XNET AND SUSTAINABILITY

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OVERVIEW

Sustainability is an important consideration for the XNET project. We are committed to the intentional and thoughtful management of the positive and negative externalities of our project, including environmental and social impacts. This includes, but is not limited to, climate-related impacts.

Anthropogenic, or human-made climate change, and its associated challenges collectively represent one of the largest problems facing humanity in the 21st century. Like many problems, the topic is often framed in simplistic terms but can only be meaningfully addressed in a nuanced way that trades off a more comprehensive set of risks and benefits, and recognizes the legitimate interests of many stakeholders.

Our goal with this paper is to provide a framework for understanding XNET's approach to sustainability, including impacts on the environment, to make explicit the costs and benefits that we are weighing, as well as providing insights into some of the design choices we have made to maximize benefits while minimizing costs.

BENEFITS AND COSTS

The author has spent decades grappling with the intersection of sustainability, technology, human culture, and the environment. This multi-decade odyssey has led to a perspective that is grounded in science, empiricism, pragmatism, and transparency. We believe that improving connectivity is beneficial for many reasons, ranging from improving economic opportunity to reducing social inequality to advancing education and the standing of underrepresented minorities. We are also aware that this comes with costs, which can include increased energy consumption, accelerating the generation of e-waste, and amplifying the divisive power of social media.

On the balance, we believe that under most circumstances improving connectivity provides benefits that far outweigh the costs, including negative externalities such as driving climate change. Here is a top level accounting of important costs and benefits we are considering as they relate to XNET:

XNET NEGATIVE EXTERNALITIES (SOCIALIZED COSTS)

1. Power consumption[1]
    a. XNET nodes consume power to operate, including power for radio functions as well as power for network coordination, including the blockchain component
    b. XNET back-end services consume power, principally the mobile-network coordination services that connect the XNET network with other mobile operators (the XNETMNO functions)
2. E-waste generation from lifecycle management of XNET nodes
3. Spectrum crowding
4. Aesthetic impacts, such as the cluttering of sightlines with towers or antenna installations
5. Social negatives, including the harmful effects of some advertising-driven social media content and the publication of some potentially sensitive information (such as the GPS location of XNET nodes) on a public blockchain

It is worth noting that with the exception of some XNET-specific nuances around power consumption and blockchain data publishing, this list of negative externalities applies equally to any expansion of wireless connectivity.

[1] Although we generally account for power consumption as a negative externality, that may not always be true. For example, if power is low- or zero-carbon and the PPA (power purchase agreement) is used to support the economics of renewable or zero-carbon sources, this externality might be positive.

XNET POSITIVE EXTERNALITIES (SOCIALIZED BENEFITS)

1. Improved disaster notification and emergency response
2. Improved access to education and economic opportunity
3. Improved access to telehealth and remote health monitoring
4. Improved industrial equipment monitoring, security monitoring, and management of shared resources like airspace for drone delivery
5. Reduced need for physical transportation of people, including:
    a. Reduced transportation energy costs
    b. Reduction of vehicle-related pollution and crash-induced trauma
6. Enabling lower-carbon-intensity delivery of physical goods, like small semi-autonomous delivery robots and drones
7. Direct economic benefits to XNET network enablers in the form of recurring income, which can have larger economic impact on the community
8. Reduced cost of connectivity for XNET enablers and customers, which tends to drive down the cost of end-user connectivity at large

Items 1-6 on the positive externality list are benefits that accrue from improving the availability and lowering the cost of high-bandwidth wireless connectivity, and are therefore not specific to XNET. Indeed, the motivation for the XNET project can largely be attributed to the founders' desire to promote connectivity as a social good. Items 7 and 8 are more specific to the XNET approach, although not unique to XNET as other disruptive blockchain-based connectivity projects may claim similar benefits.

If we did not believe the positives would drastically outweigh the negatives under virtually all plausible scenarios we would not be pursuing this project. That being said, XNET embodies specific design choices meantto mitigate the negative impacts we have identified.

NEGATIVE EXTERNALITY MITIGATION

POWER CONSUMPTION

A common topic of discussion around blockchain technology and sustainability is power consumption, with Bitcoin's proof-of-work consensus algorithm often cited as a significant driver of power consumption and emblematic of the industry at large. However, there are many approaches to achieving consensus for blockchain systems that are not proof-of-work based, and the industry is undergoing an overall shift away from proof-of-work towards other consensus algorithms, such as proof-of-stake.

From our perspective, power consumption is an important consideration, but one that must be considered in the context of two other equally important considerations: the carbon intensity of the power (and more broadly, the life cycle embodied carbon of the system), and the benefits derived from the power utilization.

Indeed, from this perspective bitcoin mining and electric car charging can both be seen as creating either net positive or net negative externalities depending on the values one assigns to the goods provided and the carbon intensity of the power source and embodied carbon of the miners/vehicles. Put another way, a grid-charged Tesla isn't inherently more environmentally virtuous than a solar-powered bitcoin miner[2], and is likely quite the opposite.

XNET Design for Power Efficiency

That being said, if we account for power consumption as a negative externality, then making choices that reduce that power consumption and reduce carbon intensity without reducing benefits is beneficial. Thus XNET employs state-of-the-art low-power radio and computing equipment, and works with cloud computing partners with a high renewable energy mix. In addition, XNET has chosen a low-power blockchain consensus approach that preserves the security of the consensus while also significantly reducing power consumption.

XNET employs a blockchain-based connectivity mining approach that is built with Ethereum Virtual Machine (EVM) technology and, in the pre-launch phase, implemented in the form of a private blockchain employing a Proof of

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[2] As of recent reporting, the energy mix of bitcoin mining is about 58% renewable, significantly higher than the California grid, which was about 33% renewable as of 2020, the last year for which I can find data. Sources:
https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2020-total-system-electric-generation
https://cointelegraph.com/news/sustainable-energy-usage-for-btc-mining-grows-nearly-60-in-a-year

Authority (EIP-225: Clique) consensus algorithm, a very low-power consensus approach. At launch, we anticipate relying on either a Proof of Stake (see EIP-2982 and EIP-3675) or Proof of Authority consensus system, which will result in significantly lower power consumption than the proof-of-work consensus approach that has been in widespread use in the Ethereum ecosystem.

E-WASTE

Managing the lifecycle impact of products is now a major challenge, especially in the consumer electronics products space where product lifetimes are short and the embodied environmental impacts from resource extraction to disposal can be high.

XNET products are designed for a relatively long product life cycle, with service life of 5+ years anticipated for our nodes. We are also committed to responsible product end-of-life processes, and anticipate offering trade-in credit for newer equipment with the return or verified proper disposal of old equipment.

SPECTRUM CROWDING

Wireless spectrum is a scarce resource, and has historically been managed poorly. The CBRS radio system used by XNET represents a major improvement over previous spectrum management approaches, with a low barrier to entry and high-level management to mitigate global interference problems.

XNET plans to implement additional monitoring of the CBRS radio band (band 48) as part of the routine operation of the XNET network and will provide this information to regulators and the public. In addition, our nodes will be able to coordinate spectrum use so as to maximize the benefits of the spectrum used while minimizing transmission power and band utilization.

NEGATIVE BUILT ENVIRONMENT IMPACTS

Traditional mobile network operation requires relatively heavy-weight infrastructure with a large operational and aesthetic footprint. Deploying such networks typically requires the construction of free-standing towers or substantial roof masts that clutter sight lines and create aesthetic and operational challenges for property owners or city managers.

CBRS radio systems, such as those used by XNET, can be effectively deployed at a smaller scale and with a correspondingly lower footprint. Indeed, in densely populated areas an XNET node with a similar size and aesthetic profile to a WiFi router (but greater coverage) can be used to provide connectivity for a facility or dozens of dwelling units, with little or no impact on the built environment.

XNETs medium-sized outdoor nodes are designed to be minimally intrusive, and can be deployed on rooftops or balconies with small mounting systems and an aesthetic impact similar to that of a small satellite dish. XNETs largest nodes are intended to be deployed mostly in co-location with existing communications infrastructure, and thus will minimally impact the aesthetics or operations of the built environment.

SOCIAL NEGATIVES OF CONNECTIVITY

XNET operates as a common carrier, and lacks the technical means or the motivation to provide any type of content monitoring or filtering. As such, we must rely on others to make good choices about the type of content they engage with, whether this content is delivered by means of an XNET network or not.

The operation of the XNET project does require the publishing of some potentially sensitive information, such as the GPS coordinates of XNET nodes, to a public blockchain. It is conceivable that this information could be used for nefarious purposes, such as the harassment of XNET node operators. We do not believe this will become an operational problem in most parts of the world, but it is an important consideration for those who believe that operating an XNET node might make them targets.

CONCLUSIONS

Every human endeavor has positive and negative externalities — XNET is no different. We believe that on balance, the XNET project will provide significant benefits to individuals and society at large. Furthermore, we are committed to the conscious exploitation and intentional balancing of these externalities so as to maximize the benefits and minimize the negative effects.

For questions related to this Sustainability paper please consider visiting our Discord server or email Sint Connexa: connexa@xnet.company, @connexa#0185.