

OFFICIAL PROPOSAL  
Radio Installation on Harper Tower  
December 22, 2006

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### Small Radio Installation on Harper Tower

December 22, 2006

Initial Proposal Criteria:

**A) Service or infrastructure to be offered**

Lawrence Freenet would like to expand the Harper tower's role in public service by providing broadband wireless Internet services to Lawrence, the University, and its surroundings.

As part of its mission, Freenet brings low cost broadband service to Lawrence residents without expensive and complex modems, routers, or switches. This reduces the costs of delivering service and allows students to access the internet wherever they are.

The organization has over 100 access points online in the Lawrence area, including coverage of downtown Lawrence and over 3,000 apartments. Freenet is currently providing free access to families with children who make less than 140% of the income required to obtain food assistance from the state. Here is our chart we use to qualify charity users:

Total Household	Monthly Income	Qualifies
<input type="checkbox"/> 2	Less than \$1,457	<input type="checkbox"/>
<input type="checkbox"/> 3	Less than \$1,828	<input type="checkbox"/>
<input type="checkbox"/> 4	Less than \$2,200	<input type="checkbox"/>
<input type="checkbox"/> 5	Less than \$2,570	<input type="checkbox"/>
<input type="checkbox"/> 6+	Less than \$29,40 + \$370 for each additional member	<input type="checkbox"/>

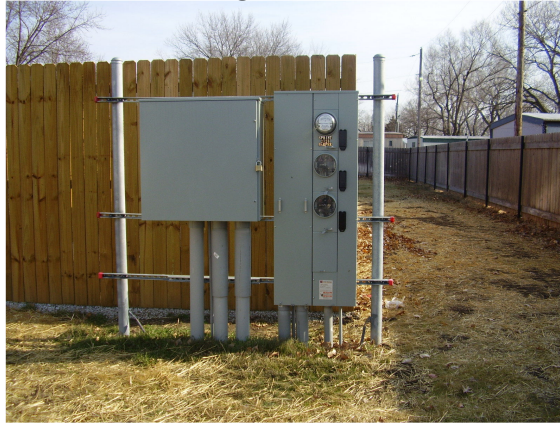
As the project moves toward universal coverage in 2007, residents will be able to use the network from any location in the community.

- B) The technical description of the service including requirements for access, electricity, and any other expectations from the City of Lawrence.**

## **Harper St. Tower Radio Install Proposal**

Lawrence Freenet would like to install small radio equipment on existing pole mounts at the top of the Harper St. water tower. Along with the radios there will be Cat5e cable runs to each of the radios. The wire runs will run from the existing fenced in area to the base of the tower via hand dug trenches with PVC conduit and enter at the point of existing cable lines. Once inside the tower, the Cat5e cable will run along existing cable clamps to the top of the tower where they will be connected to the radios.

Existing fenced in area:



This area is a fenced in enclosure that will house all electrical and computer equipment.

Tower entry point



Cable entry point inside Tower



This is the entry area for the Cat5e to be entered into the tower.

Cable run up Tower



Existing cable run that our Cat5e cable will follow up the tower.

Mounts on top of Tower



The mounts that Freenet equipment will attach to.

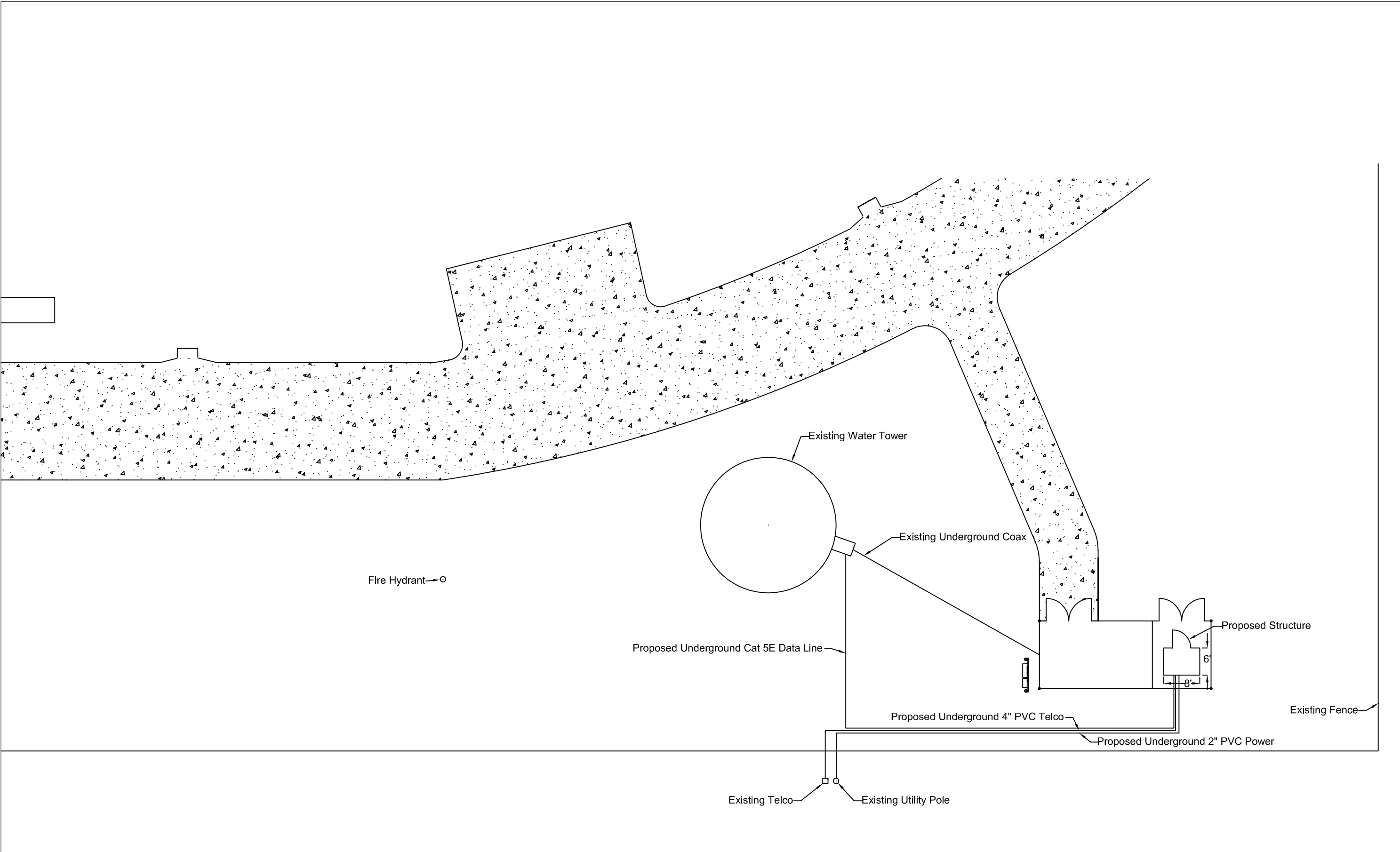
7 radios will be installed directed on the tower. Specifications for those are listed in Appendix A-C of the structural analysis.

- C) Financial arrangements for the proposal, including plan to cover any out-of-pocket costs for the City of Lawrence (e.g., cost of utilities used, repair of any damages, etc.).**

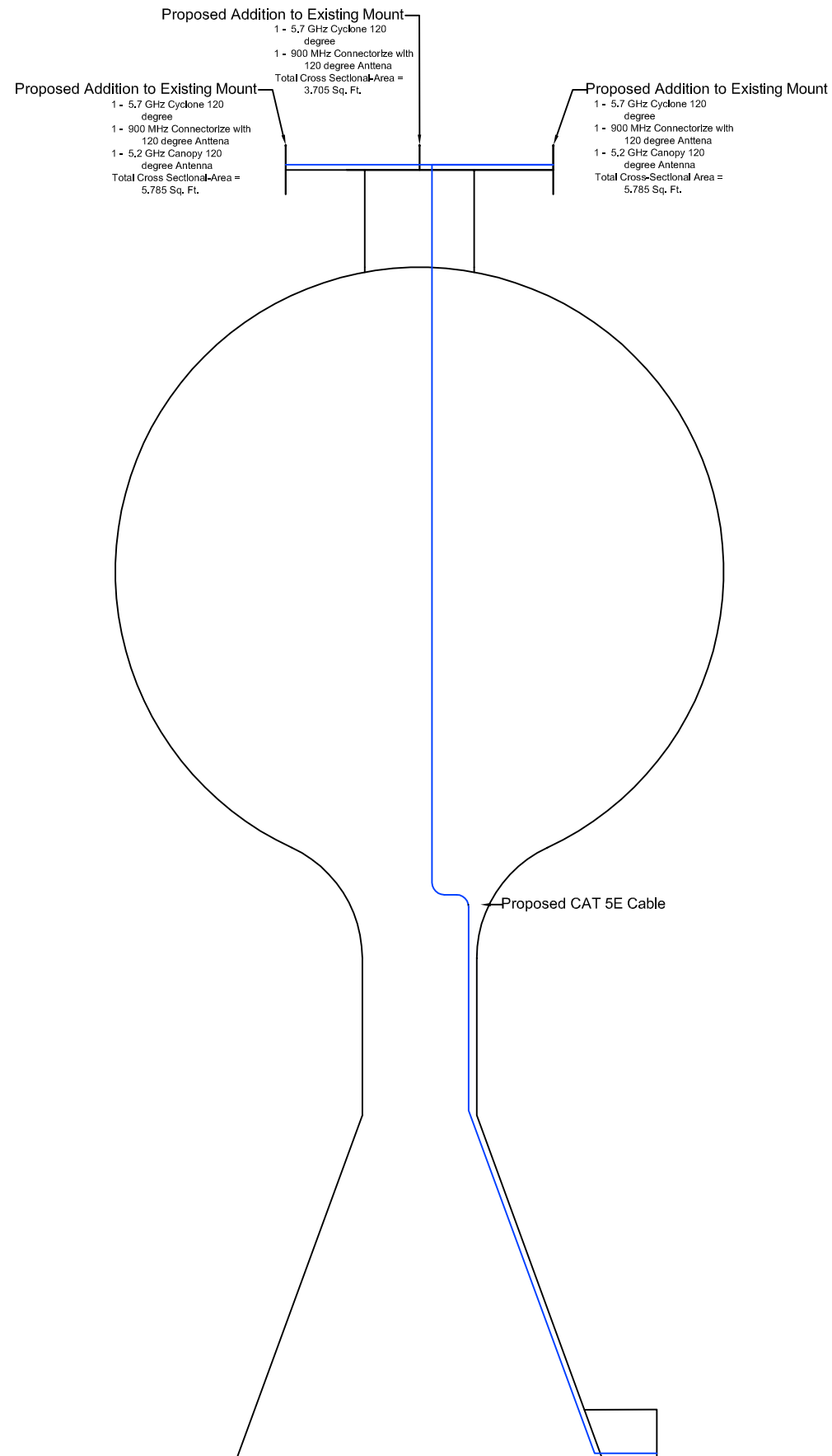
The cost of the radio equipment, power, structures, and other equipment will be incurred by Lawrence Freenet.

**D) Summary of Lawrence Freenet.**

Lawrence Freenet is a non-profit broadband service provider for the Lawrence Area that is dedicated to the proposition that the Internet should be available to everyone, regardless of income. There are two primary reasons for this belief. First, the Internet is a valuable educational tool that gives students of all ages instant access to large quantities of information. Second, the Internet serves the same capacity as the public square of old; the Internet provides citizens with access to the public forum where they can remain informed, express their opinions and contribute to the public debate.









## **Harper St. Tower Structural Analysis**

Structure Description:	Existing 120' pedestal Tank
Freenet Site Identification:	Harper Street
General Site Identification:	Harper Street Fire Station Water Tower
Site Location:	2128 Harper Street Lawrence, KS 66046
Date:	December, 20 <sup>th</sup> 2006
Prepared By:	Joshua W. Montgomery

Wind / Antenna Loading  
Overall Impact Assessment

Scope: Freenet to add onto 3 existing mounts (3) 5.7 GHz Cyclone 5750 - 120° Unit weighing 9 lbs each (see appendix A), (3) 5.2 GHz Cyclone 5250 - 120° unit weighing 9 lbs each (see appendixes B), and (2) Motorola Canopy 900 MHz AP weighing 12.5 lbs each (see appendix C).

## Wind Loading:

Douglas County Kansas Wind Speed at 33 ft 80 MPH<sup>i</sup>  
 Handrail Represents Maximum Height of Wind Load (Center of Drag) 100 Ft<sup>i</sup>

$$F_c = q_z G_H \sum C_A A_A \quad \text{Equation 1}^{ii}$$

$$q_z = 0.00256 K_z V^2 \quad \text{Equation 2}^{ii}$$

$$q_z = 0.00256 \times \left( \frac{100}{33} \right)^{\frac{2}{7}} 80^2 = 22.49 \frac{lb}{ft^2} \quad \text{Equation 3}$$

$$G_H = 0.65 + \frac{0.6}{\left( \frac{120 FT}{33 FT} \right)^{\frac{1}{7}}} = 1.149 \quad \text{Equation 4}^i$$

$$C_A = 1.4 \quad \text{Equation 5}$$

## New Loads on Mounting System

### Wind Loads

Area is composed of 8 components:

(3) 5.2 GHz Unit Measuring 30" by 10" by 4"

$$A_A = 2.083 \text{ ft}^2$$

$$F_c = 226 \text{ lbs}$$

(3) 5.7 GHz Unit Measuring 30" by 10" by 4"

$$A_A = 2.083 \text{ ft}^2$$

$$F_c = 226 \text{ lbs}$$

(2) 900 MHz Unit Measuring 19.5" by 12" by 4.75"

$$A_A = 1.625 \text{ ft}^2$$

$$F_c = 118 \text{ lbs}$$

$$F_{\text{Total}} = 570 \text{ lbs}$$

## Gravity Weight of Freenet Installation

5.7 GHz Unit	9lb x 3	= 27 lbs
5.2 GHz Unit	9 lb x 3	= 27 lbs
900 MHz Unit	12.5 x 2	= 25 lbs
Total Radio Weight		= 79 lbs

Total Cable Weight:

Cable Run  $\approx 2,500\text{ ft}$

Length Density  $\approx 0.025 \frac{\text{lb}}{\text{ft}}$

Total Cable Weight = 62.5 lbs

Total Installation Weight = 141.5 lbs

Total weight of installation is negligible when compared to the weight of water and other equipment installed on tower.

## Overall Impact of Freenet Installation

As far as frequency is concerned, Lawrence Freenet uses unlicensed spectrums, unlike the large cellular vendors on the tower. Our frequency selections are 902-928 MHz, 5,250-5,350 MHz and 5,725-5,850 MHz. Our use of public frequency coupled with heavy reliance on spectrums almost an order of magnitude above the existing equipment precludes the likelihood of any interference with existing equipment on the tower. Should any interference manifest itself, we will work diligently to resolve the issue immediately.

The additional wind loading on the tower due to freenet's installation is 570 lbs. This is quite minimal due to the fact that the Tower has such an enormously wide base. Considering this fact, the unit's contribution to the overall wind load allotment should be considered negligible.

The weight of the freenet installation will total 141.5 lbs. This is though to be insignificant when compared to the 4 million lb water weight in the tower. A full scale structural analysis of the tank is therefore unwarranted.



## **Appendix A: 5.2 GHz Cyclone 5250 - 120° Specification Sheet**



Toll Free 1-866-230-9174

Cyclone components are 100% compatible with the entire line of Motorola Canopy Subscriber Modules, Backhauls, and Access Points.

CYCLONE		5200-120		5201-120		5250-120		5251-120	
Antenna Specifications	Polarization					Vertical			
	Gain, dbi (nominal) Beamwidth -3dB					11.7			
	Horizontal Plane Beamwidth					120°			
	Vertical Beamwidth -3 db					8			
	X-Polarization Rejection					>25 dB			
	Front to Back					25 dB			
	VSWR					1.5 Maximum			
	Model #					CY-5V-120-14NM			
Radio Specifications	Frequency, GHz					5.250-5.350 UNII			
	Access Mode					TDD/TDMA			
	Signaling Rate	10 Mbps				20 Mbps			
	Carrier to Interference	3dB nominal, with receiver input @ –65 dBm and higher.							
	Receiver Sensitivity	–83 dBm 10– <sup>4</sup> BER							
	Operating Range	Up to 4 miles							
	Output EIRP	30 dBm							
	DC Power	0.30 Amp @ 24 VDC (7.2 watts)							
	Interface	10/100 BaseT, Half/Full Duplex rate auto negotiated.							
	Protocols used by Cyclone	IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, DES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, AES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, DES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, AES	
	Protocols supported by Cyclone	Switched Layer 2 Transport w/support for all common Ethernet protocols including IPV6, NetBIOS, DHCP, IPX, Etc.							
	Software Upgrade Path	Remotely Downloaded into Flash via RF link							
	Network Management	HTTP, TELNET, FTP,SNMP Version 2C							
	Temperature	–40° C to +55° C (–40° F ~ 131° F)							
	Weight	9 lbs.							
	Dimensions	Length 30", Width 4", Depth 10"							
	FCC/IC Certification	QSX5200ISM / 4586A-5700EC							
	Wind Loading Specifications	70.89 Lbs.@80 M.P.H.	110.76 Lbs.@100 M.P.H.	159.50 Lbs.@120 M.P.H.	217.09 Lbs.@140 M.P.H.	283.55 Lbs.@160 M.P.H.			

### Cyclone Mount

The Cyclone Mount is designed for flexibility and dependability. All components are custom machined from Aircraft Grade Anodized Aluminum and High Quality 304 Stainless Steel in order to create the most durable product possible. Our Mount is designed to accommodate mounting surfaces up to 3.5" in diameter and allows for greater than 15° of Downtilt as well as 4° of Uptilt.



**Cyclone Support** Last Mile Gear provides some of the best Technical Support in the business for Cyclone radios as well as the entire line of Motorola Canopy equipment. We are here to assist you Monday thru Friday 8:00 to 5:00 Pacific Time. Last Mile Gear can also provide full network integration and design services.

**Warranty** All Cyclone Radios are covered by a one year conditional warranty. Cyclone Access Points and Backhauls are covered for manufacturing defects only. Equipment that is damaged due to improper handling, installation, or acts of God such as lightning, flood, or ice are not the responsibility of Last Mile Gear nor its Distributors. **DO NOT ATTEMPT TO REPAIR CYCLONE EQUIPMENT YOURSELF.** Radios that are returned with the case seal broken will NOT be covered under warranty under any circumstance.

**RMA** Please call in advance to request an RMA Number. Equipment returned without a valid RMA Number clearly written on the outside of the packaging will be refused. If you have questions contact Keith at +1 (866) 230-9174 Extension 17. RMAs are generally returned within 3 business days.

**Last Mile Gear**  
1324 Vandercreek Way  
Longview, WA 98632

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**Tel:** +1(360)414-5990  
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**Sales:** sales@lastmilegear.com  
**Support:** support@lastmilegear.com  
**Web:** www.lastmilegear.com



**Appendix B: 5.7 GHz Cyclone 5750 - 120° Specification Sheet**



Toll Free 1-866-230-9174

Cyclone components are 100% compatible with the entire line of Motorola Canopy Subscriber Modules, Backhauls, and Access Points.

CYCLONE		5700-120		5701-120		5750-120		5751-120	
Antenna Specifications	Polarization	Vertical							
	Gain, dbi (nominal) Beamwidth -3dB	14							
	Horizontal Plane Beamwidth	120°							
	Vertical Beamwidth -3 db	8							
	X-Polarization Rejection	>25 dB							
	Front to Back	25 dB							
	VSWR	1.5 Maximum							
	Model #	CY-5V-120-14NM							
Radio Specifications	Frequency, GHz	5.725-5.850 UNII							
	Access Mode	TDD/TDMA							
	Signaling Rate	10 Mbps				20 Mbps			
	Carrier to Interference	3dB nominal, with receiver input @ –65 dBm and higher.							
	Receiver Sensitivity	–83 dBm 10 <sup>–4</sup> BER							
	Operating Range	Up to 5 miles w/o Reflector, up to 15 miles w/Reflector							
	Output EIRP	36 dBm							
	DC Power	0.30 Amp @ 24 VDC (7.2 watts)							
	Interface	10/100 BaseT, Half/Full Duplex rate auto negotiated.							
	Protocols used by Cyclone	IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, DES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, AES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, DES		IPv4, UDP, TCP,ICMP,Telnet, HTTP, FTP, SNMP, AES	
	Protocols supported by Cyclone	Switched Layer 2 Transport w/support for all common Ethernet protocols including IPV6, NetBIOS, DHCP, IPX, Etc.							
	Software Upgrade Path	Remotely Downloaded into Flash via RF link							
	Network Management	HTTP, TELNET, FTP,SNMP Version 2C							
	Temperature	–40° C to +55° C (–40° F ~ 131° F)							
	Weight	9 lbs.							
	Dimensions	Length 30", Width 4", Depth 10"							
	FCC/IC Certification	QXSX5700ISM / 4586A-5700EC							
Wind Loading Specifications	64.03 Lbs.@80 M.P.H.	100.04 Lbs.@100 M.P.H.	144.06 Lbs.@120 M.P.H.	196.08 Lbs.@140 M.P.H.	256.11 Lbs.@160 M.P.H.				

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## **Appendix C: Motorola Canopy 900 MHz Connectorizer Specification Sheet**

## Specifications Sheet



### Motorola Canopy 900 MHz AP



Canopy Part Number	9000AP
Description	900 MHz AP
Market Availability	North America, South America, Asia
Signaling Rate	6 Mbps maximum
Typical LOS Range	40 Miles (64 km)
Typical Aggregate Useful Throughput	4 Mbps maximum
Frequency range of band	ISM 902-928 MHz
Non-overlapping Channels	3
Channel Width	8 MHz
Modulation Type	High Index 2-level and 4-level Frequency Shift Keying (FSK) optimized for interference rejection
Channel Spacing	1 MHz
Encryption	DES capable
Latency	< 15 msec
Carrier to Interference ratio (C/I)	-3dB @ 3 Mbps, -10dB @ 6 Mbps at -70dBm
Nominal Receiver Sensitivity (dbm typical)	-90 dBm
Antenna Gain (dB)	12 dBi
EIRP (dB)	36 dBm
Equivalent Isotropic Radiated Power (EIRP)	4 W
DC Power (typical)	0.3 A @ 24 VDC = 7.2 W
Antenna Beam Width	60 degree beam width azimuth and 35 degree elevation -12.5 dBi
Mean Time Between Failure (MTBF)	40 yr
Temperature	-40° C to +55° C (-40° F to +131° F)
Wind Survival	190 km/hr (118 miles/hr)
Dimensions	19.5 H x 12 W x 4.75 D (50 cm H x 30 cm W x 12 cm D)
Weight	5.4 kg (12.5 lb)
Access Method	Time Division Duplexing/Time Division Multiple Access (TDD/TDMA)
Interface	10/100 Base T, half/full duplex. Rate auto negotiated (802.3 compliant)
Protocols Used	IPv4, UDP, TCP, ICMP, Telnet, HTTP, FTP, SNMP
Network Management	HTTP, TELNET, FTP, SNMP Version 2c
FCC ID	ABZ89FC5809
Industry Canada Certification Number	109W-9000

Specifications subject to change without notice.

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## References

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<sup>i</sup> Kuhn, David H. "Structural Analysis Cingular KS5530-KU", 7/16/2004

<sup>ii</sup> ANSI/TIA/EIA 222-F "Structural Standards for Steel Antenna Towers and Antenna Supporting Structures"