

EchoNest AI - Key Integration Points Analysis

1. Frontend to Backend Online Integration

Authentication & User Management

- **Contract Document:**
EchoNest_AI_Frontend_Backend_Contract_Part1_Auth_Profile
- **Key Endpoints:**
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- **Requirements:**
 - JWT-based authentication for all secure endpoints
 - Multi-role support (parent/teacher/admin)
 - Email verification and password reset flows

Content Management

- **Contract Document:**
EchoNest_AI_Frontend_Backend_Contract_Part2_Content_SSE
- **Key Endpoints:**
 - (FormData with binary file)
 - (SSE for real-time progress)
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- **Requirements:**
 - Support for multiple content types (document/audio/video)
 - Real-time progress updates via Server-Sent Events
 - Content assignment to children or groups

RAG Chat Interface

- **Contract Document:**
EchoNest_AI_Frontend_Backend_Contract_Part3_RAG_Chat_SSE
- **Key Endpoints:**
 - (synchronous endpoint)
 - (SSE streaming endpoint)

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- **Requirements:**
- Token streaming via SSE for responsive UI
- Document source attribution in responses
- Feedback and flagging mechanisms for content control

Metrics & Diagnostics

- **Contract Document:**
EchoNest_AI_Frontend_Backend_Contract_Part4_Metrics_Diagnostics
- **Key Endpoints:**
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- **Requirements:**
- Device status monitoring and diagnostics
- Usage analytics and metrics dashboards
- Event notification system (polling or webhooks)

2. Device to Backend Online Integration

Manifest Synchronization

- **Contract Document:** EchoNest_AI_Device_Manifest_Sync_Contract
- **Key Endpoints:**
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- **Requirements:**
- Device authentication via JWT
- Content filtering based on assigned child/group
- Resource constraints (max 10 documents or 100MB)
- Priority content handling for offline use

Content Synchronization

- **Contract Document:** EchoNest_AI_Document_Pull_Contract
- **Key Endpoints:**
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- **Requirements:**
- Chunked or streamed content delivery
- Retry mechanism for network failures
- Storage space validation before download

Status Reporting

- **Contract Document:** EchoNest_AI_Sync_Status_Contract
- **Key Endpoints:**
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- **Requirements:**
 - Periodic health and sync status reporting
 - Battery status and connectivity information
 - Cache usage statistics

OTA Updates

- **Contract Document:** EchoNest_AI_OTA_Update_Contract
- **Key Endpoints:**
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- **Requirements:**
 - Version checking and download resumption
 - Checksum validation for security
 - Safe update process with fallback mechanism

3. Device Internal Integration (Offline Mode)

Local API Server

- **Contract Document:** EchoNest_AI_Offline_Device_Communication_Contract
- **Key Endpoints:**
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- **Requirements:**
 - Local HTTP server on device (localhost:8080)
 - Voice input/output routing
 - Local LLM and RAG functionality
 - Session-based memory for conversation continuity

LLM Fallback Mechanism

- **Contract Document:** EchoNest_AI_LLM_Fallback_Contract
- **Key Endpoints:**

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- **Requirements:**
- Fallback invocation when cloud LLM fails
- Token limits and content filtering
- Response confidence scoring

4. Critical Cross-Component Requirements

Offline to Online Transition

- Seamless transition between online and offline modes
- Consistent user experience regardless of connectivity
- Prioritized content synchronization for offline use

Security & Authentication

- JWT-based authentication for all secure endpoints
- Device-specific authentication for sync and OTA
- Content filtering and safety mechanisms

Performance Constraints

- Response time objectives for offline mode:
- STT processing: 500ms max
- LLM response: 2 seconds max
- Emotion feedback: 100ms max
- Resource constraints for edge device:
- Maximum 10 documents or 100MB cache
- Token usage tracking and rate limiting

Error Handling & Resilience

- Retry mechanisms for network failures
- Fallback logic for offline operation
- Safe update processes with rollback capability