

Azure Rebate Recovery System – Architecture Documentation

Comprehensive Technical Overview

Executive Summary

The Azure Rebate Recovery System is a fully cloud-native enterprise solution engineered to automate and optimize rebate recovery for medical supplies vendor contracts. Developed exclusively on Microsoft Azure, the platform incorporates advanced AI document processing, intelligent data reconciliation, and orchestrated workflow automation to eliminate manual inefficiencies, ensure scalability, and deliver operational excellence.

1. System Overview

1.1 Architecture Principles

The solution architecture is governed by the following foundational principles:

- **Cloud-Native:** Built entirely with Azure services to ensure scalability and reliability.
- **API-First:** Comprehensive RESTful APIs enable seamless integration across platforms.
- **Event-Driven:** Asynchronous processing supports robust scaling and high throughput.
- **Microservices-Based:** Loosely coupled, independently deployable services enhance maintainability.
- **Security by Design:** Implements a zero-trust model with thorough end-to-end encryption.
- **Vendor Agnostic:** Flexible contract ingestion and processing accommodate diverse vendor requirements.

1.2 High-Level Architecture

The architecture is structured into three logical tiers:

- **Presentation Layer:** React SPA on Azure Static Web Apps, distributed globally via Azure CDN.
- **Application Layer:** Azure API Gateway routes to .NET Core APIs on Azure App Service; Azure Functions manage background operations.

- Data Layer: Azure SQL Database (structured data), Azure Blob Storage (document management), Azure Redis Cache (performance), and Azure AI (intelligent processing).

2. Technology Stack

2.1 Frontend Technologies

- Framework: React 18+ with TypeScript for robust, maintainable development.
- State Management: Redux Toolkit ensures consistent state across the application.
- UI Components: Azure Fluent UI for seamless Microsoft ecosystem alignment.
- Build Pipeline: Vite for accelerated builds and optimized deployment.
- Hosting: Azure Static Web Apps with automated SSL and CDN support.

2.2 Backend Technologies

- Platform: .NET 8.0 for enhanced performance and extended support.
- API Framework: ASP.NET Core Web API, documented via OpenAPI specifications.
- Authentication: Azure ENTRA ID provides secure, scalable user identity management.
- Hosting: Azure App Service (Linux) for cost-effective, scalable deployments.
- Serverless Processing: Azure Functions (Isolated .NET 8 runtime) handle background workloads efficiently.

2.3 Data Technologies

- Main Database: Azure SQL Database (Business Critical tier) for high availability.
- Document Storage: Azure Blob Storage with tiered lifecycle management.
- Caching: Azure Redis Cache Premium for low-latency data access.
- Search: Azure Cognitive Search with custom analyzers for deep document discovery.

3. Detailed Architecture

3.1 Frontend Architecture

The React application leverages modular feature-based components and robust service abstractions:

- Contract management: Upload, viewing, and amendment-handling interfaces.

- Dashboards: Real-time rebate tracking and compliance monitoring.
- Authentication: Azure ENTRA ID integration for secure access control.
- Utility services: Standardized modules for API, authentication, and file operations.
- Real-time updates: SignalR WebSocket connections inform users of status changes instantly.
- Analytics: Embedded Power BI dashboards provide actionable business insights.

3.2 Backend Architecture

The system adheres to Clean Architecture principles, enforcing strict separation of concerns:

- API Controllers: RESTful design, with comprehensive error handling and uniform responses.
- Business Logic Services: Core orchestration of contract, rebate, and compliance workflows.
- Data Access: Repository pattern with Entity Framework Core; external integrations handled by distinct service clients.
- Cross-Cutting Infrastructure: Centralized logging, caching, and monitoring.

3.2.1 Core Service Responsibilities

- Contract Management: Upload, metadata extraction, amendment linking, and version tracking.
- AI Processing: Azure AI Document Intelligence and OpenAI GPT-4 for advanced data extraction and interpretation.
- Data Integration: ETL orchestration via Azure Data Factory, with comprehensive data validation and cleansing.
- Rebate Calculation: Automated, contract-specific logic with multi-vendor reconciliation and variance analysis.

4. Azure Services Architecture

4.1 Core Infrastructure Design

Logical resource segregation supports efficient management and cost visibility:

- Production Resources: All production workloads, compute, storage, and AI services.
- Shared Services: Centralized Key Vault, Log Analytics, and Application Insights.

- Networking: Virtual networks, application gateways, and private endpoints for secure connectivity.

4.2 Service Mapping

- Web and API hosting: Azure Static Web Apps and App Service with auto-scaling.
- Background processing: Serverless Azure Functions for document and data workflows.
- AI document intelligence: Pre-trained and custom models for data extraction.
- Natural language processing: Azure OpenAI for interpretation and business logic generation.
- Business intelligence: Embedded Power BI for real-time reporting and analytics.

4.3 Data Flow Overview

Contract Processing Workflow:

- User uploads trigger document storage and event-driven AI processing.
- Data extraction and business term interpretation are handled by AI services.
- Structured data is stored securely with full audit capabilities and indexed for rapid retrieval.
- Real-time notifications are delivered to the user interface upon completion.

Data Integration Workflow:

- External system data is ingested, validated, and matched via intelligent algorithms.
- Data is consolidated and made accessible for reporting and analytics.

5. Data Architecture

5.1 Database Schema

A normalized schema supports transactional and analytical operations:

- Vendor management, contract and amendment tracking, item relationships, and rebate processing tables.
- Comprehensive audit trails and compliance reporting structures.

5.2 Blob Storage Organization

- Hierarchically structured containers for raw, processed, reports, and archival content.

- Lifecycle policies for efficient storage management and compliance.

6. AI and Machine Learning Integration

6.1 Document Intelligence Pipeline

Phased data extraction, semantic interpretation, rule generation, and quality validation ensure robust, automated contract analysis.

6.2 Intelligent Matching Strategy

A multi-algorithm approach (Levenshtein distance, semantic embeddings) with confidence scoring, machine learning feedback loops, and exception handling for unmatched items.

7. Integration Architecture

7.1 External System Integration

- Secure, scheduled, and resilient connections to Item Master, General Ledger, and Premier systems.
- Data validation and reconciliation with robust error handling and automated retries.

7.2 API Standards

- RESTful, versioned APIs with standardized JSON payloads, error codes, and OpenAPI documentation.
- Comprehensive authentication and scope-based authorization for secure access.

8. Security Architecture

8.1 Layered Defense

- Network: Virtual networks, private endpoints, web application firewalls.
- Identity: Azure ENTRA ID with MFA and managed identities for service authentication.
- App Security: Input validation, SQL parameterization, CSRF and CSP protections.
- Data Protection: Encryption at rest (customer-managed HSM keys) and in transit (TLS 1.3).

8.2 Compliance Framework

- HIPAA-compliant architecture with audit logging and data retention policies.
- Automated support for privacy and right-to-be-forgotten requests.
- Continuous vulnerability assessment and SIEM integration (Azure Sentinel).

9. DevOps and Deployment

9.1 Continuous Integration & Deployment

- Git-based source control, feature branching, and protected mainline workflows.
- Automated build and test pipelines with quality gates and parallel execution.
- Zero-downtime blue-green deployments, environment separation, and approval gates.

9.2 Infrastructure as Code

- Bicep templates for repeatable, parameterized resource provisioning and management.
- Secrets and configuration via Key Vault with environment-specific injection.
- Orchestrated deployments with Azure DevOps pipelines.

10. Monitoring and Observability

10.1 Performance Monitoring

- End-to-end application and infrastructure monitoring with Azure Application Insights and Monitor.
- Centralized logging and analytics with automated alerts and custom dashboards.

10.2 Key Performance Indicators

- Contract processing time: <5 minutes per document
- API response: <2 seconds (95th percentile)
- System availability: >99.9%
- Extraction accuracy: >90%
- Fuzzy matching confidence: >85%
- User satisfaction and process efficiency metrics tracked quarterly

11. Scalability and Optimization

11.1 Scaling Strategy

- Application auto-scaling, database read replicas, and elastic pools for workload management.
- Blob Storage with lifecycle and cost optimization policies.

11.2 Performance Enhancements

- Advanced caching, CDN delivery, optimal indexing, and asynchronous task processing for maximum efficiency.

12. Cost Management

12.1 Resource and Financial Optimization

- Rightsized environments, automated shutdowns, lifecycle storage management.
- Comprehensive cost tracking, tagging, and monthly optimization reviews.

13. Disaster Recovery & Business Continuity

13.1 Backup & Recovery

- Automated, geo-redundant database and document storage backups.
- Rapid environment re-creation via Infrastructure as Code.

13.2 Continuity Planning

- RTO: 4 hours; RPO: 1 hour; SLA: 99.9% availability.
- Cross-region failover and stakeholder communication procedures.

14. Implementation Roadmap

- Phase 1: Foundation: Core infrastructure, authentication, document upload, initial metadata extraction.
- Phase 2: AI Integration: Document intelligence, NLP, fuzzy matching, amendment workflows.
- Phase 3: Data Integration: External system connections, data validation, ETL pipelines, Power BI analytics.

- Phase 4: Advanced Features (Months 7–8): Compliance automation, advanced analytics, optimization, user training.

15. Success Metrics

15.1 Technical Criteria

- Consistent achievement of performance benchmarks and reliability metrics.
- Demonstrated scalability and uninterrupted operations under projected load.

15.2 Business Value

- Significant reduction in manual processing, improved accuracy, user adoption, and measurable ROI.

16. Conclusion

This architecture establishes a secure, scalable, and intelligent framework for modernizing rebate recovery operations in the medical supplies sector. By leveraging the full Azure ecosystem, the solution addresses critical business and technical challenges, enhances compliance and security, and sets the foundation for future innovation and operational agility. The phased roll-out ensures continuous value delivery, early adoption, and tangible results for stakeholders throughout the transformation journey.