

TraceRoo: Asset Track & Trace Solution

Business Blueprint Document

EXECUTIVE SUMMARY

1.1 Business Problem & Value Proposition

In today's complex supply chain environment, businesses face significant challenges in maintaining visibility and accountability across their asset lifecycle. From manufacturing facilities to distribution centers, the inability to track products, components, and materials in real-time leads to:

- **Lost visibility:** Difficulty pinpointing where products are in the supply chain
- **Quality compliance failures:** Inability to quickly identify and isolate defective batches
- **Operational inefficiency:** Manual tracking processes consuming excessive labor and time
- **Regulatory non-compliance:** Inadequate audit trails for recall situations and FDA/GS1 compliance
- **Revenue leakage:** Inefficient rejection, scrap, and return processes
- **Customer dissatisfaction:** Delayed shipments and lack of proof-of-delivery

TraceRoo solves these problems by providing an end-to-end, integrated platform that combines web-based label design with mobile-first execution, enabling organizations to track every asset from creation through final disposition.

1.2 Solution Overview (Web + Mobile Split)

TraceRoo is a two-tier platform designed for operational efficiency:

Web Platform (TraceRoo Designer):

- Intuitive label template designer with BarTender-like canvas capabilities
- Barcode/QR code configuration for GS1, Code128, DataMatrix, and custom standards
- Dynamic label hierarchy setup (Item → Box → Pallet → Container)
- Bulk label generation and print queue management
- Real-time operations dashboard with traceability analytics
- Quality check workflow builder and rejection process management

Mobile App (TraceRoo Scanner):

- Offline-capable scanning for packing, receiving, and lifecycle tracking
- Hierarchical barcode scanning with audio/visual feedback

- Thermal printer integration for on-demand label printing
- Quality check execution with photo capture and notes
- Rejection, scrap, and return process initiation
- Real-time sync when connectivity is restored

1.3 Key Benefits & ROI Indicators

Benefit	Impact	ROI Metric
Visibility & Traceability	Complete audit trail from production to delivery	100% asset location knowledge
Quality Assurance	Immediate batch isolation and root cause analysis	40-60% reduction in customer complaints
Operational Efficiency	Automated label generation and scanning workflows	50% reduction in manual tracking time
Compliance & Audit	Immutable records for regulatory requirements	Zero compliance violations
Scrap Reduction	Efficient rejection and return workflows	25-35% reduction in scrap costs
Customer Experience	Proof-of-delivery and real-time tracking	Higher customer retention

2. BUSINESS OBJECTIVES & SCOPE

2.1 In-Scope Processes

TraceRoo Phase 1 encompasses the following core business processes:

Label Design & Generation:

- Custom template designer with drag-and-drop canvas
- Support for logos, multiple barcodes, QR codes, and dynamic fields
- Version control and template approval workflows
- Bulk generation with print-to-file or direct printer routing
- Label hierarchy configuration (1:N relationships)

Packing Process:

- Initiate pack sessions with target container information
- Hierarchical scanning: Item barcode → Box creation → Pallet assignment → Container seal
- Auto-trigger label printing from mobile thermal printer
- Photo capture for pack verification
- Exception handling for quantity mismatches or damaged items

Lifecycle Stage Tracking:

- Define and configure custom workflow stages
- Scan-triggered state transitions:
 - **Shipping:** Load to truck (generate shipment manifest)
 - **Receiving:** GRN creation and put-away confirmation
 - **Storage:** Bin transfer and location updates
 - **Dispatch:** Pick list generation and pack verification
 - **In-Transit:** Milestone scans (optional GPS integration)
 - **Delivery:** Proof-of-delivery (POD) with customer signature/photo
 - **Return:** Receiving return items and restocking

Quality Check Workflow:

- QC checklist builder (web interface)
- Mobile QC execution with pass/fail outcomes
- Photo and note capture for failed inspections
- Conditional routing: Accept → Next Stage; Reject → Quarantine; Scrap → Disposal

Rejection, Scrap & Return (RSR) Processes:

- Initiate rejection/scrap/return with reason codes
- Quarantine location tracking
- Disposition workflows (Rework, Scrap, RTV)
- Analytics and trend reporting

Master Data Management:

- Product/SKU catalog with packaging specifications
- Location hierarchy (Sites → Warehouses → Zones → Bins)
- User and device management
- Role-based access control

2.2 Out-of-Scope / Future Phases

Phase 2 & Beyond:

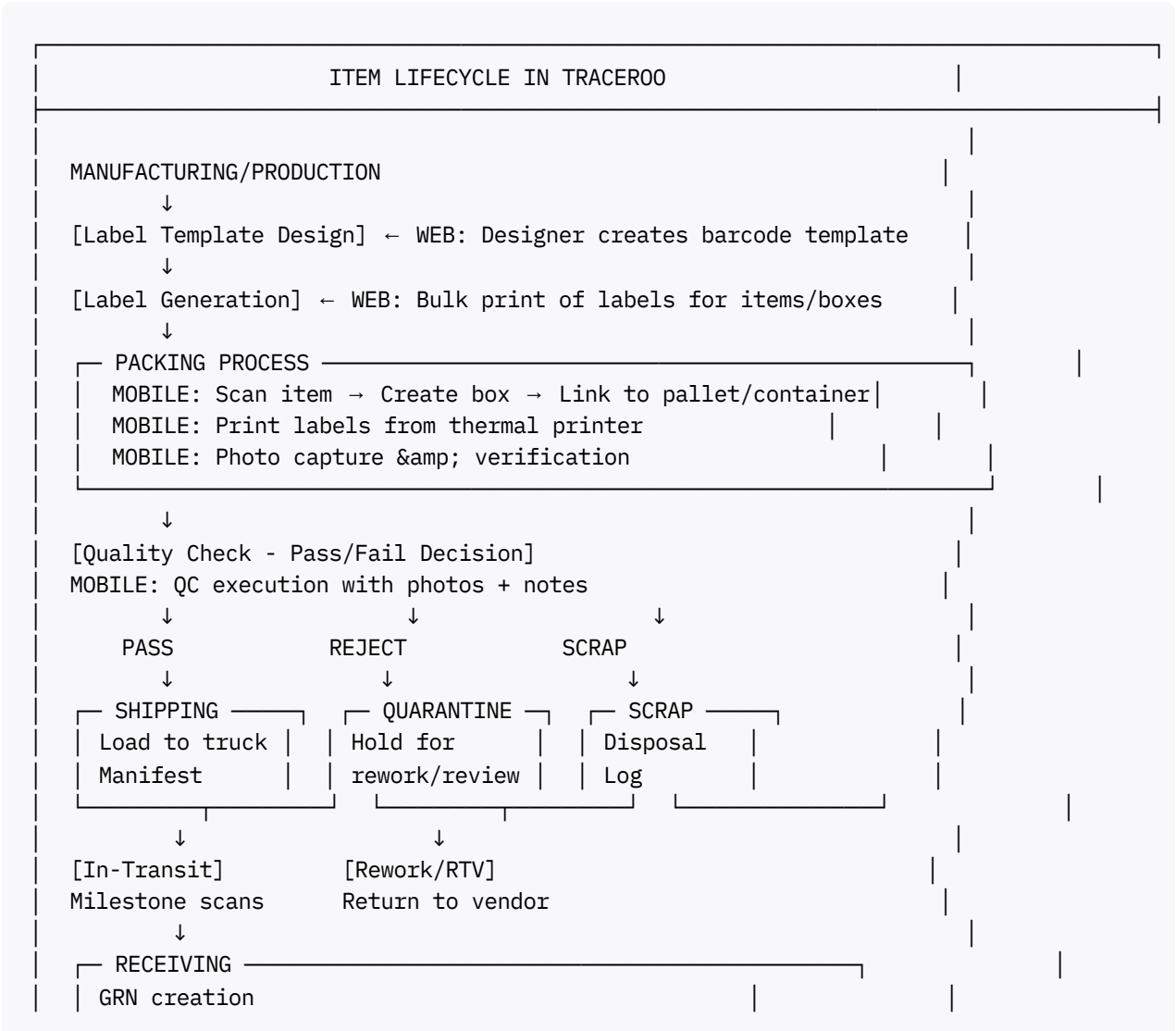
- Advanced IoT sensor integration (temperature, humidity logging)
- Predictive analytics and AI-driven anomaly detection
- Supplier portal for automated RTV processing
- Third-party logistics (3PL) EDI integration
- Real-time inventory forecasting
- Mobile app features: NFC tag reading, voice-guided workflows, AR label verification

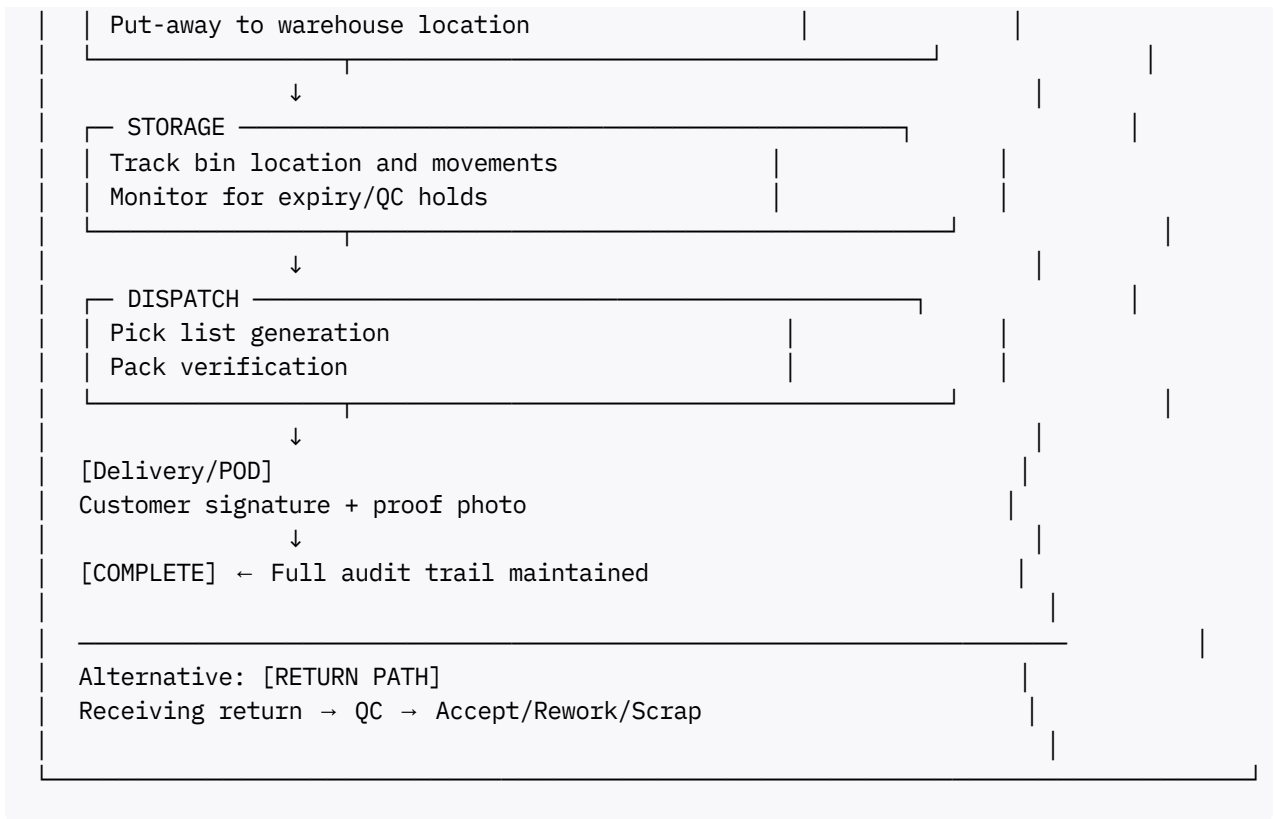
2.3 Success Metrics (KPIs)

KPI	Target	Measurement
System Uptime	99.5%	Monthly availability report
Label Accuracy	99.9%	Barcode scanning success rate
Packing Cycle Time	-40% vs. baseline	Time per container packed
Quality Defect Detection	100% visibility	QC scan rate compliance
Asset Traceability	100%	All items tracked end-to-end
Mobile App Adoption	90%+	Active user engagement
Rejection Rate Visibility	100% logged	RSR audit trail completeness
System Performance	<2s response time	API and UI responsiveness

3. HIGH-LEVEL PROCESS FLOW

3.1 End-to-End Lifecycle Diagram (Item → Scrap/Return)





3.2 Web vs Mobile Touchpoints Map

Stage	Web Portal	Mobile App	Key Interaction
Label Design	✓ Designer UI	—	Create templates
Label Generation	✓ Bulk print	—	Queue to printer
Pack Initiation	✓ Dashboard	✓ Scan start	Mobile captures
Hierarchical Scan	— (view only)	✓ Live scanning	Item → Box → Pallet → Container
Label Print	✓ Queue mgmt	✓ Thermal print	Mobile triggers on-demand
QC Workflow	✓ Builder	✓ Execution	Mobile executes, web reviews
Rejection/Scrap	✓ Config	✓ Initiate	Mobile flags, web analyzes
Lifecycle Tracking	✓ Real-time dashboard	✓ Scan stages	Mobile scans, web displays
Reporting/Analytics	✓ Full suite	—	Web-only analysis
Audit Trail	✓ Genealogy reports	—	Complete history view

4. USER PERSONAS & ROLES

4.1 Role Matrix (Permissions Grid)

TRACEROO ROLE MATRIX						
Feature/Function	Admin	Design	Op	QC	Driver/End	
Create/Edit Label Template	✓	✓	–	–	–	
Approve Label Template	✓	–	–	–	–	
Bulk Generate Labels	✓	✓	–	–	–	
Print to Queue	✓	✓	✓	–	–	
Initiate Pack Session	✓	–	✓	–	–	
Scan Items/Boxes/Pallets	–	–	✓	–	–	
Print from Mobile	–	–	✓	–	–	
Execute QC Workflow	–	–	–	✓	–	
Approve/Reject Items	–	–	–	✓	–	
Scan Receiving/Shipping	–	–	✓	–	✓	
Scan Delivery POD	–	–	–	–	✓	
Initiate RSR Process	✓	–	✓	✓	–	
View Real-Time Dashboard	✓	✓	✓	✓	–	
Generate Reports/Analytics	✓	✓	–	–	–	
Manage Users & Devices	✓	✓	–	–	–	
Audit Trail Access	✓	✓	✓	✓	–	
Configure Master Data	✓	–	–	–	–	
Configure QC Workflows	✓	✓	–	–	–	

Legend:

Admin = System Administrator / Super User

Design = Label Designer / Template Manager

Op = Warehouse Operator / Packing Staff

QC = Quality Check Inspector

Driver = Logistics Driver / Last-Mile Delivery

4.2 Persona Journey Maps

Persona 1: Ravi (Warehouse Operations Manager)

- **Role:** Operations
- **Daily Tasks:** Oversee packing, manage pack sessions, handle exceptions
- **TraceRoo Interaction:**
 - Morning: Launch mobile app, start pack sessions
 - Throughout day: Scan items into boxes/pallets, handle quantity mismatches
 - End of day: Review mobile sync status, view real-time dashboard on web
- **Pain Point Solved:** Previously spent 2 hours daily on manual pack tracking → Now 15 minutes with automated scanning

Persona 2: Priya (Label Template Designer)

- **Role:** Design

- **Daily Tasks:** Create and update barcode label templates, manage approvals
- **TraceRoo Interaction:**
 - Morning: Open TraceRoo Designer, drag-and-drop barcode elements
 - Configure dynamic fields (SKU, batch, expiry date, etc.)
 - Test label generation, submit for approval
 - Manage template versions
- **Pain Point Solved:** Previously created labels in Illustrator/BarTender → Now in intuitive web UI

Persona 3: Arun (Quality Inspector)

- **Role:** QC
- **Daily Tasks:** Execute QC checklists, photograph defects, log rejections
- **TraceRoo Interaction:**
 - Morning: Mobile app → QC work queue
 - Scan item barcode, open QC checklist, mark pass/fail
 - For failures: Take photos, add notes, select reason code
 - Log rejections and quarantine locations
- **Pain Point Solved:** Previously used paper checklists → Now digital with photo proof

Persona 4: Suresh (Logistics Driver)

- **Role:** Driver/End User
- **Daily Tasks:** Scan deliveries, collect proof-of-delivery, update status
- **TraceRoo Interaction:**
 - En route: Mobile app in offline mode
 - At delivery: Scan item barcode, take customer signature photo
 - Sync to cloud when internet available
- **Pain Point Solved:** Previously had no POD → Now complete digital trail

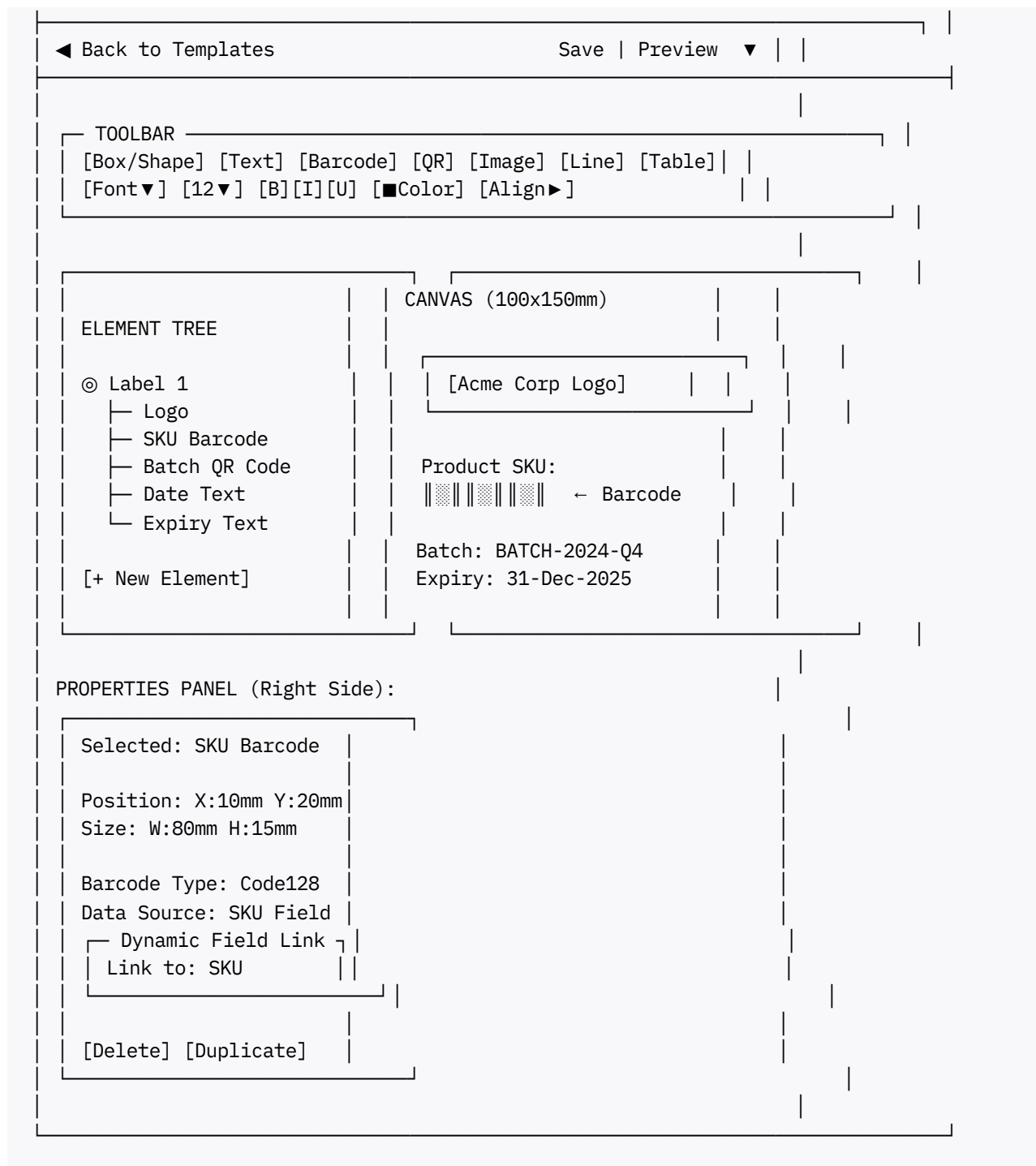
5. LABEL DESIGN & GENERATION (WEB APPLICATION)

5.1 Label Template Designer UI/UX

The TraceRoo Designer is a web-based canvas interface similar to BarTender but simplified for non-technical users.

Main Canvas Features:

TRACEROO LABEL DESIGNER - Create New Template					
File	Edit	View	Insert	Format	Help



Key Designer Capabilities:

1. **Drag-and-Drop Canvas:** 100% drag-and-drop interface (no coding required)
2. **Multi-Element Support:**
 - Text fields (static and dynamic)
 - Barcode generators (Code128, Code39, EAN-13, etc.)
 - QR codes with URL/data embedding
 - Company logos and images
 - Shapes, lines, and borders

- Tables for multi-row data

3. **Dynamic Field Placeholders:**

- {{SKU}} → Pulls from product catalog
- {{BATCH_ID}} → From packing session
- {{EXPIRY_DATE}} → Calculated from manufacturing date
- {{SERIAL_NO}} → Auto-incremented
- {{WAREHOUSE_LOCATION}} → From put-away
- {{TIMESTAMP}} → Current date/time
- Custom fields → User-defined

4. **Label Hierarchy Management:**

- Item Label Template
- Box Label Template (contains multiple items)
- Pallet Label Template (contains multiple boxes)
- Container Label Template (contains multiple pallets)
- **Relationship Builder:** Define "Box contains 10 Items" or "Pallet contains 5 Boxes"

5. **Template Versioning:**

- Auto-save drafts every 2 minutes
- Version history with rollback
- Compare versions side-by-side
- Comment threads for designer collaboration

5.2 **Data Fields & Dynamic Placeholders**

Supported Dynamic Fields:

Field Name	Source	Example Value	Auto-Populated
{{SKU}}	Product Catalog	SKU-2024-001	Yes
{{PRODUCT_NAME}}	Catalog	Acme Widget Pro	Yes
{{BATCH_ID}}	Packing Session	BATCH-Q4-2024-789	Yes
{{MANUFACTURING_DATE}}	Packing Session	15-Nov-2024	Yes
{{EXPIRY_DATE}}	Shelf-life calculation	15-Nov-2025	Yes
{{QUANTITY}}	Pack session	50 units	Yes
{{BOX_NUMBER}}	Auto-increment	BOX-00001	Yes
{{SERIAL_NUMBER}}	Auto-increment (item level)	SN-2024-0001	Yes
{{WAREHOUSE_LOCATION}}	At receiving	WH-A-Z3-B5	During GRN
{{PALLET_ID}}	Packing assignment	PAL-2024-456	Yes

Field Name	Source	Example Value	Auto-Populated
{{CONTAINER_ID}}	Truck manifest	CONT-789	Yes
{{DESTINATION}}	Shipment order	Pune Distribution	Yes
{{CUSTOMER_NAME}}	Order data	XYZ Retail	Yes
{{PRINT_DATE}}	System timestamp	15-Nov-2024	Auto
{{PRINTED_BY}}	Current user	Ravi Kumar	Auto
{{QUALITY_CHECKPOINT}}	QC workflow	PASSED	Post QC

5.3 Barcode/QR Standards (GS1, Code128, DataMatrix, etc.)

TraceRoo supports multiple barcode standards to meet different compliance and operational requirements:

Barcode Standards Supported:

Standard	Format	Data Capacity	Use Case	GS1 Compliance
Code128	Alphanumeric + special	20-30 chars	Primary SKU barcode	Yes (with GS1 prefix)
EAN-13	Numeric only	13 digits	Product barcode	Yes (global)
DataMatrix	2D matrix	2-3KB	High-density, serialization	Yes
QR Code	2D matrix	1-4KB	URL, batch tracking, mobile	Yes (with GS1 AI)
GS1-128	Extended Code128	With AI markers	Full supply chain data	Yes (standard)
Code39	Alphanumeric	20-30 chars	Legacy systems	Limited
Codabar	Numeric + symbols	16 chars	Library/inventory	Limited

GS1 Compliance (India specific):

- TraceRoo automatically adds GS1 prefix when configured
- GTIN (Global Trade Item Number) assignment and validation
- Batch/Lot number encoding per GS1 standards
- Serial number tracking for item-level traceability
- Compliance reports for regulatory audits

5.4 Label Hierarchy Configuration (Item ↔ Box ↔ Pallet ↔ Container)

Hierarchy Setup Interface:

LABEL HIERARCHY CONFIGURATION

Define the relationship between label types

ITEM LABEL (Innermost Level)

Template: Product_SKU_Item_v2
Barcode Type: Code128 (SKU + Serial)
Quantity per box: [_____] items
Size: 50mm × 30mm
[Edit Template]



BOX LABEL (Level 2)

Template: Product_Box_Label_v2
Barcode Type: GS1-128 (Box Code + Batch + Qty)
Quantity per pallet: [_____] boxes
Size: 100mm × 100mm
Contains: Item barcode reference
[Edit Template]



PALLET LABEL (Level 3)

Template: Product_Pallet_Label_v1
Barcode Type: QR Code (Pallet ID + Destination)
Quantity per container: [_____] pallets
Size: 150mm × 150mm
Contains: Box barcode reference
[Edit Template]



CONTAINER/SHIPMENT LABEL (Outermost Level)

Template: Shipment_Manifest_Label_v1
Barcode Type: Code128 (Container/Truck ID)
Size: 100mm × 75mm
Contains: Pallet barcode reference
[Edit Template]

[Save Hierarchy] [Test Label Generation] [Preview]

5.5 Version Control & Approval Workflow

Label Template Lifecycle:

LABEL TEMPLATE LIFECYCLE

1. DRAFT Status

- └ Designer creates/edits template
- └ Auto-save every 2 minutes
- └ Comments from collaborators



2. REVIEW Status

- └ Submitted for approval
- └ Admin/Manager reviews
- └ Can request revisions
- ▼
- 3. APPROVED Status
 - └ Ready for production use
 - └ Locked from editing
 - └ Versioned (v1.0, v2.0, etc.)
- ▼
- 4. ACTIVE Status
 - └ Currently in use for label generation
 - └ Audit logged for every label printed
- ▼
- 5. RETIRED Status (Optional)
 - └ No longer used for new prints
 - └ Historical records maintained
 - └ Can be reactivated

5.6 PDF Generation Engine & Print Queues

Bulk Label Generation Process:

BULK LABEL GENERATION

Template: Product_Box_Label_v2
Quantity: 500 labels
Start Serial: SN-2024-0001
Batch ID: BATCH-Q4-2024-901
Layout: 4 labels per A4 sheet

[Generate PDF] [Print Directly] [Email]

Status: ✓ Generated (3.5 MB)

Output Options:

- ☒ Download PDF
- ☐ Send to printer: [Printer Selection▼]
- ☐ Email to: [users@company.com]
- ☐ Queue for batch print job

[Confirm & Generate]

Print Queue Management:

Job ID	Template	Qty	Status	Printer	Submitted	ETA
PJ-001	Box_Label_v2	500	Processing	Thermal-01	09:15 AM	09:22 AM
PJ-002	Pallet_Label_v1	50	Queued	Thermal-02	09:18 AM	09:45 AM

Job ID	Template	Qty	Status	Printer	Submitted	ETA
PJ-003	Item_Label_v3	2000	Completed	Thermal-01	08:30 AM	09:05 AM

5.7 Bulk Label Generation & Re-print Logic

Re-print Management:

TraceRoo maintains a complete log of all printed labels, enabling:

- **Reprint by Job ID:** Reprint an entire job (e.g., PJ-001)
- **Reprint by Range:** Reprint specific serial number range (SN-0050 to SN-0100)
- **Reprint by Reason:** Damaged label, misprinted, quality check failure
- **Audit Trail:** Every reprint logged with reason, user, and timestamp
- **Waste Tracking:** Monitor reprint ratio to identify quality issues

6. MASTER DATA MANAGEMENT

6.1 Product / SKU Catalog

Product Master Setup:

PRODUCT MASTER DATA CONFIGURATION

Product Details	Packaging	Compliance	Lifecycle
SKU/Product ID: SKU-2024-001 Product Name: Acme Widget Pro Category: Industrial Equipment Manufacturer: Acme Industries Ltd.			
PACKAGING SPECIFICATIONS: └─ Unit Packaging: Cardboard box └─ Items per box: 10 └─ Box dimensions: 200mm × 150mm × 100mm └─ Boxes per pallet: 50 └─ Pallet dimensions: 1200mm × 1000mm × 1500mm └─ Pallets per container: 20 └─ Container capacity: 1000 units (20 boxes × 50)			
SHELF LIFE & EXPIRY: └─ Manufacturing date: [Date field] └─ Shelf life: [_____] months └─ Expiry calculation: Auto (Mfg + Shelf life) └─ Storage conditions: Cool & Dry			
BARCODE ASSIGNMENT: └─ Primary barcode (Item): Code128 - SKU-2024-001 └─ Secondary barcode (Box): GS1-128			

```

└─ Tertiary barcode (Pallet): QR Code
└─ GS1 Prefix: [_____]

LABEL TEMPLATES LINKED:
└─ Item template: Product_Item_v2
└─ Box template: Product_Box_v2
└─ Pallet template: Product_Pallet_v1
└─ Container template: Shipment_Manifest_v1

[Save] [Cancel] [Activate]

```

6.2 Packaging Hierarchy Templates

Pre-configured Packaging Models:

Hierarchy Name	Item per Box	Boxes per Pallet	Pallets per Container	Total Capacity
Standard (Electronics)	10	50	20	10,000
Heavy Goods	5	25	15	1,875
Pharmaceuticals	100	40	10	40,000
Food & Beverage	12	80	12	11,520
Custom (User-defined)	[Config]	[Config]	[Config]	Auto

6.3 Location Hierarchy (Sites, Warehouses, Zones, Bins)

Warehouse Location Structure:

```

LOCATION MASTER HIERARCHY
└─ SITE: Mumbai Manufacturing Plant
    └─ WAREHOUSE: WH-MUM-01 (Production Facility)
        └─ ZONE: Production Output
            └─ BIN: BIN-001 (Quality Pass Area)
            └─ BIN: BIN-002 (QC Hold Area)
            └─ BIN: BIN-003 (Rejected Items)
        └─ ZONE: Staging
            └─ BIN: BIN-STAGE-01
            └─ BIN: BIN-STAGE-02
        └─ ZONE: Despatch
            └─ BIN: LOADING-BAY-01
            └─ BIN: LOADING-BAY-02

└─ SITE: Pune Distribution Center
    └─ WAREHOUSE: WH-PUN-01 (Regional Distribution)
        └─ ZONE: Receiving
            └─ BIN: INBOUND-01
            └─ BIN: INBOUND-02
        └─ ZONE: Storage
            └─ AISLE-A
                └─ BIN-A-01 to BIN-A-50 (Rack position)
            └─ AISLE-B

```

```

├── BIN-B-01 to BIN-B-50
├── COLD-STORAGE
│   ├── BIN-C-01 to BIN-C-20
├── ZONE: Despatch
│   ├── PICK-AREA-01
│   ├── PACK-AREA-01
│   └── LOADING-DOCK
└── SITE: Customer Locations (Return Destinations)
    ├── CUSTOMER: XYZ Retail Ltd.
    │   └── LOCATION: Delhi Store
    ├── CUSTOMER: ABC Distributors
    │   ├── LOCATION: Bangalore Warehouse
    │   └── LOCATION: Chennai Service Center

```

6.4 User & Device Management

User Profile Configuration:

USER MANAGEMENT INTERFACE

User Details	Roles	Devices	Permissions	Audit
<div>Full Name: Ravi Kumar</div> <div>Employee ID: EMP-0001</div> <div>Email: ravi.kumar@company.com</div> <div>Mobile: +91-9876543210</div> <div>Department: Warehouse Operations</div>				
<div>ASSIGNED ROLES:</div> <div><input checked="" type="checkbox"/> Warehouse Operator</div> <div><input type="checkbox"/> Quality Inspector</div> <div><input type="checkbox"/> Label Designer</div> <div><input type="checkbox"/> System Administrator</div>				
<div>ASSIGNED DEVICES:</div> <div><div>└─ Mobile: Samsung Galaxy A12 (IMEI: ...1234)</div><div>└─ Status: Active Last sync: 10 min ago</div><div>└─ Mobile: iPhone 12 (UDID: ...5678)</div><div>└─ Status: Inactive Last sync: 3 days ago</div><div>└─ [+ Add Device]</div></div>				
<div>WAREHOUSE ACCESS:</div> <div><input checked="" type="checkbox"/> WH-MUM-01 (Primary)</div> <div><input type="checkbox"/> WH-PUN-01 (Secondary)</div>				
<div>ACTIVE STATUS: <input checked="" type="checkbox"/> Enabled</div> <div>Account Created: 15-Aug-2024</div> <div>Last Login: 02-Nov-2024 09:45 AM</div>				
<div>[Save] [Reset Password] [Disable Account]</div>				

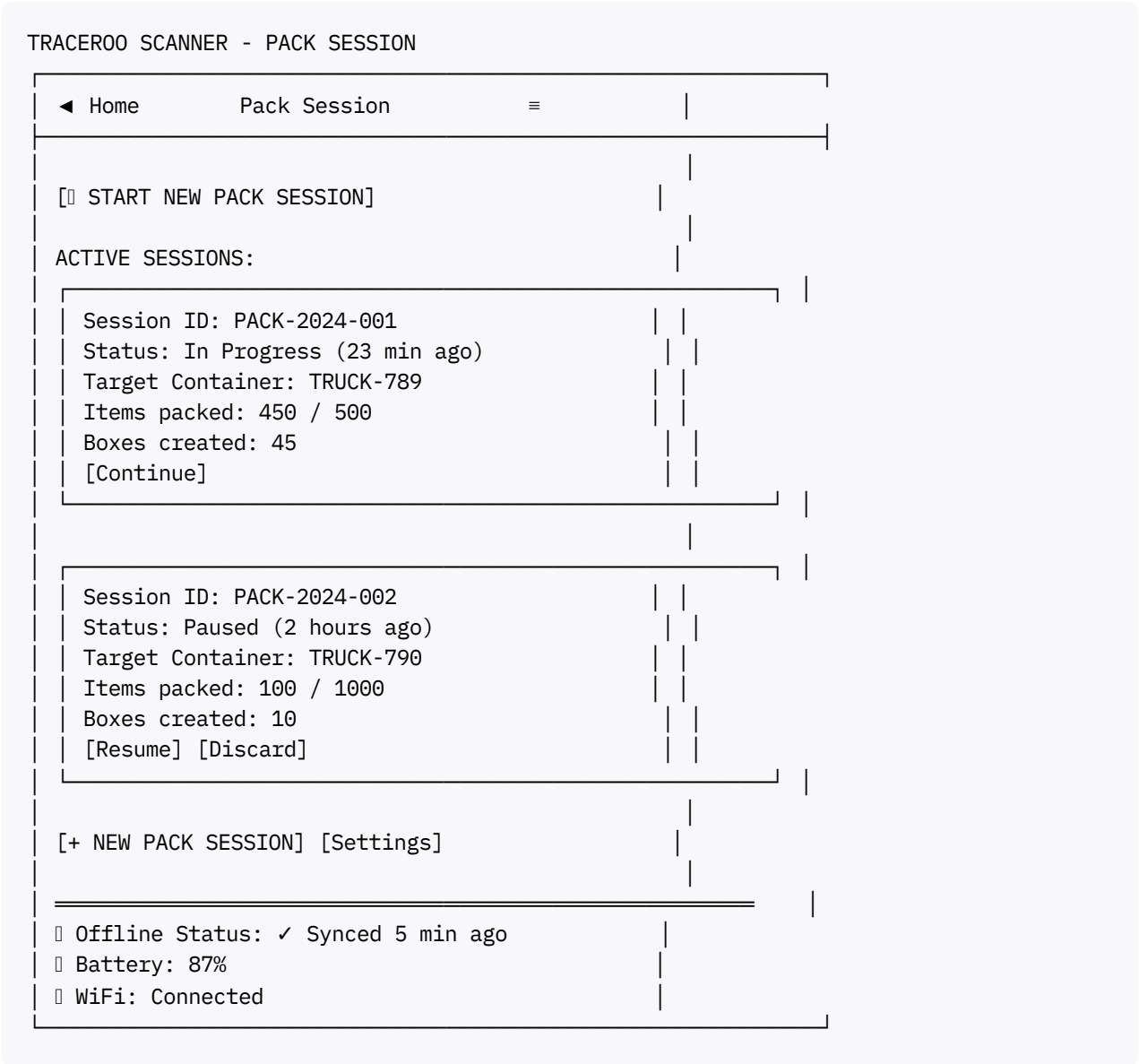
Mobile Device Enrollment:

- **Auto-enrollment:** Device registers via QR code scan
- **Device ID tracking:** IMEI, phone model, OS version stored
- **Offline capability:** Device can work without internet for up to 8 hours
- **Sync scheduling:** Automatic sync when connectivity restored
- **Device lockout:** Lost/stolen device can be remotely disabled

7. PACKING PROCESS (MOBILE APP)

7.1 Pack Session Initiation

Mobile App: Pack Session Screen



Pack Session Details Entry:

NEW PACK SESSION SETUP

◀ Back	New Pack Session	✓
--------	------------------	---

SHIPMENT DETAILS:

Shipment ID: [Enter or scan barcode]

Truck/Container: [▼ Select from list]

Destination: [▼ Auto-populated]

Total Items Expected: [_____]

LABEL TEMPLATE:

Template: [▼ Product_Box_Label_v2]

Batch ID: BATCH-Q4-2024-901

Mfg Date: 15-Nov-2024

(Expiry auto-calculated: 15-Nov-2025)

PRINTER SETTINGS:

☒ Connect Thermal Printer

Printer: [▼ ZEBRA-MP845-01]

Status: ● Connected

[Test Print]

[START PACKING]

Tip: Make sure printer is loaded with labels!

7.2 Hierarchical Scanning (Item → Box → Pallet → Container)

Hierarchical Scan Workflow:

PACKING WORKFLOW - HIERARCHICAL SCANNING

◀ Back	Pack Session PACK-2024-001	□
--------	----------------------------	---

CONTAINER: TRUCK-789

Target: 500 items | Packed: 450 items (90%)

PALLET #5

ID: PAL-2024-0005

Status: IN PROGRESS

Boxes: 3/5 | Items: 30/50

BOX #48

ID: BOX-2024-0048

Status: IN PROGRESS

Items: 9/10 [██████████░]

Expected: SKU-2024-001

[□ SCAN NEXT ITEM]

Waiting for item barcode...

Manual Entry

Box Full

+ NEW BOX

Pallet Full

Issues?

RECENT SCANS (This Session):
✓ SN-2024-0441 → Box 48, Pallet 5
✓ SN-2024-0440 → Box 48, Pallet 5
✓ SN-2024-0439 → Box 47, Pallet 5
✓ [+ 447 more items]

Save & Sync

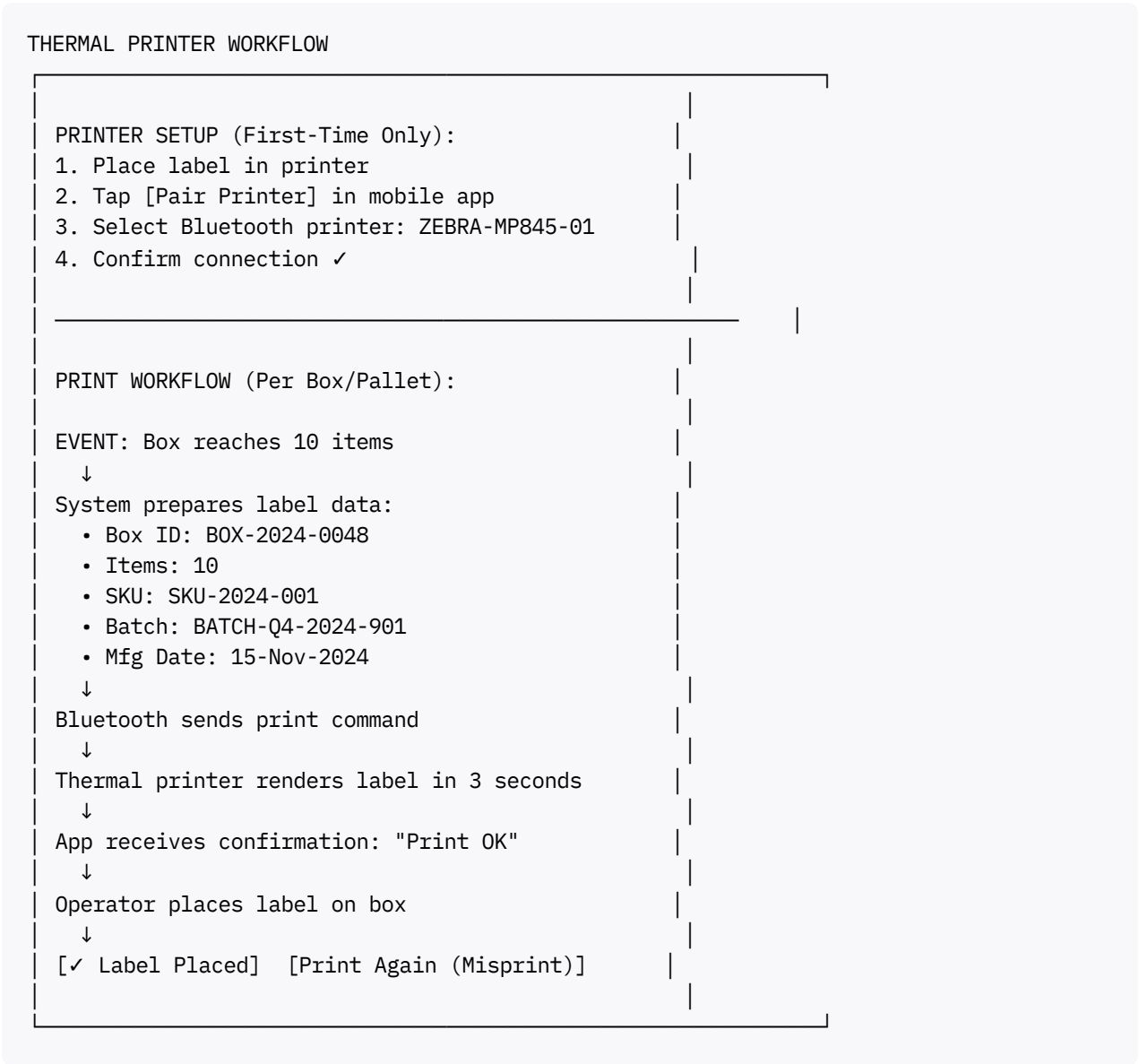
Pause Session

Step-by-step Scanning Process:

- Box Creation:** Operator taps "[+ NEW BOX]"
 - System generates Box ID (BOX-2024-0048)
 - Displays target item SKU
 - Prepares to receive item scans
- Item Scan:** Operator scans item barcode
 - System validates barcode format
 - Confirms item SKU matches expected product
 - Increments box item count
 - Visual/audio confirmation
- Quantity Check:** When box reaches target quantity
 - Audio beep + "Box is full!" message
 - Operator confirms box completion
 - System generates box label for thermal printer
 - Prompts for next box creation
- Pallet Assignment:** When pallet reaches target boxes
 - System assigns pallet ID
 - Generates pallet label
 - Prompts operator to move to next pallet
- Container Closure:** When all items packed
 - System displays summary
 - Calculates manifest data
 - Triggers print of container/manifest label

7.3 Auto-Label Printing from Handheld Thermal Printer

Thermal Printer Integration:



Printer Compatibility:

- **Supported Models:** Zebra MP (MP845, MP847), Brother QL-series, Epson thermal
- **Connection:** Bluetooth 5.0 for wireless mobile connectivity
- **Label Size:** 50mm × 30mm to 150mm × 100mm (configurable)
- **Resolution:** 203 DPI (8 dots/mm) for barcode clarity
- **Print Speed:** 2-4 labels per second

7.4 Pack Verification & Photo Capture

Verification Steps:

PACK VERIFICATION PROCESS

◀ Back

Verify Pack

✓

BOX: BOX-2024-0048

Items Expected: 10 | Items Scanned: 10 ✓

SKU Match: SKU-2024-001 ✓

CHECKLIST:

☒ All items physically present

☒ Items undamaged

☒ Barcode label applied

☒ Packaging intact

☐ Photo evidence captured

📷 CAPTURE PHOTO

Box photo shows:

- Box condition
- Label placement
- Seal integrity

SIGNATURE / APPROVAL:

Packed by: Ravi Kumar

Time: 10:45 AM

Comments: [Optional notes] _____

[✓ APPROVE PACK]

[⚠ REPORT ISSUE]

Photo Capture Features:

- Automatic timestamp and geolocation (if enabled)
- Multiple photos per box (top, bottom, side views)
- Compression for offline storage
- Auto-sync to server when connected
- Indexed by barcode for quick retrieval

7.5 Exception Handling (Missing, Damaged, Wrong Qty)

Exception Handling Screen:

EXCEPTION HANDLING

◀ Back

Report Issue

✓

ISSUE TYPE:

☒ Missing Item (expected but not scanned)

☐ Extra Item (scanned but not expected)

☐ Damaged Item (physical damage found)

☐ Wrong SKU (barcode doesn't match expected)

☐ Quantity Mismatch (count doesn't match label)

☐ Other

ITEM DETAILS:

Expected SKU: SKU-2024-001

Scanned Qty: 9 of 10

Missing: 1 item

ROOT CAUSE:

☐ Item not available in bin

☐ Item damaged before packing

☐ Item lost/misplaced

☐ Barcode scan failed

☐ Manual input error

☐ Unknown

ACTION TO TAKE:

☒ Hold this box pending resolution

☐ Replace item and continue

☐ Accept shortfall and move ahead

☐ Other: [_____]

COMMENTS:

[Item SN-2024-0439 was physically broken]

[📷 ATTACH PHOTO]

1 photo attached: IMG_001.jpg

ESCALATION: Notify Manager []

[SUBMIT EXCEPTION] [CANCEL]

This exception will be logged for QC review.

8.1 Stage Definitions & Configurable Workflow

Stage	Description	Trigger	Duration	Location
Pack	Items packed into boxes/pallets	Manual start	2-4 hours	Production
QC Hold	Awaiting quality inspection	Pack complete	1-2 hours	QC Area
QC Pass	Quality approved	QC passed	Instant	QC Area
Quarantine	Failed QC, awaiting decision	QC failed	24-48 hrs	Quarantine Bin
Shipping	Loaded to truck	Dispatch order	1-2 hours	Loading Bay
In-Transit	Traveling to destination	Truck depart	1-7 days	Route
Receiving	Arrived at warehouse	Physical arrival	2-4 hours	Receiving Bay
Put-Away	Stocked to assigned location	Checked in	1-2 hours	Storage Zone
Storage	In long-term storage	Put-away complete	Days/Months	Bin Location
Pick	Retrieved for customer order	Pick order	30 mins	Pick Zone
Dispatch	Ready for delivery	Pack verification	2-4 hours	Dispatch Area
Delivery	Delivered to customer	Signature/POD	Instant	Customer Location
Return	Returned from customer	Receive return	1-3 days	Receiving
Scrap	Marked for disposal	Scrap initiated	1-7 days	Scrap Yard

Stage-Wise Scanning Workflow:

◀ Back

Shipping Stage

✓

TRUCK/CONTAINER ID: TRUCK-789

Destination: Pune Distribution Center

Expected Containers: 20 pallets

Loaded Containers: 18 pallets 90%

[📄 SCAN PALLET/CONTAINER]

Waiting for barcode...

RECENTLY SCANNED:

✓ PAL-2024-0018 | 16:30 | 50 items

✓ PAL-2024-0017 | 16:28 | 50 items

✓ PAL-2024-0016 | 16:25 | 50 items

✓ [+ 15 more pallets]

MANIFEST DETAILS:

Departure Time: 17:00 IST

Driver: Suresh Singh

Plate Number: MH-02-XYZ-1234

[COMPLETE LOADING] [ISSUES?]

① All items will be marked as "In-Transit" and customer notified of shipment.

Other Stage Examples:

RECEIVING Stage (GRN & Put-away):

◀ Back

Receiving GRN


✓


GRN (Goods Receipt Note) #: GRN-2024-0456

Shipment ID: SHIP-0789

Truck Arrived: 14-Nov-2024 | 14:30

Expected Items: 1000

Received Items: 950 [] 95%

[] SCAN ITEM/BOX]

SCANNED THIS SESSION:

✓ BOX-2024-0001 (10 items)

✓ BOX-2024-0002 (10 items)

✓ [+ 93 more boxes]

NEXT: Assign to Storage Location

Scanned items will be moved to:

Warehouse: WH-PUN-01

Zone: AISLE-A

Bin: [▼ Select bin]

[COMPLETE GRN & PUT-AWAY]

DELIVERY Stage (POD Collection):

◀ Back

Delivery POD

✓

SHIPMENT: SHIP-0789
Customer: XYZ Retail Ltd.
Delivery Address: Mumbai Store, Bandra
Items: 1000 units (100 boxes)
Boxes Delivered: 100/100 ✓

[📄 SCAN ITEM/BOX] (Optional verification)

PROOF OF DELIVERY (POD):

Recipient Name: Rajesh Sharma
Signature: [Get digital signature]

[Draw Signature Here] [Accept]

Photo Evidence: [📷 CAPTURE PHOTO]

Customer with delivery (1 photo)

DELIVERY NOTES:

[All items received in good condition]

[CONFIRM DELIVERY]

Delivery confirmed at 16:45 IST
Customer will receive SMS notification.

8.3 Real-Time Status Dashboard (Web)

Web Dashboard - Traceability View:

TRACEROO - REAL-TIME TRACEABILITY DASHBOARD

Dashboard | Operations | QC | Reports

INVENTORY STATUS TODAY 16:45 IST

In Production: 5000 items
In QC: 2000 items (awaiting check)
QC Approved: 18000 items (ready)
Quarantine: 500 items (on hold)
Shipped: 45000 items
In Transit: 12000 items
Received: 38000 items
In Storage: 36000 items

ACTIVE SHIPMENTS

Shipment	Status	Items	Next Stop	ETA	Track		
SHIP-789	In-Transit	1000	Pune Warehouse	18:00	▶		
SHIP-790	Delivery	500	Mumbai Store	17:30	▶		
SHIP-791	Shipped	2000	In-Transit	Next Day	▶		
SHIP-792	Processing	800	QC Hold	TBD	□		

[Click shipment for detailed genealogy]

ALERTS & EXCEPTIONS

- ⚠ 15 items in Quarantine → Review QC Hold
- ⚠ Shipment SHIP-792 delayed → QC check in progress
- ✓ 98% delivery success rate this week

9. QUALITY CHECK WORKFLOW (MOBILE + WEB)

9.1 QC Checklist Builder (Web)

Web Interface - QC Template Configuration:

QC CHECKLIST BUILDER

Edit QC Template: Electronics_Standard_v2

Active | Draft | Archive

GENERAL INFO:

Template Name: Electronics_Standard_v2
Product Category: Electronics
Version: 2.0 (Updated 10-Oct-2024)
Last Modified By: Priya Sharma

CHECKLIST ITEMS:

Check #1

Item: Physical Integrity
Question: Is the product packaging intact?
Type: Yes/No
Required: ☒ Yes
Fail Action: Reject
Notes: Look for dents, tears, or damage
[Edit] [Delete] [↑↓ Move]

Check #2

Item: Barcode Verification

Question: Barcode scans without errors?

Type: Yes/No

Required: ☒ Yes

Fail Action: Hold for re-labeling

Notes: Test scan with mobile app

[Edit] [Delete] [↑↓ Move]

Check #3

Item: Weight Verification

Question: Weight within ±5% of spec?

Type: Range (min: _____ max: _____)

Required: ☒ Yes

Fail Action: Reject

Notes: Use calibrated scale

[Edit] [Delete] [↑↓ Move]

[+ ADD NEW CHECK]

OUTCOME ROUTING:

If ALL checks PASS → Route to: Shipping

If ANY check FAIL → Route to: Quarantine Inspection

If PHOTO EVIDENCE REQUIRED: ☒ Yes

[SAVE TEMPLATE] [TEST] [PREVIEW]

9.2 Mobile QC Execution (Pass/Fail + Photos + Notes)

Mobile QC Execution Screen:

TRACEROO SCANNER - QC EXECUTION

◀ Back

QC Inspection

✓

QC TEMPLATE: Electronics_Standard_v2

Item: SKU-2024-001 (Acme Widget Pro)

Batch: BATCH-Q4-2024-901

Time: 15:30 IST

CHECK #1 of 3:

"Is the product packaging intact?"

☒ YES ☐ NO

[CONTINUE TO NEXT CHECK]

After selecting NO (Fail):

◀ Back

QC Failure Details

✓

CHECK FAILED: Physical Integrity

Question: Is packaging intact?

Your Answer: NO

FAILURE REASON (Required):

☐ Minor damage (superficial)

☒ Major damage (affects usability)

☐ Packaging torn

☐ Contents missing

☐ Seal broken

☐ Other: [specify] _____

SEVERITY LEVEL:

☐ Low (Can be reworked)

☒ Medium (Needs quarantine)

☐ Critical (Discard immediately)

EVIDENCE (Optional):

☐ CAPTURE PHOTO

1 photo attached: Damage_001.jpg

Timestamp: 15:30:45 IST

NOTES:

[Corner dent approximately 2cm, does not...]

[NEXT ACTION]

Complete QC Summary (All Checks Done):

◀ Back

QC Summary

✓

ITEM: SKU-2024-001 | Batch: BATCH-Q4-2024-901

OVERALL RESULT:

⚠ FAILED - 1 of 3 checks failed

CHECK RESULTS:

- ✓ Check #1: Physical Integrity → FAILED
- ✓ Check #2: Barcode Verification → PASSED
- ✓ Check #3: Weight Verification → PASSED

FAILURE DETAILS:

- └ Reason: Major damage (affects usability)
- └ Severity: Medium
- └ Evidence: 1 photo attached
- └ Inspector: Arun Singh
- └ Time: 15:32 IST

RECOMMENDED ACTION:

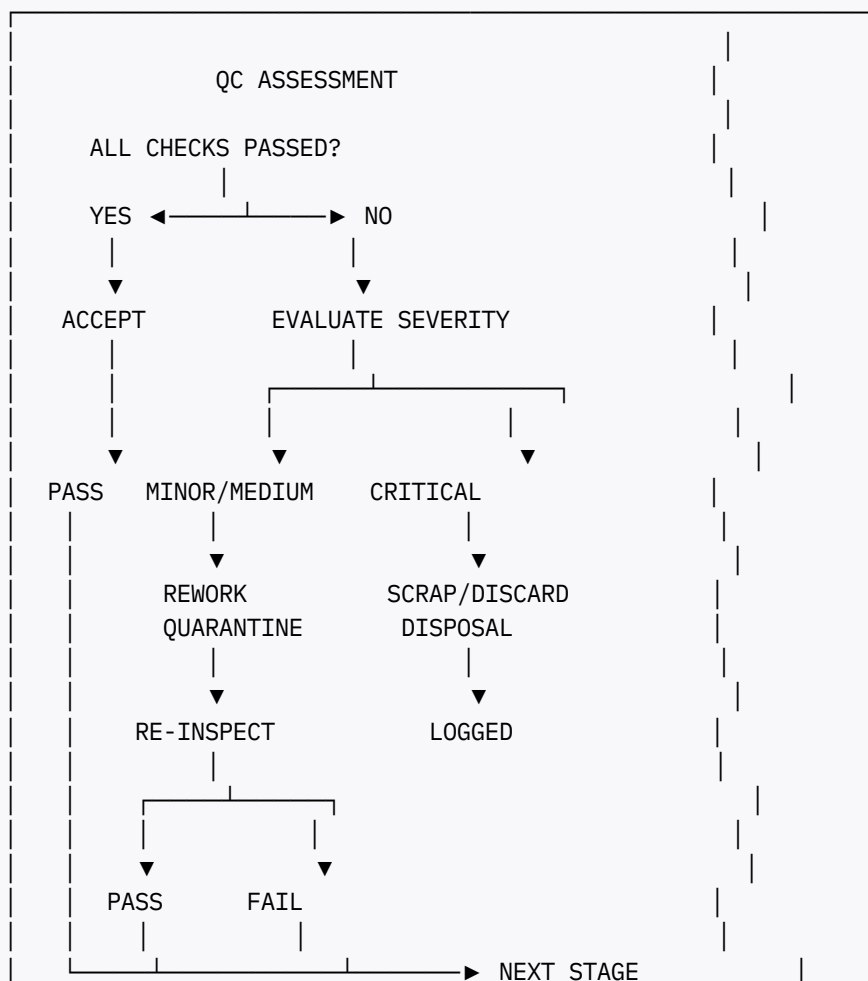
- QUARANTINE (Hold for supervisor review)

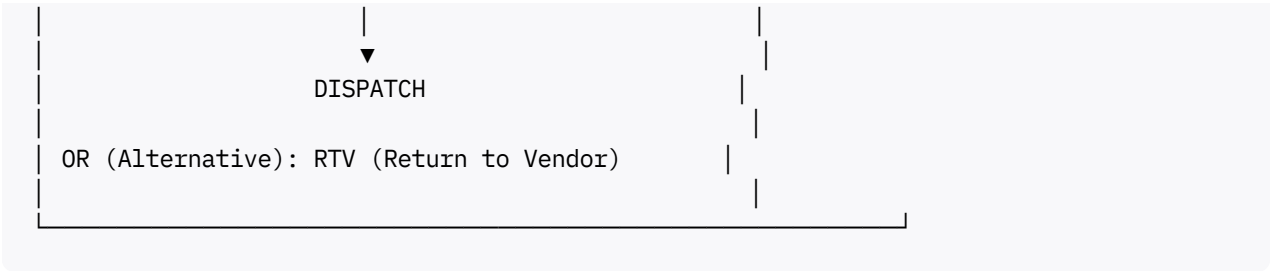
[CONFIRM OUTCOME]

9.3 Conditional Outcomes

QC Outcome Decision Tree:

QC RESULT OUTCOME ROUTING



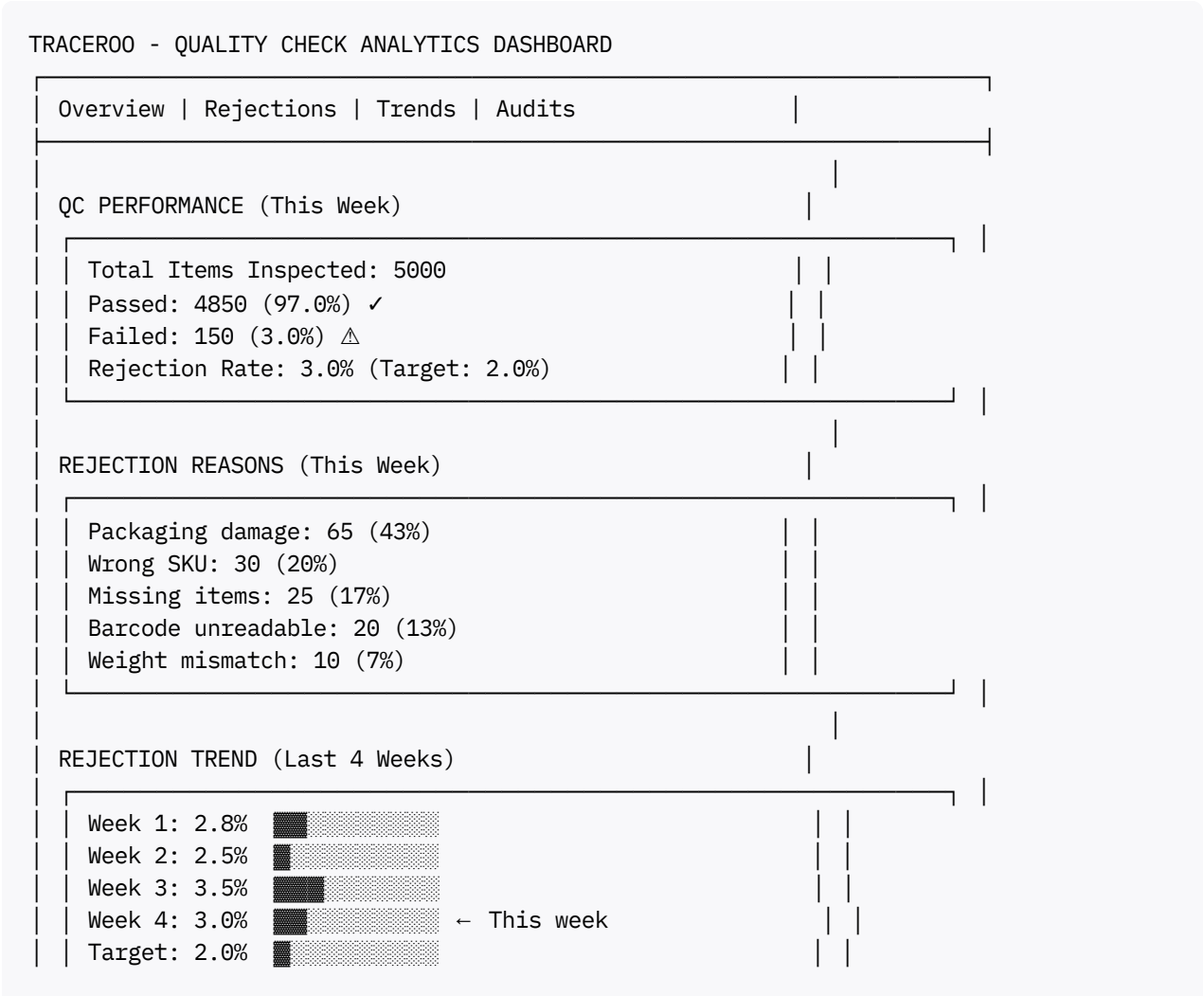


Outcome Actions:

Outcome	Action	Destination	Timeline	Notes
Accept	Item proceeds to next stage	Shipping/Dispatch	Immediate	Standard flow
Reject	Hold item in quarantine	Quarantine Bin	24-48 hrs	Supervisor review
Rework	Item sent back for repair	Rework Station	1-3 days	Cost tracked
Scrap	Item marked for disposal	Scrap Yard	7 days	Inventory write-off
RTV	Return to Vendor	Vendor Portal	Per agreement	Credit note generated

9.4 QC Dashboard & Rejection Trend Analytics

Web Dashboard - QC Analytics:



QC INSPECTOR PERFORMANCE

Inspector	Items	Passed	Failed	Accuracy
Arun Singh	1200	1164	36	97.0%
Meera Patel	1100	1067	33	97.0%
Rajesh Rao	950	912	38	96.0%
Neha Gupta	1050	1022	28	97.3%
Average				96.8%

[Filter] [Export] [Detailed Report]

10. REJECTION, SCRAP & RETURN (RSR) PROCESSES

10.1 RSR Initiation (Mobile Scan + Reason Codes)

Mobile Interface - Initiate Rejection/Scrap/Return:

TRACEROO SCANNER - INITIATE RSR

◀ Home

RSR Process

✓

SELECT RSR TYPE:

☒ REJECT

☐ SCRAP

☐ RETURN TO VENDOR

ITEM BARCODE:

☐ SCAN BARCODE

SKU-2024-001-SN-2024-0045

Acme Widget Pro (Box #48, Pallet #5)

REASON CODE (Required):

Category: [▼ Quality Issues]

Specific Reason:

☐ Packaging damaged

☒ Defective product (non-functional)

☐ Contamination detected

☐ Expired/Out of date

☐ Wrong SKU shipped

☐ Manufacturing defect


☐ Customer complaint

☐ Other: [_____]

SEVERITY:

☐ Low ☒ Medium ☐ Critical

EVIDENCE:

 PHOTO] [1 photo attached]

NOTES:

[Device powers on but screen not responsive] _____

[SUBMIT RSR REQUEST]

10.2 Quarantine Location Tracking

Quarantine Management System:

QUARANTINE & HOLD MANAGEMENT

Dashboard | Active Holds | History | Analytics

ACTIVE QUARANTINED ITEMS

Item ID	Reason	Date	Location	Action
SN-001	Reject	1-11	Q-BIN-01	Review
BOX-045	Scrap	31-10	Q-BIN-02	Dispose
SN-089	RTV	2-11	Q-BIN-03	Process

QUARANTINE LOCATION MAP:

Warehouse: WH-MUM-01

Zone: QUARANTINE_AREA

Q-BIN-01: 15 items (Rejects pending review)

Q-BIN-02: 8 items (Scrap awaiting disposal)

Q-BIN-03: 3 items (RTV awaiting shipment)

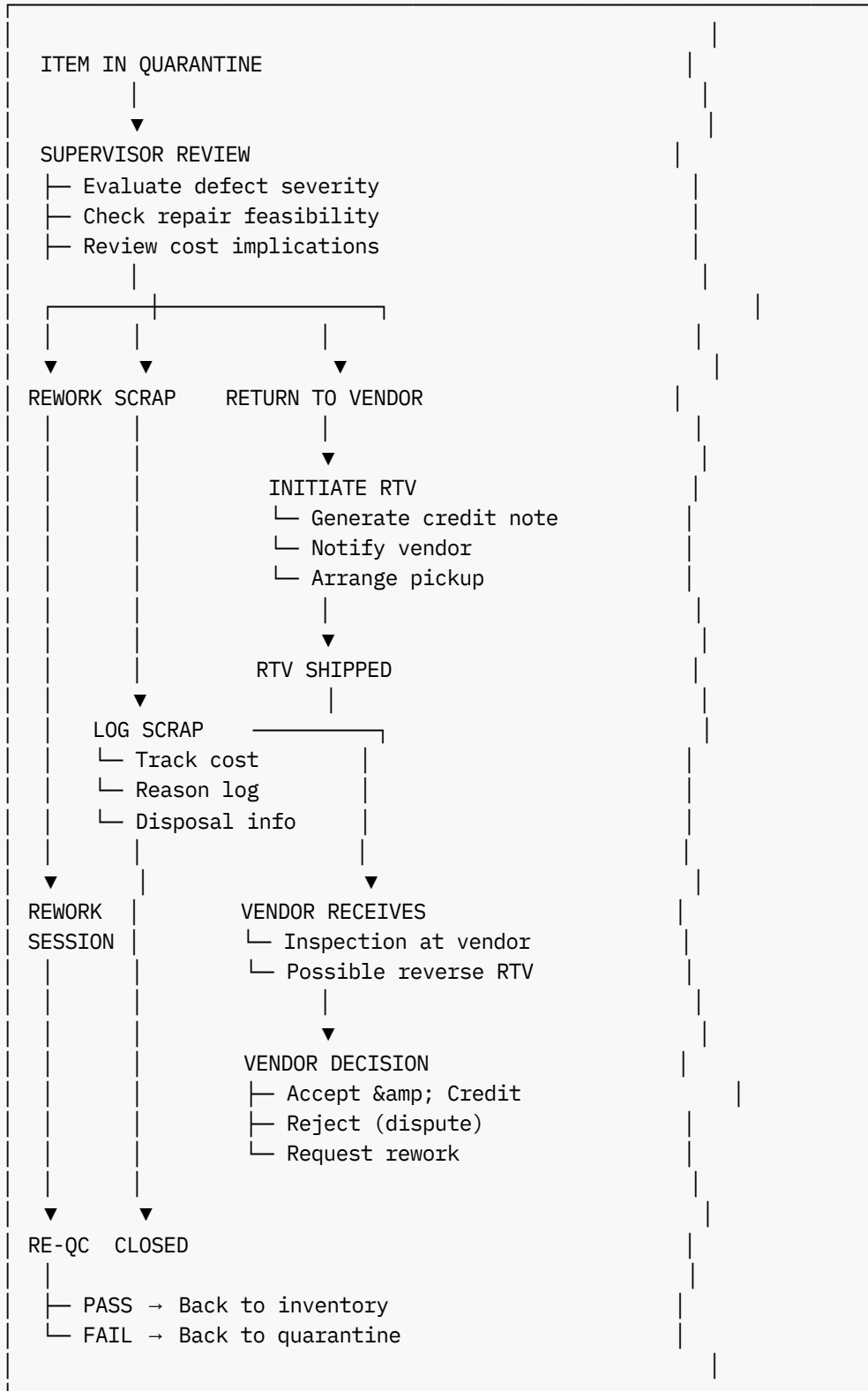
QUARANTINE AGE ALERT:

⚠ 2 items held >7 days → Action required

10.3 Disposition Workflows (Rework, Scrap, RTV)

Disposition Decision Framework:

RSR DISPOSITION WORKFLOW



10.4 Credit Note & Supplier Portal Link (future)

Credit Note Generation (Phase 2):

CREDIT NOTE - RETURN TO VENDOR

Credit Note #: CN-2024-0156

Generated: 03-Nov-2024 | 14:30 IST

DETAILS:

Original PO: PO-2024-0891

Vendor: Acme Industries Ltd.

Item: SKU-2024-001 (Acme Widget Pro)

Qty Returned: 25 units

Unit Price: ₹500

Total Value: ₹12,500

REASON FOR RETURN:

Manufacturing defect - Device malfunction

RTV SHIPMENT:

Tracking #: TRK-RTV-2024-0156

Courier: BlueDart

Expected Delivery: 05-Nov-2024

STATUS: Awaiting Vendor Acceptance

SUPPLIER PORTAL:

Vendor can track RTV and dispute/accept on
supplier.traceroo.in/rtv/CN-2024-0156

[PRINT CN]

[EMAIL TO VENDOR]

[TRACK SHIPMENT]

11. MOBILE APP USER EXPERIENCE

11.1 Offline Mode & Sync Architecture

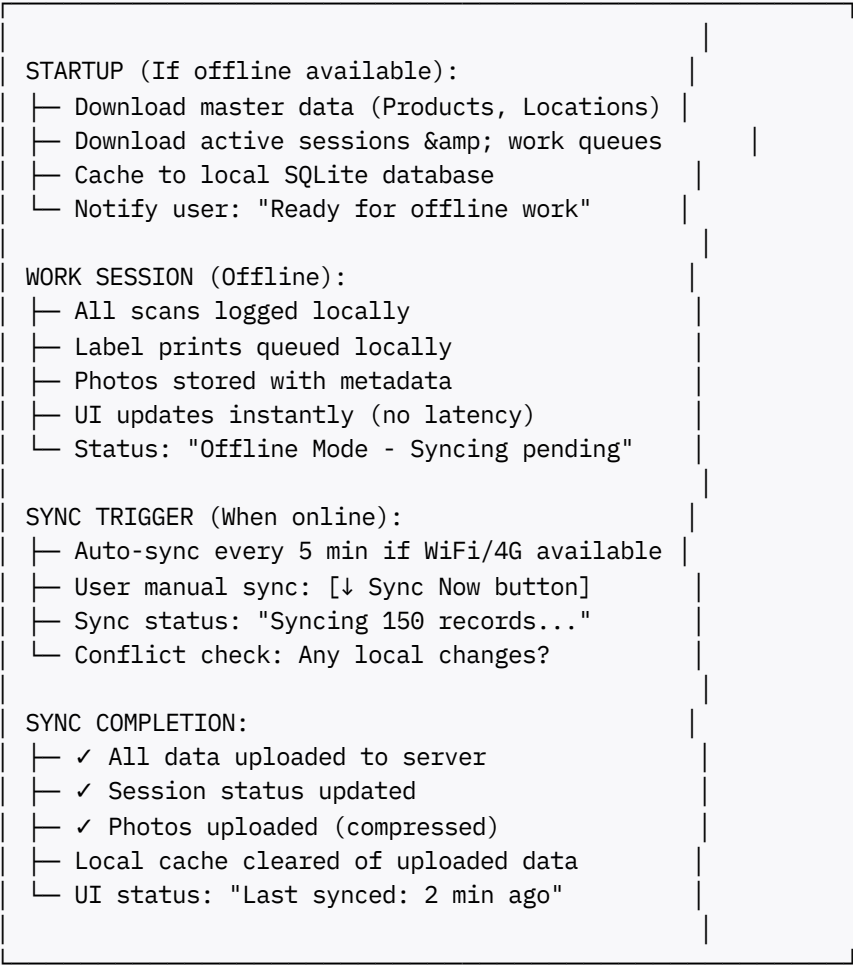
Offline Capabilities:

TraceRoo Mobile is designed to work in challenging connectivity environments:

- **Offline Duration:** Up to 8 hours of continuous work without internet
- **Data Caching:** All critical master data synced locally at app startup
- **Queue Management:** All scans queued locally with automatic retry logic
- **Conflict Resolution:** If data changed on server, user is notified at sync

Sync Workflow:

OFFLINE / ONLINE SYNC ARCHITECTURE



11.2 Scanner Integration (Camera + Bluetooth)

Scanner Integration Features:

Component	Technology	Purpose	Integration
Camera Scanner	Phone camera + OpenCV	Read barcodes/QR codes	Native camera API
Bluetooth Printer	Zebra MP series	Print labels on-demand	BLE 5.0 pairing
Barcode Formats	Code128, QR, GS1	Multi-standard support	Supported by scanner
Audio Feedback	Phone speaker	Scan confirmation	System audio
Haptic Feedback	Vibration motor	Tactile confirmation	Device vibration API
### 11.3 Home Screen Widgets (Pack	QC	Receive	Ship)

Mobile Home Screen Layout:

TRACEROO SCANNER - HOME SCREEN

TraceRoo

QUICK ACCESS

PACKING

QC CHECK

RECEIVE

SHIPPING

DELIVERY

RSR

MY WORK QUEUE

PACK SESSION PACK-2024-001

Status: In Progress

450/500 items packed (90%)

Started: 14:00 | Elapsed: 2h 15m

[CONTINUE]

QC INSPECTIONS TODAY

Completed: 45/50

Rejection Rate: 4.2%

[START NEW QC]

SYSTEM STATUS

Online

 |

WiFi

 |

87%

Last sync: 5 minutes ago

11.4 Voice-Guided Scanning (optional)

Voice Command Features (Phase 2):

- **Voice Prompts:** "Scan next item barcode now"
- **Hands-Free Operation:** Operator can work with gloves on
- **Audio Feedback:** "Item accepted" / "Item rejected"
- **Multi-language Support:** Hindi, English, Marathi, etc.
- **Accessibility:** Supports hearing-impaired with visual alerts

12. WEB PORTAL – OPERATIONS & ANALYTICS

12.1 Real-Time Traceability Dashboard

(See Dashboard mockup in Section 8.3)

12.2 Audit Trail & Genealogy Report (Item History)

Genealogy/Traceability Report:

TRACER00 - ITEM GENEALOGY REPORT			
Item: SN-2024-0456 (SKU-2024-001)			
COMPLETE LIFECYCLE HISTORY			
15-Nov-2024 09:00 PRODUCTION			
Action: Item manufactured			
User: Production system			
Location: MFG-LINE-01			
Details: Serial# assigned, barcode printed			
15-Nov-2024 10:30 PACKING			
Action: Item packed into box			
User: Ravi Kumar (OP-001)			
Box ID: BOX-2024-0048			
Pallet: PAL-2024-0005			
Container: TRUCK-789			
Details: Barcode verified, label applied			
Photo: [View photo] (timestamp: 10:32)			
15-Nov-2024 11:15 QUALITY CHECK			
Action: QC inspection completed			
User: Arun Singh (QC-001)			
Template: Electronics_Standard_v2			
Result: PASSED (3/3 checks)			
Photos: [2 photos] (evidence)			
Time spent: 3 minutes			
15-Nov-2024 12:00 SHIPPING			
Action: Item loaded to truck for shipment			
User: Logistics team			
Truck: TRUCK-789			
Destination: Pune Distribution Center			
Details: Pallet sealed, manifest generated			
15-Nov-2024 16:45 IN-TRANSIT			
Action: Milestone scan (Highway checkpoint)			
Location: Khopoli Toll Booth			

GPS Coordinates: 19.0234°N, 73.2556°E
Time: 16:45 IST

16-Nov-2024 | 08:30 | RECEIVING
Action: Received at destination warehouse
User: Warehouse staff
GRN #: GRN-2024-0456
Location: WH-PUN-01
Condition: Received in good condition
Photos: [1 photo] (inbound verification)

16-Nov-2024 | 10:00 | PUT-AWAY
Action: Stocked to storage location
Assigned Location: WH-PUN-01 / AISLE-B / BIN-B-23
Bin Coordinates: Row 5, Shelf 3, Position 7
Details: Item accessible for customer orders

SUMMARY:

- Total time in system: 25 hours
- States: 6 (Production → Delivery → Storage)
- Scans: 8 (multiple stages)
- Photos: 4 (documentation)
- Current Status: In Storage (Available)
- Risk Status: No issues

[PRINT REPORT] [EMAIL] [EXPORT PDF]

12.3 Inventory Snapshot by Location/Status

Location-based Inventory View:

INVENTORY SNAPSHOT BY LOCATION

Warehouse: WH-PUN-01 | As of: 03-Nov-2024 | 16:45 IST

RECEIVING AREA

└ Inbound Bay 1: 250 items (3 shipments)
└ QC Hold Area: 150 items (pending inspection)
└ Ready for Put-Away: 100 items

STORAGE ZONES

└ AISLE-A (General):
└ └ BIN-A-01 to A-25: 8500 items (SKU-2024-001)
└ └ BIN-A-26 to A-50: 6200 items (SKU-2024-002)
└ └ Total AISLE-A: 14700 items

└ AISLE-B (High-demand):
└ └ BIN-B-01 to B-25: 3400 items (SKU-2024-003)
└ └ BIN-B-26 to B-50: 2100 items (SKU-2024-004)

- └ Total AISLE-B: 5500 items
- └ COLD STORAGE (Temperature-controlled):
 - └ BIN-C-01 to C-10: 1800 items (Pharma SKU)
 - └ Temp: 2-8°C ✓ Compliant
 - └ Total COLD: 1800 items

STAGING / DISPATCH AREA

- └ Pick Zone: 500 items (active picks)
- └ Pack Area: 800 items (ready to pack)
- └ Shipping Dock: 300 items (ready to load)
- └ Total Dispatch Ready: 1600 items

QUARANTINE AREA

- └ QC Hold: 150 items
- └ Rejected/Rework: 75 items
- └ Scrap Awaiting Disposal: 50 items

TOTAL WAREHOUSE INVENTORY: 24,250 items
Capacity Utilization: 68%

[DETAILED VIEW] [EXPORT] [TRANSFERS]

12.4 Configurable Alerts (Expiry, QC Hold, etc.)

Alert Configuration & Management:

ALERT & NOTIFICATION SYSTEM

Configure Alerts	Active Alerts	History
------------------	---------------	---------

ALERT RULES (Editable)

✓ EXPIRY ALERT

- └ Trigger: Items approaching expiry date
- └ Condition: Expiry within [30▼] days
- └ Action: Email + SMS to warehouse manager
- └ Frequency: Daily at 06:00 AM

✓ QC HOLD ALERT

- └ Trigger: Items pending QC >4 hours
- └ Condition: QC hold duration > [4▼] hours
- └ Action: Escalate to QC supervisor
- └ Frequency: Every 1 hour

✓ SHELF STOCK ALERT

- └ Trigger: Stock below minimum threshold
- └ Condition: Stock < [500▼] units
- └ Action: Purchase order alert to procurement
- └ Frequency: Real-time when threshold breached

- ✓ REJECTION RATE ALERT
 - └ Trigger: QC rejection rate exceeds target
 - └ Condition: Rejection rate > [2.5▼] %
 - └ Action: Quality review alert
 - └ Frequency: Daily summary
- ✓ TRUCK DELAY ALERT
 - └ Trigger: Shipment delayed beyond ETA
 - └ Condition: Delay > [2▼] hours
 - └ Action: Notify shipping manager & customer
 - └ Frequency: Real-time

ACTIVE ALERTS TODAY

- ⚠ 5 items expiring within 15 days
- ⚠ Shipment SHIP-0456 delayed by 1 hour
- ⚠ QC hold: 12 items pending >3 hours
- 📢 Low stock alert: SKU-2024-005 (499 units)

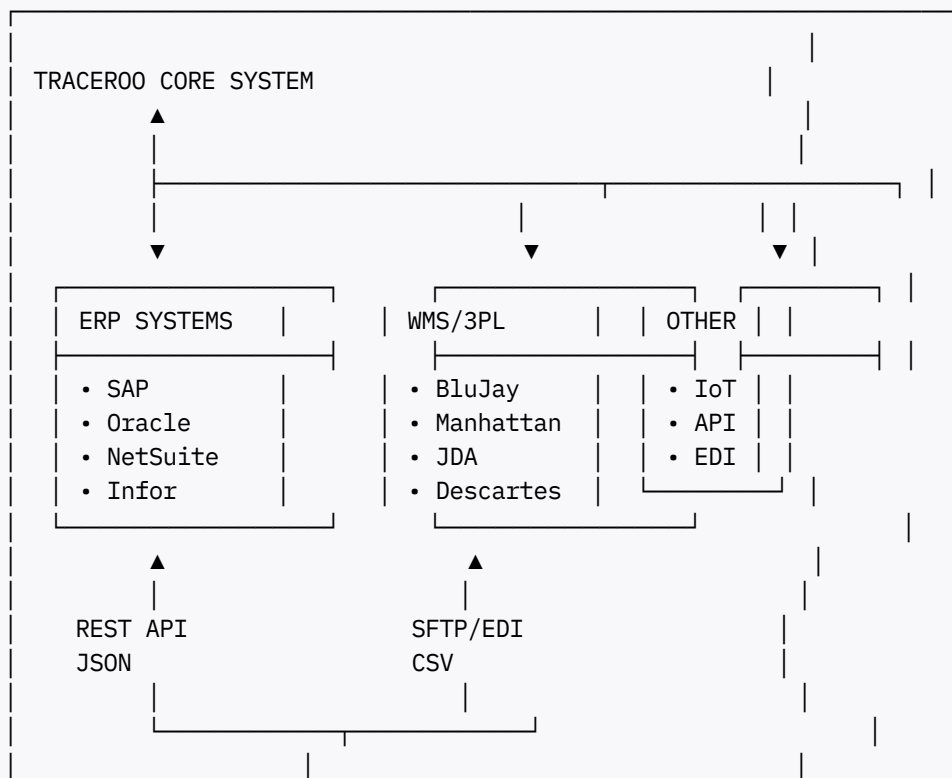
[MANAGE RECIPIENTS] [SAVE] [TEST ALERT]

13. INTEGRATION LAYER

13.1 ERP/WMS Connectors (SAP, Oracle, NetSuite, etc.)

TraceRoo Integration Architecture:

TRACEROO SYSTEM INTEGRATIONS



TraceRoo API Gateway
(Authentication, Validation)

Data Flows:

- ERP sends SKU master data, production orders
- ← TraceRoo sends packing status, QC results, shipment confirmation
- WMS sends location hierarchy, receiving instructions
- ← TraceRoo sends inventory snapshots, pick lists completion

Sample Integration: SAP ERP Connector

TraceRoo ↔ SAP Integration Points:

1. OUTBOUND (TraceRoo → SAP):

- Packing Confirmation: BOX-0001 packed with 10 units
- QC Results: Batch accepted/rejected with reason
- Shipment Manifest: Container manifests with POD proof
- Goods Receipt: GRN confirmation with location

2. INBOUND (SAP → TraceRoo):

- Production Orders: Batch ID, SKU, Qty to pack
- Purchase Orders: Receiving instructions
- Sales Orders: Shipment requirements, delivery address
- Inventory Master: Stock levels by location

13.2 IoT Printer API

Thermal Printer Integration:

THERMAL PRINTER API INTEGRATION

TraceRoo Mobile App

Bluetooth Connection
(Zebra BLE API)

Zebra Thermal Printer (MP845)

- Model: Zebra MP845
- Connection: Bluetooth 5.0
- Format: GLabel (Zebra Format)
- Print Speed: 150mm/sec
- Resolution: 203 DPI

Print Workflow:

1. Mobile app generates label PNG
2. Convert PNG → Zebra proprietary format
3. Send via Bluetooth to printer

4. Printer renders and prints in 3-4 seconds
5. App receives print confirmation

Supported Printers:

- Zebra MP845 / MP847
- Brother QL-1110 / QL-820
- Epson TM-T20
- Custom thermal printer via API

13.3 Third-Party Logistics (3PL) EDI

EDI Integration for Logistics Partners:

TRACEROO ↔ 3PL EDI INTEGRATION

TraceRoo

→ SFTP Server (EDI Gateway)

- BluDart
- FedEx
- Aramex

Outbound EDI Messages (TraceRoo → 3PL):

- Shipment Manifest (850 ASN)
- Container Details, Item counts, Destinations
- Special instructions (Fragile, Temperature, etc)
- Tracking requirement

Inbound EDI Messages (3PL → TraceRoo):

- Pickup Confirmation (855)
- In-Transit updates (997)
- Delivery Confirmation (997)
- Shipment problem notification

File Format: EDIFACT / X12 CSV

Frequency: Real-time push or hourly batch

Security: SFTP with 256-bit encryption

14. SECURITY, COMPLIANCE & AUDIT

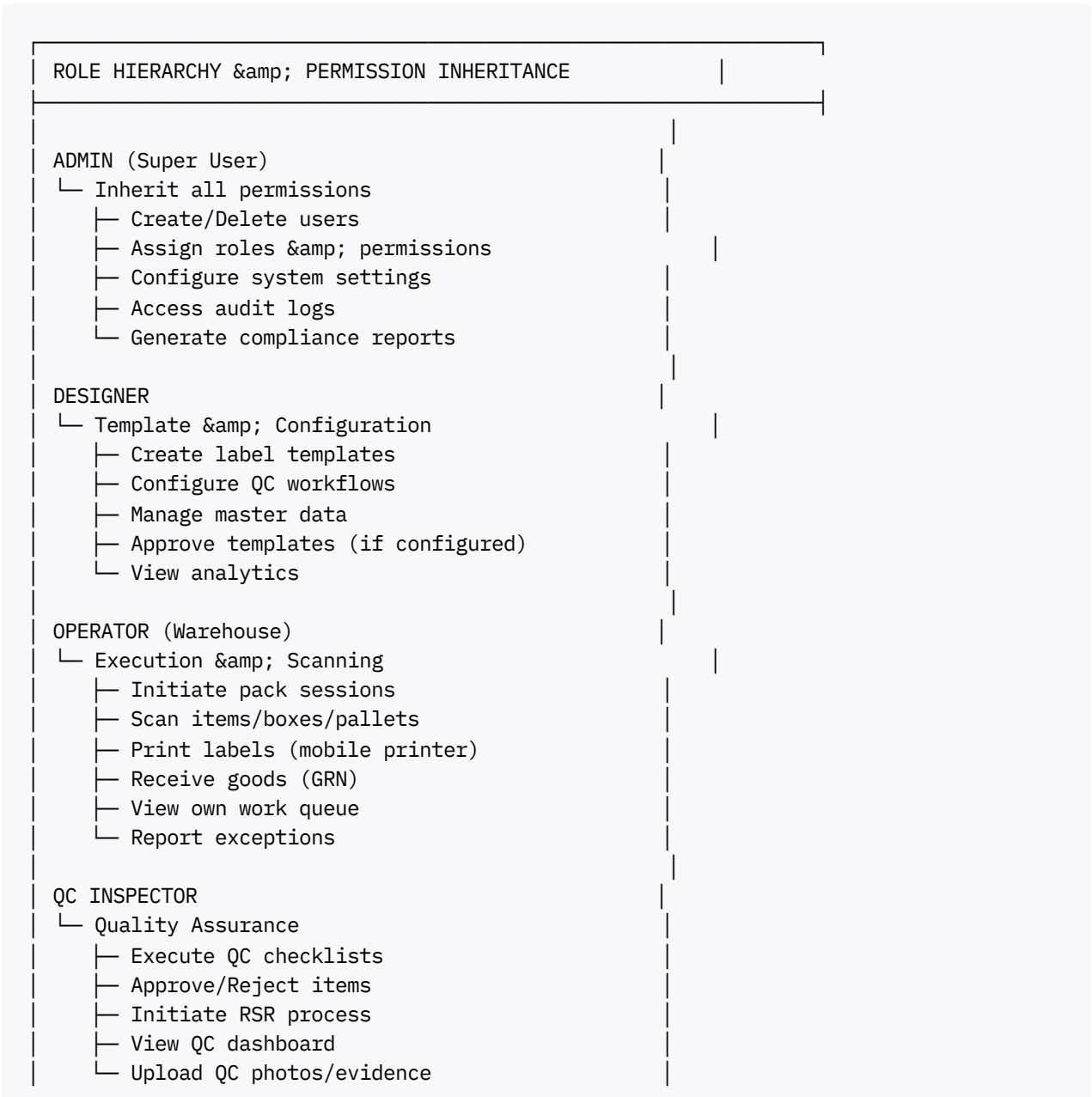
14.1 Data Encryption (at rest & in transit)

Encryption Standards:

Type	Standard	Implementation	Key Management
In Transit	TLS 1.3	All API calls over HTTPS	Automatic certificate rotation
At Rest	AES-256	Database encryption	AWS KMS or HashiCorp Vault
Barcode Data	GS1 Encoding	Standard GS1 encryption	Industry standard
PII Data	AES-256	Customer names, addresses	Separate encryption keys
Audit Logs	HMAC-SHA256	Immutable signing	Tamper detection

14.2 Role-Based Access Control (RBAC)

RBAC Permission Hierarchy:



```
VIEWER (Read-Only)
└─ Limited Access
    ├── View dashboards (no edit)
    ├── View reports
    ├── Generate genealogy reports
    └─ Export data
```

14.3 GS1 Compliance & FDA 21 CFR Part 11 (if applicable)

Compliance Features:

Compliance	Requirement	TraceRoo Implementation
GS1	GTIN assignment	Auto-assignment per GS1 standards
GS1	Batch/Lot serialization	Encoded in barcode per GS1 spec
GS1	Company prefix	Configurable per company
FDA 21 CFR Part 11	Digital signatures	Supported for authorization records
FDA 21 CFR Part 11	Immutable audit trail	Timestamped, cryptographically signed logs
FDA 21 CFR Part 11	Access controls	RBAC with role-based workflows
GDPR	Data privacy	Anonymization of PII on export
GDPR	Data retention	Configurable retention policies
ISO 8601	Date/Time format	All timestamps in ISO 8601 standard

14.4 Immutable Audit Log

Audit Trail Features:

IMMUTABLE AUDIT LOG SYSTEM

Every Action in TraceRoo is Logged:

```
└─ Packing Log
    Timestamp: 15-Nov-2024 10:32:45.123 IST
    User: Ravi Kumar (OP-001)
    Action: Scan item into box
    Item: SN-2024-0456
    Box: BOX-2024-0048
    Status: Success
    Hash: abc123def456... (SHA-256)
    Previous Hash: xyz789abc123...
    Digital Signature: ✓ Verified
```

```
└─ QC Log
```

```
Timestamp: 15-Nov-2024 11:15:30.456 IST
Inspector: Arun Singh (QC-001)
Action: QC completed
Item: SKU-2024-001
Result: PASSED
Photos: 2 evidence photos attached
Photo Hashes: img001.jpg (hash), img002.jpg
Digital Signature: ✓ Verified
```

Rejection Log

```
Timestamp: 15-Nov-2024 14:45:12.789 IST
User: Supervisor
Action: Item marked for scrap
Reason: Manufacturing defect
Item: SN-2024-0789
Approval: Yes (signed)
Digital Signature: ✓ Verified
```

AUDIT LOG PROPERTIES:

- Immutable: Once written, cannot be modified
- Cryptographically Signed: SHA-256 hash chain
- Tamper-Detection: Any change breaks hash chain
- Retention: Configurable (min. 7 years default)
- Export: Audit-ready XML/CSV format
- Accessibility: Full audit logs for compliance

[SEARCH LOGS] [EXPORT] [VERIFY SIGNATURE]

CONCLUSION & IMPLEMENTATION ROADMAP

Key Takeaways

TraceRoo is a comprehensive, enterprise-grade Asset Track & Trace solution that combines:

1. **Powerful Web-based Label Design:** Create sophisticated barcode labels with BarTender-like flexibility
2. **Mobile-first Execution:** Scan-based workflows for packing, QC, receiving, and delivery
3. **Complete Lifecycle Tracking:** From production through delivery and returns
4. **Quality-First Approach:** Built-in QC workflows with rejection and scrap management
5. **Enterprise Security:** Immutable audit trails, RBAC, encryption, and compliance-ready

Recommended Implementation Phases

Phase 1 (Months 1-3): Core Platform Launch

- Label designer and PDF generation
- Basic packing and scanning workflows
- Real-time dashboard
- Mobile app MVP

Phase 2 (Months 4-6): Advanced Features

- QC workflow engine
- RSR process automation
- ERP integration
- Advanced reporting

Phase 3 (Months 7-9): Intelligence & Scale

- IoT sensor integration
- Predictive analytics
- Supplier portal
- Multi-warehouse support

TraceRoo Business Blueprint Document

Version 1.0 | Published: November 2024

Confidential - For Authorized Use Only