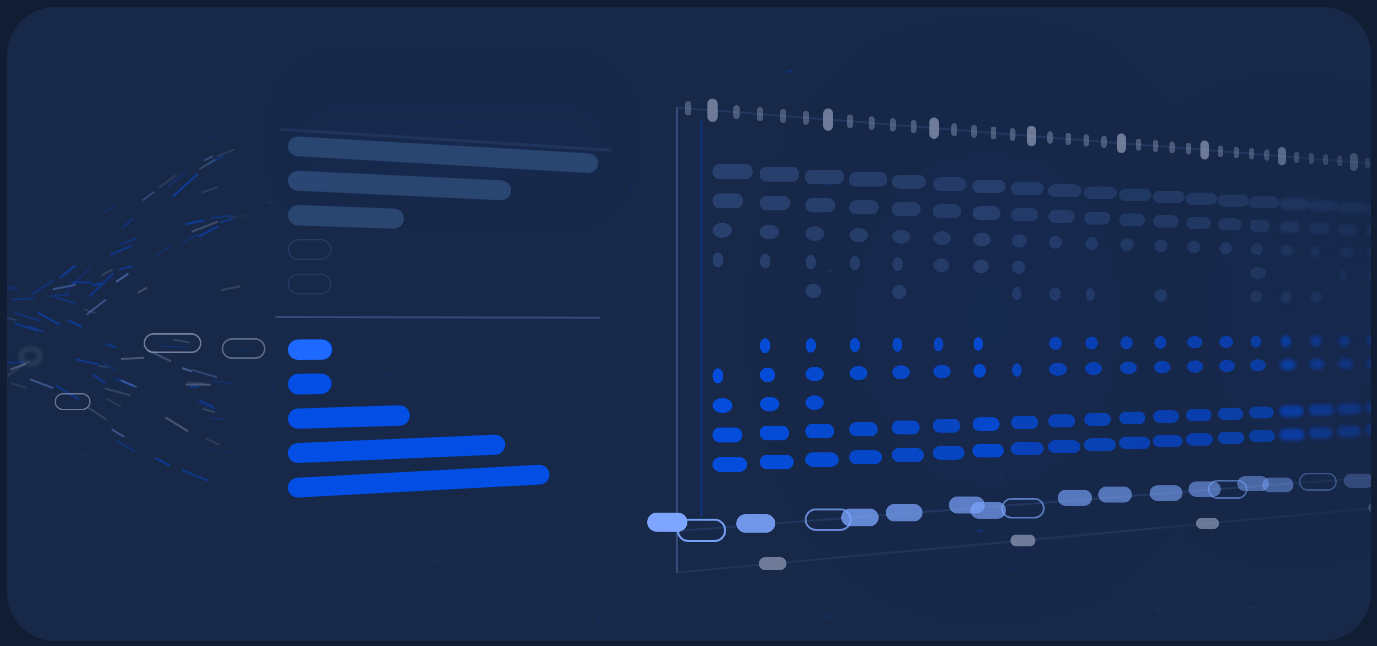
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EXPLAINER

Perpetual DEX market structure, 2025 to 2026

How on-chain perpetual futures venues match orders, charge fees, set funding and oracle prices, and what public data shows about their volume, open interest and real-world-asset markets.



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Summary

- Perpetual DEX volume grew quickly in 2025. CoinGecko counts $6.38 trillion on the top 12 venues, up from $1.50 trillion in 2024, against $85.3 trillion on centralized perpetual exchanges [1]. The DEX share of perpetual volume rose from 3% in January 2025 to 13% by December and stood at 10% in April 2026 [1].
- Four designs dominate: a fully on-chain order book (Hyperliquid), validator-run off-chain order books with trades settled on-chain (dYdX v4), matching proven with succinct proofs on an Ethereum Layer 2 (Lighter) and oracle-priced liquidity pools (GMX) [8, 15, 16, 21].
- Fee models differ in kind. Hyperliquid uses volume and staking tiers [9]. Lighter offers zero fees in exchange for added latency [17]. GMX charges a position fee that depends on whether a trade narrows or widens the long-short imbalance [22].
- Funding is hourly on Hyperliquid and Lighter and per-second on GMX, with different premium sampling, interest terms and caps [10, 18, 22]. Oracle design decides how a market behaves when its reference market is closed [19, 26].
- Activity is concentrated. As of 30 April 2026, Hyperliquid held 39.5% of top-12 DEX volume and 59.1% of open interest [1]. On 10 October 2025, more than $19 billion of positions were liquidated across the market within 24 hours [7].
- Real-world-asset perpetuals grew from a niche to a large category. Grayscale reported that HIP-3 markets on Hyperliquid hit a peak of $3.2 billion of open interest in June 2026 [6], and a16z crypto counts $701 billion of real-world-asset perpetual volume in August 2026 across tracked venues, 85% of it on centralized exchanges [25].
- Public data varies in depth. Some venues publish trade counterparties and full book streams [14, 20]; one large venue's volume was removed from a major aggregator because it did not publish who made and filled orders [27].
- U.S. regulation moved: CFTC-regulated perpetual-style futures in 2025 [29], a CFTC order and policy statement on perpetual listings in May 2026 [30], a CME lawsuit against that order [31] and a proposal to offer HIP-3 markets to U.S. clients through a regulated exchange [32].

Background

What a perpetual future is

A perpetual future has no expiry date. It stays near its underlying price through funding, a periodic payment between longs and shorts. When the rate is positive, longs pay shorts; when it is negative, shorts pay longs [18]. The rate grows with the premium, the gap between the prices at which the contract's order book can absorb trades and the index price [10, 18]. Positions can be held indefinitely.

Perpetuals have traded outside the U.S. since 2016 [32]. CoinGecko dates the emergence of perpetual DEXes to dYdX's bitcoin perpetual in April 2020 [1]. By 2025, the category was a significant part of crypto derivatives trading: $6.38 trillion on the top 12 DEXes, up from $1.50 trillion in 2024 [1].

Why market structure matters

A perpetual venue makes design choices that a regulated exchange makes through rules and a clearinghouse. It decides where orders are matched, who takes the other side, which price sets margin and liquidations, how funding is computed and what happens when the reference market is closed. These choices determine costs, risks and what can be measured from the outside.

Data and method

This explainer draws on three kinds of public source:

1. **Venue documentation** for Hyperliquid, dYdX, Lighter and GMX, read in October 2026 [8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22].
2. **Industry data reports:** CoinGecko's 2026 perpetuals report, covering January 2025 to April 2026 [1]; Castle Labs research published in April and October 2026 [4, 26]; Grayscale research citing Artemis and CoinGecko data [5, 6]; a16z crypto's real-world-asset perpetuals analysis [25]; and reporting by The Block, Cointelegraph and CoinDesk [2, 3, 7, 27, 28].
3. **Regulatory and corporate documents:** a CFTC press release, a law firm's summary of the CME complaint, press releases from Payward and S&P Dow Jones Indices, and published posts from Coinbase and FalconX [23, 24, 29, 30, 31, 32].

Figures are quoted with their source, the period they cover and, where it matters, the set of venues counted. Totals from different providers are not combined, because providers count different venues. Where two figures disagree, both are reported. The spread measurements in the section on order-level data come from Rillor's own study of crude oil perpetuals [34].

Findings

1. Four venue designs

On-chain order book. Hyperliquid's state has two parts, HyperCore and the general-purpose HyperEVM. HyperCore holds margin and matching engine state, and the documentation states that it "does not rely on the crutch of off-chain order books." The chain is secured by HyperBFT, a variant of HotStuff consensus, which produces one consistent order of transactions. For a co-located client, end-to-end latency has a median of 0.2 seconds and a 99th percentile of 0.9 seconds. Mainnet supports about 200,000 orders per second, with execution as the current bottleneck [8].

Validator order books. dYdX's announcement of v4 describes a design in which each validator runs an in-memory order book that is never committed to consensus. Orders are matched in real time by the network, and "the resulting trades are then committed on-chain each block" [15]. Open orders and cancellations are not part of chain state.

Proven matching. Lighter describes itself as an application-specific Layer 2 on Ethereum. Its whitepaper describes a prover that generates execution proofs for "complete financial operations, including price-time-priority order matching, risk management, and account updates" [16]. The whitepaper argues that off-chain order books settled on a blockchain leave smart contracts unable to verify price-time priority, and that proofs close that gap [16].

Oracle-priced pools. GMX runs on Arbitrum, Avalanche and MegaETH. It routes every order against its GM and GLV liquidity pools and quotes the oracle index price, with no order book or outside market makers. Prices come from Chainlink Data Streams. Liquidity providers earn 63% of fees on Arbitrum and Avalanche [21]. In a pool design, the pool is the counterparty to traders. Castle Labs notes that pool designs are less flexible than order books for launching new markets, and that GMX's earlier GLP v1 pool suffered a $40 million reentrancy hack in 2025 [4].

The choice of design also sets what the venue's data can show. An on-chain order book keeps orders in the chain's own transaction history [8, 13]. A validator book commits trades to the chain but not open orders [15]. A pool has no order book to publish.

2. Fee models

Venue and tier	Maker	Taker	Terms
Hyperliquid, base tier	0.015%	0.045%	Falls with 14-day volume, to 0.000% maker and 0.024% taker above $7 billion; staking discounts of 5% to 40%; maker rebates up to 0.003% [9]

Venue and tier	Maker	Taker	Terms
Lighter, standard	0	0	300 ms taker latency, 0 ms maker latency [17]
Lighter, premium	0.0040%	0.0280%	Before staking discounts of up to 30%; 140 ms taker latency [17]
Lighter, plus	0.005%	0.005%	300 ms taker and 200 ms maker latency [17]
GMX	0.04% or 0.06%	0.04% or 0.06%	Position fee, lower when a trade narrows the long-short gap; GOLD, SILVER, WTIOIL, BRENTOIL, QQQ and SPY charge 0.01% or 0.02% during on-hours; price impact, borrowing and funding are separate [22]

Source: venue documentation, read in October 2026.

Three points stand out. First, Lighter's tiers price speed. Its standard accounts pay nothing, and the cost is latency on taker orders [17]. In Rillor's study of the crude oil perpetual, the zero-fee and low-latency terms in force during the study were mutually exclusive, and that trade-off was central to whether a cross-venue lead could be captured [34].

Second, GMX's fees depend on the state of the pool. The position fee rewards trades that reduce the imbalance between long and short open interest. Price impact is computed on that imbalance and charged or credited only when a position is closed or reduced, and only the side with larger open interest pays the borrow fee [22].

Third, Hyperliquid's builder-deployed markets add a layer. A HIP-3 deployer can set an additional fee share of 0% to 300%, and above 100% the protocol fee rises to match. Deployers may keep up to 50% of the fees their markets generate. A growth mode cuts protocol fees by 90% for markets that do not overlap with validator-operated perpetuals [9, 12].

3. Oracles, mark prices and funding

Mechanism	Hyperliquid	Lighter	GMX
Index or oracle	Weighted median of centralized exchange prices, published by validators about every 3 seconds [11]	For real-world assets, external feeds such as Chainlink, Pyth and Stork, with an internal fallback [19]	Chainlink Data Streams [21]

Mechanism	Hyperliquid	Lighter	GMX
Mark price	Median of three inputs, including a weighted median of perpetual mid prices on five centralized exchanges [11]	For real-world assets, an internal-pricing component with a 2-minute moving average [19]	Orders are quoted at the oracle index price [21]
Funding interval	Hourly, at one eighth of a computed 8-hour rate [10]	Hourly [18]	Accrues per second [22]
Premium sampling	Every 5 seconds, averaged over the hour [10]	Once a minute at a random time, 60 samples per hour [18]	Set by long-short open interest imbalance [22]
Interest component	0.01% per 8 hours [10]	0.01% for most markets [18]	None stated
Cap	4% per hour [10]	4% per 8 hours [18]	On Arbitrum, a keeper sets the ceiling from external rates between 15% and 300% APR [22]

Source: venue documentation, read in October 2026.

Hyperliquid's oracle price is computed from centralized exchange prices so that it "does not depend on hyperliquid's market data at all," and it sets funding. The mark price, which drives margin, liquidations and unrealized profit and loss, is the median of three inputs: the oracle price adjusted by a 150-second moving average of the gap to Hyperliquid's own mid, the median of Hyperliquid's best bid, best ask and last trade, and a weighted median of perpetual mid prices on Binance, OKX, Bybit, Gate IO and MEXC [11]. HIP-3 markets use a more responsive premium formula based on the midpoint of impact prices [10].

Lighter applies a premium multiplier of one half to real-world-asset markets and one hundredth to pre-IPO and pre-market contracts, so those markets' funding responds less to premium [18].

4. When the reference market is closed

Lighter's real-world-asset perpetuals trade around the clock [33], while their reference markets do not. Venues handle this differently.

Lighter uses external oracle feeds as the primary price. When oracle data becomes stale, it switches to an internal price built from order-book impact prices and smoothed with a time-weighted moving average: a 30-minute time constant for the index and 2 minutes for the mark price. When the external price returns, the

internal price converges to it. These internal prices were capped at ±1/L of the last oracle price, where L is the market's leverage; the documentation records that the caps were removed on 10 July 2026 for markets including SPY, XAU, NVDA and WTI, with internal prices still validated against prices from other venues [19].

On Hyperliquid, Castle Labs reports that markets deployed by Trade[XYZ] bound off-hours moves to ±(1/max leverage) of the reference price, that its crude market hit its 5% bound and stopped moving during a weekend, and that markets can now re-anchor their bounds when price nears them [4]. Its study of the xyz:CL crude market around the 2026 Iran crisis found that, over the first weekend after the strikes of 28 February, the perpetual reached about 45% of the gap that CME opened with on Monday before hitting its bound; over the second weekend it captured about 68% [26].

These rules matter for anyone who reads a weekend perpetual price as a forecast of the Monday open. The price is bounded by design.

5. Volume and open interest

Measure	Value	Period or date	Source
Top 12 perpetual DEX volume	$6.38 trillion	2025	[1]
Top 12 perpetual DEX volume	$1.50 trillion	2024	[1]
Centralized perpetual exchange volume	$85.3 trillion	2025	[1]
Perpetual DEX monthly volume	$1.05 trillion	September 2025	[2]
Top 12 perpetual DEX monthly volume	$751.59 billion	January 2026	[1]
Top 12 perpetual DEX monthly volume	$481.84 billion	April 2026	[1]
DEX share of perpetual volume	3%, 13%, 10%	January 2025, December 2025, April 2026	[1]
Top 12 perpetual DEX open interest	$4.29 billion, $24.63 billion, $13.33 billion	1 January 2025, 7 October 2025, end of April 2026	[1]

Measure	Value	Period or date	Source
DEX share of perpetual open interest	3.6%, 13.5%	Start of 2025, 30 April 2026	[1]
Hyperliquid average open interest	About $9 billion, up 54% year over year	Second quarter of 2026	[5]

In September 2025, Aster recorded more than $420 billion of volume, Hyperliquid $282.5 billion and Lighter $164.4 billion [2]. As of 30 April 2026, Hyperliquid accounted for 39.5% of top-12 DEX volume, 59.1% of open interest and 63.4% of total value locked [1]. Castle Labs' current figures put Hyperliquid above 56% of DEX open interest, followed by Aster at 9.7%, Variational at 6.2% and Lighter at 5.7% [4]. Grayscale described Hyperliquid as the only major perpetuals venue with any growth over that period, defining major venues as the top five by perpetuals volume or open interest in CoinGecko data [5].

CoinGecko reports that newer venues such as Pacifica, Extended and Variational each held 3% to 4% of DEX volume in April 2026, ahead of Jupiter and dYdX, and that all three run points programs [1].

6. The 10 October 2025 liquidations

On 10 October 2025, according to Coinglass data cited by CoinDesk Research, more than $19 billion of leveraged positions were liquidated within 24 hours. The initial trigger was the announcement of a 100% U.S. tariff on Chinese imports. Perpetual open interest across major exchanges fell 43%, from $217 billion on 10 October to $123 billion on 11 October. Hyperliquid's open interest fell 57%, from $14 billion to $6 billion [7]. CoinGecko's data shows top-12 DEX open interest peaking at $24.63 billion on 7 October 2025 and DEX total value locked peaking at $12.42 billion that month before falling after the event [1].

CoinDesk Research pointed to exchange-specific oracles and shared collateral as amplifiers, alongside crowded long positions and market makers withdrawing bids [7].

7. Real-world-asset perpetuals

Hyperliquid's HIP-3 lets a builder deploy a perpetual DEX on HyperCore by staking 500,000 HYPE, held for at least 183 days after deployment. The deployer defines each market, including the oracle and contract specifications, and operates it, including setting oracle prices and leverage limits. Validators can slash a deployer's stake for malicious operation [12]. FalconX reported that HIP-3 went live on mainnet on 13 October 2025 and that the first market to trade was XYZ100, which reached about $80 million of daily volume and $70 million of open interest by 28 October [23].

On 18 March 2026, S&P Dow Jones Indices licensed the S&P 500 to Trade[XYZ] for a perpetual contract on Hyperliquid, available to eligible non-U.S. investors. The release stated that XYZ markets had exceeded $100 billion of volume since October 2025 [24]. Grayscale reported that HIP-3 markets reached peak open interest

of $3.2 billion in June 2026, with about $200 billion of cumulative volume, citing Artemis data as of 11 June 2026 [6].

The broader category, which includes centralized exchanges, is larger:

- CoinGecko, using its own and Dune Analytics data, reported real-world-asset perpetual volume of $524.79 billion in the first quarter of 2026, 67.7% more than the $313.02 billion for all of 2025, and April alone saw $333.56 billion. Commodities made up all such trading until July 2025, and between 69.7% and 95.3% of monthly volume in the six months to April 2026 [1].
- a16z crypto reported $766 billion of real-world-asset perpetual volume in July 2026 and $701 billion in August across tracked venues, with centralized exchanges at 85% of volume. In August, equities made up 62% of volume, commodities 22% and indices 15%, and open interest reached $9.3 billion [25].
- Castle Labs reported that, as of 10 September 2026, seven of the top 10 assets traded in perpetuals were real-world assets, led by the Nasdaq 100 index and gold [4].

These sources measure different venue sets, so their totals should not be compared directly.

8. What order-level data shows

What venues publish. Hyperliquid's trade feed includes the buyer and seller address on each trade. Its order book feed aggregates by price level and reports an order count per level, with up to 20 levels per side [14]. It publishes L2 book snapshots and asset contexts to a public archive about once a month, with "no guarantee of timely updates and data may be missing," and fills from a non-validating node in a separate archive [13]. Lighter's order book channel sends a full snapshot on subscription and then only changes, in batches every 50 ms, with continuity checked by nonce. Its trade channel separates liquidation trades from ordinary trades [20].

What happens when a venue does not publish it. On 5 October 2025, DefiLlama removed Aster's perpetual volume after it began tracking Binance's perpetual volume closely. DefiLlama's founder, 0xngmi, wrote that Aster "doesn't make it possible to get lower level data such as who is making and filling orders," and that the volumes would stay delisted until that data allowed a check for wash trading [27]. Cointelegraph reported the correlation between the two venues' volumes at about 1 [3].

What fill data can measure. Castle Labs measured depth on Hyperliquid's crude market from fills, as volume traded within a few basis points of the mid. Over overlapping hours, CME offered a median of $19 million within 2 basis points per five-minute bucket against $152,000 on the perpetual, and slippage on a simulated $1 million order was 15.4 basis points against 0.79 [26].

What shortcuts get wrong. In Rillor's crude oil study, the spread on Lighter's WTI perpetual measured from its own trade tape was 0.8 to 1.3 basis points per side. Roll's estimator put it at about twice that, and a stand-in from another venue's top-of-book feed put it at about a third [34].

What the headline numbers hide. Different reports count different venues. CoinGecko's report gives $6.38 trillion for 2025 DEX volume in its main text and $6.2 trillion in its introduction [1]. Incentive programs move activity: after Lighter's token airdrop on 30 December 2025, about $250 million was withdrawn within 24 hours, about 20% of its $1.4 billion total value locked [28]. CoinGecko notes that yield farming, points programs and liquidity bootstrapping can inflate total value locked [1].

9. Regulation

On 21 July 2025, Coinbase began offering U.S. customers CFTC-regulated perpetual-style futures on bitcoin and ether through Coinbase Financial Markets, with five-year expiries and up to 10 times intraday leverage [29].

On 29 May 2026, the CFTC issued an order permitting a designated contract market to list a perpetual contract referencing the spot price of bitcoin as a futures contract, together with a policy statement on perpetual listings. For perpetuals referencing asset classes not contemplated in the order, the Commission considers case-by-case review under Regulation 40.3 appropriate [30].

On 18 June 2026, CME filed a complaint in the U.S. District Court for the District of Columbia challenging that order. CME argues that perpetuals are swaps under the Commodity Exchange Act because they have no expiration date, no delivery obligation and no settlement on a specific future date, and it seeks vacatur of the order and the policy statement [31].

On 16 September 2026, Payward announced its intention to offer U.S. clients on-chain perpetual futures through permissioned HIP-3 markets on Hyperliquid. Subject to regulatory approval, the contracts would be listed under the rules of Bitnomial Exchange, a CFTC-regulated designated contract market; Bitnomial would create, own and administer the markets and clear and settle the contracts, and NinjaTrader Clearing, Payward's futures commission merchant, would carry client accounts [32]. Grayscale reported that in August 2026 the President said the CFTC chair was working to bring Hyperliquid into the country legally [5].

Implications

For builders

Design choices are product choices. The matching design decides what can be verified; the fee schedule decides who can act on information first; the oracle and off-hours rules decide how a market behaves when its reference market is closed. Lighter's speed-for-fees trade-off [17] and HIP-3's deployer-defined oracles and bounds [4, 12] are examples of rules that shape outcomes as much as the matching engine does.

Publishing order-level data is part of credibility. DefiLlama's treatment of Aster shows that, without data on who makes and fills orders, a venue's volume can be excluded from aggregated figures [27].

For buyers of market data and researchers

Read every volume figure with its source and venue set. CoinGecko, The Block, Castle Labs, Grayscale and a16z crypto each count a different universe [1, 2, 4, 5, 25]. Incentive programs, token launches and wash trading can all move reported volume [1, 27, 28].

Measure costs and depth from the venue's own data. Castle Labs measured depth from executed fills on the venue itself [26]. In Rillor's crude study, a generic estimator and another venue's feed misstated the spread in opposite directions [34].

Check data completeness. Hyperliquid states that its public archive may be missing data [13], and Lighter's server offsets are not guaranteed to be continuous [20]. A dataset built from these sources needs gap checks before it is used.

For lenders and risk managers

Perpetual exposure carries venue-specific risk that a regulated futures position does not. Mark prices, liquidation rules, funding caps and off-hours bounds differ by venue [10, 11, 18, 19, 22]. The October 2025 liquidations showed how quickly open interest can fall when leverage is crowded and oracles are venue-specific [7]. Any valuation or collateral policy that relies on a perpetual price should say which venue, which mark price and which off-hours rule it assumes.

Limits of this analysis

- The review covers four venue designs and the venues named in public rankings. Many smaller venues exist; Castle Labs counts more than 261 perpetual DEXes launched since Hyperliquid [4].
- Venue documentation changes often. Fee schedules, caps and oracle rules are described as published in October 2026.
- Volume and open interest figures come from third-party aggregators and reports with different coverage and methods. They are quoted as published and are not reconciled.
- Some sources are research by firms with commercial interests in the venues they describe. Their figures are attributed to them.
- The regulatory record is described up to the documents cited. Those documents report no ruling in the CME lawsuit, and the Payward proposal was subject to regulatory approval.
- Rillor's spread measurements come from one market on one venue [34].
- Nothing in this report is investment advice or a recommendation to use any venue or trade any instrument.

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