Economics of Fiber Deep

Presented by: James Stegeman, President/CEO of CostQuest Associates

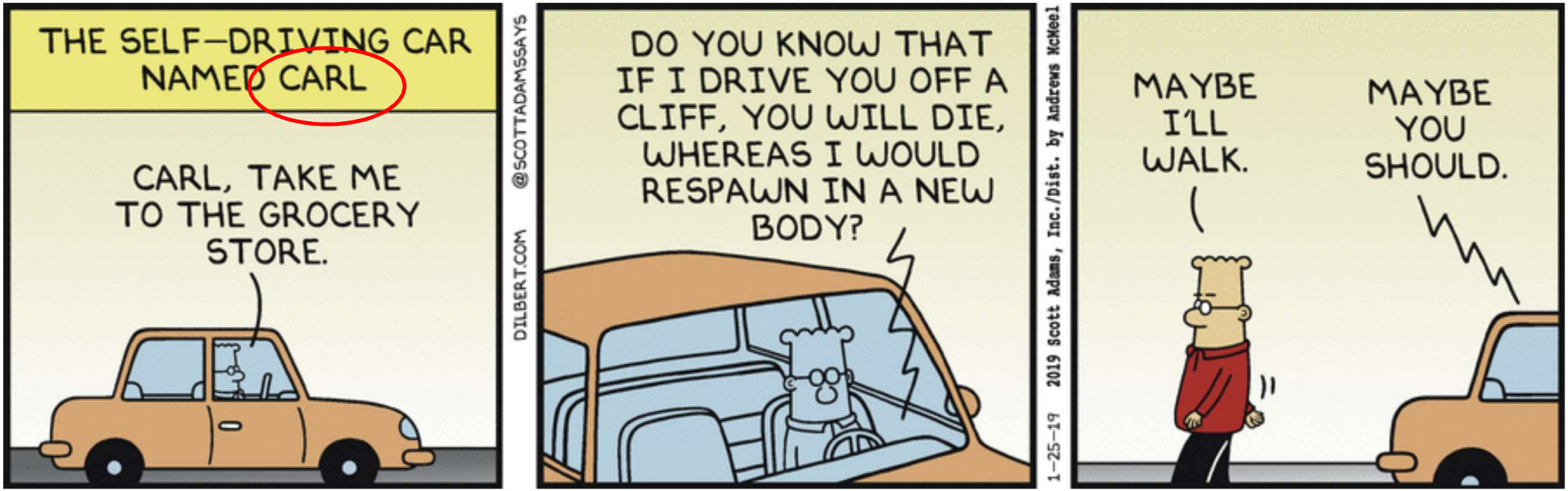
Location: TFI Conference in Austin, TX

When: January 2019

CQA

…my nightmare

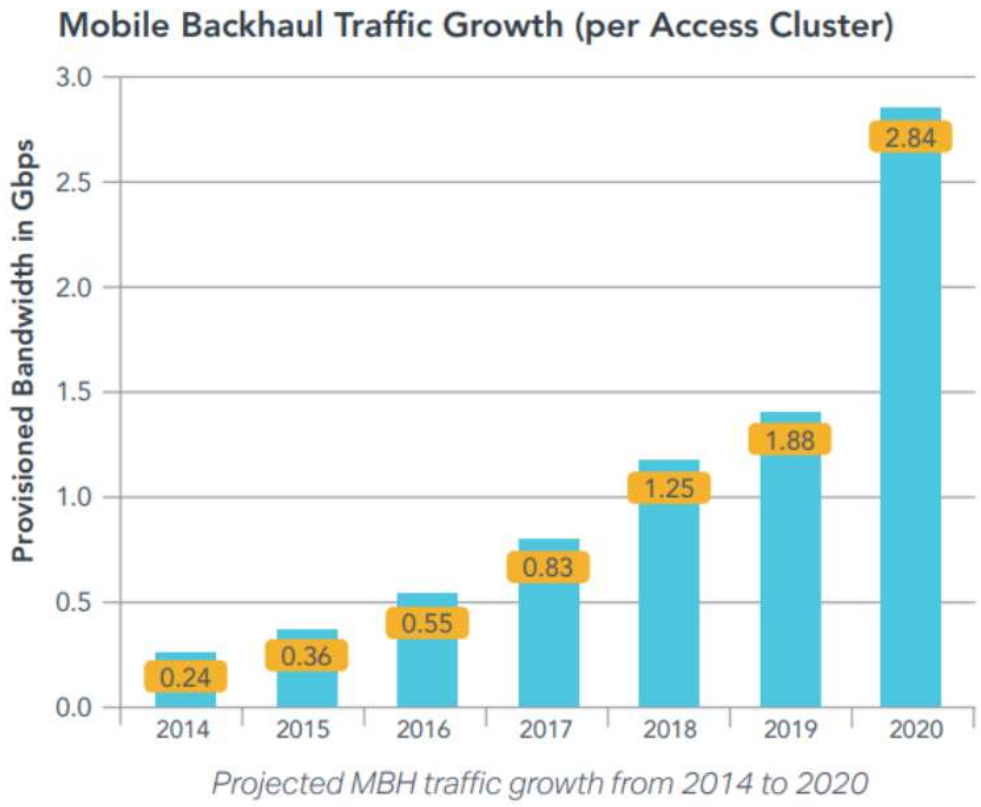
Friday January 25, 2019 *Self Driving Car Named Carl*



5G needs fiber

CQA

5G fiber demand



Source: Ciena - 5G wireless needs fiber, and lots of it

- More demand served directly by macro sites
  - Continued growth in video consumption
- Larger clusters of radios per backhaul site
  - Macro sites likely to serve as aggregation points for distributed radios
  - Fiber fronthaul to aggregation point
- Current LTE averages 1Gb per site
- With 5G at least 10Gb

5G fiber providers

- Incumbents with wireless like ATT and Verizon
  - 5G rollout on home wireline turf
  - One example: Verizon's 2017 deal with Corning to buy a billion $ of fiber. Under the deal Verizon purchases up to 12.4 million miles of optical fiber from Corning every year from 2018 to 2020.
- Incumbents like Comcast, Charter, Cox, and CenturyLink
- Fiber business service provider like Zayo
- Tower and venue developers like Crown and ATC
  - Including in-building operators
- SmartCity partners
- Self provisioned by mobile network operator
  - Fiber for fronthaul
  - Wireless point-to-point

5G is bigger than a breadbox

CQA

CQA study on 5G costs

Study Description		User Demand	Total Investment
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	$61B
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	$145B
Scenario 3	Ubiquitous Coverage, Autonomous Vehicle support	2Gb/Mo.	$185B
Scenario 4	Ubiquitous Coverage, Autonomous Vehicle support, Future Demand	50Gb/Mo.	$250B

CQA

CQA study on 5G costs

Study Description		User Demand	Capital Type: Fiber Backhaul	Capital Type: RAN Equipment
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	$14B	$47B
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	$15B	$130B
Scenario 3	Ubiquitous Coverage, Autonomous support	2Gb/Mo.	$56B	$129B
Scenario 4	Ubiquitous Coverage, Autonomous support, Future Demand	50Gb/Mo.	$57B	$193B

CQA study on 5G costs

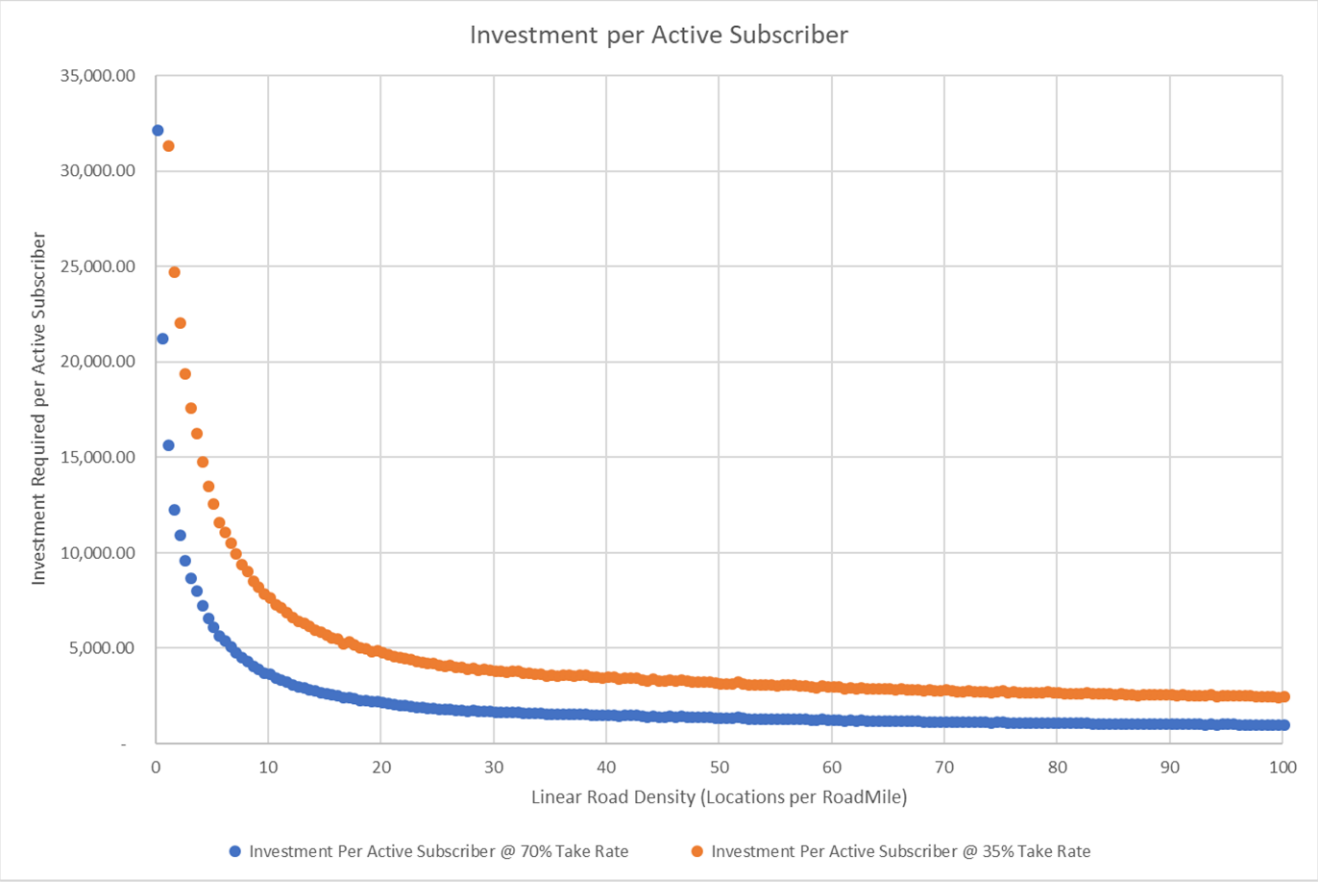
Study Description		User Demand	Cell Counts: Total	Cell Counts: MicroGrids
Scenario 1	Ubiquitous Coverage	2Gb/Mo.	454,019	386,149
Scenario 2	Ubiquitous Coverage, Future Demand	50Gb/Mo.	755,509	540,879
Scenario 3	Ubiquitous Coverage, Autonomous support	2Gb/Mo.	2,587,003	2,523,422
Scenario 4	Ubiquitous Coverage, Autonomous support, Future Demand	50Gb/Mo.	2,800,944	2,620,138

CQA

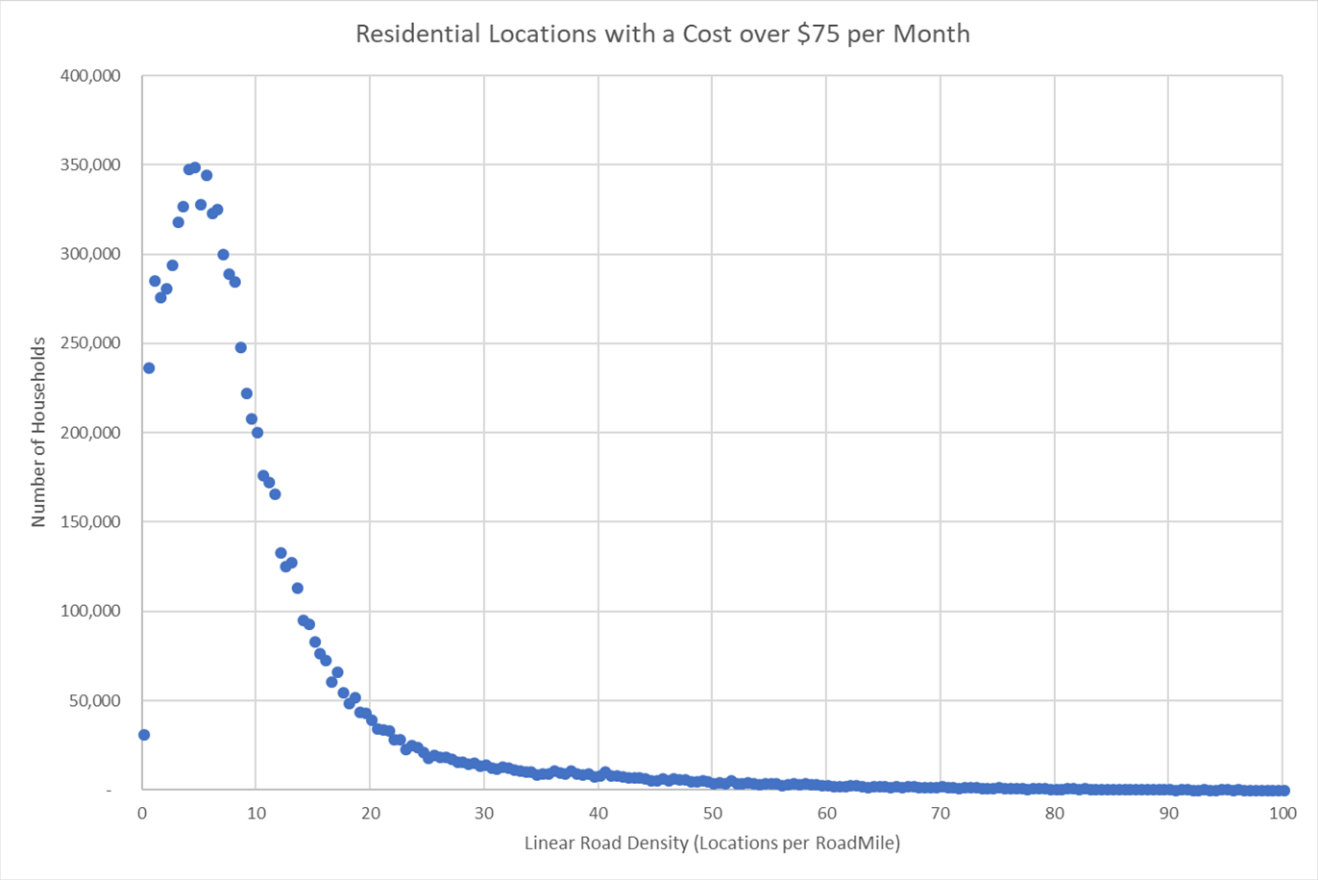
Economics of Fiber

CQA

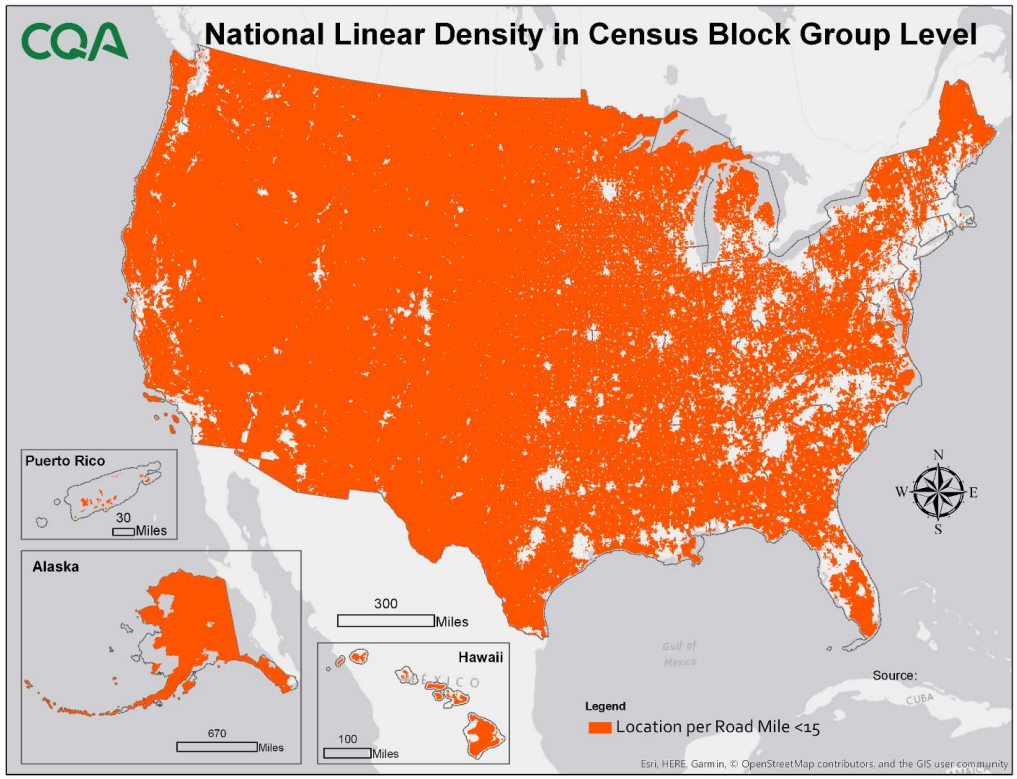
Fiber investment requirements by linear density



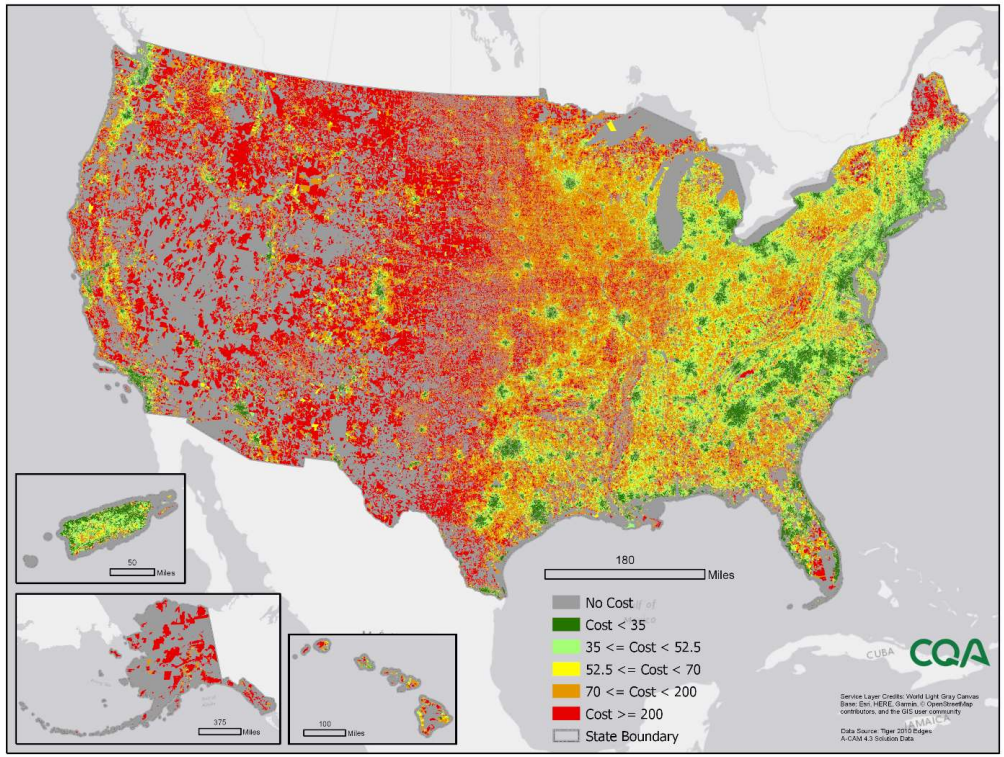
Household counts with monthly cost exceeding $75



Census Block Groups which have a linear density below 15 locations per road mile



Uneconomic areas for fiber network deployment



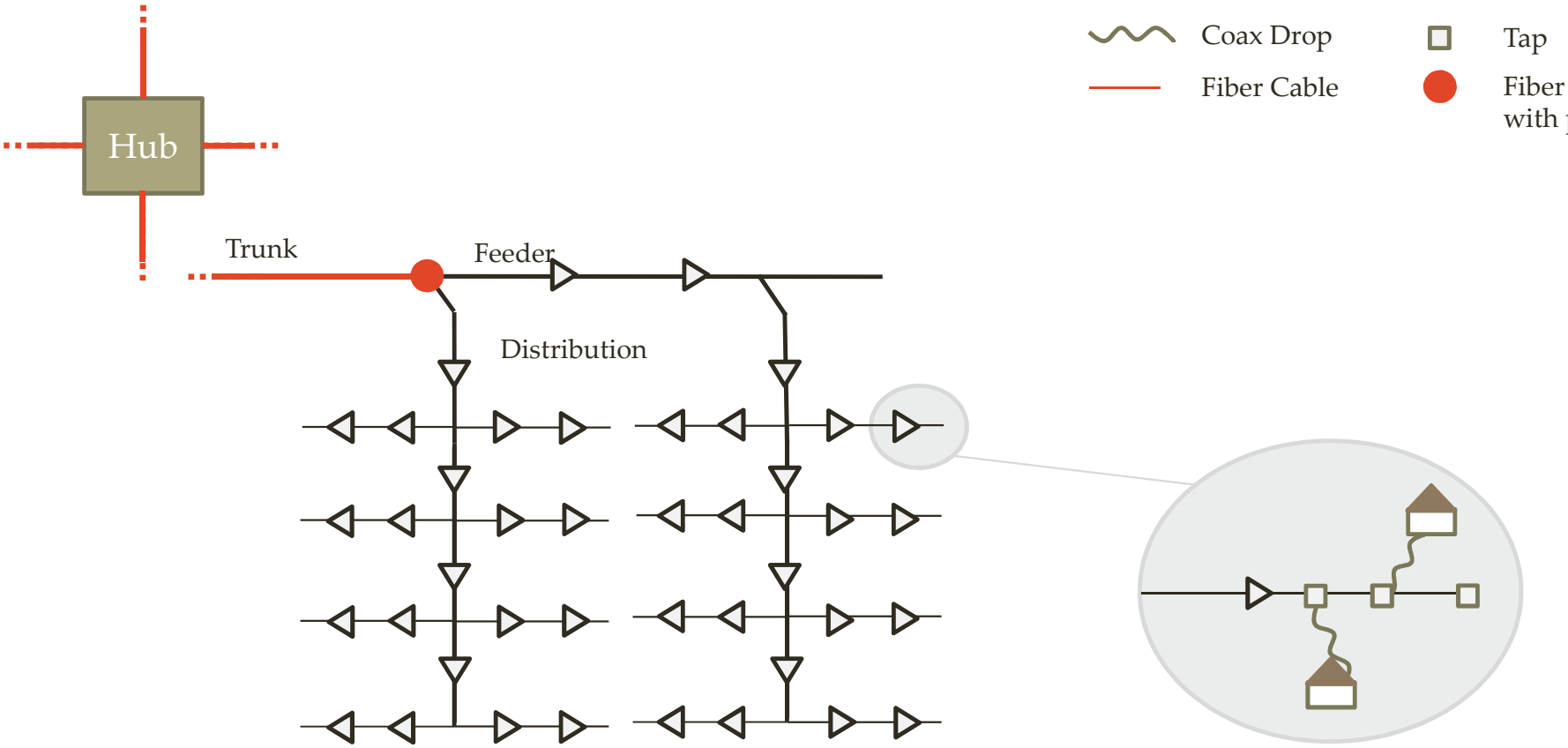
Marketplace

- External focus on deployment of high speed Broadband service in lower density areas:
  - NY State provided $500M in funding to encourage 100Mb network deployments in rural areas
    - Mostly fiber, some fixed wireless
  - FCC provides over $4B annually to providers to build out broadband networks in rural areas
    - Fixed Wireless is a key component
  - FCC recently completed CAF2 Auction for support in high cost Rural areas
    - Almost $1.5B was awarded (preliminarily)
    - Many winners are offering 1G service
    - Many winners were Rural Electric Coops
    - Many winners were WISPs
  - PA, GA, ME, and other states are looking at programs similar to NY for rural areas
  - Municipalities are building their own networks
    - Next Century Cities has 192 members

Focus on Cable Fiber Deep

CQA

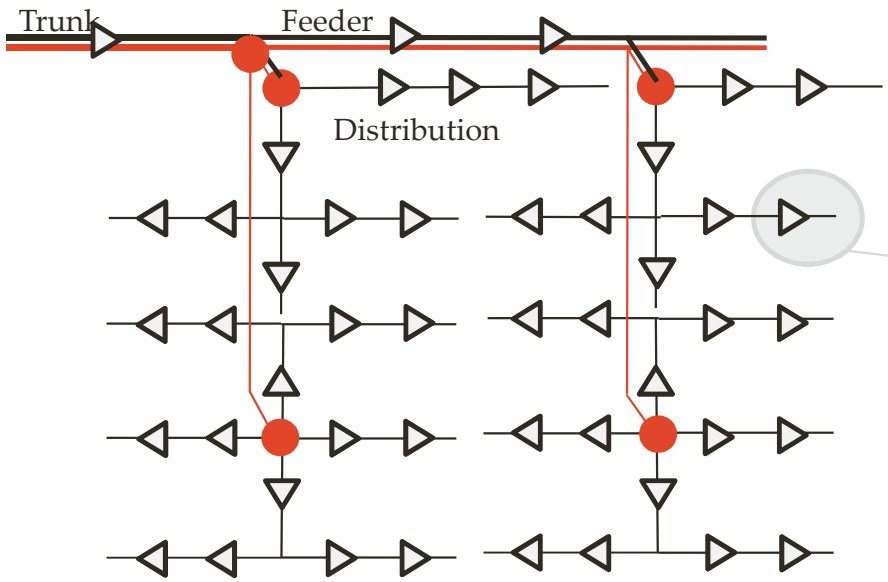
HFC system: New build



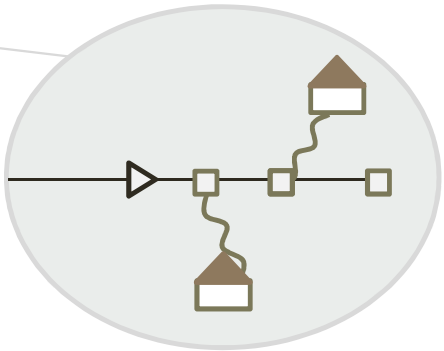
CQA

HFC system N+x: Overlay

Coax Cable
Amplifier
Fiber Cable
Fiber Node with power supply
Coax segments – no signal

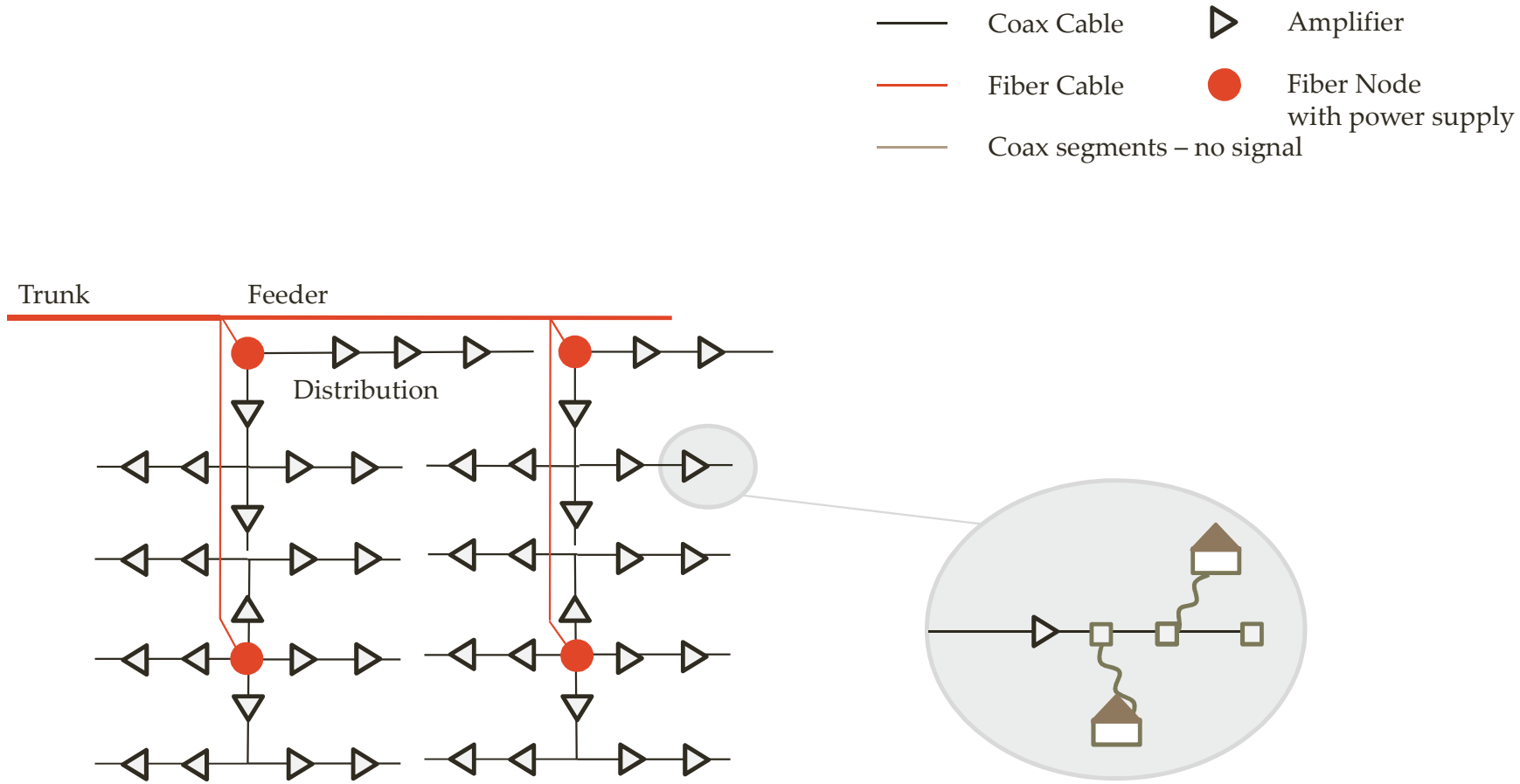


Early obsolescence: Feeder cable from last tap in new cluster, with amplifiers, power supplies.



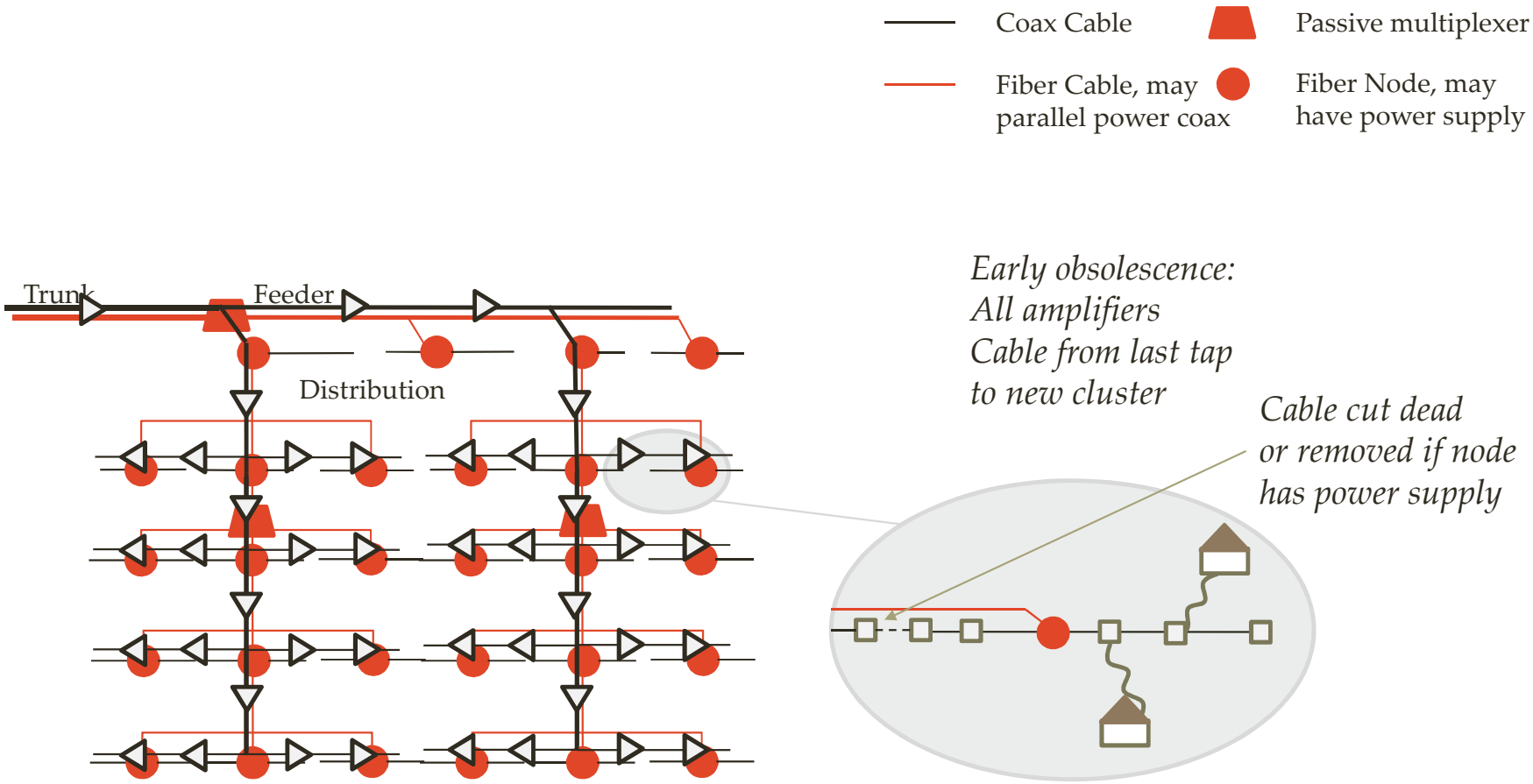
CQA

HFC system N+x: New build



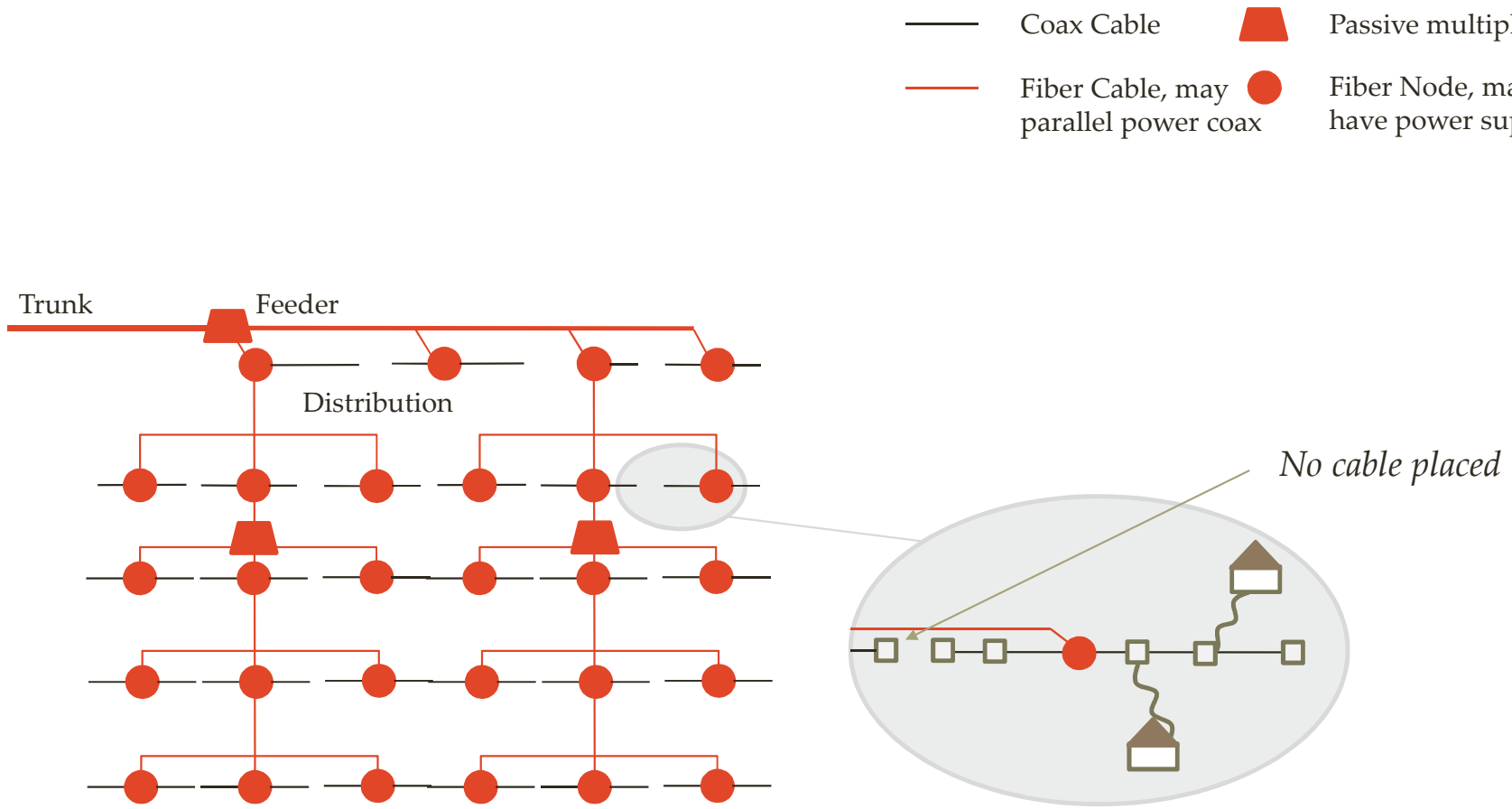
CQA

Fiber Deep: HFC N+0: Overlay



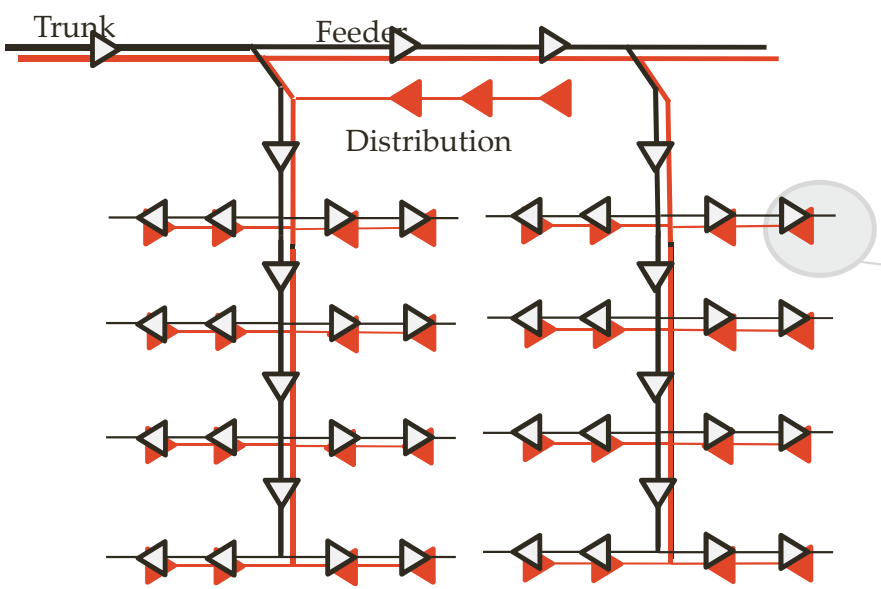
CQA

Fiber Deep: HFC N+0: New build



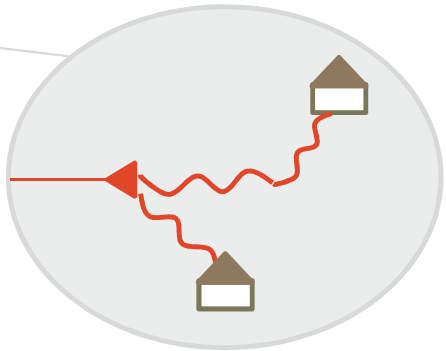
CQA

FTTP system: Overlay



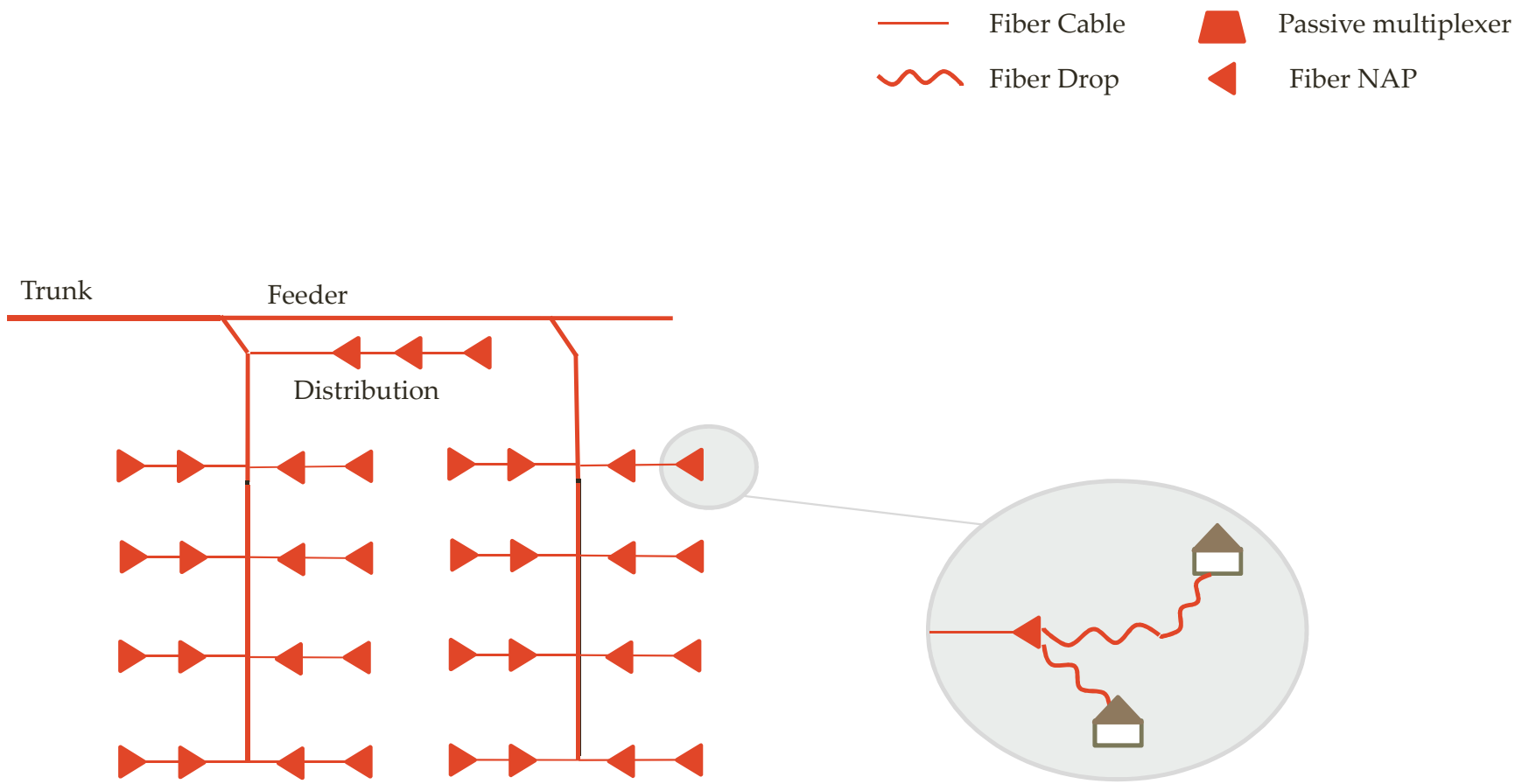
Fiber Cable
Fiber Drop
Passive multiplexer
Fiber NAP

Early obsolescence:
All amplifiers and power supplies
All coax cable and drops



CQA

FTTP system: New build

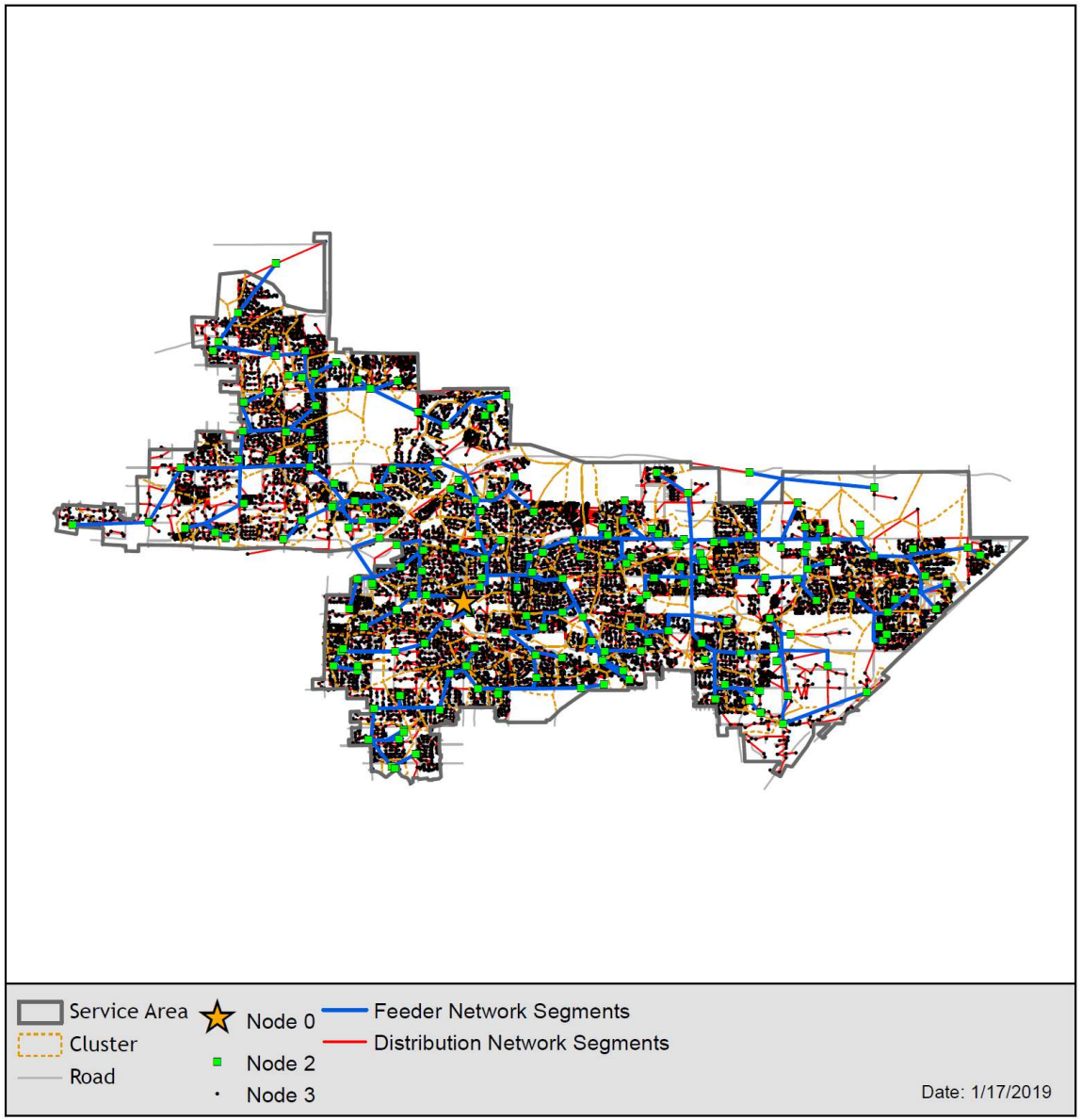


HFC versus Fiber Deep design parameters

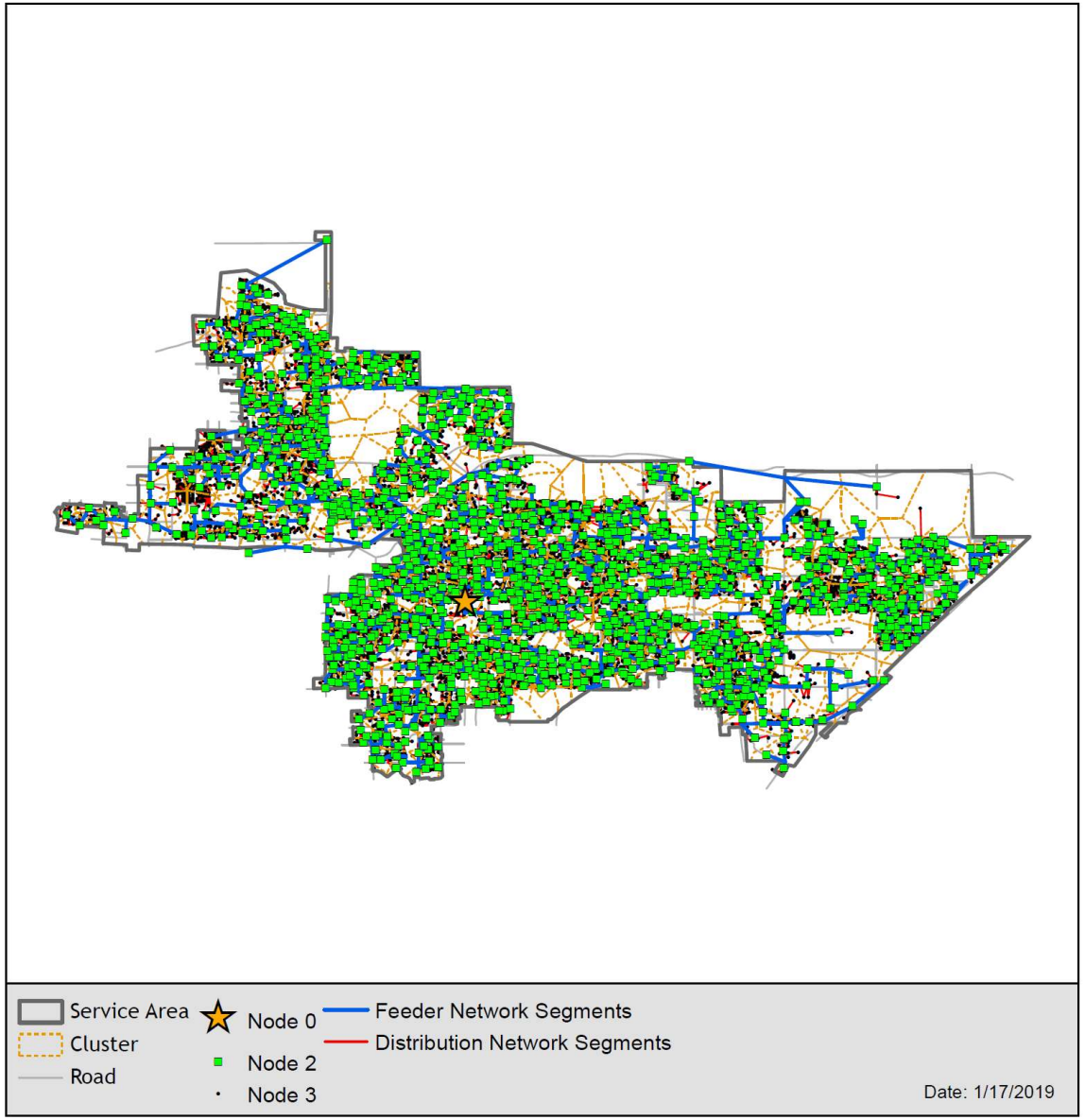
- Target locations passed per Fiber Node:
  - HFC: 300-750
  - Fiber Deep: 60-80
- Max Coax distance:
  - HFC: 5000ft
  - Fiber Deep: 1000ft

CQA

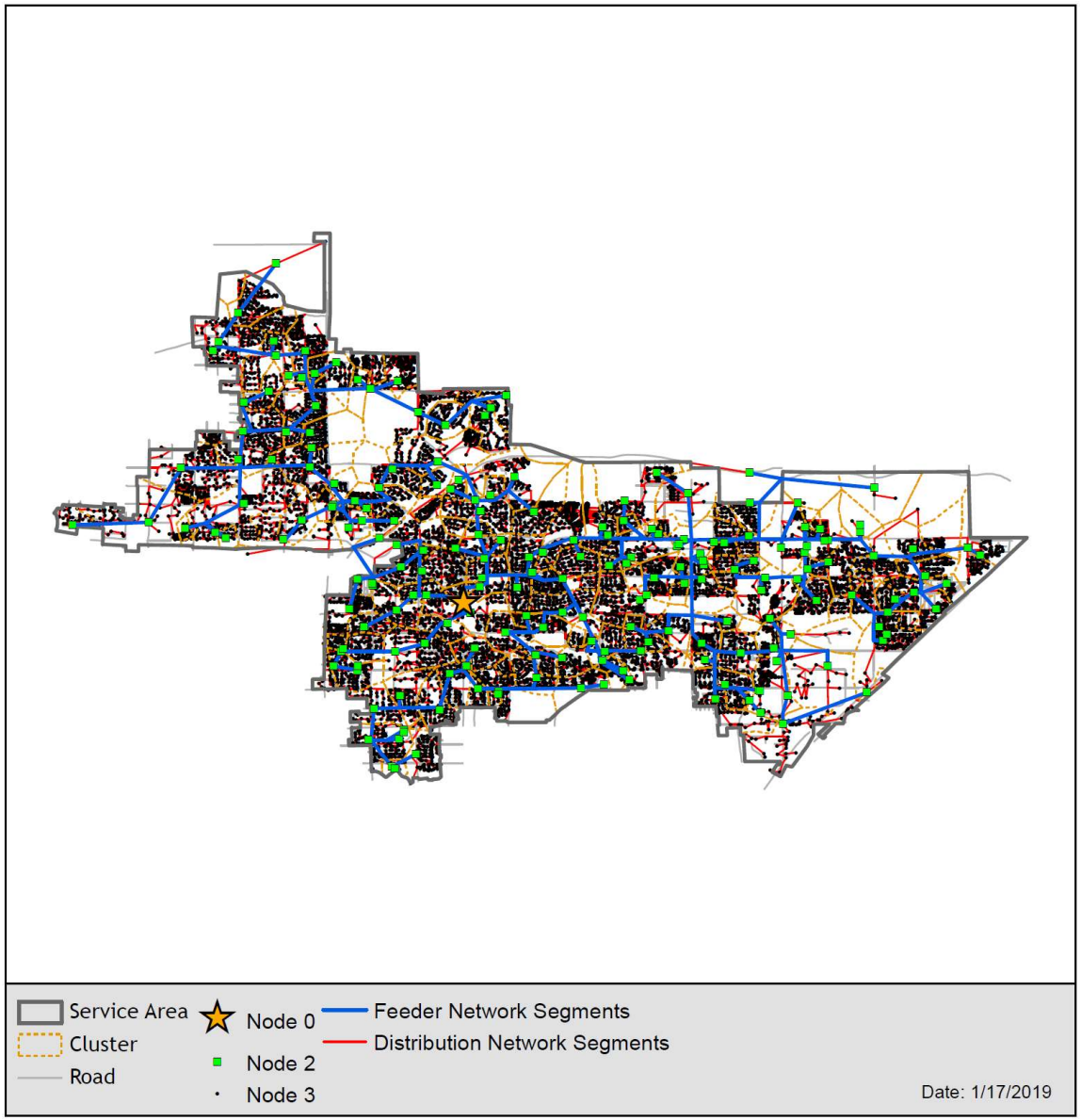
HFC sample area design



Fiber Deep sample area design



FTTp sample area design



Comparison of HFC vs Fiber Deep: Initial deployment

	HFC (40%)	FiberDeep (40%)
Drop	3,299,436	3,299,498
Total OSP	42,658,694	44,641,976
Dist Coax	*34,564,354*	*26,048,964*
Amps/Splitters/Taps	*439,637*	*132,423*
Feeder Fiber	*7,271,944*	*18,077,137*
Pole/MakeReady	*382,759*	*383,452*
COT/FiberNode	2,161,564	12,162,737
TOTAL BUILD	48,119,694	60,104,211

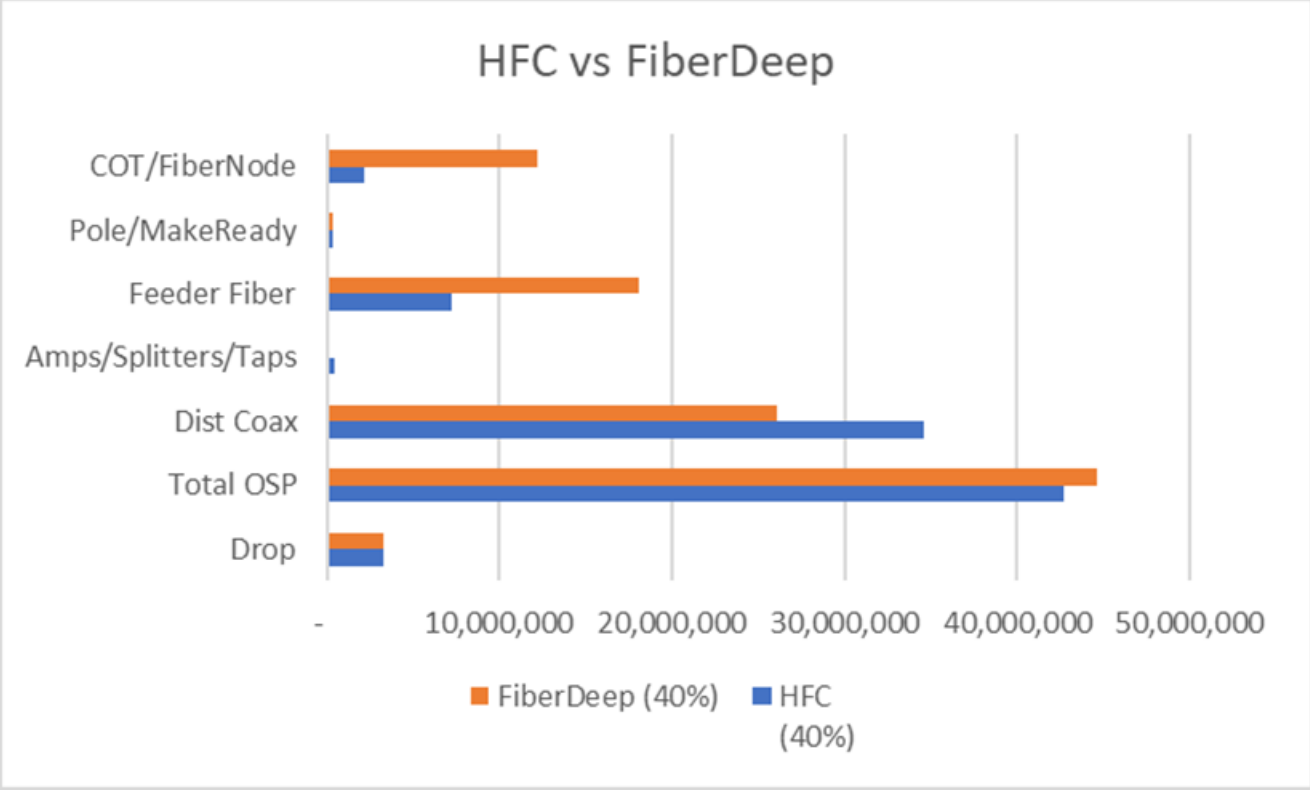
Comparison of HFC vs Fiber Deep: Cable footage

- Plant cable footage design comparison
  - HFC
    - Coax: 1,986,803
    - Fiber: 600,359
  - Fiber Deep
    - Coax: 1,630,277
    - Fiber: 1,272,998

Comparison of HFC vs Fiber Deep: Equipment counts

- Equipment count design comparison
  - HFC
    - Fiber Node Count: 207
    - Locations per Node: 515
  - Fiber Deep
    - Fiber Node Count: 1488
    - Locations per Node: 70

Comparison of HFC vs Fiber Deep: New build cost



CQA

Comparison of HFC vs Fiber Deep: New build cost

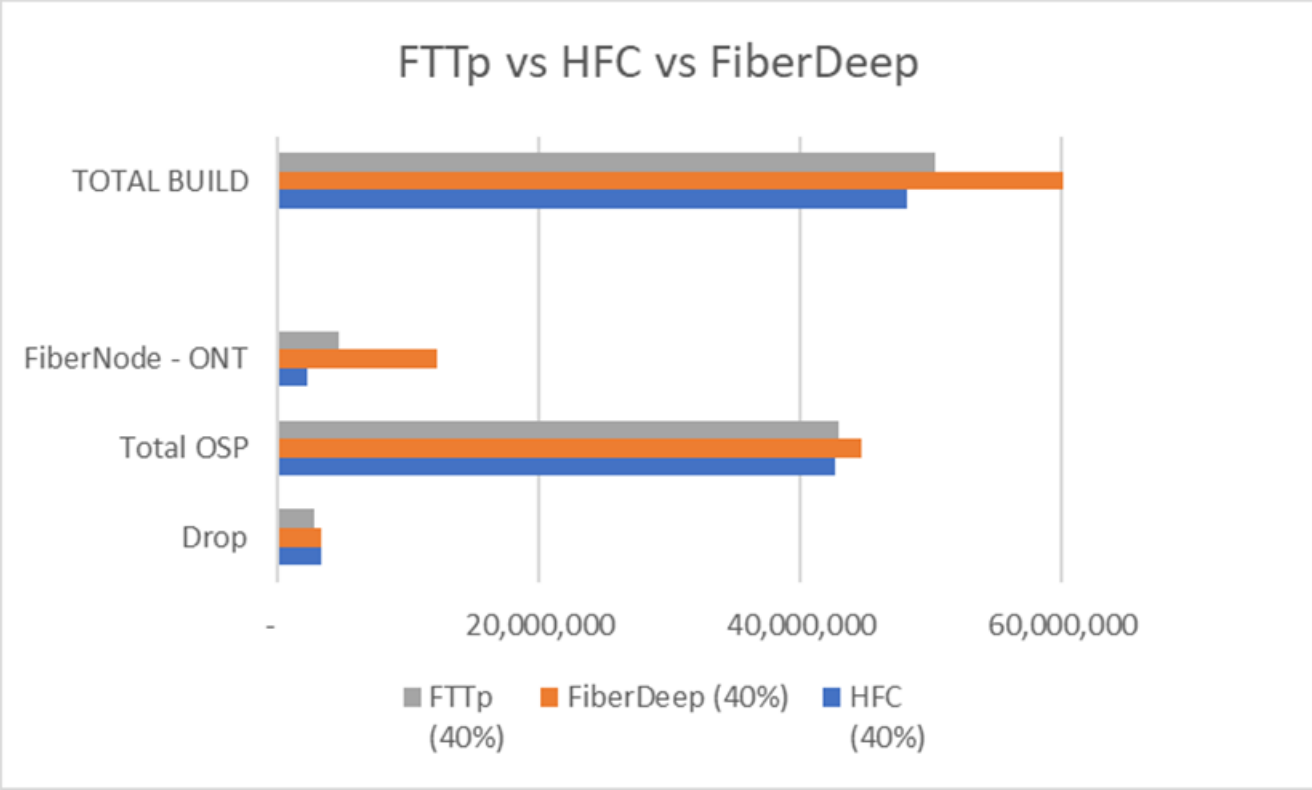
	HFC (40%)	FiberDeep (40%)	New Build Change	Pct New Build Change
Drop	3,299,436	3,299,498	62	0.0%
Total OSP	42,658,694	44,641,976	1,983,282	4.6%
Dist Coax	*34,564,354*	*26,048,964*	*(8,515,390)*	*-24.6%*
Amps/Splitters/Taps	*439,637*	*132,423*	*(307,214)*	*-69.9%*
Feeder Fiber	*7,271,944*	*18,077,137*	*10,805,193*	*148.6%*
Pole/MakeReady	*382,759*	*383,452*	*693*	*0.2%*
COT/FiberNode	2,161,564	12,162,737	10,001,173	462.7%
TOTAL BUILD	**48,119,694**	**60,104,211**	**11,984,517**	**24.9%**

Comparison of HFC vs Fiber Deep: Estimated brownfield cost

	HFC (40%)	FiberDeep (40%)	New Build Change	Pct New Build Change	Brownfield Change
Drop	3,299,436	3,299,498	62	0.0%	
Total OSP	42,658,694	44,641,976	1,983,282	4.6%	
Dist Coax	*34,564,354*	*26,048,964*	*(8,515,390)*	*-24.6%*	
Amps/Splitters/Taps	*439,637*	*132,423*	*(307,214)*	*-69.9%*	
Feeder Fiber	*7,271,944*	*18,077,137*	*10,805,193*	*148.6%*	10,805,193
Pole/MakeReady	*382,759*	*383,452*	*693*	*0.2%*	
COT/FiberNode	2,161,564	12,162,737	10,001,173	462.7%	10,001,173
TOTAL BUILD	**48,119,694**	**60,104,211**	**11,984,517**	**24.9%**	**20,806,366**

CQA

FTTp, HFC and Fiber Deep: Initial new build comparison



FTTp, HFC and Fiber Deep: Initial new build comparison

	HFC (40%)	FiberDeep (40%)	FTTp (40%)
Drop	3,299,436	3,299,498	2,694,026
Total OSP	42,658,694	44,641,976	42,896,666
FiberNode - ONT	2,161,564	12,162,737	4,650,956
TOTAL BUILD	48,119,694	60,104,211	50,241,648

Why Fiber Deep for the subject plant owner

	Brownfield FiberDeep (40%)	FTTp (40%)
Drop	-	2,694,026
Total OSP	10,805,193	42,896,666
FiberNode - ONT	10,001,173	4,650,956
TOTAL BUILD	**20,806,366**	**50,241,648**

However, what would be built new today

- If we ask engineers and business managers– "Assuming you were building new, what would you build today, if given the choice?"
  - The common answer is FTTp
- Why FTTp
  - In short, it provides the best business case
    - It provides the ultimate delivery platform (and is somewhat future proof)
    - Is cheaper to operate
    - Expands revenue opportunities, improves take, and decreases churn
    - And as shown below, is only marginally more expensive than HFC for the initial build

	HFC (40%)	FiberDeep (40%)	FTTp (40%)
Drop	3,299,436	3,299,498	2,694,026
Total OSP	42,658,694	44,641,976	42,896,666
FiberNode - ONT	2,161,564	12,162,737	4,650,956
TOTAL BUILD	**48,119,694**	**60,104,211**	**50,241,648**

A quick view of the FTTp business case

CostQuest Associates, Inc. RetailProvider Study	
Component:	*City Scorecard*
Technology:	*GPON*
Provider Type:	*RetailProvider*
City:	*CQA1*
State	*NV*

Demographics in Served Area

AreaSqMiles	227.88
RoadMiles	4,937.71
HwyMiles	1.96
ResLocations	50,123
BusLocations	4,248
Buildings	50,778
MDU	955
Householeds in MDU	217
ResPopulation	153,316
ResHouseholds	56,495
ResHousingUnits	56,495
BusFirms	2,294
BusEnterprises	217
BusEmployees	28,228
WirelessTowers	37
ResAndBusPerRoadMile	11.91
ResAndBusPerSqMile	257.98
AvgHHSize	2.71
AvgHHIncome	64,080.61
Age0to17	44,483
Age18to24	13,739
Age25to39	35,343
Age40to54	30,548
Age55Plus	29,202
LessThanHSGrad	16,285
HSGradOrEquiv	43,171
SomeCollegeOrAssociates	60,406
BachelorDegOrHigher	33,454

In Total

	Res Households	Bus Firms
Total locations	56,507	2,308
% locations passed in Served area	*100.0%*	*99.4%*

Supply in Served Area

	Locations Served	Pct.
Cable_3orMore	53,468	*98.3%*
FW_3orMore	23,932	*44.0%*
Mobility_3orMore	54,371	*100.0%*
Telco_3orMore	53,732	*98.8%*
Cable_10orMore	53,468	*98.3%*
FW_10orMore	11,299	*20.8%*
Mobility_10orMore	54,371	*100.0%*
Telco_10orMore	52,710	*96.9%*
Cable_25orMore	53,468	*98.3%*
FW_25orMore	-	*0.0%*
Mobility_25orMore	-	*0.0%*
Telco_25orMore	50,329	*92.6%*

Financials in Served Area

	Total
Locations Passed	54,371
Potential Customers Passed	58,789
Estimated Broadband Market	87.5%
Estimated Levelized Take	16,757
PotentialMarketShare	35.1%
TotalCapex (excluding replacment)	$ 51,507,408
AnnualARPU	$ 13,718,862
AnnualNetworkOpex	$ 2,774,999
AnnualEBITDA	$ 10,943,863
NetNRC	$ (398,769)
AnnualCapexCost	$ 6,003,370

From Financial Report - Levelized

CQA

The in-depth view of the FTTp business case

Financials

Unit	Product	Measure	Res/Bus/Tota	Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Revenues	Data High																		
		Subscription			1,631,648	4,207,935	5,410,202	5,839,583	6,268,964	6,698,345	6,870,097	6,870,097	6,870,097	6,870,097	6,870,097	6,870,097	6,870,097	6,870,097	6,870,097
		NRC			205,078	120,770	35,603	25,131	36,140	25,668	4,296	4,296	4,296	4,296	4,296	4,296	4,296	4,296	4,296
	Data Low																		
		Subscription			2,125,698	5,482,063	7,048,367	7,607,761	8,167,156	8,726,550	8,950,307	8,950,307	8,950,307	8,950,307	8,950,307	8,950,307	8,950,307	8,950,307	8,950,307
		NRC			534,082	314,519	92,720	65,449	94,118	66,848	11,188	11,188	11,188	11,188	11,188	11,188	11,188	11,188	11,188
	Voice																		
		Subscription			411,870	1,062,192	1,365,675	1,474,062	1,582,449	1,690,836	1,734,190	1,734,190	1,734,190	1,734,190	1,734,190	1,734,190	1,734,190	1,734,190	1,734,190
		NRC			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Total				**4,908,376**	**11,187,479**	**13,952,566**	**15,011,986**	**16,148,826**	**17,208,246**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**	**17,570,079**
Operational Cost	Voice expenses				5,069	13,072	16,806	18,140	19,474	20,808	21,341	21,341	21,341	21,341	21,341	21,341	21,341	21,341	21,341
	Customer Acquisition																		
		Data High			136,719	80,513	23,735	16,754	24,093	17,112	2,864	2,864	2,864	2,864	2,864	2,864	2,864	2,864	2,864
		Data Low			71,211	41,936	12,363	8,727	12,549	8,913	1,492	1,492	1,492	1,492	1,492	1,492	1,492	1,492	1,492
		TOTAL			207,930	122,449	36,098	25,481	36,642	26,025	4,356	4,356	4,356	4,356	4,356	4,356	4,356	4,356	4,356
	Service Install				739,160	435,290	128,322	90,580	130,258	92,516	15,484	15,484	15,484	15,484	15,484	15,484	15,484	15,484	15,484
	Customer Operations, Advertising, G&A				1,144,531	1,651,549	1,880,632	1,966,914	2,057,167	2,143,623	2,176,005	2,177,489	2,178,809	2,180,363	2,181,917	2,183,470	2,185,024	2,186,578	2,188,131
	Network operating expenses				1,145,420	1,204,184	1,221,481	1,233,669	1,251,202	1,263,625	1,265,632	1,267,629	1,269,406	1,271,497	1,273,588	1,275,679	1,277,770	1,279,861	1,281,952
	TOTAL				**3,242,110**	**3,426,544**	**3,283,339**	**3,334,784**	**3,494,743**	**3,546,597**	**3,482,818**	**3,486,298**	**3,489,396**	**3,493,041**	**3,496,686**	**3,500,330**	**3,503,975**	**3,507,620**	**3,511,264**
EBITDA					**1,666,267**	**7,760,935**	**10,669,227**	**11,677,202**	**12,654,083**	**13,661,650**	**14,087,261**	**14,083,781**	**14,080,683**	**14,077,038**	**14,073,393**	**14,069,749**	**14,066,104**	**14,062,459**	**14,058,815**
Tax Depreciation					5,544,738	9,798,822	7,546,487	5,807,790	5,564,747	4,266,570	3,004,191	2,942,525	2,964,406	3,079,738	3,216,643	3,348,016	3,494,451	3,644,723	3,784,804
EBIT					**(3,878,472)**	**(2,037,886)**	**3,122,740**	**5,869,412**	**7,089,336**	**9,395,079**	**11,083,070**	**11,141,256**	**11,116,277**	**10,997,300**	**10,856,750**	**10,721,732**	**10,571,653**	**10,417,736**	**10,274,010**
Interest					991,284	991,284	991,284	991,284	956,148	918,904	879,426	837,578	793,220	746,200	696,359	643,528	587,527	528,165	465,242
Income					**(4,869,756)**	**(3,029,171)**	**2,131,456**	**4,878,128**	**6,133,187**	**8,476,175**	**10,203,645**	**10,303,678**	**10,323,057**	**10,251,099**	**10,160,391**	**10,078,204**	**9,984,126**	**9,889,571**	**9,808,768**
Tax					(58,437)	(36,350)	25,577	58,538	73,598	101,714	122,444	123,644	123,877	123,013	121,925	120,938	119,810	118,675	117,705
After Tax Income					**(4,811,319)**	**(2,992,820)**	**2,105,878**	**4,819,590**	**6,059,589**	**8,374,461**	**10,081,201**	**10,180,034**	**10,199,180**	**10,128,086**	**10,038,466**	**9,957,266**	**9,864,316**	**9,770,896**	**9,691,062**

Unit	Item			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
Capital	Initial Deployment			44,357,906	-	-	-	-	-	-	-	-							
	Success Based			0	4,234,460	2,492,973	733,766	517,053	743,823	527,000	85,159	84,716	75,401	88,707	88,707	88,707	88,707	88,707	88,707
	Network Capital Replacment				521,990	745,939	969,944	1,184,676	1,398,364	1,611,788	1,816,824	2,006,181	2,179,683	2,333,947	2,466,571	2,575,671	2,660,494	2,721,418	2,759,982
	TOTAL			**44,357,906**	**4,756,451**	**3,238,912**	**1,703,710**	**1,701,730**	**2,142,187**	**2,138,788**	**1,901,983**	**2,090,896**	**2,255,085**	**2,422,655**	**2,555,278**	**2,664,378**	**2,749,201**	**2,810,125**	**2,848,689**
				27,836,501	-	-	-	-											

Unit	Item			Year 0	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10	Year 11	Year 12	Year 13	Year 14	Year 15
FCF	Raw			(27,836,501)	211,429	3,567,089	7,948,655	8,340,053	8,861,415	9,844,265	10,485,953	10,292,358	10,124,839	9,954,488	9,819,308	9,707,549	9,620,211	9,556,777	9,515,538
	PV			(27,836,501)	201,627	3,093,584	6,269,123	5,982,012	5,780,252	5,839,723	5,656,947	5,049,570	4,517,446	4,039,141	3,623,399	3,257,693	2,935,962	2,652,422	2,401,761

Debt Service Coverage Ratio				**0%**	**168%**	**783%**	**1076%**	**741%**	**802%**	**866%**	**893%**	**893%**	**893%**	**893%**	**892%**	**892%**	**892%**	**892%**	**892%**
Assumed Loan Balance (accumulated capital less accumulated depr				**16,521,404**	**16,521,404**	**16,521,404**	**16,521,404**	**16,521,404**	**15,935,807**	**15,315,073**	**14,657,095**	**13,959,638**	**13,220,334**	**12,436,672**	**11,605,990**	**10,725,468**	**9,792,113**	**8,802,758**	**7,754,041**

Present value of cash flows - Initial Deployment	**(27,836,501)**
Present value of cash flows - Post Deployment	**81,083,406**
Present value of 30 year cash flow	**53,246,905**
Terminal Multiple	9.92
Present value of terminal value	**6,289,399**
NPV	**59,536,304**

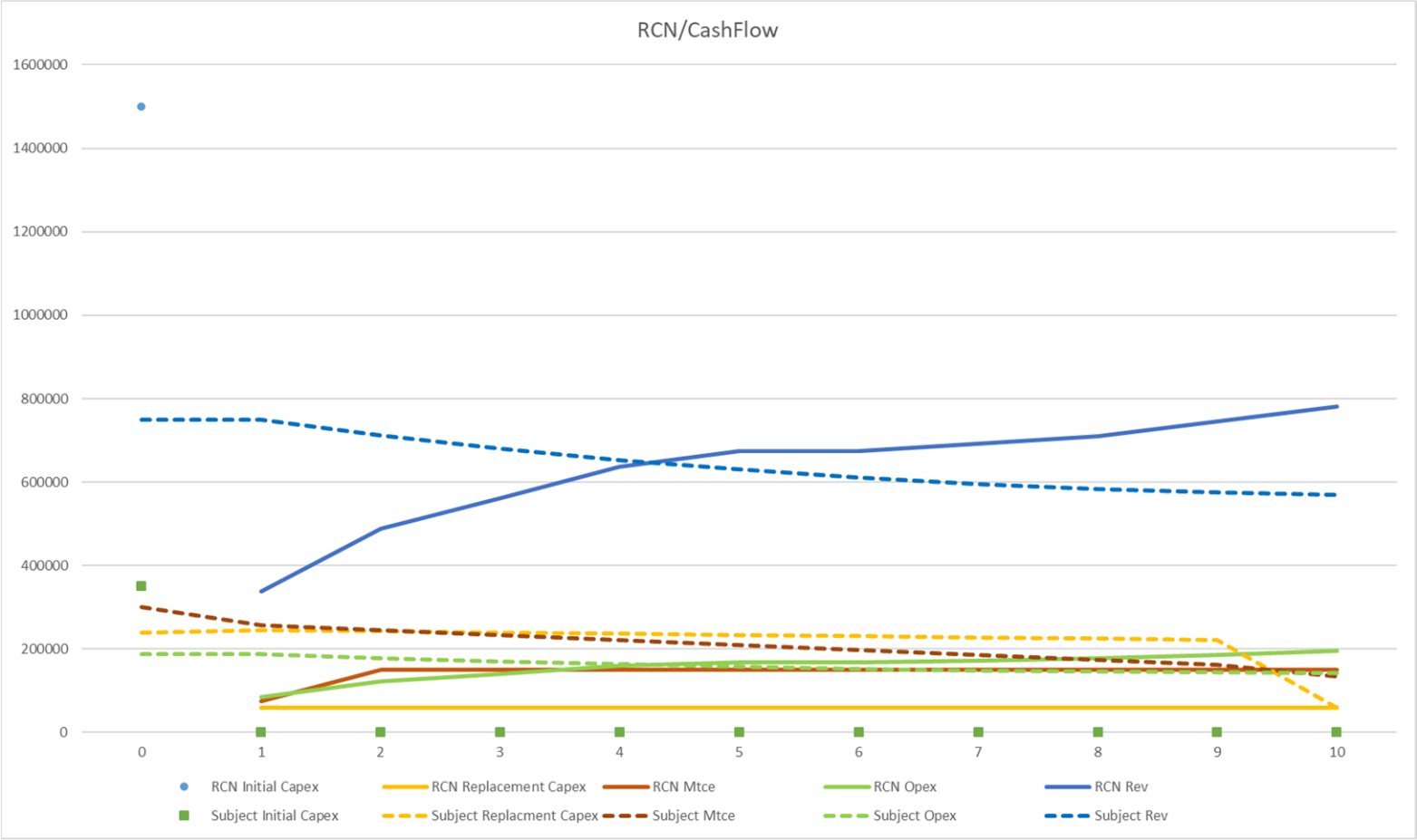
View truncated to first 15 years

And from the view of Valuation, what do we base the Value on

- In the replacement cost approach, the appraiser is comparing the Subject Property to its most likely Replacement
  - From the American Society of Appraisers, Valuing Machinery and Equipment: The Fundamentals of Appraising Machinery and Technical Assets, Third Edition, 2011
    - The replacement property would be the most economical new property replacing the service provided by the Subject Property.
    - This recognizes that prudent buyers will not pay more for a property than the cost of acquiring a substitute property of equivalent utility taking into consideration all physical depreciation, as well as any functional and external obsolescence present in the assets in arriving at a reasonable determination of Fair Market Value.41 Thus, the ReplCN is generally the proper starting point
- In short, what option, that is available in the market, provides the greatest value

… FTTp is the likely choice – The choice of most experts…the choice that typically provides the greatest value

The Decision: Cash Flows



Additional concepts to consider

- When choosing the replacement plant, we need to:
  - Estimate the initial capex
  - Review the differences in ongoing capex between the replacement and the subject
  - Review the differences in operational cost between the replacement and the subject
  - Review the differences in revenue between the replacement and the subject

  … in short, understand the cash flow differentials

- In the case of Cable systems, if we use an FTTP replacement, we now need to look at
  - Coax cost of removal
  - Power cost savings
  - Operational cost savings
  - Lost revenue

  … in short, additional forms of obsolescence

HOWEVER…

Are there additional obsolescence adjustments with FTTp