

# EDGE / GPRS / UMTS / LTE

IMPORTANCE OF MOBILE CELLULAR ANTENNA PLACEMENT



IS HEIGHT AND DIRECTION IMPORTANT ?

**Lets determine and see for ourselves**



# WHAT IS REQUIRED TO DO THE TEST ?

## TOOLKIT

- EXPANDABLE MAST TO 7 METERS
- POYNTING LPDA 92 ANTENNA - 12DBI – WIDE BAND 698-3000 MHZ
- LAPTOP I5 16GIG INTEL WIN10
- SPECTRUM ANALYSIS SOFTWARE BY ANTENNA WIRELESS
- FREQUENCY SPECTRUM KNOWLEDGE

## WHAT NEXT



FIND A SUITABLE PLACE TO WORK, FIX  
THE LPDA ANTENNA TO EXPANDABLE  
MAST,  
ACTIVATE SOFTWARE AND PREPARE TO  
THINK



# TEST – 900 MHZ BAND

- TEST GROUP A - USUALLY VOICE / GPRS / EDGE AND IN SOME INSTANCES UMTS

WE SET THE SPECTRUM ANALYSER TO COVER FREQUENCY RANGE

STARTING AT 870MHZ TO 1000MHZ

WE ARE ONLY INTERESTED IN THE DOWNLINK (RX) BAND AS THIS WILL GIVE US AN IDEA OF DIRECTION AND SIGNAL STRENGTH RECEIVED BY OUR RECEIVER

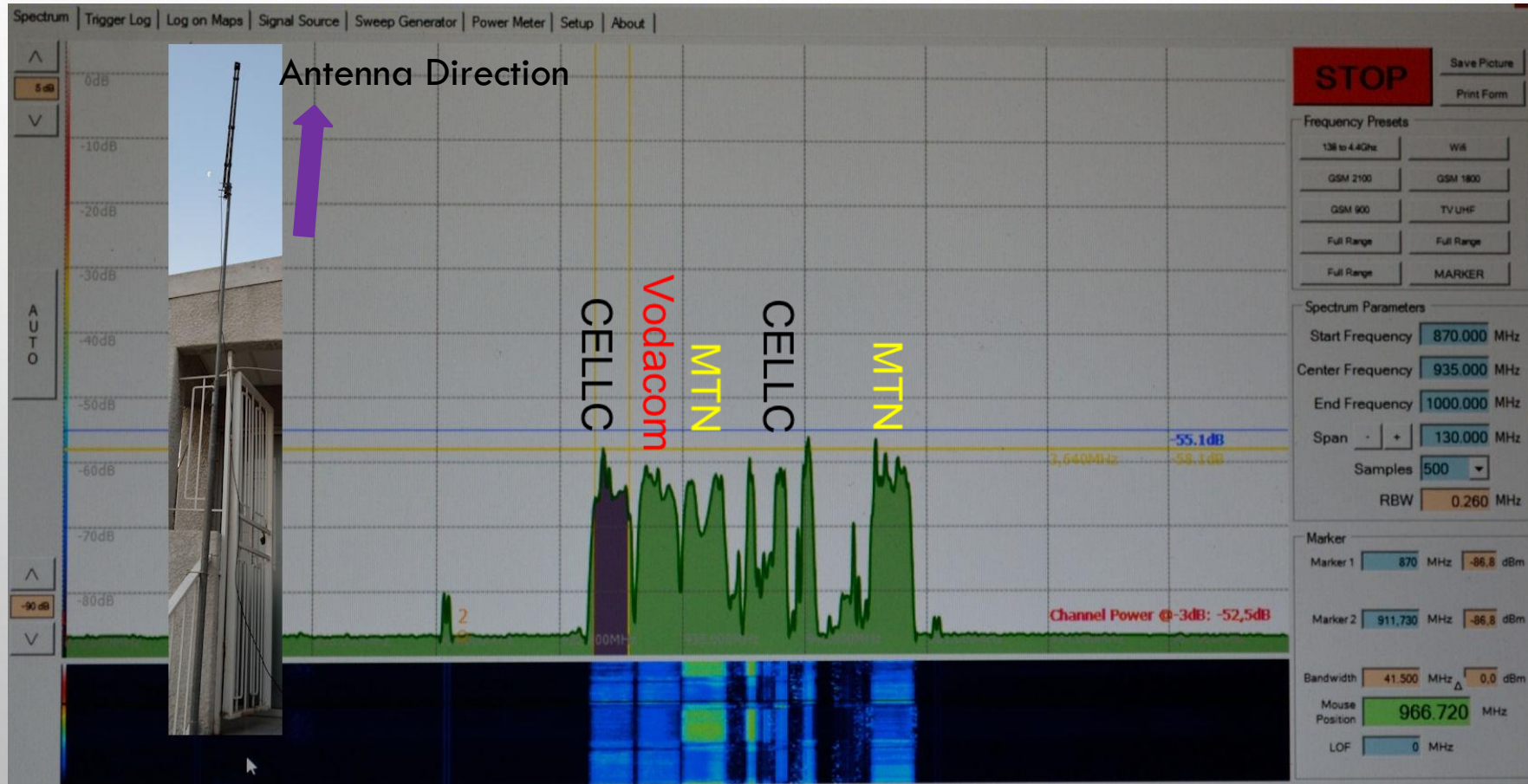
WE ARE GOING TO ROTATE THE ANTENNA 360° AND ALSO PROCEED WITH THE SAME ROTATION AT DIFFERENT HEIGHTS.







# TEST 1 – 900 MHz BAND



Antenna at height of 3m pointing in direction A located at 210° Depicted by the picture in the far left of the analyser screen.

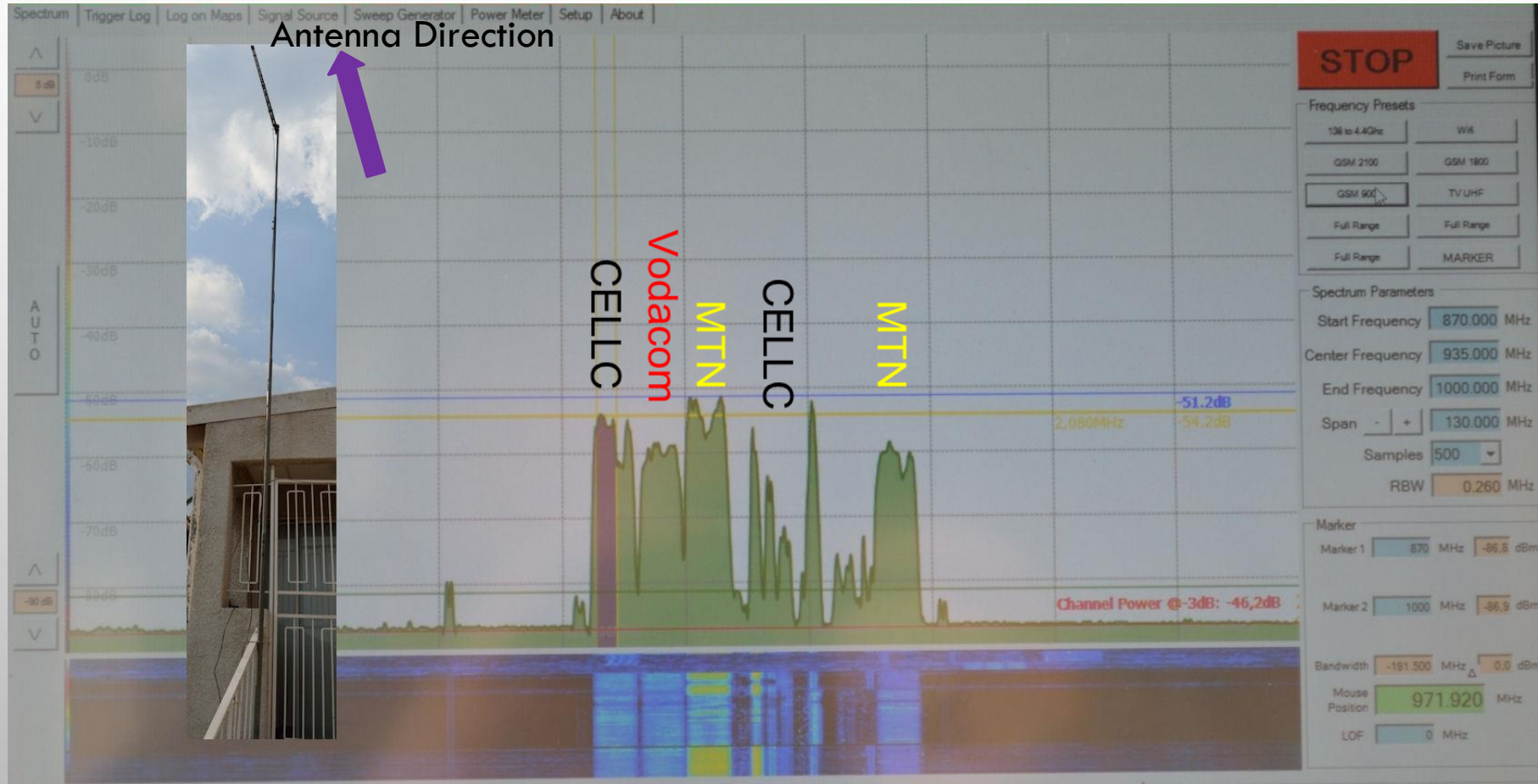
Notice each band represented by the spectrum display and the corresponding decibel reading.

- CellC @ 925.1 Mhz
- Vodacom @ 934.9 Mhz
- Mtn @946.3Mhz
- CellC @ 950.9 Mhz
- Mtn @ 959.7 Mhz

on



# TEST 2 – 900 MHz BAND



Antenna at height of 5m pointing in direction B located at 234°

Changed Direction, Same height

Notice with direction the channel strength changes level.

The carrier of CellC changed from the previous slide from -55 dB to -51.2dB. That's a 4dB gain just on direction change of +-20°

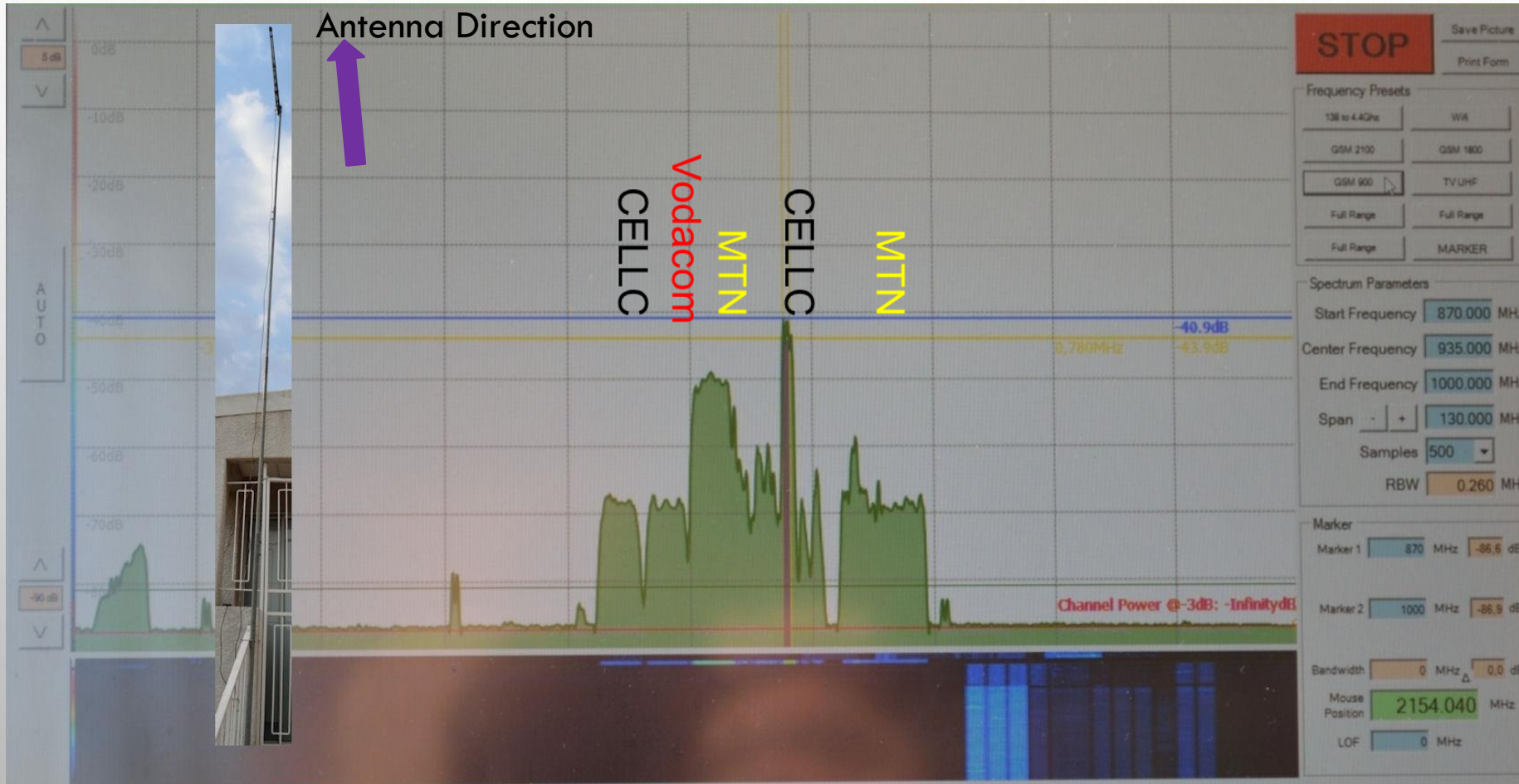
No Change in the height







# TEST 3 – 900 MHz BAND



Antenna at height of 7m pointing in direction B located at 256°

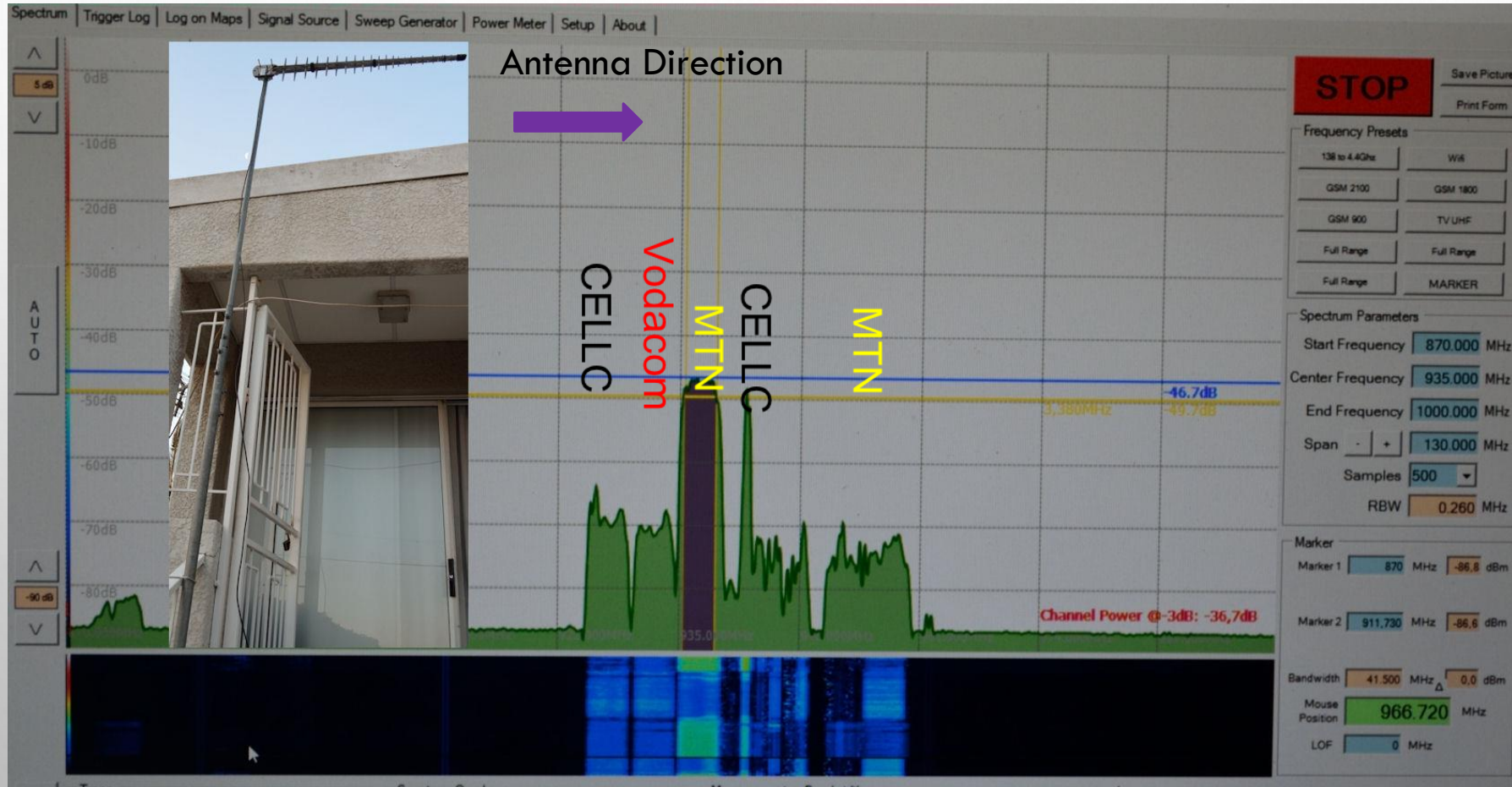
Raised mast to 7 Meter Height

Notice with direction and height the channels strength changes level. – possible co channel interference from other towers in other directions

The carrier of main CellC/Vodacom carries remained the same and the Carrier channel of MTN has increased dramatically, together with the voice carrier of CellC.

Clear indication of different positioned provider masts in the area.

# TEST 4 – 900 MHz BAND



Antenna at height of 3m pointing in direction C located at 165°

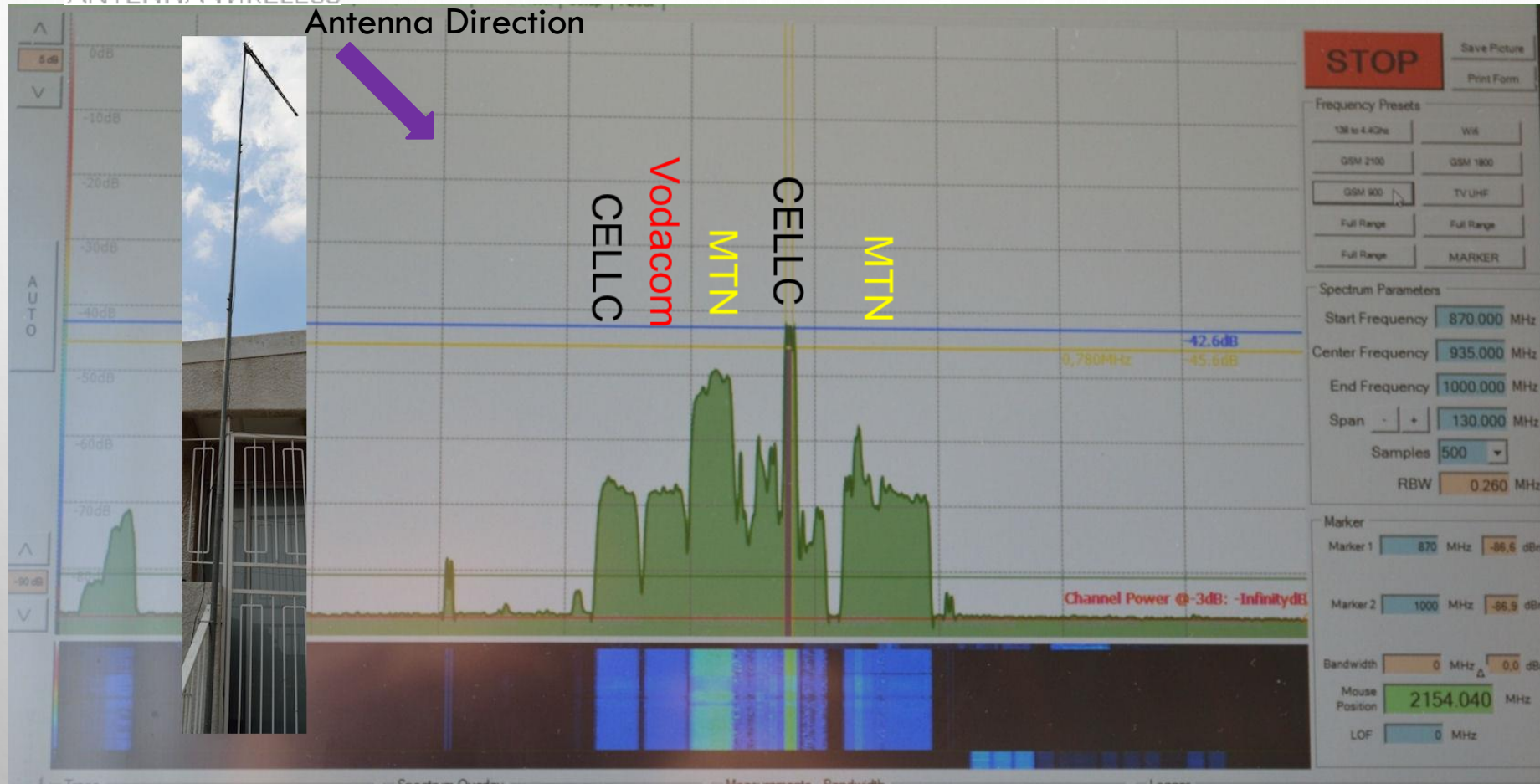
Changed Direction, 3m Height

Notice with direction the channel strength changes level. The carrier of MTN is peaked at -46dB.

This is the F/B Antenna ratio to be considered.



# TEST 5 – 900 MHz BAND



Antenna at height of 5m pointing in direction D located at 132°

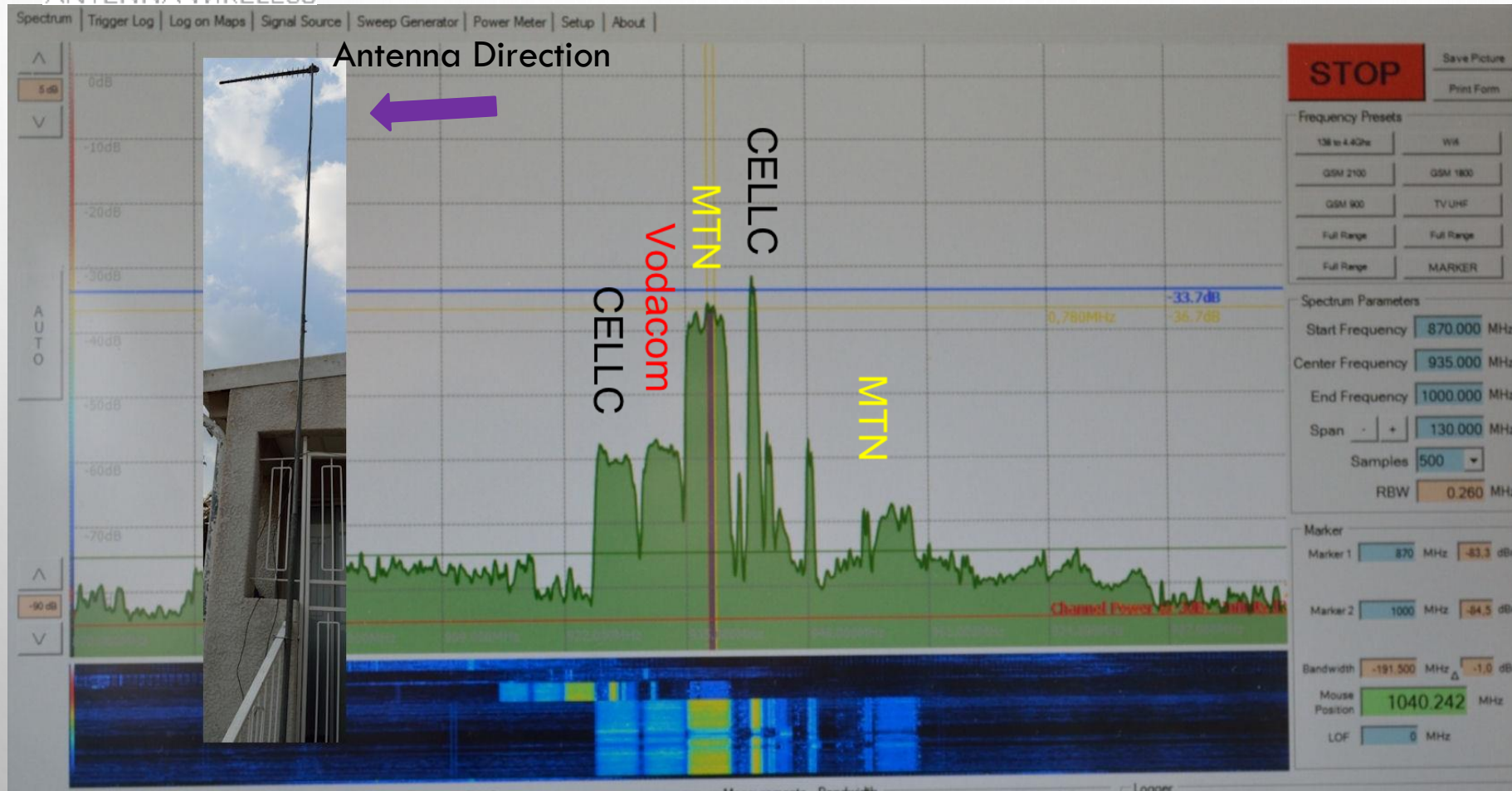
Changed Direction, 5m Height

Notice with change in direction the channel strength changes levels of different carriers changes. The small voice carrier of CELLC is peaked at -42.6dB.

Antenna Peaked for CellC Voice .

Notice the Direction relative to other slides

# TEST 6 – 900 MHz BAND



Antenna at height of 5m pointing in direction E located at 332°

Changed Direction, 5m Height

Notice with change in direction the channel strength changes levels of different carriers changes. The small voice carrier of CELLC is peaked at -33.6dB. MTN at -36.7dB

Antenna Peaked for CellC Voice and MTN.

Notice the Direction relative to other slides, and compare this slide to slide 8

# TEST 1 – 1800 MHZ BAND

- TEST GROUP B - USUALLY LTE BAND

WE SET THE SPECTRUM ANALYSER TO COVER FREQUENCY RANGE

STARTING AT 1700MHZ TO 1900MHZ

WE ARE ONLY INTERESTED IN THE DOWNLINK (RX) BAND AS THIS WILL GIVE US AN IDEA OF DIRECTION AND SIGNAL STRENGTH RECEIVED BY OUR RECEIVER

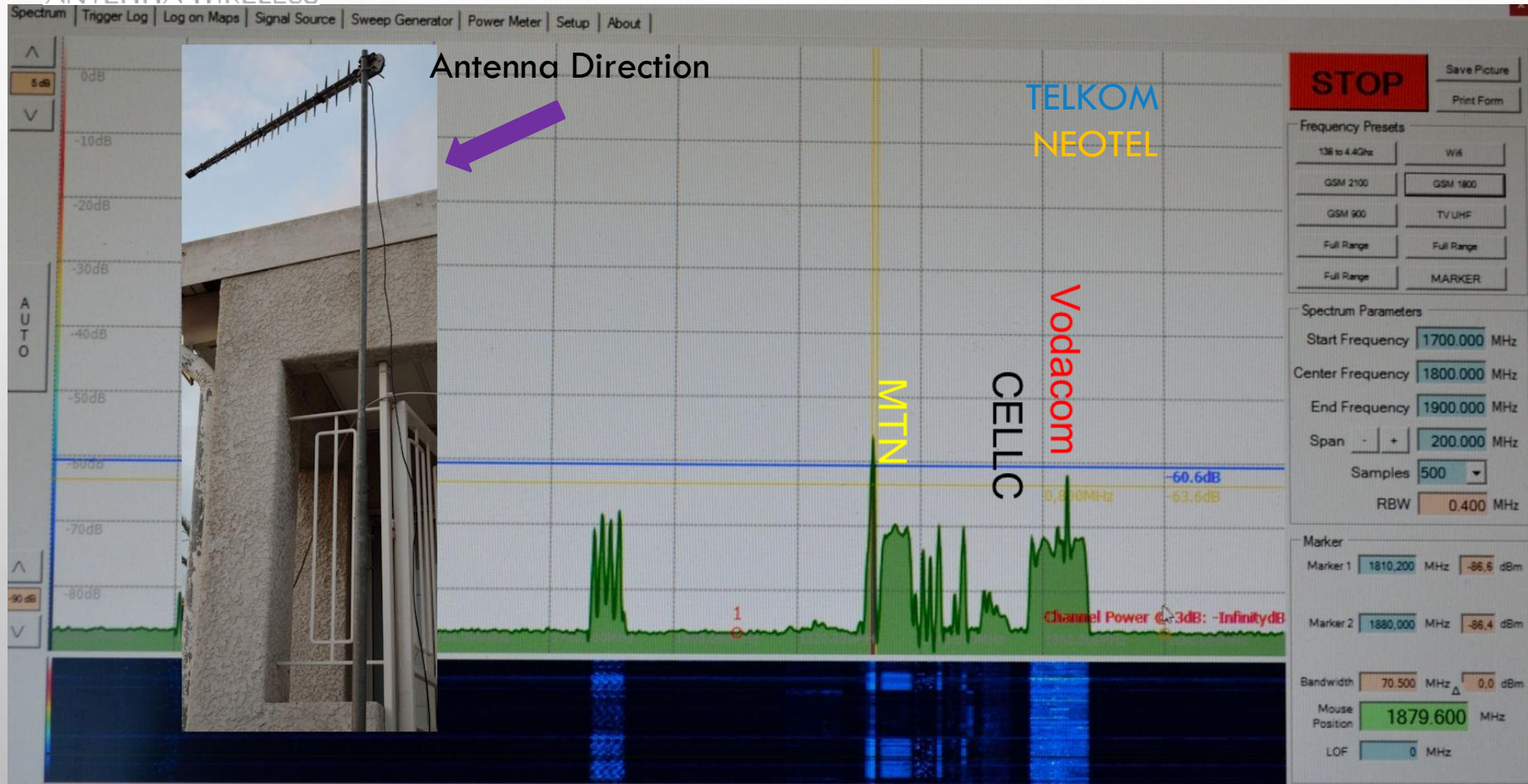
WE ARE GOING TO ROTATE THE ANTENNA 360° AND ALSO PROCEED WITH THE SAME ROTATION AT DIFFERENT HEIGHTS OF 3 METERS / 5 METERS AND 7 METERS.

IN INSTANCES WHERE NO SIGNAL FOUND - TEST ARE NOT COMPLETED





# TEST 1 – 1800 MHz BAND



Antenna at height of 3m pointing in direction E located at 357°

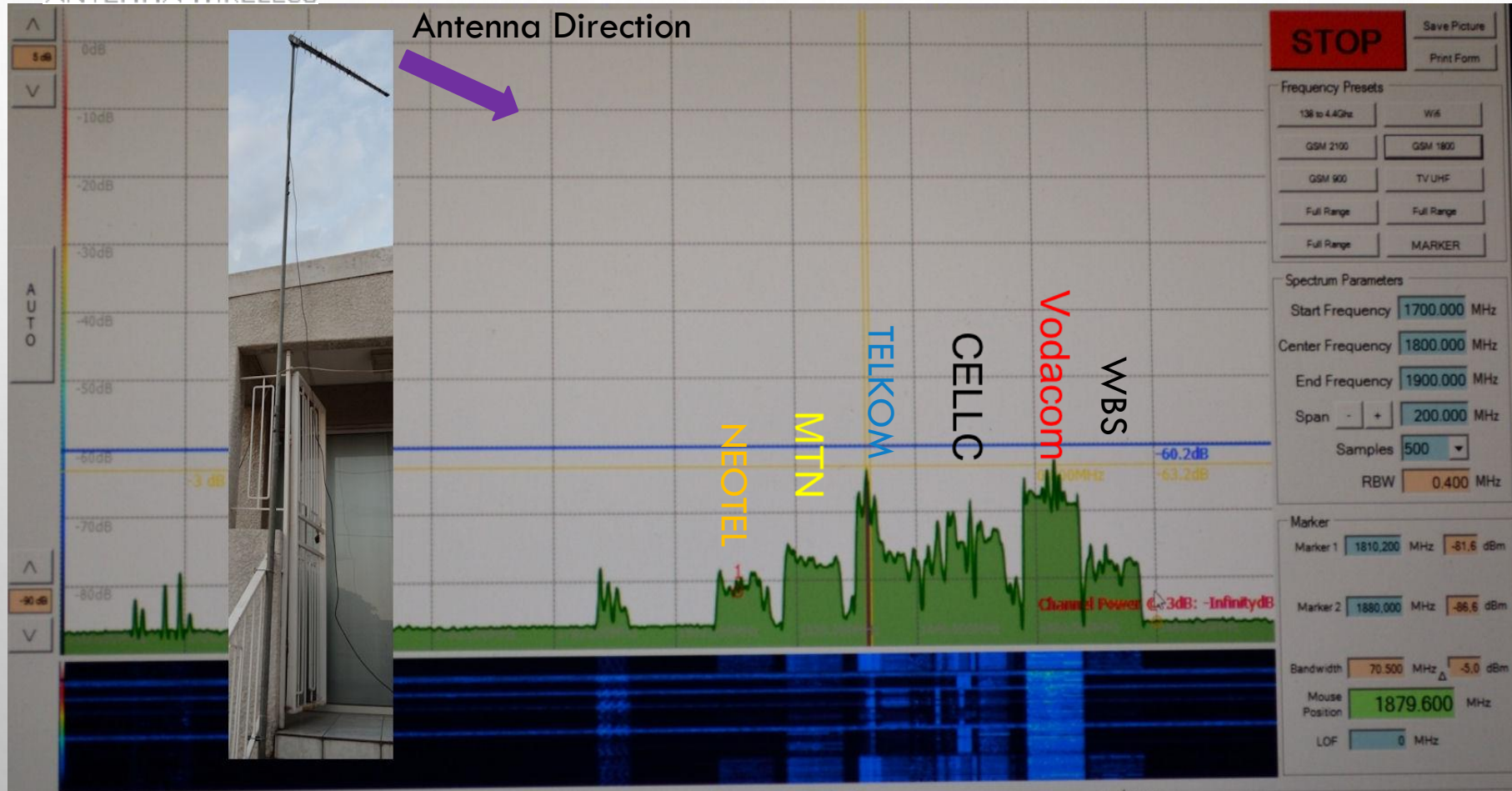
At this point we can only receive Vodacom and MTN on LTE band

Vodacom and Mtn at -70dB level

Notice complete different signal strength levels for the higher Frequency relative to the 900mhz Band.

Notice the antenna height and direction.

# TEST 2 – 1800 MHz BAND



Antenna at height of 5m pointing in direction D located at 121°

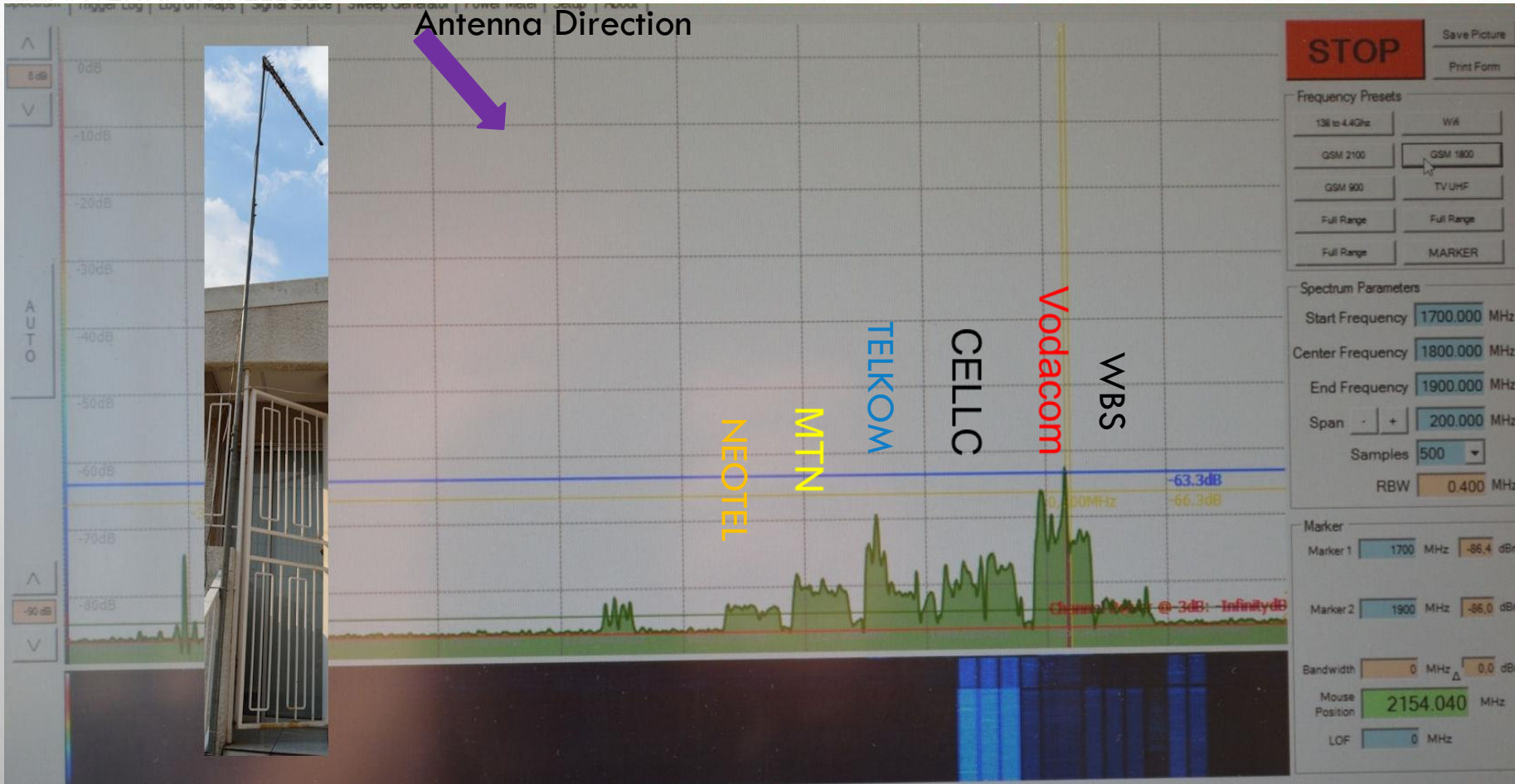
In this TEST we can receive all Carriers on the band.

With Vodacom being the strongest at -60.2dB and Neotel/WBS being the weakest -80dB.

Notice complete different signal strength levels from the previous slide. Only because of antenna rotation and increased height.



# TEST 3 – 1800 MHz BAND



Antenna at height of 5m pointing in direction D located at 100°

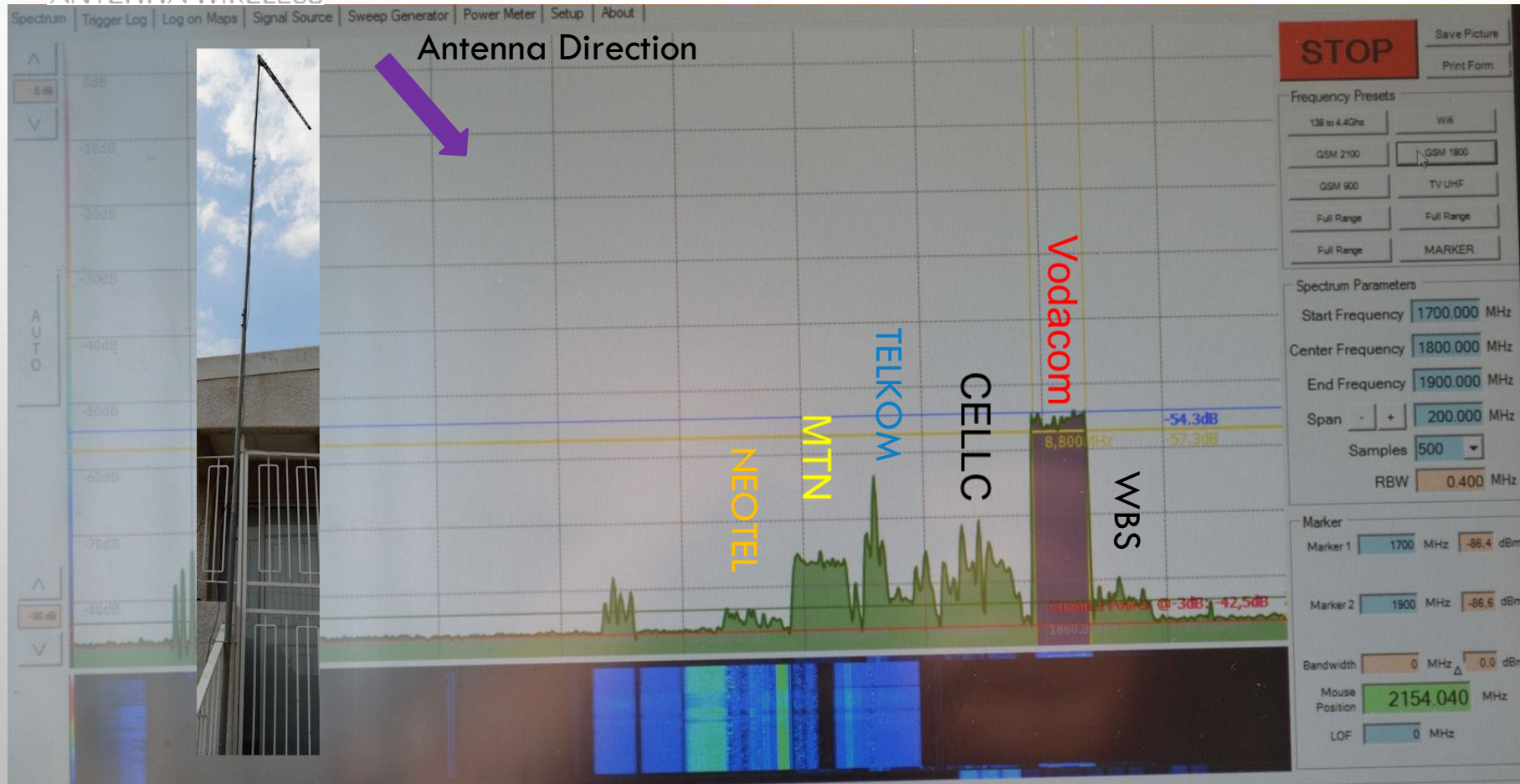
In this TEST we can receive all Carriers on the band.

Notice the decrease in signal level from rotating the antenna 20° - We are 6dB down

Notice complete different signal strength levels from the previous slide. Only because of antenna rotation, **Meaning Direction does matter !**



# TEST 4 – 1800 MHz BAND



Antenna at height of 7m pointing in direction D located at 100°

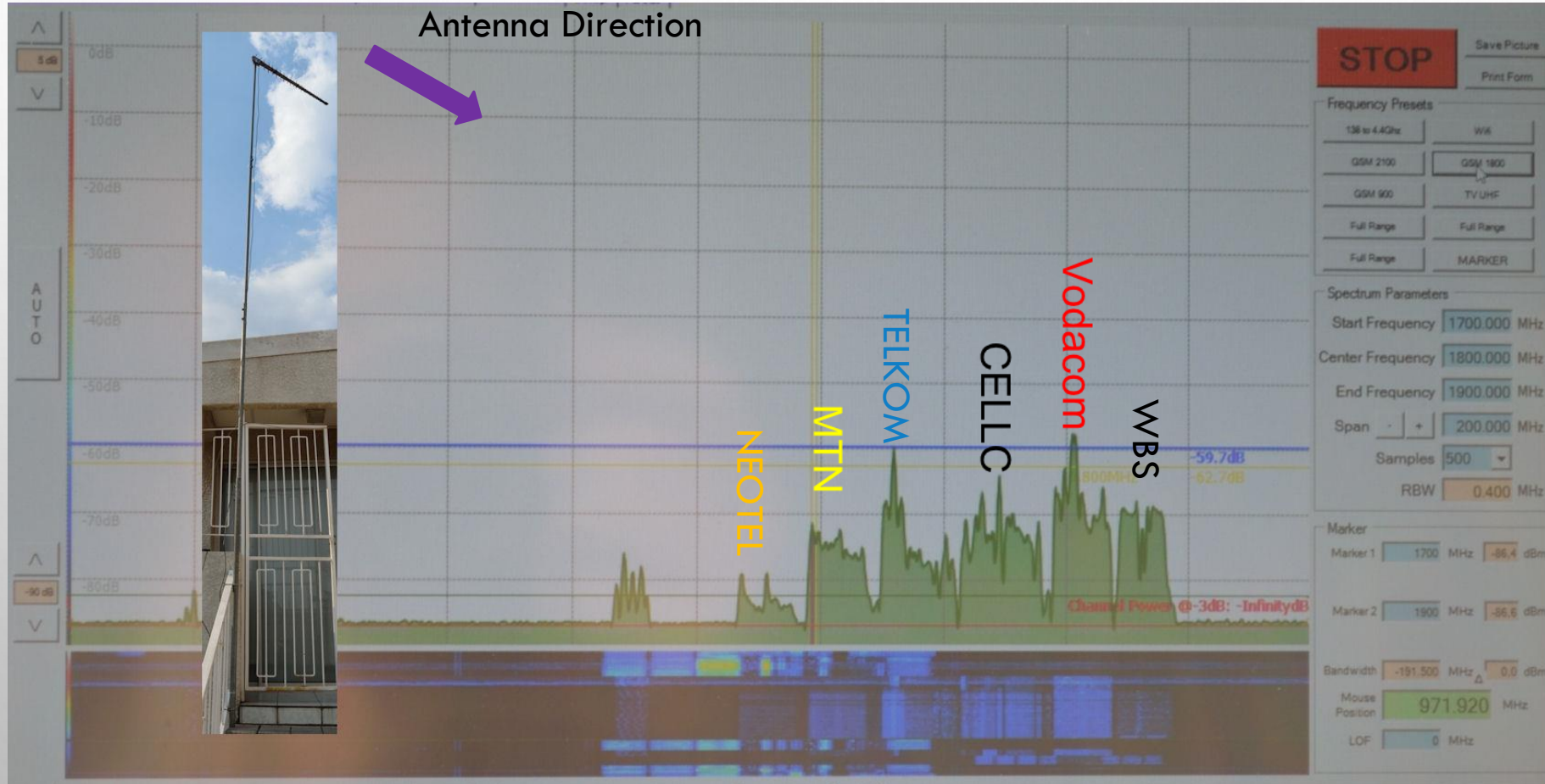
Raised the MAST to 7m, Direction remained constant to previous slide.

Vodacom Carrier up on previous slide to -54dB. This would be ideal direction for Vodacom BTS with LTE.

Notice complete different signal strength levels and decrease in other provider signals. Only because of antenna height adjustment, **Meaning height does matter !**



# TEST 5 – 1800 MHz BAND



Antenna at height of 7m pointing in direction D located at 121°

MAST at 7m, Direction changed by 20°

Notice the change to Vodacom carrier,

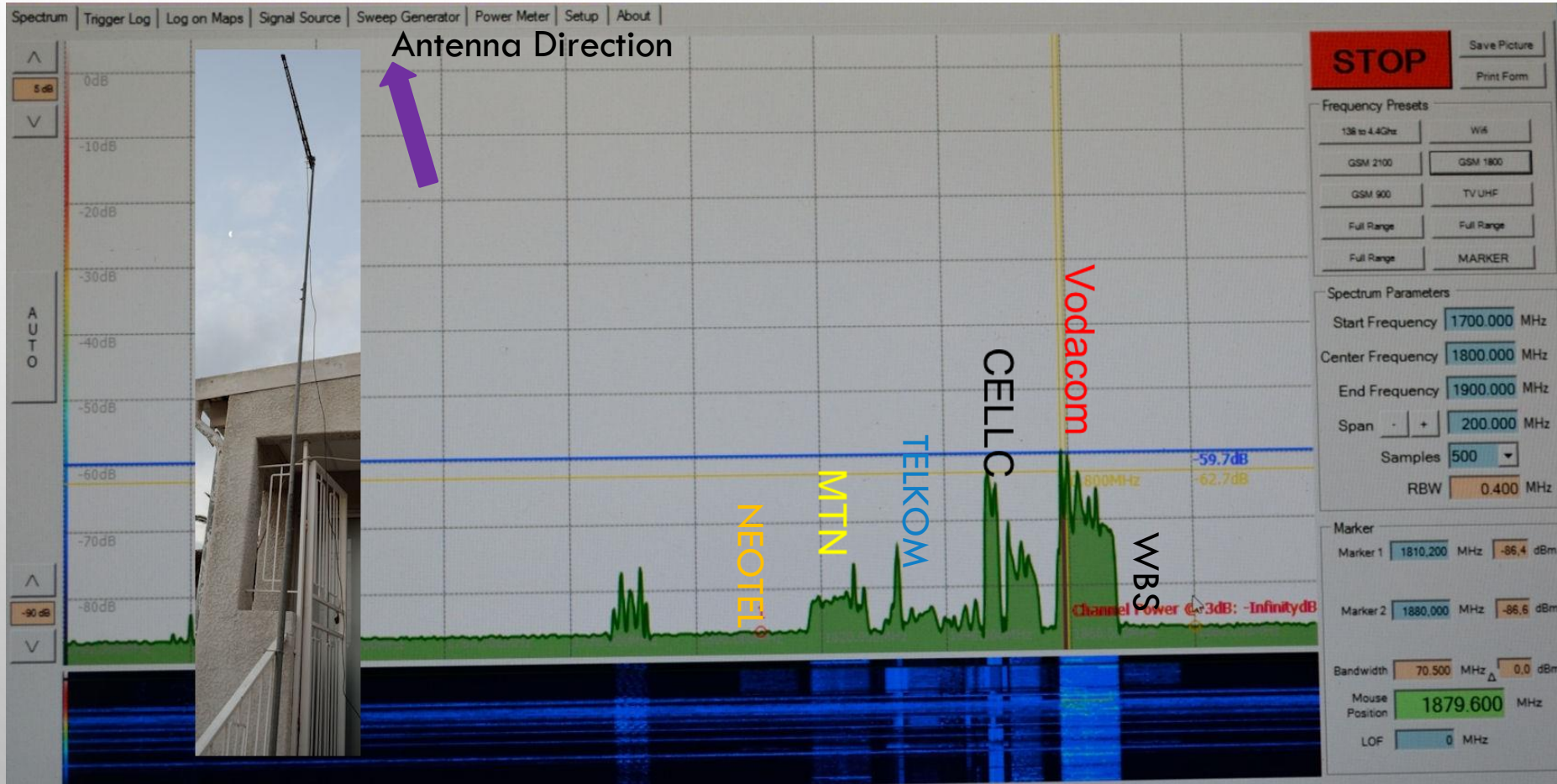
Compare with Slide 13 where the mast was at 5meters.

We have and over increase in signal gain +10dB over the band due to antenna height adjustment, **Meaning height does matter !**





# TEST 6 – 1800 MHz BAND



Antenna at height of 5m pointing in direction B located at 234°

MAST at 5m, Direction changed by 20°

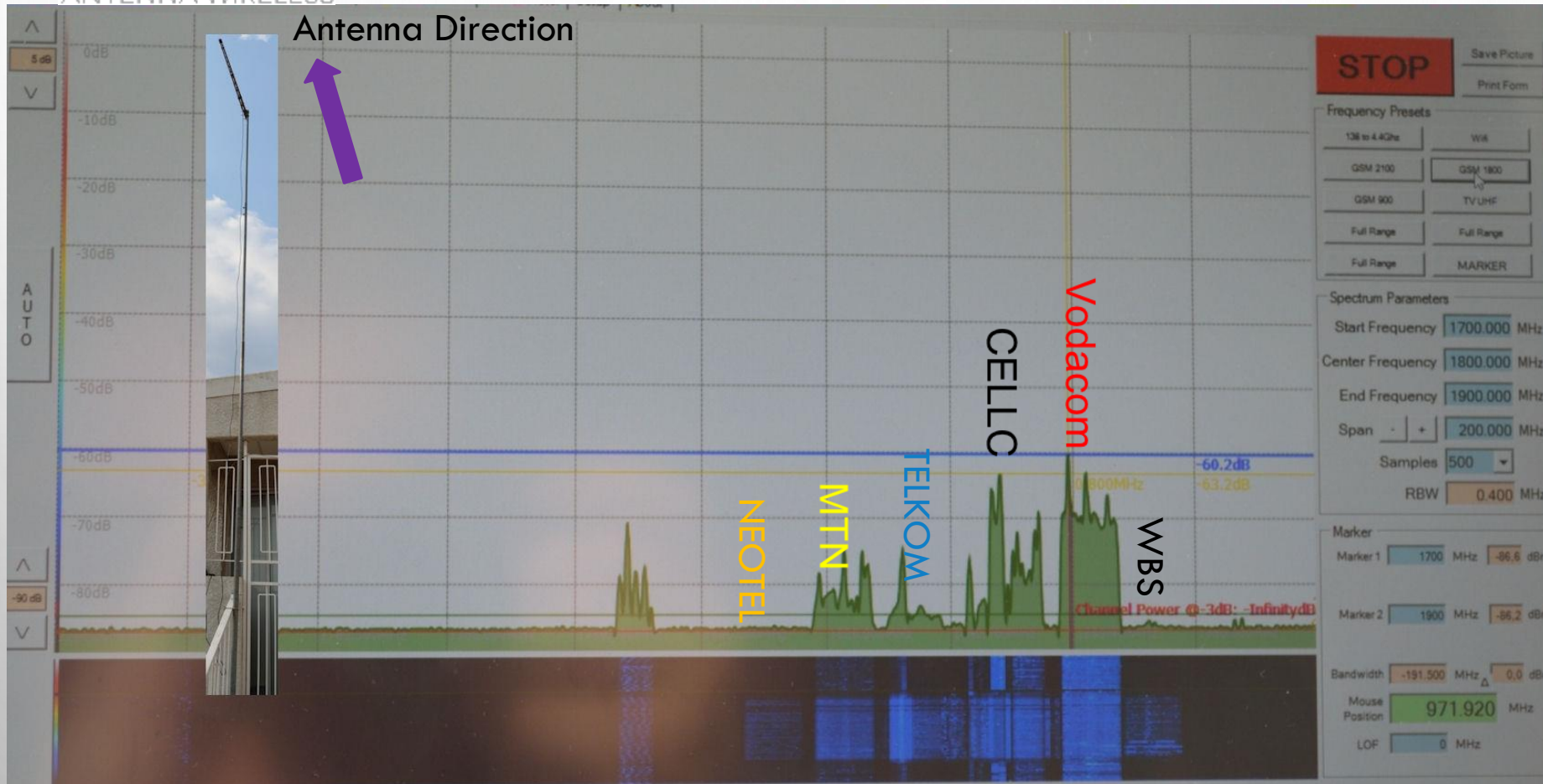
Notice the change to carrier, Neotel & WBS disappeared. Leaving only CellC and Vodacom

Signal peaked for CellC on LTE band at -59dB





# TEST 7 – 1800 MHz BAND



Antenna at height of 7m pointing in direction B located at 234°

MAST at 5m, Direction changed by 20°

Not much change from the previous slide with and increase in height.

# TEST 1 – 2100 MHZ BAND

- TEST GROUP C - USUALLY UMTS BAND

WE SET THE SPECTRUM ANALYSER TO COVER FREQUENCY RANGE

STARTING AT 1900MHZ TO 2200MHZ

WE ARE ONLY INTERESTED IN THE DOWNLINK (RX) BAND AS THIS WILL GIVE US AN IDEA OF DIRECTION AND SIGNAL STRENGTH RECEIVED BY OUR RECEIVER

WE ARE GOING TO ROTATE THE ANTENNA 360° AND ALSO PROCEED WITH THE SAME ROTATION AT DIFFERENT HEIGHTS OF 3 METERS / 5 METERS AND 7 METERS.

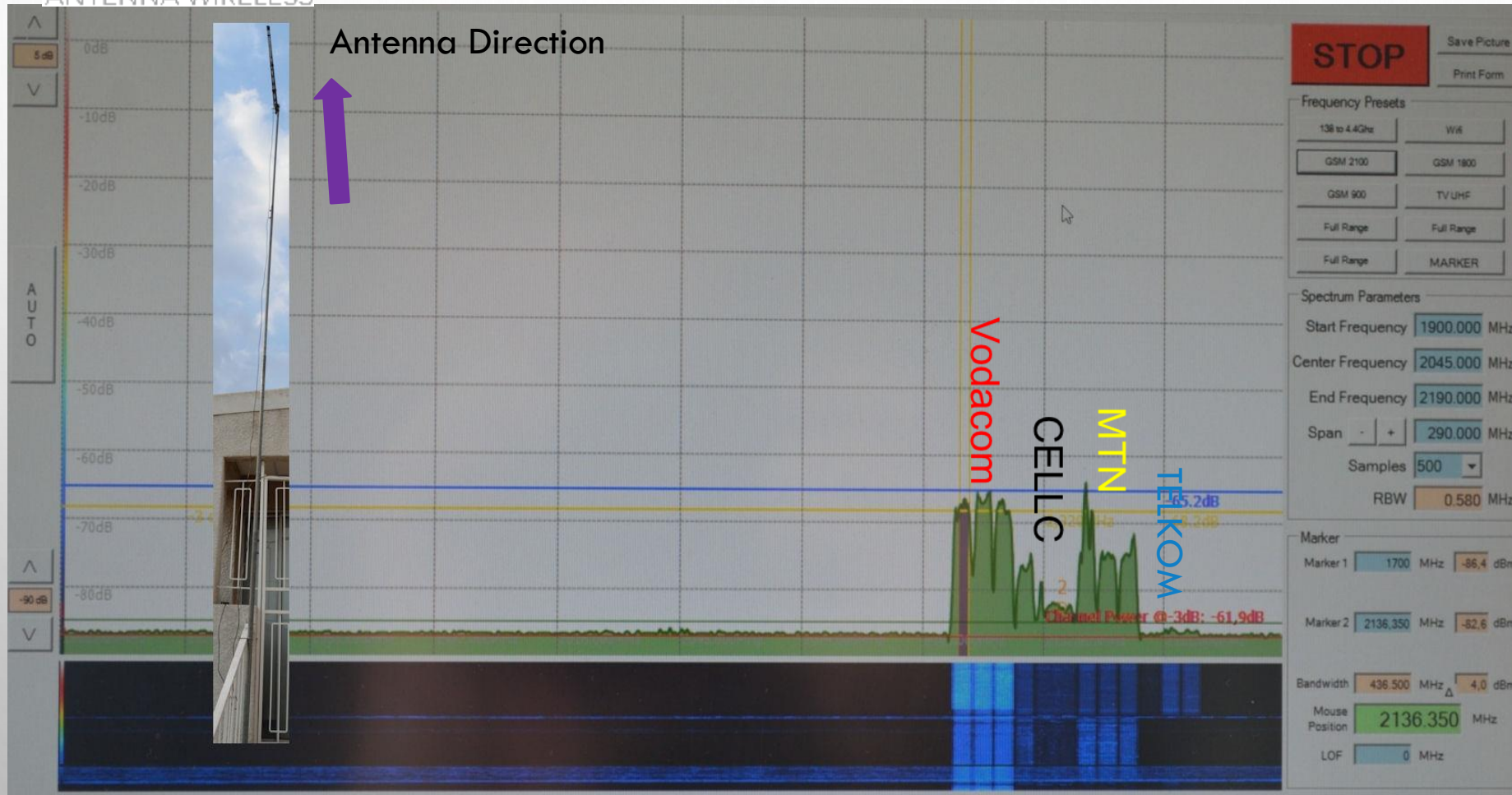
IN INSTANCES WHERE NO SIGNAL FOUND - TEST ARE NOT COMPLETED







# TEST 1 – 2100 MHz BAND



Antenna at height of 7m pointing in direction B located at 256°

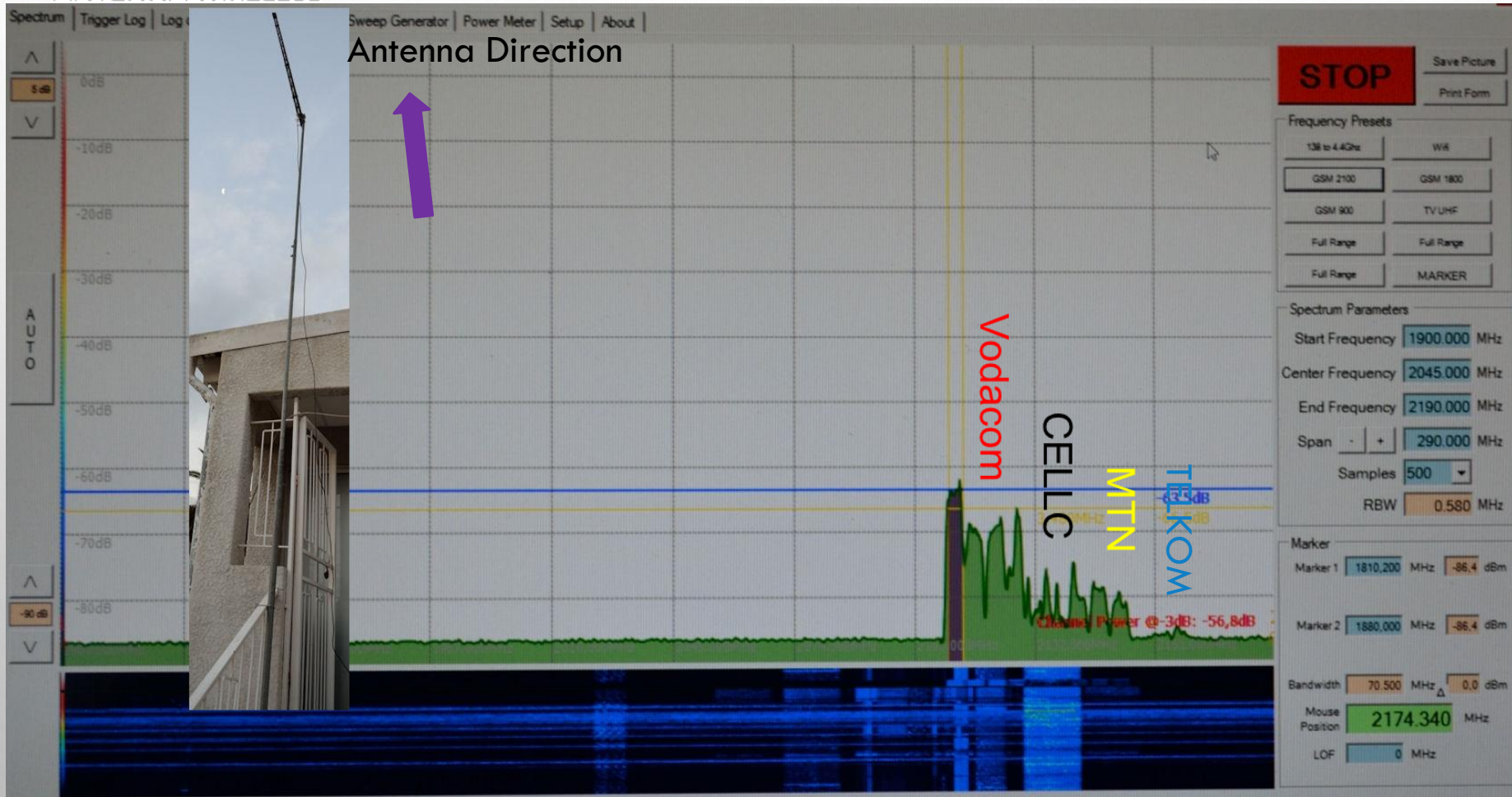
Antenna at 7m

In this test Vodacom and Mtn have 3 discrete Channels. Cellc Using 1 Channel

No Telkom

Vodacom @ -65dB  
CellC @ -75dB  
Mtn @ -73dB

# TEST 2 – 2100 MHz BAND



Antenna at height of 5m pointing in direction B located at 234°

Antenna height reduced to 5m

In this test Vodacom and Mtn have 3 discrete Channels. Cellc Using 1 Channel

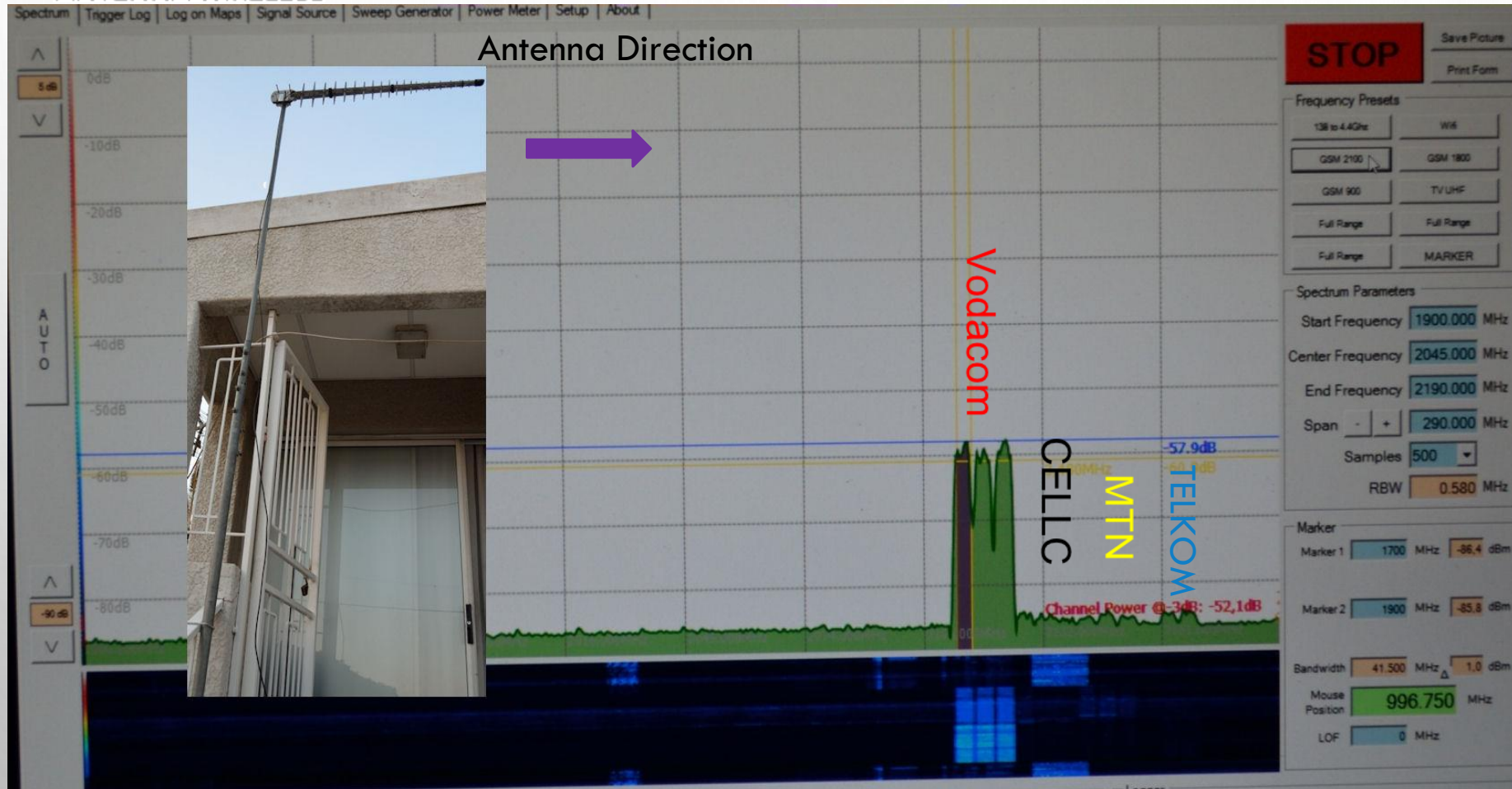
No Telkom

Vodacom @ -62dB  
CellC @ -80dB  
Mtn @ -80dB

Not much change on signal level on Main carrier Vodacom by changing height.



# TEST 3 – 2100 MHz BAND



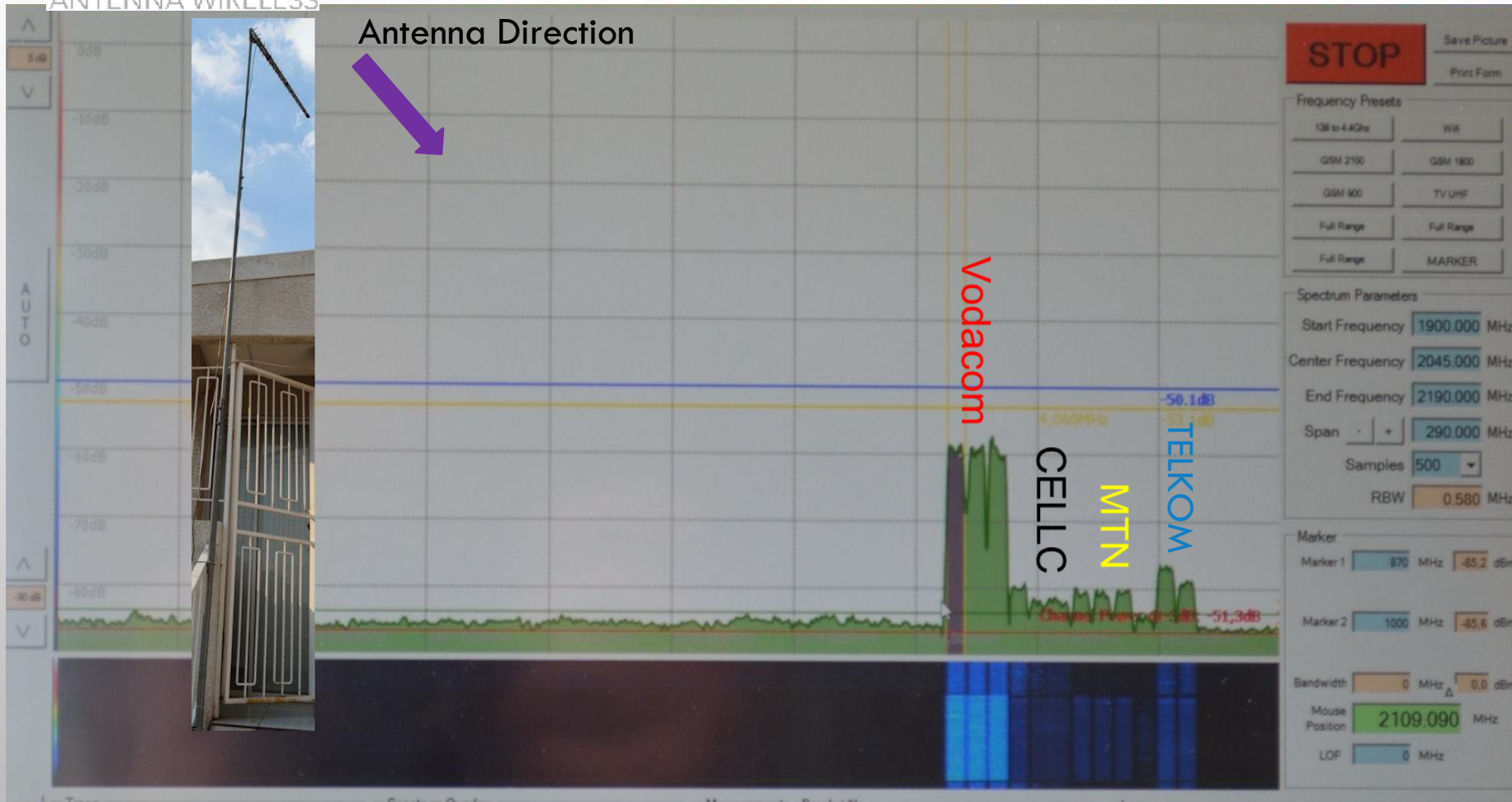
Antenna at height of 3m pointing in direction C located at 165°

Antenna height reduced to 3mm Direction changed

In this test No other providers Signal peaked for Vodacom @ -57dB

In this instance **height** is not an issue and **works to our benefit** if we trying to align to Vodacom. The reduction in height filters out all other providers and allows only 1 Service provider

# TEST 4 – 2100 MHz BAND



Antenna at height of 5m pointing in direction D located at 121°

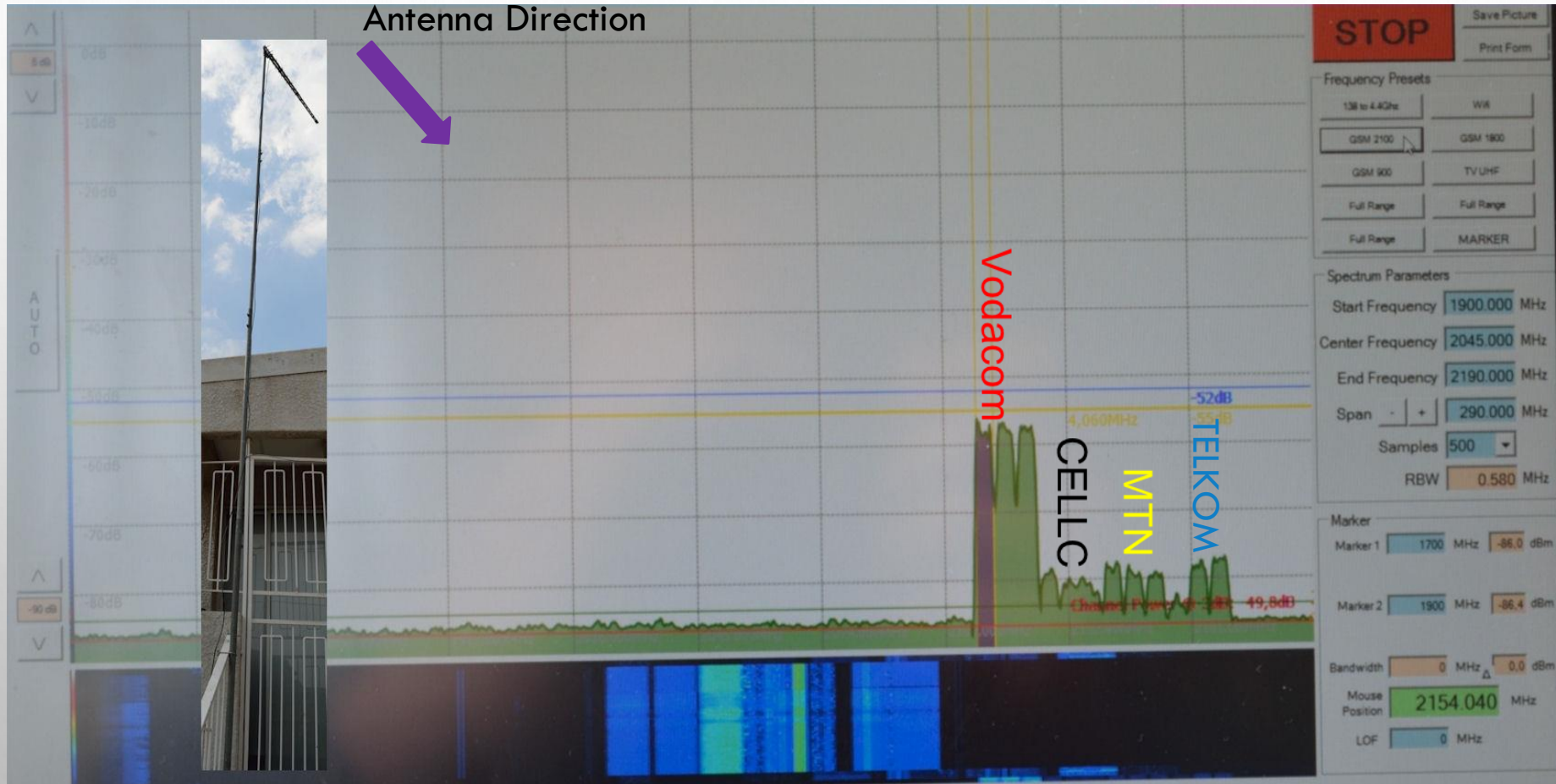
Antenna height at 5m

In this test Aligned for max providers  
Vodacom @ -50.1dB  
Cellc @ -85dB  
Mtn @ -80dB  
Telkom @ -75dB

In this instance it CLEAR that direction to BTS is imperative. If LTE has to drop back to 3G, Direction will make a difference. Note the Low signal strength at Ultra High Frequency. Location of BTS important.



# TEST 5 – 2100 MHz BAND



Antenna at height of 7m pointing in direction D located at 121°

Antenna height increased to 7m

In this test  
 Vodacom @ -52.1dB  
 Cellc @ -80dB  
 Mtn @ -79dB  
 Telkom @ -78dB

In this scenario increasing the height of the antenna made negligible difference to the reception. .

# CONCLUSION

- PLACEMENT OF ANTENNA IS IMPERATIVE
- KNOWING THE SERVING BTS (OR PROVIDER) WILL MAKE IT BENEFICIAL FOR ANTENNA ALIGNMENT, THAT IS, TO WHICH PROVIDER AND TO WHAT SERVICE DOES THE CUSTOMER OR END USER REQUIRE. ( VODACOM LTE, CELLC 3G, MTN VOICE, ALL OF THE ABOVE)
- DIRECTION IS CRITICAL WHEN USING A DIRECTIONAL ANTENNA WITH NARROW BEAM WIDTH, DIRECTION NOT CRITICAL WITH OMNI OR FLAT PANEL NON DIRECTIONAL ANTENNA. POLARISATION IS IMPORTANT
- HEIGHT AND LENGTH OF MAST CAN BE USED BOTH FROM AN ADVANTAGE AND DISADVANTAGE POINT DEPENDING ON WHAT IS REQUIRED. LINE OF SIGHT WILL HELP, AS WELL AS BUILDINGS, TREES AND OBSTACLES.
- SIGNAL LEVELS DECREASE AND REQUIRE MORE POWER AS YOUR FREQUENCY INCREASES.. SO 900MHZ BETTER THAN 1800MHZ (-20DB) BETTER THAN 2100MHZ (-40DB). I.E. 900MHZ AVERAGE OF -40DB, 1800MHZ AVERAGE OF -60DB, AND 2100MHZ AN AVERAGE OF -80DB
- THE HIGHER THE FREQUENCY THE CLOSER YOU NEED TO BE TO A BASE STATION. SO NO WONDER WE HAVE LTE ON STREET LAMPS
- ANTENNA WILL ALWAYS IN MOST INSTANCES IMPROVE YOUR SIGNAL, IMPROVED SIGNAL MEANS IMPROVED THROUGHPUT, BETTER MODULATION, LESS ERROR CORRECTION AND THUS FASTER SPEEDS !

