

# Low Level Design

## Validation Development

### Basic Plot Validations

#### XLSForm

Field	Value	Description
type	text	
name	validate_polygon	
required	true	
appearance	ex:org.akvo.afribamodkvalidator.VALIDATE_POLYGON(shape=\${target_field})	
constraint	. = \${manual_boundary}	
constraint_message	Please revalidate by clicking "Launch" button	

Full source: [Spreadsheet - African Bamboo B.V. Parcel Boundary Mapping](#)

### Geometry Validation Logic and Response

The following describes various validation scenarios and error messages related to plot/boundary recording in forms:

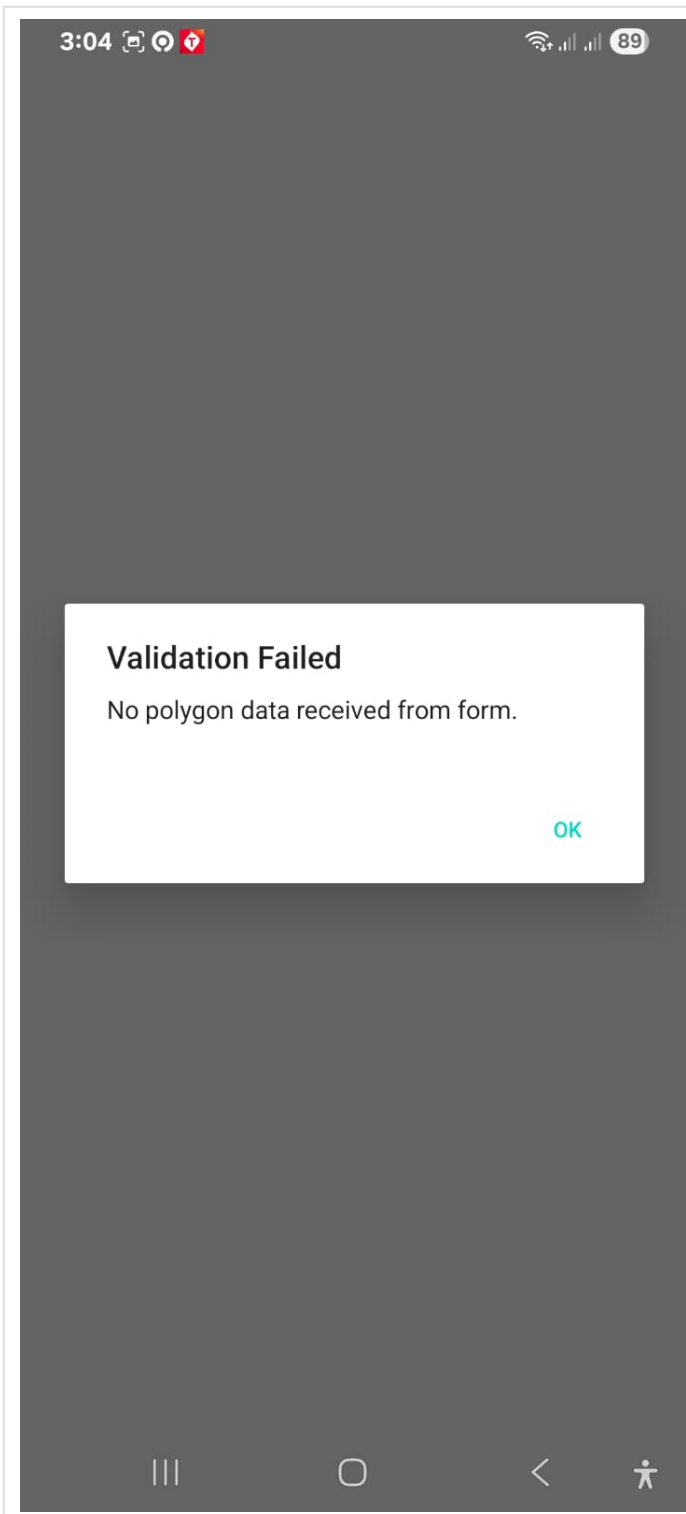
ODK External Validation Screen	Description
--------------------------------	-------------

**\* Validate Boundary**

Please press the "Launch" button to validate the plot you have recorded. This field is required to proceed with the validation action.

 Launch Sorry, this response is required! < Back Next >**GV.1 - Required Field Error**

The validation field for the plot is mandatory. When the user presses the continue button without taking any action (such as pressing the launch button to record a plot), an error message will appear: *"Sorry, this response is required!"*



## GV.2 - Empty or Null Plot Error

This error message appears if:

- The recorded plot/boundary is empty, OR
- The polygon field is not set as mandatory and results in a null value

12:21

100

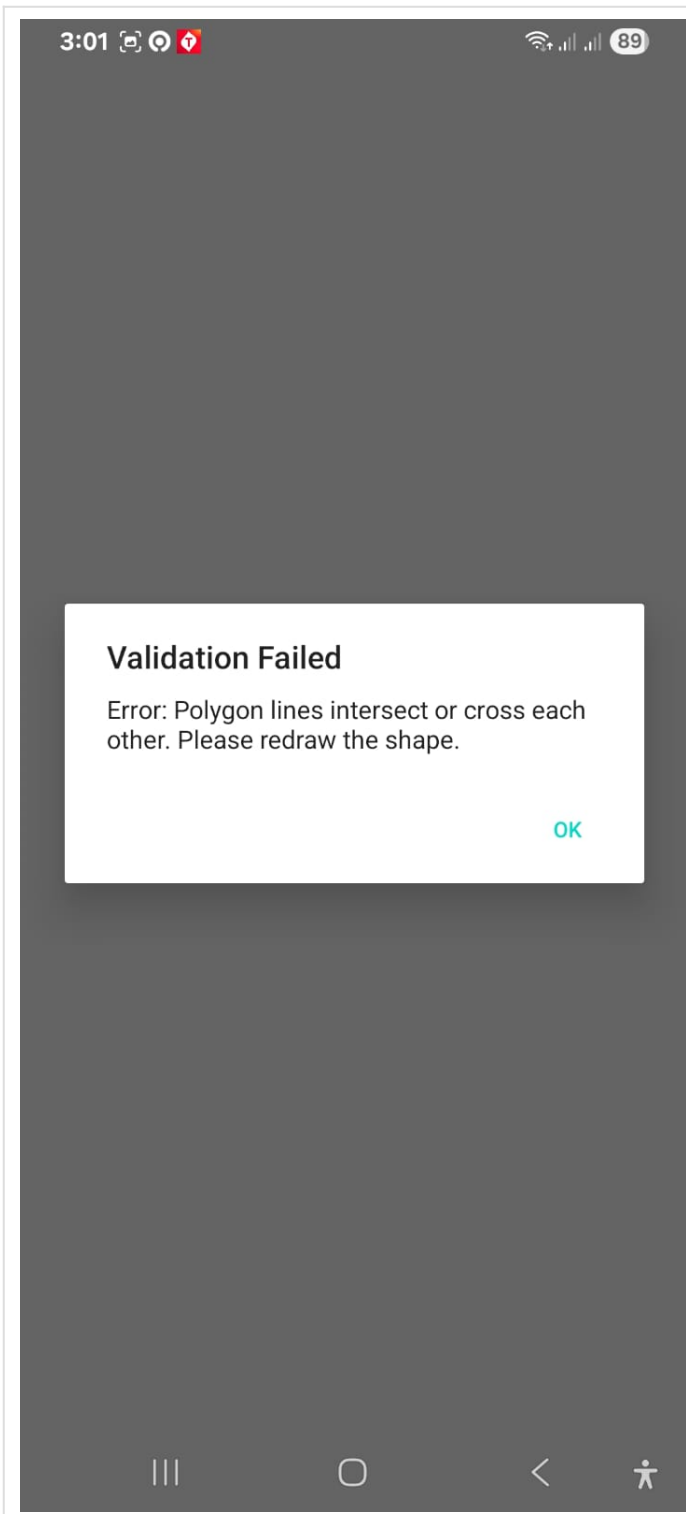
### Validation Failed

Error: Polygon area is too small. Minimum required: 10 square meters.

OK

### GV.3 - Minimum Area Error

This error message appears if the drawn/recorded plot is too small, with an area of less than **10 square meters**.



#### GV.4 - Invalid Geometry Error


This error message appears if the drawn/recorded plot/boundary has **overlapping lines** or self-intersecting geometry, which does not meet valid polygon criteria.

**\* Validate Boundary**

Please press the "Launch" button to validate the plot you have recorded. This field is required to proceed with the validation action.



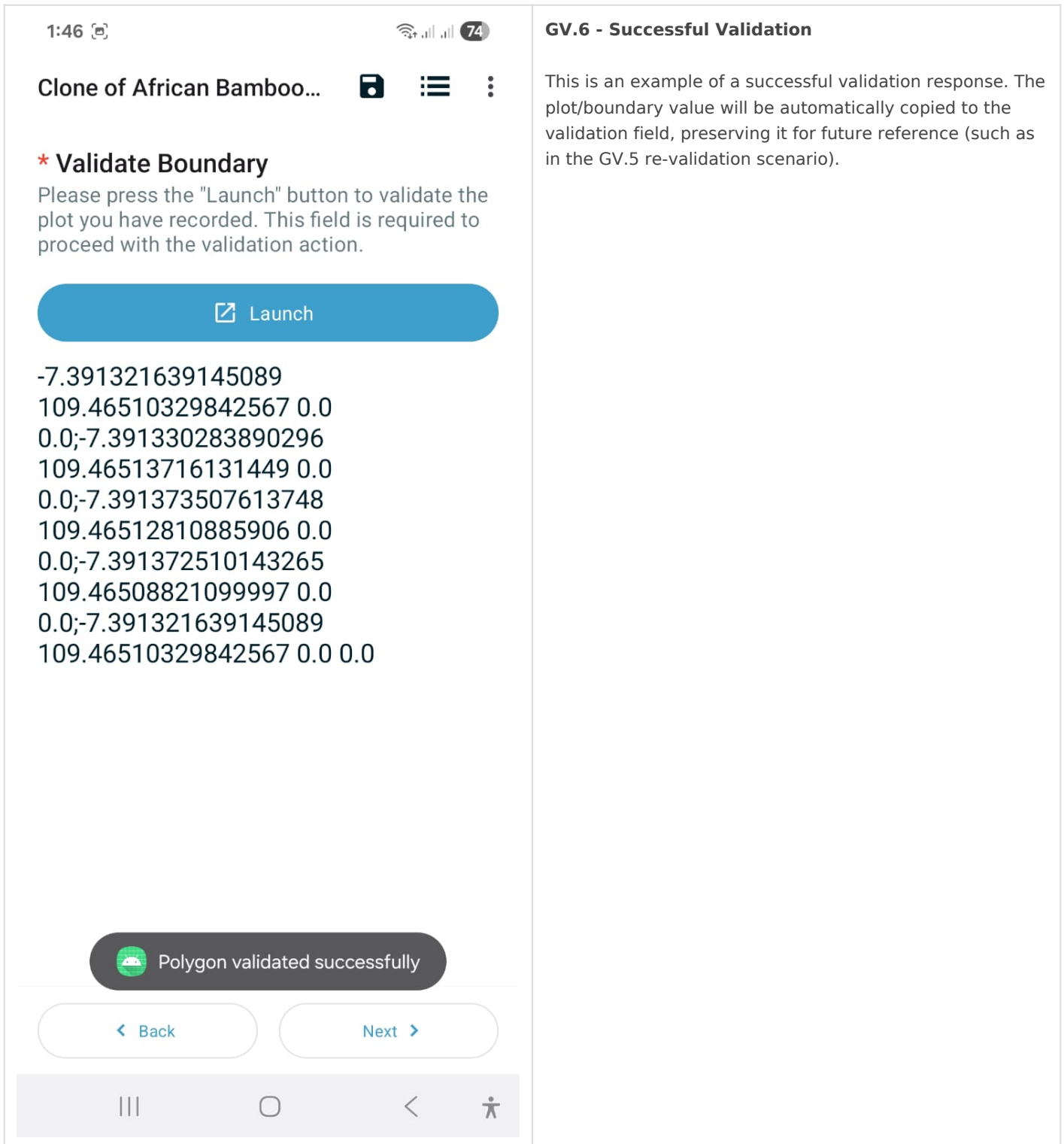
-7.3913080070465496  
109.46510329842567 0.0  
0.0;-7.391373175123587  
109.46508251130581 0.0  
0.0;-7.391385809749659  
109.46513883769512 0.0  
0.0;-7.391312329419305  
109.46515660732985 0.0  
0.0;-7.3913080070465496  
109.46510329842567 0.0 0.0

 Please revalidate by selecting the "Launch" button. The current boundary value differs from the previous valid plot.

**GV.5 - Re-validation Required Error**

This error message appears when:

- The user has already validated a valid plot/boundary
- They navigate back to a previous question to re-record the plot/boundary
- Validation needs to be performed again to ensure the plot remains valid



# Application Development

## 1. Overview

The African Bamboo - ODK External Validations is an Android client for KoboToolbox API integration. It downloads form submissions, stores them locally, and supports incremental sync for offline access.

## Implementation Progress

Component	Status	Notes
Authentication	☐ Complete	Encrypted storage with BasicAuth
API Integration	☐ Complete	Pagination, delta sync
Database	☐ Complete	Room with hybrid schema
All 6 Screens	☐ Complete	Jetpack Compose + Material 3
Navigation	☐ Complete	Type-safe routes
ViewModels	☐ Complete	StateFlow/MVVM
Geoshape Display	☐ Planned	Map thumbnails not yet implemented
Testing	☐☐ Minimal	Test skeletons only

## 2. API Integration

### Endpoint

```
GET /api/v2/assets/{asset_uid}/data.json
```

### Authentication

**Implementation:** `BasicAuthInterceptor.kt`

- Uses HTTP Basic Auth via OkHttp Interceptor
- Credentials stored in `EncryptedSharedPreferences`
- Dynamic base URL support for custom Kobo instances

### Pagination

**Implementation:** `KoboRepository.kt`

- Page size: `limit=10`
- Cursor-based: follows `next` URL until null
- All pages inserted within single transaction

### Delta Sync (Resync)

**Query Parameter:**

```
query={"_submission_time": {"$gte": "{last_sync_timestamp}"}}
```

- Timestamp format: ISO 8601 (UTC)
- Stored in `FormMetadataEntity.lastSyncTimestamp`

## 3. Data Model & Database Schema

### Architecture Decision: Hybrid Storage

Instead of form-specific columns, we use:

- **Typed columns** for system fields (`_uuid`, `submissionTime`, `submittedBy`)
- **JSON blob** (`rawData`) for all form answers

This enables support for any KoboToolbox form without schema changes.

#### Entity: `SubmissionEntity`

**File:** `data/entity/SubmissionEntity.kt`

Field	Type	Source	Description
<code>_uuid</code>	String (PK)	<code>_uuid</code>	Unique submission identifier
<code>assetUid</code>	String	Form ID	Links submission to form
<code>_id</code>	Int	<code>_id</code>	Kobo's internal ID
<code>submissionTime</code>	Long	<code>_submission_time</code>	Parsed ISO 8601 → timestamp
<code>submittedBy</code>	String?	<code>_submitted_by</code>	Username of submitter
<code>instanceName</code>	String?	<code>meta/instanceName</code>	Form instance name
<code>rawData</code>	String	Full JSON	Complete submission payload
<code>systemData</code>	String?	Extracted	Geolocation, tags, etc.

**Indices:** `assetUid`, `submissionTime`, `instanceName`, `_uuid`

#### Entity: `FormMetadataEntity`

**File:** `data/entity/FormMetadataEntity.kt`

Field	Type	Description
<code>assetUid</code>	String (PK)	Form identifier

Field	Type	Description
lastSyncTimestamp	Long	Last successful sync time

## DAOs

### SubmissionDao (data/dao/SubmissionDao.kt)

- insertAll(), insert() - Bulk/single insert with REPLACE
- getSubmissions(assetUid): Flow<List> - Reactive list
- getByUuid(uuid) - Single submission lookup
- getCount(assetUid) - Total count
- getLatestSubmissionTime(assetUid) - For display
- deleteByAssetUid(), deleteAll() - Cleanup

### FormMetadataDao (data/dao/FormMetadataDao.kt)

- insertOrUpdate() - Upsert pattern
- getLastSyncTimestamp(assetUid) - For delta sync

## 4. Screen Specifications

### Screen 1: Login

**File:** ui/screen/LoginScreen.kt **ViewModel:** LoginViewModel.kt

Element	Implementation
Username field	Text input, required
Password field	Password input, obscured
Server URL	Text, default: https://eu.kobotoolbox.org
Form ID	Text, required
Submit button	"Download Data"

#### Workflow:

1. Validate all fields non-empty
2. Save credentials to EncryptedSharedPreferences
3. Navigate to Loading screen (DOWNLOAD type)

**Note:** Original spec called for /token endpoint. Implementation uses BasicAuth directly—no token exchange needed.

### Screen 2: Download Loading

**File:** `ui/screen/LoadingScreen.kt` **ViewModel:** `LoadingViewModel.kt`

Element	Implementation
Spinner	CircularProgressIndicator
Message	"Downloading data..."
Error state	Retry + Back to Login buttons

### Logic:

1. Construct URL: `{server_url}/api/v2/assets/{form_id}/data.json`
2. Fetch all pages (limit=10, follow `next`)
3. Transform JSON → `SubmissionEntity` list
4. Batch insert to Room
5. Store `lastSyncTimestamp`
6. Navigate to Download Complete with metrics

## Screen 3: Download Complete

**File:** `ui/screen/DownloadCompleteScreen.kt`

Element	Implementation
Total entries	Passed via navigation args
Latest submission	Formatted date string
"View Data" button	Navigate to Home
"Resync Data" button	Navigate to Loading (RESYNC)

## Screen 4: Home/Dashboard

**File:** `ui/screen/HomeDashboardScreen.kt` **ViewModel:** `HomeViewModel.kt`

Element	Implementation
Submission list	<code>LazyColumn</code> with <code>Flow&lt;List&gt;</code>
Search	TopAppBar search field
Sort	Bottom sheet (Name A-Z/Z-A, Date New/Old)
Resync FAB	Navigate to Loading (RESYNC)
Logout	Menu option with confirmation
Item click	Navigate to Submission Detail

**Geoshape Indicator:**  Not yet implemented. LLD specified map thumbnails or "Map Available" badge.

## Screen 5: Resync Loading

**File:** `ui/screen/LoadingScreen.kt` (shared with Download)

Element	Implementation
Spinner	CircularProgressIndicator
Message	"Syncing data..."

### Delta Sync Logic:

1. Get `lastSyncTimestamp` from `FormMetadataDao`
2. API call with `query` parameter (dates  $\geq$  timestamp)
3. Diff against local:
  - **Added:** `_uuid` not in Room  $\rightarrow$  Insert
  - **Updated:** `_uuid` exists AND remote `submissionTime`  $>$  local  $\rightarrow$  Update
4. Count added/updated records
5. Update `lastSyncTimestamp` to now
6. Navigate to Sync Complete with counts

## Screen 6: Sync Complete

**File:** `ui/screen/SyncCompleteScreen.kt`

Element	Implementation
Added records	Count from sync
Updated records	Count from sync
Latest sync time	Current timestamp
"Return to Dashboard"	Navigate to Home

## Screen 7: Submission Detail

**File:** `ui/screen/SubmissionDetailScreen.kt` **ViewModel:** `SubmissionDetailViewModel.kt`

Element	Implementation
Title	Instance name or formatted date
Submitted on	Formatted timestamp
Submitted by	Username
Answers list	Parsed from <code>rawData</code> JSON

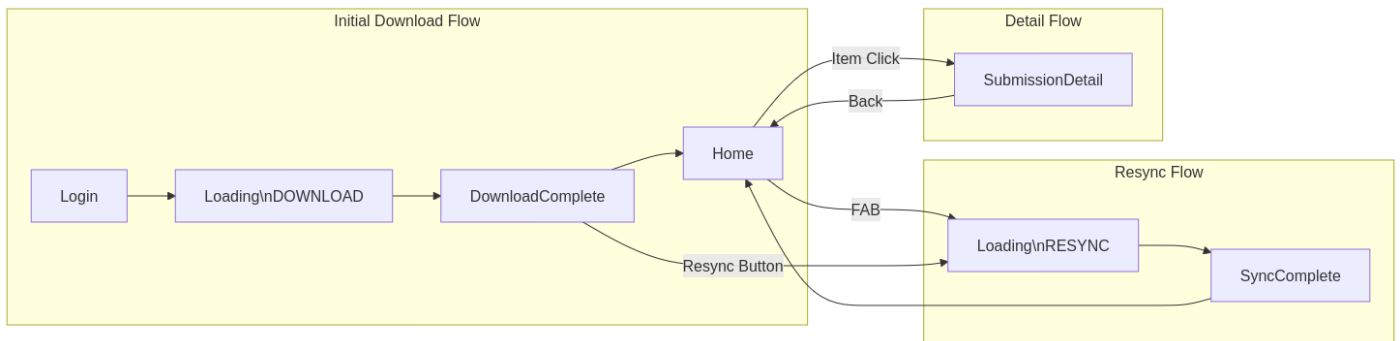
### Answer Parsing:

- Filters out system fields (prefix `_`, `meta`, `formhub`)

- Converts `snake_case` keys to `Title Case` labels
- Handles all JSON types (primitives, arrays, objects)

## 5. Navigation

**File:** `navigation/Routes.kt`, `navigation/AppNavHost.kt`

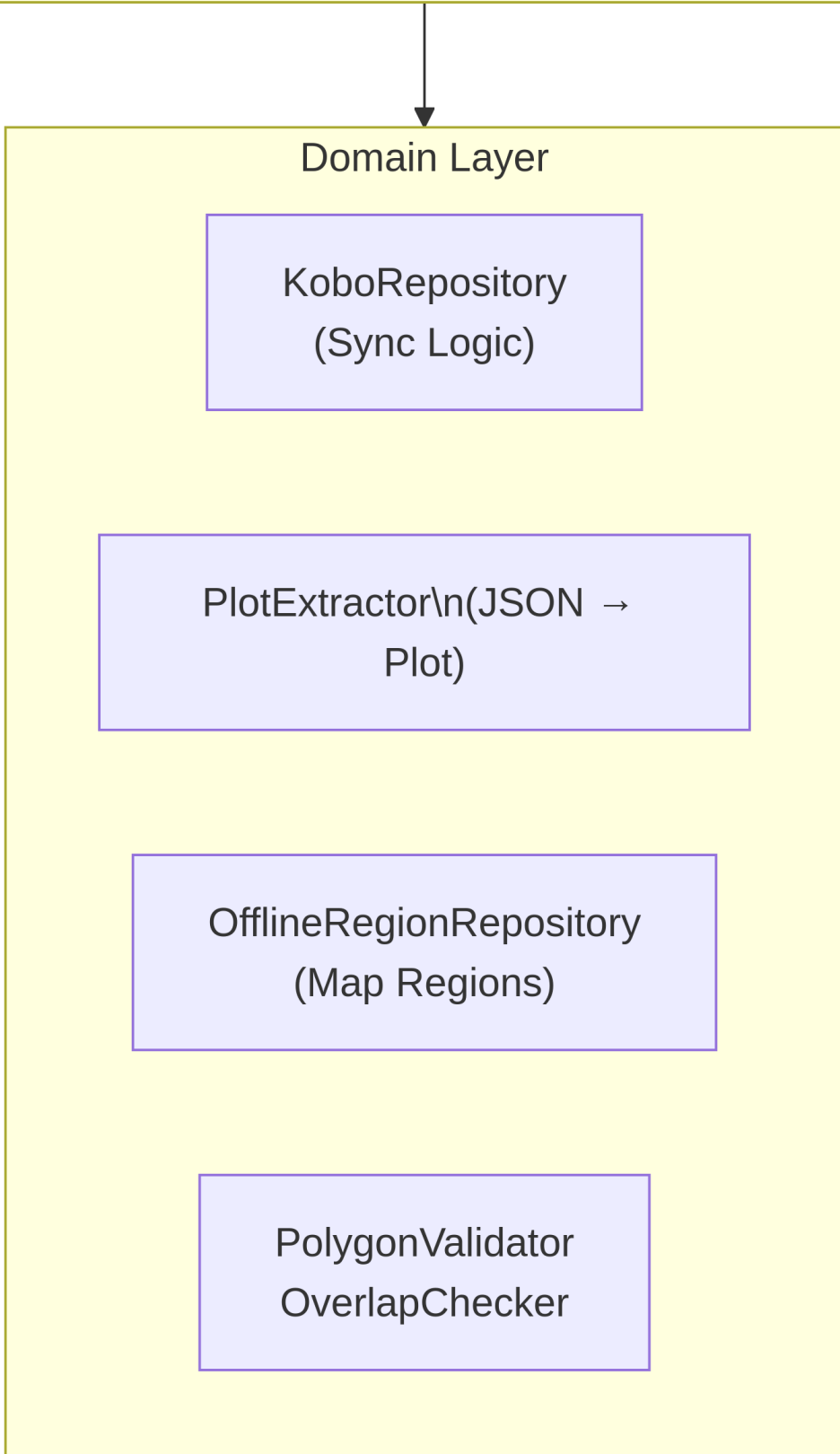
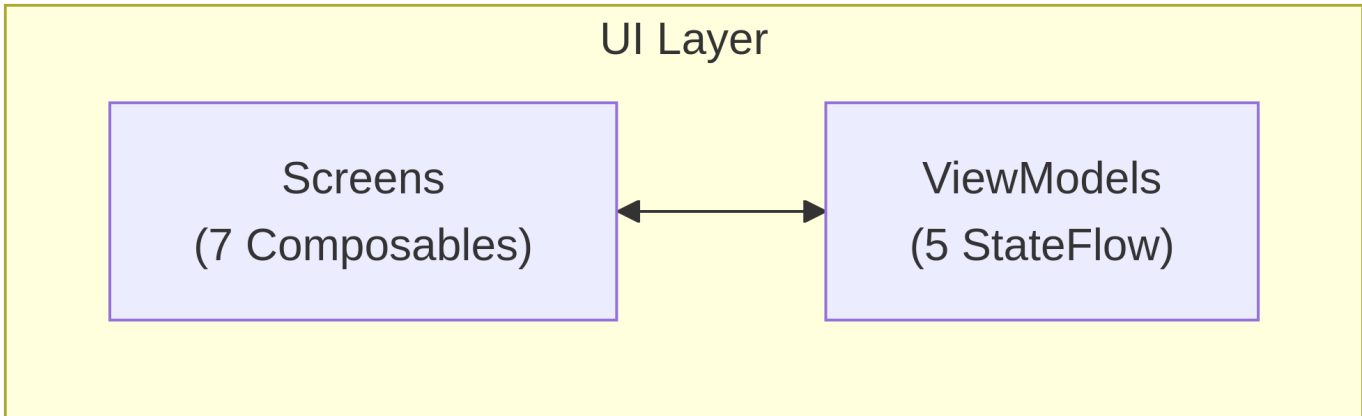


### Route Definitions:

- `Login` - Entry point for logged-out users
- `Loading(type: LoadingType)` - `DOWNLOAD` or `RESYNC`
- `DownloadComplete(totalEntries, latestSubmissionDate)`
- `Home` - Entry point for logged-in users
- `SubmissionDetail(uuid)`
- `SyncComplete(addedRecords, updatedRecords, latestRecordTimestamp)`

## 6. Architecture

Pattern: MVVM + Clean Architecture



# Dependency Injection

**Framework:** Hilt

Module	Provides
NetworkModule	KoboApiService, OkHttpClient, Json
DatabaseModule	AppDatabase, DAOs

## State Management

- **ViewModels:** `StateFlow` for UI state
- **Database:** `Flow<List<T>>` for reactive lists
- **Collection:** `collectAsStateWithLifecycle()` in Composables

## 7. Security

### Credential Storage

**File:** `data/session/SessionManager.kt`

- `EncryptedSharedPreferences` with AES256\_GCM
- `MasterKey` with AES256\_GCM scheme
- Stores: username, password, serverUrl, assetUid

### Network Security

- BasicAuth over HTTPS only
- No token stored (credentials used per-request)
- Dynamic base URL validated before use

## 8. Definition of Done

Requirement	Status	Evidence
MVVM with StateFlow	☐	All 4 ViewModels use <code>MutableStateFlow</code>
Jetpack Compose UI	☐	All screens in <code>ui/screen/</code>
<code>collectAsStateWithLifecycle</code>	☐	Used in all screen Composables
Login + encrypted session	☐	<code>SessionManager</code> with AES256
Pagination (no missing records)	☐	<code>KoboRepository.fetchSubmissions()</code> follows <code>next</code>

Requirement	Status	Evidence
Delta sync (Added vs Updated)	☐	<code>KoboRepository.resync()</code> with diffing
Offline access (Room cache)	☐	<code>SubmissionDao.getSubmissions()</code> returns cached data
Password/token encrypted	☐	<code>EncryptedSharedPreferences</code>

## 9. Known Gaps & Future Work

### Not Yet Implemented

Feature	Priority	Notes
Geoshape map display	Medium	Show map thumbnail in list items
Geolocation validation	Low	External validation logic
Database migrations	High	Currently uses destructive migration
Comprehensive tests	High	Only skeleton files exist
Offline-first indicators	Low	No explicit offline mode UI
Error logging/Crashlytics	Medium	No crash reporting

### Technical Debt

- Destructive migrations:** `fallbackToDestructiveMigration()` will lose data on schema changes
- Test coverage:** Minimal unit/instrumented tests
- Accessibility:** Limited `contentDescription` coverage

## 10. File Structure

```

app/src/main/java/com/akvo/externalodk/
├─ data/
│   ├─ dao/           # SubmissionDao, FormMetadataDao
│   ├─ database/     # AppDatabase
│   ├─ dto/          # KoboSubmissionDto, KoboDataResponse
│   ├─ entity/       # SubmissionEntity, FormMetadataEntity
│   ├─ network/      # KoboApiService, Interceptors
│   ├─ repository/   # KoboRepository
│   └─ session/      # SessionManager, AuthCredentials

```

└─ di/	# Hilt modules
└─ navigation/	# Routes, AppNavHost
└─ ui/	
└─ screen/	# All 6 Composable screens
└─ theme/	# Material 3 theming
└─ viewmodel/	# Login, Loading, Home, SubmissionDetail

## Appendix: API Response Example

```
{
  "count": 1250,
  "next": "https://kf.kobotoolbox.org/api/v2/assets/xxx/data.json?start=300",
  "previous": null,
  "results": [
    {
      "_id": 12345,
      "_uuid": "abc-123-def",
      "_submission_time": "2026-01-15T10:30:00Z",
      "_submitted_by": "field_worker",
      "meta/instanceName": "Survey 001",
      "question_1": "Answer 1",
      "question_2": 42,
      "geoshape": "..."
    }
  ]
}
```

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