Diagrama Entidad-Relación - Marketplace Inmobiliario

Esquema General de la Base de Datos

```
erDiagram
    %% Core Entities
    USERS {
        uuid id PK
        citext email UK
        text password_hash
        text first_name
        text last_name
        text phone
        core_user_role role
        boolean email_verified
        timestamptz created_at
        timestamptz updated_at
    }

    AGENCIES {
        uuid id PK
        text name
        text license_number UK
        text description
        text website
        text email
        text phone
        timestamptz created_at
        timestamptz updated_at
    }

    USER_AGENCY {
        uuid user_id PK,FK
        uuid agency_id PK,FK
    }

    %% Listings (Partitioned)
```

```
LISTINGS {
    uuid id PK
    timestamptz created_at PK
    uuid owner_user_id FK
    uuid agency_id FK
    core_listing_status status
    core_operation_type operation
    core_property_type property_type
    text title
    text description
    numeric price
    char currency
    smallint bedrooms
    smallint bathrooms
    smallint parking_spaces
    numeric area_m2
    smallint year_built
    text address
    text district
    text province
    text country
    numeric latitude
    numeric longitude
    core_verification_status verification_status
    boolean is_featured
    boolean is_premium
    timestamptz published_at
    timestamptz expires_at
    timestamptz updated_at
    tsvector search_doc
    text slug UK
}

LISTING_IMAGES {
    uuid id PK
    uuid listing_id FK
    timestamptz listing_created_at FK
    text image_url
    text alt_text
    integer display_order
    boolean is_primary
    timestamptz created_at
}
```

```
LISTING_VIDEOS {
    uuid id PK
    uuid listing_id FK
    timestamptz listing_created_at FK
    text video_url
    text title
    integer duration_seconds
    timestamptz created_at
}

%% Amenities
AMENITIES {
    serial id PK
    text name UK
    text icon
}

LISTING_AMENITIES {
    uuid listing_id PK,FK
    timestamptz listing_created_at PK,FK
    integer amenity_id PK,FK
}

%% User Interactions (Partitioned)
LEADS {
    uuid id PK
    timestamptz created_at PK
    uuid listing_id FK
    timestamptz listing_created_at FK
    uuid user_id FK
    text contact_name
    text contact_phone
    citext email
    text message
    text utm_source
    text utm_medium
    text utm_campaign
    text utm_term
    text utm_content
}

FAVORITES {
    uuid user_id PK,FK
    uuid listing_id PK,FK
```

```
        timestamptz listing_created_at PK,FK
        timestamptz created_at
    }

    SEARCH_ALERTS {
        uuid id PK
        uuid user_id FK
        text name
        jsonb search_criteria
        text frequency
        boolean is_active
        timestamptz last_run
        timestamptz created_at
    }

    %% Analytics (Partitioned)
    EVENTS {
        uuid id PK
        timestamptz created_at PK
        uuid user_id FK
        text session_id
        text event_type
        uuid listing_id FK
        timestamptz listing_created_at FK
        jsonb properties
        inet ip_address
        text user_agent
    }

    %% Moderation (Partitioned)
    VERIFICATIONS {
        uuid id PK
        timestamptz created_at PK
        uuid listing_id FK
        timestamptz listing_created_at FK
        moderation_verification_status status
        uuid assigned_to FK
        text rejection_reason
        text notes
        timestamptz updated_at
    }

    %% Security & Audit
    AUDIT_LOG {
```

```
        uuid id PK
        uuid user_id FK
        text action
        text table_name
        uuid record_id
        jsonb old_values
        jsonb new_values
        inet ip_address
        text user_agent
        timestamptz created_at
    }

    USER_SESSIONS {
        uuid id PK
        uuid user_id FK
        text token_hash UK
        inet ip_address
        text user_agent
        timestamptz last_activity
        timestamptz expires_at
        timestamptz created_at
        timestamptz revoked_at
    }

    USER_CONSENTS {
        uuid id PK
        uuid user_id FK
        text purpose
        boolean granted
        timestamptz granted_at
        timestamptz withdrawn_at
        inet ip_address
        text user_agent
    }

    FAILED_LOGINS {
        uuid id PK
        citext email
        inet ip_address
        text user_agent
        text failure_reason
        timestamptz created_at
    }
```

```
%% Subscriptions & Billing
PLANS {
    uuid id PK
    text code UK
    text name
    text description
    text tier
    smallint period_months
    numeric price_amount
    char price_currency
    integer max_active_listings
    integer listing_active_days
    integer max_images_per_listing
    integer max_videos_per_listing
    integer max_video_seconds
    boolean is_active
    timestamptz created_at
    timestamptz updated_at
}

SUBSCRIPTIONS {
    uuid id PK
    uuid user_id FK
    uuid plan_id FK
    core_subscription_status status
    timestamptz starts_at
    timestamptz ends_at
    timestamptz canceled_at
    timestamptz created_at
    timestamptz updated_at
}

INVOICES {
    uuid id PK
    text number UK
    uuid user_id FK
    uuid subscription_id FK
    uuid plan_id FK
    char currency
    numeric amount_due
    numeric tax_amount
    numeric discount_amount
    numeric amount_paid
    core_invoice_status status
```

```
        uuid tax_rate_id FK
        uuid coupon_id FK
        timestamptz issued_at
        timestamptz due_at
        timestamptz paid_at
        timestamptz created_at
        timestamptz updated_at
    }

    PAYMENTS {
        uuid id PK
        uuid invoice_id FK
        uuid user_id FK
        char currency
        numeric amount
        core_payment_status status
        core_billing_provider provider
        text provider_payment_id
        jsonb provider_data
        text failure_reason
        timestamptz processed_at
        timestamptz created_at
        timestamptz updated_at
    }

    %% Relationships with composite FKs for partitioned tables
    USERS ||--o{ USER_AGENCY : "belongs to"
    AGENCIES ||--o{ USER_AGENCY : "has members"

    USERS ||--o{ LISTINGS : "owns"
    AGENCIES ||--o{ LISTINGS : "manages"

    LISTINGS ||--o{ LISTING_IMAGES : "has (composite FK)"
    LISTINGS ||--o{ LISTING_VIDEOS : "has (composite FK)"
    LISTINGS ||--o{ LISTING_AMENITIES : "has (composite FK)"
    AMENITIES ||--o{ LISTING_AMENITIES : "belongs to"

    USERS ||--o{ LEADS : "generates"
    LISTINGS ||--o{ LEADS : "receives (composite FK)"

    USERS ||--o{ FAVORITES : "marks"
    LISTINGS ||--o{ FAVORITES : "favorited by (composite FK)"

    USERS ||--o{ SEARCH_ALERTS : "creates"
```

```
    USERS ||--o{ EVENTS : "generates"
    LISTINGS ||--o{ EVENTS : "subject of (composite FK)"

    LISTINGS ||--o{ VERIFICATIONS : "verified by (composite FK)"
    USERS ||--o{ VERIFICATIONS : "assigned to"

    USERS ||--o{ AUDIT_LOG : "actions by"
    USERS ||--o{ USER_SESSIONS : "has"
    USERS ||--o{ USER_CONSENTS : "grants"

    USERS ||--o{ SUBSCRIPTIONS : "subscribes to"
    PLANS ||--o{ SUBSCRIPTIONS : "basis for"

    USERS ||--o{ INVOICES : "billed to"
    SUBSCRIPTIONS ||--o{ INVOICES : "generates"
    PLANS ||--o{ INVOICES : "for plan"

    INVOICES ||--o{ PAYMENTS : "paid by"
    USERS ||--o{ PAYMENTS : "made by"
```

Tablas Particionadas

Particionado por fecha (RANGE)

Las siguientes tablas están particionadas mensualmente por `created_at`:

- **core.listings**: PRIMARY KEY (id, created_at)
- **core.leads**: PRIMARY KEY (id, created_at)
- **analytics.events**: PRIMARY KEY (id, created_at)
- **moderation.verifications**: PRIMARY KEY (id, created_at)

Estrategia de particionado

```
-- Ejemplo: Particiones de listings por mes
core.listings_2025_01  -- Enero 2025
core.listings_2025_02  -- Febrero 2025
core.listings_2025_03  -- Marzo 2025
-- ... etc
```

Foreign Keys Compuestas

Requisito PostgreSQL 17.x

Todas las referencias a tablas particionadas requieren FK compuestas:

```
-- Patrón para FK a tablas particionadas
FOREIGN KEY (listing_id, listing_created_at)
REFERENCES core.listings (id, created_at)
```

Tablas con FK Compuestas

- **core.listing_images**: (listing_id, listing_created_at)
- **core.listing_videos**: (listing_id, listing_created_at)
- **core.listing_amenities**: (listing_id, listing_created_at)
- **core.leads**: (listing_id, listing_created_at)
- **core.favorites**: (listing_id, listing_created_at)
- **analytics.events**: (listing_id, listing_created_at) - referencia
- **moderation.verifications**: (listing_id, listing_created_at)

Índices Principales

Core Tables

- **listings**: (status, verification_status, published_at), (operation, property_type, price), GIN(search_doc)
- **users**: (email), (role), (email_verified)
- **agencies**: (license_number)

Analytics & Performance

- **events**: (user_id, created_at), (event_type, created_at), (listing_id, listing_created_at)
- **leads**: (listing_id, listing_created_at), (email), (contact_phone)

Security

- **audit_log**: (user_id, created_at), (table_name, record_id)
- **user_sessions**: (user_id, expires_at), (token_hash)

Vistas Materializadas

Analytics

- **mv_price_m2_90d**: Precios promedio por m^2 últimos 90 días
- **mv_leads_daily**: Leads diarios por distrito

Performance

- Actualización programada cada hora
- Índices específicos para consultas frecuentes
- Refresh concurrente para evitar bloqueos

Consideraciones de Seguridad

Datos Personales (Ley 29733)

- Consentimientos granulares por propósito
- Derecho al olvido implementado
- Auditoría completa de accesos

Autenticación

- Sesiones con tokens hash seguros
- Tracking de dispositivos
- Auto-expiración configurable

Monitoring

- Log de intentos fallidos de login
- Alertas por actividad sospechosa
- Backup automático de audit logs