DEPARTMENT OF COMMERCE
National Telecommunications and Information Administration
Broadband Equity, Access, and Deployment (BEAD) Program:

Re: Draft | Pre-decisional Policy Notice: Alternative Broadband Technology version 1.0

Submission for NTIA's Request for Comment

Summary:

The Draft of the BEAD Alternative Broadband Technology Policy Notice is missing critical inclusions and guidelines; the lack of these inclusions may result in unserved and underserved areas being ignored and not bid upon, or lead to unduly burdensome costs that would drain BEAD resources from achieving more expansive coverage.

The purpose of these Comments are to highlight some of the challenges the BEAD Program may encounter, address issues in this guidance that might dampen participation in the BEAD program by Alternative Technology providers, and demonstrate the value of including Free-Space Optical Communication (FSOC) as a named Alternative Technology to help mitigate these issues.

Challenges:

There are many impediments to deploying and maintaining Reliable Broadband Service to unserved and underserved areas, including rivers, railroads, mountains, historic preservation areas, distance to existing Broadband service, network resilience and speed of deployment.

These challenges compound across last-mile and middle-mile networks, which in turn increases the overall cost of projects. The total costs of these challenges are measurable in capital expense, as well as increased time to completion, latency, bandwidth and the environment.

The BEAD Program has taken a positive step toward mitigating these challenges by identifying backhaul and middle-mile networks as eligible uses of funding in connection with last-mile broadband deployments, as noted in BEAD NOFO § IV.B.7.a.ii: An "Unserved Service Project" or "Underserved Service Project" may include Middle Mile Infrastructure in or through any area required to reach interconnection points or otherwise to ensure the technical feasibility and financial sustainability of a project providing service to an unserved location, underserved location, or eligible community anchor institution (CAI).

Alternative Technologies like FSOC are available for backhaul, middle-mile infrastructure, and addresses the common challenges across deployments in rural and urban projects. As a named technology in the Policy Notice, FSOC will help increase the efficiency of the BEAD Program by providing a lower cost, high bandwidth solution, and maximize the distribution of BEAD funding.

FSOC Technology:

FSOC is, in some ways, identical to Priority Broadband Service – both use the same beam of light pulses to transmit data, and both can leverage the same, standard, retail telecommunications equipment, e.g. routers, switches, optics, to deliver high speed bandwidth across long distances. The primary difference between them is that fiber cables transmit the light over flexible glass wires, whereas FSOC transmits the same light wirelessly over free-space between two optical heads with a transmitter and receiver. A common colloquialism for FSOC is "wireless fiber."

David Bragg, University of Florida, National Security Program Area Lead, Florida Applied Research in Engineering (FLARE), has the following to say about FSOC:

> "The maturation of FSOC has reached levels where it has become a reasonable utilization methodology for the support of communications over distances. The amount of bandwidth that the systems are capable of handling has increased with the advancement of the transmission systems and the data handling equipment that the optical systems are capable of interfacing with. The applications for employment of FSOC systems will continue to grow in terms of both general mission sets and specialized missions, such as supporting disaster recovery operations."

Each FSOC link can be deployed, aligned and operational in less than one day, and has the capability of transmitting significant bandwidth over 100 Gbps. By integrating Coherent detection, Dense Wavelength Division Multiplexing (DWDM), and Single Mode Fiber (SMF) coupling detection, FSOC is able to transmit the same, high-speed light pulses as fiber optic cables across long distance. FSOC exceeds the bandwidth and latency required to satisfy BEAD NOFO requirements, and for middle-mile infrastructure needs at a lower price on a Gigabit per second basis. Mr. Bragg adds:

> "The nature of FSOC allows for its implementation without the requirement of large capital investments in construction that many more traditional means require. The system reduces the complications often associated with the obtaining right of ways and reduces the impact to the focused nature of what is required for its installation. There is also increased safety considerations over RF systems due to the focused nature of the transmission beam. The system is better suited for "middle mile" installation due to it high bandwidth and focused nature; it is a cost-effective solution for connection of geographically challenged locations. It can be used as a "last mile" solution but is not ideal for this application."

Reducing Risk and Cost in Challenging Deployments with FSOC:

FSOC is not meant to replace fiber or LFW. FSOC is a reliable broadband option to be deployed as a augmentation in many use-cases where it is well-equipped to reduce the risk, costs and pain points of challenging deployments.

Speed to Deployment. The lag to deployment of fiber can delay infrastructure months to multiple years. The BEAD Program will accelerate the number of concurrent projects. As all Eligible Entities will be awarding Subgrantees around the same time, it is likely that competent, trained

construction resources will be spread thin, increasing the risk of delays to project completion, and jeopardizing the BEAD Program's four-year deployment deadline.

This construction date slippage is compounded by the unpredictable, expensive delays caused by railroads, rivers, rocks, and historic preservation areas. Providers of all sizes and experience are struggling with negotiations of non-standard permitting and exorbitant fees for these challenging deployments, all which unnecessarily, unpredictably increase the cost and time.

Mr. Bragg notes:

> "As discussed above, the nature of FSOC reduces the time for deployment of a system compared to other systems. The system can be installed in hours if conditions are favorable to establish initial connections until a more permanent support infrastructure can be constructed. The nature of the system negates many of the terrain challenges that many systems encounter that restrict their ability to be efficiently installed. The flexibility of FSOC makes it an ideal candidate for installation in most rural areas to support small geographically isolated communities."

FSOC can be rapidly deployed and redeployed with immaterial cost – it is a highly-transportable utility. FSOC links can be deployed as a temporary solution in order to immediately provide middle-mile infrastructure, and establish a high-bandwidth connections while a fiber project is built or is delayed. Then, once the fiber project is completed, the FSOC link can be easily redeployed to a new expansion area, or remain in place as a redundancy solution.

The speed to deployment of FSOC for middle-mile infrastructure is a valuable Alternative Technology to help the BEAD Program meet the four-year deployment deadlines, and reduce the enforcement of clawback provisions when excessive fiber construction delays manifest.

Latency. FSOC is faster than fiber optics. Both utilize the same light beam carrying data, but due to the refractive properties of glass in the wires fiber cables are 30% slower compared to wireless over-the-air with FSOC. The improved latency of FSOC is particularly useful for middle-mile infrastructure where a last-mile need is very far from a data center or internet exchange – in some cases, the mileage of fiber is so far that fiber might not satisfy BEAD NOFO latency requirements for less than or equal to 100 milliseconds, and therefore lead to a "no bid" situation. FSOC can improve the latency by 30%, making some ignored areas serviced. LEO can also satisfy latency to remote areas, however without bandwidth comparable to FSOC.

Bandwidth. As noted above, FSOC is capable of over 100Gbps. FSOC is also "future-proof" – it leverages "off the shelf" components (routers, switches and optics) to transmit data, and, as optics increase in speed, so does FSOC. There is no need to replace the hardware infrastructure to upgrade bandwidth, as the optical head components of FSOC are "field upgradeable." This is not the case with fiber optics, as bandwidth upgrades often require retrenching at high cost.

Environmental cost. FSOC is a wireless, zero-emission technology, and is the most eco-friendly communication system commercially available. LFW, ULFW and LEO are also wireless,

however, the radiation emission from microwave dishes can be hazardous to humans, animals and vegetation.

Some Eligible Entities have adopted “Dig Once” policies, which should help mitigate the environmental impact due to construction; however, it is valuable to note that FSOC is a ”Dig Never” approach, minimizing-to-eliminating the need for ground disturbance across long ranges.

Given the reduction-to-elimination of ground disturbance required to establish FSOC links, there is an overall immediate reduction in Environmental cost, as well as significant time savings without a need for the standard 6 – 24 months for Environmental Assessments or Environmental Impact Statements.

Laser class safety is an important consideration to include in the guidelines for Alternative Technology, and an obligation to which FSOC providers must adhere. The U.S. Food & Drug Administration recognizes four major hazard classes (I to IV), where Class I is non-hazardous and eye-safe. Examples of Class 1 lasers are DVD players, laser printers, LiDar; examples of Class IV lasers that could lead to harm are medical devices, industrial lasers. FSOC providers must be Class I lasers to be safely deployed for BEAD, and preserve environmental costs.

Cybersecurity & Privacy. FSOC is a hyper-secure method of data communication. Through coherent detection, SMF-coupled detection, and a narrow beam of light, FSOC is non-jammable, non-interceptable, and it has no RF-interference. FSOC offers a higher degree of security and privacy compared to Microwave technologies or fiber optic cables.

Resilience & Redundancy. Fiber optic cables suffer fewer network outages than wireless technologies, but they are not immune to network outages. Fiber is regularly, accidentally cut due to digging or excavation accidents, rodents or other wildlife eating away at the petroleum-based elements in cables, human error, floods and fires. When fiber is subjected to such an accident, the downtime is significant, lasting days to weeks, and the capital expenses are high to repair such damage.

As a wireless technology, FSOC is a “Never-Sever” solution. This benefit reduces operational expenses to repair fiber, and can drastically improve the resilience of fiber-based networks as an Alternative Technology for backup, not susceptible to the same issues with which fiber struggles.

Disaster Recovery is a prime use-case for FSOC – as a rapidly deployed, high-bandwidth, wireless solution, it can reestablish middle-mile infrastructure in hours.

Perhaps most importantly, is how FSOC can address the critical vulnerability in our undersea fiber. Over the last 12 months, undersea fiber cables have been purposely severed in the South Pacific, eavesdropping equipment has been discovered in Northern European seas, and increased foreign naval activity above undersea cables has been monitored globally – this is a significant risk to our privacy, security and global connectivity, and repairing undersea fiber damage is time consuming and expensive. FSOC is capable of both terrestrial long range, up to 30 miles where there is line of sight and where island-to-island connection is beneficial, and celestial, going from ground-to-space-to-ground. LEO is also capable of ground-to-space, however, at the time of

these Comments, the LEO constellations commercially available utilize Microwave technology between ground and space, and therefore are insufficient in bandwidth suitable for middle-mile infrastructure for a substantial community.

Considering the value FSOC offers to address common challenges of deployments, we recommend including FSOC as a named Alternative Technology and be evaluated by Eligible Entities and Subgrantees. The following modifications are proposed for the Policy Notice:

Modify § **1. Policy Notice Background & Purpose**:

> … Examples of alternative technologies include low-earth orbit (LEO) satellite broadband service, unlicensed fixed wireless (ULFW) service, and free-space optical communication (FSOC). …

Modify § **2. Definitions, (a) Alternative Technologies**:

> The term "Alternative Technologies" describes any broadband access technology that (a) terminates at the end user's location or premises, and does not qualify as Reliable Broadband Service, but meets the BEAD Program's minimum technical requirements for end user's location or premises of speeds of not less than 100 Mbps for downloads and 20 Mbps for uploads and latency less than or equal to 100 milliseconds,[13] and (b) is used for backhaul, middle-mile infrastructure in or through any area required to reach interconnection points or otherwise to ensure the technical feasibility and financial sustainability of a project providing service to an unserved location, underserved location, or eligible community anchor institution, and does not qualify as Reliable Broadband Service, including ULFW, LEO and FSOC.

Modify **Figure 1: Other Broadband Technologies**, inset box:

> … Alternative Technologies, e.g Unlicensed Fixed Wireless (ULFW), Low Earth Orbit (LEO) Satellite, and Free Space Optical Communication (FSOC), meeting the BEAD Program's speed and latency technical requirements (eligible for BEAD funding); and…

Modify § **4.3 Subgrantee Obligations**

> … These obligations include the speed and latency requirements,[41] network outage limitations,[42] low-cost broadband service option and other service obligations,[43] network management practices,[44] cybersecurity and supply chain risk management,[45] and, in the case of FSOC, maintaining U.S. Food & Drug Administration Class 1 laser safety.[48] …

[48] The FDA recognizes four major hazard classes (I to IV) of lasers, including for the use of fiber optic communication systems, where Class I is considered non-hazardous. https://www.fda.gov/radiation-emitting-products/home-business-and-entertainment-products/laser-products-and-instruments

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This Submission for NTIA's Request for Comment was prepared by Zev Suissa, Chief Growth Officer, X-lumin Corporation, with additional comments by David Bragg, University of Florida, National Security Program Area Lead, Florida Applied Research in Engineering (FLARE). For the avoidance of doubt, David Bragg received no financial benefit for his comments herein, nor from FSOC's inclusion in eligibility for the BEAD Program. X-lumin is a dual-use entity, providing Department of Defense and commercial customers with FSOC products and services.