

Carrier Roaming Settlement Without a Central Clearing House

When a subscriber of one mobile network places a call on another operator's infrastructure, two independently run systems each produce a record of the same event, and the two records must later be reconciled by parties with opposing financial interests. The common answer is an intermediary: a clearing house that collects usage files from both sides, matches them, and pronounces a balance. U.S. Provisional Application No. 64/117,812 discloses a different settlement primitive. Two parties settle on a matched pair of signed governed observations, each carrying an authority credential and a continuity hash, recognized as a pair within a spatial or temporal proximity window declared by a governing policy object. Finality attaches upon recognition and admission of the pair, without a third-party intermediary, without centralized consensus, and without pre-negotiated session state. Reconciliation is framed as a per-event outcome that either party can verify from the record alone.

Two Networks, Two Records, One Event

A visiting handset attaches to a host network, uses it, and detaches. The host network writes a usage record. The home network, receiving a rated file some time later, writes its own view of what its subscriber consumed. The two views originate in different

equipment, under different clock discipline, with different rounding conventions and different rules about what counts as a chargeable session. Where they disagree, they tend to disagree at the margins.

The structural difficulty is not measurement error. Neither party can verify the other's record without trusting the other's system, and neither has much reason to extend that trust to a counterparty whose gain is its own loss. The common answer has been to insert a third party. Files go to a clearing intermediary, the intermediary matches them, and its output becomes the number both operators book. Challenges are raised against that matching and worked through a correction cycle after the event.

Complaints commonly voiced about roaming settlement seem to follow from that shape rather than from any particular implementation of it. Recognition of a balance waits on a batch. Argument happens over aggregates rather than over single events. Establishing a new relationship involves an agreement, an enrollment, a format negotiation, and a place in a clearing schedule before the first record settles, which plausibly weighs hardest on small operators and short-lived arrangements. No quantification is attempted here.

The Intermediary Solves a Real Problem, Badly

Bilateral reconciliation between distrusting parties is genuinely hard, and the clearing model exists because it is. The intermediary supplies a neutral matcher, a common format, and a party against whom a dispute can be raised. Remove it naively and all three go with it.

Efforts to improve on the model have tended to keep the intermediary and change its implementation. Shared ledgers substitute a consensus protocol for the clearing party, trading one dependency for another: settlement waits on a commit, and who may write becomes a fresh governance negotiation. Direct bilateral interfaces drop the middle party but reintroduce it as an account relationship, since each pair of operators must

enroll, exchange keys, and maintain standing session state before anything settles. Such arrangements suit a small number of large counterparties better than many small or short-lived ones.

Beneath these approaches sits an assumption that goes unexamined: that settlement requires a prior relationship, and that finality is conferred by an external process rather than attaching to the evidence itself. While that assumption holds, the cycle stays long and the entry cost stays high.

Settlement as a Recognized Pair

Chapter 6 of the filing settles a bilateral exchange through a **matched pair (600)** of governed observations. A **governed observation** is a signed structure comprising, in sequence, an authority credential field, a continuity hash field encoding identity continuity of the emitting party, a spatial reference field, a temporal reference field, a time-to-live field encoding a validity duration, a payload field, and an observation lineage field carrying a cryptographic integrity attestation. An observation lacking a verifiable authority credential is not a governed observation within the meaning of the disclosure. Emission is complete upon emission: the emitting party requires no acknowledgment, no handshake, no delivery confirmation, and no registration with a central authority.

A matched pair comprises a **first governed observation (608)** representing an offer, tender, claim, demand, or commitment, and a **second governed observation (610)** from the other party representing an acceptance, counter-tender, acknowledgment, refusal, or fulfillment. The two are recognized as a pair by a pairing rule within one or more of a spatial proximity window and a **temporal proximity window (602)**, the rule requiring spatial coincidence, temporal coincidence, or both as the governing policy object declares. Pairing forms include a content-matching form over declared content fields, a cryptographic-handshake form, a derivation-chain form, and a sequence-ordered form.

Recognition produces a **settlement record (604)** containing the two signed observations, a cryptographic binding over both, and an attestation of the window within which the pair was recognized, verifiable by a downstream consumer from the record alone. A **settlement-lineage entry (606)** is appended to the append-only lineage field of each party, so each side reconstructs its own transaction history without recourse to the counterparty and without recourse to any registry.

Identity for pairing rests on continuity rather than enrollment. The continuity hash field carries a successor hash field, being the emitting party's dynamic agent hash at emission, and a continuity vector field, an ordered tuple of normalized projections of operational state. A trust-slope validator computes a consistency measure from the continuity vector field and no other field, over a declared tolerance window. A received observation is accepted on continuity only where two conditions hold together: the per-step distance against its predecessor does not exceed a declared per-step ceiling, and the measure is not less than a declared acceptance threshold. Both bounds are policy-declared and left unvalued in the filing.

Three negative conditions are stated explicitly. No clearing party, payment processor, platform adjudicator, or escrow party is required for a pair to settle. No quorum, ledger commit, or consensus round is a condition of settlement, and finality attaches upon recognition and admission of the pair. No account relationship, session key, standing channel, or prior enrollment is a precondition, and a party that has never encountered the counterparty may nonetheless form a pair.

What Changes on the Settlement Desk

Consider that same event under this architecture. The host network emits a governed observation as the usage occurs, bearing its authority credential and continuity hash, with a payload describing the chargeable event and a time-to-live field declaring how long the assertion stays valid. The home network emits its counterpart. The two are recognized as a matched pair under whichever pairing form the governing policy object

declares, most naturally a content-matching form over fields such as subscriber identity, session identifier, and duration. Settlement is that recognition and admission, which the disclosure conditions on no intermediary matching pass and no batch.

Two carriers are not physically co-located, so ordinary spatial-window forms do not apply. The disclosure anticipates that case: the spatial proximity window admits a **scope-partition form**, satisfied by a non-empty intersection of the scope-partition identifiers declared by the two observations where the parties operate without physical co-location. Where a party maintains several scope partitions, each with its own per-partition lineage record, a settlement implicating a partition of one party and a partition of the other is admissible only in the intersection of the two scopes, and the cross-partition settlement record is appended to the per-partition lineage record of each partition in that intersection and to no other. Where a carrier already divides its business along lines such as wholesale versus retail, region, or traffic class, those divisions supply candidate partition identifiers.

Latency and disconnection are treated as ordinary conditions. A first governed observation whose match has not arrived is an **orphan observation**, held in a deferral queue under a deferral-expiration parameter declared in the governing policy object and re-evaluated as further observations arrive. Deferred pairing completes where the second observation arrives while the orphan remains held, including where store-and-forward carried it across a disconnection, the pair then settling identically to an immediately recognized pair. While orphaned it settles nothing and binds no party.

Disagreement is where the shape departs furthest from the clearing model. A party that declines to complete a pairing emits the refusal as a **refusal observation**, itself a governed observation bearing that party's authority credential and referencing the observation refused. The refusal pairs with the offer it refuses and is recorded by both sides, and no party performs any adjudication of the merits as a condition of that recording. Emission of a refusal is instead metered against the refusing party's own **settlement-binding authorization**, by a refusal meter carried in its memory field,

incremented once per refusal by an increment declared in the governing policy object and accumulated over a declared window. Only responsive to that meter satisfying a declared bound is the refusing party's settlement-binding authorization written from a granting state to a withheld state, whereupon it binds no further settlements while its capacity to observe, to produce determinations, and to emit further refusals is preserved.

So reflexive rejection carries a cost to the refusing party, and it does so without anyone having to prove a refusal was wrong. The disclosure also forecloses the loading of a counterparty's meter: the refusal meter is incremented by the emission of a refusal observation and by nothing else. Initiating a dispute record, a resolution rendered by a dispute-resolution authority, a non-convergence in negotiation, a rejection for want of a partition intersection, a holding of an orphan observation, a timeout, and a failed fulfillment each increment no refusal meter. Timeouts are likewise neutral: neither the party whose observation went unanswered nor the party that did not answer incurs any adverse consequence.

Admissibility comes in grades, not a yes or a no. A settlement admissibility evaluator produces exactly one outcome from admit, gate, defer, solicit, reject, and escalate, a reject recording a reason classification such as insufficient authority, failed continuity validation, staleness, failed corroboration, or window violation. Evidential weight is a weighted sum of four declared factors: authority, continuity, freshness, and corroboration. A marginal record need not be refused outright, since where the evidential weight is less than a declared admission threshold the gate outcome admits the input at the product of that weight and a declared gate reduction factor.

Fitting It to a Live Network

None of this removes the need to produce accurate usage records. The mechanism governs how two independently produced assertions become a settled pair, not how either party measures. An operator with poor mediation quality will emit poor

observations, and the architecture will faithfully settle a matched pair of wrong numbers. Metering integrity remains a separate discipline.

Integration is bounded in a useful way. A governed observation is a signed structure with a defined field sequence, so one plausible adoption path is a mediation-adjacent component that wraps existing rated event output in the credential, continuity hash, spatial and temporal reference, time-to-live, payload, and lineage fields, then emits. Existing record formats need not be displaced, since the payload field encodes the content of the observation. Because emission requires no acknowledgment or registration, a carrier can begin emitting before any counterparty is ready to pair, and those observations simply sit unpaired.

The real prerequisite is credential infrastructure. Authority credentials are issued by a deploying authority under an authority taxonomy specifying, at each level, a behavioral-response mapping, a mutation-admission specification, an evidential-weight specification, and a supersession specification. Somebody must stand that taxonomy up. The disclosure guards the self-dealing case: where an escalation credential was self-issued, the receiving party applies a self-escalation discount factor declared in the governing policy object, greater than zero and not exceeding unity, and excludes the observation from the corroboration factor and convergence count, so a party is incapable of corroborating or escalating its own input. That answers self-issuance, not who should issue.

Divergent policy is accommodated, not prevented. Where the parties resolve different policy objects, each applies its own, so two operators can run different windows and thresholds without negotiating them jointly. Some inputs will then admit for one evaluator and gate for the other.

The architecture does not adjudicate. A settled pair is subject to challenge only through a credentialed dispute procedure, in which a dispute record is initiated by either settled party under its authority credential, evaluated for admissibility against declared time

limits, an authority scope enclosing the action class, and standing, then routed to a dispute-resolution procedure declared in the governing policy object, such as authority adjudication, arbitration, regulatory review, legal-system procedures, peer mediation, or algorithmic resolution.

Records are not deleted. A settlement-lineage entry is neither removed nor modified, a subsequent reversal or amendment being itself appended, and a rollback record removes no entry of the lineage field. Where a counterparty record must be made less persistent, that demotion is effected only as a matched pair, one party proposing and the counterparty accepting, and the demotion record itself persists, so that what is forgotten is the record content and not the fact of the forgetting.

Several parameters an implementer will want numbers for are, in the filing, declared rather than valued: the proximity and time windows, the continuity ceiling and acceptance threshold, the refusal increment and bound, the escrow-depth bound, the retry bound, and the deferral-expiration parameter.

Disclosure Scope

The architecture described here is disclosed in Chapter 6, Matched-Pair Settlement, of U.S. Provisional Application No. 64/117,812. That chapter covers the governed observation and its authority credential, the matched pair and the pairing rule, the three negative conditions, identity by continuity, failed pairings, the settlement-lineage entry, metered non-acceptance, deferred pairing, escrow and settlement in the intersection of scope partitions, bilateral demotion, chained settlement, composite admissibility, and credentialed dispute resolution. Other chapters of the same filing govern other subjects and are not described here.

This article applies that disclosure to telecommunications inter-carrier settlement. It is offered as a public, timestamped description of the approach and does not name or characterize any operator, vendor, or product. The application is pending.

Governed Matched-Pair Settlement

[All 49 steps → \(/inventive-steps\)](#)

(/governed-settlement)

Two agents settle on matched signed observations, by continuity, with no clearer.

Provisional application

PRIMARY TECHNICAL DISCLOSURE

- [Matched-Pair Settlement Between Agents: Bilateral Closure Without a Clearer \(/articles/governed-settlement/matched-pair-settlement-without-a-clearer\)](#).

SECONDARY TECHNICAL

- [The Derived-Artifact Provenance Chain and Chain-Head Identifier \(/articles/governed-settlement/derived-artifact-provenance-chain\)](#).
- [Provenance Withdrawal and the Provenance-Withdrawn Attribute \(/articles/governed-settlement/provenance-withdrawal\)](#).
- [Matched-Pair-Gated Corpus Contribution \(/articles/governed-settlement/matched-pair-gated-corpus-contribution\)](#).
- [Partition-Scoped Escrow Release Gated on Intersection Non-Emptiness \(/articles/governed-settlement/partition-scoped-escrow-release\)](#).
- [The First-Encounter Settled Pair and Promotion to the Persistent Tier \(/articles/governed-settlement/first-encounter-settled-pair\)](#).
- [Contribution Encumbrance on Severance or Quarantine: Governing Dispatch to Models Trained on a Severed Counterparty's Corpus Without Retraining or Deletion \(/articles/governed-settlement/contribution-encumbrance-severance-quarantine\)](#).
- [Encumbrance Bounds That Bar Persistence Promotion and Onward Tool-Source Emission Once the Per-Endpoint Count Exceeds the Bound \(/articles/governed-settlement/encumbrance-bound-barring-promotion-onward-emission\)](#).
- [Blinded Encumbrance Commitments: Carrying a Severed Contributor's Encumbrance Along With an Inference Endpoint Emitted to a Peer Agent \(/articles/governed-settlement/encumbrance-commitment-travelling-emitted-endpoint\)](#).
- [Release of a Contribution Encumbrance: Matched-Pair Re-Admission or a Substitution With an Empty Intersection \(/articles/governed-settlement/release-contribution-encumbrance\)](#).
- [Registering Third-Party Reliance on a Settled Matched Pair: The Reliance Record and the Settled-Party Reliance Register \(/articles/governed-settlement/reliance-record-registered-settled-parties\)](#).

- [Conditioning a Settlement Reversal on a Reliance-Completeness Predicate Evaluated Over the Reverting Party's Own Reliance Register \(/articles/governed-settlement/reliance-completeness-predicate-conditioning-reversal\)](/articles/governed-settlement/reliance-completeness-predicate-conditioning-reversal)
- [The Relying Party's Reversal Mark: Barring a Reversed Settlement as a Determination Input and Re-Resolving the Determination That Consumed It \(/articles/governed-settlement/relying-party-reversal-mark-and-re-resolution\)](/articles/governed-settlement/relying-party-reversal-mark-and-re-resolution)
- [Transitive Reliance Records and the Reliance Chain: Registering Second-Order Dependency on a Settlement Without Any Party Enumerating the Whole Chain \(/articles/governed-settlement/transitive-reliance-record-reliance-chain\)](/articles/governed-settlement/transitive-reliance-record-reliance-chain)
- [Transitive Reversal Notices That Carry a Settlement Reversal One Hop at a Time Along a Reliance Chain No Party Enumerates \(/articles/governed-settlement/one-hop-propagation-reversal-along-reliance\)](/articles/governed-settlement/one-hop-propagation-reversal-along-reliance)
- [Contested Pairing in Matched-Pair Settlement: Withheld Recognition, a Distinct-Identity Claimant Count, and the Not-Determinable Resolution \(/articles/governed-settlement/contested-pairing-not-determinable-resolution\)](/articles/governed-settlement/contested-pairing-not-determinable-resolution)
- [Attributable Contest Resolution: Settling a Contested Offer by Re-Emitting a First Governed Observation That Names Exactly One Claimant \(/articles/governed-settlement/attributable-contest-resolution-named-re-emission\)](/articles/governed-settlement/attributable-contest-resolution-named-re-emission)
- [Local Outcome-Quality Records and Smoothed Endpoint Selection Preference for Governed Inference Dispatch \(/articles/governed-settlement/outcome-quality-record-endpoint-selection-preference\)](/articles/governed-settlement/outcome-quality-record-endpoint-selection-preference)

APPLICATIONS • GENERAL

- [B2B Agent Commerce: Bilateral Settlement Without a Clearing House \(/articles/governed-settlement/b2b-agent-commerce-settlement\)](/articles/governed-settlement/b2b-agent-commerce-settlement)
- [Supply Chain Handoffs: Settling a Transfer on Matched Observations \(/articles/governed-settlement/supply-chain-agent-handoffs\)](/articles/governed-settlement/supply-chain-agent-handoffs)
- [Carrier Roaming Settlement Without a Central Clearing House \(/articles/governed-settlement/carrier-roaming-settlement\)](/articles/governed-settlement/carrier-roaming-settlement)

APPLICATIONS • SPECIFIC

- [ISO 20022 and Settlement Messaging: Matched Pairs in Financial Infrastructure \(/articles/governed-settlement/iso-20022-settlement-messaging\)](/articles/governed-settlement/iso-20022-settlement-messaging)
- [Stripe Agent Toolkit: Agent Payments and the Settlement Layer \(/articles/governed-settlement/stripe-agent-toolkit\)](/articles/governed-settlement/stripe-agent-toolkit)
- [Visa Intelligent Commerce: Mandates, Trust, and Bilateral Settlement \(/articles/governed-settlement/visa-intelligent-commerce\)](/articles/governed-settlement/visa-intelligent-commerce)

- [Mastercard Agent Pay: Tokenized Agent Identity and Settlement \(/articles/governed-settlement/mastercard-agent-pay\)](/articles/governed-settlement/mastercard-agent-pay).
- [Coinbase x402: Machine-Native Payments and Governed Settlement \(/articles/governed-settlement/coinbase-x402\)](/articles/governed-settlement/coinbase-x402).
- [Skyfire: Agent Payment Rails and Counterparty Conduct Records \(/articles/governed-settlement/skyfire-payments\)](/articles/governed-settlement/skyfire-payments).

TERMINOLOGY

- [governed observation \(/glossary#governed-observation\)](/glossary#governed-observation)
- [matched pair \(/glossary#matched-pair\)](/glossary#matched-pair)
- [scope partition \(/glossary#scope-partition\)](/glossary#scope-partition)

[Governed Matched-Pair Settlement overview → \(/governed-settlement\)](/governed-settlement).