DUALIS

TECHNICAL WHITEPAPER V1.0

Dualis Finance

Institutional-Grade Hybrid Lending Infrastructure for the Tokenized Economy

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ABSTRACT

Dualis Finance introduces the first hybrid lending protocol purpose-built for Canton Network -- the enterprise blockchain infrastructure selected by DTCC, Euroclear, and the world's largest financial institutions for real-asset tokenization. Traditional securities lending, representing $2.8 trillion in outstanding loans (ISLA, 2024), operates on T+2 settlement cycles, opaque pricing models, and prime broker intermediation that excludes smaller institutions. Existing decentralized lending protocols have demonstrated the viability of on-chain lending but remain unsuitable for institutional adoption due to the absence of transaction privacy, compliance frameworks, and credit risk differentiation. Dualis bridges this divide through five architectural innovations: (1) a hybrid credit scoring system combining on-chain behavioral analytics, zero-knowledge off-chain credential verification, and ecosystem reputation into a five-tier classification enabling differentiated lending terms; (2) productive real-world lending deploying capital into verified physical and digital economy projects; (3) an advanced securities lending protocol reducing fees by approximately 90% versus prime brokers through atomic Canton settlement; (4) a dual-track architecture serving institutional participants via KYB-verified dedicated pools and retail users via standard shared pools; and (5) privacy-by-design leveraging Canton's sub-transaction privacy to ensure position confidentiality while maintaining regulatory auditability. The protocol comprises 101,000+ lines of code, 38 DAML smart contract templates across 25 modules, 262 API endpoints, and is deployed on Canton devnet with all core DeFi operations functional.

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1. Introduction

1.1 The Structural Gap

The global lending ecosystem operates along two disconnected tracks. Traditional securities lending $(2.8 trillion outstanding, ISLA 2024) is constrained by T+2 settlement, manual reconciliation consuming 15-20$69B TVL), Compound, Maple Finance -- have proven on-chain lending viable at scale, but suffer from three structural deficiencies preventing institutional adoption: fully transparent positions visible to all participants, absence of credit risk differentiation where all borrowers pay identical rates, and a circular crypto economy generating no productive economic value.

No protocol in production combines institutional-grade privacy, hybrid credit scoring, asset-agnostic collateral frameworks accepting tokenized real-world assets, productive lending, and regulatory compliance sufficient for bank participation. This gap is a structural impediment to the tokenized economy's growth.

1.2 The Tokenization Catalyst

The convergence of regulatory clarity and institutional commitment has created an unprecedented opportunity. Tokenized real-world assets have grown from $5 billion (2022) to over 36 billion (2025), with projections of $16-30 trillion by 2030 (BCG, Standard Chartered, Citigroup). DTCC -- custodian of $99 trillion in securities -- has selected Canton Network for its digital asset initiatives. BlackRock's BUIDL fund has accumulated $2.85 billion in tokenized Treasury bills. In February 2026, Canton's expanded institutional working group -- comprising LSEG, Euroclear, Citadel Securities, Tradeweb, Goldman Sachs -- convened to develop standards for interoperable financial applications, including lending and collateral management.

1.3 Thesis Statement

> *Dualis Finance is the lending infrastructure layer for Canton Network -- the blockchain where the world's largest financial institutions tokenize real assets. We do not tokenize assets; we build the lending markets those assets need.*

Dualis delivers on this thesis through five core innovations:

1. **Hybrid Credit Scoring.** A three-layer composite system combining on-chain behavioral analytics (40%), zero-knowledge off-chain credentials (35%), and ecosystem reputation (25%) to classify borrowers into five tiers -- Diamond, Gold, Silver, Bronze, Unrated -- each with differentiated terms.
2. **Productive Real-World Lending.** Borrowed capital deployed into verified physical and digital economy projects -- trade finance, equipment leasing, renewable energy -- generating yield from real economic activity.
3. **Institutional Securities Lending.** On-chain securities lending leveraging Canton's atomic settlement to reduce fees by ~90% versus prime brokers, from 50–200 bps to 5–20 bps.
4. **Dual-Track Architecture.** Institutional participants access KYB-verified dedicated pools; retail users access standard shared pools; both draw from a unified liquidity layer.
5. **Privacy-by-Design.** Canton's sub-transaction privacy ensures position confidentiality visible only to transaction participants and authorized regulators.

2. Protocol Architecture

2.1 System Overview

Dualis Finance is a monorepo comprising five packages -- shared utilities, backend API, frontend application, configuration, and Canton smart contracts -- orchestrated by pnpm workspaces and Turborepo.

The architecture separates concerns along three axes: *confidentiality* (Canton), *performance* (Redis + PostgreSQL), and *correctness* (DAML smart contracts).

2.2 Hybrid On-Chain / Off-Chain Design

On-Chain State (Canton DAML). All financial state requiring cryptographic integrity resides on-ledger: position contracts, atomic settlement transactions, collateral locks, and governance votes. Canton provides sub-transaction privacy (only participants see data), atomic settlement (all-or-nothing execution), and regulatory auditability.

Off-Chain State (PostgreSQL). Derived and non-financial state resides in PostgreSQL via Drizzle ORM: analytics aggregations, user preferences, credit score components, and oracle price cache. Synchronization operates through Canton's gRPC transaction stream subscription with sub-second propagation delay.

This hybrid approach enables sub-100ms page loads while preserving Canton's guarantees for all financial state modifications.

2.3 Canton Network Integration

Command Submission via Canton JSON API v2 for all write operations with built-in command deduplication. **Transaction Stream** via gRPC Ledger API for real-time state synchronization.

DAML Smart Contracts. 38 templates across 25 modules, compiled to Daml-LF 2.1. Key design decisions: no contract keys (LF 2.1 constraint -- lookups via contract IDs with off-chain mapping), signatory/observer authorization replacing role-based access control, and atomic multi-party transactions eliminating reentrancy risks.

2.4 Technology Stack

LAYER	TECHNOLOGY	PURPOSE
Smart Contracts	DAML 3.4.11 (LF 2.1)	On-chain financial logic, atomic settlement
API Framework	Fastify 5.7	High-performance REST API (262 endpoints)
ORM	Drizzle	Type-safe PostgreSQL query builder
Database	PostgreSQL 16	Persistent storage (63 tables)
Cache	Redis (ioredis)	Sessions, rate limiting, caching
Job Queue	BullMQ	Interest accrual, oracle sync
Frontend	Next.js 14.2	React SSR (89 pages, 116 components)
Client State	Zustand	Lightweight state management
UI	Radix UI + Tailwind CSS	Accessible components
Wallet	PartyLayer SDK	CIP-0103 Canton wallet abstraction
Identity	Sumsub	KYB/KYC verification
Compliance	Chainalysis	Transaction screening, AML
Build	Turborepo + pnpm	Monorepo orchestration
Testing	Vitest	230+ unit/integration tests

3. Hybrid Lending Protocol

3.1 Supply and Borrow Mechanics

Supply. Liquidity providers deposit assets into lending pools. The protocol records a supply position with principal A and captures the current supply index $I_s(t_0)$. No receipt token is minted -- the Canton contract itself serves as the authoritative record. At any time t:

$$\text{Balance}(t) = A \times \frac{I_s(t)}{I_s(t_0)}$$

Borrow. Borrowers post collateral and draw loans up to their borrowing capacity:

$$\text{BorrowingCapacity} = \sum_{i=1}^{n} (\text{Collateral}_i \times \text{Price}_i \times \text{LTV}_i \times \text{TierHaircut}_i)$$

Outstanding debt at time t: $\text{Debt}(t) = \text{Principal} \times I_b(t)/I_b(t_0)$

3.2 Interest Rate Model -- Jump Rate Model

Dualis employs a Jump Rate Model with a utilization kink that provides predictable rates at normal levels and sharply escalating rates as utilization approaches 100%.

$$R_{borrow}(U) = \begin{cases} R_{base} + U \times R_{slope1} & \text{if } U \leq U_{optimal} \\ R_{base} + U_{optimal} \times R_{slope1} + (U - U_{optimal}) \times R_{slope2} & \text{if } U > U_{optimal} \end{cases}$$

$$R_{supply}(U) = R_{borrow}(U) \times U \times (1 - \text{ReserveFactor})$$

Per-Asset Rate Parameters:

ASSET					RESERVE FACTOR
USDC / USDT	2.0%	7.0%	80%	30.0%	10%
wBTC / wETH / ETH	1.0%	4.0%	65%	50.0%	15%
CC (Canton Coin)	3.0%	10.0%	60%	80.0%	20%
RWA T-Bills	4.0%	3.0%	90%	15.0%	5%
TIFA Receivables	8.0%	12.0%	70%	60.0%	15%
Tokenized Equity	2.0%	5.0%	75%	18.0%	10%

3.3 Index-Based Interest Accrual

Each pool maintains supply and borrow indices (initialized to 1.0), updated at each accrual event:

$$I_b(t + \Delta t) = I_b(t) \times (1 + r_b \times \Delta t)$$

where $r_b = R_{borrow}(U)/31{,}557{,}600$. Any user's balance is computed as $P \times I(t)/I(t_0)$ -- capturing all accrued interest in O(1) computation regardless of position count. This mechanism is validated against 230+ unit tests covering edge cases including zero-time deltas and multi-year compounding.

3.4 Health Factor and Liquidation

$$HF = \frac{\sum_i (\text{Collateral}_i \times \text{Price}_i \times \text{LiqThreshold}_i \times \text{TierHaircut}_i)}{\text{TotalBorrowsUSD}}$$

STATUS	HF RANGE	DESCRIPTION
Safe	HF > 2.0	Well over-collateralized
Healthy	1.5 < HF ≤ 2.0	Adequate margin
Caution	1.2 < HF ≤ 1.5	Reduced margin, warnings issued
Danger	1.0 < HF ≤ 1.2	Approaching liquidation
Liquidatable	HF ≤ 1.0	Eligible for third-party liquidation

When HF ≤ 1.0, liquidators repay up to 50% of debt ($\text{CloseFactor}_{normal} = 0.50$; for HF < 0.50, full liquidation at $\text{CloseFactor}_{critical} = 1.00$). Collateral seized: $\text{DebtRepaid} \times (1 + \text{LiqPenalty}) / \text{CollateralPrice}$. Of the penalty, 90% goes to the liquidator and 10% to the protocol treasury.

3.5 Flash Loans

Atomic, single-transaction uncollateralized loans that must be repaid within the same Canton transaction. Fee: 0.09% (9 bps). Use cases include arbitrage, collateral swaps, self-liquidation (avoiding 3–10% penalty), and debt refinancing. Canton's atomic multi-party transactions guarantee the lending pool is never exposed to credit risk.

4. Asset-Agnostic Collateral Framework

4.1 Three-Tier Classification

The protocol classifies collateral into three tiers based on liquidity, volatility, and settlement risk:

TIER	ASSET CLASS	HAIRCUT	EFFECTIVE VALUE	RATIONALE
crypto	USDC, wBTC, wETH, ETH, CC	0%	100%	Deep 24/7 liquidity, instant settlement
rwa	T-Bills, bonds, structured products	5%	95%	Settlement risk, oracle latency, transfer restrictions
tifa	Trade receivables and invoices	20%	80%	Illiquid secondary markets, counterparty risk

4.2 Per-Asset Risk Parameters

ASSET	LTV	LIQ. THRESHOLD	LIQ. PENALTY	BORROW CAP	SUPPLY CAP	TIER
USDC	80%	85%	4%	$500M	1B	crypto
wBTC	73%	80%	6%	$50M	100M	crypto
wETH	75%	82%	5%	$100M	200M	crypto
ETH	75%	82%	5%	$100M	200M	crypto
CC	55%	65%	8%	$20M	50M	crypto
RWA-TBILL	85%	90%	3%	$200M	500M	rwa
TIFA-REC	50%	60%	10%	--	$100M	tifa
SPY (Equity)	65%	75%	6%	$50M	100M	crypto

The LTV-to-Liquidation Threshold gap creates a buffer zone (5–10 percentage points per asset). TIFA-REC is collateral-only (`isBorrowEnabled: false`). Cross-collateralization allows

multiple asset types simultaneously, with the Health Factor calculation independently weighting each asset's contribution.

4.3 Governance-Driven Asset Onboarding

New collateral assets are onboarded through a four-phase governance process: (1) Proposal submission with oracle, liquidity, and risk analysis; (2) Risk assessment covering oracle reliability, liquidity depth, regulatory status, and smart contract review; (3) Supermajority governance vote (67% with 10% quorum); (4) Staged activation with conservative initial parameters progressively relaxed as usage data validates behavior.

5. Hybrid Credit Scoring System

5.1 Composite Architecture

The Dualis credit score combines three independent dimensions:

$$S_{credit} = 0.40 \times S_{onchain} + 0.35 \times S_{offchain} + 0.25 \times S_{ecosystem}$$

Layer 1: On-Chain History (40%). Analyzes verifiable protocol behavior across four sub-factors: repayment ratio ($\alpha_1 = 0.35$, max 300 pts), utilization volume on logarithmic scale ($\alpha_2 = 0.25$, max 200 pts), risk management discipline via lowest-ever HF ($\alpha_3 = 0.25$, max 150 pts), and tenure via securities lending activity ($\alpha_4 = 0.15$, max 100 pts).

Layer 2: Off-Chain ZK Credentials (35%). Borrowers submit zero-knowledge proofs of real-world credentials -- credit score ranges, employment verification, asset thresholds -- without revealing underlying data. ZK circuits produce boolean attestations as public output while keeping credentials private.

Layer 3: Ecosystem Reputation (25%). Measures Canton Network participation: governance activity, validator staking, multi-protocol interactions. Anti-sybil measures include time-weighted scoring, diminishing marginal returns, and cross-correlation analysis.

5.2 Credit Tiers and Benefits

TIER	SCORE	MAX LTV	RATE DISCOUNT	MIN COLLATERAL	LIQ. BUFFER
Diamond	850–1000	85%	25%	1.15×	5%
Gold	700–849	78%	15%	1.25×	8%
Silver	500–699	70%	8%	1.35×	10%
Bronze	300–499	60%	0%	1.50×	12%
Unrated	0–299	50%	0%	1.75×	15%

The effective LTV is always $\min(\text{AssetLTV}, \text{TierMaxLTV})$. A Diamond borrower using wETH (LTV 75%) borrows at $7.60\% \times 0.75 = 5.70\%$ -- saving $19,000/year on a 1M loan versus an Unrated borrower.

5.3 Pre-Liquidation Alerts and Credit Oracle

Tiered alerts calibrated per credit tier: Diamond receives first warning at HF 1.30, Unrated at HF 1.80. The **Credit Oracle API** exposes composite scores and tier information to third-party Canton applications, with volume-tiered pricing ($5–50/query) and explicit user consent enforced through Canton's authorization model.

6. Liquidation Engine

6.1 Four-Tier Liquidation Cascade

Unlike binary liquidation models, Dualis implements a graduated cascade mirroring institutional risk management:

TIER	HEALTH FACTOR	MAX LIQUIDATION %	BEHAVIOR
Margin Call	$0.95 \leq HF < 1.00$	0%	Warning only; no forced action
Soft Liquidation	$0.90 \leq HF < 0.95$	25%	Partial liquidation to restore solvency
Forced Liquidation	$0.85 \leq HF < 0.90$	50%	Standard half-debt liquidation
Full Liquidation	$HF < 0.85$	100%	Emergency full position closure

The Margin Call tier provides an institutional grace period for internal approval workflows. Soft Liquidation's 25% cap preserves borrower capital while often restoring HF above 1.0. The entire liquidation sequence executes atomically within a single Canton transaction.

6.2 Protective Mechanisms

- **Circuit Breaker**: 20%+ price movement within 5 minutes pauses all liquidation
- **Institutional Grace Period**: Margin Call zone extensible via governance
- **Emergency Admin Pause**: Global liquidation halt for black-swan events
- **Per-asset penalties**: 3% (T-Bills) to 10% (TIFA), split 90/10 between liquidator and treasury

7. Securities Lending Protocol

7.1 Market Structure

Securities lending on Dualis operates as a peer-to-peer marketplace for tokenized securities with five lifecycle steps: offer creation (`FractionalOffer`), offer matching with collateral lock, atomic asset transfer, continuous fee accrual, and return with settlement.

$$\text{LendingFee} = \text{Notional} \times r_{\text{annual}} \times \frac{t_{\text{duration}}}{365}$$

Expected rates of 5–20 bps annually versus 50–200 bps from prime brokers -- a ~90% fee reduction. The protocol extracts 10% of the lending fee for the treasury.

7.2 Structural Advantages

PARAMETER	TRADITIONAL	DUALIS FINANCE
Settlement	T+2 (2 business days)	Atomic (sub-second)
Fee Range	50–200 bps	5–20 bps
Market Access	Top-tier only	Any verified participant
Operating Hours	Market hours (M-F)	24/7/365
Counterparty Risk	Credit limits + ISDA	Eliminated via collateral lock

Additional features: automated multilateral netting via `NettingAgreement` (reducing settlement operations from O(n) to O(1) per counterparty pair), and automated corporate action handling via `CorporateActionHandler` for dividends, coupons, and splits during active loans.

8. Governance and Tokenomics

8.1 The DUAL Token

Canton-native governance token (CIP-56) with 1 billion fixed supply:

ALLOCATION	%	VESTING
Protocol Development	25%	4-year linear, 12-month cliff
Community Rewards	25%	Per-epoch, usage-based
Ecosystem Growth	20%	3-year linear, 6-month cliff
Treasury	15%	DAO-controlled
Investors	10%	2-year linear, 6-month cliff
Advisors	5%	2-year linear, 12-month cliff

Each token confers one governance vote, with delegation via `VoteDelegation` template.

8.2 Governance Process

Proposals require 100,000 DUAL (0.01%) to create. **Lifecycle:** Draft → Active (5-day voting) → Succeeded/Failed (10% quorum, simple majority) → Queued (48h timelock) → Executed. Emergency proposals: 24h voting + 6h timelock. Governance controls all protocol parameters: rate models, collateral parameters, reserve factors, asset onboarding, and fee structures.

8.3 Economic Model

ACTION	FEE	REVENUE DESTINATION
Borrow Interest	5–20% reserve factor	Treasury
Flash Loan	0.09% of principal	Treasury
Liquidation	3–10% penalty	90% Liquidator / 10% Treasury
Securities Lending	10% of fee	Treasury
Credit Oracle Query	5–50/query	Treasury
Supply / Withdraw	Free	--

Revenue projections: Year 1 ($10M TVL$, 410K revenue), Year 2 ($100M TVL$, 4.1M revenue, 35% margin), Year 3 ($500M TVL$, 20.5M revenue, 84% margin). Break-even at ~$50M TVL (months 14–16).

Value accrual: governance rights, staking rewards from protocol revenue, fee discounts for staked DUAL, and planned buyback-and-distribute mechanism from Year 2.

9. Privacy and Dual-Track Architecture

9.1 Canton Sub-Transaction Privacy

Canton's privacy model provides four guarantees:

- **Need-to-Know Visibility**: Only transaction signatories and designated observers see data
- **Encrypted Commitments**: Validators verify transaction validity without accessing plaintext
- **GDPR Compatibility**: Data exists only on participant nodes, not globally replicated
- **MEV Immunity**: No public mempool, no fee-based sequencing -- front-running and sandwich attacks are architecturally impossible

9.2 Three Privacy Levels

LEVEL	VISIBLE TO	USE CASE
Standard	Counterparty only	Default for all operations
Enhanced	Counterparty + auditor	Internal compliance
Full Disclosure	Counterparty + auditor + regulator	Regulated securities

These levels are composable: a single user may operate with different privacy levels for different transaction types simultaneously.

9.3 Dual-Track Design

Institutional Track. KYB-verified entities (banks, asset managers, hedge funds) receive dedicated pools (`InstitutionalPool`), full API integration (262 endpoints), elevated limits, and credit tier acceleration via off-chain credential attestation.

Retail Track. Permissionless wallet-based access via PartyLayer SDK. Self-custody, shared pool access, frontend-optimized experience. New users begin at Bronze tier and progress through on-chain behavioral history.

Shared Liquidity. Both tracks draw from unified pools -- institutional deposits increase retail borrowing liquidity and vice versa, creating deeper markets, better rates, and network effects.

10. Oracle and Price Feed System

The `OracleAggregator` collects data from four independent sources (Chainlink Data Streams, Proof of Reserve, NAVLink/DTCC feeds, TIFA Oracle). The aggregated price is the **median** with outlier detection:

$$P_{\text{agg}} = \text{Median}(S_1, S_2, S_3, S_4) \quad \text{excluding } |S_i - \text{Median}| > 2\sigma$$

Staleness Detection. Maximum oracle staleness: 300 seconds. Affected pool operations pause until fresh price is received.

Circuit Breakers. Price movement exceeding 20% within 5 minutes pauses all lending, borrowing, and liquidation for the affected asset until manual review confirms the movement is genuine.

11. Security Considerations

11.1 Smart Contract Security

DAML provides foundational advantages: purely functional language eliminating reentrancy attacks, built-in integer overflow protection via `Decimal` types, cryptographic signatory/observer authorization, and strong type system with compile-time correctness assurance. The 38 DAML templates are validated through 8 dedicated test suites.

11.2 Infrastructure Security

Role-based access control with JWT + 2FA, Redis-backed rate limiting, Zod schema input validation, parameterized queries via Drizzle ORM (eliminating SQL injection), TLS 1.3 with Helmet.js security headers.

11.3 Economic Security

Multi-source median oracle aggregation requires compromising 3+ sources. Canton's lack of public mempool eliminates flash-loan-based governance attacks. The four-tier liquidation cascade prevents cascading sell spirals.

11.4 Audit Plan

Internal security hardening (completed) → External smart contract audit (pre-mainnet) → Economic stress simulation → Bug bounty program (post-mainnet).

12. Canton Network and Ecosystem

12.1 Why Canton

Five requirements no other platform satisfies simultaneously: sub-transaction privacy, institutional credibility (DTCC, Euroclear, LSEG), atomic multi-party transactions, DAML's formal guarantees, and regulatory compliance by design.

12.2 Ecosystem Position

LAYER	PARTICIPANTS	RELATIONSHIP
Settlement	LSEG, Euroclear, Tradeweb	Working Group co-members
Custody	Fireblocks, BitGo, Copper.co	Wallet integration
Asset Issuers	DTCC, BlackRock, Franklin Templeton	Collateral sources
Wallet Providers	Console, Loop, Helvault, Lace, Begin	PartyLayer SDK

12.3 Cayvox Labs Product Stack

PRODUCT	FUNCTION	STATUS
PartyLayer (Wallet SDK)	Wallet-agnostic Canton connectivity	Production
Dualis Finance	Institutional lending protocol	Devnet live
TIFA Finance	Receivables tokenization	Devnet live

PartyLayer provides wallet abstraction; TIFA Finance creates tokenized receivables serving as TIFA-REC collateral in Dualis -- a vertically integrated ecosystem.

13. Roadmap and Conclusion

13.1 Development Roadmap

PHASE	TIMELINE	STATUS	KEY MILESTONES
Foundation	Q4 2025	Complete	Architecture, DAML spec, devnet setup
Development	Q4 2025–Q1 2026	Complete	101K+ LOC, 38 DAML templates, 262 endpoints
Audit	Q1–Q2 2026	Active	External audit, stress testing, mainnet prep
Mainnet Launch	Q2–Q3 2026	Planned	Canton mainnet, initial pools, institutional onboarding
Growth	H2 2026	Planned	Securities lending, Credit Oracle API
Scale	2027+	Planned	Multi-domain deployment, cross-chain bridging

13.2 Conclusion

When DTCC tokenizes the first US Treasury on Canton, that token will need a lending market. When Euroclear enables cross-border settlement of tokenized European government bonds, those securities will need borrowing infrastructure that institutional counterparties can trust with their balance sheet data.

Dualis Finance is building that market -- combining a five-tier hybrid credit system, four-tier liquidation cascade, Canton sub-transaction privacy, on-chain securities lending, and dual-track architecture. The infrastructure for a $16 trillion tokenized asset economy is being built now. The institutions building it have chosen Canton. Dualis Finance transforms that settlement layer into a capital-efficient lending market.

References

[1] ISLA, "Securities Lending Market Report," 2024. [2] BCG and Standard Chartered, "On-Chain Asset Tokenization in Financial Markets," 2024. [3] DTCC, "Annual Report," 2024. [4] E. Frangella, L. Herskind, "Aave V3 Technical Paper," 2022. [5] R. Leshner, G. Hayes, "Compound: The Money Market Protocol," 2019. [6] Digital Asset, "Canton Network Technical Documentation," 2025. [7] Digital Asset, "DAML Language Reference," v3.4, 2025. [8] S. Kulechov, "Abundance Assets: The Future of Tokenized Finance," 2026. [9] DeFiLlama, "Aave V3 TVL," accessed February 2026. [10] BlackRock, "BUIDL Fund Documentation," 2025. [11] M. Gontier Delaunay, P. Frambot, "Morpho Blue Whitepaper," 2023. [12] Maple Finance, "Orthogonal Trading Default Post-Mortem," 2022. [13] Canton Network Foundation, "Working Group Results," 2026. [14] Aave Protocol, "Aave Horizon: Institutional DeFi," 2025.

Appendix A: DAML Smart Contract Templates

#	TEMPLATE	MODULE	PURPOSE
1	LendingPool	Lending.Pool	Pool state: supply, borrows, reserves, indices
2	SupplyPosition	Lending.Pool	Supplier position with entry index
3	BorrowPosition	Lending.Borrow	Borrower debt with entry index
4	CollateralVault	Lending.Collateral	Locked collateral with tier classification
5	PriceOracle	Oracle.PriceFeed	Authoritative price state per asset
6	PriceFeed	Oracle.PriceFeed	Individual price source submission
7	OracleAggregator	Trigger.OracleAggregator	Multi-source median + outlier filtering
8	StalenessChecker	Trigger.StalenessChecker	300s freshness monitoring
9	LiquidationTrigger	Liquidation.Engine	Initiate liquidation for eligible positions
10	LiquidationScanner	Trigger.LiquidationScanner	Periodic position scanning
11	LiquidationResult	Liquidation.Engine	Immutable liquidation record
12	InterestAccrualTrigger	Trigger.InterestAccrual	Periodic index updates
13	FlashLiquidation	Liquidation.Engine	Flash-loan-funded liquidation
14	BatchLiquidation	Liquidation.Engine	Multi-liquidation batch processing
15	Proposal	Governance.Proposal	Governance proposal + voting state
16	VoteRecord	Governance.Vote	Individual vote record
17	VoteDelegation	Governance.Delegation	Voting power delegation
18	GovernanceConfig	Governance.Config	Quorum, periods, thresholds
19	TimelockExecution	Governance.Timelock	Execution delay enforcement
20	ProtocolConfig	Core.Config	Global protocol configuration
21	DUALToken	Governance.Token	Token with transfer + delegation
22	DualTokenBalance	Token.DUAL	Per-party balance + staking metadata

#	TEMPLATE	MODULE	PURPOSE
23	DualMintFactory	Token.DUAL	Authorized minting
24	TokenVesting	Token.DUAL	Vesting schedule enforcement
25	StakingPosition	Token.DUAL	Staking state + reward accumulator
26	CompositeCredit	Credit.CompositeScore	Combined credit score
27	CreditAttestationBundle	Credit.Attestation	ZK credential bundle
28	InstitutionalPool	Institutional.Core	Dedicated institutional pool
29	VerifiedInstitution	Institutional.Core	KYB-verified institution record
30	NettingAgreement	SecLending.Advanced	Multilateral netting
31	FractionalOffer	SecLending.Advanced	Securities lending offer
32	CorporateActionHandler	SecLending.Advanced	Dividend/coupon automation
33	ProductiveProject	Productive.Core	Project definition + cashflow
34	ProductiveBorrow	Productive.Core	Active productive loan
35	ProductiveLendingPool	Productive.Core	Project-based underwriting pool
36	PrivacyConfig	Privacy.Config	Per-party privacy levels
37	BulkOperation	Core.Config	Batch operation wrapper
38	BalanceSnapshot	Core.Config	Point-in-time balance snapshot

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