11/06/2017

PRP VZW UCSC RRU Upgrade Venue

LTE MIMO in 700 MHz, 850 MHz, 1900 MHz and 2100 MHz
Polygon Name: UCSC

The Foundation for a Wireless World.

Executive Summary

oDAS Design Criteria: To upgrade current amplifier equipment and improve capacity of UCSC in Santa Clara, CA for Verizon in the 700 MHz, 850 MHz, 1900MHz and 2100MHz.

Item	Frequency Bands				
	700 MHz	850 MHz	850 MHz	1900 MHz	2100 MHz
Technology	LTE	LTE	CDMA	LTE	LTE
# of RF Carriers per Node	1	1	8	1	1
MIMO or SISO/Diversity (Bandwidth)	2x2 MIMO (10 MHz)	2x2 MIMO (10 MHz)	SISO (1.25 MHz)	4x4 MIMO (10 MHz)	4x4 MIMO (10 MHz)
Simulcast Ratio	1:1	1:1	11:1	1:1	1:1
# of Sectors	12	12	1	12	12
PA Power per Frequency Band	40W	40W	20W	40W	40W
Proposed Node Count	12				
# of Antenna Ports Required	6				
# of Physical Antenna Ports	6				
Fiber Count (Max Length)	(RRUs) 6 fiber strands per node using fiber (CPRI) connection – Verizon to Provide (10 km) (ION) 1 fiber strand per node				
Battery Back-up	No BBU				
Proposed Equipment	(1) New 2x40W Radio 4449 (700/850) (AC power option) per node – Verizon to Provide (2) New 4x40W RRUS32 (PCS, AWS) (AC power option) per node – Verizon to Provide (1) Existing Commscope ION-M 85P/19P or Andrew MMR 8/19 20W per node				
Proposed Antenna (Omni/Panel)	New Commscope SBNHH-1D85A / Existing Amphenol HTXCWW631518R000				
Average Antenna Height	49 Ft.				

Summary Continued

1. 9 of 12 UCSC Nodes
   - Existing Andrew 8/19 will remain for 850MHz CDMA service
   - New Radio 4449 (700MHz/850 MHz) will replace existing RRUL
   - New RRUS32(2100MHz) will replace existing RRUS12(2100MHz)
   - New RRUS32(1900Mhz) will be added
   - 7 fiber strands needed – 2 existing – 5 new
   - Antennas and passives will be upgraded to support 4x4 MIMO for 1900MHZ and 2100MHz
2. 3 of 12 UCSC nodes – Humanities, Village & College 9
   - Existing ION 85P/19HP will remain for 850MHz CDMA service
   - New Radio 4449 (700MHz/850 MHz) will replace existing RRUL
   - New RRUS32(2100MHz) will replace existing RRUS12(2100MHz)
   - New RRUS32(1900Mhz) will be added
   - 7 fiber strands needed – 2 existing – 5 new
   - Passives will be upgraded to support 4x4 MIMO for 1900MHZ and 2100MHz
   - Existing Amphenol antenna will be used

Node Specifications and Link Budgets

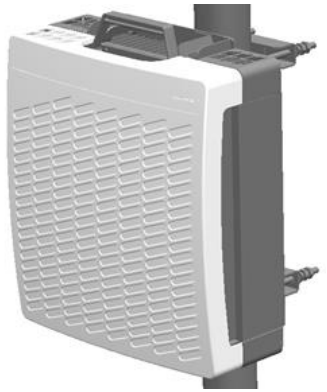
Equipment Specifications

Specification	Ericsson Radio 4449
Band(s)	**LTE B13 (700 MHz) + LTE B5 (850 MHz)**
Output power	**(2) 2 x 40W**
Power consumption	**1439W**
Power supply	**-48 V_{DC} or external (100-250)V_{AC} power supply unit**
Physical dimensions	**18.0" (height) x 13.2" (width) x 9.4" (depth)**
Weight	**70.0 lbs**
Connectors	**4 x 4.3-10 female**

Specification	Ericsson RRUS32
Band(s)	**LTE B2 (1900 MHz)**
Output power	**4 x 40W**
Power consumption	**910W**
Power supply	**-48 V_{DC} or external (100-250)V_{AC} power supply unit**
Physical dimensions	**27.2" (height) x 11.9" (width) x 7.0" (depth)**
Weight	**52.91 lbs**
Connectors	**4 x 7/16 DIN-female**

Equipment Specifications (Continues)

Specification	Ericsson RRUS32
Band(s)	**LTE B4 (2100 MHz)**
Output power	**4 x 40W**
Power consumption	**860W**
Power supply	**-48 V_{DC} or external (100-250)V_{AC} power supply unit**
Physical dimensions	**27.2" (height) x 11.9" (width) x 7.0" (depth)**
Weight	**52.91 lbs**
Connectors	**4 x 7/16 DIN-female**

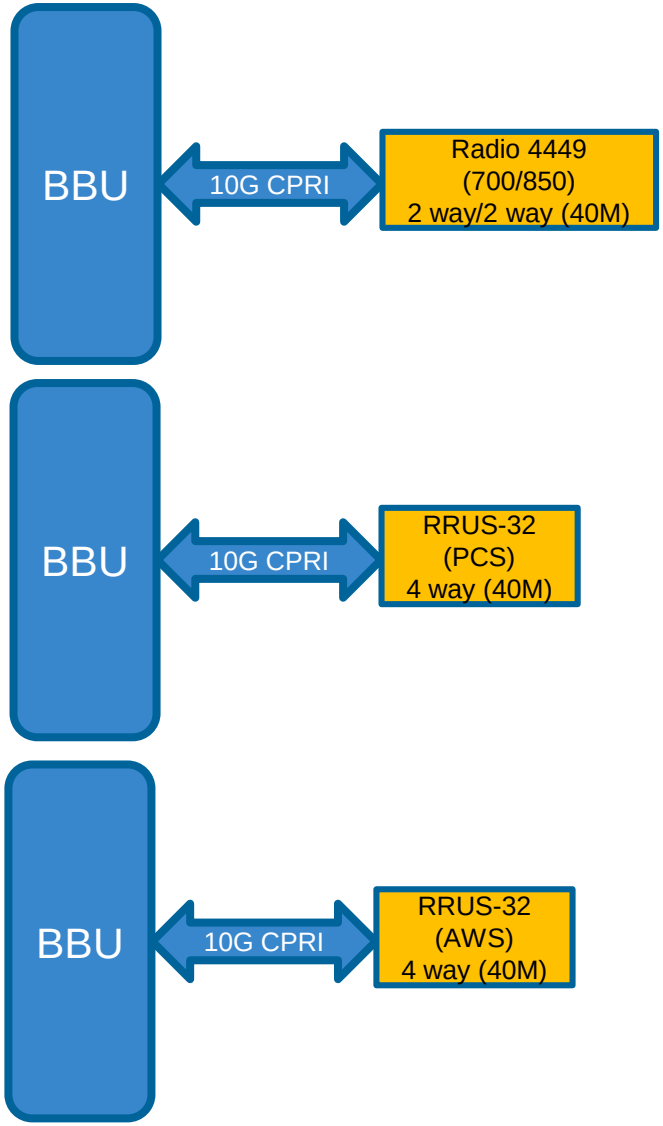


Specification	Commscope ION-M 85P/19P or MMR 8/19
Band(s)	**CDMA 850MHz band.**
Output power	**850 MHz 20W (43 dBm)**
Power consumption	**550 W**
Power supply	**115 or 230 V_{AC}**
Physical dimensions	**32.7" (height) x 6.1" (width) x 5.8" (depth)**
Weight	**44 lbs**
Connectors	**N-Female 850/1900 MHz**

Equipment Specifications (Continues)

Specification	Andrew MMR 8/19	
Band(s)	**CDMA 850MHz band.**	
Output power	**850 MHz 20W (43 dBm)**	
Power consumption	**450 W**	
Power supply	**115 or 230 V_{AC}**	
Physical dimensions	**32.7” (height) x 6.1” (width) x 5.8” (depth)**	
Weight	**44 lbs**	
Connectors	**N-Female 850/1900 MHz**	

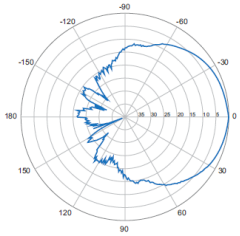
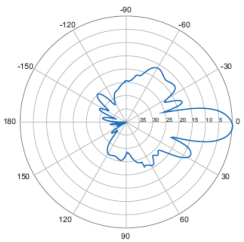
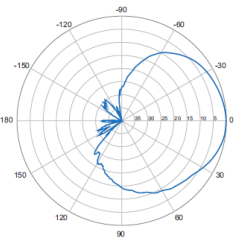
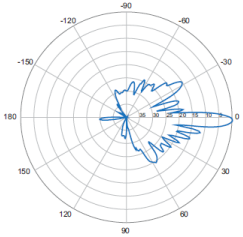
Fiber (CPRI) Connection



Antenna Specifications

Amphenol HTXCWW631518x000

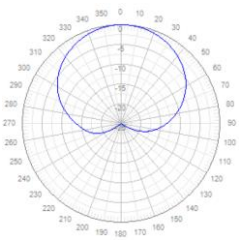
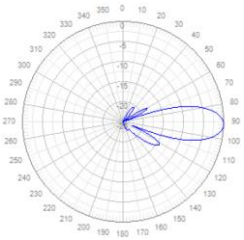
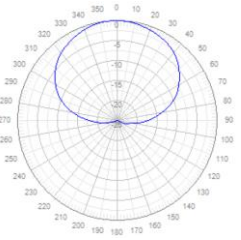
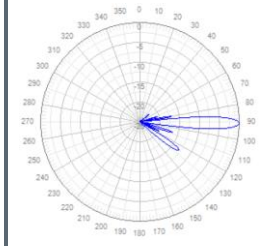
Electrical	Amphenol HTXCWW631518x000				
Frequency (MHz)	696-806	806-960	1710-1880	1850-1990	1920-2170
Gain (dBi)	14.4	14.9	16.5	17.0	17.5
Horizontal BW (°)	70°	65°	65°	63°	61°
Vertical BW (°)	17°	15°	8°	7°	6°
PIM rating (dBc)	-150 (2 x 20W tones)				
VSWR	1.5:1				
Polarization	(± 45°) high/low band				

Mechanical	Amphenol HTXCWW631518x000	750 MHz		2100 MHz	
Antenna type	Tri-band 6 Port antenna panel				
Dimensions (inches)	54.9” (L) x 12.0” (W) x 7.1” (D)				
Weight (lbs)	29.8				
Survival wind speed	> 125 mph				
Connectors	(6) 7-16 DIN Female				
Patterns		HBW	VBW	HBW	VBW

Antenna Specifications

Commscope SBNHH-1D85A

Electrical	Commscope SBNHH-1D85A					
Frequency (MHz)	698-806	806-896	1695-1880	1850-1990	1920-2200	2300-2360
Gain (dBi)	13.0	13.0	15.9	16.6	16.8	17.1
Horizontal BW (°)	84°	87°	81°	79°	80°	77°
Vertical BW (°)	18.9°	17.1°	7.9°	7.3°	6.9°	6.0°
PIM rating (dBc)	-153 (2 x 20W tones)					
VSWR	1.5:1					
Polarization	(± 45°) high/low band					

Mechanical	Commscope SBNHH-1D85A	746 MHz		2110 MHz	
Antenna type	Tri-band 6 Port antenna panel				
Dimensions (inches)	48.0” (L) x 11.9” (W) x 7.1” (D)				
Weight (lbs)	31.7				
Survival wind speed	> 150 mph				
Connectors	(6) 7-16 DIN Female				
Patterns		HBW	VBW	HBW	VBW

Link Budget – 2x40W Radio 4449 – 700MHz LTE MIMO

1 Panel – SBNHH-1D85A (Simulcast 1:1)

LTE Link Budget: Verizon - UCSC - 1P			
DAS Equipment: Ericsson RRU 46dBm		**Technology: LTE 700**	
Down Link		**Up Link**	
RF Node		**RF Node**	
Number of LTE Carriers Per Node	1	Channel Bandwidth (KHz)	10000
Total LTE Carrier Bandwidth (MHz)	10	Total Reference Signal Resource Blocks	50.0
% of Power for LTE	100%	Up Link Noise Floor per RB (dBm)	-121.9
Maximum Node Output Per Channel (dBm)	**46.0**	Primary Simulcast Ratio	1
Total Reference Signal Resource Blocks	50	Noise Figure Per Repeater (dB)	0.0
Total Usable Subcarriers	600	Up Link DAS System Noise Figure (dB)	0.0
Number of Tx Antennas	2	Up Link eNodeB Noise Figure (dB)	4.0
Down Link Node Antenna Gain (dBi)	13.0	Up Link DAS System Gain (dB)	0.0
Node Cable/Splitter Loss (dB)	2.0	Up Link Aggregated System Noise Figure (dB)	4.0
Spatial Diversity Gain at Cell Edge (dB)	3	SINR Requirement (dB)	2.0
Node Reference Signal EIRP Per Channel (dBm)	32.2	Interference Margin (dB)	2.4
Limiting Link	DL by 30.8		
Usable Node Reference Signal EPRE (dBm)	**32.2**	Effective RF Node Sensitivity (dBm)	**-113.5**
		Up Link Node Antenna Gain (dBi)	13.0
Mobile Station		Node Cable/Splitter Loss (dB)	2.0
eNodeB Sensitivity (dBm)	-88.5	Minimum Antenna Received Power (dBm)	**-124.5**
Downlink Interference Margin (dB)	4.0	**Mobile Station**	
Minimum UE RSRP Received Power (dBm)	-84.5	UE Output EIRP (dBm)	**23.0**
Body Loss (dB)	0.0	**Path Loss Calculation**	
Available In-Vehicle/In-Building Loss (dB)	-23.7	Total Available Up Link Path Loss (dB)	147.5
Log Normal Fading Margin (dB)	10.2	Up Link Frequency Loss Advantage (dB)	0.0
Multi-Path Fading Margin (dB)	3.0		
UE RSRP Power (dBm)	**-95.0**	Adjusted Available Up Link Path Loss (dB)	147.5
		Body Loss (dB)	0.0
		In-Vehicle/In-Building Loss (dB)	-23.7
Path Loss Calculation		Log Normal Fading Margin (dB)	10.2
Total Available Down Link Path Loss (dB)	116.7	Multi-Path Fading Margin (dB)	3.0
Down Link Cell Edge Design Path Loss (dB)	**127.2**	Up Link Cell Edge Design Path Loss (dB)	**158.0**

Antenna Configurations	Technology	Frequency band (MHz)	Channel BW (MHz)	PA Power (dBm)	PA Power %	Simulcast	Antenna model	# of antennas	antenna gain (dBi)	node-antenna loss (dB)	EPRE (dBm)
Current:	LTE	700	10.00	46	100%	1:1	Commscope SBNHH-1D85A	1	13.0	2.0	32.2
Additional:	LTE	700	10.00	46	100%	1:1	Commscope SBNHH-1D85A	3	13.0	7.0	27.2
	LTE	700	10.00	46	100%	1:1	Amphenol HTXCWW631518	3	14.4	7.0	28.6

Link Budget – 2x40W Radio 4449 – 850MHz LTE MIMO

1 Panel – SBNHH-1D65A (Simulcast 1:1)

LTE Link Budget: Verizon - UCSC - 1P			
DAS Equipment: Ericsson RRU 46dBm		**Technology: LTE 850**	
Down Link		**Up Link**	
RF Node		**RF Node**	
Number of LTE Carriers Per Node	1	Channel Bandwidth (KHz)	10000
Total LTE Carrier Bandwidth (MHz)	10	Total Reference Signal Resource Blocks	50.0
% of Power for LTE	100%	Up Link Noise Floor per RB (dBm)	-121.9
Maximum Node Output Per Channel (dBm)	**46.0**	Primary Simulcast Ratio	1
Total Reference Signal Resource Blocks	50	Noise Figure Per Repeater (dB)	0.0
Total Usable Subcarriers	600	Up Link DAS System Noise Figure (dB)	0.0
Number of Tx Antennas	2	Up Link eNodeB Noise Figure (dB)	4.0
Down Link Node Antenna Gain (dBi)	13.0	Up Link DAS System Gain (dB)	0.0
Node Cable/Splitter Loss (dB)	2.1	Up Link Aggregated System Noise Figure (dB)	4.0
Spatial Diversity Gain at Cell Edge (dB)	3	SINR Requirement (dB)	2.0
Node Reference Signal EIRP Per Channel (dBm)	32.1	Interference Margin (dB)	2.4
Limiting Link	DL by 30.8		
Usable Node Reference Signal EPRE (dBm)	**32.1**	Effective RF Node Sensitivity (dBm)	**-113.5**
		Up Link Node Antenna Gain (dBi)	13.0
Mobile Station		Node Cable/Splitter Loss (dB)	2.1
eNodeB Sensitivity (dBm)	-88.5	Minimum Antenna Received Power (dBm)	**-124.4**
Downlink Interference Margin (dB)	4.0	**Mobile Station**	
Minimum UE RSRP Received Power (dBm)	-84.5	UE Output EIRP (dBm)	**23.0**
Body Loss (dB)	0.0	**Path Loss Calculation**	
Available In-Vehicle/In-Building Loss (dB)	-23.7	Total Available Up Link Path Loss (dB)	147.4
Log Normal Fading Margin (dB)	10.2	Up Link Frequency Loss Advantage (dB)	0.0
Multi-Path Fading Margin (dB)	3.0		
UE RSRP Power (dBm)	**-95.0**	Adjusted Available Up Link Path Loss (dB)	147.4
		Body Loss (dB)	0.0
		In-Vehicle/In-Building Loss (dB)	-23.7
Path Loss Calculation		Log Normal Fading Margin (dB)	10.2
Total Available Down Link Path Loss (dB)	116.6	Multi-Path Fading Margin (dB)	3.0
Down Link Cell Edge Design Path Loss (dB)	**127.1**	Up Link Cell Edge Design Path Loss (dB)	**157.9**

Antenna Configurations	Technology	Frequency band (MHz)	Channel BW (MHz)	PA Power (dBm)	PA Power %	Simulcast	Antenna model	# of antennas	antenna gain (dBi)	node-antenna loss (dB)	EPRE (dBm)
Current:	LTE	850	10.00	46	100%	1:1	Commscope SBNHH-1D85A	1	13.0	2.0	32.1
Additional:	LTE	850	10.00	46	100%	1:1	Commscope SBNHH-1D85A	3	13.0	7.0	27.1
	LTE	850	10.00	46	100%	1:1	Amphenol HTXCWW631518	3	14.4	7.0	28.5

Link Budget – 4x40W RRUS32 – 1900MHz LTE MIMO

1 Panel – SBNHH-1D85A (Simulcast 1:1)

LTE Link Budget: Verizon - UCSC - 1P			
DAS Equipment: Ericsson RRU 46dBm		**Technology: LTE 1900**	
Down Link		**Up Link**	
RF Node		**RF Node**	
Number of LTE Carriers Per Node	1	Channel Bandwidth (KHz)	10000
Total LTE Carrier Bandwidth (MHz)	10	Total Reference Signal Resource Blocks	50.0
% of Power for LTE	100%	Up Link Noise Floor per RB (dBm)	-121.9
Maximum Node Output Per Channel (dBm)	**46.0**	Primary Simulcast Ratio	1
Total Reference Signal Resource Blocks	50	Noise Figure Per Repeater (dB)	0.0
Total Usable Subcarriers	600	Up Link DAS System Noise Figure (dB)	0.0
Number of Tx Antennas	4	Up Link eNodeB Noise Figure (dB)	4.0
Down Link Node Antenna Gain (dBi)	16.8	Up Link DAS System Gain (dB)	0.0
Node Cable/Splitter Loss (dB)	2.0	Up Link Aggregated System Noise Figure (dB)	4.0
Spatial Diversity Gain at Cell Edge (dB)	6	SINR Requirement (dB)	2.0
Node Reference Signal EIRP Per Channel (dBm)	39.1	Interference Margin (dB)	2.4
Limiting Link	DL by 27.8		
Usable Node Reference Signal EPRE (dBm)	**39.1**	Effective RF Node Sensitivity (dBm)	**-113.5**
		Up Link Node Antenna Gain (dBi)	16.8
Mobile Station		Node Cable/Splitter Loss (dB)	2.0
eNodeB Sensitivity (dBm)	-88.5	Minimum Antenna Received Power (dBm)	**-128.3**
Downlink Interference Margin (dB)	4.0	**Mobile Station**	
Minimum UE RSRP Received Power (dBm)	-84.5	UE Output EIRP (dBm)	**23.0**
Body Loss (dB)	0.0	**Path Loss Calculation**	
Available In-Vehicle/In-Building Loss (dB)	-23.7	Total Available Up Link Path Loss (dB)	151.3
Log Normal Fading Margin (dB)	10.2	Up Link Frequency Loss Advantage (dB)	0.0
Multi-Path Fading Margin (dB)	3.0		
UE RSRP Power (dBm)	**-95.0**	Adjusted Available Up Link Path Loss (dB)	151.3
		Body Loss (dB)	0.0
		In-Vehicle/In-Building Loss (dB)	-23.7
Path Loss Calculation		Log Normal Fading Margin (dB)	10.2
Total Available Down Link Path Loss (dB)	123.5	Multi-Path Fading Margin (dB)	3.0
Down Link Cell Edge Design Path Loss (dB)	**134.1**	Up Link Cell Edge Design Path Loss (dB)	**161.9**

Antenna Configurations	Technology	Frequency band (MHz)	Channel BW (MHz)	PA Power (dBm)	PA Power %	Simulcast	Antenna model	# of antennas	antenna gain (dBi)	node-antenna loss (dB)	EPRE (dBm)
Current:	LTE	1900	10.00	46	100%	1:1	Commscope SBNHH-1D85A	1	16.8	2.0	39.1
Additional:	LTE	1900	10.00	46	100%	1:1	Commscope SBNHH-1D85A	3	16.8	7.0	34.0
	LTE	1900	10.00	46	100%	1:1	Amphenol HTXCWW631518	3	17.5	7.0	34.7

Link Budget – 4x40W RRUS32 – 2100MHz LTE MIMO

1 Panel – SBNHH-1D85A (Simulcast 1:1)

LTE Link Budget: Verizon - UCSC - 1P			
DAS Equipment: Ericsson RRU 46dBm		**Technology: LTE 2100**	
Down Link		**Up Link**	
RF Node		**RF Node**	
Number of LTE Carriers Per Node	1	Channel Bandwidth (KHz)	10000
Total LTE Carrier Bandwidth (MHz)	10	Total Reference Signal Resource Blocks	50.0
% of Power for LTE	100%	Up Link Noise Floor per RB (dBm)	-121.9
Maximum Node Output Per Channel (dBm)	**46.0**	Primary Simulcast Ratio	1
Total Reference Signal Resource Blocks	50	Noise Figure Per Repeater (dB)	0.0
Total Usable Subcarriers	600	Up Link DAS System Noise Figure (dB)	0.0
Number of Tx Antennas	4	Up Link eNodeB Noise Figure (dB)	4.0
Down Link Node Antenna Gain (dBi)	16.8	Up Link DAS System Gain (dB)	0.0
Node Cable/Splitter Loss (dB)	2.0	Up Link Aggregated System Noise Figure (dB)	4.0
Spatial Diversity Gain at Cell Edge (dB)	6	SINR Requirement (dB)	2.0
Node Reference Signal EIRP Per Channel (dBm)	39.0	Interference Margin (dB)	1.0
Limiting Link	DL by 11.3		
Usable Node Reference Signal EPRE (dBm)	**39.0**	Effective RF Node Sensitivity (dBm)	**-114.9**
		Up Link Node Antenna Gain (dBi)	15.9
Mobile Station		Node Cable/Splitter Loss (dB)	2.0
eNodeB Sensitivity (dBm)	-106.5	Minimum Antenna Received Power (dBm)	**-128.8**
Downlink Interference Margin (dB)	4.0	**Mobile Station**	
Minimum UE RSRP Received Power (dBm)	-102.5	UE Output EIRP (dBm)	**23.0**
Body Loss (dB)	0.0	**Path Loss Calculation**	
Available In-Vehicle/In-Building Loss (dB)	-5.7	Total Available Up Link Path Loss (dB)	151.8
Log Normal Fading Margin (dB)	10.2	Up Link Frequency Loss Advantage (dB)	1.0
Multi-Path Fading Margin (dB)	3.0		
UE RSRP Power (dBm)	**-95.0**	Adjusted Available Up Link Path Loss (dB)	152.8
		Body Loss (dB)	0.0
		In-Vehicle/In-Building Loss (dB)	-5.7
Path Loss Calculation		Log Normal Fading Margin (dB)	10.2
Total Available Down Link Path Loss (dB)	141.5	Multi-Path Fading Margin (dB)	3.0
Down Link Cell Edge Design Path Loss (dB)	**134.0**	Up Link Cell Edge Design Path Loss (dB)	**145.3**

Antenna Configurations	Technology	Frequency band (MHz)	Channel BW (MHz)	PA Power (dBm)	PA Power %	Simulcast	Antenna model	# of antennas	antenna gain (dBi)	node-antenna loss (dB)	EPRE (dBm)
Current:	LTE	2100	10.00	46	100%	1:1	Commscope SBNHH-1D85A	1	16.8	2.0	39.0
Additional:	LTE	2100	10.00	46	100%	1:1	Commscope SBNHH-1D85A	3	16.8	7.0	34.0
	LTE	2100	10.00	46	100%	1:1	Amphenol HTXCWW631518	3	17.5	7.0	34.7

Link Budget – 20W ION-M – 850MHz CDMA

1 Panel – SBNHH-1D85A (Simulcast 11:1)

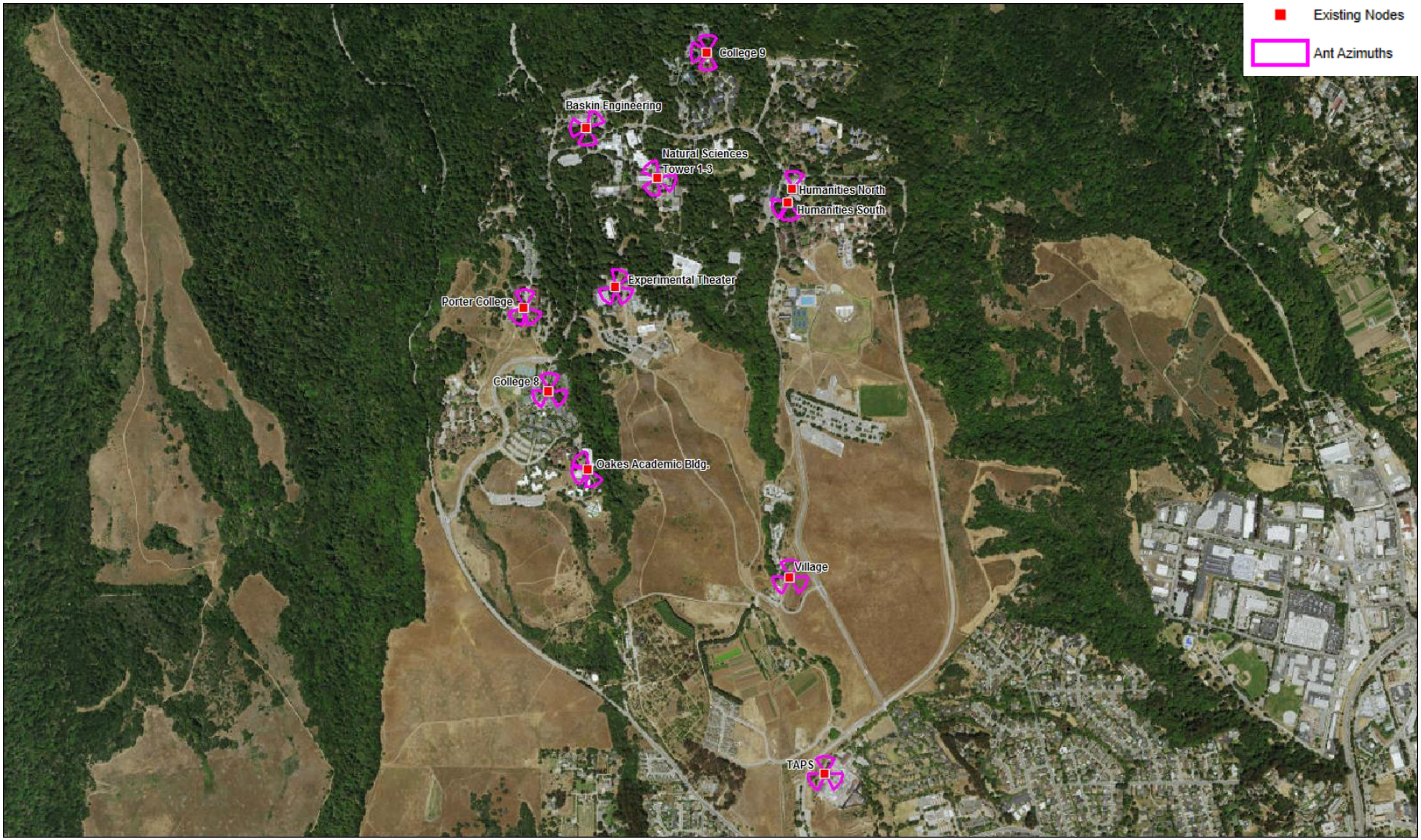
CDMA Link Budget: Verizon - UCSC - 1P			
DAS Equipment: Commscope ION-M 43dBm		Technology: CDMA 850	
Down Link		**Up Link**	
RF Node		**RF Node**	
Number of CDMA Carriers	8	Channel Bandwidth (KHz)	1230
Percentage of Total Power Dedicated to CDMA	100.0%	Up Link Data Rate (kbps)	9.6
Maximum Node Output Per Channel (dBm)	**34.0**	Up Link Noise Floor (dBm)	-113.1
Percentage Pilot Power to Total Power (%)	15%	Primary Simulcast Ratio	11
Pilot Power Offset (dB)	8.2	Noise Figure Per Repeater (dB)	4.5
Down Link Node Antenna Gain (dBi)	13.0	Up Link DAS System Noise Figure (dB)	14.5
Node Cable/Splitter Loss (dB)	2.0	Up Link BTS Noise Figure (dB)	4.0
Node Pilot EIRP Per Channel (dBm)	36.7	Up Link DAS System Gain (dB)	0.0
Limiting Link	UL by 4.7dB	Up Link Aggregated System Noise Figure (dB)	14.7
Usable Node Pilot EIRP Per Channel (dBm)	**32.1**	Eb/Io Requirement (dB)	6.0
		Interference Margin (dB)	5.0
Mobile Station		Processing Gain (dB)	21.1
MS Sensitivity (dBm)	-115.4	Up Link Diversity Gain (dB)	0.0
Mobile Antenna Gain (dBi)	0.0	Up Link Soft Handover Gain (dB)	3.0
Down Link Soft Handover Gain (dB)	3.0	Effective RF Node Sensitivity (dBm)	**-111.5**
Minimum Mobile Received Power (dBm)	**-113.4**	Up Link Node Antenna Gain (dBi)	13.0
Body Loss (dB)	3.0	Node Cable/Splitter Loss (dB)	2.0
Available In-Vehicle/In-Building Loss (dB)	16.4	Minimum Antenna Received Power (dBm)	**-122.4**
Log Normal Fading Margin (dB)	7.0	**Mobile Station**	
Multi-Path Fading Margin (dB)	3.0	Mobile Output EIRP (dBm)	**23.0**
Mobile Received Pilot Power (dBm)	**-84.0**	**Path Loss Calculation**	
		Total Available Up Link Path Loss (dB)	145.4
		Up Link Frequency Loss Advantage (dB)	0.0
		Adjusted Available Up Link Path Loss (dB)	145.4
		Body Loss (dB)	3.0
		In-Vehicle/In-Building Loss (dB)	16.4
Path Loss Calculation		Log Normal Fading Margin (dB)	7.0
Total Available Down Link Path Loss (dB)	150.1	Multi-Path Fading Margin (dB)	3.0
Down Link Cell Edge Design Path Loss (dB)	**116.1**	Up Link Cell Edge Design Path Loss (dB)	**116.1**

Antenna Configurations	Technology	Frequency band (MHz)	Channel BW (MHz)	PA Power (dBm)	PA Power %	Simulcast	Antenna model	# of antennas	antenna gain (dBi)	node-antenna loss (dB)	EPRE (dBm)
Current:	CDMA	850	1.23	43	100%	11:1	Commscope SBNHH-1D85A	1	13.0	2.0	32.1
Additional:	CDMA	850	1.23	43	100%	11:1	Commscope SBNHH-1D85A	3	13.0	7.0	27.1
	CDMA	850	1.23	43	100%	11:1	Amphenol HTXCWW631518	3	14.9	7.0	29.2

Existing Node Locations

Existing Node Locations

Mapinfo Image – UCSC



Existing Node Locations
UCSC

Polygon Name	Crown Castle Name	SCU	Latitude	Longitude	Rad Center (ft)	Equipment Type	Antenna Model	Azimuths	Pole Type	Hub Location	Build Type	Sales Object
UCSC	Baskin Engineering	410067	37.000147	-122.062969	70.71'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	40, 180, 270	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Porter College	410068	36.994547	-122.065492	84.71'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	0, 140, 220	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Oakes Academic Bldg.	410073	36.989500	-122.062920	28.31'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	160, 245, 320	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Experimental Theater	410076	36.995180	-122.061830	45.71'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	20, 130, 230	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Natural Sciences Tower 1	410041	36.998583	-122.060100	88.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	110	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Natural Sciences Tower 2	410041	36.998583	-122.060100	88.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	210	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Natural Sciences Tower 3	410041	36.998583	-122.060100	88.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	320	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	TAPS	410066	36.979986	-122.053386	26.71'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	0, 120, 240	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	College 8	410069	36.991940	-122.064503	51.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Commscope SBNHH-1D85A	0, 120, 240	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Village	410080	36.986111	-122.054805	19.21'	(1) Andrew MMR 8/19, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Amphenol HTXCWW631518X000	0, 120, 240	Monopole	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Humanities North	410081	36.998240	-122.054690	82.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Amphenol HTXCWW631518X000	5	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	Humanities South	NA	36.997816	-122.054863	78.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Amphenol HTXCWW631518X000	175, 250	Rooftop	Santa Cruz-236/536	Upgrade	DVEN
UCSC	College 9	410078	37.002500	-122.058130	63.71'	(1) Commscope ION 85P/19P, (1) Ericsson Radio 4449 2x40W (700/850), (2) Ericsson RRUS32 4x40W (PCS, AWS)	Amphenol HTXCWW631518X000	0, 180, 270	Rooftop	Santa Cruz-236/536	Upgrade	DVEN

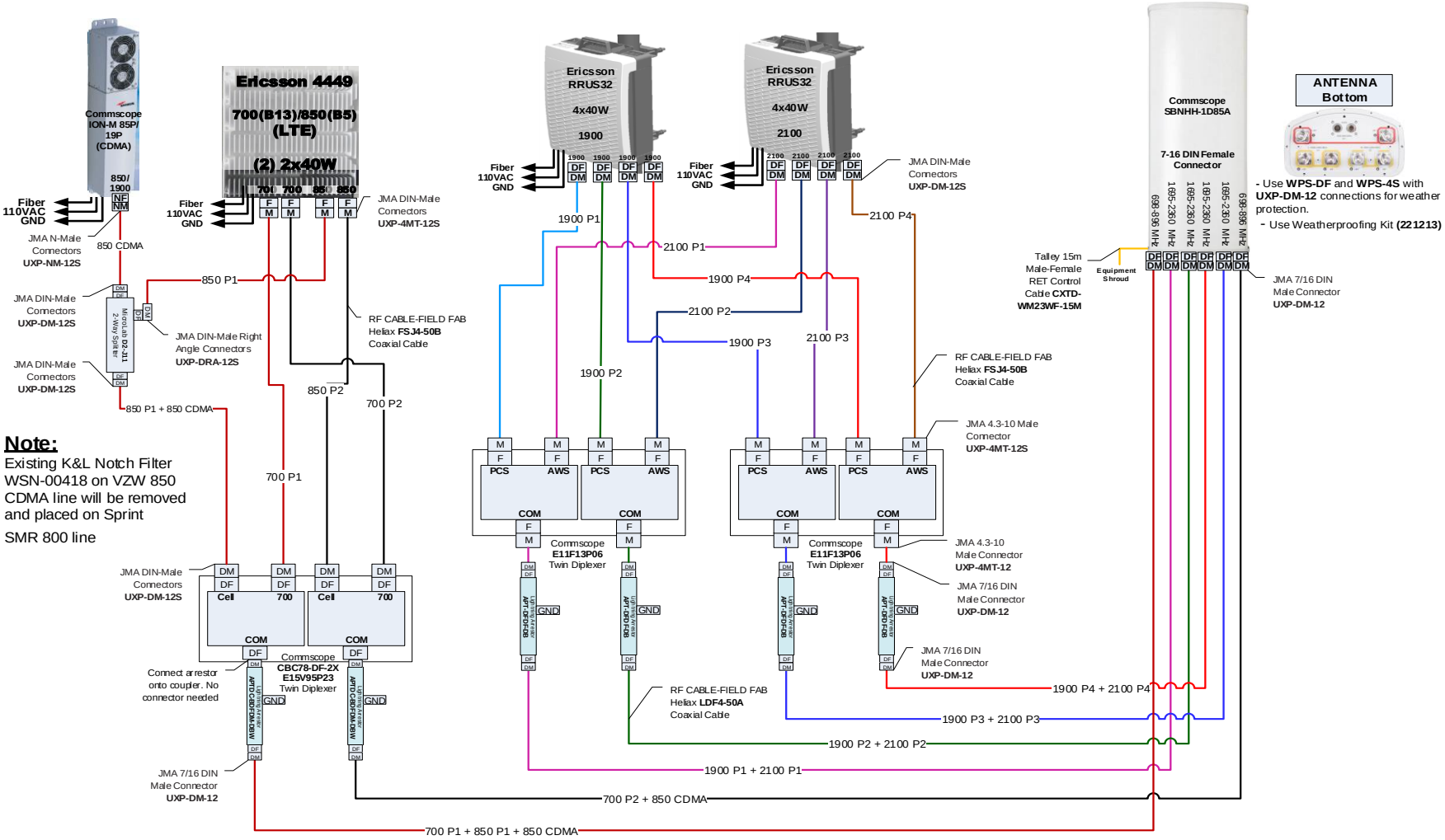
VZW UCSC Hub (Site ID): 37.00266 / -122.05213
Santa Cruz 236/536 at UCSC

Node Wiring and Demarcation Diagram

Node Wiring Diagram

Commscope SBNHH-1D85A (1 Panel)

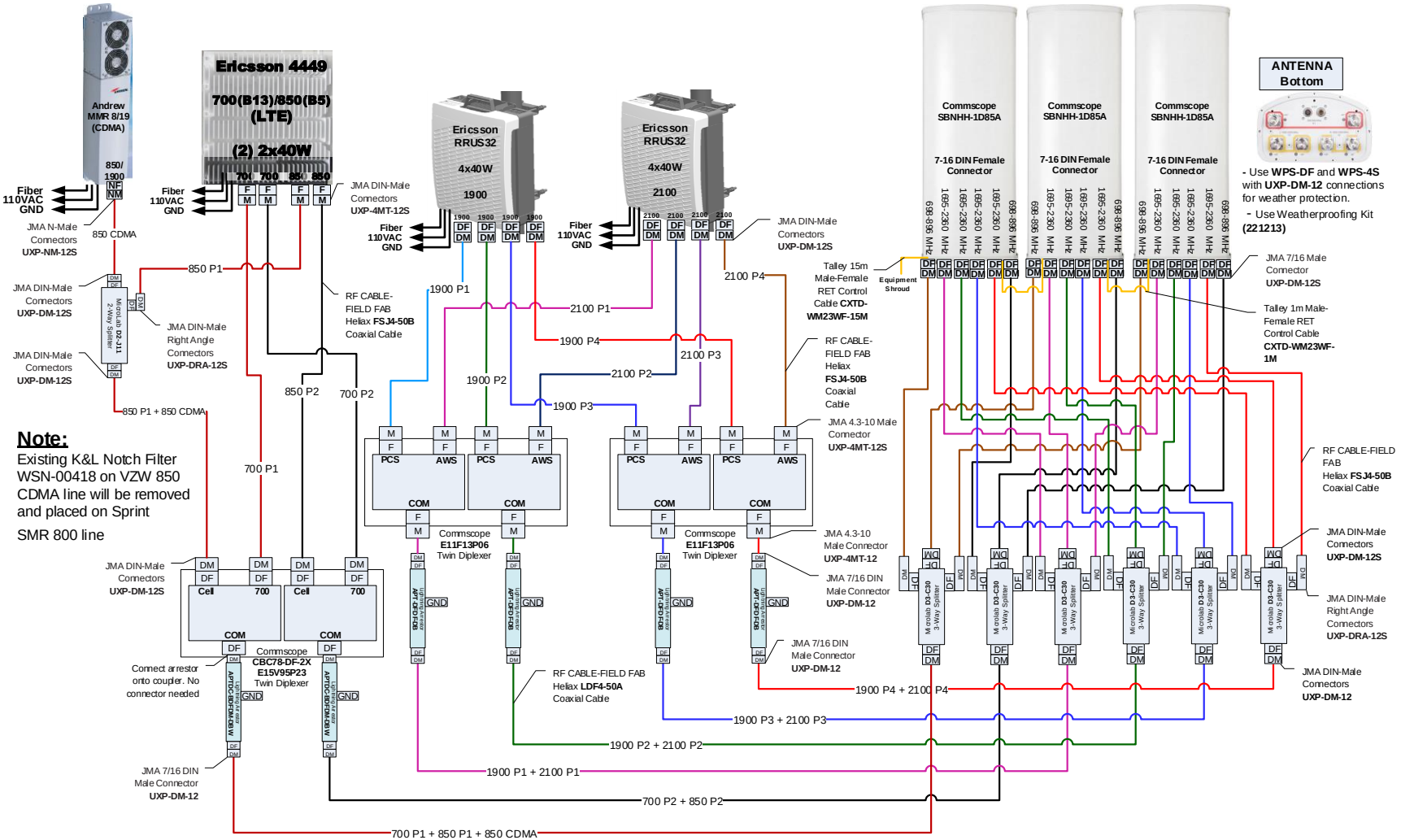
1 Node: Natural Science - Tower 1, Tower 2, Tower 3



Node Wiring Diagram

Commscope SBNHH-1D85A (3 Panels)

5 Nodes: Baskin Engineering, Porter College, Oakes Academic, Experimental Theater, TAPS



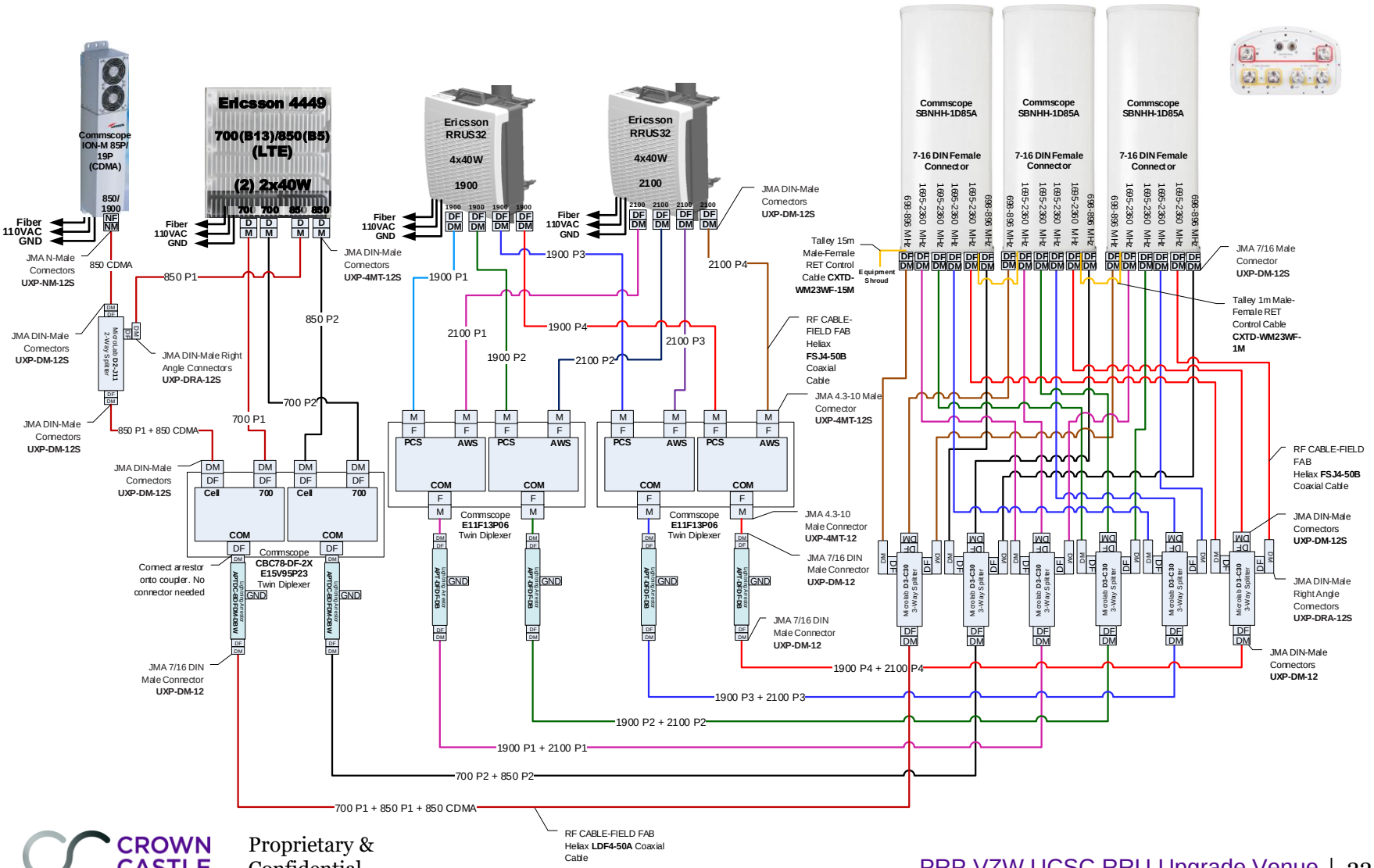
Note:

Existing K&L Notch Filter WSN-00418 on VZW 850 CDMA line will be removed and placed on Sprint SMR 800 line

Node Wiring Diagram

Commscope SBNHH-1D85A (3 Panels)

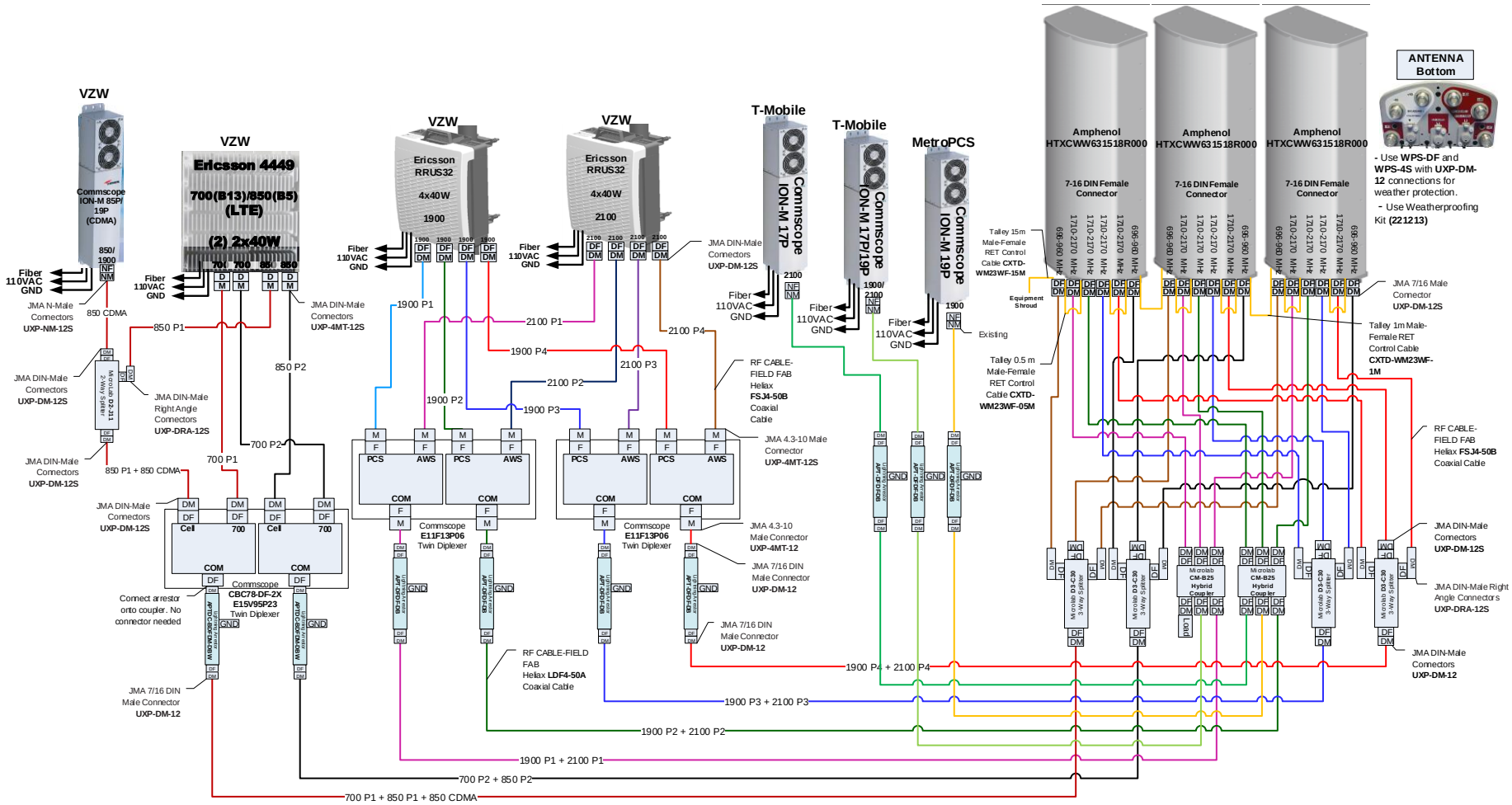
1 Node: College 8



Node Wiring Diagram

Amphenol HTXCWW631518R000 (3 Panels)

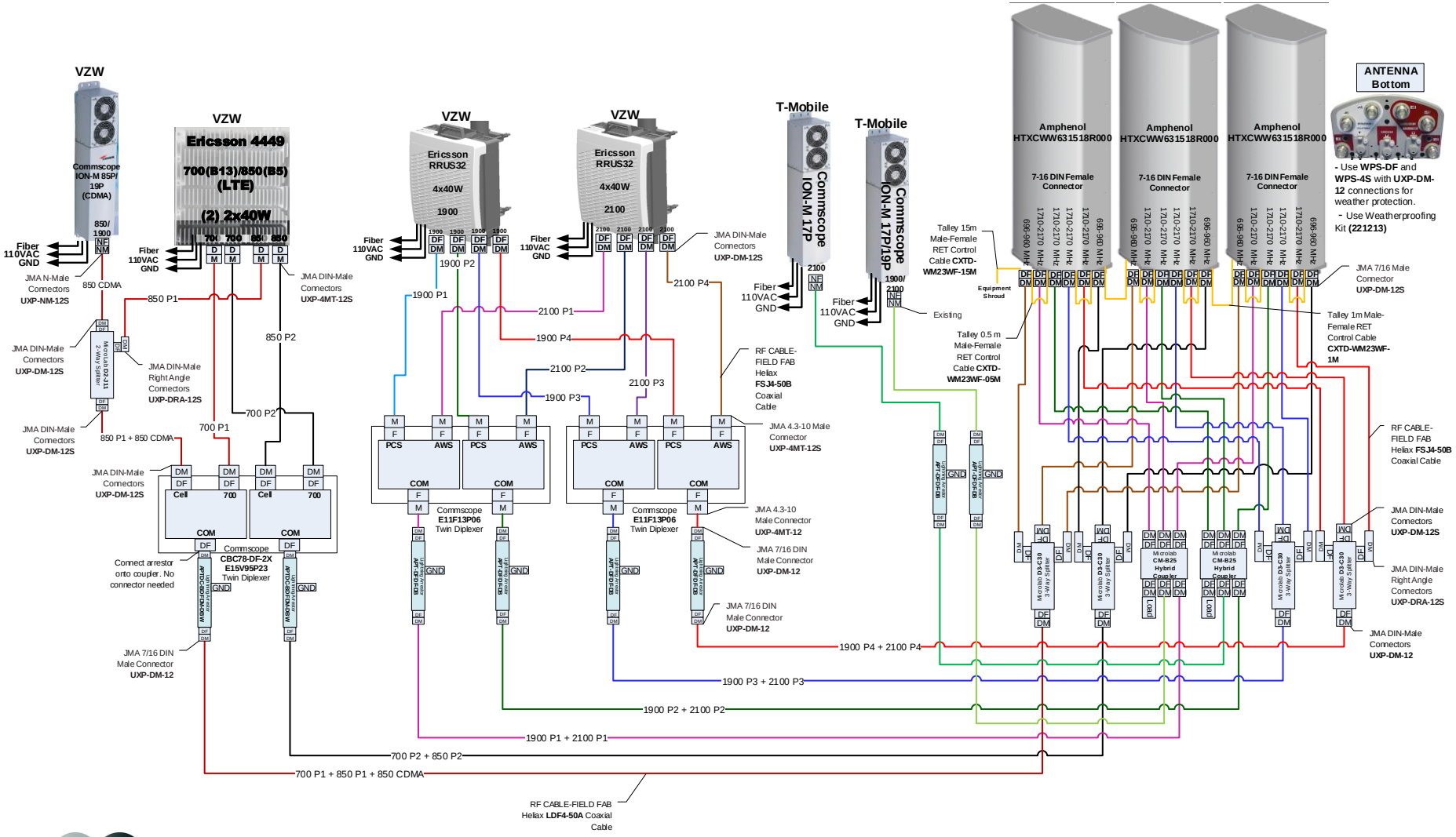
2 Nodes: Village (Lower Antenna Set), College 9 (Upper Antenna Set)



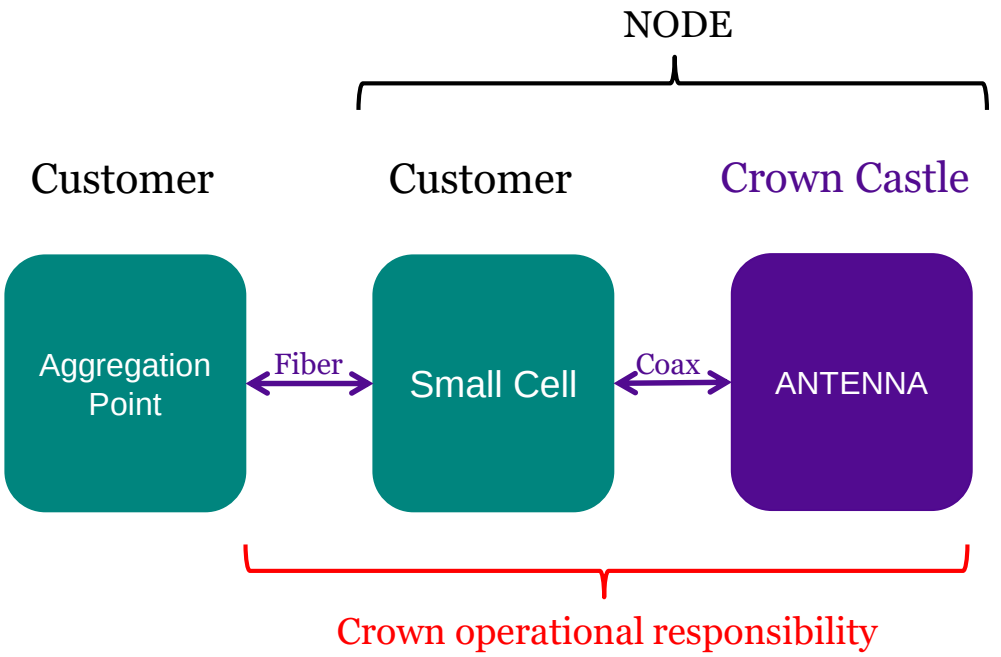
Node Wiring Diagram

Amphenol HTXCWW631518R000 (3 Panels)

1 Node: Humanities (North/South Upper Antenna Set)



Equipment Demarcation – Small Cell

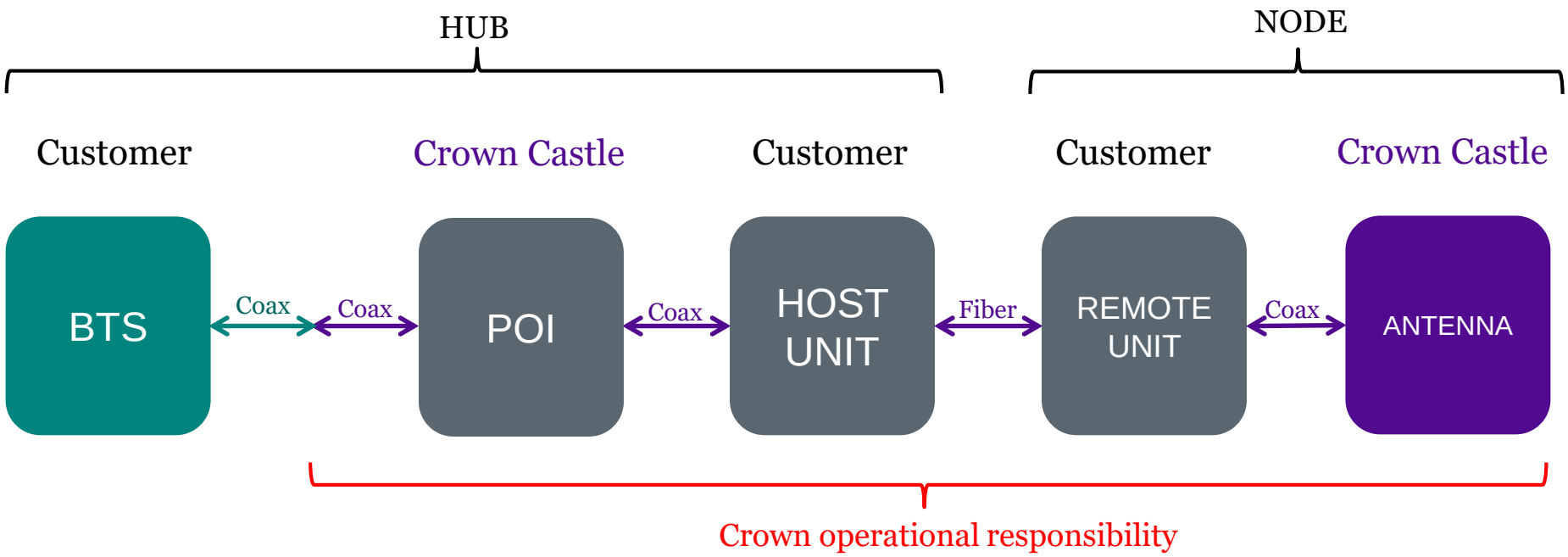


Customer purchased & owned equipment

Crown Castle purchased & owned equipment

{ Demarcation Point between Crown Castle and Carrier (excludes Small Cell Equipment)

Equipment Demarcation – DAS with Crown POI
(ION-M 85P/19P or MMR 8/19)



Customer purchased & owned equipment

Crown Castle purchased & titled to customer equipment

Crown Castle purchased & owned equipment

{ Demarcation Point between Crown Castle and Carrier

Thank You

FOR FURTHER INFORMATION
PLEASE CONTACT:

Jesus Garcia
RF Engineer
(408) 468-5528
Jesus.Garcia@CrownCastle.com