Before the

United States Department of Commerce

National Telecommunications and Information Administration

Washington, DC

Infrastructure Investment and Jobs Act Implementation	))	Docket No. NTIA-2021-0002 RIN 0660-ZA33

COMMENTS OF THE FIBER OPTIC SENSING ASSOCIATION

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COMMENTS OF THE FIBER OPTIC SENSING ASSOCIATION

The Fiber Optic Sensing Association (FOSA) appreciates the opportunity to comment on NTIA's implementation of the Infrastructure Investment and Jobs Act of 2021[1] (The Bipartisan Infrastructure Law or "BIL") and to share our thoughts on the questions posed in the NTIA's Request for Comments dated January 5, 2022 (Notice or PN).

I. OVERVIEW

A. Summary

FOSA commends NTIA for encouraging a comprehensive program involving diverse stakeholders and broadband use applications. NTIA's "Multi-Use" approach can more fully harness broadband's potential and help address the BIL's policy objectives. FOSA offers related recommendations to several individual questions of the PN. In support of a "Multi-Use" strategy, FOSA believes NTIA can:

- **Engage other stakeholders, including non-traditional providers:** FOSA encourages NTIA and is program participants to involve non-traditional providers, especially infrastructure owners with long rights-of-way. Their participation further serves as a "Multi-Use" strategy toward meeting the BIL's objectives.
- **Track Fiber-Enabled Rights of Way**: FOSA recommends that NTIA encourage states and other program participants to establish and maintain mechanisms for tracking the availability of "fiber-enabled rights-of-way" in a publicly available and searchable format. This access will encourage broadband "Multi-Use," such as promoting interconnection and other fiber optic cable uses, such as fiber optic sensing.
- **Encourage Conduit Use:** FOSA strongly encourages fiber optic cable conduits to enable future cable installation. These conduits provide mechanical protection of the fiber cable, both during the installation of the fiber cable and over the entire life of the fiber cable. Conduits promote "Multi-Use" because network infrastructure can be more

[1] Notice, Request for Comment National Telecommunications and Information Administration, Infrastructure Investment and Jobs Act Implementation, Docket No. 220105–0002 RIN 0660–ZA33,

easily upgraded in the future.

B. Fiber Optic Sensing Association (FOSA)

FOSA is a non-profit organization created in Washington DC in 2017 with the mission of educating the industry, government, and the public on the benefits of fiber optic sensing. Our association comprises industry leaders in distributed fiber optic sensing (DFOS) technology. It includes companies and academic institutions that manufacture, install, test, evaluate, and support or use DFOS systems and equipment. Our members have delivered thousands of mature, commercially ready, and viable solutions across the United States and worldwide.

DFOS systems are sensor technologies used to monitor constantly and consistently, roads, bridges, railways, pipelines, power stations, terrestrial and subsea power cables, international borders, critical infrastructure, and telecom networks. DFOS systems connect laser interrogator units to a fiber optic cable converting the optical fiber to an array of distributed sensors.

Fiber optic sensing works by measuring changes in the "backscatter" of light occurring in an optical fiber when the fiber encounters vibration, strain, or temperature change. The fiber serves as a sensor over an optical cable's entire length, delivering real-time information and pinpointing the precise location of events and conditions occurring at or near the sensor cable. The sensing laser equipment only requires installation and connection to the fiber optic cable at very long-distance intervals. A dedicated dark fiber or in-service 'lit' fiber can be used for sensing, with no impact on broadband data transmission.

Developed primarily by the U.S. and U.K. defense agencies in the 1980s as an early warning technology, fiber optic sensing is now commercialized and used worldwide to monitor railways, bridges, tunnels, pipelines, power cables, energy facilities, water facilities, and other critical infrastructure assets. Use cases revolve around safety, security, or extending operational life and include structural health monitoring on bridges, alerting to the presence of construction machinery neared buried utilities, train tracking on railroads, or monitoring the temperature of electrical cables. To date, fiber optic sensing systems protect over a hundred thousand miles of assets globally. In addition, to established applications, "smart roads" are an emerging use. Fiber optic cables buried alongside roadways monitor traffic patterns, road conditions and detect accidents.

II. STAKEHOLDER INCLUSION

The Notice poses several questions concerning the inclusion of relevant stakeholders and infrastructure operators in BIL implementation. The list includes Questions 15, 20, and 35.

- Question 15. "How can existing infrastructure be leveraged to facilitate and amplify these benefits?"

- Question 20: "When formulating state broadband plans, what state agencies or stakeholder groups should be considered in the development of those plans?"
- Question 35: "How can the Middle Mile Broadband Infrastructure program leverage existing middle-mile facilities, access to rights of way, poles, conduit, and other infrastructure and capabilities that are owned, operated, or maintained by traditional and non-traditional providers (public and investor) owned utilities, grid operators, co-ops, academic institutions, cloud service providers, and others) to accelerate the deployment of affordable, accessible, high-speed broadband service to all Americans?"

The owners of infrastructure with long rights-of-way can be involved by NTIA and its program participants to maximize the potential impact of the BIL. These non-traditional providers can help NTIA advance a "Multi-Use" strategy by leveraging additional resources and potential uses. This includes consulting with traditional and emerging broadband providers and related technology providers in the formulation of State broadband plans.

By facilitating the use of advanced services like fiber optic sensing, fiber broadband investment can help satisfy other goals reflected in the BIL, including:

§ 1108 Railway-Highway Crossings, for the elimination of hazards, installation of protective devices at railway-highway crossings, and replacement of functionally obsolete warning devices.
§ 11118 Bridge Investment Program, requiring consideration of innovative technologies.
§ 11308 Geomatic Data, contemplating the use of remote sensing and other technologies.
§ 1404 Congestion Relief Program, relating to integrated congestion management systems.
§ 13006 Research and Technology Development and Deployment, relating to advanced transportation technologies to improve safety, mobility, automated vehicles, etc.
§ 22103 Consolidated Rail Infrastructure and Safety Improvement Grants, including railroad safety technology.
§ 25005 Strengthening Mobility and Revolutionizing Transportation Grant Program, relating to intelligent sensor-based infrastructure, smart grid, smart technology traffic signals, and other technologies.
§ 40104 Preventing Outages and Enhancing the Resilience of the Electric Grid, relating technologies, equipment, and hardening measures including, among other things, "monitoring and control technologies.
§ 40107 Deployment of Technologies to Enhance Grid Flexibility, relating to fiber and wireless broadband communication networks that enable data flow between distribution system components.
§ 40125 Enhanced Grid Security, which adds physical security to the cybersecurity for energy networks.
§ 50106 Operational Sustainability of Small Public Water Systems, relating to leak detection technology and other technologies.

Consequently, the additional stakeholders which may appropriately be consulted include:

- **State Broadband Offices and Public Utility Commissions -**In some states, PUCs serve as the State Broadband Office. In others, they will provide essential information

regarding utility assets statewide. One essential task by the PUC or Broadband Office will be to support and utilize the FCC's Broadband DATA maps to help identify potential interconnection points. This will support the deployment of additional fiber optic cables for broadband, as well as for additional technologies like 5G wireless networks and fiber optic sensing.

- **State Departments of Transportation (DOTs) -** State DOTs control access to and construction along rights-of-way crucial to middle-mile and broadband deployment. Financing methods already used by State DOTs, such as public-private partnerships, already provide effective models for more active broadband deployment participation. Additionally, many states have "Dig Once" policies requiring or encouraging the installation of fiber optic cable conduit during highway construction. (As discussed below in more detail, State DOTs are encouraged to use conduit to enable future fiber optic cable installation. Moreover, positioning the cables/conduits along the highway right-of-way will synergize broadband and sensing.)

The same fiber optic cables carrying broadband signals can be used for fiber optic sensing, converting highways to "smart roads" where traffic data and road conditions are constantly monitored with great precision. This can be done with minor tweaks to established engineering rules for fiber laying without high extra cost. The Utah DOT is a recent example of an agency that has successfully leveraged multiple use cases of fiber, including broadband and sensing, to optimize investments in fiber deployment. [2]

Future-proofing our nation's highways involves placing fiber optic cables along roads when the opportunity arises to do so economically. This will lower future infrastructure upgrade costs. Specifically, placing fiber along highway rights-of-way will advance automated vehicles' comprehensive infrastructure for intelligent transportation.
As autonomous vehicles take to the roads, infrastructure changes will be necessary to accommodate their arrival safely. One of the most challenging issues involves tracking autonomous vehicles' precise location in transit. At present, much of the tracking relies on GPS to provide location data. But GPS alone is not accurate enough for a self-driving car. GPS-enabled smartphones only have an accuracy of five meters under an open sky in dense urban environments. [3]

Distributed Acoustic Sensing (DAS) adds value to intelligent transportation monitoring. In contrast to other sensing methods, DAS can continuously sense over every point along a road's entirety. Additionally, by using fiber optic cable of existing telecommunication

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[2] See Utah Department of Transportation "How a State Agency Can Drive Fiber Development," https://osit.nv.gov/uploadedFiles/ositnvgov/Content/Meetings/Broadband/2016/UTAH%20FIBER%20EXPANSION%20MODEL%20-%20V-2.pdf

[3] For a more detailed discussion, see Comments of the Fiber Optic Sensing Association on March 21, 2001 to the Office of the Secretary (OST), U.S. Department of Transportation (DOT) on the document, Automated Vehicles Comprehensive Plan (Comprehensive Plan). Docket No. DOT-OST-2021-0005, Federal Register: 2021-01115. RIN: N/A. Docket Number: DOT-OST-2021-0005 https://www.fiberopticsensing.org/p/cm/ld/fid=726&tid=357&sid=3357

infrastructure, DAS obviates the prohibitive deployment, maintenance, electrical power, and connectivity required of alternative sensors. DAS also can provide an independent audit of the autonomous vehicle position. Significantly DAS can look much further ahead and around bends, where onboard sensors are blind.

DAS provides vehicle position information and detects the speed of all road users as well as noise-related accidents. This information could be helpful to slow down and redirect vehicles before approaching traffic jams and mitigate many crashes involving driver error, judgment, or other human-related causes.

- **Railroad Operators and Regulators –** Rail's long miles of right-of-way corridors could accommodate cost-effective middle mile deployment, opening multiple points for local interconnection. Fiber deployment along railroad right-of-way complements existing safety initiatives, such as positive train control. Railroad operators and regulators should be consulted to use railroad rights-of-way for fiber optic cable installation both for middle-mile and broadband purposes.

Fiber optic sensing is currently supporting railroads worldwide by reducing delays, cutting costs, and improving safety. Trackside fiber optic communications cables are transforming single optical fibers within these cables into thousands of sensing points per mile.

Fiber optic sensing supports railroads worldwide by reducing delays, cutting costs, and improving safety. A 2018 study by the USDOT's Transportation Technology Center entitled "Fiber Optic Availability and Opportunity Analysis for North American Railroads" identified multiple "priority applications" for the deployment of fiber optic sensing technology – broken rail detection, train tracking, monitoring equipment health, and track integrity, fire detection in cable ducts, and security and detection of people or other objects on tracks.[4]

- **Electric Power Operators and Regulators -** Including power transmission operators in middle-mile broadband infrastructure leverages ongoing extensive investment in smart grid initiatives that include the installation of fiber optic cable. As with other long linear infrastructure, transmission operators offer opportunities for long-distance deployment.

Even as many electric power operators are now becoming broadband providers, smart grid initiatives increase the utilization of fiber optic cable beyond broadband into greater efficiency and protection of the grid. As in the highway and railroad discussions above, the fiber optic cables used for broadband can double as sensors for monitoring of power cable temperatures for optimal load monitoring, delivering operational status, fault condition assessment, and early warning of intrusion threats.

Electric Grid Security Distributed Fiber Optic Sensing (DFOS) can be used to monitor and protect electric grid infrastructure. Distributed Temperature Sensing (DTS) continuously

[4] see USDOT FRA, Fiber Optic Availability and Opportunity Analysis for North American Railroads, https://railroads.dot.gov/elibrary/fiber-optic-availability-and-opportunity-analysis-north-american-railroads

monitors high-power cable temperatures, detects hotspots before they become an issue, delivers operational status, condition assessment, and power circuit rating data. Distributed Acoustic Sensing (DAS) provides accurate cable fault detection and location as well as protection of electric grid infrastructure from third-party interference on land (digging and drilling) and subsea (anchor drops and drags). Distributed Strain Sensing (DSS) adds the capability to monitor the earth surrounding buried electric transmission cables to alert when conditions of ground disruption occur.

- **Pipeline Operators and Regulators-** Pipeline rights-of-way is a potential path for middle-mile and last-mile broadband services. Many of the longest pipelines in the world already use fiber optic sensing to monitor operations and protect against accidents. Some operators are exploring telecommunications and broadband opportunities. In the case of new pipelines, fiber optic cables should be installed during construction as a matter of course. Installing cable near existing pipelines obviously must be done with extreme care.

In shared right-of-way utility corridors, such as in city environments, broadband fiber deployments can be considered. The fiber cable can protect and monitor the other assets within the same right of way using sensing support. Telecommunications operators or other broadband asset stakeholders could consider sensing data supply in their business models, providing monitoring data to other utilities within the same corridor, protecting the public, and reducing downtime or damage costs for utility assets.

III. TRACK FIBER ENABLED RIGHTS OF WAY AVAILABILITY

NTIA's PN appropriately asks for strategies to "meet our nation's broadband network connectivity needs in the future" and for the "benefits Americans can expect from this program and the networks it will help fund in other industries and across the economy." (Question 15)

FOSA recommends that NTIA encourage states and other program participants to establish and maintain mechanisms for tracking the availability of "fiber-enabled rights-of-way" in a publicly available format. This access will encourage broadband Multi-Use, such as promoting interconnection and other uses of fiber optic cable uses, such as sensing. Toward this objective, FOSA suggests that NTIA establish standard reporting mechanisms and metrics to provide for reporting uniformity and that these metrics be maintained in a publicly accessible format allowing for tracking the availability and location of "fiber enabled infrastructure."

FOSA notes that fiber-optic *broadband* networks are synergistic with fiber optic *sensing* networks. The same fiber optic cable used for broadband can be used for sensing, with the sensing function available at every inch of the cable's path. Therefore, the more fiber broadband networks that are deployed, the more fiber optic sensing capability becomes available. In effect, the investment in fiber expands the use cases for the broadband infrastructure

The BIL's Broadband Equity, Access and Deployment ("BEAD") program provides for certain broadband projects to be treated as "priority broadband projects". Specifically, the BIL at Division F, Title 1, Section 60102(a)(1)(I) includes the following definition:

> "priority broadband project" means a project designed to—
> (i) provide broadband service that meets speed, latency, reliability, consistency in quality of service, and related criteria as the Assistant Secretary shall determine; and
> (ii) ensure that the network built by the project can easily scale speeds overtime to—
> (I) meet the evolving connectivity needs of households and businesses; and
> (II) *support the deployment of 5G, successor wireless technologies, and other advanced services."*

Congress's intent and one of the Act's goals is that BEAD program funds be prioritized to projects providing the greatest benefit to American communities as reflected in several factors, one of which is support for other advanced services. Fiber deployments have the benefit of supporting multiple advanced services, such as fiber optic sensing. Tracking the availability of fiber-enabled rights-of-way supports these goals.

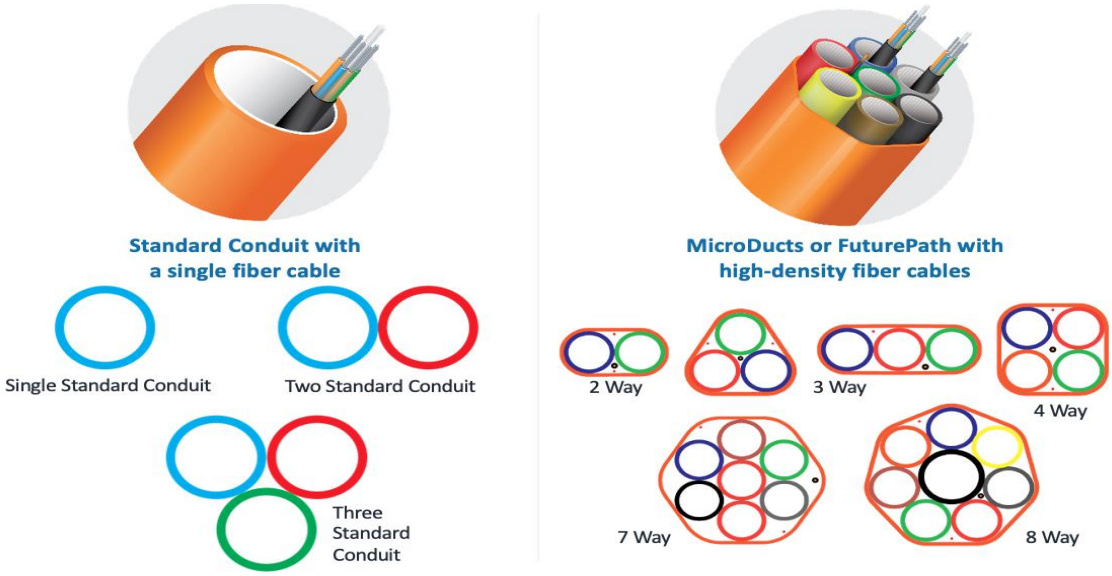
IV. Conduit Use Recommended

As previously noted, Question 15 of the PN appropriately asks for strategies to "meet our nation's broadband network connectivity needs in the future" and for the "benefits can Americans expect from this program and the networks it will help fund in other industries and across the economy."

FOSA strongly encourages "Dig Once" policies and the use of conduits to enable future fiber optic cable installation.[5] Conduits are narrow pipes and initially need not contain fiber optic cable housed within them. However, fiber cable can be installed within these conduits either at the initial installation or at a future date. These conduits provide mechanical protection of the fiber cable, both during the installation of the fiber cable and over its entire life.[6]

[5] See FOSA Comments to Federal Highway Administration (FHWA), U.S. Department of Transportation (DOT) Notice of Proposed Rulemaking (NPRM) for Broadband Infrastructure Deployment, Docket Number: FHWA-2019-0037 Docket RIN 2125-AF92, Sept 20, 2020, available at https://www.fiberopticsensing.org/p/cm/ld/fid=726&tid=357&sid=3234

[6] FOSA has produced two relevant documents: DIG ONCE POLICY: 16 STATE MODELS July 2020 https://www.fiberopticsensing.org/p/cm/ld/fid=726&tid=357&sid=3217 and FOSA's FOSA Dig Once Primer detail the advantages to DOTs in enabling the deployment of fiber optic cable along highway rights of way. https://www.fiberopticsensing.org/p/cm/ld/fid=726&tid=357&sid=3216 c



Typically, direct buried fiber cables require additional design enhancements to withstand environmental conditions, whereas a conduit can provide that environmental, tensile, and crush protection itself. The conduit itself is relatively inexpensive, so installing conduits for later use can save providers hundreds of thousands of dollars in construction costs.

Telecommunications providers, however, will sometimes only use cable and not conduits in their installations. If a local government is not familiar with engineering standards, it can contract with a provider to install conduits that others can use. In addition to installation, government agencies will need to work out responsibility for mapping the conduit and maintenance location. A service-level agreement or service-level management agreement can address these issues. By anticipating the future and installing conduits to furnish extra permanent pathways, networks can adapt to changes more quickly.

As the U.S. Government Accountability Office (GAO) has concluded, "For instance, if companies have access to a state-owned conduit, they may be able to deploy fiber through that conduit without completing steps such as environmental impact studies, which would have been completed at the time of conduit installation."[7]

According to GAO: "Officials in some localities also stated that access to locally owned conduit has reduced local government telecommunications costs. Second, some officials stated that a dig once policy might lead to decreases in broadband prices and/or increased broadband performance for consumers because of potentially increased competition

[7] United States Government Accountability Office, Broadband Conduit Deployment, June 27, 2012, GAO- 12-687R, at https://www.gao.gov/assets/600/591928.pdf

resulting from the availability of conduits open to all broadband providers. Third, officials in some localities, as well as industry stakeholders, stated that increased access to broadband benefits existing businesses and could draw new businesses to the area, both of which could increase local economic activity."

V. SUMMARY

To recap, in support of a "Multi-Use" strategy to capitalize on the BIL's opportunities more fully, FOSA recommends that:

- NTIA and its program participants can involve non-traditional providers, especially infrastructure owners with long rights-of-way. Their participation further serves as a "Multi-Use" strategy toward meeting the BIL's objectives.
- NTIA can encourage states and other program participants to establish and maintain mechanisms for tracking in a publicly accessible format the availability of fiber-enabled rights-of-way.
- NTIA can encourage using fiber optic cable conduits to enable future cable installation.

Collectively these recommendations promote a "Multi-Use" approach to broadband network infrastructure deployment.

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