
PRETTY FLY
FOR A WI-FI

Introduction

Pretty Fly For A Wi-Fi revisits the histories, origins and uses of self-made Wi-Fi antennas. Many of these designs were once shared through home pages that no longer exist and are now only partially accessible through the Internet Archive. This project tries to revive these designs by rebuilding, testing and documenting them. The antennas serve as an interesting point of departure to think about the internet's infrastructure and how day-to-day users could potentially influence its shape and use.

Most of the antennas result out of the idea of wireless community networks, an idea which emerged shortly after the commercial introduction of Wi-Fi equipment in the early 2000s. These grassroots initiatives aim to build alternative network infrastructures, often on a peer-to-peer basis and without the need for costly wires. Such network infrastructures can be found on rooftops, balconies and windowsills and can cover large distances by broadcasting from building to building. They are built for a variety of reasons, sometimes to provide broadband connections in areas where there are none, to make censorship free alternatives to the internet or to share the costs of a single internet connection.

What all these networks have in common is that they are based on consumer electronics built according to the Wi-Fi standard. Wi-Fi (a play on Hi-Fi) is the trademark for the IEE 802.11 standard for wireless data exchange on the 2.4Ghz radio band. This standard was designed to intentionally limit the broadcasting power and thus the transmission range to limit the use to indoors local area networks only. To overcome these limitations and make long range wide area connections possible, the wireless community networks often relied on self-made antennas. Whereas Wi-Fi was designed for a range of about 30 meters, using self-made antennas people have been able to connect machines kilometers apart.

Through these self-made antennas people from around the world have reshaped the possibilities of Wi-Fi to create computer networks that reflect their personal ideals. They have been able to do so in part because 2.4Ghz Wi-Fi, with a wavelength of about 12,5 centimeters, has dimensions which are literally 'handy'. As a consequence, these antennas are both clever appropriations and accidental convergences of the shapes and sizes of household objects and the dimensions of the 2.4Ghz radio waves.

Colophon

Roel Roscam Abbing

https://roelof.info

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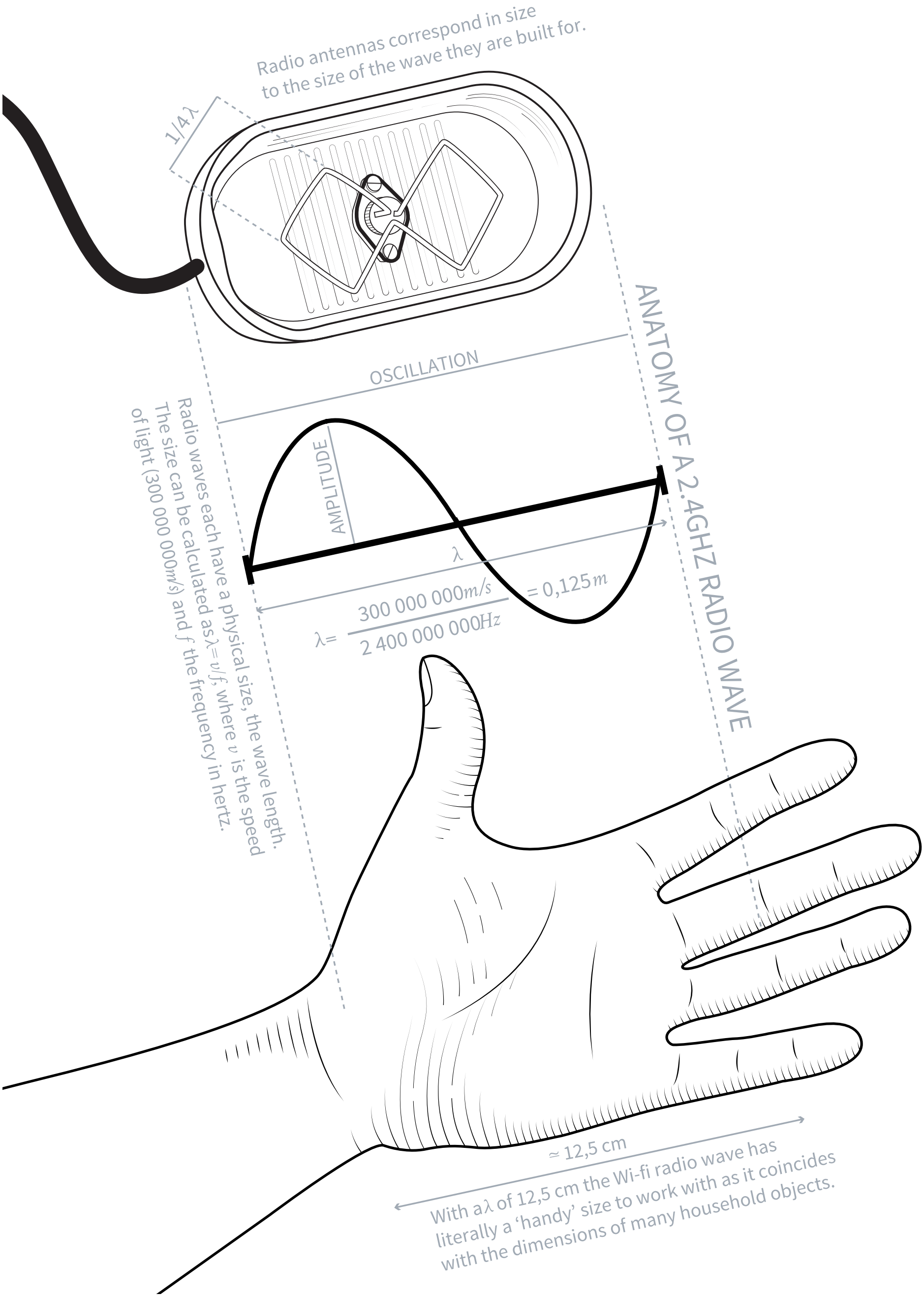

ANATOMY OF A 2.4GHZ RADIO WAVE
Radio antennas correspond in size
to the size of the wave they are built for.
1/4λ
OSCILLATION
AMPLITUDE
λ
λ= 300 000 000m/s / 2 400 000 000Hz = 0,125m
Radio waves each have a physical size, the wave length.
The size can be calculated as λ=v/f, where v is the speed
of light (300 000 000m/s) and f the frequency in hertz.
≃ 12,5 cm
With a λ of 12,5 cm the Wi-fi radio wave has
literally a 'handy' size to work with as it coincides
with the dimensions of many household objects.

Anatomy of a Wi-Fi antenna

The antennas in this booklet can be roughly divided into three categories, reflectors, waveguides and bi-quads. In practice however many antenna designs combine elements of each category. N-connectors, a type of coax connector for radio signals, are often used in the construction. The N-connectors is then connected o the Wi-Fi card using a special adaptor cables, colloquially known as a 'pigtail'.

Reflectors

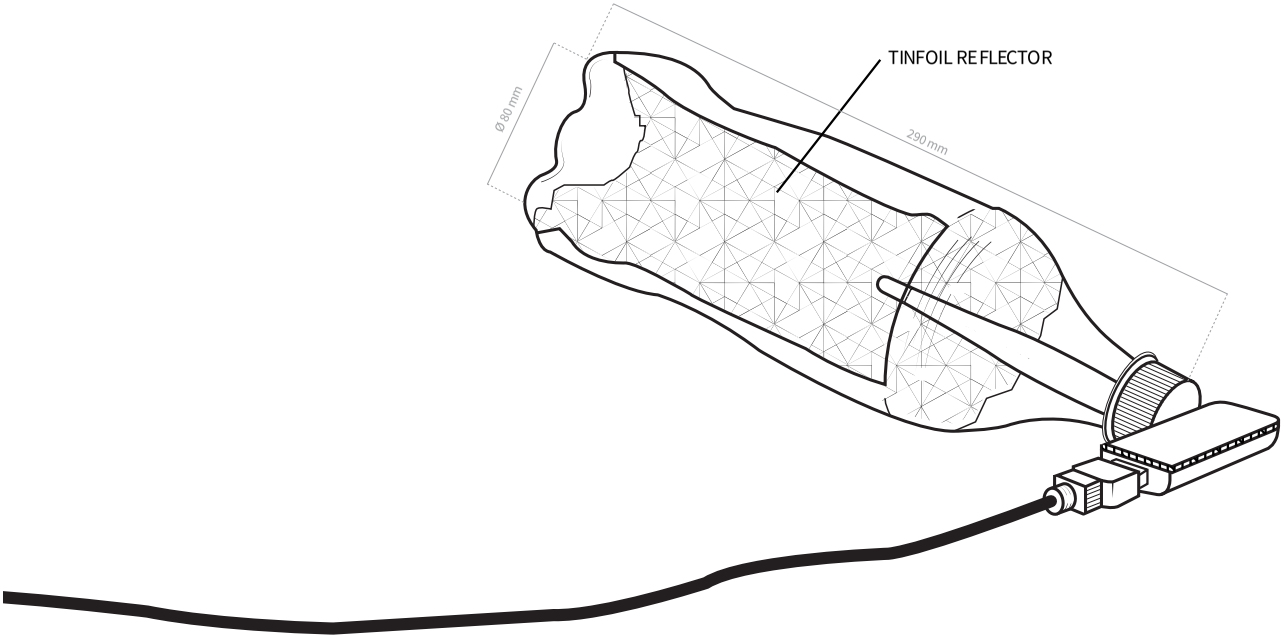
As the name suggests reflectors work by reflecting incoming radiowaves towards the antenna of the USB Wi-fi. This focusses the various waves into a single spot. When transmitting, the reflector reflects all waves emitted by the radio into one direction.

Waveguides

Cantennas are so-called waveguide antennas. These antennas work as a funnel which first captures the radio waves and then reflects them around inside the can. In this process the waves amplify their power due to an effect called the 'standing wave'.

Bi-quads

Tie 'tie' shape of bi-quad or bi-loop antennas optimally converts the radio waves into current. Each wing of the antenna equals a wavelength. In the case of the bi-quad each side of the square 'tie' is 1/4 λ. This design is often used in conjunction with a reflective backpane.


TINFOIL REFLECTOR
Ø 80 mm
290 mm

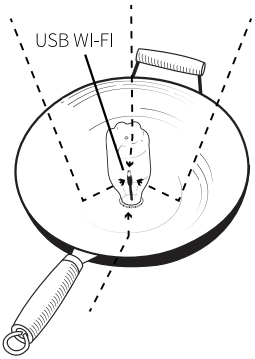
COLABOTTLE

2007, US

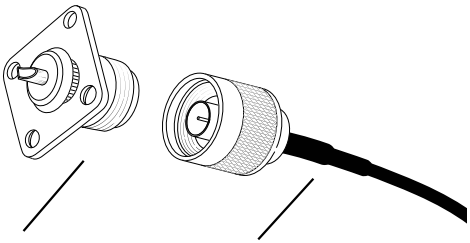
http://www.instructables.com/id/Cheap-and-easy-WI-FI-antenna-signal-booster-that-is/

Another article from instructables.com uploaded by user BadMonkey63 from Oregon, USA. This reflector uses the slight parabolic shape of a cut Coca Cola bottle to reflect the radio waves onto a router's antenna, increasing its efficiency. Like the other instructables antenna the signal gain is rather small but present.

REFLECTOR



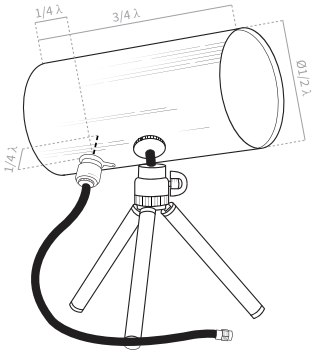
CONNECTOR



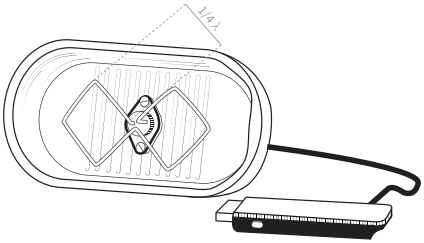
PANEL MOUNT
N-CONNECTOR

REVERSE POLARITY
SMA TO MALE
N- CONNECTOR CABLE

WAVEGUIDE



BIQUAD



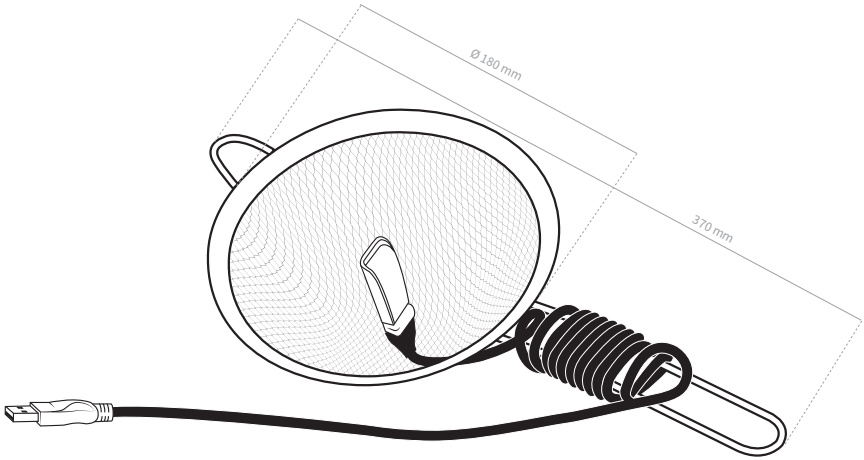
WOK

2005, NL

https://web.archive.org/web/20100602075315/http://wifiwok.web-log.nl/wifiwok/2005/10/joti_2005_bij_s.html

The wok-type reflector is easily both the most simple and most powerful Wi-Fi antenna. The shape of the wok provides an almost perfect parabolic form, bundling the radio signals into one spot where a USB Wi-Fi adapter is located. Waterproofing for outside use is provided through the addition of a plastic container to cover the adapter. Wi-Fi links of 20km in line-of-sight have been reported using this type of Wi-Fi antenna.

This particular design was used to provide a youth camp with broadband internet, which was shared by a kind neighbour. The original source is now offline and the text is accessible only through the Internet Archive. Images of the antenna itself on the other hand are only available as part of a collage on the famous "Poor Man's Wifi" page.

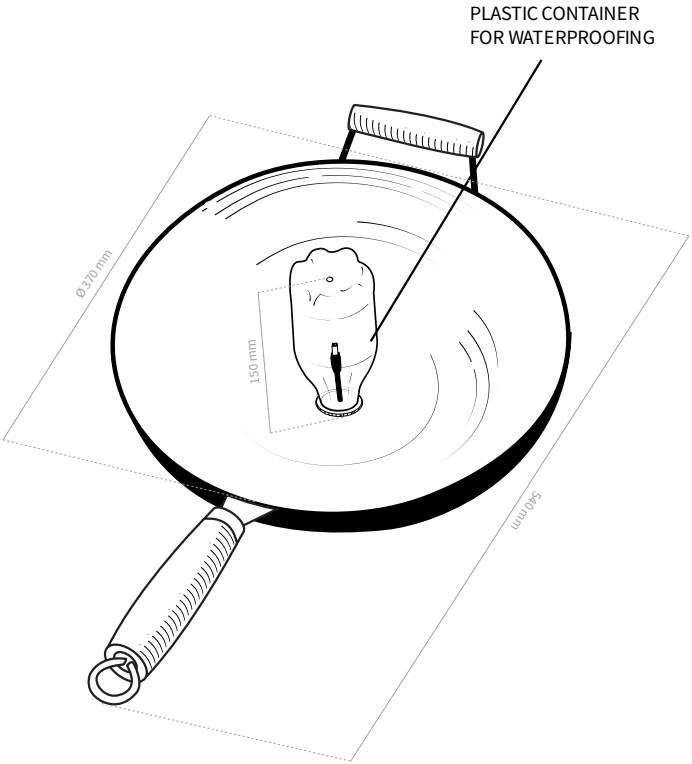

Ø 180 mm
370 mm

SIEB

2008, DE

http://www.kein-dsl.de/forum/showthread.php?t=11945

This strainer antenna was proposed in order to receive wireless internet via 3G, offered by mobile providers, as an alternative for poor broadband connections. People use it by pointing their 3G adapters at distant radio towers. Although not Wi-Fi and operating on a different radio band (2.1Ghz), the 3G signal is similar enough for the do-it-yorself Wi-Fi techniques to work. The website where this design was proposed, kein-dsl.de is a grassroots movement of people trying to get (better) broadband connections. According to them, many villages in Germany still have dial-up connections.


PLASTIC CONTAINER
FOR WATERPROOFING
Ø 370 mm
150 mm
540 mm

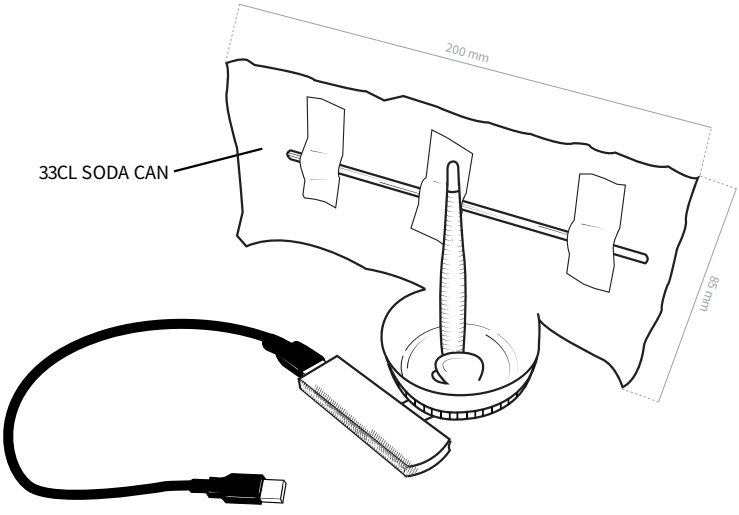
PRINGLES

2001, US

http://archive.oreilly.com/pub/post/antenna_on_the_cheap_er_chip.html

The Pringles cantenna, a neologism combining antenna and can, is one of the most popular designs on the web. The first traceable mention online of this antenna is in an article by Rob Flickenger, who wrote about it in the O'Reilly blog in 2001. The goal of the design, as he explains in the article, is to provide everyone with free and infinite bandwidth.

Although one of the most iconic of DIY antennas, several commentators have noted, it is far from being efficient, in part because the container is made out of carboard. In reaction to this article others began publishing improved cantenna designs. In 2011 Rob Flickenger celebrated the 10 year anniversary of his article on his personal blog.

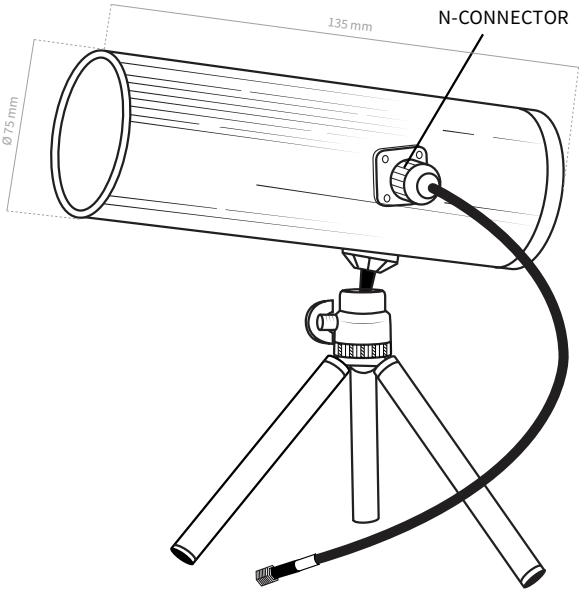

200 mm
33CL SODA CAN
85 mm

30SECOND ANTENNA

2012, CA

http://www.instructables.com/id/The-30-second-WiFi-extender/

Advertised on instructables.com as the “30 Second Wi-Fi range extender”, uploaded by user WhiteTech. This design is as flimsy as it is quick to make. It is probably only suitable for quick ad-hoc solutions. It works reflecting some of the radio waves in the general direction required.


N-CONNECTOR
135 mm
Ø 75 mm

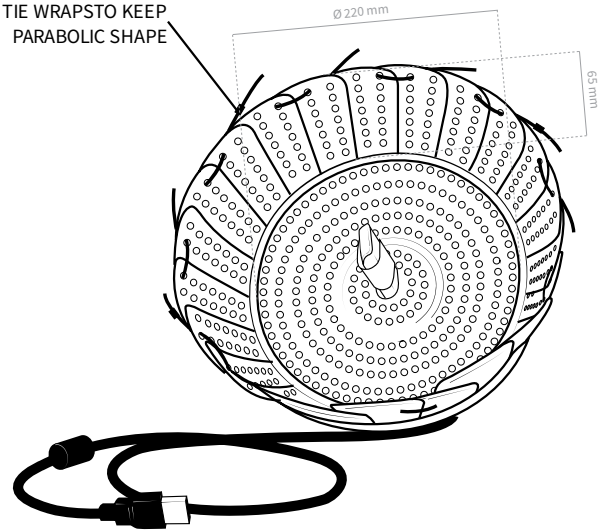
CD

2010, ES

http://www.sorgonet.com/trashing/antenacd/

Based on a 2003 French model of a CD case antenna. This antenna uses objects easily found in the proximity of one's desk. It consists of two CD-ROMs with a layer of tinfoil between them as a reflector. The size of the CDs is roughly the required size to fit the antenna connector and is likewise big enough to be an efficient reflector. The CD spindle itself is used for waterproofing.

This CD case antenna was made and documented by Sorgonet, a Spanish hacker collective from Tordera. This object seems to be a part of their research for the Tordera Wireless community network.

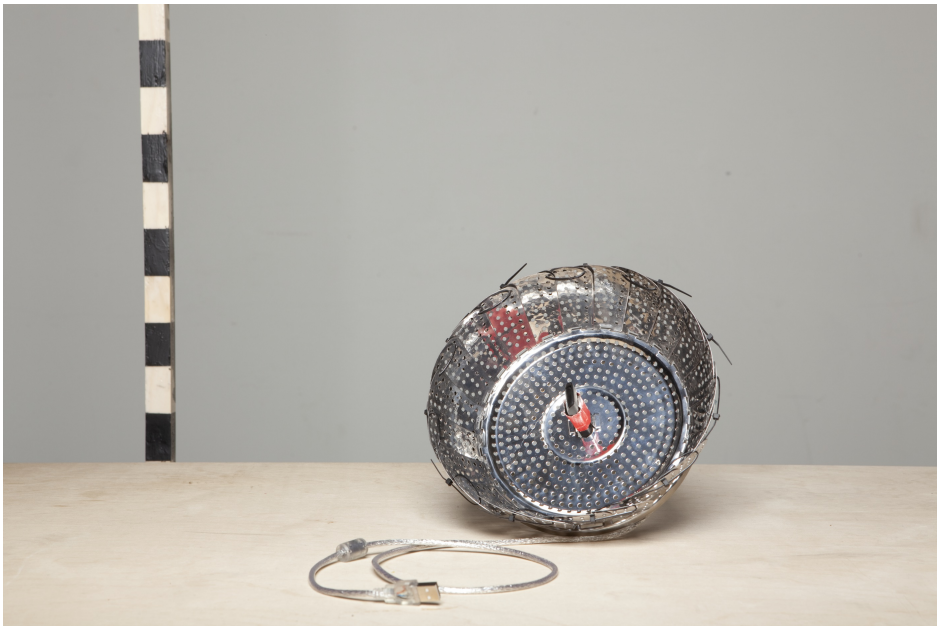

TIE WRAPSTO KEEP
PARABOLIC SHAPE
Ø 220 mm
65 mm

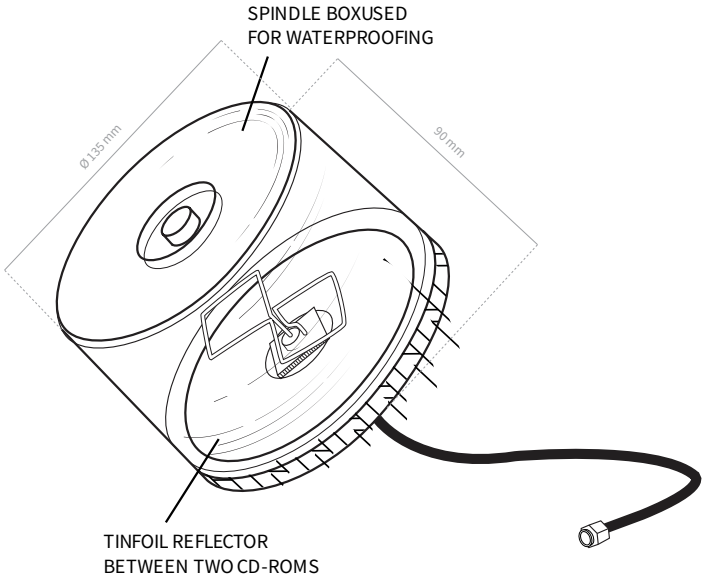
VEGETABLE STEAMER

2006, US

http://www.usbwifi.orconhosting.net.nz/vsteamer.jpg

One of the many 'fan submissions' to Stan Swan's USB Wi-Fi page, this object uses a vegetable steamer to make a portable antenna. It features the same simple design as the other cookware antennas, but because it lacks the parabolic shape, it is less efficient.




SPINDLE BOXUSED
FOR WATERPROOFING
Ø 135 mm
90 mm
TINFOIL REFLECTOR
BETWEEN TWO CD-ROMS

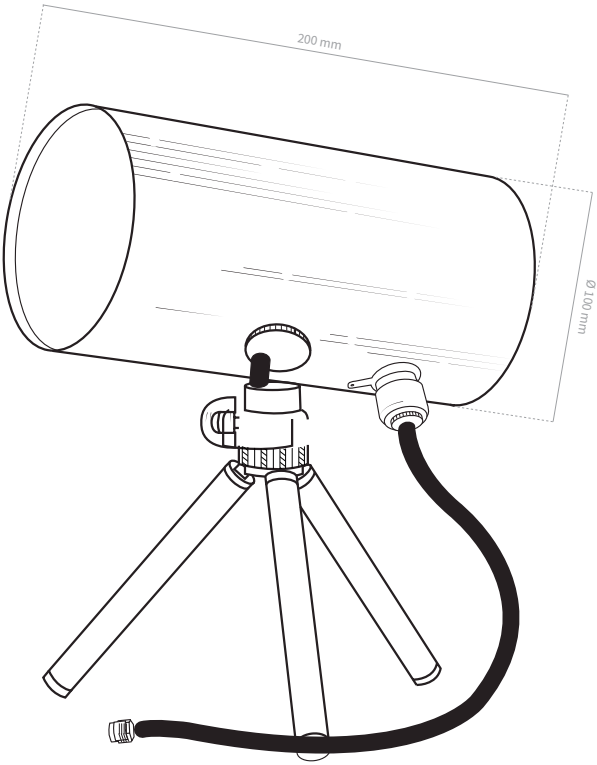
SIERPINSKI

2011, CA

http://www.andrewhazelden.com/blog/2011/02/homemade-sierpinski-gasket-fractal-wifi-antenna/

This antenna uses the Sierpinski Gasket fractal pattern as its basis and is made out of a double-sided copper printed circuit board. The antenna can be either etched or milled and is both easy to reproduce and small. Fractal antenna designs are regularly used in commercial equipment. While this design is challenging to produce, the fact that the etching mask itself is digitally distributed makes it a popular choice.

The model was posted on Andrew Hazelden's personal blog, where he writes about photography, visual effects and hobby electronics. He lives in a remote part of West-Dover in Canada, which required him to build his own network in order to set up an internet connection.


200 mm
Ø 100 mm

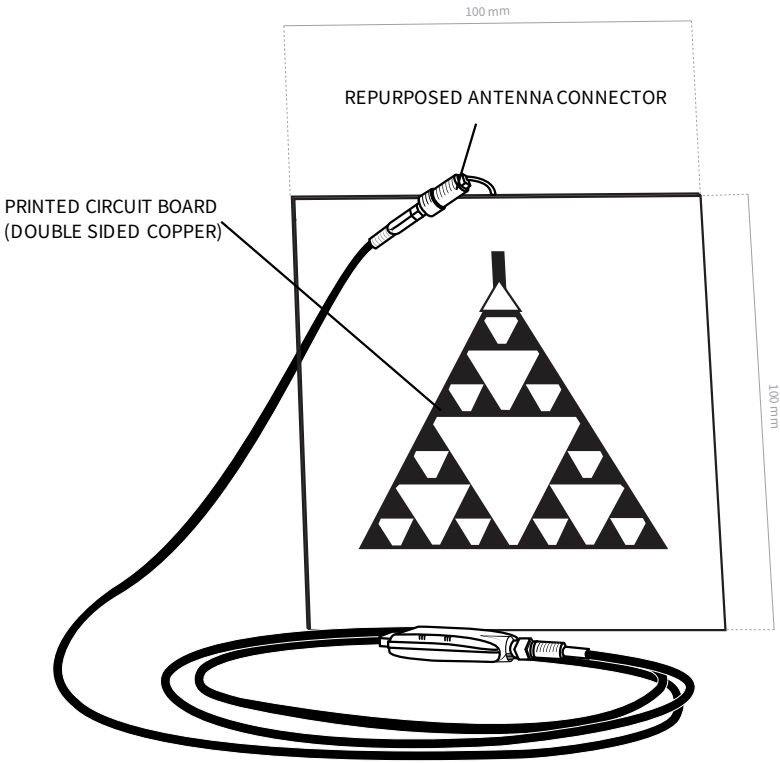
CHEESCANTENNA

2002, US

http://www.seattlewireless.net/DirectionalWaveguide?action=show&redirect=TinCantenna

Since 2000 the Seattle Wireless community has been working on a useful decentralized multi-owner mesh network in the city of Seattle. In the process they have tested and shared various designs for Wi-Fi antennas. In reaction to the Pringles cantenna, the people of the Seattle Wireless community decided to put various cantenna designs to the test. While the Pringles cantenna is the most famous example of a cantenna, they actually come in all shapes and sizes. Usually, when making this kind of antenna, people rely on cans of specific products that are sold in their area.

The particular cantennas shown here, originate from Amsterdam where, thanks to a large community of Turkish immigrants, olive and cheese cans are easy to come by and have proven suitable for use.


100 mm
REPURPOSED ANTENNA CONNECTOR
PRINTED CIRCUIT BOARD
(DOUBLE SIDED COPPER)
100 mm

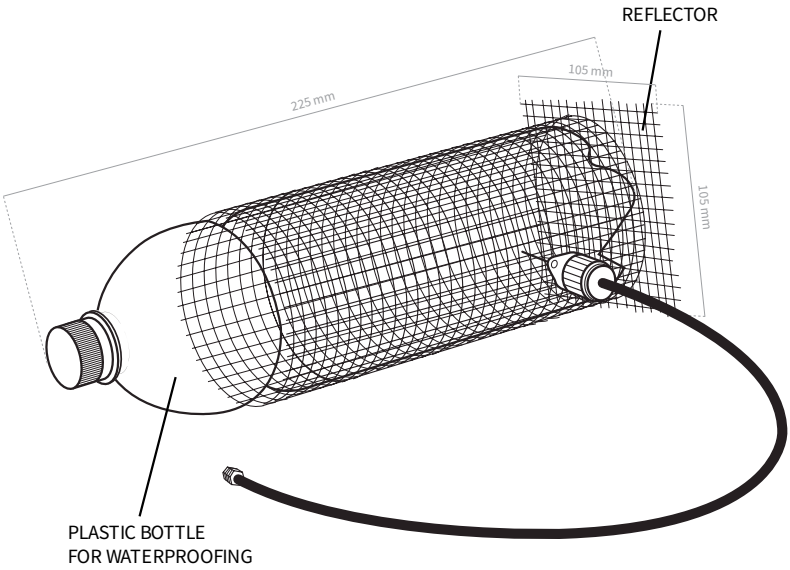
YAGI

2008, MY

http://www.ab9il.net/wlan-projects/wifi6.html

This Yagi-style antenna is one of the most difficult designs to make, considering that it requires sub-millimeter precision in order to work well. However, Yagi antennas often yield exceptionally good results. This particular model was designed by Philip Collier and posted on his personal website AB9IL.net. On the page he provides detailed schematics as well as a calculator tool to aid in designing the antenna. As an airline pilot by day, a radio enthusiast and proponent of 'liberation technologies' by night he devotes much of his website to these topics.

Furthermore he writes that as an American national living in Asia, he realizes the extent as to which media censorship is part of daily life. Consequently he dedicates much of his time writing on how to 'beat' censorship with software and hardware tools.

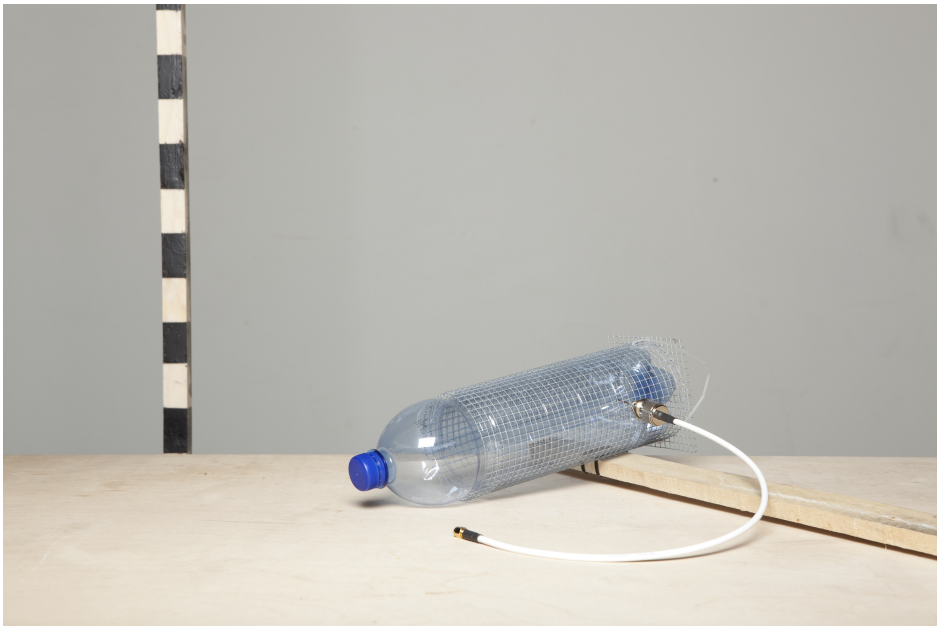

REFLECTOR
225 mm
105 mm
105 mm
PLASTIC BOTTLE
FOR WATERPROOFING

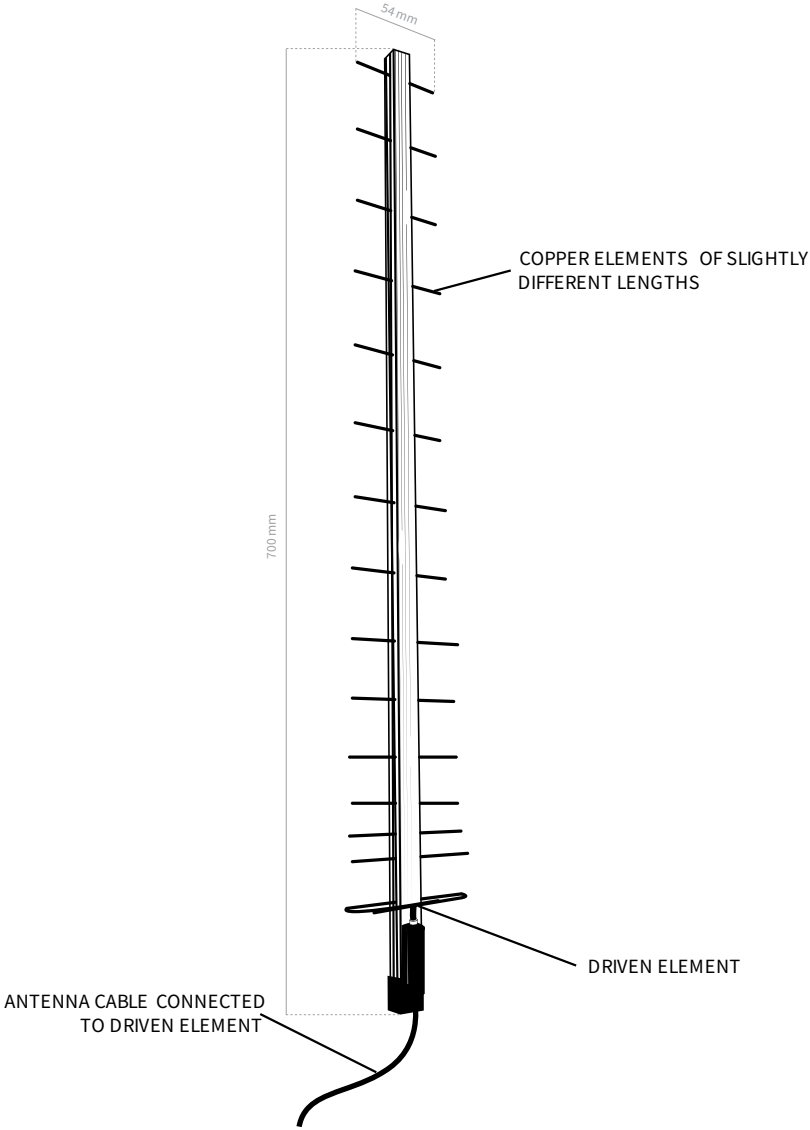
BOTTLENET

2005, ML

https://web.archive.org/web/20070129024850/http://mali.geekcorps.org/2005/11/07/how-to-make-a-bottlenet-antenna/

Geekcorps Mali is a not-for-profit organization, supported by the US AID fund, that tries to foster digital independence. They try to to spur the development private enterprises in developing countries with the help of volunteers working in the technology industries. Between 2004 and 2005 Geekcorps developed a project in Mali. One of the great challenges they met there was to establish internet connections. In order to do so they built wireless antennas by recycling locally available materials and creating what they call the 'Bottle Net' which provided inhabitants of remote villages with internet connections. The design works in a similar fashion to a cantenna but it uses folded wire-mesh instead. The water bottle in this design serves both as 'mold' and water proofing for this design.



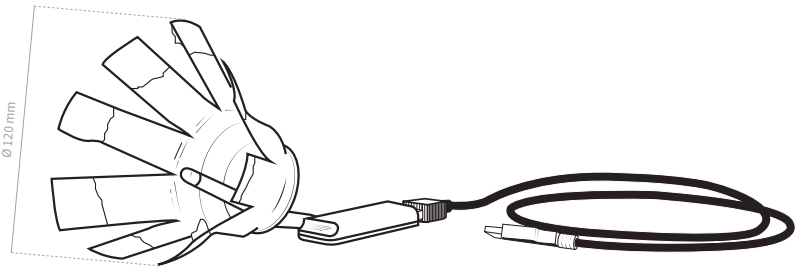

54 mm
700 mm
COPPER ELEMENTS OF SLIGHTLY DIFFERENT LENGTHS
DRIVEN ELEMENT
ANTENNA CABLE CONNECTED TO DRIVEN ELEMENT

DUMPLING SCOOP

2004, NZ

http://www.usbwifi.orconhosting.net.nz/

The 'asian dumpling scoop' is the product of research by Stan Swan and his students of the Wellington's Massey University. The emergence of affordable Wi-Fi cards on the consumer market prompted them to start researching cost-effective and creative solutions to improve the performance of these little adapters. Their search for 'ready-made' Wi-Fi antennas lead them to use 'asian parabolic cookware' such as woks and scoops. Over the years their website became well renowned because of their meticulous experimentation and documentation. Many of their designs inspired others to try them out - these attempts are likewise documented on the website.

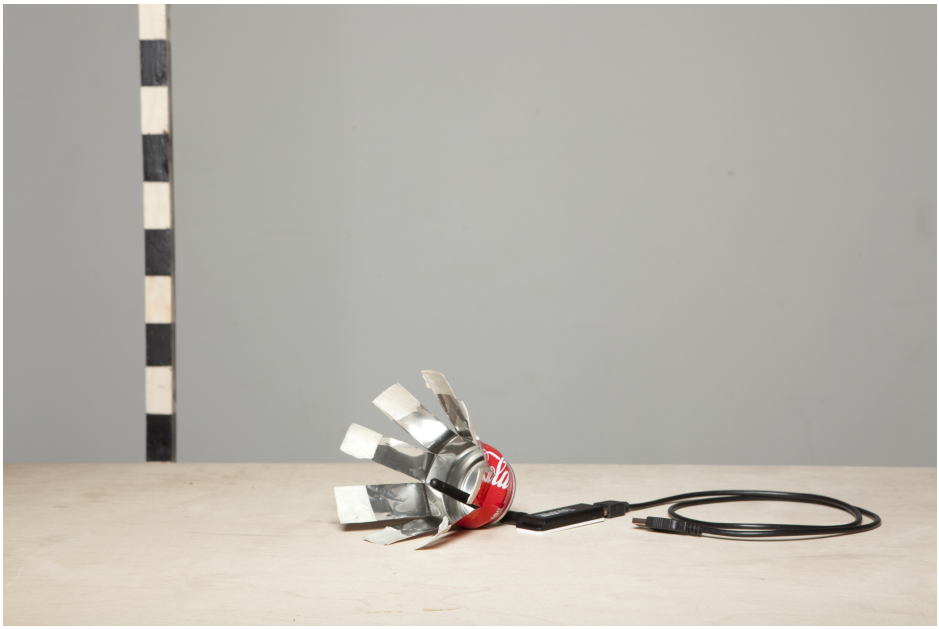

Ø 120 mm

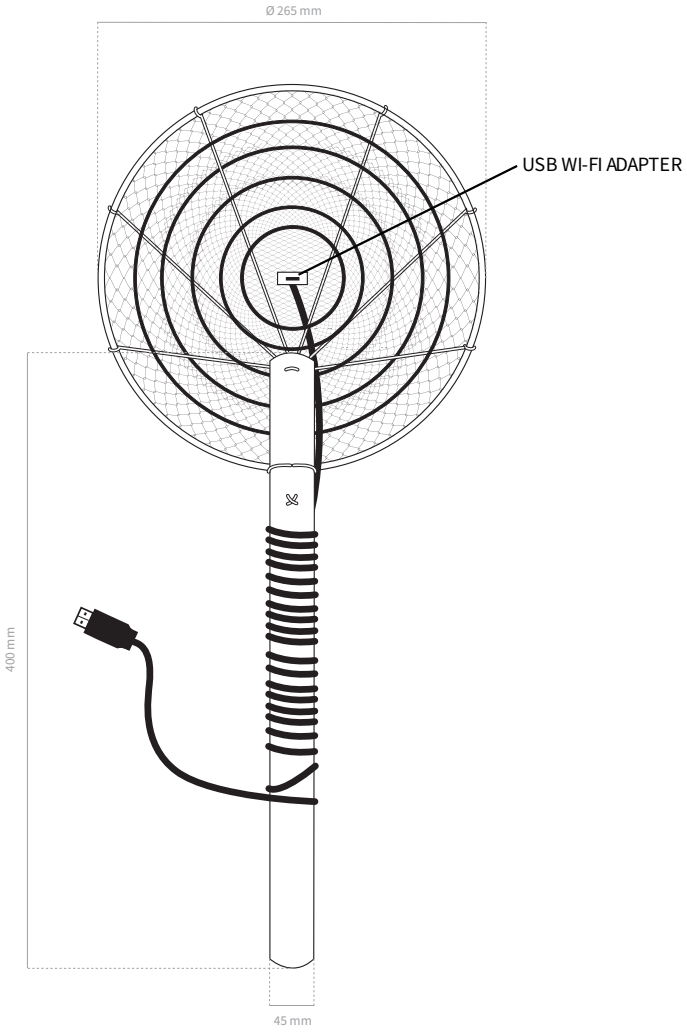
COLA FLOWER

2007, IT

http://mark0.net/forum/index.php?topic=51.0

Improvisation by Marco Pontello, an Italian software engineer, who quickly needed to improve the Wi-Fi reception from an access point in a friend's house. In a forum post he shares his story and design with a lot of images. Although the signal gain is very slight, for him it was enough to get a connection. The antenna works by 'funneling' the radio waves and reflecting them at the antenna of the Wi-Fi adapter.



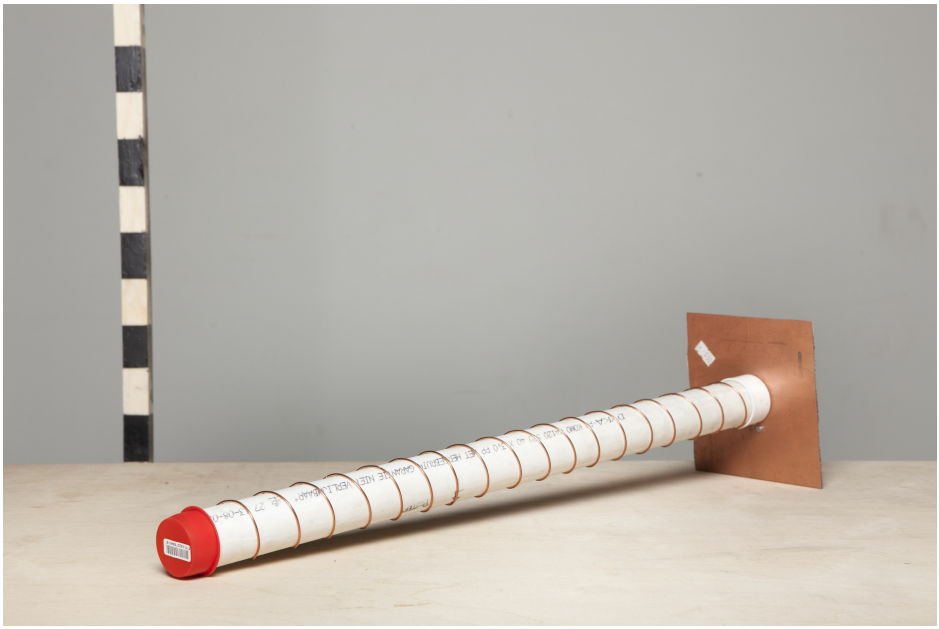

Ø 265 mm
USB WI-FI ADAPTER
400 mm
45 mm

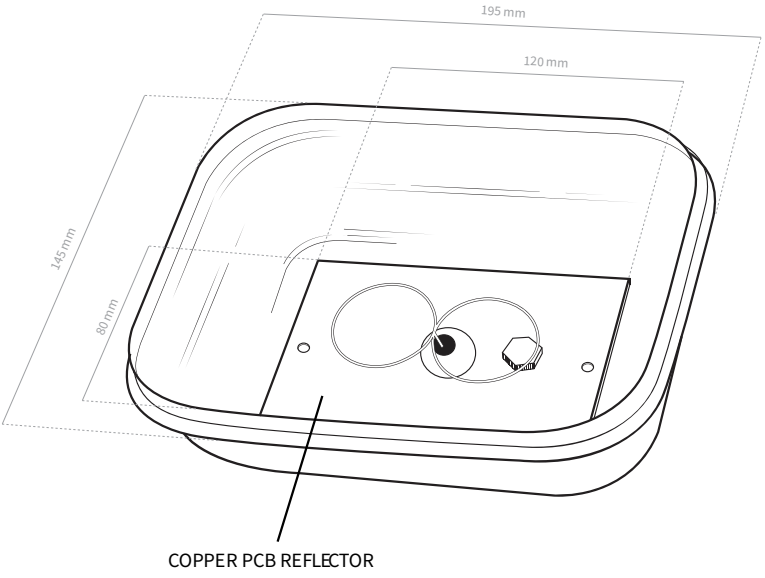
HELIX

2002, NL

http://home.deds.nl/~pa0hoo/helix_wifi/index.htm

The Helix Antenna is a design that is common in radio amateur circles. These communities then also adapted the design to be used for Wi-Fi. The great advantage of this antenna is that it is quite strong and that its particular measurements are not so critical for the antenna to function. The slight error margin makes this design ideal for DIY antenna building. The homepage of radio amateur PA0HOO is one of the earliest sources for these kinds of antennas. Many mirrors of this page exist.



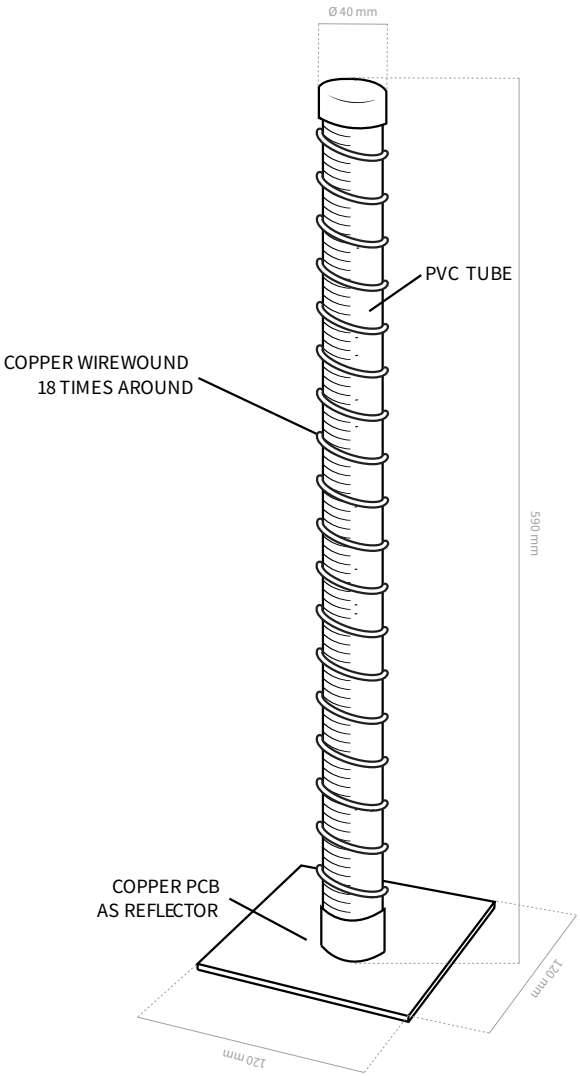

195 mm
120 mm
145 mm
80 mm
COPPER PCB REFLECTOR

BILOOP

2007, NL

http://pe2er.nl/biloop/index.htm

This Biloop design is very common in combination with a dish. Tupperware is used to shield the antenna from water. Since microwave ovens operate 2.4ghz, just as Wi-Fi, it is best to use microwave oven proof tupperwares since these will not insulate against Wi-Fi signals. This particular design was found on the web page of radio amateur Erwijn Gijzen, where he displays various technical designs for radio antennas.

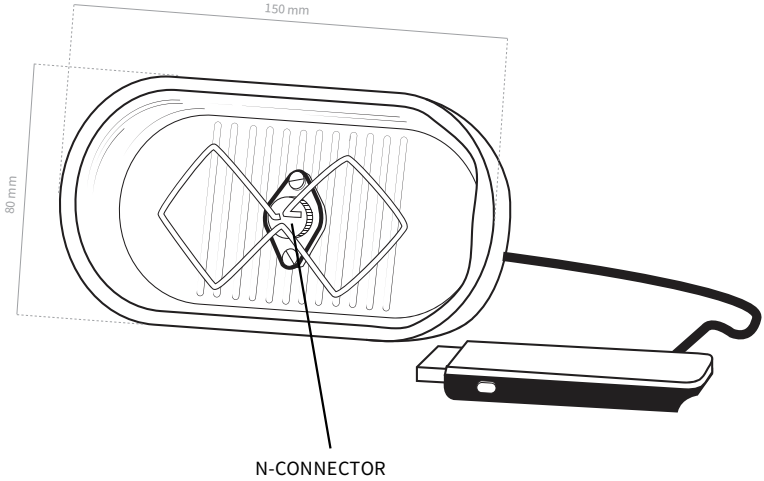

Ø 40 mm
PVC TUBE
COPPER WIREWOUND
18 TIMES AROUND
590 mm
COPPER PCB
AS REFLECTOR
120 mm
120 mm

SARDINECAN

2006, BE

http://reseaucitoyen.be/wiki/index.php/SardineCanAntenna

This sardine tin antenna was found on the Wiki of the Brussels-based Réseau Citoyen (Citizen's Network) wireless community. The organization describes itself as being inspired by libertarian values, trying to provide all the members of the network with internet access, outside of the grasp of big corporations. They cite the aforementioned research by Stan Swan as an inspiration for this sardine can antenna, which they describe as the best choice for a beginner to get into antenna building. One only needs to fold the 'biquad' element out of a copper wire and solder this to a connector which is mounted inside the sardine tin.


150 mm
80 mm
N-CONNECTOR