A. APPELANT INFORMATION	
Company Name	Cumberland Telephone Company
Address	106 Washington St.
City	Cumberland
State	IA
Zip	50843
B. DESIGNATED CONTACT INFORMATION	
Contact Name	Devan Amdor
Contact Phone Number	712-774-2221
Contact Email	amdor@netins.net

C. CERTIFICATION/ATTESTATION/AFFIRMATION

In signing and submitting this form, the above-identified company, and its duly authorized representative signing on behalf thereof, hereby affirms, attests, and certifies under penalty of perjury that, as represented in its submission: Choose one option that describes company/affiliation status.

Company, consistent with the representations made in this form, and regardless of whether your company's prior reporting to to the FCC or State of Iowa was correct or in error as of July 1, 2021, either: (a.) Facilitated material Broadband service according to the designated Tier speed indicated on the Map; or (b.) Did NOT Facilitate Broadband according to the designated Tier speed in the identified census blocks.	☐
Another unaffiliated company, as of July 1, 2021, consistent with the representations made in this form, either: (a.) Facilitated material Broadband service according to the designated Tier speed indicated on the Map; or (b.) Did NOT Facilitate Broadband according to the designated Tier speed in the identified census blocks.	☑

D. ADDITIONAL EXPLANATION (To the extent you believe additional explanation is required to ensure that you are communicating full and accurate information, please use the below space to further explain, qualify, or substantiate your above certification/attestation/affirmation. To the extent necessary, please feel free to upload additional explanations/supporting documentation.

Cumberland Telephone Company no longer provides wireless interenet in this area. Cumberland Telephone Comanys Fiber is mainly used for transport between Bridgewate and Fontanelle.

E. SIGNATURE* By typing your full name you are affixing your signature to this form and attesting to the accuracy of the information submitted herein.

Authorized Signature:	**Devan Amdor**
Title:	**General Manager**
Date:	**7/14/2021**

*PLEASE READ BEFORE SIGNING: By signing and submitting this form, I, on my own behalf or as a representative of the company identified above, as applicable, expressly represent that I am authorized to make the above factual representation on behalf of said company and/or myself, as applicable, and under penalty of perjury as authorized by Iowa Code section 622.1 and pursuant to the laws of the state of Iowa, certify the following with respect to this form submitted on behalf of said company and/or myself: any statements, representations, warranties, certifications, or attestations made in this form, including any attachments or enclosures associated therewith, are true and accurate; I, on behalf of said company and/or myself, have not knowingly made any false statements or representations in this form. In addition to any criminal penalties authorized by Iowa Code section 720.2 that may result from any false statements of material fact made herein or any other remedies available at law, equity, or otherwise, if it is subsequently determined that I have made a statement, representation, warranty, certification, or attestation in this form, or any attachments or enclosures associated herewith, that is later proven untrue in any material respect, the company on which I submitted this form on behalf of may be disqualified from current incentive programs administered by the Office or may be ordered to repay the Office the entire amount of any funds previously distributed by the Office to said company in connection with any current incentive programs administered by the Office. OCIO makes no guarantees as to whether the information supplied by you will result in any change to the Broadband Availability Map V4 or the way any incentive decisions are reviewed, scored, or decided. This form, as completed, any attachments hereto, and any other information or materials submitted to the Office in connection with this form or related inquiry, shall be considered public records and shall be made available for public examination and/or disseminated upon request by third parties as required by Iowa Code chapter 22. The Office reserves the right to reject this form and relatedly consider any information communicated through this form as neither credible nor probative if this form is not fully and properly filled out.

Please familiarize yourself with the following terms prior to determining whether a broadband block may be appealed.	
Targeted Service Area	A Targeted Service Area (TSA) is a census block within which no communications service provider offers or facilitates broadband service at or above the tier 1, tier 2, or tier 3 download and upload speeds.
Existing Broadband Speed Tiers	The speed tiers used to determine whether a broadband block qualifies as a Targeted Service Area on the Statewide Broadband Availability Map.
Tier 1	A maximum download speed of less than 25 megabits per second (Mbps) and a maximum upload speed of less than 3 Mbps.
Tier 2	A minimum download speed of greater than or equal to 25 Mbps but less than 50 Mbps. No minimum upload speed is applicable for Tier 2.
Tier 3	A minimum download speed of greater than or equal to 50 Mbps but less than 80 Mbps. No minimum upload speed is applicable for Tier 3.
Non-TSA	A non-TSA is a census block in which speeds are Facilitated at greater than equal to 80 Mbps
Facilitate	A communication service provider's ability to provide broadband service at or above the download and upload speeds defined above to a home, farm, school, or business within a commercially reasonable time and at a commercially reasonable price upon request by a consumer. This does *not* pertain to the Broadband Infrastructure used to facilitate said service; Broadband Infrastructure is *not* a basis for appeal.

CENSUS BLOCK ID	Prior Reporting to FCC or Connected Nation Definitions 1. ***In Error*** means data was reported incorrectly to FCC or Connected Nation. 2. ***Correct*** means data was reported coreectly to FCC or Connected Nation. 3. ***No Response*** means data was not reported to FCC or Connected Nation. 4. ***Unknown*** means data is incorrect for unknown reasons	Speed Tier that is reflected on Map v.4	What do you believe the Map should reflect for Facilitated service as of July1, 2021?
190019602002083	Unknown	non-TSA	Tier 1
190019602002109	Unknown	non-TSA	Tier 1
190019602002307	Unknown	non-TSA	Tier 1
190019602002075	Unknown	non-TSA	Tier 1
190019602002054	Unknown	non-TSA	Tier 1
190019602002079	Unknown	non-TSA	Tier 1
190019602002077	Unknown	non-TSA	Tier 1
190019602002303	Unknown	non-TSA	Tier 1
190019602002210	Unknown	non-TSA	Tier 1
190019602002067	Unknown	non-TSA	Tier 1
190019603004114	Unknown	non-TSA	Tier 1
190019603004087	Unknown	non-TSA	Tier 1
190019603004089	Unknown	non-TSA	Tier 1
190019603004110	Unknown	non-TSA	Tier 1
190019602002020	Unknown	non-TSA	Tier 1
190019602002021	Unknown	non-TSA	Tier 1
190019603004007	Unknown	non-TSA	Tier 1
190019602002022	Unknown	non-TSA	Tier 1
190019602002060	Unknown	non-TSA	Tier 1
190019602002035	Unknown	non-TSA	Tier 1
190019603004017	Unknown	non-TSA	Tier 1
190019603004003	Unknown	non-TSA	Tier 1
190019603004004	Unknown	non-TSA	Tier 1

190019603004016	**Unknown**	non-TSA	Tier 1
190019603004005	**Unknown**	non-TSA	Tier 1
190019602002030	**Unknown**	non-TSA	Tier 1
190019602002029	**Unknown**	non-TSA	Tier 1
190019602002028	**Unknown**	non-TSA	Tier 1
190019602002027	**Unknown**	non-TSA	Tier 1
190019602002032	**Unknown**	non-TSA	Tier 1
190019603004138	**Unknown**	non-TSA	Tier 1
190019603004080	**Unknown**	non-TSA	Tier 1
190019603004085	**Unknown**	non-TSA	Tier 1
190019603004175	**Unknown**	Non-TSA	Tier 1
190019603004083	Unknown	Non-TSA	Tier 1
190019602002041	Unknown	Non-TSA	Tier 1
190019603004174	Unknown	Non-TSA	Tier 1
190019603004164	Unknown	Non-TSA	Tier 1
190019603004000	Unknown	Non-TSA	Tier 1
190019602002305	Unknown	Non-TSA	Tier 1
190019603004053	Unknown	Non-TSA	Tier 1
190019602002049	Unknown	Non-TSA	Tier 1
190019603004074	Unknown	Non-TSA	Tier 1
190019603004019	Unknown	Non-TSA	Tier 1
190019603004073	Unknown	Non-TSA	Tier 1
190019603004014	Unknown	Non-TSA	Tier 1
	"See attached document for further explanation on fixed wireless networks" .		

Fixed wireless has its place in the telecommunications arena. It can provide service to a number of subscribers using a shared bandwidth to provide data, voice and video. The access points can be located in elevated locations to provide service to a given areas. These systems can be installed relativity quickly, providing power, permits, clear line-of-sight and back-haul are available.

There are, however, a number of factors that will degrade the performance of a fixed wireless link. The following takes a look at some of these factors.

Free space loss is the starting point in determining the loss in signal strength and performance of the link between the transmitter and the receiver. Free space loss is dependent on frequency and distance. As these variables increase, the loss increases.

One of the general equations used to estimate free space loss is:

$$L_{FSL} = 92.45 + 20\log log\, f_{GHz} + 20\log log\, d_{km}$$

Where:

- L_{FSL} – total path loss in dB
- f – frequency in GHz
- d – distance in kilometers

An example: With a fixed frequency of f = 5.8 GHz and a distance varying form 0.5 km (0.31 miles) to 3 km (1.86 miles):

$$L_{FSL} = 92.45 + 20\log log\,(5.8) + 20\log log\,(0.5) = 101.70\, dB$$

$$L_{FSL} = 92.45 + 20\log log\,(5.8) + 20\log log\,(1.25) = 109.65\, dB$$

$$L_{FSL} = 92.45 + 20\log log\,(5.8) + 20\log log\,(2.0) = 113.78\, dB$$

$$L_{FSL} = 92.45 + 20\log log\,(5.8) + 20\log log\,(3.0) = 117.23\, dB$$

For a change of just over 1.55 miles, the results in an additional 15.53 dB of loss in the signal path.

Another factor that can have a major impact on system performance is vegetation attenuation. Vegetation loss is dependent on transmit frequency and the depth of the

foliage that the signal is passing through. As can be seen from the equation below, the loss will increase with both frequency and depth of the foliage.
One of the equations used to determine the vegetation attenuation is:

$$L_{Veg} = 0.2 f^{0.3} d^{0.6}$$

Here:

- f – frequency in MHz
- d – depth of foliage

Using the same frequency as above, 5800 MHz (5.8 GHz) and depth of foliage between 5 and 20 feet.

$$L_{Veg} = 0.2(5800)^{0.3}(5)^{0.6} = 3.47\ dB$$

$$L_{Veg} = 0.2(5800)^{0.3}(10)^{0.6} = 5.25\ dB$$

$$L_{Veg} = 0.2(5800)^{0.3}(15)^{0.6} = 6.70\ dB$$

$$L_{Veg} = 0.2(5800)^{0.3}(20)^{0.6} = 7.96\ dB$$

This shows how quickly the loss increase as the depth of the foliage increase. This can be thought of as a tree growing between the transmitter and the receiver. The system performance drops off as the tree grows.

The vegetation can be related to the Fresnel zone. As seen in the figure below, the Fresnel zone expands as it moves way from the antennas. The Fresnel zone will be at its maximum diameter at the mid-point between the transmit and receive antennas. As can be seen in the figure below.

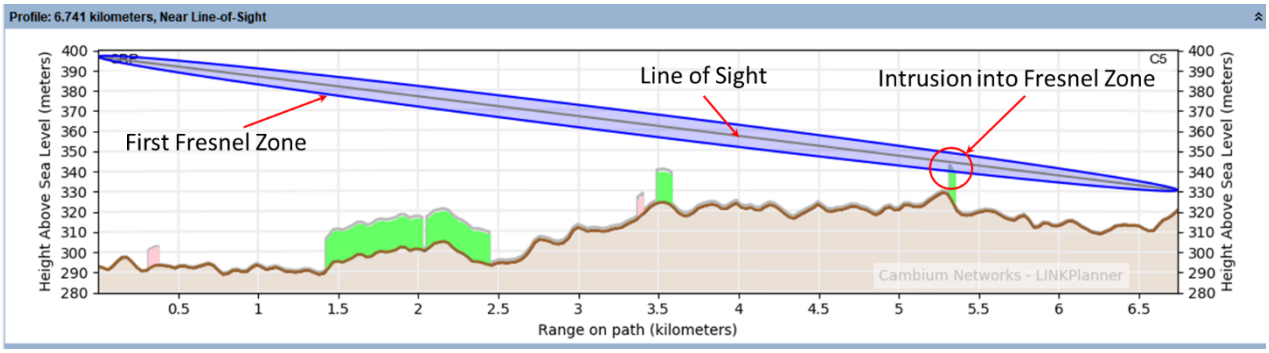


Figure 1 Fresnel Zone

As can be seen, the Line-of-Sight may be clear, but the Fresnel zone may not. The deeper the intrusion into the Fresnel zone the bigger the effect. This can run from 0 dB to the total blockage of the signal.

To see how these two factors affect the link, we add the losses together as 15.53 dB + 7.96 dB to obtain an additional loss of up to 23.49 dB. At 3 km the total path loss will increase from 117.23 dB up to 140.72 dB.

What does this mean? As the amount of loss increases, the signal level will decrease. As the signal level decreases, it approaches the noise floor. Once the single reaches and drops below the noise floor, the signal is loss.

As the signal-to-noise ratio decreases, the channel capacity also decreases. This can to estimated using Shannon equation for channel capacity.

$$C \leq W\left[1 + \left(\frac{s}{n}\right)\right]$$
$$C \leq 3.322\, W\left(\frac{s}{n}\right)$$
$$C \leq 0.3322\, W\left[\frac{S}{N}(dB)\right]$$

Where:
C – channel capacity in (Mbps)
W – channel bandwidth (MHz)
s/n – channel signal to noise (power ratio)
S/N – channel signal to noise (dB)

The following table shows the effect of decreasing the signal power against a fixed noise floor.

Table 1 Channel Capacity vs. S/N Ratio

Parameters	dBm	S/N (dB)	Capacity (Mbps)
Noise	-56	54	231.25
Signal	-110		
Noise	-75	35	206.8
Signal	-110		
Noise	-90	20	175.69
Signal	-110		
Noise	-100	10	138.38
Signal	-110		
Noise	-109	1	40
Signal	-110		

In addition to these, there are a number of other factors that impact the performance. Without going into details, the following include:

- Gas absorption
- Precipitation
    - Rain
    - Snow
    - Hail
    - Fog
    - Haze
- Obstacles
    - Buildings
    - Trees
    - Terrain
- Ground reflection
    - Water
    - Flat ground
    - Paved areas
- Fading
    - Atmospheric changes
    - Ground and water reflection changes
    - Flat fading
    - Frequency-selective fading
- Multipath fading
- Interference
    - Other transmitter on the same frequency
    - Transmitters located in the side-lobes
    - Background noise
    - Intentional interference

All of these will have a detrimental effect on the system performance. Some factors will have more of an effect than other.

One method of increasing the through put is to use various modulation formats. For the equipment used in this document, Quadrature Amplitude Modulation (QAM). This format allows multiple bits of information to be transmitted at one time. The table below show how many bits can be transmitted for each of the modulation levels.

Table 2 QAM Modulations

Modulation	MINO Type	Aggregated Max Data Rate	# BITS per symbol
256 QAM	B	271.97 Mbps	8
128 QAM	B	237.98 Mbps	7
64 QAM	B	203.98 Mbps	6
32 QAM	B	169.98 Mbps	5
16 QAM	B	135.99 Mbps	4
8 QUAM	B	101.99 Mbps	3
QPSK	B	67.99 Mbps	2
256 QAM	A	135.99 Mbps	8
64 QAM	A	101.99 Mbps	6
16 QAM	A	67.99 Mbps	4
QPSK	A	34.00 Mbps	2

These levels are affected by rain. The heaver the rain the lower the modulation level that can be used. The figure below provides an example of rain fade on the link.

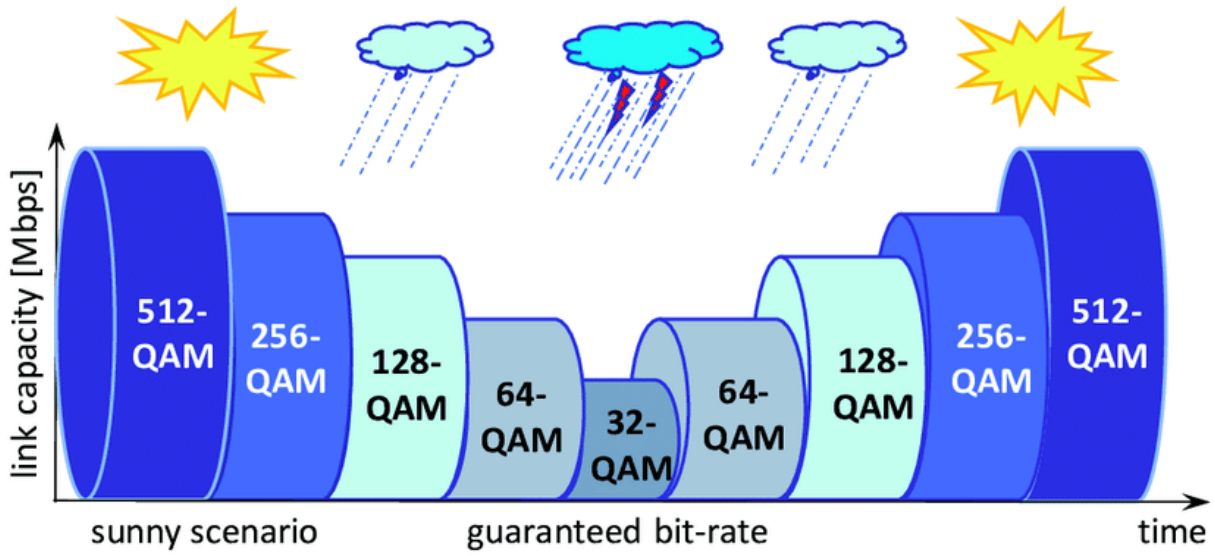
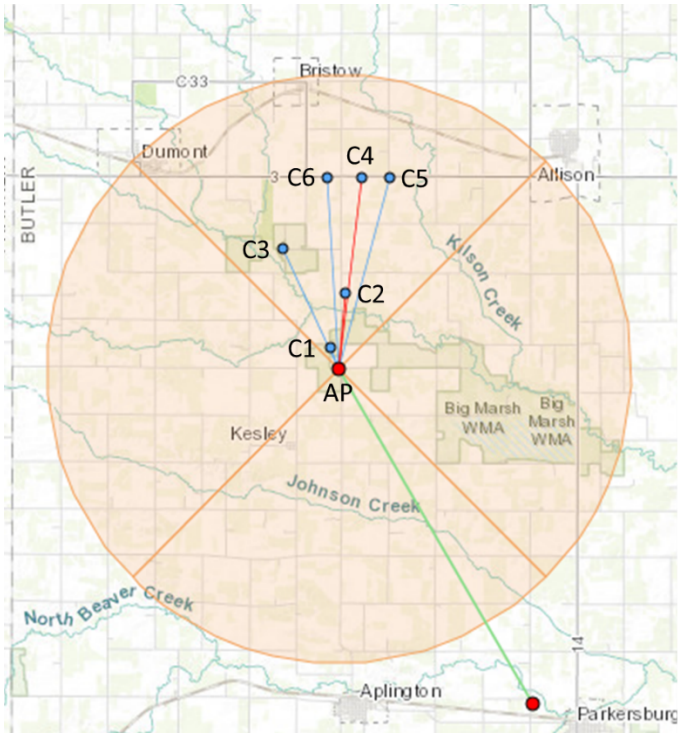


Figure 2 Rain Fade

The following looks at some simulations that demonstrate the effects. The tool used to generate the following: Cambium LINKPlanner 64-bit, 5.5.0 build date 2021-07-01.

The following simulations are based on a tower located between Dumont and Parkersburg; IA. Six potential subscriber locations were selected.

NOTE: This configuration does not represent the actual configuration for these locations, but is being used for demonstrations purposes only. This is being used to demonstrate the effects of some common variables on the link performance.



Frequency band – 5.8 GHz
Tower height – 104 meters
Equipment – PTP – PTP670
PMP – PM450i
Bandwidth – 40 MHz
EIRP – 36 dBm Max power 18 dBm
SM Receiver target level - -56 dBm
Antenna sector – 90 deg
Sector gain – 18 dB

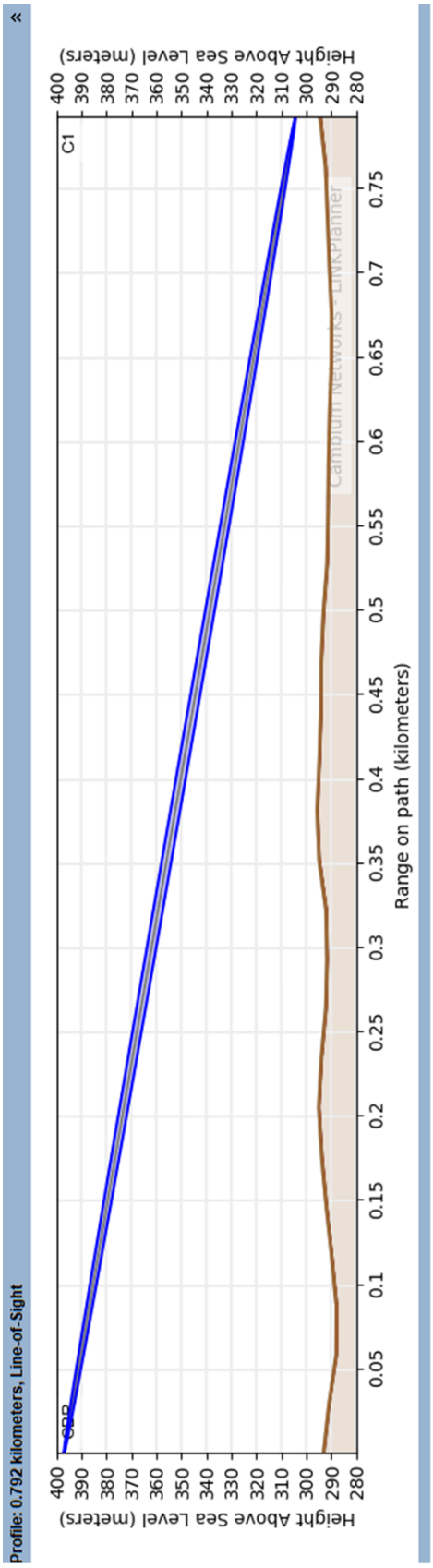
Subscriber Modules
Bandwidth – 40 MHz
EIRP – 37 dBm Max power 14 dBm
Antenna – MIMO-A/B
Antenna – 10 deg high gain 23 dBi
Height – 10 meters

Figure 3 Baseline for Simulations

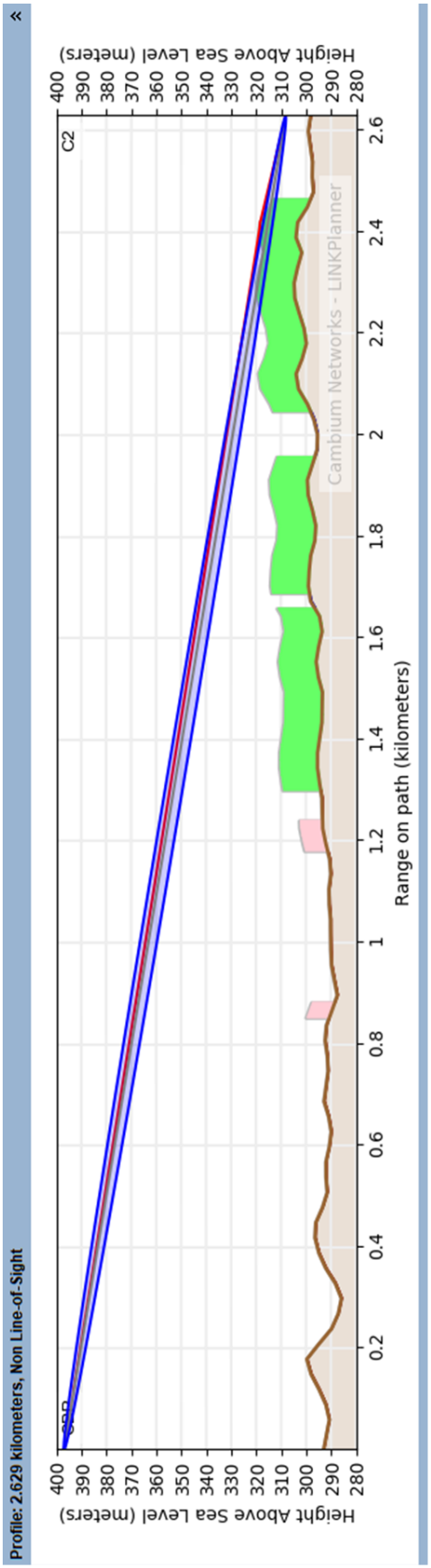
The following figures show the elevation view of the link. The access point is located on the left side of the figure and the subscriber is on the right side. Raised green areas indicate the presents of vegetation, trees in these cases. The red raised areas indicate the presents of different structures, homes, sheds, animal confinements, grain binds and the like.

The frequency, location, height of the antennas, transmit power, receive level and bandwidth are maintain through all simulations.

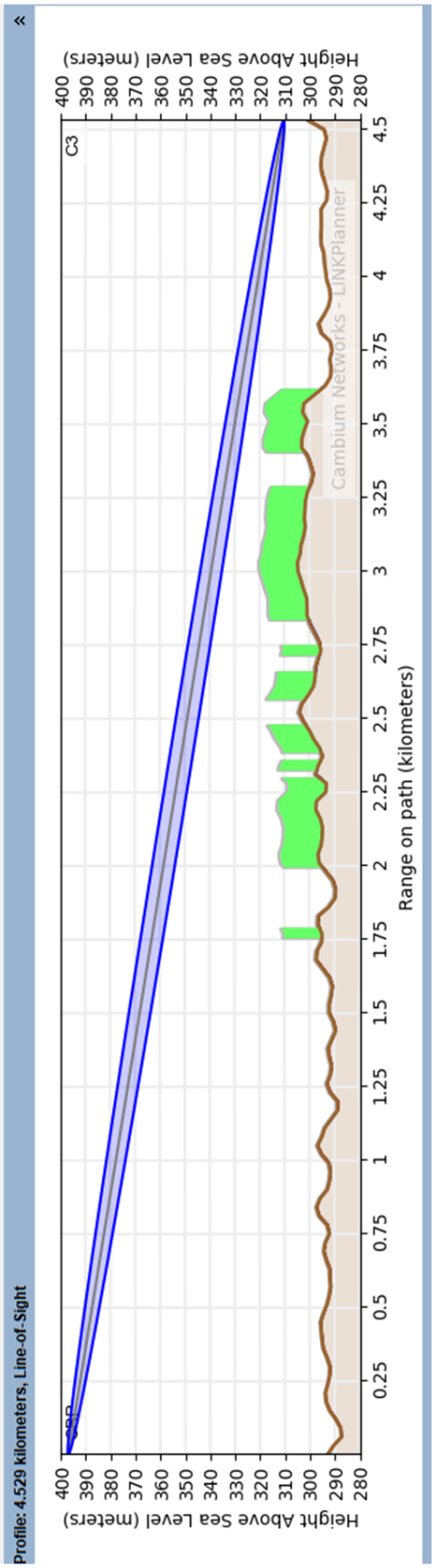
During the simulations, the percent availability and the interference levels were changed to show how some minor changes can have a large effect on the link budget.



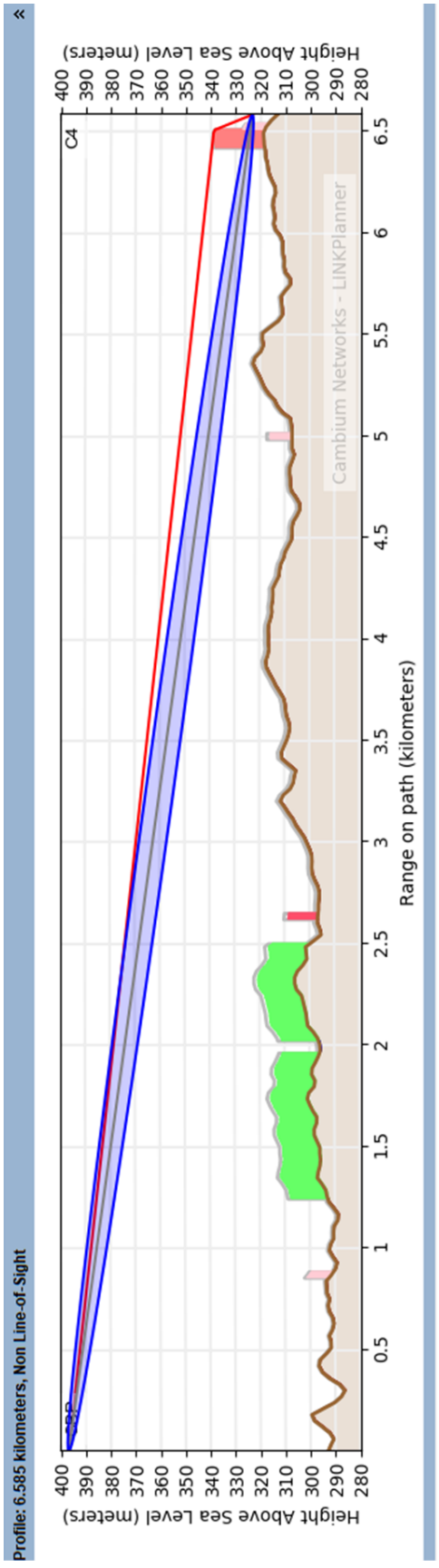
Subscriber C1
Distance 0.96 km/0.60 miles
Clear Line-of-Sight and Fresnel zone
Fairly flat terrain



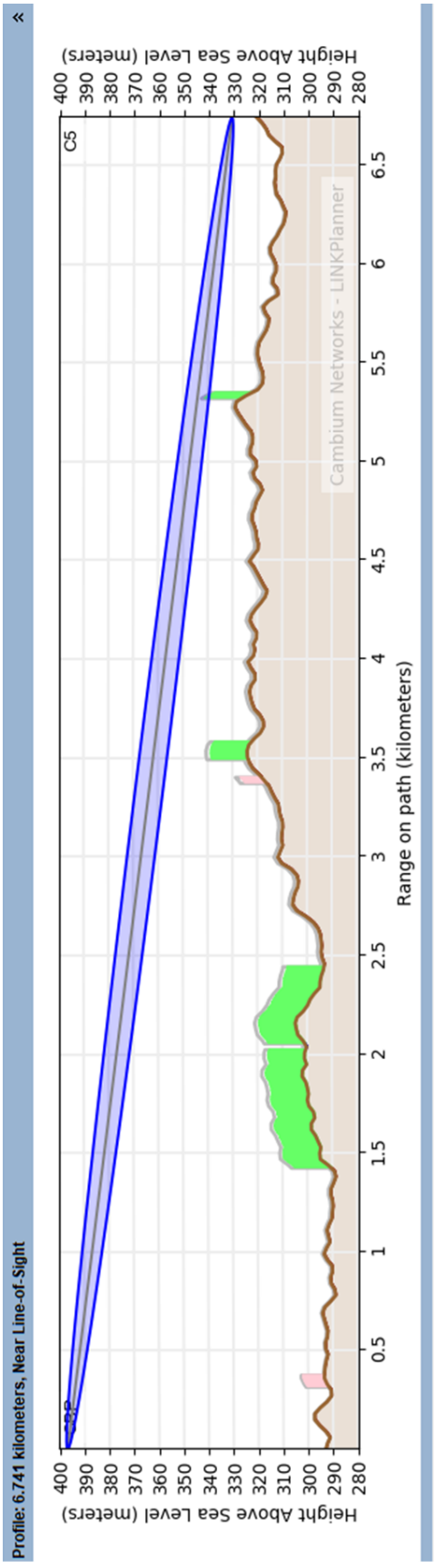
Subscriber C2
Distance 2.63 km/1.63 miles
Vegetation in Line-of-Sight



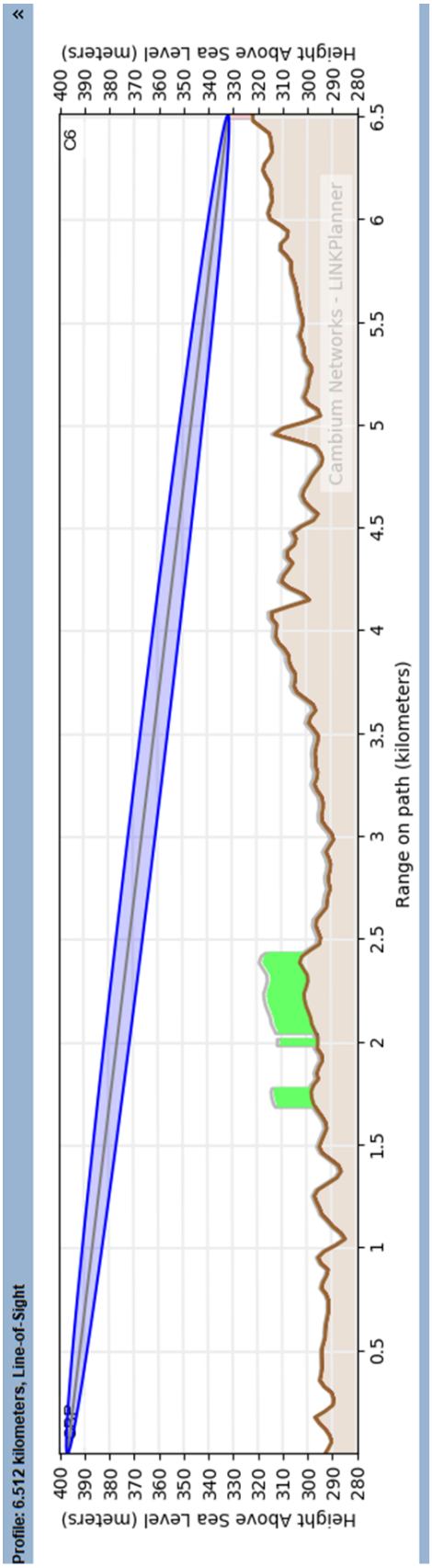
Subscriber C3
Distance 4.53 km/2.81 miles
Clear Line-of-Sight and Fresnel zone
Terrain rough with trees along path



Subscriber C4
Distance 6.53 km/4.06 miles
Site shadowed by another structure
Terrain rough with trees and other structures along the path



Subscriber C5
Distance 6.73 km/4.18 miles
Small tree entering the Fresnel zone
Terrain rough with increase in elevation and trees and other structures along the path



Subscriber C6
Distance 6.51 km/4.04 miles
Clear Line-of-Sight and Fresnel zone
Rough terrain with trees along the path

Fixed Wireless Simulation Initial Condition

Parameters	C1	C2	C3	C4	C5	C6
AP Interference	-90 dBm	-90 dBm	-90 dBm	-90 dB	-90 dB	-90 dB
SM Interference	-90 dBm	-90 dBm	-90 dBm	-90 dB	-90 dB	-90 dB
Distance	0.96 km/0.60 miles	2.63 km/1.63 miles	4.53 km/2.81 miles	6.53 km/4.06 miles	6.73 km/4.18 miles	6.51 km/4.04 miles
Predicted Received Power	-53 dBm	-83 dBm	-64 dBm	-30.18 dBm	-72 dBm	-67 dBm
Min Availability Required	99.0000%	99.0000%	99.0000%	99.0000%	99.0000%	99.0000%
Max Usable Mode	x7 (128QAM MIMO--B)	N/A	x4 (16QAM MIMO-B)	N/A	x1(QPSK MIMO-A)	x4(16QAM MIMO-B)
Predicted Available	99.9995%	6.12%	100.0000%	0.0000%	99.9984%	99.3320%
System Gain Margin	22.48 dB	-2.58 dB	16.35 dB	-30.18 dB	7.74 dB	13.43 dB
Free Space Path Loss	105.68 dB	116.09 dB	120.82 dB	124.07 dB	124.27 dB	123.97 dB
Gaseous Absorption Loss	0.01 dB	0.02 dB	0.04 dB	0.06 dB	0.06 dB	0.06 dB
Excess Path Loss	0.00 dB	25.63 dB	0.00 dB	43.29 dB	4.87 dB	0.00 dB
Total Path Loss	105.68 dB	141.74 dB	120.86 dB	167.42 dB	129.20 dB	124.03 dB

Fixed Wireless Simulation Increase in Availability

Parameters	C1	C2	C3	C4	C5	C6
AP Interference	-90 dBm	-90 dBm	-90 dBm	-90 dB	-90 dB	-90 dB
SM Interference	-90 dBm	-90 dBm	-90 dBm	-90 dB	-90 dB	-90 dB
Distance	0.96 km/0.60 miles	2.63 km/1.63 miles	4.53 km/2.81 miles	6.53 km/4.06 miles	6.73 km/4.18 miles	6.51 km/4.04 miles
Predicted Received Power	-53 dBm	-83 dBm	-64 dBm	-30.18 dBm	-72 dBm	-67 dBm
Min Availability Required	99.9990%	99.9990%	99.9990%	99.9990%	99.9990%	99.9990%
Max Usable Mode	x6 (128QAM MIMO–B)	N/A	x2 (16QAM MIMO-B)	N/A	N/A	x2(QAM MIMO-B)
Predicted Available	99.9995%	6.12%	100.0000%	0.0000%	99.9984%	99.3320%
System Gain Margin	22.48 dB	-2.58 dB	16.35 dB	-30.18 dB	7.74 dB	13.43 dB
Free Space Path Loss	105.68 dB	116.09 dB	120.82 dB	124.07 dB	124.27 dB	123.97 dB
Gaseous Absorption Loss	0.01 dB	0.02 dB	0.04 dB	0.06 dB	0.06 dB	0.06 dB
Excess Path Loss	0.00 dB	25.63 dB	0.00 dB	43.29 dB	4.87 dB	0.00 dB
Total Path Loss	105.68 dB	141.74 dB	120.86 dB	167.42 dB	129.20 dB	124.03 dB

Number of seconds per year	31,557,600		
Outage at 99.0000%	315,576	3.6525	days
Outage at 99.9000%	31,557.6	8.766	hours
Outage at 99.9900%	3155.76	52.596	seconds
Outage at 99.9990%	315.576	5.2596	seconds
Outage at 99.9999%	31.5576	0.52596	seconds

Fixed Wireless Simulation Results Increase in Interference

Parameters	C1	C2	C3	C4	C5	C6
AP Interference	-75 dBm	-75 dBm	-75 dBm	-75 dBm	-75 dBm	-75 dBm
SM Interference	-75 dBm	-75 dBm	-75 dBm	-75 dBm	-75 dBm	-90 dB
Distance	0.96 km/0.60 miles	2.63 km/1.63 miles	4.53 km/2.81 miles	6.53 km/4.06 miles	6.73 km/4.18 miles	6.51 km/4.04 miles
Predicted Received Power	-53 dBm	-83 dBm	-64 dBm	-110 dBm	-72 dBm	-67 dBm
Min Availability Required	99.0000%	99.0000%	99.0000%	99.0000%	99.0000%	99.0000%
Max Usable Mode	x4 (16QAM MIMO--B)	N/A	x1 (QAM MIMO-B)	N/A	N/A	N/A
Predicted Available	99.9831%	0.0000%	99.9762%	0.0000%	0.0126%	0.0001%
System Gain Margin	10.75 dB	-14.46 dB	4.47 dB	-42.06 dB	-4.14 dB	1.55 dB
Free Space Path Loss	105.68 dB	116.09 dB	120.82 dB	124.07 dB	124.27 dB	123.97 dB
Gaseous Absorption Loss	0.01 dB	0.02 dB	0.04 dB	0.06 dB	0.06 dB	0.06 dB
Excess Path Loss	0.00 dB	25.63 dB	0.00 dB	43.29 dB	4.87 dB	0.00 dB
Total Path Loss	105.68 dB	141.74 dB	120.86 dB	167.42 dB	129.20 dB	124.03 dB

Increase AP interference	**-75 dB**
Increase SM interference	**-75 dB**

In summary, what this shows is that there are a number of variables that have a detrimental effect on the performance of fixed wireless networks. The networks will work well as long as the conditions are near ideal. As can be seen above, each variable can have an affect on the link by its self. However, in the operating environment, each variable not only has its own effect on the link, but will also affects other parameters which results in more degradation of the signal.

For example, the signal-to-noise (S/N) ratio will cause the signal power level to decrease, it also effects the Bit Error Rate (BER). Thus, with a high S/N ratio in addition to losing power the number of errors will increase also. This will result in the loss of usable information.

Another example is rain fade. As the perception increases, the amount of data that can be transmitted over the link decreases. This means that the amount of bandwidth available to each user on that link will be reduced. If this happens to the backhaul channel, all access point associated with that back haul link will be affected. This results in a lowering of the bandwidth available to each subscriber.

A fixed wireless link will behave in a manner similar to an xDSL link. As the length of a xDSL link increases, the uplink and downlink speeds decrease. A wireless link will behave in a similar manner. This is due to the spreading of the pulses. Each pulsed in made up of a number of different frequencies that are centered on the center frequency. As the pulse propagates through a medium, (air or copper in this case) each frequency will travel as a slightly different velocity. As the distance gets longer, the pulses will spread until they begin to interfere with the pulses on either side. In addition to the spreading, the power of the pulse will also decrease. This results in an increase in the BER, resulting in the loss of usable information.

The performance for a wireless network can not be given is general terms, covering a large area. Each location needs to be evaluated on its own. Two subscribes using the same equipment and at the same distance from the access point can have very different levels of performance. The difference between the two can be as simple as a tree in the path at is intruding into the Fresnel zone.

The fixed wireless performance will be affected by changes during the seasons, the weather, new construction in the area, addition of new service provides located in the general area, and the stability of the power to the equipment. All will have an effect on the performance of the fixed wireless link.