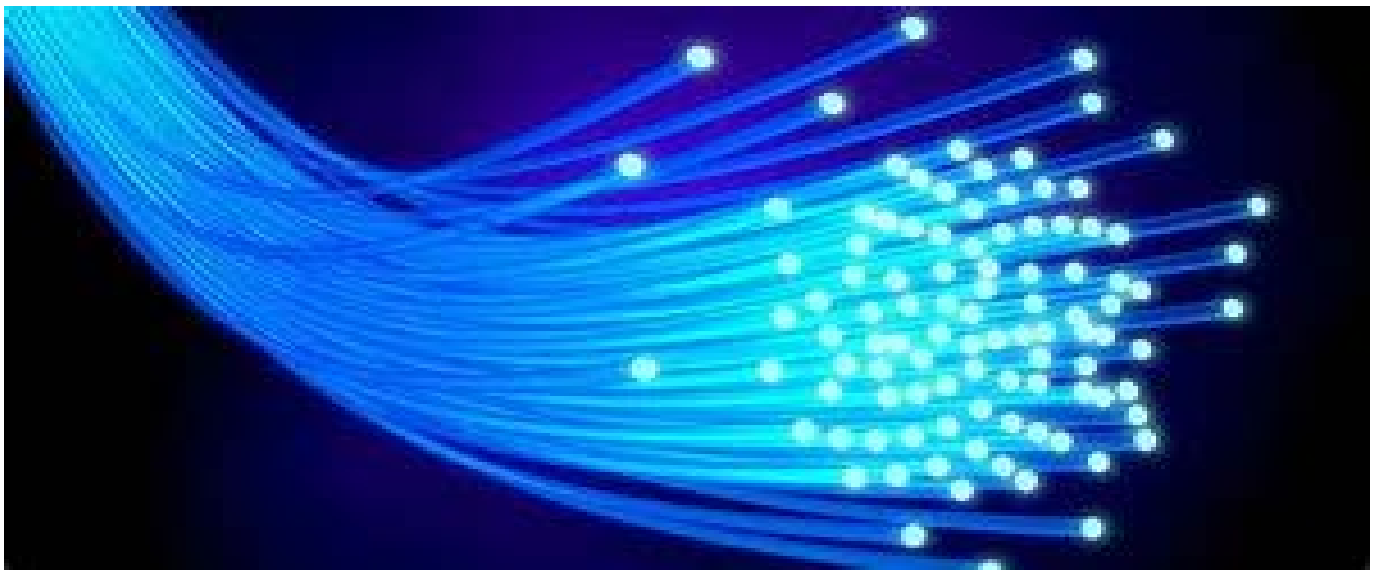

State of Maine

Broadband Action Plan

June 2018

CONNECTME

DECD
Maine Department of Economic and Community Development

Statewide Broadband Action Plan

Department of Economic and Community Development (DECD) – State of Maine

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1.0 Executive Summary

Broadband is now a necessary asset to attract and retain businesses and residents in Maine. Many rural communities do not have access to viable high-speed connectivity. This limits their ability to grow, innovate, support seniors staying in their homes, develop a strong workforce and to create an environment to attract business growth. Broadband access can also reduce costs of services, including health care and education over time.

The Broadband private sector investment model doesn't work in rural Maine. The low population density and limited scale make it unprofitable for the private sector to expand their networks with private investment only.

Public/Private partnerships is an option to optimize the private sector investment while driving the expansion needed to grow the Maine economy. We outline the model in the Action Plan.

This Statewide Broadband Action Plan (Action Plan) proposes that the state will contribute 25% of the total cost of the expansion needed for rural Maine. The remaining costs will come from the private sector, federal government and the local communities. That would make the State's investment be $150m.

Our goal is to complete this program in 5 years, with a minimum $40 million dollars committed by the State of Maine this year, with the balance over the next two years. The first year funding will start the work in high impact communities and demonstrate to the other public and private partners that Maine is committed to supporting and growing our rural economy and encourage their investment.

1st Year Funding Levels		
	Fund Amount	% of Goal
Minimum Commitment	$10,000,000	7%
Meaningful Contribution	$40,000,000	27%
LD-520	$100,000,000	67%
Full Commitment	$150,000,000	100%

2.0 Action Plan

Our Action Plan first builds a solid foundation from which to enable successful Public/Private partnerships by:

- Collaborating with the existing service providers to produce more accurate mapping of actual broadband speed availability by address;
- Redefines our definition of unserved to recognize the value of longer term investment;
- Sets long-term and intermediate goals to measure progress and success;
- Determines the overall cost to fill the gaps in availability, the ability of which has eluded us until now;
- Places our local communities firmly in the drivers seat to determine their own broadband destiny;
- Positions the State to support the local communities their effort to expand broadband;
- Distributes available subsidy dollars in a competitive and efficient manner;
- Holds the local communities accountable for the efficient deployment and use of public dollars;
- Leads a high-level effort, in collaboration with State leadership and our congressional delegation, to seek increased federal funding and private provider participation; and,
- Rewards those communities that are willing to lead, have the capacity to contribute funds and/or are willing to make broadband adoption commitments to convert what is currently an uneconomic investment, into a viable and sustainable solution.

2.1 DEVELOP ADDRESS SPECIFIC BROADBAND SPEED AVAILABILITY

The current ConnectME Authority Mapping relies upon the service provider submission of FCC Form 477 data, which by its definition, over-states availability geographically *(as an example, if a single address is served within the census block, the entire census block is considered served)* and reports the maximum advertised speed instead of the actual speeds available at a specific address.

With the cooperation of the service providers[1], we will revise the methodology to require address specific, actual speed available submissions to develop mapping with a much higher degree of accuracy. Providers who do not provide address specific actual speed availability data will not be eligible for subsidies.

[1] As of this writing, Consolidated Communications has entered into a non-disclosure agreement to provide address specific, actual speed availability and the other service providers we spoke with regarding this Action Plan have indicated a willingness to share their address specific data under similar non-disclosure agreements. This initiative is moving forward under ConnectME Authority guidance in parallel to this Action Plan and is not reliant upon this plan.

2.2 REDEFINE UNSERVED AND IDENTIFY BROADBAND TARGET

We have defined unserved potential subscribers as those locations where the available service is less than 25Mbps/3Mbps. We will also select 100/10 as the broadband target. These definitions will more closely align the Maine standards to the federal standards used by the FCC and other federal agencies and their funding programs. The current FCC standard considers service at 25Mbps/3Mbps as served.

Importantly, these definitions will be utilized to determine geographic areas eligible for implementation subsidies under this Action Plan, but do not necessarily define the capabilities to be deployed with the subsidized services.

2.3 DETERMINE TOTAL COSTS TO DEPLOY

Using the geography defined in the steps above and industry deployment metrics for outside plant construction, we will determine high-level estimated costs to deploy service using the following architectures:

- Open-access dark fiber capable of providing service at 10Gbps symmetrical
- Expand existing cable TV hybrid/fiber infrastructure capable of providing service at speeds up to 1Gbps symmetrical

This effort will define the scale of the broadband challenge on a statewide basis in terms of the maximum total dollars required. It is important to note that we are not excluding deployment of twisted-pair copper DSL solutions and their associated costs; rather, we recognize the determination of costs for DSL solutions cannot easily be calculated without detailed knowledge of the actual method of construction of the existing copper, the condition of that network, and the gauge of the conductors, all of which is proprietary to the underlying service providers.

2.4 PRELIMINARY COST ESTIMATES

In the absence of accurate mapping, we have made a series of assumptions to develop preliminary cost estimates to guide our efforts.

- The total sphere of Addressed Road Miles per Maine E911, which includes most seasonal and private roads, is 35,162 miles. We use this mileage to define to total addressable road mileage.
- Our best estimate of the total road mileage served by hybrid fiber/coax infrastructure is 17,502 miles. We arrive at this amount by interpolation of the FCC Form 477 reporting data *(based on census blocks)* and reduce the amount by 10% to account for the inherent overstatement of availability using this data *(see Section 2.1 above).*
- As a result, roughly 50% of roadways in Maine, or 17,660 miles, is considered unserved or below the broadband target level.

2.4.1 Open-Access Dark Fiber Cost Estimate

We estimate the total cost to deploy a statewide open-access dark fiber network, designed to enable any service provider to be able to lease a fiber connection to any location would cost at least $1.6 billion dollars. Importantly, this cost estimate does not include the drop fiber cable from the street to the subscriber or any electronics to deliver a finished service, which would be the responsibility of the service providers. Further, it is unlikely any private provider would contribute capital dollars for construction of such a statewide network unless they were afforded a long period of exclusive use before permitting other service providers to utilize the infrastructure.

Operating and maintaining such a network, and gaining sufficient market share to achieve sustainability, would also be a challenge in the face of a viable competitive infrastructure such as the cable TV hybrid/fiber networks already deployed in the most densely populated areas across 50% of the roadway footprint.

2.4.2 Cost Estimate to Expand Cable TV Hybrid Fiber/Coax Infrastructure

We estimate the total cost to expand the existing cable TV hybrid fiber/coax infrastructure, already deployed in the most densely populated areas may cost at least $600 million dollars, or more than 60% less than a ubiquitous open-access dark fiber network.

Unlike the open-access dark fiber network discussed above, the service providers whose network is being expanded would contribute private funding and be fully responsible for the operation and maintenance of such a network. As such, sustainability would not be an ongoing concern.

As with any public/private partnership, determining the share of public or private funding is difficult to project with certainty. We can however, leverage the experience in New York where the New York State Broadband Program Office (NYBPO) is in the process of implementing the third phase of their three phase reverse auction program to deploy high-speed broadband to the entire state.

Figure 1: New York State Private Contribution Example

New York State Broadband Program					
	State		Private Provider		Total
Phase 1 (Actual)	$54.2	72%	$21.6	28%	$75.8
Phase 2 (Actual)	$212.0	79%	$56.0	21%	$268.0
Subtotal	**$266.2**	**77%**	**$77.6**	**23%**	**$343.8**
Phase 3 (Planned)	*TBD*		*Minimum*	*20%*	*TBD*

**Dollar amounts in millions*

Based on the New York program, we would expect private providers to contribute 20%-25% of the deployment costs.

2.4.3 State Share of Funding

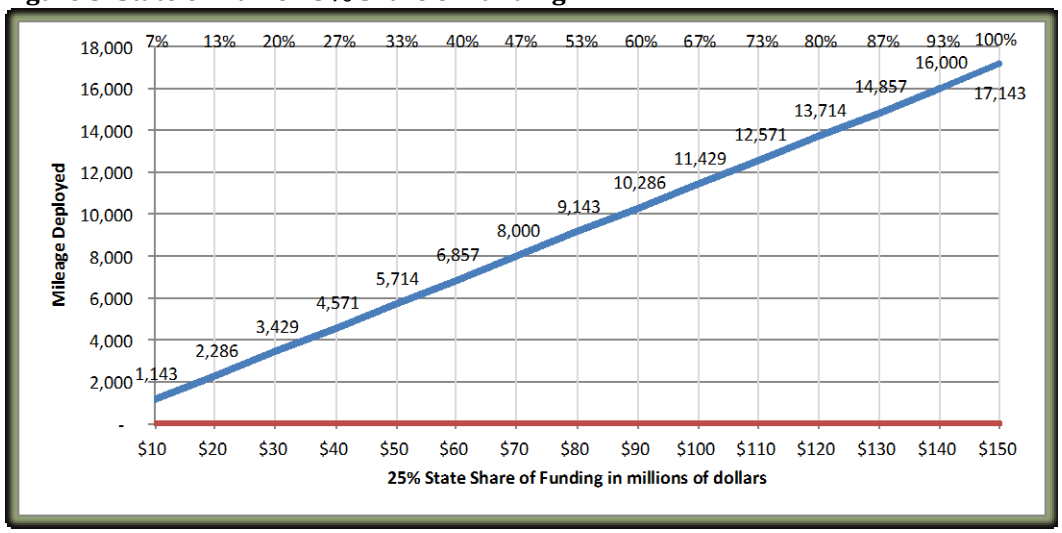
We believe the ideal method of sharing the funding is an equal allocation between the private provider and local, state and federal government, each contributing 25% of the funds. At the same time, we recognize many local communities may not have the capacity to fund at this level and also recognize we cannot count on the federal government to fill the gap. As a result, we anticipate the State share of funding to be 25% or $150 million dollars at the low end and as high as 75% or $450 million dollars without local or federal funding.

Figure 2: Public/Private Partnership Funding Matrix

Funding Amount	$600,000,000						
Public/Private Partnership Funding Matrix							
Private Provider		Local		State		Federal	
25%	$150	0%	$0	75%	$450	0%	$0
25%	$150	25%	$150	50%	$300	0%	$0
25%	$150	25%	$150	25%	$150	25%	$150
*Dollar amounts in millions							

Assuming the State funds 25% of the deployment, the chart below illustrates the road mileage and percent attainment to fill the broadband gap.

Figure 3: State of Maine 25% Share of Funding



2.5 ACTION PLAN FUNDING APPROACH

While committing the State to provide up to 75% or $450 million dollars will result in closing the gaps and solving the broadband challenge in the shortest time possible; we believe a much more conservative and capital efficient approach should be attempted as follows:

- State commitment to fund up to 25% or $150 million dollars of overall program. Funding can be disbursed on an annual basis as projects are developed and approved and does not require funding of entire program on day one.
- State commitment will act as seed funding to encourage and align funding by local and federal governments.
- Minimum 25% private provider contribution will be required in all instances.
- State will aggressively pursue federal funding to support specific projects and/or block grants to State *(directed to ConnectME Fund).*
- The local governments must secure any remaining funding; from whatever source they choose *(private, foundation, taxes, bonds, federal grants, etc.)*

This cost sharing approach appropriately balances the funding capacity of each partner, encourages both local and state governments to seek the balance of funding elsewhere, and encourages public/private partnership solutions without relying solely on state government to bridge the gap.

The table below illustrates the minimum commitment and what we believe is a meaningful amount that may stimulate participation by private providers, local government and the federal government.

Figure 4: 1st Year Funding Request

1st Year Funding Levels		
	Fund Amount	% of Goal
Minimum Commitment	$10,000,000	7%
Meaningful Contribution	$40,000,000	27%
LD-520	$100,000,000	67%
Full Commitment	$150,000,000	100%

2.6 PRIORITIZE AREAS ELIGIBLE TO BE SUBSIDIZED

The statewide unserved areas will be subdivided by county and by municipality to enable each government entity within the State to understand the broadband capability within each of their borders. Municipalities will be eligible for subsidy and participation in the reverse auctions based on the following criteria:

i. Municipality, or County if on behalf of the municipality, must have an active broadband committee guiding the effort to address broadband availability and adoption. Broadband committees must have members representing the following categories where available:
   a. Selectman or commissioner
   b. Educator
   c. Economic development
   d. Information technology

e. Small business
f. Large business
g. Residential consumer
h. Healthcare provider
i. Hospitality/tourism
j. Banking/Finance
k. Student

ii. Municipality/County has an adoption plan to maximize the use of the proposed broadband deployment that includes commitments/strategies.
iii. Municipality/County can demonstrate that efforts to negotiate with existing providers to upgrade or expand their networks have been exhausted, if the solution being proposed is not in partnership with an existing provider.
iv. Existing providers acknowledge that the areas being proposed meet the current unserved and/or are below the broadband target definition and that the existing providers have no finalized plans to upgrade or expand their service into the project area with capabilities exceeding the broadband target definition within 12 months.
v. Municipality/County can demonstrate that no more than 20% of potential subscribers to be served by the deployment are currently defined as underserved, and that no grant funding will be utilized to deploy infrastructure in areas already served.
vi. Municipality, or County if on behalf of the municipality, or their partner, can demonstrate that it has the technical, managerial and financial capacity and experience to operate the network capability being subsidized.

2.7 CONDUCT ANNUAL REVERSE AUCTION TO AWARD SUBSIDIES

Our primary method for the award of subsidies will be a reverse auction, although we recognize the potential need to develop an alternative method should there be areas without qualified applicants.

A reverse auction is a type of auction in which the roles of buyer and seller are reversed. In an ordinary auction (also known as a “forward auction”), buyers compete to obtain goods or services by offering increasingly higher prices. In a reverse auction, the sellers compete to obtain business from the buyer and prices will typically decrease as the sellers underbid each other.

In this instance, service providers will compete for subsidies with the subsidy awarded to the service provider willing to provide service with the least amount of subsidy. Properly administered, a reverse auction should result in the greatest capital efficiency.

At least two other reverse auction programs are in process for expansion of broadband service that can serve as a model for the State of Maine.

2.7.1 New York Reverse Auction Model

In 2017, the New York State Broadband Program Office (NYBPO) launched Phase 3 (final round of funding) to secure access to high-speed Internet for all New Yorkers by the end of 2018.

The award recipients are selected through a "reverse-auction" methodology, which prioritizes bidders seeking the lowest amount of state investment per new location served. Each RFP issued by the NYBPO contained refinements and enhancements that have enabled the NYBPO to design an innovative auction process across the state, preserving state funds and driving robust, cost-effective broadband deployments.

The NYBPO has defined an "Unserved" area as an area where the fastest available advertised Internet download speed offered by a wireline-based provider is less than 25 Mbps. An "Underserved" area is defined as an area where broadband service is only available from a wireline-based provider at advertised Internet download speeds between 25 Mbps and 99 Mbps. The NYBPO sets as a requirement for service a goal of 100 Mbps download speeds, with 25 Mbps acceptable in the most remote and rural areas.

Round III consists of two separate, simultaneous auction processes, which together will target all remaining unserved and underserved areas in the state. The majority of the locations in Round III will be addressed through the "New York Auction," which is modeled after the two previous rounds and will consist solely of state funding. Additionally, the "New York CAF Auction," will focus on the remaining areas, which are eligible for $170 million in Connect America Funds (CAF) recently allocated to New York State by the Federal Communications Commission (FCC). A significant enhancement to the Round III RFP is the inclusion of this federal matching fund – allowing eligible areas to complete broadband projects with both state and federal capital.

Rounds 1 and 2 have generated $344 million in Public/Private investment, with $266 million (77%) in State funding and $78 million (23%) in private funding.

2.7.2 FCC Connect America Fund Phase II Reverse Auction Model

On August 4, 2017, the FCC released its public notice and technical guidance outlining the structure and procedures for the Connect America Fund Phase II (CAF II) reverse auction. Up to $198 million per year for 10 years of ongoing support for fixed broadband networks will be available in the auction. The auction is open to all types of entities, public and private, that have experience operating networks and can meet other requirements. Bidding consortia are allowed.

The minimum bidding area is a census block group, but bidders can propose to serve multiple and extended areas.

The auction is a reverse auction, in which the winning bidder is the one that requires the lowest amount of support funds. Bidders start high and bid lower in each round until the aggregate support requested fits within the overall budget.

Bidders must demonstrate basic technical and financial competence. Bids are weighted to favor networks with high bandwidth, high data caps and low latency.

2.8 KEY DESIGN ELEMENTS FOR FUNDING

2.8.1 Technology

- Technology neutral
- No projects funded at less than 25Mbps/3Mbps
- Wireless and hybrid solutions are included with evidence demonstrating availability

2.8.2 Type of Projects to Fund

- Last mile solutions only
- Required middle mile to connect to backbone may be included

2.8.3 Method of Allocating Funding

- Program structured as reverse auction
- Awards to projects that meet goals at lowest cost per unit of State investment

2.8.4 Reimbursement/Payment Structure

- State funds capital expenditures only
- Private sector match targeted at 50%, but must be at least 20%
- Program can be combined with other existing incentives and federal programs

2.8.5 Pricing

- Service must be priced at the same price or lower than the providers pricing in other areas of the State

2.8.6 Qualifications

- Applicants must demonstrate financial, technical and management capabilities
- Must qualify per Section 4.4

2.8.7 Application Weighting

- Preference given to the following:

- Solutions of 100Mbps/10Mbps or greater (e.g. fiber, cable)
- Applications that include a local public and/or private (non-service provider) contribution, as well a contribution from the service provider

2.9 PROVIDE FUNDING LEADERSHIP

Success under this Action Plan will be defined by our ability to secure a combination of private funding (service provider investment) and public funding (local, state and federal), and will require a high level collaborative effort between State administrative and legislative leadership, and our congressional delegation.

We believe sufficient private funding is available from the service providers if sufficient subsidy funding is available to develop an overall economic investment on the part of the service providers. Securing sufficient pubic funding is clearly the most significant barrier to success.

2.9.1 Federal Funding

To confront this challenge, we propose the appointment of a high-level special envoy with extensive broadband development experience that will have the authority to represent the administration and have access to State leadership, and whose sole purpose will be to lead the State of Maine efforts to secure federal funding in collaboration with our congressional delegation. This special envoy will focus in the following areas for the State of Maine:

- Build a relationship with the FCC to influence the direct federal broadband subsidy programs to maximize the State's share of those dollars.
- Build relationships with the Administration of President Trump to influence the President's infrastructure investment program to maximize the federal dollars directed toward rural broadband expansion.
- Work with other executive departments of the Trump Administration to better coordinate programs that can direct funds from those budgets toward a greater level of funding for broadband expansion.

While we anticipate a near singular focus to secure federal funding, an additional mission will be to build relationships with the executive leadership of the large national providers to maximize their private investment in the State of Maine. As an example:

In 2015, the New York Public Service Commission approved the merger of Time Warner Cable and Charter Communications with the following requirements:

- Charter expanding service to 145,000 unserved premises in New York State
- Charter increasing speeds for over 2 million customers
  - 100 Mbps by end of 2018
  - 300 Mbps by end of 2019

- Charter launching first-ever statewide low-income broadband program
  - 30 Mbps for $14.99 per month

2.9.2 State Funding

2.9.2.1 ConnectME Fund

Currently funded by a ¼ of 1 percent assessment on Communications Service Provider State revenues, this funding source should be retained. We recognize this funding source is declining year-over-year as subscribers discontinue land-line based services and migrate to wireless services not assessed this fee. This source of funding should be devoted to administrative and project management expenses to govern this Action Plan and to continue funding Broadband Feasibility Studies at the municipal level to prepare communities for participation in the Action Plan.

2.9.3 Low Interest Loans

Low interest loans may enhance the ability of private industry to participate in public/private partnerships that will expand broadband availability under this Action Plan. Collaboration with the Finance Authority of Maine (FAME) will present an opportunity for the State to take a leadership position in assisting service providers to invest in these types of projects.

2.9.4 Local Funding

A key design element of the reverse auction process is to award projects meeting goals at the lowest cost per unit of State investment. Local funding in addition to private funding will naturally be given preference, as the cost per unit will theoretically be lower with local government participation. Local funding may be in the form of local public funding, local private funding (non-service provider partner), business donations, and public or private donations.

2.10 ACCOUNTABILITY

Accountability must be a key component and should be required of any applicant receiving funds as a result of this Action Plan. Likewise, it will be important for the State to be accountable for properly and efficiently distributing funds.

2.10.1 State of Maine Accountability

- Maintain mapping
- Develop and manage reverse auction process
- Collaborate with municipalities and service providers
- Present an annual progress report to legislature
- Educate stakeholders and constituents regarding the challenges and processes required to expand broadband availability

2.10.2 Applicant Accountability

- Complete projects on-time and within budget
- Measure and report actual speeds provided, latency, etc., in conformance with FCC Connect America Fund standards
- Measure and report on adoption attainment compared to plan

2.11 GOALS

2.11.1 Five-Year Goal

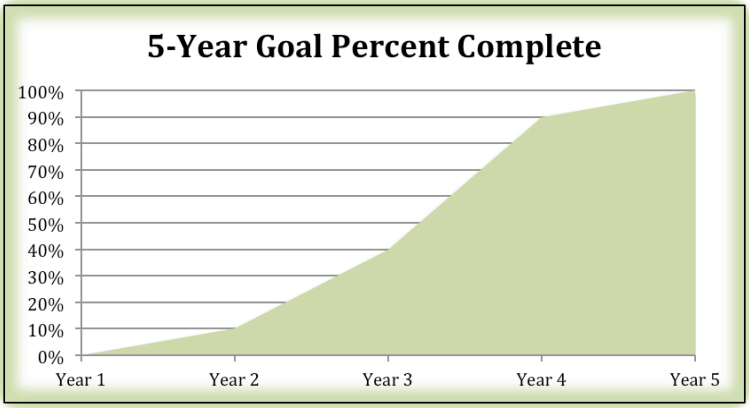
Within five years, 99%[2] of all potential subscriber locations statewide have access to at least one broadband provider with sufficient capacity needed for full participation in our society, democracy and economy, to enable civic and cultural participation, employment, lifelong learning, and access to essential services.

2.11.2 Interim Goals

Figure 5: Interim Goals

	Year 1	Year 2	Year 3	Year 4	Year 5
Redefine Unserved & Underserved					
Conduct 1st Round - Reverse Auction					
Establish Federal Funding Relationships					
Secure State Funding Commitment					
Secure Federal Funding Commitments					
5-Year Goal Percent Complete		10%	40%	90%	100%

Figure 6: Five-Year Goal Forecast



[2] The 99% goal is based upon the assumption that the cost to reach the last 1% is exorbitant and will be much more reasonably served via satellite-based services.

2.11.3 Actions necessary to reach 5-Year Goal

2.11.3.1 Funding Availability

The greatest risk to achieving the five-year plan will be the availability of funding in the early years of the plan. Once projects are awarded, engineering, utility pole make-ready and network construction will require 12-18 month to complete. As a result, all project areas will need to be awarded no later than the beginning of the fourth year.

If sufficient funding is not available within the first two years, the schedule will necessarily be extended until such funding becomes available.

2.11.3.2 Additional ConnectME Authority Staffing

The two current ConnectME staff positions will not be sufficient to achieve this aggressive five-year plan. We anticipate a requirement to augment the staff with either permanent employees or temporary contractors to manage the reverse auction process, assist the community applicants, govern the awards and ensure overall compliance with this Action Plan.

2.12 REVIEW AND UPDATE ACTION PLAN ANNUALLY

With the rapid changes in broadband technology, application development, and bandwidth capacity requirements, we anticipate this Action Plan to be reviewed and updated on an annual basis.

3.0 Potential Legislative Action

We have reviewed Title 35-A: Part 7, Sections 9201–9218, and find no requirements for legislative action to execute this Action Plan.

We note that any funds provided, from whatever source, should be directed to the ConnectME Fund as defined in Section 9211, and not into the Municipal Gigabit Broadband Network Access Fund as defined in Section 9211-A, as that fund requires the deployment of specific technology, speeds, symmetry and access that may inhibit the ability to implement the Action Plan, and further places limits on the grant amounts and required cash matches, thereby increasing the administrative burden and reducing the likelihood of success.

Appendix A – Stakeholder Collaboration

We believe stakeholder collaboration is a critical foundational element to a successfully implemented Action Plan. In the course of developing this Plan, we shared the guiding principles of our draft plan and sought input from a wide range of service providers (supply-side) and constituents (demand-side). While we regret that we did not have sufficient time to solicit a wider range of input, we are confident our plan will be widely supported based upon the conversations conducted. Importantly, this Action Plan has benefited tremendously from those conversations. All of the input we received was valuable to the effort and many thoughts and concepts shared have been incorporated into this Plan.

Going forward, it will be important to create an environment of routine, transparent and realistic collaboration between our supply-side and demand-side to execute on this Action Plan and improve the Plan on an annual basis.

Service Providers (Supply-side)
Below is a list of service providers who were engaged in the course of developing this Action Plan.

- FairPoint Communications
- Maine Fiber Company
- Telephone Association of Maine and its members
- Unitel
- Otelco
- Pioneer Broadband
- Charter Communications (Spectrum)
- Comcast Communications
- Bee Line Cable
- Axiom Technologies
- GWI
- TDS Telecom

Constituents (Demand-side)
Below is a list of organizations representing demand-side that was engaged in the course of developing this Action Plan.

- ConnectME Authority
- Maine Broadband Coalition

- Island Institute
- Somerset Economic Development Corporation
- Franklin County Broadband Coalition
- Piscataquis County Economic Development Council
- Downeast Economic Development
- Maine West
- Maine Farm Bureau
- Maine Municipal Association
- Maine School & Library Network

Appendix B – Principal Assumptions

- Current unserved areas are uneconomic to serve and require subsidy to attract private investment.
- Medium and large businesses have access to one or more providers offering sufficient high-speed services, although many rural areas do not enjoy the benefit of robust competition.
- Addressing residential service gaps will encompass small business and in-home small business needs, and will attract high-level professional employees and telecommuters seeking to relocate or stay in Maine.
- Extending an existing network or operational/organizational infrastructure is the lowest cost of deployment.
- Ubiquitous geographic competition is not sustainable in low density, rural areas.
- Subsidized private deployment is preferable to government-owned network infrastructure. Where a private provider is willing to serve but cannot generate the necessary returns without a portion of the capital investment subsidized, a public subsidy leverages that provider's existing infrastructure. This eliminates the risk to the community that building and operating its own network will require ongoing annual subsidies to fund the operation. If no private provider is willing to serve, even with a capital subsidy, then a government-owned network may be the only viable alternative.
- Utility pole make-ready costs and time frames are a significant barrier to deployment, but are already being addressed by state legislative and PUC actions/proceedings. As such, this Action Plan does not address this important component to solving Maine's broadband challenge.
- Reverse auctioning public subsidies for deployment of specific broadband capabilities will produce the lowest public cost to deploy and stretch public dollars further.

- Deployment in unserved areas will be prioritized over areas that have service over 25/3 but are not at the broadband target level.
- Projects may include underserved areas up to a maximum of 20% of the total project.
- It cannot be our responsibility to reach remote areas or to extend service to potential subscriber buildings far from a serving roadway.

Appendix C – Definitions

Definitions of Terms Used in this Action Plan

1. **Broadband –** Any wide-bandwidth data transmission method with the ability to transport multiple signals and traffic types simultaneously.

2. **Central Office –** A local telephone company building typically located in the center of a community or group of communities that houses optical and electronic equipment to distribute services via cables that emanate from the central office to all locations of the community.

3. **CLEC –** Competitive Local Exchange Carrier. (Examples in Maine are GWI, LCI, Pioneer Broadband, Otelco, and FirstLight.)

4. **ConnectME Authority –** An independent State agency formed to develop and implement broadband strategy for Maine.

5. **Dark Fiber –** A single fiber optic strand without the optical electronics required to light the fiber and provide services.

6. **DECD –** State of Maine Department of Economic and Community Development.

7. **DSL –** Digital Subscriber Line. A technology used to deliver Internet Access over twist-pair copper cable.

8. **DSLAM –** Digital Subscriber Line Access Multiplexer. Electronic device used to aggregate multiple DSL circuits into a single downstream connection to the Internet. Commonly located in a central office or remote terminal.

9. **Drop –** The connection from the service provider's cabling running along the roadway in front of a subscriber to the subscriber building.

10. **FCC –** Federal Communications Commission.

11. **Fiber Optic –** A glass strand smaller than a human hair that it capable of transmitted a virtually unlimited amount of bandwidth using optical lasers.

12. **FTTP –** Fiber-to-the-Premise (FTTP) is a network utilizing fiber optic cables directly to the home or business and is capable of offering virtually unlimited symmetrical bandwidth.

13. **Hybrid Fiber/Coax –** The infrastructure deployed by cable TV providers that utilizes fiber optic cables to a node and coaxial cable from the node to the subscriber.

14. **ILEC – Incumbent Local Exchange Carrier –** The local telephone company serving the area.

15. **ISP –** Internet Service Provider. Most all ILECs, RLECs, RBOCs and CLEC are ISPs.

16. **Internet access –** Connects individual computer terminals, computers, mobile devices, and computer networks to the Internet, enabling users to access Internet services, such as email, applications and information delivered via the World Wide Web. Internet service providers (ISPs) offer Internet access through various technologies that offer a wide range of data signaling rates (speeds).

17. **Lit Fiber –** Dark fiber that has been activated (lit) with optical electronics on either end of the dark fiber to provide broadband or telecommunications services.

18. **Make-Ready –** Process to make a utility pole ready for attachment of a new communications cable.

19. **Open-Access Dark Fiber –** Dark fiber available to any user on a non-discriminatory basis.

20. **Open-Access Lit Fiber –** Services offered on a non-discriminatory basis over a fiber optic cable where the service provider has installed the required optical electronics to light the fiber.

21. **Outside Plant –** Communications cabling attached to utility poles or run through underground conduits.

22. **OSP –** Outside Plant

23. **POTS –** Plain Old Telephone Service

24. **Potential Subscriber –** A residential or business location that could potentially subscribe to broadband service.

25. **RBOC – Regional Bell Operating Company –** The regional companies that were created at the breakup of AT&T in 1984. FairPoint is considered the RBOC for Maine.

26. **RLEC – Rural Local Exchange Carrier –** A local telephone company that is not an RBOC. TDS Telecom is a RLEC.

27. **Remote Terminal –** An outside plant cabinet located on the ground or attached to a utility pole or some other supporting structure that houses optical electronics for the provision of DSL service over a twisted-pair copper cable.

28. **Served (area) –** A geographic area where broadband service is available at speeds in excess of 100 Mbps/10 Mbps.

29. **Twisted-pair copper –** The type of outside plant cabling initially used to provide POTS and more recently to provide DSL-based Internet access.

30. **Unserved (area)** – A geographic area where broadband service is not available or where the speeds are less than 25 Mbps/3 Mbps.

31. **World Wide Web –** The World Wide Web (abbreviated WWW or the Web) is an information space where documents and other web resources are identified by Uniform Resource Locators (URLs), interlinked by hypertext links, and can be accessed via the Internet.

Appendix D – FCC Household Broadband Guide

As defined by the FCC Office of Engineering & Technology *(date last updated/ reviewed: September 22, 2017)*[3], the chart below compares minimum download speed (Mbps) needed for light, moderate and high household use with one, two, three or four devices at a time (such as a laptop, tablet or game console).

These numbers are rough guidelines and are not based on surveys or experiments conducted by the FCC.

Figure 7: FCC Household Broadband Guide

	Light Use	Moderate Use	High Use
	(Basic functions: email, browsing, basic video, VoIP, Internet Radio)	(Basic functions plus *one* high-demand application: streaming HD video, multiparty video conferencing, online gaming, telecommuting)	(Basic functions plus *more than one* high-demand application running at the same time)
1 user on 1 device	Basic	Basic	Medium
2 users or devices at a time	Basic	Medium	Medium/Advanced
3 users or devices at a time	Medium	Medium	Advanced
4 users or devices at a time	Medium	Advanced	Advanced

Basic Service = 3 to 8 Mbps*
Medium Service = 12 to 25 Mbps
Advanced Service = More than 25 Mbps
*Mbps (Megabits per second) is the standard measure of broadband speed. It refers to the speed with which information packets are downloaded from, or uploaded to, the Internet.

[3] https://www.fcc.gov/research-reports/guides/household-broadband-guide

Appendix E – Broadband Delivery Technologies

In this section, we present an overview of different Internet access technology, including digital subscriber line, cable modem, fixed wireless, 4G/LTE Advanced, satellite, and Fiber-to-the-Premise.

Digital Subscriber Line (DSL)
Digital subscriber line (DSL) is a technology used primarily by traditional telephone system operators to deliver Internet services over twisted pair copper telephone wires. This technology typically has lower data carrying capacity than the hybrid fiber coaxial network deployed by cable system operators. Data speeds are range-limited by the length of the copper cable serving the premise, the wire gauge of the copper conductors, and the condition of the copper.

The bit rate of consumer DSL services can range from 256Kbps to over 100 Mbps in the direction to the customer (downstream), depending on the DSL technology, line conditions, and the length of the copper loop.

At the central office, a digital subscriber line access multiplexer (DSLAM) terminates the DSL circuits and aggregates them, where they are handed off to other networking transport equipment. The DSLAM terminates all connections and recovers the original digital information. For locations beyond the maximum distance from the central office for the particular type of DSL technology deployed (7,000 – 12,000 feet), DSLAMs can be deployed in the field in outside plant cabinets (remote terminals) and connected to the central office by fiber optic cables. A shorter distance from the premise to the DSLAM results in greater bandwidth (speed and/or capacity) for the connected users.

Hybrid Fiber / Coax
Cable modem Internet access is provided over a hybrid fiber-coaxial (HFC) broadband network. It has been employed globally by cable television operators since the early 1990s, and is the network architecture utilized by the cable system operators here in Maine. In a HFC cable system, the television channels are sent from the cable system's distribution facility, the headend, to local communities through optical fiber trunk lines. The fiber-optic trunk lines provide adequate

bandwidth to allow future expansion for bandwidth-intensive services. At the local community, an optical node translates the signal from a light beam to an electrical signal, and sends it over coaxial cable lines for distribution to subscriber residences.

The coaxial portion of the network connects 25–2,000 homes in a tree-and-branch configuration off from the node. RF amplifiers are used at intervals to overcome cable attenuation and passive losses of the electrical signals caused by splitting or "tapping" the coaxial cable.

Data over Cable Service Interface Specification (DOCSIS) is an international telecommunications standard that permits the addition of high-bandwidth data transfer to an existing cable TV (CATV) system. The latest version, DOCSIS 3.1, is capable of supporting Internet speeds of up to 10 Gbps, but most providers are currently offering speeds of 1 Gbps or less for residential users.

Fiber-to-the-Premise (FTTP)
Fiber to the Premise (FTTP) is a network utilizing fiber optic cables directly to the home or business and is capable of offering virtually unlimited symmetrical bandwidth. Most FTTP networks can offer 1 Gbps of bandwidth in both download and upload directions, with some providers offering 2 Gbps and even 10 Gbps service capacity.

Fixed Wireless
Fixed wireless broadband is the operation of wireless devices or systems used to connect two fixed locations (e.g., building to building or tower to building) with a radio or other wireless link. Fixed wireless data (FWD) links are often a cost-effective alternative to leasing fiber or installing cables between the buildings. The point-to-point signal transmissions occur through the air over a terrestrial microwave platform. The advantages of fixed wireless include the ability to connect with users in remote areas without the need for laying new cables and the capacity for broad bandwidth that is not impeded by fiber or cable capacities. Fixed wireless services typically use a directional radio antenna on each end of the signal. These antennas are generally larger than those seen in Wi-Fi setups and are designed for outdoor use. They are typically designed to be used in the unlicensed Industrial, Scientific, and Medical (ISM) radio frequency bands (900 MHz, 1.8GHz, 2.4 GHz and 5 GHz). However, in many commercial installations, licensed frequencies may be used to ensure quality of service (QoS) or to provide higher connection speeds.

To receive this type of Internet connection, consumers mount a small dish to the roof of their home or office and point it to the transmitter. Line-of-sight is usually necessary for Wireless Internet Service Providers (WISPs) operating in the 2.4 and 5 GHz bands. The 900 MHz band offers better non-line-of-sight (NLOS) performance. Providers of unlicensed fixed wireless broadband services typically provide equipment to customers and install a small antenna or dish somewhere on the roof.

This equipment is usually deployed and maintained by the company providing that service.

Mobile Wireless

4G/LTE Advanced is the latest wireless technology that is being deployed by cellular telephone providers such as AT&T, Verizon Wireless, US Cellular, Sprint and T-Mobile for traditional mobile phone and data services. The latest standard incorporates two new technologies - Carrier Aggregation, and Multiple Input Multiple Output (MIMO), in order to provide speeds in excess of 100 Mbps, and eventually up to 1 Gbps and beyond. While standard data connections use one antenna and one signal at any given time, 4G LTE Advanced has the capability of utilizing multiple signals and multiple antennas.

Mobile LTE wireless service uses MIMO technology to combine multiple antennas on both the transmitter and the receiver. A 2×2 MIMO configuration has two antennas on the transmitter and two on the receiver, but the technology is not limited to 2x2. More antennas could theoretically operate at faster speeds as the data streams can travel more efficiently. The signal is then combined with 'carrier aggregation," which allows a device to receive multiple different 4G signals at once. The received signals don't have to be on the same frequency; you could receive an 1800MHz and an 800MHz signal at the same time which is not possible with standard 4G. Up to five different 20MHz signals can be combined to create a data pipe of up to 100MHz of bandwidth.

LTE wireless is a rapidly evolving technology and the next generation (5G) is already being field tested and deployed. The term "5G" is the fifth generation of wireless systems and expected to provide significant increases in bandwidth.

Satellite

Satellite Internet is available to virtually the entire lower 48 states, with some coverage in Alaska, Hawaii and Puerto Rico. The satellites are positioned more than 22,000 miles above the equator. These satellites are geostationary, which means they are always above a specific point on the earth as it rotates. The first Internet satellites successfully brought the Internet to a larger audience, but the rates were incredibly slow. Modern satellites use more advanced technology to transmit information, which provides faster Internet access, but still much slower than landline-based Internet and terrestrial wireless Internet services.

When a consumer subscribes to satellite Internet, the company installs household equipment that consists of an antenna dish and a modem. The antenna is located outside of the house and is generally two or three feet in diameter. The antenna must have an unobstructed view of the sky, called the line-of-sight, in order to communicate with the satellite. The antenna is connected to a modem, which connects to a computer with an Ethernet cable.

To manage bandwidth quality for all users, each plan comes with a cap on the data you can transmit or consume per month. The amount of data allotted depends on the subscriber's plan. Plans typically range from 5GB to 50GB of data transmission per month with use limits prescribed. If you exceed the allotted data amount, Internet speeds will be throttled until the next month. However, some companies allow subscribers to pay for more data capacity once the threshold is met, resetting normal operation levels.

Looking forward, a new company – OneWeb (shareholders include Qualcomm, Hughes, Intelsat, Coca-Cola, Airbus Group, the Virgin Group and SoftBank Group) is shooting for 2021 to achieve 2.5 gigabits per second direct to a rural home. OneWeb claims the service will be low latency and will enable uninterrupted voice, data and video capabilities. The company received permission from the FCC in June to deploy a global network of 720 low-Earth orbit satellites using the Ka (20/30 GHz) and Ku (11/14 GHz) frequency bands. Earlier this year, the company broke new ground for a satellite manufacturing facility in Exploration Park, Florida, that will be capable of producing 15 satellites per week.

OneWeb is the first of several entities that filed for FCC authority to deploy a large constellation of non-geostationary-satellite orbit (NGSO) fixed satellite system satellites. According to the Satellite Industry Association, the FCC received more than 15 NGSO applications in three processing rounds for system constellations in the Ku and Ka bands and V band. SpaceX and Boeing are among those proposing new, huge constellations.

Satellite industry proponents say that now, unlike decades ago when Teledesic and the earlier iteration of Iridium failed to make successful businesses, technology advancements are enabling satellite service to be offered more affordably and efficiently.