



**Request for Proposals for Design and Engineering Support
Services for the Last Mile Networks Project**

RFP No. MBI-2016-02

NOTE: Enclosed are excerpts of the full RFP

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1 Introduction

Massachusetts Technology Collaborative (“Mass Tech Collaborative”), on behalf of Massachusetts Broadband Institute, is issuing this Request for Proposals for Design and Engineering Support Services for the *Last Mile Network* (RFP No. MBI-2016-02) (the “RFP”) to solicit responses from qualified contractors (“Respondents”) with experience in design and engineering *Last Mile* networks (e.g. Fiber-to-the-Premise (FTTP), wireless networks). Respondents will be competing in an open procurement to provide the design, project management, project support, and consulting services set forth herein (the “Services”). The submissions of all Respondents shall be compared and evaluated pursuant to the evaluation criteria set forth in this RFP, and a single Respondent shall be selected.

Mass Tech Collaborative will be the contracting entity on behalf of Massachusetts Broadband Institute. For the purposes of this RFP (and except where the specific context warrants otherwise), Massachusetts Broadband Institute, MBI and Mass Tech Collaborative are collectively referred to as Mass Tech Collaborative.

1.1 Key Principles

- All procurements will be conducted in accordance with applicable Massachusetts laws governing the design and construction of public works projects.
- Mass Tech Collaborative will utilize a design-bid-build approach for ALL elements of the project.
- Mass Tech Collaborative may approach the construction work by dividing it up into smaller groupings or clusters of towns that decide to participate in a centralized design and construction process administered by Mass Tech Collaborative. The size and composition of the clusters could be based on the timing of town decisions to make binding commitments to authorize a broadband project and other factors that create logical and manageable groupings.
- Mass Tech Collaborative will release a construction bid package for each cluster of towns. Each construction bid package will incorporate a final design with precise specifications for all elements of the work, including procurement and installation of equipment, materials and supplies (inside plant and outside plant).
- The design of the last mile network(s) will incorporate the relevant portions of the MBI Last Mile Program Policy Statement (See Attachment I) that was approved by the MBI Board of Directors and the Executive Committee of the Mass Tech Collaborative Board of Directors. For example, the design must accommodate the near-term preferences of each participating town and provide sufficient downstream flexibility to allow a participating town to join or leave a regional network.

1.2 Characterization (Essential Features) of the Project

- Mass Tech Collaborative has been charged by the Commonwealth of Massachusetts with building out broadband infrastructure in the 44 remaining towns in western Massachusetts that do not meet the Federal Communications Commission (FCC) minimum broadband speed of 25 Mbps down and 3 Mbps up.
- Mass Tech Collaborative has already built a robust fiber, carrier class, middle mile network that runs through towns in western and north central Massachusetts. Mass Tech Collaborative is seeking to leverage the middle mile network to extend infrastructure in these 44 unserved towns. Considerations associated with an additional distribution layer between towns will need to be addressed.
- While many of the towns have expressed an interest in a regional, FTTP network, other towns have yet to decide on the best option to meet their needs. Open issues for many of these towns include:
 - Opt in or opt out to contracting with Mass Tech Collaborative to design and construct FTTP network. Some of the 44 towns may elect not to proceed with a broadband project.
 - Choice of technology – GPON vs. active Ethernet; fiber vs. wireless vs. hybrid fiber-wireless.
 - Operation and/or provisioning of services on the municipal network – who will operate the network for the town? Will the town be part of a larger regional network? Who will be

- selected to provide services? What are the technical requirements needed to support the services the provider wishes to offer?
- Extent of the coverage within each town – balancing ubiquitous access vs. cost of reaching outliers.
- Where fiber drops will be terminated during construction – Fiber to the Curb (FTTC) vs. Fiber to the premise (FTTP).
- Mass Tech Collaborative will work with each interested town to help the town make an informed decision on whether to proceed with a broadband project and the nature of the broadband project to be implemented. The Design-Engineering (“D/E”) firm will support Mass Tech Collaborative with town education and outreach efforts.
- Each participating town is required to co-invest and cover approximately 2/3 of the capital cost to build a ubiquitous FTTP municipal network in that town. Several towns have taken initial steps to move forward to authorize the issuance of Government Obligation (“GO”) bonds to cover the town’s share of the capital costs. The actual number of towns that will ultimately decide to finance broadband infrastructure under the current program, and the timing of such decisions, is uncertain.
- Broadband infrastructure that is built in a participating town will be owned by that town.

1.3 Structure of the D/E Procurement

It is Mass Tech Collaborative’s intent and strong preference to conduct a single procurement for a D/E firm that will support this multi-year project through its conclusion.

- The services of the selected D/E will proceed on a phased basis.
- This RFP provides a detailed scope for an initial program development phase (Phase 1).
- This RFP provides an illustrative, preliminary scope of services for Phase 2 project execution work that represents Mass Tech Collaborative’s current thinking on the broader range of services that the selected D/E firm will provide over the life of the project.
- D/E bidders will submit a fixed price proposal for the program development phase (Phase 1).
- D/E bidders will submit hourly rates and estimated level of effort for personnel that would perform Phase 2 services (based on the preliminary list of Phase 2 services as described in section 3.2.2 of this RFP). Bidders will also provide staff and firm qualifications for the Phase 2 work.
- If the selected D/E firm performs satisfactorily on the initial program development phase, Mass Tech Collaborative intends to work with the D/E firm to reach mutual agreement on a final scope and budget for the subsequent Phase 2 work. The final scope will be informed by the outcomes of the program development phase.

2 Background on Sponsors and Project

2.1 The Last Mile Network

Of the towns and cities included in the **MassBroadband 123** network, 79 are served to varying degrees by an incumbent or new cable broadband provider but the remaining 44 towns in the **MassBroadband 123** footprint are low density, rural areas that do not have an incumbent cable broadband provider and are referred to as “unserved.” The Mass Tech Collaborative is addressing the last mile challenge with the goal of making high-speed Internet available to unserved residents and businesses within the 44 unserved towns.

The Commonwealth has responded to the *last mile* challenge with a \$50 Million appropriation of state capital funding (Chapter 257 of the Acts of 2014) enacted in August of 2014 to support the build-out of *last mile* infrastructure in western Massachusetts. Of these funds, \$40 million have been allocated for the unserved towns. Mass Tech Collaborative’s main objective is to develop solutions to offer broadband access for households and businesses that maximize the impact of limited public resources, leverage other sources of funding (to the extent necessary and appropriate), and promote economic growth in the region.

Most of the *Last Mile* Network will constitute the installation of new fiber optic cables attached to existing utility poles. Mass Tech Collaborative plans to construct about 2,040 miles of new fiber optic cabling in western Massachusetts with approximately 29,000 homes being passed based upon current desk top town

model estimates. Mass Tech Collaborative anticipates that the *Last Mile* network may consist of multiple Fiber-to-the-Premises (“FTTP”) Gigabit-capable Passive Optical Network (GPON), Active Ethernet (AE) networks or a combination thereof. Mass Tech Collaborative also anticipates a wireless component may need to supplement areas where homes are unreachable and fiber cabling is not deemed practicable or cost effective.

2.2 Project Stakeholders

2.2.1 Massachusetts Technology Collaborative

Mass Tech Collaborative is an independent public instrumentality of the Commonwealth of Massachusetts chartered by the Commonwealth to serve as a catalyst for growing its innovation economy. Mass Tech Collaborative brings together leaders from industry, academia, and government to advance technology-focused solutions that lead to economic growth, job creation, and public benefits in Massachusetts. Mass Tech Collaborative energizes emerging markets in the high-tech sector by filling gaps in the marketplace, connecting key stakeholders, expanding broadband services, conducting critical economic analysis, and providing access to intellectual and financial capital. Mass Tech Collaborative has three primary divisions: The Innovation Institute at Mass Tech Collaborative, the Massachusetts Broadband Institute, and the Massachusetts e-Health Institute. For additional information about Mass Tech Collaborative and its programs and initiatives, please visit our website at www.masstech.org.

2.2.2 Massachusetts Broadband Institute (MBI)

The MBI is the central broadband program for the Commonwealth. The MBI was created on August 4, 2008, when Governor Deval Patrick signed Chapter 231 of the Acts of 2008, An Act Establishing and Funding the Massachusetts Broadband Institute (the “Broadband Act”). The primary mission of the MBI is to extend affordable, robust, high-speed Internet access to all homes, businesses, schools, libraries, medical facilities, government offices and other public places across Massachusetts, with a focus on the hard-to-serve areas of western and central Massachusetts. For more information about the MBI and its programs and activities generally, please visit the web site at www.massbroadband.org.

2.2.3 Towns and/or Municipal Lighting Plants (MLPs)

The *Last Mile* project is intended to bring broadband services to unserved towns in western Massachusetts. Interested towns willing to take part in the *Last Mile* project will be required to obtain funding to pay for two-thirds of the total cost of their towns build-out. Towns will own the infrastructure and assets that are built in participating town upon completion of the project.

A town may create a Municipal Lighting Plant (MLP) which are public corporations formed for the purpose of furnishing efficient, low cost, and reliable electric power, energy-related services and cable television services. Any number of municipal lighting plants may associate themselves together and with other public organizations.

2.3 Roles and Responsibilities

2.3.1 Mass Tech Collaborative

Mass Tech Collaborative’s primary role and responsibility is to serve as the project “sponsor” and to perform overall management of the *Last Mile* project. Mass Tech Collaborative will contribute information, provide recommendations, articulate strategic plans, review deliverables, and approve design changes. Mass Tech Collaborative will engage design and engineering and construction firms as well as other project consultants deemed necessary. Mass Tech Collaborative will report to the towns, its Board of Directors and other stakeholders.

2.3.2 Towns and/or Municipal Lighting Plants (MLPs)

Towns and their MLPs are the customers of Mass Tech Collaborative. Each town will ultimately own the last mile network built in the town. A town may have its MLP serve as the political body responsible in the decision making process for each town and will provide high-level requirements for its *Last Mile* network. Mass Tech Collaborative will communicate directly with the towns or their MLPs.

2.3.3 **Project Team**

2.3.3.1 **Design Engineering Firm**

Design Engineer services will be performed by the awarded respondent to this RFP. The D/E firm selected will not be eligible to construct any of the *Last Mile* Networks. Select personnel from the firm will be required to work in the Westborough, MA office to work closely on a day to day basis with Mass Tech Collaborative personnel. The selected D/E firm's primary role and responsibility will be to perform design, engineering and project management services for up to 44 towns in the *Last Mile* networks project as specified in section 3.2. The selected D/E firm is currently expected to have the following high level responsibilities:

- Design *Last Mile* networks,
- Create system specifications and test procedures,
- Inspect all system functions related to the *Last Mile* networks,
- Perform project management tasks as specified,
- Oversee the pole and conduit licensing process and conduct pole data collection,
- Recommend vendor equipment,
- Prepare bid packages for each construction cluster,
- Perform construction QA/QC,
- Ensure system specifications are being met by construction management firm(s) and/or its subcontractors in the Access, Distribution, Core, and Service layers,
- Coordinate testing, and
- Hire or manage sub-contractors or other project vendors.

Mass Tech Collaborative will provide Westborough, MA office space for the D/E firm that accommodates two persons. This "float space" will be used to support integration between the D/E firm and the Mass Tech Collaborative team. Each workspace (cubicle) will include a telephone, internet access and power. Personnel will be granted standard work day building and office access capabilities.

2.3.3.2 **Construction Management Firm**

Construction Management (CM) firm(s) will perform multiple construction disciplines for different aspects of the project such as outside plant (OSP), inside plant (ISP), active electronics, and civil construction of network shelters. A CM firm will be hired for each construction cluster and will be responsible to perform the work specified in the construction bid package which may include subcontracting to construction or professional service companies if necessary.

Mass Tech Collaborative intends not to impose the risk for make ready work on the CM and will work with the D/E firm to develop a project approach for scheduling and sequencing of construction to accomplish this objective. The CM, however, will still assume full responsibility for implementing the final design.

2.3.3.3 **Route Facility Owners**

Route Facility Owners are the owners of poles, conduit, railroad structures and bridges to which fiber of the Project may be attached or through which fiber of the Project may pass. The pole, conduit, etc., are referred to in this RFP as Route Facilities. Many Route Facility Owners process applications for licenses to make such attachments or otherwise to use such Route Facilities. Part of that application process involves make-ready work. Route Facility Owners also have insurance requirements.

2.3.3.4 **Property Owners**

Property Owners are the owners of homes, business and other premises to which fiber of the Project may be attached to structures or through which fiber of the Project may pass aurally or below ground. The homes, business, etc. are referred to in this RFP as Premises. Access to Property Owners' private properties can only be obtained with prior written consent of the Property Owner.

3 **Services Required**

3.1 **Design Engineering Qualifications and Project Management Services**

Mass Tech Collaborative is requesting responses to this RFP) for services to design and engineer various options in building a multi town/single town wide FTTP network(s). These network(s) will provide broadband services to residents and businesses in up to 44 towns in western Massachusetts.

Mass Tech Collaborative expects the selected firm to provide final design options for a complete FTTP solution utilizing GPON and/or AE. The FTTP networks will be building off the **MassBroadband 123** fiber optic network present within each town in the design areas. The D/E firm is expected to propose plans that would offer Video, VoIP and Data. It is expected that the preliminary design for the first construction cluster will be completed within 4 months from the start of the execution phase.

The D/E firm will create an overall project plan with the input from Mass Tech Collaborative. The D/E firm will manage to this plan with scheduling input from all CMs and subcontractors throughout the life cycle of the project.

To participate in this RFP, respondents or their subcontractors must possess the following minimum qualifications and provide supporting documentation.

- Designed and managed a minimum of three FTTP projects
- Experienced with large public (state and/or federal) fiber optic/broadband projects
- Proven ability to project manage, design and document fiber optic cable installations and have designed and/or managed a project with similar scope and scale to this project
- Knowledgeable in all FTTP transmission standards and protocols used for PONs, Active Ethernet (AE), and next generation systems with the ability to analyze and assess these emerging technologies
- Experienced in identifying and evaluating the differences between active Ethernet and passive optical networks from selection, design, impacts, cost comparisons and migration path considerations
- Able to recognize how bandwidth will be impacted by new end user technologies and services
- Knowledgeable of IP Services (including voice and data) via FTTP topologies and familiar with IPTV delivery systems and infrastructure requirements
- Competent in the creation and execution of an Acceptance Test Plan (ATP) for all components
- Experienced in and having technical capabilities working with Route Facility Owners in Massachusetts and conducting utility pole inspections
- Able to create and maintain a safety and health program conforming to industry best practices
- Experienced in the design and engineering of wireless networks

3.2 **Scope of Services**

Mass Tech Collaborative desires to contract with one qualified firm that would serve as the Design, Engineering, and Project Management contractor for all related tasks outlined in this RFP. The work to be performed will be completed in two phases; Program Development Phase (Phase 1) and Execution Phase (Phase 2). This section provides descriptions of the work to be completed by the selected D/E firm and/or its subcontracting partners.

3.2.1 **Program Development Phase**

Mass Tech Collaborative is not the typical initiator of a large scale broadband infrastructure build-out project. We are a public agency that has a core mission of fostering the growth of dynamic, innovative businesses and industry clusters in Massachusetts. While Mass Tech Collaborative has been involved in implementing a large-scale network infrastructure project, we have limited staff to support a project with the size, scale, scope and complexity of the last mile networks project. Therefore, Mass Tech Collaborative seeks a D/E firm that understands our needs and is willing to work with us on an initial program development phase. The objective of the program development phase is to define all key elements of the project, which will require the D/E firm to help Mass Tech Collaborative resolve, clarify and/or define critical components of the project approach.

D/E will have **90 days** from contract execution date to complete the program development phase.

The following sections define tasks to be included in the program development phase:

3.2.1.1 Recommend an Approach to Project Unknowns

The selected D/E firm will recommend an approach to dealing with project “unknowns” that will be influenced by individual town decisions, including:

- Unified regional network vs. multiplicity of smaller municipal networks (small aggregations or individual, stand-alone networks)
- Location of towns that opt into a regional network – how does the Mass Tech Collaborative structure the build-out of infrastructure and optimize a regional network that includes non-geographically contiguous towns
- Extent of coverage to premises – ubiquity vs. geographic outliers
- Uncertainty of number of towns participating and timing of town decisions and related actions that towns must take to participate in the project
- Technology diversity – fiber vs. wireless vs. hybrid solutions
- What are the towns and/or service providers going to request in terms of data, video and voice services
- Extent to which existing conduit will be used rather than existing aerial
- Extent to which new underground (conduit) or aerial (poles) infrastructure will need to be installed

3.2.1.2 Develop Technology/Product Roadmaps

Mass Tech Collaborative expects the selected D/E firm to create a ten (10) year network technology and vendor product evolution roadmap outlined in a one town example with 1000 subscribers identifying the differences between Active Ethernet, passive optical, and wireless networks from selection, design, impacts, cost comparisons and migration path considerations. Vendor products should include key features of each platform consisting of the following but not limited to hardware capacities, software specifications, environmental and management capabilities.

Upon completion, the D/E firm will provide a recommendation on the selection of technology for a regional network – GPON, Active Ethernet, wireless or a combination thereof.

3.2.1.3 Develop Project-Wide Network Architecture for the 44 towns

The selected D/E firm will develop a high-level analysis document that takes into account all proposed 44 towns in the *Last Mile* networks project. The document will incorporate the network architecture for the entire project and consist of the following:

- Solution overview
 - Design Layer 1 (physical), Layer 2 (switching) and Layer 3 (routing) Architecture that utilizes homogeneous network equipment
 - Closing network “spurs” to provide redundant connection to the **MassBroadband 123** network. A KMZ Map of the existing *MB123* network is available online at: <http://broadband.masstech.org>
 - Design for growth, redundancy and owner specified service levels
 - Design to support data (i.e. Internet)
 - Design an integration strategy for cloud based voice services
 - Video services will be designed for an IPTV or video content/streaming technology solution (linear, video-on-demand, in-home and out of home streaming)
 - Perform network traffic engineering study to assist in capacity planning for the *Last Mile* networks and their use of **MassBroadband 123** connections where applicable.
- Regional design considerations
 - Specify backhaul and other network-to-network interconnections
 - Establish high-level design(s) for one or more potential regional solutions that encompass all 44 towns
 - Shared hut(s) for regional design

- Provide Layer 3 networking ability between town huts participating in a regional operator's network
- Overlash considerations
 - Pros and cons of possible overlashing of **MassBroadband 123** fiber and resulting impact on design
 - The average percentage of currently licensed poles that could be overlashed across all 44 towns is 16% but some towns have as low a percentage as 3% and some towns have as high a percentage is 33%

The selected D/E firm will also develop a desktop model that allows for the technical classification and pricing for each of the 44 unserved towns. Model shall be flexible in nature to allow towns to select features for their networks. The following are attributes that will be included in the model:

- Voice, data, and video services,
- Sharing resources and/or infrastructure between adjacent towns (e.g. single hut per town vs. shared huts with adjacent towns),
- Driveway lengths, number of premises per mile, percentage aerial/underground, material and labor estimates,
- Basic architecture drawings that depict the anticipated/typical town network designs.

3.2.1.4 **Develop town network design requirements for each construction cluster**

Mass Tech Collaborative has provided in Attachment G the list of the 44 towns, premises, number of poles and route miles, which may be included in this project and each town's preliminary data, which includes:

- Unit count (households or businesses consisting of one or more people living or working together that occupy all or part of a standalone building)
- Number of telephone poles
- Route miles

Working with Mass Tech Collaborative and the Towns, and using the data from Attachment G, the selected D/E firm will develop high level network design data per town highlighting the items that will be included in the preliminary and final design drawings in the execution phase of this project. This data will include but is not limited to:

- Physical topology (i.e. point-to-point, bus, star)
- Network technology (i.e. AE, GPON, and/or supplemental wireless requirement)
- Potential hut/FDH location(s)
- Splitter placements (i.e. centralized, distributed, or central office split)
- Outside Plant (OSP) distribution and drop cable types
- Cable management recommendations (e.g. FDH, FAT, splice closures, vaults, handholes, etc.)

Mass Tech Collaborative is defining a "cluster" as a group or batch of towns where construction crews can be mobilized simultaneously to economize on the deployment to save time and money where appropriate. These clusters of towns may or may not be adjacent to each other.

The selected D/E firm will provide an approach to sizing and composition of construction clusters that reflects interests that include but are not limited to:

- Reducing barriers to competition among qualified construction companies (e.g. bonding capacity)
- Addressing external constraints (e.g. ability of Route Facility Owners to process make ready applications and prosecute make ready work or material acquisition lead times)
- Completing all work within project time frame
- Sequencing construction activities across multiple clusters regarding make ready work timeframes imposed by Route Facility Owners

The selected D/E firm will also provide a project execution strategy including but not limited to:

- Analyzing Mass Tech Collaborative's construction cluster strategy
- Proposing alternative construction strategies

The owner will organize and schedule a design charrette with towns at which the owner and Design Professional will facilitate a town discussion of design variables at which the owner requests town input.

3.2.1.5 Evaluate Material/Equipment Uniformity

The selected D/E firm will evaluate the extent to which the project needs uniformity of OSP materials/equipment and systems equipment across all towns and/or regional networks. This is to be evaluated within Massachusetts procurement rules that emphasize competitive procurements vs. proprietary specifications and with respect to projected operational efficiency.

3.2.1.6 Develop Systems Integration Approach

The selected D/E firm will provide an approach to systems integration and commissioning of a regional network or multiple regional networks. The following questions should be analyzed within the context of the guiding principle that the project should be implemented on a design-bid-build basis:

- How will systems integration and commissioning be completed from the Access Layer up through the Distribution and Core to the Service layer?
- What options exist to create the appropriate level of integration standardization and consistency throughout the project?
- How and by whom will network equipment installations be performed to ensure consistency and standardization of installations across clusters? Should the professional service arm of a network equipment manufacturer be considered?
- How do we integrate towns or clusters of towns which may be part of separate construction clusters?
- When is it critical to have a network operator(s) involved to assist with decisions around systems integration?

3.2.1.7 Develop a System of Record Approach

The selected D/E firm will provide an approach to develop and maintain a system of record (SOR) that will be the authoritative source for and ensure the integrity and validity of all data collected, created and maintained during the project. The selected D/E firm will need to determine if this SOR could also be used as a means of collaboration between all stakeholders (i.e. information repository) to upload, manage, preserve, and disseminate project content as well as a Route Facility and License management application as requested in section 3.2.2.3.

The SOR will include data managed using Relational Database Management System (RDBMS), Geographic Information System (GIS), and Computer Aided Design (CAD) software. The D/E firm will coordinate with Mass Tech Collaborative GIS and IT staff to define data access roles and privileges, ensures compatibility with ESRI ArcGIS software, and enable real-time access to the data.

All project outputs will flow through the SOR. Data stored in the SOR will be used to support project management requirements, enabling Mass Tech Collaborative to view progress, make decisions, evaluate options, and generate maps, charts and reports.

The selected D/E firm will need to determine if a secure cloud-based system could be used for both the SOR and stakeholder information repository and could be configured for web-based accessibility, usability and administration, and information must be able to be structured to allow or deny access on a town-by-town basis.

Mass Tech Collaborative requires the ability to take ownership and administration of the SOR and/or information repository at the close of the project. All project software is required to remain operational after the close of the project.

The preferred attributes for the SOR are listed in the table below:

| |
|---|
| Platform - Virtual Machine technology capable of increasing CPU, Memory, and Storage at will. Multiple instances for production and development or test. |
| Security - SSL encryption, role based security, optional file/folder encryption, role base security, and user access logging. |
| Metadata - The ability to capture, edit, and report on metadata surrounding security, content, and changes. |
| Exportable - The ability to Export and import into the same or like system preserving metadata related to attached files, data, databases and associated repository information. |
| Data Model and Standard Work Flows - Develop data models used to store and track information for each phase of the project (e.g., route and premise evaluations, make ready and pole licensing, network design, construction management, equipment testing, and project closeout punchlists); establish standard data input and editing workflows; develop extraction, transformation and loading (ETL) procedures |
| Features - The ability to store and search on a variety of formats – DOC, XLS, PPT, PDF, GIS formats, links and video, as well as other features like version control, drag & drop, unique identifiers, tagging, check in check out, notes, tasks, scheduling, advanced search capabilities, forms and or workflow approval process. |
| Database - Relational database, management tools and connectivity functionality. |
| Integration - The ability to integrate associated sub systems such as reporting, mapping systems, and both proprietary and non-proprietary software and databases. |
| GIS/CAD Interoperability - The ability to assign and maintain unique identifiers for all data, enabling relationships between GIS and CAD features and tabular information stored in RDBMS tables; create and maintain data in accordance with the CAD and GIS Data Standards document developed for this project |

3.2.1.8 **Develop an Equipment Evaluation Approach**

In Phase 2, the selected D/E firm will perform network equipment manufacturer evaluations to identify specifications for equipment to be deployed in the *Last Mile* network and to ensure interoperability of this equipment with the **MassBroadband 123** network. The Design Professional shall provide its approach to conducting these evaluations. The approach must include but is not limited to:

- Identifying where equipment evaluations will take place (i.e. existing lab or create a new lab)
- Identifying possible accommodations needed for equipment demonstrations to the Owner, Towns and other stakeholders
- Identifying equipment manufacturers to be evaluated
- Identifying the materials and equipment the D/E firm will need to perform evaluation; with the understanding that the D/E firm will procure said equipment
- Determining level of effort and test plan considerations
- Determining if physical connectivity to the **MassBroadband 123** network is needed for interoperability testing
- Determine how to address updates to software and firmware codes occurring after initial testing and issuance of construction bid documents

3.2.1.9 **Develop a Detailed Baseline Project Plan**

The selected D/E firm will develop a detailed baseline project plan listing all tasks to be performed during the entire scope of the project.

3.2.2 **Program Execution Phase**

The following sections provide and illustrate a description of tasks that Mass Tech Collaborative currently expects to be included in the execution phase of this project (Phase 2):

3.2.2.1 **Develop preliminary design drawings for each construction cluster**

The selected D/E firm will develop high-level design drawings that allow Mass Tech Collaborative and towns the ability to approve, reject or request modifications of the design recommendation. These drawings will also be provided to pole data collection firms, used as a basis for route and premise evaluations, and can be used in support of special permitting projects such as conservation commission hearings, historical society hearings, MassDOT bridge attachment petitions, etc.

Preliminary design drawings will include but are not limited to the following:

- Physical topology
- Network technology
- Premise locations
- Proposed hut/FDH location(s)
- Splitter placements (if required)
- Route definition (distribution and drop locations, construction types (aerial/underground new/existing, multiple egress connections) with or without overlashng *Last Mile* networks cables with existing **MassBroadband 123** cables
- Distance calculations (optical and road miles)
- Strand counts

3.2.2.2 **Perform Route and premise evaluations, site visits and identification of challenges**

The selected D/E firm will be required to ride out each planned route and visit each premise to document the feasibility of the route and document any roadblocks and hurdles that may delay the construction of these routes. Evaluations will consist of the following:

- Surveys in each town in the construction cluster to identify existing utility infrastructure along all roads to support development of a route design
- Surveys in each town in the construction cluster to collect information about each premise that will be served by the *Last Mile* networks to support development of a customer premise design. The surveys must include information as to driveway lengths, types of entry, entry locations, and any privately-owned poles
- Identification of any permitting or construction challenges while conducting surveys to support development of route design alternatives
- Identify any Multiple Dwelling Units (MDU), Multiple Tenant units (MTU), seasonal properties, and buildable land parcels with no existing structures
- Identify hut and/or Fiber Distribution Hub (FDH) location(s) per town
- Verify fiber egress points to support redundant connections and regional inter-town networks

3.2.2.3 **Develop Route Facility and License Management Application**

The selected D/E firm will develop and manage a robust application and make ready tracking management system.

- Web or cloud based system to bring data from collection through application, make ready, true ups to license issuance
- Procure or develop, establish, populate and maintain the Route Facility and License Management Application, which shall contain all data collected or generated for the project by pole vendor, including but not limited to the pole data collector(s), route and premises evaluation support surveys, as well as links to electronic copies of all agreements, permits, licenses and other similar documents relating to a route facility, the Network route, rights of way, conduit used and access to property, and information with respect to the status and progress of work on and licenses for each route facility
- All locations in the Master Pole Attachment, Route Facility and License Database shall be geo-located (i.e. GPS coordinates shall be provided at each facility point with 1 meter accuracy) and tracked using a unique project identifier

- The Route Facility and License Management Application shall be web- or cloud-based. The Route Facility and License Management Application shall be suitable for use and accessible to the Owner and its designees, and its data susceptible to export, during the term of this Agreement
- D/E shall coordinate with Route Facility Owners and other Project vendors to identify and implement opportunities to achieve efficiencies and cost savings for Mass Tech Collaborative by use of the Route Facility and License Management Application
- Any intellectual property rights arising from development of the Route Facility and License Management Application, and all data therein shall be property of Mass Tech Collaborative or its designee. The vendor shall work with Mass Tech Collaborative's legal counsel to document such ownership

3.2.2.4 Make Ready Management and Pole Data Collection Support

The selected D/E firm will manage make ready licensing process and perform all pole data collection tasks for the Project.

3.2.2.4.1 Make Ready and Route Facility License Management

The selected D/E firm will populate and maintain the Route Facility and License Management Application. The selected D/E firm will manage all pole data, make ready applications and pole attachment licenses. This will be completed by executing the following tasks:

- Pole data
 - Perform QA/QC on collected pole data
- Make Ready
 - Coordinate frequent conference calls and other communications with route facility owners to monitor and facilitate performance of make-ready in accordance with the project schedule, and to manage any delays to the project schedule
 - Review, evaluate, dispute, negotiate and reconcile all make ready estimates to assess pricing accuracy and modify make ready estimates to remove unneeded poles from applications
 - Track all make ready invoices
- Licensing
 - Update license information in Route Facility and License Management Application
 - Complete utility attachment verification forms and submit to the Mass Tech Collaborative which will be provided to the Route Facility Owner,
 - Extract license data from the Route Facility and License Management Application to be turned over to the town
- True-ups
 - Reconcile and track all license application true-ups
- License Data
 - Develop, populate and maintain license geographic information systems (GIS) data and other license data and/or documentation in the System of Record.

3.2.2.4.2 Pole Data Collection Services

The selected D/E firm will be required to collect all pole data within the 44 Towns and present that data to the Mass Tech Collaborative. Acting on behalf of the towns, the Mass Tech Collaborative will submit all utility licenses applications to the route facility owner's.

3.2.2.4.2.1 Pole data Collection

The selected D/E firm will provide Pole Data Collection Services by:

- Attending coordination meeting with the Mass Tech Collaborative and/or the Towns to discuss:
 - Content and format of pole data to be collected,
 - How pole data will be maintained in the Route Facility and License Management Application, and
 - Schedule for and sequence of the pole data collection in the Towns.

- Record and gather the required information for all public and private utility pole within the towns as set forth in Attachment G.
- Prepare and distribute the required survey data to the Mass Tech Collaborative. *Note that the data shall be in the required MSEXcel® formats and GIS format (e.g. shape files).*

The selected respondent will execute the following Pole Data Collection procedures:

- Record all required attributes specified in Attachment K
- GPS coordinates are to be collected with sub one meter accuracy
- Take 3 photos of each pole
 - Collect one straight on photo that allows for photogrammetry calculations of pole (above ground) and attachment heights,
 - Collect one photo that allows for photogrammetry calculations of midspan height,
 - Collect one side perspective photo,
 - At least one of the three photos must clearly show the pole tag number(s),
 - Photos must show all substantive pole attributes which include but are not limited to: transformers, boxed poles, municipal fire alarm cables, street lights, traffic control cables, pole mounted cabinets, wireless radios/antennas, risers, and guys.
 - Photos must follow an easily understandable naming convention, that includes (at a minimum): pole numbers, town, roadway, and time stamp
- Perform photogrammetry using the photo(s) to collect the following additional attributes (at a minimum) to support make ready reconciliation activities specified in section 1.1.5:
 - Height of each pole attachment,
 - Height of pole above ground, and
 - Height of midspan, one span for each pole.

3.2.2.4.2.2 Pole Load Screening and Detailed Load Analysis

The Route Facility Owner National Grid (“NGrid”) requires pole load screening and detailed pole load analysis (“Pole Load Analysis”) be conducted for all poles listed on NGrid pole applications. For this reason, the Mass Tech Collaborative requires support for pole load analysis from the selected D/E firm.

3.2.2.4.2.2.1 Pole Load Analysis Procedures

- All Pole Loading Analysis and Reporting shall be developed and performed under the direction of a professional engineer licensed in Massachusetts, all of which shall be subject to National Grid’s review and acceptance.
- Two pole load analysis runs will be made for each structure. The first will analyze the structure with the existing loads to determine the capacity of the structure to accept additional loads. A second run will be made to show the final structure with the new loads on it. Similar structure configurations may be modeled and analyzed using allowable span runs. The following are the scenarios that can happen:

| Existing Run | New Run | Fix Needed |
|------------------------|------------------------|------------|
| Passes (stress < 100%) | Passes (stress < 100%) | No |
| Passes (stress < 100%) | Fails (stress > 100%) | Yes |
| Fails (stress > 100%) | | Yes |

- When the results of the pole load analysis demonstrate that a fix is required, this can be addressed with the installation of a new pole, a rehabilitated pole or new guy(s) (whichever is appropriate). The stress level required for a fix is 85%.

Note: The Pole Load Analysis Procedures above were directly conveyed to Mass Tech Collaborative by NGrid and only subject to change by NGrid.

3.2.2.4.2.2.2 Pole Load Analysis Criteria

- The Pole Load Analysis shall be done using the following codes and standards:
 - National Electrical Safety Code 2007
 - ANSI O5.1 - 2002 Specifications and Dimensions for Wood Poles

- National Grid Overhead Electric Distribution Standards
- The loading criteria shall be NESC Heavy:
 - ½" radial ice, 4 psf wind and 0 degrees F
 - Extreme Ice – As Appropriate
 - Extreme Wind – As Appropriate
 - Grade B for Crossings as defined in NESC Section 24
 - Grade C for all others
- Conductor/cable diameter and weights should be provided by the appropriate utility. If unavailable then manufacturer's data should be used
- Conductor/cable tension should be provided by the appropriate utility. If unavailable then maximum tension under heavy loading is not to exceed 60% RBS of conductor or messenger (whichever is appropriate)

Note: The Pole Load Analysis Criteria above were directly conveyed to Mass Tech Collaborative by NGrid and only subject to change by NGrid.

3.2.2.4.2.3 Drafting Pole/conduit License Applications

- Prepare and quality check Route Facility Owner pole license applications with a 200 pole limit per application for all poles surveyed in the Towns; Route Facility Owner application forms are provided as:
 - Attachment L – Eversource,
 - Attachment M – National Grid, and
 - Attachment N – Verizon
- Prepare and distribute applications to the Mass Tech Collaborative
- Maintain applications in the System of Record and provide links to the applications in the Route Facility and License Management Application
- Make edits or modifications to the draft application after the Mass Tech Collaborative and/or the Towns review
- Resubmit edited applications to the Mass Tech Collaborative

Note: The Mass Tech Collaborative will coordinate with the Towns to obtain their review and/or approval. Upon approval, Mass Tech Collaborative will submit the application to the Route Facility Owners on behalf of the Towns.

3.2.2.4.2.4 Make Ready Support

After submittal of pole license applications, the Mass Tech Collaborative and the Route Facility Owners will schedule joint make ready ride-outs (i.e. Verizon and National Grid) or desktop reconciliation discussions (i.e. Eversource). It is during these ride-outs or discussions that the Mass Tech Collaborative and the Route Facility Owners will negotiate make ready costs and upon which the Route Facility Owners will base its make estimates. The Mass Tech Collaborative requires support for these joint make ready ride-outs or desktop discussions from the D/E firm selected. The selected D/E firm will provide Make Ready Support Services by:

3.2.2.4.2.4.1 Make Ready: Joint-Ride-out Support

Provide, qualified OSP professional(s) to track and participate in, joint make ready ride outs with Verizon and National Grid. The OSP professional(s) will support Mass Tech by providing analysis and OSP expertise in support of negotiations with pole owner(s) to obtain the lowest cost make ready estimates.

3.2.2.4.2.4.2 Make Ready: Desktop Reconciliation Support

Provide, qualified OSP professional(s) to track and participate in, teleconference conversations with Eversource. The OSP professional(s) will support Mass Tech by providing analysis and OSP expertise in support of negotiations with pole owner(s) to obtain the lowest cost make ready estimates.

3.2.2.5 Develop final design and construction bid packages for each construction cluster

The selected D/E firm will create construction bid packages that will be similar or equal in quality, level of development, detail and scope to the *RUS Form 515 Construction Contract* documents. Bid packages will be issued for bidding by construction firm(s) for the physical construction and equipment installation and configuration of the fiber optic network. The selected D/E firm will assist the Owner in responding to questions received from bidders during the bidding period and participate in the evaluation of bids and qualifications of such bidders.

Construction packages will consist of but are not limited to the following:

- EWD (Engineering Work Documents)
 - Finalized detailed OSP cable construction and splicing plans (fiber counts, splice plans, cable management locations)
 - Fully developed, stamped GIS/CAD drawings with pole by pole detail
 - Finalized detailed hut construction plans including, but not limited to:
 - Civil drawing requirements for hut location(s)
 - Infrastructure design including ladder tray, relay racks, vertical/horizontal wire management, patch panels, fiber trough, fiber modules/splice trays
 - Network design drawings, equipment specifications, port mapping documentation, and system configurations
 - Power requirements including backup and redundant systems
 - Grounding requirements
 - HVAC requirements
 - Floor plans
 - Relay rack elevations drawings
 - Environmental alarming (HVAC, Temperature, site access, etc.)
 - Out of Band management requirements
 - Detailed description of network equipment specifications to be deployed
 - Test plan responsibilities, execution and documentation
- Detailed Bill of Materials (BOM) for all aspects of the project including hardware, software and licensing (HSL) components
- Qualifications required of bidders (and/or their subcontractors) for the physical construction and equipment installation and configuration of the fiber optic network
- Any conditions imposed by conservation commissions as dictated by environmental permits
- Should a NPDES notice threshold be met for any proposed Cluster, Construction Documents shall include the requirements the Construction Management Firm(s) must meet to comply with the NPDES requirements

Each bid package shall be capable of being transmitted in electronic form and the Design Engineer shall deliver three printed sets and one reproducible set of each bid package to the Owner.

The D/E firm will support Mass Tech Collaborative's evaluation of the qualifications listed in responses from bidders and the bidders' subcontractors.

3.2.2.6 **General Engineering and Project Management Services**

The selected D/E firm will provide the following engineering and Project management services:

3.2.2.6.1 **General Engineering and Project Management Services (Town Specific)**

- Reviewing the Construction Management Firm's submittals, including shop drawings, product data, and samples, and making approvals of or recommendations about such submittals to the Mass Tech Collaborative
- Reviewing and recommending approval, rejection, or modification of invoices from project vendors
- Responding to requests for information or clarification from the Construction Management Firm regarding the plans and specifications
- Ensuring construction firms' compliance with the approved design by performing the following:
 - Processing Red Lined Construction Plans:

- Updating plans with red lined information from construction firm(s)
- Conducting desktop assessments of red lined plans identifying any deviations from design plans
- Preparing final as-built plans
- Managing version control
- Preparing inspection checklists and develop inspection schedules
- Leading, participating in, and reporting on routine inspection of contractors, ensuring proper construction methods and specifications for the project are being met
- Identifying and reporting any unauthorized deviations from design plans as punch list items
- Developing punch lists that include photos and corrective actions to be taken which will be documented in system of record
- Tracking construction status for all active route segments from the time that the license is received from the utilities through completion of construction
- Making modifications to the approved designs as a result of route adds, moves and/or changes
- Evaluating change requests, providing recommendations and tracking all approved change requests by project stakeholders
- Identifying and recommending actions and contract provisions aimed at value engineering and other cost-saving opportunities
- Performing oversight on all aspects of Acceptance Testing
- Verifying completion of all aspects of the build whether physical or virtual by any vendor or operator to ensure all work has been completed to specification
- Ensuring network and equipment can deliver the services requested by towns (e.g. voice, data, video)
- Directing and Monitoring Construction Management Firm's
 - Construction Permits
 - Electrical Permits
- Directing and Monitoring towns progress in granting and/or securing Right of Way (ROW) and in securing Right of Access (ROA) from towns and property owners
- Recommending when construction segments can be released to construction
- Ensuring that all final design plans, licenses, permits, etc. are stored in the System of Record

3.2.2.6.2 **General Engineering and Project Management Services (Non-Town Specific)**

- Project Management and scheduling services
 - Coordinating, scheduling, and attending pre-construction and on-going construction meetings
 - Maintaining project schedule
- The selected D/E firm will be responsible for and provide electronic meeting minutes to Mass Tech Collaborative within two days of any meeting.
- Monitoring progress and performance of all project vendors
- Submitting status and productivity reports for all project vendors to the Mass Tech Collaborative
- Draft notices or other forms of correspondence with the CM, and submit to the Mass Tech Collaborative
- Preparing, maintaining, updating and reporting on the project budget and recommending adjustments for optimization, changes, or to address variances that arise during the project (e.g. design, materials, equipment, labor, software development, administrative and legal)
- Periodically updating desktop models for all participating towns
- Reviewing, tracking, negotiating, recommending and updating all requests for changes by any project vendor, including but not limited to changes in software or firmware code
- Creating and enforcing safety assurance plan for the project
- Creating and enforcing quality assurance plan for the project
- Critical Path Monitoring

- Alerting project team of potential critical path slippage and upcoming milestones to keep team on track with regard to critical payment dates for pole applications, make ready estimates; material acquisition lead time delays; weather delays; permitting issues; manpower or crew shortages; etc.

3.2.2.7 Lab Creation and Test Plan Development

Based on decisions made during the program development phase, the selected D/E firm may be required to create a Last Mile network laboratory. The selected D/E firm may be required to execute the following:

- Develop lab test plan
- Procure lab equipment
- Lab setup
- Evaluate chosen manufacturers and perform a Proof of Concept (POC)
- Technical manual development
- Test interoperability and compatibility between and among recommended Last Mile equipment manufacturers and with the *MassBroadband 123* network
- Evaluate equipment management software functionality for service configuration, surveillance, performance, and administration
- Host demonstrations for the Owner, Towns and other stakeholders

3.2.2.8 Standards & Procedural Manual Development

The selected D/E firm will prepare and submit for approval, manuals for all for all contractors to follow. These manuals shall include the following:

Standards

- Writing standards (conventions for design plan markups)
- Document templates (BOM, Change in the Work Documents, etc.)
- Naming conventions
- Labeling standards
- CAD and GIS data standards
- Workmanship and installation standards
 - These standards should incorporate all relevant ANSI/TIA/EIA and Telcordia SR-1421 standards

Manuals

- Safety plan
- Quality management plan
- Construction installation procedure (Method of Procedure (MOP))

3.2.2.9 Special Permitting Services

The selected D/E firm will be responsible for the following permitting services:

3.2.2.9.1 Providing Archaeological Permit Services

- Coordination and Consultation – which involves coordinating
 - With local historical commissions, historical district and the Massachusetts Historical Commission for any elements of the *Last Mile* networks project that require review under Section 106 of the National Historic Preservation Act of 1966, as amended,
 - Tasks associated with the work and ensuring the quality and timeliness of the work products, and
 - With members of the *Last Mile* networks project team(s) to utilize plans, photographs, and other materials that assist with the identification of below ground and visual impacts to cultural resources.
- Apply for any permits required and pay any associated fees
- Archaeological Sensitivity Assessment – which involves the review by a qualified archaeologist of any elements of the Last Mile networks project for potential ground disturbance. This review may be conducted as any combination of desktop survey, review of aerial photography, walk-over/drive-

over survey, consultation with DE and/or Construction Management Firm or archaeological dig. Upon review completion, the D/E firm will compile the information, document findings, make recommendations regarding the potential effect of the new Last Mile networks construction on archaeological resources.

- Historic Architectural Assessment – which involves the review by a qualified archaeologist of any elements of the Last Mile networks project for potential visual effects caused by alterations to properties or their immediate surroundings. This review may be conducted as any combination of desktop survey, review of aerial photography, walk-over/drive-over survey, or consultation with DE and/or Construction Management Firm. Upon review completion, the D/E firm will compile the information, document findings, make recommendations regarding the potential impact of the new Last Mile networks construction on historical properties.

3.2.2.9.2 Providing Environmental Permit Services

- Project Documentation and Administration – which involves:
 - Preparing meeting minutes,
 - Assessing the extent, if any, to which the Project is subject to federal, state or local environmental compliance regulations, included but not limited to, the Environmental Protection Agency (“EPA”) Construction General Permit requirements. Pursuant to the Federal Clean Water Act, construction activities which disturb one acre or more are required to apply to the U.S. EPA for coverage under the National Pollutant Discharge Elimination System (“NPDES”) General Permit for Storm Water Discharges from Construction Activities
 - Documenting and tracking of environmental aspects of project areas,
 - Coordinating follow-on consultations,
 - Communicating conditions imposed by conservation commissions to Construction Management firm and other members of the Last Mile networks project team, and
 - Creating close-out documentation for all environmental permitting activities conducted during the Last Mile networks project.
- Ongoing Consultations – which involves coordinating:
 - With federal agencies (e.g. US Environmental Protection Agency, US Army Corps of Engineers),
 - With state agencies (e.g. Department of Environmental Protection, the Natural Heritage and Endangered Species Program (NHESP), the Department of Conservation and Recreation (DCR)), and
 - With local conservation commissions.
- Permitting Support – which involves:
 - Conducting field surveys with qualified environmental scientist,
 - Conducting wetlands delineation,
 - Reviewing construction plans by qualified environmental scientist to determine the potential for wetland or endangered species impact,
 - Supporting design conversations and suggesting specific construction techniques to mitigate impacts where required by state law,
 - Assisting Mass Tech Collaborative by completing the documents necessary to obtain permits,
 - Assisting Mass Tech Collaborative by representing them in permit hearings with conservation commissions
 - Applying for any permits required and paying any associated fees; this includes Filing permits with the Registry of Deeds if needed
 - Presenting mitigations and/or species protection plans to the NHESP
 - Assisting Mass Tech Collaborative by implementing non-construction related mitigating actions approved by the NHESP, per the species protection plan.

3.2.2.9.3 Providing Railroad Crossing and Access Permit Services

- Railroad Crossing Engineering – which involves:
 - Developing a preliminary design plan for the fiber optic cable crossing that is certified and approved by a Professional Engineer that has done all the necessary structural analysis and calculations

- Submitting a preliminary design plan for the fiber-optic cable crossing of the railroad tracks to rail company that indicates that the proposed crossing meets railroad vertical clearance and horizontal span requirements
- Receiving approval for the preliminary design plan from railroad company's engineering department
- **Railroad Crossing Documentation and Administration – which involves:**
 - Submitting advance deposit for railroad flagging/inspection cost and paying any associated permitting fees
 - Supporting the Mass Tech Collaborative in its negotiations with rail company's real estate department to establish a license agreement for the crossing
 - Receiving notification from the Mass Tech Collaborative that it has received a railroad crossing license for the crossing and file the license in the System of Record
 - Coordinating between CM firm and rail company to schedule the crossing work
 - Ensuring that the CM firm has submitted proof of railroad protective liability insurance to rail company
 - Ensuring that the CM firm has executed a standard railroad service contract
 - Coordinating with rail company's railroad flagging/inspection representative to supervise the work

3.2.2.9.4 **Providing Highway Access Permit and Bridge Attachment Services**

- **Bridge Attachment Engineering – which involves:**
 - Developing a preliminary design plan for the conduit attachment that is certified and approved by a Massachusetts Licensed Professional Engineer that has done all the necessary structural analysis, installation method determination, clearance calculations, restoration planning and other calculations
 - Ensuring design is in accordance with the latest edition of the AASHTO LRFD Bridge Design Specifications and the MassHighway Bridge Manual
 - Submitting a preliminary design plan for the conduit attachment to the MassDOT that indicates the proposed attachment meets MassDOT requirements
 - Receiving approval for the preliminary design plan from MassDOT's engineering department
- **Highway Access Engineering – which involves:**
 - Work with Mass Tech Collaborative to develop and submit traffic plans to the MassDOT
- **Documentation and Administration – which involves:**
 - Submitting advance deposit for inspection costs and paying any associated permitting fees
 - Supporting the Mass Tech Collaborative in its application to the MassDOT to establish a license agreement for the attachment
 - Receiving notification from the Mass Tech Collaborative that it has received a bridge attachment and highway access permit and file the permit in the System of Record
 - Coordinating between CM firm and MassDOT to schedule the work
 - Coordinating with MassDOT representative to supervise the work

3.2.2.10 **Systems Integration/Commissioning**

Based on decisions made during the program development phase, the selected D/E firm will be required to specify a systems integration and commissioning plan listing all tasks to be completed and responsible parties from the Access Layer up through the Distribution and Core to the Service layer.

3.2.2.11 **Acceptance Test Plan**

The selected D/E firm will be required to develop an overall Acceptance Test Plan (ATP) through all aspects of the project. This plan will outline all testing procedures to be completed by the selected D/E firm as well as all other contractors and shall include but is not limited to:

- **OSP installation inspections**
 - Installation inspection checklist should list tasks which can verify contractors have followed all applicable installation standards such as ANSI/EIA/TIA and Telcordia which were outlined in the standards and procedural manuals created by the selected D/E firm.
 - The selected D/E firm will be both responsible to track and accountable for performing these inspections.

- Tracer wire tests
 - When applicable, testing of each tracer wire on underground fiber will be required to verify end-to-end electrical continuity.
- Developing optical performance, power, signal quality, and maintenance specifications
 - Inspection guidelines and oversight.
 - Standardize final acceptance test result documents specifying the types of tests. These tests will be documented in the system of record. Summary data will also be required at a town by town level.
 - Tier 1 Optical Loss Test (OLT) and Light Source and Power Meter (LSPM) tests
 - Link attenuation
 - Polarity check
 - Tier 2 Optical Time Domain Reflectometer (OTDR) testing will be performed at different stages throughout the project such as prior to installation to test for cable length, defects, splices, abnormalities and loss value as well as upon completion of a fiber span. Testing should include:
 - Continuity uniformity test
 - Splice loss test
 - Optical length measurement
 - Loss budget calculations to determine if the systems were installed correctly and if the combined loss of all installed components is within allowable limits. Loss budget should include fiber optic connectors, fiber splices, and the fiber cable.
 - Fiber characterization (when required)
 - The fiber characterization test shall record Polarization Mode Dispersion (PMD) and Chromatic Dispersion (CD) on the entire span.
- Testing equipment specifications and calibration requirements
- Developing network performance specifications which should consist of the following:
 - Component level test
 - Link level test
 - System level test
- Developing the following inspection checklists, which should include any room or site modifications, grounding systems, electrical work, HVAC systems, relay racks, cable and wiring, labeling, and general suitability for network operations and maintenance activities, as applicable:
 - Fiber construction checklist
 - Hut construction checklist
 - Customer premise construction checklist
- The ATP should include all corrective action steps and/or punch list procedures for any items found not to be within the specifications, including:
 - Deviation policy
 - Anomaly tracking
 - Maximum number of re-burns

3.2.2.12 Town-Specific Turnover Package Development

The selected D/E firm will assist Mass Tech Collaborative in preparing robust turnover packages for delivery to Towns upon completion of construction and inspection. The D/E shall prepare each element of the turnover package unless otherwise agreed. The selected D/E firm's responsibility includes but is not limited to:

- Assembling Turnover Packages for each Town within each construction cluster which will include but not be limited to:
 - Town manual (Mass Tech Collaborative is primarily responsible but the Design Engineer will provide some content)
 - Technical Equipment Manual (Manufacturer supplied owner's manuals)
 - Technical Operations Manual (network service provisioning guidelines)
 - Final As-Built Development
 - Create the final as-built plans for each construction cluster when all construction is complete and all punch list items have been addressed

- Route Facility licenses (database export)
- Permits
- GIS data export
- Warranty
- Software licenses
- Test results
- Inspection reports
- Asset listing and transfer
- Final financial report (prepared by the owner)
- BOM for OSP restoration kit
 - Material list
 - Ordering information
 - Date coded issues; material with expiration dates (e.g. adhesives, sealing compounds)
 - Instructions
- Sparing recommendation
- Updating the turnover package based on feedback from the Towns

3.2.2.13 Develop Communications Management Plan

The selected D/E firm will be required to develop an overall communications management plan for the interaction between all stakeholders, including but not limited to Mass Tech Collaborative, Design Engineer, Town, construction team. This plan will have effective and timely delivery methods and should include but is not limited to the following:

- Communication Type – Reports, presentations, reviews and meetings, announcements
- Communication Purpose – Project status, project review, team meeting, risk assessment
- Delivery Method – Email, meeting, conference call
- Frequency – Daily, weekly, monthly, quarterly
- Audience – Program Manager, project team, executive team, construction team, town

The selected D/E firm shall provide a detailed description of how they will comply with the reporting requirements for this project. The table below lists reports required. Mass Tech Collaborative reserves the right to add, remove, or modify any or all reporting requirements.

Reports shall be linked and maintained in the system of record.

Table 3.2.2.13

| Report Title | Frequency | Description |
|--|-----------|---|
| Pole license status report | Bi-Weekly | Provide MBI a report on pole data collection firm progress with license/application status per town (e.g. Permitting, make ready) |
| Design status reports | Bi-Weekly | Provide MBI a report on progress with design effort |
| Route and premise evaluation status report | Weekly | Provide MBI a report on progress with route and premise evaluations and site visits |
| Equipment vendor progress report | Weekly | Provide MBI a report on progress with equipment vendor evaluations and product installation and integration |
| Project budget status report | Monthly | Provide MBI/MassTech a project budget report |
| Change Management status report | Monthly | Provide MBI a report on progress with changes, status of request, impact analysis (budget/schedule) |
| Safety inspection status report | Monthly | Provide MBI a report of ongoing safety inspections |
| Construction status report | Weekly | Provide MBI a report on construction firm progress per town/cluster |
| Project health status report | Bi-Weekly | Provide MBI a dashboard listing of overall project health regarding time/budget |
| Quality Management status report | Monthly | Provide MBI a report on construction and equipment vendor work quality and/or design deviations |
| Design Engineer team status report | Monthly | Provide MBI a report on staffing and engineering teams' progress (e.g. Lab, Design, Engineering, PM, Permitting) |

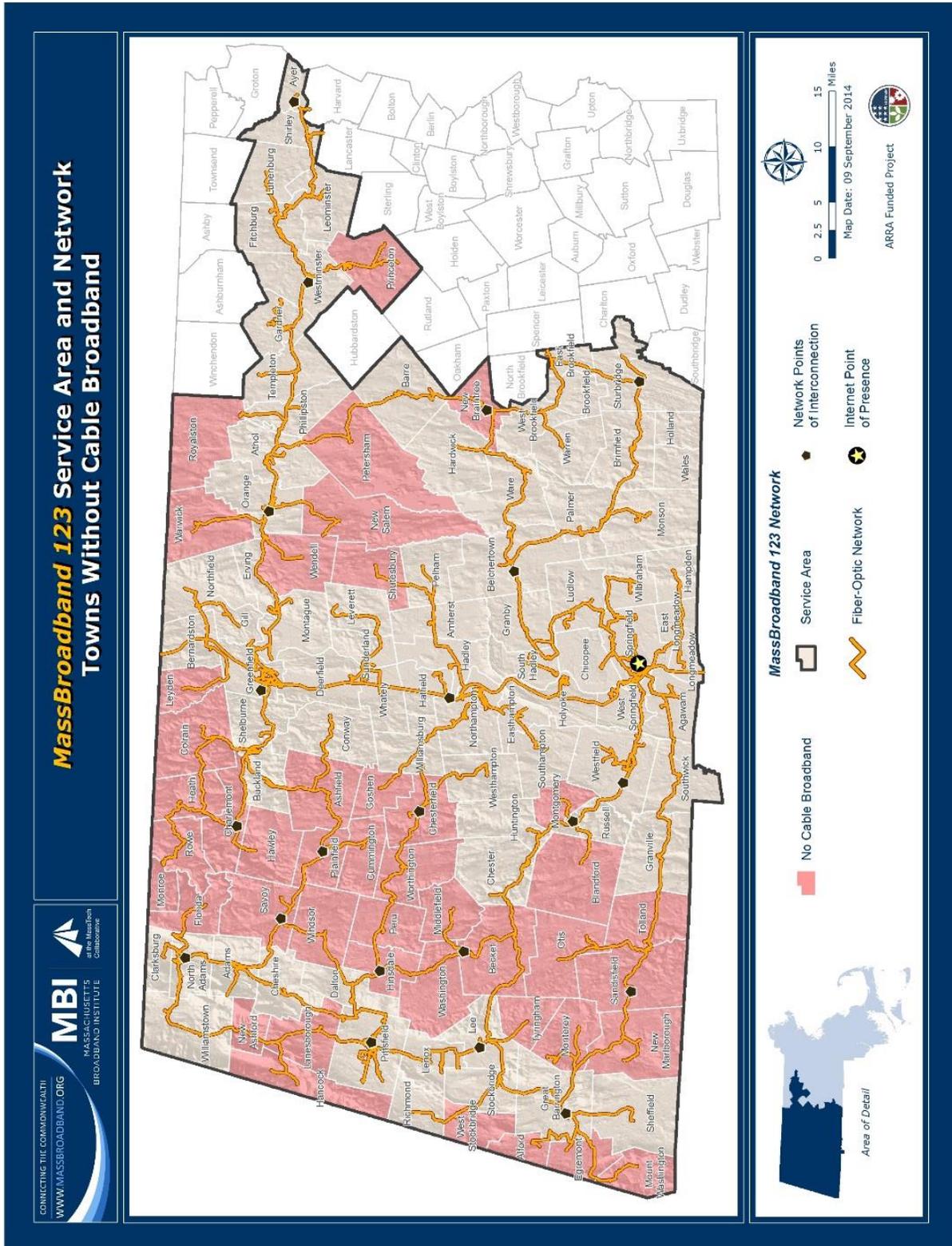
3.2.2.14 Implementing SOR and/or Information Repository

The selected D/E firm will be responsible for implementing and managing the SOR and/or information repository as identified in program development phase through the project lifecycle and the turnover of the system and data to Mass Tech Collaborative and Towns, as applicable. SOR will be capable of storing multiple types of information which will be determined in Phase 1 in accordance with section 3.2.1.7.

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Attachment E Map of Proposed Participating Towns

MAP OF THE PROPOSED PARTICIPATING TOWNS WITH AN OVERLAY OF MASSBROADBAND 123 NETWORK



Attachment G Town Information

* Units are households or businesses consisting of one or more people living or working together that occupy all or part of a standalone building.

| County | Municipality | Maintenance Responsibility | Power Distribution Provider (Service Area) | Estimated Unit Count* | Estimated Number of Poles | Estimated Route Miles for Existing Poles per town |
|---------------|------------------|----------------------------|--|-----------------------|---------------------------|---|
| BERKSHIRE | ALFORD | NGRID | NGrid - MassElectric (Baystate West) | 357 | 730 | 21 |
| FRANKLIN | ASHFIELD | VZ | Eversource Energy (Northern Division) | 934 | 1743 | 77 |
| BERKSHIRE | BECKET | EVERSOURCE | Eversource Energy (Northern Division) | 1862 | 3560 | 119 |
| HAMPDEN | BLANDFORD | SPLIT | Eversource Energy (Northern Division) | 612 | 1385 | 55 |
| FRANKLIN | CHARLEMONT | NGRID | NGrid - MassElectric (Baystate West) | 671 | 1783 | 52 |
| HAMPSHIRE | CHESTERFIELD | VZ | Eversource Energy (Northern Division) | 618 | 1320 | 47 |
| FRANKLIN | COLRAIN | SPLIT | Eversource Energy (Northern Division) | 908 | 1802 | 74 |
| HAMPSHIRE | CUMMINGTON | VZ | Eversource Energy (Northern Division) | 533 | 1275 | 49 |
| BERKSHIRE | EGREMONT | NGRID | NGrid - MassElectric (Baystate West) | 1034 | 1837 | 47 |
| BERKSHIRE | FLORIDA | NGRID | NGrid - MassElectric (Baystate West) | 383 | 1108 | 36 |
| HAMPSHIRE | GOSHEN | SPLIT | NGrid - MassElectric (Baystate West) | 636 | 1324 | 35 |
| BERKSHIRE | HANCOCK | EVERSOURCE | Eversource (Northern Division)/Ngrid (Baystate West) | 755 | 758 | 30 |
| FRANKLIN | HAWLEY | VZ | NGrid - MassElectric (Baystate West) | 218 | 833 | 28 |
| FRANKLIN | HEATH | VZ | NGrid - MassElectric (Baystate West) | 403 | 1563 | 49 |
| BERKSHIRE | HINSDALE | EVERSOURCE | Eversource Energy (Northern Division) | 1259 | 1202 | 46 |
| BERKSHIRE | LANESBOROUGH | EVERSOURCE | Eversource Energy (Northern Division) | 1848 | 1423 | 61 |
| FRANKLIN | LEYDEN | VZ | Eversource Energy (Northern Division) | 350 | 817 | 34 |
| HAMPSHIRE | MIDDLEFIELD | EVERSOURCE | Eversource Energy (Northern Division) | 287 | 781 | 33 |
| FRANKLIN | MONROE | NGRID | NGrid - MassElectric (Baystate West) | 88 | 260 | 13 |
| BERKSHIRE | MONTEREY | NGRID | NGrid - MassElectric (Baystate West) | 994 | 1900 | 55 |
| HAMPDEN | MONTGOMERY | EVERSOURCE | Eversource Energy (Northern Division) | 372 | 722 | 27 |
| BERKSHIRE | MOUNT WASHINGTON | NGRID | NGrid - MassElectric (Baystate West) | 180 | 630 | 19 |
| BERKSHIRE | NEW ASHFORD | EVERSOURCE | Eversource Energy (Northern Division) | 114 | 228 | 12 |
| WORCESTER | NEW BRAINTREE | NGRID | NGrid - MassElectric (Baystate West) | 400 | 1510 | 49 |
| BERKSHIRE | NEW MARLBOROUGH | NGRID | NGrid - MassElectric (Baystate West) | 1116 | 2818 | 88 |
| FRANKLIN | NEW SALEM | NGRID | NGrid - MassElectric (Baystate West) | 472 | 1289 | 37 |
| BERKSHIRE | OTIS | VZ | Eversource Energy (Northern Division) | 1751 | 2421 | 80 |
| BERKSHIRE | PERU | EVERSOURCE | Eversource Energy (Northern Division) | 433 | 971 | 33 |
| WORCESTER | PETERSHAM | NGRID | NGrid - MassElectric (Baystate West) | 713 | 1561 | 50 |
| HAMPSHIRE | PLAINFIELD | VZ | Eversource Energy (Northern Division) | 361 | 979 | 41 |
| WORCESTER | PRINCETON | PRINCETON MUNICIPAL | Princeton Municipal Light Department | 1394 | 2373 | 74 |
| FRANKLIN | ROWE | NGRID | NGrid - MassElectric (Baystate West) | 249 | 942 | 29 |
| BERKSHIRE | ROYALSTON | VZ | NGrid - MassElectric (Baystate West) | 673 | 2000 | 62 |
| BERKSHIRE | SANDSFIELD | SPLIT | Eversource Energy (Northern Division) | 766 | 1762 | 70 |
| BERKSHIRE | SAVOY | EVERSOURCE | Eversource Energy (Northern Division) | 388 | 735 | 34 |
| FRANKLIN | SHUTESBURY | SPLIT | NGrid - MassElectric (Baystate West) | 881 | 1350 | 37 |
| HAMPDEN | TOLLAND | EVERSOURCE | Eversource Energy (Northern Division) | 566 | 868 | 38 |
| BERKSHIRE | TYRINGHAM | VZ | Eversource Energy (Northern Division) | 338 | 750 | 22 |
| FRANKLIN | WARWICK | VZ | NGrid - MassElectric (Baystate West) | 399 | 1570 | 47 |
| BERKSHIRE | WASHINGTON | EVERSOURCE | Eversource Energy (Northern Division) | 269 | 562 | 26 |
| FRANKLIN | WENDELL | VZ | NGrid - MassElectric (Baystate West) | 471 | 1150 | 43 |
| BERKSHIRE | WEST STOCKBRIDGE | NGRID | NGrid - MassElectric (Baystate West) | 949 | 1541 | 45 |
| BERKSHIRE | WINDSOR | EVERSOURCE | Eversource Energy (Northern Division) | 510 | 1310 | 55 |
| HAMPSHIRE | WORTHINGTON | VZ | Eversource Energy (Northern Division) | 698 | 1623 | 61 |
| TOTALS | | | | 29213 | 59069 | 2040 |