cuba, this lack of connectivity is even more apparent, throughout the country. Due to years of economic embargoes, Cubans general do not have access, or can afford high-speed mobile data service. They find wifi where they can when it leaks out from foreign embassies and tourist hotels, or pay for service available in public squares and spaces. Those who work at universities or at the government have some additional access. This all means the vast majority of people are using smartphones with no mobile data plan - only wifi - and relying already upon the offline caching and queueing features available in apps today. They get apps through physical “app stores”, that install them over wifi hotspots or USB drives. Most famously, the “Weekly Packet” service, El Paquete Semanal, delivers a one terabyte drive of entertainment, software, news and knowledge, to a huge audience of Cubans willing to pay a small fee. This combined model, of physical hotspot spaces and terabyte size “data mules”, is another phenomenon that we can harness through the systems proposed in Wind. The F-Droid system that our WindSock component is based on is already deployed in Cuba, and we are currently working to support distributing apps and content through a weekly packet-type service.

In Mexico, poverty, corruption and the drug trade, have created a variety of situations where access to or use of the mobile networks are not possible or safe.This sadly includes the Mexican Government, who recently was involved in a spying campaign against journalists and activists advocating for anti corruption legislations and justice for 43 students who mysteriously disappeared. Drug cartels have been know to use the same kind of technologies to spy on their rivals, intimidate government officials and force common people to work for them. The less communication happens over insecure, compromised centralized networks, the more it can stay safe and secure within local communities.

By supporting alternate, local networks for communication that are secure, private and not tied to phone numbers or other public, registered identifiers, we can ensure users are not just connected, but also safe. WindChime not only helps in discovering users and services nearby, but it also does so in a privacy-preserving and enhancing way. WindReport is an app specifically developed for the kind of post-disaster humanitarian and human rights documentation capture that is necessary for relief efforts and recovery beyond just the physical infrastructure. In a country like Mexico, where corruption and non-state actors wield great power, privacy, security, and evidence gathering is essential.

In Kathmandu, Nepal and Dharamsala, India, the lack of a reliable power grid or robust connectivity is the norm. Often, after heavy storms, or as happened after the 2015 earthquake in Nepal, power can be out for days, and a mobile signal hard to find. In both communities, the local hackerspaces and technical communities often rise to the occasion to help solve the day to day and emergency problems. AirJaldi is a Dharamsala-based mobile service provider that provides long distance wifi-based networks to homes, businesses, schools and the local government. They have a trained team of experts, ready to deploy new hardware and services. Kathmandu Living Labs is a technology NGO that organized off-grid mapping efforts after the 2015 earthquake. Their QuakeMap efforts was essential to the relief and recovery effort, even serving as a primary resource for the Nepalese Army. Our work on Wind would provide a toolkit to groups like AirJaldi and Kathmandu Living Lab, who have the technical skill to customize, deploy, and even improve upon it.

As many of us have lived in New York for a number of years, we have strong memories of the moments in which the city was brought to a standstill, either due to an attack, accident or natural incident. After 9/11, the NYCWireless community banded together to extend wifi networks over long distance. This was a pre-existing community interested in enabling regions of the city to have wifi hotspot access, when 802.11x technology was new and rare. After Hurricane Sandy, the Red Hook community benefited from having a pre-existing community mesh network, that kept that connected even when the rest of the city was still struggling. In both cases, having active, interested, skilled communities already tinkering, testing and teaching people how to deploy and use these systems is critical for their adoption in an emergency. By developing Wind in a transparent, open-source manner, deeply engaging users and communities along the way, we will help ensure it is ready for use, when the time comes.

Lastly, through our connection with the LibraryBox, we have followed its development and adoption over the last few years. LibraryBox is an open source, portable digital file distribution tool based on inexpensive hardware that enables delivery of educational, healthcare, and other vital information to individuals off the grid, over WiFi. It is in use in thousands of schools, homes, libraries and businesses around the world. We have deployed multiple LibraryBox networks in context of our work in India, where we used it to distributes apps, videos and PDF technical content at large gatherings where the mobile networks were overwhelmed. Our WindSock and WindFarm components, as shown in our Cuba example, build on the value that LibraryBox is already providing day to day to people around the world. More importantly, libraries and schools specifically provide a physical space in which any Wind-style network can be rooted.

TECHNICAL FEASIBILITY:

Explain the technical design of your solution. What technical capabilities do you envision a working prototype will have? Are there any technical hurdles or problems that will need to be solved in order to build a working prototype? At what stage of development is your solution currently? 5000 words

It is important to clearly point out that our entire approach to this effort is to incrementally improve upon existing efforts, while also focusing on developing the new integration glue necessary to provide a smooth, usable and practical to deploy experience. We are not inventing a new stack or protocol from scratch, or envisioning a utopian silo in which our systems solves all of the potential problems end-to-end. The issue that we see is that there are many potential components, protocols or software libraries that exist today, but that they have not been unified into a cohesive, usable experience that promotes easy deployment, bootstrapping and adoption. Work in the past by others has also run out of “fuel”, both human and financial, and there was no focus on sustainability or maintenance of the project with a long term view. We seek to address these by building upon a large body of excellent work that needs to be weaved together in a new way, and extended to provide a cohesive solution for the off-grid disaster scenario. We will do this primarily through partnership, collaboration and leadership.

There are also still a significant amount of complex engineering tasks to complete. While we our proud of our community and user-centered work, it would not matter if we could not fulfill that promise with our ability to solve technical problems and ship usable applications. Our existing work on nearby communication features and code libraries has been significant over the last few years. We deeply understand the potential and limitations of technologies like Bluetooth LE, Wifi P2P, Wifi Hotspots, Beacons and more. Our ability to delivery systems that are both usable, and also include advanced security and privacy features, is also critical to any system that is targeted at vulnerable user populations. Finding a way to both promote widespread adoption of a new alternative network topology and applications, while also providing privacy and security capabilities within, is one of the key problems to solve.

Within our Wind prototype, we propose to design and implement a system that includes the following components:

- **Wind Chime:** A delay-tolerant peer-to-peer protocol, and core apps such as messaging and mapping that support it, to enable the flow of messages, knowledge and data within and between users and communities.

- **Wind Farm:** A decentralized software and content distribution system built upon the Debian repository model, but made available through usable mobile app and web user experiences.

- **Wind Sock:** Physical infrastructure nodes built from common routers and lower-power computing platforms, that provide gathering points for providing services, sharing content and discovering other users.

- **Wind Report:** An eyewitness testimony and verifiable multimedia evidence capture system, that allows anyone to gather and report on recovery and relief efforts, interviews refugees and victims, and capture incidents of corruption and abuse of power.

Wind Chime

Chime is a delay-tolerant peer-to-peer protocol, and core apps such as messaging and mapping that support it, to enable the flow of messages, knowledge and data within and between users and communities.

- Discovery

  Chime provides a way for users and applications to be aware of their proximity to services and users. This is achieved through a combination of existing broadcast and discovery technologies in Bluetooth and Wifi, emerging specifications like AltBeacon, and new Wind-oriented approaches sharing GPS place and time data between nodes in motion.

The AltBeacon specification defines the format of the advertisement message that Bluetooth Low Energy proximity beacons broadcast. The AltBeacon specification is intended to create an open, competitive market for proximity beacon implementations. The AltBeacon specification is free for all to implement, with no royalty or fees. AltBeacon does not favor one vendor over another for any reason other than the technical standards compliance of a vendor's implementation.

- Sharing

Built on our current LibNearbyShare Android library, the Sharing features of Chime simplifies the discovery of other devices currently nearby, and enables a secure channel for transferring a set of data or media to them. It attempts to unify all possible nearby network technologies under a simple, clean interface that any developer can implement without too much trouble or overhead. This library does not require any Internet connection, cloud service, or other centralized method for discovering peers. All detection is done purely using the signals being broadcast by devices themselves. It unifies access to Bluetooth, WiFi LAN/NSD sharing, and Wifi P2P Sharing. We are also investigating adding additional methods for discovery and sharing, including audio-based discovery using ultrasonic and audible tones, QR code bootstrapping, WiFi Hotspot auto-setup, NFC and more.

- Messaging Protocol

Wind Chime also offers delay-tolerant peer-to-peer messaging support through the Murmur (formerly known as “Rangzen” protocol). Messages are spread directly from one device to another (forming a delay-tolerant peer-to-peer network) without user intervention using Bluetooth and WiFi Direct. The more devices the faster the message spreads and if no device is around, the message is queued in the feed to be sent later. Users control their anonymity and decide what information to share. Lastly, Connection Scores help users filter spam messages and Restricted Messages limit the audience to their friends. It is also:

  - Infrastructure Independent: A mobile mesh that easily scales without compromising users’ safety
  - Trustworthy: Leveraging social connections to resist attack and infiltration
  - Private: Providing strong anonymity guarantees to users to preserve their privacy

Murmur was implemented originally by the Denovo Group, following the tenets laid down in the UC Berkeley EECS research paper called “Rangzen: Circumventing Government-Imposed Communication Blackouts”: https://www2.eecs.berkeley.edu/Pubs/TechRpts/2013/EECS-2013-128.pdf

- Core Applications

  The Wind prototype will feature number of Chime-enabled apps, including a mobile messaging app, a mapping application, a news app, and the updated Wind Farm (F-Droid) and Wind Report (Proofmode) apps. All of these apps will be optimized for offline and off-grid use, and make the users aware of opportunities to share, collaborate and connect with users, services and resources around them.

Wind Farm

Farm is a decentralized software and content distribution system similar to the Debian repository model, but made available through a mobile app and distributor toolkit. It is built upon our work on the F-Droid open-source project. For an off-grid or disaster scenario, designing systems to both distribute and keep software updated is a critical linchpin for both onboarding and security of the entire system. Wind Farm will be powered by F-Droid, enhanced with support for Chime, and fully tested to work in off-grid scenarios with Wind Sock hosted repositories. Chime supports will also improve the capability of the F-Droid Nearby “App Swap” feature, that allows any devices to become an app store themselves, offering any app or content to nearby friends over Bluetooth or Wifi.

The F-Droid.org site offers a repository of FOSS apps, along with an Android client to perform installations and updates, and news, reviews and other features covering all things Android and software-freedom related. It is an installable catalogue of FOSS (Free and Open Source Software) applications for the Android platform. The client makes it easy to browse, install, and keep track of updates on your device.

With the Repomaker tool of F-Droid, everyone can create their own repo. So whether you are a musician who wants to publish their music or a developer who wants to serve nightly builds of their app, you are free to create your own repo and share it with other people independently of F-Droid.org. In the past, creating a repo has been difficult because you had to have knowledge on the command line, needed to edit text files to edit your packages’ store details and had to paste screenshots in a special system of directories to have them served well inside the F-Droid app. This all got easier now: with Repomaker, you are able to create your own repo and do not need to have any special knowledge to do so.

Wind Sock

Wind Socks provides physical infrastructure nodes built from common routers and lower-power computing platforms, that provide gathering points for providing services, sharing content and discovering other users. The Box component will be built primarily upon the excellent LibraryBox system, but expanded to support the Chime protocol for improved nearby discovery and messaging, as well as Store, for hosting software and content repositories.

LibraryBox (http://librarybox.us/) is an open source, portable digital file distribution tool based on inexpensive hardware that enables delivery of educational, healthcare, and other vital information to individuals off the grid. LibraryBox v2.0 is a combination of a router (a variety of hardware will work), USB drive, and software that, when combined, give you a small, low powered webserver. The webserver acts like a captive portal, and delivers files that are stored on the USB drive. To use LibraryBox, you simply connect to the wifi SSID "LibraryBox" and launch a browser. Attempting to visit any webpage will push you to the LibraryBox homepage on the device, which has information about the project, and links on the menu for downloads. You can browse the contents of the Shared folder, and download any files you'd like.

At our Wind Farm event hosted in 2015, we initially experimented with deploying F-Droid app repositories on a mid-range LibraryBox. In 2016, we deployed multiple LibraryBox with digital security training content and app repositories at a large cultural gathering in India with 100,000 attendees. The devices were displayed prominently with QR Codes, “tap to use” NFC Stickers, and others information about how to bootstrap into the system. Once the user was connected once to the unique Wifi SSD used by our LibraryBox, they would then auto-connect to another other similarly configured Box deployed at these events. At Wind Farm, we deploy a number of boxes throughout the Harvard campus, and enabled content uploading so that users could submit photos, videos recording and other reports of our simulation event, as it was occurring.

In both cases, these were powered by a large external battery capable of running for one to multiple days. Power usage is dependent upon the number of users of the system, and the amount of data stored and transferred from the device. Multiple batteries could also be paired with generators or solar capture to extend the availability.

The portability of a Box can vary depending upon the size and capacity of the box itself, the batteries it is using, and the way in which power is generated for it. LibraryBox are often both carried in people’s backpacks for opportunistic sharing in meetings, conferences, cafes, subways and so on, but they are also installed in permanent locations like libraries, schools and lobbies. We also see great possibilities in hosting Boxes in buses, trains and trucks that have a regular, predictable path between towns, cities and other regions. These can act as a backbone of content, synchronized between any Chime-enable Box or app, as they encounter each other. The flexibility of the Box approach, and the work with what you have mentality, make it an appropriate and useful component within our prototype for the off-grid challenge.

Wind Report

Report provides an eyewitness testimony and verifiable multimedia evidence capture system, that allows anyone to gather and report on recovery and relief efforts, interviews refugees and victims, and capture incidents of corruption and abuse of power

We have been working for many years with our partners at WITNESS, a leading human rights media training and advocacy organization, to figure out how best to turn smartphone cameras into tools of empowerment for activists. We have also contributed to Benetech's Martus platform, the leading human rights reporting and data gathering tool. While it is often enough to use the visual pixels you capture to create awareness or pressure on an issue, sometimes you want those pixels to actually be treated as evidence. This means, you want people to trust what they see, to know it hasn't been tampered with, and to believe that it came from the time, place and person you say it came from.

Proofmode is a light, minimal "reboot" of our more heavyweight, verified media app, CameraV. Our aim was to create a lightweight (< 3MB!), almost invisible utility (minimal battery impact!), that you can run all of the time on your phone (no annoying notifications or popups), that automatically adds extra digital proof data to all photos and videos you take. This data can then be easily shared, when you really need it, through a "Share Proof" share action, to anyone you choose over email or a messaging app, or uploaded to a cloud service or reporting platform.

Wind Report would integrate our work on the ProofMode app and service with Wind Chime and Wind Sock. Adding Chime capability will allow evidence to be notarized and shared between many people in an area, without require any network infrastructure. Wind Sock will be expanded to support the submission of Report generated evidence, building in chain-of-custody features, as well as a workflow for aggregating and delivering the reports to the necessary authorities and organizations.

We believe these are the kinds of applications that are essential to not only Wind succeeding from a technical and product perspective, but for the community themselves to have the support and services needed for relief, recovery and healing.

Access, Reach and Capacity

A Windy network or application can operate at many different scales. In some cases, people in a rural community may find value in accessing a shared WindSock hosted at their relief center that has been brought from the city. On it might be news and entertainment, that they can download and store on their own personal devices. There may only be 10 people a time using it, with perhaps a few hundred throughout the day. Thus, at this scale, we are talking about helping hundreds of people, through one Wind deployment, in a static physical location.

When you begin to consider larger instances of WindSock, or multiple boxen, combined with apps and devices that speak WindChime, and can share apps and content through WindFarms, the potential scale of users connecting and benefiting from the windy network increases dramatically. A medium to large portable WindSock can host communication, serve content, and provide software to a few hundred simultaneous users. Each of those users can then continue on their way, with the content and communications they have exchanged with the WindSock.

Through WindChime, they will continue to discover others around them, on the bus, in the square, at the hospital, in line for services, that they can exchange knowledge with. Some of these people they might know, and some they may be connected through interest in a topic or some other shared connection. In this collective scenario, where you have multiple large WindSock in motion, each connecting to hundreds of users, who then each connect to ten to a hundred users around them as they move through their town or city, the reach and impact grow exponentially.

We have created a tool to simulate a variety of scenarios to understand how quickly information can move through a community, based on different physical configurations, speed, distance and density. Here are a few examples:

"GriffeyNet" portable WindSock:
https://rawgit.com/jcushman/windviz/master/windviz.html?nodes=SimpleNode(.5,.5)|WaypointNode([[.15,.85],[.5,.7],[.85,.15],[.5,.7]],3)|SimpleNode(.2,.7)|SimpleNode(.1,.9)|SimpleNode(.3,.9)|SimpleNode(.8,.1)|SimpleNode(.7,.3)|SimpleNode(.9,.3)

"Causeway": WindChime Peer-to-Peer Communication
https://rawgit.com/jcushman/windviz/master/windviz.html?nodes=WaypointNode([[.01,.2],[.99,.2],0],2.1)|WaypointNode([[.01,.4],[.99,.4],0],1.1)|WaypointNode([[.01,.6],[.99,.6],0],2.9)|WaypointNode([[.01,.8],[.99,.8],0],1.9)|WaypointNode([[.99,.1],[.01,.1],0],1.9)|WaypointNode([[.99,.3],[.01,.3],0],3.1)|WaypointNode([[.99,.5],[.01,.5],0],2.2)|WaypointNode([[.99,.7],[.01,.7],0],1.2)|WaypointNode([[.99,.9],[.01,.9],0],1.5)

"Temple": A mobile user accessing multiple WindSock static instances, sharing WindReports
https://rawgit.com/jcushman/windviz/master/windviz.html?nodes=SimpleNode(.5,.5)|SimpleNode(.5,.1)|SimpleNode(.5,.9)|SimpleNode(.1,.3)|SimpleNode(.1,.7)|SimpleNode(.9,.3)|SimpleNode(.9,.7)|WaypointNode([[.5,.4],[.5,.15],[.85,.3],[.85,.7],[.5,.85],[.15,.7],[.15,.3]],4)

And of course the original lots of random people approach:
https://rawgit.com/jcushman/windviz/master/windviz.html?nodes=RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()|RandomNode()

You can play with our javascript simulation tool in real-time here: https://jsfiddle.net/2L0ffqfL/3/

DIFFERENTIATION:

How does the proposed solution differ from or improve upon existing solutions? What is innovative or novel about the proposed concept or technology? 1250 words

Thinking Bigger (and Windier!)

Many proposals for off-grid solutions focus on an end-to-end stack, dependent upon often herculean tasks to get all the right pieces, people, training and resources in order to make it succeed. That is not our approach here. While we will implement a working prototype system within the context of this challenge, our larger goal is to impact the broader world of application and service designers and developers. In the same way our work on implementing an “auto face blur” technology in our ObscuraCam app helped guide and move YouTube to implement a similar feature, or how WhatsApp and now many others adopted Signal’s end-to-end encryption scheme, we seek to change the approach to communication at scale. Facebook’s Android app today supports routing through Tor, due to the fact that a developer there found our NetCipher open-source library that made that easy to implement. WeChat adopted our SQLCipher encrypted database in order to protect messages stored on the device, delivering our code to hundreds of millions of users. We believe the same approach can work with Wind.

Focus on Usability and Understanding

At Guardian Project we have developed our understanding through hosting and participating in a number of workshops and “simulation events” over the last three years. In April 2014, we organized an “Internet Blackout Simulation Event”, at Eyebeam in New York City. In May 2015, we held “Wind Farm”, another off-grid simulation event at Harvard’s Berkman Center. Most recently, in August 2017, we helped organize “Sneakercon”, our third off-grid focused event at the Brown Institute at Columbia University.

All of these events provided a venue for developers to meet people and communities either with experience in facing these situations or a desire to be prepared for the future. In all cases, a deeper understanding was gained, and software and proposed solutions benefited greatly. We will continue this kind of process in our current and proposed work on Wind, to ensure that what we deliver is relevant, useful and as maximally beneficial to those in most urgent need of communication.

Opportunistic People-Powered Networks

To understand how the movement and density of people can shape or impact network design, we have modeled and studied a number of typical patterns in physical space, including three we call the Temple, the Causeway, and the Cafe (or “Meetup”). We believe our approach to considering the common, culture-rooted patterns of motion have an impact both on the design of our software, and the way in which it is deployed. Through our work on Wind, we both use these patterns as inspiration for design and as test cases against our implementations.

The Temple is a pattern inspired by religious traditions in the Himalayan region, in which multiple times a day, large numbers of people converge on a temple, shrine or holy place, to perform circumambulation. For a specific set of time, people walk on a set course, in a circle that can be blocks or miles in length. They come into contact with people in front and behind them, and also with static groups of people, sitting or watching, along the path. In contrast, the Causeway is a pattern inspired by observing the sudden intense swell of people moving all together in a direction in public spaces. This can happen during rush hour in public transit, between classes at a school, or during a political protest march. Lastly, the Cafe (or “Meetup”), is when a small group of people converge from many directions to a static, central place, in which they stay for a meaningful amount of time.

In all of these Wind patterns, there a number of variables at work. How fast are people moving? How often do they stop, and how long do they stop for? How close are they to another person? How many people are within arms length, or shouting distance? Are the people moving in the same direction, towards each other or away from each other? Considering all of these factories, finding ways to account from them in both interaction design and algorithmic design, is all part of the work we are doing on Wind.

Other key tenets of Wind, are the lack of expectation of static infrastructure, or the need for permission or other centralized authority. The focus is on opportunistic communication and sharing, such that if there are people with the means and interest, then communication can happen. To empower this idea, is adopting an architecture that is flexible when it comes to its design. Instead of identify a device as a “Server” or “Client”, with a traditional hub and spoke architecture, we allow devices to shift their identity or role depending on the situation.

In some cases, a Wind-powered smartphone might activate its own wifi hotspot and announce itself to other devices, as such, running a local web service to allow data to be synchronized. In other cases, a pure peer-to-peer Bluetooth LE and Wifi P2P based “beacon” might be activated, to share small status update information between peers. In another, a Wind Sock, a small Raspberry Pi type server, operates both as a “Server” sharing feeds of news, map data, and other essential timely information, and it could be a repeater “cache” updated from another device upstream that it connects to once a day. Every device should be able to play multiple roles, and have the ability to extend the network itself, and to pass along any content it has received.

Off-Grid Methods

Through our recent research in supporting limited connectivity communities, we have designed a number of design patterns or methods. These are to be used in the product development process to ensure that our team, and any others who may adopt them, are considering new features and optimizations that are most useful to the off-grid, or limited-grid, scenario. You can view the full public post on these here: http://okthanks.com/blog/viento-methods and a few of them below:

1) Rest: If the device battery power is low, wait to sync the contents of your app until it's charger to a higher level. For example, my battery drops to 19%. I want to preserve the remaining battery for emergencies. So, I don't want my news app doing anything in the background. It should just rest.
2) Be Useful: Rather than appearing broken when there's no internet, consider which activities users can do while offline. The app should finish the process for me when I'm connected to Wifi rather than requiring me to come back and try again when there's internet. Download new content when my phone is connected to wifi, so when there's no internet, the latest stories available can be read.
3) Use Nearby: Give users the option to send and receive content to and from people who are physically near them. As a user, I spend much of my day in remote areas without internet. I want to share documents and videos with people offline.
4) Work with Wifi Only: Slim down on data use. Offer the user the option to use the app only over Wifi. As a user, I don't want to spend my data on updating apps. I would only want to do that over wifi.

These are just a small sample of the work we are doing to ensure our entire product development process is considerate of the wide variety of needs that off-grid or limited connectivity users have.

AFFORDABILITY:

How affordably do you envision the solution could be implemented in a real community? 1250 words

From the beginning, our work at Guardian Project, and more recently on Wind, has focused on working with what is available today, in the hands of real users. We aren't interested in the latest flagship phone, or the most expensive, technically capably piece of kit. We are more interested in taking advantage of the latent capability present in the existing smartphones, routers, laptops and other gadgets that people are carrying with them today. Affordability means accessibility, fairness, and a kind of robustness built upon plentiful, not scarce, technology.

Hardware

Even in Cuba, where there is little mobile data connectivity, users have Android smartphones with gigabytes of storage, gigahertz of processing power, along with GPS sensors, a compass, and Bluetooth and Wifi radios. The proliferation of wifi hotspots running on devices supporting OpenWRT or some Linux or Debian variant, provides a pre-existing physical infrastructure that is highly underutilized. Together these provide an inexpensive, pre-existing platform on which to build during a crisis.

To go beyond this core concept, we can estimate some costs. An average Android smartphone or tablet that would be able to fully participate in and utilize a Wind network would cost, on average $100. A high-powered router serving as a WindSock with a large external battery, solar panel, and a sizeable storage device would cost in the area of $200. This device serve a low hundreds of simultaneous users within a range of 40 to 100 meters.

If a civic center, school, library or other organizations, wanted to deploy 2 WindSocken and a set of 10 devices for their staff to use, an estimate cost would be $1400 for the hardware. If this was replicated across 4 sites in a town, the cost would come to $5600, reaching potentially to thousands of simultaneous users, and tens of thousands of total users benefited.

Software

All of the work we produce is freely licensed and open-source. It requires no cost to use, deploy, copy, share, remix, mashup or otherwise build upon. We aim to empower developers, users, organizations, trainers, teachers and students through code, libraries, binaries, guides, how-to's and an active open-source community project. Anyone with access to our website or Github, can download what they need to begin using Wind, as a set of components, or the beginning of something new, tuned for their needs. Thus the cost of the software itself is free.

Services

In both the cases of hardware and software, you ultimately need skilled technicians, developers and designers to implement, customize, enhance and deploy. While their often seems to be interest by outside volunteer labor after a crisis, the goal should be to support the local professionals, businesses, service providers, to help them recover along with everyone else. With that in mind, usual rates for paying for these services should be factored into any budget or plan.

A typical cost for a skilled technical engineering can range in the $25/hr range to $150/hr. For this scenario, we will pick the rate of $50/hr. The deployment and customization of a WindSock network and devices, with a customized set of WindFarm apps and content, might take 40 hours. That would result in an estimated cost of $2000.

Optionally, if customization of WindReport or another application on top of WindChime needed to occur, that could require advanced developer and designer skills at a rate of $100/hr. Guardian Project in the past has worked on small, but useful projects, estimated in the 50 hour range. This would result in the cost of $5000. From there, costs for ongoing maintenance, bug fixing and enhancements should also be considered.

In summary, while in most cases, local and outside volunteer skilled labor will often be given for free in a crisis, it can be useful and helpful to consider the value of the services being offered or donated, in the overall plan. More importantly, with our hope that Wind style services are deployed in advance of any crisis, more accurate budgeting and fundraising should occur, in order to pay fair rates for services to local providers.

Bandwidth

As we are focused on using unlicensed spectrum through Wifi and Bluetooth radios, the cost of mobile data bandwidth is free. However, providing “bandwidth” through USB drives that are transported by data mules and sneakernets, does introduce some kind of cost. A 1 terabyte drive costs roughly $50USD today. If a town wanted to purchase 100 drives to bootstrap an El Paquete style offline content distribution system, that would come to a cost of $5000 USD. A smaller system built on 32GB drives, $10USD a piece, would only cost $1000 USD. As with Cuba, the cost of accessing this content could be turned into a sustainable, for profit business, where the end user is charged a small subscription fee for access to updated drives each week, returning the existing drive they had from the previous weekly packet delivery. In the WindSock scenario, these drives would be plugged into a router in a public location, allowing hundreds of simultaneous users in the vicinity to access the content, without needing their own drive.

SOCIAL IMPACT:

How well-tailored is the solution to the needs of the community and users for which it is designed? How will the design of the solution help engage community members in order to maximize utilization? 1250 words

As discussed earlier in this proposal, we deeply and value the stories, needs and potential of the communities we aim to support through Wind. Through our work on limited connectivity environments in Latin America, we are already engaged in improve the daily lives of users, through providing alternate methods of communicating, sharing and documenting. We strive to have an accurate assessment of the kind of technology they have at their disposal, what they can afford, and how they are already using it for the benefit of them and their families. We also have studied the user experiences and features they are most used to, or enjoy using, in order to better understand how we can design our software to meet them where they are, rather than require them to learn a new interface or concept.

As demonstrated in our stories shared from Cuba and India, this technology can also serve as a toolkit and service upon which a sustainable business can be built. While we focus on free, libre, open-source software, there are still many compatible business models within that realm. Red Hat itself is one of the best known cases of a profitable public company, whose core offering is sales, services, and support for open-source software. AirJaldi, for example, as a Wireless ISP, builds upon open-source software, but charges a fee for service of installation and bandwidth. The DroidT shop in Cuba is using F-Droid as both a service to charge for, but as a way of drawing customers to their store on a regular basis, through “free updates”. We expect that a Wind toolkit, either as a whole, or specific components, can be easily utilized within schools, businesses, libraries and other civic centers, to attract patrons, build utilization, develop skills, and if appropriate, generate revenue.

Another approach that we take to our work is a focus on training and education. Through workshops and mentorship, we have provided opportunities for hundreds of people around the world to understand how to use our apps or build upon our code. We also invest in partnership with organizations such as WITNESS, Tactical Tech, Tibet Action Institute, the Freedom of the Press Foundation and others, we expand the reach of our technology to communities beyond our own reach, but that find benefit in the free, privacy-enhancing tools we provide. In Colombia, we have worked with communities facing violence and racism through our partnerships with AfroLatinoDigital and Movilizatorio. The process has included week long workshops and month long engagements focused on collaborative focus groups, in-field testing, and mentorship of software developers and interaction designers within these communities. We will continues these activities and engagements as part of our process of prototyping and deploying Wind networks.

We care deeply about not only providing a way for people to connect, but to do so in a way that is as secure as possible, and privacy-enhancing, not degrading. In all work we do, we perform a thorough threat modeling process, and work to mitigate all the ways a bad actor might co-opt a system. This includes surveilling communication, impersonating users, extracting data or metadata in an unauthorized manner, or otherwise utilize the system in a malicious way. We work to minimize all logs and other data residue, and provide private by default configurations. In most cases, our systems implement strong end-to-end encryption and a variety of methods for authenticating services, devices and users. We also focus on pseudonymous identities, and do not rely on real names or phone numbers, though in some cases, it may be useful to allow people to be discovered by their “known” identities. These types of privacy-reducing options, will always be up to the user to opt-in to. All of this is meant to uplift the communities we aim to assist, to preserve their dignity, and to empower them to have control of their communication and personal data.

The first three components of our Wind prototype (Chime, Sock and Farm) are about providing infrastructure for discovery, opportunistic communication, and decentralized software and content distribution. These provide a core platform for a variety of applications and services. WindReport, is the default app and service we will provide in our prototype, that focuses on a capability critical for positive social impact in the aftermath of a disaster: capturing verifiable evidence, news and eyewitness reports for use by governments, law enforcement, humanitarian and human rights aid organizations. Beyond just “getting back online”, we must provide ways for everyone to gather interviews and testimonies from survivors and refugees to help plan relief efforts, document the rollout of services and supplies (or the lack thereof), and capture direct evidence of violence, corruption and other crimes. From there, we must ensure, through protocols like WindChime and WindSock infrastructure, that this evidence can be securely shared, stored, and make its way to the appropriate places, all with a verifiable chain-of-custody. Our work for the last four years with WITNESS on secure smart camera apps that automatically encrypt and sign photos and videos captured on a smartphone, while generating enhancing “proof data”, is the foundation for WindReport. Today, it used to document police violence, capture evidence of human trafficking, and generate enhanced eyewitness reports of rights violations at large gatherings and protests. All of these capabilities provide a positive, useful social impact, that is definitely need within the aftermath of a disaster.

SCALABILITY:

How will the solution be adaptable to a broader set of communities or areas? How scalable is the solution? How will you provide tools and documentation to anyone who might wish to build upon your work or launch a similar effort? 1250 words

As we have discussed throughout this proposal, thinking at a broad scale of impact and benefit is core to the mission of Guardian Project. While we do spend time investing and developing our expertise in specific regions, such as Latin America or Himalaya, we always maintain a wider view of where might be next. In some ways, we believe in a "trickle up" scenario: "if it can work in Cuba or Tibet, then it can work anywhere!". In other ways, our firm rooting in the open-source communities of Debian, Tor Project and others, has taught us that it is as important that anyone interested can reproduce your work themselves, as it is to create the work in the first place. Beyond code, we seek to transparently document and share our approach to design, usability and collaborative design processes with the communities we are working to support.

Another important aspect of scalability is sustainability - how will this work be maintained, supported, enhanced and live beyond the original inspiration and funding? Our approach to this is to not reinvent the wheel, and instead to actively seek out and support open-source projects that are already addressing the capabilities we need. By supporting these efforts, you connect these isolated works to a larger community and purpose, while providing resources and attention where it is needed. In 2010, Guardian Project was looking at the best option for an encrypted mobile database, and became aware of Zetetic's SQLCipher, which was only available on iOS and desktop OSes. We ported it to Android, and implemented additional components for key generation and management. All of this code was open-source, and we worked closely with Zetetic to merge our efforts upstream, where it is now maintained by the primary SQLCipher community.

This is similar to our approach to work on Tor, F-Droid, Debian and more, and we will continue this work under the Wind program. With F-Droid, we have already implement the first version of "Nearby" features, enabling users to easily share apps, updates and media between devices, only using Bluetooth or Wifi. This capability will be expanded under the proposed work on WindChime and WindFarm. Also, with LibraryBox, we will contribute our work on WindChime and WindSock, in order to provide improved nearby discovery, sharing of content over Bluetooth, and support for additional services hosted on each box. All of this will be done in coordination with the LibraryBox developers, and improvements will be offered to be adopted upstream, as appropriate and desired. In this way, we hope every LibraryBox in the world, can interoperate with a Wind environment, helping scale the deployment of our system more rapidly.

We also have experience with influencing the design and submitting code improvements to even larger services. For example, we are currently working within the Mozilla community as part of the partnership with Tor Project, to integrate privacy and security features from Tor

Browser, and mobile aspects of Tor, into core Mozilla Firefox codebase. As mentioned previously, Facebook and WeChat both currently integrate our code in their Android apps, for providing privacy-enhancing features. There are many more examples of this kind. As our code is integrated upstream by these product teams, the reach of our features expands from a few million users to hundreds of millions. We see this same path as being possible for our work on Wind. Imagine if Facebook, WhatsApp or Twitter integrated nearby features based on code or concepts from Wind? The logic is simple - if we can get this into apps on everyone's phones before disaster strikes, users will more easily stay connected, and communities more in touch, more safe, and out of harm's way.

A final approach to scalability that we have explored and wish to expand our work on is through policy and position paper publishing. The creation of best practice documents, usability guidelines and patterns, white papers and more, focused on topics such as "What apps should do when the internet isn't available?" or "How cloud services should work when a natural disaster strikes!" would go a long way to providing highly scalable benefit and impact for all. We are already taking this approach within our smaller human rights and internet freedom communities, through workshops such as Sneakercon and Wind Farm. Within our current focus on Latin America, we have very publicly shared our process related to developing accurate, data-based user personas. We have also published our "Viento Method" cards, for use by any development or design team looking for some "off-grid inspiration". We will continue and expand this kind of work through the Wind prototype development process.

OPENNESS:

Mozilla works in the open. How will you document and share your project progress with the community? What documentation and resources have you created to help others understand and leverage your design in their own work? 1250 words

Guardian Project is a leading open-source project in the area of mobile security and privacy. Since 2009, we have developed all of our software in an open and transparent manner, utilizing the typical set of community tools such as public mailing lists, issue trackers, code repos, irc channels, and blog posts. All of this can be easily accessed through our website at https://guardianproject.info and on Github at https://github.com/guardianproject. In particular, we have developed a wide variety of software libraries providing mobile security and privacy features, that are in use by organizations ranging from Facebook and Tencent, to DuckDuckGo and Tor Project. A recent audit showed that over 3000 apps included SQLCipher for Android, the encrypted database we ported to the mobile operation system. We also have recently launched our "Developer Square" portal at https://devsq.net to help promote our tools to a wider audience, in a more formal way, through videos, podcasting, forums and more.

As mentioned previously, we have hosted and participated in a number of workshops and conferences on the topic of off-grid communications. The goal was to always include a wide variety of developers, users and communities. Our goal is to drive effective solutions for all, not to simply come up with our own technology solution in a vacuum.

In April 2014, at Eyebeam in New York, we hosted our first “Internet Blackout Simulation Event” (http://eyebeam.org/events/eyebeam-square-an-internet-blackout-simulation-event/), in which we invited people to join us in *“playing an interactive role game we will get people thinking and talking about the need to create decentralized Internet networks and Internet ownership, and the practical steps that people can take as individuals in order to improve the situation.”* In May 2015, at Wind Farm (https://cyber.harvard.edu/events/2015/05/Windfarm), our second event, this time held at Harvard’s Berkman Center, we invited developers and users to collaborate, and hoped that *“Through playing games and hands-on learning, we will share ideas about how to build more types of nearby networks in more places, used and operated by more people and communities.”*

In August of 2017, we helped organized the first Sneakercon (“Sneakernet Conference” http://sneakercon.brown.columbia.edu/) , “A Forum to Reexamine Offline Networks”, held at the Brown Institute at Columbia University. Again, the format was interactive and inclusive, seeking to get a the root of the human behavior that could help drive successful implementations and solutions. *“Our audience of journalists, academics, developers, activists, and artists will collectively learn how to notice, measure, map, and otherwise make sense of an offline network -- while bearing in mind the potential risks and ethical concerns that may arise when you observe or enter into these communities.”*

Most recently, as part of our research and planning for off-grid work over the last year, we have developed a set of design patterns or methods for use by devices that are constrained by connectivity and power. We call these our “Viento Methods”, which can be access digitally or printed out on physical cards. They are meant to be used in the product development process to ensure that our team, and any others who may adopt them, are considering new features and optimizations that are most useful to the off-grid, or limited-grid, scenario. You can view the full public post on these here: http://okthanks.com/blog/viento-methods