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MVPS Architecture: Specification Conformance for the Multi-Vantage Path-Coherence Drafts

draft-melegassi-iab-mvps-architecture-00

Abstract

This document specifies the abstract Multi-Vantage Path-coherence Specification (MVPS) as a surface-independent algebraic structure on a bounded simplex. Five structural axioms (MVPS-A1 through MVPS-A5) are stated; the Invariance Theorem establishes that any architecture satisfying the five axioms inherits, verbatim, the v4.0 theorem catalogue of MVPS (Theorems 1, 2, 3, 3’, 4, 5, 9, the unified detection-latency lemma L_DL, and Stein’s Lemma for N-vantage joint error exponents).

This document is the structural roof of the MVPS family. It explains, normatively and in a small number of axioms, why the seven MVPS Internet-Drafts ([I-D.melegassi-ippm-mvps-bundle] through [I-D.melegassi-ippm-mvps-orbital-coherence]) are seven instantiations of the same specification rather than seven independent specifications. Each of the seven existing drafts is shown to satisfy the five axioms (Section 6.1); anticipated instantiations (kernel, dataplane, datacenter, IoT, post-quantum link) are catalogued as design targets; protocols that violate one or more axioms (BGP, BFD, DNS, TCP retransmission) are identified as non-conformant, and the structural reason for their tau_sampling-bound reactive latency floor under the Planetary Coherence Floor ([I-D.melegassi-iab-mvps-planetary-floor]) is named.

This document is informational. It follows the IETF architecture-document pattern of [RFC1958], [RFC3439], [RFC1633], [RFC2475], [RFC2775], [RFC6973], and [RFC7258]. It standardises no codepoints, defines no wire format, and introduces no RFC-2119 keywords beyond the conventions section. Its sole content is the abstract specification, the axiom set, the Invariance Theorem, and the conformance catalogue.

The mathematical device introduced is SPECIFICATION CONFORMANCE: an architecture A is MVPS-conformant if and

only if its 5-tuple (V_A, B_A, (C_A, H_A), D^2_A, Pub_A) satisfies A1..A5. Conformance is strictly weaker than a categorical functor between surfaces (which the v4.0 mathematical existence proof explicitly disclaims) but strictly stronger than parallel construction: conformant

architectures inherit the v4.0 theorem catalogue by mechanical substitution. No morphisms between surfaces are required.

Status of This Memo

Copyright Notice

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1. Introduction

The MVPS family currently comprises seven Internet-Drafts (D-1 through D-7) whose proofs are structurally identical but whose surface vocabularies differ. [I-D.melegassi-ippm-mvps-bundle] (D-1) defines the canonical network-observatory surface (RTT, fingerprint, edges). [I-D.melegassi-mvps-ai-coherence] (D-5) defines the AI-serving surface (embedding W_2, attention CKA, falsifiability under perturbation). [I-D.melegassi-ippm-mvps-orbital-coherence] (D-7) defines the orbital-segment surface (mixed-medium causal lower bound, TLE-predicted edge set via SGP4).

A reader of the seven drafts will observe that the proofs in each are structurally the same theorem catalogue applied to different per-axis metrics. The v4.0 mathematical existence proof ([v4-proof]) explicitly DECLINES a categorical functor between profiles -- the correct call, since no canonical morphism between "an RTT measurement at a probe" and "a 2-Wasserstein distance between LLM embeddings" exists. But the disclaimer leaves a gap: the reader is told what does NOT unify the seven drafts; the reader is not told what DOES.

This document fills exactly that gap. It provides a unification strictly weaker than a functor (no inter-surface morphisms required) but strictly stronger than parallel construction: the same theorem catalogue is mechanically inherited by every conformant instantiation.

THE ANSWER (Invariance Theorem, Section 6). Any architecture A satisfying the five MVPS axioms (MVPS-A1 through MVPS-A5 of Section 5) inherits, verbatim, the v4.0 theorem catalogue: Theorems 1, 2, 3, 3', 4, 5, 9, the unified detection-latency lemma L_DL, and Stein's Lemma for the N-vantage joint error exponent.

THE PATTERN. This document follows the IETF architecture-document lineage of [RFC1958] (Internet architectural principles), [RFC3439] (Internet architectural guidelines and philosophy), [RFC1633] (Integrated Services), [RFC2475] (Differentiated Services), [RFC2775] (Internet transparency), [RFC6973] (privacy considerations), and [RFC7258] (pervasive monitoring). It is a small (15-30 page) informational document that defines the abstract specification underlying a protocol family and is referenced normatively by every instantiation draft.

SCOPE. This document standardises NO codepoints, defines NO wire format, and introduces NO RFC-2119 keyword usage beyond the conventions section. Its content is exclusively the abstract specification, the five axioms, the Invariance Theorem, and the conformance catalogue.

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.

Architecture
: A 5-tuple A = (V_A, B_A, (C_A, H_A), D^2_A, Pub_A) per Section 4.1.

Surface
: The measurable space on which a vantage takes its observation samples (Section 4.2).

Vantage
: An observer v_i : Time -> Surface_i that emits, at every

tick instant t_k = k * T_tick, an observation record o_i(k).

Bundle
: The N-tuple { o_i(k) : i in [N] } at a common tick.

Coherence triple
: The vector (C_1, C_2, C_3) in [0,1]^3 computed from a bundle per [I-D.melegassi-ippm-mvps-bundle].

Hamiltonian
: The scalar H : [0,1]^3 -> [0, H_max] with H_max = -3 log eps per Theorem 1 of [v4-proof].

Mahalanobis decision quantity
: D^2(C; mu, Sigma) := (C - mu)^T Sigma^{-1} (C - mu).

Conformance
: The property of an architecture A of satisfying the five MVPS axioms (Section 5).

v4.0 catalogue
: Theorems 1, 2, 3, 3’, 4, 5, 9 of [v4-proof], the unified detection-latency lemma L_DL of [LDL-doc], and Stein’s Lemma for N-vantage joint error exponents per Appendix A of [I-D.melegassi-ippm-mvps-orbital-coherence].

Functor
: A category-theoretic mapping between two categories preserving identity and composition. This document does NOT introduce a functor; it introduces

conformance, which is strictly weaker.

Parallel construction
: The pattern of stating the SAME theorem on different surfaces with different per-axis metrics, INDEPENDENTLY for each surface. v4.0 uses parallel construction. This document strengthens parallel construction to conformance by stating a single axiom set whose satisfaction implies inheritance of the catalogue.

3. Why an Architecture Document is Needed Now

Reading D-1 through D-7 in sequence, a reviewer faces a structural question that no single draft answers normatively:

> "Are these seven drafts seven independent specifications or seven instantiations of the same specification?"

v4.0 explicitly declines the strongest possible answer (a functor between profiles). Quoting MVPS_IETF_FOUNDATIONS.txt Section 5 on C-5.1:

> "PARALLEL CONSTRUCTION (Closing of v4.0 explicitly disclaims a functor between profiles)."

This was the right call mathematically: a functor would force morphisms between surfaces that do not, in general, exist.

But the disclaimer leaves a gap. This document fills it.

The unification introduced here is the WEAKEST possible that still suffices for theorem inheritance: NO morphisms between surfaces are required. All that is required is that each surface’s instantiation satisfy the same axiom set; the v4.0 theorem catalogue then applies VERBATIM by mechanical substitution.

4. The Abstract MVPS Specification

4.1. Architecture as 5-tuple

An MVPS architecture is a 5-tuple

A = (V_A, B_A, (C_A, H_A), D^2_A, Pub_A)

consisting of:

V_A
: A finite set of N >= 3 OBSERVATION VANTAGES, each a function v_i : Time -> Surface_i that emits, at every tick instant t_k = k * T_tick, an observation record o_i(k) in Surface_i.

B_A
: A BUNDLE-CONSTRUCTION RULE that, at each tick k, composes the N records into a bundle

B(k) := { o_i(k) : i in [N] }.

(C_A, H_A)
A COHERENCE TRIPLE C_A := (C_1, C_2, C_3) : B -> [0,1]^3 together with a scalar HAMILTONIAN H_A : [0,1]^3 -> [0, H_max] satisfying H_max = -3 log eps per Theorem 1 of [v4-proof].

D^2_A
The MAHALANOBIS DECISION quantity D^2(C; mu, Sigma) := (C - mu)^T Sigma^{-1} (C - mu) against a baseline (mu, Sigma) calibrated per OC3 (n_calib >= 18,500 per Corollary 3'.1 of [v4-proof]).

Pub_A
A PUBLISH-SUBSCRIBE primitive delivering the alarm signal from broker to all subscribers within a bounded tau_RTT envelope.

4.2. Surface

A surface is an arbitrary measurable space on which observation vantages can take samples. Examples:

Network surface (D-1, D-2, D-3, D-4, D-6).
Surface_i = R+ x F x P(V x V) with RTT in R+, F a fingerprint string, P(V x V) an observed edge set.

AI surface (D-5).
Surface_i = R^d x R^{d x d} x V with embedding, attention, output.

Orbital surface (D-7).
Surface_i = R+ x F x P(V x V) x P(V x V) with additional TLE-predicted edge set.

Kernel, dataplane, IoT, datacenter, and post-quantum link surfaces are anticipated (Section 7.2).

No morphisms between surfaces are required. Surfaces are catalogued, not categorified.

4.3. Conformance

An MVPS architecture A is CONFORMANT to the MVPS specification if and only if it satisfies all five MVPS axioms (Section 5).

5. The Five MVPS Axioms (A1..A5)

5.1. MVPS-A1: Multi-vantage on a common tick lattice

V_A has N >= 3 vantages on a tick lattice with period T_tick > 0. The bundle rule B_A is well-defined: B(k) exists and is finite for every tick k.

5.2. MVPS-A2: Bounded coherence triple

The map C_A := (C_1, C_2, C_3) sends every bundle B(k) into [0,1]^3 by construction (per-axis clipping per Design D4 of [v4-proof]). Equivalently, each axis is bounded above by 1 and below by 0 on the support of B_A.

5.3. MVPS-A3: Mahalanobis decision with FAR control

D^2_A is computed against a baseline (mu, Sigma) satisfying:

```
rank(Sigma)          = 3            (OC4 of D-1)
min_eig(Sigma_hat)   > 0            (OC4 of D-1)
n_calib              >= 18,500      (OC3, Corollary 3'.1)
sampling cadence G   >= W_max       (OC2)
```

FAR is controlled either parametrically (chi^2(3, 1-alpha) when Theorem 2 of [v4-proof] applies) or empirically (Theorem 3’, distribution-free DKW envelope).

5.4. MVPS-A4: Conditional independence of vantages

The observation records o_i(k) are conditionally independent given the hypothesis H_0 (baseline) or H_1 (event):

```
p(o_1, ..., o_N | H_k)
    = prod_{i=1..N}  p(o_i | H_k),    k in {0, 1}.
```

This is Hypothesis A1 of [I-D.melegassi-ippm-mvps-orbital-

coherence] Section 4. It is required for Stein additivity in Theorem 9 below.

5.5. MVPS-A5: Byzantine resilience via geometric median

The aggregator across vantages is the geometric median on the per-vantage statistics, with bias bound

```
|| m* - mu_0 ||   <=   (2 f / (N - 2 f)) * sqrt(2)
```

whenever at most f < N/2 vantages are corrupt (Theorem 9 of [I-D.melegassi-ippm-mvps-bundle]).

6. The Invariance Theorem

6.1. Statement and proof

THEOREM 1 (Invariance of the v4.0 catalogue under conformant instantiation).

Let A be any MVPS architecture satisfying axioms MVPS-A1 through MVPS-A5 (Section 5). Then A inherits, as theorems on its own bundle space, ALL of:

```
Theorem 1     (boundedness; H_max = -3 log eps)
Theorem 2     (chi^2 null under Gaussian C)
Theorem 3     (scaled-F null under estimated Sigma)
Theorem 3'    (distribution-free FAR via empirical
               quantile)
Theorem 4     (joint Mahalanobis vs q_J; EXACT Schur)
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Theorem 5   (Heisenberg-Gabor time-frequency floor)
Theorem 9   (geometric-median max-bias on a simplex)
L_DL   (unified detection latency)
Stein’s Lemma ([Cover-Thomas-2006] Theorem 11.8.1)
              under A4.

Furthermore, the COMPOSITION of any of these theorems remains valid in A (since composition uses only A1..A5).

PROOF. We chase each theorem of the catalogue back to the axioms. Each step is mechanical substitution.

STEP 1 (Theorem 1). v4.0 Theorem 1 states H : [0,1]^3 -> [0, H_max] with H_max = -3 log eps. Proof relies on the [0,1]^3 image of C (axis-by-axis), the choice of H as H(c) = -sum_k log(c_k + eps), and the clipping bound. A2 guarantees C_A(B(k)) in [0,1]^3 for all bundles. Inheritance holds.

STEP 2 (Theorem 2). v4.0 Theorem 2 states: under the Gaussian null C ~ N(mu, Sigma) the statistic D^2 follows chi^2(3). Proof uses only: D^2 is a quadratic form in C - mu with Sigma^{-1}; rank(Sigma) = 3; Gaussian null assumption. A3 guarantees rank(Sigma) = 3 and min_eig(Sigma_hat) > 0. Gaussian null is a hypothesis; when it holds, Theorem 2 fires verbatim.

STEP 3 (Theorem 3). v4.0 Theorem 3 states: when Sigma is estimated from a calibration sample of size n_calib, D^2 follows the scaled-F distribution. Proof uses Wishart distribution theory + Hotelling T^2. A3 (n_calib >= 18,500, rank(Sigma) = 3) provides every prerequisite.

STEP 4 (Theorem 3’). v4.0 Theorem 3’ uses the Dvoretzky-Kiefer-Wolfowitz (DKW) inequality + a non-Gaussian C distribution. Proof requires only: the [0,1]^3 image (A2) and n_calib (A3); produces an FAR within +/- 1% of nominal at n_calib >= 18,500.

STEP 5 (Theorem 4). v4.0 Theorem 4 uses the EXACT Schur complement formula and the Sylvester identity to construct the joint detector across two surfaces. Proof uses linear-algebra identities valid on any inner-product space. A1+A2+A3 provide the bundle structure.

STEP 6 (Theorem 5). v4.0 Theorem 5 imports the Heisenberg-Gabor inequality sigma_t * sigma_f >= 1/(4 pi). Proof is independent of surface; depends only on the L^2 inner product of the time-domain signal with itself. A1 (tick lattice) gives the time grid; the inequality holds.

STEP 7 (Theorem 9). v4.0 Theorem 9 states: with at most f < N/2 byzantine vantages, the geometric median has bias <= (2f/(N-2f))*sqrt(2). Proof imports [Minsker-2015] / [Cohen-et-al-2016] on a compact metric space. A5 (geometric median aggregator) + the bounded simplex of A2 provides the space. The bound holds on any inner-product or Hilbert space (per C-5.6 of D-5 for the AI surface where the simplex is replaced by a compact embedding ball).

STEP 8 (L_DL). L_DL of [LDL-doc] states tau_detect(phi) = M*T_tick - phi + tau_RTT, with the three canonical specialisations tau_min, tau_E, tau_max. Proof uses only: tick lattice (A1) +

multiplier M (architectural) + subscriber-arrival latency (Pub_A).

STEP 9 (Stein's Lemma). The MAIN THEOREM of D-7 Appendix A composes Stein's Lemma + KL chain rule under conditional independence (A4) to give E_N = sum_i D_i. A4 is the SOLE hypothesis specific to this step; A1..A3 supply the per-vantage Mahalanobis structure required.

STEP 10 (Composition closure). Each of v4.0's Theorems 1-9 is stated in the SAME bundle-space abstraction. Any composition uses only the inputs of the composed theorems. Inheriting EACH theorem implies inheriting their compositions.

Each step above is mechanical substitution. No new mathematics. QED.

6.2. Remarks on functor-vs-conformance

REMARK 1 (what surface-specific content remains). A1..A5 do NOT determine the CHOICE of metric on each axis:

```
C_2 may be   1 - JSD on token distributions   (network)
             1 - W_2 on embeddings            (AI)
             mean Jaccard on observed-vs-predicted edge
                 sets                         (orbital)
             normalised Hamming on packet fingerprints
                                              (kernel,
                                               dataplane).
```

Each choice satisfies the [0,1] image required by A2 and the bias bound required by A5. Theorem 1 guarantees that the v4.0 catalogue applies to all such choices identically.

REMARK 2 (Invariance is strictly weaker than a functor). A categorical functor F : Surface -> Bundle would require, for every surface morphism f : S_1 -> S_2, an induced map F(f) : F(S_1) -> F(S_2) preserving the coherence triple. This document imposes NO such inter-surface morphisms. Two conformant instantiations on different surfaces are RELATED ONLY by the fact that both inherit the same theorem catalogue. This is the precise mathematical sense in which v4.0's disclaimer ("PARALLEL CONSTRUCTION ... no functor") is preserved while a normative unification IS achieved.

7. Catalogue of Conformant Instantiations

7.1. Proved conformant (D-1..D-7)

For each of D-1 through D-7 the axiom check is one paragraph per axiom and reduces, in each case, to citing the draft’s own internal claims (already proved in the respective draft).

D-1 [I-D.melegassi-ippm-mvps-bundle].
Surface: network observatory.
A1 holds (OC1: N >= 3 vantages).
A2 holds (Design D4 + Theorem 1).
A3 holds (OC3, OC4 + Theorem 3’).
A4 holds (geographic separation; operational).
A5 holds (Design D9 + Theorem 9).

D-2 [I-D.melegassi-mvps-incremental-be].
Surface: D-1 + cell partition.
A1-A5 inherited from D-1; A5 strengthened per cell.

D-3 [I-D.melegassi-coherence-bfd].
Surface: D-1 specialised to BFD wire format.
A1 holds with cardinality caveat (V3 Echo permits N = 2; full conformance recommends N >= 3 per D-1 OC1).
A2-A5 inherited from D-1.

D-4 [I-D.melegassi-mvps-ddos-resilience].
Surface: D-1 + multi-region cell partition.
A1-A4 inherited; A5 strengthened by Theorem D2 (cell-aware geometric median).

D-5 [I-D.melegassi-mvps-ai-coherence].
Surface: AI serving.
A1 holds (N >= 3 replicas).
A2 holds (W_2 / CKA / falsifiability in [0,1]).
A3 holds (CBF calibration).
A4 holds (replicas independently seeded; operational).
A5 holds (Theorem C-5.6, Byzantine-robust C_2^gm).

D-6 [I-D.melegassi-ippm-mvps-coherence-leadtime].
Surface: D-1 specialised to rank-1 propagating signals. A1-A5 inherited from D-1.

D-7 [I-D.melegassi-ippm-mvps-orbital-coherence].
Surface: ground vantages + orbital metadata + TLE.
A1 holds (OC7-1: N >= 3 ground vantages, separation

>= 500 km).

      A2 holds (T-6 + T-7 of D-7 inherit [0,1] image with
                TLE-predicted component).
      A3 holds (OC7-2 baseline excludes handover windows;
                empirical T_3’).
      A4 holds (D-7 Hypothesis A1).
      A5 holds (Theorem 9 with diameter D_emb = sqrt(2)).

By Theorem 1 (Section 6), all seven inherit the v4.0 theorem catalogue.

7.2. Anticipated conformant

The following architectures are described as proposals in the MVPS repository. Each is anticipated to satisfy A1..A5 once a reference implementation and FAR calibration are completed.

D-8 — IoT (RPL parent change, CoAP RTT). See [I-D.melegassi-roll-mvps-iot].

KERNEL — Linux kernel internals via eBPF / perf / ftrace. See MVPS_KERNEL_PROFILE.txt.

DATAPLANE — Forwarding silicon (ASIC/NPU counters, queue depths). See MVPS_DATAPLANE_PROFILE.txt.

DATACTR — Datacenter fabric (Clos topology, RDMA latency, GPU NVLink congestion). Future.

PQ-LINK — Post-quantum link layer (QKD link, post-quantum handshake latency). Future.

7.3. Non-conformant (and the structural reason)

The following classical protocols are catalogued as structurally NON-CONFORMANT. The specific axiom violated determines the protocol’s tau_sampling-bound reactive latency floor under PCF ([I-D.melegassi-iab-mvps-planetary-floor]).

BGP-4 ([RFC4271]).
    Violates A1: per-AS-boundary single-vantage; no
                 multi-vantage joint inference at the
                 protocol layer.
    Violates A4: route propagation is correlated by AS
                 path; not conditionally independent.
    Consequence: cannot inherit Stein additivity;

                 bounded below by tau_sampling^{BGP} =
                 60 s per [RFC4271] Section 10 keepalive
                 lattice.

BFD ([RFC5880]).
    Violates A2: no coherence triple, just binary
                 up/down state.
    Violates A1: per-session pair, not multi-vantage
                 joint.
    Consequence: cannot inherit Theorem 1 or Theorem 9;

bounded below by tau_sampling^{BFD} =
M * MinTx per [RFC5880] Section 6.8.1.

DNS ([RFC1034], [RFC1035], [RFC2181]).

Violates A1: resolvers are single-vantage per query.
Violates A2: no coherence triple; just (name -> address) binding cached under TTL.
Consequence: cannot inherit any v4.0 theorem; bounded below by tau_sampling^{DNS} = TTL_min per [RFC2181].

TCP retransmission ([RFC9293], [RFC6298]).

Violates A1: per-connection single-endpoint timer.
Violates A4: timer doubles deterministically (binary backoff is not conditionally independent sampling).
Consequence: bounded below by tau_sampling^{TCP-RTX} = RTO_min = 1 s per [RFC6298] Section 2.4.

The non-conformance examples above are PRECISELY the tau_sampling-binding floors of [I-D.melegassi-iab-mvps-planetary-floor] Section 6. This is not a coincidence: PCF Theorem (Section 5 of the planetary-floor draft) bounds the reactive latency floor of any architecture by max{tau_causal, tau_sampling, tau_information, tau_consensus, tau_coupling}. An architecture's reactive latency is dominated by tau_causal ONLY IF tau_information is below tau_causal, which requires Stein additivity, which requires A4. Architectures that violate A4 are STRUCTURALLY bound to be tau_sampling-bound.

D-16 therefore SUBSUMES PCF's binding-floor analysis: every classical-Internet protocol whose tau_sampling floor PCF computes is precisely a non-conformant architecture per this document's axiom check.

8. Relationship to PCF

This document and [I-D.melegassi-iab-mvps-planetary-floor] (PCF) are the two halves of the MVPS family's closing act:

THIS DOCUMENT (ARCH)	says WHAT MVPS is.
PCF	says HOW FAST MVPS reacts under the floor composition.

The recommended reading order for a new IETF reviewer is:

1. This document (ARCH) -- understand the unification.
2. D-1 [I-D.melegassi-ippm-mvps-bundle] -- the canonical instantiation.
3. D-2..D-7 -- the parallel instantiations, in any order.
4. [LDL-doc] -- the unifying detection-latency lemma.
5. PCF [I-D.melegassi-iab-mvps-planetary-floor] -- the operational consequence; the world number.

The family thereby closes at NINE Internet-Drafts:

```
SEVEN INSTANTIATIONS    +    TWO CAPSTONES
(D-1..D-7)                  (this document + PCF)
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The nine are MUTUALLY INDEPENDENT (each proves something the others do not) and JOINTLY EXHAUSTIVE (no further capstone is derivable from existing material without introducing new measurement or new mathematics).

9. Conformance Procedure for New Deployments

A new deployment that wishes to claim MVPS conformance SHOULD author a short (5-10 page) "MVPS Conformance Statement" that:

- (a) describes its surface and per-axis metric choice;
- (b) demonstrates A1 (N >= 3, tick lattice exists);
- (c) demonstrates A2 (each axis lies in [0,1]);
- (d) demonstrates A3 (n_calib >= 18,500; rank-3 Sigma);
- (e) demonstrates A4 (conditional independence; possibly an operational hypothesis like H-3 of D-7);
- (f) demonstrates A5 (geometric median aggregator with bias bound);
- (g) cites this document as the source of the inherited theorems.

A WG chair MAY verify conformance by reading the conformance statement against the axiom checklist of Section 5 above. This is the same pattern [RFC2475] uses to admit new DiffServ PHB groups via per-codepoint specification.

10. Operational Contracts inherited from D-1..D-7

The MVPS Operational Contracts (OC1..OC8) from [I-D.melegassi-ippm-mvps-bundle] apply to every conformant instantiation:

- OC1 N >= 3 vantages required.
- OC2 Sampling cadence G >= W_max.
- OC3 n_calib >= 18,500 for +/- 1% FAR precision.
- OC4 rank(Sigma) = 3 with min_eig(Sigma_hat) > 0.
- OC5 C_2 comparisons valid only within a session at fixed N.
- OC6 tau_OU uses the rho_1^clip of Design D12.
- OC7 Recalibrate whenever 7-day FAR > 5% empirically.
- OC8 K_1, K_2 thresholds in [exp(-1), 1].

Surface-specific OCs (e.g., OC7-1..OC7-4 of D-7 for orbital deployments) apply to their respective instantiations as published.

11. Security Considerations

This document is descriptive; it standardises no wire format or codepoint. It inherits the security model of [I-D.melegassi-ippm-mvps-bundle] (HMAC-SHA256 wire integrity, [RFC2104]) and [I-D.melegassi-mvps-ddos-resilience] (cell-aware Byzantine bound, Theorem 9 + D2).

A1 (multi-vantage) is itself a security-relevant property: a single-vantage architecture has no Byzantine resilience (Theorem 9 is vacuous at N = 1). A4 (conditional independence) is operationally fragile if vantages share a corruption channel; deployments MUST ensure vantage independence at the instrumentation level.

12. IANA Considerations

This document has no IANA actions.

13. References

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