THE "TO AND THROUGH" OPPORTUNITY:

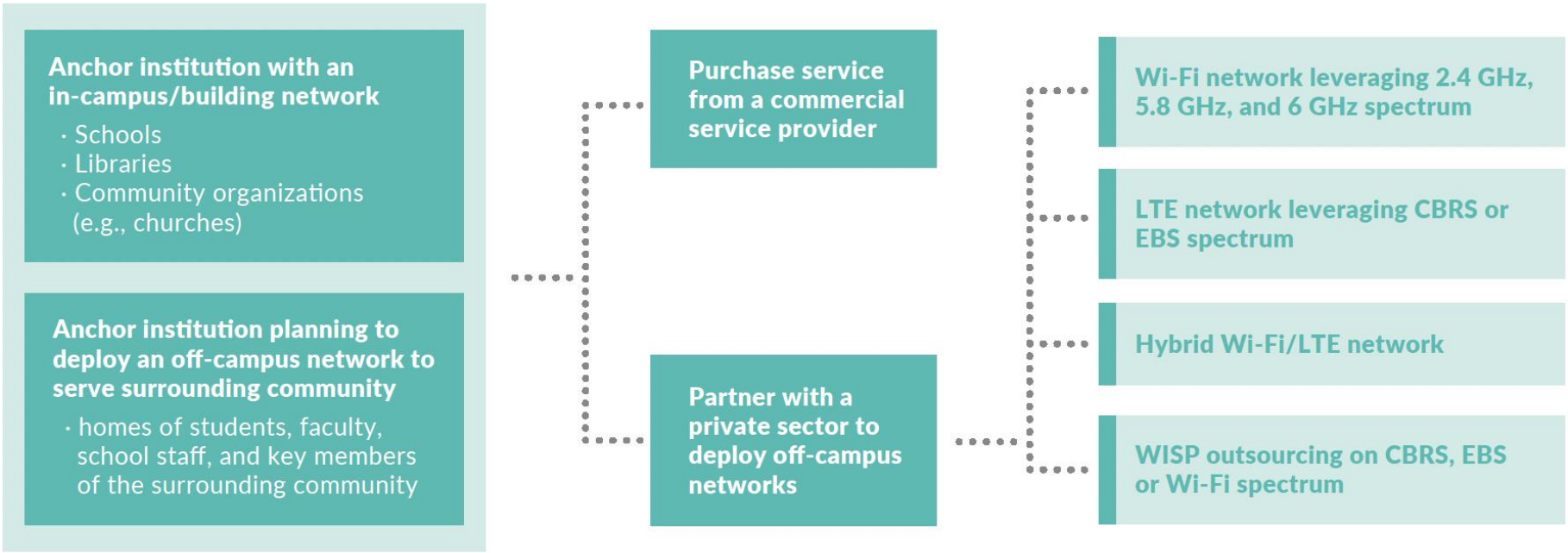
An Economic Analysis of Options to Extend Affordable Broadband to Students and Households via Anchor Institutions

Economic analysis, Cost Calculation Toolkit and Public Policy Implications

Dr. Raul Katz

Telecom Advisory Services LLC

Purpose of this study: economic assessment of options for anchor institutions to offer wireless broadband services to users (students and their families) off-campus



Source: Telecom Advisory Services analysis

In addition to deciding who the target customers (students and/or households) are, anchor institutions face a set of structural and technology options

STRUCTURAL OPTIONS

TECHNOLOGY OPTIONS

	PURCHASE SERVICE FROM A COMMERCIAL WIRELESS SERVICE PROVIDER	CONTRACT OR PARTNER WITH A NON-TRADITIONAL SERVICE PROVIDER	SELF-PROVISION
LTE	Purchase public LTE service from a commercial service provider		
CBRS		Contract a CBRS based WISP	Leverage CBRS spectrum to deploy an LTE private network
EBS		Contract an EBS based WISP	Use EBS Spectrum
White space			Use TV White spaces
Wi-Fi		Contract a Wi-Fi based WISP	• Deploy a mesh Wi-Fi network relying on unlicensed spectrum • Contract with a third-party integrator to deploy and operate the network

Some options might not be available due to spectrum availability, topographic or population density conditions

STRUCTURAL OPTIONS

TECHNOLOGY OPTIONS

	PURCHASE SERVICE FROM A COMMERCIAL WIRELESS SERVICE PROVIDER	CONTRACT OR PARTNER WITH A NON-TRADITIONAL SERVICE PROVIDER	SELF-PROVISION
LTE	Service quality from a commercial provider does not meet needs		
CBRS		Area to be covered is adjacent to an airport or defense facility precluding construction of towers	
EBS		Originally assigned spectrum is no longer available because of a past agreement to lease it to a commercial operator	
White space			Target population is too large
Wi-Fi		The community to be served is spread through a large geography (low density) or resident across hilly area	

Beyond potential spectrum availability or geographic/topographic constraints, decisions are driven by economic factors: initial funds for deployment and ongoing resources to support operations

STRUCTURAL OPTIONS

TECHNOLOGY OPTIONS

	PURCHASE SERVICE FROM A COMMERCIAL WIRELESS SERVICE PROVIDER	**CONTRACT OR PARTNER WITH A NON-TRADITIONAL SERVICE PROVIDER**	**SELF-PROVISION**
LTE	Purchase public LTE service from a commercial service provider ?		
CBRS		Contract a CBRS based WISP ?	Leverage CBRS spectrum to deploy an LTE private network ?
EBS		Contract an EBS based WISP ?	Use EBS Spectrum?
White space			Use TV White spaces ?
Wi-Fi		Contract a Wi-Fi based WISP ?	• Deploy a mesh Wi-Fi network relying on unlicensed spectrum? • Contract with a third-party integrator to deploy and operate the network ?

The approach followed for the development of comparative economic models was structured around three phases

First Round of Interviews

- Conduct interviews with institutions that have already deployed off-campus networks
- Formalize drivers and quantification of variables

Model Development

- Develop models based on three real-life cases
- Structure models with standard set of drivers and outputs
- Use models to project costs with institutions that have not been interviewed before

Final Deliverables

- Develop toolkit and documentation
- Prepare final report

Source: Telecom Advisory Services analysis

Model development was based on extensive interviews of “real life” cases – data was standardized to allow “apples to apples” comparisons

- Consider only one of the potentially many project phases
- Avoid equipment refreshments
- Use interview or price sheet data
- Model project CAPEX as a one-time event
- Model OPEX over five years

Once data was standardized it was integrated to estimate economics against a common set of drivers – the objective: serve 19,000 users

Key Drivers

- Projected user population (schools, students, households)
- Geographic deployment (km^2)
- Topography
- Population density
- Estimated usage per device (smartphones, tablet, wireless modems)
- Devices provided to users (PC, tablets, netbooks, routers, wireless modems)
- Access to vertical assets (cell towers, water towers)
- Access to subsidized siting (buildings, lamp-posts, etc.)
- Access to subsidized backhaul or passive infrastructure
- Partnership opportunities (WISP, commercial service provider, municipality, device/equipment mfrg)
- Service level targets (speeds, throttle conditions)

Private LTE Mesh Wi-Fi Hybrid LTE/Wi-Fi & Commercial Carrier Calculations

- Network Eqipment
- Total CAPEX (Fiber/wiring to the APs/towers, APs, civil engineering, RF engineering
- Initial CAPEX (site infrastructure, equipment)
- CPE costs
- Deployment costs
- Backhaul costs
- OPEX (operations, maintenance)

Model Comparison (comparative results of the three options)

- Financials
  - Internal Rate of Return
  - NPV (with and without terminal value)
- Service quality
- Social impact
  - Adoption
  - Use
- Economics

Source: Telecom Advisory Services analysis

Three options for purchasing service from a commercial service provider were estimated without considering potential discounts

	WIRELESS MONTHLY PLAN	CAPEX (UPFRONT) FOR ACQUIRING MiFi HOTSPOTS	OPEX (ANNUAL)
• Verizon jetpack MIFI 8800L • 5G Play More Plan 50 GB then unlimited data at throttled down speed	$ 45	$ 4,465,000	$ 10,260,000
• Verizon jetpack MIFI 8800L • 5G Start (5G/4G hotspot data 5GB then unlimited data at throttled down speed)	$ 40	$ 4,465,000	$ 9,120,000
• Verizon jetpack MIFI 8800L • Unlimited 5G (5G/4G hotspot data with throttled down speed at congestion times)	$ 30	$ 4,465,000	$ 6,840,000

The option of purchasing service from a commercial operator was compared against some of the alternatives

STRUCTURAL OPTIONS

TECHNOLOGY OPTIONS

	PURCHASE SERVICE FROM A COMMERCIAL WIRELESS SERVICE PROVIDER	CONTRACT OR PARTNER WITH A NON-TRADITIONAL SERVICE PROVIDER	SELF-PROVISION
LTE	CAPEX: $ 4,465,000 OPEX: $ 10,260,000 - $ 6,840,000		
CBRS		CAPEX: $ 871,175 OPEX: $ 227,000	CAPEX: $ 3,027,086 OPEX: $ 206,327 - $ 412,300
EBS		Not estimated because, with few exceptions, spectrum is not available	
White space			Deployment cases address very small target user base
Wi-Fi		Option economics is close to the self-provision option	CAPEX: $ 899,824 OPEX: $ 742,000
CBRS-Wi-Fi hybrid			CAPEX: $ 2,215,000 OPEX: $ 577,000

In sum…

- Purchasing of service through a commercial ISP is less cost-effective and financially sustainable than the other deployment options where they are feasible
- If the objective is to serve users located in a high-density geography, where access points can be installed in municipality streetlights, contracting with a third-party integrator to deploy and operate a mesh Wi-Fi network presents the lowest initial cost of deployment
- While CAPEX of private CBRS-enabled LTE networks is higher than mesh Wi-Fi , ongoing costs, even if O&M is outsourced, are quite advantageous. Furthermore, the primary benefit of CBRS use is related to the opportunity to serve exurban and other communities with low density located in geographies not particularly convenient for large Wi-Fi networks
- The option entailing a public-private partnership that leverages CBRS spectrum is more advantageous in terms of CAPEX upfront costs and ongoing OPEX when compared to similar network configuration within a self- provision arrangement