

Project MCWAP2_Radio_Path_Profile

LINKPlanner PTP Proposal Report

23 June 2020

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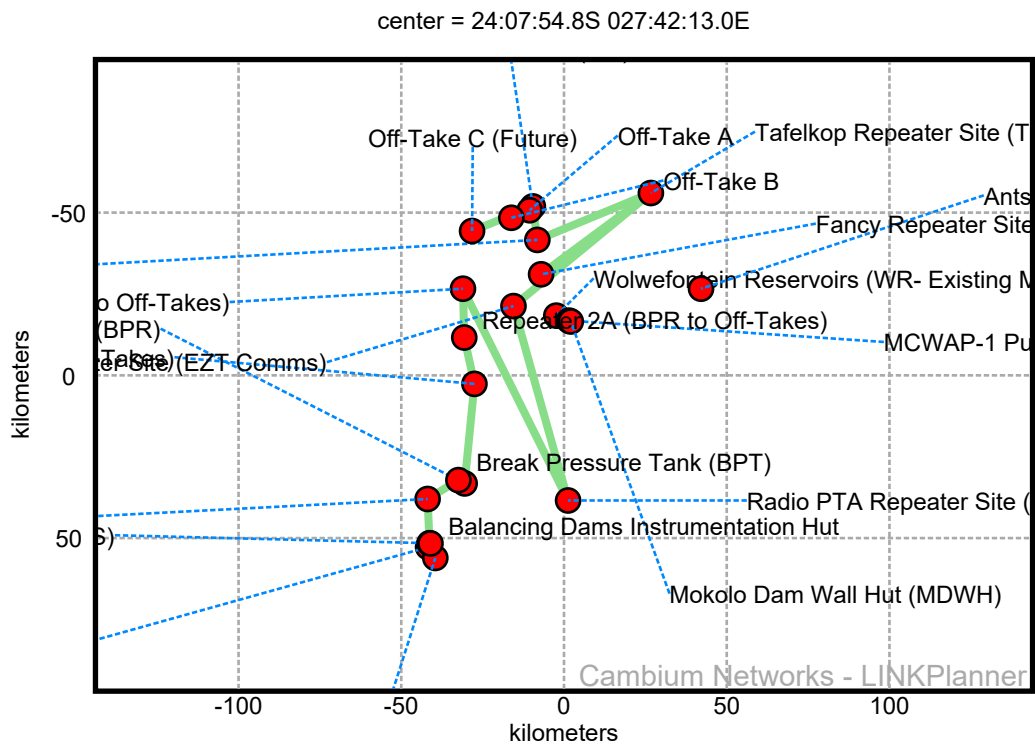


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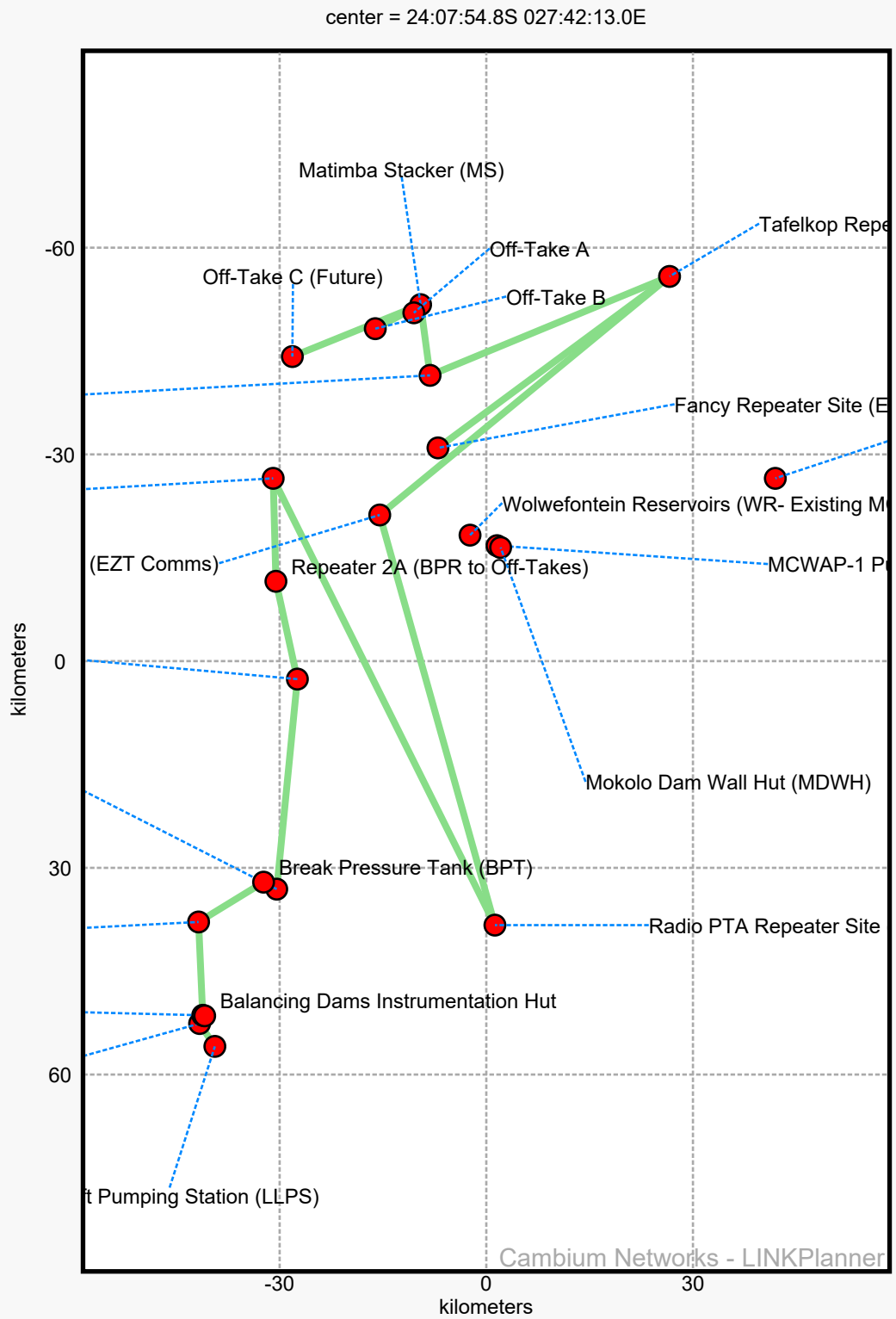
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1. Project Summary

Project: MCWAP2_Radio_Path_Profile
Description: Mokolo Crocodile Water Augmentation Project Phase 2 (MCWAP-2) Contract No TCTA 20-041

General Information	
Customer Name	Trans-Caledon Tunnel Authority (TCTA)
Company Name	CCIDS - Sub-consultant to GBN-JV
Address	140 Barry Hertzog Avenue Greenside 2193 Johannesburg
Phone	0114860504
Cell Phone	0834172516
Email	ehannie@ccids.co.za

Network Map



Link name	Product	Local antenna	Remote antenna	Max aggregate IP throughput
Break Pressure Reservoir (BPR) to Repeater 1A (BPR to Off-Takes)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	213.86 Mbps
Break Pressure Tank (BPT) to Break Pressure Reservoir (BPR)	PTP23820C	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	221.13 Mbps
Fancy Repeater Site (EZT Comms) to Tafelkop Repeater Site (TR)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	200.01 Mbps
High-Lift Pumping Station (HLPS) to Balancing Dams Instrumentation Hut	PTP23820C	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	221.13 Mbps
High-Lift Pumping Station (HLPS) to Repeater 1A (HLPS to BPT)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.10 Mbps
Kuncura Repeater Site (EZT Comms) to Radio PTA Repeater Site (EZT Comms)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	205.29 Mbps
Low-Lift Pumping Station (LLPS) to Repeater 1A (LLPS to HLPS)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Matimba Stacker (MS) to Off-Take A	PTP23820C	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	221.13 Mbps
Matimba Stacker (MS) to Off-Take B	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Matimba Stacker (MS) to Off-Take C (Future)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Matimba Stacker (MS) to Zeeland WTW (ZWTW)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Repeater 1A (BPR to Off-Takes) to Repeater 2A (BPR to Off-Takes)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps

(continued)

Link name	Product	Local antenna	Remote antenna	Max aggregate IP throughput
Repeater 1A (HLPS to BPT) to Break Pressure Tank	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Repeater 1A (LLPS to HLPS) to High-Lift Pumping Station (HLPS)	PTP23820C	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	Cambium Networks 1ft Single Pol (Global) N230082D021 - Direct	221.13 Mbps
Repeater 2A (BPR to Off-Takes) to Repeater 3A (BPR to Off-Takes)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps
Repeater 3A (BPR to Off-Takes) to Radio PTA Repeater Site (EZT Comms)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.01 Mbps
Tafelkop Repeater Site (TR) to Kuncura Repeater Site (EZT Comms)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.09 Mbps
Zeeland WTW (ZWTW) to Tafelkop Repeater Site (TR)	PTPU6820C	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	Cambium Networks 3ft Single Pol (Global) N060082D128 - Direct	221.13 Mbps

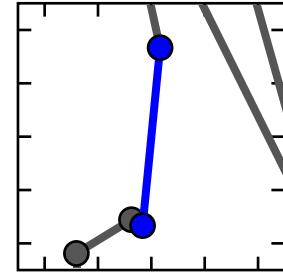
Bill of Materials : PTP Network

Part Number	Qty	Description
(no part number)	8	Unspecified 23 GHz ODU (invalid TX frequency selection). Please select a TX frequency
(no part number)	32	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	28	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	64	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	36	PTP820C Extended Warranty, 4 Additional Years
N000065L001	32	AC Power Injector 56V
N000082L014	36	PTP 820 Glands_x5_KIT
N000082L016	22	PTP 820 CAT5E Outdoor 100m drum
N000082L018	4	PTP 820 Outdoor_DC_cbl_2x12AWG_drum, 305m
N000082L059	4	PTP 820 SFP Optical 1000Base-LX,EXT TEMP, 1310 nm, Single Mode
N000082L065	4	PTP 820 DC Connector

Bill of Materials : PTP Network (continued)		
Part Number	Qty	Description
N000082L073	32	PTP 820 GBE_Connector_kit
N000082L116	36	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	36	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L147	8	PTP 820 Fiber Adapter
N000082L173	66	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	28	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	28	PTP 820C OMT KIT 6GHz
N060082L147	28	PTP 820 RFU-C 6GHz OMT Interface-Andrew
N230082D021	8	PTP 820 1' ANT,SP,23GHz,RFU-C TYPE&Std UBR220 - Andrew. Shorter lead time. Available in all regions
N230082L034	8	PTP 820C OMT KIT 23GHz
N230082L039	8	PTP 820 RFU-C 23GHz OMT Interface-Andrew



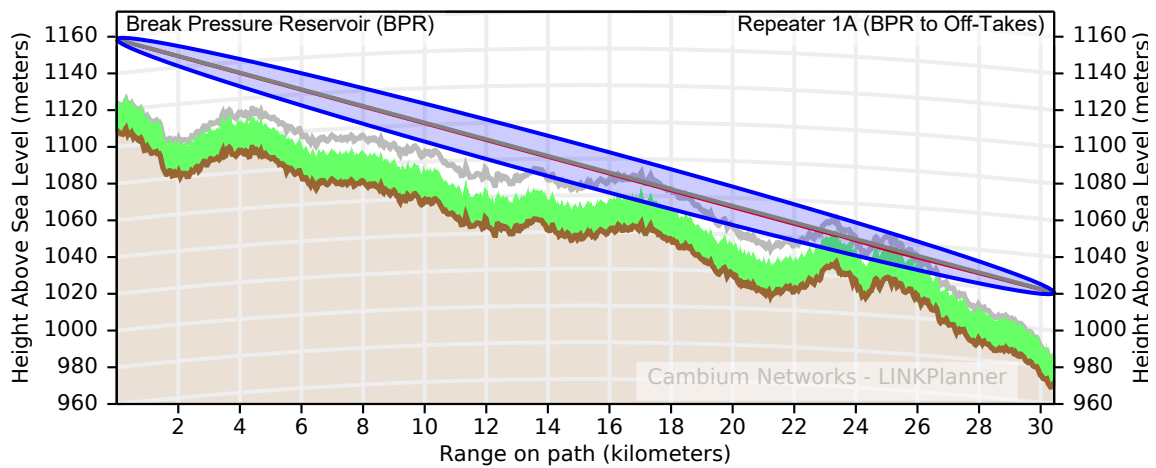
Break Pressure Reservoir (BPR) to Repeater 1A (BPR to Off-Takes)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m

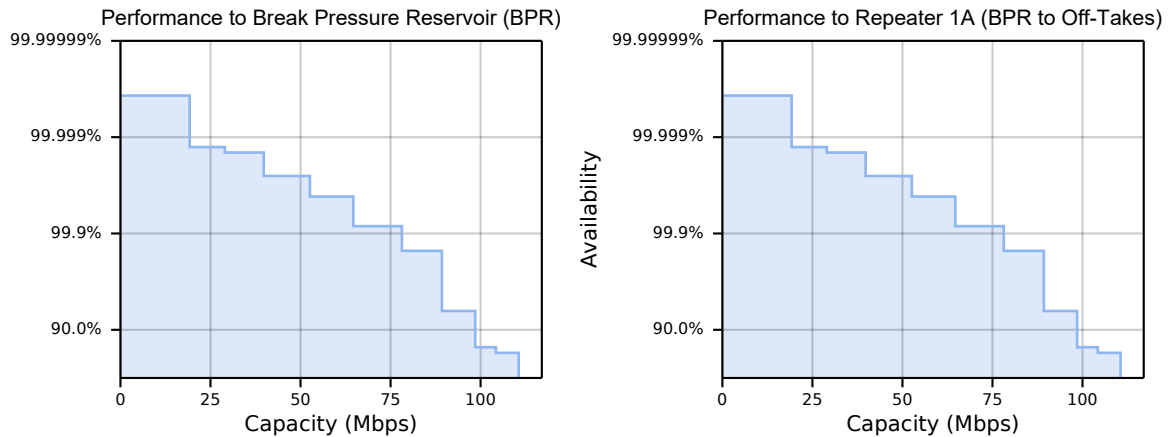
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m



	Performance to Break Pressure Reservoir (BPR)	Performance to Repeater 1A (BPR to Off-Takes)
Mean IP	106.93 Mbps	106.93 Mbps
IP Availability	99.9999 % for 1.0 Mbps	99.9999 % for 1.0 Mbps

Link Summary			
Link Length	30.439 km	System Gain Margin	34.20 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	213.86 Mbps
Regulation	ETSI	Annual Link Availability	99.9997 %
Modulation	Adaptive	Annual Link Unavailability	1.4 mins/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	151.08 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-301.96 N units/km	Excess Path Loss	12.10 dB
Area roughness 110x110km	171.79 metre	Annual 2-way Availability	99.9997 %
Geoclimatic factor	1.17e-04	Annual 2-way Unavailability	1.4 mins/year
Fade Occurrence Factor (P0)	2.77e-03	Rain Availability	100.0000 %
Path inclination	4.53 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.69	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	21.63 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	50.81 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	138.72 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.25 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Non Line-of-Sight		

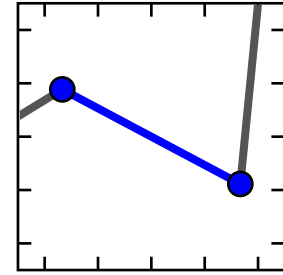
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	2	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



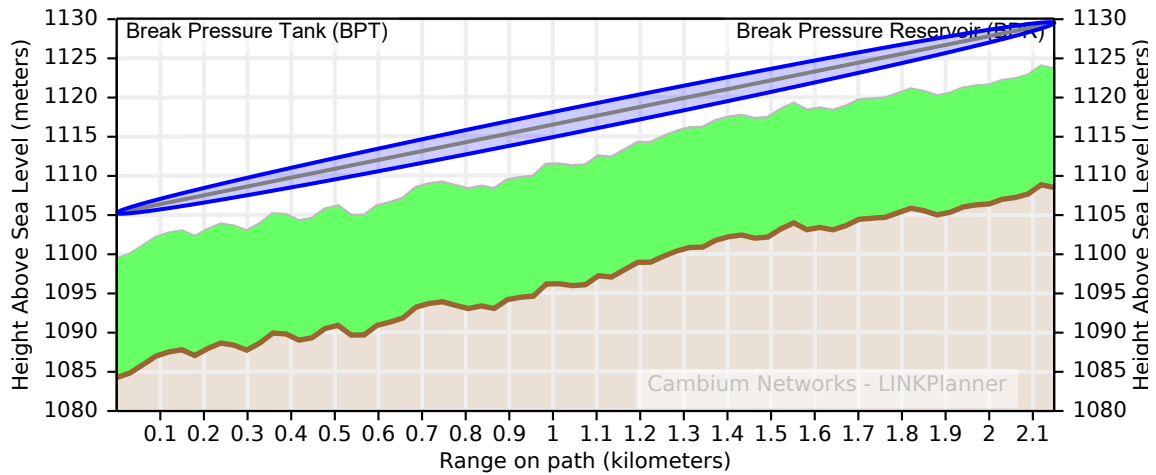
Break Pressure Tank (BPT) to Break Pressure Reservoir (BPR)



Equipment: Cambium Networks PTP23820C - 1+0

Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 21 m

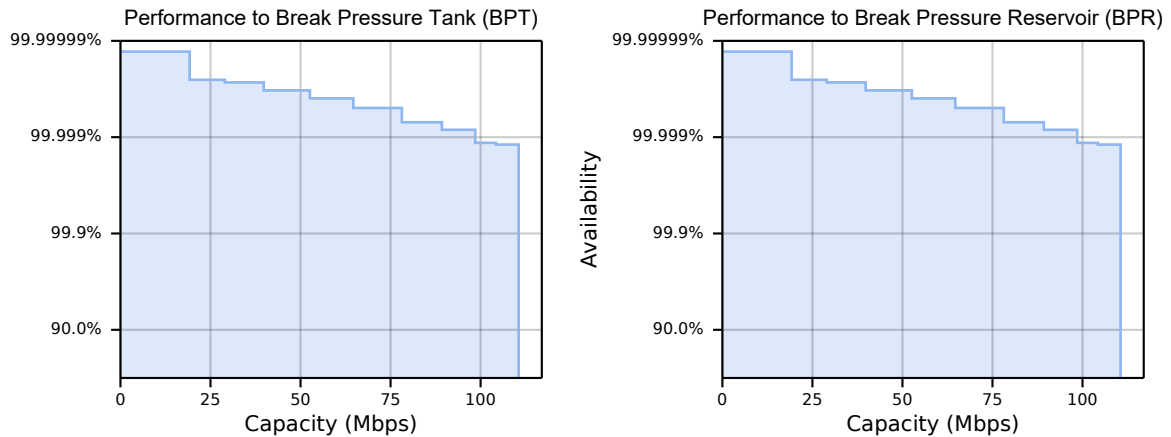
Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 21 m



	Performance to Break Pressure Tank (BPT)	Performance to Break Pressure Reservoir (BPR)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	2.149 km	System Gain Margin	52.76 dB
Band	23 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	5 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	126.44 dB	Prediction Model	ITU-R
System Gain	179.20 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-299.24 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	168.07 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.16e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	7.03e-07	Rain Availability	100.0000 %
Path inclination	11.28 mr	Rain Unavailability	5 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.24 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	126.10 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.35 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

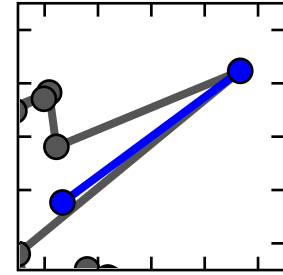
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified 23 GHz ODU (invalid TX frequency selection). Please select a TX frequency
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N230082D021	2	PTP 820 1' ANT,SP,23GHz,RFU-C TYPE&Std UBR220 - Andrew. Shorter lead time. Available in all regions
N230082L034	2	PTP 820C OMT KIT 23GHz
N230082L039	2	PTP 820 RFU-C 23GHz OMT Interface-Andrew



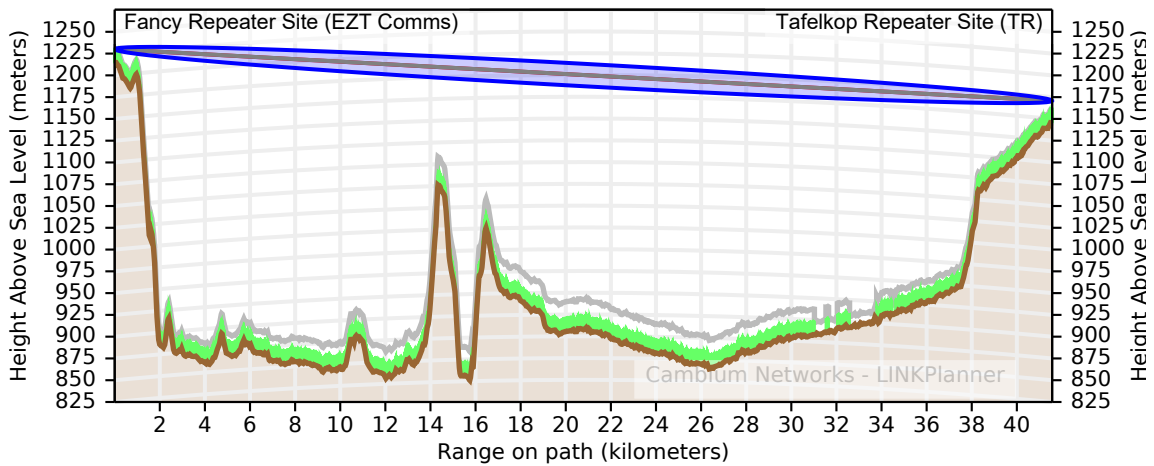
Fancy Repeater Site (EZT Comms) to Tafelkop Repeater Site (TR)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 15 m

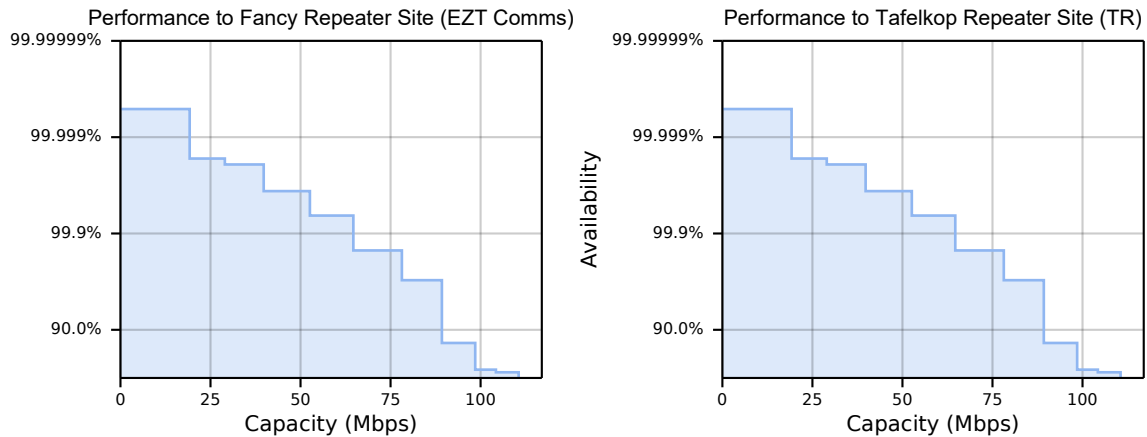
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 25 m



	Performance to Fancy Repeater Site (EZT Comms)	Performance to Tafelkop Repeater Site (TR)
Mean IP	100.01 Mbps	100.01 Mbps
IP Availability	99.9997 % for 1.0 Mbps	99.9997 % for 1.0 Mbps

Link Summary			
Link Length	41.566 km	System Gain Margin	31.60 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	200.01 Mbps
Regulation	ETSI	Annual Link Availability	99.9995 %
Modulation	Adaptive	Annual Link Unavailability	2.7 mins/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	153.68 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-299.12 N units/km	Excess Path Loss	11.92 dB
Area roughness 110x110km	156.82 metre	Annual 2-way Availability	99.9995 %
Geoclimatic factor	1.19e-04	Annual 2-way Unavailability	2.7 mins/year
Fade Occurrence Factor (P0)	1.27e-02	Rain Availability	100.0000 %
Path inclination	1.42 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.76	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	12.92 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.69 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	141.42 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.33 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Non Line-of-Sight		

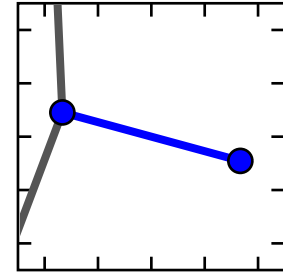
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
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N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



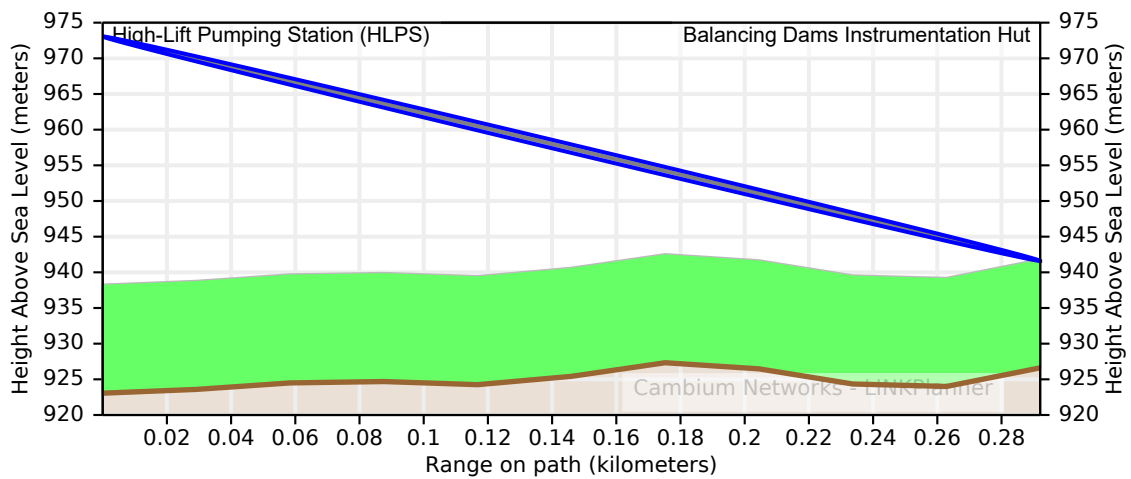
High-Lift Pumping Station (HLPS) to Balancing Dams Instrumentation Hut



Equipment: Cambium Networks PTP23820C - 1+0

Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 50 m

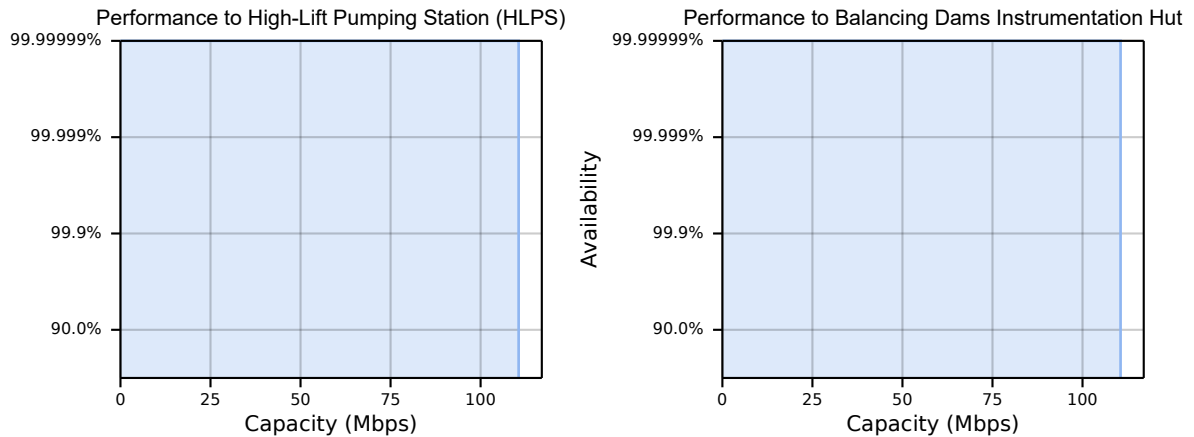
Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 15 m



	Performance to High-Lift Pumping Station (HLPS)	Performance to Balancing Dams Instrumentation Hut
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	0.292 km	System Gain Margin	58.39 dB
Band	23 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	108.81 dB	Prediction Model	ITU-R
System Gain	167.20 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-296.97 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	155.20 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.18e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	2.00e-10	Rain Availability	100.0000 %
Path inclination	107.68 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.89 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	108.76 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.05 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

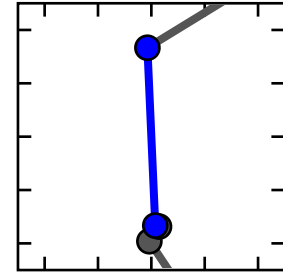
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N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
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N230082D021	2	PTP 820 1' ANT,SP,23GHz,RFU-C TYPE&Std UBR220 - Andrew. Shorter lead time. Available in all regions
N230082L034	2	PTP 820C OMT KIT 23GHz
N230082L039	2	PTP 820 RFU-C 23GHz OMT Interface-Andrew



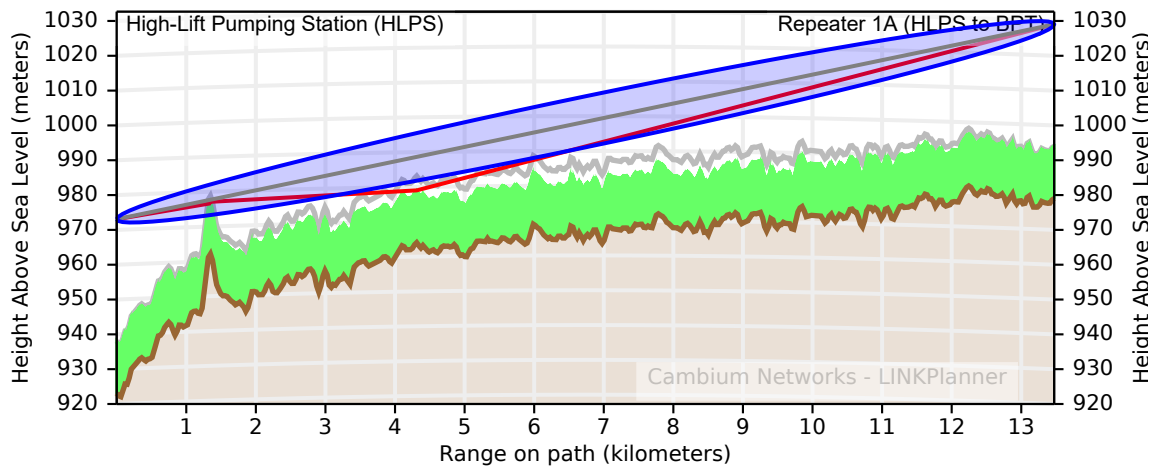
High-Lift Pumping Station (HLPS) to Repeater 1A (HLPS to BPT)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m

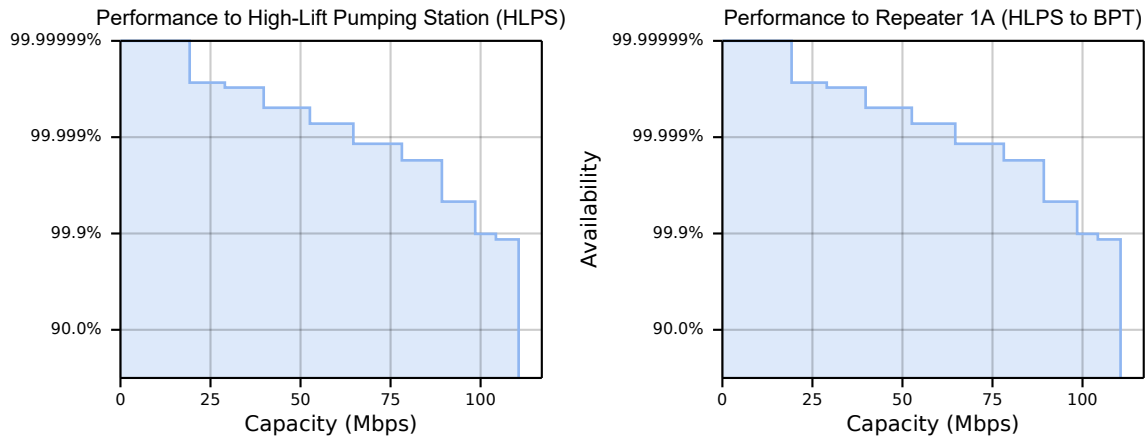
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m



	Performance to High-Lift Pumping Station (HLPS)	Performance to Repeater 1A (HLPS to BPT)
Mean IP	110.55 Mbps	110.55 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	13.473 km	System Gain Margin	42.64 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.10 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	5 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	142.64 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-298.85 N units/km	Excess Path Loss	10.89 dB
Area roughness 110x110km	156.71 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.19e-04	Annual 2-way Unavailability	4 secs/year
Fade Occurrence Factor (P0)	2.44e-04	Rain Availability	100.0000 %
Path inclination	4.15 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.48	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	15.38 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.68 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	131.64 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.11 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Non Line-of-Sight		

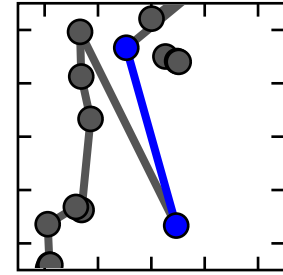
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	2	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



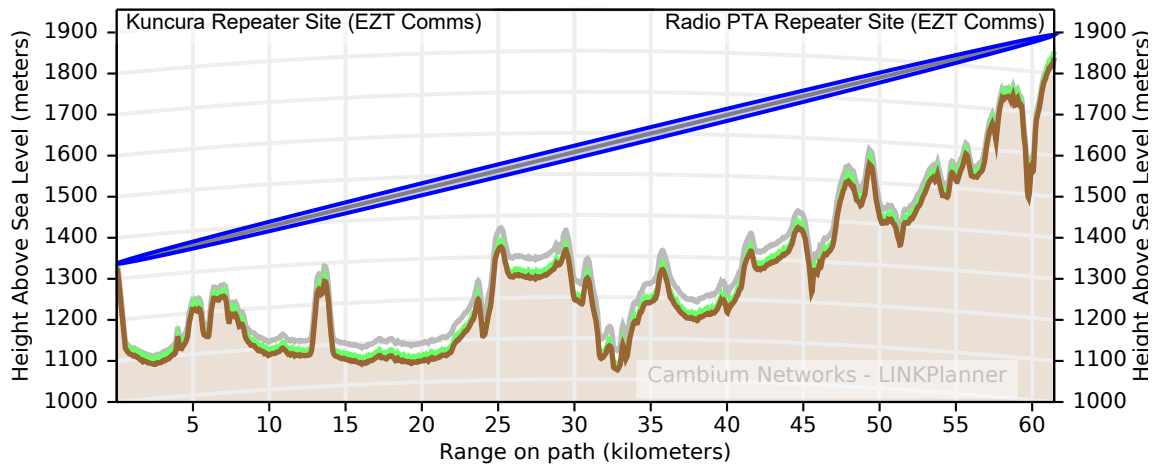
Kuncura Repeater Site (EZT Comms) to Radio PTA Repeater Site (EZT Comms)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 15 m

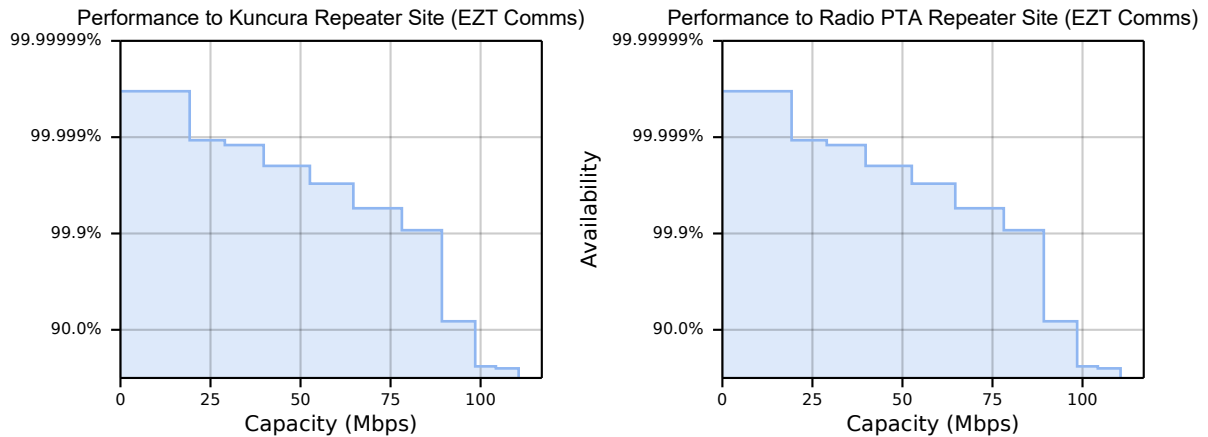
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 55 m



	Performance to Kuncura Repeater Site (EZT Comms)	Performance to Radio PTA Repeater Site (EZT Comms)
Mean IP	102.64 Mbps	102.64 Mbps
IP Availability	99.9999 % for 1.0 Mbps	99.9999 % for 1.0 Mbps

Link Summary			
Link Length	61.441 km	System Gain Margin	32.35 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	205.29 Mbps
Regulation	ETSI	Annual Link Availability	99.9998 %
Modulation	Adaptive	Annual Link Unavailability	1.2 mins/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	152.93 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-296.82 N units/km	Excess Path Loss	7.67 dB
Area roughness 110x110km	185.23 metre	Annual 2-way Availability	99.9998 %
Geoclimatic factor	1.09e-04	Annual 2-way Unavailability	1.2 mins/year
Fade Occurrence Factor (P0)	7.39e-03	Rain Availability	100.0000 %
Path inclination	9.06 mr	Rain Unavailability	1 secs/year
Value of K Exceeded for 99.99% (ke)	0.84	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	8.58 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	50.58 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	144.82 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.44 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Near Line-of-Sight		

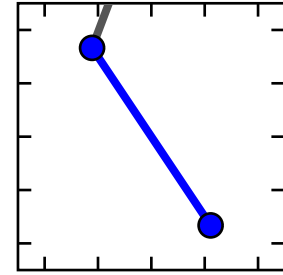
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	5	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



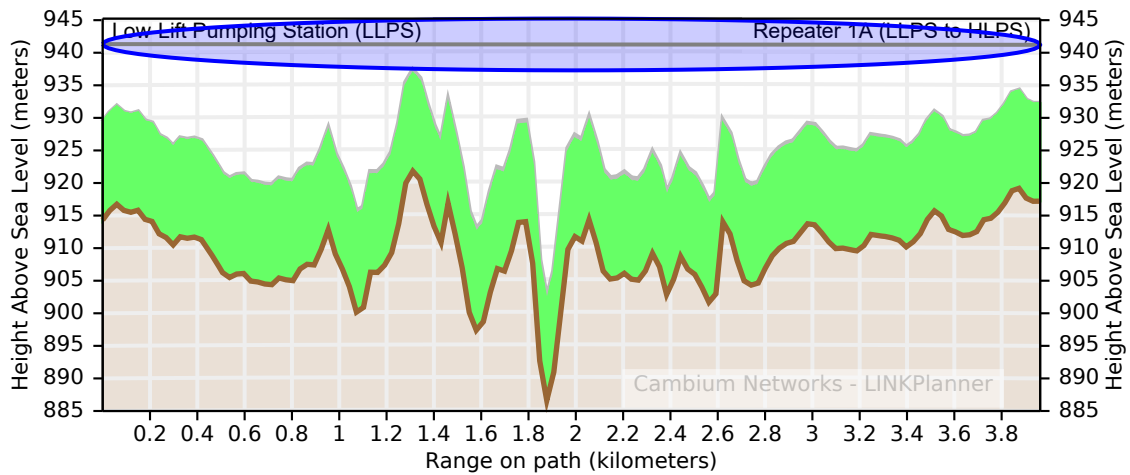
Low-Lift Pumping Station (LLPS) to Repeater 1A (LLPS to HLPS)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 27 m

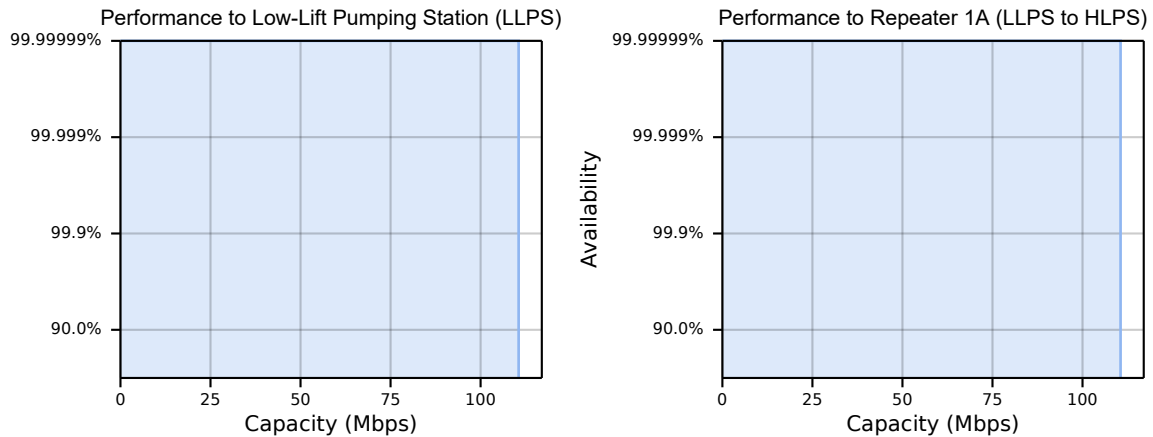
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 24 m



	Performance to Low-Lift Pumping Station (LLPS)	Performance to Repeater 1A (LLPS to HLPS)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	3.963 km	System Gain Margin	60.24 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	121.04 dB	Prediction Model	ITU-R
System Gain	181.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-296.12 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	154.87 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.17e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	2.44e-05	Rain Availability	100.0000 %
Path inclination	0.03 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.97 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	121.01 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.03 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

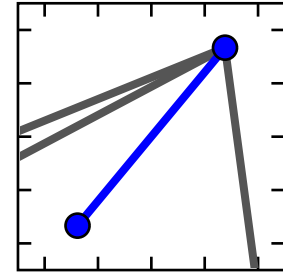
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



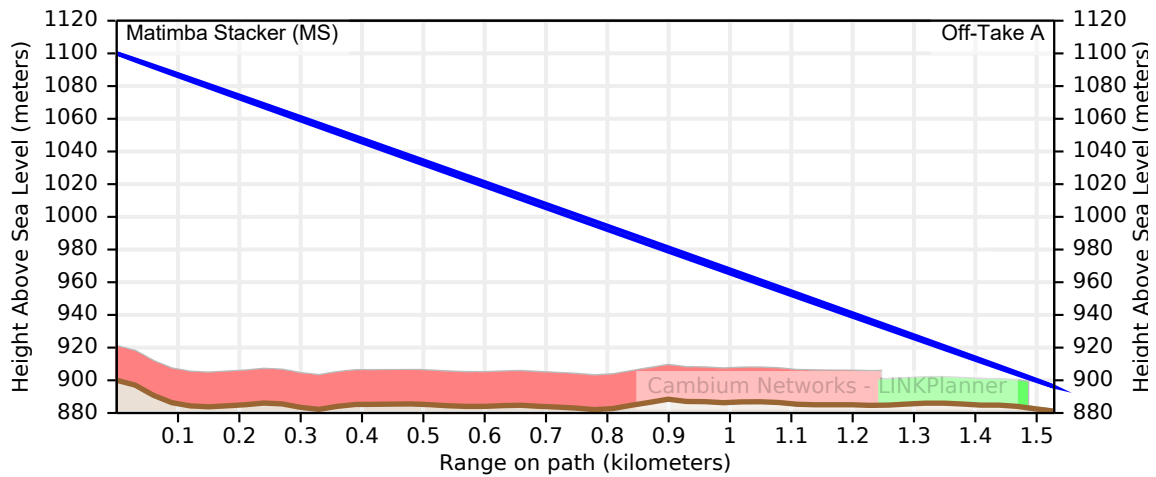
Matimba Stacker (MS) to Off-Take A



Equipment: Cambium Networks PTP23820C - 1+0

Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 200 m

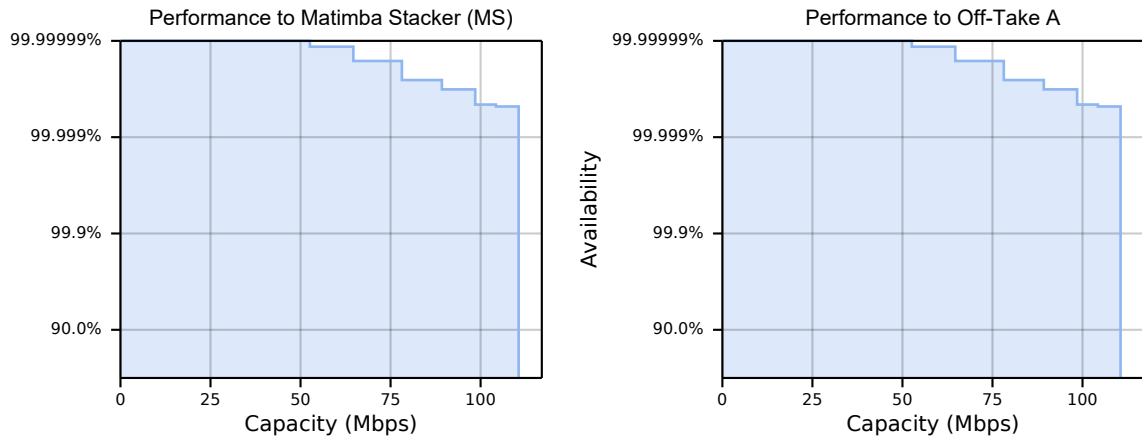
Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 15 m



	Performance to Matimba Stacker (MS)	Performance to Off-Take A
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	1.529 km	System Gain Margin	55.80 dB
Band	23 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	123.40 dB	Prediction Model	ITU-R
System Gain	179.20 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-305.17 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	122.36 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.38e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	4.16e-08	Rain Availability	100.0000 %
Path inclination	133.41 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.13 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	123.14 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.26 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

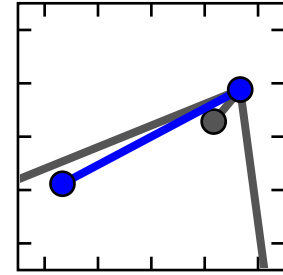
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified 23 GHz ODU (invalid TX frequency selection). Please select a TX frequency
(no part number)	1	Unspecified Power Lead. (set the region in the Bill of Materials options)
C000000L033	2	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	1	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L018	1	PTP 820 Outdoor_DC_cbl_2x12AWG_drum, 305m

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L059	1	PTP 820 SFP Optical 1000Base-LX,EXT TEMP, 1310 nm, Single Mode
N000082L065	1	PTP 820 DC Connector
N000082L073	1	PTP 820 GBE_Connector_kit
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L147	2	PTP 820 Fiber Adapter
N000082L173	2	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N230082D021	2	PTP 820 1' ANT,SP,23GHz,RFU-C TYPE&Std UBR220 - Andrew. Shorter lead time. Available in all regions
N230082L034	2	PTP 820C OMT KIT 23GHz
N230082L039	2	PTP 820 RFU-C 23GHz OMT Interface-Andrew



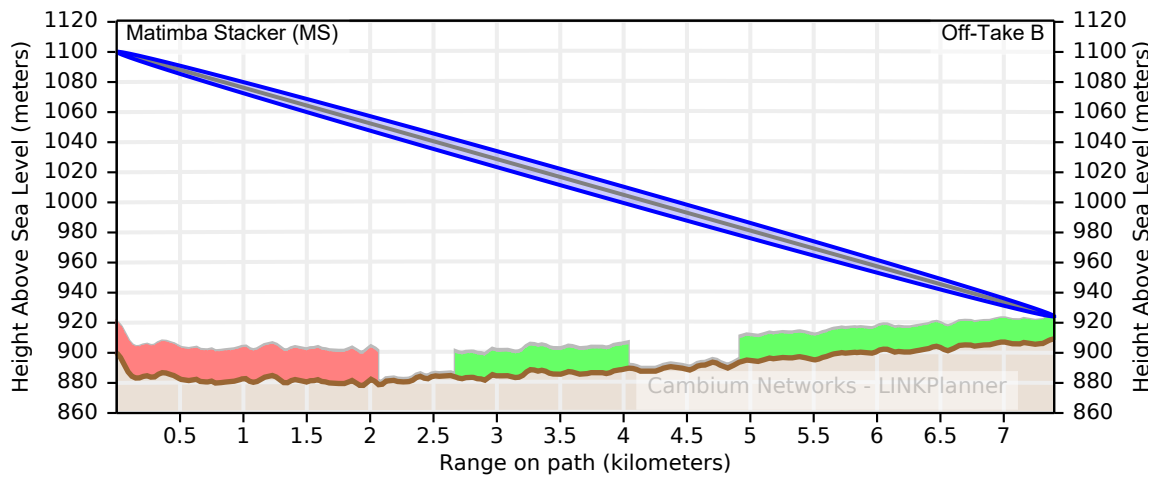
Matimba Stacker (MS) to Off-Take B



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 200 m

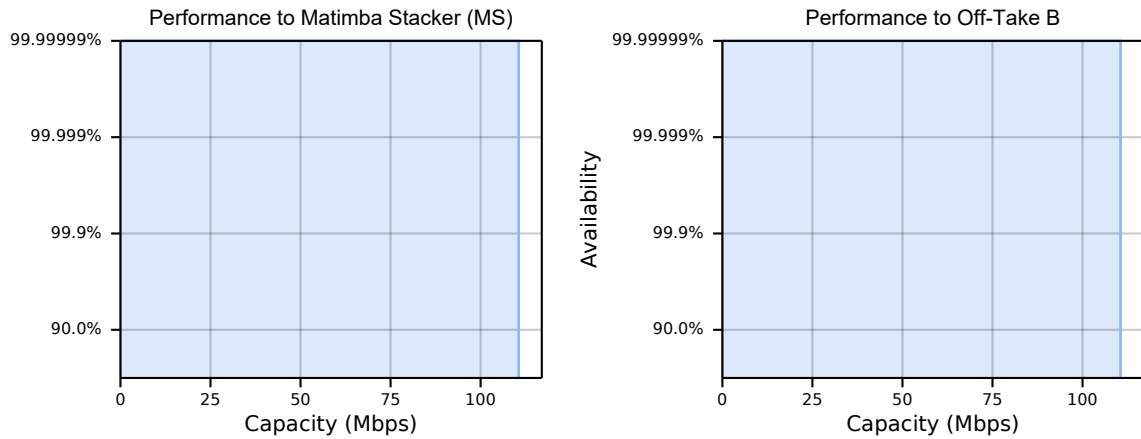
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 15 m



	Performance to Matimba Stacker (MS)	Performance to Off-Take B
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	7.398 km	System Gain Margin	58.79 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	126.49 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-305.76 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	119.87 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.39e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	1.01e-05	Rain Availability	100.0000 %
Path inclination	23.75 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.10 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	126.43 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.06 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

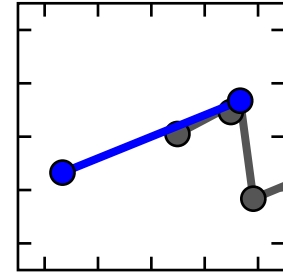
Bill of Materials

Part Number	Qty	Description
(no part number)	1	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	2	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	1	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L018	1	PTP 820 Outdoor_DC_cbl_2x12AWG_drum, 305m

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L059	1	PTP 820 SFP Optical 1000Base-LX,EXT TEMP, 1310 nm, Single Mode
N000082L065	1	PTP 820 DC Connector
N000082L073	1	PTP 820 GBE_Connector_kit
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L147	2	PTP 820 Fiber Adapter
N000082L173	2	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



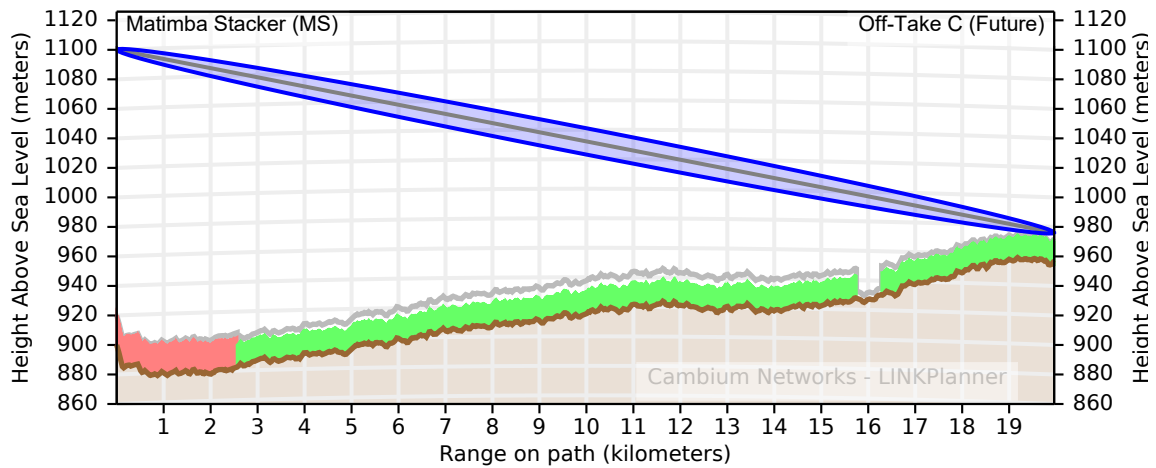
Matimba Stacker (MS) to Off-Take C (Future)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 200 m

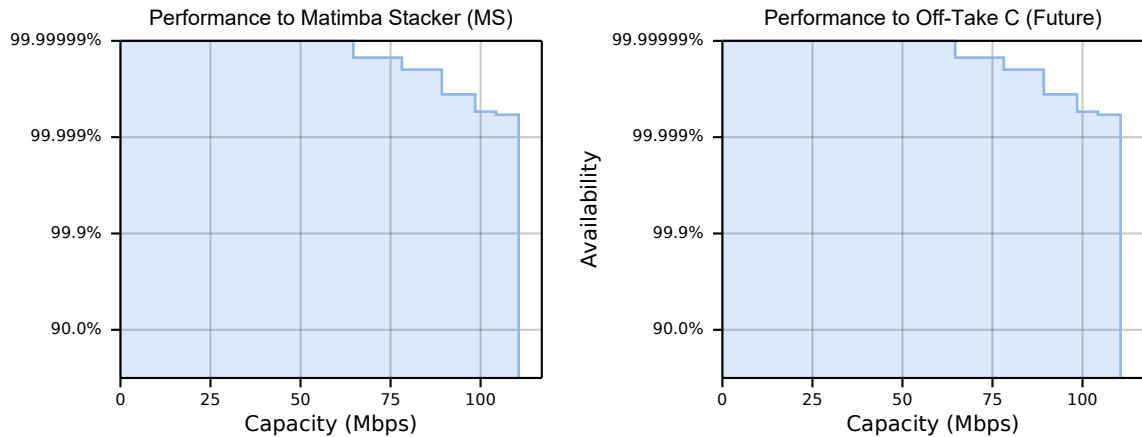
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 21 m



	Performance to Matimba Stacker (MS)	Performance to Off-Take C (Future)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	19.959 km	System Gain Margin	50.06 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	135.22 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-307.13 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	113.75 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.44e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	7.46e-04	Rain Availability	100.0000 %
Path inclination	6.21 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.59	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.03 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	135.05 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.17 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

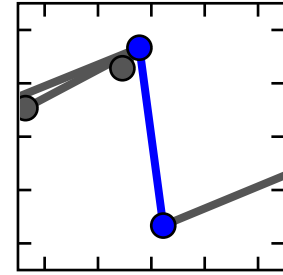
Bill of Materials

Part Number	Qty	Description
(no part number)	1	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	2	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	1	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L018	1	PTP 820 Outdoor_DC_cbl_2x12AWG_drum, 305m

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L059	1	PTP 820 SFP Optical 1000Base-LX,EXT TEMP, 1310 nm, Single Mode
N000082L065	1	PTP 820 DC Connector
N000082L073	1	PTP 820 GBE_Connector_kit
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L147	2	PTP 820 Fiber Adapter
N000082L173	2	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



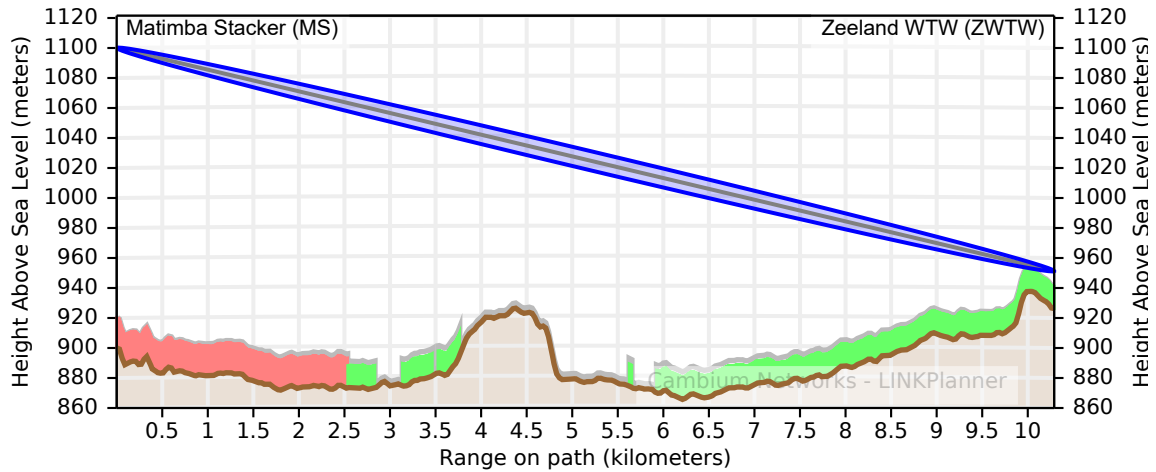
Matimba Stacker (MS) to Zeeland WTW (ZWTW)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 200 m

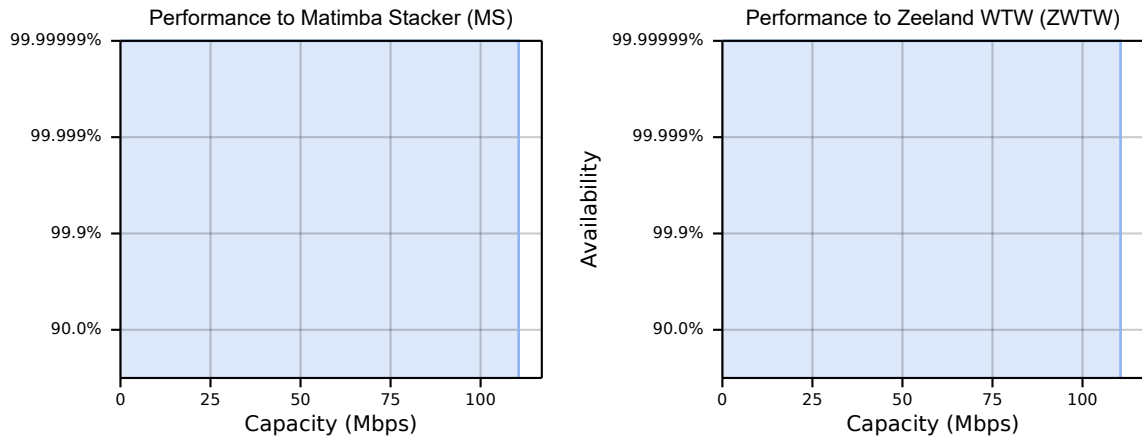
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 25 m



	Performance to Matimba Stacker (MS)	Performance to Zeeland WTW (ZWTW)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	10.290 km	System Gain Margin	55.89 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	129.39 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-304.48 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	128.92 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.34e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	4.18e-05	Rain Availability	100.0000 %
Path inclination	14.45 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.41	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.26 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	129.30 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.09 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

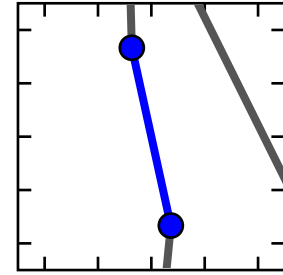
Bill of Materials

Part Number	Qty	Description
(no part number)	1	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	2	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	1	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L018	1	PTP 820 Outdoor_DC_cbl_2x12AWG_drum, 305m

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L059	1	PTP 820 SFP Optical 1000Base-LX,EXT TEMP, 1310 nm, Single Mode
N000082L065	1	PTP 820 DC Connector
N000082L073	1	PTP 820 GBE_Connector_kit
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L147	2	PTP 820 Fiber Adapter
N000082L173	2	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



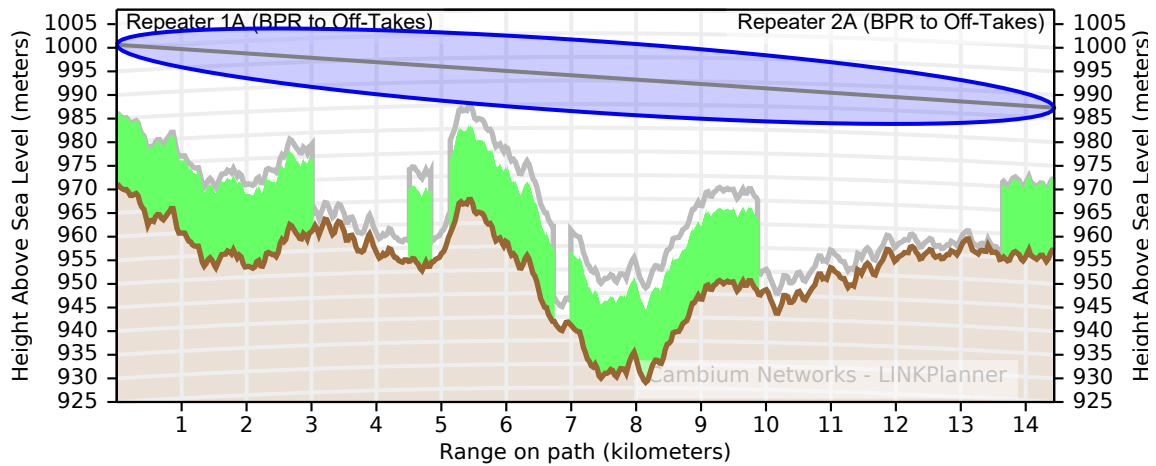
Repeater 1A (BPR to Off-Takes) to Repeater 2A (BPR to Off-Takes)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 30 m

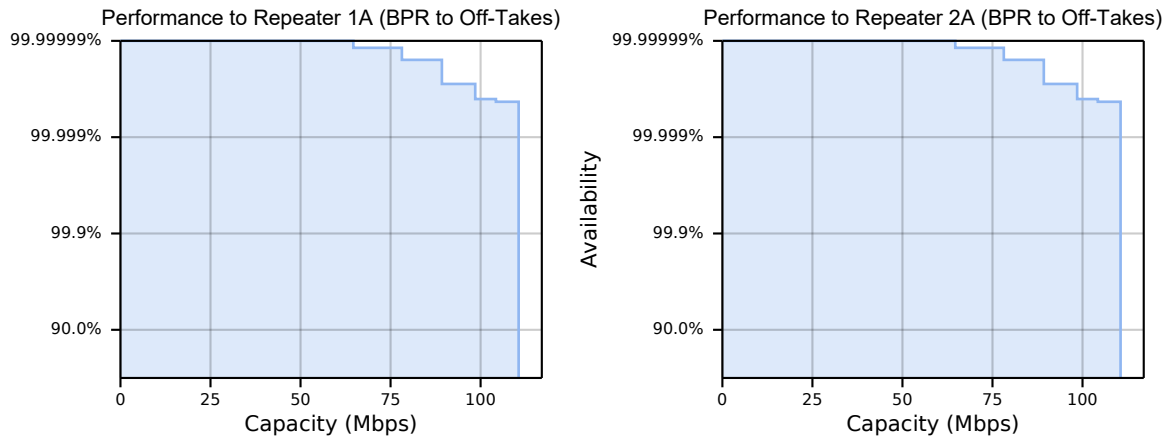
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 30 m



	Performance to Repeater 1A (BPR to Off-Takes)	Performance to Repeater 2A (BPR to Off-Takes)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	14.438 km	System Gain Margin	52.92 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	132.36 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-307.11 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	170.07 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.21e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	7.88e-04	Rain Availability	100.0000 %
Path inclination	0.92 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.50	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	50.15 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	132.24 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.12 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

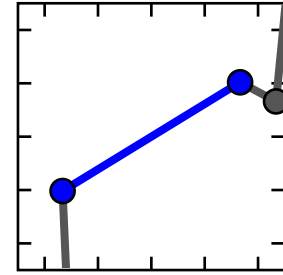
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



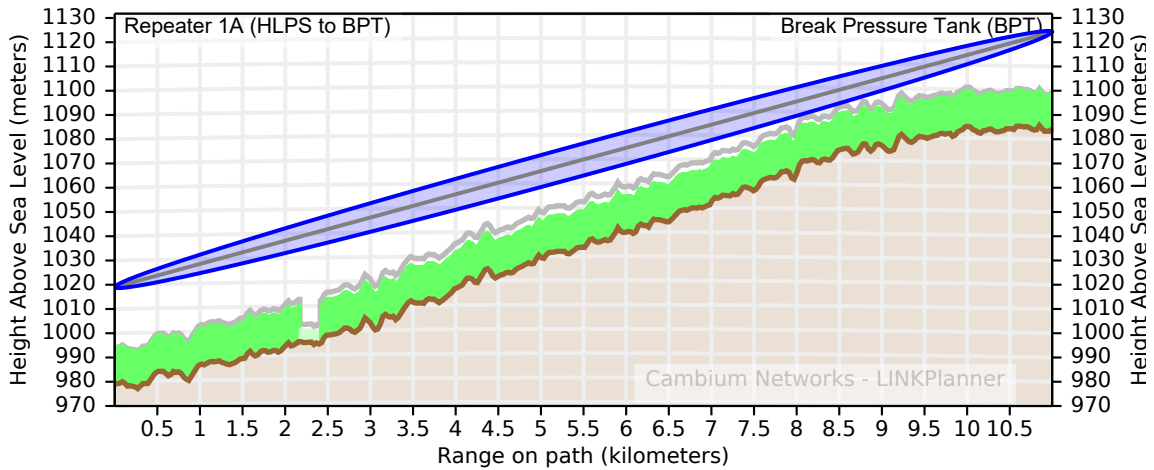
Repeater 1A (HLPS to BPT) to Break Pressure Tank



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 40 m

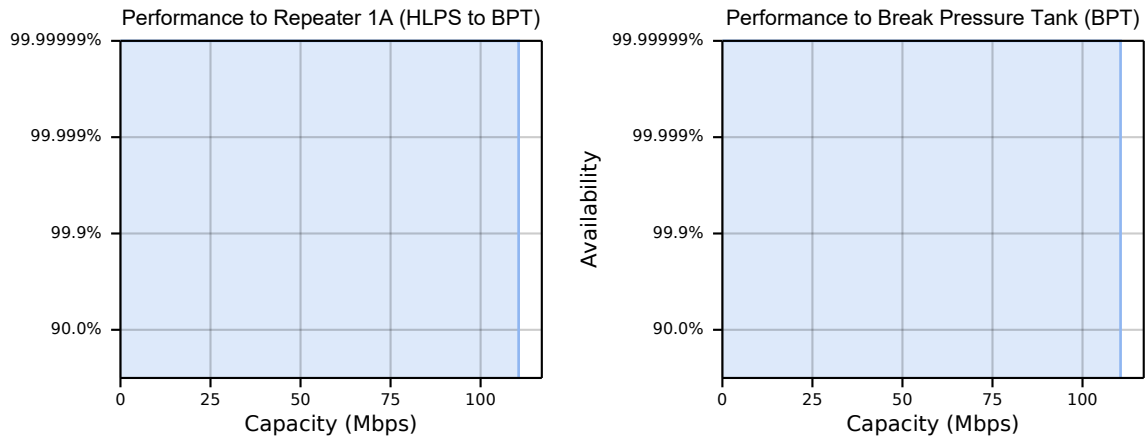
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 40 m



	Performance to Repeater 1A (HLPS to BPT)	Performance to Break Pressure Tank (BPT)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	10.997 km	System Gain Margin	55.31 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	129.97 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-300.20 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	162.09 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.18e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	5.77e-05	Rain Availability	100.0000 %
Path inclination	9.57 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.43	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.34 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	129.88 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.09 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

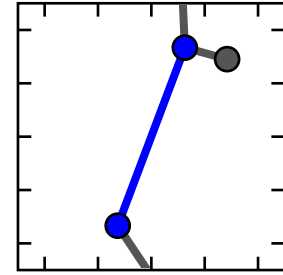
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



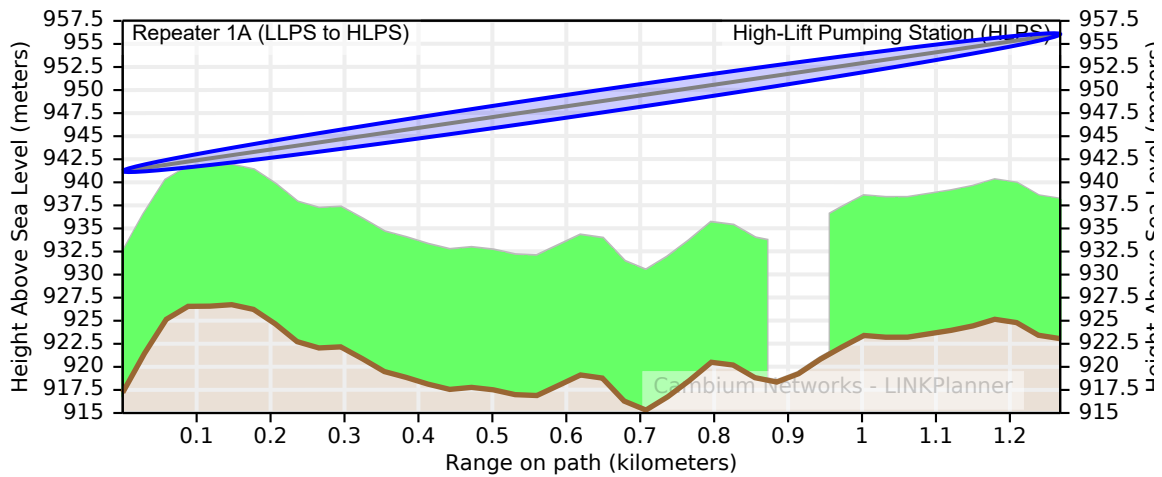
Repeater 1A (LLPS to HLPS) to High-Lift Pumping Station (HLPS)



Equipment: Cambium Networks PTP23820C - 1+0

Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 24 m

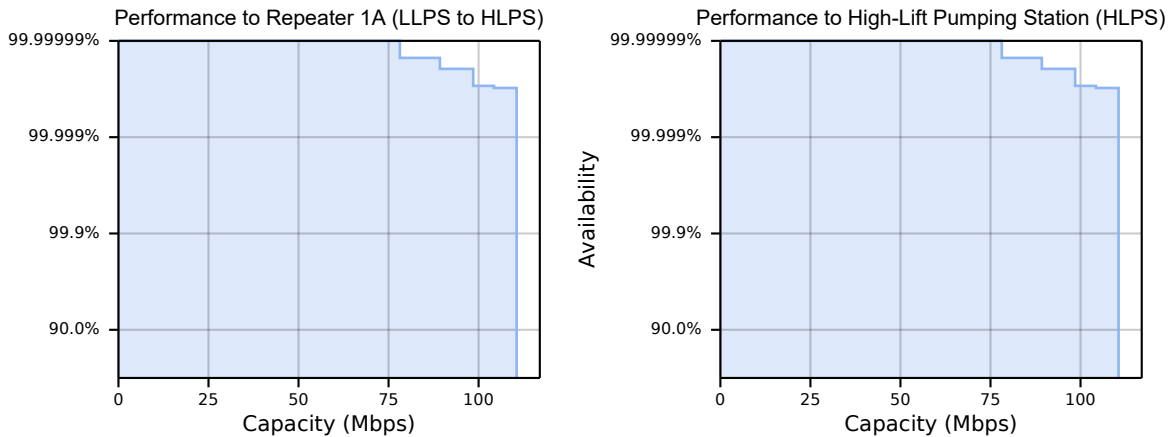
Cambium Networks 1ft Single Pol (Global)
N230082D021 - Direct @ 33 m



	Performance to Repeater 1A (LLPS to HLPS)	Performance to High-Lift Pumping Station (HLPS)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	1.268 km	System Gain Margin	57.47 dB
Band	23 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	121.73 dB	Prediction Model	ITU-R
System Gain	179.20 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-296.90 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	154.71 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.18e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	1.77e-07	Rain Availability	100.0000 %
Path inclination	11.71 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.40	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	51.91 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	121.52 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.22 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

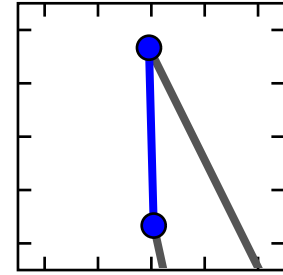
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified 23 GHz ODU (invalid TX frequency selection). Please select a TX frequency
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N230082D021	2	PTP 820 1' ANT,SP,23GHz,RFU-C TYPE&Std UBR220 - Andrew. Shorter lead time. Available in all regions
N230082L034	2	PTP 820C OMT KIT 23GHz
N230082L039	2	PTP 820 RFU-C 23GHz OMT Interface-Andrew



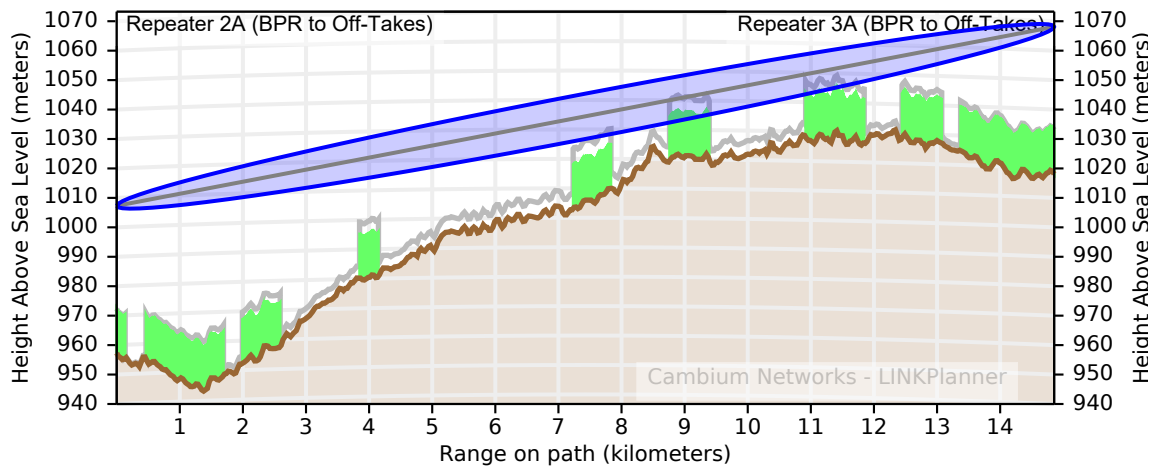
Repeater 2A (BPR to Off-Takes) to Repeater 3A (BPR to Off-Takes)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m

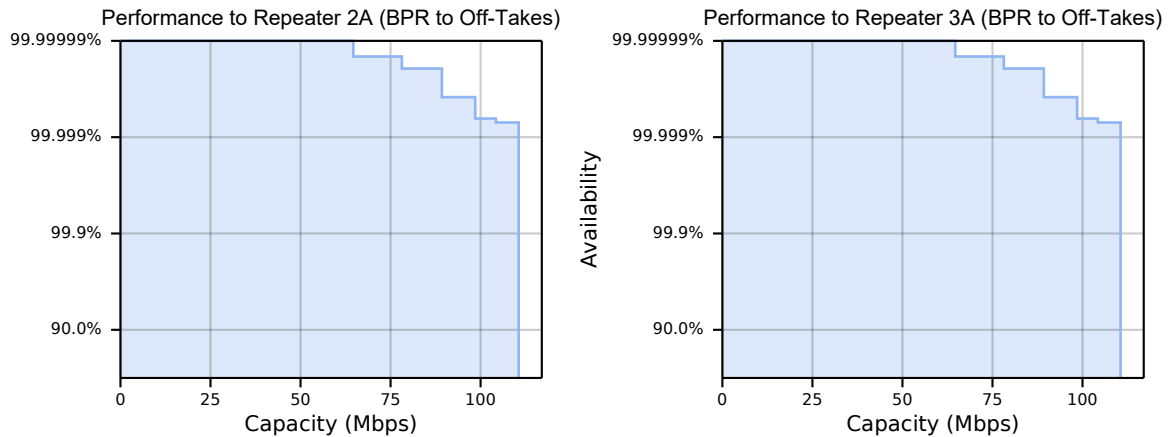
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m



	Performance to Repeater 2A (BPR to Off-Takes)	Performance to Repeater 3A (BPR to Off-Takes)
Mean IP	110.57 Mbps	110.57 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	14.856 km	System Gain Margin	46.80 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	0 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	138.48 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-310.14 N units/km	Excess Path Loss	5.86 dB
Area roughness 110x110km	156.16 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.29e-04	Annual 2-way Unavailability	0 secs/year
Fade Occurrence Factor (P0)	3.42e-04	Rain Availability	100.0000 %
Path inclination	4.09 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.51	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	14.35 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.69 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	132.49 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.13 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Near Line-of-Sight		

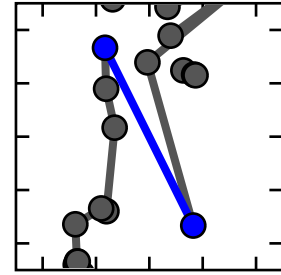
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	2	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



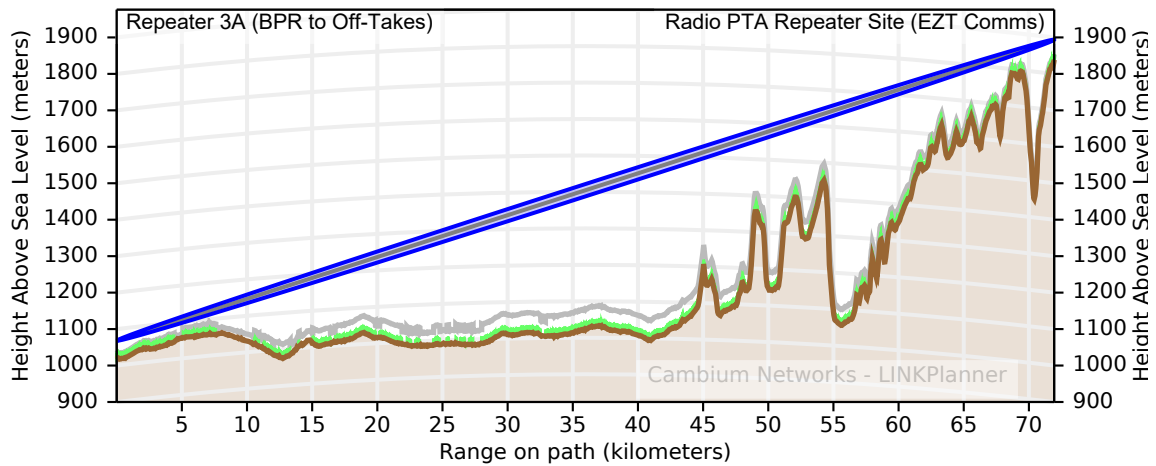
Repeater 3A (BPR to Off-Takes) to Radio PTA Repeater Site (EZT Comms)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 50 m

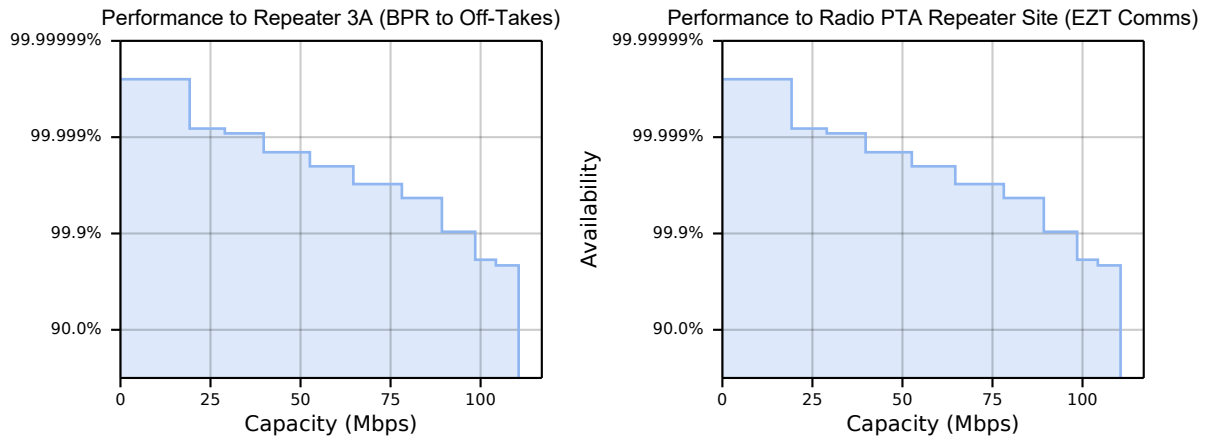
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 55 m



	Performance to Repeater 3A (BPR to Off-Takes)	Performance to Radio PTA Repeater Site (EZT Comms)
Mean IP	110.50 Mbps	110.50 Mbps
IP Availability	99.9999 % for 1.0 Mbps	99.9999 % for 1.0 Mbps

Link Summary			
Link Length	71.939 km	System Gain Margin	38.55 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.01 Mbps
Regulation	ETSI	Annual Link Availability	99.9999 %
Modulation	Adaptive	Annual Link Unavailability	40 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	146.73 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-299.91 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	183.40 metre	Annual 2-way Availability	99.9999 %
Geoclimatic factor	1.12e-04	Annual 2-way Unavailability	39 secs/year
Fade Occurrence Factor (P0)	1.72e-02	Rain Availability	100.0000 %
Path inclination	11.48 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.87	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	50.50 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	146.19 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.54 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

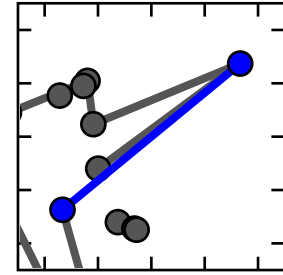
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	2	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	5	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



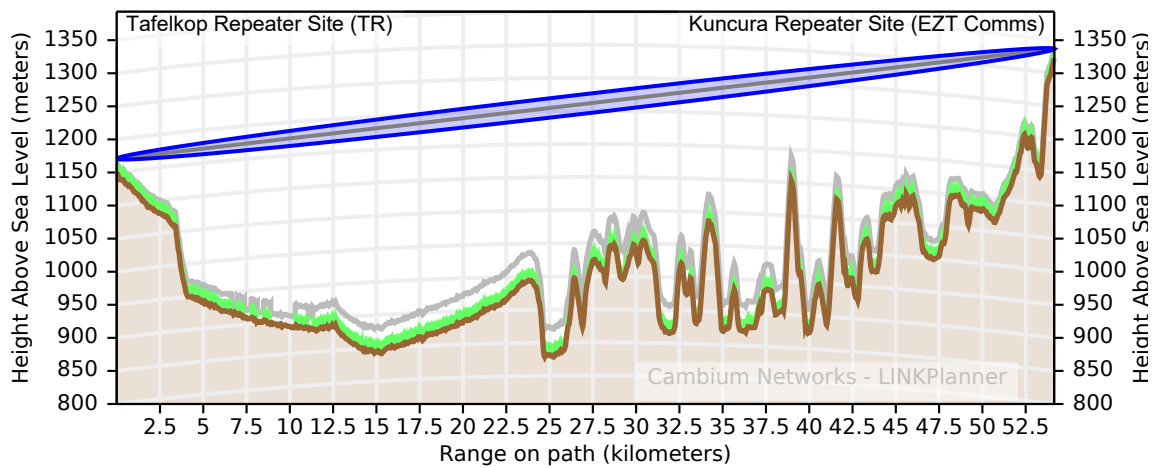
Tafelkop Repeater Site (TR) to Kuncura Repeater Site (EZT Comms)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 25 m

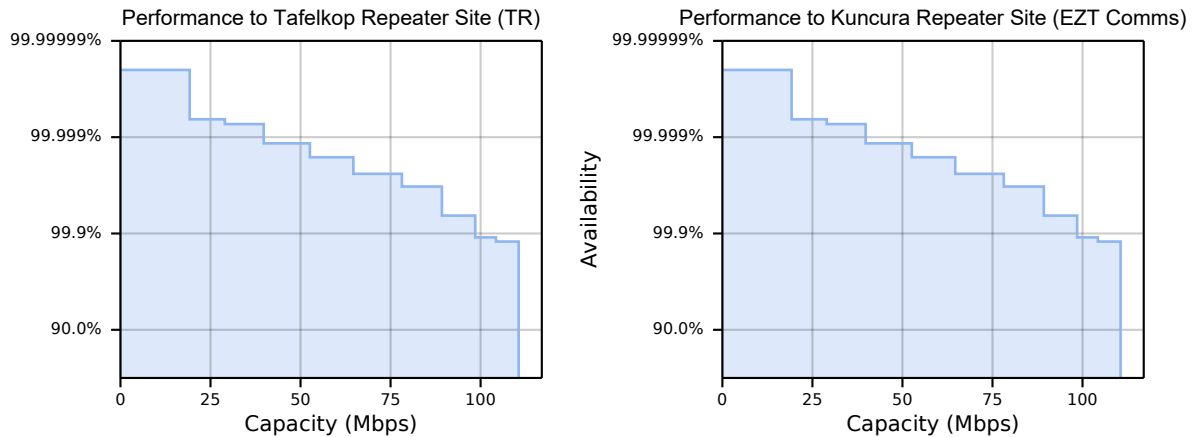
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 15 m



	Performance to Tafelkop Repeater Site (TR)	Performance to Kuncura Repeater Site (EZT Comms)
Mean IP	110.54 Mbps	110.54 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	54.146 km	System Gain Margin	41.13 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.09 Mbps
Regulation	ETSI	Annual Link Availability	99.9999 %
Modulation	Adaptive	Annual Link Unavailability	26 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	144.15 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-299.53 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	159.72 metre	Annual 2-way Availability	99.9999 %
Geoclimatic factor	1.18e-04	Annual 2-way Unavailability	25 secs/year
Fade Occurrence Factor (P0)	1.78e-02	Rain Availability	100.0000 %
Path inclination	3.07 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.82	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.71 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	143.72 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.43 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

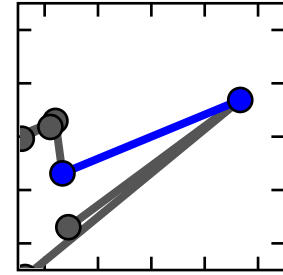
Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
C000000L033	4	Gigabit Surge Suppressor (56V)
EW-E4PT820C-WW	2	PTP820C Extended Warranty, 4 Additional Years
N000065L001	2	AC Power Injector 56V
N000082L014	2	PTP 820 Glands_x5_KIT
N000082L016	1	PTP 820 CAT5E Outdoor 100m drum
N000082L073	2	PTP 820 GBE_Connector_kit

Bill of Materials (continued)		
Part Number	Qty	Description
N000082L116	2	Grounding Cable, 1m with M6 ring to M6 ring
N000082L124	2	PTP 820 Act.Key - Capacity 200M with ACM Enabled, Per Tx Chan
N000082L173	4	Grounding Kit for CAT5e F/UTP 8mm and Cat6A Cable. Add 2 additional kits per PoE Injector that is installed outdoors
N060082D128	2	PTP 820 3' ANT,SP,6GHz,RFU-C TYPE&Std UDR70 - Andrew. Shorter lead time. Available in all regions
N060082L137	2	PTP 820C OMT KIT 6GHz
N060082L147	2	PTP 820 RFU-C 6GHz OMT Interface-Andrew



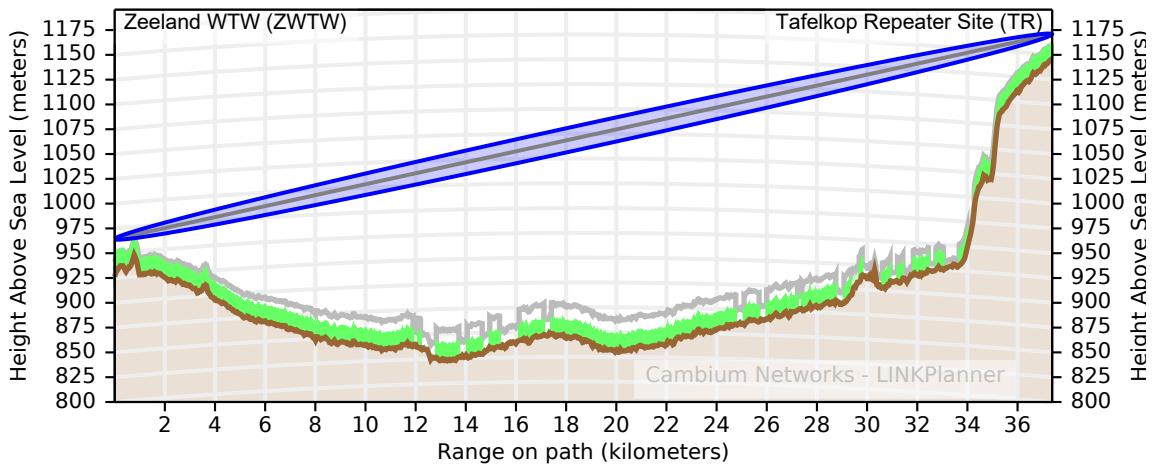
Zeeland WTW (ZWTW) to Tafelkop Repeater Site (TR)



Equipment: Cambium Networks PTPU6820C - 1+0

Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 38 m

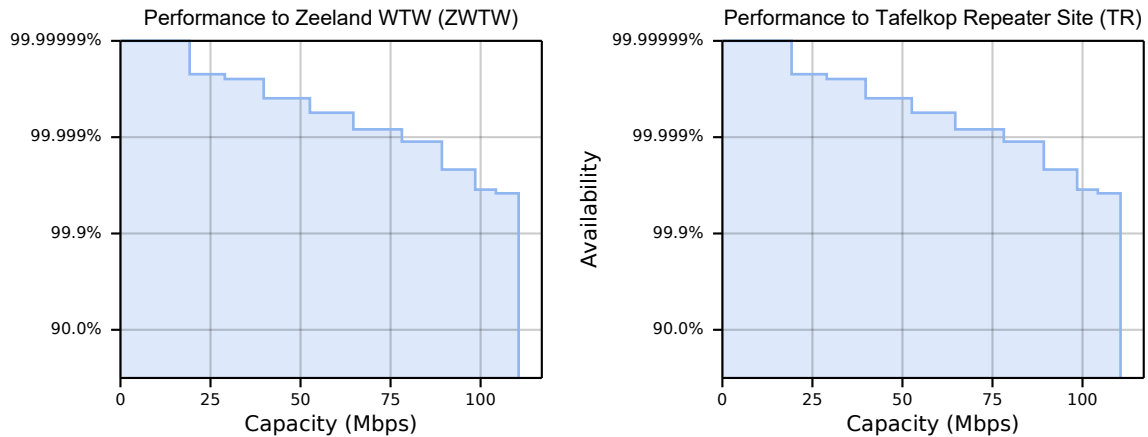
Cambium Networks 3ft Single Pol (Global)
N060082D128 - Direct @ 25 m



	Performance to Zeeland WTW (ZWTW)	Performance to Tafelkop Repeater Site (TR)
Mean IP	110.56 Mbps	110.56 Mbps
IP Availability	100.0000 % for 1.0 Mbps	100.0000 % for 1.0 Mbps

Link Summary			
Link Length	37.379 km	System Gain Margin	44.47 dB
Band	Upper 6 GHz	Mean Aggregate Data Rate	221.13 Mbps
Regulation	ETSI	Annual Link Availability	100.0000 %
Modulation	Adaptive	Annual Link Unavailability	3 secs/year
Bandwidth	14 MHz	Frame Size	1518 Bytes
Total Path Loss	140.81 dB	Prediction Model	ITU-R
System Gain	185.28 dB		

Performance Charts



Climatic Factors, Losses and Standards

dN/dH not exceeded for 1% of time	-300.15 N units/km	Excess Path Loss	0.00 dB
Area roughness 110x110km	149.36 metre	Annual 2-way Availability	100.0000 %
Geoclimatic factor	1.22e-04	Annual 2-way Unavailability	3 secs/year
Fade Occurrence Factor (P0)	5.33e-03	Rain Availability	100.0000 %
Path inclination	5.52 mr	Rain Unavailability	0 secs/year
Value of K Exceeded for 99.99% (ke)	0.74	Atmospheric Gasses	ITU-R P.676-7, ITU-R P.835-4
Excess Path Loss at ke	0.00 dB	Diffraction Loss	ITU-R P.526-14
0.01% Rain rate	49.58 mm/hr	Propagation	ITU-R P.530-12
Free Space Path Loss	140.50 dB	Rain Rate	ITU-R P.837-5
Gaseous Absorption Loss	0.31 dB	Refractivity Index	ITU-R P.453-9
Profile Type	Line-of-Sight		

Bill of Materials

Part Number	Qty	Description
(no part number)	2	Unspecified Power Lead. (set the region in the Bill of Materials options)
(no part number)	2	Unspecified Upper 6 GHz ODU (invalid TX frequency selection). Please select a TX frequency
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Disclaimer

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