(This comment was copied into the MBI online form on November 16, 2023)

Dear Sir or Madam,

We are thankful to the Massachusetts Broadband Institute (MBI) for the opportunity to submit comments in response to the Initial Proposal to Implement the Broadband Equity, Access, and Deployment ("BEAD") Program. The Environmental Health Trust is a not-for-profit think tank that promotes a healthier environment through research, education and policy. We work directly with policymakers, communities, and health and education professionals to bring awareness of environmental hazards and how to mitigate them[1].

The money that will be made available to Massachusetts through BEAD funding represents a once in a lifetime opportunity to advance to Massachusetts's technological future through the 21st century and beyond. It is critical that the decisions made with this money will create an infrastructure that is truly future-proof and not just good-enough-for-now. Investments made into to Massachusetts's Broadband future need to consider performance, scalability for future needs, energy efficiency, and effects on the environment and human health. The National Telecommunications and Information Association (NTIA), charged with distributing the bulk of the $65 billion federal broadband infrastructure grant program, has stated clearly that "Eligible Entity should prioritize projects designed to provide fiber connectivity directly to the end user."[2] And we agree.

It is imperative that BEAD funding decisions for to Massachusetts's broadband future favors fiber technology all the way to the end user and not be wasted on wireless infrastructure which will not meet future connectivity needs, harm the environment and the health of Massachusetts residents. We encourage municipally owned broadband for these investments to ensure that the most informed decisions are made for each community.

Fiber is superior to wireless because it:

1. achieves the highest performance metrics like speed, low latency, reliability, cybersecurity and privacy;
2. can be easily and affordably scaled for future needs;
3. will make us competitive with other countries that have surpassed the U.S. thus far with their fiber deployments;
4. is energy efficient with the least carbon footprint to keep us on track with Massachusetts's environmental objectives;
5. has the least impact on the environment;
6. does not emit wireless radiation[3,4,5,6] and will preserve the health and safety of residents.

Currently, all these goals can only be achieved with fiber optics to and through the premises. We urge MBI to accept nothing less than the best for every resident of Massachusetts. Whether they live in urban, suburban, rural or tribal lands, whether rich or poor, every Massachusetts resident deserves fiber, the technology investment that will catapult them into the future.

Performance and Scalability

While wireless infrastructure promises faster and cheaper deployment, it is no match for the performance of fiber infrastructure and ends up being costlier in the long run to maintain and upgrade.[7] The poor performance metrics of wireless infrastructure costs our states billions of dollars when residents and businesses are held up by unreliable service, low speeds, and issues with cybersecurity[8] and privacy.

Baseline speed requirements of 100/20Mbps (download/upload) can be achieved with current cable infrastructure, the kind that is already available for most homes and businesses. 5G wireless infrastructure offers speeds similar to what cable currently provides[9] and is limited in its capacity to reliably offer faster upload speeds peaking at just 50 Mbps. Using BEAD funding for wireless infrastructure will put communities in another digital divide in just a few years when bandwidth demands increase with future technology demands.

Baseline speeds for fiber infrastructure is 1000/1000 Mbps (download/upload) far surpassing wireless speeds at its minimum performance capabilities. Currently cities that have adopted all fiber networks are seeing speeds of 10,000/10,000 Mbps with the capabilities of upgrading to Terabyte symmetrical speeds. Chattanooga, Tennessee adopted fiber 12 years ago with symmetrical speeds of 1000 Mbps and has now upgraded to 10Gbps (or 10,000 Mbps) symmetrical speeds by simply replacing the electronics and keeping all the fiber intact.[10]

The pandemic shutdowns forced large families to work and school from home and it was a quick lesson on the imperative need for fast, reliable internet that not only allowed us to quickly download information but to also have fast upload speeds so that multiple family members can have online video calls at the same time. Wireless infrastructure fails in allowing multiple users on the same network to reliably have online video meetings at the same time.

Wireless infrastructure fails during inclement weather or when the path of the signal is obstructed.[3] Fiber and current cable infrastructure can reliably offer superior service without these challenges.

Competition With Other Countries

The quality of broadband will make or break our ability to compete with the rest of the world.[11] Other countries have recognized the importance of fiber optics all the way to the premises and have invested heavily to reach 100% penetration, ensuring that even rural communities with unfavorable terrain have fiber. As of 2019 - 92% of China's internet users had fiber all the way to the home.[12] 62% of homes in the European Union 39 bloc nations have fiber to the premises.[13] United Arab Emirates, Qatar, Singapore and Hong Kong all have higher than 90% penetration of fiber all the way to the premises while Iceland, Spain and Portugal are catching up at 76.8%, 73.5% and 71.1% respectively.[14] The US, on the other hand, stands at 16.39% penetration of Fiber to the Premises and ranked 30th among Organization for Economic Co-operation and Development countries, as of 2020.[15]

Energy Efficiency

According to IEEE Magazine, 5G base stations are expected to consume roughly 3 times the power of 4G base stations and more 5G base stations are required to cover the same area.[16] Energy consumption is expected to increase by 61 times from 2020 to 2030 with 5G.[17] Adding more strain

on Massachusetts's electric grid, especially when we have not fully moved to renewable energy, will further exacerbate carbon emissions. One study found that the digital carbon footprint of an American is 5 times larger than the world average.[18]

According to countries that have already installed fiber to the homes (FTTH), like China and Spain, fiber is 85% more energy efficient than copper yielding a saving of 208GWh which represents a reduction of 56,500 tons of CO_2 emissions.[6] One study done by the Federal Environment Ministry and the German Environment Agency found that video transmission through fiber optics is nearly 50 times more energy efficient than wireless.[19] Research on whole network level assessments of the operational energy use implications of 5G warns "Energy-intensive user practices contribute to ever-growing levels of data traffic, and counteract the energy-saving potential of 5G efficiency improvements."[20]

Wireless Radiation Impacts on the Environment

No U.S. agency or international authority has ever acted to review research on wireless radiation effects on the environment nor set exposure limits to ensure protections for birds, bees, trees and wildlife.[21,22] It is a critical regulatory gap.

In 2014, the U.S. Department of Interior wrote a letter to the NTIA detailing several published studies showing impacts of wireless radiofrequency radiation (RFR) to birds stating that, "There is a growing level of anecdotal evidence linking effects of non-thermal, non-ionizing electromagnetic radiation from communication towers on nesting and roosting wild birds and other wildlife." It further stated, "However, the electromagnetic radiation standards used by the Federal Communications Commission (FCC) continue to be based on thermal heating, a criterion now nearly 30 years out of date and inapplicable today."[23]

Significant research has accumulated indicating serious environmental effects, yet with no review by federal agencies. On August 13, 2021, the United States Court of Appeals for the District of Columbia Circuit ruled in our case against the FCC (EHT et al. v FCC[27]) stating "we find the Commission's order arbitrary and capricious in its complete failure to respond to comments concerning environmental harm caused by RF radiation." The Commission also "completely failed even to acknowledge, let alone respond to, comments concerning the impact of RF radiation on the environment. That utter lack of a response does not meet the Commission's obligation to provide a reasoned explanation for terminating the notice of inquiry."[28] To this date the FCC still has not revisited its wireless radiation guidelines despite its court orders to do so over two years ago.

In 2021 and 2022 a three-part landmark research review by U.S experts of over 1,200 studies on the effects of non-ionizing radiation to wildlife entitled "Effects of non-ionizing electromagnetic fields on flora and fauna" found adverse effects in all species studies and at even very low intensities. Findings included impacts to orientation, migration, reproduction, mating, nest, den building and survivorship.[24 25 26]

In a review published in *Environment International* on the ecological effects of RF-EMF, 70% of the studies reviewed found RF had a significant effect on birds, insects, other vertebrates, organisms, and plants, with development and reproduction in birds and insects being the most strongly affected.[29] Biologists caution that non ionizing electromagnetic radiation is a critical factor in the decline of pollinator and insect populations. [30]

Trees are at risk from wireless as well. A field monitoring study spanning nine years involving over 100 trees found damage on the side of the trees facing transmitting cell antennas.[31] Researchers have released subsequent reports documenting continued impacts to tree canopy from cell tower antennas.[32, 33] Other RF effects include impacts to leaf, shoot, seedlings of Aspen trees[34] and biochemical impacts to plants.[35]

Fiber optics not only offers superior performance metrics and energy savings, but also has no radio frequency radiation emissions and therefore surpasses all these environmental issues.

Health and Safety

Extensive published scientific evidence indicates that wireless radiofrequency (RF) radiation at levels far below FCC limits can cause cancer[36], increased oxidative stress[37] genetic damage[38] structural and functional changes of the reproductive system[39], memory deficit[40], behavioral problems[41], and neurological impacts.[42]

EHT et al. v. FCC the U.S. Court of Appeals for the D.C. Circuit[43] also ruled the FCC ignored scientific evidence on negative health effects from long term wireless radiation exposure at current allowable levels, especially in regards to children, who the American Academy of Pediatrics states[44] are more vulnerable to wireless radiation. The court ordered the FCC to examine the record evidence regarding long term exposure to children, health effects unrelated to cancer and environmental impacts. So far, the FCC has not responded. This landmark ruling highlights how no federal health agency has reviewed the full body of current research to ensure current safety standards are protective.[17]

The state of New Hampshire had similar findings when it commissioned a study on the Environmental and Health Effects of Evolving 5G Technology and issued a final report[45] in 2020 with 15 recommendations including: requiring setbacks of all wireless transmitters from residences, businesses and schools, adopting a statewide position to encourage fiber optics to the premise, acknowledging the need for further studies to outline clinical symptoms related to RF exposure, developing RF safety limits to protect the environment, among other recommendations.

In 2022, the Pittsfield, Massachusetts Board of Health voted to send a cease-and-desist order to shut down a Verizon cell tower. The order [46] issued to Verizon states "Whereas, soon after the facility was activated and began transmitting, the City started to receive reports of illness and negative health symptoms from residents living nearby the facility, and in particular, from residents living in the so-called "Shacktown" neighborhood. The negative health symptoms the affected residents have reported include complaints of headaches, sleep problems, heart palpitations, tinnitus (ringing in the ears), dizziness, nausea, skin rashes, and memory and cognitive problems, among other medical complaints. … Whereas, as further documented below, the neurological and dermatological symptoms experienced by the residents are consistent with those described in the peer-reviewed scientific and medical literature as being associated with exposure to pulsed and modulated Radio Frequency ("RF") radiation, including RF from cell towers."

A major 2022 review of the existing scientific literature on cell tower radiation and health found associations with radiofrequency sickness, cancer and changes in biochemical parameters.[47] For example, a study published in Electromagnetic Biology and Medicine on people living near cell antennas found significant biochemical changes in the blood. This study evaluated effects in the

human blood of individuals living near mobile phone base stations compared with healthy controls living more than 300 meters from a base station. The group living closer to the antennas had statistically significant higher frequency of micronuclei and a rise in lipid peroxidation in their blood; these changes are considered biomarkers predictive of cancer.[48]

A review paper on corporate risk entitled "Limiting Liability with Positioning to Minimize Negative Health Effects of Cellular Phone Towers" reviewed the "large and growing body of evidence that human exposure to RFR from cellular phone base stations causes negative health effects." The authors recommend restricting antennas near homes and within 500 meters of schools and hospitals to protect companies from future liability.[49]

An Uninsured Risk

Currently, insurance authorities classify 5G and wireless radiation as "high" risk [50, 51] carriers define radio frequency as a pollutant and their insurers exclude it from health effects liability coverage.[52, 53]

A 2019 Report by Swiss Re Institute[54], a world leading provider of insurance, classifies 5G mobile networks as a "high", "off-the-leash" risk stating, "Existing concerns regarding potential negative health effects from electromagnetic fields (EMF) are only likely to increase. An uptick in liability claims could be a potential long-term consequence" and "[a]s the biological effects of EMF in general and 5G in particular are still being debated, potential claims for health impairments may come with a long latency."

Wireless companies inform shareholders of the risk[55] but not the communities impacted by the infrastructure[56]. For example, Crown Castle states in their 2020 10-K tax filing that:

> "If radio frequency emissions from wireless handsets or equipment on our communications infrastructure are demonstrated to cause negative health effects, potential future claims could adversely affect our operations, costs or revenues.
>
> "The potential connection between radio frequency emissions and certain negative health effects, including some forms of cancer, has been the subject of substantial study by the scientific community in recent years. We cannot guarantee that claims relating to radio frequency emissions will not arise in the future or that the results of such studies will not be adverse to us."
>
> "If a connection between radio frequency emissions and possible negative health effects were established, our operations, costs, or revenues may be materially and adversely affected. We currently do not maintain any significant insurance with respect to these matters."[57]

Conclusion

Massachusetts has the potential to be at the forefront of technological advancements, environmental protections and health protections. The Massachusetts Broadband Institute has been given a once in a lifetime spending opportunity and can achieve all of these goals by investing into fiber optics all the way to every home and business, no matter the initial cost. We urge MBI to stay steadfast in these goals so that Massachusetts can have the opportunity to compete on the world stage while keeping residents and the environment safe.

We are happy to provide MBI with more information and resources if needed.

Sincerely,

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[1] www.EHTrust.org
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