

# How to build your own internet

## A simple guide

3<sup>rd</sup> Draft – October 2020

Prepared for Internet South Africa

by <http://wish.org.za>  
and volunteers from all over

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# Part 1: The plans

## How do I start?

You have already started! Just keep reading and then follow the steps.

## Plans to connect yourself

This guide will share two plans for how to get connected.

We recommend that you start with the first plan because it is an easier plan, and it can make the second plan easier too.

## Some advice

The first **important thing to accomplish anything is to make it look easy**. This guide will help you.

Don't be shy to ask for help. To each person different things are easy.

Everything you do will be easier if people help you. If you make it look easy, then others will be more likely to help you when you get stuck.

You may also want to grow this project. For that you will need to find a team of people who believe in the plan. It is easy to get people to believe when you show them.

## Showing that it is possible

The best thing that you can do that will make things look easy, is to show that it is possible.

You have to be patient, keep moving forward and keep following the path around any obstacles.

We will start with the first step: showing that **it is possible no matter where you are**. There are many examples of people who built this who had even less than you may have.

## Can I get this guide in other languages?

We need people like you to volunteer not only to help to translate this, but also to let us know what we can improve. Please visit our web page as we will explain below.

## The Easy Plan: “Internet-in-a-box”

An easy way to get started is to build a Wi-Fi network that anybody with a phone or a computer can access.

You can offer useful information even if there is no other connection. **It also works without any airtime or data.** People can connect to this box in the same way they connect to the internet. It contains some information that you can find on the internet and it works just like the internet, with just some services not available, that you can add later.

It can contain videos and movies anyone with a phone or computer can watch, copy or read at home. This kind of connection is especially useful to help kids and adults who want to learn things. It can contain information about farming, building or anything else that you can find helpful.

For this connection there is no monthly cost. You can decide where you want to install it and how you will tell people about it. If you simply install it and keep it on, some people will see the Wi-Fi signal and connect with their phones and computers, even if you don't tell them about it.

This Wi-Fi signal will reach about **50 meters**. We have another guide that you can find on our website that explains how you can make the signal go for 500 meters or even 1km or more. Some people have built networks that reach more than 300km.

## The Long Plan: Start a Community Network or an ISP

To make the internet available, you need to first connect to it, and then share it. If there are limited or no options where you are, or the connection is expensive but not good, then there is an opportunity for you to improve things and to even make a livelihood doing so.

You can read more about how it works in the next part of this booklet.

There are two main ways to do this: a community network lets you invite anybody to contribute. This is also sometimes called a “Wireless User Group”. The other way is to start an Internet Service Provider business.

In the short run, sometimes the Internet Service Provider model works better, but in the long run everybody can gain more from a Community Network model and it is a model that is followed even between Internet Service Providers.

Usually a Community Network model works better in rural areas, but there are examples where it works for networks of all sizes even in the biggest cities.

# How to build Internet-in-a-Box

## What do I need to get started?

You will need to find someone who has a phone or a computer. Don't worry if you do not know how to use it, you will learn.



If you see things here you can not understand, don't worry about it, just carry on reading - and read it again later. Just know that anybody can do this and that your brain will learn by itself.

## The building blocks

You will need to save money or ask people to contribute about \$400 for all the parts you will need. If you already have electricity and you don't want to start too big then you can do it with \$200 or less. There is also an option for \$50.

**If you don't have money, you can ask for contributions on the internet too.** You can read more about that in part 2. You can get the price in your own currency by multiplying this number by the current exchange rate. This money will be used to order the components.

You will only need some of these items, so read carefully:

|  |   |
|--|---|
| <ul style="list-style-type: none"><li>• A small computer called a "Raspberry Pi 4B"</li></ul> <p>Cost:                      \$50</p>   |   |
| <ul style="list-style-type: none"><li>• A very small piece of plastic that contains all the information, called an SD Card. U1, U2, U3 or better.</li></ul> <p>Cost:                      \$20</p> |  |

- A box for your computer

Cost: \$10

You can also make your own box or use any small container or even a bucket. If it gets dirty or wet, it will break. This one also has a fan to keep it cool, which makes it run faster. For some boxes you will need a screwdriver to assemble it.



If you have electricity, then all you need to power it is this:

- A USB-C charging cable to give it power

Cost: \$15

Not all cables will work. Some will work but only a 3A charger will keep the red light on all the time and make the network run at full speed. Make sure that it will fit your sockets, because the plugs look different if you order it from other countries.



Only if you don't have electricity or if you don't want to pay for electricity all the time, then you will need a solar panel and car charger:

- A 12V solar panel

Cost: \$60

100W or bigger. Every device you use for a network uses about 5W. A 100W panel will produce 5W even without sunshine. You can also ask about bolts and planks to attach it to a roof.



- USB C car charger:

Cost: \$20

You can connect this to the solar panel or to a battery to charge a phone, or to run the Raspberry Pi.



- Flex or Speaker Wire

Cost: \$50

You will need this to connect the car charger to the solar charge controller. This will also allow you to put the solar panel outside if it is long enough.






With the solar panel you will need one of the following to connect the flex wire to the car charger:

|   |  |
|---|--|
| <ul style="list-style-type: none"><li>• Just a piece of solder wire</li></ul> <p>Cost: \$2</p> <p>Ask any plumber, electrician or at a hardware store. The proper tool to melt it is a soldering iron, but you can also use a candle.</p> |   |
| <ul style="list-style-type: none"><li>• If you can't find solder, you can use masking tape, but solder wire is best.</li></ul> <p>Cost: \$1</p>   |   |
| <ul style="list-style-type: none"><li>• Or some poster putty or sticky tack</li></ul> <p>Cost: \$2</p> <p>This can get messy and loose easily, so it should be your last choice.</p>  |  |

If you want to run the Internet in a Box at night, or when there is no power close by:

|  |  |
|--|--|
| <ul style="list-style-type: none"><li>• A power bank</li></ul> <p>Cost: \$50</p> <p>You will need this if you want to run it at night and you don't have a power socket.</p> |  |
|--|--|

These items can improve the range of the network, but it is not needed:

|  |  |
|--|--|
| <ul style="list-style-type: none"><li>• A wireless access point.</li></ul> <p>Cost: \$40</p> <p>This one is good enough to connect 10 people at a time from up to 200 meters.</p>  |    |
| <ul style="list-style-type: none"><li>• Or a better wireless access point: Ubiquiti Unifi AC Mesh</li></ul> <p>Cost: \$100</p> <p>This one is good enough to connect 50 people and it is easy to add more and make it go even further.</p> <ul style="list-style-type: none"><li>• If running from a solar panel, then you will also need a 12V to 24V DC to DC Booster</li></ul> <p>Cost: \$5</p> <ul style="list-style-type: none"><li>• If running from a solar panel, and you have a battery, you will need a “Solar charge controller”</li></ul> <p>Cost: \$10</p> <ul style="list-style-type: none"><li>• And you will also need a small 12V motorcycle or car battery</li></ul> <p>Cost: \$30</p> | <br><br> |

- One or two network cables

Cost: \$10

You will need this to connect the Raspberry Pi to the wireless access point. For a “POE” wireless access point like the Unifi, you will need an additional cable - one to connect it to it’s “POE” power source and one to connect it to another device like the Pi. One cable can be up to 100m long if you want to put the device somewhere far away, but for the cable to last more than 1 year exposed to the sun, you need a black shielded cable that costs a bit more.



To make the network share a lot more information, you can use these, but they are not needed:

- External SSD hard drive

Cost: \$150

This can replace the SD card, and it is a lot faster so it can also make your network work better for more than 100 people but there are also more ways it can cause problems that may be difficult to fix.



- Laptop or computer to replace the Raspberry Pi 4

Cost: \$100 - \$500

This can be used to serve more than 500 people at the same time. The battery and hard drive are already inside, so from that perspective it is simpler, but the instructions to set it up is different. We will try to write a guide for how to do this and share it on our website. The difficult part of using a laptop is to keep it hidden somewhere so people won't try to use it for other things. The battery also does not last as long as for a small computer like a Pi so you will need a bigger 12V battery to power it when the battery inside runs out.



- Automotive Laptop Charger or an inverter.

Cost: \$15 - \$40

If there is no power, and you want to use a solar panel then you will need one of these to charge the laptop. The inverter is a more versatile choice because you can run other things with it as well, but the automotive charger may last longer because it converts the power directly..



## Do small details make a difference?

Electronic things contain a lot of details. If one letter or number is different then the steps to use it change. It can be quite difficult to write down these steps, as there are some variations - and it is almost impossible to write down the steps for every variation.

If you do run into trouble, you will have to find help. If you can find an internet connection, you can ask on the internet for help or if you are lucky find the phone number for someone who can help. We will explain how a bit later.

For now we will jump into how to connect everything.

After that you can read about the small details that you have to look out for.

# Putting it all together

1. Find a clean and dry place where you can put it all together.
2. Make sure that your hands are clean and dry! Just a bit of water or dirt might not cause damage right away, but over time it can break the devices.
3. Open the boxes and take everything out of them and put it on a flat space in front of you and count that you have all the items you need. Put the small items like screws, and the SD Card, on a clean flat rock or in a white box or a white plate so that you can easily see it and that it can't roll away.
4. Pick up the Raspberry Pi 4 and look at it. It is best to hold it gently on the sides. Notice that there are silver things around the sides. These are the connectors where you connect things to it like the power, a network cable, and other devices.

Don't worry about the number of connections, we will only use three of them. Maybe two.

If you are interested, this device can be used to build over 100 different projects, but they are all a lot harder than what you are going to build now, and using the project you are building here, you will be able to learn about those if you are interested.



**Figure 1. Raspberry Pi Top**



**Figure 2. Raspberry Pi Bottom**

The small flat connector with the rounded edges, on the corner bottom left corner, is the USB C connection where the power goes.

On the bottom side, that is the side that is mostly green, on one of the short sides, there is a silver slot. This is where we will put in the SD Card. Put down the Raspberry Pi.

The biggest socket is where you can connect a network cable. The ones next to it are for

USB A devices like the external hard drive or a USB disk, also called a USB Flash Drive. These just do the same as the SD Card, but are more expensive.

The USB connectors with the blue plastic inside make a faster connection so it is better to use those for certain devices like the USB drives. The two small connectors on the other side next to the power socket, are ones where you can connect a display or a TV and use it just like a normal computer, but you need a special cable for that. There is even a connector for headphones or a speaker to play music, but for that you will need special programs on the SD Card.

5. Pick up the SD Card and look at it on both sides. You will see that there is a lot of writing on the one side and shiny connections on the one side and also that the one edge is shorter than the other edge. Look for a U shape with a number in it on the side with the writing, this means it is a fast card that will work well.



**Figure 3. SD Card top**



**Figure 4. SD Card Bottom**

6. With the SD Card in your one hand, pick up the Raspberry Pi with your other hand and look at the bottom of the Raspberry Pi. Now hold the side of the SD Card with the shiny connections toward the bottom of the Raspberry Pi, and turn the SD Card so that the short edge goes into the silver slot at the bottom of the Raspberry Pi. Gently push it in as far as it goes, but don't force it. When it is all the way in it will still stick out a bit over the side of the Raspberry Pi, that is okay. But just a little bit. There is also a tiny hole in the silver plate where you can see if the SD Card is all the way in, but if it can't go any more, and you are sure that the side the with picture faces outwards and the connectors are on the side of the Raspberry Pi, then you have done it correctly.



**Figure 5. Raspberry Pi with SD Card inserted**





7. Now put down the Raspberry Pi and look for the USB Cable. It is the cable with a socket at both ends - the one might be bigger than the other. If the connector on the one side is bigger, then that is the USB A socket that goes into the battery or the USB Charger. Even though the bigger side can also plug into the Raspberry Pi, it will damage the Raspberry Pi if you connect it like that to power, so don't plug it in like that.

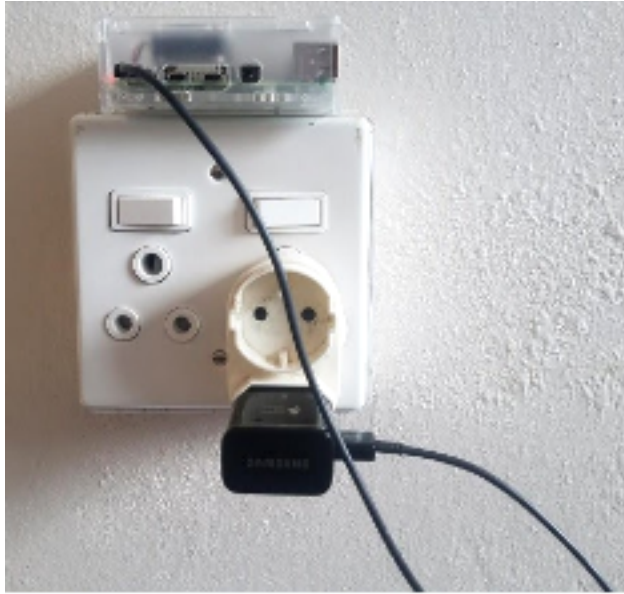
The smaller connector will be the USB C connector that plugs into the Raspberry Pi power connector.

Some power supplies might not have a removal cable, so it will only have the small connector. If it doesn't fit, don't force it, there are tiny connectors for older phones that do not fit on the Raspberry Pi 4, but only on a different one called the Raspberry Pi 3 or Zero. These cables won't work for the Raspberry Pi 4, and if you force it it will break! Only the ones with the USB C connector will work.



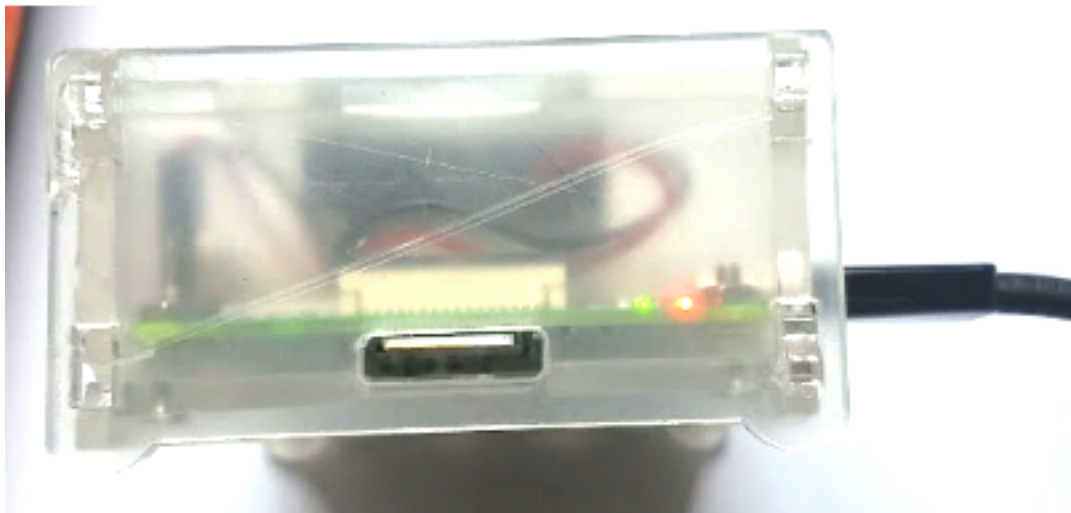
**Figure 6. USB A to USB C Cable**

8. Plug the smallest side of the cable into the Raspberry Pi. Plugging bigger USB A side into the Raspberry Pi is possible, but it will not work and can break the Raspberry Pi. The USB C connector will slide in easily.



**Figure 7. Raspberry Pi connected to battery    Figure 8. Raspberry Pi connected to charger**

9. Connect the other side of the power cable to either the battery bank, or the USB Charger, or if the other side is the charger, then plug it into a power socket. If you look at the short side of the Pi, closest to the power connector, you will see red and green lights that flash on and off, or stay on.



**Figure 9. Red and green lights**

These lights are how the Raspberry Pi tells you what it is busy doing.

**If the green light is flashing in a repeated pattern, then it means that there is a problem** - either the Raspberry Pi is damaged or the SD Card is empty or does not contain the software, or you might have inserted the SD Card the wrong way around or upside down or not deep enough. Go back to step 5 and 6. For a computer, **the software is the really**

**important part** and that is what is stored on the SD Card. Without it the computer doesn't know what to do and then it just does nothing. There is more about this in Part 2.

If the lights don't come on at all then it can mean one of three things: maybe your power socket is not working or is switched off. Try to switch it on or test if something else that you can plug in works. Also, the cable might not fit all the way in, especially if your Raspberry Pi is in a case or a box where it can block the power connector from going in all the way, so it is best to test it before you put it in the case or the box. The USB cable may be damaged or dirty, so you might have to try another one. If you have tested all of these and the lights still don't go on, try to use a different charger, or a battery bank. If it still doesn't work, then touch the flat metal part on the Raspberry Pi, if it is very hot then it means your Raspberry Pi is damaged and you will have to get a new one.

The red light means that the Raspberry Pi is getting enough power. **If the red light does not stay on then it means that your charger will not be good enough to run it at full speed**, but it might still work. The red light can be controlled from the software, so in future it can also mean something different.

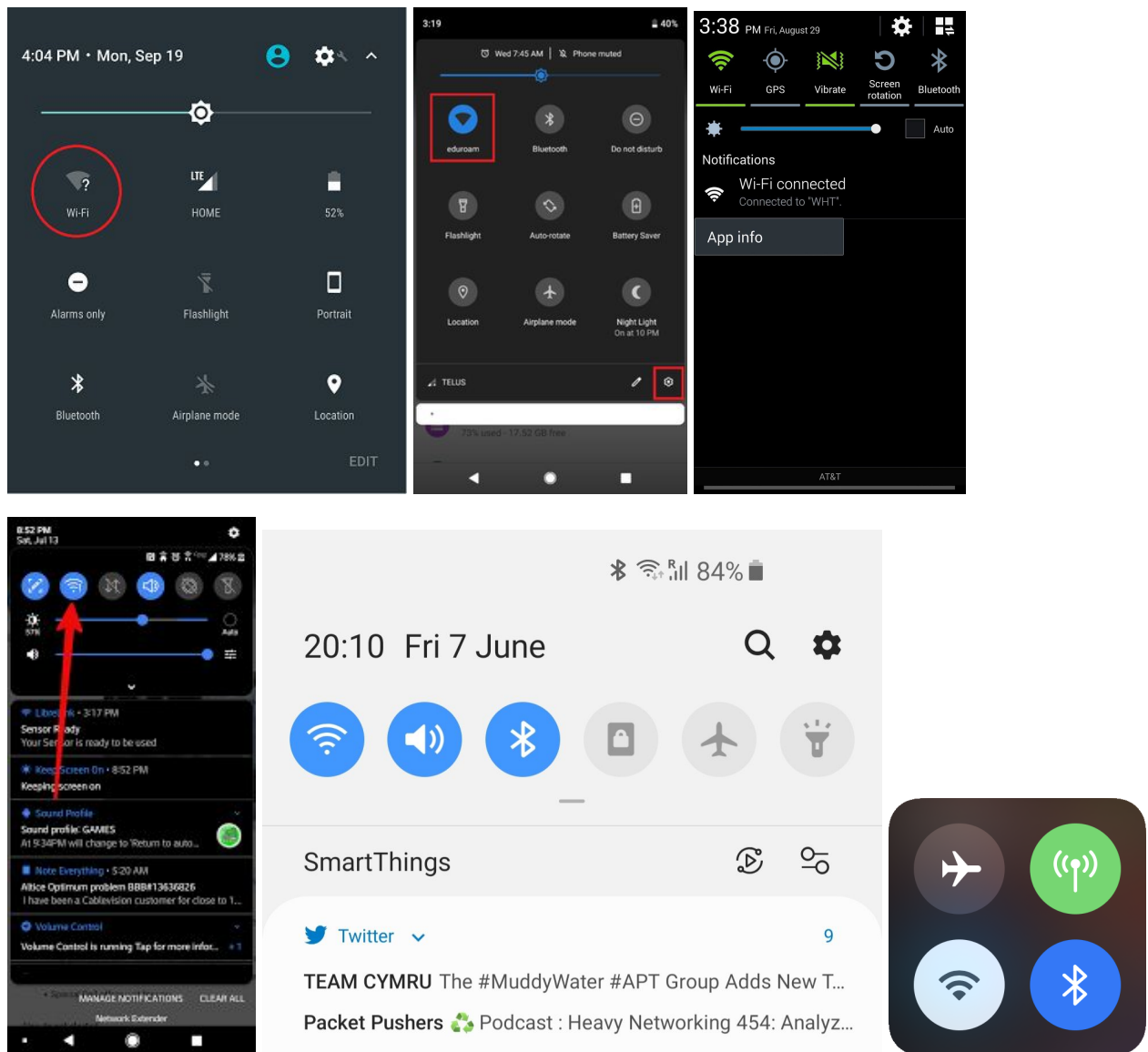
**If the green light just flashed a few times, then you can wait for 2 minutes and you will be ready to test the connection!**

10. Put it all down and pick up your phone or a computer that has Wi-Fi.

If the phone has lots of buttons on the front then it will not work, you need a phone that is called a "smart phone". It is not really smart, but it is just called that way.

If the phone screen is off, you will have to push one of the buttons on the side, the power button, usually the top button on the right - then it will come on. Even when the screen comes on, it might still be locked: you will need to unlock it first by putting in a code or drawing a pattern that was set on it, or just sliding your finger across the screen. If it doesn't come on, then the battery might be flat and you will first have to charge it for an hour or so, and then turn it on by holding down the power button for 3 seconds. You will know if it is charging because it will show a light or a picture when the charger is working. Remember to switch on the plug!

Once it is unlocked, turn the wifi on your phone or computer on by making sure that the Wi-Fi icon is coloured and shows the connection fans.



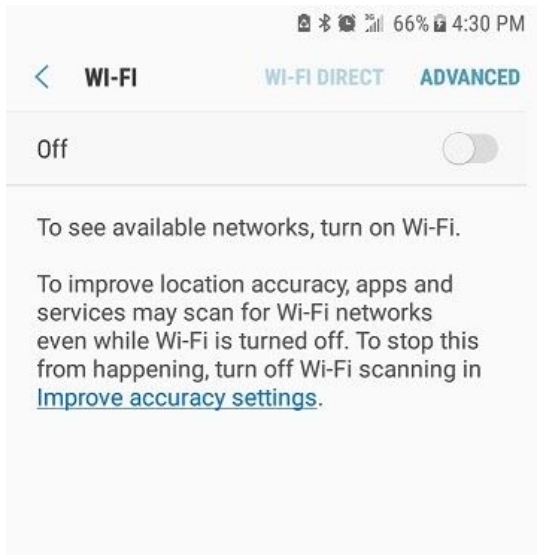
**Figure 9. Wi-Fi icons on various devices**

On most phones you slide your finger down the top and all the way past the middle of the screen, and then a top bar will appear and stay there. On some you have to slide from the bottom up. If it doesn't, then you need to start further and slide it further.

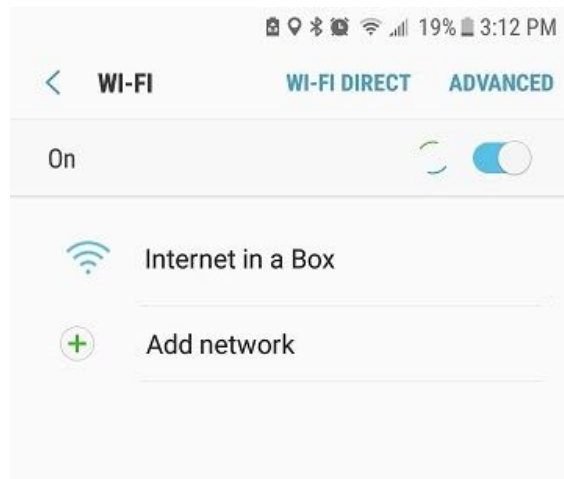
On the bar there will be an icon that will look like a slice of a circle, or bended lines from the top that get shorter with just a dot at the bottom. It can also have the name of a connection, or just simply "Wi-Fi" written underneath it.

If it is in black and white, or grey, then you can tap it once and wait, and then it should show color, which means that it is turned on. (Enabled, activated, or switched on means the same thing.)

11. Now you can hold down your finger on the Wi-Fi icon then the list of Wi-Fi networks should appear. If you have a very old phone, then you will have to navigate through the settings icon, the one that looks like a sun, or a star, or a gear, and look for Connections and then Wi-Fi connections.



**Figure 10. Wi-Fi Off**

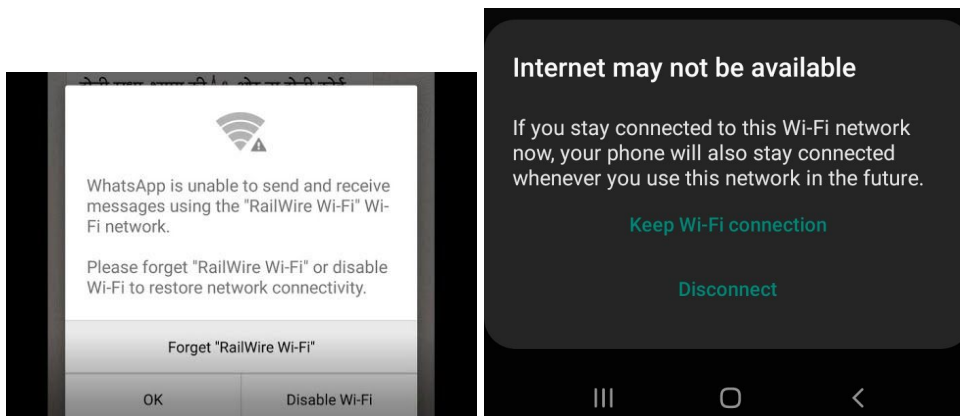


**Figure 11. Wi-Fi On**

You may have to wait a minute or so. When you see a network named “Internet in a Box”, click or touch it to connect.

Now you must read carefully. Different messages may come up that say that there is no internet connection and that want you to disconnect again. On some of them you have to click “No” and on some “Yes”.

You must look carefully to press the right option on these messages, otherwise you will have to start this step again, because it will disconnect or automatically connect to another connection if there is one that was used before on this device.



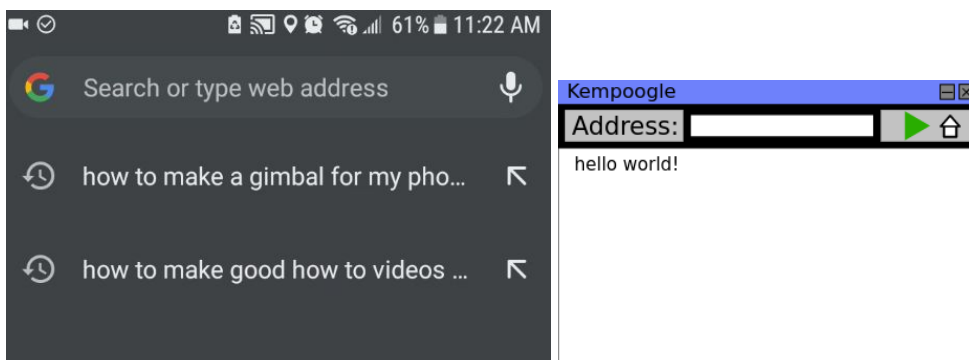
**Figure 12. No internet available messages on different devices, showing what to choose.**

12. As long as you are close enough, and your device is connected, a small Wi-Fi icon will stay in the corner of your screen. If it disappears, then the connection will no longer work and only some of the things that you accessed will still be available.
13. Open your browser by touching or clicking one of the icons that look like the ones below. You might have to push the big button on the front of the screen first, to show them, or there might be another button with lots of dots that you need to press before you can see one of these. You might also have to swipe left or right or up or down to find one. You only need to find one of them.



**Figure 13. Browser icons on various devices, you only need to find one.**

14. When the browser opens, you may see different places where you can type an address - you have to touch or click use the bar right right at the top. On a mobile device like a phone or tablet, an on-screen keyboard will show when you touch the bar, and then you can start typing.



**Figure 15. Address bars**



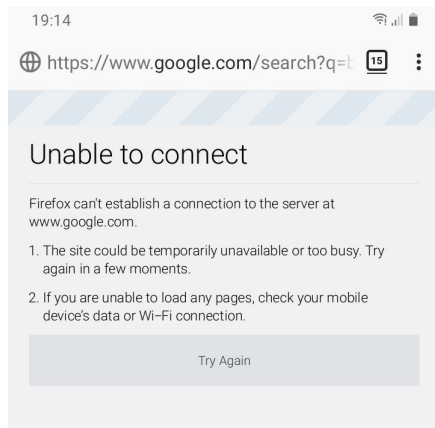
**Figure 16. Keyboards showing “Enter” and “Shift” and “Backspace”**

The onscreen keyboard can be any color and can look different. On the onscreen keyboard above, the blue arrow means “Enter” or “I’m done!” or “Go” and the left arrow just above it is “Backspace” which deletes a letter if you make a mistake. The up arrow is “Shift” and if you push it you can find letters that are not shown at first. On a real keyboard, you have to keep



“Shift” pressed even when pressing other keys, to make the other letters (or characters) on the keys, or to make Capital letters, or the : or the / (forward slash) characters.

You now have to type: “<http://box.lan>”. If you type anything else, it will try to ask a search company for that page - but we do not allow a connection to the search company for now, so it will show a page like the next ones pictured here.



**Figure 17. Error page**

If you see a page like this, then you typed it in the wrong place and you must try again. Remember to type it in the space right at the top, and to type the http:// part first!

15. You will be redirected to a page where you should be able to access all of the pre-installed programs like, Wikipedia and BookDash. In the future you will also be able to add additional services like iNethi, where you can share videos of what is happening, or stories, with other people more easily.





Figure 18. An Internet-in-a-Box homepage

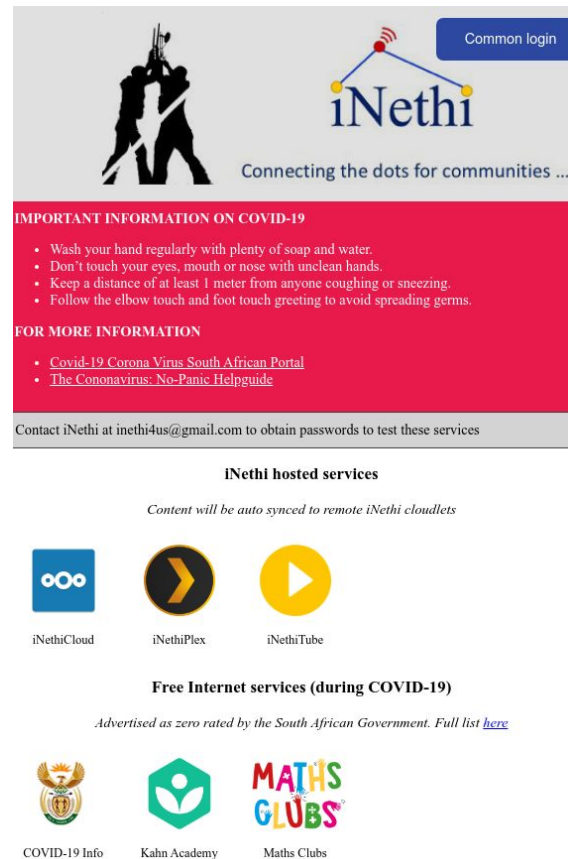
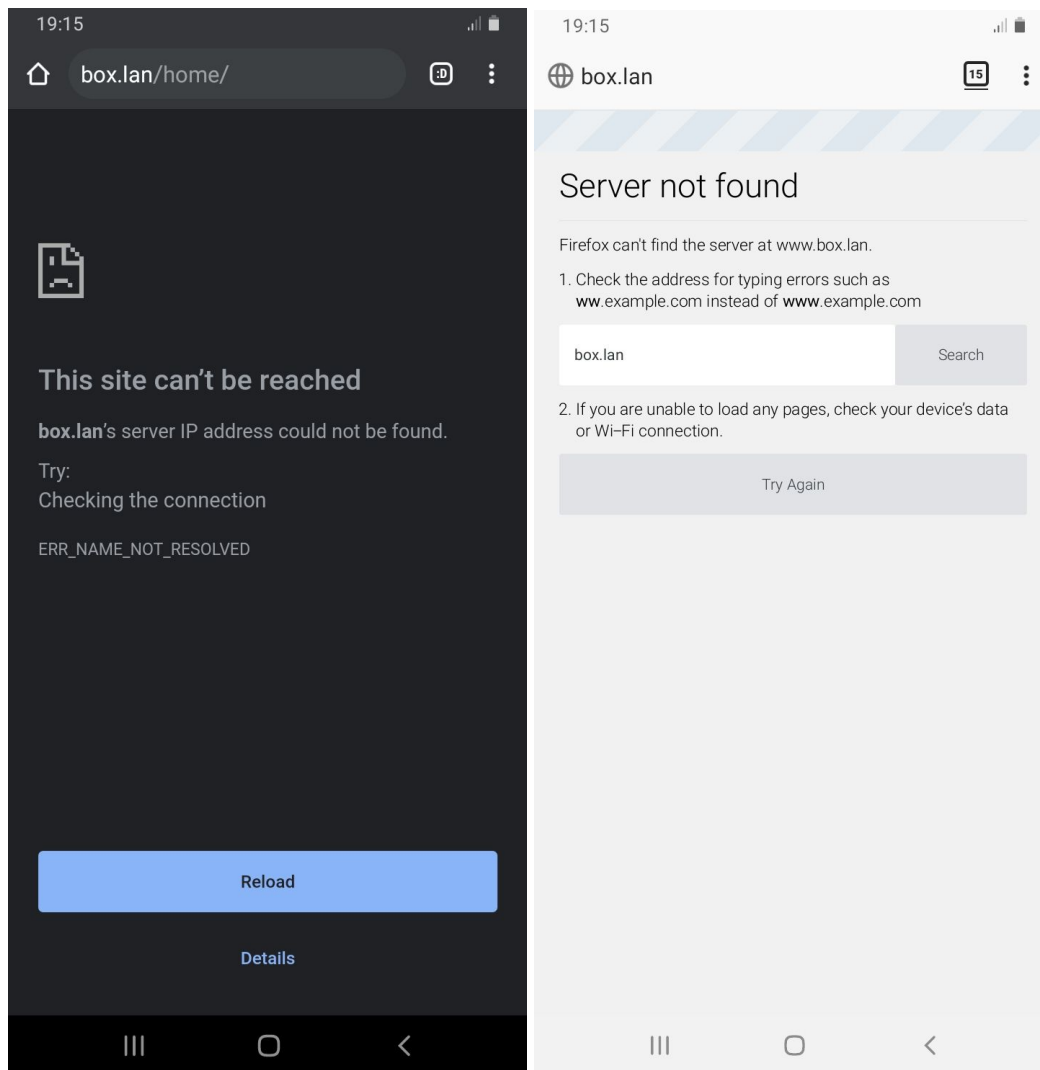


Figure 19. An iNethi homepage

16. Most of the books you will be able to access from your phone even when you leave the network, because the file will be stored on your device - but some services may disappear when you go too far from the network. If that happens you must go back to step 10.



**Figure 20. Messages you get when you are too far from the network or if it has lost power.**

## Some finer details that matter

The items where you don't have to care too much about the finer details and for which any similar item you can get can be good enough:

- Network cable - but make sure it is not damaged, because some old network cables can be damaged or made incorrectly, and it will not immediately be visible, only when you try to use it will you find that it is not working, where another cable does work.
- Box - if it is a big one, much bigger than the Raspberry Pi 4. Some people even use a small bucket or make a wooden box. The purpose is to keep the parts safe from dust and water, and hidden from kids or people who can damage it. If it's a box made for a Raspberry Pi, it has to be the exact one for a Raspberry Pi 4, otherwise the connectors won't fit.

The things where some details matter:

- USB power bank - not all USB power banks are strong enough. It is difficult to know if one is strong enough without testing it. Most power banks will power up the device, so that the lights come on, and the Wi-Fi might show up and then it will stop working after a minute or two, so you will have to test it for at least 5 minutes to be sure it is working. It may be safer to just use a USB Charger if this is your first project, because this happens more often with battery banks.
- USB Charger - most chargers do not give enough power. This is the same problem with many power banks. Only get chargers that are 2A or more. The Raspberry Pi company says 3.1A is needed, and they sell a charger that gives that, so it is safest to get that one.
- USB Charger Cable - this cable needs to have the rounded edge USB C connector at the one end to fit the Raspberry Pi 4.
- Car / motorcycle battery - it must be the right voltage and it must work with the charge controller. Most are 12V "Lead Acid" batteries, but all of them are all exactly 13.7V when charged. If the battery voltage drops below 10V then the battery is permanently damaged and you will have to get a new one. Never connect anything directly to the battery, even if it looks like it is working, always connect it to the load output on the solar charge controller, because it will protect the battery from this damage.
- Solar Charge controller - this one must work with the battery and the solar panel, check that it is for 12V and set to Lead Acid, or if you use a Gel or AGM battery, to Gel or AGM. You can connect two batteries to give 12V or 24V, but it will actually be 27.6V, which can damage a lot of things that work fine on 12V, so it is safer to connect it to work with 12V.
- DC to DC booster - this one must have an input range similar to the maximum battery charge voltage, and an output voltage of 24V for the equipment that need it. If it is more it will damage your equipment. If the battery voltage is more than about 23V, a boost converter will not work, and you will need a buck converter, and you will have to set it to 21V which will be the minimum required by some 24V antennas.

- Car charger - most chargers will only work with a battery of less than 15V but some will work with more. If the voltage gets too high, it will damage or destroy the charger and possibly also everything connected to it.
- Solar Panel - this one needs to have an output voltage that works with the solar charge controller. Even a 12V panel sometimes outputs up to 21V, but most charge controllers will reduce it to 13.7V for the battery and the output. Not all of them will, so you have to be sure and you might have to ask someone to test and measure it for you.
- SD Card - get the biggest and best SD Card you can. It needs to be fast, last long and look for cards with a U on them with a number inside the U.

The things where all details matter:

- The Raspberry Pi 4B - you can also build the same using a phone or router, or any other type of computer or Raspberry Pi (Raspberry Pi 3B, Raspberry Pi Zero W, ODroid, Laptop, or any other computer, even a phone). The instructions for the other devices are more difficult, except for the Raspberry Pi Zero W, but we can't list them all here. Maybe in future we can add some.
- SD Card - it is easiest if you use an SD Card that is already prepared, but it can be the most difficult to get because you can't just buy a prepared SD Card at any shop. If you know somebody who has technical experience, ask them to help you prepare an SD Card by following the SD Card guide on our website at <http://internetsouthafrica.org/iiab> otherwise try to order one from one of the links on the same website.

## Can I get the components at any shop?

If you can get the exact same items then you can follow these instructions exactly and everything will work. But if some of your components are slightly different, then the instructions will not be the same. You are welcome to contact us to suggest improvements or to share your journey!

You may have a hard time finding the exact same products where you are. If you get different products you will need to ask for help, and these instructions may not be adequate - so you will need to be prepared to learn and test options.

## Can someone send it to me, or to a local shop?

Yes, most online shops have a delivery service that can either send a package directly to you, or to the nearest shop or post office.

## How do I order something on the internet?

This is what the internet is all about and the way you can be sure to get the exact right components. This is also how most shops get their stock.

To order something on the internet, you will need to find a connection and also someone with a credit card - and of course a phone or a computer. There are other ways to pay on the internet, but a credit card is the easiest way.

If you don't have these, you can ask someone who has it if they can order it for you, like a local shop owner.

## Where can I order all the components online?

There are many online shops that sell these components. Some shops only deliver in certain countries. We have made a list of some of the shops that we know about on our website. You can find it if you type <https://internetsouthafrica.org/iiab/order> into a browser if you are connected.

**The most difficult component to get as of this writing, is the SD Card that is already prepared.**

There are instructions for how you can prepare it yourself, but it is even longer than this whole guide and may require more technical knowledge, so it is easier if you order one that is prepared already.

## What is still missing?

You might not have electricity and you might want to know how to connect the solar panel. Even though we built many networks and learned from many mistakes - so that you don't have to - this guide is the first one we wrote and we did it in just two days.

You might also want more details about the steps to connect your network to the internet.

We will add the missing information and you will be able to find it on our website. See below.

## How can I find help?

If you struggle with something, it can sometimes be difficult to find someone to help. The internet makes it easier, but you have to be patient and you have to be sure that you can be contacted.

We have created a space on our website where you can find contact details for people who have

volunteered to help, or where you can share your contact details, or find a group to join that can help you.

You can type the following into a browser to find it: <https://internetsouthafrica.org/iiab>

IIAB stands for “Internet in a Box”.

We are based in South Africa, **but we can help to find help for anybody in the world, it doesn't matter where you are**, because we can use the internet to do it.

Information is also a bit like water - if there is even the tiniest hole where it can get through, it will find a way to get through to you.

## How to build a Community Network or ISP

### Start by talking to people about it

Once you start talking to people about building a network you will quickly start to see who can help you and where you can start.

Show them the video of “[The village that built its own Wi-Fi network](#)”.

## The steps

First you have to find the closest place where you can connect. It might be 5 km or less or it might be 500km or even more. Then you have to find out what equipment you will need and what it will cost - it can be surprisingly cheap - the technology becomes better and cheaper all the time, so don't worry if things move slowly - you might be able to get much better equipment if you wait a little bit longer. Then you will have to work out how you will pay for that equipment. Then you have to get the money to buy it, and buy it. Then you will have to learn to install it and configure it, or invite someone who has done it to help you. Then you will have to connect people to it, and also maintain and improve it. That's everything in a nutshell. You can find more details on the internet!

## Learn together

There was a time when nobody had a connection and it was difficult to build.

Today, there are a lot of resources available to help you - almost too much. This is a problem of technology: it is easier than ever to do something but it is more difficult than ever to find the easy way to do things. This makes knowledge even more valuable today than ever before. But now you are so much closer to knowing where to get the knowledge that you need to succeed.

## Today you can choose

Progress used to happen only generations at a time: only the kids or the grandkids of those who first earned money, had the opportunity to earn money with technology or knowledge work.

Today, more than ever, living without technology doesn't have to be something you do because you don't have any choice, but if you choose to live a rural life, it can be something you can do because you are informed and you understand the options.

But computers, as fast and powerful as they are, can not yet understand humans - they are just machines that can not think for themselves.

A rural life allows you to understand people better, and to know things that people who live in cities have forgotten. A technological life helps you to understand computers and big systems better.

Who knows what change bringing connectivity to where you are, can bring to the world?

Maybe your work will empower the person who can teach computers how to really understand humans one day. Or even better, can teach humans how to really understand each other?

# Part 2: About the internet

## Introduction

This part of this guide answers some questions about the internet that you might encounter. You don't have to read everything and you can skip ahead and read whatever interests you, but we can assure you that it is all important, and we have cut a lot more away so we can only share the most important things here.

We will keep making this guide simpler and easier to follow and you can always find the best version of this document from our web page, that you can find at <http://internetsouthafrica.org>

## Is the internet for me?

Yes. The internet is for **everybody**, everywhere. **It doesn't matter who you are or where you live.**

You may think you can not understand it if you don't have the right education or opportunities, but this guide **will help you understand** how it works!

If you are reading this, then you have already taken the first step to success.

## How can the internet help me?

The internet brings things closer to you. Things like knowledge, other people, work and things made by other people.

Everything is made by somebody. On the internet you can find who, and how they made it, and often learn how to make it yourself - even a phone!

Before the internet you had to visit a shop to buy certain things, you had to visit a mall to watch a movie, you had to visit a library or a school to get information and to educate yourself. Today you can do all of these things using an internet connection.

Knowledge is power and can make life so much easier. On the internet you can learn to do almost anything better **without having to spend money to go anywhere.**

Some people don't have to travel to the city to work to earn a salary, they can do their job from home by doing all their work on the internet. Some people even earn money in other cities and countries that they have never visited. If you're on the internet, you can use your computer or phone to do work without leaving your house, even if you live far from a city.



Some of the best education is on the internet. Anyone can get a university degree or skills qualification. You can get a degree or skills much cheaper on the internet and without having to visit a school or a university.

Some people only use the internet for social media and watching videos. They are only using a small part of what the internet makes possible. Learning new skills and getting valuable information can help you grow as a person and improve your life. People who grew up with the internet forget just how much it can change their lives. **You don't have to make the same mistake.**

You can't help but wonder what somebody who lived in the past before this was available, would give to travel to this future that is available today, or what they would say about those of us who only use it for entertainment.

## What is the internet?

The internet is a way to share information.

Information is anything that you can know. You can see or learn this information by watching videos, reading documents, listening to recordings or talking about ideas.

What makes the internet special is that we use computers to access this information. Computers are electronic devices that work with and process information. Most people think of laptop or desktop computers when they use the word "computer" but phones and tablets are also computers.

The internet used to be called the "World Wide Web", which helps us understand how it works. Spider webs connect and spread out in all directions. In the same way, the internet connects through wires, antennas and computers. The internet first connected through telephone lines but can now easily connect using "radio" signals.

## What is data or airtime?

Data is information that is sent over a network using computer signals. Mobile phone companies have built networks with signal towers to provide better coverage. They charge customers for airtime and data and this generates the revenue that they need to maintain their network and pay the salaries for their employees.

Airtime is used to make telephone calls using cellular networks but even a phone call is just information, that is why it can also be changed into data in order to access the internet.

## Why is it so expensive?

Big cellular networks cost a lot of money to build. Once their systems are in place they have to make enough money to pay back loans, maintain equipment and big offices and salaries and they pay this using the money you pay for airtime or data.

The cost of airtime and data varies from country to country. This is because each country has different needs and economies, for example some countries only need a few towers while other countries need a lot of towers.

Mobile phone companies will charge users based on what they think they can pay. In some places, a fast and stable connection is cheaper because more people there have learned how to build and share it.

When you pay to connect through a network the money that you pay makes it possible for that network to keep running and grow.

If you build a better network, then people can pay you. If you choose not to spend money on a big office or big salaries, then your network can be cheaper.

## What other costs are there?

Besides the cost of the equipment and the connection, there are also services and shops on the internet. The internet is like a road that connects you to these services and shops, and your phone or computer is like the vehicle that can drive on this road. But it is not a real road, it just works similarly.

It's easy to sell things on the internet. Some websites allow people to post adverts for free, others create an online shop where you can pick products and pay and have them delivered to you.

This buying and selling is called e-commerce. It's easy to find what is available and you can compare prices. Before you buy any product or sign up for any services, try searching for better prices or a free version. You can get so much for free online.

# What if my community is poor and will never have it?

When you get a connection, search the internet for “[the village that built its own Wi-Fi network](#)”.

If someone in your community followed these steps to make airtime cheaper and better would you support them? Maybe you would like to do it? Part one of this guide shows you the first steps, wherever you live.

**You can get the same internet connection that even the richest person in the world can get.**

## Local economic development

The internet is like a road that brings more opportunities. If you have to pay too much to use this road, then fewer people will be able to use it, and then it will bring fewer opportunities.

Everybody creating something in a community indirectly works together to improve the community even if that is not their plan - this includes all the shops and employers. The business people will say that good services or products attract more customers and money. That money can then pay for things from someone else in the same community. That means that someone else in the community now has more money, and they can again pay for more people in the community, and that way there is more money going around in the same community, and more people can work doing things for each other. This is what economics is all about and how a community teaches people how to make things that other people want so that everybody can become good at something.

Some small communities don't need or use money, but when communities grow, money becomes an easier way to trade goods or services. Today, even small communities are part of a larger economy. If we want to share in the fruits of that economy, then learning about money is the only way.

If you think about a community as a tree, **then spending money in the community is like giving water to that tree**. If you look after the tree, your community can enjoy its shade and fruits. You look after the tree by buying things made in your own community.

## What is Wi-Fi?

Wi-Fi is an easy way to connect to the internet.

You may be surprised to learn that Wi-Fi is a radio signal.

# What is radio?

Did you ever wonder if there are more colors than those you can see? Radio is exactly that! It is the name for colours of light that we can't see. We can make devices that can see it and we call these radios and we call the colour a frequency.

More than 150 years ago, a scientist predicted that radio waves existed and then just over 100 years ago, some inventors who were playing with the latest technology of that time, accidentally discovered it. Anybody can do these experiments today and today we use these invisible wireless signals to broadcast radio stations and transmit information.

# What is a “mobile network”?

It is another way to connect to the internet.

It is similar to Wi-Fi, but uses different radio signals called GSM, LTE, 3G, 4G or 5G to transmit and receive signals that represent phone calls and messages.

It is also different in that it uses a SIM card and a phone number.

# What about wires?

Another way to connect to the internet is with a wire.

ADSL, Ethernet and Fiber are names for the technologies used when connecting through a telephone line or network cable, but it is still just wires.

## Are internet wires dangerous?

Internet cables use very little power so touching those wires is usually safe. Avoid touching broken wires if you can't see what they are connecting to. Always avoid touching the thicker electrical wires. If you are not sure, ask someone who knows or rather just don't touch these wires, unless you have received training.

# What is a website?

A website is a page with information that is stored on a computer that is connected to the internet.

When you are watching a movie or reading something then that information is sent from another computer to you. Anybody can create a website.

You access a website with a program called a “browser”. The names of the most popular browsers are Brave, Chrome, Edge and Firefox. On many phones it is just an app called “Internet”.

## What is an app?

An application is just like a website, except that a website can not control your phone but an application can. For example, an application can turn off your phone, or steal your money, but for a website to do that it will first need to trick you into downloading an application. Apps are also usually faster than websites, and many work even without a connection.

## What is a domain name?

A domain name is a way to identify a computer on the internet. It works like a directory where the computer can identify another computer by a specific name. It usually ends in .org or .com for global sites, or co.za, org.uk for country specific services, but nowadays you can also get almost any name like .africa and even .party and many others.

## What is http or https?

This is the “website language” - it is the protocol (like the language) that a connection uses to connect to a webpage. The format is to put “http://” or “https://” in front of the domain name. Nowadays browsers just hide this part, but sometimes you have to type it out. The “s” stands for “secure”, which means private, so that anybody connected to a network can't understand the information going through it to you, and only your device can decode it.

## What is a “cookie”?

A cookie is a way for a website to remember when you last visited it and what you did. It is just a small bit of information that is stored on the website about your visits. There are laws that force websites to tell you about this, because this information can be used to figure out who you are and some people may use that to manipulate you - for example, if you do something that only rich people do, then they will charge you more money than usual or to pressure you to make a decision saying that an offer will expire, even if it is almost always a lie to get you to pay for something that you might not want.

## What is e-mail?

Email is a way to communicate on the internet. It stands for “electronic mail”.

Anybody can create an e-mail address and then protect it with a password. This address can then be used to send and receive messages – and is required by some services.

Most people create this address at a certain company. Some companies charge money for this, but others give it for free but they show you ads from other people who pay them the most for the opportunity to sell something to you.

## Is the internet dangerous?

When you are doing something on the internet, **it is like doing something outside where everybody can see you**. For everything that you do on the internet, **pretend that you are doing it outside in a public place with your parents or grandparents and ask yourself what they would say about it**.

The internet is also like a busy marketplace. This means you have to be careful of scams and pickpockets. People may try to trick you into sharing personal information that they can use to steal money or even votes.

Many scammers create fake websites that look like the real ones, but if you look carefully you can avoid them. Some websites put up numbers that count down that try to trick you to do something right away, or they say that you have won a prize because you are a special visitor – this is all lies.

The internet also makes things happen faster because you don't have to travel to ask for things. This includes both good and bad things, this is why it is **important to promote good things about the internet** and know how to be safe and to protect against the bad things. It is possible to stop some bad things, but the internet is international, it has no borders. This makes it very difficult for police to stop things that come from and go to other countries, where there is no police.

The internet gives you power, but **power comes with responsibility**. Your actions on the internet may seem invisible but have real effects in the world and in the lives of other people. Do not share your personal details with anybody – no matter how good they seem. Always stay on the safe side.

## Pornography

Most people do not let their children use the internet without adult supervision. Parents should allow their kids to use the internet but with parental control, because there are things on the internet that can cause a lot of damage to a child's development.

The internet connects you with other people who do not share your values. This makes it very easy for someone to see or read sensitive things that are not acceptable in your community, bad things that you did not even know that people were capable of.

## Scams, lies, and fake news

In a normal community, it is often easy to catch a thief or to see when someone is lying. This is very difficult on the internet.

It is easy to fall for a lie and lose money on the internet. It is even possible for somebody to get a loan in your name that you did not know that you qualify for. Some people will sell you something, take your money and never send the product, no matter how good their product looks in the pictures.

There are also people who will mislead you with lies and stories. People can even make fake pictures and videos of important people saying or doing things that those people would never do, so it can be very difficult to know who really made it up and what is true or false.

Be careful where you get your information. Don't share suspicious links or stories. **Don't share information that you can not test yourself.**

## Passwords

The biggest problem on the internet is passwords.

You may think that a password is not important but we will explain here why it can cause big problems for you.

The computers that you connect to through the internet cannot see your face so you need to create a password for services or websites to identify you - otherwise you can just as well be anybody from anywhere in the world, who can take your things on the internet.

**Passwords are like keys** to secure boxes where you store valuable things. If someone has the password they can take anything they want from that secure box. Sometimes you will not even know it until it is too late.

## Password reuse

**Bad people can break into one service and steal all the passwords that people used there and then use it for another service.**

For this reason, every person using the internet will need at least four different passwords to be safe: One for banking, one for email, one for social media, and then one for other sites where the risk is not that high.

## Password managers

Even easier is to use a program that can remember your passwords, then you only need to remember one password for that program. For example, many people let Keepass, Apple or Google remember all their passwords, and then they only have to remember that one password. This is also risky because then if someone finds that one password, then all their online services can be stolen.

## Identity theft

While for some things if your password is stolen it might not be a problem, most people with money keep a lot of it in the bank and protect it with just one password. If somebody gets this password, then they can spend all that money.

Even if you do not have any money, what if somebody can pretend to be you, with your password, and then **they can take a loan in your name that you will have to pay back**? You may not even know about it until you visit the bank. This is called identity theft.

Another example, **if you could guess the password of somebody rich or famous, then you can pretend to be that person** and say things and then people will think it is that person who said it, and you could also spend their money. You may think it is funny, but if you are that person it will be a big problem for you and can cause a lot of trouble.

## Passwords linked to your phone

People often forget passwords and can then ask the service that they are trying to access for a new password. The service can then send a code or a new password to their phone or their email so that they can choose a new password.

For this reason it is also very important to make sure that your phone number is registered in your name.

## Is your phone number registered in your own name?

Most countries require your phone number to be registered.

A SIM card contains the password that you use to tell your phone company who you are. That password can be protected by a PIN, which is just a 4 digit code, but the PIN is not the password. The phone company uses the password that is hidden on the SIM card to know which phone is yours and where to send the messages and calls meant for your phone number.

**Sometimes you can just buy a SIM card or a phone from anyone, without having to do the registration yourself. Don't do this** - because now, if you link a bank account to this phone number, then **the person you who registered the phone can steal everything that is linked to**



**your phone:** they can then request a new SIM card and then your phone will stop working and they will start to receive your calls and messages - and then they can tell the bank that they are you and that the bank must send them a new password to their phone - that way they can then reset your password to one chosen by them and then steal your money.

This is why it is important to register your phone number yourself and to do it at the phone company's main shops if you can.

While this may be a lot of trouble because there may not be a shop near you, if you do this it can save you a lot of trouble and it can allow you to safely keep money on the internet - and having money on the internet gives you a lot of power because you can then pay anybody in the world to do things for you.

**If you did not have the opportunity to buy your own SIM card with your own identity documents from the mobile company's official shop, then it will be safer to wait until you have done that before you open a bank account.**

Also, if you do this, and then lose your phone, then you can get your old number and all our old accounts back - and if you forget a password, then you can set a new password if it is linked to your phone.

## Choosing good passwords

One day we will have a better system than passwords, but it is not here yet. (Maybe you or someone you know will invent it one day? Remember that there was a time that even the smartest person in the world didn't know more than you, and that you can access more knowledge than at any time in history, so you can be smarter than anybody who lived before you if this is your goal.)

To make a good password, it helps to understand how computers can be programmed to make guesses. Computers are very fast and can be programmed to create billions of passwords within seconds. Most computers can count to one thousand, one million times, every second. If you ask anybody who can program a computer to show you how quickly a computer can count, they will. That means that it can try different passwords just as quickly. Just one computer can try every word in every dictionary in every language in the time that it takes you to read this paragraph.

With just a bit of knowledge you can tell a computer to guess every word in a dictionary and every sentence in almost every book on the internet and every number up to 15 digits and even random combinations. There are also lists of every password that millions of people just like you have used in the past and it is commonly known that a lot of people used the word "password" or "1234" or "asdf" as their password. In the future, as we make faster computers, they will soon be able to guess 20 and 30 digit passwords. The good news is that even a short sentence is longer than this, so for the foreseeable future we can still make passwords that bad people using computers can't guess.

**A good password is any sentence that you can not find in any book or in any of these lists and that is longer than four words - but it also needs to be easy for you and only you to remember.**

Some people say you should use special characters and punctuation and numbers, and while it helps, it won't help if your password is too short.

An easy way to create a good password is to use a few words. The problem is that most sentences are already in books, so you have to be creative and mix the words around and make a sentence that you won't find in a book!

You can make up passwords that consist of a few words by making up a silly story that you will remember about something that you can see reminds you of, for example: "The leaves on this tree look like raindrops." or "These six words are my password" or "This is a silly sentence." The problem now is that you can not use these sentences because I wrote them down here and a computer can read it too, and can add it to the list of passwords that it can try.

So you have to make it even more secure by adding a number that you will remember - but the first thing that any computer will try when you program it to find someones password is to use numbers of the year that they were born, or the date in which one of their family members were born - or even every year during which them or their parents were alive - for example, in less than 1 second, a computer can guess all the numbers from 1900 to 2100 with many combinations of words. Even your phone number and identity number can easily be found by some people.

So how do you come up with a number that nobody can guess, but that you will remember? You can use the above numbers but you have to change it and remember how you changed it. For example, you can use the date that you met someone special, but then add a number that you like to it. For example "1007". So say you were born in 1980, if you add that to one of the above sentences, then  $1980 + 1007 = 2987$  and then come up with a password like "2987 trees with raindrops". You can also add special characters and capital letters, like "Trees with \$2987 raindrops #green." This is a really good password and if I did not write it here, even a thousand computers working together will take many lifetimes to guess it so it will be very difficult to steal your money from the bank if you have a password that you came up with like this.

If you want to help yourself to remember your password, then you can write down just one of the words, or the number, to remind yourself. But don't write down everything.

## Privacy

Because it is easier to manipulate people when you know more about them, most companies on the internet compete with each other to find out the most information about you, and they use this information against you in different ways. For example, if you often go to expensive websites, then

they think that you have money, and then they charge you more for other things. This also includes medicine that you might need and can find on the internet.

For this reason it is better to not search for websites, but to go directly to them if you know their address. For example, most browsers will try to trick you into searching first, so that the search company can see where you are going, but if you put in the address of where you are going directly, then they can't track you and then it is more difficult for them to manipulate you. Also, if you refuse the cookies, they can't track you. Of course, some websites also give you better offers if they know that you don't have a lot of money, so it is hard to tell. But this is why privacy is also an issue.

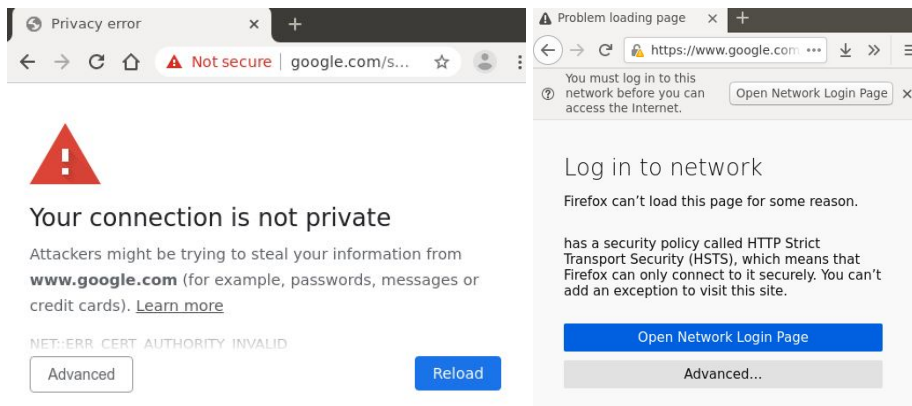
## Fake websites

Bad people can make a website that looks just like your bank or email website and then if you put your password on that website then they can steal your password and go and use it at the real site.

This is also a big risk at some Wi-Fi hotspots, as it is easier to set it to show you a fake site that will look like the real one, but not without showing you a warning - so if you see a warning then you must read it carefully and you must not type in any passwords. Rather wait until you are using a connection that you can trust before you do that.

## SSL Errors

There is a system that protects you against fake websites, that is called SSL. How it works is that somebody who has a web page that remembers important details about you, can use SSL to prove to your browser that their website is the real one that they registered with SSL. If they can not prove this, then it will show you a warning.



**Figure. SSL Warnings**

The problem with this is that you can still get past this warning, but then you can be sure that your information can be stolen - and your phone or computer can remember that you accepted the risk and it will not ask again. That is why it is better to never go past this page, and if you do, **never ever type in any of your passwords.**

There is only one exception to this rule and it is for network technicians when they are configuring the network, and only for addresses that start with `https://192.168` or `https://10` or `https://172.16` or `https://172.31`. Because network technicians might see this warning often, they are highest at risk of making the mistake of visiting a fake website, because they might have a habit of ignoring the message. Habits can be dangerous!

**If you are not a network technician, you should always go back when you see this message, and change the address you are trying to access to “http://” without the s.** This sometimes happens with a Wi-Fi hotspot that was not set up properly: these will try to show you a page when you are going to a secure page - and this will cause this message to show. You should go back, because if it is a bad hotspot it can be telling you to accept its certificate for any website. You should always go back and type in a valid address that starts only with `http://`, without the s. For example <http://neverssl.com>. That way it can redirect you to the hotspot page without showing an error. If you are using a newer phone or laptop, it will show you that you need to log in first, so that you can just remember that you should never proceed when you see the warning.

# What is software?

Software is the instructions that computers use to process information. This way a computer can be made once and then programmed to do many things without having to make a new computer every time.

Often you can run new software on an old computer, and then that computer will be like it is brand new.

# What is free software all about?

Free software is not about the cost, but about the freedom for you to study it and to learn from it and understand how it works. Free software comes with the instructions for how it is made, just like seeds contain the instructions that makes plants grow.

Many companies hide how their software works from you, so you are dependent on them when you use it, and they can often force you to pay the price that they have decided and leave you with no other choice if you have become too used to their software. This is called proprietary software, and even though you can sometimes get it for free, it does not give you the freedom to see how it works to control how it uses your information.

Proprietary software can be very convenient to use, and it can also be free, but do not be fooled.

Proprietary software can be very powerful, because it can generate a lot of money, which can be used to pay for some of the smartest people, to make it even better - but it can also steal the information of an entire country, and manipulate elections, so it gives the owners of those companies a lot of power to change the world to what they like the most.

Free software is what made the internet possible, and also cheaper, and it is also what makes it possible for almost anybody who understands it, to help you.

When you have a choice, you should always use free software - and if you can, you should pay generously to those who share their improvements with other people with a free software license.

## Can I get free internet?

You can often get a free connection at a public Wi-Fi hotspot. If your device's Wi-Fi doesn't find one then just ask someone. If you are near a city, you can often find free internet near a mall or a bank or at a restaurant, or at a library or public office.

It may be free, but as we all know, it will cost time or money even just to go there.

You can also search on the internet or find an "app" for your phone that will tell you where to find an internet connection for free.

## Should I share my connection for free?

If you build your own network you can make the connection available for free - but you must be careful because if it is free and then you run out of time or money to maintain it, and it stops working, and if there is no other choice, then people will get angry and blame you for taking something from them, even if all you did was work hard and try your best.

Usually it is best to make educational materials available for free, and then charge people who want to access entertainment, unless there are people who are paying you enough to maintain everything, no matter what you do.

For a solar Internet-in-a-Box you should of course only charge enough to cover your expenses, for example if you have to travel to go and copy more content from the internet.

## Are there other options besides Internet-in-a-box?

Yes, there are many other options too. Some of the easiest ones are to just install an App like "Kiwix" and "Khan Academy" on a phone that has a connection - but the problem is that these will only work on that one phone and it is much more difficult to share it with more people.

But you never know, maybe somebody will make something better - and maybe it will be you?

## Where can I find the newest version of this guide?

We will always put a copy at <https://internetsouthafrica.org> - and even if it disappears, you will be able to find it by going to <http://web.archive.org/internetsouthafrica.org> or just by searching for "Internet in a box" or "Community Networks".