THE MERTON GROUP

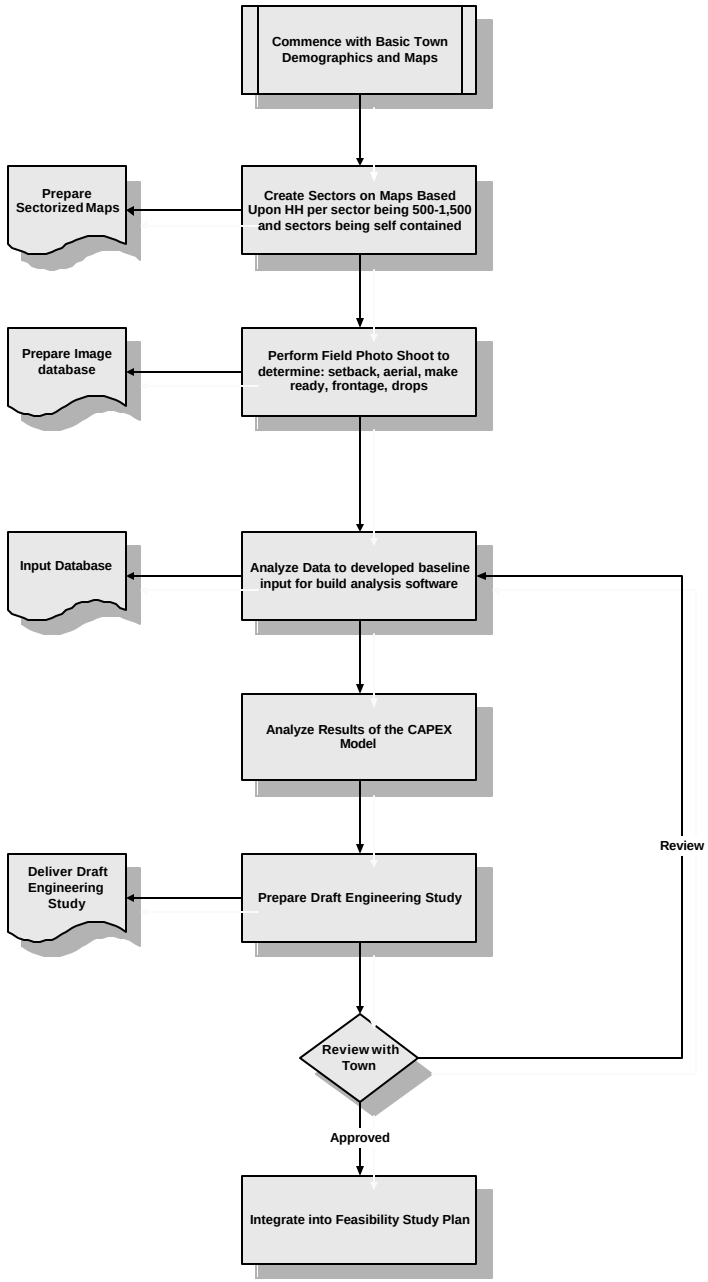
Municipal Broadband Networks

Infrastructure

Princeton, MA

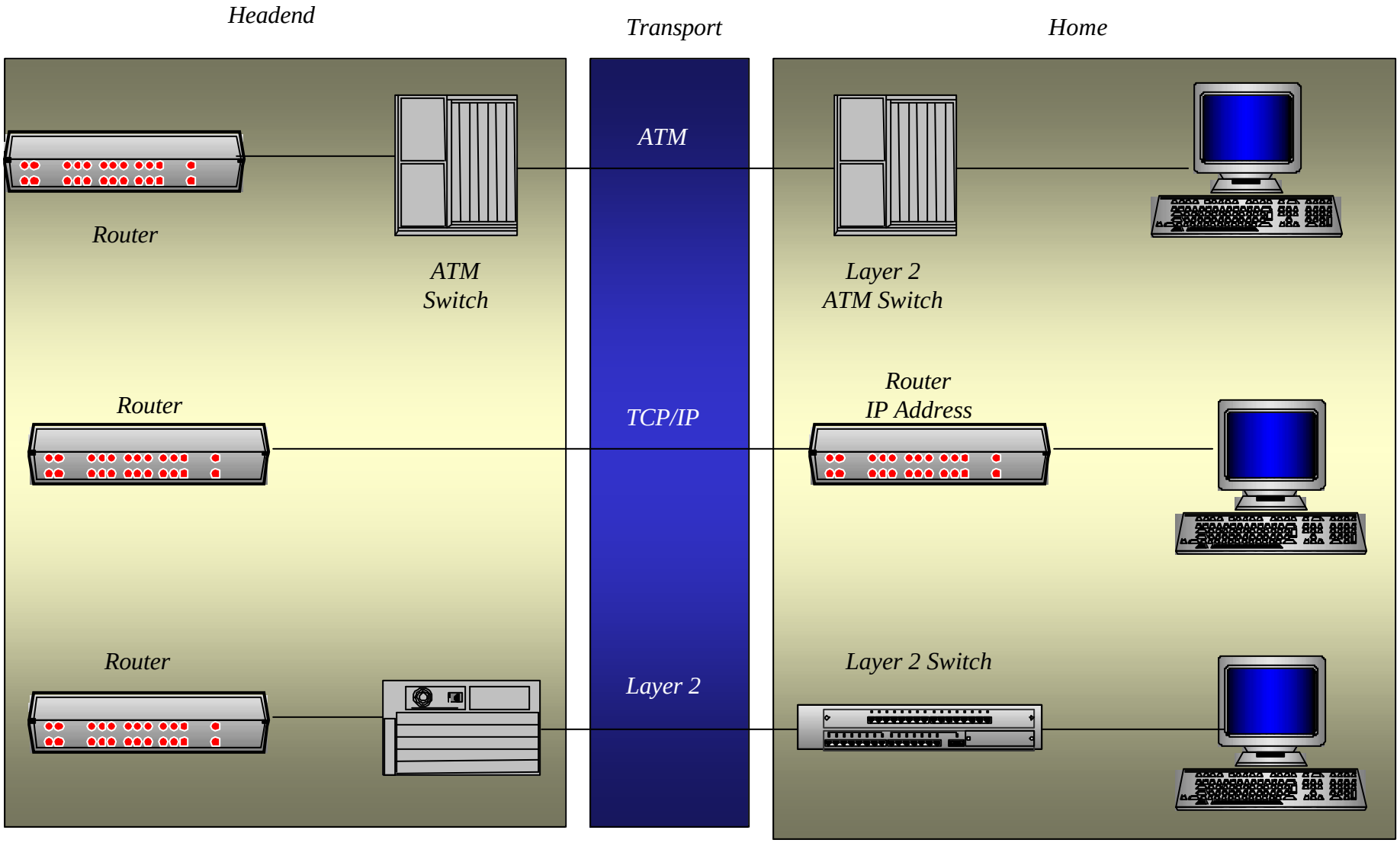
Methodology

Engineering Methodology

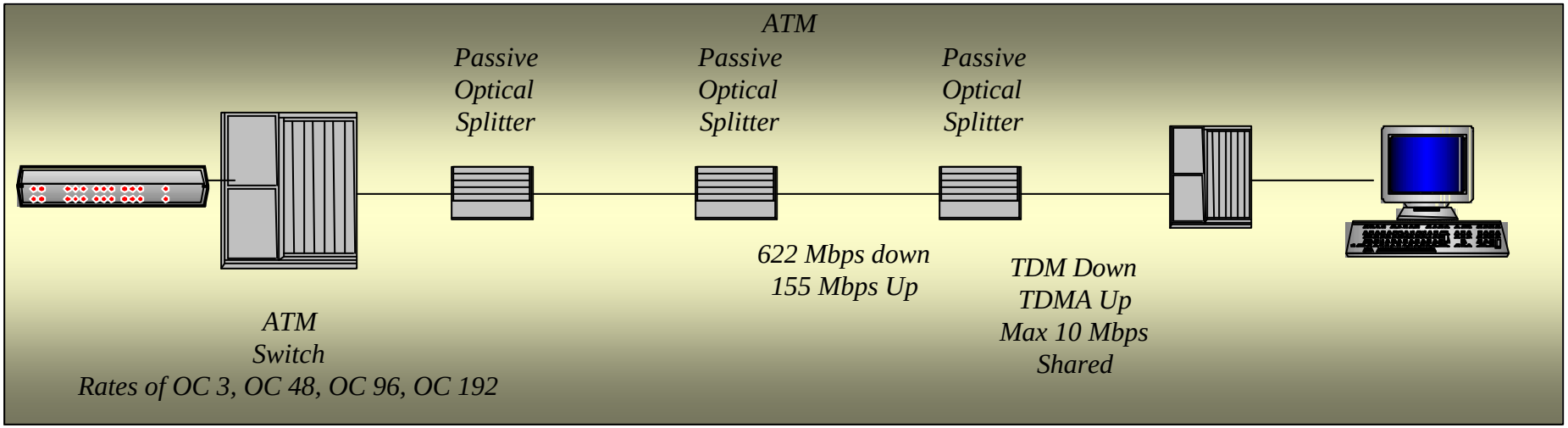


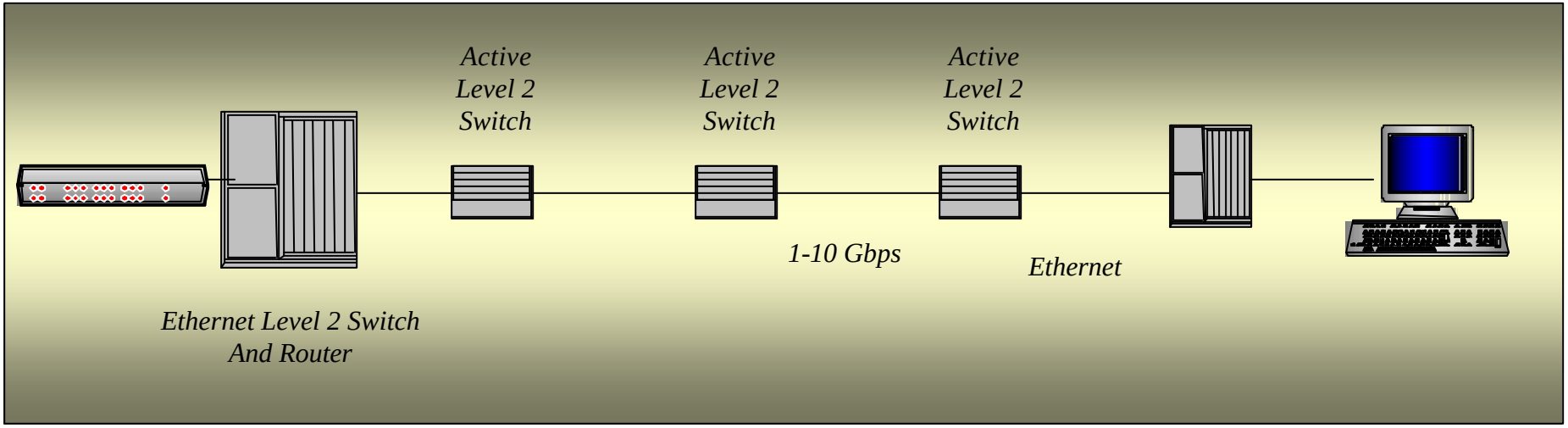
General Architecture

Ethernet Layer 2, 3 and ATM

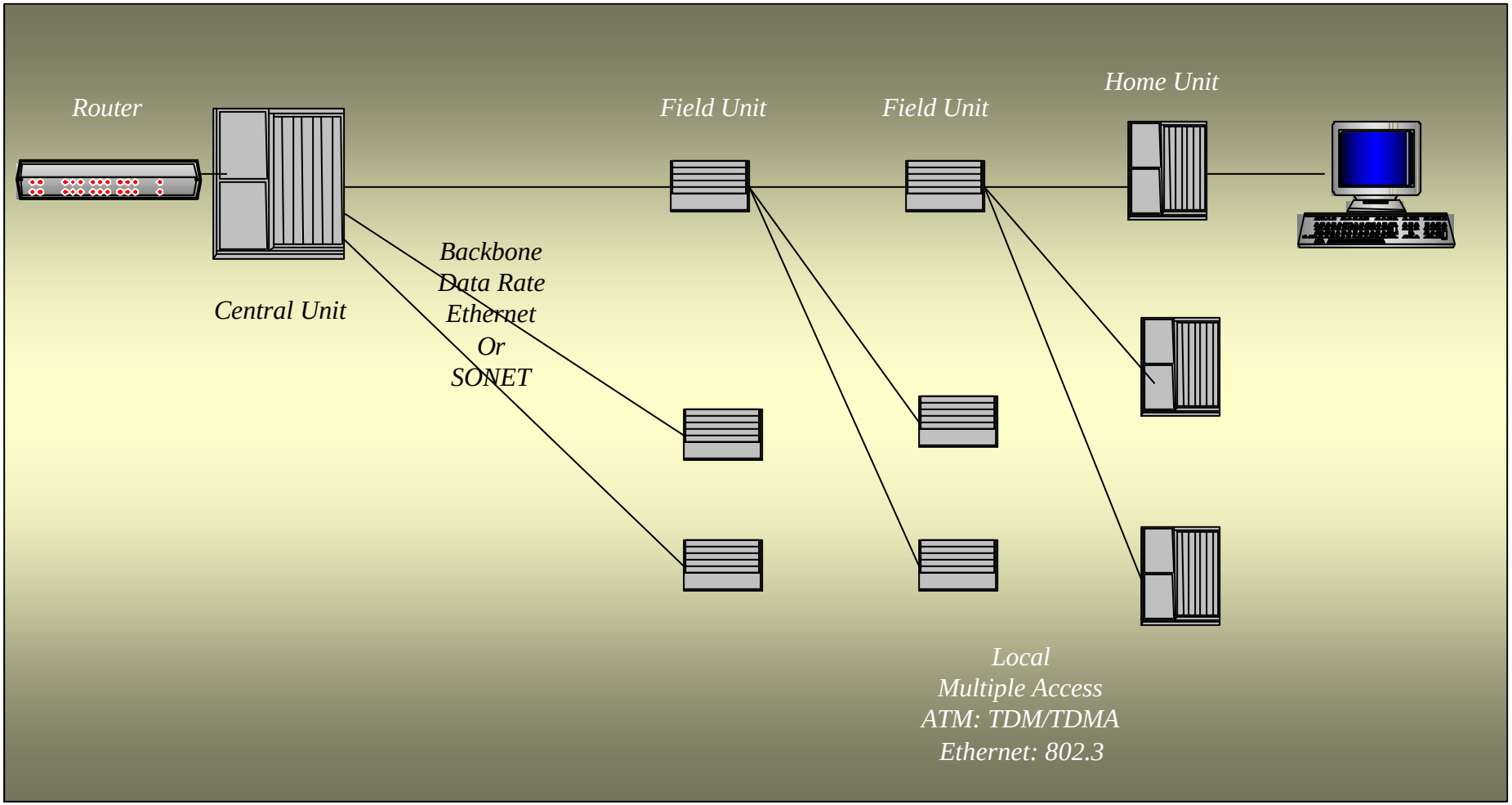


Fiber Rates ATM v GigE

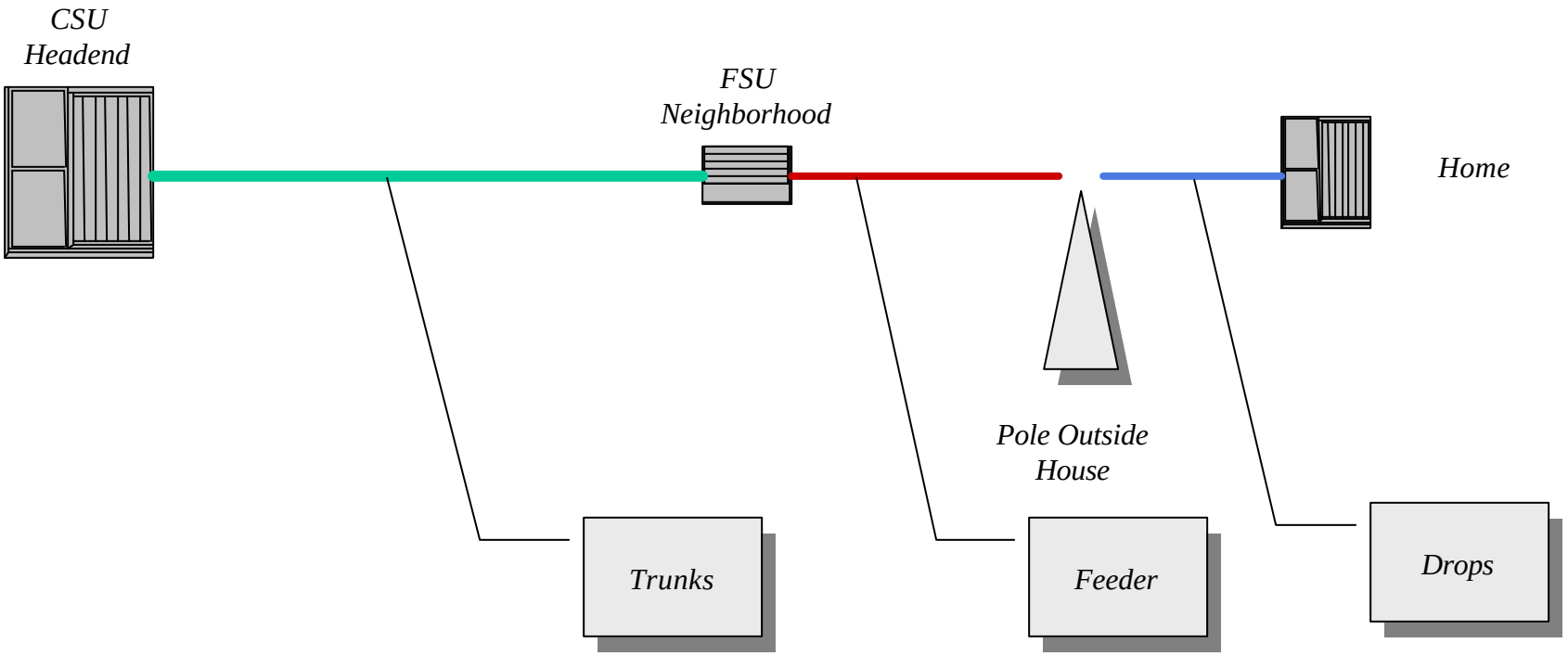




Basic Architecture

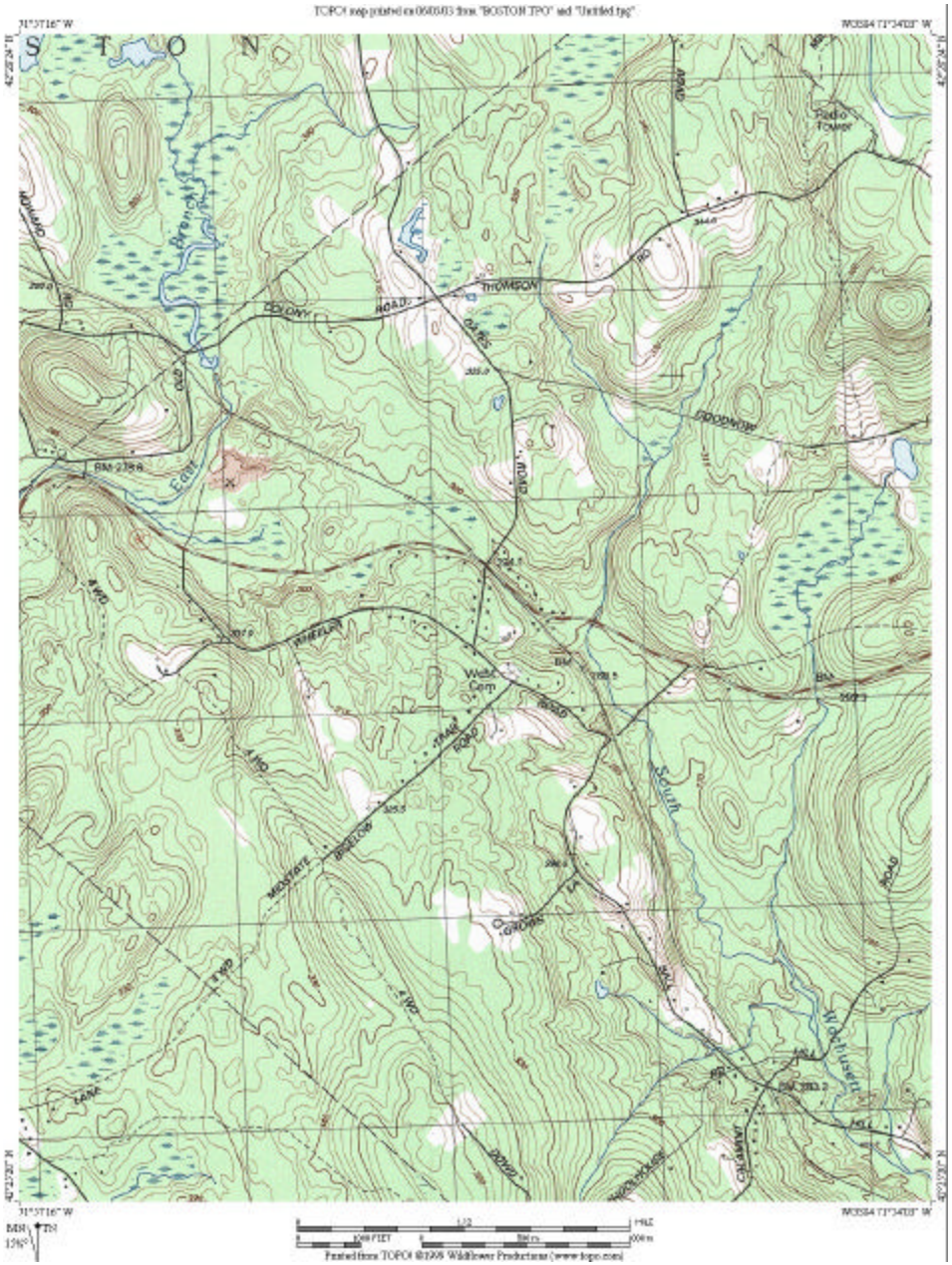


Generic Fiber Network Elements



Local Architecture

Princeton, MA



Princeton, MA Sectorization

Princeton, MA

Sector	Population	Percent	Street Miles	Percent	HH/mi
1	1,000	100%	55	100%	18.18
2	-	0%	-	0%	
3	-	0%	-	0%	
4	-	0%	-	0%	
5	-	0%	-	0%	
	1,000	100%	55	100%	

Total HH: 1,000
Total Miles Streets: 55

Princeton, MA Set Back

Sector	Street Miles	Average Set Back	Weighted Average Setback
1	55	1,108	1,108
2	-		-
3	-		-
4	-		-
5	-		-
	55		
Total Average Set Back			1,108

Princeton, MA Frontage

Sector	Street Miles	Average Frontage	Weighted Average Frontage	Total Frontage	Percent Frontage
1	55	440	440	439,623	76%
2	-		-	-	
3	-		-	-	
4	-		-	-	
5	-		-		
Total Average Frontage			440	439,623	76%

Princeton Aerial

Sector	Street Miles	Average Aerial	Weighted Average Aerial
1	55	84%	84%
2	-		0%
3	-		0%
4	-		0%
5	-		0%

Total Average Aerial	84%

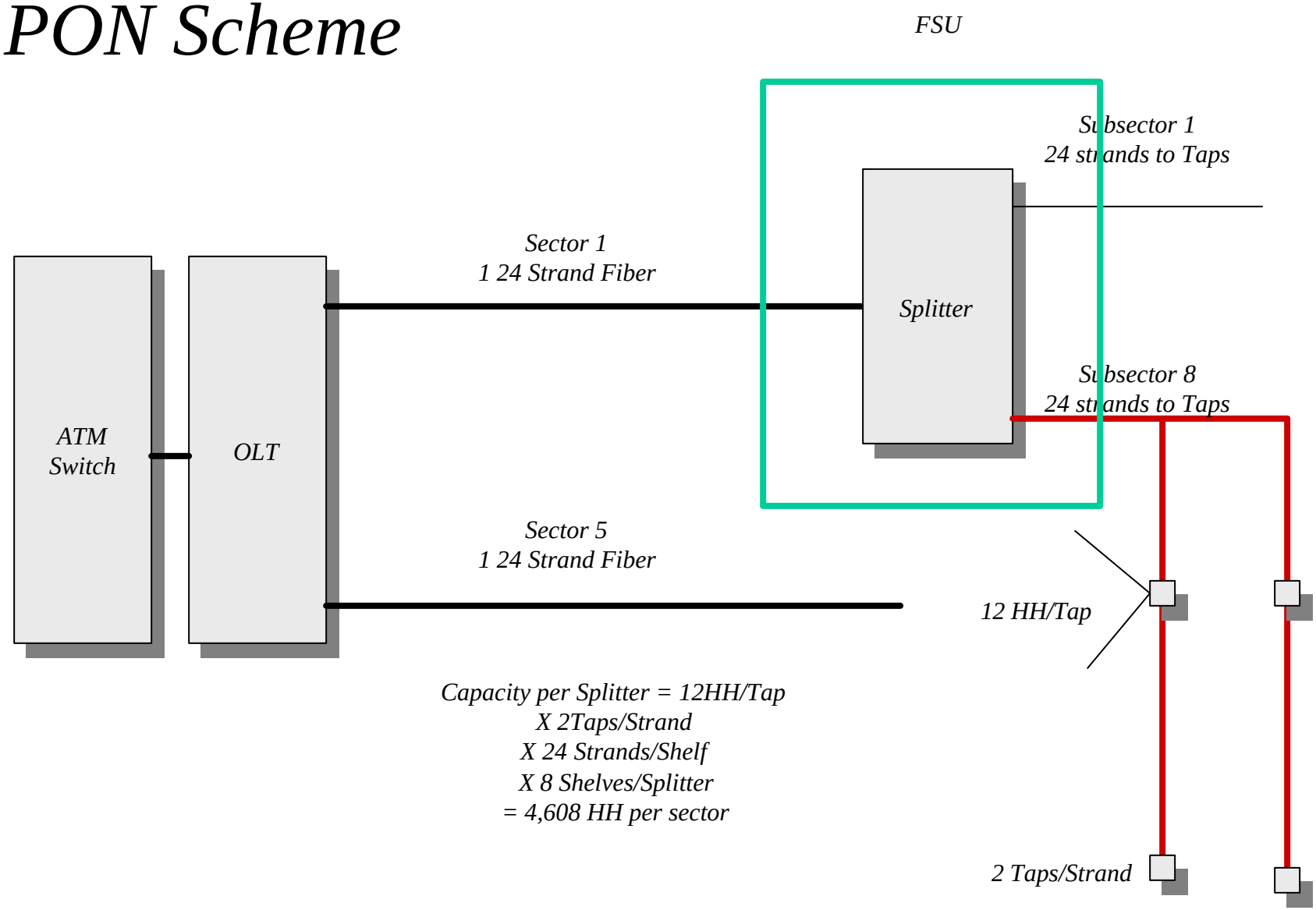
Princeton, MA Make Ready

Sector	Street Miles	Average Make Ready	Weighted Make Ready
1	55	0%	0%
2	-		0%
3	-		0%
4	-		0%
5	-		0%

Total Average Make Ready	0%

PON Architecture

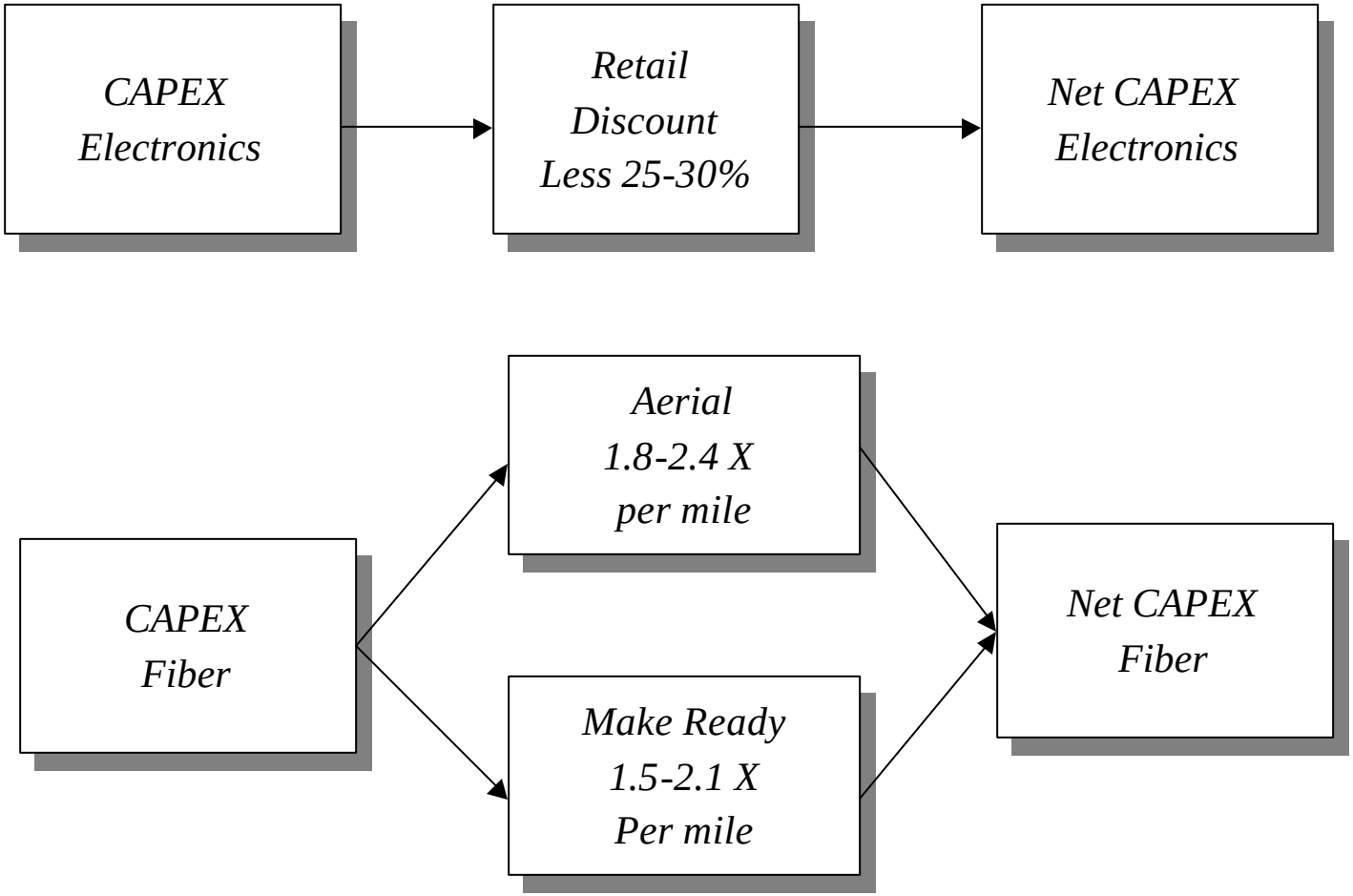
PON Scheme



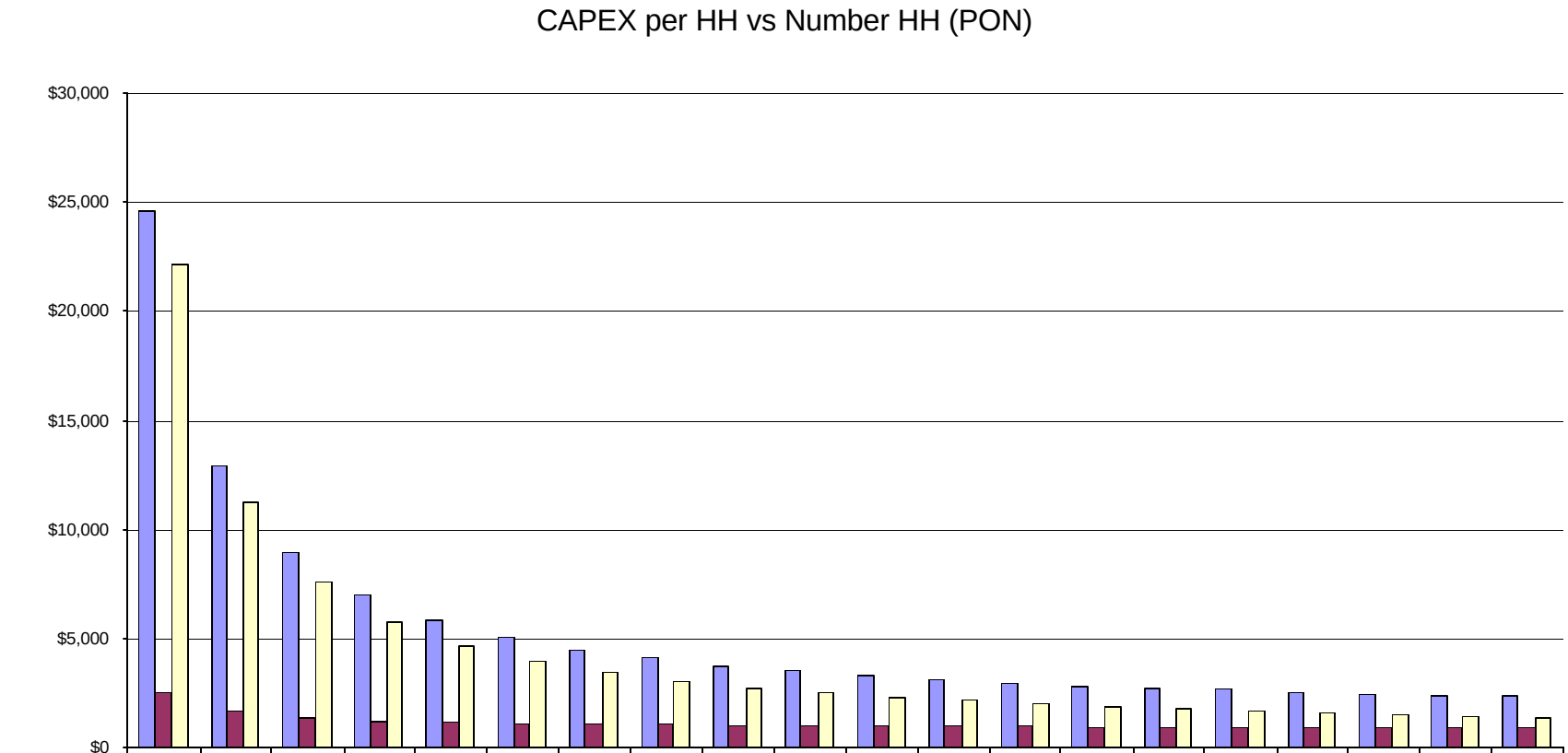
PON Cost Analysis

Unit	*Fixed*	*Variable*	*Capacity*	*Example for 1,000 HH*	*Per HH CAPEX*
EUU, End User Unit		$1,067	1 per user	$1,067,000	$1,067
Taps		$558	12 users per Tap	$46,500	$47
Splitter	$7,000	$1,380	8 spliter draws pre cabinet, 576 HH per splitter draw, maxium of 4,608 HH per Splitter cabinet. Typically 5 sectors so 5 splitters	$41,900	$42
ATM Switch	$40,000	$4,000	Max capacity 15 OC-3 Cards, incrementyal cost per OC-3 Card, user has 2 Mbps at 5% utilization is 100 Kbps per user.	$44,000	$44
OLT PON Card		$6,000	Maximum 18 Cards per shelf, capacity of 64 users per card	$93,750	$94
OLT Rack		$10,000	Maximun of 3 Shelves per rack. 3,456 HH per Rack	$10,000	$10
Number HH				1,000	
Total				$1,303,150	
Total per HH				$1,303	$1,303
Total Fiber Miles		$25,000	In town of 80 miles with 70% coverage	$1,400,000	$1,400
Drop Cost		$300		300,000	$300
Total per HH with Fiber					$3,003

Design Detail Modifications



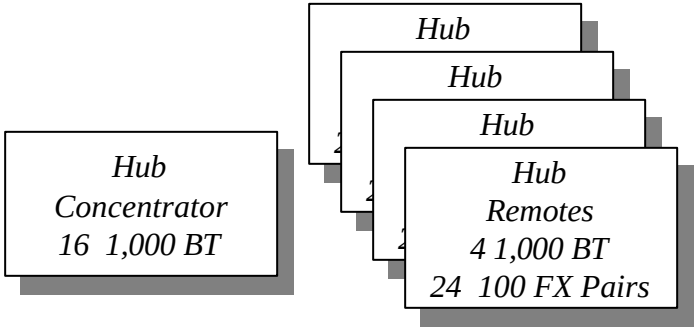
CAPEX PON

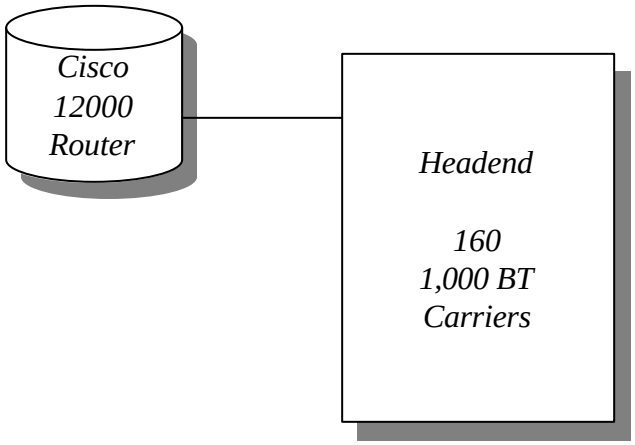


	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1,000
Total CAPEX	$24,680	$12,912	$8,990	$7,029	$5,852	$5,070	$4,513	$4,096	$3,772	$3,521	$3,308	$3,129	$2,979	$2,850	$2,745	$2,647	$2,560	$2,483	$2,414	$2,357
Electronics	$2,506	$1,668	$1,388	$1,249	$1,165	$1,112	$1,075	$1,049	$1,028	$1,020	$1,006	$993	$983	$974	$973	$966	$959	$954	$948	$949
Fiber	$22,174	$11,245	$7,601	$5,780	$4,687	$3,958	$3,438	$3,047	$2,744	$2,501	$2,302	$2,137	$1,996	$1,876	$1,772	$1,681	$1,601	$1,529	$1,465	$1,408

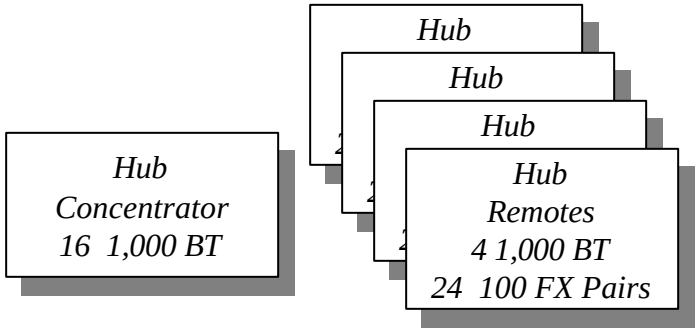
GigE Architecture

Design Issues

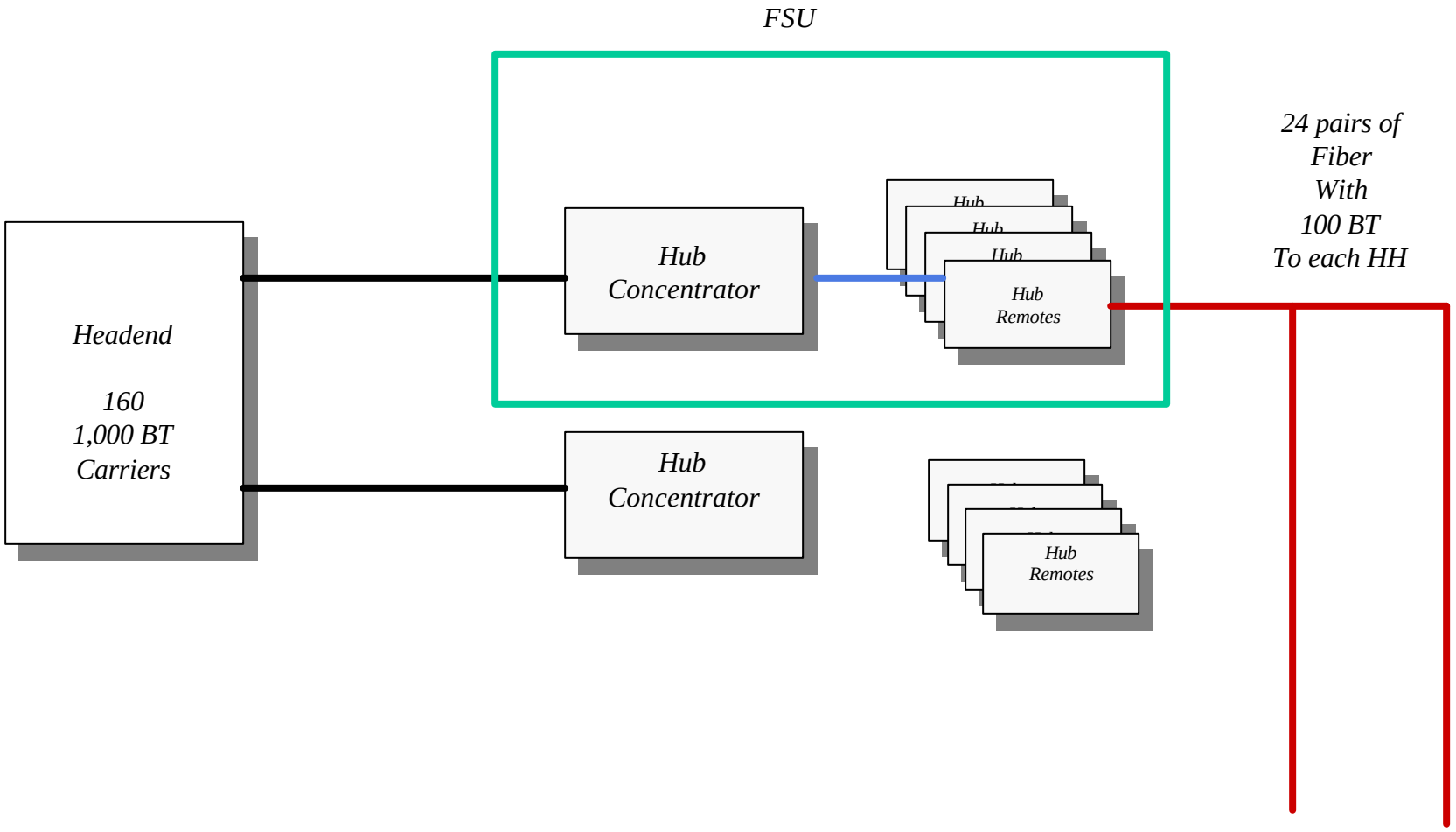




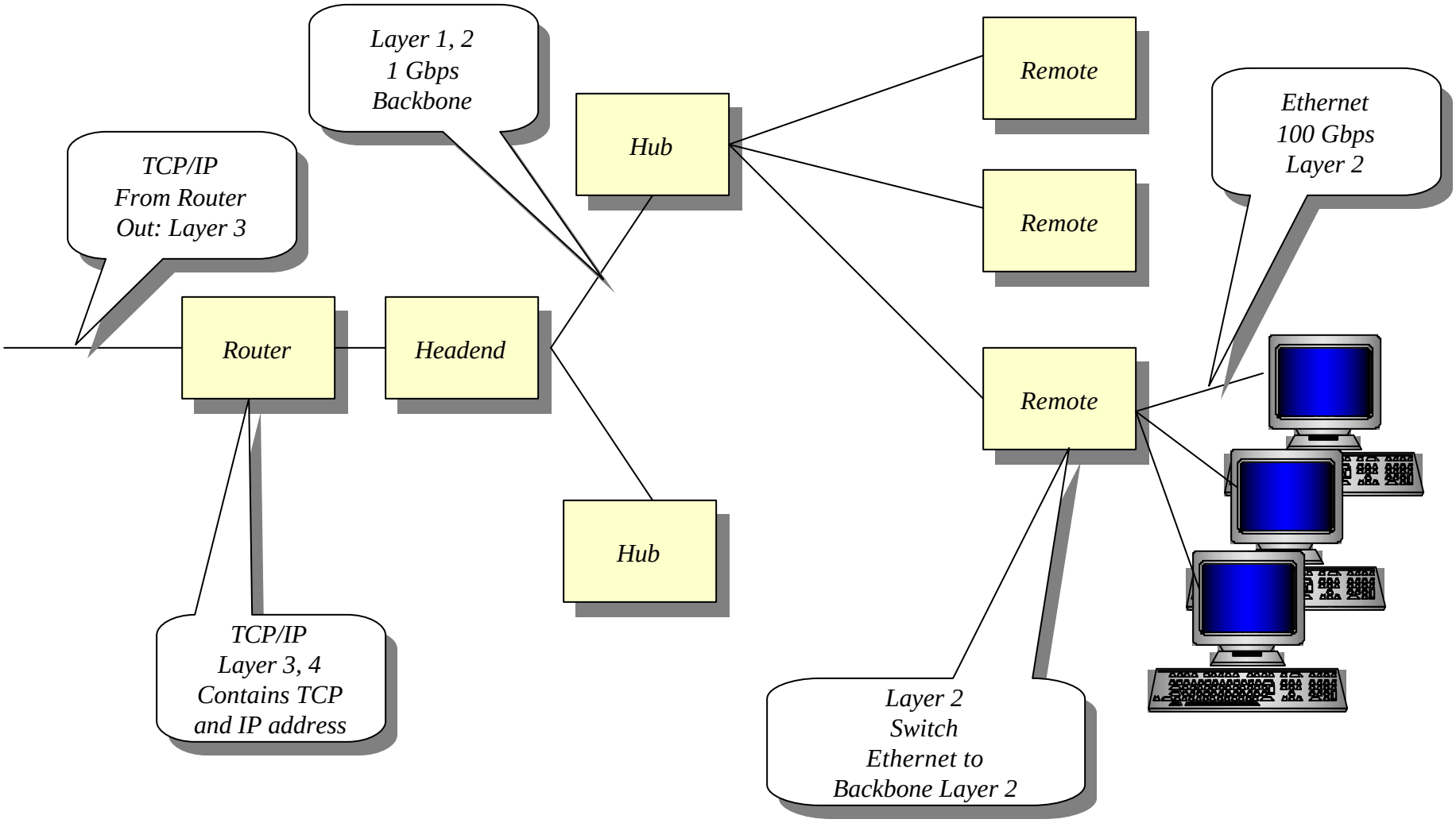
If low load per HH, then can set 15 HH 317 Per 410, and one 1 Gbps from 410 Back to 3700, with 1 Gbps on in and 1 Gbps on out.



System Elements GigE



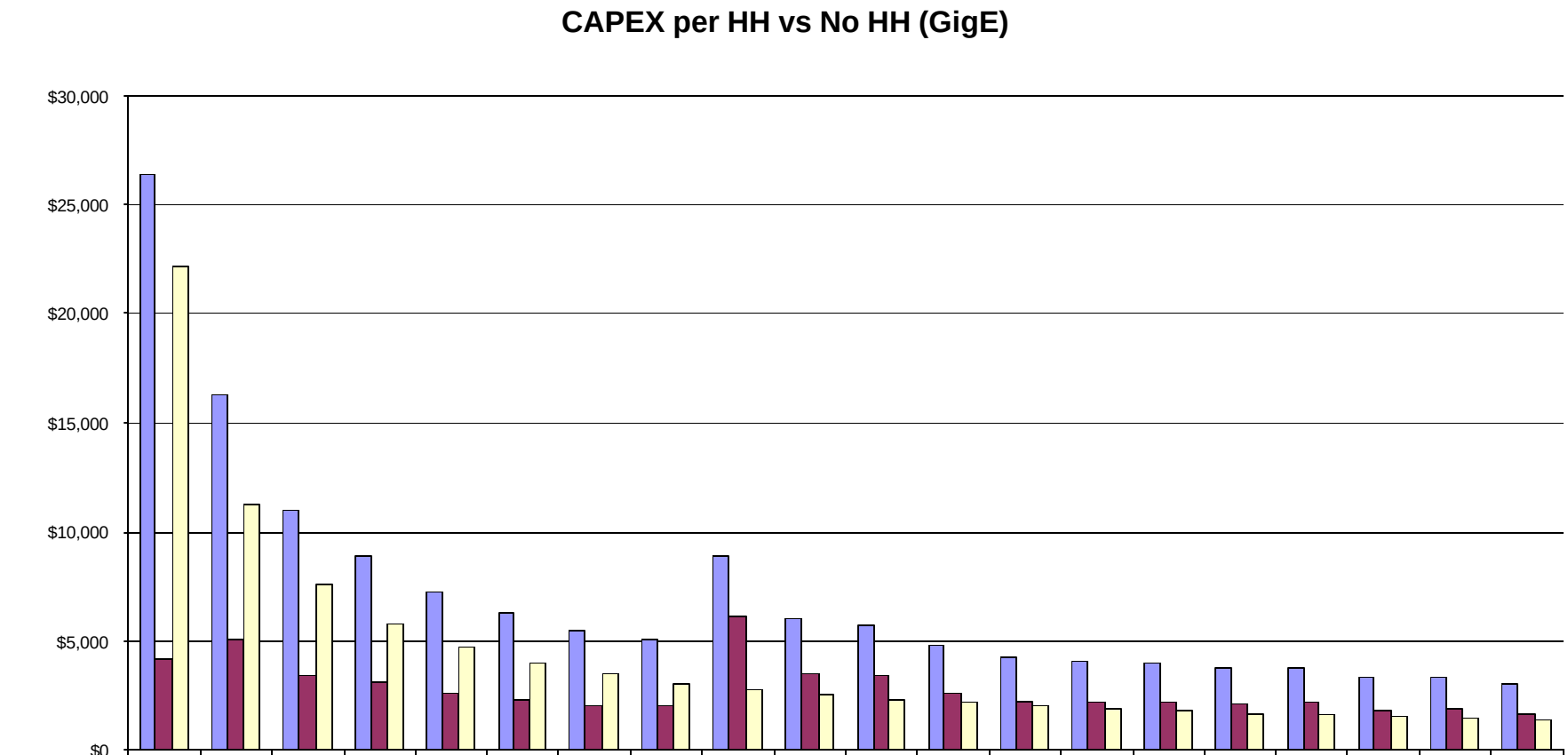
GigE Architecture



CAPEX GigE

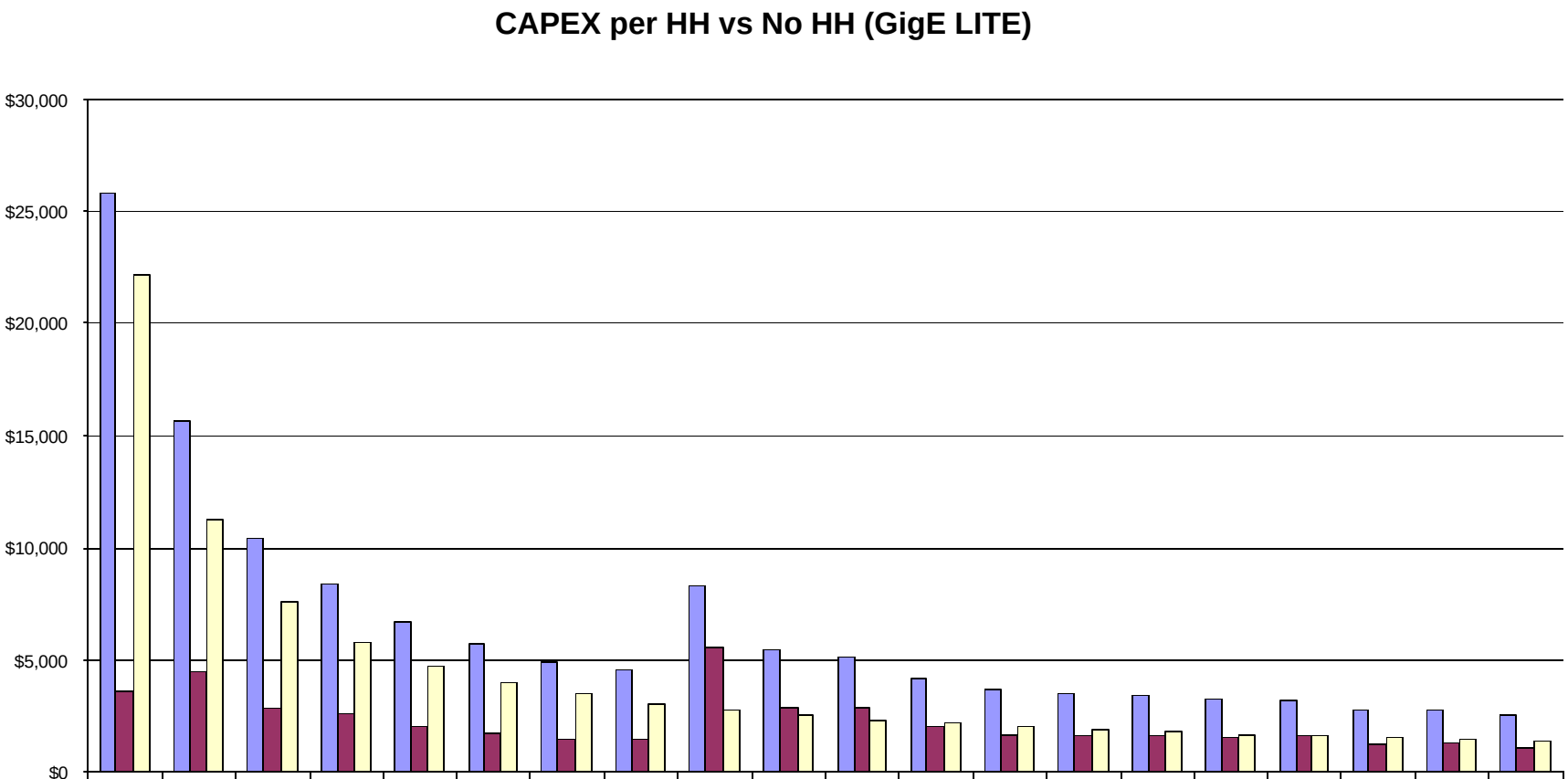
Unit	*Fixed*	*Variable*	*Capacity*	*Example for 1,000 HH*	*Per HH CAPEX*
EUU, End User Unit		$1,165	1 per user	$1,165,000	$1,165
Remote		$7,695	Supports 4 1 Gbps BT and 24 100 Mbps port pairs with 10 km range	$320,625	$321
Concentrator		$6,995	Supports 16 1 Gbps BT connections at 10 km range	$34,975	$35
Headend	$190,000	$12,000	Supports 160 1 Gbps BT connections	$202,000	$202
Number HH				1,000	
Total				$1,722,600	
Total per HH				$1,723	$1,723
Total Fiber Miles		$25,000	In town of 80 miles with 70% coverage	$1,400,000	$1,400
Drop Cost		$300		300,000	$300
Total per HH with Fiber					$3,423

CAPEX per HH GigE



	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1,000
Total CAPEX	$26,367	$16,274	$10,978	$8,914	$7,264	$6,258	$5,459	$5,082	$8,861	$5,965	$5,721	$4,736	$4,232	$4,017	$3,950	$3,779	$3,734	$3,335	$3,310	$3,068
Electronics	$4,193	$5,030	$3,376	$3,134	$2,577	$2,300	$2,021	$2,034	$6,117	$3,464	$3,419	$2,599	$2,236	$2,141	$2,177	$2,098	$2,133	$1,805	$1,844	$1,660
Fiber	$22,174	$11,245	$7,601	$5,780	$4,687	$3,958	$3,438	$3,047	$2,744	$2,501	$2,302	$2,137	$1,996	$1,876	$1,772	$1,681	$1,601	$1,529	$1,465	$1,408

CAPEX GigE LITE



	50	100	150	200	250	300	350	400	450	500	550	600	650	700	750	800	850	900	950	1,000
Total CAPEX	$25,807	$15,714	$10,418	$8,354	$6,704	$5,698	$4,899	$4,522	$8,301	$5,405	$5,161	$4,176	$3,672	$3,457	$3,390	$3,219	$3,174	$2,775	$2,750	$2,508
Electronics	$3,633	$4,470	$2,816	$2,574	$2,017	$1,740	$1,461	$1,474	$5,557	$2,904	$2,859	$2,039	$1,676	$1,581	$1,617	$1,538	$1,573	$1,245	$1,284	$1,100
Fiber	$22,174	$11,245	$7,601	$5,780	$4,687	$3,958	$3,438	$3,047	$2,744	$2,501	$2,302	$2,137	$1,996	$1,876	$1,772	$1,681	$1,601	$1,529	$1,465	$1,408