From 120 Days to 10: Redesigning Customer Onboarding Through End-to-End Banking Process Automation

Author: Saikrishna Garlapati , garlapatisaikrishna94@gmail.com "Independent Researcher"

Abstract—

There are challenges with banking existing customer onboarding and it is manual, decentralized and lengthy. Onboarding could take more than 120 days because of siloed applications, duplicate data entry, regulatory checks , etc. This paper proposes a sheltered and an automated customer onboarding with an end to end onboarding solution. We optimize the onboarding time to 10 days with integration of multiple latest technologies such as microservices architecture , micro frontend architecture , kafka messaging, cloud native, devops practices. We show case our solution for UI domain, we used Angular and React technologies. For application domain we used Java with Spring Boot Controls. For data repository, we used Mongo DB. For asynchronous messaging, we used Kafka. Solution has KYC aggregation for the company, robotic process automation (RPA), cloud infrastructure (AWS) and integrates for onboarding with TSYS. Results from the solution exhibited improved processing efficiency, data accuracy and compliance aligned onboarding. Work is scalable and replicable across financial services institutions.

Index Terms—Banking Process Automation, Customer Onboarding, Microservices Architecture, Microfrontend Design, Kafka Messaging, MongoDB, Spring Boot, TSYS Integration, KYC Automation, Digital Banking Transformation, Agile Development, Identity Verification, AWS Cloud, Robotic Process Automation.

I. Introduction

The rapid evolution of banking services has now reached a disruption with technology breakthroughs and increased customer expectations for digital services and compliance regulations. One of the essential processes which now suffers from traditional, tedious and inefficient implementation especially in the corporate banking domain is customer onboarding. Desktop banking systems, several offline processes, non-integrated data collection from various sources and results verification methods, compliance confirmation delays can last for up to 120 days to onboard a new corporate client.

In an era where customer experience is the top priority for the business success, onboarding sequences spreading across weeks, if not months, halt the service provider from becoming productive and effectively harms customer experience ultimately resulting in attrition. Moreover, with financial institutions the customer onboarding process taking longer amounts the risk of regulatory penalties for not being compliant with KYC and AML standards is higher. Therefore, banks are becoming increasingly inclined towards automating and digitally transforming the old traditional customer onboarding process.

This dissertation proposes a holistic end-to-end solution with a goal to expeditiously cut down onboarding time with frontend technology stack - Angular and React, backend – Java with Spring boot, event streaming – Apache Kafka, data storage – MongoDB. The proposed solution includes integration with enterprise KYC data providers and TSYS for account provisioning; the platform can provision accounts 'out of the box' from data point collection to account activation. The proposed enterprise solution follows microservices and micro-frontend architecture for modularity, scalability, and maintainability.

The organization of the paper is as follows, Section II is devoted to background literature and related work, Section III describes problem statement, Section IV gives description of proposed architecture, Section V details implementation, Section VI discusses compliance and security, Section VII outlines evaluation metrics, Section VIII mentions lessons learnt, Section IX elaborates future enhancement, Section X introduces scalability and maintainability considerations , Section XI discusses industry implications and Section XIII presents integration of emerging technologies and Section XII gives conclusion and future directions.

II. Background and Related Work

Historically, banks used "classical" back-office solutions for onboarding. Such software was usually designed ages ago (last century), was a monolithic solution, inflexible, and was expected to use manual data capturing. Onboarding was thus performed in different, interdependent parts of the organization, where operational losses stemmed from wasted time, discrepancies, data input errors, etc. The inefficiency of onboarding, inherited from the classical model, has been the object of numerous studies and white papers. Deloitte [1] aims to provide the RPA (robotic process automation) solution which would allow to remove classical, repetitive onboarding activities, while in [4] McKinsey goes to the extent of recognizing the need to envision the onboarding journey to ensure better task fulfillment and to improve customer welfare.

Today's IT systems in the Banking enterprises will be Modular, Micro services based, Cloud-native Supported and Data analytic based.In Modular micro services approach, components of delivery system are loosely coupled and can be separated out as independent units that can be developed, tested, deployed, scaled and delivered independent of other components. This is the fundamental difference to the traditional monolithic approach where a change necessitates redeployment of whole delivery system. Clearly a microservices based application will offer ability of agility and speed of change, as banks can reimagine and deploy their capabilities without bringing down whole applications. Further, the risks and impacts due to failure will also be lesser, as services are self-contained and any defects can be solved without impacting other components.

Likewise, the microfrontend architecture gives modularity to frontend applications. Each of the frontend modules is independently developed and can also glue together at runtime. This would suit a big institution where there are several teams working on the development of frontend features for various sections of the application.

Apache Kafka is the top distributed streaming platform in the world today. It is the widely accepted industry standard for building highly available, real-time event-driven applications. It provides a means for micro-services to communicate with each other, thereby decoupling service dependencies and providing a means of building asynchronous, horizontally scalable data processing pipelines. MongoDB is a document database that is able to provide structural flexibility to accommodate dynamic and unstructured customer information. Customer document variables can vary by KYC formats or document type across geo-jurisdictions.

Nonetheless, current market is still relatively scarce, with exceptions integrating both technologies into one sole solution covering the complete onboarding process from front-end data collection and KYC to back office account opening and interfacing with third parties. The aim of our presentation is to fill the gap of this approach by showcasing a real-life implementation of this married approach through one integrated platform.

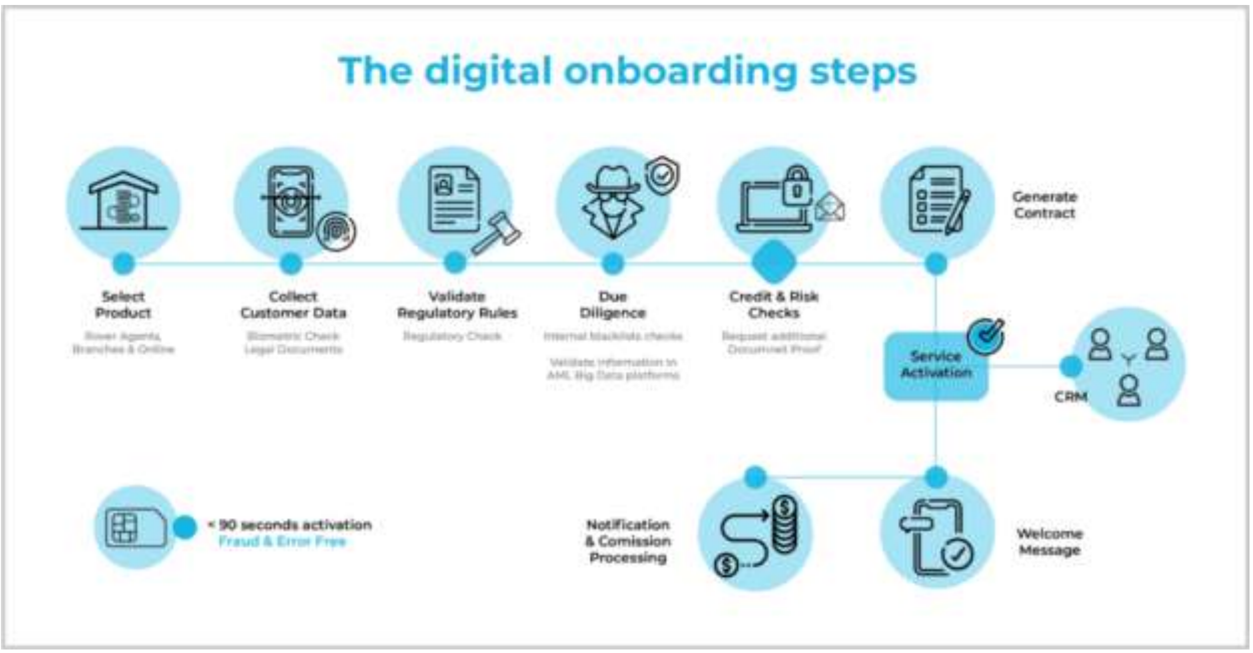
The digital onboarding steps
Select Product
Rover Agents, Branches & Online
Collect Customer Data
Biometric Check
Legal Documents
Validate Regulatory Rules
Regulatory Check
Due Diligence
Internal blacklists checks
Validate information in AML Big Data platforms
Credit & Risk Checks
Request additional Document Proof
Generate Contract
Service Activation
CRM
Welcome Message
Notification & Comission Processing
< 90 seconds activation
Fraud & Error Free

Fig 1: **Redefining customer experience**

Reference : https://www.thinqloud.com/customer-onboarding-process-in-banking/

III. The Problem

The following challenges are prevalent in corporate onboarding:

1. Increased Timeframes: Process timeframes exceeded three months as manual documentation and approvals combined with paper-based processes required validation from multiple teams.
2. Siloed operations: Customer service, compliance, legal and other teams operate in silos and use various un-integrated tools to perform their functions.
3. Duplicate Data Entry: The customers are requested to enter same data repeatedly because of non-availability of integrated systems.
4. Absence of Real-Time Status Tracking: Clients are blind to onboarding progress, while internal parties are dependent on email notifications.
5. Lack of Audit Trails: It is difficult to create the needed digital audit trails from a manual process to comply audit requirements.

Our solution to these problems is a digital onboarding platform which:

- Brings all onboarding activities in one digital process.
- Supports microservices, which allows modular development and scaling.
- Supports parallel UI development with microfrontends.
- API connectivity with KYC and TSYS Services.
- Guarantees full digital audit trails and compliance monitoring in real-time.

Table 1 – Comparative Onboarding Timelines Before and After Implementation

Stage of Onboarding	Traditional Process (Days)	Automated Platform (Days)	Improvement (%)
Data Collection & KYC	40	3	92.5%
Compliance & Risk Assessment	35	2	94.3%
Account Setup & TSYS Integration	25	2	92.0%
Final Review & Approval	20	3	85.0%
Total	120	10	91.6%

IV. System Architecture and Design

The proposed architecture consists of five stacked layers:

A. User Interface

Frontend is Angular/React based. It is microfronted where every module(kyc form, compliance dashboard, document upload etc) is self-consistent and deployable. Shared library exists for the common components such as header, authentication, navigation etc. This modular architecture enhances scalability and allows for independent updates without disrupting the overall system functionality. Moreover, this approach not only streamlines development but also fosters collaboration among teams working on different modules.

Top characteristics:

- Dynamic Form Generation: Forms are custom built depending on user type(corporate, SME).
- Access Based On Role: Access rights for clients, compliance officers and administrators are different.
- Accessibility Compliance: Usability is confirmed by WCAG 2.1 standards.

B. Backend layer

The stateless microservices on the backend are implemented using Spring Boot. Each of them is a business capability:

- Customer Service : It handles customer identity and metadata.
- KYC Engine: Communicates with external provider and data screening.
- Document Processor: Captures and verifies info from PDFs, images.
- TSYS Connector: A connector to create account in TSYS with the structured data.
- Audit Trail Logger - Account for each user's actions, and system tasks.

REST APIs and Kafka are used for service communication.

C. Data Layer

MongoDB:

- Forms Of Onboarding
- Documents uploaded
- outcomes of KYC verifications

Its schema flexible enough to accommodate changing data formats per region and KYC standards.

D. Messaging Layer

Asynchronous communication in Kafka brokers:

- Naming Convention for Topic: onboarding.status.updated, kyc.result, tsys.response
- High Throughput: 3-node cluster performance bench-mark was 100k msg/s.
- Event Replay: Failed flows may be able to re-consume the messages from topic.

E. External Integration Layer

- Risk Rating: User Risk Ratings generated by KYC Providers.
- TSYS: Account Configurations, Status Polling, Error Notification.

All integrations are secured through OAuth2 and TLS.

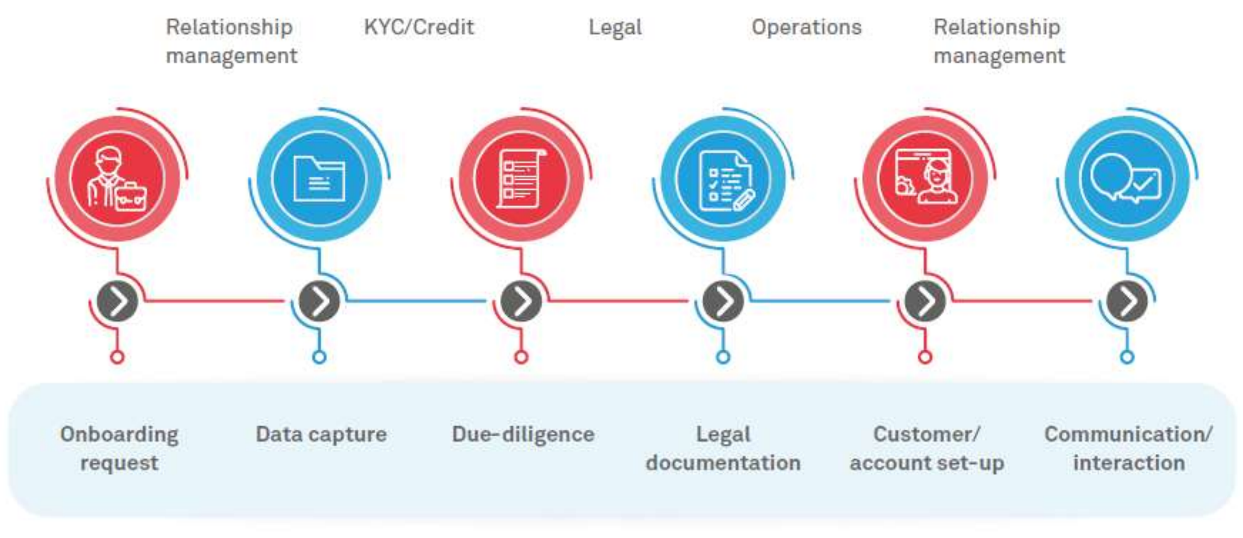

Fig 2: Commercial customer onboarding process

Reference : https://www.wipro.com/banking/the-future-of-commercial-customer-onboarding-in-banks/

V. Implementation Details

Table 2 – Technology Stack and Role in Onboarding

Layer	Technology Used	Purpose / Functionality
Frontend	Angular, React	Microfrontend architecture for modular UI, role-based access, WCAG compliance
Backend	Java, Spring Boot	Stateless microservices for customer, KYC, document processing, and TSYS integration
Database	MongoDB	Flexible schema for diverse KYC and onboarding documents
Messaging	Apache Kafka	Event-driven architecture, asynchronous service communication, high throughput
Cloud & Orchestration	AWS, Kubernetes	Scalable, containerized deployment, auto-scaling, CI/CD integration
Automation	RPA (UiPath/BluePrism)	Automating legacy and non-API processes
Security	OAuth2, JWT, AES-256	Authentication, authorization, encryption in transit and at rest

A. DevOps Pipeline

The CI/CD pipeline using GitLab automates the validation, testing and deployment of code changes in the repository. Important stages:

- Static Code Analysis: The code quality is performed by using SonarQube.
- Unit Testing, Integration Testing Tools: JUnit, Mockito, Postman.
- Blue-Green Deployment: Kubernetes Rollout with Zero-Downtime.

B. Monitoring and Observability

- Prometheus + Grafana: service health status, Kafka throughput, MongoDB performance metrics.
- ELK Stack: anomaly detection framework and log repository.
- AlertManager: An component which is responsible to send alerts related to threshold breaches.

C. Compliance Engine

Rule are encoded in order to provide automated compliance on regulation:

- AML risk scores computed via predefined algorithms.
- Dynamic flags for missing documents or PEP matches.
- Region-specific validation rules for GDPR, FATCA.

These rules can be configured in real-time by compliance officers via an admin dashboard.

VI. Security and Compliance

Security was embedded throughout the platform to address contemporary compliance' needs:

- Authentication and Authorization: Implemented using OAuth2 and JWT.
- Data Encryption: AES-256 for data at rest, TLS 1.3 for data in transit.
- Role-Based Access Control: Applied across all services.
- Audit Logging: All user and system actions are timestamped and versioned.
- Vulnerability Scanning: Integrated with CI/CD.

Moreover, penetration testing and threat modeling are performed regularly. The system is compliant with GDPR, AMLD5, and PCI DSS.

VII. Outcome and Assessment

A. Business Impact

- Revenue Acceleration: With faster time to onboard, we can start generating revenue with new accounts quicker.
- Streamlined Processes: Automation allows more cases per staff.
- Regulatory confidence: Reduced risk of audits through digital trails and real-time screening.

Table 3 – Business Impact Metrics Post-Implementation

Metric	Before Automation	After Automation	Improvement (%)
Average Onboarding Time (days)	120	10	91.6%
Customer Drop-off Rate (%)	15	4	73.3%
Manual Data Entry Errors (%)	12	1	91.7%
Compliance Audit Pass Rate (%)	78	98	25.6%
Staff Productivity (cases/month)	30	120	300%

VIII. Insights Gained and Difficulties Encountered

1. Microfrontend Governance: Efforts were made to standardize the design across the teams.
2. Service Versioning: New features need to be introduced using semantic versioning and backward-compatible APIs without breaking compatibility.
3. Latency Management: Need to optimize Kafka, MongoDB and API calls for real-time processing.
4. User Training: Internal users required training to use the new tools, which was reduced by using embedded tooltips and documentation.

IX. Future Improvements

Future versions will include the following improvements:

- AI based KYC: Use AI/ML models to identify the type of documents and automatically flag anomalies.
- Blockchain Identity: Use self-sovereign identity for customer identity secure exchange.
- Chatbots: Implement AI driven chat platforms for customers to navigate the onboarding process dynamically.
- Mobile-First Experience: Create native mobile versions for the onboarding portal.
- Real time dashboards: Use BI tools like Power BI for better monitoring.

These capabilities will enhance the onboarding transparency, risk management, and personalization features.

X. Scaling and Maintenance Aspect

One of the major success factors for an enterprise banking platform is the scalability and maintainability of the service. The onboarding solution described in this paper is designed for horizontal scaling and long-term maintainability. The following design decisions have been made with respect to these attributes:

A. Containerization with Orchestration

On the backend, all microservices are developed as containers, using Docker as a standard format. This will allow being consistent across development, testing and production environments. Kubernetes provides orchestration for the microservices and also allows for auto-scaling based on traffic and load. This will ensure that the onboarding system can absorb any influx during business hours or at specific times of year.

B. Service Versioning and Backward Compatibility

Services are tightly-coupled but semantically-versioned for longevity. API-gateways check requests format and ensure backward compatibility for zero-downtime-deployments. They also provide usage analytics to device deprecation timelines.

C. Modular Codebase

There are separate repository for each module with CI/CD pipeline support. Reusable library for authentication, logging, and UI components to minimize duplication and ensure quick delivery.

XI. Industry Implications and Replicability

Noteworthy is that this shift from onboarding technology is also aligned with the general banking trends towards platformization, modularization and real-time services.

A. Competitive Advantage

First movers have an enormous advantage over banks which can bring onboard clients in days (maybe weeks) compared with months. Being able to go to market quicker means more clients, faster revenue and greater scope for cross-selling.

B. Compliance Readiness

Also, automated compliance workflows lessen the regulatory burden and better audit results on the bank's outcome, and allowing banks to embrace future interventions such as real-time KYC refresh or continuous AML scoring.

C. Model for Future Usage

The designed architectural pattern including microservices, microfrontends, Kafka as messaging layer and MongoDB as database is reusable in other banking domains such as loan processing, vendor onboarding, card issuance etc. This adds to the value of the designed solution due to scalability and replicability.

XII. New Technologies Integration

This onboarding solution's scalability, automation, and compliance would also be enabled through the latest technologies integration.

A. AWS

AWS – is the cloud provider that supplies the cloud infrastructure for microservices deployment, container orchestration, and workloads dynamic scaling. The solution utilizes:

- Orchestration platform: Amazon EKS.
- Amazon S3 for document storage and security.
- Real time file validation using AWS Lambda which is serverless computing.
- Secure credential management is done by AWS Secrets Manager.
- Performance Monitoring & Alerting: Amazon CloudWatch

AWS's elasticity and pay-as-you-go model promotes economical resources consumption, notably at onboarding's high demand seasons.

B. Robotic Process Automation (RPA)

Legacy processes that are not made available through APIs (i.e., Application User Interfaces) have been integrated with RPA (Robotic Process Automation) bots to automate the following processes:

- Extracting data from scanned or emailed onboarding forms.
- Validating input from PDF documents.
- Interacting with legacy systems without native integration support.

These bots run in parallel with microservices, feeding structured data back into Kafka topics to ensure synchronized onboarding workflows.

C. AI / ML

Currently, there's been proof of concepts that utilize AI and ML functionalities for:

- Document Classification: They also can classify documents such as tax records, business permits, and identity cards.

- Anomaly detection: ML models identify anomalies or threats in KYC submissions.
- Chatbot Assistance: Natural Language Processing tools can assist in onboarding all the time. Bot can be available to answer questions and gather initial information.

AI/ML based systems are also ability to augment rule based validation engines and add to the scalability to think.

XIII. Conclusion

The use cases in this research provide a promising pragmatic and scalable solution which can immensely enhance the corporate customer onboarding process in the banking sector. With a current timeline of 120 days to onboard a corporate client down to merely 10 days, the platform delivers astonishing benefits in customer experience, regulatory compliance, and internal productivity.

It employs cutting-edge software engineering paradigms—microservices, microfrontends, event-driven architecture, DevSecOps—to develop a robust, extensible architecture. On one hand, MongoDB provides the required versatility for variable formats of KYC information, Kafka provides the needed resiliency, fault-tolerance, and real-time communication; on the other, TSYS integration smoothly closes the onboarding cycle by automating account creation on the backend.

AWS cloud infrastructure provides elasticity, secure storage, and high availability. RPA automates legacy applications. AI and ML build the capability for intelligent decision making and operational efficiency.

The conclusion remarks are:

- Digital onboarding is a back-end issue as well as an architectural one.
- The modular design provides major benefits, such as accelerated feature deliveries, improved resilience and simplified compliance.
- From this model, we observe that the real-time event streaming enables better operational visibility and customer interaction.
- AWS will allow scalable as well as cost-efficient cloud-native deployment.
- RPA and AI support the advancement of intelligent automation that enhances precision and judgment.

In the future, this platform also creates possibilities for next level innovations such as blockchain-enabled identity provider, autonomous AI-based risk scoring and enhanced integration with Open Banking. With further developments in the financial sector, such platforms will remain instrumental in ensuring competitiveness, fulfilment of customer demands and compliance with intricate regulation.

Future studies will assess how these novel solutions will affect parameters like customer lifetime value, risk exposure, and fraud probability. Additionally, the potential for collaborations with RegTech and FinTech providers will be investigated to increase agility and innovation further.

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