✅ DEPLOYED TO TON TESTNET

Lido-TVM

Complete behavioral replication of Lido's staking vault protocol from Ethereum to TON — 17 contracts, 182 tests, all deployed and verified on-chain.

17	182	16	9/9
CONTRACTS	TESTS PASSING	DEPLOYED	ON-CHAIN TESTS

Prepared by	Date	Repository
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Executive Summary

We performed a **ground-up reimplementation** of Lido's staking vault protocol — one of Ethereum's most sophisticated DeFi systems ($15B+ TVL) — from Solidity to Tact for the TON blockchain. This is not a wrapper or bridge. It is a behaviorally equivalent protocol preserving the same invariants, access control, economic logic, and state transitions.

> *"Every EVM protocol is now a potential TON protocol. The migration engine dramatically reduces the barrier to bringing established DeFi to TON."*

Migration Scope

ASPECT	SOURCE (EVM)	TARGET (TON)
Language	Solidity 0.8.25	Tact
Contracts	20 files (7,838 lines)	17 contracts (3,580 lines)
Tests	—	182 tests (11 suites, 4,104 lines)
Token Standard	ERC-20 (stETH)	TEP-74 Jetton (StTON)
Execution Model	Synchronous	Async message-passing
Validator Minimum	32 ETH	10,000 TON
Upgrade Pattern	UUPS Proxy	setCode + Controller

Architectural Adaptations

Preserved (Behavioral Equivalence)

- ✓ Share-to-token ratio across rebases
- ✓ Role-based access control (12 roles)
- ✓ Vault lifecycle state machine
- ✓ Fee distribution formulas
- ✓ Capacity-based bonding curves

Adapted (Platform-Specific)

- ✓ Jetton wallets for StTON holders
- ✓ Oracle state roots (vs beacon SSZ)
- ✓ TON elector model (vs beacon chain)
- ✓ Bounce handlers for failed messages
- ✓ Async callbacks (vs sync views)

Implemented Contracts

CONTRACT	LINES	TESTS	PURPOSE
PredepositGuarantee	522	23	Pre-deposit bonding system
VaultHub	456	28	Central vault registry, share minting/burning
NodeOperatorFee	293	26	Fee distribution with splitting
ValidatorConsolidation	256	22	Validator consolidation (from EIP-7251)
CLProofVerifier	256	14	State root verification (adapted)
StakingVault	252	18	Individual vault with operator mgmt
StTON	225	16	Liquid staking Jetton with rebase
OperatorGrid + Dashboard	430	26	Operator registry + admin dashboard
Permissions	181	12	Role-based access (12 roles)
6 utility contracts	509	17	Cache, recovery, factory, upgrade, stub

Testing & Verification

11	182	4,104	12.4s
TEST SUITES	ALL PASSING	TEST LINES	RUN TIME

Economic Properties Verified

- ✓ Total shares = sum of holder shares
- ✓ Rounding always favors protocol
- ✓ Fee splits sum to 100%
- ✓ Share ratio preserved across rebases

Safety Properties Verified

- ✓ No integer overflow in share math
- ✓ Bounce handlers prevent stuck funds
- ✓ Minimum stake thresholds enforced
- ✓ 0 findings in automated security audit

Testnet Deployment

All 16 contracts deployed and active on TON testnet. Total cost: ~0.36 TON. Verifiable at testnet.tonscan.org.

CONTRACT	TESTNET ADDRESS
VaultHub	`EQCwqMLFC6c3UT9-MR87K2aR7RQjPVXctDjEqjHB0zQte-0t`
StTON	`EQBmKk_Hondk10cpIgekEqCRZAUeNNuQxLwxvuS0tdcmZN85`
VaultFactory	`EQCKEi4lwVYsdPSZ-aMrAPI6VHchrDutdLpNFN1E4saX-sog`
Permissions	`EQCdqpCDXpLdRbPBjVY9FsvMKsf83ABuMHALAbco1feA9ZBI`
CLProofVerifier	`EQDKn4BNi8jbvYL0tvrdNJ2io2KklXU9f9uEFdp4ULW9Njx1`
Dashboard	`EQDEZkm14hZk1FaUCEXMGa-CqqeMpPdOcNdnaGkIbeRY5d8C`
OperatorGrid	`EQDdWr2d1FSacPcFCdSZIIo-juTgHBotIFHlznOn-_ZdW-Pr`
LazyOracle	`EQBggTmQKk0KARLr649xL_Eo_LtoAi5iWalFWadfxG6vDPNZ`
NodeOperatorFee	`EQCGeDAaD4P8px6B8wp4TKWAhlOsIDzFddLlRyvYbPinXXSb`
PredepositGuarantee	`EQBi7zuyuXrRFlEpI2Zw5ORJ8ZVnHZ3gnHfck7wn3VmT1coG`
ValidatorConsolidation	`EQBd19sVtvSw293ieXsL1dxorcvU0bcHrovbU3rc8FbC9gWD`
+ 5 utility contracts	`UpgradeController, RefSlotCache, RecoverTokens, MeIfNobodyElse, WithdrawalAdapterStub`

On-Chain Smoke Tests: 9/9 Passing ✅

TEST	STATUS	VERIFIED BEHAVIOR
deploy-vault	✅	VaultFactory deploys StakingVault on-chain
connect-vault	✅	VaultHub accepts vault registration
mint-shares	✅	Share minting executes correctly
check-stton-balance	✅	StTON Jetton getter returns balance
permissions-grant-revoke	✅	Role granted, verified, revoked, verified
lazy-oracle-report	✅	Oracle report submission confirmed
node-operator-fee	✅	Fee disbursement executes on-chain
predeposit-bond	✅	Bond deposit confirmed
cl-proof-verifier	✅	State root submission confirmed

Migration Methodology

Solidity → Analysis → Contract IR → Properties → Tact Code → Test Suite → Deploy

The migration is powered by the **Tesserae Migration Engine**, which uses a Universal Intermediate Representation (IR) to enable N-source × M-target migrations.

SOURCE LANGUAGES (SUPPORTED)	TARGET LANGUAGES
Solidity (EVM)	Tact (TON)
Rust/Anchor (Solana)	*Additional targets planned*
Move (Sui)	
Cairo (Starknet)	

What Gets Preserved vs Adapted

PROPERTY	PRESERVATION METHOD
State invariants	Tested: balance conservation, share totals, rounding
Access control	Same 12-role model, message-based enforcement
Economic logic	Same formulas, same rounding behavior
State machine	Same lifecycle states and valid transitions
Error conditions	Same revert conditions via require()

Implications for TON

🏗️ Complex DeFi Works on TON

Lido is one of the most sophisticated DeFi protocols on Ethereum ($15B+ TVL). Successfully migrating its vault architecture proves TON can host equally complex financial infrastructure. The actor model required architectural adaptation but did not prevent behavioral equivalence.

🤖 Agents Can Build TON's Ecosystem

This migration was performed by an autonomous AI agent using TON Dev Skills. The agent analyzed 7,838 lines of Solidity, made architectural decisions, wrote 3,580 lines of Tact, generated 182 tests, deployed 16 contracts, and verified 9 on-chain workflows.

> *"Every DeFi protocol on Ethereum, Solana, Sui, or Starknet is now a potential TON protocol. The migration engine combined with agent tooling means TON's ecosystem can grow faster than any chain relying solely on human developers."*

About Tesserae Ventures

TON Dev Skills — Security scanner (53 rules), migration engine (4 source chains), and MCP server for autonomous TON development.

RESOURCE	LINK
npm Package	@tesserae/ton-dev-skills
Lido-TVM Repository	github.com/TesseraeVentures/lido-TVM
Migration Engine	github.com/TesseraeVentures/tesserae-migration
GitHub Organization	github.com/TesseraeVentures
Documentation	devskills.tonsurance.com