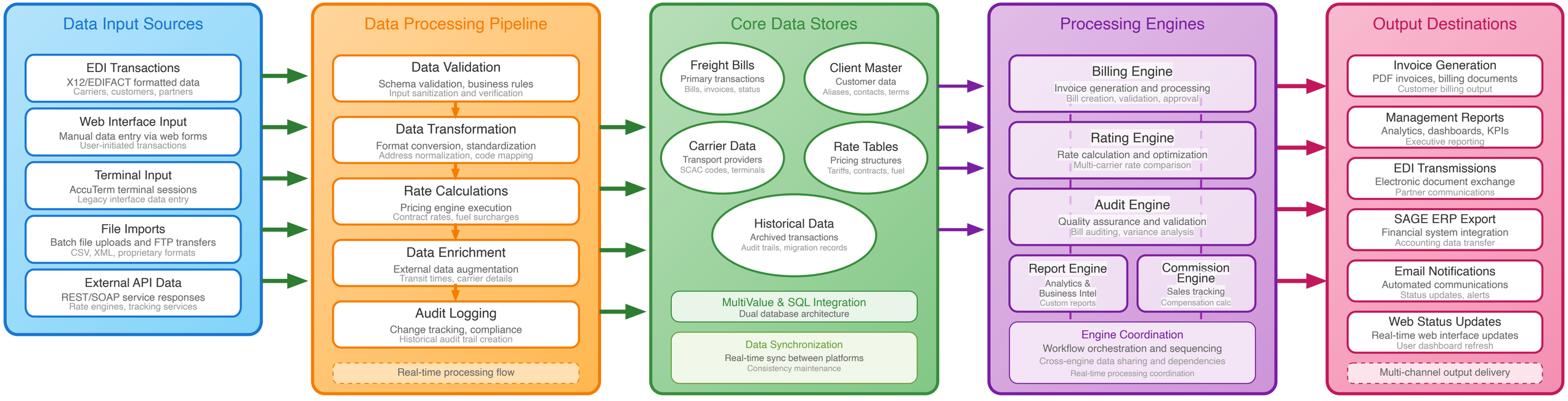
# AFS Freight Billing & Logistics Management System - Data Flow Architecture

End-to-End Data Processing Pipeline




## Data Volume & Processing Metrics

**Input Sources:**
- EDI: 1000+ transactions/day

**Processing:**
- Real-time validation & transformation

**Storage:**
- 1.78M lines of code, 2,333 files

**Engines:**
- Multi-threaded processing

**Outputs:**
- 6 primary delivery channels

**Integration:**
- 918 integration layer files

## Data Processing Patterns

### Real-time Processing
- Web interface transactions
- Terminal input processing
- API responses

Immediate validation & storage

### Batch Processing
- EDI file processing
- Bulk data imports
- Scheduled rate updates

Scheduled overnight processing

### Event-driven Processing
- Status change triggers
- Audit event logging
- Email notifications

Triggered by business events

### Data Quality & Integrity Controls

Schema Validation • Business Rule Enforcement • Duplicate Detection • Cross-Reference Validation
Error Handling • Retry Logic • Dead Letter Queues • Audit Trail Maintenance

## External System Integration Data Flow

### Inbound Data Integrations
- PC Miler: Mileage calculations
- RateWareXL: Rate comparisons
- TEMPO: Cost estimations

Real-time API responses enriching core data

### Outbound Data Integrations
- SAGE ERP: Financial data export
- EDI Partners: Transaction exchange
- Customer portals: Status updates

Scheduled and event-driven data transmission

### Bidirectional Data Exchange

Carrier Connect: Transit times, tracking • UPS/FedEx APIs: Shipment status • SQL Synchronization: Multi-platform consistency
OCR Processing: Document scanning • Email Services: Automated notifications • FTP: Bulk file transfers

## Data Security & Compliance Framework

### Data Encryption
- In-transit encryption (TLS/SSL)
- At-rest encryption

PII and financial data protection

### Access Control
- Role-based permissions
- Multi-factor authentication

User activity monitoring

### Audit Logging
- Complete data lineage tracking
- Change history maintenance

Compliance reporting

### Data Validation
- Schema enforcement
- Business rule validation

Data quality assurance

### Backup & Recovery
- Automated backups
- Point-in-time recovery

Disaster recovery planning

## Data Flow Legend & Architecture Summary

**Data Flow Types:**
- Primary Data Flow
- Processing Pipeline
- Engine Processing
- Output Generation
- Coordination Flow

**Processing Stages:**
- Input Sources (5 types)
- Processing Pipeline (5 stages)
- Core Data Stores (5 stores)
- Processing Engines (5 engines)
- Output Destinations (6 channels)

**Architecture Characteristics:**
- Real-time and batch processing capabilities
- Multi-modal data input with comprehensive validation
- Dual database architecture (MultiValue + SQL)
- Event-driven processing with audit trail
- Extensive external system integration
- Multi-channel output delivery

**Performance Metrics:**
- Processing Volume: 1000+ EDI transactions/day
- Response Time: Sub-second for real-time processing
- Data Integrity: 99.9% accuracy with validation
- Integration Points: 8 major external systems
- Audit Coverage: 100% transaction tracking
- Availability: 99.5% uptime with redundancy

**Technology Stack:**
- MultiValue Database Platform
- SQL Database Integration
- EDI Processing (X12/EDIFACT)
- REST/SOAP Web Services
- Batch Processing Framework
- Real-time Event Processing