

Overview of the "Variant Bundle" Framework

To comply with the Same Entity Allocation principle, our system treats a domain registration and its associated variants as a single logical entity called a "Variant Bundle." The system ensures that for any registered second-level label ($s1$) under a specific TLD ($t1$), all allocatable variants ($s1, s1v2, \dots$) across all allocated variant TLD labels ($t1, t1v1, \dots$) are strictly bound to the same registrant or withheld exclusively for them.

Cross-TLD Matrix Calculation

When a registration request is received, the LGR Engine performs a multi-dimensional calculation to identify the full scope of the variant set:

- Second-Level (SLD) Expansion: Based on the SLD LGR table, the system generates the set of all allocatable second-level variants $\{s1, s1v1, \dots\}$.
- Top-Level (TLD) Expansion: The system identifies all associated variant TLD labels $\{t1, t1v1, \dots\}$.
- Matrix Mapping: The system generates a matrix of all possible combinations (e.g., $s1.t1, s1.t1v1, s1v1.t1, s1v1.t1v1$). All labels within this matrix are managed under a single Bundle ID in the Registry database.

Implementation of the "Same Entity" Binding

Our system enforces the Same Entity requirement through the following technical mechanisms:

Entity Binding via Bundle ID: Upon the first registration of any label in the set, the system creates a Bundle ID that is permanently linked to a unique Registrant Entity.

Same Registrar Enforcement & Contact ID Validation:

- Primary Identifier (`<contact:id>`): When the registrar provides a standard EPP `<contact:id>` (Registrant Contact ID, per RFC 5733) in the `<create>` command, the system uses this `<contact:id>` as the primary identifier to validate and enforce the Same Entity requirement.
- PII-based Fingerprint (Supplementary): Operating under the Thick registry data model, our system receives registrant contact information (PII, such as email address) via standard EPP commands. The system calculates a cryptographic hash of key PII attributes to generate a supplementary fingerprint, ensuring robust and precise identification of the underlying registrant entity.
- Same Registrar Principle: Because `<contact:id>` is registrar-scoped, the system strictly enforces the ICANN gTLD policy that all domains within a Variant Bundle must be sponsored by the Same Registrar. Cross-registrar variant allocation is not supported. If a registrar attempts to register a variant label that belongs to a Bundle

held at a different registrar, or with a different <contact: id> at the same registrar, the system rejects the EPP <create> command with Error 2306 (Parameter value policy error).

Mandatory Withholding: Any allocatable variant label in the set that is not actively registered is automatically placed in a "Withheld for Same Entity" state. These labels are removed from the general availability pool and can only be activated by the holder of the Bundle ID.

Lifecycle Synchronization and Policy Enforcement

To prevent ownership fragmentation, the system enforces strict synchronization across the entire life cycle of the Variant Bundle:

- **Atomic Transfer:** The system does not allow individual variant labels to be transferred to different registrants. A Bundle Transfer policy is enforced: if one domain in the set is transferred, all associated registered variants must be transferred to the same gaining entity simultaneously.
- **Synchronized Registrant Updates (Trade):** Any update to the registrant contact information (the "entity") for one domain in the bundle is automatically propagated to all other registered domains within the same bundle.
- **Coordinated Expiration and Deletion:** To avoid "cherry-picking" of variants by third parties, the system synchronizes expiration dates where applicable. If the primary registration is deleted or purged, the withheld status for all associated variants is released only at the same time, following the standard pending-delete cycle.

EPP and Backend Validation Logic

- **EPP <check> Validation:** When a registrar performs a <check> on a variant label (e.g., *s1v1.t1v1*), the system verifies the Bundle ID. If the bundle is already "owned" by an entity, the check returns available="0".
- **EPP <create> Authorization:** During a <create> request for a withheld variant, the Registry backend validates that the Registrant Contact ID (or the verified identity of the registrant) matches the entity currently bound to the Bundle ID.
- **Database Constraints:** At the schema level, the database utilizes unique constraints and relational triggers to ensure that no two different Account IDs can ever be associated with labels belonging to the same Bundle ID.

Compliance with ICANN Policy

By implementing this Matrix-based Bundle Management, the RSP ensures that:

- All $\{s1, s1v1, \dots\}$ under $\{t1, t1v1, \dots\}$ are either allocated to the Same Entity or Withheld for that entity.
- No variant can be "hijacked" by a third party.
- The integrity of the IDN namespace is maintained across all variant TLDs operated by the RSP.