ctc technology & energy

engineering & business consulting



Broadband and Digital Equity Strategic Plan Prepared for the City of Dallas and Dallas Independent School District August 2021

Columbia Telecommunications Corporation 10613 Concord Street • Kensington, MD 20895 • Tel: 301-933-1488 • Fax: 301-933-3340 • www.ctcnet.us

Contents

1	Executive summary	1
	1.1 Project overview	3
	1.2 Network investment has not occurred consistently across all Dallas neighborhoods	4
	1.3 Speed-test survey results identified lack of uniform broadband speeds	8
	1.4 Survey results indicate gaps in broadband access, affordability, device ownership, and digital skills amor DISD families and Dallas residents	ng 9
	 1.5 The City and DISD's infrastructural and programmatic efforts to ameliorate digital inequities provide a strong foundation for expansion 1.5.1 DISD operates an educational wireless network pilot at Lincoln High School 1.5.2 The City of Dallas launched two Wi-Fi pilots in priority zones 	<i>11</i> 12 12
2	Summary of recommendations	13
	2.1 Proceed with building a fiber backbone and add additional fiber to create a 180-mile network to support growing City needs and digital equity efforts	t 13
	2.2 Consider building wireless infrastructure as a partial solution to filling broadband gaps for DISD families and other residents	16
	2.3 Expand the Digital Navigators program to maximize participation in low-cost programs and federal subsidy programs	19
	2.4 Purchase devices and fund the expansion of digital skills training and device recycling—building on the Digital Navigators program	21
	2.5 A municipal fiber-to-the-premises deployment would be unlikely to succeed without large and ongoing subsidies	22
	2.6 DISD should prepare for procurement of home-based services under the Emergency Connectivity Fund— potentially with bulk purchase from Charter or AT&T	23
	2.7 Evaluate bulk purchase of service for unserved residents	24
	 2.8 Pursue relevant recent federal funding opportunities 2.8.1 Coronavirus State and Local Fiscal Recovery Funds Program 2.8.2 Connecting Minority Communities Pilot Program 2.8.3 Emergency Broadband Benefit Program 2.8.4 Coronavirus Capital Projects Fund 	25 25 26 26 27
3	Dallas is served by ubiquitous cable and DSL, and some fixed wireless, but significant broadband	
in	nvestment gaps remain	28
	 3.1 Analysis of fixed broadband service providers 3.1.1 Fiber availability and pricing 3.1.2 Cable availability and pricing 3.1.3 DSL availability and pricing 	29 29 31 33

ii

	3.	.1.4	Fixed wireless availability and pricing	36
	3.2	Analy	rsis of demographic patterns and network investment	37
	3.3	Onlin	e speed test results show sub-broadband speeds for many Spectrum and AT&T wired broadband	
	custo	omers		44
		م اله م ما	und une neuro quiet envene studente en d'ethen neuidente in the Dellas anno	50
4	В	roadba	and use gaps exist among students and other residents in the Dallas area	50
	4.1	Key f	indings	50
	4.	.1.1	Broadband access gaps	50
	4.	.1.2	Device utilization gaps	51
	4.	.1.3	Covid-19 impacts on broadband use	52
	4.	.1.4	Skills gaps in using broadband and computers	53
	4.2	Surve	py process	54
	4.3	Surve	<i>by results</i>	56
	4.	.3.1	Internet connection and use	56
	4.	.3.2	Covid-19 impacts on home broadband	74
	4.	.3.3	Computer and internet skills	88
	4.	.3.4	Technology for minor children	98
	4.	.3.5	Internet use for jobs/careers	102
	4.	.3.6	Respondent opinions	103
	4.	.3.7	Respondent information	108
5	N	ew wi	reless infrastructure could be a partial solution to broadband gaps in Dallas: Evaluation and	
re	comn	nendat	tions regarding wireless pilots and expansion	112
	5.1	Intro	duction to fixed wireless network connectivity	112
	5.	.1.1	Fixed wireless spectrum and architecture	112
	5.	.1.2	Fixed wireless network characteristics and considerations	115
	5.2	DISD	educational network pilot at Lincoln High School	116
	5.3	City c	f Dallas Wi-Fi pilot in priority zones	117
	5.4	Reco	mmendations for data evaluation and trackina	120
	5.	.4.1	Technical evaluation	120
	5.	.4.2	Business evaluation	121
	5.5	Cand	idate wireless desian and cost estimates	122
	5.	.5.1	RE coverage modeling methodology and assumptions	123
	5.	.5.2	High-level coverage and cost estimates by model	125
	F C	~	menore and the first deployed with loss convision for low income residents, it should do so at mini	
	5.6	Reco	nimendation: ij the City deploys wheless services for low-income residents, it should do so at mini o users	imal 120
	5.6 or no	Reco cost t	o users	mal 138
6	5.6 or no A	Recol cost t City-o	wned fiber optic backbone network would deliver considerable value	imal 138 139

6.2 Buil	ding 180 miles of fiber would cost approximately \$25 million but could provide significa	nt long term
savings a	s compared to leased services	142
6.3 Off-	the-balance-sheet benefits of a middle-mile fiber network	145
6.3.1	Ownership provides control over facilities and management	146
6.3.2	Ownership facilitates high-availability and reliability	147
6.3.3	Private fiber networks offer independence from public networks	148
6.3.4	Fiber ownership offers control over network security	149
7 Dallas	is home to digital equity initiatives—and strategic development of existing and new p	rograms can
address rem	aining needs	150
7.1 Ach	ieving affordability: A review of the existing low-cost and subsidy programs available in	the Dallas
market		150
7.1.1	Spectrum Internet Assist	150
7.1.2	AT&T Access	151
7.1.3	Lifeline	152
7.1.4	Emergency Broadband Benefit Program	152
7.2 Ach	ieving access: A review of existing City and DISD digital equity initiatives	154
7.2.1	Internet for All Coalition builds community-wide digital equity strategy	154
7.2.2	Digital Navigators program helps residents access internet subscriptions, devices, and	training
opport	runities	154
7.2.3	The City's purchase of laptops and hotspots make devices more accessible	155
7.2.4	Texas Education Agency matching funds support the purchase of devices and home ir	iternet for
studer	ts155	
7.2.5	DISD's purchase of mobile hotspots supports student connectivity	156
7.2.6	Signal extender initiative expands access to free Wi-Fi	157
7.3 Dal	las organizations active in digital equity	157
7.3.1	Dallas Innovation Alliance (DIA)	157
7.3.2	Comp-U-Dopt	158
7.4 A sc	ample of digital equity programs and strategies in other cities	158
7.4.1	Coalitions are key drivers of change in other cities	159
7.4.2	Examples of digital equity funds in Seattle, Austin, and Boston	160
7.4.3	Foundation engagement accelerates efforts in Cleveland	160
7.4.4	Digital equity guides and resources	161
7.5 Rec	ommendations for expansion or creation of digital equity initiatives in Dallas	162
7.5.1	Recommendation: Expand the Digital Navigators program across systems to maximize	e participation
in low-	cost programs and federal subsidy programs	162
7.5.2	Recommendation: Fund the expansion of digital skills training offered through the Dig	gital Navigators
progra	m 165	
7.5.3	Recommendation: Purchase devices and fund the expansion of digital skills training a	nd device
recycli	ng168	
7.5.4	Recommendation: DISD should prepare for procurement of home-based services und	er Emergency
Conne	ctivity Fund	171
7.5.5	Recommendation: Evaluate bulk purchase of service for unserved residents	172

8 Summ	ary of grant and other funding opportunities	174
8.1 Bro	adband funding in the 2021 appropriations package	174
8.1.1	Broadband Infrastructure Program (Department of Commerce)	174
8.1.2	Connecting Minority Communities Pilot Program (Department of Commerce)	175
8.1.3	Emergency Broadband Benefit Program (Federal Communications Commission)	176
8.2 Bro	adband funding in the American Rescue Plan Act	177
8.2.1	Coronavirus State and Local Fiscal Recovery Fund (Department of the Treasury)	177
8.2.2	Coronavirus Capital Projects Fund (Department of the Treasury)	180
8.2.3	Emergency Connectivity Fund (Federal Communications Commission)	181
8.3 Pub	olic Works and Economic Adjustment Assistance Program (Department of Commerce)	182
Appendix A	Internet usage survey instrument	184
Appendix B	Glossary of basic broadband terms	190
Appendix C	Summary cost tables	191

Tables

Table 1: Estimated 100-Mile Fiber Backbone Costs	13
Table 2: Estimated Costs of 180 Miles of Fiber	15
Table 3: Estimated Fixed Wireless Costs	18
Table 4: Estimated Initiative Budget – Providing Resources to Help Residents Enroll in Low-Cost and Subsidy	
Programs	21
Table 5: Estimated Budget for Digital Navigators Training Program	22
Table 6: Estimated Budget for One-Time Device Purchase Program	22
Table 7: Estimated Alternative Annual Budget for Ongoing Broadband Connectivity Subsidy Program	25
Table 8: Fiber Services Offered by AT&T in the Dallas Market	29
Table 9: Cable Services Offered by Charter in the Dallas Market	32
Table 10: Cable Services Offered by Suddenlink in the Dallas Market	32
Table 11: DSL Services Offered by AT&T Nationally	34
Table 12: Fixed Wireless Services Offered by Rise Broadband in the Dallas Market	37
Table 13: Where Tests Were Conducted Within Dallas and DISD, by Poverty Rate	46
Table 14: Internet Access by Key Demographics	62
Table 15: Home Internet Connection Ever Used for Various Activities by Respondent Age	72
Table 16: Home Internet Connection Frequently Used for Various Activities by Respondent Age	72
Table 17: Home Internet Connection Ever Used for Various Activities by Children in Household	73
Table 18: Home Internet Connection Frequently Used for Various Activities by Children in Household	73
Table 19: Agreement with Statements About Internet Skills (Mean Ratings) by Age	90
Table 20: Agreement with Statements About Internet Skills (% Strongly Agree) by Age	90
Table 21: Agreement with Statements About Internet Skills (Mean Ratings) by Income	91
Table 22: Agreement with Statements About Internet Skills (% Strongly Agree) by Income	91
Table 23: Fixed Wireless Spectrum	112
Table 24: Estimated Fixed Wireless Capital Costs	125
Table 25: Estimated Fixed Wireless Operating Costs	126
Table 26: Model 1 Predicted Coverage (All DISD Family Addresses)	127
Table 27: Capital Cost Estimate for Model 1	128
Table 28: Total Cost Estimate for Model 1 at 60 Percent Penetration Rate	128
Table 29: Model 2 Predicted Coverage (All DISD Family Addresses)	129
Table 30: Capital Cost Estimate for Model 2	130
Table 31: Total Cost Estimate for Model 2 at 60 Percent Penetration Rate	130
Table 32: Model 3 Predicted Coverage (All Addresses in Areas With Less Broadband Infrastructure)	131
Table 33: Capital Cost Estimate for Model 3	132
Table 34: Total Cost Estimate for Model 3 at 60 Percent Penetration Rate	132
Table 35: Capital Cost Estimate for Model 4	134
Table 36: Total Cost Estimate for Model 4 at 60 Percent Penetration Rate	134
Table 37: Predicted Coverage (All Addresses)	136
Table 38: Capital Cost Estimate for Model 5	136
Table 39: Total Cost Estimate for Model 5 at 60 Percent Penetration Rate	136
Table 40: Estimated Costs of 180 Miles of Fiber	142
Table 41: Estimated Initiative Budget – Providing Resources to Help Residents Enroll in Low-Cost and Subsidy	/
Programs	165
Table 42: Estimated Budget for Digital Navigators Training Program	167

Table 43: Estimated Budget for One-Time Device Purchase Program	171
Table 44: Estimated Alternative Annual Budget for Ongoing Broadband Connectivity Subsidy Program	173
Table 45: Estimated 100-Mile Fiber Ring Costs	191
Table 46: Estimated Fixed Wireless Costs	191
Table 47: Estimated Initiative Budget – Providing Resources to Help Residents Enroll in Low-Cost and Sub	sidy
Programs	192
Table 48: Estimated Budget for Digital Navigators Training Program	192
Table 49: Estimated Budget for One-Time Device Purchase Program	192
Table 50: Estimated Alternative Annual Budget for Ongoing Broadband Connectivity Subsidy Program	192

Figures

Figure 1: Low-Investment Areas Within the City and DISD Boundaries	5
Figure 2: Areas Without Fiber, Lower-Than-Average Internet Subscriptions, and High Covid-19 Risk	7
Figure 3: Distribution of SpeedSurvey Tests Above or Below Broadband Speeds	9
Figure 4: City of Dallas Fiber Backbone and Rings: One Concept for a 100-Mile Design	14
Figure 5: Cost Scenarios for 180 Miles of City Fiber	16
Figure 6: Model 1 Coverage and DISD Locations	19
Figure 7: Fiber Providers Within the City and DISD Boundaries	30
Figure 8: Cable Providers Within the City and DISD Boundaries	31
Figure 9: DSL Providers Within the City and DISD Boundaries	33
Figure 10: Maximum Reported DSL Download Speed (Mbps) Within the City and DISD Boundaries	35
Figure 11: Fixed Wireless Providers Within the City and DISD Boundaries	36
Figure 12: Low-Investment Areas Within the City and DISD Boundaries	38
Figure 13: Poverty Rates Within the City and DISD Boundaries	39
Figure 14: Covid-19 Risk Levels Where Fiber Is Also Unavailable	41
Figure 15: Areas Without Fiber, Lower-Than-Average Computer Ownership, and High Covid-19 Risk	42
Figure 16: Areas Without Fiber, Lower-Than-Average Internet Subscription, and High Covid-19 Risk	43
Figure 17: Raw SpeedSurvey Data	44
Figure 18: Distribution of Tests Above or Below Broadband Speeds	45
Figure 19: Speed Tests of AT&T Service Using Four Speed Categories	46
Figure 20: Speed Tests of Spectrum Service Using Four Speed Categories	47
Figure 21: Speed Tests of DISD Customers Using Four Speed Categories	48
Figure 22: Speed Survey Results	49
Figure 23: Age of Respondents and Adult Population	55
Figure 24: Internet Usage by Age of Respondent	56
Figure 25: Reasons for Not Using the Internet (Mean Ratings)	57
Figure 26: Reasons for Not Using the Internet	57
Figure 27: Importance of Communication Service Aspects (Mean Ratings)	58
Figure 28: Importance of Communication Service Aspects	58
Figure 29: Importance of Communication Services by Household Income	59
Figure 30: Importance of Communication Services by Segment	59
Figure 31: Primary Internet Service Provider	60
Figure 32: Primary Internet Service by Household Income	61
Figure 33: Monthly Price for Internet Service	63
Figure 34: Enrolled in AT&T's Access Program	64
Figure 35: Enrolled in Spectrum's Internet Assist Program	64
Figure 36: Receive \$9.25 Subsidy Under FCC's Lifeline Program	65
Figure 37: Number of Personal Computing Devices in Home by Household Size	65
Figure 38: Devices Available in the Home	66
Figure 39: Devices Available in the Home by Respondent Age	67
Figure 40: Devices Available in the Home by Children in Household	67
Figure 41: Devices Available in the Home by Household Income	68
Figure 42: Computer Becomes Unusable	69
Figure 43: When Could Replace Computer	69
Figure 44: How Often Computer Becomes Unusable by Household Income	70

Figure 45: When Could Replace Computer by Household Income	70
Figure 46: Home Internet Connection Use for Various Activities	71
Figure 47: Daily Use of the Internet at Various Times Before and During Covid-19 Pandemic	74
Figure 48: How Often Use the Internet at Various Times Before Covid-19 Pandemic	75
Figure 49: How Often Use the Internet at Various Times During Covid-19 Pandemic	75
Figure 50: Increase in Internet Use at Various Times of Day by Respondent Age	76
Figure 51: Increase in Internet Use at Various Times of Day by Segment	77
Figure 52: Ever Use the Internet in Various Locations Before and During Covid-19 Pandemic	78
Figure 53: How Often Use the Internet in Various Locations Before Covid-19 Pandemic	79
Figure 54: How Often Use the Internet in Various Locations During Covid-19 Pandemic	79
Figure 55: Decrease in Internet Use at Various Locations by Respondent Age	80
Figure 56: Decrease in Internet Use at Various Locations by Segment	80
Figure 57: Ever Used the Internet for Various Activities Before and During Covid-19 Pandemic	82
Figure 58: How Often Used the Internet for Various Activities Before Covid-19 Pandemic	83
Figure 59: How Often Used the Internet for Various Activities During Covid-19 Pandemic	83
Figure 60: Increase in Internet Use for Various Activities by Respondent Age	84
Figure 61: Increase in Internet Use for Various Activities by Segment	84
Figure 62: Education Level of Household Internet Users	85
Figure 63: Education Level of Household Internet Users by Respondent Age	85
Figure 64: Education Level of Household Internet Users by Household Income	86
Figure 65: Education Level of Household Internet Users by Children in Household	86
Figure 66: Number of Households Members Online During Peak Usage Times	87
Figure 67: Number of Households Members Online During Peak Usage Times by Age	87
Figure 68: Agreement with Statements About Internet Skills (Mean Ratings)	88
Figure 69: Agreement with Statements About Internet Skills	89
Figure 70: Agreement with Statements About Training Related to Computers and the Internet (Mean Ratings)) 92
Figure 71: Agreement with Statements About Training Related to Computers and the Internet	93
Figure 72: Agreement with Statements About Training by Respondent Age	94
Figure 73: Agreement with Statements About Training by Household Income	95
Figure 74: Agreement with Statements About Training by Household Income	96
Figure 75: Agreement with Statements About Training by Household Income	97
Figure 76: Agreement with Statements About Children's Use of Technology (Mean Ratings)	98
Figure 77: Agreement with Statements About Children's Use of Technology During the Covid-19 Pandemic	99
Figure 78: Agreement with Reasons Children Cannot Compete Homework by Household Income	100
Figure 79: Agreement with Statements About Minimizing Online Risks (Mean Ratings)	101
Figure 80: Agreement with Statements About Minimizing Online Risks	102
Figure 81: Own or Plan to Start a Home-Based Business	102
Figure 82: Importance of High-Speed Internet	103
Figure 83: Opinions About the Role(s) for the City or DISD (Mean Ratings)	104
Figure 84: Opinions About the Role(s) for the City or DISD	104
Figure 85: Opinions About the Role(s) for the City or DISD by Children in Household	105
Figure 86: Willingness to Purchase 1 Gbps Internet at Price Levels (Mean Ratings)	106
Figure 87: Willingness to Purchase 1 Gbps Internet at Various Price Levels	106
Figure 88: Willingness to Purchase 1 Gbps Internet Service by Household Income	107
Figure 89: Age of Respondents and City of Dallas/DISD Adult Population	108

Figure 90: Education of Respondent	109
Figure 91: Annual Household Income	109
Figure 92: Race/Ethnicity	110
Figure 93: Total Household Size	110
Figure 94: Number of Children in Household	110
Figure 95: Own or Rent Residence	111
Figure 96: Number of Years Lived at Current Residence	111
Figure 97: Sample Indoor and Outdoor Customer Antenna Configurations for a Fixed Wireless Network	113
Figure 98: CBRS Tiers (Source: FCC)	113
Figure 99: City of Dallas Pilot Locations	118
Figure 100: Model 1 Coverage and DISD Locations	127
Figure 101: Model 2 Coverage and DISD Locations	129
Figure 102: Model 3 Coverage and DISD Locations	131
Figure 103: Model 4 Coverage and DISD Locations	133
Figure 104: Model 5 Coverage and DISD Locations	135
Figure 105: City of Dallas Fiber Backbone and Rings: a Potential 100-Mile Design	141
Figure 106: Cost Scenarios for 180 Miles of City Fiber	144
Figure 107: Enrolled in AT&T's Access Program	163
Figure 108: Enrolled in Spectrum's Internet Assist Program	163
Figure 109: Receive \$9.25 Subsidy Under FCC's Lifeline Program	164
Figure 110: Agreement with Statements About Training Related to Computers and the Internet	166
Figure 111: Agreement with Statements About Training by Respondent Age	167
Figure 112: Devices Available in the Home by Respondent Age	168
Figure 113: Devices Available in the Home by Household Income	169
Figure 114: How Often Computer Becomes Unusable by Household Income	170
Figure 115: When Could Replace Computer by Household Income	170