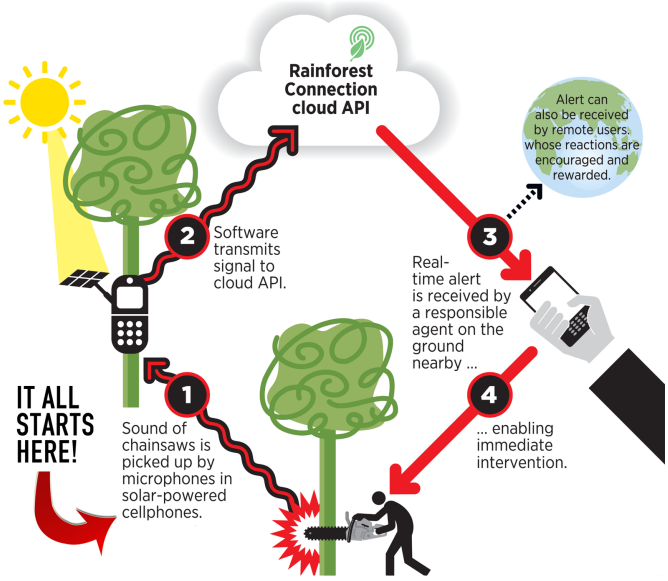
Real-time data is the key:

Rainforest Connection (RFCx) was founded based on widespread perceived consensus that producing real-time data on the state of the tropical rainforest is essential to saving it from imminent destruction. The premise is based upon a substantiated belief that only real-time data (as opposed to data obtained from surveys, economic tracebacks, or mainstream high-latency remote-sensing techniques, including satellite imagery) can address some of the unsolved problems in anti-deforestation that persist today.

The RFCx premise has been proven through applications such as gunshot location technologies which pinpoint the location of gunshots on a map in real-time, allowing police to respond in real-time. Additionally, data collected in these cases show patterns of activity and have been used to prosecute crimes.



As no scalable system for producing such data yet existed for rainforest conservation, we were encouraged to create one. The most straightforward way to produce real-time data of sufficient precision and low-latency is to employ on-the-ground sensors. From a technical standpoint alone, doing so presents several notable challenges, namely:

- **Reliability**
- **Autonomy**
- **Connectivity**
- **Cost**

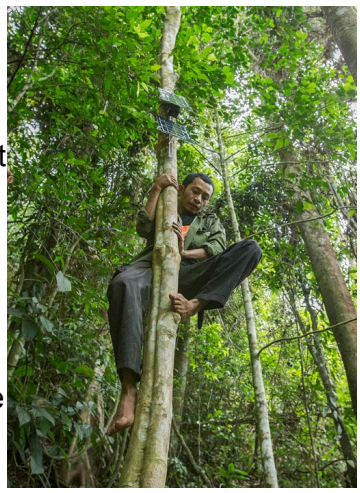
RFCx addresses these challenges in concert by relying upon commodity, recycled hardware whenever possible, by building upon free, open-source software, and by piggybacking on existing infrastructure in-the-field.

Data “Source” - Hardware

RFCx on-the-ground sensors are referred to as “Sources”.

Sources are hardware devices installed sporadically on tree-trunks in the forest canopy layer, whose sole purpose is to constantly gather data on the surrounding environment, and transmit it in real-time to a central RFCx database for processing and storage. The current focus is on audio data, but, in principle any type of data (imagery, for example) could be streamed as well, and this can be developed in later versions.

A specialized configuration of solar panels (designed to capitalize on the thin and short-lived bands of sunlight that penetrate tree canopies) keep the Sources powered and somewhat protected from the elements. An internal power regulation system holds a stock of up to 50 hours worth of battery-life (replenished daily) to keep Sources running during non-daylight hours and particularly dark periods.

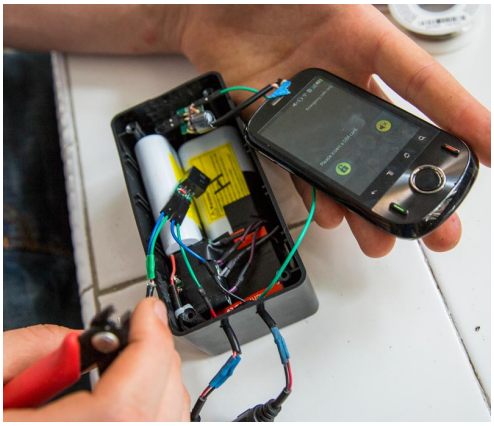


Highly-sensitive external microphones capture all ambient sound within 1km of the Source (range is somewhat dependent on topography and forest type). Though Sources are mounted on tree trunks (and the microphones are thereby not entirely omnidirectional) , the solar panel configuration is designed to reflect sounds originating from behind the tree toward the microphone, thereby giving each Source a nearly omnidirectional range.

Sources are intended to be autonomous in operation, capable of operating indefinitely in the field, with almost no physical maintenance. Once installed in a tree, they may be considered abandoned until planned removal at the end of their service life (the length of which cannot yet be confirmed, but is expected to be 1-2 years).

Data “Source”: Software

At the core of each Source is an Android smartphone (currently Huawei IDEOS model, circa 2010) running a specially modified version of Android 4.2. Modifications to the core Android operating system are geared toward resource management, power efficiency, and internal analytics.



Each Source also runs a collection of “services” responsible for gathering, caching, and transmitting audio data continuously during daylight hours. At this time, there is a particular focus on capturing sound within the range of 50 Hz up to 2 kHz though this range may eventually be expanded.

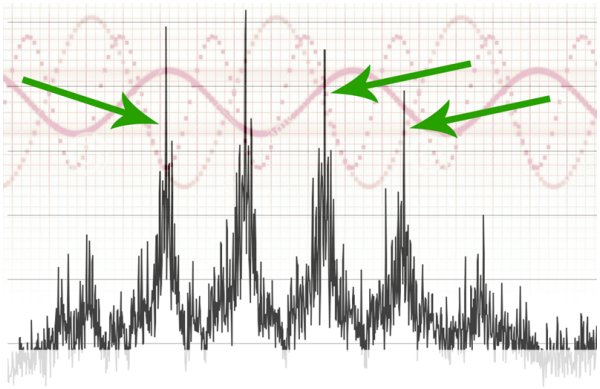
At 5-minute intervals, a lossless audio recording of the full previous 5-minutes is packaged, compressed and transferred over an encrypted HTTPS connection, provided by the local GSM network. Though it varies based on what is recorded, a Source can be expected to transmit around 50 megabytes of data in a single day.

Anti-Theft: Based on the difficulty of finding Sources hidden in trees, we do not expect theft to be a significant problem, but Sources have been designed with anti-theft functionality. As Sources are intended to be entirely stationary (and are firmly attached to trees), any post-installation displacement of the hardware is considered cause for alarm. In this case, the Source immediately enables its geo-location hardware (which are otherwise disabled for power conservation) and a specialized alert is sent to the RFCx central database every one minute with an updated location on the device, giving stakeholders an immediate ability to physically track

and potentially recover it.

GSM subscription tracking: Based on our short experience in the field, the GSM providers that appear to have the most reliable and low-cost coverage in remote areas are “pay-as-you-go” plans. As devices must always have the ability to connect and transmit data, this introduces the need to “top-up” the accounts associated with SIM cards in the Sources, which can be automated with the software. When possible, however, it will be preferable to obtain monthly data plans that can be centrally managed.

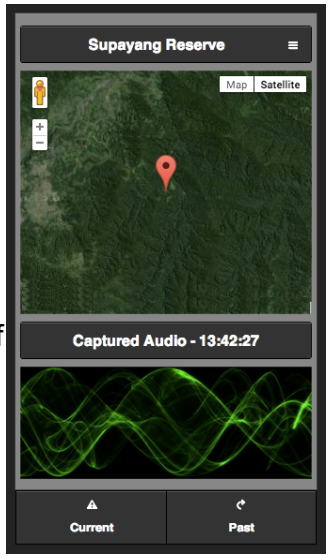
API / Web-services



At the heart of the RFCx detection system are internet-based servers and a central database, made accessible by web-services. Sources send audio snapshots to these web-services, where they are immediately saved and analyzed. It is here in the RFCx API that the detection of events actually occurs, and from whence alerts are sent to responsible authorities.

Analysis is performed immediately and automatically on every audio snapshot that is received, and typically completes within several seconds. Currently, audio analysis is particularly focused on detecting chainsaw frequencies, and upon estimating the distance of the detected frequency from the Source. These details are compared with data gathered by other adjacent Sources, and an estimated location of the event is determined. For this reason, it is suggested that that Sources be installed no more than 1.5 km distant from one another, to facilitate detection of events by multiple Sources at the same time.

If analysis of the audio snapshot indicates the use of a chainsaw, and a location of the event can be determined, a number of possible follow-up actions are immediately carried out, including SMS or push alerts sent to “subscribed” authorities with details of the current event.



Client Alert Application

Partners in the field will also be provided with a special client smartphone application that works in concert with the RFCx API. This application will receive push-notifications when a logging event is detected, and provide a monitoring console for tracking the location of the event on an interactive map, listening to the audio snapshot to verify false-positives, viewing past events, and much more. In our initial pilots, this application will be largely tailored to the specific needs of our partners, and will further developed based on their feedback.