

Study for Link between FR and 3B8 X-band Repeaters Project

October 21, 2016

Document Reference: LinkREU

Table of Contents

1.0	Scope	3
2.0	Repeater Sites - Mauritius	4
3.0	Proposed Frequency plan in Mauritius	6
4.0	Repeater Sites – Reunion	7
5.0	Frequency Plan Reunion:	8
6.0	Interference	8
7.0	Colorado (La Montagne):	9
8.0	Piton Textor:	12
9.0	Col de Bellvue (Plaine des Cafres):	15
10.0	Grand Islet (Salazie):	19
11.0	La Croix de L’Esperance (Plaine des Palmiste):	22
12.0	Alternatives:	25
13.0	Conclusion/Recommendations:	25

1.0 Scope

Prepare a technical study to ensure that the future link to Reunion Island will be stable, particularly in natural disaster conditions, such as strong cyclone or others. I used the opportunity of my recent visits to Reunion to make some measurements to confirm desktop work.

To find an alternative site to Colorado to link Reunion repeaters at the end of the chain of the East side of the island so that both sides of the communication made be heard, thus avoiding QRM from OM's not hearing one side only.

Methodology:

- a) Equipment used for tests: Baofeng UV5R
- b) Software: Radio Mobile V 11.5.8
- c) Mapping/ Geodata: Shuttle Radar Topography Mission (SRTM) high-resolution digital topographic database of Earth.
- d) Potential sites without electricity mains supply and no construction have been de facto been eliminated as these would be costly to develop.
- e) Sites identified during desktop study not receiving 3B8VTC repeater have been eliminated.
- f) The link to local repeaters in Reunion should be confirmed with more tests as exact location and specifications unknown to calculate the theoretical signal strength and compare it with the result obtained. Therefore the test was limited to verify that local communication may be heard at each location.
- g) All location and altitude given in this document are from Google Earth for ease of locating as it differ slightly from SRTM mapping data.

Limitations:

- h) In spite driving around over 1,000 Km in 4 days, the lack of knowledge of the terrain may result in not evaluating opportunities which may be obvious to the locals.
- i) Local factors such as access to potential sites and cost have not been evaluated and may be a hurdle.
- j) The propagation model has not been proven over such long distance above water and may be prove wrong, however from experience for several months now it seems that the model is pessimistic so prudent and test made seems to confirm same.

Remarks:

- a) It should be noted that all measurements have been made with un-calibrated Amateur Equipment (Baofeng UV5R) and as such not fully reliable, however these are good indication to confirm desktop studies.
- b) Over water the most reliable link is not necessarily the strongest signal but the one less affected by multi path due to changing weather conditions, particularly sea state and heavy rain in the path.
- c) Local link from proposed site to existing repeaters need to be fully ascertain.

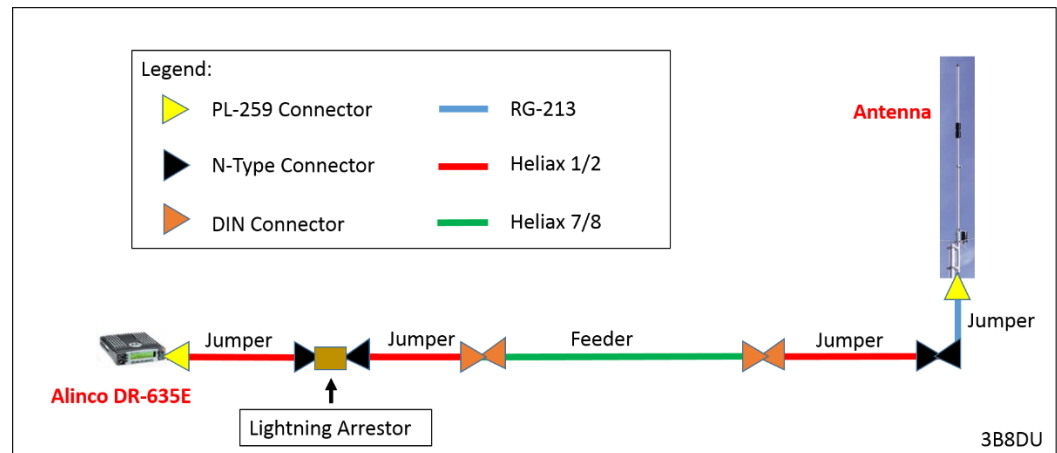
2.0 Repeater Sites - Mauritius



Note/reminder:

- a) All position and altitude given in this document are from Google Earth and differs slightly from SRTM Geodata.
- b) Only Trou aux Cerfs install as at date of this document, antennas and feeders being installed on other sites pending regulatory clearance.

Typical installation in Mauritius:



Note : If antenna fitted with N-Type, Heliac 1/2" tower jumper is connected directly to antenna, thus reducing the loss by 0.8 dB on UHF.

Trou aux Cerfs (installed):

Position: Lat. 20°19'11.41" S Lon. 057°30'41.0" E

Altitude: 607 m

Transceiver: Alinco DR-635E

Antenna: Diamond X-200N Gain VHF 6dbi UHF 8dbi

Feeder total loss: VHF 3.36 dB UHF 6.38 dB

EIRP: VHF 36.70 W UHF 25.4 W

Signal Mountain (planned):

Position: Lat. 20°19'11.41" S Lon. 057°30'41.0" E

Altitude: 298 m

Transceiver: Alinco DR-635E

Antenna: Sirio SA-270LN Gain VHF 3.15 dB UHF 5.45 dB

Feeder total loss: VHF 2.54 dB UHF 5.0 dB

EIRP: VHF 23.01 W UHF 19.40 W

Grand Bassin (planned):

Position: Lat. 20°19'11.41" S Lon. 057°30'41.0" E

Altitude: 675 m

Transceiver: Alinco DR-635E

Antenna: Cushcraft AR-270 Gain VHF 3.70 dB UHF 5.45 dB

Feeder total loss: VHF 3.44 dB UHF 6.52 dB

EIRP: VHF 21.23 W UHF 13.83 W

Bar Le Duc (planned):

Position: Lat. 20°19'11.41" S Lon. 057°30'41.0" E

Altitude: 592 m

Transceiver: Alinco DR-635E

Antenna: Diamond X-200N Gain VHF 6dbi UHF 8dBi

Feeder total loss: VHF 3.87 dB UHF 7.32 dB

EIRP: VHF 32.66 W UHF 20.46 W

3.0 Proposed Frequency plan in Mauritius

In spite several frequency plans have been worked out, only 2 scenarios are given as examples of the possible final set-up for 4 or 3 repeaters installed in Mauritius, depending on the final link between FR and 3B8 other scenarios may be required in Mauritius.

4 repeaters in Mauritius:

Scenario 1 (VHF Link to Signal Mountain)			
Signal Mountain	Bar Le Duc	Grand Bassin	Trou Aux Cerfs
145,400	145,400	145,225	145,225
431,700	431,675	431,675	431,650

3 repeaters in Mauritius:

Scenario 2 (UHF Link to Signal Mountain)		
Signal Mountain	Bar Le Duc	Grand Bassin
145,400	145,225	145,225
431,650	431,650	431,675

Note: 145.400 MHz may be unusable due to interference, if confirmed this frequency may have to be changed.

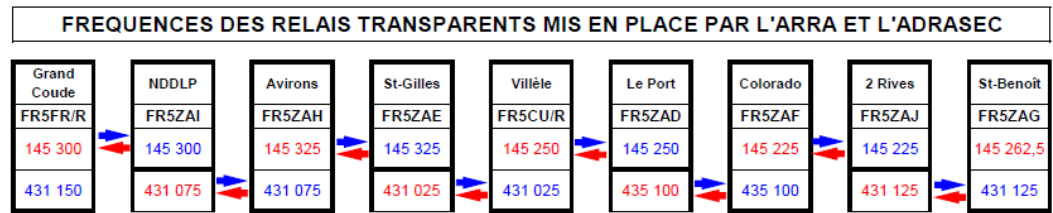
4.0 Repeater Sites – Reunion

Map below showing approximate location of repeaters in Reunion, as exact characteristics of the repeater sites unknown it has not been listed here.



5.0 Frequency Plan Reunion:

Frequency plan of repeaters in Reunion provided by ARRA:



Si je rentre dans un RT par la fréquence écrite en bleu, je pars dans le sens des flèches bleues
Si je rentre dans un RT par la fréquence écrite en rouge, je pars dans le sens des flèches rouges

Pour trafiquer en /M à La Réunion, un bibande VHF UHF est préférable	
RN2	: Après Grands Bois (direction sud sauvage), Saint Joseph, utilisez le RT de Gd Coude
RN2	: De Grands Bois à St Pierre (inclus), utilisez le RT de NDDL
RN3	: de St Pierre à La Plaine des Cafres, utilisez le RT de NDDL
RN3	: De La Plaine des Palmistes à St Benoît, utilisez le RT de St Benoît
RN2	: De St Benoît à Sainte Suzanne, utilisez le RT de St Benoît
RN2	: De Sainte Suzanne à Gillot, utilisez le RT de 2 Rives
RN2	: De Gillot à St Denis (inclus), utilisez le RT du Colorado
RN1	: Du radar (route du littoral) jusqu'au 2ème tunnel de la RDT après le viaduc, utilisez le RT du Port
RN1 RDT	: Du 2ème tunnel de la RDT jusqu'à l'héliport "corail hélicop", utilisez le RT de Villèle
RN1 RDT	: De l'héliport jusqu'au musée de Stella zone du Portail, utilisez le RT de St Gilles
RN1 RDT	: Du musée de Stella zone du Portail jusqu'à Etang Salé (Gouffre), utilisez le RT des Avirons
RN1 RDT	: D' Etang Salé (Gouffre) jusqu'à St Pierre (inclus), utilisez le RT de NDDL
Ancienne RN1	(route côtière) : D'Etang Salé à Saint Leu ("Le Souffleur"), utilisez le RT des Avirons
Ancienne RN1	(route côtière) : De Saint Leu ("Le Souffleur") à Boucan Canot, utilisez le RT de St Gilles
Ancienne RN1	(route côtière) : De Boucan Canot à St Paul (inclus), Le Port, utilisez le RT du Port

Reunion ARRA ADRASEC V2.9

Note: Ideally the link between Mauritius and Reunion should be connected at the end of the chain in each Island so that both side of an ongoing QSO be heard.

6.0 Interference

- During tests in Reunion it was noticed that strong interference present on 145.200 MHz on the North East and on 145.400 MHz at Le Port.
- Also an external interference on 145.400 MHz in Mauritius was received at 3B8DU QTH on the test repeater which blocked the whole chain of repeaters between the islands.

Action:

- To scan all the proposed frequencies and ensure that these are clear before cascading the repeaters in the chain.
- Longer Term: Have remote switch off on all repeaters.

7.0 Colorado (La Montagne):

From below predictions it is quite clear that Trou aux Cerfs is the best site to link Mauritius to Colorado as only Earth curvature is the obstacle.

Colorado station details/ assumptions:

Position: Lat. 20°54'42.62" S Lon. 055°25'18.8" E

Transceiver: Kenwood TMV7

Altitude: 731 m

Antenna: Diamond X-50 Gain VHF 4.5 dBi UHF 7.2 dBi

Feeder total loss: VHF 2.0 dB UHF 4.0 dB (assumed loss)

EIRP: VHF 35.57 W UHF 20.89 W

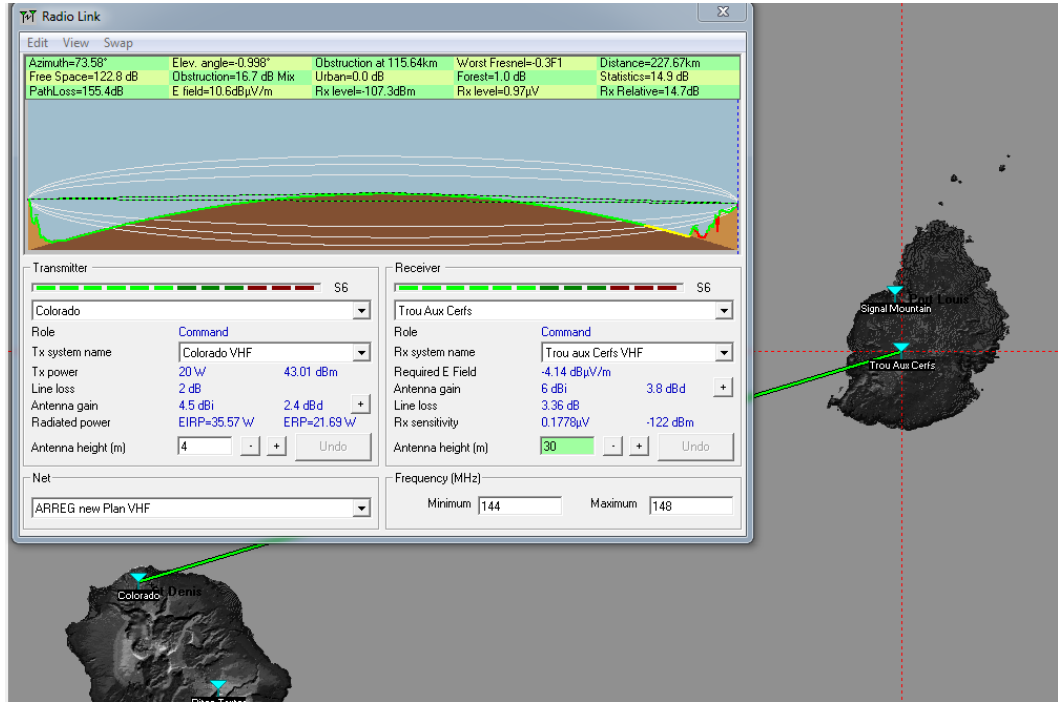
Tests carried out:

Many tests have been made and save the interference issue, it seems that modifications at Trou aux Cerfs has improved the link between the islands and clear communication at all time of the day is now possible.

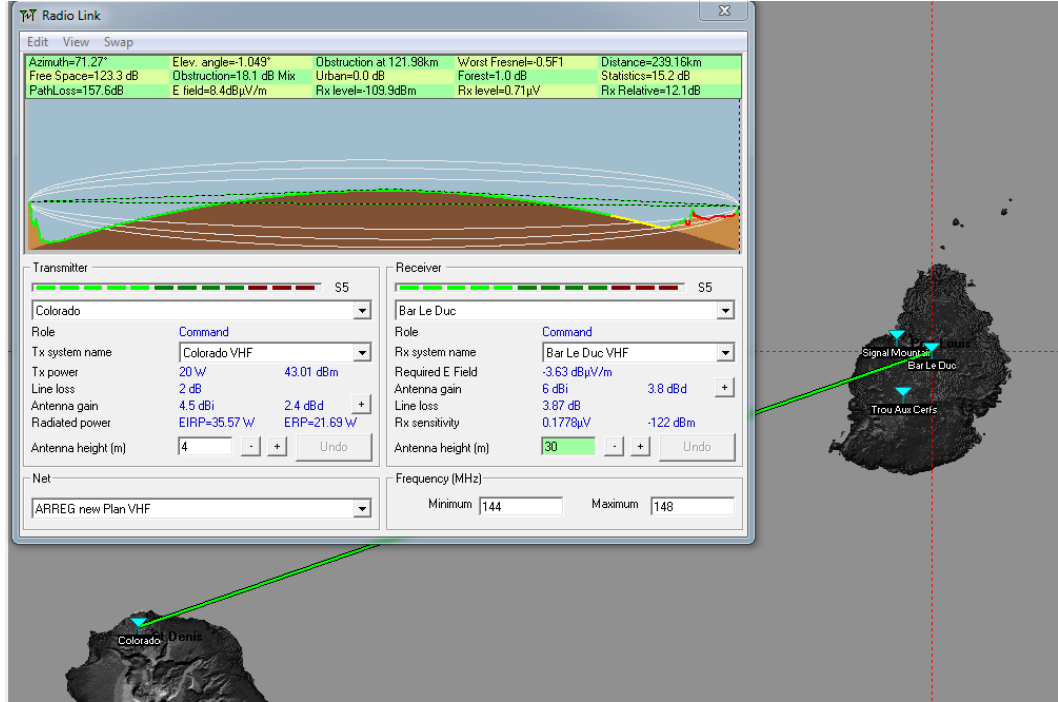
The link between Trou aux Cerfs and Colorado seems now to be stable and reliable, this is still to be proven over time and with seasonal changes, particularly in winter when sea are rough compare to summer and precipitation between the island heavy.

It would be useful to understand fully if clear communication possible in all circumstances, particularly in bad weather between the islands.

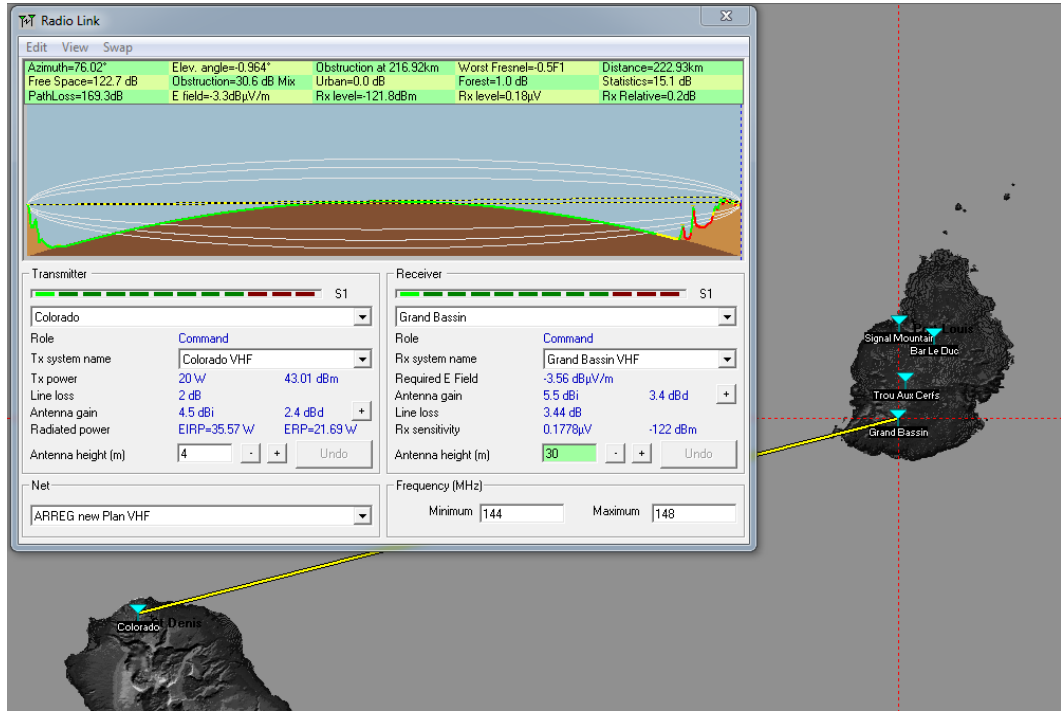
Below link budget between Colorado and Trou aux Cerfs:



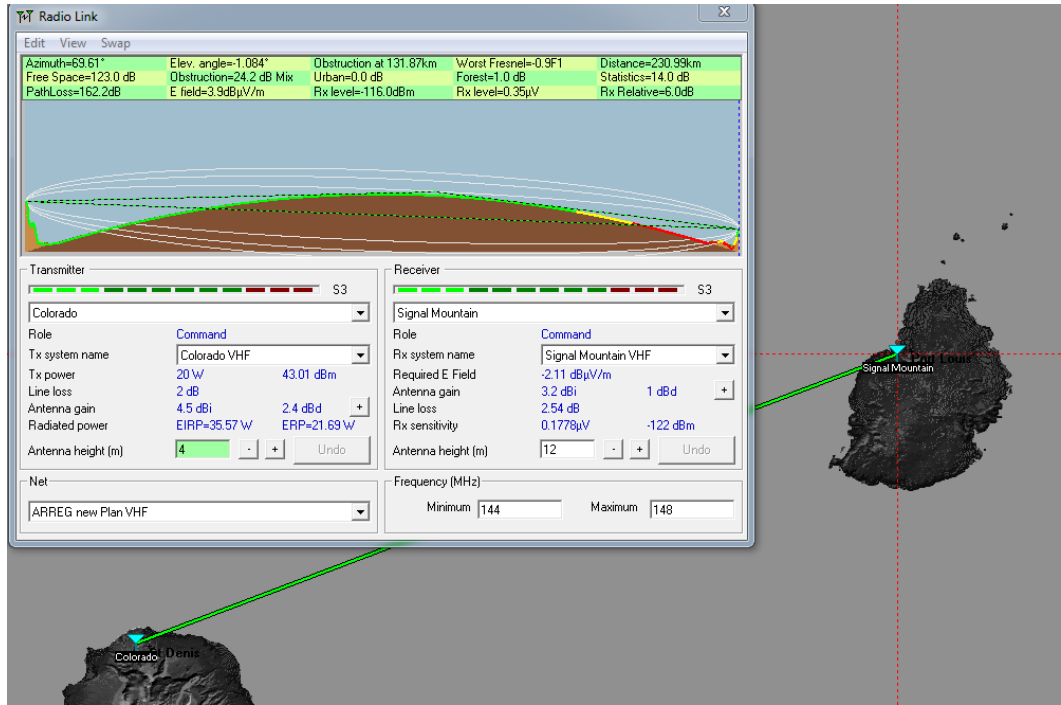
Below link budget between Colorado and Bar le Duc:



Below link budget between Colorado and Grand Bassin:



Below link budget between Colorado and Signal Mountain:



8.0 Piton Textor:

From below predictions it is quite clear that Bar le Duc and Signal Mountain are the best sites to link with Piton Textor with clear line of sight.

For link to Trou aux Cerfs in spite an obstacle entering significantly within the 1st Fresnel zone on Mauritius side, the link should work with high reliability as some 23 dB margin available. This seems confirmed by tests carried out end-September 2016.

Grand Bassin is not workable.

Piton Textor station details/ assumptions:

Position: Lat. 21°11' 18.40" S Lon. 055°38'06.83" E

Altitude: 2147 m

Antenna: Diamond X-50 Gain VHF 4.5 dBi UHF 7.2 dBi

Feeder total loss: VHF 2.54 dB UHF 5.0 dB (assumed loss)

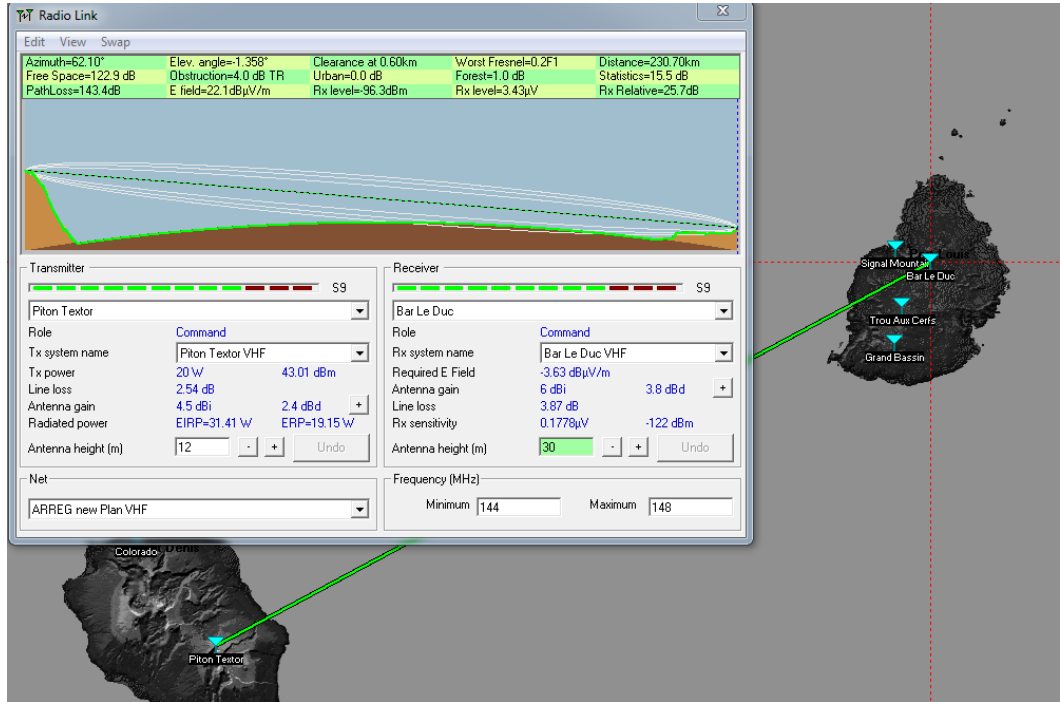
EIRP: VHF 31.41 W UHF 16.60 W

The site belongs to TDF and the high cost (around Euro 24/k yearly) makes it unfeasible, except if TDF waive its hosting cost which seems improbable.

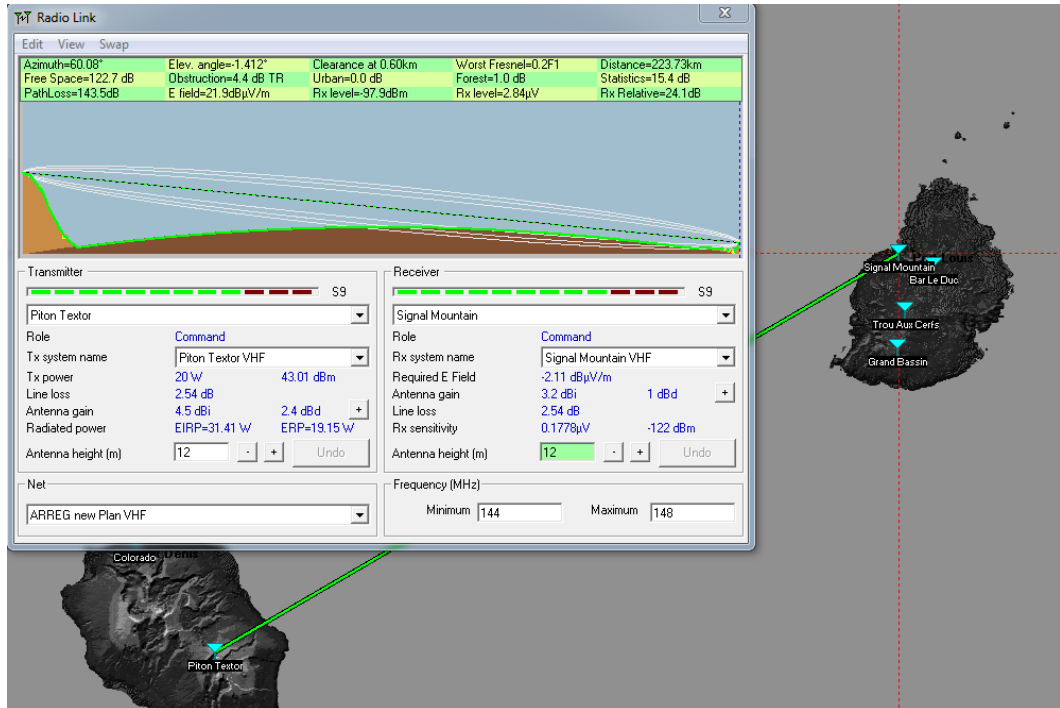
Tests carried out:

Tests was carried on access road at ground level and signal received from Trou aux Cerfs was > S9 on both VHF (145.225) and UHF 431.650 MHz).

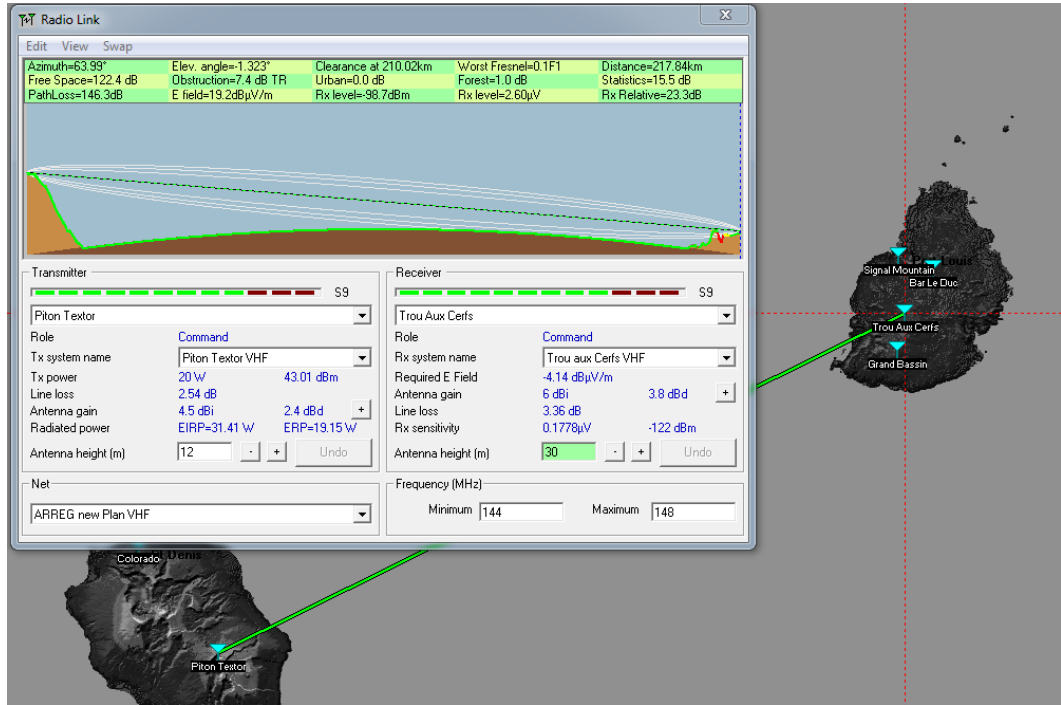
Below link budget between Piton Textor and Bar le Duc:



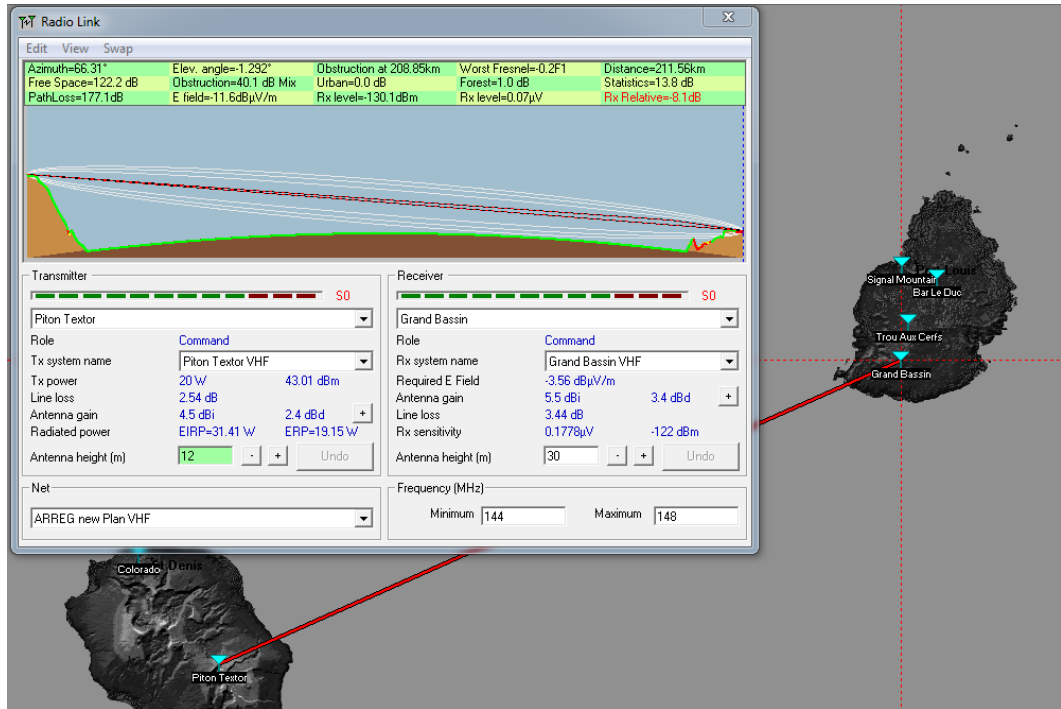
Below link budget between Piton Textor and Signal Mountain:



Below link budget between Piton Textor and Trou aux Cerfs:



Below link budget between Piton Textor and Grand Bassin:



9.0 Col de Bellvue (Plaine des Cafres):

From below predictions it is quite clear that all 4 sites in Mauritius should work with good reliability, the best link being to Bar le Duc.

Col de Bellevue station details/ assumptions:

Position: Lat. 21°09'56.20" S Lon. 055°35'17.3" E

Altitude: 1617 m

Antenna: Diamond X-50 Gain VHF 4.5 dBi UHF 7.2 dBi

Feeder total loss: VHF 2.0 dB UHF 4.0 dB (assumed loss)

EIRP: VHF 35.57 W UHF 20.89 W

- The building, ex-telecommunication site, seems to be abandoned by unknown owner and a small room inside may be easily refurbished. It would be interesting to contact owner and enquire if permission may be granted to install a repeater on this site.
- Due to good propagation to Mauritius there is no need to have a tower, antenna may be mounted on a small (1m) pole on the roof thus avoiding long feeder and undue losses.
- In order to provide power in case of mains supply failure a battery back-up is advisable, particularly in time of natural calamities such as cyclones.

Tests carried out:

Tests were carried out near the building, at ground level, and signal received from Trou aux Cerfs was > S9 on both VHF (145.225) and UHF (431.650 MHz), however there was some trees on the path which will not be the case with a permanent installation.

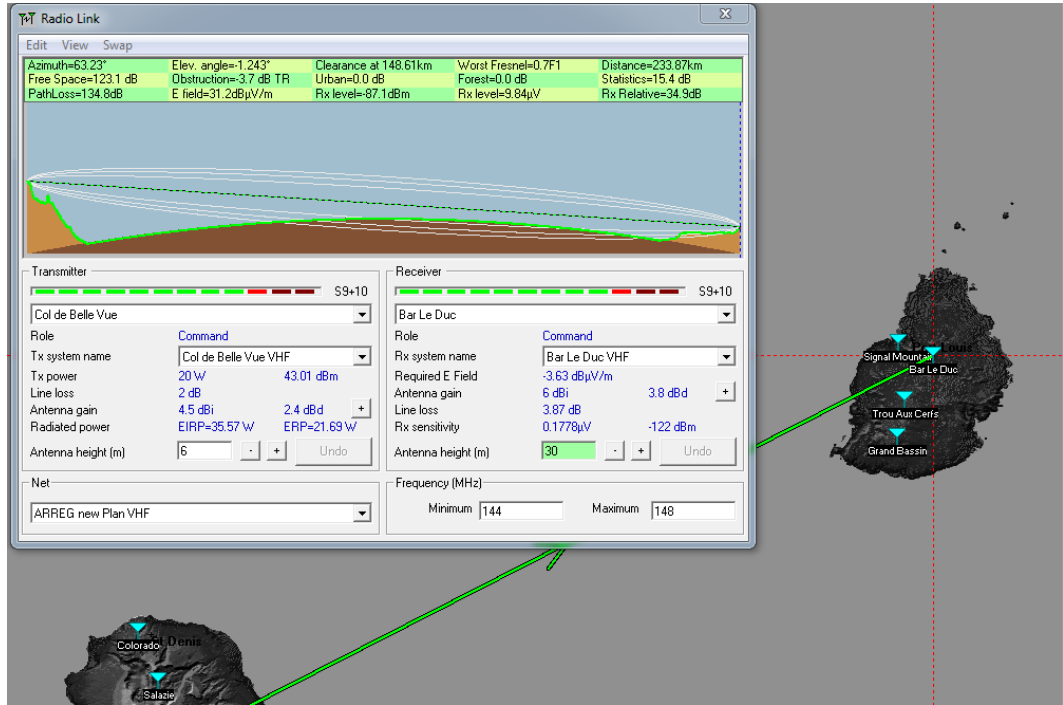
Photo of site/building at Col de Bellevue:



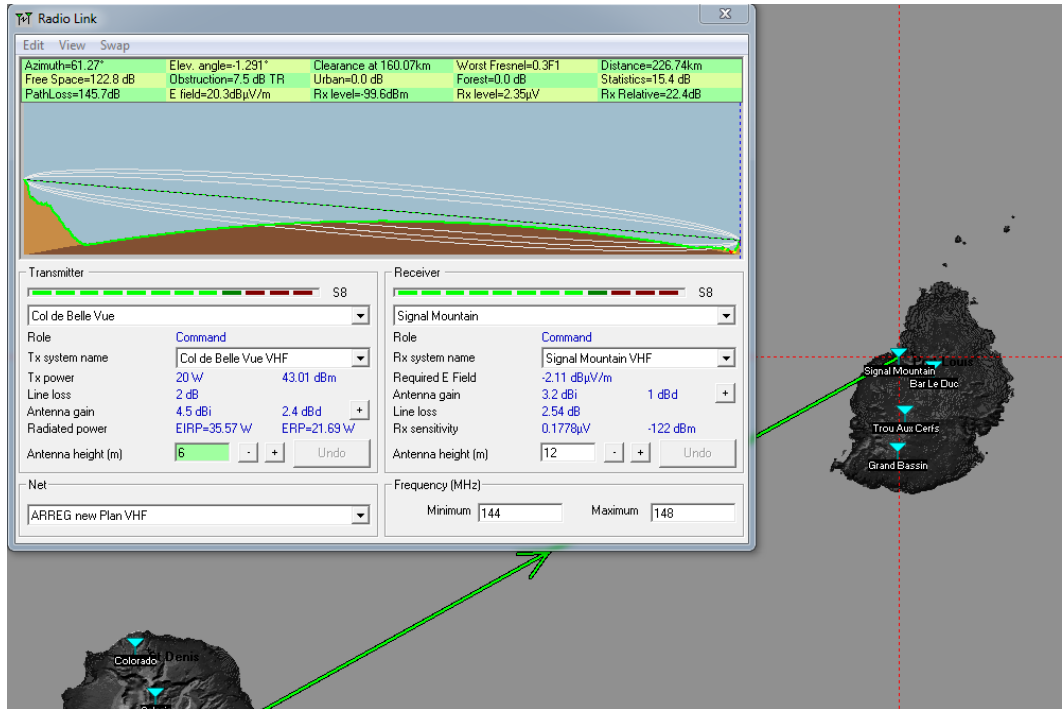
Google Earth position of Col de Bellevue:



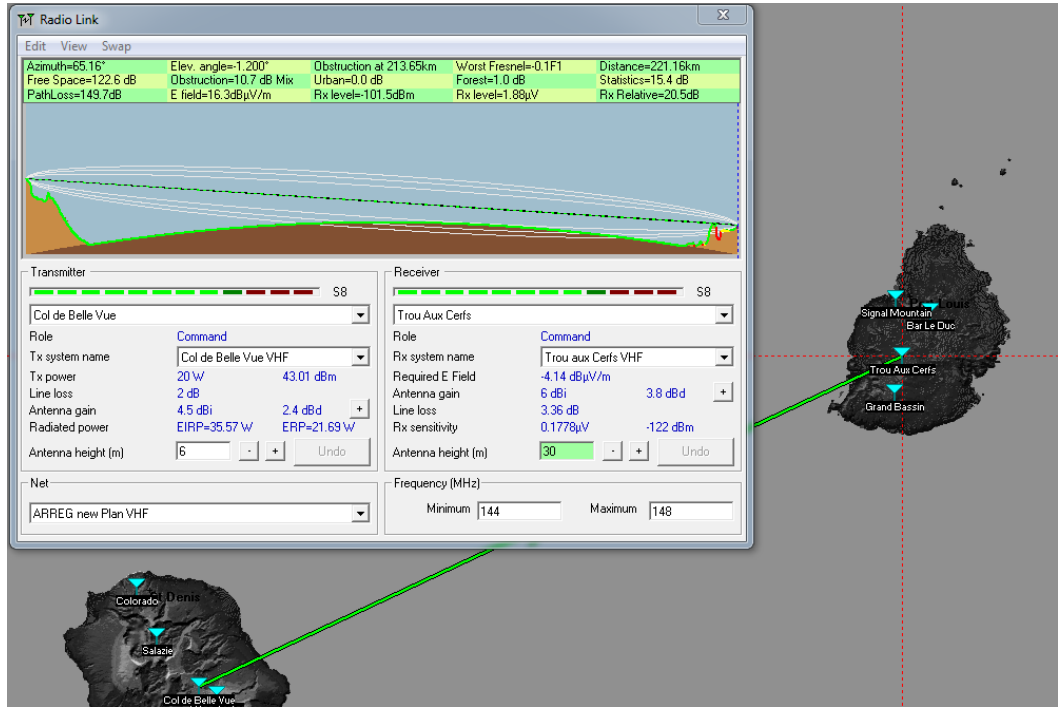
Below link budget between Col de Bellevue and Bar le Duc:



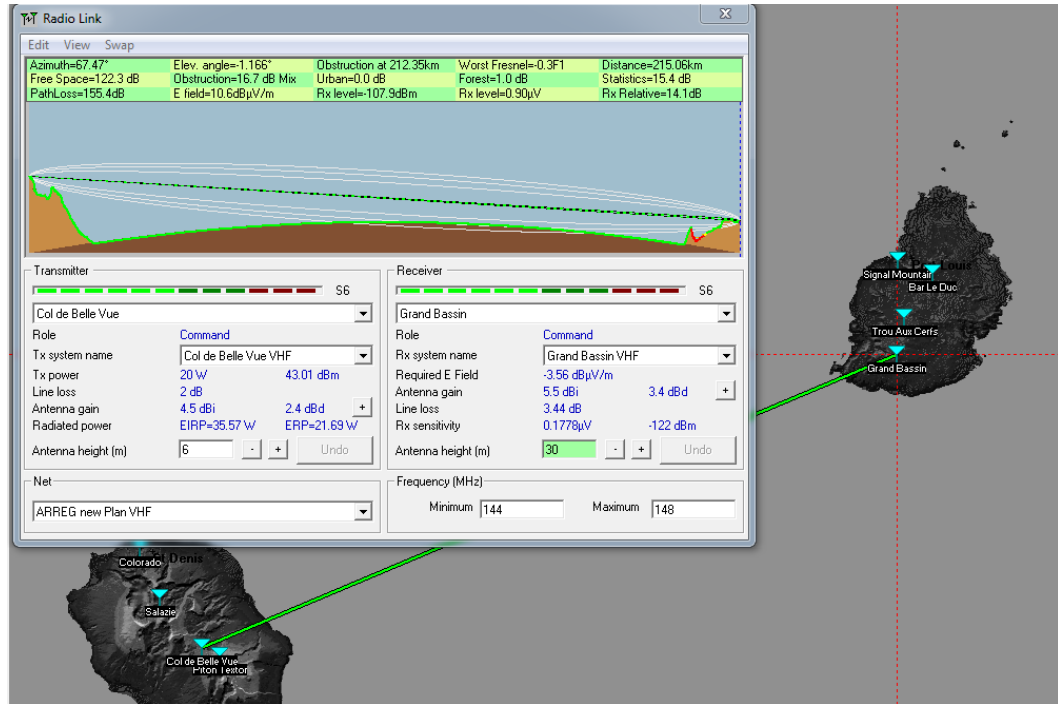
Below link budget between Col de Bellevue and Signal Mountain:



Below link budget between Col de Bellevue and Trou aux Cerfs:



Below link budget between Col de Bellevue and Grand Bassin:



10.0 Grand Islet (Salazie):

Grand Islet station details/ assumptions:

Position: Lat. 20°02'43.29" S Lon. 055°27'36.66" E

Altitude: 1250 m

Antenna: Diamond X-50 Gain VHF 4.5 dBi UHF 7.2 dBi

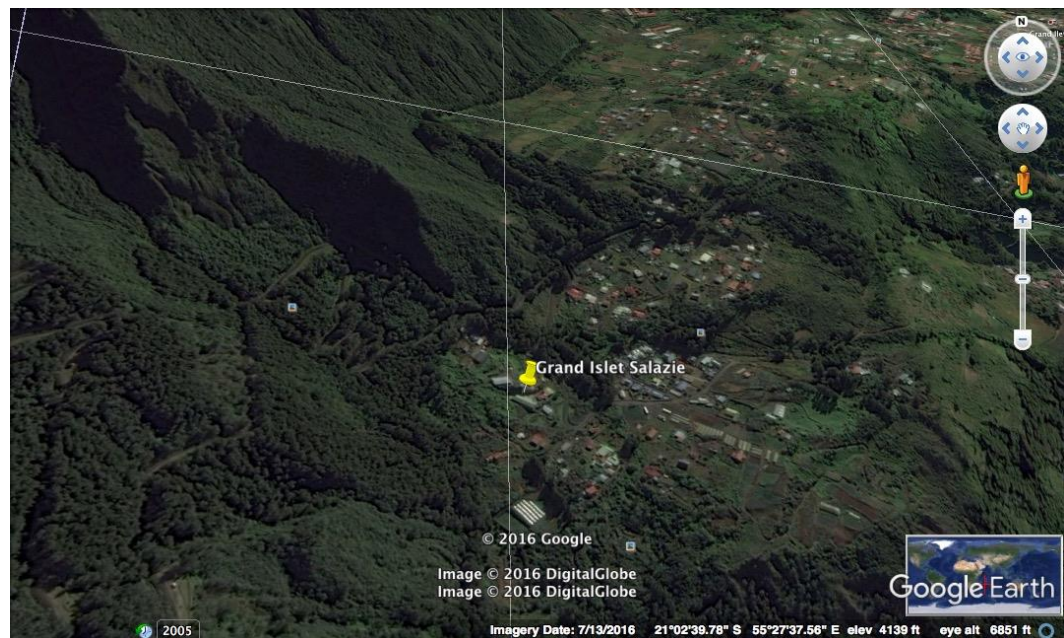
Feeder total loss: VHF 2.0 dB UHF 4.0 dB (assumed loss)

EIRP: VHF 35.57 W UHF 20.89 W

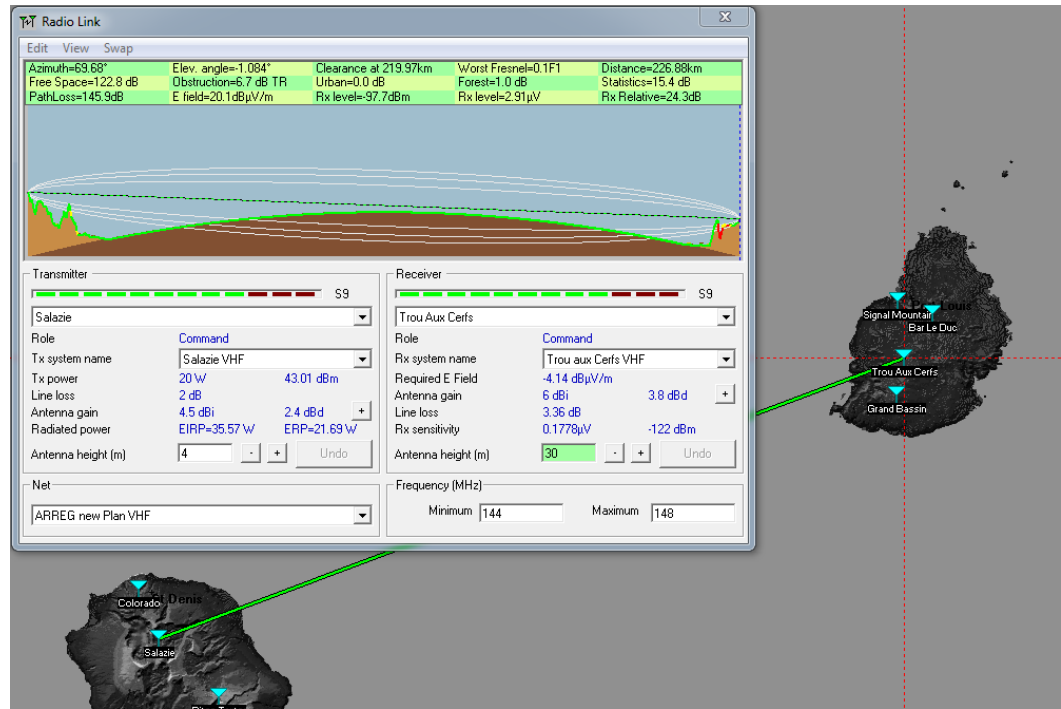
Tests carried out:

Tests was carried on road at ground level and signal received from Trou aux Cerfs was S6 on VHF (145.225 MHz) and S4 on UHF (431.650 MHz) with some obstructions from trees on the road side.

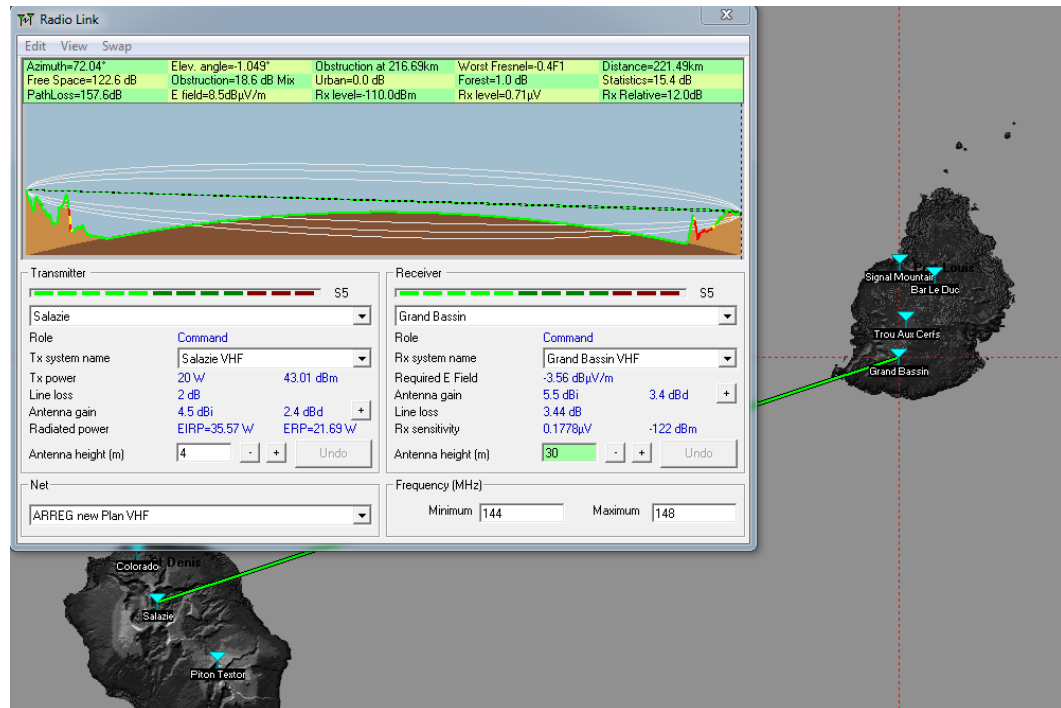
Google Earth position of Grand Islet:



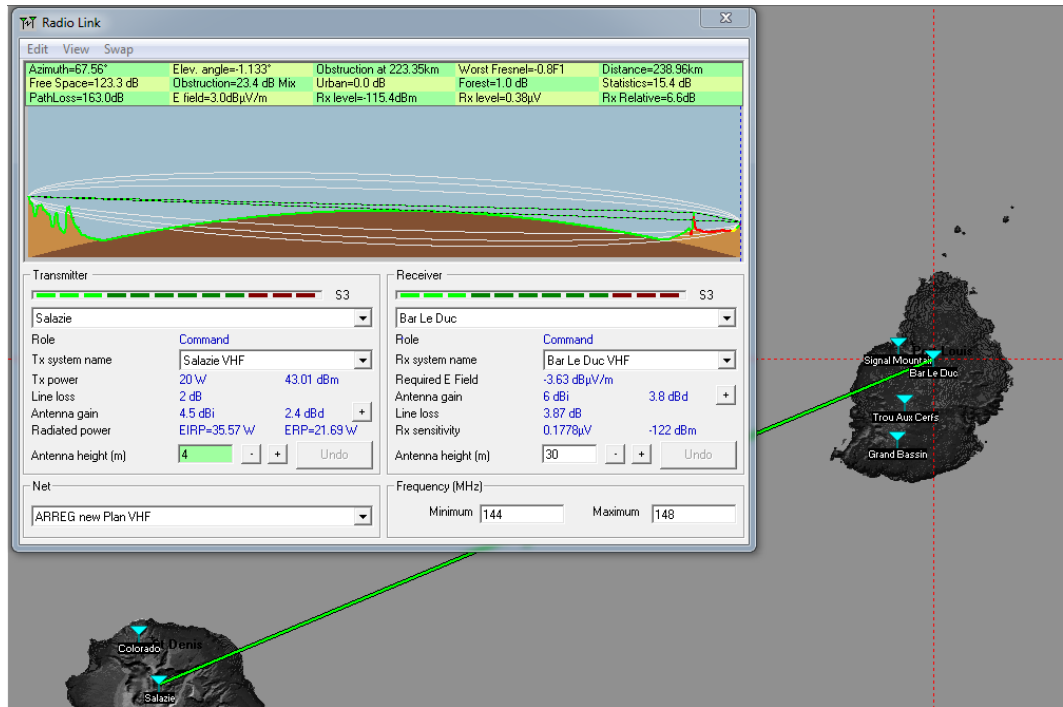
Below link budget between Grand Islet and Trou aux Cerfs:



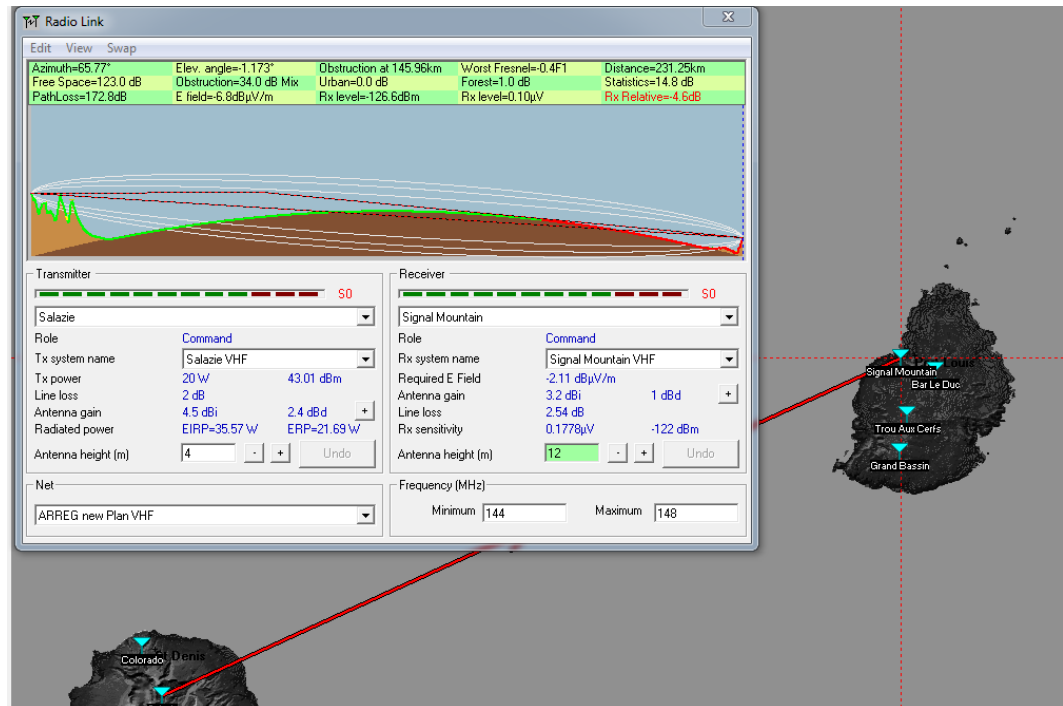
Below link budget between Grand Islet and Grand Bassin:



Below link budget between Grand Islet and Bar le Duc:



Below link budget between Grand Islet and Signal Mountain:



11.0 La Croix de L'Esperance (Plaine des Palmiste):

La Croix de L'Esperance station details/assumptions:

Position: Lat. 21°09'08.37" S Lon. 055°36'41.36" E

Altitude: 1208 m

Antenna: Diamond X-50 Gain VHF 4.5 dBi UHF 7.2 dBi

Feeder total loss: VHF 2.0 dB UHF 4.0 dB (assumed loss)

EIRP: VHF 35.57 W UHF 20.89 W

Tests carried out:

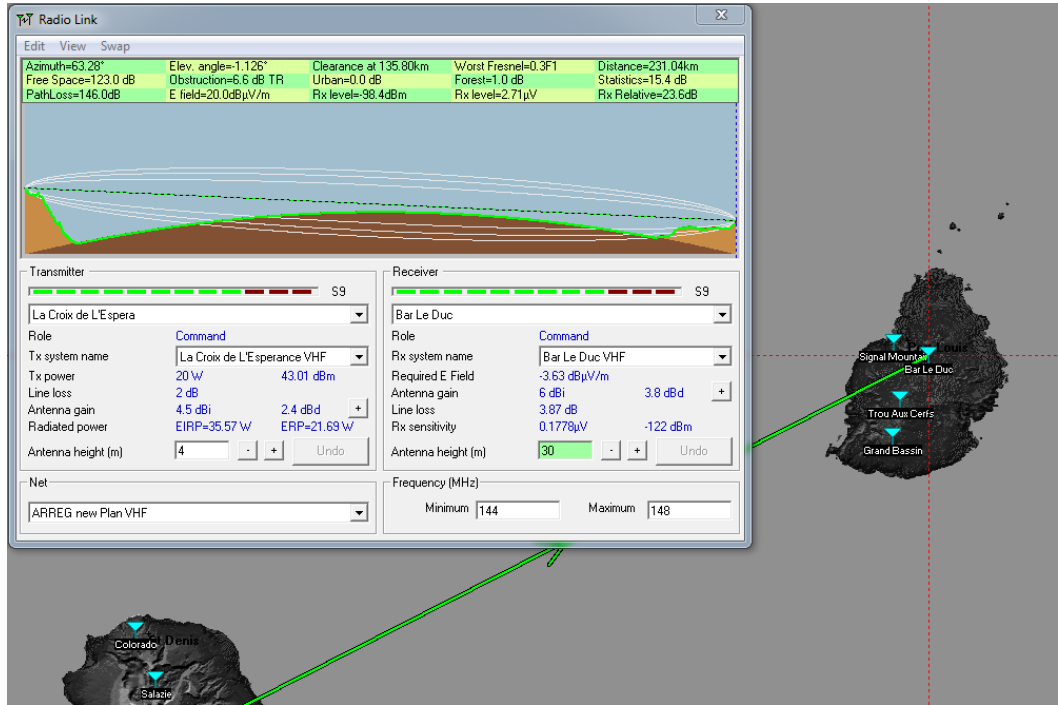
Tests was carried near the Cross on the side of the road and signal received from Trou aux Cerfs was S5 only on VHF (145.225), UHF 431.650 MHz) was not available.

Higher near the Cross on the hill both VHF and UHF was received with variable strength between S5 and S8. However, uphill there is no electricity nor shelter to host the repeater.

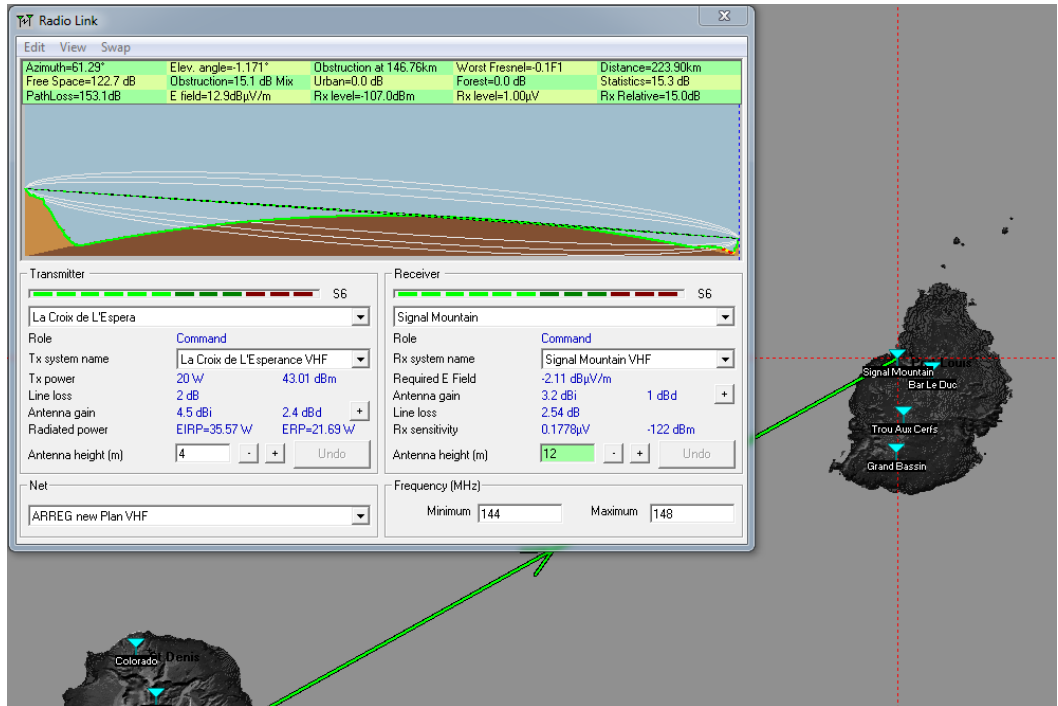
Google Earth position of Croix de L'Esperance:



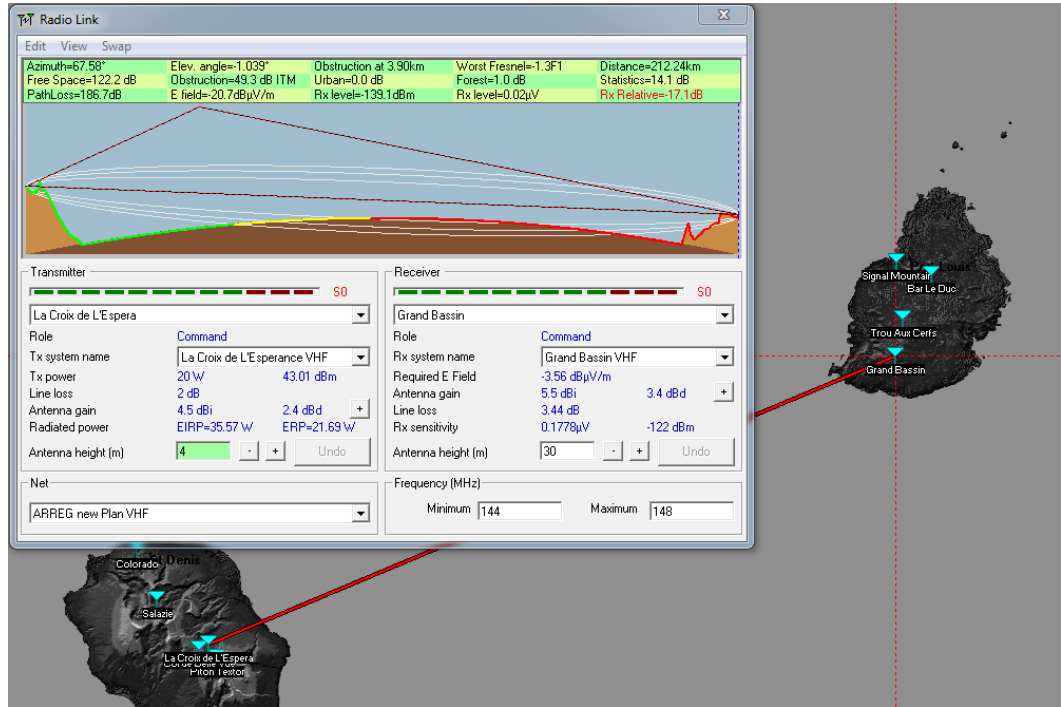
Below link budget between Croix de L'Esperance and Bar le Duc:



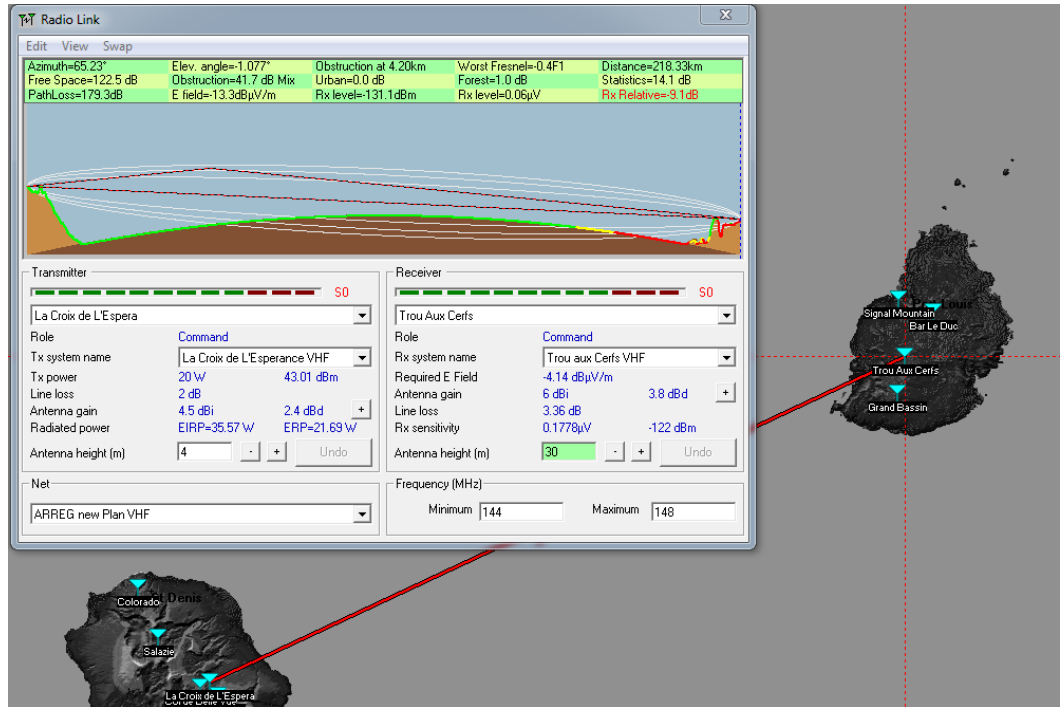
Below link budget between Croix de L'Esperance and Signal Mountain:



Below link budget between Croix de L'Esperance and Grand Bassin:



Below link budget between Croix de L'Esperance and Trou aux Cerfs:



12.0 Alternatives:

Sites of Telecom/mobile Operators should be also be studied, contacts have been made and will hopefully be a possible alternative/opportunity.

13.0 Conclusion/Recommendations:

- a) Piton Textor can be eliminated upfront due to high colocation cost from TDF.
- b) Col de Bellevue is a good potential site if the colocation may be obtained free, some civil works needed such a strong door but I believe this is manageable.
- c) Grand Islet (Salazie) may work out if hosting with inhabitants obtained.
- d) Croix de L'Esperance may also be eliminated as does not bring much improvement over actual Colorado link.

I therefore suggest that the Col de Bellevue site be explored further and eventually other alternatives may come in which may change positively the possibilities.

Jean Marc Momplé (3B8DU)