On DeWi Network Design Tradeoffs

In our last piece, *On DeWi Unit Economics*, we proposed that DeWi networks are fundamentally better businesses than TradWi telco networks. Why?

- **DeWi token models align the incentives of landlords + networks, reducing rents in the system.** In retail deployments, the "landlord" and the "network" are the same economic actor. In institutional deployments, landlords are more likely to accept revenue-share agreements because of the transparency of mining rewards earned on a property. TradWi networks run <40% cash operating margins. We think DeWi networks can reach 50-60%+.
- **Tokenizing spectrum licenses transforms spectrum from an unproductive asset to a productive one.** Spectrum licenses make up 55% of TradWi's productive assets ($350B+ in the US alone), yet they often sit unused on balance sheets for years while compatible equipment is deployed and new offerings are marketed. Licenses reduce TradWi networks' productive asset turnover (a measure of capital efficiency) from 120% to 50%. We think DeWi networks can reach 70-80%+.

> 💡 **TradWi:** (0.5x asset turnover) x (40% operating cash flow margin) = **20% unlevered returns**
>
> **DeWi:** (0.75x asset turnover) x (55% operating cash flow margin) = **41% unlevered returns**

DeWi networks can generate double the returns of TradWi. DeWi can undercut incumbents by 50% and still earn higher unlevered returns than TradWi networks. Furthermore, if demand for data transfer is elastic, then cutting the cost of data transfer in half should grow the total addressable market size significantly.

Research suggests that long-term consumers' price elasticity for mobile voice communication is 1.12 in developed markets and that enterprises' price elasticity for public clouds is 1.20. A price elasticity >1 implies that a decrease in price is more-than-offset by an increase in demand at the new lower price, and therefore revenue grows even as prices fall. At the range above (1.12-1.20), cutting data transfer prices in half would mean that DeWi networks can tap into $30-50B of latent demand for data transfer in the US (that is, in addition to taking the $315B+ service revenues earned by incumbents in 2021).

DeWi Layer-1 Protocols

Layer-1 protocols are the most asymmetric bets in crypto. As we've previously written, L1s sell access to one of the three digital commodities: compute, storage, bandwidth.

The winning L1 in each of these categories has a credible path towards achieving a monetary premium via the utility hypothesis. With a potential opportunity of $75T+ (the combined M2 money supply of the world's 5 largest economies), even a minuscule chance of becoming global money deserves - in probabilistic terms - an expected value in the billions of dollars.

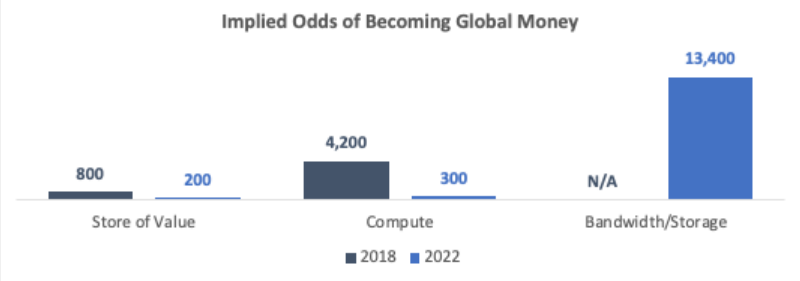
Today, market valuations imply **1-in-200 odds** for the **store of value thesis**: that an asset with self-sovereignty, censorship-resistance, scarcity, and security will become global money, regardless of its other qualities (i.e., a lack of utility). The market implies **1-in-300 odds** for the **compute utility thesis**: that an asset that tokenizes compute (in other words, the native token of a smart contract layer-1 chain) will become global money by virtue of its widespread utility. Finally, the market implies **1-in-13,400 odds** for the **bandwidth/storage utility thesis**.

Store of Value Thesis		
	Mkt Cap	Implied Odds
Bitcoin	$454	200
Ripple	$19	3,900
Dogecoin	$9	8,300
Shiba Inu	$7	11,500
Litecoin	$4	17,400
Store of Value Chains	**$493**	**200**

Utility Thesis: Compute		
	Mkt Cap	Implied Odds
Ethereum	$208	400
BNB	$47	1,600
Cardano	$18	4,200
Solana	$15	5,000
Polkadot	$8	9,400
Compute Chains	**$296**	**300**

Utility Thesis: Bandwidth & Storage		
	Mkt Cap	Implied Odds
Helium	$2	35,700
Filecoin	$2	35,700
Arweave	$1	75,000
Pollen	$0	375,000
Sia	$0	375,000
Bandwidth/Storage Chains	**$6**	**13,400**

Crypto is a nascent space where both fundamentals and market sentiment change quickly. In 2018, before demand for smart contract chains was obvious, crypto markets priced 5x higher odds for the “store of value thesis” vs the “compute utility thesis” (1-in-800 vs 1-in-4,200)… and the first bandwidth/storage blockchains were still being invented.



Today, crypto markets price the store of value thesis and the compute utility thesis at roughly equal odds - around 1-in-250 (a 2.7 std dev event) - while the bandwidth/storage thesis trades like a near-impossibility at 1-in-13,400 odds (a 3.8 std dev event). To be clear, by bandwidth/storage I mean the more generous definition (bandwidth ∪ storage); the individual odds of the bandwidth utility thesis are priced at 1-in-32,600 (a 4.0 std dev event).

Given the odds, it’s worth asking ourselves whether the bandwidth utility thesis - the idea that tokenized bandwidth will become a digital commodity money - is truly 100x+ less likely than the compute utility or store-of-value theses.

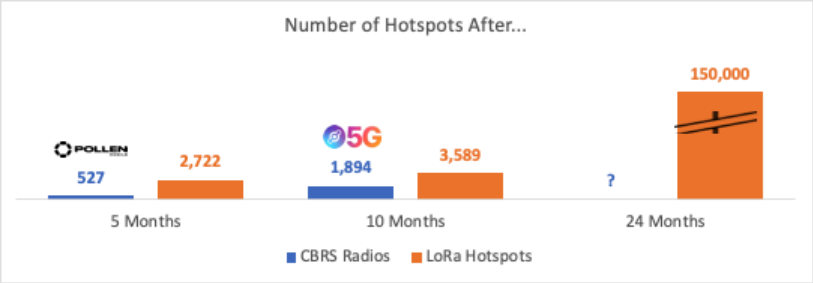
What does it take for blockchains to create tokenized bandwidth worthy of a monetary premium? What is the design space and tradeoffs inherent in bandwidth-based crypto-networks?

1. Power vs Cost

In order for a DeWi network to become valuable, it must provide *useful* coverage. Networking equipment that is larger, more expensive, and harder to deploy tends to be more powerful (in terms of coverage area, throughput, or reliability). For example, Helium/Pollen CBRS radios are 1-1.5 orders of magnitude more expensive than LoRa hotspots and have 1 order of magnitude smaller coverage area—but the data transfer capacity is 4 orders of magnitude higher than LoRa.

	Capacity (in KBPS)	Cost (in $)	Coverage (in km)
CBRS Radios	250,000	$7,500	1
LoRa Hotspots	27	$250	10
Orders of Magnitude	**4.0**	**1.5**	**-1.0**

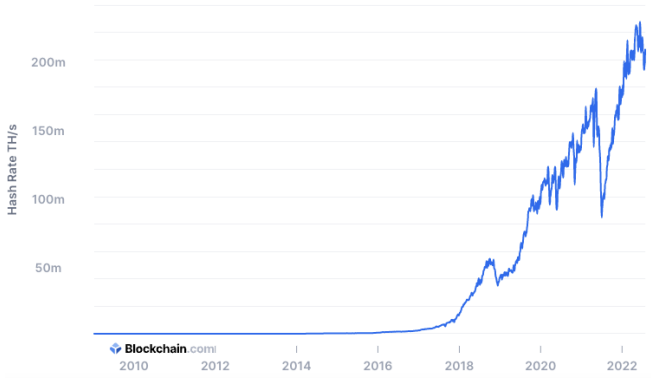
But equipment costs are incurred by miners, not the protocol directly. The protocol “pays the price” in the form of slower growth and decentralization. For example, Pollen Mobile and Helium CBRS are both smaller than Helium’s LoRa network was at their respective stages, even before LoRa hit its exponential growth curve in 2021. This behavior is intuitive: as a DeWi network increases the human and financial capital requirements to become a miner, there’s a smaller universe of potential miners, driving flatter network growth.



DeWi networks can mitigate this tradeoff by creating tiers of mining equipment, and in fact is mitigated passively via increased mining difficulty.

The latter - increased mining difficulty - is a consequence of how most cryptonetworks are designed. Early miners take equity-like risk on a network, and are rewarded with a disproportionate amount of mining rewards relative to their underlying contribution. Miners who join later are taking less equity-like risk, and earn correspondingly lower rewards.

Take the Bitcoin network for example. The total hash rate securing the Bitcoin network has increased by a factor of roughly 200 million since 2012, while three halvings have reduced block rewards from 50 to 6.25 BTC during the same period. Taken together, BTC rewards per hash have fallen by a factor of 1.6 billion since 2012.



As Bitcoin mining became increasingly competitive, miners went from at-home retail rigs to sophisticated industrial farms. Institutional miners with lower costs of capital (i.e., access to debt funding), better margins (i.e., access to cheap electricity), and operating leverage (i.e., bulk hardware) have an inherent cost advantage vs retail miners, and eventually outcompete them. The same will be true in DeWi: as more nodes are added to a network, average rewards fall per node fall, and only the most efficient nodes can generate attractive returns. Therefore, DeWi networks trend from retail → institutional over time, regardless of network design choices.

> 💡 DeWi community members may be disheartened to hear that mining will only become less profitable over time, but it's the truth of how crypto-networks operate—a feature, not a bug. From users' perspective, it means the network is in a constant state of becoming more efficient—providing better coverage at lower costs.

Networks can proactively target both retail and institutional miners via tiers of nodes, which allows networks to benefit from high-growth retail deployments as well as high-powered institutional deployments. This tiering is currently in production for both Pollen Mobile (offers $7.5K outdoor radio; $775 indoor radio; $512 mapper), as well as Helium CBRS (offers $5.7K outdoor radio, $1.5K indoor radio, mapper currently in beta). Increasing the number of tiers is a

form of price discrimination that expands the total addressable market of potential miners. For example, an Uber driver might buy a $500 mapper to validate coverage on their routes and tell their friends about it, driving viral growth. At the same time, a venture-backed mining operation might deploy hundreds of $10K+ radios across enterprise-grade locations. Both on the same network.

The downside to creating multiple tiers - especially in the early days of DeWi networks - is complexity. With more tiers, it becomes harder to do things like accurately validate coverage, prevent gaming, manage supply chains, and provide customer support to miners. Over time, DeWi networks progressively decentralize and push these complexities out to the edges.

Which brings us to our next tradeoff…

2. Centralization vs Decentralization

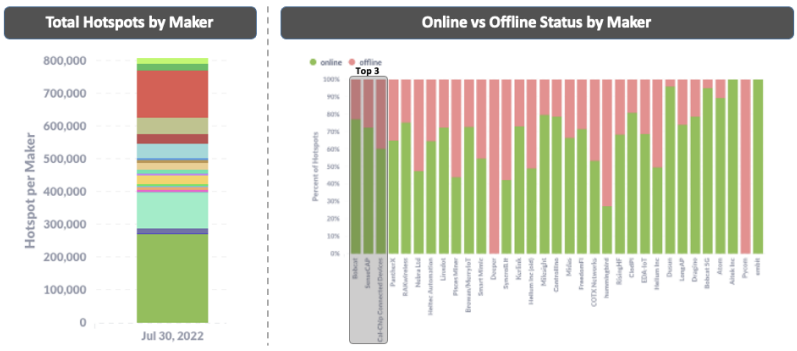
DeWi networks progressively decentralize over time. One of the most important areas is decentralizing manufacturing. Helium began with Nova Labs (fka Helium Inc) as the sole manufacturer of hotspots, but over time 30+ independent manufacturers were approved to sell Helium-compatible hotspots, all of whom are responsible for managing their own supply chain and customer fulfillment / support. There are a handful of lessons to learn from Helium's progressive decentralization:

Decentralization is a gradual process. Work on Helium's third-party manufacturer approval process began in November 2020 (HIP-19), and it took a full year before there were 5+ manufacturers consistently onboarding hotspots onto the network. Today, nearly 2 years later, Helium's LoRa network has 30+ approved manufacturers, of which 15+ onboard new hotspots on any given day, and dozens more are in the approval pipeline.

It can also take time for DeWi networks to transition non-core functions, such as fulfillment and customer support, over to third-party manufacturers. For example, Nova Labs announced plans in February 2022 to deprecate the open-source Helium App (which helps miners to onboard hotspots onto the network), choosing instead to push the responsibility onto the manufacturers.

> 💡 Most manufacturing companies lack internal software development resources to maintain a world-class mobile app. This allows software companies like Hotspotty to build a leading mobile app experience (Hotspotty Connect) and partner with manufacturers to deliver a consistent hotspot onboarding experience for the entire Helium community.

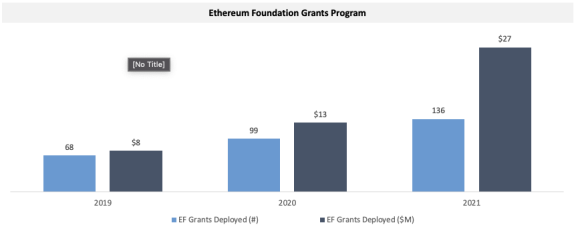
Decentralization does not guarantee diversity. In Helium LoRa, the top 3 vendors represent more than 70% of total hotspots. It's also true that some manufacturers are better than others, evidenced by the wide range in online vs offline percentage by manufacturer, and that the biggest vendors are not necessarily the best. Manufacturer diversity in DeWi networks is roughly analogous to client diversity in Ethereum, which is even more concentrated.



Decentralization does not guarantee fairness. In fact, the opposite is often true: networks need to find a way to hold onto some centralization in order to protect the integrity of the system. In Helium LoRa, cases of institutional gaming quickly emerged where approved manufacturers would partner with illicit miners to artificially boost rewards, at the expense of the rest of the network. To combat this, the Helium Foundation set up the Manufacturing Compliance Committee (MCC), endowing it with the power to revoke manufacturers' ability to onboard new devices. The MCC has exercised its powers with at least two manufacturers, Deeper and Panther, both of whom were suspected of colluding with fraudulent hotspot operators (you can watch MCC meeting recordings here). The MCC also manages the process of approving and onboarding new manufacturers.

There are many are many non-core areas to be decentralized. The points above focus on manufacturing, since it's typically the first and foremost hurdle that DeWi networks face in order to reach scale. But it's not the only piece of DeWi networks that should be decentralized over time:

- Price Oracles: Most DeWi networks convert between their native token and dollar-denominated "data credits" at prevailing market prices. Unfortunately, determining the prevailing market price in a trustless manner is not trivial (see: Oracle Problem). Manipulating oracles, especially via flash loans, is one of the most common attack vectors in DeFi, causing $350M+ of hacking losses in 2021 (e.g., Cream Finance). Helium mitigates this risk by trusting eleven price oracles - the Helium Foundation, Nova Labs, and nine anonymous community members selected by the Helium Foundation - at least 5 of which must collude to submit a fraudulent price. **Price oracles are difficult to decentralize, especially in the early days. Even after there is plenty of liquidity in the native token across multiple venues, decentralized oracles can still be susceptible to sophisticated flash loan attacks.**
- Treasury Management: Most cryptonetworks have protocol treasuries which can hold both the protocol's native token (think: unissued stock) as well as other cryptoassets (think: balance sheet assets). Most DeFi treasuries are controlled by tokenholder vote, an approach that is more democratic, transparent, and drives governance value to the native token. Unfortunately, it can also lead to slow and short-term oriented decision-making, capital misallocation, and create a bigger attack vector for hacks. Most DeWi protocols today, including Helium and Pollen, control their treasuries out of their foundations. This approach leads to more centralization and opacity (e.g., the size and composition of Helium/Pollen's treasuries is not publicly available to our knowledge), but also leads to faster decision-making and a unified strategy. **Treasury management is difficult to decentralize, but should be in the long-term in order to protect the integrity of the protocol's funds and drive value to the native token.**
- Grants: Grants programs are a special case of treasury management. Protocols generally allocate 5-10% of their treasuries into grants program to accelerate growth of a developer ecosystem and buildout of critical network infrastructure. Perhaps the best example is the Ethereum Foundation grants program, which deployed $27M worth of grants in 2021 and has funded projects including Uniswap, Starkware, ENS, and Harmony in their early days (in addition to building a ton of core-but-less-flashy infrastructure for the Ethereum ecosystem). Grants are a low-stakes avenue for DeWi networks to begin to decentralize in their early days, with little regulatory/technical risk and high potential upside. **Both the Helium Foundation Grants Program and the recently-announced Pollen Grants Program are actively making grants to developers building in the DeWi ecosystem (takes only a few minutes to apply).**



There are costs to decentralizing too early. The two public DeWi networks today, Helium ($2.0B FDV) and Pollen ($235M FDV), are in different stages of their development and have different philosophies with respect to progressive decentralization. Helium has a robust Improvement Proposal process, with 29 HIPs approved/deployed, 5 denied, and 34 in discussion to date (although many "in discussion" ones are no longer actively being discussed). Pollen has yet to launch their first Improvement Proposal, and protocol functions are still controlled by the core team. That said, the Pollen team has been open about their plans to progressively decentralize both in the Pollen Mobile whitepaper as well as bi-weekly community calls.

Helium's decentralization makes the network more robust, with more voices and ideas considered in protocol governance decisions. For example:

- **Infrastructure:** The Helium community has been actively discussing moving to a separate smart contract layer-1 for the past few months, motivated by Helium's massive scale causing scaling issues. Both Solana, which Pollen currently uses, and Cosmos are being considered.
- **Governance:** There are multiple active proposals around voting mechanisms for the Helium DAO, including entity-weighted voting and token-lock voting, the latter of which has been approved by the DAO and is set to be implemented by the core development team as part of HIP-51.
- **Proof of Coverage:** there have been at least a dozen HIPs related to proof-of-coverage mechanisms, a few of which have been implemented. In contrast, Pollen's proof-of-coverage still has many closed-source elements.

Despite the benefits of decentralization, there is a clear tradeoff with speed of iteration. We note that Pollen shipped its first hardware in February 2022, went live with mining rewards the same month, and has since announced 3+ iterations on their proof-of-coverage. Helium CBRS shipped its first hardware in October 2021 (3 months before Pollen) and launched MOBILE token rewards a few weeks ago (4 months after Pollen). Pollen has 400+ mappers (Bumblebees) on its network, while Helium CBRS' mappers are awaiting beta release (per FreedomFi's public roadmap). Both networks are still nascent, but the evidence suggests that decentralized governance brings both benefits and drawbacks in the early days of a DeWi network.

> 💡 The end goal is to build **credibly-neutral telecom networks**. To skeptics who ask "why does this need to be decentralized?", consider this: the FCC paid out $2B (the equivalent of Helium's fully-diluted market cap…) to small US telcos this year as reimbursement for ripping-and-replacing Chinese telecom equipment, and subsequently requested an additional $3B. The equipment is mostly being replaced by Nokia and Ericsson equipment, Finnish and Swedish companies, which is proof that the US government is willing to pay billions of dollars to secure American telecom networks with *credibly-neutral* European hardware.

3. New vs Existing Demand

DeWi networks can target a number of different end-markets, both vertically (e.g., cellular, IoT, enterprise) and horizontally (e.g., LoRa, WiFi, 4G/5G, Bluetooth). There's a clear tradeoff between building for *new* vs *existing* data transfer demand. New uses cases, like IoT or autonomous vehicles, are poorly served by incumbent networks. This makes for an easy sale (there's no competition), but comes with a lot of uncertainty about how big use cases can be and how quickly they might emerge. Existing use cases, like mobile phones, can have hundreds of billions of dollars of addressable revenues on day one. The downside is extremely competitive markets which generally require partnering with an incumbent to overcome the chicken-and-egg problem.

Helium's first network is a LoRaWAN network designed for IoT sensors. Helium's LoRa network has gotten plenty of attention in the past week after blogger Liron Shapira's viral tweets pointed out that data transfer is less than $100K per year, despite hundreds of millions of dollars invested into the network. Assuming $0.50 of annual data transfer

spend per device, there are 200K LoRa devices are currently active on Helium's LoRa network. Semtech reports 250M LoRa devices globally, which suggests Helium's LoRa network has a little less than 0.1% market share.

Sounds like lots of room to grow, right? The issue is this: even if every LoRa device on earth today transferred data exclusively on Helium, it would only generate $120M of annual data transfer demand, which is small relative to Helium's fully-diluted market valuation of $2.0B. You would need to assume a 30x multiple on cash flows - a multiple that exceptionally few businesses can sustain at scale - in order to generate a 12% annualized return over 5 years (on a fully-diluted basis).

Helium LoRa Implied Valuation With $120M Annual Revenue			
Assumed Multiple	Implied Value ($M)	Implied Total Return	Implied 5-Yr IRR
7x	$840	-58%	-16%
15x	$1,800	-10%	-2%
20x	$2,400	20%	4%
30x	$3,600	80%	12%

For context, Brazil's 10-year government debt currently yields 13%. So, the market believes the odds of Helium's LoRa network achieving 100% market share in LoRa and a 30x multiple are a little bit higher than the odds of the Brazilian government paying back its debts. This is a semi-facetious example, but goes to show the extent to which HNT today is really a bet on: 1) **explosive** growth in the number of LoRaWAN devices globally, and/or 2) non-LoRa networks.

Helium's second network is a cellular network primarily focused on indoor offload for mobile phones. Cellular networks are attractive verticals for DeWi for a few reasons: for starters, there are 350M+ mobile subscriptions in the US alone, representing at least $200B+ of revenues. Second, companies like AT&T and Verizon can raise prices without issues, so long as they're raising prices around the same time. Third, the quality of incumbent networks is often complete garbage, especially indoors, in rural areas, or in overly dense areas.

Indoor offload - providing coverage indoors and re-selling it through carriers - is a relatively small market today. The largest player, Boingo, generated $108M of revenue in 2020 and was subsequently acquired by private equity investor Colony Capital for $850M last year. Here are their 2020 financials:

Boingo 2020 Financials					
	Indoor Offload	Military Bases	Apartment Buildings	Legacy	Total
Income Statement					
Revenue	$108	$77	$22	$30	$237
(x) Gross Margin	37%	76%	27%	58%	52%
Gross Profit	$40	$59	$6	$17	$123
(-) Operating Expenses	($19)	($34)	($10)	($16)	($127)
Operating Profit	$21	$25	($4)	$1	($4)
(+) Depreciation	$37	$17	$3	$8	$82
Cash Operating Profit	$58	$42	($1)	$9	$78
Metrics					
(-) Capex	($86)	($10)	($2)	($4)	($106)
Free Cash Flow	($28)	$32	($3)	$6	($28)
Assets	$365	$67	$13	$19	$576
Asset Turnover	0.3x	1.1x	1.7x	1.6x	0.4x
Cash Operating Margin	54%	54%	-5%	31%	33%
No. of Locations	74	50	226		
Revenue per	*$1.5*	*$1.5*	*$0.1*		
Gross Profit per	*$0.5*	*$1.2*	*$0.0*		
Cash Operating Profit per	*$0.8*	*$0.8*	*($0.0)*		
Employees per	*1.0*	*1.0*	*0.4*		
No. of Employees	76	51	84	22	390

💡 The **indoor offload** segment provides internet connectivity at 74 locations, primarily high-traffic buildings like airports or train stations. The average location has 550 nodes, each of which is worth $9K (i.e., $5M of equipment per location). Boingo earns $1.5M revenue per location per year, of which half is cash operating profit. This implies a 15% cash operating yield which, if you read our last piece, you'll recall is similar to tower businesses. A decent business.

The **multi-family** segment provides internet connectivity inside 226 apartment buildings across the US. This is a business with shoddy gross margins (27%), made worse by the fact that it's operating subscale (only $22M of annual revenue with 84 dedicated employees). Boingo loses money on it and is in the process of winding it down (-15% revenue growth in 2020). A bad business.

The **military** segment provides internet connectivity 50 US military bases around the world. The average base has 2.6K subscribers, of which Boingo in total serves 128K. Each base requires $1.3M of equipment and earns $1.5M revenue per location per year ($50 per subscriber per month). Rent is much lower than in indoor offload, but operating costs are higher, which nets out to the same $750K of cash operating profit, or an asset yield of 55%+!

Providing wireless coverage at military bases is a truly exceptional business. Even better, given the stickiness of government contracts, you can run the business with significant leverage. You might wonder - is the military really a high-growth customer segment? No, in fact it barely outpaces inflation. But it literally does not matter. When a business is generating 55% asset yields, you can finance half of it with debt and earn your money back in less than a year. It's almost too good to be true!

You might think - *why does the market value DeWi, in its nascent stage, at $1-2B, when the biggest player in indoor offload is only worth $850M?* We believe DeWi-powered indoor offload can be orders of magnitude bigger than Boingo. First off, the average Boingo deployment is huge, with 550+ nodes ($5M worth of equipment); in fact, at least a quarter of Boingo's deployments are international airports. DeWi could see realistically serve deployments that are 100x smaller in places like schools, malls, hospitals, or offices. While there are only 150 international airports, there are 1K stadiums, 6K hospitals, 116K malls, and 130K schools, not to mention 6M commercial buildings in the US.

Now you're thinking - *surely the vast majority of these buildings have WiFi networks already, why do they need DeWi cellular networks?* There are fundamental differences that make cellular networks perform better than WiFi networks, especially in scenarios where: 1) devices are moving around a large area, or 2) reliability/uptime is important. In fact, there's a trend towards large public venues deploying both private cellular and WiFi networks in parallel, using the former for mission-critical use cases while freeing up WiFi spectrum for less critical uses.

So how big can the US indoor offload market be? Even with our rosiest glasses on, the market for massive venues (e.g., airports, stadiums) is likely less than than $2-3B of addressable revenue per year (a figure which would suggest Boingo has only 3-5% of the total market). The next tier of venues - hospital, malls, schools, and offices - are part of what has traditionally been called private 4G/5G, a market which the IDC projects to grow from $2B in 2021 to $8B in 2026. Combining the two, and admittedly using very fuzzy math, we estimate the indoor offload market could be $10B of revenues over a 5-year time frame: nothing to sneeze at, but still a small fraction of incumbent telcos' revenues.

4. Token Dilution Now vs Later

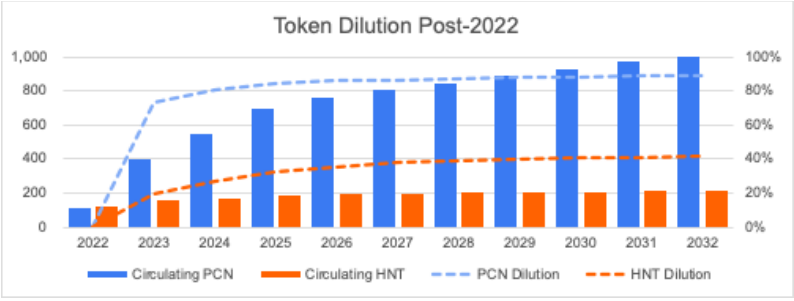
DeWi networks, indeed all crypto-networks, face a tradeoff between *diluting now* and *diluting later.* Given that the majority of tokens in DeWi networks are reserved for mining rewards, the crux of the question is deciding how many tokens to pay out to miners relative to the supply cap. Paying out more tokens increases the attractiveness of mining returns and, all else equal, leads to faster network build-outs *today*. As we saw with Helium's LoRa network in 2021, in bull markets there's a reflexive spiral where higher token price → higher miner returns → faster node growth →

token buy pressure… This drove Helium's LoRa network to grow from 0 to 315K+ hotspots (with millions more on back-order) during a period when HNT's market price rose from $0.27 to a peak of over $52.

On the other hand, paying out *too many* token rewards is dangerous:

- **1) it reduces the incentive to hold the token, which can lead to a downward spiral.** Selling pressure → lower token price → lower miner rewards → slower node growth → more selling pressure. The natural lag between purchasing and delivery of equipment can mitigate the impact, but not totally prevent the downward spiral from affecting the growth and health of the network.
    - Let's take Helium's LoRa network for example. HNT's market price fell from a peak of $52 in November 2021 down to $9 today (-83%). Despite the price action, the number of onboarded LoRa hotspots has nearly tripled over the same period to 900K+, due to the large backlog of orders accumulated in 2021. Node growth has slowed down relative to last year, but is still running at an impressive rate of 50%+ annualized.
    - There are also signs that the flywheel is beginning to slow: only 625K hotspots out of 912K are online (69%), with the other 285K+ inactive or offline. A pessimist could say these offline hotspots have effectively erased the last 4 months of growth.
- **2) it limits optionality for future network build-outs.** Most DeWi networks set a hard cap on token supply and allocate a certain portion of locked tokens for future mining rewards. These rewards allocations finance any and all network build-outs until there is meaningful data transfer flowing through the system.
    - Helium, for example, implemented a max supply of 223M tokens (per HIP-20), of which ~62% are allocated for lifetime mining rewards. The network has already paid out most of this - roughly 35% of max supply - in order to incentivize the buildout of the LoRa network. Therefore, only 27% of total tokens remain to finance the build-out of CBRS and other future Helium subDAOs.

This is, according to our estimates, the go-forward monetary policy and cumulative for HNT and PCN:



💡 Some people believe that Helium's HIP-51/52/53 restructuring, which creates new tokens for the LoRa network ($IoT), the CBRS network ($MOBIL), other future networks, with a bonding curve + treasury buyback mechanism to $HNT, solves this. The argument goes like this: subDAO tokens will have their own speculative buyers, which means their market cap will decouple from the underlying value of the $HNT treasury and will trade at a significant premium to book value (say, above 30%). Helium can then use this newly-found value to finance new network build-outs like 5G. Personally, we're skeptical that the market will buy this argument, and think it's more likely that subDAO tokens will trade roughly near par. But we'd be more than happy to be proven wrong.

The opposite point of view is that every network needs its own independent token in order to "afford" high dilution and offer competitive mining rewards. We are skeptical of this point of view, too, because there are massive benefits to tapping into an existing community. Let's use Pollen as an example: PCN holders will see their ownership of the network diluted 73% in 2023 vs only 19% for HNT holders. Some folks will say this creates a disincentive to hold PCN, which will drive miners to sell token rewards on DEXs or OTC. Others folks say that high dilution is justified in the early days in order to drive outsized returns for early miners and build-out the network faster than competitors. Time will tell.

We think the best framework for thinking holistically about network growth vs token dilution boils down to unit economics, which are specific to individual DeWi network. Mostly, it depends on the *types* of miners that need to deploy nodes.

In networks geared towards retail miners, outsized rewards can drive truly viral growth. In networks geared towards institutional miners, outsized rewards have less of an impact. This happens for at least two reasons: 1) institutional miners want to protect their margins and won't advertise outsized returns the way retail miners do (they will, however, deploy as much of their own hardware as possible), and 2) institutional deployments are operationally intensive, and at a certain point miners face operational constraints and cannot put hardware up any faster regardless of the rewards. The same laws hold in TradWi: Crown Castle, for example, was peppered with analysts in its Q2'22 earnings call with questions about the company's ability to increase small cell deployments from 500 to 1,000 per year. Entrepreneurs and communities running DeWi networks should identify what types of miners are most valuable to the network, what capabilities those miners need to have (i.e., financial capital, human capital, property), and whether higher token rewards truly incentivizes faster network build-out.

Let's go back to the Helium CBRS vs Pollen Mobile data. Our math suggests that, if Helium allocates 25% of its total miner rewards to 5G, they will be able to onboard twice the amount of hotspots in 2022 and the same amount of hotspots in 2023, all while taking much less dilution (25% cumulative dilution for holding HNT over '22-23 vs 80% dilution for PCN). Note that this analysis is highly speculative: PCN price is based on a DEX with less than $100K of depth, and the initial percentage of rewards to Helium's CBRS network looks to be much lower than 25% (likely single digits). However, we hope the framework is useful for contextualizing the respective networks' growth potential, the advantages of a high market cap, and the tradeoffs of high token dilution.

Deployment Assumptions

Deployment Costs		
Model	*Buttercup*	*Nova436H*
Hardware	$7,500	$5,700
Install	$750	$750
Up-Front Costs	**$8,250**	**$6,450**
Rent	$3,000	$3,000
Backhaul	$1,800	$1,800
Labor	$500	$500
Annual Costs	**$5,300**	**$5,300**
Total 1-Yr Costs	**$13,550**	**$11,750**
Annual Rewards for 3-Mos Payback	*$38,300*	*$31,100*
Annual Rewards for 24-Mos Payback	*$9,425*	*$8,525*

Network Growth Implications

	PCN	HNT	Helium Advantage
DeWi Deployment Capacity			
Token Price	$0.25	$10.00	
Assumed % of Rewards for 5G	100%	25%	
$M Network Value Based On…			
Current Supply ('22)	$27	$1,330	49x
FY5 Supply ('27)	$201	$2,080	10x
FY10 Supply ('32)	$250	$2,202	9x
Total Deployment Capacity in 2022 At…			
3-Month Paybacks	705	1,495	2.1x
12-Month Paybacks	1,993	3,957	2.0x
24-Month Paybacks	2,865	5,455	1.9x
Total Deployment Capacity in 2023 At…			
3-Month Paybacks	775	836	1.1x
12-Month Paybacks	2,192	2,212	1.0x
24-Month Paybacks	3,151	3,048	1.0x

5. Open-Source vs Closed-Source Mobile Core

Mobile cores are the core network that operate a mobile telecom network. They are extremely complex undertakings that require significant development resources (i.e., a former Ericcson executive estimated it would take 1,000 engineers and 3 years to build a competitive 5G core).

Helium and Pollen both leverage Magma, an open-source mobile core which was developed by Facebook and subsequently transferred to the Linux Foundation. Magma has many benefits, including no costs and an active community of open-source contributors (including Helium and FreedomFi). It also has drawbacks, including limited interoperability with “old school” telecom systems and it has data-only capabilities (i.e., can’t make phone calls or send SMS messages).

There are many closed-source mobile core offerings, both from new competitors (e.g., Azure, Oracle, Rakuten, Mavenir) as well as telco equipment incumbents (e.g., Nokia, Ericsson, Cisco). These cores have clear downsides for DeWi networks, such as higher costs and vendor lock-in. They may also have potential benefits, such as the ability to provide non-data services and existing off-the-shelf integrations with traditional telco networks.

6. Licensed vs Unlicensed Spectrum

DeWi cellular networks today operate on CBRS general-access spectrum. This has a number of negative consequences:

- 1) they are susceptible to interference from private license-holders and the US government
- 2) there are regulatory power limits on networking equipment they can use
- 3) every miner must register with an FCC-designated vendor
- 4) networks can only operate in the US, since other countries have not yet allocated spectrum for general public usage

As we alluded to in prior posts, we believe tokenization can turn spectrum from an unproductive asset to a productive asset, thereby enabling DeWi networks to use their assets more efficiently than TradWi networks. These efforts are already partially underway in the industry (see Federated Wireless’ Spectrum Exchange), but tokenization is the logical extension. If DAOs can bid on a copy of the constitution, they can surely participate in spectrum auctions, or simply purchase them on secondary markets. DeFi teams including MakerDAO and Centrifuge, among many others, have been working on tokenization of real-world assets for years, and many of the primitives they’ve built are applicable to tokenizing spectrum licenses.

DeWi is still likely years away from seeing tokenized spectrum licenses in production. If you’re building this - let’s talk!

- Sal (*sal@ev3.xyz*) & Mahesh (*mahesh@ev3.xyz*)

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