

## Middlefield Hybrid Broadband Project Costs

<b>Towers &amp; poles</b>	\$	97,400
<b>Network equipment</b>	\$	216,550
<b>Customer Premises Equipment</b>	\$	78,675
<b>Network Infrastructure</b>	\$	11,662
<b>Professional Services</b>	\$	79,000
<b>Total</b>	<b>\$</b>	<b>483,287</b>

<b>(Initial Pilot cost)</b>	<b>\$</b>	<b>128,974</b>
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**Middlefield Hybrid Broadband Capital Budget\***

	Material price	Labor price	Class	Quantity	Materials	Labor	Total	Notes
Total number of 50' wood pole (42' up)	\$1,400	\$1,400	t	5	\$7,000	\$7,000	\$14,000	Class 1 wood
Total number of 55-60' wood r (47-51 up)	\$2,400	\$2,300	t	3	\$7,200	\$6,900	\$14,100	
Total number of 70-80' wood r (56-65' up)	\$4,700	\$2,800	t	4	\$18,800	\$11,200	\$30,000	
Total number of 90' tower	\$10,400	\$10,400	t	1	\$10,400	\$10,400	\$20,800	90' tower with all material
Engineering drawing	\$	\$750	t	1	\$	\$750	\$750	MA certified
Equipment slab	\$	\$2,000	t	1	\$	\$2,000	\$2,000	Concrete slab & fencing
Tower geatechnical analysis	\$	\$5,350	t	1	\$	\$5,350	\$5,350	
Total number of lit sites/cabinets	\$2,500	\$1,000	e	14	\$35,000	\$14,000	\$49,000	for box, switch, batteries, etc.
Sites needing power installed	\$200	\$600	t	13	\$2,600	\$7,800	\$10,400	short trench to metered pole
Total number of sites w/5GHz if A5	\$	\$	e	7	\$	\$	\$	A5-360 lights all directions, if used
Total number of sites w/TVWS	\$5,000	\$300	e	7	\$35,000	\$2,100	\$37,100	if multi-sector APs are used
Total number of 5 GHz sectors	\$600	\$250	e	15	\$9,000	\$3,750	\$12,750	ePMP 2000 (most Life)
Total number of 2.4 GHz sectors	\$600	\$250	e	16	\$9,600	\$4,000	\$13,600	ePMP 1000 sync
Total number of 900 PMPi sectors	\$2,700	\$250	e	1	\$2,700	\$250	\$2,950	
Total number of TVWS unisectors	\$	\$	e	10	\$	\$	\$	if single sector APs are used
Total TVWS sector antennas	\$300	\$125	e	10	\$3,000	\$1,250	\$4,250	with either type of AP
Total number of backhaul radios	\$600	\$250	e	26	\$15,600	\$6,500	\$22,100	point to point, used in pairs
Total number of miniPOPs	\$950	\$650	e	3	\$2,850	\$1,950	\$4,800	fill in using CPE backhaul
fiber on CWR to River			t		\$	\$	\$	only if no fire tower
Fiber in business dist incl. town hall	\$30,000	\$40,000	e	1	\$30,000	\$40,000	\$70,000	Approx. 1.3 mi; 48+ strands.
Ryan fiber to tower	\$500	\$1,000	t	1	\$500	\$1,000	\$1,500	Omit if only microwave to lbSP
<b>Total</b>					\$188,750	\$125,200	<b>\$313,950</b>	

t total	\$46,500	\$52,400	\$97,400	Towers
e network	\$142,750	\$73,800	\$216,550	Field network equipment
e total	\$187,775	\$114,450	\$295,225	Network+CPE eq. total

Use Mimosa A5-360? **FALSE** one box, four sectors, antennas (vs. ePMP)  
 Use multi-sector TVWS AP? **TRUE** one box, enough sectors  
 Use PMP450 for 2.4 GHz? **FALSE** (vs. ePMP)  
 Supply home Wi-Fi? **TRUE** additional indoor box

total APs: 32

*Budgetary equipment; not final choices*

	Material	Installation			
Mimosa A5-360 AP	\$1,000	\$250	includes antennas	Price of Mimosa A5-360 AP	
ePMP 2 GHz sync sector	\$600	\$250	includes antenna	Price of ePMP 2 GHz sync sector	
Cambium PMP450i AP	\$1,350	\$250	includes antenna	Price of Cambium PMP450 AP	
ePMP2000 5GHz sector	\$500	\$250	includes antenna	Price of 5GHz ePMP2000 sector	
Single sector TVWS	\$3,500	\$300	includes antenna	Price of single sector TVWS	
Multi-sector TVWS	\$5,000	\$300	antennas extra	Price of multi-sector TVWS	
TVWS sector antenna	\$250	\$125	(installed w/sector)	Price of TVWS sector antenna	
Backhaul radio	\$600	\$250	average	Price of backhaul radio	
5G eForce200 SM	\$150	\$200	inc. mounting h/w	Price of 5GHz Force 200 SM	
2.4G eForce 200 SM	\$150	\$200	inc. mounting h/w	Price of 2.4GHz Force 200 SM	
PMP450 SM	\$375	\$250	connectorized + antenna	Price of PMP450i -900 MHz SM	
TVWS SM	\$300	\$250	includes external antenna	Price of TVWS SM	
Home WiFi	\$25	\$25		Price of home Wi-Fi demarc box	
				Price of TVWS SM	
				Price of 900 MHz PMP450i SM	
				Tower climber fees man/day	

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

**Planned locations**

Locations	266
Take rate	60%
Total take	160

CPEs	Sub per sector	seas. subs	Adj. subs	Spare SMs	SM cost	Install	Total	
Subscribers on 5G	51	32%	3.4	47	3	\$9,100	\$10,200	\$18,300
Subscribers on 2G	45	28%	2.8	41	3	\$7,200	\$9,000	\$16,200
Subscribers on 900 MHz	12	8%	12.0	11	1	\$4,875	\$3,000	\$7,875
Subscribers using TVWS	50	32%	5.0	46	3	\$15,900	\$12,500	\$28,400
Home WiFi						\$3,950	\$3,950	\$7,900
<b>Total</b>	158	100%	3.9	145	10	\$40,025	\$38,650	<b>\$78,675</b>

**Network Infrastructure**

		h/w	labor	total
Core routing/switching		\$5,000	\$2,000	\$7,000
Spare common equipment	4%	\$4,662		\$4,662
<b>Total</b>				<b>\$11,662</b>

**Professional Services**

Design/engineering/integration	\$25,000
Administrative[1]	\$50,000
Upstream ISP installation	\$4,000
<b>Total</b>	<b>\$79,000</b>

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

Total initial project including pilot	\$483,287
Total CapEx/subscriber	\$3,059

\* Installed radio equipment will depend on current available models and pricing.

## Middlefield Hybrid Broadband Monthly Operating Costs

### MLP Expenses

Operator AP fees @\$25:		Total
Per access point	28 \$	700
Per backhaul link	13 \$	325
<b>Total</b>	<b>\$</b>	<b>1,025</b>

### Other Expenses

Insurance	\$500	
Upstream ISP	\$1,290	(150 Mbps)
MLP Manager	\$500	
Electricity	\$250	
Pole rental (35 poles)	\$35	
Break/fix replacements	\$782	
<b>Total</b>	<b>\$3,357</b>	

("Cash" MLP Expenses) \$ 4,382

### Depreciation

Electronics	\$ 3,130
Tower/pole	\$ 129
<b>Total</b>	<b>\$ 3,259</b>

"Fiscal" MLP Expenses \$ 7,641

### Operator subscriber fees @ \$25

	Quantity	Total
40% take	98 \$	2,450
50% take	122 \$	3,050
60% take	146 \$	3,650
65% take	159 \$	3,975
70% take	171 \$	4,275

### Phone Revenue @60% of subs x \$10\*

	Quantity	Total
40% take	59 \$	590
50% take	73 \$	730
60% take	88 \$	880
65% take	95 \$	950
70% take	103 \$	1,030

\*Cust charge of \$25-\$15 cost

### Net Operating Expenses

	Cash	Fiscal
40% take	\$ 6,242	\$ 9,501
50% take	\$ 6,702	\$ 9,961
60% take	\$ 7,152	\$ 10,411
65% take	\$ 7,407	\$ 10,666
70% take	\$ 7,627	\$ 10,886

### Subscribers (% of seasonally adj)

	40%	50%	60%	65%	70%
	98	122	146	159	171
"Cash" internet break even	\$63.70	\$54.94	\$48.99	\$47.97	\$44.60
"Fiscal" internet break even	\$96.95	\$81.65	\$71.31	\$68.47	\$63.66

**Number of Premises**

Total premises	273
Habitable premises	266
Seasonal premises (6 mo avg)	44
Seasonally adjusted habitable	244
Electronics depreciation months	60
Infrastructure depreciation months	360
Break/fix % per year of capex	5%

<b>Middlefield Hybrid Broadband Itemized Pilot Budget</b>		
<b>Infrastructure</b>	<b>Est. Cost</b>	<b>Notes</b>
<b>Tower</b>		
Tower	\$23,000	Purchase & install Rohn 55G guyed steel tower, 55G110R90, with TA55 Torque Arm Stabilizer Assemblies for dual guy wire attachments. Engineering drawings included.
Equipment slab	\$2,000	Concrete 4' x 8' slab + fencing at tower base for equipment cabinet
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	
Geotechnical analysis	\$5,350	
<b>Fiber &amp; power</b>		
Fiber	\$0	No longer need for pilot - utilizing AccessPlus from Washington tower
Power	\$2,000	15A circuit from transfer station to tower
<b>Tower radio gear</b>		
5GHz connectorized	\$1,560	3X Cambium ePMP 2000 (\$520 each)
5GHz 90 degree sector	\$660	3x Cambium ePMP 2000 sectors 90/120 (\$220 each)
5GHz installation	\$750	3 x \$250
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	\$750	
<b>Cabinet electronics</b>		
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
<b>5 GHz CPE</b>		
Cambium dish	\$1,469	13x 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)
5 GHz installation	\$2,800	14 x \$200
<b>2 GHz CPE</b>		
Cambium dish	\$1,342	11x Cambium C024900C161A - ePMP Force 200 2.4GHz Dish Antenna w Integrated High Gain Radio (FC9C, US version) (\$122 ea.)
2GHz installation	\$2,200	11 x \$200
<b>TVWS CPE</b>		
CPE	\$2,500	Up to 10 TVWS "3G" CPE prototypes (if not yet production units), retail price est. around \$250
CPE antennas	\$1,000	Up to 10 matching CPE antennas to be determined by Carlson, retail price est. around \$100 each.
TVWS installation	\$2,500	10 x \$250
<b>Arthur Pease</b>		
46' pole	\$4,700	55' class 1
Cabinet & contents	\$3,000	cabinet, batteries, rectifier (smaller than tower's), Netonix switch
Install cabinet	\$1,500	
Power to cabinet	\$800	
5 GHz AP radios	\$530	2 ePMP 2000 Lite
5 GHz antennas	\$440	
2 GHz APs	\$1,290	3 ePMP 1000
2 GHz antennas	\$783	
2 GHz install	\$750	
5 GHz install	\$500	
5 GHz CPEs installed	\$1,878	6 @ \$113 + \$200 install for each
2.4 GHz CPEs installed	\$2,576	8 @ \$122+ \$200 install for each
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	\$550	
<b>Network Infrastructure</b>		
Core routing	\$1,500	Most is for expert installation configuration (\$400 for the box)
Spare	\$0	
<b>Professional Services</b>		
Design/engineering	\$12,000	
Administration	\$25,000	
<b>CapEx Total</b>	<b>\$123,754</b>	
<b>OpEx</b>		
Subscriber fees	\$1,600	32 x \$25 x 2 mo
AP fees	\$450	9 x \$25 x 2 mo
Upstream ISP	\$3,100	\$550 x 2 mo (50 Mbps) + \$2,000 installation
Electricity	\$70	\$35 x 2 mo
<b>OpEx Total</b>	<b>\$5,220</b>	
<b>Total Pilot</b>	<b>\$128,974</b>	

## Middlefield Wireless Pilot Monthly Operating Expenses

<b>Operator fees:</b>		<b>Fee</b>	<b>Quantity</b>	<b>Total</b>
Per subscriber		\$25	32	\$800
Per access point		\$25	9	\$225
<b>Total</b>	\$1,025			
<b>Upstream ISP</b>	\$550	50 Mbps		
<b>Electricity</b>	\$35			
<b>Total</b>	<b>\$1,610</b>			

## Middlefield Hybrid Broadband Access Sectors

Enabled sites	Lat (°)	Long (°)	Ht (ft)	Access sectors					Total	Notes
				5 GHz	2 GHz	TVWS	900 MHz	Bkhaul		
Transfer Station	42.34972	-73.0119	90	1	2	3		5	11	Primary access site
Arthur Pease	42.34861	-72.9986	47	3	3	2		3	11	
BCKT:Surriner W	42.31	-73.0411	42		1			1	2	Relay to Bancroft
Blush Hollow (THR)	42.33611	-73.0306	42		1	1		1	3	
Chester Rd.	42.32778	-72.9989	65		2			1	3	Below Alderman
Chipman N of Root	42.36333	-72.9953	51	2	2	2		1	7	
CHST:Holcomb Hill FT	42.32472	-72.9575	existing	1			1	4	6	
East River bend	42.37111	-72.9664	56	2				1	3	
HPease&TownHill	42.34806	-73.0233	42		2			1	3	
Reservoir Rd	42.35694	-73.0525	51	2				1	3	
River S of 149	42.35611	-72.9639	42	2				1	3	
Skyline	42.36194	-73.0319	56		1	1		3	5	
Smith Hollow	42.38028	-72.9778	65	2	1			1	4	
[Contingency pole for budget]			42		1	1		2	4	

### Relay-only sites:

WRTH: Old North@River                      42.42355 -72.9864                      Redundant MBI access

<b>Total Sectors</b>		<b>15</b>	<b>16</b>	<b>10</b>	<b>1</b>	<b>26</b>	<b>68</b>
<b>(Subscriber sectors)</b>	<b>41</b>						

### 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 (above ground) monopole. Antennas generally attach to mounting hardware offset from the sides, below the top.

## Middlefield's Hybrid Broadband Sustainability Model

Subscriber Calculation	Year 1	Year 2	Year 3	Year 4	Year 5
Number of premises	273	273	273	273	273
Habitable premises	266	266	266	266	266
Percentage served	96%	100%	100%	100%	100%
Seasonal premises (6 mo avg.)	44	44	44	44	44
Seasonally adjusted habitable	244	244	244	244	244
Projected take rate	40%	50%	60%	65%	65%
Effective subscribers	98	122	146	159	159
<b>Monthly Costs Per Subscriber</b>					
MLP "Cash" expenses	\$44.90	\$35.92	\$29.93	\$27.63	\$27.63
Operator fee	\$25.00	\$25.00	\$25.00	\$25.00	\$25.00
Phone net @60% of subs * \$10	-\$6.00	-\$6.00	-\$6.00	-\$6.00	-\$6.00
<b>Net "Cash" Cost</b>	<b>\$63.90</b>	<b>\$54.92</b>	<b>\$48.93</b>	<b>\$46.63</b>	<b>\$46.63</b>
Depreciation	\$33.39	\$26.71	\$22.26	\$20.55	\$20.55
<b>Net "Fiscal" Cost</b>	<b>\$97.29</b>	<b>\$81.63</b>	<b>\$71.19</b>	<b>\$67.18</b>	<b>\$67.18</b>