

Middlefield Wireless Broadband Project Costs

Towers & poles	\$	160,000
Network equipment	\$	156,900
Customer Premises Equipment	\$	60,100
Network Infrastructure	\$	12,216
Project Management	\$	70,000
2016 Total	\$	459,216
<i>2017 Upgrades</i>	\$	29,000
Total after 2017 upgrades	\$	488,216
(Initial Pilot cost)	\$	129,082

Middlefield Wireless Broadband Capital Budget

	Material price	Labor price	Class	Quantity	Materials	Labor	Total	Notes
50' wood poles (42' up)	\$1,500	\$1,000	t	10	\$15,000	\$10,000	\$25,000	
80' wood poles (65' up)	\$3,700	\$2,500	t	5	\$18,500	\$12,500	\$31,000	
120' monopole (120' up)	\$20,000	\$20,000	t	1	\$20,000	\$20,000	\$40,000	
90' monopole (90' up)	\$18,000	\$20,000	t	1	\$18,000	\$20,000	\$38,000	e.g. Rohn DEP90HA
Lit sites/cabinets	\$2,500	\$1,000	e	16	\$40,000	\$16,000	\$56,000	Switch, batteries, etc.
Transfer station equipment	\$5,500	\$1,500	e	1	\$5,500	\$1,500	\$7,000	
Sites w/5GHz A5	\$1,000	\$200	e	7	\$7,000	\$1,400	\$8,400	A5-360 lights all directions
Sites w/2.4GHz			e	9				No multi-sector option
Sites w/TVWS	\$5,000	\$250	e	9	\$45,000	\$2,250	\$47,250	If multi-sector APs used
5 GHz sectors	\$	\$	e	13	\$	\$	\$	If not A5-360
2.4 GHz sectors	\$600	\$150	e	13	\$7,800	\$1,950	\$9,750	
TVWS sectors	\$	\$	e	15	\$	\$	\$	If single sector APs
TVWS sector antennas	\$250	\$100	e	15	\$3,750	\$1,500	\$5,250	With either type of AP
Backhaul radios	\$600	\$150	e	31	\$18,600	\$4,650	\$23,250	Point-to-point pairs
Fiber on CWR to River Rd			t		\$5,000	\$15,000	\$20,000	
Fiber extension to transfer station			t		\$2,000	\$4,000	\$6,000	
Total					\$206,150	\$110,750	\$316,900	

t total	\$78,500	\$81,500	\$160,000	Towers
e network	\$127,650	\$29,250	\$156,900	Field network equipment
e total	\$170,650	\$53,350	\$217,000	Network+CPE eq. total

true or false

Use Mimosa A5-360?	TRUE	one box, four sectors, antennas (vs. Ubiquiti)
Use multi-sector TVWS AP?	TRUE	one box, enough sectors
Use PMP450 for 2.4 GHz?	FALSE	(vs. Ubiquiti)

total AI 29

5 GHz subscribers	46	29%
2.4 GHz subscribers	70	44%
TVWS subscribers	43	27%
total	159	at 60% take rate

Budgetary equipment; not final choices	Material	Installation	
Mimosa A5-360 AP	\$1,000	\$200	includes antennas
ePMP 2 GHz sync sector	\$600	\$150	includes antenna
Cambium PMP450 AP	\$1,350	\$150	includes antenna
Single sector (UBNT) 5G	\$250	\$150	includes antenna
Single sector TVWS	\$3,500	\$250	includes antenna
Multi-sector TVWS	\$5,000	\$250	antennas extra
TVWS sector antenna	\$250	\$100	(installed w/sector)
Backhaul radio	\$600	\$150	average
5G SM	\$200	\$150	inc. mounting h/w
2.4G eForce 200 SM	\$150	\$125	inc. mounting h/w
PMP450 SM	\$375	\$150	connectorized + antenna
TVWS SM	\$325	\$175	includes external antenna

Note: Subscriber Module installation is average of low-cost "standard" and some high-cost "customized" efforts

Planned subscribers

Total houses	265
Take rate	60%
Total take	159

CPE by band			Sub per sector	Spare SMs	SM cost	Install	Total
Subscribers in 5G range	46	29%	3.5	3	\$9,800	\$6,900	\$16,700
Subscribers in 2G range	70	44%	4.4	3	\$10,950	\$8,750	\$19,700
Subscribers using TVWS	43	27%	2.9	3	\$17,250	\$6,450	\$23,700
Total	159		3.6		\$38,000	\$22,100	\$60,100

Network Infrastructure

		h/w	labor	total
Core routing/switching		\$5,000	\$2,000	\$7,000
Spare common equipment	4%	\$5,216		\$5,216
Total				\$12,216

Project Management

Design/engineering/integration	\$20,000
Administrative[1]	\$50,000
Total	\$70,000

[1] Includes oversight, RFPs, MLP operation, project management, tower siting paperwork, marketing, etc.

Total initial project including pilot	\$459,216
Total CapEx/subscriber	\$2,888

Middlefield Wireless Broadband Monthly Operating Expenses

Operator fees:	Fee	Quantity	Total
Per subscriber (60% take)	\$25	159	\$3,975
Per access point	\$25	29	\$725
Per backhaul link	\$25	15.5	\$388
Total			\$5,088

Insurance \$500 (estimated)

Upstream ISP \$1,400 (100-150 Mbps)

Consulting support \$500 (ongoing average, not retainer)

MLP management (PT) \$1,000

Electricity \$250

Break/fix replacements \$711

Electronics depreciation \$2,844

Tower/pole depreciation \$218

	Number of Users				
	40%	50%	60%	70%	
Per User Break Even:*	106	132.5	159	185.5	
Monthly "fiscal" total	\$12,511	\$118.03	\$94.42	\$78.68	\$67.44
Monthly "cash" total	\$9,449	\$89.14	\$71.31	\$59.42	\$50.94

*Excluding phone subscriptions.

Electronics depreciation months	60
Infrastructure depreciation months	360
Break/fix % per year of capex	5%

Middlefield Wireless Broadband Itemized Pilot Budget		
Infrastructure	Est. Cost	Notes
Tower		
Tower	\$40,000	Engineered and bid, no specific manufacturer. A 100 to 120 foot monopole tower (get prices for both) using a 10x10x4' or similar concrete base. Wind load should support 45 square feet with 70% on top and 30% between 20' and 30' lower, using 90 MPH wind and 110 MPH maximum gust and a 3 degree sway limit. Accessories include step bolts, lightning rod, safety cable system, and 4-rod grounding with buried halo. (About \$40,000 installed, including labor, excluding excavation in ledge.)
Excavation	\$4,000	16 Cu yards
Antenna mounts	\$3,566	12'-6" Ventev - 12'-6" Co-Location Platform Kit w/ 9 60" pipes (\$2973) + ring mounts (\$593). Alternative: Two sets chain or ring mounts, each with three tower-offset brackets, offset from the tower, with pipe mounts at both ends. E.g., Commscope Monopole Dual Pipe Mount Kit (\$3,502).
Install platform mount	\$1,000	
Tower base equipment	\$3,450	AmProD 36RU modular enclosure (\$2552) 68"H 25"D 26"W with fan (\$370), insulation (\$152), 4" mounting base (\$141), interior light (\$92), tray (\$143).
Batteries	\$950	4 12V 75AH AGM batteries
Rectifier set	\$2,000	Redundant 54V 10A rectifiers, shelf, breakers.
Install base equipment	\$1,000	
Fiber & power		
Fiber	\$4,000	Fiber from firehouse to tower
Power	\$2,000	Power from transfer station to tower
Tower radio gear		
5GHz connectorized	\$1,290	3x Cambium C058900A112A ePMP 1000 5GHz Connectorized Radio with GPS Sync (FCC, US version) (\$430 each).
5GHz 90 degree sector	\$444	3x Cambium C050900D003A - ePMP 1000 5GHz 90 Degree Sector Antenna (\$148 each).
5GHz installation	\$450	3 x \$150
Integrated 5GHz AP	\$911	Mimosa A5-360-18 integrated access point system.
Mimosa installation	\$200	
2.4GHz connectorized	\$1,290	3x Cambium C024900A011A - ePMP 1000 2.4GHz Connectorized Radio GPS Sync (FCC, US/CA version) (\$430 each).
2.4GHz sector antennas	\$783	3x Cambium C024900D004A - ePMP 1000 2.4GHz 90/120-deg Dual-Pol Sector Antenna (\$261 each).
2.4Ghz installation	\$450	
3G TVWS AP	\$5,000	1 Carlson Wireless 3G TVWS access point prototype. (Production price around \$5000.)
TVWS sector antennas	\$800	2 Carlson Wireless TVWS sector antennas (to be specified by Carlson).
TVWS installation	\$450	
Cabinet electronics		
PoE	\$398	Netonix WS-12-250-DC 12-port 250-watt power over Ethernet / switch (\$380) with RMK-250 rack ears (\$18).
Installation	\$150	Including software
5 GHz CPE		
Cambium dish	\$565	5x Cambium C058900C062A - ePMP Force 200 5GHz Dish Antenna w Integrated High Gain Radio (FCC, US version). (\$113 each).
Cambium radio	\$255	3x ePMP Force 180 5GHz Integrated Radio (FCC, US version) (\$85 each)
Mimosa C5	\$400	4 x \$100
Mimosa C5c	\$480	4 x \$120
Antennas	\$480	4x 5 GHz dish antennas to be identified for the Mimosa C5c's (around \$120 each installed)
5 GHz installation	\$1,650	11 x \$150
2 GHz CPE		
Cambium dish	\$1,350	9x Cambium C024900C161A - ePMP Force 200 2.4GHz Dish Antenna w Integrated High Gain Radio (FC9C, US version) (\$150 ea.)
Cambium dish	\$300	2x Cambium C024900C031A - ePMP 1000 2.4GHz Integrated Radio (FCC, US/CA version) (\$150 ea.)
2GHz installation	\$1,650	11 x \$150
TVWS		
CPE	\$2,500	Up to 10 TVWS "3G" CPE prototypes, retail price est. around \$250; may be divided between indoor and outdoor versions.
CPE antennas	\$1,000	Up to 10 matching CPE antennas to be determined by Carlson, retail price est. around \$100 each.
TVWS installation	\$1,750	10 x \$175
Network Infrastructure		
Core routing	\$1,500	Most is for expert installation configuration (\$400 for the box)
Spare	\$0	
Project Management		
Design/engineering	\$12,000	
Administration	\$25,000	
CapEx Total	\$125,462	
OpEx		
Subscriber fees	\$1,600	32 x \$25 x 2 mo
AP fees	\$450	9 x \$25 x 2 mo
Upsteram ISP	\$1,500	\$750 x 2 mo (50 Mbps)
Electricity	\$70	\$35 x 2 mo
OpEx Total	\$3,620	
Total Pilot	\$129,082	

Middlefield Wireless Pilot Monthly Operating Expenses

Operator fees:		Fee	Quantity	Total
Per subscriber		\$25	32	\$800
Per access point		\$25	9	\$225
Total	\$1,025			
Upstream ISP	\$750	50 Mbps		
Electricity	\$35			
Total	\$1,810			

Middlefield Wireless Broadband 2017 Upgrades

Upgrades/adjustments to achieve 100% 25/3 coverage

Additional sites determined to be needed	\$22,000
Redundant MBI route	\$7,000
Total	\$29,000

*Since we need to make 25/3 available everywhere, it is possible that after building the network based on predictions, some houses are still not able to get that. This budgets for two additional poles, with equipment boxes, APs, & backhaul, to fill in such gaps by bringing base stations closer to those houses.

Middlefield Wireless Broadband Access Sectors

Enabled sites	Lat (°)	Long (°)	Elev (m)	Ht (ft)	Access sectors				Total	Notes
					5 GHz	2 GHz	TVWS	Backhl		
Alderman Rd	42.3287	-73.0033	465.5	65		2	2	3	7	Foot of Johnnycake Hill
Bancroft	42.309	-73.0272	274	42		2		1	3	onTown Hill near 199
Chipman S	42.3491	-72.9902	418	65		2	1	1	4	nr. 147 Chipman
ClarkWright & River	42.3494	-72.9658	317	42			2	1	3	fiber fed from cemetery
East River S	42.3601	-72.9654	259	42			1	2	3	nr 128 E River
Skyline	42.362	-73.032	487.8	65	2			3	5	1.1 mi. n of Town Hill Rd
Skyline N	42.3718	-73.039	494.5	42			2	1	3	nr 54 Skyline
Town Hall	42.3446	-73.0094	506	30	1			1	2	
TownHill Rd.S	42.3362	-73.0306	393.6	42	1	1		1	3	nr 87 Town Hill
Chipman Near Root	42.3621	-72.9942	485.8	90	2	2	2	3	9	nr 101 Chipman
Transfer Station	42.3499	-73.0119	520.5	120	3	3	2	7	15	primary access site
WASH: Middlefield Rd	42.3481	-73.0694	472	42		1		1	2	Serves Becket Rd. area
Chester Rd.	42.3277	-72.9989	423.4	65	2			1	3	below Alderman
Cone Rd.	42.3719	-72.9829	434.5	51			1	1	2	near 83 Cone
HPease&TownHill	42.3478	-73.0233	466	65	2	2		1	5	
Clark Wright near cemetery	42.3489	-72.9697	343.8	51		1	2	1	4	feeds fiber to River
Relay-only sites:										
BCKT:Surriner Rd	42.3063	-73.0397	356.3	42				2	2	Likely relay to Bancroft area
East River bend	42.3711	-72.9665	272.5	42						Relay up/down River Rd - UNLIKELY
WRTH: Old North@River	42.4236	-72.9864	457							Redundant MBI access
Total Sectors					13	16	15	31	75	
(Subscriber sectors)	44									

Pole descriptions:

42/47-foot wood utility poles are 50/55-foot poles, planted 8'. A mast can raise a small antenna to the 52-55 foot level.

65-foot wood utility poles are 80-foot poles, planted 15'.

90-foot or taller towers are that height (above ground) monopoles. Antennas generally attach to mounting hardware offset from the sides, below the top.