

Implementing a Broadband Network Vision: A Toolkit for Local and Tribal Governments

AUGUST 2017



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Office of Telecommunications and Information Applications

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Foreword

The National Telecommunications and Information Administration (NTIA), in the U.S. Department of Commerce, is the Executive Branch agency principally responsible for advising the President on telecommunications and information policy issues. NTIA's BroadbandUSA program is an initiative to promote innovation and economic growth by supporting efforts to expand broadband access and promote digital inclusion for all Americans.

NTIA launched BroadbandUSA in January 2015 after recognizing that while communities may understand that broadband connectivity and use are vital to their economic development, innovation, education, health care, and public safety needs, they often lack the resources and expertise to seize those benefits. BroadbandUSA assists, educates, and convenes government, community, and industry leaders working to advance broadband initiatives and policy. BroadbandUSA serves as a trusted and neutral strategic advisor, working with public and private sector partners to assess local broadband needs and gaps; identify possible funding and other resources; and plan network infrastructure projects and digital inclusion programs.

Leveraging years of hands-on private sector experience along with expertise gained from its administration and oversight of broadband grants, BroadbandUSA is publishing a series of guides and toolkits for communities determined to take steps to secure the robust broadband services and digital literacy skills needed to compete in today's global economy. These publications provide practical

advice for developing programs to help communities successfully meet their current and future broadband needs. This Toolkit, *Implementing a Broadband Network Vision*, describes in detail the nine steps that local and tribal governments should take to realize the goal of deploying broadband network infrastructure to promote economic development, encourage innovation, enhance job opportunities and improve the well-being of community residents.

If you are interested in receiving technical assistance from BroadbandUSA, please contact us at broadbandusa@ntia.doc.gov. For more information about BroadbandUSA, visit our website at http://www2.ntia.doc.gov/new_BroadbandUSA.

Setting the Stage for Broadband Network Implementation

This guide is the second of a set of publications designed for communities to learn about the many facets of planning, implementing, and sustaining broadband initiatives.

The first toolkit in this series, *Planning a Community Broadband Roadmap*, provides guidance to local and tribal governments on how to envision and choose the types of broadband initiatives that will yield the greatest benefits for their constituents. This Toolkit, *Implementing a Broadband Network Vision*, covers the next steps in the process to implement broadband infrastructure projects.

This Toolkit guides local and tribal governments through the sequential stages of broadband network implementation, from planning through network construction and activation. It offers tips and advice on how to turn a broadband network plan into reality. NTIA's goal in releasing this Toolkit is to help local and tribal governments:

- ✦ Develop policies to encourage broadband infrastructure deployment and expansion.
- ✦ Use their broadband planning initiatives to refine a network implementation strategy.
- ✦ Embark upon a program — either on their own or with partners — to implement broadband infrastructure to benefit their residents.

How to Use the Toolkit

This Toolkit describes the steps that local and tribal governments should take to implement a broadband network. NTIA developed this publication based on the implementation experiences of its broadband infrastructure grantees and the best practices it observed through its management and oversight of these projects.

Any discussion of network implementation best practices is complex because of the wide range of strategies, technologies, network topologies, business plans, and partnerships a local or tribal government may choose from to achieve their broadband network vision. This Toolkit uses

Nine Steps in Broadband Network Implementation:

1. Create local policies beneficial to building broadband infrastructure
2. Refine the business plan
3. Develop the plan for construction and operational implementation
4. Select network equipment, software, and personnel
5. Evaluate Request for Proposal (RFP) bids and outsourced services
6. Conduct pre-construction community outreach and public relations
7. Construct and test the network
8. Develop the marketing and customer service plans
9. Roll out the network and service offerings

charts and graphics to explain the multiple decision points and implementation steps associated with three different types of broadband networks: institutional networks, middle-mile networks and last-mile networks.

Each section below contains:

- ✦ Advice on implementing broadband networks.
- ✦ Best practices, as developed by NTIA based on the experiences of its broadband grantees.
- ✦ Resources available online.

The *Implementation Self-Assessment Tool* at the end of this publication contains a list of questions to help local and tribal governments gauge whether a project has the critical network implementation components in place.

Using Planning Work to Choose an Implementation Strategy

The specific network strategy that each local or tribal government chooses will drive the broadband implementation process. This section provides advice on how local and tribal governments can use the work completed during broadband planning to develop the most effective implementation strategy.

Moving from Planning to Implementation

Significant planning work should guide local and tribal governments in choosing the best course of action to implement a broadband network. The general steps that they should use to create a broadband plan, including broadband infrastructure planning, are detailed in BroadbandUSA's publication *Planning a Community Broadband Roadmap*. BroadbandUSA also offers one-on-one planning assistance.

This section reviews how the outputs from the local and tribal governments' planning activities should inform their selection of a specific broadband implementation strategy. In the planning stage, local and tribal governments should have developed:

- ✦ The vision of the type of broadband infrastructure and capacity needed.
- ✦ Evaluation of existing resources and funds needed for any additional infrastructure.
- ✦ Preliminary business plans to compare the financial and operational implications of various options.

Planning Phase



Implementation Phase



Broadband Infrastructure

To determine whether additional broadband capacity is needed in a specific community or across a region, BroadbandUSA's publication *Planning a Community Broadband Roadmap* recommends that local and tribal governments create an inventory of local broadband infrastructure and service providers, assess community and institutional broadband needs, and analyze the gaps in broadband service, coverage, and network capacity.

The objective of these planning surveys, data collection activities, and community meetings is to determine whether additional broadband capacity and connectivity is needed to achieve the local or tribal government's goals, including for government operations, public safety operations, local libraries, educational institutions, businesses, industrial parks, health care institutions or local households.

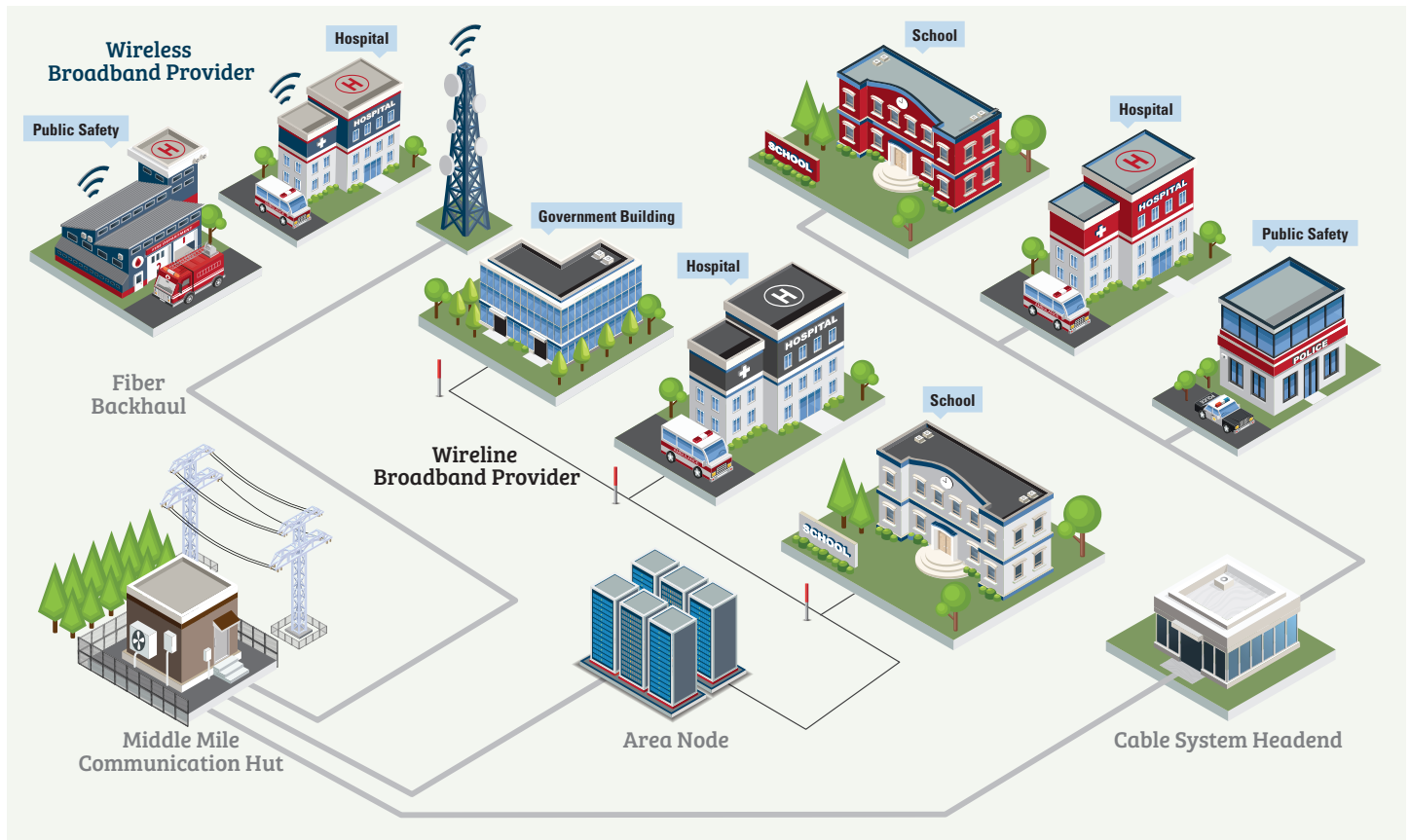
Depending upon the broadband infrastructure currently in place and the areas lacking high-speed broadband connectivity, local and tribal governments, their constituents, and partners may discuss the need to build or expand three types of networks:

- ✦ Institutional Networks
- ✦ Middle-Mile Networks
- ✦ Last-Mile Networks

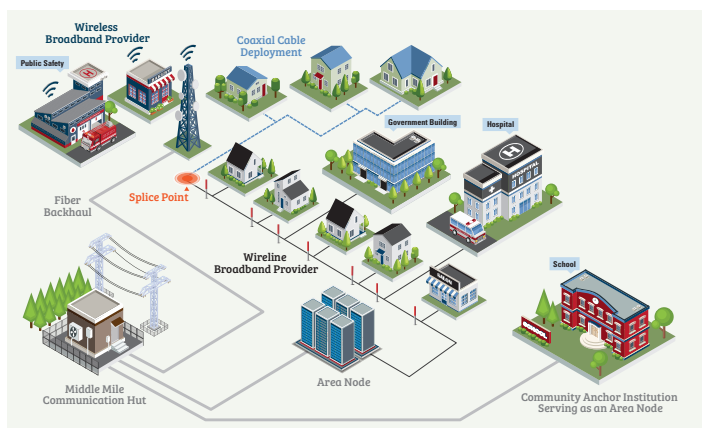
Institutional Networks: Infrastructure that provides broadband capacity and service to Community Anchor Institutions (CAIs) — schools, libraries, government agencies, medical and health care providers, public safety entities, and other community institutions.

Middle-Mile Networks: Components of a broadband infrastructure project that provide broadband service from an Internet point of presence to one or more centralized facilities (i.e., the central office, the cable headend, the wireless switching station or other centralized facility), which allows a last-mile provider to provide Internet access

Institutional Networks



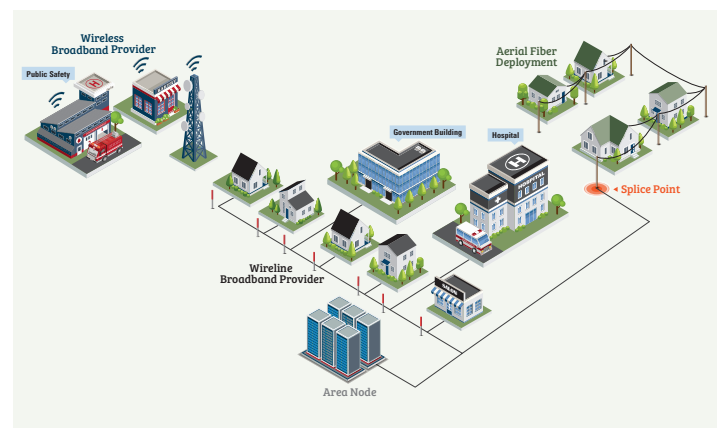
Middle Mile Networks



to a home, business, or CAI. Middle-mile networks often provide service directly to governments, businesses and other local institutions.

Last-Mile Networks: Components of a broadband infrastructure project that provide service to end-user devices. In most cases, the last-mile connection goes to the end-user device in a home, business or CAI.

Last Mile Network



These networks are often optical fiber networks in which the cables are either buried in underground conduit or strung on utility poles through an aerial deployment. In remote rural areas, such as tribal lands, or across difficult terrain, equipment for microwave and wireless broadband networks are mounted on towers so that broadband signals can reach homes, businesses, institutions and government facilities.

A local or tribal government decides to build or extend a broadband network for a variety of reasons, including to:

- ✦ Provide broadband capacity where none is available. Often these are cases in which incumbent service providers lack incentive to upgrade or expand their broadband networks.
- ✦ Provide capacity when other broadband providers find it cost-prohibitive to build middle-mile and/or last-mile broadband infrastructure to serve the community — an issue of particular importance to rural and sparsely populated areas.
- ✦ To realize economic development goals requiring robust broadband access.

The local or tribal government should evaluate how each of the network types described above best help it realize its goals.

Resources and Funds Available to Enhance Networks

After identifying the extent to which broadband network resources are lacking in a community or region, a local or tribal government should examine whether existing resources can be leveraged to help bridge the gaps, regardless of which broadband network implementation strategy or technology it ultimately chooses.

Many local and tribal governments have both broadband and non-broadband assets and resources that can be leveraged to build or expand networks. Such assets may include government-owned conduit, excess optical fiber between government facilities, real estate where broadband network facilities could be located, extra space in public buildings, antenna space on top of or outside public structures, space inside hardened facilities and alternative power-generation facilities.

Another objective of gathering information during planning is to determine, document and value the assets and resources the local or tribal government could potentially contribute to a broadband project. NTIA has found that local and tribal governments that implemented broadband networks successfully:

- ✦ **Developed an inventory of local and tribal-owned assets and facilities.** The list should include land, water towers, conduit, fiber, poles and public structures where network towers, antennas or other equipment could be located.

- ✦ **Created a facilities map showing locations.** The map should display structures, land and conduit. If possible, this information should show the geo-spatial locations with enough precision to facilitate decisions on future network topology and capital investment.

NTIA recommends that local and tribal governments speak with other stakeholders — including private broadband service providers — to discover common interests and to lay the groundwork for potential broadband partnerships. Local and tribal governments may use the asset inventories and facilities map they developed to frame the discussion and identify the potential for similar asset contributions by prospective partners.

To develop a baseline from which to quantify total potential asset and resource contributions, local and tribal governments should evaluate the number of staff, if any, to be allocated for ongoing broadband network implementation, operations, and oversight and identify the sources of any potential cash investments they are potentially prepared to make in broadband infrastructure. Any partners that make upfront equity contributions to the project may also help with ongoing sustainability.

BroadbandUSA's Toolkit *The Power of Broadband Partnerships* provides detailed guidance on formalizing partnerships to enhance broadband infrastructure and provides many case studies on the combinations of assets, resources and financing that made each successful.

Preliminary Business Plan

Implementing broadband network infrastructure — alone or with partners — is a major financial investment requiring significant expertise, staff time and resources.

Local and tribal governments should draft preliminary business plans (or financial pro forma forecast models) to evaluate the financial and operational implications of each option they consider. They should also run a sensitivity analysis for each financial model varying the assumptions driving the model.

BroadbandUSA's Toolkit *Planning a Community Broadband Roadmap* presents the framework for developing an initial pro forma for a broadband infrastructure project. The goal of this exercise is to understand the investment needed to build or expand the broadband network and to select the most realistic or achievable broadband implementation strategy.

Choosing a Broadband Implementation Strategy

Once a local or tribal government determines the broadband infrastructure and capacity it needs, the resources that it or its partners can devote to the project, and the financial ramifications of various options, it is time to move forward with the primary implementation strategy.

The role of local and tribal governments in broadband infrastructure projects typically falls into one of the following categories, each of which will be discussed in more detail below:

1. Encourage other broadband service providers to build or extend an existing broadband network to serve community broadband needs.
2. Run a network on another service provider's broadband network.
3. Build or extend a broadband network.

Local and tribal governments choose an implementation strategy based on their strengths, weaknesses and capabilities, and those of their potential partners, along with the market demand and needs of their end users. Local and tribal governments should evaluate the degree to which they want to take on a significant role in a complex broadband infrastructure project. For example:

- ✦ Option 1 requires little hands-on implementation responsibilities but calls for significant political action to update and streamline regulatory requirements to incentivize a broadband provider to build or extend a middle-mile or last-mile broadband network.
- ✦ Option 2 requires a local or tribal government to have the financial resources to enter into a contract with a broadband service provider. Contracts may range from ones where the broadband provider provides all services and equipment to where the local or tribal government (and any partners) purchases capacity, provides the equipment and manages the network services it offers.
- ✦ Option 3 requires significant resources to build infrastructure, whether alone or with partners, and sustained oversight and staff effort to ensure network engineering, construction, marketing, customer support and management tasks are being carried out according to the project plan.

Option 1: Encourage Other Broadband Providers to Build or Extend a Network

NTIA recommends that local and tribal governments start by investigating whether existing broadband network providers are able to expand the capacity and/or reach of existing networks to build out to CAIs or to unserved and underserved areas. This broadband implementation strategy is predominantly used to persuade broadband providers to extend middle-mile and last-mile networks.

The goal of this implementation option is for local and tribal governments to:

- ✦ Work with a middle-mile provider to expand service or the network to the targeted customers; or
- ✦ Encourage a last-mile provider serving another geographic area to expand its service area; or
- ✦ Encourage last-mile providers that already provide service in the community to increase broadband access, capacity and/or speeds to end users at reasonable prices.

This strategy relies upon building relationships with private companies, sometimes issuing Requests for Proposals (RFPs) to assess interest and entering into discussions that demonstrate the local government's commitment to easing the way for potential broadband network expansion. These discussions with private broadband providers will give local and tribal governments insight into providers' expansion plans, a chance to learn about providers' implementation experiences and find out if providers are open to building or expanding broadband networks in the area and what local and tribal governments can do to encourage broadband builds or expansion.

Typically, integrating the demand side for broadband is important to encourage other broadband providers to increase supply by building or expanding their networks. Local and tribal governments have several ways to incentivize this outcome, such as leveraging their buying power by aggregating the broadband demand of several government departments. In this scenario, all departments would collectively form one long-term customer contract for the broadband network. Governments can also take the initiative to assess broadband demand from local institutions in addition to their own departments to help broadband providers

justify the expense of building broadband network extensions. Governments can also promote private investment in broadband by offering incentives to encourage network construction or expansion. One approach is to create a Tax Increment Financing (TIF) district for an area in which broadband infrastructure is needed to entice network builds.

Local or tribal governments that chose Option 1 will only carry out *Step 1* of the broadband implementation steps described below.

Option 2: Run a Network on Another Provider's Network

Local and tribal governments can buy services from a broadband provider, freeing them from the responsibility of managing equipment, networks or other implementation duties. Others may choose to run virtual networks over another provider's broadband infrastructure. By doing so, they can serve local and tribal government facilities and other CAIs as well as manage networks of regional facilities via a middle-mile network. If a local or tribal government operates its own virtual network, it is usually responsible for the equipment, operations and management of the virtual network.

The goal of Option 2 is to acquire the broadband services or capacity the local or tribal government needs; however, operating a virtual network over another broadband provider's network requires that the government have the staff and resources to manage the network in-house or have a third-party contractor operate the virtual network. Governments that choose Option 2 will only be involved in some of the broadband implementation steps described below (*Steps 1* and *2*, developing the operational plans outlined in *Step 3*, personnel choices in *Step 4*, *Step 6*, and *Step 8*). Governments will not have to be concerned about the physical network construction or maintenance unless they are contributing those resources.

Option 3: Build or Extend a Network

Local and tribal governments pursue this broadband network implementation strategy when they seek to:

- ✦ Participate in a partnership that owns and operates a broadband network.
- ✦ Interconnect a network with those of other broadband providers.

- ✦ Own, build or extend its own broadband network.
- ✦ Own, build or extend a broadband network but have it operated and/or services provided by one or more separate entities.

The BroadbandUSA publication *The Power of Broadband Partnerships* provides significant detail on the nature of these alliances — public-private partnerships, government-led partnerships, and other models. In other cases, the local or tribal government's role may require only peripheral involvement in the implementation details.

Governments that choose Option 3 will be fully involved in all steps in the broadband implementation process.

Tool

- ✦ Local and tribal governments can use the *Network Implementation Strategy Checklist* at the end of this publication as a discussion guide to evaluate which broadband implementation option is most suitable for their needs, capabilities and resources.

Nine Steps to Implement Broadband Infrastructure

The nine steps described below broadly outline how local and tribal governments can implement institutional, middle-mile and last-mile broadband networks, from conception to operation.

The nine steps are not strictly sequential, but are presented in this manner to provide clarity and definition to a complex process with many moving, interrelated parts. For example:

- ✦ **Step 2** components about refining the business plan will have significance later in defining the construction implementation plan (**Step 3**). The Step 2 discussion of the service plan has significance later when conducting pre-construction outreach (**Step 6**) and marketing and sales (**Step 8**).
- ✦ The initial conceptualization of the network (**Step 3** engineering analysis) drives equipment selection (**Step 4**) and influences permitting and other make-ready activities (**Step 6**).

The timing of activities within certain steps may start earlier than this sequential diagram suggests. For example, if an environmental assessment is required and the timeframe for conducting the assessment is lengthy, it might be started as part of **Step 3** or **4**.

While the actions and recommendations for each implementation step are primarily directed to the local or tribal government, many of the implementation components are often carried out by third parties — *e.g.*, pole permit acquisition, environmental and historic preservation compliance, cultural assessments, and physical network construction. NTIA recommends these best practices for local and tribal government personnel and officials who oversee project implementation (or who are involved in a partnership) or oversee tasks carried out by third parties.

Step 1: Create Local Policies Beneficial to Building Broadband

Local and tribal governments have the authority to create local policies and regulations that can promote broadband

deployment, identify assets that can be used to build or expand networks, and can consider adopting open access policies that require the networks to interconnect with other entities. This section discusses three best practices in this area:

- ✦ **Broadband-friendly permitting and related rights-of-way approval processes.** Local and tribal governments can create streamlined permitting and rights-of-way approval processes along with dig-once policies that assist entities constructing middle-mile and last-mile broadband networks.
- ✦ **Asset Inventory.** Local and tribal governments can inventory assets that can be leased or contributed to a broadband partnership.
- ✦ **Open access interconnection policy.** Local and tribal governments can assess whether an interconnection policy is appropriate for middle-mile and last-mile networks in which they are partners or that they own and operate.

Streamlining the Permitting and Rights-of-Way Processes

Local and tribal governments control rights-of-way in their jurisdictions. Any broadband network construction project — except construction undertaken by the government itself — requires permits to mount equipment on poles, dig trenches for fiber optic conduit along streets, and lease space on public rights-of-way. Local and tribal governments can facilitate broadband network expansion by:

- ✦ Building relationships with broadband providers and partners and working together to improve infrastructure policies.
- ✦ Providing guidance on how broadband providers can most easily acquire the permits needed to expand or build networks.

The following chart suggests actions that local and tribal governments can take to improve the permitting process.

Actions	Details
Involve broadband providers in infrastructure planning	Broadband providers or utilities have experience navigating rights-of-way requirements. Where appropriate, local and tribal governments should invite broadband providers to participate in discussions about future public construction projects and infrastructure planning (<i>e.g.</i> , improvements to bridges and crossroads, new projects that will cross difficult terrain and locations where new conduit will be deployed). This dialogue will enable all parties to discover which changes in rights-of-way permitting and use procedures could be beneficial.
Discuss the local or tribal government’s plans for public infrastructure	Local or tribal governments should inform network providers about their long-term plans for street and infrastructure construction, including where they might lay conduit during any planned road construction projects, whether street intersection improvements will affect existing networks and what plans they may have to lay extra underground conduit in new neighborhoods.
Implement a dig-once policy	This creates a process to notify utilities and broadband providers of upcoming construction in the public rights-of-way. This policy gives broadband providers an opportunity to install conduit, equipment or fiber optic cable simultaneously with other construction in public rights-of-ways. A dig-once policy decreases the expense of broadband network construction and public road repair.
Streamline the permit process and provide guidance on how to obtain the right permits	Local and tribal governments should clearly define the permit process and make sure that all internal systems are in place to process the associated paperwork. For example, designating a single government point of contact for broadband permitting may expedite the review and approval process. Creating a preliminary permitting information packet informs network providers about the type of permits required, the type of information needed and the timeframes in which parties are expected to respond. Tribal governments should explain their cultural review process and timeframe.
Create a permit and rights-of-way authorization toolkit	Local and tribal governments should provide sample permit forms and examples of pre-construction surveys, construction maps and construction inspection forms. The toolkit can include draft agreements for rights-of-way access, land use, building entry, pole attachments, conduit use and use of public structures. The toolkit should list any applicable regulations, fees (permit or asset use fees) and other requirements, such as a Tribal Employment Rights Ordinance (which requires all reservation employers to give preference to qualified Indians in employment, contracting and other related activities), local sales or property taxes and necessary business licenses.
Provide a rights-of-way overview	Local and tribal governments should identify the rights-of-way owners, such as railroads, the state transportation departments, the Bureau of Indian Affairs, and state highway departments. Broadband providers should be told what is required to use public property and what steps they should take to obtain these approvals.
Develop local resource and supplier lists	Local and tribal governments should provide a list of area contractors or other local resources to facilitate infrastructure construction. This information is also useful if rights-of-way owners lack sufficient manpower to meet the necessary requirements but would be open to allowing approved entities to provide the services (<i>e.g.</i> , conducting make-ready studies for pole attachments, carrying out construction inspections or obtaining approvals from tribal allottees, <i>i.e.</i> , persons having interests in building on an allotted parcel of tribal land).

Asset Development and Agreements

As noted earlier, planning a broadband infrastructure project results in local and tribal governments identifying assets and facilities they own that can be developed or made available for a broadband infrastructure project. Assets that are most commonly offered include:

- ✦ **Conduit:** Providing broadband providers with access to government-owned conduit.
- ✦ **Fiber:** Selling or leasing excess fiber strands from an existing institutional network or other government-owned fiber.

- ✦ **Real estate:** Offering broadband providers land on which to locate Network Operations Centers, satellite antennas, towers, hubs and other equipment.
- ✦ **Pole attachments:** Using traffic lights and government- or tribal-owned utility poles for fiber runs, wireless routers, antennas and other associated equipment.
- ✦ **Public structures:** Offering space in existing buildings and locating antennas and other equipment on public structures. Many local governments sell or lease space to broadband providers on water towers, tower farms, rooftops or buildings.

- ✦ **Hardened facilities and alternative power generation facilities:** Offering to share these types of facilities can help broadband providers meet their network resiliency and disaster-response requirements.

Local or tribal governments should clearly identify which assets might be available for use by the broadband providers and include the requirements to use them. Best practices for asset development include:

- ✦ **Creating a menu of potential agreements:** Local and tribal governments have many options in offering these assets to providers for broadband network expansion, such as asset sales or leases, capacity-sharing agreements and schedules of fees for use. Local and tribal governments should identify the assets available for broadband implementation and describe associated financial arrangements for each — for example, fee schedules or leasing options.
- ✦ **Providing a facilities map:** As broadband network providers move forward with their implementation plans, engineers will draft highly specific technical network plans. For example, broadband providers may use a Geographic Information System (GIS) or other software to develop explicit images of where conduit will be laid and where support facilities will be located. To encourage the use of public facilities, local and tribal governments should provide interested broadband providers with GIS maps showing locations of the facilities, structures, land and conduit that they can make available to the project.

Other Policy Considerations

One of NTIA broadband grants' key statutory requirements was the concept that all broadband infrastructure projects were required to operate as open-access networks — facilities that are made available to all requesting parties at reasonable rates and on reasonable terms. This policy applied to all middle-mile and last-mile networks.

An open-access policy distinguishes between:

- ✦ **Owners/operators** of a broadband network that manage the physical facility and may or may not operate the open access segments of the network.

- ✦ **Wholesale broadband service providers** that offer capacity on a network to others that directly serve customers.
- ✦ **Retail broadband service providers** that buy capacity from the wholesaler and offer service directly to the end user, such as a local business, resident, library, hospital, school, government department, police department or other public safety organization.

The primary element of an open-access broadband network policy is:

- ✦ **Interconnection:** Network operators must offer interconnection to any party and offer wholesale broadband services and capacity at reasonable rates and terms. Interconnecting parties are typically allowed to collocate their equipment with that of the network owner in a secure, separate space.

Open-access middle-mile networks offer their facilities to requesting parties, enabling them to interconnect with high-speed data networks on a regional, state and national basis. Implementing open-access middle-mile networks is intended to encourage the deployment of last-mile networks and provide additional broadband options for businesses and CAIs to support overall economic development. Interconnection allows the networks a source of income and primes the pump for additional investment from Internet Service Providers.

Exceptions to interconnection requirements were permissible in some circumstances — law enforcement or public safety networks do not have the same open-access requirements; state or local laws that do not allow specific institutions or governments to offer service beyond state requirements, and some managed service networks designated for a specific application (*e.g.*, telemedicine, distance learning). These exceptions are typically identified during the planning process.

Step 2: Refine the Business Plan

The local or tribal government chooses a broadband implementation strategy by modifying assumptions in its financial pro formas to reflect different broadband scenarios and selecting the most advantageous scenario as the basis for the business plan.

The next step is to refine the business plan to the specifics of the chosen infrastructure initiative. At a minimum, the business plan should include:

- ✦ The mission and goals of the broadband initiative — the core strategy.
- ✦ Description of the core business and details of the service plan.
- ✦ The initial network design and general cost estimates.
- ✦ Potential contributions by other partners and financing.
- ✦ Pro forma forecast models.

The refined business plan should include more detailed information on construction costs, equipment purchasing, financing options, operating expenses, and revenue projections. These data points and assumptions will drive the overall infrastructure plan and associated costs of the implementation. Price estimates for services or capacity and projected take rates are assumptions driving the pro forma forecast models and sensitivity analyses.

While implementation of each broadband network varies, the sections below offer general guidance and best practices on refining business plans.

Service Plan

This portion of the business plan identifies the services that may be offered by either the wholesale and/or retail broadband network. The work associated in developing a service plan varies depending upon the scale and market of the broadband initiative.

For a government institutional network, the process may simply involve surveying users to identify their future needs — information that a local or tribal government IT department may know well.

- ✦ A local or tribal government may also take the lead to develop an institutional network involving groups of schools, hospitals, or public safety entities, because similar organizations may have similar broadband service requirements. A best practice is to meet with these institutions, reach agreement to aggregate their collective broadband demand, and incorporate these numbers into the financial pro forma documents.
- ✦ A local or tribal government may also develop or participate as a partner in a middle-mile network in which institutional sub-networks are planned — for example, a sub-network of public schools or county public safety facilities. In this case, the process may be more involved and require an outside consultant to perform a detailed analysis of regional or local wholesale and retail broadband requirements of large customers. A best practice is to meet with potential broadband customers and discuss the specific types of broadband capacity they purchase (or are interested in purchasing) and find out which additional services they need and when their current contracts expire.
- ✦ For a last-mile residential broadband network that will be newly constructed, the government or partners will need to assess customer preferences and determine the range of broadband, video or other services people are willing to buy. To identify services for last-mile networks, surveys and focus groups are often the best methods to ascertain what potential customers want for services and their willingness to pay for them.

Getting out into the market and speaking directly to potential customers should reveal if there are any unforeseen challenges that must be overcome to attract target customers, as well as the mix of services that should be offered, and at what price points.

Definition: Pro Forma

A pro forma financial statement is a collection of financial statements that are based on certain assumptions and projections. An organization prepares pro forma financial statements in an effort to provide a “big picture” view of its overall financial situation.

Generally, the prepared statements include projected balance sheet, income statement and cash-flow statement; collectively, these projected financial statements are referred to as “pro formas.” Pro formas do not follow Generally Accepted Accounting Principles (GAAP) and there are no guidelines for the assumptions used in pro forma statements and projections; therefore, organizations must define the assumptions they use in preparing these statements and provide the assumptions as part of the pro forma package.

Service Package/Pricing Options

- ✦ Fixed-price service contract
- ✦ Price according to bandwidth used
- ✦ Client premise contracts
- ✦ Add-on services (*e.g.*, network engineering, cloud services)

This customer-focused or market demand research will provide critical information to refine the business plan as to:

- ✦ List of services offered (*e.g.*, broadband access only or bundled services).
- ✦ The manner in which groups of services are bundled for the customer.
- ✦ Broadband speed requirements.
- ✦ The network topologies and architectures to be supported.
- ✦ The services to be available (see list below).
- ✦ What equipment customers need to access the planned infrastructure.
- ✦ A plan for introducing the services (*e.g.*, whether to roll out all services at once or over time).
- ✦ A price structure for the services.

Although the exact services to be offered can be refined further in the implementation process, the business plan at this

stage should reflect the broad strategy of service packaging — grouping services that are targeted to different types of customers and a broad sketch of the price structure. For example, a broadband network provider could allow a broadband service subscriber to modify the level of service as their activity expands and their needs for new services changes (*e.g.*, beginning by offering Ethernet services and expand to video conferencing or GIS service over time).

Cost Estimates

Decisions on the mix of services and capacity to be offered are directly related to developing the capital and operating cost estimates to build the network and configure it to deliver the service. A local or tribal government that sets up a virtual private network-based (VPN) institutional network needs estimates of the equipment and configuration costs. For projects involving the construction of broadband infrastructure, cost estimates for the entire network are needed.

The items below can lower the initial capital cost of building a network.

- ✦ **Indefeasible Rights-of-Use (IRUs):** Obtaining broadband capacity on other networks through IRU agreements.
- ✦ **Existing Assets:** Getting approval, if appropriate, to use assets already built (*e.g.*, fiber for traffic signalization and smart roads, conduits, water towers).

Potential Middle-Mile/ Institutional Network Service Offerings

- ✦ Virtual Private Network (VPN)
- ✦ Voice
- ✦ Cloud
- ✦ Licensing program (virtualization licenses)
- ✦ Collocation
- ✦ Service for mobile telephone switching offices or mobile switching center's utility service
- ✦ Smart-grid connectivity
- ✦ Tower space
- ✦ Microwave and fiber backhaul
- ✦ Roaming
- ✦ Network planning and consultation
- ✦ 24x7 network monitoring and performance e-measuring
- ✦ Wholesale offerings, individually negotiated
- ✦ Peering agreements usage
- ✦ Ethernet, Wavelength Division Multiplexing (WDM) technology
- ✦ Tiered speed offerings
- ✦ Network Operations Center (NOC)
- ✦ Data center
- ✦ Engineering support

- ✦ **Joint construction:** Constructing jointly with other infrastructure projects.
- ✦ **Construction Type:** Aerial deployments with associated costs to prepare the pole for attachments (make ready), underground, micro trenching, and other approaches.
- ✦ **Existing assets:** Negotiating use of existing towers or other facilities instead of building them and over-lashing cable to another cable or constructing on a pole with a brace.

Capital costs should be updated regularly during network design because construction costs can vary significantly. In construction projects, it is common to deviate from the initial plan because of unexpected events or circumstances, so ongoing planning is critical. For example, underground rock could be encountered unexpectedly during construction, unanticipated building-entry issues could arise, and delays from permitting, weather and crew availability are possible. Both the business plan and the construction budget should be flexible enough to accommodate for these contingencies.

Local and tribal governments typically have their IT, planning, economic development and financing experts refine or — in the case of a partnership where the partner is responsible for the analysis — review the broadband network business plan, but some may hire a consultant to do a portion of this work.

Financial plans should be updated continually during the implementation process to ensure that the project management team is working with timely data based on actual costs.

Income Forecasts for Institutional and Middle-Mile Networks

Forecasting income from a broadband network must take into account the type of services to be offered, customer demand/willingness to pay for the service, local or tribal government and CAI users, and the presence of alternative sources of broadband service (i.e., competitors).

The forecast should be based on the size of the potential market for broadband services and the percentage of this market that the network could capture after deployment.

Open-access middle-mile networks offer several advantages, including:

- ✦ Generating revenue from the sale of broadband capacity, broadband network management services and backhaul transmission from microwave towers used in wireless service provider networks.
- ✦ Increasing broadband capacity for government, other institutions or other broadband service providers.
- ✦ Offering third-party providers an “on ramp” to a broadband network in previously unserved or underserved areas.

The revenue estimates in the financial pro forma will be based on the services offered to customers, the pricing structure for the services, the value of the service, and whether other alternatives exist in the community or region for the same service. If other broadband providers are offering similar wholesale or retail service, the estimates in the business plan should reflect what other players are offering, what they deliver, whether customers are satisfied, how sensitive customers are to price and how willing prospective customers are to use the new broadband service. New entrants should expect the other providers to make service and price modifications.

NTIA recommends the following best practices for refining forecasts for an institutional or middle-mile network business plan:

- ✦ **Leverage assets of other broadband providers.** Preliminary conversations with other broadband providers will provide an understanding of whether any of their capacity or services can be utilized for network operation services and support. Using another provider’s conduit and entering into long-term fiber leases are strategies to lower the general cost of network implementation.
- ✦ **Develop a service plan to generate revenue in addition to sales and capacity.** Local or tribal governments should give thought to developing revenue-generating services that might be offered in addition to broadband (*e.g.*, network management services or on-site network assistance).
- ✦ **Aggregate demand for estimates.** A recommended approach to maximize potential revenue for financial forecasts is to estimate broadband demand by aggregating current and projected use estimates from all government departments and groups of local institutions (*e.g.*, schools, hospitals, libraries).

Forecasts for Last-Mile Networks

Deploying a last-mile residential network is often significantly more complicated and expensive than deploying a middle-mile or institutional network in the same area. A government-led or partnership initiative to build a residential broadband network should evaluate customer demand and market conditions carefully.

Launching a new last-mile network in a competitive market requires a deep understanding of the environment, which includes: public demand, benefits, density in the proposed service area and take rates. Surveys and focus groups are useful tools to gain insight to consumers' sensitivity on pricing. Marketing expenses will probably be higher in the early years following the introduction of the network, but these will always be an ongoing expense.

To gauge long-term sustainability, local and tribal governments should consider the network's initial and future upgrade capital costs, operating expenses and the logistical and political complexities of launching residential broadband service. A last-mile residential network requires substantial long-term operational support and significantly high rates of subscription.

NTIA recommends the following best practices for refining forecasts for a last-mile broadband network business plan:

- ✦ **Streamline expenses:** Evaluating the type of broadband service to offer customers (*e.g.*, broadband access only vs. triple play) should be considered carefully, since the operating and capital cost structures of the different options vary enormously. Due to the high expense of last-mile networks, the refined business plan should incorporate strategies to lower infrastructure and operational expenses — for example, leasing offerings provided by another provider's cable television headend, using microfiber cable to connect homes or outsourcing installation services. To reduce capital costs, a middle-mile network could be used to interconnect with partners who provide cable, cloud, voice-over-IP or other residential services. Forecasts should also reflect service increases for programming expense and other increases that are beyond local control.

- ✦ **Position competitively:** If the network is built in an area served by an incumbent broadband service provider, the plan should reflect the likelihood that the incumbent will lower rates or improve service. The service offering must be competitively priced and packaged for long-term success. Ensuring that early customers have a positive experience with the service should be a particular focus for all involved.
- ✦ **Obtain advance commitments:** Survey the willingness of customers to commit to buying broadband service before network construction (*e.g.*, crowdsourcing). This approach should reveal whether sufficient demand for last-mile service exists to justify the expense of construction, particularly in rural areas.

Tool

- ✦ Local and tribal governments can use the *Implementation Self-Assessment* included in this publication to ensure that they have examined the different parts of the business plan — the underlying strategy and the financial projections.

Step 3: Develop Construction and Operational Implementation Plan

The project plans developed should be detailed enough to guide network construction and the day-to-day operations and should include staffing, outsourcing, engineering, marketing and customer relations.

NTIA recommends that local and tribal governments:

- ✦ Create an implementation framework for network construction that relies on robust project management tools.
- ✦ Create well-defined processes and procedures for each operational area in the plan.

The sections below highlight two primary types of implementation plans — construction and operations.

Construction Implementation Plan and Related Project Management Tools

The components of the construction implementation plan include all the tasks related to broadband network construction and activation, along with the timing needed for completion. Each

component has its own list of associated activities, which must be detailed with distinct initiation dates, interrelated time schedules and completion dates. Critical activities include:

- ✦ Timetables for designing the infrastructure, engineering each segment of the network and obtaining the necessary approvals.
- ✦ Environmental, historic preservation and cultural reviews, including local, tribal, state, and federal requirements.
- ✦ Multiple permit processes.
- ✦ Land lease or acquisition.
- ✦ Equipment and materials procurement.
- ✦ Labor contracts and, where required, inclusion of federal Davis-Bacon prevailing wages or state prevailing wages.
- ✦ Timing associated with the remaining implementation steps (*e.g.*, hut or tower construction, equipment installation, construction oversight and sign-off).

At this point in the process, local and tribal governments should develop:

- ✦ A detailed construction implementation schedule and list of associated tasks.
- ✦ A process for updating the construction plan on a regular basis.
- ✦ An understanding of the different tasks of each strategic partner or supplier.
- ✦ A reporting process to keep managers of the project apprised by the contractors/partners on at least a weekly basis.
- ✦ Project milestones.

Robust project management serves as the foundation for implementation of all broadband infrastructure projects. Complex deployments need organizations, partners and contractors to work together to meet schedule, cost and service-quality targets. Strong project management staff, tools and processes are fundamental to this effort. Staffing of the project management teams should be based on the different responsibilities of the entities handling the various operational components (*e.g.*, marketing, engineering, administration, customer service and financial).

Local and tribal governments may want to consider using project management software to manage each of the components related to broadband network construction. Project implementation plans and processes are based on educated assessments of how the project will proceed, but reality often differs from expectations, particularly in complex network builds. Project planning tools show the critical paths for each activity, including how delays impact the overall timing of the project. Software programs should have the capability to automatically adjust.

Tasks associated with each implementation step are mapped onto project management software and other organizational tools to provide a clear overview of when the various stages of implementation will be achieved and how all components — from RFPs to network rollout — fit into the project’s overall timeframe.

In creating the construction implementation plan, the project management team may make strategic decisions that greatly influence the time and cost of the project. For example:

- ✦ The inclusion of leased fiber as a component of the plan may reduce the cost of the network and the time needed to construct it.
- ✦ The need for networks to cross difficult terrain, the lack of power lines near proposed tower locations or lack of roads — common in some tribal areas — may necessitate additional time and resources to prepare for the network construction itself.
- ✦ The network build may commence all at once or incrementally as financing, design and opportunities arise and needs dictate.

NTIA found that successful broadband network implementation plans had the following characteristics:

- ✦ **Setting realistic expectations for construction:** Local and tribal governments should speak with others that have implemented and launched similar broadband networks to better understand the timeframes needed to meet key milestones.
- ✦ **Leveraging expertise of private partners or outside experts:** If a partnership includes private broadband providers, local and tribal governments can leverage the experience and knowledge of the partner to anticipate potential construction challenges and remedies or work with outside experts.

- ✦ **Setting realistic timelines for procurement and make-ready work:** Construction implementation plans often underestimate the time necessary to obtain fiber optic cable, complete environmental reports, work with utilities to prepare the facilities and area for construction and obtain rights-of-way from railroads or other agencies.
- ✦ **Phasing-in network implementation:** Incremental building, or building to demand, is an alternative to building out to the entire geographic market during one construction cycle. For example, some last-mile network projects build out first to serve Multiple Dwelling Units (MDUs). An incremental build-out could prioritize areas where quick sign-ups are likely and demand is high.
- ✦ **Creating processes that tie together different elements of the plan:** During pre-construction, for example, an engineer can visit each proposed fiber location, document any environmental impact and requirements, review cultural studies for changes needed in the path of the network, document existing assets at the site, and develop a cost estimate for the construction request.
- ✦ **Monitoring every part of the implementation plan and how it is executed:** Successful implementation requires that project managers concentrate on all of the details of using, operating and/or building a network. Attention to implementation details will help to anticipate and mitigate potential cost overruns by third-party contractors.
- ✦ **Instituting strict cost accounting and inventory control practices:** Setting up solid policies in advance of construction will enable local and tribal governments to monitor spending by contractors and subcontractors and control inventory more effectively during periods of intense activity.
- ✦ **Continuously updating the plan:** At a minimum, plans should be updated monthly to reflect any changes to the schedule.

Tool

- ✦ Local and tribal governments can use the *Implementation Self-Assessment Tools* at the end of this publication to assist in setting up the proper procedures to monitor network construction and creating a realistic process to track expenditures.

Operational Implementation Plans

The components of an operational implementation plan include all of the strategy, tasks and policies to guide contracting, staffing, ongoing maintenance, network extensions, marketing, customer service training and related activities for the project over the long term.

The operational implementation plan should define the following:

- ✦ **Operational processes:** Managing broadband service and networks requires clearly defining processes for all functional areas of the project, including procurement, purchasing, administration, inventory control, customer service, plant and/or equipment management, external communications, and marketing. Developing the inputs and timetables for project updates, dashboards and analyses of customer service will help to track performance indicators and more effectively manage these processes.
- ✦ **Vendor processes:** Processes should be established to manage relationships and the performance of contractors and vendors that are not signed on as project partners. These processes include service oversight; equipment and software introduction and quality control; construction oversight; construction inspection; outsourcing components of network, NOCs or data center construction; and contracting for specific equipment repair and maintenance. Depending on the project and the types of partners, these functions may be managed by more than one party.
- ✦ **Decision-escalation processes:** The project management team should develop appropriate processes to allow staff or partners, in accordance with the governance structure, to escalate issues if simple solutions are not apparent. For example, guidance should be provided to customer service representatives as well as managers on when to escalate a complaint to a supervisor or to the management team. The project management team should regularly review the schedule to resolve issues that have been escalated.

Establishing and fine-tuning project, operational, procurement and financial processes are essential to successful network implementation. With the construction implementation schedule in hand, local and tribal governments should evaluate whether other factors may affect the successful implementation of the broadband network:

Operational Implementation Plan Components:

- ✦ Staffing
- ✦ Outsourcing
- ✦ Engineering, system, equipment and software maintenance and repair plan
- ✦ Marketing
- ✦ Customer service
- ✦ Stakeholder and owner relations
- ✦ Human Resources
- ✦ Training

- ✦ Identifying any non-construction implementation challenges.
- ✦ Instituting policies and procedures to address the challenges.
- ✦ Setting up robust procedures to test and verify all constructed assets.
- ✦ Creating procedures and systems to manage facilities and inventory.

Transparency, communication and clear processes are helpful for successful operational implementation, particularly as the project progresses to network completion and activities such as marketing and customer relations increase. Clear communication combined with establishing specific goals and timelines should keep a complex process steadily moving forward and deliver effective results.

NTIA recommends the following best practices to serve as a framework for high-quality operational implementation:

- ✦ **Maintain oversight:** The project management team should use dashboards and other management tools (*e.g.*, Gantt and Critical Path charts) to understand the changes needed to meet the overall project timetable and goals.
- ✦ **Segment responsibilities:** Management responsibility for RFPs and other tasks should be divided among sub-groups to reduce the burdens on any single group and to allow greater overall efficiency.
- ✦ **Keep teams informed and involved:** Project team members should help develop and update the sections of the implementation plans relating to their areas of responsibility. Regularly updating project and operational plans keep the teams and management apprised of progress, problems, and delays and focused on meeting milestones.

- ✦ **Encourage a proactive approach:** Project team members and management should take action when changes occur to avoid problems and mitigate them to ensure the project stays on track.
- ✦ **Create templates and best practices for contractors:** Local and tribal governments should provide contractors and subcontractors with guidance on procurement and contracting practices; construction management; and compliance with environmental and historic preservation requirements. To facilitate network construction, contractors and subcontractors can be given templates to facilitate reporting and tracking of technical designs, construction activities and permitting.
- ✦ **Encourage teamwork:** Regularly schedule cross-functional team meetings to keep communications channels open across different groups.
- ✦ **Maintain communication with key partners:** Continual information sharing among all parties keeps the major goals and realistic expectations in focus. If the local or tribal government is working with another party to manage the broadband network, they should hold regular meetings to establish processes and standardize procedures for inventory management and other critical parts of the implementation.
- ✦ **Continue risk assessment:** Operations plans should be reviewed on a regular basis to evaluate if any aspect of the implementation is at risk.
- ✦ **Focus on the broadband benefit:** Communicating the benefits of the broadband implementation to stakeholders — whether as an engine for economic, social or financial benefit — should always be at the forefront.

Tools

- ✦ Local and tribal governments can use the *Network Implementation Strategy Checklist* and *Implementation Self-Assessment Tool* at the end of this publication to ensure that they are looking at factors that may affect the successful implementation of the network and management of facilities and inventory over the long-term.

Step 4: Selecting Network Equipment, Software and Personnel

The project management team now understands the general construction and operational direction of the broadband network and can take more specific action by:

- ✦ Undertaking a detailed engineering analysis.
- ✦ Making equipment choices.
- ✦ Selecting the types of software required.
- ✦ Deciding on personnel and outsourced services to carry out operations, construction, equipment and software installation.
- ✦ Deciding if vendors should provide training for the equipment and software.

The steps in this process are to:

- ✦ Conduct a review of available assets and equipment necessary for the broadband network.
- ✦ Perform an engineering analysis on the extent to which these resources and assets meet short-term and long-term broadband needs.
- ✦ Complete a design for the network.
- ✦ Plan which equipment, software and services will be requested in an RFP.
- ✦ Consider the time required for certain tasks and determine whether the task can be performed by the internal staff or partners, or whether outside parties should be contracted for using the normal hiring or contracting processes.

Local or tribal governments may perform these tasks in-house, delegate to project partners or contract with a third party — typically a network design and/or engineering or construction firm.

Engineering Analysis and Network Design

The detailed engineering analysis drives specific equipment and software choices. In this phase, the design team identifies the broadband network topology and its components, including:

- ✦ Interconnection points with other broadband networks.
- ✦ The network fiber segments where optical fiber is currently or will be deployed.

Broadband Network Components

- ✦ Core backbone
- ✦ Backhaul
- ✦ Laterals
- ✦ Interconnection points

- ✦ Microwave tower locations and other sites for wireless network components.
- ✦ Locations of the physical network components, such as Network Operations Centers (NOCs), optical fiber electronics and wireless broadband equipment.
- ✦ Connection locations for CAIs and government sites.
- ✦ The physical broadband plant to reach homes or other users of the last-mile network.

Incorporating sufficient network redundancy into network design is a major engineering consideration. Local and tribal governments should meet with other network providers to determine whether it is possible to collaborate to use redundant broadband connections from major carrier hotels or national interconnection points. All interconnection points, data centers and NOCs should be engineered to carrier-quality standards.

The location of interconnection points in the engineering plan is an important strategic consideration. Local or tribal governments should meet with other network providers, CAIs and businesses to determine the most cost-effective, technically feasible interconnection points with new customers and other local, state or regional broadband providers. For example:

- ✦ If network interconnections with NOCs and POPs (Points of Presence) are planned, it may be possible to purchase low-cost broadband capacity and join a wider network that pools demand (*e.g.*, through construction, IRUs or other agreements).
- ✦ If the network is designed to interconnect with a variety of data centers, customers have the option to select the data center that best meets their needs.

The network engineering plan helps determine the extent to which the following items are needed for the project:

- ✦ Permissions for rights-of-way access and for securing permits include using the FCC’s Tribal Consultation Notification System (TCNS) to facilitate review and approval of tower construction on tribal lands and local, tribal, state or federal permitting processes.
- ✦ Permits for mounting network equipment on utility poles, towers or other structures.
- ✦ Land to be purchased or leased.
- ✦ Leased space on towers, buildings, collocation sites or other facilities.
- ✦ Licensed or unlicensed spectrum.
- ✦ Environmental, historic and cultural studies and approvals.
- ✦ Building access to install wireless and/or wireline equipment.
- ✦ The number of interconnection points, hubs or nodes.

NTIA recommends several best practices to engineer successful middle-mile and institutional networks:

- ✦ **Build in capacity for future broadband demand.** Network designers should always plan for the future by adding fiber and conduit that exceeds the plan’s initial estimates. The expense of adding fiber and conduit during the initial construction phase will be far less than adding it later. Adding structural supports on towers during construction will open up future revenue opportunities from other network operators that are willing to lease tower space for their equipment.
- ✦ **Anticipate community expansion.** Broadband networks and innovative ideas to use them are always growing. The network design should accommodate locations where future development may occur, such as proposed sites for industrial parks, government offices, healthcare facilities and other community buildings. Access points should be located where network connections will most likely be needed in the future.
- ✦ **Take advantage of backhaul revenue opportunities.** Tower locations requiring backhaul services – a major revenue generator for open-access, middle-mile networks – should be a major consideration in planning the network. Network designers should consider if backhaul might be needed near tower locations. If CAIs are located along the network route to the towers, connecting institutions will not only provide

them with access to high-speed broadband service, but will amortize the network extension costs across a greater number of revenue-generating locations.

- ✦ **Design frequent interconnection points.** The goal is to design the network so that it has frequent interconnection points at locations most appropriate to local users — for example, accommodating last-mile providers by optimizing short-distance runs from interconnection points.
- ✦ **Use mapping technology to highlight areas that could cause challenges.** In the network design process, using digital topographical maps helps to visualize terrain and mitigate issues that could cause protracted delays, require complex regulatory approvals or drive up construction costs — for example, adjusting plans to avoid crossing endangered species habitats or areas with high make-ready costs for pole attachments.
- ✦ **Engineer connection points to minimize service disruption and maintenance.** Middle-mile broadband providers can design and configure the splice points at add/drop sites so that each provider has access only to fiber capacity that it requires, allowing it to reduce maintenance costs.

Equipment and Software Selection

Prior to issuing RFPs, the nature, specifications and quantity of equipment and associated software should be determined by the engineering, construction and plant operations personnel along with the project management team. The type of fiber deployed along the route determines the nature of the transmission equipment required for the outside plant and at the customer premises. The service plan determines the kind of equipment needed to deliver the type of broadband capacity and service being offered (*e.g.*, Ethernet, wavelength-division multiplexing (WDM) or VPN service).

Broadband Network Equipment and Software:

- ✦ Fiber cables
- ✦ Microwave towers
- ✦ Splicing and termination hardware
- ✦ Collocation facilities
- ✦ Network operations centers
- ✦ Operational Support Systems
- ✦ Business Support Systems

Equipment selection is also affected by where the equipment will be deployed — hung on poles; buried in a trench; attached to towers, light poles or roofs; mounted on pedestals; or housed in vaults or inside buildings. Local and tribal governments should rely on in-house network experts or outside consultants who specialize in network engineering and construction to make such decisions because of the variation in the types of equipment for middle-mile and last-mile broadband network construction.

The quantity of equipment for the broadband network will depend upon:

- ✦ The number of fiber segments in the network.
- ✦ The degree to which the business plan incorporates leased miles of fiber and associated equipment.
- ✦ The number of towers or other facilities used for wireless portions of the network.
- ✦ The number of homes and/or institutions to be served.

Software required for middle-mile and last-mile broadband networks is classified into two categories:

- ✦ Operational Support Systems (OSS), which are used to manage the network, provide service and deliver customer support.
- ✦ Business Support Systems (BSS), which are tied to the financial systems and support customer-facing activities such as billing, sales and marketing.

NTIA recommends that local and tribal governments periodically review the standard specifications for equipment purchases to ensure new purchases are consistent with improvements in broadband technology.

Tools

- ✦ Local and tribal governments can use the *Implementation Self-Assessment Tool* in the final section of this publication to ensure that their network design reflects all necessary fiber, wireless and back-office equipment and software components.

Personnel and Outsource Choices

Local and tribal governments or their project partners may have staff with the expertise to implement a broadband network. However, limited access to local personnel and the scale and scope of the broadband construction project often cause many tribes and local governments to rely on outside resources (*e.g.*, consultants or other contractors) to take responsibility for the following activities:

- ✦ Network design, engineering and construction oversight.
- ✦ Obtaining environmental, historic preservation, and cultural approvals prior to construction.
- ✦ Obtaining the required rights-of-way permits, approvals and pole attachment licenses prior to network construction.
- ✦ Constructing one or more portions of the network.
- ✦ Ongoing network operations.
- ✦ Customer service.
- ✦ Maintenance.
- ✦ Some or all operations.
- ✦ Marketing and sales.

If the local or tribal government or their project partners choose to outsource any of these tasks, an internal staff member or an experienced contractor should provide oversight.

Operational Support Systems	Business Support Systems
<ul style="list-style-type: none"> ✦ NOC software, including broadband provisioning ✦ Fault management ✦ Inventory control systems, which link to the fiscal management system ✦ Client databases 	<ul style="list-style-type: none"> ✦ Financial and procurement control systems ✦ Service ordering systems ✦ Lead tracking software for customer development ✦ Billing and customer service software

Step 5: Issue Requests for Proposals and Evaluate Bids

Local and tribal governments should have experience in issuing RFPs and evaluating vendor responses. The RFP process encourages competitive bids for the elements needed to build or expand broadband networks, including software, equipment, construction and other services, which should potentially lower overall costs.

Local and tribal governments have used the RFP process to seek services, network providers or other types of technical contractors. The nature of the solicitation varies widely based on the project and project partners. The RFPs could be for:

- ✦ A single turnkey construction bid or multiple bids to construct parts of the network
- ✦ A single, consolidated fiber and equipment bid
- ✦ Additional equipment bids, segmented by technology (*e.g.*, microwave, fiber, towers)
- ✦ Network software
- ✦ Equipment deployment
- ✦ Network testing
- ✦ Operational support
- ✦ A round-the-clock NOC
- ✦ Training on the use of equipment

Required Components of a Broadband Network Request for Proposal

- ✦ Quality of service
- ✦ Repair response time
- ✦ Reliability
- ✦ Upstream and downstream capacity
- ✦ Pricing targets or commitments
- ✦ Contract duration
- ✦ Future upgrades
- ✦ Types of equipment
- ✦ Services offered
- ✦ Redundancy
- ✦ Equipment (*e.g.*, Ethernet, WDM)
- ✦ Privacy policies
- ✦ Community benefits
- ✦ Innovative approaches
- ✦ Delivery and turn-up timeframes and costs
- ✦ Interconnection opportunities
- ✦ Peering arrangements

In addition to the requirements of a typical broadband network RFP, tribal governments may require bidders for project construction to comply with the Tribal Employment Rights Ordinance (TERO). Building good relationships with TERO offices is critical as they can help identify tribal members with prior construction experience that could be employed on fiber construction teams.

Local and tribal governments should follow their normal procurement practices and set up a team with the expertise to evaluate bids for technology and services. If the local or tribal government does not have sufficient resources to carry out the fairly complex procurement process for a broadband network, it should seek assistance from either partners or consultants. If a partner handles all or some of the bidding procedures, the local or tribal government should have input into the procurement and evaluation processes.

NTIA recommends the following RFP best practices for successful broadband networks:

- ✦ **Define the need.** Among the most important elements of any RFP will be statements that clearly define the needs to be addressed and the outcome(s) expected upon project completion.
- ✦ **Clarify evaluation criteria.** Local and tribal governments should develop broadband-supplier evaluation criteria — including fiscal health — so that making comparisons among bidders is easy. A pre-bid meeting should be held to clarify issues.
- ✦ **Standardize evaluation procedures.** Local and tribal governments can use checklists to ensure that every contractor being considered has all proper documents on file before the cost/price analysis is performed to evaluate the contractor’s suitability for the project.
- ✦ **Procure construction services locally.** For extensive middle-mile projects, it is often more efficient to solicit local-area construction companies. If a large broadband network construction project is divided into parts, the RFP can seek bidders for each section and award to the lowest bids for each.

- ✦ **Research contractor qualifications.** For construction projects, a pre-qualification process, including background checks, ensures that local or tribal governments select vendors from a reputable, competent pool of contractors.
- ✦ **Ask for fixed prices on difficult jobs.** If terrain is difficult, requiring fixed-price bids in an RFP is a strategy to minimize budget overruns. Even if terrain is not difficult, middle-mile network operators can require construction contractors to bid on a fixed-price, per-foot basis.
- ✦ **Anticipate growth.** As discussed earlier, planning for more capacity than expected is recommended — both in the number of resources being requested in the RFP and in the volume of equipment being ordered. Contractors should be able to scale up their capacity if required.
- ✦ **Review end-use sites.** Every site should be checked to ensure all equipment locations are appropriate for the network, including back-up power, off-hour access and cooling requirements.

Tools

- ✦ Local and tribal governments can use the *Implementation Self-Assessment Tool* in the final section of this publication to ensure that their procurement policies and RFP procedures are in place to proceed with broadband network construction.

Step 6: Conduct Preconstruction Outreach and Public Relations

Prior to any construction, local and tribal governments and their partners should obtain all necessary approvals and permits for construction and begin building support for the network with the public, potential customers and community members whose activities can be disrupted by the construction.

Pre-construction Outreach

Prior to construction, local or tribal governments building middle-mile or last-mile networks should establish clear, transparent processes to facilitate, as required:

- ✦ Environmental assessments
- ✦ Cultural assessments

- ✦ Historical preservation assessments
- ✦ Rights-of-way permits
- ✦ Tower, land and pole attachment licensing and make-ready work
- ✦ All required wireless spectrum licenses and permissions

Early and frequent interactions with all relevant parties — government regulators, utility companies, tribal TERO and cultural offices, railroads, historical preservation agencies and others — is necessary to minimize delays.

NTIA offers the following best practices for implementing these types of assessments:

- ✦ **Reserve sufficient time in the implementation schedule to obtain required assessments:** NTIA recommends that local or tribal governments contact approving offices or agencies handling the type of assessment required (*e.g.*, archeological, cultural, historical, waterway, endangered species or wetlands) and plan long lead times to accomplish the required work.
- ✦ **Work with specialists:** Working with outside specialists in environmental compliance, cultural and historical preservation matters to develop reports that meet regulatory standards can expedite the environmental review and approval process.
- ✦ **Provide field support and monitoring:** Assigning a staff member to work alongside the specialists to troubleshoot problems ensures that significant attention is devoted to following up with adjustments required to gain approval.

As noted in *Step 3*, setting up a permit and rights-of-way approval process is a key part of the construction implementation plan. Obtaining approvals may require interaction with a number of different entities — for example, tower owners, leased site owners, railroads whose property is crossed, tribes, the Bureau of Indian Affairs, tribal allottees, the Federal Aviation Administration, the Federal Communications Commission, state departments of transportation, and historical and environmental regulators. Hiring an outside contractor to perform these tasks is a common solution if the local or tribal governments do not have the capacity to obtain these permits and approvals themselves, particularly when building networks across federal and tribal lands.

Another part of pre-construction activity is to gain approvals from CAIs and other end-users to allow construction to occur on their premises. Approvals at these sites could include allottee approval for use of allottee lands, tribal approvals, building entry issues, inside wiring and space to house equipment.

NTIA recommends these best practices to follow for pre-construction permitting for broadband networks:

- ✦ **Hold Pre-application meetings:** Meeting with federal agencies or tribal representatives to discuss permitting needs and network plans, helps facilitate a smoother application and approval process.
- ✦ **Create templates:** Creating standard templates for easements and right-of-entry can make an often cumbersome process more efficient. Local and tribal governments should consider creating standard Memoranda of Understanding (MOU) to facilitate the process if a third party is engaged to handle pole attachment assessments and permit applications.
- ✦ **Establish a permit-tracking process:** Tracking permits and authorizations will foster accountability for the staff or consultant carrying out the work and facilitate a close working relationship with them.
- ✦ **Create a permit-minimization approach:** Partnering or contracting with entities that already have access to required rights-of-way, such as utilities, significantly speeds up this portion of the make-ready process for broadband network implementation.
- ✦ **Review progress frequently:** Performing ongoing reviews of the progress being made on land acquisition and access, including contracts and easement completion, will keep the process moving forward in a timely manner.

Pre-construction Public Relations

The pre-construction phase is the time to begin boosting community awareness of the new broadband service through a thoughtful public relations campaign. Advance communications with the public and potential customers is vital to the success of any type of broadband implementation — middle-mile, last-mile or institutional networks, or networks operated over an existing broadband provider's network.

The public should be aware of how the network will bring value to the community. Network operators should play visible roles as local broadband experts and continually deliver strong, compelling explanations of the benefits and value of high-speed broadband.

NTIA recommends that local and tribal governments engage in the following activities during pre-construction:

- ✦ **Target specific customers and stakeholders.** Effective public relations activities and communications should target prospective large customers, institutional stakeholders and government stakeholders.
- ✦ **Discuss implementation plans with open-access users.** Middle-mile network operators should meet with potential open-access customers and interconnecting network operators to provide them with up-to-date information about the network's completion date, because the timing may have an impact upon their own and their customers' business plans and budgets.
- ✦ **Develop sample contracts.** Prospective clients or users should be given drafts of open-access contracts to illustrate the types of enhanced services that will be offered.

How to Facilitate Approvals for Pole Attachments

A pole attachment requires an application to the utility pole owner. To prepare:

- ✦ Do a pre-construction survey to determine if the pole can handle the attachment.
- ✦ Conduct a field survey on each pole to be licensed.
- ✦ Hire a third party to determine pole adequacy and develop make-ready work estimates.
- ✦ Work with local providers to execute Memoranda of Understanding (MOUs) to describe roles and responsibilities of all parties.

- ✦ **Provide technical advice to prospective customers.** While the network is still being completed, technical staff can build trust with last-mile providers and institutional customers by consulting with them on broadband solutions.
- ✦ **Promote the network with government agencies and departments.** An internal communications campaign with government departments will solidify support for the undertaking and ensure that all future government users are creating budgets and allocating resources to use the new broadband capabilities.

NTIA observed these best practices in successful network implementations:

- ✦ **Hold preconstruction meetings.** In advance of construction, schedule a kick-off meeting with each contractor to set expectations for performance. Managers should explain the need for daily reports, appropriate signage, labor requirements, wage policies, safety and other standards to be upheld during the construction.
- ✦ **Publicize permit meetings.** Advertising permit meetings in the newspaper and online forums increases community awareness of the project and reduces the amount of community surprise surrounding construction.
- ✦ **Issue construction alerts.** Repeat notices should be distributed to CAIs and homes near the construction area to keep everyone updated.
- ✦ **Manage expectations.** Since construction delays are common, it is important to reinforce realistic expectations about the network's completion among stakeholders.
- ✦ **Issue progress reports.** Potential customers can be kept informed of the network construction progress through web-based newsletters, social media, local media, web sites and digital maps.

Step 7: Construct and Test Network

Once the required permits and approvals are in place, network construction begins. Local and tribal governments may work with one or more construction contractors to build the network. If the local or tribal government has a public utility, the utility may construct all or part of the broadband network.

During the construction phase, the processes and procedures created in *Step 3*— the operational and construction implementation plans — are executed.

The broad range of construction activities include:

- ✦ **Receiving equipment.** On-time, accurate delivery of the correct facilities and equipment is essential. A good working relationship with equipment vendors and construction contractors helps to ensure that everything that is ordered meets the specifications when it arrives. For example, coordinating with prefabricated building manufacturers ensures that the delivered buildings contain the requested equipment and number of racks.
- ✦ **Tracking inventory.** Processes should be implemented to track the timing of all equipment arrival, check-in, storage, tagging and control. If the size of the project is appropriate for using a barcode scanner and inventory management system, a significant amount of efficiency can be brought to this time-intensive process.
- ✦ **Documenting network equipment.** Based upon the initial network design (*Step 3*), construction documentation requires each cable and connection point to be diagramed. A database is created for cables, racks and panels. Because cables run to different destinations, the documentation should include its position, path, capacity and type.
- ✦ **Testing equipment.** Where appropriate, equipment can be sampled and tested upon receipt to ensure it works within manufacturers' specifications. For example, the fiber optic cable is tested to determine that it meets design specifications and identify any points of failure before it is placed in the network. This allows for the discovery of any transportation or manufacturing faults.
- ✦ **Site preparation.** The work required to prepare the tower and other building sites should be assessed by an engineer. Other make-ready work involves ensuring there is sufficient spacing on poles for fiber aerial construction work and there are sufficient electrical connections to critical power sources between the equipment and the network.
- ✦ **Deployment, documentation and construction sign-off.** Location-specific data is used to track and monitor fiber

equipment, markers and splice points. Construction reviews are critical. Policies should be established so that contractors are aware of the requirements.

- ✦ **Testing the network.** Written procedures should be drafted for the network's readiness testing, certification and acceptance. It is vital to establish and test redundant broadband access, core electronics, ring completion, customer requirements for billing and service and other key service factors. Implementing service prior to the completion of network construction should be managed carefully to avoid customer disappointment with service and damage to the networks' reputation.

If network customers and CAIs have signed up for service before network activation, middle-mile providers can assist them before and after their location is connected. Every contact is an opportunity to develop a good customer relationship.

Unexpected events often happen. Identifying and reducing risks of potential delays and mitigating problems during construction are vital. Any local assets to be used in the project should be assessed for any potential upgrades or changes that will be needed.

NTIA recommends the following best practices to ensure that the construction schedule encounters as few unexpected challenges as possible:

- ✦ **Use robust project management tools to monitor the different moving parts of the broadband network project.** Project and operational plans are fluid. Using tools that support a dynamic project plan ensures that management has real-time understanding of how changes to the implementation plan affect the project's overall timeline. For example, if there are delays in equipment delivery, using project management software will help determine when to reschedule the affected construction personnel.
- ✦ **Procure materials early.** Due to long wait times for certain fiber equipment, orders should be placed well in advance of construction so that deployment is not held up.
- ✦ **Monitor progress.** Daily checklists should be used to monitor progress. Engineers and plant supervisors should travel to visit construction sites frequently — including random quality control inspections — to monitor progress and discover if any

issues could potentially impede progress (*e.g.*, if construction crews are hitting miles of rock as they trench or if other easement problems occur). Contractors should be encouraged by the project management team or through the RFP process to work on more difficult portions of the build earlier in the process to allow time to work through issues without delaying the overall project schedule.

- ✦ **Maintain ongoing communications.** Constant communication is essential among engineering, construction and splicing crews. Weekly status meetings should be held among engineering teams and consultants to review construction progress.
- ✦ **Document changes.** Written and signed change orders should be used to document changes to the initial contract.
- ✦ **Update as-built maps.** Data to the GIS should be continuously updated by the GIS mapping staff or a contractor to generate accurate construction maps and as-built maps for the project's conclusion.
- ✦ **Use fiber management software and location data on equipment.** The local and tribal government should ensure that warehouse or construction staff or project partners document the receipt, storage and installation of all equipment.

Tools

- ✦ Local and tribal governments can use the *Implementation Self-Assessment Tool* in the final section of this publication to ensure that sufficient vendor oversight occurs during broadband network construction.

Step 8: Develop Marketing and Customer Service Plan

While construction is underway, local and tribal governments should:

- ✦ Package and price broadband services are packaged to meet the needs of the local market
- ✦ Create marketing materials and outreach activities to explain the new services
- ✦ Aggregate demand by groups of users and close sales

Services

Defining the service that will be offered includes specifying:

- ✦ Service offerings for either wholesale or retail broadband service
- ✦ Pricing for the service and packages.
- ✦ Draft standard Service Level Agreements (SLAs)

Step 3 in the implementation process — refining the business plan — discussed the preliminary work to define the type of services to be offered. At the network construction stage of the process, service should be refined into distinct offers that are packaged and priced to the target customers. Typical service offerings include:

- ✦ Services or capacity provided on an institutional network
- ✦ Wholesale middle-mile services and bandwidth to third parties and offering connectivity to businesses, institutions, government agencies or last-mile providers
- ✦ Retail middle-mile services offered directly to businesses, institutions and government departments, which can include managed bandwidth and a full range of support services to end users (see **Step 1** service list)
- ✦ Retail last-mile services offered to residents, which can include broadband, television services or Internet-based telephone services

Packages should be designed by the public relations and outreach team or by a contractor based upon the customer's value drivers — that is, the reason that pushes the customer to seek out the particular broadband service.

Understanding the factors that compel customers to seek specific broadband capacity or services will drive the creation of marketing materials and strategies to capture their business.

The marketing and project management teams assemble product offerings into one or more packages that fit the needs of different types of customers. Services and pricing should be designed to attain the penetration rate needed to sustain the network.

NTIA found some common threads among local and tribal governments that have developed successful broadband service offerings:

How to Determine the Value Driver

- ✦ What underlying factors drive the customer to seek a particular service?
- ✦ What motivates their purchase decision?
- ✦ How does the broadband service offer meet this customer need?

- ✦ **Develop top-notch customer outreach and marketing tactics, which are essential to any successful service launch.** Target customers require messages that build confidence in the brand and service. Outreach and marketing initiatives should be tested in the earliest stages of implementation and modified as the project achieves its various milestones. Post daily and weekly opportunities that exist for reaching new and current customers. The focus should be on what truly differentiates this offering from other available options.
- ✦ **Develop information about services, pricing and SLAs.** Standard materials should be developed for use in sales and marketing by local and tribal government staffs, partners or contractors.
- ✦ **Develop packages that scale.** The local or tribal government should develop packages with broadband speed tiers to allow customers to scale their use of bandwidth in future years as their bandwidth needs grow.
- ✦ **Work with other service providers to expand offerings.** Middle-mile service providers should assemble the types of back-end support from third parties to offer advanced, specialized cloud-based applications (*e.g.*, video surveillance, electrical control systems, building control systems) if market research suggests that customers want them. Fiber networks are valuable to these back-end support firms.

Marketing

The marketing implementation process includes:

- ✦ Developing a marketing program and plan.
- ✦ Determining which personnel execute the plan.
- ✦ Assigning tasks that will potentially involve partners for targeted groups of customers (*e.g.*, telemedicine, smart grid, education).

- ✦ Documenting customer meetings and the results.
- ✦ Establishing systems to track the outcome of different outreach and marketing activities.

Step 6 outlined many of the steps that operators of middle-mile networks take to build relations with potential customers prior to network construction – strategic targeting, preliminary meetings to explain broadband services, showing customers sample contracts and promoting broadband with government agencies and departments. The key is to begin designing and implementing the marketing plan early in the process.

Many tactics are used to ensure that the appropriate messages about the broadband service reach the targeted potential customers. Among the most important tactics are face-to-face meetings with government organizations, CAls, and business customers to recommend the types of broadband services that customers should consider and from which they can benefit. This tactic is critical in places where broadband was previously unavailable to educate potential customers about the new range of service possibilities.

Marketing materials and tactics should be designed around the customer's value drivers, including developing special, targeted materials for specific sets of customers within the service area. Marketing materials should persuade potential customers that their wants, needs and concerns are being addressed. Traditional marketing channels are used to promote awareness of broadband networks, such as:

- ✦ **Participation in forums and public meetings:** Attending events can involve informing people of the general economic and social benefits of high-speed broadband.
- ✦ **Logos:** Branded logos on emails, websites, vehicles, employee shirts, brochures and handouts to build brand awareness. For some, this can involve co-branding.
- ✦ **Articles:** Published articles in specialized publications or regional business newspapers.
- ✦ **Mailers and newsletters:** Mailers and newsletters about the new network (*e.g.*, local and tribal government newsletters, project specific quarterly newsletters).
- ✦ **Print materials:** Marketing literature created for targeted customer groups, which includes details of the service offering and terms of the contract.
- ✦ **Signs:** Signs and banners to showcase features of the service to users (*e.g.*, in storefront offices, institutional user locations, bus stops).
- ✦ **Advertisements:** Traditional mass media marketing (*e.g.*, radio, TV, print, paid advertising, PSAs, press releases and news conferences).
- ✦ **Social media:** Social media channels (*e.g.*, Facebook, YouTube, Twitter, Instagram), broadband construction projects frequently have hundreds of Twitter followers.
- ✦ **Websites:** Residential last-mile broadband providers should build in features to allow customers to register online; middle-mile network websites should feature updates on construction progress.
- ✦ **Booths:** Presentations and booths at fairs, tribal meetings, festivals, town hall meetings, conferences, community meetings, job fairs, civic association meetings, trade shows and seminars.

Customers need materials containing messages that build confidence in the brand and service. If prospective customers voice any initial concerns or questions about the offerings, such as concerns about the team's experience, technology, high-speed broadband, cost-saving potential or community benefits, these issues will provide clues for developing messages that allay those concerns.

Every speaking engagement does not need to be exclusively about the broadband network. Contact with community groups can be broadly educational, discussing the economic and community benefits of broadband access and adoption. The following activities build general visibility for a broadband network project:

- ✦ **Development teams:** Local and tribal governments or their project partners appoint staff to a business or stakeholder development team to keep stakeholders engaged, seek new business or customers, and provide focus for the sales staff.
- ✦ **Workshops:** The public relations and outreach teams hold broadband workshops and conferences for economic development organizations, IT professionals, parents and educators, government departments, health care professionals, or other target audiences.

- ✦ **Speaking engagements:** Project management team members speak at the local Chamber of Commerce and other civic organizations to spread the message about how high-speed broadband can benefit businesses and institutions.
- ✦ **Community boards of directors:** Local and tribal governments or their project partners encourage staff to serve on boards and committees (*e.g.*, economic development, broadband roundtables and committees).
- ✦ **Surveys:** Conduct surveys of potential customers to increase awareness of new services and gain insight to customer needs and sensitivity to price.
- ✦ **Promotions:** Customer-facing staff implements promotions as they interface with customers or users (*e.g.*, 311 customer service representatives, trainers, network installers).

Like the other parts of the network, the local or tribal government should test marketing materials and key messages to be sure they resonate with the target audience. Outreach and marketing initiatives should be tested in the earliest stages of implementation and modified as the project achieves its various milestones. The focus should be on what truly differentiates this offering from other available options. The goal of marketing is to gain customers. Customer relationship management (CRM) software is helpful in tracking opportunities and existing customer interactions.

NTIA found that the tribal, county, state and local governments that have been most successful in broadband marketing used these best practices:

- ✦ **Create customized marketing material.** Developing collateral explaining the benefits of broadband to different categories of potential institutional and business customers demonstrates sensitivity to their concerns and needs — a strategy that could help to make sales later if coupled with repeated contact with representatives.
- ✦ **Jointly market with last-mile retail providers.** Success for the wholesale broadband service provider depends upon the success of the retail provider. If a wholesale middle-mile provider is taking initiative to boost awareness of the new broadband service, last-mile providers should be included.

- ✦ **Arm construction crews with marketing literature.** Brochures with benefit, service and contact information should be given to construction contractors to pass on to the public as people stop by construction sites to inquire about the activity. The benefit of using marketing literature in this way is to ensure that information being conveyed is accurate and that crews are responsive to questions without being unduly distracted.

Tools

- ✦ Local and tribal governments can use the *Implementation Self-Assessment Tool* in the final section of this publication to ensure that marketing and sales activities are being implemented.

Demand Aggregation and Sales

Pooling demand will improve customer participation in the network build and could lower operating costs. Implementing a demand aggregation strategy is important due to the benefits it brings — providing a more accurate vision of the necessary services and capacity required by a target customer group, potentially reducing broadband prices for the collective base of users and reducing service-provisioning costs for the broadband supplier.

Subscribers having multiple locations — across town or on a single campus — can combine their broadband utilization and request an aggregated bill. This results in multiple sites being treated as a single customer. This has a dual benefit for customers — it enables smaller customers to share service among a larger group and it increases the buying power they have in making aggregate service purchases to reduce costs.

Demand aggregation can be implemented at the national, state, local, regional or community level for a variety of end users, including hospitals, health care facilities, government buildings, public safety locations, libraries, community colleges, industrial parks, residents, businesses and schools. For example:

- ✦ **Local schools:** A middle-mile network may serve local schools or connect them to regional or state networks.

- ✦ **State organizations:** At a state level, many institutions already participate in groups, such as state associations of libraries, healthcare providers or educators. Within these associations, broadband advocates can form working groups to organize members to gather data and present a comprehensive estimate of broadband demand at the state level. From the supplier end, broadband providers can work through state or regional organizations to conduct surveys to estimate aggregated demand and gain support from members. States can also amass demand for broadband from local governments through RFPs, like many do for E-Rate.
- ✦ **National participation:** On the national level, middle-mile networks often work with bulk purchasing organizations (*e.g.*, tower backhaul) or national associations that have existing connections and deals that can be leveraged.

NTIA found the following best practices useful in aggregating demand and successfully concluding sales:

- ✦ **Make state and national connections.** Working with associations, national organizations and bulk aggregators allows middle-mile network operators to leverage a wider set of connections and service agreements.
- ✦ **Joint sales effort for wholesale and retail broadband services.** Some middle-mile broadband wholesalers developed processes to match end users with last-mile providers — a process that begins with the wholesaler identifying specific broadband service packages with the customer, notifying last-mile providers of the opportunity and explaining the wholesale price and lead-generation fee. The last-mile provider follows up and if a successful contract is negotiated, the last-mile provider signs a separate agreement with the wholesaler. After construction is completed on the broadband link, the wholesaler turns on the customer’s service.

Step 9: Roll Out Network Operations and Service

Before the network begins offering service, network operations should be up and running (*e.g.*, billing, customer service, sales, installation and repair) and diagnostic systems should be tested and in place.

If partners have significant operational responsibility for the network, local or tribal governments need to maintain close working relationships with them. This will help address day-to-day issues efficiently and encourage continual operational improvement.

At this step in the implementation process, three basic types of testing occur:

- ✦ Service beta testing.
- ✦ Operations testing (including customer service staff and software).
- ✦ Network and final systems integration testing.

Beta testing services often starts with the involvement of “friendly users” (*e.g.* staff members and their families), who are aware that tweaks will be needed. Sometimes this preliminary testing can begin on a section of the network before full network completion, allowing changes and corrections to be made with “friendly” users rather than with paying customers.

After the initial problems are solved, beta service testing can be expanded to engage users in different locations. Even after service rollout, network operators should continue for several months in a “testing” mode to detect problems early and fix them. The broadband service is often either rolled out in sections or sequentially to specific categories of users.

Operations testing should be a part of the implementation plan. System and operations software is typically rolled out upon receipt and put into operation during the construction and implementation phases. If the software shows problems, then there is sufficient time to have the vendor or contractor provide training or troubleshooting before the wider rollout to customers.

Staff training is an important part of operations testing and rollout. The goal should be to train all staff and test operations prior to rollout to customers or users. The amount of training needed will be based on the experience of the staff, partners and contractors. For example, if customer-service staff from a utility operation is being cross-trained, they will already know many of the fundamentals. Training can be rolled into vendor contracts.

For example:

- ✦ Customer-service staff needs training on the service and broadband capacity offered, rates, how to handle typical consumer problems and other types of trouble shooting.
- ✦ Installers require training both in wireline and/or wireless installation and customer service. Well-trained installers can bring valuable information to management about customers and users of the system.

Network and final systems integration tests are completed prior to final sign-off on the network and its equipment. Most systems are reviewed, tested and repaired in segments as construction continues. Once construction is completed, the network as a whole needs to be tested to ensure that it meets the operating specifications for each segment of the network and for the network as a whole. If a number of technologies and software are being used, testing the seamlessness and latency of handoffs is required both during construction and at network completion. If problems exist, the engineers and vendors will need to work out solutions.

NTIA has identified the key features of the most successful network operations and service rollouts:

- ✦ **Allow sufficient time for testing.** It is critical, especially on large projects and projects that use multiple technologies, to allow ample time for testing and to bring in expert resources as needed to assist in making sure the broadband network met design specifications.
- ✦ **Beta test every service.** Every service offering is complicated and deserves to be part of a beta test. Skipping a beta test can mean that customers do not receive a quality service and that could mean a loss of that customer. Beta-testing all services allows the detection of problems during the beta test and to make corrections prior to service rollout. Following this practice leads to a successful rollout and satisfied customers.
- ✦ **Roll out services in phases.** The most successful rollouts of services were done in phases. Some phased-in customers by type of user while others rolled out in phases by geographic region. The phased rollout allowed the customer service staff and installers to keep up with demand and avoid disappointing potential customers.

- ✦ **Stay customer-focused in training.** Customer service is an important component of every aspect of training for broadband service delivery and is especially important for customer-facing staff - whether customer service representatives, billing, repair or installation. Customer-facing staff can be major asset for the project.

Broadband Implementation in Context

Each local and tribal government will have a different approach to broadband implementation, since local presence of broadband infrastructure and the resources available to build infrastructure vary widely. Local and tribal governments always have the ability to establish policies to encourage others to build networks or to enhance broadband infrastructure by streamlining the permitting and rights-of-way processes and offering assets to a broadband provider (*Step 1*).

If a local government operates a virtual private network on a broadband provider's network, steps *1, 2, 3, 4, 6* and *8* will apply.

If a local or tribal governments decides to become a partner in a broadband infrastructure project or proceeds to build infrastructure on its own, this Toolkit maps out the essential steps in the overall process that follows the initial planning phase — refining the overall forecasts in the business plan (*Step 2*) and developing more detailed construction and operational implementation plans (*Step 3*).

Whether working with an outside consultant or relying upon in-house expertise, local and tribal governments have an important oversight role to play in technology and personnel decisions (*Step 4*), the personnel and equipment selection process (*Step 5*), creating goodwill and understanding about the broadband project in the community (*Step 6*), network construction (*Step 7*), marketing and promoting the service (*Step 8*), and promoting the new infrastructure when it all goes live (*Step 9*).

Below is a summary of the key best practices for local and tribal governments seeking to implement a broadband infrastructure project:

- ✦ **Pay extremely close attention to every part of the broadband implementation plan and how it is executed.** After initial network planning has concluded, implementation requires teams to concentrate even

more scrupulously on all of the details of using, operating and/or building a network and to meet weekly to assess results and discuss potential solutions to any problems.

- ✦ **Develop and update detailed operations plans and working closely with partners on the fine points.** This approach addresses day-to-day issues efficiently and encourages continual operational improvement.
- ✦ **Provide aggressive oversight of network construction, equipment deployment and service launch.** Problems can be identified early and dealt with quickly with this daily oversight.
- ✦ **Use robust project management tools to monitor the many different parts of a broadband network project.** Project and operational plans are fluid. Using tools that support a dynamic project plan ensures that management has real-time understanding of how changes to the implementation plan affect the project's timeline. For example, if there are delays in equipment delivery, using project management software will help determine when to reschedule the affected construction personnel.
- ✦ **Develop top-notch customer outreach and marketing tactics, which are essential to any successful service launch.** Target customers require messages that build confidence in the brand and service. Outreach and marketing initiatives should be tested in the earliest stages of implementation and modified as the project achieves its various milestones. The focus should be on what truly differentiates this offering from other available options.

With expertise implementing other large public works projects, participating in public-private partnerships and managing utilities for communities, local and tribal governments have the background, skills and vision to tackle broadband infrastructure implementation.

Resources for Broadband Implementation

Implementation:

- ✦ BroadbandUSA's publication, *Introduction to Effective Public-Private Partnerships*, explains how to develop successful partnerships and offers best practices NTIA has observed through overseeing \$4 billion in broadband grants to public, private and joint-venture projects across the country: http://www2.ntia.doc.gov/effective_public-private_partnerships
- ✦ NTIA's publication, *BroadbandUSA Introduction to Stakeholder Outreach* includes strategies for mapping a network of possible stakeholders and including them in program planning and implementation: https://www2.ntia.doc.gov/files/stakeholderoutreach_052417.pdf
- ✦ BroadbandUSA's *The Power of Broadband Partnerships* is a toolkit publication that provides best practices for local and tribal governments on how to form successful partnerships to expand broadband infrastructure in their communities. https://www2.ntia.doc.gov/files/powerbroadband_070517.pdf.

More About BroadbandUSA

- ✦ The centerpiece of BroadbandUSA is its technical assistance team, which provides individualized and group technical assistance to state, local, nonprofit, and industry leaders interested in planning, funding, and implementing broadband initiatives. BroadbandUSA's experts know that there is no one-size-fits-all approach to expanding broadband access and adoption and its works with communities to tailor solutions that best address their unique challenges.
- ✦ BroadbandUSA also organizes events that bring together state, local, and federal officials, industry, community leaders, and other stakeholders to share broadband success stories and lessons learned.
- ✦ BroadbandUSA connects communities to other federal agencies and funding sources and improves coordination among federal agencies and state and local officials on broadband issues.

Broadband Network Implementation Tools

Implementation Tool: Network Implementation Strategy Checklist

This checklist summarizes the reasons that local and tribal governments choose one broadband network implementation option over another. This checklist is intended to be a guide for discussion once local or tribal governments have mapped their broadband resources, considered available funding and resources for the broadband initiative, and drafted one or more financial pro formas to reflect various options.

Checklist: Conditions Associated with Broadband Implementation Options

Option 1: Encourage Other Providers to Build or Extend a Broadband Network

- Government does not want to undertake broadband implementation task itself
- Government lacks resources to undertake broadband implementation task itself
- Government has sufficient funds in its budget for a service contract with a provider
- Government can demonstrate that sufficient broadband demand exists in a community to justify a broadband network extension
- Government offers incentives to entice operators to build or to extend broadband service to community

Option 2: Operate a Virtual Private Network (VPN) on Another Provider's Broadband Network

- Government has critical operations for which direct network operation and management is preferred.
- Government has staff and IT resources to operate a VPN
- IT staff supervision of broadband network is cost-effective:
 - In-house management by IT staff
 - Third-party management contract managed by IT staff

Option 3: Form a Partnership to Build or Extend a Broadband Network

- Government sees partnership as a way to reduce broadband service expense over time
- Government can increase broadband capacity and/or network reliability through shared facilities
- Government sees how economic development and other community goals can be reached by extending middle-mile broadband networks
- Government extends an existing institutional network to offer middle-mile network capacity and services

Option 4: Build or Extend a Government- or Tribal-Owned Network

- Government needs to replace or upgrade an institutional network formerly provided as part of a cable television franchise
- Government wants broadband connectivity and service where none is available
- Government sees that other service providers lack incentive to upgrade or expand broadband networks
- Government sees that other broadband providers find it cost-prohibitive to build last-mile broadband infrastructure to serve the community
- Government sees that undertaking broadband infrastructure projects to meet economic-development goals and serve constituents

Implementation Tool: Implementation Self-Assessment

This worksheet is a guide for local and tribal governments to use through the different parts of the broadband implementation — *Steps 2 through 9.*

	Status/ Comments	Area of Concern?
Strategy and Financial Projections		
What is your core business strategy? Which services do you plan to provide: + Wholesale service + Retail services directly to customer		
What markets will you serve? What is the size of your overall addressable market? What percentage of this addressable market are you forecasting to capture?		
For each major wholesale and/or retail services category (<i>e.g.</i> , wholesale transport, retail broadband), estimate: + Projected in-service dates + Product feature set + Target market + Pricing		
What recent changes have occurred in the market (<i>e.g.</i> , products, pricing)? How will you continue to monitor the market?		
How do you expect competitors to respond to your entry into the market? How will you react?		
What are your plans to serve community anchor institutions through last-mile providers, wholesalers, or other intermediaries?		
How will your project be sustained over the long run? Do you have up-to-date financial pro formas that demonstrate sustainability?		
What challenges will you face in ensuring the long-term sustainability of the network?		
Project Management and Schedule		
Do you have a complete, up-to-date schedule that shows and accounts for all dependencies? If not, when and how will this schedule be developed?		
How will you monitor the implementation of this project?		
Which project management tools and approaches will be utilized to manage the project (<i>e.g.</i> , Microsoft Excel, Microsoft Project) Who is responsible for documenting progress? How often will the project plan be updated to reflect the current status?		

	Status/ Comments	Area of Concern?
Project Management and Schedule, continued		
<p>What functional tasks will be performed by each strategic partner and vendor for:</p> <ul style="list-style-type: none"> + Network design + Building the network + Equipment installation + Management 		
<p>How will the project plan ensure that all permits and environmental assessments are in place prior to installation?</p>		
<p>How will construction contractors report construction progress? Which tools will your construction contractors utilize:</p> <ul style="list-style-type: none"> + Weekly written reports + Regular project management calls + Agendas to track construction progress <p>How will contractor construction progress be communicated to the project team?</p>		
<p>How will construction contractor progress be entered into the project schedule?</p>		
<p>What is the status of the network design? If partially complete, when will it be complete? How will this timing affect the schedule for network completion?</p>		
<p>Update your project’s quarterly targets for:</p> <ul style="list-style-type: none"> + New miles deployed + Existing miles upgraded + Existing miles leased + New miles leased + Microwave links + Towers + Community anchor institutions connected + Businesses connected + Households connected + Signed last-mile and wholesale agreements 		
<p>Describe the network’s readiness testing approach, phasing, and projected completion dates.</p>		
<p>What critical path items have been identified in the project schedule? What major milestones in the project plan are most critical to staying aligned with the schedule and successful project implementation?</p>		
<p>In each area where you anticipate potential delays or shortfalls, what issues do you face? What is your strategy to overcome them?</p>		

	Status/ Comments	Area of Concern?
Broadband Implementation Budget		
Do you have a complete, detailed budget for the broadband implementation project?		
How did you estimate the project cost?		
How confident are you in this estimate?		
How will you perform budget forecasts through the life of the project?		
How often will you update these forecasts?		
If your project goes over budget, what are your plans for covering cost overruns?		
If your project comes in under budget, do you have ideas or plans for spending the associated cost savings?		
How will you track the project budget?		
Can budget line items be tracked on a level that allows you to compare key project and task metrics?		
How often will you reconcile balance sheet accounts to subsidiary ledgers or external statements to substantiate that account balances are correct?		
Implementation Challenges		
Other than construction delays, what other issues that may impact your network build schedule?		
In what ways will you address those issues?		
Describe the state of each business relationship with strategic partners and vendors, including the degree of satisfaction with the partner or vendor performance in past endeavors		
Are there particular barriers and constraints associated with the proposed technological approach:		
<ul style="list-style-type: none"> + Human + Organizational + Budget + Contractual + Operational 		
If so what steps will you take to mitigate these problems?		
Are appropriate skill sets available to manage the required technology solution?		
Fiscal Controls and Property Management		
Describe your property management policies, procedures and systems		
What documents, systems and reports are used in the implementation of the ongoing monitoring of facilities, materials and equipment?		
How often do you conduct a physical inventory of equipment?		
Does the person who observed the inventory sign the inventory document?		

	Status/ Comments	Area of Concern?
Fiscal Controls and Property Management, continued		
What is the process for approving expenditures to prevent instances of false claims?		
How will you maintain the details and documentation of all vendor payments and ensure that you pay only for services, materials, and equipment that have been received?		
Network Design		
Does the project plan break the design and schedule into sub-segments by geography, technology, miles or operational areas? For example by: <ul style="list-style-type: none"> + New miles deployed + Existing miles upgraded + Existing miles leased + New miles leased + Microwave links + Towers + Pole agreements + Wi-Fi routers installed + Community anchor institutions connected + Businesses connected + Households connected + Signed last-mile and wholesale agreements 		
Fiber Project Components		
Has the network segment structure been identified? <ul style="list-style-type: none"> + Number of fiber segments + City-pairs + Mileage + Major geographic sub-segments + Other 		
If IRUs are required: <ul style="list-style-type: none"> + What are the total miles of IRU fiber that must be secured + How many IRUs must be secured? For the IRUs to be acquired, what construction is required?		
If serial fiber components are required: <ul style="list-style-type: none"> + How many poles are required? + What is the number of pole owners with whom negotiations must commence? + What resources are being allocated to ensure that negotiations are completed in a timely manner? + When will make-ready work be complete? + What is the plan if make-ready costs, level of effort and the number of pole replacements are higher than budgeted? 		
How many total miles of fiber are needed and how will it be procured?		

	Status/ Comments	Area of Concern?
Wireless Project Components		
How many towers are required?		
How many existing towers will be used?		
How many new towers will be constructed?		
What types of wireless licenses, if any, are required in the network design? + WiMax + Microwave + Other How many are required?		
What frequencies are required? What is the status for obtaining the necessary FCC licenses?		
For new tower construction: Is the land owned or leased at these locations? What is the number of landowners with whom negotiations must commence? What is the plan if negotiations are unsuccessful?		
If equipment is to be placed atop buildings, have owners granted access to their buildings?		
Which towers are ready for equipment installation and when will links be turned up for each tower?		
Will fiber be run to each tower? What is the plan for backhaul?		
Equipment		
What quantities and types of equipment are needed for the network (e.g., optical, routers, antennas, radios)?		
What is the plan to procure equipment? Are processes consistent with organizational and investor guidelines (e.g., standard contracts, competitive bidding processes)?		
Does the project plan include appropriate lead times for equipment selection, ordering and delivery?		
How will equipment be staged, tracked and made ready for installation?		
Are there written procedures for the network's readiness testing, certification and acceptance?		

	Status/ Comments	Area of Concern?
Network and Back-Office Systems		
<p>What is the timing for all network elements to be in place and ready to support customer traffic?</p> <ul style="list-style-type: none"> + Core backbone + Laterals + OSS/BSS + Backhaul + Relationships with upstream providers <p>What is the timing for all associated support processes?</p> <ul style="list-style-type: none"> + Break/fix + Trouble management + Customer care + Billing + Accounting 		
<p>How will the required level of staffing or outsourced support be obtained to operate the business across all key functional areas?</p> <ul style="list-style-type: none"> + SG&A + Network operations + Finance + Product management + Executive 		
<p>What is the facilities provisioning process?</p> <p>For existing providers, will pre-existing processes, procedures and systems be used? For new providers, will these functions be outsourced or will new systems be deployed?</p>		
<p>What business systems will be put in place to track:</p> <ul style="list-style-type: none"> + Opportunities + Sales + Order submissions + Provisions + Customer care <p>What is the status of acquiring and installing these systems?</p>		
<p>What billing processes will be used?</p> <p>Has the billing tool been established?</p> <p>Has it been successfully deployed elsewhere?</p>		
<p>How many Network Operations Centers (NOCs) are required?</p> <p>How many exist and how many will be constructed?</p> <p>What is the timing for NOCs to be operational? What areas will each NOC cover?</p>		
<p>Will each NOC be staffed 24x7?</p> <p>Will NOC monitoring be done in-house, outsourced or a combination?</p>		

	Status/ Comments	Area of Concern?
Network and Back-Office Systems, continued		
What are the processes for responding to service outages? How will break/fix activities be handled? If a network outage is triggered by a fiber cut or ground disturbance, what communication process will be used?		
What process is in place for subscriber non-payment or slow payment?		
Construction		
Has a construction contractor been procured?		
What is the process and timing to execute construction contracts for all network segments?		
Will the number of construction crews be increased as needed if there are unforeseen construction delays?		
What is the necessary rate of production for crews to meet the project schedule?		
Does the construction schedule have any slack built into it?		
What contingency plans are in place (<i>e.g.</i> , phased construction) to deploy the required network miles and meet the projected timetable?		
Marketing		
How will you develop your marketing program/plan?		
What is your sales and marketing approach (<i>e.g.</i> , in-house staffing, contract, strategic alliance, partnerships)?		
How many full-time equivalent resources are on board or planned for marketing and customer outreach?		
Will you be using indirect distribution channels or will most be direct sales?		
Will you work with any partners to market to a specific group (<i>e.g.</i> , telemedicine, smart grid, colleges, or economic development boards)?		
How will you track or measure the impact of your community outreach activities?		
With how many of your targeted community anchor institutions and businesses have you signed agreements?		
With how many have you held in-person meetings?		
Do you have a detailed opportunity pipeline reporting process in place? <ul style="list-style-type: none"> ✦ Organization or business ✦ Product ✦ Timing ✦ Revenue opportunity ✦ Probability of capture ✦ Signed agreement 		

	Status/ Comments	Area of Concern?
Marketing, continued		
Which templates do you have ready to support near-term revenue generating opportunities: + Service offerings + Pricing sheets + Service Level Agreements (SLAs) + Contracts		
How will you establish SLAs to ensure quality of service delivery? How will these SLAs compare to those of your competitors?		
What has been the result of discussions with broadband/last mile providers? For those agreements that are signed or in progress, what markets in your service area do they represent?		

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ABOUT BROADBANDUSA

The National Telecommunications and Information Administration's (NTIA) BroadbandUSA program promotes innovation and economic growth by supporting efforts to expand broadband access and meaningful use across America. BroadbandUSA serves communities, industry and nonprofits that want to expand broadband infrastructure and promote digital inclusion. BroadbandUSA's services are driven by the needs and interests of state and local broadband leaders, and focus on supporting planning efforts, helping to identify funding, and implementing local broadband programs.

BroadbandUSA also holds regional workshops that bring local stakeholders together and provides solution-neutral guides and tools. These efforts equip state and local leaders with information to make key decisions, guidance on how to use broadband to meet their community's needs, and connections to federal, state and industry stakeholders to advance their overarching goals such as economic development, job creation, educational outcomes, healthcare delivery and public safety.

ABOUT NTIA

The National Telecommunications and Information Administration in the U.S. Department of Commerce is the Executive Branch agency principally responsible for advising the President on telecommunications and information policy issues.

NTIA's programs and policymaking focus largely on expanding broadband Internet access and adoption in America, expanding the use of spectrum by all users and ensuring that the Internet remains an engine for continued innovation and economic growth.

AUGUST 2017

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