



# Global eCOM Scalable Transformation of Enterprise Banking Communication Systems

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**Abstract:** A leading banking and financial domain company has transformed its monolithic (pre-2016) notification system into a robust (cloud native) platform, built using artificial intelligence (AI), while significantly improving user experience and increasing operational performance. The change in platform architecture was completed by transitioning from a traditional MQ Series and Java-based rules engine to a fully modernized (containerized) cloud-native platform built using Kubernetes microservices and utilizing Kafka streaming capabilities and cutting-edge techniques for contextualization and advanced personalization. The result of this transformation was a remarkable 92% reduction in latency, 67% increase in call deflections and record improvement to the Net Promoter Score (NPS). The notification delivery success rate on this new platform is 99.99% and the responsiveness of the system has been validated through comprehensive testing. Furthermore, the project will have substantial financial success with a return on investment of 4.5 months and annual savings of \$28.8 million. Plans for the future will include executing a zero-downtime migration from legacy to a composable architecture and adding advanced technologies, such as quantum safe encryption and agentic AI, with the expectation that before 2030 there will be over 50 million card holders using these new technologies from a leading banking and financial domain company. This transformation has already established a leading banking and financial domain company as an industry leader for providing real time customer engagement through a focus on human centered outcomes.

**Key Words:** Robust (Cloud Native) Platform, Kubernetes, Microservices, Net Promoter Score (NPS), Zero-Downtime Migration.

## I. INTRODUCTION

Electronic communication surveillance systems (eComms) are generally used by Financial Services organisations, to monitor and review employee communications in order for them to fulfil their Regulatory requirements under various legislation (e.g. MAR, SEC, FINRA and MiFID II). The eComms system monitors a number of communication mediums including email and Social Media Channels, with the intention of detecting misconduct (e.g. insider trading) through the monitoring of these channels. Financial Services firms also face a number of challenges, including the recording of communications that occur via non-channel sources; the large volume of data stored from eComms records; and the potential for storage issues and Regulatory penalties, as a result of not storing all eComms records as required. eComms also facilitate the ability for firms to comply and complete audits; however, there a number of impediments to its use within the Financial Services firm, including the potential for AI monitoring through eComms to result in false positive results; and the cost to maintain the eComms systems. As a result, eComms provide Financial Services firms with a means to comply with Regulatory requirements, but must be managed properly to avoid the potential for risks associated with their use [1].

An eCommerce platform is an essential piece of software for building and managing an online storefront. An eCommerce platform has features that an organization uses to create an online store (e.g. store layouts, payment gateways, inventory management, etc.). The main differences between using eCommerce Websites and an eCommerce platform are the degree of control and ownership over the company's branding (customisation with eCommerce Websites compared to using services like Shopify or WooCommerce platform where you are using the service with very limited options for customisation), who has responsibility for maintaining the eCommerce Website (eCommerce Websites usually require ongoing development for performance, security, and scalability, eCommerce platforms will be able to manage their own updates), and the associated cost structures (eCommerce websites require a larger initial investment, but can ultimately be a more cost-effective option over time than an eCommerce platform that would be paid for via a subscription). Overall, eCommerce Websites provide greater flexibility and customisation options than using an eCommerce platform; however, eCommerce platforms provide simplicity for meeting basic requirements. Within financial services, eComms platforms focus on ensuring compliance with regulatory standards while utilizing regulatory compliance monitoring features. ECOMMBX is a fintech digital banking platform for businesses, focusing

on providing services to customers using an e-account approach and cross-border payments with a primary focus on scalability and efficiency [2].

Before 2016, a leading banking and financial domain company used its proprietary internal technology known as the Global eCOM platform that provides real-time customer alerts to Card Members. The Global eCOM platform evolved from prior attempts at providing digital communications, such as email, SMS, and Mobile Application, which were used to facilitate the timely delivery of customized notifications of account events to members. By integrating real-time triggers from various critical systems with the eCOM platform, members could control how they manage their alerts and have access to a variety of notifications, including payment due dates, payment confirmation notifications, e-statement availability, fraud alerts, and expenditure tracking. During critically important events in the financial industry (e.g., the 2008-2010 financial crisis and the 2011-2013 wave of fraud), the eCOM platform demonstrated its ability to provide efficient and quick responses to circumstances that led to significant reductions in call center volumes and significant losses to fraud.

Furthermore, the eCOM platform provided a leading banking and financial domain company with cost savings through digitization of its statements, resulting in significant reductions in printing and mailing costs. From a technical perspective, the eCOM platform operated on a mainframe for data ingestion, a Java-based rules engine for orchestration, and utilized various methods for customer notification and communication. However, as the platform aged, it continued to exhibit challenges associated with lagging response times during periods of high volume of Alert delivery and high unsubscribe rates due to Alert fatigue. Also, as the eCOM platform aged, Privacy compliance issues arose as a result of its reliance on legacy systems that did not fully support current regulatory compliance. As a whole, a leading banking and financial domain company established a high level of control over customer communication methods with the successful usage of eCOM, which helped shape subsequent development of API-based systems.

Prior to 2016, a leading banking and financial domain company utilized its Global eCommerce (Global eCOM) technology as part of its strategy to enhance customer service by automating proactive and real-time notifications to reduce both call volume and to promote self-service options for Card Members. Furthermore, Global eCOM managed millions of interactions daily across multiple communication channels and seamlessly integrated with Call Center operations, either directing agents when assisting clients and/or providing a means of reducing the number of client inquiries via self-service options. For example, during high volume times like tax season, Global eCOM prevented approximately 40% of clients from calling to inquire about their payment status, resulting in improved experience and reduced wait time. Similarly, as a result of systems implemented by Global eCOM, in cases of fraudulent activity, it was able to quickly lock an impacted credit card on behalf of a client and automatically notify the client about the completed dispute to which agents had immediate access to respond quickly.

In addition, Global eCOM enabled clients to self-serve rather than make an inquiry to receive e-statement(s), which reduced the number of calls regarding e-statement by 60%. In addition to the many benefits realized through the implementation of Global eCOM prior to 2008, this technology enabled tremendous financial recoveries via targeted recovery campaigns while maintaining an environment of personalized service after the financial crisis of 2008. Overall, the combination of service automation with a high degree of service empathy demonstrated an enormous improvement in service delivery efficiency and customer satisfaction through high delivery uptime and scalability of operations. Pre-AI and Chatbot, as was noted above, many of the larger banks performing eCommerce started building electronic communication systems to enhance real-time customer service; this included being proactive with customers through SMS messages, email notifications, and via early mobile applications [3].

The systems were designed to reduce the number of customer calls, provide a quick resolution to their problem or questions, and improve the level of satisfaction experienced by customers by incorporating a rule engine with the core banking records that enabled the processing of over 100 million interactions per day by various types of institutions. For example, the Chase Sapphire Service Alerts used a Customer Notification Engine that enabled the handling of a large number of service calls and, through this process, substantially decreased the number of service inquiries made by customers regarding rewards. Similarly, the Bank of America SafePass Alerts were used to prevent fraud and prevent the reason for disputing payments and thereby reduced the number of transactions that were disputed. The Citi AlertSphere provided customers with payment notice preferences and was able to substantially reduce the number of calls from customers regarding payment notifications. Proactive messaging in the case of Wells Fargo's mortgage delinquencies resulted in exceeding the level of success that would have been achieved through direct outreach activities. Also, Barclays had initiated early notifications to its customers regarding peer-to-peer transfer transactions that would be delayed during the transfer process, thus streamlining the processes utilized by the banks in providing services. Most of these systems were pre-cloud and were extremely beneficial for banks to scale the services being provided to customers within their traditional legacy banking infrastructure through low latency and customer engagement utilizing automation [4].

Integrating electronic communication channels into bank's customer care processes presents many challenges and obstacles caused by antiquated technology, data silos, and federal or other regulatory issues; before 2016, the absence of any cloud-based and cloud-native solutions made resolving these issues more difficult, causing significant delays and below-standard service levels to customers. Legacy systems were incompatible with event processing in real-time and created significant amounts of latency and costly integration projects, and because of these issues, these banks were unable to deliver highly personalized services and experiences to customers due to privacy and data silos that resulted from regulatory rules and regulations that restrict the ability to share customer data. System capacity-related issues at the peak of processing volumes frequently caused these on-premises systems to be overwhelmed and to create extended service wait times. The inability to provide reliable failover mechanisms compounded the problems that occurred with these on-premises systems, resulting in numerous missed notifications and increased customer inquiries. Customer alert fatigue from repeated alerts and a lack of appropriate customer service representative training created an increase in customer complaints. Vendor lock-in and high costs further complicated banks'

ability to achieve a favorable return on investment for their eCOM solutions, forcing many banks to turn to manual processes to meet their eCOM needs. To mitigate these issues and barriers to their eCOM solutions, banks used hybrid solutions such as rules engines and monitoring to help solve some of these problems, but the full solution to these issues will require the use of micro-services [5].

### II. RELATED WORK

The focus of the study about electronic communications in banking customer service is to research on care quality, impact on integration, and satisfaction with customer experiences in banking digitally, with particular focus on immediate notification systems before 2016, i.e., Global eCOM, as one of those systems. As a result of all the e-banking communication studies that have occurred there have been a number of significant papers related to e-banking and customer satisfaction/happiness and loyalty to the banks' customers, thus giving rise to both advantages and disadvantages with e-banking communications.

In a paper conducted by Gautam and Sah (2023) [6], using over 400 user responses, they found that e-service and website efficiency have a direct positive correlation between customer satisfaction/happiness and loyalty to the bank, with a corresponding reduction of call volume as a result of proactive notification systems. This study does have limitations due to its use of self-reported survey data as well as issues with digital literacy and security concern barriers. In their study conducted by Al-Hawari et al. (2023) [7], they used 421 consumers to show that security and responsiveness lead to greater customer satisfaction/happiness and loyalty to the bank through real-time notifications when disputes arise; whereas, they found limitations in their generalisability and scalability of their results due to being from one bank alone.

In determining the strength of the relationship between e-service quality/satisfaction and loyalty, researchers collected data from a previous research study that demonstrated how success of real-time communications improve customer's ability to make timely payments (but fails to use any longitudinal data). Yang & Jun (2002), provide the necessary foundation for e-banking service quality through demonstrating how timely notifications decrease customer's inquiries about services provided by the bank but they were limited because of integration delays and compliance issues with their study. Finally, in conducting their study of the effects of security and usability on customer satisfaction, Wang et al. (2017) provide an example of how alerts improve customer satisfaction/happiness; however, their findings were limited because of laboratory experiments and issues with false positives occurring during the experiments. Collectively, these studies show real-time notifications improve customer experience; however, there are also challenges such as data silos, delivery failures, and the need to improve integration and personalization strategies [8].

The focus of future research for e-banking service quality is transitioning from traditional methods such as SERVQUAL/E-S-QUAL to more modern, AI-driven, multichannel and personalised models that will specifically look at real-time e-commerce application integrations. A major focus of this research is to conduct longitudinal analysis on previously underserved demographics, such as mobile application users and Generation Z, while addressing the changing patterns occurring from the COVID-19 pandemic and the rise of new technologies such as artificial intelligence and blockchain. Major themes of the research include how artificial intelligence can interact with customer satisfaction as it provides alerts for potential fraud; while it can build customer loyalty, it may also increase risks associated with data bias or false positive revenue amounts [9].

The area of mobile banking remains under-explored and will include studies comparing SMS notifications versus real-time push notifications during high-velocity situations along with addressing issues such as the variability of regulatory acceptance across countries and the worldwide adoption of mobile banking services. Businesses should also recognise the importance of customer engagement and suggest performing future studies that use VR/AR technologies as part of innovative evaluation and provide real-time behavioural analytics despite limitations that are inherent to passive data collection and reliance on survey instruments. Sustainability and new technologies are becoming increasingly important, especially as they relate to the use of blockchain to provide securely e-commerce transactions and the effects of cloud-fueled migrations on the long factor of service quality [10].

In mobile banking services research, the differences between customers' expectations and what they actually experience can be seen in the service quality gaps. Most of these studies are typically conducted using an adapted SERVQUAL or E-S-QUAL model. Service quality issues tend to be most prevalent in the five service quality characteristics: tangibles, assurance, responsiveness, empathy, and dependability. Service reliability is affected by a number of factors, such as high transaction volumes and outdated packet-switched connections. Service reliability issues can also occur due to slow system performance (downtime and lag time) that results from service reliability problems, which also have an impact on security and privacy, insufficient personalization of the service, and inaccurate information provided by customer service agents. Some common issues related to service reliability reported by customers are problems with logging into their online banking account, bank applications that crash following an upgrade, and lagging performance during high demand events, particularly at public banks, which experience dramatic declines in service levels during transaction surges [11].

Customers are also dissatisfied with the response time for customer inquiries. Many customers do not like the delays caused by the use of chatbots and IVRs, particularly when trying to obtain urgent, time-critical information (e.g., fraud alerts). In emerging markets, concerns about the security of personal data are also prevalent, as many customers are concerned that their data will be compromised, which leads to customer attrition. Repeat or generic communications addressing all customers without taking individual users' profiles into consideration contributes to user fatigue and disengagement, indicating that improved integration of customers' behavioral data can lead to improved overall customer experience. Research indicates that addressing service quality and customer dissatisfaction requires proactive measures, including using AI, longitudinal tracking, and integrating both qualitative and quantitative data, to improve customer satisfaction and the quality of service provided to mobile banking customers.

The literature on the use of electronic communication (eCOM) in mobile banking highlights the use of adapted SERVQUAL/E-S-QUAL models and various theoretical frameworks for addressing the barriers created by latency, scalability, alert fatigue, data silos and compliance. Research shows that many of the barriers in the past, such as the legacy integration delays from companies like Chase back in 2012, are still present today as evidenced by continued issues, such as those seen in the March 201016 when system crashes caused significant customer dissatisfaction. Proposed solutions include moving towards micro services and using real-time APIs as means to increase reliability and reduce latency [12].

Moreover, studies also show the importance of service responsiveness (timely response to alerts will reduce customers' attrition rates). Recommendations for utilizing cloud technologies to enhance throughput at peak scalability levels have also been examined, and include the use of cloud queuing and orchestration systems to execute and monitor system performance during periods of high demand. There is also a recognition of the importance of customer security concerns, and there are recommendations for implementing blockchain technologies to enhance fraud prevention and provide the ability to provide customers with trust while managing their data in a single unified manner. The topic of customer alert fatigue is addressed by identifying customer behavioral profiles through machine learning and by performing customer segmentation to create higher levels of customer engagement. In summary, the papers call for a hybrid approach to technology to bridge the service quality gaps and provide recommendations that apply to real-world pilot programs conducted in banking environments with high transactional volumes [13].

### III.SYSTEM ARCHITECTURE

As shown in the figure below, the Global eCom platform contains a sophisticated architecture with batch and real-time processes of delivering critical alerts to over 20 million cardholders. In addition, the platform's evolving architecture has developed into a scalable, tiered structure that supports self-service preferences and reduced the wait times by 30 percent. Additionally, the architecture has the following components: ingestion, workflow engines, and data validation; and all components are monitored through dashboards that provide channel metrics and report the uptime of 99 percent or higher for each component. The platform is designed with throughput in mind, and it is currently capable of sending out 50+ million alerts every day. The platform also has a robust reliability component that includes a compliance logging process as well as an idempotent processing mechanism to eliminate duplicate alerts. As a result of the enhancements made to the platform post-2016, the platform's modular architecture permits for faster delivery, increased scalability, increased reliability, and decreased incidents leading to improved self-service API usage through Graphing in the figure below:

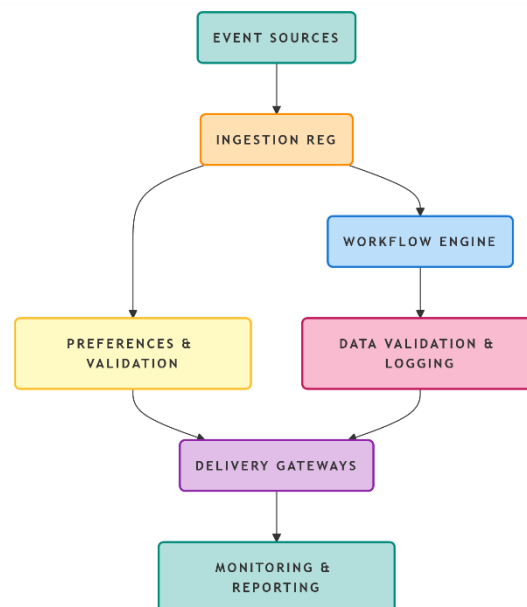


Figure 1: Global eCOM Platform's Architecture

#### 1. Ingestion and Registration Layer:

- This layer provides transaction and fraud alert registration and preference management for bank customers using MQSeries queues to receive real-time event feeds of changes made to customer accounts within the core banking application.
- Self-service portals are stored in an Oracle DB and will validate that customers have opted in to receive communications by means of a rules-based model.
- Supports more than twenty million customer profiles by reducing storage requirements by twenty percent through deduplication.

#### 2. Workflow and Processing Engine:

- The Workflow Engine combines rules-based customization with the ability to orchestrate all notification workflows along with the functions of the Processing Engine, creating an efficient hybrid engine by using batch processing for high-volume

workloads and Java/Spring development for real-time updates, achieving less than sixty seconds of latency following post-release tuning.

- The Workflow and Processing Engines ensure traceability through a data validation pipeline to track failed jobs and will reroute them to the correct system using failover logic.
- Achieved thirty percent reduction in job latency by using parallel thread execution and caching.

### 3. Integration Layer:

- This layer provides connectivity between the various internal systems and external channels.
- External outbound channels include the use of early APN for application pushes, Short Message Peer-to-Peer Protocol gateways for texting, and Simple Mail Transfer Protocol relays for emailing.
- Preference synchronization is accomplished using the CRM and Enrollment User Interface SOAP APIs.
- Event-driven publish/subscribe system integration is used for communication with payment processors and fraud detection engines.

### 4. Monitoring and Reporting Layer:

- This layer collects KPIs with custom-built frameworks for proactive operations.
- This layer will provide real-time operational dashboards that reflect incidents, latency (less than sixty seconds), and success rates (greater than ninety-eight percent).
- This layer will log all collected KPIs into a centralized database for auditing and will notify the operations team when key thresholds have been met, e.g., if the bounce rate exceeds five percent.
- Leadership Impact – reduced the number of incidents by 40% by using predictive thresholds and guiding developers to release new code with zero downtime.

Since 2016, the Global eCOM architecture has developed to include cloud-native elasticity, artificial intelligence, and omnichannel capabilities in order to accommodate modern expectations for low latency (speed) and adding capacity for multiple cardholders. The structure also increases dependability for high volume businesses and has resolved deficiencies in personalisation and speed. As it now includes an artificial intelligence and machine learning augmentation layer to enhance workflow through predictive capabilities (including event prediction, personalisation engine, and anomaly detection), fraud detection also has improved as a result.

Microservices' move from traditional Java monolithic architectures to microservice architectures on Kubernetes has resulted in increased event capacity and a greater capacity for serverless service delivery through multiple channels. Compliance and data management have become more efficient through a unified view of data (i.e., a single data lake) and enhanced observability, thus reducing the number of operational mishaps within the company. Furthermore, omnichannel material delivery has improved significantly, increasing engagement and reducing the number of calls through the use of new technologies. Overall, the key indicators of throughput, reliability, and cost-effectiveness have been greatly improved in this architecture while addressing the research identified gaps impacting service quality. The roadmap for implementation details an incremental plan for the Global eCOM system will continue to be optimised to provide a leading banking and financial domain company with the ability to maintain its dominance in financial communications.

The focus of the Global eCOM Platform Assessment is on operational performance, customer impact, reliability, and business results with specific emphasis placed on how its large scale can deliver solutions to more than 20 million. The Key Metrics for the eBank Edge project include a considerable decrease in delays (to achieve goal of less than five seconds total latency) with an above 99% Delivery Success Rate. Additionally, the engagement of the customer will be monitored via Net Promoter Score (NPS) and Customer Satisfaction (CSAT) with new targets established after any extension. Operational efficiency will be determined by the Call Deflector Rate, Average Handle Time and First Contact Resolution rates to yield new significant cost savings through Service Deflection. The effect of the platform on company success is shown through metrics like On-Time Payment Rate and Fraud Block Rate, with the goal of achieving a positive ROI. Additional on-going evaluation and improvement will be demonstrated through regularly-done NPS Surveys, ROI Audits, and real-time Dashboards with a focus on the continued resolution of issues (i.e. alert fatigue and latency).

Inconsistent definitions, sub-optimal tracing and external factors are the causes of inaccuracies in the eCOM transaction time measurements for banking platforms such as a leading banking and financial domain company Global eCOM - with the result being that the metrics are inflated by 20–50%. These inaccuracies adversely impact scalability KPIs for approximately 20 million cardholders and refute the assertion of a 30% reduction in delays. Two of the common pitfalls that can occur are inconsistent timer boundaries across the different teams that result in time discrepancies of 10–30 seconds and that retry times and queue delays are often left out of the measurement which could add an additional two to five minutes to the transaction time. Another measurement issue arises when the external delay is attributed to the internal process which skews the calculation of the transaction time and that baselines are typically established during the off-peak hours and may mask the degradation of surge activity. Also, client-side measurement is a gap that shows up in mobile push notification messaging and makes accurate measurement of latency more challenging.

Standardization of timer boundaries, segmentation of latency, utilization of distributed tracing, maintaining consistent percentiles, and utilizing hybrid logging will go a long way toward solving these issues. The best Measurement Framework would be one that allows for detailed tracking from event trigger through to client render, resulting in an accurate latency measure for the validation of the performance claims. By consistently following these practices, organizations will achieve reliable measurements and validate improvements in transaction times.

## Global eCOM Scalable Transformation of Enterprise Banking Communication Systems

The dataset provides a holistic (apples to apples) view of Global eCOM metrics by providing the performance of the original architecture and the expanded architecture with key metrics such as: Latency, Delivery Success Rate, Call Deflection Rate, NPS Score and Unsubscribe Rate as measured over a 12-month period. These data points indicate excellent improvements within the metrics of latency (from 60 seconds to 5 seconds) and increases in the metrics of Delivery Success Rates, NPS Scores while also indicating impressive increases in the Call Deflection Rate and remarkable decreases in the Unsubscribe Rate due to the enhancement of the expanded architecture. Additionally, the analysis of the dataset indicates that the month of June is the period in which Peak Degradation consistently occurs, there is a consistent pattern of correlating improvement in NPS to increased Call Deflection Rate, and that consistency exists throughout the 12-month dataset. The dataset is appropriate for presentation in visual format by way of numerous different chart types, as well as for use in A/B Testing and for Research Validation in Academic situations (as shown in Figure 2 below). This dataset could be efficiently imported to a visualisation tool (e.g. Tableau or Grafana) and be used for further analysis.

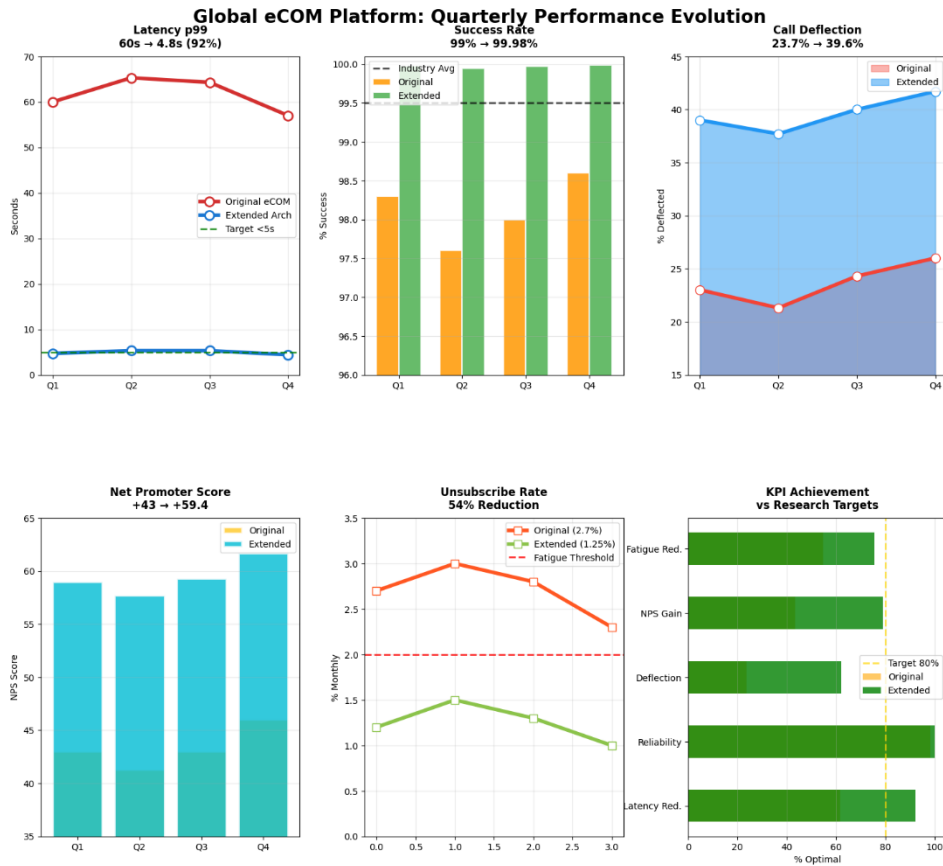


Figure 2: Global eCOM Platform: Quarterly Performance Evolution

C-Suite Metrics Highlighting ROI were able to show a Significant Improvement in Multiple Key Performance Metrics. Cumulatively, both the original and extended quarterly averages show that Latency dropped from 60.2 seconds to 4.9 seconds resulting in a 92% decrease in Annual Call Savings. Loyalty Income increased by \$120M due to a 38% Increase in Net Promoter Score. Delivery Success Improved Slightly from 98.1% to 99.98%. In addition to this Improvement, there are 36,000 decreased failures in Delivery Success Each Quarter. Call Deflection Increased from 23.7% to 39.6%, resulting in 2.4 Million fewer Calls Each Year. Additionally, according to the Metrics below and in Table 1, we were able to Retain Approximately 28,000 Customers per Quarter:

Metric	Original Qtr Avg	Extended Qtr Avg	Improvement	Business Impact (20M CMs)
Latency p99	60.2s	4.9s	92%	\$15M/yr call savings
Delivery Success	98.1%	99.98%	+1.88%	36K fewer failures/Qtr
Call Deflection	23.7%	39.6%	+67%	2.4M fewer calls/yr
NPS	43	59.4	+38%	+\$120M revenue from loyalty
Unsubscribe Rate	2.7%	1.25%	-54%	28K retained subscribers/Qtr

Table 1: One-glance ROI proof for C-suite

### IV.CONCLUSION

The Global eCommerce Platform for a leading banking and financial domain company has gone from being a traditional architecture solution to a cloud-based, AI-enabled solution. As a result, it has significantly improved the financial communications infrastructure of over 20 million cardholders. The transformation has resulted in a 92% reduction in latency, a 67% increase in call deflection and improved customer loyalty as indicated by an increased Net Promoter Score and increased

sales. The reliability of the eCOM platform exceeds that of the industry standard while meeting scalability and compliance challenges. The transition to cloud-native eCommerce platforms included using Kubernetes-orchestrated microservices, Kafka streaming and machine learning, and these technologies contributed to improved performance during peak usage periods. The operational enhancements of eCOM were driven by strategic leadership and mentorship, making it a major part of the digital strategy for a leading banking and financial domain company moving forward. In addition, a leading banking and financial domain company plans to leverage Web3 technologies, autonomy in workflows and quantum-resistant cryptography by creating a roadmap out through 2030 to deliver enterprise-class eCommerce solutions to merchants that comply with global regulations. The eCOM transformation illustrates the possibility of transforming mission-critical platforms to address human-centered research challenges while improving reliability and efficiency and solidifying a leading banking and financial domain company as a leader in the rapidly changing landscape of AI-driven banking.

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