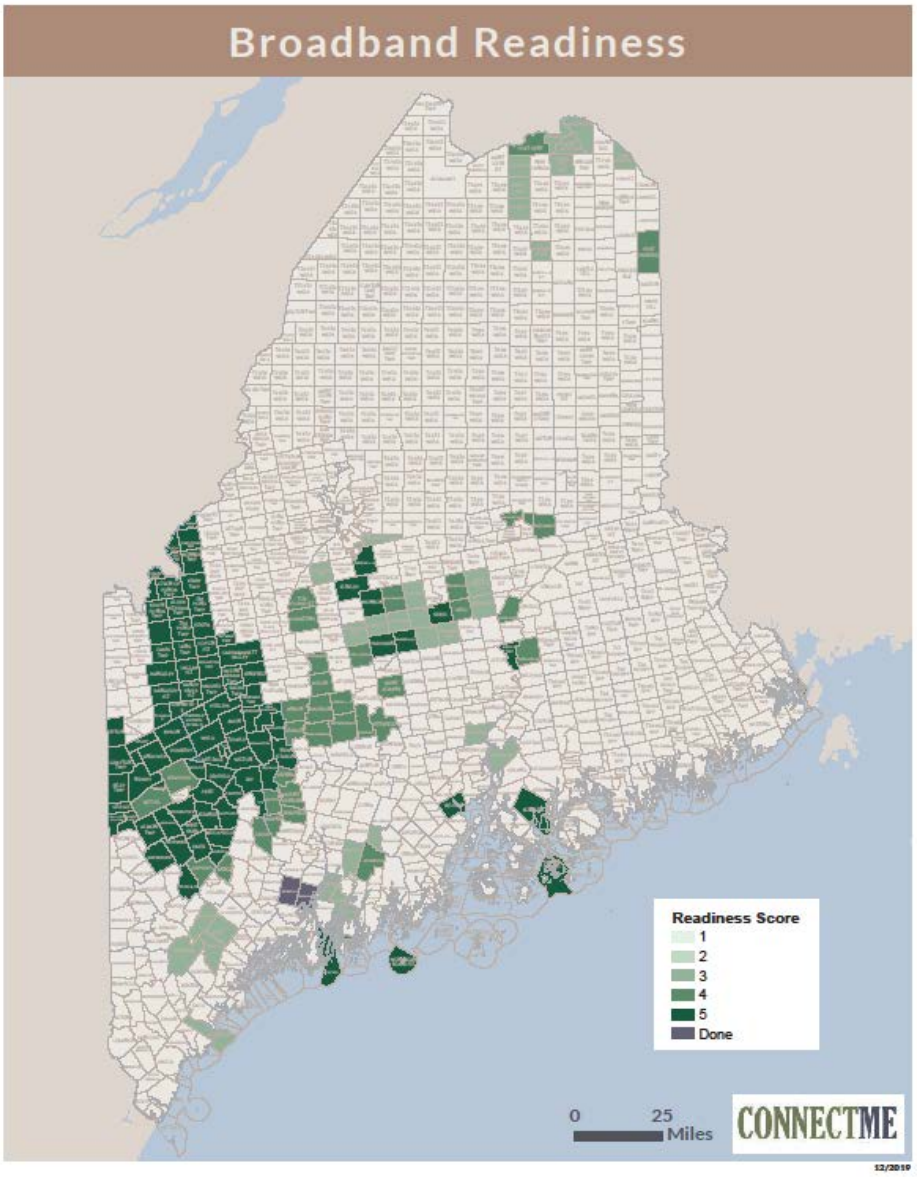
CONNECTMAINE



State of Maine

Broadband Action Plan January 2020

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Executive Summary

Broadband is now a necessary asset to attract and retain businesses and residents in Maine. Most rural communities do not have access to viable high-speed connectivity. This limits their ability to develop a strong workforce, incubate innovation, create an environment to attract new residents and businesses, and support seniors and others to stay in their homes. Broadband access can also improve delivery and reduce costs of services including health care and education. As Maine works to address significant workforce challenges, universal access to high speed broadband will play a foundational role in building digital skills, attracting workforce and reducing inequality in our educational system.

The private sector broadband 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. This persistent market failure is the driving force behind state, local and federal investments in high speed internet connectivity for rural areas.

This plan recognizes the importance of high-speed connections for Maine's economic development. It also recognizes the importance of a focus on higher upload speed as a key element to that strategy. Download is how the world talks to Maine. Upload is how Maine talks to the world. For high speed broadband to have the potential to transform workforce development, education, health care, and communities; it is critical for upload speed to be adequate to meet the demands of Maine's economy. We recognize that adequate upload speeds will drive technology that is scalable for the future. That ability to scale to meet future increased capacity demands is at the core of our state investment strategy.

While Maine communities have similar economic and community challenges, every community in Maine will have a different solution to those challenges. When you have seen one rural Maine community, you have seen one rural Maine community. For that reason, ConnectMaine's plan to build out high speed affordable, reliable internet is based on a community planning model. Communities, whether a single town, a group of towns, a county or some other compilation, must be firmly in the driver's seat in determining their own broadband destiny.

These community plans will rely on public/private partnerships to optimize the private and public-sector investment while driving the high-speed internet expansion needed to grow the Maine economy.

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. To complete this program by 2025, we are recommending an investment of *$30 million dollars in FY20/21 and $42.5 million in each of the next four years* to be committed by the State of Maine.

That would make the total State's investment $200 million over the next five years to reach the goal set forth in the State of Maine Strategic Plan. This total amount is less than half of what MDOT spends on the State highway and bridge system annually. Bringing high speed

connectivity to rural Maine is relativity cheap, given the economic payback, estimated to be at least a 4:1 return.[1] It is also the critical infrastructure needed for Maine communities to attract new residents, increase workforce and education, and address climate change issues.[2]

ConnectMaine understands that an average investment of $40 million over the next 5 years is a significant lift, even though the need and projects are there right now to successfully use this level of funding to bring connectivity to rural Maine. The planning process in Oxford and Franklin Counties alone have identified a need for $140 million to bring a Fiber-to-the-Premise (FTTP) solution to residents. For this action plan, ConnectMaine is revising the idea of using a reverse auction to distribute the funding.

Instead, ConnectMaine is recommending a two-track grant/loan process. The first track depends on public/private partnerships that will fund already identified projects in communities. These communities have been engaged in community planning and actively engaged providers, residents, businesses, education and health care to create a specific strategy for near universal service. These will be substantial projects that seek to bring affordable, reliable, scalable high-speed connectivity to 90-95% of the community's geographic footprint. Currently, well over 50 communities in Maine have gone through this process and are awaiting enough funding to implement their plan.

The second track is for providers who are seeking to fill in "dark" gaps in communities that are currently unserved. These projects are by their nature smaller and require less community engagement. Both tracks will require match from providers and community support to demonstrate need.

Action Plan

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

- Placing our local communities firmly in the driver's seat to determine their own broadband destiny;
- Collaborating with the existing service providers to produce more accurate mapping of actual broadband speed availability by address;
- Defining our definition of unserved and underserved to recognize the value of longer-term investment;
- Supporting deployment of a high-quality networks that have the ability to deploy low latency, symmetrical upload and download speeds, fixed broadband which are scalable for the future.

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[1] https://www.pcrd.purdue.edu/files/media/006-RPINsights-Indiana-Broadband-Study.pdf and: https://blandinfoundation.org/learn/research-rural/broadband-resources/broadband-initiative/measuring-impact-broadband-5-rural-mn-communities/return-on-investment/

[2] http://www.cetfund.org/files/BB_GREEN_STRATEGY_Summary%20Report_05092014.pdf

- Setting long-term and intermediate goals to measure progress and success;
- Determining the overall cost to fill the gaps in availability;
- Positioning the State to support the local communities in their effort to expand broadband;
- Distributing available subsidy dollars in a competitive and efficient manner;
- Holding the local communities and their partners accountable for the efficient deployment and use of public dollars;
- Working closely with Maine's federal delegation and national organizations to develop different financing models and increase federal funding, provider participation and reduce the restrictions that make federal funds difficult to obtain; and
- Rewarding 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.

Develop Address Specific Broadband Speed Availability

The current ConnectMaine Authority Mapping relies upon the service provider submission of FCC Form 477 data, which by its definition, dramatically over-states availability geographically. As an example, if a single address is served within the census block or could reasonably be served, the entire census block is considered served. The 477 forms also report the maximum advertised speed and not the actual speeds available at a specific address.

Over the last year, ConnectMaine has worked with service providers to improve data collection with mixed results. Consolidated Communications signed a non-disclosure agreement last year and has provided ConnectMaine with address specific, actual speed availability for their former Verizon footprint. Many of Maine's small ISPs have provided information to improve ConnectMaine mapping with better information on unserved areas within their service footprint.

Charter, Comcast and TDS have declined to provide ConnectMaine with similar information to improve the data communities need to determine the best options for expanding service. Lack of accurate data is one of the key barriers standing in the way of improving high speed internet to communities undertaking a planning process. *Providers who do not provide address specific actual speed availability data will not be eligible for subsidies.*

Define Unserved and Underserved Areas

The Authority will define unserved potential subscribers as those locations where the available service is less than 25Mbps/3Mbps and underserved potential subscribers as those locations where less than 20% of the households within a geographic area have access to adequate broadband service. The current FCC standard considers service at 25Mbps/3Mbps as served. Therefore, using these definitions aligns the Maine standards to the federal standards used by the FCC and other federal agencies and their funding programs.

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

Calculation of Preliminary Cost Estimates to Bring High-Speed Internet To 95% Of Maine by 2025.

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.
- As a result, roughly 50% of roadways in Maine, or 17,660 miles, is considered unserved or underserved.

This effort defines the scale of the broadband challenge on a statewide basis in terms of the 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.

Cost Estimate to expand high speed internet to areas unserved by current Hybrid Fiber/Coax Infrastructure

This estimate focuses on areas of the state that cannot get access to at least a 25Mbps/3Mbps within the current hybrid fiber/coax infrastructure as we know it. There are two significant caveats here. The first refers to the inaccuracy of the mapping and data as noted. This is a national problem that originates with the data the FCC collects. While the FCC is revising its data collection and mapping process in 2020, the current "form 477 data" is the best available without participation of the providers at the state level. **The second caveat is that this plan makes an assumption that cable service will continue to upgrade the capacity of their service to** meet performance criteria that are essential to real-time video communications, video streaming, interactive gaming, file-sharing, and network storage and other applications and meets the ConnectMaine criteria for determining what areas are underserved.

Using our estimate of 17,502 miles that are unserved by current cable fiber/coax infrastructure, and a cost of $35,000 per mile to construct, we estimate the total cost to build out those areas to be at least $600 million dollars. Using these calculations and the information provided by providers, we estimate that over 83,000 addresses in Maine do not have adequate broadband access. In reality, that number is most likely to be greatly understated, meaning many more than 83,000 households are unserved.

Expanding networks to areas unserved by the current cable TV hybrid fiber/coax infrastructure will allow for development of private/public partnership strategies that will provide the greatest flexibility in terms combining funding options for the build out of these networks. It will also

provide greater flexibility for the operation and maintenance of networks. As such, network sustainability can be built into these partnerships.

These networks must be designed to meet performance criteria that are essential to real-time video communications, video streaming, interactive gaming, file-sharing, network storage and other applications. Once installed, the networks must be able to be easily upgraded as the demand for internet capacity increases.

Having access to connectivity is not the only barrier to internet use; the cost of service is also a key element that hinders Mainer's ability to access the internet. As part of the grant process ConnectMaine does look at the cost of service to the customer, including whether a plan's monthly data cap would unreasonably hinder these uses.

As with any public/private partnership, determining the share of public or private funding is difficult to project with certainty. There are many examples across the county of how state, local and private funding combined with the potential of federal funds can bring service to specific areas. Based on similar programs nationwide, we would expect private providers to contribute 20% - 50% of the deployment costs. We can also learn from the last five years of ConnectMaine grants.

Figure 1: Past 5 years of Community Match

Community Match	Provider Match	ConnectMaine Funding	Total Project Cost	Households Served
$1,367,473	**$3,632,969**	**$3,523,491**	**$8,523,933**	**3,876**
16%	**43%**	**41%**	**100%**	

State Investment

We believe the ideal method of sharing the funding is an equal allocation between the private provider and local, state, and federal government. At the same time, we recognize many local communities may not have the capacity to fund at this level and recognize we cannot count on the federal government to fill the gap. In some areas funding from other sources like local banks and increased take rates (the rate that subscribers take an internet service) may fill some of the financing gap.

We envision the State share of these investments could be as high as 75% or $450 million without local or federal funding. At the low end, if the state can fund an average of 25% of the projected cost, it would require a minimum of $200 million. In the end, state funds required will be somewhere in between those two numbers. This mix of state, local, provider and federal funding is one of the key reasons our strategy depends on strong community planning activity.

Figure 2: Ideal 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*

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 $200 million dollars of overall program. Funding can be disbursed on an annual basis for the next five years 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, private providers, potential loans and federal government programs.
- 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 ConnectMaine 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.

Prioritize Areas Eligible to Be Subsidized Through the Track One Community Planning Process

Currently, well over 50 communities statewide have undertaken a community planning process and have a plan in place to expand high speed connectivity but are awaiting funding. Unserved and underserved areas will be eligible for grant and/or loan subsidy based on the following criteria:

i. Have an active broadband committee guiding the effort to address broadband availability and adoption. Broadband committees will have members representing the following categories where available:

   a. Selectman, councilman or commissioner
   b. Education
   c. Economic development
   d. Information technology
   e. Small business

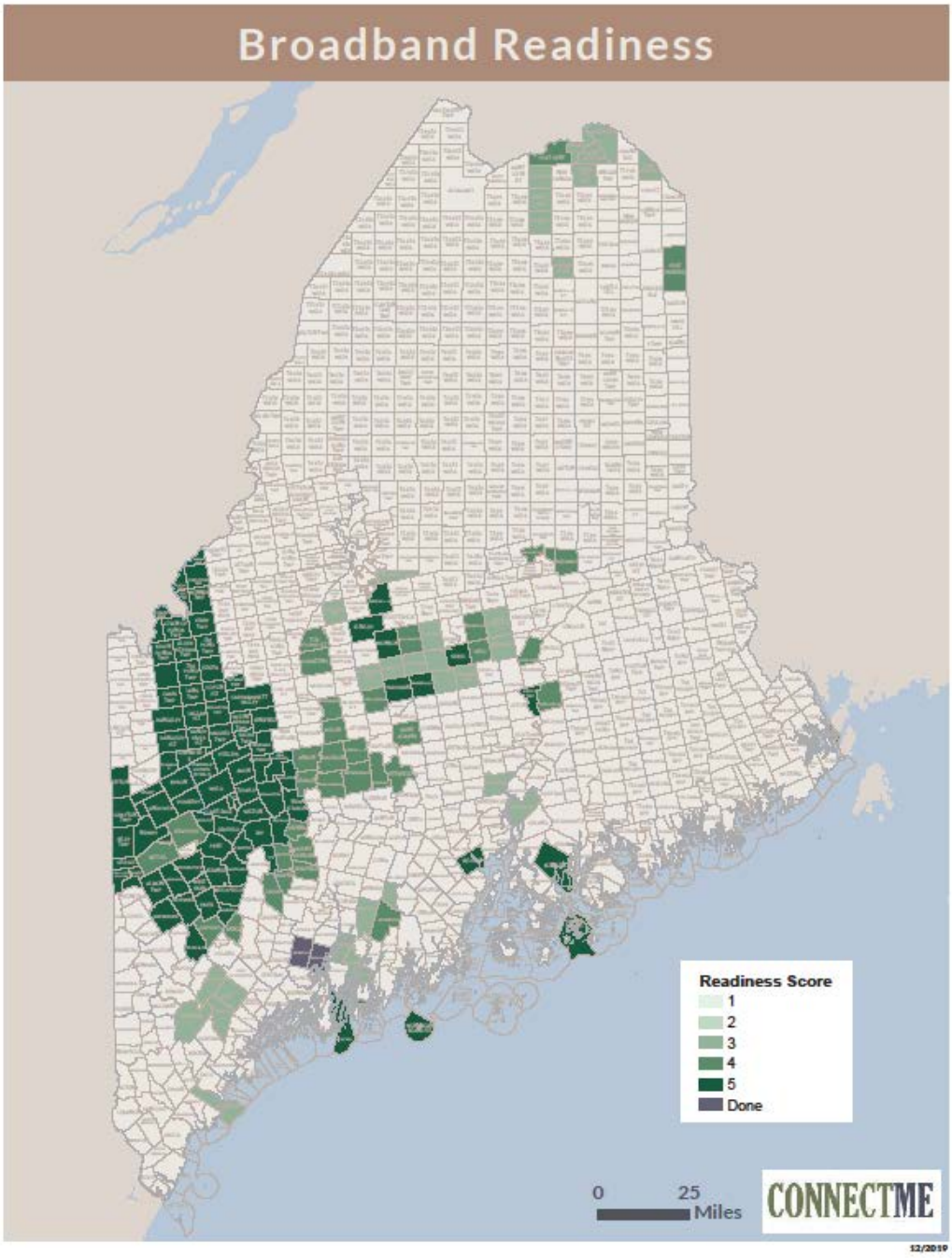
f. Large business
g. Residential consumer
h. Healthcare provider
i. Hospitality/tourism
j. Banking/Finance
k. Students

ii. The area has an adoption plan to maximize the use of the proposed broadband deployment that includes commitments/strategies.
iii. The area 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 underserved definition and that the existing providers have no finalized plans to upgrade or expand their service into the project area with capabilities exceeding the underserved definition within 12 months.
v. 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. Demonstration of technical, managerial and financial capacity and experience to operate the network capability being subsidized.

Priority Areas Eligible for Subsidy Through the Track Two - Small Scale Gaps Process

Unserved areas will be eligible for grant and/or loan subsidy based on the following criteria:

i. The applicant has the support of at least 35% of the potential customers for the expansion
ii. The applicant can demonstrate that efforts to negotiate with existing providers to upgrade or expand their networks have been exhausted.
iii. Existing providers acknowledge that the areas being proposed meet the current unserved definition and that the existing providers have no finalized plans to upgrade or expand their service into the project area with capabilities exceeding the ConnectMaine build standard of 10/10 within 12 months. Build standard is the minimum speed capacity any expansion of internet service must provide when funded with ConnectMaine funds.
iv. Demonstration of technical, managerial and financial capacity and experience to operate the network capability being subsidized.
v. 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. Applicants with federal and local match will be scored higher. In no case will ConnectMaine subsidies be more than 65% of the cost of a build.



Key Design Elements for Funding

Technology

- Technology neutral, and easily scalable to meet future demands that meet the minimum build standard of 10/10
- Wireless and hybrid solutions are included with evidence demonstrating availability to meet minimum build standards and that are easily scalable for future demand.

Type of Projects to Fund

- Last mile solutions primarily. Last mile is the final connection to a premise.
- Required open access middle mile to connect the last mile to backbone (for example: the 3Ring Binder) may be included.

Priority infrastructure projects through a competitive process.

The Authority will give preference among infrastructure grant applications to public/private partnerships that provide the greatest relative improvement to existing internet service using the following criteria:

- Active community engagement in planning process;
- Level of match from the community and provider;
- Number of potential subscribers and cost per pass;
- Increase in download and upload speeds;
- Cost of service for customers;
- Inclusion of an affordability component for low to moderate income.

Reimbursement/Payment Structure

- State funds capital expenditures through grants, loans or demand aggregation provision
- Private sector match targeted at 50% but must be at least 25% for Track One, and no less than 45% for Track Two.
- Program can be combined with other existing incentives and federal programs

Pricing

- Service must be priced at the same price or lower than the providers pricing in other areas of the State
- No data caps

Qualifications

- Applicants must demonstrate financial, technical and management capabilities
- Private ISP, unit of local government, including town, city, county, regional council of governments, broadband utility district or corporation wholly or partially owned by a unit of local government.

Application Weighting – ConnectMaine Scoring Criteria

ConnectMaine's scoring preference include

- 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.

ConnectMaine also utilizes the following scoring criteria when evaluating applications for infrastructure:

Cost-Benefit. The cost-benefit scoring is based on the amount of funding requested from the Authority per customer eligible to be served by the project, with lower funding per customer receiving a higher cost-benefit score;

Community Support. The community support score is based on evidence of community support for the project and the percentage of a households within the project area that will be served by the proposed project;

Project Scope. The project scope score is based on the number of customers to be served by the project, the type and, when relevant, the speed of service to be offered by the project and the applicant's financial commitment to the project; and

Project Value. The project value score is based on the estimated price per customer to receive service from the proposed project and any other details of the project that may benefit customers in the area proposed to be served by the proposed project.

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 Maine's congressional delegation.

Without public funding, areas of the state that do not have broadband service will not attract private investment. Sufficient public funding is clearly the most significant barrier to implementing this plan. We believe private funding is available from the service providers if sufficient public subsidy funding is available to develop an overall economic investment on the part of the service providers.

Federal Funding

While anticipated federal funding is a key element of how Maine will finance high speed connectivity in rural areas, we acknowledge the current federal program guidelines do not align well with Maine's funding needs.

For example, the USDA ReConnect Program's requirement of no more than 10% of a grant proposal be served at greater than 10Mbps/1Mbps limits the areas where those grants can be used. ConnectMaine will work with our federal delegation and federal agencies to encourage changes in program structure that are more favorable to funding projects in Maine. ConnectMaine will work with communities and providers to provide information, data, mapping and match to facilitate applications and improve the applications.

The FCC has additional funding through their Alternate Connect America Fund (ACAM) and the new Rural Digital Opportunity Fund (RODF). ACAM is designed to help Independent Rate of Return Carriers improve connectivity. RDOF is the replacement for the Connect America Fund, and its rules for eligibility and areas to be served are still in development. RDOF will be

conducted through a reverse auction in the fall of 2020, using the current FCC mapping. ConnectMaine will monitor the development of RDOF closely and keep in-state providers informed of the potential for funding through this mechanism.

State Funding

ConnectMaine Fund

ConnectMaine is currently funded by two assessments on land-line phones. The first assessment is a ¼ of 1 percent assessment on Communications Service Provider State revenues. The second source of revenue was added in the FY20-21 budget and is a 10 cent per line or per number surcharge on land-land phones.

We recognize these funding sources are declining year-over-year as subscribers discontinue land-line based services and migrate to wireless services which are not assessed this fee. This source of funding should be devoted to administrative and project management expenses to continue funding Community Planning Grants to prepare communities for participation in the Action Plan.

Low Interest Loans

Low interest loans can enhance the ability of private industry to participate in public/private partnerships that will expand broadband availability under this Action Plan. The 10-year Economic Development Plan[3] calls for establishment of a low interest loan program at the Finance Authority of Maine (FAME). The capitalization of a loan guarantee fund at $20 million could reduce some of the need for direct state subsidies. For example, the reserves needed to support high speed internet would be 20% of the total investment so a $20 million reserve will leverage $100 million investment. Those reserves could revolve many times with solid projects.

Local Funding

A key design element of the competitive grant process is to reward projects located in communities that have identified economic goals that broadband will enhance. In making grants, the Authority will give preference to projects that have strong local engagement and funding because the need for state funds will be lower. 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.

Accountability

Accountability must be a key component and should be required of any applicant receiving funds from a ConnectMaine grant. Likewise, it will be important for the State to be accountable for properly and efficiently distributing funds.

[3] https://www.maine.gov/decd/strategic-plan

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
- Provide accurate mapping, cost and speed level data to ConnectMaine

State of Maine Accountability

- Maintain and improve mapping
- 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

Goals

Five-Year Goal

Within five years, 95%[4] of all potential subscriber locations statewide have access to at least one broadband provider with sufficient capacity needed for full participation in our society, to enable civic and cultural participation, employment, lifelong learning, and access to essential services.

Interim Goals

To achieve the goal set forth by the State Strategic Plan, the State must commit to a funding level of ***at least $30 million in FY 20/21***. This level of State investment will demonstrate to communities and providers and the State's commitment to expanding the critical infrastructure required for communities to participate in today's economy.

This level of investment will also serve to entice additional local, federal, private investors and companies to step up to the plate. Without State leadership this year, Maine will miss out on its chance to attract these additional funds and Maine's unserved areas will not be able to reach their economic potential.

This plan calls for a minimal State investment of $200 million over a five-year period. If $30 million is provided in FY20/21, additional investments of at least $42.5 million will be required in each subsequent fiscal year (FY21-FY24) to meet that goal.

It is important to note that the initial investment of $30 million this fiscal year is designed to show a sincere commitment on the part of the State to attract outside funding to reach the overall goal of $600 million in total funding. If funding in future years from the State is insufficient to reach the projected minimum state investment of $200 million, then achieving the overall goal of this plan – to connect 95% of Maine households will not be met.

[4] The 95% goal is based upon the assumption that the cost to reach the last 4% of Maine residents currently not being served is exorbitant and will be much more reasonably served via non-wired services.

Actions necessary to reach 5-Year Goal

Funding Availability

The greatest risk to achieving the five-year plan will be the availability of funding.

Without sufficient consistent funding from the State, communities that are currently ready to build will be unable to, and new communities who undertake the planning process in the coming months will be left further and further behind. This is not a recipe for economic success for rural Maine. Once projects are awarded, engineering, utility pole make-ready and network construction will require 12-18 months to complete.

Additional ConnectMaine Authority Staffing

The two current ConnectMaine 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 assist the community applicants, manage and oversee the grant/loan awards and ensure overall compliance with this Action Plan and the ConnectMaine rules. Because if limitations on bond funding to capital expenses only, costs for consultants and compliance monitoring at ConnectMaine will come from the ongoing funding for the Authority and not any bond funds that may be provided.

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.

Potential Legislative Action

ConnectMaine staff have reviewed Title 35-A: Part 7, Sections 9201–9218, and concludes that the statute provides sufficient authority and latitude at present to carry out this Action Plan.

Any funds provided, from whatever source, should be directed to the ConnectMaine Fund as defined in Section 9211, and not into the Municipal Gigabit Broadband Network Access Fund as defined in Section 9211-A. ConnectMaine's statute allows for the flexibility, including the funding of municipal networks, that is needed to accommodate the wide variety of business strategies to meet identified community needs. The Municipal Gigabyte fund, as set forth in statute, 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 – Principal Assumptions

- Current unserved and underserved 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.

- Projects may include underserved areas up to a maximum of 20% of the total project.

- It cannot be the State's responsibility to reach remote areas or to extend service to potential subscriber buildings far from a serving roadway.

Appendix B – 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. **Underserved (area) –** A geographic area where adequate broadband service is unavailable to less than 20% of the households.

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

32. **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 C – FCC Household Broadband Guide

As defined by the FCC Office of Engineering & Technology *(date last updated/ reviewed: September 22, 2017)*[5], 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 3: 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.

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

Appendix D – 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 an 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 but requires deep fiber capacity to the node to be able to deliver the anticipated speeds and capacity.

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.