FTTP Feasibility Study

for

The City of Hillsboro, Oregon

June 2015

[redacted], LLC

[redacted], Principals

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- Technology Strategy & Sample Designs
- Business Strategy & Business Structure Analysis
  - Baseline Case
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- Pro Forma Results & Funding Requirements
  - Sensitivity Analysis
  - Funding Plan
- Timeline & Next Steps

Quantitative Survey

Current Broadband Services Usage

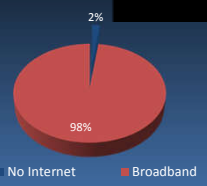
DESIGN FRAMEWORK

- Area of Interest: Universe of ≈ 36,000 households (HHs)
  - Total sample size of 403 respondents
  - 95% Confidence Interval with ± 4.9 sample error)
- Results weighted to reflect Hillsboro actual age distribution from 2010 Census data.
- Respondents screened to ensure
  - Decision-maker for telecommunications and entertainment services in the home
  - Respondents with immediate family members employed by any of the following were excluded:
    - The City of Hillsboro
    - Frontier
    - Comcast

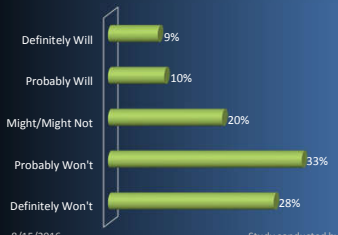
INTERNET SERVICE PURCHASING BEHAVIOR

- 98% of Hillsboro households use the Internet at home
- Cable Modem and DSL have the vast majority of market share at 96%

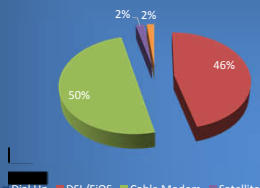
Incidence of Internet Households



Q17: *"How likely are you to upgrade your Internet service speed…"*



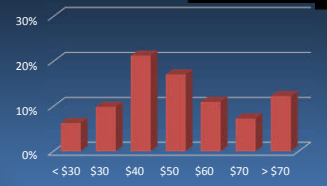
Internet Market Share *(Households)*



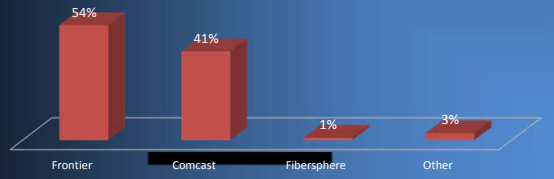
INTERNET SERVICE PURCHASING BEHAVIOR

- Comcast and Frontier are the only two ISPs with material market share in Hillsboro
- *Stated* average monthly Internet spend is $43 per household

Monthly Internet Spend



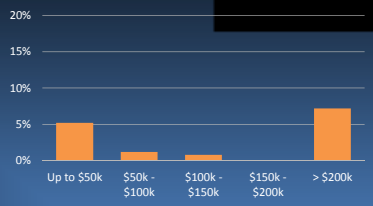
Internet Access Provider



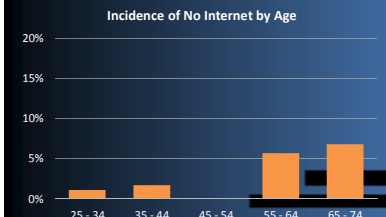
INTERNET USAGE BY HOUSEHOLD DEMOGRAPHIC

- The use of Internet in the home drops off at lower income levels (non-pays)
- Internet usage is prevalent across all age groups

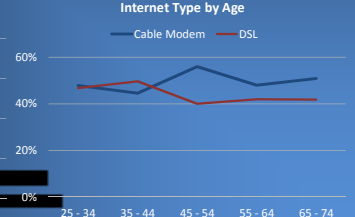
Incidence of No Internet by Income



Incidence of No Internet by Age



Internet Type by Age

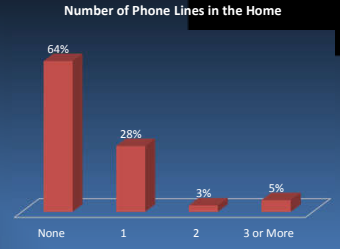


WIRELINE PHONE MARKET SHARE

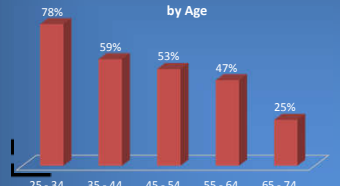
- The average number of lines is:
  - All Households: 0.5
  - Wireline Households: 1.2
- Wireless substitution is higher than the national average
- A further 12% of wireline phone users will drop for wireless in the next 12 months

Q12: *"How likely are you to disconnect the wired phone line and only use your cell…"*

Number of Phone Lines in the Home



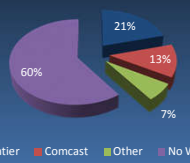
Households Without Wireline Phone Service by Age



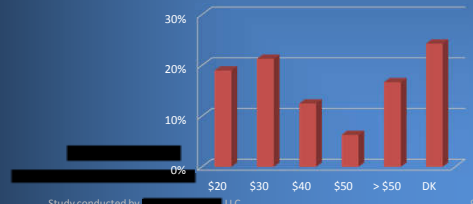
VOICE SERVICES USAGE

- Frontier still maintains market share leadership of the residential voice market
- *Stated* residential spending on local phone service averages about $29 monthly per HH

Q8: *"Who is your local phone service provider?"*



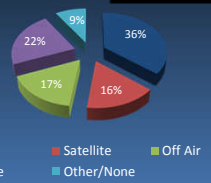
Monthly Local Phone Spending



VIDEO SERVICES PURCHASING BEHAVIOR

- Only 52% of households use traditional pay TV (cable or satellite dish)
- In Hillsboro today, 22% of households are using online video
- Another 17% are using Off Air reception without supplemental Pay TV service
- *Stated* average monthly spend:
  - Cable: $59
  - Satellite: $79

Q2: *"For TV service, do you have…"*

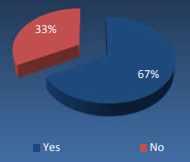


Monthly Pay TV Spend

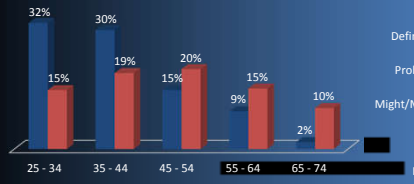
EMERGING VIDEO SERVICES

- Over-the-Top (OTT) or online TV viewing has recently become a material substitute service for traditional cable TV with a majority of households using OTT
- Among younger households, up to 32% are using OTT as a substitute service
- Uptown estimates a further 10% of pay TV users in Hillsboro will 'cut the cord' in the next 12 months

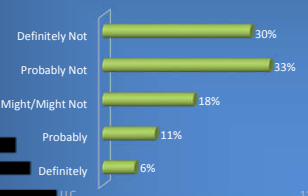
Q6: *"Do you sometimes watch TV online?" (Among Pay TV Households)*



Households Watching TV Online In Place of Pay TV by Age



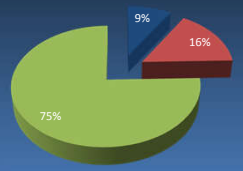
Likelihood of Cancelling Pay TV for OTT *(among all pay TV users)*



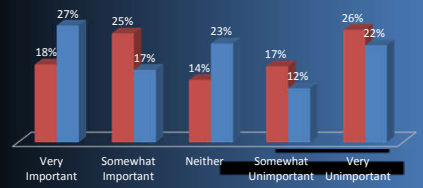
BUNDLING

- Across all households in Hillsboro , 16% have all 3 services from a single provider
- The importance of bundling is low, especially compared to a recent Cleveland TN survey

Incidence of Triple Play Bundle

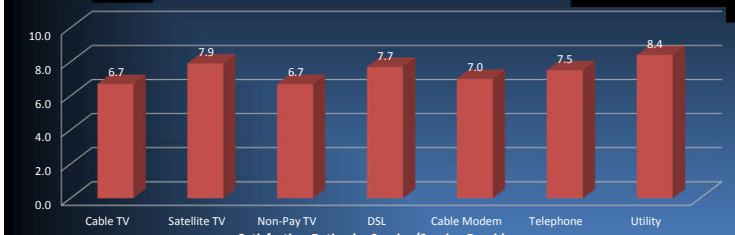


Importance of Having All 3 Services from a Single Provider *(Among All Respondents)*

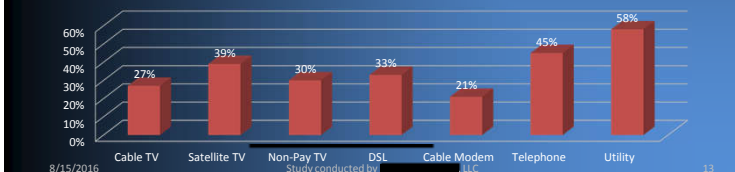


SATISFACTION RATINGS

Satisfaction Rating by Service/Service Provider
(Mean Rating on a 1-10 Scale)



Satisfaction Rating by Service/Service Provider
(Percent Rating a '9' or '10')

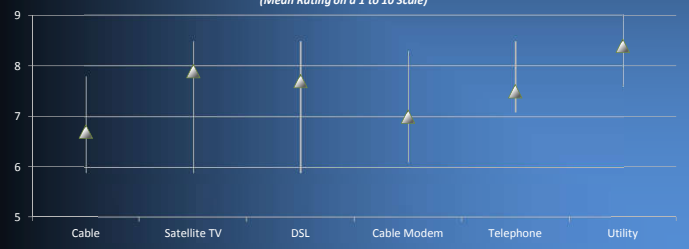


SATISFACTION RATING BENCHMARKS

- The chart below compares the results of this study with 22 other markets where [redacted] has completed similar quantitative research:

Ohio (3)	*Washington (state)*	*North Carolina*	*Oregon*
California	*Wisconsin*	*Kansas (2)*	*Alabama*
Georgia	*Oklahoma (2)*	*New York*	*Arkansas*
Tennessee (3)	*Michigan*	*Kentucky*	*Colorado (2)*

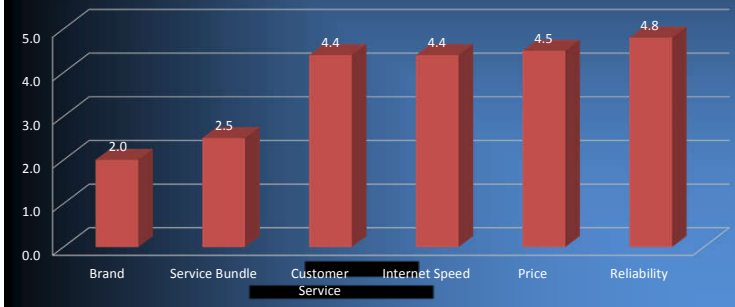
Satisfaction Rating by Service/Service Provider
(Mean Rating on a 1 to 10 Scale)



ATTRIBUTE IMPORTANCE

- While reliability and price are always important, Internet speed has dramatically increased in importance over the last several years. Bundling and Brand are secondary in importance to other attributes…

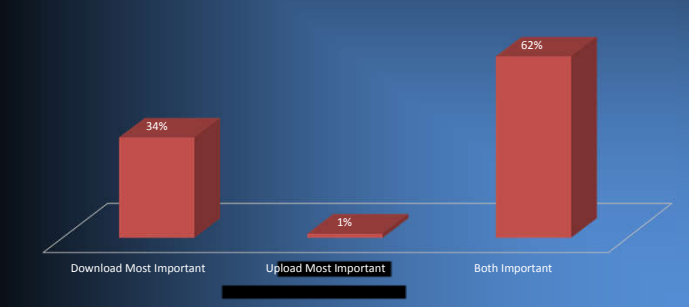
Importance Rating of Select Broadband Service Attributes
(Mean Rating on a 1-5 Scale)



IMPORTANCE OF DOWNLOAD VS. UPLOAD

- Question 32: "What aspect of Internet speed is most important?"

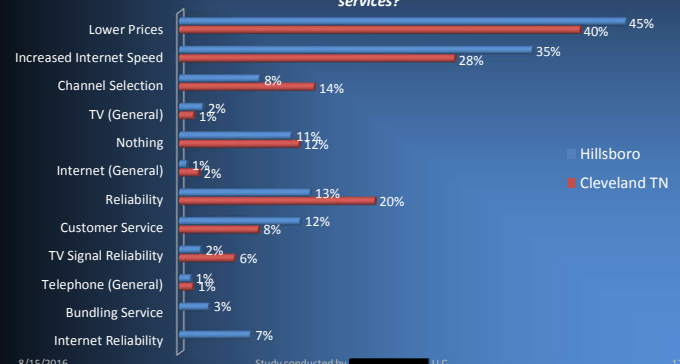
Importance of Internet Speed on Download vs. Upload



CUSTOMER NEEDS

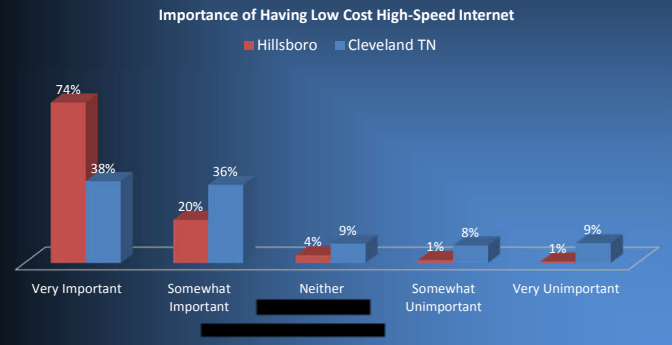
- Lower prices and increased Internet speed dominate the wish list for services improvement as Internet speed has gained importance…

Q31: *"What would you like to see most improved from your current broadband services?"*



IMPORTANCE OF LOW COST HIGH-SPEED INTERNET

- Question 30: "In your opinion, is the availability of low-cost, high-speed Internet important to the future local economy?"



Quantitative Survey

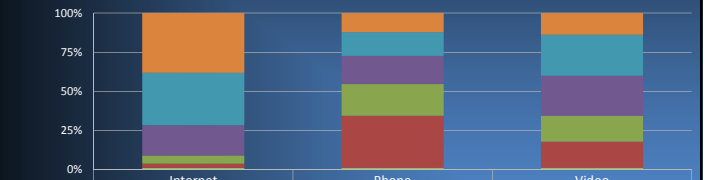
FTTP Market Potential

[redacted]

PURCHASE INTENT

- 72% of respondents indicated they would definitely or probably switch to the FTTP system for Internet service…

Q25-27: *"How likely would you be to subscribe to* [insert service] *if it were 10% less than Comcast or Frontier charges?*



	Internet	Phone	Video
Definitely	38%	12%	14%
Probably	34%	15%	26%
Might/Might Not	19%	18%	26%
Probably Not	5%	20%	17%
Definitely Not	3%	[redacted] 33%	17%
Don't Know	1%	[redacted] 1%	1%

PENETRATION CALCULATIONS

- [redacted] uses a 'Likert Scale' with Overstatement Adjustment
  - Conservative research techniques from the Packaged Goods sector
  - Clearly specify purchase intent vs. "interest" and removes overstatement bias
- Example: "How likely would you be to subscribe?"
  - Definitely Would 21.5% x 70% = 15.0%
  - Probably Would 35.6% x 30% = 10.7%
  - Might/Might Not 20.0% x 10% = 2.0%
  - Probably Would Not 10.4% **27.7%** = Penetration Estimate
  - Definitely Would Not 4.4%
  - Don't Know 8.1%

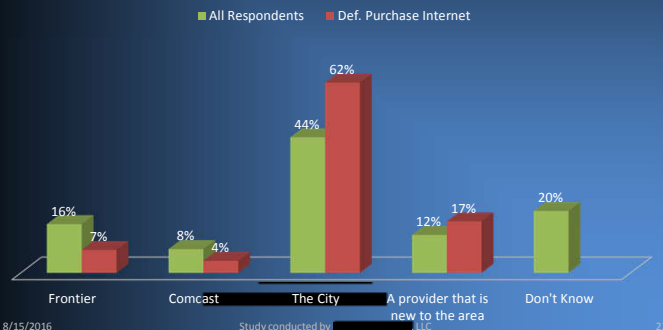
	Residential (Terminal / Year 5 Eroded)	Small Business
Video	20.1% / 17.1%	0%
Internet	38.7%	30%
Telephone	14.9% / 11.9%	25%

8/15/2016 Study conducted by [redacted], LLC 21

PROVIDER PREFERENCE

- The majority of respondents, when given the choice, would prefer to receive high speed Internet from the City…

Q28: *"Among the following list of potential providers, who would you prefer to receive high-speed Internet service from?"*



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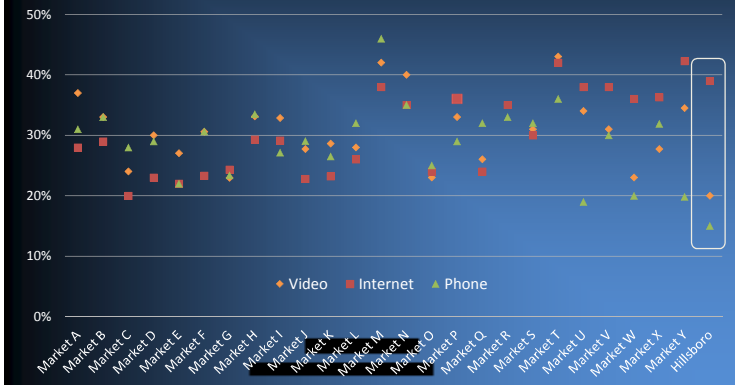
PURCHASE INTENT BENCHMARKING

Terminal Penetration by Service
(Across all Tested Price Points)



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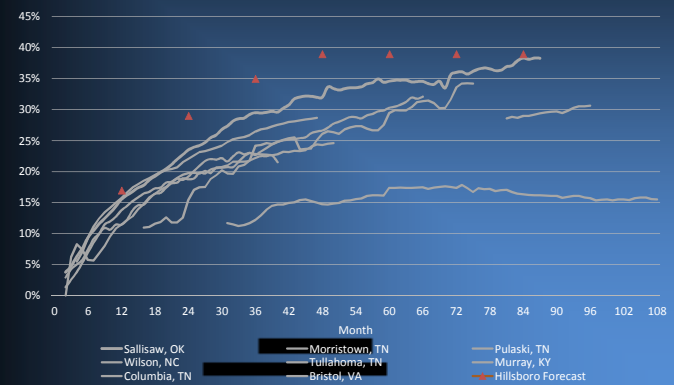
INTERNET PENETRATION OF MUNI OVERBUILDERS

Internet Penetration
(By Month Since Launch)



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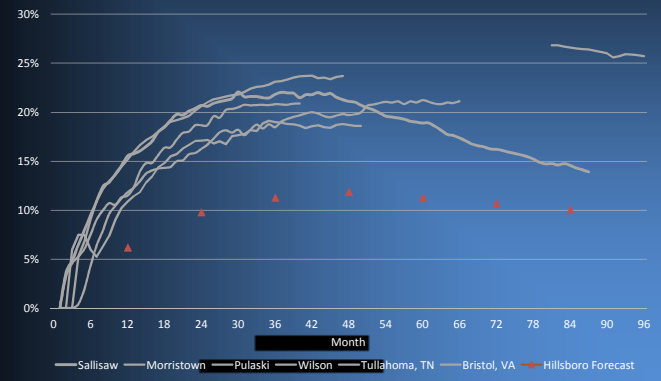
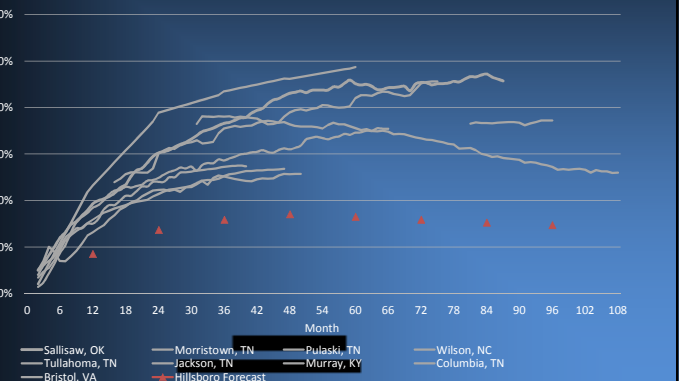
VOICE PENETRATION OF MUNI OVERBUILDERS

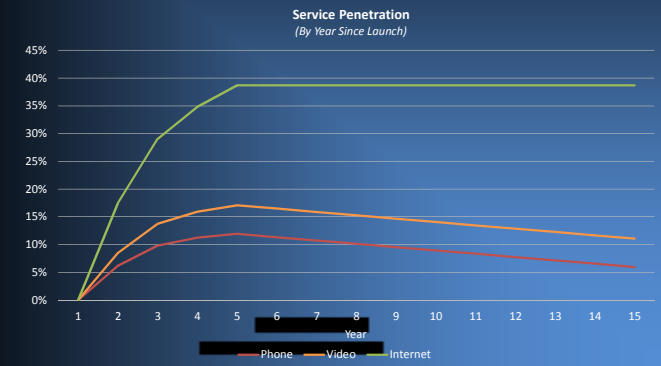


VIDEO PENETRATION OF MUNI OVERBUILDERS



PENETRATION FORECAST

- Business case projections for voice penetration reflect the quantitative research outcome and reflect ongoing wireless (voice) and OTT (video) substitution within the residential segment…



Depth Interviews

[redacted]

COMMERCIAL DATA NETWORK SERVICES MARKET

	Internet Access	Metro Ethernet (Transport)	Dedicated Internet (Access)
Connection Type	Standard Internet tiers up to 1G	Point-to-point transport from 1G to 10G	Dedicated access bandwidth from 100M to 10G
Market Segment	Non Data-Intensive Businesses	Data-Intensive Businesses	
Service Area Prospects	6,305 97% of Commercial)	195 (3% of Commercial)	
Percent of Segment	100%	25%	75%
Penetration	30% (Year 5)	5% (Year 8)	

[redacted]

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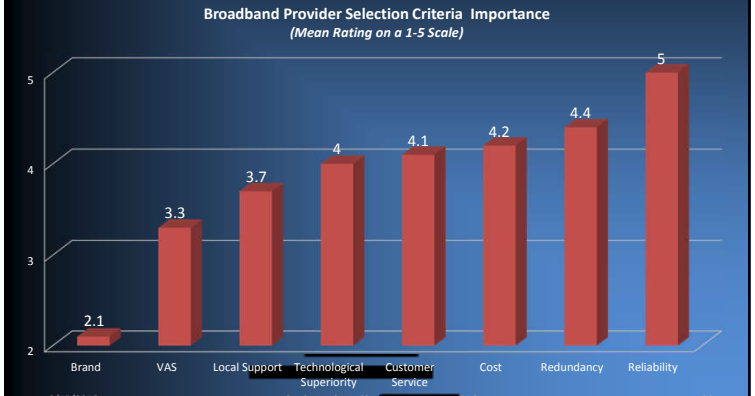
SERVICE PROVIDER SELECTION CRITERIA

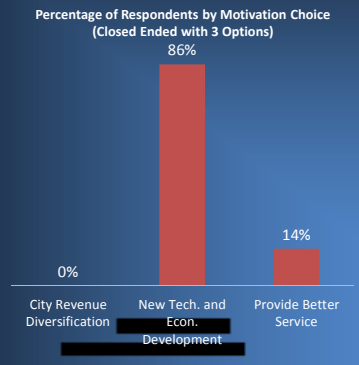


8/15/2016 Study conducted by [redacted], LLC 30

SATISFACTION SCORES

8/15/2016 Study conducted by [redacted], LLC 31

PERCEIVED MOTIVATION FOR FTTP



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PARTICIPANT BROADBAND UTILIZATION

	Current Bandwidth	Utilized Bandwidth	Desired Bandwidth	Out of Market Connections	Unmet Needs	Pricing (per Meg)	Opportunity for the City
Company A	50M	50%	1G	No	Price	$22.00	Yes. Want better pricing and provider diversity.
Company B	200	40%	NA	No	No	$18.00	No. Do not need additional bandwidth
Company C	200	50%	300	No	Price	DK	No. Would not be willing to switch to a non-Tier 1 provider regardless of price.
Company D	70	DK	NA	No	No	$3.29	No. 3.5 years remaining on contract. No unmet needs.
Company E	35	25%	100	No	Price	$ 5.71	Yes. Desire more bandwidth and lower price.
Company F	50	DK	100	No	No	$ 2.20	No. Would stay with Comcast unless their service performance drops
Company G	1000	90%	10G+	No	No	DK	Yes. Would prefer dark fiber.

SUMMARY OF OPPORTUNITY

- Limited market opportunity exists among larger institutions and business
  - The need for additional capacity was cited by 3 of 7 interview participants
  - Need for bandwidth is low among most participants. Except for the school system, the highest current bandwidth used is 200Mbps.
  - Market pricing is $2-$6/Mbps at lower bandwidth levels.
- The City will have a limited ability to serve some businesses for High Cap
  - Multi-location entities with locations outside of Hillsboro typically require a Tier 1 provider.
  - Entities with corporate purchasing divisions located outside of Hillsboro
- Pro forma includes conservative high cap services revenues
  - Eleven High Cap accounts by Year 10 of the plan
  - Monthly ARPU per account of $975

Network Architecture

FIBER TO THE PREMISES

- Why FTTP?
  - Gold standard for local broadband services distribution
  - Technology is far superior to any other option now and in the future
- Gigabit Passive Optical Network assumed for new network
  - 2.4 Gbps down / 1.2 Gbps up
  - GPON commercially available from multiple suppliers
  - Mature technology with millions of units shipped
  - System reach is 20 km from GPON equipment (OLT) location
- Splitting approaches
  - 1x4 and 1x8 splitters deployed in series throughout network
  - 1x32 splitters deployed in centralized cabinets
  - Best approach depends on the desire to limit splicing
- FTTP outside plant comprises the largest capital cost

REFERENCE ARCHITECTURE

- Network hub sites
  - Up to four new huts to house new FTTP backbone electronics
  - Small walk-in huts similar to cellular remotes
- Backbone
  - Connect huts with 144 fiber backbone
  - Fiber backbone to be used to backhaul network traffic to huts
- Feeder system
  - New feeder network connects each hub site to FTTP service areas
  - Feeder tap splice closures and cabinets connect feeder network to FTTP service areas
- Distribution system
  - New fiber network connecting feeder taps to drop terminals
  - Drop terminals placed near each home or business
  - New drops placed to premises only after subscriber order is received

Sample Designs

CAPITAL BUDGETING APPROACH

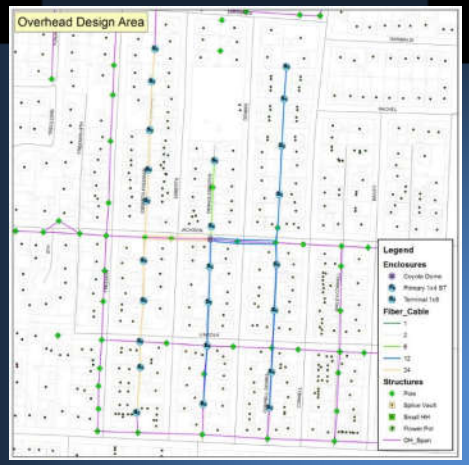
- Capital budget accuracy is critical
  - Funding estimates need to be close to what will actually be used
  - Unexpended bond amounts can cause arbitrage issues
  - Underfunding raises credibility issues with investors in latter rounds
- Uptown draws on many sources for each capital budget
  - Actual bid results from our latest FTTP implementations
  - Our role as the engineering firm for five other FTTP systems
  - Ongoing pilot projects and studies for other clients
- Sample designs are primary source for each study
  - Each community is different from outside plant perspective
  - Uptown selected representative areas
  - Single family home neighborhoods – overhead and underground
  - Uptown updated sample designs previous feasibility study
  - New costs used based on recent bid and build out experience
- Uptown used conservative assumptions for this process

CONSTRUCTION AND TECHNICAL SERVICES COSTS

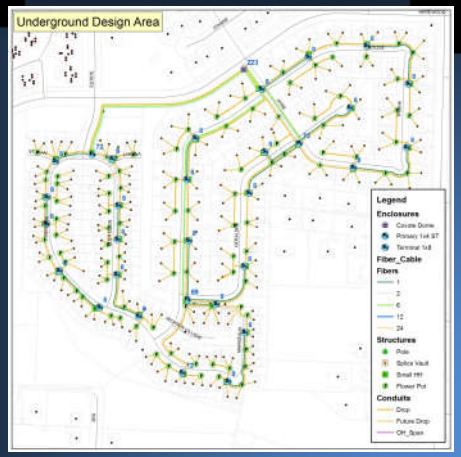
	Unit Cost*	Unit
Place New Strand and Lash Cable (Labor)	$2.00	Per Strand Foot
Underground Path Creation	$12.50	Per Path Foot
Average Drop Terminal Cost	$200.00	Each
Terminal Prep	$200.00	Per Closure
Splicing and Testing	$40.00	Per Splice
Poles Requiring Make Ready Rearrangement	50%	
Average Cost per Rearrangement	$500	Per Pole

* Unit cost inputs are based upon recent FTTP procurement actuals.

OVERHEAD SAMPLE DESIGN



UNDERGROUND SAMPLE DESIGN



DESIGN SUMMARY STATISTICS

	Overhead	Underground
Passings	205	223
Miles of Plant	1.4	2.6
Passings per Mile	86	66
Drop Closures	30	24
Passings per Closure	7.6	7.4
Total Labor per Passing	$95	$884
Total Materials per Passing	$65	$135
Total Cost per Passing	$160	$1,019
Weighting	20%	80%
Weighted Average Cost/Passing	$850	

[redacted]

Service and Market Mix Options

[redacted]

STRATEGY OPTIONS FOR THE CITY

	Most Active			Least Active
Video	Retail via Own Headend	Retail via Imported Video feed from Vubiquity	3rd Party RSP(s)	No Video Offering
Internet	Retail and directly source BW via own leased circuit	Retail and lease delivered BW via Tier 1 provider		-
Voice	Retail as own CLEC	Retail by reselling wholesale voice via CLEC		No Voice Offering

= Traditional municipal broadband model

MARKET TRENDS FOR MUNICIPALS

		Outlook	Key Trends
Video	Revenue	↓	Pay TV subscription peaked in 2010. To date, an estimated 7.6M homes have cut the cord.
	Margin	↓	Continued decline due to industry concentration from 40% down to 10-20%
	Capital	→	Opportunity to decrease HE investment via shared HE and terrestrial delivery. STBs still costly.
Internet	Revenue	→	ARPU flat. Usage-based pricing could be a game changer.
	Margin	↑	Improved due to lower bandwidth costs to 90% margin.
	Capital	↓	Lower ONT cost. Capacity upgrades among incumbents will drive 10G standard.
Voice	Revenue	↓	Ongoing erosion of market share from wireless substitution.
	Margin	→	
	Capital	→	

OPTION ANALYSIS SCENARIOS

- Baseline Case
  - the City serves as Retailer
  - Video, Internet, and Voice
- Service Mix Options - Video
  - Own video headend for direct satellite feed
  - Own video hubsite for terrestrial feed (eliminates video headend)
  - No Video
- Service Mix Options - Internet
  - Delivered Bandwidth
  - Direct Access
- Business Structure Options - Wholesale
  - the City builds/operates FTTC wholesale network
  - Third Party operator serves as Retail Service Provider (RSP)
  - Evaluate wholesale fee outcomes (equivalent to Retail Case results)
  - Identify RSP financial outcomes using target City wholesale rates
- Sensitivity Analysis
  - Retail & Wholesale Cases: 20% reduction in Internet penetration to 31.0%

Concept & Option Analysis

Baseline

VIDEO COMPETITION

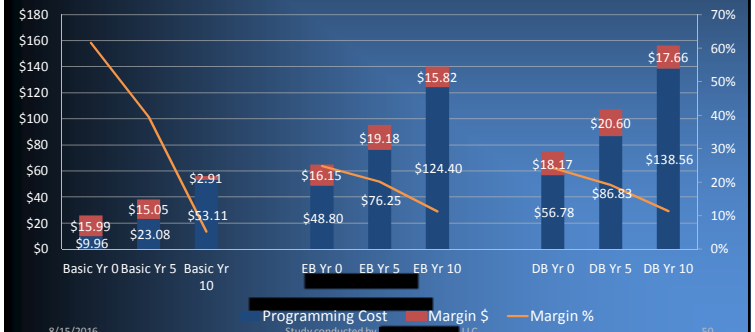
Service Package	*Comcast* [1]	*The City (Year 0)*	*Discount to Comcast*
Basic	$25.19	$25.95	-
Expanded Basic	$72.49	$64.95	10%
Digital Basic	$90.99	$74.95	17%
Digital Tiers	Sports: $9.99 Latino: $16.95	Sports: $10.00 Latino: $10.00	
Premiums	$19.99 each	$20.00 each	
DB + 2 Premiums *$2 discount*	$124.49 HBO/Starz	$112.95	
DB + 3 Premiums *$5 discount*		$124.95	
DB + 4 Premiums *$9 discount*	$144.49 All premiums + Sports	$145.95	
Set Top Box Fee HD/HD with DVR	$10.00 / $19.95	$7.95 / $17.95	
Whole Home DVR	$19.95	$19.95	

[1] All Comcast package rates include a Broadcast TV surcharge of $1.50/mo.

VIDEO GROSS MARGIN

- The pro forma includes programming cost increases and pricing increases of 6% and 8% annually respectively. Despite this, video gross margin will continue to substantially deteriorate over time…

Price and Programming Cost by Video Package
(Proposed City Video Services in Years 0, 5, and 10)



INCUMBENT RESIDENTIAL INTERNET PRICING

	Download	Upload	Price Internet Only / Bundled	Technology
Comcast	3M 6M 50M 100M 150M	768K 1M 10M 20M 20M	$39.95 / $29.95 $49.95 / $49.95 $66.95 / $53.95 $78.95 / $65.95 $114.95 / $99.95	Cable Modem (DOCSIS 3.0)
Frontier (FiOS)*	30M 50M	30M 50M	$34.99 (24 mos.) $59.99 (24 mos.)	Fiber
WildBlue	12M (10G Cap) 12M (15G Cap) 12M (25G Cap)	3M 3M 3M	$49.99 $79.99 $129.99	Satellite

Prices reflect subscription to Internet service. Frontier pricing per rate card provided at Beaverton retail location. Comcast pricing from comcast.com as of May2015 and published 'Product s and Services Price List'. WildBlue rates per wildblue.com effective November 2014.

*FiOS is not available in all areas of Hillsboro. Pricing valid for 24 months only.

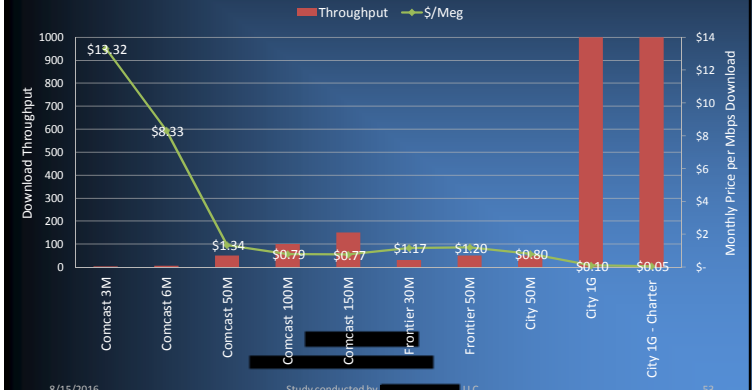
PROPOSED RESIDENTIAL INTERNET PRICING

City	Comcast	Discount
50M / 50M Tier $39.95	Comcast 50M / 10M $66.95 / $53.95	40% 26% if Bundled
1G / 1G Tier $99.95	-	-
1G / 1G Charter Member $49.95	-	-
WiFi ONT Upgrade (80211.ac) $7.95	$10.00	20%

Note: Prices reflect providers single-service Internet rate card pricing unless noted.

RESIDENTIAL INTERNET VALUE

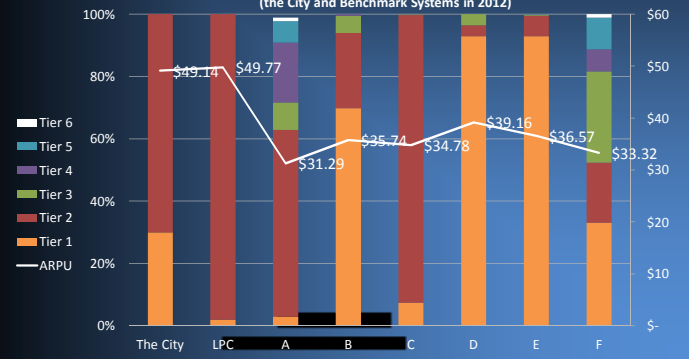
Internet Downstream Throughput and Price per Mbps
(Incumbents and Proposed City Tiers)



INTERNET ARPU BENCHMARKS

The City should follow LPC's Gigabit pricing and Charter member strategy to maximize ARPU…

Internet Dispersion and ARPU
(the City and Benchmark Systems in 2012)



INCUMBENT COMMERCIAL INTERNET PRICING

	Download	Upload	Price Rate Card / Promo	Technology
Comcast	16M 50M 75M 105M 150M	3M 10M 15M 20M 20M	$69.95 $109.95 $149.95 $199.95 $249.95	Cable Modem (DOCSIS 3.0)
Frontier	Up to 7M Up to 15M Up to 20M	NA	$49.98 (24 mos.) $69.98 (24 mos.) $99.98 (24 mos.)	DSL & FTTC

Comcast pricing from comcast.com as of May2015 . Frontier prices from frontier.com.

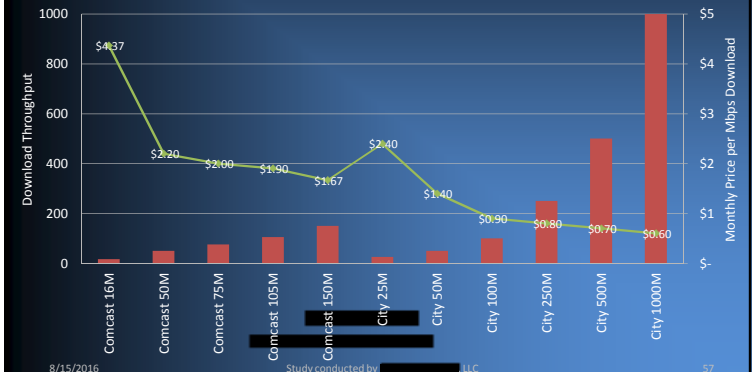
PROPOSED COMMERCIAL INTERNET PRICING

City Download / Upload	City Price	Incumbent Comparable	Incumbent Price	Discount
25M / 5M	$59.95	Comcast 16M	$69.95	14%
50M / 10M	$69.95	Comcast 50M	$109.95	36%
100M / 20M	$89.95	Comcast 105M	$199.95	55%
250M / 50M	$199.95	-	-	-
500M / 250M	$349.95	-	-	-
1G / 500M	$599.95	-	-	-

Note: Prices reflect providers single-service Internet rate card pricing.

COMMERCIAL INTERNET VALUE

Internet Downstream Throughput and Price per Mbps
(Incumbents and Proposed City Tiers)



COMMERCIAL DATA NETWORK SERVICES

- High capacity network services should be offered by the City for point-to-point transport and access to the service provider and medium-large business segments. Tier pricing from other markets provides a target price range in lieu of incumbent tariffs/rate cards for these services…

	Service Description	Service Terms	Tiers	Avg MRC
Metro Ethernet (Transport)	A private circuit with dedicated capacity between 2 or more client locations	• Targeted contract term of 3 years with auto-renewal • Incremental construction cost recovered during the initial term • Minimum capacity commitment with potential for increase(s) during the term • Protected route options • SLA metrics for latency, availability, and packet loss • No mileage component for competitive advantage	100M to 10G	$1,500
Dedicated Internet (Access)	Dedicated, symmetrical bandwidth for end user or service provider access needs		100M to 1G	$800

VOICE PROVIDER ROLE

Function	Operational Responsibility	the City	CLEC
Capital	Local Loop and Premises NIU	✓	
	Fiber MUX, Transport, and Switch		✓
Interconnect	LNP, Operator Services, PSAP, IC Agreements		✓
Marketing & Sales	Advertising, Sales	✓	
	Brand, Pricing	✓	✓
Provisioning	Work Order Creation	✓	
	Bell Processes		✓
	Switch Provisioning		✓
	Customer Install	✓	
Billing	Bill Fulfillment	✓	
	Call Detail Record (LD), Taxes & Fees		✓
Internet	Backbone [redacted] Interconnection		✓

RESIDENTIAL VOICE SERVICES WITH INTERNET

		Frontier	Comcast	City
Package	Line & Features		-	-
	Line, Features, and Unlimited LD	$27.99 (24 mos.)	$39.95	$28.00
Subscriber Line Charge		Yes	No	$6.50

Frontier prices from frontier.com Comcast pricing from comcast.com as of May2015 and published 'Product s and Services Price List' and reflects subscription to Internet service as well.

COMMERCIAL VOICE EXCHANGE SERVICES (PER LINE)

	Service	Comcast	City
Line & Feature Packages	Access Line & Feature Package (CID, CF,3Way)	-	-
Line, Features, & Unlimited LD		2 Year: $29.95	Monthly: $29.95 2 Year: $24.95 3 Year: $22.95

VOICE ARPU

		City Retail	Wholesale Rate	City Share	Dispersion	SLC	Contribution per Line
Residential	Unlimited local & LD	$28.00	$10.00	$18.00	100%	$6.50	**$24.50**
Commercial (Unl. LD)	Business Package (Monthly)	$29.95	$12.00	$17.95	40%		-
	Business Package (2 Year)	$24.95	$12.00	$12.95	20%		-
	Business Package (3 Year)	$22.95	$12.00	$10.95	40%		-
	Total Commercial					$6.50	**$20.65**

Financial Analysis

Baseline Pro Forma

OPEX OVERVIEW

- COGS (previous slides)
- Staffing (detail next slides)
- Marketing & Sales
  - Based on template campaign budget for Years 1-3 (launch campaigns peaking at $260k in Year 2) and then 1% of revenue annually.
- Billing
  - 80% of residential and 50% of commercial customers are paperless billing in Year 1 with monthly cost of $.75 each.
- Professional Services/Franchise Fee/Pole Attachment
  - Legal and accounting is $30k in Year 1. Ongoing legal of $5k annually.
  - Franchise fee equal to 3.5% of total annual revenues
  - Pole attachment of $13 per pole/year
- Annual Maintenance
  - Averages 15% annually for OSS/BSS, video middleware, and conditional access system. FTTP electronics is $25k annually.

FTE LEVELS: MANAGEMENT EMPLOYEES

- Dedicated 'Broadband' Positions
  - NOC Manager
  - Marketing/PR Coordinator
  - MDU Account Manager
  - Commercial Account Rep
  - Headend Technician
  - Data Technician
  - Field Ops Supervisor
- Positions funded at City wage scale midpoints (Step 4) and 50% benefits loading
- Non-dedicated management staffing indirect costs not allocated to Broadband (incremental cash view)

FTE LEVELS: DEDICATED FRONTLINE EMPLOYEES

- Customer / Technical Service Representatives (CSRs/TSRs)
  - CSRs handle inbound/office sales, order entry and first tier support
  - TSRs handle all second tier customer support, dispatch and service provisioning
  - Staffed at 1 FTE per 2k accounts growing to 4k by Year 5, but with minimum of 3 FTE each for CSR and TSR positions to ensure phone coverage
- Install Technicians
  - Installs are 2-phase with pre-install followed by separate premise install
  - Pre-Installs completed by contractor at fixed rate (100% Years 1-3 and 50% Year 4) and then insourced
  - Each Install Tech can complete 3/day growing to 4/day by Year 5
- Service Technicians
  - Service techs fix subscriber problems
  - FTE based on the number of truck rolls related to service and churn
- Maintenance Technicians
  - Network techs maintain the fiber system from the backbone to the network access point. Network tech is most senior tech in the line crew
  - 1 per 1,000 plant miles

INCREMENTAL BROADBAND FTE REQUIRED

- CSR and TSR headcount levels are driven by phone coverage and scheduling needs versus customer demand…

Position Title	Range	Midpoint	Year1	Year2	Year3	Year4	Year5
NOC Manager	41	$115k	1.0	1.0	1.0	1.0	1.0
Marketing /PR Mgr.	32	$81k	0.5	1.0	1.0	1.0	1.0
MDU Account Rep	30	$75k		1.0	1.0	1.0	1.0
Comm. Acct Rep	30	$75k		1.0	1.0	1.0	1.0
Headend Tech	36	$95k	0.5	1.0	1.0	1.0	1.0
Data Tech	36	$95k	0.5	1.0	1.0	1.0	1.0
Field Ops Supervisor	21	$53k			1.0	1.0	1.0
CSRs	19	$49k		3.0	5.0	5.0	5.0
TSRs	21	$53k		3.0	5.0	5.0	5.0
Install Techs	17	$45k		4.0	9.0	5.0	4.0
Maintenance Techs	21	$53k		1.0	1.0	1.0	1.0
Service Techs	19	$49k		1.0	3.0	3.0	3.0
Total Headcount			**2.5**	**18.0**	**30.0**	**26.0**	**25.0**

CAPITAL OVERVIEW

- FTTP Network Construction
  - Outside Plant: $39.3M
  - Make ready construction: $3.1M
  - Ring enhancement to Hillsboro Data Center: $60k
- Land & Building
  - Floor space for equipment & FTEs: $400k (w/ video) or $200k (w/o video)
- Software
  - OSS/BSS: $300k
  - Fiber Management & Network Management: $250k
  - Middleware/CAS (video only): $820k
- Professional Services
  - Implementation support: $360k

CAPITAL OVERVIEW (CONT.)

- Fixed Equipment
  - Backbone electronics and core HE switch: $600k
  - Video HE system: $1.75M
  - Internet systems back office: $125k
  - Field Tech Equipment/Tools: $242k
- Vehicles
  - Bucket trucks (non-insulated): $360k (4 at $90k/ea.)
  - Service vans: $405k (9 at $45k/ea.)
- Contract Labor
  - Pre-Installs: $2.8M (first 3 years at $200/ea.)
- Year 7 & 10 Network Upgrades
  - Year 7 ONT upgrade: $700k ($40/ea.)
  - Year 10 Network electronics upgrade: $3.6M ($75/premise passed)

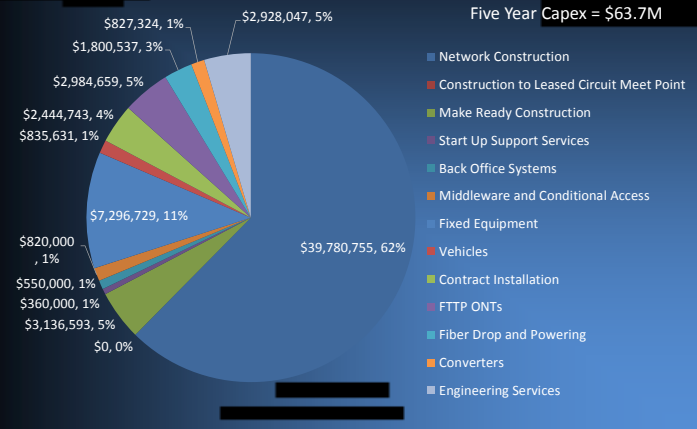
CAPITAL OVERVIEW (CONT.)

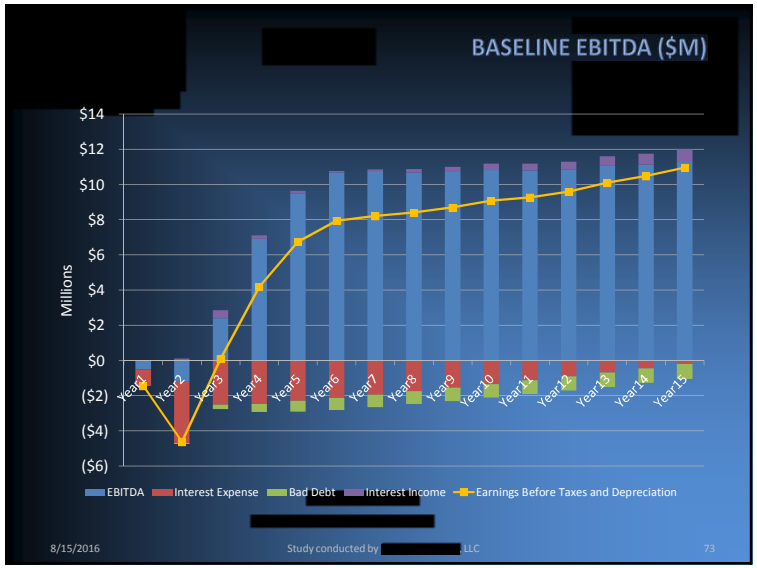
- ONT's
  - Non-WiFi: $1.48M for years 1-4 ($140/ea.)
  - WiFi 80211.ac: $1.1M for years 1-4 ($240/ea.)
- Fiber drop and ONT powering
  - Fiber drop and connectors: $1.2M for years 1-4 ($75/ea.)
  - Power cord and UPS: $385k for years 1-4
- Set Top Boxes
  - HD and HD/DVR set tops: $730k for years 1-4 ($100/ea. and $225/ea. respectively)
- Engineering and Integration
  - Walk out: $577k
  - Make ready engineering: $577k
  - FTTP design: $1.055M
  - Headend design and integration: $200k

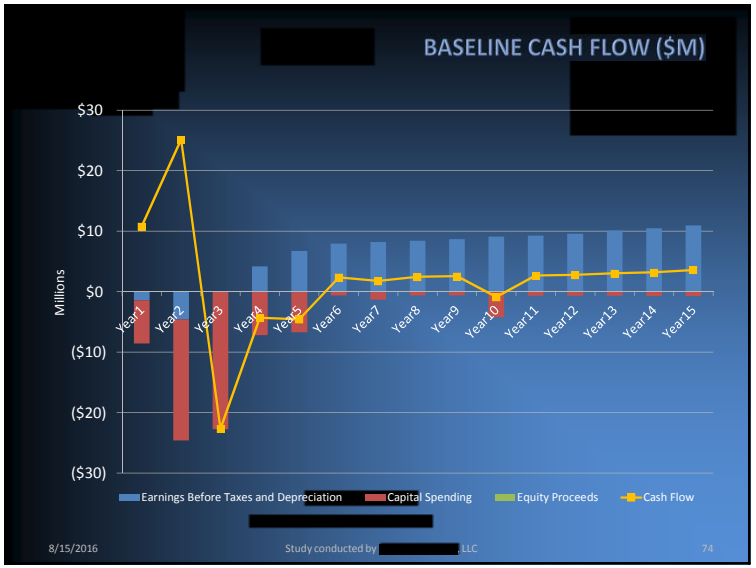
PROJECT FINANCING

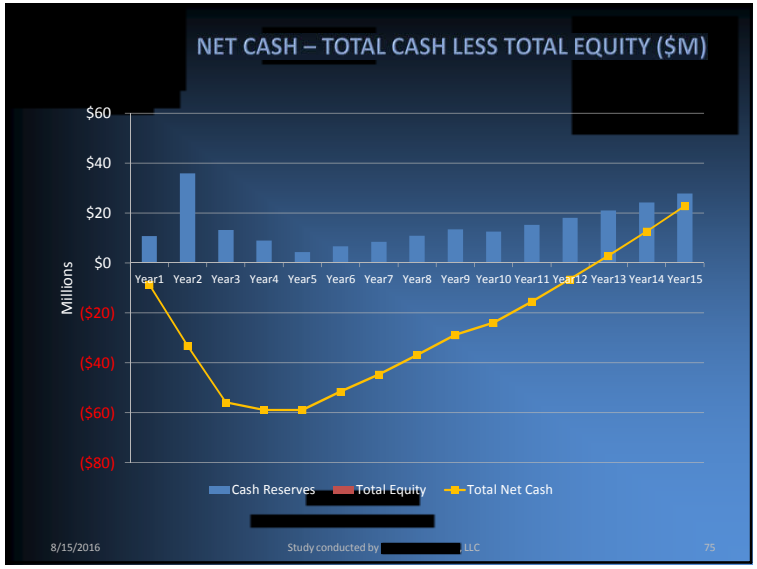
- Long term financing
  - Two rounds of financing assumed over the first two years
  - Three years interest only
  - 12 years of level payments
  - 2.0% issuance, $0 reserve requirement
  - Interest rate – 3% for Round One and 4% for Round Two
- Short term financing
  - Provides for cash needs not covered by long term financing
  - Balance accumulates over first five years including interest
  - Level payments begin in year six over ten year payment plan
- Start-up period included as Year 1 of the business case
  - No revenues assumed during first year of the plan
  - Technical trial underway at the end of the first year with 100 testers
- Other assumptions
  - Bad debt = 3% of gross revenues
  - Overhead loading of 50%
  - 1%/2%/3% interest on cash reserves in year1/year5/year10 respectively
  - Discount rate = 5% for present value calculations
  - 10 billable months in year2

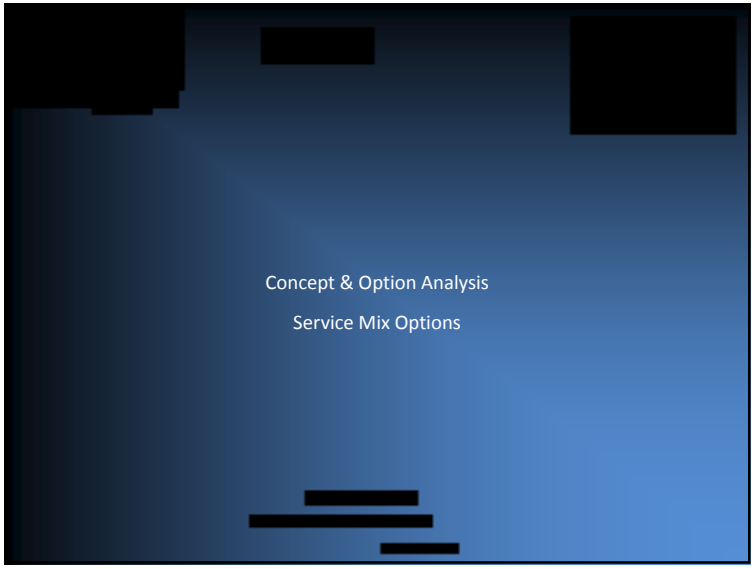
BASELINE CAPEX – 1ST FIVE YEARS




BASELINE EBITDA ($M)
Millions
$14
$12
$10
$8
$6
$4
$2
$0
($2)
($4)
($6)
Year1 Year2 Year3 Year4 Year5 Year6 Year7 Year8 Year9 Year10 Year11 Year12 Year13 Year14 Year15
EBITDA
Interest Expense
Bad Debt
Interest Income
Earnings Before Taxes and Depreciation
8/15/2016
Study conducted by [redacted], LLC
73


BASELINE CASH FLOW ($M)
Millions
$30
$20
$10
$0
($10)
($20)
($30)
Year1 Year2 Year3 Year4 Year5 Year6 Year7 Year8 Year9 Year10 Year11 Year12 Year13 Year14 Year15
Earnings Before Taxes and Depreciation
Capital Spending
Equity Proceeds
Cash Flow
8/15/2016
Study conducted by [redacted], LLC
74


NET CASH – TOTAL CASH LESS TOTAL EQUITY ($M)
Millions
$60
$40
$20
$0
($20)
($40)
($60)
($80)
Year1 Year2 Year3 Year4 Year5 Year6 Year7 Year8 Year9 Year10 Year11 Year12 Year13 Year14 Year15
Cash Reserves
Total Equity
Total Net Cash
8/15/2016
Study conducted by [redacted], LLC
75


Concept & Option Analysis
Service Mix Options

BANDWIDTH SOURCING

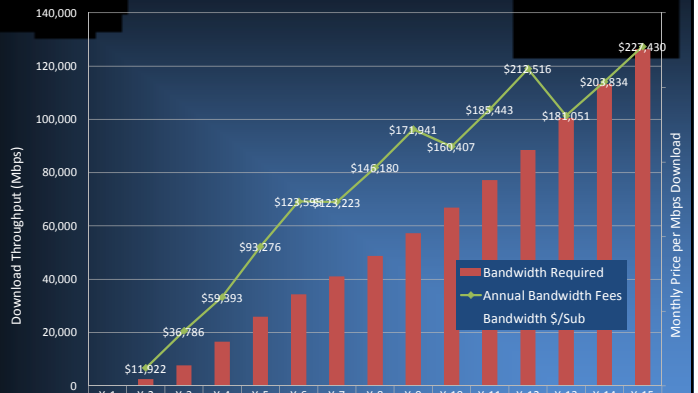
There are 2 strategy options for the City to acquire the necessary bandwidth to provide Internet access service:

A. Contract for delivered bandwidth to the City network headend from a service provider (e.g. Level3, Spectrum Networks, etc.)

B. Lease/build a transport circuit for direct access to either the Hillsboro Data Center and/or Pittock Internet Exchange and separately lease bandwidth from another provider via x-connect to their cage

	Delivered Bandwidth	Direct Access
Access	Cogent: 1G = $4,300 ($4.30) 5G on 10G port = $10,350 ($2.10) 10G = $12,150 ($1.22)	HDC: L3, Spectrum, Cogent, etc. have physical presence Pittock: L3, Hurricane Electric, Northwest Fiber Network, etc. have physical presence Cogent: 10G committed (1 year) = $6,500 MRC **Hurricane Electric: 10G committed (5 year) = $3,700 MRC**
Transport	Not Applicable	**Build into HDC** • **Construction: $60k (3 miles total UG fiber with dual entrance)** • **Co-location fees (City cage): $1,000 MRC** **Lease transport to Pittock** • **Spectrum Networks circuit: 10G = $8,000 MRC**
Other Fees	Not Applicable	**X-Connect: $250 MRC per circuit**

BANDWIDTH FORECAST



	Yr1	Yr2	Yr3	Yr4	Yr5	Yr6	Yr7	Yr8	Yr9	Yr10	Yr11	Yr12	Yr13	Yr14	Yr15
Bandwidth Required		2,484	7,664	16,49	25,91	34,33	41,07	48,72	57,31	66,83	77,26	88,54	100,5	113,2	126,3
Annual Bandwidth Fees		$11,92	$36,78	$59,39	$93,27	$123,5	$123,2	$146,1	$171,9	$160,4	$185,4	$212,5	$181,0	$203,8	$227,4
Bandwidth $/Sub		$4.20	$1.90	$1.66	$1.93	$2.25	$2.11	$2.46	$2.85	$2.43	$2.76	$3.12	$2.57	$2.85	$3.14

MARKET FORCES AFFECTING VIDEO DISTRIBUTORS

- Market Concentration/Vertical Integration
  - Distributors: Cable system mergers increasing
  - Content: Broadcasters and vertical integration (e.g. Comcast)
- These trends – along with an outdated regulatory model – have resulted in greater market power for content providers
  - Broadcasters: Retrans consent fees are doubling every 3 years
  - Linear Channels: Annual cost increases averaging 8%
- This rate increase pressure – and regulatory changes - will accelerate OTT adoption
  - OTT services are priced lower with less content breadth
  - FCC expected to grant OTT providers program access protection
- Facilities based video distributors will lose competitive advantage in the next 5 years
  - OTT providers will have ubiquitous market reach across the U.S.
  - National consumer brands can leverage this scale and brand power: Google, Apple…
  - New players have the cash to acquire content (Apple: $178B, Google: $62B)

OTT PROVIDERS

- Sling TV
  - Launched by Dish Network
  - Includes ESPN. Excludes broadcast channels.
  - Multi-platform including Roku, Xbox One, Amazon Fire TV, etc.
  - $20 per month and 100,000 subscribers.
- Sony
  - 50 channels of content via PlayStation box
  - Launched in New York, Philadelphia, and Chicago
  - Includes CBS, NBC, Fox
- Apple
  - In talks with major programmers sourcing content deals
  - Will offer 25 channels including ABC, CBS, and Fox
  - Pricing range of $30 -$40 anticipated

[redacted]

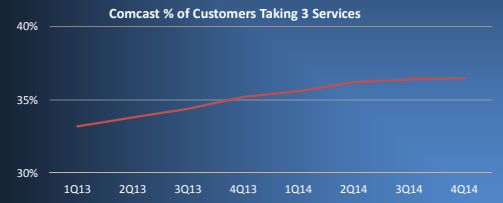
KEY QUESTIONS ON VIDEO STRATEGY

- Revenue: Does offering video service improve the penetration results of other services via bundling?
- Capital: Can the fixed costs associated with offering traditional video be recovered prior to earnings erosion from OTT substitution? Are there less capital-intensive options for offering video minimize this ROI risk?
- Cash Flow: Does offering video improve the cash flow performance of the network by Year 5?
- Business Model: Can the City leverage an RSP partnership to improve video ROI? If so, what is the economically neutral value of the RSP's role?

[redacted]

IS VIDEO NEEDED FOR SERVICE BUNDLING?

- Bundling is losing importance over time.
  - Only 16% of households are bundled via one provider in Hillsboro
  - In Cleveland, the percentage of households rating bundling as 'Very Important' has dropped from 46% in 2007 to 27% in 2015
- Comcast's percentage of triple play subs has flattened at 36%

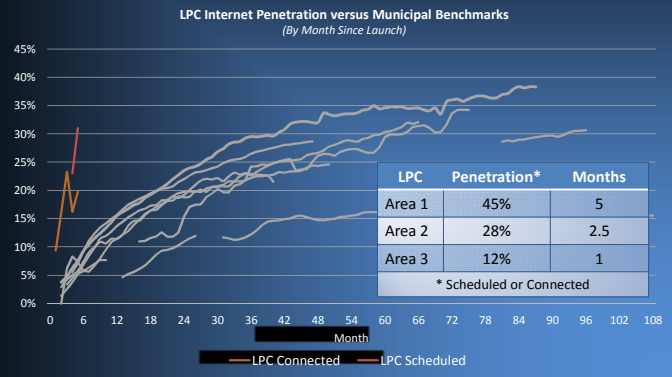


- The Longmont, CO example is an early indication that a 'no-video' strategy does not limit Internet penetration results

[redacted]

LONGMONT INTERNET PENETRATION RESULTS

- A retail service strategy excluding video has not impeded LPC's market performance since launching in November 2014…



LPC	Penetration*	Months
Area 1	45%	5
Area 2	28%	2.5
Area 3	12%	1

* Scheduled or Connected

SOURCING VIDEO: VUBIQUITY TERRESTRIAL DELIVERY

FIBER NETWORK

VU VUBIQUITY

Architecture

- Dedicated 10 Gig Waves (Level-3)
- Vubiquity owned/managed switched
- Multi-ring architecture
- Unique fiber paths into each Co-Lo
- Co-Lo at primary meet-me point
- GigE and 10 Gig Interconnect Support

Vubiquity Confidential. This document is intended solely for

NCTC

PORTLAND POP: 921 SW WASHINGTON

FIBER NETWORK

SOURCING VIDEO: VIDEO FEED

A recently launched national linear cable feed backbone can now provide terrestrial delivery of most cable channels to video distributors. This can replace the vast majority of the headend investment.

	Own Headend	*Vubiquity LiveVU*
Content Delivery & Reception	Direct Feed via satellite (linears) and tower reception (off-airs)	Direct Feed via 10G terrestrial fiber network (linears) and tower reception (off-airs)
Buildings & Land	Tower site and 2,000 sq. ft. room with desk space for 12 FTEs ($250k)	Tower Site and 2 racks with desk space for 12 FTEs ($100k)
Opex Requirements	Utilities & Insurance: $75k Software Annual Maintenance: $100k	Utilities & Insurance: $25k Software Annual Maintenance: $100k Transport Fee: $2.50/Sub/Month Annual Maintenance: $2500 Leased transport circuit (to LiveVU's Portland POP: $8k/Month via Spectrum Networks
Fixed Capital Requirements	Video Processing & Equipment: $1.3M Off-Air Tower & Antennae: $150k Powering: $300k Project Management/Integration: $200k Middleware/CAS Licensing: $820k (10k subs)	Gateway & Professional Services: $20k Off-Air Tower & Antennae: $150k Powering: $100k Project Management/Integration: $30k Middleware/CAS Licensing: $820k (10k subs)
Variable Capital Requirements	Set Top Boxes: HD=$100 HD/DVR=$225	

VIDEO STRATEGY OUTCOMES

	Video with City Headend	Video with LiveVU Video Feed	No Video
Opex	Utilities & Insurance: $75k	Utilities & Insurance: $25k Transport Fee: $2.50/Sub/mo. Annual Maintenance: $2500 Leased Transport : $8k/mo.	No Headend Tech
Capital	Building: $400k Headend: $1.75M Project Management: $200k	Renovation: $200k Hubsite: $270k Project Management: $30k	Renovation: $200k
Working Capital	$1.7M	$1.9M	$1.5M
LT Debt	$67.4M	$65.4M	$64.7M
Year 5 Net Cash	- $58.8M	- $57.7M	- $58.0M
Years to Project B/E	13	13	14

VIDEO STRATEGY NET CASH OUTCOMES

	Year 5 Inc. Debt versus No Video	Year 5 Inc. Net Cash versus No Video
City HE	$2,923,277	($797,300)
LiveVU	$1,115,554	$330,945

VIDEO STRATEGY FINDINGS & RECOMMENDATION

- Bundling video will not materially improve Internet or voice revenues. Consequently the 'No Video' case does not adjust other service revenues downward
- There are no financial advantages to building a video headend. Only an imported video feed should be considered if video is offered. For the terrestrial feed, LiveVU is a very cost-effective source.
- Staffing costs are minimally affected. FTE staff levels reflect coverage, however customer service is greatly simplified/streamlined without video
- Because incremental video investment cannot be recovered within 5 years, Uptown recommends that the City not offer video (if the City serves as the retailer)

Concept & Option Analysis

Business Structure Analysis

WHOLESALE MODEL ROLES

Function	Operational Responsibility	The City	RSP
Capital	Fiber ring and FTTC system	✓	
	Drop, ONT and Inside Wiring		✓
	Headend, Switch and NOC		✓
	Set Top Boxes		✓
Network Operations	Maintenance and Pole Attachment	✓	
	Customer Installs and Disconnects		✓
Bandwidth & Content	Backbone Interconnection and Video Programming		✓
Software	OSS/BSS		✓
	Fiber Management	✓	
	Middleware		✓
Marketing & Sales	Advertising, Sales, Branding, Pricing		✓
Customer Service	Help Desk, Service Calls, Billing		✓
Incremental Headcount	[redacted]	7	20 (Year 3 peak) 12 (Year 6+)

WHOLESALE MODEL: CITY ROLE

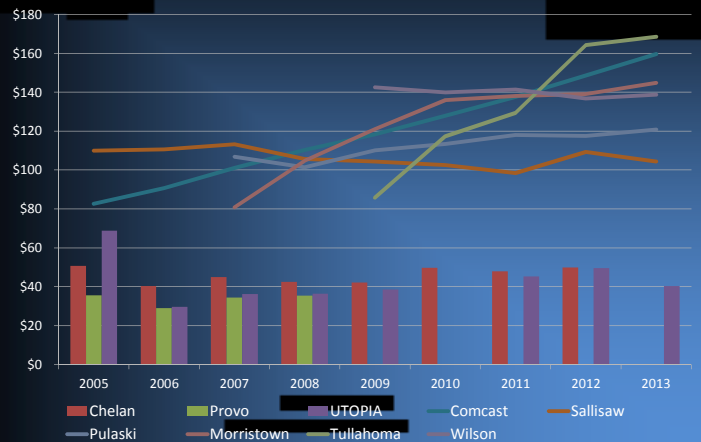
- The City builds and maintains fiber network up to drop splitter location
- The City is responsible for:
  - Design, construction, and maintenance of FTTC system
  - Rackspace for RSP electronics ($0 land/buildings budget)
  - Network engineers (2) and field maintenance techs (1 per 8,000 passings)
- Penetration equals retail case for Internet (residential and commercial)
- Monthly Fee per Active Connection
  - Flat fee differentiated for residential versus commercial, but not service or throughput.
  - Tested at the following wholesale rates per connection (residential/commercial):
    - $20/$40
    - $30/$50
    - $40/$60
    - $50/$70

WHOLESALE MODEL: RSP ROLE

- RSP offers Triple Play in other markets (has existing operation with headend)
- RSP responsible for:
  - Customer drop, ONT, set tops, and installation process and materials
  - Bandwidth, voice switch, video feed
  - Customer service, billing, help desk, and ONT monitoring
- RSP staffing:
  - 1 FTE as system GM
  - 2 Sales Reps (MDU and Commercial)
  - 2 incremental CSRs and 2 incremental TSRs
  - Same resource levels for Field Technicians and contractors
- Financial Outcome:
  - Initial equity investment of $8.0M
  - Cash flow positive in Year 4
  - Net Cash breakeven in Year 7

WHOLESALE NET CASH OUTCOMES

RETAIL VS. WHOLESALE ARPU



WHOLESALE STRUCTURE RISKS

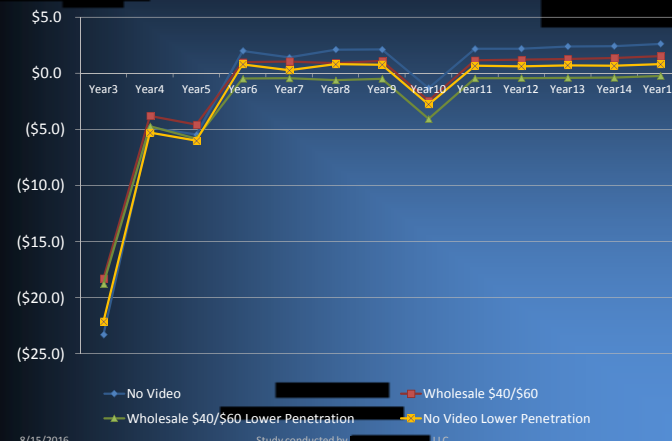
- Track Record
  - Major financial failures including Provo, UTOPIA, and Chelan PUD
  - Despite this, public-private partnerships remain a popular model, at least conceptually
- Performance covenants would be required
- Brand preference
- The City would always be the "provider of last resort"
- The $64 question: Does wholesale de-risk the FTTP network?

FINANCIAL OUTCOMES

Outcome	City Retail No Video	City Wholesale $40/$60	RSP Case $40/$60
Equity Investment	$0	$0	$8.0M
Long Term Debt	$64.7M	$54.0M	$0
Operating Losses (Working Capital)	$1.5M	$0.9M	$0.9M
Total Funding	**$66.2M**	**$54.9M**	**$8.9M**
Total Outstanding Debt - Year15	$5.0M	$4.1M	$0
Net Cash - Year15	$15.9M	$6.5M	$32.9
Project Break Even	**14 Years**	**15 Years**	**7 Years**

8/15/2016 Study conducted by [redacted], LLC 97

CASH FLOW WITH DEBT SERVICE ($M)



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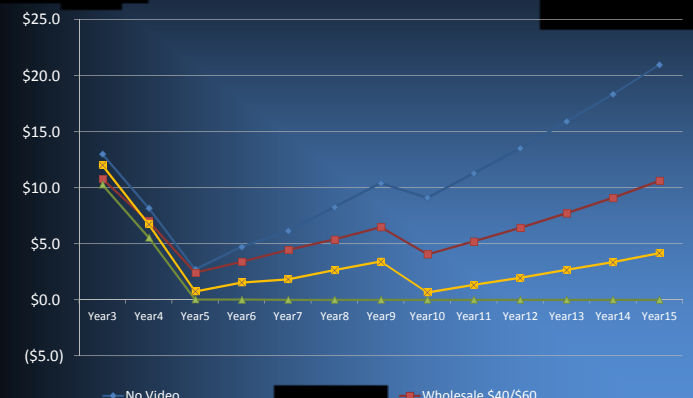
CASH RESERVES ($M)



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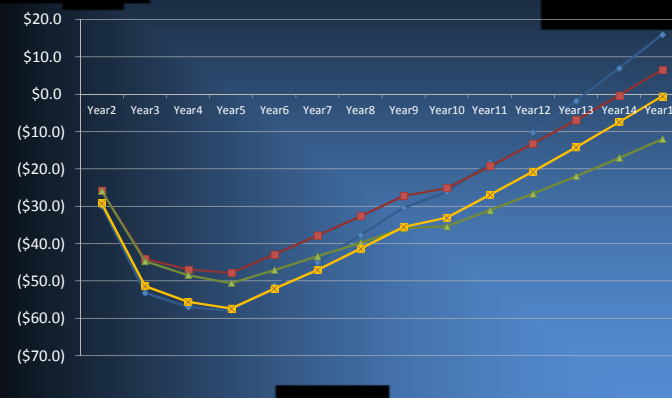
NET CASH ($M)



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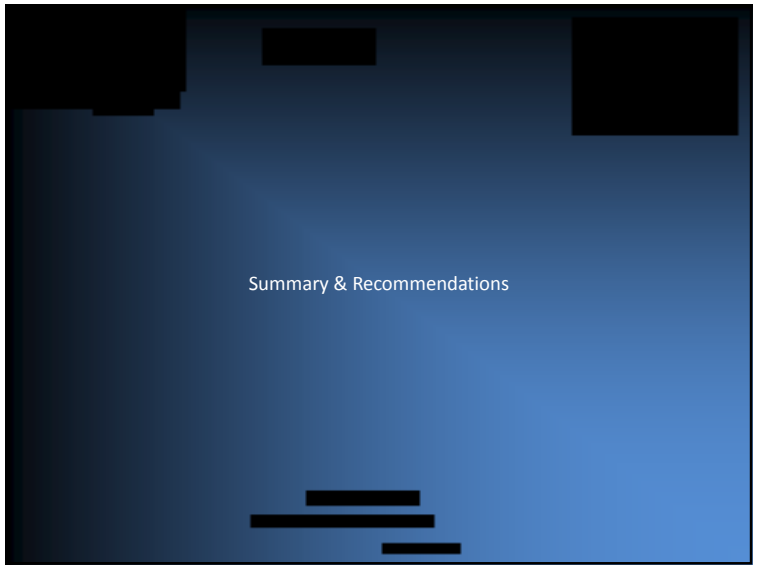

CONCLUSIONS AND RECOMMENDATIONS

- Recommended strategy is the City serving as retailer of Internet and voice service (via CLEC partner)
  - Offering video does not provide significant financial return on required capital spending
  - The wholesale approach does not improve the financial outcome and does not significantly reduce the investment requirement ($55M versus $66M)
- Funding of $66M is required
  - Two bond issues totaling $64.7M
  - Additional working capital financing of $1.5M
- The project is marginally viable
  - Project is net cash positive in 14 years
  - Sensitivity to a 20% reduction in Internet penetration

MEMORANDUM

To: City Council

From: Greg Mont, Information Services Director

Date: 7/29/15

Subject: Fiber-to-the-Home Feasibility Study

Summary
The City of Hillsboro contracted with [redacted] to conduct a municipal high-speed broadband fiber network feasibility study. The purpose of this study was to evaluate the financial viability of building and operating a fiber-to-the-home (FTTH) network within Hillsboro. The study included a phone survey of Hillsboro residents, in-depth interviews of local businesses, an analysis of the City's geography and existing infrastructure, and financial modeling and analysis of different options related to the construction and operation of a municipal FTTH service.

The study concludes that a FTTH network would be financially viable, but the modeling indicates the full payback period would be on the edge of the recommended range. Given the level of uncertainty built into the assumptions, it is quite possible that the actual performance of the program could fall outside of what would be acceptable.

Based on this information, the consultants recommend that we not pursue building and operating our own municipal FTTH service. It should be noted that this recommendation is based on the financial analysis alone. The survey indicates there is demand for such a service, and that residents are receptive to the City providing said service.

Key Findings

- 74 percent of Hillsboro residents rate access to low-cost, high-speed internet very important to the future local economy.
- More than 77 percent indicated interest in switching to a municipal FTTH network for internet service if it was 10 percent less expensive than what they are paying now. This was adjusted to a 28 percent take rate using the Likert Scale to reduce the overstatement bias. This number is critical because it has a significant impact on the financial performance and is difficult to predict.
- 44 percent of residents would prefer to receive high-speed internet service from the City.

- There is little interest in traditional voice or video service. The models indicate minimal value in offering these services.
- Approximately 80 percent of Hillsboro buildings would be served with underground infrastructure. Underground access is considerably more expensive than aerial.
- Building the network that covers the entire City would require $66 million. This funding would cover capital expenditures and annual operating costs until the break-even point when the program generated a positive cash flow.
- The predicted outcome is that the program would pay off all debt and become net cash positive in the 13th year of operation if the City owned and operated the network; Year 14, if the City owned the network but a third party provided the service. If the take rate is reduced by 20 percent, the break-even point shifts into the 15th year.

Next Steps

The goals described in the attached "Illuminate Hillsboro" handout which led the City to consider a municipal FTTH network remain. The value of having affordable high-speed broadband fiber network access for all residents and businesses remains. We will continue to seek opportunities to achieve the goals that led to this study and ensure that Hillsboro has the connectivity required to keep it a thriving and successful community.