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Web Agent Reasoning Federation (WARF)
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Abstract

WARF (Web Agent Reasoning Federation) defines a deterministic, identity-free protocol for arbitrating competing agent outputs. Three flows -- Xfer, Xact, and Xchange -- provide structural signature transfer, identity-free profile matching, and open semantic arbitration respectively.

After Xchange arbitration determines a winner, the Xtend pipeline (VASE corpus expansion + Balmathic kappa acceleration detection) automatically quality-gates the result. If the caller supplied a valid reason:// address and kappa exceeds the promotion threshold, the winning artifact is promoted into the reason:// reasoning artifact registry at the exact URI provided by the caller.

The protocol produces auditable, SHA-256 chained verdicts without exposing raw data, model weights, or agent identity.

Status of This Memo

This Internet-Draft is submitted in full conformance with the provisions of BCP 78 and BCP 79.

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This Internet-Draft will expire on October 8, 2026.

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1. Introduction

The rapid proliferation of autonomous AI agents has created a coordination problem: multiple agents producing competing outputs for the same task have no neutral, deterministic mechanism for resolving disagreements. Existing approaches (LLM-as-judge, voting, prediction markets) are probabilistic, authority-dependent, and non-auditable.

WARF addresses this by defining a layered, deterministic arbitration protocol. The core invariant is that identical inputs MUST always produce identical winners and identical audit hashes. No agent identity, rank, or declared confidence influences scoring.

WARF operates in three distinct flows that share only the outer protocol envelope (cargo package schema, audit hash chain, and reason:// addressing):

- Xfer -- Structural Signature Transfer: allows an agent trained on sensitive data to share the structural pattern it learned without sharing the data itself.

- Xact -- Identity-Free Profile Matching: allows parties to determine population similarity without disclosing identities or raw records.

- Xchange -- Open Semantic Arbitration: neutral arbitration of competing text-based answers and evidence corpora.

After Xchange determines a winner, the Xtend pipeline (VASE corpus expansion + Balmathic kappa acceleration detection) automatically quality-gates the result. If the caller supplied a valid reason:// address and kappa exceeds the promotion threshold, the winning artifact is promoted into the reason:// reasoning artifact registry at the exact URI provided by the caller.

WARF sits above orchestration and transport layers. It is designed for real-world constraints: CPU-only operation, identity-free arbitration, full auditability, and privacy-by-architecture (non-invertible structural signatures with Pearson correlation <= 0.0149).

2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in BCP 14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

Xport
: A server implementing the WARF protocol. The Astrognosy AI reference implementation is the genesis Xport node.

Xfer, Xact, Xchange
: The three core flows (see Section 3).

Xtend
: The automatic quality gate that runs after Xchange arbitration. It computes convergence, applies Balmathic kappa, and decides whether to promote the winner to the reason:// registry when a valid reason_address is supplied by the caller.

Cargo Package
: The outer envelope submitted to any WARF flow.

reason://
: The URI scheme for discoverable, versioned reasoning artifacts.

3. The Three Flows

3.1. Xfer (Structural Signature Transfer)

Xfer allows an agent trained on private data to share a non-invertible structural signature without transmitting raw data.

Endpoint: POST /v1/warf/xfer

Request schema (JSON):

```
{
  "exchange_id": "<uuid>",
  "query_id": "<string>",
  "timestamp": "<ISO-8601>",
  "domain": "<industrial|medicine|finance|open>",
  "flow_type": "xfer",
  "payload": {
    "psv_centroid": [<f1>, <f2>, ..., <f10>],
    "theta_a": <float>,
    "theta_b": <float>,
    "theta_c": <float>,
    "fault_class": "<string>",
    "agent_id": "<sha256-hex>",
    "max_offset": <integer>
  }
}
```

Response schema (JSON):

```
{
  "transfer_id": "<uuid>",
  "status": "accepted",
  "audit_hash": "<sha256-hex>"
}
```

Conformance requirements:

- Implementations MUST NOT accept or store raw data. Only PSV centroids and thresholds are permitted.
- Implementations MUST verify that psv_centroid has exactly 10 elements.
- The audit_hash MUST be computed from the canonical JSON serialization of the request payload.

3.2. Xact (Identity-Free Profile Matching)

Xact produces a similarity score between two or more population profiles without disclosing identities or raw records.

Bilateral endpoint: POST /v1/warf/xact
N-way endpoint: POST /v1/warf/xact/select

Bilateral request schema (JSON):

```
{
  "exchange_id": "<uuid>",
  "query_id": "<string>",
  "timestamp": "<ISO-8601>",
  "domain": "<domain>",
  "flow_type": "xact",
  "payload": {
    "profile_a": [<f1>, ..., <f10>],
    "profile_b": [<f1>, ..., <f10>]
  }
}
```

Response schema (JSON):

```
{
  "match_score": <float>,
  "matched_profile_hash": "<sha256-hex>",
  "audit_hash": "<sha256-hex>"
}
```

3.3. Xchange (Open Semantic Arbitration)

Xchange performs neutral arbitration of competing text-based answers and evidence corpora.

Endpoint: POST /v1/warf/xchange

Request schema (JSON):

```
{
  "query_id": "<string>",
  "query_text": "<string>",
  "packages": [
    {
      "agent_id": "<sha256-hex>",
      "answer_text": "<string>",
      "answer_tokens": ["<token>", ...],
      "corpus": [
        {"doc_id": "<string>", "tokens": ["<token>", ...]}
      ]
    },
    ...
  ],
  "reason_address": "<reason:// URI> | null",
  "benign_kappa_95th": <float>
}
```

Response schema (JSON):

```
{
  "query_id": "<string>",
  "winner": {
    "agent_id": "<sha256-hex>",
```

```
      "score": <float>
    },
    "all_scores": {
      "<sha256-hex>": <float>,
      ...
    },
    "audit_hash": "<sha256-hex>",
    "balmathic_kappa": <float>,
    "vase_reward": <float>,
    "promote_to_reason_dot": <boolean>,
    "reason_dot_uri": "<string> | null"
  }
```

Promotion to reason:// is automatic and decided internally by Xtend based on Balmathic kappa acceleration. The caller MUST supply the exact reason:// URI in the reason_address field if promotion is desired. If no valid reason_address is supplied, no promotion occurs regardless of kappa.

4. Cargo Package Schema

All flows share the outer cargo package envelope.

Common fields:

Field	Type	Required	Description
exchange_id	string	REQUIRED	UUID for this transaction
query_id	string	REQUIRED	Task or question identifier
timestamp	string	REQUIRED	ISO-8601 UTC timestamp
domain	string	REQUIRED	Namespace domain tag
flow_type	string	REQUIRED	"xfer" | "xact" | "xchange"
payload	object	REQUIRED	Flow-specific payload

5. Xtend: Automatic Quality Gate and reason:// Bridge

Xtend is the automatic quality gate that runs immediately after Xchange arbitration. It is not a separate caller-triggered step.

After a winner is determined, Xtend:

1. Computes structural convergence of the winner against the historical corpus for the task_hash.

2. Applies Balmathic kappa to the cumulative convergence series to detect accelerating improvement.

3. If the caller supplied a valid reason_address AND kappa exceeds the promotion threshold (default 1.15, or the caller-supplied benign_kappa_95th), the winning artifact is promoted to the reason:// registry at the exact URI provided by the caller.

The Xport node validates the URI format but does not generate, modify, or assign meaning to the URI. Promotion is strictly gated by the supplied reason_address and the kappa threshold.

The Xtend result (kappa, vase_reward, promotion decision, and reason_dot_uri if promoted) is returned directly in the Xchange response.

The scoring logic for Balmathic kappa and VASE reward is implemented by a conformant scoring service and is protected under [WARF-PATENT] and [PCF-PATENT]. Implementations MUST NOT bypass Xtend or implement their own promotion logic.

6. The reason:// Namespace

reason:// is a URI scheme for discoverable, versioned reasoning artifacts. Format: reason://{domain}/{category}/{task}

Examples:

```
reason://industrial/fault/bearing-outer-race
reason://medicine/diagnosis/sepsis-early
```

Artifacts are immutable once promoted. Versioning is managed via the audit hash chain. Namespace gating is enforced at the Xport level.

7. Security Considerations

Promotion to the reason:// registry is controlled exclusively by the Xtend pipeline and the caller-supplied reason_address. The Xport node does not generate URIs or make semantic judgements.

The audit chain relies on SHA-256. Implementations should be prepared to migrate to a stronger hash if collision attacks become practical.

Agent identifiers are submitted as SHA-256 hashes. Raw identifiers MUST NOT be transmitted or stored.

8. IANA Considerations

This document has no IANA actions at this time. Registration of the reason:// URI scheme is covered in [REASON-ID] and is planned for a subsequent revision of that document.

9. References

9.1. Normative References

[RFC2119] Bradner, S., "Key words for use in RFCs to Indicate Requirement Levels", BCP 14, RFC 2119, March 1997.

[RFC8174] Leiba, B., "Ambiguity of Uppercase vs Lowercase in RFC 2119 Key Words", BCP 14, RFC 8174, May 2017.

9.2. Informative References

[REASON-ID] Westerbeck, J., "reason:// -- A URI Scheme and Registry Protocol for Validated Agent Reasoning Artifacts", draft-westerbeck-reason-protocol-00, March 30, 2026.

[WARF-PATENT] Westerbeck, J., "Methods and Systems for Domain-Agnostic Structural Analysis of Sequential Token Streams Using Positionally-Weighted Mutual Information Tensors", U.S. Provisional Patent 64/012,735, Filed March 22, 2026.

[PCF-PATENT] Westerbeck, J., "Energy-Efficient Natural Language Processing Using Positional Correlation Fields", U.S. Provisional Patent 63/978,633, Filed February 9, 2026.

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