How to Use Internet Audio Streaming and Messaging Apps to Produce Community Radio.

Based on the Red Cross Children's Hospital Radio Station, South Africa.

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January 2021
Version 1.2, page 1

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Abstract

This brief explains how to use commodity software, hardware, Internet audio streaming, and messaging apps to empower members of a community to operate a broadcasting service akin to a "community radio station" at low-cost, even while physical distancing restrictions are in place due to the Covid-19 pandemic.

The paper covers technical aspects for operating such a broadcasting service and provides references to the approach taken by the Red Cross Children's Hospital Radio station, winner of the Reboot Health & Wellbeing challenge organized by the World Health Organization and its partners.

Keywords:
Streaming radio, messaging apps, children, internet radio, podcasting, Covid-19, zero-rating.

Introduction

On July 7th, 2020, Children's Voices on COVID -19 by RX Radio was announced as one of the two winners of the Reboot Youth Health innovation challenge organized by the World Health Organization (WHO), the Office of Information and Communication Technology (UN-OICT), the World Food Program (WFP), UNAIDS and UNICEF. RX Radio is a 24/7 internet radio station at the Red Cross War Memorial Children's Hospital in Cape Town, South Africa. Starting from their great belief in the importance of children's voices and its impact on the children and youth themselves, the station is run by and for children. Leveraging the potential of a rights-based framework, RX Radio uses the 'magic of the microphone' to give children attending hospital a platform for expression, information, and participation, as well as the chance to build the life skills/confidence needed to voice their opinions, take on new roles, and become actively involved in community life. Children and youth (ages 4 -18) are given specialized training along with the opportunity to become the Child and Young Reporters of RX Radio, broadcasting from within the hospital.

With the outbreak of COVID-19, Reporters at RX Radio began utilizing WhatsApp voice notes and other remote recording methods to gather content about the pandemic and act as an educational, informational, and entertainment tool for their audience. This project also helped children engage with adults – such as parents, healthcare workers, policymakers, and professionals – to show them that children have a key role in tackling this pandemic and helping to shape the response to the Coronavirus. You can read more about the complex legal, organizational, ethical, and many other issues involving the operation of this station by reading the Red Cross Children's Hospital Radio station case study at rxradio.co.za.[1]

This brief explains the technical aspects of using internet voice streaming in combination with messaging apps (e.g. WhatsApp, WeChat, etc.) to effectively operate a community radio station.

Internet for Community Broadcasting

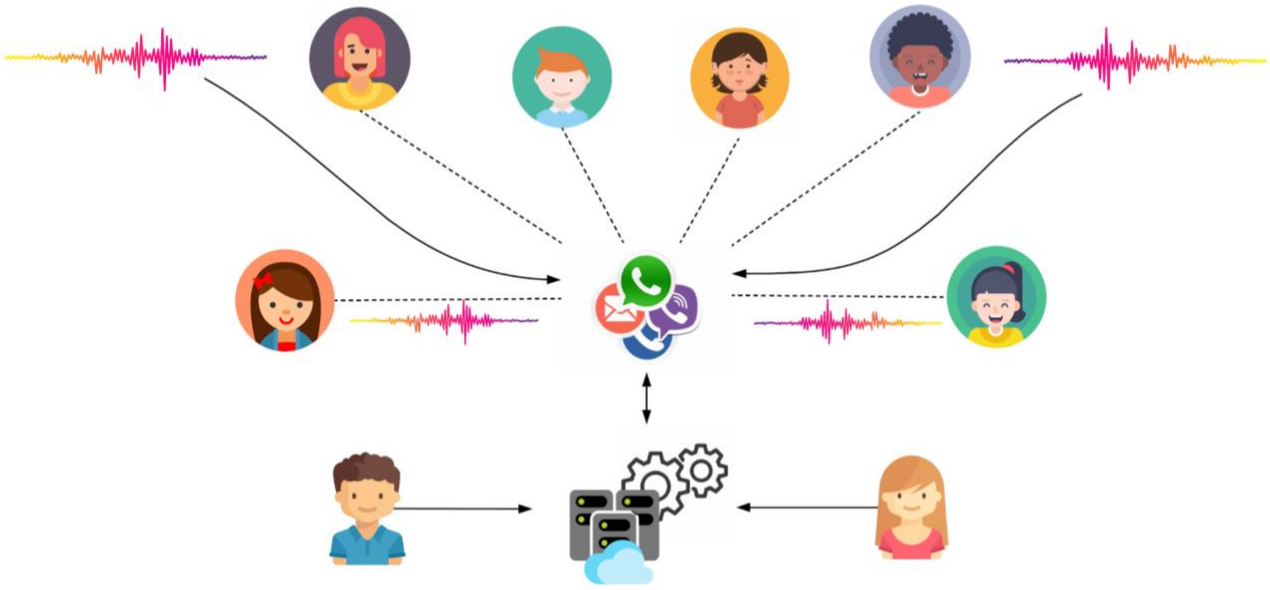
Since the invention of the traditional radio, content producers have used electromagnetic waves such as Amplitude Modulation (AM), Frequency Modulation (FM), and satellite radio stations to engage with their

[1] Red Cross Children's Hospital Radio station case study (2020). http://rxradio.co.za/wp-content/uploads/2020/11/RX-Radio-Case-Study-October-2020.pdf

audiences. Since the 1990's Internet radio - the transmission and reception of audio files by streaming over the internet in real-time - has gained popularity as an alternative or complement to traditional radio due to its advantages of simplicity, easy access, global coverage, and low implementation cost.

Communication software such as Skype, WeChat, WhatsApp, Periscope, and many more – also known as Messaging apps - have in the last decade transformed how people communicate, giving people the ability to send and receive audio and video globally (in real-time, or recorded) for the price of the data transmitted over the Internet. Technically speaking, millions of people worldwide now receive audio (music and talk) and video (shows, movies, learning) through Internet streaming services which have displaced other forms of broadcast such as traditional, cable, or satellite television, as well as radio.

Communities and individuals are using these apps and streaming technology in creative for a wide range of purposes, including for community radio.



How it works

Both Internet radio and audio over messaging apps work by encoding analog audio (sounds) into a digital format that can be efficiently transmitted over the Internet. The paragraphs below outline the main steps to achieve this transmission. Specifically, we will show how RX Radio leverages Internet radio and messaging apps to achieve their community objectives and will provide examples of open-source software to implement a similar setup.

As a way of background, RX Radio broadcast their programming in two main ways: (1) through the local sound system at common areas and rooms at the Red Cross War Memorial Children's Hospital in Cape Town,

South Africa, and (2) via Internet radio streaming to any listener in the world and to affiliated hospitals which repeat the broadcast through their local sound system. This brief only focuses on the Internet radio streaming method.

Content collection using messaging apps

As a first step, in producing a radio programme, reporters need to generate the content which will be broadcasted. This is done by recording audio interviews or segments using a device with a microphone, such as a hand-held recorder or a mobile phone. The audio recordings are then sent to the programme producer for editing.
Before the Covid-19 pandemic it was common practice for the reporters to record the audio and hand it over directly to the editors in person, using disks or connecting devices through a cable, but this became impractical during lockdowns. Since the Covid-19 crisis, reporters at RX Radio started using content messaging apps to send their recordings though the Internet.

Content aggregation by the programme producer

The programme producer or programme editor may receive the voice recording from the reporters on their messaging apps on their mobile phones or on their computers. The recordings must then be saved to a computer where mixing and editing will take place.

At this stage, the producer can combine any number of audio files received from different reporters with other media such as music or previously recorded programmes. This is done with audio editing software which also gives the producer the ability to save the file (encoded) to the right format to be streamed by the streaming server in the next stage.

Once the mixing and editing are ready, the shows are played and scheduled on the studio playout computer. This computer may be one of several sources of audio, sitting alongside other audio sources such as microphones, CD players, and others in-studio.

The producer can automate the playout of the programmes, music, or promotional materials using scheduling software. RX Radio used RadioBoss software for this function.

Streaming audio to the world

The output audio from the production studio (which may combine audio from the playout computer, microphones, and other sources in the studio) is encoded live into a format suitable to send audio data efficiently though the Internet to an Internet audio streaming server (RX Radio uses the AAC+ format).

This streaming server then does onwards distribution to online listeners. The Internet Audio Streaming server is a critical component in this process, and it is possible for any person with an internet-connected computer to hosts their own. There is widely available free open-source software capable of hosting professional internet radio stations. RX Radio uses the Icecast streaming media (audio/video) server.

However, this streaming server must always be powered on, and it must have sufficient memory and bandwidth (a good Internet connection) to cope with the demand from the number of listeners. As the number of listeners grows, the server needs to be strengthened and bandwidth increased, so it requires investment in equipment and an experienced server administrator.

Fortunately, some companies provide subscription-based audio streaming hosting services, enabling content producers to outsource this important process, and start streaming within minutes. Additionally, these hosting companies offer the possibility to start broadcasting by paying for a subscription for a low number of listeners for a lower price, and only if and when their audience grows, they can spend more on a subscription including the capacity for more listeners. For example, RX Radio's streaming server (Icecast) is hosted by a media streaming host named streamguys.com.

At this stage, RX Radio, not only distributes its programming via Internet radio streaming. It also distributes recorded versions of its programmes, which people can listen to on-demand at any time. This is done through "podcasting". For this activity, RX Radio relies on a podcast hosting provider named Podbean.

Podcasting

In addition to Internet radio streaming, "podcasting" is a different and popular method for disseminating recorded audio programmes. Aspiring community radio producers might want to start their journey by podcasting, given its simplicity and reach.

A podcast is a digital audio file downloaded through the Internet (rather than streamed online) to a computer or mobile device, featuring a pre-recorded radio programme. Listeners can find and subscribe to podcasts of interest through a variety of directories and devices, such as Apple Podcasts (iTunes), Spotify, Castbox, iHeartRadio, Overcast, Google Podcasts, and Stitcher. After subscribing, the user will be able to monitor whenever new episodes are published by the producers and choose to download these episodes. Technically, publishing a podcast is a simple 3 step process: (1) recording an audio file (MP3, OGG, etc.), (2) storing it on any web server, and (3) creating a file containing the description of the audio files (the episodes), such as the title, description and the link to the audio file. (This file is known as an RSS feed. RSS stands for Really Simple Syndication format).

A critical step to successful podcasting is finding listeners who will monitor the RSS feed regularly to know when new episodes become available for this purpose. There are large podcast directories such as Apple Podcasts (iTunes), Spotify, Google Podcasts, and Stitcher which specialize in keeping up-to-date listings of the RSS feeds of podcasts from around the world, and making them searchable by listeners, so they can easily find content that suits their interest.

While the process described above is not overly complicated, there are companies called podcast service providers (or podcast hosts) that offer the storage of the audio files and the RSS feeds on their Internet servers for free for a few episodes and for as low as US$ 10 for unlimited listeners, such as Podbean, which is used by RX Radio. These service providers also list the podcasts on the most popular podcast directories so they can be found by listeners. This enables any content producer to effectively distribute their podcasts online in a matter of hours after having recorded their content, without requiring any advanced computer skills.

Listening to Internet Radio

The final step of the process is listening to the internet radio stream. This is achieved when the listener accesses the audio stream using an internet radio player.

The simplest way to listen to internet radio is to visit a web page that has a player pre-installed by the website owner and is already set up to tune in to the station they want. This requires the least amount of effort for the listener. For example, RX Radio live stream can be listened to by visiting this Internet address: http://rxradio.co.za/live/. To provide this feature, RX Radio embeds on their webpage a player called Muses which is pre-configured to listen to the stream.

Listeners can find Internet radio stations from around the world by visiting websites that provide directory listings by country, topic, language, and free keyword searches (such as TuneIn, iHeartradio, and others). After finding a station, a listener can play the programming using the media player embedded on that website or through the use of dedicated software (or apps) called internet media players. These players are available on mobile phones, personal computers, smart speakers, connected televisions, and car radios.

Tools and Standards

A myriad of tools exists for producing internet radio and podcasting. Below is a list of the tools used by RX Radio as well as some alternative ones.

For recording and sending audio:
RX Radio uses smartphones and the messaging app Whatsapp.
Alternatives: Signal messaging app, (free open-source).

Audio editing and mixing software:
RX Radio uses Adobe Audition.
Alternatives: Audacity software (free open-source).

Radio station scheduling:
RX Radio uses RadioBoss software.
Alternatives: OpenBroadcaster (free open-source).

Audio encoding formats:
RX Radio uses the MP3 format for exchanging files, and the HE-AAC (also known as AAC+) format to send the final encoded audio stream to the Internet Audio Streaming Server.
Alternatives: Ogg Vorbis (.OGG) is a fully open format for audio files useable across platforms and also by streaming servers.

Internet audio streaming:
RX Radio uses the Icecast streaming server. (free open-source).
Alternatives: Shoutcast (free).

Media streaming and podcast hosts:
RX Radio uses Streamguys.com and Podbean.com

Alternatives: Shoutcast.com, Radio.co, Wowza.com, Cloudrad.io, Buzzsprout.com, Soundcloud.com.

Internet radio (media) players:
RX Radio uses Muses software embedded on their website (free open source).
Alternatives: VLC media player (free open source), Apple iTunes, Microsoft Windows Media player, Amazon Echo, Google Nest.

The authors successfully tested implementing an Internet radio station within a few hours and simulated the workflow including sending WhatsApp voice notes (longer than 10 minutes), streaming them using Icecast streaming server installed both on a local computer and on an Internet server, and finally, listening to the broadcasts through different media players on mobile phones and computers of various brands.

Costs Factors

The calculation of the technical costs to operate an internet radio station vary widely depending on the quality of the equipment, the studio, and the number of listeners. The following paragraphs will outline the costs for starting a station with minimal equipment, for a few hundred listeners, but which can be scaled to a larger audience. The prices shown are rough generalizations, as costs vary across countries and the type and brand of equipment.

Firstly, we want to highlight that an advantage of Internet radio over AM/FM is that for Internet Radio, in most countries, there is no requirement to apply or pay for a broadcasting license. This may save money and time. Another advantage is that from the first day in operation, Internet radio broadcasters can nearly reach the entire planet.

The simplest approach to recording audio is through the use of a mobile phone. Thanks to intense global competition in the mobile phone markets over the past two decades, handsets are equipped with good microphones, and often they are sold with accompanying headphones/microphones and have noise canceling features. Prices vary widely worldwide, but smartphones start at around US$ 50. While it is better to use professional microphones, this would require additional expenses; mobile phones on the other hand are often already available for use at no additional cost.

Editing and mixing content to produce a program can be done on a computer or a powerful tablet, with a cost starting at around US$ 250. Audio Editing software can be purchased, though high-quality professional free open-source software alternatives exist (e.g. Audacity).

Automatic scheduling software and Internet radio streaming server software are available commercially and there are also free open-source alternatives. The prices vary widely and the features and complexity to using them vary as well. RX Radio uses commercial software (costing in the range of several hundred US$ for a long-term license) for scheduling pre-recorded programmes and mixing it with live sources at their studio, and for this purpose, they have a dedicated playout computer.

For their Internet Streaming radio server, however, RX Radio’s choice was to rely on a service provider on the Internet, instead of dealing with the expense and difficulty of running a server (computer) at their facility. This service may range from US$ 25 to US$ 100 per month for up to 1,000 simultaneous listeners. Internet hosts

often provide the scheduling software and the streaming server hosted on the internet as a bundle, which makes this an attractive proposition, since the only requirement is the availability of one local computer to do the initial audio editing, and the rest can be done on the Internet cloud. An important advantage of using a service provider is that they usually have reliable internet connections, servers, and power supply. As the station gains listeners, the economics might change, and it might be more cost-effective to self-host more equipment and software.

A very critical component which can be very expensive is the technical expertise to operate all the computers and software. This complexity is reduced when using internet-based service providers and is thus a good option for starting stations.

In summary, as a starting point, a new station could begin broadcasting by acquiring a phone and a computer from US$ 300 upward and a monthly fee for an Internet streaming service provider of US$ 25 for up to one thousand listeners. The same initial investment would require for starting a podcast (a phone and a computer), in addition to a podcast hosting service fee of US$ 10 per month for unlimited listeners.

Challenges and Opportunities

Despite its advantages of simplicity, easy setup, and low cost, Internet radio faces a big challenge, namely that Internet access is not available everywhere (particularly in rural areas) and is not accessible to millions of people due to its cost. By contrast, AM/FM radio is in most countries free for the listener, with the purchase of a radio receiver.

However, the global trend in the reduction of the price to access the Internet, the availability of the Internet in public places, as well as more affordable internet-connected devices such as smartphones make Internet radio viable in the long term.

National policies such as ‘Zero-rating’ - when Internet Service Providers apply a price of zero to the data traffic associated with a particular application or class of applications (and the data does not count towards any data cap in place on the internet access service) will also contribute to increased access to the Internet. For example, if an internet access service does not charge a user for the data used to access community service radio streaming stations. RX Radio is investigating this approach.

In the short term, Internet radio offers a great opportunity for broadcasters to extend their signals to reach local community broadcasters. For example, any traditional radio station can receive an Internet radio stream and rebroadcast it locally by AM/FM. As explained earlier, RX Radio uses internet streaming to send their radio programmes to affiliated hospitals.

In summary, the technical infrastructure to operate an Internet radio station can be implemented within a few days or even hours, and with low financial investment. This infrastructure may be able to grow with the number of listeners as necessary, without having to make significant long-term commitments.

For aspiring community radio operators, the simplicity and low cost of entry of Internet audio streaming technology is a welcome phenomenon that can free their resources to focus on the remaining challenges of

establishing a successful and sustainable internet radio station, in particular the challenge of producing high quality and relevant programming.

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