0:00:00.000,0:00:02.429

Hello Youtubers, here is the guy

0:00:02.429,0:00:05.549

with the Swiss accent. Tomorrow I want to

0:00:05.549,0:00:08.010

test the range of our fabulous LoRa

0:00:08.010,0:00:11.340

system and I want to compare it with the

0:00:11.340,0:00:16.650

ordinary and cheap RFM69HW module on

0:00:16.650,0:00:19.470

the whisper node both work on the same

0:00:19.470,0:00:23.039

frequency range and both use about the

0:00:23.039,0:00:26.490

same output power. I am interested if

0:00:26.490,0:00:29.820

LoRa has a bigger range and if the two

0:00:29.820,0:00:32.309

will disturb each other if they work on

0:00:32.309,0:00:35.100

the same frequency. So let's get started.

0:00:35.100,0:00:37.620

The weather here in Switzerland

0:00:37.620,0:00:40.260

currently is quite wet and therefore I

0:00:40.260,0:00:43.320

first have to finish my gateway. As my

0:00:43.320,0:00:46.890

colleague Urs I use waste water piping

0:00:46.890,0:00:49.920

for that purpose because it first is

0:00:49.920,0:00:52.469

waterproof for the obvious reasons and

0:00:52.469,0:00:57.180

second quite cheap. And I use some 3d

0:00:57.180,0:01:00.239

printed parts to fix the Gateway and the

0:01:00.239,0:01:03.600

power supply inside the pipe. Because i

0:01:03.600,0:01:06.720

have a 240 volt outlet close to the area

0:01:06.720,0:01:09.780

i want to place the gateway i decided to

0:01:09.780,0:01:12.540

use one of my small 5 volt

0:01:12.540,0:01:15.630

5 ampere power supplies. The connection to

0:01:15.630,0:01:18.780

the internet is done via Wi-Fi using a

0:01:18.780,0:01:21.960

small dongle in the Raspberry Pi. So I

0:01:21.960,0:01:24.900

only have one opening for the SMA

0:01:24.900,0:01:28.320

connector at the top and one for the 240

0:01:28.320,0:01:31.950

volt line at the bottom. Later on I plan

0:01:31.950,0:01:34.470

to measure the humidity and temperature

0:01:34.470,0:01:37.740

inside the case and as a fan which is

0:01:37.740,0:01:40.860

started if one of these values shows a need.

0:01:40.860,0:01:43.890

You will see that the protection of

0:01:43.890,0:01:46.560

the whisper nodes will be simpler but

0:01:46.560,0:01:49.090

still functional.

0:01:49.090,0:01:52.270

So today is definitely not the best day

0:01:52.270,0:01:57.189

for LoRa wardriving because it's really

0:01:57.189,0:02:00.189

bad weather here in Switzerland but you

0:02:00.189,0:02:04.719

see something here: I mounted my gateway

0:02:04.719,0:02:10.119

in the tube here on this fence and it is

0:02:10.119,0:02:15.700

only connected by 220 volt in the outlet here.

0:02:15.700,0:02:19.390

And now let's check three stories

0:02:19.390,0:02:22.209

down in the basement whether I get a

0:02:22.209,0:02:25.030

connection to this gateway. This would be

0:02:25.030,0:02:27.819

already quite a success because with

0:02:27.819,0:02:35.379

Wi-Fi ESPs it was absolutely no go to

0:02:35.379,0:02:37.810

get a connection from three stories

0:02:37.810,0:02:42.849

below. You see the mounting for the

0:02:42.849,0:02:45.519

moment is not yet really professional

0:02:45.519,0:02:50.170

but it will survive my tests. So this is

0:02:50.170,0:02:52.989

my LoRa node with a power bank.

0:02:52.989,0:02:57.130

Fortunately or unfortunately this LoRa

0:02:57.130,0:03:01.329

device does not need enough power, so

0:03:01.329,0:03:03.910

the power bank always

0:03:03.910,0:03:07.569

switch is off and i have to switch it on

0:03:07.569,0:03:11.049

again and now let's check: I switch it on

0:03:11.049,0:03:18.700

the LoRa node is running and it should

0:03:18.700,0:03:27.370

have sent a message. Now it's 9:21 and we

0:03:27.370,0:03:34.540

check and we see here 9:20:44 I got

0:03:34.540,0:03:38.530

a message from the roof or to the roof

0:03:38.530,0:03:43.419

to the roof of our house here so it

0:03:43.419,0:03:46.750

works at least in real conditions

0:03:46.750,0:03:53.049

where the Wi-Fi ESPs and the NRF24 stuff

0:03:53.049,0:03:57.670

did not work at all. So this is already

0:03:57.670,0:04:00.800

success. So let's check

0:04:00.800,0:04:06.500

this is with SF12. Now I change the SF

0:04:06.500,0:04:10.340

the spreading factor to 7 and look if it

0:04:10.340,0:04:15.560

still works. Now let's check weather

0:04:15.560,0:04:18.560

a message arrived with spreading

0:04:18.560,0:04:20.810

factor seven which is the fastest. And

0:04:20.810,0:04:26.360

really, it also arrived. So this is really

0:04:26.360,0:04:30.410

great stuff it is really a completely

0:04:30.410,0:04:33.170

different thing than the 2.4 gigahertz

0:04:33.170,0:04:38.510

links. Much much more capable from a

0:04:38.510,0:04:40.940

reach point of view of course not from a

0:04:40.940,0:04:43.730

data throughput point of view but from a

0:04:43.730,0:04:45.500

reach point of view it's completely

0:04:45.500,0:04:51.380

different. Now I will start the LoRa wardrive.

0:04:51.380,0:04:55.880

But before that of course i want

0:04:55.880,0:04:59.360

also to check out the competitor of

0:04:59.360,0:05:05.030

Laura this is the RFM69 device on the

0:05:05.030,0:05:09.110

whisper nodes. Here i mounted a small

0:05:09.110,0:05:13.130

display and now if i connect it to the

0:05:13.130,0:05:16.070

power bank here we see the transmission

0:05:16.070,0:05:18.919

from here to here. Now this is not very

0:05:18.919,0:05:23.570

complicated but now i have to mount this

0:05:23.570,0:05:26.810

one also on the roof. Unfortunately, I do

0:05:26.810,0:05:29.930

not have such a nice tube as I had with

0:05:29.930,0:05:32.990

my LoRa gateway but we will find the

0:05:32.990,0:05:37.430

solution. So this is the not so

0:05:37.430,0:05:40.070

professional mounting of the whisper

0:05:40.070,0:05:43.100

node. It's actually in here. The antenna

0:05:43.100,0:05:48.200

is comparable with the one on the

0:05:48.200,0:05:51.080

gateway

0:05:51.080,0:05:55.370

and they send actually in the same band

0:05:55.370,0:05:57.800

and we will have to check now whether

0:05:57.800,0:06:03.530

they disturb each other. So again the

0:06:03.530,0:06:08.389

test here. The connection is also working

0:06:08.389,0:06:14.060

but the RSSI is lower of course

0:06:14.060,0:06:18.710

and i'm not sure if every message comes

0:06:18.710,0:06:21.620

through without any problems. So we

0:06:21.620,0:06:24.530

already see here i think a small

0:06:24.530,0:06:31.639

difference between LoRa and the RFM69

0:06:31.639,0:06:34.699

on the whisper node we have to check

0:06:34.699,0:06:40.400

outside. So the whisper node is on 868.080

0:06:40.400,0:06:46.219

which is basically 868.1

0:06:46.219,0:06:48.770

which is one channel of the LoRa

0:06:48.770,0:06:51.710

network. Now let's check if LoRa is

0:06:51.710,0:06:55.520

still capable to transmit because this

0:06:55.520,0:06:59.659

Whisper node transmits quite often. It

0:06:59.659,0:07:05.389

has now already 280 messages transferred

0:07:05.389,0:07:08.690

in just a few minutes. So it's sending

0:07:08.690,0:07:13.310

quite a lot of time and it might disturb

0:07:13.310,0:07:16.610

the LoRa communication. Now let's check.

0:07:16.610,0:07:23.360

And we see here we got a message on 8:48

0:07:23.360,0:07:28.400

which is here. And let's check on which

0:07:28.400,0:07:32.900

channel: It's on 868.3 and the one

0:07:32.900,0:07:38.449

before was even on 868.1. So they

0:07:38.449,0:07:40.430

do not disturb their each each other

0:07:40.430,0:07:43.490

even if they are on the same channel. And

0:07:43.490,0:07:50.539

the one before was on 868.5. So the

0:07:50.539,0:07:52.909

node really changes the frequency

0:07:52.909,0:07:56.240

regularly message after message. So we

0:07:56.240,0:08:00.110

get more or less every minute we get the

0:08:00.110,0:08:03.110

message now from the LoRa node which is

0:08:03.110,0:08:03.870

perfect

0:08:03.870,0:08:07.800

I think. So now we are ready to start the

0:08:07.800,0:08:11.400

wardrive. So just the first functional

0:08:11.400,0:08:14.040

test before i drive away. Here you see

0:08:14.040,0:08:17.280

the Gateway and the whisper node and

0:08:17.280,0:08:24.450

just a few meters away. And here we see

0:08:24.450,0:08:27.390

the whisper node works without any

0:08:27.390,0:08:32.040

problems. And the LoraWAN also works.

0:08:32.040,0:08:35.660

Now I am in the middle of the village and it

0:08:35.670,0:08:40.110

works. But it does not work if I just

0:08:40.110,0:08:45.450

leave it on the seat. I have to bring it

0:08:45.450,0:08:49.500

up. Now let's check LoRa. Just press the

0:08:49.500,0:08:53.490

button to send one message and now we

0:08:53.490,0:08:56.520

check with the mobile phone. And also

0:08:56.520,0:09:00.810

here we did not get a

0:09:00.810,0:09:06.180

message.So I also will change the

0:09:06.180,0:09:08.940

position of the antenna a little bit. And

0:09:08.940,0:09:13.830

now we got also a message from LoRa. So

0:09:13.830,0:09:17.310

here both devices to not work anymore. I

0:09:17.310,0:09:20.940

will show you all the locations on the

0:09:20.940,0:09:25.650

map when i'm back home. Also here it does

0:09:25.650,0:09:29.280

not work both devices do not work. I now

0:09:29.280,0:09:33.450

a little bit higher up but there is no

0:09:33.450,0:09:35.430

line of sight because there is a small

0:09:35.430,0:09:39.480

hill in this direction between my house

0:09:39.480,0:09:42.960

and where I am. So I have to go higher up.

0:09:42.960,0:09:50.400

Also here no luck. Both devices do not

0:09:50.400,0:09:53.580

work even if I'm now quite high up but

0:09:53.580,0:09:57.150

my house is in this direction and

0:09:57.150,0:09:59.880

there is still no line of sight here. And

0:09:59.880,0:10:07.230

now suddenly it starts to work. I don't

0:10:07.230,0:10:09.870

have enough hands today for all my

0:10:09.870,0:10:13.590

equipments. I still do not have a line of

0:10:13.590,0:10:16.530

sight but it's now very close to line of

0:10:16.530,0:10:16.950

sight,

0:10:16.950,0:10:19.440

the house is in this direction. And now

0:10:19.440,0:10:23.220

you know why I'm here: Because here is

0:10:23.220,0:10:28.740

a big Tower and if it's open I plan to

0:10:28.740,0:10:34.200

get up there. And here, the whisper node

0:10:34.200,0:10:39.630

definitely works, but not completely

0:10:39.630,0:10:44.460

reliable. Quite slow. So, I assume it will

0:10:44.460,0:10:47.760

have some retransmissions and also the

0:10:47.760,0:10:51.660

signal is not very strong. And now we

0:10:51.660,0:10:55.380

check if the LoRa connection works. And it

0:10:55.380,0:11:00.510

worked. Now let's check the messages.

0:11:00.510,0:11:03.810

And the message was also transferred on

0:11:03.810,0:11:07.770

868.1, so on the same channel as the

0:11:07.770,0:11:14.960

Whisper node is. Now the suffering starts

0:11:18.259,0:11:19.750

0:11:19.750,0:11:21.810

0:11:23.160,0:11:25.220

0:11:25.930,0:11:29.200

Third floor. So the view is already quite

0:11:29.200,0:11:32.950

nice and in this direction is Basel and

0:11:32.950,0:11:36.850

there are some LoRa gateways down

0:11:36.850,0:11:40.320

there. Maybe we will see one.

0:11:42.110,0:11:44.170

0:11:45.120,0:11:50.610

So you see I'm not alone here with all

0:11:50.610,0:11:53.360

my antennas.

0:11:53.750,0:11:57.470

Also here, some antennas, I think it's the

0:11:57.470,0:12:05.720

police and other institutions.

0:12:05.720,0:12:11.060

So now, we are on the top. And now I show you the

0:12:11.060,0:12:14.210

house and the line of sight. So first

0:12:14.210,0:12:19.760

let's check the RFM69 on the Whisper

0:12:19.760,0:12:27.860

node. No problem at all. And if I move

0:12:27.860,0:12:31.970

the antenna little bit it is quite a

0:12:31.970,0:12:38.080

strong signal here. Even on the floor it has a signal.

0:12:38.080,0:12:40.800

And now the LoRa node.

0:12:40.800,0:12:47.080

Also here and i'll check

0:12:47.500,0:12:52.270

on the mobile. So, you see, LoRa

0:12:52.270,0:12:57.760

works also. But unfortunately only one

0:12:57.760,0:13:00.280

gateway. So I don't see more than one

0:13:00.280,0:13:02.860

gateway. Maybe I have to come up again

0:13:02.860,0:13:07.810

and use a different modulation a

0:13:07.810,0:13:13.480

slower one. Maybe i will get then a

0:13:13.480,0:13:17.770

different gateway. So now I am at

0:13:17.770,0:13:20.590

a floor of the tower and this is somehow

0:13:20.590,0:13:22.390

Swiss. Everything is very well protected

0:13:22.390,0:13:26.200

like our banks. So i have to press the

0:13:26.200,0:13:29.110

button that I can go out and I really

0:13:29.110,0:13:31.600

hope that I can I do not need to sleep

0:13:31.600,0:13:44.160

here. So luckily it let me out.

0:13:44.160,0:13:48.440

Now back to the lab.

0:13:48.440,0:13:50.820

And now it starts again but

0:13:50.830,0:13:53.800

now I'm four or five hundred meters away

0:13:53.800,0:13:58.080

from my home with a clear line of sight

0:13:58.190,0:14:01.540

here is the antenna.

0:14:02.980,0:14:09.250

Now it's a new day same place to check

0:14:09.250,0:14:13.660

if everything works. Today I have only my

0:14:13.660,0:14:17.440

LoRa device with me and no whisper node

0:14:17.440,0:14:20.949

on the roof. Now I really want to test

0:14:20.949,0:14:24.430

the maximum capabilities of LoRa. I also

0:14:24.430,0:14:29.320

have selected SF11 which is the second

0:14:29.320,0:14:32.410

best spreading factor, or the second

0:14:32.410,0:14:37.329

best for transmission reach. It's very a

0:14:37.329,0:14:39.610

slow one but the rich should be better.

0:14:39.610,0:14:41.920

Now I go to the same places I went

0:14:41.920,0:14:45.279

yesterday and check if there is anything

0:14:45.279,0:14:50.079

different. The whisper node yesterday was

0:14:50.079,0:14:54.850

already on a very good or very slow rate

0:14:54.850,0:14:59.680

so it's not necessary that I have

0:14:59.680,0:15:03.310

this with me and I do not want also that

0:15:03.310,0:15:06.339

the Gateway is disturbed in any way from

0:15:06.339,0:15:09.639

another very close source like the Whisper node

0:15:09.639,0:15:14.199

of yesterday. And it works. I got

0:15:14.199,0:15:18.760

the message a few seconds ago. Same

0:15:18.760,0:15:23.230

place as yesterday, just no kids. And it worked.

0:15:23.230,0:15:27.519

I got the message few seconds ago. And by

0:15:27.519,0:15:30.850

the way: Today I have a better system

0:15:30.850,0:15:33.399

that I can keep my hands a little bit

0:15:33.399,0:15:36.550

different. I have a rubber band around

0:15:36.550,0:15:40.839

the LoRa node. So I only need one

0:15:40.839,0:15:45.040

hand to hold both. So let's continue the

0:15:45.040,0:15:50.410

drive. Now this is the third place and

0:15:50.410,0:15:51.880

here is

0:15:51.880,0:15:55.990

the node. The second place was crowded by

0:15:55.990,0:15:59.020

traffic jams so I did not try it but

0:15:59.020,0:16:01.270

here I'm a little bit higher than

0:16:01.270,0:16:06.490

usually but still the hill is in between. I

0:16:06.490,0:16:09.190

check now if i got a message. And

0:16:09.190,0:16:12.970

today I got a message here. So yesterday,

0:16:12.970,0:16:19.300

I had no success, today I had a

0:16:19.300,0:16:22.210

successful connection back home. So it

0:16:22.210,0:16:24.190

seems to make a difference either

0:16:24.190,0:16:26.770

because the connection was

0:16:26.770,0:16:30.130

not disturbed by the whisper node or

0:16:30.130,0:16:32.890

because I had a different spreading

0:16:32.890,0:16:36.580

factor. So this is good. Now the next

0:16:36.580,0:16:44.700

place is even higher up and I check it here.

0:16:47.660,0:16:51.160

But here it does not work still does

0:16:51.160,0:16:54.070

not work here. Now I do not need to go to

0:16:54.070,0:16:57.070

the tower because there we know it

0:16:57.070,0:17:00.580

worked also with a faster spreading

0:17:00.580,0:17:03.550

factor. Now I go to a completely

0:17:03.550,0:17:07.089

different place. I will show you where.

0:17:07.089,0:17:10.120

So here in the middle of a residential area

0:17:10.120,0:17:14.079

I go to signal. But in this direction

0:17:14.080,0:17:18.150

it's more or less its line of sight.

0:17:20.420,0:17:25.160

Now I'm on another hill. The weather is still

0:17:25.170,0:17:29.070

very bad you cannot see a lot it's very

0:17:29.070,0:17:36.510

it's very foggy here, but you see

0:17:36.510,0:17:40.410

another tower here and something

0:17:40.410,0:17:45.420

very interesting happened: I got now the

0:17:45.420,0:17:51.210

answer of two different LoRa gateways. We

0:17:51.210,0:17:54.150

will check at home which one answered

0:17:54.150,0:17:57.630

here. And now I will go to the tower and

0:17:57.630,0:18:02.160

maybe we get even three gateways

0:18:02.160,0:18:03.960

1 gateway, 2 gateways.

0:18:04.820,0:18:07.820

So now I'm on the top.

0:18:07.830,0:18:13.410

It snows a little bit and now I assume that

0:18:13.410,0:18:16.530

i will also see a gateway from Basel

0:18:16.530,0:18:26.100

area. So, a messate arrived arrived. I see one

0:18:26.100,0:18:30.960

gateway, two gateways three gateways.

0:18:30.960,0:18:33.600

Three different gateways, also with different

0:18:33.600,0:18:38.940

signal to noise ratio 5.5 minus 6.8 and

0:18:38.940,0:18:46.710

minus 11.2. Now let's check the frequency:

0:18:46.710,0:18:51.300

The frequency is always the same so

0:18:51.300,0:18:54.180

the LoRa node sends only on one

0:18:54.180,0:18:56.640

frequency and then each gateway which

0:18:56.640,0:19:01.260

gets the signal messages back to the

0:19:01.260,0:19:03.450

TTN network and I get the information

0:19:03.450,0:19:08.250

here. So now it gets cold and I go home

0:19:08.250,0:19:11.700

and check what happened. And now I have

0:19:11.700,0:19:14.790

to go back down the whole tower and it is

0:19:14.790,0:19:19.050

quite slippery today. At home I even

0:19:19.050,0:19:21.930

discovered that some of the messages

0:19:21.930,0:19:24.870

were transported by four different

0:19:24.870,0:19:27.510

gateways number one number two number

0:19:27.510,0:19:30.930

three and number four. Now let's check

0:19:30.930,0:19:32.490

where these

0:19:32.490,0:19:38.130

gateways are. The first gateway is

0:19:38.130,0:19:41.460

12.7 kilometers away and if we

0:19:41.460,0:19:43.830

look close here it's even not in

0:19:43.830,0:19:48.030

Switzerland it is in Germany. The next

0:19:48.030,0:19:51.780

one is only 9.7 kilometers

0:19:51.780,0:19:55.950

away and this is directly in Basel in

0:19:55.950,0:20:00.179

the city of Basel. The third one is

0:20:00.179,0:20:03.809

quite far away it's 27 kilometers away

0:20:03.809,0:20:10.800

and it is on a hill. It is on roughly

0:20:10.800,0:20:16.050

1,300 meters hight. So I'm here on about

0:20:16.050,0:20:19.020

700 meters and this is even 1300 meters.

0:20:19.020,0:20:22.020

In between it's line of sight. So 27

0:20:22.020,0:20:24.750

kilometers. And this is by the way this

0:20:24.750,0:20:27.870

is a very very good place for a LoRa

0:20:27.870,0:20:32.250

gateway. I might do a wardriving once in

0:20:32.250,0:20:34.110

a different part of Switzerland because

0:20:34.110,0:20:36.960

this LoRa gateway should be

0:20:36.960,0:20:40.110

visible in a big part of Switzerland.

0:20:40.110,0:20:42.870

This is an extremely good position

0:20:42.870,0:20:46.350

for a LoRa gateway. And the fourth one

0:20:46.350,0:20:49.740

is only 3.2 kilometers and

0:20:49.740,0:20:52.440

it is just in the city closed by. Now

0:20:52.440,0:20:57.090

disappointing: My own gateway didn't

0:20:57.090,0:21:00.900

react. So either I did not have a line of

0:21:00.900,0:21:04.740

sight or what I heard is that if the

0:21:04.740,0:21:09.030

turnaround time is too slow then TTN

0:21:09.030,0:21:12.929

discards it. So it does not show gateways

0:21:12.929,0:21:15.450

which answers slow so it might be also

0:21:15.450,0:21:18.960

this reason. But anyway, I have now four

0:21:18.960,0:21:21.720

different gateway so this is a real good

0:21:21.720,0:21:23.880

position. So let's come to the summary:

0:21:23.880,0:21:27.840

In my tests the reach of the LoRa

0:21:27.840,0:21:30.690

protocol was slightly better than the

0:21:30.690,0:21:35.190

one of the RFM69, but mainly with higher

0:21:35.190,0:21:39.690

spreading factors and lower speeds. This

0:21:39.690,0:21:41.340

is only important for critical

0:21:41.340,0:21:44.669

situations. In all other places the RFM69

0:21:44.669,0:21:46.390

module is a good

0:21:46.390,0:21:50.050

choice especially if you want to build

0:21:50.050,0:21:53.440

your own network. It is also quite cheap.

0:21:53.440,0:21:56.260

If a connection is possible depends very

0:21:56.260,0:22:00.370

much on line of sight. So the position of

0:22:00.370,0:22:05.020

the gateway is absolutely critical.

0:22:05.020,0:22:08.710

If TTN only depends on private people like

0:22:08.710,0:22:12.340

me they will need many many gateways to

0:22:12.340,0:22:16.720

cover only one country. This is the big

0:22:16.720,0:22:19.630

advantage of TELCO companies. They own

0:22:19.630,0:22:22.960

many excellent locations which they can

0:22:22.960,0:22:25.810

use for LoRa and are able to cover big

0:22:25.810,0:22:28.660

part of a country with just one gateway.

0:22:28.660,0:22:33.010

In this light the fair use policy of TTN

0:22:33.010,0:22:36.910

is exaggerated. I cannot imagine a lot of

0:22:36.910,0:22:40.630

gateways will see more than 1,000 nodes.

0:22:40.630,0:22:45.340

Most gateways will see maybe 10 to 100

0:22:45.340,0:22:49.450

nodes at max for the next few years. So

0:22:49.450,0:22:52.030

the fair use policy could easily be

0:22:52.030,0:22:55.660

changed in favor of us users and reduced

0:22:55.660,0:22:58.270

if it will be necessary in the future.

0:22:58.270,0:23:03.880

Should I start with LoRa? No, if you

0:23:03.880,0:23:06.790

have enough power and Wi-Fi where you

0:23:06.790,0:23:09.820

want to deploy your sensors. Then, the

0:23:09.820,0:23:14.740

ESP8266 is the better solution. No, if

0:23:14.740,0:23:17.380

you just want a connection between two

0:23:17.380,0:23:20.440

or more devices like a remote control or

0:23:20.440,0:23:24.760

similar without internet connection.

0:23:24.760,0:23:26.770

No, if you are able to create your own

0:23:26.770,0:23:29.140

gateway to the internet without using

0:23:29.140,0:23:34.270

LoRaWAN. Clearly yes, if your sensors

0:23:34.270,0:23:36.700

need to be connected to the internet and

0:23:36.700,0:23:39.790

your area is already covered with the TTN

0:23:39.790,0:23:44.890

gateway. Yes but, if your sensors need

0:23:44.890,0:23:47.980

an internet connection and no gateway is

0:23:47.980,0:23:51.040

around. Then, you have to build your own

0:23:51.040,0:23:54.520

gateway. In one of the next videos I will

0:23:54.520,0:23:57.520

cover simple and cheap gateways for the

0:23:57.520,0:24:00.220

TTN network. I hope this

0:24:00.220,0:24:03.070

video was useful or at least interesting

0:24:03.070,0:24:10.350

for you. If true, then like. Bye

0:24:15.800,0:24:17.860

you

0:24:18.540,0:24:20.600

you