#Structural Messaging Collapse Benchmark Spec v0.1

###(DBM-SI Structural Messaging — ITEM #268 companion specification)

##1. Purpose

This benchmark evaluates the collapse boundary of Structural Messaging, defined as the point where:

Communication collapses when reconstruction becomes cheaper than transmission.

Formally, the benchmark measures how shared structural knowledge reduces the amount of transmitted payload required to reproduce system state.

The objective is to transform the collapse concept from a theoretical observation into a **repeatable engineering measurement**.

##2. Collapse Boundary Definition

Let:

P = payload information entropy
K = shared structural knowledge
I(K) = usable structural information capacity
B = transmitted bytes
R = reconstruction success rate

Collapse occurs when:

$$I(K) \geq H(P)$$

At this point:

Message ≈ PointerIndex + MinimalPayload

Communication transitions from:

state transmission → state reconstruction

##3. Benchmark Model

We define Structural Messaging reconstruction as:

State' = Reconstruct(pointer, sharedStructure, minimalPayload)

and require:

State' == State

within a defined equivalence rule.

##4. Benchmark Levels (Shared Structure Gradient)

The benchmark evaluates communication across increasing shared-structure levels.

####Level S0 — No Shared Structure

Sender transmits full payload.

Message = FullPayload

Baseline measurement:

B(S0)

####Level S1 — Schema Shared

Shared:

schema

object model

validation rules

Sender transmits:

payload constrained by schema

Measure:

B(S1)

Expected:

B(S1) < B(S0)

####Level S2 — Snapshot Shared

Shared:

baseline snapshot

schema

structural validation rules

Sender transmits:

snapshotId
diffPayload

Measure:

B(S2)

Expected:

B(S2) << B(S1)

####Level S3 — Pointer Reconstruction

Shared:

snapshot history

structural index

evidence chain

invariant hash rules

Sender transmits:

pointerIndex
eventId
minimalPayload

Measure:

B(S3)

Expected collapse behavior:

B(S3) ≈ O(log N)

##5. Metrics

The benchmark records:

###5.1 Transmission Size
B(Si)

###5.2 Reconstruction Success Rate
R(Si)

must approach:

$$R \approx 1.0$$

###5.3 Structural Compression Ratio

$$CR(S_i) = B(S_0) / B(S_i)$$

###5.4 Convergence Stability

Repeated reconstruction should produce identical:

invariantHash

snapshot state

evidence chain hash

##6. Minimal Toy Benchmark Scenario

Recommended initial benchmark:

####Structured Workflow State Reconstruction

Shared:

workflow schema

baseline snapshot

execution rules

State example:

workflow execution state
task graph
status map
metadata

Baseline payload size example:

Full state JSON ≈ 100–200 KB

Pointer message example:

snapshotId
eventIndex
diffPointer
≈ 32–64 bytes

Expected compression:

1000×–5000×

This demonstrates collapse behavior in practice.

##7. Reference Measurement Procedure

For each level S0–S3:

Generate identical system state

Send message under Si constraints

Reconstruct state

Validate:

equality

invariant hash

evidence chain

record B(Si)

##8. Expected Collapse Curve

The benchmark should produce a monotonic curve:

$$B(S0) > B(S1) > B(S2) > B(S3)$$

Approaching:

$$B(S3) \to \text{constant}$$

This curve represents the Structural Messaging Collapse Curve.

##9. Engineering Interpretation

The collapse boundary demonstrates:

communication can be structure-substituted

messaging can become index-based coordination

state synchronization becomes reproducible

payload entropy becomes structurally recoverable

This shifts communication from:

transport protocol

to:

structural reconstruction protocol

##10. Future Extensions

Potential benchmark domains:

distributed workflow runtime

agent coordination systems

database replication

version control systems

simulation state synchronization

collaborative editing systems

##11. One-Line Definition (Spec Header Candidate)

You can safely place this at the top of README or Spec:

Communication collapses when reconstruction becomes cheaper than transmission.

##12. Versioning
Structural Messaging Collapse Benchmark Spec

Version: v0.1

Status: Experimental

Related ITEM: #268

Repository: DBM-SI Structural Messaging