Teleo Tokens v1.0
A Semantic Token Family for Goal-Oriented Cognitive and AI Systems

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Version 1.0

Abstract

Teleo Tokens (TTs) are a Universal Semantic Token (UST) family designed to encode teleological structure: goals, intentions, obligations, constraints, and directed behavior. They represent the core primitives necessary for any reasoning system that must perform goal-directed planning or evaluation. This research brief defines the token schema, the invariants that govern token correctness, the semantic boundaries that stabilize meaning across domains, and the interface expectations for execution engines such as the Universal Semantic Runtime (USR) and the Universal Semantic Engine (USE).

Contents

1 Introduction

Teleology refers to explanation in terms of goals, purposes, or intended outcomes. Traditional large language models implicitly learn teleological patterns through statistical correlations, but lack explicit, type-stable representations of goal structure. Teleo Tokens (TTs) formalize these patterns into structured semantic units.

The primary purpose of TTs is to:

- encode goals and subgoals as structured, typed primitives
- stabilize planning semantics across domains
- support deterministic planning under USR
- enforce invariant-based reasoning across contexts
- provide a bridge between abstract intention and executable strategy

Teleo Tokens operate at the same ontological layer as other UST families, but specialize in representing *directed change over time*. TTs describe states, desired states, strategies for transformation, and the semantic operators that connect them.

2 Motivation

2.1 The Need for Explicit Teleology

LLMs implicitly represent goals through patterns but cannot treat goals as stable objects. This leads to common issues:

- drift in long-horizon planning
- inconsistent intention interpretation
- failure of multi-step execution
- ambiguity in constraints or desired outcomes

By contrast, TTs create a canonical structure that disambiguates:

- what the agent wants
- why the agent wants it
- what constraints apply
- what tradeoffs exist
- how progress is evaluated

2.2 Complementarity with Other UST Families

Teleo Tokens are not isolated. They interact with:

- Semantic Tokens (ST): grounding of world entities and relationships
- Trade Tokens (TrT): valuation, risk, and economic intention
- USR: deterministic routing and invariant enforcement
- USE: execution-level sequencing of token operations
- Cognitive Engines (CE): reflective reasoning and justification

This paper focuses exclusively on the internal architecture of TTs.

3 Teleo Token Structure

Each Teleo Token follows a canonical schema composed of seven components. This schema enables deterministic parsing and compositional reasoning.

3.1 Core Schema

```
TELEO_TOKEN {
    GOAL: <desired_state>
    ORIGIN_STATE: <current_state>
    CONSTRAINTS: {...}
    MOTIVE: <reason_for_goal>
    STRATEGY_SPACE: {...}
    SUCCESS_CRITERIA: {...}
    FAILURE_MODES: {...}
}
```

Each field is semantically typed and validated under USR.

3.2 Field Interpretations

GOAL A representation of a desired world-state or mental-state transition. The GOAL field must contain a state-description token or a composite of such tokens.

ORIGIN_STATE Explicit grounding in the present state. The difference between ORIGIN_STATE and GOAL defines the teleological gap.

CONSTRAINTS Environmental, legal, ethical, or self-imposed boundaries.

MOTIVE The driving reason or justification behind the goal. This field resolves ambiguity when multiple actions satisfy the same objective.

STRATEGY_SPACE A set of allowable transformations or action pathways. This set maps to USE's execution operators.

SUCCESS_CRITERIA How progress or completion is measured.

FAILURE_MODES Expected failure points or conditions under which the token becomes invalid.

4 Type System

4.1 Purpose of the Type System

TTs must be type-checked to ensure:

- invariants hold
- strategies align with constraints
- motives map to valid justification types
- success criteria can be evaluated under available engines

4.2 Primary Teleo Types

- **T-Goal**: a desired state or outcome
- **T-Motive**: causal and justificatory structures
- **T-Constraint**: boundary or prohibition class
- **T-Strategy**: sequence of potential actions
- **T-Metric**: evaluable criteria

Type unification rules are enforced by USR.

5 Invariants

Teleo Tokens obey the following class of invariants.

5.1 Invariant 1 — Teleological Coherence

The motive must logically support the goal. Formally:

$$MOTIVE \vdash GOAL$$

5.2 Invariant 2 — Constraint Compatibility

No strategy may violate any constraint:

$$STRATEGY \not\rightarrow VIOLATION(CONSTRAINT_i)$$

5.3 Invariant 3 — Grounded Origin

ORIGIN_STATE must be well-typed and context-resolved by ST tokens.

5.4 Invariant 4 — Metric Evaluability

Success metrics must be computationally evaluable by CE or domain engines.

5.5 Invariant 5 — Deterministic Projection

Given ORIGIN_STATE and GOAL:

$$\exists STRATEGY \text{ such that deterministic transition is possible}$$

6 Teleo Token Life Cycle

6.1 1. Parsing

Teleo structure is extracted from text or previous semantic structures.

6.2 2. Type-Checking

USR validates all fields and invariants.

6.3 3. Integration with ST

Entities and relations referenced by TTs are grounded.

6.4 4. Strategy Expansion

USE expands STRATEGY_SPACE into an executable plan.

6.5 5. Engine Execution

Domain engines perform the required transformations.

6.6 6. Evaluation

Metric-based evaluation verifies completion.

6.7 7. Reintegration

Updated state becomes ORIGIN_STATE for the next TT cycle.

7 Relation to USE

USE interprets Teleo Tokens into concrete action sequences:

- mapping strategies to operators
- pruning invalid pathways
- sequencing goal transformations
- generating micro-intentions for CE reasoning

8 Relation to USR

USR provides:

- deterministic symbol routing
- type validation
- invariant enforcement
- planning safety

USR ensures that TTs retain coherence across multiple engines.

9 Failure Modes

9.1 1. Underdetermined Goals

GOAL lacks specificity.

9.2 2. Overdetermined Constraints

Impossible or conflicting constraints.

9.3 3. Invalid Motives

MOTIVE is semantically incompatible with GOAL.

9.4 4. Strategy Explosion

STRATEGY_SPACE grows exponentially.

10 Applications

10.1 AI Assistants

Stable execution of user intentions.

10.2 Robotics

Goal-directed planning with safety constraints.

10.3 Economic Decision Systems

Mapping motives, constraints, and strategies in markets.

10.4 Cognitive Engines

Reflective introspection and justification.

11 Conclusion

Teleo Tokens provide a semantic foundation for any system that must reason about goals. By encoding purpose, constraints, strategy, and evaluation into typed primitives, TTs allow deterministic, interpretable, and verifiable planning across contexts.

They form one of the three major UST families, alongside Semantic Tokens and Trade Tokens, and serve as the teleological backbone of next-generation AI systems.