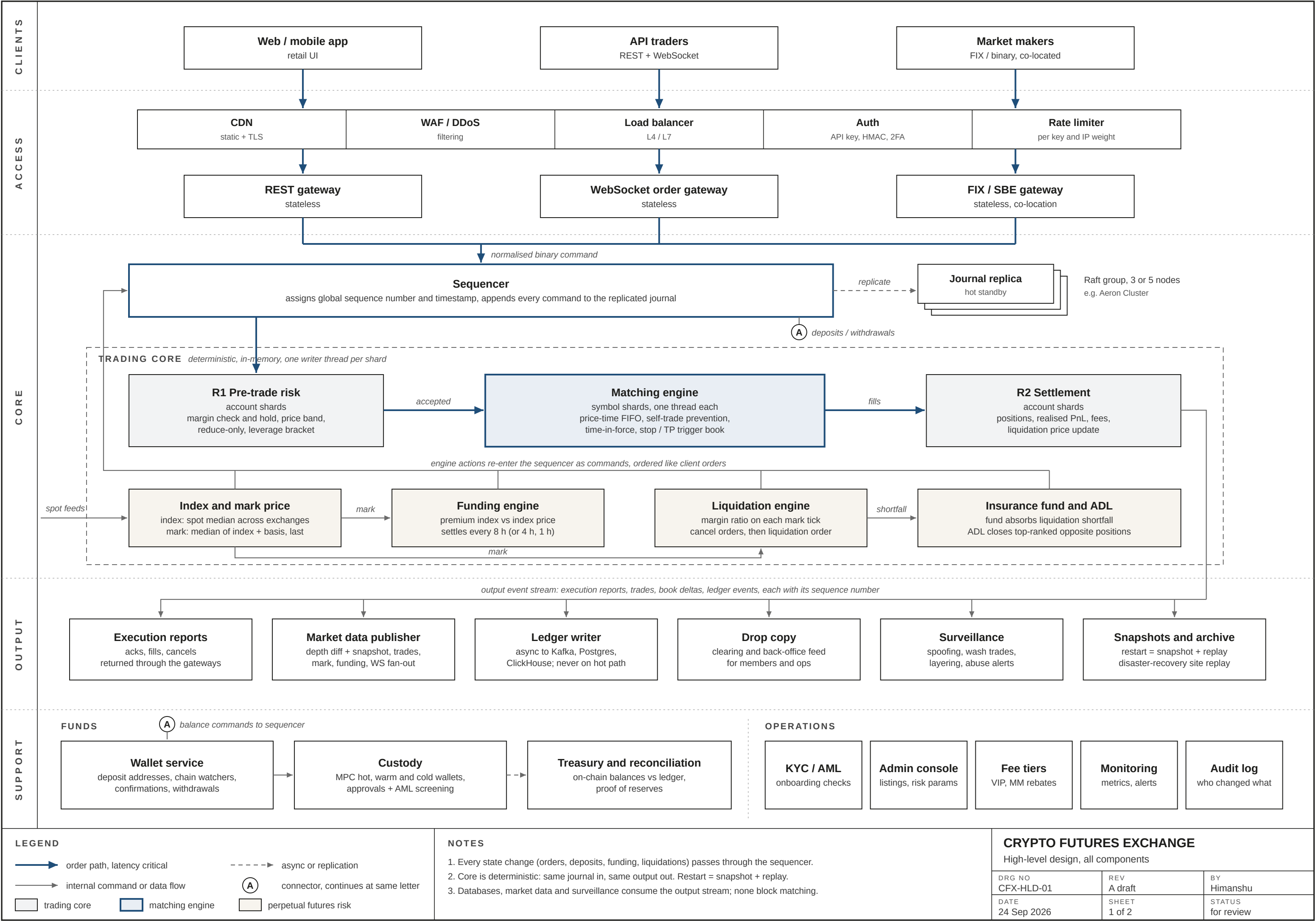




A. MATCHING ENGINE, ORDER LIFECYCLE

Sequenced command
NEW, CANCEL, AMEND, MASS CANCEL, LIQUIDATION ORDER

R1 Pre-trade risk (account shard)
symbol trading status, max order qty, max open orders
limit price inside band around mark price
leverage bracket and max position for the notional
reduce-only and close-position rules
hold initial margin + fee estimate

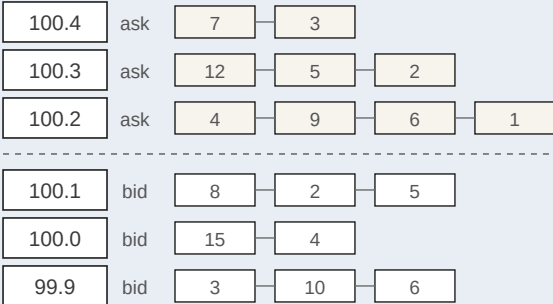
Reject
exec report

triggered order

Matching engine

one thread per symbol shard, no locks, no heap allocation on the hot path

ORDER BOOK (one per symbol)



price ladder: array indexed by tick (or RB-tree)
each level: intrusive FIFO list of orders
orderId -> node hash map, O(1) cancel / amend

Trigger book

stop, take-profit, trailing stop
watches mark or last price (workingType)
on trigger: new order re-enters through R1

Match loop (price-time priority)

1 while incoming order crosses the best opposite level:
2 self-trade check: expire taker, maker or both
3 fill = min(remaining, maker qty)
4 emit TRADE(maker, taker, price, qty, seq)
5 leftover by time in force:
GTC rests, IOC cancels, FOK all-or-none,
GTX (post-only) rejected if it would take
GTD rests until expiry

Hot-path rules

fixed-point integers for price and qty (ticks, lots)
pre-allocated order pool, no GC / malloc
no wall clock: time comes from the sequencer
no random, no hash-order iteration in logic
same input log gives byte-identical output
CPU pinned, busy-spin, cache-friendly layout

R2 Settlement (account shard)

release unused margin hold
update position: size, entry price, side (one-way or hedge)
realised PnL, maker / taker fee, new liquidation price

Execution reports

to gateways

Book deltas, trades

to market data

Ledger events

to ledger writer

B. PERPETUAL FUTURES PRICE AND RISK LOOP

Spot price feeds
constituent exchanges, e.g. Binance, Coinbase, OKX

Index price
weighted median of spot prices,
outlier filter, stale feeds dropped

Mark price
median of: index + funding basis,
index + moving-average basis, last price
published about once a second

sequenced into core

Funding engine

premium index P from impact bid / ask
 $F = P + \text{clamp}(i - P, -0.05\%, +0.05\%)$
 $i = 0.01\%$ per 8 h interval
 $F > 0$: longs pay shorts
 $F < 0$: shorts pay longs
cash moves booked in R2

Liquidation engine

on every mark tick, per account:
margin ratio = maint. margin / margin bal.
ratio $\geq 100\%$ -> liquidate:
1 cancel the account's open orders
2 liquidation order at bankruptcy price
3 large positions closed in stages

Margin model (Binance USDS-M style)

leverage brackets: max leverage falls as
notional grows; each tier has its own
maintenance rate and deduction amount
cross or isolated margin per position
one-way or hedge mode per account
portfolio margin as a later phase

Insurance fund

fill better than bankruptcy: surplus in
fill worse: fund pays the shortfall
separate fund per margin asset

fund cannot cover

Auto-deleveraging (ADL)

rank opposite-side positions:
 $\text{pnl}\% \geq 0$: $\text{pnl}\% \times \text{effective leverage}$
 $\text{pnl}\% < 0$: $\text{pnl}\% / \text{effective leverage}$
close top ranks at the bankruptcy price
no trading fee charged to ADL'd user

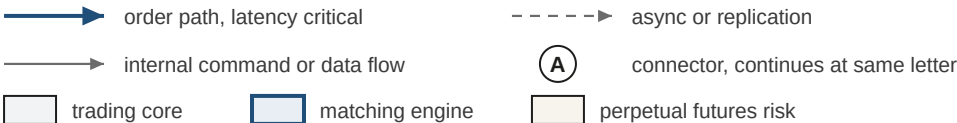
Why sequenced:

mark, funding, liquidation and ADL emit commands
into the same journal. Replay reproduces every
liquidation exactly, and a user cancel can never
race a liquidation.

Reference parameters to copy

Binance USDS-M docs: mark price, funding rate, leverage and margin tiers, liquidation protocol, ADL ranking, STP
Hyperliquid: staged liquidation, 20% tranches with 30 s cooldown on large positions
Coinbase International: single-threaded engine in a 5-node Raft cluster, replay for debugging, rolling deploys

LEGEND



NOTES

- Formulas follow Binance USDS-M public documentation as of Sep 2026; all values configurable per symbol.
- Book quantities in A are illustrative. Price levels shown in ticks of 0.1.
- Only FIFO matching is planned; Binance futures uses price-time priority.

CRYPTO FUTURES EXCHANGE

Core detail: matching engine and perpetuals risk loop

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